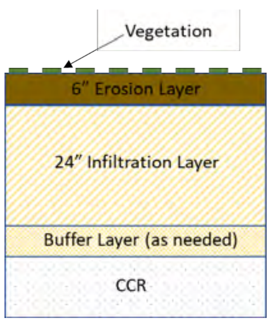
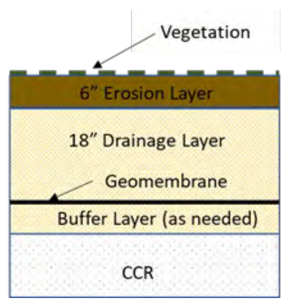
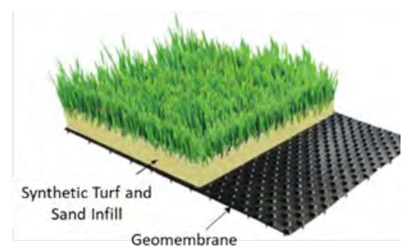
CLOSURE PLAN FOR EXISTING CCR UNIT
40 CFR 257.102 (b)

SITE INFORMATION			
Site Name / Address	DTE Energy Sibley Quarry Landfill / 801 Fort Street, Trenton, MI		
Owner Name / Address	DTE Electric Company / One Energy Plaza, Detroit, MI 48226		
CCR Unit	Landfill	Final Cover Type(s)	1) Clayey Soil Cover 2) Geomembrane and Soil Cover 3) ClosureTurf® or Approved Alternate Synthetic Cover System
Reason for Initiating Closure	Areas Filled to Permitted and/or Interim Final Grade	Closure Method	Close In-Place

CLOSURE PLAN DESCRIPTION	
(b)(1)(i) – Narrative description of how the CCR unit will be closed in accordance with this section. (b)(1)(ii) – Not Applicable.	The CCR material at the landfill will be closed in-place. The final cover will be sloped to promote drainage and the stormwater runoff will be discharged through the existing NPDES permitted outfall. Closure operations will involve: (i) placing and grading fill to create acceptable grades for closure and (ii) installation of final cover. The existing quarry bedrock side walls which laterally contain the CCR material will remain intact and the final cover system will abut the side walls where side walls rise above final cover elevation. In accordance with 257.102(b)(3), this written closure plan amends the initial closure plan, to provide additional details for planned CCR grading and cover system construction. This closure plan reflects information and closure plans currently available.
(b)(1)(iii) – If closure of the CCR unit will be accomplished by leaving CCR in place, a description of the final cover system and methods and procedures used to install the final cover.	CCR material and fill will be placed and graded as needed to achieve design grades. The final cover system will be installed in direct contact with graded CCR or fill and will include one of three alternate cover systems. • Cover System 1 includes: 1) a minimum of 24" of compacted earthen material with a permeability of equal or less than $1x10^{-7}$ cm/sec; 2) a minimum of 6" of soil capable of sustaining native plant growth; and 3) surface vegetation of select grasses. • Cover System 2 includes: 1) a low permeability geomembrane cover layer; 2) an 18" drainage layer; 3) a minimum of 6" of soil capable of sustaining native plant growth; and 4) surface vegetation of select grasses. • Cover System 3 includes: 1) a low permeability geomembrane cover layer; and 2) ClosureTurf® or approved alternate synthetic cover system. The final cover slope will be a minimum of 2% and will be graded to convey stormwater runoff to discharge through the existing NPDES permitted outfall. Drainage features such as berms and ditches will be superimposed on the 2% and greater cover slopes, and will have slopes of 0.25% and greater, as needed to achieve overall drainage objectives while managing surface water runoff flow velocities.
(b)(1)(iii) – How the final cover system will achieve the performance standards in 257.102(d).	
(d)(1)(i) Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere.	The permeability of compacted earthen final cover infiltration layer material will be equal to or less than $1x10^{-7}$ cm/sec. Geomembrane final cover will be nearly impermeable. The final cover will be graded with a minimum 2% slope with drainage features such as berms and ditches with slopes of 0.25% and greater superimposed on the 2% and greater cover slopes, as needed to achieve overall drainage objectives while managing surface water runoff flow velocities.
(d)(1)(ii) – Preclude the probability of future impoundment of water, sediment, or slurry.	The unit is and will continue to be dewatered via pumping from the sump at the base of the Quarry, thus maintaining water level below the limits of CCR. The final cover will be installed with a minimum 2% slope and with drainage berms and ditches sloped at a minimum of 0.25% as needed to convey surface runoff.
(d)(1)(iii) – Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period.	The final cover will have a maximum slope of 4-horizontal to 1-vertical (4H:1V). Final slope of the cover will meet the stability requirements to prevent sloughing or movement of the final cover system.

<table>
<tr><td>(d)(1)(iv) – Minimize the need for further maintenance of the CCR unit.</td><td colspan="2">The final cover will be vegetated or utilize ClosureTurf (or approved alternate synthetic cover system) to minimize erosion and maintenance.</td></tr>
<tr><td>(d)(1)(v) – Be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices.</td><td colspan="2">Closure design and construction phasing will be performed in a manner to complete closure in the shortest amount of time consistent with recognized and generally accepted good engineering practices.</td></tr>
<tr><td>(d)(3) – A final cover system must be installed to minimize infiltration and erosion, at minimum meet the requirements of (d)(3)(i), or as an alternative meet the requirements of (d)(3)(ii).</td><td colspan="2">The final cover will consist of Cover System 1 or 2, to meet the requirements of (d)(3)(i), or Cover System 3 to meet the requirements of (d)(3)(ii), all as noted below. All three cover system designs minimize infiltration and erosion.</td></tr>
<tr><td>(d)(3)(i) – The design of the final cover system must be included in the written closure plan.</td><td colspan="2">Final cover system designs are described herein and shown below. The landfill is closed in increments as fill areas are completed to final grade and/or when fill areas will not receive additional CCR for an extended period (interim final grade). Closure plans and specifications are prepared as needed for each phase of closure.</td></tr>
<tr><td>Cover System 1 – Soil Cover</td><td>Cover System 2 – Geomembrane and Soil Cover</td><td>Cover System 3 – ClosureTurf® (or approved alternate synthetic cover system – optional Buffer Layer, and underlying CCR not shown)</td></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
<tr><td>(d)(3)(i)(A) – The permeability of the final cover system must be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than $1x10^{-5}$ cm/sec, whichever is less.</td><td colspan="2">The permeability of the final cover will be no greater than $1x10^{-7}$ cm/sec. This will be verified during construction per the construction quality assurance (CQA) plan associated with each increment of closure.</td></tr>
<tr><td>(d)(3)(i)(B) – The infiltration of liquids through the closed CCR unit must be minimized using an infiltration layer that contains a minimum of 18 inches of earthen material.</td><td colspan="2">Cover System 1 includes a minimum 24” of compacted earthen material with a permeability no greater than $1x10^{-7}$ cm/sec (infiltration layer). Cover Systems 2 and 3 include a nearly impermeable geomembrane hydraulic barrier layer.</td></tr>
<tr><td>(d)(3)(i)(C) – The erosion of the final cover system must be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.</td><td colspan="2">Cover Systems 1 and 2 include a minimum 6” of a soil erosion layer that is capable of sustaining native plant growth (erosion layer) to minimize erosion. Cover System 3 utilizes synthetic turf to prevent erosion.</td></tr>
<tr><td>(d)(3)(i)(D) – The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.</td><td colspan="2">The final cover will be installed with a minimum 2% slope to accommodate potential settling and subsidence. If settling and subsidence occurs, areas where cover performance is degraded as a result will be repaired.</td></tr>
<tr><td>(d)(3)(ii) – The owner or operator may select an alternative final cover system design, provided the alternative final cover system is designed and constructed to meet the criteria in paragraphs (d)(3)(ii)(A) through (C).</td><td colspan="2">Cover System 3 is an alternative final cover system designed to meet the requirements of paragraphs (d)(3)(ii)(A) through (C). A demonstration of Cover System 3 equivalence with rule requirements is attached to this Closure Plan.</td></tr>
</table>

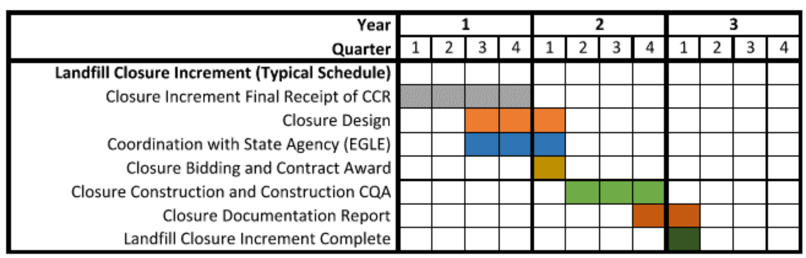
(d)(3)(ii)(A) The design of the final cover system must include an infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraphs (d)(3)(i)(A) and (B) of this section.	Cover System 3 utilizes an alternate infiltration layer consisting of a geomembrane hydraulic barrier of performance equal to or greater than that specified in (d)(3)(i)(A) and (B). As with Cover System 2, the permeability of Cover System 3 will be no greater than 1x10^{-7} cm/sec through use of a nearly impermeable geomembrane hydraulic barrier layer.
(d)(3)(ii)(B) The design of the final cover system must include an erosion layer that provides equivalent protection from wind or water erosion as the erosion layer specified in paragraph (d)(3)(i)(C) of this section.	Cover System 3 utilizes an alternate erosion layer consisting of synthetic turf of performance equal to or greater than that specified in (d)(3)(i)(C). Cover System 3 design utilizes the Design Guidance Manual for Closure Turf Final Cover Systems (Closure Turf®, February 2023) to establish sand infill thickness to resist wind uplift, and slope geometry to resist erosion from surface water runoff. The system design is depicted in the figures presented in this Closure Plan. Phase-specific construction plans and design computations will be prepared to address the unique conditions of each closure increment, with copies available upon request.
(d)(3)(ii)(C) The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.	Cover System 3 will, when used, be installed with a minimum 2% slope to accommodate potential settling and subsidence, with drainage berms and ditches sloped at a minimum of 0.25% as needed to convey surface runoff. The geomembrane and other components of the Closure Turf® system can undergo significant strain without detrimental effects on system performance. If settling and subsidence occurs, areas where cover performance is degraded as a result will be repaired.

INVENTORY AND AREA ESTIMATES	
(b)(1)(iv) – Estimate of the maximum inventory of CCR ever on-site over the active life of the CCR unit.	19,155,000 cubic yards
(b)(1)(v) – Estimate of the largest area of the CCR unit ever requiring a final cover.	188 acres

CLOSURE SCHEDULE

(b)(1)(vi) – Schedule for completing all activities necessary to satisfy the closure criteria in this section, including an estimate of the year in which all closure activities for the CCR unit will be completed. The schedule should provide sufficient information to describe the sequential steps that will be taken to close the CCR unit, including major milestones …and the estimated timeframes to complete each step or phase of CCR unit closure.

The milestones and the associated timeframes presented herein are current estimates. Amendments to the milestones and timeframes will be made periodically as CCR placement in the landfill continues and as additional increments of the landfill are ready for closure.

Initial Written Closure Plan Placed in Operating Record	October 17, 2016
Written Closure Plan Amended and Placed in Operating Record	November 13, 2023
Typical Closure Schedule Per Increment of Closure	
Estimate of Year in Which all Closure Activities Will be Completed	The year in which all closure activities will be completed is dependent on the date on which DTE's Monroe Power Plant ceases coal-fired operations. Current projections show cessation of Monroe coal-fired operations approximately year-end 2032. Application of the typical closure schedule (per increment of closure as presented above) to the Monroe cessation of coal-fired operations approximation yields an estimated year of 2034 when all closure activities will be completed. This is an approximation and will require periodic review and confirmation.

Certification by qualified professional engineer appended to this plan.

Certification Statement 40 CFR § 257.102(b){4}- Written Closure Plan for a CCR Landfill

CCR Unit: DTE Energy Sibley Quarry Landfill

I, Thomas J. Radue, being a Registered Professional Engineer in good standing in the State of Michigan, do hereby certify, to the best of my knowledge, information, and belief, that the information contained in this closure plan has been prepared in accordance with the accepted practice of engineering and that the information contained in this written closure plan dated November 13, 2023 meets the requirements of 40 CFR § 257.102.

Thomas J. Radue

Printed Name

MI PE Seal

November 13, 2023

Date

Closure Turf Equivalency Demonstration

DTE Sibley Quarry

Prepared for
DTE Electric Company

November 13, 2023

3005 Boardwalk Street, Suite 100
Ann Arbor, MI 48108
734.922.4400
www.barr.com

Certification

I hereby certify that this Plan 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 Michigan.

Thomas J. Radue

Name

November 13, 2023

Date

MI PE Seal

Closure Turf Equivalency Demonstration

DTE Sibley Quarry

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Abbreviations

Abbreviation	Term/Phrase/Name
Barr	Barr Engineering Michigan, LLC
CFR	Code of Federal Regulations
DTE	DTE Energy
GSI	Geosynthetic Institute
HDPE	High Density Polyethylene
HELP	Hydrologic Evaluation of Landfill Performance
LLDPE	Linear Low Density Polyethylene
psf	Pounds per Square Foot
RTCE	Rubber-Tired Construction Equipment
SGI	SGI Testing Services, LLC (Lilburn, GA)

1 Project Description

DTE Electric Company (DTE) is undertaking incremental closure of the Sibley Quarry, located at 803 Fort Street in Trenton, Michigan. Some closure areas will utilize synthetic ClosureTurf® (hereafter ClosureTurf), as an alternative to typical compacted soil or soil and flexible geomembrane cover systems. This document, prepared by Barr Engineering Michigan, LLC (Barr), demonstrates ClosureTurf performance equivalency with the alternative final cover design and construction requirements of the Federal Standards for Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments (Federal CCR Rules) per 40 CFR §257.102(d)(3)(ii).

Although a number of solid waste facilities, including coal combustion residuals (CCR) storage facilities, have successfully utilized final cover systems consisting of synthetic turf, the Federal CCR Rules do not contain detailed requirements for these types of systems, unlike for compacted soil or soil and flexible geomembrane cover systems. Instead, final cover systems utilizing alternative materials must demonstrate equivalency with the rules. A description of ClosureTurf follows, and Section 2.0 presents the rules that serve as the basis for the ClosureTurf cover equivalency comparisons made in Section 3.0.

1.1 ClosureTurf Description

The ClosureTurf system is shown on Figure 1-1. ClosureTurf is the name of the Watershed Geo company patented system planned for use by DTE.

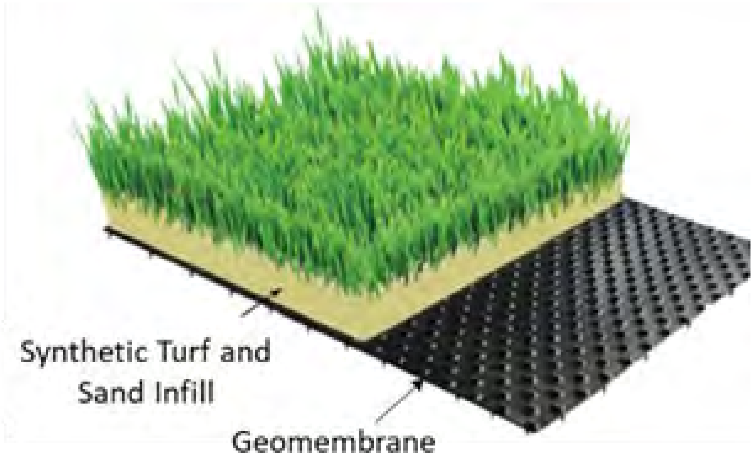


Figure 1-1 ClosureTurf – Typical Profile (shown with MicroSpike® Geomembrane)

The ClosureTurf system utilizes the following layers (from top to bottom):

- ClosureTurf® Synthetic Turf (1.25 inches high typical)
- Specified Infill that meets the criteria for use with ClosureTurf (0.5 inches of sand typical)
- 40-mil Linear Low Density Polyethylene (LLDPE) MicroSpike® (MicroSpike) Geomembrane (Figure 1-2) on 2% slope areas, and 50-mil LLDPE Super Gripnet® (Super Gripnet) Geomembrane (Figure

1-3) on 25% (4H:1V) slope areas. Both geomembranes provide a textured geomembrane interface with overlying and underlying materials, with more substantial texturing via spikes on the Super Gripnet to produce the greater interface shear required on 4H:1V slope areas. The Super Gripnet surface also provides integrated subsurface drainage via its surface geometry to more readily transmit any subsurface water flow downslope.

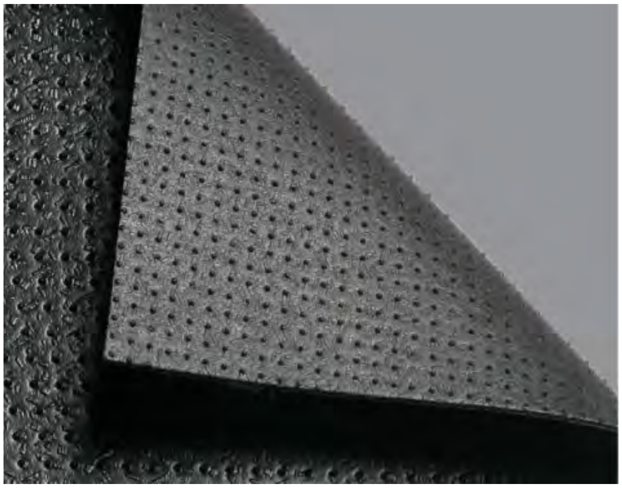
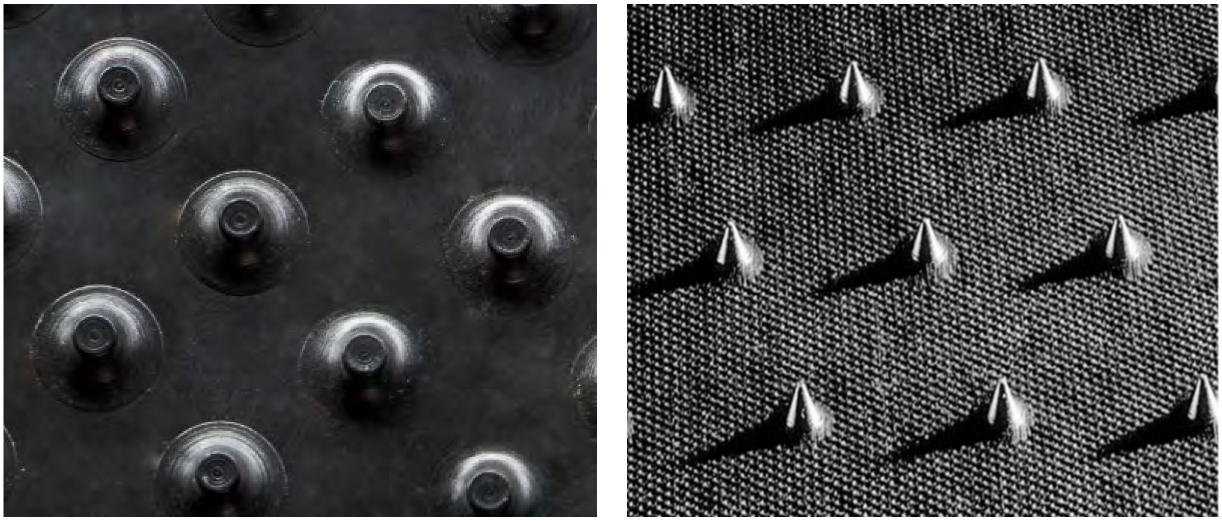


Figure 1-2 MicroSpike® Geomembrane (2% Slope Areas)



Drainage Surface (Top Side of Geomembrane) **Grip Surface (Bottom Side of Geomembrane)**

Figure 1-3 Super Gripnet® Geomembrane (25% Slope Areas)

Typical installation sequence for the ClosureTurf is as follows:

- Grading of the surface to be covered as needed to establish cover area design grades.
- Preparation of the closure area surface by final grading and compacting to achieve a smooth uniform surface resistant to rutting by vehicle traffic and acceptable for geomembrane placement.
- Geomembrane panel installation, seaming and quality control testing.
- Synthetic turf placement.
- Specified infill placement atop the synthetic turf.

The cover designs typically include various ditches, berms, and culverts for stormwater runoff control and routing, to transmit stormwater off the area of closure.

1.2 ClosureTurf Equivalency with Regulatory Requirements for Standard Cover Systems

Section 2.0 describes the Federal requirements applicable to closure of CCR fill areas at Sibley Quarry. Section 3.0 demonstrates ClosureTurf equivalence with the regulatory requirements for standard cover systems, contained in Federal CCR Rules under 40 CFR 257. ClosureTurf equivalence with regulatory requirements for standard cover systems is demonstrated on the following aspects of closure system performance:

- Stormwater Management
- Minimization of Erosion
- Minimization of Infiltration
- Presence of Protective Layer
- Settlement and Subsidence

The Protective Cover Layer section addresses the following aspects of ClosureTurf performance:

- Wind Uplift
- Wind Erosion
- Ultraviolet Light (UV) Stability
- Freeze/Thaw Effects
- Drivability and Stability

The demonstrations provided herein fully demonstrate that ClosureTurf will perform in a manner that is as protective of human health and the environment as is the rule-prescribed cover system.

2 Federal CCR Rule Cover System Requirements

Federal regulations, summarized below, prescribe the configuration and/or performance requirements for cover systems utilized for CCR Unit closure. The ClosureTurf cover system that may be used for portions of the DTE Sibley Quarry closure constitutes an alternative final cover. It's performance must be equal to or better than that of the rule-prescribed cover system – performance equivalence is demonstrated in this report. WaterShed Geo has previously commissioned independent tests of and analyses of ClosureTurf performance. Where applicable in this demonstration, reports presenting those independent tests and analyses are utilized for this demonstration in lieu of performing duplicative tests and analyses.

The design and construction requirements for an alternative final cover system are described in 40 CFR §257.102(d)(3)(ii), the applicable final cover system requirements of which are listed below, followed by identification of the section of this document used to demonstrate ClosureTurf equivalency or compliance.

A. The design of the final cover system must include an infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraphs §257.102 (d)(3)(i)(A) and (B) of this section.

   - §257.102 (d)(3)(i)(A) states - The permeability of the final cover system must be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1×10^{-5} cm/sec, whichever is less.

     A comparison of hydraulic conductivities and overall infiltration of the natural subsoil to the alternative final cover infiltration is provided in Section 3.3.

   - (d)(3)(i)(B) states - The infiltration of liquids through the closed CCR unit must be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.

     Sections 3.2 through 3.4 provide descriptions of the ClosureTurf alternative to use of earthen materials and the infiltration equivalency demonstration.

B. The design of the final cover system must include an erosion layer that provides equivalent protection from wind or water erosion as the erosion layer specified in §257.102(d)(3)(i)(C).

   - (d)(3)(i)(C) states - The erosion of the final cover system must be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

     The proposed alternative final cover system does not contain a component capable of supporting native plant growth because the synthetic turf provides the protective role of vegetation and stabilizes the sand infill, which protects the geosynthetic layers below. The synthetic turf functions as a protective layer to the geomembrane. The synthetic turf's ability to withstand erosion is demonstrated in Section 3.2.

C. The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.

The accommodation of settling and subsidence is discussed in Section 3.5.

Cover system performance using the ClosureTurf alternative is shown in Section 3.0 to be as protective of human health and the environment as the cover system prescribed in Federal regulations.

3 Cover System Performance

The following sections demonstrate equivalency of the ClosureTurf cover system with the Federal rules applicable to CCR management at Sibley Quarry. Portions of this demonstration cite content in the February 2023 WaterShed Geo Design Guidance Manual for ClosureTurf® Final Cover Systems, particularly where WaterShed Geo has retained and reported the results from reputable engineering firms and/or researchers.

3.1 Stormwater Management

Capping of CCR placed at Sibley Quarry generally entails grading the closure areas to provide a minimum final closure slope of 2-percent, with a maximum final closure slope of 25-percent (4H:1V). Surface water runoff from closure areas flows overland to the chimney drain for removal from the quarry. Drainage berms and ditches are placed as needed to intercept and direct runoff.

Final cover systems at the quarry are modeled in HydroCAD to determine adequate sizing of the stormwater conveyance features, which consist of drainage ditches and culverts. The purpose of performing these calculations is to determine the sizing of these stormwater features and to verify the flow velocities are not detrimental to the final cover or the features themselves. The storm event selected for design of closure area stormwater runoff control features typically is the 25-year 6-hour event, which totals 3.17 inches of precipitation and yields a higher design flow rate than the 25-year 24-hour event. Closure area ditch sizing and culvert sizing are based on the HydroCAD model outcomes. The berms and ditches establish the surface water runoff paths and flow distances, which in turn affect erosion control as subsequently described.

3.2 Minimization of Erosion

There are two potentially erodible components of the ClosureTurf system:

- Sand infill used as ballast over most of the turf area.
- HydroBinder® used in high velocity flow areas such as drainage ditches.

In concept sand infill and HydroBinder materials could erode due to surface water runoff, and in concept the sand infill could erode due to wind. To evaluate resistance of the sand infill and HydroBinder to erosion by surface water runoff, the hydraulic stability analysis methods recommended by ClosureTurf in their 2023 Design Guidance Manual (Watershed Geo, 2023) are followed. ClosureTurf does not contain a component capable of supporting native plant growth, nor does it contain an erosion layer consisting of six inches of earthen material. However, the synthetic turf component of ClosureTurf is designed to perform the protective role of vegetation and stabilize the sand infill and HydroBinder, which in turn protects the geosynthetic layer below. These are alternative materials used to accomplish the same goal as the erosion layer required by the Federal rules.

Per the ClosureTurf Design Guidance Manual, to mitigate erosion of the sand infill and HydroBinder due to surface water runoff, the hydraulic shear stress must be managed via the proper configuration of slopes and maximum flow lengths throughout the final cover system. The final cover system at Sibley Quarry will use crest of slope berms and toe of slope ditches to intercept runoff and limit the maximum flow length in any given closure area. The hydraulic shear stress is calculated for the primary flow paths of the closure configuration using the methods outlined in the ClosureTurf Design Guidance Manual. The computed hydraulic shear stress for each flow path is compared to the manufacturer's recommended maximum shear stress to evaluate the likelihood of erosion of the sand infill and HydroBinder.

Using independent third-party laboratory testing of ClosureTurf, Watershed Geo determined that to prevent erosion of sand infill, the hydraulic shear stress should remain at or below 0.8 psf. This is based on a hydraulic shear stress of 1.5 psf, determined by the testing laboratory to be the hydraulic shear stress at which mobilization of the sand infill begins. Employing a factor of safety of almost two, as recommended by Watershed Geo, the Sibley Quarry ClosureTurf cover areas will be configured to achieve a hydraulic shear stress at or below 0.8 psf where sand infill is used. If the calculated maximum hydraulic shear stress were greater than 0.8 psf, mitigation options would include one or more of the following: flattening the slope, shortening drainage lengths (e.g., addition of a drainage bench or swale), and using infill with a higher permissible shear stress (e.g., HydroBinder®). HydroBinder provides far greater erosion resistance than sand infill, with a permissible hydraulic shear stress of 8.8 psf. HydroBinder is used in ditches where flow velocities and resulting shear stresses exceed allowable shear stresses for sand infill.

The closure area geometry and stormwater runoff controls will be designed to maintain maximum hydraulic shear stresses below the stresses that would mobilize sand infill and HydroBinder materials and erosion will therefore be minimized from the ClosureTurf cover system. Therefore, the synthetic turf and sand infill will provide an equivalent or better degree of protection than is prescribed by 40 CFR §257.102 (d)(3)(i)(C). If some erosion of sand infill did occur, then periodic maintenance would be performed to reestablish the specified infill thickness.

Wind is another erosive force that can sometimes mobilize fine grained soil particles, making them airborne and a potential nuisance on and off site. Wind erosion problems can develop when one or more of the following conditions exist:

- Long uninterrupted ground surfaces exposed to high wind.
- Small soil particles exposed on the ground surface, particularly if particles are fine sand, silt or non-cohesive clay size particles.
- Dry ground surface.
- Ground surface subject to mechanical disturbance (e.g., repeated vehicle traffic).
- Exposed ground surface (absence of vegetation).

For natural soil and typical soil-geomembrane based closure systems, wind erosion is prevented by establishment of a vegetated cover. For ClosureTurf, the synthetic grass establishes an artificial vegetated cover, thereby protecting the sand infill from wind erosion. The HydroBinder binds (cements) the infill soil particles together. Areas that utilize HydroBinder would not be susceptible to wind erosion.

3.3 Minimization of Infiltration

To demonstrate equivalency with 40 CFR §257.102(d)(3)(i)(B), infiltration through the ClosureTurf alternative final cover system was compared to that of the rule-prescribed final cover system with a geomembrane component, which through use of a geomembrane, is more robust when compared to the rule-prescribed 18-inch infiltration layer cover system. By demonstrating that the ClosureTurf system yields a lower infiltration than the rule-prescribed cover system, it is evident that the ClosureTurf system will minimize infiltration to the extent necessary to protect the public health and the environment.

The Hydraulic Evaluation of Landfill Performance (HELP) model was used to estimate water infiltration through the alternative final cover system, and through the rule-prescribed system with geomembrane for comparison. Attachments A-1 and A-2 include summary pages from the HELP Model results. A 100-year period was used to model infiltration through each cover system.

- Attachment A-1: Typical Geomembrane Cover System
- Attachment A-2: ClosureTurf Cover System

Climate and weather data used in the HELP models was compiled for a 100-year period in the Sibley Quarry area using data from national databases defined in the HELP Model User Manual along with the synthetic weather generator in the HELP software. The evaporative zone depth was chosen to be the depth to the geomembrane for the ClosureTurf system, and the depth to the lateral drainage layer (12-inches in this case), for the geomembrane and soil cover system. The modeling parameters of the various final cover/natural soils layers were obtained using HELP default values, supplemented by product-specific data recommended by Watershed Geo and site-specific data for Sibley Quarry.

The HELP Model layers representing the ClosureTurf alternative final cover system are listed below. Details on the hydraulic conductivity and other parameters for each layer are provided in the HELP model report excerpts in Attachment A-2.

- Protective Cover Layer – Engineered Turf with Specified Infill Vertical Percolation Layer (0.5 inches of sand)
- Drainage Layer – Microdrain® Lateral Drainage Layer (0.13 inches thick)
- Flexible Membrane Liner - 50 mil LLDPE Geomembrane
- Waste Layer - Assumed 50 feet of Dense Fly Ash Waste

For comparing the ClosureTurf final cover system to the rule-prescribed cover system, the flattest possible slope configuration for the cover area was selected for HELP modeling, consisting of a 2-percent slope area. The HELP model estimates infiltration based on runoff flow length and slope angle and on geomembrane defects. The closure area cover systems were modeled with 2 pinhole defects per acre, 2 holes per acre, and good geomembrane placement quality. Model outcomes are reported as the amount (inches) and as the percent of total precipitation estimated to infiltrate the cover. Whether a 20-acre area or 25-acre area (for example) are modeled, they will yield comparable estimates of infiltration if both model the same slope angle and similar slope lengths. For a conservative comparison, ClosureTurf was modeled with a 300-foot slope length and the rule-prescribed cover was modeled with a 200-foot slope.

The HELP Model layers representing the rule-prescribed final cover system with geomembrane atop the CCR was modeled to reflect the system as it would typically be designed and constructed, as follows:

- Vegetated Rooting Zone Cover Soil – 12" Vertical Percolation Layer
- Protective Cover Layer – 12" Sand Lateral Drainage Layer
- Flexible Membrane Liner – 40 mil LLDPE Geomembrane Infiltration Layer
- Waste Layer – Assumed 50 feet of Dense Fly Ash Waste

For ease of construction and protection of the geomembrane in this cover system, a 12-inch sand layer (lateral drainage layer) would be placed atop the geomembrane, with the sand layer covered by a minimum 12-inch rooting zone soil capable of sustaining vegetation. This is the system evaluated and compared to ClosureTurf using the HELP model. The model assumes 50 feet of dense fly ash waste below the geomembrane.

The HELP Model layers representing the ClosureTurf final cover system were as follows:

- Engineered Turf and Sand Infill – Vertical Percolation Layer
- Studded Layer of Super Gripnet Geomembrane – Lateral Drainage Layer
- Flexible Membrane Liner – 50 mil LLDPE Geomembrane Infiltration Layer
- Waste Layer – Assumed 50 feet of Dense Fly Ash Waste

The geomembrane defect frequency and installation quality selected for the 40-mil geomembrane of the typical geomembrane-based cover system and for the ClosureTurf cover system were equivalent – there were no differences between them for the HELP modeling performed and reported herein.

The resulting infiltration estimated by the HELP Model is provided in Table 3-1.

Table 3-1 HELP Model Infiltration Results

Table Heading	Slope (%)	Area Modeled (acres)	Total Annual Precipitation (in)[1]	100-Year Average Annual Infiltration (in)	100-Year Average Annual Infiltration (%)
Rule-Prescribed Cover System with Geomembrane	2%	20	33.06	0.034	0.10
ClosureTurf® Alternative Cover System	2%	20	32.89	0.001	0.00

Note(s):

(1) Total annual precipitation estimates are synthetically generated by the HELP model and reported to 2 decimal places. The 0.17-inch differential shown above for precipitation occurring at the same latitude and longitude is due to this synthetic generation of rainfall estimates.

Both cover system designs prevent the build-up of any significant hydraulic head atop the cover system, thereby substantially reducing the potential for leakage through a good quality geomembrane-based cover system – there is virtually no hydraulic head so no water available and no driving force to induce infiltration through a good quality (limited defects) geomembrane-based cover system.

The ClosureTurf® system is, by virtue of its thinness and limited capability for water storage, more effective at preventing build-up of hydraulic head atop the geomembrane cover and therefore even more effective at limiting infiltration than is the rule-prescribed cover with geomembrane plus soil cover system. According to the HELP model results, the lowest annual average infiltration is from the alternative ClosureTurf final cover system, thus exceeding the infiltration performance of the rule-prescribed final cover system with geomembrane, which meets the requirements of the Federal rules. Therefore, 40 CFR §257.102(d)(3)(i)(A) is satisfied. Based on these results, the ClosureTurf® alternative final cover system has more restrictive infiltration properties than is required by Federal requirements.

3.4 Presence of Protective Layer

The Federal rules require that the infiltration layer be protected, typically by placement of earthen material atop the geomembrane (or soil) infiltration layer. The ClosureTurf system utilizes an alternate protection layer system, consisting of the synthetic turf and associated sand infill and HydroBinder infill materials. There are seven associated design considerations applicable to use of the ClosureTurf and protection layer; some common with the rule-prescribed closure system and some varying from the rule-prescribed closure system. ClosureTurf design considerations include:

- Minimization of erosion of the sand and HydroBinder infill materials. This item was addressed in Section 3.2.
- Prevention of wind uplift of the ClosureTurf synthetic turf (and hence the underlying geomembrane), addressed in Section 3.4.1.
- Prevention of wind erosion of the sand and HydroBinder infill materials, addressed in Section 3.4.2.
- Ultraviolet (UV) light stability of the ClosureTurf, addressed in Section 3.4.3.
- Freeze-thaw cycle effects on the geomembrane, addressed in Section 3.4.4.
- Drivability and Stability of the ClosureTurf system, addressed in Section 3.4.5.
- Puncture Resistance, addressed in Section 3.4.6.

Each of these design considerations are addressed below or addressed previously in this report.

3.4.1 Wind Uplift

Wind uplift is a condition where at certain wind velocities and directions, the geomembrane of the cover system could be placed in a negative pressure (vacuum) condition great enough to lift the geomembrane off the ground surface, and thereby induce potentially damaging tensile stress and strain in the geomembrane. Uplift prevention on a rule-prescribed geomembrane-based cover system is accomplished by placement of the soil cover materials atop the geomembrane. For ClosureTurf, wind uplift of the geomembrane is resisted by the combined weight of the overlying synthetic turf, the sand infill, and the geomembrane. Watershed Geo, in their 2023 ClosureTurf Design Guidance document, provide a wind uplift analysis procedure. The wind uplift analysis, which follows the ClosureTurf Design Guidance and is summarized in Attachment B, yields a Factor of Safety (FS) against uplift of 1.45. This FS is greater than 1.0 and therefore wind uplift of the ClosureTurf system is not expected to occur.

3.4.2 Wind Erosion

Wind is a non-water erosive force that can sometimes mobilize fine grained soil particles, making them airborne and a potential nuisance on and off site. Wind erosion problems can develop when one or more of the following conditions exist:

- Long uninterrupted ground surfaces exposed to high wind.
- Small soil particles exposed on the ground surface, particularly if particles are fine sand, silt or non-cohesive clay size particles.
- Dry ground surface.
- Ground surface subject to mechanical disturbance (e.g., vehicle traffic).
- Exposed ground surface (absence of vegetation).

Wind erosion prevention is a requirement of the Federal rules cited herein but requirements for wind erosion prevention are not quantified. However, for natural soil and typical soil-geomembrane based closure systems, wind erosion is prevented by establishment of a vegetated cover surface. For ClosureTurf, the synthetic grass establishes an artificial vegetated cover surface, thereby protecting the sand infill from wind erosion. Where HydroBinder is used, the HydroBinder also binds (cements) the infill soil particles together. Areas that utilize HydroBinder would not be susceptible to wind erosion. Because natural vegetation is the primary means of wind erosion control on a rule-prescribed final cover system, it is inferred that the synthetic turf is an effective and acceptable means of wind erosion control on the ClosureTurf system. Further, the sand and HydroBinder infill materials on ClosureTurf generally do not contain silt and clay size soil particles that may sometimes exist in other closure systems and be more prone to wind erosion if vegetation quality and density were poor. ClosureTurf uses a high quality, uniform (no bare spots) synthetic vegetation.

3.4.3 UV Stability

The UV degradation of ClosureTurf® has been studied extensively to get an understanding of how the cover system reacts to prolonged UV exposure. Appendix H of the ClosureTurf® Design Guidance Manual (Watershed Geo, 2023) includes a 2022 Assessment of UV Longevity that was prepared by Geosyntec Consultants, a third-party consultant for Watershed Geo. The document includes a series of tests performed at five facilities throughout the United States and utilizes tensile strength measurements to obtain the half-life of the HDPE grass blades. One such series of tests was performed in New River, Arizona for a duration of 10 years. Tests were conducted after 1, 5, 7, and 10 years of use. Using these results, Geosyntec Consultants were able to estimate the ClosureTurf material's half-life (50% tensile strength time) and the time to degrade to 12.5% of the original tensile strength. Per the report, this latter value represents the stage at which the ClosureTurf's HDPE grass blades will become susceptible to damage by vehicular traffic and the force exerted by stormwater runoff.

Results from the New River, Arizona testing found that the expected half-life of ClosureTurf will be between 75-93 years. For a 12.5 % remaining tensile strength on the Arizona site, Watershed Geo estimates ClosureTurf® will be between 181-216 years old. In other words, the HDPE blades are expected to degrade to half of the original tensile strength after 75 years and become susceptible to damage by vehicular traffic and the force exerted by stormwater runoff after 181 years. This length of time demonstrates the longevity of the material, but it is also important to note that ClosureTurf undergoing testing at the New River, Arizona laboratory experiences far greater UV exposure than areas in the Midwest. Therefore, it can be predicted that the half-life of ClosureTurf for the Sibley Quarry site will be greater.

In addition to the HDPE grass blades, there are two unexposed elements of the ClosureTurf system: (i) the polypropylene (PP) geotextile backing for the turf component; and (ii) the MicroSpike® and the Super Gripnet® which consist of Linear Low Density Polyethylene (LLDPE) geomembranes.

Watershed Geo has incorporated UV degradation inhibitors into the PP geotextile backing which, according to Watershed Geo has led to an improvement in UV resistance by a factor of 14 over the original prediction of 65% retained tensile strength after 100 years (Watershed Geo, 2014). For the geomembrane, Koerner (2011 – referenced in Watershed Geo Design Guidance Manual) has estimated that covered HDPE geomembrane will have a half-life of 446 years at 68 degrees Fahrenheit and 265 years at 77 degrees Fahrenheit.

Therefore, the most critical component of the ClosureTurf® appears to be the exposed HDPE grass blades when it comes to UV degradation. If degradation of the HDPE grass blades to an unserviceable level occurred, this could be remediated by replacement of the turf component of the ClosureTurf® system, though per the studies cited above and in Attachment C, replacement likely would not be required for 100 years or more.

3.4.4 Freeze/Thaw Effect

This topic is being considered to demonstrate that the geomembrane component of ClosureTurf will not be adversely affected by the increased frequency of freeze-thaw cycles that may result from the lack of the cover soil layer prescribed by 40 CFR §257.102(d)(3)(i)(B). The alternative final cover system has a ½-inch thick sand infill layer and textile component of the synthetic turf insulating the geomembrane layer from the ambient air temperatures. Both the rule-prescribed final cover system and the alternative final cover system are thinner than the frost depth at Sibley Quarry and therefore, susceptible to freeze-thaw cycles. However, the thinner cover layer (synthetic turf and sand infill) atop the geomembrane component of ClosureTurf may mean that the freeze-thaw cycling of the geomembrane will occur more frequently in the case of the ClosureTurf alternative final cover system.

In White Paper #28 by the Geosynthetic Institute (GSI), a freeze-thaw cycling behavior test on geomembrane seams by Comer and Hsuan in 1994 is summarized and evaluated. This White Paper is provided in Attachment D. In the study, Comer and Hsuan tested 31 different seams on 19 different geomembrane sheet materials with 7 resin types. In the study, tensile strength results were obtained from the material which would undergo cyclic temperatures ranging from -4°F to +68°F. In all parts of the study, tensile strength was taken after 1, 5, 10, 20, 50, 100 and 200 cycles. In the first part of the study, tensile strength was taken at +68°F. In the second part of the study, tensile strength was taken at -4°F. In the third part of the study tensile strength was taken at +68°F but unlike the first two tests, during the freeze-thaw cycles, a constant strain was applied in lieu of strain developed only due to thermal expansion and contraction of the geomembrane that occurred in the first and second parts of the study.

For all three parts of the study, the results showed that tensile strength, shear strength, and peel strength show no indication of change of the tested materials or their seams. The overall conclusion from this study is that geomembrane sheets and seams will not be affected by freeze-thaw cycles. Therefore, any increased frequency of freeze-thaw cycles resulting from the absence of 18- to 24-inches of soil cover should not affect the geomembrane component of ClosureTurf used in the alternative final cover system.

3.4.5 Drivability and Stability

In 2010 ClosureTurf, LLC commissioned SGI Testing Services (SGI) to evaluate post-construction drivability and stability of the ClosureTurf system. Several aspects of drivability and stability were analyzed:

i. Stability – potential sliding (shear failure) within the ClosureTurf System.
ii. Bearing capacity of the subgrade soil and associated tire rut depth.
iii. Localized settlement after construction due to waste decomposing (for Municipal Solid Waste scenarios) and compression under gravity force – addressed in Section 3.5.

A copy of SGI's report is provided as Attachment E. Figure 3-1 shows the type of rubber-tired construction equipment (RTCE) typically allowed for use atop the ClosureTurf system.

Figure 3-1 Rubber-Tired Construction Equipment on ClosureTurf System

SGI analyzed stability of the ClosureTurf system under the shear forces imposed by RTCE traveling atop the ClosureTurf. A condition similar to but more severe than what will occur at Sibley Quarry was analyzed by SGI – a 3H:1V slope (18-degree slope angle). The most severe condition at Sibley Quarry will be a 4H:1V slope (14-degree slope angle). For the 3H:1V slope and the materials proposed for use on the Sibley Quarry slopes (ClosureTurf with sand/artificial grass and 50-mil Super Gripnet LLDPE geomembrane), with a peak interface friction angle of 34 degrees, the factor of safety against localized shear failure (sliding) was computed as:

$$\boldsymbol{FS = tan\ \delta / tan\ \alpha}$$

where **δ** equals the interface friction angle and **α** equals the slope angle.

For the 3H:1V slope angle, the resulting FS is: $\boldsymbol{FS = tan\ 34/tan\ 18}$ **= 2.0**

A factor of safety of 1.5 or greater is deemed adequate and therefore the factor of safety against a shear (sliding) failure is acceptable. For the 4H:1V slope planned at Sibley Quarry:

The resulting FS is: $\boldsymbol{FS = tan\ 34/tan\ 14}$ **= 2.7**

The factor of safety for the slope configuration planned for Sibley Quarry also yields a value above 1.5 and is acceptable. An acceptable factor of safety will be achieved provided the size and weight of the RTCE, and tire contact area, is limited to that which imposes stresses within the range tested (2,000 to 5,000 psf). The RTCE shown in Figure 3-1 imposes stresses on the order of 3,700 psf. Further, at these low stresses, development of ruts from RTCE used to place sand infill would be expected to be minimal. Potential for rutting would have been incurred during final grading of the 4H:1V slope, by the wheeled and rubber-tired equipment used to compact the waste and soil subgrade materials, and by the equipment used to deploy the geomembrane sheets. If rutting is found to be problematic during geomembrane subgrade preparation, then the subgrade will require further grading and compaction prior to geomembrane placement.

As demonstrated in the previous sections, the proposed ClosureTurf alternative final cover system will minimize erosion, minimize infiltration, will resist degradation due to UV effects, will withstand freeze-thaw cycle impacts, and will remain stable during construction when appropriately sized RTCE are utilized.

3.4.6 Puncture Resistance

Watershed Geo, in their 2023 ClosureTurf Design Guidance document, provide a summary of design considerations regarding the puncture and tearing loads induced on ClosureTurf and the resistance of the system to these loads. Potential sources of puncture and tearing are:

- Large or sharp objects in the subgrade.
- Equipment loads on top of the ClosureTurf (also see Section 3.4.5)
- Imposition of significant loads atop the ClosureTurf in an area(s) having a void beneath the ClosureTurf.
- Equipment weight, acceleration, and braking.

Puncture of the ClosureTurf at Sibley Quarry will be avoided by:

- Proper preparation of the subgrade to achieve a relatively uniform and smooth surface.
- Removal of any sharp objects, oversized particles, and other deleterious materials on or protruding above the smooth subgrade surface.
- Inspection of and removal from the geomembrane surface, any damaging particles, including stones, construction debris, and soil clods that may accumulate during cover construction.
- Constraints on the size and type of mobile equipment allowed atop the geomembrane and atop the synthetic turf, and the means of operating such equipment (speed constraints, no sharp turns, no sudden starts and stops).

The preventative measures noted above will be standard operating procedure for qualified ClosureTurf installers but at Sibley Quarry will be reinforced by discussion during daily construction meetings and by observation and follow-up as construction progresses. In cases where an equipment operator is unable to comply with procedures required to prevent punctures and/or tearing of the ClosureTurf system, DTE will exercise their authority to remove the contractor from that portion of the ClosureTurf installation process.

3.5 Settlement and Subsidence

40 CFR §257.102(d)(3)(ii)(C) states that the disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence when considering an alternative final cover system.

The waste materials being covered by the ClosureTurf cover system include varying types and mixtures of CCR and DTE Gas company construction site soil and related inert waste materials. The material types and densities within the fill area to be covered are variable and not readily amenable to estimating of their potential for differential settlement and subsidence. Instead, the completed ClosureTurf cover areas will utilize a minimum 2-percent slope. This slope is sufficient to maintain positive drainage even if some settlement and subsidence occurs. Further, the closure area will periodically be visually inspected and periodically surveyed to observe and measure for areas of settlement and subsidence. If settlement and subsidence occur to the degree that cover performance is reduced, such as by areas of water ponding on the cover surface or along drainage berms and ditches, then the affected cover areas will be remedied to return the areas to desired levels of performance. The remedy could include temporary removal of ClosureTurf to facilitate area regrading, followed by replacement of the affected ClosureTurf area, filling select areas with HydroBinder and/or HydroBinder and new turf sections to modify grades as needed, or possibly by grout injection below select areas of the turf.

Per the Assessment of Maximum Allowable Strain in Polyethylene and Polypropylene Geomembranes (geosynthetica.com) the textured LLDPE geomembranes planned for the Sibley Quarry cover system can be taken in design to tolerate multiaxial strains up to 8-percent. Per AGRU America, Inc., the geomembrane manufacturer, geomembrane elongation at break is 300-percent. Therefore, the geomembrane component of the ClosureTurf system has a high strain tolerance and even under a severe settlement and subsidence condition, the geomembrane could stretch but rupture or tearing of the geomembrane would not be expected. However, if tearing or rupture did occur, it could readily be repaired by removal of the overlying infill and synthetic turf, by filling of the settled or subsided area to restore desired grades, and then patching of the geomembrane and replacement of the synthetic turf and infill materials.

The preceding sections of this document demonstrate that the alternative cover system consisting of ClosureTurf will provide CCR cover performance and environmental protections required by the rules and requirements stated in Section 2.0 and therefore a complete demonstration of equivalency has been provided.

Attachment A-1

HELP Model Output Excerpts – Typical Geomembrane Cover System

DTE Sibley Quarry Closure Area

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: Sibley Quarry Geomembrane Cove… **Simulated On:** 11/11/2023 8:40

Layer 1

Type 1 - Vertical Percolation Layer (Cover Soil)
SiL - Silty Loam
Material Texture Number 9

Thickness	=	12	inches
Porosity	=	0.501	vol/vol
Field Capacity	=	0.284	vol/vol
Wilting Point	=	0.135	vol/vol
Initial Soil Water Content	=	0.1997	vol/vol
Effective Sat. Hyd. Conductivity	=	1.90E-04	cm/sec

Layer 2

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	=	0.0959	vol/vol
Effective Sat. Hyd. Conductivity	=	5.80E-03	cm/sec
Slope	=	2	%
Drainage Length	=	200	ft

Layer 3

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 4

Type 1 - Vertical Percolation Layer (Waste)

High-Density Electric Plant Coal Fly Ash
Material Texture Number 30

Thickness	=	600	inches
Porosity	=	0.541	vol/vol
Field Capacity	=	0.187	vol/vol
Wilting Point	=	0.047	vol/vol
Initial Soil Water Content	=	0.187	vol/vol
Effective Sat. Hyd. Conductivity	=	5.00E-05	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	=	75.8	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	20	acres
Evaporative Zone Depth	=	12	inches
Initial Water in Evaporative Zone	=	2.396	inches
Upper Limit of Evaporative Storage	=	6.012	inches
Lower Limit of Evaporative Storage	=	1.62	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	115.747	inches
Total Initial Water	=	115.747	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	42.13	Degrees
Maximum Leaf Area Index	=	3.5	
Start of Growing Season (Julian Date)	=	100	days
End of Growing Season (Julian Date)	=	265	days
Average Wind Speed	=	11	mph
Average 1st Quarter Relative Humidity	=	1	%
Average 2nd Quarter Relative Humidity	=	11	%
Average 3rd Quarter Relative Humidity	=	45	%
Average 4th Quarter Relative Humidity	=	11	%

Note: Evapotranspiration data was obtained for Trenton, Michigan

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
1.942212	1.995913	2.100795	2.96921	3.368111	3.275446
3.248622	3.277203	3.202848	2.869427	2.596998	2.215822

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.13/-83.22

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
28.1	33.4	40.5	50.5	66.1	78.8
82.3	79.8	69.6	56.5	41.7	32

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.13/-83.22
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.13/-83.22

Daily Output for Year 1

Column key: Head #1: drainage from Layer 3
Drain #1: drainage from Layer 2
Leak #1: leakage thru Layer 3
Leak #2: leakage thru Layer 4

Title: Sibley Quarry Geomembrane Cover Scenario
Simulated On: 11/11/2023 8:40

Day	Freezing Status* Air	Soil	Rain (inches)	Runoff (inches)	ET (inches)	Evap. Zone Water (in/in)	Head #1 (inches)	Drain #1 (inches)	Leak #1 (inches)	Head #2 (inches)	Drain #2 (inches)	Leak #2 (inches)
1	*	*	0.00	0.000	0.000	0.1997	1.0806	0.0036	1.99E-04	0.0000	0.0000	0.00E+00
2	*	*	0.00	0.000	0.000	0.1997	1.0706	0.0035	1.97E-04	0.0000	0.0000	4.03E-04
3	*	*	0.00	0.000	0.000	0.1997	1.0607	0.0035	1.96E-04	0.0000	0.0000	1.98E-04
4	*	*	0.02	0.000	0.024	0.1997	1.0509	0.0035	1.94E-04	0.0000	0.0000	0.00E+00
5	*	*	0.11	0.000	0.022	0.1997	1.0412	0.0034	1.92E-04	0.0000	0.0000	4.16E-04
6	*	*	0.00	0.000	0.026	0.1997	1.0316	0.0034	1.91E-04	0.0000	0.0000	1.72E-04
7	*	*	0.00	0.000	0.013	0.1997	1.0221	0.0034	1.89E-04	0.0000	0.0000	0.00E+00
8	*	*	0.11	0.000	0.032	0.1997	1.0127	0.0033	1.88E-04	0.0000	0.0000	4.30E-04
9	*	*	0.00	0.000	0.021	0.1997	1.0033	0.0033	1.86E-04	0.0000	0.0000	1.43E-04
10	*	*	0.00	0.000	0.028	0.1997	0.9941	0.0033	1.84E-04	0.0000	0.0000	0.00E+00
11	*	*	0.00	0.000	0.030	0.1997	0.9849	0.0032	1.83E-04	0.0000	0.0000	3.50E-04
12	*	*	0.00	0.000	0.046	0.1997	0.9758	0.0032	1.81E-04	0.0000	0.0000	2.53E-04
13	*	*	0.00	0.000	0.000	0.1997	0.9668	0.0032	1.80E-04	0.0000	0.0000	0.00E+00
14	*	*	0.10	0.000	0.096	0.1997	0.9579	0.0031	1.78E-04	0.0000	0.0000	3.22E-04
15	*	*	0.02	0.000	0.022	0.1997	0.9490	0.0031	1.77E-04	0.0000	0.0000	2.67E-04
16	*	*	0.21	0.000	0.026	0.1997	0.9403	0.0031	1.75E-04	0.0000	0.0000	0.00E+00
17	*	*	0.00	0.000	0.035	0.1997	0.9316	0.0031	1.74E-04	0.0000	0.0000	0.00E+00
18	*	*	0.04	0.000	0.041	0.1997	0.9230	0.0030	1.72E-04	0.0000	0.0000	3.90E-04
19	*	*	0.11	0.000	0.000	0.1997	0.9145	0.0030	1.71E-04	0.0000	0.0000	2.23E-04
20	*	*	0.00	0.000	0.069	0.1997	0.9060	0.0030	1.70E-04	0.0000	0.0000	0.00E+00
21		*	0.00	0.000	0.133	0.2046	0.8977	0.0030	1.68E-04	0.0000	0.0000	3.17E-04
22			0.23	0.000	0.206	0.2067	0.8894	0.0029	1.67E-04	0.0000	0.0000	2.82E-04
23			0.00	0.000	0.129	0.1961	0.8812	0.0029	1.65E-04	0.0000	0.0000	0.00E+00
24			0.36	0.000	0.134	0.2152	0.8741	0.0029	1.64E-04	0.0000	0.0000	0.00E+00
25	*	*	0.00	0.000	0.000	0.2152	0.8690	0.0029	1.63E-04	0.0000	0.0000	3.38E-04
26	*	*	0.00	0.000	0.000	0.2152	0.8610	0.0028	1.62E-04	0.0000	0.0000	4.04E-04
27	*	*	0.00	0.000	0.000	0.2152	0.8530	0.0028	1.61E-04	0.0000	0.0000	0.00E+00
28			0.00	0.000	0.151	0.2027	0.8452	0.0028	1.59E-04	0.0000	0.0000	0.00E+00

29	*	*	0.00	0.000	0.000	0.2027	0.8373	0.0028	1.58E-04	0.0000	0.0000	0.00E+00
30			0.03	0.000	0.137	0.1934	0.8296	0.0027	1.57E-04	0.0000	0.0000	6.01E-04
31	*	*	0.17	0.000	0.112	0.1934	0.8220	0.0027	1.55E-04	0.0000	0.0000	0.00E+00
32		*	0.13	0.000	0.000	0.2071	0.8144	0.0027	1.54E-04	0.0000	0.0000	0.00E+00
33	*	*	0.00	0.000	0.023	0.2071	0.8068	0.0027	1.53E-04	0.0000	0.0000	0.00E+00
34			0.00	0.000	0.134	0.1962	0.7994	0.0026	1.51E-04	0.0000	0.0000	6.19E-04
35			0.00	0.000	0.130	0.1853	0.7920	0.0026	1.50E-04	0.0000	0.0000	0.00E+00
36			0.22	0.000	0.152	0.1906	0.7847	0.0026	1.49E-04	0.0000	0.0000	0.00E+00
37	*	*	0.00	0.000	0.000	0.1906	0.7774	0.0026	1.48E-04	0.0000	0.0000	0.00E+00
38	*	*	0.00	0.000	0.000	0.1906	0.7703	0.0025	1.46E-04	0.0000	0.0000	6.00E-04
39	*	*	0.00	0.000	0.000	0.1906	0.7631	0.0025	1.45E-04	0.0000	0.0000	0.00E+00
40	*	*	0.00	0.000	0.000	0.1906	0.7561	0.0025	1.44E-04	0.0000	0.0000	0.00E+00
41			0.24	0.000	0.144	0.1982	0.7491	0.0025	1.43E-04	0.0000	0.0000	0.00E+00
42	*	*	0.10	0.000	0.066	0.1982	0.7422	0.0024	1.41E-04	0.0000	0.0000	3.90E-04
43		*	0.00	0.000	0.035	0.1982	0.7353	0.0024	1.40E-04	0.0000	0.0000	2.24E-04
44			0.00	0.000	0.177	0.1834	0.7285	0.0024	1.39E-04	0.0000	0.0000	0.00E+00
45			0.00	0.000	0.195	0.1672	0.7218	0.0024	1.38E-04	0.0000	0.0000	0.00E+00
46			0.00	0.000	0.076	0.1608	0.7151	0.0024	1.37E-04	0.0000	0.0000	3.03E-04
47			0.00	0.000	0.064	0.1555	0.7085	0.0023	1.36E-04	0.0000	0.0000	3.87E-04
48			0.08	0.000	0.058	0.1570	0.7020	0.0023	1.35E-04	0.0000	0.0000	2.54E-04
49			0.07	0.000	0.051	0.1587	0.6955	0.0023	1.33E-04	0.0000	0.0000	0.00E+00
50			0.01	0.000	0.046	0.1554	0.6890	0.0023	1.32E-04	0.0000	0.0000	0.00E+00
51			0.16	0.000	0.043	0.1651	0.6827	0.0022	1.31E-04	0.0000	0.0000	0.00E+00
52			0.04	0.000	0.040	0.1647	0.6764	0.0022	1.30E-04	0.0000	0.0000	0.00E+00
53			0.00	0.000	0.034	0.1618	0.6701	0.0022	1.29E-04	0.0000	0.0000	3.20E-04
54			0.00	0.000	0.033	0.1591	0.6639	0.0022	1.28E-04	0.0000	0.0000	2.94E-04
55	*		0.00	0.000	0.031	0.1565	0.6578	0.0022	1.27E-04	0.0000	0.0000	0.00E+00
56	*		0.00	0.000	0.000	0.1565	0.6517	0.0021	1.26E-04	0.0000	0.0000	0.00E+00
57			0.00	0.000	0.030	0.1541	0.6457	0.0021	1.25E-04	0.0000	0.0000	0.00E+00
58			0.00	0.000	0.027	0.1518	0.6401	0.0021	1.24E-04	0.0000	0.0000	3.06E-04
59			0.00	0.000	0.027	0.1495	0.6344	0.0021	1.23E-04	0.0000	0.0000	3.06E-05
60			0.00	0.000	0.026	0.1473	0.6286	0.0021	1.22E-04	0.0000	0.0000	5.37E-04
61	*		0.00	0.000	0.025	0.1452	0.6228	0.0020	1.21E-04	0.0000	0.0000	0.00E+00
62			0.00	0.000	0.023	0.1433	0.6170	0.0020	1.20E-04	0.0000	0.0000	0.00E+00
63			0.13	0.000	0.020	0.1521	0.6113	0.0020	1.19E-04	0.0000	0.0000	0.00E+00
64	*		0.00	0.000	0.019	0.1505	0.6056	0.0020	1.18E-04	0.0000	0.0000	0.00E+00

65	*	0.00	0.000	0.019	0.1490	0.6000	0.0020	1.17E-04	0.0000	0.0000	0.00E+00
66	*	0.24	0.000	0.100	0.1506	0.5945	0.0020	1.16E-04	0.0000	0.0000	6.28E-04
67		0.01	0.000	0.000	0.1590	0.5890	0.0019	1.15E-04	0.0000	0.0000	0.00E+00
68		0.00	0.000	0.043	0.1577	0.5835	0.0019	1.14E-04	0.0000	0.0000	0.00E+00
69		0.00	0.000	0.016	0.1564	0.5781	0.0019	1.13E-04	0.0000	0.0000	0.00E+00
70		0.00	0.000	0.014	0.1552	0.5728	0.0019	1.12E-04	0.0000	0.0000	0.00E+00
71		0.00	0.000	0.015	0.1541	0.5675	0.0019	1.11E-04	0.0000	0.0000	3.44E-04
72	*	0.01	0.000	0.021	0.1529	0.5622	0.0018	1.10E-04	0.0000	0.0000	2.82E-04
73		0.14	0.000	0.017	0.1635	0.5570	0.0018	1.09E-04	0.0000	0.0000	0.00E+00
74		0.01	0.000	0.019	0.1629	0.5519	0.0018	1.08E-04	0.0000	0.0000	0.00E+00
75		0.09	0.000	0.017	0.1690	0.5468	0.0018	1.07E-04	0.0000	0.0000	0.00E+00
76		0.00	0.000	0.015	0.1678	0.5417	0.0018	1.06E-04	0.0000	0.0000	0.00E+00
77		0.00	0.000	0.013	0.1667	0.5368	0.0018	1.05E-04	0.0000	0.0000	3.80E-04
78	*	0.00	0.000	0.012	0.1656	0.5319	0.0017	1.05E-04	0.0000	0.0000	2.44E-04
79		0.03	0.000	0.016	0.1672	0.5269	0.0017	1.04E-04	0.0000	0.0000	0.00E+00
80		0.00	0.000	0.014	0.1661	0.5221	0.0017	1.03E-04	0.0000	0.0000	0.00E+00
81		0.00	0.000	0.015	0.1649	0.5172	0.0017	1.02E-04	0.0000	0.0000	0.00E+00
82		0.00	0.000	0.013	0.1638	0.5124	0.0017	1.01E-04	0.0000	0.0000	0.00E+00
83		0.00	0.000	0.012	0.1628	0.5077	0.0017	1.00E-04	0.0000	0.0000	3.83E-04
84		0.00	0.000	0.012	0.1618	0.5030	0.0017	9.95E-05	0.0000	0.0000	2.37E-04
85		0.00	0.000	0.012	0.1608	0.4983	0.0016	9.86E-05	0.0000	0.0000	0.00E+00
86		0.00	0.000	0.013	0.1597	0.4937	0.0016	9.78E-05	0.0000	0.0000	0.00E+00
87		0.00	0.000	0.013	0.1587	0.4891	0.0016	9.70E-05	0.0000	0.0000	0.00E+00
88	*	0.15	0.000	0.135	0.1598	0.4846	0.0016	9.62E-05	0.0000	0.0000	0.00E+00
89		0.00	0.000	0.013	0.1587	0.4801	0.0016	9.54E-05	0.0000	0.0000	3.13E-04
90	*	0.00	0.000	0.013	0.1577	0.4757	0.0016	9.46E-05	0.0000	0.0000	3.72E-04
91	*	0.25	0.000	0.061	0.1593	0.4713	0.0015	9.38E-05	0.0000	0.0000	2.71E-04
92	*	0.39	0.000	0.030	0.1609	0.4669	0.0015	9.30E-05	0.0000	0.0000	0.00E+00
93	*	0.40	0.000	0.000	0.1626	0.4626	0.0015	9.22E-05	0.0000	0.0000	0.00E+00
94		0.00	0.000	0.087	0.1838	0.4583	0.0015	9.14E-05	0.0000	0.0000	0.00E+00
95		0.01	0.000	0.000	0.2050	0.4541	0.0015	9.07E-05	0.0000	0.0000	0.00E+00
96	*	0.02	0.000	0.091	0.2066	0.4498	0.0015	8.99E-05	0.0000	0.0000	0.00E+00
97		0.03	0.000	0.169	0.2136	0.4457	0.0015	8.91E-05	0.0000	0.0000	0.00E+00
98		0.00	0.000	0.281	0.1902	0.4415	0.0015	8.84E-05	0.0000	0.0000	0.00E+00
99		0.07	0.000	0.018	0.1945	0.4375	0.0014	8.77E-05	0.0000	0.0000	0.00E+00
100	*	0.01	0.000	0.010	0.1945	0.4334	0.0014	8.69E-05	0.0000	0.0000	6.25E-04

101		0.44	0.000	0.019	0.2296	0.4294	0.0014	8.62E-05	0.0000	0.0000	6.53E-05
102		0.42	0.000	0.282	0.2409	0.4254	0.0014	8.55E-05	0.0000	0.0000	0.00E+00
103		0.05	0.000	0.240	0.2254	0.4220	0.0014	8.49E-05	0.0000	0.0000	0.00E+00
104		0.22	0.000	0.316	0.2175	0.4183	0.0014	8.42E-05	0.0000	0.0000	0.00E+00
105		0.18	0.000	0.280	0.2095	0.4144	0.0014	8.35E-05	0.0000	0.0000	0.00E+00
106		0.19	0.000	0.232	0.2058	0.4105	0.0013	8.28E-05	0.0000	0.0000	0.00E+00
107		0.10	0.000	0.204	0.1975	0.4067	0.0013	8.21E-05	0.0000	0.0000	0.00E+00
108		0.05	0.000	0.085	0.1950	0.4030	0.0013	8.14E-05	0.0000	0.0000	3.80E-04
109		0.00	0.000	0.063	0.1897	0.3992	0.0013	8.07E-05	0.0000	0.0000	2.44E-04
110		0.00	0.000	0.053	0.1853	0.3955	0.0013	8.00E-05	0.0000	0.0000	0.00E+00
111		0.03	0.000	0.051	0.1839	0.3919	0.0013	7.94E-05	0.0000	0.0000	0.00E+00
112		0.30	0.000	0.048	0.2045	0.3882	0.0013	7.87E-05	0.0000	0.0000	0.00E+00
113		1.26	0.000	0.046	0.3056	0.3846	0.0013	7.80E-05	0.0000	0.0000	0.00E+00
114		0.01	0.000	0.213	0.2886	0.3811	0.0013	7.74E-05	0.0000	0.0000	0.00E+00
115		0.03	0.000	0.343	0.2622	0.3775	0.0012	7.67E-05	0.0000	0.0000	0.00E+00
116		0.02	0.000	0.456	0.2262	0.3740	0.0012	7.61E-05	0.0000	0.0000	3.72E-04
117		0.01	0.000	0.499	0.1825	0.3947	0.0013	7.99E-05	0.0000	0.0000	2.60E-04
118		0.00	0.000	0.209	0.1644	0.4657	0.0015	9.28E-05	0.0000	0.0000	0.00E+00
119		0.00	0.000	0.093	0.1567	0.4679	0.0015	9.32E-05	0.0000	0.0000	0.00E+00
120		0.00	0.000	0.074	0.1489	0.5020	0.0016	9.93E-05	0.0000	0.0000	0.00E+00
121		0.00	0.000	0.061	0.1438	0.5100	0.0017	1.01E-04	0.0000	0.0000	0.00E+00
122		0.00	0.000	0.058	0.1389	0.5053	0.0017	9.99E-05	0.0000	0.0000	0.00E+00
123		0.00	0.000	0.047	0.1350	0.5006	0.0016	9.90E-05	0.0000	0.0000	6.18E-04
124		0.18	0.000	0.014	0.1486	0.4960	0.0016	9.82E-05	0.0000	0.0000	0.00E+00
125		0.41	0.000	0.023	0.1811	0.4914	0.0016	9.74E-05	0.0000	0.0000	0.00E+00
126		0.05	0.000	0.033	0.1827	0.4869	0.0016	9.66E-05	0.0000	0.0000	0.00E+00
127		0.23	0.000	0.039	0.1984	0.4824	0.0016	9.58E-05	0.0000	0.0000	0.00E+00
128		0.03	0.000	0.043	0.1977	0.4779	0.0016	9.50E-05	0.0000	0.0000	0.00E+00
129		0.00	0.000	0.034	0.1949	0.4735	0.0016	9.42E-05	0.0000	0.0000	3.44E-04
130		0.00	0.000	0.030	0.1924	0.4691	0.0015	9.34E-05	0.0000	0.0000	2.86E-04
131	*	0.16	0.000	0.115	0.1940	0.4647	0.0015	9.26E-05	0.0000	0.0000	0.00E+00
132		0.02	0.000	0.072	0.1914	0.4604	0.0015	9.18E-05	0.0000	0.0000	0.00E+00
133	*	0.08	0.000	0.080	0.1914	0.4562	0.0015	9.10E-05	0.0000	0.0000	0.00E+00
134	*	0.59	0.000	0.123	0.1930	0.4519	0.0015	9.03E-05	0.0000	0.0000	0.00E+00
135	*	0.50	0.000	0.077	0.1946	0.4477	0.0015	8.95E-05	0.0000	0.0000	0.00E+00
136		0.41	0.000	0.142	0.2885	0.4436	0.0015	8.88E-05	0.0000	0.0000	3.84E-04

137	0.13	0.000	0.436	0.2632	0.4395	0.0014	8.80E-05	0.0000	0.0000	2.36E-04
138	0.11	0.000	0.266	0.2498	0.4354	0.0014	8.73E-05	0.0000	0.0000	0.00E+00
139	0.26	0.000	0.163	0.2580	0.4314	0.0014	8.66E-05	0.0000	0.0000	0.00E+00
140	0.00	0.000	0.388	0.2257	0.4274	0.0014	8.58E-05	0.0000	0.0000	0.00E+00
141	0.00	0.000	0.370	0.1949	0.4234	0.0014	8.51E-05	0.0000	0.0000	0.00E+00
142	0.03	0.000	0.229	0.1782	0.4195	0.0014	8.44E-05	0.0000	0.0000	0.00E+00
143	0.11	0.000	0.112	0.1783	0.4156	0.0014	8.37E-05	0.0000	0.0000	3.50E-04
144	0.05	0.000	0.094	0.1747	0.4118	0.0014	8.30E-05	0.0000	0.0000	2.77E-04
145	0.00	0.000	0.074	0.1687	0.4079	0.0013	8.23E-05	0.0000	0.0000	0.00E+00
146	0.01	0.000	0.070	0.1634	0.4042	0.0013	8.16E-05	0.0000	0.0000	0.00E+00
147	0.10	0.000	0.056	0.1671	0.4004	0.0013	8.09E-05	0.0000	0.0000	0.00E+00
148	0.02	0.000	0.059	0.1638	0.3967	0.0013	8.02E-05	0.0000	0.0000	0.00E+00
149	0.00	0.000	0.062	0.1586	0.3930	0.0013	7.96E-05	0.0000	0.0000	0.00E+00
150	0.00	0.000	0.063	0.1533	0.3894	0.0013	7.89E-05	0.0000	0.0000	0.00E+00
151	0.00	0.000	0.072	0.1468	0.3858	0.0013	7.82E-05	0.0000	0.0000	3.74E-04
152	0.02	0.000	0.073	0.1422	0.3995	0.0013	8.07E-05	0.0000	0.0000	2.55E-04
153	0.00	0.000	0.076	0.1359	0.3958	0.0013	8.01E-05	0.0000	0.0000	0.00E+00
154	0.00	0.000	0.010	0.1351	0.3921	0.0013	7.94E-05	0.0000	0.0000	0.00E+00
155	0.00	0.000	0.001	0.1350	0.3885	0.0013	7.87E-05	0.0000	0.0000	0.00E+00
156	0.16	0.000	0.009	0.1478	0.3849	0.0013	7.81E-05	0.0000	0.0000	0.00E+00
157	0.21	0.000	0.037	0.1626	0.3813	0.0013	7.74E-05	0.0000	0.0000	0.00E+00
158	0.18	0.000	0.032	0.1753	0.3778	0.0012	7.68E-05	0.0000	0.0000	0.00E+00
159	0.02	0.000	0.049	0.1730	0.3743	0.0012	7.61E-05	0.0000	0.0000	3.74E-04
160	0.32	0.000	0.057	0.1946	0.3708	0.0012	7.55E-05	0.0000	0.0000	2.55E-04
161	0.50	0.000	0.352	0.2071	0.3674	0.0012	7.49E-05	0.0000	0.0000	0.00E+00
162	0.01	0.000	0.435	0.1715	0.3640	0.0012	7.42E-05	0.0000	0.0000	0.00E+00
163	0.08	0.000	0.236	0.1588	0.3606	0.0012	7.36E-05	0.0000	0.0000	0.00E+00
164	0.03	0.000	0.144	0.1495	0.3572	0.0012	7.30E-05	0.0000	0.0000	0.00E+00
165	0.00	0.000	0.118	0.1399	0.3539	0.0012	7.24E-05	0.0000	0.0000	0.00E+00
166	0.00	0.000	0.049	0.1358	0.3506	0.0012	7.18E-05	0.0000	0.0000	0.00E+00
167	0.00	0.000	0.009	0.1351	0.3474	0.0011	7.12E-05	0.0000	0.0000	0.00E+00
168	0.00	0.000	0.001	0.1350	0.3442	0.0011	7.06E-05	0.0000	0.0000	3.35E-04
169	0.00	0.000	0.000	0.1350	0.3410	0.0011	7.00E-05	0.0000	0.0000	0.00E+00
170	0.00	0.000	0.000	0.1350	0.3378	0.0011	6.94E-05	0.0000	0.0000	0.00E+00
171	0.00	0.000	0.000	0.1350	0.3347	0.0011	6.88E-05	0.0000	0.0000	3.28E-04
172	0.00	0.000	0.000	0.1350	0.3316	0.0011	6.82E-05	0.0000	0.0000	3.05E-04

173	0.00	0.000	0.000	0.1350	0.3285	0.0011	6.77E-05	0.0000	0.0000	0.00E+00
174	0.38	0.000	0.063	0.1616	0.3254	0.0011	6.71E-05	0.0000	0.0000	0.00E+00
175	0.00	0.000	0.063	0.1563	0.3224	0.0011	6.65E-05	0.0000	0.0000	0.00E+00
176	0.00	0.000	0.098	0.1481	0.3194	0.0010	6.60E-05	0.0000	0.0000	0.00E+00
177	0.00	0.000	0.102	0.1396	0.3165	0.0010	6.54E-05	0.0000	0.0000	0.00E+00
178	0.00	0.000	0.049	0.1355	0.3135	0.0010	6.49E-05	0.0000	0.0000	0.00E+00
179	0.00	0.000	0.005	0.1351	0.3106	0.0010	6.43E-05	0.0000	0.0000	0.00E+00
180	0.00	0.000	0.001	0.1350	0.3077	0.0010	6.38E-05	0.0000	0.0000	0.00E+00
181	0.00	0.000	0.000	0.1350	0.3049	0.0010	6.33E-05	0.0000	0.0000	0.00E+00
182	0.03	0.000	0.018	0.1357	0.3020	0.0010	6.27E-05	0.0000	0.0000	3.36E-04
183	0.67	0.000	0.040	0.1878	0.2992	0.0010	6.22E-05	0.0000	0.0000	0.00E+00
184	0.58	0.000	0.202	0.2194	0.2965	0.0010	6.17E-05	0.0000	0.0000	0.00E+00
185	0.13	0.000	0.258	0.2084	0.2937	0.0010	6.12E-05	0.0000	0.0000	3.36E-04
186	0.00	0.000	0.427	0.1732	0.2910	0.0010	6.06E-05	0.0000	0.0000	0.00E+00
187	0.38	0.000	0.291	0.1804	0.2883	0.0009	6.01E-05	0.0000	0.0000	0.00E+00
188	0.00	0.000	0.186	0.1649	0.2856	0.0009	5.96E-05	0.0000	0.0000	5.32E-04
189	0.00	0.000	0.163	0.1513	0.2829	0.0009	5.91E-05	0.0000	0.0000	2.67E-04
190	0.00	0.000	0.158	0.1381	0.2803	0.0009	5.86E-05	0.0000	0.0000	0.00E+00
191	0.00	0.000	0.032	0.1354	0.2777	0.0009	5.81E-05	0.0000	0.0000	0.00E+00
192	0.00	0.000	0.005	0.1350	0.2752	0.0009	5.77E-05	0.0000	0.0000	0.00E+00
193	0.00	0.000	0.000	0.1350	0.2726	0.0009	5.72E-05	0.0000	0.0000	0.00E+00
194	0.00	0.000	0.002	0.1350	0.2701	0.0009	5.67E-05	0.0000	0.0000	0.00E+00
195	0.15	0.000	0.019	0.1455	0.2676	0.0009	5.62E-05	0.0000	0.0000	0.00E+00
196	0.53	0.000	0.072	0.1834	0.2651	0.0009	5.57E-05	0.0000	0.0000	0.00E+00
197	0.03	0.000	0.159	0.1726	0.2626	0.0009	5.53E-05	0.0000	0.0000	0.00E+00
198	0.11	0.000	0.239	0.1622	0.2602	0.0009	5.48E-05	0.0000	0.0000	0.00E+00
199	0.08	0.000	0.211	0.1511	0.2577	0.0008	5.44E-05	0.0000	0.0000	0.00E+00
200	0.26	0.000	0.181	0.1579	0.2553	0.0008	5.39E-05	0.0000	0.0000	0.00E+00
201	0.37	0.000	0.116	0.1793	0.2530	0.0008	5.34E-05	0.0000	0.0000	0.00E+00
202	0.14	0.000	0.267	0.1690	0.2506	0.0008	5.30E-05	0.0000	0.0000	0.00E+00
203	0.00	0.000	0.155	0.1561	0.2483	0.0008	5.26E-05	0.0000	0.0000	0.00E+00
204	0.00	0.000	0.135	0.1448	0.2460	0.0008	5.21E-05	0.0000	0.0000	0.00E+00
205	0.15	0.000	0.123	0.1473	0.2437	0.0008	5.17E-05	0.0000	0.0000	0.00E+00
206	0.50	0.000	0.107	0.1802	0.2416	0.0008	5.13E-05	0.0000	0.0000	0.00E+00
207	0.08	0.000	0.234	0.1671	0.2396	0.0008	5.09E-05	0.0000	0.0000	0.00E+00
208	0.17	0.000	0.287	0.1572	0.2374	0.0008	5.05E-05	0.0000	0.0000	3.42E-04

209	0.44	0.000	0.299	0.1690	0.2352	0.0008	5.00E-05	0.0000	0.0000	3.00E-04
210	0.00	0.000	0.157	0.1560	0.2330	0.0008	4.96E-05	0.0000	0.0000	0.00E+00
211	0.07	0.000	0.128	0.1510	0.2308	0.0008	4.92E-05	0.0000	0.0000	0.00E+00
212	0.00	0.000	0.161	0.1376	0.2287	0.0008	4.88E-05	0.0000	0.0000	0.00E+00
213	0.07	0.000	0.054	0.1389	0.2266	0.0007	4.84E-05	0.0000	0.0000	0.00E+00
214	0.19	0.000	0.087	0.1476	0.2244	0.0007	4.80E-05	0.0000	0.0000	0.00E+00
215	0.00	0.000	0.061	0.1426	0.2224	0.0007	4.76E-05	0.0000	0.0000	0.00E+00
216	0.01	0.000	0.084	0.1366	0.2203	0.0007	4.72E-05	0.0000	0.0000	0.00E+00
217	0.00	0.000	0.016	0.1352	0.2182	0.0007	4.68E-05	0.0000	0.0000	0.00E+00
218	0.00	0.000	0.002	0.1351	0.2162	0.0007	4.64E-05	0.0000	0.0000	0.00E+00
219	0.58	0.000	0.056	0.1791	0.2142	0.0007	4.60E-05	0.0000	0.0000	0.00E+00
220	0.00	0.000	0.201	0.1624	0.2122	0.0007	4.56E-05	0.0000	0.0000	0.00E+00
221	0.00	0.000	0.103	0.1539	0.2102	0.0007	4.52E-05	0.0000	0.0000	0.00E+00
222	0.00	0.000	0.061	0.1488	0.2083	0.0007	4.48E-05	0.0000	0.0000	6.11E-04
223	0.00	0.000	0.081	0.1420	0.2063	0.0007	4.45E-05	0.0000	0.0000	0.00E+00
224	0.00	0.000	0.062	0.1368	0.2044	0.0007	4.41E-05	0.0000	0.0000	0.00E+00
225	0.00	0.000	0.017	0.1354	0.2025	0.0007	4.37E-05	0.0000	0.0000	0.00E+00
226	0.00	0.000	0.004	0.1351	0.2006	0.0007	4.34E-05	0.0000	0.0000	0.00E+00
227	1.27	0.000	0.048	0.2371	0.1988	0.0007	4.30E-05	0.0000	0.0000	0.00E+00
228	0.61	0.000	0.163	0.2743	0.1969	0.0006	4.26E-05	0.0000	0.0000	0.00E+00
229	0.24	0.000	0.335	0.2665	0.1951	0.0006	4.23E-05	0.0000	0.0000	0.00E+00
230	0.29	0.000	0.221	0.2719	0.1933	0.0006	4.19E-05	0.0000	0.0000	0.00E+00
231	0.00	0.000	0.236	0.2523	0.1915	0.0006	4.16E-05	0.0000	0.0000	0.00E+00
232	0.18	0.000	0.193	0.2513	0.1897	0.0006	4.12E-05	0.0000	0.0000	0.00E+00
233	0.00	0.000	0.171	0.2371	0.1879	0.0006	4.09E-05	0.0000	0.0000	0.00E+00
234	0.00	0.000	0.217	0.2189	0.1862	0.0006	4.05E-05	0.0000	0.0000	0.00E+00
235	0.21	0.000	0.337	0.2085	0.1844	0.0006	4.02E-05	0.0000	0.0000	0.00E+00
236	0.33	0.000	0.270	0.2132	0.1827	0.0006	3.98E-05	0.0000	0.0000	3.37E-04
237	0.00	0.000	0.271	0.1906	0.1810	0.0006	3.95E-05	0.0000	0.0000	0.00E+00
238	0.00	0.000	0.246	0.1701	0.1793	0.0006	3.92E-05	0.0000	0.0000	0.00E+00
239	0.00	0.000	0.188	0.1547	0.1777	0.0006	3.88E-05	0.0000	0.0000	5.46E-04
240	0.00	0.000	0.086	0.1475	0.1760	0.0006	3.85E-05	0.0000	0.0000	0.00E+00
241	0.06	0.000	0.081	0.1454	0.1744	0.0006	3.82E-05	0.0000	0.0000	0.00E+00
242	0.24	0.000	0.072	0.1595	0.1727	0.0006	3.79E-05	0.0000	0.0000	0.00E+00
243	0.03	0.000	0.067	0.1562	0.1711	0.0006	3.76E-05	0.0000	0.0000	0.00E+00
244	0.00	0.000	0.050	0.1521	0.1695	0.0006	3.72E-05	0.0000	0.0000	0.00E+00

245		0.00	0.000	0.035	0.1491	0.1680	0.0006	3.69E-05	0.0000	0.0000	0.00E+00
246		0.42	0.000	0.040	0.1805	0.1664	0.0005	3.66E-05	0.0000	0.0000	0.00E+00
247		0.35	0.000	0.107	0.2007	0.1648	0.0005	3.63E-05	0.0000	0.0000	0.00E+00
248		0.01	0.000	0.105	0.1924	0.1633	0.0005	3.60E-05	0.0000	0.0000	0.00E+00
249		0.42	0.000	0.181	0.2120	0.1618	0.0005	3.57E-05	0.0000	0.0000	0.00E+00
250		0.18	0.000	0.162	0.2139	0.1603	0.0005	3.54E-05	0.0000	0.0000	0.00E+00
251		1.68	0.019	0.232	0.3334	0.1588	0.0005	3.51E-05	0.0000	0.0000	0.00E+00
252		0.05	0.000	0.215	0.3032	0.3713	0.0012	7.44E-05	0.0000	0.0000	0.00E+00
253		0.05	0.000	0.335	0.2757	0.7297	0.0024	1.39E-04	0.0000	0.0000	0.00E+00
254		0.03	0.000	0.257	0.2533	0.8471	0.0028	1.60E-04	0.0000	0.0000	3.47E-04
255		0.05	0.000	0.271	0.2305	0.9496	0.0031	1.77E-04	0.0000	0.0000	2.60E-04
256		0.08	0.000	0.257	0.2119	1.0759	0.0035	1.98E-04	0.0000	0.0000	0.00E+00
257		0.24	0.000	0.298	0.2056	1.1559	0.0038	2.12E-04	0.0000	0.0000	2.88E-04
258		0.01	0.000	0.276	0.1835	1.1631	0.0038	2.13E-04	0.0000	0.0000	3.17E-04
259		0.83	0.000	0.232	0.2329	1.1524	0.0038	2.11E-04	0.0000	0.0000	0.00E+00
260		0.38	0.000	0.262	0.2430	1.1417	0.0038	2.09E-04	0.0000	0.0000	3.63E-04
261		0.61	0.000	0.177	0.2787	1.1312	0.0037	2.07E-04	0.0000	0.0000	2.21E-04
262		0.12	0.000	0.164	0.2747	1.1208	0.0037	2.06E-04	0.0000	0.0000	0.00E+00
263		0.06	0.000	0.118	0.2698	1.1104	0.0036	2.04E-04	0.0000	0.0000	4.33E-04
264		0.00	0.000	0.176	0.2551	1.1002	0.0036	2.02E-04	0.0000	0.0000	1.37E-04
265		0.00	0.000	0.235	0.2355	1.0901	0.0036	2.01E-04	0.0000	0.0000	0.00E+00
266		0.03	0.000	0.125	0.2277	1.0800	0.0035	1.99E-04	0.0000	0.0000	3.98E-04
267		0.44	0.000	0.130	0.2537	1.0700	0.0035	1.97E-04	0.0000	0.0000	2.07E-04
268		0.09	0.000	0.167	0.2474	1.0619	0.0035	1.96E-04	0.0000	0.0000	0.00E+00
269		0.00	0.000	0.197	0.2310	1.0538	0.0035	1.94E-04	0.0000	0.0000	4.11E-04
270		0.00	0.000	0.326	0.2038	1.0441	0.0034	1.93E-04	0.0000	0.0000	1.82E-04
271		0.27	0.000	0.207	0.2090	1.0344	0.0034	1.91E-04	0.0000	0.0000	0.00E+00
272		0.33	0.000	0.137	0.2252	1.0249	0.0034	1.90E-04	0.0000	0.0000	4.24E-04
273		0.00	0.000	0.124	0.2148	1.0154	0.0033	1.88E-04	0.0000	0.0000	1.55E-04
274	*	0.00	0.000	0.082	0.2080	1.0061	0.0033	1.86E-04	0.0000	0.0000	0.00E+00
275	*	0.00	0.000	0.105	0.1993	0.9968	0.0033	1.85E-04	0.0000	0.0000	3.43E-04
276	*	0.00	0.000	0.117	0.1895	0.9876	0.0032	1.83E-04	0.0000	0.0000	2.67E-04
277	*	0.62	0.000	0.110	0.1912	0.9785	0.0032	1.82E-04	0.0000	0.0000	0.00E+00
278	*	0.44	0.000	0.000	0.1928	0.9694	0.0032	1.80E-04	0.0000	0.0000	3.14E-04
279		0.00	0.000	0.072	0.2525	0.9605	0.0032	1.79E-04	0.0000	0.0000	2.81E-04
280		0.00	0.000	0.285	0.2388	0.9516	0.0031	1.77E-04	0.0000	0.0000	0.00E+00

281		0.00	0.000	0.211	0.2212	0.9428	0.0031	1.76E-04	0.0000	0.0000	0.00E+00
282		0.00	0.000	0.193	0.2051	0.9341	0.0031	1.74E-04	0.0000	0.0000	5.78E-04
283		0.04	0.000	0.269	0.1862	0.9255	0.0030	1.73E-04	0.0000	0.0000	0.00E+00
284		0.00	0.000	0.261	0.1645	0.9170	0.0030	1.71E-04	0.0000	0.0000	0.00E+00
285		0.00	0.000	0.262	0.1427	0.9085	0.0030	1.70E-04	0.0000	0.0000	3.52E-04
286		0.00	0.000	0.092	0.1350	0.9001	0.0030	1.69E-04	0.0000	0.0000	2.52E-04
287		0.00	0.000	0.000	0.1350	0.8918	0.0029	1.67E-04	0.0000	0.0000	0.00E+00
288	*	0.00	0.000	0.000	0.1350	0.8836	0.0029	1.66E-04	0.0000	0.0000	0.00E+00
289	*	0.00	0.000	0.000	0.1350	0.8754	0.0029	1.64E-04	0.0000	0.0000	5.88E-04
290	*	0.05	0.000	0.051	0.1350	0.8673	0.0029	1.63E-04	0.0000	0.0000	0.00E+00
291	*	0.13	0.000	0.097	0.1366	0.8593	0.0028	1.62E-04	0.0000	0.0000	0.00E+00
292		0.00	0.000	0.021	0.1362	0.8514	0.0028	1.60E-04	0.0000	0.0000	3.09E-04
293		0.01	0.000	0.014	0.1360	0.8435	0.0028	1.59E-04	0.0000	0.0000	3.01E-04
294		0.00	0.000	0.005	0.1355	0.8357	0.0027	1.58E-04	0.0000	0.0000	0.00E+00
295		0.00	0.000	0.005	0.1351	0.8280	0.0027	1.56E-04	0.0000	0.0000	0.00E+00
296		0.00	0.000	0.001	0.1350	0.8204	0.0027	1.55E-04	0.0000	0.0000	3.67E-04
297		0.00	0.000	0.000	0.1350	0.8128	0.0027	1.54E-04	0.0000	0.0000	2.24E-04
298		0.37	0.000	0.021	0.1643	0.8053	0.0026	1.52E-04	0.0000	0.0000	0.00E+00
299		0.03	0.000	0.020	0.1655	0.7979	0.0026	1.51E-04	0.0000	0.0000	0.00E+00
300		0.13	0.000	0.027	0.1741	0.7905	0.0026	1.50E-04	0.0000	0.0000	3.51E-04
301		0.00	0.000	0.023	0.1722	0.7832	0.0026	1.49E-04	0.0000	0.0000	2.59E-04
302		0.00	0.000	0.020	0.1706	0.7760	0.0026	1.47E-04	0.0000	0.0000	0.00E+00
303	*	0.00	0.000	0.000	0.1706	0.7688	0.0025	1.46E-04	0.0000	0.0000	0.00E+00
304	*	0.00	0.000	0.019	0.1690	0.7617	0.0025	1.45E-04	0.0000	0.0000	3.00E-04
305	*	0.00	0.000	0.019	0.1674	0.7546	0.0025	1.44E-04	0.0000	0.0000	3.58E-05
306		0.44	0.000	0.027	0.2023	0.7477	0.0025	1.42E-04	0.0000	0.0000	5.91E-04
307		0.12	0.000	0.027	0.2101	0.7408	0.0024	1.41E-04	0.0000	0.0000	0.00E+00
308		1.12	0.000	0.170	0.2890	0.7339	0.0024	1.40E-04	0.0000	0.0000	0.00E+00
309		0.25	0.000	0.257	0.2888	0.7271	0.0024	1.39E-04	0.0000	0.0000	0.00E+00
310		0.33	0.000	0.238	0.2965	0.7204	0.0024	1.38E-04	0.0000	0.0000	0.00E+00
311		0.07	0.000	0.132	0.2915	0.7138	0.0023	1.37E-04	0.0000	0.0000	3.88E-04
312		0.50	0.000	0.155	0.3206	0.7072	0.0023	1.35E-04	0.0000	0.0000	2.28E-04
313		0.00	0.000	0.129	0.2952	0.9034	0.0030	1.69E-04	0.0000	0.0000	0.00E+00
314		0.16	0.000	0.128	0.2900	1.2619	0.0041	2.29E-04	0.0000	0.0000	3.27E-04
315	*	0.00	0.000	0.109	0.2762	1.4518	0.0048	2.60E-04	0.0000	0.0000	2.15E-04
316	*	0.03	0.000	0.032	0.2722	1.5823	0.0052	2.82E-04	0.0000	0.0000	3.28E-04

317	*	0.01	0.000	0.014	0.2696	1.6760	0.0055	2.97E-04	0.0000	0.0000	1.97E-04
318	*	0.24	0.000	0.098	0.2689	1.7429	0.0057	3.08E-04	0.0000	0.0000	4.00E-04
319	*	0.04	0.000	0.104	0.2690	1.7888	0.0059	3.15E-04	0.0000	0.0000	1.21E-04
320	*	0.02	0.000	0.111	0.2631	1.8116	0.0060	3.19E-04	0.0000	0.0000	4.57E-04
321	*	0.00	0.000	0.000	0.2626	1.8217	0.0060	3.20E-04	0.0000	0.0000	9.01E-05
322	*	0.00	0.000	0.000	0.2619	1.8215	0.0060	3.20E-04	0.0000	0.0000	5.59E-04
323	*	0.00	0.000	0.086	0.2548	1.8191	0.0060	3.20E-04	0.0000	0.0000	2.80E-04
324		0.11	0.000	0.192	0.2478	1.8023	0.0059	3.17E-04	0.0000	0.0000	2.82E-04
325		0.18	0.000	0.198	0.2457	1.7935	0.0059	3.16E-04	0.0000	0.0000	3.65E-04
326		0.36	0.000	0.157	0.2627	1.7796	0.0058	3.14E-04	0.0000	0.0000	1.90E-04
327		0.04	0.000	0.219	0.2482	1.7632	0.0058	3.11E-04	0.0000	0.0000	4.53E-04
328		0.25	0.000	0.271	0.2467	1.7470	0.0057	3.08E-04	0.0000	0.0000	9.69E-05
329		0.48	0.000	0.141	0.2746	1.7309	0.0057	3.06E-04	0.0000	0.0000	5.43E-04
330		0.04	0.000	0.112	0.2687	1.7150	0.0056	3.03E-04	0.0000	0.0000	3.15E-04
331	*	0.01	0.000	0.010	0.2687	1.6992	0.0056	3.01E-04	0.0000	0.0000	2.21E-04
332	*	0.00	0.000	0.003	0.2687	1.6835	0.0055	2.98E-04	0.0000	0.0000	3.99E-04
333		0.00	0.000	0.179	0.2538	1.6683	0.0055	2.96E-04	0.0000	0.0000	1.28E-04
334		0.00	0.000	0.155	0.2409	1.6562	0.0054	2.94E-04	0.0000	0.0000	3.37E-04
335		0.07	0.000	0.230	0.2277	1.6409	0.0054	2.91E-04	0.0000	0.0000	3.59E-04
336		0.08	0.000	0.208	0.2173	1.6285	0.0054	2.89E-04	0.0000	0.0000	3.04E-04
337	*	0.01	0.000	0.111	0.2086	1.6144	0.0053	2.87E-04	0.0000	0.0000	2.48E-04
338		0.00	0.000	0.151	0.1960	1.5995	0.0053	2.84E-04	0.0000	0.0000	2.86E-04
339		0.00	0.000	0.171	0.1818	1.5848	0.0052	2.82E-04	0.0000	0.0000	2.87E-04
340	*	0.13	0.000	0.087	0.1834	1.5702	0.0052	2.80E-04	0.0000	0.0000	2.97E-04
341		0.10	0.000	0.172	0.1798	1.5557	0.0051	2.77E-04	0.0000	0.0000	2.68E-04
342		0.16	0.000	0.155	0.1806	1.5414	0.0051	2.75E-04	0.0000	0.0000	3.09E-04
343		0.02	0.000	0.088	0.1752	1.5272	0.0050	2.73E-04	0.0000	0.0000	2.47E-04
344		0.34	0.000	0.068	0.1975	1.5131	0.0050	2.70E-04	0.0000	0.0000	3.20E-04
345	*	0.31	0.000	0.048	0.1992	1.4992	0.0049	2.68E-04	0.0000	0.0000	2.25E-04
346	*	0.02	0.000	0.079	0.2008	1.4854	0.0049	2.66E-04	0.0000	0.0000	3.32E-04
347	*	0.18	0.000	0.078	0.2024	1.4717	0.0048	2.64E-04	0.0000	0.0000	2.05E-04
348	*	0.08	0.000	0.073	0.2041	1.4582	0.0048	2.61E-04	0.0000	0.0000	0.00E+00
349	*	0.05	0.000	0.036	0.2057	1.4447	0.0047	2.59E-04	0.0000	0.0000	5.90E-04
350	*	0.00	0.000	0.035	0.2074	1.4314	0.0047	2.57E-04	0.0000	0.0000	0.00E+00
351	*	0.00	0.000	0.042	0.2090	1.4182	0.0047	2.55E-04	0.0000	0.0000	4.22E-04
352	*	0.05	0.000	0.000	0.2106	1.4052	0.0046	2.53E-04	0.0000	0.0000	1.59E-04

353	*		0.00	0.000	0.059	0.2123	1.3922	0.0046	2.51E-04	0.0000	0.0000	3.65E-04
354	*		0.00	0.000	0.025	0.2139	1.3794	0.0045	2.49E-04	0.0000	0.0000	2.06E-04
355	*		0.04	0.000	0.014	0.2156	1.3667	0.0045	2.46E-04	0.0000	0.0000	3.17E-04
356	*	*	0.04	0.000	0.037	0.2156	1.3541	0.0045	2.44E-04	0.0000	0.0000	2.44E-04
357	*	*	0.00	0.000	0.031	0.2156	1.3416	0.0044	2.42E-04	0.0000	0.0000	0.00E+00
358	*	*	0.00	0.000	0.000	0.2156	1.3293	0.0044	2.40E-04	0.0000	0.0000	5.49E-04
359			0.00	0.000	0.138	0.2043	1.3170	0.0043	2.38E-04	0.0000	0.0000	0.00E+00
360	*	*	0.32	0.000	0.070	0.2043	1.3049	0.0043	2.36E-04	0.0000	0.0000	3.44E-04
361	*	*	0.00	0.000	0.058	0.2043	1.2928	0.0042	2.34E-04	0.0000	0.0000	2.52E-04
362	*	*	0.00	0.000	0.057	0.2043	1.2809	0.0042	2.32E-04	0.0000	0.0000	0.00E+00
363	*	*	0.00	0.000	0.056	0.2043	1.2691	0.0042	2.30E-04	0.0000	0.0000	5.86E-04
364	*	*	0.00	0.000	0.074	0.2043	1.2574	0.0041	2.28E-04	0.0000	0.0000	0.00E+00
365	*	*	0.00	0.000	0.009	0.2043	1.2458	0.0041	2.27E-04	0.0000	0.0000	3.68E-04

* = Frozen (air or soil)

Annual Totals for Year 1			
	inches	cubic feet	percent
Precipitation	37.85	2,748,072.7	100.00
Runoff	0.019	1,345.3	0.05
Evapotranspiration	36.831	2,673,947.9	97.30
Drainage Collected from Layer 2	0.8414	61,084.6	2.22
Percolation/Leakage through Layer 3	0.048335	3,509.1	0.13
Average Head on Top of Layer 3	0.7013	---	---
Percolation/Leakage through Layer 4	0.048363	3,511.1	0.13
Change in Water Storage	0.1127	8,183.8	0.30
Soil Water at Start of Year	117.9907	8,566,123.7	311.71
Soil Water at End of Year	118.1034	8,574,307.5	312.01
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 Outputs for Years 2 through 99 Removed for Brevity

Daily Output for Year 100

Column key: Head #1: drainage from Layer 3
Drain #1: drainage from Layer 2
Leak #1: leakage thru Layer 3
Leak #2: leakage thru Layer 4

Title: Sibley Quarry Geomembrane Cover Scenario
Simulated On: 11/11/2023 8:40

Day	Freezing Status* Air	Soil	Rain (inches)	Runoff (inches)	ET (inches)	Evap. Zone Water (in/in)	Head #1 (inches)	Drain #1 (inches)	Leak #1 (inches)	Head #2 (inches)	Drain #2 (inches)	Leak #2 (inches)
1			0.00	0.000	0.080	0.1664	0.0890	0.0003	2.08E-05	0.0000	0.0000	0.00E+00
2			0.09	0.000	0.068	0.1681	0.0882	0.0003	2.07E-05	0.0000	0.0000	0.00E+00
3			0.01	0.000	0.057	0.1646	0.0873	0.0003	2.05E-05	0.0000	0.0000	0.00E+00
4			0.01	0.000	0.049	0.1609	0.0865	0.0003	2.03E-05	0.0000	0.0000	0.00E+00
5			0.01	0.000	0.047	0.1578	0.0857	0.0003	2.01E-05	0.0000	0.0000	0.00E+00
6			0.01	0.000	0.043	0.1554	0.0849	0.0003	2.00E-05	0.0000	0.0000	0.00E+00
7			0.02	0.000	0.041	0.1537	0.0841	0.0003	1.98E-05	0.0000	0.0000	0.00E+00
8	*		0.00	0.000	0.033	0.1509	0.0833	0.0003	1.96E-05	0.0000	0.0000	0.00E+00
9			0.00	0.000	0.031	0.1483	0.0825	0.0003	1.95E-05	0.0000	0.0000	0.00E+00
10			0.00	0.000	0.030	0.1458	0.0818	0.0003	1.93E-05	0.0000	0.0000	0.00E+00
11			0.00	0.000	0.029	0.1434	0.0810	0.0003	1.91E-05	0.0000	0.0000	0.00E+00
12			0.00	0.000	0.027	0.1412	0.0803	0.0003	1.90E-05	0.0000	0.0000	0.00E+00
13			0.29	0.000	0.032	0.1625	0.0795	0.0003	1.88E-05	0.0000	0.0000	0.00E+00
14			0.14	0.000	0.031	0.1712	0.0788	0.0003	1.87E-05	0.0000	0.0000	0.00E+00
15			0.00	0.000	0.028	0.1692	0.0780	0.0003	1.85E-05	0.0000	0.0000	0.00E+00
16			0.00	0.000	0.025	0.1671	0.0773	0.0003	1.83E-05	0.0000	0.0000	0.00E+00
17	*		0.03	0.000	0.030	0.1671	0.0766	0.0003	1.82E-05	0.0000	0.0000	0.00E+00
18	*		0.06	0.000	0.088	0.1651	0.0758	0.0002	1.80E-05	0.0000	0.0000	0.00E+00
19	*		0.00	0.000	0.002	0.1651	0.0751	0.0002	1.79E-05	0.0000	0.0000	0.00E+00
20	*		0.12	0.000	0.044	0.1668	0.0744	0.0002	1.77E-05	0.0000	0.0000	6.15E-04
21	*		0.00	0.000	0.055	0.1671	0.0737	0.0002	1.76E-05	0.0000	0.0000	1.08E-04
22			0.00	0.000	0.023	0.1651	0.0730	0.0002	1.74E-05	0.0000	0.0000	0.00E+00
23			0.00	0.000	0.019	0.1635	0.0756	0.0002	1.80E-05	0.0000	0.0000	0.00E+00
24	*		0.02	0.000	0.032	0.1622	0.0749	0.0002	1.78E-05	0.0000	0.0000	0.00E+00
25	*		0.11	0.000	0.050	0.1638	0.0742	0.0002	1.77E-05	0.0000	0.0000	0.00E+00
26	*		0.00	0.000	0.038	0.1638	0.0735	0.0002	1.75E-05	0.0000	0.0000	0.00E+00
27	*		0.02	0.000	0.018	0.1638	0.0728	0.0002	1.74E-05	0.0000	0.0000	0.00E+00
28			0.00	0.000	0.018	0.1624	0.0721	0.0002	1.72E-05	0.0000	0.0000	0.00E+00

29			0.00	0.000	0.018	0.1609	0.0714	0.0002	1.71E-05	0.0000	0.0000	0.00E+00
30			0.02	0.000	0.020	0.1611	0.0708	0.0002	1.69E-05	0.0000	0.0000	0.00E+00
31			0.08	0.000	0.022	0.1663	0.0701	0.0002	1.68E-05	0.0000	0.0000	0.00E+00
32			0.25	0.000	0.022	0.1852	0.0694	0.0002	1.67E-05	0.0000	0.0000	0.00E+00
33			0.10	0.000	0.023	0.1916	0.0688	0.0002	1.65E-05	0.0000	0.0000	0.00E+00
34	*		0.04	0.000	0.062	0.1902	0.0681	0.0002	1.64E-05	0.0000	0.0000	0.00E+00
35	*		0.44	0.000	0.097	0.1918	0.0675	0.0002	1.62E-05	0.0000	0.0000	0.00E+00
36			0.00	0.000	0.161	0.2054	0.0669	0.0002	1.61E-05	0.0000	0.0000	0.00E+00
37			0.01	0.000	0.123	0.1959	0.0662	0.0002	1.60E-05	0.0000	0.0000	0.00E+00
38	*		0.02	0.000	0.024	0.1959	0.0656	0.0002	1.58E-05	0.0000	0.0000	0.00E+00
39	*		0.80	0.000	0.065	0.1975	0.0650	0.0002	1.57E-05	0.0000	0.0000	0.00E+00
40	*	*	0.00	0.000	0.029	0.1975	0.0644	0.0002	1.56E-05	0.0000	0.0000	0.00E+00
41	*	*	0.01	0.000	0.000	0.1975	0.0638	0.0002	1.54E-05	0.0000	0.0000	0.00E+00
42		*	0.35	0.335	0.037	0.2534	0.0632	0.0002	1.53E-05	0.0000	0.0000	0.00E+00
43			0.06	0.000	0.227	0.2395	0.0626	0.0002	1.52E-05	0.0000	0.0000	0.00E+00
44			0.19	0.000	0.131	0.2443	0.0620	0.0002	1.50E-05	0.0000	0.0000	0.00E+00
45	*	*	0.05	0.000	0.053	0.2443	0.0614	0.0002	1.49E-05	0.0000	0.0000	0.00E+00
46	*	*	0.00	0.000	0.000	0.2443	0.0609	0.0002	1.48E-05	0.0000	0.0000	0.00E+00
47			0.53	0.000	0.140	0.2764	0.0603	0.0002	1.47E-05	0.0000	0.0000	0.00E+00
48	*	*	0.00	0.000	0.002	0.2764	0.0597	0.0002	1.45E-05	0.0000	0.0000	0.00E+00
49	*	*	0.02	0.000	0.022	0.2764	0.0592	0.0002	1.44E-05	0.0000	0.0000	0.00E+00
50	*	*	0.31	0.000	0.032	0.2764	0.0586	0.0002	1.43E-05	0.0000	0.0000	0.00E+00
51	*	*	0.15	0.000	0.012	0.2764	0.0581	0.0002	1.42E-05	0.0000	0.0000	0.00E+00
52	*	*	0.03	0.000	0.009	0.2764	0.0575	0.0002	1.41E-05	0.0000	0.0000	0.00E+00
53	*	*	0.09	0.000	0.007	0.2764	0.0570	0.0002	1.39E-05	0.0000	0.0000	0.00E+00
54	*	*	0.06	0.000	0.000	0.2764	0.0564	0.0002	1.38E-05	0.0000	0.0000	0.00E+00
55	*	*	0.03	0.000	0.000	0.2764	0.0559	0.0002	1.37E-05	0.0000	0.0000	0.00E+00
56		*	0.25	0.271	0.036	0.3227	0.0554	0.0002	1.36E-05	0.0000	0.0000	0.00E+00
57	*	*	0.01	0.000	0.008	0.3227	0.0549	0.0002	1.35E-05	0.0000	0.0000	0.00E+00
58	*	*	0.01	0.000	0.010	0.3227	0.0543	0.0002	1.34E-05	0.0000	0.0000	0.00E+00
59			0.16	0.000	0.182	0.2928	0.2427	0.0008	4.82E-05	0.0000	0.0000	0.00E+00
60	*	*	0.00	0.000	0.000	0.2928	0.9401	0.0031	1.75E-04	0.0000	0.0000	4.05E-04
61			0.00	0.000	0.189	0.2730	0.9937	0.0033	1.84E-04	0.0000	0.0000	1.94E-04
62	*	*	0.03	0.000	0.031	0.2730	1.0526	0.0035	1.94E-04	0.0000	0.0000	0.00E+00
63	*	*	0.00	0.000	0.000	0.2730	1.0429	0.0034	1.93E-04	0.0000	0.0000	3.48E-04
64	*	*	0.00	0.000	0.000	0.2730	1.0333	0.0034	1.91E-04	0.0000	0.0000	2.54E-04

65			0.00	0.000	0.202	0.2526	1.0622	0.0035	1.96E-04	0.0000	0.0000	0.00E+00
66			0.00	0.000	0.272	0.2258	1.1767	0.0039	2.15E-04	0.0000	0.0000	3.59E-04
67			0.00	0.000	0.230	0.2043	1.2812	0.0042	2.32E-04	0.0000	0.0000	2.22E-04
68			0.00	0.000	0.177	0.1892	1.3213	0.0043	2.39E-04	0.0000	0.0000	0.00E+00
69	*	*	0.00	0.000	0.000	0.1892	1.3116	0.0043	2.37E-04	0.0000	0.0000	5.78E-04
70	*	*	0.21	0.000	0.066	0.1892	1.2995	0.0043	2.35E-04	0.0000	0.0000	0.00E+00
71	*	*	0.51	0.000	0.031	0.1892	1.2875	0.0042	2.33E-04	0.0000	0.0000	3.50E-04
72	*	*	0.00	0.000	0.064	0.1892	1.2756	0.0042	2.31E-04	0.0000	0.0000	2.40E-04
73	*	*	0.00	0.000	0.037	0.1892	1.2639	0.0042	2.29E-04	0.0000	0.0000	0.00E+00
74	*	*	0.02	0.000	0.000	0.1892	1.2522	0.0041	2.28E-04	0.0000	0.0000	5.79E-04
75	*	*	0.23	0.000	0.000	0.1892	1.2407	0.0041	2.26E-04	0.0000	0.0000	0.00E+00
76	*	*	0.00	0.000	0.113	0.1892	1.2293	0.0040	2.24E-04	0.0000	0.0000	3.76E-04
77	*	*	0.00	0.000	0.113	0.1892	1.2179	0.0040	2.22E-04	0.0000	0.0000	1.91E-04
78	*	*	0.00	0.000	0.101	0.1892	1.2067	0.0040	2.20E-04	0.0000	0.0000	0.00E+00
79		*	0.00	0.025	0.222	0.2063	1.1956	0.0039	2.18E-04	0.0000	0.0000	6.32E-04
80			0.00	0.000	0.230	0.1872	1.1846	0.0039	2.16E-04	0.0000	0.0000	2.96E-04
81			0.00	0.000	0.253	0.1660	1.1736	0.0039	2.15E-04	0.0000	0.0000	0.00E+00
82			0.42	0.000	0.201	0.1844	1.1628	0.0038	2.13E-04	0.0000	0.0000	0.00E+00
83			0.17	0.000	0.214	0.1805	1.1521	0.0038	2.11E-04	0.0000	0.0000	3.51E-04
84			0.00	0.000	0.083	0.1735	1.1415	0.0038	2.09E-04	0.0000	0.0000	2.44E-04
85			0.00	0.000	0.064	0.1682	1.1309	0.0037	2.07E-04	0.0000	0.0000	0.00E+00
86			0.06	0.000	0.058	0.1680	1.1205	0.0037	2.06E-04	0.0000	0.0000	4.28E-04
87			0.01	0.000	0.052	0.1649	1.1102	0.0036	2.04E-04	0.0000	0.0000	1.47E-04
88			0.29	0.000	0.047	0.1853	1.0999	0.0036	2.02E-04	0.0000	0.0000	0.00E+00
89			0.01	0.000	0.195	0.1695	1.0898	0.0036	2.01E-04	0.0000	0.0000	5.13E-04
90	*		0.07	0.000	0.069	0.1695	1.0797	0.0035	1.99E-04	0.0000	0.0000	2.59E-04
91	*		0.14	0.000	0.122	0.1711	1.0698	0.0035	1.97E-04	0.0000	0.0000	0.00E+00
92			0.34	0.000	0.043	0.1960	1.0621	0.0035	1.96E-04	0.0000	0.0000	0.00E+00
93	*		0.00	0.000	0.000	0.1960	1.0531	0.0035	1.94E-04	0.0000	0.0000	5.83E-04
94			0.00	0.000	0.191	0.1800	1.0434	0.0034	1.93E-04	0.0000	0.0000	0.00E+00
95			0.00	0.000	0.034	0.1772	1.0337	0.0034	1.91E-04	0.0000	0.0000	0.00E+00
96			0.00	0.000	0.032	0.1746	1.0242	0.0034	1.90E-04	0.0000	0.0000	5.80E-04
97	*		0.45	0.000	0.062	0.1762	1.0147	0.0033	1.88E-04	0.0000	0.0000	0.00E+00
98	*		0.21	0.000	0.078	0.1778	1.0054	0.0033	1.86E-04	0.0000	0.0000	0.00E+00
99	*		0.00	0.000	0.072	0.1795	0.9961	0.0033	1.85E-04	0.0000	0.0000	3.94E-04
100	*		0.04	0.000	0.077	0.1811	0.9869	0.0032	1.83E-04	0.0000	0.0000	2.16E-04

101	*		0.00	0.000	0.044	0.1828	0.9778	0.0032	1.82E-04	0.0000	0.0000	0.00E+00
102	*		0.00	0.000	0.088	0.1844	0.9688	0.0032	1.80E-04	0.0000	0.0000	3.58E-04
103	*		0.00	0.000	0.067	0.1860	0.9598	0.0032	1.79E-04	0.0000	0.0000	2.38E-04
104	*		0.03	0.000	0.000	0.1877	0.9510	0.0031	1.77E-04	0.0000	0.0000	0.00E+00
105	*		0.01	0.000	0.000	0.1893	0.9422	0.0031	1.76E-04	0.0000	0.0000	3.32E-04
106			0.04	0.000	0.200	0.1823	0.9335	0.0031	1.74E-04	0.0000	0.0000	2.48E-04
107			0.05	0.000	0.034	0.1838	0.9249	0.0030	1.73E-04	0.0000	0.0000	0.00E+00
108			0.22	0.000	0.034	0.1989	0.9164	0.0030	1.71E-04	0.0000	0.0000	0.00E+00
109			0.43	0.000	0.293	0.2100	0.9079	0.0030	1.70E-04	0.0000	0.0000	3.99E-04
110			0.11	0.000	0.215	0.2013	0.8995	0.0030	1.68E-04	0.0000	0.0000	2.05E-04
111	*		0.03	0.000	0.127	0.1930	0.8922	0.0029	1.67E-04	0.0000	0.0000	0.00E+00
112	*		0.01	0.000	0.174	0.1790	0.8843	0.0029	1.66E-04	0.0000	0.0000	3.27E-04
113	*		0.04	0.000	0.043	0.1790	0.8761	0.0029	1.64E-04	0.0000	0.0000	2.63E-04
114			0.16	0.000	0.184	0.1771	0.8680	0.0029	1.63E-04	0.0000	0.0000	0.00E+00
115	*		0.03	0.000	0.102	0.1707	0.8600	0.0028	1.62E-04	0.0000	0.0000	0.00E+00
116	*		0.08	0.000	0.124	0.1667	0.8521	0.0028	1.60E-04	0.0000	0.0000	3.47E-04
117	*	*	0.13	0.000	0.124	0.1667	0.8442	0.0028	1.59E-04	0.0000	0.0000	2.64E-04
118	*	*	0.00	0.000	0.004	0.1667	0.8364	0.0027	1.58E-04	0.0000	0.0000	0.00E+00
119	*	*	0.00	0.000	0.000	0.1667	0.8287	0.0027	1.56E-04	0.0000	0.0000	0.00E+00
120	*	*	0.07	0.000	0.045	0.1667	0.8210	0.0027	1.55E-04	0.0000	0.0000	4.10E-04
121	*	*	0.11	0.000	0.000	0.1667	0.8135	0.0027	1.54E-04	0.0000	0.0000	1.84E-04
122	*	*	0.00	0.000	0.127	0.1667	0.8059	0.0026	1.52E-04	0.0000	0.0000	0.00E+00
123	*	*	0.01	0.000	0.020	0.1667	0.7985	0.0026	1.51E-04	0.0000	0.0000	0.00E+00
124	*	*	0.07	0.000	0.073	0.1667	0.7911	0.0026	1.50E-04	0.0000	0.0000	3.92E-04
125			0.19	0.000	0.054	0.1781	0.7838	0.0026	1.49E-04	0.0000	0.0000	2.20E-04
126			0.00	0.000	0.047	0.1742	0.7766	0.0026	1.47E-04	0.0000	0.0000	0.00E+00
127			0.00	0.000	0.042	0.1707	0.7694	0.0025	1.46E-04	0.0000	0.0000	0.00E+00
128			0.00	0.000	0.038	0.1675	0.7623	0.0025	1.45E-04	0.0000	0.0000	4.10E-04
129			0.05	0.000	0.039	0.1683	0.7552	0.0025	1.44E-04	0.0000	0.0000	1.82E-04
130	*		0.00	0.000	0.035	0.1654	0.7483	0.0025	1.43E-04	0.0000	0.0000	0.00E+00
131			0.00	0.000	0.034	0.1625	0.7414	0.0024	1.41E-04	0.0000	0.0000	0.00E+00
132			0.00	0.000	0.031	0.1599	0.7345	0.0024	1.40E-04	0.0000	0.0000	3.56E-04
133	*		0.05	0.000	0.052	0.1599	0.7277	0.0024	1.39E-04	0.0000	0.0000	2.52E-04
134	*		0.01	0.000	0.036	0.1576	0.7210	0.0024	1.38E-04	0.0000	0.0000	0.00E+00
135			0.55	0.000	0.035	0.2003	0.7143	0.0023	1.37E-04	0.0000	0.0000	0.00E+00
136			0.00	0.000	0.274	0.1776	0.7077	0.0023	1.36E-04	0.0000	0.0000	0.00E+00

137		0.03	0.000	0.038	0.1767	0.7012	0.0023	1.34E-04	0.0000	0.0000	6.20E-04
138		0.47	0.000	0.036	0.2130	0.6947	0.0023	1.33E-04	0.0000	0.0000	0.00E+00
139		0.00	0.000	0.146	0.2008	0.6883	0.0023	1.32E-04	0.0000	0.0000	0.00E+00
140	*	0.00	0.000	0.185	0.1857	0.6820	0.0022	1.31E-04	0.0000	0.0000	0.00E+00
141	*	0.21	0.000	0.120	0.1873	0.6757	0.0022	1.30E-04	0.0000	0.0000	3.04E-04
142		0.05	0.000	0.212	0.1798	0.6694	0.0022	1.29E-04	0.0000	0.0000	3.21E-05
143		0.10	0.000	0.089	0.1808	0.6633	0.0022	1.28E-04	0.0000	0.0000	6.09E-04
144		0.12	0.000	0.077	0.1840	0.6571	0.0022	1.27E-04	0.0000	0.0000	0.00E+00
145		0.23	0.000	0.065	0.1974	0.6510	0.0021	1.26E-04	0.0000	0.0000	0.00E+00
146		0.03	0.000	0.190	0.1837	0.6450	0.0021	1.25E-04	0.0000	0.0000	0.00E+00
147		0.00	0.000	0.055	0.1792	0.6391	0.0021	1.24E-04	0.0000	0.0000	0.00E+00
148		0.47	0.000	0.059	0.2135	0.6331	0.0021	1.22E-04	0.0000	0.0000	0.00E+00
149		0.00	0.000	0.336	0.1855	0.6273	0.0021	1.21E-04	0.0000	0.0000	4.79E-04
150		0.87	0.000	0.059	0.2530	0.6215	0.0020	1.20E-04	0.0000	0.0000	4.60E-05
151		0.00	0.000	0.425	0.2176	0.6157	0.0020	1.19E-04	0.0000	0.0000	0.00E+00
152		0.00	0.000	0.432	0.1815	0.6100	0.0020	1.18E-04	0.0000	0.0000	0.00E+00
153		0.00	0.000	0.218	0.1634	0.6044	0.0020	1.17E-04	0.0000	0.0000	3.55E-04
154		0.01	0.000	0.109	0.1554	0.5988	0.0020	1.16E-04	0.0000	0.0000	2.59E-04
155		0.53	0.000	0.089	0.1917	0.5933	0.0019	1.15E-04	0.0000	0.0000	0.00E+00
156		0.24	0.000	0.372	0.1803	0.5878	0.0019	1.15E-04	0.0000	0.0000	0.00E+00
157		0.00	0.000	0.090	0.1730	0.5823	0.0019	1.14E-04	0.0000	0.0000	0.00E+00
158		0.22	0.000	0.090	0.1837	0.5770	0.0019	1.13E-04	0.0000	0.0000	0.00E+00
159		0.43	0.000	0.394	0.1861	0.5866	0.0019	1.14E-04	0.0000	0.0000	6.23E-04
160		0.00	0.000	0.289	0.1623	0.5961	0.0020	1.16E-04	0.0000	0.0000	9.18E-05
161		0.34	0.000	0.211	0.1732	0.5911	0.0019	1.15E-04	0.0000	0.0000	0.00E+00
162		0.02	0.000	0.116	0.1649	0.5863	0.0019	1.14E-04	0.0000	0.0000	0.00E+00
163		0.28	0.000	0.095	0.1800	0.5808	0.0019	1.13E-04	0.0000	0.0000	0.00E+00
164		0.48	0.000	0.104	0.2113	0.5759	0.0019	1.12E-04	0.0000	0.0000	0.00E+00
165		0.44	0.000	0.307	0.2224	0.5715	0.0019	1.12E-04	0.0000	0.0000	4.56E-04
166		0.71	0.000	0.377	0.2498	0.5662	0.0019	1.11E-04	0.0000	0.0000	9.07E-05
167		0.00	0.000	0.358	0.2200	0.5609	0.0018	1.10E-04	0.0000	0.0000	0.00E+00
168		0.00	0.000	0.444	0.1830	0.5557	0.0018	1.09E-04	0.0000	0.0000	0.00E+00
169		0.42	0.000	0.298	0.1929	0.5506	0.0018	1.08E-04	0.0000	0.0000	0.00E+00
170		0.00	0.000	0.419	0.1580	0.5455	0.0018	1.07E-04	0.0000	0.0000	5.25E-04
171		0.00	0.000	0.231	0.1388	0.5405	0.0018	1.06E-04	0.0000	0.0000	2.59E-04
172		0.00	0.000	0.040	0.1355	0.5355	0.0018	1.05E-04	0.0000	0.0000	0.00E+00

173	0.00	0.000	0.004	0.1351	0.5305	0.0017	1.04E-04	0.0000	0.0000	0.00E+00
174	0.01	0.000	0.011	0.1350	0.5256	0.0017	1.03E-04	0.0000	0.0000	0.00E+00
175	0.01	0.000	0.014	0.1350	0.5207	0.0017	1.03E-04	0.0000	0.0000	0.00E+00
176	0.24	0.000	0.074	0.1489	0.5159	0.0017	1.02E-04	0.0000	0.0000	0.00E+00
177	0.00	0.000	0.076	0.1426	0.5111	0.0017	1.01E-04	0.0000	0.0000	3.18E-04
178	0.00	0.000	0.082	0.1357	0.5064	0.0017	1.00E-04	0.0000	0.0000	3.12E-04
179	0.00	0.000	0.007	0.1352	0.5017	0.0016	9.92E-05	0.0000	0.0000	0.00E+00
180	0.00	0.000	0.002	0.1350	0.4971	0.0016	9.84E-05	0.0000	0.0000	0.00E+00
181	0.95	0.000	0.084	0.2069	0.4925	0.0016	9.76E-05	0.0000	0.0000	0.00E+00
182	0.02	0.000	0.347	0.1795	0.4879	0.0016	9.68E-05	0.0000	0.0000	0.00E+00
183	0.05	0.000	0.223	0.1652	0.4834	0.0016	9.59E-05	0.0000	0.0000	0.00E+00
184	0.14	0.000	0.255	0.1553	0.4789	0.0016	9.51E-05	0.0000	0.0000	3.36E-04
185	0.25	0.000	0.302	0.1507	0.4745	0.0016	9.43E-05	0.0000	0.0000	0.00E+00
186	0.13	0.000	0.121	0.1515	0.4701	0.0015	9.35E-05	0.0000	0.0000	3.37E-04
187	0.00	0.000	0.152	0.1391	0.4657	0.0015	9.28E-05	0.0000	0.0000	6.14E-04
188	0.01	0.000	0.046	0.1360	0.4614	0.0015	9.20E-05	0.0000	0.0000	0.00E+00
189	0.01	0.000	0.020	0.1352	0.4571	0.0015	9.12E-05	0.0000	0.0000	0.00E+00
190	0.06	0.000	0.029	0.1381	0.4529	0.0015	9.05E-05	0.0000	0.0000	0.00E+00
191	0.00	0.000	0.015	0.1369	0.4487	0.0015	8.97E-05	0.0000	0.0000	0.00E+00
192	0.02	0.000	0.034	0.1354	0.4445	0.0015	8.89E-05	0.0000	0.0000	0.00E+00
193	0.43	0.000	0.089	0.1638	0.4404	0.0014	8.82E-05	0.0000	0.0000	0.00E+00
194	0.22	0.000	0.189	0.1667	0.4363	0.0014	8.75E-05	0.0000	0.0000	0.00E+00
195	0.12	0.000	0.275	0.1538	0.4323	0.0014	8.67E-05	0.0000	0.0000	0.00E+00
196	0.07	0.000	0.214	0.1420	0.4283	0.0014	8.60E-05	0.0000	0.0000	0.00E+00
197	0.00	0.000	0.052	0.1377	0.4243	0.0014	8.53E-05	0.0000	0.0000	0.00E+00
198	0.00	0.000	0.024	0.1356	0.4204	0.0014	8.46E-05	0.0000	0.0000	3.42E-04
199	0.02	0.000	0.024	0.1351	0.4165	0.0014	8.39E-05	0.0000	0.0000	2.93E-04
200	0.09	0.000	0.041	0.1391	0.4126	0.0014	8.31E-05	0.0000	0.0000	0.00E+00
201	0.05	0.000	0.030	0.1405	0.4088	0.0013	8.25E-05	0.0000	0.0000	0.00E+00
202	0.01	0.000	0.045	0.1377	0.4050	0.0013	8.18E-05	0.0000	0.0000	0.00E+00
203	0.00	0.000	0.026	0.1355	0.4013	0.0013	8.11E-05	0.0000	0.0000	0.00E+00
204	0.00	0.000	0.005	0.1351	0.3975	0.0013	8.04E-05	0.0000	0.0000	0.00E+00
205	0.00	0.000	0.001	0.1350	0.3939	0.0013	7.97E-05	0.0000	0.0000	0.00E+00
206	0.18	0.000	0.036	0.1469	0.3902	0.0013	7.91E-05	0.0000	0.0000	3.68E-04
207	0.00	0.000	0.087	0.1396	0.3866	0.0013	7.84E-05	0.0000	0.0000	2.68E-04
208	0.00	0.000	0.041	0.1362	0.3830	0.0013	7.77E-05	0.0000	0.0000	0.00E+00

209	0.00	0.000	0.011	0.1353	0.3794	0.0012	7.71E-05	0.0000	0.0000	0.00E+00
210	0.00	0.000	0.003	0.1351	0.3759	0.0012	7.64E-05	0.0000	0.0000	0.00E+00
211	0.00	0.000	0.001	0.1350	0.3724	0.0012	7.58E-05	0.0000	0.0000	0.00E+00
212	0.75	0.000	0.142	0.1853	0.3690	0.0012	7.52E-05	0.0000	0.0000	0.00E+00
213	0.00	0.000	0.226	0.1664	0.3656	0.0012	7.45E-05	0.0000	0.0000	0.00E+00
214	0.03	0.000	0.192	0.1532	0.3622	0.0012	7.39E-05	0.0000	0.0000	3.46E-04
215	0.15	0.000	0.242	0.1453	0.3588	0.0012	7.33E-05	0.0000	0.0000	2.87E-04
216	0.15	0.000	0.126	0.1471	0.3555	0.0012	7.27E-05	0.0000	0.0000	0.00E+00
217	0.00	0.000	0.108	0.1381	0.3522	0.0012	7.21E-05	0.0000	0.0000	0.00E+00
218	0.00	0.000	0.028	0.1357	0.3489	0.0011	7.15E-05	0.0000	0.0000	0.00E+00
219	0.00	0.000	0.007	0.1352	0.3457	0.0011	7.09E-05	0.0000	0.0000	0.00E+00
220	0.00	0.000	0.002	0.1350	0.3425	0.0011	7.03E-05	0.0000	0.0000	0.00E+00
221	0.00	0.000	0.000	0.1350	0.3394	0.0011	6.97E-05	0.0000	0.0000	0.00E+00
222	0.00	0.000	0.000	0.1350	0.3363	0.0011	6.91E-05	0.0000	0.0000	0.00E+00
223	0.00	0.000	0.000	0.1350	0.3332	0.0011	6.85E-05	0.0000	0.0000	3.38E-04
224	0.00	0.000	0.000	0.1350	0.3301	0.0011	6.80E-05	0.0000	0.0000	4.19E-04
225	0.41	0.000	0.109	0.1601	0.3270	0.0011	6.74E-05	0.0000	0.0000	0.00E+00
226	0.00	0.000	0.094	0.1523	0.3240	0.0011	6.68E-05	0.0000	0.0000	0.00E+00
227	0.00	0.000	0.172	0.1380	0.3210	0.0011	6.63E-05	0.0000	0.0000	0.00E+00
228	0.00	0.000	0.027	0.1357	0.3180	0.0010	6.57E-05	0.0000	0.0000	0.00E+00
229	0.00	0.000	0.007	0.1352	0.3150	0.0010	6.52E-05	0.0000	0.0000	0.00E+00
230	0.00	0.000	0.002	0.1350	0.3121	0.0010	6.46E-05	0.0000	0.0000	0.00E+00
231	0.00	0.000	0.001	0.1350	0.3092	0.0010	6.41E-05	0.0000	0.0000	0.00E+00
232	0.00	0.000	0.000	0.1350	0.3063	0.0010	6.35E-05	0.0000	0.0000	0.00E+00
233	0.00	0.000	0.000	0.1350	0.3035	0.0010	6.30E-05	0.0000	0.0000	0.00E+00
234	0.00	0.000	0.000	0.1350	0.3007	0.0010	6.25E-05	0.0000	0.0000	0.00E+00
235	0.19	0.000	0.038	0.1475	0.2979	0.0010	6.19E-05	0.0000	0.0000	6.37E-04
236	0.07	0.000	0.107	0.1441	0.2951	0.0010	6.14E-05	0.0000	0.0000	0.00E+00
237	0.00	0.000	0.066	0.1386	0.2924	0.0010	6.09E-05	0.0000	0.0000	0.00E+00
238	0.41	0.000	0.114	0.1629	0.2897	0.0010	6.04E-05	0.0000	0.0000	0.00E+00
239	0.00	0.000	0.106	0.1541	0.2870	0.0009	5.99E-05	0.0000	0.0000	0.00E+00
240	0.00	0.000	0.108	0.1451	0.2843	0.0009	5.94E-05	0.0000	0.0000	0.00E+00
241	0.11	0.000	0.141	0.1428	0.2817	0.0009	5.89E-05	0.0000	0.0000	0.00E+00
242	0.00	0.000	0.071	0.1372	0.2790	0.0009	5.84E-05	0.0000	0.0000	0.00E+00
243	0.73	0.000	0.091	0.1908	0.2765	0.0009	5.79E-05	0.0000	0.0000	0.00E+00
244	0.01	0.000	0.107	0.1824	0.2739	0.0009	5.74E-05	0.0000	0.0000	0.00E+00

245	0.61	0.000	0.252	0.2125	0.2713	0.0009	5.69E-05	0.0000	0.0000	3.28E-04
246	0.00	0.000	0.184	0.1972	0.2688	0.0009	5.65E-05	0.0000	0.0000	3.12E-04
247	0.40	0.000	0.199	0.2141	0.2663	0.0009	5.60E-05	0.0000	0.0000	0.00E+00
248	0.01	0.000	0.292	0.1901	0.2638	0.0009	5.55E-05	0.0000	0.0000	0.00E+00
249	0.27	0.000	0.308	0.1872	0.2614	0.0009	5.50E-05	0.0000	0.0000	0.00E+00
250	0.09	0.000	0.376	0.1636	0.2590	0.0009	5.46E-05	0.0000	0.0000	0.00E+00
251	0.01	0.000	0.303	0.1388	0.2566	0.0008	5.41E-05	0.0000	0.0000	0.00E+00
252	0.01	0.000	0.043	0.1358	0.2542	0.0008	5.37E-05	0.0000	0.0000	0.00E+00
253	0.00	0.000	0.008	0.1351	0.2518	0.0008	5.32E-05	0.0000	0.0000	0.00E+00
254	0.05	0.000	0.028	0.1368	0.2495	0.0008	5.28E-05	0.0000	0.0000	0.00E+00
255	0.01	0.000	0.014	0.1362	0.2471	0.0008	5.23E-05	0.0000	0.0000	0.00E+00
256	0.04	0.000	0.027	0.1375	0.2449	0.0008	5.19E-05	0.0000	0.0000	0.00E+00
257	0.01	0.000	0.014	0.1369	0.2426	0.0008	5.15E-05	0.0000	0.0000	3.22E-04
258	0.30	0.000	0.045	0.1582	0.2403	0.0008	5.10E-05	0.0000	0.0000	1.27E-05
259	0.37	0.000	0.043	0.1854	0.2381	0.0008	5.06E-05	0.0000	0.0000	0.00E+00
260	0.18	0.000	0.242	0.1799	0.2359	0.0008	5.02E-05	0.0000	0.0000	0.00E+00
261	0.04	0.000	0.056	0.1785	0.2337	0.0008	4.98E-05	0.0000	0.0000	0.00E+00
262	0.00	0.000	0.040	0.1755	0.2315	0.0008	4.93E-05	0.0000	0.0000	0.00E+00
263	1.11	0.000	0.050	0.2637	0.2294	0.0008	4.89E-05	0.0000	0.0000	3.31E-04
264	0.00	0.000	0.106	0.2550	0.2272	0.0007	4.85E-05	0.0000	0.0000	3.09E-04
265	0.01	0.000	0.120	0.2457	0.2251	0.0007	4.81E-05	0.0000	0.0000	0.00E+00
266	0.14	0.000	0.142	0.2458	0.2230	0.0007	4.77E-05	0.0000	0.0000	0.00E+00
267	0.00	0.000	0.173	0.2314	0.2209	0.0007	4.73E-05	0.0000	0.0000	0.00E+00
268	0.00	0.000	0.205	0.2143	0.2189	0.0007	4.69E-05	0.0000	0.0000	0.00E+00
269	0.00	0.000	0.288	0.1903	0.2168	0.0007	4.65E-05	0.0000	0.0000	0.00E+00
270	0.00	0.000	0.201	0.1736	0.2148	0.0007	4.61E-05	0.0000	0.0000	0.00E+00
271	0.05	0.000	0.095	0.1701	0.2128	0.0007	4.57E-05	0.0000	0.0000	0.00E+00
272	0.00	0.000	0.064	0.1647	0.2108	0.0007	4.53E-05	0.0000	0.0000	0.00E+00
273	0.02	0.000	0.061	0.1612	0.2089	0.0007	4.50E-05	0.0000	0.0000	0.00E+00
274	0.00	0.000	0.047	0.1573	0.2069	0.0007	4.46E-05	0.0000	0.0000	0.00E+00
275	0.04	0.000	0.052	0.1562	0.2050	0.0007	4.42E-05	0.0000	0.0000	0.00E+00
276	0.05	0.000	0.051	0.1562	0.2031	0.0007	4.38E-05	0.0000	0.0000	0.00E+00
277	0.01	0.000	0.044	0.1535	0.2012	0.0007	4.35E-05	0.0000	0.0000	0.00E+00
278	0.02	0.000	0.045	0.1518	0.1993	0.0007	4.31E-05	0.0000	0.0000	3.61E-04
279	0.01	0.000	0.037	0.1492	0.1975	0.0006	4.27E-05	0.0000	0.0000	2.82E-04
280	0.01	0.000	0.035	0.1468	0.1956	0.0006	4.24E-05	0.0000	0.0000	0.00E+00

281		0.00	0.000	0.023	0.1449	0.1938	0.0006	4.20E-05	0.0000	0.0000	0.00E+00
282		0.00	0.000	0.028	0.1426	0.1920	0.0006	4.17E-05	0.0000	0.0000	0.00E+00
283		0.01	0.000	0.034	0.1408	0.1902	0.0006	4.13E-05	0.0000	0.0000	0.00E+00
284		0.00	0.000	0.026	0.1376	0.2002	0.0007	4.33E-05	0.0000	0.0000	0.00E+00
285		0.00	0.000	0.021	0.1360	0.2179	0.0007	4.67E-05	0.0000	0.0000	0.00E+00
286		0.44	0.000	0.021	0.1711	0.2159	0.0007	4.63E-05	0.0000	0.0000	0.00E+00
287		0.18	0.000	0.027	0.1842	0.2139	0.0007	4.59E-05	0.0000	0.0000	0.00E+00
288		0.01	0.000	0.025	0.1831	0.2119	0.0007	4.55E-05	0.0000	0.0000	0.00E+00
289		0.05	0.000	0.030	0.1851	0.2099	0.0007	4.52E-05	0.0000	0.0000	0.00E+00
290		0.01	0.000	0.025	0.1838	0.2080	0.0007	4.48E-05	0.0000	0.0000	0.00E+00
291		0.16	0.000	0.029	0.1950	0.2060	0.0007	4.44E-05	0.0000	0.0000	0.00E+00
292		0.48	0.000	0.161	0.2221	0.2041	0.0007	4.40E-05	0.0000	0.0000	0.00E+00
293		0.38	0.000	0.149	0.2415	0.2022	0.0007	4.37E-05	0.0000	0.0000	6.74E-04
294		0.05	0.000	0.212	0.2282	0.2003	0.0007	4.33E-05	0.0000	0.0000	0.00E+00
295		0.02	0.000	0.130	0.2186	0.1985	0.0007	4.29E-05	0.0000	0.0000	0.00E+00
296		0.00	0.000	0.124	0.2086	0.1966	0.0006	4.26E-05	0.0000	0.0000	3.31E-04
297	*	0.00	0.000	0.000	0.2086	0.1948	0.0006	4.22E-05	0.0000	0.0000	3.04E-04
298	*	0.02	0.000	0.019	0.2086	0.1930	0.0006	4.19E-05	0.0000	0.0000	0.00E+00
299		0.00	0.000	0.126	0.1982	0.1912	0.0006	4.15E-05	0.0000	0.0000	0.00E+00
300		0.00	0.000	0.194	0.1820	0.1894	0.0006	4.12E-05	0.0000	0.0000	0.00E+00
301		1.37	0.000	0.091	0.2888	0.1876	0.0006	4.08E-05	0.0000	0.0000	0.00E+00
302		0.18	0.000	0.242	0.2836	0.1859	0.0006	4.05E-05	0.0000	0.0000	0.00E+00
303		0.16	0.000	0.267	0.2745	0.1842	0.0006	4.01E-05	0.0000	0.0000	0.00E+00
304		0.05	0.000	0.229	0.2591	0.1824	0.0006	3.98E-05	0.0000	0.0000	0.00E+00
305		0.01	0.000	0.124	0.2493	0.1807	0.0006	3.95E-05	0.0000	0.0000	0.00E+00
306	*	0.00	0.000	0.000	0.2493	0.1791	0.0006	3.91E-05	0.0000	0.0000	0.00E+00
307	*	0.00	0.000	0.000	0.2493	0.1774	0.0006	3.88E-05	0.0000	0.0000	0.00E+00
308	*	0.00	0.000	0.000	0.2492	0.1767	0.0006	3.87E-05	0.0000	0.0000	0.00E+00
309		0.00	0.000	0.113	0.2397	0.1780	0.0006	3.89E-05	0.0000	0.0000	0.00E+00
310	*	0.00	0.000	0.000	0.2397	0.1782	0.0006	3.90E-05	0.0000	0.0000	0.00E+00
311	*	0.00	0.000	0.000	0.2396	0.1769	0.0006	3.87E-05	0.0000	0.0000	0.00E+00
312	*	0.00	0.000	0.001	0.2394	0.1820	0.0006	3.97E-05	0.0000	0.0000	0.00E+00
313		0.00	0.000	0.097	0.2313	0.1826	0.0006	3.98E-05	0.0000	0.0000	0.00E+00
314	*	0.00	0.000	0.000	0.2313	0.1809	0.0006	3.95E-05	0.0000	0.0000	0.00E+00
315	*	0.00	0.000	0.000	0.2313	0.1792	0.0006	3.92E-05	0.0000	0.0000	0.00E+00
316	*	0.08	0.000	0.041	0.2330	0.1776	0.0006	3.88E-05	0.0000	0.0000	0.00E+00

317			0.00	0.000	0.130	0.2241	0.1759	0.0006	3.85E-05	0.0000	0.0000	0.00E+00
318	*		0.00	0.000	0.000	0.2241	0.1743	0.0006	3.82E-05	0.0000	0.0000	0.00E+00
319	*		0.12	0.000	0.055	0.2257	0.1726	0.0006	3.79E-05	0.0000	0.0000	0.00E+00
320	*		0.03	0.000	0.026	0.2274	0.1710	0.0006	3.75E-05	0.0000	0.0000	0.00E+00
321	*		0.01	0.000	0.000	0.2290	0.1694	0.0006	3.72E-05	0.0000	0.0000	0.00E+00
322			0.07	0.000	0.187	0.2205	0.1679	0.0006	3.69E-05	0.0000	0.0000	0.00E+00
323			0.26	0.000	0.185	0.2265	0.1663	0.0005	3.66E-05	0.0000	0.0000	0.00E+00
324	*	*	0.00	0.000	0.000	0.2265	0.1647	0.0005	3.63E-05	0.0000	0.0000	0.00E+00
325			0.00	0.000	0.112	0.2171	0.1632	0.0005	3.60E-05	0.0000	0.0000	0.00E+00
326			0.05	0.000	0.152	0.2084	0.1622	0.0005	3.58E-05	0.0000	0.0000	6.47E-04
327			0.20	0.000	0.216	0.2070	0.1639	0.0005	3.61E-05	0.0000	0.0000	0.00E+00
328			0.20	0.000	0.185	0.2087	0.1623	0.0005	3.58E-05	0.0000	0.0000	0.00E+00
329			0.27	0.000	0.175	0.2163	0.1608	0.0005	3.55E-05	0.0000	0.0000	0.00E+00
330			0.28	0.000	0.176	0.2247	0.1593	0.0005	3.52E-05	0.0000	0.0000	0.00E+00
331			0.19	0.000	0.248	0.2201	0.1578	0.0005	3.49E-05	0.0000	0.0000	0.00E+00
332			0.10	0.000	0.291	0.2038	0.1564	0.0005	3.46E-05	0.0000	0.0000	0.00E+00
333			0.26	0.000	0.208	0.2083	0.1549	0.0005	3.43E-05	0.0000	0.0000	0.00E+00
334			0.00	0.000	0.150	0.1961	0.1535	0.0005	3.40E-05	0.0000	0.0000	0.00E+00
335			0.40	0.000	0.091	0.2223	0.1520	0.0005	3.38E-05	0.0000	0.0000	0.00E+00
336	*		0.03	0.000	0.026	0.2223	0.1506	0.0005	3.35E-05	0.0000	0.0000	0.00E+00
337	*		0.03	0.000	0.030	0.2223	0.1492	0.0005	3.32E-05	0.0000	0.0000	0.00E+00
338	*		0.04	0.000	0.017	0.2239	0.1478	0.0005	3.29E-05	0.0000	0.0000	0.00E+00
339	*	*	0.02	0.000	0.022	0.2239	0.1465	0.0005	3.26E-05	0.0000	0.0000	0.00E+00
340	*	*	0.82	0.000	0.079	0.2239	0.1451	0.0005	3.24E-05	0.0000	0.0000	0.00E+00
341		*	0.08	0.211	0.065	0.2690	0.1437	0.0005	3.21E-05	0.0000	0.0000	0.00E+00
342			0.92	0.001	0.167	0.3314	0.1424	0.0005	3.18E-05	0.0000	0.0000	0.00E+00
343			0.00	0.000	0.222	0.2903	0.6429	0.0021	1.23E-04	0.0000	0.0000	3.47E-04
344			0.13	0.000	0.216	0.2770	0.9308	0.0031	1.74E-04	0.0000	0.0000	2.59E-04
345			0.00	0.000	0.212	0.2547	1.0991	0.0036	2.02E-04	0.0000	0.0000	0.00E+00
346			0.10	0.000	0.216	0.2413	1.2240	0.0040	2.23E-04	0.0000	0.0000	2.94E-04
347			0.16	0.000	0.121	0.2428	1.2955	0.0043	2.35E-04	0.0000	0.0000	2.93E-04
348	*		0.02	0.000	0.018	0.2428	1.3100	0.0043	2.37E-04	0.0000	0.0000	0.00E+00
349	*		0.16	0.000	0.055	0.2444	1.2979	0.0043	2.35E-04	0.0000	0.0000	4.14E-04
350	*		0.52	0.000	0.072	0.2460	1.2860	0.0042	2.33E-04	0.0000	0.0000	1.75E-04
351	*		0.11	0.000	0.000	0.2477	1.2741	0.0042	2.31E-04	0.0000	0.0000	3.00E-04
352	*		0.03	0.000	0.045	0.2493	1.2624	0.0041	2.29E-04	0.0000	0.0000	2.85E-04

353		0.00	0.000	0.103	0.2711	1.2507	0.0041	2.27E-04	0.0000	0.0000	0.00E+00
354		0.07	0.000	0.000	0.2841	1.2392	0.0041	2.25E-04	0.0000	0.0000	4.32E-04
355		0.21	0.000	0.169	0.2980	1.2278	0.0040	2.24E-04	0.0000	0.0000	1.40E-04
356		0.07	0.000	0.232	0.2843	1.2165	0.0040	2.22E-04	0.0000	0.0000	3.29E-04
357		0.09	0.000	0.188	0.2764	1.2053	0.0040	2.20E-04	0.0000	0.0000	2.33E-04
358		0.05	0.000	0.240	0.2604	1.2026	0.0040	2.19E-04	0.0000	0.0000	0.00E+00
359		0.00	0.000	0.207	0.2431	1.2150	0.0040	2.21E-04	0.0000	0.0000	3.41E-04
360		0.00	0.000	0.192	0.2269	1.2113	0.0040	2.21E-04	0.0000	0.0000	2.62E-04
361		0.00	0.000	0.155	0.2132	1.2053	0.0040	2.20E-04	0.0000	0.0000	0.00E+00
362	*	0.16	0.000	0.112	0.2148	1.2160	0.0040	2.22E-04	0.0000	0.0000	5.89E-04
363	*	0.00	0.000	0.099	0.2087	1.2048	0.0040	2.20E-04	0.0000	0.0000	1.04E-04
364	*	0.00	0.000	0.000	0.2087	1.1937	0.0039	2.18E-04	0.0000	0.0000	0.00E+00
365	*	0.01	0.000	0.008	0.2087	1.1827	0.0039	2.16E-04	0.0000	0.0000	4.30E-04

* = Frozen (air or soil)

Annual Totals for Year 100			
	inches	cubic feet	percent
Precipitation	37.28	2,706,633.6	100.00
Runoff	0.843	61,225.7	2.26
Evapotranspiration	34.986	2,539,959.0	93.84
Drainage Collected from Layer 2	0.5875	42,649.8	1.58
Percolation/Leakage through Layer 3	0.034532	2,507.0	0.09
Average Head on Top of Layer 3	0.4883	---	---
Percolation/Leakage through Layer 4	0.034396	2,497.2	0.09
Change in Water Storage	0.8306	60,301.9	2.23
Soil Water at Start of Year	117.2986	8,515,878.3	314.63
Soil Water at End of Year	118.1292	8,576,180.2	316.86
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

Average Annual Totals Summary

Title: Sibley Quarry Geomembrane Cover Scenario
Simulated on: 11/11/2023 8:41

	Average Annual Totals for Years 1 - 100*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	33.06	[3.95]	2,400,345.3	100.00
Runoff	0.433	[0.423]	31,411.1	1.31
Evapotranspiration	31.988	[3.576]	2,322,331.6	96.75
Subprofile1				
Lateral drainage collected from Layer 2	0.6061	[0.4462]	44,005.6	1.83
Percolation/leakage through Layer 3	0.034386	[0.023721]	2,496.4	0.10
Average Head on Top of Layer 3	0.5049	[0.3715]	---	---
Subprofile2				
Percolation/leakage through Layer 4	0.034386	[0.023557]	2,496.4	0.10
Water storage				
Change in water storage	0.0014	[1.0972]	100.6	0.00

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: Sibley Quarry Geomembrane Cover Scenario
Simulated on: 11/11/2023 8:41

	Peak Values for Years 1 - 100*	
	(inches)	(cubic feet)
Precipitation	2.87	208,259.1
Runoff	1.275	92,563.4
Subprofile1		
Drainage collected from Layer 2	0.0190	1,379.4
Percolation/leakage through Layer 3	0.000934	67.8
Average head on Layer 3	5.7809	---
Maximum head on Layer 3	8.5596	---
Location of maximum head in Layer 2	51.87 (feet from drain)	
Subprofile2		
Percolation/leakage through Layer 4	0.000977	70.9
Other Parameters		
Snow water	3.1161	226,229.8
Maximum vegetation soil water	0.3898 (vol/vol)	
Minimum vegetation soil water	0.1350 (vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: Sibley Quarry Geomembrane Cover Scenario
Simulated on: 11/11/2023 8:42
Simulation period: 100 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	2.5046	0.2087
2	1.1809	0.0984
3	0.0000	0.0000
4	112.1998	0.1870
Snow water	0.0000	---

Attachment A-2

Help Model Output Excerpts – ClosureTurf Cover System

DTE Sibley Quarry Closure Area

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: Sibley Quarry ClosureTurf **Simulated On:** 11/10/2023 16:12

Layer 1
Type 1 - Vertical Percolation Layer (Cover Soil)
S - Sand
Material Texture Number 2

Thickness	=	0.5	inches
Porosity	=	0.437	vol/vol
Field Capacity	=	0.062	vol/vol
Wilting Point	=	0.024	vol/vol
Initial Soil Water Content	=	0.1221	vol/vol
Effective Sat. Hyd. Conductivity	=	5.80E-03	cm/sec

Layer 2
Type 2 - Lateral Drainage Layer
Drainage Net (0.5 cm)
Material Texture Number 20

Thickness	=	0.2	inches
Porosity	=	0.85	vol/vol
Field Capacity	=	0.01	vol/vol
Wilting Point	=	0.005	vol/vol
Initial Soil Water Content	=	0.0187	vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E+01	cm/sec
Slope	=	2	%
Drainage Length	=	300	ft

Layer 3
Type 4 - Flexible Membrane Liner
LDPE Membrane
Material Texture Number 36

Thickness	=	0.05	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 4
Type 1 - Vertical Percolation Layer (Waste)

High-Density Electric Plant Coal Fly Ash
Material Texture Number 30

Thickness	=	600	inches
Porosity	=	0.541	vol/vol
Field Capacity	=	0.187	vol/vol
Wilting Point	=	0.047	vol/vol
Initial Soil Water Content	=	0.187	vol/vol
Effective Sat. Hyd. Conductivity	=	5.00E-05	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	=	47.9	
Fraction of Area Allowing Runoff	=	100	%
Area projected on a horizontal plane	=	20	acres
Evaporative Zone Depth	=	0.5	inches
Initial Water in Evaporative Zone	=	0.061	inches
Upper Limit of Evaporative Storage	=	0.218	inches
Lower Limit of Evaporative Storage	=	0.012	inches
Initial Snow Water	=	0	inches
Initial Water in Layer Materials	=	112.264	inches
Total Initial Water	=	112.264	inches
Total Subsurface Inflow	=	0	inches/year

Note: SCS Runoff Curve Number was calculated by HELP.

Evapotranspiration and Weather Data

Station Latitude	=	42.13	Degrees
Maximum Leaf Area Index	=	3.5	
Start of Growing Season (Julian Date)	=	100	days
End of Growing Season (Julian Date)	=	265	days
Average Wind Speed	=	11	mph
Average 1st Quarter Relative Humidity	=	1	%
Average 2nd Quarter Relative Humidity	=	11	%
Average 3rd Quarter Relative Humidity	=	45	%
Average 4th Quarter Relative Humidity	=	11	%

Note: Evapotranspiration data was obtained for Trenton, Michigan

Normal Mean Monthly Precipitation (inches)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
1.94316	2.052453	2.111622	2.779583	3.375291	3.343076
3.250522	3.266588	3.195495	2.626734	2.633441	2.314234

Note: Precipitation was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.13/-83.22

Normal Mean Monthly Temperature (Degrees Fahrenheit)

Jan/Jul	Feb/Aug	Mar/Sep	Apr/Oct	May/Nov	Jun/Dec
26.4	33.5	40.7	52.2	67.9	78.5
82.6	79.9	70.1	56	43.6	31.9

Note: Temperature was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.13/-83.22
Solar radiation was simulated based on HELP V4 weather simulation for:
Lat/Long: 42.13/-83.22

Daily Output for Year 1

Column key: Head #1: drainage from Layer 3
Drain #1: drainage from Layer 2
Leak #1: leakage thru Layer 3
Leak #2: leakage thru Layer 4

Title: Sibley Quarry ClosureTurf
Simulated On: 11/10/2023 16:12

Day	Freezing Status* Air	Soil	Rain (inches)	Runoff (inches)	ET (inches)	Evap. Zone Water (in/in)	Head #1 (inches)	Drain #1 (inches)	Leak #1 (inches)	Head #2 (inches)	Drain #2 (inches)	Leak #2 (inches)
1	*	*	0.00	0.000	0.000	0.1221	0.0005	0.0017	1.79E-07	0.0000	0.0000	0.00E+00
2	*	*	0.11	0.000	0.048	0.1221	0.0000	0.0000	8.56E-09	0.0000	0.0000	0.00E+00
3	*	*	0.00	0.000	0.058	0.1221	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
4			0.19	0.000	0.033	0.2235	0.0164	0.0619	4.35E-06	0.0000	0.0000	0.00E+00
5			0.05	0.000	0.090	0.0469	0.0241	0.0910	6.29E-06	0.0000	0.0000	0.00E+00
6	*	*	0.59	0.000	0.097	0.0469	0.0002	0.0006	7.91E-08	0.0000	0.0000	0.00E+00
7	*	*	0.06	0.000	0.044	0.0469	0.0000	0.0000	6.64E-09	0.0000	0.0000	0.00E+00
8	*	*	0.15	0.000	0.052	0.0469	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
9	*	*	0.08	0.000	0.025	0.0469	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
10	*	*	0.00	0.000	0.050	0.0469	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
11	*	*	0.20	0.000	0.027	0.0469	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
12	*	*	0.01	0.000	0.000	0.0469	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
13		*	0.11	0.000	0.000	0.4370	0.0001	0.0005	5.07E-08	0.0000	0.0000	0.00E+00
14		*	0.17	0.735	0.118	0.4370	0.0104	0.0393	2.74E-06	0.0000	0.0000	0.00E+00
15			0.00	0.001	0.038	0.0240	0.0470	0.1695	1.06E-05	0.0000	0.0000	0.00E+00
16			0.01	0.000	0.010	0.0252	0.0000	0.0002	3.41E-08	0.0000	0.0000	0.00E+00
17			0.02	0.000	0.016	0.0267	0.0000	0.0000	4.44E-09	0.0000	0.0000	0.00E+00
18	*	*	0.00	0.000	0.000	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
19	*	*	0.04	0.000	0.040	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
20	*	*	0.17	0.000	0.025	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
21	*	*	0.01	0.000	0.035	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
22	*	*	0.05	0.000	0.019	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
23	*	*	0.10	0.000	0.000	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
24	*	*	0.10	0.000	0.000	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
25	*	*	0.12	0.000	0.032	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
26	*	*	0.00	0.000	0.037	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
27	*	*	0.01	0.000	0.017	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
28	*	*	0.07	0.000	0.009	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00

29	*	*	0.00	0.000	0.006	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
30	*	*	0.00	0.000	0.016	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
31	*	*	0.00	0.000	0.072	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
32	*	*	0.00	0.000	0.035	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
33	*	*	0.00	0.000	0.042	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
34	*	*	0.00	0.000	0.022	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
35	*	*	0.00	0.000	0.011	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
36	*	*	0.60	0.000	0.006	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
37	*	*	0.00	0.000	0.000	0.0267	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
38		*	0.01	0.099	0.000	0.4370	0.0633	0.2393	1.43E-05	0.0000	0.0000	0.00E+00
39		*	0.00	0.023	0.168	0.4370	0.0334	0.1261	7.81E-06	0.0000	0.0000	0.00E+00
40	*	*	0.00	0.000	0.000	0.4370	0.0000	0.0000	1.80E-08	0.0000	0.0000	0.00E+00
41	*	*	0.00	0.000	0.000	0.4370	0.0000	0.0000	1.83E-09	0.0000	0.0000	0.00E+00
42			0.00	0.000	0.028	0.0273	0.0517	0.1765	1.16E-05	0.0000	0.0000	0.00E+00
43	*	*	0.00	0.000	0.000	0.0273	0.0001	0.0002	3.90E-08	0.0000	0.0000	0.00E+00
44	*	*	0.00	0.000	0.000	0.0273	0.0000	0.0000	4.85E-09	0.0000	0.0000	0.00E+00
45	*	*	0.00	0.000	0.000	0.0273	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
46	*	*	0.00	0.000	0.000	0.0273	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
47	*	*	0.00	0.000	0.000	0.0273	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
48	*	*	0.00	0.000	0.000	0.0273	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
49	*	*	0.05	0.000	0.053	0.0273	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
50	*	*	0.08	0.000	0.038	0.0273	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
51	*	*	0.40	0.000	0.050	0.0273	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
52	*	*	0.06	0.000	0.024	0.0273	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
53	*	*	0.00	0.000	0.097	0.0273	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
54	*	*	0.43	0.000	0.000	0.0273	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
55	*	*	0.00	0.000	0.079	0.0273	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
56	*	*	0.00	0.000	0.071	0.0273	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
57		*	0.00	0.069	0.112	0.4370	0.0327	0.1236	7.68E-06	0.0000	0.0000	0.00E+00
58			0.00	0.000	0.031	0.0240	0.0846	0.2670	1.88E-05	0.0000	0.0000	0.00E+00
59			0.00	0.000	0.000	0.0240	0.0001	0.0003	4.59E-08	0.0000	0.0000	0.00E+00
60			0.00	0.000	0.000	0.0240	0.0000	0.0000	5.49E-09	0.0000	0.0000	0.00E+00
61			0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
62			0.11	0.000	0.050	0.1541	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
63			0.01	0.000	0.034	0.0579	0.0063	0.0237	1.82E-06	0.0000	0.0000	0.00E+00
64	*	*	0.18	0.000	0.125	0.0579	0.0001	0.0005	6.29E-08	0.0000	0.0000	0.00E+00

65	*	*	0.00	0.000	0.057	0.0579	0.0000	0.0000	6.28E-09	0.0000	0.0000	0.00E+00
66			0.22	0.000	0.037	0.2271	0.0151	0.0572	3.86E-06	0.0000	0.0000	0.00E+00
67			0.23	0.000	0.188	0.1917	0.0241	0.0909	6.27E-06	0.0000	0.0000	0.00E+00
68			0.04	0.000	0.086	0.0351	0.0094	0.0357	2.74E-06	0.0000	0.0000	0.00E+00
69			0.00	0.000	0.005	0.0249	0.0002	0.0007	8.44E-08	0.0000	0.0000	0.00E+00
70			0.00	0.000	0.000	0.0243	0.0000	0.0000	6.72E-09	0.0000	0.0000	0.00E+00
71			0.00	0.000	0.005	0.0241	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
72			0.07	0.000	0.026	0.1211	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
73			0.29	0.000	0.033	0.2533	0.0408	0.1542	9.82E-06	0.0000	0.0000	0.00E+00
74			0.43	0.000	0.030	0.2533	0.0986	0.3725	2.27E-05	0.0000	0.0000	0.00E+00
75	*	*	0.06	0.000	0.063	0.2533	0.0190	0.0717	4.70E-06	0.0000	0.0000	0.00E+00
76			0.55	0.000	0.221	0.2533	0.0721	0.2722	1.69E-05	0.0000	0.0000	0.00E+00
77			0.06	0.000	0.111	0.0423	0.0286	0.1082	7.05E-06	0.0000	0.0000	0.00E+00
78			0.03	0.000	0.039	0.0295	0.0000	0.0001	2.25E-08	0.0000	0.0000	0.00E+00
79	*		0.00	0.000	0.002	0.0295	0.0000	0.0000	7.42E-09	0.0000	0.0000	0.00E+00
80			0.03	0.000	0.032	0.0284	0.0000	0.0000	6.83E-09	0.0000	0.0000	0.00E+00
81			0.00	0.000	0.001	0.0269	0.0000	0.0000	4.52E-09	0.0000	0.0000	0.00E+00
82			0.07	0.000	0.038	0.0935	0.0000	0.0000	1.34E-10	0.0000	0.0000	0.00E+00
83			0.57	0.000	0.043	0.1918	0.0873	0.3298	1.96E-05	0.0000	0.0000	0.00E+00
84			0.00	0.000	0.046	0.0258	0.0490	0.1852	1.13E-05	0.0000	0.0000	0.00E+00
85	*		0.01	0.000	0.007	0.0242	0.0000	0.0001	2.31E-08	0.0000	0.0000	0.00E+00
86	*		0.10	0.000	0.078	0.0598	0.0000	0.0000	3.26E-09	0.0000	0.0000	0.00E+00
87	*		0.38	0.000	0.082	0.0991	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
88	*		0.16	0.000	0.093	0.1091	0.0026	0.0099	8.16E-07	0.0000	0.0000	0.00E+00
89	*		0.03	0.000	0.040	0.1121	0.0050	0.0188	1.56E-06	0.0000	0.0000	0.00E+00
90			0.00	0.000	0.152	0.2288	0.0172	0.0651	4.61E-06	0.0000	0.0000	0.00E+00
91			0.44	0.000	0.191	0.2288	0.0611	0.2309	1.48E-05	0.0000	0.0000	0.00E+00
92			0.14	0.000	0.183	0.0961	0.0216	0.0817	5.43E-06	0.0000	0.0000	0.00E+00
93			0.27	0.000	0.221	0.1998	0.0000	0.0000	1.89E-08	0.0000	0.0000	0.00E+00
94			0.01	0.000	0.056	0.0321	0.0107	0.0406	2.97E-06	0.0000	0.0000	0.00E+00
95			0.17	0.000	0.122	0.1240	0.0001	0.0004	6.04E-08	0.0000	0.0000	0.00E+00
96			0.00	0.000	0.020	0.0540	0.0032	0.0120	9.40E-07	0.0000	0.0000	0.00E+00
97			0.00	0.000	0.012	0.0261	0.0012	0.0045	4.19E-07	0.0000	0.0000	0.00E+00
98			0.00	0.000	0.001	0.0247	0.0000	0.0000	1.40E-08	0.0000	0.0000	0.00E+00
99			0.00	0.000	0.000	0.0242	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
100			0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00

101		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
102		0.15	0.000	0.025	0.2301	0.0000	0.0000	2.27E-09	0.0000	0.0000	0.00E+00
103		0.31	0.000	0.024	0.2301	0.0652	0.2463	1.57E-05	0.0000	0.0000	0.00E+00
104		0.00	0.000	0.056	0.0256	0.0290	0.1096	7.38E-06	0.0000	0.0000	0.00E+00
105		0.81	0.000	0.024	0.2750	0.2263	0.4988	4.63E-05	0.0000	0.0000	0.00E+00
106		0.05	0.000	0.066	0.0392	0.1213	0.2691	2.52E-05	0.0000	0.0000	0.00E+00
107		0.00	0.000	0.004	0.0313	0.0000	0.0001	3.07E-08	0.0000	0.0000	0.00E+00
108		0.14	0.000	0.021	0.2239	0.0000	0.0000	6.51E-09	0.0000	0.0000	0.00E+00
109		0.00	0.000	0.057	0.0284	0.0177	0.0669	4.82E-06	0.0000	0.0000	0.00E+00
110		0.00	0.000	0.002	0.0240	0.0004	0.0013	1.44E-07	0.0000	0.0000	0.00E+00
111		0.00	0.000	0.000	0.0240	0.0000	0.0000	8.12E-09	0.0000	0.0000	0.00E+00
112		0.14	0.000	0.019	0.2411	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
113		0.00	0.000	0.018	0.0312	0.0248	0.0935	6.50E-06	0.0000	0.0000	0.00E+00
114		0.17	0.000	0.020	0.2313	0.0077	0.0290	2.12E-06	0.0000	0.0000	0.00E+00
115		0.03	0.000	0.088	0.0326	0.0196	0.0740	5.19E-06	0.0000	0.0000	0.00E+00
116		0.00	0.000	0.003	0.0265	0.0003	0.0012	1.33E-07	0.0000	0.0000	0.00E+00
117		0.00	0.000	0.001	0.0248	0.0000	0.0000	1.12E-08	0.0000	0.0000	0.00E+00
118		0.00	0.000	0.000	0.0243	0.0000	0.0000	4.58E-09	0.0000	0.0000	0.00E+00
119		0.06	0.000	0.013	0.1245	0.0000	0.0000	7.22E-09	0.0000	0.0000	0.00E+00
120		0.00	0.000	0.013	0.0688	0.0033	0.0125	1.03E-06	0.0000	0.0000	0.00E+00
121		0.18	0.000	0.021	0.2435	0.0129	0.0487	3.41E-06	0.0000	0.0000	0.00E+00
122		0.05	0.000	0.020	0.1237	0.0295	0.1115	7.60E-06	0.0000	0.0000	0.00E+00
123		0.12	0.000	0.020	0.2292	0.0088	0.0334	2.57E-06	0.0000	0.0000	0.00E+00
124		0.00	0.000	0.014	0.0583	0.0216	0.0817	5.81E-06	0.0000	0.0000	0.00E+00
125		0.00	0.000	0.015	0.0258	0.0013	0.0051	4.65E-07	0.0000	0.0000	0.00E+00
126		0.03	0.000	0.009	0.0579	0.0000	0.0002	3.22E-08	0.0000	0.0000	0.00E+00
127		0.35	0.000	0.018	0.2770	0.0485	0.1833	1.12E-05	0.0000	0.0000	0.00E+00
128		0.00	0.000	0.042	0.0240	0.0317	0.1198	7.73E-06	0.0000	0.0000	0.00E+00
129		0.00	0.000	0.000	0.0240	0.0000	0.0001	2.55E-08	0.0000	0.0000	0.00E+00
130	*	0.00	0.000	0.000	0.0240	0.0000	0.0000	3.71E-09	0.0000	0.0000	0.00E+00
131	*	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
132	*	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
133		0.05	0.000	0.013	0.0886	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
134		0.07	0.000	0.019	0.1436	0.0026	0.0098	7.70E-07	0.0000	0.0000	0.00E+00
135		0.02	0.000	0.024	0.0834	0.0093	0.0352	2.72E-06	0.0000	0.0000	0.00E+00
136		0.06	0.000	0.021	0.1322	0.0017	0.0064	5.76E-07	0.0000	0.0000	0.00E+00

137	0.00	0.000	0.019	0.0695	0.0054	0.0204	1.65E-06	0.0000	0.0000	0.00E+00
138	0.01	0.000	0.022	0.0393	0.0006	0.0024	2.50E-07	0.0000	0.0000	0.00E+00
139	0.49	0.000	0.024	0.2655	0.0740	0.2795	1.68E-05	0.0000	0.0000	0.00E+00
140	0.26	0.000	0.204	0.1982	0.0429	0.1620	1.01E-05	0.0000	0.0000	0.00E+00
141	0.13	0.000	0.179	0.0896	0.0019	0.0072	6.07E-07	0.0000	0.0000	0.00E+00
142	0.34	0.000	0.143	0.2185	0.0203	0.0766	5.11E-06	0.0000	0.0000	0.00E+00
143	0.00	0.000	0.047	0.0240	0.0272	0.1029	6.89E-06	0.0000	0.0000	0.00E+00
144	0.00	0.000	0.000	0.0240	0.0000	0.0002	3.33E-08	0.0000	0.0000	0.00E+00
145	0.00	0.000	0.000	0.0240	0.0000	0.0000	4.40E-09	0.0000	0.0000	0.00E+00
146	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
147	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
148	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
149	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
150	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
151	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
152	0.25	0.000	0.037	0.2245	0.0161	0.0609	4.00E-06	0.0000	0.0000	0.00E+00
153	0.48	0.000	0.034	0.2245	0.1046	0.3953	2.40E-05	0.0000	0.0000	0.00E+00
154	0.00	0.000	0.030	0.0341	0.0447	0.1688	1.08E-05	0.0000	0.0000	0.00E+00
155	0.00	0.000	0.003	0.0272	0.0001	0.0006	7.28E-08	0.0000	0.0000	0.00E+00
156	0.00	0.000	0.002	0.0240	0.0000	0.0000	6.53E-09	0.0000	0.0000	0.00E+00
157	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
158	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
159	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
160	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
161	0.10	0.000	0.023	0.1690	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
162	0.05	0.000	0.030	0.1217	0.0114	0.0432	3.18E-06	0.0000	0.0000	0.00E+00
163	0.00	0.000	0.022	0.0649	0.0029	0.0108	9.36E-07	0.0000	0.0000	0.00E+00
164	0.00	0.000	0.017	0.0261	0.0008	0.0029	2.91E-07	0.0000	0.0000	0.00E+00
165	0.00	0.000	0.001	0.0240	0.0001	0.0002	3.68E-08	0.0000	0.0000	0.00E+00
166	0.00	0.000	0.000	0.0240	0.0000	0.0000	6.76E-09	0.0000	0.0000	0.00E+00
167	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
168	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
169	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
170	0.16	0.000	0.040	0.2443	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
171	0.26	0.000	0.035	0.2443	0.0510	0.1928	1.25E-05	0.0000	0.0000	0.00E+00
172	0.12	0.000	0.034	0.2155	0.0354	0.1337	8.99E-06	0.0000	0.0000	0.00E+00

173	0.04	0.000	0.098	0.0364	0.0111	0.0421	3.14E-06	0.0000	0.0000	0.00E+00
174	0.00	0.000	0.004	0.0293	0.0000	0.0002	3.59E-08	0.0000	0.0000	0.00E+00
175	0.43	0.000	0.046	0.2848	0.0566	0.2139	1.28E-05	0.0000	0.0000	0.00E+00
176	0.00	0.000	0.031	0.0240	0.0373	0.1411	8.95E-06	0.0000	0.0000	0.00E+00
177	0.13	0.000	0.045	0.1938	0.0000	0.0001	2.78E-08	0.0000	0.0000	0.00E+00
178	0.14	0.000	0.044	0.2233	0.0157	0.0592	4.28E-06	0.0000	0.0000	0.00E+00
179	0.00	0.000	0.027	0.0515	0.0208	0.0786	5.59E-06	0.0000	0.0000	3.35E-04
180	0.00	0.000	0.011	0.0255	0.0009	0.0033	3.26E-07	0.0000	0.0000	0.00E+00
181	0.00	0.000	0.001	0.0240	0.0000	0.0000	1.59E-08	0.0000	0.0000	0.00E+00
182	0.13	0.000	0.041	0.2079	0.0000	0.0000	6.17E-10	0.0000	0.0000	0.00E+00
183	0.00	0.000	0.057	0.0261	0.0087	0.0328	2.49E-06	0.0000	0.0000	0.00E+00
184	0.00	0.000	0.001	0.0240	0.0002	0.0006	7.64E-08	0.0000	0.0000	0.00E+00
185	0.00	0.000	0.000	0.0240	0.0000	0.0000	6.60E-09	0.0000	0.0000	0.00E+00
186	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
187	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
188	0.04	0.000	0.021	0.0712	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
189	0.00	0.000	0.012	0.0462	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
190	0.13	0.000	0.031	0.2238	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
191	0.00	0.000	0.024	0.0489	0.0178	0.0674	4.85E-06	0.0000	0.0000	0.00E+00
192	0.00	0.000	0.010	0.0255	0.0009	0.0035	3.43E-07	0.0000	0.0000	0.00E+00
193	0.02	0.000	0.020	0.0311	0.0001	0.0002	4.34E-08	0.0000	0.0000	0.00E+00
194	0.10	0.000	0.054	0.1133	0.0000	0.0000	8.98E-09	0.0000	0.0000	0.00E+00
195	0.00	0.000	0.026	0.0572	0.0003	0.0011	1.13E-07	0.0000	0.0000	0.00E+00
196	0.00	0.000	0.013	0.0250	0.0010	0.0039	3.84E-07	0.0000	0.0000	0.00E+00
197	0.00	0.000	0.001	0.0240	0.0000	0.0000	1.64E-08	0.0000	0.0000	0.00E+00
198	0.00	0.000	0.000	0.0240	0.0000	0.0000	1.05E-09	0.0000	0.0000	0.00E+00
199	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
200	0.09	0.000	0.045	0.1126	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
201	0.09	0.000	0.039	0.1594	0.0053	0.0199	1.52E-06	0.0000	0.0000	0.00E+00
202	0.10	0.000	0.133	0.0608	0.0062	0.0234	1.85E-06	0.0000	0.0000	0.00E+00
203	0.20	0.000	0.074	0.2269	0.0035	0.0130	9.54E-07	0.0000	0.0000	0.00E+00
204	0.02	0.000	0.069	0.0298	0.0216	0.0814	5.74E-06	0.0000	0.0000	0.00E+00
205	0.08	0.000	0.064	0.0702	0.0003	0.0012	1.33E-07	0.0000	0.0000	0.00E+00
206	0.00	0.000	0.014	0.0456	0.0000	0.0000	7.94E-09	0.0000	0.0000	0.00E+00
207	0.01	0.000	0.015	0.0295	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
208	0.00	0.000	0.002	0.0256	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00

209	0.49	0.000	0.094	0.2919	0.0601	0.2270	1.35E-05	0.0000	0.0000	0.00E+00
210	0.11	0.000	0.125	0.0690	0.0368	0.1392	8.83E-06	0.0000	0.0000	0.00E+00
211	0.07	0.000	0.080	0.0489	0.0000	0.0001	2.71E-08	0.0000	0.0000	0.00E+00
212	0.04	0.000	0.045	0.0349	0.0000	0.0000	3.92E-09	0.0000	0.0000	0.00E+00
213	0.05	0.000	0.044	0.0383	0.0000	0.0000	6.76E-09	0.0000	0.0000	0.00E+00
214	0.00	0.000	0.009	0.0278	0.0000	0.0001	9.15E-09	0.0000	0.0000	0.00E+00
215	0.00	0.000	0.001	0.0253	0.0000	0.0000	1.64E-08	0.0000	0.0000	0.00E+00
216	0.00	0.000	0.000	0.0244	0.0000	0.0000	1.03E-09	0.0000	0.0000	0.00E+00
217	0.00	0.000	0.000	0.0241	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
218	0.00	0.000	0.000	0.0240	0.0000	0.0000	1.30E-08	0.0000	0.0000	0.00E+00
219	0.37	0.000	0.090	0.2107	0.0288	0.1089	6.99E-06	0.0000	0.0000	0.00E+00
220	0.00	0.000	0.013	0.0276	0.0412	0.1557	1.00E-05	0.0000	0.0000	0.00E+00
221	0.00	0.000	0.002	0.0242	0.0001	0.0003	4.97E-08	0.0000	0.0000	0.00E+00
222	0.16	0.000	0.073	0.1896	0.0000	0.0000	6.22E-09	0.0000	0.0000	0.00E+00
223	0.00	0.000	0.039	0.0426	0.0090	0.0342	2.54E-06	0.0000	0.0000	0.00E+00
224	0.01	0.000	0.019	0.0291	0.0003	0.0011	1.29E-07	0.0000	0.0000	0.00E+00
225	0.03	0.000	0.021	0.0504	0.0000	0.0000	9.59E-09	0.0000	0.0000	0.00E+00
226	0.28	0.000	0.044	0.2082	0.0232	0.0877	5.73E-06	0.0000	0.0000	0.00E+00
227	0.00	0.000	0.030	0.0266	0.0345	0.1303	8.49E-06	0.0000	0.0000	0.00E+00
228	0.00	0.000	0.001	0.0240	0.0001	0.0005	6.48E-08	0.0000	0.0000	0.00E+00
229	0.00	0.000	0.000	0.0240	0.0000	0.0000	7.72E-09	0.0000	0.0000	0.00E+00
230	0.25	0.000	0.030	0.2128	0.0176	0.0664	4.32E-06	0.0000	0.0000	0.00E+00
231	0.03	0.000	0.058	0.0325	0.0328	0.1240	8.26E-06	0.0000	0.0000	0.00E+00
232	0.25	0.000	0.025	0.2019	0.0185	0.0698	4.53E-06	0.0000	0.0000	0.00E+00
233	0.62	0.000	0.223	0.2019	0.0942	0.3560	2.19E-05	0.0000	0.0000	0.00E+00
234	0.18	0.000	0.169	0.1436	0.0405	0.1531	9.82E-06	0.0000	0.0000	0.00E+00
235	0.00	0.000	0.021	0.0428	0.0068	0.0256	1.92E-06	0.0000	0.0000	0.00E+00
236	0.08	0.000	0.077	0.0507	0.0012	0.0046	4.08E-07	0.0000	0.0000	0.00E+00
237	0.00	0.000	0.005	0.0410	0.0000	0.0000	1.03E-08	0.0000	0.0000	0.00E+00
238	0.00	0.000	0.006	0.0281	0.0000	0.0000	6.19E-10	0.0000	0.0000	0.00E+00
239	0.00	0.000	0.001	0.0253	0.0000	0.0000	1.21E-08	0.0000	0.0000	0.00E+00
240	0.00	0.000	0.000	0.0244	0.0000	0.0000	1.08E-08	0.0000	0.0000	0.00E+00
241	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
242	0.43	0.000	0.035	0.2886	0.0590	0.2229	1.33E-05	0.0000	0.0000	0.00E+00
243	0.20	0.000	0.171	0.1526	0.0361	0.1365	8.68E-06	0.0000	0.0000	0.00E+00
244	0.11	0.000	0.146	0.0778	0.0000	0.0001	3.09E-08	0.0000	0.0000	0.00E+00

245	0.00	0.000	0.015	0.0470	0.0002	0.0009	1.02E-07	0.0000	0.0000	0.00E+00
246	0.00	0.000	0.010	0.0279	0.0000	0.0000	9.36E-09	0.0000	0.0000	0.00E+00
247	0.00	0.000	0.001	0.0252	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
248	0.04	0.000	0.021	0.0663	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
249	0.90	0.008	0.037	0.4370	0.3596	0.5042	7.06E-05	0.0000	0.0000	0.00E+00
250	0.00	0.000	0.050	0.0240	0.1863	0.3244	3.76E-05	0.0000	0.0000	3.26E-04
251	0.32	0.000	0.220	0.2262	0.0001	0.0003	4.59E-08	0.0000	0.0000	1.48E-05
252	0.05	0.000	0.089	0.0395	0.0131	0.0494	3.59E-06	0.0000	0.0000	0.00E+00
253	0.05	0.000	0.046	0.0389	0.0003	0.0011	1.19E-07	0.0000	0.0000	0.00E+00
254	0.00	0.000	0.005	0.0298	0.0000	0.0000	7.64E-09	0.0000	0.0000	0.00E+00
255	0.03	0.000	0.034	0.0296	0.0000	0.0000	1.05E-08	0.0000	0.0000	0.00E+00
256	0.10	0.000	0.052	0.1223	0.0000	0.0000	1.18E-08	0.0000	0.0000	0.00E+00
257	0.15	0.000	0.052	0.2257	0.0068	0.0256	1.95E-06	0.0000	0.0000	0.00E+00
258	0.15	0.000	0.047	0.2305	0.0258	0.0973	6.82E-06	0.0000	0.0000	0.00E+00
259	0.24	0.000	0.223	0.1926	0.0139	0.0525	3.83E-06	0.0000	0.0000	0.00E+00
260	0.03	0.000	0.048	0.0627	0.0123	0.0465	3.45E-06	0.0000	0.0000	0.00E+00
261	0.00	0.000	0.015	0.0273	0.0009	0.0034	3.40E-07	0.0000	0.0000	0.00E+00
262	0.00	0.000	0.001	0.0251	0.0000	0.0000	1.91E-08	0.0000	0.0000	0.00E+00
263	0.00	0.000	0.000	0.0244	0.0000	0.0000	8.86E-09	0.0000	0.0000	0.00E+00
264	0.00	0.000	0.000	0.0241	0.0000	0.0000	4.13E-11	0.0000	0.0000	0.00E+00
265	0.00	0.000	0.000	0.0240	0.0000	0.0000	4.13E-11	0.0000	0.0000	0.00E+00
266	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
267	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
268	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
269	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
270	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
271	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
272	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
273	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
274	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
275	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
276	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
277	0.02	0.000	0.009	0.0489	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
278	0.17	0.000	0.017	0.2536	0.0097	0.0365	2.36E-06	0.0000	0.0000	0.00E+00
279	0.00	0.000	0.012	0.0528	0.0269	0.1017	6.91E-06	0.0000	0.0000	0.00E+00
280	0.03	0.000	0.016	0.0774	0.0005	0.0017	1.88E-07	0.0000	0.0000	0.00E+00

281		0.02	0.000	0.016	0.0756	0.0002	0.0008	1.05E-07	0.0000	0.0000	0.00E+00
282		0.52	0.000	0.016	0.2174	0.0822	0.3106	1.86E-05	0.0000	0.0000	0.00E+00
283		0.06	0.000	0.095	0.0398	0.0468	0.1768	1.09E-05	0.0000	0.0000	0.00E+00
284		0.23	0.000	0.167	0.1600	0.0000	0.0001	2.43E-08	0.0000	0.0000	0.00E+00
285		0.00	0.000	0.032	0.0506	0.0056	0.0210	1.57E-06	0.0000	0.0000	0.00E+00
286		0.00	0.000	0.011	0.0240	0.0008	0.0032	3.14E-07	0.0000	0.0000	0.00E+00
287		0.00	0.000	0.000	0.0240	0.0000	0.0000	1.37E-08	0.0000	0.0000	0.00E+00
288		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
289		0.14	0.000	0.031	0.2397	0.0000	0.0000	1.18E-11	0.0000	0.0000	0.00E+00
290		0.01	0.000	0.027	0.0382	0.0212	0.0801	5.61E-06	0.0000	0.0000	0.00E+00
291		0.01	0.000	0.010	0.0295	0.0014	0.0053	4.64E-07	0.0000	0.0000	0.00E+00
292	*	0.02	0.000	0.020	0.0256	0.0000	0.0000	1.06E-08	0.0000	0.0000	0.00E+00
293	*	0.05	0.000	0.054	0.0245	0.0000	0.0000	2.63E-11	0.0000	0.0000	0.00E+00
294		0.23	0.000	0.024	0.2346	0.0148	0.0560	3.71E-06	0.0000	0.0000	0.00E+00
295		0.00	0.000	0.007	0.0338	0.0354	0.1337	8.90E-06	0.0000	0.0000	0.00E+00
296		0.00	0.000	0.004	0.0255	0.0002	0.0007	9.21E-08	0.0000	0.0000	0.00E+00
297		0.13	0.000	0.020	0.2379	0.0000	0.0001	2.80E-08	0.0000	0.0000	0.00E+00
298	*	0.25	0.000	0.087	0.0952	0.0226	0.0854	5.95E-06	0.0000	0.0000	0.00E+00
299	*	0.00	0.000	0.097	0.1102	0.0035	0.0134	1.13E-06	0.0000	0.0000	0.00E+00
300	*	0.00	0.000	0.023	0.0963	0.0028	0.0108	9.38E-07	0.0000	0.0000	0.00E+00
301	*	0.30	0.000	0.089	0.1147	0.0017	0.0064	5.82E-07	0.0000	0.0000	0.00E+00
302		0.00	0.000	0.215	0.0514	0.0026	0.0099	8.64E-07	0.0000	0.0000	0.00E+00
303		0.00	0.000	0.012	0.0240	0.0007	0.0026	2.68E-07	0.0000	0.0000	0.00E+00
304		0.00	0.000	0.000	0.0240	0.0000	0.0000	1.36E-08	0.0000	0.0000	0.00E+00
305	*	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
306		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
307		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
308		0.08	0.000	0.031	0.1267	0.0000	0.0000	5.88E-12	0.0000	0.0000	0.00E+00
309		0.01	0.000	0.030	0.0675	0.0025	0.0093	7.90E-07	0.0000	0.0000	0.00E+00
310		0.18	0.000	0.030	0.2409	0.0120	0.0454	3.10E-06	0.0000	0.0000	0.00E+00
311		0.01	0.000	0.023	0.0462	0.0266	0.1004	6.95E-06	0.0000	0.0000	0.00E+00
312		0.20	0.000	0.026	0.2432	0.0126	0.0476	3.25E-06	0.0000	0.0000	0.00E+00
313		0.14	0.000	0.183	0.0933	0.0154	0.0582	4.08E-06	0.0000	0.0000	0.00E+00
314		0.04	0.000	0.021	0.1206	0.0013	0.0048	4.26E-07	0.0000	0.0000	0.00E+00
315		0.02	0.000	0.023	0.0984	0.0033	0.0124	1.06E-06	0.0000	0.0000	0.00E+00
316		0.04	0.000	0.022	0.1132	0.0015	0.0055	4.97E-07	0.0000	0.0000	0.00E+00

317	*		0.00	0.000	0.000	0.0978	0.0027	0.0101	8.91E-07	0.0000	0.0000	0.00E+00
318	*		0.15	0.000	0.101	0.1147	0.0019	0.0072	6.52E-07	0.0000	0.0000	0.00E+00
319	*		0.00	0.000	0.033	0.0959	0.0035	0.0134	1.14E-06	0.0000	0.0000	0.00E+00
320	*		0.00	0.000	0.018	0.0558	0.0007	0.0026	2.75E-07	0.0000	0.0000	0.00E+00
321	*		0.00	0.000	0.000	0.0524	0.0004	0.0017	1.88E-07	0.0000	0.0000	0.00E+00
322	*		0.00	0.000	0.013	0.0240	0.0004	0.0017	1.81E-07	0.0000	0.0000	0.00E+00
323			0.48	0.000	0.020	0.2849	0.0709	0.2679	1.60E-05	0.0000	0.0000	0.00E+00
324	*		0.29	0.000	0.103	0.0634	0.0498	0.1881	1.16E-05	0.0000	0.0000	0.00E+00
325	*		0.18	0.000	0.093	0.1027	0.0000	0.0001	3.09E-08	0.0000	0.0000	0.00E+00
326	*		0.38	0.000	0.082	0.1118	0.0028	0.0105	8.66E-07	0.0000	0.0000	0.00E+00
327	*		0.24	0.000	0.000	0.1097	0.0054	0.0205	1.69E-06	0.0000	0.0000	0.00E+00
328			0.22	0.000	0.000	0.2363	0.1662	0.4983	3.53E-05	0.0000	0.0000	0.00E+00
329			0.00	0.000	0.115	0.1060	0.0630	0.2381	1.43E-05	0.0000	0.0000	0.00E+00
330	*		0.03	0.000	0.093	0.1118	0.0032	0.0122	1.03E-06	0.0000	0.0000	0.00E+00
331			0.22	0.000	0.098	0.2336	0.0167	0.0632	4.50E-06	0.0000	0.0000	0.00E+00
332	*		0.00	0.000	0.060	0.0240	0.0197	0.0743	5.24E-06	0.0000	0.0000	0.00E+00
333	*		0.46	0.000	0.096	0.0634	0.0001	0.0005	6.96E-08	0.0000	0.0000	0.00E+00
334	*		0.01	0.000	0.077	0.1027	0.0000	0.0000	6.46E-09	0.0000	0.0000	0.00E+00
335	*		0.04	0.000	0.092	0.1118	0.0028	0.0105	8.62E-07	0.0000	0.0000	0.00E+00
336			0.00	0.000	0.181	0.1083	0.0031	0.0119	1.02E-06	0.0000	0.0000	0.00E+00
337			0.16	0.000	0.164	0.0968	0.0005	0.0017	1.87E-07	0.0000	0.0000	0.00E+00
338			0.00	0.000	0.014	0.0494	0.0018	0.0066	5.41E-07	0.0000	0.0000	0.00E+00
339	*		0.00	0.000	0.001	0.0469	0.0010	0.0038	3.65E-07	0.0000	0.0000	0.00E+00
340	*		0.10	0.000	0.052	0.0853	0.0001	0.0006	7.85E-08	0.0000	0.0000	0.00E+00
341	*		0.09	0.000	0.054	0.1136	0.0003	0.0011	1.26E-07	0.0000	0.0000	0.00E+00
342	*		0.00	0.000	0.052	0.1036	0.0031	0.0118	1.01E-06	0.0000	0.0000	0.00E+00
343	*	*	0.04	0.000	0.043	0.1036	0.0002	0.0008	9.80E-08	0.0000	0.0000	0.00E+00
344			0.00	0.000	0.036	0.0242	0.0009	0.0033	3.29E-07	0.0000	0.0000	0.00E+00
345	*	*	0.00	0.000	0.000	0.0242	0.0000	0.0000	1.79E-08	0.0000	0.0000	0.00E+00
346			0.00	0.000	0.000	0.0241	0.0000	0.0000	1.46E-08	0.0000	0.0000	0.00E+00
347	*	*	0.17	0.000	0.095	0.0241	0.0000	0.0000	4.39E-09	0.0000	0.0000	0.00E+00
348	*	*	0.00	0.000	0.072	0.0241	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
349			0.10	0.000	0.078	0.0618	0.0000	0.0000	2.57E-11	0.0000	0.0000	0.00E+00
350	*	*	0.00	0.000	0.000	0.0618	0.0000	0.0000	2.57E-11	0.0000	0.0000	0.00E+00
351	*	*	0.00	0.000	0.000	0.0618	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
352	*	*	0.04	0.000	0.043	0.0618	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00

353	*	*	0.00	0.000	0.000	0.0618	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
354	*	*	0.00	0.000	0.000	0.0618	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
355	*	*	0.00	0.000	0.000	0.0618	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
356			0.00	0.000	0.009	0.0446	0.0000	0.0000	9.89E-09	0.0000	0.0000	0.00E+00
357	*	*	0.00	0.000	0.000	0.0446	0.0000	0.0000	3.38E-09	0.0000	0.0000	0.00E+00
358	*	*	0.01	0.000	0.011	0.0446	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
359	*	*	0.00	0.000	0.000	0.0446	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
360	*	*	0.00	0.000	0.000	0.0446	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
361	*	*	0.04	0.000	0.042	0.0446	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
362			0.04	0.000	0.038	0.0567	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
363	*	*	0.05	0.000	0.049	0.0567	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
364			0.10	0.000	0.039	0.1670	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
365			0.06	0.000	0.037	0.1223	0.0114	0.0431	3.27E-06	0.0000	0.0000	0.00E+00

* = Frozen (air or soil)

Annual Totals for Year 1			
	inches	cubic feet	percent
Precipitation	28.37	2,059,371.9	100.00
Runoff	0.935	67,845.8	3.29
Evapotranspiration	13.485	979,042.2	47.54
Drainage Collected from Layer 2	13.9448	1,012,395.8	49.16
Percolation/Leakage through Layer 3	0.000990	71.9	0.00
Average Head on Top of Layer 3	0.0116	---	---
Percolation/Leakage through Layer 4	0.000676	49.1	0.00
Change in Water Storage	0.0005	39.0	0.00
Soil Water at Start of Year	114.5083	8,313,301.3	403.68
Soil Water at End of Year	114.5088	8,313,340.2	403.68
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 Outputs for Years 2 through 99 Removed for Brevity

Daily Output for Year 100

Column key: Head #1: drainage from Layer 3
Drain #1: drainage from Layer 2
Leak #1: leakage thru Layer 3
Leak #2: leakage thru Layer 4

Title: Sibley Quarry ClosureTurf
Simulated On: 11/10/2023 16:12

Day	Freezing Status* Air	Soil	Rain (inches)	Runoff (inches)	ET (inches)	Evap. Zone Water (in/in)	Head #1 (inches)	Drain #1 (inches)	Leak #1 (inches)	Head #2 (inches)	Drain #2 (inches)	Leak #2 (inches)
1	*		0.00	0.000	0.076	0.0270	0.0018	0.0068	6.09E-07	0.0000	0.0000	0.00E+00
2	*		0.00	0.000	0.000	0.0270	0.0000	0.0000	1.83E-08	0.0000	0.0000	0.00E+00
3	*		0.00	0.000	0.000	0.0270	0.0000	0.0000	1.90E-09	0.0000	0.0000	0.00E+00
4	*		0.00	0.000	0.000	0.0270	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
5	*		0.83	0.000	0.020	0.0663	0.0000	0.0000	3.37E-10	0.0000	0.0000	0.00E+00
6	*		0.00	0.000	0.012	0.1057	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
7	*	*	0.00	0.000	0.008	0.1057	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
8	*	*	0.00	0.000	0.029	0.1057	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
9	*	*	0.03	0.000	0.000	0.1057	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
10		*	0.07	0.000	0.000	0.3616	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
11	*	*	0.06	0.000	0.111	0.3616	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
12	*	*	0.00	0.000	0.088	0.3616	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
13	*	*	0.00	0.000	0.097	0.3616	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
14	*	*	0.00	0.000	0.091	0.3616	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
15	*	*	0.00	0.000	0.045	0.3616	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
16	*	*	0.00	0.000	0.047	0.3616	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
17	*	*	0.00	0.000	0.024	0.3616	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
18	*	*	0.00	0.000	0.044	0.3616	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
19		*	0.00	0.000	0.122	0.3616	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
20	*	*	0.02	0.000	0.059	0.3616	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
21		*	0.08	0.000	0.117	0.3616	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
22	*	*	0.00	0.000	0.000	0.3616	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
23			0.00	0.000	0.037	0.0240	0.0348	0.1315	8.28E-06	0.0000	0.0000	0.00E+00
24			0.07	0.000	0.017	0.1390	0.0001	0.0002	3.88E-08	0.0000	0.0000	0.00E+00
25	*	*	0.10	0.000	0.085	0.1390	0.0000	0.0000	4.82E-09	0.0000	0.0000	0.00E+00
26		*	0.00	0.000	0.018	0.1390	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
27			0.00	0.000	0.016	0.0669	0.0051	0.0193	1.54E-06	0.0000	0.0000	0.00E+00
28			0.01	0.000	0.021	0.0491	0.0006	0.0022	2.31E-07	0.0000	0.0000	0.00E+00

29			0.29	0.000	0.021	0.2243	0.0313	0.1184	7.64E-06	0.0000	0.0000	0.00E+00
30	*	*	0.21	0.000	0.107	0.2243	0.0171	0.0647	4.28E-06	0.0000	0.0000	0.00E+00
31		*	0.02	0.000	0.125	0.2243	0.0000	0.0000	1.60E-08	0.0000	0.0000	0.00E+00
32			0.00	0.000	0.032	0.0257	0.0177	0.0668	4.56E-06	0.0000	0.0000	0.00E+00
33	*	*	0.00	0.000	0.000	0.0257	0.0001	0.0002	3.87E-08	0.0000	0.0000	0.00E+00
34			0.00	0.000	0.001	0.0240	0.0000	0.0000	4.81E-09	0.0000	0.0000	0.00E+00
35			0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
36	*	*	0.10	0.000	0.098	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
37	*	*	0.00	0.000	0.005	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
38			0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
39			0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
40	*	*	0.23	0.000	0.108	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
41		*	0.12	0.000	0.000	0.3423	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
42		*	0.02	0.000	0.105	0.3423	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
43			0.17	0.000	0.145	0.1159	0.0356	0.1346	8.47E-06	0.0000	0.0000	0.00E+00
44			0.01	0.000	0.014	0.0702	0.0035	0.0133	1.02E-06	0.0000	0.0000	0.00E+00
45	*		0.00	0.000	0.014	0.0371	0.0008	0.0029	3.04E-07	0.0000	0.0000	0.00E+00
46	*		0.00	0.000	0.000	0.0359	0.0002	0.0009	1.15E-07	0.0000	0.0000	0.00E+00
47	*		0.08	0.000	0.075	0.0433	0.0001	0.0004	5.87E-08	0.0000	0.0000	0.00E+00
48			0.00	0.000	0.007	0.0274	0.0002	0.0009	1.04E-07	0.0000	0.0000	0.00E+00
49			0.00	0.000	0.001	0.0251	0.0000	0.0000	9.41E-09	0.0000	0.0000	0.00E+00
50			0.00	0.000	0.000	0.0244	0.0000	0.0000	4.59E-09	0.0000	0.0000	0.00E+00
51	*		0.00	0.000	0.000	0.0241	0.0000	0.0000	5.44E-09	0.0000	0.0000	0.00E+00
52			0.00	0.000	0.000	0.0240	0.0000	0.0000	4.24E-09	0.0000	0.0000	0.00E+00
53			0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
54			0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
55	*		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
56			0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
57			0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
58			0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
59	*		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
60	*		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
61			0.02	0.000	0.007	0.0570	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
62	*		0.34	0.000	0.074	0.0964	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
63			0.09	0.000	0.163	0.2161	0.0181	0.0684	4.59E-06	0.0000	0.0000	0.00E+00
64			0.01	0.000	0.013	0.0860	0.0305	0.1153	7.73E-06	0.0000	0.0000	0.00E+00

65		0.00	0.000	0.013	0.0642	0.0005	0.0017	1.88E-07	0.0000	0.0000	0.00E+00
66		0.18	0.000	0.013	0.2337	0.0121	0.0455	3.10E-06	0.0000	0.0000	0.00E+00
67		0.00	0.000	0.053	0.0240	0.0221	0.0836	5.85E-06	0.0000	0.0000	0.00E+00
68		0.00	0.000	0.000	0.0240	0.0003	0.0010	1.15E-07	0.0000	0.0000	0.00E+00
69		0.00	0.000	0.000	0.0240	0.0000	0.0000	7.53E-09	0.0000	0.0000	0.00E+00
70		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
71		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
72		0.04	0.000	0.009	0.0942	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
73		0.00	0.000	0.008	0.0773	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
74		0.03	0.000	0.012	0.1131	0.0004	0.0014	1.62E-07	0.0000	0.0000	0.00E+00
75		0.50	0.000	0.012	0.1921	0.0819	0.3093	1.86E-05	0.0000	0.0000	0.00E+00
76		0.17	0.000	0.169	0.1353	0.0459	0.1733	1.06E-05	0.0000	0.0000	0.00E+00
77		0.00	0.000	0.019	0.0464	0.0058	0.0218	1.65E-06	0.0000	0.0000	0.00E+00
78	*	0.00	0.000	0.009	0.0261	0.0013	0.0048	4.31E-07	0.0000	0.0000	0.00E+00
79		0.00	0.000	0.001	0.0247	0.0000	0.0000	1.12E-08	0.0000	0.0000	0.00E+00
80		0.00	0.000	0.000	0.0242	0.0000	0.0000	3.46E-10	0.0000	0.0000	0.00E+00
81		0.09	0.000	0.030	0.1457	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
82		0.34	0.000	0.032	0.2167	0.0501	0.1891	1.19E-05	0.0000	0.0000	0.00E+00
83		0.00	0.000	0.020	0.0632	0.0361	0.1365	8.89E-06	0.0000	0.0000	0.00E+00
84	*	0.07	0.000	0.067	0.0585	0.0008	0.0031	3.21E-07	0.0000	0.0000	0.00E+00
85	*	0.00	0.000	0.016	0.0240	0.0004	0.0016	1.78E-07	0.0000	0.0000	0.00E+00
86		0.00	0.000	0.000	0.0240	0.0000	0.0000	1.26E-08	0.0000	0.0000	0.00E+00
87		0.00	0.000	0.002	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
88		0.19	0.000	0.022	0.2523	0.0100	0.0378	2.43E-06	0.0000	0.0000	0.00E+00
89		0.00	0.000	0.055	0.0339	0.0192	0.0727	5.08E-06	0.0000	0.0000	0.00E+00
90		0.00	0.000	0.003	0.0273	0.0002	0.0008	9.43E-08	0.0000	0.0000	0.00E+00
91	*	0.00	0.000	0.001	0.0251	0.0000	0.0000	7.52E-09	0.0000	0.0000	0.00E+00
92		0.00	0.000	0.001	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
93		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
94		0.14	0.000	0.017	0.2252	0.0000	0.0000	2.27E-09	0.0000	0.0000	0.00E+00
95		0.00	0.000	0.011	0.0373	0.0272	0.1028	7.15E-06	0.0000	0.0000	0.00E+00
96		0.00	0.000	0.006	0.0245	0.0019	0.0070	5.90E-07	0.0000	0.0000	0.00E+00
97		0.00	0.000	0.000	0.0242	0.0000	0.0000	1.11E-08	0.0000	0.0000	0.00E+00
98		0.00	0.000	0.000	0.0241	0.0000	0.0000	4.76E-11	0.0000	0.0000	0.00E+00
99		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
100	*	0.14	0.000	0.096	0.0634	0.0000	0.0000	1.98E-11	0.0000	0.0000	0.00E+00

101	*	0.02	0.000	0.044	0.0634	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
102		0.29	0.000	0.016	0.2475	0.0361	0.1365	8.61E-06	0.0000	0.0000	0.00E+00
103		0.00	0.000	0.041	0.0240	0.0312	0.1177	7.76E-06	0.0000	0.0000	0.00E+00
104		0.00	0.000	0.000	0.0240	0.0000	0.0002	3.22E-08	0.0000	0.0000	0.00E+00
105		0.00	0.000	0.000	0.0240	0.0000	0.0000	4.34E-09	0.0000	0.0000	0.00E+00
106		0.15	0.000	0.014	0.2142	0.0000	0.0000	2.27E-09	0.0000	0.0000	0.00E+00
107		0.01	0.000	0.011	0.0550	0.0295	0.1115	7.64E-06	0.0000	0.0000	0.00E+00
108		0.00	0.000	0.010	0.0344	0.0016	0.0059	5.06E-07	0.0000	0.0000	0.00E+00
109	*	0.00	0.000	0.000	0.0344	0.0000	0.0000	1.39E-08	0.0000	0.0000	0.00E+00
110		0.00	0.000	0.004	0.0265	0.0000	0.0000	6.96E-09	0.0000	0.0000	0.00E+00
111		0.00	0.000	0.001	0.0250	0.0000	0.0000	4.86E-10	0.0000	0.0000	0.00E+00
112		0.00	0.000	0.000	0.0242	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
113		0.00	0.000	0.000	0.0241	0.0000	0.0000	2.46E-11	0.0000	0.0000	0.00E+00
114		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
115		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
116		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
117		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
118		0.22	0.000	0.013	0.2301	0.0154	0.0582	3.85E-06	0.0000	0.0000	0.00E+00
119		0.75	0.000	0.013	0.2301	0.1640	0.6195	3.59E-05	0.0000	0.0000	0.00E+00
120		0.00	0.000	0.029	0.0405	0.0607	0.2292	1.41E-05	0.0000	0.0000	0.00E+00
121		0.00	0.000	0.006	0.0277	0.0002	0.0006	7.74E-08	0.0000	0.0000	0.00E+00
122		0.00	0.000	0.002	0.0240	0.0000	0.0000	6.61E-09	0.0000	0.0000	0.00E+00
123		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
124		0.00	0.000	0.002	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
125		0.10	0.000	0.032	0.1615	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
126		0.14	0.000	0.035	0.2199	0.0114	0.0429	3.17E-06	0.0000	0.0000	0.00E+00
127		0.10	0.000	0.032	0.1759	0.0265	0.1002	6.97E-06	0.0000	0.0000	0.00E+00
128		0.03	0.000	0.031	0.0840	0.0160	0.0604	4.41E-06	0.0000	0.0000	0.00E+00
129		0.01	0.000	0.028	0.0478	0.0004	0.0015	1.73E-07	0.0000	0.0000	0.00E+00
130		0.05	0.000	0.026	0.0942	0.0003	0.0012	1.40E-07	0.0000	0.0000	0.00E+00
131		0.00	0.000	0.021	0.0515	0.0000	0.0000	9.57E-09	0.0000	0.0000	0.00E+00
132		0.00	0.000	0.011	0.0285	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
133		0.01	0.000	0.006	0.0324	0.0001	0.0004	5.25E-08	0.0000	0.0000	0.00E+00
134		0.10	0.000	0.020	0.1837	0.0000	0.0000	8.31E-09	0.0000	0.0000	0.00E+00
135		0.03	0.000	0.026	0.1022	0.0124	0.0469	3.45E-06	0.0000	0.0000	0.00E+00
136		0.12	0.000	0.024	0.2296	0.0058	0.0220	1.73E-06	0.0000	0.0000	0.00E+00

137		0.31	0.000	0.024	0.2296	0.0619	0.2338	1.49E-05	0.0000	0.0000	0.00E+00
138		0.30	0.000	0.220	0.2325	0.0356	0.1346	9.01E-06	0.0000	0.0000	0.00E+00
139		0.36	0.000	0.220	0.2325	0.0331	0.1249	8.51E-06	0.0000	0.0000	0.00E+00
140		0.05	0.000	0.104	0.0392	0.0183	0.0690	4.87E-06	0.0000	0.0000	0.00E+00
141		0.00	0.000	0.005	0.0293	0.0001	0.0003	4.68E-08	0.0000	0.0000	0.00E+00
142		0.01	0.000	0.011	0.0274	0.0000	0.0000	5.55E-09	0.0000	0.0000	0.00E+00
143		0.17	0.000	0.059	0.2441	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
144		0.03	0.000	0.045	0.0468	0.0229	0.0864	6.02E-06	0.0000	0.0000	0.00E+00
145		0.28	0.000	0.047	0.2008	0.0226	0.0855	5.69E-06	0.0000	0.0000	0.00E+00
146		0.01	0.000	0.026	0.0323	0.0378	0.1428	9.24E-06	0.0000	0.0000	0.00E+00
147		0.00	0.000	0.003	0.0272	0.0001	0.0004	5.46E-08	0.0000	0.0000	0.00E+00
148		0.00	0.000	0.001	0.0244	0.0000	0.0000	5.98E-09	0.0000	0.0000	0.00E+00
149		0.10	0.000	0.026	0.1752	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
150		0.10	0.000	0.030	0.1766	0.0132	0.0499	3.64E-06	0.0000	0.0000	0.00E+00
151		0.01	0.000	0.058	0.0309	0.0111	0.0419	3.13E-06	0.0000	0.0000	0.00E+00
152		0.04	0.000	0.019	0.0725	0.0001	0.0005	6.74E-08	0.0000	0.0000	0.00E+00
153		0.04	0.000	0.027	0.0999	0.0000	0.0000	6.40E-09	0.0000	0.0000	0.00E+00
154		0.00	0.000	0.023	0.0538	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
155	*	0.21	0.000	0.143	0.0931	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
156	*	0.12	0.000	0.117	0.1134	0.0013	0.0048	4.18E-07	0.0000	0.0000	0.00E+00
157		0.59	0.000	0.153	0.2041	0.0791	0.2988	1.82E-05	0.0000	0.0000	0.00E+00
158		0.00	0.000	0.049	0.0240	0.0436	0.1646	1.02E-05	0.0000	0.0000	0.00E+00
159		0.01	0.000	0.006	0.0240	0.0000	0.0001	2.37E-08	0.0000	0.0000	0.00E+00
160		0.04	0.000	0.037	0.0254	0.0000	0.0000	3.40E-09	0.0000	0.0000	0.00E+00
161		0.00	0.000	0.000	0.0246	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
162		0.02	0.000	0.016	0.0279	0.0000	0.0000	1.05E-10	0.0000	0.0000	0.00E+00
163		0.65	0.000	0.046	0.2331	0.0969	0.3662	2.16E-05	0.0000	0.0000	3.37E-04
164		0.00	0.000	0.021	0.0271	0.0565	0.2134	1.29E-05	0.0000	0.0000	0.00E+00
165		0.02	0.000	0.017	0.0320	0.0000	0.0001	2.77E-08	0.0000	0.0000	0.00E+00
166		0.00	0.000	0.002	0.0274	0.0000	0.0000	3.99E-09	0.0000	0.0000	0.00E+00
167		0.02	0.000	0.018	0.0340	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
168		0.11	0.000	0.031	0.1844	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
169		0.03	0.000	0.038	0.0852	0.0102	0.0384	2.87E-06	0.0000	0.0000	0.00E+00
170		0.10	0.000	0.044	0.1552	0.0018	0.0069	6.12E-07	0.0000	0.0000	0.00E+00
171		0.10	0.000	0.134	0.0645	0.0055	0.0208	1.66E-06	0.0000	0.0000	0.00E+00
172		0.01	0.000	0.016	0.0436	0.0000	0.0001	2.99E-08	0.0000	0.0000	0.00E+00

173	0.01	0.000	0.020	0.0321	0.0000	0.0000	4.18E-09	0.0000	0.0000	0.00E+00
174	0.00	0.000	0.007	0.0271	0.0000	0.0000	6.21E-09	0.0000	0.0000	0.00E+00
175	0.00	0.000	0.001	0.0244	0.0000	0.0001	1.40E-08	0.0000	0.0000	0.00E+00
176	0.00	0.000	0.000	0.0241	0.0000	0.0000	1.34E-08	0.0000	0.0000	0.00E+00
177	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
178	0.00	0.000	0.000	0.0240	0.0000	0.0000	1.20E-08	0.0000	0.0000	0.00E+00
179	0.04	0.000	0.020	0.0604	0.0000	0.0000	6.71E-10	0.0000	0.0000	0.00E+00
180	0.39	0.000	0.050	0.2860	0.0516	0.1948	1.17E-05	0.0000	0.0000	0.00E+00
181	0.08	0.000	0.046	0.1217	0.0377	0.1426	9.00E-06	0.0000	0.0000	0.00E+00
182	0.21	0.000	0.190	0.1641	0.0002	0.0008	9.49E-08	0.0000	0.0000	0.00E+00
183	0.00	0.000	0.027	0.0361	0.0094	0.0356	2.61E-06	0.0000	0.0000	0.00E+00
184	0.27	0.000	0.041	0.2012	0.0196	0.0741	4.86E-06	0.0000	0.0000	0.00E+00
185	0.00	0.000	0.031	0.0245	0.0346	0.1307	8.62E-06	0.0000	0.0000	0.00E+00
186	0.16	0.000	0.045	0.2486	0.0001	0.0005	6.26E-08	0.0000	0.0000	0.00E+00
187	0.01	0.000	0.030	0.0297	0.0213	0.0805	5.59E-06	0.0000	0.0000	0.00E+00
188	0.00	0.000	0.003	0.0243	0.0015	0.0055	4.78E-07	0.0000	0.0000	0.00E+00
189	0.00	0.000	0.000	0.0241	0.0000	0.0000	1.06E-08	0.0000	0.0000	0.00E+00
190	0.08	0.000	0.031	0.1157	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
191	0.15	0.000	0.040	0.2303	0.0084	0.0315	2.30E-06	0.0000	0.0000	0.00E+00
192	0.18	0.000	0.063	0.2303	0.0305	0.1152	7.94E-06	0.0000	0.0000	0.00E+00
193	0.11	0.000	0.165	0.0697	0.0134	0.0507	3.63E-06	0.0000	0.0000	0.00E+00
194	0.01	0.000	0.020	0.0517	0.0000	0.0001	2.13E-08	0.0000	0.0000	0.00E+00
195	0.02	0.000	0.029	0.0349	0.0000	0.0000	2.73E-09	0.0000	0.0000	0.00E+00
196	0.26	0.000	0.059	0.2300	0.0148	0.0560	3.71E-06	0.0000	0.0000	0.00E+00
197	0.68	0.000	0.221	0.2300	0.1052	0.3976	2.42E-05	0.0000	0.0000	3.38E-04
198	0.00	0.000	0.041	0.0392	0.0425	0.1607	1.03E-05	0.0000	0.0000	3.65E-04
199	0.21	0.000	0.154	0.1462	0.0001	0.0006	7.28E-08	0.0000	0.0000	0.00E+00
200	0.04	0.000	0.062	0.0462	0.0058	0.0218	1.65E-06	0.0000	0.0000	0.00E+00
201	0.00	0.000	0.010	0.0262	0.0011	0.0042	3.79E-07	0.0000	0.0000	0.00E+00
202	0.00	0.000	0.001	0.0247	0.0000	0.0000	1.05E-08	0.0000	0.0000	0.00E+00
203	0.00	0.000	0.000	0.0242	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
204	0.00	0.000	0.003	0.0241	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
205	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
206	0.04	0.000	0.037	0.0353	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
207	0.00	0.000	0.003	0.0286	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
208	0.00	0.000	0.002	0.0255	0.0000	0.0000	2.75E-09	0.0000	0.0000	0.00E+00

209	0.00	0.000	0.001	0.0245	0.0000	0.0000	1.15E-08	0.0000	0.0000	0.00E+00
210	0.00	0.000	0.000	0.0242	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
211	0.11	0.000	0.092	0.0683	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
212	0.01	0.000	0.019	0.0510	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
213	0.29	0.000	0.095	0.2106	0.0158	0.0598	3.92E-06	0.0000	0.0000	0.00E+00
214	0.18	0.000	0.130	0.1942	0.0324	0.1223	8.17E-06	0.0000	0.0000	0.00E+00
215	0.00	0.000	0.036	0.0334	0.0116	0.0440	3.29E-06	0.0000	0.0000	0.00E+00
216	0.00	0.000	0.005	0.0240	0.0011	0.0042	3.75E-07	0.0000	0.0000	0.00E+00
217	0.03	0.000	0.031	0.0288	0.0000	0.0000	1.00E-08	0.0000	0.0000	0.00E+00
218	0.00	0.000	0.005	0.0264	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
219	0.00	0.000	0.001	0.0243	0.0000	0.0000	4.43E-10	0.0000	0.0000	0.00E+00
220	0.01	0.000	0.007	0.0249	0.0000	0.0000	2.22E-10	0.0000	0.0000	0.00E+00
221	0.11	0.000	0.043	0.1660	0.0000	0.0000	7.76E-11	0.0000	0.0000	0.00E+00
222	0.12	0.000	0.065	0.1619	0.0108	0.0407	3.04E-06	0.0000	0.0000	0.00E+00
223	0.11	0.000	0.149	0.0684	0.0050	0.0189	1.50E-06	0.0000	0.0000	0.00E+00
224	0.05	0.000	0.033	0.0917	0.0000	0.0000	1.92E-08	0.0000	0.0000	0.00E+00
225	0.54	0.000	0.046	0.2031	0.0821	0.3102	1.86E-05	0.0000	0.0000	0.00E+00
226	0.58	0.000	0.222	0.2371	0.1048	0.3961	2.41E-05	0.0000	0.0000	0.00E+00
227	0.00	0.000	0.040	0.0240	0.0370	0.1399	8.88E-06	0.0000	0.0000	0.00E+00
228	0.04	0.000	0.040	0.0341	0.0000	0.0001	2.43E-08	0.0000	0.0000	0.00E+00
229	0.01	0.000	0.016	0.0308	0.0000	0.0000	3.52E-09	0.0000	0.0000	0.00E+00
230	0.06	0.000	0.046	0.0521	0.0000	0.0000	5.23E-09	0.0000	0.0000	0.00E+00
231	0.15	0.000	0.049	0.2344	0.0000	0.0000	7.75E-09	0.0000	0.0000	0.00E+00
232	0.00	0.000	0.025	0.0454	0.0205	0.0774	5.51E-06	0.0000	0.0000	0.00E+00
233	1.43	0.482	0.042	0.4370	0.4764	0.5424	9.18E-05	0.0000	0.0000	0.00E+00
234	0.39	0.388	0.053	0.0240	0.1863	0.3244	3.76E-05	0.0000	0.0000	0.00E+00
235	0.00	0.000	0.000	0.0240	0.0001	0.0003	4.59E-08	0.0000	0.0000	0.00E+00
236	0.00	0.000	0.000	0.0240	0.0000	0.0000	5.49E-09	0.0000	0.0000	0.00E+00
237	0.56	0.000	0.060	0.2698	0.0791	0.2988	1.79E-05	0.0000	0.0000	0.00E+00
238	0.19	0.000	0.161	0.1352	0.0464	0.1753	1.09E-05	0.0000	0.0000	0.00E+00
239	0.81	0.000	0.222	0.1886	0.1161	0.3992	2.54E-05	0.0000	0.0000	0.00E+00
240	0.03	0.000	0.075	0.0397	0.0513	0.1938	1.19E-05	0.0000	0.0000	0.00E+00
241	0.10	0.000	0.086	0.0647	0.0004	0.0016	1.69E-07	0.0000	0.0000	0.00E+00
242	0.00	0.000	0.012	0.0400	0.0000	0.0000	8.46E-09	0.0000	0.0000	0.00E+00
243	0.00	0.000	0.007	0.0261	0.0000	0.0000	4.54E-09	0.0000	0.0000	0.00E+00
244	0.00	0.000	0.001	0.0247	0.0000	0.0000	2.22E-09	0.0000	0.0000	0.00E+00

245		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
246		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
247		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
248		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
249		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
250	*	0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
251		0.19	0.000	0.025	0.2433	0.0080	0.0301	1.99E-06	0.0000	0.0000	0.00E+00
252		0.03	0.000	0.023	0.0789	0.0303	0.1144	7.81E-06	0.0000	0.0000	0.00E+00
253		0.08	0.000	0.024	0.1615	0.0024	0.0090	7.31E-07	0.0000	0.0000	0.00E+00
254		0.00	0.000	0.013	0.0682	0.0115	0.0434	3.27E-06	0.0000	0.0000	0.00E+00
255		0.11	0.000	0.023	0.1968	0.0019	0.0072	6.40E-07	0.0000	0.0000	0.00E+00
256		0.00	0.000	0.015	0.0648	0.0164	0.0619	4.52E-06	0.0000	0.0000	0.00E+00
257		0.00	0.000	0.016	0.0292	0.0007	0.0026	2.72E-07	0.0000	0.0000	0.00E+00
258		0.00	0.000	0.003	0.0240	0.0000	0.0001	2.88E-08	0.0000	0.0000	0.00E+00
259		0.00	0.000	0.000	0.0240	0.0000	0.0000	4.09E-09	0.0000	0.0000	0.00E+00
260		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
261		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
262		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
263		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
264		0.05	0.000	0.022	0.0769	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
265		0.13	0.000	0.037	0.2211	0.0022	0.0082	6.14E-07	0.0000	0.0000	0.00E+00
266		0.00	0.000	0.011	0.0551	0.0213	0.0803	5.73E-06	0.0000	0.0000	0.00E+00
267		0.00	0.000	0.013	0.0277	0.0012	0.0046	4.18E-07	0.0000	0.0000	0.00E+00
268		0.00	0.000	0.002	0.0240	0.0001	0.0003	4.83E-08	0.0000	0.0000	0.00E+00
269		0.00	0.000	0.000	0.0240	0.0000	0.0000	7.95E-09	0.0000	0.0000	0.00E+00
270		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
271		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
272		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
273		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
274		0.00	0.000	0.003	0.0254	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
275		0.29	0.000	0.014	0.2093	0.0280	0.1059	6.81E-06	0.0000	0.0000	0.00E+00
276		0.29	0.000	0.014	0.2093	0.0728	0.2751	1.73E-05	0.0000	0.0000	0.00E+00
277		0.00	0.000	0.020	0.0286	0.0391	0.1479	9.52E-06	0.0000	0.0000	0.00E+00
278		0.01	0.000	0.009	0.0382	0.0001	0.0003	4.49E-08	0.0000	0.0000	0.00E+00
279		0.00	0.000	0.004	0.0297	0.0000	0.0000	5.42E-09	0.0000	0.0000	0.00E+00
280		0.00	0.000	0.002	0.0257	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00

281		0.00	0.000	0.001	0.0245	0.0000	0.0000	4.92E-09	0.0000	0.0000	0.00E+00
282		0.00	0.000	0.000	0.0242	0.0000	0.0000	1.16E-08	0.0000	0.0000	0.00E+00
283		0.00	0.000	0.000	0.0241	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
284		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
285		0.00	0.000	0.002	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
286		0.06	0.000	0.009	0.1216	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
287		0.02	0.000	0.012	0.1066	0.0045	0.0171	1.37E-06	0.0000	0.0000	0.00E+00
288		0.06	0.000	0.012	0.1432	0.0061	0.0231	1.84E-06	0.0000	0.0000	0.00E+00
289		0.30	0.000	0.012	0.2393	0.0512	0.1936	1.25E-05	0.0000	0.0000	0.00E+00
290	*	0.55	0.000	0.111	0.1150	0.0353	0.1334	8.77E-06	0.0000	0.0000	0.00E+00
291		0.25	0.000	0.078	0.1960	0.1386	0.3989	2.98E-05	0.0000	0.0000	0.00E+00
292		0.00	0.000	0.036	0.0243	0.0555	0.2096	1.26E-05	0.0000	0.0000	0.00E+00
293		0.00	0.000	0.000	0.0241	0.0000	0.0001	2.48E-08	0.0000	0.0000	0.00E+00
294	*	0.00	0.000	0.000	0.0241	0.0000	0.0000	4.01E-09	0.0000	0.0000	0.00E+00
295	*	0.05	0.000	0.049	0.0240	0.0000	0.0000	8.44E-11	0.0000	0.0000	0.00E+00
296	*	0.16	0.000	0.101	0.0634	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
297		0.02	0.000	0.082	0.0286	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
298		0.24	0.000	0.143	0.2151	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
299		0.01	0.000	0.058	0.0340	0.0113	0.0426	3.15E-06	0.0000	0.0000	0.00E+00
300		0.12	0.000	0.104	0.0709	0.0005	0.0019	1.88E-07	0.0000	0.0000	0.00E+00
301	*	0.00	0.000	0.000	0.0709	0.0000	0.0000	8.65E-09	0.0000	0.0000	0.00E+00
302	*	0.00	0.000	0.000	0.0709	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
303		0.31	0.000	0.208	0.2253	0.0012	0.0047	3.73E-07	0.0000	0.0000	0.00E+00
304		0.05	0.000	0.095	0.0413	0.0199	0.0752	5.33E-06	0.0000	0.0000	0.00E+00
305		0.16	0.000	0.131	0.0975	0.0002	0.0006	7.53E-08	0.0000	0.0000	0.00E+00
306		0.00	0.000	0.016	0.0614	0.0001	0.0005	6.07E-08	0.0000	0.0000	0.00E+00
307		0.00	0.000	0.017	0.0240	0.0008	0.0032	3.15E-07	0.0000	0.0000	0.00E+00
308		0.00	0.000	0.000	0.0240	0.0000	0.0000	1.36E-08	0.0000	0.0000	0.00E+00
309		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
310		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
311		0.01	0.000	0.010	0.0315	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
312		0.00	0.000	0.003	0.0259	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
313		0.00	0.000	0.001	0.0246	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
314		0.00	0.000	0.000	0.0242	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
315	*	0.00	0.000	0.000	0.0242	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
316	*	0.00	0.000	0.000	0.0242	0.0000	0.0000	2.27E-09	0.0000	0.0000	0.00E+00

317	*		0.05	0.000	0.046	0.0241	0.0000	0.0000	1.72E-09	0.0000	0.0000	0.00E+00
318			0.16	0.000	0.021	0.2128	0.0012	0.0044	3.54E-07	0.0000	0.0000	0.00E+00
319			0.14	0.000	0.021	0.2266	0.0347	0.1309	8.80E-06	0.0000	0.0000	0.00E+00
320			0.13	0.000	0.020	0.2351	0.0302	0.1142	7.87E-06	0.0000	0.0000	0.00E+00
321			0.00	0.000	0.014	0.0344	0.0261	0.0987	6.84E-06	0.0000	0.0000	0.00E+00
322			0.00	0.000	0.005	0.0246	0.0016	0.0059	5.05E-07	0.0000	0.0000	0.00E+00
323			0.86	0.000	0.018	0.3564	0.2784	0.5037	5.59E-05	0.0000	0.0000	0.00E+00
324			0.00	0.000	0.037	0.0240	0.1495	0.2972	3.05E-05	0.0000	0.0000	0.00E+00
325			0.02	0.000	0.021	0.0291	0.0000	0.0002	3.48E-08	0.0000	0.0000	0.00E+00
326			0.23	0.000	0.145	0.1900	0.0000	0.0000	4.47E-09	0.0000	0.0000	0.00E+00
327	*		0.75	0.000	0.056	0.0868	0.0170	0.0642	4.49E-06	0.0000	0.0000	0.00E+00
328	*		0.01	0.000	0.056	0.1114	0.0026	0.0099	8.33E-07	0.0000	0.0000	0.00E+00
329	*		0.53	0.000	0.060	0.1101	0.0053	0.0200	1.65E-06	0.0000	0.0000	0.00E+00
330			0.19	0.000	0.000	0.2003	0.1590	0.4288	3.38E-05	0.0000	0.0000	0.00E+00
331			0.14	0.000	0.000	0.2349	0.1313	0.4960	2.95E-05	0.0000	0.0000	0.00E+00
332			0.27	0.000	0.070	0.2349	0.1317	0.4974	2.96E-05	0.0000	0.0000	0.00E+00
333	*		0.00	0.000	0.002	0.0784	0.0499	0.1887	1.16E-05	0.0000	0.0000	0.00E+00
334			0.65	0.000	0.182	0.2282	0.0765	0.2889	1.75E-05	0.0000	0.0000	0.00E+00
335			0.00	0.000	0.034	0.0240	0.0460	0.1738	1.08E-05	0.0000	0.0000	0.00E+00
336	*		0.00	0.000	0.000	0.0240	0.0000	0.0001	2.54E-08	0.0000	0.0000	0.00E+00
337	*		0.16	0.000	0.084	0.0634	0.0000	0.0000	3.71E-09	0.0000	0.0000	0.00E+00
338	*		0.05	0.000	0.035	0.1027	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
339	*		0.17	0.000	0.060	0.1118	0.0028	0.0105	8.62E-07	0.0000	0.0000	0.00E+00
340	*		0.07	0.000	0.029	0.1097	0.0054	0.0205	1.69E-06	0.0000	0.0000	0.00E+00
341	*		0.00	0.000	0.040	0.1115	0.0051	0.0192	1.59E-06	0.0000	0.0000	0.00E+00
342			0.00	0.000	0.122	0.0631	0.0022	0.0083	7.42E-07	0.0000	0.0000	0.00E+00
343	*		0.00	0.000	0.018	0.0240	0.0006	0.0022	2.35E-07	0.0000	0.0000	0.00E+00
344			0.00	0.000	0.000	0.0240	0.0000	0.0000	1.41E-08	0.0000	0.0000	0.00E+00
345			0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
346			0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
347	*		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
348	*		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
349	*		0.00	0.000	0.000	0.0240	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
350	*		0.10	0.000	0.022	0.0634	0.0000	0.0000	1.98E-11	0.0000	0.0000	0.00E+00
351	*	*	0.03	0.000	0.032	0.0634	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
352	*	*	0.02	0.000	0.016	0.0634	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00

353	*	*	0.08	0.000	0.038	0.0634	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
354	*	*	0.13	0.000	0.000	0.0634	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
355	*	*	0.00	0.000	0.038	0.0634	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
356		*	0.00	0.000	0.118	0.2272	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
357	*	*	0.00	0.000	0.000	0.2272	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
358	*	*	0.00	0.000	0.000	0.2272	0.0000	0.0000	0.00E+00	0.0000	0.0000	0.00E+00
359			0.00	0.000	0.008	0.0422	0.0222	0.0840	5.43E-06	0.0000	0.0000	0.00E+00
360			0.05	0.000	0.031	0.0698	0.0005	0.0017	1.81E-07	0.0000	0.0000	0.00E+00
361			0.02	0.000	0.026	0.0612	0.0000	0.0000	1.04E-08	0.0000	0.0000	0.00E+00
362			0.22	0.000	0.029	0.2068	0.0156	0.0588	3.86E-06	0.0000	0.0000	0.00E+00
363			0.00	0.000	0.019	0.0581	0.0308	0.1164	7.75E-06	0.0000	0.0000	0.00E+00
364			0.17	0.000	0.025	0.2311	0.0076	0.0288	2.04E-06	0.0000	0.0000	0.00E+00
365			0.00	0.000	0.016	0.0449	0.0267	0.1007	7.01E-06	0.0000	0.0000	0.00E+00

* = Frozen (air or soil)

Annual Totals for Year 100			
	inches	cubic feet	percent
Precipitation	28.70	2,083,906.3	100.00
Runoff	0.870	63,159.3	3.03
Evapotranspiration	11.900	863,949.7	41.46
Drainage Collected from Layer 2	16.0064	1,162,063.1	55.76
Percolation/Leakage through Layer 3	0.001148	83.4	0.00
Average Head on Top of Layer 3	0.0136	---	---
Percolation/Leakage through Layer 4	0.001039	75.5	0.00
Change in Water Storage	-0.0736	-5,341.3	-0.26
Soil Water at Start of Year	114.5046	8,313,034.0	398.92
Soil Water at End of Year	114.4682	8,310,392.2	398.79
Snow Water at Start of Year	0.0372	2,699.5	0.13
Snow Water at End of Year	0.0000	0.0000	0.00
Annual Water Budget Balance	0.0000	0.0000	0.00

Average Annual Totals Summary

Title: Sibley Quarry ClosureTurf
Simulated on: 11/10/2023 16:13

	Average Annual Totals for Years 1 - 100*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	32.89	[3.55]	2,387,973.6	100.00
Runoff	2.134	[1.354]	154,964.1	6.49
Evapotranspiration	14.077	[1.621]	1,022,012.1	42.80
Subprofile1				
Lateral drainage collected from Layer 2	16.6795	[2.2184]	1,210,932.6	50.71
Percolation/leakage through Layer 3	0.001296	[0.000228]	94.1	0.00
Average Head on Top of Layer 3	0.0158	[0.0031]	---	---
Subprofile2				
Percolation/leakage through Layer 4	0.001293	[0.000373]	93.9	0.00
Water storage				
Change in water storage	-0.0004	[0.325]	-29.1	0.00

* Note: Average inches are converted to volume based on the user-specified area.

Peak Values Summary

Title: Sibley Quarry ClosureTurf
Simulated on: 11/10/2023 16:13

	Peak Values for Years 1 - 100*	
	(inches)	(cubic feet)
Precipitation	3.01	218,598.2
Runoff	2.201	159,808.9
Subprofile1		
Drainage collected from Layer 2	0.7573	54,977.8
Percolation/leakage through Layer 3	0.000123	8.9146
Average head on Layer 3	0.6357	---
Maximum head on Layer 3	1.2015	---
Location of maximum head in Layer 2	16.36 (feet from drain)	
Subprofile2		
Percolation/leakage through Layer 4	0.000672	48.8
Other Parameters		
Snow water	3.3332	241,988.7
Maximum vegetation soil water	0.4370 (vol/vol)	
Minimum vegetation soil water	0.0240 (vol/vol)	

Final Water Storage in Landfill Profile at End of Simulation Period

Title: Sibley Quarry ClosureTurf
Simulated on: 11/10/2023 16:13
Simulation period: 100 years

	Final Water Storage	
Layer	(inches)	(vol/vol)
1	0.0224	0.0449
2	0.0020	0.0100
3	0.0000	0.0000
4	112.1998	0.1870
Snow water	0.0000	---

Attachment B

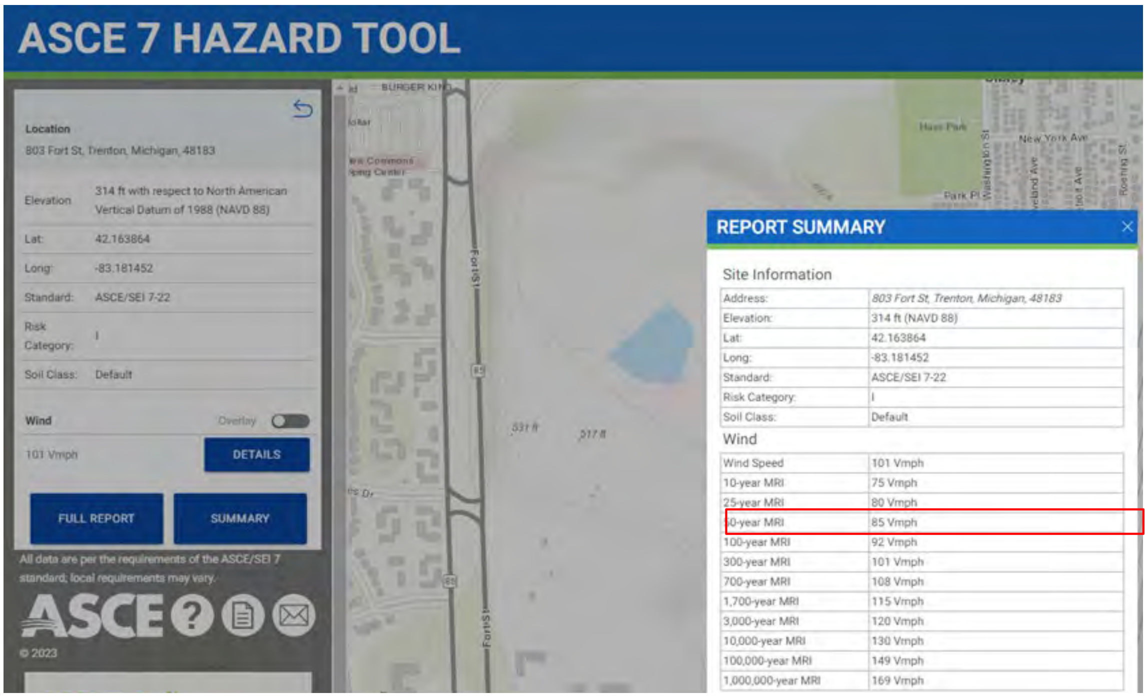
Wind Uplift Computations

DTE Sibley Quarry Closure Area

Project:	DTE - Sibley Quarry Capping Section 1A		
Computation Objectives:	Determine Factor of Safety Against Wind Uplift of ClosureTurf		
Computation Methodology:	Watershed Geo - ClosureTurf Design Guidance Manual		
Computations by:	Barr	**Date:**	10/2/2023

Step 1: Select basic wind speed according to ASCE 7-22

Assumption: Mean Return Interval (MRI) 50-Year Represents Basic Wind Speed, Called U_3 (32.8)



Basic Wind Speed U_3 (32.8): 85 mph equals 124.7 ft/s at 32.8 ft above ground surface.

Step 2: Calculate Mean Hourly Wind Speed at Top of Cover Area (50-year MRI)

Mean Hourly Speed $U(32.8)$: $U(32.8) = U_3(32.8)/1.5$ U (32.8) = 83.1 ft/s

Mean Hourly Wind Speed at Top of Closure Area: Height H of cover area slope (typical) = 100 ft

U_H = U (32.8) x $(H/32.8)^{0.14}$ = 97.1 ft/s 66.2 mph

Step 3: Select Maximum Wind Pressure Coefficient Value

Per Watershed Geo Closure Turf Design Guidance Manual 2023 - Page C-4 Table 1, the maximum wind pressure coefficient ($C_{p, max}$) is: 0.29 (uplift)

Step 4: Calculate Ground Elevation Factor

$K_e = e^{-0.0000362 \cdot Ze}$ where Ze is the ground elevation above sea level if feet.

Ze = 600 ft, amsl

K_e = 0.979

Per Watershed Geo Closure Turf Design Guidance Manual 2023 - Page 10, the wind directionality factor K_d = 1.1

Maximum wind uplift pressure is calculated as: $P_{max} = 0.5 \times C_{p,max} \times \rho \times U(H)^2 \times K_e \times K_d$

ρ = air density in slug per cubic foot at 59° F = 0.0024

P_{max} = 3.75 psf

Step 5: Estimate Self-Weight of Closure Turf

Per Watershed Geo Closure Turf Design Guidance Manual 2023 - Page C-13,
the total weight (*W*) of ClosureTurf with 0.5 inch sand infill layer thickness is: 5.44 psf

Step 6: Calculate the Factor of Safety Against Wind Uplift:

FS (uplift) = W/P_{max} = 1.45 FS (uplift) $\geq$ 1.0 "OK"

Conclusion: **The FS against wind uplift is > 1.0 and therefore the geomembrane tension and and tensile strain that could occur in an uplift situation are in this case not expected to occur.**

Attachment C

ClosureTurf UV Stability

DTE Sibley Quarry Closure Area

Geosyntec consultants

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15 May 2015

José Urrutia, P.E.
Vice President of Engineering
Watershed Geosynthetics
11400 Atlantis Place, Suite 200
Alpharetta, GA 30022

Subject: Literature Review and Assessment of ClosureTurf® UV Longevity

Dear Mr. Urrutia:

Watershed Geosynthetics, Inc. (Watershed) has patented an alternative landfill closure system termed, ClosureTurf®. ClosureTurf® consists of high-density polyethylene (HDPE) grass blades tufted through a polypropylene (PP) geotextile backing which overlies Super Gripnet®, an HDPE or linear low-density polyethylene (LLDPE) geomembrane manufactured by AGRU America Inc. The addition of a layer of sand ballast during installation completes the system. The sand ballast provides cover for the lower portion of the HDPE grass blades, the PP geotextile backing, and the Super Gripnet® (Figure 1). The ClosureTurf® system, therefore, is a "hybrid" closure system in the sense that it is neither a traditional soil cover or an exposed geomembrane. ClosureTurf® has been used to close a number of landfills throughout the United States. A select list of sites where it has been used is shown in Table 1. Applications extend to other facilities as well, such as capping of coal ash ponds.

Watershed has requested that Geosyntec Consultants, Inc. (Geosyntec) provide an assessment of the longevity of the ClosureTurf® system with regard to UV degradation. Since ClosureTurf® has elements (i.e., the HDPE grass blades) that are permanently exposed to UV radiation, this assessment will be particularly focused on the exposed portion of the system. However, the UV longevity of the PP geotextile backing and HDPE geomembrane will also be addressed by reference.

Geosyntec's approach to this assessment has been to conduct a literature review of pertinent documents available (journal papers, white papers, presentations, etc.), distill the results of the review, and perform limited analysis. This report concludes with a summary of the review and analysis along with brief discussion for recommendations.

EXECUTIVE SUMMARY

The UV longevity assessment of the ClosureTurf® system (Figure 1) began with a literature review. In general, relatively little published information was discovered regarding exposed HDPE grass blade degradation. The information that is available consists of retained tensile strength test results of HDPE grass blades after exposure (1, 5, 7 and 10 years) at a field test facility in New River, Arizona (Watershed, 2014). Extrapolation of this data by Watershed (2014) resulted in a prediction of 65% retained tensile strength after 100 years of service. In addition, Richgels *et al* (2015) published half-life (i.e., 50% retained tensile strength) predictions of exposed HDPE grass blades using a laboratory data release from the Geosynthetics Institute (GSI) on HDPE geomembrane strips exposed to UV lamp irradiation. Richgels *et al* (2015) obtains an upper bound and lower bound half-life predictions of 247 years and 176 years, respectively. Extrapolation of the field data from New River, Arizona yielded a half-life of 216 years.

Geosyntec checked the calculations shown in Richgels *et al* (2015) and obtained 277 years and 214 years for the upper and lower bound estimates of HDPE grass blade half-life. Differences in the results between Geosyntec and Richgels *et al* (2015) are attributed to rounding. Geosyntec attempted to repeat these calculations for actual performance requirements (i.e., 12.5% of original tensile strength) of the HDPE grass blades rather than a randomly assigned half-life, however the predictions resulted in service lives that were too lengthy to be reasonable. The most likely explanation is that the laboratory data has not degraded enough to allow for service life predictions using 12.5% retained tensile strength. Future data releases from GSI will aid in providing more accurate predictions below the half-life.

Based on Richgels *et al* (2015) predictions, as well as the prediction given in Watershed (2014) it appears that the half-life of the HDPE grass blades exposed to Arizona-like conditions is on the order of 100 years. These results are promising; however additional field test data is needed to improve the half-life predictions, particularly since half-life predictions for exposed HDPE geomembrane are also approximately 100 years (Koerner *et al*, 2015). Understanding the differences in weathering between HDPE grass blades in a synthetic turf and an HDPE geomembrane will provide additional insight into the similar half-life predictions of the two geosynthetics. Finally, the service life of the HDPE grass blades in the ClosureTurf® system should ideally be based on its performance requirements rather than a half-life which will result in a longer service life prediction.

In addition to the HDPE grass blades, there are two unexposed elements of the ClosureTurf® system: (i) the PP geotextile backing for turf component; and (ii) the Super Gripnet® which consist of a HDPE geomembrane (see Figure 1).

Watershed has incorporated UV degradation inhibitors into the PP geotextile backing which, according to Watershed has lead to an improvement in UV resistance by a factor of 14 over the original prediction of 65% retained tensile strength after 100 years (Watershed, 2014). Koerner (2011) has estimated that covered HDPE geomembrane will have a half-life of 446 years at 20 degrees Celsius and 265 years at 25 degrees Celsius.

Therefore, the most critical component of the ClosureTurf® appears to be the exposed HDPE grass blades when it comes to UV degradation. However, degradation of the HDPE grass blades to unserviceable levels can be remediated by replacement of the turf component of the ClosureTurf® system.

BACKGROUND AND LITERATURE REVIEW SUMMARY

In total, Geosyntec has reviewed approximately 40 technical documents to date. The database is a combination of documents provided to Geosyntec by Watershed as well as documents collected by Geosyntec. A complete reference list of the documents in the database can be made available upon request.

In general, relatively little information was found on the topic of exposed HDPE grass blades with respect to degradation due to UV radiation. The documents that were obtained and reviewed are listed below.

1. Field test data provided by Watershed from the New River, Arizona testing facility on the HDPE grass blades (Watershed, 2014).

2. Testing results (Atlas-MTS) discussing the UV longevity of polyethylene and polypropylene grass used for outdoor European athletic facilities.

3. Technical paper by Richgels, *et al.* (2015a) published in the conference proceedings for Geosynthetics 2015 in Portland, Oregon.

4. Presentation by Richgels., C. at the Geosynthetics Conference for 2015 in Portland, Oregon (Richgels, 2015b).

5. Presentation by Diguilio, D. at the Northern New England SWANA Conference on 25 September 2013 (Diguilio, 2013).

The following documents on the topic of HDPE Geomembrane degradation due to UV exposure were reviewed and found to contain useful information regarding this assessment.

1. Geosynthetic Research Institute (GRI) White Paper #6 (Koerner *et al.*, 2011). This white paper contained degradation data (% retained strength and elongation) on laboratory aged samples of 1.5 mm HDPE geomembrane. Aging was completed using a UV Fluorescent device per ASTM D7238 at 70 degrees Celsius (^{o}C).

2. Geosynthetic Institute (GSI) webinar presentation by Koerner *et al.*, (2015). This presentation contained a slide that compared predicted (laboratory vs. field) half-life of geomembranes of various resins, including HDPE, as well as a suggestion for estimating lower bound half-life.

3. Journal paper authored by Rowe *et al.* (2010) published in the Journal of Geotechnical and Geoenvironmental Engineering.

DISCUSSION OF DOCUMENTS AND DATA

The data from the New River, AZ testing facility on the artificial grass component of ClosureTurf® (Watershed, 2014) appears to be the only data set of its kind in our compiled database. The data consists of tensile property testing from field samples exposed to the Arizona environment at approximate exposure periods of 1, 5, 7 and 10 years. At each of the four exposure periods, 20 samples were tested for a total of 80 tests. The average values for tensile strength retained at each corresponding time period is 97%, 90%, 84% and 83%, respectively (Figure 2).

One additional data point was found in the Atlas-MTS document. That data point indicated that approximately 90% of tensile strength of polyethylene grass would be available after 20 years of field exposure assuming average European climatic conditions (temperature, irradiance, etc.). However, the average European irradiance is approximately one-half to one-third that of Arizona (Figure 3) notwithstanding temperature effects. Therefore, the Atlas-MTS data point will be consistent with the data from the New River, AZ facility in the 7 to 10 year time frame once adjusted for the relative levels of exposure and temperature between Europe and Arizona. As such, this data point will not extend the exposure duration covered by the New River, AZ data.

The paper and corresponding presentation by Richgels (2015a, 2015b) utilized the laboratory data released from the GSI on UV degradation of HDPE samples to make upper and lower bound estimates of the field half-life of the HDPE grass blades. The upper bound method utilizes Arrhenius modeling of lab data to project exposure times at half-life to site temperatures combined with ratios of UV irradiance between the laboratory lamp and monthly average irradiance at New River, AZ to develop half-life loss per month. A similar procedure using a linear extrapolation (rather than Arrhenius) was demonstrated for a lower bound estimate. The Watershed (2014) field data set was plotted in between the upper and lower bound estimates. This method is further discussed in the section below titled, "HDPE Grass Blade Service Life Calculations".

Koerner *et al.* (2011) discusses the UV longevity of both exposed and unexposed geomembranes made from various resins, including HDPE based on GSI's laboratory testing program. This document is particularly useful in regard to the ClosureTurf® elements that are considered non-exposed (i.e., the PP geotextile backing for the turf component and the underlying HDPE geomembrane).

The presentation by Koerner *et al.* (2015) includes estimates of half-life of exposed HDPE geomembranes as well as a recommendation for linear data extrapolation as a lower bound limit that was implemented by Richgels (2015b).

PERFORMANCE REQUIREMENTS

The definition of service life of an HDPE (or other resin) geosynthetic (grass blades and geotextiles/geomembranes) typically invokes the half-life criteria. However, the half-life criteria is arbitrary and while useful as a general indicator for comparison it does not directly relate to any aspect of field performance for ClosureTurf® or any other geosynthetic. Therefore it is more appropriate to define the service life in terms of field requirements placed on the material.

HDPE Grass Blades

For the case of the HDPE grass blades on the ClosureTurf® system, tensile strength requirements fall in the range of 2.5 to 3.5 lbs, based on applied loads of pullout forces from equipment operation and water runoff forces (Diguilo, 2013). The ClosureTurf® HDPE grass blades are manufactured with 20 lbs. of tensile strength immediately following the process (Diguilo, 2013). Therefore, without considering a factor of safety, the required tensile strength of the HDPE grass blade is equal to approximately 12.5% to 17.5% of original strength capacity.

PP Geotextile Backing and HDPE Geomembrane

Performance requirements for the PP geotextile backing and HDPE geomembrane depend on more site-specific parameters (e.g., steepness of slopes, seismicity, etc.) than the HDPE grass blades. Therefore until a parametric study is completed which will define the performance requirements over a range of expected conditions, the half-life will have to be used as a benchmark for degradation of the PP geotextile and HDPE geomembrane.

HDPE GRASS BLADE SERVICE LIFE CALCULATIONS

In order to develop a prediction for the longevity of the HDPE grass blades with respect to UV degradation, Geosyntec implemented the method found in Richgels (2015a, 2015b) for two levels of retained tensile strength. The first level is the 50% of tensile strength, or half-life, criterion that is commonly used as a benchmark for geosynthetic service life. Geosyntec performed this calculation to compare our results with the results presented by Richgels (2015a, 2015b). Once the half-life estimates were calculated, Geosyntec attempted to repeat the calculations using a retained tensile strength of 12.5% of an HPDE grass blade.

Half-Life Estimation (50% of Retained Strength)

The assessment utilized by Richgels (2015a, 2015b) begins with a laboratory data release from GSI (Figure 4). The data includes retained tensile strength of HDPE samples that have been incubated under a UV lamp at elevated temperatures, which accelerates the UV weathering process in accordance with ASTM D7238.

As mentioned, the GSI data includes samples tested at three elevated temperatures: (i) 80 degrees Celsius (^{o}C); (ii) 70^{o}C; and (iii) 60^{o}C. The testing program appears to have originally included only the 70^{o}C data, with the 80 ^{o}C and 60^{o}C testing added at a later date (therefore, weathering is not as advanced). The 70^{o}C data set has reached approximately 66%, while the 80^{o}C and 60^{o}C data sets have reached approximately 78% and 86%, respectively. Nonetheless, logarithmic extrapolations to 50% retained strength were performed for each data set. The amount of exposure time (on a log scale) corresponding to the 50% retained strength plotted vs. the inverse of the corresponding temperature (80^{o}C, 70^{o}C and 60^{o}C) is shown in Figure 5. Figure 5 allows for extrapolation to find the laboratory exposure time required to achieve 50% retained strength at temperatures lower than the test temperatures (i.e., actual field temperatures).

Once the curve is defined relating any temperature to a level of laboratory lamp exposure, the remaining task is to develop a relationship between laboratory exposure and field exposure for a particular site. In this case, the testing site in New River, AZ where Watershed has performed tests on HDPE grass blades, was selected.

Richgels (2015a, 2015b) presents monthly averages at the site for: (i) peak turf temperature; and (ii) irradiance as a fraction of the laboratory lamp irradiance. Using these two values for a given month combined with the Arrhenius model, an estimate of half-life loss per month is obtained. Summation of the half-life lost per month over a year yields the annual half-life loss. The inverse of the annual half-life loss is the predicted half-life in years. Using this method, Richgels obtains a half-life of approximately 247 years, while Geosyntec obtained a half-life of 277 years using the same data (Table 2). The difference is attributable to rounding errors in the logarithmic projections.

Following the suggestion of Koerner *et al.* (2015), Richgels (2015b) treated the results of the half-life mentioned above as an upper bound estimate. For the lower bound estimate, Koerner *et al.* (2015) suggests performing a linear extrapolation of the laboratory data to lower field temperatures, rather than using the Arrhenius model.

With the linear extrapolation, the ratio of monthly irradiance to laboratory lamp irradiance is scaled linearly to calculate the number of months required to reach half-life at 80C, 70C and 60C. Linear extrapolations per month are made from the elevated temperatures to the corresponding peak turf temperature in that month. The resulting half-life loss per month is summed to obtained half-life loss per year. The inverse of that result is the half-life in years. Richgels (2015b) calculates a half-life of 176 years using this linear model. Geosyntec's calculation using the same data resulted in a half-life of 214 years (Table 3 and Figure 6). The difference in the calculations is approximately the same as with the calculation using the Arrhenius (logarithmic) model.

Figure 7 shows the calculated upper (Arrhenius - logarithmic) and lower (linear) bound curves calculated by Richgels (2015b) along with the field data on the HDPE grass blades provided by Watershed (2014). As shown in Figure 7, the trend line fit to the field data falls in between the upper and lower bound curves produced by Richgels (2015b). Note that the first point from the field data at approximately 1 year is omitted from the trend line. This is because the first data point is assumed to be within the anti-oxidant phase of degradation rather than the polymer oxidation stage as suggested by Rowe *et al.* (2010). Additional discussion regarding the stages of degradation for polyolefin materials can be found in CUR 243 (2012).

Service Life Estimation Based on Performance Requirements (12.5% of Retained Strength)

Geosyntec repeated the calculations discussed above for the estimation of half-life, but extrapolated the GSI laboratory data down to 12.5% rather than 50% at 80C, 70C and 60C. Upper bound

(Arrhenius – logarithmic) and lower bound (linear) estimates were 2,500 years and 2,043 years, respectively.

These estimates of service life are simply too large to be reasonable. A likely explanation is that the samples tested at 80C, 70C and 60C have not degraded enough to produce accurate predictions at 12.5% retained strength. As previously mentioned, the data for 80C has reached 78% retained strength; the data for 70C has reached 66% retained strength; and the data for 60C has reached 86% retained strength. Therefore, the extrapolation for each of these data sets to 50% retained strength will be much more accurate than extrapolations to 12.5%. In addition, small uncertainties in log-based extrapolations will greatly influence results.

For these reasons, it is not practical or useful at this time to quantitatively assess service life in terms of actual performance requirements when those requirements are substantially below the half-life. There is some value, however in a qualitative use of performance requirements in comparisons with half-life estimates (i.e., to establish the factor of safety remaining at 50% degradation).

SUMMARY AND CONCLUSIONS

Geosyntec's literature review of approximately 40 documents yielded few sources of UV degradation data for exposed HDPE grass blades. Relevant data that was found included the field test data from the New River, AZ testing facility provided by Watershed (2014) and one data point from Atlas-MTS. The Atlas-MTS data point indicated that HDPE grass blades in average European climatic conditions would retain approximately 90% of its original strength after 20 years of field exposure. Taking into account the differences in temperature and UV irradiance between New River, AZ and European averages, the data point is consistent with the New River, AZ test data in the 7 to 10 year range.

Following the method presented in Richgels (2015a, 2015b) for HDPE grass blades, Geosyntec calculated an upper bound half-life of 277 years compared with Richgels 247 years using the Arrhenius (semi-log) extrapolations to site temperatures and ratio of laboratory lamp to field irradiance. Geosyntec calculated a lower bound half-life based on linear temperature extrapolations, as suggested by Koerner *et al.* (2015), of 214 years compared with 176 years obtained by Richgels (2015b). The differences between Geosyntec and Richgels calculations were attributed to rounding. As shown in Figure 7, the field data from New River, AZ suggests a half-life of 216 years when considering only the last three data points (i.e., polymer oxidation stage).

Another prediction of HDPE grass blade degradation is included in Watershed (2014) using the same (New River, AZ) field data. That prediction of retained tensile strength at 100 years of service life is 65%.

Therefore, it appears that the half-life of the HDPE grass blades will be on the order of 100 years based on the existing field data set and extrapolation methods found in the literature and presented herein. The results are promising; however additional field test data is needed to improve the half-life prediction, particularly since the half-life predictions for exposed HDPE geomembranes are also approximately 100 years (Koerner, 2015). Half-life predictions presented herein will also need to be revisited when additional labratory data is released from the GSI testing program.

Geosyntec attempted to calculate the service life of the HDPE grass blades using 12.5% of retained strength, rather than an arbitrarily assigned half-life. However, the calculation resulted in unreasonably long service life. This result is likely due to uncertainties in extrapolating the laboratory data released from GSI down to the 12.5% retained strength level. The data release has degraded to 78%, 66% and 86% for the 80 ^{o}C, 70 ^{o}C, and 60 ^{o}C test temperatures. Therefore, extrapolations to 50% may be warranted while extrapolations to 12.5% may not be until additional lab data is available. That being said, it should be recognized that half-life, or 50% of retained strength, has a factor of safety of 2.8 to 4.0 when considering the tensile capacity performance requirements of HDPE grass blades.

With regard to the unexposed elements of the ClosureTurf® system, Watershed (2014) indicates that the retained tensile strength of the PP geotextile backing prior to the addition of UV inhibitors is 65% after 100 years. This estimate is based on exhumed samples of the geotextile from the LaSalle-Grant Landfill in Louisiana. According to Watershed (2014), the addition of proprietary UV inhibitors to the PP geotextile backing has led to an improvement in UV resistance by a factor of 14. The final geosynthetic in the ClosureTurf® system is the covered HDPE geomembrane. Koerner (2011) estimates that the half-life of a covered HDPE geomembrane is 446 years at 20C, and 265 years at 25C. Furthermore, the degradation of the unexposed elements of the ClosureTurf® system invoke the half-life criteria. As discussed with regard the exposed HPDE grass blades, actual performance requirements should ideally be used to determine system longevity. However, the existing testing programs need to be allowed to degrade further before projections to lower values are made.

It is worth reiterating that applications of ClosureTurf® in areas of the United States where the UV irradiance and the temperatures are lower will result in longer half-life predictions than discussed above. In some cases (e.g., the Northeastern States), the differences will likely be quite large when compared with Arizona.

Finally, once UV degradation of the most susceptible component of ClosureTurf® (i.e., the exposed HDPE grass blades) does result in a tensile break, replacement of the HDPE grass and PP geotextile backing can be performed.

CLOSING

Geosyntec appreciates the opportunity to assist Watershed in the development of its ClosureTurf® products. Questions and comments may be directed to either of the undersigned at 678-202-9500.

Sincerely,

Will Tanner, P.E.
Project Engineer

Ming Zhu, Ph.D., P.E.
Senior Engineer

Attachments: References
Tables
Figures

Copies to: Bill Gaffigan (Geosyntec)
Mike Ayers (Watershed)

REFERENCES

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Richgels, C., Ayers, M., and Urrutia, J., (2015a) “Estimation of Geographic Ultraviolet Radiation Levels and Impact on Geosynthetic Cover Systems”. Proceedings of Geosynthetics 2015, Portland Oregon, February 15-18, 2015.

Richgels, C. (2015b) “Estimation of Geographic Ultraviolet Radiation Levels and Impact on Geosynthetic Cover Systems”. Geosynthetics 2015, Portland, Oregon, February 15-18, 2015.

Rowe, K., Islam, M., Hsuan, Y., (2010) “Effects of Thickness of the Aging of HDPE Geomembranes”. Journal of Geotechnical and Geoenvironmental Engineering, ASCE, 136(2), p.299-309.

Watershed Geosynthetics, (2014) “Technical Submittal for ClosureTurf^{TM} – Alternative Final Cover, Closure of Municipal Soild Waste Landfill Units”, December 2, 2014.

TABLES

Table 1. Selected Sites where ClosureTurf® has been Installed.

Select ClosureTurf® Installations				
Installation	**Type**	**Acres**	**State**	**Year**
Progressive - Weatherford	Public – MSW	8.5	Texas	2010
Progressive - Timberland	Public - MSW	4	Louisiana	2011
Crazy Horse (Salinas SWA – Monterey)	City – MSW	65	California	2012
Saufley Landfill (Escambia)	Public – C&D	22.5	Florida	2012
Georgia Pacific	Independent	70	Georgia	2013
Berkeley County Landfill	City - MSW	12	South Carolina	2013
Lanchester Landfill (Chester)	City - MSW	7	Pennsylvania	2013
Tangipahoa Parish	City – MSW	22	Louisiana	2013
Sandtown – (Berkeley County)	City – MSW	4	Delaware	2013
Si-County Landfill	EPA – Region 6	5	Texas	2014
Holcim Cement Landfill (Kiln Dust)	Independent	46	New York	2015

Table 2. HDPE Grass Blade Upper Bound Half-Life Calculations (Geosyntec)

Month	UV Lamp On[1] (hrs/day)	Peak Turf Temp[2] (C)	Peak Turf Temp (K)	Peak Turf Temp (1/K)	Reaction Rate[3]	Lab Half-Life[4] (lamp hrs)	Field Equivalent[5] (days)	Field Equivalent[6] (months)	Half Life Loss per Month[7]
January	4.00	27.99	301.14	0.0033	-15.67	6385286	1596322	51494	1.94196E-05
February	4.94	27.96	301.11	0.0033	-15.67	6401982	1296604	46307	2.15949E-05
March	6.13	33.94	307.09	0.0033	-15.11	3632197	593012	19129	5.22755E-05
April	6.94	40.58	313.73	0.0032	-14.50	1983742	285945	9531	0.000104915
May	7.25	51.21	324.36	0.0031	-13.58	792646	109330	3527	0.000283544
June	7.31	61.52	334.67	0.0030	-12.75	344593	47124	1571	0.00063662
July	6.94	66.82	339.97	0.0029	-12.34	228887	32993	1064	0.000939599
August	7.00	64.80	337.95	0.0030	-12.50	267230	38176	1273	0.000785841
September	6.94	59.43	332.58	0.0030	-12.91	406208	58553	1889	0.000529439
October	5.88	47.74	320.89	0.0031	-13.88	1062504	180852	5834	0.000171411
November	4.56	36.38	309.53	0.0032	-14.88	2899472	635501	21183	4.72069E-05
December	3.69	24.68	297.83	0.0034	-15.99	8826208	2393548	77211	1.29515E-05
Lab	20							**Yearly Half-life Loss[8]**	0.003604818
								Half-life[9] (years)	277.41

Notes:

(1) UV Lamp On (hours per day) is given in Richgels (2015a, 2015b).
(2) Peak Turf Temps for New River, AZ given in Richgels (2015a, 2015b).
(3) Reaction Rate is calculated from the regression curve shown in Figure 4 for the upper bound (logarithmic) case.
(4) Lab half-life in hours is equal to 1/e^(Reaction Rate).
(5) Field equivalent (days) is calculated by dividing the lab half-life in hours by the UV lamp on hours per day.
(6) Field equivalent in days is converted to months using the given days in that particular month.
(7) Half-life loss per month is the inverse of the corresponding field equivalent in months.
(8) The yearly half-life loss is the sum of each individual months half-life loss.
(9) The half-life in years is the inverse of the yearly half-life loss.

Table 3. HDPE Grass Blade Lower Bound Half-Life Calculations (Geosyntec)

Month	UV Lamp On[1] (hours/day)	Months @ 80 C[2]	Months @ 70 C[2]	Months @ 60 C[2]	Peak Turf Temp[3] (C.)	Half-life Months (from Regression)	Half-life Loss per month
January	4.00	692	1507	3078	27.99	6948	0.000143933
February	4.94	620	1352	2761	27.96	6256	0.000159849
March	6.13	452	984	2010	33.94	4059	0.00024637
April	6.94	412	898	1834	40.58	3213	0.000311281
May	7.25	382	832	1698	51.21	2248	0.000444747
June	7.31	391	852	1740	61.52	1580	0.000633027
July	6.94	399	869	1775	66.82	1237	0.00080834
August	7.00	395	861	1759	64.80	1371	0.000729293
September	6.94	412	898	1834	59.43	1826	0.000547629
October	5.88	471	1026	2095	47.74	3070	0.000325779
November	4.56	627	1365	2788	36.38	5321	0.000187929
December	3.69	750	1635	3339	24.68	7945	0.000125871
Lab	20					**Yearly Half-life Loss**	0.00466405
						Half-life (years)	214.41

Notes:

(1) UV Lamp On (hours per day) is given in Richgels (2015a, 2015b).

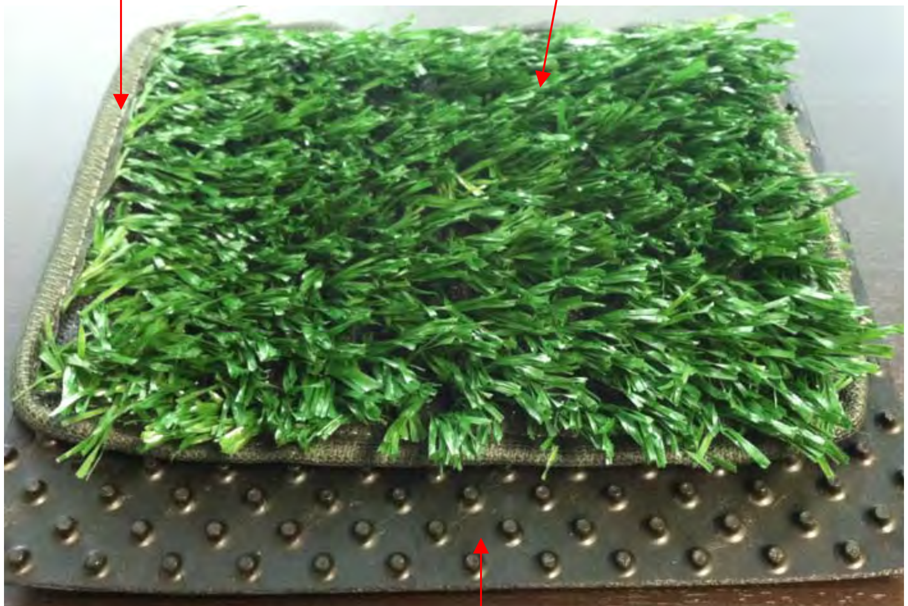
(2) The months required at each temperature is calculated using the regressions from Figure 4 for each temperature, projected down to half-life, then dividing the lamp-hours at half-life by the UV lamp on hours per day for a given month. Once this calculation is done for 80, 70 and 60 C, a linear regression (as shown in Figure 5) is used to obtain the half-life months at the corresponding peak turf temp.

(3) Peak turf temperatures given in Richgels (2015a, 2015b).

FIGURES

PP Backing

HDPE Grass Blades



AGRU Super Gripnet
HDPE Geomembrane

Sand Ballast Infill

Note: The sand ballast infill is not shown in the sample photo on the left, but is shown in a field application photo on the right.

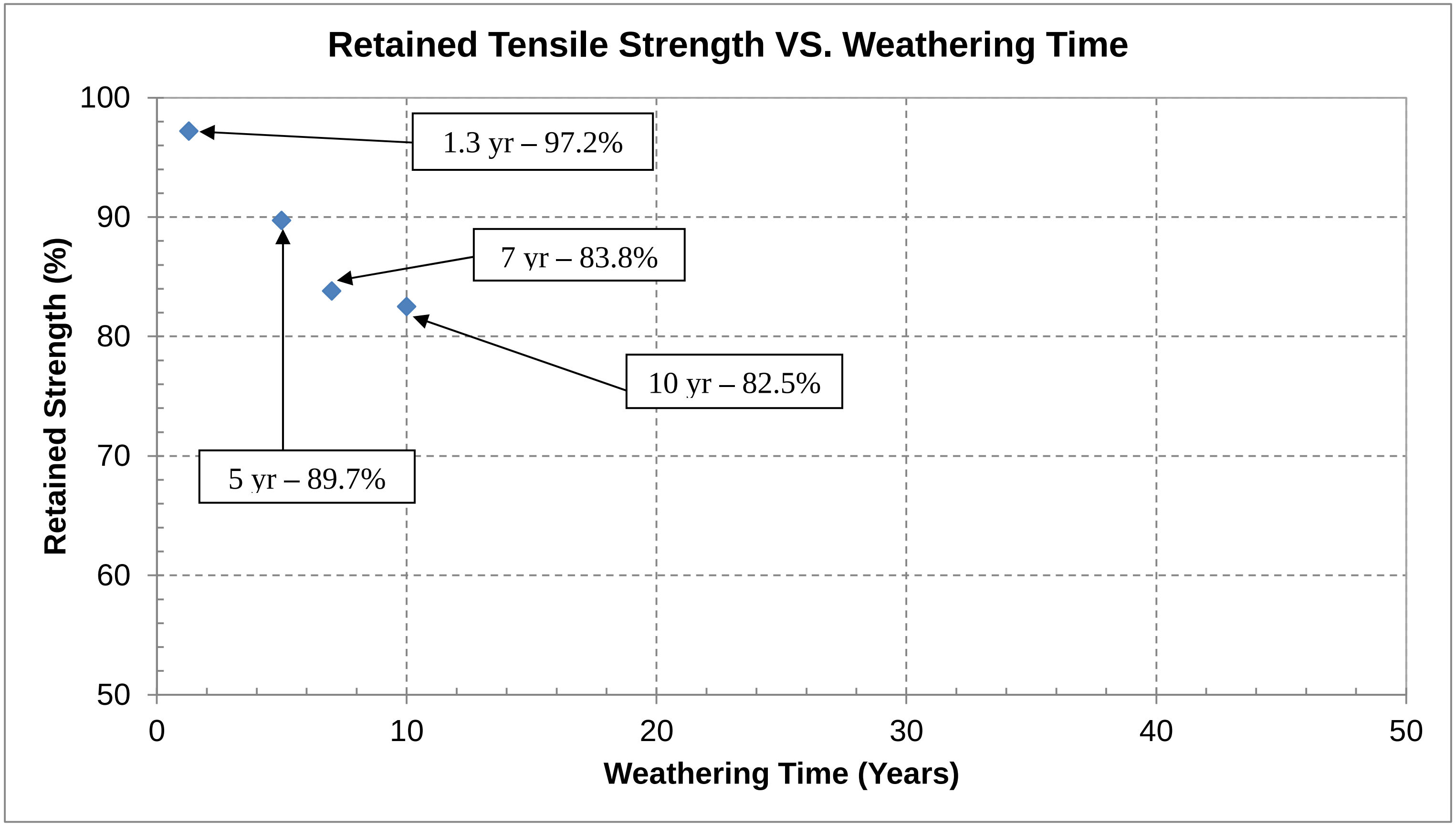
ClosureTurf® Components

Watershed Geosynthetics – ClosureTurf® UV Assessment

Geosyntec consultants

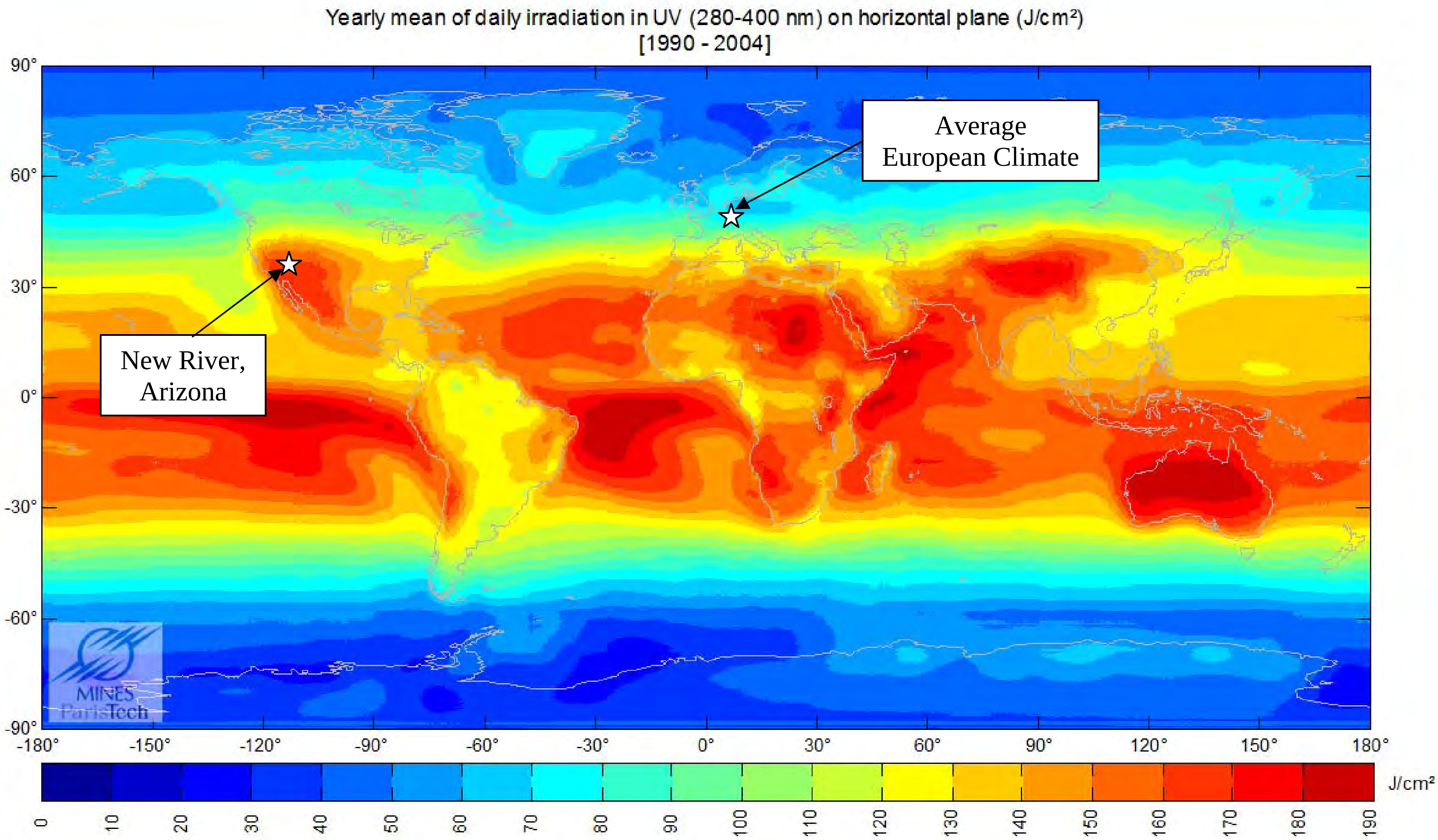
Figure **1**

Kennesaw, GA	23-April-2015



Notes:
1. The first data point at Weathering Time of 1.3 years is considered to be within the initial stage of UV degradation (i.e., anti-oxidant depletion), rather than polymer oxidation which is represented by the final three data points.
2. Each data point represents the average result of 20 tensile break tests.

Field Test Data (Watershed, 2014) **New River, AZ Atlas Testing Facility** Watershed Geosynthetics – ClosureTurf® UV Assessment		
Geosyntec consultants		Figure **2**
Kennesaw, GA	25-April-2015	



1 J/cm^2 = 4.755 ft-lbs/in^2

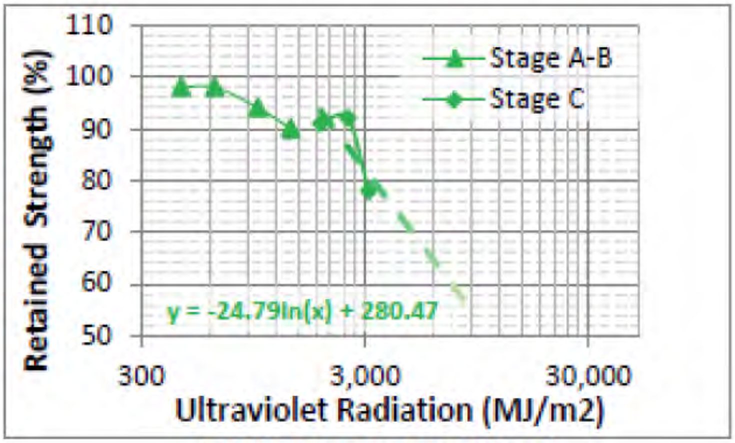
Yearly Irradiation in the Ultraviolet Range

Watershed Geosynthetics – ClosureTurf® UV Assessment

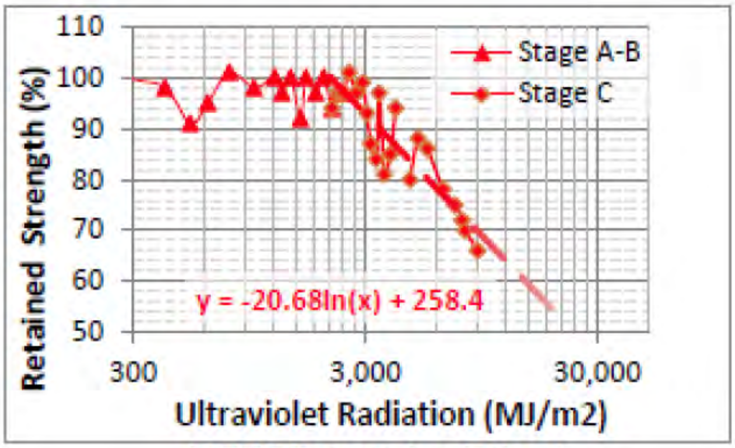
Geosyntec consultants

Figure 3

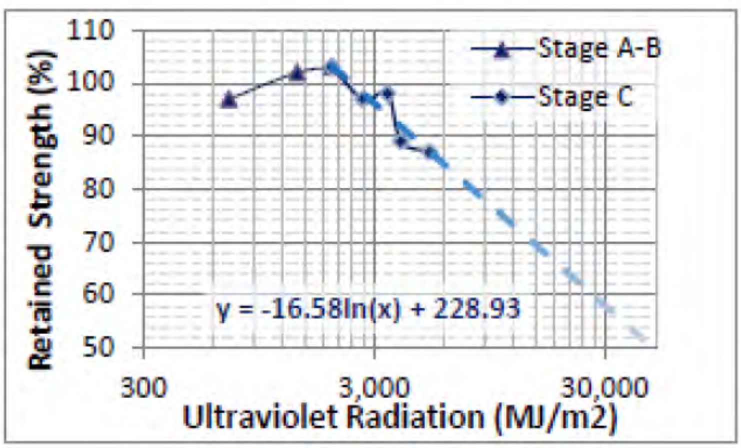
Kennesaw, GA | 23-April-2015



a) 80°C Temperature Dataset



b) 70°C Temperature Dataset



c) 60°C Temperature Dataset

GSI Data Release - Three Stage Oxidation of HDPE for Different Temperatures

Watershed Geosynthetics – ClosureTurf® UV Assessment

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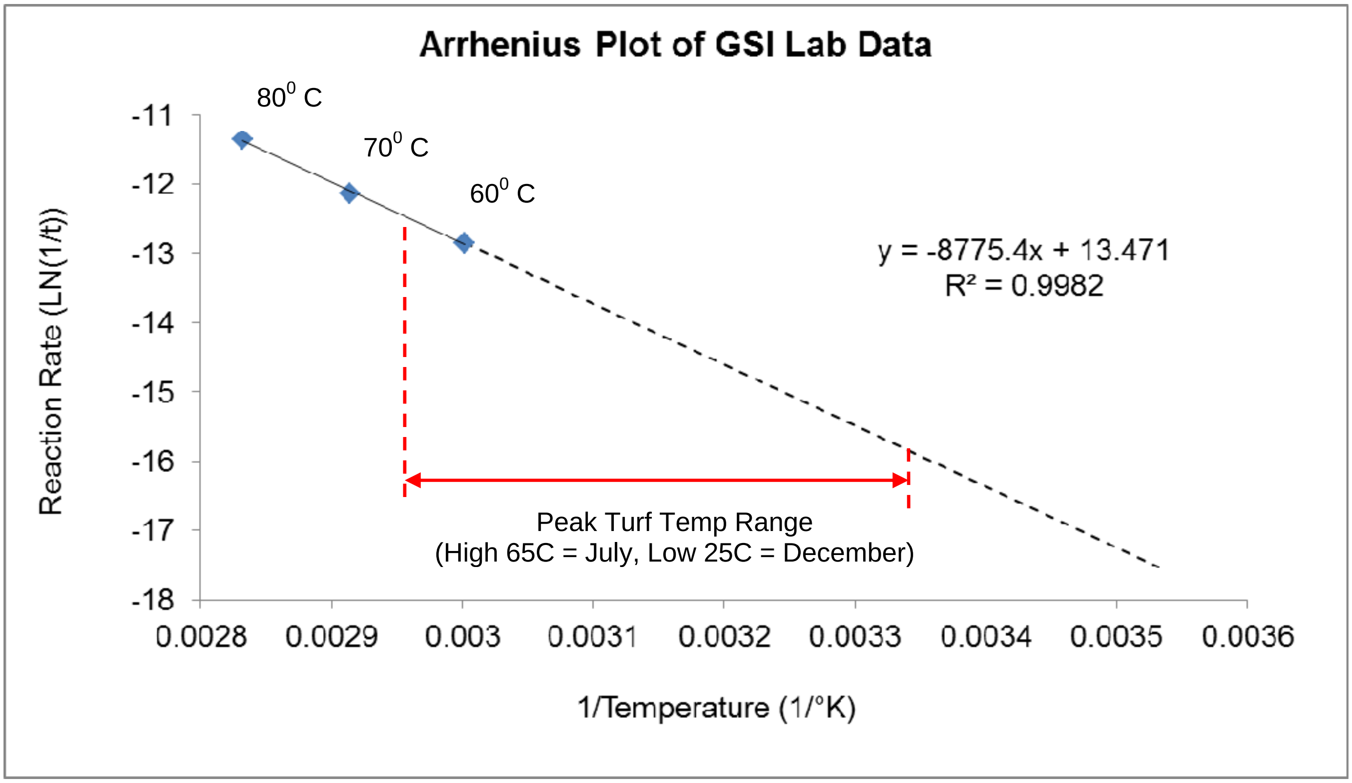
Figure 4

Kennesaw, GA | 23-April-2015



Note: Richgels (2015b) mentions that the use of peak turf temperature is conservative since it only occurs for approximately one hour per day.

Arrhenius Plot of Lab Data

Watershed Geosynthetics – ClosureTurf® UV Assessment

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Figure 5

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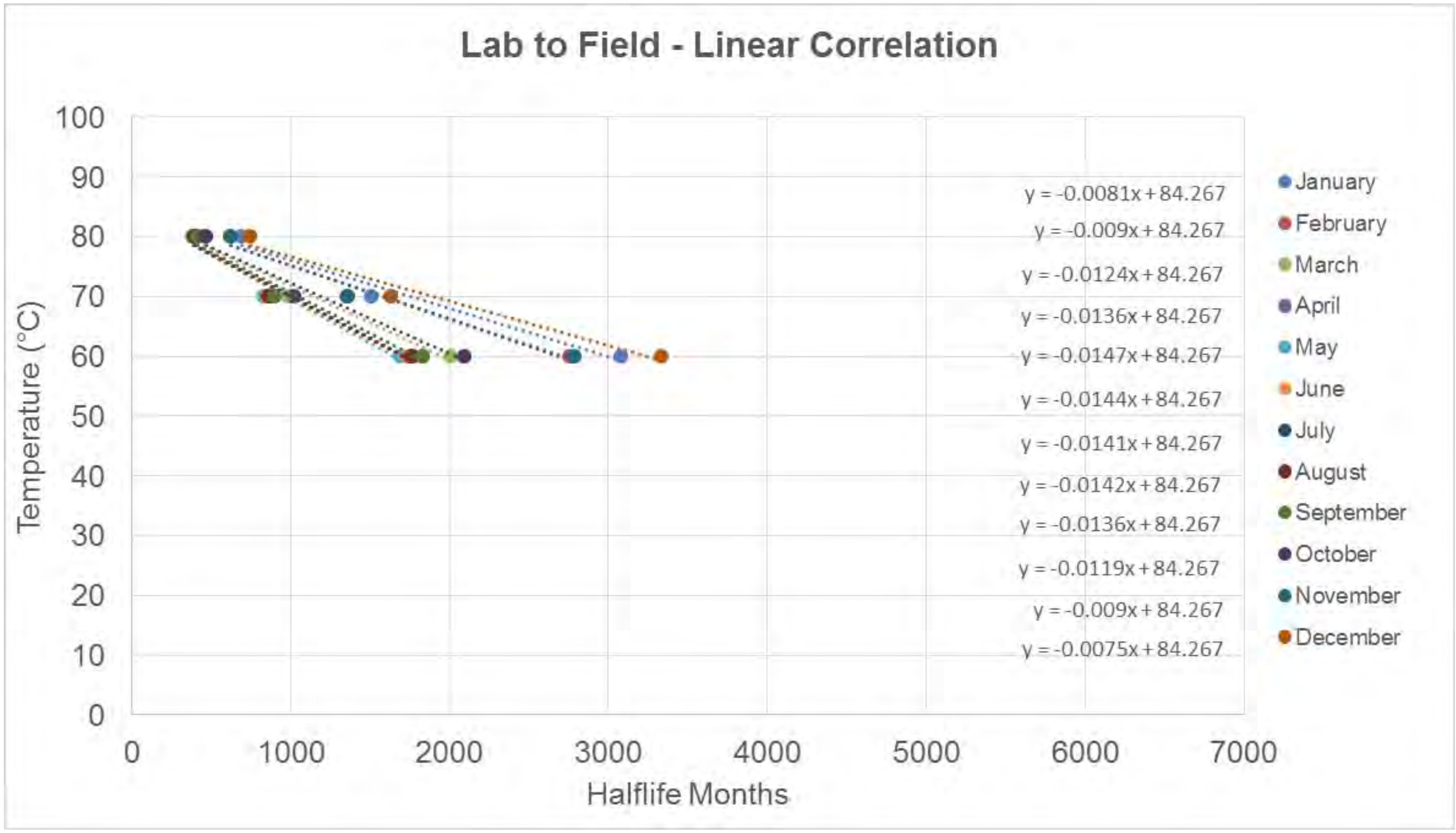

Note: Each month was projected down to the peak turf temperature given in Table 3 to get the half-life months. The inverse of half-life months is half-life loss per month. The sum of all the half-life losses for each month in a year is the yearly half-life loss, the inverse of which is the half-life.

Linear Extrapolations for Half-life Months

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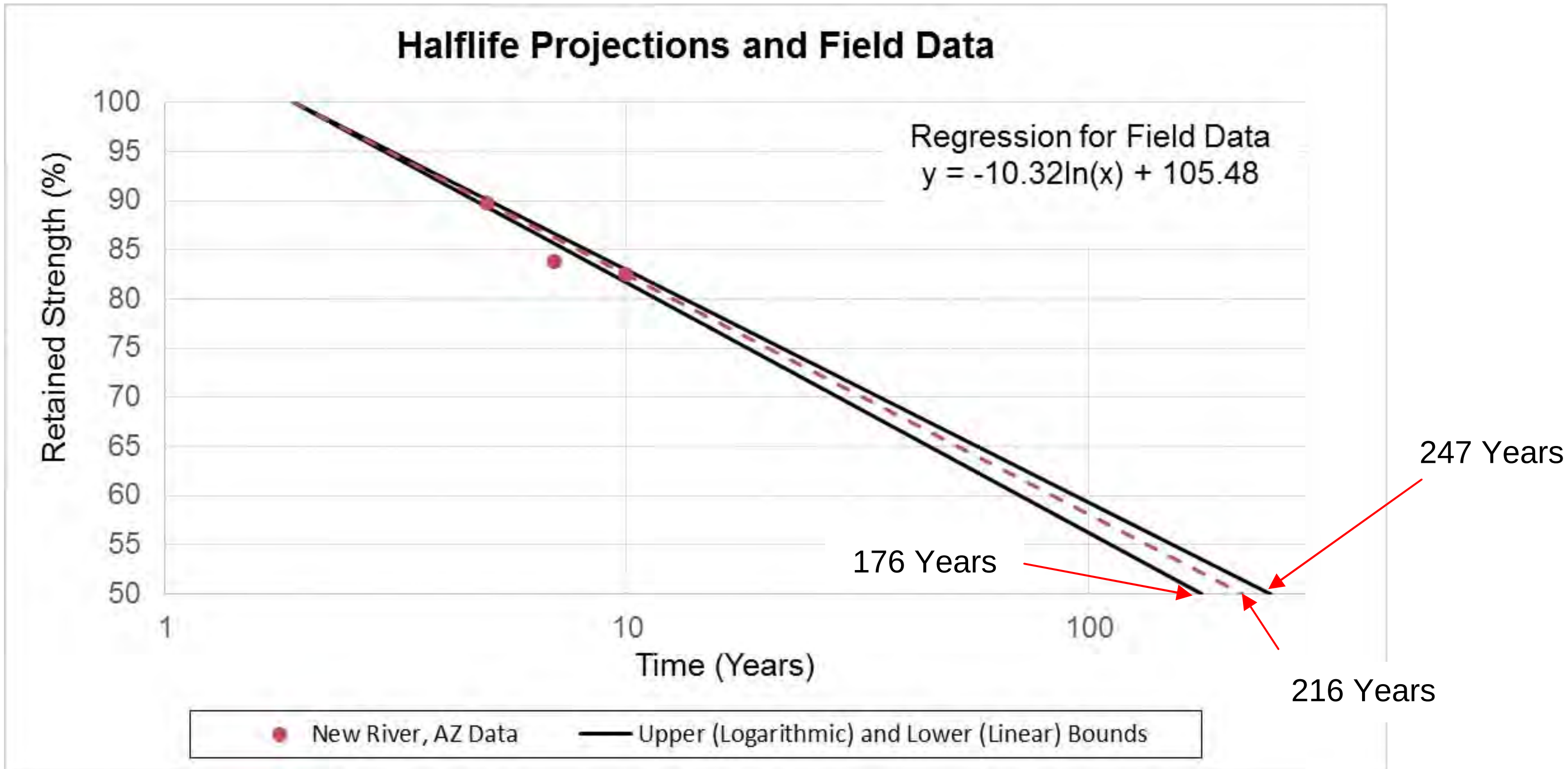
Figure **6**

Kennesaw, GA | 23-April-2015



Note: Geosyntec calculated an upper bound half-life of 277 years and a lower bound half-life of 214 years using the same data and method. Difference between Geosyntec and Richgels calculations are attributed to rounding.

Halflife Projections (Richgels, 2015a, 2015b)
Upper and Lower Bound Estimates
Watershed Geosythetics – ClosureTurf® UV Assessment

Geosyntec consultants

Figure **7**

Kennesaw, GA | 23-March-2015

Attachment D

GSI White Paper #28

DTE Sibley Quarry Closure Area

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GSI White Paper #28

"Cold Temperature and Free-Thaw Cycling Behavior of Geomembranes and Their Seams"

by

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Formally With U. S. Bureau of Reclamation
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June 17, 2013

"Cold Temperature and Free-Thaw Cycling Behavior of Geomembranes and Their Seams"

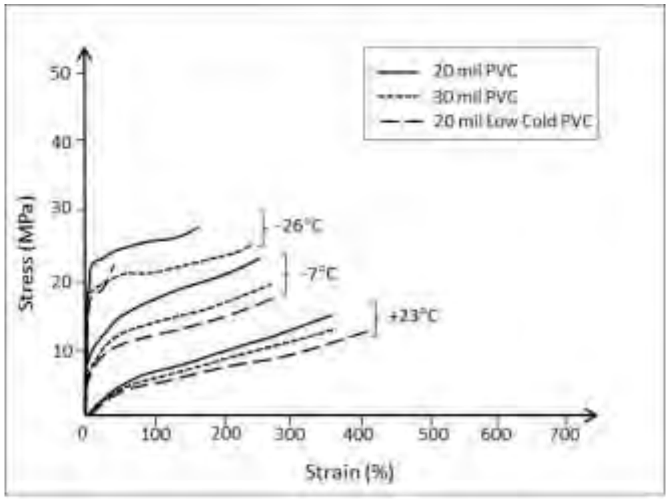
Introduction

It is common knowledge that materials in general, and polymeric materials in particular, will somewhat soften and increase in flexibility under high temperatures and will conversely somewhat harden and decrease in flexibility under cold temperatures. While there are indeed circumstances where high ambient temperatures are important, this white paper focuses entirely on cold ambient temperatures. Even further, it addresses cold temperature behavior of the various geomembranes by themselves and, most importantly, the freeze-thaw cycling behavior of a large number of geomembrane sheets and their seams.

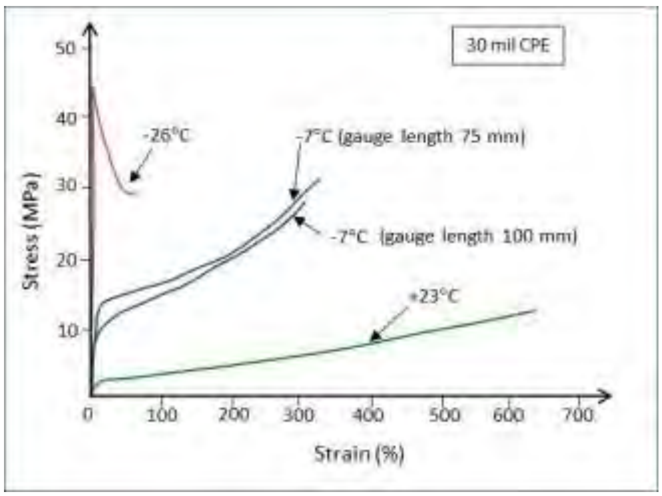
The stimulus for writing the white paper is the myriad questions that regularly come to GSI as to the potential negative effects on the tensile strength of geomembranes and their seams under cold temperature and cyclic freeze-thaw field conditions. As will be seen, the primary source for the information to be presented herein is a joint U.S. EPA/U.S. BuRec study conducted by Alice Comer and Grace Hsuan in 1996. Other companion technical information will also be presented.

Cold Temperature Behavior of Geomembranes

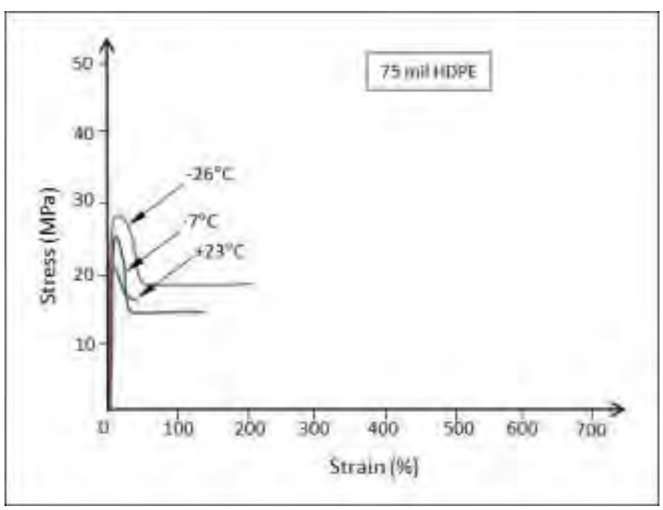
A report by Thornton and Blackall (1976) appears to be the first in describing Canadian experiences with geomembranes in cold regions. Subsequently, Rollin, et al. (1984) conducted a laboratory study on 21 types of geomembranes at temperatures down to - 35°C. They found increasing tensile strength with decreasing temperature. Richards, et al. (1985) did similar studies which also resulted in an increase in strength and a decrease in elongation with decreasing temperatures. They evaluated PVC, CPE and HDPE geomembranes and presented the stress-versus-strain curves at +23°C, -7°C and -26°C temperatures; see Figures 1a, 1b, and



(a) Tensile test results for PVC geomembranes



(b) Tensile test results for CPE geomembranes



(c) Tensile test results for HDPE geomembranes

Figure 1 – Stress-versus-strain behavior of three geomembrane types under progressively colder testing environments, Richards, et al. (1985)

1c. Here one can readily observe how the sets of curves transition from relatively ductile behavior at +23°C, to relatively brittle behavior at -26°C, with the intermediate behavior at -7°C. There are a few outliers, but the trends are undeniable. This general behavior was confirmed by Peggs, et al. (1990) and Giroud, et al. (1993), the latter working with both smooth and textured HDPE geomembranes.

While this type of thermal behavior is of interest, such information for a specific type of geomembrane must be obtained by performing or commissioning individual tests so as to obtain actual design information. Such individual testing is required due to the uniqueness of each polymer type and its specific formulation. Additives such as plasticizers, fillers, antioxidants, carbon black, colorants, etc., can influence the results to varying degrees. Even the resins themselves have behavioral differences at different temperatures. For example, the glass transition temperature of propylene is -7°C, below which the polymer is glassy and above which it is characterized as rubbery. In such a case the tensile properties are greatly influenced, as well as the material's creep and stress relaxation behavior.

There are other aspects of cold temperatures on geomembranes that go beyond the scope of this white paper. In particular are cases of impact shuttering failures in cold climates and installation concerns such as frozen subgrade, bridging, snow and ice removal and worker discomfort, Burns, et al. (1990).

<u>Freeze-Thaw Cycling of Geomembrane Sheets and Seams</u>

Budiman (1994) reported on both cold temperature behavior but also appears to be the first to include freeze-thaw cycling for up to 150 repetitions. He focused entirely on HDPE sheet (of different thicknesses) but not on seams. There was no degradation observed during his tests but he suggested that more cycles would be appropriate. At approximately the same time a much larger freeze-thaw study was ongoing. The final report by Comer and Hsuan was released by the U.S. Bureau of Reclamation in 1996. Related papers leading up to this final report are Hsuan, et al. (1993), Comer, et al. (1995), and Hsuan, et al. (1997). Their combined study involved 19 different geomembrane sheet materials and 31 different seam types. Furthermore, seven different resin types were evaluated. The resin types were the following:

- polyvinyl chloride (PVC)
- linear low density polyethylene (LLDPE)
- high density polyethylene (HDPE)
- flexible polypropylene (fPP)
- chlorosulfonated polyethylene (CSPE)
- fully crosslinked elastomeric alloy (FCEA)

All except FCEA are currently available, however, changes in additives and formulations have occurred and will likely to do so in the future. The entire study was conducted in four discrete parts although the fourth part was focused on induced tensile stress and stress relaxation and is not the specific purpose of this white paper. See Table 1 for the relevant three parts of their study.

Table 1 – Experimental Design of Different Parts of Comer and Hsuan (1996) Study

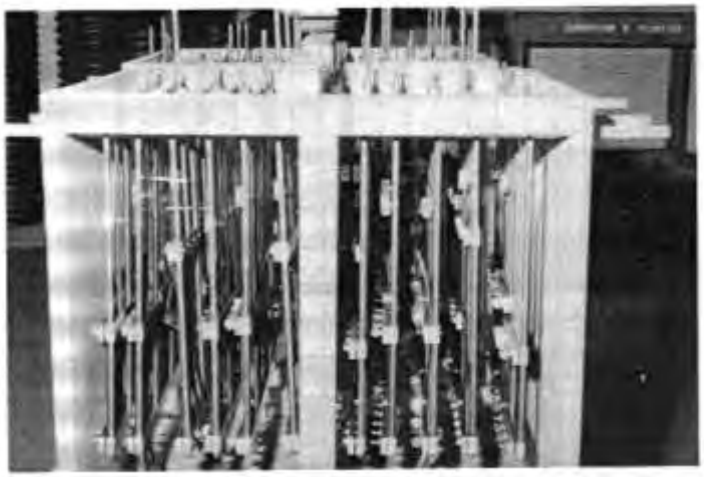
Part	Cyclic Temperature Range	Maximum Cycles	Incubation Condition	Tensile Test Temperature
I	+20°C to -20°C	200	relaxed	+20°C
II	+20°C to -20°C	200	relaxed	-20°C
III	+30°C to -20°C	500	constrained	+20°C

Part I consisted of 19 sheet materials and 27 seams. They underwent freeze-thaw cycles at +20°C for 8 hours and then -20°C for 16 hours. Tensile tests were then conducted at +20°C after 1, 5, 10, 20 50, 100 and 200 cycles.

Part II consisted of 6 sheet materials and 13 seams. They also underwent freeze-thaw cycling at +20°C for 8 hours and then -20°C for 16 hours. Different in this regard was that tensile tests were then conducted at -20°C after 1, 5, 10, 20, 50, 100 and 200 cycles. The -20°C tests were conducted in an environmental chamber (both specimens and their grips) cooled by liquid nitrogen and set at -20°C temperature.

Part III consisted of the same set of 19 sheet materials and 27 seams as in Part I but were now tensioned at a constant strain during the freeze-thaw cycling. The rack used for the tensioning is shown in Figure 2a and the assembly within the environmental chamber is shown in Figure 2b. After the targeted number of freeze-thaw cycles at +20°C for 8 hours and -20°C for 16 hours, specimens were removed and tested at +20°C after 1, 10, 50, 100, 200 and 500 cycles.

(a) Method of applying tensile load to test specimens in Part III tests



(b) Geomembrane racks in holding frame used in Part III series

Figure 2 – Method used for tensioning samples during incubation; Comer and Hsuan (1996)

Rather than showing the graphic results of the above freeze-thaw cycling study (it is available in full in the Comer and Hsuan report by the Bureau of Reclamation and the related papers by these authors) only the concluding comments will be reproduced here. They follow verbatim from the report.

Part I – Results on 200 Freeze-Thaw Cycles Tested at +20°C

- Tensile tests on geomembrane sheets: "The results show no change in either the peak strength or peak elongation of any of the tested materials".
- Shear tests on the geomembrane seams: "The results show no change in shear strength of any of the tested seam materials".
- Peel tests on the geomembrane seams: "The results show no change in peel strength of any of the tested seam materials.

Part II – Results on 200 Freeze-Thaw Cycles Tested at -20°C

- Tensile tests on geomembrane sheets: "The results show no change in either the peak strength or peak elongation of any of the tested materials".
- Shear tests on the geomembrane seams: "The results show no change in shear strength of any of the tested seam materials".
- Peel tests on the geomembrane seams: "The results show no change in peel strength of any of the tested seam materials.

Part III – Results on 500 Freeze-Thaw Cycles Tested at +20°C in a Constrained Condition

- Tensile tests on geomembrane sheets: "The results show no change in either the peak strength or peak elongation of any of the tested materials".
- Shear tests on the geomembrane seams: "The results show no change in shear strength of any of the tested seam materials".
- Peel tests on the geomembrane seams: "The results show no change in peel strength of any of the tested seam materials.

Conclusion and Recommendations

This two-part white paper focused initially on the cold temperature tensile behavior of the stress- versus-strain curves of several different types of geomembranes. As expected, the colder the temperature the more brittle, hence less ductile, were the response curves. Geomembranes made from PVC, CPE and HDPE were illustrated in this regard. The recommendation reached for this part of the white paper is that if a formulation-specific geomembrane under site-specific conditions is to be evaluated for its stress-versus-strain response, actual tests must be commissioned accordingly. The literature can only give general trends in this regard.

The second (and more important) part of this white paper focused entirely on freeze-thaw behavior of geomembranes and their different seam types. The U.S. Bureau of Reclamation report is extremely revealing in this regard. *The conclusion that the authors reached is that there is simply "no change" in tensile behavior of geomembrane sheets or their seams after freeze-thaw cycling.* It is felt that this conclusion in the context of their study is so impressive that it has essentially "closed the door" to further research on this specific topic. The essential question often raised in this regard, i.e., "will freeze-thaw conditions affect geomembrane sheets or their seam behavior," is answered with a resounding "NO".

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Attachment E

ClosureTurf Drivability and Stability

DTE Sibley Quarry Closure Area

8 July 2010

Mr. Jose Urrutia
Closure Turf, LLC
3005 Breckinridge Blvd., Suite 240
Duluth, Georgia 3096

Subject: Evaluation of Drivability
Light Weight Construction Equipment on
Closure Turf™ System

Dear Mr. Urrutia,

DEFINITION OF CLOSURE TURF™ SYSTEM

As shown in Figure 1, the installed Closure Turf™ system from top to bottom consists of:

- A thin sand layer;
- Artificial grass with geotextile down;
- Agru 50-mil Super Gripnet with spike sides down; and
- Subgarde (foundation) soil.

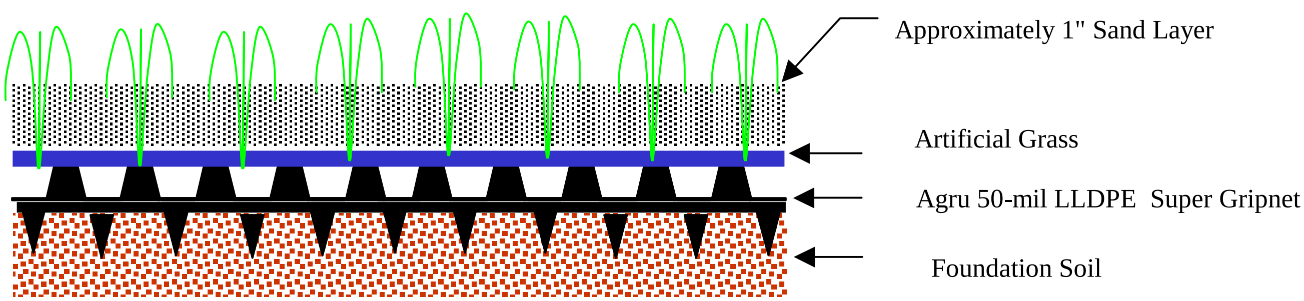

Figure 1. Cross-section of the Closure Turf system

SGI10007.REPORT.2010.04

DEFINITION OF POST-CONSTRUCTION DRIVABILITY

Drivability of rubber-tired construction equipment (RTCE) on the Closure Turf™ system is a rather broad subject including: (i) stability - potential sliding (shear failure) within the Turf Closure system; (ii) bearing capacity of the subgrade soil; (iii) localized settlement after construction due to waste decomposing and compression under gravity force; and (iv) rut depth. The purpose of this report is to evaluate the stability within the Turf Closure system and bearing capacity of the subgrade soil.

STABILITY

As shown in Figure 2, when a RTCE moves at a constant speed on the Closure Turf system, its gravity load is transferred to the Closure Turf system through the tire-soil contact.

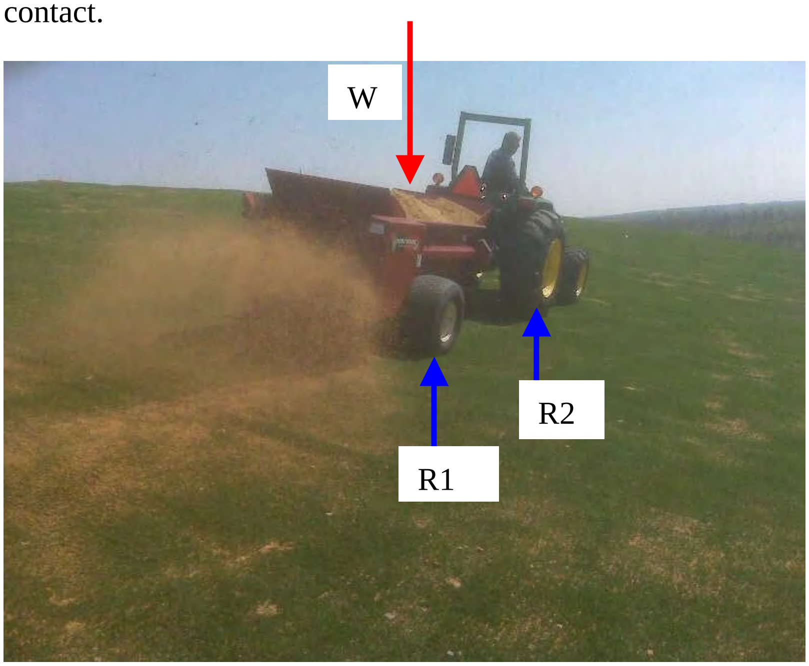

Figure 2. Rubber-tired construction equipment on the Closure Turf system.

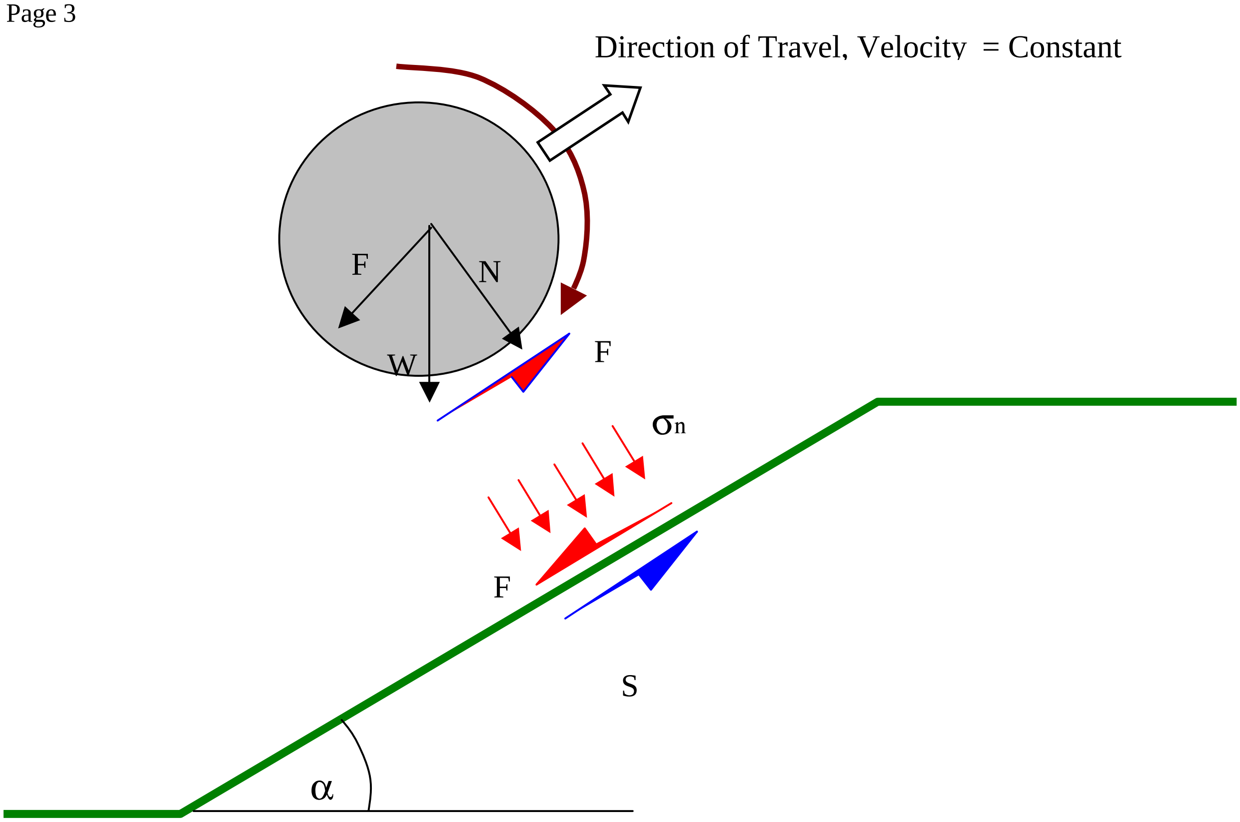

Figure 3. Tire-soil contact loading conditions on a slope. (NOTE: not to scale).

Assuming the gravity force of RTCE is evenly distributed to four tires, the contact normal stress at the tire-sand contact area as shown in Figure 3 can be estimated by the following equation:

$$\sigma_n = \frac{W \cos\alpha}{4A} \qquad (1)$$

where:

α = the slope angle;

σ_n = contact normal stress between the tire and sand;

W = total gravity force of equipment; and

A = contact area between a tire and sand layer.

Assuming: (i) the tire-soil contact area is approximately equivalent to a 10 inch diameter circular area and (ii) the total weight of a RTCE is 8000 lbs, then the contact normal stress in the unit of psi is:

$$\sigma_n = \frac{8000\cos\alpha}{4(3.14)(5^2)} = 25.5\cos\alpha \qquad (2)$$

Equation (2) is also applicable to a level surface by setting α = 0. This gives the maximum contact normal stress of 25.5 psi. It is noted that the tire-sand contact normal stress over a 10-inch diameter area is much higher than the overburden pressure of 1 inch thick cover sand. Therefore, it is necessary to evaluate the stability of the Closure Turf system in the tire-sand contact area under the high normal stress conditions. The shear strength parameters for this localized stability analysis should be determined from the interface direct shear tests at high normal stresses (2000 to 5000 psf). Based on the test results in Attachment 1, the peak friction angle and adhesion of the sand/artificial grass/Agru 50-mil Super Gripnet LLDPE geomemebrane system is 34 degree and 39 psf, respectively for the normal stress range of 2000 to 5000 psf. Under the drained conditions (i.e., no pore pressure induced by RTCE), neglecting the adhesion for the conservative reason, the safety factor (FS) against the localized shear failure within the tire-soil contact area is:

$$FS = \frac{A\sigma_n \tan\delta}{0.25(W)\sin\alpha} \qquad (3)$$

where:

α = the slope angle;

σ_n = contact normal stress between the tire and sand;

δ = the peak friction angle of the Closure Turf system;

W = total gravity force of equipment; and

A = contact area between a tire and sand layer.

Substituting Equation (1) into (3), Equation (3) is reduced to:

$$FS = \frac{\tan \delta}{\tan \alpha} \tag{4}$$

For the given Closure Turf system, the peak friction angle is constant. It is obvious that FS decreases with increasing the slope angle. Based on the information provided by Closure Turf LLC, the maximum allowable slope angle is 18 degree (3:1 slope).

At $\alpha = 18.4$ degree,

$$FS = \frac{\tan 34}{\tan 18} = 2.0 \tag{5}$$

This indicates that there is sufficient shear resistance in the Closure Turf system against the localized shear failure within the tire-soil area. It is not expected the localized internal shear failure to occur within the tire-soil contact area of Closure Turf system when it subjected to the gravity force from a typical lightweight RTCE traveling at a constant velocity.

BEARING CAPACITY

For a given RTCE, W and A are constant, therefore the maximum contact normal stress occurs when the RTCE travels on the level surface (Equation 1). The contact normal stress is transferred to the subgade soil as shown in Figure 4.

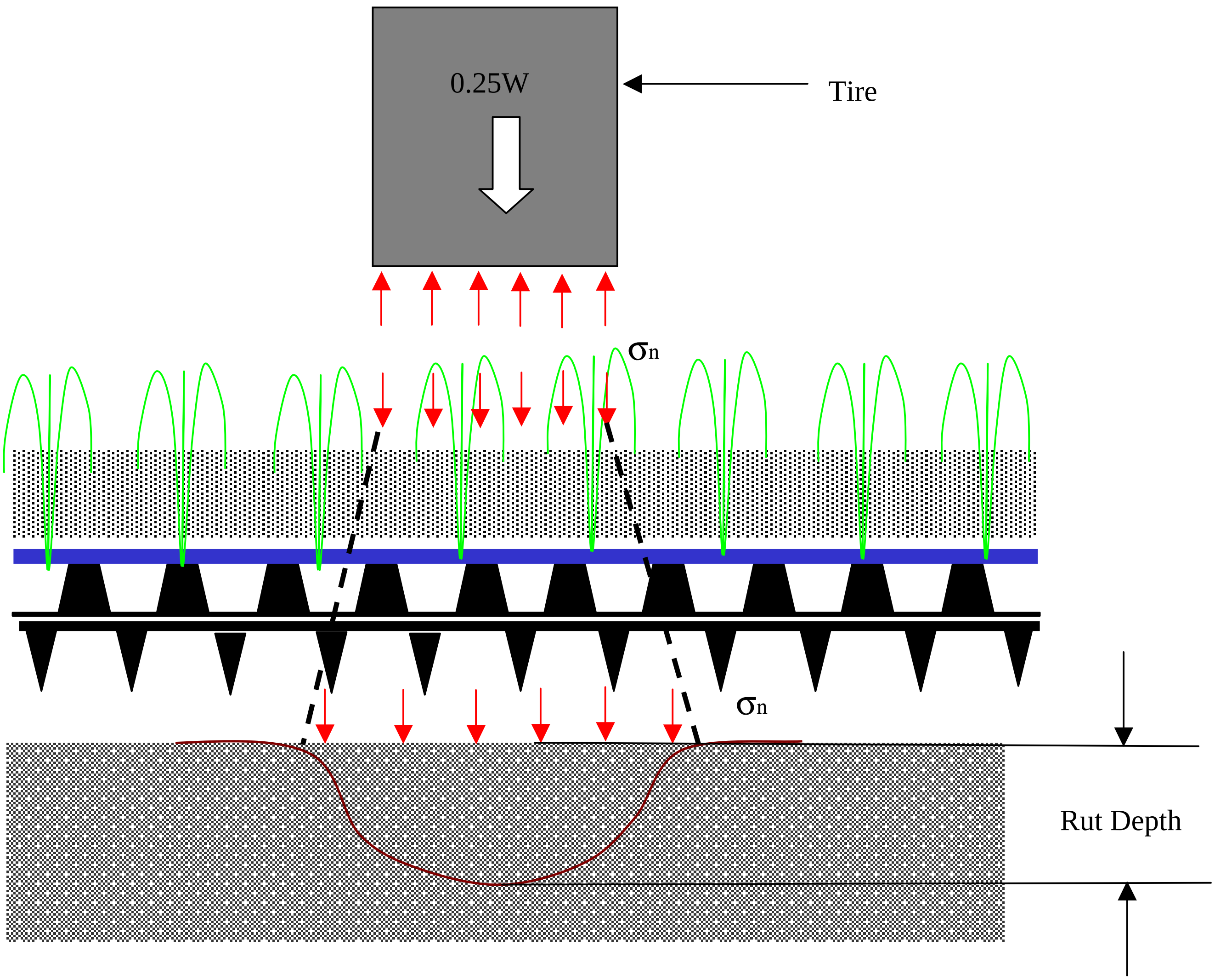

Figure 4. Normal stress acting on top of the subgrade (foundation) soil

Based on soil mechanics, the contact load (0.25W) distributes to a larger area as depth increases (depth starting from the top surface of the cover sand). However, due to the fact that the cover sand layer is only 1 inch thick, and the artificial grass and geomembrane are flexible, the load spreading angle (factor) is insignificant. The normal stress transferred to the top of subgrade soil is considered the same as the tire-sand contact stress for the conservative reason.

As shown previously (Equation 2), assuming (i) the tire-soil contact area is approximately a 10 inch diameter circular area and (ii) the total weight of a RTCE is 8000 lbs, then the maximum contact normal stress is:

$$\sigma_n = \frac{8000\cos\alpha}{4(3.14)(5^2)} = 25.5\,psi \tag{6}$$

Under the action of tire-sand contact normal stress over the contact area (10 in diameter), there are two major concerns:

- Excessive rut depth, which is not defined for the Closure Turf system at the present time. Generally speaking, the subgrade soil settles and rut forms when it is subjected a normal stress. As number of vehicle passes increases, the rut depth increases. Eventually the surface may reach such a condition that driving is difficult if the accumulated pass is larger than some critical number. Therefore, for the given type of equipment (W and A are fixed), one way to reduce rut depth is to limit the number of passes. This may be achieved by not driving over the same area when a significant rut depth is already developed. The other way is to compact subgrade soil to high density to improve the stiffness for the subgrade soil.

- Bearing capacity failure because the contact normal stress is greater than the bearing capacity of the subgrade soil.

In the case of soft subgrade soil (worst case), the bearing capacity is estimated by the following equation:

$$q_u = c_u N_C \tag{7}$$

where:

c_u = undrained shear strength of soft subgrade soil

N_c = bearing capacity factor (6.2 for a circular loading area)

$$q_u = 6.2 c_u \tag{8}$$

For the soft subgrade soil, the safety factor against bearing capacity failure is:

$$FS = \frac{6.2 c_u}{\sigma_n} \tag{9}$$

Typically, the acceptable bearing capacity safety factor is 2.0. The required undrained shear strength for the subgrade soil is,

$$c_u \geq \frac{2(25.5)}{6.2} = 8.2\, psi \tag{10}$$

The value of c_u can be estimated from the widely used CBR value for soft subgrade soil with CBR < 5 using the following equation (Giroud and Noiray 1981):

$$c_u = 4.3 CBR \tag{11}$$

Substituting Equation 11 into 10 gives the following equation:

$$CBR \geq 1.9 \tag{12}$$

Therefore, under the action of the gravity force from a typical RTCE (W = 8000 lbs, A = 79 square inch), the required minimum CBR value for the subgrade is 2. In reality, a well-compacted subgarde soil for the Closure Turf system should have a CBR value significantly higher than 2. It is expected that a well-compacted subgarde soil layer (SM or SC, typically used as subgarde soil for the landfill cover system) should have sufficient bearing capacity to support the lightweight RTCE.

CLOSURE

SGI appreciates the opportunity to provide technical services to Closure Turf, LLC. Should you have any questions regarding the attached document(s), or if you require additional information, please do not hesitate to contact the undersigned.

Sincerely,

Zehong Yuan, Ph.D., P.E.
Laboratory Manager

REFERENCES

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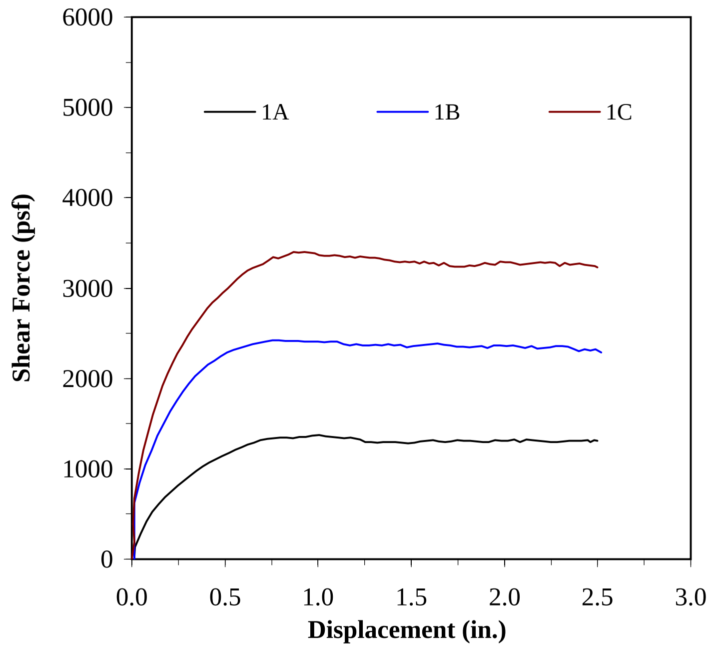
NOTES:
(1) Unless otherwise noted in the test results the sample(s)/specimen(s) were prepared in accordance with the applicable test standards or generally accepted sampling procedures.
(2) Contaminated/chemical samples and all related laboratory generated waste (i.e., test liquids, PPE, absorbents, etc.) will be returned to the client or designated representative(s), at the client's cost, within 60 days following the completion of the testing program, unless special arrangements for proper disposal are made with SGI.
(3) Materials that are not contaminated will be discarded after test specimens and archived specimens are obtained. Archived specimens will be discarded 30 days after the completion of the testing program, unless long-term storage arrangements are specifically made with SGI.
(4) The reported results apply only to the materials and test conditions used in the laboratory testing program. The results do not necessarily apply to other materials or test conditions. The test results should not be used in engineering analysis unless the test conditions model the anticipated field conditions. The testing was performed in accordance with general engineering testing standards and requirements. The reported results are submitted for the exclusive use of the client to whom they are addressed.

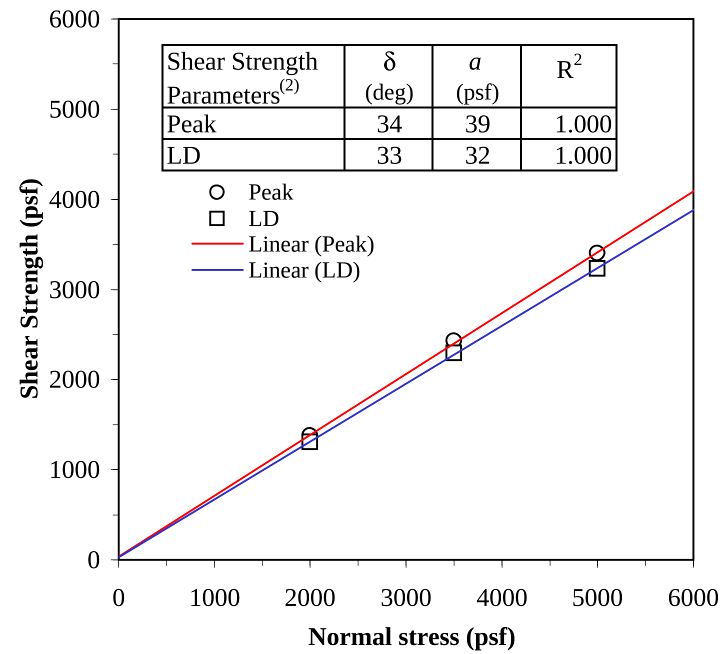
ATTACHMENT 1

INTERFACE DIRECT SHEAR TEST RESULTS

CLOSURETURF LLC -LANDFILL COVER SYSTEM
INTERFACE DIRECT SHEAR TESTING (ASTM D 5321)

Upper Shear Box: Concrete sand nominally compacted
Artificial grass with grass side (green yarns) up/
Agru 50 mil LLDPE Super Gripnet geomembrane with studs side up/
Lower Shear Box: Concrete sand





Test No.	Shear Box Size (in. x in.)	Normal Stress (psf)	Shear Rate (in./min)	Soaking Stress (psf)	Soaking Time (hour)	Consolidation Stress (psf)	Consolidation Time (hour)	Lower Soil γ_d (pcf)	Lower Soil ω_i (%)	Lower Soil ω_f (%)	Upper Soil γ_d (pcf)	Upper Soil ω_i (%)	Upper Soil ω_f (%)	GCL ω_i (%)	GCL ω_f (%)	Shear Strengths τ_P (psf)	Shear Strengths τ_{LD} (psf)	Failure Mode
1A	12 x 12	2000	0.04	10	24	-	-	-	-	-	-	-	-	-	-	1376	1308	(1)
1B	12 x 12	3500	0.04	20	24	-	-	-	-	-	-	-	-	-	-	2425	2291	(1)
1C	12 x 12	5000	0.04	50	24	-	-	-	-	-	-	-	-	-	-	3400	3233	(1)

NOTES:
(1) Sliding (i.e., shear failure) occurred at the interface between the cover (upper) sand and artificial grass.
(2) The reported total-stress parameters of friction angle and adhesion were determined from a best-fit line drawn through the test data. Caution should be exercised in using these strength parameters for applications involving normal stresses outside the range of the stresses covered by the test series. The large-displacement (LD) shear strength was calculated using the shear force measured at the end of the test.

SGI TESTING SERVICES, LLC

DATE OF TEST:	6/21/2010
FIGURE NO.	C-1
PROJECT NO.	SGI10007
DOCUMENT NO.	
FILE NO.	