# Permit Reissuance and Modification Application

Dem-Con Pilgrim Landfill
SW-254

Prepared for:
Dem-Con Companies

Prepared by:
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Date:
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Project/File:
227708930




Stantec Consulting Services Inc.

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# 1 Written Application – MN Rule 7001.0050

## 1.1 General Information

### 1.1.1 Current Owner of the Facility

Name OMG Midwest

Address 2401 SE Tones Dr #13

Ankeny, IA 50021

Telephone 507-625-4848

Status private entity

### 1.1.2 Proposed Owner of the Facility

Name Dem-Con Pilgrim Landfill, LLC

Address 13020 Dem-Con Drive

Shakopee, MN, 55379

Telephone 952-445-5755

Status private entity

### 1.1.3 Operator of the Facility

Name Dem-Con Pilgrim Landfill, LLC

Address 13020 Dem-Con Drive

Shakopee, MN, 55379

Telephone 952-445-5755

Status private entity

## 1.1.4 Application Prepared by

Name Stantec Consulting Services, Inc., on behalf of Dem-Con Companies LLC

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Plymouth, MN 55447

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## 1.1.5 Description of the Facility

Pilgrim Demolition Landfill (the Landfill or the Facility) is an existing Class I construction and demolition debris (C&D) landfill. The Landfill is located in Township 109 North, Range 26 West, Sections 30 and 31 in Lime Township of Blue Earth, Minnesota. The Landfill was initially permitted by the MPCA (permit #SW-254) for use as a demolition landfill by the Brielmaier Corporation in 1983. The total capacity of the Landfill at the time was approximately 232,000 cubic yards. Brielmaier Corporation voluntarily discontinued filling operations in 1993. Three fill areas were authorized for disposal. “Site 1”, located in the south portion of the property, was closed in 1992. “Site 2”, located in the central portion of the property, was closed in 1996. “Site 3” was never utilized for disposal. Prior to placement of demolition waste materials, Brielmaier Corporation placed four feet of “compacted sandy clay and crushed limestone” throughout the base areas for both Site 1 and Site 2. The construction for Site 2 was certified by a professional engineer in correspondence to the MPCA on February 6, 1991. These historical unlined disposal areas are designated in the current permit as Disposal Designation (DD) DD 001, representing the existing unlined Class I C&D disposal area.

The Facility was later permitted on May 4, 2004, for an ultimate waste capacity of 5,561,700 cubic yards, incorporating fill area DD 002 in the current permit. The existing demolition waste in Sites 1 and 2 was designated as DD 001. DD 002 was to be constructed with a 4-foot compacted soil attenuation layer and would ultimately fill over DD 001 as waste filling activities advanced from east to west.

The existing permit expired in 2009, and multiple renewal submittals have been completed since then, including a minor permit modification to adjust the waste limit boundary on the southeast side of the site, approved on November 5, 2024. This submittal is intended to apply for a permit reissuance and major modification, including ownership transfer, an increase in ultimate capacity (without increasing waste footprint or maximum elevation), and change in facility design and operation.

## 1.1.6 Proposed Modifications and Variance Requests

As part of this permit action, the Landfill is proposing to excavate and relocate all waste from DD 001 and place in the existing DD 002 area. The Landfill is then proposing to re-classify the existing unlined area from DD 002 to DD 001 (incorporating re-located waste from the current DD 001 area and existing waste in DD 002). The facility is proposing to construct lined cells west of the re-classified DD 001 area for a Class III lined C&D and industrial waste disposal area, to be referred to as DD 002. DD 001 would be considered a

Class I C&D disposal area which would ultimately be closed via a proposed overlay which ties into the base liner system of DD 002. Prior to construction of the overlay liner the unlined area will continue to be filled with Class 1 C&D waste, including the waste relocated from the existing DD 001 area as mentioned above. Upon completion of the closure of the unlined portion of the facility, the Landfill will operate DD 002 as a lined disposal area, accepting Class III demo and industrial waste (see Appendix A for more details).

The current Landfill operates as an unlined Class I unlined C&D Landfill. As a Class III lined C&D Landfill (DD 002), the Landfill will accept all non-hazardous C&D debris. In addition, the facility is proposing to accept industrial waste which is co-disposed with C&D materials in the lined DD 002 disposal area in accordance with the facility's ISWMP.

Leachate collected on the proposed lined DD 002 disposal area will drain into a series of sumps and be pumped into a leachate storage tank or tanks. Leachate will then be loaded out into tanker trucks and hauled for disposal at a wastewater treatment plant.

Two requests for variances to Minnesota Rules are included as part of this application:

1. Exceed a 100-foot leachate flowpath through the cell floor in the northeast corner of the site.
    - MN Rules 7035.2815 Subp. 9.E. requires maximum 100-foot leachate drainage length.
    - Request to prevent the need for a leachate cleanout extending through the final cover system and to facilitate construction of the overlay system for DD 001. All other phases of the proposed DD 002 disposal area will meet the maximum 100-foot drainage length.
    - Cell floor slopes in the new base grade design are increased to 5% in the areas with a drainage length greater than 100 feet
2. 4:1 slopes on the final cover system
    - MN Rules 7035.2815 Subp. 5.G requires maximum 5:1
    - Request to maximize the ultimate waste capacity of the site without changing the currently permitted footprint or maximum height of the Landfill. This change would increase the proposed capacity by 856,048 cubic yards to a total ultimate design capacity of 6,397,436 cubic yards.
    - It should be noted that future MN C&D Rules are anticipated to allow for 4:1 final cover slopes without variance

These proposed variances will not create any change in effect on air, water or land resources of the state compared to the current site and current use. The change in ultimate capacity will be due to the increased final cover slopes and revised base grades, facilitating a base liner system with geosynthetic liner and leachate collection. The base grades were designed to be a minimum of five (5) feet above the historical high groundwater elevations based on the data for the existing monitoring wells. Technical evaluations which support these proposed variances are included in the application are a Hydrologic Evaluation of Landfill Performance (HELP) Model and a Geotechnical Evaluation, provided in Appendices C and D, respectively. The HELP model presents that the requirement to maintain less than 1-foot of leachate head on the base liner will be met with the extended leachate flow path. The Geotechnical Evaluation presents that steeper side slopes will be stable against global and veneer failure based on exceeding minimum factors of safety for various conditions.

This application contains an updated Industrial Solid Waste Management Plan (ISWMP) and updated Permit Drawings which are included in Appendix A and Appendix B, respectively.

### 1.1.7 Topographic Map

Figure 1, *USGS Quadrangle Excerpt*, illustrates the general topography of the site and surrounding area. Sheet C-101 illustrates two-foot contours of the existing landfill and surrounding area.

# 2 Items Handled, Stored, and Disposed of at the Facility

## 2.1 Types of Materials

The facility currently accepts demolition and construction debris as defined below:

"Demolition debris" means solid waste resulting from the demolition of buildings, roads, and other structures including concrete, brick, bituminous concrete, untreated wood, masonry, glass, trees, rock, and plastic building parts. Demolition debris does not include asbestos wastes (Minn. Rule 7035.0300 Subp. 30).

“Construction debris” means waste building materials, packaging, and rubble resulting from construction, remodeling, repair, and demolition of buildings and roads (Minn. Stat. § 115A.03, Subd. 7).

Examples of C&D debris include materials generated from construction of new buildings, renovations of existing buildings, buildings torn down for redevelopment, and rubble from streets, sidewalks, and parking lot replacement.

In addition, the facility is proposing to accept industrial wastes in accordance with the ISWMP included in Appendix A. A few examples of industrial wastes proposed to be accepted include, but are not limited to, manufacturing scraps, recycling residue, off-spec products, contaminated soils, and water treatment and filtering sludges.

Some waste types are bulky, difficult to compact, and require excessive management at the working face. The shredding may be completed at a transfer facility or at the landfill. The following items may be shredded prior to final disposal:

- Bulky plastic material
    - Plastic tubing (plumbing, pipe, conduit)
    - Plastic duct work (spiral wire core)
    - Empty plastic containers (buckers, bins)
    - Plastic hardware (electrical boxes)
    - Plastic sheeting (roof, wall, untreated)
    - Plastic playground equipment
- Housing materials
    - Carpet and carpet padding (not rolls)
    - Siding and doors (vinyl, untreated wood)
    - Shingles (wood, asphalt)
    - Wood material (flooring, plywood, particle board, fencing, stumps)
    - Fiberglass material (tubs, tub surrounds)
    - Porcelain (sinks, toilets)
- Incidental packaging or wood (associated with the above items)

If shredding occurs at the landfill, shredding operations will occur on the liner with the exact location moving as the facility fills and expands; as a result, mobile shredding equipment would need to be utilized. The ultimate goal of the shredding operations is to produce a small, uniformly sized waste material that has a greater density.

Prior to placement in the landfill, the following procedures will be followed:

1. Note the quantity (volume) of material following shredding operations.
2. Incorporate into active working face with heavy equipment.
3. Complete Shredding Operations Form including the dates of shredding and quantities (Appendix E).

In accordance with Minnesota Statutes 115A.936, construction material containing gypsum such as sheetrock will not be shredded (or mechanically pulverized or size reduced) at any time.

It is proposed that recyclable materials handling and storage be incorporated into the permit. These materials will be stored on-site in the designated recyclables storage area within the western portion of the ultimate landfill footprint that has not yet been developed. Several dumpsters, roll-off containers, or similar containers will also be kept on the working face for separating recyclable materials such as metal from the incoming waste. The recycling storage area is depicted on Drawing C-101 in Appendix B. Recyclables handled on-site include but are not limited to appliances, metals, batteries, asphalt pavement, tires, electronics, cardboard, concrete, brick, clean wood debris, and shingles. Storage methods and the maximum quantities stored at a given time are included in Table 3.

The Landfill will also manage a composting area for yard waste and grain waste. Concrete, asphalt, and brick materials will be stockpiled at the site and periodically crushed for recycling. Wood waste will also be collected in a stockpile and periodically mulched for reuse. Storage locations are depicted on Drawing C-101.

## 2.2 Quantity of Material

Table 1 is a waste capacity table that includes the ten-year permitted waste capacity and the ultimate design capacity sought after in this permit modification and reissuance application. There is no proposed increase to the peak vertical elevation or ultimate horizontal footprint of the landfill due to the change in outer slope angles. The maximum elevation will be maintained at approximately 872 ft-amsl.

The estimated quantity of C&D debris, industrial waste, compost, and recycled materials handled at the facility on an annual basis is listed on Table 2. The quantity of recycled materials stored on the site and the storage method is listed in form w-sw3-33.

Table 1. Waste Capacity Table

| Type of Waste | | ID | Ultimate Design Area (acres) | 2026-2036 Remaining Ultimate Capacity as of December 2025 (CY) | Ultimate Design Capacity (CY)[1] |
|---|---|---|---|---|---|
| **Current Permit** | C&D Debris Unlined Landfill | DD 001 & DD 002 | 74.4 | 4,374,666 | 5,514,388 |
| **Proposed** | C&D Debris Unlined Landfill | DD 001 | 17.2 | 201,390 | 1,044,918 |
| | Class III C&D Debris and Industrial Waste Lined Landfill | DD 002 | 63.9[2] | 5,352,518 | 5,352,518 |

[1] Includes final cover.

[2] Includes overlay liner above existing unlined area, the total waste footprint remains the same.

[3] Relocated waste from existing DD 001 would be placed in the unlined area, proposed DD 001.

Table 2. Estimated Annual Quantities

| Type of Waste | Estimated Annual Volume (CY) |
|---|---|
| C&D Debris | 60,000 – 100,000 |
| Industrial Waste | 20,000 – 50,000 |
| Composting Yard Waste | 100,000 |
| Composting SSOM | 25,000 |
| Recyclables | Varies by material- see form w-sw3-33 |

## 2.3 Methods of Control

The methods of control for waste acceptance include checking in at the scale house at the site entrance where the type and the quantity of waste is recorded and inspected. The waste hauling vehicle will be directed to the appropriate disposal location based on the material being accepted. Personnel are on-site at the active tipping area to oversee the tipping procedure and visually inspect the waste to verify that no unacceptable wastes are tipped. If unacceptable waste is encountered at the working face, the hauler or facility staff will remove them from the working face and properly manages the materials in accordance with Minnesota Rules. Regular landfill customers may be assigned individual roll-off boxes located near the tipping area and unacceptable wastes may be placed in these boxes. When the box is full, the hauler must arrange to have the roll-off box hauled to an appropriate facility for disposal.

The landfill does not assume acceptance of waste until the load is inspected, spread and compacted, and additional material is placed vertically on existing grades.

Industrial waste is proposed to be accepted at the facility in accordance with the ISWMP. This process includes an analysis of the physical nature of the wastes, the process that generates the wastes, and a comparison of any analytical results to the acceptance limits established in the ISWMP.

Materials to be recycled or composted are directed to the appropriate locations where the material is unloaded and stockpiled until a sufficient quantity has accumulated to justify further processing or shipment to end-markets. Records are maintained of the volume of material recycled at the Facility in accordance with MPCA permit requirements.

# 3 General Information Requirements for Final Application MN Rule 7001.3300

## 3.1 General Description of Facility

The Pilgrim Demolition Landfill Facility (the Landfill) is located in Lime Township, Blue Earth County, Minnesota, within Township 109 North, Range 26 West, Sections 30 and 31. The Landfill property consists of multiple parcels totaling approximately 220 acres, with the active landfill fill area encompassing approximately 78 acres located near the center of the property. The fill area is separated from adjacent properties by established buffer areas. The location of the Landfill is illustrated on Figure 1, prepared using the USGS 7.5-minute quadrangle maps for Mankato East and Mankato West, Minnesota. Zoning information of adjacent parcels is provided on Figure 2. Land uses surrounding the site varies from mixed residential or rural vacant land to the north and west with industrial to the east and south. As shown on Figure 3, there are no parks, recreation areas, and refugees within 1-mile of the project area. Further information on adjacent properties, including a figure and a mailing list for these properties, is provided in Appendix F.

As illustrated on Figure 4, surface karst features may be present in the area, however, Section 5 further discusses site investigations which were previously completed and determined active karst is not present within the disposal area. Site-specific hydrogeologic investigations have been conducted for the Landfill, including groundwater receptor surveys completed within one mile of the facility and identification of high-capacity wells within three miles. These evaluations have been periodically updated and are documented in the Facility's hydrogeologic reports and annual operating documentation. Groundwater and surface-water protection considerations for the Landfill are addressed through site-specific analyses and ongoing operational controls. Water features surrounding the site are illustrated on Figure 5, while wells within 1-mile of the site are shown on Figure 6. The Minnesota River is located approximately 1-mile west of the facility while an unnamed creek is located south and west of the site. Further site information is provided in Section 5.

Floodplain mapping for the Landfill property was evaluated using Federal Emergency Management Agency Flood Insurance Rate Maps. This analysis confirms that the landfill fill area is located entirely outside the mapped 100-year floodplain of the Minnesota River. The Landfill is located in an area zoned for industrial use, and operation of the demolition landfill has been authorized through applicable county and township approvals. A floodplain map is provided as Figure 7.

## 3.2 Industrial Solid Waste Management Plan

An ISWMP has been developed for this facility along with this permit modification request to accept industrial waste at the facility. The ISWMP establishes waste acceptance criteria, screening procedures, handling practices, and operational controls for materials received at the landfill. A copy of the proposed ISWMP plan is included as Appendix A.

## 3.3 Description of Security Procedures and Equipment

There is a locking gate at the entrance to the facility. Berms, wooded areas, and gravel pits separate the landfill from adjacent properties and roads, prohibiting trucks from entering the fill area after hours.

## 3.4 Inspection Schedule

The landfill operator inspects the landfill at least weekly. Inspections include safety and emergency equipment, security devices, operating and monitoring equipment, as well as general site conditions. Inspection reports will be kept on record for a minimum of five years. A copy of the Inspection Report is available upon request.

Fire extinguishers are inspected and certified on an annual basis by a fire protection company. All appropriate testing is performed by this company to verify that the firefighting equipment is maintained in operating condition.

Equipment necessary for the facility operations will be maintained to ensure compliance with all permits and regulations. Any deterioration or malfunction of equipment is typically repaired within two weeks of the inspection if required supplies are available and weather permits.

## 3.5 Contingency Action Plan

The purpose of this Contingency Action Plan is to identify potential occurrences at Dem-Con, which may endanger human health and the environment. In the event of an occurrence, specific actions to be taken to minimize hazards are outlined in the following plan. The MPCA will be notified within 48 hours of a significant fire, explosion or reportable release at the facility.

### 3.5.1 Identification of Potential Events or Releases Which May Require Corrective Action and Implementation of the Contingency Action Plan

1. Fires and/or Explosions
2. Vandalism
3. Settlement of Completed Fill Areas
4. Violation of Groundwater Quality Standards
5. Violation of Surface Water Quality Standards
6. Surface Drainage Problems
7. Large Scale Erosion
8. Pump Failure
9. Leachate Storage Tank Failure
10. Liner Damage
11. Damage From Severe Rainfall
12. Leachate Spills in Reportable Quantities

13. Landfill Gas Vent Replacement

## 3.5.2 Response Actions to be Taken in the Event of the Occurrence of Items 1-13

This section lists the order of actions to be taken. Depending upon the extent or severity of the event, all actions listed below may not be required.

### 3.5.2.1 Fires and/or Explosions

- Contact Fire Department, emergency personnel and ambulance by dialing 911 if required.
- Control access to the area. Personnel not trained in firefighting methods will not be allowed at the site.
- All equipment which can be safely removed from the area will be removed from the vicinity of the fire and/or explosion.
- Trained personnel will attempt to extinguish or control fires with extinguishers, water from the water truck or by smoldering with nearby soils until the local fire department arrives.
- Notify MPCA within 48 hours of a significant fire or an explosion.
- Affected areas will be repaired. Repairs will consist of regrading as required, replacement of cover system and revegetation, and replacement or repair of equipment as necessary.

### 3.5.2.2 Vandalism

- Fencing: Damaged fencing will be repaired. Temporary access control measures will be installed as required.
- Access gate: Damaged locks or gate will be repaired. Temporary access control measures will be installed as required.
- Other acts of vandalism which may endanger human health or the environment will be repaired accordingly.

### 3.5.2.3 Settlement of Completed Fill Areas

Completed fill areas which settle and cause the disruption of positive surface water flow will be corrected as follows:

- Repairs to capping system if required
- Addition of soil to eroded areas
- Reseeding of repair area
- Mulch and erosion control matting as necessary

### 3.5.2.4 Violation of Groundwater Quality Standard

If groundwater monitoring indicates a violation of groundwater quality Dem-Con will take the actions in MN Rule 7035.2815 subp. 4(G) as follows:

*(1) immediately notify the commissioner in writing;*

*(2) immediately resample if previous samples at the facility did not exceed the intervention limits;*

*(3) evaluate the need to resample if previous samples exceeded the intervention limits;*

Furthermore, the following actions may be taken:

- The well will be retested during the next routine monitoring round to verify the violation.
- Continue routine monitoring.
- Construct an additional well.
- Perform an alternatives analysis for remediation activities.
- Work with assigned MPCA hydrogeologist to develop a response plan to address violation of groundwater standard.

#### 3.5.2.5 Violation of Surface Water Quality Standard

If a violation of surface water quality occurs the following actions may be taken:

- Resample to verify that a violation has occurred.
- Prepare and implement stormwater Best Management Practices (BMPs) to correct the violation and prevent future violations.

Revise Stormwater Pollution Prevention Plan (SWPPP) to address violation and design and implement additional BMPs as necessary.

#### 3.5.2.6 Surface Drainage Problems

If surface drainage problems occur, including evidence of leachate seeps such as odor or stressed vegetation, the following actions may be taken:

- Repair or add additional stormwater diversion berms.
- Regrade slopes.
- Repair settlement or leachate seep areas.
- Clean out perimeter stormwater ponds.

Add temporary or permanent erosion control measures.

#### 3.5.2.7 Large Scale Erosion

If large-scale erosion occurs the following actions may be taken:

- Eroded area will be corrected (regraded, vegetation established).
- Design and install additional erosion control, (riprap, energy dissipaters, erosion control matting, etc.).

### 3.5.2.8 Pump Failure

If a pump failure occurs the following actions may be taken:

- The failed pump will be repaired or replaced.

### 3.5.2.9 Tank Failure

If a leachate storage tank should fail, the following actions may be taken:

- If the leak detection riser on a double-walled tank indicates the presence of water within the secondary containment, the tank and containment will be pumped to remove leachate.
- A temporary leachate bypass system will be installed to direct leachate directly into a tanker truck or a temporary tank.
- The tank will be inspected and repaired or replaced if necessary.

If a leachate release has occurred, procedures in 2.12 will be followed.

### 3.5.2.10 Liner Damage

If liner is damaged after construction during active filling, the operator must have damaged portions repaired by a qualified individual. Repair may include the following:

- Repair liner and granular drainage materials on slopes or other areas of damage to original construction specifications.

### 3.5.2.11 Severe Rainfall Event

In the event of damage caused by a severe rainfall event, the following actions may be taken:

- Leachate will be hauled from the site as required to maintain volume in storage tank and keep collection system operational.
- Damage to slopes in unfilled portions of the liner where granular drainage layer washes down will be repaired.
- Stormwater management facilities, ponds, ditches, outlets, etc. will be inspected and repairs made as needed.

### 3.5.2.12 Leachate or Other Spills

If leachate or other spills occur, the following actions may be taken:

- Spills on soils will be cleaned up by excavation of impacted soils. Soils may be placed in an area of the facility on clay material and allowed to dry.
- Spills in the tanker loading area will collect in the sump which drains into the leachate storage tank.

- Report to EPA and MPCA as required by law, including completing notifications to the Minnesota Duty Officer or National Response Center (NRC) as applicable for the type and quantity of the spilled material.

#### 3.5.2.13 Landfill Gas Vent Replacement

If replacement or modification of a portion of the landfill gas venting system is required, the following actions may be taken:

- Install vertical or horizontal piping

## 3.5.3 Estimated Time Frame Required to Complete Response

### 3.5.3.1 Significant Fires and/or Explosions

| Action | Time |
|---|---|
| Contact Fire Department, Emergency/Medical Personnel | Immediately |
| Control access to the area | Immediately |
| Remove mobile equipment | Immediately |
| Control fires with extinguishers, water, or nearby soils | Immediately |
| Repair damaged area and/or equipment | 0-6 Months |

### 3.5.3.2 Vandalism

| Action | Time |
|---|---|
| Repair Fencing | 0-4 weeks |
| Repair Access Gate | 0-4 weeks |
| Install temporary access control measures | 0-48 hours |
| Other acts of vandalism which may endanger human health or the environment | Variable |

### 3.5.3.3 Settlement of Completed Fill Areas

| Action | Time |
|---|---|
| Repairs to capping system if required | variable |
| Addition of soil to eroded areas | 3 weeks |
| Reseeding of repair area | 2 weeks |
| Mulch and erosion control matting | 2 weeks |

### 3.5.3.4 Violation of Groundwater Quality

| Action | Time |
|---|---|
| Notify MPCA in writing | immediately |
| Resample | Immediately or next sampling event |
| Continue Routine Monitoring | Next scheduled sampling event |
| Construct an additional well | 1-6 months |
| Alternatives analysis | 6-12 months |

### 3.5.3.5 Violation of Surface Water Quality Action

| Action | Time |
|---|---|
| Resample | 0-1 month |
| Prepare and implement stormwater measures | 0-6 months |
| Revise SWPPP | 0-6 months |

### 3.5.3.6 Surface Drainage Problems

| Action | Time |
|---|---|
| Repair/add diversion berms | 0-2 months |
| Repair/add energy dissipaters | 0-2 months |
| Repair settlement areas | 0-2 months |
| Clean out stormwater ponds | 0-2 months |

### 3.5.3.7 Large Scale Erosion

| Action | Time |
|---|---|
| Correction or eroded area | 0-1 month |
| Install erosion control practices | 0-6 months |

### 3.5.3.8 Pump Failure

| Action | Time |
|---|---|
| Temporarily replace with on-site square pump | 1 day |
| Repair/replace pump permanently | 1 month |

### 3.5.3.9 Leachate Storage Tank Failure

| Action | Time |
|---|---|
| Pumping of secondary containment area | 1 day |
| Diversion of leachate and repair of tank | 1-2 months |

#### 3.5.3.10 Liner Damage

| Action | Time |
|---|---|
| Repair leachate liner or cover liner | 48 hours-4 weeks<br>Depending upon severity and weather |

#### 3.5.3.11 Severe Rainfall Event Action

| Action | Time |
|---|---|
| Leachate hauled from the site | 0-5 days |
| Repair unfilled portions of the liner | 1-2 weeks |
| Stormwater management facilities | 1-3 weeks |

#### 3.5.3.12 Leachate or Other Spills

| Action | Time |
|---|---|
| Spills on soils | Immediately |
| Spills within the containment area | Immediately |
| Spills in the tank loading area | Immediately |

#### 3.5.3.13 Landfill Gas Vent Replacement

| Action | Time |
|---|---|
| Repair/replace damaged vent or lateral | 1-2 months |

### 3.5.4 Equipment Needed

- Telephone
- Fire extinguishers
- Water truck
- Bulldozer
- Square pumps
- Spill kits (absorbents, booms, floor dry brooms/shovels)
- Specialty equipment/contractors as needed

### 3.5.5 Prior Arrangements

Fire emergency responses are anticipated to be provided by the City of Mankato Fire Department. In the event of a medical emergency, Emmanuel–St. Joseph's Hospital, located in Mankato, will be contacted. In matters involving a police emergency, the Blue Earth County Sheriff's Office will respond. Emergency

services may be contacted by calling 911. Heavy equipment operators and facility staff maintain communication via two-way radios, and fire control equipment is available on-site and inspected to ensure readiness.

## 3.5.6 Scheduled and Unscheduled Down Times for Maintenance at the Facility

Equipment is maintained on a regular basis. A variety of equipment is used during maintenance intervals which may include a spare compactor, track dozer, loader, excavator, off-road truck, and scraper which are kept on-site. These machines are regularly maintained and a working machine is always available. Equipment is readily shared between all Dem-Con sites adding layers of redundancy in the case of equipment failure. On-staff mechanics are able to perform most repairs on-site. Unscheduled down times are not anticipated in the future, however they may be required in the event of a catastrophe or natural disaster. If the facility needs to shut down for any reason the gate will be locked. The facility will only reopen when it is safe to do so and is able to operate in accordance with facility permits.

## 3.5.7 Estimated Contingency Action Costs

Costs associated with each event are listed under item 3. Costs for each type of contingency action are based on the following:

**Significant Fires and/or Explosions:**

| | | |
|---|---|---|
| Surface Fire fighting (8 hours @ $400/hour) | | $3,200 |
| Revegetation (2 acres @ $1,000/acre) | | $2,000 |
| Sub-Surface Fire fighting (3 days @ $2,500/day) | | $7,500 |
| | *Total:* | $12,700 |

**Vandalism:**

| | | |
|---|---|---|
| Repair well tops, fence structure | | $3,000 |
| | *Total:* | $3,000 |

**Settlement of Completed Fill Areas:**

| | | |
|---|---|---|
| Repair Cost (0.2 acres @ $50,000/acre) | | $10,000 |
| | *Total:* | $10,000 |

**Violations of Groundwater Quality Standards:**

| | | |
|---|---|---|
| Capital | | $150,000 |
| Install Additional Wells (3 wells @ $10,000/well) | | $ 30,000 |
| O&M (10 years @ $15,000/year) | | $150,000 |
| Sample Collection (3 events @ $550/event) | | $ 1,650 |
| Sample Analysis (33 samples @ $125/sample) | | $ 4,125 |
| Evaluation and Report | | $ 20,000 |
| | *Total:* | $355,775 |

**Violations of Surface Water Quality Standards:**

| | | |
|---|---|---|
| Work Plan | | $5,000 |
| Corrective Action Monitoring (10 years @ $9,000/year) | | $90,000 |
| Reporting | | $20,000 |
| | *Total:* | $115,000 |

**Surface Drainage Problems:**

| | | |
|---|---|---|
| Repair or addition of a diversion berm | | $2,000 |
| Energy dissipater device (400 LF @ $12.00/LF) | | $4,800 |
| Cleaning out ponds (30 hours at $150/hr.) | | $4,500 |
| | *Total:* | $11,300 |

**Large Scale Erosion:**

| | | |
|---|---|---|
| Cover Fill (1,500 CY @ $5/CY) | | $7,500 |
| Revegetation (3 acres @$1,000/acre) | | $3,000 |
| Clean Surface Water Controls | | $ 250 |
| | *Total:* | $10,750 |

**Pump Failure:**

| | | |
|---|---|---|
| Pump Replacement | | $15,000 |

| | | |
|---|---|---|
| | *Total:* | $15,000 |

**Tank Failure:**

| | | |
|---|---|---|
| Excavation and soil disposal | | $ 5,000 |
| Tank repair and installation | | $50,000 |
| | *Total:* | $55,000 |

**Liner Damage:**

| | | |
|---|---|---|
| Quantify/locate damage | | $10,000 |
| Waste excavation/relocation | | $25,000 |
| Liner repair (assuming 10,000 SF at $0.5/SF) | | $ 5,000 |
| | *Total:* | $40,000 |

**Severe Rainfall:**

| | | |
|---|---|---|
| Excess Leachate Hauling | | $2,000 |
| Cover Fill (1,500 CY @ $3/CY) | | $4,500 |
| Revegetation (3 acres @ $1,000/acre) | | $3,000 |
| | *Total*: | $9,500 |

**Leachate or Other Spills:**

| | | |
|---|---|---|
| Liquid recovery (4 hours $250/hour) | | $1,000 |
| Disposal (2 trucks @ $500/truck) | | $1,000 |
| Contaminated soil excavation (100 CY @ $5/CY) | | $ 500 |
| Clean soil fill (100 CY @ $4/CY) | | $ 350 |
| Mobilization | | $1,000 |
| | *Total:* | $3,850 |

**Landfill Gas Vent:**

| | |
|---|---|
| Install wells and/or lateral piping | $50,000 |

| | | |
|---|---|---|
| | *Total:* | $50,000 |
| **TOTAL CONTINGNECY ACTION COSTS:** | | $691,875 |
| **FUNDED @ 60% OF CONTINGNECY ACTION COSTS:** | | $415,125 |

### 3.5.8 Review and Amendment

The Contingency Action Plan will be reviewed and amended whenever the permit is re-issued or modified, a failure or release occurs which is not accounted for within this plan, or when a failure or release occurs for which an appropriate response is not provided for within this plan.

## 3.6 Description of Procedures, Structures, or Equipment

### 3.6.1 Prevent Operational Hazards

There are a variety of potential operational hazards associated with activities at the site. The hazards include but are not limited to truck congestion, truck accidents, heavy equipment accidents, slips, trips, and falls, inclement weather issues, asbestos and sharps disposal, and hazardous atmosphere. All employees at the landfill have regular safety and operations meetings to discuss incidents, close calls, and mitigation measures. Dem-Con management reviews all incidents and mitigation measures to ensure hazards are addressed appropriately.

### 3.6.2 Prevent Run-on and Run-off at the Solid Waste Tipping Area

The active phase is sloped and/or temporary diversion berms are constructed to isolate stormwater run-off within the active fill area and to divert stormwater around and away from the active fill areas, preventing run-on into the active fill area.

### 3.6.3 Prevent Contamination of Groundwater and Surface Water Supplies

Existing landfill operations are conducted as an unlined Class I construction and demolition debris landfill. A 4-foot thick clay barrier layer without leachate collection is present below the disposal area. Protection of groundwater and surface water resources is provided through engineered soil attenuation layers beneath historical disposal areas, site-specific geologic and hydrogeologic conditions, and implementation of operational controls.

As part of this permit reissuance, future lined landfill cells are proposed to be constructed with a composite liner system and a leachate collection and removal system. The proposed lining system will consist of, from bottom to top, a six-inch soil barrier layer, geosynthetic clay liner (GCL), 60-mil HDPE geomembrane, and 12’ inch granular drainage layer. The leachate collection system will involve a series of HDPE perforated pipes surrounded by coarse aggregate draining to leachate collection sumps. The leachate collection sumps will pump leachate into holding tanks where it will be loaded into tanker trucks and hauled to an

offsite wastewater treatment facility for disposal. In addition, the unlined area is proposed to be overlain with the base liner system for future disposal which limits exposure of waste in the unlined area to the elements and will further protect groundwater and surface water resources.

Following construction and certification, these lined cells will provide an enhanced level of protection for groundwater and surface water resources. Final cover systems incorporating low-permeability components will be installed in accordance with approved closure plans as landfill phases reach final grade.

Operational measures that further protect groundwater and surface water include waste acceptance controls in accordance with the approved ISWMP, inspection of incoming loads, controlled waste placement and compaction, application of cover materials, and management of run-on and run-off through stormwater diversion berms, grading, and drainage features. Groundwater conditions are evaluated through an established monitoring program, and response procedures are implemented if monitoring results indicate potential impacts.

### 3.6.4 Mitigate Effects of Equipment Failure and Power Outages

Maintenance of equipment is performed on a routine basis. If a power outage occurs and power is required, a portable generator will be used to supply power until service is restored.

### 3.6.5 Prevent Ignition or Explosions of Waste and Emergency Response Plan

1. The site is run in a manner to minimize the chance of ignition or explosion of waste. Waste loads are inspected as they are tipped. This prevents unpermitted materials which may be flammable or explosive from being buried at the facility.
2. There is communication maintained between the operators, scale attendant, and the office. All personnel are equipped with telephones for summoning emergency assistance as required.
3. Extinguishers for firefighting are available at the office and on the equipment.
4. All communication and fire equipment are checked at least annually to ensure working order.
5. Dem-Con Landfill is served by the Blue Earth County sheriff and City of Mankato fire department..
6. A written report will be submitted to the Commissioner within two weeks after a reportable emergency has occurred. The report will contain a description of events and procedures followed in responding to the emergency. Pertinent actions within the Contingency Action Plan will be referenced and performed. The Contingency Action Plan will be reviewed for adequacy and modified as required.

## 3.7 Traffic Patterns and Control

The site is accessed via Township Road 448, with the primary transportation route for trucks arriving at and leaving the facility being 3rd Avenue (County Road 5). Inbound and outbound trucks utilize a single scale located near the facility entrance. Traffic is anticipated to be composed of approximately 80% standard dump trucks and roll-offs, 10% semi-end dumps and about 10% private vehicles, which use the site.

Vehicles drive to the gatehouse, their volumes and/or weights are recorded and then they are directed to the appropriate tipping area.

## 3.8 Storage

Metals such as tin, ferrous, brass, copper and aluminum are removed from the demolition material, stockpiled, and then hauled to a scrap metal processor. Tires are stored until a sufficient quantity is obtained to make a truckload, approximately 300 tires. The tires are then loaded and hauled away for recycling. Appliances are stored on-site and hauled away for recycling once a sufficient number accumulate to fill a truck. Batteries are stored in a covered leak proof container prior to removal from the site. Cardboard is stockpiled until a large enough quantity accumulate to bale and ship. Wood is stockpiled until a large enough quantity accumulates to grind into a final product. Concrete and asphalt are stockpiled on-site until a large enough quantity accumulates to crush and recycle. Shingles are stockpiled on-site and processed as materials are needed. Processing of shingles, wood and concrete and asphalt may occur within the site. Compost material such as grain residuals and wood waste is managed in a stockpile until material is suitable for reuse as soil amendment material. Compost management is discussed further in Section 8.

# 4 Closure and Post Closure Plan

The purpose of this Closure and Post-Closure Plan is to provide a program that fulfills the requirements and responsibilities of minimizing and/or eliminating potential environmental and health hazards at the Dem-Con Pilgrim Landfill. In addition, the plan aims to ensure proper closure of the landfill, monitoring of its post-closure effects, and maintaining the site in a safe condition.

## 4.1 Closure Operational Plan

### 4.1.1 Notification of Closure

As per Minnesota Rules, the operator will notify the MPCA 90-days prior to closure. Regular customers of the landfill will be given written notification of the site's closure date no less than 60 days prior to completion of landfill activities. Notification of closure will be repeated not less than thirty days prior to the cessation of landfilling activity. All notifications will contain information on alternative disposal sites.

Notices will be published in major newspapers circulated in the landfill's service area. These notices will include date of site closure and locations of alternative disposal areas. The landfill operator will post a sign at the gate attendant’s window at least 60 days prior to and one hundred and twenty days after completion of landfilling activity. These signs will include notification of anticipated closure date and locations of alternative disposal locations.

### 4.1.2 Security

Only those persons authorized by the landfill operator and/or owner will be permitted on the site after closure of the facility. Unauthorized access to the site and further disposal of demolition debris at the site will be restricted by the use of locked gates and fences.

### 4.1.3 Responsible Party

At the time of closure, the landfill operator will provide the name, address, and telephone number of the party responsible for the facility during the post closure period.

### 4.1.4 Overlay and Closure of Unlined Disposal Area

As part of this permit modification request, it is proposed to consolidate construction and demolition waste and cease operations of the unlined Class I area on the east side of the site (existing DD 001, proposed DD 002). The facility is then proposing to construct lined disposal cells which overlay the unlined area and serve as a base liner system for the future lined disposal area. The proposed overlay system, from bottom to top, will consist of a six-inch soil barrier layer, GCL, 60-mil HDPE geomembrane, and a 12-inch granular drainage layer.

### 4.1.5 Final Cover

Final cover placement will be an on-going process as portions of the fill are brought to final grade. The placement of final cover follows the completion of filling to final grade of each individual phase as final elevations are reached.

The final cover system for all landfill areas, including unlined disposal areas and future lined disposal cells will consist of a six-inch buffer layer (1 inch minus material), a 40-mil LLDPE liner (textured and smooth), a 12-inch granular drainage layer, a six-inch rooting zone layer, and six inches of topsoil. Yard waste compost may be incorporated into the topsoil as a soil amendment. The final cover system for the unlined area will tie into the overlay system and future final cover of the lined disposal area.

### 4.1.6 Vegetation

Vegetation will be established on completed fill areas in a progressive manner. Within ninety days after termination of landfilling activity, the finished surface will be seeded, mulched, and fertilized. Areas where vegetation has been established prior to closure will be inspected at this time. If any of these areas do not have adequate vegetation, measures will be taken (reseeding, fertilizing, etc.) to reestablish vegetation.

### 4.1.7 Grading

Final grading of the landfill and placement of the final cover system will be to the grades shown on the Sheet C-105. The final grades for the top of the fill area are designed at 3% or greater and side slopes remaining to be constructed will not exceed 25% (4:1). Slopes will be interrupted with drainage swales placed no greater than every 200’ lineal feet apart down the slope. The final grades are intended to promote surface water runoff and inhibit excessive erosion. The continuity of the final grades over the top portion of the fill area will render the area suitable for ultimate land uses such as open recreational space or green space.

### 4.1.8 Surface Water Drainage

Dem-Con proposes to manage stormwater under the MPCA General Industrial Stormwater Permit. A Stormwater Pollution Prevention Plan (SWPPP) will be developed for the site.

Surface water drainage from the landfill and surrounding setback areas is generally divided into drainage areas that route runoff toward on-site stormwater management features. The majority of runoff from the landfill is directed toward a stormwater management and sedimentation basin located on the west side of the site. A second stormwater sedimentation basin will be located on the northeast corner of the site to manage stormwater from the northern and eastern portions of the site. Finally, a third smaller sedimentation basin will be located in the southeastern portion of the site to collect runoff from perimeter ditches in the southern and eastern portions of the site, as well as any drainage from the existing yard area. Discharge from on-site stormwater management features ultimately flows through existing drainage channels toward the Minnesota River.

Stormwater drainage patterns and control features described in the approved engineering plans will be maintained throughout landfill development. Pond grading is subject to change as needed at the time of construction. Any modifications to grading or sequencing associated with future landfill development will be performed in accordance with the approved SWPPP and applicable permit requirements. Updated stormwater calculations for the proposed final cover system and sedimentation basins are provided in Appendix G.

#### 4.1.8.1 Inspection

Prior to closure of the landfill, the regulatory agencies shall be notified to allow inspection of the site prior to personnel and equipment removal from the property. The final condition of the landfill shall be approved by the County and the MPCA before removal of personnel and equipment.

#### 4.1.8.2 Description

The landfill owner and/or operator shall submit a detailed description and plat of the completed landfill to Blue Earth County Registrar of Deeds and to the Commissioner of the MPCA within one month of final closure of the landfill. The description and plat shall be produced by a Land Surveyor registered in the State of Minnesota and include the general type, quantity, and location of deposited solid waste, depth of waste fill, original and final terrain descriptions, and other pertinent characteristics of the completed demolition landfill site of interest to future property owners.

#### 4.1.8.3 Certificate of Closure

Dem-Con Pilgrim Landfill shall submit to the regulatory agencies' certification from a registered Professional Engineer, licensed in the State of Minnesota, that the landfill has been closed in accordance with approved plans, ordinances, and license conditions. The certification shall be submitted no later than sixty days following completion of closure activities. The regulatory agencies shall review and approve the closure following receipt of said certification.

## 4.2 Post-Closure Operational Plan

Dem-Con Pilgrim Landfill, LLC or its successor-in-interest will be responsible for the post-closure care of the site for a period of twenty years or until such times as this responsibility has been assumed by another public or private entity acceptable to the regulatory agencies. The following activities shall be performed during the post-closure period.

### 4.2.1 Inspection

Routine inspections of the site will be conducted on a quarterly basis, excluding winter quarter in conjunction with the schedule for monitoring well sampling, for five years. Annual inspections will be made after the fifth year. A representative of the owner will inspect the site. During these inspections, the following items will be observed and commented on:

1. Effectiveness of access control and site security;
2. Condition of final cover
3. Condition of vegetation;
4. Evidence of vermin;
5. Evidence of illegal dumping;
6. Evidence of illegal use of property;
7. Inspect storm water drainage system;
8. Inspect groundwater monitoring system;
9. Inspect leachate collection, transfer, and storage system.

A summary report of the self-inspections will be submitted to the MPCA on an annual basis as part of the Annual Monitoring Report.

### 4.2.2 Maintenance

If inspections reveal problems with any of the above-mentioned items, appropriate action will be taken to rectify them. In the event that gullying or excessive erosion occurs, the liner will be repaired as needed and additional cover soil will be placed and compacted. Vegetation will be reestablished. Measures may be taken to prevent further occurrence of the problem. If there are areas of inadequate turf establishment, they will be reseeded.

### 4.2.3 Reporting

An annual report will be submitted to the MPCA describing inspection conditions, corrective actions, maintenance activities, monitoring activities, performed at the landfill by March 1st annually.

## 4.3 Closure Cost Estimates

The following section presents an itemized cost estimates used to determine the financial holdings necessary to provide for the closure and post closure of the Dem-Con Pilgrim Landfill. Material quantities are based on the current size of open landfill that has not yet received final cover. At this time, it is based on the total open area of the current unlined demolition area footprint (approximately 17.2-acres). Once the closure and overlay of the unlined disposal area is complete, the cost estimate will be revised to reflect the total open area of the active lined disposal area. Costs in this permit application are presented in 2026 dollars. Cost estimates will be reviewed annually and revised as necessary in Dem-Con Pilgrim Landfill's Annual Report.

**Mobilization:**

| | | |
|---|---|---|
| Lump sum | $ | 25,000 |

**Placement of cover soil:**

Based on 17.2 acres.

| | | | | |
|---|---|---|---|---|
| 6” Buffer soil | 13,888 cy @ $5.00/cy | (Owner Supplied) | $ | 69,440 |
| 40 Mil textured LLDPE | 750,000 sf @ $0.28/sf | | $ | 210,000 |
| 12” Drainage sand | 27,777 cy @ $10.00/cy | | $ | 277,770 |
| 6” Rooting Zone | 13,888 cy @ $3.00/cy | (Owner Supplied) | $ | 41,664 |
| 6” Topsoil | 13,888 cy @ $3.15/cy | (Owner Supplied) | $ | 43,747 |

**Seeding and mulching:**

| | | |
|---|---|---|
| 17.2 acres @ $630/acre | $ | 10,836 |

**Surveying/CQA/testing/inspection/certification:**

| | | |
|---|---|---|
| Lump sum | $ | 100,000 |

**Construction of diversion berms:**

| | | |
|---|---|---|
| Berm material (100 LF/acre) 1,720 LF @ $5/LF | $ | 8,600 |
| HDPE pipe (50 LF/acre) 860 LF @ $22.50/LF | $ | 19,350 |
| **TOTAL CLOSURE COSTS** | **$** | **806,407** |

## 4.4 Annual Post-Closure Costs

The following information summarizes costs associated with annual post- closure care of the facility.

**Inspections:**

| | | |
|---|---|---|
| Facility Inspection Costs (80 hours @ $35/hour) | $ | 2,800 |
| Landfill Supervisor (26 hours @ $50/hour) | $ | 1,300 |

**Routine Maintenance and Repair Costs:**

| | | |
|---|---|---|
| Mowing (assume 1x/year) and 75-acres | $ | 5,000 |

| | | |
|---|---|---|
| Cover Maintenance (assume 1x/year) | $ | 1,000 |
| Security | $ | 500 |
| Surface Water Management and Maintenance | $ | 1,000 |
| Access Road Maintenance | $ | 500 |
| Rodent Control | $ | 250 |
| **Leachate Management Costs:** | | |
| Leachate Disposal (10,000 gal/ac/year @ $0.04/gal, 75-ac) | $ | 30,000 |
| Leachate Monitoring | $ | 5,000 |
| Reporting | $ | 1,000 |
| Pump Replacement (assume 1 pump/5 years @ $15,000/pump) | $ | 5,000 |
| **Landfill Gas Management Costs:** | | |
| LFG Monitoring | $ | 500 |
| Reporting | $ | 250 |
| **Groundwater Monitoring Costs (2 sampling events/year):** | | |
| GW Monitoring Well Sample Collection (6 wells @ $425/well) | $ | 2,550 |
| Semi-annual Lab Analysis (6 wells @ $700/well) | $ | 4,200 |
| System Maintenance (6 hours @ $25/hour) | $ | 150 |
| Monitoring Well Replacement (assume 1 well/5 years @ $10,000/well) | $ | 2,000 |
| Reporting | $ | 4,500 |
| **Reporting Services Costs:** | | |
| Third Party Project Management | $ | 5,000 |
| **TOTAL ANNUAL POST-CLOSURE COSTS** | **$** | **72,500** |

## 4.5 Financial Assurance

The facility will maintain a financial assurance mechanism in accordance with MN Rule 7001.3300.

# 5 Site Location Information

## 5.1 Topographic and Development Map

The Pilgrim Demolition Landfill is located in Blue Earth County, Minnesota, within Lime Township. The site lies within the Minnesota River basin and is situated in an area generally characterized by gently sloping terrain that has been locally modified by historical aggregate mining operations and subsequent landfill development activities. Topographic conditions across the landfill property vary due to excavation associated with past mining and landfill construction. Existing site contours and elevations are shown on the Existing Conditions Plan included in the engineering drawings. The landform within the landfill footprint differs from surrounding properties as a result of mining and grading, while adjacent areas generally reflect natural and agricultural topography typical of the region.

## 5.2 Geologic and Location Information

A hydrogeologic study has previously been prepared for the site by Environmental Resource Group (ERG), dated August 2002. This document was submitted to MPCA as part of the 2004 re-permitting efforts and may be referenced for further regional and site hydrogeologic conditions. A summary of findings discussed in this document are provided within this section.

### 5.2.1 Regional Geology

There are three primary geologic groups near the surface in Blue Earth County. The Prairie du Chien Group (OPDC) is described in Blue Earth County as predominantly composed of dolomite and sandy dolomite with quartzose sandstone. The OPDC, where present, is in turn underlain by up to an approximate 75 foot thickness of the Jordan Formation (Jordan). The Jordan is described as a soft to poorly cemented quartzose sandstone. The Jordan crops out in the north-central part of Blue Earth County along the Minnesota River valley. In some areas, absence of OPDC has exposed the sandstone to further erosion. In these areas, only a portion of the Jordan is present and in some areas, the St. Lawrence Formation (St. Lawrence) forms the upper bedrock unit. The St. Lawrence is described as predominantly interbedded dolomite, siltstone and shale. Regional geologic cross-sections can be found in the Pilgrim Demolition Landfill Hydrogeologic Evaluation (Environmental Resource Group, 2002).

### 5.2.2 Site Geology

A typical geologic column for the site consists of unconsolidated material at the surface (0 to 50 feet) underlain in places by either the OPDC (0 to 40 feet thick), and/or Jordan (0 to 80 feet thick) and/or the St. Lawrence (60 to 100 feet thick). The St. Lawrence is underlain by the Franconia Formation (80 to 120 feet thick), Ironton and Galesville Formations (60 to 80 feet thick), Eau Claire Formation (80 to 120 feet thick), the Mt. Simon Formation (100 to several hundred feet thick) and Precambrian Rock (unknown thickness). Well log based geologic cross-sections can be found in the Pilgrim Demolition Landfill Hydrogeologic Evaluation (Environmental Resource Group, 2002).

## 5.2.3 Regional Hydrogeology

Regional hydrogeologic conditions at the Dem-Con Pilgrim Landfill are controlled by sedimentary bedrock typical of south-central Minnesota and groundwater discharge to the Minnesota River. Site-specific hydrogeologic investigations indicate that groundwater beneath the landfill occurs primarily within the Jordan Sandstone, which represents the first significant water-bearing unit in the area. The OPDC group, which overlies the Jordan Sandstone regionally, is thin to locally absent in the vicinity of the site due to erosional features and historic quarrying activities. The St. Lawrence Formation underlies the Jordan Sandstone and functions as a regional confining unit that hydraulically separates the Jordan aquifer from deeper bedrock aquifer systems.

Groundwater flow in the regional and site vicinity is generally from east to west toward the Minnesota River, which represents the regional groundwater discharge area. Hydrogeologic data collected at the site indicate that groundwater flow occurs predominantly through porous media within the sandstone rather than through fracture-dominated pathways. The presence of eroded bedrock valleys in the region does not materially alter groundwater flow direction or hydraulic gradients beneath the site.

Reconnaissance of the surrounding area identified no surficial karst features. Solution features observed within quarry walls are limited in extent, are not laterally continuous, and do not exhibit collapse characteristics. Static groundwater conditions occur within the sandstone, indicating that localized solution features in overlying dolomite do not influence regional groundwater behavior at the site. The regional hydrogeologic setting, combined with site-specific monitoring and design controls, provides a basis for groundwater protection and monitoring at the facility in accordance with MPCA requirements.

## 5.2.4 Site Hydrogeology

Site-specific hydrogeologic conditions at the Pilgrim Demolition Landfill have been evaluated through field investigations and groundwater monitoring conducted as part of a hydrogeologic evaluation. Monitoring wells installed at the site are screened within the Jordan Sandstone, which represents the primary water-bearing unit beneath the landfill.

Groundwater elevations measured during site investigations indicate that groundwater beneath the site occurs at elevations on the order of approximately 780 feet (NGVD). Groundwater flow across the site is generally from east to west toward the Minnesota River, consistent with regional groundwater discharge patterns. Water level measurements collected during multiple monitoring events indicate that groundwater flow direction and hydraulic gradients remain relatively consistent, with only minor seasonal variation. Hydrogeologic data indicate that groundwater movement at the site occurs primarily through porous media flow within the sandstone rather than through fracture-dominated pathways. Overlying Prairie du Chien Group dolomite is thin to absent within much of the site due to erosional features and historic quarrying activities. As a result, static groundwater conditions occur within the underlying sandstone, and localized solution features in remaining dolomite do not exert a controlling influence on groundwater behavior at the site.

The existing groundwater monitoring system provides ongoing evaluation of groundwater elevations and quality beneath the landfill. Monitoring data is used to confirm groundwater flow direction and to provide

early detection of any potential changes in groundwater conditions in accordance with permit requirements. Historical groundwater elevations in the current monitoring wells can be found in the SW-254 Pilgrims Demolition Landfill 2025 Annual Report (Stantec, 2026).

# 6 Operations and Maintenance

## 6.1 Facility Description

The site currently accepts C&D debris and is proposing to accept industrial wastes in accordance with the ISWMP. The site operates Monday through Sunday with season fluctuations in volumes.

The following methods and procedures are incorporated into the landfilling operation. Open burning is prohibited at the site. Windblown materials will be minimized by restricting the working area to reasonable, workable limits. Generally, the working face is approximately one acre, with an average lift thickness of 8 to 12 feet. The slope of a typical working face may vary but will not exceed 3:1 (H:V). Waste is compacted and other construction tasks performed by on-site equipment owned by Dem-Con. Available equipment changes periodically at the site. New equipment is purchased and old equipment is sold as needed for proper operation of the site. All the machinery is equipped with standard safety devices and noise control systems. The equipment is typically stored and maintained on-site but may also be serviced at the shop located at Dem-Con's Environmental Campus in Shakopee, Minnesota. Equipment available on-site changes periodically and typically consist of:

1- Compactor

1- Front End Loader

1- Off-Road Truck

1- Skidsteer

Additional equipment such as dozers and excavators are readily available on as as-needed basis from Dem-Con's Shakopee facility.

On-site personnel typically consists of two to three landfill operators. A minimum of one MPCA certified Type III landfill operator is on-site at all times during operational hours.

Windblown materials are routinely picked up as deemed necessary by the operator to maintain permit compliance. Cover material is obtained from on-site soil excavation or from clean soil hauled onto the site. Intermittent cover is placed on the active areas of the landfill on an as needed basis to control nuisance issues. However, at a minimum, the cover is placed on any wastes that are exposed for 30 days. Stockpiling measures are taken as necessary to ensure adequate cover material throughout the entire year, including winter months.

Site security is maintained by a gate that is securely locked during non-operational hours.

Inspection records, the Closure Plan, Post-closure Plan and Contingency Action Plan are all kept at the Dem-Con offices. Copies of all permits, permit applications, plans, licenses, etc. are also kept at the Dem-Con offices. A copy of the Contingency Action Plan is kept at the landfill gatehouse.

Termination procedures at the site include constructing a final cover system over completed portions of the landfill as they reach final grade. The final cover system will consist of a six-inch buffer layer, a 40–mil LLDPE cap, 12-inches of drainage sand, six inches of rooting zone soil and six inches of topsoil native to the area capable of supporting vegetative growth. The topsoil may be amended by incorporating yard waste compost into the topsoil.

Covered areas will then be seeded and vegetation established to decrease erosion and infiltration rates. Before final closure of the site, the MPCA and the County will be notified to allow their staff to conduct site inspections. Specific activities regarding closure and post-closure care for the site are addressed in Section 4 of this document.

A description, including a plat, will be filed with the County Registrar of Deeds upon closure of the landfill. The description will include information concerning the nature of the site with respect to the type of waste deposited, the location of fill areas, depth of fill and other information of interest to future landowners.

## 6.2 Emergency Procedures

Emergency services for the proposed project are provided by the City of Mankato.

Emergency Preparedness and Prevention:

Dem-Con is operated in a manner that reduces the possibility of fire, explosion or threatening pollutant release. Dem-Con has prepared for emergencies in the following manner:

Certain equipment contains CB radios and operators are equipped with mobile telephones. The use of CB radios allows landfill operators to maintain contact with truck drivers while the trucks are on-site. The office maintains radio contact with the equipment operators. The office has a telephone for immediate contact of emergency personnel in the event of an emergency.

All operating equipment and buildings are equipped with fire extinguishers that are rated for types of fires anticipated. A spare extinguisher for the heavy equipment is stored in the shop. Dem-Con Landfill is served by the City of Mankato Fire Department , which will be called in for assistance in the event of a significant fire.

## 6.3 Operation Variables

Basic operating methods do not vary seasonally. In periods of rain, operation of the facility continues uninterrupted. Water falling on the active fill area is generally quickly absorbed. The main access road leading to the facility as well as the internal roads used to access the disposal areas are constructed of all-weather materials and maintained to ensure access throughout the year. During periods of snow, haul roads are cleared by trucks with snowplows or other equipment as needed. The loader and a compactor continue to operate in the active fill area. Blowing litter is typically not a problem even during periods of high winds due to the nature of the demolition material. However, litter fences and temporary litter screens are

available and used on-site to control blowing litter should winds create a problem with occasional lighter fractions of demolition-constructions debris (such as Styrofoam or insulation).

## 6.4 Trouble Shooting Procedures

Employee meetings are held as needed but at a minimum on a monthly basis. Employees bring any items of concern up during these meetings or, if the situation warrants, immediately upon discovery.

## 6.5 Preventative Maintenance

Equipment is routinely maintained. Finished landfill slopes are not less than 3% or greater than 4:1 (H:V). Stormwater diversion berms and controls are to be constructed across the landfill slopes to intercept stormwater and decrease erosion and sedimentation potential. Final grades have been designed to promote surface water runoff and inhibit surface water infiltration and slope erosion. Surface water runoff from the demolition fill area is directed to on-site stormwater management ponds.

In the event that rodent control problems occur, control measures will be adapted to mitigate the issue in conformance with practices approved by the various agencies.

## 6.6 Safety Requirements and Procedures

Personnel are trained in the safe operation of the equipment. Equipment is equipped with standard safety features including fire extinguishers.

## 6.7 Equipment Maintenance Records

Maintenance records for facility equipment and general landfill maintenance are maintained digitally and accessible at the office.

## 6.8 Site Inspection Records

Site inspection records are completed by Dem-Con personnel and are accessible at the landfill office. The site is inspected by Dem-Con personnel on a monthly basis. The MPCA also inspects the landfill on a periodic basis.

# 7 Construction Inspection, Quality Control, and Quality Assurance Plan

A Construction Quality Assurance Plan for both base liner and final cover construction is provided in Appendix H. Construction documentation for each phase of construction or closure will be submitted to the MPCA in the form of a documentation report signed by an Engineer registered in the State of Minnesota.

# 8 Composting Operations

## 8.1 Composting Plan

The facility will continue to compost yard waste received from the general public and commercial landscaping companies. The facility has the capacity to accept and compost up to 10,000 cubic yards of yard waste on an annual basis. In order to facilitate the composting process, agricultural grain waste may be received and composted with the yard wastes. Agricultural grain wastes are subject to the conditions of the provisions of the ISWMP presented in Appendix A.

Overall, the Site has been prepared for management of surface water to prevent ponding within the compost piles and windrows. Precipitation falling on the compost piles is readily absorbed into the compost material and there is typically no run-off from the compost windrows, even with heavy rain events. Similarly, there is no leachate which is typically generated by the yard waste composting windrows.

The grading for existing conditions prevents the run-on of surface water into composting operations areas. The composting area grading provides sheet flow drainage to a low area to the west where water collects and infiltrates. The localized surface water flow directions are indicated on the existing conditions plan sheet.

Upon arrival at the facility, all incoming vehicles are asked about the quantity and nature of their load. Unacceptable materials are removed from the load near the scale and office area before proceeding to the main yard waste composting area. The access road within the facility are not paved. The interior traffic routes are watered, as needed, to control dust.

Prior to processing, yard waste may be stockpiled at the facility. The yard waste is generally moist enough not to create dusty conditions. If handling the yard waste creates dusty conditions, sufficient water would be applied to control the dust. The distance between the facility and any residential or other development is expected to further ensure that facility noise is not a nuisance.

The active composting area has the potentials to generate odors. Windrow or static pile composting is intended to be used for curing, and maturing the yard waste. Aeration of the windrows/static piles, attention to moisture content, and turning of material as needed would all assist maintenance of aerobic conditions and would minimize odors.

When active composting is completed, the compost is removed from the main operations area. The compost would be moved by a front-end loader and hauled to a screening unit. Material would be screened and stored in the finished compost product storage area near the scale and office. Compost is available to commercial landscape companies and the general public.

# 9 Other Site Information

## 9.1 Site Operating Life

The Pilgrim Demolition Landfill operated by Dem-Con includes disposal area DD 001, which is classified as a Class I Construction and Demolition (C&D) disposal area and proposed to be consolidated and closed as part of this permit action. Proposed disposal area DD002 is classified as a Class III lined C&D disposal area and includes engineered liner and leachate management systems. DD 001, the unlined area, has an anticipated remaining life of 1-2 years. DD 002, the proposed lined area, has an anticipated remaining life of over 50 years.

## 9.2 Wind Dispersion of Particulate Matter and Fugitive Dust

The primary sources of fugitive dust emissions is associated with internal haul roads throughout the landfill and legacy mining and processing operations that preceded the construction of landfill phases. Standard Best Management Practices (BMPs) such as watering, using selective materials for road construction, or paving roads are implemented to control fugitive dust. A water truck is available to water haul roads during dry periods.

## 9.3 Phase Development Plan

The site will be worked in phases as shown on the drawings in Appendix B. The first phase action will be the waste relocation of the existing DD 001 material to the existing DD 002 disposal area as described above. Proposed future lined cell phasing, as shown on the Drawings in Appendix B, is named in the likely sequence of construction of cells. Note that partial cells may be constructed rather than full phases as is shown. Final cover will be placed over each cell as final grades are reached and the area will be seeded in the spring or fall following completion of final cover placement.

## 9.4 Cross Sections

Cross Sections are included as Sheets C-107 and C-108 of the plan set. These plans show the existing grade, final grade, and approximate excavation grade with north south and east west sections through each phase. All finished grades will not exceed slopes of 25%. Base grades and the overlay liner will be constructed at a maximum 3:1 (H:V) slope.

## 9.5 Noise and Access Control Methods

The site operates within the State of Minnesota's Noise Standards, Minn. Rule 7030.0040. The site and existing landfill and expansion area are located in an area surrounded by industrial and agricultural land uses (Noise Area Classification 3). Equipment is fitted with standard noise control devices (mufflers, etc.) Access is controlled by a locking gate. Berms adjacent to the access road prohibit illegal access to the facility after hours.

## 9.6 Monitoring System Description

The environmental monitoring system (EMS) at the Dem-Con Pilgrim Landfill consists of seven groundwater monitoring wells completed in the water table aquifer and surface water sampling at the west sedimentation basin. Monitoring well construction details and sampling procedures are documented in the facility's approved Sampling and Analysis Plan.

Monitoring well MW-7 was constructed at the site in August 2010 in response to MPCA comments regarding the monitoring system. The casing for MW-7 was extended approximately five feet in 2015 to accommodate site development, and the well was resurveyed following the modification. One on-site water supply well, designated as the shop well, is sampled in conjunction with the monitoring wells.

Monitoring well MW-2 was abandoned due to progression of landfill development and was replaced by MW-14-JS, located in the vicinity of the former MW-2 location. Piezometer MW-17-JS was installed in 2019 as a nested well near MW-5 to provide additional groundwater elevation data.

The monitoring wells serve the following functions within the EMS:

MW-1: Provides upgradient groundwater quality information.

MW-14-JS: Provides upgradient groundwater quality information (replacement for MW-2).

MW-17-JS: Provides groundwater elevation information (nested with MW-5).

MW-4: Provides groundwater elevation information.

MW-5: Provides downgradient groundwater quality information.

MW-6: Provides downgradient groundwater quality information.

MW-7: Provides downgradient groundwater quality information closest to active disposal areas.

Monitoring wells range in depth from approximately 15 to 95 feet and are screened near the water table and, for the nested well, at greater depth. The wells were constructed using stainless steel screens and were developed and stabilized in accordance with applicable requirements. Well construction complies with the Minnesota Department of Health Water Well Construction Code, and the wells are suitable for monitoring volatile organic compounds, inorganic parameters, dissolved metals, general chemistry, and field parameters.

The Sampling and Analysis Plan will be updated as necessary to document changes to the EMS, and groundwater monitoring continues to be conducted in accordance with the approved plan.

## 9.7 Listing of Required Permits

The site is an established demolition landfill. All required permits have been obtained. The following is a list of the required permits.

MPCA Solid Waste Permit

MPCA Industrial Stormwater Permit

Wastewater Hauling Permit, as applicable, to be issued by the WWTP for leachate disposal.

## 9.8 Environmental Review

An MPCA Environmental Review Pre-screening Form (p-ear1-08) was completed for the site and is included in Appendix I. The form indicates further Environmental Review is not required for the proposed changes at the site.

# 10 General Solid Waste Management Facility Requirements – MN Rule 7035.2535

## 10.1 Subp. 1 Unacceptable Wastes

The unacceptable wastes listed in this section of the Minnesota Rules will not be accepted at the facility. Additional unacceptable wastes are discussed in Section 2.2 of the facility's ISWMP included as Appendix A of this application.

## 10.2 Subp. 2 Security

Only those persons authorized by the landfill operator and/or owner will be permitted on the site. Unauthorized access is controlled by the use of locking gates, fencing, and physical barriers.

## 10.3 Subp. 3 General Inspection Requirements

The operator of Dem-Con Landfill conducts weekly inspections of the facility. The operational life of the facility is reviewed annually as part of the Annual Monitoring Report. The post-closure inspections for the facility are described in Section 4 of this application.

## 10.4 Subp. 4 Industrial Solid Waste Management Plan (ISWMP)

The ISWMP is included as Appendix A of this application.

## 10.5 Subp. 5 Household Hazardous Management Plan

Household Hazardous Waste is not accepted at the Facility as described in the facility ISWMP. Additionally, the facility staff is familiar with the Blue Earth County Household Hazardous Waste management programs and designated collection facilities. If any household hazardous waste arrives at the facility it will be redirected to that facility.

## 10.6 Subp. 6A Active Karst Features, Disappearing Streams, or Caves

The geologic features of the site are discussed in detail in Section 5 of this application.

## 10.7 Subp. 6B Groundwater and Surface Water Protection

Groundwater and Surface water protection is discussed in detail in Section 3 of this application.

## 10.8 Subp. 7A Site Preparation

Initial site preparation activities have already taken place in existing Phases 1A, 1B, and 2 of the landfill footprint. As filling of each phase nears completion, a subsequent phase is prepared for construction. Construction preparation activities may include relocating the haul road, excavating to establish base grades, and backfilling with specified subgrade materials. Note that as part of the construction of Phase 3 the existing waste in existing disposal area DD 001 will be relocated in order to achieve the proposed base grades.

## 10.9 Subp. 7B Phase Development Plans

Each phase shall provide for filling in a manner to achieve final waste elevations as rapidly as possible. The phases shall be designed and constructed to minimize moisture infiltration into the fill areas while maintaining stable slopes and appropriate operating conditions. Dem-Con will bring each phase to the final waste contours as shown on the approved phase development plans and close the phase according to the approved facility closure plan. A phase development plan is shown on sheet C-104 of the drawings.

## 10.10 Subp. 7C Surface Water Drainage System

Surface water is diverted around and away from the active fill area. Perimeter berms are developed around the landfill which direct stormwater to one of several stormwater ponds designed to treat stormwater and control rates of runoff from the final landfill grades.

## 10.11 Subp. 7D Slopes and Drainageways

Slopes are designed at a maximum slope of 25% and a minimum slope of 3%. Perimeter slopes are interrupted with drainage ways and diversion berms every 200 lineal feet down the slope.

## 10.12 Subp. 7E Final Contours

Sheet C-105 illustrates the final contours of the landfill. The maximum proposed final elevation is approximately 872 ft-msl, consistent with existing maximum proposed final elevation.

## 10.13 Subp. 8 Operations and Maintenance Plan

See Section 6.

## 10.14 Subp. 9 Hydrogeologic Evaluation

See Section 3.

## 10.15 Subp. 10 Final Cover

The final cover system of the entire landfill consists of a 6 inch buffer layer overlain by a 40-mil LLDPE liner, a 12 inch granular drainage layer, 6 inches of rooting-zone, and 6 inches of topsoil. The topsoil layer will be capable of supporting vegetation and may include yard waste compost as a soil amendment and for nutrient value.

## 10.16 Subp. 11 Water Quality Monitoring

See Section 9.6

## 10.17 Subp. 12 Financial Assurance

See Section 4.

## 10.18 Subp. 13 Planned Ultimate Use

A planned ultimate use of the site has not been determined. The final grades are compatible with development of a final use consistent with the current industrial zoning of the site such as outdoor storage, environmental recycling campus, open space, etc.

# 11 Certification

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

Ethan Ketelsen , P.E.

Name



Signature of Engineer

Stantec Consulting Services, Inc.

1 Carlson Parkway, Suite 100

Plymouth, MN 55447

Address

04/24/2026

Date

763-657-9598

Telephone

56630

Registration Number

**Permit Reissuance and Modification**
11 Certification

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

Mark A. Pahl

Name

Signature of Applicant

4-24-26

Date

3230 Dem-Con Drive

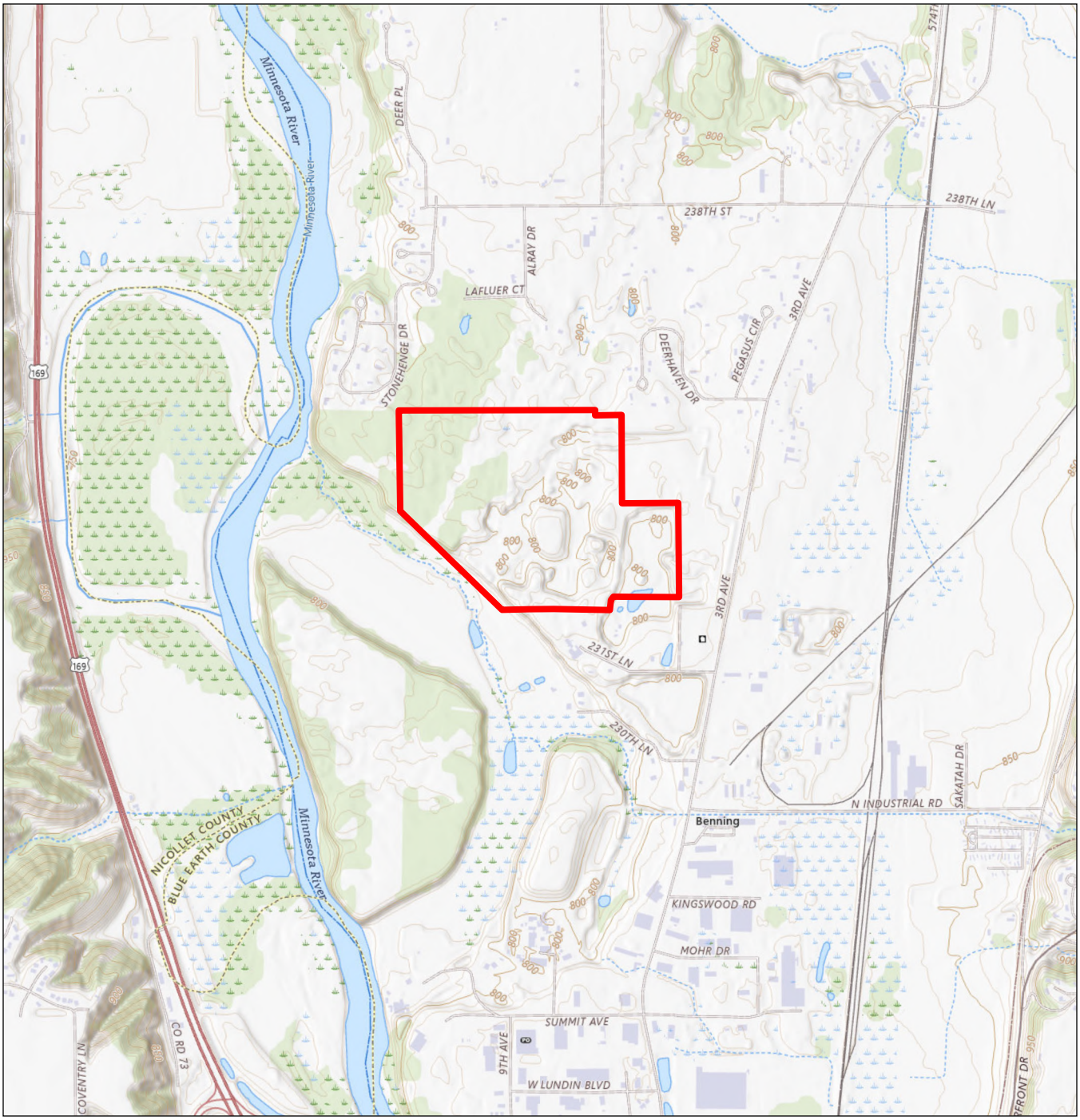
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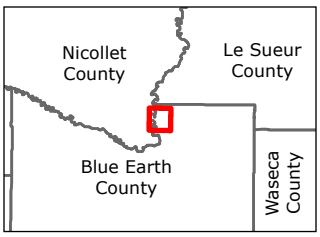
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952-445-5755

Telephone

# Figures




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*Project Location*
T109N, R26W, S30 & S31
Mankato, Blue Earth Co., MN

Prepared by BS on 2026-04-17

*Client/Project*
Dem-Con Pilgrim Landfill, LLC

227708930

*Figure No.*
1

*Title*
**Site Location**

***Notes***
**1.** Coordinate System: NAD 1983 HARN Adj MN Blue Earth Feet
**2.** Data Sources: USGS
**3.** Background: USGS 7.5 Minute Quadrangle



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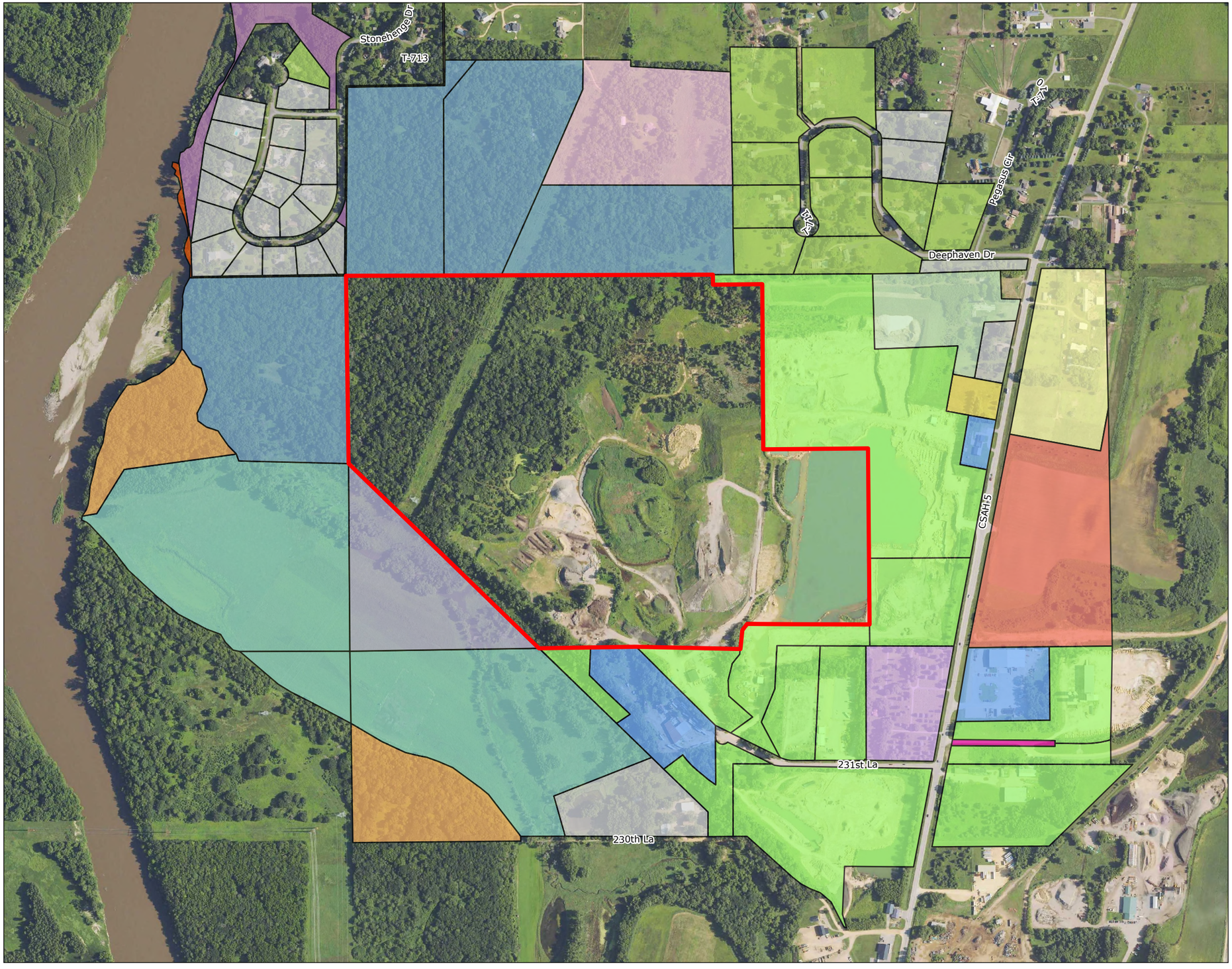



*Figure No.*
**2**

*Title*
**Zoning**

*Client/Project* 227708930
Dem-Con Pilgrim Landfill, LLC

*Project Location*
T109N, R26W, S30 & S31
Mankato, Blue Earth Co., MN

Prepared by BS on 2026-04-07

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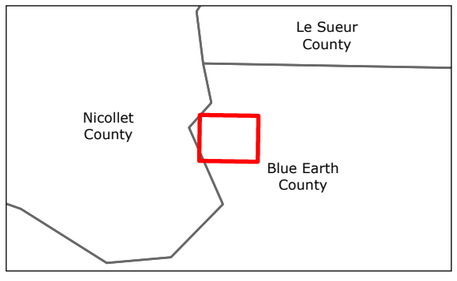
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Property Boundary

Zoning

- 101- 2A/1B/4BB AGRICULTURAL; 2B/1B RURAL VACANT LAND
- 101- (HSTD) 2A/1B/4BB AGRICULTURAL; 5E MANURE PITS
- 101- 2A/1B/4BB AGRICULTURAL; 2B/1B RURAL VACANT LAND
- 101- 2A/1B/4BB AGRICULTURAL; 2B/1B RURAL VACANT LAND; 3A INDUSTRIAL LAND AND BUILDING
- 111- 2B/1B RURAL VACANT LAND
- 112- 2C MANAGED FOREST LAND
- 201- (HSTD) 1A/1B/4BB RESIDENTIAL SINGLE UNIT
- 201- (HSTD) 1A/1B/4BB RESIDENTIAL SINGLE UNIT; 2B/1B RURAL VACANT LAND
- 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT
- 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT
  Acreage 23.04
- 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT; 3A INDUSTRIAL LAND AND BUILDING
- 206- 4B4 UNIMPROVED RESIDENTIAL LAND
- 233- 3A COMMERCIAL LAND AND BUILDING
- 234- 3A INDUSTRIAL LAND AND BUILDING
- 911- 5E CEMETERY-PUBLIC
- 955- 5E COUNTY-PUBLIC SERVICE-OTHER
- 961- 5E COMMON AREA




***Notes***
**1.** Coordinate System: NAD 1983 HARN Adj MN Blue Earth Feet
**2.** Data Sources: MnGEO, Blue Earth County
**3.** Background: Minnesota 2025 Imagery

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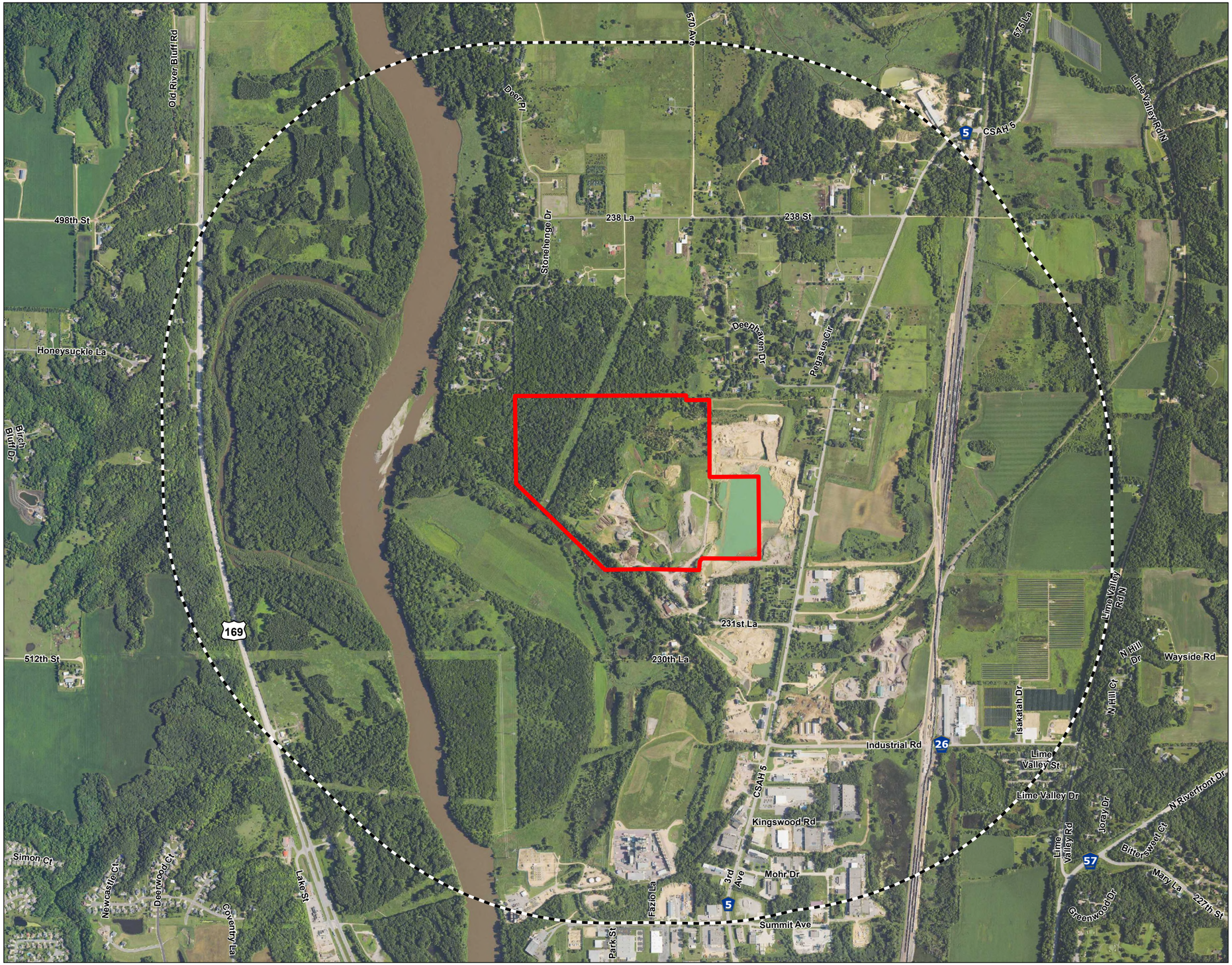



*Figure No.*
**3**

*Title*
**Parks, Recreational Areas, and Refuges Within 1 Mile**

*Client/Project* 227708930
Dem-Con Pilgrim Landfill, LLC

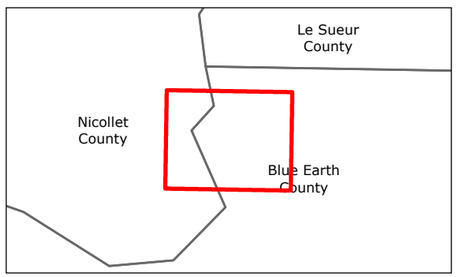
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T109N, R26W, S30 & S31
Mankato, Blue Earth Co., MN

Prepared by BS on 2026-04-17

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- Property Boundary
- 1 Mile Radius
- Minnesota State Park/Recreation Area
- National Wildlife Refuge




***Notes***
1. Coordinate System: NAD 1983 HARN Adj MN Blue Earth Feet
2. Data Sources: MnGEO, MDNR, USFWS
3. Background: Minnesota 2025 Imagery

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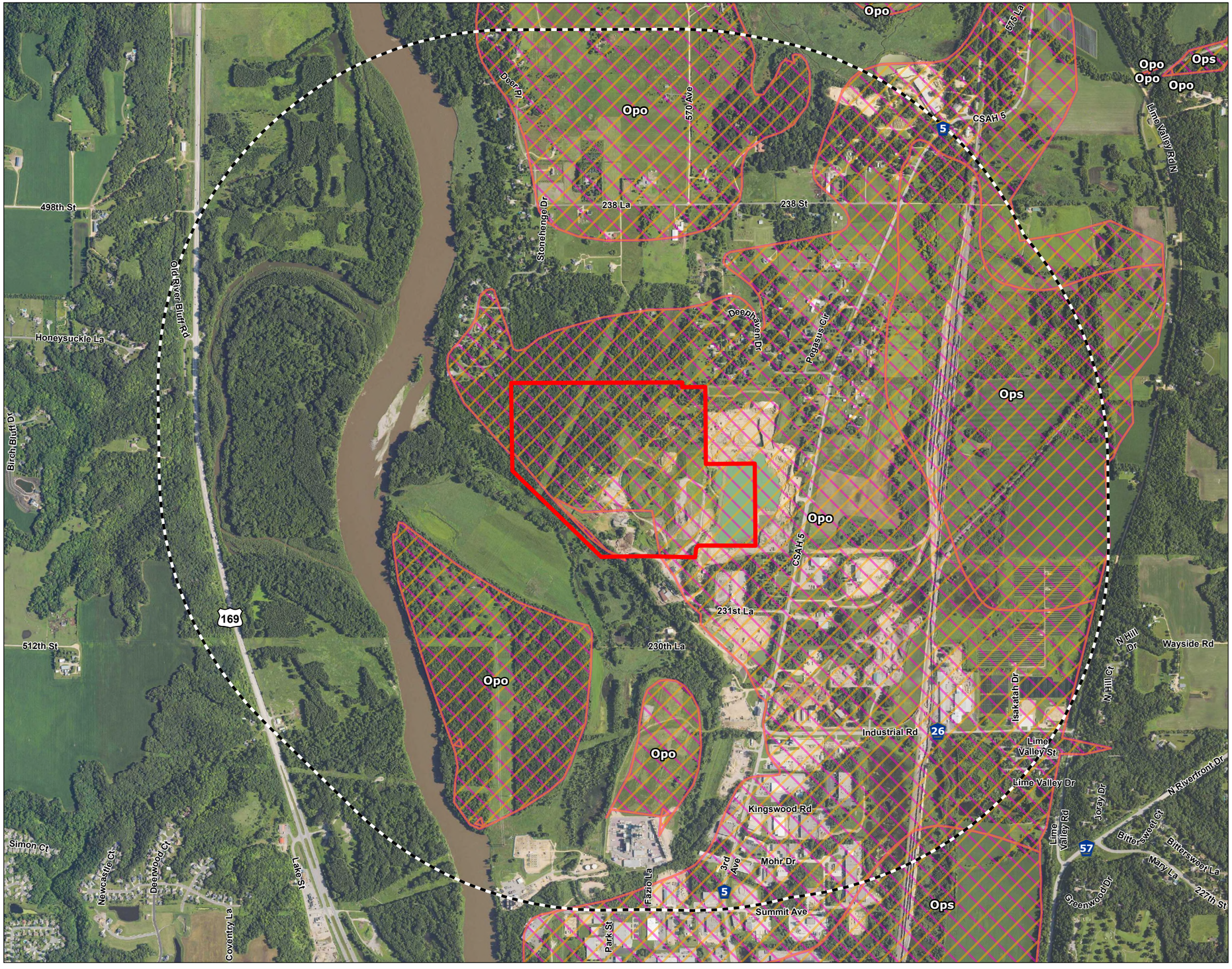



*Figure No.*
**4**

*Title*
**Potential Karst Features Within 1 Mile**

*Client/Project* 227708930
Dem-Con Pilgrim Landfill, LLC

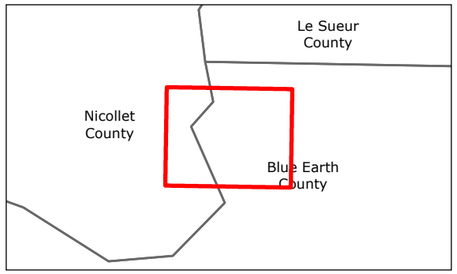
*Project Location*
T109N, R26W, S30 & S31
Mankato, Blue Earth Co., MN

Prepared by BS on 2026-04-17

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Legend
- Property Boundary
- 1 Mile Radius
- Surface Karst (Carbonate Only)
- Surface Karst (Carbonate Sandstone)




***Notes***
**1.** Coordinate System: NAD 1983 HARN Adj MN Blue Earth Feet
**2.** Data Sources: MnGEO, MDNR
**3.** Background: Minnesota 2025 Imagery

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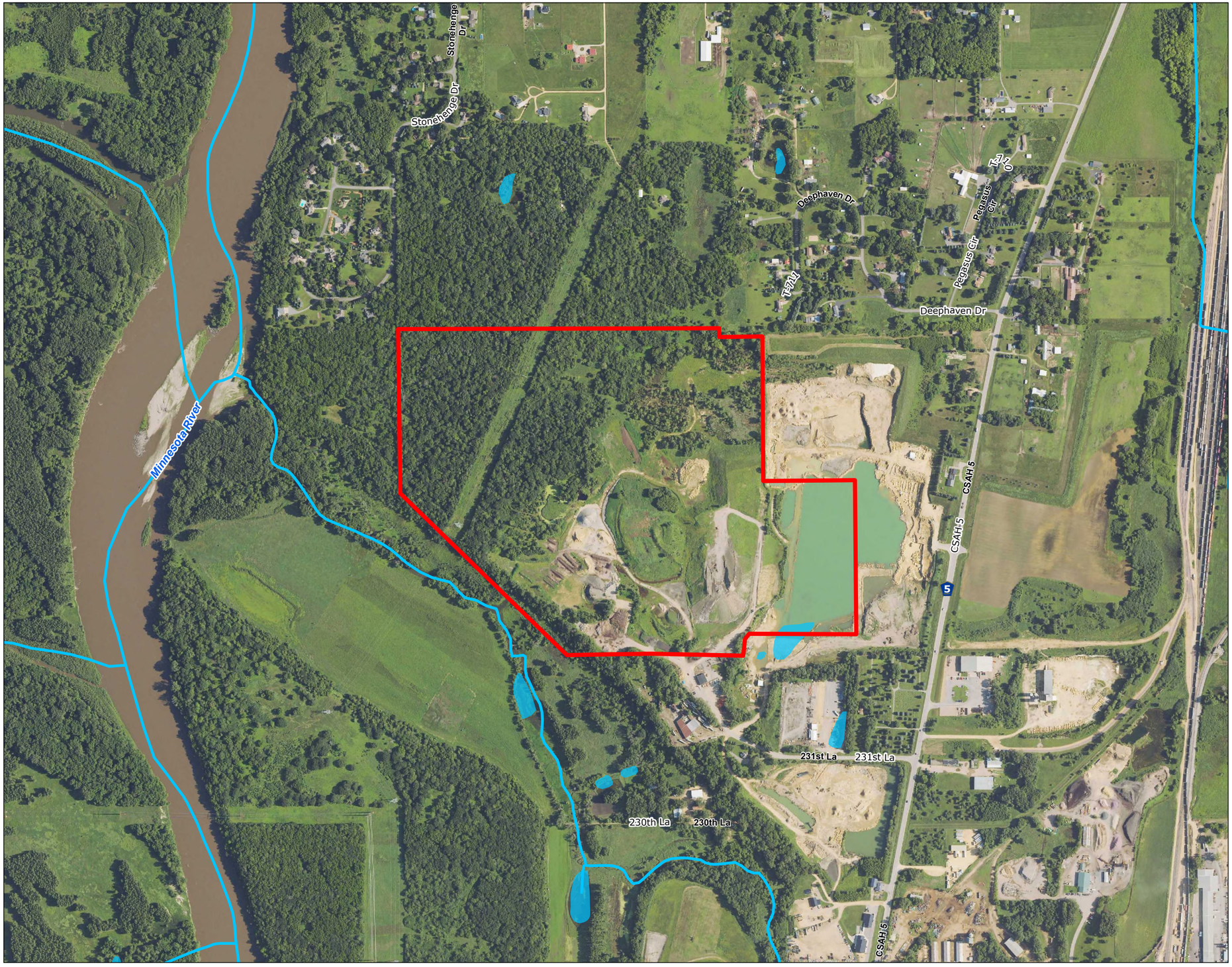



*Figure No.*
**5**

*Title*
**Water Features**

*Client/Project*
Dem-Con Pilgrim Landfill, LLC

227708930

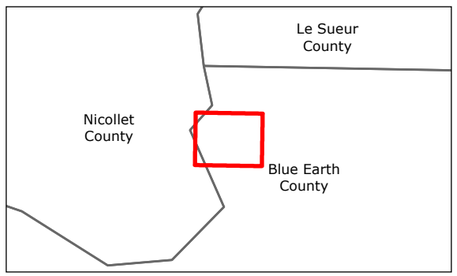
*Project Location*
T109N, R26W, S30 & S31
Mankato, Blue Earth Co., MN

Prepared by BS on 2026-04-07

N

0 400 800 Feet
(At original document size of 11x17)
1:9,600

Legend
- Property Boundary
- Waterbody
- Stream/River




***Notes***
**1.** Coordinate System: NAD 1983 HARN Adj MN Blue Earth Feet
**2.** Data Sources: MnGEO, MDNR, NHD
**3.** Background: Minnesota 2025 Imagery

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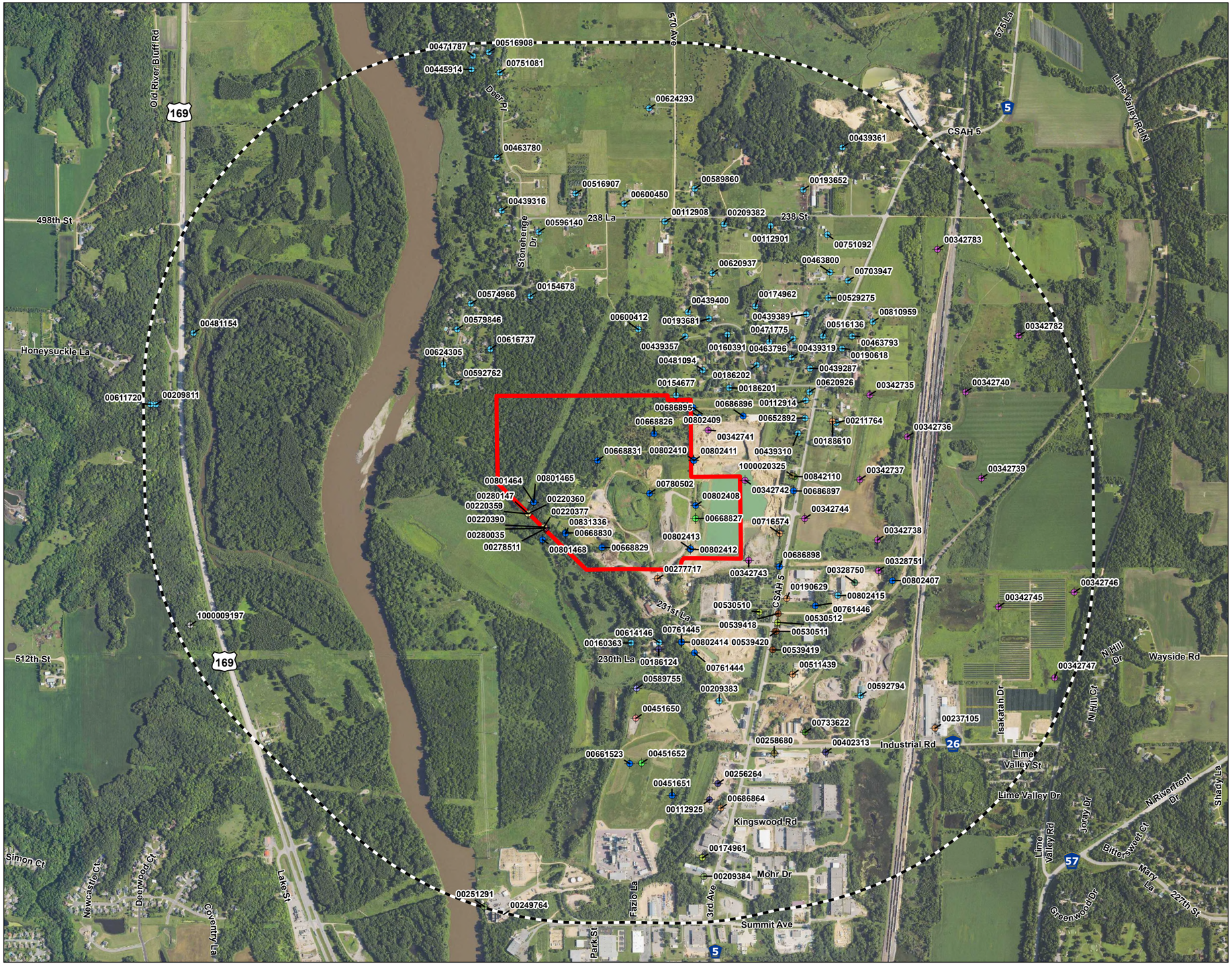



Figure No.
**6**

Title
**Wells Within 1 Mile**

Client/Project
Dem-Con Pilgrim Landfill, LLC

227708930

Project Location
T109N, R26W, S30 & S31
Mankato, Blue Earth Co., MN

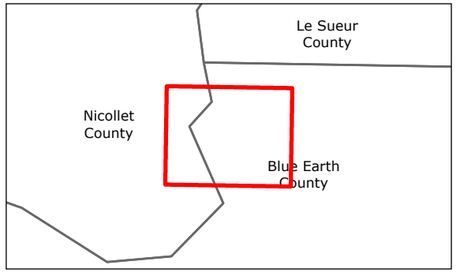
Prepared by BS on 2026-04-07

N

0 1,000 2,000 Feet
(At original document size of 11x17)
1:18,000

Legend
- Property Boundary
- 1 Mile Radius

Wells Within 1 Mile
- Unknown
- Abandoned, Sealed
- Commercial, Active
- Domestic, Active
- Domestic, Sealed
- Environmental Bore Hole, Sealed
- Exploration, Sealed
- Industrial, Active
- Monitoring Well, Active
- Monitoring Well, Sealed
- Monitoring Well, Unknown
- Observation Well, Actve
- Other, Sealed
- Public Supply/Community, Active
- Public Supply/Non-Community/Non-Transient, Active
- Public Supply/Non-Community/Non-Transient, Sealed
- Piezometer, Active
- Piezometer, Sealed
- Test Well, Active




***Notes***
**1.** Coordinate System: NAD 1983 HARN Adj MN Blue Earth Feet
**2.** Data Sources: MnGEO, CWI
**3.** Background: Minnesota 2025 Imagery

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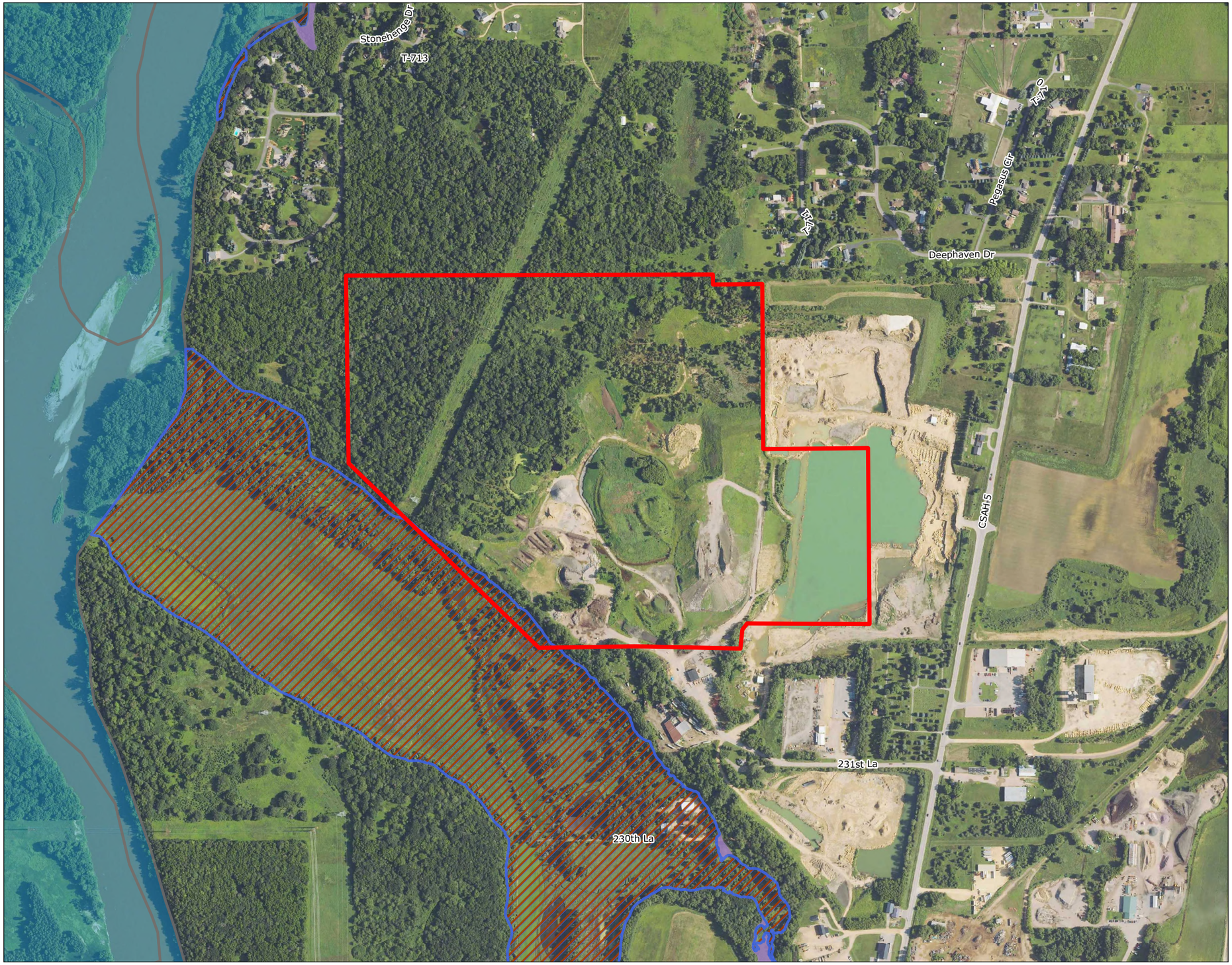



*Figure No.*
**7**

*Title*
**Floodplain Map**

*Client/Project* 227708930
Dem-Con Pilgrim Landfill, LLC

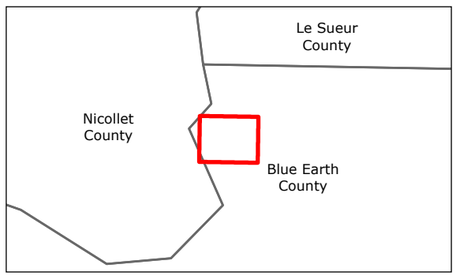
*Project Location*
T109N, R26W, S30 & S31
Mankato, Blue Earth Co., MN

Prepared by BS on 2026-04-17

N

0 350 700 Feet
(At original document size of 11x17)
1:8,400

Legend
- Property Boundary
- 0.2% Annual Chance Flood Hazard
- 1% Annual Chance Flood Hazard
- Regulatory Floodway




***Notes***
**1.** Coordinate System: NAD 1983 HARN Adj MN Blue Earth Feet
**2.** Data Sources: MnGEO, FEMA, Blue Earth County
**3.** Background: Minnesota 2025 Imagery

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# Appendix A Industrial Solid Waste Management Plan

# INDUSTRIAL SOLID WASTE MANAGEMENT PLAN

Dem-Con Pilgrim Landfill (SW-254)
Mankato, Minnesota

Dem-Con Companies
13020 Dem-Con Drive
Shakopee, Minnesota 55379

*April 22, 2026*

*Version 1*

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Appendix A Asbestos Containing Materials Guidance
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Appendix C Waste Manifest Form
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Appendix F Liner Equivalency Calculations
Appendix G Method 1030, Ignitability of Solids
Appendix H The Lethality Characteristic, MPCA Guidance Document
Appendix I Managing Sealants and Coatings Containing PCBs
Appendix J Guidelines-Disposal Methods for Water Filter Backwash Solids
Appendix K Treated Seeds, MPCA Guidance Document

# 1.0 INTRODUCTION

The "Industrial Solid Waste Management Plan" (ISWMP) for the Dem-Con Pilgrim Landfill (SW-254) was prepared to provide the specific details and procedures for the management of industrial wastes at the facility. The ISWMP was developed according to Minnesota Solid Waste Rules Part 7035.2535, subpart 5. The ISWMP discusses specific industrial waste types that will or will not be accepted at the facility, and procedures to evaluate new waste types for acceptance. It is therefore expected that the plan be revised from time to time in accordance with changes in waste stream characteristics and the evolution of the industrial waste market.

## Background

Dem-Con Pilgrim Landfill, LLC (Dem-Con) operates a demolition landfill located in Township 109 North, Range 26 West, Sections 30 and 31 in Lime Township of Blue Earth, Minnesota. The initial portion of the landfill is unlined. The permit was modified in 2026 to include a lined Class III demolition landfill area, as defined in the "Demolition Landfill Guidance (MPCA, 2005), and, as stated on page 3 of that document, can accept construction, demolition (C&D) and non-hazardous industrial wastes.

## Amendments to the Industrial Solid Waste Management Plan

The ISWMP may be amended at any time during the life of the facility. An amended ISWMP will be submitted whenever changes in operation or design affect the ISWMP procedures. The MPCA must review and approve the amended ISWMP prior to implementation.

## 2.0 ACCEPTABLE AND UNACCEPTABLE WASTES

### Acceptable Wastes

Dem-Con is permitted for landfilling in two areas. The eastern, unlined area (DD 001) is permitted as a Class I demolition landfill, and the western, lined area (DD 002) is permitted as a Class III demolition landfill by the MPCA. The following sections list types of wastes that are acceptable in each area.

#### 2.1.1 Unlined Areas

Waste types accepted in the unlined area are limited to the following demolition debris types:

- Bituminous concrete (includes asphalt pavement and blacktop)
- Concrete (including rerod)
- Stone
- Uncontaminated soil
- Masonry (bricks, stucco and plaster)
- Untreated wood (including painted, stained and/or varnished dimensional lumber, pallets, tree stumps, grubbing, root balls, particle board, plywood, fencing and dock materials)
- Siding (Includes vinyl, masonite, untreated wood, aluminum and steel.)
- Wall coverings
- Electrical wiring and components
- Roofing materials
- Duct work
- Wall board, sheet rock
- Built-in cabinetry
- Plumbing fixtures
- Affixed carpet and padding
- Ceramic items
- Conduit and pipes
- Glass (limited to window and door glass from buildings and structures)
- Insulation (Includes fiberglass, mineral wool, cellulose, polystyrene and newspaper.)
- Plastic building parts
- Sheathing
- Molded fiberglass

- Rubber
- Drain tile
- Recognizable portions of burned structures
- Metal
- Ceiling tile
- Wood and vinyl flooring
- Asbestos-containing materials (pursuant to Appendix A of this ISWMP)

### 2.1.2 Lined Areas

In the lined areas, Dem-Con can accept:

- All wastes accepted in the unlined areas (no further evaluation needed);
- Packaging from construction materials and activities (no further evaluation needed);
- Empty containers from construction and demolition activities (no further evaluation needed);
- Empty containers managed in accordance with MPCA "Managing Empty Containers" document (no further evaluation needed);
- Emergency Disaster Debris
- Depackaging waste
- Treated lumber (no further evaluation needed);
- Railroad ties (no further evaluation needed);
- Contaminated soils (evaluate as per Table 1);
- Dredged Materials (evaluate as per Appendix B);
- Foundry sands (evaluate as per Table 1);
- Sandblasting sands (evaluate as per Table 1);
- Grinding sludges (evaluate as per Table 1);
- Car wash sand sediment (no further evaluation needed);
- Non-hazardous mercury contaminated soils and construction/demolition debris free of elemental mercury (evaluate as per Appendix B and Table 1, respectively);
- Wastes containing PCB's less than 50 ppm
- Demolition debris with PCB containing caulking wastes in excess of 50 ppm that are adhered to structure;
- Demolition debris with lead paint that is adhered to the structure;
- Ash from burnt structures (evaluate as per Table 1);

- Non-PCB ballasts (no further evaluation needed);
- Naturally Occurring Radioactive Material (NORM) with radium-226 not exceeding 30 Pico curries;
- Carpet – abated (no further evaluation needed);
- Street sweepings (no further evaluation needed);
- Absorbents (evaluate as per Table 1);
- Waste traps from garages (evaluate as per Table 1);
- Sanitary & Storm Sewer Grit (evaluate as per Table 1);
- Wastewater treatment residues (evaluate as per Table 1 and MPCA Guidance Document "Guidelines-Disposal Methods for Water Filter Backwash Solids");
- Autoclaved medical waste;
- Residue from single sort recycling, tire recycling, auto recycling, and other recycling operations;
- Other wastes from manufacturing and industrial processes that do not exceed the maximum concentrations of the toxicity characteristics for a given waste using the regulatory levels included in 40 CFR part 261 (see Section 2.3 and Table 1);
- Shredded demolition debris that can be identified and or verified from generator as acceptable materials;
- Fiberglass structures (boat hulls, hot tubs, etc.)
- Treated seeds, managed in accordance with Appendix K
- "Demo-like" materials from manufacturers of building materials and structural components of buildings (including cabinets, doors, prefabricated walls, countertops, carpet, shingles, etc.), including, but not limited to, wood, wood products, tree stumps, asbestos, glass, concrete, metal, brick, clay, porcelain fixtures, block, tile, rock, insulation, shingles, sheet rock, styrofoam, plastic pipe, conduit, fiberboard, plaster and dirt;
- Residuals from yardwaste compost screening operations; and
- Other waste types specifically listed in this ISWMP.

**2.2 Unacceptable Wastes**

MPCA rules prohibit certain wastes from disposal in C&D landfills, including:

- Municipal Solid Waste (MSW)
- Hazardous wastes;
- Sewage that does not meet Class B pathogen reduction listed in part 7041.1300 subpart 3 such as, sewage sludge, septic tank pumping, sewage sludge compost;
- Wastes containing free liquids;

- Raw animal manure;
- Infectious wastes;
- Used oil;
- Radioactive wastes;
- Animal carcasses, parts, renderings and slaughterhouse wastes;
- Appliances (for disposal);
- Hot ashes or wastes that could spontaneously combust or ignite other wastes due to high temperatures;
- Batteries;
- Recyclable cardboard;
- Explosives;
- Fluorescent tubes and ballasts containing PCB's;
- Food waste;
- Mattresses;
- High-intensity discharge lamps;
- Live coal tar (including applicators, containers, and tubes);
- Household hazardous waste;
- Machinery or engine parts;
- Medical waste (non-autoclaved);
- Wastes containing elemental or free mercury (thermostats, switches);
- MSW incinerator ash;
- PCB containing wastes greater than the regulatory limit of 50 ppm;
- Tires (for disposal);
- Unrecognizable waste, unless processed at an MPCA permitted solid waste facility prior to delivery;
- Vehicles; and
- Yard waste (for disposal).

### 2.3 Mandatory Waste Types

Minnesota Rules part 7035.2535, subpart 5, item B requires that the following 12 specific waste types be addressed in an ISWMP:

| Waste Type | Accepted/Not Accepted | | Disposal Method |
|---|---|---|---|
| | Unlined Area | Lined Area | |
| Empty pesticide containers | Not accepted | Accepted | Codisposal |
| Asbestos | Category 1 & 2 non-friable only | Accepted (all forms) | See Appendix A |
| Waste containing (PCBs) at a concentration less than 50 ppm | Not accepted | Accepted | See Table 1 |
| Spilled non-hazardous materials | Not accepted | Accepted | See Table 1 |
| Rendering and slaughterhouse wastes | Not accepted | Not Accepted | |
| Wastes that could spontaneously combust or that could ignite other wastes because of high temperatures | Not accepted | Not accepted | |
| Foundry wastes | Not accepted | Accepted | See Table 1 |
| Ash from incinerators, resource recovery facilities and power plants | Not accepted | Accepted | See Table 1 (coal ash only accepted in cells with a Subtitle D -equivalent liner) |
| Paint residues, paint filters and paint dust | Not accepted | Accepted | See Table 1 |
| Sludges, including ink sludges, lime sludge, wood sludge and paper sludge | Not accepted | Accepted | See Table 1 |
| Fiberglass, urethane, polyurethane, and epoxy resin waste | Accepted | Accepted | See Table 1 |
| Spend activated carbon filters | Not accepted | Accepted | See Table 1 |

**2.4 Exempted Waste Types**

Minnesota Rules part 7035.2535, subpart 5, item D exempts the following from evaluation in the ISWMP (although whether or not the waste type is accepted must be noted):

| Waste Type | Accepted/Not Accepted | | Notes |
|---|---|---|---|
| | Unlined Area | Lined Area | |
| Paper and cardboard wastes from manufacturing processes or packaging | Not accepted | Accepted | |
| Food and beverage packaging and handling materials | Not accepted | Accepted | Includes packaging, wrapping and food handling (i.e. tissue wrap, etc.) materials not containing organic food waste |

| | | | |
|---|---|---|---|
| Food not containing free liquids | Not accepted | Not accepted | |
| Aluminum, iron, steel, glass, wood, and hardened, cured plastic waste | Accepted | Accepted | |
| Dewatered sewage sludge that has been treated by a process to significantly reduce pathogens pursuant to Minnesota Rules | Not accepted | Accepted | Needs to meet the class B pathogen reduction listed in part 7041.1300 subpart 3 |
| Compost including sewage sludge compost produced in accordance with Minnesota Rules, part 7035.2836 | Not accepted | Accepted* | *Only Class II compost. Limited, if any, markets exist for Class II compost |
| Grit and bar screenings from a wastewater treatment plant | Not accepted | Accepted | |
| Ash from boilers and incinerators using wood or biomass as a fuel source | Not accepted | Accepted | See Table 1 |

### 2.5 Waste That Requires a Subtitle D Liner

- Coal Ash and Auto Shredder Residue both require a Subtitle D liner for management in Minnesota. Dem-Con's liner and cap design meet the requirements of subtitle D. A copy of the liner equivalency calculations by Carlson McCain that demonstrate that the liner and cap design exceeds the Subtitle D standard are included in Appendix F.

### 2.6 Hazardous Wastes

The following discussion is provided to assist facility managers in understanding what is and is not a hazardous waste. The definitions were originally specified in the Resource Conservation and Recovery Act (RCRA), as administered by the United States Environmental Protection Agency (USEPA). These definitions are incorporated into Minnesota state statutes and discussed in detail in rules promulgated by the Minnesota Pollution Control Agency (MPCA), as cited below.

A substance is a hazardous waste if:

- The waste exhibits any of the characteristics of hazardous waste in Minnesota Rules, part 7045.0131 (ignitability, it is an oxidizer, corrosivity, reactivity, lethality or toxicity);
- The waste is nonspecific source (F), specific source (K), commercial chemical product (P,U), listed in Minnesota Rules, part 7045.0135; or
- The waste is a polychlorinated biphenyl waste (PCB waste) at a concentration of 50 ppm or greater as described in Minnesota Rules, part 7045.0135 subpart 5.

The characteristics of a hazardous waste are:

- Ignitability: According to MN Rule 7045.0131 Subp 2, a liquid exhibits the characteristic of ignitability if it is an aqueous solution containing less than 24 percent alcohol by volume, and has a flash point less than 60 degrees Celsius (140 degrees Fahrenheit). The flash point test determines the lowest temperature at which a chemical ignites when exposed to flame. A non-liquid waste exhibits the characteristic of ignitability if it is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture, or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard. Test method 1030 from SW-846 is the most appropriate test for a non-liquid waste for which the ignitability characteristic is suspected.
- Corrosivity: A waste exhibits the characteristic of corrosivity if a representative sample of the waste is aqueous and has a pH less than or equal to 2.0 or greater than or equal to 12.5. The pH is a measurement that determines the acidity or alkalinity of a sample.
- Oxidizers: Any waste defined in the Code of Federal Regulations (CFR), Title 49, Section 173.115 as an oxidizer or any waste that readily supplies oxygen to a reaction in the absence of air.
- Reactivity: A waste is reactive if it is normally unstable; reacts violently with water; forms an explosive or toxic mixture with water; can easily be detonated or exploded; or contains quantities of cyanide gas or sulfide that could be released into the air at toxic levels when exposed to a pH range of 2.0 to 12.5;.
- Lethality: Lethality is a hazardous waste characteristic specific to Minnesota, and considers the toxicological, or poisonous, effects of the waste. In accordance with MN Rule 7045.0131, Subp 6, Lethality shall be determined by applying knowledge of materials and processes used, including reasonably available information on the lethality of the components of the waste. A waste is hazardous for the lethality characteristic when a representative sample exhibits any of the following:

  -an oral LD50 (rat) less than 500 mg/kg

  -a dermal LD50 (rabbit) less than 1000 mg/kg

  -an inhalation LC50 (rat) less than 2000 mg/$m^3$

  -an inhalation LC50 (rat) less than 1000 ppm for gasses and vapors

- Toxicity: The Toxicity Characteristic Leaching Procedure (TCLP) is a laboratory test where the concentrations of various constituents such as heavy metals, pesticides, and organic solvents are measured in an acid solution that has passed through a sample of the waste material. If the concentration of any constituents exceeds the maximum concentrations listed in MN Rule 7045.0131, Subp 8, the waste is hazardous.

There are exemptions to the hazardous waste classification for specific wastes, as listed in Minnesota Rules, part 7045.0120. Regulated hazardous waste must be disposed of at a permitted hazardous waste

disposal facility. Any material contaminated by a hazardous waste and is deemed to be a hazardous waste by the MPCA will not be managed by Dem-Con.

Dem-Con does not accept hazardous wastes, including household hazardous wastes and hazardous wastes from conditionally exempt generators. Anyone bringing in hazardous wastes for disposal will be directed to the Blue Earth County Household Hazardous Waste Facility, 651 Summit Ave, Mankato, Minnesota, or to contact their county solid waste officer.

## 3.0 WASTE EVALUATION PROCEDURES

### 3.1 Notification

Regular customers of the landfill receive notification of the types of materials that are and are not acceptable and any changes in policy. They are also informed of the policies for ensuring that only acceptable waste are hauled to and disposed of at the site.

New customers are notified of Dem-Con's policies and procedures as the new account is opened and/or via postings in the gatehouse or on the company website. Any changes to the original policy will be presented to the generator in the form of a notification letter as appropriate.

### 3.2 Evaluation of New Industrial Wastes

Dem-Con will evaluate each new waste type considered for disposal on a case-by-case basis. Procedures for evaluating certain specific waste types are included in Table 1 and the appendices. When a request for acceptance for a new waste type is received, Dem-Con will determine the acceptability using the following procedures, as necessary:

- Determine if the waste is construction, demolition or "demo-like" waste that can be accepted without further chemical evaluation. Acceptance of these wastes will be based on physical characteristics such as moisture, odor, dust and other potential nuisance conditions to ensure we are in compliance with our approved MPCA permit for the Facility.

- Request that a waste profile sheet be completed if applicable (See example in Appendix D)
- Determine if the waste is listed as an accepted exempt waste (Section 2.4) that can be accepted without further evaluation. Acceptance of these wastes will be based on physical characteristics such as moisture, odor, dust and other potential nuisance conditions to ensure we are in compliance with our approved MPCA permit for the Facility.
- Determine if the waste is addressed in the Table 1 as an acceptable type. Follow the evaluation procedures listed as appropriate.
- If the waste is a new waste type not covered in the above three categories, request information on the chemical makeup of the waste from the generator. Material Safety Data Sheets (MSDS's) and other product data should be obtained from the generator whenever possible. If waste contains any of the chemical parameters listed in Table 2, chemical analysis should be requested, which can be limited to the specific parameters in the waste. The TCLP test is the most definitive test and should be conducted if there is no data available or if the available data is from a different method and cannot be interpreted as being below the acceptance limits in Table 2. If the results of the chemical analysis are below the acceptance limits, the waste can be accepted for disposal pending a review of the physical characteristics.
- Concurrently with the request for chemical information, request information on the physical characteristics of the waste. Information on quantity, delivery method and frequency, physical state (dry, powder, solid, etc.), odor, flammability of the waste, and on the process that

produces it, should be considered. Determine if the waste can be safely managed and if special management procedures are needed.

- The final determination on acceptability of the waste will be based on comparisons with the acceptance limits (Table 2) and any potential concerns with the physical characteristics.

The need for laboratory testing will be determined on a case-by-case basis. Only the tests needed to accurately characterize the waste will be requested. Unknown waste or waste generated from an unknown process will be required to have complete TCLP analysis.

After it is determined that the waste is acceptable, the following additional steps must be completed:

- Develop procedures for managing the waste including inspection, handling, disposal, and any other conditions of acceptance.
- If the ISWMP needs to be modified, a revision will be prepared and submitted to the MPCA.
- Maintain generator file and waste acceptance records at the facility.

### 3.3 Review of Laboratory Data

The parameters listed Table 2 are ones for which there is a hazardous waste limit set by the USEPA. The TCLP test is the laboratory method used to determine if a material is hazardous or not, as it uses a leaching procedure to simulate landfill conditions. However, in most cases, the laboratory data provided by generators for solid materials will be for the total concentrations of parameters in the materials (reported in milligrams per kilogram, or mg/kg, or micrograms per kilogram, or ug/kg). The total concentrations will always be higher than the TCLP concentrations (reported as milligrams per liter, or mg/l).

As an initial comparison of total concentrations versus TCLP concentrations, divide the total concentration by 20. This "Rule of 20" is based on the fact that the weight of the fluid used for the leaching process in the TCLP test is 20 times the weight of the sample. Therefore, the theoretical maximum concentration in the fluid at the completion of the leaching process is 1/20 of the total concentration in the sample, assuming 100 percent of the parameters being tested leaches during the test. If the result of dividing the total concentrations by 20 is less than the acceptance limits, the waste is acceptable.

In practice, the ratio of the total concentration to the TCLP concentration is more than 20, since less than 100 percent leaches from the sample. If the result of dividing the total concentration by 20 is greater than the acceptance limit, the waste may still be acceptable. Request a TCLP test for the parameters in question, which will give a definitive result.

### 3.4 Evaluation of Wastes as Alternative Daily Cover

Some waste types, including contaminated soil, some foundry sands, C&D fines etc., are suitable for use as Alternative Daily Cover (ADC). ADC replaces native soil as daily/intermittent/intermediate cover. The waste must first be determined to be acceptable at the landfill. Then, the waste can be

evaluated for use as ADC if it can fulfill the function of native soil as a cover material, in that it must have the following characteristics:

- Be “soil-like”
- Able to control vectors, odors, and fire
- Is not subject to undue erosion or dust creation
- Does not pose a physical hazard to vehicles or workers.
- Must not be odorous
- Must not contain chemical parameters that exceed the ADC limits in Table 2

ADC will be placed in a 6-inch layer over active working areas, and cannot be used on external side slopes. See Table 1 and Appendix B for information on evaluation and management of materials as ADC. The action limits for ADC are different than the action limits for disposal. See Table 2 for the ADC action limits

### 3.5 Emergency Disaster Response Material Acceptance

In the event of a natural disaster such as but not limited to; tornado, high winds, flooding, fire, earthquake or act of terrorism Dem-Con Pilgrim Landfill may accept material per Dem-Con’s ISWMP.

## 4.0 MANAGEMENT OF INDUSTRIAL WASTES

Information on general procedures to manage industrial wastes is provided below. Additional information for certain specific wastes is included in Table 1. As new waste types are approved for acceptance, corresponding entries will be added.

### 4.1 General Inspection Procedure

Waste management is an important aspect of the operating procedures at Dem-Con Pilgrim Landfill. When a new account is established, customers are required to accept Dem-Con's policy of inspecting their loads for unacceptable wastes and to work with generators to eliminate those wastes from the loads. Various measures, such as providing generators with lists of acceptable and unacceptable wastes, providing two boxes at a site, one for acceptable and one for unacceptable wastes, are suggested for use by the haulers in complying with the Dem-Con acceptance policy. Haulers must walk around their loads and inspect them for unacceptable items after they have tipped. Dem-Con requires that haulers remove the entire load from the fill area if too many unacceptable items are found. This encourages haulers to work with generators to produce clean, acceptable waste streams. The site operators then inspect the load as they work the material into the current tipping area. Unacceptable items are removed when identified by the operator. Operators are trained and certified by the MPCA in waste identification and management procedures.

When unacceptable items are found in the waste after the hauler has left, they will be removed and stored in roll-off boxes prior to removal. The items will typically be removed to a recycler or appropriate disposal facility.

### 4.2 Disposal Procedure

All loads are checked in at the landfill gatehouse. In some cases, loads of industrial waste will be tracked using a Waste Manifest Form (see example Appendix C), which must be presented at check-in. The date, time, customer name and type and quantity of waste are documented. Dem-Con does not assume acceptance of materials until the load is inspected, spread and compacted, and additional material is placed over the top.

In general, industrial waste loads are disposed of in the same area and manner as demolition debris accepted at the landfill. This minimizes the size of the working face and allows for efficient inspection and compaction.

# Tables

TABLE 1
INDUSTRIAL WASTE TESTING AND MANAGEMENT PROCEDURES
Dem-Con Pilgrim Landfill (SW-254)

| Waste Type | General Parameters | TCLP Parameters | | | | Notes | Disposal Method |
|---|---|---|---|---|---|---|---|
| | | Metals | VOCs | SVOCs | Herbicides/ Pesticides | | |
| Absorbents | Paint filter, flash point | | X | | | Determine specific parameters on case by case basis | Codisposal |
| Asbestos | | | | | | See Appendix A | See Appendix A |
| Ash - coal (power plants, boilers) | | X | | | | (In future cells w/MSW-equivalent liner only) | |
| - Wood/biomass | | See notes | | | | Ash from wood/biomass fueled power plants/boilers accepted with no testing. If mixed with coal or other fuels, review on a case-by-case basis. | Codisposal |
| Ash from fires | | X | | | | Add other parameters based on building contents. Ash from intentional fires (fire department training, etc.), new building construction sites, tree and pallet burning require no testing. | Codisposal |
| Contaminated Soils | | | | | | See Appendix B (see Section 3.4 regarding use as ADC) | Codisposal/Alternative Cover |
| Mercury Contaminated C&D Debris | | X | | | | Evaluate as per the MPCA Program Management Decision Memo dated May 8, 2007 (Appendix E) | Codisposal |
| Dredged Materials | Copper, Arsenic, PAHs (carcinogenic and non-carcinogenic) | | | | | See Dredged Materials Section in Appendix B (see Section 3.4 regarding use as ADC) | Codisposal/Alternative Cover |
| Epoxy, Fiberglass and Urethane Resins | | X | X | | | Review MSDS's for additional parameters to test | Codisposal |
| Foundry Wastes | | X | | | | Review process for additional parameters to test. Review for use as ADC (see Section 3.4). | Codisposal/Alternative Cover |
| Refractory Materials | | X | | | | | Codisposal |
| Glass - Windshield and Specialty | | Pb | | | | Add Cr analysis for mirrored glass | Codisposal |
| Old Dumps | Molybdenum, iron, boron | X | | | | | Codisposal |
| Off-Spec Products | | | | | | | |
| - Adhesives | | X | X | X | | | |
| - Wood treatment | | X | X | X | X | | |
| Paint Residue, Filters, Dust | Flashpoint | X | X | | | Review MSDS's for additional parameters to test | Codisposal |
| Wastewater Treatment Residues | PCBs, RCRA Metals, E-Coli/Fecal Coliform | X | | | | Must be treated by process to reduce pathogens or not contain pathogens as listed in Mn Rule | Codisposal |
| Sandblasting Waste | | X | | | | If from inner wall of tank, add parameters based on contents | Codisposal |
| Shredder Fluff | PCBs | X | | | | Evaluate per MPCA P.M.D. | Codisposal |
| Sludges - Paper Mill | Paint filter | X | | | | | Codisposal |
| - Ink | Paint filter, flash point | X | X | | | | Codisposal |
| - Metal finishing | Reactive cyanide, Reactive sulfur, pH, flash point | X | X | | | | Codisposal |
| Spent Carbon Filters | | X | X | | | Determine specific parameters based on use of filters | Codisposal |
| Spilled Non-Hazardous Materials / Other Wastes | * | * | * | * | * | * Review MSDS and other information to determine sampling requirements | Codisposal |
| Storm Sewer Grit | PCBs, RCRA Metals | X | | | | PCB's based on site specific conditions | Codisposal |
| Waste Traps from Garages | Metals, TPH, VOC, PCBs | X | X | X | | Determine specific parameters on case by case basis | Codisposal |

**UPDATED APRIL 2026**

**TABLE 2 - ACCEPTANCE LIMITS**

Dem-Con Pilgrim Landfill (SW-254)

| Parameter | CAS No. | RCRA No. | Acceptance Limits for Disposal | | Acceptance Limits for ADC |
|---|---|---|---|---|---|
| | | | TCLP (mg/l) | Total (mg/kg)(1) | Total (mg/kg)(3) |
| **TCLP Metals** | | | | | |
| Arsenic | 7440-38-2 | D004 | 5 | 100 | 9 |
| Barium | 7440-39-3 | D005 | 100 | 2000 | 41000 |
| Cadmium | 7440-43-9 | D006 | 1 | 20 | 23 |
| Chromium | 7440-47-3 | D007 | 5* | 100* | 200 |
| Lead | 7439-92-1 | D008 | 5 | 100 | 460 |
| Mercury | 7439-97-6 | D009 | 0.2** | 4** | 3.1 |
| Selenium | 7782-49-2 | D010 | 1 | 20 | 1200 |
| Silver | 7440-22-4 | D011 | 5 | 100 | 1200 |
| **TCLP VOCs** | | | | | |
| Benzene | 71-43-2 | D018 | 0.5 | 10 | 42 |
| Carbon tetrachloride | 56-23-5 | D019 | 0.5 | 10 | 230 |
| Chlorobenzene | 108-90-7 | D021 | 100 | 2000 | 700 |
| Chloroform | 67-66-3 | D022 | 6 | 120 | 31 |
| 1,4-Dichlorobenzene | 106-46-7 | D027 | 7.5 | 150 | 200 |
| 1,2-Dichloroethane | 107-06-2 | D028 | 0.5 | 10 | 72 |
| 1,1-Dichloroethylene | 75-35-4 | D029 | 0.7 | 14 | 1200 |
| Methyl ethyl ketone | 78-93-3 | D035 | 200 | 4000 | 28000 |
| Tetrachloroethylene | 127-18-4 | D039 | 0.7 | 14 | 170 |
| Trichloroethylene | 79-01-6 | D040 | 0.5 | 10 | 20 |
| Vinyl chloride | 75-01-4 | D043 | 0.2 | 4 | 56 |
| **TCLP SVOCs** | | | | | |
| o-Cresol *(2-methylphenol)* | 95-48-7 | D023 | 200 | 4000 | 8700 |
| m-Cresol *(3-methylphenol)* | 108-39-4 | D024 | 200 | 4000 | 8700 |
| p-Cresol *(4-methylphenol)* | 106-44-5 | D025 | 200 | 4000 | 3500 |
| Cresol(2) | | D026 | 200 | 4000 | 3500 |
| 2,4-Dinitrotoluene | 121-14-2 | D030 | 0.13 | 2.6 | 78 |
| Hexachlorobenzene | 118-74-1 | D032 | 0.13 | 2.6 | 3.2 |
| Hexachlorobutadiene | 87-68-3 | D033 | 0.5 | 10 | 17 |
| Hexachloroethane | 67-72-1 | D034 | 3 | 60 | 150 |
| Nitrobenzene | 98-95-3 | D036 | 2 | 40 | 380 |
| Pentachlorophenol | 87-86-5 | D037 | 100 | 2000 | 46 |
| Pyridine | 110-86-1 | D038 | 5 | 100 | n/a |
| 2,4,5-Trichlorophenol | 95-95-4 | D041 | 400 | 8000 | 18000 |
| 2,4,6-Trichlorophenol | 88-06-2 | D042 | 2 | 40 | 180 |
| **TCLP Pesticides/Herbicides** | | | | | |
| Chlordane | 57-74-9 | D020 | 0.03 | 0.6 | 100 |
| 2,4-D | 94-75-7 | D016 | 10 | 200 | n/a |
| Endrin | 72-20-8 | D012 | 0.02 | 0.4 | 54 |
| Heptachlor (and its epoxide) | 76-44-8 | D031 | 0.008 | 0.16 | 4.2 |
| Lindane | 58-89-9 | D013 | 0.4 | 8 | 0.17 |
| Methoxychlor | 72-43-5 | D014 | 10 | 200 | n/a |
| Toxaphene | 8001-35-2 | D015 | 0.5 | 10 | 16 |
| 2,4,5-TP (Silvex) | 93-72-1 | D017 | 1 | 20 | n/a |
| **Other Parameters** | | | | | |
| PCBs | | | 50 ppm | | 0 ppm |
| TPH (DRO, GRO, Oily Wastes) | | | no limit*** | | 5,000 ppm |
| Flammability of a Solid (SW -846 & Test Method 1030) | | | | | |

*Notes: 1. Total concentration (mg/kg) is 20 times the mg/l value and is a guidance value.* **UPDATED APRIL 2026**

*If the guidance value is exceeded, run the TCLP test. The TCLP result takes precedent.*

*2. If o, m, and p-cresol cannot be separated, total cresol is used.*

*3. With the exception of arsenic, ADC acceptance is based on the Industrial SRVs as provided by the MPCA. Because natural arsenic concentrations are above the SRV, the background threshold value (BTV) is used.*

**4. Wastes containing chromium which is exclusively or nearly exclusively trivalent chromium and do not generate hexavalent chromium are not D007 hazardous wastes if managed in non-oxidizing environments.*

*** 5. The acceptance limit for mercury contaminated soils and C&D debris is 10 ppm (or >10 ppm with written pre-approval from the MPCA) as per the MPCA Program Management Decision Memo dated May 8, 2007.*

**** 6. There is no limit on TPH, DRO, or GRO as long as materials meet all other criteria of the ISWMP such as free liquids, odor, etc.*

# Appendix A

# Asbestos-Containing Materials Guidance

# ASBESTOS-CONTAINING MATERIALS GUIDANCE FOR LANDFILL DISPOSAL

## Background

Asbestos is a mineral mined out of the ground for use in various products. The use in products has dropped significantly since the early 1970's when it was banned from further use in certain products. The bans were issued because long term exposure to airborne asbestos can result in respiratory diseases. Many of these products are now being removed as they wear out, or age.

From a landfill operator's standpoint, the primary hazard related to asbestos is possible inhalation, since asbestos is linked to lung diseases. Management of ACM is regulated by the United States Environmental Protection Agency (USEPA) under the code of federal regulations (CFR). Specifically, Title 40, section 61 (cited as 40 CFR 61), is a portion of the National Emission Standards for Hazardous Air Pollutants (NESHAP) that deals specifically with asbestos. There are requirements for all manner of asbestos related uses and management, including demolition and renovation (40 CFR 61.145), disposal procedures by generators (40 CFR 61.150), and requirements for landfill (40 CFR 61.154).

ACM is any material that contains at least 1% asbestos and any filters or packaging used during asbestos abatement. ACM comes in two forms; friable and non-friable. Friable ACM is any material that, when dry, can be crumbled or pulverized by hand pressure. Non-friable ACM cannot be crumbled or pulverized by hand pressure.

The NESHAP regulation divides non-friable ACM into two categories. Category 1 includes packings, gaskets, resilient floor covering and asphalt roofing products with at least 1% asbestos. Category 2 includes any non-friable ACM excluded from Category 1. Category 1 and 2 non-friable ACM is not subject to the NESHAP requirements, unless it has become friable. Dem-Con will accept only Category 1 and 2 non-friable ACM in the unlined areas. The lined areas of the landfill can accept Category 1 and 2 non-friable ACM as well as friable ACM..

For the remainder of this section, the requirements discussed refer to regulated ACM, which includes all friable materials and non-friable materials that may become friable. Information specific to category 1 and 2 non-friable materials is included in parentheses as necessary.

## Manifesting and Documentation

EPA regulations require that, if a facility which is being demolished or renovated that has a minimum of 260 linear feet of ACM on pipes, 160 square feet of ACM on facility components, or 35 cubic feet of ACM from facility components which could not previously be measured, notification must be made to the regional program administrator of the demolition or renovation activity. If this notification is required, all shipments of ACM to the landfill must have a waste shipment record, or manifest. Dem-Con requires that all shipments have a manifest regardless of the quantity involved. See Appendix C for an example of a manifest form available for use by haulers.

Dem-Con will maintain shipping records for a period of 2 years in accordance with NESHAP regulations. Dem-Con will maintain until closure a record of fill locations and elevations, as well as volume of ACM

disposed. Documenting ACM disposal locations is important to ensure that the ACM is not disturbed during any future excavations. If separate cells are used, the horizontal and vertical location of ACM will be defined by the most recent airspace survey preceding ACM placement and the first airspace survey after ACM placement.

Documentation of the locations of ACM disposal will be submitted with the closure report for the facility. The documentation will also be submitted to the Blue Earth County Recorder as required as part of the final closure process.

**Disposal Requirements**

The following procedures must be followed for proper delivery and inspection of regulated ACM loads:

- Advance notification of the delivery of ACM loads is required.
- The regulated ACM must be sealed in leak-tight containers, or wrapping (≥ 6 mil ) plastic bags or wrapping).
- A manifest must accompany every load, and the volume reported must be accurate to within 10% of the volume of the load. The generator (or authorized agent) and hauler must sign the manifest. (For Category 1 & 2 non-friable ACM, provide 1 manifest per day per job.)
- The manifest must be signed after verification of the load. The appropriate copy must be mailed to the Generator within 30 days. The manifest must be retained by the landfill for a minimum of two (2) years.
- The material must be shipped in such a manner (e.g., open top box, compactor box with inspection ports, drums) that will allow verification of proper packaging, labeling, and volume.
- A loading sign must be used during loading and unloading, worded as follows:

**Danger**
Asbestos Dust Hazard
Cancer and Lung Disease Hazard
Authorized Personnel Only

- If any unacceptable waste is observed, it will be the sole responsibility of the hauler to remove said waste. If the rejected waste is regulated asbestos, the rejection will be noted on the manifest and a copy sent to the MPCA. The hauler will immediately contact a certified asbestos abatement contractor to properly contain and remove ACM if necessary. Dem-Con must notify the MPCA within 48 hours of a hauler tipping unacceptable regulated ACM at the landfill. All rejected loads will be recorded by Dem-Con on a load rejection report, including the date, volume, hauler, ticket number and reason for rejection.
- The hauler is responsible for handling and unloading of all non-friable ACM. The ACM must be handled in a manner that will prevent visible emissions from the waste material. The hauler is responsible for training their personnel so they are properly informed of the health and safety issues associated with ACM.
- The location, depth, area and volume of ACM disposed of in the landfill must be recorded.
- Asbestos must be covered with six (6) inches of compacted, non-asbestos containing material or soil as soon as practical, but no later than the end of the working day. The ACM will be covered prior to compaction to prevent the release of asbestos fibers as well as to protect the waste so that

non-friable ACM does not become subject forces that will crumble or pulverize it, converting it to a friable state.
- No ACM will be placed within 5 feet of the base, side slope or final grade to ensure long-term protection.

A separate cell may be established at a location apart from the active working face. ACM will be dumped as described above. A minimum of six (6) inches of non-asbestos containing material or soil will be placed over the ACM as soon as practical, but no later than the end of the working day. The location designated for ACM disposal will move as landfilling progresses over the site.

**Emergency Procedures**

Emergency situations include, but are not limited to, the disturbance of previously buried ACM and discovery of unacceptable or undocumented ACM at the landfill. In the event of an emergency situation, a certified asbestos abatement contractor will be immediately notified. At a minimum, the area will be secured to keep landfill personnel and haulers away until the abatement contractor arrives. Under no circumstances will Dem-Con personnel handle or package any ACM.

Dem-Con personnel are trained in the facility's ACM management procedures. The procedures will be reviewed on a routine basis during regular site safety meetings.

In the event it becomes necessary to disturb buried ACM, the following procedures will be followed:

- Written notification, including a project description and schedule of proposed activity, will be submitted in writing to the MPCA a minimum of 45 days in advance. The advance notice period may be waived if the MPCA agrees that an emergency condition exists at the landfill.
- A certified asbestos abatement contractor will be on-site throughout the project to observe work and ensure that all proper regulations are followed.

# Appendix B

# Contaminated Soils

# CONTAMINATED SOILS

## Background

Soils contaminated with a variety of chemicals are acceptable in the lined area of the landfill. For the purposes of evaluation for acceptance, contaminated soils can be divided into two categories; petroleum contaminated soils and soils contaminated with other chemicals.

## Evaluation of Laboratory Data

The analysis conducted on soils is typically for total concentrations, reporting in mg/kg or ug/kg. To evaluate if soil is acceptable, convert the results to mg/kg (if necessary), and see if the results are less than 20 times higher than the acceptance limits. If so, the soil is acceptable. If some parameters are more than 20 times the acceptance limits, request a TCLP test. Typically, the ratio of the total concentration to TCLP concentration is greater than 20, so the soil still may be acceptable pending the TCLP results. When applicable, if multiple samples of the totals analysis exceed the rule of 20, TCLP should be done for the highest 30% of the total samples that exceed this rule of 20 for any contaminant. There should be a minimum of 3 TCLP samples done for each project that has multiple exceedances of the rule of 20.

## Analytical Requirements - Petroleum Contaminated Soils

These are soils from sites with contamination from various petroleum products at levels that are too high to be used as fill or to remain on-site. The testing required is based on the type of product present in the soil. It is important to determine the source of the contamination and the history of operations at the location as part of the evaluation process. The testing requirements for each source of contaminated soil should be evaluated on a case-by-case basis, as follows:

### Analytical Requirements – Petroleum Contaminated Soil

| PRODUCT | TEST REQUIRED |
|---|---|
| Regular Gasoline or Aviation Gasoline | VOCs, GRO, lead |
| Unleaded Gasoline | VOCs, GRO |
| Unused Product (Fuel Oil, Motor Oil, Diesel Fuel, Kerosene, Jet Fuels, Mineral Oil/Spirits, Crude Oil, Stoddard Solvents) | VOCs, DRO, PAH* |
| Used Oil | VOCs, DRO, RCRA metals, PCBs, PAHs |
| Hydraulic Fluids | VOCs, DRO, PAH*, PCB** |
| Unknown | Case by case |
| All Products | Flashpoint*, paint filter liquids test* |

*Notes:*

** Optional based on-site conditions or soil moisture condition*

***For hydraulic fluid used in elevators, subject to high heat prior to the 1980s*

**Analytical Requirements – Other Contaminated Soils**

These are soils from sites with contamination from products or substances other than petroleum. The testing required is typically based on the past use of the site. It is important to determine the source of the contamination and the history of operations at the location as part of the evaluation process. The testing requirements for each source of contaminated soil should be evaluated on a case-by-case basis, as follows:

## Analytical Requirements – Other Contaminated Soil

| SOURCE | TESTS REQUIRED |
|---|---|
| Plating shops | RCRA metals, pH |
| PCB sources (transformers, etc.) | RCRA metals, total PCBs |
| Pesticides | TCLP pesticides |
| Used batteries | Lead |
| Unknown | Case-by-case |

**Testing Frequency**

The number of tests recommended based on the estimated volume of soil is shown below.

## Frequency of Testing

| VOLUME (CY) | NUMBER OF TESTS |
|---|---|
| 0 – 500 | 1 |
| 500 – 1,000 | 2 |
| 1,000 - 2,000 | 3 |
| 2,000 – 4,000 | 4 |
| Each additional 2,000 | 1 additional |

**Use of Contaminated Soils as Alternative Daily Cover**

Soil can often be used as alternative daily cover (ADC), depending on the physical characteristics and contaminant concentrations. A specific set of action limits is used to determine if soils or other suitable materials can be used as ADC, as shown on Table 2. Soil must meet the ADC actions limits and have the appropriate characteristics discussed in Section 3.4.

Soil accepted as ADC will be placed in a 6-inch layer over exposed waste and cannot be placed on external sideslopes.

## Analytical and Sampling Requirements for Dredged Materials

Dredged materials include material that is excavated at or below the Ordinary High-Water Level of water basins, watercourses, public waters, or public waters wetlands, as defined by Minn. Stat. 103G.005. The testing and sampling of these soils will be performed in accordance with the Minnesota Pollution Control Agency Managing of Dredged Materials (MPCA Dredged Materials) document dated June 2009 and as amended from time to time.

Dredged materials removed from municipal or urban stormwater systems will follow the sampling requirements detailed in the Modified Characterization and Permit Approach for Urban Stormwater Ponds section of the MPCA Dredged Materials document. This section requires a minimum baseline sampling for Copper, Arsenic, and Polycyclic Aromatic Hydrocarbons (PAHs), both carcinogenic and non-carcinogenic. However, because the land use within the drainage area of a stormwater pond can be unique, additional sampling may be required based on the risk assessment approach provided in Chapter 3 of the MPCA Dredged Materials document.

The dredged materials may be used as ADC if they meet the ADC action limits listed in Table 2 and have the appropriate characteristics discussed in Section 3.4 of the ISWMP. Soil accepted as ADC will be placed in a 6-inch layer over exposed waste and cannot be placed on external side slopes. All dredged material, whether accepted as ADC or not, must pass the paint filter free liquids test.

## Disposal and Sampling Requirements for Non-hazardous Mercury Contaminated Soils

Mercury contaminated soils will be acceptable in the lined area of the Dem-Con Pilgrim landfill in accordance with the May 8, 2007 MPCA Program Management Decision Memo regarding the disposal of mercury-contaminated soils and renovation/demolition debris in Minnesota landfills (Appendix E). These soils will be tested for mercury as well as other constituents as determined by a case specific evaluation of the project. The analytical results for the soils will be compared with the waste acceptance limits listed in Table 2. The waste acceptance limits and disposal practices for mercury contaminated soil in the lined landfill shall be in accordance with the following parameters:

- Waste with total levels of 0-4 ppm. No special handling requirements.
- Waste with total levels of 4-10 ppm, if immediately covered with six (6) inches of soil upon acceptance.
- Waste at total levels >10 ppm may be acceptable with written pre-approval from the MPCA, on a case-by-base basis, depending on volume and concentration. Additional requirements include:
    - Transporting vehicles must be lined and the waste covered with polyethylene sheeting;
    - The waste must be immediately covered with six (6) inches of soil upon acceptance.

Only non-hazardous mercury-contaminated soils and construction/demolition debris that meet the above parameters and are free of elemental or free mercury will be accepted at the Dem-Con Pilgrim landfill.

# Appendix C

# Special Waste Manifest Form

DEM-CON

# WASTE MANIFEST FORM
## MPCA PERMIT SW-254

Manifest #:

**GENERATION**

| | |
|---|---|
| Work Site Name:<br>Work Site Address:<br>City, State, Zip:<br>Contact Name:<br>Contact Phone #: | Waste Disposal Site<br>**Dem-Con Landfill - Pilgrim**<br>**57032 231st Lane**<br>**Mankato, MN 56001**<br>**952-445-5755** |
| Contractor Name:<br>Street Address:<br>City, State, Zip:<br>Contact Name:<br>Contact Phone #: | Responsible Agency<br>**MPCA**<br>**520 Lafayette Road North**<br>**St. Paul, MN 55155**<br>**(651) 296-6300** |
| **BILL TO #:**<br>**PROFILE #:** | Additional Generator Information: |

| Description of Materials: | Total Quantity:<br>☐ CY ☐ TON | Special Handling/Additional Info: |
|---|---|---|
| | | |

**Generator/Contractor 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 national government regulations. I further certify that the contents of this consignment do not contain hazardous waste as defined in 40 CFR Part 261 or MN Rule Chapter 7045.

| Signature: | Date: |
|---|---|
| Printed Name: | Title: |

**TRANSPORTATION**

**TRANSPORTER INFORMATION**

| **NAME ON TRUCK:** | **TRUCK NUMBER:** |
|---|---|

**TRANSPORTER 1** (Acknowledgement of receipt of materials)

| Company Name: | Company Address: | Company Phone #: |
|---|---|---|
| Driver's Name (Printed): | Signature: | Date: |

**TRANSPORTER 2** (Acknowledgement of receipt of materials)

| Company Name: | Company Address: | Company Phone #: |
|---|---|---|
| Driver's Name (Printed): | Signature: | Date: |

**FACILITY**

**FOR DEM-CON ONLY**

Discrepancy Indication Space:

**Waste Disposal Site Owner or Operator:** Certification of materials covered by this manifest except as noted in "Discrepancy Indication Space"

| Print Name: | Signature: | Date: |
|---|---|---|

COMPLETE TWO COPIES FOR EACH LOAD

DEM-CON: ONE COPY | TRANSPORTER: ONE COPY

# Appendix D

# Waste Profile Sheet

DEM-CON COMPANIES

# DEM-CON PILGRIM LANDFILL
# WASTE PROFILE SHEET

CUSTOMER JOB #:

DEM-CON PROFILE #:

| Generator Information | | Customer/Hauler Information ☐ Same as Generator | |
|---|---|---|---|
| 1. Generator Name | | 8. Customer Name | |
| 2. Site Address | | 9. Customer Address | |
| 3. City, State, Zip | | 10. City, State, Zip | |
| 4. Contact Name | | 11. Contact Name | |
| 5. Telephone | | 12. Telephone | |
| 6. Fax | | 13. Fax | |
| 7. Email | | 14. Email | |

## Waste Stream Information

1. Waste Name:
2. Description of facility/site history:
3. Describe the process and source of the generated waste:
4. Typical Color(s):
5. Strong Odor: ☐ Yes ☐ No If yes, describe:
6. Physical State at 70°F: ☐ Solid ☐ Liquid ☐ Powder ☐ Semi-Solid or Sludge ☐ Other:
7. Waste Composition: ☐ Homogeneous/Uniform ☐ Non-Homogeneous or Layered
8. Water Reactive? ☐ Yes ☐ No If yes, describe:
9. pH Range: ☐ ≤ 2 ☐ 2.1 - 12.4 ☐ ≥ 12.5 ☐ N/A (solid) ☐ Actual:
10. Liquid Flash Point: ☐ < 140°F ☐ ≥ 140°F ☐ N/A (solid) ☐ Actual:
11. Flammable Solid: ☐ Yes ☐ No

| 12. Waste Composition and Constituents (List all known or attach document): | % | ppm |
|---|---|---|
| | | |
| | | |
| | | |

## Waste Stream Properties (Answer ALL questions)

| | | | |
|---|---|---|---|
| 13. Is this waste a stream that contains any D, F, K, U or P listed as hazardous waste; either in pure form, as a mixture or treatment residue? | ☐Yes ☐ No | 20. Does this waste stream contain PCB material? If yes, concentration: ppm | ☐Yes ☐ No |
| 14. Is this waste explosive? | ☐Yes ☐ No | 21. Does this waste contain radioactive material? | ☐Yes ☐ No |
| 15. Is this waste sewer sludge? | ☐Yes ☐ No | 22. Does this waste contain absorbents? | ☐Yes ☐ No |
| 16. Is this waste demolition & /or construction debris? | ☐Yes ☐ No | 23. Does this waste stream contain fuming acids? | ☐Yes ☐ No |
| 17. Is this putrescible waste? | ☐Yes ☐ No | 24. Does this waste contain oxidizers? | ☐Yes ☐ No |
| 18. Is this waste lethal (by Minn. Rules 7045.0131 Subp. 6)? | ☐Yes ☐ No | 25. Does this waste contain asbestos? | ☐Yes ☐ No |
| 19. Does this waste contain untreated, regulated, medical or infectious waste? | ☐Yes ☐ No | | |

26. Sample Information (check ALL that apply):
☐ Sample submitted with profile ☐ Laboratory analysis submitted ☐ Material Safety Data Sheet Submitted ☐ Other:

## Waste Volume and Shipping Information

Check One: ☐ One Time Event ☐ Ongoing Waste Generation
Estimate Annual Quantity _____ ☐ Tons ☐ Cubic Yards ☐ Other:
Shipping Frequency _____ Units Per ☐ Month ☐ Quarter ☐ Year ☐ One Time ☐ Other:
Method of Shipment ☐ Roll-off ☐ End Dump ☐ Other:
DOT Hazardous Material? ☐ Yes ☐ No

## Certification of Non-Hazardous Waste & Approval Conditions

I hereby certify that the information submitted in this profile and all attached documents contain true and accurate description of the waste material and that the waste is nonhazardous as defined in Title 42, United States Code Section 6903 and Minnesota Statute Section 116.06, Subdivision 11. Furthermore, I certify the following: that analytical data attached pertaining to the profiled waste was derived from testing a representative sample in accordance with 40 CFR 261.20 (c) or equivalent rules; that I am an agent signing on behalf of the Generator and have been delegated this authority by the generator; that any changes that occur in the character of the waste (i.e. changes in the process or new analytical) will be identified by myself or the Generator and disclosed to Dem-Con Companies prior to shipment of the waste to Dem-Con Companies. I understand that any changes in the character of the waste that are not reported to Dem-Con Companies in writing prior to shipment of the waste will invalidate this approval. I, on behalf of the generator, hereby agree to fully indemnify Dem-Con Companies for any damages and/or costs incurred as a result of any misrepresentations or falsifications made herein.

Signature | Printed Name | Title | Date

## FOR DEM-CON USE ONLY

Approval Decision: ☐ Approved ☐ Not Approved
Management Method: ☐ Landfill ☐ Recycling Processing ☐ Off-Site Transfer ☐ Other:
Management Facility Precautions, Special Handling Procedures or Limitations:
☐ Shall not contain free liquid ☐ Approval Number must accompany each shipment
☐ Shipment must be scheduled into disposal facility ☐ Waste Manifest must accompany each load

Dem-Con Authorization Name/Title | Signature | Date

# Appendix E

# MPCA Program Management Decision Memo

# Disposal of Mercury-Contaminated Soils and Renovation/Demolition Debris in Minnesota Landfills

Minnesota Pollution Control Agency

# PROGRAM MANAGEMENT DECISION MEMO

**ISSUE:** Disposal of mercury-contaminated soils and renovation/demolition debris in Minnesota landfills

**EFFECTIVE DATE:** 5/8/2007

**REPLACES**: Program Management Decision Memo "Disposal of Mercury-contaminated Soils in Minnesota Landfills," effective March 1, 2004

## DECISION

Non-hazardous mercury-contaminated soils and construction/demolition debris free of elemental mercury from products subject to regulation under Minn. Stat. 115A. 932 can be accepted in lined Minnesota landfills as part of an approved industrial solid waste management plan (ISWMP) within the following parameters:

- Waste with total levels of 0-4 ppm. No special handling requirements.

- Waste with total levels of 4-10 ppm, if immediately covered with six (6) inches of soil upon acceptance.

- Waste at total levels >10 ppm may be acceptable with written pre-approval from the MPCA, on a case-by-case basis, depending on volume and concentration. Transporting vehicles must be lined, and the waste covered, with polyethylene sheeting. The waste must be immediately covered with six (6) inches of soil upon acceptance. This approval will be considered on a case-by-case basis. In order to determine mercury emission levels during waste acceptance, the MPCA may monitor emissions before, during, and after waste acceptance at a landfill. In addition, the MPCA will examine landfill-gas monitoring data to ascertain whether increased amounts of mercury are being vented. Based on the results, it is possible that waste at total levels >10 ppm may not be allowed at landfills with active gas extraction.

This decision provides for disposal in appropriate Minnesota landfills of soils and construction/demolition debris contaminated by mercury at concentrations which are non-hazardous. This decision does not apply to wastes other than soils and construction/demolition debris. For example industrial wastes such as ash are not subject to this policy. This policy does not apply to materials which have Standing Beneficial Use Determinations, or those that have received a Case Specific Beneficial Use Determination. This allowance does **not** include elemental mercury or materials contaminated with free mercury, which must be managed as hazardous waste.

## BACKGROUND

The recent history of changing policies governing mercury disposal has led to confusion among regulators, local units of government, waste generators, consultants, and landfill operators. As a result, the MPCA is adopting one policy for mercury-contaminated soils and construction/demolition debris. In addition, past policies were extremely conservative, which often led to the transportation of waste out of state, for disposal in similarly, or even less-protective, disposal environments. This policy includes special waste handling procedures to reduce potential emissions, based upon the mercury levels in the waste.

Disposal of wastes contaminated by mercury must be approved of within a landfill's ISWMP. In evaluating requests for approval, solid waste staff should consider a range of potential risk factors, including, but not limited to, releases due to methylation of mercury, vaporization during disposal and through gas vents, and leaching into ground water. Written request by the landfill, and approval by the MPCA, must be received prior to acceptance of waste covered by this policy.

In some circumstances, it may be possible to segregate wastes contaminated at high levels from those that are not, reducing the amount of material which must be disposed of out of state. All such determinations should be made in consultation with MPCA staff.

A formal letter outlining this final policy, including the website link, will be immediately sent to landfills and County Solid Waste Administrators. MPCA remediation, solid waste, and hazardous waste program staff will implement this policy change when advising outside parties of appropriate disposal options for mercury-contaminated waste.

## RELEVANT STATUTES AND RULES

- Minn. Stat. § 115A.932: Prohibition of disposal of mercury or mercury-containing devices in Minnesota landfills;
- Minn. Rules, chapter 7045.0120, subpart 1, article F: Exempts disposal of coal ash from governance by hazardous waste rules; and
- Minn. Rules, chapter 7001.3300: industrial solid waste management plans.

## RATIONALE

The following is a summary of historical policies governing mercury-contaminated waste:

Minnesota Statutes, section 115A.932 restricts disposal of mercury, in some forms and from certain sources, in Minnesota landfills. At the same time, some of the sites being redeveloped around the state contain mercury contaminated soils or materials within

structures may be contaminated from past improper disposal practices. In some cases, these soils or materials may need to be removed from the site, depending upon the levels of contamination and the planned land and site uses. In addition, routinely generated industrial wastes such as foundry sand, wastewater sludge, and slag can contain residual mercury.

How should such materials be disposed of, and under what circumstances should the MPCA require that such material be shipped out of state for disposal? There are also ethical and environmental issues regarding whether it makes sense to ship Minnesota's mercury contaminated waste to another state, if it might be managed safely here.

MPCA staff often had interpreted Minnesota Statutes, section 115A.932 to mean that essentially no mercury could be disposed of in Minnesota landfills, regardless of its nature or source, and that the mercury contaminated material must be disposed of in accordance with Minnesota Rules, chapter 7045.

It appears, however, that Minnesota Statutes, section 115A.932 had been interpreted too broadly, to prohibit disposal of materials it was not intended to prohibit. At the time the statute was developed, the Legislature was concerned about potential mercury contamination from mercury-containing devices, mercury-containing compounds, or bulk mercury, being intentionally placed in solid waste for disposal. It can be argued that the legislature did not intend for the statute to apply, for example, to soils contaminated by historical use of coal ash as fill material.

This broad reading of the law has led to confusing and conflicting requirements for disposal practices. On the one hand, the MPCA sent a memo to landfill operators (June 1, 2000) stating that materials which "passed" a TCLP test may be disposed of in a landfill, and that this level for mercury (0.2 ppm in the TCLP leachate) is used in industrial solid waste management plans as a cut-off for acceptance of mercury-containing materials. Again, the concern was mainly over acceptance of bulk mercury or mercury-containing devices and debris.

A leaching test is simply a method for determining whether a concentration of a contaminant in soils or other materials are high enough that the contaminant can leach out of the material at concentrations that exceed thresholds established by the United States Environmental Protection Agency (EPA). Therefore, the test helps determine whether the material should be evaluated and handled as a hazardous waste.

On the other hand, an MPCA remediation program had begun using a concentration of 0.7 ppm in soil (rather than in leachate) as the criterion for determining whether to ship the soil out of state for disposal in a hazardous waste landfill. At that time, this level corresponded to the MPCA's risk-based "soil reference value" (SRV) for residential land use. It may be argued, however, that using the 0.7 ppm concentration as the cut-off level for sending such soil out of state for disposal did not necessarily make sense. SRVs represent conservative screening levels up to which contamination might safely remain in place under certain exposure conditions. Establishment of final cleanup levels may

involve reducing on-site concentrations, altering exposure conditions, or some combination of the two. The 0.7 ppm level had been developed solely to be used as a risk screening level for mercury contamination in soils in a setting to be redeveloped for residential use. So, it was possible to build a house or a child's play area on soils containing mercury at concentrations up to 0.7 ppm.

The MPCA's "Risk-based Guidance" documents from which this level was drawn also suggested that soils with mercury contamination of up to 2 ppm might remain in place under commercial or industrial land-use scenarios. Therefore, using 0.7 ppm as the criterion for determining whether to ship soils from some sites out of state (not allowing them to be placed in landfills) could result in the paradox of allowing soils at other sites contaminated at concentrations of up to at least 2 ppm to remain in place beneath new developments. It stands to reason, then, from a risk standpoint, that soils contaminated at concentrations at least somewhat higher than 0.7 ppm might safely be placed in lined landfills, where even long-term exposures would be quite limited.

In order to recommend a disposal cut-off level for concentrations of mercury in soils, in March of 2004, a Program Management Decision Memo was issued which allowed soils contaminated with mercury at concentrations of up to 4 ppm to be disposed of in municipal solid waste landfills (and possibly some other types), because 4 ppm was a pragmatic benchmark that should protect human health from an air emission pathway, and yet did not unduly restrict management of soils contaminated by ash and other waste often encountered at cleanup sites.

This approach represented a reasonable compromise among the current range of disposal practices involving mercury contaminated soils. For example, the MPCA currently allows coal ash (commonly a source of mercury in soils from redevelopment sites) to be spread as a portion of the daily cover on municipal solid waste (MSW) landfills. In addition, there are landfills in Minnesota operated by utility companies specifically for disposal of coal ash. Indeed, Minnesota already approves application of soils with mercury concentrations significantly higher than those recommended in this policy (17 ppm) to agricultural lands as a soil amendment. Moreover, disposing of contaminated soil in an appropriate landfill is essentially moving an old, unmanaged release to be managed in safer, more controlled conditions, rather than creating a new release of mercury. This decision applied to mercury-contaminated soils only.

In late 2005, a request for a reevaluation of MPCA policy was received. The request was made after two large projects involving renovations of buildings that were contaminated from past, improper disposal of mercury and/or mercury-containing devices were undertaken. The request stated that using the Residential SRV as a disposal standard was too stringent, and caused an economic hardship due to increased costs from transporting debris out of Minnesota. The MPCA's reevaluation of the policy suggested that using the Residential SRV for mercury disposal was indeed too stringent a standard when applied to controlled disposal of waste in a lined landfill. The MPCA examined the totals data from one of the above projects and the vast majority of the waste fell below 1.5 ppm, which is the current Industrial SRV. That appeared to be a reasonable threshold. As a result, the MPCA decided that it would allow disposal of mercury-contaminated

renovation/demolition debris in a lined landfill at levels up to 1.5 ppm. This was communicated to landfills and County Solid Waste Administrators in a letter dated July 14, 2006.

In September of 2006, the MPCA was approached regarding disposal of large amounts of mercury-contaminated soil that were being generated as a result of remediation of a salvage yard. A large amount of the soil exceeded the 4 ppm threshold allowance, so was therefore being disposed of out of state. The MPCA learned it was being disposed of in a biopile in Wisconsin, which is a less protective environment than a lined landfill. Additional data provided showed completed and pending soil remediation projects totaling over 85,000 cubic yards of contaminated soil that exceeded 4 ppm, that would be disposed of outside of Minnesota.

The MPCA concludes that with special handling at landfills, based on totals levels, mercury-contaminated wastes can be safely accepted within Minnesota. The Minnesota Department of Health was consulted regarding this policy, and found it to be reasonable.

**APPROVAL**

I have reviewed this management decision and I concur.

Signed: Tim Scherkenbach
Date: 5/8/07

Tim Scherkenbach
Assistant Commissioner

Signed: James L. Warner
Date: 5/8/07

James L. Warner, P.E.
Director, Industrial Division

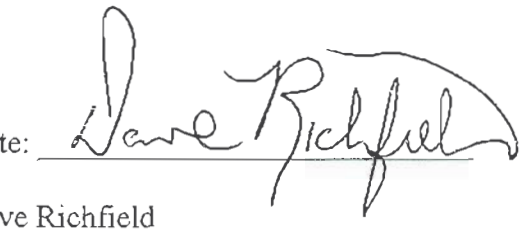
Signed: Lisa J. Thorvig
Date: 5/8/07

Lisa Thorvig
Director, Municipal Division

Signed: Gary Pulford
Date: 5/8/07

Gary Pulford
Manager
Policy, Local Government Assistance and Solid Waste Section

Signed: _____

Date: 

Dave Richfield
Supervisor, Land Policy Unit
Policy, Local Government Assistance and Solid Waste Section

# Mercury-catalyzed Polyurethane Flooring and Mercury-contaminated Demolition Debris and Soil

## Disposal in Minnesota

Mercury is an element that can cause harmful environmental and health effects when disposed of improperly. Because of previous practices, mercury contamination can be found in some soils and demolition debris in Minnesota. In one particular application, mercury was used as a catalyst in some types of synthetic flexible flooring between the 1960s and early 2000s. This flooring, called mercury-catalyzed polyurethane flooring (MCPF), is most commonly found in athletic facilities.

Normally, mercury and mercury-contaminated wastes are prohibited from land disposal in Minnesota under regulations of the Minnesota Pollution Control Agency (MPCA). However, the MPCA will allow some such wastes to be disposed in Minnesota landfills under the conditions discussed in this fact sheet.

## Do I have MCPF in my building?

MCPF was most commonly used as a poured-in-place, rubber-like flooring and could be tinted to any color. It was made by many manufacturers under multiple brand names. The only way to determine whether a particular flooring contains mercury is to test a representative (full-thickness) sample using a reputable testing laboratory. The Minnesota Department of Health (MDH) administers a voluntary laboratory certification program. Although you are not required to use a certified laboratory, the MDH or MPCA can help you locate one if you choose.

## Must I remove MCPF if I find it?

While Minnesota laws do not require you to remove MCPF, it may continue to release harmful gaseous mercury into a building's air for decades after installation. MDH has published indoor air quality guidance for mercury at http://www.health.state.mn.us/.

Mercury vapor from MCPF can penetrate and contaminate other materials, such as plastic and wood. Attempting to cover or seal MCPF instead of removing it may create more contamination and cost.

Ensure that anyone who may be exposed to the flooring or debris during removal (including employees, contractors, and students) is properly protected from exposure to mercury.

## How must I dispose of suspected MCPF and related debris?

Before disposing of suspected MCPF and related debris, test representative samples of the flooring and any other debris for both total and leachable mercury content. The type of disposal allowed for the waste will depend on both of these values and is shown in Table 1 on the following page. Total mercury should be determined in parts per million (ppm) and leachable mercury in milligrams per Liter (mg/L).

Regardless of whether the waste is disposed of in a solid or hazardous waste landfill, ensure that the landfill is permitted to accept the waste and that you have performed any pre-treatment required by the receiving landfill. Additionally, transport the waste in a totally enclosed manner, such as in a truck bed lined and covered with plastic sheeting.

In addition to MCPF and related debris, soils contaminated by naturally-occurring mercury or historical practices, such as the use of coal combustion residuals as fill, may also be disposed according to Table 1.

**Table 1: Allowed management of MCPF, related debris, and soils in Minnesota**

| Total mercury content | Non-hazardous waste (< 0.2 mg/L leachable mercury) | Hazardous waste (≥ 0.2 mg/L leachable mercury) |
|---|---|---|
| ≤ 4 ppm total mercury | Minnesota solid waste landfill or out-of-state solid waste landfill<br>▪ No special handling required | Out-of-state hazardous waste landfill or treatment facility |
| 4 < 10 ppm total mercury | Minnesota solid waste landfill or out-of-state solid waste landfill<br>▪ If in Minnesota, immediate coverage with 6 inches of soil | |
| 10 - 1000 ppm total mercury* | Minnesota solid waste landfill or out-of-state solid waste landfill<br>▪ If in Minnesota, immediate coverage with 6 inches of soil and landfill maintains location & quantity records<br>***MCPF only:***<br>No MPCA preapproval needed<br>***All other related debris & soil:***<br>Must be preapproved by MPCA | Out-of-state hazardous waste landfill or treatment facility<br>▪ Land Disposal Restriction (LDR) may apply |
| > 1000 ppm total mercury | Out-of-state solid waste landfill | |

# More information

Guidance and requirements in this fact sheet were compiled from Minnesota Statutes, Chapters 115A and 116, and Minnesota Rules, Chapters 7035 and 7045, and incorporate regulatory interpretation decisions made by the MPCA on September 3, 2013. To review Minnesota Statutes and Rules, visit the Office of the Revisor of Statutes at https://www.revisor.mn.gov/pubs.

The MPCA's Small Business Environmental Assistance Program (SBEAP) can provide free, confidential compliance assistance. The Minnesota Technical Assistance Program (MnTAP) can help reduce your waste generation. Report all hazardous waste incidents to the Minnesota Duty Officer.

## Metro County Hazardous Waste Offices

Anoka ..... 763-422-7093
Carver ..... 952-361-1800
Dakota ..... 952-891-7557
Hennepin ..... 612-348-3777
Ramsey ..... 651-266-1199
Scott ..... 952-496-8475
Washington ..... 651-430-6655
Websites ..... http://www.co.[county].mn.us

## Minnesota Technical Assistance Program

Toll free ..... 1-800-247-0015
Metro ..... 612-624-1300
Website ..... http://www.mntap.umn.edu

## Small Business Environmental Assistance

Toll free ..... 1-800-657-3938
Metro ..... 651-282-6143
Website ..... http://www.pca.state.mn.us/sbeap/

## Minnesota Pollution Control Agency

Toll free (all offices) ..... 1-800-657-3864
Brainerd ..... 218-828-2492
Detroit Lakes ..... 218-847-1519
Duluth ..... 218-723-4660
Mankato ..... 507-389-5977
Marshall ..... 507-537-7146
Rochester ..... 507-285-7343
St. Paul ..... 651-296-6300
Willmar ..... 320-214-3786
Website ..... http://www.pca.state.mn.us

## Minnesota Duty Officer

Toll free ..... 1-800-422-0798
Metro ..... 651-649-5451
Website ..... https://dps.mn.gov/divisions/bca/

## Minnesota Department of Health

Toll free ..... 1-888-345-0823
Metro ..... 651-201-5000
Website ..... http://www.health.state.mn.us/

# Appendix F

# Liner Equivalency Calculations

Date: 5/23/12
By: Dan Riggs
Client: Dem-Con

**LINER EQUIVALENCY CALCULATIONS – Confining Pressure**

**Objective:**
Determine the amount of waste needed to achieve a hydraulic conductivity of 3 x $10^{-9}$ cm/sec on the geosynthetic clay liner, which occurs at 10 psi confining pressure.

**Basis:**
Vertical pressure on the liner can be expressed as:

$$(\gamma_{sand,sat} * d_{sand,sat}) + (\gamma_{sand} * d_{sand}) + (\gamma_{waste} * d_{waste}) = \sigma_{GCL}$$

or

$$d_{waste} = \frac{\sigma_{GCL} - (\gamma_{sand,sat} * d_{sand,sat}) + (\gamma_{sand} * d_{sand})}{\gamma_{waste}}$$

Where: $\gamma$ = unit weight of material
$d$ = depth of material
$\sigma$ = pressure on material

Assumptions

1.) Leachate = 1 ft (depth permitted on liner)
2.) Thickness of sand = 2 ft
3.) Unit weight of sand above leachate, $\gamma_{sand}$ = 1.5 tons/cu. yd = 111.11 pcf
4.) Unit weight of leachate = unit weight of water = 62.4 pcf
5.) Unit weight of sand below leachate, $\gamma_{sand,sat}$ = 111.11 pcf – 62.4 pcf = 48.71 pcf
6.) Unit weight of waste = 1.3 tons/cu. yd = 96.3 pcf

Depth of waste needed:

$$d_{\text{waste}} = \frac{10 \text{ psi} * 144 \frac{\text{psf}}{\text{psi}} - (48.71 \text{ pcf} * 1\ ft) - (111.11\ pcf * 1\ ft)}{96.3\ pcf}$$

$$\boldsymbol{d_{\text{waste}} = 13.3\ ft}$$

**Results: 13.3 ft of waste will be needed above the 2 ft of sand to confine the GCL at 10 psi**

**Signature:** _____

**Daniel J. Riggs, PE**

**License No. 49559**

Date: 5/23/12
By: Dan Riggs
Client: Dem-Con

**LINER EQUIVALENCY CALCULATIONS – Leachate Flux**

**Objective:**
Demonstrate that a single-layer geosynthetic clay liner (GCL) performs equally well or better than a 2-foot compacted clay liner at restricting exfiltration from the landfill.

**Basis:**
Estimate leachate flux through each liner material based on the following equations

$$Q = Ki$$

and

$$i = \frac{h + d}{d}$$

Where: $Q$ = leachate flux through liner ($L^3/L^2/T$)
$K$ = vertical hydraulic conductivity ($L^3/L^2/T$)
$i$ = hydraulic gradient (L/L)
$h$ = leachate head on liner (L)
$d$ = saturated liner depth (L)

Assumptions

1) $K$ for compacted clay = 1 x $10^{-7}$ cm/sec (maximum allowed by MN Rules)
2) $K$ for GCL = 3 x $10^{-9}$ cm/sec (maximum value from manufacturer's specification, see attached Confining Pressure calculations and attached GCL specifications)
3) $h$ = 1 ft (leachate permitted on liner)
4) $d$ for compacted clay liner = 2 ft (fully saturated)
5) $d$ for GCL = 0.25 in, or 0.0208 ft (fully saturated)

Leachate flux through GCL

$$Q_{GCL} = \left(3 \times 10^{-9} \frac{cm}{sec}\right)\left(\frac{1ft + 0.0208ft}{0.0208ft}\right)$$

$$Q_{GCL} = 1.47 \times 10^{-7} \frac{cm}{sec}$$

Leachate flux through compacted clay liner

$$Q_{Clay} = \left(1 \times 10^{-7} \frac{cm}{sec}\right)\left(\frac{1ft + 2ft}{2ft}\right)$$

$$Q_{Clay} = 1.50 \times 10^{-7} \frac{cm}{sec}$$

$\boldsymbol{Q_{GCL} < Q_{Clay}}$ ∴ **GCL results in less leachate flux through the liner than compacted clay.**

**Signature:** _____

**Daniel J. Riggs, PE**

**License No. 49559**

# Appendix G

# Method 1030

# METHOD 1030

## IGNITABILITY OF SOLIDS

SW-846 is not intended to be an analytical training manual. Therefore, method procedures are written based on the assumption that they will be performed by analysts who are formally trained in at least the basic principles of chemical analysis and in the use of the subject technology.

In addition, SW-846 methods, with the exception of required method use for the analysis of method-defined parameters, are intended to be guidance methods which contain general information on how to perform an analytical procedure or technique, which a laboratory can use as a basic starting point for generating its own detailed standard operating procedure (SOP), either for its own general use or for a specific project application. Performance data included in this method are for guidance purposes only and must not be used as absolute quality control (QC) acceptance criteria for purposes of laboratory QC or accreditation.

## 1.0 SCOPE AND APPLICATION

1.1 This method is suitable for the determination of the ignitability of solids and is appropriate for pastes, granular materials, solids that can be cut into strips, and powdery substances. Also, if it is impractical to perform this test because of the physical form of the sample, generator knowledge should be used to determine the ignitability hazard posed by the material. The test method described here is based on the test procedure adopted by the Department of Transportation (DOT) from the United Nations regulations for the international transportation of dangerous goods (see Appendix E to Part 173 of 49 CFR).

1.2 This method is not required by the Federal regulations to determine if a waste passes or fails the characteristic of ignitability according to the RCRA regulatory definition at 40 CFR 261.21. To clarify, the test results of this method cannot be used to directly classify a waste as a D001 hazardous waste, nor can the results be used by themselves to definitively classify a waste as non-hazardous. No specific test for ignitable solids is required by the RCRA regulations, and only a waste meeting the narrative regulatory definition at 40 CFR 261.21(a)(2) is an ignitable hazardous waste because it is an ignitable solid. In addition, the test in this method for a liquid may be helpful in determining whether a liquid waste has hazardous properties; however, a liquid waste is only a D001 hazardous waste if it is an oxidizer, as defined at 40 CFR 261.21(a)(4), or based on its flash point, as defined at 40 CFR 261.21(a)(1). This test method was developed to specifically illustrate the ignitability properties of materials, including wastes, and its results provide relevant and useful information that may be applied to knowledge of a waste in determining whether a waste meets the 40 CFR 261.21 criteria.

1.3 Prior to employing this method, analysts should consult the disclaimer statement at the front of the manual and the information in Chapter Two for 1) guidance on the intended flexibility in the choice of methods, apparatus, materials, reagents, and supplies; and 2) the responsibilities of the analyst for demonstrating that the techniques employed are appropriate for the analytes of interest, in the matrix of interest, and at the levels of concern.

In addition, analysts and data users are advised that, except where explicitly specified in a regulation, the use of SW-846 methods is *not* mandatory in response to Federal testing requirements. The information contained in this method is provided by the Environmental Protection Agency (EPA) as guidance to be used by the analyst and the regulated community in

making judgments necessary to generate results that meet the data quality objectives (DQOs) for the intended application.

1.4 This method is restricted to use by, or under supervision of, appropriately experienced and trained personnel. Each analyst must demonstrate the ability to generate acceptable results with this method.

## 2.0 SUMMARY OF METHOD

In a preliminary test, the test material is formed into an unbroken strip or powder train, 250 mm in length. An ignition source is applied to one end of the test material to determine whether combustion will propagate along 200 mm of the strip within a specified time period. Materials that propagate burning along a 200-mm strip within the specified time period are then subjected to a burning rate test. Materials that do not ignite or propagate combustion as described above do not require further testing. In the burning rate test, the burning time is measured over a distance of 100 mm and the rate of burning is determined. The test method described here is based on the test procedure adopted by the Department of Transportation from the United Nations regulations for the international transportation of dangerous goods and is contained in Appendix E to Part 173 of 49 CFR.

## 3.0 DEFINITIONS

Refer to Chapter One and the manufacturer's instructions for definitions that may be relevant to this procedure.

## 4.0 INTERFERENCES

4.1 In laboratory tests, the burning rate of duplicate runs is usually repeatable to within 10%. However, large differences in burning rates may occur if experimental conditions are not held constant. Variation in airflow rates, particle size, and moisture content of the test material will affect test results. Therefore, at least triplicate determinations of the burning rate should be conducted.

4.2 Particle size of test material can affect not only the burning rate, but also the ignition of the material. Therefore, the particle size of the test material should be the same for each test run. The particle size of the test material should be reported in a simple descriptive format (e.g., fine powder, sand, coarse granular).

4.3 Temperature of some test material (such as sulfur powder) affects the burning rate. For reproducible results, all tests should be performed at approximately the same initial temperature (ambient room or laboratory temperature).

4.4 All tests must be carried out inside a fume hood with the test apparatus situated perpendicular ($90^{o}$) to the direction of airflow. Airflow parallel ($0^{o}$) to the test apparatus results in non-reproducible burning rates.

4.5 The rate of airflow through the fume hood affects the burning rate. An airflow rate that is too high distorts the flame and retards its horizontal propagation. The optimum airflow rate appears to be in the range of 0.7-1 meters per second.

4.6 Materials that are moisture sensitive (i.e., readily absorb moisture from air) should be tested as quickly as possible after removal from the sample container. All materials should be tested as received by the laboratory.

## 5.0 SAFETY

5.1 This method does not address all safety issues associated with its use. The laboratory is responsible for maintaining a safe work environment and a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of material safety data sheets (MSDSs) should be available to all personnel involved in these analyses.

5.2 Prior to starting the preliminary screening test, all sample materials must be tested to determine if that material is explosive or extremely flammable (see WARNING below). Use a very small portion of material (1 g or less) for this test.

WARNING: If the sample material is explosive or extremely flammable, do not conduct this test.

5.3 This method could involve the combustion of highly flammable materials and the generation of toxic fumes. All tests must be conducted in a suitable fume hood fitted with a pull-down sash to prevent the escape of toxic fumes into working areas. The analyst should wear appropriate protective clothing, including a laboratory jacket or apron, safety glasses, and protective gloves. The laboratory should have appropriate firefighting equipment (such as a Class A fire extinguisher) readily available to extinguish small fires.

## 6.0 EQUIPMENT AND SUPPLIES

The mention of trade names or commercial products in this manual is for illustrative purposes only, and does not constitute an EPA endorsement or exclusive recommendation for use. The products and instrument settings cited in SW-846 methods represent those products and settings used during method development or subsequently evaluated by the Agency. Glassware, reagents, supplies, equipment, and settings other than those listed in this manual may be employed provided that method performance appropriate for the intended application has been demonstrated and documented.

This section does not list common laboratory glassware (e.g., beakers and flasks) that might be used.

6.1 Low-heat conducting, non-combustible, impervious ceramic tile or equivalent material, an approximate dimension of 25 cm x 25 cm x 2.5 cm (the tile must be at least 25 cm in length to support a 250-mm test sample).

6.2 High temperature marker or equivalent marking device for marking ceramic plates.

6.3 Powder train mold (see Figure 1) for molding powdered and granular materials for the burn rate test. The material of construction can be aluminum, brass, stainless steel, or plastic. The mold is 250 mm in length and has a triangular cross-section, with a width of 20 mm, and a depth of 10 mm as measured from the bottom of the triangular opening to where the sides meet. On both sides of the mold, in the longitudinal direction, two sheets are mounted as lateral limitations which extend 2 mm beyond the upper edge of the triangular cross-section.

This device can be fabricated by most machine shops. The complete burn rate apparatus is available from: Associated Design and Manufacturing Co., Lorton, Virginia, 22079.

6.4 A Bunsen (propane gas and air) burner with a minimum diameter of 5 mm capable of attaining a temperature of at least 1,000 °C.

6.5 Stop watch.

6.6 Thermocouple to measure the temperature of the gas flame.

6.7 Thermometer to measure initial temperature of material (i.e., room temperature).

6.8 Anemometer to measure airflow in the fume hood.

## 7.0 REAGENTS AND STANDARDS

No special reagents or standards are required to conduct this test.

## 8.0 SAMPLE COLLECTION, PRESERVATION, AND STORAGE

8.1 Samples should be tested on an as-received basis unless requested otherwise. No sample preservation is required, but sample containers should be completely filled and tightly sealed to preserve sample integrity.

8.2 Samples should be tested as soon as possible after removal from the sample container (i.e., samples should not be allowed to dry or absorb moisture for excessive periods or to lose volatiles). Samples that are chilled or cooled upon receipt to the laboratory should be allowed to equilibrate to the ambient laboratory temperature in the sample container.

## 9.0 QUALITY CONTROL

9.1 Refer to Chapter One for additional guidance on quality assurance (QA) and quality control (QC) protocols. When inconsistencies exist between QC guidelines, method specific QC criteria take precedence over both technique specific criteria and Chapter One criteria; technique specific QC criteria take precedence over Chapter One criteria. Any effort involving the collection of analytical data should include development of a structured and systematic planning document, such as a Quality Assurance Project Plan (QAPP) or a Sampling and Analysis Plan (SAP), which translates project objectives and specifications into directions for those implementing the project and assessing the results.

Each laboratory should maintain a formal quality assurance program. The laboratory should also maintain records to document the quality of the data generated. Development of in-house QC limits for each method is encouraged. Use of instrument specific QC limits is encouraged, provided such limits will generate data appropriate for use in the intended application. All data sheets and quality control data should be maintained for reference or inspection.

9.2 All tests must be performed on a clean ceramic plate at room temperature.

9.3 All replicate runs must be at the same initial temperature (ambient laboratory temperature).

9.4 All replicate tests must be run at approximately the same airflow through the fume hood.

9.5 Only materials of the same particle size distribution should be used for all replicate tests.

9.6 The burn rate test must be conducted in triplicate if the preliminary screening test is positive. Any burn rate for non-metallic samples that exceeds 2.2 mm/sec (or a burn time of less than 45 seconds for 100 mm) is considered to have a positive result. For metals, a burn rate of more than 0.17 mm/sec (or burn time of less than 10 minutes for 100 mm) is considered to have a positive result.

## 10.0 CALIBRATION AND STANDARDIZATION

There are no calibration or standardization steps directly associated with this procedure. See the equipment manufacturer's instructions for the calibration of certain equipment used in this method (e.g., the thermocouple).

## 11.0 PROCEDURE

WARNING: Prior to starting the preliminary screening test, all sample materials must be tested to determine if that material is explosive or extremely flammable. Use a very small portion of material (1 g or less). If the sample material is explosive or extremely flammable, do not conduct this test.

### 11.1 Preliminary screening test

11.1.1 The preliminary screening test for ignitability is conducted on all waste materials. On a clean, impervious ceramic tile (Sec. 6.1), clearly mark a 250 mm long test path. Make another mark at exactly 200 mm from the start of the sample path.

11.1.2 Prepare the test material in its "as received" form by forming an unbroken strip or powder train of sample 250 mm long by 20 mm wide by 10 mm high on the ceramic tile. Use the mold to form the material as described in Sec. 11.2.3.1, if appropriate.

11.1.3 Place the ceramic tile with the loaded sample in a fume hood about 20 cm (~8 inches) from the front of the hood and in an area of laminar airflow. Position the sample perpendicular to the airflow (See Figure 2). The airflow across the perpendicular axis of the sample should be sufficient to prevent fumes from escaping into the laboratory and should not be varied during the test. The air velocity should be approximately 0.7 meters/second. Measure the air velocity with an anemometer.

11.1.4 Light the Bunsen burner and adjust the height of the flame (6.5 to 7.5 cm) by adjusting the propane gas and air flows. Measure the temperature of the flame (tip of the flame) by a thermocouple. The temperature of the flame must be at least 1000 °C.

11.1.5 Apply the tip of the flame to one end of the sample strip. The test period will depend on the sample matrix (whether non-metallic or metallic) as described below in Sec. 11.1.5.1 and 11.1.5.2.

11.1.5.1 If the waste is non-metallic, hold the flame tip on the sample strip until the sample ignites or for a maximum of 2 minutes. If combustion occurs, begin timing with a stop watch and note whether the combustion propagates up to the 200 mm mark within the 2 minute test period.

11.1.5.2 If the waste is a metal or metal alloy powder, hold the flame tip on the sample strip until the sample ignites or for a maximum of 5 minutes. If combustion occurs, begin timing with a stop watch and note whether the combustion propagates up to the 200-mm mark within the 20 minute test period.

11.1.6 If the waste does not ignite and propagate combustion either by burning with open flame or by smoldering along the 200-mm sample strip within the 2 minute test period (or 20 minute test period for metal powders), the waste is not considered flammable and no further testing is required. If the waste propagates burning of 200 mm of the test strip within the 2 minute test period (20 minute test period for metals), the material must be evaluated by the burning rate test (proceed to Sec. 11.2).

11.2 Burning rate test

11.2.1 The preparation of the test sample for the burning rate test will depend on the physical characteristics of the waste. Wastes that exist in a powdered or granular state are molded in a powder train mold as shown in Figure 1. Pasty materials are formed into a rope that is 250 mm in length with a cross-section of 1 $cm^2$. All tests for the burn rate test are performed on clean, ambient temperature, ceramic plates.

11.2.2 On a clean, impervious ceramic tile (Sec. 6.2), clearly mark a 250-mm long test path. Make two additional timing marks at 80 mm and 180 mm from the start of the sample path. The distance between the two marks (100 mm) will be used to calculate the rate of burn in Sec. 12.0.

11.2.3 Sample preparation based on physical characteristics

11.2.3.1 Powder or granular material -- Tighten the side plates on the mold. Place the mold on the base plate. Pour the material to fill the triangular cross section of the mold loosely. Drop the unit from a height of 2 cm onto a solid surface three times to settle the powder. Remove the side supports. Lift the mold off the base plate. Place a clean ceramic test plate with the appropriate timing marks (Sec. 11.2.2) face down on top of the mold. Invert the setup and remove the mold.

11.2.3.2 Pasty wastes - Spread the waste on a marked ceramic tile (Sec. 11.2.2) in the form of a rope 250 mm in length with a cross-section of 1 $cm^2$.

11.2.4 Place the ceramic tile with the loaded sample prepared in Sec. 11.2.3 in a fume hood about 20 cm (~8 in) from the front of the hood and in an area of laminar airflow. Position the sample perpendicular to the airflow (See Figure 2). The airflow across the perpendicular axis of the sample should be sufficient to prevent fumes from escaping into the laboratory and should not be varied during the test. The air velocity should be

approximately in the range of 0.7-1 meters/second. Measure the air velocity with an anemometer.

11.2.5 Light the Bunsen burner and adjust the height of the flame (6.5 to 7.5 cm) by adjusting the propane gas and air flows. Measure the temperature of the flame (tip of the flame) by a thermocouple. The temperature of the flame must be at least 1000 °C.

11.2.6 Apply the tip of the flame to one end of the sample strip to ignite the test strip as described in Sec. 11.1.5.1 or 11.1.5.2 (based on whether the sample is non-metallic or metallic).

11.2.7 When the test strip or powder train has burned up to the 80-mm time marker, begin timing the rate of combustion with a stop watch. Stop the timer when the burned strip reaches the 180-mm time marker. Record the amount of time (in sec) required to burn the 100-mm test strip.

## 12.0 DATA ANALYSIS AND CALCULATIONS

Calculate the rate of burning by dividing the length of the burn test strip (100 mm) by the total time (sec). Results of the burn rate test should be reported in mm/sec. Wastes that have a rate of burning of more than 2.2 mm/sec (or burn time of less than 45 sec for 100 mm) are considered to have a positive result for ignitability according to DOT regulations. For metals, this time is 10 minutes or less for 100 mm (or a burn rate of more than 0.17 mm/sec). The following format may be used to document the data.

Test Material Information

Source of material (e.g., company, operation or process):
Description of material (e.g., powder or paste, metallic or non-metallic):
Particle size (e.g., fine powder, granular, sand, etc.):
Preliminary burning time (sec):

Test Conditions

Date of Test:
Temperature of test material (°C):
Air velocity through fume hood (m/s):

| Ignitability Test Data | | | | |
|---|---|---|---|---|
| Test Number | Time (sec) Elapsed Between Application of Flame and Start of Ignition | Burning Time over 100 mm (sec) | Burning Rate (mm/sec) | Comments |
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |

## 13.0 METHOD PERFORMANCE

13.1 Performance data and related information are provided in SW-846 methods only as examples and guidance. The data does not represent required performance criteria for users of the methods. Instead, performance criteria should be developed on a project-specific basis, and the laboratory should establish in-house QC performance criteria for the application of this method. Performance data must not be used as absolute QC acceptance criteria for laboratory QC or accreditation.

13.2 An independent laboratory validation was conducted on the robustness of the burn rate test procedure. The materials selected for this evaluation included:

1. A 50/50 mixture of metallic silicon and lead dioxide ($PbO_2$)
2. Excelsior
3. Dextrin (yellow powder)
4. Sulfur (fine yellow powder)
5. Aluminum metal (coarse)
6. Magnesium metal (coarse)
7. Polyethylene high density (granular)
8. Polyethylene low density (fluffy white powder)
9. Scott fertilizer (32-3-10:N-P-K)
10. JP-4 contaminated soil (approximately 5000 ppm)

Of these materials, the 50/50 mixture of metallic silicon and lead dioxide ($PbO_2$), elemental sulfur, and excelsior gave a positive ignitability result under the conditions of the test. The remaining materials gave negative (nonflammable) results under the conditions of the test. Several test variables including: ignition source, ambient temperature, and apparatus orientation, were studied using these materials. Partial results of this study are summarized in Table 1. These data are provided for guidance purposes only.

13.3 In another evaluation of the DOT burn rate test, potentially ignitable finishing wastes from the furniture industry were collected and tested for burning rates. Each waste was tested in triplicate to establish a mean value for the burning rate. The results for the flammable wastes are summarized in Table 2. These data are provided for guidance purposes only.

13.4 In order to evaluate the ruggedness of the DOT burn rate test, select ignitable finishing wastes were split and tested by a state laboratory and an independent contract laboratory. The results of this comparison are summarized in Table 3. These data are provided for guidance purposes only.

## 14.0 POLLUTION PREVENTION

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity and/or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operations. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best option.

14.2 For information about pollution prevention that may be applicable to laboratories and research institutions consult *Less is Better: Laboratory Chemical Management for Waste Reduction*, a free publication available from the American Chemical Society (ACS), Committee on Chemical Safety, http://portal.acs.org/portal/fileFetch/C/WPCP_012290/pdf/WPCP_012290.pdf.

## 15.0 WASTE MANAGEMENT

The Environmental Protection Agency requires that laboratory waste management practices be conducted consistent with all applicable rules and regulations. Laboratories are urged to protect air, water, and land by minimizing and controlling all releases from hoods and bench operations, complying with the letter and spirit of any sewer discharge permits and regulations, and by complying with all solid and hazardous waste regulations, particularly the hazardous waste identification rules and land disposal restrictions. For further information on laboratory waste management, consult *The Waste Management Manual for Laboratory Personnel* available from the American Chemical Society at the address listed in Sec. 14.2.

## 16.0 REFERENCES


1. "Test Methods for Readily Combustible Solids. Burning Rate Test." (14.2.2.5). Recommendations on the Transport of Dangerous Goods, Fifth Revised Edition, United Nations, New York, 1988.

2. 49 CFR, Appendix E to Part 173 (12-31-91 Edition), pp. 597-598.

3. "Flammability (solids). Method A.10," Official Journal of the European Communities, No. L251/63, September 19, 1984.

4. Foster Wheeler Enviresponse, Inc., Edison NJ., "Validation of Ignitability Method For Solids," submitted to the Office of Solid Waste, US EPA, February 1994.

5. Internal Report (AMFA Report), North Carolina Department of Environmental Health and Natural Resources (Bill Hamner).


## 17.0 TABLES, DIAGRAMS, FLOW CHARTS, AND VALIDATION DATA

The following pages contain the tables and figures referenced by this method. A flow diagram of the procedure is included after the figures.

TABLE 1

TEST VARIABLES FOR IGNITABILITY

| Material Tested | Test Number | Variable combination[1] | Burn Time over 100 mm (sec) | Burn Rate (mm/sec) |
|---|---|---|---|---|
| 50% Metallic Silicon and 50% Lead IV Oxide | 1 | ABC | 0.84 | 119 |
| | 2 | Abc | 0.50 | 200 |
| | 3 | aBc | 0.69 | 145 |
| | 4 | abC | 0.65 | 154 |
| Excelsior (wood shavings) | 1 | ABC | 13.45 | 7.43 |
| | 2 | Abc | 9.14 | 10.9 |
| | 3 | aBc | 13.37 | 7.47 |
| | 4 | abC | 13.59 | 7.36 |

[1]Key:

A - Flame ignition
a - Hot wire ignition source
B - Ambient temperature of 20 ° C
b - Ambient temperature of 100 ° C
C - Orientation of test apparatus of 90 ° to air flow
c - Orientation of test apparatus of 0 ° to air flow

These data are provided for guidance purposes only.

TABLE 2

EXAMPLE BURNING RATES FOR IGNITABLE WASTES

| Sample No. | Description of Waste | Burn Time over 100 mm (sec) | Burn Rate (mm/sec) |
|---|---|---|---|
| A2 | Segregated Lacquer Dust | 4.7 | 21.3 |
| J2 | Segregated Lacquer Dust | 4.6 | 21.7 |
| U | Segregated Lacquer Dust | 8.6 | 11.6 |
| K | Consolidated Lacquer Dust | 6.0 | 16.7 |
| H | Catalyzed Lacquer Dust | 6.7 | 14.9 |
| F | Water Based Lacquer Dust | 19.4 | 5.15 |
| P | Booth Coat-Stain Overspray | 12.5 | 8.0 |
| O | Pallet Covered Cardboard | 11.1 | 9.0 |
| Q | Pallet Covered Cardboard | 12.3 | 8.13 |

These data are provided for guidance purposes only.

TABLE 3

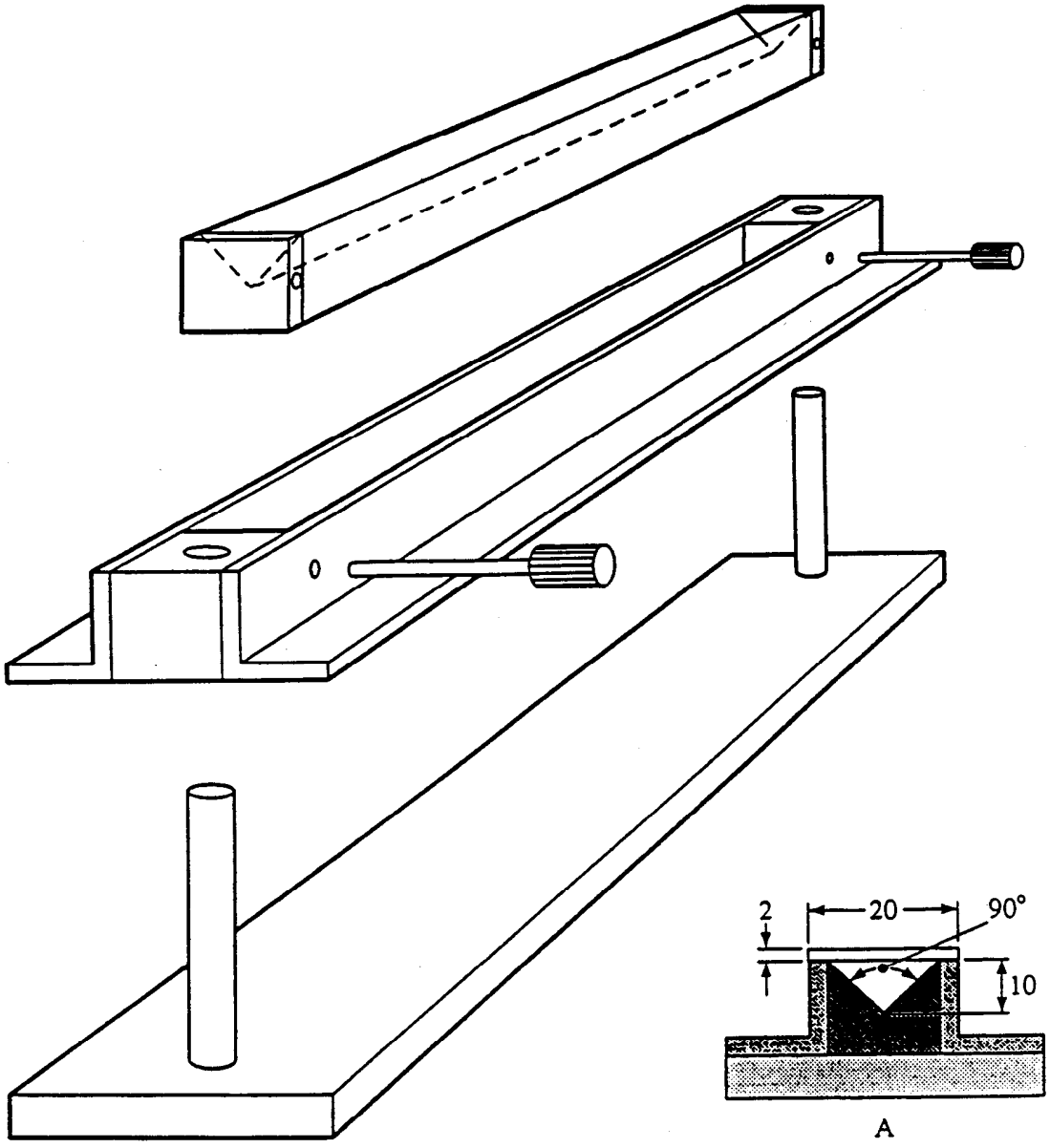
EXAMPLE COMPARISON OF BURN RATES

| Sample No. | Description of Waste | Mean Burn Time Over 100 mm (Seconds) | |
|---|---|---|---|
| | | State Laboratory | Contract Laboratory |
| A1 | Segregated Lacquer Dust | 4.7 | 5 |
| J1 | Segregated Lacquer Dust | 4.6 | 4.3 |
| 12 | Booth Coat-Glaze Overspray | 0[1] | 0[1] |

[1] Waste was found to be nonflammable under conditions of the test.
These data are provided for guidance purposes only.

FIGURE 1

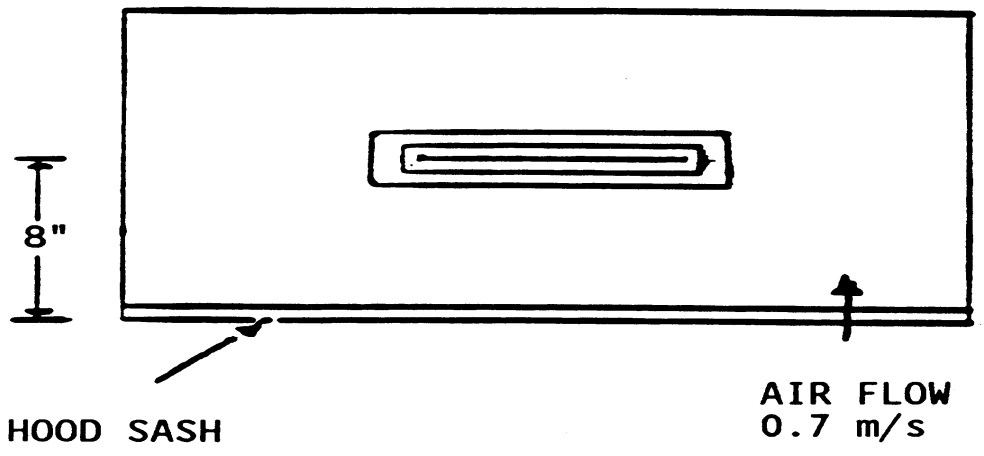
POWDER TRAIN MOLD




(A) Cross-section of 250 mm long mould

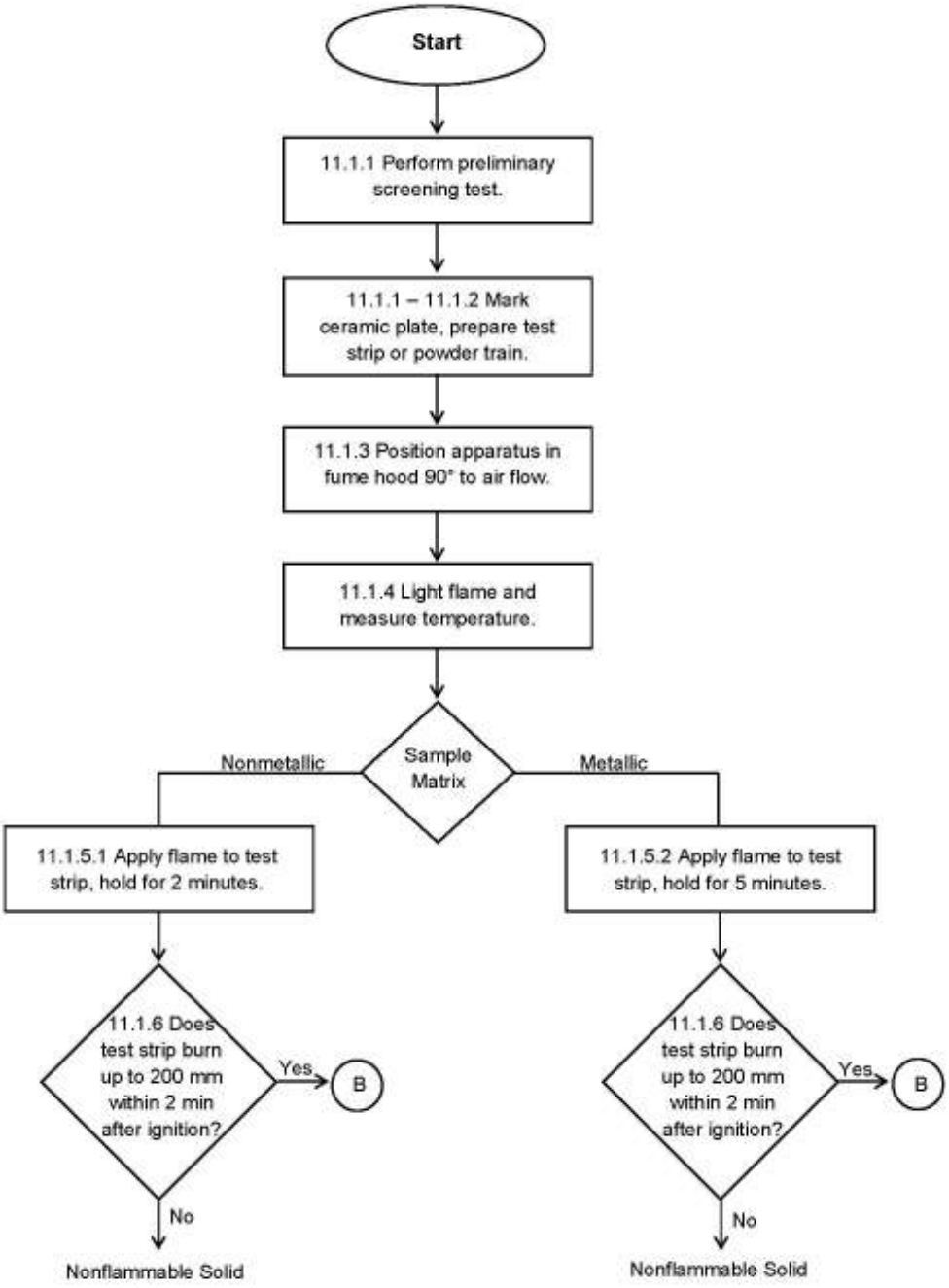
FIGURE 2

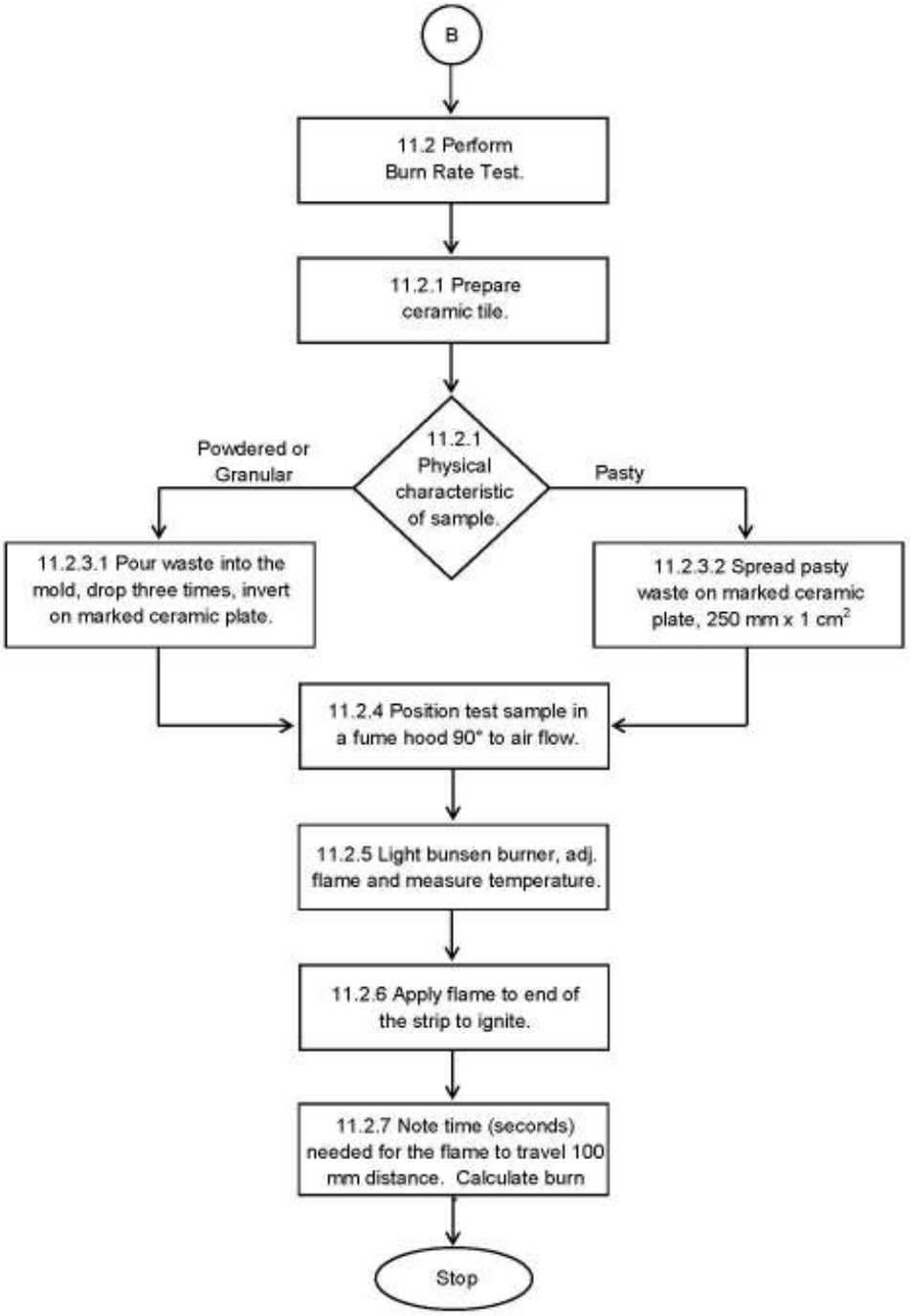
TEST APPARATUS POSITION IN FUME HOOD




SAMPLE 90° TO AIR FLOW

IGNITABILITY OF SOLIDS




B
11.2 Perform Burn Rate Test.
11.2.1 Prepare ceramic tile.
11.2.1 Physical characteristic of sample.
Powdered or Granular
Pasty
11.2.3.1 Pour waste into the mold, drop three times, invert on marked ceramic plate.
11.2.3.2 Spread pasty waste on marked ceramic plate, 250 mm x 1 cm2
11.2.4 Position test sample in a fume hood 90° to air flow.
11.2.5 Light bunsen burner, adj. flame and measure temperature.
11.2.6 Apply flame to end of the strip to ignite.
11.2.7 Note time (seconds) needed for the flame to travel 100 mm distance. Calculate burn
Stop

## Appendix A:

## Summary of Revisions to Method 1030 (From Revision 0 December 1996)

1. Improved overall method formatting for consistency with new SW-846 methods style guidance. The format was updated to Microsoft Word .docx.

2. Minor editorial and technical revisions were made throughout to improve method clarity.

3. The flowcharts on pages 14 and 15 were updated to improve visual clarity and edited for content.

4. The revision number was changed to 1 and the date published was changed to July 2014.

5. This appendix was added showing changes from the previous revision.

6. Items regarding regulatory use of this method in Sec. 1.1 and 1.2 were updated to reflect current guidance.

# Appendix H

# MPCA Guidance Document – The Lethality Characteristic

# The Lethality Characteristic

## A Minnesota-specific hazardous-waste characteristic

Waste/Hazardous Waste #2.05 • May 2009

Minnesota Pollution Control Agency

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Lethality, a hazardous waste characteristic specific to Minnesota, considers the toxicological, or poisonous, effect of a waste. Minnesota waste generators must ensure that wastes are evaluated for the Lethality characteristic as well as for the federal characteristics of Ignitability, Oxidizers, Corrosivity, Reactivity, and Toxicity. While the more familiar characteristic of Toxicity also contains the root 'toxic,' that characteristic refers to the presence and concentration of specific toxic contaminants as determined by the Toxicity Characteristic Leaching Procedure (TCLP). The Lethality characteristic is concerned with the overall toxicological effect of the waste as determined by biological testing. In this document, wastes displaying the Lethality characteristic are termed 'Lethal.'

Seek ways to reduce the total amount of waste you generate and the toxicity of the products you use to reduce the amount of potentially lethal hazardous wastes you generate. For free assistance, contact the Minnesota Technical Assistance Program (MnTAP). Contact information on page 4.

For more information on the federal characteristics, see MPCA hazardous waste fact sheet #2.04, *Characteristic Wastes*, available at www.pca.state.mn.us/publications/w-hw2-04.pdf

### Lethality thresholds

The toxicological effect of a material is often measured in terms of the median lethal dose ($LD_{50}$), which is the amount of a material which will kill half of a test population of a specific animal, presented as a ratio with the body weight of the animal. Median lethal dose information is determined for a specific exposure method and test animal. The Lethality characteristic considers the oral, dermal, and inhalation exposure methods. The median lethal dose for the inhalation exposure is commonly referred to as the median lethal concentration (LC50).

Under Minnesota Rules, a waste is hazardous for the Lethality characteristic when a representative sample of the waste exhibits any of the following:

- an oral $LD_{50}$ (rat) less than 500 milligrams per kilogram (mg/kg)
- a dermal $LD_{50}$ (rabbit) less than 1000mg/kg
- an inhalation LC50 (rat) less than 2000 milligrams per cubic meter (mg/m3) for dusts and mists
- an inhalation LC50 (rat) less than 1000 parts per million (ppm) for gases and vapors

### Evaluating for lethality

To help you evaluate waste for the Lethality characteristic, the Minnesota Pollution Control Agency (MPCA) has compiled a list of attributes that indicate a waste may be Lethal. See Table 1.

You may consider a waste does *not* meet the Lethality characteristic when you can document that the product from which the waste is generated does not display any of the Table 1 attributes. Maintain documentation at the generation site.

If a product *does* display any of the attributes, the waste *may* be Lethal; you must evaluate it further. Manage waste that



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651-296-6300 • 800-657-3864 • TTY 651-282-5332 or 800-657-3864 • Available in alternative formats

displays any of the attributes as a Lethality characteristic hazardous waste unless and until you evaluate further under Minn. R. 7045.0131, Subp. 6 and demonstrate that the waste does not display the Lethality characteristic.

Instead of performing a full evaluation, you may choose to assume a waste is lethal and manage it as fully regulated hazardous waste

**Table 1: Attributes of potential lethality**

- A **drug*** regulated by the Minnesota Board of Pharmacy
- A **pesticide** regulated by the Minnesota Department of Agriculture
- A **poisonous material** regulated for transport by the U.S. Department of Transportation
- A material bearing any of the descriptive or signal terms "**Poison**", "**Poisonous**", "**Toxic**", "**Lethal**", **"Fatal"** or **"Deadly"** on the product shipping container, product label, or in product documentation
- A material bearing the '**skull and crossbones**' graphic on the product shipping container, product label, or in product documentation



- A material bearing a U.S. Department of Transportation "**Hazard Class 6.1**" label or placard on the product shipping container, product label, or in product documentation




- A material bearing a National Fire Rating (NFR), Hazardous Materials Identification System (HMIS), or Hazardous Material Identification/Information Guide (HMIG) rating **Health Division ≥3** or **Special Hazard Division "POI"** (NFR only) label on the product shipping container, product label, or in product documentation




- A material bearing **$LD_{50}$ data** on a Material Safety Data Sheet (MSDS) which you have, or which you are required by OSHA regulations to have, which states that the $LD_{50}$ of any of the ingredients is less than the lethality thresholds on page 1 of this fact sheet
- A material having **specific information known to you** that the waste may reasonably be Lethal, including but not limited to information that your processes may alter a product or other material which does not exhibit any of the above attributes in such a way that the waste generated may reasonably be Lethal
- A material having **specific information published by the MPCA** in Table 2 of this fact sheet that the waste may reasonably be Lethal

Wastes which display no attributes may be considered non-Lethal.
Wastes which display one or more attributes may be Lethal and must be evaluated further.

*A 'drug' as specified in Table 1 above is considered by the MPCA to be a 'pharmaceutical' eligible for further evaluation for lethality under an approved Petition for the "*Alternate Method to Evaluate Pharmaceutical Waste for the Lethality Characteristic*" if you have such an approved Petition. For more information on the Alternate Method, see MPCA hazardous waste fact sheet #4.45b, *Alternate Method to Evaluate Pharmaceutical Waste for the Lethality Characteristic*, available at www.pca.state.mn.us/publications/w-hw4-45b.pdf

## Further evaluation for lethality

Further evaluation of a waste for the Lethality characteristic may include calculating the estimated $LD_{50}$ of the waste or applying specific and documented knowledge of materials and processes used in the generation of the waste. If you evaluate the waste further and can demonstrate that it does not meet the Lethality characteristic as identified in Minn. R. 7045.0131, Subp. 6, you may manage the waste as non-Lethality characteristic without further action on your part.

Note: A waste that is not hazardous due to the Lethality characteristic may be hazardous for other reasons. Always perform a complete evaluation.

## Calculating the estimated $LD_{50}$ of a waste

To calculate the estimated $LD_{50}$ of a waste, you must have the appropriate $LD_{50}$ data for all of the waste components that reasonably may produce a toxic effect. The $LD_{50}$ data you use must be for the correct exposure method and test animal. You may exclude ingredients that reasonably will not produce a harmful toxicological effect. If your reference material gives a range for the % concentration of an ingredient, you must use the maximum range value in your calculation.

Note: Ingredients identified as 'inert' on product labels, such as propellants, solvents, and carriers, may *not* be assumed to produce no harmful toxicological effect. Many product labels identify these ingredients as 'inert' only because they do not perform the main function of the product. However, many of these 'inert' ingredients, such as petroleum-based solvents, may have significant harmful toxicological effects and must be included in your $LD_{50}$ calculation.

To calculate the estimated $LD_{50}$ of the waste, use the following formula:

$$\frac{1}{T_W} = \frac{1}{100} \text{ X } \left( \frac{C_A}{T_A} + \frac{C_B}{T_B} + \frac{C_C}{T_C} \right)$$

$T_W = LD_{50}$ of the waste

$T_{A,B,...Z} = LD_{50}$ of ingredient A, B, ...Z in the waste

$C_{A,B,...Z}$ = % concentration of ingredient A, B, ...Z in the waste

Note: The total % concentrations of ingredients A, B, ...Z you use in your calculation may be less than 100% if the remainder of the waste will not produce a harmful toxicological effect.

## Applying specific knowledge to determine the lethality of a waste

As an alternative to calculating the estimated $LD_{50}$ of a waste, you may apply specific and documented knowledge of the materials and processes used in generating the waste. If the waste is an unaltered discarded product, you must determine whether the product would reasonably meet the Lethality characteristic when disposed of. Certifications or informed statements by a product manufacturer that a waste is "non-toxic" or "practically non-toxic" to humans or mammals may constitute knowledge that the waste is reasonably non-Lethal.

If you are able to locate some toxicological information but are unable to calculate the estimated $LD_{50}$ of the waste, you may still be able to use the available data to evaluate the waste for the Lethality characteristic. As an example, if the only $LD_{50}$ data you are able to locate is for an exposure method other than the one you are considering, or if the test animal is different than the required animal for the exposure method you are considering, you may apply accepted principles of biochemistry, toxicology, and physiology to the $LD_{50}$ data you do have to determine whether the waste would reasonably be Lethal.

Note: You may not use information that a product is certified for a specific use by a governmental agency, such as the U.S. Food and Drug Administration (FDA), U.S. Environmental Protection Agency (EPA) or other similar Federal or state agency, as evidence that the product is non-Lethal when disposed of unless the certified use by its nature and lack of limitation shows that the product would reasonably be non-Lethal. As an example, you may not use approval for limited medical use of a pharmaceutical by the FDA as evidence that the waste pharmaceutical is non-Lethal; however, the approval for unlimited food use of an additive would reasonably indicate the additive waste is non-Lethal.

## When sufficient information and knowledge are not available to determine lethality

When, after exercising due diligence, you are unable to locate sufficient information and knowledge to determine whether a waste displays the Lethality characteristic, you may either simply manage the waste as a Lethal hazardous waste or notify the MPCA in writing. The MPCA may require specific additional evaluation to reasonably determine whether the waste may be managed as non-Lethal.

## Specific published lethality information

Table 2 lists specific lethality information currently known to the MPCA for wastes which may not exhibit any of the other attributes from Table 1, with the approximate lethality threshold concentrations for the oral exposure method for each waste. This table does not list all known or potentially Lethal wastes, only those which the MPCA believes may otherwise not be identified and of which it has specific knowledge.

**Table 2: Specific known lethality information**

| Waste name | CAS registry number | Approximate lethality threshold concentration |
|---|---|---|
| Beryllium | 7440-41-7 | 2% |
| Formaldehyde | 50-00-0 | 20% |
| Glutaraldehyde | 111-30-8 | 27% |
| Perfluorobutanesulfonate (PFBS) | 29420-49-3 | 86% |
| Perfluorodecanoic acid (PFDA) | 335-76-2 | 11% |
| Perfluorooctanesulfonate (PFOS) | 1763-23-1 | 50% |
| Perfluorooctanesulfonylamide (FOSA or PFOSA) | 754-91-6 | 34% |
| Perfluorooctanoic acid (PFOA) | 3825-26-1 | 50% |

## More information

The MPCA, in cooperation with metropolitan county hazardous waste staff, Minnesota Technical Assistance Program (MnTAP) staff and other partners have developed guidance materials about the hazardous waste regulations available on MPCA's Web site at www.pca.state.mn.us/waste/pubs/business.html

The MPCA and your metropolitan county hazardous waste offices have staff that can help you. Contact your metropolitan county or the MPCA office nearest your facility at the numbers below. MnTAP staff can provide information and resources to help you reduce waste.

### Metro County Hazardous Waste Offices

Anoka County..... 763-422-7093
Carver County ..... 952-361-1800
Dakota County..... 952-891-7557
Hennepin County..... 612-348-3777
Ramsey County..... 651-266-1199
Scott County ..... 952-496-8475
Washington County ..... 651-430-6655
Web sites..…..... www.co.[county].mn.us

### Minnesota Pollution Control Agency

Toll free (all offices) ..... 1-800-657-3864
Brainerd.....218-828-2492
Detroit Lakes.....218-847-1519
Duluth..... 218-723-4660
Mankato..... 507-389-5977
Marshall..... 507-537-7146
Rochester.....507-285-7343
St. Paul ..... 651-296-6300
Willmar ..... 320-214-3786
Web site..... www.pca.state.mn.us

### Minnesota Technical Assistance Program

Toll-free..... 1-800-247-0015
Minneapolis.....612-624-1300
Web site ..... www.mntap.umn.edu

# Appendix I

# MPCA Guidance Document – Managing Sealants and Coatings Containing PCBs

# Managing Sealants and Coatings Containing PCBs

## Guidance for building owners and contractors

## What are PCBs?

Polychlorinated biphenyls (PCBs) are a class of 209 toxic man-made chemicals that persist in the environment and bioaccumulate in animals and humans. They were used extensively in many industrial products from the 1950's through 1978. During this period, PCBs were added to some sealants and coatings such as paint and caulking to make them more flexible and last longer. Exposure to PCBs can cause a range of human health effects and environmental impacts. For more information on other potentially PCB-containing materials and how to test for PCBs, visit the Minnesota Pollution Control Agency (MPCA) at http://www.pca.state.mn.us/publications/w-hw4-48a.pdf to view hazardous waste fact sheet #w-hw4-48a, Identifying, Using, and Managing PCBs.

## Where are sealants and coatings that may contain PCBs located?

PCBs were used as plasticizers in many industrial paints and are most commonly found in areas that required waterproof or high-impact coatings. Caulking commonly surrounds doors and windows and often was used in masonry work; it also may have been used in repairs throughout a structure. You will not be able to determine whether building materials contain PCBs by their appearance, brand, or manufacturer. Deliberate use of PCBs ended in 1978; you may assume structures or portions of structures built after 1979 do not have sealants or coatings deliberately containing PCBs.

## When are sealants and coatings that may contain PCBs regulated?

Sealants and coatings that may contain PCBs are not regulated by the MPCA when they are in good condition and will remain in place in part of a structure that will not be demolished or renovated. The U.S. Environmental Protection Agency (EPA), however, has raised concerns regarding indoor airborne exposure to building materials containing PCBs. For more information on PCB exposure and indoor air quality, see EPA Publication #EPA-747-F-09-005, *Preventing Exposure to PCBs in Caulking Material*, available from the EPA website at http://www.epa.gov.

Sealants and coatings that may contain PCBs become regulated by the MPCA as wastes when they are disposed of, either with a structure, such as during a full or partial building demolition, or after they are separated from the structure, such as during an abatement project. Different requirements apply to wastes in these two categories that potentially contain PCBs.

## Demolition debris that may contain PCBs

The MPCA will allow, without testing, disposal of demolition debris that may contain PCBs in sealants and coatings, including mastics, sealers, waxes, and manufactured rubber and plastic components in any solid waste landfill permitted by the MPCA or another state, including a demolition, municipal solid waste, and industrial solid waste landfill. Demolition debris contaminated by these wastes may also be disposed in a permitted landfill. However, landfill operators may refuse any waste regardless of MPCA allowances.

If the structure you will demolish or renovate is located in one of the Metropolitan Counties – Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, or Washington – contact your county to determine the county requirements applicable to debris from the structure.

**Note:** Before demolishing all or part of a structure, in addition to removing other problem materials, you must also remove all separable components that may contain PCBs, including fluorescent and high-intensity discharge (HID) lighting ballasts, motor start capacitors, and electrical transmission or distribution equipment, such as transformers. Manage these wastes as PCB hazardous wastes unless you document they do not contain PCBs at or above 50 parts per million (ppm).

For more information on problem materials that must be removed before demolishing all or part of a structure, visit the MPCA at http://www.pca.state.mn.us/publications/w-sw4-20.pdf to view MPCA solid waste fact checklist #w-sw4-20, Pre-Renovation/Demolition Environmental Checklist.

For guidance on managing lighting ballasts and capacitors once you have removed them, see MPCA hazardous waste fact sheet #w-hw4-48f, Managing PCBs in Ballasts and Small Capacitors at http://www.pca.state.mn.us/publications/w-hw4-48f.pdf.

You may reuse uncontaminated recognizable concrete and masonry demolition debris as a substitute for conventional aggregate without MPCA review. Reuse of any debris potentially contaminated with PCBs, including painted or oil-stained debris, must be approved on a case-by-case basis by the MPCA.

## Abatement waste and other separate wastes that may contain PCBs

Sealants or coating wastes from abatement work that may contain PCBs must be managed as a PCB hazardous waste in Minnesota unless you can document they contain less than 50 ppm PCBs. Abatement wastes include removed caulk materials, paint chips, and sandblasting debris. For information on storing and disposing of PCB hazardous waste generated in Minnesota, see MPCA hazardous waste fact sheets #w-hw4-48c, Storing PCBs, at http://www.pca.state.mn.us/publications/w-hw4-48c.pdf and #w-hw4-48d, Manifest and Dispose of PCBs, at http://www.pca.state.mn.us/publications/w-hw4-48d.pdf.

Report all PCB hazardous wastes you generate to the MPCA or your metropolitan county.

For more information on other requirements for performing sandblasting or other air-based blasting in Minnesota, see MPCA hazardous waste fact sheet #w-hw4-39a, Sandblasting and Other Air-based Blasting, at http://www.pca.state.mn.us/publications/w-hw4-39a.pdf. For more information on other requirements for performing hydroblasting or other water-based blasting in Minnesota, see MPCA hazardous waste fact sheet #w-hw4-39b, Powerwashing and Other Water-based Blasting, at http://www.pca.state.mn.us/publications/w-hw4-39b.pdf.

## Structures to be burned for live burn firefighter training

In Minnesota no structure may be burned except for live burn firefighter training. Do not burn any structure for firefighter training until you have collected at least one composite representative sample from each building material in the structure that may contain PCBs and have documented that they do not contain PCBs at 50 ppm or more.

**Note**: Live burn firefighter training in Minnesota must be conducted according to the *Live Fire Burn Training Procedures* manual prepared by the Minnesota State Colleges and University System and under a burn permit properly obtained from the Minnesota Department of Natural Resources (DNR). You may obtain a copy of the current manual from the DNR at http://www.dnr.state.mn.us/.

## More information

Guidance and requirements in this fact sheet were compiled from the Code of Federal Regulations, Chapter 40, Part 761, and Minnesota Rules, Chapters 7035 & 7045, and incorporates regulatory interpretation decisions made by the MPCA on February 28, 2013. Visit the U.S. Government Printing Office at http://www.gpo.gov/fdsys/ to review the Code of Federal Regulations directly. Visit the Office of the Revisor of Statutes at https://www.revisor.mn.gov/pubs to review the Minnesota Rules.

The MPCA and your Metropolitan County have staff available to answer waste management questions. For more information, contact your nearest MPCA regional staff.

### Metro County Hazardous Waste Offices

Anoka .....763-422-7093
Carver .....952-361-1800
Dakota .....952-891-7557
Hennepin .....612-348-3777
Ramsey .....651-266-1199
Scott.....952-496-8475
Washington.....651-430-6655
Websites ..... http://www.co.[county].mn.us

### Minnesota Pollution Control Agency

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Duluth .....218-723-4660
Mankato .....507-389-5977
Marshall .....507-537-7146
Rochester .....507-285-7343
St. Paul .....651-296-6300
Willmar .....320-214-3786
Website ..... http://www.pca.state.mn.us

# Appendix J

# MPCA Guidance Document – Guidelines-Disposal Methods for Water Filter Backwash Soilids

# Guidelines-Disposal Methods for Water Filter Backwash Solids

Water Quality/Wastewater Permits #2.02 • May 2007

Minnesota Pollution Control Agency

## Contents

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Steps for Landfilling ..... page 1
Steps for Using as Construction Fill page 1
Steps for Land Application .... page 2-4
Annual Report .. page 4
Contact Information..... page 4
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**WFB:**
Water Filter Backwash consists of both a liquid supernatant that contains dissolved and suspended solids, and a more solid sludge that has precipitated out of solution.

**WFBS**:
Water Filter Backwash Solids. These are the solids present following the backwash of water treatment media. This is considered a solid waste.

This fact sheet is intended to provide guidance for the proper disposal of water treatment backwash by-product.

## Background

Water filter backwash (WFB) is generated when potable water treatment plants treat their well water to reduce suspended and dissolved solids.

Sand filter systems pump well water into the top of a tank that is pressurized or gravity fed down through a porous (usually sand-rock) media. Periodically the filter media is backwashed to remove the entrained solids.

Water filter backwash is conveyed to wastewater treatment facilities (WWTF) or is slurried to smaller settling tanks or ponds. To reduce wastewater treatment costs some municipalities' route the supernatant to settling facilities and the sludge to a WWTF, or the other way around. WFB routed to a settling facility need to be periodically cleaned out. The frequency will depend on the size of the tank or pond; and the volume and concentration of solids in the effluent.

Options for managing WFB include slurrying the material to a WWTF, landfilling, using as non-residential construction fill, or land application. Before deciding to dispose of WFB at a WWTF, you should contact the WWTF to fully discuss this option including: (1) available capacity of the WWTF; and (2) potential need to submit a sanitary sewer extension (SSE) permit application.

As described in Minn. R. 7035.0300 subp. 100 water filter backwash solids (WFBS) are considered a solid waste. If the material is either landfilled or land applied, it must be tested and handled in accordance with this guidance document.

## Options for WFB/WFBS disposal:

1. **Wastewater Treatment Facility**
2. **Landfill**
3. **Construction Fill**
4. **Land Application**

## Steps for landfilling WFBS

1. The WFBS must pass the paint filter test (i.e. is a solid) to be accepted in a landfill.
2. Test and compare the material for the analytes and standards listed in the landfill's industrial solid waste management plan.
3. For unlined landfills radium 226 (Ra) concentrations cannot exceed 5 piC/g. For lined landfills Ra concentrations cannot exceed 30 piC/g. If radium in the WFBS exceeds 30 piC/g options for its disposal must be arranged with the Minnesota Department of Health's Radiation Section.
4. If the test results are in alignment with the landfill's industrial solid waste management plan, the WFBS may be taken to a MPCA permitted landfill.



Minnesota Pollution Control Agency • 520 Lafayette Rd. N., St. Paul, MN 55155-4194 • www.pca.state.mn.us
651-296-6300 • 800-657-3864 • TTY 651-282-5332 or 800-657-3864 • Available in alternative formats

## Steps for using WFBS as construction fill

1. Test the material for the analytes listed in Table 1.
2. Using the analytical results, and formulas provided, determine whether the cumulative land applications limits listed in Table 1 are met.

If the results are below the limits in Table 1, the material may be used as fill for non-residential projects.

## Steps for land applying WFB

1. Test the material for the analytes listed in Table 1.
2. Using the analytical results, and formulas provided, determine whether the cumulative land applications limits listed in Table 1 are met.
3. Determine the suitability of your site for land application using Tables 2-4.
4. Send in written notification to the county solid waste officer, and either the township clerk or city mayor, which ever is applicable, to provide local officials an opportunity to comment on the proposed application site.
5. Land apply the WFB in accordance with these guidelines.
6. Keep adequate records for future use.

### Testing water filter backwash

Each time the WFB is to be land applied, a representative sample of the WFB must be collected in a way that provides a sample of the material which is actually land applied. For WFB this requires that an adequate number of subsamples be collected and composited into a single sample. The sample is then sent to a certified laboratory for testing. In addition to the parameters listed in Table 1, any chemical additives present in the WFB must also be analyzed. The results of these tests will be used to calculate the acceptable application rates for the by-product.

**Table 1**
**Analytic parameters and cumulative limits for WFB**

| Parameter (Totals in mg/kg) | Cumulative Limits for land application |
|---|---|
| Radium 226 | 4.5 (milliCi/acre) |
| Arsenic | 37 lb/acre |
| Barium | No Limit Established |
| Cadmium | No Limit Established |
| Copper | No Limit Established |
| Lead | No Limit Established |
| Manganese | No Limit Established |
| Mercury | No Limit Established |
| Molybdenum | No Limit Established |
| Nickel | No Limit Established |
| Selenium | No Limit Established |
| Zinc | No Limit Established |
| % percent solids | No Limit Established |

If you have questions about what to test for, please contact the MPCA. If you have questions about sampling procedures, please contact your lab.

### Formulas used to determine cumulative limits:

**Maximum Application Rates Based on Radium and Arsenic:**

Max. application = 37 lb/acre ÷ (arsenic conc. x 0.002)
Based on arsenic (mg/kg)

Max. application = 4.5 milliCi/ac ÷ (radium 226 conc. x 0.0009)
Based on radium 226 (pCi/g)

*** The maximum allowable WTB application is the lesser of the two results above minus any amount applied to the site from previous applications.**

Actual Arsenic Loading rate (lbs/acre) = Arsenic Concentration (mg/kg) x Actual application rate of solids (dry tons/acre) x 0.002

Actual Ra-226 Loading rate (milliCi/acre) = Ra-226 Concentration (pCi/g) x Actual application rate of solids (dry tons/acre) x 0.0009

Solids Applied (dry tons/acre) = gal/acre x % total solids ÷ 240 Applied (as a decimal fraction)

Solids Applied (dry tons/acre) = Wet tons/acre x % total solids Applied (as a decimal fraction)

### Site suitability criteria

All criteria in this section, including slope restrictions, site suitability criteria, and separation distances as provided in the following tables must be met for a site to be suitable for land application.

**Table 2**
**Slope restrictions for application sites**

| Slope (percent) | Injection or Immediate Incorporation |
|---|---|
| 0-12 | Allowed |
| >12 | Not Allowed |

**Table 3**
**Soil Suitability Criteria**

| Characteristic | Minimum Requirement [1] |
|---|---|
| Soil texture at the zone of by-product application | fine sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, sandy clay, silty clay loam, silty clay, or clay |
| Depth to bedrock | 3 feet |
| Depth to seasonal high water table[2] | 3 feet |

[1] This information can be determined by obtaining information from soil surveys published by the Natural Resources Conservation Service or by characterization of the site by a state of Minnesota licensed soil scientist or other qualified individual.

### Site Selection and Use

It is recommended that a Type IV certified operator determine the suitability of each site for application and be responsible for properly land spreading the WFB. The site selection process should also include the following steps:

1. Determine that the soils located on the site meet all site suitability criteria;
2. If the site has received WTB in the past, determine the amount of pollutant that can be applied to the site. This is done by subtracting the cumulative amount of pollutant applied to the site from previous application from the cumulative pollutant limit in Table 1.

Provide written notification to the county solid waste officer, and either the township clerk or city mayor (depending on the location of the site). Notifications must include a description of the WFB, and how the WFB will be land applied including any staging or storage that will occur prior to land application.

### Miscellaneous management practices/restrictions

1. WFB must be incorporated or injected within 48 hours;
2. Application of WFB is not allowed on areas of a site ponded with water or liquid;
3. No runoff of the WFB from the application site is allowed;
4. No significant surface ponding of liquid WFB is allowed after 6 hours of the application;
5. All WFB which are land applied must be uniformly distributed over the area of the site used during application; and
6. Wind-blown WFB is not allowed.

### Record keeping requirements

1. A map which identifies the exact site location and year of application;
2. Testing results and application rates;
3. The crop of vegetation grown on the site;
4. Daily hauling records which indicate quantities transferred to storage or land applied with the storage or site location identified;
5. The cumulative quantity of pollutant applied to the site from all applications of WTB;
6. A cumulative total of the quantity of material applied on each site for the cropping year;
7. A copy of written information provided to each end user of the WFB, this includes any test results;
8. A copy of notification letters submitted to each city, county, and township.

**Table 4**
**Minimum separation distances from land application sites**

| Feature | Incorporated or Injected With 48 Hours | |
|---|---|---|
| Private drinking water supply wells | 200 ft. | |
| Public drinking water supply Wells | 1000 ft. | |
| Lakes, rivers, streams, ditches, wetlands, intermittent streams, or tile inlets connected to these surface water features[1] | slope 0%-6%<br>slope 6%-12% | 50 ft.<br>100 ft |
| Grassed Water Ways[2] | 33 ft. | |

[1] Intermittent stream means a drainage channel with definable banks that provides for runoff flow to any of the surface waters listed in the above table during snow melt or rainfall events.
[2] Grassed waterways are natural or constructed and seeded to grass as protection against erosion. Separation distances are from the centerline of grassed waterways. For a grassed waterway which is wider than the separation distances required, application is allowed to the edge of the grass strip.

## Annual report

An annual report is only required for those facilities with a surface or subsurface discharge permitted by the MPCA.

A report of all water filter backwash solids disposal activities for the past cropping year must be submitted by December 31 of each year on the Annual Report Form. An electronic version of this form is available at the following address: http://www.pca.state.mn.us. The annual report must include the following information:

1. Method of disposal;
2. Total quantity disposed; and
3. Location of disposal; and
4. Analytical results.
5. Cumulative amount of arsenic and Radium-226 pollutant applied to the application site.

## For assistance you may contact

For further assistance, contact the MPCA Customer Assistance Center at 651-297-2274, or 800-646-6247.

## Terms/Definitions

***Cropping Year*** means a year beginning on September 1 of the year prior to the growing season and ending August 31 the year the crop is harvested. For example, the 1994 cropping year began September 1, 1993 and ended August 31, 1994.

***End User*** means the person that has accepted the IBP for their use as a soil amendment.

***Immediately Incorporated*** means incorporated into the soil with tillage within 48 hours after surface application of an IBP.

***Industrial By-product (IBP***) has the same meaning as "solid waste" given in Minnesota Rules part 703 5.0300.

***Type IV Certified Operator or Inspector*** means a person certified according to Minnesota Rules chapter 7048 for land application.

***Wetlands*** generally include swamps, marshes, bogs, and similar areas. Wetlands must have the following attributes: (1) a predominance of hydric soils; (2) inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of hydrophytic vegetation typically adapted for life in a saturated soil condition; and (3) under normal circumstances support a prevalence of such vegetation.

# Appendix K

# Treated Seed Disposal

# TREATED SEED DISPOSAL

## Background

Treated seeds are seeds, including grain, forage, oil-plant, and vegetable seeds, that have been treated with pesticides or fungicides. Treated seeds can usually be identified by their distinctive color. Federal law requires that a distinctive color be applied to seeds that are treated and sold. Treated seeds that will not be used by planting are considered industrial solid wastes in Minnesota.

## Disposal requirements

The MPCA considers waste treated seed and packaging to be an industrial solid waste with no need for further hazardous waste evaluation by the generator, landfill, or WTE incineration facility. In accordance with Minnesota Rules and MPCA Guidance Documents, operators will manage these wastes with the following considerations:

- Gas generation. Waste treated seed may present a fermentation and methane gas generation risk. Landfill operators must determine on a project-by-project basis what prospective volume of waste treated seed and potential resulting gas generation the landfill can safely accept on a per-load or per-day basis.
- Stability and settlement. Landfill operators must determine when thin-spreading of waste treated seed over the active disposal area or incorporation into other received waste may be needed to maintain slope stability and minimize localized settlement.
- Daily cover. To prevent wildlife foraging and exposure, waste treated seed of any volume must be immediately covered.

# Treated seeds

Treated seeds are seeds, including grain, forage, oil-plant, and vegetable seeds, that have been treated with pesticides or fungicides. Treated seeds can usually be identified by their distinctive color. Federal law requires that a distinctive color be applied to seeds that are treated and sold.

## Treated seeds that will be used by planting

Treated seed that will be used must be planted according to the label directions on the treated seed packaging. Depending on the label directions, planting may be allowed for crop production, wildlife habitat, or erosion or weather protection. There may also be restrictions on planting rate and depth.

## Treated seeds that will not be used by planting

While the Minnesota Department of Agriculture (MDA) and the U.S. Environmental Protection Agency (EPA) regulate the pesticides and fungicides that are used to treat seeds, treated seeds themselves are exempt from these requirements. Instead, management of treated seeds that will not be used by planting is regulated by the Minnesota Pollution Control Agency (MPCA).

Treated seeds that will not be used by planting are considered industrial solid wastes in Minnesota. Because of the risk of concentrating the chemicals they are treated with, waste treated seeds in Minnesota may not be:

- Buried for disposal, except in a permitted solid waste landfill, even if burial is stated as a disposal option on the treated seed label, except that farmers in Minnesota may bury treated seeds from their own farm on the farm property. Spreading and incorporation into soil, except by a farmer of their own treated seeds on their own farm, is considered being buried for disposal and is not allowed.
- Composted.
- Burned, except in a permitted Waste-To-Energy (WTE) incineration facility. Waste treated seed may not be burned openly, in corn or wood stoves, or in residential or commercial boilers, including by farmers.
- Used for ethanol, biodiesel, or other fermentation or oil processing, unless specifically approved by the MPCA. Though some treated seed labels still list ethanol production as a management option if no measurable residues of pesticides remain in resulting by-products used in agronomic practice, the MPCA is not aware of any currently available use that does not raise this risk.

## Packaging and equipment

Disposable packaging from treated seed, such as bags, is also considered a regulated solid waste in Minnesota, and may not be buried or burned except in permitted facilities. Farmers who do not need to dispose of any treated seeds may dispose of treated seed bags with their normal solid waste, but may not burn any plastic.

Reusable packaging, such as totes and cartons, may be reused with or without rinsing for the same product. When washing equipment, such as seed treatment equipment, planting equipment, or reusable packaging, the MPCA recommends using only the minimum amount of rinsewater necessary.

Rinsewater may be discharged to a publicly owned treatment works, commonly known as a sewage treatment plant, after notifying the works operator and following any conditions or restrictions they apply. Rinsewater may also be applied at label rates to a crop for which the active ingredients in the seed treatment are registered. Rinsewater may not be allowed to discharge to uncropped ground, surface water, or septic systems.

## Arranging for proper disposal

Manufacturers, distributors, retailers, farmers, and any other person generating waste treated seed and packaging, called the waste *generators*, are responsible for arranging for proper disposal of their waste. The MPCA considers waste treated seed and packaging to be an industrial solid waste with no need for further hazardous waste evaluation by the generator, landfill, or WTE incineration facility.

You may find a list of Minnesota landfills in MPCA fact sheet #w-sw6-04, Minnesota landfills accepting mixed municipal solid waste, at: https://www.pca.state.mn.us/sites/default/files/w-sw6-04.pdf.

You may find a list of permitted Minnesota WTE incineration facilities on the website of the Minnesota Resource Recovery Association (MRRA), at: http://mnresourcerecovery.com/.

Many of these landfills and WTE facilities may accept industrial solid waste treated seed, however **generators must contact the landfill or WTE facility first to ensure that they will agree to accept waste treated seeds and can safely manage this waste stream**.

## Management in landfills

If not already explicitly included, treated seeds must be addressed in a revision to a landfill's Industrial Solid Waste Management Plan. The revised plan must be reviewed and approved by the MPCA before a landfill may receive this waste stream. Revisions for treated seeds must include:

- Gas generation. Waste treated seed may present a fermentation and methane gas generation risk. Landfill operators must determine what prospective volume of waste treated seed and potential resulting gas generation the landfill can safely accept on a per-load or per-day basis.
- Stability and settlement. Landfill operators must determine when thin-spreading of waste treated seed over the active disposal area or incorporation into other received waste may be needed to maintain slope stability and minimize localized settlement.
- Daily cover. To prevent wildlife foraging and exposure, waste treated seed of any volume must be immediately covered.

Some landfills may also be required to additionally obtain county approval to receive waste treated seed, depending on location.

## More information

Guidance and requirements in this fact sheet were compiled from Minnesota Rules, Chapters 7035 and 7045, and incorporate regulatory interpretation decisions made by the MPCA on January 12, 2022. To review Minnesota Rules, visit the Office of the Revisor of Statutes at: https://www.revisor.mn.gov/pubs.

The MPCA's Small Business Environmental Assistance Program can offer free, confidential compliance assistance. For information about waste minimization, contact the Minnesota Technical Assistance Program.

Immediately report all spills that may damage the environment to the Minnesota Duty Officer.

**Minnesota Pollution Control Agency**

Toll free (all offices) ..... 1-800-657-3864
All offices ..... 651-296-6300
..... https://www.pca.state.mn.us/

**Small Business Environmental Assistance Program**

Toll free ..... 1-800-657-3938
Metro ..... 651-282-6143
..... https://www.pca.state.mn.us/sbeap/

**Minnesota Technical Assistance Program**

Toll free ..... 1-800-247-0015
Metro ..... 612-624-1300
..... http://www.mntap.umn.edu

**Minnesota Duty Officer**

Toll free ..... 1-800-422-0798
Metro ..... 651-649-5451

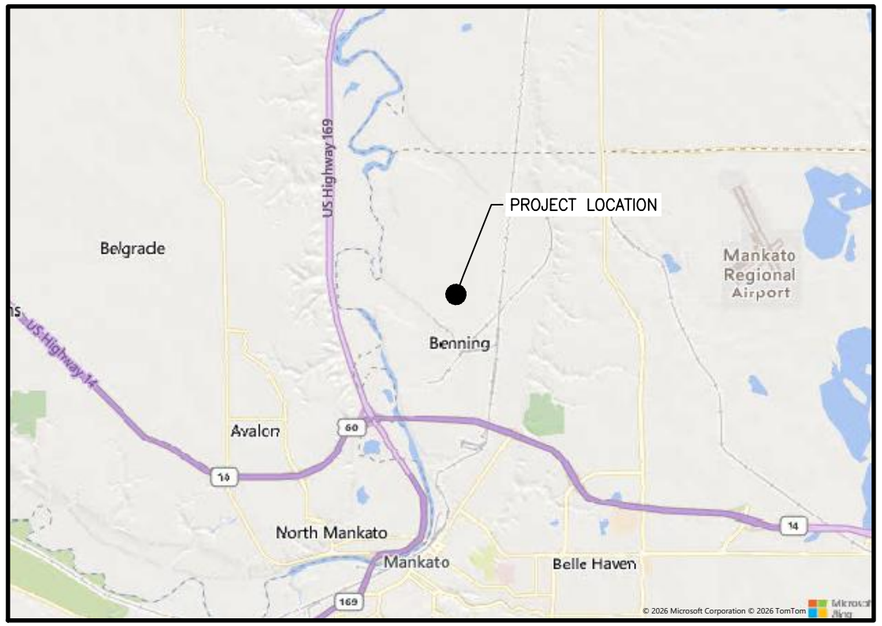
# Appendix B Permit Drawings

Plot Date & Time: 21 April 2026 1:29 PM

# 2026 PERMIT REISSUANCE & MODIFICATION APPLICATION

## PREPARED FOR
## DEM-CON PILGRIM LANDFILL, LLC.
## MANKATO, MINNESOTA

APRIL 2026




DEM-CON PILGRIM LANDFILL
VICINITY MAP

N

0 5,000 10,000
GRAPHIC SCALE IN FEET




DEM-CON PILGRIM LANDFILL
PROJECT LOCATION MAP

N

0 500 1,000
GRAPHIC SCALE IN FEET

INDEX OF SHEETS


| | |
|---|---|
| G-101 | COVER AND INDEX SHEET |
| C-101 | EXISTING CONDITIONS |
| C-102 | BASE GRADING PLAN |
| C-103 | LEACHATE MANAGEMENT PLAN |
| C-104 | INTERIM FILL PLAN |
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| D-105 | LEACHATE COLLECTION DETAILS |
| D-106 | FINAL COVER DETAILS |


| REV | REVISION DESCRIPTION | DWN | APP | REV DATE |
|---|---|---|---|---|
| 0 | ISSUED FOR PERMIT APPLICATION | JJT | EDK | 04/24/26 |

SEAL

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINT NAME ETHAN KETELSEN

SIGNATURE

DATE 04-24-2026 LICENSE # 56630

PRIME CONSULTANT

Stantec

PROJECT TITLE
2026 PERMIT REISSUANCE & MODIFICATION APPLICATION

DEM-CON PILGRIM LANDFILL, LLC.

MANKATO, MINNESOTA

SHEET TITLE
COVER AND INDEX SHEET

| DWN BY | CHK'D | APP'D | DWG DATE |
|---|---|---|---|
| JJT | BWS | EDK | APR. 2026 |

SCALE AS SHOWN

| PROJECT NO. | SHEET NO. | REV NO. |
|---|---|---|
| 227708930 | G-101 | 0 |

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Plot Date & Time: 21 April 2026 3:39 PM




N

0 150 300
GRAPHIC SCALE IN FEET

- PROPERTY BOUNDARY (SURVEYED)
- PROPERTY BOUNDARY (BEACON/GIS)
- PERMITTED WASTE LIMITS
- EXISTING PHASE BOUNDARY
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING WETLAND AREA
- EXISTING ROAD EDGE
- MW-1 EXISTING MONITORING WELL

SURVEY NOTES:

1. HORIZONTAL DATUM IS BLUE EARTH COUNTY NORTH AMERICAN DATUM NAD83(2011), US SURVEY FEET,
2. VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 88 (NAVD88). CONTOUR INTERVAL IS TWO FEET.
3. TOPOGRAPHY SURVEY AND AERIAL FROM 2023 LIDAR DATA, UPDATED VIA GROUND SURVEY BY BOLTON AND MENK IN DECEMBER 2025.

| REV | REVISION DESCRIPTION | DWN | APP | REV DATE |
|---|---|---|---|---|
| 0 | ISSUED FOR PERMIT APPLICATION | JJT | EDK | 04/24/26 |

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I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINT NAME ETHAN KETELSEN

SIGNATURE

DATE 04-24-2026 LICENSE # 56630

PRIME CONSULTANT

Stantec

PROJECT TITLE
2026 PERMIT REISSUANCE & MODIFICATION APPLICATION

DEM-CON PILGRIM LANDFILL, LLC.

MANKATO, MINNESOTA

SHEET TITLE
EXISTING CONDITIONS

| DWN BY | CHK'D | APP'D | DWG DATE |
|---|---|---|---|
| JJT | BWS | EDK | APR. 2026 |

SCALE AS SHOWN

PROJECT NO. 227708930

SHEET NO. C-101

REV NO. 0

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Plot Date & Time: 22 April 2026 3:35 PM

PROPOSED BASE LINER SYSTEM SEE DETAIL 3 D-103

PROPOSED BASE LINER ANCHOR TRENCH SEE DETAIL 4 D-103

PROPOSED 1-FOOT TALL, 3:1 SLOPE CELL TRANSITION SEE DETAIL ON SHEET C-102

PROPOSED DD002 DISPOSAL AREA

PROPOSED DD001 DISPOSAL AREA

PHASE 1A1

PHASE 1A2

PHASE 1A3

PHASE 2A

PHASE 2B

PHASE 2C

PHASE 2C-2

PHASE 2C-3

PHASE 2C-4

PHASE 3A (FUTURE)

PHASE 3B (FUTURE)

PHASE 3C (FUTURE)

PHASE 4A (FUTURE)

PHASE 4B (FUTURE)

PHASE 5A (FUTURE)

PHASE 5B (FUTURE)

PHASE 5C (FUTURE)

PROPERTY BOUNDARY

0 150 300

GRAPHIC SCALE IN FEET

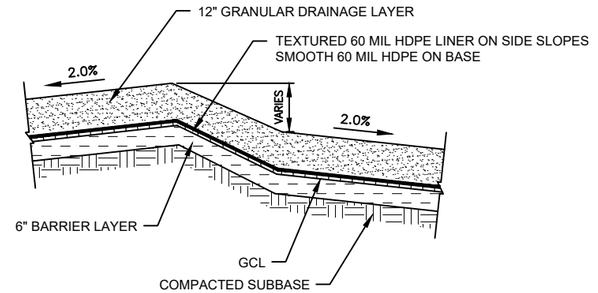
- PROPERTY BOUNDARY (SURVEYED)
- PROPERTY BOUNDARY (BEACON/GIS)
- PERMITTED WASTE LIMITS
- EXISTING PHASE BOUNDARY
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING WETLAND AREA
- PROPOSED PHASE BOUNDARY
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED OVERLINER AREA

SURVEY NOTES:

1. HORIZONTAL DATUM IS BLUE EARTH COUNTY NORTH AMERICAN DATUM NAD83(2011), US SURVEY FEET,
2. VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 88 (NAVD88). CONTOUR INTERVAL IS TWO FEET.
3. TOPOGRAPHY SURVEY FROM 2023 LIDAR DATA, UPDATED VIA GROUND SURVEY BY BOLTON AND MENK IN DECEMBER 2025.

NOTES:

1. PROPOSED GRADES SHOWN ARE TOP OF HDPE LINER GRADES.
2. BASE GRADES ARE DESIGNED A MINIMUM 5-FEET ABOVE HISTORICAL HIGH GROUNDWATER ELEVATIONS.




CELL FLOOR TRANSITIONAL OFFSET DETAIL

| REV | REVISION DESCRIPTION | DWN | APP | REV DATE |
|---|---|---|---|---|
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PRINT NAME ETHAN KETELSEN

SIGNATURE

DATE 04-24-2026 LICENSE # 56630

PRIME CONSULTANT

Stantec

PROJECT TITLE
2026 PERMIT REISSUANCE & MODIFICATION APPLICATION

DEM-CON PILGRIM LANDFILL, LLC.

MANKATO, MINNESOTA

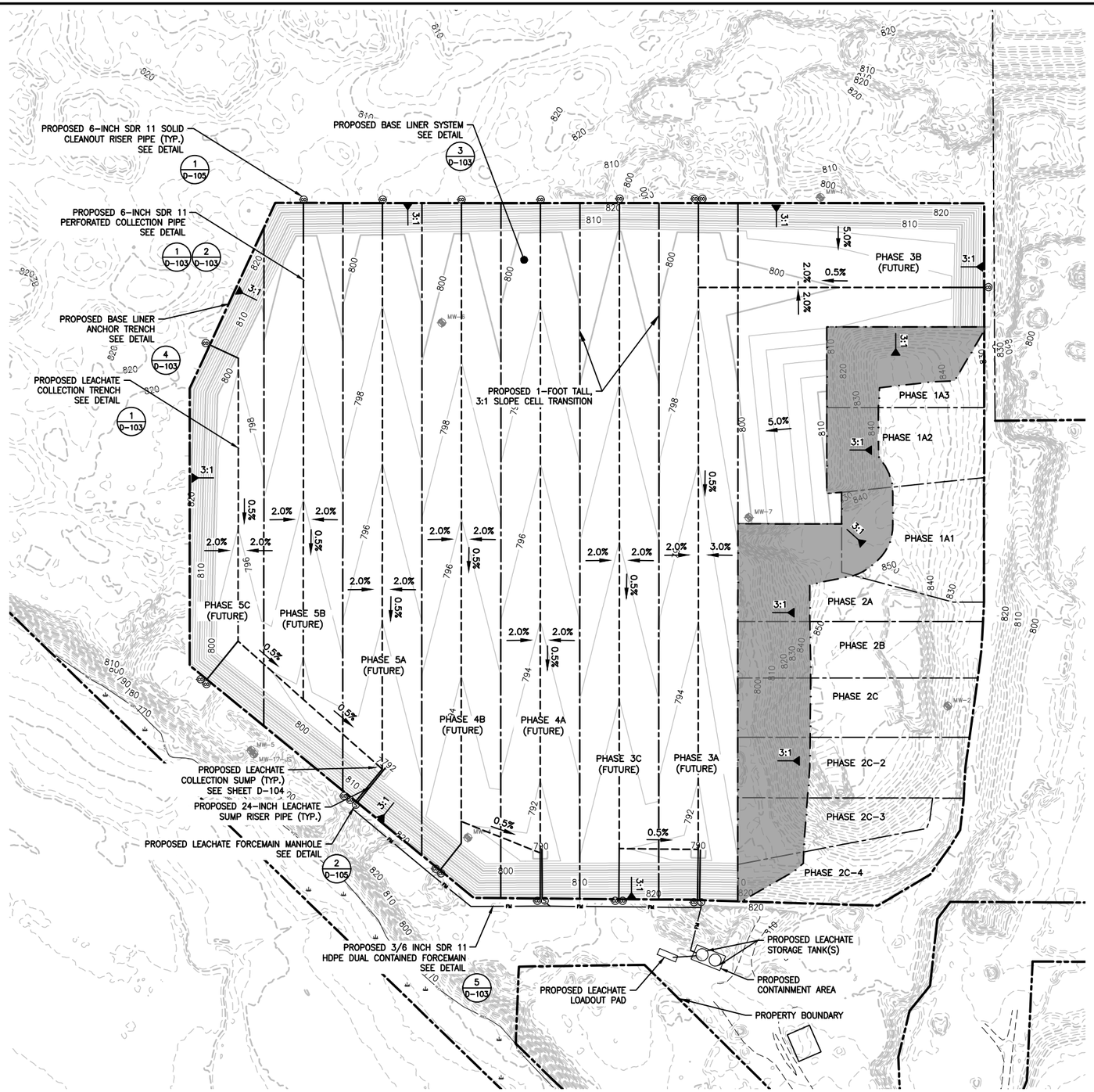
SHEET TITLE
BASE GRADING PLAN

| DWN BY | CHK'D | APP'D | DWG DATE | APR. 2026 |
|---|---|---|---|---|
| JJT | BWS | EDK | SCALE | AS SHOWN |

| PROJECT NO. | SHEET NO. | REV NO. |
|---|---|---|
| 227708930 | C-102 | 0 |

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Plot Date & Time: 22 April 2026 9:46 AM

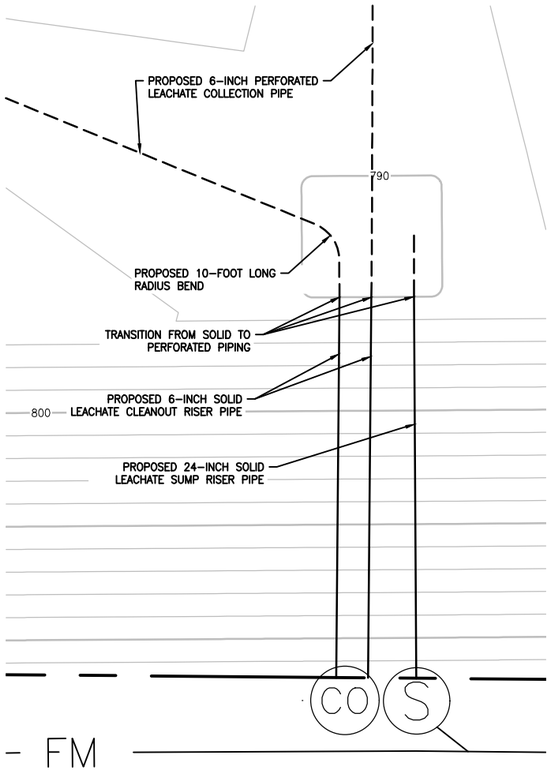



SURVEY NOTES:

1. HORIZONTAL DATUM IS BLUE EARTH COUNTY NORTH AMERICAN DATUM NAD83(2011), US SURVEY FEET,
2. VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 88 (NAVD88). CONTOUR INTERVAL IS TWO FEET.
3. TOPOGRAPHY SURVEY FROM 2023 LIDAR DATA, UPDATED VIA GROUND SURVEY BY BOLTON AND MENK IN DECEMBER 2025.

NOTE:

1. THE PROPOSED LIMIT OF THE OVERLAY LINER IS APPROXIMATE. THE ACTUAL LIMIT OF OVERLAY LINER WILL BE CONFIRMED FOLLOWING THE EXISTING DEMO WASTE RELOCATION AND BEFORE OVERLAY LINER INSTALLATION.




TYPICAL LEACHATE SUMP PIPING PLAN

0 20 40
GRAPHIC SCALE IN FEET

| REV | REVISION DESCRIPTION | DWN | APP | REV DATE |
|---|---|---|---|---|
| 0 | ISSUED FOR PERMIT APPLICATION | JJT | EDK | 04/24/26 |

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Stantec

PROJECT TITLE
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DEM-CON PILGRIM LANDFILL, LLC.

MANKATO, MINNESOTA

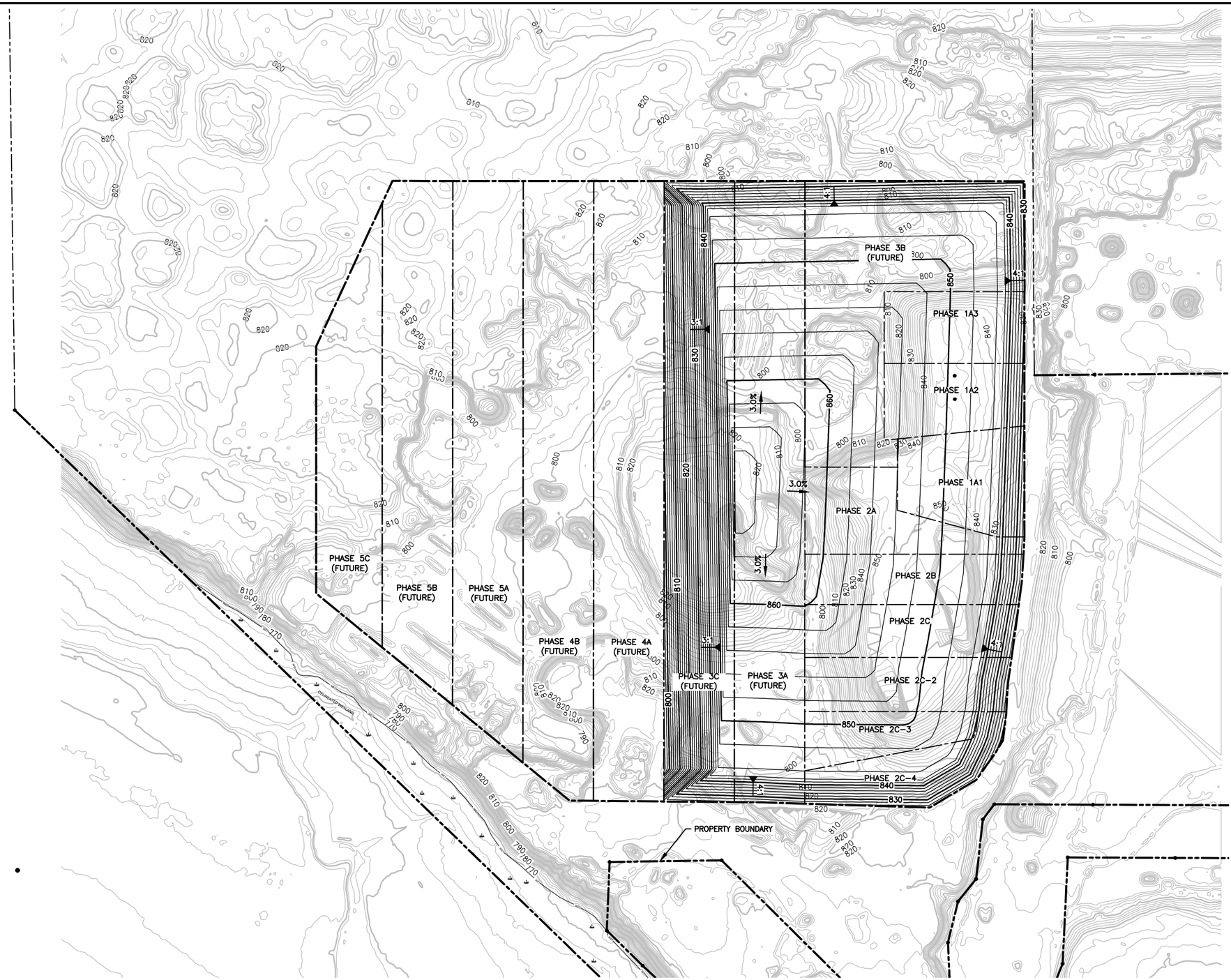
SHEET TITLE
LEACHATE MANAGEMENT PLAN

| DWN BY | CHK'D | APP'D | DWG DATE | APR. 2026 |
|---|---|---|---|---|
| JJT | BWS | EDK | SCALE | AS SHOWN |

| PROJECT NO. | SHEET NO. | REV NO. |
|---|---|---|
| 227708930 | C-103 | 0 |

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Plot Date & Time: 21 April 2026 5:24 PM




N

0 150 300
GRAPHIC SCALE IN FEET

- PROPERTY BOUNDARY (SURVEYED)
- PROPERTY BOUNDARY (BEACON/GIS)
- PERMITTED WASTE LIMITS
- EXISTING PHASE BOUNDARY
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING WETLAND AREA
- PROPOSED PHASE BOUNDARY
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR

SURVEY NOTES:

1. HORIZONTAL DATUM IS BLUE EARTH COUNTY NORTH AMERICAN DATUM NAD83(2011), US SURVEY FEET,
2. VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 88 (NAVD88). CONTOUR INTERVAL IS TWO FEET.
3. TOPOGRAPHY SURVEY FROM 2023 LIDAR DATA, UPDATED VIA GROUND SURVEY BY BOLTON AND MENK IN DECEMBER 2025.

NOTES:

1. PROPOSED GRADES SHOWN ARE TO BE TOP OF WASTE GRADES.

| REV | REVISION DESCRIPTION | DWN | APP | REV DATE |
|---|---|---|---|---|
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SIGNATURE

DATE 04-24-2026 LICENSE # 56630

PRIME CONSULTANT

Stantec

PROJECT TITLE
2026 PERMIT REISSUANCE & MODIFICATION APPLICATION

DEM-CON PILGRIM LANDFILL, LLC.

MANKATO, MINNESOTA

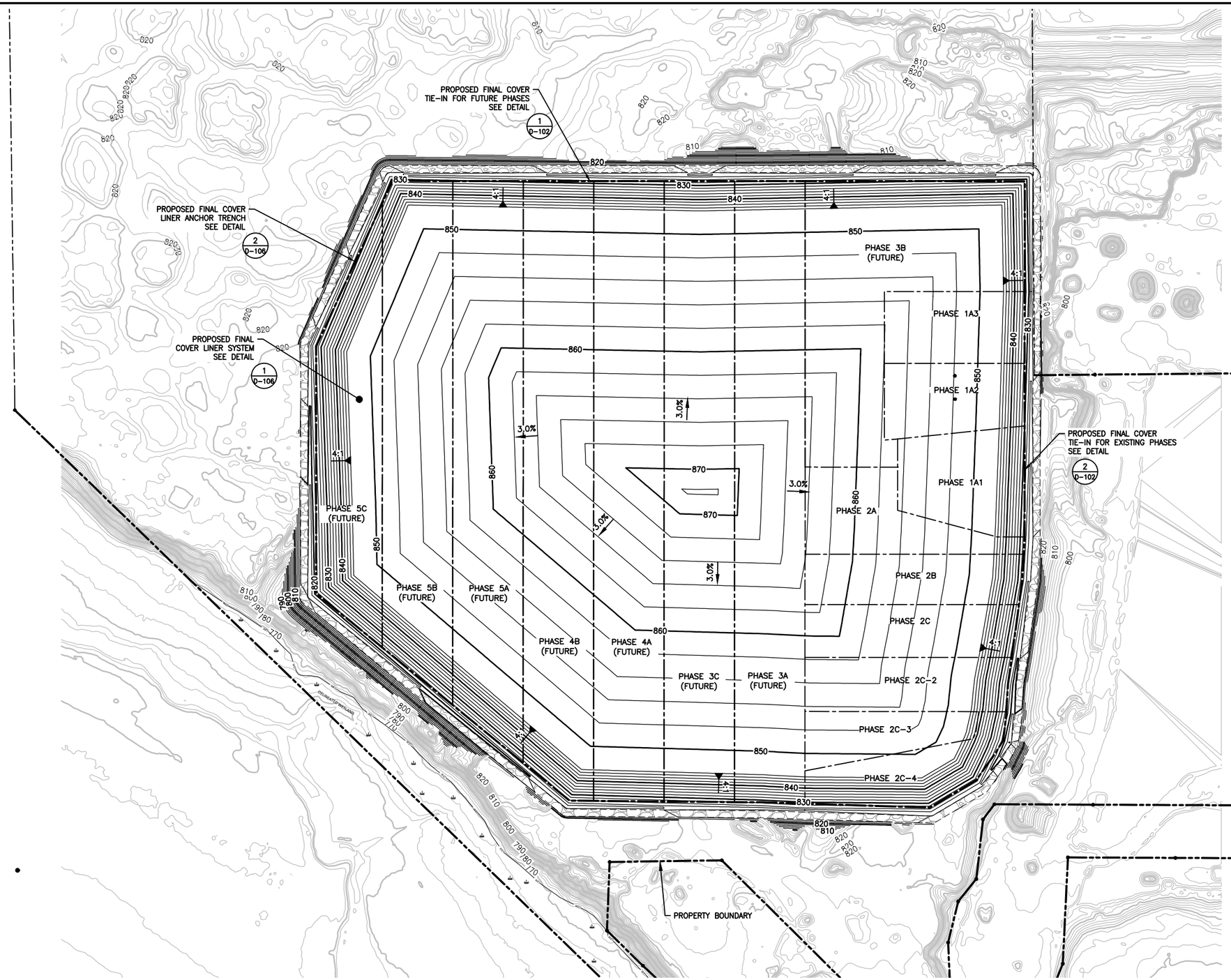
SHEET TITLE
INTERIM FILL PLAN

| DWN BY | CHK'D | APP'D | DWG DATE |
|---|---|---|---|
| JJT | BWS | EDK | APR. 2026 |

SCALE AS SHOWN

| PROJECT NO. | SHEET NO. | REV NO. |
|---|---|---|
| 227708930 | C-104 | 0 |

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SURVEY NOTES:

1. HORIZONTAL DATUM IS BLUE EARTH COUNTY NORTH AMERICAN DATUM NAD83(2011), US SURVEY FEET,
2. VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 88 (NAVD88). CONTOUR INTERVAL IS TWO FEET.
3. TOPOGRAPHY SURVEY FROM 2023 LIDAR DATA, UPDATED VIA GROUND SURVEY BY BOLTON AND MENK IN DECEMBER 2025.

NOTES:

1. PROPOSED GRADES SHOWN ARE TOP OF FINAL COVER GRADES.

| REV | REVISION DESCRIPTION | DWN | APP | REV DATE |
|---|---|---|---|---|
| 0 | ISSUED FOR PERMIT APPLICATION | JJT | EDK | 04/24/26 |

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PRIME CONSULTANT

Stantec

PROJECT TITLE
2026 PERMIT REISSUANCE & MODIFICATION APPLICATION

DEM-CON PILGRIM LANDFILL, LLC.

MANKATO, MINNESOTA

SHEET TITLE
FINAL COVER GRADING PLAN

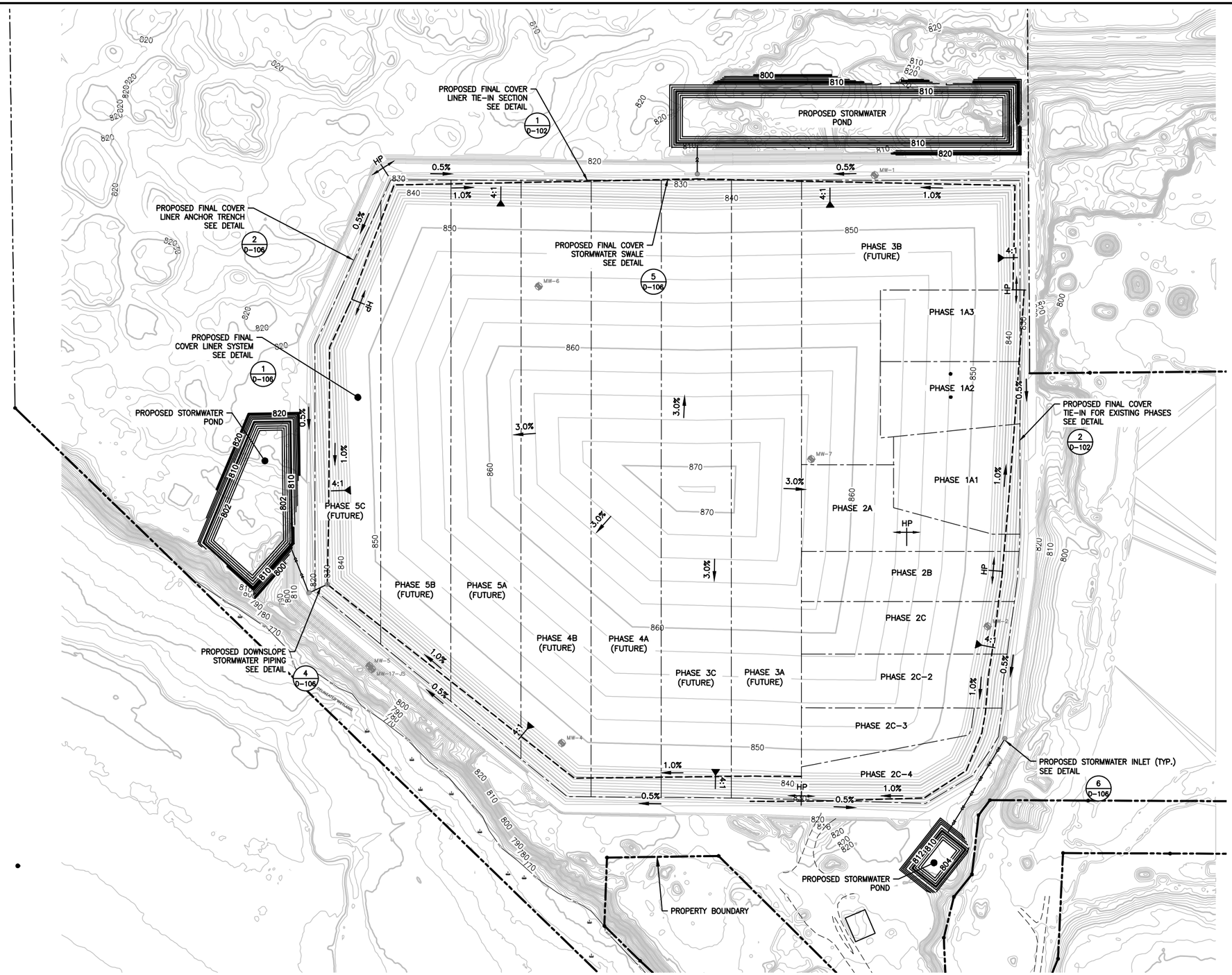
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| JJT | BWS | EDK | SCALE | AS SHOWN |

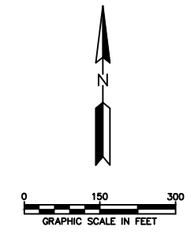
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|---|---|---|
| 227708930 | C-105 | 0 |

Plot Date & Time: 21 April 2026 5:38 PM

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Plot Date & Time: 21 April 2026 3:26 PM




- PROPERTY BOUNDARY (SURVEYED)
- PROPERTY BOUNDARY (BEACON/GIS)
- PERMITTED WASTE LIMITS
- EXISTING PHASE BOUNDARY
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING WETLAND AREA
- PROPOSED PHASE BOUNDARY
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED STORMWATER SWALE
- PROPOSED STORMWATER PIPE
- PROPOSED STORMWATER INLET

SURVEY NOTES:

1. HORIZONTAL DATUM IS BLUE EARTH COUNTY NORTH AMERICAN DATUM NAD83(2011), US SURVEY FEET,
2. VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 88 (NAVD88). CONTOUR INTERVAL IS TWO FEET.
3. TOPOGRAPHY SURVEY FROM 2023 LIDAR DATA, UPDATED VIA GROUND SURVEY BY BOLTON AND MENK IN DECEMBER 2025.

NOTES:

1. PROPOSED GRADES SHOWN ARE TOP OF FINAL COVER GRADES.
2. PROPOSED STORMWATER POND GRADING IS INTENDED TO SHOW STORAGE, FINAL POND GRADING MAY VARY AT TIME OF CONSTRUCTION.

| REV | REVISION DESCRIPTION | DWN | APP | REV DATE |
|---|---|---|---|---|
| 0 | ISSUED FOR PERMIT APPLICATION | JJT | EDK | 04/24/26 |

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PRIME CONSULTANT

Stantec

PROJECT TITLE
2026 PERMIT REISSUANCE & MODIFICATION APPLICATION

DEM-CON PILGRIM LANDFILL, LLC.

MANKATO, MINNESOTA

SHEET TITLE
SURFACE WATER MANAGEMENT PLAN

| DWN BY | CHK'D | APP'D | DWG DATE |
|---|---|---|---|
| JJT | BWS | EDK | APR. 2026 |

SCALE AS SHOWN

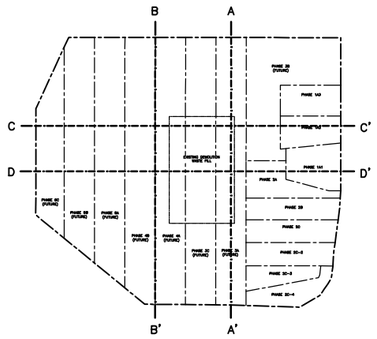
PROJECT NO. 227708930

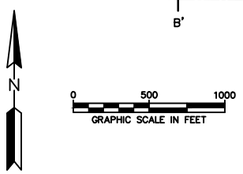
SHEET NO. C-106

REV NO. 0

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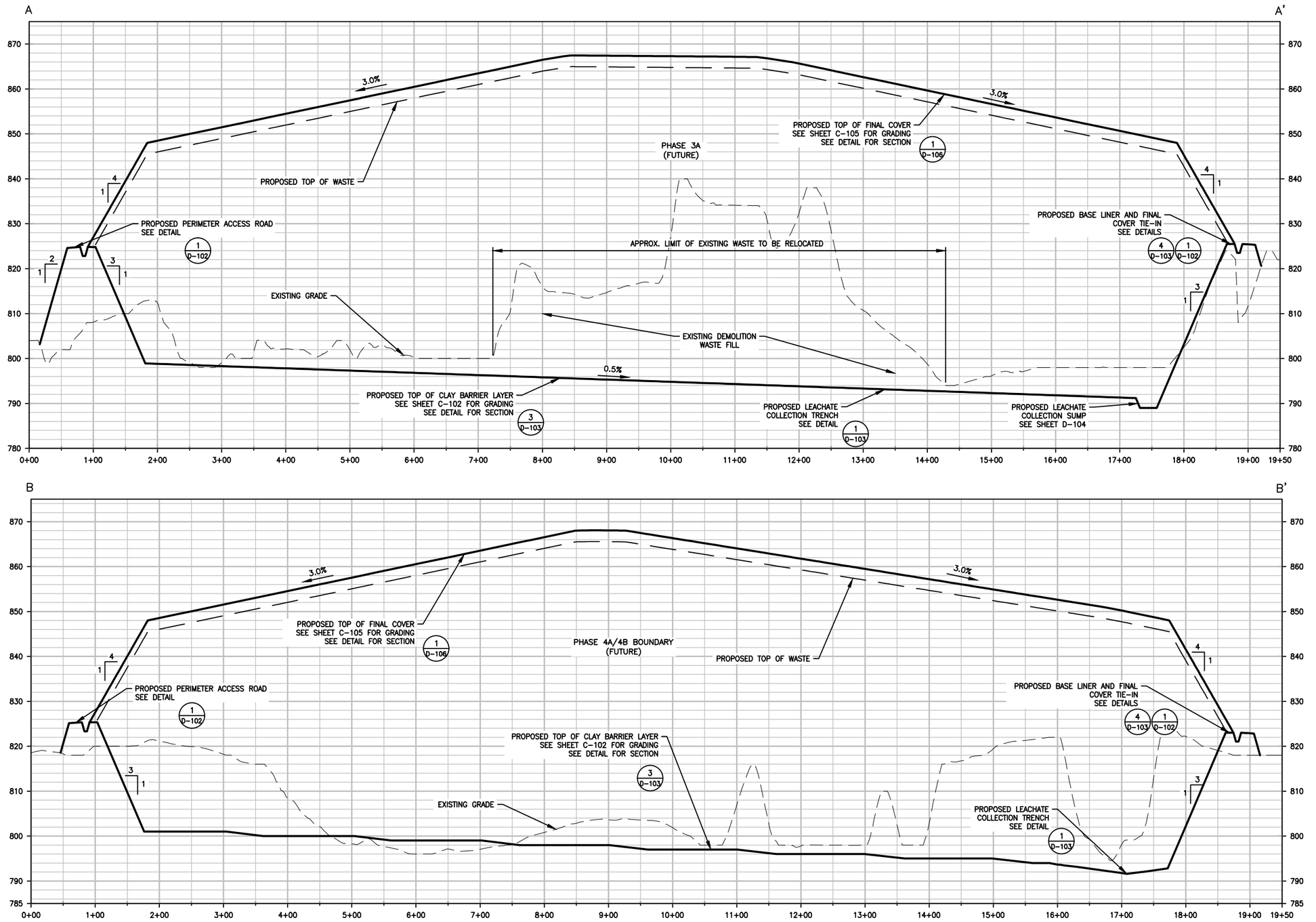
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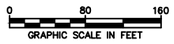



NOTE:

BASE GRADES ARE DESIGNED A MINIMUM 5–FEET ABOVE HISTORICAL HIGH GROUNDWATER ELEVATIONS.




VERTICAL EXAGGERATION: 7.0X

| REV | REVISION DESCRIPTION | DWN | APP | REV DATE |
|---|---|---|---|---|
| 0 | ISSUED FOR PERMIT APPLICATION | JJT | EDK | 04/24/26 |

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PRIME CONSULTANT

Stantec

PROJECT TITLE
2026 PERMIT REISSUANCE & MODIFICATION APPLICATION

DEM–CON PILGRIM LANDFILL, LLC.

MANKATO, MINNESOTA

SHEET TITLE
CROSS SECTIONS

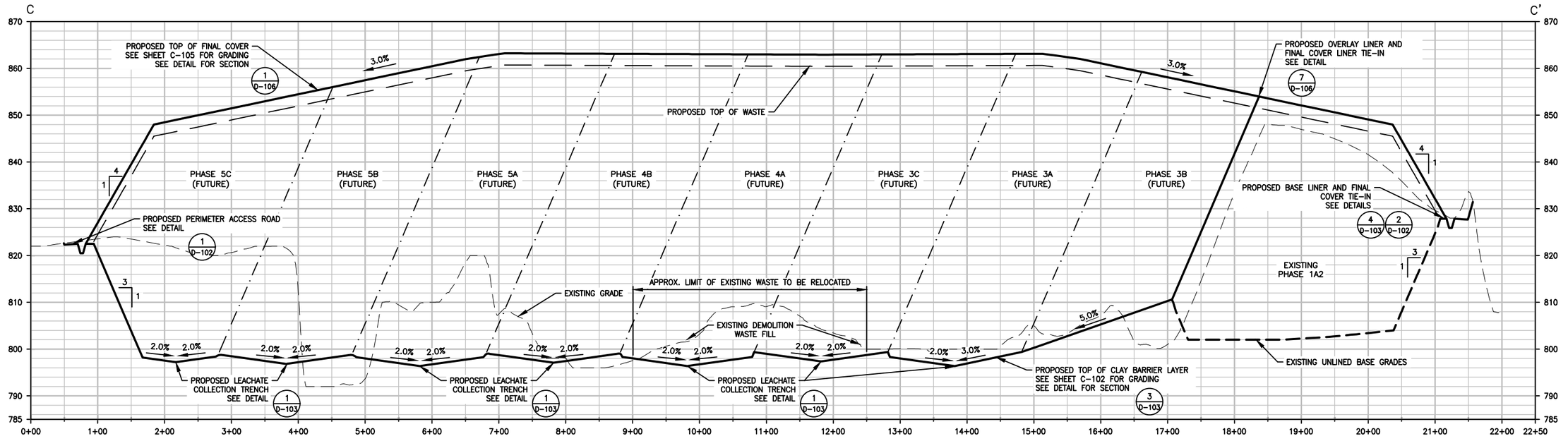
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| JJT | BWS | EDK | APR. 2026 |

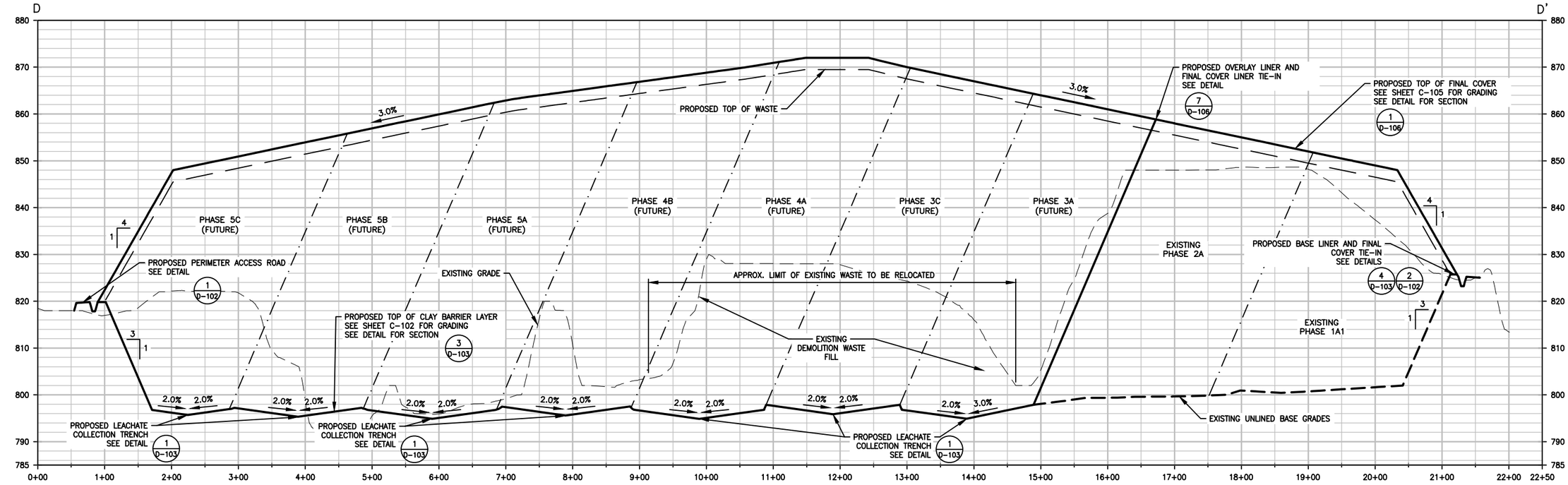
SCALE AS SHOWN

| PROJECT NO. | SHEET NO. | REV NO. |
|---|---|---|
| 227708930 | C–107 | 0 |

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Plot Date & Time: 22 April 2026 4:30 PM




NOTE:

BASE GRADES ARE DESIGNED A MINIMUM 5-FEET ABOVE HISTORICAL HIGH GROUNDWATER ELEVATIONS.

0 80 160
GRAPHIC SCALE IN FEET

VERTICAL EXAGGERATION: 7.0X

| REV | REVISION DESCRIPTION | DWN | APP | REV DATE |
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DEM-CON PILGRIM LANDFILL, LLC.

MANKATO, MINNESOTA

SHEET TITLE
CROSS SECTIONS

| DWN BY | CHK'D | APP'D | DWG DATE |
|---|---|---|---|
| JJT | BWS | EDK | APR. 2026 |

SCALE AS SHOWN

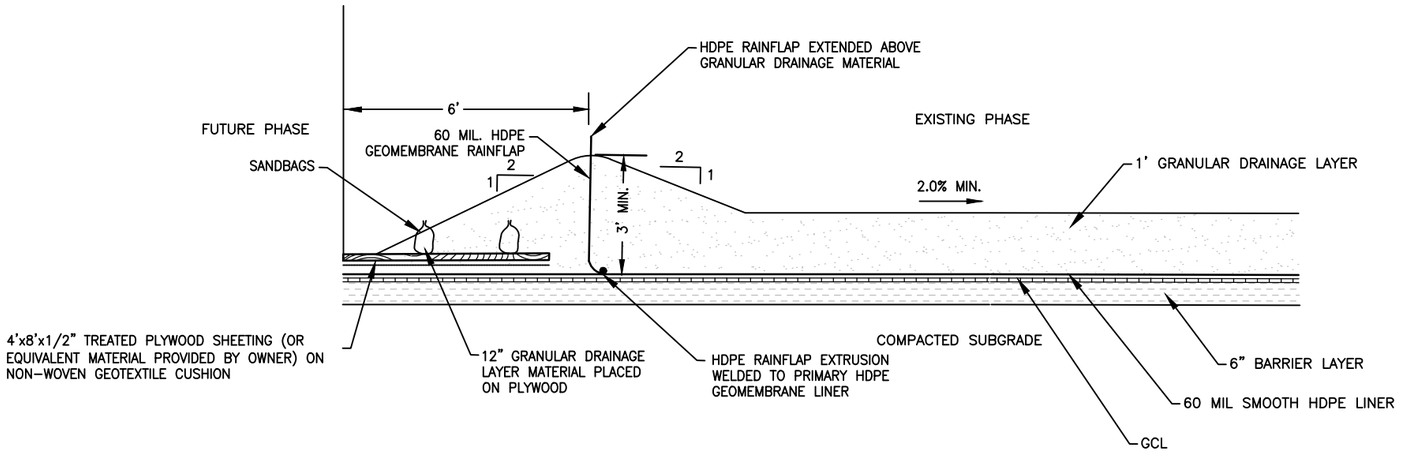
PROJECT NO. 227708930

SHEET NO. C-108

REV NO. 0

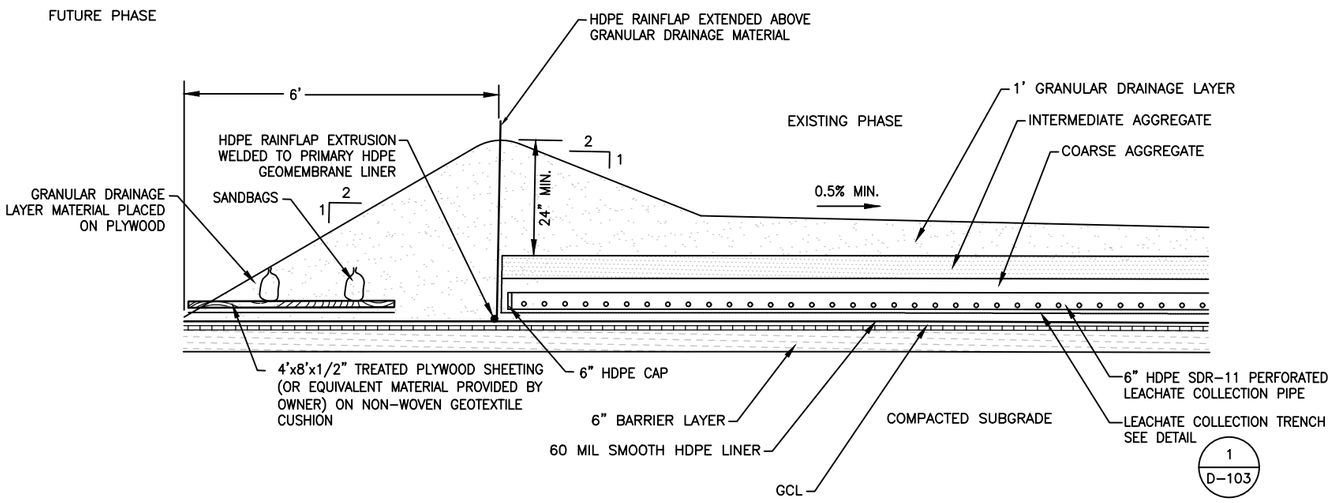
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Plot Date & Time: 21 April 2026 1:37 PM



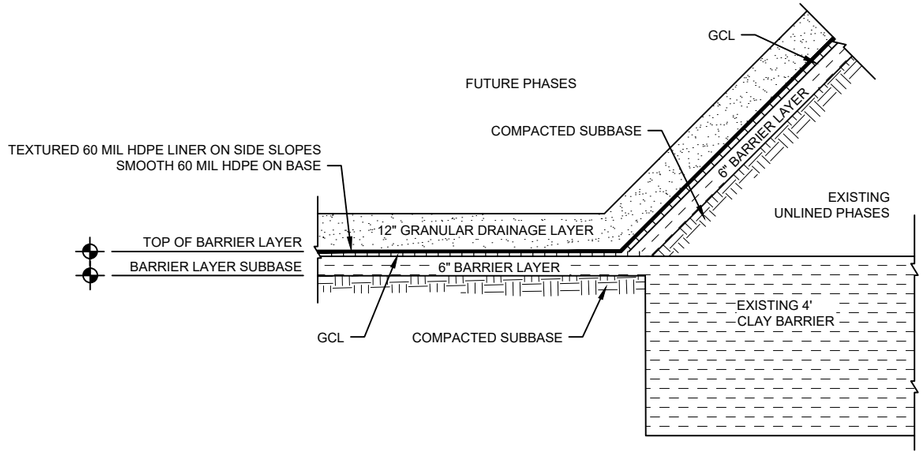

TEMPORARY PHASE DELINEATION BERM (TYPICAL) — 1 / D-101

NOT TO SCALE




TEMPORARY PHASE DELINEATION BERM AT LEACHATE HEADER TRENCH (TYPICAL) — 2 / D-101

NOT TO SCALE




PROPOSED UNLINED PHASES, LINED PHASES, AND OVERLAY LINER TIE-IN SECTION DETAIL (TYPICAL) — 3 / D-101

NOT TO SCALE

NOTE:

SIZE, TYPE, AND MATERIAL OF TYPICAL DETAILS MAY VARY AS NEEDED.

| REV | REVISION DESCRIPTION | DWN | APP | REV DATE |
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SIGNATURE

DATE 04-24-2026 LICENSE # 56630

PRIME CONSULTANT

Stantec

PROJECT TITLE
2026 PERMIT REISSUANCE & MODIFICATION APPLICATION

DEM-CON PILGRIM LANDFILL, LLC.

MANKATO, MINNESOTA

SHEET TITLE
BASE LINER DETAILS

| DWN BY | CHK'D | APP'D | DWG DATE |
|---|---|---|---|
| JJT | BWS | EDK | APR. 2026 |

SCALE AS SHOWN

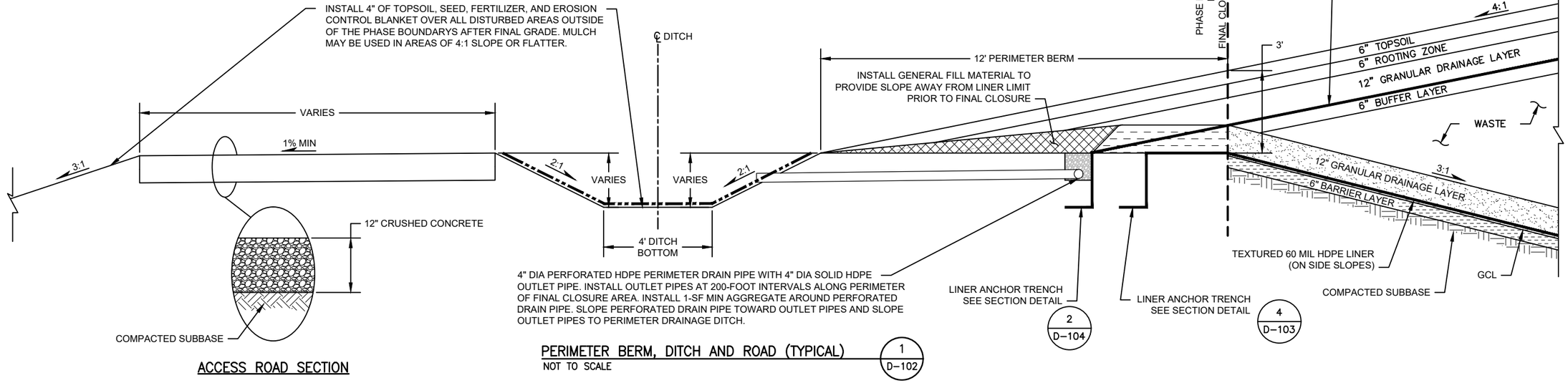
PROJECT NO. 227708930

SHEET NO. D-101

REV NO. 0

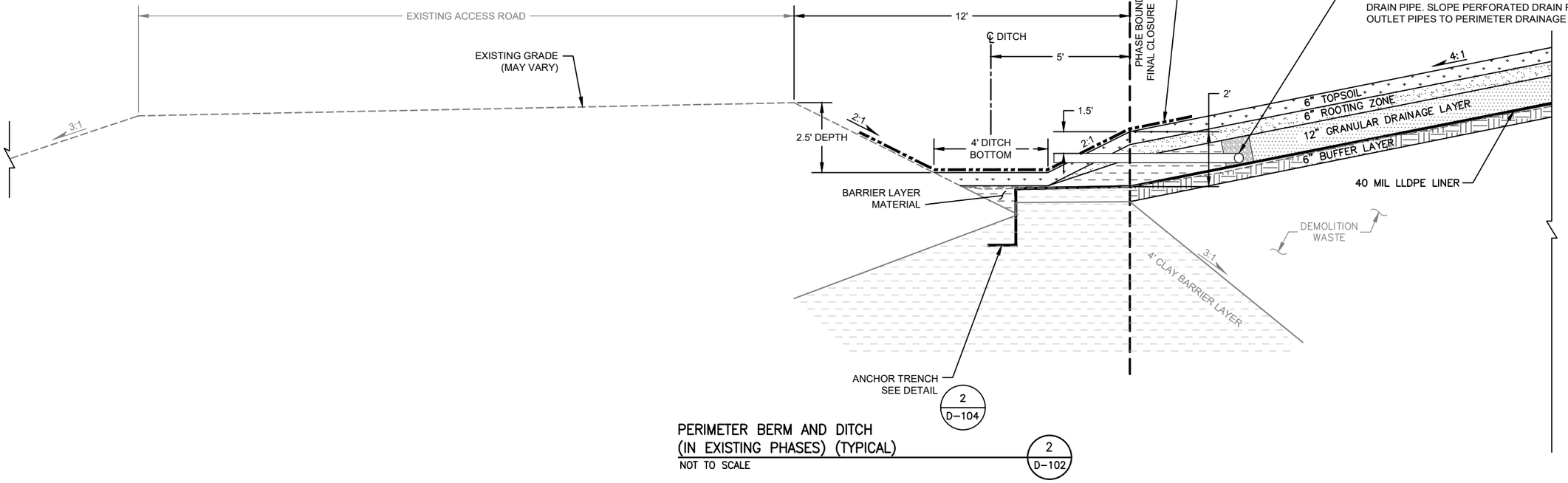
U:\227708930\drafting\civil\D-101_Civil Details.dwg

Plot Date & Time: 21 April 2026 1:37 PM




ACCESS ROAD SECTION

PERIMETER BERM, DITCH AND ROAD (TYPICAL)
NOT TO SCALE
1 D-102




PERIMETER BERM AND DITCH (IN EXISTING PHASES) (TYPICAL)
NOT TO SCALE
2 D-102

NOTE:

SIZE, TYPE, AND MATERIAL OF TYPICAL DETAILS MAY VARY AS NEEDED.

| REV | REVISION DESCRIPTION | DWN | APP | REV DATE |
|---|---|---|---|---|
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PRINT NAME ETHAN KETELSEN

SIGNATURE

DATE 04-24-2026 LICENSE # 56630

PRIME CONSULTANT

Stantec

PROJECT TITLE
2026 PERMIT REISSUANCE & MODIFICATION APPLICATION

DEM-CON PILGRIM LANDFILL, LLC.

MANKATO, MINNESOTA

SHEET TITLE
PERIMETER DETAILS

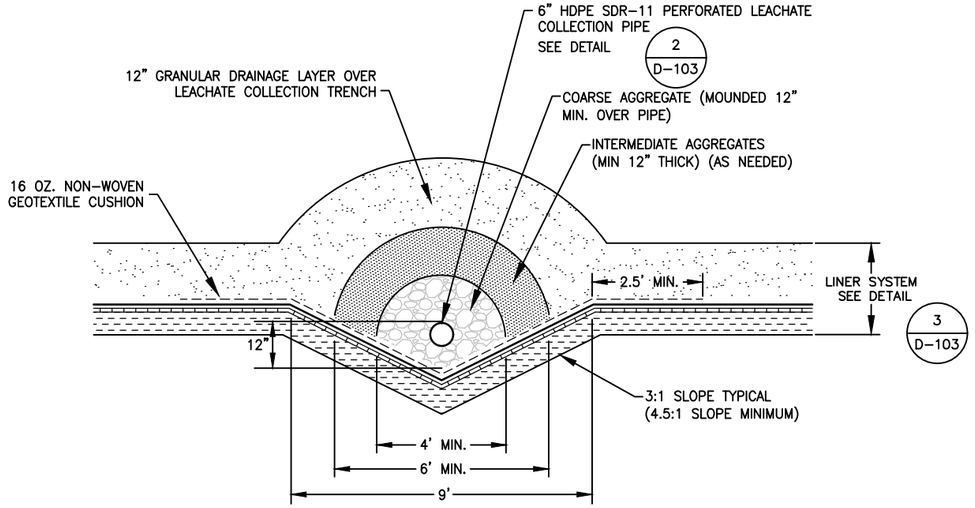
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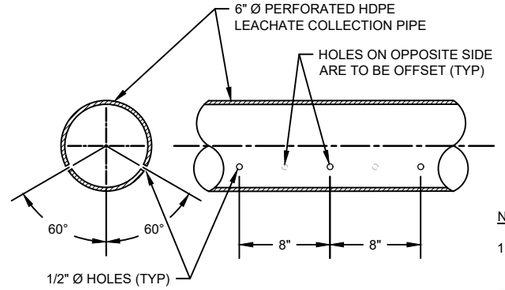
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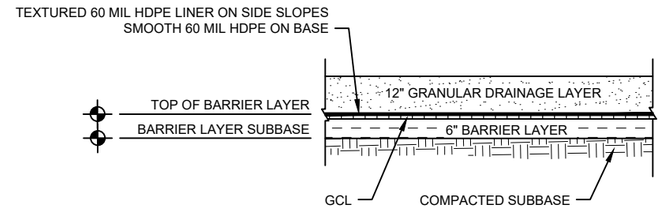

LEACHATE COLLECTION TRENCH (TYPICAL) — 1 D-103
NOT TO SCALE



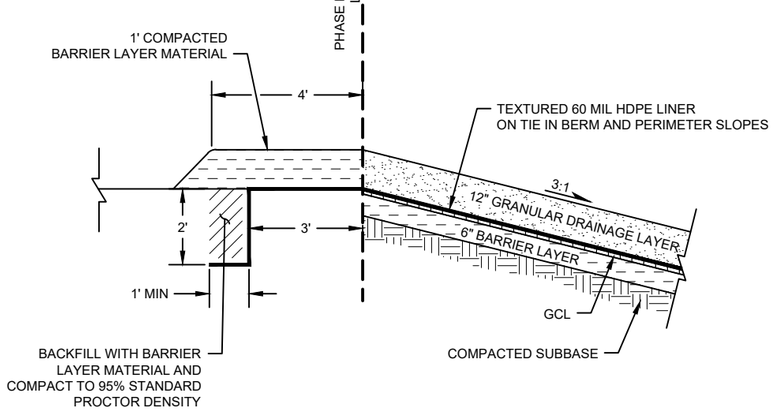

NOTES:

1. HOLES ON OPPOSITE SIDE ARE TO BE OFFSET.
2. SPACING BETWEEN HOLES TO BE 8".

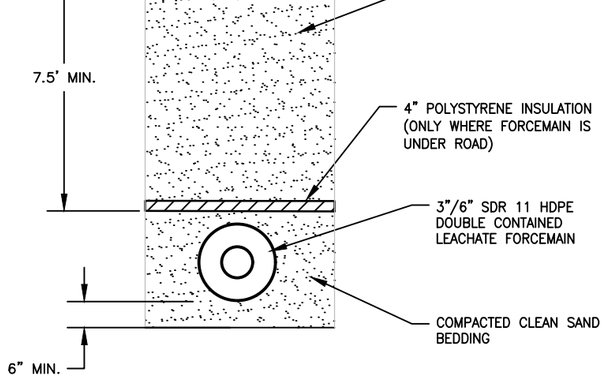
LEACHATE COLLECTION PIPE PERFORATION (TYPICAL) — 2 D-103
NOT TO SCALE




BASE LINER SYSTEM DETAIL (TYPICAL) — 3 D-103
NOT TO SCALE




BASE LINER ANCHOR TRENCH (TYPICAL) — 4 D-103
NOT TO SCALE




LEACHATE FORCEMAIN PIPE BEDDING (TYPICAL) — 5 D-103
NOT TO SCALE

NOTE:

SIZE, TYPE, AND MATERIAL OF TYPICAL DETAILS MAY VARY AS NEEDED.

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MANKATO, MINNESOTA

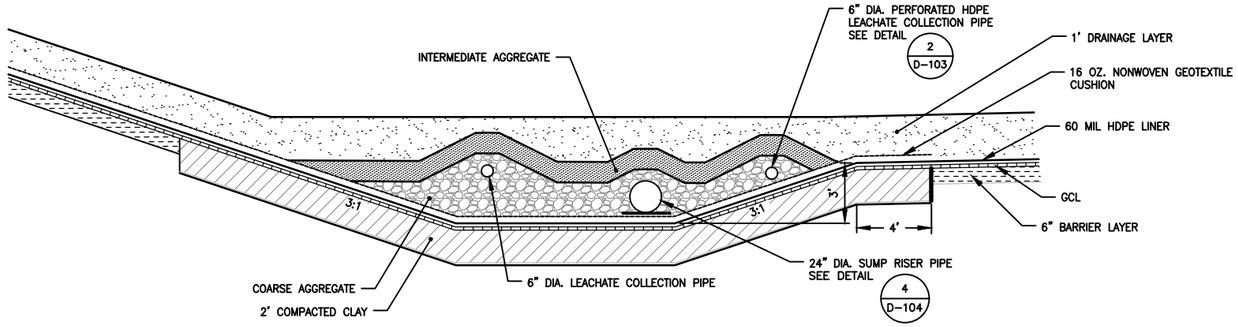
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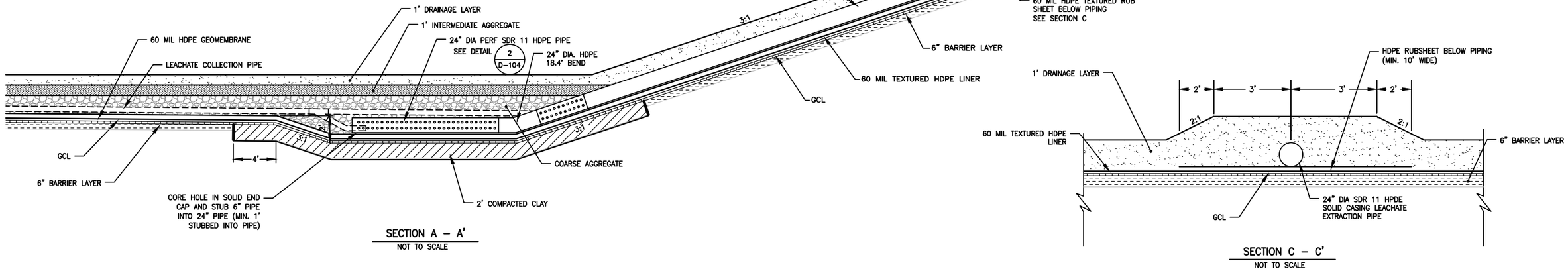
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SECTION B – B'
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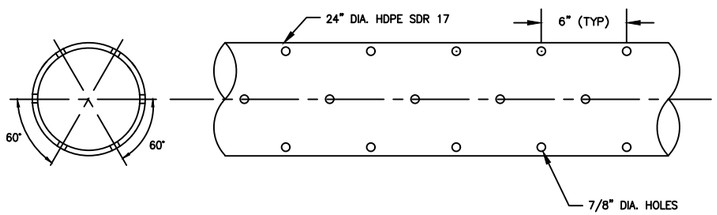



SECTION A – A'
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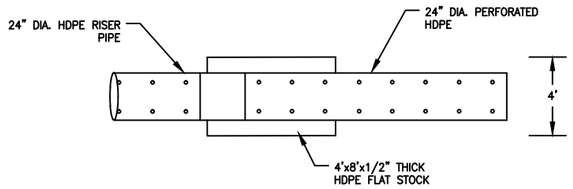



SECTION C – C'
NOT TO SCALE

LEACHATE COLLECTION SUMP SECTION (TYPICAL) — 1 / D-104
NOT TO SCALE

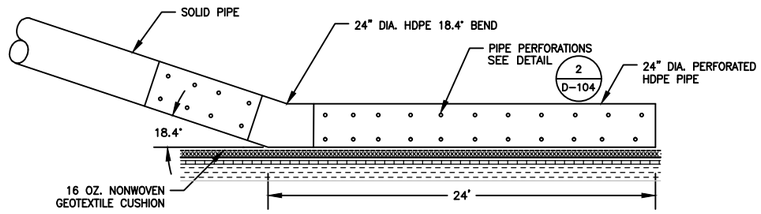



SUMP RISER PIPE PERFORATION DETAIL (TYPICAL) — 2 / D-104
NOT TO SCALE




NOTE: HDPE FLAT STOCK CORNERS TO BE ROUNDED. BOTTOM EDGES TO BE BEVELED TO CREATE A SMOOTH EDGE.

RISER PIPE BASE PLATE (TYPICAL) — 3 / D-104
NOT TO SCALE




NOTE:

SIZE, TYPE, AND MATERIAL OF TYPICAL DETAILS MAY VARY AS NEEDED.

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MANKATO, MINNESOTA

SHEET TITLE
LEACHATE COLLECTION DETAILS

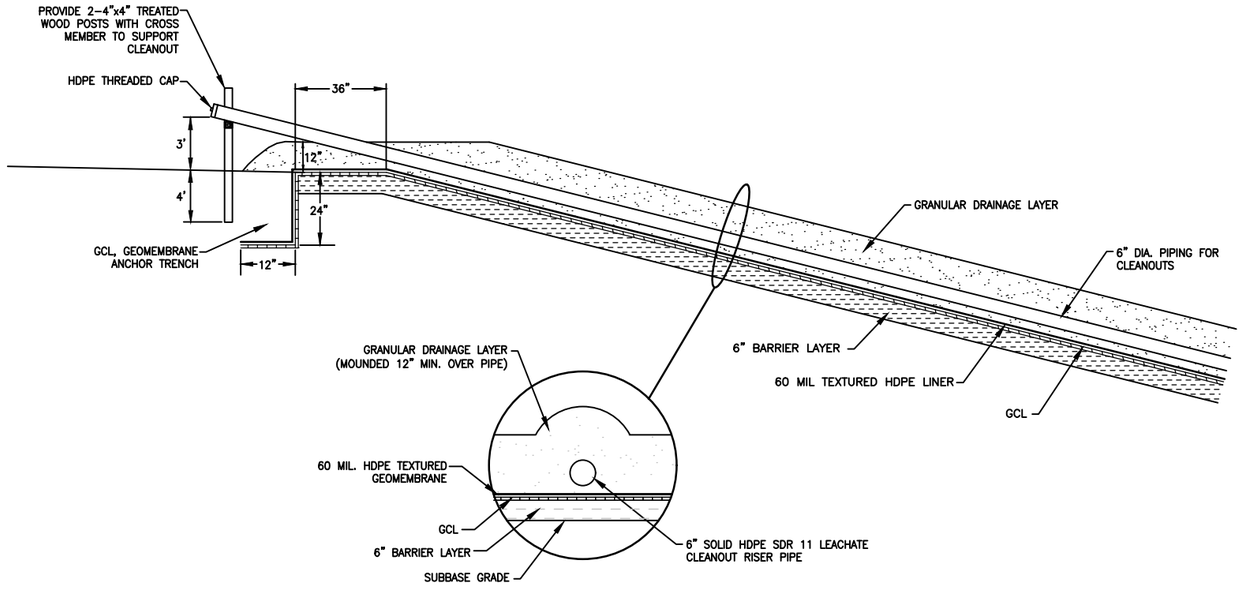
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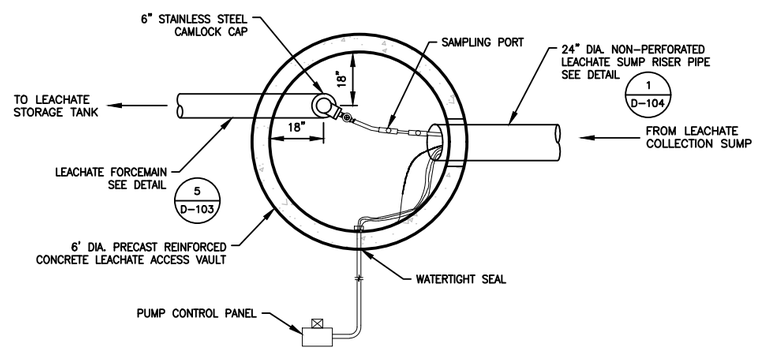
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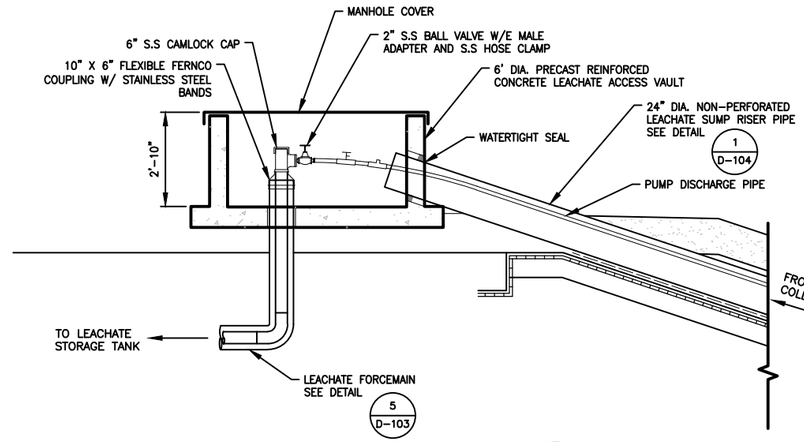
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LEACHATE COLLECTION CLEANOUT (TYPICAL) — 1 / D-105
NOT TO SCALE




PLAN VIEW
NOT TO SCALE




LEACHATE FORCEMAIN MANHOLE (TYPICAL) — 2 / D-105
NOT TO SCALE

NOTE:

SIZE, TYPE, AND MATERIAL OF TYPICAL DETAILS MAY VARY AS NEEDED.

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MANKATO, MINNESOTA

SHEET TITLE
LEACHATE COLLECTION DETAILS

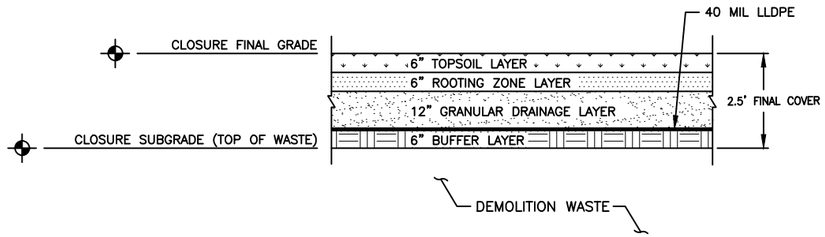
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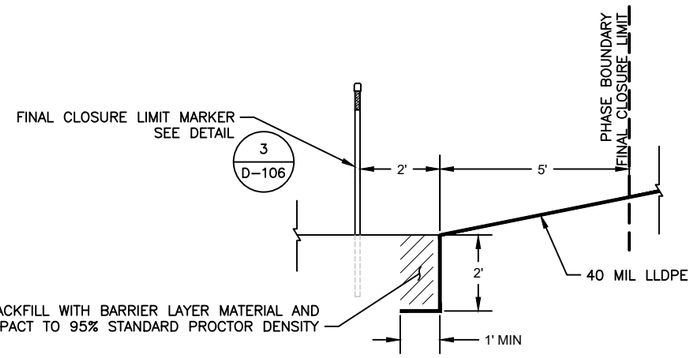
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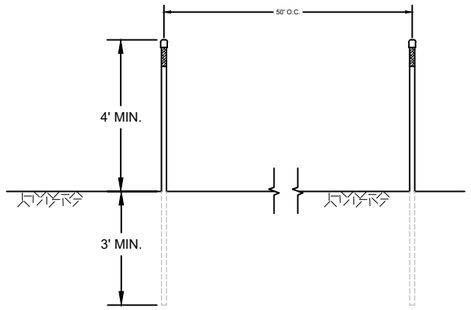
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FINAL COVER LINER SYSTEM (TYPICAL) — 1 / D-106
NOT TO SCALE



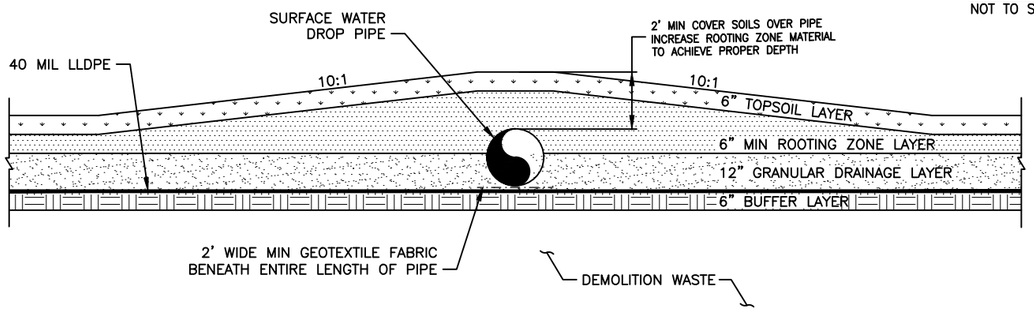

FINAL COVER LINER ANCHOR TRENCH (TYPICAL) — 2 / D-106
NOT TO SCALE



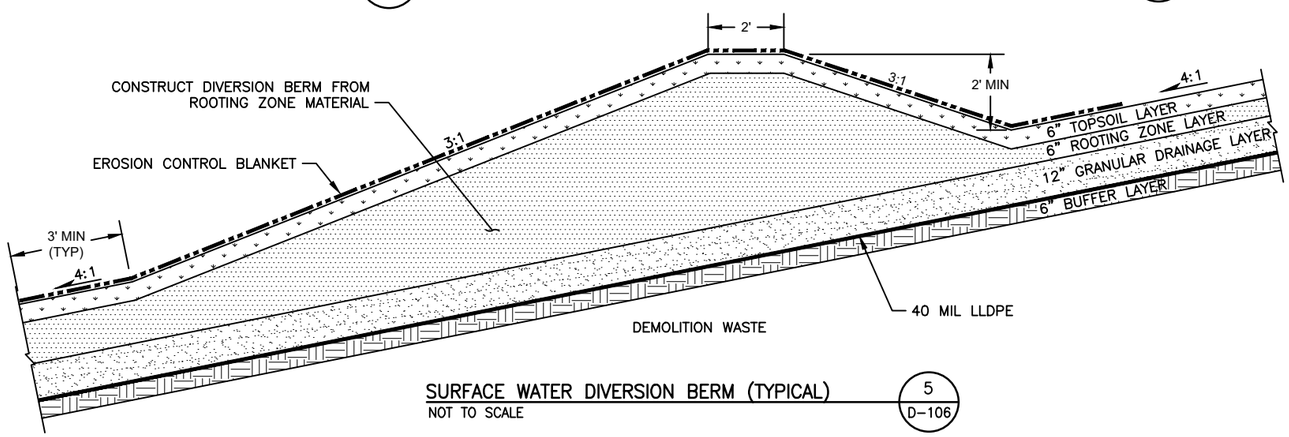

NOTES:

1. LIMITS OF LINER MARKERS PLACED AT INTERVALS OF 50-FEET ON-CENTER AND AT ALL CORNERS AROUND PERIMETER OF FINAL CLOSURE AREA.
2. MARKERS CONSTRUCTED OF 2" DIA GALVANIZED STEEL PIPE WITH CAP.
3. PLACE 6-INCH MIN HEIGHT BAND OF RED REFLECTOR TAPE NEAR THE TOP OF PIPE.
4. INSTALL LANDFILL MARKERS 2-FEET OUTSIDE LIMITS OF LINER BOUNDARY. DO NOT PENETRATE LINER. ANY DAMAGE TO THE LINER DURING INSTALLATION SHALL BE REPAIRED AT THE EXPENSE OF THE CONTRACTOR.

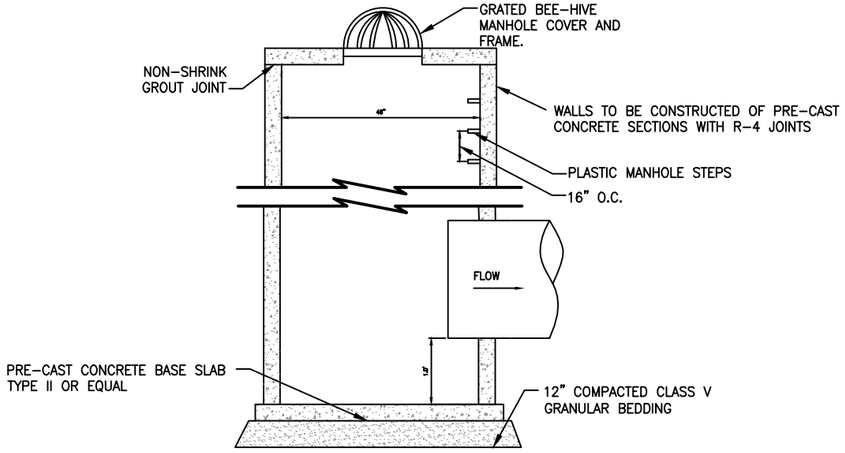
FINAL CLOSURE LIMIT MARKERS (TYPICAL) — 3 / D-106
NOT TO SCALE



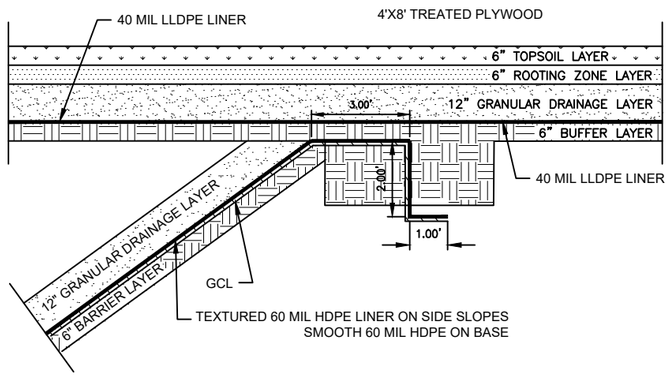

DOWN SLOPE DRAINAGE PIPE SECTION (TYPICAL) — 4 / D-106
NOT TO SCALE




SURFACE WATER DIVERSION BERM (TYPICAL) — 5 / D-106
NOT TO SCALE




STORMWATER INLET DETAIL (TYPICAL) — 6 / D-106
NOT TO SCALE




OVERLAY LINER & FINAL COVER LINER TIE-IN (TYPICAL) — 7 / D-106
NOT TO SCALE

NOTE:

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MANKATO, MINNESOTA

SHEET TITLE
FINAL COVER DETAILS

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SCALE AS SHOWN

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# Appendix C HELP Model

Stantec

# Memo

| | | | |
|---|---|---|---|
| To: | File | From: | Kyle Morberg, PE – Stantec |
| File: | 227708930 | Date: | April 10, 2026 |

**Re: Hydraulic Efficiency Analysis for Dem-Con Pilgrim Base Liner System and Final Cover**

This memorandum was prepared to present the hydraulic efficiency of the proposed base liner and cover systems for the Dem-Con Pilgrim Landfill (facility or landfill) as presented in the construction plans and specifications provided with this Major Permit Modification request.

To evaluate the performance of the proposed liner system, Stantec performed water balance calculations to illustrate the hydraulic efficiency the profiles. The water balance was calculated using the Hydrologic Evaluation of Landfill Performance (HELP) model, Version 4.0.1, developed for the United States Environmental Protection Agency (EPA). The HELP model, although limited in its use as a quantitative model, is generally used more as a qualitative model for determining landfill performance efficiencies or in this case, the base liner and cover system efficiency. In addition, the HELP model was completed to calculate if the proposed leachate collection pipe layout would maintain less than 1-foot of head on the base liner system during operations and less than 1-foot of head on the cover system during closed conditions. Furthermore, in one area of the landfill, it is proposed to exceed the 100-foot maximum leachate drainage length on the base liner to facilitate tie-in of an overlay system. This scenario was also evaluated and compared to the maximum 1-foot of head requirement.

There were several profiles and scenarios evaluated, including:

1. Scenario 1 – Closed Conditions (3% Slope, 200-foot length) with final cover over 75-feet of waste.
    a. Cover with 6-inches of buffer soil, 40-mil LLDPE geomembrane, 12-inches of drainage layer, 6-inches of rooting zone, and 6-inches of topsoil. Good grass established.
    b. Base liner system as defined in Scenario 2.
2. Scenario 2 - Landfill Floor (2% Slope, 100-foot length), open conditions with 25-feet of waste
    a. 6-inches buffer soil, overlain by geocomposite clay liner (GCL), 60-mil HDPE geomembrane and 12-inches of drainage layer sand.
3. Scenario 3 - Landfill Floor (5% Slope, 330-foot length), open conditions with 25-feet of waste
    a. 6-inches buffer soil, overlain by GCL, 60-mil HDPE geomembrane and 12-inches of drainage layer sand.

For the open landfill, the HELP model was used to illustrate performance of the base liner system based on the minimum specification requirements for materials as well as using estimated soil and geosynthetic barrier layer parameters included within the HELP model. The simulated conditions were for one acre so that output could easily be extrapolated on a per acre basis. It was assumed that 0% of the modeled area was subject to runoff to simulate open landfill conditions. For closed conditions, 100% of the modeled area was subject to runoff.

**Reference: Hydraulic Efficiency Analysis for Pilgrim Landfill**

## LINER SYSTEM SOIL DESCRIPTION

The base liner system is illustrated as Figure 1 while the cover system is shown as Figure 2.

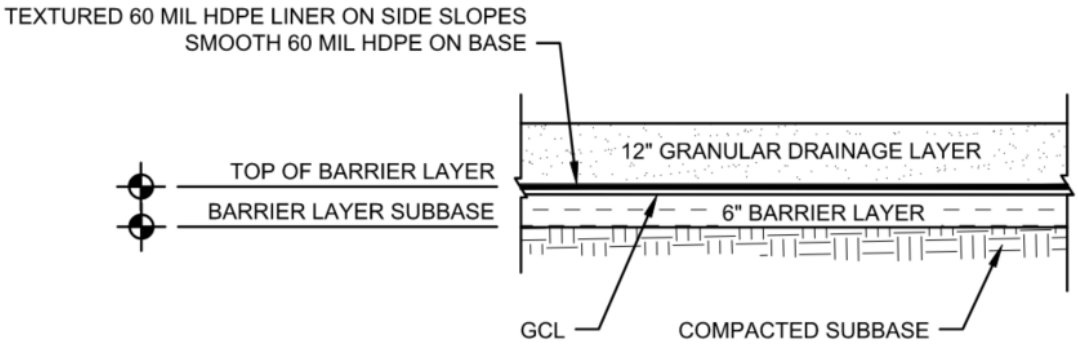



**Figure 1: Base Liner System**

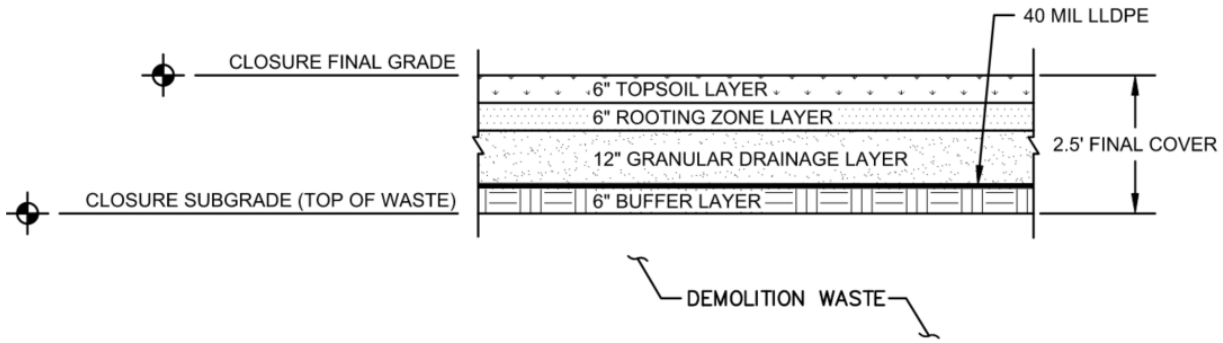



**Figure 2: Cover System**

## HELP MODEL INPUTS

### Weather and Solar Data

Synthetic climatological input values were created utilizing the Synthetic Weather Generation (WGEN) program within HELP v4.0.1. Weather parameter values used in WGEN are imported from a database of calculated weather parameters for over 13,000 points located on a 0.25 x 0.25 degree grid across the continental U.S. The program retrieves parameter values from the closest grid point in the dataset based on the latitude and longitude specified for the landfill location. For this site, a latitude of 44.13 and a longitude of 93.98 was used (located in Mankato, MN). The climatological simulation was performed over a period of 5 years. A 25-year, 24-hr storm event of 5.34-inches was manually entered to the dataset to simulate worst-case conditions.

### Soil and Design

Soil types for the liner systems were selected for modeling based on review of project specifications and visual classification from field observations. The layering used in the HELP model for the assessed profiles

are shown in Table 1. Soil parameters for the granular drainage layer are assumed based on typical regional soils. Parameters for the industrial waste layer were manually entered based conditions of typical industrial waste. The GCL was assumed to have a permeability of 3 x $10^{-9}$ cm/sec permeability based on material specifications.

Open conditions (no final cover) were simulated assuming 25-feet of waste on top of the base liner system with 6" of daily cover soil in order to model typical conditions while the cell is in operation. Closed Conditions were modeled on the shallowest slope surface with the longest drainage length as a worst-case.

**Table 1: Soil Layers Used in HELP Model**

| Layer number | Description | Thickness | Standard HELP Layer Soil Characteristics |
|---|---|---|---|
| Profile 1 – Closed Conditions | | | |
| 1 | Cover Soil | 6" | Silty Clay Loam |
| 2 | Rooting Zone | 6" | Sandy Loam |
| 3 | Drainage Sand | 12" | Sand |
| 4 | Liner | 40-mil | LLDPE Geomembrane (2 defects & pinholes /ac) |
| 5 | Buffer Soil | 6" | Silty Clay Loam |
| 6 | Waste | 840" | Industrial Waste |
| 7 | Drainage Sand | 12" | Sand (Water collected in this layer is routed to leachate collection system) |
| 8 | Geomembrane | 60-mil | HDPE (2 defects & pinholes /ac) |
| 9 | Buffer Layer | 6" | Silty Clay (Moderate) |
| Profile 2– Open Condition, 25-feet Waste, 2% Floor Slope and 100-foot Drainage Length | | | |
| 1 | Buffer Soil | 6" | Silty Clay Loam |
| 2 | Waste | 300" | Industrial Waste |
| 3 | Drainage Sand | 12" | Sand (Water collected in this layer is routed to leachate collection system) |
| 4 | Geomembrane | 60-mil | HDPE (2 defects & pinholes /ac) |
| 5 | GCL | 0.5" | Bentonite (Assumed 3 x $10^{-9}$ cm/sec permeability) |
| 6 | Buffer Layer | 6" | Silty Clay (Moderate) |
| Profile 3 – Open Condition, 25-feet Waste, 5% Floor Slope and 330-foot Drainage Length | | | |
| 1 | Buffer Soil | 6" | Silty Clay Loam |
| 2 | Waste | 300" | Industrial Waste |
| 3 | Drainage Sand | 12" | Sand (Water collected in this layer is routed to leachate collection system) |
| 4 | Geomembrane | 60-mil | HDPE (2 defects & pinholes /ac) |
| 5 | GCL | 0.5" | Bentonite (Assumed 3 x $10^{-9}$ cm/sec permeability) |
| 6 | Buffer Layer | 6" | Silty Clay (Moderate) |

## MODEL RESULTS

The results of the HELP model simulations for each of the profiles can be found in Attachments 1-3 while Table 2 summarizes the HELP model results under average annual conditions for each scenario and profile,

while Table 3 provides a summary of peak results during a worst-case rainfall event. The percentage identified for the efficiency is based on leakage through the bottom-most liner layer, or in the case of the final cover, total efficiency of the closed landfill.

**Table 2: HELP Model Outputs (Average Annual Totals)**

| Profile | Liner Efficiency (%) | Average Head on Base Liner (inches) | Average Head on Cover Liner (inches) |
|---|---|---|---|
| Closed Condition | | | |
| 1 | >99.99 | <0.01 | 0.04 |
| Open Condition, 2% Floor Slope, 100-foot drainage length | | | |
| 2 | >99.90 | 0.45 | N/A |
| Open Condition, 5% Floor Slope, 330-foot drainage length | | | |
| 3 | >99.90 | 0.57 | N/A |

**Table 3: HELP Model Outputs (Peak - 25-year, 24-hr storm event of 5.34-inches)**

| Profile | Maximum Head on Liner (inches) | Distance from Drain (feet) |
|---|---|---|
| Closed Condition | | |
| 1 | 0.2* | 2.6 |
| Open Condition, 2% Floor Slope, 100-foot drainage length | | |
| 2 | 3.25 | 22.2 |
| Open Condition, 5% Floor Slope, 330-foot drainage length | | |
| 3 | 4.94 | 23.5 |

*Head on cover liner

## SUMMARY

The proposed base liner design exceeds MPCA design standards prescribed in MN Rule 7035.2815. Note that per MN Rule 7035.2815 Subp 7.A, this expected performance also exceeds the standards for closure of an MSW disposal facility which requires rejection of 98.5% of precipitation when considering the cover and base liner system. Based on the HELP Model results for the systems described above, the actual performance of the proposed base liner system on the slope is expected to exceed this minimum value.

Furthermore, the maximum head on the base liner under average annual conditions and during a peak event while in operation is predicted to be maintained at less than 1-foot as required by the facility Solid Waste Permit. This indicates that the maximum drainage length of 100-feet on the cell floor with a 2% slope and 330-feet with a 5% slope prior to leachate entering a collection pipe is adequate. The 3% slope with a 200-foot drainage length on the cover system is also adequate to maintain less than 1-foot of head on the cover liner.

**Reference: Hydraulic Efficiency Analysis for Pilgrim Landfill**

## ATTACHMENT 1

HELP Output Scenario 1 – Closed Conditions

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**HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE**
**HELP MODEL VERSION 4.0 BETA (2018)**
**DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY**

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**Title:** Pilgrim Landfill **Simulated On:** 4/10/2026 14:13

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**Layer 1**

Type 1 - Vertical Percolation Layer (Cover Soil)
SiCL - Silty Clay Loam (Moderate)
Material Texture Number 26

| | | | |
|---|---|---|---|
| Thickness | = | 6 | inches |
| Porosity | = | 0.445 | vol/vol |
| Field Capacity | = | 0.393 | vol/vol |
| Wilting Point | = | 0.277 | vol/vol |
| Initial Soil Water Content | = | 0.3186 | vol/vol |
| Effective Sat. Hyd. Conductivity | = | 1.90E-06 | cm/sec |

**Layer 2**

Type 1 - Vertical Percolation Layer
SL - Sandy Loam
Material Texture Number 6

| | | | |
|---|---|---|---|
| Thickness | = | 6 | inches |
| Porosity | = | 0.453 | vol/vol |
| Field Capacity | = | 0.19 | vol/vol |
| Wilting Point | = | 0.085 | vol/vol |
| Initial Soil Water Content | = | 0.085 | vol/vol |
| Effective Sat. Hyd. Conductivity | = | 7.20E-04 | cm/sec |

**Layer 3**

Type 2 - Lateral Drainage Layer
S - Sand
Material Texture Number 2

| | | | |
|---|---|---|---|
| Thickness | = | 12 | inches |
| Porosity | = | 0.437 | vol/vol |
| Field Capacity | = | 0.062 | vol/vol |
| Wilting Point | = | 0.024 | vol/vol |
| Initial Soil Water Content | = | 0.0433 | vol/vol |
| Effective Sat. Hyd. Conductivity | = | 5.80E-03 | cm/sec |
| Slope | = | 3 | % |
| Drainage Length | = | 200 | ft |

**Layer 4**

Type 4 - Flexible Membrane Liner

LDPE Membrane

Material Texture Number 36

| | | | |
|---|---|---|---|
| Thickness | = | 0.04 | inches |
| Effective Sat. Hyd. Conductivity | = | 4.00E-13 | cm/sec |
| FML Pinhole Density | = | 2 | Holes/Acre |
| FML Installation Defects | = | 2 | Holes/Acre |
| FML Placement Quality | = | 3 | Good |

**Layer 5**

Type 1 - Vertical Percolation Layer

SL - Sandy Loam

Material Texture Number 6

| | | | |
|---|---|---|---|
| Thickness | = | 6 | inches |
| Porosity | = | 0.453 | vol/vol |
| Field Capacity | = | 0.19 | vol/vol |
| Wilting Point | = | 0.085 | vol/vol |
| Initial Soil Water Content | = | 0.19 | vol/vol |
| Effective Sat. Hyd. Conductivity | = | 7.20E-04 | cm/sec |

**Layer 6**

Type 1 - Vertical Percolation Layer (Waste)

Industrial Waste

Material Texture Number 83

| | | | |
|---|---|---|---|
| Thickness | = | 840 | inches |
| Porosity | = | 0.578 | vol/vol |
| Field Capacity | = | 0.076 | vol/vol |
| Wilting Point | = | 0.025 | vol/vol |
| Initial Soil Water Content | = | 0.076 | vol/vol |
| Effective Sat. Hyd. Conductivity | = | 4.10E-03 | cm/sec |

**Layer 7**

Type 2 - Lateral Drainage Layer

S - Sand

Material Texture Number 2

| | | | |
|---|---|---|---|
| Thickness | = | 12 | inches |
| Porosity | = | 0.437 | vol/vol |
| Field Capacity | = | 0.062 | vol/vol |
| Wilting Point | = | 0.024 | vol/vol |
| Initial Soil Water Content | = | 0.062 | vol/vol |
| Effective Sat. Hyd. Conductivity | = | 5.80E-03 | cm/sec |
| Slope | = | 2 | % |
| Drainage Length | = | 100 | ft |

**Layer 8**

Type 4 - Flexible Membrane Liner

HDPE Membrane
Material Texture Number 35

| | | | |
|---|---|---|---|
| Thickness | = | 0.06 | inches |
| Effective Sat. Hyd. Conductivity | = | 2.00E-13 | cm/sec |
| FML Pinhole Density | = | 2 | Holes/Acre |
| FML Installation Defects | = | 2 | Holes/Acre |
| FML Placement Quality | = | 3 | Good |

**Layer 9**
Type 3 - Barrier Soil Liner
Bentonite (High)
Material Texture Number 17

| | | | |
|---|---|---|---|
| Thickness | = | 0.5 | inches |
| Porosity | = | 0.75 | vol/vol |
| Field Capacity | = | 0.747 | vol/vol |
| Wilting Point | = | 0.4 | vol/vol |
| Initial Soil Water Content | = | 0.75 | vol/vol |
| Effective Sat. Hyd. Conductivity | = | 3.00E-09 | cm/sec |

**Layer 10**
Type 1 - Vertical Percolation Layer
SiC - Silty Clay (Moderate)
Material Texture Number 28

| | | | |
|---|---|---|---|
| Thickness | = | 6 | inches |
| Porosity | = | 0.452 | vol/vol |
| Field Capacity | = | 0.411 | vol/vol |
| Wilting Point | = | 0.311 | vol/vol |
| Initial Soil Water Content | = | 0.3697 | vol/vol |
| Effective Sat. Hyd. Conductivity | = | 1.20E-06 | cm/sec |

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Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

**General Design and Evaporative Zone Data**

| | | | |
|---|---|---|---|
| SCS Runoff Curve Number | = | 87.2 | |
| Fraction of Area Allowing Runoff | = | 100 | % |
| Area projected on a horizontal plane | = | 1 | acres |
| Evaporative Zone Depth | = | 18 | inches |
| Initial Water in Evaporative Zone | = | 2.565 | inches |
| Upper Limit of Evaporative Storage | = | 8.01 | inches |
| Lower Limit of Evaporative Storage | = | 2.316 | inches |
| Initial Snow Water | = | 0 | inches |
| Initial Water in Layer Materials | = | 71.272 | inches |
| Total Initial Water | = | 71.272 | inches |

| | | | |
|---|---|---|---|
| Total Subsurface Inflow | = | 0 | inches/year |

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Note: SCS Runoff Curve Number was calculated by HELP.

**Evapotranspiration and Weather Data**

| | | | |
|---|---|---|---|
| Station Latitude | = | 44.13 | Degrees |
| Maximum Leaf Area Index | = | 1 | |
| Start of Growing Season (Julian Date) | = | 124 | days |
| End of Growing Season (Julian Date) | = | 182 | days |
| Average Wind Speed | = | 11 | mph |
| Average 1st Quarter Relative Humidity | = | 65 | % |
| Average 2nd Quarter Relative Humidity | = | 65 | % |
| Average 3rd Quarter Relative Humidity | = | 62 | % |
| Average 4th Quarter Relative Humidity | = | 65 | % |

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Note: Evapotranspiration data was obtained for Mankato, Minnesota

**Normal Mean Monthly Precipitation (inches)**

| Jan/Jul | Feb/Aug | Mar/Sep | Apr/Oct | May/Nov | Jun/Dec |
|---|---|---|---|---|---|
| 0.683107 | 0.60023 | 1.856155 | 3.092133 | 3.787518 | 6.501913 |
| 5.935874 | 3.191535 | 2.613059 | 1.132846 | 1.140449 | 1.223736 |

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Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 44.13/-93.98

**Normal Mean Monthly Temperature (Degrees Fahrenheit)**

| Jan/Jul | Feb/Aug | Mar/Sep | Apr/Oct | May/Nov | Jun/Dec |
|---|---|---|---|---|---|
| 20.6 | 20.2 | 36 | 56.7 | 62.8 | 76.6 |
| 82.4 | 78.5 | 81.4 | 49.6 | 38.6 | 32.4 |

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Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 44.13/-93.98
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 44.13/-93.98

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**Daily Output for Year 1**

**Column key:** Head #1: drainage from Layer 4 | Head #2: drainage from Layer 8
Drain #1: drainage from Layer 3 | Drain #2: drainage from Layer 7
Leak #1: leakage thru Layer 4 | Leak #2: leakage thru Layer 9 | Leak #3: leakage thru Layer 10

**Title:** Pilgrim Landfill
**Simulated On:** 4/10/2026 14:14

| Day | Freezing Status* | | Rain | Runoff | ET | Evap. Zone Water | Head #1 | Drain #1 | Leak #1 | Head #2 | Drain #2 | Leak #2 | Head #3 | Drain #3 | Leak #3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air | Soil | (inches) | (inches) | (inches) | (in/in) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) |
| 1 | * | * | 0.00 | 0.000 | 0.004 | 0.1425 | 0.0109 | 0.0001 | 2.46E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 1.96E-04 |
| 2 | * | * | 0.00 | 0.000 | 0.000 | 0.1425 | 0.0107 | 0.0001 | 2.42E-05 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 1.95E-04 |
| 3 | * | * | 0.00 | 0.000 | 0.000 | 0.1425 | 0.0105 | 0.0001 | 2.39E-05 | 0.0004 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 1.95E-04 |
| 4 | * | * | 0.00 | 0.000 | 0.000 | 0.1425 | 0.0103 | 0.0001 | 2.35E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 1.94E-04 |
| 5 | * | * | 0.00 | 0.000 | 0.000 | 0.1425 | 0.0101 | 0.0000 | 2.32E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 1.94E-04 |
| 6 | * | * | 0.00 | 0.000 | 0.000 | 0.1425 | 0.0099 | 0.0000 | 2.28E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 1.93E-04 |
| 7 | * | * | 0.00 | 0.000 | 0.000 | 0.1425 | 0.0097 | 0.0000 | 2.25E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 1.93E-04 |
| 8 | * | * | 0.00 | 0.000 | 0.000 | 0.1425 | 0.0095 | 0.0000 | 2.22E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 1.92E-04 |
| 9 | * | * | 0.13 | 0.000 | 0.003 | 0.1425 | 0.0093 | 0.0000 | 2.18E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 1.92E-04 |
| 10 | * | * | 0.01 | 0.000 | 0.006 | 0.1425 | 0.0091 | 0.0000 | 2.15E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 1.91E-04 |
| 11 | * | * | 0.03 | 0.000 | 0.003 | 0.1425 | 0.0090 | 0.0000 | 2.12E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 1.91E-04 |
| 12 | * | * | 0.00 | 0.000 | 0.005 | 0.1425 | 0.0088 | 0.0000 | 2.09E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 1.90E-04 |
| 13 | * | * | 0.00 | 0.000 | 0.026 | 0.1425 | 0.0086 | 0.0000 | 2.06E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 1.90E-04 |
| 14 | * | * | 0.00 | 0.000 | 0.034 | 0.1425 | 0.0085 | 0.0000 | 2.03E-05 | 0.0006 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 1.89E-04 |
| 15 | * | * | 0.00 | 0.000 | 0.016 | 0.1425 | 0.0083 | 0.0000 | 2.00E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.89E-04 |
| 16 | * | * | 0.00 | 0.000 | 0.008 | 0.1425 | 0.0081 | 0.0000 | 1.97E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.88E-04 |
| 17 | * | * | 0.00 | 0.000 | 0.004 | 0.1425 | 0.0080 | 0.0000 | 1.94E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 1.88E-04 |
| 18 | * | * | 0.00 | 0.000 | 0.003 | 0.1425 | 0.0078 | 0.0000 | 1.91E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.87E-04 |
| 19 | * | * | 0.00 | 0.000 | 0.004 | 0.1425 | 0.0077 | 0.0000 | 1.88E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.87E-04 |
| 20 | * | * | 0.00 | 0.000 | 0.023 | 0.1425 | 0.0075 | 0.0000 | 1.85E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 1.86E-04 |
| 21 | * | * | 0.00 | 0.000 | 0.009 | 0.1425 | 0.0074 | 0.0000 | 1.83E-05 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 1.86E-04 |
| 22 | * | * | 0.06 | 0.000 | 0.019 | 0.1425 | 0.0072 | 0.0000 | 1.80E-05 | 0.0009 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 1.85E-04 |
| 23 | * | * | 0.03 | 0.000 | 0.020 | 0.1425 | 0.0071 | 0.0000 | 1.77E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 1.85E-04 |
| 24 | * | * | 0.02 | 0.000 | 0.000 | 0.1425 | 0.0069 | 0.0000 | 1.75E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 1.84E-04 |
| 25 | * | * | 0.00 | 0.000 | 0.025 | 0.1425 | 0.0068 | 0.0000 | 1.72E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 1.84E-04 |
| 26 | * | * | 0.00 | 0.000 | 0.023 | 0.1425 | 0.0067 | 0.0000 | 1.69E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 1.83E-04 |
| 27 | * | * | 0.13 | 0.000 | 0.022 | 0.1425 | 0.0065 | 0.0000 | 1.67E-05 | 0.0009 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 1.83E-04 |
| 28 | * | * | 0.02 | 0.000 | 0.010 | 0.1425 | 0.0064 | 0.0000 | 1.64E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 1.83E-04 |
| 29 | * | * | 0.00 | 0.000 | 0.020 | 0.1425 | 0.0063 | 0.0000 | 1.62E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 1.82E-04 |
| 30 | * | * | 0.00 | 0.000 | 0.018 | 0.1425 | 0.0062 | 0.0000 | 1.59E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 1.82E-04 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | * | * | 0.05 | 0.000 | 0.000 | 0.1425 | 0.0060 | 0.0000 | 1.57E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 1.81E-04 |
| 32 | * | * | 0.00 | 0.000 | 0.013 | 0.1425 | 0.0059 | 0.0000 | 1.55E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 1.81E-04 |
| 33 | * | * | 0.00 | 0.000 | 0.024 | 0.1425 | 0.0058 | 0.0000 | 1.52E-05 | 0.0010 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 1.80E-04 |
| 34 | | * | 0.00 | 0.005 | 0.045 | 0.1474 | 0.0057 | 0.0000 | 1.50E-05 | 0.0010 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 1.80E-04 |
| 35 | | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0056 | 0.0000 | 1.48E-05 | 0.0011 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 1.79E-04 |
| 36 | * | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0055 | 0.0000 | 1.45E-05 | 0.0011 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 1.79E-04 |
| 37 | * | * | 0.01 | 0.000 | 0.014 | 0.1474 | 0.0053 | 0.0000 | 1.43E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.78E-04 |
| 38 | | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0052 | 0.0000 | 1.41E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.78E-04 |
| 39 | | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0051 | 0.0000 | 1.39E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.78E-04 |
| 40 | | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0050 | 0.0000 | 1.37E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.77E-04 |
| 41 | * | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0049 | 0.0000 | 1.35E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.77E-04 |
| 42 | * | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0048 | 0.0000 | 1.32E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.76E-04 |
| 43 | | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0047 | 0.0000 | 1.30E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.76E-04 |
| 44 | * | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0046 | 0.0000 | 1.28E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.75E-04 |
| 45 | * | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0045 | 0.0000 | 1.26E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 1.75E-04 |
| 46 | * | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0044 | 0.0000 | 1.24E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 1.74E-04 |
| 47 | * | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0044 | 0.0000 | 1.23E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 1.74E-04 |
| 48 | * | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0043 | 0.0000 | 1.21E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 1.74E-04 |
| 49 | * | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0042 | 0.0000 | 1.19E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 1.73E-04 |
| 50 | * | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0041 | 0.0000 | 1.17E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 1.73E-04 |
| 51 | | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0040 | 0.0000 | 1.15E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 1.72E-04 |
| 52 | | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0039 | 0.0000 | 1.13E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 1.72E-04 |
| 53 | | * | 0.17 | 0.166 | 0.003 | 0.1474 | 0.0038 | 0.0000 | 1.11E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 1.72E-04 |
| 54 | | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0038 | 0.0000 | 1.10E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 1.71E-04 |
| 55 | | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0037 | 0.0000 | 1.08E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 1.71E-04 |
| 56 | | * | 0.00 | 0.000 | 0.000 | 0.1474 | 0.0036 | 0.0000 | 1.06E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 1.70E-04 |
| 57 | | * | 0.00 | 0.000 | 0.002 | 0.1475 | 0.0035 | 0.0000 | 1.05E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 1.70E-04 |
| 58 | | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0035 | 0.0000 | 1.03E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.70E-04 |
| 59 | * | * | 0.10 | 0.000 | 0.056 | 0.1475 | 0.0034 | 0.0000 | 1.01E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.69E-04 |
| 60 | | * | 0.00 | 0.000 | 0.047 | 0.1475 | 0.0033 | 0.0000 | 9.96E-06 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.69E-04 |
| 61 | * | * | 0.00 | 0.000 | 0.005 | 0.1475 | 0.0032 | 0.0000 | 9.80E-06 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.68E-04 |
| 62 | | * | 0.45 | 0.447 | 0.003 | 0.1475 | 0.0032 | 0.0000 | 9.65E-06 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.68E-04 |
| 63 | * | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0031 | 0.0000 | 9.49E-06 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.68E-04 |
| 64 | * | * | 0.00 | 0.000 | 0.004 | 0.1475 | 0.0030 | 0.0000 | 9.34E-06 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.67E-04 |
| 65 | * | * | 0.02 | 0.000 | 0.007 | 0.1475 | 0.0030 | 0.0000 | 9.19E-06 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.67E-04 |
| 66 | * | * | 0.17 | 0.000 | 0.006 | 0.1475 | 0.0029 | 0.0000 | 9.04E-06 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.66E-04 |
| 67 | * | * | 0.00 | 0.000 | 0.046 | 0.1475 | 0.0029 | 0.0000 | 8.90E-06 | 0.0011 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 1.66E-04 |
| 68 | * | * | 0.01 | 0.000 | 0.010 | 0.1475 | 0.0028 | 0.0000 | 8.75E-06 | 0.0011 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 1.66E-04 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69 | * | * | 0.00 | 0.000 | 0.030 | 0.1475 | 0.0027 | 0.0000 | 8.61E-06 | 0.0011 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 1.65E-04 |
| 70 | | * | 0.00 | 0.000 | 0.096 | 0.1475 | 0.0027 | 0.0000 | 8.47E-06 | 0.0010 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 1.65E-04 |
| 71 | | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0026 | 0.0000 | 8.33E-06 | 0.0010 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 1.64E-04 |
| 72 | * | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0026 | 0.0000 | 8.20E-06 | 0.0010 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 1.64E-04 |
| 73 | * | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0025 | 0.0000 | 8.06E-06 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 1.64E-04 |
| 74 | * | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0025 | 0.0000 | 7.93E-06 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 1.63E-04 |
| 75 | * | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0024 | 0.0000 | 7.80E-06 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 1.63E-04 |
| 76 | * | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0024 | 0.0000 | 7.67E-06 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 1.63E-04 |
| 77 | * | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0023 | 0.0000 | 7.54E-06 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 1.62E-04 |
| 78 | * | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0023 | 0.0000 | 7.42E-06 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 1.62E-04 |
| 79 | * | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0022 | 0.0000 | 7.30E-06 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 1.61E-04 |
| 80 | * | * | 0.07 | 0.000 | 0.008 | 0.1475 | 0.0022 | 0.0000 | 7.18E-06 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 1.61E-04 |
| 81 | | * | 0.00 | 0.000 | 0.062 | 0.1475 | 0.0021 | 0.0000 | 7.06E-06 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 1.61E-04 |
| 82 | * | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0021 | 0.0000 | 6.94E-06 | 0.0009 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 1.60E-04 |
| 83 | * | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0020 | 0.0000 | 6.82E-06 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 1.60E-04 |
| 84 | | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0020 | 0.0000 | 6.71E-06 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 1.60E-04 |
| 85 | | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0019 | 0.0000 | 6.60E-06 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 1.59E-04 |
| 86 | | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0019 | 0.0000 | 6.48E-06 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 1.59E-04 |
| 87 | | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0018 | 0.0000 | 6.38E-06 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 1.59E-04 |
| 88 | | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0018 | 0.0000 | 6.27E-06 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 1.58E-04 |
| 89 | | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0018 | 0.0000 | 6.16E-06 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 1.58E-04 |
| 90 | | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0017 | 0.0000 | 6.06E-06 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 1.57E-04 |
| 91 | | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0017 | 0.0000 | 5.95E-06 | 0.0009 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 1.57E-04 |
| 92 | | * | 0.00 | 0.000 | 0.000 | 0.1475 | 0.0016 | 0.0000 | 5.85E-06 | 0.0009 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 1.57E-04 |
| 93 | | * | 0.41 | 0.405 | 0.003 | 0.1475 | 0.0016 | 0.0000 | 5.75E-06 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 1.56E-04 |
| 94 | | * | 0.11 | 0.002 | 0.003 | 0.1530 | 0.0016 | 0.0000 | 5.65E-06 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 1.56E-04 |
| 95 | | * | 0.00 | 0.000 | 0.000 | 0.1530 | 0.0015 | 0.0000 | 5.56E-06 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 1.56E-04 |
| 96 | | * | 0.04 | 0.000 | 0.003 | 0.1549 | 0.0015 | 0.0000 | 5.46E-06 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 1.55E-04 |
| 97 | | | 0.21 | 0.078 | 0.083 | 0.1577 | 0.0015 | 0.0000 | 5.37E-06 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 1.55E-04 |
| 98 | | | 0.34 | 0.123 | 0.187 | 0.1593 | 0.0014 | 0.0000 | 5.28E-06 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 1.55E-04 |
| 99 | | | 0.00 | 0.000 | 0.236 | 0.1462 | 0.0014 | 0.0000 | 5.18E-06 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.54E-04 |
| 100 | | | 0.00 | 0.000 | 0.203 | 0.1349 | 0.0014 | 0.0000 | 5.09E-06 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.54E-04 |
| 101 | | | 0.00 | 0.000 | 0.089 | 0.1300 | 0.0013 | 0.0000 | 5.01E-06 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.54E-04 |
| 102 | | | 0.00 | 0.000 | 0.017 | 0.1287 | 0.0114 | 0.0001 | 2.44E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.53E-04 |
| 103 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0172 | 0.0001 | 3.48E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.53E-04 |
| 104 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0169 | 0.0001 | 3.44E-05 | 0.0007 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.53E-04 |
| 105 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0166 | 0.0001 | 3.39E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 1.52E-04 |
| 106 | * | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0163 | 0.0001 | 3.34E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 1.52E-04 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 107 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0160 | 0.0001 | 3.30E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 1.52E-04 |
| 108 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0157 | 0.0001 | 3.25E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 1.51E-04 |
| 109 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0154 | 0.0001 | 3.20E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.51E-04 |
| 110 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0152 | 0.0001 | 3.16E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.51E-04 |
| 111 | | | 0.08 | 0.000 | 0.005 | 0.1328 | 0.0149 | 0.0001 | 3.11E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.50E-04 |
| 112 | | | 0.00 | 0.000 | 0.002 | 0.1327 | 0.0146 | 0.0001 | 3.07E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.50E-04 |
| 113 | | | 0.00 | 0.000 | 0.009 | 0.1322 | 0.0143 | 0.0001 | 3.03E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.50E-04 |
| 114 | | | 0.00 | 0.000 | 0.011 | 0.1316 | 0.0141 | 0.0001 | 2.98E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.50E-04 |
| 115 | | | 0.00 | 0.000 | 0.012 | 0.1309 | 0.0138 | 0.0001 | 2.94E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.49E-04 |
| 116 | | | 0.07 | 0.000 | 0.009 | 0.1342 | 0.0135 | 0.0001 | 2.90E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.49E-04 |
| 117 | | | 0.15 | 0.014 | 0.012 | 0.1412 | 0.0133 | 0.0001 | 2.86E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.49E-04 |
| 118 | * | | 0.00 | 0.000 | 0.003 | 0.1412 | 0.0130 | 0.0001 | 2.82E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.48E-04 |
| 119 | * | | 0.44 | 0.000 | 0.021 | 0.1423 | 0.0128 | 0.0001 | 2.78E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 1.48E-04 |
| 120 | * | | 0.02 | 0.000 | 0.033 | 0.1434 | 0.0126 | 0.0001 | 2.74E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 1.48E-04 |
| 121 | | | 0.00 | 0.158 | 0.074 | 0.1509 | 0.0123 | 0.0001 | 2.70E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 1.47E-04 |
| 122 | | | 0.00 | 0.000 | 0.079 | 0.1465 | 0.0123 | 0.0001 | 2.70E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 1.47E-04 |
| 123 | | | 0.00 | 0.000 | 0.012 | 0.1458 | 0.0122 | 0.0001 | 2.68E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 1.47E-04 |
| 124 | | | 0.00 | 0.000 | 0.012 | 0.1451 | 0.0120 | 0.0001 | 2.65E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.46E-04 |
| 125 | | | 0.25 | 0.114 | 0.015 | 0.1520 | 0.0118 | 0.0001 | 2.61E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.46E-04 |
| 126 | | | 0.14 | 0.003 | 0.121 | 0.1528 | 0.0116 | 0.0001 | 2.58E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.46E-04 |
| 127 | | | 0.00 | 0.000 | 0.015 | 0.1519 | 0.0121 | 0.0001 | 2.67E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.46E-04 |
| 128 | | | 0.14 | 0.016 | 0.015 | 0.1581 | 0.0161 | 0.0001 | 3.30E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.45E-04 |
| 129 | | | 0.08 | 0.000 | 0.125 | 0.1553 | 0.0169 | 0.0001 | 3.44E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.45E-04 |
| 130 | | | 0.31 | 0.156 | 0.019 | 0.1626 | 0.0167 | 0.0001 | 3.39E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.45E-04 |
| 131 | | | 0.00 | 0.000 | 0.171 | 0.1531 | 0.0170 | 0.0001 | 3.45E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.44E-04 |
| 132 | | | 0.00 | 0.000 | 0.011 | 0.1525 | 0.0170 | 0.0001 | 3.45E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 1.44E-04 |
| 133 | | | 0.00 | 0.000 | 0.010 | 0.1519 | 0.0167 | 0.0001 | 3.40E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 1.44E-04 |
| 134 | | | 0.61 | 0.429 | 0.018 | 0.1608 | 0.0164 | 0.0001 | 3.36E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 1.43E-04 |
| 135 | | | 0.00 | 0.000 | 0.266 | 0.1461 | 0.0161 | 0.0001 | 3.31E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 1.43E-04 |
| 136 | | | 0.00 | 0.000 | 0.246 | 0.1325 | 0.0158 | 0.0001 | 3.27E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.43E-04 |
| 137 | | | 1.02 | 0.669 | 0.147 | 0.1436 | 0.0157 | 0.0001 | 3.24E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.43E-04 |
| 138 | | | 0.15 | 0.015 | 0.167 | 0.1417 | 0.0227 | 0.0001 | 4.24E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.42E-04 |
| 139 | | | 0.27 | 0.114 | 0.133 | 0.1428 | 0.0343 | 0.0002 | 5.88E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.42E-04 |
| 140 | | | 0.18 | 0.039 | 0.117 | 0.1442 | 0.0337 | 0.0002 | 5.80E-05 | 0.0007 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 1.42E-04 |
| 141 | | | 0.00 | 0.000 | 0.101 | 0.1387 | 0.0331 | 0.0002 | 5.72E-05 | 0.0007 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 1.41E-04 |
| 142 | | | 0.10 | 0.000 | 0.118 | 0.1376 | 0.0325 | 0.0002 | 5.64E-05 | 0.0006 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 1.41E-04 |
| 143 | | | 0.00 | 0.000 | 0.121 | 0.1308 | 0.0319 | 0.0002 | 5.57E-05 | 0.0006 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 1.41E-04 |
| 144 | | | 0.00 | 0.000 | 0.027 | 0.1292 | 0.0349 | 0.0002 | 5.96E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 1.41E-04 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 145 | 0.42 | 0.185 | 0.063 | 0.1387 | 0.0364 | 0.0002 | 6.15E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 1.40E-04 |
| 146 | 0.00 | 0.000 | 0.027 | 0.1373 | 0.0359 | 0.0002 | 6.08E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 1.40E-04 |
| 147 | 0.05 | 0.000 | 0.026 | 0.1386 | 0.0369 | 0.0002 | 6.22E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 1.40E-04 |
| 148 | 0.07 | 0.000 | 0.024 | 0.1413 | 0.0370 | 0.0002 | 6.23E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 1.39E-04 |
| 149 | 0.09 | 0.000 | 0.017 | 0.1453 | 0.0370 | 0.0002 | 6.23E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 1.39E-04 |
| 150 | 0.03 | 0.000 | 0.061 | 0.1436 | 0.0367 | 0.0002 | 6.19E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 1.39E-04 |
| 151 | 0.00 | 0.000 | 0.020 | 0.1425 | 0.0361 | 0.0002 | 6.11E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 1.39E-04 |
| 152 | 0.00 | 0.000 | 0.023 | 0.1412 | 0.0355 | 0.0002 | 6.03E-05 | 0.0006 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 1.38E-04 |
| 153 | 0.19 | 0.056 | 0.024 | 0.1473 | 0.0366 | 0.0002 | 6.18E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 1.38E-04 |
| 154 | 0.00 | 0.000 | 0.083 | 0.1427 | 0.0371 | 0.0002 | 6.24E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 1.38E-04 |
| 155 | 0.05 | 0.000 | 0.020 | 0.1441 | 0.0370 | 0.0002 | 6.23E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 1.38E-04 |
| 156 | 0.00 | 0.000 | 0.017 | 0.1431 | 0.0367 | 0.0002 | 6.19E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 1.37E-04 |
| 157 | 0.00 | 0.000 | 0.018 | 0.1421 | 0.0360 | 0.0002 | 6.11E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 1.37E-04 |
| 158 | 0.47 | 0.285 | 0.025 | 0.1507 | 0.0355 | 0.0002 | 6.04E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 1.37E-04 |
| 159 | 0.22 | 0.081 | 0.107 | 0.1523 | 0.0354 | 0.0002 | 6.02E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 1.37E-04 |
| 160 | 0.08 | 0.000 | 0.099 | 0.1510 | 0.0374 | 0.0002 | 6.28E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 1.36E-04 |
| 161 | 0.00 | 0.000 | 0.159 | 0.1421 | 0.0383 | 0.0002 | 6.40E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 1.36E-04 |
| 162 | 0.73 | 0.417 | 0.148 | 0.1514 | 0.0377 | 0.0002 | 6.31E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.36E-04 |
| 163 | 1.39 | 1.093 | 0.181 | 0.1578 | 0.0370 | 0.0002 | 6.23E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.35E-04 |
| 164 | 0.04 | 0.000 | 0.105 | 0.1541 | 0.0363 | 0.0002 | 6.14E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 1.35E-04 |
| 165 | 0.15 | 0.001 | 0.102 | 0.1566 | 0.0360 | 0.0002 | 6.11E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 1.35E-04 |
| 166 | 0.02 | 0.000 | 0.186 | 0.1470 | 0.0366 | 0.0002 | 6.17E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 1.35E-04 |
| 167 | 0.02 | 0.000 | 0.119 | 0.1413 | 0.0424 | 0.0002 | 6.91E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 1.34E-04 |
| 168 | 0.00 | 0.000 | 0.182 | 0.1313 | 0.0439 | 0.0002 | 7.09E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.34E-04 |
| 169 | 0.01 | 0.000 | 0.052 | 0.1291 | 0.0431 | 0.0002 | 6.99E-05 | 0.0012 | 0.0000 | 7.12E-09 | 0.0000 | 0.0000 | 1.34E-04 |
| 170 | 0.37 | 0.162 | 0.062 | 0.1370 | 0.0491 | 0.0002 | 7.72E-05 | 0.0012 | 0.0000 | 7.13E-09 | 0.0000 | 0.0000 | 1.34E-04 |
| 171 | 0.82 | 0.385 | 0.317 | 0.1434 | 0.0523 | 0.0003 | 8.11E-05 | 0.0013 | 0.0000 | 7.15E-09 | 0.0000 | 0.0000 | 1.33E-04 |
| 172 | 0.00 | 0.000 | 0.157 | 0.1347 | 0.0514 | 0.0003 | 8.00E-05 | 0.0013 | 0.0000 | 7.16E-09 | 0.0000 | 0.0000 | 1.33E-04 |
| 173 | 0.00 | 0.000 | 0.090 | 0.1297 | 0.0505 | 0.0002 | 7.90E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 1.33E-04 |
| 174 | 0.78 | 0.444 | 0.148 | 0.1403 | 0.0497 | 0.0002 | 7.79E-05 | 0.0015 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 1.33E-04 |
| 175 | 1.15 | 0.746 | 0.291 | 0.1468 | 0.0488 | 0.0002 | 7.69E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 1.32E-04 |
| 176 | 0.13 | 0.000 | 0.175 | 0.1443 | 0.0482 | 0.0002 | 7.61E-05 | 0.0016 | 0.0000 | 7.21E-09 | 0.0000 | 0.0000 | 1.32E-04 |
| 177 | 0.00 | 0.000 | 0.113 | 0.1379 | 0.0515 | 0.0003 | 8.01E-05 | 0.0016 | 0.0000 | 7.23E-09 | 0.0000 | 0.0000 | 1.32E-04 |
| 178 | 0.01 | 0.000 | 0.140 | 0.1307 | 0.0528 | 0.0003 | 8.17E-05 | 0.0017 | 0.0000 | 7.24E-09 | 0.0000 | 0.0000 | 1.32E-04 |
| 179 | 0.43 | 0.155 | 0.147 | 0.1377 | 0.0519 | 0.0003 | 8.06E-05 | 0.0017 | 0.0000 | 7.25E-09 | 0.0000 | 0.0000 | 1.31E-04 |
| 180 | 0.00 | 0.000 | 0.096 | 0.1324 | 0.0510 | 0.0003 | 7.95E-05 | 0.0018 | 0.0000 | 7.26E-09 | 0.0000 | 0.0000 | 1.31E-04 |
| 181 | 0.00 | 0.000 | 0.041 | 0.1299 | 0.0567 | 0.0003 | 8.62E-05 | 0.0018 | 0.0000 | 7.28E-09 | 0.0000 | 0.0000 | 1.31E-04 |
| 182 | 0.00 | 0.000 | 0.015 | 0.1290 | 0.0597 | 0.0003 | 8.96E-05 | 0.0019 | 0.0000 | 7.29E-09 | 0.0000 | 0.0000 | 1.31E-04 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 183 | 0.00 | 0.000 | 0.005 | 0.1288 | 0.0587 | 0.0003 | 8.85E-05 | 0.0019 | 0.0000 | 7.30E-09 | 0.0000 | 0.0000 | 1.30E-04 |
| 184 | 0.05 | 0.000 | 0.007 | 0.1310 | 0.0584 | 0.0003 | 8.82E-05 | 0.0020 | 0.0000 | 7.31E-09 | 0.0000 | 0.0000 | 1.30E-04 |
| 185 | 0.00 | 0.000 | 0.003 | 0.1309 | 0.0579 | 0.0003 | 8.76E-05 | 0.0020 | 0.0000 | 7.32E-09 | 0.0000 | 0.0000 | 1.30E-04 |
| 186 | 0.00 | 0.000 | 0.006 | 0.1306 | 0.0569 | 0.0003 | 8.65E-05 | 0.0021 | 0.0000 | 7.33E-09 | 0.0000 | 0.0000 | 1.30E-04 |
| 187 | 0.11 | 0.000 | 0.009 | 0.1363 | 0.0560 | 0.0003 | 8.54E-05 | 0.0021 | 0.0000 | 7.34E-09 | 0.0000 | 0.0000 | 1.30E-04 |
| 188 | 1.26 | 1.109 | 0.028 | 0.1432 | 0.0550 | 0.0003 | 8.43E-05 | 0.0022 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 1.29E-04 |
| 189 | 0.59 | 0.142 | 0.336 | 0.1497 | 0.0541 | 0.0003 | 8.32E-05 | 0.0022 | 0.0000 | 7.36E-09 | 0.0000 | 0.0000 | 1.29E-04 |
| 190 | 0.12 | 0.000 | 0.084 | 0.1517 | 0.0532 | 0.0003 | 8.21E-05 | 0.0022 | 0.0000 | 7.37E-09 | 0.0000 | 0.0000 | 1.29E-04 |
| 191 | 0.30 | 0.109 | 0.177 | 0.1524 | 0.0523 | 0.0003 | 8.11E-05 | 0.0023 | 0.0000 | 7.38E-09 | 0.0000 | 0.0000 | 1.29E-04 |
| 192 | 0.06 | 0.000 | 0.128 | 0.1486 | 0.0515 | 0.0003 | 8.01E-05 | 0.0023 | 0.0000 | 7.39E-09 | 0.0000 | 0.0000 | 1.28E-04 |
| 193 | 0.05 | 0.000 | 0.114 | 0.1449 | 0.0506 | 0.0002 | 7.90E-05 | 0.0024 | 0.0000 | 7.40E-09 | 0.0000 | 0.0000 | 1.28E-04 |
| 194 | 0.02 | 0.000 | 0.103 | 0.1400 | 0.0527 | 0.0003 | 8.15E-05 | 0.0024 | 0.0000 | 7.41E-09 | 0.0000 | 0.0000 | 1.28E-04 |
| 195 | 0.04 | 0.000 | 0.134 | 0.1346 | 0.0535 | 0.0003 | 8.25E-05 | 0.0025 | 0.0000 | 7.42E-09 | 0.0000 | 0.0000 | 1.28E-04 |
| 196 | 0.00 | 0.000 | 0.062 | 0.1312 | 0.0526 | 0.0003 | 8.14E-05 | 0.0025 | 0.0000 | 7.43E-09 | 0.0000 | 0.0000 | 1.27E-04 |
| 197 | 0.25 | 0.096 | 0.031 | 0.1378 | 0.0562 | 0.0003 | 8.56E-05 | 0.0025 | 0.0000 | 7.44E-09 | 0.0000 | 0.0000 | 1.27E-04 |
| 198 | 0.00 | 0.000 | 0.024 | 0.1365 | 0.0579 | 0.0003 | 8.76E-05 | 0.0026 | 0.0000 | 7.45E-09 | 0.0000 | 0.0000 | 1.27E-04 |
| 199 | 0.00 | 0.000 | 0.021 | 0.1353 | 0.0569 | 0.0003 | 8.64E-05 | 0.0026 | 0.0000 | 7.45E-09 | 0.0000 | 0.0000 | 1.27E-04 |
| 200 | 0.00 | 0.000 | 0.023 | 0.1341 | 0.0562 | 0.0003 | 8.56E-05 | 0.0026 | 0.0000 | 7.46E-09 | 0.0000 | 0.0000 | 1.26E-04 |
| 201 | 0.08 | 0.000 | 0.024 | 0.1371 | 0.0554 | 0.0003 | 8.47E-05 | 0.0027 | 0.0000 | 7.47E-09 | 0.0000 | 0.0000 | 1.26E-04 |
| 202 | 0.00 | 0.000 | 0.017 | 0.1362 | 0.0545 | 0.0003 | 8.36E-05 | 0.0027 | 0.0000 | 7.48E-09 | 0.0000 | 0.0000 | 1.26E-04 |
| 203 | 0.00 | 0.000 | 0.012 | 0.1356 | 0.0540 | 0.0003 | 8.31E-05 | 0.0027 | 0.0000 | 7.48E-09 | 0.0000 | 0.0000 | 1.26E-04 |
| 204 | 0.20 | 0.067 | 0.018 | 0.1420 | 0.0533 | 0.0003 | 8.22E-05 | 0.0028 | 0.0000 | 7.49E-09 | 0.0000 | 0.0000 | 1.26E-04 |
| 205 | 0.00 | 0.000 | 0.011 | 0.1414 | 0.0524 | 0.0003 | 8.12E-05 | 0.0028 | 0.0000 | 7.50E-09 | 0.0000 | 0.0000 | 1.25E-04 |
| 206 | 0.00 | 0.000 | 0.011 | 0.1408 | 0.0518 | 0.0003 | 8.04E-05 | 0.0028 | 0.0000 | 7.51E-09 | 0.0000 | 0.0000 | 1.25E-04 |
| 207 | 0.45 | 0.264 | 0.025 | 0.1496 | 0.0511 | 0.0003 | 7.96E-05 | 0.0029 | 0.0000 | 7.51E-09 | 0.0000 | 0.0000 | 1.25E-04 |
| 208 | 0.13 | 0.002 | 0.071 | 0.1530 | 0.0502 | 0.0002 | 7.86E-05 | 0.0028 | 0.0000 | 7.50E-09 | 0.0000 | 0.0000 | 1.25E-04 |
| 209 | 0.00 | 0.000 | 0.073 | 0.1490 | 0.0493 | 0.0002 | 7.75E-05 | 0.0028 | 0.0000 | 7.49E-09 | 0.0000 | 0.0000 | 1.24E-04 |
| 210 | 0.00 | 0.000 | 0.100 | 0.1434 | 0.0487 | 0.0002 | 7.68E-05 | 0.0027 | 0.0000 | 7.48E-09 | 0.0000 | 0.0000 | 1.24E-04 |
| 211 | 0.11 | 0.000 | 0.100 | 0.1437 | 0.0480 | 0.0002 | 7.59E-05 | 0.0027 | 0.0000 | 7.47E-09 | 0.0000 | 0.0000 | 1.24E-04 |
| 212 | 0.01 | 0.000 | 0.052 | 0.1411 | 0.0471 | 0.0002 | 7.49E-05 | 0.0026 | 0.0000 | 7.46E-09 | 0.0000 | 0.0000 | 1.24E-04 |
| 213 | 0.00 | 0.000 | 0.040 | 0.1389 | 0.0463 | 0.0002 | 7.39E-05 | 0.0026 | 0.0000 | 7.45E-09 | 0.0000 | 0.0000 | 1.24E-04 |
| 214 | 0.00 | 0.000 | 0.034 | 0.1369 | 0.0462 | 0.0002 | 7.37E-05 | 0.0025 | 0.0000 | 7.44E-09 | 0.0000 | 0.0000 | 1.23E-04 |
| 215 | 0.00 | 0.000 | 0.023 | 0.1356 | 0.0507 | 0.0002 | 7.91E-05 | 0.0025 | 0.0000 | 7.43E-09 | 0.0000 | 0.0000 | 1.23E-04 |
| 216 | 0.06 | 0.000 | 0.024 | 0.1377 | 0.0502 | 0.0002 | 7.85E-05 | 0.0024 | 0.0000 | 7.42E-09 | 0.0000 | 0.0000 | 1.23E-04 |
| 217 | 0.09 | 0.000 | 0.024 | 0.1411 | 0.0494 | 0.0002 | 7.76E-05 | 0.0024 | 0.0000 | 7.41E-09 | 0.0000 | 0.0000 | 1.23E-04 |
| 218 | 0.00 | 0.000 | 0.022 | 0.1399 | 0.0486 | 0.0002 | 7.66E-05 | 0.0024 | 0.0000 | 7.40E-09 | 0.0000 | 0.0000 | 1.23E-04 |
| 219 | 0.11 | 0.000 | 0.018 | 0.1448 | 0.0502 | 0.0002 | 7.85E-05 | 0.0023 | 0.0000 | 7.39E-09 | 0.0000 | 0.0000 | 1.22E-04 |
| 220 | 0.00 | 0.000 | 0.012 | 0.1442 | 0.0508 | 0.0003 | 7.93E-05 | 0.0023 | 0.0000 | 7.38E-09 | 0.0000 | 0.0000 | 1.22E-04 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 221 | 0.00 | 0.000 | 0.010 | 0.1436 | 0.0501 | 0.0002 | 7.84E-05 | 0.0022 | 0.0000 | 7.37E-09 | 0.0000 | 0.0000 | 1.22E-04 |
| 222 | 0.29 | 0.136 | 0.016 | 0.1512 | 0.0493 | 0.0002 | 7.75E-05 | 0.0022 | 0.0000 | 7.36E-09 | 0.0000 | 0.0000 | 1.22E-04 |
| 223 | 0.58 | 0.298 | 0.169 | 0.1577 | 0.0484 | 0.0002 | 7.65E-05 | 0.0022 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 1.21E-04 |
| 224 | 0.17 | 0.036 | 0.102 | 0.1594 | 0.0476 | 0.0002 | 7.54E-05 | 0.0021 | 0.0000 | 7.34E-09 | 0.0000 | 0.0000 | 1.21E-04 |
| 225 | 0.00 | 0.000 | 0.134 | 0.1519 | 0.0471 | 0.0002 | 7.48E-05 | 0.0021 | 0.0000 | 7.33E-09 | 0.0000 | 0.0000 | 1.21E-04 |
| 226 | 0.00 | 0.000 | 0.102 | 0.1462 | 0.0464 | 0.0002 | 7.40E-05 | 0.0020 | 0.0000 | 7.33E-09 | 0.0000 | 0.0000 | 1.21E-04 |
| 227 | 0.01 | 0.000 | 0.107 | 0.1406 | 0.0456 | 0.0002 | 7.30E-05 | 0.0020 | 0.0000 | 7.32E-09 | 0.0000 | 0.0000 | 1.21E-04 |
| 228 | 0.00 | 0.000 | 0.165 | 0.1314 | 0.0448 | 0.0002 | 7.21E-05 | 0.0020 | 0.0000 | 7.31E-09 | 0.0000 | 0.0000 | 1.20E-04 |
| 229 | 0.00 | 0.000 | 0.039 | 0.1293 | 0.0440 | 0.0002 | 7.11E-05 | 0.0019 | 0.0000 | 7.30E-09 | 0.0000 | 0.0000 | 1.20E-04 |
| 230 | 0.00 | 0.000 | 0.006 | 0.1287 | 0.0524 | 0.0003 | 8.10E-05 | 0.0019 | 0.0000 | 7.29E-09 | 0.0000 | 0.0000 | 1.20E-04 |
| 231 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0569 | 0.0003 | 8.64E-05 | 0.0019 | 0.0000 | 7.29E-09 | 0.0000 | 0.0000 | 1.20E-04 |
| 232 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0559 | 0.0003 | 8.53E-05 | 0.0018 | 0.0000 | 7.28E-09 | 0.0000 | 0.0000 | 1.20E-04 |
| 233 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0549 | 0.0003 | 8.42E-05 | 0.0018 | 0.0000 | 7.27E-09 | 0.0000 | 0.0000 | 1.19E-04 |
| 234 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0540 | 0.0003 | 8.31E-05 | 0.0018 | 0.0000 | 7.26E-09 | 0.0000 | 0.0000 | 1.19E-04 |
| 235 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0531 | 0.0003 | 8.20E-05 | 0.0017 | 0.0000 | 7.26E-09 | 0.0000 | 0.0000 | 1.19E-04 |
| 236 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0522 | 0.0003 | 8.09E-05 | 0.0017 | 0.0000 | 7.25E-09 | 0.0000 | 0.0000 | 1.19E-04 |
| 237 | 0.32 | 0.145 | 0.014 | 0.1377 | 0.0513 | 0.0003 | 7.98E-05 | 0.0017 | 0.0000 | 7.24E-09 | 0.0000 | 0.0000 | 1.19E-04 |
| 238 | 0.00 | 0.000 | 0.010 | 0.1372 | 0.0504 | 0.0002 | 7.88E-05 | 0.0017 | 0.0000 | 7.24E-09 | 0.0000 | 0.0000 | 1.18E-04 |
| 239 | 0.00 | 0.000 | 0.010 | 0.1366 | 0.0495 | 0.0002 | 7.78E-05 | 0.0016 | 0.0000 | 7.23E-09 | 0.0000 | 0.0000 | 1.18E-04 |
| 240 | 0.00 | 0.000 | 0.012 | 0.1359 | 0.0487 | 0.0002 | 7.67E-05 | 0.0016 | 0.0000 | 7.22E-09 | 0.0000 | 0.0000 | 1.18E-04 |
| 241 | 0.00 | 0.000 | 0.013 | 0.1352 | 0.0478 | 0.0002 | 7.57E-05 | 0.0016 | 0.0000 | 7.22E-09 | 0.0000 | 0.0000 | 1.18E-04 |
| 242 | 0.00 | 0.000 | 0.014 | 0.1346 | 0.0470 | 0.0002 | 7.47E-05 | 0.0015 | 0.0000 | 7.21E-09 | 0.0000 | 0.0000 | 1.18E-04 |
| 243 | 0.00 | 0.000 | 0.013 | 0.1339 | 0.0462 | 0.0002 | 7.38E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 1.17E-04 |
| 244 | 0.00 | 0.000 | 0.013 | 0.1332 | 0.0454 | 0.0002 | 7.28E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 1.17E-04 |
| 245 | 0.00 | 0.000 | 0.012 | 0.1325 | 0.0447 | 0.0002 | 7.19E-05 | 0.0015 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 1.17E-04 |
| 246 | 0.00 | 0.000 | 0.012 | 0.1319 | 0.0440 | 0.0002 | 7.10E-05 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 1.17E-04 |
| 247 | 0.08 | 0.000 | 0.015 | 0.1356 | 0.0432 | 0.0002 | 7.01E-05 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 1.17E-04 |
| 248 | 0.02 | 0.000 | 0.014 | 0.1362 | 0.0425 | 0.0002 | 6.92E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 1.16E-04 |
| 249 | 0.78 | 0.626 | 0.019 | 0.1437 | 0.0418 | 0.0002 | 6.83E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 1.16E-04 |
| 250 | 0.64 | 0.326 | 0.196 | 0.1501 | 0.0410 | 0.0002 | 6.74E-05 | 0.0013 | 0.0000 | 7.16E-09 | 0.0000 | 0.0000 | 1.16E-04 |
| 251 | 0.45 | 0.190 | 0.139 | 0.1566 | 0.0403 | 0.0002 | 6.65E-05 | 0.0013 | 0.0000 | 7.16E-09 | 0.0000 | 0.0000 | 1.16E-04 |
| 252 | 0.99 | 0.628 | 0.248 | 0.1630 | 0.0396 | 0.0002 | 6.56E-05 | 0.0013 | 0.0000 | 7.15E-09 | 0.0000 | 0.0000 | 1.16E-04 |
| 253 | 0.03 | 0.000 | 0.210 | 0.1532 | 0.0393 | 0.0002 | 6.53E-05 | 0.0013 | 0.0000 | 7.14E-09 | 0.0000 | 0.0000 | 1.15E-04 |
| 254 | 0.00 | 0.000 | 0.175 | 0.1435 | 0.0389 | 0.0002 | 6.47E-05 | 0.0012 | 0.0000 | 7.14E-09 | 0.0000 | 0.0000 | 1.15E-04 |
| 255 | 0.00 | 0.000 | 0.090 | 0.1385 | 0.0382 | 0.0002 | 6.38E-05 | 0.0012 | 0.0000 | 7.13E-09 | 0.0000 | 0.0000 | 1.15E-04 |
| 256 | 0.00 | 0.000 | 0.129 | 0.1313 | 0.0375 | 0.0002 | 6.30E-05 | 0.0012 | 0.0000 | 7.13E-09 | 0.0000 | 0.0000 | 1.15E-04 |
| 257 | 1.56 | 1.210 | 0.147 | 0.1425 | 0.0369 | 0.0002 | 6.21E-05 | 0.0012 | 0.0000 | 7.12E-09 | 0.0000 | 0.0000 | 1.15E-04 |
| 258 | 0.00 | 0.000 | 0.155 | 0.1338 | 0.0368 | 0.0002 | 6.20E-05 | 0.0012 | 0.0000 | 7.12E-09 | 0.0000 | 0.0000 | 1.15E-04 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 259 | 0.00 | 0.000 | 0.062 | 0.1301 | 0.0466 | 0.0002 | 7.41E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 1.14E-04 |
| 260 | 0.00 | 0.000 | 0.019 | 0.1290 | 0.0510 | 0.0003 | 7.95E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 1.14E-04 |
| 261 | 0.00 | 0.000 | 0.003 | 0.1287 | 0.0553 | 0.0003 | 8.46E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.14E-04 |
| 262 | 0.11 | 0.000 | 0.008 | 0.1341 | 0.0575 | 0.0003 | 8.71E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 1.14E-04 |
| 263 | 0.00 | 0.000 | 0.019 | 0.1330 | 0.0565 | 0.0003 | 8.60E-05 | 0.0011 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 1.14E-04 |
| 264 | 0.04 | 0.000 | 0.023 | 0.1337 | 0.0555 | 0.0003 | 8.48E-05 | 0.0010 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 1.13E-04 |
| 265 | 0.00 | 0.000 | 0.021 | 0.1325 | 0.0546 | 0.0003 | 8.37E-05 | 0.0010 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 1.13E-04 |
| 266 | 0.00 | 0.000 | 0.015 | 0.1317 | 0.0538 | 0.0003 | 8.29E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 1.13E-04 |
| 267 | 0.00 | 0.000 | 0.015 | 0.1309 | 0.0536 | 0.0003 | 8.26E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 1.13E-04 |
| 268 | 0.33 | 0.157 | 0.030 | 0.1386 | 0.0528 | 0.0003 | 8.16E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 1.13E-04 |
| 269 | 0.00 | 0.000 | 0.013 | 0.1378 | 0.0519 | 0.0003 | 8.06E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 1.12E-04 |
| 270 | 0.00 | 0.000 | 0.011 | 0.1372 | 0.0514 | 0.0003 | 8.00E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 1.12E-04 |
| 271 | 0.00 | 0.000 | 0.013 | 0.1365 | 0.0507 | 0.0002 | 7.92E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 1.12E-04 |
| 272 | 0.00 | 0.000 | 0.014 | 0.1357 | 0.0499 | 0.0002 | 7.82E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 1.12E-04 |
| 273 | 0.00 | 0.000 | 0.013 | 0.1350 | 0.0490 | 0.0002 | 7.71E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 1.12E-04 |
| 274 | 0.00 | 0.000 | 0.013 | 0.1343 | 0.0482 | 0.0002 | 7.61E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 1.12E-04 |
| 275 | 0.03 | 0.000 | 0.016 | 0.1349 | 0.0473 | 0.0002 | 7.51E-05 | 0.0009 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 1.11E-04 |
| 276 | 0.01 | 0.000 | 0.016 | 0.1345 | 0.0465 | 0.0002 | 7.41E-05 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 1.11E-04 |
| 277 | 0.00 | 0.000 | 0.012 | 0.1339 | 0.0457 | 0.0002 | 7.32E-05 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 1.11E-04 |
| 278 | 0.00 | 0.000 | 0.010 | 0.1333 | 0.0449 | 0.0002 | 7.22E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 1.11E-04 |
| 279 | 0.00 | 0.000 | 0.010 | 0.1327 | 0.0449 | 0.0002 | 7.22E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 1.11E-04 |
| 280 | 0.00 | 0.000 | 0.010 | 0.1322 | 0.0446 | 0.0002 | 7.18E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 1.11E-04 |
| 281 | 0.00 | 0.000 | 0.010 | 0.1316 | 0.0438 | 0.0002 | 7.08E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.10E-04 |
| 282 | 0.00 | 0.000 | 0.010 | 0.1311 | 0.0430 | 0.0002 | 6.99E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.10E-04 |
| 283 | 0.07 | 0.000 | 0.013 | 0.1340 | 0.0423 | 0.0002 | 6.89E-05 | 0.0007 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 1.10E-04 |
| 284 | 0.25 | 0.111 | 0.013 | 0.1410 | 0.0415 | 0.0002 | 6.80E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 1.10E-04 |
| 285 | 0.00 | 0.000 | 0.067 | 0.1373 | 0.0412 | 0.0002 | 6.76E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 1.10E-04 |
| 286 | 0.00 | 0.000 | 0.010 | 0.1368 | 0.0407 | 0.0002 | 6.70E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 1.09E-04 |
| 287 | 0.00 | 0.000 | 0.010 | 0.1362 | 0.0400 | 0.0002 | 6.61E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.09E-04 |
| 288 | 0.05 | 0.000 | 0.013 | 0.1380 | 0.0394 | 0.0002 | 6.53E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.09E-04 |
| 289 | 0.06 | 0.000 | 0.013 | 0.1407 | 0.0387 | 0.0002 | 6.45E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 1.09E-04 |
| 290 | 0.00 | 0.000 | 0.011 | 0.1401 | 0.0381 | 0.0002 | 6.36E-05 | 0.0007 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 1.09E-04 |
| 291 | 0.19 | 0.053 | 0.014 | 0.1467 | 0.0374 | 0.0002 | 6.28E-05 | 0.0007 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 1.09E-04 |
| 292 | 0.05 | 0.000 | 0.057 | 0.1460 | 0.0370 | 0.0002 | 6.23E-05 | 0.0006 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 1.08E-04 |
| 293 | 0.00 | 0.000 | 0.038 | 0.1439 | 0.0375 | 0.0002 | 6.29E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 1.08E-04 |
| 294 | 0.00 | 0.000 | 0.041 | 0.1416 | 0.0379 | 0.0002 | 6.34E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 1.08E-04 |
| 295 | 0.00 | 0.000 | 0.040 | 0.1394 | 0.0372 | 0.0002 | 6.26E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 1.08E-04 |
| 296 | 0.00 | 0.000 | 0.031 | 0.1377 | 0.0366 | 0.0002 | 6.17E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 1.08E-04 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 297 | | | 0.00 | 0.000 | 0.026 | 0.1362 | 0.0359 | 0.0002 | 6.09E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 1.08E-04 |
| 298 | | | 0.00 | 0.000 | 0.023 | 0.1350 | 0.0353 | 0.0002 | 6.01E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 1.07E-04 |
| 299 | | | 0.00 | 0.000 | 0.021 | 0.1338 | 0.0347 | 0.0002 | 5.93E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 1.07E-04 |
| 300 | | | 0.00 | 0.000 | 0.019 | 0.1328 | 0.0341 | 0.0002 | 5.85E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 1.07E-04 |
| 301 | * | | 0.00 | 0.000 | 0.000 | 0.1328 | 0.0335 | 0.0002 | 5.77E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 1.07E-04 |
| 302 | * | | 0.00 | 0.000 | 0.000 | 0.1328 | 0.0329 | 0.0002 | 5.69E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 1.07E-04 |
| 303 | * | | 0.00 | 0.000 | 0.000 | 0.1328 | 0.0323 | 0.0002 | 5.62E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 1.07E-04 |
| 304 | * | | 0.00 | 0.000 | 0.000 | 0.1328 | 0.0317 | 0.0002 | 5.54E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 1.06E-04 |
| 305 | * | | 0.00 | 0.000 | 0.000 | 0.1328 | 0.0312 | 0.0002 | 5.47E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 1.06E-04 |
| 306 | | | 0.00 | 0.000 | 0.018 | 0.1318 | 0.0306 | 0.0002 | 5.39E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 1.06E-04 |
| 307 | | | 0.00 | 0.000 | 0.017 | 0.1309 | 0.0301 | 0.0001 | 5.32E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 1.06E-04 |
| 308 | | | 0.01 | 0.000 | 0.019 | 0.1306 | 0.0295 | 0.0001 | 5.25E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 1.06E-04 |
| 309 | | | 0.00 | 0.000 | 0.018 | 0.1296 | 0.0290 | 0.0001 | 5.18E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 1.06E-04 |
| 310 | | | 0.00 | 0.000 | 0.010 | 0.1289 | 0.0311 | 0.0002 | 5.46E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 1.06E-04 |
| 311 | | | 0.00 | 0.000 | 0.003 | 0.1288 | 0.0323 | 0.0002 | 5.61E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 1.05E-04 |
| 312 | | | 0.00 | 0.000 | 0.001 | 0.1287 | 0.0317 | 0.0002 | 5.54E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 1.05E-04 |
| 313 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0311 | 0.0002 | 5.46E-05 | 0.0004 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 1.05E-04 |
| 314 | | | 0.04 | 0.000 | 0.005 | 0.1305 | 0.0306 | 0.0002 | 5.39E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 1.05E-04 |
| 315 | * | | 0.00 | 0.000 | 0.002 | 0.1304 | 0.0301 | 0.0001 | 5.32E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 1.05E-04 |
| 316 | | | 0.04 | 0.000 | 0.006 | 0.1324 | 0.0295 | 0.0001 | 5.25E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 1.05E-04 |
| 317 | * | | 0.00 | 0.000 | 0.000 | 0.1324 | 0.0290 | 0.0001 | 5.18E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 1.04E-04 |
| 318 | | | 0.00 | 0.000 | 0.008 | 0.1320 | 0.0285 | 0.0001 | 5.11E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 1.04E-04 |
| 319 | * | | 0.00 | 0.000 | 0.000 | 0.1320 | 0.0280 | 0.0001 | 5.04E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 1.04E-04 |
| 320 | * | | 0.00 | 0.000 | 0.000 | 0.1320 | 0.0275 | 0.0001 | 4.97E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 1.04E-04 |
| 321 | | | 0.00 | 0.000 | 0.007 | 0.1315 | 0.0270 | 0.0001 | 4.90E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 1.04E-04 |
| 322 | * | | 0.00 | 0.000 | 0.000 | 0.1315 | 0.0265 | 0.0001 | 4.84E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 1.04E-04 |
| 323 | * | | 0.00 | 0.000 | 0.000 | 0.1315 | 0.0261 | 0.0001 | 4.77E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 1.03E-04 |
| 324 | * | | 0.00 | 0.000 | 0.000 | 0.1315 | 0.0256 | 0.0001 | 4.70E-05 | 0.0004 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 1.03E-04 |
| 325 | * | | 0.00 | 0.000 | 0.000 | 0.1315 | 0.0251 | 0.0001 | 4.64E-05 | 0.0004 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 1.03E-04 |
| 326 | * | | 0.00 | 0.000 | 0.010 | 0.1310 | 0.0247 | 0.0001 | 4.58E-05 | 0.0004 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 1.03E-04 |
| 327 | * | * | 0.00 | 0.000 | 0.000 | 0.1310 | 0.0243 | 0.0001 | 4.53E-05 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 1.03E-04 |
| 328 | * | * | 0.00 | 0.000 | 0.000 | 0.1310 | 0.0239 | 0.0001 | 4.46E-05 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 1.03E-04 |
| 329 | * | * | 0.00 | 0.000 | 0.000 | 0.1310 | 0.0234 | 0.0001 | 4.40E-05 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 1.03E-04 |
| 330 | * | * | 0.00 | 0.000 | 0.000 | 0.1310 | 0.0230 | 0.0001 | 4.34E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 1.02E-04 |
| 331 | * | * | 0.00 | 0.000 | 0.000 | 0.1310 | 0.0226 | 0.0001 | 4.28E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 1.02E-04 |
| 332 | * | * | 0.00 | 0.000 | 0.000 | 0.1310 | 0.0222 | 0.0001 | 4.22E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 1.02E-04 |
| 333 | * | * | 0.00 | 0.000 | 0.000 | 0.1310 | 0.0218 | 0.0001 | 4.16E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 1.02E-04 |
| 334 | * | * | 0.00 | 0.000 | 0.000 | 0.1310 | 0.0214 | 0.0001 | 4.11E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 1.02E-04 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 335 | * | * | 0.17 | 0.000 | 0.044 | 0.1310 | 0.0210 | 0.0001 | 4.05E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 1.02E-04 |
| 336 | | * | 0.00 | 0.002 | 0.082 | 0.1335 | 0.0206 | 0.0001 | 3.99E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 1.02E-04 |
| 337 | | * | 0.00 | 0.000 | 0.000 | 0.1335 | 0.0203 | 0.0001 | 3.94E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 1.01E-04 |
| 338 | | * | 0.00 | 0.000 | 0.000 | 0.1335 | 0.0199 | 0.0001 | 3.88E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 1.01E-04 |
| 339 | | * | 0.00 | 0.000 | 0.000 | 0.1335 | 0.0195 | 0.0001 | 3.83E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 1.01E-04 |
| 340 | | * | 0.00 | 0.000 | 0.000 | 0.1335 | 0.0192 | 0.0001 | 3.78E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 1.01E-04 |
| 341 | | * | 0.00 | 0.000 | 0.000 | 0.1335 | 0.0188 | 0.0001 | 3.72E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 1.01E-04 |
| 342 | | * | 0.02 | 0.000 | 0.003 | 0.1347 | 0.0185 | 0.0001 | 3.67E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 1.01E-04 |
| 343 | | * | 0.00 | 0.000 | 0.000 | 0.1347 | 0.0181 | 0.0001 | 3.62E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 1.00E-04 |
| 344 | | * | 0.00 | 0.000 | 0.000 | 0.1347 | 0.0178 | 0.0001 | 3.57E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 1.00E-04 |
| 345 | | * | 0.00 | 0.000 | 0.000 | 0.1347 | 0.0175 | 0.0001 | 3.52E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 1.00E-04 |
| 346 | | * | 0.00 | 0.000 | 0.000 | 0.1347 | 0.0172 | 0.0001 | 3.47E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 1.00E-04 |
| 347 | | * | 0.00 | 0.000 | 0.000 | 0.1347 | 0.0168 | 0.0001 | 3.42E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 9.99E-05 |
| 348 | * | * | 0.00 | 0.000 | 0.000 | 0.1347 | 0.0165 | 0.0001 | 3.37E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 9.98E-05 |
| 349 | | * | 0.01 | 0.000 | 0.003 | 0.1353 | 0.0162 | 0.0001 | 3.33E-05 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 9.96E-05 |
| 350 | * | * | 0.00 | 0.000 | 0.000 | 0.1353 | 0.0159 | 0.0001 | 3.28E-05 | 0.0004 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 9.95E-05 |
| 351 | | * | 0.12 | 0.001 | 0.003 | 0.1415 | 0.0156 | 0.0001 | 3.23E-05 | 0.0004 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 9.94E-05 |
| 352 | * | * | 0.00 | 0.000 | 0.000 | 0.1415 | 0.0153 | 0.0001 | 3.19E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 9.92E-05 |
| 353 | * | * | 0.03 | 0.000 | 0.018 | 0.1415 | 0.0151 | 0.0001 | 3.14E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 9.91E-05 |
| 354 | * | * | 0.02 | 0.000 | 0.007 | 0.1415 | 0.0148 | 0.0001 | 3.10E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 9.89E-05 |
| 355 | * | * | 0.24 | 0.000 | 0.003 | 0.1415 | 0.0145 | 0.0001 | 3.05E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 9.88E-05 |
| 356 | * | * | 0.04 | 0.000 | 0.002 | 0.1415 | 0.0142 | 0.0001 | 3.01E-05 | 0.0004 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 9.86E-05 |
| 357 | * | * | 0.00 | 0.000 | 0.004 | 0.1415 | 0.0140 | 0.0001 | 2.97E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 9.85E-05 |
| 358 | * | * | 0.00 | 0.000 | 0.006 | 0.1415 | 0.0137 | 0.0001 | 2.93E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 9.84E-05 |
| 359 | * | * | 0.00 | 0.000 | 0.000 | 0.1415 | 0.0134 | 0.0001 | 2.88E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 9.82E-05 |
| 360 | * | * | 0.00 | 0.000 | 0.042 | 0.1415 | 0.0132 | 0.0001 | 2.84E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 9.81E-05 |
| 361 | | * | 0.00 | 0.194 | 0.048 | 0.1415 | 0.0129 | 0.0001 | 2.80E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 9.80E-05 |
| 362 | | * | 0.00 | 0.000 | 0.000 | 0.1415 | 0.0127 | 0.0001 | 2.76E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 9.78E-05 |
| 363 | | * | 0.00 | 0.000 | 0.000 | 0.1415 | 0.0125 | 0.0001 | 2.72E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 9.77E-05 |
| 364 | | * | 0.02 | 0.000 | 0.003 | 0.1424 | 0.0122 | 0.0001 | 2.68E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 9.75E-05 |
| 365 | | * | 0.00 | 0.000 | 0.000 | 0.1424 | 0.0120 | 0.0001 | 2.65E-05 | 0.0006 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 9.74E-05 |

* = Frozen (air or soil)

| Annual Totals for Year 1 | | | |
|---|---|---|---|
| | inches | cubic feet | percent |
| Precipitation | 26.23 | 95,214.0 | 100.00 |

| | | | |
|---|---|---|---|
| Runoff | 12.865 | 46,699.6 | 49.05 |
| Evapotranspiration | 13.302 | 48,284.6 | 50.71 |
| Drainage Collected from Layer 3 | 0.0489 | 177.4 | 0.19 |
| Percolation/Leakage through Layer 4 | 0.017021 | 61.8 | 0.06 |
| Average Head on Top of Layer 4 | 0.0272 | --- | --- |
| Drainage Collected from Layer 7 | 0.0025 | 8.9836 | 0.01 |
| Percolation/Leakage through Layer 9 | 0.000003 | 0.0094 | 0.00 |
| Average Head on Top of Layer 8 | 0.0010 | --- | --- |
| Percolation/Leakage through Layer 10 | 0.049519 | 179.8 | 0.19 |
| Change in Water Storage | -0.0376 | -136.4 | -0.14 |
| Soil Water at Start of Year | 72.4123 | 262,856.7 | 276.07 |
| Soil Water at End of Year | 72.3747 | 262,720.3 | 275.93 |
| Snow Water at Start of Year | 0.0000 | 0.0000 | 0.00 |
| Snow Water at End of Year | 0.0000 | 0.0000 | 0.00 |
| Annual Water Budget Balance | 0.0000 | 0.0000 | 0.00 |

**Daily Output for Year 2**

**Column key:** Head #1: drainage from Layer 4 | Head #2: drainage from Layer 8
Drain #1: drainage from Layer 3 | Drain #2: drainage from Layer 7
Leak #1: leakage thru Layer 4 | Leak #2: leakage thru Layer 9 | Leak #3: leakage thru Layer 10

**Title:** Pilgrim Landfill
**Simulated On:** 4/10/2026 14:14

| Day | Freezing Status* | | Rain | Runoff | ET | Evap. Zone Water | Head #1 | Drain #1 | Leak #1 | Head #2 | Drain #2 | Leak #2 | Head #3 | Drain #3 | Leak #3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air | Soil | (inches) | (inches) | (inches) | (in/in) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) |
| 1 | * | * | 0.00 | 0.000 | 0.000 | 0.1424 | 0.0118 | 0.0001 | 2.61E-05 | 0.0007 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 9.73E-05 |
| 2 | * | * | 0.00 | 0.000 | 0.000 | 0.1424 | 0.0116 | 0.0001 | 2.57E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 9.71E-05 |
| 3 | * | * | 0.00 | 0.000 | 0.000 | 0.1424 | 0.0113 | 0.0001 | 2.53E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 9.70E-05 |
| 4 | * | * | 0.00 | 0.000 | 0.000 | 0.1424 | 0.0111 | 0.0001 | 2.50E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 9.69E-05 |
| 5 | * | * | 0.53 | 0.000 | 0.027 | 0.1424 | 0.0109 | 0.0001 | 2.46E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 9.67E-05 |
| 6 | | * | 0.00 | 0.500 | 0.000 | 0.1424 | 0.0107 | 0.0001 | 2.42E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 9.66E-05 |
| 7 | | * | 0.00 | 0.000 | 0.000 | 0.1424 | 0.0105 | 0.0001 | 2.39E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 9.65E-05 |
| 8 | | * | 0.26 | 0.260 | 0.003 | 0.1424 | 0.0103 | 0.0001 | 2.35E-05 | 0.0009 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 9.63E-05 |
| 9 | | * | 0.41 | 0.406 | 0.003 | 0.1424 | 0.0101 | 0.0000 | 2.32E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 9.62E-05 |
| 10 | | * | 0.00 | 0.000 | 0.000 | 0.1424 | 0.0099 | 0.0000 | 2.29E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 9.61E-05 |
| 11 | | * | 0.00 | 0.000 | 0.000 | 0.1424 | 0.0097 | 0.0000 | 2.25E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 9.59E-05 |
| 12 | | * | 0.00 | 0.000 | 0.000 | 0.1424 | 0.0095 | 0.0000 | 2.22E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 9.58E-05 |
| 13 | * | * | 0.00 | 0.000 | 0.000 | 0.1424 | 0.0093 | 0.0000 | 2.19E-05 | 0.0009 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 9.57E-05 |
| 14 | * | * | 0.00 | 0.000 | 0.000 | 0.1424 | 0.0092 | 0.0000 | 2.16E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 9.55E-05 |
| 15 | | * | 0.00 | 0.000 | 0.000 | 0.1424 | 0.0090 | 0.0000 | 2.12E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 9.54E-05 |
| 16 | | * | 0.00 | 0.000 | 0.000 | 0.1424 | 0.0088 | 0.0000 | 2.09E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 9.53E-05 |
| 17 | | * | 0.00 | 0.000 | 0.000 | 0.1424 | 0.0086 | 0.0000 | 2.06E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 9.51E-05 |
| 18 | | * | 0.00 | 0.000 | 0.000 | 0.1424 | 0.0085 | 0.0000 | 2.03E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 9.50E-05 |
| 19 | | * | 0.05 | 0.000 | 0.003 | 0.1450 | 0.0083 | 0.0000 | 2.00E-05 | 0.0010 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 9.49E-05 |
| 20 | * | * | 0.00 | 0.000 | 0.000 | 0.1450 | 0.0082 | 0.0000 | 1.97E-05 | 0.0010 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 9.47E-05 |
| 21 | * | * | 0.00 | 0.000 | 0.000 | 0.1450 | 0.0080 | 0.0000 | 1.94E-05 | 0.0010 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 9.46E-05 |
| 22 | * | * | 0.16 | 0.000 | 0.039 | 0.1450 | 0.0078 | 0.0000 | 1.91E-05 | 0.0011 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 9.45E-05 |
| 23 | | * | 0.00 | 0.000 | 0.044 | 0.1463 | 0.0077 | 0.0000 | 1.88E-05 | 0.0011 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 9.44E-05 |
| 24 | | * | 0.00 | 0.000 | 0.054 | 0.1463 | 0.0075 | 0.0000 | 1.86E-05 | 0.0011 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 9.42E-05 |
| 25 | * | * | 0.00 | 0.000 | 0.000 | 0.1463 | 0.0074 | 0.0000 | 1.83E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 9.41E-05 |
| 26 | * | * | 0.00 | 0.000 | 0.000 | 0.1463 | 0.0072 | 0.0000 | 1.80E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 9.40E-05 |
| 27 | | * | 0.00 | 0.000 | 0.000 | 0.1463 | 0.0071 | 0.0000 | 1.77E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 9.39E-05 |
| 28 | | * | 0.00 | 0.000 | 0.000 | 0.1463 | 0.0070 | 0.0000 | 1.75E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 9.37E-05 |
| 29 | * | * | 0.00 | 0.000 | 0.000 | 0.1463 | 0.0068 | 0.0000 | 1.72E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 9.36E-05 |
| 30 | * | * | 0.00 | 0.000 | 0.000 | 0.1463 | 0.0067 | 0.0000 | 1.70E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 9.35E-05 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | | * | 0.10 | 0.001 | 0.003 | 0.1518 | 0.0066 | 0.0000 | 1.67E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 9.33E-05 |
| 32 | * | * | 0.01 | 0.000 | 0.012 | 0.1518 | 0.0064 | 0.0000 | 1.65E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 9.32E-05 |
| 33 | * | * | 0.00 | 0.000 | 0.000 | 0.1518 | 0.0063 | 0.0000 | 1.62E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 9.31E-05 |
| 34 | * | * | 0.00 | 0.000 | 0.000 | 0.1518 | 0.0062 | 0.0000 | 1.60E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 9.30E-05 |
| 35 | * | * | 0.00 | 0.000 | 0.000 | 0.1518 | 0.0061 | 0.0000 | 1.57E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 9.28E-05 |
| 36 | * | * | 0.00 | 0.000 | 0.000 | 0.1518 | 0.0059 | 0.0000 | 1.55E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 9.27E-05 |
| 37 | * | * | 0.00 | 0.000 | 0.000 | 0.1518 | 0.0058 | 0.0000 | 1.52E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 9.26E-05 |
| 38 | * | * | 0.00 | 0.000 | 0.000 | 0.1518 | 0.0057 | 0.0000 | 1.50E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 9.25E-05 |
| 39 | * | * | 0.00 | 0.000 | 0.000 | 0.1518 | 0.0056 | 0.0000 | 1.48E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 9.24E-05 |
| 40 | | * | 0.00 | 0.000 | 0.000 | 0.1518 | 0.0055 | 0.0000 | 1.46E-05 | 0.0011 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 9.22E-05 |
| 41 | | * | 0.00 | 0.000 | 0.000 | 0.1518 | 0.0054 | 0.0000 | 1.43E-05 | 0.0011 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 9.21E-05 |
| 42 | | * | 0.06 | 0.000 | 0.003 | 0.1548 | 0.0053 | 0.0000 | 1.41E-05 | 0.0011 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 9.20E-05 |
| 43 | | * | 0.06 | 0.000 | 0.003 | 0.1582 | 0.0051 | 0.0000 | 1.39E-05 | 0.0010 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 9.19E-05 |
| 44 | | * | 0.00 | 0.000 | 0.000 | 0.1582 | 0.0050 | 0.0000 | 1.37E-05 | 0.0010 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 9.17E-05 |
| 45 | * | * | 0.09 | 0.000 | 0.036 | 0.1582 | 0.0049 | 0.0000 | 1.35E-05 | 0.0010 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 9.16E-05 |
| 46 | * | * | 0.00 | 0.000 | 0.012 | 0.1582 | 0.0048 | 0.0000 | 1.33E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 9.15E-05 |
| 47 | * | * | 0.00 | 0.000 | 0.008 | 0.1582 | 0.0047 | 0.0000 | 1.31E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 9.14E-05 |
| 48 | * | * | 0.00 | 0.000 | 0.008 | 0.1582 | 0.0046 | 0.0000 | 1.29E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 9.13E-05 |
| 49 | * | * | 0.03 | 0.000 | 0.000 | 0.1582 | 0.0045 | 0.0000 | 1.27E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 9.11E-05 |
| 50 | | * | 0.05 | 0.000 | 0.099 | 0.1582 | 0.0045 | 0.0000 | 1.25E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 9.10E-05 |
| 51 | | * | 0.00 | 0.000 | 0.000 | 0.1582 | 0.0044 | 0.0000 | 1.23E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 9.09E-05 |
| 52 | * | * | 0.00 | 0.000 | 0.000 | 0.1582 | 0.0043 | 0.0000 | 1.21E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 9.08E-05 |
| 53 | * | * | 0.03 | 0.000 | 0.025 | 0.1582 | 0.0042 | 0.0000 | 1.19E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 9.07E-05 |
| 54 | * | * | 0.01 | 0.000 | 0.010 | 0.1582 | 0.0041 | 0.0000 | 1.17E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 9.05E-05 |
| 55 | * | * | 0.00 | 0.000 | 0.000 | 0.1582 | 0.0040 | 0.0000 | 1.15E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 9.04E-05 |
| 56 | | * | 0.00 | 0.000 | 0.000 | 0.1582 | 0.0039 | 0.0000 | 1.13E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 9.03E-05 |
| 57 | | * | 0.00 | 0.000 | 0.000 | 0.1582 | 0.0039 | 0.0000 | 1.12E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 9.02E-05 |
| 58 | | * | 0.03 | 0.000 | 0.003 | 0.1598 | 0.0038 | 0.0000 | 1.10E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 9.01E-05 |
| 59 | | * | 0.04 | 0.000 | 0.003 | 0.1619 | 0.0037 | 0.0000 | 1.08E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 9.00E-05 |
| 60 | | * | 0.68 | 0.675 | 0.003 | 0.1619 | 0.0036 | 0.0000 | 1.06E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 8.98E-05 |
| 61 | | * | 0.00 | 0.000 | 0.000 | 0.1619 | 0.0035 | 0.0000 | 1.05E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 8.97E-05 |
| 62 | | * | 0.24 | 0.239 | 0.003 | 0.1619 | 0.0035 | 0.0000 | 1.03E-05 | 0.0009 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 8.96E-05 |
| 63 | * | * | 0.07 | 0.000 | 0.043 | 0.1619 | 0.0034 | 0.0000 | 1.01E-05 | 0.0009 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 8.95E-05 |
| 64 | | * | 0.19 | 0.059 | 0.110 | 0.1648 | 0.0033 | 0.0000 | 9.98E-06 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 8.94E-05 |
| 65 | * | * | 0.00 | 0.000 | 0.000 | 0.1648 | 0.0033 | 0.0000 | 9.82E-06 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 8.93E-05 |
| 66 | * | * | 0.00 | 0.000 | 0.000 | 0.1648 | 0.0032 | 0.0000 | 9.66E-06 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 8.91E-05 |
| 67 | * | * | 0.23 | 0.000 | 0.023 | 0.1648 | 0.0031 | 0.0000 | 9.51E-06 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 8.90E-05 |
| 68 | * | * | 0.10 | 0.000 | 0.011 | 0.1648 | 0.0031 | 0.0000 | 9.35E-06 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 8.89E-05 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69 | * | * | 0.01 | 0.000 | 0.015 | 0.1648 | 0.0030 | 0.0000 | 9.20E-06 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 8.88E-05 |
| 70 | | * | 0.00 | 0.260 | 0.029 | 0.1648 | 0.0029 | 0.0000 | 9.06E-06 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 8.87E-05 |
| 71 | | * | 0.00 | 0.000 | 0.001 | 0.1648 | 0.0029 | 0.0000 | 8.91E-06 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 8.86E-05 |
| 72 | | * | 0.01 | 0.000 | 0.003 | 0.1653 | 0.0028 | 0.0000 | 8.76E-06 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 8.85E-05 |
| 73 | | * | 0.03 | 0.000 | 0.003 | 0.1669 | 0.0027 | 0.0000 | 8.62E-06 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 8.84E-05 |
| 74 | | * | 0.00 | 0.000 | 0.000 | 0.1669 | 0.0027 | 0.0000 | 8.48E-06 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 8.82E-05 |
| 75 | * | * | 0.00 | 0.000 | 0.000 | 0.1669 | 0.0026 | 0.0000 | 8.34E-06 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 8.81E-05 |
| 76 | * | * | 0.00 | 0.000 | 0.000 | 0.1669 | 0.0026 | 0.0000 | 8.21E-06 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 8.80E-05 |
| 77 | | * | 0.00 | 0.000 | 0.000 | 0.1669 | 0.0025 | 0.0000 | 8.07E-06 | 0.0007 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 8.79E-05 |
| 78 | | * | 0.00 | 0.000 | 0.000 | 0.1669 | 0.0025 | 0.0000 | 7.94E-06 | 0.0007 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 8.78E-05 |
| 79 | * | * | 0.22 | 0.000 | 0.019 | 0.1669 | 0.0024 | 0.0000 | 7.81E-06 | 0.0006 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 8.77E-05 |
| 80 | * | * | 0.00 | 0.000 | 0.062 | 0.1669 | 0.0024 | 0.0000 | 7.68E-06 | 0.0006 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 8.76E-05 |
| 81 | | * | 0.00 | 0.000 | 0.135 | 0.1669 | 0.0023 | 0.0000 | 7.56E-06 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 8.75E-05 |
| 82 | * | * | 0.00 | 0.000 | 0.000 | 0.1669 | 0.0023 | 0.0000 | 7.43E-06 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 8.73E-05 |
| 83 | * | * | 0.00 | 0.000 | 0.000 | 0.1669 | 0.0022 | 0.0000 | 7.31E-06 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 8.72E-05 |
| 84 | | * | 0.00 | 0.000 | 0.000 | 0.1669 | 0.0022 | 0.0000 | 7.19E-06 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 8.71E-05 |
| 85 | | * | 0.00 | 0.000 | 0.000 | 0.1669 | 0.0021 | 0.0000 | 7.07E-06 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 8.70E-05 |
| 86 | | * | 0.00 | 0.000 | 0.000 | 0.1669 | 0.0021 | 0.0000 | 6.95E-06 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 8.69E-05 |
| 87 | | * | 0.00 | 0.000 | 0.000 | 0.1669 | 0.0020 | 0.0000 | 6.83E-06 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 8.68E-05 |
| 88 | | * | 0.17 | 0.170 | 0.003 | 0.1669 | 0.0020 | 0.0000 | 6.72E-06 | 0.0006 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 8.67E-05 |
| 89 | | * | 0.00 | 0.000 | 0.000 | 0.1669 | 0.0019 | 0.0000 | 6.61E-06 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 8.66E-05 |
| 90 | | * | 0.00 | 0.000 | 0.000 | 0.1669 | 0.0019 | 0.0000 | 6.50E-06 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 8.65E-05 |
| 91 | * | * | 0.71 | 0.000 | 0.040 | 0.1669 | 0.0018 | 0.0000 | 6.39E-06 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 8.64E-05 |
| 92 | * | * | 0.00 | 0.000 | 0.017 | 0.1669 | 0.0018 | 0.0000 | 6.28E-06 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 8.63E-05 |
| 93 | * | * | 0.63 | 0.000 | 0.000 | 0.1669 | 0.0018 | 0.0000 | 6.17E-06 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 8.62E-05 |
| 94 | | * | 0.23 | 0.750 | 0.000 | 0.1669 | 0.0017 | 0.0000 | 6.07E-06 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 8.60E-05 |
| 95 | * | * | 0.00 | 0.000 | 0.034 | 0.1669 | 0.0017 | 0.0000 | 5.96E-06 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 8.59E-05 |
| 96 | * | * | 0.00 | 0.000 | 0.018 | 0.1669 | 0.0016 | 0.0000 | 5.86E-06 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 8.58E-05 |
| 97 | * | * | 0.01 | 0.000 | 0.000 | 0.1669 | 0.0016 | 0.0000 | 5.76E-06 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 8.57E-05 |
| 98 | | * | 0.04 | 0.762 | 0.004 | 0.1669 | 0.0016 | 0.0000 | 5.66E-06 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 8.56E-05 |
| 99 | | * | 0.15 | 0.147 | 0.003 | 0.1669 | 0.0015 | 0.0000 | 5.57E-06 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 8.55E-05 |
| 100 | * | * | 0.31 | 0.000 | 0.034 | 0.1669 | 0.0015 | 0.0000 | 5.47E-06 | 0.0004 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 8.54E-05 |
| 101 | * | * | 0.00 | 0.000 | 0.042 | 0.1669 | 0.0015 | 0.0000 | 5.38E-06 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 8.53E-05 |
| 102 | | * | 0.00 | 0.000 | 0.056 | 0.1669 | 0.0014 | 0.0000 | 5.28E-06 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 8.52E-05 |
| 103 | * | * | 0.00 | 0.000 | 0.064 | 0.1669 | 0.0014 | 0.0000 | 5.19E-06 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 8.51E-05 |
| 104 | | * | 0.00 | 0.000 | 0.111 | 0.1669 | 0.0014 | 0.0000 | 5.10E-06 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 8.50E-05 |
| 105 | | * | 0.00 | 0.000 | 0.000 | 0.1669 | 0.0013 | 0.0000 | 5.01E-06 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 8.49E-05 |
| 106 | | * | 0.00 | 0.000 | 0.000 | 0.1669 | 0.0013 | 0.0000 | 4.93E-06 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 8.48E-05 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 107 | | * | 0.00 | 0.000 | 0.000 | 0.1669 | 0.0013 | 0.0000 | 4.84E-06 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 8.47E-05 |
| 108 | | * | 0.00 | 0.000 | 0.000 | 0.1669 | 0.0013 | 0.0000 | 4.76E-06 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 8.46E-05 |
| 109 | | * | 0.00 | 0.000 | 0.000 | 0.1669 | 0.0012 | 0.0000 | 4.67E-06 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 8.45E-05 |
| 110 | * | * | 0.13 | 0.000 | 0.057 | 0.1669 | 0.0012 | 0.0000 | 4.59E-06 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 8.44E-05 |
| 111 | | * | 0.03 | 0.005 | 0.097 | 0.1669 | 0.0012 | 0.0000 | 4.51E-06 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 8.43E-05 |
| 112 | | | 0.00 | 0.000 | 0.115 | 0.1605 | 0.0011 | 0.0000 | 4.43E-06 | 0.0004 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 8.42E-05 |
| 113 | | | 0.00 | 0.000 | 0.092 | 0.1554 | 0.0011 | 0.0000 | 4.35E-06 | 0.0004 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 8.41E-05 |
| 114 | * | | 0.01 | 0.000 | 0.049 | 0.1535 | 0.0011 | 0.0000 | 4.27E-06 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 8.40E-05 |
| 115 | * | | 0.06 | 0.000 | 0.061 | 0.1535 | 0.0011 | 0.0000 | 4.20E-06 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 8.39E-05 |
| 116 | * | | 0.44 | 0.000 | 0.022 | 0.1546 | 0.0010 | 0.0000 | 4.12E-06 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 8.38E-05 |
| 117 | | | 0.03 | 0.245 | 0.030 | 0.1628 | 0.0010 | 0.0000 | 4.05E-06 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 8.36E-05 |
| 118 | * | | 0.65 | 0.000 | 0.034 | 0.1639 | 0.0010 | 0.0000 | 3.98E-06 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 8.35E-05 |
| 119 | * | | 0.00 | 0.000 | 0.027 | 0.1650 | 0.0010 | 0.0000 | 3.91E-06 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 8.34E-05 |
| 120 | * | | 0.06 | 0.000 | 0.028 | 0.1661 | 0.0009 | 0.0000 | 3.84E-06 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 8.33E-05 |
| 121 | | | 0.00 | 0.282 | 0.142 | 0.1736 | 0.0009 | 0.0000 | 3.77E-06 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 8.32E-05 |
| 122 | | | 0.08 | 0.000 | 0.234 | 0.1649 | 0.0015 | 0.0000 | 5.26E-06 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 8.31E-05 |
| 123 | | | 0.15 | 0.000 | 0.193 | 0.1625 | 0.0049 | 0.0000 | 1.32E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 8.30E-05 |
| 124 | | | 0.46 | 0.118 | 0.244 | 0.1681 | 0.0063 | 0.0000 | 1.62E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 8.29E-05 |
| 125 | * | | 0.00 | 0.000 | 0.104 | 0.1624 | 0.0061 | 0.0000 | 1.59E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 8.28E-05 |
| 126 | | | 0.00 | 0.000 | 0.226 | 0.1493 | 0.0155 | 0.0001 | 3.07E-05 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 8.27E-05 |
| 127 | | | 0.00 | 0.000 | 0.210 | 0.1376 | 0.0308 | 0.0002 | 5.41E-05 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 8.26E-05 |
| 128 | | | 0.00 | 0.000 | 0.111 | 0.1314 | 0.0302 | 0.0001 | 5.34E-05 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 8.26E-05 |
| 129 | | | 1.28 | 1.013 | 0.064 | 0.1425 | 0.0297 | 0.0001 | 5.27E-05 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 8.25E-05 |
| 130 | | | 0.30 | 0.115 | 0.204 | 0.1409 | 0.0450 | 0.0002 | 7.20E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 8.24E-05 |
| 131 | | | 0.07 | 0.000 | 0.055 | 0.1420 | 0.0534 | 0.0003 | 8.24E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 8.23E-05 |
| 132 | | | 0.28 | 0.129 | 0.056 | 0.1472 | 0.0525 | 0.0003 | 8.13E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 8.22E-05 |
| 133 | | | 0.00 | 0.000 | 0.111 | 0.1410 | 0.0516 | 0.0003 | 8.02E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 8.21E-05 |
| 134 | | | 0.24 | 0.061 | 0.226 | 0.1381 | 0.0507 | 0.0002 | 7.92E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 8.20E-05 |
| 135 | | | 0.00 | 0.000 | 0.109 | 0.1321 | 0.0498 | 0.0002 | 7.81E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 8.19E-05 |
| 136 | | | 0.39 | 0.155 | 0.138 | 0.1372 | 0.0568 | 0.0003 | 8.63E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 8.18E-05 |
| 137 | | | 0.00 | 0.000 | 0.057 | 0.1340 | 0.0605 | 0.0003 | 9.06E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 8.17E-05 |
| 138 | | | 0.00 | 0.000 | 0.076 | 0.1298 | 0.0605 | 0.0003 | 9.06E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 8.16E-05 |
| 139 | | | 0.00 | 0.000 | 0.017 | 0.1288 | 0.0600 | 0.0003 | 9.00E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 8.15E-05 |
| 140 | | | 0.00 | 0.000 | 0.002 | 0.1287 | 0.0602 | 0.0003 | 9.02E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 8.14E-05 |
| 141 | | | 0.09 | 0.000 | 0.008 | 0.1334 | 0.0598 | 0.0003 | 8.98E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 8.13E-05 |
| 142 | | | 0.04 | 0.000 | 0.017 | 0.1349 | 0.0588 | 0.0003 | 8.87E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 8.12E-05 |
| 143 | | | 0.67 | 0.500 | 0.038 | 0.1421 | 0.0578 | 0.0003 | 8.75E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 8.11E-05 |
| 144 | | | 0.16 | 0.028 | 0.060 | 0.1461 | 0.0569 | 0.0003 | 8.64E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 8.10E-05 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 145 | 0.00 | 0.000 | 0.096 | 0.1408 | 0.0559 | 0.0003 | 8.53E-05 | 0.0003 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 8.09E-05 |
| 146 | 0.00 | 0.000 | 0.153 | 0.1323 | 0.0550 | 0.0003 | 8.42E-05 | 0.0003 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 8.08E-05 |
| 147 | 0.00 | 0.000 | 0.050 | 0.1295 | 0.0540 | 0.0003 | 8.31E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 8.07E-05 |
| 148 | 0.00 | 0.000 | 0.013 | 0.1287 | 0.0565 | 0.0003 | 8.59E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 8.06E-05 |
| 149 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0579 | 0.0003 | 8.76E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 8.05E-05 |
| 150 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0569 | 0.0003 | 8.64E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 8.04E-05 |
| 151 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0560 | 0.0003 | 8.53E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 8.03E-05 |
| 152 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0550 | 0.0003 | 8.43E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 8.02E-05 |
| 153 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0541 | 0.0003 | 8.31E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 8.02E-05 |
| 154 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0532 | 0.0003 | 8.21E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 8.01E-05 |
| 155 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0522 | 0.0003 | 8.10E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 8.00E-05 |
| 156 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0513 | 0.0003 | 7.99E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 7.99E-05 |
| 157 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0505 | 0.0002 | 7.89E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 7.98E-05 |
| 158 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0496 | 0.0002 | 7.78E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 7.97E-05 |
| 159 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0487 | 0.0002 | 7.68E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 7.96E-05 |
| 160 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0479 | 0.0002 | 7.58E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 7.95E-05 |
| 161 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0471 | 0.0002 | 7.48E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 7.94E-05 |
| 162 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0463 | 0.0002 | 7.38E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 7.93E-05 |
| 163 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0455 | 0.0002 | 7.28E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 7.92E-05 |
| 164 | 0.39 | 0.202 | 0.021 | 0.1382 | 0.0447 | 0.0002 | 7.19E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 7.91E-05 |
| 165 | 0.13 | 0.005 | 0.011 | 0.1443 | 0.0439 | 0.0002 | 7.09E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 7.91E-05 |
| 166 | 0.16 | 0.041 | 0.011 | 0.1504 | 0.0431 | 0.0002 | 7.00E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 7.90E-05 |
| 167 | 0.28 | 0.146 | 0.020 | 0.1568 | 0.0424 | 0.0002 | 6.91E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.89E-05 |
| 168 | 0.10 | 0.000 | 0.176 | 0.1524 | 0.0417 | 0.0002 | 6.82E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.88E-05 |
| 169 | 0.00 | 0.000 | 0.013 | 0.1518 | 0.0409 | 0.0002 | 6.73E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.87E-05 |
| 170 | 0.00 | 0.000 | 0.013 | 0.1511 | 0.0402 | 0.0002 | 6.64E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.86E-05 |
| 171 | 0.37 | 0.204 | 0.020 | 0.1593 | 0.0398 | 0.0002 | 6.58E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.85E-05 |
| 172 | 0.00 | 0.000 | 0.189 | 0.1488 | 0.0396 | 0.0002 | 6.55E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.84E-05 |
| 173 | 0.00 | 0.000 | 0.010 | 0.1482 | 0.0390 | 0.0002 | 6.48E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.83E-05 |
| 174 | 0.00 | 0.000 | 0.010 | 0.1477 | 0.0383 | 0.0002 | 6.40E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.82E-05 |
| 175 | 0.00 | 0.000 | 0.010 | 0.1471 | 0.0377 | 0.0002 | 6.31E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.82E-05 |
| 176 | 0.68 | 0.499 | 0.018 | 0.1563 | 0.0370 | 0.0002 | 6.23E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.81E-05 |
| 177 | 0.00 | 0.000 | 0.144 | 0.1483 | 0.0363 | 0.0002 | 6.14E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.80E-05 |
| 178 | 0.95 | 0.511 | 0.286 | 0.1570 | 0.0357 | 0.0002 | 6.06E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.79E-05 |
| 179 | 0.87 | 0.469 | 0.288 | 0.1635 | 0.0351 | 0.0002 | 5.98E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.78E-05 |
| 180 | 0.93 | 0.499 | 0.317 | 0.1699 | 0.0345 | 0.0002 | 5.91E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.77E-05 |
| 181 | 0.00 | 0.000 | 0.224 | 0.1575 | 0.0339 | 0.0002 | 5.83E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.76E-05 |
| 182 | 0.00 | 0.000 | 0.209 | 0.1458 | 0.0362 | 0.0002 | 6.13E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.75E-05 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 183 | 0.00 | 0.000 | 0.225 | 0.1333 | 0.0372 | 0.0002 | 6.26E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.75E-05 |
| 184 | 0.00 | 0.000 | 0.065 | 0.1293 | 0.0419 | 0.0002 | 6.83E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.74E-05 |
| 185 | 0.00 | 0.000 | 0.006 | 0.1287 | 0.0641 | 0.0003 | 9.46E-05 | 0.0002 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.73E-05 |
| 186 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0673 | 0.0003 | 9.83E-05 | 0.0002 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.72E-05 |
| 187 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0663 | 0.0003 | 9.71E-05 | 0.0002 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.71E-05 |
| 188 | 0.01 | 0.000 | 0.006 | 0.1287 | 0.0652 | 0.0003 | 9.59E-05 | 0.0002 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.70E-05 |
| 189 | 0.03 | 0.000 | 0.006 | 0.1297 | 0.0641 | 0.0003 | 9.47E-05 | 0.0002 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.69E-05 |
| 190 | 0.82 | 0.608 | 0.032 | 0.1398 | 0.0630 | 0.0003 | 9.34E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.68E-05 |
| 191 | 0.00 | 0.000 | 0.145 | 0.1318 | 0.0620 | 0.0003 | 9.22E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.68E-05 |
| 192 | 0.04 | 0.000 | 0.021 | 0.1328 | 0.0609 | 0.0003 | 9.10E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.67E-05 |
| 193 | 0.54 | 0.349 | 0.029 | 0.1416 | 0.0599 | 0.0003 | 8.98E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.66E-05 |
| 194 | 0.02 | 0.000 | 0.168 | 0.1332 | 0.0588 | 0.0003 | 8.87E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.65E-05 |
| 195 | 0.35 | 0.143 | 0.190 | 0.1340 | 0.0617 | 0.0003 | 9.20E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.64E-05 |
| 196 | 0.00 | 0.000 | 0.037 | 0.1319 | 0.0630 | 0.0003 | 9.34E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.63E-05 |
| 197 | 0.16 | 0.008 | 0.063 | 0.1366 | 0.0643 | 0.0003 | 9.49E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.62E-05 |
| 198 | 0.04 | 0.000 | 0.042 | 0.1363 | 0.0646 | 0.0003 | 9.53E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.62E-05 |
| 199 | 0.41 | 0.224 | 0.050 | 0.1437 | 0.0636 | 0.0003 | 9.40E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.61E-05 |
| 200 | 0.00 | 0.000 | 0.151 | 0.1353 | 0.0625 | 0.0003 | 9.28E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.60E-05 |
| 201 | 0.00 | 0.000 | 0.026 | 0.1338 | 0.0621 | 0.0003 | 9.24E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.59E-05 |
| 202 | 0.00 | 0.000 | 0.023 | 0.1325 | 0.0614 | 0.0003 | 9.17E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.58E-05 |
| 203 | 0.00 | 0.000 | 0.027 | 0.1312 | 0.0604 | 0.0003 | 9.05E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.57E-05 |
| 204 | 0.09 | 0.000 | 0.028 | 0.1348 | 0.0594 | 0.0003 | 8.93E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.57E-05 |
| 205 | 0.36 | 0.202 | 0.030 | 0.1419 | 0.0584 | 0.0003 | 8.81E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.56E-05 |
| 206 | 0.07 | 0.000 | 0.162 | 0.1367 | 0.0595 | 0.0003 | 8.94E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.55E-05 |
| 207 | 0.28 | 0.136 | 0.029 | 0.1432 | 0.0646 | 0.0003 | 9.52E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.54E-05 |
| 208 | 0.35 | 0.111 | 0.276 | 0.1412 | 0.0635 | 0.0003 | 9.40E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.53E-05 |
| 209 | 0.00 | 0.000 | 0.138 | 0.1335 | 0.0643 | 0.0003 | 9.49E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.52E-05 |
| 210 | 0.00 | 0.000 | 0.058 | 0.1303 | 0.0666 | 0.0003 | 9.75E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.52E-05 |
| 211 | 0.65 | 0.404 | 0.063 | 0.1401 | 0.0655 | 0.0003 | 9.62E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.51E-05 |
| 212 | 0.42 | 0.117 | 0.256 | 0.1429 | 0.0644 | 0.0003 | 9.50E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.50E-05 |
| 213 | 0.00 | 0.000 | 0.158 | 0.1341 | 0.0633 | 0.0003 | 9.37E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.49E-05 |
| 214 | 0.00 | 0.000 | 0.067 | 0.1302 | 0.0682 | 0.0003 | 9.92E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.48E-05 |
| 215 | 0.01 | 0.000 | 0.026 | 0.1291 | 0.0706 | 0.0003 | 1.02E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.48E-05 |
| 216 | 0.02 | 0.000 | 0.012 | 0.1293 | 0.0751 | 0.0004 | 1.07E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.47E-05 |
| 217 | 0.02 | 0.000 | 0.008 | 0.1298 | 0.0773 | 0.0004 | 1.09E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.46E-05 |
| 218 | 0.65 | 0.426 | 0.042 | 0.1398 | 0.0760 | 0.0004 | 1.08E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.45E-05 |
| 219 | 0.57 | 0.271 | 0.179 | 0.1462 | 0.0747 | 0.0004 | 1.06E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.44E-05 |
| 220 | 1.01 | 0.620 | 0.275 | 0.1527 | 0.0735 | 0.0004 | 1.05E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.44E-05 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 221 | 0.86 | 0.501 | 0.243 | 0.1592 | 0.0722 | 0.0004 | 1.04E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.43E-05 |
| 222 | 0.25 | 0.106 | 0.180 | 0.1571 | 0.0710 | 0.0003 | 1.02E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.42E-05 |
| 223 | 0.21 | 0.070 | 0.171 | 0.1554 | 0.0698 | 0.0003 | 1.01E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 7.41E-05 |
| 224 | 0.00 | 0.000 | 0.090 | 0.1504 | 0.0686 | 0.0003 | 9.97E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 7.40E-05 |
| 225 | 0.01 | 0.000 | 0.102 | 0.1449 | 0.0736 | 0.0004 | 1.05E-04 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 7.40E-05 |
| 226 | 0.00 | 0.000 | 0.155 | 0.1363 | 0.0760 | 0.0004 | 1.08E-04 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 7.39E-05 |
| 227 | 0.00 | 0.000 | 0.117 | 0.1298 | 0.0747 | 0.0004 | 1.06E-04 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 7.38E-05 |
| 228 | 0.81 | 0.464 | 0.147 | 0.1408 | 0.0735 | 0.0004 | 1.05E-04 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 7.37E-05 |
| 229 | 0.23 | 0.103 | 0.076 | 0.1436 | 0.0759 | 0.0004 | 1.08E-04 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 7.36E-05 |
| 230 | 0.25 | 0.106 | 0.124 | 0.1448 | 0.0807 | 0.0004 | 1.13E-04 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 7.36E-05 |
| 231 | 0.52 | 0.114 | 0.298 | 0.1510 | 0.0793 | 0.0004 | 1.11E-04 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 7.35E-05 |
| 232 | 0.05 | 0.000 | 0.076 | 0.1496 | 0.0780 | 0.0004 | 1.10E-04 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 7.34E-05 |
| 233 | 0.04 | 0.000 | 0.152 | 0.1434 | 0.0767 | 0.0004 | 1.09E-04 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 7.33E-05 |
| 234 | 0.40 | 0.116 | 0.269 | 0.1444 | 0.0754 | 0.0004 | 1.07E-04 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 7.32E-05 |
| 235 | 0.52 | 0.273 | 0.126 | 0.1509 | 0.0741 | 0.0004 | 1.06E-04 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 7.32E-05 |
| 236 | 0.00 | 0.000 | 0.102 | 0.1452 | 0.0729 | 0.0004 | 1.04E-04 | 0.0010 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 7.31E-05 |
| 237 | 0.21 | 0.071 | 0.111 | 0.1468 | 0.0762 | 0.0004 | 1.08E-04 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 7.30E-05 |
| 238 | 0.00 | 0.000 | 0.151 | 0.1384 | 0.0777 | 0.0004 | 1.10E-04 | 0.0012 | 0.0000 | 7.12E-09 | 0.0000 | 0.0000 | 7.29E-05 |
| 239 | 0.00 | 0.000 | 0.148 | 0.1301 | 0.0784 | 0.0004 | 1.10E-04 | 0.0012 | 0.0000 | 7.13E-09 | 0.0000 | 0.0000 | 7.29E-05 |
| 240 | 0.15 | 0.000 | 0.034 | 0.1364 | 0.0783 | 0.0004 | 1.10E-04 | 0.0013 | 0.0000 | 7.15E-09 | 0.0000 | 0.0000 | 7.28E-05 |
| 241 | 0.00 | 0.000 | 0.080 | 0.1317 | 0.0825 | 0.0004 | 1.15E-04 | 0.0013 | 0.0000 | 7.16E-09 | 0.0000 | 0.0000 | 7.27E-05 |
| 242 | 0.00 | 0.000 | 0.042 | 0.1294 | 0.0843 | 0.0004 | 1.17E-04 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 7.26E-05 |
| 243 | 0.00 | 0.000 | 0.010 | 0.1289 | 0.0829 | 0.0004 | 1.15E-04 | 0.0015 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 7.25E-05 |
| 244 | 0.00 | 0.000 | 0.002 | 0.1287 | 0.0828 | 0.0004 | 1.15E-04 | 0.0015 | 0.0000 | 7.21E-09 | 0.0000 | 0.0000 | 7.25E-05 |
| 245 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0821 | 0.0004 | 1.14E-04 | 0.0016 | 0.0000 | 7.22E-09 | 0.0000 | 0.0000 | 7.24E-05 |
| 246 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0809 | 0.0004 | 1.13E-04 | 0.0016 | 0.0000 | 7.23E-09 | 0.0000 | 0.0000 | 7.23E-05 |
| 247 | 0.22 | 0.051 | 0.006 | 0.1379 | 0.0796 | 0.0004 | 1.12E-04 | 0.0017 | 0.0000 | 7.24E-09 | 0.0000 | 0.0000 | 7.22E-05 |
| 248 | 0.00 | 0.000 | 0.012 | 0.1373 | 0.0782 | 0.0004 | 1.10E-04 | 0.0017 | 0.0000 | 7.26E-09 | 0.0000 | 0.0000 | 7.22E-05 |
| 249 | 0.00 | 0.000 | 0.013 | 0.1366 | 0.0769 | 0.0004 | 1.09E-04 | 0.0018 | 0.0000 | 7.27E-09 | 0.0000 | 0.0000 | 7.21E-05 |
| 250 | 0.13 | 0.000 | 0.019 | 0.1428 | 0.0756 | 0.0004 | 1.07E-04 | 0.0018 | 0.0000 | 7.28E-09 | 0.0000 | 0.0000 | 7.20E-05 |
| 251 | 0.19 | 0.060 | 0.015 | 0.1490 | 0.0743 | 0.0004 | 1.06E-04 | 0.0019 | 0.0000 | 7.29E-09 | 0.0000 | 0.0000 | 7.19E-05 |
| 252 | 1.28 | 1.141 | 0.026 | 0.1555 | 0.0731 | 0.0004 | 1.05E-04 | 0.0019 | 0.0000 | 7.30E-09 | 0.0000 | 0.0000 | 7.19E-05 |
| 253 | 0.21 | 0.066 | 0.098 | 0.1577 | 0.0721 | 0.0004 | 1.04E-04 | 0.0020 | 0.0000 | 7.32E-09 | 0.0000 | 0.0000 | 7.18E-05 |
| 254 | 0.00 | 0.000 | 0.134 | 0.1503 | 0.0711 | 0.0004 | 1.02E-04 | 0.0020 | 0.0000 | 7.33E-09 | 0.0000 | 0.0000 | 7.17E-05 |
| 255 | 0.12 | 0.000 | 0.117 | 0.1502 | 0.0699 | 0.0003 | 1.01E-04 | 0.0021 | 0.0000 | 7.34E-09 | 0.0000 | 0.0000 | 7.16E-05 |
| 256 | 0.14 | 0.000 | 0.137 | 0.1507 | 0.0687 | 0.0003 | 9.98E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 7.16E-05 |
| 257 | 0.08 | 0.000 | 0.115 | 0.1486 | 0.0745 | 0.0004 | 1.06E-04 | 0.0022 | 0.0000 | 7.36E-09 | 0.0000 | 0.0000 | 7.15E-05 |
| 258 | 0.04 | 0.000 | 0.099 | 0.1455 | 0.0774 | 0.0004 | 1.09E-04 | 0.0022 | 0.0000 | 7.37E-09 | 0.0000 | 0.0000 | 7.14E-05 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 259 | | 0.00 | 0.000 | 0.143 | 0.1376 | 0.0761 | 0.0004 | 1.08E-04 | 0.0023 | 0.0000 | 7.38E-09 | 0.0000 | 0.0000 | 7.13E-05 |
| 260 | | 0.00 | 0.000 | 0.088 | 0.1326 | 0.0784 | 0.0004 | 1.10E-04 | 0.0023 | 0.0000 | 7.39E-09 | 0.0000 | 0.0000 | 7.13E-05 |
| 261 | | 0.08 | 0.000 | 0.053 | 0.1341 | 0.0793 | 0.0004 | 1.11E-04 | 0.0024 | 0.0000 | 7.40E-09 | 0.0000 | 0.0000 | 7.12E-05 |
| 262 | | 0.00 | 0.000 | 0.027 | 0.1324 | 0.0802 | 0.0004 | 1.12E-04 | 0.0024 | 0.0000 | 7.41E-09 | 0.0000 | 0.0000 | 7.11E-05 |
| 263 | | 0.00 | 0.000 | 0.016 | 0.1315 | 0.0855 | 0.0004 | 1.18E-04 | 0.0024 | 0.0000 | 7.42E-09 | 0.0000 | 0.0000 | 7.10E-05 |
| 264 | | 0.00 | 0.000 | 0.011 | 0.1309 | 0.0841 | 0.0004 | 1.16E-04 | 0.0025 | 0.0000 | 7.43E-09 | 0.0000 | 0.0000 | 7.10E-05 |
| 265 | | 0.00 | 0.000 | 0.009 | 0.1304 | 0.0827 | 0.0004 | 1.15E-04 | 0.0025 | 0.0000 | 7.44E-09 | 0.0000 | 0.0000 | 7.09E-05 |
| 266 | | 0.00 | 0.000 | 0.008 | 0.1302 | 0.0817 | 0.0004 | 1.14E-04 | 0.0026 | 0.0000 | 7.44E-09 | 0.0000 | 0.0000 | 7.08E-05 |
| 267 | | 0.07 | 0.000 | 0.007 | 0.1336 | 0.0811 | 0.0004 | 1.13E-04 | 0.0026 | 0.0000 | 7.45E-09 | 0.0000 | 0.0000 | 7.08E-05 |
| 268 | | 0.28 | 0.136 | 0.021 | 0.1406 | 0.0798 | 0.0004 | 1.12E-04 | 0.0026 | 0.0000 | 7.46E-09 | 0.0000 | 0.0000 | 7.07E-05 |
| 269 | | 0.19 | 0.073 | 0.014 | 0.1466 | 0.0785 | 0.0004 | 1.10E-04 | 0.0027 | 0.0000 | 7.47E-09 | 0.0000 | 0.0000 | 7.06E-05 |
| 270 | | 0.11 | 0.000 | 0.051 | 0.1497 | 0.0772 | 0.0004 | 1.09E-04 | 0.0027 | 0.0000 | 7.48E-09 | 0.0000 | 0.0000 | 7.05E-05 |
| 271 | | 0.02 | 0.000 | 0.083 | 0.1464 | 0.0759 | 0.0004 | 1.08E-04 | 0.0027 | 0.0000 | 7.48E-09 | 0.0000 | 0.0000 | 7.05E-05 |
| 272 | | 0.00 | 0.000 | 0.096 | 0.1410 | 0.0746 | 0.0004 | 1.06E-04 | 0.0028 | 0.0000 | 7.49E-09 | 0.0000 | 0.0000 | 7.04E-05 |
| 273 | | 0.00 | 0.000 | 0.042 | 0.1387 | 0.0734 | 0.0004 | 1.05E-04 | 0.0028 | 0.0000 | 7.50E-09 | 0.0000 | 0.0000 | 7.03E-05 |
| 274 | * | 0.01 | 0.000 | 0.039 | 0.1370 | 0.0730 | 0.0004 | 1.05E-04 | 0.0028 | 0.0000 | 7.51E-09 | 0.0000 | 0.0000 | 7.02E-05 |
| 275 | | 0.01 | 0.000 | 0.030 | 0.1361 | 0.0723 | 0.0004 | 1.04E-04 | 0.0029 | 0.0000 | 7.52E-09 | 0.0000 | 0.0000 | 7.02E-05 |
| 276 | * | 0.02 | 0.000 | 0.041 | 0.1349 | 0.0711 | 0.0004 | 1.02E-04 | 0.0029 | 0.0000 | 7.52E-09 | 0.0000 | 0.0000 | 7.01E-05 |
| 277 | * | 0.12 | 0.000 | 0.043 | 0.1359 | 0.0699 | 0.0003 | 1.01E-04 | 0.0029 | 0.0000 | 7.53E-09 | 0.0000 | 0.0000 | 7.00E-05 |
| 278 | | 0.00 | 0.000 | 0.074 | 0.1352 | 0.0687 | 0.0003 | 9.98E-05 | 0.0030 | 0.0000 | 7.54E-09 | 0.0000 | 0.0000 | 7.00E-05 |
| 279 | | 0.05 | 0.000 | 0.024 | 0.1367 | 0.0675 | 0.0003 | 9.85E-05 | 0.0030 | 0.0000 | 7.54E-09 | 0.0000 | 0.0000 | 6.99E-05 |
| 280 | | 0.00 | 0.000 | 0.022 | 0.1355 | 0.0664 | 0.0003 | 9.72E-05 | 0.0030 | 0.0000 | 7.55E-09 | 0.0000 | 0.0000 | 6.98E-05 |
| 281 | | 0.00 | 0.000 | 0.020 | 0.1344 | 0.0653 | 0.0003 | 9.60E-05 | 0.0031 | 0.0000 | 7.56E-09 | 0.0000 | 0.0000 | 6.97E-05 |
| 282 | | 0.00 | 0.000 | 0.020 | 0.1332 | 0.0642 | 0.0003 | 9.47E-05 | 0.0031 | 0.0000 | 7.56E-09 | 0.0000 | 0.0000 | 6.97E-05 |
| 283 | | 0.04 | 0.000 | 0.024 | 0.1343 | 0.0641 | 0.0003 | 9.46E-05 | 0.0031 | 0.0000 | 7.57E-09 | 0.0000 | 0.0000 | 6.96E-05 |
| 284 | | 0.00 | 0.000 | 0.017 | 0.1334 | 0.0646 | 0.0003 | 9.53E-05 | 0.0031 | 0.0000 | 7.57E-09 | 0.0000 | 0.0000 | 6.95E-05 |
| 285 | | 0.00 | 0.000 | 0.014 | 0.1325 | 0.0646 | 0.0003 | 9.52E-05 | 0.0032 | 0.0000 | 7.58E-09 | 0.0000 | 0.0000 | 6.95E-05 |
| 286 | | 0.00 | 0.000 | 0.011 | 0.1321 | 0.0641 | 0.0003 | 9.46E-05 | 0.0032 | 0.0000 | 7.59E-09 | 0.0000 | 0.0000 | 6.94E-05 |
| 287 | | 0.00 | 0.000 | 0.012 | 0.1314 | 0.0633 | 0.0003 | 9.38E-05 | 0.0032 | 0.0000 | 7.59E-09 | 0.0000 | 0.0000 | 6.93E-05 |
| 288 | | 0.00 | 0.000 | 0.011 | 0.1307 | 0.0624 | 0.0003 | 9.28E-05 | 0.0033 | 0.0000 | 7.60E-09 | 0.0000 | 0.0000 | 6.93E-05 |
| 289 | | 0.17 | 0.028 | 0.009 | 0.1382 | 0.0614 | 0.0003 | 9.16E-05 | 0.0033 | 0.0000 | 7.60E-09 | 0.0000 | 0.0000 | 6.92E-05 |
| 290 | | 0.00 | 0.000 | 0.009 | 0.1378 | 0.0604 | 0.0003 | 9.04E-05 | 0.0033 | 0.0000 | 7.61E-09 | 0.0000 | 0.0000 | 6.91E-05 |
| 291 | | 0.00 | 0.000 | 0.007 | 0.1374 | 0.0596 | 0.0003 | 8.95E-05 | 0.0033 | 0.0000 | 7.61E-09 | 0.0000 | 0.0000 | 6.90E-05 |
| 292 | | 0.00 | 0.000 | 0.008 | 0.1369 | 0.0587 | 0.0003 | 8.85E-05 | 0.0033 | 0.0000 | 7.62E-09 | 0.0000 | 0.0000 | 6.90E-05 |
| 293 | | 0.00 | 0.000 | 0.009 | 0.1364 | 0.0577 | 0.0003 | 8.73E-05 | 0.0034 | 0.0000 | 7.62E-09 | 0.0000 | 0.0000 | 6.89E-05 |
| 294 | * | 0.00 | 0.000 | 0.000 | 0.1364 | 0.0567 | 0.0003 | 8.62E-05 | 0.0034 | 0.0000 | 7.63E-09 | 0.0000 | 0.0000 | 6.88E-05 |
| 295 | * | 0.00 | 0.000 | 0.000 | 0.1364 | 0.0557 | 0.0003 | 8.51E-05 | 0.0034 | 0.0000 | 7.63E-09 | 0.0000 | 0.0000 | 6.88E-05 |
| 296 | * | 0.04 | 0.000 | 0.015 | 0.1375 | 0.0548 | 0.0003 | 8.40E-05 | 0.0034 | 0.0000 | 7.64E-09 | 0.0000 | 0.0000 | 6.87E-05 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 297 | * | | 0.00 | 0.000 | 0.008 | 0.1376 | 0.0538 | 0.0003 | 8.29E-05 | 0.0035 | 0.0000 | 7.64E-09 | 0.0000 | 0.0000 | 6.86E-05 |
| 298 | * | | 0.00 | 0.000 | 0.000 | 0.1376 | 0.0529 | 0.0003 | 8.18E-05 | 0.0035 | 0.0000 | 7.65E-09 | 0.0000 | 0.0000 | 6.86E-05 |
| 299 | * | | 0.00 | 0.000 | 0.000 | 0.1376 | 0.0520 | 0.0003 | 8.07E-05 | 0.0035 | 0.0000 | 7.65E-09 | 0.0000 | 0.0000 | 6.85E-05 |
| 300 | * | | 0.00 | 0.000 | 0.000 | 0.1376 | 0.0511 | 0.0003 | 7.97E-05 | 0.0035 | 0.0000 | 7.66E-09 | 0.0000 | 0.0000 | 6.84E-05 |
| 301 | * | | 0.00 | 0.000 | 0.000 | 0.1376 | 0.0502 | 0.0002 | 7.86E-05 | 0.0035 | 0.0000 | 7.66E-09 | 0.0000 | 0.0000 | 6.84E-05 |
| 302 | * | | 0.00 | 0.000 | 0.000 | 0.1376 | 0.0494 | 0.0002 | 7.76E-05 | 0.0036 | 0.0000 | 7.67E-09 | 0.0000 | 0.0000 | 6.83E-05 |
| 303 | * | | 0.00 | 0.000 | 0.003 | 0.1376 | 0.0485 | 0.0002 | 7.66E-05 | 0.0036 | 0.0000 | 7.67E-09 | 0.0000 | 0.0000 | 6.82E-05 |
| 304 | * | | 0.00 | 0.000 | 0.000 | 0.1376 | 0.0477 | 0.0002 | 7.55E-05 | 0.0036 | 0.0000 | 7.68E-09 | 0.0000 | 0.0000 | 6.81E-05 |
| 305 | * | | 0.00 | 0.000 | 0.000 | 0.1376 | 0.0469 | 0.0002 | 7.46E-05 | 0.0036 | 0.0000 | 7.68E-09 | 0.0000 | 0.0000 | 6.81E-05 |
| 306 | * | | 0.00 | 0.000 | 0.000 | 0.1376 | 0.0460 | 0.0002 | 7.36E-05 | 0.0036 | 0.0000 | 7.68E-09 | 0.0000 | 0.0000 | 6.80E-05 |
| 307 | | | 0.00 | 0.000 | 0.010 | 0.1370 | 0.0453 | 0.0002 | 7.26E-05 | 0.0037 | 0.0000 | 7.69E-09 | 0.0000 | 0.0000 | 6.79E-05 |
| 308 | | | 0.00 | 0.000 | 0.012 | 0.1365 | 0.0445 | 0.0002 | 7.16E-05 | 0.0037 | 0.0000 | 7.69E-09 | 0.0000 | 0.0000 | 6.79E-05 |
| 309 | | | 0.12 | 0.000 | 0.014 | 0.1423 | 0.0437 | 0.0002 | 7.07E-05 | 0.0037 | 0.0000 | 7.70E-09 | 0.0000 | 0.0000 | 6.78E-05 |
| 310 | | | 0.00 | 0.000 | 0.007 | 0.1419 | 0.0429 | 0.0002 | 6.98E-05 | 0.0037 | 0.0000 | 7.70E-09 | 0.0000 | 0.0000 | 6.77E-05 |
| 311 | | | 0.00 | 0.000 | 0.006 | 0.1416 | 0.0424 | 0.0002 | 6.91E-05 | 0.0037 | 0.0000 | 7.70E-09 | 0.0000 | 0.0000 | 6.77E-05 |
| 312 | | | 0.00 | 0.000 | 0.007 | 0.1412 | 0.0418 | 0.0002 | 6.83E-05 | 0.0037 | 0.0000 | 7.71E-09 | 0.0000 | 0.0000 | 6.76E-05 |
| 313 | | | 0.01 | 0.000 | 0.011 | 0.1409 | 0.0411 | 0.0002 | 6.74E-05 | 0.0038 | 0.0000 | 7.71E-09 | 0.0000 | 0.0000 | 6.75E-05 |
| 314 | * | | 0.00 | 0.000 | 0.009 | 0.1404 | 0.0404 | 0.0002 | 6.65E-05 | 0.0038 | 0.0000 | 7.71E-09 | 0.0000 | 0.0000 | 6.75E-05 |
| 315 | * | | 0.00 | 0.000 | 0.000 | 0.1404 | 0.0397 | 0.0002 | 6.57E-05 | 0.0038 | 0.0000 | 7.72E-09 | 0.0000 | 0.0000 | 6.74E-05 |
| 316 | * | | 0.00 | 0.000 | 0.000 | 0.1404 | 0.0390 | 0.0002 | 6.48E-05 | 0.0038 | 0.0000 | 7.72E-09 | 0.0000 | 0.0000 | 6.73E-05 |
| 317 | * | | 0.00 | 0.000 | 0.000 | 0.1404 | 0.0383 | 0.0002 | 6.39E-05 | 0.0038 | 0.0000 | 7.72E-09 | 0.0000 | 0.0000 | 6.73E-05 |
| 318 | * | * | 0.00 | 0.000 | 0.000 | 0.1404 | 0.0376 | 0.0002 | 6.31E-05 | 0.0038 | 0.0000 | 7.73E-09 | 0.0000 | 0.0000 | 6.72E-05 |
| 319 | * | * | 0.00 | 0.000 | 0.000 | 0.1404 | 0.0370 | 0.0002 | 6.22E-05 | 0.0038 | 0.0000 | 7.72E-09 | 0.0000 | 0.0000 | 6.71E-05 |
| 320 | * | * | 0.00 | 0.000 | 0.000 | 0.1404 | 0.0363 | 0.0002 | 6.14E-05 | 0.0037 | 0.0000 | 7.71E-09 | 0.0000 | 0.0000 | 6.71E-05 |
| 321 | * | * | 0.00 | 0.000 | 0.000 | 0.1404 | 0.0357 | 0.0002 | 6.06E-05 | 0.0037 | 0.0000 | 7.69E-09 | 0.0000 | 0.0000 | 6.70E-05 |
| 322 | * | * | 0.00 | 0.000 | 0.000 | 0.1404 | 0.0350 | 0.0002 | 5.98E-05 | 0.0036 | 0.0000 | 7.68E-09 | 0.0000 | 0.0000 | 6.69E-05 |
| 323 | * | * | 0.00 | 0.000 | 0.000 | 0.1404 | 0.0344 | 0.0002 | 5.90E-05 | 0.0036 | 0.0000 | 7.66E-09 | 0.0000 | 0.0000 | 6.69E-05 |
| 324 | * | * | 0.00 | 0.000 | 0.000 | 0.1404 | 0.0338 | 0.0002 | 5.82E-05 | 0.0035 | 0.0000 | 7.65E-09 | 0.0000 | 0.0000 | 6.68E-05 |
| 325 | * | * | 0.00 | 0.000 | 0.000 | 0.1404 | 0.0332 | 0.0002 | 5.74E-05 | 0.0034 | 0.0000 | 7.64E-09 | 0.0000 | 0.0000 | 6.68E-05 |
| 326 | * | * | 0.00 | 0.000 | 0.000 | 0.1404 | 0.0326 | 0.0002 | 5.66E-05 | 0.0034 | 0.0000 | 7.62E-09 | 0.0000 | 0.0000 | 6.67E-05 |
| 327 | * | * | 0.23 | 0.000 | 0.041 | 0.1404 | 0.0321 | 0.0002 | 5.59E-05 | 0.0033 | 0.0000 | 7.61E-09 | 0.0000 | 0.0000 | 6.66E-05 |
| 328 | | * | 0.00 | 0.089 | 0.032 | 0.1444 | 0.0315 | 0.0002 | 5.51E-05 | 0.0033 | 0.0000 | 7.60E-09 | 0.0000 | 0.0000 | 6.66E-05 |
| 329 | | * | 0.01 | 0.000 | 0.004 | 0.1449 | 0.0309 | 0.0002 | 5.44E-05 | 0.0032 | 0.0000 | 7.59E-09 | 0.0000 | 0.0000 | 6.65E-05 |
| 330 | | * | 0.17 | 0.164 | 0.004 | 0.1449 | 0.0304 | 0.0001 | 5.36E-05 | 0.0031 | 0.0000 | 7.57E-09 | 0.0000 | 0.0000 | 6.64E-05 |
| 331 | | * | 0.00 | 0.000 | 0.002 | 0.1450 | 0.0299 | 0.0001 | 5.29E-05 | 0.0031 | 0.0000 | 7.56E-09 | 0.0000 | 0.0000 | 6.64E-05 |
| 332 | | * | 0.00 | 0.000 | 0.000 | 0.1450 | 0.0293 | 0.0001 | 5.22E-05 | 0.0030 | 0.0000 | 7.55E-09 | 0.0000 | 0.0000 | 6.63E-05 |
| 333 | | * | 0.00 | 0.000 | 0.000 | 0.1450 | 0.0288 | 0.0001 | 5.15E-05 | 0.0030 | 0.0000 | 7.54E-09 | 0.0000 | 0.0000 | 6.62E-05 |
| 334 | * | * | 0.00 | 0.000 | 0.000 | 0.1450 | 0.0283 | 0.0001 | 5.08E-05 | 0.0029 | 0.0000 | 7.53E-09 | 0.0000 | 0.0000 | 6.62E-05 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 335 | | * | 0.00 | 0.000 | 0.000 | 0.1450 | 0.0278 | 0.0001 | 5.01E-05 | 0.0029 | 0.0000 | 7.52E-09 | 0.0000 | 0.0000 | 6.61E-05 |
| 336 | * | * | 0.01 | 0.000 | 0.008 | 0.1450 | 0.0273 | 0.0001 | 4.94E-05 | 0.0028 | 0.0000 | 7.50E-09 | 0.0000 | 0.0000 | 6.60E-05 |
| 337 | * | * | 0.00 | 0.000 | 0.000 | 0.1450 | 0.0268 | 0.0001 | 4.87E-05 | 0.0028 | 0.0000 | 7.49E-09 | 0.0000 | 0.0000 | 6.60E-05 |
| 338 | * | * | 0.05 | 0.000 | 0.028 | 0.1450 | 0.0263 | 0.0001 | 4.81E-05 | 0.0027 | 0.0000 | 7.48E-09 | 0.0000 | 0.0000 | 6.59E-05 |
| 339 | * | * | 0.00 | 0.000 | 0.020 | 0.1450 | 0.0259 | 0.0001 | 4.74E-05 | 0.0027 | 0.0000 | 7.47E-09 | 0.0000 | 0.0000 | 6.59E-05 |
| 340 | | * | 0.00 | 0.000 | 0.000 | 0.1450 | 0.0254 | 0.0001 | 4.68E-05 | 0.0026 | 0.0000 | 7.46E-09 | 0.0000 | 0.0000 | 6.58E-05 |
| 341 | | * | 0.00 | 0.000 | 0.000 | 0.1450 | 0.0249 | 0.0001 | 4.61E-05 | 0.0026 | 0.0000 | 7.45E-09 | 0.0000 | 0.0000 | 6.57E-05 |
| 342 | | * | 0.13 | 0.130 | 0.004 | 0.1450 | 0.0245 | 0.0001 | 4.55E-05 | 0.0025 | 0.0000 | 7.44E-09 | 0.0000 | 0.0000 | 6.57E-05 |
| 343 | | * | 0.01 | 0.000 | 0.004 | 0.1453 | 0.0240 | 0.0001 | 4.49E-05 | 0.0025 | 0.0000 | 7.43E-09 | 0.0000 | 0.0000 | 6.56E-05 |
| 344 | | * | 0.02 | 0.000 | 0.004 | 0.1461 | 0.0236 | 0.0001 | 4.43E-05 | 0.0025 | 0.0000 | 7.42E-09 | 0.0000 | 0.0000 | 6.55E-05 |
| 345 | | * | 0.00 | 0.000 | 0.002 | 0.1462 | 0.0232 | 0.0001 | 4.36E-05 | 0.0024 | 0.0000 | 7.42E-09 | 0.0000 | 0.0000 | 6.55E-05 |
| 346 | * | * | 0.57 | 0.000 | 0.040 | 0.1462 | 0.0228 | 0.0001 | 4.30E-05 | 0.0024 | 0.0000 | 7.41E-09 | 0.0000 | 0.0000 | 6.54E-05 |
| 347 | * | * | 0.24 | 0.000 | 0.015 | 0.1462 | 0.0224 | 0.0001 | 4.25E-05 | 0.0024 | 0.0000 | 7.40E-09 | 0.0000 | 0.0000 | 6.53E-05 |
| 348 | * | * | 0.73 | 0.000 | 0.025 | 0.1462 | 0.0220 | 0.0001 | 4.19E-05 | 0.0023 | 0.0000 | 7.39E-09 | 0.0000 | 0.0000 | 6.53E-05 |
| 349 | * | * | 0.05 | 0.000 | 0.010 | 0.1462 | 0.0216 | 0.0001 | 4.13E-05 | 0.0023 | 0.0000 | 7.39E-09 | 0.0000 | 0.0000 | 6.52E-05 |
| 350 | * | * | 0.00 | 0.000 | 0.022 | 0.1462 | 0.0212 | 0.0001 | 4.07E-05 | 0.0023 | 0.0000 | 7.38E-09 | 0.0000 | 0.0000 | 6.52E-05 |
| 351 | * | * | 0.00 | 0.000 | 0.025 | 0.1462 | 0.0208 | 0.0001 | 4.02E-05 | 0.0023 | 0.0000 | 7.38E-09 | 0.0000 | 0.0000 | 6.51E-05 |
| 352 | | * | 0.03 | 0.238 | 0.000 | 0.1462 | 0.0204 | 0.0001 | 3.96E-05 | 0.0022 | 0.0000 | 7.37E-09 | 0.0000 | 0.0000 | 6.50E-05 |
| 353 | * | * | 0.00 | 0.000 | 0.041 | 0.1462 | 0.0200 | 0.0001 | 3.91E-05 | 0.0022 | 0.0000 | 7.37E-09 | 0.0000 | 0.0000 | 6.50E-05 |
| 354 | | * | 0.09 | 0.160 | 0.000 | 0.1462 | 0.0197 | 0.0001 | 3.85E-05 | 0.0022 | 0.0000 | 7.36E-09 | 0.0000 | 0.0000 | 6.49E-05 |
| 355 | | * | 0.00 | 1.125 | 0.000 | 0.1462 | 0.0193 | 0.0001 | 3.80E-05 | 0.0022 | 0.0000 | 7.36E-09 | 0.0000 | 0.0000 | 6.49E-05 |
| 356 | | * | 0.00 | 0.000 | 0.000 | 0.1462 | 0.0190 | 0.0001 | 3.74E-05 | 0.0022 | 0.0000 | 7.36E-09 | 0.0000 | 0.0000 | 6.48E-05 |
| 357 | * | * | 0.00 | 0.000 | 0.000 | 0.1462 | 0.0186 | 0.0001 | 3.69E-05 | 0.0022 | 0.0000 | 7.36E-09 | 0.0000 | 0.0000 | 6.47E-05 |
| 358 | * | * | 0.00 | 0.000 | 0.000 | 0.1462 | 0.0183 | 0.0001 | 3.64E-05 | 0.0022 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 6.47E-05 |
| 359 | * | * | 0.00 | 0.000 | 0.000 | 0.1462 | 0.0179 | 0.0001 | 3.59E-05 | 0.0022 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 6.46E-05 |
| 360 | * | * | 0.00 | 0.000 | 0.000 | 0.1462 | 0.0176 | 0.0001 | 3.54E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 6.45E-05 |
| 361 | | * | 0.22 | 0.221 | 0.004 | 0.1462 | 0.0173 | 0.0001 | 3.49E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 6.45E-05 |
| 362 | | * | 0.00 | 0.000 | 0.000 | 0.1462 | 0.0170 | 0.0001 | 3.44E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 6.44E-05 |
| 363 | * | * | 0.00 | 0.000 | 0.000 | 0.1462 | 0.0166 | 0.0001 | 3.39E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 6.44E-05 |
| 364 | | * | 0.00 | 0.000 | 0.000 | 0.1462 | 0.0163 | 0.0001 | 3.35E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 6.43E-05 |
| 365 | | * | 0.05 | 0.000 | 0.004 | 0.1489 | 0.0160 | 0.0001 | 3.30E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 6.42E-05 |

* = Frozen (air or soil)

| Annual Totals for Year 2 | | | |
|---|---|---|---|
| | inches | cubic feet | percent |
| Precipitation | 34.27 | 124,383.8 | 100.00 |

| | | | |
|---|---|---|---|
| Runoff | 18.682 | 67,816.2 | 54.52 |
| Evapotranspiration | 15.377 | 55,820.3 | 44.88 |
| Drainage Collected from Layer 3 | 0.0659 | 239.3 | 0.19 |
| Percolation/Leakage through Layer 4 | 0.021002 | 76.2 | 0.06 |
| Average Head on Top of Layer 4 | 0.0366 | --- | --- |
| Drainage Collected from Layer 7 | 0.0031 | 11.4 | 0.01 |
| Percolation/Leakage through Layer 9 | 0.000003 | 0.0095 | 0.00 |
| Average Head on Top of Layer 8 | 0.0013 | --- | --- |
| Percolation/Leakage through Layer 10 | 0.028667 | 104.1 | 0.08 |
| Change in Water Storage | 0.1082 | 392.7 | 0.32 |
| Soil Water at Start of Year | 72.3747 | 262,720.3 | 211.22 |
| Soil Water at End of Year | 72.4829 | 263,113.0 | 211.53 |
| Snow Water at Start of Year | 0.0000 | 0.0000 | 0.00 |
| Snow Water at End of Year | 0.0000 | 0.0000 | 0.00 |
| Annual Water Budget Balance | 0.0000 | 0.0000 | 0.00 |

**Daily Output for Year 3**

**Column key:** Head #1: drainage from Layer 4 | Head #2: drainage from Layer 8
Drain #1: drainage from Layer 3 | Drain #2: drainage from Layer 7
Leak #1: leakage thru Layer 4 | Leak #2: leakage thru Layer 9 | Leak #3: leakage thru Layer 10

**Title:** Pilgrim Landfill
**Simulated On:** 4/10/2026 14:14

| Day | Freezing Status* | | Rain | Runoff | ET | Evap. Zone Water | Head #1 | Drain #1 | Leak #1 | Head #2 | Drain #2 | Leak #2 | Head #3 | Drain #3 | Leak #3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air | Soil | (inches) | (inches) | (inches) | (in/in) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) |
| 1 | * | * | 0.00 | 0.000 | 0.000 | 0.1489 | 0.0157 | 0.0001 | 3.25E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 6.42E-05 |
| 2 | | * | 0.00 | 0.000 | 0.000 | 0.1489 | 0.0155 | 0.0001 | 3.21E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 6.41E-05 |
| 3 | * | * | 0.00 | 0.000 | 0.000 | 0.1489 | 0.0152 | 0.0001 | 3.16E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 6.41E-05 |
| 4 | * | * | 0.00 | 0.000 | 0.000 | 0.1489 | 0.0149 | 0.0001 | 3.12E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 6.40E-05 |
| 5 | * | * | 0.01 | 0.000 | 0.010 | 0.1489 | 0.0146 | 0.0001 | 3.07E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 6.39E-05 |
| 6 | * | * | 0.00 | 0.000 | 0.000 | 0.1489 | 0.0143 | 0.0001 | 3.03E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 6.39E-05 |
| 7 | | * | 0.00 | 0.000 | 0.000 | 0.1489 | 0.0141 | 0.0001 | 2.98E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 6.38E-05 |
| 8 | * | * | 0.00 | 0.000 | 0.000 | 0.1489 | 0.0138 | 0.0001 | 2.94E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 6.38E-05 |
| 9 | * | * | 0.00 | 0.000 | 0.000 | 0.1489 | 0.0135 | 0.0001 | 2.90E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 6.37E-05 |
| 10 | * | * | 0.19 | 0.000 | 0.007 | 0.1489 | 0.0133 | 0.0001 | 2.86E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 6.36E-05 |
| 11 | * | * | 0.12 | 0.000 | 0.003 | 0.1489 | 0.0130 | 0.0001 | 2.82E-05 | 0.0021 | 0.0000 | 7.34E-09 | 0.0000 | 0.0000 | 6.36E-05 |
| 12 | * | * | 0.00 | 0.000 | 0.021 | 0.1489 | 0.0128 | 0.0001 | 2.78E-05 | 0.0021 | 0.0000 | 7.34E-09 | 0.0000 | 0.0000 | 6.35E-05 |
| 13 | * | * | 0.02 | 0.000 | 0.000 | 0.1489 | 0.0126 | 0.0001 | 2.74E-05 | 0.0021 | 0.0000 | 7.34E-09 | 0.0000 | 0.0000 | 6.35E-05 |
| 14 | * | * | 0.02 | 0.000 | 0.000 | 0.1489 | 0.0123 | 0.0001 | 2.70E-05 | 0.0021 | 0.0000 | 7.34E-09 | 0.0000 | 0.0000 | 6.34E-05 |
| 15 | * | * | 0.21 | 0.000 | 0.000 | 0.1489 | 0.0121 | 0.0001 | 2.66E-05 | 0.0021 | 0.0000 | 7.34E-09 | 0.0000 | 0.0000 | 6.33E-05 |
| 16 | * | * | 0.03 | 0.000 | 0.000 | 0.1489 | 0.0119 | 0.0001 | 2.62E-05 | 0.0021 | 0.0000 | 7.33E-09 | 0.0000 | 0.0000 | 6.33E-05 |
| 17 | * | * | 0.00 | 0.000 | 0.033 | 0.1489 | 0.0116 | 0.0001 | 2.58E-05 | 0.0021 | 0.0000 | 7.33E-09 | 0.0000 | 0.0000 | 6.32E-05 |
| 18 | * | * | 0.00 | 0.000 | 0.023 | 0.1489 | 0.0114 | 0.0001 | 2.55E-05 | 0.0021 | 0.0000 | 7.33E-09 | 0.0000 | 0.0000 | 6.32E-05 |
| 19 | | * | 0.00 | 0.304 | 0.013 | 0.1489 | 0.0112 | 0.0001 | 2.51E-05 | 0.0020 | 0.0000 | 7.33E-09 | 0.0000 | 0.0000 | 6.31E-05 |
| 20 | | * | 0.00 | 0.144 | 0.032 | 0.1489 | 0.0110 | 0.0001 | 2.47E-05 | 0.0020 | 0.0000 | 7.32E-09 | 0.0000 | 0.0000 | 6.31E-05 |
| 21 | * | * | 0.03 | 0.000 | 0.028 | 0.1489 | 0.0108 | 0.0001 | 2.44E-05 | 0.0020 | 0.0000 | 7.32E-09 | 0.0000 | 0.0000 | 6.30E-05 |
| 22 | * | * | 0.15 | 0.000 | 0.030 | 0.1489 | 0.0106 | 0.0001 | 2.40E-05 | 0.0020 | 0.0000 | 7.32E-09 | 0.0000 | 0.0000 | 6.29E-05 |
| 23 | * | * | 0.00 | 0.000 | 0.036 | 0.1489 | 0.0104 | 0.0001 | 2.37E-05 | 0.0020 | 0.0000 | 7.31E-09 | 0.0000 | 0.0000 | 6.29E-05 |
| 24 | | * | 0.00 | 0.000 | 0.065 | 0.1500 | 0.0102 | 0.0001 | 2.33E-05 | 0.0020 | 0.0000 | 7.31E-09 | 0.0000 | 0.0000 | 6.28E-05 |
| 25 | * | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0100 | 0.0000 | 2.30E-05 | 0.0020 | 0.0000 | 7.31E-09 | 0.0000 | 0.0000 | 6.28E-05 |
| 26 | * | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0098 | 0.0000 | 2.27E-05 | 0.0019 | 0.0000 | 7.30E-09 | 0.0000 | 0.0000 | 6.27E-05 |
| 27 | * | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0096 | 0.0000 | 2.23E-05 | 0.0019 | 0.0000 | 7.30E-09 | 0.0000 | 0.0000 | 6.27E-05 |
| 28 | * | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0094 | 0.0000 | 2.20E-05 | 0.0019 | 0.0000 | 7.29E-09 | 0.0000 | 0.0000 | 6.26E-05 |
| 29 | * | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0092 | 0.0000 | 2.17E-05 | 0.0019 | 0.0000 | 7.29E-09 | 0.0000 | 0.0000 | 6.25E-05 |
| 30 | | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0091 | 0.0000 | 2.14E-05 | 0.0019 | 0.0000 | 7.28E-09 | 0.0000 | 0.0000 | 6.25E-05 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0089 | 0.0000 | 2.10E-05 | 0.0018 | 0.0000 | 7.28E-09 | 0.0000 | 0.0000 | 6.24E-05 |
| 32 | * | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0087 | 0.0000 | 2.07E-05 | 0.0018 | 0.0000 | 7.27E-09 | 0.0000 | 0.0000 | 6.24E-05 |
| 33 | * | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0085 | 0.0000 | 2.04E-05 | 0.0018 | 0.0000 | 7.27E-09 | 0.0000 | 0.0000 | 6.23E-05 |
| 34 | * | * | 0.13 | 0.000 | 0.027 | 0.1500 | 0.0084 | 0.0000 | 2.01E-05 | 0.0018 | 0.0000 | 7.26E-09 | 0.0000 | 0.0000 | 6.23E-05 |
| 35 | * | * | 0.00 | 0.000 | 0.021 | 0.1500 | 0.0082 | 0.0000 | 1.98E-05 | 0.0018 | 0.0000 | 7.26E-09 | 0.0000 | 0.0000 | 6.22E-05 |
| 36 | | * | 0.19 | 0.256 | 0.015 | 0.1500 | 0.0081 | 0.0000 | 1.95E-05 | 0.0017 | 0.0000 | 7.25E-09 | 0.0000 | 0.0000 | 6.21E-05 |
| 37 | | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0079 | 0.0000 | 1.92E-05 | 0.0017 | 0.0000 | 7.25E-09 | 0.0000 | 0.0000 | 6.21E-05 |
| 38 | | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0077 | 0.0000 | 1.90E-05 | 0.0017 | 0.0000 | 7.24E-09 | 0.0000 | 0.0000 | 6.20E-05 |
| 39 | | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0076 | 0.0000 | 1.87E-05 | 0.0017 | 0.0000 | 7.24E-09 | 0.0000 | 0.0000 | 6.20E-05 |
| 40 | | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0074 | 0.0000 | 1.84E-05 | 0.0016 | 0.0000 | 7.23E-09 | 0.0000 | 0.0000 | 6.19E-05 |
| 41 | | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0073 | 0.0000 | 1.81E-05 | 0.0016 | 0.0000 | 7.23E-09 | 0.0000 | 0.0000 | 6.19E-05 |
| 42 | * | * | 0.02 | 0.000 | 0.021 | 0.1500 | 0.0072 | 0.0000 | 1.79E-05 | 0.0016 | 0.0000 | 7.22E-09 | 0.0000 | 0.0000 | 6.18E-05 |
| 43 | * | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0070 | 0.0000 | 1.76E-05 | 0.0016 | 0.0000 | 7.22E-09 | 0.0000 | 0.0000 | 6.17E-05 |
| 44 | * | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0069 | 0.0000 | 1.73E-05 | 0.0015 | 0.0000 | 7.21E-09 | 0.0000 | 0.0000 | 6.17E-05 |
| 45 | * | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0067 | 0.0000 | 1.71E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 6.16E-05 |
| 46 | * | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0066 | 0.0000 | 1.68E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 6.16E-05 |
| 47 | * | * | 0.25 | 0.000 | 0.033 | 0.1500 | 0.0065 | 0.0000 | 1.66E-05 | 0.0015 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 6.15E-05 |
| 48 | | * | 0.01 | 0.182 | 0.000 | 0.1500 | 0.0063 | 0.0000 | 1.63E-05 | 0.0014 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 6.15E-05 |
| 49 | | * | 0.01 | 0.000 | 0.053 | 0.1500 | 0.0062 | 0.0000 | 1.61E-05 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 6.14E-05 |
| 50 | | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0061 | 0.0000 | 1.58E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 6.14E-05 |
| 51 | * | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0060 | 0.0000 | 1.56E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 6.13E-05 |
| 52 | | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0059 | 0.0000 | 1.53E-05 | 0.0013 | 0.0000 | 7.16E-09 | 0.0000 | 0.0000 | 6.12E-05 |
| 53 | * | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0057 | 0.0000 | 1.51E-05 | 0.0013 | 0.0000 | 7.16E-09 | 0.0000 | 0.0000 | 6.12E-05 |
| 54 | * | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0056 | 0.0000 | 1.49E-05 | 0.0013 | 0.0000 | 7.15E-09 | 0.0000 | 0.0000 | 6.11E-05 |
| 55 | * | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0055 | 0.0000 | 1.46E-05 | 0.0013 | 0.0000 | 7.15E-09 | 0.0000 | 0.0000 | 6.11E-05 |
| 56 | | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0054 | 0.0000 | 1.44E-05 | 0.0013 | 0.0000 | 7.14E-09 | 0.0000 | 0.0000 | 6.10E-05 |
| 57 | | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0053 | 0.0000 | 1.42E-05 | 0.0012 | 0.0000 | 7.13E-09 | 0.0000 | 0.0000 | 6.10E-05 |
| 58 | * | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0052 | 0.0000 | 1.40E-05 | 0.0012 | 0.0000 | 7.13E-09 | 0.0000 | 0.0000 | 6.09E-05 |
| 59 | | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0051 | 0.0000 | 1.38E-05 | 0.0012 | 0.0000 | 7.12E-09 | 0.0000 | 0.0000 | 6.09E-05 |
| 60 | | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0050 | 0.0000 | 1.36E-05 | 0.0012 | 0.0000 | 7.12E-09 | 0.0000 | 0.0000 | 6.08E-05 |
| 61 | * | * | 0.00 | 0.000 | 0.004 | 0.1500 | 0.0049 | 0.0000 | 1.33E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 6.08E-05 |
| 62 | * | * | 0.03 | 0.000 | 0.030 | 0.1500 | 0.0048 | 0.0000 | 1.31E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 6.07E-05 |
| 63 | * | * | 0.42 | 0.000 | 0.010 | 0.1500 | 0.0047 | 0.0000 | 1.29E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 6.06E-05 |
| 64 | * | * | 0.96 | 0.000 | 0.000 | 0.1500 | 0.0046 | 0.0000 | 1.27E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 6.06E-05 |
| 65 | * | * | 0.00 | 0.000 | 0.037 | 0.1500 | 0.0045 | 0.0000 | 1.25E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 6.05E-05 |
| 66 | * | * | 0.00 | 0.000 | 0.013 | 0.1500 | 0.0044 | 0.0000 | 1.23E-05 | 0.0011 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 6.05E-05 |
| 67 | * | * | 0.00 | 0.000 | 0.022 | 0.1500 | 0.0043 | 0.0000 | 1.22E-05 | 0.0010 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 6.04E-05 |
| 68 | * | * | 0.03 | 0.000 | 0.000 | 0.1500 | 0.0042 | 0.0000 | 1.20E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 6.04E-05 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69 | | * | 0.00 | 0.300 | 0.007 | 0.1500 | 0.0041 | 0.0000 | 1.18E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 6.03E-05 |
| 70 | | * | 0.00 | 1.027 | 0.000 | 0.1500 | 0.0041 | 0.0000 | 1.16E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 6.03E-05 |
| 71 | | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0040 | 0.0000 | 1.14E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 6.02E-05 |
| 72 | | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0039 | 0.0000 | 1.12E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 6.02E-05 |
| 73 | * | * | 0.00 | 0.000 | 0.000 | 0.1500 | 0.0038 | 0.0000 | 1.11E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 6.01E-05 |
| 74 | | * | 0.32 | 0.312 | 0.004 | 0.1500 | 0.0037 | 0.0000 | 1.09E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 6.01E-05 |
| 75 | | * | 0.10 | 0.002 | 0.004 | 0.1553 | 0.0036 | 0.0000 | 1.07E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 6.00E-05 |
| 76 | | * | 0.01 | 0.000 | 0.003 | 0.1555 | 0.0036 | 0.0000 | 1.05E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 6.00E-05 |
| 77 | | * | 0.16 | 0.153 | 0.004 | 0.1555 | 0.0035 | 0.0000 | 1.04E-05 | 0.0009 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 5.99E-05 |
| 78 | | * | 0.00 | 0.000 | 0.000 | 0.1555 | 0.0034 | 0.0000 | 1.02E-05 | 0.0009 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 5.98E-05 |
| 79 | | * | 0.00 | 0.000 | 0.000 | 0.1555 | 0.0034 | 0.0000 | 1.00E-05 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 5.98E-05 |
| 80 | | * | 0.00 | 0.000 | 0.000 | 0.1555 | 0.0033 | 0.0000 | 9.88E-06 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 5.97E-05 |
| 81 | | * | 0.00 | 0.000 | 0.000 | 0.1555 | 0.0032 | 0.0000 | 9.72E-06 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 5.97E-05 |
| 82 | | * | 0.16 | 0.158 | 0.004 | 0.1555 | 0.0031 | 0.0000 | 9.57E-06 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 5.96E-05 |
| 83 | | * | 0.62 | 0.614 | 0.004 | 0.1555 | 0.0031 | 0.0000 | 9.41E-06 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 5.96E-05 |
| 84 | | | 0.13 | 0.000 | 0.078 | 0.1582 | 0.0030 | 0.0000 | 9.26E-06 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 5.95E-05 |
| 85 | | | 0.00 | 0.000 | 0.149 | 0.1499 | 0.0031 | 0.0000 | 9.48E-06 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 5.95E-05 |
| 86 | | | 0.00 | 0.000 | 0.115 | 0.1435 | 0.0031 | 0.0000 | 9.55E-06 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 5.94E-05 |
| 87 | | | 0.00 | 0.000 | 0.200 | 0.1324 | 0.0031 | 0.0000 | 9.39E-06 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 5.94E-05 |
| 88 | | | 0.00 | 0.000 | 0.049 | 0.1297 | 0.0030 | 0.0000 | 9.24E-06 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 5.93E-05 |
| 89 | | | 0.00 | 0.000 | 0.011 | 0.1287 | 0.0141 | 0.0001 | 2.89E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 5.93E-05 |
| 90 | | | 0.00 | 0.000 | 0.001 | 0.1287 | 0.0205 | 0.0001 | 3.97E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 5.92E-05 |
| 91 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0204 | 0.0001 | 3.96E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 5.92E-05 |
| 92 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0202 | 0.0001 | 3.92E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 5.91E-05 |
| 93 | * | | 0.00 | 0.000 | 0.003 | 0.1287 | 0.0198 | 0.0001 | 3.87E-05 | 0.0007 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 5.91E-05 |
| 94 | | | 0.02 | 0.000 | 0.007 | 0.1294 | 0.0194 | 0.0001 | 3.82E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 5.90E-05 |
| 95 | | | 0.10 | 0.000 | 0.006 | 0.1345 | 0.0191 | 0.0001 | 3.76E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 5.90E-05 |
| 96 | | | 0.00 | 0.000 | 0.012 | 0.1339 | 0.0187 | 0.0001 | 3.71E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 5.89E-05 |
| 97 | | | 0.35 | 0.166 | 0.030 | 0.1422 | 0.0184 | 0.0001 | 3.66E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 5.89E-05 |
| 98 | | | 0.05 | 0.000 | 0.014 | 0.1444 | 0.0180 | 0.0001 | 3.61E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 5.88E-05 |
| 99 | | | 0.00 | 0.000 | 0.010 | 0.1438 | 0.0177 | 0.0001 | 3.56E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 5.88E-05 |
| 100 | * | | 0.00 | 0.000 | 0.000 | 0.1438 | 0.0174 | 0.0001 | 3.51E-05 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 5.87E-05 |
| 101 | | | 0.00 | 0.000 | 0.010 | 0.1433 | 0.0171 | 0.0001 | 3.46E-05 | 0.0009 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 5.87E-05 |
| 102 | | | 0.63 | 0.452 | 0.025 | 0.1520 | 0.0168 | 0.0001 | 3.41E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 5.86E-05 |
| 103 | | | 1.34 | 1.038 | 0.187 | 0.1584 | 0.0165 | 0.0001 | 3.37E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 5.86E-05 |
| 104 | * | | 0.05 | 0.000 | 0.090 | 0.1564 | 0.0162 | 0.0001 | 3.32E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 5.85E-05 |
| 105 | | | 0.00 | 0.000 | 0.098 | 0.1510 | 0.0159 | 0.0001 | 3.27E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 5.85E-05 |
| 106 | | | 0.00 | 0.000 | 0.121 | 0.1443 | 0.0156 | 0.0001 | 3.23E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 5.84E-05 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 107 | | | 0.17 | 0.011 | 0.104 | 0.1475 | 0.0153 | 0.0001 | 3.18E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 5.84E-05 |
| 108 | * | | 0.00 | 0.000 | 0.101 | 0.1419 | 0.0150 | 0.0001 | 3.14E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 5.83E-05 |
| 109 | | | 0.00 | 0.000 | 0.123 | 0.1348 | 0.0166 | 0.0001 | 3.38E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 5.83E-05 |
| 110 | | | 0.00 | 0.000 | 0.091 | 0.1296 | 0.0319 | 0.0002 | 5.57E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 5.82E-05 |
| 111 | | | 0.00 | 0.000 | 0.014 | 0.1288 | 0.0329 | 0.0002 | 5.69E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 5.82E-05 |
| 112 | | | 0.00 | 0.000 | 0.002 | 0.1287 | 0.0348 | 0.0002 | 5.95E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 5.81E-05 |
| 113 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0358 | 0.0002 | 6.07E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 5.81E-05 |
| 114 | | | 0.30 | 0.121 | 0.020 | 0.1375 | 0.0351 | 0.0002 | 5.99E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 5.80E-05 |
| 115 | | | 0.31 | 0.154 | 0.038 | 0.1439 | 0.0345 | 0.0002 | 5.91E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 5.80E-05 |
| 116 | * | | 0.43 | 0.000 | 0.038 | 0.1450 | 0.0339 | 0.0002 | 5.83E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 5.79E-05 |
| 117 | * | | 0.00 | 0.000 | 0.023 | 0.1461 | 0.0333 | 0.0002 | 5.75E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 5.79E-05 |
| 118 | * | | 0.15 | 0.000 | 0.016 | 0.1472 | 0.0327 | 0.0002 | 5.67E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 5.78E-05 |
| 119 | * | | 0.19 | 0.000 | 0.000 | 0.1483 | 0.0321 | 0.0002 | 5.60E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 5.78E-05 |
| 120 | * | | 0.04 | 0.000 | 0.026 | 0.1494 | 0.0316 | 0.0002 | 5.52E-05 | 0.0009 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 5.77E-05 |
| 121 | * | | 0.00 | 0.000 | 0.000 | 0.1505 | 0.0310 | 0.0002 | 5.45E-05 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 5.77E-05 |
| 122 | | | 0.00 | 0.382 | 0.064 | 0.1579 | 0.0305 | 0.0002 | 5.37E-05 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 5.76E-05 |
| 123 | | | 0.00 | 0.000 | 0.066 | 0.1543 | 0.0299 | 0.0001 | 5.30E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 5.76E-05 |
| 124 | | | 0.00 | 0.000 | 0.207 | 0.1428 | 0.0294 | 0.0001 | 5.23E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 5.75E-05 |
| 125 | | | 0.00 | 0.000 | 0.196 | 0.1319 | 0.0289 | 0.0001 | 5.16E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 5.75E-05 |
| 126 | | | 0.03 | 0.000 | 0.060 | 0.1302 | 0.0289 | 0.0001 | 5.17E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 5.74E-05 |
| 127 | | | 0.09 | 0.000 | 0.016 | 0.1337 | 0.0412 | 0.0002 | 6.74E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 5.74E-05 |
| 128 | | | 0.00 | 0.000 | 0.019 | 0.1326 | 0.0471 | 0.0002 | 7.49E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 5.73E-05 |
| 129 | | | 0.35 | 0.154 | 0.043 | 0.1411 | 0.0463 | 0.0002 | 7.39E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 5.73E-05 |
| 130 | | | 0.40 | 0.120 | 0.226 | 0.1441 | 0.0455 | 0.0002 | 7.29E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 5.72E-05 |
| 131 | | | 0.00 | 0.000 | 0.047 | 0.1417 | 0.0447 | 0.0002 | 7.20E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 5.72E-05 |
| 132 | | | 0.11 | 0.000 | 0.082 | 0.1434 | 0.0440 | 0.0002 | 7.11E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 5.71E-05 |
| 133 | | | 0.02 | 0.000 | 0.174 | 0.1345 | 0.0434 | 0.0002 | 7.04E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 5.71E-05 |
| 134 | | | 0.62 | 0.301 | 0.148 | 0.1440 | 0.0432 | 0.0002 | 7.01E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 5.70E-05 |
| 135 | | | 0.99 | 0.558 | 0.317 | 0.1504 | 0.0427 | 0.0002 | 6.94E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 5.70E-05 |
| 136 | | | 0.32 | 0.116 | 0.238 | 0.1484 | 0.0433 | 0.0002 | 7.02E-05 | 0.0007 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 5.69E-05 |
| 137 | | | 0.22 | 0.093 | 0.051 | 0.1526 | 0.0432 | 0.0002 | 7.01E-05 | 0.0006 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 5.69E-05 |
| 138 | * | | 0.03 | 0.000 | 0.046 | 0.1517 | 0.0467 | 0.0002 | 7.43E-05 | 0.0006 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 5.68E-05 |
| 139 | | | 0.03 | 0.000 | 0.051 | 0.1504 | 0.0484 | 0.0002 | 7.64E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 5.68E-05 |
| 140 | * | | 0.01 | 0.000 | 0.007 | 0.1504 | 0.0476 | 0.0002 | 7.54E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 5.68E-05 |
| 141 | * | | 0.00 | 0.000 | 0.090 | 0.1454 | 0.0468 | 0.0002 | 7.44E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 5.67E-05 |
| 142 | | | 0.00 | 0.000 | 0.108 | 0.1394 | 0.0460 | 0.0002 | 7.35E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 5.67E-05 |
| 143 | | | 0.00 | 0.000 | 0.153 | 0.1308 | 0.0452 | 0.0002 | 7.26E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 5.66E-05 |
| 144 | | | 0.04 | 0.000 | 0.051 | 0.1303 | 0.0445 | 0.0002 | 7.16E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 5.66E-05 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 145 | 0.00 | 0.000 | 0.015 | 0.1293 | 0.0486 | 0.0002 | 7.66E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 5.65E-05 |
| 146 | 0.00 | 0.000 | 0.009 | 0.1288 | 0.0507 | 0.0002 | 7.91E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 5.65E-05 |
| 147 | 0.00 | 0.000 | 0.002 | 0.1287 | 0.0498 | 0.0002 | 7.81E-05 | 0.0006 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 5.64E-05 |
| 148 | 0.20 | 0.044 | 0.008 | 0.1367 | 0.0489 | 0.0002 | 7.71E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 5.64E-05 |
| 149 | 0.07 | 0.000 | 0.019 | 0.1396 | 0.0483 | 0.0002 | 7.62E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 5.63E-05 |
| 150 | 0.00 | 0.000 | 0.013 | 0.1389 | 0.0475 | 0.0002 | 7.53E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 5.63E-05 |
| 151 | 0.00 | 0.000 | 0.013 | 0.1381 | 0.0467 | 0.0002 | 7.44E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 5.62E-05 |
| 152 | 0.00 | 0.000 | 0.016 | 0.1372 | 0.0459 | 0.0002 | 7.34E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 5.62E-05 |
| 153 | 0.00 | 0.000 | 0.017 | 0.1363 | 0.0451 | 0.0002 | 7.24E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 5.61E-05 |
| 154 | 0.03 | 0.000 | 0.021 | 0.1365 | 0.0443 | 0.0002 | 7.14E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 5.61E-05 |
| 155 | 1.17 | 0.995 | 0.027 | 0.1448 | 0.0435 | 0.0002 | 7.05E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 5.60E-05 |
| 156 | 1.27 | 1.030 | 0.129 | 0.1513 | 0.0428 | 0.0002 | 6.96E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 5.60E-05 |
| 157 | 0.01 | 0.000 | 0.076 | 0.1477 | 0.0420 | 0.0002 | 6.86E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 5.60E-05 |
| 158 | 0.00 | 0.000 | 0.111 | 0.1416 | 0.0414 | 0.0002 | 6.79E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 5.59E-05 |
| 159 | 0.00 | 0.000 | 0.103 | 0.1358 | 0.0413 | 0.0002 | 6.77E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 5.59E-05 |
| 160 | 0.00 | 0.000 | 0.109 | 0.1298 | 0.0407 | 0.0002 | 6.69E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 5.58E-05 |
| 161 | 0.00 | 0.000 | 0.015 | 0.1290 | 0.0400 | 0.0002 | 6.60E-05 | 0.0004 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 5.58E-05 |
| 162 | 0.61 | 0.379 | 0.065 | 0.1384 | 0.0397 | 0.0002 | 6.57E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 5.57E-05 |
| 163 | 0.20 | 0.053 | 0.130 | 0.1391 | 0.0433 | 0.0002 | 7.01E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 5.57E-05 |
| 164 | 0.01 | 0.000 | 0.133 | 0.1323 | 0.0446 | 0.0002 | 7.18E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 5.56E-05 |
| 165 | 0.00 | 0.000 | 0.044 | 0.1298 | 0.0438 | 0.0002 | 7.08E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 5.56E-05 |
| 166 | 0.00 | 0.000 | 0.015 | 0.1290 | 0.0430 | 0.0002 | 6.99E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 5.55E-05 |
| 167 | 0.00 | 0.000 | 0.003 | 0.1287 | 0.0445 | 0.0002 | 7.17E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 5.55E-05 |
| 168 | 0.00 | 0.000 | 0.001 | 0.1287 | 0.0451 | 0.0002 | 7.24E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 5.55E-05 |
| 169 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0444 | 0.0002 | 7.16E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 5.54E-05 |
| 170 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0437 | 0.0002 | 7.07E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 5.54E-05 |
| 171 | 0.16 | 0.014 | 0.007 | 0.1366 | 0.0430 | 0.0002 | 6.98E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 5.53E-05 |
| 172 | 1.24 | 1.096 | 0.032 | 0.1430 | 0.0422 | 0.0002 | 6.89E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 5.53E-05 |
| 173 | 0.72 | 0.454 | 0.154 | 0.1494 | 0.0415 | 0.0002 | 6.79E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 5.52E-05 |
| 174 | 0.59 | 0.118 | 0.359 | 0.1558 | 0.0408 | 0.0002 | 6.70E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 5.52E-05 |
| 175 | 0.60 | 0.199 | 0.283 | 0.1622 | 0.0401 | 0.0002 | 6.62E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 5.51E-05 |
| 176 | 0.07 | 0.000 | 0.108 | 0.1602 | 0.0394 | 0.0002 | 6.53E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 5.51E-05 |
| 177 | 0.00 | 0.000 | 0.234 | 0.1474 | 0.0387 | 0.0002 | 6.44E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 5.50E-05 |
| 178 | 0.03 | 0.000 | 0.205 | 0.1375 | 0.0380 | 0.0002 | 6.35E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 5.50E-05 |
| 179 | 0.07 | 0.000 | 0.133 | 0.1338 | 0.0373 | 0.0002 | 6.27E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 5.50E-05 |
| 180 | 0.06 | 0.000 | 0.055 | 0.1337 | 0.0418 | 0.0002 | 6.83E-05 | 0.0007 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 5.49E-05 |
| 181 | 0.45 | 0.256 | 0.064 | 0.1409 | 0.0502 | 0.0002 | 7.86E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 5.49E-05 |
| 182 | 0.00 | 0.000 | 0.129 | 0.1338 | 0.0494 | 0.0002 | 7.76E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 5.48E-05 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 183 | 0.39 | 0.184 | 0.050 | 0.1425 | 0.0485 | 0.0002 | 7.65E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 5.48E-05 |
| 184 | 0.70 | 0.351 | 0.229 | 0.1490 | 0.0477 | 0.0002 | 7.55E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 5.47E-05 |
| 185 | 0.51 | 0.228 | 0.163 | 0.1554 | 0.0469 | 0.0002 | 7.45E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 5.47E-05 |
| 186 | 0.53 | 0.239 | 0.172 | 0.1619 | 0.0460 | 0.0002 | 7.36E-05 | 0.0011 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 5.46E-05 |
| 187 | 0.04 | 0.000 | 0.110 | 0.1579 | 0.0452 | 0.0002 | 7.26E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 5.46E-05 |
| 188 | 0.11 | 0.000 | 0.108 | 0.1583 | 0.0445 | 0.0002 | 7.16E-05 | 0.0012 | 0.0000 | 7.13E-09 | 0.0000 | 0.0000 | 5.46E-05 |
| 189 | 0.00 | 0.000 | 0.126 | 0.1513 | 0.0437 | 0.0002 | 7.07E-05 | 0.0013 | 0.0000 | 7.14E-09 | 0.0000 | 0.0000 | 5.45E-05 |
| 190 | 0.00 | 0.000 | 0.140 | 0.1432 | 0.0525 | 0.0003 | 8.12E-05 | 0.0013 | 0.0000 | 7.16E-09 | 0.0000 | 0.0000 | 5.45E-05 |
| 191 | 0.18 | 0.023 | 0.113 | 0.1458 | 0.0573 | 0.0003 | 8.69E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 5.44E-05 |
| 192 | 0.00 | 0.000 | 0.213 | 0.1340 | 0.0564 | 0.0003 | 8.58E-05 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 5.44E-05 |
| 193 | 0.41 | 0.155 | 0.148 | 0.1399 | 0.0554 | 0.0003 | 8.47E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 5.43E-05 |
| 194 | 0.03 | 0.000 | 0.148 | 0.1330 | 0.0619 | 0.0003 | 9.21E-05 | 0.0015 | 0.0000 | 7.21E-09 | 0.0000 | 0.0000 | 5.43E-05 |
| 195 | 0.26 | 0.110 | 0.053 | 0.1383 | 0.0665 | 0.0003 | 9.73E-05 | 0.0016 | 0.0000 | 7.22E-09 | 0.0000 | 0.0000 | 5.43E-05 |
| 196 | 5.34 | 4.859 | 0.365 | 0.1448 | 0.0653 | 0.0003 | 9.60E-05 | 0.0017 | 0.0000 | 7.24E-09 | 0.0000 | 0.0000 | 5.42E-05 |
| 197 | 0.00 | 0.000 | 0.148 | 0.1364 | 0.0680 | 0.0003 | 9.90E-05 | 0.0017 | 0.0000 | 7.25E-09 | 0.0000 | 0.0000 | 5.42E-05 |
| 198 | 0.00 | 0.000 | 0.115 | 0.1300 | 0.0690 | 0.0003 | 1.00E-04 | 0.0018 | 0.0000 | 7.26E-09 | 0.0000 | 0.0000 | 5.41E-05 |
| 199 | 0.00 | 0.000 | 0.018 | 0.1290 | 0.0679 | 0.0003 | 9.89E-05 | 0.0018 | 0.0000 | 7.27E-09 | 0.0000 | 0.0000 | 5.41E-05 |
| 200 | 0.00 | 0.000 | 0.003 | 0.1287 | 0.0718 | 0.0004 | 1.03E-04 | 0.0019 | 0.0000 | 7.29E-09 | 0.0000 | 0.0000 | 5.40E-05 |
| 201 | 0.01 | 0.000 | 0.009 | 0.1287 | 0.0736 | 0.0004 | 1.05E-04 | 0.0019 | 0.0000 | 7.30E-09 | 0.0000 | 0.0000 | 5.40E-05 |
| 202 | 0.07 | 0.000 | 0.008 | 0.1321 | 0.0724 | 0.0004 | 1.04E-04 | 0.0020 | 0.0000 | 7.31E-09 | 0.0000 | 0.0000 | 5.40E-05 |
| 203 | 0.00 | 0.000 | 0.003 | 0.1319 | 0.0711 | 0.0004 | 1.02E-04 | 0.0020 | 0.0000 | 7.32E-09 | 0.0000 | 0.0000 | 5.39E-05 |
| 204 | 0.02 | 0.000 | 0.015 | 0.1322 | 0.0699 | 0.0003 | 1.01E-04 | 0.0021 | 0.0000 | 7.33E-09 | 0.0000 | 0.0000 | 5.39E-05 |
| 205 | 0.70 | 0.524 | 0.035 | 0.1400 | 0.0688 | 0.0003 | 9.99E-05 | 0.0021 | 0.0000 | 7.34E-09 | 0.0000 | 0.0000 | 5.38E-05 |
| 206 | 0.09 | 0.000 | 0.154 | 0.1366 | 0.0676 | 0.0003 | 9.86E-05 | 0.0022 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 5.38E-05 |
| 207 | 0.01 | 0.000 | 0.024 | 0.1359 | 0.0665 | 0.0003 | 9.73E-05 | 0.0022 | 0.0000 | 7.36E-09 | 0.0000 | 0.0000 | 5.37E-05 |
| 208 | 1.40 | 1.224 | 0.031 | 0.1439 | 0.0653 | 0.0003 | 9.60E-05 | 0.0022 | 0.0000 | 7.37E-09 | 0.0000 | 0.0000 | 5.37E-05 |
| 209 | 0.00 | 0.000 | 0.177 | 0.1340 | 0.0642 | 0.0003 | 9.48E-05 | 0.0023 | 0.0000 | 7.38E-09 | 0.0000 | 0.0000 | 5.37E-05 |
| 210 | 0.00 | 0.000 | 0.065 | 0.1304 | 0.0646 | 0.0003 | 9.52E-05 | 0.0023 | 0.0000 | 7.39E-09 | 0.0000 | 0.0000 | 5.36E-05 |
| 211 | 0.00 | 0.000 | 0.023 | 0.1291 | 0.0644 | 0.0003 | 9.50E-05 | 0.0024 | 0.0000 | 7.40E-09 | 0.0000 | 0.0000 | 5.36E-05 |
| 212 | 0.08 | 0.000 | 0.020 | 0.1319 | 0.0698 | 0.0003 | 1.01E-04 | 0.0024 | 0.0000 | 7.41E-09 | 0.0000 | 0.0000 | 5.35E-05 |
| 213 | 0.00 | 0.000 | 0.005 | 0.1317 | 0.0724 | 0.0004 | 1.04E-04 | 0.0024 | 0.0000 | 7.42E-09 | 0.0000 | 0.0000 | 5.35E-05 |
| 214 | 0.11 | 0.000 | 0.019 | 0.1370 | 0.0712 | 0.0004 | 1.03E-04 | 0.0025 | 0.0000 | 7.43E-09 | 0.0000 | 0.0000 | 5.34E-05 |
| 215 | 0.00 | 0.000 | 0.019 | 0.1360 | 0.0700 | 0.0003 | 1.01E-04 | 0.0025 | 0.0000 | 7.44E-09 | 0.0000 | 0.0000 | 5.34E-05 |
| 216 | 0.00 | 0.000 | 0.016 | 0.1351 | 0.0688 | 0.0003 | 9.99E-05 | 0.0026 | 0.0000 | 7.45E-09 | 0.0000 | 0.0000 | 5.34E-05 |
| 217 | 0.40 | 0.209 | 0.035 | 0.1439 | 0.0677 | 0.0003 | 9.86E-05 | 0.0026 | 0.0000 | 7.45E-09 | 0.0000 | 0.0000 | 5.33E-05 |
| 218 | 0.07 | 0.000 | 0.021 | 0.1468 | 0.0666 | 0.0003 | 9.75E-05 | 0.0026 | 0.0000 | 7.46E-09 | 0.0000 | 0.0000 | 5.33E-05 |
| 219 | 0.00 | 0.000 | 0.089 | 0.1419 | 0.0656 | 0.0003 | 9.63E-05 | 0.0027 | 0.0000 | 7.47E-09 | 0.0000 | 0.0000 | 5.32E-05 |
| 220 | 0.00 | 0.000 | 0.018 | 0.1409 | 0.0648 | 0.0003 | 9.55E-05 | 0.0027 | 0.0000 | 7.48E-09 | 0.0000 | 0.0000 | 5.32E-05 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 221 | 0.23 | 0.086 | 0.021 | 0.1478 | 0.0639 | 0.0003 | 9.44E-05 | 0.0027 | 0.0000 | 7.49E-09 | 0.0000 | 0.0000 | 5.31E-05 |
| 222 | 0.00 | 0.000 | 0.019 | 0.1468 | 0.0629 | 0.0003 | 9.33E-05 | 0.0028 | 0.0000 | 7.49E-09 | 0.0000 | 0.0000 | 5.31E-05 |
| 223 | 0.00 | 0.000 | 0.018 | 0.1457 | 0.0624 | 0.0003 | 9.27E-05 | 0.0028 | 0.0000 | 7.50E-09 | 0.0000 | 0.0000 | 5.31E-05 |
| 224 | 0.00 | 0.000 | 0.014 | 0.1449 | 0.0628 | 0.0003 | 9.32E-05 | 0.0028 | 0.0000 | 7.51E-09 | 0.0000 | 0.0000 | 5.30E-05 |
| 225 | 0.06 | 0.000 | 0.018 | 0.1474 | 0.0618 | 0.0003 | 9.20E-05 | 0.0029 | 0.0000 | 7.52E-09 | 0.0000 | 0.0000 | 5.30E-05 |
| 226 | 0.81 | 0.658 | 0.024 | 0.1546 | 0.0607 | 0.0003 | 9.08E-05 | 0.0029 | 0.0000 | 7.52E-09 | 0.0000 | 0.0000 | 5.29E-05 |
| 227 | 0.37 | 0.125 | 0.163 | 0.1591 | 0.0597 | 0.0003 | 8.97E-05 | 0.0029 | 0.0000 | 7.53E-09 | 0.0000 | 0.0000 | 5.29E-05 |
| 228 | 0.00 | 0.000 | 0.106 | 0.1532 | 0.0587 | 0.0003 | 8.85E-05 | 0.0030 | 0.0000 | 7.54E-09 | 0.0000 | 0.0000 | 5.29E-05 |
| 229 | 0.00 | 0.000 | 0.092 | 0.1481 | 0.0582 | 0.0003 | 8.80E-05 | 0.0030 | 0.0000 | 7.54E-09 | 0.0000 | 0.0000 | 5.28E-05 |
| 230 | 0.14 | 0.000 | 0.187 | 0.1453 | 0.0575 | 0.0003 | 8.72E-05 | 0.0030 | 0.0000 | 7.55E-09 | 0.0000 | 0.0000 | 5.28E-05 |
| 231 | 0.01 | 0.000 | 0.188 | 0.1351 | 0.0566 | 0.0003 | 8.60E-05 | 0.0031 | 0.0000 | 7.56E-09 | 0.0000 | 0.0000 | 5.27E-05 |
| 232 | 0.00 | 0.000 | 0.083 | 0.1301 | 0.0677 | 0.0003 | 9.86E-05 | 0.0031 | 0.0000 | 7.56E-09 | 0.0000 | 0.0000 | 5.27E-05 |
| 233 | 0.00 | 0.000 | 0.019 | 0.1290 | 0.0738 | 0.0004 | 1.05E-04 | 0.0031 | 0.0000 | 7.57E-09 | 0.0000 | 0.0000 | 5.27E-05 |
| 234 | 0.33 | 0.148 | 0.032 | 0.1371 | 0.0778 | 0.0004 | 1.10E-04 | 0.0031 | 0.0000 | 7.57E-09 | 0.0000 | 0.0000 | 5.26E-05 |
| 235 | 0.00 | 0.000 | 0.019 | 0.1360 | 0.0796 | 0.0004 | 1.12E-04 | 0.0032 | 0.0000 | 7.58E-09 | 0.0000 | 0.0000 | 5.26E-05 |
| 236 | 0.00 | 0.000 | 0.021 | 0.1348 | 0.0782 | 0.0004 | 1.10E-04 | 0.0032 | 0.0000 | 7.59E-09 | 0.0000 | 0.0000 | 5.25E-05 |
| 237 | 0.24 | 0.097 | 0.027 | 0.1412 | 0.0769 | 0.0004 | 1.09E-04 | 0.0032 | 0.0000 | 7.59E-09 | 0.0000 | 0.0000 | 5.25E-05 |
| 238 | 0.00 | 0.000 | 0.015 | 0.1403 | 0.0756 | 0.0004 | 1.07E-04 | 0.0032 | 0.0000 | 7.60E-09 | 0.0000 | 0.0000 | 5.24E-05 |
| 239 | 0.15 | 0.023 | 0.019 | 0.1465 | 0.0748 | 0.0004 | 1.06E-04 | 0.0033 | 0.0000 | 7.60E-09 | 0.0000 | 0.0000 | 5.24E-05 |
| 240 | 0.00 | 0.000 | 0.072 | 0.1426 | 0.0738 | 0.0004 | 1.05E-04 | 0.0033 | 0.0000 | 7.61E-09 | 0.0000 | 0.0000 | 5.24E-05 |
| 241 | 0.00 | 0.000 | 0.018 | 0.1416 | 0.0728 | 0.0004 | 1.04E-04 | 0.0033 | 0.0000 | 7.61E-09 | 0.0000 | 0.0000 | 5.23E-05 |
| 242 | 0.26 | 0.118 | 0.021 | 0.1483 | 0.0717 | 0.0004 | 1.03E-04 | 0.0033 | 0.0000 | 7.62E-09 | 0.0000 | 0.0000 | 5.23E-05 |
| 243 | 0.00 | 0.000 | 0.120 | 0.1418 | 0.0705 | 0.0003 | 1.02E-04 | 0.0034 | 0.0000 | 7.62E-09 | 0.0000 | 0.0000 | 5.22E-05 |
| 244 | 0.15 | 0.003 | 0.025 | 0.1482 | 0.0715 | 0.0004 | 1.03E-04 | 0.0034 | 0.0000 | 7.63E-09 | 0.0000 | 0.0000 | 5.22E-05 |
| 245 | 0.24 | 0.114 | 0.077 | 0.1512 | 0.0723 | 0.0004 | 1.04E-04 | 0.0034 | 0.0000 | 7.63E-09 | 0.0000 | 0.0000 | 5.22E-05 |
| 246 | 0.04 | 0.000 | 0.124 | 0.1464 | 0.0740 | 0.0004 | 1.06E-04 | 0.0034 | 0.0000 | 7.64E-09 | 0.0000 | 0.0000 | 5.21E-05 |
| 247 | 0.01 | 0.000 | 0.100 | 0.1413 | 0.0744 | 0.0004 | 1.06E-04 | 0.0034 | 0.0000 | 7.63E-09 | 0.0000 | 0.0000 | 5.21E-05 |
| 248 | 0.00 | 0.000 | 0.042 | 0.1389 | 0.0732 | 0.0004 | 1.05E-04 | 0.0033 | 0.0000 | 7.62E-09 | 0.0000 | 0.0000 | 5.20E-05 |
| 249 | 0.16 | 0.005 | 0.036 | 0.1452 | 0.0730 | 0.0004 | 1.05E-04 | 0.0033 | 0.0000 | 7.60E-09 | 0.0000 | 0.0000 | 5.20E-05 |
| 250 | 0.82 | 0.659 | 0.043 | 0.1517 | 0.0725 | 0.0004 | 1.04E-04 | 0.0032 | 0.0000 | 7.59E-09 | 0.0000 | 0.0000 | 5.20E-05 |
| 251 | 0.00 | 0.000 | 0.062 | 0.1483 | 0.0712 | 0.0004 | 1.03E-04 | 0.0032 | 0.0000 | 7.58E-09 | 0.0000 | 0.0000 | 5.19E-05 |
| 252 | 0.00 | 0.000 | 0.130 | 0.1409 | 0.0736 | 0.0004 | 1.05E-04 | 0.0031 | 0.0000 | 7.57E-09 | 0.0000 | 0.0000 | 5.19E-05 |
| 253 | 0.00 | 0.000 | 0.095 | 0.1356 | 0.0746 | 0.0004 | 1.06E-04 | 0.0030 | 0.0000 | 7.55E-09 | 0.0000 | 0.0000 | 5.18E-05 |
| 254 | 0.00 | 0.000 | 0.089 | 0.1307 | 0.0733 | 0.0004 | 1.05E-04 | 0.0030 | 0.0000 | 7.54E-09 | 0.0000 | 0.0000 | 5.18E-05 |
| 255 | 0.00 | 0.000 | 0.032 | 0.1289 | 0.0721 | 0.0004 | 1.03E-04 | 0.0029 | 0.0000 | 7.53E-09 | 0.0000 | 0.0000 | 5.18E-05 |
| 256 | 0.00 | 0.000 | 0.002 | 0.1287 | 0.0746 | 0.0004 | 1.06E-04 | 0.0029 | 0.0000 | 7.52E-09 | 0.0000 | 0.0000 | 5.17E-05 |
| 257 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0756 | 0.0004 | 1.07E-04 | 0.0028 | 0.0000 | 7.51E-09 | 0.0000 | 0.0000 | 5.17E-05 |
| 258 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0743 | 0.0004 | 1.06E-04 | 0.0028 | 0.0000 | 7.50E-09 | 0.0000 | 0.0000 | 5.16E-05 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 259 | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0731 | 0.0004 | 1.05E-04 | 0.0027 | 0.0000 | 7.49E-09 | 0.0000 | 0.0000 | 5.16E-05 |
| 260 | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0719 | 0.0004 | 1.03E-04 | 0.0027 | 0.0000 | 7.47E-09 | 0.0000 | 0.0000 | 5.16E-05 |
| 261 | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0706 | 0.0003 | 1.02E-04 | 0.0026 | 0.0000 | 7.46E-09 | 0.0000 | 0.0000 | 5.15E-05 |
| 262 | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0694 | 0.0003 | 1.01E-04 | 0.0026 | 0.0000 | 7.45E-09 | 0.0000 | 0.0000 | 5.15E-05 |
| 263 | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0683 | 0.0003 | 9.93E-05 | 0.0026 | 0.0000 | 7.44E-09 | 0.0000 | 0.0000 | 5.15E-05 |
| 264 | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0671 | 0.0003 | 9.80E-05 | 0.0025 | 0.0000 | 7.43E-09 | 0.0000 | 0.0000 | 5.14E-05 |
| 265 | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0660 | 0.0003 | 9.68E-05 | 0.0025 | 0.0000 | 7.42E-09 | 0.0000 | 0.0000 | 5.14E-05 |
| 266 | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0649 | 0.0003 | 9.55E-05 | 0.0024 | 0.0000 | 7.41E-09 | 0.0000 | 0.0000 | 5.13E-05 |
| 267 | | 0.18 | 0.032 | 0.006 | 0.1366 | 0.0638 | 0.0003 | 9.43E-05 | 0.0024 | 0.0000 | 7.40E-09 | 0.0000 | 0.0000 | 5.13E-05 |
| 268 | | 0.01 | 0.000 | 0.012 | 0.1363 | 0.0627 | 0.0003 | 9.30E-05 | 0.0023 | 0.0000 | 7.39E-09 | 0.0000 | 0.0000 | 5.13E-05 |
| 269 | | 0.14 | 0.014 | 0.013 | 0.1425 | 0.0616 | 0.0003 | 9.18E-05 | 0.0023 | 0.0000 | 7.39E-09 | 0.0000 | 0.0000 | 5.12E-05 |
| 270 | | 0.00 | 0.000 | 0.010 | 0.1419 | 0.0606 | 0.0003 | 9.06E-05 | 0.0023 | 0.0000 | 7.38E-09 | 0.0000 | 0.0000 | 5.12E-05 |
| 271 | | 0.10 | 0.000 | 0.012 | 0.1469 | 0.0597 | 0.0003 | 8.97E-05 | 0.0022 | 0.0000 | 7.37E-09 | 0.0000 | 0.0000 | 5.11E-05 |
| 272 | | 0.09 | 0.000 | 0.013 | 0.1509 | 0.0588 | 0.0003 | 8.87E-05 | 0.0022 | 0.0000 | 7.36E-09 | 0.0000 | 0.0000 | 5.11E-05 |
| 273 | | 0.01 | 0.000 | 0.011 | 0.1507 | 0.0580 | 0.0003 | 8.77E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 5.11E-05 |
| 274 | | 0.00 | 0.000 | 0.011 | 0.1501 | 0.0571 | 0.0003 | 8.67E-05 | 0.0021 | 0.0000 | 7.34E-09 | 0.0000 | 0.0000 | 5.10E-05 |
| 275 | | 0.00 | 0.000 | 0.011 | 0.1495 | 0.0561 | 0.0003 | 8.55E-05 | 0.0021 | 0.0000 | 7.33E-09 | 0.0000 | 0.0000 | 5.10E-05 |
| 276 | | 0.00 | 0.000 | 0.011 | 0.1489 | 0.0552 | 0.0003 | 8.44E-05 | 0.0020 | 0.0000 | 7.32E-09 | 0.0000 | 0.0000 | 5.09E-05 |
| 277 | * | 0.00 | 0.000 | 0.000 | 0.1489 | 0.0542 | 0.0003 | 8.33E-05 | 0.0020 | 0.0000 | 7.32E-09 | 0.0000 | 0.0000 | 5.09E-05 |
| 278 | * | 0.00 | 0.000 | 0.010 | 0.1483 | 0.0533 | 0.0003 | 8.22E-05 | 0.0020 | 0.0000 | 7.31E-09 | 0.0000 | 0.0000 | 5.09E-05 |
| 279 | * | 0.00 | 0.000 | 0.010 | 0.1478 | 0.0524 | 0.0003 | 8.11E-05 | 0.0019 | 0.0000 | 7.30E-09 | 0.0000 | 0.0000 | 5.08E-05 |
| 280 | * | 0.00 | 0.000 | 0.000 | 0.1478 | 0.0515 | 0.0003 | 8.01E-05 | 0.0019 | 0.0000 | 7.29E-09 | 0.0000 | 0.0000 | 5.08E-05 |
| 281 | * | 0.00 | 0.000 | 0.004 | 0.1478 | 0.0506 | 0.0002 | 7.90E-05 | 0.0019 | 0.0000 | 7.28E-09 | 0.0000 | 0.0000 | 5.08E-05 |
| 282 | * | 0.00 | 0.000 | 0.002 | 0.1478 | 0.0497 | 0.0002 | 7.80E-05 | 0.0018 | 0.0000 | 7.28E-09 | 0.0000 | 0.0000 | 5.07E-05 |
| 283 | * | 0.00 | 0.000 | 0.000 | 0.1478 | 0.0489 | 0.0002 | 7.70E-05 | 0.0018 | 0.0000 | 7.27E-09 | 0.0000 | 0.0000 | 5.07E-05 |
| 284 | * | 0.00 | 0.000 | 0.000 | 0.1478 | 0.0480 | 0.0002 | 7.60E-05 | 0.0018 | 0.0000 | 7.26E-09 | 0.0000 | 0.0000 | 5.06E-05 |
| 285 | | 0.00 | 0.000 | 0.010 | 0.1472 | 0.0472 | 0.0002 | 7.50E-05 | 0.0017 | 0.0000 | 7.26E-09 | 0.0000 | 0.0000 | 5.06E-05 |
| 286 | | 0.27 | 0.126 | 0.014 | 0.1546 | 0.0464 | 0.0002 | 7.40E-05 | 0.0017 | 0.0000 | 7.25E-09 | 0.0000 | 0.0000 | 5.06E-05 |
| 287 | * | 0.00 | 0.000 | 0.012 | 0.1540 | 0.0456 | 0.0002 | 7.30E-05 | 0.0017 | 0.0000 | 7.24E-09 | 0.0000 | 0.0000 | 5.05E-05 |
| 288 | * | 0.06 | 0.000 | 0.048 | 0.1546 | 0.0448 | 0.0002 | 7.20E-05 | 0.0016 | 0.0000 | 7.23E-09 | 0.0000 | 0.0000 | 5.05E-05 |
| 289 | | 0.22 | 0.077 | 0.016 | 0.1617 | 0.0452 | 0.0002 | 7.25E-05 | 0.0016 | 0.0000 | 7.23E-09 | 0.0000 | 0.0000 | 5.05E-05 |
| 290 | * | 0.02 | 0.000 | 0.023 | 0.1617 | 0.0451 | 0.0002 | 7.24E-05 | 0.0016 | 0.0000 | 7.22E-09 | 0.0000 | 0.0000 | 5.04E-05 |
| 291 | | 0.00 | 0.000 | 0.047 | 0.1591 | 0.0443 | 0.0002 | 7.14E-05 | 0.0016 | 0.0000 | 7.21E-09 | 0.0000 | 0.0000 | 5.04E-05 |
| 292 | * | 0.01 | 0.000 | 0.011 | 0.1591 | 0.0435 | 0.0002 | 7.05E-05 | 0.0015 | 0.0000 | 7.21E-09 | 0.0000 | 0.0000 | 5.03E-05 |
| 293 | * | 0.00 | 0.000 | 0.000 | 0.1591 | 0.0428 | 0.0002 | 6.96E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 5.03E-05 |
| 294 | * | 0.00 | 0.000 | 0.000 | 0.1591 | 0.0420 | 0.0002 | 6.86E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 5.03E-05 |
| 295 | * | 0.00 | 0.000 | 0.000 | 0.1591 | 0.0413 | 0.0002 | 6.77E-05 | 0.0015 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 5.02E-05 |
| 296 | | 0.00 | 0.000 | 0.048 | 0.1565 | 0.0411 | 0.0002 | 6.75E-05 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 5.02E-05 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 297 | | | 0.04 | 0.000 | 0.101 | 0.1533 | 0.0407 | 0.0002 | 6.69E-05 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 5.02E-05 |
| 298 | | | 0.00 | 0.000 | 0.047 | 0.1507 | 0.0400 | 0.0002 | 6.60E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 5.01E-05 |
| 299 | * | | 0.01 | 0.000 | 0.046 | 0.1485 | 0.0393 | 0.0002 | 6.52E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 5.01E-05 |
| 300 | | | 1.10 | 0.891 | 0.043 | 0.1575 | 0.0386 | 0.0002 | 6.43E-05 | 0.0013 | 0.0000 | 7.16E-09 | 0.0000 | 0.0000 | 5.00E-05 |
| 301 | | | 0.00 | 0.000 | 0.096 | 0.1520 | 0.0405 | 0.0002 | 6.68E-05 | 0.0013 | 0.0000 | 7.15E-09 | 0.0000 | 0.0000 | 5.00E-05 |
| 302 | | | 0.00 | 0.000 | 0.043 | 0.1496 | 0.0471 | 0.0002 | 7.48E-05 | 0.0013 | 0.0000 | 7.15E-09 | 0.0000 | 0.0000 | 5.00E-05 |
| 303 | | | 0.00 | 0.000 | 0.050 | 0.1468 | 0.0480 | 0.0002 | 7.59E-05 | 0.0013 | 0.0000 | 7.14E-09 | 0.0000 | 0.0000 | 4.99E-05 |
| 304 | | | 0.00 | 0.000 | 0.046 | 0.1443 | 0.0472 | 0.0002 | 7.49E-05 | 0.0012 | 0.0000 | 7.14E-09 | 0.0000 | 0.0000 | 4.99E-05 |
| 305 | | | 0.00 | 0.000 | 0.053 | 0.1413 | 0.0464 | 0.0002 | 7.39E-05 | 0.0012 | 0.0000 | 7.13E-09 | 0.0000 | 0.0000 | 4.99E-05 |
| 306 | | | 0.00 | 0.000 | 0.102 | 0.1356 | 0.0455 | 0.0002 | 7.30E-05 | 0.0012 | 0.0000 | 7.13E-09 | 0.0000 | 0.0000 | 4.98E-05 |
| 307 | | | 0.00 | 0.000 | 0.109 | 0.1296 | 0.0448 | 0.0002 | 7.20E-05 | 0.0012 | 0.0000 | 7.12E-09 | 0.0000 | 0.0000 | 4.98E-05 |
| 308 | | | 0.00 | 0.000 | 0.008 | 0.1287 | 0.0577 | 0.0003 | 8.72E-05 | 0.0012 | 0.0000 | 7.12E-09 | 0.0000 | 0.0000 | 4.97E-05 |
| 309 | | | 0.04 | 0.000 | 0.013 | 0.1301 | 0.0649 | 0.0003 | 9.55E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 4.97E-05 |
| 310 | | | 0.07 | 0.000 | 0.009 | 0.1334 | 0.0638 | 0.0003 | 9.43E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 4.97E-05 |
| 311 | | | 0.00 | 0.000 | 0.019 | 0.1323 | 0.0627 | 0.0003 | 9.30E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 4.96E-05 |
| 312 | | | 0.00 | 0.000 | 0.019 | 0.1312 | 0.0616 | 0.0003 | 9.18E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 4.96E-05 |
| 313 | * | | 0.00 | 0.000 | 0.000 | 0.1312 | 0.0606 | 0.0003 | 9.06E-05 | 0.0011 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 4.96E-05 |
| 314 | * | | 0.00 | 0.000 | 0.009 | 0.1307 | 0.0595 | 0.0003 | 8.95E-05 | 0.0010 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 4.95E-05 |
| 315 | * | | 0.00 | 0.000 | 0.007 | 0.1303 | 0.0585 | 0.0003 | 8.83E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 4.95E-05 |
| 316 | * | | 0.28 | 0.000 | 0.031 | 0.1314 | 0.0575 | 0.0003 | 8.72E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 4.95E-05 |
| 317 | | | 0.00 | 0.044 | 0.061 | 0.1384 | 0.0565 | 0.0003 | 8.60E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 4.94E-05 |
| 318 | | | 0.00 | 0.000 | 0.013 | 0.1376 | 0.0559 | 0.0003 | 8.53E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 4.94E-05 |
| 319 | | | 0.00 | 0.000 | 0.013 | 0.1369 | 0.0552 | 0.0003 | 8.44E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 4.93E-05 |
| 320 | * | | 0.00 | 0.000 | 0.000 | 0.1369 | 0.0542 | 0.0003 | 8.33E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 4.93E-05 |
| 321 | | | 0.00 | 0.000 | 0.015 | 0.1361 | 0.0533 | 0.0003 | 8.23E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 4.93E-05 |
| 322 | | | 0.00 | 0.000 | 0.015 | 0.1353 | 0.0524 | 0.0003 | 8.12E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 4.92E-05 |
| 323 | | | 0.00 | 0.000 | 0.015 | 0.1344 | 0.0515 | 0.0003 | 8.01E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 4.92E-05 |
| 324 | | | 0.00 | 0.000 | 0.014 | 0.1337 | 0.0506 | 0.0002 | 7.91E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 4.92E-05 |
| 325 | | | 0.00 | 0.000 | 0.014 | 0.1329 | 0.0498 | 0.0002 | 7.81E-05 | 0.0009 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 4.91E-05 |
| 326 | | | 0.00 | 0.000 | 0.013 | 0.1322 | 0.0490 | 0.0002 | 7.71E-05 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 4.91E-05 |
| 327 | | | 0.00 | 0.000 | 0.013 | 0.1315 | 0.0482 | 0.0002 | 7.61E-05 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 4.91E-05 |
| 328 | | | 0.73 | 0.524 | 0.023 | 0.1419 | 0.0474 | 0.0002 | 7.51E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 4.90E-05 |
| 329 | | | 0.02 | 0.000 | 0.033 | 0.1414 | 0.0465 | 0.0002 | 7.42E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 4.90E-05 |
| 330 | | | 0.00 | 0.000 | 0.034 | 0.1395 | 0.0458 | 0.0002 | 7.32E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 4.90E-05 |
| 331 | | | 0.10 | 0.000 | 0.055 | 0.1421 | 0.0456 | 0.0002 | 7.31E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 4.89E-05 |
| 332 | | | 0.03 | 0.000 | 0.071 | 0.1400 | 0.0452 | 0.0002 | 7.26E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 4.89E-05 |
| 333 | | | 0.00 | 0.000 | 0.047 | 0.1374 | 0.0452 | 0.0002 | 7.25E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 4.89E-05 |
| 334 | | | 0.00 | 0.000 | 0.042 | 0.1350 | 0.0448 | 0.0002 | 7.20E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 4.88E-05 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 335 | | | 0.00 | 0.000 | 0.062 | 0.1315 | 0.0458 | 0.0002 | 7.32E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 4.88E-05 |
| 336 | | | 0.00 | 0.000 | 0.037 | 0.1294 | 0.0460 | 0.0002 | 7.35E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 4.87E-05 |
| 337 | | | 0.00 | 0.000 | 0.010 | 0.1289 | 0.0452 | 0.0002 | 7.25E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 4.87E-05 |
| 338 | | | 0.00 | 0.000 | 0.002 | 0.1287 | 0.0472 | 0.0002 | 7.50E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 4.87E-05 |
| 339 | * | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0481 | 0.0002 | 7.60E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 4.86E-05 |
| 340 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0472 | 0.0002 | 7.50E-05 | 0.0007 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 4.86E-05 |
| 341 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0464 | 0.0002 | 7.40E-05 | 0.0006 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 4.86E-05 |
| 342 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0456 | 0.0002 | 7.31E-05 | 0.0006 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 4.85E-05 |
| 343 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0448 | 0.0002 | 7.21E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 4.85E-05 |
| 344 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0441 | 0.0002 | 7.12E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 4.85E-05 |
| 345 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0433 | 0.0002 | 7.02E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 4.84E-05 |
| 346 | * | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0426 | 0.0002 | 6.93E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 4.84E-05 |
| 347 | * | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0418 | 0.0002 | 6.84E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 4.84E-05 |
| 348 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0411 | 0.0002 | 6.75E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 4.83E-05 |
| 349 | | | 0.07 | 0.000 | 0.006 | 0.1323 | 0.0404 | 0.0002 | 6.66E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 4.83E-05 |
| 350 | | | 0.02 | 0.000 | 0.006 | 0.1328 | 0.0397 | 0.0002 | 6.57E-05 | 0.0006 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 4.83E-05 |
| 351 | | | 0.00 | 0.000 | 0.008 | 0.1324 | 0.0390 | 0.0002 | 6.48E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 4.82E-05 |
| 352 | | | 0.00 | 0.000 | 0.008 | 0.1319 | 0.0383 | 0.0002 | 6.39E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 4.82E-05 |
| 353 | | | 0.00 | 0.000 | 0.009 | 0.1314 | 0.0376 | 0.0002 | 6.31E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 4.82E-05 |
| 354 | | | 0.08 | 0.000 | 0.015 | 0.1353 | 0.0370 | 0.0002 | 6.22E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 4.81E-05 |
| 355 | | | 0.25 | 0.114 | 0.012 | 0.1421 | 0.0363 | 0.0002 | 6.14E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 4.81E-05 |
| 356 | | | 0.00 | 0.000 | 0.007 | 0.1417 | 0.0359 | 0.0002 | 6.09E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 4.81E-05 |
| 357 | * | | 0.00 | 0.000 | 0.007 | 0.1414 | 0.0354 | 0.0002 | 6.02E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 4.80E-05 |
| 358 | | | 0.00 | 0.000 | 0.009 | 0.1409 | 0.0348 | 0.0002 | 5.94E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 4.80E-05 |
| 359 | * | | 0.00 | 0.000 | 0.000 | 0.1409 | 0.0341 | 0.0002 | 5.86E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 4.79E-05 |
| 360 | * | | 0.04 | 0.000 | 0.011 | 0.1420 | 0.0335 | 0.0002 | 5.78E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 4.79E-05 |
| 361 | * | | 0.00 | 0.000 | 0.022 | 0.1415 | 0.0330 | 0.0002 | 5.70E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 4.79E-05 |
| 362 | | | 0.00 | 0.000 | 0.007 | 0.1411 | 0.0324 | 0.0002 | 5.63E-05 | 0.0004 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 4.78E-05 |
| 363 | | | 0.00 | 0.000 | 0.008 | 0.1406 | 0.0320 | 0.0002 | 5.58E-05 | 0.0004 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 4.78E-05 |
| 364 | * | | 0.00 | 0.000 | 0.000 | 0.1406 | 0.0315 | 0.0002 | 5.52E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 4.78E-05 |
| 365 | * | | 0.06 | 0.000 | 0.019 | 0.1417 | 0.0310 | 0.0002 | 5.44E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 4.77E-05 |

* = Frozen (air or soil)

| Annual Totals for Year 3 | | | |
|---|---|---|---|
| | inches | cubic feet | percent |
| Precipitation | 38.80 | 140,856.4 | 100.00 |

| | | | |
|---|---|---|---|
| Runoff | 23.721 | 86,107.1 | 61.13 |
| Evapotranspiration | 15.093 | 54,788.0 | 38.90 |
| Drainage Collected from Layer 3 | 0.0706 | 256.4 | 0.18 |
| Percolation/Leakage through Layer 4 | 0.022877 | 83.0 | 0.06 |
| Average Head on Top of Layer 4 | 0.0393 | --- | --- |
| Drainage Collected from Layer 7 | 0.0034 | 12.4 | 0.01 |
| Percolation/Leakage through Layer 9 | 0.000003 | 0.0095 | 0.00 |
| Average Head on Top of Layer 8 | 0.0014 | --- | --- |
| Percolation/Leakage through Layer 10 | 0.020139 | 73.1 | 0.05 |
| Change in Water Storage | -0.1049 | -380.7 | -0.27 |
| Soil Water at Start of Year | 72.4829 | 263,113.0 | 186.80 |
| Soil Water at End of Year | 72.3588 | 262,662.6 | 186.48 |
| Snow Water at Start of Year | 0.0000 | 0.0000 | 0.00 |
| Snow Water at End of Year | 0.0192 | 69.8 | 0.05 |
| Annual Water Budget Balance | 0.0000 | 0.0000 | 0.00 |

**Daily Output for Year 4**

**Column key:** Head #1: drainage from Layer 4 | Head #2: drainage from Layer 8
Drain #1: drainage from Layer 3 | Drain #2: drainage from Layer 7
Leak #1: leakage thru Layer 4 | Leak #2: leakage thru Layer 9 | Leak #3: leakage thru Layer 10

**Title:** Pilgrim Landfill
**Simulated On:** 4/10/2026 14:14

| Day | Freezing Status* | | Rain | Runoff | ET | Evap. Zone Water | Head #1 | Drain #1 | Leak #1 | Head #2 | Drain #2 | Leak #2 | Head #3 | Drain #3 | Leak #3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air | Soil | (inches) | (inches) | (inches) | (in/in) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) |
| 1 | * | | 0.11 | 0.000 | 0.007 | 0.1428 | 0.0304 | 0.0002 | 5.37E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 4.77E-05 |
| 2 | * | | 0.00 | 0.000 | 0.004 | 0.1439 | 0.0299 | 0.0001 | 5.30E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 4.77E-05 |
| 3 | * | | 0.00 | 0.000 | 0.012 | 0.1450 | 0.0294 | 0.0001 | 5.22E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 4.76E-05 |
| 4 | * | | 0.05 | 0.000 | 0.000 | 0.1461 | 0.0288 | 0.0001 | 5.15E-05 | 0.0004 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 4.76E-05 |
| 5 | * | | 0.00 | 0.000 | 0.009 | 0.1472 | 0.0283 | 0.0001 | 5.08E-05 | 0.0004 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 4.76E-05 |
| 6 | * | * | 0.00 | 0.000 | 0.018 | 0.1472 | 0.0278 | 0.0001 | 5.01E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 4.75E-05 |
| 7 | * | * | 0.02 | 0.000 | 0.029 | 0.1472 | 0.0273 | 0.0001 | 4.95E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 4.75E-05 |
| 8 | | * | 0.00 | 0.000 | 0.028 | 0.1472 | 0.0268 | 0.0001 | 4.88E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 4.75E-05 |
| 9 | | * | 0.00 | 0.000 | 0.000 | 0.1472 | 0.0264 | 0.0001 | 4.81E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 4.74E-05 |
| 10 | | * | 0.00 | 0.000 | 0.000 | 0.1472 | 0.0259 | 0.0001 | 4.75E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 4.74E-05 |
| 11 | * | * | 0.00 | 0.000 | 0.000 | 0.1472 | 0.0254 | 0.0001 | 4.68E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 4.74E-05 |
| 12 | | * | 0.00 | 0.000 | 0.000 | 0.1472 | 0.0250 | 0.0001 | 4.62E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 4.73E-05 |
| 13 | | * | 0.15 | 0.113 | 0.004 | 0.1491 | 0.0245 | 0.0001 | 4.55E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 4.73E-05 |
| 14 | * | * | 0.00 | 0.000 | 0.000 | 0.1491 | 0.0241 | 0.0001 | 4.49E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 4.73E-05 |
| 15 | | * | 0.00 | 0.000 | 0.000 | 0.1491 | 0.0237 | 0.0001 | 4.43E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 4.72E-05 |
| 16 | | * | 0.00 | 0.000 | 0.000 | 0.1491 | 0.0232 | 0.0001 | 4.37E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 4.72E-05 |
| 17 | | * | 0.00 | 0.000 | 0.000 | 0.1491 | 0.0228 | 0.0001 | 4.31E-05 | 0.0007 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 4.72E-05 |
| 18 | * | * | 0.10 | 0.000 | 0.022 | 0.1491 | 0.0224 | 0.0001 | 4.25E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 4.71E-05 |
| 19 | * | * | 0.00 | 0.000 | 0.009 | 0.1491 | 0.0220 | 0.0001 | 4.19E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 4.71E-05 |
| 20 | * | * | 0.00 | 0.000 | 0.004 | 0.1491 | 0.0216 | 0.0001 | 4.13E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 4.71E-05 |
| 21 | * | * | 0.00 | 0.000 | 0.002 | 0.1491 | 0.0212 | 0.0001 | 4.08E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 4.70E-05 |
| 22 | * | * | 0.00 | 0.000 | 0.010 | 0.1491 | 0.0208 | 0.0001 | 4.02E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 4.70E-05 |
| 23 | * | * | 0.00 | 0.000 | 0.012 | 0.1491 | 0.0204 | 0.0001 | 3.96E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 4.70E-05 |
| 24 | * | * | 0.01 | 0.000 | 0.000 | 0.1491 | 0.0201 | 0.0001 | 3.91E-05 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 4.69E-05 |
| 25 | * | * | 0.12 | 0.000 | 0.006 | 0.1491 | 0.0197 | 0.0001 | 3.86E-05 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 4.69E-05 |
| 26 | * | * | 0.00 | 0.000 | 0.010 | 0.1491 | 0.0193 | 0.0001 | 3.80E-05 | 0.0009 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 4.69E-05 |
| 27 | * | * | 0.02 | 0.000 | 0.000 | 0.1491 | 0.0190 | 0.0001 | 3.75E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 4.68E-05 |
| 28 | * | * | 0.00 | 0.000 | 0.036 | 0.1491 | 0.0186 | 0.0001 | 3.70E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 4.68E-05 |
| 29 | * | * | 0.00 | 0.000 | 0.018 | 0.1491 | 0.0183 | 0.0001 | 3.65E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 4.68E-05 |
| 30 | * | * | 0.00 | 0.000 | 0.017 | 0.1491 | 0.0180 | 0.0001 | 3.59E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 4.68E-05 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | * | * | 0.00 | 0.000 | 0.018 | 0.1491 | 0.0176 | 0.0001 | 3.54E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 4.67E-05 |
| 32 | * | * | 0.00 | 0.000 | 0.017 | 0.1491 | 0.0173 | 0.0001 | 3.49E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 4.67E-05 |
| 33 | * | * | 0.00 | 0.000 | 0.029 | 0.1491 | 0.0170 | 0.0001 | 3.45E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 4.67E-05 |
| 34 | * | * | 0.01 | 0.000 | 0.011 | 0.1491 | 0.0167 | 0.0001 | 3.40E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 4.66E-05 |
| 35 | * | * | 0.00 | 0.000 | 0.005 | 0.1491 | 0.0164 | 0.0001 | 3.35E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 4.66E-05 |
| 36 | * | * | 0.09 | 0.000 | 0.010 | 0.1491 | 0.0161 | 0.0001 | 3.30E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 4.66E-05 |
| 37 | * | * | 0.04 | 0.000 | 0.000 | 0.1491 | 0.0158 | 0.0001 | 3.26E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 4.65E-05 |
| 38 | * | * | 0.01 | 0.000 | 0.000 | 0.1491 | 0.0155 | 0.0001 | 3.21E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 4.65E-05 |
| 39 | * | * | 0.01 | 0.000 | 0.026 | 0.1491 | 0.0152 | 0.0001 | 3.16E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 4.65E-05 |
| 40 | * | * | 0.00 | 0.000 | 0.033 | 0.1491 | 0.0149 | 0.0001 | 3.12E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 4.64E-05 |
| 41 | * | * | 0.00 | 0.000 | 0.014 | 0.1491 | 0.0146 | 0.0001 | 3.08E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 4.64E-05 |
| 42 | * | * | 0.00 | 0.000 | 0.019 | 0.1491 | 0.0144 | 0.0001 | 3.03E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 4.64E-05 |
| 43 | * | * | 0.00 | 0.000 | 0.016 | 0.1491 | 0.0141 | 0.0001 | 2.99E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 4.63E-05 |
| 44 | * | * | 0.00 | 0.000 | 0.004 | 0.1491 | 0.0138 | 0.0001 | 2.95E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 4.63E-05 |
| 45 | * | * | 0.19 | 0.000 | 0.005 | 0.1491 | 0.0136 | 0.0001 | 2.90E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 4.63E-05 |
| 46 | * | * | 0.21 | 0.000 | 0.000 | 0.1491 | 0.0133 | 0.0001 | 2.86E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 4.62E-05 |
| 47 | * | * | 0.00 | 0.000 | 0.005 | 0.1491 | 0.0131 | 0.0001 | 2.82E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 4.62E-05 |
| 48 | * | * | 0.00 | 0.000 | 0.000 | 0.1491 | 0.0128 | 0.0001 | 2.78E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 4.62E-05 |
| 49 | * | * | 0.12 | 0.000 | 0.007 | 0.1491 | 0.0126 | 0.0001 | 2.74E-05 | 0.0009 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 4.61E-05 |
| 50 | * | * | 0.19 | 0.000 | 0.000 | 0.1491 | 0.0123 | 0.0001 | 2.70E-05 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 4.61E-05 |
| 51 | * | * | 0.19 | 0.000 | 0.000 | 0.1491 | 0.0121 | 0.0001 | 2.66E-05 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 4.61E-05 |
| 52 | * | * | 0.03 | 0.000 | 0.000 | 0.1491 | 0.0119 | 0.0001 | 2.62E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 4.60E-05 |
| 53 | | * | 0.04 | 1.003 | 0.000 | 0.1491 | 0.0117 | 0.0001 | 2.59E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 4.60E-05 |
| 54 | | * | 0.06 | 0.000 | 0.004 | 0.1520 | 0.0114 | 0.0001 | 2.55E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 4.60E-05 |
| 55 | | * | 0.01 | 0.000 | 0.004 | 0.1523 | 0.0112 | 0.0001 | 2.51E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 4.60E-05 |
| 56 | | * | 0.00 | 0.000 | 0.003 | 0.1524 | 0.0110 | 0.0001 | 2.48E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 4.59E-05 |
| 57 | | * | 0.01 | 0.000 | 0.004 | 0.1528 | 0.0108 | 0.0001 | 2.44E-05 | 0.0007 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 4.59E-05 |
| 58 | | * | 0.00 | 0.000 | 0.000 | 0.1528 | 0.0106 | 0.0001 | 2.41E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 4.59E-05 |
| 59 | | * | 0.00 | 0.000 | 0.000 | 0.1528 | 0.0104 | 0.0001 | 2.37E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 4.58E-05 |
| 60 | | * | 0.00 | 0.000 | 0.000 | 0.1528 | 0.0102 | 0.0001 | 2.34E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 4.58E-05 |
| 61 | * | * | 0.00 | 0.000 | 0.000 | 0.1528 | 0.0100 | 0.0000 | 2.30E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 4.58E-05 |
| 62 | | * | 0.00 | 0.000 | 0.000 | 0.1528 | 0.0098 | 0.0000 | 2.27E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 4.57E-05 |
| 63 | | * | 0.00 | 0.000 | 0.000 | 0.1528 | 0.0096 | 0.0000 | 2.24E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 4.57E-05 |
| 64 | | * | 0.00 | 0.000 | 0.000 | 0.1528 | 0.0094 | 0.0000 | 2.20E-05 | 0.0007 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 4.57E-05 |
| 65 | | * | 0.00 | 0.000 | 0.000 | 0.1528 | 0.0092 | 0.0000 | 2.17E-05 | 0.0007 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 4.56E-05 |
| 66 | * | * | 0.13 | 0.000 | 0.041 | 0.1528 | 0.0091 | 0.0000 | 2.14E-05 | 0.0006 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 4.56E-05 |
| 67 | * | * | 0.07 | 0.000 | 0.037 | 0.1528 | 0.0089 | 0.0000 | 2.11E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 4.56E-05 |
| 68 | | * | 0.55 | 0.644 | 0.024 | 0.1528 | 0.0087 | 0.0000 | 2.08E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 4.55E-05 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69 | | * | 0.00 | 0.000 | 0.000 | 0.1528 | 0.0086 | 0.0000 | 2.05E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 4.55E-05 |
| 70 | | * | 0.00 | 0.000 | 0.000 | 0.1528 | 0.0084 | 0.0000 | 2.02E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 4.55E-05 |
| 71 | | * | 0.13 | 0.009 | 0.004 | 0.1591 | 0.0082 | 0.0000 | 1.99E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 4.55E-05 |
| 72 | | | 0.08 | 0.000 | 0.164 | 0.1543 | 0.0081 | 0.0000 | 1.96E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 4.54E-05 |
| 73 | | | 0.11 | 0.000 | 0.060 | 0.1573 | 0.0079 | 0.0000 | 1.93E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 4.54E-05 |
| 74 | | | 0.04 | 0.000 | 0.112 | 0.1534 | 0.0078 | 0.0000 | 1.90E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 4.54E-05 |
| 75 | | | 0.26 | 0.106 | 0.108 | 0.1556 | 0.0119 | 0.0001 | 2.61E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 4.53E-05 |
| 76 | * | | 0.00 | 0.000 | 0.000 | 0.1556 | 0.0142 | 0.0001 | 3.01E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 4.53E-05 |
| 77 | * | | 0.01 | 0.000 | 0.006 | 0.1556 | 0.0140 | 0.0001 | 2.97E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 4.53E-05 |
| 78 | * | | 0.02 | 0.000 | 0.015 | 0.1561 | 0.0137 | 0.0001 | 2.92E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 4.52E-05 |
| 79 | * | | 0.00 | 0.000 | 0.000 | 0.1561 | 0.0134 | 0.0001 | 2.88E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 4.52E-05 |
| 80 | * | | 0.17 | 0.000 | 0.005 | 0.1572 | 0.0132 | 0.0001 | 2.84E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 4.52E-05 |
| 81 | * | | 0.29 | 0.000 | 0.000 | 0.1583 | 0.0129 | 0.0001 | 2.80E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 4.52E-05 |
| 82 | * | | 0.00 | 0.000 | 0.012 | 0.1594 | 0.0127 | 0.0001 | 2.76E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 4.51E-05 |
| 83 | * | * | 0.01 | 0.000 | 0.015 | 0.1594 | 0.0125 | 0.0001 | 2.72E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 4.51E-05 |
| 84 | * | * | 0.05 | 0.000 | 0.018 | 0.1594 | 0.0122 | 0.0001 | 2.68E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 4.51E-05 |
| 85 | | * | 0.01 | 0.370 | 0.015 | 0.1604 | 0.0120 | 0.0001 | 2.64E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 4.50E-05 |
| 86 | | * | 0.00 | 0.000 | 0.000 | 0.1604 | 0.0118 | 0.0001 | 2.61E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 4.50E-05 |
| 87 | | * | 0.00 | 0.000 | 0.000 | 0.1604 | 0.0115 | 0.0001 | 2.57E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 4.50E-05 |
| 88 | | * | 0.00 | 0.000 | 0.000 | 0.1604 | 0.0113 | 0.0001 | 2.53E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 4.49E-05 |
| 89 | | * | 0.00 | 0.000 | 0.001 | 0.1604 | 0.0111 | 0.0001 | 2.49E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 4.49E-05 |
| 90 | | * | 0.65 | 0.647 | 0.004 | 0.1604 | 0.0109 | 0.0001 | 2.46E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 4.49E-05 |
| 91 | | * | 0.03 | 0.000 | 0.004 | 0.1621 | 0.0107 | 0.0001 | 2.42E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 4.49E-05 |
| 92 | | * | 0.03 | 0.000 | 0.004 | 0.1637 | 0.0105 | 0.0001 | 2.39E-05 | 0.0004 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 4.48E-05 |
| 93 | | * | 0.00 | 0.000 | 0.000 | 0.1637 | 0.0103 | 0.0001 | 2.35E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 4.48E-05 |
| 94 | | * | 0.00 | 0.000 | 0.000 | 0.1637 | 0.0101 | 0.0000 | 2.32E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 4.48E-05 |
| 95 | | * | 0.00 | 0.000 | 0.000 | 0.1637 | 0.0099 | 0.0000 | 2.28E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 4.47E-05 |
| 96 | | * | 0.00 | 0.000 | 0.000 | 0.1637 | 0.0097 | 0.0000 | 2.25E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 4.47E-05 |
| 97 | * | * | 0.00 | 0.000 | 0.000 | 0.1637 | 0.0095 | 0.0000 | 2.22E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 4.47E-05 |
| 98 | | * | 0.00 | 0.000 | 0.000 | 0.1637 | 0.0093 | 0.0000 | 2.19E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 4.46E-05 |
| 99 | | * | 0.00 | 0.000 | 0.000 | 0.1637 | 0.0092 | 0.0000 | 2.15E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 4.46E-05 |
| 100 | | | 0.00 | 0.000 | 0.103 | 0.1582 | 0.0090 | 0.0000 | 2.12E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 4.46E-05 |
| 101 | | | 0.00 | 0.000 | 0.225 | 0.1455 | 0.0128 | 0.0001 | 2.77E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 4.46E-05 |
| 102 | | | 0.06 | 0.000 | 0.268 | 0.1341 | 0.0149 | 0.0001 | 3.12E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 4.45E-05 |
| 103 | | | 0.57 | 0.257 | 0.148 | 0.1432 | 0.0147 | 0.0001 | 3.08E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 4.45E-05 |
| 104 | | | 0.86 | 0.162 | 0.579 | 0.1497 | 0.0144 | 0.0001 | 3.04E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 4.45E-05 |
| 105 | | | 0.00 | 0.000 | 0.275 | 0.1340 | 0.0185 | 0.0001 | 3.66E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 4.44E-05 |
| 106 | | | 0.09 | 0.000 | 0.102 | 0.1332 | 0.0369 | 0.0002 | 6.21E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 4.44E-05 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 107 | | | 0.07 | 0.000 | 0.033 | 0.1353 | 0.0395 | 0.0002 | 6.54E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 4.44E-05 |
| 108 | | | 0.01 | 0.000 | 0.031 | 0.1339 | 0.0433 | 0.0002 | 7.02E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 4.43E-05 |
| 109 | | | 0.00 | 0.000 | 0.027 | 0.1324 | 0.0453 | 0.0002 | 7.26E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 4.43E-05 |
| 110 | | | 0.02 | 0.000 | 0.028 | 0.1318 | 0.0445 | 0.0002 | 7.16E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 4.43E-05 |
| 111 | | | 0.00 | 0.000 | 0.007 | 0.1314 | 0.0438 | 0.0002 | 7.08E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 4.43E-05 |
| 112 | | | 0.01 | 0.000 | 0.011 | 0.1312 | 0.0439 | 0.0002 | 7.09E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 4.42E-05 |
| 113 | * | | 0.00 | 0.000 | 0.004 | 0.1310 | 0.0434 | 0.0002 | 7.03E-05 | 0.0004 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 4.42E-05 |
| 114 | | | 0.60 | 0.410 | 0.031 | 0.1400 | 0.0427 | 0.0002 | 6.94E-05 | 0.0004 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 4.42E-05 |
| 115 | | | 0.33 | 0.122 | 0.154 | 0.1429 | 0.0419 | 0.0002 | 6.85E-05 | 0.0004 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 4.41E-05 |
| 116 | * | | 0.41 | 0.000 | 0.052 | 0.1440 | 0.0412 | 0.0002 | 6.76E-05 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 4.41E-05 |
| 117 | | | 0.54 | 0.627 | 0.119 | 0.1515 | 0.0405 | 0.0002 | 6.67E-05 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 4.41E-05 |
| 118 | | | 0.02 | 0.000 | 0.033 | 0.1509 | 0.0399 | 0.0002 | 6.59E-05 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 4.41E-05 |
| 119 | | | 0.00 | 0.000 | 0.094 | 0.1457 | 0.0392 | 0.0002 | 6.51E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 4.40E-05 |
| 120 | | | 0.32 | 0.130 | 0.136 | 0.1485 | 0.0385 | 0.0002 | 6.42E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 4.40E-05 |
| 121 | | | 0.00 | 0.000 | 0.087 | 0.1437 | 0.0379 | 0.0002 | 6.34E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 4.40E-05 |
| 122 | | | 0.00 | 0.000 | 0.071 | 0.1396 | 0.0395 | 0.0002 | 6.54E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 4.39E-05 |
| 123 | | | 0.55 | 0.159 | 0.243 | 0.1476 | 0.0402 | 0.0002 | 6.63E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 4.39E-05 |
| 124 | | | 0.22 | 0.067 | 0.186 | 0.1456 | 0.0395 | 0.0002 | 6.54E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 4.39E-05 |
| 125 | | | 0.09 | 0.000 | 0.101 | 0.1451 | 0.0389 | 0.0002 | 6.47E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 4.39E-05 |
| 126 | | | 0.02 | 0.000 | 0.109 | 0.1398 | 0.0409 | 0.0002 | 6.73E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 4.38E-05 |
| 127 | | | 0.23 | 0.071 | 0.179 | 0.1386 | 0.0417 | 0.0002 | 6.82E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 4.38E-05 |
| 128 | | | 0.00 | 0.000 | 0.095 | 0.1333 | 0.0410 | 0.0002 | 6.73E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 4.38E-05 |
| 129 | | | 0.02 | 0.000 | 0.056 | 0.1315 | 0.0434 | 0.0002 | 7.04E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 4.37E-05 |
| 130 | | | 0.58 | 0.275 | 0.148 | 0.1402 | 0.0446 | 0.0002 | 7.18E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 4.37E-05 |
| 131 | | | 0.14 | 0.008 | 0.049 | 0.1446 | 0.0439 | 0.0002 | 7.09E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 4.37E-05 |
| 132 | | | 0.00 | 0.000 | 0.126 | 0.1376 | 0.0449 | 0.0002 | 7.21E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 4.37E-05 |
| 133 | | | 0.10 | 0.000 | 0.169 | 0.1338 | 0.0450 | 0.0002 | 7.23E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 4.36E-05 |
| 134 | | | 0.06 | 0.000 | 0.031 | 0.1356 | 0.0442 | 0.0002 | 7.13E-05 | 0.0003 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 4.36E-05 |
| 135 | | | 0.00 | 0.000 | 0.027 | 0.1340 | 0.0464 | 0.0002 | 7.40E-05 | 0.0003 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 4.36E-05 |
| 136 | | | 0.00 | 0.000 | 0.025 | 0.1326 | 0.0474 | 0.0002 | 7.52E-05 | 0.0003 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 4.35E-05 |
| 137 | | | 0.13 | 0.000 | 0.031 | 0.1379 | 0.0466 | 0.0002 | 7.42E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 4.35E-05 |
| 138 | | | 0.00 | 0.000 | 0.017 | 0.1370 | 0.0458 | 0.0002 | 7.32E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 4.35E-05 |
| 139 | * | | 0.00 | 0.000 | 0.000 | 0.1370 | 0.0450 | 0.0002 | 7.22E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 4.35E-05 |
| 140 | * | | 0.00 | 0.000 | 0.000 | 0.1370 | 0.0442 | 0.0002 | 7.13E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 4.34E-05 |
| 141 | | | 0.47 | 0.277 | 0.035 | 0.1456 | 0.0435 | 0.0002 | 7.04E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 4.34E-05 |
| 142 | * | | 0.03 | 0.000 | 0.074 | 0.1429 | 0.0432 | 0.0002 | 7.01E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 4.34E-05 |
| 143 | | | 0.29 | 0.131 | 0.096 | 0.1466 | 0.0427 | 0.0002 | 6.94E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 4.33E-05 |
| 144 | | | 0.00 | 0.000 | 0.084 | 0.1419 | 0.0420 | 0.0002 | 6.86E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 4.33E-05 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 145 | 0.00 | 0.000 | 0.097 | 0.1364 | 0.0429 | 0.0002 | 6.97E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 4.33E-05 |
| 146 | 0.00 | 0.000 | 0.040 | 0.1342 | 0.0430 | 0.0002 | 6.99E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 4.33E-05 |
| 147 | 0.00 | 0.000 | 0.031 | 0.1324 | 0.0423 | 0.0002 | 6.89E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 4.32E-05 |
| 148 | 0.00 | 0.000 | 0.022 | 0.1312 | 0.0416 | 0.0002 | 6.80E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 4.32E-05 |
| 149 | 0.00 | 0.000 | 0.029 | 0.1296 | 0.0409 | 0.0002 | 6.72E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 4.32E-05 |
| 150 | 0.00 | 0.000 | 0.015 | 0.1287 | 0.0414 | 0.0002 | 6.79E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 4.32E-05 |
| 151 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0448 | 0.0002 | 7.21E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 4.31E-05 |
| 152 | 1.20 | 0.965 | 0.031 | 0.1398 | 0.0443 | 0.0002 | 7.14E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 4.31E-05 |
| 153 | 0.00 | 0.000 | 0.053 | 0.1368 | 0.0435 | 0.0002 | 7.04E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 4.31E-05 |
| 154 | 0.70 | 0.344 | 0.195 | 0.1459 | 0.0427 | 0.0002 | 6.95E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 4.30E-05 |
| 155 | 0.05 | 0.000 | 0.083 | 0.1441 | 0.0420 | 0.0002 | 6.86E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 4.30E-05 |
| 156 | 0.00 | 0.000 | 0.120 | 0.1374 | 0.0413 | 0.0002 | 6.77E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 4.30E-05 |
| 157 | 0.00 | 0.000 | 0.123 | 0.1305 | 0.0428 | 0.0002 | 6.96E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 4.30E-05 |
| 158 | 0.26 | 0.059 | 0.097 | 0.1365 | 0.0433 | 0.0002 | 7.02E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.29E-05 |
| 159 | 0.39 | 0.123 | 0.189 | 0.1409 | 0.0432 | 0.0002 | 7.01E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.29E-05 |
| 160 | 0.00 | 0.000 | 0.128 | 0.1338 | 0.0456 | 0.0002 | 7.30E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.29E-05 |
| 161 | 1.01 | 0.685 | 0.139 | 0.1440 | 0.0460 | 0.0002 | 7.35E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.28E-05 |
| 162 | 0.33 | 0.109 | 0.256 | 0.1421 | 0.0452 | 0.0002 | 7.26E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.28E-05 |
| 163 | 1.00 | 0.549 | 0.334 | 0.1484 | 0.0444 | 0.0002 | 7.16E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.28E-05 |
| 164 | 0.00 | 0.000 | 0.148 | 0.1401 | 0.0443 | 0.0002 | 7.14E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.28E-05 |
| 165 | 0.00 | 0.000 | 0.159 | 0.1312 | 0.0497 | 0.0002 | 7.80E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.27E-05 |
| 166 | 0.00 | 0.000 | 0.041 | 0.1289 | 0.0514 | 0.0003 | 8.00E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.27E-05 |
| 167 | 0.00 | 0.000 | 0.002 | 0.1287 | 0.0544 | 0.0003 | 8.35E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.27E-05 |
| 168 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0558 | 0.0003 | 8.51E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.27E-05 |
| 169 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0548 | 0.0003 | 8.40E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.26E-05 |
| 170 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0539 | 0.0003 | 8.29E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.26E-05 |
| 171 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0529 | 0.0003 | 8.18E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.26E-05 |
| 172 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0520 | 0.0003 | 8.07E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.25E-05 |
| 173 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0511 | 0.0003 | 7.97E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.25E-05 |
| 174 | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0503 | 0.0002 | 7.86E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.25E-05 |
| 175 | 0.13 | 0.000 | 0.007 | 0.1357 | 0.0494 | 0.0002 | 7.76E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.25E-05 |
| 176 | 0.13 | 0.006 | 0.016 | 0.1420 | 0.0485 | 0.0002 | 7.66E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.24E-05 |
| 177 | 0.00 | 0.000 | 0.011 | 0.1414 | 0.0477 | 0.0002 | 7.56E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.24E-05 |
| 178 | 0.00 | 0.000 | 0.015 | 0.1408 | 0.0469 | 0.0002 | 7.46E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.24E-05 |
| 179 | 0.92 | 0.735 | 0.026 | 0.1494 | 0.0461 | 0.0002 | 7.36E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 4.24E-05 |
| 180 | 0.17 | 0.037 | 0.070 | 0.1530 | 0.0453 | 0.0002 | 7.26E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 4.23E-05 |
| 181 | 0.03 | 0.000 | 0.072 | 0.1507 | 0.0446 | 0.0002 | 7.18E-05 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 4.23E-05 |
| 182 | 0.11 | 0.000 | 0.115 | 0.1502 | 0.0443 | 0.0002 | 7.14E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 4.23E-05 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 183 | 0.15 | 0.000 | 0.098 | 0.1532 | 0.0435 | 0.0002 | 7.05E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 4.23E-05 |
| 184 | 0.00 | 0.000 | 0.146 | 0.1449 | 0.0456 | 0.0002 | 7.30E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 4.22E-05 |
| 185 | 0.00 | 0.000 | 0.096 | 0.1396 | 0.0464 | 0.0002 | 7.40E-05 | 0.0006 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 4.22E-05 |
| 186 | 0.00 | 0.000 | 0.040 | 0.1374 | 0.0456 | 0.0002 | 7.31E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 4.22E-05 |
| 187 | 0.09 | 0.000 | 0.036 | 0.1403 | 0.0449 | 0.0002 | 7.22E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 4.21E-05 |
| 188 | 0.00 | 0.000 | 0.032 | 0.1386 | 0.0442 | 0.0002 | 7.13E-05 | 0.0009 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 4.21E-05 |
| 189 | 0.23 | 0.089 | 0.033 | 0.1449 | 0.0436 | 0.0002 | 7.06E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 4.21E-05 |
| 190 | 0.00 | 0.000 | 0.025 | 0.1435 | 0.0430 | 0.0002 | 6.98E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 4.21E-05 |
| 191 | 0.00 | 0.000 | 0.024 | 0.1421 | 0.0423 | 0.0002 | 6.89E-05 | 0.0011 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 4.20E-05 |
| 192 | 0.00 | 0.000 | 0.024 | 0.1408 | 0.0415 | 0.0002 | 6.80E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 4.20E-05 |
| 193 | 0.02 | 0.000 | 0.027 | 0.1404 | 0.0419 | 0.0002 | 6.85E-05 | 0.0012 | 0.0000 | 7.12E-09 | 0.0000 | 0.0000 | 4.20E-05 |
| 194 | 2.50 | 2.321 | 0.028 | 0.1488 | 0.0445 | 0.0002 | 7.16E-05 | 0.0012 | 0.0000 | 7.14E-09 | 0.0000 | 0.0000 | 4.20E-05 |
| 195 | 0.08 | 0.000 | 0.193 | 0.1426 | 0.0439 | 0.0002 | 7.09E-05 | 0.0013 | 0.0000 | 7.15E-09 | 0.0000 | 0.0000 | 4.19E-05 |
| 196 | 0.00 | 0.000 | 0.184 | 0.1323 | 0.0437 | 0.0002 | 7.07E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 4.19E-05 |
| 197 | 0.04 | 0.000 | 0.080 | 0.1298 | 0.0452 | 0.0002 | 7.25E-05 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 4.19E-05 |
| 198 | 2.50 | 2.160 | 0.148 | 0.1405 | 0.0447 | 0.0002 | 7.19E-05 | 0.0015 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 4.19E-05 |
| 199 | 0.00 | 0.000 | 0.074 | 0.1362 | 0.0489 | 0.0002 | 7.70E-05 | 0.0015 | 0.0000 | 7.21E-09 | 0.0000 | 0.0000 | 4.18E-05 |
| 200 | 0.00 | 0.000 | 0.107 | 0.1302 | 0.0510 | 0.0003 | 7.95E-05 | 0.0016 | 0.0000 | 7.22E-09 | 0.0000 | 0.0000 | 4.18E-05 |
| 201 | 0.02 | 0.000 | 0.039 | 0.1289 | 0.0501 | 0.0002 | 7.85E-05 | 0.0016 | 0.0000 | 7.23E-09 | 0.0000 | 0.0000 | 4.18E-05 |
| 202 | 0.00 | 0.000 | 0.002 | 0.1287 | 0.0521 | 0.0003 | 8.08E-05 | 0.0017 | 0.0000 | 7.25E-09 | 0.0000 | 0.0000 | 4.18E-05 |
| 203 | 0.28 | 0.091 | 0.065 | 0.1355 | 0.0529 | 0.0003 | 8.18E-05 | 0.0018 | 0.0000 | 7.26E-09 | 0.0000 | 0.0000 | 4.17E-05 |
| 204 | 0.00 | 0.000 | 0.054 | 0.1327 | 0.0520 | 0.0003 | 8.07E-05 | 0.0018 | 0.0000 | 7.27E-09 | 0.0000 | 0.0000 | 4.17E-05 |
| 205 | 0.00 | 0.000 | 0.037 | 0.1306 | 0.0511 | 0.0003 | 7.96E-05 | 0.0019 | 0.0000 | 7.28E-09 | 0.0000 | 0.0000 | 4.17E-05 |
| 206 | 0.00 | 0.000 | 0.013 | 0.1299 | 0.0502 | 0.0002 | 7.86E-05 | 0.0019 | 0.0000 | 7.29E-09 | 0.0000 | 0.0000 | 4.17E-05 |
| 207 | 0.00 | 0.000 | 0.008 | 0.1294 | 0.0504 | 0.0002 | 7.88E-05 | 0.0020 | 0.0000 | 7.31E-09 | 0.0000 | 0.0000 | 4.16E-05 |
| 208 | 0.07 | 0.000 | 0.010 | 0.1330 | 0.0502 | 0.0002 | 7.85E-05 | 0.0020 | 0.0000 | 7.32E-09 | 0.0000 | 0.0000 | 4.16E-05 |
| 209 | 0.15 | 0.022 | 0.010 | 0.1397 | 0.0493 | 0.0002 | 7.75E-05 | 0.0021 | 0.0000 | 7.33E-09 | 0.0000 | 0.0000 | 4.16E-05 |
| 210 | 0.00 | 0.000 | 0.012 | 0.1390 | 0.0485 | 0.0002 | 7.66E-05 | 0.0021 | 0.0000 | 7.34E-09 | 0.0000 | 0.0000 | 4.15E-05 |
| 211 | 0.00 | 0.000 | 0.013 | 0.1383 | 0.0477 | 0.0002 | 7.56E-05 | 0.0021 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 4.15E-05 |
| 212 | 0.00 | 0.000 | 0.015 | 0.1375 | 0.0469 | 0.0002 | 7.46E-05 | 0.0022 | 0.0000 | 7.36E-09 | 0.0000 | 0.0000 | 4.15E-05 |
| 213 | 0.00 | 0.000 | 0.015 | 0.1366 | 0.0461 | 0.0002 | 7.36E-05 | 0.0022 | 0.0000 | 7.37E-09 | 0.0000 | 0.0000 | 4.15E-05 |
| 214 | 0.05 | 0.000 | 0.019 | 0.1384 | 0.0453 | 0.0002 | 7.27E-05 | 0.0023 | 0.0000 | 7.38E-09 | 0.0000 | 0.0000 | 4.14E-05 |
| 215 | 0.14 | 0.010 | 0.018 | 0.1448 | 0.0445 | 0.0002 | 7.17E-05 | 0.0023 | 0.0000 | 7.39E-09 | 0.0000 | 0.0000 | 4.14E-05 |
| 216 | 0.00 | 0.000 | 0.009 | 0.1443 | 0.0443 | 0.0002 | 7.14E-05 | 0.0024 | 0.0000 | 7.40E-09 | 0.0000 | 0.0000 | 4.14E-05 |
| 217 | 0.20 | 0.064 | 0.014 | 0.1510 | 0.0439 | 0.0002 | 7.09E-05 | 0.0024 | 0.0000 | 7.41E-09 | 0.0000 | 0.0000 | 4.14E-05 |
| 218 | 0.00 | 0.000 | 0.097 | 0.1456 | 0.0431 | 0.0002 | 7.00E-05 | 0.0024 | 0.0000 | 7.42E-09 | 0.0000 | 0.0000 | 4.13E-05 |
| 219 | 0.00 | 0.000 | 0.013 | 0.1449 | 0.0425 | 0.0002 | 6.92E-05 | 0.0025 | 0.0000 | 7.43E-09 | 0.0000 | 0.0000 | 4.13E-05 |
| 220 | 0.00 | 0.000 | 0.013 | 0.1442 | 0.0418 | 0.0002 | 6.83E-05 | 0.0025 | 0.0000 | 7.43E-09 | 0.0000 | 0.0000 | 4.13E-05 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 221 | 0.00 | 0.000 | 0.012 | 0.1435 | 0.0412 | 0.0002 | 6.76E-05 | 0.0026 | 0.0000 | 7.44E-09 | 0.0000 | 0.0000 | 4.13E-05 |
| 222 | 0.00 | 0.000 | 0.012 | 0.1429 | 0.0406 | 0.0002 | 6.68E-05 | 0.0026 | 0.0000 | 7.45E-09 | 0.0000 | 0.0000 | 4.12E-05 |
| 223 | 0.00 | 0.000 | 0.011 | 0.1422 | 0.0399 | 0.0002 | 6.59E-05 | 0.0026 | 0.0000 | 7.46E-09 | 0.0000 | 0.0000 | 4.12E-05 |
| 224 | 0.09 | 0.000 | 0.016 | 0.1461 | 0.0392 | 0.0002 | 6.50E-05 | 0.0027 | 0.0000 | 7.47E-09 | 0.0000 | 0.0000 | 4.12E-05 |
| 225 | 0.25 | 0.118 | 0.017 | 0.1528 | 0.0385 | 0.0002 | 6.42E-05 | 0.0027 | 0.0000 | 7.48E-09 | 0.0000 | 0.0000 | 4.12E-05 |
| 226 | 0.71 | 0.454 | 0.143 | 0.1592 | 0.0378 | 0.0002 | 6.33E-05 | 0.0027 | 0.0000 | 7.48E-09 | 0.0000 | 0.0000 | 4.11E-05 |
| 227 | 0.00 | 0.000 | 0.163 | 0.1501 | 0.0372 | 0.0002 | 6.25E-05 | 0.0028 | 0.0000 | 7.49E-09 | 0.0000 | 0.0000 | 4.11E-05 |
| 228 | 0.28 | 0.114 | 0.199 | 0.1483 | 0.0373 | 0.0002 | 6.27E-05 | 0.0028 | 0.0000 | 7.50E-09 | 0.0000 | 0.0000 | 4.11E-05 |
| 229 | 0.00 | 0.000 | 0.159 | 0.1395 | 0.0372 | 0.0002 | 6.25E-05 | 0.0028 | 0.0000 | 7.51E-09 | 0.0000 | 0.0000 | 4.11E-05 |
| 230 | 0.24 | 0.060 | 0.170 | 0.1397 | 0.0473 | 0.0002 | 7.49E-05 | 0.0029 | 0.0000 | 7.51E-09 | 0.0000 | 0.0000 | 4.10E-05 |
| 231 | 0.00 | 0.000 | 0.133 | 0.1323 | 0.0529 | 0.0003 | 8.18E-05 | 0.0029 | 0.0000 | 7.52E-09 | 0.0000 | 0.0000 | 4.10E-05 |
| 232 | 0.28 | 0.106 | 0.099 | 0.1362 | 0.0548 | 0.0003 | 8.40E-05 | 0.0029 | 0.0000 | 7.53E-09 | 0.0000 | 0.0000 | 4.10E-05 |
| 233 | 0.00 | 0.000 | 0.034 | 0.1343 | 0.0556 | 0.0003 | 8.49E-05 | 0.0030 | 0.0000 | 7.53E-09 | 0.0000 | 0.0000 | 4.10E-05 |
| 234 | 0.10 | 0.000 | 0.033 | 0.1379 | 0.0570 | 0.0003 | 8.66E-05 | 0.0030 | 0.0000 | 7.54E-09 | 0.0000 | 0.0000 | 4.09E-05 |
| 235 | 0.00 | 0.000 | 0.019 | 0.1368 | 0.0575 | 0.0003 | 8.72E-05 | 0.0030 | 0.0000 | 7.55E-09 | 0.0000 | 0.0000 | 4.09E-05 |
| 236 | 0.00 | 0.000 | 0.016 | 0.1359 | 0.0571 | 0.0003 | 8.66E-05 | 0.0031 | 0.0000 | 7.55E-09 | 0.0000 | 0.0000 | 4.09E-05 |
| 237 | 0.00 | 0.000 | 0.019 | 0.1349 | 0.0564 | 0.0003 | 8.59E-05 | 0.0031 | 0.0000 | 7.56E-09 | 0.0000 | 0.0000 | 4.09E-05 |
| 238 | 0.00 | 0.000 | 0.019 | 0.1338 | 0.0555 | 0.0003 | 8.48E-05 | 0.0031 | 0.0000 | 7.57E-09 | 0.0000 | 0.0000 | 4.08E-05 |
| 239 | 0.00 | 0.000 | 0.018 | 0.1328 | 0.0545 | 0.0003 | 8.37E-05 | 0.0031 | 0.0000 | 7.57E-09 | 0.0000 | 0.0000 | 4.08E-05 |
| 240 | 0.24 | 0.089 | 0.021 | 0.1401 | 0.0536 | 0.0003 | 8.26E-05 | 0.0032 | 0.0000 | 7.58E-09 | 0.0000 | 0.0000 | 4.08E-05 |
| 241 | 0.37 | 0.226 | 0.028 | 0.1466 | 0.0527 | 0.0003 | 8.15E-05 | 0.0032 | 0.0000 | 7.58E-09 | 0.0000 | 0.0000 | 4.08E-05 |
| 242 | 0.10 | 0.000 | 0.136 | 0.1447 | 0.0518 | 0.0003 | 8.05E-05 | 0.0032 | 0.0000 | 7.59E-09 | 0.0000 | 0.0000 | 4.07E-05 |
| 243 | 0.00 | 0.000 | 0.134 | 0.1372 | 0.0513 | 0.0003 | 7.99E-05 | 0.0032 | 0.0000 | 7.60E-09 | 0.0000 | 0.0000 | 4.07E-05 |
| 244 | 0.00 | 0.000 | 0.091 | 0.1322 | 0.0506 | 0.0002 | 7.90E-05 | 0.0033 | 0.0000 | 7.60E-09 | 0.0000 | 0.0000 | 4.07E-05 |
| 245 | 0.00 | 0.000 | 0.048 | 0.1295 | 0.0497 | 0.0002 | 7.80E-05 | 0.0033 | 0.0000 | 7.61E-09 | 0.0000 | 0.0000 | 4.07E-05 |
| 246 | 0.00 | 0.000 | 0.015 | 0.1287 | 0.0536 | 0.0003 | 8.26E-05 | 0.0033 | 0.0000 | 7.61E-09 | 0.0000 | 0.0000 | 4.06E-05 |
| 247 | 0.00 | 0.000 | 0.005 | 0.1287 | 0.0556 | 0.0003 | 8.49E-05 | 0.0033 | 0.0000 | 7.62E-09 | 0.0000 | 0.0000 | 4.06E-05 |
| 248 | 0.08 | 0.000 | 0.008 | 0.1327 | 0.0546 | 0.0003 | 8.38E-05 | 0.0034 | 0.0000 | 7.62E-09 | 0.0000 | 0.0000 | 4.06E-05 |
| 249 | 0.07 | 0.000 | 0.007 | 0.1363 | 0.0537 | 0.0003 | 8.27E-05 | 0.0034 | 0.0000 | 7.63E-09 | 0.0000 | 0.0000 | 4.06E-05 |
| 250 | 0.00 | 0.000 | 0.012 | 0.1357 | 0.0528 | 0.0003 | 8.16E-05 | 0.0034 | 0.0000 | 7.63E-09 | 0.0000 | 0.0000 | 4.05E-05 |
| 251 | 0.03 | 0.000 | 0.016 | 0.1366 | 0.0519 | 0.0003 | 8.05E-05 | 0.0034 | 0.0000 | 7.62E-09 | 0.0000 | 0.0000 | 4.05E-05 |
| 252 | 0.00 | 0.000 | 0.014 | 0.1358 | 0.0510 | 0.0003 | 7.95E-05 | 0.0033 | 0.0000 | 7.61E-09 | 0.0000 | 0.0000 | 4.05E-05 |
| 253 | 0.09 | 0.000 | 0.015 | 0.1399 | 0.0501 | 0.0002 | 7.85E-05 | 0.0032 | 0.0000 | 7.59E-09 | 0.0000 | 0.0000 | 4.05E-05 |
| 254 | 1.06 | 0.903 | 0.027 | 0.1472 | 0.0494 | 0.0002 | 7.77E-05 | 0.0032 | 0.0000 | 7.58E-09 | 0.0000 | 0.0000 | 4.04E-05 |
| 255 | 0.00 | 0.000 | 0.059 | 0.1440 | 0.0489 | 0.0002 | 7.70E-05 | 0.0031 | 0.0000 | 7.57E-09 | 0.0000 | 0.0000 | 4.04E-05 |
| 256 | 0.63 | 0.314 | 0.163 | 0.1526 | 0.0482 | 0.0002 | 7.62E-05 | 0.0031 | 0.0000 | 7.56E-09 | 0.0000 | 0.0000 | 4.04E-05 |
| 257 | 0.00 | 0.000 | 0.113 | 0.1464 | 0.0474 | 0.0002 | 7.52E-05 | 0.0030 | 0.0000 | 7.55E-09 | 0.0000 | 0.0000 | 4.04E-05 |
| 258 | 0.00 | 0.000 | 0.140 | 0.1386 | 0.0468 | 0.0002 | 7.44E-05 | 0.0030 | 0.0000 | 7.53E-09 | 0.0000 | 0.0000 | 4.03E-05 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 259 | | 0.00 | 0.000 | 0.099 | 0.1331 | 0.0479 | 0.0002 | 7.58E-05 | 0.0029 | 0.0000 | 7.52E-09 | 0.0000 | 0.0000 | 4.03E-05 |
| 260 | | 0.00 | 0.000 | 0.044 | 0.1306 | 0.0479 | 0.0002 | 7.58E-05 | 0.0029 | 0.0000 | 7.51E-09 | 0.0000 | 0.0000 | 4.03E-05 |
| 261 | | 0.00 | 0.000 | 0.026 | 0.1292 | 0.0471 | 0.0002 | 7.49E-05 | 0.0028 | 0.0000 | 7.50E-09 | 0.0000 | 0.0000 | 4.03E-05 |
| 262 | | 0.00 | 0.000 | 0.004 | 0.1287 | 0.0537 | 0.0003 | 8.26E-05 | 0.0028 | 0.0000 | 7.49E-09 | 0.0000 | 0.0000 | 4.02E-05 |
| 263 | | 0.15 | 0.003 | 0.009 | 0.1366 | 0.0571 | 0.0003 | 8.66E-05 | 0.0027 | 0.0000 | 7.48E-09 | 0.0000 | 0.0000 | 4.02E-05 |
| 264 | | 0.33 | 0.171 | 0.043 | 0.1430 | 0.0561 | 0.0003 | 8.55E-05 | 0.0027 | 0.0000 | 7.47E-09 | 0.0000 | 0.0000 | 4.02E-05 |
| 265 | | 0.00 | 0.000 | 0.044 | 0.1406 | 0.0551 | 0.0003 | 8.44E-05 | 0.0026 | 0.0000 | 7.46E-09 | 0.0000 | 0.0000 | 4.02E-05 |
| 266 | | 0.00 | 0.000 | 0.075 | 0.1364 | 0.0542 | 0.0003 | 8.33E-05 | 0.0026 | 0.0000 | 7.45E-09 | 0.0000 | 0.0000 | 4.02E-05 |
| 267 | | 0.00 | 0.000 | 0.096 | 0.1310 | 0.0533 | 0.0003 | 8.22E-05 | 0.0025 | 0.0000 | 7.44E-09 | 0.0000 | 0.0000 | 4.01E-05 |
| 268 | | 0.00 | 0.000 | 0.032 | 0.1292 | 0.0523 | 0.0003 | 8.11E-05 | 0.0025 | 0.0000 | 7.43E-09 | 0.0000 | 0.0000 | 4.01E-05 |
| 269 | | 0.00 | 0.000 | 0.008 | 0.1287 | 0.0529 | 0.0003 | 8.18E-05 | 0.0024 | 0.0000 | 7.42E-09 | 0.0000 | 0.0000 | 4.01E-05 |
| 270 | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0545 | 0.0003 | 8.37E-05 | 0.0024 | 0.0000 | 7.41E-09 | 0.0000 | 0.0000 | 4.01E-05 |
| 271 | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0536 | 0.0003 | 8.26E-05 | 0.0024 | 0.0000 | 7.40E-09 | 0.0000 | 0.0000 | 4.00E-05 |
| 272 | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0527 | 0.0003 | 8.15E-05 | 0.0023 | 0.0000 | 7.39E-09 | 0.0000 | 0.0000 | 4.00E-05 |
| 273 | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0518 | 0.0003 | 8.05E-05 | 0.0023 | 0.0000 | 7.38E-09 | 0.0000 | 0.0000 | 4.00E-05 |
| 274 | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0509 | 0.0003 | 7.94E-05 | 0.0022 | 0.0000 | 7.37E-09 | 0.0000 | 0.0000 | 4.00E-05 |
| 275 | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.0500 | 0.0002 | 7.84E-05 | 0.0022 | 0.0000 | 7.36E-09 | 0.0000 | 0.0000 | 3.99E-05 |
| 276 | | 0.60 | 0.400 | 0.028 | 0.1385 | 0.0492 | 0.0002 | 7.73E-05 | 0.0022 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 3.99E-05 |
| 277 | | 0.00 | 0.000 | 0.083 | 0.1339 | 0.0483 | 0.0002 | 7.63E-05 | 0.0021 | 0.0000 | 7.34E-09 | 0.0000 | 0.0000 | 3.99E-05 |
| 278 | | 0.00 | 0.000 | 0.015 | 0.1330 | 0.0475 | 0.0002 | 7.53E-05 | 0.0021 | 0.0000 | 7.34E-09 | 0.0000 | 0.0000 | 3.99E-05 |
| 279 | | 0.00 | 0.000 | 0.014 | 0.1322 | 0.0467 | 0.0002 | 7.43E-05 | 0.0020 | 0.0000 | 7.33E-09 | 0.0000 | 0.0000 | 3.98E-05 |
| 280 | * | 0.24 | 0.000 | 0.036 | 0.1333 | 0.0459 | 0.0002 | 7.33E-05 | 0.0020 | 0.0000 | 7.32E-09 | 0.0000 | 0.0000 | 3.98E-05 |
| 281 | | 0.00 | 0.000 | 0.081 | 0.1394 | 0.0451 | 0.0002 | 7.24E-05 | 0.0020 | 0.0000 | 7.31E-09 | 0.0000 | 0.0000 | 3.98E-05 |
| 282 | | 0.00 | 0.000 | 0.014 | 0.1386 | 0.0443 | 0.0002 | 7.15E-05 | 0.0019 | 0.0000 | 7.30E-09 | 0.0000 | 0.0000 | 3.98E-05 |
| 283 | | 0.00 | 0.000 | 0.016 | 0.1377 | 0.0436 | 0.0002 | 7.06E-05 | 0.0019 | 0.0000 | 7.30E-09 | 0.0000 | 0.0000 | 3.97E-05 |
| 284 | | 0.00 | 0.000 | 0.016 | 0.1368 | 0.0429 | 0.0002 | 6.97E-05 | 0.0019 | 0.0000 | 7.29E-09 | 0.0000 | 0.0000 | 3.97E-05 |
| 285 | | 0.00 | 0.000 | 0.016 | 0.1359 | 0.0421 | 0.0002 | 6.87E-05 | 0.0018 | 0.0000 | 7.28E-09 | 0.0000 | 0.0000 | 3.97E-05 |
| 286 | | 0.01 | 0.000 | 0.017 | 0.1357 | 0.0431 | 0.0002 | 6.99E-05 | 0.0018 | 0.0000 | 7.27E-09 | 0.0000 | 0.0000 | 3.97E-05 |
| 287 | | 0.00 | 0.000 | 0.012 | 0.1351 | 0.0428 | 0.0002 | 6.96E-05 | 0.0018 | 0.0000 | 7.27E-09 | 0.0000 | 0.0000 | 3.97E-05 |
| 288 | | 0.00 | 0.000 | 0.013 | 0.1344 | 0.0420 | 0.0002 | 6.86E-05 | 0.0017 | 0.0000 | 7.26E-09 | 0.0000 | 0.0000 | 3.96E-05 |
| 289 | | 0.00 | 0.000 | 0.011 | 0.1337 | 0.0418 | 0.0002 | 6.84E-05 | 0.0017 | 0.0000 | 7.25E-09 | 0.0000 | 0.0000 | 3.96E-05 |
| 290 | | 0.00 | 0.000 | 0.011 | 0.1331 | 0.0414 | 0.0002 | 6.78E-05 | 0.0017 | 0.0000 | 7.24E-09 | 0.0000 | 0.0000 | 3.96E-05 |
| 291 | | 0.00 | 0.000 | 0.011 | 0.1325 | 0.0408 | 0.0002 | 6.71E-05 | 0.0017 | 0.0000 | 7.24E-09 | 0.0000 | 0.0000 | 3.96E-05 |
| 292 | * | 0.05 | 0.000 | 0.029 | 0.1336 | 0.0402 | 0.0002 | 6.63E-05 | 0.0016 | 0.0000 | 7.23E-09 | 0.0000 | 0.0000 | 3.95E-05 |
| 293 | * | 0.00 | 0.000 | 0.002 | 0.1336 | 0.0395 | 0.0002 | 6.54E-05 | 0.0016 | 0.0000 | 7.22E-09 | 0.0000 | 0.0000 | 3.95E-05 |
| 294 | * | 0.00 | 0.000 | 0.000 | 0.1336 | 0.0388 | 0.0002 | 6.46E-05 | 0.0016 | 0.0000 | 7.22E-09 | 0.0000 | 0.0000 | 3.95E-05 |
| 295 | | 0.00 | 0.000 | 0.010 | 0.1330 | 0.0381 | 0.0002 | 6.37E-05 | 0.0015 | 0.0000 | 7.21E-09 | 0.0000 | 0.0000 | 3.95E-05 |
| 296 | * | 0.01 | 0.000 | 0.011 | 0.1330 | 0.0375 | 0.0002 | 6.29E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 3.94E-05 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 297 | * | | 0.00 | 0.000 | 0.014 | 0.1324 | 0.0368 | 0.0002 | 6.20E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 3.94E-05 |
| 298 | * | | 0.43 | 0.000 | 0.039 | 0.1335 | 0.0362 | 0.0002 | 6.12E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 3.94E-05 |
| 299 | | | 0.00 | 0.200 | 0.024 | 0.1416 | 0.0355 | 0.0002 | 6.04E-05 | 0.0015 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 3.94E-05 |
| 300 | | | 0.00 | 0.000 | 0.028 | 0.1400 | 0.0353 | 0.0002 | 6.01E-05 | 0.0015 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 3.94E-05 |
| 301 | | | 0.00 | 0.000 | 0.037 | 0.1380 | 0.0349 | 0.0002 | 5.96E-05 | 0.0014 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 3.93E-05 |
| 302 | | | 0.07 | 0.000 | 0.056 | 0.1388 | 0.0345 | 0.0002 | 5.90E-05 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 3.93E-05 |
| 303 | | | 0.00 | 0.000 | 0.053 | 0.1358 | 0.0340 | 0.0002 | 5.83E-05 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 3.93E-05 |
| 304 | | | 0.00 | 0.000 | 0.038 | 0.1337 | 0.0343 | 0.0002 | 5.88E-05 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 3.93E-05 |
| 305 | * | | 0.00 | 0.000 | 0.029 | 0.1321 | 0.0350 | 0.0002 | 5.97E-05 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 3.92E-05 |
| 306 | | | 0.01 | 0.000 | 0.035 | 0.1306 | 0.0344 | 0.0002 | 5.89E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 3.92E-05 |
| 307 | | | 0.21 | 0.055 | 0.024 | 0.1378 | 0.0339 | 0.0002 | 5.83E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 3.92E-05 |
| 308 | * | | 0.00 | 0.000 | 0.000 | 0.1378 | 0.0336 | 0.0002 | 5.78E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 3.92E-05 |
| 309 | * | | 0.00 | 0.000 | 0.015 | 0.1370 | 0.0338 | 0.0002 | 5.81E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 3.91E-05 |
| 310 | * | | 0.00 | 0.000 | 0.000 | 0.1370 | 0.0337 | 0.0002 | 5.80E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 3.91E-05 |
| 311 | * | | 0.00 | 0.000 | 0.000 | 0.1370 | 0.0331 | 0.0002 | 5.72E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 3.91E-05 |
| 312 | * | | 0.23 | 0.000 | 0.015 | 0.1381 | 0.0325 | 0.0002 | 5.64E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 3.91E-05 |
| 313 | * | | 0.56 | 0.000 | 0.016 | 0.1392 | 0.0319 | 0.0002 | 5.57E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 3.91E-05 |
| 314 | * | | 0.00 | 0.000 | 0.025 | 0.1403 | 0.0314 | 0.0002 | 5.49E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 3.90E-05 |
| 315 | * | * | 0.00 | 0.000 | 0.027 | 0.1403 | 0.0308 | 0.0002 | 5.42E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 3.90E-05 |
| 316 | * | * | 0.00 | 0.000 | 0.024 | 0.1403 | 0.0303 | 0.0001 | 5.34E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 3.90E-05 |
| 317 | * | * | 0.07 | 0.000 | 0.022 | 0.1403 | 0.0297 | 0.0001 | 5.27E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 3.90E-05 |
| 318 | * | * | 0.00 | 0.000 | 0.033 | 0.1403 | 0.0292 | 0.0001 | 5.20E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 3.89E-05 |
| 319 | | * | 0.00 | 0.621 | 0.000 | 0.1413 | 0.0287 | 0.0001 | 5.13E-05 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 3.89E-05 |
| 320 | | * | 0.00 | 0.000 | 0.000 | 0.1413 | 0.0282 | 0.0001 | 5.06E-05 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 3.89E-05 |
| 321 | | * | 0.00 | 0.000 | 0.000 | 0.1413 | 0.0277 | 0.0001 | 4.99E-05 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 3.89E-05 |
| 322 | | * | 0.00 | 0.000 | 0.000 | 0.1413 | 0.0272 | 0.0001 | 4.92E-05 | 0.0015 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 3.88E-05 |
| 323 | | * | 0.00 | 0.000 | 0.000 | 0.1413 | 0.0267 | 0.0001 | 4.86E-05 | 0.0015 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 3.88E-05 |
| 324 | * | * | 0.02 | 0.000 | 0.024 | 0.1413 | 0.0262 | 0.0001 | 4.79E-05 | 0.0015 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 3.88E-05 |
| 325 | | * | 0.21 | 0.208 | 0.005 | 0.1413 | 0.0257 | 0.0001 | 4.72E-05 | 0.0015 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 3.88E-05 |
| 326 | | * | 0.00 | 0.000 | 0.000 | 0.1413 | 0.0253 | 0.0001 | 4.66E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 3.88E-05 |
| 327 | | * | 0.00 | 0.000 | 0.000 | 0.1413 | 0.0248 | 0.0001 | 4.60E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 3.87E-05 |
| 328 | | * | 0.00 | 0.000 | 0.000 | 0.1413 | 0.0244 | 0.0001 | 4.53E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 3.87E-05 |
| 329 | | * | 0.00 | 0.000 | 0.000 | 0.1413 | 0.0239 | 0.0001 | 4.47E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 3.87E-05 |
| 330 | * | * | 0.00 | 0.000 | 0.000 | 0.1413 | 0.0235 | 0.0001 | 4.41E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 3.87E-05 |
| 331 | * | * | 0.25 | 0.000 | 0.014 | 0.1413 | 0.0231 | 0.0001 | 4.35E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 3.86E-05 |
| 332 | | * | 0.00 | 0.219 | 0.018 | 0.1413 | 0.0227 | 0.0001 | 4.29E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 3.86E-05 |
| 333 | | * | 0.09 | 0.000 | 0.005 | 0.1463 | 0.0223 | 0.0001 | 4.23E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 3.86E-05 |
| 334 | | * | 0.00 | 0.000 | 0.000 | 0.1463 | 0.0219 | 0.0001 | 4.17E-05 | 0.0015 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 3.86E-05 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 335 | * | * | 0.00 | 0.000 | 0.000 | 0.1463 | 0.0215 | 0.0001 | 4.11E-05 | 0.0015 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 3.86E-05 |
| 336 | | * | 0.00 | 0.000 | 0.000 | 0.1463 | 0.0211 | 0.0001 | 4.06E-05 | 0.0015 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 3.85E-05 |
| 337 | | * | 0.00 | 0.000 | 0.000 | 0.1463 | 0.0207 | 0.0001 | 4.00E-05 | 0.0014 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 3.85E-05 |
| 338 | | * | 0.00 | 0.000 | 0.000 | 0.1463 | 0.0203 | 0.0001 | 3.95E-05 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 3.85E-05 |
| 339 | | * | 0.00 | 0.000 | 0.000 | 0.1463 | 0.0199 | 0.0001 | 3.89E-05 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 3.85E-05 |
| 340 | | | 0.00 | 0.000 | 0.040 | 0.1440 | 0.0196 | 0.0001 | 3.84E-05 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 3.84E-05 |
| 341 | * | | 0.00 | 0.000 | 0.000 | 0.1440 | 0.0192 | 0.0001 | 3.78E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 3.84E-05 |
| 342 | | | 0.00 | 0.000 | 0.044 | 0.1416 | 0.0189 | 0.0001 | 3.73E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 3.84E-05 |
| 343 | * | | 0.00 | 0.000 | 0.000 | 0.1416 | 0.0185 | 0.0001 | 3.68E-05 | 0.0014 | 0.0000 | 7.16E-09 | 0.0000 | 0.0000 | 3.84E-05 |
| 344 | * | | 0.00 | 0.000 | 0.001 | 0.1416 | 0.0182 | 0.0001 | 3.63E-05 | 0.0013 | 0.0000 | 7.16E-09 | 0.0000 | 0.0000 | 3.84E-05 |
| 345 | * | | 0.20 | 0.000 | 0.010 | 0.1427 | 0.0179 | 0.0001 | 3.58E-05 | 0.0013 | 0.0000 | 7.16E-09 | 0.0000 | 0.0000 | 3.83E-05 |
| 346 | * | | 0.00 | 0.000 | 0.011 | 0.1438 | 0.0175 | 0.0001 | 3.53E-05 | 0.0013 | 0.0000 | 7.15E-09 | 0.0000 | 0.0000 | 3.83E-05 |
| 347 | * | | 0.05 | 0.000 | 0.018 | 0.1448 | 0.0172 | 0.0001 | 3.48E-05 | 0.0013 | 0.0000 | 7.14E-09 | 0.0000 | 0.0000 | 3.83E-05 |
| 348 | * | | 0.00 | 0.000 | 0.019 | 0.1459 | 0.0169 | 0.0001 | 3.43E-05 | 0.0013 | 0.0000 | 7.14E-09 | 0.0000 | 0.0000 | 3.83E-05 |
| 349 | | | 0.00 | 0.000 | 0.046 | 0.1501 | 0.0166 | 0.0001 | 3.38E-05 | 0.0012 | 0.0000 | 7.13E-09 | 0.0000 | 0.0000 | 3.82E-05 |
| 350 | * | | 0.00 | 0.000 | 0.027 | 0.1486 | 0.0166 | 0.0001 | 3.38E-05 | 0.0012 | 0.0000 | 7.13E-09 | 0.0000 | 0.0000 | 3.82E-05 |
| 351 | * | | 0.00 | 0.000 | 0.004 | 0.1486 | 0.0164 | 0.0001 | 3.36E-05 | 0.0012 | 0.0000 | 7.12E-09 | 0.0000 | 0.0000 | 3.82E-05 |
| 352 | | | 0.21 | 0.062 | 0.046 | 0.1542 | 0.0161 | 0.0001 | 3.31E-05 | 0.0012 | 0.0000 | 7.12E-09 | 0.0000 | 0.0000 | 3.82E-05 |
| 353 | | | 0.39 | 0.183 | 0.089 | 0.1606 | 0.0158 | 0.0001 | 3.27E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 3.82E-05 |
| 354 | | | 0.16 | 0.031 | 0.065 | 0.1641 | 0.0158 | 0.0001 | 3.26E-05 | 0.0011 | 0.0000 | 7.11E-09 | 0.0000 | 0.0000 | 3.81E-05 |
| 355 | | | 0.21 | 0.080 | 0.058 | 0.1679 | 0.0178 | 0.0001 | 3.57E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 3.81E-05 |
| 356 | | | 0.00 | 0.000 | 0.042 | 0.1655 | 0.0184 | 0.0001 | 3.65E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 3.81E-05 |
| 357 | | | 0.00 | 0.000 | 0.029 | 0.1639 | 0.0180 | 0.0001 | 3.60E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 3.81E-05 |
| 358 | | | 0.00 | 0.000 | 0.030 | 0.1622 | 0.0177 | 0.0001 | 3.55E-05 | 0.0011 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 3.81E-05 |
| 359 | | | 0.00 | 0.000 | 0.040 | 0.1600 | 0.0174 | 0.0001 | 3.50E-05 | 0.0010 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 3.80E-05 |
| 360 | * | | 0.00 | 0.000 | 0.029 | 0.1584 | 0.0170 | 0.0001 | 3.45E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 3.80E-05 |
| 361 | * | | 0.00 | 0.000 | 0.000 | 0.1584 | 0.0167 | 0.0001 | 3.40E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 3.80E-05 |
| 362 | * | | 0.00 | 0.000 | 0.031 | 0.1566 | 0.0174 | 0.0001 | 3.50E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 3.80E-05 |
| 363 | * | | 0.05 | 0.000 | 0.028 | 0.1577 | 0.0176 | 0.0001 | 3.54E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 3.79E-05 |
| 364 | * | * | 0.23 | 0.000 | 0.010 | 0.1577 | 0.0173 | 0.0001 | 3.49E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 3.79E-05 |
| 365 | * | * | 0.11 | 0.000 | 0.012 | 0.1577 | 0.0170 | 0.0001 | 3.44E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 3.79E-05 |

* = Frozen (air or soil)

| Annual Totals for Year 4 | | | |
|---|---|---|---|
| | inches | cubic feet | percent |
| Precipitation | 34.04 | 123,555.1 | 100.00 |

| | | | |
|---|---|---|---|
| Runoff | 18.570 | 67,407.6 | 54.56 |
| Evapotranspiration | 14.821 | 53,800.4 | 43.54 |
| Drainage Collected from Layer 3 | 0.0600 | 217.7 | 0.18 |
| Percolation/Leakage through Layer 4 | 0.020561 | 74.6 | 0.06 |
| Average Head on Top of Layer 4 | 0.0332 | --- | --- |
| Drainage Collected from Layer 7 | 0.0029 | 10.5 | 0.01 |
| Percolation/Leakage through Layer 9 | 0.000003 | 0.0095 | 0.00 |
| Average Head on Top of Layer 8 | 0.0012 | --- | --- |
| Percolation/Leakage through Layer 10 | 0.015528 | 56.4 | 0.05 |
| Change in Water Storage | 0.5682 | 2,062.6 | 1.67 |
| Soil Water at Start of Year | 72.3588 | 262,662.6 | 212.59 |
| Soil Water at End of Year | 72.6438 | 263,697.1 | 213.42 |
| Snow Water at Start of Year | 0.0192 | 69.8 | 0.06 |
| Snow Water at End of Year | 0.3024 | 1,097.9 | 0.89 |
| Annual Water Budget Balance | 0.0000 | 0.0000 | 0.00 |

**Daily Output for Year 5**

**Column key:** Head #1: drainage from Layer 4 | Head #2: drainage from Layer 8
Drain #1: drainage from Layer 3 | Drain #2: drainage from Layer 7
Leak #1: leakage thru Layer 4 | Leak #2: leakage thru Layer 9 | Leak #3: leakage thru Layer 10

**Title:** Pilgrim Landfill
**Simulated On:** 4/10/2026 14:14

| Day | Freezing Status* | | Rain | Runoff | ET | Evap. Zone Water | Head #1 | Drain #1 | Leak #1 | Head #2 | Drain #2 | Leak #2 | Head #3 | Drain #3 | Leak #3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Air | Soil | (inches) | (inches) | (inches) | (in/in) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) | (inches) |
| 1 | * | * | 0.00 | 0.000 | 0.036 | 0.1577 | 0.0163 | 0.0001 | 3.35E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 3.79E-05 |
| 2 | | * | 0.00 | 0.007 | 0.030 | 0.1635 | 0.0160 | 0.0001 | 3.30E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 3.78E-05 |
| 3 | | * | 0.00 | 0.007 | 0.041 | 0.1678 | 0.0157 | 0.0001 | 3.25E-05 | 0.0009 | 0.0000 | 7.05E-09 | 0.0000 | 0.0000 | 3.78E-05 |
| 4 | | * | 0.01 | 0.000 | 0.005 | 0.1683 | 0.0155 | 0.0001 | 3.21E-05 | 0.0009 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 3.78E-05 |
| 5 | * | * | 0.00 | 0.000 | 0.000 | 0.1683 | 0.0152 | 0.0001 | 3.16E-05 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 3.78E-05 |
| 6 | * | * | 0.00 | 0.000 | 0.000 | 0.1683 | 0.0149 | 0.0001 | 3.12E-05 | 0.0008 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 3.77E-05 |
| 7 | * | * | 0.00 | 0.000 | 0.000 | 0.1683 | 0.0146 | 0.0001 | 3.07E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 3.77E-05 |
| 8 | * | * | 0.00 | 0.000 | 0.000 | 0.1683 | 0.0143 | 0.0001 | 3.03E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 3.77E-05 |
| 9 | * | * | 0.05 | 0.000 | 0.010 | 0.1683 | 0.0141 | 0.0001 | 2.99E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 3.77E-05 |
| 10 | * | * | 0.00 | 0.000 | 0.000 | 0.1683 | 0.0138 | 0.0001 | 2.94E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 3.77E-05 |
| 11 | | * | 0.00 | 0.000 | 0.039 | 0.1683 | 0.0136 | 0.0001 | 2.90E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 3.76E-05 |
| 12 | | * | 0.00 | 0.000 | 0.000 | 0.1683 | 0.0133 | 0.0001 | 2.86E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 3.76E-05 |
| 13 | * | * | 0.00 | 0.000 | 0.000 | 0.1683 | 0.0130 | 0.0001 | 2.82E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 3.76E-05 |
| 14 | | * | 0.00 | 0.000 | 0.000 | 0.1683 | 0.0128 | 0.0001 | 2.78E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 3.76E-05 |
| 15 | * | * | 0.00 | 0.000 | 0.000 | 0.1683 | 0.0126 | 0.0001 | 2.74E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 3.76E-05 |
| 16 | * | * | 0.00 | 0.000 | 0.000 | 0.1683 | 0.0123 | 0.0001 | 2.70E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 3.75E-05 |
| 17 | * | * | 0.00 | 0.000 | 0.000 | 0.1683 | 0.0121 | 0.0001 | 2.66E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 3.75E-05 |
| 18 | * | * | 0.00 | 0.000 | 0.000 | 0.1683 | 0.0119 | 0.0001 | 2.62E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 3.75E-05 |
| 19 | * | * | 0.00 | 0.000 | 0.000 | 0.1683 | 0.0116 | 0.0001 | 2.58E-05 | 0.0007 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 3.75E-05 |
| 20 | | * | 0.00 | 0.000 | 0.003 | 0.1685 | 0.0114 | 0.0001 | 2.55E-05 | 0.0006 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 3.75E-05 |
| 21 | | * | 0.00 | 0.000 | 0.000 | 0.1685 | 0.0112 | 0.0001 | 2.51E-05 | 0.0006 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 3.74E-05 |
| 22 | * | * | 0.00 | 0.000 | 0.000 | 0.1685 | 0.0110 | 0.0001 | 2.47E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 3.74E-05 |
| 23 | | * | 0.00 | 0.000 | 0.000 | 0.1685 | 0.0108 | 0.0001 | 2.44E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 3.74E-05 |
| 24 | | * | 0.00 | 0.000 | 0.000 | 0.1685 | 0.0106 | 0.0001 | 2.40E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 3.74E-05 |
| 25 | | * | 0.00 | 0.000 | 0.000 | 0.1685 | 0.0104 | 0.0001 | 2.37E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 3.73E-05 |
| 26 | | * | 0.00 | 0.000 | 0.000 | 0.1685 | 0.0102 | 0.0001 | 2.33E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 3.73E-05 |
| 27 | | * | 0.00 | 0.000 | 0.002 | 0.1685 | 0.0100 | 0.0000 | 2.30E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 3.73E-05 |
| 28 | | * | 0.00 | 0.000 | 0.000 | 0.1685 | 0.0098 | 0.0000 | 2.27E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 3.73E-05 |
| 29 | | * | 0.00 | 0.000 | 0.000 | 0.1685 | 0.0096 | 0.0000 | 2.23E-05 | 0.0006 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 3.73E-05 |
| 30 | | * | 0.00 | 0.000 | 0.000 | 0.1685 | 0.0094 | 0.0000 | 2.20E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 3.72E-05 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | * | * | 0.00 | 0.000 | 0.001 | 0.1685 | 0.0092 | 0.0000 | 2.17E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 3.72E-05 |
| 32 | | * | 0.00 | 0.000 | 0.003 | 0.1686 | 0.0091 | 0.0000 | 2.14E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 3.72E-05 |
| 33 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0089 | 0.0000 | 2.10E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 3.72E-05 |
| 34 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0087 | 0.0000 | 2.07E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 3.72E-05 |
| 35 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0085 | 0.0000 | 2.04E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 3.71E-05 |
| 36 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0084 | 0.0000 | 2.01E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 3.71E-05 |
| 37 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0082 | 0.0000 | 1.98E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 3.71E-05 |
| 38 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0081 | 0.0000 | 1.95E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 3.71E-05 |
| 39 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0079 | 0.0000 | 1.92E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 3.71E-05 |
| 40 | * | * | 0.01 | 0.000 | 0.007 | 0.1686 | 0.0077 | 0.0000 | 1.90E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 3.70E-05 |
| 41 | * | * | 0.00 | 0.000 | 0.003 | 0.1686 | 0.0076 | 0.0000 | 1.87E-05 | 0.0004 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 3.70E-05 |
| 42 | * | * | 0.10 | 0.000 | 0.009 | 0.1686 | 0.0074 | 0.0000 | 1.84E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 3.70E-05 |
| 43 | * | * | 0.07 | 0.000 | 0.000 | 0.1686 | 0.0073 | 0.0000 | 1.81E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 3.70E-05 |
| 44 | * | * | 0.00 | 0.000 | 0.023 | 0.1686 | 0.0072 | 0.0000 | 1.79E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 3.70E-05 |
| 45 | * | * | 0.00 | 0.000 | 0.009 | 0.1686 | 0.0070 | 0.0000 | 1.76E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 3.69E-05 |
| 46 | * | * | 0.00 | 0.000 | 0.024 | 0.1686 | 0.0069 | 0.0000 | 1.73E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 3.69E-05 |
| 47 | * | * | 0.00 | 0.000 | 0.019 | 0.1686 | 0.0067 | 0.0000 | 1.71E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 3.69E-05 |
| 48 | * | * | 0.00 | 0.000 | 0.007 | 0.1686 | 0.0066 | 0.0000 | 1.68E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 3.69E-05 |
| 49 | * | * | 0.00 | 0.000 | 0.011 | 0.1686 | 0.0065 | 0.0000 | 1.66E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 3.69E-05 |
| 50 | * | * | 0.00 | 0.000 | 0.024 | 0.1686 | 0.0063 | 0.0000 | 1.63E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 3.68E-05 |
| 51 | | * | 0.00 | 0.000 | 0.042 | 0.1686 | 0.0062 | 0.0000 | 1.61E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 3.68E-05 |
| 52 | | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0061 | 0.0000 | 1.58E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 3.68E-05 |
| 53 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0060 | 0.0000 | 1.56E-05 | 0.0004 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 3.68E-05 |
| 54 | | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0059 | 0.0000 | 1.53E-05 | 0.0004 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 3.68E-05 |
| 55 | | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0057 | 0.0000 | 1.51E-05 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 3.67E-05 |
| 56 | | * | 0.30 | 0.296 | 0.005 | 0.1686 | 0.0056 | 0.0000 | 1.49E-05 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 3.67E-05 |
| 57 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0055 | 0.0000 | 1.46E-05 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 3.67E-05 |
| 58 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0054 | 0.0000 | 1.44E-05 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 3.67E-05 |
| 59 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0053 | 0.0000 | 1.42E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 3.67E-05 |
| 60 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0052 | 0.0000 | 1.40E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 3.66E-05 |
| 61 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0051 | 0.0000 | 1.38E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 3.66E-05 |
| 62 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0050 | 0.0000 | 1.36E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 3.66E-05 |
| 63 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0049 | 0.0000 | 1.34E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 3.66E-05 |
| 64 | * | * | 0.01 | 0.000 | 0.006 | 0.1686 | 0.0048 | 0.0000 | 1.31E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 3.66E-05 |
| 65 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0047 | 0.0000 | 1.29E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.65E-05 |
| 66 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0046 | 0.0000 | 1.27E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.65E-05 |
| 67 | | * | 0.00 | 0.000 | 0.003 | 0.1686 | 0.0045 | 0.0000 | 1.25E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.65E-05 |
| 68 | * | * | 0.03 | 0.000 | 0.029 | 0.1686 | 0.0044 | 0.0000 | 1.23E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.65E-05 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 69 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0043 | 0.0000 | 1.22E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.65E-05 |
| 70 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0042 | 0.0000 | 1.20E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.64E-05 |
| 71 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0041 | 0.0000 | 1.18E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.64E-05 |
| 72 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0041 | 0.0000 | 1.16E-05 | 0.0003 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.64E-05 |
| 73 | * | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0040 | 0.0000 | 1.14E-05 | 0.0003 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.64E-05 |
| 74 | | * | 0.20 | 0.194 | 0.005 | 0.1686 | 0.0039 | 0.0000 | 1.12E-05 | 0.0003 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.64E-05 |
| 75 | | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0038 | 0.0000 | 1.11E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.63E-05 |
| 76 | | * | 0.00 | 0.000 | 0.000 | 0.1686 | 0.0037 | 0.0000 | 1.09E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.63E-05 |
| 77 | | * | 0.06 | 0.000 | 0.005 | 0.1715 | 0.0036 | 0.0000 | 1.07E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.63E-05 |
| 78 | | * | 0.10 | 0.008 | 0.005 | 0.1765 | 0.0036 | 0.0000 | 1.05E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.63E-05 |
| 79 | * | * | 0.00 | 0.000 | 0.000 | 0.1765 | 0.0035 | 0.0000 | 1.04E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.63E-05 |
| 80 | * | * | 0.00 | 0.000 | 0.000 | 0.1765 | 0.0034 | 0.0000 | 1.02E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.62E-05 |
| 81 | * | * | 0.15 | 0.000 | 0.035 | 0.1765 | 0.0034 | 0.0000 | 1.00E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.62E-05 |
| 82 | * | * | 0.09 | 0.000 | 0.011 | 0.1765 | 0.0033 | 0.0000 | 9.88E-06 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.62E-05 |
| 83 | * | * | 0.00 | 0.000 | 0.022 | 0.1765 | 0.0032 | 0.0000 | 9.73E-06 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.62E-05 |
| 84 | | * | 0.00 | 0.042 | 0.134 | 0.1765 | 0.0031 | 0.0000 | 9.57E-06 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.62E-05 |
| 85 | | * | 0.01 | 0.000 | 0.004 | 0.1768 | 0.0031 | 0.0000 | 9.42E-06 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.61E-05 |
| 86 | | * | 0.08 | 0.005 | 0.005 | 0.1807 | 0.0030 | 0.0000 | 9.26E-06 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.61E-05 |
| 87 | | * | 0.27 | 0.261 | 0.005 | 0.1807 | 0.0030 | 0.0000 | 9.11E-06 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.61E-05 |
| 88 | | * | 0.00 | 0.000 | 0.000 | 0.1807 | 0.0029 | 0.0000 | 8.97E-06 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.61E-05 |
| 89 | | * | 0.11 | 0.020 | 0.005 | 0.1856 | 0.0028 | 0.0000 | 8.82E-06 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.61E-05 |
| 90 | | * | 0.00 | 0.000 | 0.000 | 0.1856 | 0.0028 | 0.0000 | 8.68E-06 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.60E-05 |
| 91 | | * | 0.03 | 0.000 | 0.005 | 0.1868 | 0.0027 | 0.0000 | 8.54E-06 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.60E-05 |
| 92 | | * | 0.13 | 0.035 | 0.005 | 0.1917 | 0.0027 | 0.0000 | 8.40E-06 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.60E-05 |
| 93 | | * | 0.01 | 0.000 | 0.004 | 0.1919 | 0.0026 | 0.0000 | 8.26E-06 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.60E-05 |
| 94 | | * | 0.11 | 0.022 | 0.005 | 0.1962 | 0.0025 | 0.0000 | 8.13E-06 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.60E-05 |
| 95 | | * | 0.40 | 0.392 | 0.005 | 0.1962 | 0.0025 | 0.0000 | 7.99E-06 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.59E-05 |
| 96 | | * | 0.00 | 0.000 | 0.000 | 0.1962 | 0.0024 | 0.0000 | 7.86E-06 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.59E-05 |
| 97 | | | 0.22 | 0.083 | 0.147 | 0.1956 | 0.0024 | 0.0000 | 7.73E-06 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.59E-05 |
| 98 | | | 0.16 | 0.022 | 0.168 | 0.1939 | 0.0023 | 0.0000 | 7.61E-06 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.59E-05 |
| 99 | | | 0.08 | 0.000 | 0.124 | 0.1916 | 0.0023 | 0.0000 | 7.48E-06 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.59E-05 |
| 100 | | | 0.10 | 0.000 | 0.097 | 0.1914 | 0.0097 | 0.0000 | 2.19E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.58E-05 |
| 101 | | | 0.04 | 0.000 | 0.067 | 0.1898 | 0.0153 | 0.0001 | 3.18E-05 | 0.0002 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.58E-05 |
| 102 | | | 0.00 | 0.000 | 0.202 | 0.1785 | 0.0150 | 0.0001 | 3.13E-05 | 0.0002 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.58E-05 |
| 103 | | | 0.00 | 0.000 | 0.188 | 0.1680 | 0.0192 | 0.0001 | 3.78E-05 | 0.0002 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.58E-05 |
| 104 | | | 0.00 | 0.000 | 0.281 | 0.1524 | 0.0188 | 0.0001 | 3.73E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.58E-05 |
| 105 | | | 0.00 | 0.000 | 0.131 | 0.1450 | 0.0236 | 0.0001 | 4.41E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.57E-05 |
| 106 | | | 0.00 | 0.000 | 0.054 | 0.1420 | 0.0248 | 0.0001 | 4.60E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.57E-05 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 107 | | | 0.00 | 0.000 | 0.042 | 0.1397 | 0.0244 | 0.0001 | 4.53E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.57E-05 |
| 108 | | | 0.00 | 0.000 | 0.035 | 0.1376 | 0.0245 | 0.0001 | 4.55E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.57E-05 |
| 109 | | | 0.00 | 0.000 | 0.031 | 0.1358 | 0.0311 | 0.0002 | 5.46E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.57E-05 |
| 110 | | | 0.00 | 0.000 | 0.028 | 0.1341 | 0.0377 | 0.0002 | 6.31E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 3.57E-05 |
| 111 | | | 0.00 | 0.000 | 0.026 | 0.1325 | 0.0438 | 0.0002 | 7.09E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.56E-05 |
| 112 | | | 0.20 | 0.045 | 0.029 | 0.1394 | 0.0496 | 0.0002 | 7.79E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.56E-05 |
| 113 | | | 0.08 | 0.000 | 0.027 | 0.1420 | 0.0559 | 0.0003 | 8.53E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.56E-05 |
| 114 | | | 0.08 | 0.000 | 0.026 | 0.1441 | 0.0718 | 0.0004 | 1.03E-04 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.56E-05 |
| 115 | | | 0.05 | 0.000 | 0.017 | 0.1455 | 0.0952 | 0.0005 | 1.28E-04 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.56E-05 |
| 116 | | | 0.34 | 0.180 | 0.026 | 0.1528 | 0.0969 | 0.0005 | 1.30E-04 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.55E-05 |
| 117 | | | 0.00 | 0.000 | 0.090 | 0.1478 | 0.0953 | 0.0005 | 1.28E-04 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.55E-05 |
| 118 | | | 0.00 | 0.000 | 0.014 | 0.1471 | 0.0937 | 0.0005 | 1.26E-04 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.55E-05 |
| 119 | | | 0.00 | 0.000 | 0.013 | 0.1463 | 0.0921 | 0.0005 | 1.25E-04 | 0.0003 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.55E-05 |
| 120 | | | 0.00 | 0.000 | 0.013 | 0.1456 | 0.0906 | 0.0004 | 1.23E-04 | 0.0003 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.55E-05 |
| 121 | | | 2.07 | 1.884 | 0.023 | 0.1546 | 0.0891 | 0.0004 | 1.22E-04 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.54E-05 |
| 122 | * | | 0.01 | 0.000 | 0.012 | 0.1546 | 0.0876 | 0.0004 | 1.20E-04 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.54E-05 |
| 123 | * | | 0.03 | 0.000 | 0.029 | 0.1549 | 0.0861 | 0.0004 | 1.19E-04 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.54E-05 |
| 124 | * | | 0.00 | 0.000 | 0.057 | 0.1519 | 0.0847 | 0.0004 | 1.17E-04 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.54E-05 |
| 125 | | | 0.20 | 0.059 | 0.105 | 0.1542 | 0.0833 | 0.0004 | 1.16E-04 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.54E-05 |
| 126 | | | 0.00 | 0.000 | 0.103 | 0.1485 | 0.0819 | 0.0004 | 1.14E-04 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.53E-05 |
| 127 | | | 0.08 | 0.000 | 0.216 | 0.1406 | 0.0896 | 0.0004 | 1.22E-04 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.53E-05 |
| 128 | | | 0.00 | 0.000 | 0.142 | 0.1327 | 0.0936 | 0.0005 | 1.26E-04 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.53E-05 |
| 129 | | | 0.00 | 0.000 | 0.056 | 0.1296 | 0.0920 | 0.0005 | 1.25E-04 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.53E-05 |
| 130 | | | 0.00 | 0.000 | 0.010 | 0.1287 | 0.0998 | 0.0005 | 1.33E-04 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.53E-05 |
| 131 | | | 0.00 | 0.000 | 0.001 | 0.1287 | 0.1038 | 0.0005 | 1.37E-04 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.53E-05 |
| 132 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.1023 | 0.0005 | 1.35E-04 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.52E-05 |
| 133 | | | 0.00 | 0.000 | 0.000 | 0.1287 | 0.1008 | 0.0005 | 1.34E-04 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.52E-05 |
| 134 | | | 0.20 | 0.044 | 0.008 | 0.1368 | 0.0992 | 0.0005 | 1.32E-04 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.52E-05 |
| 135 | | | 0.00 | 0.000 | 0.013 | 0.1360 | 0.0975 | 0.0005 | 1.30E-04 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.52E-05 |
| 136 | * | | 0.01 | 0.000 | 0.005 | 0.1360 | 0.0959 | 0.0005 | 1.29E-04 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.52E-05 |
| 137 | * | | 0.01 | 0.000 | 0.024 | 0.1353 | 0.0943 | 0.0005 | 1.27E-04 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.51E-05 |
| 138 | * | | 0.00 | 0.000 | 0.000 | 0.1353 | 0.0927 | 0.0005 | 1.25E-04 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.51E-05 |
| 139 | | | 0.51 | 0.315 | 0.031 | 0.1443 | 0.0912 | 0.0004 | 1.24E-04 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.51E-05 |
| 140 | | | 0.02 | 0.000 | 0.086 | 0.1406 | 0.0897 | 0.0004 | 1.22E-04 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.51E-05 |
| 141 | * | | 0.04 | 0.000 | 0.061 | 0.1396 | 0.0882 | 0.0004 | 1.21E-04 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.51E-05 |
| 142 | | | 0.28 | 0.131 | 0.023 | 0.1466 | 0.0867 | 0.0004 | 1.19E-04 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.51E-05 |
| 143 | | | 0.00 | 0.000 | 0.090 | 0.1416 | 0.0853 | 0.0004 | 1.18E-04 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.50E-05 |
| 144 | | | 0.13 | 0.000 | 0.146 | 0.1409 | 0.0863 | 0.0004 | 1.19E-04 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.50E-05 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 145 | 0.30 | 0.126 | 0.119 | 0.1440 | 0.0864 | 0.0004 | 1.19E-04 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.50E-05 |
| 146 | 0.04 | 0.000 | 0.109 | 0.1399 | 0.0874 | 0.0004 | 1.20E-04 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.50E-05 |
| 147 | 0.37 | 0.170 | 0.065 | 0.1476 | 0.0875 | 0.0004 | 1.20E-04 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.50E-05 |
| 148 | 0.00 | 0.000 | 0.091 | 0.1426 | 0.0860 | 0.0004 | 1.18E-04 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.49E-05 |
| 149 | 0.00 | 0.000 | 0.038 | 0.1404 | 0.0846 | 0.0004 | 1.17E-04 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.49E-05 |
| 150 | 0.00 | 0.000 | 0.028 | 0.1388 | 0.0859 | 0.0004 | 1.18E-04 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.49E-05 |
| 151 | 0.07 | 0.000 | 0.028 | 0.1411 | 0.0861 | 0.0004 | 1.18E-04 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.49E-05 |
| 152 | 0.04 | 0.000 | 0.028 | 0.1417 | 0.0846 | 0.0004 | 1.17E-04 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.49E-05 |
| 153 | 1.55 | 1.388 | 0.034 | 0.1490 | 0.0832 | 0.0004 | 1.15E-04 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.48E-05 |
| 154 | 0.12 | 0.000 | 0.173 | 0.1462 | 0.0818 | 0.0004 | 1.14E-04 | 0.0002 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.48E-05 |
| 155 | 0.01 | 0.000 | 0.175 | 0.1368 | 0.0828 | 0.0004 | 1.15E-04 | 0.0002 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.48E-05 |
| 156 | 0.04 | 0.000 | 0.144 | 0.1311 | 0.0826 | 0.0004 | 1.15E-04 | 0.0002 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.48E-05 |
| 157 | 0.00 | 0.000 | 0.028 | 0.1295 | 0.0812 | 0.0004 | 1.13E-04 | 0.0002 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.48E-05 |
| 158 | 0.00 | 0.000 | 0.009 | 0.1288 | 0.0848 | 0.0004 | 1.17E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.48E-05 |
| 159 | 0.00 | 0.000 | 0.002 | 0.1287 | 0.0863 | 0.0004 | 1.19E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.47E-05 |
| 160 | 0.77 | 0.523 | 0.045 | 0.1398 | 0.0848 | 0.0004 | 1.17E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.47E-05 |
| 161 | 0.18 | 0.048 | 0.079 | 0.1429 | 0.0835 | 0.0004 | 1.16E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.47E-05 |
| 162 | 0.20 | 0.047 | 0.140 | 0.1434 | 0.0822 | 0.0004 | 1.14E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.47E-05 |
| 163 | 0.00 | 0.000 | 0.124 | 0.1365 | 0.0808 | 0.0004 | 1.13E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.47E-05 |
| 164 | 0.00 | 0.000 | 0.087 | 0.1317 | 0.0795 | 0.0004 | 1.12E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.46E-05 |
| 165 | 0.00 | 0.000 | 0.043 | 0.1293 | 0.0781 | 0.0004 | 1.10E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.46E-05 |
| 166 | 0.00 | 0.000 | 0.008 | 0.1287 | 0.0818 | 0.0004 | 1.14E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.46E-05 |
| 167 | 0.58 | 0.370 | 0.044 | 0.1381 | 0.0835 | 0.0004 | 1.16E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.46E-05 |
| 168 | 0.00 | 0.000 | 0.104 | 0.1323 | 0.0821 | 0.0004 | 1.14E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.46E-05 |
| 169 | 0.00 | 0.000 | 0.024 | 0.1310 | 0.0807 | 0.0004 | 1.13E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.46E-05 |
| 170 | 0.34 | 0.165 | 0.037 | 0.1386 | 0.0793 | 0.0004 | 1.11E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.45E-05 |
| 171 | 0.00 | 0.000 | 0.123 | 0.1317 | 0.0782 | 0.0004 | 1.10E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.45E-05 |
| 172 | 0.16 | 0.014 | 0.027 | 0.1382 | 0.0795 | 0.0004 | 1.11E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.45E-05 |
| 173 | 0.38 | 0.109 | 0.298 | 0.1368 | 0.0794 | 0.0004 | 1.11E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.45E-05 |
| 174 | 0.03 | 0.000 | 0.094 | 0.1332 | 0.0801 | 0.0004 | 1.12E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.45E-05 |
| 175 | 0.17 | 0.025 | 0.043 | 0.1387 | 0.0800 | 0.0004 | 1.12E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.45E-05 |
| 176 | 0.71 | 0.527 | 0.066 | 0.1451 | 0.0786 | 0.0004 | 1.11E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.44E-05 |
| 177 | 0.00 | 0.000 | 0.123 | 0.1382 | 0.0775 | 0.0004 | 1.09E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.44E-05 |
| 178 | 0.93 | 0.615 | 0.138 | 0.1479 | 0.0769 | 0.0004 | 1.09E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.44E-05 |
| 179 | 0.28 | 0.112 | 0.200 | 0.1460 | 0.0770 | 0.0004 | 1.09E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.44E-05 |
| 180 | 0.36 | 0.122 | 0.197 | 0.1482 | 0.0764 | 0.0004 | 1.08E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.44E-05 |
| 181 | 0.11 | 0.000 | 0.137 | 0.1467 | 0.0781 | 0.0004 | 1.10E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.43E-05 |
| 182 | 0.00 | 0.000 | 0.152 | 0.1383 | 0.0786 | 0.0004 | 1.11E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.43E-05 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 183 | 0.42 | 0.146 | 0.263 | 0.1388 | 0.0773 | 0.0004 | 1.09E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.43E-05 |
| 184 | 0.32 | 0.126 | 0.151 | 0.1411 | 0.0760 | 0.0004 | 1.08E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.43E-05 |
| 185 | 0.00 | 0.000 | 0.120 | 0.1342 | 0.0831 | 0.0004 | 1.15E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.43E-05 |
| 186 | 0.08 | 0.000 | 0.101 | 0.1328 | 0.0866 | 0.0004 | 1.19E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.43E-05 |
| 187 | 0.16 | 0.002 | 0.041 | 0.1393 | 0.0852 | 0.0004 | 1.18E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.42E-05 |
| 188 | 0.01 | 0.000 | 0.066 | 0.1363 | 0.0863 | 0.0004 | 1.19E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.42E-05 |
| 189 | 0.21 | 0.073 | 0.045 | 0.1416 | 0.0864 | 0.0004 | 1.19E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.42E-05 |
| 190 | 0.02 | 0.000 | 0.037 | 0.1403 | 0.0849 | 0.0004 | 1.17E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.42E-05 |
| 191 | 0.00 | 0.000 | 0.025 | 0.1389 | 0.0851 | 0.0004 | 1.17E-04 | 0.0001 | 0.0000 | 6.84E-09 | 0.0000 | 0.0000 | 3.42E-05 |
| 192 | 0.00 | 0.000 | 0.017 | 0.1379 | 0.0846 | 0.0004 | 1.17E-04 | 0.0001 | 0.0000 | 6.84E-09 | 0.0000 | 0.0000 | 3.42E-05 |
| 193 | 0.00 | 0.000 | 0.020 | 0.1368 | 0.0839 | 0.0004 | 1.16E-04 | 0.0001 | 0.0000 | 6.84E-09 | 0.0000 | 0.0000 | 3.41E-05 |
| 194 | 0.09 | 0.000 | 0.024 | 0.1402 | 0.0830 | 0.0004 | 1.15E-04 | 0.0001 | 0.0000 | 6.84E-09 | 0.0000 | 0.0000 | 3.41E-05 |
| 195 | 0.00 | 0.000 | 0.016 | 0.1394 | 0.0816 | 0.0004 | 1.14E-04 | 0.0001 | 0.0000 | 6.84E-09 | 0.0000 | 0.0000 | 3.41E-05 |
| 196 | 0.00 | 0.000 | 0.011 | 0.1388 | 0.0806 | 0.0004 | 1.13E-04 | 0.0001 | 0.0000 | 6.84E-09 | 0.0000 | 0.0000 | 3.41E-05 |
| 197 | 0.00 | 0.000 | 0.013 | 0.1381 | 0.0795 | 0.0004 | 1.12E-04 | 0.0001 | 0.0000 | 6.84E-09 | 0.0000 | 0.0000 | 3.41E-05 |
| 198 | 0.00 | 0.000 | 0.014 | 0.1373 | 0.0781 | 0.0004 | 1.10E-04 | 0.0001 | 0.0000 | 6.84E-09 | 0.0000 | 0.0000 | 3.40E-05 |
| 199 | 0.00 | 0.000 | 0.014 | 0.1365 | 0.0768 | 0.0004 | 1.09E-04 | 0.0001 | 0.0000 | 6.84E-09 | 0.0000 | 0.0000 | 3.40E-05 |
| 200 | 0.00 | 0.000 | 0.014 | 0.1358 | 0.0755 | 0.0004 | 1.07E-04 | 0.0001 | 0.0000 | 6.84E-09 | 0.0000 | 0.0000 | 3.40E-05 |
| 201 | 0.00 | 0.000 | 0.013 | 0.1350 | 0.0743 | 0.0004 | 1.06E-04 | 0.0001 | 0.0000 | 6.84E-09 | 0.0000 | 0.0000 | 3.40E-05 |
| 202 | 0.00 | 0.000 | 0.013 | 0.1343 | 0.0730 | 0.0004 | 1.05E-04 | 0.0001 | 0.0000 | 6.84E-09 | 0.0000 | 0.0000 | 3.40E-05 |
| 203 | 0.00 | 0.000 | 0.012 | 0.1336 | 0.0718 | 0.0004 | 1.03E-04 | 0.0001 | 0.0000 | 6.84E-09 | 0.0000 | 0.0000 | 3.40E-05 |
| 204 | 0.41 | 0.237 | 0.023 | 0.1422 | 0.0706 | 0.0003 | 1.02E-04 | 0.0001 | 0.0000 | 6.84E-09 | 0.0000 | 0.0000 | 3.39E-05 |
| 205 | 0.47 | 0.329 | 0.022 | 0.1487 | 0.0694 | 0.0003 | 1.01E-04 | 0.0001 | 0.0000 | 6.84E-09 | 0.0000 | 0.0000 | 3.39E-05 |
| 206 | 0.00 | 0.000 | 0.103 | 0.1429 | 0.0683 | 0.0003 | 9.93E-05 | 0.0001 | 0.0000 | 6.84E-09 | 0.0000 | 0.0000 | 3.39E-05 |
| 207 | 1.27 | 0.952 | 0.152 | 0.1519 | 0.0671 | 0.0003 | 9.80E-05 | 0.0001 | 0.0000 | 6.84E-09 | 0.0000 | 0.0000 | 3.39E-05 |
| 208 | 0.00 | 0.000 | 0.099 | 0.1464 | 0.0660 | 0.0003 | 9.68E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.39E-05 |
| 209 | 0.00 | 0.000 | 0.193 | 0.1356 | 0.0653 | 0.0003 | 9.60E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.39E-05 |
| 210 | 0.00 | 0.000 | 0.078 | 0.1313 | 0.0666 | 0.0003 | 9.75E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.38E-05 |
| 211 | 0.00 | 0.000 | 0.035 | 0.1293 | 0.0663 | 0.0003 | 9.71E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.38E-05 |
| 212 | 0.67 | 0.422 | 0.065 | 0.1395 | 0.0651 | 0.0003 | 9.58E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.38E-05 |
| 213 | 0.00 | 0.000 | 0.073 | 0.1351 | 0.0737 | 0.0004 | 1.05E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.38E-05 |
| 214 | 0.00 | 0.000 | 0.082 | 0.1306 | 0.0782 | 0.0004 | 1.10E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.38E-05 |
| 215 | 0.14 | 0.000 | 0.042 | 0.1359 | 0.0769 | 0.0004 | 1.09E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.38E-05 |
| 216 | 0.00 | 0.000 | 0.079 | 0.1313 | 0.0786 | 0.0004 | 1.11E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.37E-05 |
| 217 | 0.45 | 0.155 | 0.149 | 0.1394 | 0.0790 | 0.0004 | 1.11E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.37E-05 |
| 218 | 0.21 | 0.074 | 0.085 | 0.1422 | 0.0777 | 0.0004 | 1.10E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.37E-05 |
| 219 | 0.00 | 0.000 | 0.084 | 0.1375 | 0.0764 | 0.0004 | 1.08E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.37E-05 |
| 220 | 0.00 | 0.000 | 0.096 | 0.1322 | 0.0761 | 0.0004 | 1.08E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.37E-05 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 221 | 0.16 | 0.011 | 0.045 | 0.1379 | 0.0755 | 0.0004 | 1.07E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.36E-05 |
| 222 | 0.00 | 0.000 | 0.037 | 0.1358 | 0.0742 | 0.0004 | 1.06E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.36E-05 |
| 223 | 0.00 | 0.000 | 0.022 | 0.1345 | 0.0771 | 0.0004 | 1.09E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.36E-05 |
| 224 | 0.05 | 0.000 | 0.028 | 0.1359 | 0.0783 | 0.0004 | 1.10E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.36E-05 |
| 225 | 0.14 | 0.001 | 0.025 | 0.1423 | 0.0770 | 0.0004 | 1.09E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.36E-05 |
| 226 | 0.00 | 0.000 | 0.013 | 0.1415 | 0.0765 | 0.0004 | 1.08E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.36E-05 |
| 227 | 0.00 | 0.000 | 0.013 | 0.1408 | 0.0757 | 0.0004 | 1.07E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.35E-05 |
| 228 | 0.00 | 0.000 | 0.015 | 0.1399 | 0.0745 | 0.0004 | 1.06E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.35E-05 |
| 229 | 0.00 | 0.000 | 0.015 | 0.1391 | 0.0732 | 0.0004 | 1.05E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.35E-05 |
| 230 | 0.00 | 0.000 | 0.015 | 0.1383 | 0.0720 | 0.0004 | 1.03E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.35E-05 |
| 231 | 0.00 | 0.000 | 0.014 | 0.1375 | 0.0708 | 0.0003 | 1.02E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.35E-05 |
| 232 | 0.05 | 0.000 | 0.019 | 0.1392 | 0.0696 | 0.0003 | 1.01E-04 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.35E-05 |
| 233 | 0.00 | 0.000 | 0.013 | 0.1385 | 0.0684 | 0.0003 | 9.95E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.34E-05 |
| 234 | 0.00 | 0.000 | 0.012 | 0.1379 | 0.0673 | 0.0003 | 9.82E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.34E-05 |
| 235 | 0.00 | 0.000 | 0.009 | 0.1373 | 0.0668 | 0.0003 | 9.77E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.34E-05 |
| 236 | 0.02 | 0.000 | 0.016 | 0.1379 | 0.0661 | 0.0003 | 9.69E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.34E-05 |
| 237 | 0.02 | 0.000 | 0.017 | 0.1381 | 0.0650 | 0.0003 | 9.57E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.34E-05 |
| 238 | 0.00 | 0.000 | 0.009 | 0.1376 | 0.0639 | 0.0003 | 9.44E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.34E-05 |
| 239 | 0.00 | 0.000 | 0.007 | 0.1372 | 0.0631 | 0.0003 | 9.35E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.33E-05 |
| 240 | 0.04 | 0.000 | 0.013 | 0.1387 | 0.0622 | 0.0003 | 9.25E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.33E-05 |
| 241 | 0.00 | 0.000 | 0.009 | 0.1382 | 0.0612 | 0.0003 | 9.13E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.33E-05 |
| 242 | 0.01 | 0.000 | 0.012 | 0.1383 | 0.0602 | 0.0003 | 9.03E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.33E-05 |
| 243 | 0.00 | 0.000 | 0.009 | 0.1378 | 0.0595 | 0.0003 | 8.94E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.33E-05 |
| 244 | 0.00 | 0.000 | 0.007 | 0.1374 | 0.0585 | 0.0003 | 8.83E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.33E-05 |
| 245 | 0.00 | 0.000 | 0.007 | 0.1370 | 0.0577 | 0.0003 | 8.73E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.32E-05 |
| 246 | 0.00 | 0.000 | 0.008 | 0.1365 | 0.0568 | 0.0003 | 8.63E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.32E-05 |
| 247 | 0.00 | 0.000 | 0.008 | 0.1361 | 0.0558 | 0.0003 | 8.52E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.32E-05 |
| 248 | 0.00 | 0.000 | 0.009 | 0.1356 | 0.0549 | 0.0003 | 8.41E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.32E-05 |
| 249 | 0.04 | 0.000 | 0.014 | 0.1372 | 0.0539 | 0.0003 | 8.30E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.32E-05 |
| 250 | 0.00 | 0.000 | 0.008 | 0.1367 | 0.0530 | 0.0003 | 8.19E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.32E-05 |
| 251 | 0.00 | 0.000 | 0.006 | 0.1364 | 0.0521 | 0.0003 | 8.08E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.31E-05 |
| 252 | 0.00 | 0.000 | 0.007 | 0.1361 | 0.0515 | 0.0003 | 8.01E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.31E-05 |
| 253 | 0.00 | 0.000 | 0.007 | 0.1357 | 0.0508 | 0.0003 | 7.93E-05 | 0.0001 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.31E-05 |
| 254 | 0.00 | 0.000 | 0.007 | 0.1353 | 0.0499 | 0.0002 | 7.83E-05 | 0.0002 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.31E-05 |
| 255 | 0.00 | 0.000 | 0.007 | 0.1349 | 0.0491 | 0.0002 | 7.72E-05 | 0.0002 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.31E-05 |
| 256 | 0.00 | 0.000 | 0.007 | 0.1345 | 0.0482 | 0.0002 | 7.62E-05 | 0.0002 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.31E-05 |
| 257 | 0.00 | 0.000 | 0.008 | 0.1341 | 0.0474 | 0.0002 | 7.52E-05 | 0.0002 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.30E-05 |
| 258 | 0.10 | 0.000 | 0.013 | 0.1387 | 0.0466 | 0.0002 | 7.42E-05 | 0.0002 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.30E-05 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 259 | | 0.21 | 0.074 | 0.012 | 0.1455 | 0.0458 | 0.0002 | 7.32E-05 | 0.0002 | 0.0000 | 6.85E-09 | 0.0000 | 0.0000 | 3.30E-05 |
| 260 | | 0.00 | 0.000 | 0.005 | 0.1453 | 0.0452 | 0.0002 | 7.25E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.30E-05 |
| 261 | | 0.00 | 0.000 | 0.006 | 0.1449 | 0.0445 | 0.0002 | 7.17E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.30E-05 |
| 262 | | 0.00 | 0.000 | 0.007 | 0.1445 | 0.0437 | 0.0002 | 7.07E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.30E-05 |
| 263 | | 0.00 | 0.000 | 0.007 | 0.1441 | 0.0430 | 0.0002 | 6.98E-05 | 0.0002 | 0.0000 | 6.86E-09 | 0.0000 | 0.0000 | 3.29E-05 |
| 264 | | 0.00 | 0.000 | 0.007 | 0.1437 | 0.0422 | 0.0002 | 6.89E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.29E-05 |
| 265 | | 0.00 | 0.000 | 0.007 | 0.1433 | 0.0415 | 0.0002 | 6.79E-05 | 0.0002 | 0.0000 | 6.87E-09 | 0.0000 | 0.0000 | 3.29E-05 |
| 266 | | 0.00 | 0.000 | 0.007 | 0.1429 | 0.0408 | 0.0002 | 6.70E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.29E-05 |
| 267 | | 0.00 | 0.000 | 0.007 | 0.1425 | 0.0400 | 0.0002 | 6.61E-05 | 0.0002 | 0.0000 | 6.88E-09 | 0.0000 | 0.0000 | 3.29E-05 |
| 268 | | 0.00 | 0.000 | 0.007 | 0.1421 | 0.0393 | 0.0002 | 6.53E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.29E-05 |
| 269 | | 0.00 | 0.000 | 0.007 | 0.1417 | 0.0387 | 0.0002 | 6.44E-05 | 0.0003 | 0.0000 | 6.89E-09 | 0.0000 | 0.0000 | 3.28E-05 |
| 270 | | 0.05 | 0.000 | 0.012 | 0.1440 | 0.0380 | 0.0002 | 6.35E-05 | 0.0003 | 0.0000 | 6.90E-09 | 0.0000 | 0.0000 | 3.28E-05 |
| 271 | | 0.08 | 0.000 | 0.013 | 0.1475 | 0.0373 | 0.0002 | 6.27E-05 | 0.0003 | 0.0000 | 6.91E-09 | 0.0000 | 0.0000 | 3.28E-05 |
| 272 | | 0.00 | 0.000 | 0.008 | 0.1470 | 0.0367 | 0.0002 | 6.19E-05 | 0.0004 | 0.0000 | 6.92E-09 | 0.0000 | 0.0000 | 3.28E-05 |
| 273 | | 0.00 | 0.000 | 0.008 | 0.1466 | 0.0361 | 0.0002 | 6.11E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 3.28E-05 |
| 274 | | 0.00 | 0.000 | 0.007 | 0.1461 | 0.0363 | 0.0002 | 6.14E-05 | 0.0004 | 0.0000 | 6.93E-09 | 0.0000 | 0.0000 | 3.28E-05 |
| 275 | | 0.00 | 0.000 | 0.006 | 0.1458 | 0.0360 | 0.0002 | 6.10E-05 | 0.0005 | 0.0000 | 6.94E-09 | 0.0000 | 0.0000 | 3.28E-05 |
| 276 | | 0.00 | 0.000 | 0.006 | 0.1454 | 0.0353 | 0.0002 | 6.02E-05 | 0.0005 | 0.0000 | 6.95E-09 | 0.0000 | 0.0000 | 3.27E-05 |
| 277 | | 0.00 | 0.000 | 0.006 | 0.1451 | 0.0347 | 0.0002 | 5.93E-05 | 0.0005 | 0.0000 | 6.96E-09 | 0.0000 | 0.0000 | 3.27E-05 |
| 278 | * | 0.00 | 0.000 | 0.000 | 0.1451 | 0.0341 | 0.0002 | 5.85E-05 | 0.0006 | 0.0000 | 6.97E-09 | 0.0000 | 0.0000 | 3.27E-05 |
| 279 | * | 0.00 | 0.000 | 0.006 | 0.1447 | 0.0335 | 0.0002 | 5.78E-05 | 0.0006 | 0.0000 | 6.98E-09 | 0.0000 | 0.0000 | 3.27E-05 |
| 280 | * | 0.00 | 0.000 | 0.006 | 0.1444 | 0.0329 | 0.0002 | 5.70E-05 | 0.0006 | 0.0000 | 6.99E-09 | 0.0000 | 0.0000 | 3.27E-05 |
| 281 | * | 0.00 | 0.000 | 0.000 | 0.1444 | 0.0323 | 0.0002 | 5.62E-05 | 0.0007 | 0.0000 | 7.00E-09 | 0.0000 | 0.0000 | 3.27E-05 |
| 282 | | 0.00 | 0.000 | 0.006 | 0.1440 | 0.0318 | 0.0002 | 5.55E-05 | 0.0007 | 0.0000 | 7.01E-09 | 0.0000 | 0.0000 | 3.26E-05 |
| 283 | * | 0.00 | 0.000 | 0.000 | 0.1440 | 0.0312 | 0.0002 | 5.47E-05 | 0.0008 | 0.0000 | 7.02E-09 | 0.0000 | 0.0000 | 3.26E-05 |
| 284 | | 0.00 | 0.000 | 0.006 | 0.1437 | 0.0307 | 0.0002 | 5.40E-05 | 0.0008 | 0.0000 | 7.03E-09 | 0.0000 | 0.0000 | 3.26E-05 |
| 285 | * | 0.00 | 0.000 | 0.006 | 0.1433 | 0.0301 | 0.0001 | 5.32E-05 | 0.0009 | 0.0000 | 7.04E-09 | 0.0000 | 0.0000 | 3.26E-05 |
| 286 | | 0.00 | 0.000 | 0.006 | 0.1430 | 0.0296 | 0.0001 | 5.25E-05 | 0.0009 | 0.0000 | 7.06E-09 | 0.0000 | 0.0000 | 3.26E-05 |
| 287 | | 0.00 | 0.000 | 0.006 | 0.1427 | 0.0291 | 0.0001 | 5.18E-05 | 0.0010 | 0.0000 | 7.07E-09 | 0.0000 | 0.0000 | 3.26E-05 |
| 288 | | 0.00 | 0.000 | 0.006 | 0.1423 | 0.0285 | 0.0001 | 5.11E-05 | 0.0010 | 0.0000 | 7.08E-09 | 0.0000 | 0.0000 | 3.25E-05 |
| 289 | | 0.00 | 0.000 | 0.006 | 0.1420 | 0.0280 | 0.0001 | 5.04E-05 | 0.0011 | 0.0000 | 7.09E-09 | 0.0000 | 0.0000 | 3.25E-05 |
| 290 | | 0.04 | 0.000 | 0.011 | 0.1438 | 0.0275 | 0.0001 | 4.97E-05 | 0.0011 | 0.0000 | 7.10E-09 | 0.0000 | 0.0000 | 3.25E-05 |
| 291 | | 0.00 | 0.000 | 0.006 | 0.1435 | 0.0270 | 0.0001 | 4.91E-05 | 0.0012 | 0.0000 | 7.12E-09 | 0.0000 | 0.0000 | 3.25E-05 |
| 292 | | 0.02 | 0.000 | 0.012 | 0.1438 | 0.0266 | 0.0001 | 4.84E-05 | 0.0012 | 0.0000 | 7.13E-09 | 0.0000 | 0.0000 | 3.25E-05 |
| 293 | | 0.83 | 0.674 | 0.014 | 0.1515 | 0.0261 | 0.0001 | 4.77E-05 | 0.0013 | 0.0000 | 7.14E-09 | 0.0000 | 0.0000 | 3.25E-05 |
| 294 | | 0.00 | 0.000 | 0.110 | 0.1454 | 0.0259 | 0.0001 | 4.75E-05 | 0.0013 | 0.0000 | 7.15E-09 | 0.0000 | 0.0000 | 3.24E-05 |
| 295 | | 0.01 | 0.000 | 0.108 | 0.1397 | 0.0260 | 0.0001 | 4.76E-05 | 0.0014 | 0.0000 | 7.17E-09 | 0.0000 | 0.0000 | 3.24E-05 |
| 296 | | 0.00 | 0.000 | 0.135 | 0.1321 | 0.0280 | 0.0001 | 5.04E-05 | 0.0014 | 0.0000 | 7.18E-09 | 0.0000 | 0.0000 | 3.24E-05 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 297 | | 0.00 | 0.000 | 0.049 | 0.1294 | 0.0283 | 0.0001 | 5.08E-05 | 0.0015 | 0.0000 | 7.19E-09 | 0.0000 | 0.0000 | 3.24E-05 |
| 298 | | 0.03 | 0.000 | 0.020 | 0.1296 | 0.0338 | 0.0002 | 5.81E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 3.24E-05 |
| 299 | | 0.01 | 0.000 | 0.008 | 0.1296 | 0.0368 | 0.0002 | 6.20E-05 | 0.0015 | 0.0000 | 7.20E-09 | 0.0000 | 0.0000 | 3.24E-05 |
| 300 | | 0.05 | 0.000 | 0.008 | 0.1317 | 0.0361 | 0.0002 | 6.12E-05 | 0.0015 | 0.0000 | 7.21E-09 | 0.0000 | 0.0000 | 3.24E-05 |
| 301 | | 0.08 | 0.000 | 0.008 | 0.1357 | 0.0355 | 0.0002 | 6.04E-05 | 0.0015 | 0.0000 | 7.21E-09 | 0.0000 | 0.0000 | 3.23E-05 |
| 302 | | 0.18 | 0.042 | 0.018 | 0.1426 | 0.0349 | 0.0002 | 5.96E-05 | 0.0016 | 0.0000 | 7.21E-09 | 0.0000 | 0.0000 | 3.23E-05 |
| 303 | | 0.00 | 0.000 | 0.012 | 0.1419 | 0.0343 | 0.0002 | 5.88E-05 | 0.0016 | 0.0000 | 7.22E-09 | 0.0000 | 0.0000 | 3.23E-05 |
| 304 | | 0.09 | 0.000 | 0.018 | 0.1458 | 0.0337 | 0.0002 | 5.80E-05 | 0.0016 | 0.0000 | 7.22E-09 | 0.0000 | 0.0000 | 3.23E-05 |
| 305 | | 0.03 | 0.000 | 0.018 | 0.1465 | 0.0331 | 0.0002 | 5.72E-05 | 0.0016 | 0.0000 | 7.23E-09 | 0.0000 | 0.0000 | 3.23E-05 |
| 306 | | 0.00 | 0.000 | 0.010 | 0.1460 | 0.0327 | 0.0002 | 5.67E-05 | 0.0016 | 0.0000 | 7.23E-09 | 0.0000 | 0.0000 | 3.23E-05 |
| 307 | | 0.00 | 0.000 | 0.014 | 0.1452 | 0.0323 | 0.0002 | 5.62E-05 | 0.0017 | 0.0000 | 7.24E-09 | 0.0000 | 0.0000 | 3.22E-05 |
| 308 | | 0.00 | 0.000 | 0.014 | 0.1445 | 0.0317 | 0.0002 | 5.54E-05 | 0.0017 | 0.0000 | 7.24E-09 | 0.0000 | 0.0000 | 3.22E-05 |
| 309 | | 0.00 | 0.000 | 0.014 | 0.1437 | 0.0312 | 0.0002 | 5.47E-05 | 0.0017 | 0.0000 | 7.25E-09 | 0.0000 | 0.0000 | 3.22E-05 |
| 310 | | 0.00 | 0.000 | 0.013 | 0.1430 | 0.0306 | 0.0002 | 5.39E-05 | 0.0017 | 0.0000 | 7.26E-09 | 0.0000 | 0.0000 | 3.22E-05 |
| 311 | | 0.00 | 0.000 | 0.013 | 0.1423 | 0.0301 | 0.0001 | 5.32E-05 | 0.0018 | 0.0000 | 7.26E-09 | 0.0000 | 0.0000 | 3.22E-05 |
| 312 | | 0.00 | 0.000 | 0.012 | 0.1416 | 0.0295 | 0.0001 | 5.25E-05 | 0.0018 | 0.0000 | 7.27E-09 | 0.0000 | 0.0000 | 3.22E-05 |
| 313 | | 0.10 | 0.000 | 0.017 | 0.1459 | 0.0290 | 0.0001 | 5.18E-05 | 0.0018 | 0.0000 | 7.28E-09 | 0.0000 | 0.0000 | 3.21E-05 |
| 314 | | 1.00 | 0.844 | 0.022 | 0.1534 | 0.0285 | 0.0001 | 5.11E-05 | 0.0019 | 0.0000 | 7.29E-09 | 0.0000 | 0.0000 | 3.21E-05 |
| 315 | | 0.01 | 0.000 | 0.050 | 0.1514 | 0.0280 | 0.0001 | 5.04E-05 | 0.0019 | 0.0000 | 7.30E-09 | 0.0000 | 0.0000 | 3.21E-05 |
| 316 | * | 0.17 | 0.000 | 0.025 | 0.1525 | 0.0275 | 0.0001 | 4.97E-05 | 0.0019 | 0.0000 | 7.30E-09 | 0.0000 | 0.0000 | 3.21E-05 |
| 317 | * | 0.03 | 0.000 | 0.000 | 0.1535 | 0.0270 | 0.0001 | 4.90E-05 | 0.0020 | 0.0000 | 7.31E-09 | 0.0000 | 0.0000 | 3.21E-05 |
| 318 | * | 0.43 | 0.000 | 0.016 | 0.1546 | 0.0265 | 0.0001 | 4.83E-05 | 0.0020 | 0.0000 | 7.32E-09 | 0.0000 | 0.0000 | 3.21E-05 |
| 319 | * | 0.00 | 0.000 | 0.033 | 0.1557 | 0.0260 | 0.0001 | 4.77E-05 | 0.0021 | 0.0000 | 7.33E-09 | 0.0000 | 0.0000 | 3.21E-05 |
| 320 | * | 0.33 | 0.000 | 0.000 | 0.1568 | 0.0256 | 0.0001 | 4.70E-05 | 0.0021 | 0.0000 | 7.34E-09 | 0.0000 | 0.0000 | 3.20E-05 |
| 321 | | 0.00 | 0.657 | 0.000 | 0.1643 | 0.0251 | 0.0001 | 4.64E-05 | 0.0022 | 0.0000 | 7.35E-09 | 0.0000 | 0.0000 | 3.20E-05 |
| 322 | * | 0.00 | 0.000 | 0.000 | 0.1643 | 0.0247 | 0.0001 | 4.57E-05 | 0.0022 | 0.0000 | 7.36E-09 | 0.0000 | 0.0000 | 3.20E-05 |
| 323 | | 0.00 | 0.000 | 0.034 | 0.1623 | 0.0253 | 0.0001 | 4.67E-05 | 0.0022 | 0.0000 | 7.37E-09 | 0.0000 | 0.0000 | 3.20E-05 |
| 324 | | 0.00 | 0.000 | 0.039 | 0.1602 | 0.0255 | 0.0001 | 4.69E-05 | 0.0023 | 0.0000 | 7.38E-09 | 0.0000 | 0.0000 | 3.20E-05 |
| 325 | | 0.00 | 0.000 | 0.036 | 0.1582 | 0.0251 | 0.0001 | 4.63E-05 | 0.0023 | 0.0000 | 7.39E-09 | 0.0000 | 0.0000 | 3.20E-05 |
| 326 | * | 0.00 | 0.000 | 0.026 | 0.1567 | 0.0246 | 0.0001 | 4.57E-05 | 0.0024 | 0.0000 | 7.40E-09 | 0.0000 | 0.0000 | 3.19E-05 |
| 327 | * | 0.00 | 0.000 | 0.000 | 0.1567 | 0.0242 | 0.0001 | 4.50E-05 | 0.0024 | 0.0000 | 7.41E-09 | 0.0000 | 0.0000 | 3.19E-05 |
| 328 | * | 0.02 | 0.000 | 0.044 | 0.1553 | 0.0237 | 0.0001 | 4.44E-05 | 0.0024 | 0.0000 | 7.42E-09 | 0.0000 | 0.0000 | 3.19E-05 |
| 329 | * | 0.00 | 0.000 | 0.000 | 0.1553 | 0.0233 | 0.0001 | 4.38E-05 | 0.0025 | 0.0000 | 7.43E-09 | 0.0000 | 0.0000 | 3.19E-05 |
| 330 | * | 0.00 | 0.000 | 0.000 | 0.1553 | 0.0229 | 0.0001 | 4.32E-05 | 0.0025 | 0.0000 | 7.44E-09 | 0.0000 | 0.0000 | 3.19E-05 |
| 331 | | 0.00 | 0.000 | 0.055 | 0.1522 | 0.0225 | 0.0001 | 4.26E-05 | 0.0026 | 0.0000 | 7.45E-09 | 0.0000 | 0.0000 | 3.19E-05 |
| 332 | | 0.00 | 0.000 | 0.091 | 0.1471 | 0.0221 | 0.0001 | 4.20E-05 | 0.0026 | 0.0000 | 7.45E-09 | 0.0000 | 0.0000 | 3.19E-05 |
| 333 | | 0.00 | 0.000 | 0.073 | 0.1430 | 0.0217 | 0.0001 | 4.14E-05 | 0.0026 | 0.0000 | 7.46E-09 | 0.0000 | 0.0000 | 3.18E-05 |
| 334 | | 0.00 | 0.000 | 0.073 | 0.1390 | 0.0213 | 0.0001 | 4.09E-05 | 0.0027 | 0.0000 | 7.47E-09 | 0.0000 | 0.0000 | 3.18E-05 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 335 | | | 0.00 | 0.000 | 0.058 | 0.1358 | 0.0209 | 0.0001 | 4.03E-05 | 0.0027 | 0.0000 | 7.48E-09 | 0.0000 | 0.0000 | 3.18E-05 |
| 336 | | | 0.00 | 0.000 | 0.068 | 0.1319 | 0.0216 | 0.0001 | 4.14E-05 | 0.0028 | 0.0000 | 7.49E-09 | 0.0000 | 0.0000 | 3.18E-05 |
| 337 | | | 0.01 | 0.000 | 0.058 | 0.1291 | 0.0272 | 0.0001 | 4.92E-05 | 0.0028 | 0.0000 | 7.50E-09 | 0.0000 | 0.0000 | 3.18E-05 |
| 338 | | | 0.04 | 0.000 | 0.015 | 0.1301 | 0.0358 | 0.0002 | 6.07E-05 | 0.0028 | 0.0000 | 7.50E-09 | 0.0000 | 0.0000 | 3.18E-05 |
| 339 | | | 0.03 | 0.000 | 0.010 | 0.1314 | 0.0365 | 0.0002 | 6.17E-05 | 0.0028 | 0.0000 | 7.50E-09 | 0.0000 | 0.0000 | 3.17E-05 |
| 340 | | | 0.00 | 0.000 | 0.004 | 0.1312 | 0.0359 | 0.0002 | 6.08E-05 | 0.0028 | 0.0000 | 7.49E-09 | 0.0000 | 0.0000 | 3.17E-05 |
| 341 | | | 0.10 | 0.000 | 0.014 | 0.1358 | 0.0352 | 0.0002 | 6.00E-05 | 0.0028 | 0.0000 | 7.49E-09 | 0.0000 | 0.0000 | 3.17E-05 |
| 342 | | | 0.01 | 0.000 | 0.020 | 0.1352 | 0.0346 | 0.0002 | 5.92E-05 | 0.0028 | 0.0000 | 7.49E-09 | 0.0000 | 0.0000 | 3.17E-05 |
| 343 | | | 0.43 | 0.246 | 0.036 | 0.1432 | 0.0340 | 0.0002 | 5.84E-05 | 0.0028 | 0.0000 | 7.49E-09 | 0.0000 | 0.0000 | 3.17E-05 |
| 344 | | | 0.00 | 0.000 | 0.035 | 0.1413 | 0.0334 | 0.0002 | 5.76E-05 | 0.0028 | 0.0000 | 7.49E-09 | 0.0000 | 0.0000 | 3.17E-05 |
| 345 | | | 0.10 | 0.000 | 0.040 | 0.1446 | 0.0330 | 0.0002 | 5.70E-05 | 0.0028 | 0.0000 | 7.49E-09 | 0.0000 | 0.0000 | 3.17E-05 |
| 346 | * | | 0.00 | 0.000 | 0.000 | 0.1446 | 0.0325 | 0.0002 | 5.64E-05 | 0.0028 | 0.0000 | 7.49E-09 | 0.0000 | 0.0000 | 3.16E-05 |
| 347 | * | | 0.00 | 0.000 | 0.000 | 0.1446 | 0.0319 | 0.0002 | 5.56E-05 | 0.0028 | 0.0000 | 7.50E-09 | 0.0000 | 0.0000 | 3.16E-05 |
| 348 | * | | 0.02 | 0.000 | 0.011 | 0.1449 | 0.0313 | 0.0002 | 5.49E-05 | 0.0028 | 0.0000 | 7.50E-09 | 0.0000 | 0.0000 | 3.16E-05 |
| 349 | * | | 0.00 | 0.000 | 0.000 | 0.1449 | 0.0308 | 0.0002 | 5.41E-05 | 0.0028 | 0.0000 | 7.50E-09 | 0.0000 | 0.0000 | 3.16E-05 |
| 350 | * | | 0.00 | 0.000 | 0.000 | 0.1449 | 0.0302 | 0.0001 | 5.34E-05 | 0.0028 | 0.0000 | 7.50E-09 | 0.0000 | 0.0000 | 3.16E-05 |
| 351 | * | | 0.00 | 0.000 | 0.000 | 0.1449 | 0.0297 | 0.0001 | 5.27E-05 | 0.0028 | 0.0000 | 7.51E-09 | 0.0000 | 0.0000 | 3.16E-05 |
| 352 | * | | 0.09 | 0.000 | 0.006 | 0.1460 | 0.0292 | 0.0001 | 5.20E-05 | 0.0029 | 0.0000 | 7.51E-09 | 0.0000 | 0.0000 | 3.16E-05 |
| 353 | * | | 0.06 | 0.000 | 0.013 | 0.1471 | 0.0286 | 0.0001 | 5.13E-05 | 0.0029 | 0.0000 | 7.51E-09 | 0.0000 | 0.0000 | 3.15E-05 |
| 354 | * | * | 0.00 | 0.000 | 0.014 | 0.1471 | 0.0281 | 0.0001 | 5.06E-05 | 0.0029 | 0.0000 | 7.52E-09 | 0.0000 | 0.0000 | 3.15E-05 |
| 355 | * | * | 0.11 | 0.000 | 0.006 | 0.1471 | 0.0276 | 0.0001 | 4.99E-05 | 0.0029 | 0.0000 | 7.52E-09 | 0.0000 | 0.0000 | 3.15E-05 |
| 356 | * | * | 0.00 | 0.000 | 0.008 | 0.1471 | 0.0271 | 0.0001 | 4.92E-05 | 0.0029 | 0.0000 | 7.53E-09 | 0.0000 | 0.0000 | 3.15E-05 |
| 357 | * | * | 0.00 | 0.000 | 0.004 | 0.1471 | 0.0267 | 0.0001 | 4.85E-05 | 0.0030 | 0.0000 | 7.53E-09 | 0.0000 | 0.0000 | 3.15E-05 |
| 358 | * | * | 0.00 | 0.000 | 0.007 | 0.1471 | 0.0262 | 0.0001 | 4.79E-05 | 0.0030 | 0.0000 | 7.54E-09 | 0.0000 | 0.0000 | 3.15E-05 |
| 359 | * | * | 0.00 | 0.000 | 0.000 | 0.1471 | 0.0257 | 0.0001 | 4.72E-05 | 0.0030 | 0.0000 | 7.54E-09 | 0.0000 | 0.0000 | 3.14E-05 |
| 360 | * | * | 0.00 | 0.000 | 0.034 | 0.1471 | 0.0253 | 0.0001 | 4.66E-05 | 0.0030 | 0.0000 | 7.55E-09 | 0.0000 | 0.0000 | 3.14E-05 |
| 361 | * | * | 0.01 | 0.000 | 0.037 | 0.1471 | 0.0248 | 0.0001 | 4.59E-05 | 0.0031 | 0.0000 | 7.56E-09 | 0.0000 | 0.0000 | 3.14E-05 |
| 362 | * | * | 0.10 | 0.000 | 0.016 | 0.1471 | 0.0244 | 0.0001 | 4.53E-05 | 0.0031 | 0.0000 | 7.56E-09 | 0.0000 | 0.0000 | 3.14E-05 |
| 363 | * | * | 0.00 | 0.000 | 0.007 | 0.1471 | 0.0239 | 0.0001 | 4.47E-05 | 0.0031 | 0.0000 | 7.57E-09 | 0.0000 | 0.0000 | 3.14E-05 |
| 364 | * | * | 0.00 | 0.000 | 0.010 | 0.1471 | 0.0235 | 0.0001 | 4.41E-05 | 0.0032 | 0.0000 | 7.58E-09 | 0.0000 | 0.0000 | 3.14E-05 |
| 365 | * | * | 0.00 | 0.000 | 0.017 | 0.1471 | 0.0231 | 0.0001 | 4.35E-05 | 0.0032 | 0.0000 | 7.58E-09 | 0.0000 | 0.0000 | 3.14E-05 |

* = Frozen (air or soil)

| Annual Totals for Year 5 | | | |
|---|---|---|---|
| | inches | cubic feet | percent |
| Precipitation | 25.46 | 92,408.5 | 100.00 |

| | | | |
|---|---|---|---|
| Runoff | 13.481 | 48,935.5 | 52.96 |
| Evapotranspiration | 12.202 | 44,292.9 | 47.93 |
| Drainage Collected from Layer 3 | 0.0771 | 280.0 | 0.30 |
| Percolation/Leakage through Layer 4 | 0.024041 | 87.3 | 0.09 |
| Average Head on Top of Layer 4 | 0.0429 | --- | --- |
| Drainage Collected from Layer 7 | 0.0017 | 6.1427 | 0.01 |
| Percolation/Leakage through Layer 9 | 0.000003 | 0.0093 | 0.00 |
| Average Head on Top of Layer 8 | 0.0007 | --- | --- |
| Percolation/Leakage through Layer 10 | 0.012559 | 45.6 | 0.05 |
| Change in Water Storage | -0.3172 | -1,151.6 | -1.25 |
| Soil Water at Start of Year | 72.6438 | 263,697.1 | 285.36 |
| Soil Water at End of Year | 72.4649 | 263,047.7 | 284.66 |
| Snow Water at Start of Year | 0.3024 | 1,097.9 | 1.19 |
| Snow Water at End of Year | 0.1641 | 595.7 | 0.64 |
| Annual Water Budget Balance | 0.0000 | 0.0000 | 0.00 |

**Average Annual Totals Summary**

**Title:** Pilgrim Landfill
**Simulated on:** 4/10/2026 14:14

| | Average Annual Totals for Years 1 - 5* | | | |
|---|---|---|---|---|
| | (inches) | [std dev] | (cubic feet) | (percent) |
| Precipitation | 31.76 | [5.73] | 115,283.6 | 100.00 |
| Runoff | 17.464 | [4.441] | 63,393.2 | 54.99 |
| Evapotranspiration | 14.159 | [1.357] | 51,397.2 | 44.58 |
| Subprofile1 | | | | |
| Lateral drainage collected from Layer 3 | 0.0645 | [0.0108] | 234.1 | 0.20 |
| Percolation/leakage through Layer 4 | 0.021100 | [0.002681] | 76.6 | 0.07 |
| Average Head on Top of Layer 4 | 0.0358 | [0.006] | --- | --- |
| Subprofile2 | | | | |
| Lateral drainage collected from Layer 7 | 0.0027 | [0.0007] | 9.8731 | 0.01 |
| Percolation/leakage through Layer 9 | 0.000003 | [0] | 0.0094 | 0.00 |
| Average Head on Top of Layer 8 | 0.0011 | [0.0003] | --- | --- |
| Subprofile3 | | | | |
| Percolation/leakage through Layer 10 | 0.025282 | [0.014852] | 91.8 | 0.08 |
| Water storage | | | | |
| Change in water storage | 0.0433 | [0.331] | 157.3 | 0.14 |

* Note: Average inches are converted to volume based on the user-specified area.

**Peak Values Summary**

**Title:** Pilgrim Landfill
**Simulated on:** 4/10/2026 14:14

| | Peak Values for Years 1 - 5* | | |
|---|---|---|---|
| | (inches) | | (cubic feet) |
| Precipitation | 5.34 | | 19,384.2 |
| Runoff | 4.859 | | 17,638.1 |
| Subprofile1 | | | |
| Drainage collected from Layer 3 | 0.0005 | | 1.8563 |
| Percolation/leakage through Layer 4 | 0.000137 | | 0.4961 |
| Average head on Layer 4 | 0.1038 | | --- |
| Maximum head on Layer 4 | 0.2046 | | --- |
| Location of maximum head in Layer 3 | 2.62 | (feet from drain) | |
| Subprofile2 | | | |
| Drainage collected from Layer 7 | 0.0000 | | 0.0916 |
| Percolation/leakage through Layer 9 | 0.000000 | | 0.0000 |
| Average head on Layer 8 | 0.0038 | | --- |
| Maximum head on Layer 8 | 0.0077 | | --- |
| Location of maximum head in Layer 7 | 0.19 | (feet from drain) | |
| Subprofile3 | | | |
| Percolation/leakage through Layer 10 | 0.000196 | | 0.7115 |
| Other Parameters | | | |
| Snow water | 1.4979 | | 5,437.3 |
| Maximum vegetation soil water | 0.1962 | (vol/vol) | |
| Minimum vegetation soil water | 0.1287 | (vol/vol) | |

**Final Water Storage in Landfill Profile at End of Simulation Period**

**Title:** Pilgrim Landfill
**Simulated on:** 4/10/2026 14:15
**Simulation period:** 5 years

| | Final Water Storage | |
|---|---|---|
| Layer | (inches) | (vol/vol) |
| 1 | 1.9910 | 0.3318 |
| 2 | 0.3691 | 0.0615 |
| 3 | 0.7405 | 0.0617 |
| 4 | 0.0000 | 0.0000 |
| 5 | 1.1400 | 0.1900 |
| 6 | 63.9441 | 0.0761 |
| 7 | 0.7452 | 0.0621 |
| 8 | 0.0000 | 0.0000 |
| 9 | 0.3750 | 0.7500 |
| 10 | 2.0919 | 0.3487 |
| Snow water | 0.1641 | --- |

**Reference: Hydraulic Efficiency Analysis for Pilgrim Landfill**

## ATTACHMENT 2

HELP Output Scenario 2 -Open Conditions 2% Floor and 100-foot drainage length

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**HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE**
**HELP MODEL VERSION 4.0 BETA (2018)**
**DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY**

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**Title:** Pilgrim Landfill **Simulated On:** 4/10/2026 14:00

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**Layer 1**

Type 1 - Vertical Percolation Layer (Cover Soil)
SiCL - Silty Clay Loam
Material Texture Number 12

| | | | |
|---|---|---|---|
| Thickness | = | 6 | inches |
| Porosity | = | 0.471 | vol/vol |
| Field Capacity | = | 0.342 | vol/vol |
| Wilting Point | = | 0.21 | vol/vol |
| Initial Soil Water Content | = | 0.2587 | vol/vol |
| Effective Sat. Hyd. Conductivity | = | 4.20E-05 | cm/sec |

**Layer 2**

Type 1 - Vertical Percolation Layer (Waste)
Industrial Waste
Material Texture Number 83

| | | | |
|---|---|---|---|
| Thickness | = | 300 | inches |
| Porosity | = | 0.578 | vol/vol |
| Field Capacity | = | 0.076 | vol/vol |
| Wilting Point | = | 0.025 | vol/vol |
| Initial Soil Water Content | = | 0.0846 | vol/vol |
| Effective Sat. Hyd. Conductivity | = | 4.10E-03 | cm/sec |

**Layer 3**

Type 2 - Lateral Drainage Layer
S - Sand
Material Texture Number 2

| | | | |
|---|---|---|---|
| Thickness | = | 12 | inches |
| Porosity | = | 0.437 | vol/vol |
| Field Capacity | = | 0.062 | vol/vol |
| Wilting Point | = | 0.024 | vol/vol |
| Initial Soil Water Content | = | 0.062 | vol/vol |
| Effective Sat. Hyd. Conductivity | = | 5.80E-03 | cm/sec |
| Slope | = | 2 | % |
| Drainage Length | = | 100 | ft |

**Layer 4**

Type 4 - Flexible Membrane Liner

HDPE Membrane
Material Texture Number 35

| | | | |
|---|---|---|---|
| Thickness | = | 0.06 | inches |
| Effective Sat. Hyd. Conductivity | = | 2.00E-13 | cm/sec |
| FML Pinhole Density | = | 2 | Holes/Acre |
| FML Installation Defects | = | 2 | Holes/Acre |
| FML Placement Quality | = | 3 | Good |

**Layer 5**
Type 3 - Barrier Soil Liner
Bentonite (High)
Material Texture Number 17

| | | | |
|---|---|---|---|
| Thickness | = | 0.5 | inches |
| Porosity | = | 0.75 | vol/vol |
| Field Capacity | = | 0.747 | vol/vol |
| Wilting Point | = | 0.4 | vol/vol |
| Initial Soil Water Content | = | 0.75 | vol/vol |
| Effective Sat. Hyd. Conductivity | = | 3.00E-09 | cm/sec |

**Layer 6**
Type 1 - Vertical Percolation Layer
SiC - Silty Clay (Moderate)
Material Texture Number 28

| | | | |
|---|---|---|---|
| Thickness | = | 6 | inches |
| Porosity | = | 0.452 | vol/vol |
| Field Capacity | = | 0.411 | vol/vol |
| Wilting Point | = | 0.311 | vol/vol |
| Initial Soil Water Content | = | 0.3736 | vol/vol |
| Effective Sat. Hyd. Conductivity | = | 1.20E-06 | cm/sec |

---

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

**General Design and Evaporative Zone Data**

| | | | |
|---|---|---|---|
| SCS Runoff Curve Number | = | 95.4 | |
| Fraction of Area Allowing Runoff | = | 0 | % |
| Area projected on a horizontal plane | = | 1 | acres |
| Evaporative Zone Depth | = | 24 | inches |
| Initial Water in Evaporative Zone | = | 3.526 | inches |
| Upper Limit of Evaporative Storage | = | 13.23 | inches |
| Lower Limit of Evaporative Storage | = | 1.71 | inches |
| Initial Snow Water | = | 0 | inches |
| Initial Water in Layer Materials | = | 30.302 | inches |
| Total Initial Water | = | 30.302 | inches |

| | | | |
|---|---|---|---|
| Total Subsurface Inflow | = | 0 | inches/year |

---

Note: SCS Runoff Curve Number was calculated by HELP.

**Evapotranspiration and Weather Data**

| | | | |
|---|---|---|---|
| Station Latitude | = | 44.13 | Degrees |
| Maximum Leaf Area Index | = | 1 | |
| Start of Growing Season (Julian Date) | = | 124 | days |
| End of Growing Season (Julian Date) | = | 182 | days |
| Average Wind Speed | = | 11 | mph |
| Average 1st Quarter Relative Humidity | = | 65 | % |
| Average 2nd Quarter Relative Humidity | = | 65 | % |
| Average 3rd Quarter Relative Humidity | = | 62 | % |
| Average 4th Quarter Relative Humidity | = | 65 | % |

---

Note: Evapotranspiration data was obtained for Mankato, Minnesota

**Normal Mean Monthly Precipitation (inches)**

| Jan/Jul | Feb/Aug | Mar/Sep | Apr/Oct | May/Nov | Jun/Dec |
|---|---|---|---|---|---|
| 0.683107 | 0.60023 | 1.856155 | 3.092133 | 3.787518 | 7.569913 |
| 4.867874 | 3.191535 | 2.613059 | 1.132846 | 1.140449 | 1.223736 |

---

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 44.13/-93.98

**Normal Mean Monthly Temperature (Degrees Fahrenheit)**

| Jan/Jul | Feb/Aug | Mar/Sep | Apr/Oct | May/Nov | Jun/Dec |
|---|---|---|---|---|---|
| 20.6 | 20.2 | 36 | 56.7 | 62.8 | 76.6 |
| 82.4 | 78.5 | 81.4 | 49.6 | 38.6 | 32.4 |

---

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 44.13/-93.98
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 44.13/-93.98

**Average Annual Totals Summary**

**Title:** Pilgrim Landfill
**Simulated on:** 4/10/2026 14:01

| | Average Annual Totals for Years 1 - 5* | | | |
|---|---|---|---|---|
| | (inches) | [std dev] | (cubic feet) | (percent) |
| Precipitation | 31.76 | [5.73] | 115,283.6 | 100.00 |
| Runoff | 0.000 | [0] | 0.0000 | 0.00 |
| Evapotranspiration | 26.141 | [2.928] | 94,891.1 | 82.31 |
| Subprofile1 | | | | |
| Lateral drainage collected from Layer 3 | 1.0739 | [1.6523] | 3,898.2 | 3.38 |
| Percolation/leakage through Layer 5 | 0.000047 | [0.00007] | 0.1717 | 0.00 |
| Average Head on Top of Layer 4 | 0.4472 | [0.6885] | --- | --- |
| Subprofile2 | | | | |
| Percolation/leakage through Layer 6 | 0.029239 | [0.019776] | 106.1 | 0.09 |
| Water storage | | | | |
| Change in water storage | 4.5146 | [4.0683] | 16,388.1 | 14.22 |

* Note: Average inches are converted to volume based on the user-specified area.

**Peak Values Summary**

**Title:** Pilgrim Landfill
**Simulated on:** 4/10/2026 14:01

| | Peak Values for Years 1 - 5* | | |
|---|---|---|---|
| | (inches) | | (cubic feet) |
| Precipitation | 5.34 | | 19,384.2 |
| Runoff | 0.000 | | 0.0000 |
| Subprofile1 | | | |
| Drainage collected from Layer 3 | 0.0137 | | 49.9 |
| Percolation/leakage through Layer 5 | 0.000001 | | 0.0022 |
| Average head on Layer 4 | 2.0903 | | --- |
| Maximum head on Layer 4 | 3.2530 | | --- |
| Location of maximum head in Layer 3 | 22.16 | (feet from drain) | |
| Subprofile2 | | | |
| Percolation/leakage through Layer 6 | 0.000270 | | 0.9807 |
| Other Parameters | | | |
| Snow water | 1.4979 | | 5,437.3 |
| Maximum vegetation soil water | 0.3837 | (vol/vol) | |
| Minimum vegetation soil water | 0.1180 | (vol/vol) | |

**Final Water Storage in Landfill Profile at End of Simulation Period**

**Title:** Pilgrim Landfill
**Simulated on:** 4/10/2026 14:02
**Simulation period:** 5 years

| | Final Water Storage | |
|---|---|---|
| Layer | (inches) | (vol/vol) |
| 1 | 1.5583 | 0.2597 |
| 2 | 47.1624 | 0.1572 |
| 3 | 1.5199 | 0.1267 |
| 4 | 0.0000 | 0.0000 |
| 5 | 0.3750 | 0.7500 |
| 6 | 2.0955 | 0.3493 |
| Snow water | 0.1641 | --- |

**Reference: Hydraulic Efficiency Analysis for Pilgrim Landfill**

## ATTACHMENT 3

HELP Output Scenario 3 - Open Conditions 5% Floor and 330-foot drainage length

---

**HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE**
**HELP MODEL VERSION 4.0 BETA (2018)**
**DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY**

---

**Title:** Pilgrim Landfill **Simulated On:** 4/10/2026 14:19

---

**Layer 1**

Type 1 - Vertical Percolation Layer (Cover Soil)
SiCL - Silty Clay Loam
Material Texture Number 12

| | | | |
|---|---|---|---|
| Thickness | = | 6 | inches |
| Porosity | = | 0.471 | vol/vol |
| Field Capacity | = | 0.342 | vol/vol |
| Wilting Point | = | 0.21 | vol/vol |
| Initial Soil Water Content | = | 0.2587 | vol/vol |
| Effective Sat. Hyd. Conductivity | = | 4.20E-05 | cm/sec |

**Layer 2**

Type 1 - Vertical Percolation Layer (Waste)
Industrial Waste
Material Texture Number 83

| | | | |
|---|---|---|---|
| Thickness | = | 300 | inches |
| Porosity | = | 0.578 | vol/vol |
| Field Capacity | = | 0.076 | vol/vol |
| Wilting Point | = | 0.025 | vol/vol |
| Initial Soil Water Content | = | 0.0846 | vol/vol |
| Effective Sat. Hyd. Conductivity | = | 4.10E-03 | cm/sec |

**Layer 3**

Type 2 - Lateral Drainage Layer
S - Sand
Material Texture Number 2

| | | | |
|---|---|---|---|
| Thickness | = | 12 | inches |
| Porosity | = | 0.437 | vol/vol |
| Field Capacity | = | 0.062 | vol/vol |
| Wilting Point | = | 0.024 | vol/vol |
| Initial Soil Water Content | = | 0.062 | vol/vol |
| Effective Sat. Hyd. Conductivity | = | 5.80E-03 | cm/sec |
| Slope | = | 5 | % |
| Drainage Length | = | 330 | ft |

**Layer 4**

Type 4 - Flexible Membrane Liner

HDPE Membrane
Material Texture Number 35

| | | | |
|---|---|---|---|
| Thickness | = | 0.06 | inches |
| Effective Sat. Hyd. Conductivity | = | 2.00E-13 | cm/sec |
| FML Pinhole Density | = | 2 | Holes/Acre |
| FML Installation Defects | = | 2 | Holes/Acre |
| FML Placement Quality | = | 3 | Good |

**Layer 5**
Type 3 - Barrier Soil Liner
Bentonite (High)
Material Texture Number 17

| | | | |
|---|---|---|---|
| Thickness | = | 0.5 | inches |
| Porosity | = | 0.75 | vol/vol |
| Field Capacity | = | 0.747 | vol/vol |
| Wilting Point | = | 0.4 | vol/vol |
| Initial Soil Water Content | = | 0.75 | vol/vol |
| Effective Sat. Hyd. Conductivity | = | 3.00E-09 | cm/sec |

**Layer 6**
Type 1 - Vertical Percolation Layer
SiC - Silty Clay (Moderate)
Material Texture Number 28

| | | | |
|---|---|---|---|
| Thickness | = | 6 | inches |
| Porosity | = | 0.452 | vol/vol |
| Field Capacity | = | 0.411 | vol/vol |
| Wilting Point | = | 0.311 | vol/vol |
| Initial Soil Water Content | = | 0.3736 | vol/vol |
| Effective Sat. Hyd. Conductivity | = | 1.20E-06 | cm/sec |

---

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

**General Design and Evaporative Zone Data**

| | | | |
|---|---|---|---|
| SCS Runoff Curve Number | = | 95.4 | |
| Fraction of Area Allowing Runoff | = | 0 | % |
| Area projected on a horizontal plane | = | 1 | acres |
| Evaporative Zone Depth | = | 24 | inches |
| Initial Water in Evaporative Zone | = | 3.526 | inches |
| Upper Limit of Evaporative Storage | = | 13.23 | inches |
| Lower Limit of Evaporative Storage | = | 1.71 | inches |
| Initial Snow Water | = | 0 | inches |
| Initial Water in Layer Materials | = | 30.302 | inches |
| Total Initial Water | = | 30.302 | inches |

| | | | |
|---|---|---|---|
| Total Subsurface Inflow | = | 0 | inches/year |

---

Note: SCS Runoff Curve Number was calculated by HELP.

**Evapotranspiration and Weather Data**

| | | | |
|---|---|---|---|
| Station Latitude | = | 44.13 | Degrees |
| Maximum Leaf Area Index | = | 1 | |
| Start of Growing Season (Julian Date) | = | 124 | days |
| End of Growing Season (Julian Date) | = | 182 | days |
| Average Wind Speed | = | 11 | mph |
| Average 1st Quarter Relative Humidity | = | 65 | % |
| Average 2nd Quarter Relative Humidity | = | 65 | % |
| Average 3rd Quarter Relative Humidity | = | 62 | % |
| Average 4th Quarter Relative Humidity | = | 65 | % |

---

Note: Evapotranspiration data was obtained for Mankato, Minnesota

**Normal Mean Monthly Precipitation (inches)**

| Jan/Jul | Feb/Aug | Mar/Sep | Apr/Oct | May/Nov | Jun/Dec |
|---|---|---|---|---|---|
| 0.683107 | 0.60023 | 1.856155 | 3.092133 | 3.787518 | 7.569913 |
| 4.867874 | 3.191535 | 2.613059 | 1.132846 | 1.140449 | 1.223736 |

---

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 44.13/-93.98

**Normal Mean Monthly Temperature (Degrees Fahrenheit)**

| Jan/Jul | Feb/Aug | Mar/Sep | Apr/Oct | May/Nov | Jun/Dec |
|---|---|---|---|---|---|
| 20.6 | 20.2 | 36 | 56.7 | 62.8 | 76.6 |
| 82.4 | 78.5 | 81.4 | 49.6 | 38.6 | 32.4 |

---

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 44.13/-93.98
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 44.13/-93.98

**Average Annual Totals Summary**

**Title:** Pilgrim Landfill
**Simulated on:** 4/10/2026 14:20

| | Average Annual Totals for Years 1 - 5* | | | |
|---|---|---|---|---|
| | (inches) | [std dev] | (cubic feet) | (percent) |
| Precipitation | 31.76 | [5.73] | 115,283.6 | 100.00 |
| Runoff | 0.000 | [0] | 0.0000 | 0.00 |
| Evapotranspiration | 26.141 | [2.928] | 94,891.1 | 82.31 |
| Subprofile1 | | | | |
| Lateral drainage collected from Layer 3 | 1.0303 | [1.5966] | 3,740.0 | 3.24 |
| Percolation/leakage through Layer 5 | 0.000060 | [0.000091] | 0.2191 | 0.00 |
| Average Head on Top of Layer 4 | 0.5676 | [0.88] | --- | --- |
| Subprofile2 | | | | |
| Percolation/leakage through Layer 6 | 0.029229 | [0.019785] | 106.1 | 0.09 |
| Water storage | | | | |
| Change in water storage | 4.5582 | [4.0323] | 16,546.3 | 14.35 |

* Note: Average inches are converted to volume based on the user-specified area.

**Peak Values Summary**

**Title:** Pilgrim Landfill
**Simulated on:** 4/10/2026 14:20

| | Peak Values for Years 1 - 5* | | |
|---|---|---|---|
| | (inches) | | (cubic feet) |
| Precipitation | 5.34 | | 19,384.2 |
| Runoff | 0.000 | | 0.0000 |
| Subprofile1 | | | |
| Drainage collected from Layer 3 | 0.0132 | | 48.1 |
| Percolation/leakage through Layer 5 | 0.000001 | | 0.0028 |
| Average head on Layer 4 | 2.6659 | | --- |
| Maximum head on Layer 4 | 4.9406 | | --- |
| Location of maximum head in Layer 3 | 23.45 | (feet from drain) | |
| Subprofile2 | | | |
| Percolation/leakage through Layer 6 | 0.000270 | | 0.9807 |
| Other Parameters | | | |
| Snow water | 1.4979 | | 5,437.3 |
| Maximum vegetation soil water | 0.3837 | (vol/vol) | |
| Minimum vegetation soil water | 0.1180 | (vol/vol) | |

**Final Water Storage in Landfill Profile at End of Simulation Period**

**Title:** Pilgrim Landfill
**Simulated on:** 4/10/2026 14:20
**Simulation period:** 5 years

| | Final Water Storage | |
|---|---|---|
| Layer | (inches) | (vol/vol) |
| 1 | 1.5583 | 0.2597 |
| 2 | 47.1624 | 0.1572 |
| 3 | 1.7379 | 0.1448 |
| 4 | 0.0000 | 0.0000 |
| 5 | 0.3750 | 0.7500 |
| 6 | 2.0957 | 0.3493 |
| Snow water | 0.1641 | --- |

# Appendix D Geotechnical Evaluation

Stantec

# Memo

To: File

From: Stantec Consulting Services, Inc.

Date: April 14, 2026

File: 227708930

---

**Reference: Geotechnical Analysis for 4H:1V Side Slope Variance Request**
**Dem-Con Pilgrim Landfill (SW-254)**

This technical memorandum summarizes the slope stability analysis performed for the modification of the side slope grades to a maximum of 4H:1V at the Pilgrim Landfill (landfill or facility). The Landfill is currently permitted for 5H:1V side slopes in accordance with MN Rule 7035.2825 subp.8 (E). The geotechnical analyses discussed herein confirm that the proposed 4H:1V side slope profile, submitted as part of the 2026 MPCA Major Permit Modification Application, exceeds the minimum standard factor of safety (FS) for long-term slope stability.

## Methods and Material Properties

Two slope stability analyses were completed to demonstrate the veneer stability of the proposed final cover system at the modified slope. The first analysis was completed using Slope/W slope stability analysis software by Bentley Systems. The second analysis was a numerical analysis including construction equipment loads on the proposed cover system. In addition to the veneer analysis, a global stability analysis was performed using Slope/W to demonstrate the stability of the waste mass with a 4H:1V slope configuration.

Interface friction properties were not available for the materials to be used for the cover installation. For the purpose of this analysis, Stantec used interface friction properties of similar cover materials tested at other landfill sites. Soil parameters were determined upon review of regional soil data and site knowledge. The modelled system components and geometry represent the proposed final cover profile and proposed cover systems outlined below (top to bottom):

**Cover System**

- 6” Topsoil
- 6” Rooting Zone
- 12” Drainage Sand
- 40-Mil LLDPE Geomembrane
- 6” Buffer Soils
- Waste

**Reference: Dem-Con Pilgrim Landfill SW-254 Geotechnical Analysis for 4H:1V Side Slope Variance Request**

## Stability Analysis Results

### *Veneer Stability Analysis*

A cross section was created through the north slope of the landfill from the proposed top of Phase 3A to the sedimentation pond at the bottom of the slope as shown in **Attachment 1**. The geometry from the cross section was drawn in Slope/W to model the veneer stability of proposed cover system and the 4:1 slope. The minimum desired factor of safety for long-term slope stability is 1.5. The Slope/W model for the cover system indicated a minimum factor of safety of 1.68 for the proposed cover system with a 4:1 slope. A numerical analysis was also completed for the cover system to provide a second form of analysis and also to evaluate the veneer stability of the proposed cover with the weight of the equipment that will be used during construction. The numerical analysis indicated higher factors of safety for long-term slope stability compared to the Slope/W model with a minimum long-term factor of safety of 1.88 calculated for the interface between the buffer soils and the waste material. The equipment loading reduced the factor of safety to 1.71. However, construction is a temporary loading and the resulting factor of safety remains above the desired long-term factor of safety of 1.5. The results of the Slope/W model and the numerical analysis for the cover system are included in **Attachments 2A and 2B** for reference.

### *Global Stability Analysis*

The global limit equilibrium slope stability analysis was performed using Slope/W at the cross section through the west slope as shown in **Attachment 1**. A global stability analysis evaluates the stability of the waste mass and the subgrade soils for the proposed 4:1 slope. The cross section for this analysis was extended through the sedimentation pond at the bottom of the slope. A piezometric surface representing a maximum one-foot of leachate head on the base liner was included to represent potential leachate conditions. The model indicated a factor of safety of 1.87 for the critical slip surface. The critical slip surface remains within the waste mass and does not extend into the base soils. The model results for the global stability analysis is included in **Attachment 3** for reference.

## Summary

The proposed cover system was evaluated for slope stability using the proposed 4:1 slope gradient. Both the Slope/W analysis and the numerical analysis indicated factors of safety greater than the desired minimum of 1.5 for long term veneer stability for both cover systems. In addition, the global stability analysis indicated that the proposed 4:1 slope will provide long-term factor of safety exceeding the minimum desired FS of 1.5.

**Reference:** **Dem-Con Pilgrim Landfill SW-254 Geotechnical Analysis for 4H:1V Side Slope Variance Request**

Regards,

**Stantec Consulting Services Inc.**



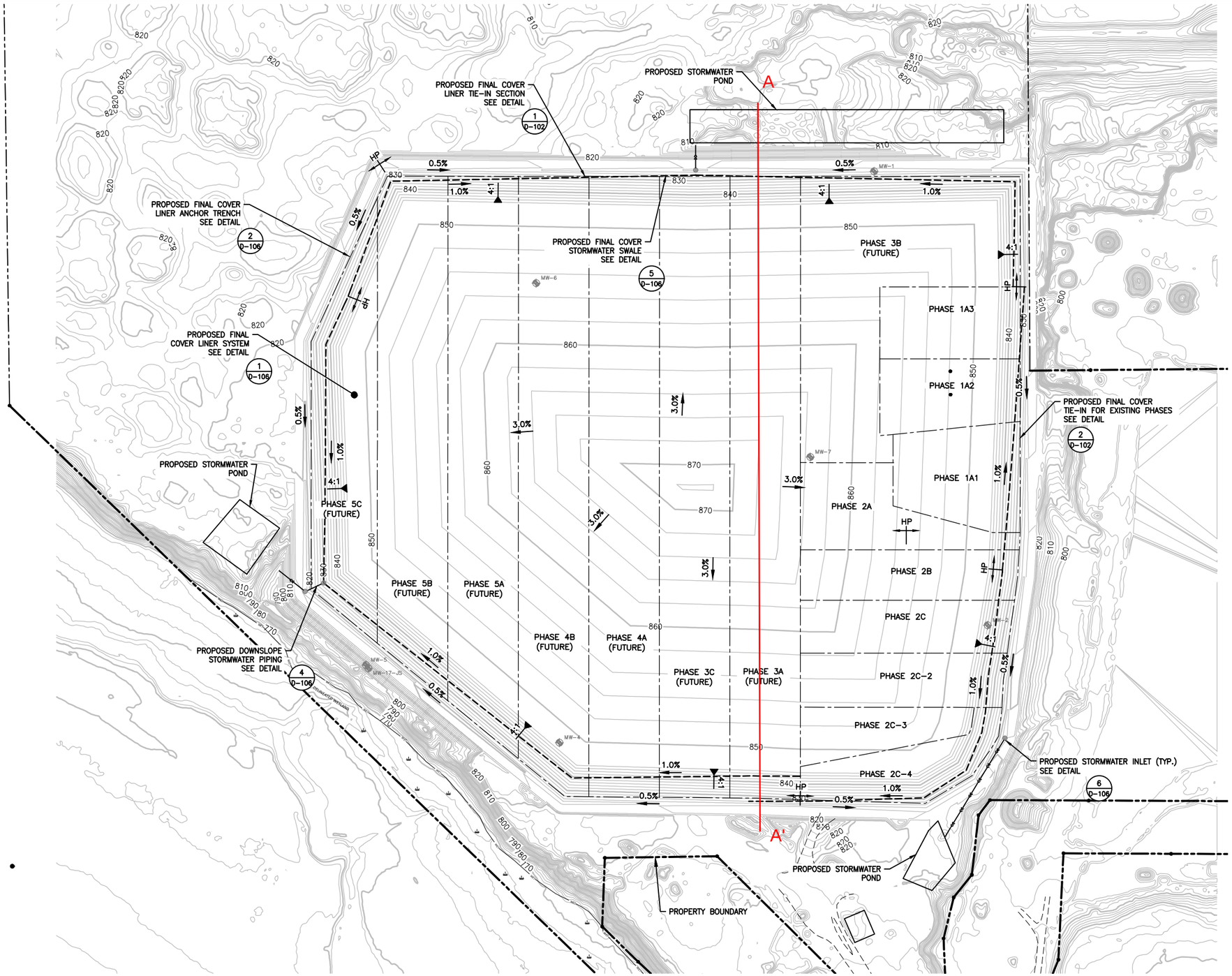
**Kyle Morberg,** PE

Associate, Environmental Engineer
Phone: (218) 591-0790
Kyle.morberg@stantec.com

Attachment:

Attachment 1 - Cross-Section Figure
Attachment 2A - Slope/W Veneer Stability Analysis – Drainage Sand
Attachment 2B - Numerical Veneer Stability Analysis – Drainage Sand
Attachment 3 - Slope/W Global Stability Analysis

# Attachment 1 – Cross-Section




SURVEY NOTES:

1. HORIZONTAL DATUM IS BLUE EARTH COUNTY NORTH AMERICAN DATUM NAD83(2011), US SURVEY FEET,
2. VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 88 (NAVD88). CONTOUR INTERVAL IS TWO FEET.
3. TOPOGRAPHY SURVEY FROM 2023 LIDAR DATA, UPDATED VIA GROUND SURVEY BY BOLTON AND MENK IN DECEMBER 2025.

NOTES:

1. PROPOSED GRADES SHOWN ARE TOP OF FINAL COVER GRADES.

| REV | REVISION DESCRIPTION | DWN | APP | REV DATE |
|---|---|---|---|---|
| 0 | ISSUED FOR PERMIT APPLICATION | JJT | EDK | 04/24/26 |

SEAL

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINT NAME ETHAN KETELSEN

SIGNATURE

DATE 04-24-2026 LICENSE # 56630

PRIME CONSULTANT

Stantec

PROJECT TITLE
2026 PERMIT REISSUANCE & MODIFICATION APPLICATION

DEM-CON PILGRIM LANDFILL, LLC.

MANKATO, MINNESOTA

SHEET TITLE
SURFACE WATER MANAGEMENT PLAN

| DWN BY | CHK'D | APP'D | DWG DATE |
|---|---|---|---|
| JJT | BWS | EDK | APR. 2026 |

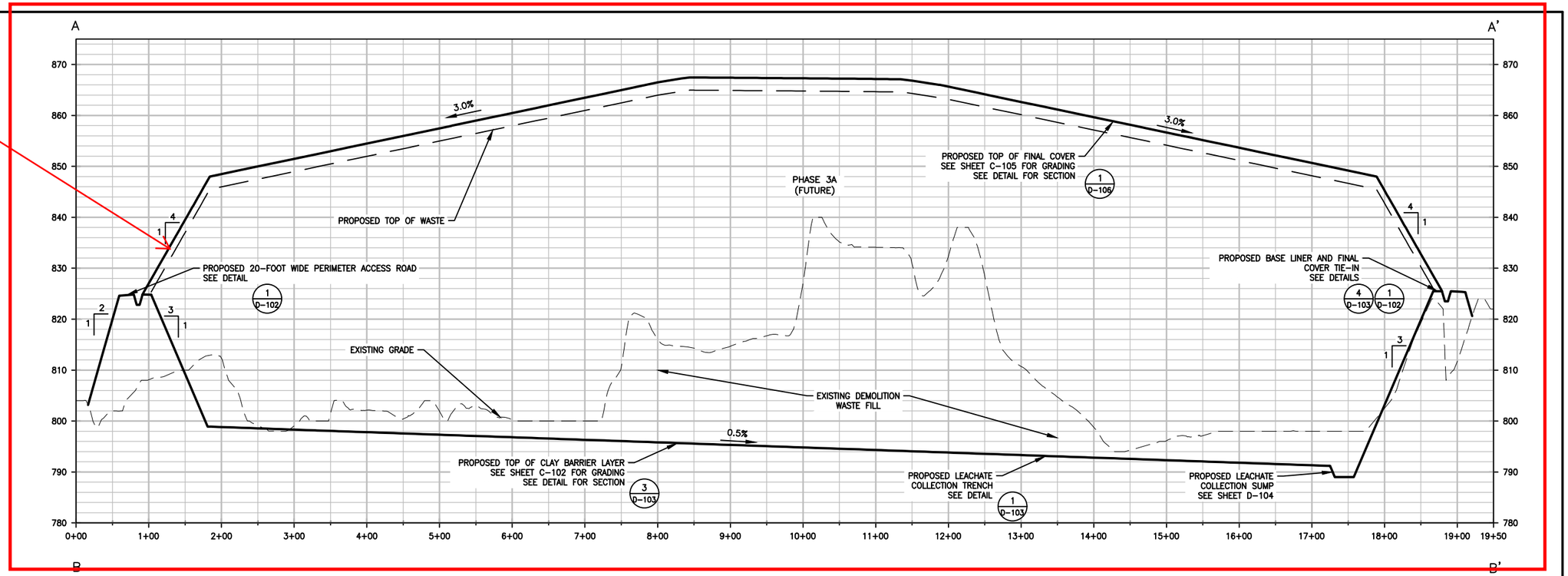
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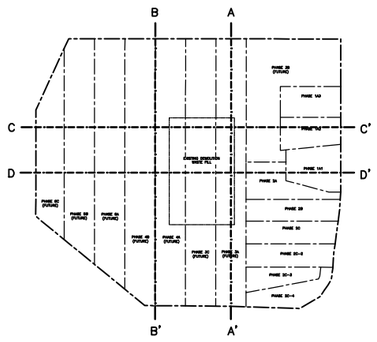
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Slope A Evaluated




0 80 160
GRAPHIC SCALE IN FEET

VERTICAL EXAGGERATION: 7.0X




| REV | REVISION DESCRIPTION | DWN | APP | REV DATE |
|---|---|---|---|---|
| 0 | ISSUED FOR PERMIT APPLICATION | JJT | EDK | 04/24/26 |

SEAL

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINT NAME ETHAN KETELSEN

SIGNATURE

DATE 04-24-2026 LICENSE # 56630

PRIME CONSULTANT

Stantec

PROJECT TITLE
2026 PERMIT REISSUANCE & MODIFICATION APPLICATION

DEM-CON PILGRIM LANDFILL, LLC.

MANKATO, MINNESOTA

SHEET TITLE
CROSS SECTIONS

| DWN BY | CHK'D | APP'D | DWG DATE |
|---|---|---|---|
| JJT | BWS | EDK | APR. 2026 |

SCALE AS SHOWN

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|---|---|---|
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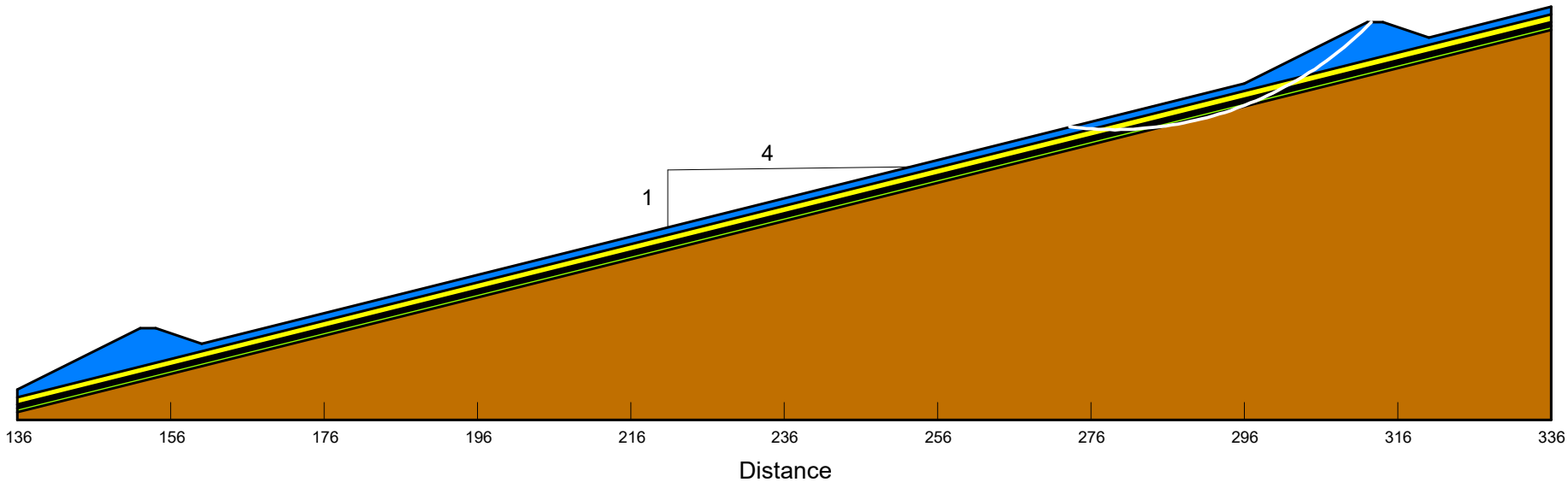
I:\227708930\drafting\civ\C-107_Cross Sections.dwg

# Attachment 2A – Slope/W Veneer Stability (Drainage Sand)

| Color | Name | Unit Weight (pcf) | Effective Cohesion (psf) | Effective Friction Angle (°) |
|---|---|---|---|---|
| | Buffer Soils | 100 | 10 | 23 |
| | Drainage Sand | 120 | 0 | 32.3 |
| | Geomembrane | 1 | 0 | 30 |
| | Rooting Zone/Topsoil | 100 | 25 | 23 |
| | Waste | 75 | 0 | 25 |

# Dem-Con Pilgrim Landfill (SW-254)
# Veneer Stability Analysis
# Worst case 40 vert. feet between diversion berms
# Sand drainage layer

1.68



# Attachment 2B – Numerical Veneer Stability (Drainage Sand)

Stantec

# Slope Stability Analyses for Landfill Cover System using Peak Shear Strength Parameters

## Liner System (Layer 1. Topsoil, Layer 2. Rooting Soil, Layer 3. Sand Drainage, Layer 4. Geomembrane, Layer 5. Intermediate Cover, Layer 6. Waste)

**Slope Geometry**

14.04 degrees :Slope Angle, β
**4.0H:1V** :Slope Run
**90 feet** :Slope Length, L

**Layering System and Interfaces**

**Layer 1. Topsoil**
**6 inches** :Thickness, t
**100 pcf** :Unit Weight, γs
4,500 lbs :Weight per Slope Length

*Layer 1/2 Interface Information*
***23 degrees*** :*Friction Angle*
***25 psf*** :*Adhesion (Root Strength)*

**Layer 2. Rooting Soil**
**6 inches** :Thickness, t
**105 pcf** :Unit Weight, γs
4,725 lbs :Weight per Slope Length

*Layer 2/3 Interface Information*
***23.0 degrees*** :*Friction Angle*
***25 psf*** :*Adhesion*

**Layer 3. Sand Drainage**
**12 inches** :Thickness, t
**120 pcf** :Unit Weight, γs
10,800 lbs :Weight per Slope Length

*Layer 3/4 Interface Information*
***32.3 degrees*** :*Friction Angle*
***0 psf*** :*Adhesion*

**Layer 4. Geomembrane**

*Layer 4/5 Interface Information*
***30.0 degrees*** :*Friction Angle*
***0 psf*** :*Adhesion*

**Layer 5. Intermediate Cover**
**6 inches** :Thickness, t
**110 pcf** :Unit Weight, γs
4,950 lbs :Weight per Slope Length

*Layer 5/6 Interface Information*
***23 degrees*** :*Friction Angle*
***10 psf*** :*Adhesion*

**Layer 6. Waste**

**External Equipment, E**
**42,000 lbs** :Weight of CAT D6
**2.5 feet** :Single Track Width
**8.0 feet** :Width of Equipment
**15.3 feet** :Length of Equipment
8,400 psf :In-Line Ground Pressure
548 psf :Equivalent Ground Pressure

### Long-Term Factor of Safety

***Considers dry conditions only***

**1.50** :Required Factor of Safety
**1.88** :Minimum Calculated Factor of Safety
**Okay**

*Resisting Force; Slope = [ γs x t x L x cos( β ) x tan( δ)] + [L x a]*
*Resisting Force; Buttress = [ γs x $H^2$ x tan( ϕs)/sin(2 β) ] x [ cos( ϕs)/cos( ϕs + β )]*
*Driving Force = γs x t x L x sin( β )*
*Factor of Safety = Resisting / Driving*

**Layer 1. Topsoil vs. Layer 2. Rooting Soil**
4,103 lbs :Resisting Force; Slope
26 lbs :Resisting Force; Buttress
1,091 lbs :Driving Force
**3.78** :Factor of Safety

**Layer 2. Rooting Soil vs. Layer 3. Sand Drainage**
6,049 lbs :Resisting Force; Slope
53 lbs :Resisting Force; Buttress
2,237 lbs :Driving Force
**2.73** :Factor of Safety

**Layer 3. Sand Drainage vs. Layer 4. Geomembrane**
12,281 lbs :Resisting Force; Slope
282 lbs :Resisting Force; Buttress
4,857 lbs :Driving Force
**2.59** :Factor of Safety

**Layer 4. Geomembrane vs. Layer 5. Intermediate Cover**
11,216 lbs :Resisting Force; Slope
282 lbs :Resisting Force; Buttress
4,857 lbs :Driving Force
**2.37** :Factor of Safety

**Layer 5. Intermediate Cover vs. Layer 6. Waste**
11,185 lbs :Resisting Force; Slope
207 lbs :Resisting Force; Buttress
6,057 lbs :Driving Force
**1.88** :Factor of Safety

### Short-Term Factor of Safety

***Considers seepage through cover system***

**1.20** :Required Factor of Safety
**1.62** :Minimum Calculated Factor of Safety
**Okay**

*Resisting Force = [ γs x t x L x cos( β ) x tan( δ)] + [L x a]*
*Resisting Force; Buttress = [ γs x $H^2$ x tan( ϕs)/sin(2 β) ] x [ cos( ϕs)/cos( ϕs + β )]*
*Driving Force = γs x t x L x sin( β )*
*Factor of Safety = Resisting / Driving*

**75%** :Percent Saturated
63% :Reduction Factor based on Seepage

4,103 lbs :Resisting Force; Slope
26 lbs :Resisting Force; Buttress
1,091 lbs :Driving Force
3.78 :Factor of Safety
**2.36** :Reduced Factor of Safety based on Seepage

6,049 lbs :Resisting Force; Slope
53 lbs :Resisting Force; Buttress
2,237 lbs :Driving Force
2.73 :Factor of Safety
**1.70** :Reduced Factor of Safety based on Seepage

12,281 lbs :Resisting Force; Slope
282 lbs :Resisting Force; Buttress
4,857 lbs :Driving Force
2.59 :Factor of Safety
**1.62** :Reduced Factor of Safety based on Seepage

11,216 lbs :Resisting Force; Slope
282 lbs :Resisting Force; Buttress
4,857 lbs :Driving Force
**2.37** :Factor of Safety*
*No seepage below the membrane

11,185 lbs :Resisting Force; Slope
207 lbs :Resisting Force; Buttress
6,057 lbs :Driving Force
**1.88** :Factor of Safety*
*No seepage below the membrane

### Short-Term Factor of Safety

***Considers equipment loading***

**1.20** :Required Factor of Safety
**1.71** :Minimum Calculated Factor of Safety
**Okay**

*Resisting Force = {[( γs x t) + E] x L x cos( β ) x tan( δ)} + [L x a]*
*Resisting Force; Buttress = [ γs x $H^2$ x tan( ϕs)/sin(2 β) ] x [ cos( ϕs)/cos( ϕs + β )]*
*Driving Force = [( γs x t x L) +(1.3 x E)] x sin( β )*
*Factor of Safety = Resisting / Driving*

7,562 lbs :Resisting Force; Slope
26 lbs :Resisting Force; Buttress
3,740 lbs :Driving Force
**2.03** :Factor of Safety

9,508 lbs :Resisting Force; Slope
53 lbs :Resisting Force; Buttress
4,886 lbs :Driving Force
**1.96** :Factor of Safety

17,433 lbs :Resisting Force; Slope
282 lbs :Resisting Force; Buttress
7,505 lbs :Driving Force
**2.36** :Factor of Safety

15,921 lbs :Resisting Force; Slope
282 lbs :Resisting Force; Buttress
7,505 lbs :Driving Force
**2.16** :Factor of Safety

14,644 lbs :Resisting Force; Slope
207 lbs :Resisting Force; Buttress
8,706 lbs :Driving Force
**1.71** :Factor of Safety

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# Slope Stability Analyses for Landfill Cover System using Large-Displacement Shear Strength Parameters

## Liner System (Layer 1. Topsoil, Layer 2. Rooting Soil, Layer 3. Drainage Sand, Layer 4. Geomembrane, Layer 5. Intermediate Cover, Layer 6. Waste)

**Slope Geometry**

14.04 degrees :Slope Angle, β
**4.0H:1V** :Slope Run
**90 feet** :Slope Length, L

**Layering System and Interfaces**

**Layer 1. Topsoil**
**6 inches** :Thickness, t
**100 pcf** :Unit Weight, γs
4,500 lbs :Weight per Slope Length

*Layer 1/2 Interface Information*
***20 degrees*** :*Friction Angle*
***50 psf*** :*Adhesion (Root Strength)*

**Layer 2. Rooting Soil**
**6 inches** :Thickness, t
**105 pcf** :Unit Weight, γs
4,725 lbs :Weight per Slope Length

*Layer 2/3 Interface Information*
***23 degrees*** :*Friction Angle*
***50 psf*** :*Adhesion*

**Layer 3. Drainage Sand**
**12 inches** :Thickness, t
**115 pcf** :Unit Weight, γs
10,350 lbs :Weight per Slope Length

*Layer 3/4 Interface Information*
***31 degrees*** :*Friction Angle*
***0 psf*** :*Adhesion*

**Layer 4. Geomembrane**

*Layer 4/5 Interface Information*
***26 degrees*** :*Friction Angle*
***50 psf*** :*Adhesion*

**Layer 5. Intermediate Cover**
**12 inches** :Thickness, t
**110 pcf** :Unit Weight, γs
9,900 lbs :Weight per Slope Length

*Layer 5/6 Interface Information*
***30 degrees*** :*Friction Angle*
***50 psf*** :*Adhesion*

**Layer 6. Waste**

**External Equipment, E**

**42,000 lbs** :Weight of CAT D6
**2.5 feet** :Single Track Width
**8.0 feet** :Width of Equipment
**15.3 feet** :Length of Equipment
8,400 psf :In-Line Ground Pressure
548 psf :Equivalent Ground Pressure

### Long-Term Factor of Safety

***Considers dry conditions only***

**1.20** :Required Factor of Safety
**2.42** :Minimum Calculated Factor of Safety
**Okay**

*Resisting Force; Slope = [ γs x t x L x cos( β) x tan( δ)] + [L x a]*
*Resisting Force; Buttress = [ γs x $H^2$ x tan( φs)/sin(2 β)] x [ cos( φs)/cos( φs + β)]*
*Driving Force = γs x t x L x sin( β)*
*Factor of Safety = Resisting / Driving*

**Layer 1. Topsoil vs. Layer 2. Rooting Soil**

6,089 lbs :Resisting Force; Slope
22 lbs :Resisting Force; Buttress
1,091 lbs :Driving Force
**5.60** :Factor of Safety

**Layer 2. Rooting Soil vs. Layer 3. Drainage Sand**

8,299 lbs :Resisting Force; Slope
53 lbs :Resisting Force; Buttress
2,237 lbs :Driving Force
**3.73** :Factor of Safety

**Layer 3. Drainage Sand vs. Layer 4. Geomembrane**

11,411 lbs :Resisting Force; Slope
79 lbs :Resisting Force; Buttress
4,748 lbs :Driving Force
**2.42** :Factor of Safety

**Layer 4. Geomembrane vs. Layer 5. Intermediate Cover**

13,762 lbs :Resisting Force; Slope
62 lbs :Resisting Force; Buttress
4,748 lbs :Driving Force
**2.91** :Factor of Safety

**Layer 5. Intermediate Cover vs. Layer 6. Waste**

21,009 lbs :Resisting Force; Slope
238 lbs :Resisting Force; Buttress
7,149 lbs :Driving Force
**2.97** :Factor of Safety

### Short-Term Factor of Safety

***Considers seepage through cover system***

**1.10** :Required Factor of Safety
**1.51** :Minimum Calculated Factor of Safety
**Okay**

*Resisting Force = [ γs x t x L x cos( β) x tan( δ)] + [L x a]*
*Resisting Force; Buttress = [ γs x $H^2$ x tan( φs)/sin(2 β)] x [ cos( φs)/cos( φs + β)]*
*Driving Force = γs x t x L x sin( β)*
*Factor of Safety = Resisting / Driving*

**75%** :Percent Saturated
63% :Reduction Factor based on Seepage

**Layer 1. Topsoil vs. Layer 2. Rooting Soil**

6,089 lbs :Resisting Force; Slope
22 lbs :Resisting Force; Buttress
1,091 lbs :Driving Force
5.60 :Factor of Safety
**3.50** :Reduced Factor of Safety based on Seepage

**Layer 2. Rooting Soil vs. Layer 3. Drainage Sand**

8,299 lbs :Resisting Force; Slope
53 lbs :Resisting Force; Buttress
2,237 lbs :Driving Force
3.73 :Factor of Safety
**2.33** :Reduced Factor of Safety based on Seepage

**Layer 3. Drainage Sand vs. Layer 4. Geomembrane**

11,411 lbs :Resisting Force; Slope
79 lbs :Resisting Force; Buttress
4,748 lbs :Driving Force
2.42 :Factor of Safety
**1.51** :Reduced Factor of Safety based on Seepage

**Layer 4. Geomembrane vs. Layer 5. Intermediate Cover**

13,762 lbs :Resisting Force; Slope
62 lbs :Resisting Force; Buttress
4,748 lbs :Driving Force
**2.91** :Factor of Safety*
*No seepage below the membrane

**Layer 5. Intermediate Cover vs. Layer 6. Waste**

21,009 lbs :Resisting Force; Slope
238 lbs :Resisting Force; Buttress
7,149 lbs :Driving Force
**2.97** :Factor of Safety*
*No seepage below the membrane

### Short-Term Factor of Safety

***Considers equipment loading***

**1.10** :Required Factor of Safety
**2.22** :Minimum Calculated Factor of Safety
**Okay**

*Resisting Force = {[( γs x t) + E] x L x cos( β) x tan( δ)} + [L x a]*
*Resisting Force; Buttress = [ γs x $H^2$ x tan( φs)/sin(2 β)] x [ cos( φs)/cos( φs + β)]*
*Driving Force = [( γs x t x L) +(1.3 x E)] x sin( β)*
*Factor of Safety = Resisting / Driving*

**Layer 1. Topsoil vs. Layer 2. Rooting Soil**

9,055 lbs :Resisting Force; Slope
22 lbs :Resisting Force; Buttress
3,740 lbs :Driving Force
**2.43** :Factor of Safety

**Layer 2. Rooting Soil vs. Layer 3. Drainage Sand**

11,758 lbs :Resisting Force; Slope
53 lbs :Resisting Force; Buttress
4,886 lbs :Driving Force
**2.42** :Factor of Safety

**Layer 3. Drainage Sand vs. Layer 4. Geomembrane**

16,307 lbs :Resisting Force; Slope
79 lbs :Resisting Force; Buttress
7,396 lbs :Driving Force
**2.22** :Factor of Safety

**Layer 4. Geomembrane vs. Layer 5. Intermediate Cover**

17,737 lbs :Resisting Force; Slope
62 lbs :Resisting Force; Buttress
7,396 lbs :Driving Force
**2.41** :Factor of Safety

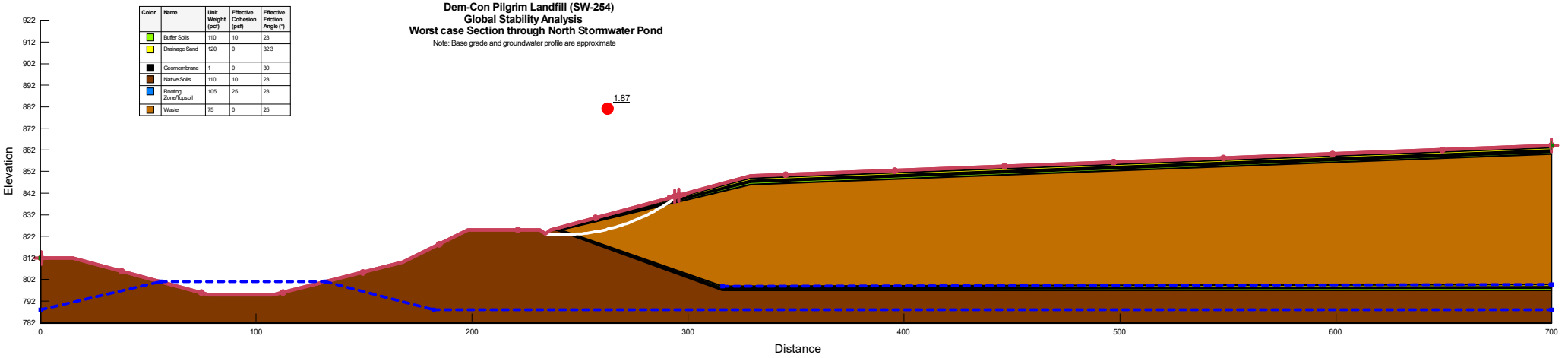
**Layer 5. Intermediate Cover vs. Layer 6. Waste**

25,714 lbs :Resisting Force; Slope
238 lbs :Resisting Force; Buttress
9,797 lbs :Driving Force
**2.65** :Factor of Safety

# Attachment 3 – Slope/W Global Stability

**Dem-Con Pilgrim Landfill (SW-254)**
**Global Stability Analysis**
**Worst case Section through North Stormwater Pond**
Note: Base grade and groundwater profile are approximate

| Color | Name | Unit Weight (pcf) | Effective Cohesion (psf) | Effective Friction Angle (°) |
|---|---|---|---|---|
| | Buffer Soils | 110 | 10 | 23 |
| | Drainage Sand | 120 | 0 | 32.3 |
| | Geomembrane | 1 | 0 | 30 |
| | Native Soils | 110 | 10 | 23 |
| | Rooting Zone/Topsoil | 105 | 25 | 23 |
| | Waste | 75 | 0 | 25 |



# Appendix E  Shredding Operations Form

# SHREDDING OPERATIONS FORM

DISPOSAL DATE:_____

LOCATION OF SHREDDING OPERATIONS (check one):

☐ DEM-CON PILGRIM LANDFILL (SW-254)

☐ OTHER:_____

WASTE QUANTITY:

_____ ☐TONS ☐CUBIC YARDS

WASTE CATEGORY

☐ CONSTRUCTION & DEMOLITION DEBRIS

☐ INDUSTRIAL SOLID WASTE

DESCRIPTION:_____

_____

WASTE MATERIALS APPROVED FOR SHREDDING (check all that apply):

☐ Plastic tubing (plumbing, pipe, conduit)

☐ Plastic duct work (spiral wire core)

☐ Empty plastic containers (buckets, bins)

☐ Plastic hardware (electrical boxes)

☐ Plastic sheeting (roof, wall, untreated)

☐ Plastic playground equipment

☐ Incidental nonrecyclable packaging

☐ Siding and doors (vinyl, untreated wood)

☐ Shingles (wood, asphalt)

☐ Carpet and carpet padding

☐ Fiberglass (tubs, tub surrounds)

☐ Porcelain (sinks, toilets)

☐ Wood (flooring, plywood, particle board, fencing, stumps)

☐ Other (list):_____

_____

_____

Completed by:_____ Date:_____

# Appendix F  Adjacent Properties

*Figure No.*
**1**

*Title*
## Abutting Properties

*Client/Project* 227708930
Dem-Con Pilgrim Landfill, LLC

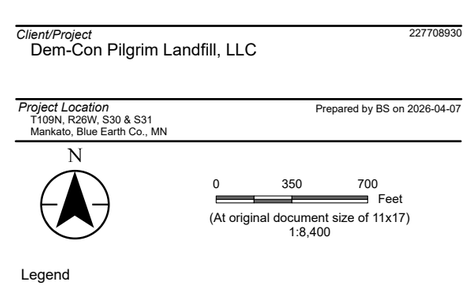
*Project Location*
T109N, R26W, S30 & S31
Mankato, Blue Earth Co., MN

Prepared by BS on 2026-04-07

N

0 350 700 Feet
(At original document size of 11x17)
1:8,400

Legend
- Property Boundary
- Approximate Parcel Boundary




***Notes***
1. Coordinate System: NAD 1983 HARN Adj MN Blue Earth Feet
2. Data Sources: MnGEO, Blue Earth County
3. Background: Minnesota 2025 Imagery

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Disclaimer: This document has been prepared based on information provided by others as cited in the Notes section. Stantec has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Stantec assumes no responsibility for data supplied in electronic format, and the recipient accepts full responsibility for verifying the accuracy and completeness of the data.

U:\227\227708930\03_data\gis_cad\gis\ArcPro\Pilgrims Demolition Landfill\Pilgrims Demolition Landfill.aprx Revised: 2026-04-07 By: tschaffermeyer

| PID | Owner | OwnerAddress | Zone |
|---|---|---|---|
| R400430300003 | SCHMIDT J & W & KIECKER M & D TSTS | 23070 506TH LN LAKE CRYSTAL, MN 56055 | 101- 2A/1B/4BB AGRICULTURAL; 2B/1B RURAL VACANT LAND |
| R400325400002 | WONG ANDREW J & MELANIE J IMKER | 216 STONEHENGE DR MANKATO, MN 56001 | 111- 2B/1B RURAL VACANT LAND |
| R400325400005 | SCHMIDT J & W & KIECKER M & D TSTS | 23070 506TH LN LAKE CRYSTAL, MN 56055 | 101- 2A/1B/4BB AGRICULTURAL; 2B/1B RURAL VACANT LAND |
| R400336200007 | SCHMIDT J & W & KIECKER M & D TSTS | 23070 506TH LN LAKE CRYSTAL, MN 56055 | 101- 2A/1B/4BB AGRICULTURAL; 2B/1B RURAL VACANT LAND |
| R400431100008 | SCHMIDT J & W & KIECKER M & D TSTS | 23070 506TH LN LAKE CRYSTAL, MN 56055 | 101- 2A/1B/4BB AGRICULTURAL; 2B/1B RURAL VACANT LAND |
| R400431100009 | SCHMIDT J & W & KIECKER M & D TSTS | 23070 506TH LN LAKE CRYSTAL, MN 56055 | 112- 2C MANAGED FOREST LAND |
| R400431100007 | WINKLER CATHY L | 57076 230TH LN MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400431100014 | OMG MIDWEST INC | PO BOX 55038 LEXINGTON, KY 40555 | 234- 3A INDUSTRIAL LAND AND BUILDING |
| R400431200039 | OMG MIDWEST INC | PO BOX 55038 LEXINGTON, KY 40555 | 234- 3A INDUSTRIAL LAND AND BUILDING |
| R400431200040 | OMG MIDWEST INC | PO BOX 55038 LEXINGTON, KY 40555 | 234- 3A INDUSTRIAL LAND AND BUILDING |
| R400431200033 | CAMPQUARRY LLC | 3301 3RD AVE MANKATO, MN 56001 | 234- 3A INDUSTRIAL LAND AND BUILDING |
| R400431200030 | IMMANUEL EVANG LUTHERAN CHURCH | 421 N SECOND ST MANKATO, MN 56001 | 911- 5E CEMETERY-PUBLIC |
| R400431200005 | CAMPQUARRY LLC | 3301 3RD AVE MANKATO, MN 56001 | 234- 3A INDUSTRIAL LAND AND BUILDING |
| R400431200042 | MANKATO ACOUSTICS INC | 3501 THIRD AVE MANKATO, MN 56001 | 234- 3A INDUSTRIAL LAND AND BUILDING |
| R400431200044 | CHS INC | SAINT PAUL, MN 55164 | 234- 3A INDUSTRIAL LAND AND BUILDING |
| R400431200666 | LIME INDUSTRIAL PARK ASSOCIATION | 3640 BAYSIDE RD ORONO, MN 55356 | 961- 5E COMMON AREA |
| R400431200036 | K7 QUARRIES LLC | 818 WILLOW ST MANKATO, MN 56001 | 234- 3A INDUSTRIAL LAND AND BUILDING |
| R400431200027 | HIGH WIRE PROPERTIES LLC (CFD) | MANKATO, MN 56002 | 233- 3A COMMERCIAL LAND AND BUILDING |
| R400430400006 | IMMANUEL EVANG LUTH CHURCH OF MKTO | 421 N 2ND ST MANKATO, MN 56001 | 234- 3A INDUSTRIAL LAND AND BUILDING |
| R400430400014 | CAMPQUARRY LLC | 3301 3RD AVE MANKATO, MN 56001 | 234- 3A INDUSTRIAL LAND AND BUILDING |
| R400430400005 | AZUL REIGN PROPERTIES LLC | 716 N BROAD ST MANKATO, MN 56001 | 233- 3A COMMERCIAL LAND AND BUILDING |
| R400430400004 | CAMPQUARRY LLC | 3301 3RD AVE MANKATO, MN 56001 | 206- 4B4 UNIMPROVED RESIDENTIAL LAND |
| R400430400018 | CAMPQUARRY LLC | 3301 3RD AVE MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT; 3A INDUSTRIAL LAND AND BUILDING |
| R400430400017 | CAMPQUARRY LLC | 3301 3RD AVE MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400430400016 | K5 QUARRIES LLC | 818 WILLOW ST MANKATO, MN 56001 | 101- 2A/1B/4BB AGRICULTURAL; 2B/1B RURAL VACANT LAND; 3A INDUSTRIAL LAND AND BUILDING |
| R400430400010 | COLLINS ERWIN H JR & PROCTOR BERTHA L | 23471 3RD AVE MANKATO, MN 56001 | 101- (HSTD) 2A/1B/4BB AGRICULTURAL; 5E MANURE PITS |
| R400430200037 | CALHOUN PAMELA | 150 PEGASUS CIR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400430200032 | CALHOUN PAMELA | 150 PEGASUS CIR MANKATO, MN 56001 | 201- (HSTD) 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400430200014 | ALLEN JUSTIN C & MARY A | 57132 DEERHAVEN DR MANKATO, MN 56001 | 201- (HSTD) 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400430200023 | CHATLEAIN RICHARD E & LORETTA | 57096 DEERHAVEN DR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400430200022 | WOOD LANE LLC (CFD) | 170 PEGASUS CIR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400430200021 | GLASER RANDY & LYNN | 57072 DEERHAVEN DR MANKATO, MN 56001 | 201- (HSTD) 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400430200026 | MCVENES DAVID | 57062 DEERHAVEN DR MANKATO, MN 56001 | 201- (HSTD) 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400430200048 | BUSCH W V FAMILY TRUST | 57133 DEERHAVEN DR MANKATO, MN 56001 | 201- (HSTD) 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400430200013 | ALLEN SUSAN MARIE | 57115 DEERHAVEN DR MANKATO, MN 56001 | 201- (HSTD) 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400430200012 | MILLER ROBERT DWIGHT & RENAE ANN | 57105 DEERHAVEN DR MANKATO, MN 56001 | 201- (HSTD) 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400430200047 | ROSENAU BARRY | 57014 DEERHAVEN DR MANKATO, MN 56001 | 201- (HSTD) 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400430200046 | ITES RICK R & AMY J | 57026 DEERHAVEN DR MANKATO, MN 56001 | 201- (HSTD) 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400430200020 | SCHABERT LEO J & DONNA M (LE) | 57054 DEERHAVEN DR MANKATO, MN 56001 | 201- (HSTD) 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400430176001 | MANKATO AREA MOUNTAIN BIKERS | 607 N RIVERFRONT DR MANKATO, MN 56001 | 201- (HSTD) 1A/1B/4BB RESIDENTIAL SINGLE UNIT; 2B/1B RURAL VACANT LAND |
| R400430176002 | MANKATO AREA MOUNTAIN BIKERS | 607 N RIVERFRONT DR MANKATO, MN 56001 | 111- 2B/1B RURAL VACANT LAND |
| R400430151003 | ANDERSON JEFFREY J & ROOT LEAH JEAN | 29094 BIEHN DR MADISON LAKE, MN 56063 | 111- 2B/1B RURAL VACANT LAND |
| R400430151002 | ANDERSON JEREMY JUSTIN & JEFF | 29094 BIEHN DR MADISON LAKE, MN 56063 | 111- 2B/1B RURAL VACANT LAND |
| | | | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325226003 | STONEHENGE ASSOCIATION INC | 232 STONEHENGE DR MANKATO, MN 56001 | Acreage 23.04 |
| R400325226002 | BLUE EARTH COUNTY | PO BOX 3524 MANKATO, MN 56002 | 955- 5E COUNTY-PUBLIC SERVICE-OTHER |
| R400325400007 | SCHMIDT JEFFREY D & WENDY E | 23070 506TH LN LAKE CRYSTAL, MN 56055 | 112- 2C MANAGED FOREST LAND |
| R400325226009 | CLEMENSEN LISA R | 256 STONEHENGE DR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325276002 | KIECKER LEROY E & CHERYL R | 236 STONEHENGE DR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325276003 | JEPPSON LANCE & STACIA | 232 STONEHENGE DR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325276004 | HOLTMEIER JOSEPH F & BETHANY L | 228 STONEHENGE DR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325276005 | SONTAG DRS MICHAEL & SANDRA REV TRUSTS | 224 STONEHENGE DR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325276006 | PECK RONALD J & JULIE R | 1608 NORTHRIDGE LN NORTH MANKATO, MN 56003 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325276007 | WONG ANDREW J & MELANIE I | 216 STONEHENGE DR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325276008 | WONG ANDREW J & MELANIE I | 216 STONEHENGE DR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325276009 | EBEL DONALD J & TERESA | 208 STONEHENGE DR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325276010 | HICKS CLAUDIA & JONATHAN | 204 STONEHENGE DR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325276011 | WONG ANDREW J & MELANIE J IMKER | 216 STONEHENGE DR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325277002 | KOTTKE MARVIN & LINDA | 225 STONEHENGE DR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325226008 | TOLZMAN TATE | 252 STONEHENGE DR MANKATO, MN 56001 | 201- (HSTD) 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325277008 | VOLK JEFFREY J & CONNIE J | 213 STONEHENGE DR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325277009 | FLAHERTY TIMOTHY M & TAMMY L | 205 STONEHENGE DR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325277007 | BJERKE ROBERT | 209 STONEHENGE DR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325277004 | MINKS CLARK & CODY | 217 STONEHENGE DR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325277003 | BIRD SCOTT & HOLLY | 221 STONEHENGE DR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400325277001 | KOTTKE MARVIN & LINDA | 225 STONEHENGE DR MANKATO, MN 56001 | 201- 1A/1B/4BB RESIDENTIAL SINGLE UNIT |
| R400431100002 | SPRING STREET PROPERTIES LLC | 20499 555TH LN MANKATO, MN 56001 | 233- 3A COMMERCIAL LAND AND BUILDING |

# Appendix G Stormwater Calculations

Stantec

# Memo

| | | | |
|---|---|---|---|
| To: | Mark Pahl, Dem-Con Companies | From: | Ethan Ketelsen, PE – Stantec<br>Noah Garay, EIT – Stantec |
| Project/File: | 227708930 | Date: | April 22, 2026 |

**Reference: Dem-Con Pilgrim Surface Water Analysis**

Stantec prepared this Surface Water Analysis (SWA) for the Dem-Con Companies Pilgrim Landfill (Facility), located in Mankato, MN. Per Minnesota Pollution Control Agency (MPCA) rules, the surface water management system must be designed to manage the 25-year 24-hour storm event. At the site, the regulatory storm event is 5.29-inches. Stormwater generated by the facility will be controlled primarily via drainage berms and ditches, routing to three stormwater ponds as shown in the drawings. Storm features at the facility have been sized to minimize erosion from the site based on the required 25-year storm event.

Sub-watershed areas representative of the facility run-off are shown on the attached sub-watershed map. The facility is divided into three (3) primary drainage areas based on the receiving pond with sub-watersheds delineated within those areas, as shown on the figure. The south and southwest areas of the facility drain to a proposed basin in the southwest portion of the facility. The majority of the remainder of the landfill will drain to a proposed basin on the north side of the landfill, and a small part of the perimeter berm and ditching will drain to a proposed basin in the southeast portion of the facility.

The surface water analysis was based on the Natural Resources Conservations Service (NRCS) methodology using curve numbers (CN), time of concentration (Tc), and Atlas 14 precipitation data with MSE3 24-hour distributions in HydroCAD. To determine surface water runoff for this analysis, the primary sub-watersheds were further delineated based on the flow routing consistent with the design plans. Flows are routed from each sub-watershed through the facility's stormwater features and then discharged to the stormwater basins. Routing and calculations were performed to determine the maximum water elevations in each pond.

For developed conditions, the facility final cover will be planted with shallow-rooted, drought-resistance grasses that will be mowed periodically. A runoff CN of 74 was selected for the facility, based on grasslands with HSG C soils. Time of concentration in the final cover area was calculated using the HydroCAD model by inputting hydraulic distance and slope for each sub-watershed for applicable sheet flow and shallow concentrated flow conditions

Runoff calculations were used in sizing the various components of the surface water management system discussed below.

## Drainage Berms and Perimeter Ditching

Surface water diversion berms, located on the outer side slopes around the perimeter of the site provide 2-feet of flow depth. At the toe of the side slopes, a perimeter ditch, providing a minimum of 2 feet flow depth, exists between the facility's liner limits and the outer perimeter road, as shown on the drawings.

The drainage berms have been designed to handle the flow for each sub-watershed and to minimize erosion and direct the runoff to the appropriate storm control. It is anticipated that erosion control blanket will be installed over any final cover slopes greater than 10% to address erosion concerns and provide stabilization prior to vegetation establishment.

# Stormwater Ponds

The proposed design consists of three stormwater ponds. The southwest pond was previously constructed and currently provides stormwater management for developed portions of the site. Ponds located at the north and southeast portions of the facility are proposed, receiving runoff from the north and southeastern portions of the facility, respectively.

Design details and HydroCAD model outputs for the ponds are tabulated below. The HydroCAD report is included as an attachment to this memo.

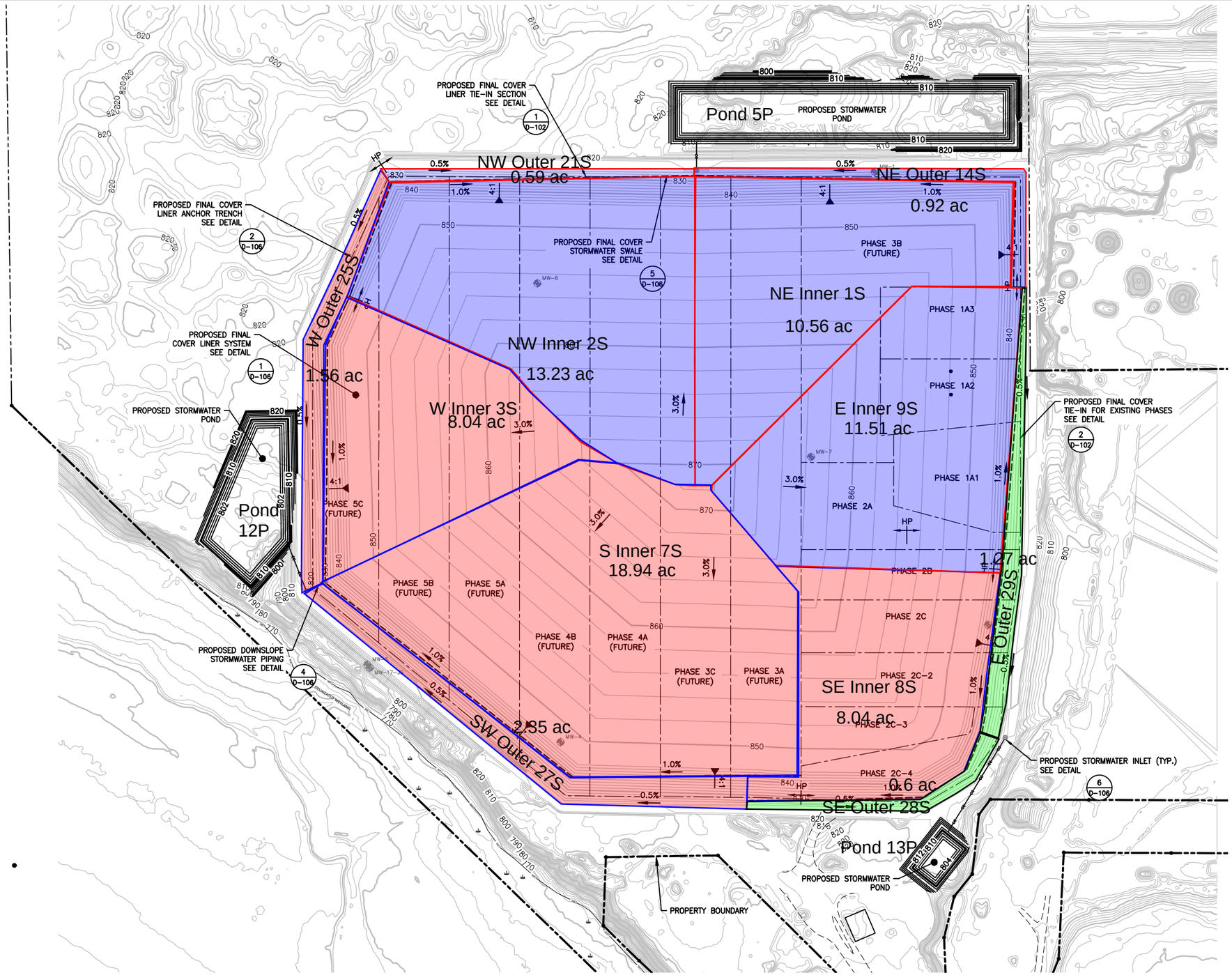
**Table 1. Pond Design Parameters Summary**

| Pond | Bottom Elevation (ft) | Top Elevation (ft) | Total Storage Capacity (acre-ft) |
|---|---|---|---|
| North (N Pond) | 804 | 814 | 31.525 |
| Southeast (SE Pond) | 804 | 812 | 1.720 |
| West (W Pond) | 802 | 810 | 11.877 |

**Table 2. 25-year Storm Event Summary**

| Pond | Peak Inflow (cfs) | Discharge (cfs) | Peak Storage Volume (acre-ft) | HWL (ft) |
|---|---|---|---|---|
| North (N Pond) | 4.48 | 4.48 | 16.583 | 809.84 |
| Southeast (SE Pond) | 1.82 | 1.82 | 0.588 | 807.74 |
| West (W Pond) | 5.33 | 5.33 | 9.597 | 808.68 |

Plot Date & Time: 17 April 2026 3:26 PM




- PROPERTY BOUNDARY (SURVEYED)
- PROPERTY BOUNDARY (BEACON/GIS)
- PERMITTED WASTE LIMITS
- EXISTING PHASE BOUNDARY
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING WETLAND AREA
- PROPOSED PHASE BOUNDARY
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED STORMWATER SWALE
- PROPOSED STORMWATER PIPE
- PROPOSED STORMWATER INLET

SURVEY NOTES:

1. HORIZONTAL DATUM IS BLUE EARTH COUNTY NORTH AMERICAN DATUM NAD83(2011), US SURVEY FEET,
2. VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 88 (NAVD88). CONTOUR INTERVAL IS TWO FEET.
3. TOPOGRAPHY SURVEY FROM 2023 LIDAR DATA, UPDATED VIA GROUND SURVEY BY BOLTON AND MENK IN DECEMBER 2025.

NOTES:

1. PROPOSED GRADES SHOWN ARE TOP OF FINAL COVER GRADES.

| REV | REVISION DESCRIPTION | DWN | APP | REV DATE |
|---|---|---|---|---|
| 0 | ISSUED FOR PERMIT APPLICATION | JJT | EDK | 04/24/26 |

SEAL

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

PRINT NAME ETHAN KETELSEN

SIGNATURE

DATE 04-24-2026 LICENSE # 56630

PRIME CONSULTANT

Stantec

PROJECT TITLE
2026 PERMIT REISSUANCE & MODIFICATION APPLICATION

DEM-CON PILGRIM LANDFILL, LLC.

MANKATO, MINNESOTA

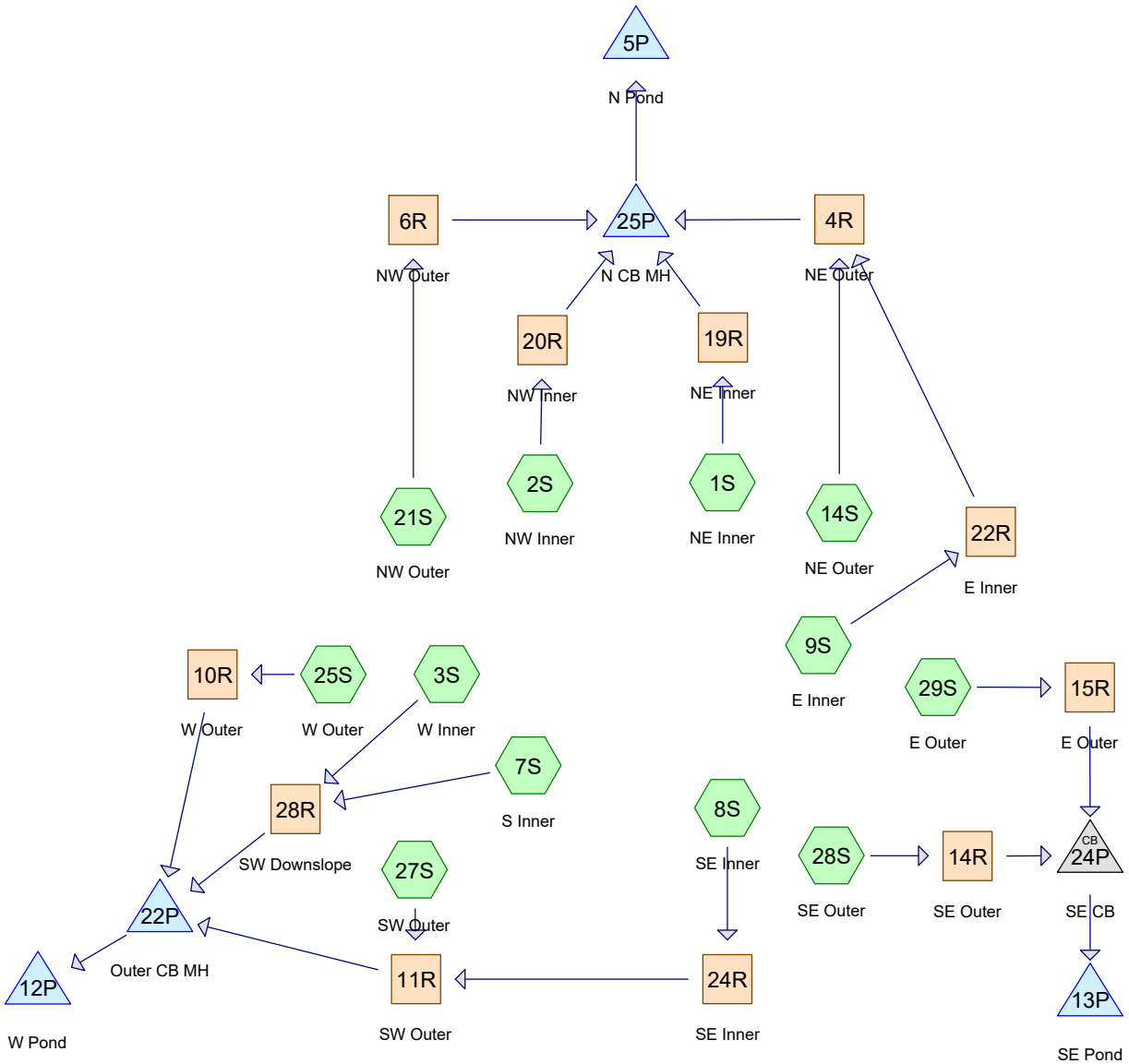
SHEET TITLE
SURFACE WATER MANAGEMENT PLAN

| DWN BY | CHK'D | APP'D | DWG DATE |
|---|---|---|---|
| JJT | BWS | EDK | APR. 2026 |

SCALE AS SHOWN

| PROJECT NO. | SHEET NO. | REV NO. |
|---|---|---|
| 227708930 | C-106 | 0 |

L:\227708930_drafting\civil\C-106_Surface Water Management.dwg




Subcat Reach Pond Link

**Routing Diagram for Demcon Final Cover Stormwater**
Prepared by Stantec Consultants, Printed 4/21/2026
HydroCAD® 10.20-6a s/n 02201 © 2024 HydroCAD Software Solutions LLC

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 77.490 | 74 | >75% Grass cover, Good, HSG C (1S, 2S, 3S, 7S, 8S, 9S, 14S, 21S, 25S, 27S, 28S, 29S) |
| **77.490** | **74** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| 0.000 | HSG B | |
| 77.490 | HSG C | 1S, 2S, 3S, 7S, 8S, 9S, 14S, 21S, 25S, 27S, 28S, 29S |
| 0.000 | HSG D | |
| 0.000 | Other | |
| **77.490** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 77.490 | 0.000 | 0.000 | 77.490 | >75% Grass cover, Good | 1S, 2S, 3S, 7S, 8S, 9S, 14S, 21S, 25S, 27S, 28S, 29S |
| **0.000** | **0.000** | **77.490** | **0.000** | **0.000** | **77.490** | **TOTAL AREA** | |

## Pipe Listing (all nodes)

| Line# | Node Number | In-Invert (feet) | Out-Invert (feet) | Length (feet) | Slope (ft/ft) | n | Width (inches) | Diam/Height (inches) | Inside-Fill (inches) | Node Name |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5P | 809.00 | 804.00 | 100.0 | 0.0500 | 0.011 | 0.0 | 36.0 | 0.0 | |
| 2 | 12P | 805.50 | 805.00 | 100.0 | 0.0050 | 0.011 | 0.0 | 12.0 | 0.0 | |
| 3 | 13P | 807.00 | 804.00 | 300.0 | 0.0100 | 0.011 | 0.0 | 12.0 | 0.0 | |
| 4 | 22P | 810.00 | 809.00 | 165.0 | 0.0061 | 0.012 | 0.0 | 36.0 | 0.0 | |
| 5 | 24P | 816.00 | 812.00 | 330.0 | 0.0121 | 0.012 | 0.0 | 36.0 | 0.0 | |
| 6 | 25P | 814.00 | 813.00 | 75.0 | 0.0133 | 0.012 | 0.0 | 36.0 | 0.0 | |

Time span=0.00-48.00 hrs, dt=0.05 hrs, 961 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: NE Inner** Runoff Area=10.560 ac 0.00% Impervious Runoff Depth=2.60"
Flow Length=870' Tc=19.2 min CN=74 Runoff=31.16 cfs 2.286 af

**Subcatchment2S: NW Inner** Runoff Area=13.230 ac 0.00% Impervious Runoff Depth=2.60"
Flow Length=867' Tc=19.1 min CN=74 Runoff=39.17 cfs 2.864 af

**Subcatchment3S: W Inner** Runoff Area=8.020 ac 0.00% Impervious Runoff Depth=2.60"
Flow Length=825' Tc=18.6 min CN=74 Runoff=24.05 cfs 1.736 af

**Subcatchment7S: S Inner** Runoff Area=18.840 ac 0.00% Impervious Runoff Depth=2.60"
Flow Length=874' Tc=19.3 min CN=74 Runoff=55.47 cfs 4.078 af

**Subcatchment8S: SE Inner** Runoff Area=8.040 ac 0.00% Impervious Runoff Depth=2.60"
Flow Length=636' Tc=15.1 min CN=74 Runoff=26.68 cfs 1.740 af

**Subcatchment9S: E Inner** Runoff Area=11.510 ac 0.00% Impervious Runoff Depth=2.60"
Flow Length=836' Tc=18.8 min CN=74 Runoff=34.32 cfs 2.492 af

**Subcatchment14S: NE Outer** Runoff Area=0.920 ac 0.00% Impervious Runoff Depth=2.60"
Flow Length=1,268' Slope=0.0500 '/' Tc=20.5 min CN=74 Runoff=2.63 cfs 0.199 af

**Subcatchment21S: NW Outer** Runoff Area=0.590 ac 0.00% Impervious Runoff Depth=2.60"
Flow Length=883' Slope=0.0500 '/' Tc=15.4 min CN=74 Runoff=1.94 cfs 0.128 af

**Subcatchment25S: W Outer** Runoff Area=1.560 ac 0.00% Impervious Runoff Depth=2.60"
Flow Length=1,247' Slope=0.0500 '/' Tc=20.3 min CN=74 Runoff=4.48 cfs 0.338 af

**Subcatchment27S: SW Outer** Runoff Area=2.350 ac 0.00% Impervious Runoff Depth=2.60"
Flow Length=1,670' Slope=0.0500 '/' Tc=25.6 min CN=74 Runoff=5.94 cfs 0.509 af

**Subcatchment28S: SE Outer** Runoff Area=0.600 ac 0.00% Impervious Runoff Depth=2.60"
Flow Length=805' Slope=0.0500 '/' Tc=14.3 min CN=74 Runoff=2.04 cfs 0.130 af

**Subcatchment29S: E Outer** Runoff Area=1.270 ac 0.00% Impervious Runoff Depth=2.60"
Flow Length=1,274' Slope=0.0500 '/' Tc=20.6 min CN=74 Runoff=3.62 cfs 0.275 af

**Reach 4R: NE Outer** Avg. Flow Depth=1.43' Max Vel=3.27 fps Inflow=35.27 cfs 2.691 af
n=0.030 L=1,265.0' S=0.0047 '/' Capacity=62.87 cfs Outflow=31.86 cfs 2.691 af

**Reach 6R: NW Outer** Avg. Flow Depth=0.26' Max Vel=1.27 fps Inflow=1.94 cfs 0.128 af
n=0.030 L=883.0' S=0.0048 '/' Capacity=62.95 cfs Outflow=1.48 cfs 0.128 af

**Reach 10R: W Outer** Avg. Flow Depth=0.43' Max Vel=1.71 fps Inflow=4.48 cfs 0.338 af
n=0.030 L=1,242.0' S=0.0048 '/' Capacity=63.44 cfs Outflow=3.56 cfs 0.338 af

**Reach 11R: SW Outer** Avg. Flow Depth=1.27' Max Vel=3.10 fps Inflow=31.08 cfs 2.249 af
n=0.030 L=1,671.0' S=0.0048 '/' Capacity=63.16 cfs Outflow=25.88 cfs 2.249 af

**Reach 14R: SE Outer** Avg. Flow Depth=0.27' Max Vel=1.42 fps Inflow=2.04 cfs 0.130 af
n=0.030 L=687.0' S=0.0058 '/' Capacity=69.65 cfs Outflow=1.69 cfs 0.130 af

**Reach 15R: E Outer** Avg. Flow Depth=0.36' Max Vel=1.66 fps Inflow=3.62 cfs 0.275 af
n=0.030 L=1,281.0' S=0.0055 '/' Capacity=67.48 cfs Outflow=2.83 cfs 0.275 af

**Reach 19R: NE Inner** Avg. Flow Depth=1.45' Max Vel=3.89 fps Inflow=31.16 cfs 2.286 af
n=0.030 L=1,204.0' S=0.0100 '/' Capacity=67.41 cfs Outflow=28.60 cfs 2.286 af

**Reach 20R: NW Inner** Avg. Flow Depth=1.61' Max Vel=4.17 fps Inflow=39.17 cfs 2.864 af
n=0.030 L=867.0' S=0.0100 '/' Capacity=67.64 cfs Outflow=37.43 cfs 2.864 af

**Reach 22R: E Inner** Avg. Flow Depth=1.53' Max Vel=4.02 fps Inflow=34.32 cfs 2.492 af
n=0.030 L=805.0' S=0.0099 '/' Capacity=67.31 cfs Outflow=32.90 cfs 2.492 af

**Reach 24R: SE Inner** Avg. Flow Depth=1.37' Max Vel=3.85 fps Inflow=26.68 cfs 1.740 af
n=0.030 L=757.0' S=0.0106 '/' Capacity=69.41 cfs Outflow=25.21 cfs 1.740 af

**Reach 28R: SW Downslope** Avg. Flow Depth=0.91' Max Vel=8.18 fps Inflow=79.49 cfs 5.814 af
n=0.069 L=70.0' S=0.2286 '/' Capacity=802.92 cfs Outflow=79.34 cfs 5.814 af

**Pond 5P: N Pond** Peak Elev=809.84' Storage=16.583 af Inflow=90.74 cfs 7.968 af
36.0" Round Culvert n=0.011 L=100.0' S=0.0500 '/' Outflow=4.48 cfs 4.374 af

**Pond 12P: W Pond** Peak Elev=808.68' Storage=9.599 af Inflow=86.47 cfs 8.401 af
12.0" Round Culvert n=0.011 L=100.0' S=0.0050 '/' Outflow=5.33 cfs 7.352 af

**Pond 13P: SE Pond** Peak Elev=807.74' Storage=0.588 af Inflow=3.98 cfs 0.405 af
12.0" Round Culvert n=0.011 L=300.0' S=0.0100 '/' Outflow=1.82 cfs 0.403 af

**Pond 22P: Outer CB MH** Peak Elev=817.95' Storage=0.005 af Inflow=86.49 cfs 8.401 af
36.0" Round Culvert n=0.012 L=165.0' S=0.0061 '/' Outflow=86.47 cfs 8.401 af

**Pond 24P: SE CB** Peak Elev=816.74' Inflow=3.98 cfs 0.405 af
36.0" Round Culvert n=0.012 L=330.0' S=0.0121 '/' Outflow=3.98 cfs 0.405 af

**Pond 25P: N CB MH** Peak Elev=822.60' Storage=0.005 af Inflow=90.67 cfs 7.968 af
36.0" Round Culvert n=0.012 L=75.0' S=0.0133 '/' Outflow=90.74 cfs 7.968 af

**Total Runoff Area = 77.490 ac Runoff Volume = 16.775 af Average Runoff Depth = 2.60"**
**100.00% Pervious = 77.490 ac 0.00% Impervious = 0.000 ac**

## Summary for Subcatchment 1S: NE Inner

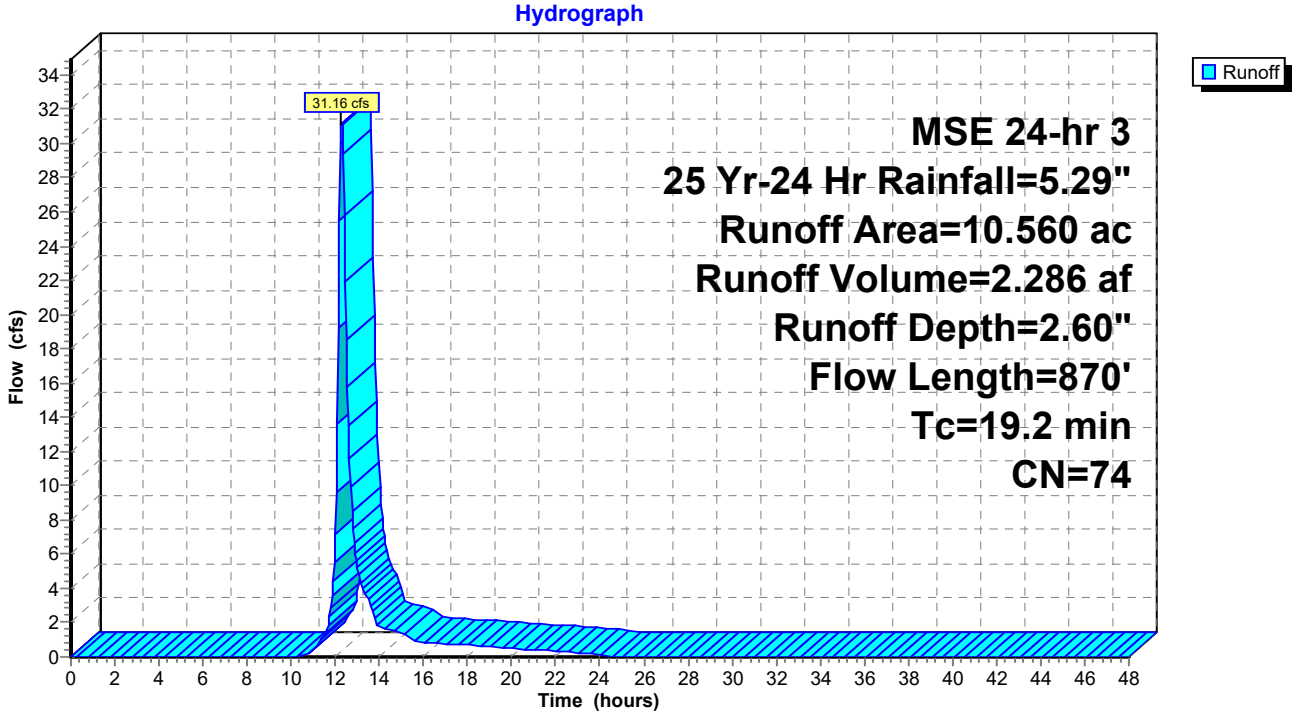
Runoff = 31.16 cfs @ 12.29 hrs, Volume= 2.286 af, Depth= 2.60"
Routed to Reach 19R : NE Inner

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 25 Yr-24 Hr Rainfall=5.29"

| Area (ac) | CN | Description |
|---|---|---|
| 10.560 | 74 | >75% Grass cover, Good, HSG C |
| 10.560 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 18.2 | 790 | 0.0300 | 0.73 | | **Lag/CN Method, 33:1** |
| 1.0 | 80 | 0.2500 | 1.32 | | **Lag/CN Method, 4:1** |
| 19.2 | 870 | Total | | | |

## Subcatchment 1S: NE Inner



## Summary for Subcatchment 2S: NW Inner

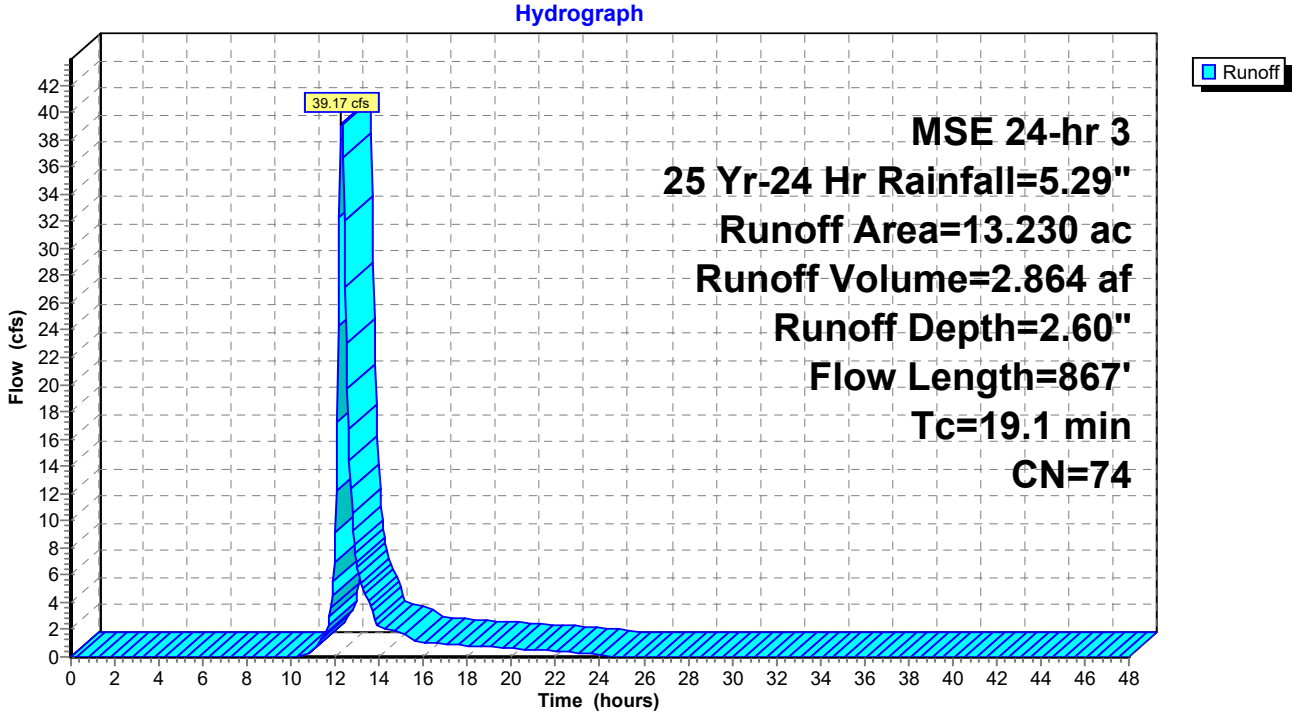
Runoff = 39.17 cfs @ 12.29 hrs, Volume= 2.864 af, Depth= 2.60"
Routed to Reach 20R : NW Inner

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 25 Yr-24 Hr Rainfall=5.29"

| Area (ac) | CN | Description |
|---|---|---|
| 13.230 | 74 | >75% Grass cover, Good, HSG C |
| 13.230 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 18.1 | 787 | 0.0300 | 0.72 | | **Lag/CN Method, 33:1** |
| 1.0 | 80 | 0.2500 | 1.32 | | **Lag/CN Method, 4:1** |
| 19.1 | 867 | Total | | | |

## Subcatchment 2S: NW Inner



## Summary for Subcatchment 3S: W Inner

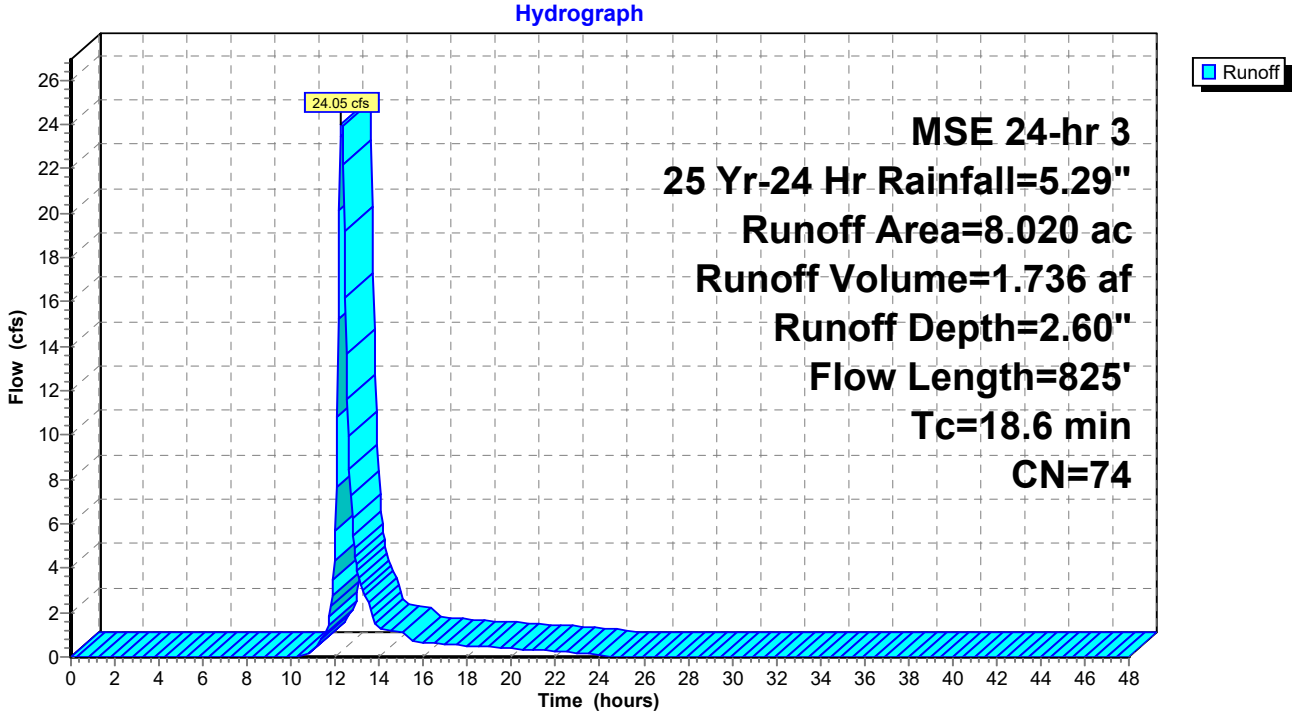
Runoff = 24.05 cfs @ 12.29 hrs, Volume= 1.736 af, Depth= 2.60"
Routed to Reach 28R : SW Downslope

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 25 Yr-24 Hr Rainfall=5.29"

| Area (ac) | CN | Description |
|---|---|---|
| 8.020 | 74 | >75% Grass cover, Good, HSG C |
| 8.020 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 17.8 | 769 | 0.0300 | 0.72 | | **Lag/CN Method, 33:1 Slope** |
| 0.8 | 56 | 0.2500 | 1.23 | | **Lag/CN Method, 4:1 slope** |
| 18.6 | 825 | Total | | | |

## Subcatchment 3S: W Inner



## Summary for Subcatchment 7S: S Inner

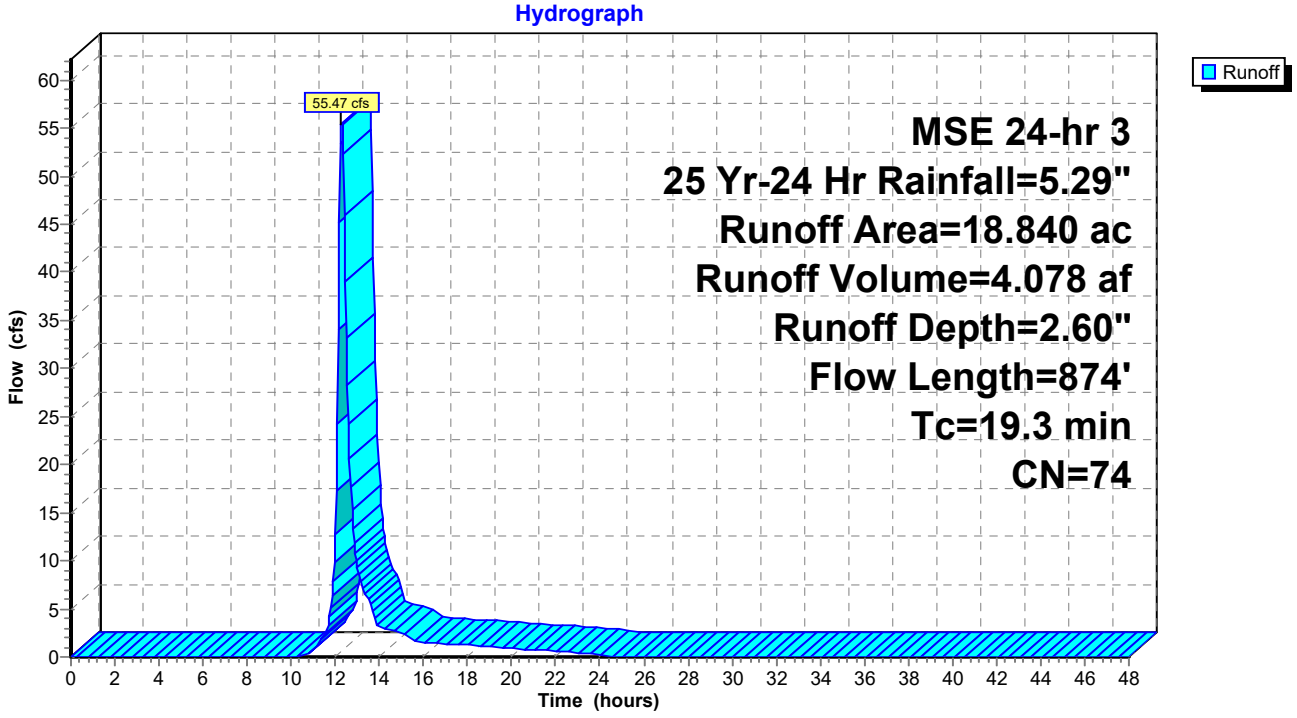
Runoff = 55.47 cfs @ 12.29 hrs, Volume= 4.078 af, Depth= 2.60"
Routed to Reach 28R : SW Downslope

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 25 Yr-24 Hr Rainfall=5.29"

| Area (ac) | CN | Description |
|---|---|---|
| 18.840 | 74 | >75% Grass cover, Good, HSG C |
| 18.840 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 18.4 | 802 | 0.0300 | 0.73 | | **Lag/CN Method, 33:1** |
| 0.9 | 72 | 0.2500 | 1.30 | | **Lag/CN Method, 4:1** |
| 19.3 | 874 | Total | | | |

### Subcatchment 7S: S Inner



## Summary for Subcatchment 8S: SE Inner

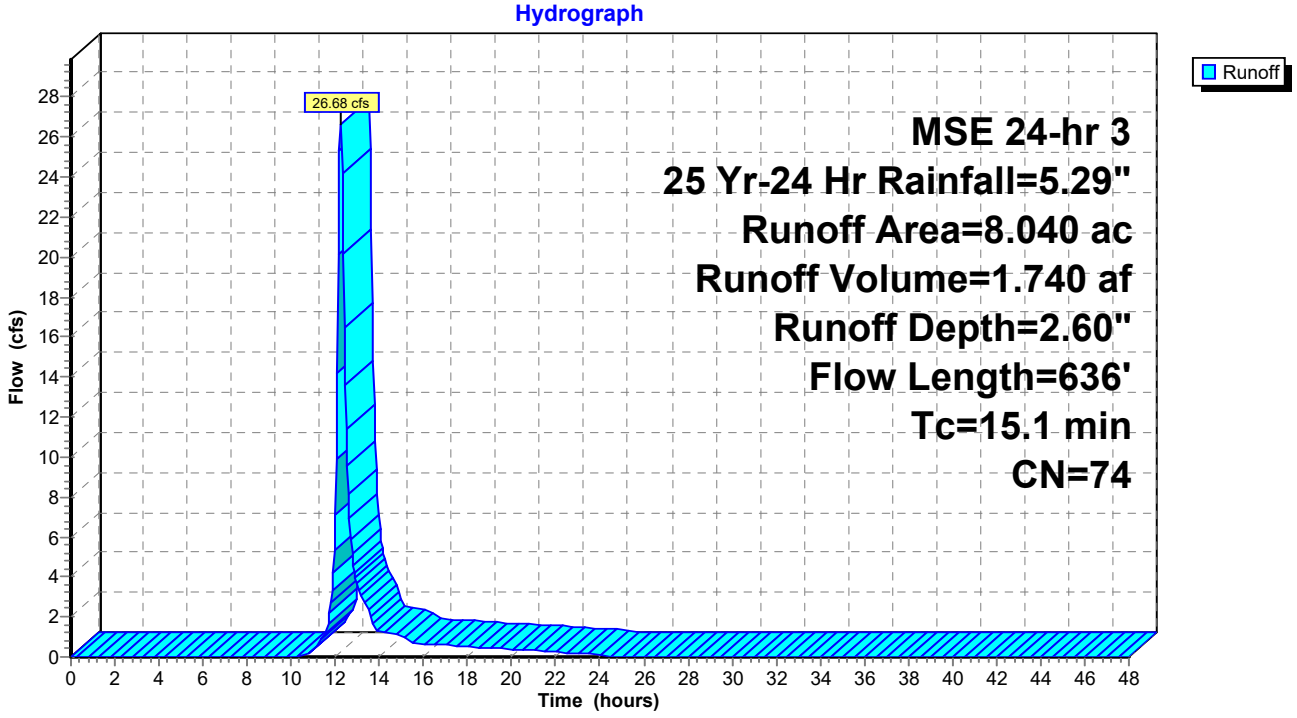
Runoff = 26.68 cfs @ 12.24 hrs, Volume= 1.740 af, Depth= 2.60"
Routed to Reach 24R : SE Inner

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 25 Yr-24 Hr Rainfall=5.29"

| Area (ac) | CN | Description |
|---|---|---|
| 8.040 | 74 | >75% Grass cover, Good, HSG C |
| 8.040 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 14.5 | 596 | 0.0300 | 0.69 | | **Lag/CN Method, 33:1** |
| 0.6 | 40 | 0.2500 | 1.15 | | **Lag/CN Method, 4:1** |
| 15.1 | 636 | Total | | | |

## Subcatchment 8S: SE Inner



## Summary for Subcatchment 9S: E Inner

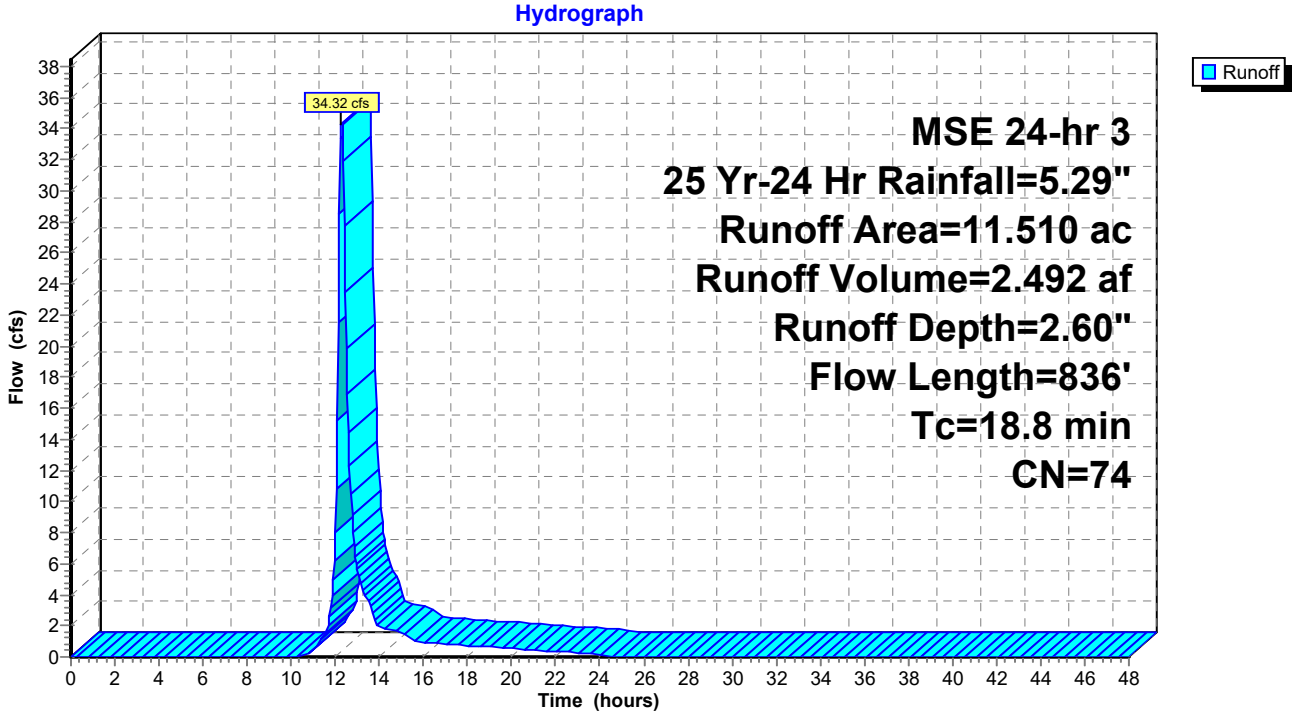
Runoff = 34.32 cfs @ 12.29 hrs, Volume= 2.492 af, Depth= 2.60"
Routed to Reach 22R : E Inner

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 25 Yr-24 Hr Rainfall=5.29"

| Area (ac) | CN | Description |
|---|---|---|
| 11.510 | 74 | >75% Grass cover, Good, HSG C |
| 11.510 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 18.1 | 786 | 0.0300 | 0.72 | | **Lag/CN Method, 33:1** |
| 0.7 | 50 | 0.2500 | 1.21 | | **Lag/CN Method, 4:1** |
| 18.8 | 836 | Total | | | |

## Subcatchment 9S: E Inner



## Summary for Subcatchment 14S: NE Outer

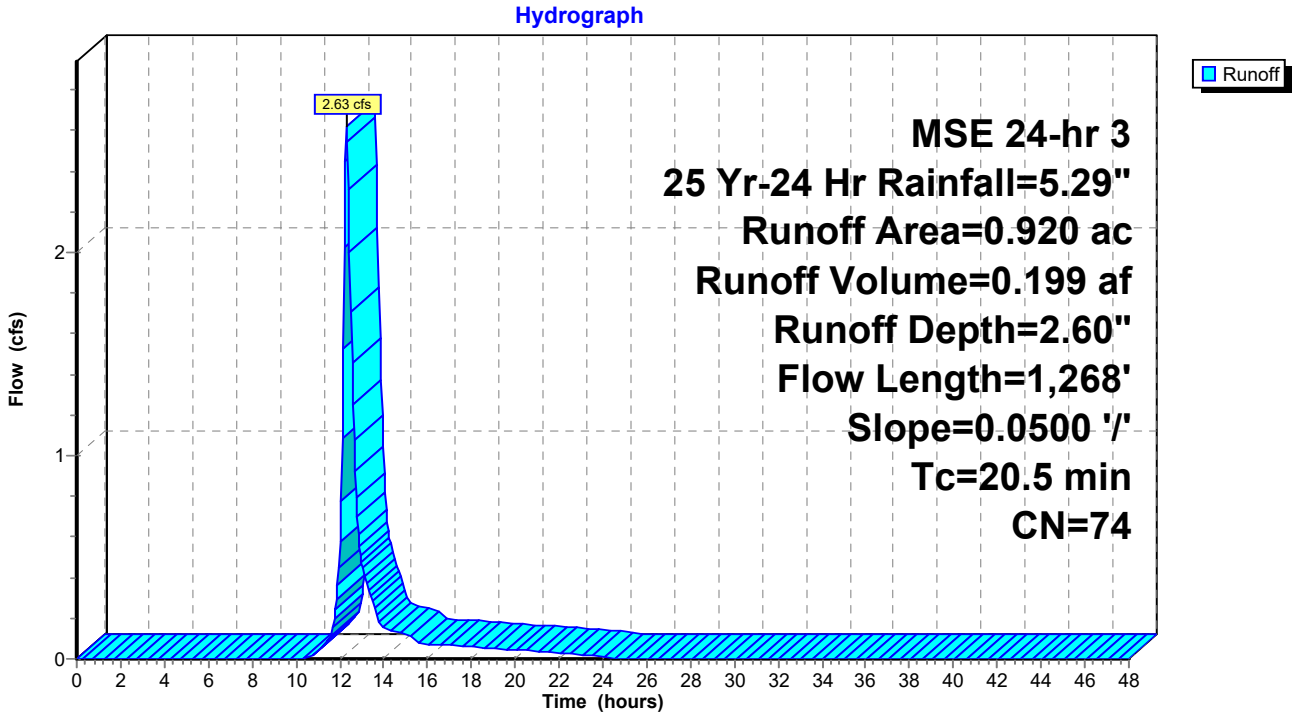
Runoff = 2.63 cfs @ 12.31 hrs, Volume= 0.199 af, Depth= 2.60"
Routed to Reach 4R : NE Outer

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 25 Yr-24 Hr Rainfall=5.29"

| Area (ac) | CN | Description |
|---|---|---|
| 0.920 | 74 | >75% Grass cover, Good, HSG C |
| 0.920 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 20.5 | 1,268 | 0.0500 | 1.03 | | **Lag/CN Method,** |

## Subcatchment 14S: NE Outer



## Summary for Subcatchment 21S: NW Outer

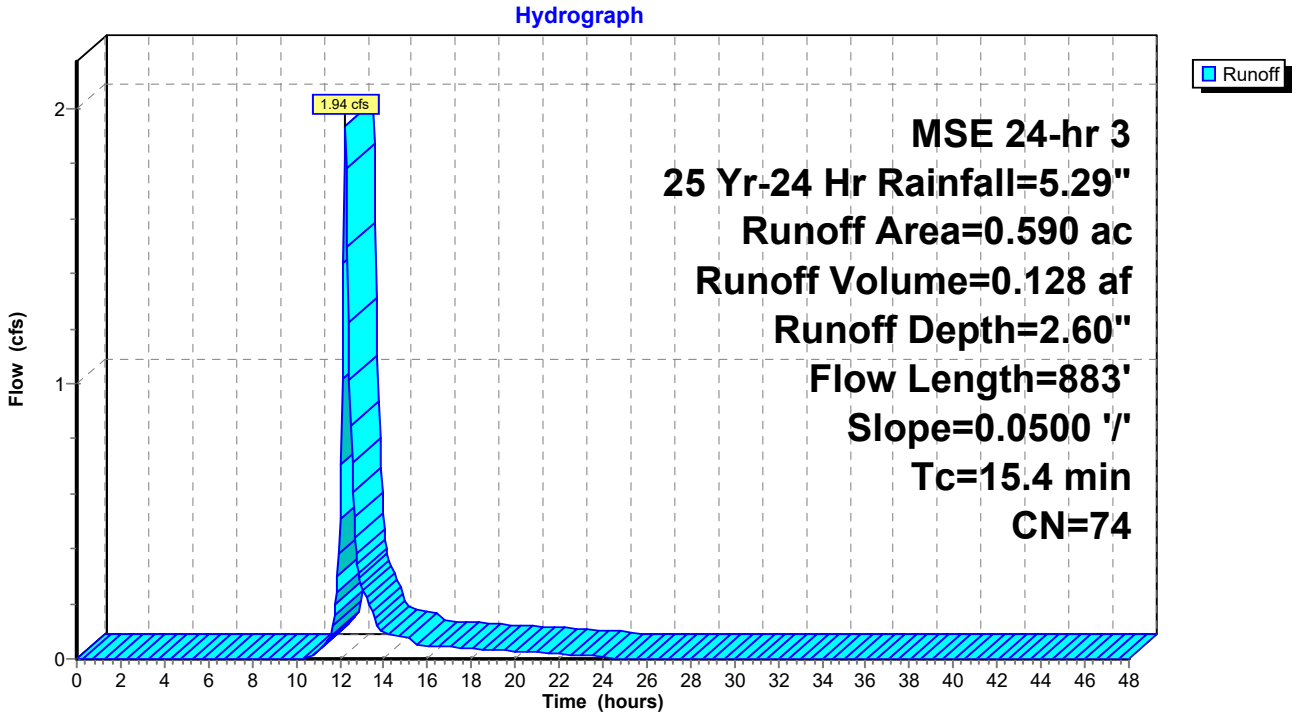
Runoff = 1.94 cfs @ 12.25 hrs, Volume= 0.128 af, Depth= 2.60"
Routed to Reach 6R : NW Outer

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 25 Yr-24 Hr Rainfall=5.29"

| Area (ac) | CN | Description |
|---|---|---|
| 0.590 | 74 | >75% Grass cover, Good, HSG C |
| 0.590 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.4 | 883 | 0.0500 | 0.96 | | **Lag/CN Method,** |

### Subcatchment 21S: NW Outer



## Summary for Subcatchment 25S: W Outer

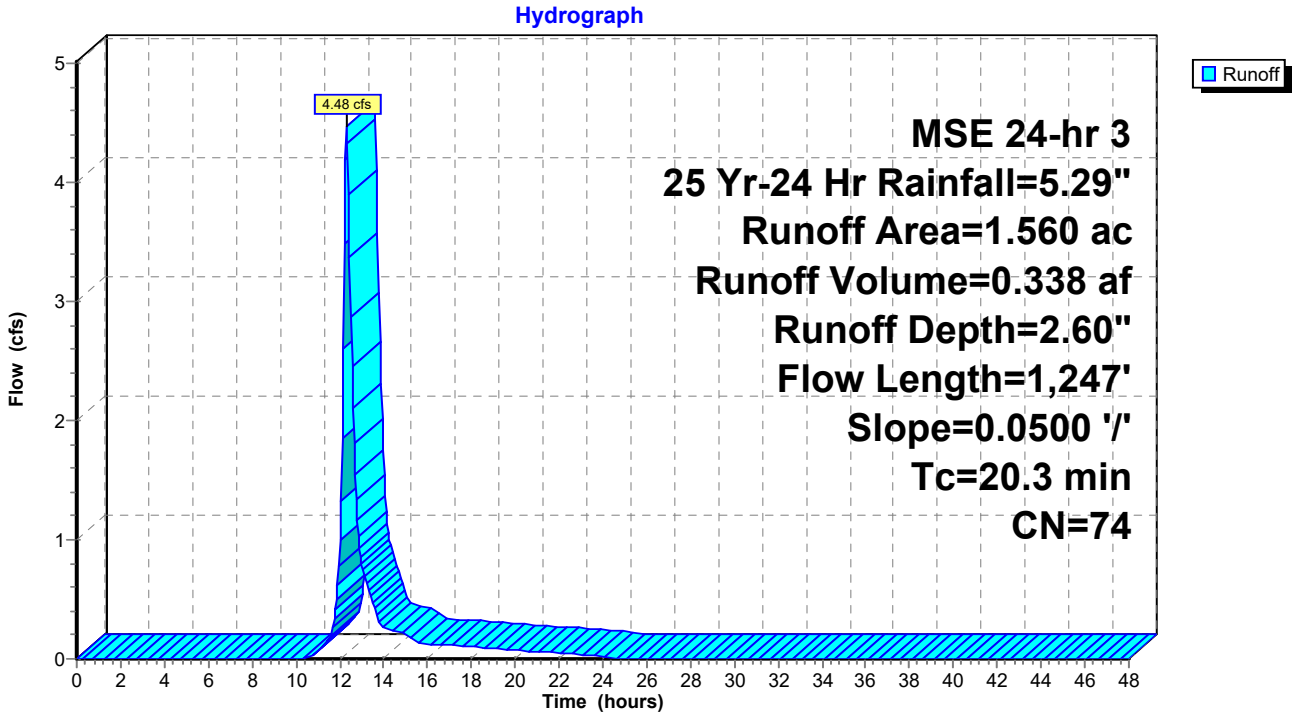
Runoff = 4.48 cfs @ 12.31 hrs, Volume= 0.338 af, Depth= 2.60"
Routed to Reach 10R : W Outer

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 25 Yr-24 Hr Rainfall=5.29"

| Area (ac) | CN | Description |
|---|---|---|
| 1.560 | 74 | >75% Grass cover, Good, HSG C |
| 1.560 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 20.3 | 1,247 | 0.0500 | 1.03 | | **Lag/CN Method,** |

### Subcatchment 25S: W Outer



## Summary for Subcatchment 27S: SW Outer

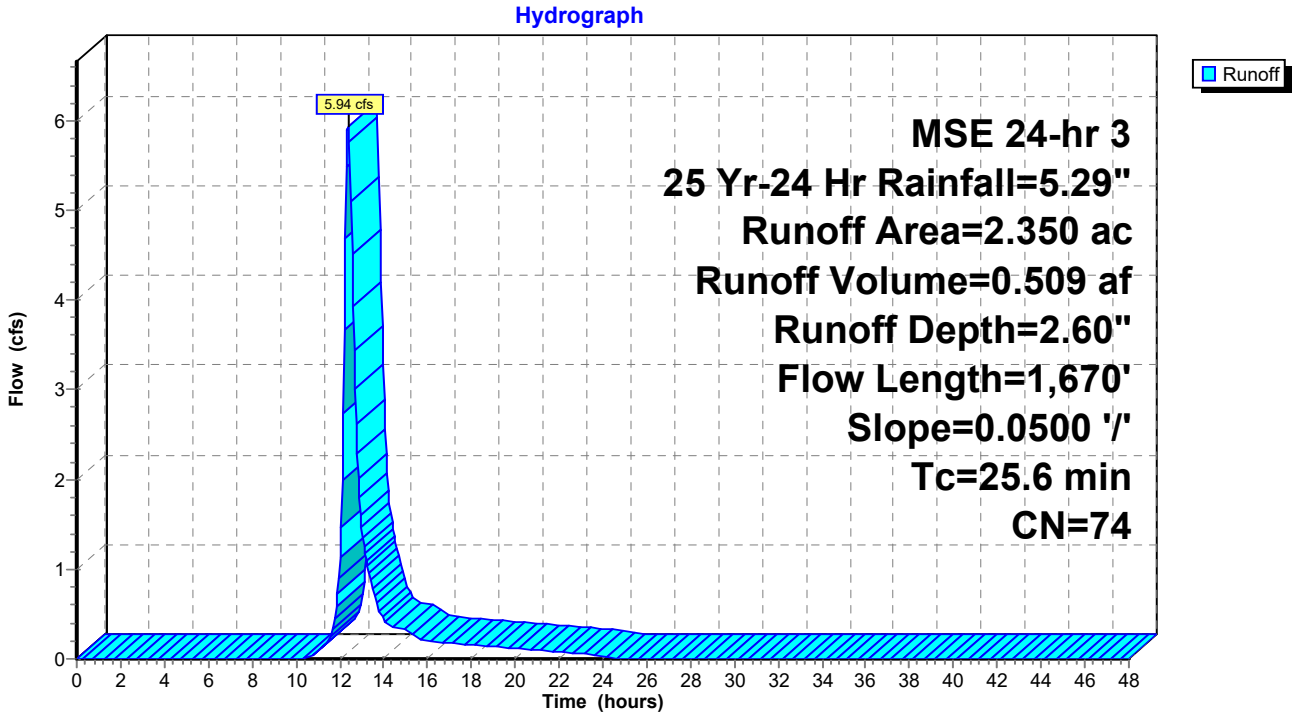
Runoff = 5.94 cfs @ 12.38 hrs, Volume= 0.509 af, Depth= 2.60"
Routed to Reach 11R : SW Outer

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 25 Yr-24 Hr Rainfall=5.29"

| Area (ac) | CN | Description |
|---|---|---|
| 2.350 | 74 | >75% Grass cover, Good, HSG C |
| 2.350 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 25.6 | 1,670 | 0.0500 | 1.09 | | **Lag/CN Method,** |

### Subcatchment 27S: SW Outer



## Summary for Subcatchment 28S: SE Outer

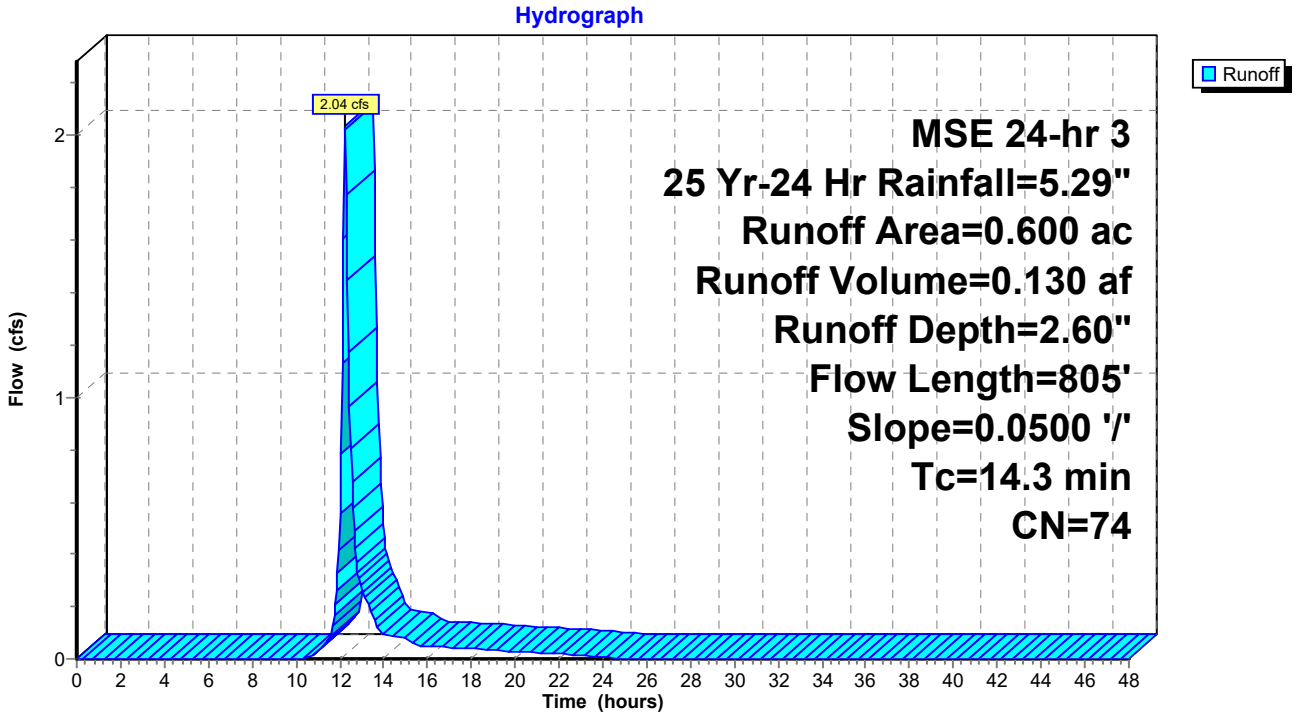
Runoff = 2.04 cfs @ 12.23 hrs, Volume= 0.130 af, Depth= 2.60"
Routed to Reach 14R : SE Outer

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 25 Yr-24 Hr Rainfall=5.29"

| Area (ac) | CN | Description |
|---|---|---|
| 0.600 | 74 | >75% Grass cover, Good, HSG C |
| 0.600 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 14.3 | 805 | 0.0500 | 0.94 | | **Lag/CN Method,** |

### Subcatchment 28S: SE Outer



## Summary for Subcatchment 29S: E Outer

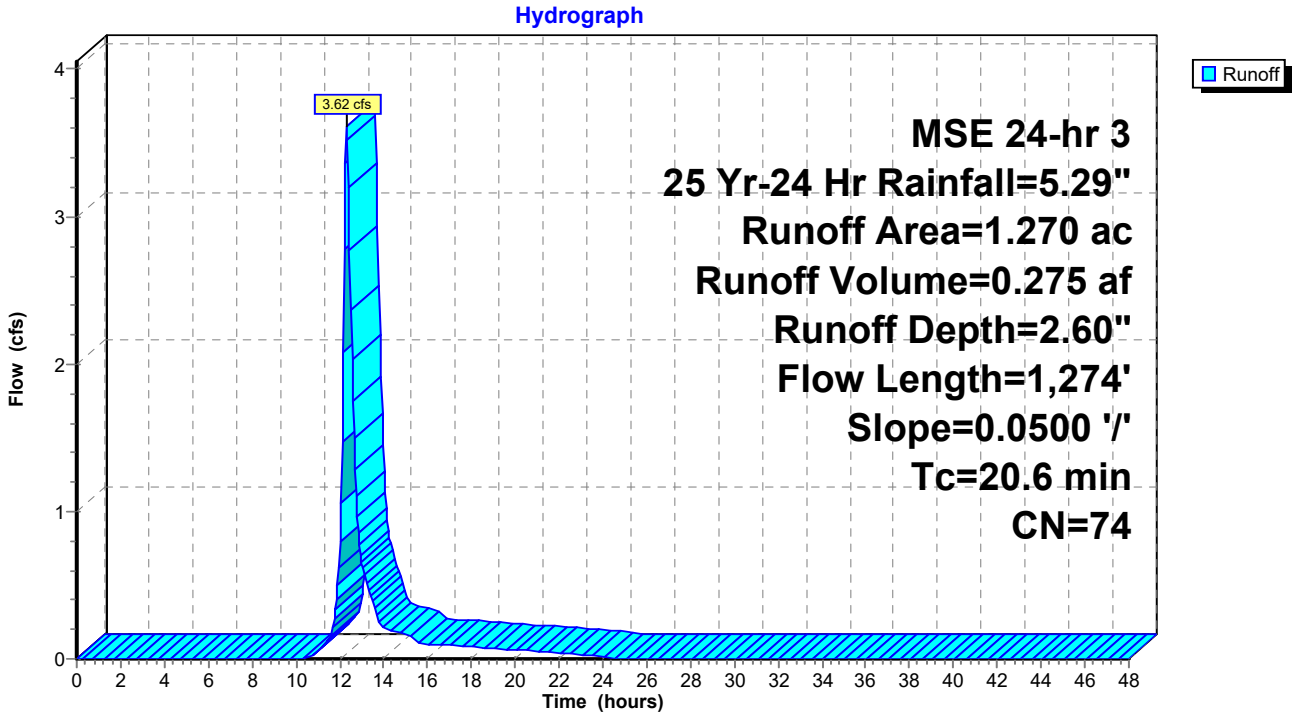
Runoff = 3.62 cfs @ 12.31 hrs, Volume= 0.275 af, Depth= 2.60"
Routed to Reach 15R : E Outer

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 25 Yr-24 Hr Rainfall=5.29"

| Area (ac) | CN | Description |
|---|---|---|
| 1.270 | 74 | >75% Grass cover, Good, HSG C |
| 1.270 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 20.6 | 1,274 | 0.0500 | 1.03 | | **Lag/CN Method,** |

## Subcatchment 29S: E Outer



## Summary for Reach 4R: NE Outer

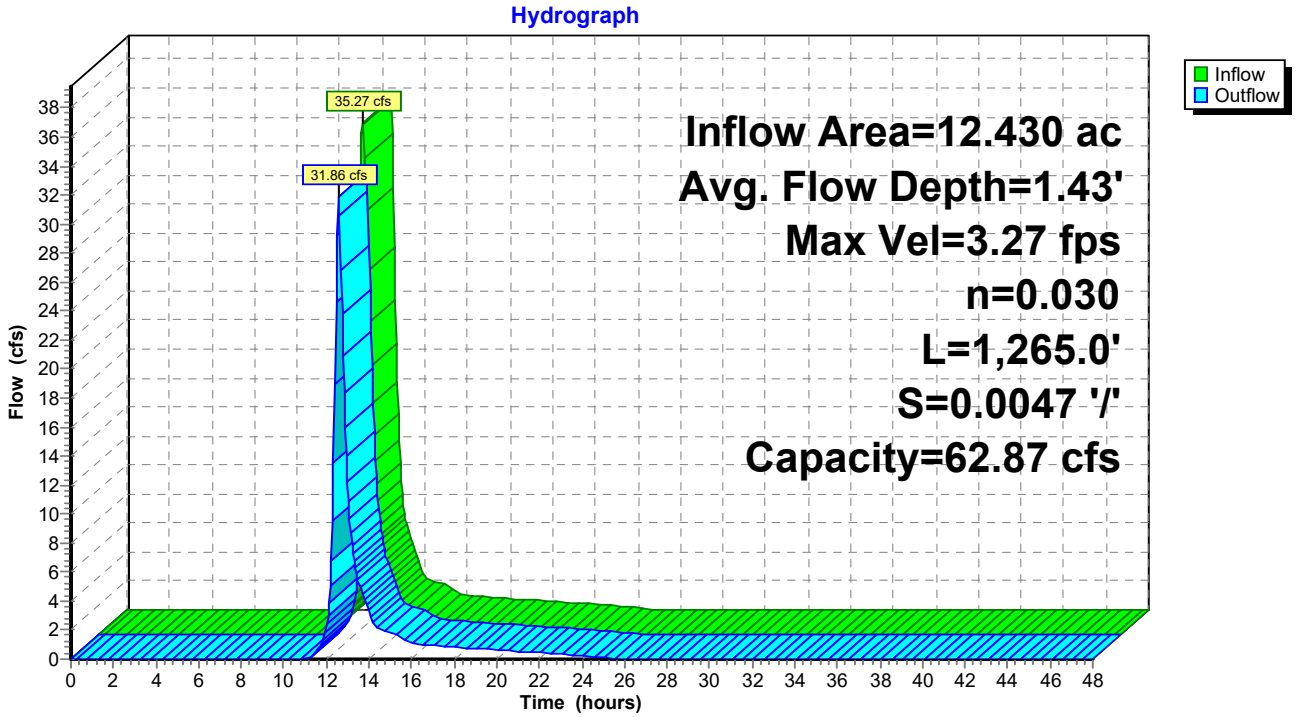
Inflow Area = 12.430 ac, 0.00% Impervious, Inflow Depth = 2.60" for 25 Yr-24 Hr event
Inflow = 35.27 cfs @ 12.39 hrs, Volume= 2.691 af
Outflow = 31.86 cfs @ 12.57 hrs, Volume= 2.691 af, Atten= 10%, Lag= 11.2 min
Routed to Pond 25P : N CB MH

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.27 fps, Min. Travel Time= 6.4 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 28.1 min

Peak Storage= 12,358 cf @ 12.47 hrs
Average Depth at Peak Storage= 1.43' , Surface Width= 9.70'
Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 62.87 cfs

4.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 1,265.0' Slope= 0.0047 '/'
Inlet Invert= 828.00', Outlet Invert= 822.00'





## Summary for Reach 6R: NW Outer

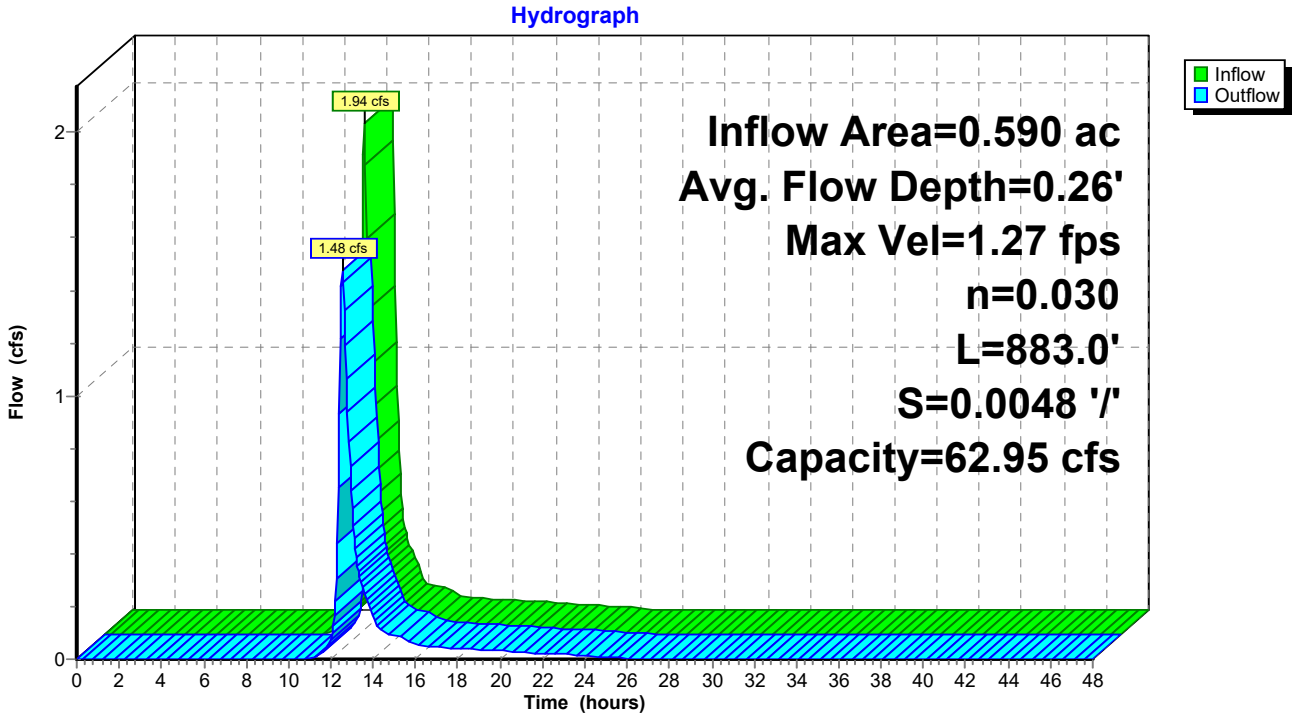
Inflow Area = 0.590 ac, 0.00% Impervious, Inflow Depth = 2.60" for 25 Yr-24 Hr event
Inflow = 1.94 cfs @ 12.25 hrs, Volume= 0.128 af
Outflow = 1.48 cfs @ 12.55 hrs, Volume= 0.128 af, Atten= 24%, Lag= 18.4 min
Routed to Pond 25P : N CB MH

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.27 fps, Min. Travel Time= 11.6 min
Avg. Velocity = 0.35 fps, Avg. Travel Time= 42.0 min

Peak Storage= 1,032 cf @ 12.36 hrs
Average Depth at Peak Storage= 0.26' , Surface Width= 5.03'
Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 62.95 cfs

4.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 883.0' Slope= 0.0048 '/'
Inlet Invert= 826.20', Outlet Invert= 822.00'





## Summary for Reach 10R: W Outer

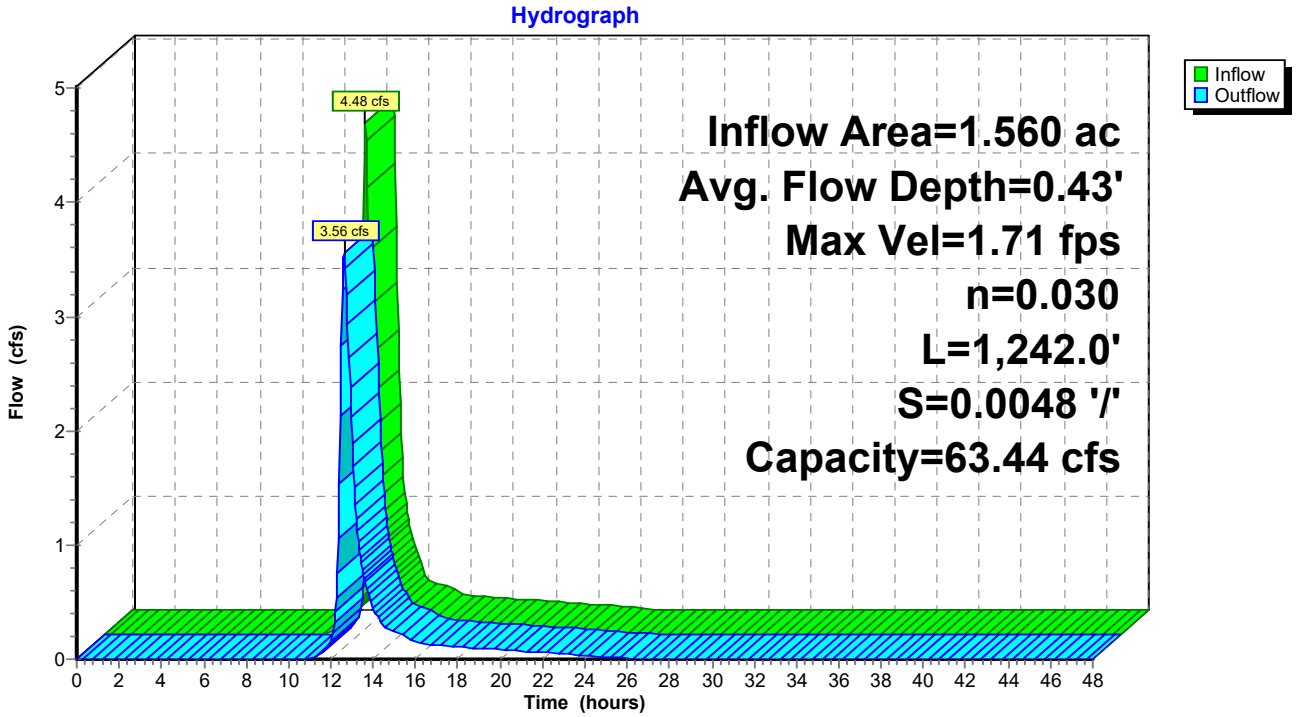
Inflow Area = 1.560 ac, 0.00% Impervious, Inflow Depth = 2.60" for 25 Yr-24 Hr event
Inflow = 4.48 cfs @ 12.31 hrs, Volume= 0.338 af
Outflow = 3.56 cfs @ 12.64 hrs, Volume= 0.338 af, Atten= 21%, Lag= 19.8 min
Routed to Pond 22P : Outer CB MH

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.71 fps, Min. Travel Time= 12.1 min
Avg. Velocity = 0.43 fps, Avg. Travel Time= 47.8 min

Peak Storage= 2,582 cf @ 12.44 hrs
Average Depth at Peak Storage= 0.43' , Surface Width= 5.71'
Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 63.44 cfs

4.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 1,242.0' Slope= 0.0048 '/'
Inlet Invert= 824.00', Outlet Invert= 818.00'





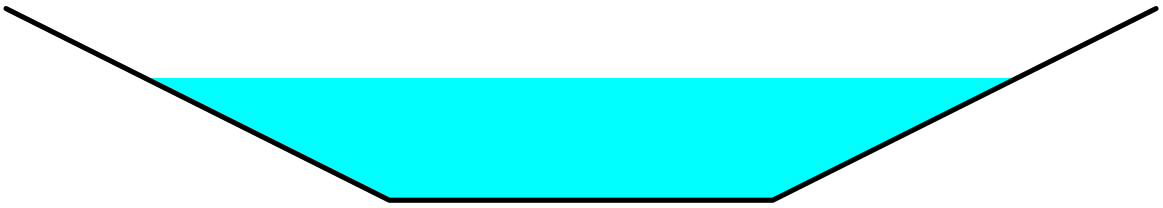
## Summary for Reach 11R: SW Outer

Inflow Area = 10.390 ac, 0.00% Impervious, Inflow Depth = 2.60" for 25 Yr-24 Hr event
Inflow = 31.08 cfs @ 12.35 hrs, Volume= 2.249 af
Outflow = 25.88 cfs @ 12.60 hrs, Volume= 2.249 af, Atten= 17%, Lag= 15.2 min
Routed to Pond 22P : Outer CB MH

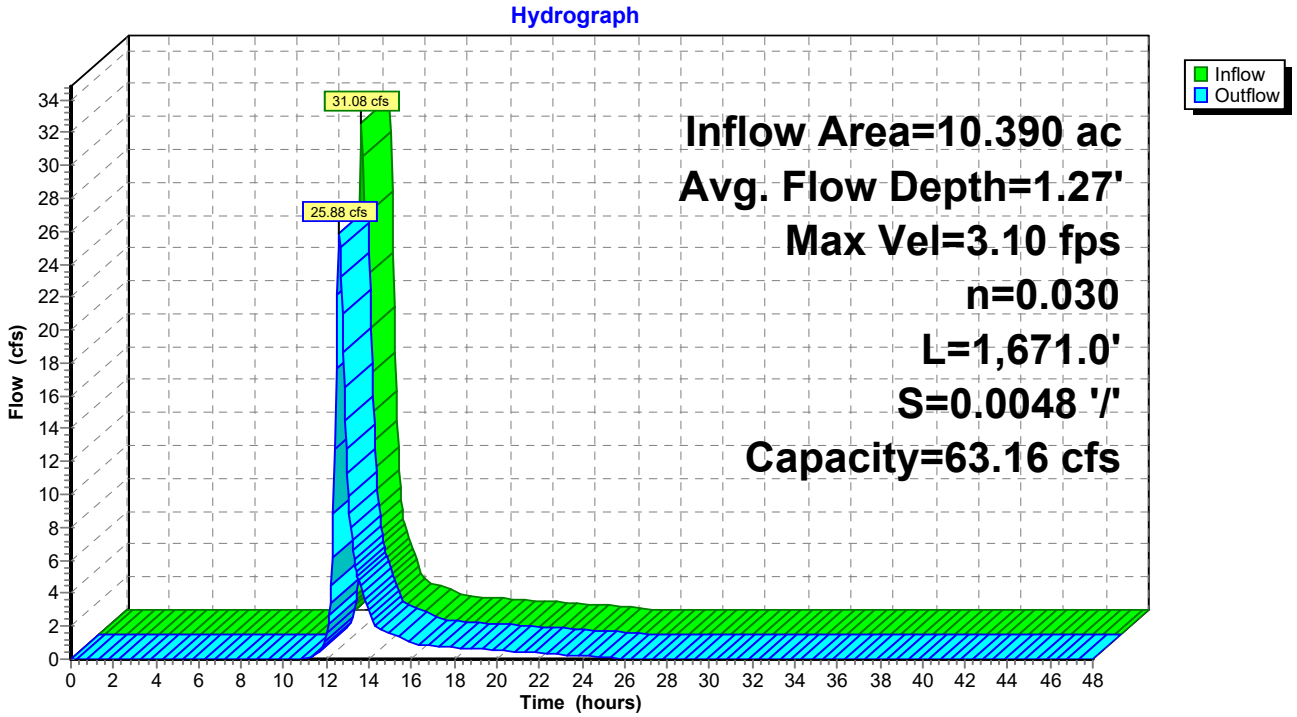
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.10 fps, Min. Travel Time= 9.0 min
Avg. Velocity = 0.67 fps, Avg. Travel Time= 41.9 min

Peak Storage= 13,948 cf @ 12.45 hrs
Average Depth at Peak Storage= 1.27' , Surface Width= 9.10'
Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 63.16 cfs

4.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 1,671.0' Slope= 0.0048 '/'
Inlet Invert= 824.00', Outlet Invert= 816.00'



**Reach 11R: SW Outer**



## Summary for Reach 14R: SE Outer

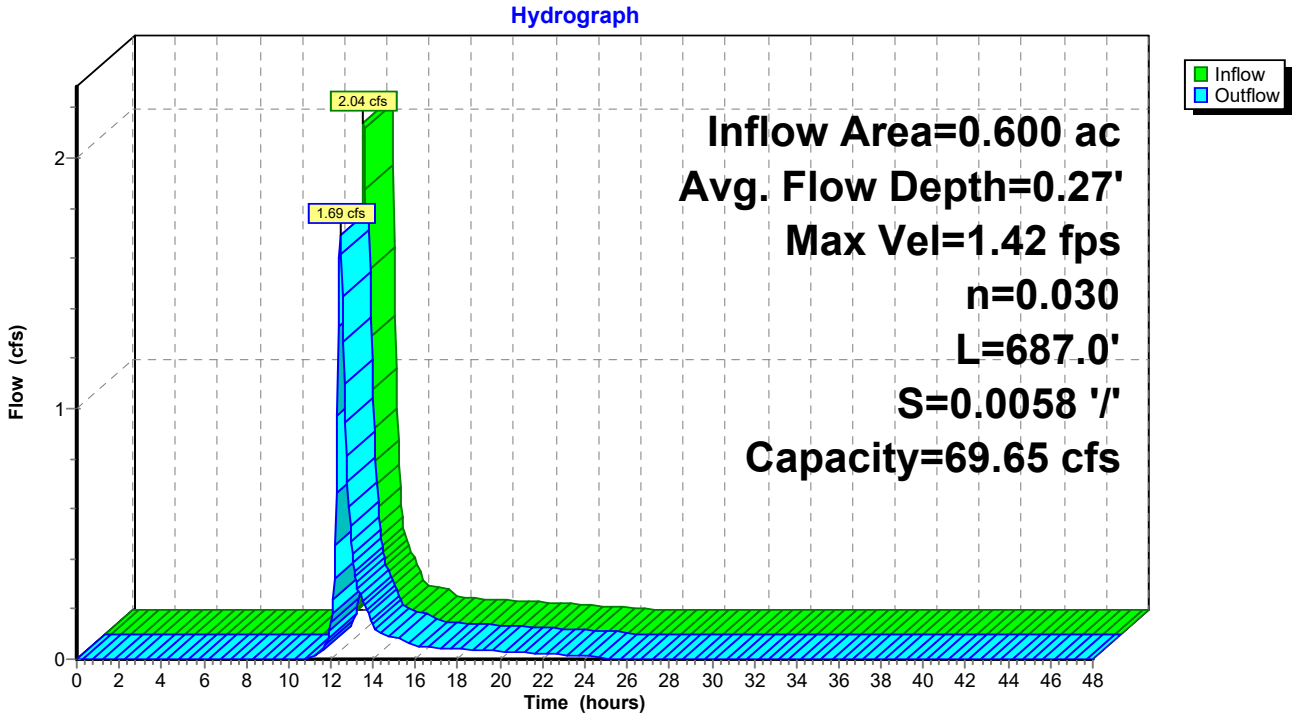
Inflow Area = 0.600 ac, 0.00% Impervious, Inflow Depth = 2.60" for 25 Yr-24 Hr event
Inflow = 2.04 cfs @ 12.23 hrs, Volume= 0.130 af
Outflow = 1.69 cfs @ 12.45 hrs, Volume= 0.130 af, Atten= 17%, Lag= 13.2 min
Routed to Pond 24P : SE CB

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.42 fps, Min. Travel Time= 8.0 min
Avg. Velocity = 0.39 fps, Avg. Travel Time= 29.5 min

Peak Storage= 825 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.27' , Surface Width= 5.06'
Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 69.65 cfs

4.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 687.0' Slope= 0.0058 '/'
Inlet Invert= 820.00', Outlet Invert= 816.00'





## Summary for Reach 15R: E Outer

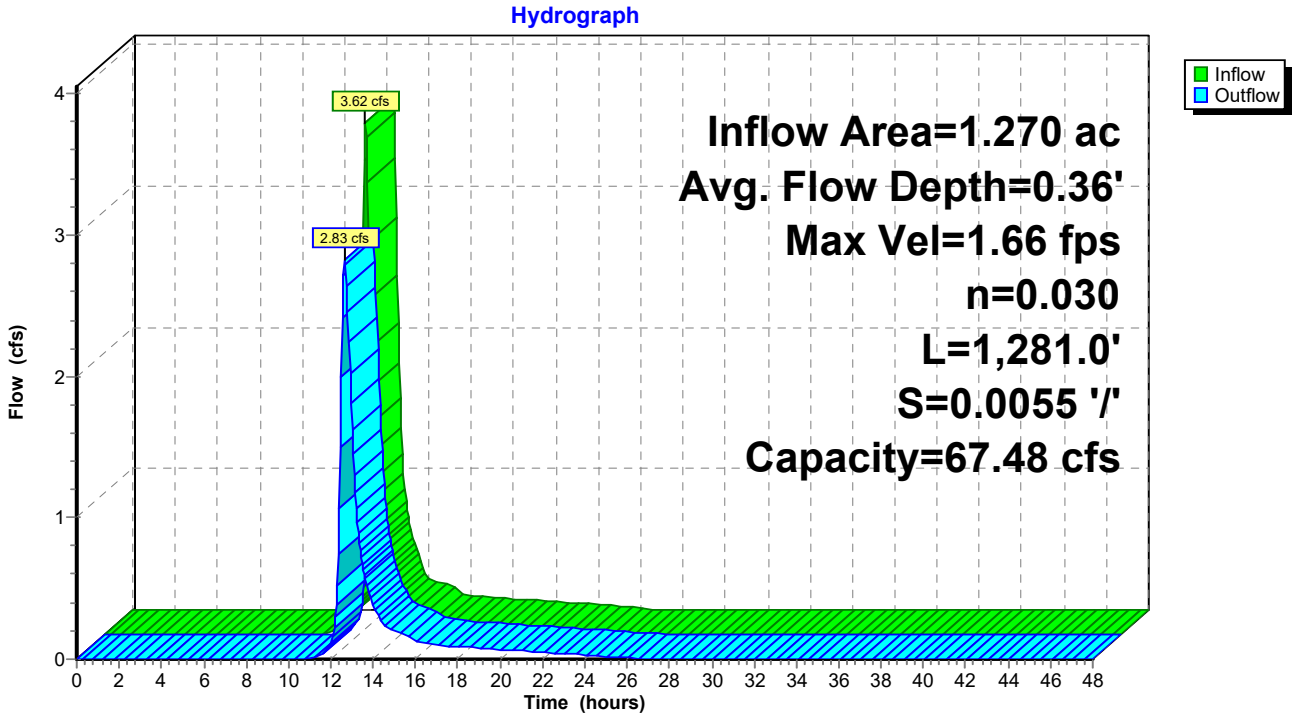
Inflow Area = 1.270 ac, 0.00% Impervious, Inflow Depth = 2.60" for 25 Yr-24 Hr event
Inflow = 3.62 cfs @ 12.31 hrs, Volume= 0.275 af
Outflow = 2.83 cfs @ 12.66 hrs, Volume= 0.275 af, Atten= 22%, Lag= 21.0 min
Routed to Pond 24P : SE CB

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.66 fps, Min. Travel Time= 12.9 min
Avg. Velocity = 0.43 fps, Avg. Travel Time= 49.5 min

Peak Storage= 2,194 cf @ 12.45 hrs
Average Depth at Peak Storage= 0.36' , Surface Width= 5.45'
Bank-Full Depth= 2.00' Flow Area= 16.0 sf, Capacity= 67.48 cfs

4.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 2.0 '/' Top Width= 12.00'
Length= 1,281.0' Slope= 0.0055 '/'
Inlet Invert= 823.00', Outlet Invert= 816.00'





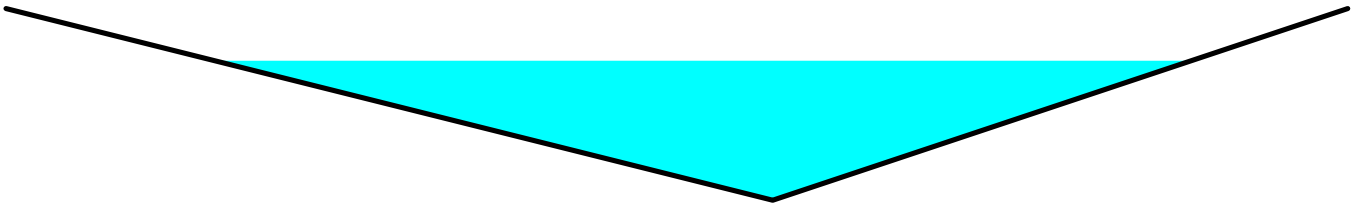
## Summary for Reach 19R: NE Inner

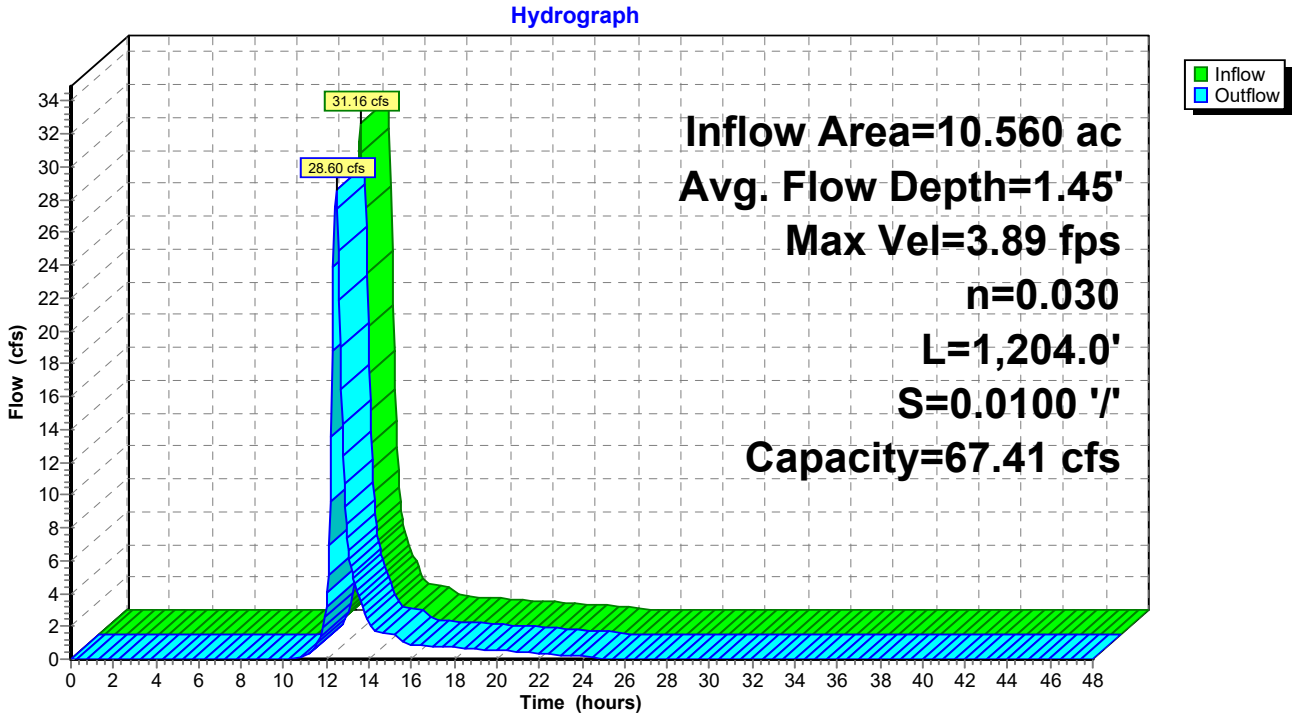
Inflow Area = 10.560 ac, 0.00% Impervious, Inflow Depth = 2.60" for 25 Yr-24 Hr event
Inflow = 31.16 cfs @ 12.29 hrs, Volume= 2.286 af
Outflow = 28.60 cfs @ 12.45 hrs, Volume= 2.286 af, Atten= 8%, Lag= 9.3 min
Routed to Pond 25P : N CB MH

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.89 fps, Min. Travel Time= 5.2 min
Avg. Velocity = 1.18 fps, Avg. Travel Time= 17.0 min

Peak Storage= 8,920 cf @ 12.36 hrs
Average Depth at Peak Storage= 1.45' , Surface Width= 10.18'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 67.41 cfs

0.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 4.0 3.0 '/' Top Width= 14.00'
Length= 1,204.0' Slope= 0.0100 '/'
Inlet Invert= 838.00', Outlet Invert= 826.00'





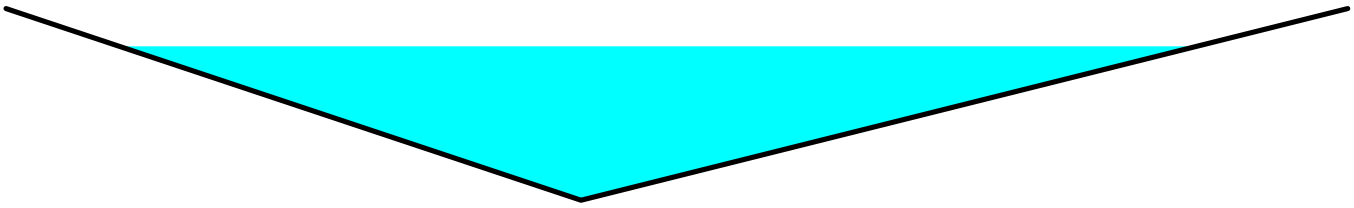
## Summary for Reach 20R: NW Inner

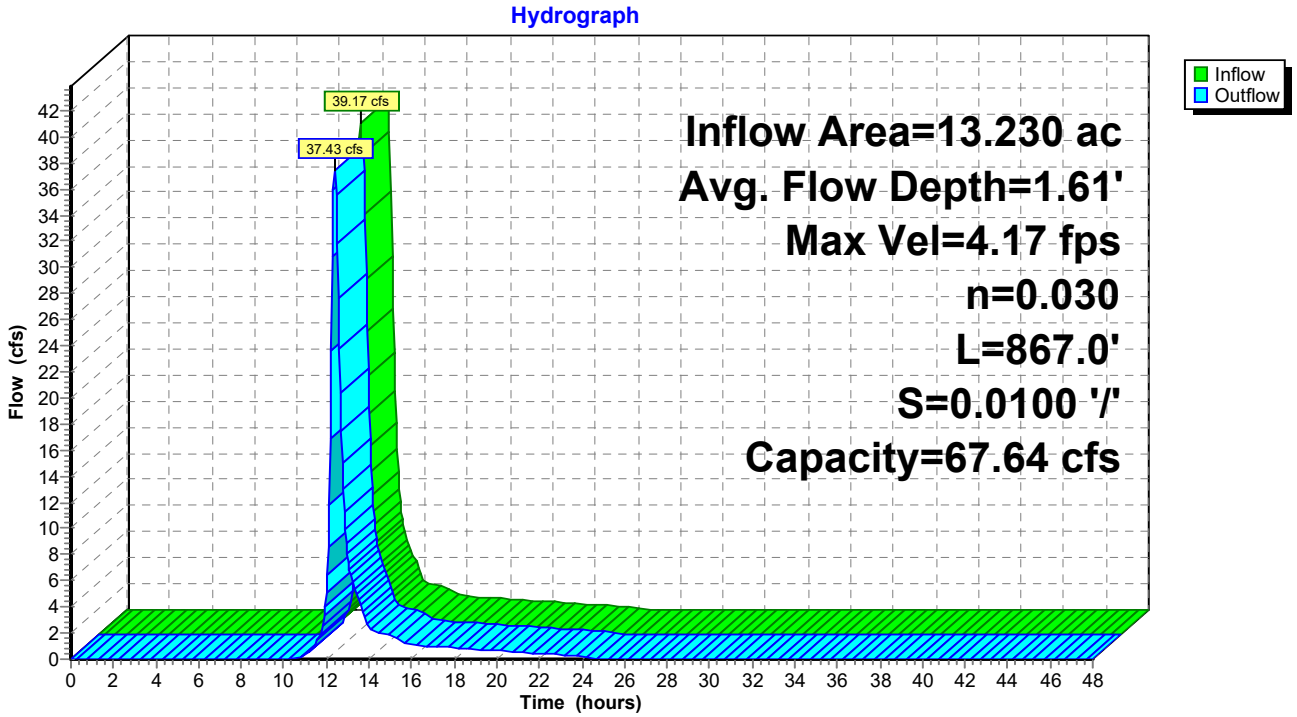
Inflow Area = 13.230 ac, 0.00% Impervious, Inflow Depth = 2.60" for 25 Yr-24 Hr event
Inflow = 39.17 cfs @ 12.29 hrs, Volume= 2.864 af
Outflow = 37.43 cfs @ 12.40 hrs, Volume= 2.864 af, Atten= 4%, Lag= 6.4 min
Routed to Pond 25P : N CB MH

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.17 fps, Min. Travel Time= 3.5 min
Avg. Velocity = 1.34 fps, Avg. Travel Time= 10.8 min

Peak Storage= 7,821 cf @ 12.34 hrs
Average Depth at Peak Storage= 1.61' , Surface Width= 11.24'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 67.64 cfs

0.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 4.0 '/' Top Width= 14.00'
Length= 867.0' Slope= 0.0100 '/'
Inlet Invert= 834.70', Outlet Invert= 826.00'





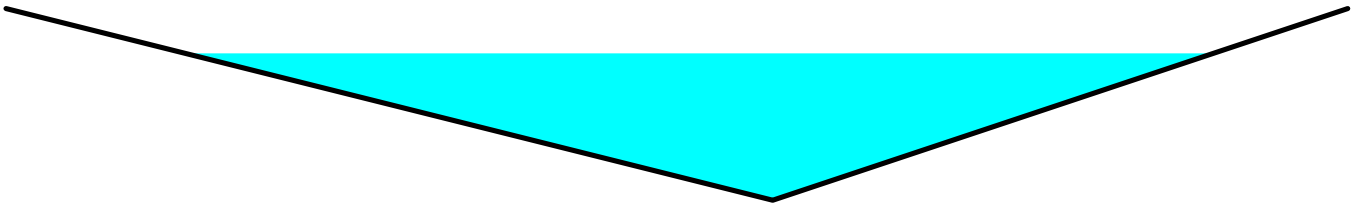
## Summary for Reach 22R: E Inner

Inflow Area = 11.510 ac, 0.00% Impervious, Inflow Depth = 2.60" for 25 Yr-24 Hr event
Inflow = 34.32 cfs @ 12.29 hrs, Volume= 2.492 af
Outflow = 32.90 cfs @ 12.39 hrs, Volume= 2.492 af, Atten= 4%, Lag= 6.1 min
Routed to Reach 4R : NE Outer

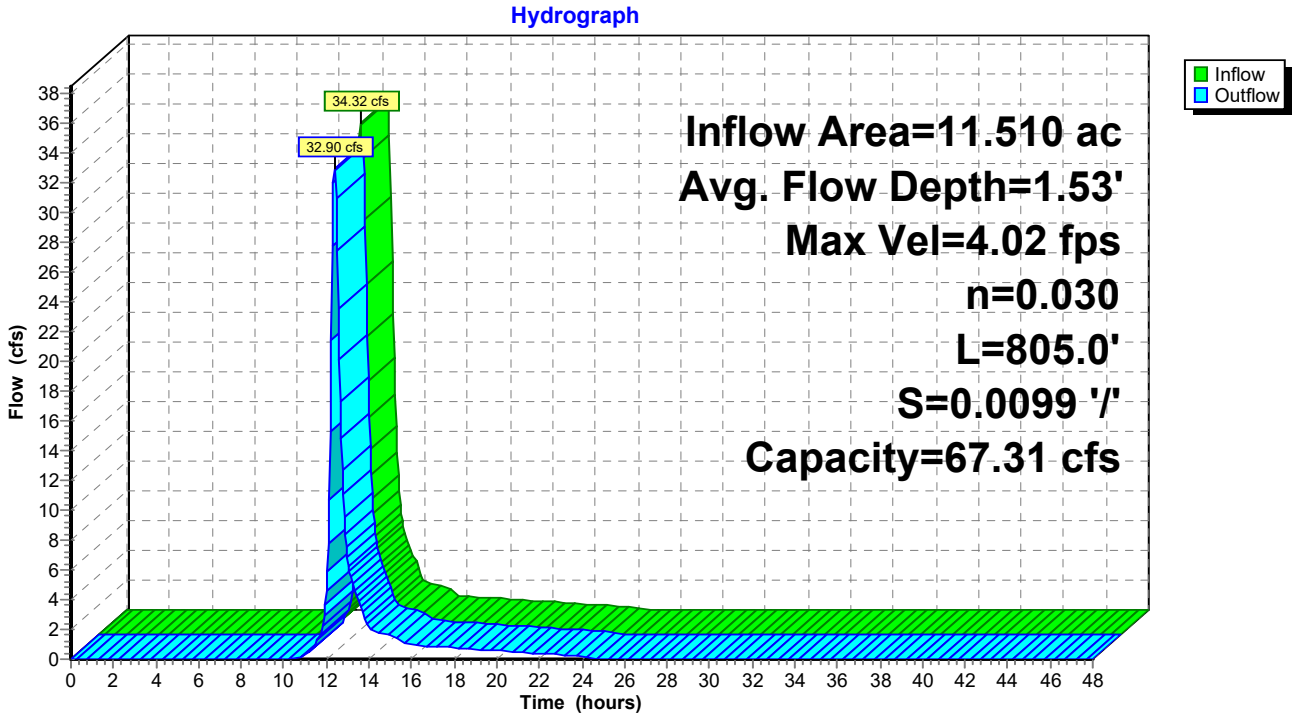
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.02 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 1.31 fps, Avg. Travel Time= 10.2 min

Peak Storage= 6,610 cf @ 12.33 hrs
Average Depth at Peak Storage= 1.53' , Surface Width= 10.72'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 67.31 cfs

0.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 4.0 3.0 '/' Top Width= 14.00'
Length= 805.0' Slope= 0.0099 '/'
Inlet Invert= 838.00', Outlet Invert= 830.00'



### Reach 22R: E Inner



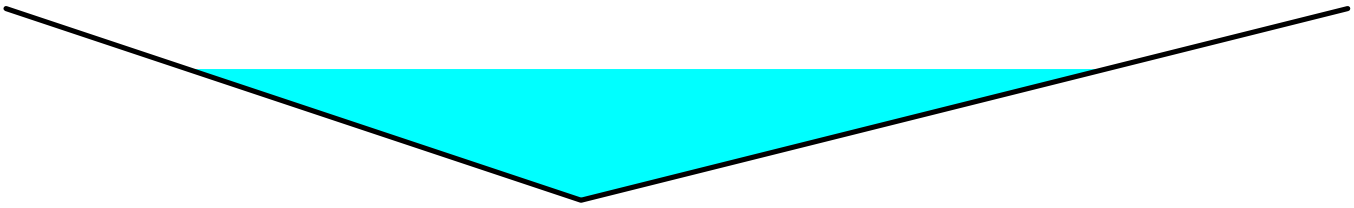
## Summary for Reach 24R: SE Inner

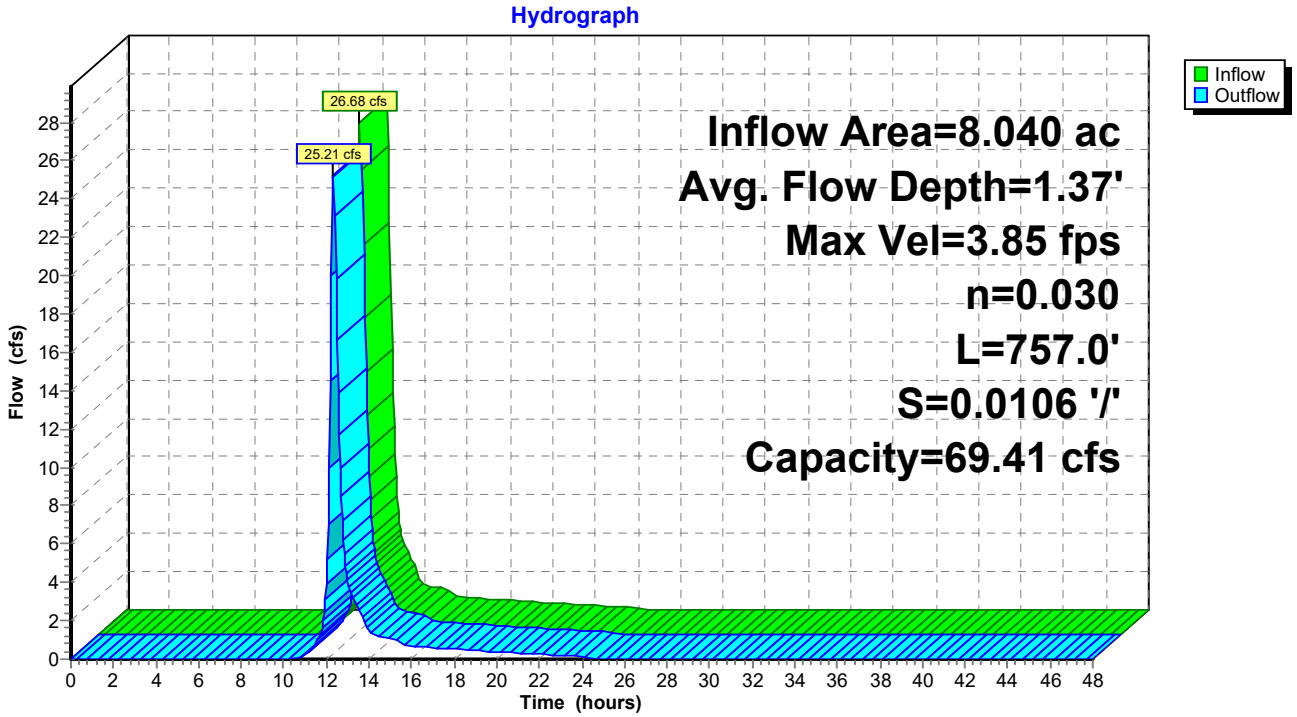
Inflow Area = 8.040 ac, 0.00% Impervious, Inflow Depth = 2.60" for 25 Yr-24 Hr event
Inflow = 26.68 cfs @ 12.24 hrs, Volume= 1.740 af
Outflow = 25.21 cfs @ 12.34 hrs, Volume= 1.740 af, Atten= 6%, Lag= 5.9 min
Routed to Reach 11R : SW Outer

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.85 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 1.25 fps, Avg. Travel Time= 10.1 min

Peak Storage= 4,976 cf @ 12.29 hrs
Average Depth at Peak Storage= 1.37' , Surface Width= 9.59'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 69.41 cfs

0.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 4.0 '/' Top Width= 14.00'
Length= 757.0' Slope= 0.0106 '/'
Inlet Invert= 834.00', Outlet Invert= 826.00'





## Summary for Reach 28R: SW Downslope

Inflow Area = 26.860 ac, 0.00% Impervious, Inflow Depth = 2.60" for 25 Yr-24 Hr event
Inflow = 79.49 cfs @ 12.29 hrs, Volume= 5.814 af
Outflow = 79.34 cfs @ 12.30 hrs, Volume= 5.814 af, Atten= 0%, Lag= 0.3 min
Routed to Pond 22P : Outer CB MH

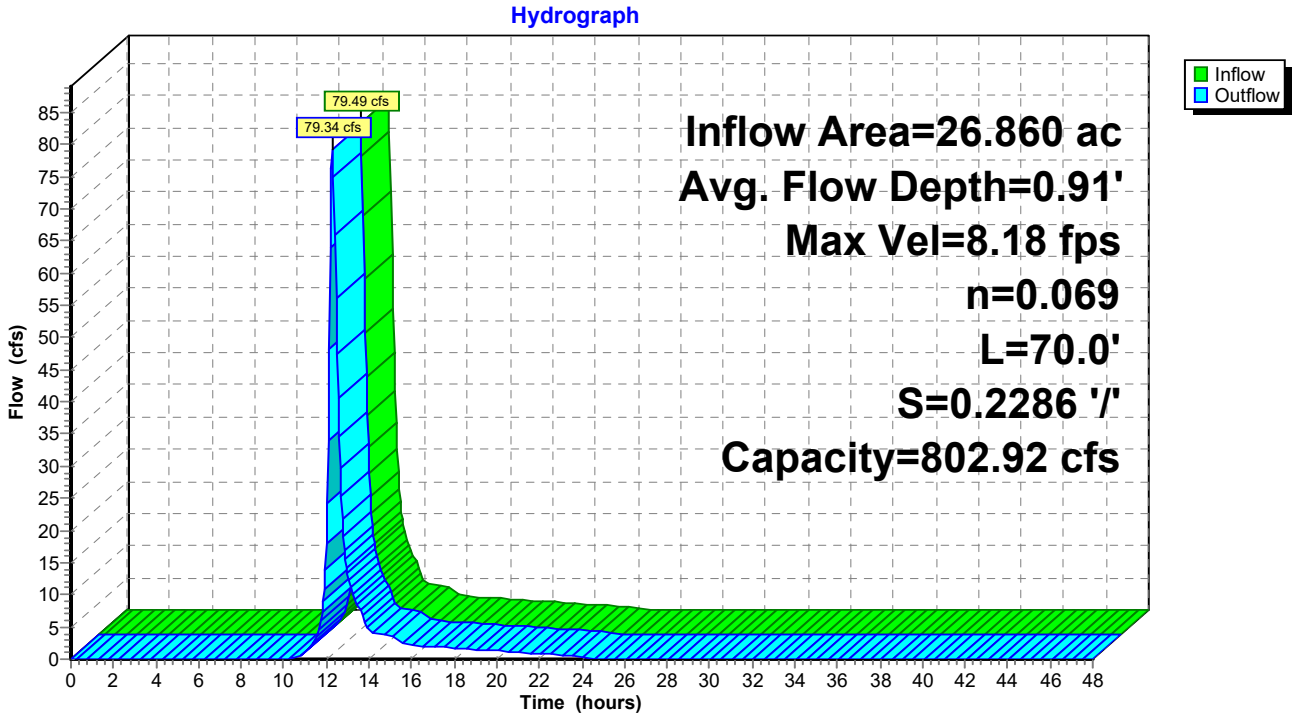
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.18 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.37 fps, Avg. Travel Time= 0.5 min

Peak Storage= 681 cf @ 12.29 hrs
Average Depth at Peak Storage= 0.91' , Surface Width= 13.44'
Bank-Full Depth= 3.00' Flow Area= 51.0 sf, Capacity= 802.92 cfs

8.00' x 3.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 3.0 '/' Top Width= 26.00'
Length= 70.0' Slope= 0.2286 '/'
Inlet Invert= 832.00', Outlet Invert= 816.00'



‡



## Summary for Pond 5P: N Pond

Inflow Area = 36.810 ac, 0.00% Impervious, Inflow Depth = 2.60" for 25 Yr-24 Hr event
Inflow = 90.74 cfs @ 12.47 hrs, Volume= 7.968 af
Outflow = 4.48 cfs @ 15.42 hrs, Volume= 4.374 af, Atten= 95%, Lag= 177.0 min
Primary = 4.48 cfs @ 15.42 hrs, Volume= 4.374 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 808.00' Surf.Area= 2.996 ac Storage= 10.815 af
Peak Elev= 809.84' @ 15.42 hrs Surf.Area= 3.272 ac Storage= 16.583 af (5.767 af above start)

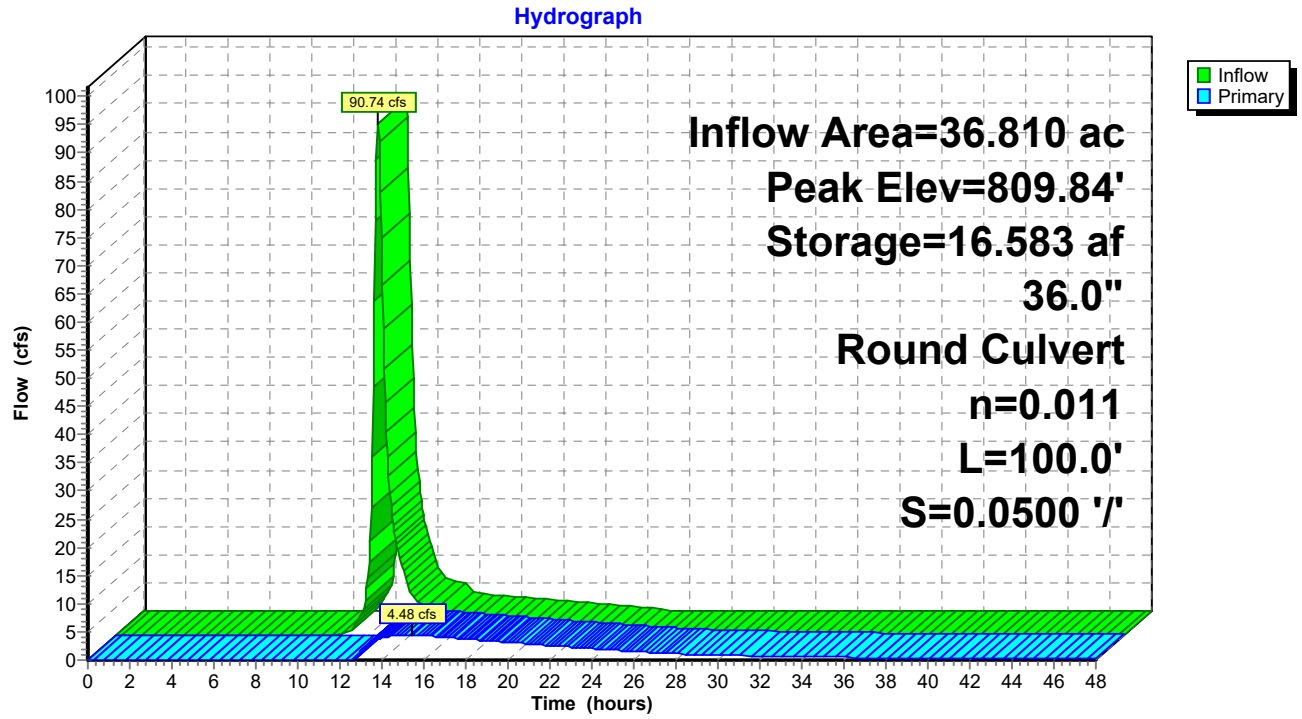
Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 480.1 min ( 1,317.3 - 837.2 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 804.00' | 31.525 af | **115.00'W x 915.00'L x 10.00'H Prismatoid Z=3.0** |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 809.00' | **36.0" Round RCP_Round 36"**<br>L= 100.0' RCP, mitered to conform to fill, Ke= 0.700<br>Inlet / Outlet Invert= 809.00' / 804.00' S= 0.0500 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, straight & clean, Flow Area= 7.07 sf |

**Primary OutFlow** Max=4.46 cfs @ 15.42 hrs HW=809.84' (Free Discharge)
**1=RCP_Round 36"** (Inlet Controls 4.46 cfs @ 2.75 fps)

## Pond 5P: N Pond



## Summary for Pond 12P: W Pond

Inflow Area = 38.810 ac, 0.00% Impervious, Inflow Depth = 2.60" for 25 Yr-24 Hr event
Inflow = 86.47 cfs @ 12.32 hrs, Volume= 8.401 af
Outflow = 5.33 cfs @ 15.13 hrs, Volume= 7.352 af, Atten= 94%, Lag= 169.0 min
Primary = 5.33 cfs @ 15.13 hrs, Volume= 7.352 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 805.00' Surf.Area= 1.409 ac Storage= 3.918 af
Peak Elev= 808.68' @ 15.13 hrs Surf.Area= 1.679 ac Storage= 9.599 af (5.682 af above start)

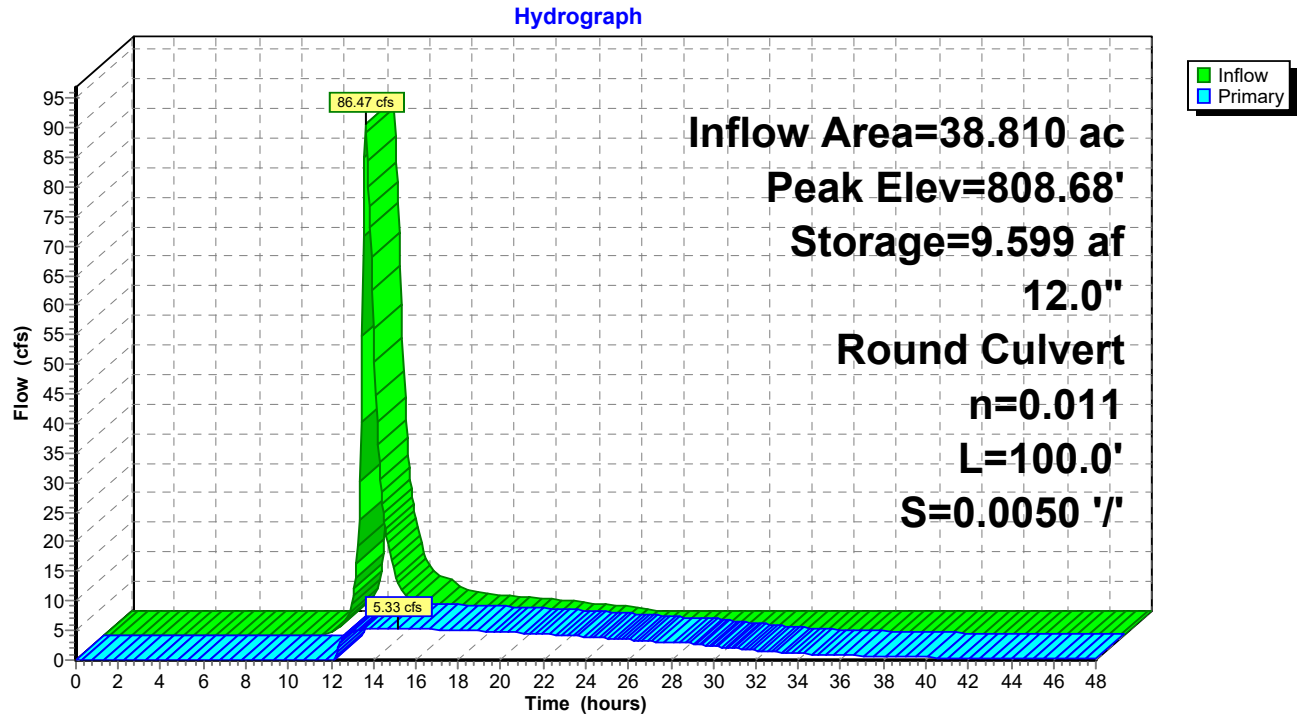
Plug-Flow detention time= 991.5 min calculated for 3.435 af (41% of inflow)
Center-of-Mass det. time= 520.9 min ( 1,351.7 - 830.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 802.00' | 11.877 af | **175.00'W x 300.00'L x 8.00'H Prismatoid Z=3.0** |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 805.50' | **12.0" Round RCP_Round 12"**<br>L= 100.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 805.50' / 805.00' S= 0.0050 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf |

**Primary OutFlow** Max=5.33 cfs @ 15.13 hrs HW=808.68' (Free Discharge)
**1=RCP_Round 12"** (Barrel Controls 5.33 cfs @ 6.79 fps)

### Pond 12P: W Pond



## Summary for Pond 13P: SE Pond

Inflow Area = 1.870 ac, 0.00% Impervious, Inflow Depth = 2.60" for 25 Yr-24 Hr event
Inflow = 3.98 cfs @ 12.61 hrs, Volume= 0.405 af
Outflow = 1.82 cfs @ 13.06 hrs, Volume= 0.403 af, Atten= 54%, Lag= 26.9 min
Primary = 1.82 cfs @ 13.06 hrs, Volume= 0.403 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Starting Elev= 807.00' Surf.Area= 0.184 ac Storage= 0.445 af
Peak Elev= 807.74' @ 13.06 hrs Surf.Area= 0.204 ac Storage= 0.588 af (0.143 af above start)

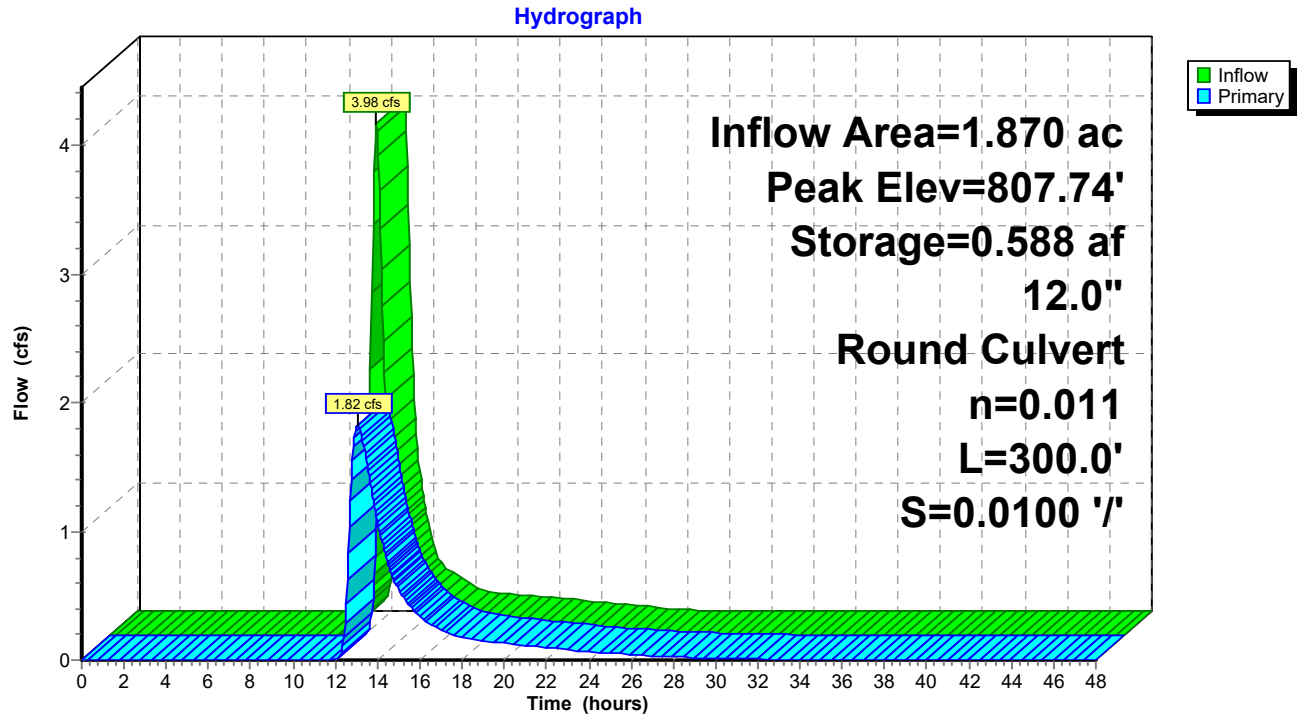
Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= 105.6 min ( 959.8 - 854.2 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 804.00' | 1.720 af | **50.00'W x 100.00'L x 8.00'H Prismatoid Z=3.0** |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 807.00' | **12.0" Round RCP_Round 12"**<br>L= 300.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 807.00' / 804.00' S= 0.0100 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf |

**Primary OutFlow** Max=1.82 cfs @ 13.06 hrs HW=807.74' (Free Discharge)
**1=RCP_Round 12"** (Inlet Controls 1.82 cfs @ 2.93 fps)

### Pond 13P: SE Pond



## Summary for Pond 22P: Outer CB MH

Inflow Area = 38.810 ac, 0.00% Impervious, Inflow Depth = 2.60" for 25 Yr-24 Hr event
Inflow = 86.49 cfs @ 12.31 hrs, Volume= 8.401 af
Outflow = 86.47 cfs @ 12.32 hrs, Volume= 8.401 af, Atten= 0%, Lag= 0.1 min
Primary = 86.47 cfs @ 12.32 hrs, Volume= 8.401 af
Routed to Pond 12P : W Pond

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 817.95' @ 12.32 hrs Surf.Area= 0.001 ac Storage= 0.005 af

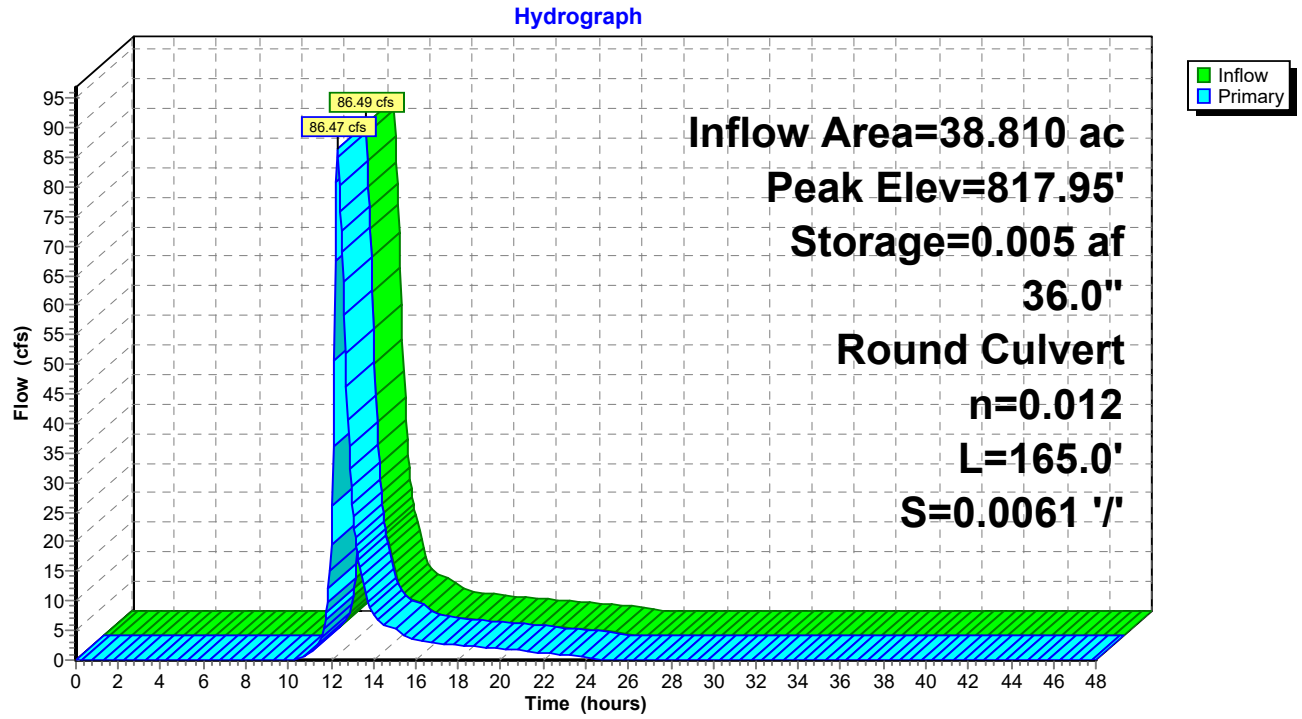
Plug-Flow detention time= 0.1 min calculated for 8.401 af (100% of inflow)
Center-of-Mass det. time= 0.1 min ( 830.8 - 830.7 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 810.00' | 0.006 af | **6.00'D x 9.00'H Vertical Cone/Cylinder** |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 810.00' | **36.0" Round Culvert**<br>L= 165.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 810.00' / 809.00' S= 0.0061 '/' Cc= 0.900<br>n= 0.012, Flow Area= 7.07 sf |

**Primary OutFlow** Max=85.78 cfs @ 12.32 hrs HW=817.85' (Free Discharge)
**1=Culvert** (Inlet Controls 85.78 cfs @ 12.14 fps)

## Pond 22P: Outer CB MH



## Summary for Pond 24P: SE CB

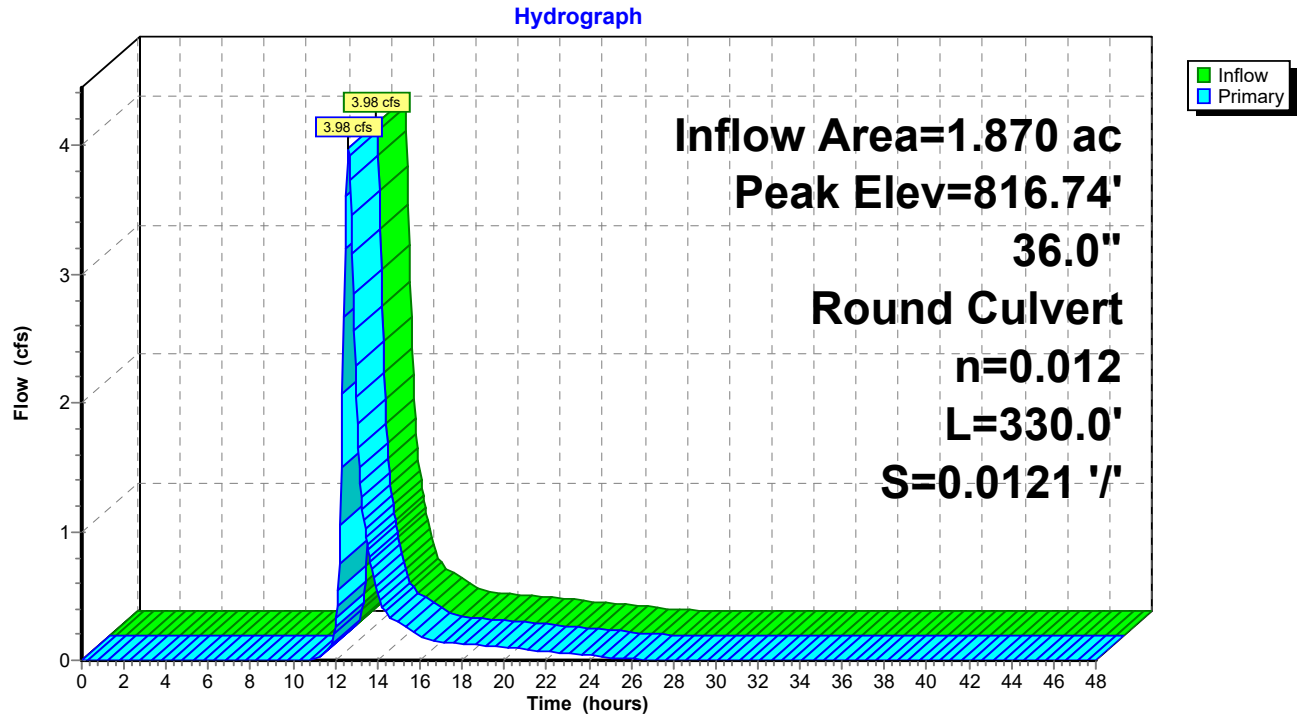
Inflow Area = 1.870 ac, 0.00% Impervious, Inflow Depth = 2.60" for 25 Yr-24 Hr event
Inflow = 3.98 cfs @ 12.61 hrs, Volume= 0.405 af
Outflow = 3.98 cfs @ 12.61 hrs, Volume= 0.405 af, Atten= 0%, Lag= 0.0 min
Primary = 3.98 cfs @ 12.61 hrs, Volume= 0.405 af
Routed to Pond 13P : SE Pond

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 816.74' @ 12.61 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 816.00' | **36.0" Round RCP_Round 36"**<br>L= 330.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 816.00' / 812.00' S= 0.0121 '/' Cc= 0.900<br>n= 0.012 Concrete pipe, finished, Flow Area= 7.07 sf |

**Primary OutFlow** Max=3.96 cfs @ 12.61 hrs HW=816.74' (Free Discharge)
**1=RCP_Round 36"** (Inlet Controls 3.96 cfs @ 2.93 fps)

## Pond 24P: SE CB



## Summary for Pond 25P: N CB MH

Inflow Area = 36.810 ac, 0.00% Impervious, Inflow Depth = 2.60" for 25 Yr-24 Hr event
Inflow = 90.67 cfs @ 12.47 hrs, Volume= 7.968 af
Outflow = 90.74 cfs @ 12.47 hrs, Volume= 7.968 af, Atten= 0%, Lag= 0.0 min
Primary = 90.74 cfs @ 12.47 hrs, Volume= 7.968 af
Routed to Pond 5P : N Pond

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 822.60' @ 12.47 hrs Surf.Area= 0.001 ac Storage= 0.005 af

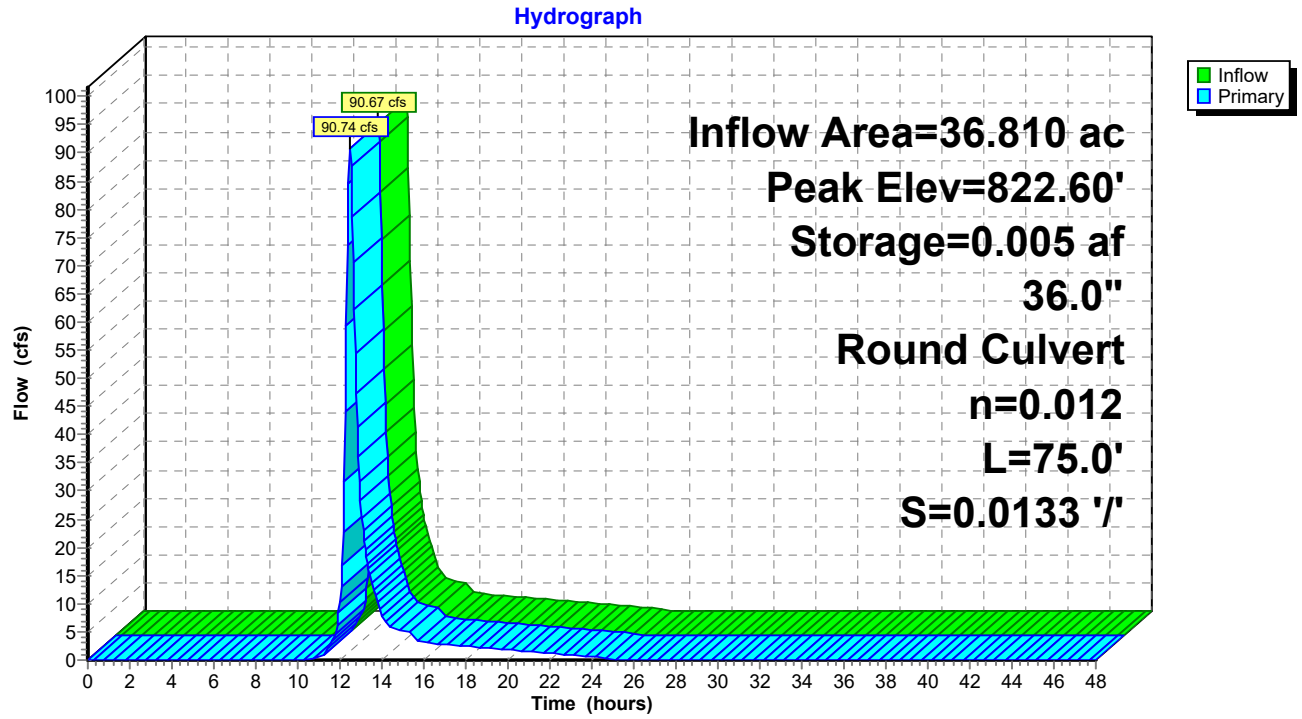
Plug-Flow detention time= 0.1 min calculated for 7.968 af (100% of inflow)
Center-of-Mass det. time= 0.1 min ( 837.2 - 837.1 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 814.00' | 0.005 af | **6.00'D x 8.00'H Vertical Cone/Cylinder** |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 814.00' | **36.0" Round Culvert**<br>L= 75.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 814.00' / 813.00' S= 0.0133 '/' Cc= 0.900<br>n= 0.012 Concrete pipe, finished, Flow Area= 7.07 sf |

**Primary OutFlow** Max=90.01 cfs @ 12.47 hrs HW=822.49' (Free Discharge)
**1=Culvert** (Inlet Controls 90.01 cfs @ 12.73 fps)

## Pond 25P: N CB MH



# Appendix H Construction Quality Assurance Plan

# Construction Quality Assurance Program

Cell Construction
Dem-Con Pilgrim Landfill (SW-254)

April 2026

Prepared for:

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Prepared by:

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ATTACHMENT 1: TECHNICAL SPECIFICATIONS

# 1.0 INTRODUCTION

This manual outlines Construction Quality Assurance (CQA) procedures for the installation of the landfill liner system for new cell development at the Dem-Con Companies Pilgrim Landfill (facility or Landfill) near Mankato in Blue Earth County, Minnesota. This manual addresses survey requirements, soils, piping, and geosynthetic components of the leachate collection and liner systems, and is to be used as the basis of the overall CQA program.

The overall goal of this construction quality assurance program is to ensure that proper construction techniques and procedures are used and to verify that the materials and installation techniques used meet the project design requirements. At completion of the work, the program will culminate in a certification report which documents that the project has been constructed in substantial accordance with the design standards and specifications. Construction specifications for cell construction are provided in Attachment 1.

## 1.1 DEFINITIIONS

**Quality Assurance**: Means and actions employed by Owner to assure conformity of the materials and installation with the approved drawings, specifications, and other project requirements.

**Quality Control**: Actions taken by the product manufacturers, installers, contractor, and subcontractors to ensure that materials and workmanship meet the requirements of the drawings, specifications, and other project requirements.

**Lining System:** Refers to a base liner system.

**Technical Specifications:** A document produced by the Designer declaring minimum values of performance of construction materials.

**Subgrade:** The surface of the underlying soil prepared to receive the lining system.

**Certification Report:** A report documenting construction procedures, and that the construction was carried out according to approved drawings and specifications, and this CQA plan.

## 1.2 PARTIES

The parties discussed in this section are associated with the ownership, design, supply, manufacture, transportation, installation, and quality assurance of a component of the landfill such as the lining or leachate collection system. The typical parties involved and their functions are described below:

**Owner:** The party that owns and operates the facility that is responsible for the overall coordination of CQA activities. The Owner is also responsible for selecting the necessary parties associated with construction.

**Designer:** The firm responsible for preparing the engineering design, associated plans, and specifications for the facility. The Designer for the project shall be a registered professional engineer in the State of Minnesota. The Designer may provide clarification necessitated during construction.

**Quality Assurance Contractor (QAC):** A firm, independent of the Owner, that observes tests and documents construction activities on behalf of the Owner. The QAC will identify and notify the Owner of any deviations or problems that arise during construction and assist in resolution. The QAC is also responsible for preparation of the construction certification report required for submittal to the Minnesota Pollution Control Agency (MPCA). The QAC will have an individual identified as the CQA Officer. The CQA Officer will be a registered professional engineer in the State of Minnesota. The QAC may also be denoted as the ENGINEER in the Technical Specifications. For this project, the QAC is also responsible for marking and recording the necessary grades. The QAC will provide grade verification of necessary subgrade and liner system component thicknesses as well as locations and elevations of piping components.

**Contractor:** This firm is mainly responsible for the earthwork preparation and construction of the soil components of the lining system. The Contractor typically prepares the subgrade or foundation soil on which the geosynthetics are placed. The contractor may also be responsible for placing the soil materials over the lining system. In addition, the contractor may install other components associated with the leachate collection system.

**Geosynthetic Manufacturer (GM):** The GM is the firm or firms responsible for the production and supply of the various geosynthetic components. The geosynthetic manufacturer will be responsible for providing QC documentation that the materials meet the material requirements of the drawings, specifications, and other project requirements. The GM is responsible for the condition of the product until the material is accepted by the Owner on-site.

**Geosynthetic Installer (GI):** The GI is responsible for field handling, storing, placing, seaming, loading, and other aspects of the installation of geosynthetics.

**Quality Assurance Laboratory (QAL)**: Firm that performs necessary testing on samples taken from the site.

# 2.0 FOUNDATION AND BERMS

## 2.1 GENERAL

The foundation and berms serve as the components on which the liner systems are constructed.

## 2.2 MATERIAL QUALITY CONTROL

Material for foundation and berms may either be on-site or imported, depending on use and material availability. Testing may be required prior to use, depending on the source and the designated use. On-site soils are suitable for use as long as there are no foreign objects visible and no organic soils are encountered, which must be removed and replaced with suitable soil.

## 2.3 OBSERVATION AND DOCUMENTATION

No unsuitable material will be used in structural berms or in the subgrade of the liner system. Construction activities will be documented. The QAC shall document the grades and elevations after surface preparation.

## 2.4 SURVEY

The survey of specific locations will provide the basis for record drawings. The survey will be performed by the QAC. The survey will be conducted on a grid and at major breaks. Grading tolerances are provided in Table 1.

## 2.5 TESTING

The material will be tested in accordance with the project requirements. The surface will be prepared to be capable of supporting construction of the overlaying layers. Soil material specifications are provided in Table 2.

# 3.0 BARRIER SOIL LAYER

## 3.1 GENERAL

This layer serves as the earthen barrier in the base liner system and is the surface upon which the geosynthetic components of the liner system are deployed. The barrier soil layer is replaced with a low-permeability clay barrier layer in the leachate collection sumps. See project specifications for further information on material and construction requirements for the clay barrier layer.

## 3.2 MATERIAL QUALITY CONTROL

Samples of the material will be tested for USCS classification and moisture-density relationship. Testing parameters and frequencies are listed in Table 2. The contractor is responsible for selection of barrier layer material to complete construction. Source testing of soil materials will be in accordance with the Specifications.

## 3.3 SUBGRADE

The CONTRACTOR shall be responsible for preparing the subgrade for the soil barrier layer. Once complete, the ENGINEER shall examine the surface and verify the adequacy of the survey data provided. When the ENGINEER deems the surface acceptable, the ENGINEER shall prepare an acceptance certificate. The acceptance certificate shall state the following at a minimum:

1. The required survey has been performed and the results meet the specifications.
2. The subgrade has been tested and meets the project requirements.

The CONTRACTOR must prepare and grade the soils below the liner to create a smooth, stable subgrade. The surface must be free of foreign objects and wood and must not have objects protruding above the surface. At any time during construction of the soil liner, the ENGINEER shall inform the Owner of any areas that are unacceptable. Such defects in the subgrade shall be corrected by the CONTRACTOR such that repaired areas meet the project specifications. Subgrade testing will be completed as identified in Table 2.

## 3.4 OBSERVATION AND DOCUMENTATION

The ENGINEER shall document the following during the construction of the barrier layer:

**Excavation:** The ENGINEER shall document the slope and the depth of the excavation and document that the subgrade surface meets specification.

**Borrow Sources:** For each borrow source the ENGINEER shall document the following:

- Location;

- Description of soil;
- Moisture-density relationship;
- Removal of deleterious or off-specification material;
- Placed and compacted volume of soil.

The laboratory test requirements are given in Table 2.

**Compaction:** The following will be documented during compaction of the soil:

- Type and weight of compaction equipment;
- Method of surface preparation;
- Method of adjusting soil moisture and controlling desiccation;
- Compacted lift thickness;
- General number of passes and uniformity of coverage;
- Reduction in clod size;
- Repair;
- Observation of the thickness of lifts as loosely placed and as compacted;
- Observation of the action of the compaction and heavy hauling equipment on the construction surface (sheepsfoot penetration, pumping, cracking, etc.);
- Verification that all frozen soil is removed prior to placement of subsequent material;
- Verification that frozen soil is not placed.

## 3.5 TESTING

Laboratory test methods and frequencies to develop data upon which acceptability evaluations can be based will be as provided in Table 2.

Barrier layer material will be thoroughly and uniformly compacted within the specified moisture content window and shall be compacted to greater than or equal to 95% of the standard proctor as outlined in the project specifications. The clay barrier layer used in the leachate collection sumps must also meet a 0-5% wet of optimum moisture content requirement. Each lift (maximum eight-inch loose lifts) will be integrated into the previous lift by techniques such as scarifying each lift and by using compaction equipment that is capable of penetrating the thickness of each compacted lift, except that such a compactor shall not be used in the first 2 lifts immediately above the synthetic liner, secondary collection system, or other sensitive liner system component, if applicable. CONTRACTOR shall compact with sheepsfoot roller, or similar kneading-type compactor. The feet of the compactor shall be greater than the thickness of each lift. CONTRACTOR shall compact the layers of soil to form continuous monolithic material with excessively dry or wet soil removed before placement of additional lifts; knead each lift into previously placed lift. Nuclear density methods will be preferred for moisture and density testing due to the ease of testing and the relatively large number of tests which can be run in a given period of time. Areas that are not sufficiently compacted must be re-worked and re-compacted over an area that extends one-half of the distance in all directions to the nearest passing test locations. Questions concerning the accuracy of any single test will be addressed by retesting in the same location until a passing test is obtained.



Final surface shall be smooth-rolled prior to geosynthetic placement. Finished surface will be smooth and even with no sheepsfoot roller indentations. Surface must be smooth and free of debris, roots, and stones or rocks larger than 3/8 inch in diameter or angular stone of any size or any other material that would be deleterious to the overlying geomembrane liner. CONTRACTOR shall be responsible for the integrity of the barrier soil layer. CONTRACTOR shall maintain the subbase in an acceptable condition and make repairs, as needed, until the geosynthetic materials are placed, tested, and approved by the Owner.

CQA testing will be conducted on samples taken from the material during the course of construction. Sampling locations will be selected by ENGINEER according to the number of required tests. Locations of tests will be documented for report purposes.

A special testing frequency will be used when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- Lift thickness is greater than specified;
- Earth fill is at variable moisture content;
- Dirt-clogged rollers are used to compact the material;
- Rollers may not have used optimum ballast;
- The degree of compaction is questionable.

During construction, the frequency of testing may also be increased in the following situations:

- Adverse weather conditions;
- Breakdown of equipment;
- At the start and finish of grading;
- Material fails to meet specifications;
- The size of the work area is increased.

Perforations in the soil liner will occur during construction due to in-place testing. The perforation would be caused by:

1. Nuclear density test probe locations.

Unless otherwise directed by the ENGINEER or Owner, all perforations of the soil liner by probe shall be backfilled with a soil-bentonite mixture. The mixture shall be compacted in-place with a tamping rod, or hand tamper, depending on the size of the perforation.

The test locations will be on a grid that will maximize the coverage of the construction area, or as directed by the ENGINEER to test suspect areas. Soil density and moisture content will be documented for each lift on an offset grid to provide adequate coverage of the construction.

## 3.6 DAMAGE AND REPAIR

Should the subgrade become damaged during construction, the unsuitable material will be removed and the Owner may choose to either; replace the removed material with native fill and document the grades;

or replace the material with the same material used in the soil barrier layer documenting the additional thickness in the affected area.

Areas of the soil liner that become damaged due to precipitation or desiccation will be reworked and retested until satisfactory results are obtained. If it appears unlikely to correct the damage by reworking the soil, the affected area will be removed, replaced, and tested.

## 3.7 SURVEY

The survey of specific locations will provide the basis for the record drawings and provide documentation of soil barrier layer thicknesses. The major components of the survey will include the following at a minimum:

1. Top of subgrade.
2. Top of soil barrier layer.

The survey will be conducted on a grid with survey points at major breaks in slope (i.e., top and toe of slope) and top and base of sumps (if applicable). The grid will be extended vertically to enable calculation of vertical thicknesses of the liner or cover component. Grading tolerances are provided in Table 1.

## 3.8 CONFORMANCE WITH PROJECT SECIFICATIONS

The ENGINEER shall document that the barrier soil layer installation was done in accordance with the project specifications.



# 4.0 GEOSYNTHETIC CLAY LINER

## 4.1 GENERAL

A geosynthetic clay liner (GCL) is used as the earthen barrier layer in a composite base liner. This section applies to a GCL which consists of a sodium bentonite core encapsulated by a geotextile.

## 4.2 MATERIAL QUALITY CONTROL

### 4.2.1 Raw Material

The GCL shall be manufactured with geotextile on each side of the bentonite. The bentonite shall meet the manufacturer's specifications as outlined by the GCL supplier for each batch of material. The material test reports on each batch shall accompany each roll. All product used onsite will be reinforced with needle-punching of the geotextiles together. Sideslopes will include a GCL product containing non-woven geotextiles for both surfaces.

### 4.2.2 Final Product

The GCL shall be tested to conform to the manufacturer's specifications. The GEOSYNTHETIC MANUFACTURER shall provide the ENGINEER with all GCL product certification sheets with each roll delivered to the site.

The ENGINEER shall examine the results and report any nonconformance to the Owner. QC results shall be reviewed and accepted or rejected by the ENGINEER prior to deployment.

## 4.3 SUBGRADE

When the GCL is placed on a soil subgrade, the CONTRACTOR shall be responsible for preparing the subgrade for the GCL. Once complete, the ENGINEER shall examine the surface, and verify the adequacy of the survey data provided. When the ENGINEER deems the surface acceptable, the ENGINEER shall prepare an acceptance certificate for the Owner. The acceptance certificate shall state the following at a minimum:

1. The required survey has been performed and the results meet the specifications.
2. The subgrade has been tested and meets the project requirements.

When the GCL is placed on a geosynthetic subgrade, the GEOSYNTHETIC INSTALLER shall be responsible for preparing the subgrade for the GCL. Once complete, the ENGINEER shall examine the surface, and verify the adequacy of the documentation completed and any test data required. When the ENGINEER deems the surface acceptable, the ENGINEER shall prepare an acceptance certificate for the Owner. The acceptance certificate shall state the following at a minimum:

1. Documentation of the underlying geosynthetics is complete, and any necessary tests show satisfactory results.



At any time during construction of the soil liner, the ENGINEER shall inform the Owner of any areas which are unacceptable. Such defects in the subgrade shall be corrected by the appropriate contractor such that repaired areas meet the project specifications.

## 4.4 OBSERVATIONS AND DOCUMENTATION

### 4.4.1 Roll Inspections

Prior to placement of the GCL, rolls shall be observed for defects by both the ENGINEER and the GEOSYNTHETIC INSTALLER. Rolls shall be wrapped in an impermeable, opaque cover material to prevent premature hydration and protect the rolls from UV radiation. Additional covering may be necessary during heavy precipitation events.

Each roll shall have a roll label which clearly identifies all standard manufacturer's information. This information should include: manufacturer's name, type of material, thickness, batch, date of fabrication, and physical dimensions. This information shall be recorded by the ENGINEER for each roll.

### 4.4.2 Installation Equipment

The GEOSYNTHETIC INSTALLER shall use equipment that will not damage the GCL or subgrade by handling, trafficking, excessive heat, and leakage of oils or other means. Vehicle use directly over a GCL that overlies a geomembrane is prohibited as a standard means of deployment unless otherwise approved by the MPCA.

### 4.4.3 Placement

The GEOSYNTHETIC INSTALLER shall cover the GCL each night with the overlying liner to prevent hydration of the GCL. No material shall be placed in areas of ponded water or excessively wet subgrade. If any material becomes hydrated it shall be removed and replaced.

The GEOSYNTHETIC INSTALLER shall inspect liner material for defects or flaws after installation.

### 4.4.4 Crest Anchorage System

The anchor trench is typically excavated by the CONTRACTOR according to the approved drawings. The GCL shall be placed in the anchor trench and the trench shall be backfilled and compacted by light compaction equipment to the required grade.

### 4.4.5 Field Seaming

The GEOSYNTHETIC INSTALLER shall overlap the GCL panels edges as specified by the manufacturer. The overlap shall be inspected by the ENGINEER to ensure proper length of overlap. The GEOSYNTHETIC INSTALLER shall overlap the GCL panel roll in accordance with the manufacturer’s specifications. All seaming shall conform to the manufacturer's installation specifications.

## 4.5 DAMAGE AND REPAIR

Areas of flaws or damage shall be repaired by the GEOSYNTHETIC INSTALLER. Repairs shall be made by placement of a patch of the same materials at least 1 foot beyond the edge of the flaw or damage. The



GEOSYNTHETIC INSTALLER shall ensure that the patch conforms with the manufacturers installation specifications. Additionally, any GCL that hydrates prior to placement of the geomembrane shall be removed and replaced.



# 5.0 GEOMEMBRANE

## 5.1 GENERAL

Geomembranes are the geosynthetic component of the composite base lining system. This section is applicable to the Polyethylene (PE) geomembranes used in base liner systems. CQA testing requirements are included in Table 3.

## 5.2 MATERIAL QUALITY CONTROL

### 5.2.1 Raw Material

The resin used to make geomembrane sheet shall be tested in accordance with the manufacturer's guidelines. Material ingredients of the geomembrane shall be randomly sampled by the manufacturing plant to ensure compliance with these specifications. Test reports of quality control tests, such as specific grading, melt flow index and carbon black content will be provided.

### 5.2.2 Geomembrane Material Specifications

The GEOSYNTHETIC MANUFACTURER shall provide the ENGINEER with the following:

1. A quality control certificate indicating conformance with the Geosynthetics Research Institute's (GRI) GEOSYNTHETIC MANUFACTURER 13 for HDPE or GEOSYNTHETIC MANUFACTURER 17 for LLDPE.
2. Certification that property values given in the properties sheet are guaranteed by the GEOSYNTHETIC MANUFACTURER.
3. Certification that 100 percent of every roll has been visually inspected for holes, cracks, thin spots, tears, punctures, blisters, or any other foreign material.

The GEOSYNTHETIC MANUFACTURER shall provide the following information to the ENGINEER for each roll delivered to the site:

- Name of the manufacturer and fabricator;
- Name and type of liner;
- Thickness of liner;
- Batch code;
- Date of fabrication;
- Physical dimensions;
- Panel number;
- Location and method of storage at the site.

This information shall accompany each roll delivered to the job site.



The ENGINEER will examine results and report any nonconformance to Owner. QC results will be reviewed and accepted or rejected by the ENGINEER prior to deployment.

## 5.3 SUBGRADE

When the geomembrane is placed on a geosynthetic subgrade, the GEOSYNTHETIC INSTALLER shall be responsible for preparing the subgrade for the geomembrane and shall install the geosynthetic subgrade simultaneously with the geomembrane. Once complete, the ENGINEER shall examine the surface and verify the adequacy of the documentation completed and any test data required. When the ENGINEER deems the surface acceptable, the ENGINEER shall prepare an acceptance certificate for the Owner. The acceptance certificate shall state the following at a minimum:

1. Documentation of the underlying geosynthetics is complete and any necessary tests show satisfactory results.

The GEOSYNTHETIC INSTALLER will also inspect the subgrade and will sign the subgrade acceptance forms.

At any time during installation of the geomembrane, the ENGINEER shall inform the owner of any areas that are unacceptable. Such defects in the subgrade shall be corrected by the appropriate contractor such that repaired areas meet the project specifications. If additional work is required on a soil subgrade it is the GEOSYNTHETIC INSTALLER's responsibility to notify the CONTRACTOR and OWNER of such work and also provide this notification to the ENGINEER.

## 5.4 OBSERVATIONS AND DOCUMENTATION

### 5.4.1 Roll Inspections

Prior to placement of any lining material, rolls shall be observed for defects and damage by both the ENGINEER and the GEOSYNTHETIC INSTALLER. Storage of the rolls shall be in a location that minimizes on-site handling and the possibility of damage.

Each roll shall have a roll label which clearly identifies the manufacturing information. This information along with the panel number and location/method of on-site storage, shall be recorded by the ENGINEER.

The ENGINEER shall also visually observe each roll for imperfections or damage including holes, cracks, thin spots, tears, punctures, blisters, or the presence of foreign material.



## 5.4.2 Placement

### 5.4.2.1 Equipment

The installer shall use equipment that does not damage the geomembrane by handling, trafficking, excessive heat, leakage of oils or other means. The method and equipment used to unroll the material shall not cause scratches, crimps, or any damage to the underlying GCL, or excessive rutting of the soil subgrade.

### 5.4.2.2 Method of Deployment

No personnel working on the geosynthetic liner shall smoke, wear damaging shoes, or engage in other activities that could damage the geomembrane. The method used to place the panels shall minimize wrinkles.

Adequate temporary loading and/or anchoring shall be provided to prevent uplift of the liner by wind. The anchoring system shall not damage the liner.

The installer shall inspect each panel after placement and prior to seaming for damage. Damaged panels or portions of damaged panels that have been rejected shall be marked and their removal from the work area recorded.

### 5.4.2.3 Crest Anchorage System

The anchor trench shall be excavated to the lines and widths shown on the drawings prior to geomembrane placement. The trench shall be drained to prevent ponding or softening of adjacent soils where trench is open. The corners of the trench shall be slightly rounded to avoid sharp bends in the geomembrane. The trench shall be backfilled and compacted by light compaction equipment to the required grade.

Since backfilling the anchor trench can affect material bridging at the toe of slope, consideration should be given to backfilling the liner at its most contracted state; preferably during the cool of the morning or extended period of overcast skies. Care should be taken when backfilling the trenches to prevent damage to the geosynthetics.

## 5.4.3 Trial Seams

To verify that seaming conditions are adequate, trial seams shall be performed on fragmented pieces of geomembrane. Trial seams shall be made as follows:

1. Twice per day (typically first thing in the morning and again after lunch).
2. Anytime equipment is turned off.
3. For each seaming apparatus.
4. Other times as deemed necessary by the ENGINEER.



A test weld, long enough to obtain required samples shall be run at the frequency described above (typically at least 5 feet).

The test weld shall be recorded on the GEOSYNTHETIC INSTALLER's trial weld log with date, ambient temperature, and welding machine number.

Three adjoining specimens each 1-inch wide shall be cut from the trial seam sample. The specimens shall be tested respectively in shear and in peel using a field tensiometer and they shall not fail in the seam. If any specimen fails, the entire operation shall be repeated. If the additional specimen fails, the seaming apparatus and seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful full trial welds are achieved. The ENGINEER will observe and document results of trial seam procedures.

## 5.4.4 Field Seaming

### 5.4.4.1 Seam Layout

Prior to liner installation, panel layout drawings shall be submitted and approved by the ENGINEER and Owner. Seams should typically be oriented parallel to the line of maximum slope. All seam-numbering and panel-numbering systems shall be agreed upon prior to installation. Individual liner panels shall be laid out and overlapped as required prior to welding. The area to be welded shall be cleaned prior to welding. Panel locations shall be recorded by the ENGINEER on the record drawings.

### 5.4.4.2 Seaming Equipment and Accessories

The fusion welding apparatus will be an automated, vehicle-mounted device that produces a double seam enclosing a void. This apparatus shall be equipped with gauges permitting a direct reading of the applicable temperatures.

The extrusion welding apparatus shall be equipped with gauges giving the temperatures of the apparatus at the nozzle.

### 5.4.4.3

Seaming shall not take place during precipitation, in the presence of excess moisture or in the presence of excessive winds. Seaming shall not take place at ambient temperatures less than 40°F unless authorized by the Owner and ENGINEER.

### 5.4.4.4 General Seaming Procedures

The rolls of geomembrane shall be overlapped as required by the manufacturer’s specifications.



A base T-seam shall not be closer than 10 feet from the toe of the slope. Seams shall be aligned with the least possible number of wrinkles and "fish mouths". Excessively large wrinkles and all fish mouths shall be relieved and cap-stripped.

The ENGINEER shall document field seam locations and panel overlaps. Panels that are factory fabricated or factory seamed will undergo the same observation and documentation as panels that are field seamed.

# 5.5 TESTING

## 5.5.1 Nondestructive Testing

The installer shall nondestructively test all field fusion seams over their full length by air-pressure testing. Extrusion-welded seams shall be tested by vacuum gauge. All seams must be inspected by the QAC and the Installer, and any defects marked and repaired.

### 5.5.1.1 Air Pressure Testing

This type of testing will be performed on the majority of the seams since the double fusion-seaming method is the method of choice.

Generally, the equipment shall be comprised of the following:

- An air pump capable of providing the required pressure;
- A rubber hose with fittings and connections;
- A sharp hollow needle or other approved pressure-feed device.

The following procedures shall be followed:

1. Seal both ends of the seam to be tested.
2. Insert needle or other approved pressure-feed device into the tunnel created by the fusion weld.
3. Energize the air pump to minimum 30 psi; close the valve and sustain pressure for a minimum of five minutes.

If loss of pressure exceeds 3 psi or does not stabilize, locate the faulty area, repair, and retest (either vacuum or air test).

### 5.5.1.2 Vacuum Testing

The equipment shall be comprised of the following:

- A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly, and a gauge to indicate chamber vacuum;
- A pump assembly equipped with a pressure controller and pipe connections;
- A rubber pressure/vacuum hose with fittings and connections;



- A bucket and wide brush or spray assembly;
- A soapy solution.

The following procedures will generally be followed:

1. Wet a strip of geomembrane approximately 12 x 48 inches with the soapy solution.
2. Place the box over the wetted area.
3. Close the bleed valve and open the vacuum valve.
4. Ensure that a leak-tight seal is created.
5. Energize the vacuum pump and reduce the tank pressure to approximately 5 psi.
6. For a period of approximately 10 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.

If no bubble appears after 10 seconds, close the vacuum valve, and open the bleed valve, move the box over the next adjoining area with a minimum of 1-inch overlap, and repeat the process. Areas where soap bubbles appear shall be marked and repaired in accordance with Section 5.6.

The ENGINEER shall document the following for each non-destructive seam test:

- Date;
- Seam number;
- Welder I.D.;
- Seamer;
- Air Pressure.

### 5.5.2 Destructive Testing

Destructive seam tests, including extrusion weld seams, shall be performed every 500 lineal feet of seam, or at least one per seaming device per crew per day. This requirement will apply to all seams with the exception of the seam connecting the base liner to the cover system liner. The purpose of these tests is to check that welds are fully integrated with each other and to evaluate seam strength. Seam strength testing shall be done as the seaming work progresses, not at the completion of field seaming.

#### 5.5.2.1 Location and Frequency

The ENGINEER shall select locations where seam samples will be cut. These locations shall be estimated as follows:

1. A minimum frequency of one test location per 500 feet of seam length, or at least one per seaming device per crew per day. This minimum frequency is to be determined as an average taken throughout the entire facility.
2. The seaming technician shall not be informed in advance of the locations where the seam samples will be taken.



#### 5.5.2.2 Sampling Procedure

Sampling shall be cut by the installer as the seaming progresses in order to have laboratory test results before the geomembrane is covered by another material. The GEOSYNTHETIC INSTALLER shall:

1. Cut samples.
2. Assign a number to each sample that is to be based upon seam and sample number and mark it accordingly.
3. Record sample location on construction record drawings.
4. All holes in the geomembrane resulting from destructive seam sampling shall be immediately repaired in accordance with repair procedures described in Section 5.6. The continuity of the new seams in the repaired area shall be tested according to this section.

#### 5.5.2.3 Size of Samples

The samples for field-testing shall be taken by the installer. These samples shall be 1 by 12 inches with the seam-centered perpendicular to the length.

If both samples pass the field tensiometer test, the initial samples shall be cut into two parts and distributed as follows:

1. One portion to the installer for laboratory testing (12 x 12 inches)
2. One portion to the Owner for archive storage (12 x 12 inches)

Final determination of the sample sizes shall be determined prior to liner installation at the preconstruction meeting.

### 5.5.3 Field Testing

The 1-inch wide strips shall be tested in the field for peel and shear and shall not fail in the seam. If any field test sample fails to pass, then the procedures outlined in this section shall be followed.

### 5.5.4 Laboratory Testing

Passing tensiometer testing in the field qualifies the sample for laboratory testing.

Destructive test samples shall be packaged and shipped to the geomembrane testing laboratory consultants by overnight mail. The laboratory shall provide test results to the ENGINEER.

Destructive testing involves two techniques: 1) shear testing, and 2) peel testing. Shear testing applies a tensile stress from the top sheet through the weld and into the bottom sheet. Peel testing peels the top sheet back against the overlapped edge of the bottom sheet in order to observe how separation occurs. The peel test indicates whether or not the sheets are continuously and homogeneously connected through the seam. A total of 10 coupons will be subject to testing, for which 5 will be tested in shear and 5 in peel (ASTM 6392). Fusion seam specimens will have both tracks tested in peel.



Both tests (shear and peel) must have a Film Tearing Bond (FTB) type of separation to pass. With an FTB, the polymer material tears indicating a fully integrated connection between top and bottom sheets. It is important that no weld bead/sheet or sheet/sheet interface exists as such an interface might be separated by absorbed chemicals, causing failure of the seam. The criteria for pass/fail are outlined in Table 3.

The ENGINEER shall document the following for each non-destructive seam test:

- Location;
- Seam number;
- Welder I.D.;
- Seamer;
- Sample I.D.

### 5.5.5 Procedures for Destructive Test Failure

The following procedures shall apply whenever a sample fails a destructive test. The GEOSYNTHETIC INSTALLER has two options:

1. Reconstruct the seam between the two adjacent passed test locations.
2. Trace the welding path to intermediate locations (10 feet minimum from the point of the failed test in each direction) and take a sample for an additional field test at each location. If these additional samples pass the field test, then full laboratory samples shall be taken. If these laboratory samples pass the tests, then the seam is reconstructed between these locations. If either laboratory sample fails, then the process is repeated to establish the zone in which the seam shall be reconstructed.

All acceptable seams must be bound by two locations from which samples passing laboratory destructive tests have been taken.

The GEOSYNTHETIC INSTALLER shall document all actions taken in conjunction with destructive test failures; e.g., capping of failed seam area.

## 5.6 DEFECT AND REPAIRS

All seams and non-seam areas of the geomembrane shall be examined by the installer for identification of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter.

### 5.6.1 Evaluation

Each suspect location both in seam and non-seam areas shall be nondestructively tested using the methods described in this section as appropriate. Each location that fails the nondestructive testing shall be marked by the GEOSYNTHETIC INSTALLER and repaired. Work shall not proceed with any materials that will cover locations that have been repaired until non-destructive test results are recorded.



### 5.6.2 Repair Procedures

All portions of the geomembrane exhibiting a flaw or failing a destructive or nondestructive test shall be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be agreed upon between the ENGINEER, GEOSYNTHETIC INSTALLER, and Owner. The procedures available include:

1. Patching: Used to repair large holes, tears, and contamination by foreign matter.
2. Buffing and re-welding: Used to repair small sections of extruded seams.
3. Spot welding or seaming: Used to repair small tears, pinholes, or other minor localized flaws.
4. Capping: Used to repair areas of inadequate seams that have an exposed edge.

In addition, the following provisions shall be satisfied:

1. Surfaces of the geomembrane that are to be repaired shall be abraded no more than one hour prior to the repair.
2. Surfaces must be clean and dry at the time of repair.
3. Seaming equipment used in repairing procedures must be approved.

The repair procedures, materials, and techniques shall be approved in advance of the specific repair by the ENGINEER.

Patches or caps shall extend at least 6 inches beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least 3 inches.

### 5.6.3 Verification of Repairs

Each major repair requiring a patch or cap shall be identified in the GEOSYNTHETIC INSTALLER's repair log. Each repair shall use nondestructive test methods described in this section as appropriate. Repairs that pass the nondestructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be re-done and re-tested until a passing test result is obtained. The ENGINEER may choose to take a destructive test in an area of repair. The ENGINEER shall document the location of each type of repair and the type of repair made.

## 5.7 FINAL ACCEPTANCE

The geomembrane must be final observed for completion of liner construction activities. The final inspection shall be performed by the ENGINEER, GEOSYNTHETIC INSTALLER and Owner. The ENGINEER and GEOSYNTHETIC INSTALLER shall document completion or incompletion. The GEOSYNTHETIC INSTALLER shall repair or complete any testing that has been determined incomplete. The ENGINEER and GEOSYNTHETIC INSTALLER shall then re-inspect the repairs or testings to complete final inspection. GEOSYNTHETIC INSTALLER will submit to ENGINEER results of all testing conducted, including the pre-welding tests, non-destructive tests, and destructive tests performed onsite. GEOSYNTHETIC INSTALLER must provide a report following completion of the project that includes the



results for the destructive test samples from an independent laboratory, pre-seaming tests, on-site destructive and non-destructive tests, certificate of completion and an as-built drawing.

Geomembrane material shall be final inspected prior to being covered by overlying geosynthetic materials or soil layers. Vehicle use directly over the geomembrane is prohibited as a standard means of deployment.

The geosynthetic lining system shall be accepted when the final observation and documentation is complete and approved by the ENGINEER and Owner.

## 5.8 CONFORMANCE WITH PROJECT SPECIFICAITONS

The ENGINEER shall document that the installation and necessary repairs were done in accordance with the project specifications.



# 6.0 GRANULAR DRAINAGE MEDIA

## 6.1 GENERAL

The granular drainage media consists of natural material used as a drainage layer in a base liner system.

## 6.2 MATERIAL QUALITY CONTROL

Samples of the granular drainage media will be tested for grain size distribution and hydraulic conductivity. Testing frequencies are provided in Table 2. Material source testing is to be performed in accordance with the specifications.

The ENGINEER shall examine the results and report any nonconformance to the Owner. QC results shall be reviewed and accepted or rejected by the ENGINEER prior to installation.

## 6.3 OBSERVATION AND DOCUMENTATION

Observation of the construction work by ENGINEER or Owner include the following:

- Hauling of material to ensure no damage to underlying geosynthetics;
- Spreading of granular drainage media material to ensure excess wrinkling of underlying geosynthetics does not occur;
- Placement of filter aggregates to ensure pipes are properly bedded and covered;
- Documentation will include; laboratory test data, material information, placement methods and thicknesses, and construction procedures used to prevent migration of fines by run-off into the leachate collection system.

## 6.4 TESTING

Laboratory test methods and frequencies upon which acceptability evaluations can be based are as provided in Table 2.

CQA testing will be conducted on samples taken from the material during the course of construction. Sampling locations will be selected by ENGINEER or Owner according to the number of required tests. Locations of all tests will be documented for report purposes.

## 6.5 DAMAGE AND REPAIRS

Granular drainage media that does not meet the requirements of the CQA Plan or the Specifications will be removed and replaced with suitable material.

## 6.6 SURVEY

The minimum thickness of soil drainage media shall be as shown on the drawings and extending over the lining system. The thickness of granular drainage media shall be verified on a grid using methods that shall not damage the liner. Grading tolerances are provided in Table 1.

## 6.7 CONFORMANCE WITH PROJECT SPECIFICATIONS

The ENGINEER shall document that the granular drainage media installation was done in accordance with the project specifications.



# 7.0 PIPING SYSTEMS

## 7.1 GENERAL

This section addresses the HDPE piping installed in the leachate collection pipe trenches and leachate forcemain.

## 7.2 MATERIAL QUALITY CONTROL

The CONTRACTOR (or other piping contractor, if applicable) shall inspect all piping and fittings received at the site and shall verify that piping materials are:

1. In accordance with drawings and specifications (size, SDR ratio, schedule, material).
2. Free of material defects.
3. Undamaged.
4. Resistant to corrosion

CONTRACTOR shall be responsible for storing piping materials in a protected location where they will not be damaged.

The ENGINEER shall examine the results and report any nonconformance to the Owner. QC results shall be reviewed and accepted or rejected by the ENGINEER prior to installation.

## 7.3 OBSERVATION AND DOCUMENTATION

CONTRACTOR shall install piping at locations and elevations as shown on drawings. All piping connections shall be made in accordance with manufacturer's recommendations. Installation of backfill around piping shall be done carefully to ensure damage to the piping does not occur. ENGINEER will document piping types installed, methods of connection/fitting types, and backfilling procedures. Documentation of the piping will include information on the method used to join sections of the pipe.

## 7.4 DAMAGE AND REPAIRS

Damaged or defective portions of the piping, as determined by ENGINEER, will be removed and replaced.

## 7.5 SURVEY

The piping trenches will be surveyed for horizontal and vertical position. Critical points of the piping will be surveyed. Invert tolerances are provided in Table 1.



## 7.6 CONFORMANCE WITH PROJECT SPECIFICATIONS

The ENGINEER shall document that the piping installation was done in accordance with the project specifications.



# 8.0 VEGETATIVE SOILS

## 8.1 GENERAL

The vegetative layer will be topsoil capable of sustaining vegetative grasses on the back side of the perimeter berm and any other disturbed areas as designated on the drawings.

## 8.2 OBSERVATION AND DOCUMENTATION

The ENGINEER will observe and document the placement methods of the vegetative soils. The CONTRACTOR (or other contractor, if applicable) shall ensure conformance to the project requirements regarding topsoil quality and placement, fertilizer content and application, seed mixture, seeding operations, mulching, and reseeding/repair work to sustain vegetation.

The ENGINEER shall examine the results and report any nonconformance to the Owner. QC results shall be reviewed and accepted or rejected by the ENGINEER prior to installation.

## 8.3 DAMAGE AND REPAIR

Seeded areas must be guaranteed by the CONTRACTOR to be alive and in satisfactory growth for a period of 1 year. If areas of non-growth or spotty growth are present, they will be reseeded.



# 9.0 CONSTRUCTION DOCUMENTATION, DOCUMENTATION REPORT, AND RECORD DRAWINGS

## 9.1 CONSTRUCTION DOCUMENTATION

The QAC will maintain a daily log of activities of the site. The daily log will generally include the following:

1. Date and weather conditions
2. List of contractor's equipment and all subcontractors at work at the site
3. A summary of the work completed during the day, including:
   a. Work by contractor / subcontractors
   b. Grade verification data collected
   c. CQA testing and/or samples collected
   d. A description of materials used.
4. A list of personnel who visited the site.
5. A summary of project communications that resulted in decisions impacting the construction activities.
6. A description of any work that deviated from the plans and specifications as well as a summary of communications regarding such work.

Photographs should be collected daily or as construction activities change to document overall progress and to show material and construction procedures used. Photographs should also be used to document discussion items, deviations from the plans and specifications, and/or materials and methods used to rectify construction issues. Photographs should be organized and named appropriately, based on subject.

## 9.2 DOCUMENTATION REPORT

The documentation report is the summary of the construction activities that were documented throughout the project. The construction portion of the report will include discussion of all documented procedures. The report will include results from field and laboratory tests and summarize survey documentation. A summary of the documentation report is as follows:

1. Summary of relevant construction specifications
2. Photo documentation of all critical aspects of construction (select photographs, appropriately labeled
3. Narrative description of all as-built variances from the plans and/or specifications
4. Survey documentation of liner system soil components and/or a table of layer thickness measurements
5. As-built elevations for all pipe inlets and outlets and pump-on/pump-off controls
6. All material testing results and a review of the results
7. Geomembrane installation information.
8. A schedule of major events during construction, including start and finish dates
9. A list of contractors and subcontractors involved in the project
10. A summary description of procedures and equipment used



11. Description or figure of the locations of moisture/density tests for each lift and for permeability test samples
12. Leak Location Survey Report
13. Record drawings

The documentation report will be certified by a Professional Engineer registered in the State of Minnesota.



# TABLES

**TABLE 1**

**System Grading Tolerances**

| **Base Lining System Grading Tolerances** | | | | |
|---|---|---|---|---|
| **Soil Layer/Surface** | **Measurement** | **Method** | **Pass/Fail Criteria** | **Frequency** |
| Top of Subgrade | Elevation | Survey | -0.2’ to 0.0’ | 100′ grid* |
| Top of Soil liner (base grade) | Thickness[1] | Survey | 0.0’ to +0.2′ | 100′ grid* |
| Granular drainage layer | Thickness | Survey | 0.0’ to +0.2′, 1’ minimum thickness | 100′ grid* |
| **Piping System Grading Tolerances** | | | | |
| **Surface** | **Measurement** | **Method** | **Pass/Fail Criteria** | **Frequency** |
| Leachate Collection System Piping / Other Piping | Elevation | Survey | ±0.2’ | 50’ and changes in direction and all pipe fittings |

* Also breaks in grade and bases of sumps.

[1] Minimum thickness as specified on the Drawings per the selected base liner system profile.

**TABLE 2**

**Soils Quality Assurance Testing Requirements**

| Subgrade / Controlled fill | | | |
|---|---|---|---|
| **Test** | **ASTM Method** | **Pass/Fail Criteria** | **Frequency** |
| Standard Proctor | D698 | NA | Minimum 1 per each material type used |
| USCS Classification | D2487 | | |
| Dry Density | D6938 (nuclear) | ≥95% Standard Proctor | 1/Acre (Top of Cell Subgrade)<br>1/2,000 CY Placed, minimum 1 per placed lift (Subgrade and Berm Construction/Embankment) |

| Soil Barrier Layer | | | |
|---|---|---|---|
| **Test** | **ASTM Method** | **Pass/Fail Criteria** | **Frequency** |
| Standard Proctor | D698 | max particle size 3/8-inch | 1/3,000 cubic yards |
| USCS Classification | D2487 | | |
| Dry Density | D6938 (nuclear) | ≥95% Standard Proctor | Test on 100-foot grid pattern<br>Offset every lift-min 5 tests/acre |

| Clay Barrier Layer Testing (Sump Area) | | | |
|---|---|---|---|
| **Test** | **ASTM Method** | **Pass/Fail Criteria** | **Frequency** |
| Grain Size | D6913/D7928 and D1140 | ≥50% passing the #200 sieve; max particle size 3/8-inch | 1/3,000 cubic yards |
| Atterberg Limits | D4318 | LL≥25%<br>PI≥12 | |
| USCS Classification | D2487 | CL, CH, SC | |
| Standard Proctor | D698 | NA | |
| Permeability (see Note 2) | D5084 | Max. 1 x $10^{-7}$ cm/sec | 1 per acre/foot |
| Dry Density and Moisture Content | D6938 (nuclear) | ≥95% Standard Proctor and 0% to +5% of the OMC | Test on 100-foot grid pattern<br>Offset every lift-min 5 tests/acre |

| Sand Drainage Layer Testing | | | |
|---|---|---|---|
| **Test** | **Method** | **Pass/Fail Criteria** | **Frequency** |
| Permeability | D2434 | 1x$10^{-3}$ cm/sec at 90% Standard Proctor density | 1 per acre |
| Grain Size and USCS Classification | D6913, D1140, D2487 | Per Specifications | 1/2,000 cubic yards |

| Coarse and Intermediate Aggregate Testing | | | |
|---|---|---|---|
| **Test** | **Method** | **Pass/Fail Criteria** | **Number of Tests** |
| Grain Size and USCS Classification | D6913 and D2487 | Per Specifications | 1/1000 feet (Min. 3) |

**TABLE 3**

**Geosynthetic Quality Assurance Testing Requirements**

| Geomembrane Testing | | |
|---|---|---|
| **Test** | **Reference** | **Frequency** |
| Material Properties | GRI GM 13 | By manufacturer<br>Every roll provided |
| Visual Inspection | -- | Entire sheet |
| Trial Seam Welding | -- | Start of seaming process,<br>any time equipment turned off,<br>at the end of each work day,<br>twice per day minimum,<br>each seamer or seaming apparatus |
| Non-Destructive Seam Testing | -- | All seams/patches |
| Destructive Seam Strength Test | ASTM D6392;<br>GRI GM 19a | 1 test per 500 L.F. seam minimum |

| Geotextile/Geonet/Geonet Geocomposite / GCL | | |
|---|---|---|
| **Test** | **Reference** | **Frequency** |
| Material Properties | Spec Section<br>02921<br>02924<br>02273 | By manufacturer<br>Every Roll Provided |
| Visual Inspection of Material and Seams | Spec Section<br>02921<br>02924<br>02273 | Entire installation |

# Attachment 1: Technical Specifications

**SECTION 02201**

**GRANULAR DRAINAGE LAYER**

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes descriptions and requirements for the installation of the granular drainage layer placed as shown on the drawings directly over the primary liner system for cell construction.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D6913- Standard Test Methods for Particle-Size Distribution (Gradation) of Soils using Sieve Analysis
2. ASTM D7928 - Standard Test Methods for Particle-Size Distribution (Gradation) of Fine-Grained Soils using the Sedimentation (Hydrometer) Analysis
3. ASTM D698 – Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
4. ASTM D2434 – Standard Test Method for Permeability of Granular Soils (constant head).
5. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System

1.03 SUBMITTALS

A. Location of off-site source of materials.
B. Name, address, telephone number and contact person of independent soils laboratory.
C. Material test results as detailed in Section 1.04.
D. Method of off-site source soils material sampling and analyses.
E. Off-site source material quality control analyses shall be submitted at least 14 days prior to installation.
F. Proposed haul road planned for transportation of all off-site materials to the project site.

1.04 SOIL MATERIAL SOURCE QUALITY ASSURANCE

A. Independent soils laboratory to be approved by OWNER.

B. Source testing to be performed by CONTRACTOR at no cost to the OWNER.

C. Permeability testing to be done at 90% of standard Proctor density in accordance with ASTM D698.

D. Provide the following source test results for material test requirements:

| Property | Test Method | Frequency |
|---|---|---|
| Grain Size Analysis | ASTM D6913/ D7928 | 1/2000 cy |
| Permeability | ASTM D2434 | 1/2000 cy |
| USCS Soil Classification and Uniformity Coefficient | ASTM D2487 | 1/2000 cy |

PART 2 – PRODUCTS

2.01 GRANULAR DRAINAGE MATERIAL

A. CONTRACTOR to supply Granular Drainage Material meeting the requirements of Part 2.01.B below.

B. Granular sand, consisting of rounded to sub-rounded particle material, durable particles, inorganic non-calcareous material (no limestone source rock). Free from organic substance and other deleterious matter.

1. Uniformity coefficient: Less than 6
2. Grain Size: Range from minimum 99% passing the 3/8-inch sieve to maximum 5% by weight passing #200 sieve.
3. Minimum permeability of $1x10^{-3}$ cm/sec at 90 percent of Standard Proctor density.

PART 3 - EXECUTION

3.01 FILL USAGE

A. Directly over geomembrane as shown on Drawings.

3.02 PREPARATION

A. CONTRACTOR to receive OWNER'S permission to begin installation of granular drainage layer.

B. CONTRACTOR shall be responsible for surface water control within construction limits and shall keep the construction area well drained and minimize surface water ponding.

C. Subgrade elevation shall be documented by the CONTRACTOR or ENGINEER prior to placement of granular drainage layer material.

3.03 PLACEMENT

A. Placement of granular materials on geomembrane shall not proceed at ambient temperatures below 5°C (40°F).

B. Spread with one pass of low ground pressure tracked equipment or equivalent as approved by ENGINEER prior to placement. Do not allow rubber-tired vehicles on granular blanket after placement. Operation of hauling equipment will be allowed only on areas with a 3-foot minimum thickness of granular drainage material; no sharp turns shall be permitted. Provide a minimum thickness of 12 inches of drainage sand for tracked equipment on the geomembrane.

C. Spread upslope ($90^{o}$ to slope) only. No abrupt stops on slope. No stockpiling on slope.

D. Do not compact material on geosynthetics.

E. Protect buried pipes, geotextiles, geosynthetics, and similar installations.

F. Granular materials shall not be placed over a fold in the geomembrane; CONTRACTOR to utilize spotter(s) as necessary to prevent folding of the geomembrane as the drainage material is spread.

G. CONTRACTOR shall place granular material by such method as to prevent wrinkling and possible damage to the HDPE liner once the geosynthetic lining system has been accepted by the ENGINEER. It shall be the CONTRACTOR'S responsibility to ensure that the geosynthetics are not damaged. Should they become damaged, the CONTRACTOR shall at his own expense:

1. Immediately notify the ENGINEER, and
2. Have the geosynthetic installer make any necessary repairs at the CONTRACTOR'S expense.

3.04 FIELD QUALITY CONTROL

A. Comply with approved Quality Assurance Manual. CONTRACTOR shall cooperate and assist the ENGINEER with obtaining required documentation and testing.

B. Specified soil layers shall be graded to the minimum thicknesses as shown on drawings and specified herein. Thickness tolerance of the granular drainage layer must be between –0.0 and +0.2 feet.

C. Testing:
1. Granular drainage layer in-place testing will be performed through the Project by ENGINEER to monitor material parameters
2. Tests performed and frequency of tests specified are listed in the Construction Quality Assurance Manual.

3.05 ADJUSTMENT AND CLEANING

A. Remove excess material not suitable for use to OWNER designated on-site stockpile. Grade to drain.

***END OF SECTION***

**SECTION 02202**

**COARSE AGGREGATE**

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes descriptions and requirements for supply and installation of the coarse aggregate as shown on the Drawings in the leachate collection system.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D6913- Standard Test Methods for Particle-Size Distribution (Gradation) of Soils using Sieve Analysis
2. ASTM D2487- Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

1.03 SUBMITTALS

A. Location of off-site source of materials.

B. Name, address, telephone number and contact person of independent soils laboratory.

C. Material test results as detailed in section 1.04.

D. Method of off-site source soils material sampling and analyses.

E. Off-site source material quality control analyses shall be submitted at least 14 days prior to installation.

F. Proposed haul road planned for transportation of all off-site materials to the project site.

1.04 SOIL MATERIAL SOURCE QUALITY CONTROL

A. Independent soils laboratory to be approved by OWNER.

B. Source testing to be performed by CONTRACTOR at no cost to the OWNER.

C. Provide the following source test results for material test requirements:

| Property | Test Method | Frequency |
|---|---|---|
| Grain Size Analysis* | ASTM D6913 | 1/1000 LF of trench |
| USCS Soil Classification and Uniformity Coefficient* | ASTM D2487 | 1/1000 LF of trench |

*Min. 3 samples per source

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. CONTRACTOR Supplied Coarse Aggregate

Granular material, bank-run gravel, consisting of sub-angular to rounded particle material (crushed aggregate not allowed), durable particles (no limestone source rock).

1. Uniformity coefficient: Less than 4.
2. Grain Size: Range from minimum 99% passing the 1.5-inch sieve to maximum 1% by weight passing 5/8-inch sieve.
3. Contains no organic matter
4. Non-calcareous material

PART 3 – EXECUTION

3.01 FILL USAGE

A. Coarse Aggregate: Leachate collection line trenches and leachate collection sump as shown on Drawings.

3.02 PREPARATION

A. CONTRACTOR shall receive OWNER'S permission to begin installation of coarse aggregate.

3.03 PLACEMENT

A. Transport material into landfill cell in a manner that will not damage underlying soil or synthetic layers. Low ground pressure equipment shall be used and no sharp turns with tracked equipment shall be made.

B. The coarse aggregate must be placed over a geotextile and not come into contact with the geomembrane.

C. Do not compact.

D. CONTRACTOR shall place coarse aggregate by such method as to prevent wrinkling and possible damage to the underlying geosynthetics. Once the geosynthetic lining system has been accepted by the OWNER, it shall be the CONTRACTOR'S responsibility to ensure that the geosynthetics are not damaged. Should they become damaged, the CONTRACTOR shall at his own expense:

1. Immediately notify ENGINEER

2. Have the geosynthetic installer make any necessary repairs at the CONTRACTOR'S expense.

E. If a rock box is used, a granular drainage layer thickness of 3 feet shall be present over the underlying geosynthetics below the box.

3.04 FIELD QUALITY CONTROL

A. Comply with approved Construction Quality Assurance Manual. Cooperate with quality control program.

B. Testing:

1. In-place tests performed, and frequency of tests, specified in the Construction Quality Assurance Manual.
2. CONTRACTOR is responsible for all costs related to retests of materials not meeting specifications.

3.05 ADJUSTMENT AND CLEANING

A. Stockpile excess material not suitable for use for any part of the project in OWNER designated location at the site.

***END OF SECTION***

**SECTION 02203**

**INTERMEDIATE FILTER AGGREGATE**

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes descriptions and requirements for the installation of the intermediate filter aggregate as shown on the Drawings.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D6913- Standard Test Methods for Particle-Size Distribution (Gradation) of Soils using Sieve Analysis
2. ASTM D2487- Standard Test Method for Classification of Soils for Engineering Purposes

1.03 SUBMITTALS

A. Location of off-site source of materials.

B. Name, address, telephone number and contact person of independent soils laboratory.

C. Method of off-site source soils material sampling and analyses.

D. Off site material source quality control analyses shall be submitted at least 14 days prior to installation.

E. Intermediate filter aggregate relationship to coarse aggregate and granular drainage layer material shall be submitted to show compliance with this spec section.

F. Proposed haul route planned for transportation of all off-site materials to the project site.

1.04 SOIL MATERIAL SOURCE QUALITY CONTROL

A. Independent soils laboratory to be approved by OWNER.

B. Source testing to be performed by CONTRACTOR at no cost to the OWNER.

C. Provide the following source test results for material test requirements:

| Property | Test Method | Frequency |
|---|---|---|
| Grain Size Analysis* | ASTM D6913 | 1/1000 LF of trench |
| USCS Soil Classification and Uniformity Coefficient* | ASTM D2487 | 1/1000 LF of trench |

*Min 3 samples per source.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. CONTRACTOR Supplied Intermediate Filter Aggregate: Durable, washed, coarse rounded to subangular, durable gravel (no limestone source rock).
   a. Contains no organic matter
   b. Non-calcareous material
   c. Crushed aggregate and/or limestone are not allowed.

B. The intermediate filter aggregate shall exhibit the following relationships to the coarse aggregate:

   1. $\frac{D_{15}\text{ (coarse aggregate)}}{D_{85}\text{ (intermediate filter aggregate)}} \leq 5$

   2. $\frac{D_{50}\text{ (coarse aggregate)}}{D_{50}\text{ (intermediate filter aggregate)}} \leq 25$

   3. $\frac{D_{15}\text{ (coarse aggregate)}}{D_{15}\text{ (intermediate filter aggregate)}} \geq 5$

C. The intermediate filter aggregate shall exhibit the following relationships to the granular drainage material:

   1. $\frac{D_{15}\text{ (intermediate filter aggregate)}}{D_{85}\text{ (granular drainage material)}} \leq 5$

   2. $\frac{D_{50}\text{ (intermediate filter aggregate)}}{D_{50}\text{ (granular drainage material)}} \leq 25$

   3. $\frac{D_{15}\text{ (intermediate filter aggregate)}}{D_{15}\text{ (granular drainage material)}} \geq 5$

   Where $D_{15}$, $D_{50}$, and $D_{85}$ are the diameters with which 15%, 50%, and 85% by weight are finer than, respectively.

PART 3 - EXECUTION

3.01 FILL USAGE

A. Intermediate Filter Aggregate: Leachate collection trenches and sump in the landfill between coarse aggregate and granular drainage layers as shown on the Drawings.

3.02 PREPARATION

A. CONTRACTOR to receive OWNER'S permission to begin installation of intermediate filter aggregate.

3.03 PLACEMENT

A. Transport material into landfill cell in a manner that will not damage underlying soil or synthetic layers. Low ground pressure equipment shall be used and no sharp turns with tracked equipment shall be made.

B. Aggregates must not come into contact with the geomembrane.

B. Do not compact.

C. CONTRACTOR shall place material by such method as to prevent wrinkling and possible damage to the underlying geosynthetics. Once the geosynthetic lining system has been accepted by the OWNER, it shall be the CONTRACTOR'S responsibility to ensure that the geosynthetics are not damaged. Should they become damaged, the CONTRACTOR shall at his own expense:

1. Immediately notify ENGINEER
2. Have the geosynthetic installer make any necessary repairs at the CONTRACTOR'S expense.

D. If a rock box is used, a granular drainage layer thickness of 3 feet shall be present below the box.

3.04 FIELD QUALITY CONTROL

A. Comply with approved Quality Assurance Manual. Cooperate with quality control program.

B. Testing:

1. In-place tests performed, and frequency of tests, specified in the Quality Assurance Manual.
2. CONTRACTOR is responsible for all costs related to retests of materials not meeting specifications.

3.05 ADJUSTMENT AND CLEANING

A. Stockpile excess material not suitable for use in OWNER designated location.

***END OF SECTION***

**SECTION 02205**

**COMPACTED SOIL BARRIER LAYER**

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes descriptions and requirements for installation of the clay barrier layer located in the sumps as shown on the Drawings.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D6913- Standard Test Methods for Particle-Size Distribution (Gradation) of Soils using Sieve Analysis
2. D7928- Standard Test Methods for Particle-Size Distribution (Gradation) of Fine-Grained Soils using the Sedimentation (Hydrometer) Analysis
3. ASTM D698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
4. ASTM D854 – Standard Test Method for Specific Gravity of Soils.
5. ASTM D1140 - Standard test method for amount of material in soils finer than the No. 200 (75 um) sieve.
6. ASTM D1587 - Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes.
7. ASTM D2216 - Standard test method for laboratory determination of water (moisture) content of soil and rock by mass.
8. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
9. ASTM D2488 - Standard practice for description and identification of soils (visual-manual procedure).
1. ASTM D4318 - Standard test method for liquid limit, plastic limit, and plasticity index of soils.
11. ASTM D5084 - Standard test method for measurement of hydraulic conductivity of saturated porous materials using a flexible wall permeameter.
12. ASTM D6938 – Standard Test Method for In-place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.03 SUBMITTALS

A. Description of proposed blending equipment 7 days prior to clay placement.

1.04 SOIL MATERIAL QUALITY CONTROL

A. Clay barrier material to be provided and installed by CONTRACTOR
B. Source testing to be performed by CONTRACTOR
C. Permeability testing to be done at minimum 95% of standard Proctor dry density in accordance with ASTM D698.
D. Material shall meet the following properties:

| Property | Test Method | Frequency |
|---|---|---|
| Hydraulic Conductivity (Permeability) | ASTM 5084 | 1 per 5,000 cubic yards |

| | | |
|---|---|---|
| Grain Size Analysis | ASTM D6913/D1140 | 1 per 3,000 cubic yards |
| Atterberg Limits | ASTM D4318 | 1 per 3,000 cubic yards |
| USCS Soil Classification | ASTM D2487 | 1 per 3,000 cubic yards |
| Standard Proctor | ASTM D698 | 1 per 3,000 cubic yards |

E. ENGINEER will perform in-place material testing in accordance with the Construction Quality Assurance Manual. CONTRACTOR may perform additional in-place material testing at no cost to the OWNER. If CONTRACTOR does perform additional in-place testing, CONTRACTOR shall submit all testing results to the OWNER and ENGINEER.

PART 2 - PRODUCTS

2.01 SOURCE OF MATERIAL

A. CONTRACTOR supplied material.

2.02 COMPACTED SOIL BARRIER LAYER

A. Compacted soil barrier layer (clay) material shall have a USCS classification of CL or CH, although SC or other soils that exhibit the following are acceptable:

| **Property** | **Specification** |
|---|---|
| In-place permeability | $1x10^{-7}$ cm/sec or less when compacted to 95% of Standard Proctor dry density at a moisture content of 0% to +5% of the optimum moisture content |
| Grain size | Minimum 50% passing the #200 sieve, maximum particle size is 3/8-inch |
| Liquid limit | 25% or greater |
| Plasticity index | 12 or greater |
| Compaction | 95% standard proctor density or greater at a moisture content 0% to +5% of the optimum moisture content |

B. Clay barrier layer material shall contain no clods larger than 2 inches and be free of debris, roots, organic material, solid mineral material larger than 1 inch in diameter, angular stones of any diameter and other materials considered deleterious to the overlying geomembrane liner.

PART 3 – EXECUTION

3.01 FILL USAGE

A. Compacted soil (clay) barrier layer: Directly below geomembrane liner within the limits indicated on the Drawings for new cell construction within the sump areas. The layer thickness as shown on Drawings is the compacted thickness.

3.02 PREPARATION

A. Prepare surface to lines and grades as shown on Drawings.

B. CONTRACTOR shall be responsible for surface water control within construction limits and shall keep the construction well drained and minimize surface water ponding.

C. Proof roll surfaces to receive fill and subgrades within limits of excavation to determine existence of soft areas, areas loosened by frost action or softened by flooding, weather or of unsuitable materials.

1 Determination of soft, wet or loose areas will be based on ENGINEER'S judgment.

2. Soft areas will generally be detected by soil deflection of greater than 2 inches and accompanied with stress cracks in soil when rolled over by heavy construction equipment intended for the placement and compaction of clay.

D. Replace materials determined to be unsuitable or soft soils by sub-cutting 2 feet and replacing with common fill or other material approved by the ENGINEER in writing.

E. Subgrade elevation shall be documented by CONTRACTOR or ENGINEER prior to placement of clay barrier layer material.

3.03 PLACEMENT

A. CONTRACTOR shall place clay barrier layer material as follows:

| **Property** | **Specification** |
|---|---|
| Maximum Compacted Lift Thickness | 6 inches compacted (8-inch loose) |
| Minimum Compaction | 95% of dry density, ASTM D698 Standard Proctor |
| Moisture Content | 0% to +5% of the optimum moisture content* |
| Maximum Clod Size | Reasonably free of clods; max size 3 inches |
| Maximum Permeability | $1x10^{-7}$ cm/sec, (ASTM D5084-falling head) |

*Acceptable moisture content may be adjusted based on source testing data from the actual clay borrow area to be used for construction.

B. The clay barrier material shall be within the specified moisture window prior to placement. Clay conditioning may be performed in the area designated by OWNER.

C. Material distribution and gradation throughout clay barrier shall be such that material is free from lenses, pockets, streaks or layers of material differing substantially in texture or gradation from surrounding material. Blend clay prior to compaction.

D. Uniformly distribute moisture content of clay material prior to and during compaction throughout each lift of material. Dry excavated materials too wet for immediate compaction to permit compaction conditions and at proper moisture content.

E. Place layers of clay to form continuous monolithic material. Remove excessively dry or wet soil before placement of additional lifts. Knead each lift into previously placed lift.

F. Compact with sheepsfoot roller, or similar kneading type compactor capable of influencing entire lift.

G. Final surface shall be smooth-rolled prior to geosynthetic placement. Finished surface will be smooth and even with no sheepsfoot roller indentations.

H. Construct sidewall liners by pushing clay material up the sidewall from the cell base. Placement or movement of clay down from the top of the sidewall will not be allowed. Placement and compaction of sidewall liner shall be performed in accordance with the specifications.

I. Do not place clay below air temperatures of 32°F, unless CONTRACTOR can demonstrate fill material temperature above freezing.

J. CONTRACTOR shall be responsible for the integrity of the clay liner and shall not allow the surface to dry or desiccate.

K. CONTRACTOR shall be responsible for maintaining the clay surface until it is covered by CONTRACTOR'S geosynthetic installation contractor.

L. Surface of clay liner must be approved by the Geosynthetics INSTALLER prior to installation of geosynthetics. Surface rutting or drying will not be acceptable. Surface must be smooth and free of debris, roots, and angular or sharp rocks larger than 3/8 inches in diameter to a depth of 4 inches below surface to be lined.

3.04 FIELD QUALITY CONTROL

A. Comply with approved Construction Quality Assurance Manual. CONTRACTOR shall cooperate and assist ENGINEER and OWNER with obtaining required documentation and testing.

B. Specified soil layers shall be graded to the minimum thicknesses as shown on drawings and specified herein. Thickness tolerance of the soil layers must be between -0.0 and +0.2 feet.

C. Testing:

1. Clay barrier layer in-place testing will be performed through the Project by ENGINEER to monitor clay parameters.
2. Tests performed and frequency of tests specified are listed in the Construction Quality Assurance Manual.
3. CONTRACTOR is responsible for all costs related to retests of materials not meeting specifications for in-place density, moisture, and permeability.
4. CONTRACTOR shall backfill all perforations of the clay layer by probe or sample tube with a 100% bentonite mixture. The mixture shall be compacted in-place with a tamping rod, or hand tamper, depending on the size of the perforation.

3.05 ADJUSTMENT AND CLEANING

A. Remove excess material not suitable for use to on-site stockpile in OWNER designated location. Grade to drain.

*** END OF SECTION ***

**SECTION 02206**

**Buffer Soil Layer**

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes the placement of the buffer soils.

1.02 QUALITY ASSURANCE

A. In accordance with the Construction Quality Assurance Manual for this project.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. Buffer Soils:

1. Material will be supplied by the Owner and available from on-site stockpile/borrow areas. CONTRACTOR shall be responsible for selecting suitable buffer soil material to supplement in place soils as necessary.
2. Free from gravel, cinders, stone over 3/8-inch in any dimension and other undesirable material.

PART 3 - EXECUTION

3.01 FILL USAGE

A. Buffer soils: Directly below the geosynthetic liner components of the base liner system. The layer thickness as shown on Drawings is the compacted thickness.

3.02 PREPARATION

A. Surface Water Control:

1. CONTRACTOR responsible for surface water control within construction limits.
2. Keep construction and borrow areas well drained and minimize surface water pooling.

3.03 PLACEMENT OF BUFFER SOILS

A. Construct to limits and to the elevations as shown on Drawings.

B. Final surface must be firm and free of stones greater than 3/8-inch diameter or any other material which would be deleterious to the overlying geosynthetics layers.

C. Compact material to a minimum 95% of the Standard Proctor in accordance with ASTM D698.

D. Smooth drum surface to provide smooth surface for geomembrane installation. Remove and replace excessively soft or wet areas.

E. Final surface shall be smooth, uniform, and free from sudden changes in grade (such as vehicular ruts).

F. Before geomembrane installation begins, verify grade and accept subgrade per Section 02922.

3.04 FIELD QUALITY CONTROL

A. Comply with approved Quality Assurance Manual. Cooperate with quality control program.

B. Specified soil layers shall be graded to the minimum thicknesses as shown on drawings and specified herein. Thickness tolerance of the buffer soil layer must be between -0.0 and +0.2 feet.

C. Survey Requirements: ENGINEER shall perform documentation survey in accordance with the Quality Assurance Manual.

3.05 ADJUSTMENT AND CLEANING

A. Remove excess material not suitable for use to OWNER designated location on-site.

*** END OF SECTION ***

**SECTION 02207**

**CONTROLLED FILL**

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes descriptions and requirements of the OWNER-supplied native soils required for construction with controlled fill soils.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D6913- Standard Test Methods for Particle-Size Distribution (Gradation) of Soils using Sieve Analysis
2. D7928- Standard Test Methods for Particle-Size Distribution (Gradation) of Fine-Grained Soils using the Sedimentation (Hydrometer) Analysis
3. ASTM D1140- Standard Test Method for Amount of Material in Soils Finer than the No. 200 (75 um) Sieve.
4. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3)).
6. ASTM D2216- Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures.
7. ASTM D2487- Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
9. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

B. Minnesota Department of Transportation “Standard Specifications for Construction”, latest edition.

1.03 SUBMITTALS

A. None required.

PART 2 - PRODUCTS

2.01 CONTROLLED FILL

A. Shall consist of mineral soil free from organic materials, loam, wood, trash, and other objectionable materials which may be compressible or which cannot be properly compacted.

B. OWNER-supplied native excavated subsoil from designated borrow, excavation, and/or stockpile areas to be used for berms, embankments, backfill, and subgrade excavation replacement where applicable. CONTRACTOR to assist with sample collection for standard proctor testing for completion of project CQA program.

C. Material free from roots, debris, and stones larger than six (6) inches.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine and verify acceptability of surface to receive installation of material.

B. Proof-roll and examine surfaces to receive fill and subgrades within influence zone to determine existence of soft areas, areas loosened by frost action or softened by flooding, groundwater or weather or existence of unsuitable materials.

3.02 PREPARATION

A. Prepare surfaces to receive materials to lines and grades shown on Drawings prior to placement.

3.03 BACKFILLING AND COMPACTION

A. Notify ENGINEER before placing fill material.

B. Do not use frozen material or place fill on frozen subgrade.

C. Where pipes or electrical conduits are located, protect by backfilling influence zone down to undisturbed soil with controlled fill.

D. Place fill simultaneously on both sides of free-standing structures.

E. Provide mechanical compaction for cohesive material and vibratory compaction for granular materials. When approved by ENGINEER, jetting, flooding, puddling, or vibroflotation methods may be used for compacting if CONTRACTOR furnishes test results to confirm required degree of compaction being obtained uniformly throughout entire mass.

F. Lift Thickness and Compaction: Place and compact fill material in maximum lift thickness and to minimum densities listed below. Where “Quality Compaction Method” is listed, reference “Standard Specifications” Section 2106.3.G.2.

| | **Fill Placement** | **Maximum Compacted Lift Thickness (inches)** | **Standard Proctor (%)** |
|---|---|---|---|
| 1 | Controlled Fill for Anchor Trench Backfill and Piping Installation Backfill | 6 | “Quality Compaction Method” |
| 2 | Controlled Fill for Temporary Berm Construction | 6 | “Quality Compaction Method” |
| 3 | Controlled Fill for Subgrade and Berm Construction | 8 | 95 |
| 4 | Controlled Fill for Unsuitable Material Subcut Replacement | 8 | 100 |

3.04 FIELD QUALITY CONTROL

A. In-place testing shall be performed by ENGINEER in accordance with the Construction Quality Assurance manual; any laboratory retesting due to test failure will be paid for by the CONTRACTOR.

3.05 TRANSPORTATION AND HAUL ROADS

A. Observe State, County, and Local traffic rules and weight restrictions.

B. All vehicle trips loaded or unloaded shall be on designated haul roads only.

C. CONTRACTOR to coordinate selection of haul roads with the appropriate governing body and acquire any necessary permits.

D. On-site road utilized should be left in same or better condition than at start of project.

***END OF SECTION***

**SECTION 02211**

**SITE PREPARATION**

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the requirements for preparing the site for construction, stripping existing cover soils, and miscellaneous surface features.

1.02 DEFINITIONS

A. Structures and Surface Features: For purpose of this section, shall mean existing structures and surface features, including but not limited to buildings, pavements, curb and gutter, signs, posts, fences, trees, shrubs, other landscaped features.

B. Salvaged Topsoil: Natural loam, sandy loam, silt loam, silty clay loam, or clay loam humus-bearing soils available from overlying portions of areas to be excavated for construction.

C. Unsuitable Material: Topsoil, peat, organic soils, and materials containing slag, cinders, foundry sand, debris, and rubble or soil with less than required bearing capacity as determined by ENGINEER.

D. Utilities: Existing gas mains; water mains; electric lines; conduits, telephone, and other communication lines; sewer pipe; cable television, other utilities, and appurtenances.

1.03 PROJECT/SITE CONDITIONS

A. Provide 72 hour notice, prior to beginning construction, to OWNERS of utilities, structures, and surface features.

1.04 COORDINATION

A. Coordinate work with others performing work at project site.

B. Call Gopher One to check for utilities prior to beginning Work.

C. Coordinate with OWNER to complete private utility locate prior to beginning work.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.01 PREPARATION

A. Provide protection and support during construction for existing utilities, structures, and surface features adjacent to construction area or easements and rights-of-way.

B. Remove obstructions such as mounds of dirt, stone or debris located within working limits.

C. Obstructions such as street signs, small culverts, and guard posts located within construction easements of rights-of-way may be removed if promptly replaced to original condition unless otherwise specified.

D. All material stockpile areas shall be stripped of topsoil prior to stockpiling.

E. Provide transportation of material and sites for stockpiles if adequate areas not available within the construction limits as shown on the Drawings.

3.02 RESTORATION

A. Restore existing utilities, surface feature, and structures to condition equal to or exceeding condition which existed prior to construction.

3.03 MAINTENANCE AND RESTORATION OF ON-SITE AND OFF-SITE HAUL ROADS

A. While hauling operations are in progress, CONTRACTOR shall maintain haul roads in condition satisfactory to the OWNER. Work shall include any or all of the following items:

1. Application of water
2. Bituminous material
3. Calcium chloride
4. Sweeping
5. Others as necessary

B. When hauling operations are completed, CONTRACTOR shall:

1. Restore to condition that existed at the time hauling operations were started; or
2. Compensate the local road authority in the amount satisfactory to that road authority.

C. The OWNER shall make the determination as to the kind and amount of Work required to restore the haul road to a condition equal to the time hauling operations began.

D. When hauling operations are complete and restoration is complete to the satisfaction of the OWNER, the CONTRACTOR will be relieved of any additional obligation in connection to the maintenance and restoration of the haul road.

***END OF SECTION***

**SECTION 02220**

**EXCAVATION**

PART 1 - GENERAL

1.01 SUMMARY

A. Work described in this section includes excavation for cell construction, anchor trench excavation, pipe installation and all excavations as shown on the Drawings. This section also includes any subgrade preparation required prior to backfilling.

1.02 REFERENCES

A. Minnesota Department of Transportation “Standard Specifications for Construction”, latest edition.

1.03 SUBMITTALS

A. Shoring, Bracing, and Sheeting Layout and Details: ENGINEER will review submitted material to ascertain effect on new construction. ENGINEER will not review shoring, bracing, and sheeting for structural integrity or effect on existing facilities.

B. Additional soil testing results as may be required.

1.04 QUALITY CONTROL

A. Sheeting, Shoring, and Bracing:

1. If determined necessary by CONTRACTOR, sheeting, shoring, and bracing shall be designed by a Professional Engineer registered in the state of Minnesota.
2. Sheeting, shoring, and bracing shall conform to safety requirements of federal, state, or local public agency having jurisdiction over such matters. Most stringent of these requirements shall apply.

1.05 DEFINITIONS

A. Influence Zone Under Foundations or Pavements: Area below foundation or pavement as bounded by 1 horizontal to 2 vertical slope extending outward from 1 ft beyond outer edges of foundation or pavement.

B. Influence Zone Around Piping or Electrical Ducts: Area below limits bounded by line 12 in. above pipe or duct and by 1 horizontal to 2 vertical slope extending outward from that line 1 ft beyond outer edge of pipe or duct.

C. Unsuitable Material: Topsoil, peat, organic soils, and materials containing slag, cinders, foundry sand, debris, and rubble or soil with less than required bearing capacity as determined by ENGINEER.

1.06 FIELD MEASUREMENTS

A. Verify control monuments and intended elevations for Work as shown on Drawings.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine and verify acceptability and condition of surfaces to perform Work.

3.02 PREPARATION

A. Identify required lines, grades, levels, contours, and datum.

B. Protect benchmarks, structures, equipment, and partially completed Work.

C. Over-excavate soft areas of subgrade not capable of in-situ compaction as directed by ENGINEER. CONTRACTOR shall notify and receive approval from ENGINEER prior to any undercutting or over-excavation activities due to soft, saturated soils or other reasons.

D. Notify corporations, companies, individuals, or authorities owning above- or belowground conduits, wires, pipes, or other utilities running to property or encountered during excavating operations.

E. Cap or remove and relocate services in accordance with instructions by owners of services.

F. Protect, support, and maintain conduits, wires, pipes, and other remaining utilities in accordance with requirements of owners of said services.

G. CONTRACTOR may encounter groundwater and upward seepage during construction and is responsible for dewatering:

1. Keep excavations free from water.
2. Maintain groundwater minimum of 12 inches below excavations.
3. Remove soil disturbed by pressure or flow of groundwater and replace with free-draining material.
4. Maintain dewatering system to prevent uplifting of structures.
5. Protect adjacent properties from damage resulting from dewatering operations.
6. Dewatering wells shall be drilled, maintained, and abandoned in accordance with federal, state, and local ordinances.

H. Keep construction site free-draining.

I. Fill settled areas where excavations or trenches were backfilled and holes made by demolition, tree removal, and site preparation work.

J. Remove all topsoil, organic material, and soft, wet, or loose soils below proposed berm and roadway areas. During excavation or exposure of in-situ soils, the CONTRACTOR shall subcut 2 feet beneath plan subgrade if soft, wet, or loose soils are encountered. Replace unsuitable materials with controlled fill material. Soft,

wet, loose, and competent soils will be determined by the ENGINEER. CONTRACTOR shall notify and receive approval from ENGINEER prior to any undercutting or over-excavation activities due to soft, saturated soils or other reasons.

K. Disc level surfaces.

L. The CONTRACTOR shall stage construction to prevent slippage or sloughing of the berms during construction.

3.03 COMMON EXCAVATION

A. Excavations shall conform to lines and grades as staked, and as shown on Drawings.

B. Excavations beyond those lines and grades without the ENGINEER's authorization will be considered unauthorized work.

C. Method of excavation shall be consistent with soil types encountered and result in competent subgrade.

D. Remove stumps, roots, debris, large stones or boulders, and any other deleterious material from excavated materials to be used in embankments.

E. Do not excavate within influence zone of existing footings or foundations without prior approval of ENGINEER.

F. Upon completion of excavation, notify ENGINEER before proceeding with further work.

3.04 MUCK EXCAVATION

A. Excavate all saturated and unsaturated mixtures of soil and organic matter not suitable for foundation materials in accordance with Standard Specifications 2106.2.A.4. CONTRACTOR shall notify and receive approval from ENGINEER prior to any undercutting or over-excavation activities due to soft, saturated soils or other reasons.

3.05 ANCHOR TRENCH EXCAVATION

A. Excavate anchor trench to elevations and dimensions necessary to anchor geomembrane as shown on Drawings.

B. Coordinate all work with geomembrane installer.

## 3.06 WASTE EXCAVATION AND RELOCATION

A. Excavate waste from areas designated on the Drawings to achieve subgrade appropriate for geosynthetics installation and as necessary to expose tie-in to existing liner systems.

B. Relocate excavated waste to OWNER designated location and coordinate hauling and placement with site operations. CONTRACTOR shall compact relocated waste and place cover materials over exposed waste if directed by OWNER. Compaction and cover thickness requirements shall be designated by OWNER prior to waste excavation and relocation activities.

## 3.07 TRENCHING

A. Excavate to elevations and dimensions necessary to complete construction.

B. Trenching Tolerances:

1. Excavate so pipes, ducts, and conduits can be laid straight at uniform grade, without sags or humps, between elevations shown on Drawings.
2. Maximum width of excavation on top of pipe shall be outside diameter of pipe plus 24 inches, or as otherwise shown on the Drawings. When stringers and sheathing required, width of trench may be increased to allow for their use, provided provisions for this excess width of trench are met.
3. Where trench width for that portion of trench depth between trench bottom and outside top of pipe barrel, for any reason within CONTRACTOR'S control, exceeds specified limits, CONTRACTOR, at his expense, shall furnish pipe with strength adequate for actual trench width.
4. Excavate electrical conduit trenches as required so top of conduit shall be minimum of 36 inches below final grade or as shown on Drawings.

C. Do not advance excavation of trenches more than 300 feet ahead of completed pipe installation.

D. Do not excavate for manholes and other structures until scheduled for construction.

E. Do not excavate within influence zone of existing footings or foundations without prior approval of ENGINEER.

F. Excavation of Rigid Surfacing:

a. Remove width 1 foot beyond anticipated edge of excavation.
b. Saw to ensure straight joint.
c. Surface replacement shall match existing surfacing.

G. Excavation Across Roadways: Excavation shall conform to the requirements of local highway authority. In no case shall surface replacement edges bear on less than 12 inches of undisturbed soil.

## 3.08 FIELD QUALITY CONTROL

A. Subgrade elevations shall be surveyed prior to placement of fill material. Elevations of subgrade to be as shown on Drawings.

B. Subgrade elevations shall be between –0.2 and +0.0 feet.

C. Testing: in-place density/moisture testing of the final prepared subgrade surface within the cell construction limits will be performed as specified in the Construction Quality Assurance Manual, prior to clay barrier layer placement. CONTRACTOR shall prepare subgrade to 95% Standard Proctor. CONTRACTOR is responsible for all costs related to retests of materials not meeting specifications for in-place density/moisture.

3.09 ADJUSTMENT AND CLEANING

A. Stockpile excavated material suitable for backfill on site in OWNER designated location and grade to drain.

B. Haul excavated material not suitable for backfilling and unsuitable materials to OWNER designated location within the active working face or to on-site stockpile, as designated by OWNER.

***END OF SECTION***

**SECTION 02273**

**GEOSYNTHETIC CLAY LINER**

PART 1 - GENERAL

1.01 SUMMARY

A. Work covered under this section includes the manufacture, fabrication (if needed), and supply and installation of the geosynthetic clay liner (GCL). As part of the landfill composite liner system, all work shall be performed in accordance with the lines, grades, cross-sections, and dimensions on the DRAWINGS, or as directed by OWNER.

B. Sufficient geosynthetic clay liner and accessory bentonite shall be furnished to cover all areas to be lined as shown on the Drawings, including overlaps at field seams and anchor trenches.

C. It is the intent of these Technical Specifications to ensure that the performance criteria for these Projects are achieved. It shall be the CONTRACTOR'S responsibility to ensure that these criteria are met.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
2. ASTM D5321 - Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear
3. ASTM D5887 – Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Well Permeameter
4. ASTM D5890 – Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners
5. ASTM D5891 – Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners
6. ASTM D5993 – Standard Test Method for Measuring Mass Per Unit Area of Geosynthetic Clay Liners
7. ASTM D6243 - Standard Test Method for Determining the Internal and Interface Shear Strength of Geosynthetic Clay Liner by the Direct Shear Method
8. ASTM D6495 - Standard Guide for Acceptance Testing Requirements for Geosynthetic Clay Liners
9. ASTM D6496 – Standard Test Method for Determining Average Bonding Peel Strength Between Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners
10. ASTM D6768 – Standard Test Method for Tensile Strength of Geosynthetic Clay Liners

1.03 SEQUENCING AND SCHEDULING

A. Submit material delivery and installation schedule for incorporation into the project schedule.

1.04 SUBMITTALS

A. CONTRACTOR shall submit certification in writing that the surface upon which the geosynthetic clay liner is to be installed is acceptable (complete form contained at the end of this Section).

B. CONTRACTOR shall submit Certificate of Compliance from supplier for each roll of geosynthetic clay liner delivered to the site, indicating material compliance with the specified manufacturer specifications prior to or at the time of delivery of the material.

C. Test methods and results defining physical properties as specified herein, of the GCL to be used for this project. Test results shall be representative of each roll of GCL furnished for this project (e.g., a test sample taken between two consecutive rolls from a continuous run will be considered representative of both rolls). Test results shall be reported with corresponding roll identification numbers.

D. Statement of the GCL manufacturer's quality control procedures and frequency of sampling

E. CONTRACTOR shall submit certified test results from the supplier to OWNER to obtain approval for use of the product prior to mobilization of the product to the project site. Any proposed alternate geosynthetic clay liner not approved by OWNER shall not be used.

F. CONTRACTOR shall submit a plan for installation layout identifying placement patterns and overlap orientations prior to placement. The layout diagram shall be to scale and used as a construction plan and shall include all necessary dimensions and details. The layout diagram shall be compatible with the panel and seam layout requirements specified in Article 3.02 of this Section.

G. Submit for documentation a material and workmanship warranty prior to substantial completion.

1.05 EXPERIENCE

A. The GCL installation shall be performed under the direct supervision of a single field supervisor who must remain onsite throughout installation, including inspection of the surface upon which the GCL is to be installed, GCL handling and storage, panel layout and placement, seaming, seam testing, panel and seam repair, installation of appurtenances, anchorage and other GCL-related work. The field supervisor shall have a personal GCL installation record totaling at least 1 million square feet.

B. The GCL manufacturer shall have at least two (2) years continuous experience in manufacturing GCL rolls and a manufacturing record totaling no less than 10 million square feet of GCL.

C. The GCL manufacturer and any GCL installation subcontractors to the CONTRACTOR must be approved by OWNER prior to mobilization for GCL installation. OWNER has the right to reject any GCL manufacturer or Installer, and request that CONTRACTOR select an alternate.

1.06 Pre-Installation Meeting

A. Representatives of the CONTRACTOR and any GCL subcontractors shall attend a meeting prior to installation of the geomembrane to discuss details of the proposed design, installation, quality control documentation requirements and schedule.

PART 2 - PRODUCTS

2.01 GEOSYNTHETIC CLAY LINER (GCL)

A. The GCL must meet the requirements of ASTM D6495. The CONTRACTOR shall submit certified test results from the supplier to ENGINEER to obtain approval for use of the

product prior to mobilization of the product to the project site. Any proposed alternate GCL not approved by OWNER shall not be used.

B. The Side-Slope GCL shall meet the material properties listed on Table 1, for use on slopes steeper than 10%. The Floor GCL shall meet the material properties listed on Table 2, for slopes no steeper than 10% slope. Testing frequencies shall be per the approved manufacturer data sheet. (MARV = Minimum Average Roll Value)

**Table 1: Side-Slope GCL**

| Material Property | Test Method | Required Values |
|---|---|---|
| Product Description | -- | Needle-punched reinforced composite GCL comprised of a uniform layer of granular sodium bentonite encapsulated between a nonwoven and a scrim-nonwoven geotextile for dimensional stability. Intended for steep slopes and high load applications. |
| Bentonite Swell Index | ASTM D 5890 | 24 mL/2 g minimum |
| Bentonite Fluid Loss | ASTM D 5891 | 18 mL maximum |
| Bentonite Mass/Area | ASTM D 5993 | 0.75 lb/ft$^2$ |
| GCL Grab Strength | ASTM D 6768 | 50 lbs/in MARV |
| GCL Peel Strength | ASTM D 6496 | 12 lbs/in minimum |
| | ASTM D 4632 | 60 lbs MARV |
| GCL Index Flux | ASTM D 5887 | $10^{-8}$ m$^3$/m$^2$/sec maximum |
| GCL Hydraulic Conductivity | ASTM D 5887 | $5x10^{-9}$ cm/sec maximum |
| GCL Internal Shear Strength | ASTM D 5321/D 6243 | 500 psf @ 200 psf typical |

**Table 2: Floor GCL**

| Material Property | Test Method | Required Values |
|---|---|---|
| Bentonite Swell Index | ASTM D 5890 | 24 mL/2 g minimum |
| Bentonite Fluid Loss | ASTM D 5891 | 18 mL maximum |
| Bentonite Mass/Area | ASTM D 5993 | 0.75 lb/ft$^2$ |
| GCL Grab Strength | ASTM D 6768 | 30 lbs/in MARV |
| GCL Peel Strength | ASTM D 6496 | 3.5 lbs/in minimum |
| | ASTM D 4632 | 21 lbs MARV |
| GCL Index Flux | ASTM D 5887 | $10^{-8}$ m$^3$/m$^2$/sec maximum |
| GCL Hydraulic Conductivity | ASTM D 5887 | $5x10^{-9}$ cm/sec maximum |
| GCL Internal Shear Strength | ASTM D 5321/D 6243 | 500 psf @ 200 psf typical |

C. GCLs shall consist of natural sodium bentonite between polypropylene geotextiles that are connected by needle-punching.

D. A six (6) inch lap line and a nine (9) inch match line shall be printed or marked in the field on both edges of the upper geotextile of the GCL (as installed) to assist in overlap quality control.

E. Each roll shall be marked with the following information:
   I. Manufacturer's name and brand name
   II. Lot and roll number
   III. Roll length and width
   IV. Total roll weight

F. All rolls shall be bagged in packaging that water resistant and UV resistant.

G. Accessory bentonite used to augment seam overlaps, penetrations, and panel edges at structures shall be powdered or granulated bentonite of the same type used in the manufacture of the GCL.

## PART 3 - EXECUTION

### 3.01 SUBGRADE INSPECTION

A. CONTRACTOR shall certify in writing that the surface upon which the GCL is to be installed is acceptable (acceptance form contained at the end of this Section).

B. The subgrade shall be prepared and compacted in accordance with Section 02205: Clay Barrier Layer. Debris, roots, solid mineral particles larger than 3/8-inch diameter, and other material that may damage the GCL shall be removed. Prior to the deployment of

the GCL, the subgrade shall be final-graded to fill any voids or cracks and rolled to provide a smooth surface for the installation of the GCL.

C. After subgrade surface has been accepted by CONTRACTOR, it shall be their responsibility to indicate any change in subgrade condition that may require repair work. Special care shall be taken to maintain prepared GCL subgrade (i.e., dry and free of foreign matter). Daily observations shall ascertain the integrity of subgrade. Damage to subgrade caused by precipitation and desiccation shall be repaired at the CONTRACTOR'S expense. Any damage to subgrade caused by CONTRACTOR shall be repaired at CONTRACTOR's expense. GCL placement over subgrades having damage or excessive moisture as determined by OWNER or ENGINEER is not acceptable.

D. Particular attention shall be paid to subgrade condition at the panel edges. Panel edges shall lay flat against the subgrade with no puckering, creasing, or curling.

3.02 HANDLING, TRANSPORTATION, STORAGE, AND PLACEMENT

A. GCL rolls shall be packaged and labeled prior to transporting to the site. GCL rolls delivered to the site shall be wrapped in an impermeable and opaque protective cover. Rolls shall be stored on a flat dry surface raised several inches above the ground. Tarping stored materials is suggested to avoid any unnecessary stress on the packaging and to protect materials from moisture in the event of rain.

B. Rolls shall be handled utilizing a solid steel bar inserted through the core bar and slings or chains attached to the ends of the bar. The core bar shall be suspended from a spreader bar so that the edges of the GCL are not damaged by the suspending straps or chains. Where the GCL has a non-woven geotextile on one side and a woven geotextile on the other, panels shall be placed with the non-woven side against the subgrade, and the woven side oriented upwards.

C. Onsite storage of the GCL rolls shall be in a safe manner according to manufacturer's recommendations, with rolls protected from grease, dirt, moisture, excessive heat, direct sunlight, vehicle traffic, and other possible sources of damage including theft and vandalism. Storage areas shall be at the location approved by the OWNER. In addition, the onsite storage of the GCL is subject to the OWNER's approval of storage arrangement, including pallets, timbers, or other support and separation from ground, stacking height, packaging/covering, etc.

D. GCL and appurtenant materials delivered to the site shall be checked for proper labeling and visually inspected for transport or manufacturing damage. OWNER reserves the right to reject any unacceptable material at no cost to OWNER.

E. Only that quantity of GCL that is to be placed that day shall be removed from the packaging. GCL rolls shall be transported from the storage area to the construction area using wide lifting straps and properly sized forklifts, front-end loaders, or other appropriate equipment. Under no circumstances shall any heavy equipment be allowed directly on the GCL. Prior to placement, the GCL shall be visually inspected for damage and manufacturing defects. GCL material that, in the opinion of OWNER or OWNER's Representative, is damaged or otherwise unsuitable shall not be used for the project.

3.03 INSTALLATION

A. Edge seams shall be perpendicular to the toe of the slope at all times.

B. Seam areas or runs shall also be flat and clear of any large rocks, debris or ruts. Contacting surfaces shall be clean and clear of dirt or native soil with all edges pulled tight to maximize contact and to smooth out any wrinkles or creases. Edge overlaps shall be a minimum of six (6) inches and verified by OWNER or ENGINEER. A proper seam shall cover the six (6) inch lap line and leave the nine (9) inch match line exposed. End overlaps shall be a minimum of 24 inches and in a rainlap orientation and verified by OWNER or ENGINEER.

C. All seams shall be augmented with granular bentonite to ensure seam integrity as necessary or as required by manufacturer's recommendations. Granular bentonite, where required, shall be dispersed evenly from the panel edge to the lap line at a minimum rate of 1/4 pound per lineal foot continuously along all seams or overlap areas. Accessory bentonite shall be of the same type as the material within the geosynthetic clay liner.

D. The CONTRACTOR shall only work on an area that can be completed in one working day or before an inclement weather condition. Completion can be defined as the full installation and anchoring of the bentonite blanket and placement of the overlying geomembrane. Any GCL that is hydrated prior to placement of the geomembrane will be removed and replaced at the CONTRACTOR'S expense.

E. Large rips or tears or thin worn areas shall be repaired by completely exposing the affected area, removing all foreign objects or soil, and by then placing a patch over the damage. The patch shall overlap the GCL at least 12 inches on all edges. Accessory bentonite shall be placed between the patch and the repaired material at a rate of 1/2 pound per lineal foot of edge, spread in a six (6) inch width. The above procedures shall also be implemented in the event that a rip or tear or thin worn area occurs on a sloped surface. In this instance, the edges of the patch shall be fastened to the repaired liner with construction adhesive, as recommended by the GCL supplier in addition to the bentonite-enhanced seam.

F. During startup of the geosynthetic clay liner installation, an agent or representative of the manufacturer shall provide onsite assistance as needed and instruction to the CONTRACTOR and OWNER regarding product application techniques.

3.04 PROTECTION AFTER INSTALLATION

A. Prevent movement of GCL after installation by sandbagging or other approved methods.

B. The GCL shall be kept clean and free of soil, debris, and foreign material until covered by the geomembrane. The geomembrane shall be installed in direct contact with the GCL.

C. No vehicle traffic will be permitted directly on the GCL. Only soft-soled/rubber-soled boots and shoes shall be worn on the GCL.

D. GCL Installer shall coordinate with CONTRACTOR and geomembrane Installer regarding deployment, seaming, and testing of geomembrane and placement of cover soils over GCL such that geomembrane installation and cover soil placement occurs expeditiously and without damage to the GCL.

E. Geomembrane deployment and positioning shall be done such that no disruption of the GCL occurs, particularly at the overlapped seams.

3.05 CLEANUP

A. CONTRACTOR shall place ALL material scraps in OWNER designated area at the end of each working day. Disposal of scraps in the anchor trenches will not be acceptable. No scraps of materials will be allowed to be left on top of GCL.

B. Once the installation is complete the CONTRACTOR shall:

1. Remove all sand bags from site; or
2. Remove all sand bags and place in OWNER designated area.

PART 4 - WARRANTY

4.01 MATERIAL/WORKMANSHIP WARRANTY

A. A five (5) year material and one (1) year workmanship warranty shall be provided by the CONTRACTOR.

**END OF SECTION**

**Attachment 1 to Section 02273**

**Certificate of Acceptance of**
**GCL Subgrade Surface by CONTRACTOR**

DESCRIPTION OF AREA TO BE CERTIFIED:_____
_____
LOCATION:_____
PROJECT:_____
ADDRESS:_____

The undersigned, _____ certifies that he is a representative of _____ _____, duly authorized to execute this certificate, that he visually inspected the subgrade surface described above on _____ and found the surface to be acceptable for installation of the geosynthetic clay liner (GCL).

This certification is based on observations of the surface of the subgrade only. No sub terrain inspections or tests have been performed and_____ (OWNER) makes no representations or warranties regarding conditions which may exist below the surface of the subgrade.

Date: _____ Signature: _____
Name: _____ Title:_____

| CERTIFICATE RECEIVED BY CONTRACTOR | CERTIFICATE RECEIVED BY OWNER |
|---|---|
| Date:_____ | OWNER:_____ |
| Name:_____ | Name:_____ |
| Signature_____ | Signature_____ |
| Title_____ | Title:_____ |

**SECTION 02276**

**EROSION CONTROL**

PART 1 - GENERAL

1.01 SUMMARY

A. Work includes providing temporary and permanent erosion control as shown on the Drawings and for compliance with the site specific NPDES permit for industrial stormwater and in accordance with the Minnesota Department of Transportation “Standard Specifications”, latest edition.

B. OWNER has a NPDES permit for industrial stormwater discharge and applicable site specific SWPPP. CONTRACTOR to comply with permit and SWPPP requirements; a copy of the permit and SWPPP is available for review from the OWNER.

1.02 SUBMITTALS

A. Manufacturer's certificates indicating specification conformance test results of furnished material.

PART 2 - PRODUCT

2.01 SILT FENCE

A. Machine Sliced (MS) silt fence in accordance with the MNDOT “Standard Specifications” Section 3886.

2.03 SEDIMENT CONTROL LOG

A. Wood Fiber Log in accordance with the “Standard Specification” Section 3897.2.B.

B. Wood Stakes to be in accordance with “Standard Specification” Section 3897.2.H.

2.03 EROSION CONTROL BLANKET

A. Category 20 in accordance with the MNDOT “Standard Specification” Section 3885.

2.04 USAGE

A. Silt fence and bio-roll as determined necessary and in accordance with the site specific SWPPP.

B. Category 20 erosion control blanket on disturbed areas for protection for vegetation establishment.

PART 3 – EXECUTION

3.01 SILT FENCE INSTALLATION

A. Erosion control measures to be installed prior to site disturbance.

B. Installation of silt fence shall be in accordance with MNDOT “Standard Specifications” Section 2573.3.B.2 for machine sliced.

C. CONTRACTOR shall be responsible for maintenance and repair of silt fence until final acceptance of the project.

3.02 REMOVAL OF SILT FENCE

A. CONTRACTOR shall remove and dispose of silt fence after completion of project and the establishment of vegetation.

3.03 SEDIMENT CONTROL LOG

A. Place in accordance with Manufacturer’s recommendations.

B. Installation shall be in accordance with “Standard Specifications” Section 2573.3.F.1.

3.04 EROSION CONTROL BLANKET

A. Place in accordance with Manufacturer’s recommendations.

B. At a minimum, anchor upstream edges of all materials at least 4 inches into the soil to prevent underflow.

C. Shingle materials downslope.

D. Overlaps shall be as follows:
   a. End lap – 24 inches minimum
   b. Edges - 4 inches minimum

E. Staple sizes and spacing to be in accordance with “Standard Specifications” Section 3885.

F. Install rolled erosion control products in accordance with “Standard Specification” Section 2575.

***END OF SECTION***

**SECTION 02486**

**TURF RESTORATION**

PART 1 - GENERAL

1.01 SUMMARY

A. This section contains requirements for topsoil, seeding, fertilizing, and mulching.

B. Seed all areas disturbed by construction activities at the site outside of the waste disposal area, as designated by OWNER.

1.02 REFERENCES

A. Minnesota Department of Transportation Standard Specifications for Construction, latest edition. (Standard Specifications)

1.03 SUBMITTALS

A. Location of off-site source of materials.
B. Name, address, telephone number and contact person of independent soils laboratory.
C. Method of off-site source soils material sampling and analyses.
D. Off-site source material quality control analyses shall be submitted at least 14 days prior to installation.
E. Proposed haul road planned for transportation of all off-site materials to the project site.

F. Test Results:

1. Suppliers analysis for standard products.
2. Source testing of topsoil (minimum 1 sample result per source) if necessary per Part 2.01.A and as necessary to determine fertilizer requirements.

G. Seed mix.

H. Submit in accordance with Section 01300.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Delivery:

1. Deliver fertilizer to site in original, unopened containers bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark, and conformance to state law.
2. Deliver seed to site in unopened, original bags bearing supplier's name and address, type of seed contained, percentage of purity and germination, percentage of hard seed if any, and percentage of inert material.
3. Fertilizer and seed delivered to site shall be stored in a waterproof location as directed by OWNER.
4. Locate mulch on site where indicated by OWNER.

1.05 GUARANTEE

A. Guarantee seeded area for duration of one year after seeding to be alive and in satisfactory growth at end of guarantee period.

1. For purpose of establishing acceptable standard, scattered bare spots, none larger than 1 square foot will be allowed up to maximum of 3 percent of seeded area.
2. Acceptance will be based upon meeting this standard one year after initial seeding or reseeding.

PART 2 - PRODUCTS

2.01 TOPSOIL

A. Topsoil may be available on-site. CONTRACTOR supplied topsoil shall be used if on-site material is unavailable.

B. Topsoil performance will be determined based on proper vegetation establishment. Topsoil sampling will be conducted only if proper vegetation is not established.

2.02 FERTILIZER

A. In accordance with Standard Specification 3881.

B. Fertilize at the ratio recommended by the soil testing lab after submittal of a topsoil sample (if necessary to establish vegetation).

2.03 GRASS SEED

A. General

1. Local nursery grown seed sources in the specified seed mix.
2. Weeds shall not exceed 0.25%.
3. Comply with current U.S. Department of Agriculture rules and regulations.
4. Mix grass seeds in proportions by weight to meet or exceed minimum percentages of purity and germination. Only certified seed as defined in Standard Specifications Section 3876.3 shall be used.

B. MNDOT 25-121 seed mix. Sow the appropriate seed mixture, including additional seed which may be required as a nurse crop, depending on the sowing date, as specified by MNDOT 2575.3.

2.04 WATER

A. CONTRACTOR shall be responsible for water.

2.05 MULCH

A. Type 1 or Type 5 per "Standard Specification" Section 3882.

PART 3 – EXECUTION

3.01 INSPECTION

A. Do not begin ground preparation until boulders, debris, and similar materials have been removed, depressions and ruts filled, and area to be seeded is shaped, trimmed, and finished uniformly to grades and cross-sections shown on Drawings, or to match original grade.

3.02 SITE PREPARATION FOR SEEDING

A. Topsoil

1. Scarify subgrade to depth of 3 inches for bonding of subsoil with topsoil.
2. No topsoil shall be placed or worked in frozen or muddy condition.
3. Prepare areas to be seeded to required depth of approximately 3 inches by disking, rototilling, harrowing or other approved means.
4. Remove and dispose of rock, trash, or other materials brought to surface from preparation activities.
5. Fine grade with no more than 15% of rocks or lumps between 2 inches and 1 ½ inches in greatest dimension.

3.03 TOPSOIL/FINISH GRADING

A. Topsoil/Finish grade is established final grade as shown on Contract Drawings. Grades not otherwise indicated are uniform levels or slopes between points where elevations are given or between such points and existing finished grades. Finish grade shall be approved by the ENGINEER prior to seeding.

B. Grade, rake, and roll with roller weighing not more than 100 lbs./lf and not less than 25 lbs./lf.

C. Maximum allowable variation from correct elevation is -0.0 to +0.2.

3.04 APPLYING FERTILIZER

A. Apply fertilizer uniformly over the designated area using mechanical spreading devices. Mix thoroughly with disk into upper 2 inches of soil.

B. Apply at a rate recommended by the soil testing as defined in Section 2.02.A.

C. Apply fertilizer no more than 48 hours prior to seeding.

3.05 SEEDING

A. Do not seed on saturated or frozen soil.

B. Do not seed when wind velocity exceeds 6 mph.

C. Seed all areas disturbed by construction.

D. The grass seed shall be drilled horizontally across the slope.

E. Do not seed if surface has been compacted by recent rain event.

3.06 MULCHING

A. Mulch seeded areas not designated to receive erosion control blanket within 3 days after seeding is complete.

B. Application rate shall be 2 tons per acre or no more than 1 inch in depth.

C. Mulch shall be spread uniformly in a continuous blanket. Mulch shall be started on the windward side of relatively flat area or on the upper part of a steep slope and continued uniformly until area is covered. The mulch shall not be bunched.

D. Do not mulch during periods of excessively high winds.

E. Immediately following the spreading of the mulch, the material shall be anchored securely into the soil a minimum of 3-inches by means of a mulch anchoring machine equipped with large coulter-type discs spaced on approximate 8-inch centers. All anchoring shall be at right angles to slope. Edges of the discs shall be dull to prevent cutting of the mulching and equipment operation shall be such as to embed the mulch to the required depth. In areas where equipment cannot be used, mulch shall be secured by shallow covering of earth or by embedding with approved hand methods, including straight-bladed spade with dull edge.

F. Mulch in accordance with Section 2575 of the Standard Specifications.

3.07 CLEANUP

A. Paved surface and other site areas shall be kept clean of seeding, fertilizing, and mulching materials.

B. Clean up shall occur at the end of each work day or as required by OWNER. Pavement shall be swept with a street sweeper as directed by ENGINEER throughout the project.

C. Restore existing utilities, surface features, and structures to condition equal to condition which existed prior to construction.

D. Replace to original condition or better, damaged vegetation or landscape work.

E. Complete project punch-list prepared by ENGINEER.

3.08 MAINTENANCE OF SEEDED AREA

A. Maintenance of seeded areas shall begin immediately following last seeding application. Continue until Work is accepted.

B. Maintain seeded area by watering, mowing, and replanting as necessary to produce uniform stand of grass until Work is accepted.

C. Rework/replace topsoil where original topsoil has eroded or washed away as directed by ENGINEER.

D. Re-mulch any areas where the original mulch has washed away as directed by the ENGINEER.

E. Implement erosion control measures as required to keep area free of rutted and eroded soils and protection fences and barriers as necessary.

3.09 RESEEDING AND REPAIR

A. Reseed areas that fail to show more than 75 plants/square feet and open areas or gaps larger than 6 inches in diameter.

B. Where plant density is less than 50 plants/square foot, retill and reseed areas in accordance with seeding and maintenance requirements.

3.10 ACCEPTANCE OF SEEDED AREAS

A. CONTRACTOR shall notify OWNER in writing 7 days prior to inspecting seeded area for acceptance.

B. CONTRACTOR and OWNER shall inspect seeded areas for contract compliance and acceptance of work. Upon completion of inspecting seeded areas, OWNER shall provide written acceptance or rejection to CONTRACTOR with further requirement for completing the seeding work. Seeding work remaining to be completed shall be reinspected by OWNER before final acceptance.

***END OF SECTION***

**SECTION 02775**

**ELECTRICAL LEAK LOCATION SURVEYING OF SOIL-COVERED GEOMEMBRANE LINER**

PART 1 - GENERAL

1.01 SUMMARY

A. Performing electrical leak location testing in accordance with ASTM D7007 to detect calibration holes (if used), installation/construction related holes, and other damage.

B. Reporting results of leak location surveying.

1.02 REFERENCES

A. American Society for Testing and Materials, current edition, hereafter referred to as ASTM.

B. ASTM D7007: Standard Practice for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earth Materials (most current edition).

1.03 SUBMITTALS

A. Submit contact information for proposed leak location testing firm; include statement of factors that influence leak detection sensitivity and accuracy, and which may be adjusted or corrected in the field to improve the accuracy and sensitivity of leak detection.

B. Submit qualifications for proposed leak location testing firm.

C. Submit leak location survey plan, including equipment, setup requirements, survey grid spacing, data management method, QA/QC plan, crew size, and other pertinent information.

D. Submit an example of proposed format for reporting results of the leak location survey prior to completion of testing.

E. Submit final report with results of leak location survey following completion of testing/repairs.

1.04 JOB CONDITIONS

A. It shall be solely the CONTRACTOR’s responsibility to review available tests and reports, conduct additional tests, and otherwise determine to its own satisfaction the location and nature of all surface and subsurface features and the soil and water conditions that may be encountered.

B. It shall be solely the CONTRACTOR’s responsibility to review project construction plans and specifications, sequencing and scheduling plans, and other construction-related information, and determine to its own satisfaction CONTRACTOR’s ability to perform the required work within the context of the overall construction project.

PART 2 PRODUCTS

Not Applicable

PART 3 – EXECUTION

3.01 ACCEPTANCE OF SITE AND SURVEY CONDITIONS

A. Prior to performing sensitivity testing or leak location surveying, CONTRACTOR shall be responsible for watering and maintaining the required moisture within the drainage layer material to facilitate testing. CONTRACTOR is also responsible for electrically isolating the test area as required to complete testing. Isolated areas shall be kept free of sand and water during testing activities.

B. CONTRACTOR shall provide generator, fuel, testing grid materials, and any other equipment or materials required to complete testing.

3.02 LEAK LOCATION SURVEYING

A. CONTRACTOR shall perform the leak location survey procedure in conformance with the surveying plan submitted above and in general conformance with ASTM D7007. Survey shall be performed in the presence of OWNER and/or ENGINEER.

C. CONTRACTOR shall mark detected leak locations with lath, flagging, or similar marking, and shall remove cover soil from the area to expose the underlying geosynthetics. CONTRACTOR shall replace cover soil following completion of repairs.

D. Resurveying shall be performed in the areas near leak locations to verify that repairs were adequate and that an additional leak is not present which may have been masked by the detected leak.

3.03 REPORTING

A. CONTRACTOR shall field-report to OWNER and ENGINEER summary results of surveying on a daily basis. Daily reports shall include:

1. The results of beginning and end-of-day leak detection sensitivity tests.
2. A summary of leaks detected and repair/resurvey status with a description of the area surveyed that day.

B. A final report with supporting data shall be submitted to OWNER and ENGINEER within 5 calendar days of completion of leak location surveying.

C. The final report shall contain the following items:

1. A description of the leak location methods and procedures, the survey methodology, the liner components and configuration, and cover and subgrade soil types and conditions.
2. A discussion of the results of leak location sensitivity tests and actions taken in response to the tests.
3. A map of the area showing the limits of the leak location survey, the layout of the surveying grid, the location of the source electrode, and other pertinent layout information.
4. A complete description of the leaks found, including location, size, configuration, and photographs. The report shall clearly distinguish between calibration holes, if used and installation/construction-related holes.
5. The final report shall include electronic data files containing plots of leak signals from sensitivity testing, calibration holes, and construction-related holes

along with maps, grids, and other information necessary to locate each data set within the project limits.

***END OF SECTION***

**SECTION 02920**

**HIGH DENSITY POLYETHYLENE GEOMEMBRANE (HDPE)**

PART 1 - GENERAL

1.01 SUMMARY

A. Work includes manufacture, fabrication (if needed), supply, and installation of textured and smooth High Density Polyethylene (HDPE) geomembrane liner for base liner system construction. Textured geomembrane shall have a smooth edge for seaming.

1.02 DEFINITIONS/REFERENCES

A. American Society for Testing and Materials (ASTM) Standards specifically referenced in this Section:

1. ASTM D6693 - Standard Test Method for Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
2. ASTM D751 - Standard Test Methods for Coated Fabrics
3. ASTM D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
4. ASTM D1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting
5. ASTM D1238 - Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
6. ASTM D1505 - Standard Test Method for Density of Plastics by the Density Gradient Technique
7. ASTM D1603 - Standard Test Method for Carbon Black Content in Olefin Plastics
8. ASTM D3895 - Standard Test Method for Oxidative Induction Time of Polyolefins by Differential Scanning Calorimetry
9. ASTM D4218 - Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
10. ASTM D4437 - Standard Practice for Non-destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes
11. ASTM D4833 - Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
12. ASTM D5199 - Standard Test Method for Measuring Nominal Thickness of Geosynthetics
13. ASTM D5397 - Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
14. ASTM D5596 - Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
15. ASTM D5641 - Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber
16. ASTM D5721 - Standard Practice for Air-Oven Aging of Polyolefin Geomembranes
17. ASTM D5885 - Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry
18. ASTM D5994 - Standard Test Method for Measuring the Core Thickness of Textured Geomembranes
19. ASTM D6365 - Standard Practice for the Nondestructive Testing of Geomembrane Seams using the Spark Test
20. ASTM D6747 - Standard Guide for Selection of Techniques for Electrical Leak Location of Leaks in Geomembranes
21. ASTM D7002 - Standard Practice for Electrical Leak Location on Exposed Geomembranes Using the Water Puddle Method
22. ASTM D7007 - Standard Practices for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earthen Materials

23. ASTM D7238 - Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus
24. ASTM D7466 - Standard Test Method for Measuring Asperity Height of Textured Geomembranes
25. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

B. Geosynthetic Research Institute (GRI) Standards:

1. GRI GM 6: Standard Practice for Pressurized Air Channel Test for Dual Seamed Geomembranes
2. GRI GM 9: Standard Practice for Cold Weather Seaming of Geomembranes
3. GRI GM 10: Standard Guide for The Stress Crack Resistance of HDPE Geomembrane Sheet
4. GRI GM 13: Standard Specifications for Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes
5. GRI GM 14: Standard Guide for Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes
6. GM 19a: Standard Specifications for Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes/Barriers

C. U.S. Environmental Protection Agency Technical Guidance Document “Quality Control Assurance and Quality Control for Waste Containment Facilities,” EPA/600/R-93/182, September 1993, 305 pgs.

1.03 SUBMITTALS

A. The following submittals shall be provided to and approved by OWNER or ENGINEER prior to delivery of geomembrane to the site or mobilization of the geomembrane CONTRACTOR’S crew or equipment:

1. CONTRACTOR shall supply information from the resin manufacturer regarding the resin type, properties as specified herein, and production dates of the resin used for this project. The resin type identification shall include the cell classification of the resin in accordance with the requirements of the latest ASTM Designation D3350.
2. CONTRACTOR shall submit from the geomembrane sheet manufacturer, test methods and results defining physical properties as specified herein, of the geomembrane to be used for this project. Test results at the frequency specified in the GRI standards of geomembrane furnished for this project shall be submitted, and test results shall be reported with corresponding roll identification numbers.
3. CONTRACTOR shall supply a statement of the geomembrane manufacturer's quality control procedures, identification of any resin admixtures, frequency of sampling, methods of material transportation and storage, and acceptance criteria for roll goods delivered to the site.
4. CONTRACTOR shall provide submittals describing the geomembrane sheet manufacturer's details of any factory seaming process proposed. Roll test results which may not be available prior to construction (i.e., environmental stress crack) shall be presented as preliminary prior to construction, with final test results submitted or affected rolls within the construction time frame.
5. CONTRACTOR shall submit from the extrudate weld rod manufacturer, verification that the weld rod was manufactured using the same resin as was used in the geomembrane sheets prior to using material.
6. CONTRACTOR shall submit a proposed panel and seam layout diagram specifying the type and location of all field and factory seams. The layout diagram shall be to scale and used as a construction Plan and shall include all necessary dimensions and details. The layout diagram shall be compatible with the panel and seam layout requirements specified in this Section.
7. CONTRACTOR shall submit an installation schedule.

8. CONTRACTOR shall submit a list of personnel performing field supervision, and quality control, along with experience records and resumes.
9. CONTRACTOR shall submit a list of equipment types proposed to be used in panel layout, membrane seaming, and destructive and nondestructive testing.

B. The CONTRACTOR shall remit the following during geomembrane Installation:

1. CONTRACTOR shall, at the end of each working day provide a detailed report of work completed that day, including:
   a) Panel Placement
   b) Trial Welds Results
   c) Subgrade Acceptance Form
   d) Seams
   e) Seam Testing (air and vacuum tests)
   f) Destructive Tests
   g) Repair Log

2. ENGINEER shall review with the CONTRACTOR and sign the above report at the end of each day. OWNER shall be provided with a copy of the report.

C. CONTRACTOR shall update their liner layout drawings on a daily basis. The drawings shall include all panel locations and numbering, seam locations and numbering, and test locations and numbering. The CONTRACTOR shall maintain a current liner layout drawing on the construction site at all times. At the request of OWNER, a copy of the current liner layout drawing will be submitted with 24 hours.

D. CONTRACTOR shall submit final as-built liner layout drawing(s) to OWNER within 14 calendar days of completion of the liner work. Drawings shall be submitted in paper and digital form.

E. Quality control certificates indicating resin type, properties as specified herein, and production dates shall be provided with each shipment of extrudate rods delivered to the site no later than the time of delivery.

F. Prior to the installation of any geomembrane, the CONTRACTOR shall submit CONTRACTOR'S certification in writing that the surface upon which the geomembrane is to be installed is acceptable (complete form contained at end of this Section).

G. Submit material delivery and installation schedule for incorporation into the Project schedule.

1.04 EXPERIENCE

A. The geomembrane installation shall be performed under the direct supervision of a single field supervisor who must remain on-site throughout installation, including inspection of the surface upon which the geomembrane is to be installed, geomembrane handling and storage, panel layout and placement, seaming, seam testing, panel and seam repair, installation of appurtenances, anchorage, and other geomembrane-related work. The field supervisor shall have a personal HDPE geomembrane installation record totaling at least 2 million square feet.

1.05 Pre-Installation Meeting

A. Representatives of the CONTRACTOR shall attend a meeting prior to installation of the geomembrane to discuss details of the proposed design, installation, and schedule.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Raw Materials:

1. Smooth and textured HDPE geomembrane, and extrudate rods used for this project shall be manufactured of new, first quality resins containing no more than 2 percent clean recycled polymer by weight, with a minimum specific gravity of 0.940 and carbon black content of 2.0-3.0 percent, designed specifically for use in flexible membrane liner installations.

2. HDPE resin used in manufacturing geomembranes used for this Project shall meet requirements set forth in the latest revision of the Geosynthetics Research Institute (GRI) for HDPE (GRI GM 13).

B. Geomembrane Roll Goods:

1. HDPE geomembrane sheets used for this project shall meet the requirements set forth in the latest revision of the Geosynthetics Research Institute (GRI) for HDPE, both smooth and textured (GRI GM 13).
2. The geomembranes shall consist of unreinforced high density polyethylene containing at a maximum 3 percent by weight additives, fillers, or extenders.
3. The geomembranes shall be free of holes, blisters, striations, undispersed raw material, and contamination by foreign matter.
4. The geomembranes shall be supplied as a continuous sheet with no factory seams in rolls. Each roll shall be identified and labeled with the thickness of the geomembrane, length and width, manufacturer, lot number, and roll identification number. This identification number shall be used to identify roll location on the panel layout record drawing.

C. Extrudate: Resin used in the polyethylene extrudate shall be the same as that used to manufacture the geomembrane sheets. Extrudate rods are to be delivered in original sealed containers with the manufacturer's labeling. Extrudate rods shall be free of dirt, grease, moisture, other contaminants, and shall be free of damage.

D. Neoprene Foam: Closed cell, weatherproof, black neoprene foam with adhesive backing suitable for long-term sun and liquid exposure. Dimensions shall be as specified on the DRAWINGS.

E. Clamped Boots: Boots required to seal the HDPE geomembrane to the structures passing through it shall be made of the same materials as the geomembrane. The boots shall be fabricated so that all field assembly, welding, and seam testing can be accomplished using equipment and procedures regularly employed in the field for equipment and HDPE geomembrane installation. Smooth geomembrane shall be used in all geomembrane boots.

F. Banding Straps: Type 302 stainless steel banding straps suitable for use on the pipe diameters shown on the DRAWINGS. Banding strap dimensions shall be as specified on the DRAWINGS. All surfaces of the banding straps shall be machined smooth to prevent tearing or puncturing of the HDPE pipe boots. Outer lip of boot shall be sealed with silicone sealant as shown on Drawings.

2.02 EQUIPMENT

A. Extruding equipment shall be equipped with a temperature gauge at the barrel and nozzle.

B. Fusion equipment shall be equipped with a temperature gauge capable of continuous monitoring.

C. Provide digital or dial continuous temperature recording instruments, in satisfactory working condition, with each welding unit. Welding equipment shall not be operated without functioning temperature recording instruments for measuring geomembrane sheet temperature.

D. A coupon cutter and a calibrated tensiometer shall be provided for in-field seaming pre-qualification testing and destructive sample testing.

E. Store, transport, and operate all equipment to avoid damage to geomembranes.

F. Glass top of each vacuum box must be clear and free of scratches for easy reading of pressure gauge. The sealing gasket shall be intact and functioning to form close seals during testing.

G. OWNER reserves the right to order the CONTRACTOR to remove any equipment that in OWNER or ENGINEER'S opinion is not satisfactory. The CONTRACTOR will remove the equipment promptly from the construction site and replace the unsatisfactory equipment with suitable equipment within 24 hours.

PART 3 - EXECUTION

3.01 SUBGRADE INSPECTION

A. CONTRACTOR shall certify in writing that the surface upon which the geomembrane is to be installed is acceptable (acceptance form contained at end of this Section).

B. CONTRACTOR shall provide daily written acceptance for the surface to be covered by the geomembrane in that day's operations. The surface shall be maintained in a manner during geomembrane installation to ensure subgrade suitability.

C. After subsurface has been accepted by CONTRACTOR, it shall be CONTRACTOR'S responsibility to indicate any change in subsurface conditions that may require repair work and perform required repair work. Damage to subsurface caused by work involved in installing geomembrane shall be repaired at CONTRACTOR'S expense. Geomembrane placement over damaged subsurface, as determined by ENGINEER or CONTRACTOR, is not acceptable. Nothing will waive CONTRACTOR'S contractual requirements with respect to warranty on installed system.

3.02 CREST ANCHORAGE SYSTEM

A. Backfilling of Anchor Trench:

1. Backfill and compaction of anchor trench will be performed by the CONTRACTOR.
2. Generally, the anchor trench is not backfilled until at least one day after deployment to allow shrinkage of the material overnight.

2. CONTRACTOR shall monitor the backfilling of anchor trench to ensure proper method is employed. Any damage noticed shall be reported to OWNER or ENGINEER.

3.03 HANDLING, TRANSPORTATION, AND STORAGE

A. Geomembrane rolls shall be packaged and labeled prior to transporting to the site. Geomembrane rolls delivered to the site shall be wrapped in a relatively impermeable and opaque protective cover which may consist of a sacrificial wrap of geomembrane. The sacrificial wrap shall be removed prior to geomembrane installation.

B. Geomembrane transportation shall be in a manner that minimizes the possibility of material damage during shipment. When offloading geomembrane from the truck, straps and a spanbar shall be used. Direct contact with forklifts or front end loaders to offload the material will not be allowed without written consent from OWNER.

C. On-site storage of the geomembrane rolls shall be in a safe manner, with rolls protected from grease, dirt, moisture, excessive heat, direct sunlight, vehicle traffic, and other possible sources of damage including theft and vandalism. The rolls will be placed in neat order and placed such that identification tags for each roll can be read. Storage areas shall be at the OWNER'S designated location.

D. Geomembrane and appurtenant materials delivered to the site shall be checked for proper labeling and visually inspected for transport or manufacturing damage. OWNER or ENGINEER reserves the right to reject any unacceptable material at no cost to OWNER. Any roll that arrives on site without factory roll identification will not be used for the work and will be removed from the site promptly.

E. Only that quantity of geomembrane that is to be placed on a particular day shall be removed from the packaging. Geomembrane rolls shall be transported from the storage area to the construction area and deployed using wide lifting straps and properly sized forklifts, front end loaders, or other appropriate equipment.

F. Under no circumstances shall any heavy equipment be allowed directly on the geomembranes unless approved by OWNER or ENGINEER.

G. Prior to placement, the geomembranes shall be visually inspected for compliance with this Section. Geomembrane material which, in the opinion of the OWNER or ENGINEER is damaged or does not meet Specifications will be rejected by the OWNER. Minor damage may be repaired as specified in this Section. Damage to geomembranes caused by CONTRACTOR during handling shall be repaired or replaced at CONTRACTOR'S expense.

3.04 PANEL LAYOUT AND PLACEMENT

A. Panel and Seam Layout Diagram:

1. Prepare panel and seam layout diagram so that panel seams run parallel to the direction of maximum slope (i.e., down the slope).
2. All slopes steeper than or equal to 4H:1V, the seams shall be oriented in the direction of the slope. Horizontal seams shall not be allowed on 4:1 slopes unless unavoidable, where seam shall be diagonal at 45 degrees.
3. All slopes steeper than 10% shall use geomembrane textured on both sides, unless specifically identified otherwise on the DRAWINGS. Textured panels shall extend a minimum of 5 feet past the toe of the slope or edge of trench, or as otherwise indicated on the DRAWINGS. The seam connecting to the smooth

geomembrane shall be on a surface of less than 10%. Smooth or textured geomembrane may be used in the leachate collection trench. A single panel should run along the entire length of the primary leachate collection trench and be centered about the trench centerline, minimizing seaming and/or repairs within the trench. Where panels must cross the leachate header trench at the toe of the slope, panels shall be overlapped in the direction of flow.

4. Slope panels shall not be constructed from more than two pieces of geomembrane (i.e., not more than one cross-seam shall be permitted on any one slope panel).
5. Cross seams in slope panels, where allowed, shall be oriented at 45°. Cross seams shall be located on at least the bottom half of the slope, wherever possible.
6. Cross seams in adjacent panels shall be staggered.
7. Assign identification number to each seam for reference to test results and record Drawings.
8. Seams shall not be located at low points in the subgrade unless required by site geometry and approved by OWNER or ENGINEER.

B. PANEL PLACEMENT:

1. Panel size and placement shall be in general accordance with the panel layout diagram submitted to OWNER as defined in this Specification.
2. Geomembrane shall be anchored with sand bags or other approved methods to prevent uplift and damage by wind.
3. A panel identification number shall be assigned to each panel for reference to test results and Record Drawings. The panel identification number and geomembrane roll number shall be written on each panel with a grease pencil, immediately following deployment of the panel.
4. Smoking during placement of panels is prohibited. Wearing damaging shoes or engaging in any behavior which may damage the geomembrane is prohibited.
5. Eating, drinking, disposal of food wraps, drinking bottles and cans on top of geomembrane is not allowed.
6. Place panels with appropriate slack incorporated into geomembrane to accommodate expansion and contraction without jeopardizing the integrity of the geomembrane.
7. Vehicle traffic over geosynthetics as a means of panel deployment is expressly prohibited without the consent of the OWNER.
8. To prevent a ‘trampoline effect’ from forming, the CONTRACTOR shall place sufficient sand bags on the liner along the toe of slopes to ensure full contact of geomembrane to the subgrade.

C. OWNER or ENGINEER and CONTRACTOR will visually inspect in-place panels prior to seaming. Any damaged panels shall be repaired, and if requested by OWNER, replaced at no additional cost to OWNER. Repairs shall be performed as specified in this Section. All damages and repairs shall be recorded on the Record Drawings.

3.05 SEAMING

A. Seaming Methods: All seams shall be joined using a heat extrusion or hot fusion (split wedge) weld process in accordance with the geomembrane manufacturer's recommendations. The CONTRACTOR shall maintain in working order at the site at least one spare seaming apparatus for each type of welder used. The hot fusion weld process will be used whenever possible. The use of extrusion welded seams shall be limited to repairs and any areas or seam configuration inaccessible to fusion welding equipment.

B. Factory and field seams shall meet the minimum specifications set forth by the latest revision of the GRI GM 19a.

C. Seam Configuration and Preparation:

1. Overlap panels to be seamed at least 4 inches but not more than 6 inches. The loose end of the upper panel shall extend no more than 3 inches from the weld. All seams shall be made in a rainlap manner with the loose end of the upper panel downgradient of potential water flow.
2. Cross seams on slopes, where allowed, shall be made at a 45 degree angle to the edge of the panel.
3. The contact area between panels shall be clean and free of moisture, dust, dirt, debris, and foreign material. A protective layer of filter fabric or a sacrificial HDPE strip shall be used directly beneath each seam overlap to achieve proper support and a clean work surface, if necessary.
4. Where extrusion welding is used, the contact surfaces between panels shall be ground to remove oxidation prior to welding. Grinding shall not result in grooving of the liner nor reduction of the liner thickness by more than 10 percent. The grinding motion shall be made perpendicular to the seam. Grinding in a direction parallel to the seam shall not be permitted. All ground areas shall be covered completely with extrudate.
5. Seams shall be aligned to minimize the number and size of wrinkles. The CONTRACTOR shall ensure that wrinkles greater than 4-inches tall are addressed as drainage layer material is placed in order to minimize wrinkle propagation and accumulation towards the end of drainage material placement. Wrinkles greater than 4-inches tall will not be accepted. In no case will wrinkles of any size be allowed to be folded over or left in a manner that would impact the integrity of the liner system or impede leachate drainage within the cell.
6. All seam ends shall be staggered a minimum of 5 feet in length between contiguous panels.

D. Test Seam:

1. A prequalification test seam sample shall be prepared with each piece of seaming equipment/seamer approximately every four hours at the beginning of each seaming period (usually morning and afternoon), unless otherwise directed by OWNER or ENGINEER. Each sample shall be prepared by the operator of the equipment for that seaming period and shall be at least 3 feet long (in the direction of the seam) by at least 1 foot wide and may be performed on scrap pieces of geomembrane.
2. Ten 1-inch wide specimens (coupons) from each test seam sample shall be prepared for on-site field testing for shear and peel strength. Coupons shall be prepared using a sheet cutter so that consistent, uniform 1-inch wide coupons are obtained. Samples should be distributed evenly over the 6 feet length.
3. The CONTRACTOR will make these test seams in the presence of OWNER or ENGINEER.
4. The extension rates for these tests will not exceed 2-inches per minute unless permission from the OWNER is given.
5. Five coupons shall be tested in shear and five in peel. All coupons shall exhibit the required strength at yield and failure mechanism FTB as set forth in *Paragraph 3.05B*. Seam separation equal to or greater than 10% of the track width shall be considered a failing test. If any of the coupons fail, the reason for the failure shall be identified and corrected prior to preparing another test seam. The new test seam shall be prepared reflecting adjustments made to the seamer/seaming equipment and a new set of coupons shall be cut and tested.

6. Seaming equipment shall not be used until satisfactory prequalification test seams have been prepared, witnessed by OWNER or ENGINEER.
7. The test results on all prequalification test seams will be reported to OWNER and ENGINEER.

E. Climatic Conditions for Seaming:

1. Seaming shall be performed only when panel temperatures are between 32°F and 170°F, unless otherwise approved by OWNER. If seaming is permitted to be performed at panel temperatures below 32°F, the panel contact surface shall be preheated and CONTRACTOR shall certify in writing that the low-temperature seaming procedures will not cause any short-term or long-term damage to the geomembrane or the welded seam. CONTRACTOR shall demonstrate to OWNER or ENGINEER that field seams comply with project specifications using pre-qualification test seams. CONTRACTOR shall submit to OWNER or ENGINEER, for approval, detailed procedures for seaming at low temperatures, including the following:
    a. Preheating of the geomembrane
    b. Provision of a tent or other device if necessary to prevent heat losses during seaming and rapid heat losses subsequent to seaming.
    c. Number of additional test welds to determine appropriate seaming parameters.
2. Seaming during rainy weather or when dew is present on panels shall not be allowed.
3. CONTRACTOR shall provide any special lighting required for seaming during low-light or dark hours.
4. CONTRACTOR shall leave slack in the geomembrane as necessary to account for thermal expansion or contraction of geomembrane. Stress on panels due to thermal expansion and contraction shall be minimized by performing field seaming operations during the coolest parts of the day or night, if necessary. Special scheduling or extended hours of operation require approval by OWNER.

F. All welding shall provide a tight, leak proof, homogeneous bond between panels. All seams shall extend to ends of panels.

G. Welding equipment shall be continuously monitored to control the temperature of extrudate and wedge. If recording equipment allows for a hard copy of the monitoring, a copy of the monitoring labeled with the weld identification number will be submitted to OWNER or ENGINEER.

## 3.06 PIPE AND STRUCTURE PENETRATION SEALING SYSTEM

A. Penetration sealing systems shall be constructed from the base geomembrane material, flat stock, prefabricated boots, and accessories as shown on the Drawings.
B. All penetration sealing systems must be tested. Where field non-destructive testing cannot be performed, field spark testing shall be performed using standard holiday leak detectors in accordance with ASTM 6365. Spark testing should be performed in areas where both air pressure testing and vacuum testing are not possible.

## 3.07 NONDESTRUCTIVE TESTING OF PRODUCTION SEAMS

A. All field seams shall be non-destructively tested by the CONTRACTOR over the full seam length before the seams are covered. Each seam shall be numbered or otherwise designated. The location, date, test unit, name of test, and outcome of all non-destructive testing shall be recorded and submitted to the OWNER or ENGINEER.

B. Testing shall be done as the seaming work progresses, not at the completion of all field seaming. All defects found during testing shall be numbered and marked immediately after detection. All defects found shall be repaired, retested, and remarked to indicated acceptable completion of the repair.

C. Non-destructive tests shall be performed by experienced technicians familiar with the specified test methods.

D. Visual Inspection: A visual inspection of all seams shall be performed. This inspection shall look for obvious flaws in seaming patches, penetration sealing, material defects, or other problems. Deviations from acceptable workmanship standards shall be noted and corrected.

E. Pressure Testing (Double-Fusion Welds): Where a double-fusion weld seaming system is employed, the continuity of the seam shall be tested with air pressure in accordance with the following procedure. The flow channel must not be obstructed by foreign objects or geomembrane material throughout the length of seam being tested. The vacuum test described in *Paragraph 3.07F* must be employed for testing of all seams that do not have a continuous flow channel.

1. A test device consisting of an inflation needle and pressure gauge mounted on a "T" fitting shall be used for air pressure testing. Insert the needle into the flow channel and seal the end of the channel around the needle. Connect a pump (such as a small bicycle pump) to the test device.
2. Ascertain that the flow channel is continuous by leaving the other end of the channel open and pumping air through the channel. If air does not pass through the channel the test length must be shortened until a continuous length of flow channel is found.
3. Seal and clamp both ends of the flow channel to assure an airtight seal. Inflate the flow channel to 27 to 40 psig. Allow one minute for the seam to stabilize.
4. Re-inflate as needed to achieve 27 to 40 psig on the seam and test for a period of five minutes.
5. At the end of the test period, if the pressure has not dropped more than 3 psi, the test shall be considered a pass and the following procedure will be implemented;
    a. Remove the test device and clamps.
    b. Make any repairs, if necessary, to the area where the flow channel was clamped or inflated.
    c. Record the test results, mark the seam as a pass, the date tested, and proceed to the next seam.
6. If the pressure drops below the 3 psi allowance, the test shall be considered a failure and the following procedure shall be implemented to identify the failure:
    a. Check to determine if there is excessive seepage around the inflation needle.
    b. Check both ends of the seam to ensure the flow channel is completely sealed off.
    c. Walk the length of the seam; look and listen for air leaks.
    d. If either of these procedures fail to identify the leak, trim the seam overlap and vacuum test the seam to locate the leak.
    e. Once the leak is identified, make the necessary repairs, and retest the seam.
7. Seam to be approved before testing by OWNER or ENGINEER; test to be performed in presence of OWNER or ENGINEER personnel.

F. Vacuum Testing: Vacuum testing shall be used to test the continuity of extrusion welded and mechanical seams. A clear topped vacuum box, supplied by CONTRACTOR, shall be placed over the seam to be tested after application of a soapy solution. Upon

evacuation, bubbles will be evident through the viewing window if the seam lacks integrity. The following procedure shall be followed:

1. Wet seam to be tested with a soapy solution mixed at a ratio of 1 ounce soap to 1 gallon water. No antifreeze solution is allowed to be added to the water.
2. Place vacuum box over seam to be tested, evacuate box to a vacuum equal to 5 psig, and tug up to ensure a leak tight seal has been developed.
3. Examine the seam for a minimum of 10 seconds to detect soap bubbles.
4. If the bubbles are not evident, move to next test location. Adjacent test sections are to overlap by at least 1 inch.
5. If bubbles are present, mark area clearly for repair.
6. If the vacuum testing indicates leakage, the area shall be spot patched; or if major leaks are detected, the entire seam shall be reworked.
7. Seam to be approved before testing by OWNER or ENGINEER; test to be done in presence of OWNER or ENGINEER personnel.

3.08 DESTRUCTIVE TESTING OF PRODUCTION SEAMS

A. The purpose of destructive testing is to verify that the seaming process has produced seams of acceptable mechanical integrity. One seam sample shall be taken at random for each 500 feet of seam. Sample locations shall be designated by OWNER or ENGINEER. Each sample shall be shown on the panel layout drawing. All holes in the installed geomembrane resulting from obtaining samples shall be repaired immediately. The sample ID number shall be marked on the patch. All repairs shall be 100 percent vacuum tested for continuity.

B. *Maximum frequency of test locations shall be agreed upon by the CONTRACTOR, OWNER, and ENGINEER prior to commencement of installation*. Additional test locations, not to exceed agreed upon maximum frequency, shall be determined during seaming at OWNER or ENGINEER'S discretion. Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset welds, or other potential cause of imperfect welding.

C. CONTRACTOR shall not be informed in advance of locations where seam samples will be taken.

D. Cut samples as seaming progresses in order to obtain documentation test results prior to completion of liner installation. Number each sample and identify sample number and location on panel layout drawing.

E. Samples shall be 12 inches wide by 36 inches long with seam centered lengthwise. Cut one 25 mm (1 in.) wide strip from each end of sample and test in field, by hand or tensiometer, for peel and shear, respectively. The tested sample shall not fail through the seam. If tensiometer is not available and if 25 mm (1.0 in.) wide specimen is too difficult to test by hand, 10 mm (0.5 in.) wide specimen is acceptable. Cut remaining sample into 3 parts and distribute as follows.

1. One portion to CONTRACTOR for field documentation testing, 12 inches by 12 inches.
2. One portion to OWNER independent laboratory testing, 12 inches by 12 inches.
3. One portion to OWNER for archive storage, 12 inches by 12 inches.

F. For field testing, the CONTRACTOR shall cut 10 identical 1-inch wide replicated specimens from his sample. The CONTRACTOR shall test five specimens for seam shear strength and five for peel strength. Peel tests shall be performed on both inside

and outside weld tracks. To be acceptable four out of five specimens must pass the test criteria with less than 10% separation. The CONTRACTOR shall submit field documentation test results to the OWNER or ENGINEER as soon as they become available, but no later than 2 working days after the sample was taken. Field seams shall meet the minimum specifications of GRI GM 19a.

Note: All seams must exhibit a film tear bond (FTB).

G. All testing equipment required for these quality control tests shall be provided by CONTRACTOR. Any seams failing the quality control tests shall be repaired at CONTRACTOR'S expense until passing test results are obtained. At all times, care shall be exercised to avoid damaging the geomembrane.

H. ENGINEER shall be present for all field documentation testing of seam strength.

I. CONTRACTOR shall submit results of test it performs as a result of its quality control assurance program to OWNER and ENGINEER.

3.09 PROCEDURES FOR DESTRUCTIVE TEST FAILURE

A. The following procedures shall apply when sample fails lab destructive test.

1. Obtain additional destructive test samples at locations approximately 10 feet on either side of the failed test location.
2. Perform destructive tests.
3. If test passes, the seam shall be considered adequate.
4. If tests fail, all seams represented by the original destructive test shall be repaired with a cap-strip extrusion welded to all sides of the capped area. All cap-strip seams shall be non-destructively tested until adequacy of the seams is achieved. Cap strip seams exceeding 150 feet in length shall be destructively tested.

B. In any case, acceptable seams shall be bounded by 2 passed test locations (i.e., above procedure shall be followed in both directions from original failed location), and one sample for destructive testing shall be taken within reconstructed area.

C. If sample fails laboratory destructive test (whether conducted by independent laboratory or by CONTRACTOR'S laboratory), above procedures shall be followed considering laboratory tests exclusively. Since final seam must be bounded by 2 passed test locations, it may be necessary to take one or more new samples for laboratory testing in addition to one required in reconstructed seam area.

3.10 DEFECTS AND REPAIRS

A. Identification: Broom or wash geomembrane if amount of dust or mud inhibits inspection.

B. Evaluation: Non-destructively test each suspect location in seam and non-seam areas. Repair each location failing nondestructive testing.

C. Repair Procedures:

1. Repair defective seams by reconstruction.
2. Repair tears or pinholes by seaming or patching.
3. Repair blisters, larger holes, undispersed raw materials, and contamination by foreign matter with patches.
4. Surfaces of geomembrane to be patched shall be abraded no more than 1 hour prior to repair.

5. Seams used in repairing patches shall be approved extrusion welded seams and may be subjected to same destructive test procedures as outlined for other seams.
6. Patches shall be made of same geomembrane, extend minimum of 150 mm (6 in.) beyond edge of defects, and applied using approved extrusion welding methods only. Report areas of repair to OWNER and ENGINEER immediately.

D. SEAM RECONSTRUCTION PROCEDURES:

1. Seam reconstruction for extrusion welding process shall be achieved by installing a cap strip over the defective weld a minimum of 6 inches either side of the weld and extrusion welding.
2. Seam reconstruction for fusion process shall be achieved by cutting out existing seam and welding in replacement strip, or reseaming by extrusion welding along the overlap at the outside seam edge left by the fusion welding process,or welding a cap strip over the defective seam length.

E. Verification of Repairs: Test each repair non-destructively. Repairs passing nondestructive test shall be taken as indication of adequate repair. Failed tests indicate repair shall be redone and retested until passing test results.

3.11 GEOMEMBRANE ACCEPTANCE

A. CONTRACTOR shall retain ownership and responsibility for geomembrane until acceptance by OWNER. Geomembrane liner will be accepted by OWNER when:

1. Written certification letter, including "as-built" drawings, is received by OWNER.
2. Installation of the geomembrane is complete.
3. All required documentation of installation is submitted to OWNER, including inspector's final report.
4. Verification of adequacy of field seams and repairs, including associated testing, is complete and all paperwork accepted and approved by OWNER or ENGINEER.
5. The five year material and one-year workmanship warranties are received.

3.12 CLEANUP

A. The CONTRACTOR shall place ALL material scraps in OWNER designated area at the end of each working day. Disposal of scraps in the anchor trenches will not be acceptable. No scraps of materials will be allowed to be left on top of liner.

B. Once liner installation is complete the CONTRACTOR shall:

1. Remove all sand bags from site; or
2. Remove all sand bags and place in OWNER designated area; or
3. If sand in sand bags is acceptable as a drainage layer material the CONTRACTOR may empty each bag and remove and dispose of the empty bags. This will only be allowed if the material meets the criteria for a granular drainage layer. The CONTRACTOR must receive permission from OWNER prior to emptying the sand bags onto the liner.

**END OF SECTION**

**Certificate of Acceptance of**
**Geomembrane Subgrade Surface by CONTRACTOR**

DESCRIPTION OF AREA TO BE CERTIFIED:_____
_____

LOCATION:_____

PROJECT:_____

ADDRESS:_____

The undersigned, _____ certifies that he is a representative of _____ _____, duly authorized to execute this certificate, that he visually inspected the subgrade surface described above on _____ and found the surface to be acceptable for installation of the geomembrane.

This certification is based on observations of the surface of the subgrade only. No sub terrain inspections or tests have been performed and_____ (company) makes no representations or warranties regarding conditions which may exist below the surface of the subgrade.

Date: _____ Signature: _____

Name:_____ Title:_____

CERTIFICATE RECEIVED BY CONTRACTOR CERTIFICATE RECEIVED BY OWNER

Date:_____ Date:_____

Contractor:_____ Company:_____

Name:_____ Name: _____

Signature_____ Signature_____

Title_____ Title:_____

**SECTION 02921**

**GEOTEXTILE**

PART 1 - GENERAL

1.01 SUMMARY

Under this section, Work includes manufacture; fabrication (if needed); furnishing; installation of geotextile for the leachate collection system and other areas as shown on the Drawings.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D3776—Standard Test Method of Mass per Unit Area (Weight) of Fabric.
2. ASTM D4491—Standard Test Method for Water Permeability of Geotextiles by Permittivity.
3. ASTM D4632—Standard Test Method for Breaking Load and Elongation of Geotextiles (Grab Method)
4. ASTM D4751—Standard Test Method for Determining Apparent Opening Size of a Geotextile.
5. ASTM D4833—Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
6. ASTM D3786 -Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
7. ASTM D4884 -Standard Test Method for Strength of Sewn or Bonded Seams of Geotextiles

1.03 SUBMITTALS

A. Manufacturer's certificates indicating conformance test results of furnished material to Specifications.

B. Submit in accordance with Section 01300.

1.04 QUALITY CONTROL AND MATERIAL HANDLING

A. Roll Identification:

1. Provide geotextiles in rolls wrapped in relatively impermeable and opaque protective covers and marked or tagged with following information:
   a. Manufacturer's name
   b. Product identification
   c. Lot number
   d. Roll number
   e. Roll dimensions
2. Indicate special handling marked on geotextile itself, e.g., "This Side Up".
3. Conformance testing to indicated conformance with specifications.

B. Handle geotextiles in such manner as to ensure geotextiles are not damaged.

PART 2 - PRODUCT

2.01 GENERAL

A. Unless otherwise noted on Drawings, furnish materials whose minimum average roll values as defined by Federal Highway Administration (FHWA), meet or exceed Geotextile Fabric Properties.

B. Except when specifically authorized, supplier shall not furnish special run or value added products.

C. Unless longer durability is specified, geotextiles shall be capable of withstanding direct exposure to sunlight for 30 days with no measurable deterioration.

2.02 GEOTEXTILE FABRIC MINIMUM PROPERTIES:

A. Leachate Collection System (minimum 16-ounce geotextile)

1. Minimum general.
   a. Nonwoven, nonbiodegradable.
   b. Polypropylene.
2. Minimum dimensional.
   a. Mass/unit area – minimum 16 ounces per square yard (ASTM D3776)
3. Minimum mechanical.
   a. Puncture resistance – 200 pounds (ASTM D4833) or 1025 pounds (ASTM D6241).
   b. Grab strength – 380 pounds (ASTM D4632).
   c. Grab elongation – 50% (ASTM D4632).

PART 3 - EXECUTION

3.01 GEOTEXTILES INSTALLATION

A. General

1. On slopes, roll down slope in such manner as to continually keep geotextile sheet in tension.
2. In presence of wind, weight geotextiles with sandbags or equivalent. Install sandbags during placement and keep in place until replaced with cover materials.
3. Take necessary precautions to prevent damage to underlying layers during placement of geotextile.
4. During placement of geotextiles, care shall be taken not to entrap in geotextile, stones, excessive dust or moisture that could damage geomembrane or hamper subsequent seaming.
5. Do not expose geotextiles to precipitation prior to being installed and do not expose to direct sunlight for more than 15 days, unless otherwise specified.
6. All geotextile installation shall be completely covered at the end of each work day unless otherwise approved by the ENGINEER.

B. Seams and Overlaps:

1. On slopes steeper than 10 horizontal/1 vertical, seam geotextiles.
   a. Seam by sewing, adhesive, fusion or other approved means.
   b. Continuously seam; do not spot seam.

1) Spot seaming when overlapping may be considered as measure against wind uplift.

c. Overlap geotextile minimum 8-inches prior to seaming.
d. Sew horizontal seams along slope, not across slope.
e. Using polymeric thread with properties equal to or exceeding those of geotextile.
f. Orient overlaps in direction of earth filling.

C. Geotextile Repair:

1. A spot seam fabric patch in place with minimum of 24-inch overlap in each direction.
2. Remove soil or other material that may have penetrated torn geotextile.

D. Appurtenances:

1. Install geotextile around appurtenances protruding through geotextile as shown on Drawings.
2. After material is placed and seamed, complete final field seam connection between appurtenance sleeve or shield or geotextile. Maintain sufficient initial overlap of appurtenance sleeve so shifts in location of geotextile can be accommodated.

***END OF SECTION***

**SECTION 15064**

**HIGH DENSITY POLYETHYLENE PIPE**

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes installation of CONTRACTOR supplied piping for the leachate collection system.

B. Extent of pipe and fittings required by this section indicated on Drawings.

1.02 REFERENCES

A. American Water Works Association (AWWA).

B. American Society for Testing and Materials (ASTM):

1. ASTM D638- Test Method for Tensile Properties of Plastics.
2. ASTM D790- Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating.
3. ASTM D1238- Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
4. ASTM D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
5. ASTM D1505 – Standard Test Method for Density of Plastics by the Density-Gradient Technique.
6. ASTM D1693 – Standard Test Method for Environmental Stress Cracking of Ethylene Plastics.
7. ASTM D1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
8. ASTM D1785 – Standard Specifications for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
9. ASTM D2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
10. ASTM D3350 - Standard Specification for Polyethelene Pipe and Fittings Material.
11. ASTM D2122 - Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings.
12. ASTM D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
13. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
14. ASTM F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
15. ASTM 5105 – Standard Practice for Performing Accelerated Outdoor Weathering of Pressure-Sensitive Tapes Using Concentrated Natural Sunlight

1.03 SUBMITTALS

A. List of materials to be furnished, the names of the suppliers and the date of delivery of materials to the site.

B. Documentation from the resin's manufacturer showing results of the following tests for resin identification:
   a. Melt Flow Index (ASTM D1238)
   b. Density (ASTM D5105)

C. Complete, detailed shop drawings of all polyethylene pipe, including the location of all fittings, joints, and connections to structures.

D. Manufacturer's recommendations for handling, storing, and installing pipe and fittings.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Handle and protect product to ensure product is not damaged.

B. Provide factory applied basic end caps on each length of HDPE pipe. Maintain caps during shipping, storage, and handling to prevent end damage.

C. Provide protection for flanges and fittings by storing inside or packaging with impermeable opaque material.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS/SUPPLIERS

A. All HDPE pipe and fittings required for construction will be supplied by the CONTRACTOR.

B. HDPE Pipe:

   1. Acceptable Manufacturers:
      a. Phillips Driscopipe, Inc., Dallas, Texas.
      b. Poly Pipe Industries, Gainesville, Texas.
      c. Or approved equal.
   2. High performance, high molecular weight, high density polyethylene pipe.
   3. Material designation PPI-PE 4710.
   4. ASTM D3350, minimum cell classification value 445574C.
   5. Marking: Intervals of 5 feet or less.
      a. Manufacturer's name or trademark.
      b. Nominal pipe size.
      c. Legend: Industrial pipe SDR as indicated on Drawings.
      d. ASTM F714.
      e. Extrusion date, period of manufacture or lot number.
   6. Perforated pipe:
      a. Pattern as shown on Drawings.

C. Fittings:

   1. Molded from polyethylene compound having cell classification equal or exceeding compound used in pipe to insure compatibility of resins.

2. Be of same manufacture as pipe.
3. Fusion weld joints.
4. Markings:
    a. Manufacturer's name or trademark.
    b. Nominal size.
    c. Material designation "HDPE".
    d. ASTM D3261.

PART 3 - EXECUTION

3.01 EXECUTION

A. Examine and verify acceptability of surface to receive product.

3.02 HDPE PIPE INSTALLATION

A. Location, lines, and grades as shown on Drawings.

B. Welded joints.

1. Weld in accordance with manufacturer's recommendations for butt fusion methods.
2. Butt fusion equipment used in joining procedures capable of meeting conditions recommended by manufacturer, including, but not limited to: temperature required, alignment, and fusion pressures.
3. Electrofusion couplers to be installed as shown on Drawings for pipe penetrations through the perimeter berm; any other use of electrofusion couplers shall be approved by the OWNER or ENGINEER prior to installation.

C. CONTRACTOR to supply flange adapters (if necessary) and fittings necessary to connect new pipe to existing piping where shown on Drawings in accordance with manufacturer's recommendations. Butt fusion welding of new to existing, preferred.

D. No defective pipe installed. Defective pipe removed from site and replaced at CONTRACTOR'S expense.

E. Install aggregate and bedding material as shown on Drawings.

F. Attach HDPE flatstock, if applicable, with the following:
1. Continuously weld to pipe and configure such that it will have full bearing contact onto sump bottom.
2. Round edges of flatstock to prevent damage to underlying geosynthetics.
3. Groove bottom of flatstock to provide smooth bottom.

G. Perforations:
1. Penetrate pipe in pattern shown on Drawings.
2. Remove all cuttings and shavings prior to placement.

3.03 EXCAVATION AND PREPARATION OF SUBGRADE

A. Excavate and prepare subgrade as specified in Section 02220 and as shown on Drawings.

3.04 BACKFILL

A. Backfill with required pipe bedding and cover material as shown on Drawings.

3.05 FIELD QUALITY CONTROL

A. Pipe may be rejected for failure to conform to specification, or:

1. Fractures or cracks passing through pipe wall, except single crack not exceeding 2 inches in length at either end of pipe which could be cut off and discarded. Pipes within one shipment will be rejected if defects exist in more than 5 percent of shipment or delivery.
2. Cracks sufficient to impair strength, durability, or serviceability of pipe.
3. Defects indicating improper proportioning, mixing, and molding.
4. Damaged ends, where damage would prevent making satisfactory joint.
5. Noticeable variations from true alignment and grade sufficient cause for rejection of Work.

B. Acceptance of fittings, stubs or other specially fabricated pipe sections based on visual inspection at site and documentation that they conform to these specifications.

***END OF SECTION***

# Construction Quality Assurance Plan

Final Closure
Dem-Con Pilgrim Landfill (SW-254)

April 2026

Prepared for:

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Attachment 1: Technical Specifications

# 1.0 Introduction

This CQA Plan outlines the necessary procedures, standards and methods for appropriate monitoring and documentation of the installation of a final cover lining system and intermediate cover lining system at the Dem-Con Pilgrim Landfill (facility or Landfill) near Mankato in Blue Earth County, Minnesota. The overall goals of this construction quality assurance program are to ensure that proper construction techniques and procedures are implemented and to verify that materials and installation techniques used meet the project design requirements. At the completion of the work, the program will culminate in a certification report which documents that the grading, liner, and piping systems have been constructed in general accordance with design standards and specifications with any deviations noted.

This plan also outlines the responsibilities of the various key parties involved in landfill construction. This plan is intended in conjunction with the project drawings, specifications, and other project documents to comprise the CQA program. Construction specifications for cover construction are provided in Attachment 1.

## 1.1 Definitions

Quality Assurance: Means and actions employed by OWNER to assure conformity of the lining system production and installation with the approved drawings, specifications and other project requirements.

Quality Control: Actions taken by the liner manufacturer, installer, earthwork contractor to ensure that materials and workmanship meet the requirements of the drawings, specifications, and other project requirements.

Cover System: Refers to a final or intermediate cover system.

Technical Specifications: A document produced by the Designer declaring minimum values of performance of construction materials.

Subgrade: The surface of the underlying soil prepared to receive the final cover.

Certification Report: A report documenting that construction was carried out according to approved drawings and specifications, and this CQA plan.

## 1.2 Parties

The parties discussed in this section are associated with the ownership, design, supply, manufacture, transportation, installation, and quality assurance of a lining system. The parties involved and their functions are described below:

**OWNER:** The party that owns and operates the facility that is responsible for the overall coordination of CQA activities. The OWNER is also responsible for selecting the necessary parties associated with construction.

**Designer:** The firm responsible for preparing the engineering design, associated plans, and specifications for the facility. The Designer for the project shall be a registered professional engineer in the State of Minnesota. The Designer may provide clarification necessitated during construction. The Designer may also be referred to as the ENGINEER in the Technical Specifications.

**Quality Assurance Contractor (QAC):** A person designated by OWNER to observe tests and document construction activities on behalf of the OWNER. The QAC will identify and notify the OWNER of any deviations or problems that arise during construction and assist in resolution. The QAC is also responsible for preparation of the construction certification report required for submittal to the MPCA. The QAC will have an individual identified as the CQA Officer. The CQA Officer will be a registered professional engineer in the State of Minnesota. The QAC may also be denoted as the ENGINEER in the Technical Specifications.

**Earthwork Contractor (EC):** This firm is mainly responsible for the earthwork preparation and construction of the soil components of the lining system. The EC typically prepares the subgrade or foundation soil on which the geosynthetics are placed. The EC is also responsible for placing the soil materials over the lining system. In addition, the EC may install piping and backfill material.

**Geosynthetic Manufacturer (GM):** The GM is the firm or firms responsible for the production and supply of the various geosynthetic components. The geosynthetic manufacturer will be responsible for providing QC documentation that the materials meet the requirements of the drawings, specifications, and other project requirements. The GM is responsible for the condition of the product until the material is accepted by the OWNER on-site.

**Geosynthetic Installer (GI):** The GI is responsible for field handling, storing, placing, seaming, loading, and other aspects of the installation of geosynthetics.

**Quality Assurance Laboratory (QAL):** Firm which performs necessary testing on samples taken from the site.

**Land Surveyor (LS):** Responsible for documenting the subgrade and cover system component thicknesses.

# 2.0 Documentation

## 2.1 General

The QAC will be on site to document construction activities. The QAC will prepare the daily activity logs, assemble the test reports, prepare the record drawings, and prepare the certification report. This section addresses the content of the various reports.

## 2.2 Documentation Reports

Daily Activity Log: The QAC will prepare daily activity logs, for the days they are present on-site, which will typically contain the following:

- Name and title of construction supervisor; contractor(s) personnel and equipment onsite
- Date of activity
- Weather, including maximum and minimum temperatures and amount of precipitation, if any
- Type of activity conducted.
- Summary of all quality assurance tests conducted, indicating which tests passed and failed specifications.
- Documentation of all repairs made on the liner system.

Photographs: The QAC shall create a photographic record of key construction activities to document the overall progress of construction.

Test Reports: The quality assurance laboratory will prepare a test report for each sample tested and provide copies to the QAC.

The test reports will typically contain the following information.

- Date
- Sample I.D.
- Project name and location
- Sample size and description
- Test being performed.
- Applicable ASTM standards
- Method of sample preparation
- Test results, including a statement that the test either passed or failed the project requirements.

The laboratory shall certify the accuracy of the test reports and compliance with relevant standards.

The liner installation record drawing will be provided by the GI. The QAC will work closely with the GI to ensure that panel numbers, seam locations, and destructive test numbers and locations are correctly located on the record drawing.

Certification Report: The QAC will prepare a certification report that documents construction and includes certification from a professional engineer registered in the State of Minnesota that the construction was in general accordance with this CQA plan, engineering drawings, and specifications.

The report shall include:

- A schedule of major events during construction, including start and finish dates, as appropriate.
- A list of the contractor and subcontractors involved.
- A summary description of the procedures and equipment used during each phase of construction (a summary of the daily activity logs).
- Final cover soils records
    - sampling and testing results as applicable dependent on material[1]
    - thickness verification information
- Geomembrane installation records: including panel layout record (to be supplied by the GI)
- Piping system records
- Record drawings containing the information previously listed.
- Select photographs, appropriately labeled.

[1] Final cover construction projects may be phased and span multiple construction seasons dependent on waste fill rates, weather, and other site-specific considerations. Projects that span multiple seasons may be considered as the same project with separate “phases”. In that case, soil material from the same borrow source may be used during subsequent phases as in the initial phase, without additional soil testing completed. Separate construction documentation reports may be developed and submitted for each phase of construction. The construction documentation report(s) for the subsequent phase(s) will contain the soil testing information from the initial phase, as applicable.

# 3.0 Geomembrane

## 3.1 General

Geomembranes are the geosynthetic component of the final cover system. This section is applicable to the Polyethylene (PE) geomembranes used in the final cover system. Material specifications for the geomembrane are displayed in Table 2.

## 3.2 Material Quality Control

### 3.2.1 Raw Material

The resin used to make geomembrane sheet shall be tested in accordance with the manufacturer's guidelines. Material ingredients of the geomembrane shall be randomly sampled by the manufacturing plant to ensure compliance with these specifications. Test reports of quality control tests, such as specific grading, melt flow index and carbon black content will be provided.

### 3.2.2 Geomembrane Material Specifications

The GI shall provide the QAC with the following:

1. A quality control certificate including the specified measure using test methods indicated at a frequency to meet conformance with the Geosynthetics Research Institute's (GRI) GM 17 for LLDPE.
2. Certification that property values given in the properties sheet are guaranteed by the GI.
3. Certification that 100 percent of every roll has been visually inspected for holes, cracks, thin spots, tears, punctures, blisters, or any other foreign material.

The GI shall provide the following information to the QAC for each roll delivered to the site:

- Name of the manufacturer and fabricator
- Name and type of liner
- Thickness of liner
- Batch code
- Date of fabrication
- Physical dimensions
- Panel number
- Location and method of storage at the site

This information shall accompany each roll delivered to the job site.

The QAC will examine results and report any nonconformance to OWNER. QC results will be reviewed and accepted or rejected by the QAC prior to deployment.

## 3.3 Subgrade

When the geomembrane is placed on a soil subgrade, the EC shall be responsible for preparing the subgrade for the geomembrane. Once complete, the QAC shall examine the surface, and verify the adequacy of the survey data provided. When the QAC deems the surface acceptable the QAC shall certify at a minimum:

1. The required subgrade survey has been completed and the results meet the specifications.
2. The subgrade has been inspected and meets the project requirements.

The GI will also inspect the subgrade and will sign the subgrade acceptance forms.

At any time during installation of the geomembrane, the QAC shall inform the OWNER of any areas that are unacceptable. Such defects in the subgrade shall be corrected by the appropriate contractor such that repaired areas meet the project specifications. If additional work is required on a soil subgrade it is the GI's responsibility to notify the EC and OWNER of such work and also provide this notification to the QAC.

## 3.4 Observations and Documentation

### 3.4.1 Roll Inspections

Prior to placement of any lining material, rolls shall be observed for defects and damage by both the QAC and the GI. Storage of the rolls shall be in a location that minimizes on-site handling and the possibility of damage.

Each roll shall have a roll label which clearly identifies the manufacturing information. This information, along with the panel number and location/method of on-site storage, shall be recorded by the QAC.

The QAC shall also visually observe each roll for imperfections or damage including holes, cracks, thin spots, tears, punctures, blisters, or the presence of foreign material.

### 3.4.2 Placement

#### 3.4.2.1 Equipment

The GI shall use equipment that does not damage the geomembrane by handling, trafficking, excessive heat, leakage of oils or other means. The method and equipment used to unroll the material shall not cause scratches, crimps or any damage to the underlying geosynthetics, or excessive rutting of the soil subgrade.

#### 3.4.2.2 Method of Deployment

No personnel working on the geosynthetic liner shall smoke, wear damaging shoes or engage in other activities that could damage the geomembrane. The method used to place the panels shall minimize wrinkles.

Adequate temporary loading and/or anchoring shall be provided to prevent uplift of the liner by wind. The anchoring system shall not damage the liner.

The GI shall inspect each panel after placement and prior to seaming for damage. Damaged panels or portions of damaged panels that have been rejected shall be marked and their removal from the work area recorded.

#### 3.4.2.3 Crest Anchorage System

An anchor trench may not be required dependent on the footprint of the cover system and tie-in locations. If required, the anchor trench shall be excavated to the lines and widths shown on the drawings, prior to geomembrane placement. The trench shall be drained to prevent ponding or softening of adjacent soils where trench is open. The corners of the trench shall be slightly rounded to avoid sharp bends in the geomembrane. The trench shall be backfilled and compacted by light compaction equipment to the required grade.

Since backfilling the anchor trench can affect material bridging at the toe of slope, or at the drainage terraces, consideration should be given to backfilling the liner at its most contracted state, preferably during the cool of the morning or extended period of overcast skies. Care should be taken when backfilling the trenches to prevent damage to the geosynthetics.

### 3.4.3 Trial Seams

To verify that seaming conditions are adequate, trial seams shall be performed on fragmented pieces of geomembrane. Trial seams shall be made as follows:

1. Approximately every 4-hours at the beginning of each seaming period (usually morning and afternoon)
2. Anytime equipment is turned off.
3. For each seaming apparatus
4. Other times as deemed necessary by the QAC.

A test weld, long enough to obtain required samples shall be run at the frequency described above (typically approximately 6 feet long).

The test weld shall be recorded on the GI's trial weld log with date, ambient temperature, and welding machine number. Testing shall be completed in accordance with the project specifications. The QAC will observe and document results of trial seam procedures.

## 3.4.4 Field Seaming

### 3.4.4.1 Seam Layout

Prior to liner installation, panel layout drawings shall be submitted and approved by the QAC and OWNER. Seams should typically be oriented parallel to the line of maximum slope. All seam-numbering and panel-numbering systems shall be agreed upon prior to installation. Individual liner panels shall be laid out and overlapped as required prior to welding. The area to be welded shall be cleaned prior to welding. Panel locations shall be recorded by the GI/QAC.

### 3.4.4.2 Seaming Equipment and Accessories

The fusion welding apparatus will be an automated, vehicle-mounted device that produces a double seam enclosing a void. This apparatus shall be equipped with gauges permitting a direct reading of the applicable temperatures.

The extrusion welding apparatus shall be equipped with gauges giving the temperatures of the apparatus at the nozzle.

### 3.4.4.3 Weather Conditions for Seaming

Seaming shall not take place during precipitation, in the presence of excess moisture or in the presence of excessive winds. Excessive moisture is a condition where condensation or other moisture on the sheet is the cause of poor seams or seams failing non-destructive or destructive testing. Excessive winds shall be determined by the GI, but if the QAC feels panel deployment poses a safety concern with the wind or that the geomembrane cannot be adequately held in place with sandbags, deployment shall cease until wind conditions allow further seaming. Seaming shall not take place when panel temperatures are less than 32$^{o}$F or more than 170$^{o}$F unless authorized by the OWNER and QAC.

### 3.4.4.4 General Seaming Procedures

The rolls of geomembrane shall be overlapped as required by the manufacturer’s specifications.

A base T-seam shall not be closer than 10 feet from the toe of the slope. Seams shall be aligned with the least possible number of wrinkles and "fish mouths". Excessively large wrinkles and all fish mouths shall be relieved and cap stripped.

The QAC shall document field seam locations and panel overlaps. Panels that are factory fabricated or factory seamed will undergo the same observation and documentation as panels that are field seamed.

## 3.5 Testing

### 3.5.1 Nondestructive Seam Continuity Testing

The GI shall nondestructively test all field fusion seams over their full length by air-pressure testing. Extrusion-welded seams shall be tested by vacuum gauge.

Air pressure testing will be performed on most of the seams, since the double fusion-seaming method is the method of choice. Vacuum testing will be performed on extrusion welded seams. Air pressure and vacuum testing shall be in accordance with the project specifications.

The QAC shall document the following for each non-destructive seam test:

- Date
- Seam number
- Welder I.D.
- Seamer
- Air Pressure

### 3.5.2 Destructive Testing

Destructive seam tests shall be performed every 500 lineal feet of seam. The purpose of these tests is to check that welds are fully integrated with each other and to evaluate seam strength. Seam strength testing shall be done as the seaming work progresses, not at the completion of field seaming.

#### 3.5.2.1 Location and Frequency

The QAC shall select locations where seam samples will be cut. These locations shall be estimated as follows:

a) A minimum frequency of one test location per 500 feet of seam length. This minimum frequency is to be determined as an average taken throughout the entire facility.
b) The seaming technician shall not be informed in advance of the locations where the seam samples will be taken.

Sampling shall be cut by the GI as the seaming progresses in order to have timely laboratory test results. The GI shall:

a) Cut samples.
b) Assign a number to each sample that is to be based upon seam and sample number and mark it accordingly.
c) Record sample location on construction record drawings.
d) All holes in the geomembrane resulting from destructive seam sampling shall be immediately repaired in accordance with the project specifications. The continuity of the new seams in the repaired area shall be tested accordingly.

#### 3.5.2.2 Size of Samples

Samples shall be approximately 16 X 44 inches for testing to be distributed in accordance with the project specifications for field documentation testing, OWNER independent laboratory testing and OWNER archive storage.

Final determination of the sample sizes shall be determined prior to liner installation at the preconstruction meeting.

#### 3.5.2.3 Field Testing

For field testing, the GI shall cut 10 identical 1-inch wide replicated specimens from the sample. The GI shall test five specimens for seam shear strength and five for peel strength. Peel tests shall be performed on both inside and outside weld tracks. To be acceptable 5 out of 5 specimens must pass the test criteria with less than 10% separation. If any field test sample fails to pass, then the procedures outlined in the specifications shall be followed.

#### 3.5.2.4 Laboratory Testing

Passing tensiometer testing in the field qualifies the sample for laboratory testing.

Destructive test samples shall be packaged and shipped to the geomembrane testing laboratory consultants by overnight mail. The laboratory shall provide test results to the QAC.

Destructive testing involves two techniques: 1) shear testing, and 2) peel testing. Shear testing applies a tensile stress from the top sheet through the weld and into the bottom sheet. Peel testing peels the top sheet back against the overlapped edge of the bottom sheet in order to observe how separation occurs. The peel test indicates whether or not the sheets are continuously and homogeneously connected through the seam. A total of 10 coupons will be subject to testing, for which five will be tested in shear and 5 in peel (ASTM D6392). Fusion seam specimens will have both tracks tested in peel.

Both tests (shear and peel) must have a Film Tearing Bond (FTB) type of separation to pass. With an FTB, the polymer material tears indicating a fully integrated connection between top and bottom sheets. It is important that no weld bead/sheet or sheet/sheet interface exists as such an interface might be separated by absorbed chemicals, causing failure of the seam.

The QAC shall document the following for each destructive seam test:

- Location
- Seam number
- Welder I.D.
- Seamer
- Sample I.D.

#### 3.5.2.5 Procedures for Destructive Test Failure

Procedures for destructive test failure are outlined in the specifications.

The GI and QAC shall document all actions taken in conjunction with destructive test failures; e.g., capping of failed seam area.

## 3.6 Defect And Repairs

All seams and non-seam areas of the geomembrane shall be examined by the GI and QAC for identification of defects, holes, blisters, un-dispersed raw materials and any sign of contamination by foreign matter.

### 3.6.1 Evaluation

Each suspect location both in seam and non-seam areas shall be nondestructively tested using the methods described in this section as appropriate. Each location that fails the nondestructive testing shall be marked by the GI and repaired. Work shall not proceed with any materials that will cover locations that have been repaired until non-destructive test results are recorded.

### 3.6.2 Repair Procedures

All portions of the geomembrane exhibiting a flaw or failing a destructive or nondestructive test shall be repaired in accordance with the project specifications. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be agreed upon between the QAC, GI, and OWNER. The procedures available include:

1. Patching: Used to repair large holes, tears, and contamination by foreign matter.
2. Buffing and re-welding: Used to repair small sections of extruded seams.
3. Spot welding or seaming: Used to repair small tears, pinholes, or other minor localized flaws.
4. Capping: Used to repair areas of inadequate seams that have an exposed edge.

### 3.6.3 Verification of Repairs

Each major repair requiring a patch or cap shall be identified in the GI's repair log. Each repair shall use nondestructive test methods described in this section as appropriate. Repairs that pass the nondestructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be re-done and re-tested until passing test results are obtained. The QAC may choose to take a destructive test in an area of repair. The QAC shall document the location of each type of repair and the type of repair made.

## 3.7 Final Acceptance

The geomembrane must be observed for completion of liner construction activities. The final inspection shall be performed by the QAC, GI and OWNER. The QAC and GI shall document completion or incompletion. The GI shall repair or complete any testing that has been determined incomplete. The QAC and GI shall then re-inspect the repairs and observe testing to complete final inspection.

Geomembrane material shall be final inspected prior to being covered by overlying geosynthetic materials or soil layers.

## 3.8 Conformance With Project Specifications

The QAC shall document that the installation and necessary repairs were done in accordance with the project specifications.

# 4.0 Geotextile

## 4.1 General

This section addresses geotextiles that may be used as part of a synthetic drainage system in the final cover. Use of a studded drain liner would require installation of a non-woven geotextile to prevent clogging of the system from the overlying cover soils. A synthetic drainage system may not be applicable to each project; the construction drawings reflect the final cover profile to be installed.

## 4.2 Material Quality Control

The manufacturer shall provide a list of guaranteed minimum average roll value properties for the specified geotextile to be installed. Each roll of geotextile shall bear a label that identifies the properties. The QAC will examine results and report any nonconformance to OWNER. QC results will be reviewed and accepted or rejected by the QAC prior to deployment.

## 4.3 Observation and Documentation

### 4.3.1 Roll Inspection

Prior to placement, rolls shall be inspected for damage and defects by the QAC. During shipment and storage, geotextile shall be protected from ultraviolet light exposure, precipitation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions. Consistent with these objectives, geotextile rolls shall be shipped and stored in relatively opaque and watertight wrappings. The GC shall be responsible for proper on-site storage of geotextile materials and geotextiles shall be handled in such a manner as to ensure they are not damaged. In the presence of wind, the materials shall be weighted with sandbags. Care shall be taken to ensure that stones, mud, dirt and debris are not entrapped beneath the geotextile during placement and seaming operations that could cause damage.

### 4.3.2 Seaming

Geotextiles shall be sealed by overlapping 4 inches and sewing or by an alternate method as approved by the QAC and OWNER. Manufacturer recommended overlap lengths will be followed for slope applications. Sewing threads shall be a polymeric material with chemical resistance similar to the geotextile. The QAC shall observe and document that the panel overlap meets the project specifications and that there are no excessive folds or wrinkles in the geotextile.

### 4.3.3 Damage And Repairs

Any holes or tears in geotextiles shall be repaired by patching with the same geotextile materials. The patch shall be a minimum of 24 inches larger than the area to be repaired in all directions and shall be thermally spot-bonded (lystered) or stitched in accordance with the technical specifications. The QAC shall document that any holes or defects were repaired.

### 4.3.4 Conformance with Project Specifications

The QAC shall document that the installation and necessary repairs were done in accordance with the project specifications.

# 5.0 Granular Drainage Media

## 5.1 General

The granular drainage media consists of natural material used as a drainage layer in the cover system. Use of this section may not apply dependent on the final cover system selected for installation; see construction drawings for the final cover profile.

## 5.2 Material Quality Control

Samples of the granular drainage media will be tested in-place or during placement for grain size distribution and hydraulic conductivity. Frequencies are provided in Table 1 and acceptability criteria are listed in the technical specifications. Source testing requirements are identified in the technical specifications.

The QAC shall examine the results and report any nonconformance to the OWNER. QC results shall be reviewed and accepted or rejected by the QAC prior to installation.

## 5.3 Observation and Documentation

Observations of the construction work by QAC or OWNER include the following:

- Hauling of material to ensure no damage to underlying geosynthetics
- Spreading of granular drainage media material to ensure excess wrinkling of underlying geosynthetics does not occur.
- Placement of pipes to ensure proper bedding and coverage and protection of underlying geosynthetics.
- Documentation will include; laboratory test data, material information, placement methods and thicknesses.

## 5.4 Testing

CQA testing will be conducted on samples taken from the material during the course of construction. Sampling locations will be selected by QAC or OWNER according to the number of required tests. Locations of all tests will be documented for report purposes. Laboratory test methods and frequencies to develop data upon which acceptability evaluations can be based will be as provided in Table 1. Source testing requirements are identified in the technical specifications.

## 5.5 Damage and Repairs

Granular drainage media that does not meet the requirements of the CQA Plan or the Specifications will be removed and replaced with suitable material.

## 5.6 Survey

The minimum thickness of soil drainage media shall be as shown on the drawings and extending over the lining system. The thickness of granular drainage media shall be verified on a grid spacing as specified in Table 3 using consistent methods that shall not damage the liner. Grading tolerances are provided in Table 3. Settlement verification locations will be used to adjust subgrade elevations throughout granular drainage placement. The settlement verification locations will be determined by the ENGINEER prior to granular drainage media placement.

## 5.7 Conformance With Project Specifications

The QAC shall document that the granular drainage media installation was done in accordance with the project specifications.

# 6.0 Piping Systems

## 6.1 General

This section addresses the HDPE piping installed for the gas extraction system (if used) and stormwater management system piping.

## 6.2 Material Quality Control

The EC (or other piping contractor, if applicable) shall inspect all piping and fittings received at the site and shall verify that piping materials are:

1) In accordance with drawings and specifications (size, SDR ratio, material)
2) Free of material defects
3) Undamaged

EC shall be responsible for storing piping materials in a protected location where they will not be damaged.

The QAC shall examine the results and report any nonconformance to the OWNER. QC results shall be reviewed and accepted or rejected by the QAC prior to installation.

## 6.3 Observation And Documentation

### 6.3.1 Installation

EC shall install piping at locations and elevations as shown on drawings. All piping connections shall be made in accordance with manufacturer's recommendations and with the technical specifications. Installation of backfill around piping shall be done carefully to ensure damage to the piping does not occur. QAC will document piping types installed, methods of connection/fitting types, and backfilling procedures. Documentation of the piping will include information on the method used to join sections of the pipe.

## 6.4 Damage and Repairs

Damaged or defective portions of the piping, as determined by QAC, will be removed and replaced.

## 6.5 Survey

The piping will be surveyed to verify minimum required slope / grade. Pipe tolerances are provided in Table 3.

## 6.6 Conformance With Project Specifications

The QAC shall document that the piping installation was done in accordance with the project specifications.

# 7.0 Vegetative Soils

## 7.1 General

The vegetative layer will be topsoil capable of sustaining vegetative grasses over areas disturbed during construction.

## 7.2 Observation and Documentation

The QAC will observe and document the placement methods of the vegetative soils. The EC (or other contractor, if applicable) shall ensure conformance to the project requirements regarding topsoil quality and placement, fertilizer content and application, seed mixture, seeding operations, mulching, and reseeding/repair work to sustain vegetation.

The QAC shall examine the results and report any nonconformance to the OWNER. QC results shall be reviewed and accepted or rejected by the QAC prior to installation.

Topsoil thickness shall be documented to verify conformance with the Drawings and in accordance with the specifications and Table 3.

## 7.3 Damage and Repair

Seeded areas must be guaranteed by the EC to be alive and in satisfactory growth for a period of 1 year. If areas of non-growth or spotty growth are present, they will be reseeded.

# TABLES

1. Soil Quality Assurance Testing Requirements
2. Geosynthetic Quality Assurance Testing Requirements
3. Grading Tolerances

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# TABLE 1

## Soils Quality Assurance Testing Requirements (In-place Testing Requirements[1])

| Granular Drainage Layer | | | |
|---|---|---|---|
| **Test** | **Method** | **Number of Tests** | **Pass/Fail Criteria** |
| Grain Size | D6913 | 1/2,000 cubic yards<br>Min. 1/source<br>Min. 3 tests | <5% passing No. 200<br>Max. 3/8" (99% passing)<br>Uniformity Coeff <6 |
| USCS Classification | D2487 | 1/2,000 cubic yards<br>Min. 1/source<br>Min. 3 tests | - |
| Hydraulic Conductivity | D2434 | 1/5,000 cubic yards<br>Min. 1/source<br>Min. 3 tests | ≥ 1 x $10^{-3}$ cm/sec at 90% standard proctor dry density |

| Rooting Zone & Topsoil | | | |
|---|---|---|---|
| **Test** | **Method** | **Number of Tests** | **Pass/Fail Criteria** |
| Visual Observation | -- | -- | Particle size and material limitations per the specifications. |

[1]Source testing requirements for the final cover soil layers, as applicable, are identified in the technical specifications. Final cover construction projects may be phased and span multiple construction seasons dependent on waste fill rates, weather, and other site-specific considerations. Projects that span multiple seasons may be considered as the same project with separate "phases". In that case, soil material from the same borrow source may be used during subsequent phases as in the initial phase, without additional soil testing completed. Separate construction documentation reports may be developed and submitted for each phase of construction. The construction documentation report(s) for the subsequent phase(s) will contain the soil testing information from the initial phase, as applicable. Quality assurance testing (in-place testing) will be completed as tabulated above.

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## TABLE 2

## Geosynthetic Quality Assurance Testing Requirements

| LLDPE Geomembrane Testing | | |
|---|---|---|
| **Test** | **Reference** | **Frequency** |
| Material Properties | GRI GM 17 and Spec Section 02922 | By manufacturer<br>Every roll provided |
| Visual Inspection | -- | Entire sheet |
| Trial Seam Welding | CQA Plan Section 3.4.3 and Spec Section 02922 | Approximately every 4-hours (typically morning and afternoon); anytime equipment is turned off; for each seaming apparatus |
| Non-Destructive Seam Testing | CQA Plan Section 3.5.1 and Spec Section 02922 | All seams/patches |
| Destructive Seam Strength Test | CQA Plan Section 3.5.2 and Spec Section 02922<br>GRI GM 19a<br>ASTM D 6392<br>Pass Fail Criteria in Accordance with GRI GM 19a | 1 test per 500 L.F. seam minimum |

| Geotextile | | |
|---|---|---|
| **Test** | **Reference** | **Frequency** |
| Material Properties | Spec Section 02924 | By manufacturer<br>Every roll provided |
| Visual Inspection of Material and Seams | Spec Section 02924 | Visual Inspection of Material and Seams |

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**TABLE 3**

**Grading Tolerances**

| Soil Layer/Surface | Measurement | Method | Pass/Fail Criteria[1] | Frequency |
|---|---|---|---|---|
| Top of Subgrade | Elevation | Survey | + 0.2’ | 100’ Grid and Breaklines |
| Top of Granular Drainage Layer | Thickness | Survey or Hand Probe | 12-inch minimum | 100′ Grid and break lines |
| Top of Rooting Zone Layer | Thickness | Survey or Hand Probe | 6-inch minimum | 100’ Grid and Breaklines |
| Top of Final Cover | Elevation & Thickness | Survey | +0.2’<br>6-inch minimum topsoil | 100’ Grid and Breaklines |
| Piping | Elevation | Survey | Minimum required slope/grade per Drawings | Fittings, changes of direction, and every 50’ along piping |

[1] Final cover grades may be lower than permit elevations; therefore, a maximum tolerance only is listed for soil layer elevations.

# Attachment 1: Technical Specifications

**SECTION 02201**

**GRANULAR DRAINAGE LAYER**

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes descriptions and requirements for the installation of the granular drainage layer placed as part of the Final Cover System as shown on the drawings.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D422 - Standard Method for Particle Size Analysis of Soils
2. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft$^3$)
3. ASTM D1140 – Standard Test Methods for Determining the Amount of Material in Soils Finer than No. 200 (75-µm) Sieve by Washing
4. ASTM D2434 – Standard Test Method for Permeability of Granular Soils (Constant Head)
5. ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

1.03 SOIL MATERIAL QUALITY ASSURANCE

A. Granular drainage material may be available from OWNER designated on-site stockpile or imported to site by CONTRACTOR.

B. Source testing to be performed by OWNER or CONTRACTOR depending on source of material.

| Property | Test Method | Frequency |
|---|---|---|
| Constant Head Permeability | ASTM D2434 | 1 test/2,000 cy, min. 1 test/source |
| Grain Size Analysis | ASTM D422/D1140 | 1 test/2,000 cy, min. 1 test/source |
| USCS Soil Classification | ASTM D2487 | 1 test/2,000 cy, min. 1 test/source |
| Standard Proctor | ASTM D698 | 1 test / source |

PART 2 – PRODUCTS

2.01 Granular Drainage Layer: Durable, coarse rounded to subangular gravel exhibiting the following:

A. Grain Size: 99% passing 3/8-inch sieve and maximum 5% by weight which passes the #200 Sieve.

B. Minimum permeability: Minimum permeability of $1x10^{-3}$ cm/s for cover system at 90% of standard proctor density.
C. Uniformity Coefficient: Less than 6 (guideline, not requirement)

PART 3 - EXECUTION

3.01 FILL USAGE

A. Final Cover System construction: Directly over final cover geomembrane as shown on Drawings.

3.02 PREPARATION

A. CONTRACTOR to receive OWNER'S permission to begin installation of granular drainage layer.

B. CONTRACTOR shall be responsible for surface water control within construction limits and shall keep the construction and borrow areas well drained and minimize surface water ponding.

c. Subgrade elevation shall be documented by ENGINEER prior to placement of granular drainage layer material.

3.03 PLACEMENT

A. Placement of granular materials on geomembrane shall not proceed at ambient temperatures below 5°C (40°F).

B. Spread with one pass of low ground pressure tracked equipment or equivalent as approved by ENGINEER prior to placement. Do not allow rubber-tired vehicles on granular blanket after placement. Operation of hauling equipment will be allowed only on areas with a 3-foot minimum thickness on slopes. **Spread upslope only.**

C. Do not compact material on geosynthetics.

D. Protect buried pipes, geotextiles, geosynthetics, and similar installations.

E. CONTRACTOR shall place granular material by such method as to prevent wrinkling and possible damage to the LLDPE liner. Once the geosynthetic lining system has been accepted by the ENGINEER, it shall be the CONTRACTOR'S responsibility to ensure that the geosynthetics are not damaged. Should they become damaged, the CONTRACTOR shall at his own expense:

1. Immediately notify ENGINEER; and
2. Have the geosynthetic installer make any necessary repairs at the CONTRACTOR'S expense.

3.04 FIELD QUALITY CONTROL

A. Comply with approved Quality Assurance Manual. CONTRACTOR shall cooperate and assist ENGINEER with obtaining required documentation and testing.

B. Specified soil layers shall be graded to the minimum thicknesses as shown on drawings and specified herein.

C. Testing:

1. Granular drainage layer in-place testing will be performed by ENGINEER to monitor material parameters.
2. Tests to be performed and frequency of tests specified are in the Quality Assurance Manual.

D. ENGINEER shall perform documentation survey in accordance with the CQA manual. CONTRACTOR shall assist with determining settlement of surfaces due to construction loads for the ENGINEER to use in preparing the construction certification. Settlement will be determined on a spacing of approximately 2 per acre. Grid points used for settlement correction will be incorporated into the granular drainage layer thickness survey to be performed on an approximate 100-foot grid in accordance with the verification table. At the settlement correction survey locations, the thickness of the granular drainage material will also be surveyed. This survey will be done at the same time the top of granular drainage material survey is completed. CONTRACTOR shall manually excavate down to liner surface at these locations so that the liner surface may be surveyed at the same location and the settlement can be determined. CONTRACTOR is responsible for any damage to the underlying geosynthetics and replacement of granular drainage material during this process. ENGINEER must be present during excavation for settlement verification.

## 3.05 ADJUSTMENT AND CLEANING

A. Remove excess material not suitable for use to OWNER designated stockpile area. Grade to drain.

***END OF SECTION***

**SECTION 02204**

**ROOTING ZONE**

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes the placement of the rooting zone soils.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D422 - Standard Method for Particle Size Analysis of Soils.
2. ASTM D1140 - Standard Test Method for Amount of Material in Soils Finer than the No. 200 (75 um) Sieve.
3. ASTM D2487 - Standard Test Method for Classification of Soils for Engineering Purposes.

1.03 QUALITY ASSURANCE

A. Rooting zone to be obtained from OWNER designated on-site stockpile/borrow area. CONTRACTOR responsible to select suitable material from designated on-site source(s).

B. OWNER will perform quality control and quality assurance in accordance with the Construction Quality Assurance Manual.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. Rooting Zone:

1. Friable soil; Horizon B soils, suitable for establishment of rooting system of grass and plants
2. Free of stones, lumps, live plants and roots, sticks, and other undesirable material. The maximum particle size shall be no larger than three (3) inches.
3. Topsoil may be used for rooting zone soils.

PART 3 - EXECUTION

3.01 FILL USAGE

A. Rooting zone material: Directly on top of granular drainage layer for final cover system construction.

3.02 PREPARATION

A. Surface Water Control:

1. CONTRACTOR responsible for surface water control within construction limits.

2. Keep construction and borrow areas well drained and minimize surface water pooling.

3.03 PLACEMENT OF ROOTING ZONE

A. Construct to limits and thicknesses as shown on Drawings.

B. Spread with one pass using tracked equipment.

C. Spread uphill only.

D. Rubber-tired vehicles only allowed on areas with a 3-foot minimum thickness when being placed over geosynthetics.

3.04 FIELD QUALITY CONTROL

A. Comply with approved Quality Assurance Manual. Cooperate with quality control program.

B. Specified soil layers shall be graded to the minimum thicknesses as shown on drawings and specified herein. Thickness tolerance of the soil layers must be between -0.0 and +0.2 feet.

C. ENGINEER shall perform documentation survey in accordance with CQA manual. CONTRACTOR shall assist with determining settlement of surfaces due to construction loads for the ENGINEER to use in preparing the construction certification. Settlement will be determined at a frequency of approximately 2 locations per acre. Grid points used for settlement correction will be incorporated into the thickness survey to be performed on an approximate 100-foot grid in accordance with the verification table. At the settlement correction survey locations, the combined thickness of the rooting zone and topsoil material will be surveyed. This survey will be done at the same time the top of final cover survey is completed. CONTRACTOR shall manually excavate down to the top of the granular drainage layer at these locations so that the surface may be surveyed at the same location and the settlement can be determined. CONTRACTOR is responsible for any damage to the underlying geosynthetics and replacement of cover soils during this process. ENGINEER must be present during excavation for settlement verification. Topsoil thickness will be verified during excavation for settlement correction and per Section 02486 requirements.

D. Testing:

1. Tests performed and frequency of tests specified in the Quality Assurance Manual.
2. CONTRACTOR is responsible for all costs related to retests of materials not meeting specifications.

E. ENGINEER shall perform documentation survey in accordance with the CQA manual.

3.05 ADJUSTMENT AND CLEANING

A. Remove excess material not suitable for use to OWNER designated location on-site.

*** END OF SECTION ***

**SECTION 02206**

**INTERMEDIATE COVER (BUFFER SOILS)**

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes the placement of the buffer soils.

1.02 QUALITY ASSURANCE

A. In accordance with the Construction Quality Assurance Manual for this project.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. Intermediate Cover/Buffer Soils:

1. Buffer soil material shall be in-place intermediate cover material supplemented as need to provide the minimum thickness shown on the Drawings. Material will be supplied by the OWNER and available from on-site stockpile/borrow areas. CONTRACTOR shall be responsible for selecting suitable buffer soil material to supplement in place soils as necessary.
2. Free from gravel, cinders, stone over 1/2 inch in any dimension and other undesirable material.

PART 3 - EXECUTION

3.01 FILL USAGE

A. Intermediate Cover/Buffer soils: Directly on top of the waste fill within the closure area.

3.02 PREPARATION

A. Surface Water Control:

1. CONTRACTOR responsible for surface water control within construction limits.
2. Keep construction and borrow areas well drained and minimize surface water pooling.

3.03 PLACEMENT OF BUFFER SOILS

A. Construct to limits and to the elevations as shown on Drawings.

B. Final surface must be firm and free of stones greater than ½ -inch diameter or any other material which would be deleterious to the overlying geomembrane liner.

C. Smooth drum surface to provide smooth surface for geomembrane installation. Remove and replace excessively soft or wet areas.

D. Final surface shall be smooth, uniform, and free from sudden changes in grade (such as vehicular ruts).

E. Before geomembrane installation begins, verify grade and accept subgrade per Section 02922.

3.04 FIELD QUALITY CONTROL

A. Comply with approved Quality Assurance Manual. Cooperate with quality control program.

B. Specified soil layers shall be graded to the minimum thicknesses as shown on drawings and specified herein. Thickness tolerance of the buffer soil layer must be between -0.0 and +0.2 feet.

C. Survey Requirements: ENGINEER shall perform documentation survey in accordance with the Quality Assurance Manual.

3.05 ADJUSTMENT AND CLEANING

A. Remove excess material not suitable for use to OWNER designated location on-site.

*** END OF SECTION ***

**SECTION 02211**

**SITE PREPARATION**

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the requirements for general site preparation, salvaged topsoil, and miscellaneous surface features.

1.02 DEFINITIONS

A. Structures and Surface Features: For purpose of this section, shall mean existing structures and surface features, including but not limited to buildings, pavements, curb and gutter, signs, posts, fences, trees, shrubs, and other landscaped features.

B. Salvaged Topsoil: Natural loam, sandy loam, silt loam, silty clay loam, or clay loam humus-bearing soils available from overlying portions of areas to be excavated for construction.

C. Unsuitable Material: Topsoil, peat, organic soils, and materials containing slag, cinders, foundry sand, debris, and rubble or soil with less than required bearing capacity as determined by ENGINEER.

D. Utilities: Existing landfill infrastructure including leachate piping, electric lines; conduits, telephone, and other communication lines; sewer pipe; cable television, other utilities, and appurtenances.

1.03 PROJECT/SITE CONDITIONS

A. Provide 72 hour notice, prior to beginning construction, to OWNER.

B. Several leachate lines, geosynthetics, landfill gas infrastructure, electrical utilities, existing surface water management features, and associated landfill features will be located in and adjacent to the project area. Locations of these pipes and utilities are shown on to the extent possible. CONTRACTOR should use caution around such infrastructure as due to landfill conditions, locations may not be exact.

1.04 COORDINATION

A. Coordinate work with others performing work at project site.

B. Call Gopher One to check for utilities prior to beginning Work.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.01 PREPARATION

A. Provide protection and support during construction for existing utilities, structures, and surface features adjacent to construction area or easements and rights-of-way.

B. Remove obstructions such as mounds of dirt, stone or debris located within working limits.

C. Obstructions such as street signs, small culverts, and guard posts located within construction easements of rights-of-way may be removed if promptly replaced to original condition unless otherwise specified.

3.02 SALVAGED TOPSOIL

A. Excavate and temporarily stockpile salvaged topsoil where topsoil exists to restore areas disturbed by construction.

B. All material stockpile areas shall be stripped of topsoil prior to stockpiling.

C. Provide transportation of material and sites for stockpiles if adequate areas not available within the construction limits as shown on the Drawings.

3.03 RESTORATION

A. Restore existing utilities, surface feature, and structures to condition equal to or exceeding condition which existed prior to construction.

***END OF SECTION***

**SECTION 02220**

**TRENCHING & EXCAVATION**

PART 1 - GENERAL

1.01 SUMMARY

A. Work described in this section includes trenching and excavation for stormwater piping and related infrastructure installation.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D422 - Standard Method for Particle Size Analysis of Soils.
2. ASTM D1140- Standard Test Method for Amount of Material in Soils Finer than the No. 200 (75 um) Sieve.
3. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft$^3$)
4. ASTM D2487- Standard Test Method for Classification of Soils for Engineering Purposes.
5. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

B. Minnesota Department of Transportation “Standard Specifications for Construction”, latest edition.

1.03 SUBMITTALS

A. Shoring, Bracing, and Sheeting Layout and Details: ENGINEER will review submitted material to ascertain effect on new construction. ENGINEER will not review shoring, bracing, and sheeting for structural integrity or effect on existing facilities.

B. Additional soil testing results as may be required.

1.04 QUALITY ASSURANCE

A. Sheeting, Shoring, and Bracing:

1. If determined necessary by CONTRACTOR, sheeting, shoring, and bracing shall be designed by a Professional Engineer registered in the state of Minnesota.
2. Sheeting, shoring, and bracing shall conform to safety requirements of federal, state, or local public agency having jurisdiction over such matters. Most stringent of these requirements shall apply.

1.05 DEFINITIONS

A. Influence Zone Under Foundations or Pavements: Area below foundation or pavement as bounded by 1 horizontal to 2 vertical slope extending outward from 1 ft beyond outer edges of foundation or pavement.

B. Influence Zone Around Piping or Electrical Ducts: Area below limits bounded by line 12 in. above pipe or duct and by 1 horizontal to 2 vertical slope extending outward from that line 1 ft beyond outer edge of pipe or duct.

C. Unsuitable Material: Topsoil, peat, organic soils, and materials containing slag, cinders, foundry sand, debris, and rubble or soil with less than required bearing capacity as determined by ENGINEER.

1.06 FIELD MEASUREMENTS

A. Verify control monuments and intended elevations for Work as shown on Drawings.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine and verify acceptability and condition of surfaces to perform Work.

3.02 PREPARATION

A. Identify required lines, grades, levels, contours, and datum.

B. Protect benchmarks, structures, equipment, and partially completed Work.

C. Notify corporations, companies, individuals, or authorities owning above- or belowground conduits, wires, pipes, or other utilities running to property or encountered during excavating operations.

D. Cap or remove and relocate services in accordance with instructions by owners of services.

E. Protect, support, and maintain conduits, wires, pipes, and other remaining utilities in accordance with requirements of owners of said services.

F. Keep construction site free-draining.

G. Fill settled areas where excavations or trenches were backfilled and holes made by demolition, tree removal, and site preparation Work.

3.03 TRENCHING

A. Excavate to elevations and dimensions necessary to complete construction.

B. Place spoils pile upgradient of trench such that runoff from pile would drain to trench.

C. Comply with OSHA Health and Safety Standards.

D. Trenching Tolerances:

1. Excavate so pipes, ducts, and conduits can be laid straight at uniform grade, without sags or humps, between elevations shown on Drawings.
2. Maximum width of excavation on top of pipe shall be outside diameter of pipe plus 24 inches or as shown on the Drawings. When stringers and sheathing required, width of trench may be increased to allow for their use, provided provisions for this excess width of trench are met.
3. Where trench width for that portion of trench depth between trench bottom and outside top of pipe barrel, for any reason within CONTRACTOR'S control, exceeds specified limits, CONTRACTOR, at his expense, shall furnish pipe with strength adequate for actual trench width.

E. Do not advance excavation of trenches more than 150 feet ahead of completed pipe installation.

F. CONTRACTOR shall be aware that trenches may be wet.

G. Excess excavated waste shall be hauled to the active working face of the appropriate disposal area and disposed of in OWNER designated areas. Daily cover of such waste, if required, shall be coordinated with the OWNER. CONTRACTOR shall not perform waste excavation outside of normal landfill operating hours without prior approval from the OWNER.

3.04 COMMON EXCAVATION

A. Excavations shall conform to lines and grades as staked, and as shown on Drawings.

B. Excavations beyond those lines and grades without the ENGINEER's authorization will be considered unauthorized Work.

C. Method of excavation shall be consistent with soil types encountered and result in competent subgrade.

D. Remove stumps, roots, debris, large stones or boulders, and any other deleterious material from excavated materials to be used in embankments.

E. Do not excavate within influence zone of existing footings or foundations without prior approval of ENGINEER.

F. Upon completion of excavation, notify ENGINEER before proceeding with further Work.

3.05 ADJUSTMENT AND CLEANING

A. Stockpile excess excavated material suitable for backfill on site in OWNER designated location and grade to drain.

B. Haul excavated material not suitable for backfilling and unsuitable materials to OWNER designated location within the active working face.

***END OF SECTION***

**SECTION 02271**

**RIPRAP**

PART 1 - GENERAL

1.01 SUMMARY

A. Work described in the Section includes description and requirements for imported riprap material.

1.02 SUBMITTALS

A. Location of source of riprap material.

B. One gradation for each source and class of riprap.

1.03 QUALITY ASSURANCE

A. Testing of materials shall be provided by CONTRACTOR in accordance with this section.

B. Test results shall meet requirements for the materials and class of riprap defined on the Drawings in accordance with the latest edition of the Minnesota Department of Transportation “Standard Specification for Construction” Section as described in Part 2.02 below.

PART 2 - PRODUCTS

2.01 SOURCE OF MATERIAL

A. The CONTRACTOR is responsible for providing riprap material that conforms to the Technical Specifications.

2.02 MATERIALS

A. Classes of Riprap shall be as shown on Drawings and in accordance with Standard Specification Section 3601.
   a. Usage
      i. Class II Riprap at stormwater pipe inlets.
      ii. Class III Riprap at outlet to pond.

B. Riprap shall be hard, durable, angular in shape and resistant to weathering. Individual rock fragments shall be dense, sound and free from cracks, seams and other debris conducive to accelerated weathering.

C. Geotextile underlayment shall be non-woven polypropylene fabric meeting the requirements of Standard Specifications Section 3733 Type 4 geotextile for use with Class III riprap and Type 3 geotextile for use with Class II riprap.

D. Granular Filter shall be in accordance with Standard Specifications Section 3601.B; to be installed at the pond outlet location as shown on the Drawings.

PART 3 - EXECUTION

3.01 PREPARATION

A. Geotextile fabric, granular filter material (where applicable), and riprap shall be installed around surface water control inlet structures and at the outlet to the pond as indicated on Drawings.

B. Areas on which geotextile, granular filter material, and riprap are to be placed shall be graded and dressed as shown on the Drawings or as required by ENGINEER.

3.03 INSTALLATION

A. CONTRACTOR shall place geotextile and granular filter material (where applicable) under riprap, anchor geotextile as shown on the Drawings, and cover completely. No fabric shall be exposed along edges or under riprap. CONTRACTOR shall place granular filter material and riprap so geotextile is not damaged.

***END OF SECTION***

**SECTION 02276**

**EROSION CONTROL**

PART 1 - GENERAL

1.01 SUMMARY

A. Work includes the furnishing of the permanent and temporary erosion control as shown on the Drawings and the site specific Stormwater Pollution Prevention Plan (SWPPP).

B. Sediment control logs and heavy-duty silt fence shall be installed for erosion control where required.

C. Erosion control blanket shall be installed as detailed on the Drawings.

D. OWNER will obtain the required NPDES construction activity permit if required. CONTRACTOR is responsible to comply with permit requirements and perform maintenance as required as detailed in the site specific SWPPP.

1.02 REFERENCES

A. MNDOT Standard Specifications for Construction, latest edition.

1.03 SUBMITTALS

A. Manufacturer's certificates indicating specification conformance test results of furnished material.

PART 2 – PRODUCTS

2.01 SILT FENCE

A. Machine sliced (MS) silt fence shall conform to "Standard Specification" Section 3886.

2.02 EROSION CONTROL BLANKET

A. Category 20 in accordance with the “Standard Specification” Section 3885.

2.03 SEDIMENT CONTROL LOGS

A. Wood fiber in accordance with “Standard Specification” Section 3897.2.B. Anchors in accordance with 3897.2.I.

PART 3 – EXECUTION

3.01 USAGE

A. Silt fence and/or sediment control log where required for NPDES Permit compliance.

B. Erosion Control Blanket: Category 20 on the final cover sideslopes, in drainage berms, and other surface water drainage features as shown on Drawings.

C. Temporary erosion control measures to be installed prior to site disturbance.

3.02 SILT FENCE INSTALLATION

A. Silt fence shall be trenched in with a minimum of 6 inches of fabric buried.

B. Silt fence to be installed using the static slicing method or approved equivalent installation method, per Standard Specification Section 2573.3.B.

C. CONTRACTOR shall be responsible for maintenance and repair of silt fence until final acceptance of the project.

3.03 REMOVAL OF SILT FENCE

A. CONTRACTOR shall remove and dispose of silt fence after completion of project and the establishment of vegetation.

3.04 EROSION CONTROL BLANKET INSTALLATION

A. Place in accordance with Manufacturer's recommendations.

B. At a minimum, anchor upstream edges of all materials at least 4 inches into the soil to prevent underflow.

C. Shingle materials downslope.

D. Overlaps shall be as follows:
   1. End lap – 24 inches minimum.
   2. Edges – 4 inches minimum.

3.05 SEDIMENT CONTROL LOG

A. Place in accordance with Standard Specification Section 2573.3.F.

***END OF SECTION***

**SECTION 02486**

**TURF RESTORATION**

PART 1 - GENERAL

1.01 SUMMARY

A. This section contains requirements for topsoil, seeding, fertilizing, and mulching.

B. Seed all areas disturbed by construction activities at the site.

1.02 REFERENCES

A. Minnesota Department of Transportation Standard Specifications for Construction, latest edition. (Standard Specifications)

1.03 SUBMITTALS

A. Location of off-site source of materials.
B. Name, address, telephone number and contact person of independent soils laboratory.
C. Method of off-site source soils material sampling and analyses.
D. Off-site source material quality control analyses shall be submitted at least 14 days prior to installation.
E. Proposed haul road planned for transportation of all off-site materials to the project site.
F. Test Results:
   1. Suppliers analysis for standard products. Copy of source testing soils results, including fertilizer and lime requirement before seeding work begins.
G. Seed mix.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Delivery:

   1. Deliver fertilizer to site in original, unopened containers bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark, and conformance to state law.
   2. Deliver seed to site in unopened, original bags bearing supplier's name and address, type of seed contained, percentage of purity and germination, percentage of hard seed if any, and percentage of inert material.
   3. Fertilizer and seed delivered to site shall be stored in a waterproof location as directed by OWNER.
   4. Locate mulch on site where indicated by OWNER.

1.05. GUARANTEE

A. Guarantee seeded area for duration of one year after seeding to be alive and in satisfactory growth at end of guarantee period.

   1. For purpose of establishing acceptable standard, scattered bare spots, none larger than 1 square foot will be allowed up to maximum of 3 percent of seeded area.

2. Acceptance will be based upon meeting this standard one year after initial seeding or reseeding.

PART 2 - PRODUCTS

2.01 TOPSOIL

A. CONTRACTOR supplied topsoil consisting of friable, fertile, natural loam capable of sustaining vigorous vegetative growth shall be used. The application of fertilizer and/or lime shall be determined by the CONTRACTOR through testing of the topsoil material prior to construction. Topsoil and/or amended topsoil shall meet requirements of "Standard Specification" 3877.2.A. CONTRACTOR shall provide source testing of the material as follows:

| Test | Frequency |
|---|---|
| Particle Size ASTM D422 | 1/source |
| Soil Classification ASTM D2487 | 1/source |
| Nutrient Content, Organic Content, pH* | 1/source |

*Topsoil testing per University of Minnesota Soil Testing Laboratory regular series for turf.

B. CONTRACTOR shall place topsoil at a thickness of minimum 6 inches.

C. OWNER will perform quality control/quality assurance in accordance with the Construction Quality Assurance Manual.

2.02 FERTILIZER

A. In accordance with Standard Specification 3881 at the ratio recommended by the soil testing lab after submittal of a topsoil sample.

2.03 GRASS SEED

A. General

1. Local nursery grown seed sources in the specified seed mix.
2. Weeds shall not exceed 0.25%.
3. Comply with current U.S. Department of Agriculture rules and regulations.
4. Seed mix shall be in accordance with Standard Specification 3876.2, mix 25-121 (without switchgrass) with a nurse crop depending on the sowing date as specified by MNDOT 2575.3.

5. Apply seed at recommended rate for specified mix.

2.04 WATER

A. CONTRACTOR shall be responsible for water.

2.05 MULCH

A. Type 1 or Type 5 per Standard Specifications 3882.

PART 3 – EXECUTION

3.01 INSPECTION

A. Do not begin ground preparation until boulders, debris, and similar materials have been removed, depressions and ruts filled, and area to be seeded is shaped, trimmed, and finished uniformly to grades and cross-sections shown on Drawings, or to match original grade.

3.02 SITE PREPARATION FOR SEEDING

A. Topsoil

1. Place topsoil directly on top of rooting zone material for final cover system construction. Construct to limits and thicknesses as shown on Drawings.
   a. Spread with one pass using tracked equipment.
   b. **Spread uphill only.**
   c. Rubber-tired vehicles only allowed on areas with a 3-foot minimum thickness when being placed within the final cover limits (over geosynthetics).
2. Scarify subgrade to depth of 3 inches for bonding of subsoil with topsoil.
3. No topsoil shall be placed or worked in frozen or muddy condition.
4. Prepare areas to be seeded to required depth of approximately 3 inches by disking, rototilling, harrowing or other approved means.
5. Remove and dispose of rock, trash, or other materials brought to surface from preparation activities.

3.03 TOPSOIL/FINISH GRADING

A. Topsoil/Finish grade is established final grade as shown on Drawings. Grades not otherwise indicated are uniform levels or slopes between points where elevations are given or between such points and existing finished grades. Finish grade shall be approved by the ENGINEER prior to seeding.

B. Grade, rake, and roll with roller weighing not more than 100 lbs./lf and not less than 25 lbs./lf.

C. Maximum allowable variation from correct elevation is 2 in. in 10 ft.

3.04 APPLYING FERTILIZER

A. Apply fertilizer uniformly over the designated area using mechanical spreading devices. Mix thoroughly with disk into upper 2 inches of soil. Apply in two passes at right angles to each other.

B. Apply at a rate recommended by the soil testing as defined in Section 2.02.A.

C. Apply fertilizer no more than 48 hours prior to seeding.

3.05 SEEDING

A. Do not seed on saturated or frozen soil.

B. Do not seed when wind velocity exceeds 6 mph.

C. Seed all areas disturbed by construction.

D. The grass seed shall be broadcasted according to methods in “MNDOT’s Seeding Manual”, latest edition. A rake or other implement shall be used to drag topsoil over the seed. Alternately, the grass seed may be drilled horizontally across the slope.

E. Do not seed if surface has been compacted by recent rain event.

3.06 MULCHING

A. Mulch seeded areas not designated to receive erosion control blanket within 24 hrs after seeding is complete.

B. Application rate shall be 2 tons per acre or no more than 1 inch in depth.

C. Mulch shall be spread uniformly in a continuous blanket. Mulch shall be started on the windward side of relatively flat area or on the upper part of a steep slope and continued uniformly until area is covered. The mulch shall not be bunched.

D. Do not mulch during periods of excessively high winds.

E. Immediately following the spreading of the mulch, the material shall be anchored securely into the soil a minimum of 3-inches by means of a mulch anchoring machine equipped with large coulter-type discs spaced on approximate 8-inch centers. All anchoring shall be at right angles to slope. Edges of the discs shall be dull to prevent cutting of the mulching and equipment operation shall be such as to embed the mulch to the required depth. In areas where equipment cannot be used, mulch shall be secured by shallow covering of earth or by embedding with approved hand methods, including straight-bladed spade with dull edge.

F. Mulch in accordance with Section 2575 of the Standard Specifications.

3.07 CLEANUP

A. Paved surface and other site areas shall be kept clean of seeding, fertilizing, and mulching materials.

B. Clean up shall occur at the end of each work day or as required by OWNER. Pavement shall be swept with a street sweeper as directed by ENGINEER throughout the project.

C. Restore existing utilities, surface features, and structures to condition equal to condition which existed prior to construction.

D. Replace to original condition or better, damaged vegetation or landscape work.

E. Complete project punch-list prepared by ENGINEER.

3.08 MAINTENANCE OF SEEDED AREA

A. Maintenance of seeded areas shall begin immediately following last seeding application. Continue until Work is accepted.

B. Maintain seeded area by watering, mowing, and replanting as necessary to produce uniform stand of grass until Work is accepted.

C. Rework/replace topsoil where original topsoil has eroded or washed away as directed by OWNER.

D. Remulch any areas where the original mulch has washed away as directed by the OWNER.

E. Implement erosion control measures as required to keep area free of rutted and eroded soils and protection fences and barriers as necessary.

3.09 RESEEDING AND REPAIR

A. Reseed areas that fail to show more than 75 plants/square feet and open areas or gaps larger than 6 inches in diameter.

B. Where plant density is less than 50 plants/square foot, retill and reseed areas in accordance with seeding and maintenance requirements.

3.10 ACCEPTANCE OF SEEDED AREAS

A. CONTRACTOR shall notify OWNER in writing 7 days prior to inspecting seeded area for acceptance.

B. CONTRACTOR and OWNER shall inspect seeded areas for contract compliance and acceptance of work. Upon completion of inspecting seeded areas, OWNER shall provide written acceptance or rejection to CONTRACTOR with further requirement for completing the seeding work. Seeding work remaining to be completed shall be reinspected by OWNER before final acceptance.

3.11 SURVEY QUALITY CONTROL

A. Topsoil shall be graded to the minimum thicknesses as shown on Drawings and specified herein. Thickness tolerance of topsoil shall be between -0.0 feet and +0.2 feet. Elevation tolerance shall be +/- 0.2 foot.

B. ENGINEER shall perform documentation survey in accordance with CQA manual. CONTRACTOR shall assist with determining settlement of surfaces due to construction loads for the ENGINEER to use in preparing the construction certification. Settlement will be determined at a frequency of approximately 2 locations per acre. Grid points used for settlement correction will be incorporated into the thickness survey to be performed on an approximate 100-foot grid in accordance with the verification table. At the settlement correction survey locations, the combined thickness of the rooting zone and topsoil material will be surveyed. This survey will be done at the same time the top of final cover survey is completed. CONTRACTOR shall manually excavate down to the top of the granular drainage layer at these locations so that the surface may be surveyed at the same location and the settlement can be determined. CONTRACTOR is responsible for any damage to the underlying geosynthetics and replacement of cover soils during this process. ENGINEER must be present during excavation for settlement verification.

C. Topsoil thickness will be verified during excavation for settlement correction detailed part 3.11.B above. Additionally, topsoil thickness will be verified on the approximate 100-foot grid points by either survey or hand verification methods (i.e. pothole, hand auger, etc.). Inverted grade stakes marked with the required thickness may also be used to visually verify topsoil thickness at the grid points.

***END OF SECTION***

**SECTION 02623**

**PERFORATED AND NON-PERFORATED DRAIN PIPE**

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish and install perforated and non-perforated corrugated polyethylene pipe (CPEP) and appurtenances as shown on Drawings.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO).

1. AASHTO M252 - Corrugated Polyethylene Drainage Pipe.

B. American Society for Testing and Materials (ASTM)

1. ASTM F405 - Standard Specifications for Corrugated Polyethylene (PE) Pipe and Fittings.

1.03 SEQUENCING AND SCHEDULING

A. Include piping activities in the project schedule.

1.04 SUBMITTALS

A. The CONTRACTOR shall submit to the OWNER the manufacturer's literature that describes the physical characteristics of the pipe provided, the recommended installation procedures, and allowable pipe bend radius.

PART 2 - PRODUCTS

2.01 CORRUGATED POLYETHYLENE PIPE, DRAINAGE TUBING (CPEP), AND FITTINGS

A. CPEP and fittings shall meet the requirements of ASTM F405 or AASHTO M252. The pipe shall meet the dimensional requirements indicated on the Contract Drawings and be manufactured by Prinsco, ADS, Hancor, or other approved manufacturer.

B. CPEP used for surface water control (culverts or piping) shall be of double-wall construction with a smooth inner bore, and shall have watertight gasketed joints.

C. All CPEP used for surface water control (culverts) shall have flared end sections, both ends.

D. Perforated pipe shall be factory perforated with a minimum inlet area of 1 square inch/ft.

E. Fittings shall be from the same manufacturer as the pipe.

F. Drainage tubing wrap ("sock") shall be ADS Sock synthetic wrap or approved equivalent.

PART 3 - EXECUTION

3.01 CPEP AND FITTINGS

A. Install perforated and non-perforated CPEP of the size and in the locations and to the elevations and grades shown on the Drawings.

B. Do not install pipe with bends of smaller radius than the minimum recommended by the manufacturer.

C. Install marker posts at each drainage tubing outlet.

3.02 FILL PLACEMENT AROUND PIPES

A. CONTRACTOR shall mechanically tamp bedding material around the piping in lifts.

B. The CONTRACTOR shall notify OWNER before placing fill around pipes.

C. Do not use frozen fill material or place on frozen subgrade.

D. Pipe installed outside the boundaries of the geomembrane:

1. Install bedding and cover soils making sure pipe haunches are properly shaped.

3.03 FIELD QUALITY CONTROL

A. Pipe and pipe installation will be subject to rejection for any of the following reasons:

1. Failure to conform to the SPECIFICATIONS, particularly compaction under and around the pipe.
2. Fractures or cracks passing through pipe wall or socket.
3. Cracks which, in the opinion of OWNER or OWNER'S On-Site Representative, may impair strength, durability, or serviceability of pipe.
4. Defects indicating improper proportioning, mixing, or molding.
5. Damaged ends where such damage would prevent making a satisfactory joint.

B. Survey Requirements:

1. CONTRACTOR to provide survey information for all inverts and alignments of piping.

***END OF SECTION***

**SECTION 02922**

**LINEAR LOW DENSITY POLYETHYLENE GEOMEMBRANE (LLDPE)**

PART 1 - GENERAL

1.01 SUMMARY

A. Work includes manufacture, fabrication (if needed), supply, and installation of textured and smooth Linear Low Density Polyethylene (LLDPE) geomembrane liner. Textured geomembrane shall have a smooth edge for seaming.

1.02 DEFINITIONS/REFERENCES

A. American Society for Testing and Materials (ASTM) Standards specifically referenced in this Section:

A. American Society for Testing and Materials (ASTM) Standards specifically referenced in this Section:

1. ASTM D6693 Standard Test Method for Tensile Properties of Plastics.
2. ASTM D792 Standard Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement
3. ASTM D1004 Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
4. ASTM D1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
5. ASTM D1505 Standard Test Method for Density of Plastics by the Density Gradient Technique.
6. ASTM D1603 Standard Test Method for Carbon Black in Olefin Plastics.
7. ASTM D3895 Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis.
8. ASTM D4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
9. ASTM D4437 Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes.
10. ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
11. ASTM D5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
12. ASTM D5323 Practice for Determination of 2% Secant Modulus for Polyethylene Geomembranes.
13. ASTM D5596 Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
14. ASTM D5617 Test Method for Multi-Axial Tension Test for Geosynthetics
15. ASTM D5641 Standard Practice fo Geomembrane Seam Evaluation by Vacuum Chamber.
16. ASTM D5721 Practice for Air-Oven Aging of Polyolefin Geomembranes.
17. ASTM D5885 Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry.ASTM D5994 Test Method for Measuring the Core Thickness of Textured Geomembranes.

18 STM D6365 Standard Practice for the Nondestructive Testing of Geomembrane Seams using the Spark Test.
19 STM D6747 Standard Guide for Leak Location
20 ASTM D7002 Standard Practices for Bare Geomembranes (Leak Location)
21 ASTM D7007 Standard Practices for Geomembranes Covered with Water or Earth Materials (Leak Location)

B. Geosynthetic Research Institute (GRI) Standards:

1. GRI GM 6: Pressurized Air Channel Test for Dual Seamed Geomembranes
2. GRI GM 9: Cold Weather Seaming of Geomembranes
3. GM10: Specification for the Stress Crack Resistance of Geomembrane Sheet.
4. GM11: Accelerated Weathering of Geomembranes Using a Fluorescent UVA-Condensation Exposure Device.
5. GM12: Measurement of the Asperity Height of Textured Geomembranes Using a Depth Gage.
6. GM17: Test Properties, Testing Frequency and Recommended Warranty for LLDPE Smooth and Textured Geomemebranes.
7. GM 14: Test Frequencies for Destructive Seam Testing.

C. C. U.S. Environmental Protection Agency Technical Guidance Document “Quality Control Assurance and Quality Control for Waste Containment Facilities,” EPA/600/R-93/182, September 1993, 305 pgs.

1.03 SUBMITTALS

A. The following submittals shall be provided to and approved by OWNER or ENGINEER prior to delivery of geomembrane to the site or mobilization of the geomembrane CONTRACTOR’S crew or equipment:

1. INSTALLER shall supply information from the resin manufacturer regarding the resin type, properties as specified herein, and production dates of the resin used for this project. The resin type identification shall include the cell classification of the resin in accordance with the requirements of the latest ASTM Designation D3350.
2. INSTALLER shall submit from the geomembrane sheet manufacturer, test methods and results defining physical properties as specified herein, of the geomembrane to be used for this project. Test results at the frequency specified in the GRI standards of geomembrane furnished for this project shall be submitted, and test results shall be reported with corresponding roll identification numbers.
3. INSTALLER shall supply a statement of the geomembrane manufacturer's quality control procedures, identification of any resin admixtures, frequency of sampling, methods of material transportation and storage, and acceptance criteria for roll goods delivered to the site.
4. INSTALLER shall provide submittals describing the geomembrane sheet manufacturer's details of any factory seaming process proposed. Roll test results which may not be available prior to construction (i.e., environmental stress crack) shall be presented as preliminary prior to construction, with final test results submitted or affected rolls within the construction time frame.
5. INSTALLER shall submit from the extrudate weld rod manufacturer, verification that the weld rod was manufactured using the same resin as was used in the geomembrane sheets prior to using material.
6. INSTALLER shall submit a proposed panel and seam layout diagram specifying the type and location of all field and factory seams. The layout diagram shall be to scale and used as a construction Plan and shall include all necessary dimensions and details. The layout

diagram shall be compatible with the panel and seam layout requirements specified in this Section.

7. INSTALLER shall submit an installation schedule.
8. INSTALLER shall submit a list of personnel performing field supervision, and quality control, along with experience records and resumes.
9. INSTALLER shall submit a list of equipment types proposed to be used in panel layout, membrane seaming, and destructive and nondestructive testing.

B. The INSTALLER shall remit the following during geomembrane installation:

1. INSTALLER shall, at the end of each working day provide a detailed report of work completed that day, including:
   a) Panel Placement
   b) Trial Welds Results
   c) Subgrade Acceptance Form
   d) Seams
   e) Seam Testing (air and vacuum tests)
   f) Destructive Tests
   g) Repair Log

2. ENGINEER shall review with the INSTALLER and sign the above report at the end of each day. OWNER shall be provided with a copy of the report.

C. INSTALLER shall update their liner layout drawings on a daily basis. The drawings shall include all panel locations and numbering, seam locations and numbering, and test locations and numbering. The INSTALLER shall maintain a current liner layout drawing on the construction site at all times. At the request of ENGINEER, a copy of the current liner layout drawing will be submitted within 24 hours.

D. CONTRACTOR shall submit final as-built liner layout drawing(s) to OWNER within 14 calendar days of completion of the liner work. Drawings shall be submitted in paper and digital form.

E. Quality control certificates indicating resin type, properties as specified herein, and production dates shall be provided with each shipment of extrudate rods delivered to the site no later than the time of delivery.

F. Prior to the installation of any geomembrane, the CONTRACTOR shall submit CONTRACTOR'S certification in writing that the surface upon which the geomembrane is to be installed is acceptable (complete form contained at end of this Section).

G. Submit material delivery and installation schedule for incorporation into the Project schedule.

H. Required warranties: Five-year material warranty. One-year workmanship warranty.

## 1.04 EXPERIENCE

A. The geomembrane installation shall be performed under the direct supervision of a single field supervisor who must remain on-site throughout installation, including inspection of the surface upon which the geomembrane is to be installed, geomembrane handling and storage, panel layout and placement, seaming, seam testing, panel and seam repair, installation of appurtenances, anchorage and other geomembrane-related work. The field supervisor shall have a personal LLDPE or geomembrane installation record totaling at least 1 million square feet.

## 1.05 PRE-INSTALLATION MEETING

A. Representatives of the INSTALLER shall attend a meeting prior to installation of the geomembrane to discuss details of the proposed design, installation, and schedule.

1.06 MATERIAL DELIVERY

A. Geomembrane material may be delivered to the site at any time. CONTRACTOR is responsible for storage per manufacturer's recommendations and safekeeping of material onsite until material is installed.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Raw Materials:

1. Textured LLDPE geomembrane and extrudate rods used for this project shall be manufactured of new, first quality resins containing no more than 2 percent clean recycled polymer by weight, with a minimum specific gravity of 0.915 and carbon black content of 2.0-3.0 percent, designed specifically for use in flexible membrane liner installations.
2. LLDPE resin used in manufacturing geomembranes used for this Project shall meet requirements set forth in the latest revision of the Geosynthetics Research Institute (GRI) for LLDPE (GRI GM 17).

B. Geomembrane Roll Goods:

1. LLDPE geomembrane sheets used for this project shall meet the requirements set forth in the latest revision of the Geosynthetics Research Institute (GRI) for LLDPE (GRI GM 17).
2. The geomembranes shall consist of unreinforced polyethylene containing at a maximum 3 percent by weight additives, fillers, or extenders.
3. The geomembranes shall be free of holes, blisters, striations, undispersed raw material, and contamination by foreign matter.
4. The geomembranes shall be supplied as a continuous sheet with no factory seams in rolls. Each roll shall be identified and labeled with the thickness of the geomembrane, length and width, manufacturer, lot number, and roll identification number. This identification number shall be used to identify roll location on the panel layout record drawing.

C. Extrudate: Resin used in the polyethylene extrudate shall be the same as that used to manufacture the geomembrane sheets. Extrudate rods are to be delivered in original sealed containers with the manufacturer's labeling. Extrudate rods shall be free of dirt, grease, moisture, other contaminants, and shall be free of damage.

D. Neoprene Foam (if applicable): Closed cell, weatherproof, black neoprene foam with adhesive backing suitable for long-term sun and liquid exposure. Dimensions shall be as specified on the DRAWINGS, if applicable.

E. Clamped Boots (if applicable): Boots required to seal the LLDPE geomembrane to the structures passing through it shall be made of the same materials as the geomembrane. The boots shall be fabricated so that all field assembly, welding, and seam testing can be accomplished using equipment and procedures regularly employed in the field for equipment and LLDPE geomembrane installation.

F. Banding Straps (if applicable): Type 302 stainless steel banding straps suitable for use on the pipe diameters shown on the DRAWINGS. Banding strap dimensions shall be as specified on the DRAWINGS. All surfaces of the banding straps shall be machined smooth to prevent tearing or puncturing of the LLDPE pipe boots. Outer lip of boot shall be sealed with silicone sealant as shown on Drawings.

2.02 EQUIPMENT

A. Extruding equipment shall be equipped with a temperature gauge at the barrel and nozzle.

B. Fusion equipment shall be equipped with a temperature gauge capable of continuous monitoring.

C. Provide digital or dial continuous temperature recording instruments, in satisfactory working condition, with each welding unit. Welding equipment shall not be operated without functioning temperature recording instruments for measuring geomembrane sheet temperature.

D. A coupon cutter and a calibrated tensiometer shall be provided for in-field seaming pre-qualification testing and destructive sample testing.

E. Store, transport, and operate all equipment to avoid damage to geomembranes.

F. Glass top of each vacuum box must be clear and free of scratches for easy reading of pressure gauge. The sealing gasket shall be intact and functioning to form close seals during testing.

G. ENGINEER reserves the right to order the CONTRACTOR to remove any equipment that in ENGINEER'S opinion is not satisfactory. The CONTRACTOR will remove the equipment promptly from the construction site and replace the unsatisfactory equipment with suitable equipment within 24 hours.

PART 3 - EXECUTION

3.01 SUBGRADE INSPECTION

A. CONTRACTOR shall certify in writing that the surface upon which the geomembrane is to be installed is acceptable (acceptance form contained at end of this Section).

B. CONTRACTOR shall provide daily written acceptance for the surface to be covered by the geomembrane in that day's operations. The surface shall be maintained in a manner during geomembrane installation to ensure subgrade suitability.

C. After subsurface has been accepted by CONTRACTOR, it shall be CONTRACTOR'S responsibility to indicate any change in subsurface conditions that may require repair work and perform required repair work. Damage to subsurface caused by work involved in installing geomembrane shall be repaired at CONTRACTOR'S expense. Geomembrane placement over damaged subsurface, as determined by ENGINEER or CONTRACTOR, is not acceptable. Nothing will waive CONTRACTOR'S contractual requirements with respect to warranty on installed system.

3.02 HANDLING, TRANSPORTATION, AND STORAGE

A. Geomembrane rolls shall be packaged and labeled prior to transporting to the site. Geomembrane rolls delivered to the site shall be wrapped in a relatively impermeable and opaque protective cover which may consist of a sacrificial wrap of geomembrane. The sacrificial wrap shall be removed prior to geomembrane installation.

B. Geomembrane transportation shall be in a manner that minimizes the possibility of material damage during shipment. When offloading geomembrane from the truck, straps and a spanbar shall be used. Direct contact with forklifts or front-end loaders to offload the material will not be allowed without written consent from ENGINEER.

C. On-site storage of the geomembrane rolls shall be in a safe manner, with rolls protected from grease, dirt, moisture, excessive heat, direct sunlight, vehicle traffic, and other possible sources of damage including theft and vandalism. The rolls will be placed in neat order and placed such that identification tags for each roll can be read. Storage areas shall be at the ENGINEER'S designated location.

D. Geomembrane and appurtenant materials delivered to the site shall be checked for proper labeling and visually inspected for transport or manufacturing damage. ENGINEER reserves the right to reject any unacceptable material at no cost to OWNER. Any roll that arrives on site without factory roll identification will not be used for the work and will be removed from the site promptly.

E. Only that quantity of geomembrane that is to be placed on a particular day shall be removed from the packaging. Geomembrane rolls shall be transported from the storage area to the construction area and deployed using wide lifting straps and properly sized forklifts, front end loaders, or other appropriate equipment.

F. Under no circumstances shall any heavy equipment be allowed directly on the geomembranes unless approved by ENGINEER.

G. Prior to placement, the geomembranes shall be visually inspected for compliance with this Section. Geomembrane material which, in the opinion of the ENGINEER is damaged or does not meet Specifications will be rejected by the ENGINEER. Minor damage may be repaired as specified in this Section. Damage to geomembranes caused by CONTRACTOR during handling shall be repaired or replaced at CONTRACTOR'S expense.

3.03 PANEL LAYOUT AND PLACEMENT

A. Panel and Seam Layout Diagram:

1. Prepare panel and seam layout diagram so that panel seams run parallel to the direction of maximum slope (i.e., down the slope).
2. Slope panels shall not be constructed from more than two pieces of geomembrane (i.e., not more than one cross-seam shall be permitted on any one slope panel).
3. Cross seams in slope panels, where allowed, shall be oriented at 45 degrees. Cross seams shall be located on at least the bottom half of the slope, wherever possible.
4. Cross seams in adjacent panels shall be staggered.
5. Assign identification number to each seam for reference to test results and record Drawings.

B. PANEL PLACEMENT:

1. Panel size and placement shall be in general accordance with the panel layout diagram submitted to ENGINEER as defined in this Specification.
2. Geomembrane shall be anchored with sand bags or other approved methods to prevent uplift and damage by wind.

3. A panel identification number shall be assigned to each panel for reference to test results and Record Drawings. The panel identification number and geomembrane roll number shall be written on each panel with a grease pencil, immediately following deployment of the panel.
4. Smoking during placement of panels is prohibited. Wearing damaging shoes or engaging in any behavior which may damage the geomembrane is prohibited.
5. Eating, drinking, disposal of food wraps, drinking bottles and cans on top of geomembrane is not allowed.
6. Place panels with appropriate slack incorporated into geomembrane to accommodate expansion and contraction without jeopardizing the integrity of the geomembrane.
7. Vehicle traffic over geosynthetics as a means of panel deployment is expressly prohibited without the consent of the ENGINEER.

C. ENGINEER and CONTRACTOR will visually inspect in-place panels prior to seaming. Any damaged panels shall be repaired, and if requested by ENGINEER, replaced at no additional cost to OWNER. Repairs shall be performed as specified in this Section. All damages and repairs shall be recorded on the Record Drawings.

3.04 SEAMING

A. Seaming Methods: All seams shall be joined using a heat extrusion or hot fusion (split wedge) weld process in accordance with the geomembrane manufacturer's recommendations. The CONTRACTOR shall maintain in working order at the site at least one spare seaming apparatus for each type of welder used. The hot fusion weld process will be used whenever possible. The use of extrusion welded seams shall be limited to repairs and any areas or seam configuration inaccessible to fusion welding equipment.

B. Factory and field seams shall meet the minimum specifications set forth by the latest revision of the GRI GM 19.

C. Seam Configuration and Preparation:

1. Overlap panels to be seamed at least 4 inches but not more than 6 inches. The loose end of the upper panel shall extend no more than 3 inches from the weld. All seams shall be made in a rainlap manner with the loose end of the upper panel downgradient of potential water flow.
2. Cross seams on slopes, where allowed, shall be made at a 45 degree angle to the edge of the panel.
3. The contact area between panels shall be clean and free of moisture, dust, dirt, debris, and foreign material. A protective layer of filter fabric or a sacrificial geomembrane strip shall be used directly beneath each seam overlap to achieve proper support and a clean work surface, if necessary.
4. Where extrusion welding is used, the contact surfaces between panels shall be ground to remove oxidation prior to welding. Grinding shall not result in grooving of the liner nor reduction of the liner thickness by more than 10 percent. The grinding motion shall be made perpendicular to the seam. Grinding in a direction parallel to the seam shall not be permitted. All ground areas shall be covered completely with extrudate.
5. Seams shall be aligned to minimize the number and size of wrinkles.

D. Test Seam:

1. A prequalification test seam sample shall be prepared with each piece of seaming equipment/seamer approximately every four hours at the beginning of each seaming period (usually morning and afternoon), unless otherwise directed by ENGINEER. Each sample shall be prepared by the operator of the equipment for that seaming period and

shall be at least 6 feet long (in the direction of the seam) by at least 1 foot wide and may be performed on scrap pieces of geomembrane.

2. Ten 1-inch wide specimens (coupons) from each test seam sample shall be prepared for on-site field testing for shear and peel strength. Coupons shall be prepared using a sheet cutter so that consistent, uniform 1-inch wide coupons are obtained. Samples should be distributed evenly over the 6 feet length.
3. The CONTRACTOR will make these test seams in the presence of ENGINEER.
4. The extension rates for these tests will not exceed 2-inches per minute unless permission from the ENGINEER is given.
5. Five coupons shall be tested in shear and five in peel. All coupons shall exhibit the required strength at yield and failure mechanism FTB as set forth in Paragraph 3.05B. Seam separation equal to or greater than 10% of the track width shall be considered a failing test. If any of the coupons fail, the reason for the failure shall be identified and corrected prior to preparing another test seam. The new test seam shall be prepared reflecting adjustments made to the seamer/seaming equipment and a new set of coupons shall be cut and tested.
6. Seaming equipment shall not be used until satisfactory prequalification test seams have been prepared, witnessed by ENGINEER.
7. The test results on all prequalification test seams will be reported to ENGINEER.

E. Climatic Conditions for Seaming:

1. Seaming shall be performed only when panel temperatures are between 32°F and 170°F, unless otherwise approved by ENGINEER. If seaming is permitted to be performed at panel temperatures below 32°F, the panel contact surface shall be preheated and CONTRACTOR shall certify in writing that the low-temperature seaming procedures will not cause any short-term or long-term damage to the geomembrane or the welded seam. CONTRACTOR shall demonstrate to ENGINEER that field seams comply with project specifications using pre-qualification test seams. CONTRACTOR shall submit to ENGINEER, for approval, detailed procedures for seaming at low temperatures, including the following:
    a. Preheating of the geomembrane
    b. Provision of a tent or other device if necessary to prevent heat losses during seaming and rapid heat losses subsequent to seaming.
    c. Number of additional test welds to determine appropriate seaming parameters.
2. Seaming during rainy weather or when dew is present on panels shall not be allowed.
3. CONTRACTOR shall provide any special lighting required for seaming during low-light or dark hours.
4. CONTRACTOR shall leave slack in the geomembrane as necessary to account for thermal expansion or contraction of geomembrane. Stress on panels due to thermal expansion and contraction shall be minimized by performing field seaming operations during the coolest parts of the day or night, if necessary. Special scheduling or extended hours of operation require approval by OWNER.

F. All welding shall provide a tight, leak proof, homogeneous bond between panels. All seams shall extend to ends of panels.

G. Welding equipment shall be continuously monitored to control the temperature of extrudate and wedge. If recording equipment allows for a hard copy of the monitoring, a copy of the monitoring labeled with the weld identification number will be submitted to ENGINEER.

## 3.05 PIPE PENETRATION SEALING SYSTEM

A. Penetration sealing systems shall be constructed from the base geomembrane material, flat stock, prefabricated boots and accessories, as applicable as shown on the Drawings.

B. All penetration sealing systems must be tested. Where field non destructive testing cannot be performed, field spark testing shall be performed using standard holiday leak detectors in accordance with ASTM 6365. Spark testing should be performed in areas where both air pressure testing and vacuum testing are not possible.

3.06 NONDESTRUCTIVE TESTING OF PRODUCTION SEAMS

A. All field seams shall be non-destructively tested by the CONTRACTOR over the full seam length before the seams are covered. Each seam shall be numbered or otherwise designated. The location, date, test unit, name of test, and outcome of all non-destructive testing shall be recorded and submitted to the ENGINEER.

B. Testing shall be done as the seaming work progresses, not at the completion of all field seaming. All defects found during testing shall be numbered and marked immediately after detection. All defects found shall be repaired, retested and remarked to indicated acceptable completion of the repair.

C. Non-destructive tests shall be performed by experienced technicians familiar with the specified test methods.

D. Visual Inspection: A visual inspection of all seams shall be performed. This inspection shall look for obvious flaws in seaming patches, penetration sealing, material defects, or other problems. Deviations from acceptable workmanship standards shall be noted and corrected.

E. Pressure Testing (Double-Fusion Welds): Where a double-fusion weld seaming system is employed, the continuity of the seam shall be tested with air pressure in accordance with the following procedure. The flow channel must not be obstructed by foreign objects or geomembrane material throughout the length of seam being tested. The vacuum test described in Paragraph 3.07F must be employed for testing of all seams that do not have a continuous flow channel.

1. A test device consisting of an inflation needle and pressure gauge mounted on a "T" fitting shall be used for air pressure testing. Insert the needle into the flow channel and seal the end of the channel around the needle. Connect a pump (such as a small bicycle pump) to the test device.
2. Ascertain that the flow channel is continuous by leaving the other end of the channel open and pumping air through the channel. If air does not pass through the channel the test length must be shortened until a continuous length of flow channel is found.
3. Seal and clamp both ends of the flow channel to assure an airtight seal. Inflate the flow channel to 25 to 30 psig. Allow one minute for the seam to stabilize.
4. Re-inflate as needed to achieve 25 to 30 psig on the seam and test for a period of five minutes.
5. At the end of the test period, if the pressure has not dropped more than 3 psi, the test shall be considered a pass and the following procedure will be implemented;
    a. Remove the test device and clamps.
    b. Make any repairs, if necessary, to the area where the flow channel was clamped or inflated.
    c. Record the test results, mark the seam as a pass, the date tested, and proceed to the next seam.
6. If the pressure drops below the 3 psi allowance, the test shall be considered a failure and the following procedure shall be implemented to identify the failure:
    a. Check to determine if there is excessive seepage around the inflation needle.
    b. Check both ends of the seam to ensure the flow channel is completely sealed off.

c. Walk the length of the seam; look and listen for air leaks.
d. If either of these procedures fail to identify the leak, trim the seam overlap and vacuum test the seam to locate the leak.
e. Once the leak is identified, make the necessary repairs and retest the seam.

7. Seam to be approved before testing by ENGINEER; test to be performed in presence of ENGINEER personnel.

F. Vacuum Testing: Vacuum testing shall be used to test the continuity of extrusion welded and mechanical seams. A clear topped vacuum box, supplied by CONTRACTOR, shall be placed over the seam to be tested after application of a soapy solution. Upon evacuation, bubbles will be evident through the viewing window if the seam lacks integrity. The following procedure shall be followed:

1. Wet seam to be tested with a soapy solution mixed at a ratio of 1 ounce soap to 1 gallon water. No antifreeze solution is allowed to be added to the water.
2. Place vacuum box over seam to be tested, evacuate box to a vacuum equal to 3 to 5 inches water column, and tug up to ensure a leak tight seal has been developed.
3. Examine the seam for a minimum of 10 seconds to detect soap bubbles.
4. If the bubbles are not evident, move to next test location. Adjacent test sections are to overlap by at least 1 inch.
5. If bubbles are present, mark area clearly for repair.
6. If the vacuum testing indicates leakage, the area shall be spot patched; or if major leaks are detected, the entire seam shall be reworked.
7. Seam to be approved before testing by ENGINEER; test to be done in presence of ENGINEER personnel.

3.07 DESTRUCTIVE TESTING OF PRODUCTION SEAMS

A. The purpose of destructive testing is to verify that the seaming process has produced seams of acceptable mechanical integrity. One seam sample shall be taken at random for each 500 feet of seam. Sample locations shall be designated by ENGINEER. Each sample shall be shown on the panel layout drawing. All holes in the installed geomembrane resulting from obtaining samples shall be repaired immediately. The sample ID number shall be marked on the patch. All repairs shall be 100 percent vacuum tested or spark tested for continuity.

B. Maximum frequency of test locations shall be agreed upon by the INSTALLER and ENGINEER prior to commencement of installation. Additional test locations, not to exceed agreed upon maximum frequency, shall be determined during seaming at ENGINEER'S discretion. Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset welds or other potential cause of imperfect welding.

C. INSTALLER shall not be informed in advance of locations where seam samples will be taken.

D. Cut samples as seaming progresses in order to obtain documentation test results prior to completion of liner installation. Number each sample and identify sample number and location on panel layout drawing.

E. Samples shall be 0.4 m (16 in.) wide by 2.1 m (44 in.) long with seam centered lengthwise. Cut one 25 mm (1 in.) wide strip from each end of sample and test in field, by hand or tensiometer, for peel and shear respectively. The tested sample shall not fail through the seam. If tensiometer is not available and if 25 mm (1.0 in.) wide specimen is

too difficult to test by hand, 10 mm (0.5 in.) wide specimen is acceptable. Cut remaining sample into 3 parts and distribute as follows.

1. One portion to INSTALLER for field documentation testing, 0.40 m by 0.38 m (16 in. by 15 in.).
2. One portion to INSTALLER independent laboratory testing, 0.40 m by 0.38 m (16 in. by 15 in.) if required.
3. One portion to ENGINEER for archive storage, 0.40 m by 0.30 m (16 in. by 12 in.).

F. For field testing, the CONTRACTOR shall cut 10 identical 1-inch wide replicated specimens from his sample. The CONTRACTOR shall test five specimens for seam shear strength and five for peel strength. Peel tests shall be performed on both inside and outside weld tracks. To be acceptable 4 out of 5 specimens must pass the test criteria with less than 10% separation. The CONTRACTOR shall submit field documentation test results to the ENGINEER as soon as they become available, but no later than 2 working days after the sample was taken. Field seams shall meet the minimum specifications of GRI GM 19.

Note: All seams must exhibit a film tear bond (FTB).

G. All testing equipment required for these quality control tests shall be provided by CONTRACTOR. Any seams failing the quality control tests shall be repaired at CONTRACTOR'S expense until passing test results are obtained. At all times, care shall be exercised to avoid damaging the geomembrane.

H. ENGINEER shall be present for all field documentation testing of seam strength.

I. INSTALLER shall submit results of test it performs as a result of its quality control assurance program to ENGINEER.

3.08 PROCEDURES FOR DESTRUCTIVE TEST FAILURE

A. The following procedures shall apply when sample fails field or lab destructive test.

1. Obtain additional destructive test samples at locations approximately 10 feet on either side of the failed test location.
2. Perform destructive tests.
3. If test passes, the seam shall be considered adequate.
4. If tests fail, all seams represented by the original destructive test shall be repaired with a cap-strip extrusion welded to all sides of the capped area. All cap-strip seams shall be non-destructively tested until adequacy of the seams is achieved. Cap strip seams exceeding 150 feet in length shall be destructively tested.

B. In any case, acceptable seams shall be bounded by 2 passed test locations (i.e., above procedure shall be followed in both directions from original failed location), and one sample for destructive testing shall be taken within reconstructed area.

C. If sample fails laboratory destructive test (whether conducted by independent laboratory or by INSTALLER'S laboratory), above procedures shall be followed considering laboratory tests exclusively. Since final seam must be bounded by 2 passed test locations, it may be necessary to take one or more new samples for laboratory testing in addition to one required in reconstructed seam area.

3.09 DEFECTS AND REPAIRS

A. Identification: Broom or wash geomembrane if amount of dust or mud inhibits inspection.

B. Evaluation: Non-destructively test each suspect location in seam and non-seam areas. Repair each location failing nondestructive testing.

C. Repair Procedures:

1. Repair defective seams by reconstruction.
2. Repair tears or pinholes by seaming or patching.
3. Repair blisters, larger holes, undispersed raw materials, and contamination by foreign matter with patches.
4. Surfaces of geomembrane to be patched shall be abraded no more than 1 hour prior to repair.
5. Seams used in repairing patches shall be approved extrusion welded seams and may be subjected to same destructive test procedures as outlined for other seams.
6. Patches shall be made of same geomembrane, extend minimum of 150 mm (6 in.) beyond edge of defects, and applied using approved extrusion welding methods only. Report areas of repair to ENGINEER immediately.

D. SEAM RECONSTRUCTION PROCEDURES:

1. Seam reconstruction for extrusion welding process shall be achieved by installing a cap strip over the defective weld a minimum of 6 inches either side of the weld and extrusion welding.
2. Seam reconstruction for fusion process shall be achieved by cutting out existing seam and welding in replacement strip by welding a cap strip over the defective seam length.

E. Verification of Repairs: Test each repair non-destructively. Repairs passing nondestructive test shall be taken as indication of adequate repair. Failed tests indicate repair shall be redone and retested until passing test results.

3.10 GEOMEMBRANE ACCEPTANCE

A. INSTALLER shall retain ownership and responsibility for geomembrane until acceptance by ENGINEER. Geomembrane liner will be accepted by ENGINEER when:

1. Written certification letter, including "as-built" drawings, is received by ENGINEER.
2. Installation of the geomembrane is complete.
3. All required documentation of installation is submitted to ENGINEER, including inspector's final report.
4. Verification of adequacy of field seams and repairs, including associated testing, is complete and all paperwork accepted and approved by ENGINEER.
5. The five-year material and one-year workmanship warranties are received.

3.11 CLEANUP

A. The INSTALLER shall place ALL material scraps in ENGINEER designated area at the end of each working day. No scraps of materials will be allowed to be left on top of liner.

B. Once liner installation is complete the CONTRACTOR shall:

1. Remove all sand bags from site; or
2. Remove all sand bags and place in ENGINEER designated area; or
3. If sand in sand bags is acceptable as cover soil material the INSTALLER may

empty each bag and remove and dispose of the empty bags. This will only be allowed if the material meets the criteria for the rooting zone layer. The INSTALLER must receive permission from ENGINEER prior to emptying the sand bags onto the liner.

**END OF SECTION**

**Attachment 1 to Section 02922**

**Certificate of Acceptance of**
**Geomembrane Subgrade Surface by INSTALLER**

DESCRIPTION OF AREA TO BE CERTIFIED:_____
_____
LOCATION:_____
PROJECT:_____
ADDRESS:_____

The undersigned, _____ certifies that he is a representative of _____ _____, duly authorized to execute this certificate, that he visually inspected the subgrade surface described above on _____ and found the surface to be acceptable for installation of the geomembrane.

This certification is based on observations of the surface of the subgrade only. No sub terrain inspections or tests have been performed and_____ (company) makes no representations or warranties regarding conditions which may exist below the surface of the subgrade.

Date: _____ Signature: _____
Name:_____ Title:_____

CERTIFICATE RECEIVED BY CONTRACTOR CERTIFICATE RECEIVED BY ENGINEER

Date:_____ Date:_____
Contractor:_____ Company:_____
Name:_____ Name: _____
Signature_____ Signature_____
Title_____ Title:_____

**SECTION 15064**

**HIGH DENSITY POLYETHYLENE PIPE**

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes HDPE piping for stormwater management system construction.

B. Extent of pipe and fittings required by this section indicated on Drawings.

1.02 REFERENCES

A. American Water Works Association (AWWA).

B. American Society for Testing and Materials (ASTM):

1. ASTM D638 – Standard Test Method for Tensile Properties of Plastics.
2. ASTM D790 – Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
3. ASTM D1238 – Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
4. ASTM D1248 – Standard Specification for Polyethelene Plastics and Extrusion Materials for Wire and Cable
5. ASTM D1505 – Standard Test Method for Density of Plastics by the Density-Gradient Technique.
6. ASTM D1693 – Standard Test Method for Environmental Stress Cracking of Ethylene Plastics.
7. ASTM D2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
8. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Material.
9. ASTM D2122 - Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings.
10. ASTM D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
11. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
12. ASTM F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
13. ASTM F1473 – Standard Test Method for Notch Tensile Test to Measure the Resistance to Slow Crack Growth of Polyethylene Pipes and Resins

1.03 SUBMITTALS

A. Manufacturer's certificates indicating conformance test results of furnished material to Specifications.

B. Provide information where applicable as follows:

1. Manufacturer's name.
2. Nominal pipe size.
3. High density polyethylene (HDPE) classification, ASTM D3350.

4. Use for each type and size of pipe.
5. Extrusion date.
6. Lot number.

C. Stock density, melt flow, flexural modulus tensile strength, coloration, resin type and cell classification where applicable.

D. Provide instructions on special handling during transportation and storage.

E. Aforementioned submittals provided to OWNER a minimum of 30 days prior to beginning work on Project.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Handle and protect product to ensure product is not damaged.

B. Elevate material above grade.

C. Store and handle in such a manner as to prevent soil from entering or becoming lodged in the pipe.

D. Provide protection for flanges and fittings by storing inside or packaging with impermeable opaque material.

PART 2 - PRODUCTS

PART 2 - PRODUCTS

A. Dimensions as shown on Drawings. Physical properties in conformance with cell classification requirements.

B. Pipe

1. High performance, high molecular weight, high density polyethylene pipe.
2. Material designation PPI-PE 4710; minimum cell classification value 445574C.
3. Marking: Intervals of 5 feet or less.
   a. Manufacturer's name or trademark.
   b. Nominal pipe size.
   c. HDPE cell classification, ASTM D3350.
   d. Legend: Industrial pipe SDR as indicated on Drawings.
   e. ASTM F714.
   f. Extrusion date, period of manufacture or lot number.
5. Perforations shall be pre-drilled and deburred prior to delivery to the Site, according to pattern indicated in the Drawings. Do not drill perforations within 1-ft of the ends of the pipe.

C. Fittings

1. Molded from polyethylene compound having cell classification equal or exceeding compound used in pipe to insure compatibility of resins.
2. Be of same manufacture as pipe.
3. Fusion weld joints.
4. Markings:
   a. Manufacturer's name or trademark.
   b. Nominal size.
   c. Material designation "HDPE".

d. ASTM D3261.

D. Fittings

1. Molded from polyethylene compound having cell classification equal or exceeding compound used in pipe to insure compatibility of resins.
2. Be of same manufacturer as pipe.
3. Fusion weld joints.
4. Markings:
   a. Manufacturer's name or trademark.
   b. Nominal size.
   c. Material designation "HDPE".
   d. ASTM D3261.

PART 3 - EXECUTION

3.01 EXECUTION

A. Examine and verify acceptability of surface to receive product.

3.02 HDPE PIPE INSTALLATION

A. Location, lines, and grades as shown on Drawings.

B. Welded joints.

1. Weld in accordance with manufacturer's recommendations for butt fusion methods.
2. Butt fusion equipment used in joining procedures capable of meeting conditions recommended by manufacturer, including, but not limited to: temperature required, alignment, and fusion pressures.

C. Electrofusion or butt fusion welding methods are allowable for piping installation. Electrofusion couplers to be approved by OWNER or ENGINEER.

D. No defective pipe installed. Defective pipe removed from site and replaced at CONTRACTOR'S expense.

E. Install granular bedding in accordance with Section 02208.

3.04 EXCAVATION AND PREPARATION OF SUBGRADE

A. Excavate and prepare subgrade as necessary for installation and as shown on Drawings.

B. CONTRACTOR to take care to avoid damage to underlying geosynthetics during stormwater piping installation; damage to underlying geomembrane shall be repaired at CONTRACTOR’s expense. Damages shall be repaired and documented in accordance with Section 02920.

3.04 BACKFILL

A. Backfill with required pipe bedding and place cover material as shown on Drawings.

3.05 FIELD QUALITY CONTROL

A. Pipe may be rejected for failure to conform to specification, or:

1. Fractures or cracks passing through pipe wall, except single crack not exceeding 2 inches in length at either end of pipe which could be cut off and discarded. Pipes within one shipment will be rejected if defects exist in more than 5 percent of shipment or delivery.
2. Cracks sufficient to impair strength, durability or serviceability of pipe.
2. Defects indicating improper proportioning, mixing, and molding.
3. Damaged ends, where damage would prevent making satisfactory joint.
5. Noticeable variations from true alignment and grade sufficient cause for rejection of Work.

B. Acceptance of fittings, stubs or other specially fabricated pipe sections based on visual inspection at site and documentation that they conform to these specifications.

C. Survey pipe and fitting locations per CQA plan.

***END OF SECTION***

# Appendix I Environmental Review Pre-Screening Form

MINNESOTA POLLUTION CONTROL AGENCY
520 Lafayette Road North
St. Paul, MN 55155-4194

# Environmental Review pre-screening form

**Environmental Review Program**

*Doc Type: Environmental Review Checklist*

**Instructions:** The following questions are designed to help you and the Minnesota Pollution Control Agency (MPCA) staff determine if your project requires environmental review before proceeding with the permitting process. If you need help with this form or have questions about environmental review, please contact MPCA staff at 651-296-6300 or via email at env.review.pca@state.mn.us.

**Submittal:** To avoid unnecessary and costly delays in your project, complete and submit this form with your permit application.

**Important note:** Under Environmental Quality Board (EQB) Rules, a project may not begin construction and no final government decisions may be made to grant a permit, approve a project, or begin a project until the environmental review process is complete.

## Part A: Permitting information

Name of project: Dem-Con Pilgrim Landfill

City: Mankato County: Blue Earth

Contact name: Mark A. Pahl Contact phone number: 952-445-5755

Email address: markpahl@dem-con.com

1. List all MPCA permit(s) that may be needed for this project:

   Solid Waste Permit, General Industrial Stormwater Permit

2. Is this permit application for reissuance ***only**** of an existing permit? ☐ Yes ☒ No

   **If this project involves any physical alterations, construction projects or operational changes to the facility or process you must answer **No.***

3. Provide a project description:

   The current Landfill operates as an unlined Class I unlined C&D Landfill. The facility is proposing to modify its design and operations to function as a Class III lined C&D Landfill and accept industrial waste which is co-disposed with C&D materials in the future lined DD 002 disposal area in accordance with the facility's ISWMP.

## Part B: Environmental Review

| | Yes | No |
|---|---|---|
| 1. Are you required to prepare, are you preparing, or have you completed an Environmental Assessment Worksheet (EAW), Environmental Impact Statement (EIS), Alternative Urban Areawide Review (AUAR), or Federal Environmental Assessment (EA) for any responsible governmental unit (RGU) other than the MPCA (e.g., city, township, county, state or federal agency) as part of this project? | ☐ | ☒ |

If yes, please identify the following:

RGU: _____

Type of Environmental Review document (EAW, EA, EIS, AUAR): _____

Other (specify): _____

**If you answered "Yes" to either of the questions, you are finished.** Please submit this form to the MPCA along with the permit application.

**If you answered "No" to both of the above questions, please complete the remainder of the form, both part C and D.** When completed, please submit this form to the MPCA along with the permit application.

## Part C: The MPCA Environmental Review mandatory thresholds
**(Minn. R. 4410.4300 and 4410.4400)**

| | **Answer each question to determine if your project meets or exceeds the mandatory thresholds for environmental review.**<br>**Does your project consist of:** | **Yes** | **No** |
|---|---|---|---|
| **Subp. 2** | **Construction *or* expansion of a nuclear fuel or nuclear waste processing facility?** | ☐ | ☒ |
| **Subp. 3** | **Construction of an electric power generating plant and associated facilities designed for or capable of operating at a capacity of 25 megawatts or more but less than 50 megawatts and for which an air permit from the MPCA is required?** | ☐ | ☒ |
| **Subp. 4** | **Construction of a new *or* expansion of an existing petroleum refinery?** If yes, complete Q1 and Q2. | ☐ | ☒ |
| | Q1: Are you constructing a new petroleum refinery? | ☐ | ☐ |
| | Q2: Are you expanding an existing petroleum refinery that increases its capacity by 10,000 or more barrels per day? | ☐ | ☐ |
| **Subp.5A** | **Construction of a facility for the conversion of coal, peat, or other biomass sources to a gaseous, liquid, or solid fuel (this includes anaerobic digesters)?** If yes, complete Q1. | ☐ | ☒ |
| | Q1: Are you constructing a facility for the conversion of coal, peat, or biomass sources to gaseous, liquid, or solid fuels if that facility has the capacity to utilize 25,000 dry tons or more per year of input? | ☐ | ☐ |
| **Subp. 5B** | **Construction of a facility for the production of alcohol fuels?** If yes, complete Q2 - Q4. | ☐ | ☒ |
| | Q2: Are you constructing a new fuel conversion facility for the production of alcohol fuels that would have the capacity to produce 5,000,000 or more gallons per year of alcohol? | ☐ | ☐ |
| | Q3: Are you constructing or expanding an alcohol fuel production facility located in the seven-county metro area that would have or would increase its capacity by 50,000,000 or more gallons per year? | ☐ | ☐ |
| | Q4: Are you constructing or expanding an alcohol fuel production facility located outside the seven-county metro area that produces more than 125,000,000 gallons per year? | ☐ | ☐ |
| **Subp.8A** | **Construction or expansion of a coal transfer facility?** If yes, complete Q1 and Q2. | ☐ | ☒ |
| | Q1: Are you constructing a facility designed for or capable of transferring 300 tons or more of coal per hour or with an annual throughput of 500,000 tons of coal from one mode of transportation to a similar or different mode of transportation? | ☐ | ☐ |
| | Q2: Are you expanding an existing facility designed for or capable of transferring 300 tons or more of coal per hour or with an annual throughput of 500,000 tons of coal from one mode of transportation to a similar or different mode of transportation? | ☐ | ☐ |
| **Subp. 8B** | **Construction or expansion of a hazardous materials transfer facility?** If yes, complete Q3 and Q4. | ☐ | ☒ |
| | Q3: Are you constructing a new facility for the bulk transfer of hazardous materials with the capacity of 10,000 or more gallons per transfer and is the facility is located in a shoreland area, delineated flood plain, a state or federally designated wild and scenic rivers district, Minnesota River Project Riverbend area, or the Mississippi headwaters area? | ☐ | ☐ |
| | Q4: Are you expanding an existing facility, by 50 percent or more, for the bulk transfer of hazardous materials with the capacity of 10,000 or more gallons per transfer and is the facility is located in a shoreland area, delineated flood plain, a state or federally designated wild and scenic rivers district, Minnesota River Project Riverbend area, or the Mississippi headwaters area? | ☐ | ☐ |
| **Subp. 10A** | **Construction or expansion of a storage facility for coal?** If yes, complete Q1. | ☐ | ☒ |
| | Q1: Are you constructing or expanding a facility designed for or capable of storing more than 7,500 tons of coal or with an annual throughput of more than 125,000 tons of coal? | ☐ | ☐ |
| **Subp. 10B** | **Construction of a facility for the storage of hazardous materials?** If yes, complete Q2. | ☐ | ☒ |
| | Q2: Are you constructing a new major facility, as defined in Minn. R. 7151.1200 that results in a designed storage capacity of 1,000,000 gallons or more of hazardous materials? | ☐ | ☐ |
| **Supb. 10C**<br>**Subp. 10D** | **Expansion of a facility for the storage of hazardous materials?** If yes, complete Q3 and Q4. | ☐ | ☒ |
| | Q3: Are you expanding an existing major facility, as defined in Minn. R. 7151.1200, with a designed storage capacity of 1,000,000 gallons or more of hazardous materials and the expansion adds a net increase of 1,000,000 gallons or more of a hazardous material? | ☐ | ☐ |
| | Q4: Are you expanding a facility that has less than 1,000,000 gallons in total designed storage capacity of hazardous materials when the net increase in designed storage capacity results in 1,000,000 gallons or more of hazardous materials? | | |

| **Answer each question to determine if your project meets or exceeds the mandatory thresholds for environmental review.**<br>**Does your project consist of:** | | **Yes** | **No** |
|---|---|---|---|
| **Subp. 10H** | **Construction or expansion of a facility that will store silica sand?** If yes, complete Q4. | ☐ | ☒ |
| | Q4: Are you constructing a facility designed for or capable of storing on a single site 7,500 tons or more of silica sand or has an annual throughput of more than 200,000 tons of silica sand? | ☐ | ☐ |
| **Subp. 13** | **Construction or expansion of a paper or pulp processing facility?** If yes, complete Q1 and Q2. | ☐ | ☒ |
| | Q1: Are you expanding an existing paper or pulp processing facility that will increase its production capacity by 50 percent or more? | ☐ | ☐ |
| | Q2: Are you constructing a new paper or pulp processing facility? | ☐ | ☐ |
| **Subp. 15** | **Construction or modification of a stationary source of air emissions resulting in an increase in air emissions or greenhouse gases?** If yes, complete Q1 and Q2. | ☐ | ☒ |
| | Q1: Are you constructing or modifying a stationary emission source that will emit 250 tons per year or more of a single air pollutant after the installation of air pollution control equipment? | ☐ | ☐ |
| | Q2: Are you constructing or modifying a stationary source facility that generates a combined 100,000 tons or more per year of greenhouse gas emissions, expressed as carbon dioxide equivalents, after the installation of air pollution control equipment? | ☐ | ☐ |
| **Subp. 16** | **Construction or expansion of a hazardous waste disposal facility?** If yes, complete Q1 - Q5. | ☐ | ☒ |
| | Q1: Are you constructing or expanding a hazardous waste disposal facility? | ☐ | ☐ |
| | Q2: Are you constructing a new facility for hazardous waste storage or treatment that is generating or receiving 1,000 kilograms or more per month of hazardous waste or one kilogram or more per month of acute hazardous waste? | ☐ | ☐ |
| | Q3: Are you expanding an existing facility for hazardous waste storage or treatment that increases its capacity by 10 percent or more? | ☐ | ☐ |
| | Q4: Are you constructing or expanding a facility that sells hazardous waste storage services to generators other than the owner and operator of the facility or a facility at which a generator's own hazardous wastes will be stored for a time period in excess of 90 days and the facility is located in a water-related land use management district, or in an area characterized by soluble bedrock? | ☐ | ☐ |
| | Q5: Are you constructing or expanding a hazardous waste disposal, storage or treatment facility in a water-related land use management district or in an area characterized by soluble bedrock? | ☐ | ☐ |
| **Subp. 17** | **Construction or expansion of a mixed municipal solid waste disposal, transfer, energy recovery, or compost facility?** If yes, complete Q1 – Q9. | ☐ | ☒ |
| | Q1: Are you constructing a mixed municipal solid waste land disposal facility for up to 100,000 cubic yards of waste fill per year? | ☐ | ☐ |
| | Q2: Are you constructing a mixed municipal solid waste land disposal facility for 100,000 cubic yards or more of waste fill per year? | ☐ | ☐ |
| | Q3: Are you expanding by 25 percent or more of previously permitted capacity of a mixed municipal solid waste land disposal facility for up to 100,000 cubic yards of waste fill per year? | ☐ | ☐ |
| | Q4: Are you constructing or expanding a mixed municipal solid waste land disposal facility in a water-related land use management district or in an area characterized by soluble bedrock? | ☐ | ☐ |
| | Q5: Are you constructing or expanding a mixed municipal solid waste transfer station for 300,000 or more cubic yards per year? | ☐ | ☐ |
| | Q6: Are you constructing or expanding a mixed municipal solid waste energy recovery facility or incinerator, or the utilization of an existing facility for the combustion of mixed municipal solid waste or refuse-derived fuel, with a capacity of 30 or more tons per day of input? | ☐ | ☐ |
| | Q7: Are you constructing or expanding a mixed municipal solid waste compost facility or a refused-derived fuel production facility with a permitted capacity of 50 or more tons per day of input? | ☐ | ☐ |
| | Q8: Are you expanding a mixed municipal solid waste land disposal facility for 100,000 cubic yards or more of waste fill per year by at least 10 percent but less than 25 percent? | ☐ | ☐ |
| | Q9: Are you constructing or expanding a mixed municipal solid waste energy recovery facility ash landfill receiving ash from an incinerator that burns refuse-derived fuel or mixed municipal solid waste? | ☐ | ☐ |
| **Subp. 18A**<br>**Subp. 18B** | **Expansion, modification, or replacement of a municipal sewage collection system?** If yes, complete Q1 and Q2. | ☐ | ☒ |
| | Q1: If you are discharging to a wastewater treatment facility with a capacity of less than 20,000,000 gallons per day, are you expanding, modifying, or replacing a municipal sewage collection system that will result in an increase in design average daily flow of 1,000,000 gallons per day or more? | ☐ | ☐ |

| Answer each question to determine if your project meets or exceeds the mandatory thresholds for environmental review.<br>Does your project consist of: | | Yes | No |
|---|---|---|---|
| | Q2: If you are discharging to a wastewater treatment facility with a capacity **greater than 20,000,000 gallons per day**, are you expanding, modifying, or replacing a municipal sewage collection system that will result in an increase in design average daily flow of 2,000,000 gallons per day or more? | ☐ | ☐ |
| **Subp. 18C** | **Expansion or reconstruction of an existing municipal or domestic wastewater treatment facility?** If yes, complete Q3. | ☐ | ☒ |
| | Q3: Are you expanding or reconstructing an existing municipal or domestic wastewater treatment facility that will result in an increase in capacity by 50 percent or more and by at least 200,000 gallons per day of its average wet weather design flow capacity? | ☐ | ☐ |
| **Subp. 18D** | **Construction of a new municipal or domestic wastewater treatment facility?** If yes, complete Q4. | ☐ | ☒ |
| | Q4: Are you constructing a new municipal or domestic wastewater treatment facility with an average wet weather design flow capacity of 200,000 gallons per day or more? | ☐ | ☐ |
| **Subp. 18E** | **Expansion or modification of an existing industrial process wastewater treatment facility?** If yes, complete Q5. | ☐ | ☒ |
| | Q5: Are you expanding or modifying an existing industrial process wastewater treatment facility that increases the facilities design flow capacity by 50 percent or more and by at least 200,000 gallons per day or more? | ☐ | ☐ |
| **Subp. 18F** | **Construction of a new industrial process wastewater treatment facility?** If yes, complete Q6. | ☐ | ☒ |
| | Q6: Are you constructing a new industrial process wastewater treatment facility with a design flow capacity of 200,000 gallons per day or more, or 5,000,000 gallons per month or more, or 20,000,000 gallons per year or more? | ☐ | ☐ |
| **Subp. 25** | **Incineration of wastes containing Polychlorinated Biphenyls (PCBs)?** | ☐ | ☒ |
| **Subp. 29** | **Construction or expansion of an animal feedlot facility?** If yes, complete Q1 and Q2. | ☐ | ☒ |
| | Q1: Are you constructing an animal feedlot facility with a capacity of 1,000 animal units or more? | ☐ | ☐ |
| | Q2: Are you expanding an animal feedlot by 1,000 animal units or more? **If "Yes" to Q1 or Q2, proceed to Part D. If "No", proceed to Q3.** | ☐ | ☐ |
| | Q3: Are you constructing or expanding an animal feedlot facility by more than 500 animal units? **If "No" to Q3, proceed to Part D. If "Yes", proceed to Q4.** | ☐ | ☐ |
| | Q4: Is the existing or proposed facility located wholly or partially in any of the following sensitive locations: | | |
| | Shoreland or delineated floodplain? | ☐ | ☐ |
| | A state or federally designated wild and scenic river district? | ☐ | ☐ |
| | The Minnesota River Project Riverbend Area? | ☐ | ☐ |
| | The Mississippi Headwaters Area? | ☐ | ☐ |
| | A drinking water supply management area? | ☐ | ☐ |
| | Within 1000 feet of a sinkhole, cave, resurgent spring, disappearing spring, Karst window, blind valley or dry valley? | ☐ | ☐ |

## Part D: Phased or connected actions (Minn. R. 4410.1000)

| Answer each question to determine if your project could be a phased or connected action. Multiple projects and multiple stages of a single project must be considered in total when determining the need for an EAW or EIS. | | Yes | No |
|---|---|---|---|
| A. | Has a previous phase of this project been conducted in the last three years? | ☐ | ☒ |
| B. | Are you planning an expansion or another phase of this project within the next three years? | ☐ | ☒ |
| C. | Do you have other existing facilities or proposed projects that may affect the same geographic area as this project? | ☐ | ☒ |
| | If yes, what is the linear distance between the existing facilities or proposed project(s) and this project?: | | |
| D. | Is this project a prerequisite for another project, whether by you or another entity? | ☐ | ☒ |
| E. | Is this project part of a larger project? | ☐ | ☒ |

Stantec

Stantec is a global leader in sustainable engineering, architecture, and environmental consulting. The diverse perspectives of our partners and interested parties drive us to think beyond what's previously been done on critical issues like climate change, digital transformation, and future-proofing our cities and infrastructure. We innovate at the intersection of community, creativity, and client relationships to advance communities everywhere, so that together we can redefine what's possible.

**Stantec Consulting Services Inc.**
1 Carlson Parkway, Suite 100
Plymouth, MN 55447
stantec.com

## VI. Local acknowledgment

This section is primarily meant to notify the county and local authorities of the applicant's intent so that all county and local ordinances and plans can be met. It is intended to validate that counties and local authorities were properly notified of this permit application for construction and operation. Signature by the county or local authority is not meant to imply approval.

### A. County acknowledgment/permission (to be completed by County Solid Waste Administrator or County Zoning Administrator)

Print name: John Considine Title: Property and Zoning Land Supervisor

Email: john.considine@blueearthcountymn.gov Phone: (507) 304-4339

Organization: Blue Earth County

Address: Blue Earth County Government Center, 10 South 5th Street, P.O. Box 3566

City: Mankato State: MN Zip: 56002

### B. Local acknowledgment/permission (to be completed by local building or zoning office)

Print name: Victoria Potts Title: Lime Township Planning and Zoning

Email: vpotts@mankatomn.gov Phone: (507) 387-8621

Organization: Lime Township

Address: PO Box 4444

City: Mankato State: MN Zip: 56002

In lieu of completion of this part of the application, the applicant may submit documentation that the applicant has sent appropriate notification to the county and local authorities. Documentation must consist of copies of letters sent to the county and local authorities via certified mail, return receipt requested and copies of the signed return receipt.

### C. Local approvals

**Have all local licenses/approvals been acquired?** ☒ Yes ☐ No

**If yes,** please list all approvals, include issuances and expiration dates (include a copy of each approval)

Blue Earth County License - expires December 31, 2026

Lime Township CUP - issued May 18, 2004, does not expire

**If no,** please explain:

### D. Solid waste transfer facilities and source-separated organic material (SSOM) compost facilities

The applicant for a transfer facility or SSOM compost facility must attach copies of all required municipal licenses/approvals, unless the applicant is a municipality. The MPCA will not process an application without these approvals. See Minn. R. 7001.3400, item C, or 7001.3375 item L for more details. If no municipal approvals are required the owner or operator must sign the statement below stating that no municipal approvals are required.

I certify, no municipal approvals are required:

Print name: _____ Title: _____

Signature: _____ Date (mm/dd/yyyy): _____

### E. Land disposal facilities

The MPCA may not issue a permit for a new disposal area or an expansion of an existing disposal area prior to local units of government granting approval. All local approval will need to be obtained prior to issuance of the MPCA solid waste permit for disposal activities. See Minn. Stat. § 116.07, subd. 4j, item d(1) for more details.

MINNESOTA POLLUTION CONTROL AGENCY
520 Lafayette Road North
St. Paul, MN 55155-4194

# Permit application change of ownership/operator/landowner

**Solid Waste Permit Program**

*Doc Type: Permit Application*

| MPCA Use Only | |
|---|---|
| AI number: | |
| Activity ID: | |

**Print or type application:** Before submitting, make a photocopy for your records. The Minnesota Pollution Control Agency (MPCA) will review the application for completeness and provide an official response to the permittees within 30 business days of receipt of the application.

**Permit application assembly:** To expedite the processing and review of your application, **put this form at the beginning** of your submittal package. Attach additional sheets as necessary. For more information, please contact the MPCA at: In Metro Area: 651-296-6300 or Outside Metro Area: 800-657-3864.

**Completeness instructions:** Without properly completed forms, an application cannot be processed and will be determined to be incomplete. All sections of this form must be completed. If portions do not apply to this facility, please indicate so with "n/a".

**The completed form is to be returned to:** **Solid Waste Permit Document Coordinator**
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

**Submittal:** You must submit one (1) paper copy ***and*** one (1) electronic copy (i.e., disc or thumb drive) of your application.

**Application is for** (check appropriately): ☒ Change in Permitted Activity Owner
☒ Change in Permitted Landowner
☒ Change in Permitted Operator

## Facility information (Minn. R. 7001.0050, item D)

Facility name: Dem-Con Pilgrim Landfill

Street address: 57032 231st Ln

City/Township: Mankato State: MN Zip code: 56001

Email: Phone:

MPCA Region (check one): ☐ Brainerd ☐ Detroit Lakes ☐ Duluth ☐ Marshall ☐ Metro ☒ Rochester

Current solid waste permit number: PBR **or** SW 254

## I. Submittal information

A. Have you included copy of the binding written agreement between the permittee and the proposed transferee? (Minn. R. 7001.0190, subp. 2)

☒ Yes
☐ No

B. Does the written agreement include a specific date for transfer of permit responsibilities and allocation of liabilities? (Minn. R. 7001.0190, subp. 2)

☐ Yes Please include the date (mm/dd/yyyy):

☒ No Please explain:

The agreement is contingent on receipt of solid waste and any other applicable permits

C. Was a revised permit application submitted 90 days prior to the change in ownership or control (7001.0190, subp. 2(A))

☒ Yes Please include the date (mm/dd/yyyy): 4/24/2026

☐ No Please explain:

## II. Current permittee information (Minn. R. 7001.0190, subp. 2)

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

I further certify that the construction and operation of the above described facility will be in accordance with the plans, specifications, reports and related communications accepted by the MPCA and on file in its office; and in accordance with conditions imposed in the permit issued by the MPCA.

I certify that the facility is consistent with local solid waste management plans. I am aware an MPCA permit must be obtained before construction or operation of the facility may begin and all local permits, licenses or other government approval must be obtained before an MPCA permit can be issued.

I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment.

**Landowner** [Minn. R. 7001.0060, item E]

Print name: Chad Phillips Title:

Email: chad.phillips@minnpm.com Phone: 507-380-7875

Organization: OMG Midwest d/b/a Minnesota Paving and Materials

Address: 1905 3rd Ave

City: Mankato State: MN Zip: 56003

Signature: Chad Phillips Date (mm/dd/yyyy): 04/20/2026

**Activity Owner (Applicant)** [Minn. R. 7001.0050, item A]

Print name: same as landowner Title:

Email: Phone:

Organization:

Address:

City: State: Zip:

Signature: Date (mm/dd/yyyy):

**Operator*** [Minn. R. 7001.0050, item B]

Print name: same as landowner Certification No:

Title: Expiration date:

Email: Phone:

Organization:

Address:

City: State: Zip:

Signature: Date (mm/dd/yyyy):

## III. New Owner/Operator information (Minn. R. 7001.0190, subp. 2)

**New landowner** [Minn. R. 7001.0060, item E]

Print name: Mark Pahl | Title: Partner
Email: markpahl@dem-con.com | Phone: 951-224-7101
Organization: Dem-Con Companies
Address: 13020 Dem-Con Drive
City: Shakopee | State: MN | Zip: 55379
Signature: | Date (mm/dd/yyyy): 4-24-26

**New activity owner** [Minn. R. 7001.0050, item A]

Print name: same as new landowner | Title:
Email: | Phone:
Organization:
Address:
City: | State: | Zip:
Signature: | Date (mm/dd/yyyy):

**New operator*** [Minn. R. 7001.0050, item B]

Print name: Erik Klehr | Certification No: 67333916
Title: Landfill Manager | Expiration date:
Email: erikklehr@dem-con.com | Phone: 952-356-2401
Organization: Dem-Con Companies
Address: 13020 Dem-Con Drive
City: Shakopee | State: MN | Zip: 55379
Signature: | Date (mm/dd/yyyy): 4-24-26

**Provide the same information for other certified operators.*

## IV. Local acknowledgment

This section is primarily meant to notify the county and local authorities of the applicant's intent so that all county and local ordinances and plans can be met. It is intended to validate that counties and local authorities were properly notified of this permit application for construction and operation. Signature by the county or local authority is not meant to imply approval.

### A. County acknowledgment/permission (to be completed by County Solid Waste Administrator or County Zoning Administrator)

Print name: John Considine | Title: Property and Zoning Land Supervisor
Email: john.considine@blueearthcountymn.gov | Phone: 507-304-4339
Organization: Blue Earth County
Address: Blue Earth County Government Center, 10 South 5th Street, P.O. Box 3566
City: Mankato | State: MN | Zip: 56002

### B. Local acknowledgment/permission (to be completed by local building or zoning office)

Print name: Victoria Potts | Title: Lime Township Planning and Zoning
Email: vpotts@mankatomn.gov | Phone: 507-387-8621
Organization: Lime Township
Address: PO Box 4444
City: Mankato | State: MN | Zip: 56002

In lieu of completion of this part of the application, the applicant may submit documentation that the applicant has sent appropriate notification to the county and local authorities. Documentation must consist of copies of letters sent to the county and local authorities via certified mail, return receipt requested and copies of the signed return receipt.

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

# Solid Waste Facility Application Checklist

## Solid Waste Permit Program

*Doc Type: Permit Application*

**Purpose:** This checklist has been developed as a guide for permit application preparers and reviewers in order to assist with the submittal of a substantially complete permit application. Thoroughly review all applicable rules, statutes and guidance documents for further details and requirements. Minnesota Rules can be found at: https://www.revisor.mn.gov/rules/. All guidance documents can be found on the Minnesota Pollution Control Agency (MPCA) Solid Waste Publications webpage at: http://www.pca.state.mn.us/lupg880.

Many items listed below must be discussed in depth within the permit application submittal package. Be sure to include the most recently updated information, drawings and plans. Previously submitted documents **cannot** be referenced; all necessary documents must be included in this package. The permit application submittals should discuss all applicable MPCA Guidance Documents; include justification if the facility does not follow the guidance provided.

**Instructions for permit application preparers:** The following checklist must be completed and included with a permit application for all solid waste facilities. In the table below, indicate in the far left column the name and page number(s) of the document where the specified rule requirement is addressed. If the rule requirement does not apply, please indicate with "n/a" for not applicable. **The permit application will be determined to be incomplete if there are any blank spaces in this column**.

| Document and page number | Minn. R. citation | MPCA use only | | |
|---|---|---|---|---|
| | | Completeness review | | Comments |
| | | Admin | Technical | |
| form w-sw3-33 and Section 1 | 7001.0050, item A<br>Name, address, and telephone number of the owner of the facility for which the application is submitted and identification of the status of the owner as a federal, state, public, private, or other entity | | | |
| form w-sw3-33 and Section 1 | 7001.0050, item B<br>If the operator of the facility for which the application is submitted is different from the owner, the name, address, and telephone number of the operator and identification of the status of the operator as a federal, state, public, private, or other entity | | | |
| form w-sw3-33 and Section 1 | 7001.0050, item C<br>Name, address, and telephone number of the person who prepared the application | | | |
| Section 1.1.5 | 7001.0050, item D<br>Description including the location of the business, plant, system, facility, or activity for which the permit is sought | | | |
| Section 2 | 7001.0050, item E<br>General description of the materials handled, processed, stored, or disposed of by the applicant; and a statement of the nature and quantity of the materials proposed to be stored, processed, discharged, emitted, or disposed of during the period of the required permit, and proposed methods for control of these materials | | | |

| Document and page number | Minn. R. citation | MPCA use only | | |
|---|---|---|---|---|
| | | Completeness review | | Comments |
| | | Admin | Technical | |
| N/A | 7001.0060, item A<br>For a corporation, the permit application must be signed by a<br>principal executive officer of at least the level of vice-president or the duly authorized representative or agent of the executive officer if the representative or agent is responsible for the overall operation of the facility that is the subject of the permit application | | | |
| form w-sw3-33 | 7001.0060, item B<br>For a partnership or sole proprietorship, the permit application must be signed by a general partner or the proprietor, respectively | | | |
| N/A | 7001.0060, item C<br>For a municipality, state, federal, or other public agency, the permit application must be signed by either a principal executive officer or ranking elected official | | | |
| form w-sw3-33 | 7001.0060, item D<br>If the operator of the facility for<br>which the application is submitted is different from the owner, the permit application must be signed by both the owner according to items A through C above | | | |
| form w-sw3-33 | 7001.0060, item E<br>For solid waste management facilities, the permit application must be signed by the facility owner and landowner under items A to C if the landowner is different from the owner of the facility for which the application is submitted | | | |
| form w-sw3-33 | 7001.0060, item F<br>For a firm preparing the necessary reports and plans for a solid waste management facility permit application, the permit application must be signed by an engineer registered in Minnesota | | | |
| form w-sw3-33 | 7001.0070<br>A person who signs a permit application shall make the following certification: “I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information. The information is, to the best of my knowledge and belief, true, accurate, and complete.” | | | |

| Document and page number | Minn. R. citation | MPCA use only | | |
|---|---|---|---|---|
| | | Completeness review | | Comments |
| | | Admin | Technical | |
| form w-sw3-33 | 7001.3150<br>A person who signs a permit application or any portion of it, or any report required by a permit to be submitted to the commissioner or agency must make the certification required by part 7001.0070 and shall make the following additional certification: "I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment."<br>An engineer registered in Minnesota must certify all technical documents, such as design drawings and specifications, engineering reports, and hydrogeologic studies, required to be submitted as part of a permit application or by a permit condition.<br>The hydrogeologic report and all related groundwater and surface water monitoring reports must be signed by a person knowledgeable in the field of hydrogeology. This person must certify the quality of work performed and must have been responsible for the gathering and interpretation of the hydrogeologic data and the preparation of the reports. | | | |
| Section 1.1.5 | 7001.3300, item A<br>General description of the facility | | | |
| Appendix A | 7001.3300, item B<br>Industrial solid waste management plan in accordance with 7035.2535 | | | |
| Section 3.3 | 7001.3300, item C<br>Description of security procedures and equipment | | | |
| Section 3.4 | 7001.3300, item D<br>Inspection schedule | | | |
| Section 3.5 | 7001.3300, item E<br>Contingency action plan | | | |
| Section 3.6.1 | 7001.3300, item F(1)<br>Description of procedures, structures or equipment to prevent operational hazards | | | |
| Section 3.6.2 | 7001.3300, item F(2)<br>Description of procedures, structures or equipment to prevent run-off, run-on | | | |
| Section 3.6.3 | 7001.3300, item F(3)<br>Description of procedures, structures or equipment to prevent ground and surface water contamination | | | |
| Section 3.6.4 | 7001.3300, item F(4)<br>Description of procedures, structures or equipment to mitigate effects of equipment failure | | | |
| Section 3.6.5 | 7001.3300, item G<br>Description of precautions to prevent ignition or explosions and emergency response plan | | | |

| Document and page number | Minn. R. citation | MPCA use only | | |
|---|---|---|---|---|
| | | Completeness review | | Comments |
| | | Admin | Technical | |
| Section 3.7 | 7001.3300, item H<br>Traffic patterns and control | | | |
| Section 3.8 | 7001.3300, item I<br>Storage descriptions | | | |
| Section 4 | 7001.3300, item J<br>Closure and Postclosure Plan | | | |
| Section 4.3 | 7001.3300, item K<br>Closure cost estimates and evidence of financial assurance | | | |
| Section 4.4 | 7001.3300, item L<br>Postclosure cost estimates and evidence of financial assurance | | | |
| Section 3.5.1, Section 3.5.7 | 7001.3300, item M<br>Corrective action cost estimates and evidence of financial assurance | | | |
| Section 5.1, Figure 1, Appendix B | 7001.3300, item N(1 to 18)<br>Topographic and development map | | | |
| Section 5 | 7001.3300, item O<br>Geologic and location information | | | |
| Section 6 | 7001.3300, item P(1 to 9)<br>Operations and maintenance manual | | | |
| Section 7, Appendix H | 7001.3300, item Q<br>Construction QA/QC plan | | | |
| Section 10.5 | 7001.3300, item R<br>Household hazardous waste management plan | | | |
| Appendix B | 7001.3300, item S<br>Full size copies of all engineering plan sheets | | | |
| Appendix B | 7001.3300, item S<br>Reduced copies of all engineering plan sheets (11” x 17”) | | | |
| Appendix F | 7001.3300, item S<br>Address labels for all adjacent properties owners and interested parties | | | |
| Appendix F | 7001.3300, item S<br>Plan sheet with adjacent land owner information | | | |
| N/A | 7001.3300, item S<br>Discussion of all previously granted variances | | | |
| Section 1.1.6, Variance Application Checklist | 7001.3300, item S<br>Variance application according to Minn. R. 7000.7000 for all new requests | | | |
| Section 1.1.6, Section 10 | 7001.3300, item S<br>Description of how and why the facility does or does not operate according to all applicable MPCA Guidance Documents | | | |
| available upon request | 7001.3300, item S<br>Inspection Form | | | |

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

# Demolition Debris Landfill Application Checklist

**Solid Waste Permit Program**

*Doc Type: Permit Application*

**Purpose:** This checklist has been developed as a guide for permit application preparers and reviewers in order to assist with the submittal of a substantially complete permit application. Thoroughly review all applicable rules, statutes and guidance documents for further details and requirements. Minnesota Rules can be found at: https://www.revisor.mn.gov/rules/. All guidance documents can be found on the Minnesota Pollution Control Agency (MPCA) Solid Waste Publications webpage at: http://www.pca.state.mn.us/lupg880.

Many items listed below must be discussed in depth within the permit application submittal package. Be sure to include the most recently updated information, drawings and plans. Previously submitted documents **cannot** be referenced; all necessary documents must be included in this package. The permit application submittals should discuss all applicable MPCA Guidance Documents; include justification if the facility does not follow the guidance provided.

**Instructions for permit application preparers:** The following checklist must be completed and included with a permit application for all demolition debris landfill disposal facilities. In the table below, indicate in the far left column the name and page number(s) of the document where the specified rule requirement is addressed. If the rule requirement does not apply, please indicate with "n/a" for not applicable. **The permit application will be determined to be incomplete if there are any blank spaces in this column**.

| Document and page number | Minn. R. citation | MPCA use only | | |
|---|---|---|---|---|
| | | Completeness review | | Comments |
| | | Admin | Technical | |
| Section 2.2 | 7001.3425, item A<br>Site capacity calculation and operating life | | | |
| see report | 7001.3425, item B<br>Detailed plans and engineering report | | | |
| Section 9.2 | 7001.3425, item C<br>Particulate and fugitive dust control methods | | | |
| Section 9.3 | 7001.3425, item D<br>Phase development plan | | | |
| Section 9.4, Appendix B | 7001.3425, item E<br>Cross-section plan | | | |
| previous applications/ n/a | 7001.3425, item F<br>Soils evaluation | | | |
| previous applications/ n/a | 7001.3425, item G<br>7035.2815, subp. 3(A to D)<br>Hydrogeological evaluation (extent to be determined by Commissioner) | | | |
| previous applications/ n/a | 7035.2815, subp. 3(E)<br>Phase I hydrogeologic evaluation | | | |
| previous applications/ n/a | 7035.2815, subp. 3(F)<br>Phase II hydrogeologic evaluation | | | |
| previous applications/ n/a | 7035.2815, subp. 3(G)<br>Phase II hydrogeologic evaluation report | | | |
| previous applications/ n/a | 7035.2815, subp. 3(H)<br>Phase III hydrogeologic evaluation | | | |
| previous | 7035.2815, subp. 3(I)(1) | | | |

| | | | | |
|---|---|---|---|---|
| applications/ n/a | Phase IV hydrogeologic evaluation work plan | | | |

| Document and page number | Minn. R. citation | MPCA use only | | |
|---|---|---|---|---|
| | | Completeness review | | Comments |
| | | Admin | Technical | |
| Section 3.5.2.4, Section 9.6, SAP (to be completed within 60 days of permit issuance) | 7035.2815, subp. 4<br>Groundwater performance standards | | | |
| Sdection 9.5 | 7001.3425, item H<br>Noise and access control methods | | | |
| Section 6.1 | 7001.3425, item I<br>Equipment list | | | |
| Section 9.6 | 7001.3425, item J<br>Groundwater monitoring system description | | | |
| Section 9.7 | 7001.3425, item K<br>Listing of required permits | | | |
| Section 10.1 | 7035.2535, subp. 1<br>Unacceptable wastes | | | |
| Section 10.2 | 7035.2535, subp. 3<br>Security | | | |
| Section 10.3 | 7035.2535, subp. 4<br>General inspection requirement | | | |
| Section 3.2, Section 10.4 and Appendix A | 7035.2535, subp. 5<br>Industrial solid waste management plan (ISWMP) | | | |
| Section 10.5 | 7035.2535, subp. 6<br>Household hazardous waste management plan | | | |
| Section 3.5 | 7035.2615<br>Contingency action plan | | | |
| Section 5 | 7035.2825, subp. 7<br>Location standards | | | |
| Appendix H | 7035.2825, subp. 8(A)<br>Site preparation specifications | | | |
| Appendix B | 7035.2825, subp. 8(B)<br>Phase development plans | | | |
| Section 4.1.8 | 7035.2825, subp. 8(C)<br>Surface water drainage control system | | | |
| Section 4.1.7 | 7035.2825, subp. 8(D)<br>Slopes and drainageways | | | |
| Section 4.1.7 and Appendix B | 7035.2825, subp. 8(E)<br>Final contours | | | |
| Section 6 | 7035.2825, subp. 9<br>Operation and maintenance plan | | | |
| previous applications/ n/a | 7035.2825, subp. 10<br>Hydrogeologic evaluation | | | |

| | | | | |
|---|---|---|---|---|
| Section 4.1.5 | 7035.2825, subp. 11<br>Cover system design | | | |
| Section 9.6 | 7035.2825, subp. 12<br>Water quality monitoring | | | |
| Section 4.5 | 7035.2825, subp. 13<br>Financial assurance (if required) | | | |
| Section 4 | 7035.2825, subp. 14<br>Closure and postclosure plan | | | |

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

# Industrial Waste Landfill Application Checklist

## Solid Waste Permit Program

*Doc Type: Permit Application*

**Purpose:** This checklist has been developed as a guide for permit application preparers and reviewers in order to assist with the submittal of a substantially complete permit application. Thoroughly review all applicable rules, statutes and guidance documents for further details and requirements. Minnesota Rules can be found at: https://www.revisor.mn.gov/rules/. All guidance documents can be found on the Minnesota Pollution Control Agency (MPCA) Solid Waste Publications webpage at: http://www.pca.state.mn.us/lupg880.

Many items listed below must be discussed in depth within the permit application submittal package. Be sure to include the most recently updated information, drawings and plans. Previously submitted documents **cannot** be referenced; all necessary documents must be included in this package. The permit application submittals should discuss all applicable MPCA Guidance Documents; include justification if the facility does not follow the guidance provided.

**Instructions for permit application preparers:** The following checklist must be completed and included with a permit application for all industrial waste land disposal facilities. In the table below, indicate in the far left column the name and page number(s) of the document where the specified rule requirement is addressed. If the rule requirement does not apply, please indicate with "n/a" for not applicable. **The permit application will be determined to be incomplete if there are any blank spaces in this column**.

| Document and page number | Minn. R. citation | MPCA use only | | |
|---|---|---|---|---|
| | | Completeness review | | Comments |
| | | Admin | Technical | |
| 1.1.6 | 7035.1700, items B and F<br>Minimum separation distances | | | |
| Appendix A | 7035.1700, item D<br>Daily and intermediate cover | | | |
| Section 4.1.8, Section 10.10 | 7035.1700, item E<br>Surface water drainage system | | | |
| Section 6.3 | 7035.1700, item H<br>Access roads | | | |
| Section 6.1 | 7035.1700, items J and K<br>Equipment | | | |
| Section 3.5.5, Section 3.6.5 | 7035.1700, item L<br>Communication facilities | | | |
| Section 3.2, Appendix A | 7035.1700, item O<br>Screening | | | |
| Section 9.5 | 7035.1700, item Q<br>Access control | | | |
| Section 9.6 | 7035.1700, item S<br>Water monitoring program | | | |
| Section 1.1.5, Section 3.6.3, Appendix B | 7035.1700, item T<br>Leachate collection system | | | |
| n/a | 7035.1700, item U<br>Gas management system | | | |
| Section 4.1.7, Appendix B | 7035.1700, item Y<br>Final contours | | | |
| Section 4.1.5, Appendix B | 7035.1700, item Y<br>Cover system design | | | |
| see forms | 7035.1800, item A<br>A completed permit application form | | | |

| Document and page number | Minn. R. citation | MPCA use only | | |
|---|---|---|---|---|
| | | Completeness review | | Comments |
| | | Admin | Technical | |
| Section 1.1, Section 3.1 | 7035.1800, item B(1)<br>General information | | | |
| previous applications/ n/a | 7035.1800, item B(2)<br>7035.2815, subp. 3(A to D)<br>Hydrogeological evaluation | | | |
| previous applications/ n/a | 7035.2815, subp. 3(E)<br>Phase I hydrogeologic evaluation | | | |
| previous applications/ n/a | 7035.2815, subp. 3(F)<br>Phase II hydrogeologic evaluation | | | |
| previous applications/ n/a | 7035.2815, subp. 3(G)<br>Phase II hydrogeologic evaluation report | | | |
| previous applications/ n/a | 7035.2815, subp. 3(H)<br>Phase III hydrogeologic evaluation | | | |
| previous applications/ n/a | 7035.2815, subp. 3(I)(1)<br>Phase IV hydrogeologic evaluation work plan | | | |
| Section 9.6 | 7035.2815, subp. 4<br>Groundwater performance standards | | | |
| Section 6 | 7035.1800, item B(3)<br>Operating procedures | | | |
| Section 6.1 | 7035.1800, item B(4)<br>Listing of equipment to be used | | | |
| Appendix B | 7035.1800, item C(1)<br>Existing conditions plan | | | |
| Appendix B | 7035.1800, item C(2)<br>Development plan | | | |
| Appendix B | 7035.1800, item C(3)<br>Engineering plans and drawings - cross section plan | | | |
| Section 3.1 | 7035.1800, item C(4)<br>Ultimate land use plan | | | |
| Section 4.5 | 7035.2665 to 7035.2805<br>Financial Assurance (if Required) | | | |

Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, MN 55155-4194

# Solid Waste Compost Facility Application Checklist

**Solid Waste Permit Program**

Mixed Municipal Solid Waste (MSW)

*Doc Type: Permit Application*

**Purpose:** This checklist has been developed as a guide for permit application preparers and reviewers in order to assist with the submittal of a substantially complete permit application. Thoroughly review all applicable rules, statutes and guidance documents for further details and requirements. Minnesota Rules can be found at: https://www.revisor.mn.gov/rules/. All guidance documents can be found on the Minnesota Pollution Control Agency (MPCA) Solid Waste Publications webpage at: http://www.pca.state.mn.us/lupg880.

Many items listed below must be discussed in depth within the permit application submittal package. Be sure to include the most recently updated information, drawings and plans. Previously submitted documents **cannot** be referenced; all necessary documents must be included in this package. The permit application submittals should discuss all applicable MPCA Guidance Documents; include justification if the facility does not follow the guidance provided.

**Instructions for permit application preparers:** The following checklist must be completed and included with a permit application for all solid waste compost facilities. In the table below, indicate in the far left column the name and page number(s) of the document where the specified rule requirement is addressed. If the rule requirement does not apply, please indicate with "n/a" for not applicable. **The permit application will be determined to be incomplete if there are any blank spaces in this column**.

| Document and page number | Minn. R. citation | MPCA use only | | |
|---|---|---|---|---|
| | | Completeness review | | Comments |
| | | Admin | Technical | |
| Section 8 | 7001.3375, item A<br>Description of area for each stage of the composting process | | | |
| Section 8 | 7001.3375, item B<br>Description of design and features of the facility, including run-off, run-on, and leachate control systems | | | |
| Section 8 | 7001.3375, item C<br>Description of material(s) to be composted | | | |
| Section 8 | 7001.3375, item D<br>Description of the residue's composition | | | |
| Section 8 | 7001.3375, item E<br>Description of residue disposal method | | | |
| Section 8 | 7001.3375, item F<br>Design of odor control system | | | |
| n/a | 7001.3375, item G<br>Design and performance specifications | | | |
| n/a | 7001.3375, item H<br>Description of composting method, including retention time, temperature, number of turns and air flow design | | | |
| Section 6 | 7001.3375, item I<br>Operating plan and waste analysis plan | | | |
| Section 8 | 7001.3375, item J<br>Description of the proposed uses for the compost | | | |
| Section 8 | 7035.2836, subp. 4(A)<br>Site preparations specifications | | | |

| Document and page number | Minn. R. citation | MPCA use only | | |
|---|---|---|---|---|
| | | Completeness review | | Comments |
| | | Admin | Technical | |
| Section 8, Section 9.5 | 7035.2836, subp. 4(B) Facility access plan | | | |
| Section 8 | 7035.2836, subp. 4(C) Surface water management | | | |
| n/a | 7035.2836, subp. 4(D) The composting, curing, and storage area liners | | | |
| n/a | 7035.2836, subp. 4(E) Leachate collection and treatment system | | | |
| Section 8 | 7035.2836, subp. 4(F) Residual management | | | |
| Section 8 | 7035.2836, subp. 4(G) Odor control design | | | |
| | 7035.2836, subp. 5(A) Secured access | | | |
| | 7035.2836, subp. 5(B) Personnel training program | | | |
| Section 8 | 7035.2836, subp. 5(C) Designated delivery area | | | |
| Section 8 | 7035.2836, subp. 5(D) Recyclable materials management | | | |
| Section 8 | 7035.2836, subp. 5(E) Residuals management | | | |
| n/a | 7035.2836, subp. 5(F) Leachate management | | | |
| Section 8 | 7035.2836, subp. 5(G) Odor control | | | |
| n/a | 7035.2836, subp. 5(H) Wind control | | | |
| n/a | 7035.2836, subp. 5(I) PFRP method | | | |
| n/a | 7035.2836, subp. 5(J)(1) Testing plan for compost maturity | | | |
| n/a | 7035.2836, subp. 5(J)(2) Metals analysis | | | |
| n/a | 7035.2836, subp. 5(J)(3) Percent inert material analysis | | | |
| n/a | 7035.2836, subp. 5(J)(4) Testing plan for pH, moisture content, particle size, NPK ratio, and soluble salt content | | | |
| n/a | 7035.2836, subp. 5(J)(5)(a) Training and experience of person collecting samples | | | |
| n/a | 7035.2836, subp. 5(J)(5)(b) Equipment used to collect, process and store samples | | | |
| n/a | 7035.2836, subp. 5(J)(5)(c) Equipment cleaning procedures | | | |

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|---|---|---|---|---|
| | | Completeness review | | Comments |
| | | Admin | Technical | |
| n/a | 7035.2836, subp. 5(J)(5)(d) Sample collection locations | | | |
| n/a | 7035.2836, subp. 5(J)(5)(e) Grab sample procedures | | | |
| n/a | 7035.2836, subp. 5(J)(5)(f) Composite sample procedures | | | |
| n/a | 7035.2836, subp. 5(J)(5)(g) Chain-of-custody and storage procedures | | | |
| n/a | 7035.2836, subp. 5(J)(5)(h) Sampling QA/QC | | | |
| n/a | 7035.2836, subp. 6 Compost classification and description of how results will determine distribution | | | |
| n/a | 7035.2836, subp. 7(A) Registration with MN Department of Agriculture | | | |
| Section 8 | 7035.2836, subp. 7(B) Allowable end uses | | | |
| Section 8 | 7035.2836, subp. 7(C) Compost distribution | | | |

| Page Number | Minn. R. citation | Requirement | MPCA use only | |
|---|---|---|---|---|
| | | | Completeness Review | Technical Review |
| N/A | | plant, system, or facility has not been in operation for this period, then the financial statements and analysis must be based on the most complete data available); | | |
| N/A | 7000.7000, sub. 2.F. | *if seeking a variance on grounds that compliance is not technologically feasible*:<br><br>a report from a registered professional engineer, or other person acceptable to the agency, stating fully the reasons why compliance is not technologically feasible; | | |
| Section 1.1.6 | 7000.7000, sub. 2.G. | other additional data or information that is required by any applicable agency rule or standard; | | |
| Section 2.1 | 7000.7000, sub. 2.H(1) | a general description of the materials handled or processed by the applicant that are pertinent to the subject application; | | |
| Section 2.1 | 7000.7000, sub. 2.H(1) | a statement of the nature and quantity of the materials being discharged, emitted, or disposed of, and that can reasonably be expected to be discharged, emitted, or disposed of during the period of the proposed variance, | | |
| Section 2.3 | 7000.7000, sub. 2.H(1) | proposed methods for the control of the materials listed above; | | |
| N/A | 7000.7000, sub. 2.H(2) | a comprehensive proposed plan indicating the steps to be taken by the applicant during the period of the variance, even if the applicant is seeking a permanent variance, to reduce emission levels or discharges to the lowest limits practical; | | |
| Section 1.1.6 | 7000.7000, sub. 2.H(3) | a concise statement of the effect upon the air, water, and land resources of the state and upon the public and other persons affected, including those residing in the area where the variance will take effect, which will result from board or commissioner approval of the requested variance; | | |
| Section 1.1.6 | 7000.7000, sub. 2.H(4) | a statement of the alternatives to the proposed operation under the variance which have been considered by the applicant; | | |
| Section 1.1.6 | 7000.7000, sub. 2.H(5) | a concise statement of the effect on the establishment, maintenance, operation, and expansion of business, commerce, trade, traffic, and other economic factors that may result from approval and from denial of the requested variance. | | |

| Page Number | Minn. R. citation | Requirement | MPCA use only | |
|---|---|---|---|---|
| | | | Completeness Review | Technical Review |
| see report | 7000.7000, sub. 2.H. | any other relevant data or information that the commissioner deems essential to a determination on the application. | | |