DuPont Titanium Technologies
Edge Moor Plant
104 Hay Road
Edge Moor, DE 19809

March 12, 2010

Mr. Wilmer Reyes
Program Manager
Delaware Department of Natural Resources and Environmental Control (DNREC)
Site Investigation and Restoration Branch
391 Lukens Drive
New Castle, DE 19720-2774

Revised Remedial Design Report
DuPont Hay Road Sludge Drying Site (DE-0024)
Wilmington, Delaware

Dear Mr. Reyes:

Enclosed are three hard copies of the revised text, spine, and Appendix H design drawings from the *Remedial Design Report* for the DuPont Hay Road Sludge Drying Site located in Wilmington, Delaware. Also, enclosed is an updated electronic copy of the entire report, including tables, figures, and appendices. Please note that these hard copies are to replace the text, spine, and Appendix H design drawings in the hard copies you received in December 2009, as these hardcopies are revised in response to DNREC comments provided in your February 9, 2010 letter. The DuPont response to each DNREC comment is also provided in this letter. In addition, the report includes a revised intermediate and final grading plan for the cap based on several phone conversations between DuPont and DNREC personnel in February 2010.

The following paragraphs provide responses in the order of the comments presented in your February 9, 2010 letter.

Design

DNREC Comment 1: The engineering calculations are acceptable. DNREC Industrial Waste Landfill (IWL) regulations provide for a minimum 30 mil geomembrane and maximum side slopes of 3:1. The design exceeds these requirements with a proposed 40 mil geomembrane and 4:1 side slopes.

DuPont Response 1: No response required.

DNREC Comment 2: DNREC IWL regulations provide for six inches of soil between the capping components and the waste in order to provide a stable subgrade for the cap.

The proposed design does not provide for this additional fill layer. Will the IRM itself or the geotextile provide for a suitable subgrade?

DuPont Response 2: The Staged IRM will provide a stable subgrade. The geotextile component in the cap design functions as a protective cushion/separation layer between the Staged IRM subgrade and the LPDE geomembrane barrier layer. The IRM was regraded and compacted in 2002 and has been allowed to consolidate since that time. The IRM is primarily an inorganic, soil-like material that is not conducive to degradation or creation of void spaces within the landfill. Therefore, additional settlement and subsidence is expected to be negligible.

DNREC Comment 3: DNREC IWL regulations provide for 18 inches of fill underlying a 6 inch topsoil cover to provide adequate protection against freezing and thawing and suitable rooting for plant growth. The proposed design only calls for 12 inches of soil. Please explain.

DuPont Response 3: The final cover design, 12 inches of fill and 6 inches of topsoil overlying a geocomposite drainage layer and 40-mil LDPE liner, will allow for adequate protection against freezing and thawing and suitable rooting for plant growth. The final cover design is also consistent with other designs, including covers for the previous pond closures at the site. Routine inspections have indicated a healthy vegetative stand under similar site conditions. No impacts from freeze/thaw have been observed.

Literature regarding performance and effectiveness indicates geosynthetics in general are not susceptible to freezing or freeze-thaw cycles. Specifically, a technical paper entitled "Effects of Freeze-Thaw Cycling on Geomembrane Sheets and Their Seams – Part II" presented by Dr. Robert M. Koerner of the Geosynthetic Institute at its 1997 conference states that after 200 freeze-thaw cycles, the tensile properties of geomembrane sheets and seams showed no statistically significant change and that geomembranes and their seaming methods are not sensitive to freeze-thaw cycling. Subsequent research has demonstrated that even after 500 freeze-thaw cycles, no adverse effects to geomembranes and their seams were observed (Koerner, *Designing with Geosynthetics*, 4th Edition, 1998).

As discussed at our initial meeting in May 2009 and subsequent phone calls in February 2010, the final cover was designed to meet substantive requirements for a hazardous waste landfill. In accordance with the Voluntary Cleanup Program (VCP) Agreement for the site, activities are to be performed consistent with the Delaware Hazardous Substance Cleanup Act (HSCA) and the Delaware Regulations Governing Hazardous Substance Cleanup (Regulations). Therefore, as described in Section 5.0 of the *Remedial Design Report*, the cap was designed to meet the following (in accordance with Delaware Administrative Code, Title 7, Section 1302, Part 264 – Standards for Owners and Operators of Hazardous Waste Treatment Storage and Disposal Facilities, Subsection 264.310):

1. Provide long-term minimization of migration of liquids through the closed cover
2. Function with minimum maintenance
3. Promote drainage and minimize erosion or abrasion of the cover
4. Accommodate settling and subsidence so that the cover's integrity is maintained
5. Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present

DNREC Comment 4: Please provide any information that support the similarity of the IRM to the unstabilized waste and filter cake material upon which the calculation in section 5.1.1 of the design was made.

DuPont Response 4: Section 5.1.1 of the *Remedial Design Report* presents a brief discussion of a 1990 slope stability analysis completed within the Sludge Drying Site for what was then to be Cell 4 of the landfill. The analysis incorporated anticipated loading conditions for Cell 4 that were larger in size (area covered) and magnitude (total height) than the current loading conditions within the Sludge Drying Site. The similarities to the current design in this section refer to the anticipated loading and physical configuration of the pile rather than the physical properties of the material. The 1990 analysis concluded that the subsoils were stable under the anticipated loading conditions. Because the 1990 analysis used larger loads than the current loading conditions, an updated slope stability analysis was not performed.

Erosion and Sediment Controls

DNREC Comment 5: Revise Item #3 of the Sequence of Construction to include a perimeter inspection by DNREC Sediment & Stormwater Program representative after installation of controls and prior to the start of any further site disturbance.

DuPont Response 5: The sequence of construction has been revised to include DNREC inspection.

DNREC Comment 6: Please add an item to the general "Erosion and Sediment Control" notes on Sheet 2 that addresses dust control.

DuPont Response 6: A note has been added to Sheet 2 that discusses dust control.

DNREC Comment 7: The symbology for the erosion and sediment control practices shown on Sheet 4 will need to be revised so that they are consistent with those contained in the Delaware ESC Handbook. In addition, a legend for these symbols should be added to Sheet 4.

DuPont Response 7: Sheet 4 has been modified to be consistent with the Delaware ESC Handbook.

DNREC Comment 8: All details for ESC practices must be presented on the detail sheets exactly as shown in the Delaware ESC Handbook, including the border information and any data for that practice. (These details can be downloaded in TIF format for import into CAD drawings from the Sediment & Stormwater Program Web site.)

DuPont Response 8: The erosion and sediment control details have been replaced by the details presented in the Delaware ESC Handbook.

DNREC Comment 9: Any practice being proposed that is not included in the Delaware ESC Handbook requires prior consent from DNREC Sediment & Stormwater Program. The "Typical Stone Outlet Detail" shown on Sheet 5 is not an approved practice and it is unclear what purpose it is intended to serve that could not otherwise be accomplished with one of the standard practices from the Handbook.

DuPont Response 9: The typical stone outlet detail presented on Sheet 5 has been removed.

DNREC Comment 10: Please add the proposed stabilization seeding specifications for both temporary and permanent stabilization to the plan itself.

DuPont Response 10: The proposed temporary and permanent seeding mixes have been added to the Erosion and Sediment Control Plan.

DNREC Comment 11: The proposed skimmer shown on Sheet 5 appears to be a "Faircloth Skimmer", which is a proprietary device and should be identified as such. This device has site specific sizing and discharge criteria which I was not able to find in the application package. However, the Delaware ESC Handbook contains a generic skimmer detail which would not require such criteria. Unless the design engineer has a reason to use a Faircloth Skimmer in this particular application, the generic version would be acceptable.

DuPont Response 11: The proposed skimmer detail presented on Sheet 5 has been replaced with the generic skimmer detail as presented in the Delaware ESC Handbook.

Other Comments

DNREC Comment 12: Executive Summary: Please indicate that the Design meets the requirements for landfill construction regulated by DSHWMB (as specified in Section 4), as well as the requirements of the final plan of remedial action.

DuPont Response 12: The Executive Summary has been revised to indicate that the design meets the requirements of Delaware Administrative Code, Title 7, Section

1302, Part 264 – Standards for Owners and Operators of Hazardous Waste Treatment Storage and Disposal Facilities.

DNREC Comment 13: Page 1 and 18. Use environmental covenant instead of deed restriction.

DuPont Response 13: The term "deed restriction" has been replaced with "environmental covenant" on pages 1 and 18 of the report text.

DNREC Comment 14: Page 7. Figure 2 does not include monitoring well locations, as referred in last paragraph.

DuPont Response 14: The last sentence on page 7 of the report text has been deleted.

DNREC Comment 15: Page 9. Please indicate that the action levels for contaminants of concern presented in the remedial action objectives will be developed as part of the monitoring program and may not be consistent with those proposed in the report.

DuPont Response 15: A groundwater monitoring program will be developed concurrently with remedial construction and will be forwarded to DNREC for review when completed. Consistent with the scope of work for the VCP Agreement, the monitoring will be integrated into the ongoing Solid Waste Post-Closure Care monitoring program of the DuPont Hay Road Solid Waste Landfill, which is adjacent to the Sludge Drying Site.

DNREC Comment 16: Page 19, Section 7.1.1. Please clarify the statement about beneficial re-use of site soil from areas outside of the limit of the site that will be considered to achieve intermediate cap design grades.

DuPont Response 16: The term "beneficial re-use" has been deleted from the text. DuPont is considering using excavated soil from the previous Hay Road slurry wall excavation, currently stockpiled adjacent to the Sludge Drying Site, as grading fill (above the existing Staged IRM but below the geotextile). The text has been clarified to reflect this as a potential on-site borrow area to meet the intermediate grading plan.

DNREC Comment 17: Page 24. Dust control: Please discuss the need of PM10 monitoring.

DuPont Response 17: The text has been modified to include a description of proposed dust monitoring. In addition to work zone and perimeter real time monitoring, low volume air sampling will be conducted at the perimeter of the SDS. Real time monitoring for particulates will be performed using an aerosol monitor (Miniram). Monitoring will be performed within the Exclusion Zone and upwind and downwind of the Exclusion Zone. Results will be recorded daily in a health and safety logbook.

Disturbance of the iron material during the construction of a geosynthetic capping system over the Staged Iron Rich Material is expected to be minimal; therefore, the need to perform PM10 monitoring was determined not to be necessary. However, because a few tasks (e.g., intermediate grading) associated with the construction of the geosynthetic capping system may result in a minor disturbance of the Staged Iron Rich Material, air sampling will be performed using low flow air sampling techniques to ensure that engineering controls are effective. Area sample locations will be staged upwind, downwind, and within the work area of the intrusive activity using NIOSH Method 0500 with a PVC Filter for Total Particulate analysis. In addition to air sampling, real time monitoring for particulates will be performed using a MIE PDM-3 Aerosol Monitor (Miniram). Monitoring will be performed upwind and downwind of the exclusion zone and recorded daily in a health and safety logbook.

DNREC Comment 18: Page 25. Please indicate that an approval is required by DNREC for any imported soil to be used at the site during landfill construction.

DuPont Response 18: As discussed during a February 16, 2010 conference call with DNREC, DuPont intends to use commercial borrow sources that certify the material is clean and suitable for its intended use. Certification from the approved borrow sources will be included in the record documentation for the project.

DNREC Comment 19: Appendix E and G1. Operation and Maintenance. These appendices are very preliminary and need substantial improvement, especially regarding environmental monitoring. However, because these appendices do not affect the construction of the cap system, DNREC suggests conditional approval of these appendices, with the understanding that a more detailed version of these appendices will be provided to DNREC for approval.

DuPont Response 19: As stated in the response to DNREC Comment 15, the monitoring program will be developed concurrently with remedial construction and will be forwarded to DNREC for review when completed.

DNREC Comment 20: Appendix F. Contingency Plan does not include potential access problems to the site due to eventual flooding of the surrounding area. How do the O&M activities be performed in a situation like this?

DuPont Response 20: If flooding conditions exist within or around the site, no O&M activities will be undertaken until the flooding conditions no longer exist. At that time, the site will be inspected to identify any impacts due to flooding. If impacts are observed, they will be repaired within a reasonable timeframe.

If you have any questions, please call me at 302.761.2302.

Sincerely,

Tushar Durve
Environmental Manager
DuPont Titanium Technologies – Edge Moor Plant

Enclosure – To be submitted separately by URS

cc: File: 509135
S. Rahaim
M. Thomson
J. McCarthy
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N. Pepper
R. Deadwyler

Remedial Design Report
Hay Road Sludge Drying Site
(DE-0024)
Wilmington, Delaware

Original Date: December 2009
Revised Date: March 2010

Project No.: 18985726.20103

URS

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March 12, 2010

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Acronym List

Acronym	Explanation
AWQC	Ambient Water Quality Criteria
COC	Constituent of Concern
CQA	Construction Quality Assurance
CRG	Corporate Remediation Group
DAWM	Division of Air and Waste Management
DM	Dredge Material
DNREC	Department of Natural Resources and Environmental Control
DuPont	E.I. du Pont de Nemours and Company
EC	Environmental Covenant
ECB	Erosion Control Blanket
EPA	U.S. Environmental Protection Agency
E&S	Erosion and Sediment
FEMA	Federal Emergency Management Agency
FFS	Focused Feasibility Study
GSI	Geosynthetics Institute
HASP	Health and Safety Plan
HCR	House Concurrent Resolution
LDPE	Low-Density Polyethylene
O&M	Operation and Maintenance
oz/sy	Ounce per square yard
NAVD	North American Vertical Datum
NPDES	National Pollutant Discharge Elimination System
PPRA	Proposed Plan of Remedial Action
RAO	Remedial Action Objective
RI/RA	Remedial Investigation/Remedial Assessment
SIRB	Site Investigation and Remediation Branch
SCE	Stabilized Construction Entrance
SCS	Soil Conservation Service
Staged IRM	Staged Iron Rich Material
UECA	Uniform Environmental Covenants Act
USACE	United States Army Corps of Engineers
USDA	U.S. Department of Agriculture
USLE	Universal Soil Loss Equation
VCP	Voluntary Cleanup Program
WWTP	Wastewater Treatment Plant

Executive Summary

This *Remedial Design Report* for the Hay Road Sludge Drying Site (DE-0024) located in Wilmington, Delaware is being submitted because the remedy design has been completed in accordance with applicable Delaware Department of Natural Resources and Environmental Control (DNREC) regulations. Specifically, the engineered cap system was designed in accordance with the Consent Order (C.A. 01c-10-288CHT) and the Scope of Work in the Voluntary Cleanup Program (VCP) agreement to meet or exceed the performance requirements detailed in the DNREC Final Plan of Remedial Action (Secretary's Order No. 2009-A-0005) dated January 16, 2009 (DNREC, 2009). The proposed design for the Hay Road Sludge Drying Site is based on currently accepted geotechnical and environmental engineering principles and practices and meets the requirements for a landfill cover as detailed in the Delaware Regulations Governing Hazardous Waste, Delaware Administrative Code, Title 7, Section 1302, Part 264, Subpart N – Landfills, Section 264.310, Closure and Post-Closure Care.

The selected remedial alternative for the site is outlined as follows:

- Construct a capping system over the Staged Iron Rich Material (Staged IRM), consisting of a multilayer geosynthetic liner system pursuant to a DNREC-approved remedial design plan.
- Place an Environmental Covenant (EC) consistent with the Delaware's Uniform Environmental Covenants Act (UECA) (Title 7, Del. Code Chapter 79, Subtitle II) that will prohibit current and future residential or unrestricted use of the property; any digging, drilling, excavating, grading, constructing, earth moving, or any other land disturbing activities on the property without the prior written approval of DNREC; and the installation of any water wells on-site or use of groundwater at the site without the prior written approval of DNREC
- Develop a DNREC-approved Operation and Maintenance (O&M) Plan to maintain the cap to prevent exposure to site soil contamination and monitoring on-site wells to evaluate the hydrogeology and chemistry of the underlying dredge material and groundwater. Additional remedial actions may be required based on the results of the on-site monitoring program and the area-wide groundwater investigation.

The proposed cap system consists of geosynthetic and natural soil components and was designed to meet DNREC requirements and to protect the environment. Geosynthetic components were selected because of the performance advantages (e.g., tensile strength, durability, drainage capacity, and long-term impermeability) they offer relative to a clay barrier cap system without geosynthetics. In addition, geosynthetic materials are easier to install and repair than a clay barrier cap system.

The typical cap system cross section consists of the following components, from top to bottom:

- A 6-inch vegetative soil layer
- A 12-inch cover soil layer

- A geocomposite drainage layer
- A 40-mil low-density polyethylene (LDPE) geomembrane
- A 10–ounce-per-square-yard geotextile protective layer
- Staged Iron Rich Material (Staged IRM)

When implemented at the site, the remedial action will achieve the overall Remedial Action Objectives (RAOs) established for the site. The implementation of the remedial action will protect human health and the environment.

1.0 Introduction

E.I. du Pont de Nemours and Company (DuPont) agreed to enter its Hay Road Sludge Drying Site (DE-0024) in the Delaware Department of Natural Resources and Environmental Control (DNREC), Division of Air and Waste Management (DAWM), Site Investigation and Remediation Branch (SIRB) Voluntary Cleanup Program (VCP). DuPont entered into the VCP in accordance with the Consent Order (C.A. 01c-10-288CHT) lodged with the Superior Court of the State of Delaware on November 2, 2001 and signed by DNREC on September 11, 2002.

This *Remedial Design Report* for the Hay Road Sludge Drying Site (DE-0024) located in Wilmington, Delaware is being submitted because the remedy design has been completed in accordance with applicable DNREC regulations. Specifically, the engineered cap system was designed in accordance with the Consent Order (C.A. 01c-10-288CHT) and Scope of Work in the VCP agreement and to meet or exceed the performance requirements detailed in the DNREC Final Plan of Remedial Action dated January 16, 2009.

1.1 Report Organization

This report has been organized in accordance with the Hazardous Substance Cleanup Act Guidance Manual (DNREC, 1994) as follows:

- Section 1.0 presents the report organization and objectives.
- Section 2.0 presents the description of the site.
- Section 3.0 summarizes the previous investigations and reports and provides a site history.
- Section 4.0 presents the remedial action scope of work.
- Section 5.0 discusses the design requirements and provisions of the design.
- Section 6.0 discusses the environmental covenant for the site.
- Section 7.0 presents details of the cap system design and construction activities.
- Section 8.0 discusses erosion and sediment (E&S) control.
- Section 9.0 presents other plans, including the Construction Quality Assurance (CQA) Plan, Health and Safety Plan (HASP), Operations and Maintenance (O&M) Plan, Contingency Plan, and cost estimates and schedules.
- Section 10.0 presents the references cited in this report.

1.2 Design Report Supporting Information

The following support materials for the closure design are included in this report:

- Design Calculations and Support Documentation
  Calculations and technical information pertaining to design issues are presented in Appendix A.
- Technical Specifications
  Materials and construction procedures required to properly construct the design are documented in Technical Specifications, included in Appendix B.
- E&S Control Plan
  The E&S Control Plan is included in Appendix C and describes measures for management of stormwater, mitigation of erosion, and control of sediment migration.
- CQA Plan
  The CQA Plan is included in Appendix D and describes QA responsibilities, activities, and testing required to document construction in compliance with the technical specifications and construction drawings.
- O&M Plan
  The O&M Plan is included in Appendix E and describes the O&M activities that will be implemented following construction of the cap system.
- Contingency Plan
  The site Contingency Plan is included in Appendix F.
- Cost Estimates and Schedules
  An engineer's estimate of probable construction costs and a construction schedule associated with the remedial action construction is included in Appendix G.
- Construction Drawings
  Construction Drawings are presented in Appendix H.

The proposed Hay Road Sludge Drying Site cap construction design is based on currently accepted geotechnical and environmental engineering principles and practices. The plans and accompanying documentation are intended for the exclusive use of DuPont and DNREC.

2.0 Site Description

DuPont owns 108 acres of property (Hay Road property) on Cherry Island in Wilmington, Delaware, as shown in Figure 1. The closed Hay Road Landfill, formerly known as the Cherry Island Landfill, occupies approximately 30 acres of the Hay Road property. The Sludge Drying Site [naming convention as defined in the VCP agreement] occupies approximately 23 acres, of which 16 acres is comprised of the Staged Iron Rich Material (IRM). Undeveloped, unused land comprises the remaining 55 acres. The Sludge Drying Site boundary is shown in Figure 2.

The Sludge Drying Site is bordered by Shellpot Creek to the north, the Delaware River to the east, the 12th Street Extension to the south, and the closed Hay Road Landfill to the west (see Figures 1 and 2). The DuPont Edge Moor Plant is located 1 mile north (see Figure 1) of the Hay Road property.

The site is not within the 100-year flood plain [elevation of 9 feet in North American Vertical Datum (NAVD88)] or 500-year flood plain (elevation of 10.7 feet in NAVD88) based upon a review of the Flood Insurance Rate Maps of New Castle County, #10003C0160 J [Federal Emergency Management Agency (FEMA), 2007a] and the FEMA Flood Insurance Study of the City of Wilmington, 10003CV008 (FEMA, 2007b), dated January 17, 2007.

3.0 Site History and Enforcement Activities

3.1 Hay Road Property Operational History

Prior to 1927, the present day Sludge Drying Site and most of the Hay Road property was submerged and part of the Delaware River. Historical records document that around 1927 a seawall was constructed parallel to and approximately 2,300 feet east of the then-existing shoreline. DM originating from the Delaware and Christina Rivers was pumped by the United States Army Corps of Engineers (USACE) between the shoreline and the constructed seawall to create new land (i.e., Cherry Island). DM placement in this area ceased around 1946 or shortly thereafter. The 1927 seawall forms the current Delaware River shoreline.

DuPont purchased the 108-acre parcel from the American Dredge Company in 1956. A portion of the Hay Road property is native land, and the remainder is a man-made land feature created by the historic dredging activities. From 1958 to 1996, DuPont operated an industrial solid waste landfill (the Hay Road Landfill) for the disposal of industrial solid wastes generated by the plant. Landfill operations were conducted within the northwestern portion of the Hay Road property (area nearest to Hay Road as shown in Figure 2) in an area underlain by both native soils and made-land. The first state-issued landfill permit was received in October 1968. In 1993, landfill closure was initiated under DNREC Permit SW-93/01. Closure was completed in 1996 and approved by DNREC in 1997. Post-closure care and monitoring of the closed landfill is currently conducted under DNREC Post-Closure Permit SW-93/01. A DNREC-approved National Pollutant Discharge Elimination System (NPDES) permit was issued for the Hay Road property in 1976 and remained in place until the Hay Road Landfill was closed in 1996. Drainage from the site is currently permitted under the Post-Closure Permit SW-93/01.

3.2 Sludge Drying Site Background and Regulatory History

3.2.1 Sludge Drying Site Background

Adjacent to the closed landfill is a 23-acre parcel of land known as the Hay Road Sludge Drying Site (DE-0024). A site map is presented in Figure 2. The entire Hay Road Sludge Drying Site is underlain by made-land created by the USACE river dredging activities. Beginning in the early 1980s and continuing through 1996, waste sludge from the plant was placed within bermed drying beds to dewater the solids prior to stabilization and disposal in the adjacent landfill, hence, the name “Sludge Drying Site.” During this time period, DuPont and the City of Wilmington were co-permitted by DNREC (Solid Waste Permit SW-83/23) to air-dry sludge from both the DuPont Edge Moor Plant and the City of Wilmington Wastewater Treatment Plant (WWTP) at the Sludge Drying Site. Sludge drying activities ceased in 1996 when the solid waste landfill was closed. During the landfill closure, the sludge drying beds were cleaned out and the excavated, dewatered solids were stabilized and placed in the landfill for final disposal.

Beginning in 1997 and continuing to mid-2001, the plant generated approximately 500,000 tons of Iron Rich Material, which was transported as a saleable product and staged at the Sludge Drying Site in preparation for sale as a soil substitute. In mid-2001, DuPont discontinued marketing the product and ceased sending materials to the Sludge Drying Site. Since that time, the plant has disposed of all Iron Rich Material at industrial waste landfills.

3.2.2 Voluntary Cleanup Program

In 2001, DuPont agreed to enter into the DNREC DAWM SIRB VCP. The Sludge Drying Site was accepted into the VCP on September 11, 2002 to select a remedial alternative for the Staged IRM at the Sludge Drying Site. The VCP agreement defined the nature and extent of contamination by the chemical properties and areal extent (e.g., footprint) of the Staged IRM.

3.2.3 Remedial Investigation and Risk Assessment

The Scope of Work attached to the VCP agreement requires DuPont and DNREC to complete a seven-step process. The first step of the process is to complete a Remedial Investigation and Risk Assessment (RI/RA).

The purpose of the RI was to define the nature and extent of the Staged IRM at the Hay Road Sludge Drying Site. As a manufactured material, the detailed chemical and physical analysis of the Staged IRM that accompanied its original development as a soil substitute product provides the “nature” of the material. The extent of Staged IRM is very easily determined by visual inspection due to its signature “iron-red” color. The RI presented the data known about the Staged IRM and the site environmental setting, as well as the nature and extent of the material.

The purpose of the RA was to define the probability of human health or ecological effects due to exposure of people or biota to the Staged IRM. It holistically evaluated potential sources, the potential pathways of exposure, and the potential receptors (i.e., human or biota).

DuPont completed and submitted the *Final Remedial Investigation/Risk Assessment Report* (DuPont, 2004a) to DNREC on May 14, 2004. DNREC approved the report on May 20, 2004. On December 8, 2008, DuPont submitted the *Remedial Investigation and Risk Assessment Report Addendum* (DuPont, 2008) to update the RI/RA using new information collected during the 2008 Supplemental Investigation. DuPont received approval of the *Remedial Investigation and Risk Assessment Report Addendum* on December 18, 2008. In both the 2004 RI/RA Report and 2008 RI/RA Addendum, the RA concluded that implementation of a cap-in-place remedy for the Staged IRM is appropriate for the final disposition of this material, as it is fully protective of human health and the environment from exposure to the staged materials.

3.2.4 Focused Feasibility Study

The second step of the process involved the preparation of Remedial Action Objectives (RAOs) by DNREC. The Focused Feasibility Study (FFS) was the third step of the

process. The purpose of the FFS was to develop and evaluate a limited range of remedial alternatives that meet the Sludge Drying Site RAOs and select the appropriate remedial plan. The feasibility study was performed in accordance with specific steps developed by the United States Environmental Protection Agency (EPA) and presented in "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (EPA, 1988). The following three basic components presented in the feasibility study were the:

- Development of remedial alternatives
- Screening of remedial alternatives
- Detailed analysis of remedial alternatives

The *Focused Feasibility Study* for the Hay Road Sludge Drying Site was submitted to DNREC for review on June 18, 2004 and was approved by DNREC on June 23, 2004 (DuPont, 2004b).

3.2.5 Plan of Remedial Action

DNREC prepared a Proposed Plan of Remedial Action (PPRA), which presented the cap-in-place remedy for the staged materials with institutional/engineering controls as the preferred remedial alternative for the Sludge Drying Site (DNREC, 2004). In response to public comments to the PPRA, the House Concurrent Resolution No. 22 (HCR 22) was passed in June 2005 by the 143rd General Assembly of the House of Representatives.

Following the request of HCR 22, DNREC engaged an independent engineering firm, Schnabel Engineering, to complete a review of the existing data that was used to support the PPRA. Schnabel Engineering recommended in their December 2006 report (Schnabel Engineering, 2006) that additional technical data be obtained to more fully support DNREC's selection of a final remedial alternative. DuPont agreed to collect the information recommended by Schnabel Engineering, plus some additional data requested by DNREC. DuPont prepared a *Supplemental Investigation Work Plan* (DuPont, 2007) and completed the Supplemental Investigation in 2008. Information obtained from the investigation was incorporated into the *Remedial Investigation and Risk Assessment Report Addendum*, submitted to DNREC on December 8, 2008 (DuPont, 2008). DuPont received approval of the *Remedial Investigation and Risk Assessment Report Addendum* on December 18, 2008.

DNREC subsequently published an approved Final Plan of Remedial Action on January 16, 2009 under the Secretary's Order No. 2009-A-0005. This plan was appealed by the Mid-Atlantic Environmental Law Center on February 13, 2009. A public notice, re-opening the existing Public Record and introducing eight new documents, was issued on Sunday, October 4, 2009. The record was available for public comment for a period of 30 days, from October 5 to November 3, 2009. DNREC did not receive comments during the public comment period. This document was prepared in accordance with the Secretary's Order No. 2009-A-0005.

3.3 Previous Investigations

Since 1958, many investigations into the subsurface conditions at the Hay Road property have been conducted. These investigations have primarily focused on the use of the property as a Solid Waste Landfill. Recent investigations, however, have focused on the Sludge Drying Site. The following reports have been prepared and have been previously submitted to DNREC:

- Woodward-Clyde Consultants, 1977, *Geotechnical Investigation Proposed Cherry Island Landfill*, Plymouth Meeting, PA, August 4, 1977
- Woodward-Clyde Consultants, 1979, *Supplemental Geotechnical Investigation Proposed Cherry Island Landfill Expansion Area*, Plymouth Meeting, PA, June 13, 1979
- Woodward-Clyde Consultants, 1990, *Geotechnical Investigation Proposed Cell No. 4 Cherry Island Landfill*, Plymouth Meeting, PA, April 2, 1990
- DuPont Engineering, 1992, *Report of Geotechnical Investigation Cherry Island Landfill Closure*, Wilmington, DE, November 9, 1992
- Advanced GeoServices Corporation, 1997, *Phase II Investigation at DuPont Cherry Island Landfill*, Chadds Ford, PA, July 7, 1997
- URS Corporation/Woodward-Clyde Diamond Group, 2000, *Proposal for Remedial Action and Transmittal of Pre-design Investigation Results*, DuPont Cherry Island Landfill, Wilmington, DE, June 9, 2000
- DuPont Engineering, 2001, *Scope of Work for Remediation of Iron-Rich Staging Area*, DuPont Cherry Island Site, Wilmington, DE, July 24, 2001
- DuPont, 2007, *Supplemental Investigation Work Plan*, Hay Road Sludge Drying Site (DE-0024), DuPont Edge Moor Plant, Edgemoor, Delaware, August
- DuPont, 2008, *Remedial Investigation and Risk Assessment Report Addendum*, Hay Road Sludge Drying Site (DE-0024), Wilmington, Delaware, December 8.

Because of the close proximity of the landfill cells to the site, the subsurface data and hydrogeological conceptual model developed for the landfill construction (Woodward-Clyde, 1977 and 1979) and its closure (DuPont Engineering, 1992) also pertains to the site.

The results of the 1988 and 1989 investigations conducted in the proximity of the Hay Road Sludge Drying Site for the planned expansion of the landfill were documented in the *Geotechnical Investigation Proposed Cell No. 4 Cherry Island Landfill* report referenced above.

Since DuPont acquired the property, environmental monitoring requirements have steadily changed and additional borings and groundwater monitoring wells have been installed and monitored. Several of the wells are between the Staged IRM and Shell Pot Creek and the Staged IRM and the Delaware River.

3.4 Interim Measure

DuPont conducted a DNREC-approved interim measure in 2002 to consolidate the areal extent of the Staged IRM from 22.7 acres to 15.9 acres (see Figure 2). The interim measure also involved the application of a temporary cover over the staged materials to minimize potential water infiltration and airborne particle generation. Reapplication of the temporary cover over the Staged IRM has been completed on an as-needed basis, based on observations during monthly inspections. In 2007, DNREC approved a change in the temporary cover material from the Soil Sement® polymer to fiber-reinforced cement (Posi–Shell®). Additional Posi–Shell applications were completed in the spring of 2008 and the summer of 2009. DuPont conducts monthly inspections to monitor the continued integrity of the Posi-Shell coating and the effectiveness of the surrounding sediment and erosion control measures. The Posi-Shell covering continues to minimize potential human and ecological exposures to the Staged IRM.

The current 15.9-acre Staged IRM footprint is presented in an as-built survey dated June 2009 and is shown on Sheet 3, Existing Conditions, of the design drawings in Appendix H. The approximate 6 acres from which Staged IRM was removed was underlain by DM. The exposed DM was covered with 6 to 12 inches of topsoil. Silt fence was installed around the regraded and coated Staged IRM to further contain potential sediment migration from the Staged IRM. A construction completion report was submitted to DNREC SIRB for the interim measure on November 27, 2002 and was approved in April 2003.

4.0 Remedial Action Scope of Work

This section discusses the scope of work for remediation activities for the Staged IRM at the Hay Road Sludge Drying Site. Remediation will be accomplished by the installation of a cap system using applicable components from the technical performance criteria detailed in the Delaware Regulations Governing Hazardous Waste, Delaware Administrative Code, Title 7, Section 1302, Part 264, Subpart N – Landfills, Section 264.310, Closure and Post-Closure Care.

4.1 Remedial Action Objectives

RAOs were developed in the FFS to assist in the selection of a remedial alternative that, when implemented, is protective of human health and the environment and is consistent with the current and future use of the site. Based on an analysis of the site conditions, exposure pathways, and RA presented in the *Final Remedial Investigation/Risk Assessment Report* and *Remedial Investigation Risk Assessment Report Addendum*, specific RAOs were established for specific areas or media of concern at the site. The qualitative RAOs for the site include the following:

- Minimize human and ecological exposure to the Staged IRM and historic dredge spoils.
- Minimize migration of the Staged IRM constituents to air, surface water, and sediments by wind transport, stormwater runoff, and/or groundwater/surface-water interaction.
- Minimize further migration of iron and/or any other constituent of concern (COC) present in the Staged IRM from the staged materials to the groundwater.
- Continue the prohibition of the withdrawal of groundwater for potable use and limit withdrawal and use consistent with current restrictions on groundwater use in the area (groundwater management zone DRBC regulations).
- Prohibit residential or unrestricted use of the property.

Based on the qualitative objectives, the approved quantitative objectives are as follows:

- Minimize human exposure to the Staged IRM that would result in a carcinogenic risk exceeding $1x10^{-5}$ or a hazard index of 1.0.
- Maintain adequate stormwater controls in the stormwater retention area adjacent to the Iron Rich Pile to minimize human and ecological exposure to the historic dredge spoils.
- Minimize discharge of Staged IRM into Shellpot Creek and the Delaware River above the EPA ambient water quality criteria (AWQC).
- Place a deed restriction on the property to prohibit residential or unrestricted use and to limit groundwater use.

- Develop a groundwater monitoring program to monitor for compliance with EPA AWQC for Shellpot Creek or the Delaware River. The maximum concentrations allowed in groundwater monitoring wells on the bank of Shellpot Creek will be 3,580 mg/L for iron and 286 mg/L for manganese.

These objectives are consistent with the current use of the site (commercial in an urban setting), New Castle County zoning policies, and state regulations governing water supply and worker health and safety.

4.2 Selected Remedial Alternative

The selected remedial alternative for the site combines remedial actions for the various areas or media of concern. When implemented at the site, the required remedial action will achieve the overall established RAOs and will be protective of human health and the environment. The selected remedial alternative for the site is outlined as follows:

- Construct a capping system over the Staged IRM, consisting of a multilayer geosynthetic liner system pursuant to a DNREC-approved remedial design plan.
- Place an Environmental Covenant (EC) consistent with the UECA (Title 7, Del. Code Chapter 79, Subtitle II) that will prohibit current and future residential or unrestricted use of the property; any digging, drilling, excavating, grading, constructing, earth moving, or any other land disturbing activities on the property without the prior written approval of DNREC; and the installation of any water wells on-site or use of groundwater at the site without the prior written approval of DNREC.
- Develop a DNREC-approved O&M Plan to maintain the cap to prevent exposure to site soil contamination and monitor on-site wells to evaluate the hydrogeology and chemistry of the underlying dredge material and groundwater. Additional remedial actions may be required based on the results of the on-site monitoring program and the area-wide groundwater investigation.

These components are discussed further in the remaining sections of the report.

5.0 Design Requirements and Provisions

This section discusses details of the remedial design and addresses major aspects of the design, including technical issues. The primary component of the recommended remedial alternative is an engineered cap system covering the Staged IRM. The cap system was designed to be both protective of the environment and to meet the established performance standards in accordance with the Delaware Administrative Code, Title 7, Section 1302, Part 264 Standards for Owners and Operators of Hazardous Waste Treatment Storage and Disposal Facilities, Section 264.310 Closure and Post-Closure Care. The performance standards include the following:

- Provide long-term minimization of migration of liquids through the Staged IRM
- Function with minimum maintenance
- Promote drainage and minimize erosion or abrasion of the cover
- Accommodate settling and subsidence so that the cover integrity is maintained
- Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoil present

5.1 Special Technical Problems

In order to meet the performance standards, several key design issues had to be addressed. These design issues included the following:

- Evaluation of slope stability
- Evaluation of the subsidence or settlement potential of the Staged IRM
- Establishment of cap system component properties
- Development of stormwater and sediment control measures
- Establishment of vehicle and equipment access during construction and post-construction periods

The means by which these design issues were addressed, including assumptions, criteria, and calculations, are discussed in the subsequent sections.

5.1.1 Slope Stability

In 1990, Woodward-Clyde Consultants completed a geotechnical investigation for a proposed expansion (Cell 4) to the DuPont Hay Road Landfill in the area of the current Hay Road Sludge Drying Site. The investigation evaluated the subsurface conditions at the site and developed recommendations pertaining to the design and construction of an additional landfill cell. This cell was designed to contain stabilized and unstabilized waste and filter cake from the existing titanium dioxide pigment manufacturing process (prior to the development of the Iron Rich Material process). The waste and filter cake was physically similar to the Staged IRM.

The investigation evaluated slope stability through deep failure surfaces passing through the historical dredge material and shallow surfaces located within the anticipated exterior slopes between 20% [5 horizontal (H):1 vertical (V)] and 33% (3H:1V). The evaluation concluded that slopes containing stabilized material similar to Staged IRM could be safely constructed to elevations between 45 and 55 at the anticipated slopes. The Staged IRM has slopes ranging between 5% (20H:1V) and 25% (4H:1V) to elevation 46. These conditions are more conservative than the parameters evaluated in the Woodward-Clyde investigation; that is, the slopes are flatter and lower than expected. In addition, the historical dredge material will have increased shear strength since the placement of Staged IRM in 1997 (surcharge loading) and dredge material consolidation. Therefore, additional slope stability analyses were not performed on the current Staged IRM configuration.

5.1.2 Cap System Stability

The intermediate grades established upon completion of the interim measure consist of a maximum 25% (4H:1V) side slopes and an approximate 5% (20H:1V) slope across the crown of the Staged IRM. The cap system veneer stability was evaluated using an infinite slope stability analysis (see Appendix A). The method of analysis was selected based on the relatively small thickness of the cap system compared to the height of the slope being considered. The stability was also analyzed under saturated conditions.

The required minimum interface friction angle between cap components was evaluated for the maximum cap system slopes of 25% (4H:1V). Using a factor of safety of 1.5, the minimum interface friction angle between any two cap components was determined to be 20.6 degrees.

Based on a comparison of the calculated minimum interface friction angle with data available from literature and previous testing of cap system components, it was determined that there could be three interfaces of concern for slopes of 25% (4H:1V). The interfaces of concern were as follows:

- Interface between separate geotextile and geonet components
- Interface between geonet and smooth geomembrane components
- Interface between geotextile or geocomposite and smooth geomembrane components

The analysis determined that low interface friction could be overcome by using a laminated geocomposite in place of separate geotextile and geonet components. Also, a textured geomembrane can be used to improve interface friction between adjacent components. The geocomposite and textured geomembrane will be used throughout the cap area.

The internal friction angles associated with the cover soil were also considered. The internal friction angle of representative cover soils reported in available literature was generally above the minimum friction angle of 20.6 degrees.

The required geomembrane runout length was also evaluated to determine if the “crown” of the Hay Road Sludge Drying Site provided sufficient length to prevent pullout of the

geomembrane without anchor trenches. Based on the length (240 feet) of the 5% (4H:1V) grade within the crown of the Hay Road Sludge Drying Site, sufficient anchorage is provided to ensure the stability of the constructed cap system. In addition, the cap system has been designed to incorporate geosynthetic components that will have sufficient interface friction to prevent sliding on slopes less than or equal to 25% (4H:1V). Therefore, it is not anticipated that the geomembrane or any other geosynthetic component will be placed in tension. Because tension must be mobilized in the geosynthetic components before pullout can occur, it is unlikely that pullout resistance will be needed.

Based on the evaluation of the veneer stability, cover soil stability, and runout length, a stable cap system design can be achieved on slopes of up to 25% (4H:1V).

5.1.3 Subsidence and Settlement

Comparison of topographic survey data from 2004 and 2009 indicates that negligible settlement has occurred during this period and that additional consolidation of the Staged IRM under its own weight is not likely.

Evaluation of potential primary and secondary consolidation settlement indicates that minor settlement of the Staged IRM may occur after cap construction. Primary settlement at the center of the cap system during the first month after cap construction is conservatively estimated to range between 0.32 and 0.39 feet. Secondary settlement after cap construction is conservatively estimated to range between 0.07 and 1.43 feet over the cap area. Based on the differential settlement between the center and the edges of the cap system, it is estimated that the grade at the crown of the Staged IRM may be reduced by approximately 0.3% over the 30-year post-construction period.

Cap system components have been selected based on the magnitude of allowable settlement determined from design calculations. A low-density polyethylene (LDPE) geomembrane, which can sustain significant elongation without being susceptible to failure, is specified. The use of a LDPE geomembrane is conservative because only minor settlement is anticipated. Periodic inspection of the landfill will be performed to monitor settlement. Repairs will be made to the cap system if settlement either has exceeded acceptable limits (based on design calculations) or the cap surface exhibits visible signs of distress/failure. Primary and secondary consolidation settlement calculations are presented in Appendix A.

5.1.4 Geotextile Properties

Geotextile will be utilized as an underlay (cushion) to protect the geomembrane and as a component of the geocomposite drainage layer to provide separation and filtration. Based on current industry accepted recommendations for geotextiles used for protection of geomembrane barrier layers, a 10–ounce-per-square-yard, needle-punched, non-woven geotextile was selected for this function.

The geotextile component of the geocomposite drainage layer was evaluated for permittivity (i.e., cross-plane permeability), soil retention (i.e., apparent opening size), puncture resistance, burst resistance, and tensile strength (see Appendix A).

Based on current industry accepted recommendations for geotextiles used for separation and filtering, a needle-punched, non-woven geotextile was selected. For individual geotextile properties, the calculated minimum property values were compared to the minimum values required for a "high" degree of survivability by AASHTO M288-96. The more conservative values were used in specifying the geotextile.

5.1.5 Geomembrane Properties

The geomembrane was evaluated for the properties of thickness, tensile strength, puncture resistance, tear resistance, and seam strength (see Appendix A).

The geomembrane thickness was evaluated based on the following conditions:

- Applied stress on the geomembrane due to the soil cover
- Estimated angle of deformation, assuming a 10 foot by 10 foot localized subsidence, which is a convention used in designing municipal waste landfills and is conservative for potential localized subsidence of the Staged IRM
- Distance of mobilization assuming a relatively low (i.e., 165 psf) applied pressure
- Allowable stress and interface friction angles published in commercially available geomembrane literature

A textured 40-mil LDPE geomembrane provides an acceptable factor of safety for thickness.

The geomembrane tensile strength was evaluated by assuming that the cap system is constructed using components with sufficient interface friction to prevent sliding of the cap system. Therefore, only tensile stresses induced by the weight of the geomembrane or associated with deformation due to differential settlement need to be evaluated. The calculation indicates that no tension is induced by the weight of the textured LDPE geomembrane and that the tensile stress due to differential settlement governs. A minimum tensile strength of 81 pounds per inch is required for a 40-mil LDPE geomembrane.

The puncture resistance of the geomembrane was evaluated, assuming that the load on the geomembrane due to the weight of the cover soil and other cap components is minimal and that the overlying geocomposite will protect the geomembrane. A puncture resistance of 42 pounds is required.

Tear resistance was determined based on the minimum required value to provide a "high" degree of survivability. A tear resistance of 15 pounds is required.

The required seam strength was based on minimum requirements recommended by the Geosynthetics Institute (GSI). For hot wedge and extrusion seams, a shear strength of 53 pounds per inch and a peel strength of 44 pounds per inch are required for a 40-mil LDPE.

The calculated minimum required properties for the geomembrane were generally greater than the minimum requirements for a "high" degree of installation survivability as recommended for landfill covers. For the properties of puncture resistance and tear resistance, the calculated minimum required value was less than the minimum

requirements recommended by the GSI standard specification GM-17, which is recognized as the industry-wide minimum standard. Therefore, for these properties, the minimum required values recommended in GM-17 are specified to provide a higher factor of safety.

5.1.6 Geocomposite Properties

The geonet component of the geocomposite drainage layer was evaluated to determine whether it would adequately convey the anticipated flow rate. The Unit Gradient Method in conjunction with the HELP Model was used in the evaluation (see Appendix A). The geotextile component of the geocomposite was evaluated under the geotextile evaluation.

The geonet component of the specified geocomposite drainage layer must have a minimum transmissivity of 1×10^{-3} m^2/second.

5.1.7 Roadway Properties

The geotextile underlying the access roadway on the Staged IRM was evaluated considering its primary functions of reinforcement and separation. The evaluation was made assuming that the roadway subgrade will be constructed of well-graded, granular select fill that has been placed and adequately compacted to minimize deformation (CBR > 10). Therefore, only properties associated with the separation function were evaluated. The material properties that were evaluated included burst resistance, tensile strength, puncture resistance, and tear resistance (see Appendix A).

Based on current industry-accepted recommendations for geotextiles used for separation, a needle-punched, non-woven geotextile was selected. For individual geotextile properties, the calculated minimum property values were compared to the minimum values required for a “high” degree of survivability. The more conservative values were used in specifying the geotextile.

5.1.8 Gas Collection and Ventilation

The Hay Road Sludge Drying Site received Staged IRM, which is primarily inorganic in nature and has a very low potential for producing gases. The underlying strata of the Hay Road Sludge Drying Site consist of dredge spoils that may contain organic material capable of producing methane. Small pockets of methane have been encountered during drilling activities on-site, primarily in the higher permeable strata, which are below several feet of low permeability DM. Throughout the interim maintenance activities associated with the Staged IRM, including monthly inspections of the material surface, application of temporary cover materials, and the Supplemental Investigation activities, signs of methane permeating from the Staged IRM have not been observed. Likewise, the cap system on the adjacent closed landfill cells, which contain material similar to the Staged IRM, have functioned for over 12 years without gas vents. Therefore, the need for a gas collection and ventilation system is not anticipated.

5.1.9 Stormwater Control Measures

Stormwater management for this project consists of collecting and redirecting runoff in a non-erosive manner from the engineered cap area to a proposed stormwater management area. The stormwater calculations assess the post-construction site runoff conditions for the 2, 10, 25, and 100-year/24-hour storm events.

The stormwater calculations presented in Appendix A were completed using the Soil Conservation Service's (SCS) hydrology models: TR-55 and Haestad Methods hydraulics software: Flow Master. Peak flows for the storm events were computed with TR-55 and ditch computations were calculated with Flow Master.

A more detailed discussion of the stormwater control design is included in Section 8.0.

5.1.10 Erosion and Sediment Control Measures

The universal soil loss equation (USLE) was used to estimate sediment loss from the site, based on representative slope conditions proposed for the cap (see Appendix A). The USLE is an empirical model developed by W.H. Wischmeier and D.D. Smith of the U.S. Department of Agriculture (USDA) to estimate sheet and rill erosion. The USLE was used to calculate the maximum allowable length of slope for a given slope angle. This allowable slope length was compared against actual proposed slope lengths to determine if erosion controls are necessary.

For slopes exceeding 5% (20H:1V), the maximum erosion rate should not exceed 2 tons per acre per year. Values used in the USLE were taken from the USDA, Science and Education Administration, Agricultural Handbook Number 537, "Predicting Rainfall Erosion Losses, A Guide to Conservation Planning" and other available literature.

It is anticipated that topsoil imported from local sources will be used to establish a suitable growth platform for vegetative cover on the cap. Local topsoil typically consists of silty loam, clay loam, sandy loam, silty-clay loam, and sandy-clay loam. The Staged IRM cap will be permanently seeded upon completion of grading to reduce erosion. Final land cover on the cap will consist primarily of native grasses and will cover greater than 90% of the Staged IRM and adjacent areas. Routine maintenance of the vegetative cover is the only erosion control practice anticipated once the landfill cap vegetation is established.

It is anticipated that slopes for the Hay Road Sludge Drying Site cap will not exceed 25% (4H:1V). The Delaware Erosion and Sediment Control Handbook for Development requires that 25% (4H:1V) slopes exceeding 40 feet in vertical height that are not protected using special erosion control materials or stabilization methods must be divided using diversions (i.e., benches).

Based on the calculation results, permanent erosion controls (such as erosion control mats, riprap, or a combination of similar controls) will not be necessary. Likewise, the vertical height does not exceed 40 feet so diversions are not required. Temporary erosion controls such as erosion control blanket (ECB), silt fence, hay bales, diversion ditches/berms, and sedimentation traps will be used, as necessary, during construction.

The SCS methodologies were followed during the design of the E&S control measures. A more detailed discussion of the E&S control design is included in Section 8.0.

5.2 Additional Engineering Data Requirements

Pre-design activities focused on developing accurate survey information to establish the existing site conditions and reviewing previous investigation reports and Staged IRM process documents to obtain the properties necessary to complete the design.

Testing of the actual geosynthetic and natural materials to be used in construction may be conducted prior to the actual field installation of cap system components to ensure the required interface friction angles and factors of safety are achieved. Likewise, geotechnical testing of the proposed borrow source prior to construction will be used to verify that the material properties are appropriate and are in compliance with the Technical Specifications.

5.3 Permit and Regulatory Requirements

The engineered cap system was designed in accordance with the Scope of Work in the VCP agreement and to meet or exceed the performance requirements presented in the Final Plan of Remedial Action. Based on the area to be disturbed during construction (greater than 5,000 square feet), DuPont will apply for a Sediment and Stormwater Management Plan Approval from DNREC and will submit the “Notice of Intent (NOI) for Storm Water Discharges Associated with Construction Activity Under a NPDES General Permit.”

5.4 Access, Easements, and Right-of-Ways

5.4.1 Site Access Control System

Access to the site is controlled by the existing 6-foot high chain-link perimeter fence along Hay Road and the 12th Street Extension. Personnel and vehicular gates exist to facilitate future site access during cap system maintenance activities.

5.4.2 Easements and Right-of-Ways

There currently are no easements or right-of-ways associated with the site.

5.5 Community Relations Activities

DuPont will develop a project-specific Community Relations Plan for the Hay Road Sludge Drying Site prior to initiation of construction activities. The DuPont Edge Moor Plant has an on-going community, media, and government relations outreach program and dedicated Public Relations representatives. The Community Relations Plan will be implemented during remedy construction.

6.0 Environmental Covenant

The Final Plan of Remedial Action requires placing an EC consistent with the UECA (Title 7, Del. Code Chapter 79, Subtitle II) that will prohibit current and future residential or unrestricted use of the property; any digging, drilling, excavating, grading, constructing, earth moving, or any other land disturbing activities on the property without the prior written approval of DNREC; and the installation of any water wells on-site or use of groundwater at the site without the prior written approval of DNREC.

7.0 Construction Activities

7.1 Cap System

The proposed cap system consists of geosynthetic and natural soil components and was designed to meet DNREC requirements and be protective of the environment. Geosynthetic components were selected because of the performance advantages (e.g., tensile strength, durability, drainage capacity, and long-term impermeability) they offer relative to a clay barrier cap system without geosynthetics. In addition, geosynthetic materials are easier to install and repair than a clay barrier cap system. The typical cap system cross section consists of the following components, from top to bottom:

- A 6-inch vegetative soil layer
- A 12-inch cover soil layer
- A geocomposite drainage layer
- A 40-mil LDPE geomembrane
- An 10-ounce/square yard non-woven geotextile
- Regraded Staged IRM

Cap system components are presented on the drawings (see Appendix H), and the component functions are summarized below.

7.1.1 Regraded Staged IRM

As described in Section 3.4, the Staged IRM was consolidated within the proposed cap footprint and regraded to achieve intermediate cap system grades that will promote stormwater runoff in a controlled manner and provide a stable foundation for the cap system. If necessary, site soil from areas outside of the limit of the Sludge Drying Site will be considered to achieve intermediate cap system grades. The existing grades, based on a May 27 through June 2, 2009 survey of the Staged IRM area, are presented on Sheet 3 of the drawings (see Appendix H). Staged IRM that has deposited along the existing silt fence will be consolidated within the area to be capped prior to installation of the geotextile cushion.

7.1.2 Geotextile

A geotextile layer has been selected to protect (or cushion) the geomembrane against puncture or tear due to rock, stones, concrete, and other hard surfaces and objects. The geotextile will be 10–ounce-per-square-yard, non-woven geotextile. Materials and construction procedures required to properly construct the geotextile are documented in Technical Specification Section 02073 (included in Appendix B) and Sheet 10 of the drawings (see Appendix H).

7.1.3 Geomembrane

A geomembrane will be installed above the geotextile as a barrier layer. A 40-mil LDPE geomembrane that is textured on both sides has been selected based on the following benefits:

- Textured geomembrane will provide improved interface friction between adjacent cap system components required to meet the factor of safety against failure on steeper slopes.
- LDPE is flexible, which allows simple, efficient installation for capping applications.
- A properly installed polyethylene geomembrane is essentially impervious (i.e., $k \leq 1 \times 10^{-11}$ cm/sec).
- LDPE can withstand significant elongation/deformation without failure.

Materials and construction procedures required to properly construct the geomembrane are documented in Technical Specification Section 02079 (included in Appendix B) and Sheet 10 of the drawings (see Appendix H).

7.1.4 Geocomposite

A geocomposite drainage layer has been selected to ensure the removal of stormwater that infiltrates the cover soil and to maintain the stability of cover soil on top of the constructed cap system. The geocomposite drainage layer will be composed of geonet with geotextile on the top and bottom, heat bonded together to provide, as a composite, the interface shear friction characteristics required to meet the factor of safety against failure when applied to steeper slopes. Materials and construction procedures required to properly construct the geocomposite are documented in Technical Specification Section 02077 (included in Appendix B) and Sheet 10 of the drawings (see Appendix H).

7.1.5 Cover Soil

Cover soil will be placed in a 12-inch layer above the geocomposite to support the overlying vegetative layer while allowing percolation into the underlying drainage layer. The cover soil will also protect the underlying geosynthetics from damage. Materials and construction procedures required to properly construct the cover soil are documented in Technical Specification Section 02300 (included in Appendix B) and Sheets 7 through 11 of the drawings (see Appendix H).

7.1.6 Vegetative Layer

A 6-inch thick vegetative layer (topsoil) will be placed above the cover soil to germinate and sustain vegetative growth. A good vegetative stand will minimize water and wind erosion and increase evapotranspiration, which will minimize infiltration. The vegetative layer will extend beyond the limits of the geosynthetic cap to cover areas disturbed by construction. The geosynthetic cap area and adjacent stormwater management basin will be seeded with native grasses to improve site aesthetics and provide an enhanced habitat

for native fauna. Materials and construction procedures required to properly construct this layer are documented in Technical Specification Sections 02900 (included in Appendix B) and Sheets 7 through 11 of the drawings (see Appendix H).

7.2 Construction Plans

The design drawings are included in Appendix H and include the following sheets:

- Sheet 1: Title Sheet
- Sheet 2: Legend and Notes
- Sheet 3: Existing Conditions
- Sheet 4: Erosion and Sediment Control Plan
- Sheet 5: Erosion and Sediment Control Details – 1
- Sheet 6: Erosion and Sediment Control Details – 2
- Sheet 7: Intermediate Grading Plan
- Sheet 8: Final Grading Plan
- Sheet 9: Cross Sections
- Sheet 10: Cap System Details
- Sheet 11: Drainage Ditch Profiles

7.3 Technical Specifications

Materials and construction procedures required to properly construct the design are documented in the Technical Specifications, included in Appendix B. Division I of the Technical Specifications provide general project requirements, including a description of the work, construction administration requirements, health and safety provisions, site protection and mobilization requirements, quality control expectations, and contract closeout procedures. Division II of the Technical Specifications details the specific work component requirements including cap construction, E&S control, and site restoration.

8.0 Erosion and Sediment Control

To satisfy all pertinent E&S control requirements, a Sediment and Stormwater Management Plan has been prepared in accordance with the *Delaware Erosion and Sediment Control Handbook* (DNREC, 2003) and the *Delaware Sediment and Stormwater Regulations* (DNREC, 2005). The Sediment and Stormwater Management Plan is included in Appendix C.

8.1 Current Conditions

The hydrologic soil classification of the site is comprised of Types C and D Soil and is based on the texture of the existing conditions (stabilized material) and information from the SCS Soils Survey. The entire site is identified as "Ou – Othello-Fallsington – Urban Land Complex" in the SCS Soils Survey. The site has limited vegetative cover and is predominantly comprised of Staged IRM, open space with fair grass cover, brush, and gravel.

The stormwater runoff has been controlled using an existing outlet structure and is directed to tidewater (Delaware River), which qualifies the site for a waiver or variance of stormwater management for water quantity control.

8.2 Construction and Post-Construction Periods

During construction, borrow material and topsoil will be placed within the cap system and stormwater management basin to protect the geosynthetic components of the cap system and sustain vegetative growth. It is assumed that the soil will be classified as the current soils (Types C & D). Permanent seeding with herbaceous plants will stabilize the constructed cap vegetative cover. The land use after construction will change from newly graded areas to a vegetated condition, which will result in a decrease in peak discharge for the post-development conditions.

8.3 Stormwater Management

Stormwater management for this project consists of collecting and redirecting runoff in a non-erosive manner from the engineered cap area to a stormwater management basin. The stormwater calculations assess the post-construction site runoff conditions for the 1, 10, 25, and 100-year/24-hour storm events.

The surface of the cap will have a crown slope of approximately 5% (20H:1V) and side slopes of 25% (4H:1V) to promote drainage and prevent ponding if any incidental settlement of the capped material occurs.

Drainage ditches were designed to be stable for the peak flow from a 10-year/24-hour storm event. The ditches have trapezoidal sections and are designed to have a minimum of 3 inches of freeboard for the design flow. The design drawings depict the final topographic contours and drainage channels associated with the engineered cap system.

The installation of erosion control matting throughout the ditches will also promote a stable and “self-healing” system that will reduce future maintenance at the site.

During construction, the existing basin will function as a sediment basin by modifying the existing outlet structure and regrading the basin to provide the required wet/dry storage volume to comply with the Delaware Erosion and Sediment Control Handbook. The regrading will also provide positive drainage and divert the water to the outlet.

After the entire site is stabilized, the sediment basin will be converted back to a stormwater management basin. The basin has been designed to safely pass the runoff from a 100-year storm event without impacting the cap and overtopping the perimeter road.

8.4 Temporary Erosion Controls

Temporary erosion controls will be implemented to stabilize all sediment-producing areas on a short-term basis. The erosion controls are applicable for any area of exposed soil where construction activity will not occur for a period longer than 14 days. Additional controls that may be required during construction activities will be implemented as needed by DuPont. The temporary E&S controls to be implemented for the Hay Road Sludge Drying Site project are presented in the following sections.

8.4.1 Sediment Basin

The existing stormwater management basin will be used as a sediment basin during construction activities to reduce the quantity of sediment-laden runoff from leaving the site. The sediment basin was designed with a sediment storage volume to collect the estimated sediment yield from the contributing drainage area. The principle spillway will be able to handle the peak flow from a 10-year/24-hour rainfall with a minimum 1 foot of free board per the handbook.

8.4.2 Erosion Control Blanket

The ECB will be placed along the side slopes of the cap during construction to stabilize the slope until vegetation is established and provide additional support to the vegetative cover, once developed. The ECB mats will be placed parallel to the flow direction and will be overlapped and stapled to the soil.

The ECB will also be installed in all permanent grass waterways during construction to reduce erosion and ensure channel stability as the vegetation is established in the ditches.

8.4.3 Silt Fence

Silt fencing is a temporary barrier with a typical life expectancy of 6 months or less. For this project, a silt fence will be installed to capture eroded sediment from sheet flow over disturbed areas. A silt fence will be installed perpendicular to the grade of the ground surface. The existing super silt fence along the toe of the pile will be maintained during construction. Additional silt fencing may be required during construction to replace damaged fencing previously installed or to augment existing controls.

8.4.4 Mulching

Mulching consists of the application of materials such as straw, hay, wood chips, or shredded bark to the soil surface. Application of mulch conserves soil moisture, prevents surface crusting and desiccation, controls weeds, and helps protect against erosion. Mulch may be applied alone to bare soil to prevent erosion during periods when weather conditions do not permit seeding with temporary or permanent vegetation. Mulch shall be used as a step in the overall seeding process. Mulch shall be applied to bare or other areas requiring temporary or permanent stabilization and seeding.

8.4.5 Temporary Seeding

Temporary seeding and mulching will help stabilize sediment-producing areas and prevent erosion on a short-term basis. All topsoil piles, borrow areas, cleared land, cut and fill slopes waiting for final grading, and bare or recently disturbed areas where no construction activity is anticipated for a period of longer than 14 days, but less than one year, shall receive temporary seeding and mulching.

8.4.6 Dust Control and Monitoring

Dust control shall be implemented to reduce surface and air movement of dust during construction activities. To control dust generated from site activities, a minimum amount of bare and unstabilized soil will be exposed at a given time. Furthermore, additional measures include use of the existing stone roadways to limit truck and heavy traffic on unprotected soil, rapid mulching and seeding of bare areas, and irrigation with water trucks.

Real time air monitoring will be conducted for particulates using a MIE PDM-3 Aerosol Monitor (Miniram) within the work zone and at the work zone perimeter. Additional controls will be implemented as necessary to prevent dust from leaving the work zone. Activities will be suspended if dust conditions can not be mitigated.

8.4.7 Stabilized Construction Entrance/Decontamination Pad

A stabilized construction entrance (SCE) will be located at the entrance to the Sludge Drying Site. The SCE will consist of a minimum10-foot wide stone bed with a flared end to reduce the tracking of mud from the disturbed construction areas to other site areas or off-site.

A decontamination pad will also be provided to allow for the decontamination of all equipment, vehicles, and bulk debris.

8.4.8 Stone Check Dams

Stone check dams shall be installed in the ditches to dissipate runoff velocity during construction. They are installed with an inner permeable and porous core protected by an outer layer of smaller stone to aid in filtration.

8.4.9 Filter Bag

A filter bag, capable of trapping particles larger than 150 microns, may be used to filter any water pumped from disturbed areas prior to discharging to the outlet structure or adjacent areas.

8.5 Permanent Erosion Controls

Permanent controls are applied to stabilize sediment-producing areas on a long-term basis. Long-term stabilization controls are applicable for disturbed areas where construction is not expected to occur for more than 1 year and any final graded areas where work has been completed. The selected permanent controls will reduce sediment loss, reduce maintenance, and improve appearance. The permanent E&S controls to be implemented for the Hay Road Sludge Drying Site project are presented in the following sections.

8.5.1 Vegetative Cover/Topsoil

The entire cap system will receive a 6-inch vegetative cover soil layer to promote vigorous plant growth on areas that are disturbed by construction or otherwise supporting an inadequate vegetative cover. The vegetative cover soil layer will consist of topsoil or cover soil amended to improve the soil medium for plant growth. The use of vegetative cover soil will reduce the time required to generate satisfactory vegetative growth and reduce the care and maintenance of the cap system and drainage system.

8.5.2 Permanent Seeding

Permanent seeding with herbaceous plants will stabilize the cap system and other soils, reduce erosion, reduce runoff velocity, lower the peak runoff, improve appearance, reduce long-term maintenance, and provide wildlife habitat.

9.0 Other Plans

9.1 Construction Quality Assurance Plan

The CQAP is included in Appendix D and describes quality assurance responsibilities, activities, and testing required to document construction in compliance with the Technical Specifications and design drawings.

9.2 Health and Safety Plan

The HASP assigns responsibilities, establishes personnel protection standards, specifies safe operating procedures, and provides for contingencies that may arise during the remedial action construction. The HASP was developed in accordance with the DuPont Corporate Remediation Group (CRG) and URS Corporation safety and health standard operating procedures and is in compliance with requirements set forth in 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response. The HASP will be provided to each qualified bidder during the contractor selection phase of the project.

9.3 Operation and Maintenance Plan

An O&M Plan (see Appendix E) was prepared to address the operation and maintenance needs of the implemented remedy. The O&M Plan indicates that the Hay Road Sludge Drying Site monitoring will be integrated to the ongoing monitoring program of the Hay Road Landfill, which is adjacent to this site, consistent with the VCP Scope of Work. In addition, to ensure the effectiveness of the remedy and to verify that site remedial objectives are being met, five 5-Year Remedy Evaluations will be prepared by DuPont. Both the O&M Plan and 5-Year Remedy Evaluations will be prepared in accordance with the DNREC-SIRB's Operation and Maintenance Guidance for HSCA and VCP Sites (DNREC, 2002).

9.4 Contingency Plan

The Site Contingency Plan is included as Appendix F and addresses the emergency response procedures that will be used during closure construction and operations and maintenance activities.

9.5 Cost Estimates and Schedules

9.5.1 Preliminary Annual O&M Cost Estimate and Duration

An engineer's estimate of annual O&M costs associated with the post-closure care is included in Appendix G.

9.5.2 Project Schedule

The long-term effectiveness and functionality of the proposed design is dependent on establishing sufficient vegetation before the end of the growing season in late October. It is currently estimated that approximately 6 months will be necessary to select and execute a contract with a qualified construction contractor, and approximately 5 months will be needed to complete construction of the cap system. As a result, cap construction must be initiated by late spring in order to complete all closure construction activities with ample time to establish a vegetative cover.

DuPont currently anticipates the initiation of cap construction during the spring of 2010, pending DNREC approval of the cap system design. An estimated construction schedule associated with the remedial action is included in Appendix G.

10.0 References

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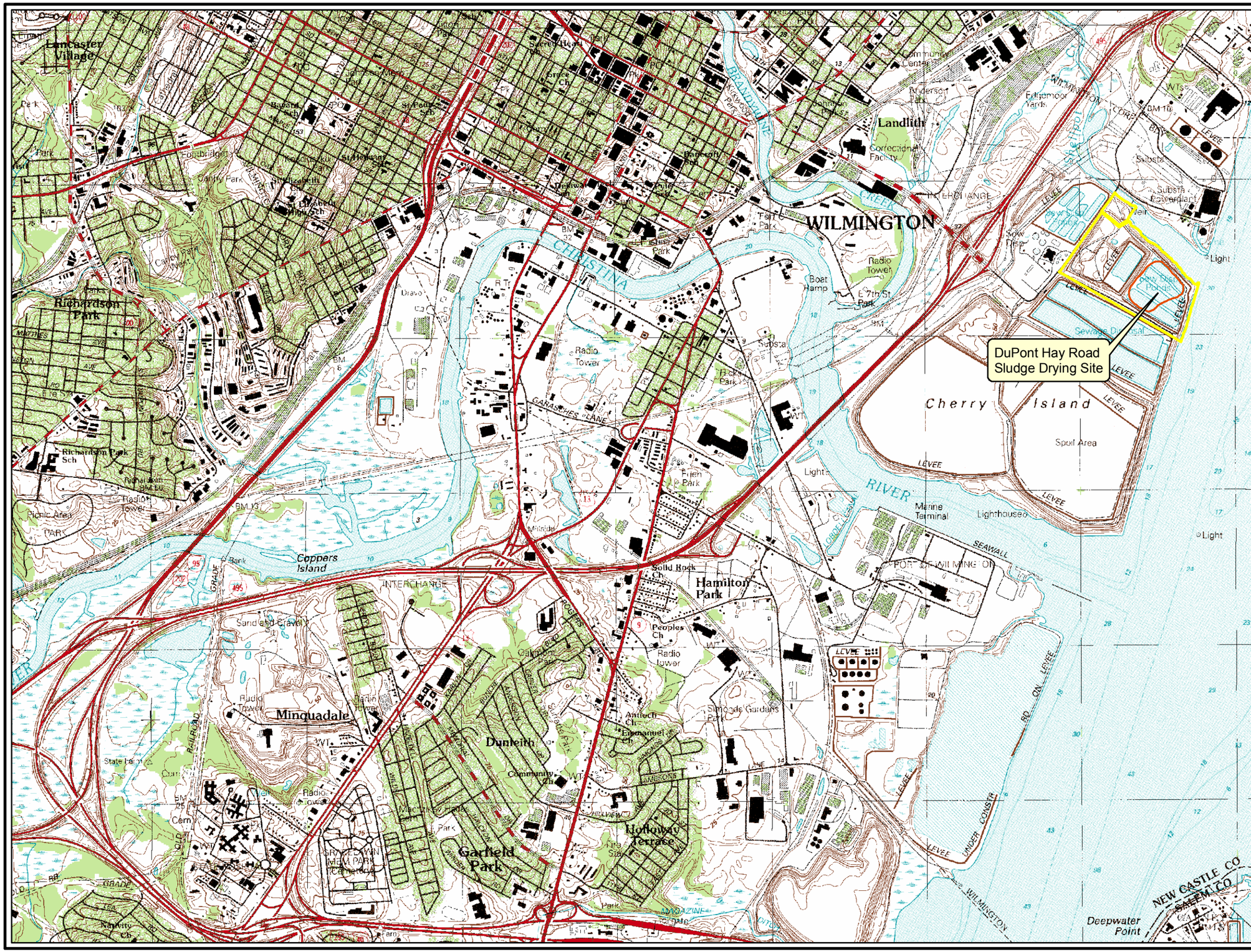
Figures



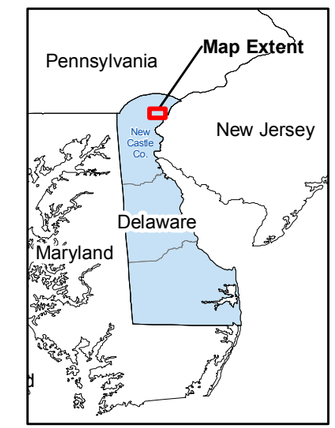
Legend

Iron Rich Material Footprint

Property Boundary

Topographic map source: 1993 Topographic map, Wilmington South USGS quadrangle, 7.5 Minute series provided by Delaware State, DRG and DLG Server Homepage, http://www.rdms.udel.edu/drgdlg/, downloaded 08/05/08

DuPont Property Boundary: New Castle County Tax Parcels, downloaded from the Delaware DataMIL (datamil.delaware.gov), retrieved 08/06/08



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URS

URS Corporation
Iron Hill Corporate Center
4051 Ogletown Road, Suite 300
Newark, DE 19713

Site Location Map
Remedial Design Report
Hay Road Sludge Drying Site (DE-0024)
Wilmington, DE

Created: CA	DuPont Project Number: 508795
Date: 09/17/2009	URSD Project Number: 18985726.9001D
DQC: ND 12/03/2009	Figure Number: 1

File Name:
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Legend

- Sea Wall
- Staged Iron Rich Material Footprint
- Property Boundary
- Sludge Drying Site

Notes:
All locations and boundaries are approximate, digitized in GIS from scanned images or CAD drawings georeferenced to DE State Plane NAD83 (ft) coordinate system or manually digitized using landmarks on hardcopy maps.

Staged Iron-Rich Material footprint digitized in GIS from georeferenced 2006 aerial provided by Delaware Solid Waste Authority.

Aerial photo source: 2008 aerial photo from Delaware Solid Waste Authority.

DuPont Property Boundary: New Castle County Tax Parcels, downloaded from the Delaware DataMIL (datamil.delaware.gov), retrieved 08/06/08

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URS

URS Corporation
Iron Hill Corporate Center
4051 Ogletown Road, Suite 300
Newark, DE 19713

Site Map
Remedial Design Report
Hay Road Sludge Drying Site (DE-0024)
Wilmington, DE

Created: ND	DuPont Project Number: 508795
Date: 09/17/2009	URSD Project Number: 18985726.9001D
DQC: ML 12/03/2009	Figure Number: 2

File Name: S:\URS Barley Mill\Hay_Road\GIS\Hay_Fig_2_SiteMap.mxd

Appendices

Appendix A

Engineering Calculations

1. Cap Stability Calculation
2. Saturated Cap Stability Calculation
3. Geomembrane Calculation
4. Geocomposite Calculation
5. Geotextile Calculation
6. HELP Analysis
7. Primary Settlement Calculation
8. Secondary Settlement Calculation
9. Roadway Design Calculation
10. Runout Calculation
11. Slope Length Evaluation

PURPOSE:

To evaluate the cap system stability on maximum cap system slopes of 25 percent (4H:1V).

PROCEDURE:

The proposed cap system [Ref.1] configuration consists, from top to bottom, of the following:

- six (6) inches of vegetative soil
- twelve (12) inches of cover soil
- geosynthetic stormwater collection and removal layer
- geomembrane
- geotextile (cushion layer)

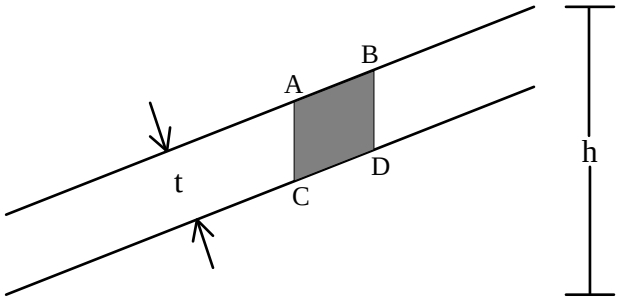
An infinite slope stability analysis will be performed to evaluate the stability of the cap. The following steps will be performed in the stability analysis:

1. Determine the formula for factor of safety based on an infinite slope stability analysis.
2. Determine the minimum interface friction angle, ϕ_{min}, between the cap components required for the cap system to be stable on the maximum cap slope.
3. Compare the calculated minimum interface friction angle to friction angles for cap interface components tabulated from available test data.
4. Identify potential areas of concern within the proposed cap system.
5. Evaluation of the proposed cap.

EVALUATION:

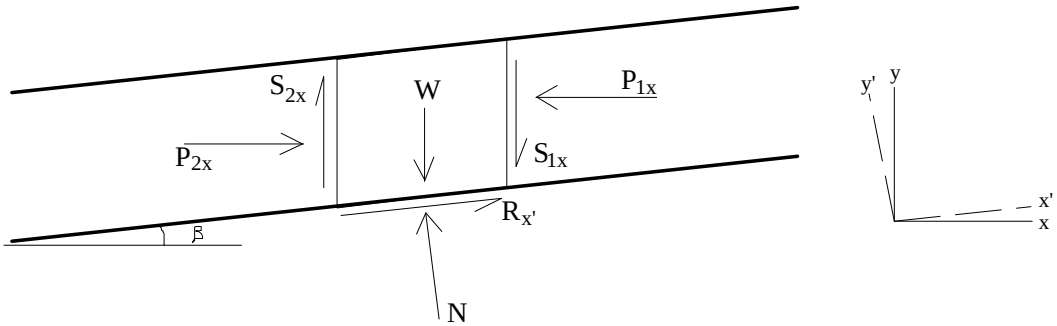
1. Determine the formula for factor of safety from infinite slope stability analysis.

An infinite slope stability analysis is appropriate when considering a mass of material on an incline, whose thickness is small compared to the height of the slope. This would be the case for the cover soil and geosynthetic components of the proposed cap. The failure surface for this analysis is parallel to the slope (i.e. sliding along interfaces of two different cap components).



Where,

t	=	thickness of earth mass
h	=	height of slope
t/h	⇒	small



Where,

W	=	weight of soil mass ($\gamma_{soil} \times t$)
N	=	normal force applied to each cap component interface
P	=	normal soil pressure force
S	=	shear soil pressure force
$R_{x'}$	=	resisting force in x' direction
β	=	slope angle

By summing the x and y components, the resisting force to sliding, $R_{x'}$, can be estimated.

$$\Sigma F_{x'} = R_{x'} - W\sin\beta = 0$$

$$R_{x'} = W\sin\beta$$

$$\Sigma F_{y'} = N - W\cos\beta = 0$$

$$N = W\cos\beta$$

$$W = N/\cos\beta$$

By substitution,

$$R_{x'} = W\sin\beta = (N / \cos\beta)\sin\beta = N(\sin\beta / \cos\beta) = N\tan\beta$$

The shear force along a cap component interface is given by:

$$F = N\tan\phi_i$$

Where;

ϕ_i = angle of internal friction between cap components

The factor of safety against sliding is given by:

$$FS = (\text{available shear at interface, } F) / (\text{resisting force, } R_{x'})$$

$$= (N\tan\phi_i) / (N\tan\beta)$$

$$= \tan\phi_i / \tan\beta$$

Therefore, for the cap system to be stable (i.e. sliding will not occur), the interface friction angle between each cap component, including cover soil, must be greater than the existing slope angle.

2. Determine the minimum interface friction angle to prevent sliding of the cap system.

First, a minimum factor of safety must be determined. Reference 2 provides several design examples using factors of safety against sliding, ranging from a minimum of 1.2 for cover soil above a geomembrane to 2.0 for cover soil above a stormwater collection system. Reference 3 states that a factor of safety of 1.3 for sliding is typically recommended. This is compared to a factor of safety of 1.5 to 2.0 generally applied to the sliding analysis of dams and retaining walls. Therefore, a factor of safety of 1.5 would be considered conservative.

For a minimum FS = 1.5, and a maximum cap slope of 25 percent (β = 14.04°), the minimum interface friction angle would be determined by:

$$FS = (\tan\phi_{min}) / (\tan\beta)$$

$$\tan\phi_{min} = FS\ (\tan\beta)$$

$$\boldsymbol{\phi_{min}} = \tan^{-1}[FS\ (\tan\beta)]$$

$$= \tan^{-1}[1.5\ (\tan 14.04°)]$$

$$= \tan^{-1}(0.359)$$

$$\approx \mathbf{20.6°}$$

Therefore, for there to be no tension in the geosynthetics, the interface friction angle between any two components should be greater than or equal to 20.6°.

When direct shear tests are performed to demonstrate conformance to specifications, testing should be performed under saturated conditions when applicable (i.e. cover soil/geotextile interface, geonet/geotextile interface, geonet/geomembrane interface, etc.).

3. Compare the minimum interface friction angle to typical friction angles listed in references.

The following tables provide a summary of interface friction angles obtained from various sources for cap system component interfaces.

Interface[a, c]	Typical Interface Friction Angles [Ref.]
Soil/ Geotextile or Geocomposite	40° [4], 26°-30° [5], 30.7° [6], 30.8° [7], 30.7° [4], 30.1° [14]
Geotextile/ Geonet	19° [4], 18° [8], 15.5° [6], 16° [13], 13° [13][b]
Geonet/ Smooth Geomembrane (GM)	10° [4], 15° [11], 12.6° [12], 11.1° [8], 8.75° [10], 8.6° [9]
Geotextile or Geocomposite/ Smooth GM	11° [4], 10.9° [9], 12° [13][b], 20° [4], 28.1° [4]
Geotextile or Geocomposite/ Textured GM	28.1° [6], 18.9° [9], 35.4° [14]
Smooth GM/ Soil	Sand 9°-25° [10, 15, 16], sand 21° [13], 28° [4], 28.2° [12]
Textured GM/ Soil	Sand 28° [13], 13.7° [10], 33.8° [14]

Calculated Minimum Allowable Interface Friction Angle – 20.6°

[a] - geotextile is a nonwoven needle-punched geotextile in all cases.
[b] - nonwoven needle-punched geotextile with single calendered side used as tested interface.
[c] - geomembrane evaluated includes HDPE, LLDPE and VLDPE.

4. Identify areas of concern within proposed cap system.

It is desirable to construct the cap system with components that have interface friction angles greater than the specified minimum interface friction angle. If this can be achieved, sliding of the cap system should not be a concern.

If interface friction angles greater than the specified minimum cannot be provided in the cap system, then anchor trenches or run out length must be provided to keep the cap components from sliding. This in turn may cause one or more cap components to be placed in tension if the shear stress above the component is greater than the shear stress below the component (i.e. $\phi_{upper}>\phi_{lower}$). However, this will only occur when the slope angle, β, is greater than the internal interface friction angle of a given cap component, ϕ_i (i.e. $\phi_{upper}>\phi_{lower}>\beta$ will not produce tension in the component). Tension cannot be induced in a component unless the stress is mobilized by the action of sliding.

For the proposed cap, it is desirable that all interface friction angles of the cap components be greater than ϕ_{min}, so that the components are not required to take tension. Interfaces within the proposed cap system that may not meet the desired criteria include the interfaces between:

- Separate geotextile and geonet components

- Geonet and smooth geomembrane components
- Geotextile or geocomposite and smooth geomembrane components

5. Evaluation of the Proposed Cap

The following table presents a summary of interface friction angle data for possible cap system interfaces associated with cap systems.

Interface	Friction Angle Range
Cover Soil/ Geotextile or Geocomposite	26° - 40°
Geotextile/ Geonet	13° - 19°
Geotextile or Geocomposite/ Smooth GM	10.9° - 28.1°
Geotextile or Geocomposite/ Textured GM	18.9° - 35.4°
Geonet/ GM	8.6° - 15°
Smooth GM/ Geotextile	10.9° - 28.1°
Textured GM/ Geotextile	18.9° - 35.4°
Geotextile/ Subgrade	26° - 40°
Smooth GM/ Subgrade	9° - 28.2°
Textured GM/ Subgrade	13.7° - 33.8°

Calculated Minimum Allowable Interface Friction Angle – 20.6°

A review of the tabulated interface friction angle data indicates that for the proposed capping system, the geotextile/geonet and geonet/geomembrane interfaces provide the lowest friction angle ranges and will probably not provide the minimum interface friction angle for 4H:1V ($\phi_{req} \approx 20.6°$) slopes.

There are several potential modifications that could be made to address these interfaces. To address the geotextile/geonet interface, a pre-fabricated geocomposite drainage layer consisting of a geotextile permanently bonded to each side of a geonet could replace the singular components. Shear force would then occur at the outside interfaces of the geocomposite or internally through the geocomposite. At low normal loads experienced in a capping application, internal shear strength will most likely be adequate and shear at the interface will govern. Shear strength of the geocomposite needs to be evaluated and the acceptable value specified.

To address the geonet/geomembrane interface, a geomembrane textured on both faces could be used in place of a smooth geomembrane to increase the interface friction angles between the geocomposite and the geomembrane, as well as between the geomembrane and the underlying geotextile. Elimination of the geotextile underlying the geomembrane is not recommended due to the lower range indicated for geomembrane/soil interface friction angles versus a geomembrane/geotextile interface. The geotextile will also provide a protective cushion between the geomembrane and the existing subgrade.

The internal friction angles associated with the cover soil must also be considered. The internal friction angle of representative cover soils generally ranges from 26° to 36° [Ref. 17], which is above the required friction angle of 20.6°. Therefore, it is anticipated that the internal friction angle of the cover soil will not be a concern for the cap slopes proposed.

CONCLUSIONS:

In order to minimize the potential for sliding of the cap system, components that have interface friction angles greater than the specified minimum interface friction angle of 20.6° is recommended. The following cap system configuration, from top to bottom, will improve resistence to sliding:

- six (6) inches of topsoil
- twelve (12) inches of cover soil
- geocomposite with geotextile bonded to both sides
- geomembrane textured on both sides
- geotextile (cushion layer)

Although these cap system components provide improved interface friction to prevent sliding on the proposed 25 percent cap slope, evaluation of an anchor trench or run out length should be considered to provide a sufficient factor of safety. Likewise the tensile properties of each geosynthetic component should be evaluated due to the potential for stress to be mobilized by the action of sliding.

The above evaluation is based on limited data, but is believed to be representative of test results that would be obtained by testing actual cap system materials. The cap system contractor will be required to conduct direct shear testing of representative materials to be used as actual cap components to verify that adequate friction angles will be provided at each interface of the constructed cap system.

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10. Direct Shear Test Results provided by Sevenson Environmental, January 1993, based on testing performed by J&L Testing Company, Inc.

11. Direct Shear Test Results performed by GRI, Drexel University, presented in a letter report to Mr. George Yazdani of Poly-America, Inc., on February 26, 1989.

12. Direct Shear Test Results performed by J & L Testing Co., Inc., on 4/22/91.

13. Direct Shear Test Results performed by Geotechnics Testing Laboratory during the design of the B & E Landfill Capping Project, Circleville, Ohio, April 1996.

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16. Kriofske, K.P., Yazdani, G., and Nobert, J., "VLDPE - State of the Art Synthetic Membrane for Capping Landfills," presented at the 13th annual Madison Waste Conference, September 1990.

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PURPOSE:

A calculation package was prepared in February 2003 for various aspects of cap design. Later in October 2004, C. W. Kim of the URS Ft. Washington office reviewed the calculation package. In the cover memo of that review dated 10/27/2004 and addressed to Jim Whitty, James Coffman pointed out the need to address the cover soil saturation issue, i.e., cap veneer stability considering the destabilizing forces of water after rain/snow events. This assessment addresses the cap stability issue associated with cove soil saturation.

NATURE OF THE PROBLEM:

Cover soils on geosynthetic materials are very susceptible to sliding failure when saturated during extended rainfall events. Instability of saturated soils is briefly described below.

- Assume a cover soil layer (sandy soil) over a geotextile layer for dry to wet conditions. For a slope angle (β) of 208 (2.75H:1V) and a friction angle (ϕ) of 308, the factor of safety is,

  $FS = \tan(\phi)/\tan(\beta) = \tan(308)/\tan(208) = 1.59$ Good

- Next, assume that the same cover soil is fully saturated by rainwater infiltration. The factor of safety in this case is given by the following formula:

  $FS = (\gamma'/\gamma_t) \times [\tan(\phi)/\tan(\beta)] = 0.5 \times [\tan(308)/\tan(208)] = 0.79$ No Good

Note that γ' is the buoyant unit weight and γ_t is the total (saturated) unit weight of the cover soil. For compacted sandy soil, the typical value of (γ'/γ_t) is about 0.5. This example shows the critical nature of cover soil stability associated with cover soil saturation.

Comment 1 – The above statements consider whether cover soils (dry or saturated) are stable against the infinite slope. Here are my comments:

- As long as the landfill dimension is available, it would be reasonable to run 'finite' slope analysis. Typically, infinite slope is conservative, however, it would be appropriate to evaluate the actual landfill dimension.
- As described under Section 2-1 of our 2004 comments, the proposed cover system needs to be evaluated to address the following mechanisms relative to its external stability (i.e., veneer stability):
  - Sloughing of protective cover soil and
  - Sliding along cover material interfaces (soil-to-geosynthetic and geosynthetic-to-geosynthetic).

SOLUTION APPROACH 1 – DESIGN FOR NO SATURATION:

Cover soil stability against soil saturation may be evaluated by comparing the rainwater infiltration rate into the cover soil and the flow capacity of the drainage layer. Here, this design intends to prevent soil saturation by making the flow capacity of the drainage layer larger than the infiltration rate into the cover soil. This approach is outlined below.

- Key variables – Slope angle, slope length, permeability of cover soil, interface friction, and drain layer flow capacity.
- Select values for the key design variables.
- Slope evaluation and design procedure

Step 1 – Evaluate veneer stability for dry to wet conditions. If OK, go to Step 2. Otherwise, go to Step 4.

Step 2 – Compare the flow capacity of the drainage layer (Qd) and infiltration rate into the cover soil (Qi) for a unit width strip of the slope. If Qd is larger than Qi with a wide margin (i.e., a larger factor of safety), the cover soil will be stable as it will not be saturated. Stop here. Otherwise, go to Step 3.

Step 3 – Evaluate veneer stability for the saturated condition. If the cover soil is stable for the saturated condition, stop here. Otherwise, go to Step 4.

Step 4 – Modify the cap design values and repeat the above steps until the cover soil layer becomes stable. Consider modifying the design values as follows:

A. Reduce the slope angle.

B. Reduce the slope length (using benches).

C. Use cover soils with a lower permeability (but not clayey soils).

D. Use cover soils with a higher interface friction value.

E. Increase the flow capacity of the drainage layer.

Comment 2 – The above statements deal with two aspects simultaneously; drainage and veneer stability. It would be more appropriate to evaluate drainage analysis first then veneer stability (sloughing & sliding along cover material interfaces).

If the drainage analysis results (i.e., HELP model results) indicate 'water head build-up atop the geomembrane', then the computed water head should be considered during the sloughing analysis.

Design rainfall issue – The above steps assume that the infiltration rate is controlled by the soil permeability, not by the design rainfall event. The reason: It is impossible to select a design rainfall (intensity and duration) for saturation analysis in Step 2 because the design rainfall is bound to be exceeded sooner or later. Using the HELP model to obtain the saturation depth is not appropriate for

two reasons. First, HELP uses the daily rainfall data averaged over 24-hour period (i.e., a 6-hr, 3-in storm ist taken as a 24-hr, 3-in storm) and underestimates the infiltration rate. Second, HELP focuses on "water balance" to generate "peak average saturation depth." In reality, the low end of the slope may become saturated and start to "blow out" while the saturation depth at the top end is negligible. Thus, taking the soil permeability as a single variable for saturation analysis is simple and reasonable. Besides, we may change the soil permeability as needed.

EVALUATION:

Assume a cover soil layer (sandy soil) over a geotextile layer for dry to wet conditions. For a slope angle (β) of 148 (4H:1V) and a friction angle (ϕ) of 308, the factor of safety is,

$FS = \tan(\phi)/\tan(\beta) = \tan(308)/\tan(148) = 2.31$ Good

Next, assume that the same cover soil is fully saturated by rainwater infiltration. The factor of safety in this case is given by the following formula:

$FS = (\gamma'/\gamma_t) \times [\tan(\phi)/\tan(\beta)] = 0.5 \times [\tan(308)/\tan(148)] = 1.15$ Good

PURPOSE:

To evaluate the geomembrane properties and determine the minimum specifications for the geomembrane to meet acceptable factors of safety. Both high density polyethylene (HDPE) and low density polyethylene (LDPE) will be evaluated. Based on the evaluation of stability for the proposed cap system a geomembrane textured on both sides was recommended [Ref. 5].

PROCEDURE:

The following properties will be evaluated for the geomembrane:

- Thickness
- Tensile Strength
- Puncture Resistance
- Tear Resistance
- Seam Strength

Evaluation of geomembrane properties listed above will be performed using the design by function method [Ref. 1]. This method will use the required (design) property and a global factor of safety to determine the allowable (performance) property. Partial factors of safety will then be applied to the allowable property to adjust for site specific conditions and to determine the ultimate (laboratory-measured) property. The ultimate property will serve as the basis for determining geomembrane specifications. The following is a summary generalizing the design by function equations:

i) allowable (performance) property = $FS_g \times$ required (design) property; where,
FS_g = global factor of safety

ii) ultimate (lab-measured) property = allowable (performance) property $\times FS_p$; where,
FS_p = sum of partial factors of safety

Geomembrane properties will be specified based on the more conservative of values determined by the design by function method described above or from minimum properties for a high degree of survivability.

EVALUATION OF DESIGN PROPERTIES:

A. Thickness

Using the procedure recommended by Dr. Robert Koerner in his book "Designing with Geosynthetics," [Ref. 1], the minimum thickness will be evaluated. The factor of safety will be calculated based on the ratio of the actual geomembrane thickness to the required thickness.

$$FS = t_{act} / t_{req'd}$$

Where;

$$t_{req'd} = \frac{\sigma_n \xi(\tan\delta_u + \tan\delta_L)}{\sigma_{allow}(\cos\beta - \sin\beta\tan\delta_L)}$$ [Ref. 1, Eqn. 5.18, pg. 471]

$t_{req'd}$ = required geomembrane thickness
σ_n = applied stress on geomembrane due to soil cover
β = angle created by geomembrane deformation
ξ = distance of mobilized geomembrane deformation
σ_{allow} = allowable geomembrane stress
δ_u = interface friction angle between geomembrane and geocomposite
δ_L = interface friction angle between geomembrane and subsoil

Evaluation:

1. Calculate Applied Stress on Geomembrane Due to Soil Cover (σ_n)

   Assumptions:

   - typical unit weight of soil cover: γ_s = 110 pcf
   - weight of other cap components (i.e., geocomposite) overlying the geomembrane is negligible in comparison to the weight of soil cover
   - soil cover thickness, D = 1.5 feet based on initial proposed cap system [Ref. 2]

   Then;

   $\sigma_n = \gamma_s D$

   $= 110 \text{ pcf} \times 1.5 \text{ ft}$

   $\boxed{\sigma_n = 165 \text{ psf}}$

2. Estimate Angle of Deformation (β)

   The material underlying the geomembrane consists of stabilized co-product solids from the titanium dioxide manufacturing process and therefore they are fairly uniform in nature. The material has recently been regraded and lightly compacted using standard construction equipment.

   Unlike municipal or mixed waste landfills where local subsidence may be the result of the collapse of a drum or large appliance, subsidence within the Iron Rich Staging Area will most likely occur due to variations in compaction during placement. Based on the method used to place and compact the material, the effective area that could be susceptible to such variation is assumed to be 10 x 10 feet.

Assumptions:

- FS for settlement strain = 5 [Ref. 3]
- maximum depth of waste = 30 feet based on recent topographic survey [Ref. 6]
- settlement feature width = 10 ft. based on scenario described above

Then,

$$FS = \in_{rupt} / \in_{uniform}$$ [Ref. 3]

or

$$\in_{uniform} = \in_{rupt} / FS$$

Where;

$\in_{rupt}$ = maximum strain from Axi-Symmetric Tension Tests [Ref. 1, Table 5.5c, pg.430] (at ultimate stress for VLDPE and yield stress for HDPE)

$\in_{uniform}$ = uniform strain

<u>For HDPE:</u>

$$\in_{uniform} = \in_{rupt} / FS = 12\% / 5 = 2.4\%$$

From the subsidence "circular trough model" chart [Ref. 3], using 2.4% uniform strain, the maximum allowable Subsidence Ratio (SR) is approximately 0.09.

$$SR = S / 2L$$

Where;

S = allowable subsidence depth (ft)

2L = settlement feature width

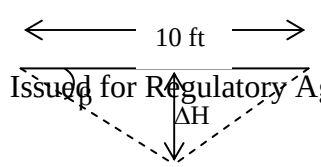
Then,

$$S = SR \times 2L = 0.09 \times 10 \text{ ft} = 0.9 \text{ ft.*}$$

* Actual subsidence is anticipated to be much smaller than the maximum allowable depth based on primary and secondary settlement calculations [Ref. 9 and 10].

If we assume a maximum allowable subsidence depth of 0.9 ft (ΔH or S), over a 10 ft. width, then;

$$\tan \beta = \Delta H / (L/2)$$



$= 0.9 \text{ ft} / 5 \text{ ft}$

$= 0.18$

$\beta = \tan^{-1}(0.18)$

$\boxed{\beta = 10.2° \text{ for HDPE}}$

For LDPE:

$\in_{uniform} = \in_{rupt} / FS$

$= 75\% / 5$

$= 15\%$

From the subsidence "circular trough model" chart [Ref. 3], using 15% uniform strain, the maximum allowable Subsidence Ratio (SR) is approximately 0.24.

$SR = S / 2L$

Where;

S = allowable subsidence depth (ft)

2L = settlement feature width

Then,

$S = SR \times 2L$

$= 0.24 \times 10 \text{ ft}$

$= 2.4 \text{ ft.*}$

* Actual subsidence depths are anticipated to be much smaller than the maximum allowable depth based on primary and secondary settlement calculations [Ref. 9 and 10].

If we assume a maximum allowable subsidence depth of 2.4 ft (ΔH or S), over a 10 ft. width, then;

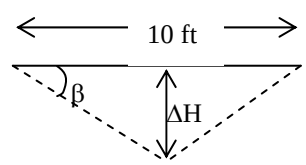
$\tan \beta = \Delta H / (L/2)$

$= 2.4 \text{ ft} / 5 \text{ ft}$

$= 0.48$

$\beta = \tan^{-1}(0.48)$

$\boxed{\beta = 25.6° \text{ for LDPE}}$



3. Determine Distance of Mobilization (ξ)

For HDPE:

According to Reference 1, Figure 5.10 (p. 441), the distance of mobilization for HDPE geomembrane ranges from approximately 2 inches to 16 inches, depending on the applied pressure. Conservatively, we will assume 16 inches, because the applied pressure on the geomembrane is relatively low.

ξ = 16 inches for HDPE

For LDPE:

According to Reference 1, Figure 5.10 (p. 441), the distance of mobilization for PVC geomembrane ranges from approximately 0.2 to 19 inches, depending on the applied pressure. Assuming that LDPE geomembrane and PVC geomembrane will respond to mobilized deformation the same, then conservatively, we will assume 19 inches, because the applied pressure on the geomembrane is relatively low.

ξ = 19 inches for LDPE

4. Determine Allowable Geomembrane Stress (σ_{allow})

For HDPE: σ_{allow} = 3,410 psi [Ref.1, Table 5.5c, pg. 430]

For LDPE: $\sigma_{allow\ (VLDPE)}$ = 1,495 psi [Ref.1, Table 5.5c, pg. 430]

5. Determine angle of shearing resistance between Geomembrane and Geocomposite Interface (δ_u)

For Textured HDPE:

δ_u = 21° Assumed from typical range provided in Ref. 5.

For Textured LDPE:

δ_u = 25° Assumed from typical range provided in Ref. 5.

6. Determine angle of shearing resistance between Geomembrane and Geotextile Interface (δ_L)

For Textured HDPE:

δ_L = 21° Assumed from typical range provided in Ref. 5.

For Textured LDPE:

δ_L = 25° Assumed from typical range provided in Ref. 5.

7. Calculate Geomembrane Thickness

For Textured HDPE:

$$t_{req'd} = \frac{\sigma_n \xi(\tan\delta_u + \tan\delta_L)}{\sigma_{allow}(\cos\beta - \sin\beta\tan\delta_L)}$$

$$= \frac{(165\ \text{psf} \times 1\ \text{sf} / 144\ \text{in}^2)(16\ \text{in})(\tan 21° + \tan 21°)}{(3410\ \text{psi})(\cos 10.2° - \sin 10.2°\ \tan 21°)}$$

$$= 0.00443\ \text{in}$$

$$= 4.43\ \text{mils} \Rightarrow \text{use 5 mil}$$

$$FS = t_{act} / t_{req'd}$$

$$= 40\ \text{mil} / 5\ \text{mil}$$

$$\boxed{FS = 8 \text{ for 40 mil textured HDPE}}$$

For Textured LDPE:

$$t_{req'd} = \frac{\sigma_n \xi(\tan\delta_u + \tan\delta_L)}{\sigma_{allow}(\cos\beta - \sin\beta\tan\delta_L)}$$

$$= \frac{(165\ \text{psf} \times 1\ \text{sf} / 144\ \text{in}^2)(19\ \text{in})(\tan 25° + \tan 25°)}{(1495\ \text{psi})(\cos 25.6° - \sin 25.6°\ \tan 25°)}$$

$$= 0.01890\ \text{in}$$

$$= 18.9\ \text{mils} \Rightarrow \text{use 19 mil}$$

$$FS = t_{act} / t_{req'd}$$

$$= 40\ \text{mil} / 19\ \text{mil}$$

$$\boxed{FS = 2.1 \text{ for 40 mil textured LDPE}}$$

8. Compare Calculated Value to Recommended Minimum Property for Installation Survivability

The recommended minimum thickness for general geomembrane installation requiring a "High" degree of installation survivability typical of landfill liners and covers is 0.88 mm or approximately 35 mil [Ref. 1, Table 5.11, see Sheet 16]. A 40 mil HDPE or LDPE geomembrane exceeds the recommended minimum property for installation survivability.

Using a textured 40 mil HDPE or textured 40 mil LDPE geomembrane will provide an acceptable Factor of Safety for thickness.

B. Tensile Strength

It is desirable to construct the cap system with components that have interface friction angles greater than the specified minimum interface friction angle so that sliding of the cap system will not occur, and the cap components will not be required to take tension [Ref. 5].

If we assume that these interface friction angles can be provided, then the only tensile stresses needed to be considered are for survivability. These stresses can include the geomembrane's ability to support its own weight during construction and deformation of the liner due to subsidence.

1. Calculate the Tensile Stress Induced by the Weight of Geomembrane

Assumptions:

- liner thickness (t) = 40 mil HDPE or 40 mil LDPE
- slope angle (β) = 25% = 14.04° [Ref. 6]
- height of slope (H) = 19 ft. based on a 25% slope over the maximum slope length of 75 ft. [Ref. 6]
- FS for tensile stress = 10 [Ref. 1, table 5.19, see Sheet 17]
- G for HDPE = 0.941
- G for LDPE = 0.920 [Ref. 7]

The weight of the geomembrane is given by:

$$W_{GM} = [(G)(\gamma_W)(t)][(1)(H)/\sin\beta] \qquad \text{[Ref. 3]}$$

Where;

W_{GM} = weight of the geomembrane
G = specific density of the geomembrane
γ_W = 62.4 pcf, density of water
t = thickness of liner
H = height of slope
β = slope angle

The shear force between the geomembrane and geotextile cushion is given by:

$$F = W\cos\beta \tan\delta_L \qquad \text{[Ref. 3]}$$

Where;

F = shear force between geomembrane and geotextile cushion

β = slope angle

δ_L = interface friction angle between geomembrane and geotextile

The tensile force (T) induced in the geomembrane is given by:

$$T_{req.} = W\sin\beta - F \qquad \text{[Ref. 3]}$$

The tensile stress is given by:

$$\sigma_{req.} = T_{req.} / A$$

Where,

A = Area = 1 ft. × t

From Reference 3, the tensile stress at yield is:

$$FS = \sigma_Y / \sigma_{req.}$$

or

$$\sigma_Y = (FS)(\sigma_{req.})$$

<u>For Textured HDPE</u>

δ_L = 21° From Step A6

$W_{GM} = [(G)(\gamma_W)(t)][(1)(H)/\sin\beta]$

$= [(0.941)(62.4\text{ pcf})(0.040/12)] \times [1 \times 19\text{ ft} / \sin 14.04°]$

$= 15.33$ lb/ft.

$F = W\cos\beta \tan\delta_L$

$= 15.33\text{ lb/ft} \times \cos 14.04° \tan 21°$

$= 5.71$ lb/ft.

$T_{req.} = W\sin\beta - F$

$= 15.33\text{ lb/ft} \times \sin 14.04° - 5.71\text{ lb/ft}$

$= -1.99$ lb/ft

T can not be compressive, ∴ T = 0 and $\sigma_{req.} = 0$

No Tension Induced By Weight of Textured HDPE

For Textured LDPE:

Assume VLDPE would act similarly as LDPE with regard to friction angle.

δ_L = 25° From Step A6

W_{GM} = $[(G)(\gamma_W)(t)][(1)(H)/\sin\beta]$

= $[(0.920)(62.4\text{ pcf})(0.040/12)] \times [1 \times 19\text{ ft} / \sin 14.04°]$

= 14.99 lb/ft.

F = $W\cos\beta \tan\delta_L$

= $14.99\text{ lb/ft} \times \cos 14.04° \tan 25°$

= 6.78 lb/ft.

$T_{req.}$ = $W\sin\beta - F$

= $14.99\text{ lb/ft} \times \sin 14.04° - 6.78\text{ lb/ft}$

= -3.14 lb/ft

T can not be negative (compressive), ∴ T = 0 and $\sigma_{req.} = 0$

No Tension Induced By Weight of Textured LDPE

2. Calculate the Tensile Stress Induced by Subsidence

From Step A2, S = 0.9 ft. for HDPE and S = 2.4 ft. for LDPE

Based on the maximum allowable subsidence depth determined above, the required geomembrane tensile strength can be determined.

When $\Delta S < L/2$:

$\sigma = [(L^2 + 4\,\Delta S^2)\,p] / [4Lt \sin(\theta/2)]$ (Ref. 4, Eqn. 5, pg. 184)

Where:

σ = maximum stress induced on the geomembrane
L = width of subsidence
ΔS = maximum depth of subsidence
p = pressure applied by soil cover
t = thickness of geomembrane
θ = central angle of subsidence

Using the calculated value of σ, and the thickness of the geomembrane (t), the required tensile strength, $T_{req'd}$ can be calculated by the following relationship:

$T_{req'd} = \sigma t$

The central angle of subsidence θ , is defined as:

$$\theta = 2 \tan^{-1} [4L\ \Delta S/(L^2 - 4\Delta S^2)]; \qquad \text{(Ref. 4, Eqn. 5, pg. 182)}$$

For HDPE:

For L = 10 feet, it was previously determined that ΔS = 0.9 feet.

$$\theta = 2 \tan^{-1} [4\ (10\ \text{feet})(0.9\ \text{feet}) / \{(10\ \text{feet})^2 - 4\ (0.9\ \text{feet})^2\}]$$

$$= 2 \tan^{-1} (0.372)$$

$$= 40.8°$$

Assume that the density of cover soil is γ_{cs} = 110 pcf with a depth of cover, h = 1.5 feet.

$$p = (\gamma_{cs})(h) = (110\ \text{pcf})(1.5\ \text{feet}) = 165\ \text{psf}$$

Using a nominal thickness of 40 mils, t = (0.040)(1 foot/12 inches) = 0.003 feet.

Then:

$$\sigma = [[(10\ \text{feet})^2 + 4\ (0.9\ \text{feet})^2](165\ \text{psf})] / [4\ (10\ \text{feet})(0.003\ \text{feet}) \sin (40.8° / 2)]$$

$$\sigma = (366{,}386\ \text{lb/ft}^2)(1\ \text{ft}^2 / 144\ \text{in}^2)$$

$$\sigma = 2{,}544\ \text{lb/in}^2$$

The required strength of the geomembrane is;

$$T_{req'd} = (2544\ \text{lb/in.}^2)(0.040\ \text{in.}) = 102\ \text{lb/in.}$$

Assuming $T_{allow} = T_{ult}$ and a factor of safety, FS_g = 1.5 [Ref. 1, Table 5.19, see Sheet 18],

Then;

$$T_{ult} = T_{allow} = (102)(1.5)$$

$$\boxed{T_{ult} = 153\ \text{lb/in. for HDPE}}$$

For LDPE:

For L = 10 feet, it was previously determined that ΔS = 2.4 feet.

$$\theta = 2 \tan^{-1} [4\ (10\ \text{feet})(2.4\ \text{feet}) / \{(10\ \text{feet})^2 - 4\ (2.4\ \text{feet})^2\}]$$

$$= 2 \tan^{-1} (1.25)$$

$$= 102.6°$$

Assume that the density of cover soil is γ_{cs} = 110 pcf with a depth of cover, h = 1.5 feet.

$p = (\gamma_{cs})(h) = (110 \text{ pcf})(1.5 \text{ feet}) = 165 \text{ psf}$

Using a nominal thickness of 40 mils, t = (0.040)(1 foot/12 inches) = 0.003 feet.

Then:

$$\sigma = [[(10 \text{ feet})^2 + 4\,(2.4 \text{ feet})^2](165 \text{ psf})] / [4\,(10 \text{ feet})(0.003 \text{ feet}) \sin(102.6° / 2)]$$

$$\sigma = (195{,}149 \text{ lb/ft}^2)(1 \text{ ft}^2 / 144 \text{ in}^2)$$

$$\sigma = 1{,}355 \text{ lb/in}^2$$

The required strength of the geomembrane is;

$$T_{req'd} = (1{,}355 \text{ lb/in.}^2)(0.040 \text{ in.}) = 54 \text{ lb/in.}$$

Assuming $T_{allow} = T_{ult}$ and a factor of safety, $FS_g = 1.5$ [Ref. 1, Table 5.19, see Sheet 18],

Then;

$$T_{ult} = T_{allow} = (54)(1.5)$$

$$\boxed{T_{ult} = 81 \text{ lb/in. for LDPE}}$$

3. Compare Calculated Value to Recommended Minimum Property for Installation Survivability

The recommended minimum tensile strength for general geomembrane installation requiring a "High" degree of installation survivability typical of landfill liners and covers is 11 kN/m or approximately 62.8 psi [Ref. 1, Table 5.11, see Sheet 16]. Considering that tension was not induced by the weight of the geomembrane for either HDPE or LDPE, the more conservative of the required tensile strength due to subsidence or the recommended minimum property for installation survivability should be used.

Because the calculated tensile strength due to subsidence is greater than the minimum required tensile strength for a high degree of installation survivability for both HDPE and LDPE, the tensile strength due to subsidence governs. A minimum tensile strength of 153 lb./in. is required for 40 mil textured HDPE geomembrane and a minimum of 81 lb./in. is required for 40 mil textured LDPE geomembrane.

4. Compare the Specified Property Value to Commercial Product Data

A review of several manufacturer's product specifications shows that 40 mil textured LDPE geomembranes exceeding the required minimum tensile strengths are commercially available. Commercially available 40 mil textured HDPE geomembranes do not meet the required minimum tensile strength. Depending on the manufacturer either a 60 mil or 80 mil textured HDPE geomembrane would be required to provide the minimum tensile strength.

C. Puncture Resistance

It is anticipated that the geomembrane will be required to resist puncture during placement of the cap system components above the geomembrane. At all other times the load on the geomembrane due to weight of the cover soil and other cap system components is minimal (< 2 lbs./in.^{2}).

1. Determine Appropriate Factor of Safety (FS)

   The geomembrane will be placed on a geotextile above the compacted Iron Rich material. The geotextile will act as a cushion between the compacted waste material and the geomembrane. In addition, the double-sided geocomposite drainage layer above the geomembrane should not cause puncture itself. In fact, the drainage layer should protect the geomembrane during select fill placement because the nonwoven geotextile will act as a cushion.

   Therefore use a Factor of Safety (FS) = 1

2. Calculate Required Puncture Resistance

   The required puncture strength is given by:

   $$F_{req'd} = p' d_a^2 S_1 S_2 S_3$$ [Ref. 1, pg. 156, Eqn. 2.30]

   where:

   $F_{req'd}$ = required vertical force to be resisted
   p' = pressure exerted on the geomembrane (approximately 100% of tire inflation pressure at the ground surface for small stone thickness)
   d_a = average diameter of the puncturing aggregate or sharp object
   h_h = Protrusion height $\leq d_a$,
   S_1 = Protrusion factor = h_h/d_a
   S_2 = Scale factor to adjust ASTM D4833 test value using 5/16-in.-diameter puncture probe to actual puncturing object = $0.31/d_a$
   S_3 = Shape factor to adjust flat puncture probe of ASTM D4833 to actual shape of puncturing object = $1 - A_p/A_c$, where A_p is the projected area of the particle and A_c is the area of the smallest circumscribing circle around the particle

   Assuming:

   p' = 100 psi

   d_a = 3 in. assuming a maximum allowable particle size for subgrade material

   h_h = ¾ d_a = 2.25 in.

   A_p/A_c = 0.4 for crushed rock [Ref. 1]

Then,

$$S_1 = h_h/d_a = 2.25 \text{ in} / 3 \text{ in} = 0.75$$

$$S_2 = 0.31/d_a = 0.31 \text{ in} / 3 \text{ in} = 0.103$$

$$S_3 = 1 - A_p/A_c = 1 - 0.4 = 0.6$$

Substituting into equation for $F_{req'd}$,

$$F_{req'd} = p' d_a^2 S_1 S_2 S_3 = (100 \text{ lb/in}^2)(3 \text{ in})^2(0.75)(0.103)(0.6)$$

$$\boxed{F_{req'd} = 42 \text{ lbs.}}$$

3. Calculate Allowable Puncture Resistance

$$T_{allow} = T_{req'd} \times FS = 42 \times 1$$

$$\boxed{T_{allow} = 42 \text{ lbs.}}$$

4. Compare Calculated Value to Recommended Minimum Property for Installation Survivability

Reference 1, Table 5.11 (see Sheet 16), lists the minimum properties for general geomembrane installation survivability. According to this table the minimum required puncture resistance, for a high degree of survivability, is 170 N or approximately 38 lbs. Because the calculated required puncture resistance is greater than the recommended minimum value for a high degree of installation survivability, the calculated puncture resistance governs. A minimum puncture resistance of 42 lbs. is required.

5. Compare the Specified Property Value to Commercial Product Data

A review of several manufacturer's product specifications shows that both 40 mil textured LDPE geomembranes and HDPE geomembranes exceeding the required minimum puncture resistance are commercially available.

D. Tear Resistance

A geomembrane can be damaged by large tensile stresses that result in tearing. These types of stresses can be generated during installation by dragging the geomembrane panel during placement, and by wind uplift. Reference 1, Table 5.11 (see Sheet 16), lists the minimum properties for general geomembrane installation survivability. Based on this table the minimum required tear resistance, for a high degree of survivability, is 67 N or approximately 15 lbs.

E. Seam Strength

The Seam Strength for the geomembrane will be specified based on the minimum requirements recommended by recognized standards such as the Geosynthetic Research Institute and their standard specification for Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes [Ref. 8]. Excerpts from this specification are located on Sheet 19 and Sheet 20. Table 1(a) and Table 2(a) list the seam strength and related properties of thermally bonded smooth and textured HDPE and LDPE geomembranes, respectively.

Based on these tables the minimum required shear strength and peel strength for both hot wedge and extrusion seams will be specified as:

For 40 mil LDPE: Shear strength = 53 lb/in. Peel strength = 44 lb/in.

For 80 mil HDPE: Shear stength = 160 lb/in. Peel stength = 104 lb/in.

CONCLUSIONS:

The minimum required properties for the geomembrane are listed below. Generally, the specified properties are greater than the minimum requirements for a high degree of installation survivability as recommended for landfill covers [Ref. 1, Table 5.11, see Sheet 16].

Property	Minimum Required Value	
Material	HDPE	LDPE
Thickness (mil.)	80	40
Tensile (lb./in.)	153	81
Elongation at Break (%)	100	250
Puncture (lbs.)	42	42
Tear (lbs.)	15	15
Seam Shear Strength (lb./in.)	160	53
Seam Peel Strength (lb./in.)	104	44

However, the geomembrane will be specified based on the minimum requirements recommended by recognized standards such as the Geosynthetic Research Institute standard specifications GRI GM-13 [Ref. 11] and GRI GM-17 [Ref.12] where these standards exceed the calculated required values. Excerpts from these specifications are located on Sheet 21 and Sheet 22 and list the related properties of textured HDPE and LDPE geomembranes, respectively.

The recommended geomembrane specification for the Iron Rich Staging Area is:

Property	Minimum Required Value
Material	LDPE
Thickness (mil.)	40
Tensile (lb./in.)	81
Elongation at Break (%)	250
Puncture (lbs.)	44
Tear (lbs.)	22
Seam Shear Strength (lb./in.)	53
Seam Peel Strength (lb./in.)	44

REFERENCE 1, TABLE 5.11

TABLE 5.11 RECOMMENDED MINIMUM PROPERTIES FOR GENERAL GEOMEMBRANE INSTALLATION SURVIVABILITY

Property and Test Method	Required Degree of Installation Survivability*			
	Low	Medium	High	Very High
Thickness (D1593) (mm)	0.63	0.75	0.88	1.00
Tensile D882 (25 mm strip) (kN/m)	7.0	9.0	11	13
Tear (D1004 Die C) (N)	33	45	67	90
Puncture (D4833) (N)	110	140	170	200
Impact (D3998 mod.) (J)	10	12	15	20

*Low refers to careful hand placement on a very uniform well-graded subgrade with light loads of a static nature, typical of vapor barriers beneath building floor slabs.

Medium refers to hand or machine placement on a machine-graded subgrade with medium loads, typical of canal liners.

High refers to hand or machine placement on a machine-graded subgrade of poor texture with high loads, typical of landfill liners and covers.

Very high refers to hand or machine placement on machine-graded subgrade of very poor texture with high loads, typical of liners for heap leach pads and reservoir covers.

REFERENCE 1, TABLE 5.19

TABLE 5.19 VARIOUS DESIGN MODELS FOR GEOMEMBRANES IN WASTE DISPOSAL SITUATIONS

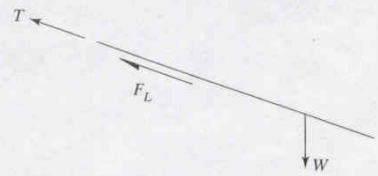
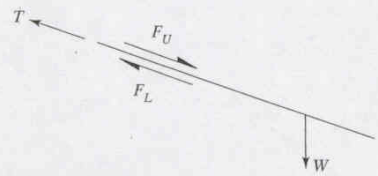
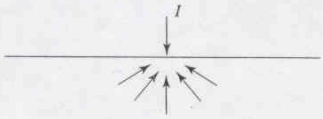
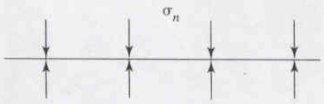
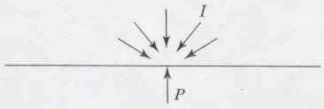
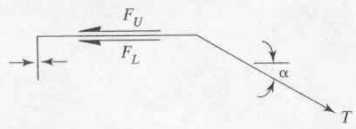
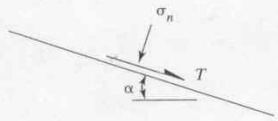
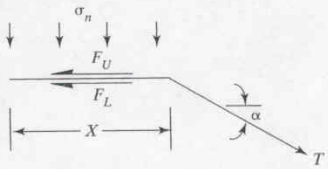
Problem	Liner Stress	Free-Body Diagram	Required Properties: Geomembrane	Required Properties: Landfill	Typical Factor of Safety
Liner self-weight	tensile		$G, t, \sigma_{allow}, \delta_L$	β, H	≥ 10
Weight of cover soil	tensile		$t, \sigma_{allow}, \delta_U, \delta_L$	β, h, γ, H	0.5 to 2
Impact during construction	impact		I	d, w	0.1 to 5
Weight of landfill	compression		σ_{allow}	γ, H	≥ 10
Puncture	puncture		σ_p	γ, H, P, A_p	0.5 to 3

TABLE 5.19 VARIOUS DESIGN MODELS FOR GEOMEMBRANES IN WASTE DISPOSAL SITUATIONS

Problem	Liner Stress	Free-Body Diagram	Required Properties: Geomembrane	Required Properties: Landfill	Typical Factor of Safety
Anchorage	tensile		$t, \sigma_{allow}, \delta_U, \delta_L$	β, γ, ϕ	0.7 to 5
Settlement of landfill	shear		τ, δ_U	β, γ, H	≥ 10
Subsidence under landfill	tensile		$t, \sigma_{allow}, \delta_U, \delta_L, \chi$	α, γ, H	0.3 to 10

Abbreviations: Geomembrane properties:
- G = specific gravity
- t = thickness
- σ_{allow} = allowable stress (yield, break or allow)
- τ = shear stress
- I = impact resistance
- σ_p = puncture stress
- δ_U = friction with material above
- δ_L = friction with materal below
- X = mobilization distance

Landfill properties:
- β = slope angle
- H = height
- γ = unit weight
- h = lift height
- α = subsidence angle
- ϕ = friction angle
- d = drop height
- W = weight
- p = puncture force
- A_p = puncture area

Source: Koerner and Richardson [83].

REFERENCE 8, TABLE 1(A)

Table 1(a) – Seam Strength and Related Properties of Thermally Bonded Smooth and Textured High Density Polyethylene (HDPE) Geomembranes **(English Units)**

Geomembrane Nominal Thickness	30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils
Hot Wedge Seams(1)							
shear strength(2), lb/in.	57	80	100	120	160	200	240
shear elongation at break(3), %	50	50	50	50	50	50	50
peel strength(2), lb/in.	39	52	65	78	104	130	156
peel separation, %	25	25	25	25	25	25	25
Extrusion Fillet Seams							
shear strength(2), lb/in.	57	80	100	120	160	200	240
shear elongation at break(3), %	50	50	50	50	50	50	50
peel strength(2), lb/in.	39	52	65	78	104	130	156
peel separation, %	25	25	25	25	25	25	25

Notes for Tables 1(a) and 1(b):

1. Also for hot air and ultrasonic seaming methods
2. Value listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values
3. Elongation measurements should be omitted for field testing

Table 1(b) – Seam Strength and Related Properties of Thermally Bonded Smooth and Textured High Density Polyethylene (HDPE) Geomembranes **(S.I. Units)**

Geomembrane Nominal Thickness	0.75 mm	1.0 mm	1.25 mm	1.5 mm	2.0 mm	2.5 mm	3.0 mm
Hot Wedge Seams(1)							
shear strength(2), N/25 mm.	250	350	440	525	700	875	1050
shear elongation at break(3), %	50	50	50	50	50	50	50
peel strength(2), N/25 mm	170	225	285	340	455	570	680
peel separation, %	25	25	25	25	25	25	25
Extrusion Fillet Seams							
shear strength(2), N/25 mm	250	350	440	525	700	875	1050
shear elongation at break(3), %	50	50	50	50	50	50	50
peel strength(2), N/25 mm	170	225	285	340	455	570	680
peel separation, %	25	25	25	25	25	25	25

REFERENCE 8, TABLE 2(A)

Table 2(a) – Seam Strength and Related Properties of Thermally Bonded Smooth and Textured Linear Low Density Polyethylene (LLDPE) Geomembranes **(English Units)**

Geomembrane Nominal Thickness	20 mils	30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils
Hot Wedge Seams[1]								
shear strength[2], lb/in.	26	40	53	66	79	105	133	160
shear elongation[3], %	50	50	50	50	50	50	50	50
peel strength[2], lb/in.	22	34	44	57	66	88	114	136
peel separation, %	25	25	25	25	25	25	25	25
Extrusion Fillet Seams								
shear strength[2], lb/in.	26	40	53	66	79	105	133	160
shear elongation[3], %	50	50	50	50	50	50	50	50
peel strength[2], lb/in.	22	34	44	57	66	88	114	136
peel separation, %	25	25	25	25	25	25	25	25

Notes for Tables 2(a) and 2(b):

1. Also for hot air and ultrasonic seaming methods
2. Values listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen can be as low as 80% of the listed values
3. Elongation measurements should be omitted for field testing

Table 2(a) – Seam Strength and Related Properties of Thermally Bonded Smooth and Textured Linear Low Density Polyethylene (LLDPE) Geomembranes **(S.I. Units)**

Geomembrane Nominal Thickness	0.50 mm	0.75 mm	1.0 mm	1.25 mm	1.5 mm	2.0 mm	2.5 mm	3.0 mm
Hot Wedge Seams[1]								
shear strength[2], N/25 mm	115	175	230	290	345	460	580	700
shear elongation[3], %	50	50	50	50	50	50	50	50
peel strength[2], N/25 mm	95	150	190	250	290	385	500	595
peel separation, %	25	25	25	25	25	25	25	25
Extrusion Fillet Seams								
shear strength[2], N/25 mm	115	175	230	290	345	460	580	700
shear elongation[3], %	50	50	50	50	50	50	50	50
peel strength[2], N/25 mm	95	150	190	250	290	385	500	595
peel separation, %	25	25	25	25	25	25	25	25

REFERENCE 11, TABLE 2(A)

ENGLISH UNITS

Table 2(a) – High Density Polyethylene (HDPE) Geomembrane - Textured

Properties	Test Method	Test Value							Testing Frequency (minimum)
		30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
Thickness mils (min. ave.) • lowest individual for 8 out of 10 values • lowest individual for any of the 10 values	D 5994	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	per roll
Asperity Height mils (min. ave.) *(1)*	GM 12	10 mil	10 mil	10 mil	10 mil	10 mil	10 mil	10 mil	every 2nd roll *(2)*
Density (min. ave.)	D 1505/D 792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	200,000 lb
Tensile Properties (min. ave.) *(3)* • yield strength • break strength • yield elongation • break elongation	D 638 Type IV	63 lb/in. 45 lb/in. 12% 100%	84 lb/in. 60 lb/in. 12% 100%	105 lb/in. 75 lb/in. 12% 100%	126 lb/in. 90 lb/in. 12% 100%	168 lb/in. 120 lb/in. 12% 100%	210 lb/in. 150 lb/in. 12% 100%	252 lb/in. 180 lb/in. 12% 100%	20,000 lb
Tear Resistance (min. ave.)	D 1004	21 lb	28 lb	35 lb	42 lb	56 lb	70 lb	84 lb	45,000 lb
Puncture Resistance (min. ave.)	D 4833	45 lb	60 lb	75 lb	90 lb	120 lb	150 lb	180 lb	45,000 lb
Stress Crack Resistance *(4)*	D 5397 (App.)	200 hr.	200 hr.	200 hr.	200 hr.	200 hr.	200 hr.	200 hr.	per GRI GM10
Carbon Black Content (range)	D 1603 *(5)*	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	2.0-3.0 %	20,000 lb
Carbon Black Dispersion	D 5596	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	note *(6)*	45,000 lb
Oxidative Induction Time (OIT) (min. ave.) *(7)* (a) Standard OIT — or — (b) High Pressure OIT	 D 3895 D 5885	 100 min. 400 min.	 100 min. 400 min.	 100 min. 400 min.	 100 min. 400 min.	 100 min. 400 min.	 100 min. 400 min.	 100 min. 400 min.	200,000 lb
Oven Aging at 85°C *(7), (8)* (a) Standard OIT (min. ave.) - % retained after 90 days — or — (b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5721 D 3895 D 5885	 55% 80%	 55% 80%	 55% 80%	 55% 80%	 55% 80%	 55% 80%	 55% 80%	per each formulation
UV Resistance *(9)* (a) Standard OIT (min. ave.) — or — (b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(11)*	GM11 D 3895 D 5885	 N.R. *(10)* 50%	 N.R. *(10)* 50%	 N.R. *(10)* 50%	 N.R. *(10)* 50%	 N.R. *(10)* 50%	 N.R. *(10)* 50%	 N.R. *(10)* 50%	per each formulation

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

REFERENCE 12, TABLE 2(A)

English Units

Table 2(a) – Linear Low Density Polyethylene (LLDPE) Geomembrane (TEXTURED)

Properties	Test Method	Test Value								Testing Frequency (minimum)
		20 mils	30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
Thickness mils (min. ave.) • lowest individual for 8 out of 10 values • lowest individual for any of the 10 values	D 5994	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	nom. (-5%) -10% -15%	per roll
Asperity Height mils (min. ave.) *(1)*	GM 12	10	10	10	10	10	10	10	10	Every 2nd roll *(2)*
Density g/ml (max.)	D 1505/D 792	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	200,000 lb
Tensile Properties *(3)* (min. ave.) • break strength – lb/in. • break elongation - %	D 638 Type IV	30 250	45 250	60 250	75 250	90 250	120 250	150 250	180 250	20,000 lb
2% Modulus – lb/in. (max.)	D 5323	1200	1800	2400	3000	3600	4800	6000	7200	per formulation
Tear Resistance – lb (min. ave.)	D 1004	11	16	22	27	33	44	55	66	45,000 lb
Puncture Resistance – lb (min. ave.)	D 4833	22	33	44	55	66	88	110	132	45,000 lb
Axi-Symmetric Break Resistance Strain - % (min.)	D 5617	30	30	30	30	30	30	30	30	per formulation
Carbon Black Content - %	D 1603 *(4)*	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0	45,000 lb
Carbon Black Dispersion	D 5596	note *(5)*	note *(5)*	note *(5)*	note *(5)*	note *(5)*	note *(5)*	note *(5)*	note *(5)*	45,000 lb
Oxidative Induction Time (OIT) (min. ave.) *(6)* (a) Standard OIT — or — (b) High Pressure OIT	 D 3895 D 5885	 100 400	 100 400	 100 400	 100 400	 100 400	 100 400	 100 400	 100 400	200,000 lb
Oven Aging at 85°C *(7)* (a) Standard OIT (min. ave.) - % retained after 90 days — or — (b) High Pressure OIT (min. ave.) - % retained after 90 days	D 5721 D 3895 D 5885	 35 60	 35 60	 35 60	 35 60	 35 60	 35 60	 35 60	 35 60	per formulation
UV Resistance *(8)* (a) Standard OIT (min. ave.) — or — (b) High Pressure OIT (min. ave.) - % retained after 1600 hrs *(10)*	D 3895 D 5885	N. R. *(9)* 35	N.R. *(9)* 35	N.R. *(9)* 35	N.R. *(9)* 35	N.R. *(9)* 35	N.R. *(9)* 35	N.R. *(9)* 35	N.R. *(9)* 35	per formulation

(1) Of 10 readings; 8 out of 10 must be ≥ 7 mils, and lowest individual reading must be ≥ 5 mils
(2) Alternate the measurement side for double sided textured sheet
(3) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
- Break elongation is calculated using a gage length of 2.0 in. at 2.0 in./min.

(4) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.
(5) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
- 9 in Categories 1 or 2 and 1 in Category 3

(6) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
(7) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
(8) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
(9) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
(10) UV resistance is based on percent retained value regardless of the original HP-OIT value.

REFERENCES:

1. Koerner, Robert M., "Designing with Geosynthetics," 4th edition, 1998.

2. DuPont Corporate Remediation Group. Remedial Investigation and Risk Assessment Report Addendum at the Hay Road Sludge Drying Site (DE-024), Wilmington, Delaware. December 2008.

3. United States Environmental Protection Agency, "Geosynthetic Design Guidance for Hazardous Waste Landfill Cells and Surface Impoundments." Report No. EPA/600/2-87/097, March 1987.

4. Koerner, Robert M., G. R. Koerner, and Bao-lin, Hwu, "Three Dimensional Axi-Symmetric Geomembrane Tension Test," ASTM STP-1081, Geosynthetic Testing for Waste Containment Applications, 1990.

5. Cap Stability calculation for Hay Road Landfill Sludge Drying Site (DE-0024), performed by EEB, URS, 2/5/03.

6. Topographical survey by URS Corporation, January 2003, October 2004, and June 2009.

7. "Geotechnical Fabrics Report 1999 Specifier's Guide," published by the Industrial Fabrics Association International, December 1998.

8. Geosynthetic Research Institute Test Method GM19, "Standard Specification for Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes", February 18, 2002.

9. Primary Settlement calculation for Hay Road Landfill Sludge Drying Site (DE-0024), performed by TEC, URS, 2/6/03.

10. Secondary Settlement calculation for Hay Road Landfill Sludge Drying Site (DE-0024), performed by TEC, URS, 2/6/03.

11. Geosynthetic Research Institute Test Method GM13, "Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes", December 13, 2000.

12. Geosynthetic Research Institute Test Method GM17, "Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes", December 13, 2000.

PURPOSE:

To assess the geonet within the cap system to determine whether it will adequately handle anticipated flow rates for the 4H:1V and 5% slope across the top of the cap..

PROCEDURE:

Evaluation of geocomposite properties listed above will be performed using the design by function method [Ref. 1]. This method will use the required (design) property and a global factor of safety to determine the allowable (performance) property. Partial factors of safety will then be applied to the allowable property to adjust for site specific conditions and to determine the ultimate (laboratory-measured) property. The ultimate property will serve as the basis for determining geomembrane specifications. The following is a summary generalizing the design by function equations:

i) allowable (performance) property = $FS_g \times$ required (design) property; where,

FS_g = global factor of safety

ii) ultimate (lab-measured) property = allowable (performance) property $\times \Pi(RF)$; where,

$\Pi(RF)$ = sum of Reduction Factors

The following steps will be taken to determine the ultimate transmissivity to be specified:

1. Determine the required transmissivity, θ_{req}, for the geonet on the 4H:1V slope using the Unit Gradient Method.
2. Determine the saturated hydraulic conductivity, k_{sat}, using the θ_{req} for the 4H:1V slope.
3. Determine the maximum liquid depth and location of the maximum liquid depth on the 5% slope by applying the k_{sat} to the geocomposite drainage layer in the HELP model. Compare results to the cover soil thickness.

EVALUATION OF DESIGN PROPERTIES:

A. Transmissivity, θ, for the 4H:1V Slope

1. Determine required transmissivity, θ_{req}:

The required transmissivity for the 4H:1V slope can be determined using the Unit Gradient Method.

$$\theta_{req} = k_{veg} \times L / \tan \beta \qquad \text{[Ref. 2, Eqn. 4.6, pg. 37]}$$

Where;

θ_{req} = required geonet transmissivity
k_{veg} = saturated hydraulic conductivity of the vegetative layer
β = slope angle
L = slope length

Assumptions:

- Vegetative cover soil saturated hydraulic conductivity: $k_{veg} = 1 \times 10^{-4}$ cm/sec
- Slope length: L = 100 ft. = 30.48 m

Then;

$$\theta_{req} = k_{veg} \times L / \tan \beta$$

$$= [(1 \times 10^{-4} \text{ cm/sec} \times 0.01 \text{ m/cm}) \times 30.48 \text{ m}] / \tan(\tan^{-1}(0.25))$$

$$\boxed{\theta_{req} = 1.22 \times 10^{-4} \text{ m}^2/\text{sec}}$$

2. Determine ultimate transmissivity, θ_{ult}

$$\theta_{ult} = FS \times \Pi(RF) \times \theta_{req}$$

Where;

θ_{ult} = ultimate geonet transmissivity
θ_{req} = required geonet transmissivity
FS = factor of safety
RF = reduction factors

Assumptions:

- FS = 2.1
- RF_{IN} = reduction factor for intrusion = 1.5 [Ref. 1, Table 4.2]
- RF_{CR} = reduction factor for creep deformation = 1.4 [Ref. 1, Table 4.2]
- RF_{CC} = reduction factor for chemical clogging = 1.2 [Ref. 1, Table 4.2]
- RF_{BC} = reduction factor for biological clogging = 1.5 [Ref. 1, Table 4.2]

Then,

$$\theta_{ult} = FS \times \Pi(RF) \times \theta_{req}$$

$$= 2.1 \times 1.5 \times 1.4 \times 1.2 \times 1.5 \times 1.22 \times 10^{-4} \text{ m}^2/\text{sec}$$

$$\boxed{\theta_{ult} = 9.68 \times 10^{-4} \text{ m}^2/\text{sec}}$$

B. Transmissivity, θ, for the 5% Slope

The Unit Gradient Method is limited to slopes steeper than 20%. Therefore, the transmissivity of the geocomposite calculated for the 4H:1V slope will be evaluated by comparing the maximum depth of liquid in the drainage layer from the HELP model to the drainage layer thickness (i.e., thickness of the geocomposite and cover soil layer acting as a drainage layer).

1. Calculate the saturated hydraulic conductivity, k_{sat}, using the θ_{req} for the 4H:1V slope

$$k_{sat} = \theta_{req} / t$$

Where;

θ_{req} = required geonet transmissivity
t = thickness of the geonet

Assumptions:

- geonet thickness (t) = 0.76 cm

Then,

$k_{sat} = \theta_{req} / t$

$= (1.22 \times 10^{-4}\ m^2/sec \times 10{,}000\ cm^2/m^2) / 0.76\ cm$

$k_{sat} = 1.61\ cm/sec$

2. Determine the maximum liquid depth and location of the maximum liquid depth on the 5% slope using the HELP model:

Case 1: Typical Slope Length for 5% Slope Along Northern, Western, and Southern Slopes

Assumptions:

- Slope Length = 250 ft. = 76 m

Then,

Peak Day Average Liquid Depth = 0.36 m (14.28 in)

Peak Day Max. Liquid Depth = 0.56 m (21.93 in)

Location of Max. Liquid Depth = 17.5 m (57.4 ft) from drain

Note: Excerpts from the HELP Model output are attached below.

Case 2: Maximum Slope Length for 5% Slope Along Eastern Slope

Assumptions:

- Slope Length = 410 ft. = 125 m

Then,

Peak Day Average Liquid Depth = 0.39 m (15.19 in)

Peak Day Max. Liquid Depth = 0.63 m (24.75 in)

Location of Max. Liquid Depth = 22.9 m (75.2 ft) from drain

Note: Excerpts from the HELP Model output are attached below.

3. Compare Calculated Values to Drainage Layer Thickness

For Case 1 the peak day maximum liquid depth of 0.56 meters (21.93 inches) exceeds the cover soil thickness of 0.46 meters (18 inches). The location of the maximum liquid depth is approximately 17.5 meters (57.4 feet) from the toe of the 5% slope.

For Case 2 the peak day maximum liquid depth of 0.63 meters (24.75 inches) exceeds the cover soil thickness of 0.46 meters (18 inches). The location of the maximum liquid depth is approximately 22.9 meters (75.2 feet) from the toe of the 5% slope.

CONCLUSIONS:

For the 4H:1V slopes, a geocomposite drainage layer having a minimum transmissivity of 9.68×10^{-4} m^2/sec should be specified.

For the 5% slopes, the peak day maximum flow infiltrating the cover soil to the geocomposite drainage layer will create a saturated condition within the drainage layer (i.e., the geocomposite drainage layer and cover soil). This saturated condition is not anticipated to occur frequently and the Saturated Cap Stability Calculation [Ref. 3] shows that an adequate factor of safety is present under the saturated condition. Additional surface flow from seepage during saturated conditions will be negligible and the erosion controls established for the site will be sufficient. If the frequency of saturated conditions proves to be detrimental to the selected vegetation on the cap, the area can be overseeded with a more suitable “wet condition” seed mixture.

In order to minimize the effects during saturated conditions, a commercially available, high-flow (e.g., transmissivity of 2.5×10^{-3} m^2/second) triaxial geocomposite is recommended.

REFERENCE 1, TABLE 4.2

TABLE 4.2 RECOMMENDED REDUCTION FACTOR VALUES FOR EQUATION (4.5) DETERMINING ALLOWABLE FLOW RATE OR TRANSMISSIVITY OF GEONETS

Application Area	Reduction Factor Values in Equation (4.5)			
	RF_{IN}*	RF_{CR}*	RF_{CC}	RF_{BC}
Sport fields	1.0–1.2	1.0–1.5	1.0–1.2	1.1–1.3
Capillary breaks	1.1–1.3	1.0–1.2	1.1–1.5	1.1–1.3
Roof and plaza decks	1.2–1.4	1.0–1.2	1.0–1.2	1.1–1.3
Retaining walls, seeping rock, and soil slopes	1.3–1.5	1.2–1.4	1.1–1.5	1.0–1.5
Drainage blankets	1.3–1.5	1.2–1.4	1.0–1.2	1.0–1.2
Infiltrating water drainage for landfill covers	1.3–1.5	1.1–1.4	1.0–1.2	1.5–2.0
Secondary leachate collection (landfill)	1.5–2.0	1.4–2.0	1.5–2.0	1.5–2.0
Primary leachate collection (landfills)	1.5–2.0	1.4–2.0	1.5–2.0	1.5–2.0

*These values are sensitive to the type of geonet, rib separation distance, and density of the resin used in the geonet's manufacture. The magnitude of the applied load is also of major importance.

HELP MODEL EXCERPTED OUTPUT FOR CASE 1

```
******************************************************************************
******************************************************************************
**                                      **
**                                      **
**         HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE          **
**          HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)          **
**           DEVELOPED BY ENVIRONMENTAL LABORATORY              **
**            USAE WATERWAYS EXPERIMENT STATION                 **
**        FOR USEPA RISK REDUCTION ENGINEERING LABORATORY       **
**                                      **
**                                      **
******************************************************************************
******************************************************************************

PRECIPITATION DATA FILE:    C:\HELP3\HRSDS4.D4
 TEMPERATURE DATA FILE:      C:\HELP3\HRSDS7.D7
 SOLAR RADIATION DATA FILE:  C:\HELP3\HRSDS13.D13
 EVAPOTRANSPIRATION DATA:    C:\HELP3\HRSDS11.D11
 SOIL AND DESIGN DATA FILE:  C:\HELP3\HRSDSC01.D10
 OUTPUT DATA FILE:           C:\HELP3\HRSDSOC1.OUT

TIME:  17:25     DATE:  11/20/2009

******************************************************************************

    TITLE:  Hay Road Sludge Drying Site Geocomposite Case 1

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    NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
           COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

                        LAYER  1
                        --------

              TYPE 1 - VERTICAL PERCOLATION LAYER
                 MATERIAL TEXTURE NUMBER  10
        THICKNESS              =     15.20   CM
        EFFECTIVE SAT. HYD. COND.   =  0.119999997000E-03 CM/SEC
       NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
            FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                        LAYER  2
                        --------

              TYPE 2 - LATERAL DRAINAGE LAYER
                 MATERIAL TEXTURE NUMBER  10
        THICKNESS              =     30.50   CM
        EFFECTIVE SAT. HYD. COND.   =  0.119999997000E-03 CM/SEC

                        LAYER  3
```

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                --------

          TYPE 2 - LATERAL DRAINAGE LAYER
           MATERIAL TEXTURE NUMBER   0
  THICKNESS                =     0.76   CM
  EFFECTIVE SAT. HYD. COND.  =  1.61000001000     CM/SEC
  SLOPE                    =     5.00   PERCENT
  DRAINAGE LENGTH          =    76.0    METERS

                LAYER  4
                --------

          TYPE 4 - FLEXIBLE MEMBRANE LINER
           MATERIAL TEXTURE NUMBER  36
  THICKNESS                =     0.10   CM
  EFFECTIVE SAT. HYD. COND.  = 0.399999993000E-12 CM/SEC
  FML PINHOLE DENSITY        =     0.50   HOLES/HECTARE
  FML INSTALLATION DEFECTS   =     2.00   HOLES/HECTARE
  FML PLACEMENT QUALITY      = 6 - W/ GEOTEXTILE
  GEOTEXTILE TRANSMISSIVITY  =     0.300000 CM*CM/SEC


       GENERAL DESIGN AND EVAPORATIVE ZONE DATA
       ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
        SOIL DATA BASE USING SOIL TEXTURE #10 WITH A
        GOOD STAND OF GRASS, A SURFACE SLOPE OF  5.%
        AND A SLOPE LENGTH OF   76. METERS.

SCS RUNOFF CURVE NUMBER          =    81.00
FRACTION OF AREA ALLOWING RUNOFF   =   100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =     6.5000 HECTARES
EVAPORATIVE ZONE DEPTH           =    46.5    CM
INITIAL WATER IN EVAPORATIVE ZONE  =    11.335  CM
UPPER LIMIT OF EVAPORATIVE STORAGE  =    18.835  CM
LOWER LIMIT OF EVAPORATIVE STORAGE  =     6.219  CM
INITIAL SNOW WATER               =     0.000  CM
INITIAL WATER IN LAYER MATERIALS   =   429.795  CM
TOTAL INITIAL WATER              =   429.795  CM
TOTAL SUBSURFACE INFLOW          =     0.00   MM/YR


        EVAPOTRANSPIRATION AND WEATHER DATA
        -----------------------------------

 NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
        WILMINGTON          DELAWARE

 NOTE:  PRECIPITATION DATA FOR     PHILADELPHIA       PENNSYLVANIA
        WAS ENTERED FROM THE DEFAULT DATA FILE.

 NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
        COEFFICIENTS FOR    WILMINGTON         DELAWARE
```

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR WILMINGTON DELAWARE
AND STATION LATITUDE = 39.80 DEGREES

****

PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	3.99	232629.953
RUNOFF	2.833	165145.2660
DRAINAGE COLLECTED FROM LAYER 3	0.54915	32017.00000
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.008443	492.23773
AVERAGE HEAD ON TOP OF LAYER 4	14.275	
MAXIMUM HEAD ON TOP OF LAYER 4	21.926	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	57.4 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.003404	198.44305
AVERAGE HEAD ON TOP OF LAYER 6	0.075	
SNOW WATER	5.87	342395.0310
MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3808	
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1339	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

****

HELP MODEL EXCERPTED OUTPUT FOR CASE 2

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**                                                                          **
**                                                                          **
**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                   **
**           HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                     **
**            DEVELOPED BY ENVIRONMENTAL LABORATORY                         **
**             USAE WATERWAYS EXPERIMENT STATION                            **
**         FOR USEPA RISK REDUCTION ENGINEERING LABORATORY                  **
**                                                                          **
**                                                                          **
******************************************************************************
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PRECIPITATION DATA FILE:    C:\HELP3\HRSDS4.D4
 TEMPERATURE DATA FILE:      C:\HELP3\HRSDS7.D7
 SOLAR RADIATION DATA FILE:  C:\HELP3\HRSDS13.D13
 EVAPOTRANSPIRATION DATA:    C:\HELP3\HRSDS11.D11
 SOIL AND DESIGN DATA FILE:  C:\HELP3\HRSDSC02.D10
 OUTPUT DATA FILE:           C:\HELP3\HRSDSOC2.OUT

TIME:  17:54     DATE:  11/20/2009

******************************************************************************

    TITLE:  Hay Road Sludge Drying Site Geocomposite Case 2

******************************************************************************

    NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
           COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

                        LAYER  1
                        --------

              TYPE 1 - VERTICAL PERCOLATION LAYER
                 MATERIAL TEXTURE NUMBER  10
        THICKNESS              =    15.20   CM
        EFFECTIVE SAT. HYD. COND.   =  0.119999997000E-03 CM/SEC
       NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
            FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

                        LAYER  2
                        --------

              TYPE 2 - LATERAL DRAINAGE LAYER
                 MATERIAL TEXTURE NUMBER  10
        THICKNESS              =    30.50   CM
        EFFECTIVE SAT. HYD. COND.   =  0.119999997000E-03 CM/SEC


                        LAYER  3
```

```
--------

        TYPE 2 - LATERAL DRAINAGE LAYER
         MATERIAL TEXTURE NUMBER   0
THICKNESS              =     0.76   CM
EFFECTIVE SAT. HYD. COND.  =  1.61000001000     CM/SEC
SLOPE                  =     5.00   PERCENT
DRAINAGE LENGTH          =   125.0    METERS

                LAYER  4
                --------

        TYPE 4 - FLEXIBLE MEMBRANE LINER
         MATERIAL TEXTURE NUMBER  36
THICKNESS              =     0.10   CM
EFFECTIVE SAT. HYD. COND.  = 0.399999993000E-12 CM/SEC
FML PINHOLE DENSITY       =     0.50   HOLES/HECTARE
FML INSTALLATION DEFECTS   =     2.00   HOLES/HECTARE
FML PLACEMENT QUALITY      = 6 - W/ GEOTEXTILE
GEOTEXTILE TRANSMISSIVITY  =     0.300000 CM*CM/SEC

      GENERAL DESIGN AND EVAPORATIVE ZONE DATA
      ----------------------------------------

NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
       SOIL DATA BASE USING SOIL TEXTURE #10 WITH A
       GOOD STAND OF GRASS, A SURFACE SLOPE OF  5.%
       AND A SLOPE LENGTH OF  125. METERS.

SCS RUNOFF CURVE NUMBER          =     80.50
FRACTION OF AREA ALLOWING RUNOFF   =    100.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =     6.5000 HECTARES
EVAPORATIVE ZONE DEPTH           =     46.5    CM
INITIAL WATER IN EVAPORATIVE ZONE  =    11.366  CM
UPPER LIMIT OF EVAPORATIVE STORAGE  =    18.835  CM
LOWER LIMIT OF EVAPORATIVE STORAGE  =     6.219  CM
INITIAL SNOW WATER               =     0.000  CM
INITIAL WATER IN LAYER MATERIALS   =   429.826  CM
TOTAL INITIAL WATER              =   429.826  CM
TOTAL SUBSURFACE INFLOW          =     0.00   MM/YR

       EVAPOTRANSPIRATION AND WEATHER DATA
       -----------------------------------

NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
       WILMINGTON          DELAWARE

NOTE:  PRECIPITATION DATA FOR     PHILADELPHIA       PENNSYLVANIA
       WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE:  TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
       COEFFICIENTS FOR    WILMINGTON         DELAWARE
```

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR WILMINGTON DELAWARE
AND STATION LATITUDE = 39.80 DEGREES

****

PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	3.99	232629.953
RUNOFF	2.833	165148.7030
DRAINAGE COLLECTED FROM LAYER 3	0.33422	19486.29690
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.008986	523.89026
AVERAGE HEAD ON TOP OF LAYER 4	15.190	
MAXIMUM HEAD ON TOP OF LAYER 4	24.747	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	75.2 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.003405	198.55032
AVERAGE HEAD ON TOP OF LAYER 6	0.140	
SNOW WATER	5.87	342395.0310

MAXIMUM VEG. SOIL WATER (VOL/VOL) 0.3886

MINIMUM VEG. SOIL WATER (VOL/VOL) 0.1339

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

****

REFERENCES:

1. Koerner, Robert M., "Designing with Geosynthetics," 5th edition, 2005.

2. Richardson, Gregory N., Giroud, Jean-Pierre, and Zhao, Aigen. Design of Lateral Drainage Systems for Landfills. 2000.

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\HELP3\HRSDS4.D4
TEMPERATURE DATA FILE:      C:\HELP3\HRSDS7.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\HRSDS13.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\HRSDS11.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\HRSDSC01.D10
OUTPUT DATA FILE:           C:\HELP3\HRSDSOC1.OUT


TIME:  17:25     DATE:  11/20/2009


******************************************************************************

     TITLE:  Hay Road Sludge Drying Site Geocomposite Case 1

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  10
          THICKNESS                    =     15.20   CM
          POROSITY                     =      0.3980 VOL/VOL
          FIELD CAPACITY               =      0.2440 VOL/VOL
          WILTING POINT                =      0.1360 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.2609 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.119999997000E-03 CM/SEC
       NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
                FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                   LAYER  2
                                   --------
```

```
            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  10
THICKNESS                    =     30.50   CM
POROSITY                     =      0.3980 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2360 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.119999997000E-03 CM/SEC


                        LAYER  3
                        --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =      0.76   CM
POROSITY                     =      0.8500 VOL/VOL
FIELD CAPACITY               =      0.0100 VOL/VOL
WILTING POINT                =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2248 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =   1.61000001000     CM/SEC
SLOPE                        =      5.00   PERCENT
DRAINAGE LENGTH              =     76.0    METERS


                        LAYER  4
                        --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  36
THICKNESS                    =      0.10   CM
POROSITY                     =      0.0000 VOL/VOL
FIELD CAPACITY               =      0.0000 VOL/VOL
WILTING POINT                =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.399999993000E-12 CM/SEC
FML PINHOLE DENSITY          =      0.50   HOLES/HECTARE
FML INSTALLATION DEFECTS     =      2.00   HOLES/HECTARE
FML PLACEMENT QUALITY        =  6 - W/ GEOTEXTILE
GEOTEXTILE TRANSMISSIVITY    =      0.300000 CM*CM/SEC


                        LAYER  5
                        --------

          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  24
THICKNESS                    =    945.00   CM
POROSITY                     =      0.3650 VOL/VOL
FIELD CAPACITY               =      0.3050 VOL/VOL
WILTING POINT                =      0.2020 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.3050 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.270000010000E-05 CM/SEC
```

LAYER 6

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	305.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #10 WITH A GOOD STAND OF GRASS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 76. METERS.

SCS RUNOFF CURVE NUMBER	=	81.00	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	6.5000	HECTARES
EVAPORATIVE ZONE DEPTH	=	46.5	CM
INITIAL WATER IN EVAPORATIVE ZONE	=	11.335	CM
UPPER LIMIT OF EVAPORATIVE STORAGE	=	18.835	CM
LOWER LIMIT OF EVAPORATIVE STORAGE	=	6.219	CM
INITIAL SNOW WATER	=	0.000	CM
INITIAL WATER IN LAYER MATERIALS	=	429.795	CM
TOTAL INITIAL WATER	=	429.795	CM
TOTAL SUBSURFACE INFLOW	=	0.00	MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM WILMINGTON DELAWARE

STATION LATITUDE	=	39.80	DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50	
START OF GROWING SEASON (JULIAN DATE)	=	107	
END OF GROWING SEASON (JULIAN DATE)	=	298	
EVAPORATIVE ZONE DEPTH	=	18.3	INCHES
AVERAGE ANNUAL WIND SPEED	=	9.20	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	72.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	71.00	%

NOTE: PRECIPITATION DATA FOR PHILADELPHIA PENNSYLVANIA WAS ENTERED FROM THE DEFAULT DATA FILE.

HRSDSOC1

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR WILMINGTON DELAWARE

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
31.20	33.20	41.80	52.40	62.20	71.20
76.00	74.80	67.80	56.30	45.60	35.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR WILMINGTON DELAWARE
AND STATION LATITUDE = 39.80 DEGREES

HEAD #1: AVERAGE HEAD ON TOP OF LAYER 4
DRAIN #1: LATERAL DRAINAGE FROM LAYER 3 (RECIRCULATION AND COLLECTION)
LEAK #1: PERCOLATION OR LEAKAGE THROUGH LAYER 4
HEAD #2: AVERAGE HEAD ON TOP OF LAYER 6
DRAIN #2: LATERAL DRAINAGE FROM LAYER 5 (RECIRCULATION AND COLLECTION)
LEAK #2: PERCOLATION OR LEAKAGE THROUGH LAYER 6

****

DAILY OUTPUT FOR YEAR 1974

DAY	A I R	SOILI LEAK IN.	RAIN IN.	RUNOFF IN.	ET IN.	E. ZONE WATER IN./IN.	HEAD #1 IN.	DRAIN #1 IN.	LEAK #1 IN.	HEAD #2 IN.	DRAIN #2 IN.	LEAK #2 IN.
1			0.05	0.000	0.044	0.2438	0.0462	.8284E-02	.3976E-04	0.0001	.0000E+00	.4256E-04
2	*		0.00	0.000	0.031	0.2418	0.0376	.6738E-02	.3301E-04	0.0001	.0000E+00	.3470E-04
3	*		0.50	0.000	0.031	0.2426	0.0314	.5627E-02	.2807E-04	0.0001	.0000E+00	.2931E-04
4	*		0.15	0.000	0.027	0.2434	0.0259	.4645E-02	.2363E-04	0.0001	.0000E+00	.2474E-04
5	*		0.00	0.000	0.032	0.2442	0.0226	.4059E-02	.2094E-04	0.0000	.0000E+00	.2161E-04
6			0.00	0.000	0.010	0.2573	0.0182	.3269E-02	.1725E-04	0.0000	.0000E+00	.1817E-04
7	*		0.00	0.000	0.034	0.2583	0.0114	.2038E-02	.1132E-04	0.0000	.0000E+00	.1280E-04
8	*		0.00	0.000	0.040	0.2592	0.0149	.2672E-02	.1441E-04	0.0000		

```
.0000E+00 .1364E-04
    9         0.62  0.000  0.000  0.2964    0.4165 .7467E-01 .2710E-03    0.0003
.0000E+00 .2068E-03
   10  *      0.29  0.000  0.029  0.2802    1.7617 .3159     .1128E-02    0.0015
.0000E+00 .9139E-03
   11  *      0.50  0.000  0.000  0.2712    1.0231 .1835     .6794E-03    0.0019
.0000E+00 .7916E-03
   12  *      0.00  0.000  0.029  0.2658    0.6527 .1170     .4478E-03    0.0012
.0000E+00 .5057E-03
   13  *      0.02  0.000  0.029  0.2624    0.4523 .8110E-01 .3191E-03    0.0008
.0000E+00 .3513E-03
   14  *      0.00  0.000  0.026  0.2602    0.3345 .5999E-01 .2417E-03    0.0006
.0000E+00 .2611E-03
   15  *      0.00  0.000  0.022  0.2587    0.2603 .4668E-01 .1920E-03    0.0005
.0000E+00 .2044E-03
   16  *      0.00  0.000  0.026  0.2577    0.2096 .3759E-01 .1574E-03    0.0004
.0000E+00 .1661E-03
   17  *      0.00  0.000  0.031  0.2571    0.1718 .3081E-01 .1312E-03    0.0003
.0000E+00 .1378E-03
   18  *      0.00  0.000  0.033  0.2568    0.1412 .2533E-01 .1097E-03    0.0003
.0000E+00 .1151E-03
   19         0.02  0.000  0.000  0.2792    0.1041 .1867E-01 .8304E-04    0.0002
.0000E+00 .8971E-04
   20         0.00  0.000  0.058  0.2749    0.1161 .2081E-01 .9163E-04    0.0002
.0000E+00 .8949E-04
   21         0.51  0.000  0.067  0.2964    0.2713 .4864E-01 .1984E-03    0.0003
.0000E+00 .1717E-03
   22         0.00  0.000  0.051  0.2839    0.9877 .1771     .6576E-03    0.0009
.0000E+00 .5428E-03
   23         0.00  0.000  0.063  0.2709    0.9749 .1748     .6497E-03    0.0014
.0000E+00 .6517E-03
   24         0.05  0.000  0.068  0.2633    0.6653 .1193     .4559E-03    0.0012
.0000E+00 .5043E-03
   25         0.00  0.000  0.056  0.2552    0.5106 .9155E-01 .3569E-03    0.0008
.0000E+00 .3817E-03
   26         0.02  0.000  0.053  0.2498    0.3706 .6645E-01 .2656E-03    0.0006
.0000E+00 .2884E-03
   27         0.12  0.000  0.056  0.2506    0.2674 .4795E-01 .1968E-03    0.0005
.0000E+00 .2140E-03
   28         0.10  0.000  0.056  0.2512    0.1916 .3435E-01 .1449E-03    0.0004
.0000E+00 .1579E-03
   29         0.00  0.000  0.050  0.2469    0.1526 .2737E-01 .1178E-03    0.0003
.0000E+00 .1246E-03
   30         0.00  0.000  0.056  0.2425    0.1331 .2387E-01 .1040E-03    0.0002
.0000E+00 .1074E-03
   31         0.00  0.000  0.049  0.2387    0.1167 .2093E-01 .9221E-04    0.0002
.0000E+00 .9515E-04
   32  *      0.00  0.000  0.043  0.2352    0.1141 .2046E-01 .9033E-04    0.0002
.0000E+00 .9080E-04
   33  *      0.08  0.000  0.039  0.2354    0.0933 .1673E-01 .7522E-04    0.0002
.0000E+00 .7900E-04
   34         0.02  0.000  0.049  0.2342    0.0726 .1302E-01 .5990E-04    0.0001
.0000E+00 .6373E-04
   35  *      0.00  0.000  0.038  0.2316    0.0591 .1060E-01 .4972E-04    0.0001
.0000E+00 .5226E-04
   36  *      0.00  0.000  0.040  0.2289    0.0495 .8881E-02 .4236E-04    0.0001
.0000E+00 .4420E-04
   37  *      0.11  0.000  0.042  0.2296    0.0400 .7174E-02 .3493E-04    0.0001
.0000E+00 .3679E-04
   38         0.18  0.000  0.034  0.2399    0.0320 .5741E-02 .2858E-04    0.0001
.0000E+00 .3017E-04
   39         0.51  0.000  0.060  0.2642    0.0272 .4880E-02 .2470E-04    0.0001
.0000E+00 .2567E-04
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40		0.00	0.000	0.055	0.2611	0.0116	.2085E-02	.1146E-04	0.0000	.0000E+00 .1477E-04
41		0.00	0.000	0.071	0.2571	0.0146	.2618E-02	.1403E-04	0.0000	.0000E+00 .1339E-04
42		0.00	0.000	0.076	0.2528	0.0151	.2701E-02	.1358E-04	0.0000	.0000E+00 .1369E-04
43		0.00	0.000	0.072	0.2475	0.1335	.2393E-01	.1040E-03	0.0001	.0000E+00 .8136E-04
44		0.01	0.000	0.067	0.2425	0.1947	.3491E-01	.1471E-03	0.0003	.0000E+00 .1363E-03
45		0.00	0.000	0.074	0.2366	0.1877	.3365E-01	.1423E-03	0.0003	.0000E+00 .1435E-03
46		0.00	0.000	0.071	0.2310	0.1721	.3087E-01	.1315E-03	0.0003	.0000E+00 .1342E-03
47		0.18	0.000	0.060	0.2361	0.1509	.2706E-01	.1166E-03	0.0003	.0000E+00 .1203E-03
48		0.00	0.000	0.066	0.2312	0.1318	.2364E-01	.1031E-03	0.0002	.0000E+00 .1064E-03
49		0.00	0.000	0.067	0.2263	0.1201	.2154E-01	.9465E-04	0.0002	.0000E+00 .9675E-04
50		0.34	0.000	0.058	0.2408	0.0939	.1684E-01	.7564E-04	0.0002	.0000E+00 .8040E-04
51		0.00	0.000	0.063	0.2367	0.0715	.1283E-01	.5908E-04	0.0001	.0000E+00 .6322E-04
52		0.00	0.000	0.075	0.2320	0.0562	.1007E-01	.4747E-04	0.0001	.0000E+00 .5037E-04
53		0.02	0.000	0.051	0.2299	0.0408	.7320E-02	.3554E-04	0.0001	.0000E+00 .3853E-04
54	*	0.00	0.000	0.052	0.2268	0.0286	.5136E-02	.2585E-04	0.0001	.0000E+00 .2827E-04
55		0.00	0.000	0.051	0.2238	0.0273	.4903E-02	.2480E-04	0.0001	.0000E+00 .2507E-04
56	*	0.69	0.000	0.036	0.2246	0.0236	.4227E-02	.2171E-04	0.0000	.0000E+00 .2248E-04
57		0.00	0.000	0.033	0.2267	0.0187	.3354E-02	.1765E-04	0.0000	.0000E+00 .1867E-04
58		0.00	0.000	0.003	0.2553	0.0162	.2906E-02	.1553E-04	0.0000	.0000E+00 .1606E-04
59		0.00	0.000	0.078	0.2513	0.1434	.2570E-01	.1022E-03	0.0001	.0000E+00 .8057E-04
60		0.07	0.000	0.062	0.2468	0.4982	.8933E-01	.3489E-03	0.0005	.0000E+00 .2872E-03
61	*	0.05	0.000	0.046	0.2437	0.3433	.6155E-01	.2475E-03	0.0006	.0000E+00 .2728E-03
62	*	0.00	0.000	0.000	0.2414	0.2313	.4148E-01	.1723E-03	0.0004	.0000E+00 .1911E-03
63		0.00	0.000	0.065	0.2364	0.1559	.2795E-01	.1200E-03	0.0003	.0000E+00 .1331E-03
64		0.00	0.000	0.085	0.2305	0.1243	.2229E-01	.9768E-04	0.0002	.0000E+00 .1033E-03
65		0.01	0.000	0.052	0.2272	0.1052	.1886E-01	.8385E-04	0.0002	.0000E+00 .8731E-04
66	*	0.00	0.000	0.057	0.2233	0.0731	.1310E-01	.6020E-04	0.0002	.0000E+00 .6611E-04
67		0.18	0.000	0.088	0.2278	0.0594	.1065E-01	.4992E-04	0.0001	.0000E+00 .5249E-04
68	*	0.19	0.000	0.056	0.2283	0.0492	.8817E-02	.4206E-04	0.0001	.0000E+00 .4403E-04
69		0.00	0.000	0.071	0.2303	0.0372	.6667E-02	.3270E-04	0.0001	.0000E+00 .3504E-04
70	*	0.00	0.000	0.065	0.2264	0.0345	.6189E-02	.3058E-04	0.0001	.0000E+00 .3111E-04
71	*	0.00	0.000	0.057	0.2230	0.0330	.5912E-02	.2935E-04	0.0001	

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.0000E+00 .2966E-04
   72  *      0.00  0.000  0.044  0.2204    0.0234 .4203E-02 .2157E-04    0.0001
.0000E+00 .2352E-04
   73         0.00  0.000  0.079  0.2159    0.0140 .2519E-02 .1366E-04    0.0000
.0000E+00 .1564E-04
   74         0.00  0.000  0.086  0.2110    0.0153 .2742E-02 .1472E-04    0.0000
.0000E+00 .1446E-04
   75         1.02  0.000  0.077  0.2624    0.0197 .3539E-02 .1852E-04    0.0000
.0000E+00 .1757E-04
   76         0.00  0.000  0.058  0.2591    0.0145 .2592E-02 .1397E-04    0.0000
.0000E+00 .1511E-04
   77         0.00  0.000  0.068  0.2553    0.0101 .1739E-02 .8863E-05    0.0000
.0000E+00 .1014E-04
   78         0.06  0.000  0.096  0.2519    0.1360 .2438E-01 .1057E-03    0.0001
.0000E+00 .8147E-04
   79         0.00  0.000  0.110  0.2439    0.2060 .3694E-01 .1549E-03    0.0003
.0000E+00 .1426E-03
   80         1.42  0.034  0.074  0.3098    0.5823 .1044     .3901E-03    0.0006
.0000E+00 .3313E-03
   81         0.00  0.000  0.107  0.2815    2.2793 .4087     .1436E-02    0.0019
.0000E+00 .1175E-02
   82         0.00  0.000  0.118  0.2639    1.1380 .2041     .7496E-03    0.0023
.0000E+00 .9213E-03
   83         0.00  0.000  0.112  0.2523    0.5560 .9969E-01 .3860E-03    0.0012
.0000E+00 .4769E-03
   84         0.00  0.000  0.116  0.2422    0.3877 .6951E-01 .2768E-03    0.0007
.0000E+00 .3041E-03
   85         0.00  0.000  0.127  0.2325    0.2844 .5100E-01 .2083E-03    0.0005
.0000E+00 .2254E-03
   86         0.00  0.000  0.106  0.2244    0.2308 .4139E-01 .1719E-03    0.0004
.0000E+00 .1810E-03
   87         0.00  0.000  0.113  0.2164    0.1839 .3298E-01 .1397E-03    0.0003
.0000E+00 .1477E-03
   88         0.36  0.000  0.117  0.2281    0.1573 .2821E-01 .1211E-03    0.0003
.0000E+00 .1257E-03
   89         1.28  0.010  0.114  0.2902    0.1168 .2094E-01 .9225E-04    0.0002
.0000E+00 .9945E-04
   90         0.27  0.000  0.104  0.2864    1.3078 .2345     .8541E-03    0.0010
.0000E+00 .6636E-03
   91         0.05  0.000  0.081  0.2759    0.8886 .1593     .5961E-03    0.0015
.0000E+00 .6606E-03
   92         0.11  0.000  0.104  0.2707    0.5613 .1007     .3892E-03    0.0010
.0000E+00 .4409E-03
   93         0.00  0.000  0.137  0.2603    0.2976 .5337E-01 .2170E-03    0.0006
.0000E+00 .2601E-03
   94         0.24  0.000  0.100  0.2654    0.2668 .4784E-01 .1964E-03    0.0004
.0000E+00 .2015E-03
   95         0.29  0.000  0.103  0.2734    0.2216 .3974E-01 .1657E-03    0.0004
.0000E+00 .1733E-03
   96         0.02  0.000  0.063  0.2689    0.2202 .3949E-01 .1647E-03    0.0003
.0000E+00 .1649E-03
   97         0.00  0.000  0.087  0.2621    0.2039 .3656E-01 .1533E-03    0.0003
.0000E+00 .1562E-03
   98         0.43  0.000  0.072  0.2806    0.1170 .2098E-01 .9232E-04    0.0003
.0000E+00 .1076E-03
   99  *      0.80  0.000  0.042  0.2790    0.2678 .4801E-01 .1969E-03    0.0003
.0000E+00 .1707E-03
  100         0.00  0.000  0.034  0.3057    1.2056 .2162     .7825E-03    0.0010
.0000E+00 .6361E-03
  101         0.00  0.000  0.123  0.2751    2.7588 .4341     .1718E-02    0.0026
.0000E+00 .1913E-02
  102         0.00  0.000  0.107  0.2568    1.2594 .2258     .8243E-03    0.0009
.0000E+00 .6182E-03
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103	0.46	0.000	0.116	0.2686	0.7212	.1293	.4910E-03	0.0014	.0000E+00	.5743E-03
104	0.00	0.000	0.123	0.2575	0.4406	.7900E-01	.3115E-03	0.0008	.0000E+00	.3564E-03
105	0.00	0.000	0.115	0.2488	0.2397	.4299E-01	.1778E-03	0.0005	.0000E+00	.2112E-03
106	0.00	0.000	0.145	0.2387	0.2227	.3994E-01	.1664E-03	0.0004	.0000E+00	.1693E-03
107	0.00	0.000	0.184	0.2265	0.2233	.4005E-01	.1668E-03	0.0003	.0000E+00	.1667E-03
108	0.00	0.000	0.151	0.2161	0.2152	.3858E-01	.1612E-03	0.0003	.0000E+00	.1626E-03
109	0.10	0.000	0.151	0.2115	0.1897	.3401E-01	.1437E-03	0.0003	.0000E+00	.1481E-03
110	0.00	0.000	0.197	0.1991	0.1646	.2952E-01	.1262E-03	0.0003	.0000E+00	.1306E-03
111	0.00	0.000	0.209	0.1864	0.1206	.2162E-01	.9495E-04	0.0002	.0000E+00	.1028E-03
112	0.00	0.000	0.158	0.1770	0.0842	.1509E-01	.6845E-04	0.0002	.0000E+00	.7508E-04
113	0.27	0.000	0.110	0.1852	0.0575	.1030E-01	.4843E-04	0.0001	.0000E+00	.5343E-04
114	0.00	0.000	0.166	0.1757	0.0429	.7693E-02	.3721E-04	0.0001	.0000E+00	.4001E-04
115	0.00	0.000	0.085	0.1707	0.0342	.6124E-02	.3028E-04	0.0001	.0000E+00	.3201E-04
116	0.00	0.000	0.066	0.1669	0.0147	.2635E-02	.1416E-04	0.0000	.0000E+00	.1819E-04
117	0.00	0.000	0.052	0.1640	0.0039	.6481E-03	.3756E-05	0.0000	.0000E+00	.6356E-05
118	0.00	0.000	0.048	0.1614	0.0028	.4549E-03	.2768E-05	0.0000	.0000E+00	.3015E-05
119	0.00	0.000	0.047	0.1588	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.6920E-06
120	0.00	0.000	0.043	0.1565	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
121	0.00	0.000	0.040	0.1543	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
122	0.10	0.000	0.043	0.1574	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
123	0.47	0.000	0.042	0.1808	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
124	0.00	0.000	0.195	0.1701	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
125	0.00	0.000	0.038	0.1681	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
126	0.25	0.000	0.043	0.1794	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
127	0.00	0.000	0.220	0.1674	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
128	0.00	0.000	0.038	0.1653	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
129	0.22	0.000	0.045	0.1749	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
130	0.67	0.000	0.044	0.2091	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
131	0.00	0.000	0.180	0.1993	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
132	0.43	0.000	0.204	0.2116	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
133	0.00	0.000	0.244	0.1983	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
134	0.00	0.000	0.195	0.1876	0.0000	.0000E+00	.0000E+00	0.0000		

.0000E+00	.0000E+00								
135	0.00	0.000	0.244	0.1743	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
136	0.00	0.000	0.211	0.1627	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
137	0.11	0.000	0.140	0.1611	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
138	0.02	0.000	0.114	0.1560	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
139	0.00	0.000	0.103	0.1503	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
140	0.00	0.000	0.092	0.1453	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
141	0.00	0.000	0.080	0.1410	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
142	0.32	0.000	0.108	0.1525	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
143	0.43	0.000	0.118	0.1696	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
144	0.14	0.000	0.113	0.1710	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
145	0.00	0.000	0.166	0.1619	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
146	0.00	0.000	0.124	0.1552	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
147	0.00	0.000	0.154	0.1467	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
148	0.00	0.000	0.146	0.1388	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
149	0.03	0.000	0.096	0.1352	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
150	0.00	0.000	0.016	0.1343	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
151	0.02	0.000	0.027	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
152	0.06	0.000	0.025	0.1358	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
153	0.36	0.000	0.084	0.1509	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
154	0.00	0.000	0.106	0.1451	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
155	0.00	0.000	0.109	0.1392	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
156	0.00	0.000	0.073	0.1352	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
157	0.00	0.000	0.019	0.1342	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
158	0.05	0.000	0.027	0.1355	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
159	0.00	0.000	0.017	0.1346	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
160	0.00	0.000	0.009	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
161	0.00	0.000	0.003	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
162	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
163	0.01	0.000	0.010	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
164	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
165	0.56	0.000	0.074	0.1604	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								

166	0.00	0.000	0.108	0.1545	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
167	0.57	0.000	0.125	0.1789	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
168	0.20	0.000	0.159	0.1811	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
169	0.00	0.000	0.210	0.1696	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
170	0.00	0.000	0.203	0.1585	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
171	0.00	0.000	0.206	0.1473	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
172	0.88	0.000	0.247	0.1819	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
173	0.06	0.000	0.268	0.1705	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
174	1.20	0.001	0.187	0.2258	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
175	0.00	0.000	0.291	0.2099	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
176	0.06	0.000	0.240	0.2000	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
177	0.00	0.000	0.286	0.1843	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
178	0.00	0.000	0.275	0.1693	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
179	0.30	0.000	0.265	0.1713	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
180	0.00	0.000	0.238	0.1582	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
181	0.12	0.000	0.247	0.1513	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
182	0.05	0.000	0.212	0.1424	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
183	0.00	0.000	0.121	0.1358	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
184	0.00	0.000	0.029	0.1342	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
185	0.00	0.000	0.005	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
186	0.39	0.000	0.077	0.1510	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
187	0.00	0.000	0.123	0.1443	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
188	0.00	0.000	0.143	0.1365	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
189	0.00	0.000	0.039	0.1343	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
190	0.00	0.000	0.006	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
191	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
192	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
193	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
194	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
195	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
196	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
197	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00								
198	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
199	0.03	0.000	0.027	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
200	0.02	0.000	0.021	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
201	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
202	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
203	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
204	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
205	0.96	0.000	0.096	0.1811	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
206	0.00	0.000	0.185	0.1710	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
207	0.00	0.000	0.207	0.1597	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
208	0.09	0.000	0.115	0.1583	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
209	0.00	0.000	0.186	0.1481	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
210	0.34	0.000	0.190	0.1563	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
211	0.20	0.000	0.157	0.1586	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
212	0.00	0.000	0.186	0.1485	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
213	0.00	0.000	0.175	0.1389	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
214	0.24	0.000	0.127	0.1451	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
215	0.00	0.000	0.111	0.1390	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
216	0.05	0.000	0.104	0.1361	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
217	0.00	0.000	0.027	0.1346	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
218	0.00	0.000	0.010	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
219	0.45	0.000	0.087	0.1539	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
220	0.00	0.000	0.094	0.1488	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
221	0.00	0.000	0.138	0.1412	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
222	0.00	0.000	0.107	0.1354	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
223	0.00	0.000	0.022	0.1342	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
224	0.00	0.000	0.003	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
225	0.00	0.000	0.003	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
226	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
227	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
228	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								

229	0.07	0.000	0.043	0.1353	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
230	0.00	0.000	0.016	0.1345	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
231	0.00	0.000	0.008	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
232	0.00	0.000	0.002	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
233	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
234	0.17	0.000	0.042	0.1408	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
235	0.86	0.000	0.105	0.1821	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
236	1.70	0.106	0.140	0.2616	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
237	0.00	0.000	0.170	0.2523	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
238	0.00	0.000	0.225	0.2400	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
239	0.00	0.000	0.211	0.2285	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
240	0.04	0.000	0.128	0.2237	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
241	0.00	0.000	0.199	0.2126	0.0261	.4679E-02	.2250E-04	0.0000	.2250E-04
242	0.25	0.000	0.176	0.2156	0.1021	.1830E-01	.8160E-04	0.0002	.8160E-04
243	0.00	0.000	0.182	0.2047	0.0985	.1766E-01	.7901E-04	0.0002	.7901E-04
244	0.16	0.000	0.128	0.2057	0.0766	.1374E-01	.6287E-04	0.0001	.6287E-04
245	0.02	0.000	0.151	0.1980	0.0570	.1022E-01	.4811E-04	0.0001	.4811E-04
246	1.35	0.005	0.146	0.2631	0.0446	.8001E-02	.3854E-04	0.0001	.3854E-04
247	0.38	0.000	0.170	0.2743	0.0286	.5133E-02	.2573E-04	0.0001	.2573E-04
248	0.00	0.000	0.174	0.2646	0.0190	.3410E-02	.1785E-04	0.0000	.1785E-04
249	0.39	0.000	0.134	0.2774	0.1241	.2225E-01	.9612E-04	0.0002	.9612E-04
250	0.79	0.002	0.127	0.2967	1.7088	.3064	.1087E-02	0.0023	.1087E-02
251	0.00	0.000	0.135	0.2716	1.8076	.3241	.1155E-02	0.0024	.1155E-02
252	0.00	0.000	0.143	0.2551	0.8850	.1587	.5935E-03	0.0012	.5935E-03
253	0.00	0.000	0.155	0.2425	0.4143	.7428E-01	.2939E-03	0.0006	.2939E-03
254	0.00	0.000	0.149	0.2323	0.2099	.3763E-01	.1575E-03	0.0003	.1575E-03
255	0.19	0.000	0.122	0.2343	0.1768	.3170E-01	.1347E-03	0.0003	.1347E-03
256	0.16	0.000	0.116	0.2351	0.1604	.2877E-01	.1233E-03	0.0003	.1233E-03
257	0.34	0.000	0.088	0.2475	0.1430	.2565E-01	.1110E-03	0.0002	.1110E-03
258	0.00	0.000	0.179	0.2365	0.1285	.2304E-01	.1007E-03	0.0002	.1007E-03
259	0.00	0.000	0.135	0.2281	0.0988	.1772E-01	.7923E-04	0.0002	.7923E-04
260	0.00	0.000	0.107	0.2215	0.0705	.1265E-01	.5832E-04	0.0001	

.0000E+00	.5832E-04									
261	0.00	0.000	0.143	0.2132	0.0525	.9405E-02	.4461E-04	0.0001	.0000E+00	.4461E-04
262	0.00	0.000	0.140	0.2051	0.0420	.7534E-02	.3651E-04	0.0001	.0000E+00	.3651E-04
263	0.00	0.000	0.117	0.1983	0.0338	.6056E-02	.2999E-04	0.0001	.0000E+00	.2999E-04
264	0.14	0.000	0.137	0.1983	0.0218	.3902E-02	.2011E-04	0.0000	.0000E+00	.2011E-04
265	0.00	0.000	0.130	0.1912	0.0015	.2613E-03	.1570E-05	0.0000	.0000E+00	.1570E-05
266	0.00	0.000	0.110	0.1852	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
267	0.00	0.000	0.106	0.1794	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
268	0.00	0.000	0.121	0.1728	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
269	0.00	0.000	0.110	0.1668	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
270	0.00	0.000	0.123	0.1600	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
271	0.76	0.000	0.109	0.1956	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
272	0.00	0.000	0.107	0.1898	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
273	0.00	0.000	0.077	0.1856	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
274	0.00	0.000	0.048	0.1829	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
275	0.00	0.000	0.057	0.1798	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
276	0.00	0.000	0.048	0.1772	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
277	0.00	0.000	0.068	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
278	0.00	0.000	0.054	0.1705	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
279	0.00	0.000	0.071	0.1666	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
280	0.00	0.000	0.075	0.1625	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
281	0.00	0.000	0.070	0.1587	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
282	0.00	0.000	0.063	0.1552	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
283	0.00	0.000	0.041	0.1530	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
284	0.00	0.000	0.034	0.1511	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
285	0.00	0.000	0.046	0.1486	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
286	0.00	0.000	0.043	0.1463	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
287	0.00	0.000	0.043	0.1439	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
288	0.33	0.000	0.073	0.1580	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
289	1.60	0.030	0.063	0.2404	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
290	0.00	0.000	0.029	0.2388	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
291	0.00	0.000	0.038	0.2367	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

292	0.00	0.000	0.029	0.2352	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
293	0.00	0.000	0.036	0.2332	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
294	0.00	0.000	0.041	0.2310	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
295	0.00	0.000	0.032	0.2292	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
296	0.00	0.000	0.027	0.2277	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
297	0.00	0.000	0.027	0.2263	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
298	0.00	0.000	0.028	0.2248	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
299	0.00	0.000	0.020	0.2237	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
300	0.00	0.000	0.043	0.2213	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
301	0.00	0.000	0.045	0.2189	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
302	0.00	0.000	0.039	0.2167	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
303	0.00	0.000	0.045	0.2142	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
304	0.00	0.000	0.045	0.2118	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
305	0.00	0.000	0.053	0.2089	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
306	0.06	0.000	0.058	0.2090	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
307	0.02	0.000	0.049	0.2074	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
308	0.00	0.000	0.045	0.2049	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
309	0.07	0.000	0.061	0.2054	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
310	0.00	0.000	0.059	0.2021	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
311	0.00	0.000	0.055	0.1991	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
312	0.00	0.000	0.058	0.1960	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
313	0.00	0.000	0.051	0.1932	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
314	0.00	0.000	0.062	0.1898	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
315	0.00	0.000	0.058	0.1866	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
316	0.34	0.000	0.067	0.2015	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
317	0.00	0.000	0.057	0.1984	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
318	0.00	0.000	0.051	0.1956	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
319	0.05	0.000	0.064	0.1948	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
320	0.00	0.000	0.058	0.1917	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
321	0.00	0.000	0.046	0.1892	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
322	0.00	0.000	0.039	0.1870	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
323	0.00	0.000	0.039	0.1849	0.0000	.0000E+00	.0000E+00	0.0000	

```
.0000E+00 .0000E+00
  324         0.22  0.000  0.057  0.1938    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  325         0.02  0.000  0.044  0.1925    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  326         0.00  0.000  0.035  0.1905    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  327         0.00  0.000  0.032  0.1888    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  328         0.00  0.000  0.031  0.1871    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  329         0.03  0.000  0.049  0.1861    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  330         0.00  0.000  0.041  0.1838    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  331         0.00  0.000  0.033  0.1820    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  332         0.00  0.000  0.034  0.1802    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  333         0.00  0.000  0.042  0.1779    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  334         0.00  0.000  0.033  0.1761    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  335         0.66  0.000  0.051  0.2094    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  336         0.49  0.000  0.045  0.2337    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  337         0.00  0.000  0.034  0.2318    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  338         0.00  0.000  0.029  0.2302    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  339         0.00  0.000  0.030  0.2286    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  340         0.00  0.000  0.036  0.2267    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  341         0.07  0.000  0.045  0.2280    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  342         0.72  0.000  0.047  0.2648    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  343         0.00  0.000  0.037  0.2618    0.0974 .1747E-01 .7572E-04    0.0002
.0000E+00 .7572E-04
  344         0.00  0.000  0.028  0.2578    0.2498 .4478E-01 .1848E-03    0.0004
.0000E+00 .1848E-03
  345  *      0.00  0.000  0.023  0.2536    0.3009 .5396E-01 .2193E-03    0.0005
.0000E+00 .2193E-03
  346  *      0.00  0.000  0.000  0.2509    0.2735 .4905E-01 .2009E-03    0.0004
.0000E+00 .2009E-03
  347  *      0.00  0.000  0.000  0.2486    0.2320 .4160E-01 .1728E-03    0.0004
.0000E+00 .1728E-03
  348  *      0.11  0.000  0.020  0.2478    0.1998 .3583E-01 .1507E-03    0.0003
.0000E+00 .1507E-03
  349  *      0.00  0.000  0.032  0.2473    0.1576 .2826E-01 .1213E-03    0.0003
.0000E+00 .1213E-03
  350         1.54  0.063  0.050  0.3171    0.9317 .1671     .6041E-03    0.0013
.0000E+00 .6041E-03
  351         0.00  0.000  0.039  0.2881    3.6003 .4888     .2211E-02    0.0034
.0000E+00 .2211E-02
  352         0.00  0.000  0.029  0.2719    1.4814 .2656     .9591E-03    0.0020
.0000E+00 .9591E-03
  353  *      0.00  0.000  0.025  0.2636    0.7094 .1272     .4832E-03    0.0010
.0000E+00 .4832E-03
  354  *      0.00  0.000  0.000  0.2595    0.4157 .7454E-01 .2952E-03    0.0006
.0000E+00 .2952E-03
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  355  *      0.00  0.000  0.000  0.2562    0.3335 .5980E-01 .2411E-03    0.0005
.0000E+00 .2411E-03
  356         0.00  0.000  0.029  0.2520    0.2698 .4838E-01 .1984E-03    0.0004
.0000E+00 .1984E-03
  357         0.00  0.000  0.037  0.2479    0.2127 .3814E-01 .1595E-03    0.0003
.0000E+00 .1595E-03
  358         0.00  0.000  0.043  0.2439    0.1619 .2903E-01 .1243E-03    0.0003
.0000E+00 .1243E-03
  359         0.14  0.000  0.054  0.2473    0.1407 .2522E-01 .1093E-03    0.0002
.0000E+00 .1093E-03
  360         0.00  0.000  0.040  0.2438    0.1295 .2323E-01 .1014E-03    0.0002
.0000E+00 .1014E-03
  361         0.00  0.000  0.040  0.2405    0.1132 .2031E-01 .8971E-04    0.0002
.0000E+00 .8971E-04
  362         0.00  0.000  0.049  0.2368    0.1086 .1947E-01 .8636E-04    0.0002
.0000E+00 .8636E-04
  363         0.00  0.000  0.045  0.2334    0.0970 .1740E-01 .7793E-04    0.0002
.0000E+00 .7793E-04
  364         0.00  0.000  0.046  0.2301    0.0776 .1391E-01 .6358E-04    0.0001
.0000E+00 .6358E-04
  365         0.31  0.000  0.048  0.2438    0.0608 .1091E-01 .5102E-04    0.0001
.0000E+00 .5102E-04

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                    MONTHLY TOTALS (IN INCHES) FOR YEAR 1974
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                                  JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                                  ------- ------- ------- ------- ------- -------

 PRECIPITATION                     2.95    2.14    4.91    2.77    3.21    4.43
                                   2.08    3.83    4.68    1.93    0.81    4.04

 RUNOFF                            0.000   0.000   0.044   0.000   0.000   0.001
                                   0.000   0.106   0.007   0.030   0.000   0.063

 EVAPOTRANSPIRATION                1.158   1.524   2.531   3.219   3.623   4.111
                                   2.132   2.654   3.889   1.421   1.463   1.031

 LATERAL DRAINAGE COLLECTED        1.8817  0.3838  1.6868  1.9200  0.0000  0.0000
   FROM LAYER  3                   0.0000  0.0406  1.1306  0.0000  0.0000  1.6999

 PERCOLATION/LEAKAGE THROUGH       0.0073  0.0017  0.0065  0.0075  0.0000  0.0000
   LAYER  4                        0.0000  0.0002  0.0043  0.0000  0.0000  0.0070

 PERCOLATION/LEAKAGE THROUGH       0.0073  0.0017  0.0063  0.0078  0.0000  0.0000
   LAYER  6                        0.0000  0.0002  0.0043  0.0000  0.0000  0.0070


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                    MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
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 AVERAGE DAILY HEAD ON             0.339   0.076   0.303   0.368   0.000   0.000
   TOP OF LAYER  4                 0.000   0.007   0.210   0.000   0.000   0.334
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STD. DEVIATION OF DAILY	0.396	0.058	0.480	0.560	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.025	0.455	0.000	0.000	0.682
AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 6	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.001	0.001	0.000	0.000
HEAD ON TOP OF LAYER 6	0.000	0.000	0.001	0.000	0.000	0.001

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ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.78	2202697.250	100.00
RUNOFF	0.252	14677.791	0.67
EVAPOTRANSPIRATION	28.753	1676387.870	76.11
DRAINAGE COLLECTED FROM LAYER 3	8.7435	509772.812	23.14
PERC./LEAKAGE THROUGH LAYER 4	0.034503	2011.634	0.09
AVG. HEAD ON TOP OF LAYER 4	0.1365		
PERC./LEAKAGE THROUGH LAYER 6	0.034516	2012.376	0.09
AVG. HEAD ON TOP OF LAYER 6	0.0002		
CHANGE IN WATER STORAGE	-0.003	-153.907	-0.01
SOIL WATER AT START OF YEAR	172.871	10078929.000	
SOIL WATER AT END OF YEAR	172.868	10078775.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.255	0.00

****

HEAD #1: AVERAGE HEAD ON TOP OF LAYER 4
DRAIN #1: LATERAL DRAINAGE FROM LAYER 3 (RECIRCULATION AND COLLECTION)
LEAK #1: PERCOLATION OR LEAKAGE THROUGH LAYER 4
HEAD #2: AVERAGE HEAD ON TOP OF LAYER 6
DRAIN #2: LATERAL DRAINAGE FROM LAYER 5 (RECIRCULATION AND COLLECTION)
LEAK #2: PERCOLATION OR LEAKAGE THROUGH LAYER 6

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DAILY OUTPUT FOR YEAR 1975

DAY	A I R	S O I L	RAIN IN.	RUNOFF IN.	ET IN.	E. ZONE WATER IN./IN.	HEAD #1 IN.	DRAIN #1 IN.	LEAK #1 IN.	HEAD #2 IN.	DRAIN #2 IN.	LEAK #2 IN.
1			0.11	0.000	0.051	0.2466	0.0480	.8600E-02	.4114E-04	0.0001	.0000E+00	.4114E-04
2			0.00	0.000	0.034	0.2444	0.0391	.7006E-02	.3419E-04	0.0001	.0000E+00	.3419E-04
3		*	0.01	0.000	0.044	0.2422	0.0327	.5857E-02	.2910E-04	0.0001	.0000E+00	.2910E-04
4		*	0.02	0.000	0.044	0.2406	0.0276	.4948E-02	.2501E-04	0.0001	.0000E+00	.2501E-04
5			0.00	0.000	0.037	0.2384	0.0240	.4307E-02	.2208E-04	0.0000	.0000E+00	.2208E-04
6			0.42	0.000	0.051	0.2583	0.0210	.3771E-02	.1960E-04	0.0000	.0000E+00	.1960E-04
7			0.08	0.000	0.052	0.2597	0.0150	.2699E-02	.1454E-04	0.0000	.0000E+00	.1454E-04
8		*	0.12	0.000	0.038	0.2607	0.0109	.1947E-02	.1087E-04	0.0000	.0000E+00	.1087E-04
9		*	0.54	0.000	0.025	0.2617	0.0048	.8649E-03	.5302E-05	0.0000	.0000E+00	.5302E-05
10		*	0.00	0.000	0.026	0.2628	0.0019	.3475E-03	.2401E-05	0.0000	.0000E+00	.2401E-05
11		*	0.16	0.000	0.019	0.2635	0.0350	.6281E-02	.2983E-04	0.0001	.0000E+00	.2983E-04
12		*	0.01	0.000	0.026	0.2630	0.1586	.2844E-01	.1219E-03	0.0003	.0000E+00	.1219E-03
13		*	0.75	0.000	0.018	0.2620	0.2159	.3872E-01	.1618E-03	0.0003	.0000E+00	.1618E-03
14		*	0.00	0.000	0.019	0.2609	0.2149	.3854E-01	.1611E-03	0.0003	.0000E+00	.1611E-03
15		*	0.00	0.000	0.022	0.2601	0.1932	.3464E-01	.1461E-03	0.0003	.0000E+00	.1461E-03
16		*	0.00	0.000	0.026	0.2595	0.1682	.3016E-01	.1287E-03	0.0003	.0000E+00	.1287E-03
17		*	0.00	0.000	0.031	0.2592	0.1464	.2625E-01	.1134E-03	0.0002	.0000E+00	.1134E-03
18		*	0.71	0.000	0.000	0.2590	0.1298	.2327E-01	.1016E-03	0.0002	.0000E+00	.1016E-03
19			0.24	0.000	0.000	0.2760	0.1232	.2208E-01	.9682E-04	0.0002	.0000E+00	.9682E-04
20		*	0.37	0.000	0.032	0.2760	0.1154	.2069E-01	.9120E-04	0.0002	.0000E+00	.9120E-04
21			0.00	0.000	0.033	0.2768	0.1599	.2866E-01	.1219E-03	0.0003	.0000E+00	.1219E-03
22		*	0.00	0.000	0.031	0.2739	0.4063	.7285E-01	.2890E-03	0.0006	.0000E+00	.2890E-03
23		*	0.00	0.000	0.033	0.2706	0.4513	.8092E-01	.3185E-03	0.0007		

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.0000E+00 .3185E-03
   24  *  *   0.00  0.000  0.027  0.2677    0.2919 .5235E-01 .2129E-03    0.0004
.0000E+00 .2129E-03
   25  *  *   0.30  0.000  0.028  0.2665    0.1176 .2108E-01 .9262E-04    0.0002
.0000E+00 .9262E-04
   26  *  *   0.00  0.000  0.023  0.2661    0.0473 .8487E-02 .4056E-04    0.0001
.0000E+00 .4056E-04
   27  *  *   0.00  0.000  0.033  0.2659    0.0190 .3415E-02 .1790E-04    0.0000
.0000E+00 .1790E-04
   28  *  *   0.00  0.000  0.035  0.2658    0.0077 .1374E-02 .7965E-05    0.0000
.0000E+00 .7965E-05
   29  *  *   0.02  0.000  0.029  0.2658    0.0031 .5521E-03 .3584E-05    0.0000
.0000E+00 .3584E-05
   30  *  *   0.00  0.000  0.027  0.2658    0.0012 .2218E-03 .1635E-05    0.0000
.0000E+00 .1635E-05
   31  *  *   0.14  0.000  0.000  0.2657    0.0005 .8898E-04 .7606E-06    0.0000
.0000E+00 .7606E-06
   32     *   0.08  0.001  0.000  0.2702    0.0002 .3566E-04 .3638E-06    0.0000
.0000E+00 .3638E-06
   33  *  *   0.00  0.000  0.031  0.2702    0.0001 .1426E-04 .1815E-06    0.0000
.0000E+00 .1815E-06
   34  *  *   0.00  0.000  0.028  0.2702    0.0000 .5685E-05 .9632E-07    0.0000
.0000E+00 .9632E-07
   35  *  *   0.19  0.000  0.000  0.2702    0.0000 .2254E-05 .5579E-07    0.0000
.0000E+00 .5579E-07
   36  *  *   0.63  0.000  0.031  0.2702    0.0000 .8843E-06 .3592E-07    0.0000
.0000E+00 .3592E-07
   37  *  *   0.00  0.000  0.032  0.2702    0.0000 .3394E-06 .2526E-07    0.0000
.0000E+00 .2526E-07
   38     *   0.00  0.000  0.037  0.2702    0.0000 .1237E-06 .2129E-07    0.0000
.0000E+00 .2129E-07
   39     *   0.00  0.066  0.008  0.2790    0.0000 .3739E-07 .2110E-07    0.0000
.0000E+00 .2110E-07
   40     *   0.00  0.511  0.000  0.2918    0.0000 .3785E-08 .9900E-08    0.0000
.0000E+00 .7425E-08
   41     *   0.00  0.352  0.000  0.3010    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .2475E-08
   42     *   0.02  0.216  0.000  0.3079    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   43     *   0.49  1.318  0.000  0.3151    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   44  *  *   0.00  0.000  0.000  0.3151    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   45  *  *   0.00  0.000  0.000  0.3151    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   46  *  *   0.00  0.000  0.000  0.3151    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   47     *   0.00  0.000  0.000  0.3151    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   48  *  *   0.22  0.000  0.027  0.3151    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   49  *  *   0.01  0.000  0.030  0.3151    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   50  *  *   0.01  0.000  0.000  0.3151    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   51     *   0.00  0.000  0.056  0.3151    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   52     *   0.00  0.000  0.062  0.3151    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   53  *  *   0.00  0.000  0.056  0.3151    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   54  *  *   0.70  0.000  0.000  0.3151    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
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   55     *   0.56  0.598  0.000  0.3204    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   56  *  *   0.00  0.000  0.032  0.3204    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   57  *  *   0.00  0.000  0.031  0.3204    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   58     *   0.00  0.096  0.018  0.3230    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   59  *  *   0.00  0.000  0.033  0.3230    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   60  *  *   0.01  0.000  0.031  0.3230    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   61  *  *   0.00  0.000  0.035  0.3230    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   62  *  *   0.00  0.000  0.030  0.3230    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   63  *  *   0.00  0.000  0.030  0.3230    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   64  *  *   0.00  0.000  0.028  0.3230    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   65     *   0.00  0.108  0.057  0.3234    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   66     *   0.04  0.007  0.006  0.3249    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   67     *   0.00  0.000  0.000  0.3249    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   68     *   0.00  0.000  0.000  0.3249    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   69     *   0.13  0.074  0.006  0.3276    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   70     *   0.00  0.000  0.000  0.3276    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   71     *   0.38  0.315  0.006  0.3309    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   72     *   0.00  0.000  0.000  0.3309    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   73     *   0.71  0.648  0.006  0.3340    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   74     *   0.00  0.000  0.000  0.3340    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   75     *   0.00  0.000  0.000  0.3340    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   76         0.00  0.000  0.099  0.3090    3.8982 .3542     .2352E-02    0.0033
.0000E+00 .1651E-02
   77         0.00  0.000  0.110  0.2737    4.9894 .5330     .3020E-02    0.0027
.0000E+00 .1714E-02
   78         2.27  0.277  0.058  0.3540    3.5811 .4647     .2198E-02    0.0020
.0000E+00 .2005E-02
   79  *      0.02  0.000  0.074  0.3208    8.3255 .5473     .4956E-02    0.0022
.0000E+00 .7817E-03
   80  *      0.00  0.000  0.075  0.2887    3.8743 .5111     .2371E-02    0.0033
.0000E+00 .2194E-02
   81         0.12  0.000  0.091  0.2739    1.6638 .2983     .1069E-02    0.0019
.0000E+00 .9274E-03
   82         0.00  0.000  0.083  0.2602    0.9348 .1676     .6246E-03    0.0012
.0000E+00 .5645E-03
   83         0.60  0.000  0.085  0.2830    0.5445 .9763E-01 .3786E-03    0.0094
.0000E+00 .2551E-02
   84         0.00  0.000  0.123  0.2704    0.5931 .1064     .4083E-03    0.0235
.0000E+00 .3402E-02
   85         0.00  0.000  0.136  0.2573    0.5780 .1036     .4002E-03    0.0104
.0000E+00 .1887E-02
   86         0.00  0.000  0.148  0.2445    0.4759 .8533E-01 .3345E-03    0.0008
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.0000E+00	.3509E-03								
87	0.00	0.000	0.116	0.2347	0.3566	.6395E-01	.2564E-03	0.0006	
.0000E+00	.2759E-03								
88	0.00	0.000	0.111	0.2259	0.2810	.5038E-01	.2059E-03	0.0005	
.0000E+00	.2186E-03								
89	0.40	0.000	0.089	0.2408	0.2150	.3856E-01	.1611E-03	0.0004	
.0000E+00	.1723E-03								
90	0.00	0.000	0.137	0.2316	0.1750	.3138E-01	.1335E-03	0.0003	
.0000E+00	.1404E-03								
91	0.00	0.000	0.105	0.2245	0.1374	.2464E-01	.1070E-03	0.0003	
.0000E+00	.1136E-03								
92	0.00	0.000	0.143	0.2157	0.1001	.1795E-01	.8018E-04	0.0002	
.0000E+00	.8688E-04								
93	0.55	0.000	0.167	0.2359	0.0714	.1280E-01	.5897E-04	0.0001	
.0000E+00	.6428E-04								
94	0.00	0.000	0.155	0.2269	0.0559	.1002E-01	.4725E-04	0.0001	
.0000E+00	.5018E-04								
95	0.00	0.000	0.126	0.2195	0.0440	.7884E-02	.3803E-04	0.0001	
.0000E+00	.4034E-04								
96	0.00	0.000	0.138	0.2117	0.0284	.5087E-02	.2564E-04	0.0001	
.0000E+00	.2874E-04								
97	0.00	0.000	0.108	0.2056	0.0248	.4438E-02	.2268E-04	0.0001	
.0000E+00	.2342E-04								
98	0.00	0.000	0.109	0.1995	0.0100	.1720E-02	.9355E-05	0.0000	
.0000E+00	.1269E-04								
99	0.00	0.000	0.142	0.1918	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.2339E-05								
100	0.00	0.000	0.139	0.1842	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
101	0.00	0.000	0.124	0.1774	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
102	0.00	0.000	0.083	0.1728	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
103	0.00	0.000	0.064	0.1693	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
104	0.00	0.000	0.054	0.1664	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
105	0.20	0.000	0.052	0.1745	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
106	0.00	0.000	0.043	0.1721	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
107	0.00	0.000	0.039	0.1700	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
108	0.00	0.000	0.037	0.1680	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
109	0.05	0.000	0.039	0.1686	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
110	0.00	0.000	0.032	0.1668	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
111	0.00	0.000	0.031	0.1651	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
112	0.00	0.000	0.030	0.1634	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
113	0.00	0.000	0.030	0.1618	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
114	0.80	0.000	0.033	0.2038	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
115	1.37	0.035	0.109	0.2708	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
116	0.00	0.000	0.162	0.2604	0.1574	.2823E-01	.1173E-03	0.0002	
.0000E+00	.1173E-03								
117	0.00	0.000	0.160	0.2480	0.3658	.6560E-01	.2625E-03	0.0005	
.0000E+00	.2625E-03								

118	0.00	0.000	0.158	0.2363	0.3175	.5693E-01	.2304E-03	0.0005	.0000E+00	.2304E-03
119	0.00	0.000	0.166	0.2246	0.2642	.4738E-01	.1946E-03	0.0004	.0000E+00	.1946E-03
120	0.00	0.000	0.166	0.2135	0.2143	.3843E-01	.1607E-03	0.0003	.0000E+00	.1607E-03
121	0.18	0.000	0.165	0.2126	0.1690	.3030E-01	.1292E-03	0.0003	.0000E+00	.1292E-03
122	0.02	0.000	0.139	0.2049	0.1169	.2096E-01	.9231E-04	0.0002	.0000E+00	.9231E-04
123	0.00	0.000	0.182	0.1941	0.0823	.1475E-01	.6707E-04	0.0001	.0000E+00	.6707E-04
124	0.81	0.000	0.126	0.2310	0.0599	.1074E-01	.5027E-04	0.0001	.0000E+00	.5027E-04
125	0.00	0.000	0.205	0.2193	0.0466	.8347E-02	.4005E-04	0.0001	.0000E+00	.4005E-04
126	0.25	0.000	0.179	0.2229	0.0301	.5394E-02	.2685E-04	0.0001	.0000E+00	.2685E-04
127	0.00	0.000	0.188	0.2126	0.0014	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
128	0.00	0.000	0.229	0.2001	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
129	0.00	0.000	0.193	0.1895	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
130	0.00	0.000	0.189	0.1792	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
131	0.00	0.000	0.188	0.1689	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
132	0.62	0.000	0.097	0.1974	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
133	0.57	0.000	0.165	0.2196	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
134	0.00	0.000	0.173	0.2101	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
135	0.00	0.000	0.130	0.2031	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
136	0.71	0.000	0.085	0.2372	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
137	0.00	0.000	0.169	0.2280	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
138	0.01	0.000	0.160	0.2198	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
139	0.00	0.000	0.203	0.2087	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
140	0.00	0.000	0.228	0.1963	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
141	0.86	0.000	0.189	0.2330	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
142	0.06	0.000	0.194	0.2256	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
143	0.00	0.000	0.205	0.2144	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
144	0.00	0.000	0.206	0.2032	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
145	0.00	0.000	0.217	0.1913	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
146	0.00	0.000	0.230	0.1788	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
147	0.00	0.000	0.225	0.1665	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
148	0.00	0.000	0.231	0.1539	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
149	0.00	0.000	0.148	0.1458	0.0000	.0000E+00	.0000E+00	0.0000		

									.0000E+00	.0000E+00
150	0.90	0.000	0.129	0.1879	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
151	0.00	0.000	0.186	0.1778	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
152	1.42	0.021	0.170	0.2450	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
153	0.00	0.000	0.210	0.2335	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
154	0.00	0.000	0.206	0.2223	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
155	0.00	0.000	0.219	0.2103	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
156	2.10	0.146	0.227	0.3047	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
157	0.16	0.000	0.233	0.2828	1.8174	.3259	.1159E-02	0.0024	.0000E+00	.1159E-02
158	0.00	0.000	0.243	0.2591	1.0570	.1895	.6996E-03	0.0015	.0000E+00	.6996E-03
159	0.00	0.000	0.253	0.2409	0.4496	.8062E-01	.3168E-03	0.0007	.0000E+00	.3168E-03
160	0.00	0.000	0.323	0.2210	0.2275	.4079E-01	.1696E-03	0.0004	.0000E+00	.1696E-03
161	0.00	0.000	0.277	0.2037	0.2118	.3798E-01	.1589E-03	0.0003	.0000E+00	.1589E-03
162	0.08	0.000	0.177	0.1965	0.2033	.3646E-01	.1531E-03	0.0003	.0000E+00	.1531E-03
163	1.42	0.012	0.232	0.2594	0.1416	.2539E-01	.1099E-03	0.0002	.0000E+00	.1099E-03
164	0.63	0.000	0.209	0.2815	0.0856	.1535E-01	.6947E-04	0.0001	.0000E+00	.6947E-04
165	0.00	0.000	0.216	0.2599	0.9968	.1787	.6634E-03	0.0014	.0000E+00	.6634E-03
166	0.00	0.000	0.241	0.2395	0.7416	.1330	.5039E-03	0.0010	.0000E+00	.5039E-03
167	0.43	0.000	0.196	0.2475	0.4809	.8624E-01	.3376E-03	0.0007	.0000E+00	.3376E-03
168	0.00	0.000	0.195	0.2338	0.3141	.5632E-01	.2281E-03	0.0005	.0000E+00	.2281E-03
169	0.00	0.000	0.222	0.2194	0.2292	.4110E-01	.1709E-03	0.0004	.0000E+00	.1709E-03
170	0.22	0.000	0.199	0.2188	0.1758	.3152E-01	.1340E-03	0.0003	.0000E+00	.1340E-03
171	0.00	0.000	0.241	0.2044	0.1214	.2177E-01	.9555E-04	0.0002	.0000E+00	.9555E-04
172	0.00	0.000	0.233	0.1908	0.0859	.1539E-01	.6971E-04	0.0001	.0000E+00	.6971E-04
173	0.00	0.000	0.258	0.1761	0.0639	.1146E-01	.5335E-04	0.0001	.0000E+00	.5335E-04
174	0.00	0.000	0.235	0.1627	0.0539	.9668E-02	.4526E-04	0.0001	.0000E+00	.4526E-04
175	0.00	0.000	0.238	0.1496	0.0139	.1872E-02	.9077E-05	0.0000	.0000E+00	.9077E-05
176	0.00	0.000	0.162	0.1408	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
177	0.10	0.000	0.140	0.1386	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
178	0.01	0.000	0.038	0.1370	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
179	0.13	0.000	0.065	0.1406	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
180	0.87	0.000	0.138	0.1806	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

181	0.00	0.000	0.190	0.1702	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
182	0.00	0.000	0.210	0.1587	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
183	0.00	0.000	0.265	0.1442	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
184	0.15	0.000	0.210	0.1409	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
185	0.00	0.000	0.095	0.1357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
186	0.00	0.000	0.027	0.1342	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
187	0.00	0.000	0.005	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
188	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
189	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
190	0.09	0.000	0.042	0.1365	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
191	0.14	0.000	0.043	0.1418	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
192	0.00	0.000	0.104	0.1361	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
193	0.13	0.000	0.067	0.1396	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
194	1.87	0.064	0.158	0.2297	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
195	2.15	0.344	0.150	0.3181	0.2171	.3893E-01	.1459E-03	0.0003	.0000E+00
196	0.16	0.000	0.183	0.2944	2.2759	.4081	.1435E-02	0.0030	.0000E+00
197	0.00	0.000	0.238	0.2680	1.3672	.2452	.8900E-03	0.0019	.0000E+00
198	0.00	0.000	0.280	0.2455	0.7268	.1303	.4945E-03	0.0010	.0000E+00
199	0.00	0.000	0.251	0.2273	0.4608	.8263E-01	.3247E-03	0.0007	.0000E+00
200	0.00	0.000	0.259	0.2098	0.3378	.6057E-01	.2439E-03	0.0005	.0000E+00
201	1.24	0.002	0.211	0.2634	0.2630	.4716E-01	.1938E-03	0.0004	.0000E+00
202	0.04	0.000	0.288	0.2482	0.1660	.2976E-01	.1269E-03	0.0003	.0000E+00
203	0.00	0.000	0.290	0.2319	0.0460	.8247E-02	.3918E-04	0.0001	.0000E+00
204	0.00	0.000	0.284	0.2161	0.0298	.5337E-02	.2621E-04	0.0001	.0000E+00
205	0.00	0.000	0.257	0.2010	0.1050	.1883E-01	.8357E-04	0.0002	.0000E+00
206	0.35	0.000	0.216	0.2070	0.1354	.2427E-01	.1056E-03	0.0002	.0000E+00
207	0.00	0.000	0.248	0.1924	0.1078	.1933E-01	.8574E-04	0.0002	.0000E+00
208	0.00	0.000	0.276	0.1763	0.1009	.1810E-01	.8078E-04	0.0002	.0000E+00
209	0.00	0.000	0.249	0.1622	0.0449	.8060E-02	.3843E-04	0.0001	.0000E+00
210	0.00	0.000	0.198	0.1504	0.1052	.1887E-01	.8176E-04	0.0002	.0000E+00
211	0.00	0.000	0.220	0.1384	0.0043	.0000E+00	.0000E+00	0.0000	.0000E+00
212	0.00	0.000	0.083	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00									
213	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
214	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
215	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
216	0.50	0.000	0.108	0.1553	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
217	0.00	0.000	0.120	0.1487	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
218	0.28	0.000	0.195	0.1534	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
219	0.00	0.000	0.161	0.1446	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
220	0.00	0.000	0.153	0.1362	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
221	0.00	0.000	0.035	0.1343	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
222	0.00	0.000	0.006	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
223	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
224	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
225	0.43	0.000	0.075	0.1533	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
226	0.00	0.000	0.107	0.1474	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
227	0.00	0.000	0.152	0.1391	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
228	0.76	0.000	0.152	0.1724	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
229	0.01	0.000	0.132	0.1657	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
230	0.00	0.000	0.140	0.1581	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
231	0.00	0.000	0.159	0.1494	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
232	0.10	0.000	0.113	0.1487	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
233	0.00	0.000	0.174	0.1391	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
234	0.00	0.000	0.083	0.1346	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
235	0.00	0.000	0.009	0.1341	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
236	0.13	0.000	0.061	0.1379	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
237	0.00	0.000	0.029	0.1363	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
238	0.00	0.000	0.035	0.1344	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
239	0.00	0.000	0.007	0.1340	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
240	0.00	0.000	0.002	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
241	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
242	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
243	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									

244	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
245	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
246	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
247	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
248	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
249	0.03	0.000	0.030	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
250	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
251	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
252	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
253	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
254	0.04	0.000	0.037	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
255	0.82	0.000	0.097	0.1736	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
256	0.00	0.000	0.125	0.1667	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
257	0.00	0.000	0.159	0.1581	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
258	0.00	0.000	0.087	0.1533	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
259	0.03	0.000	0.074	0.1509	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
260	0.00	0.000	0.083	0.1464	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
261	0.08	0.000	0.113	0.1446	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
262	0.12	0.000	0.114	0.1449	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
263	0.06	0.000	0.108	0.1423	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
264	0.02	0.000	0.081	0.1389	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
265	0.22	0.000	0.104	0.1453	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
266	2.75	0.310	0.107	0.2728	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
267	1.57	0.221	0.134	0.3275	1.5945	.2143	.9835E-03	0.0020	.0000E+00
268	0.28	0.000	0.113	0.3071	4.9717	.5366	.3010E-02	0.0032	.0000E+00
269	1.19	0.070	0.091	0.3350	4.4226	.5178	.2691E-02	0.0024	.0000E+00
270	0.00	0.000	0.070	0.3011	5.2727	.5469	.3187E-02	0.0030	.0000E+00
271	0.00	0.000	0.061	0.2752	2.2842	.4096	.1440E-02	0.0028	.0000E+00
272	0.00	0.000	0.079	0.2589	1.2232	.2193	.8022E-03	0.0017	.0000E+00
273	0.00	0.000	0.070	0.2484	0.6775	.1215	.4634E-03	0.0093	.0000E+00
274	0.00	0.000	0.027	0.2430	0.3978	.7133E-01	.2834E-03	0.0032	.0000E+00
275	0.00	0.000	0.038	0.2383	0.2711	.4861E-01	.1992E-03	0.0004	

.0000E+00	.1992E-03									
276	0.00	0.000	0.036	0.2343	0.2022	.3626E-01	.1523E-03	0.0003		
.0000E+00	.1523E-03									
277	0.00	0.000	0.052	0.2300	0.1539	.2760E-01	.1187E-03	0.0002		
.0000E+00	.1187E-03									
278	0.00	0.000	0.060	0.2254	0.1264	.2267E-01	.9918E-04	0.0002		
.0000E+00	.9918E-04									
279	0.00	0.000	0.053	0.2215	0.1142	.2047E-01	.9036E-04	0.0002		
.0000E+00	.9036E-04									
280	0.00	0.000	0.049	0.2179	0.0900	.1614E-01	.7279E-04	0.0002		
.0000E+00	.7279E-04									
281	0.00	0.000	0.033	0.2154	0.0688	.1233E-01	.5699E-04	0.0001		
.0000E+00	.5699E-04									
282	0.14	0.000	0.072	0.2186	0.0520	.9327E-02	.4426E-04	0.0001		
.0000E+00	.4426E-04									
283	0.00	0.000	0.035	0.2163	0.0408	.7315E-02	.3555E-04	0.0001		
.0000E+00	.3555E-04									
284	0.43	0.000	0.072	0.2355	0.0350	.6272E-02	.3095E-04	0.0001		
.0000E+00	.3095E-04									
285	0.00	0.000	0.044	0.2328	0.0305	.5463E-02	.2734E-04	0.0001		
.0000E+00	.2734E-04									
286	0.00	0.000	0.041	0.2303	0.0274	.4913E-02	.2485E-04	0.0001		
.0000E+00	.2485E-04									
287	0.00	0.000	0.050	0.2274	0.0221	.3967E-02	.2051E-04	0.0000		
.0000E+00	.2051E-04									
288	0.00	0.000	0.059	0.2240	0.0182	.3270E-02	.1726E-04	0.0000		
.0000E+00	.1726E-04									
289	0.00	0.000	0.040	0.2216	0.0147	.2643E-02	.1426E-04	0.0000		
.0000E+00	.1426E-04									
290	0.93	0.000	0.070	0.2685	0.0127	.2271E-02	.1246E-04	0.0000		
.0000E+00	.1246E-04									
291	0.46	0.000	0.075	0.2852	0.4489	.8049E-01	.2938E-03	0.0006		
.0000E+00	.2938E-03									
292	0.92	0.006	0.074	0.3078	2.6795	.4227	.1670E-02	0.0035		
.0000E+00	.1670E-02									
293	0.12	0.000	0.060	0.2910	2.0449	.3667	.1297E-02	0.0027		
.0000E+00	.1297E-02									
294	0.00	0.000	0.028	0.2791	1.0520	.1886	.6973E-03	0.0015		
.0000E+00	.6973E-03									
295	0.00	0.000	0.018	0.2707	0.7577	.1359	.5142E-03	0.0011		
.0000E+00	.5142E-03									
296	0.00	0.000	0.015	0.2640	0.5896	.1057	.4077E-03	0.0008		
.0000E+00	.4077E-03									
297	0.00	0.000	0.022	0.2582	0.4690	.8409E-01	.3300E-03	0.0007		
.0000E+00	.3300E-03									
298	0.15	0.000	0.060	0.2597	0.3554	.6372E-01	.2556E-03	0.0005		
.0000E+00	.2556E-03									
299	0.00	0.000	0.024	0.2557	0.2735	.4904E-01	.2009E-03	0.0004		
.0000E+00	.2009E-03									
300	0.00	0.000	0.037	0.2516	0.2113	.3789E-01	.1586E-03	0.0003		
.0000E+00	.1586E-03									
301	0.00	0.000	0.038	0.2478	0.1709	.3064E-01	.1305E-03	0.0003		
.0000E+00	.1305E-03									
302	0.00	0.000	0.041	0.2444	0.1188	.2130E-01	.9369E-04	0.0002		
.0000E+00	.9369E-04									
303	0.09	0.000	0.055	0.2455	0.0814	.1460E-01	.6646E-04	0.0001		
.0000E+00	.6646E-04									
304	0.00	0.000	0.033	0.2429	0.0825	.1479E-01	.6725E-04	0.0001		
.0000E+00	.6725E-04									
305	0.00	0.000	0.039	0.2398	0.0917	.1644E-01	.7402E-04	0.0002		
.0000E+00	.7402E-04									
306	0.00	0.000	0.033	0.2373	0.0796	.1427E-01	.6508E-04	0.0001		
.0000E+00	.6508E-04									

307		0.00	0.000	0.033	0.2347	0.0713	.1278E-01	.5890E-04	0.0001	.0000E+00 .5890E-04
308		0.00	0.000	0.046	0.2316	0.0694	.1244E-01	.5747E-04	0.0001	.0000E+00 .5747E-04
309		0.00	0.000	0.037	0.2289	0.0628	.1126E-01	.5252E-04	0.0001	.0000E+00 .5252E-04
310		0.00	0.000	0.037	0.2264	0.0555	.9955E-02	.4697E-04	0.0001	.0000E+00 .4697E-04
311		0.00	0.000	0.042	0.2236	0.0502	.9006E-02	.4290E-04	0.0001	.0000E+00 .4290E-04
312		0.11	0.000	0.060	0.2258	0.0468	.8386E-02	.4022E-04	0.0001	.0000E+00 .4022E-04
313		0.00	0.000	0.027	0.2239	0.0435	.7791E-02	.3763E-04	0.0001	.0000E+00 .3763E-04
314		0.48	0.000	0.055	0.2468	0.0366	.6562E-02	.3223E-04	0.0001	.0000E+00 .3223E-04
315		0.00	0.000	0.041	0.2442	0.0329	.5892E-02	.2926E-04	0.0001	.0000E+00 .2926E-04
316		1.90	0.162	0.053	0.3311	0.5338	.9571E-01	.3444E-03	0.0007	.0000E+00 .3444E-03
317		0.34	0.000	0.048	0.3180	4.3271	.5302	.2636E-02	0.0025	.0000E+00 .1925E-02
318		0.00	0.000	0.033	0.2947	2.1849	.3918	.1381E-02	0.0015	.0000E+00 .2092E-02
319		0.00	0.000	0.038	0.2777	1.5156	.2718	.9800E-03	0.0020	.0000E+00 .9800E-03
320		0.00	0.000	0.037	0.2665	0.9395	.1685	.6277E-03	0.0013	.0000E+00 .6277E-03
321		0.00	0.000	0.036	0.2582	0.6367	.1142	.4376E-03	0.0009	.0000E+00 .4376E-03
322		0.00	0.000	0.038	0.2518	0.4365	.7828E-01	.3088E-03	0.0006	.0000E+00 .3088E-03
323		0.00	0.000	0.040	0.2466	0.3067	.5499E-01	.2232E-03	0.0005	.0000E+00 .2232E-03
324		0.00	0.000	0.040	0.2423	0.2179	.3906E-01	.1630E-03	0.0003	.0000E+00 .1630E-03
325		0.28	0.000	0.053	0.2529	0.1764	.3162E-01	.1344E-03	0.0003	.0000E+00 .1344E-03
326		0.00	0.000	0.037	0.2494	0.1501	.2691E-01	.1160E-03	0.0002	.0000E+00 .1160E-03
327		0.00	0.000	0.027	0.2467	0.1259	.2257E-01	.9878E-04	0.0002	.0000E+00 .9878E-04
328	*	0.00	0.000	0.024	0.2442	0.1189	.2132E-01	.9377E-04	0.0002	.0000E+00 .9377E-04
329		0.00	0.000	0.035	0.2413	0.1008	.1808E-01	.8068E-04	0.0002	.0000E+00 .8068E-04
330		0.00	0.000	0.032	0.2390	0.0574	.1029E-01	.4831E-04	0.0001	.0000E+00 .4831E-04
331		0.03	0.000	0.050	0.2375	0.0378	.6770E-02	.3315E-04	0.0001	.0000E+00 .3315E-04
332		0.00	0.000	0.045	0.2346	0.0488	.8756E-02	.4182E-04	0.0001	.0000E+00 .4182E-04
333		0.00	0.000	0.045	0.2316	0.0449	.8051E-02	.3876E-04	0.0001	.0000E+00 .3876E-04
334		0.00	0.000	0.042	0.2290	0.0359	.6436E-02	.3167E-04	0.0001	.0000E+00 .3167E-04
335		0.10	0.000	0.056	0.2311	0.0339	.6071E-02	.3005E-04	0.0001	.0000E+00 .3005E-04
336		0.00	0.000	0.040	0.2285	0.0362	.6492E-02	.3193E-04	0.0001	.0000E+00 .3193E-04
337		0.00	0.000	0.047	0.2256	0.0322	.5767E-02	.2870E-04	0.0001	.0000E+00 .2870E-04
338		0.00	0.000	0.034	0.2235	0.0234	.4193E-02	.2155E-04	0.0000	

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.0000E+00 .2155E-04
  339         0.00  0.000  0.029  0.2218    0.0164 .2946E-02 .1572E-04    0.0000
.0000E+00 .1572E-04
  340         0.01  0.000  0.040  0.2200    0.0160 .2866E-02 .1534E-04    0.0000
.0000E+00 .1534E-04
  341         0.00  0.000  0.034  0.2180    0.0146 .2612E-02 .1412E-04    0.0000
.0000E+00 .1412E-04
  342  *      0.02  0.000  0.037  0.2169    0.0153 .2745E-02 .1475E-04    0.0000
.0000E+00 .1475E-04
  343  *      0.09  0.000  0.025  0.2178    0.0166 .2969E-02 .1582E-04    0.0000
.0000E+00 .1582E-04
  344  *      0.00  0.000  0.022  0.2187    0.0207 .3708E-02 .1931E-04    0.0000
.0000E+00 .1931E-04
  345  *      0.00  0.000  0.024  0.2174    0.0219 .3926E-02 .2032E-04    0.0000
.0000E+00 .2032E-04
  346  *      0.00  0.000  0.000  0.2172    0.0212 .3805E-02 .1976E-04    0.0000
.0000E+00 .1976E-04
  347  *      0.00  0.000  0.000  0.2170    0.0190 .3412E-02 .1793E-04    0.0000
.0000E+00 .1793E-04
  348  *      0.00  0.000  0.022  0.2156    0.0130 .2336E-02 .1275E-04    0.0000
.0000E+00 .1275E-04
  349  *      0.04  0.000  0.026  0.2163    0.0102 .1832E-02 .1030E-04    0.0000
.0000E+00 .1030E-04
  350  *      0.04  0.000  0.031  0.2166    0.0130 .2336E-02 .1279E-04    0.0000
.0000E+00 .1279E-04
  351         0.00  0.000  0.029  0.2149    0.0153 .2744E-02 .1476E-04    0.0000
.0000E+00 .1476E-04
  352  *      0.00  0.000  0.023  0.2135    0.0093 .1663E-02 .9446E-05    0.0000
.0000E+00 .9446E-05
  353  *      0.00  0.000  0.000  0.2134    0.0091 .1627E-02 .9271E-05    0.0000
.0000E+00 .9271E-05
  354  *      0.00  0.000  0.023  0.2121    0.0103 .1841E-02 .1035E-04    0.0000
.0000E+00 .1035E-04
  355  *      0.02  0.000  0.037  0.2111    0.0091 .1632E-02 .9303E-05    0.0000
.0000E+00 .9303E-05
  356         0.07  0.000  0.043  0.2125    0.0104 .1864E-02 .1046E-04    0.0000
.0000E+00 .1046E-04
  357         0.00  0.000  0.031  0.2106    0.0107 .1915E-02 .1069E-04    0.0000
.0000E+00 .1069E-04
  358         0.00  0.000  0.030  0.2089    0.0075 .1337E-02 .7799E-05    0.0000
.0000E+00 .7799E-05
  359         0.08  0.000  0.041  0.2110    0.0085 .1528E-02 .8773E-05    0.0000
.0000E+00 .8773E-05
  360  *      1.26  0.000  0.026  0.2120    0.0073 .1312E-02 .7671E-05    0.0000
.0000E+00 .7671E-05
  361  *      0.00  0.000  0.021  0.2130    0.0065 .1161E-02 .6887E-05    0.0000
.0000E+00 .6887E-05
  362  *      0.00  0.000  0.018  0.2140    0.0061 .1101E-02 .6572E-05    0.0000
.0000E+00 .6572E-05
  363  *   *  0.00  0.000  0.025  0.2140    0.0046 .8305E-03 .5117E-05    0.0000
.0000E+00 .5117E-05
  364     *   0.45  1.121  0.000  0.2380    0.0019 .3337E-03 .2319E-05    0.0000
.0000E+00 .2319E-05
  365     *   0.71  0.423  0.012  0.2530    0.0007 .1340E-03 .1069E-05    0.0000
.0000E+00 .1069E-05
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MONTHLY TOTALS (IN INCHES) FOR YEAR 1975

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.00	2.91	4.68	2.97	4.99	7.57
	6.32	2.21	7.21	3.24	3.14	2.89
RUNOFF	0.000	3.157	1.429	0.035	0.000	0.178
	0.410	0.000	0.600	0.006	0.162	1.545
EVAPOTRANSPIRATION	0.894	0.512	1.769	2.943	5.551	6.186
	5.407	2.210	1.936	1.410	1.204	0.826
LATERAL DRAINAGE COLLECTED	0.5794	0.0001	3.4535	0.3211	0.0905	1.3390
FROM LAYER 3	1.1636	0.0000	2.5659	1.9169	2.0199	0.0790
PERCOLATION/LEAKAGE THROUGH	0.0025	0.0000	0.0189	0.0014	0.0004	0.0051
LAYER 4	0.0044	0.0000	0.0126	0.0075	0.0084	0.0004
PERCOLATION/LEAKAGE THROUGH	0.0025	0.0000	0.0188	0.0014	0.0004	0.0051
LAYER 6	0.0044	0.0000	0.0119	0.0082	0.0084	0.0004

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.104	0.000	0.983	0.060	0.016	0.249
TOP OF LAYER 4	0.209	0.000	0.682	0.355	0.421	0.014
STD. DEVIATION OF DAILY	0.118	0.000	1.936	0.103	0.040	0.412
HEAD ON TOP OF LAYER 4	0.474	0.000	1.530	0.593	0.881	0.009
AVERAGE DAILY HEAD ON	0.000	0.000	0.002	0.000	0.000	0.000
TOP OF LAYER 6	0.000	0.000	0.001	0.001	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.005	0.000	0.000	0.001
HEAD ON TOP OF LAYER 6	0.001	0.000	0.002	0.001	0.001	0.000

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ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	52.13	3039347.750	100.00
RUNOFF	7.523	438593.000	14.43
EVAPOTRANSPIRATION	30.848	1798558.870	59.18
DRAINAGE COLLECTED FROM LAYER 3	13.5291	788789.125	25.95
PERC./LEAKAGE THROUGH LAYER 4	0.061476	3584.247	0.12

AVG. HEAD ON TOP OF LAYER 4	0.2579		
PERC./LEAKAGE THROUGH LAYER 6	0.061476	3584.247	0.12
AVG. HEAD ON TOP OF LAYER 6	0.0004		
CHANGE IN WATER STORAGE	0.168	9823.371	0.32
SOIL WATER AT START OF YEAR	172.868	10078775.000	
SOIL WATER AT END OF YEAR	173.037	10088599.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-1.123	0.00

****

HEAD #1: AVERAGE HEAD ON TOP OF LAYER 4
DRAIN #1: LATERAL DRAINAGE FROM LAYER 3 (RECIRCULATION AND COLLECTION)
LEAK #1: PERCOLATION OR LEAKAGE THROUGH LAYER 4
HEAD #2: AVERAGE HEAD ON TOP OF LAYER 6
DRAIN #2: LATERAL DRAINAGE FROM LAYER 5 (RECIRCULATION AND COLLECTION)
LEAK #2: PERCOLATION OR LEAKAGE THROUGH LAYER 6

****

DAILY OUTPUT FOR YEAR 1976

DAY	AI	SOIL	RAIN IN.	RUNOFF IN.	ET IN.	E. ZONE WATER IN./IN.	HEAD #1 IN.	DRAIN #1 IN.	LEAK #1 IN.	HEAD #2 IN.	DRAIN #2 IN.	LEAK #2 IN.
1	*		0.72	0.490	0.012	0.2650	0.0003	.5372E-04	.5041E-06	0.0000	.0000E+00	.5041E-06
2	*		0.00	0.000	0.000	0.2650	0.0001	.2150E-04	.2462E-06	0.0000	.0000E+00	.2462E-06
3	*		0.32	0.165	0.012	0.2728	0.0000	.8586E-05	.1267E-06	0.0000	.0000E+00	.1267E-06
4	*		0.00	0.000	0.000	0.2728	0.0000	.3414E-05	.7037E-07	0.0000	.0000E+00	.7037E-07
5	*		0.00	0.000	0.000	0.2728	0.0000	.1347E-05	.4317E-07	0.0000	.0000E+00	.4317E-07
6	*		0.00	0.000	0.000	0.2728	0.0000	.5232E-06	.2936E-07	0.0000	.0000E+00	.2936E-07

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    7     *   0.65  0.484  0.011  0.2813    0.0000 .1964E-06 .2208E-07    0.0000
.0000E+00 .2208E-07
    8  *  *   0.20  0.000  0.029  0.2813    0.0000 .6666E-07 .2117E-07    0.0000
.0000E+00 .2117E-07
    9  *  *   0.00  0.000  0.027  0.2813    0.0000 .1413E-07 .1940E-07    0.0000
.0000E+00 .1940E-07
   10  *  *   0.00  0.000  0.034  0.2813    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   11     *   0.14  0.138  0.010  0.2869    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   12     *   0.00  0.000  0.000  0.2869    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   13     *   0.15  0.062  0.011  0.2911    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   14     *   0.01  0.000  0.006  0.2913    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   15     *   0.00  0.000  0.000  0.2913    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   16         0.00  0.000  0.041  0.2809    0.8321 .1492     .5351E-03    0.0011
.0000E+00 .5351E-03
   17         0.00  0.000  0.041  0.2642    1.4657 .2628     .9497E-03    0.0020
.0000E+00 .9497E-03
   18         0.00  0.000  0.039  0.2538    0.8387 .1504     .5649E-03    0.0012
.0000E+00 .5649E-03
   19         0.00  0.000  0.039  0.2465    0.5345 .9585E-01 .3723E-03    0.0008
.0000E+00 .3723E-03
   20         0.15  0.000  0.055  0.2481    0.3644 .6534E-01 .2615E-03    0.0005
.0000E+00 .2615E-03
   21         0.08  0.000  0.050  0.2473    0.2530 .4536E-01 .1870E-03    0.0004
.0000E+00 .1870E-03
   22         0.00  0.000  0.048  0.2427    0.1965 .3523E-01 .1484E-03    0.0003
.0000E+00 .1484E-03
   23  *      0.00  0.000  0.038  0.2391    0.1518 .2721E-01 .1172E-03    0.0002
.0000E+00 .1172E-03
   24         0.00  0.000  0.048  0.2351    0.1407 .2522E-01 .1093E-03    0.0002
.0000E+00 .1093E-03
   25  *      0.00  0.000  0.037  0.2318    0.1291 .2315E-01 .1011E-03    0.0002
.0000E+00 .1011E-03
   26  *      0.36  0.000  0.029  0.2318    0.1155 .2070E-01 .9131E-04    0.0002
.0000E+00 .9131E-04
   27  *      1.64  0.000  0.000  0.2318    0.1020 .1829E-01 .8156E-04    0.0002
.0000E+00 .8156E-04
   28         0.08  0.000  0.000  0.2378    0.0962 .1724E-01 .7731E-04    0.0002
.0000E+00 .7731E-04
   29  *      0.00  0.000  0.033  0.2380    0.0819 .1469E-01 .6682E-04    0.0001
.0000E+00 .6682E-04
   30         0.00  0.000  0.000  0.2637    0.0672 .1204E-01 .5580E-04    0.0001
.0000E+00 .5580E-04
   31         0.00  0.000  0.000  0.2990    0.6855 .1229     .4479E-03    0.0009
.0000E+00 .4479E-03
   32         0.34  0.008  0.000  0.3231    3.4704 .4710     .2134E-02    0.0031
.0000E+00 .2134E-02
   33         0.23  0.000  0.056  0.3026    5.0455 .5469     .3055E-02    0.0032
.0000E+00 .1518E-02
   34         0.00  0.000  0.044  0.2786    2.1931 .3932     .1386E-02    0.0028
.0000E+00 .1526E-02
   35         0.00  0.000  0.047  0.2643    1.1857 .2126     .7792E-03    0.0016
.0000E+00 .2176E-02
   36         0.05  0.000  0.052  0.2581    0.6205 .1113     .4270E-03    0.0009
.0000E+00 .4270E-03
   37         0.22  0.000  0.061  0.2632    0.3652 .6549E-01 .2620E-03    0.0005
.0000E+00 .2620E-03
   38         0.00  0.000  0.051  0.2581    0.2334 .4186E-01 .1736E-03    0.0004
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.0000E+00 .1736E-03
   39         0.00  0.000  0.055  0.2534    0.1762 .3159E-01 .1343E-03    0.0003
.0000E+00 .1343E-03
   40  *      0.00  0.000  0.045  0.2493    0.1672 .2998E-01 .1280E-03    0.0003
.0000E+00 .1280E-03
   41         0.00  0.000  0.057  0.2452    0.1008 .1808E-01 .8063E-04    0.0002
.0000E+00 .8063E-04
   42         0.00  0.000  0.052  0.2417    0.0636 .1141E-01 .5314E-04    0.0001
.0000E+00 .5314E-04
   43         0.00  0.000  0.061  0.2379    0.0525 .9421E-02 .4468E-04    0.0001
.0000E+00 .4468E-04
   44         0.00  0.000  0.075  0.2330    0.0736 .1321E-01 .6065E-04    0.0001
.0000E+00 .6065E-04
   45         0.03  0.000  0.054  0.2309    0.0916 .1642E-01 .7395E-04    0.0002
.0000E+00 .7395E-04
   46         0.00  0.000  0.060  0.2266    0.1001 .1794E-01 .8016E-04    0.0002
.0000E+00 .8016E-04
   47  *      0.00  0.000  0.047  0.2231    0.0943 .1690E-01 .7592E-04    0.0002
.0000E+00 .7592E-04
   48  *      0.09  0.000  0.049  0.2234    0.0736 .1320E-01 .6062E-04    0.0001
.0000E+00 .6062E-04
   49         0.30  0.000  0.017  0.2394    0.0647 .1160E-01 .5395E-04    0.0001
.0000E+00 .5395E-04
   50  *      0.00  0.000  0.053  0.2359    0.0594 .1065E-01 .4992E-04    0.0001
.0000E+00 .4992E-04
   51  *      0.00  0.000  0.054  0.2325    0.0500 .8971E-02 .4272E-04    0.0001
.0000E+00 .4272E-04
   52  *      0.00  0.000  0.057  0.2290    0.0398 .7137E-02 .3477E-04    0.0001
.0000E+00 .3477E-04
   53         0.40  0.000  0.075  0.2464    0.0373 .6683E-02 .3278E-04    0.0001
.0000E+00 .3278E-04
   54  *      0.00  0.000  0.062  0.2427    0.0330 .5919E-02 .2938E-04    0.0001
.0000E+00 .2938E-04
   55  *      0.00  0.000  0.062  0.2391    0.0240 .4300E-02 .2205E-04    0.0000
.0000E+00 .2205E-04
   56  *      0.00  0.000  0.058  0.2356    0.0232 .4163E-02 .2142E-04    0.0000
.0000E+00 .2142E-04
   57         0.00  0.000  0.064  0.2319    0.0217 .3893E-02 .2017E-04    0.0000
.0000E+00 .2017E-04
   58         0.00  0.000  0.069  0.2280    0.0150 .2695E-02 .1445E-04    0.0000
.0000E+00 .1445E-04
   59         0.00  0.000  0.075  0.2239    0.0012 .1834E-03 .1151E-05    0.0000
.0000E+00 .1151E-05
   60         0.00  0.000  0.063  0.2205    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   61         0.00  0.000  0.072  0.2166    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   62  *      0.00  0.000  0.058  0.2134    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   63         0.02  0.000  0.075  0.2103    0.0047 .8366E-03 .4963E-05    0.0000
.0000E+00 .4963E-05
   64         0.00  0.000  0.087  0.2055    0.0116 .2087E-02 .1155E-04    0.0000
.0000E+00 .1155E-04
   65         0.03  0.000  0.068  0.2033    0.0133 .2379E-02 .1299E-04    0.0000
.0000E+00 .1299E-04
   66         0.00  0.000  0.091  0.1981    0.0139 .2499E-02 .1357E-04    0.0000
.0000E+00 .1357E-04
   67         0.00  0.000  0.092  0.1930    0.0102 .1775E-02 .9821E-05    0.0000
.0000E+00 .9821E-05
   68         0.00  0.000  0.074  0.1890    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   69         0.68  0.000  0.074  0.2221    0.0002 .1676E-04 .1513E-06    0.0000
.0000E+00 .1513E-06
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70		0.00	0.000	0.063	0.2187	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
71	*	0.03	0.000	0.056	0.2172	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
72	*	0.28	0.000	0.027	0.2183	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
73		0.50	0.000	0.000	0.2584	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
74	*	0.00	0.000	0.074	0.2544	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
75		0.00	0.000	0.091	0.2494	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
76		0.38	0.000	0.066	0.2660	0.0550	.9865E-02	.4517E-04	0.0001	.0000E+00
77		0.00	0.000	0.074	0.2603	0.1645	.2950E-01	.1260E-03	0.0003	.0000E+00
78		0.00	0.000	0.085	0.2541	0.1532	.2747E-01	.1179E-03	0.0002	.0000E+00
79		0.00	0.000	0.080	0.2486	0.1194	.2141E-01	.9404E-04	0.0002	.0000E+00
80		0.00	0.000	0.095	0.2415	0.1847	.3312E-01	.1402E-03	0.0003	.0000E+00
81		0.06	0.000	0.078	0.2387	0.1850	.3318E-01	.1405E-03	0.0003	.0000E+00
82		0.00	0.000	0.094	0.2317	0.1875	.3363E-01	.1422E-03	0.0003	.0000E+00
83		0.00	0.000	0.102	0.2245	0.1705	.3057E-01	.1303E-03	0.0003	.0000E+00
84		0.00	0.000	0.099	0.2179	0.1137	.2040E-01	.8997E-04	0.0002	.0000E+00
85		0.00	0.000	0.106	0.2114	0.0818	.1466E-01	.6668E-04	0.0001	.0000E+00
86		0.00	0.000	0.100	0.2050	0.0867	.1554E-01	.7035E-04	0.0001	.0000E+00
87		0.15	0.000	0.096	0.2072	0.0763	.1368E-01	.6264E-04	0.0001	.0000E+00
88	*	0.00	0.000	0.077	0.2025	0.0563	.1010E-01	.4756E-04	0.0001	.0000E+00
89		0.00	0.000	0.094	0.1969	0.0436	.7826E-02	.3779E-04	0.0001	.0000E+00
90		0.00	0.000	0.081	0.1921	0.0391	.7011E-02	.3422E-04	0.0001	.0000E+00
91		0.25	0.000	0.072	0.2015	0.0328	.5874E-02	.2918E-04	0.0001	.0000E+00
92		0.67	0.000	0.076	0.2337	0.0272	.4871E-02	.2466E-04	0.0001	.0000E+00
93		0.04	0.000	0.087	0.2309	0.0215	.3852E-02	.1997E-04	0.0000	.0000E+00
94		0.00	0.000	0.114	0.2245	0.0190	.3410E-02	.1792E-04	0.0000	.0000E+00
95		0.19	0.000	0.100	0.2293	0.0118	.2108E-02	.1155E-04	0.0000	.0000E+00
96		0.00	0.000	0.101	0.2238	0.0001	.0000E+00	.0000E+00	0.0000	.0000E+00
97		0.00	0.000	0.127	0.2169	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
98		0.00	0.000	0.110	0.2109	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
99		0.07	0.000	0.099	0.2093	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
100		0.00	0.000	0.132	0.2021	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
101		0.00	0.000	0.148	0.1940	0.0000	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00									
102	0.00	0.000	0.145	0.1861	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
103	0.00	0.000	0.120	0.1796	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
104	0.00	0.000	0.147	0.1715	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
105	0.00	0.000	0.083	0.1670	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
106	0.00	0.000	0.064	0.1635	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
107	0.00	0.000	0.054	0.1606	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
108	0.00	0.000	0.048	0.1580	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
109	0.00	0.000	0.043	0.1556	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
110	0.00	0.000	0.040	0.1534	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
111	0.00	0.000	0.038	0.1513	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
112	0.30	0.000	0.042	0.1654	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
113	0.57	0.000	0.040	0.1944	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
114	0.00	0.000	0.199	0.1836	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
115	0.00	0.000	0.209	0.1721	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
116	0.21	0.000	0.131	0.1765	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
117	0.00	0.000	0.087	0.1717	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
118	0.00	0.000	0.069	0.1679	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
119	0.01	0.000	0.064	0.1650	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
120	0.00	0.000	0.053	0.1621	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
121	0.00	0.000	0.051	0.1593	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
122	1.77	0.044	0.052	0.2508	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
123	0.00	0.000	0.187	0.2406	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
124	0.00	0.000	0.173	0.2312	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
125	0.00	0.000	0.171	0.2218	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
126	0.00	0.000	0.187	0.2115	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
127	0.00	0.000	0.203	0.2005	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
128	0.59	0.000	0.177	0.2231	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
129	0.00	0.000	0.185	0.2130	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
130	0.00	0.000	0.219	0.2010	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
131	0.00	0.000	0.210	0.1895	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
132	0.44	0.000	0.126	0.2066	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

133	0.17	0.000	0.109	0.2100	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
134	0.00	0.000	0.181	0.2000	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
135	0.00	0.000	0.202	0.1890	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
136	0.00	0.000	0.247	0.1755	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
137	0.00	0.000	0.204	0.1644	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
138	0.01	0.000	0.181	0.1550	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
139	0.83	0.000	0.137	0.1929	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
140	0.02	0.000	0.183	0.1840	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
141	0.07	0.000	0.163	0.1790	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
142	0.19	0.000	0.209	0.1779	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
143	0.00	0.000	0.223	0.1657	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
144	0.00	0.000	0.216	0.1539	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
145	0.00	0.000	0.218	0.1420	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
146	0.00	0.000	0.144	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
147	0.00	0.000	0.002	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
148	0.00	0.000	0.002	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
149	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
150	0.21	0.000	0.024	0.1440	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
151	0.05	0.000	0.088	0.1420	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
152	0.00	0.000	0.108	0.1361	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
153	1.32	0.001	0.169	0.1989	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
154	0.62	0.000	0.227	0.2204	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
155	0.00	0.000	0.269	0.2057	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
156	0.00	0.000	0.286	0.1901	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
157	0.00	0.000	0.262	0.1757	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
158	0.00	0.000	0.274	0.1607	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
159	0.00	0.000	0.235	0.1479	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
160	0.00	0.000	0.160	0.1392	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
161	0.00	0.000	0.073	0.1352	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
162	0.00	0.000	0.024	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
163	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
164	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00									
165	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
166	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
167	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
168	0.06	0.000	0.030	0.1355	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
169	0.14	0.000	0.037	0.1411	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
170	0.00	0.000	0.083	0.1366	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
171	0.00	0.000	0.037	0.1345	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
172	0.00	0.000	0.009	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
173	0.00	0.000	0.002	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
174	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
175	0.35	0.000	0.094	0.1479	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
176	0.00	0.000	0.095	0.1427	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
177	0.00	0.000	0.127	0.1358	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
178	0.02	0.000	0.050	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
179	0.72	0.000	0.068	0.1697	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
180	0.00	0.000	0.156	0.1612	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
181	0.00	0.000	0.167	0.1521	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
182	0.19	0.000	0.143	0.1546	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
183	0.00	0.000	0.160	0.1459	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
184	0.00	0.000	0.178	0.1361	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
185	0.63	0.000	0.134	0.1633	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
186	0.22	0.000	0.142	0.1675	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
187	0.00	0.000	0.199	0.1566	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
188	0.00	0.000	0.187	0.1464	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
189	0.33	0.000	0.167	0.1553	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
190	0.04	0.000	0.160	0.1487	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
191	0.00	0.000	0.163	0.1398	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
192	0.00	0.000	0.076	0.1357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
193	1.37	0.003	0.216	0.1986	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
194	0.03	0.000	0.255	0.1863	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
195	0.00	0.000	0.273	0.1714	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

196	0.00	0.000	0.283	0.1559	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
197	0.00	0.000	0.251	0.1422	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
198	0.07	0.000	0.177	0.1364	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
199	0.00	0.000	0.031	0.1347	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
200	0.00	0.000	0.012	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
201	0.00	0.000	0.002	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
202	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
203	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
204	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
205	0.62	0.000	0.111	0.1617	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
206	0.03	0.000	0.154	0.1549	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
207	0.00	0.000	0.194	0.1442	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
208	0.00	0.000	0.170	0.1349	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
209	0.00	0.000	0.015	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
210	0.00	0.000	0.002	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
211	0.70	0.000	0.074	0.1682	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
212	0.00	0.000	0.156	0.1597	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
213	0.00	0.000	0.213	0.1480	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
214	0.00	0.000	0.190	0.1376	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
215	0.00	0.000	0.061	0.1343	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
216	0.00	0.000	0.004	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
217	0.00	0.000	0.004	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
218	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
219	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
220	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
221	0.51	0.000	0.089	0.1569	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
222	1.17	0.002	0.120	0.2142	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
223	0.06	0.000	0.180	0.2076	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
224	0.00	0.000	0.223	0.1954	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
225	0.00	0.000	0.194	0.1848	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
226	0.15	0.000	0.150	0.1848	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
227	0.08	0.000	0.149	0.1810	0.0000	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00									
228	0.08	0.000	0.113	0.1792	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
229	0.00	0.000	0.197	0.1685	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
230	0.00	0.000	0.192	0.1579	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
231	0.00	0.000	0.214	0.1462	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
232	0.00	0.000	0.185	0.1361	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
233	0.00	0.000	0.037	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
234	0.00	0.000	0.004	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
235	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
236	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
237	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
238	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
239	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
240	0.12	0.000	0.051	0.1376	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
241	0.00	0.000	0.019	0.1366	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
242	0.00	0.000	0.036	0.1346	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
243	0.00	0.000	0.011	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
244	0.00	0.000	0.003	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
245	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
246	0.08	0.000	0.040	0.1360	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
247	0.00	0.000	0.014	0.1353	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
248	0.00	0.000	0.021	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
249	0.00	0.000	0.003	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
250	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
251	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
252	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
253	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
254	0.18	0.000	0.054	0.1407	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
255	0.00	0.000	0.065	0.1372	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
256	0.00	0.000	0.043	0.1348	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
257	0.00	0.000	0.012	0.1342	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
258	0.00	0.000	0.004	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

259	0.01	0.000	0.011	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
260	0.90	0.000	0.063	0.1797	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
261	0.00	0.000	0.105	0.1740	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
262	0.00	0.000	0.122	0.1673	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
263	0.00	0.000	0.115	0.1610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
264	0.02	0.000	0.102	0.1565	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
265	0.04	0.000	0.080	0.1544	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
266	0.00	0.000	0.102	0.1488	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
267	0.00	0.000	0.116	0.1424	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
268	0.00	0.000	0.093	0.1373	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
269	0.00	0.000	0.055	0.1343	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
270	0.21	0.000	0.055	0.1428	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
271	0.06	0.000	0.071	0.1422	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
272	0.00	0.000	0.047	0.1397	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
273	0.00	0.000	0.044	0.1373	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
274	0.94	0.000	0.080	0.1843	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
275	0.05	0.000	0.105	0.1813	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
276	0.04	0.000	0.082	0.1790	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
277	0.27	0.000	0.106	0.1879	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
278	0.00	0.000	0.079	0.1836	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
279	0.00	0.000	0.083	0.1791	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
280	0.01	0.000	0.046	0.1771	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
281	0.00	0.000	0.074	0.1730	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
282	0.02	0.000	0.064	0.1706	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
283	0.77	0.000	0.090	0.2078	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
284	0.00	0.000	0.065	0.2043	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
285	0.00	0.000	0.057	0.2011	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
286	0.00	0.000	0.038	0.1991	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
287	0.00	0.000	0.050	0.1964	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
288	0.00	0.000	0.066	0.1928	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
289	0.00	0.000	0.044	0.1904	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
290	0.00	0.000	0.040	0.1882	0.0000	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00									
291		0.12	0.000	0.064	0.1912	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
292		0.00	0.000	0.023	0.1900	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
293		0.00	0.000	0.019	0.1890	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
294		1.41	0.016	0.064	0.2617	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
295	*	0.00	0.000	0.024	0.2604	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
296	*	0.00	0.000	0.022	0.2592	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
297		0.00	0.000	0.021	0.2580	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
298		0.22	0.000	0.061	0.2667	0.0070	.1260E-02	.6357E-05	0.0000	
.0000E+00	.6357E-05									
299		0.41	0.000	0.059	0.2827	0.3228	.5788E-01	.2262E-03	0.0005	
.0000E+00	.2262E-03									
300		0.20	0.000	0.067	0.2822	0.7870	.1411	.5327E-03	0.0011	
.0000E+00	.5327E-03									
301		0.00	0.000	0.049	0.2740	0.5693	.1021	.3945E-03	0.0008	
.0000E+00	.3945E-03									
302		0.00	0.000	0.049	0.2673	0.4057	.7275E-01	.2886E-03	0.0006	
.0000E+00	.2886E-03									
303		0.00	0.000	0.045	0.2612	0.3699	.6632E-01	.2652E-03	0.0006	
.0000E+00	.2652E-03									
304		0.14	0.000	0.057	0.2618	0.3993	.7161E-01	.2846E-03	0.0006	
.0000E+00	.2846E-03									
305		0.64	0.000	0.065	0.2900	0.3231	.5793E-01	.2340E-03	0.0005	
.0000E+00	.2340E-03									
306		0.00	0.000	0.046	0.2700	1.7862	.3203	.1143E-02	0.0024	
.0000E+00	.1143E-02									
307		0.00	0.000	0.046	0.2566	1.1044	.1980	.7294E-03	0.0015	
.0000E+00	.7294E-03									
308		0.02	0.000	0.041	0.2493	0.6314	.1132	.4341E-03	0.0009	
.0000E+00	.4341E-03									
309		0.00	0.000	0.042	0.2432	0.3824	.6856E-01	.2733E-03	0.0006	
.0000E+00	.2733E-03									
310		0.00	0.000	0.042	0.2384	0.2550	.4571E-01	.1883E-03	0.0004	
.0000E+00	.1883E-03									
311		0.00	0.000	0.052	0.2337	0.1850	.3317E-01	.1404E-03	0.0003	
.0000E+00	.1404E-03									
312		0.00	0.000	0.038	0.2303	0.1373	.2462E-01	.1069E-03	0.0002	
.0000E+00	.1069E-03									
313		0.00	0.000	0.033	0.2275	0.1078	.1934E-01	.8580E-04	0.0002	
.0000E+00	.8580E-04									
314		0.00	0.000	0.032	0.2248	0.0900	.1613E-01	.7275E-04	0.0002	
.0000E+00	.7275E-04									
315		0.00	0.000	0.035	0.2221	0.0778	.1395E-01	.6376E-04	0.0001	
.0000E+00	.6376E-04									
316		0.00	0.000	0.039	0.2193	0.0682	.1223E-01	.5660E-04	0.0001	
.0000E+00	.5660E-04									
317		0.00	0.000	0.045	0.2163	0.0562	.1007E-01	.4746E-04	0.0001	
.0000E+00	.4746E-04									
318		0.00	0.000	0.035	0.2138	0.0623	.1117E-01	.5212E-04	0.0001	
.0000E+00	.5212E-04									
319		0.00	0.000	0.038	0.2111	0.0568	.1019E-01	.4798E-04	0.0001	
.0000E+00	.4798E-04									
320		0.00	0.000	0.043	0.2083	0.0488	.8749E-02	.4179E-04	0.0001	
.0000E+00	.4179E-04									
321		0.00	0.000	0.051	0.2051	0.0416	.7456E-02	.3617E-04	0.0001	
.0000E+00	.3617E-04									

322		0.00	0.000	0.044	0.2023	0.0353	.6328E-02	.3120E-04	0.0001	.0000E+00 .3120E-04
323		0.00	0.000	0.039	0.1999	0.0253	.4545E-02	.2317E-04	0.0000	.0000E+00 .2317E-04
324		0.00	0.000	0.038	0.1977	0.0201	.3612E-02	.1886E-04	0.0000	.0000E+00 .1886E-04
325		0.00	0.000	0.038	0.1954	0.0169	.3037E-02	.1615E-04	0.0000	.0000E+00 .1615E-04
326		0.00	0.000	0.027	0.1938	0.0147	.2644E-02	.1428E-04	0.0000	.0000E+00 .1428E-04
327		0.00	0.000	0.033	0.1919	0.0134	.2407E-02	.1313E-04	0.0000	.0000E+00 .1313E-04
328		0.00	0.000	0.029	0.1902	0.0122	.2189E-02	.1207E-04	0.0000	.0000E+00 .1207E-04
329		0.00	0.000	0.035	0.1882	0.0115	.2063E-02	.1145E-04	0.0000	.0000E+00 .1145E-04
330		0.00	0.000	0.042	0.1858	0.0116	.2080E-02	.1154E-04	0.0000	.0000E+00 .1154E-04
331		0.00	0.000	0.039	0.1836	0.0110	.1969E-02	.1098E-04	0.0000	.0000E+00 .1098E-04
332		0.01	0.000	0.035	0.1821	0.0097	.1743E-02	.9858E-05	0.0000	.0000E+00 .9858E-05
333	*	0.02	0.000	0.020	0.1820	0.0075	.1347E-02	.7842E-05	0.0000	.0000E+00 .7842E-05
334		0.27	0.000	0.044	0.1943	0.0074	.1322E-02	.7718E-05	0.0000	.0000E+00 .7718E-05
335		0.00	0.000	0.027	0.1928	0.0079	.1417E-02	.8209E-05	0.0000	.0000E+00 .8209E-05
336		0.00	0.000	0.029	0.1911	0.0077	.1385E-02	.8045E-05	0.0000	.0000E+00 .8045E-05
337		0.00	0.000	0.029	0.1895	0.0065	.1171E-02	.6924E-05	0.0000	.0000E+00 .6924E-05
338	*	0.00	0.000	0.025	0.1881	0.0010	.1731E-03	.1193E-05	0.0000	.0000E+00 .1193E-05
339	*	0.00	0.000	0.023	0.1868	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
340	*	0.00	0.000	0.000	0.1868	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
341	*	0.02	0.000	0.020	0.1868	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
342	*	0.97	0.000	0.021	0.1879	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
343	*	0.00	0.000	0.020	0.1890	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
344	*	0.00	0.000	0.029	0.1901	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
345		0.00	0.000	0.033	0.1911	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
346		0.00	0.000	0.001	0.2058	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
347	*	0.03	0.000	0.029	0.2069	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
348		0.00	0.000	0.023	0.2116	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
349	*	0.00	0.000	0.029	0.2127	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
350		0.00	0.000	0.009	0.2253	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
351	*	0.01	0.000	0.031	0.2264	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
352	*	0.00	0.000	0.029	0.2275	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
353	*	0.00	0.000	0.034	0.2262	0.0000	.0000E+00	.0000E+00	0.0000	

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.0000E+00 .0000E+00
  354  *      0.00  0.000  0.025  0.2249    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  355         0.30  0.000  0.042  0.2390    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  356         0.01  0.000  0.036  0.2376    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  357         0.00  0.000  0.030  0.2359    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  358         0.00  0.000  0.034  0.2341    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  359         0.00  0.000  0.036  0.2321    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  360         0.05  0.000  0.050  0.2321    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  361  *      0.15  0.000  0.028  0.2332    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  362  *      0.00  0.000  0.028  0.2343    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  363  *      0.01  0.000  0.027  0.2354    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  364  *  *   0.08  0.000  0.028  0.2354    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  365  *  *   0.00  0.000  0.028  0.2354    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  366     *   0.00  0.000  0.035  0.2357    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
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MONTHLY TOTALS (IN INCHES) FOR YEAR 1976

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.50	1.66	2.38	2.06	4.35	3.42
	4.04	2.17	2.44	4.30	0.32	1.63
RUNOFF	1.338	0.008	0.000	0.000	0.044	0.001
	0.003	0.002	0.000	0.016	0.000	0.000
EVAPOTRANSPIRATION	0.649	1.574	2.403	2.817	4.732	3.079
	4.157	2.427	1.519	1.776	1.146	0.841
LATERAL DRAINAGE COLLECTED	1.0858	2.0867	0.3234	0.0142	0.0000	0.0000
FROM LAYER 3	0.0000	0.0000	0.0000	0.5709	0.9496	0.0027
PERCOLATION/LEAKAGE THROUGH	0.0042	0.0093	0.0014	0.0001	0.0000	0.0000
LAYER 4	0.0000	0.0000	0.0000	0.0022	0.0037	0.0000
PERCOLATION/LEAKAGE THROUGH	0.0042	0.0093	0.0014	0.0001	0.0000	0.0000
LAYER 6	0.0000	0.0000	0.0000	0.0022	0.0037	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.195	0.499	0.058	0.003	0.000	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.103	0.177	0.000
STD. DEVIATION OF DAILY	0.339	1.153	0.067	0.007	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.207	0.380	0.002
AVERAGE DAILY HEAD ON	0.000	0.001	0.000	0.000	0.000	0.000
TOP OF LAYER 6	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.001	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 6	0.000	0.000	0.000	0.000	0.001	0.000

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ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	33.27	1939749.250	100.00
RUNOFF	1.412	82333.031	4.24
EVAPOTRANSPIRATION	27.120	1581195.000	81.52
DRAINAGE COLLECTED FROM LAYER 3	5.0334	293462.812	15.13
PERC./LEAKAGE THROUGH LAYER 4	0.020965	1222.356	0.06
AVG. HEAD ON TOP OF LAYER 4	0.0863		
PERC./LEAKAGE THROUGH LAYER 6	0.020965	1222.356	0.06
AVG. HEAD ON TOP OF LAYER 6	0.0001		
CHANGE IN WATER STORAGE	-0.317	-18465.305	-0.95
SOIL WATER AT START OF YEAR	173.037	10088599.000	
SOIL WATER AT END OF YEAR	172.720	10070133.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	1.256	0.00

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HEAD #1: AVERAGE HEAD ON TOP OF LAYER 4
DRAIN #1: LATERAL DRAINAGE FROM LAYER 3 (RECIRCULATION AND COLLECTION)

HRSDSOC1

LEAK #1: PERCOLATION OR LEAKAGE THROUGH LAYER 4
HEAD #2: AVERAGE HEAD ON TOP OF LAYER 6
DRAIN #2: LATERAL DRAINAGE FROM LAYER 5 (RECIRCULATION AND COLLECTION)
LEAK #2: PERCOLATION OR LEAKAGE THROUGH LAYER 6

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DAILY OUTPUT FOR YEAR 1977

DAY	A I R	S O I L	RAIN IN.	RUNOFF IN.	ET IN.	E. ZONE WATER IN./IN.	HEAD #1 IN.	DRAIN #1 IN.	LEAK #1 IN.	HEAD #2 IN.	DRAIN #2 IN.	LEAK #2 IN.
1	*	*	0.00	0.000	0.000	0.2357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
2	*	*	0.00	0.000	0.000	0.2357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
3	*	*	0.00	0.000	0.000	0.2357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
4	*	*	0.00	0.000	0.000	0.2357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
5		*	0.00	0.000	0.000	0.2357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
6		*	0.00	0.000	0.000	0.2357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
7		*	0.00	0.000	0.000	0.2357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
8		*	0.41	0.160	0.011	0.2488	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
9		*	0.00	0.000	0.000	0.2488	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
10		*	0.22	0.058	0.011	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
11	*	*	1.19	0.000	0.029	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
12	*	*	0.00	0.000	0.026	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
13	*	*	0.01	0.000	0.000	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
14	*	*	0.00	0.000	0.028	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
15	*	*	0.50	0.000	0.023	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
16	*	*	0.00	0.000	0.022	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
17	*	*	0.12	0.000	0.019	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
18	*	*	0.00	0.000	0.025	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
19	*	*	0.00	0.000	0.027	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
20	*	*	0.00	0.000	0.028	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

21	*	*	0.00	0.000	0.022	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
22	*	*	0.00	0.000	0.027	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
23	*	*	0.00	0.000	0.029	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
24		*	0.00	0.000	0.038	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
25		*	0.16	0.177	0.000	0.2672	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
26		*	0.00	0.396	0.000	0.2774	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
27		*	0.00	0.128	0.005	0.2842	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
28		*	0.00	0.306	0.002	0.2913	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
29		*	0.00	0.000	0.000	0.2913	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
30		*	0.00	0.000	0.000	0.2913	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
31		*	0.00	0.000	0.000	0.2913	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
32		*	0.00	0.000	0.000	0.2913	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
33		*	0.00	0.000	0.000	0.2913	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
34		*	0.00	0.000	0.000	0.2913	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
35			0.00	0.000	0.044	0.2802	0.8793	.1577	.5634E-03	0.0012	.5634E-03
36	*		0.02	0.000	0.045	0.2658	1.3291	.2383	.8670E-03	0.0018	.8670E-03
37	*		0.02	0.000	0.053	0.2557	0.8369	.1501	.5638E-03	0.0012	.5638E-03
38	*		0.00	0.000	0.000	0.2504	0.5459	.9789E-01	.3796E-03	0.0008	.3796E-03
39	*	*	0.00	0.000	0.000	0.2473	0.3101	.5560E-01	.2250E-03	0.0005	.2250E-03
40	*	*	0.00	0.000	0.000	0.2461	0.1249	.2239E-01	.9784E-04	0.0002	.9784E-04
41		*	0.00	0.000	0.000	0.2456	0.0503	.9014E-02	.4283E-04	0.0001	.4283E-04
42		*	0.00	0.000	0.000	0.2454	0.0202	.3627E-02	.1889E-04	0.0000	.1889E-04
43		*	0.00	0.000	0.000	0.2453	0.0081	.1459E-02	.8401E-05	0.0000	.8401E-05
44		*	0.01	0.000	0.006	0.2455	0.0033	.5865E-03	.3777E-05	0.0000	.3777E-05
45		*	0.00	0.000	0.000	0.2455	0.0013	.2356E-03	.1721E-05	0.0000	.1721E-05
46		*	0.00	0.000	0.000	0.2455	0.0005	.9453E-04	.7996E-06	0.0000	.7996E-06
47		*	0.00	0.000	0.000	0.2455	0.0002	.3788E-04	.3816E-06	0.0000	.3816E-06
48		*	0.00	0.000	0.000	0.2455	0.0001	.1515E-04	.1897E-06	0.0000	.1897E-06
49		*	0.00	0.000	0.000	0.2455	0.0000	.6042E-05	.1002E-06	0.0000	.1002E-06
50		*	0.00	0.000	0.000	0.2455	0.0000	.2397E-05	.5766E-07	0.0000	.5766E-07
51		*	0.00	0.000	0.000	0.2455	0.0000	.9413E-06	.3686E-07	0.0000	.3686E-07
52			0.14	0.000	0.070	0.2487	0.0648	.1161E-01	.5240E-04	0.0001	

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.0000E+00 .5240E-04
   53         0.00  0.000  0.056  0.2442    0.1499 .2689E-01 .1159E-03    0.0002
.0000E+00 .1159E-03
   54         0.00  0.000  0.072  0.2387    0.1586 .2843E-01 .1220E-03    0.0003
.0000E+00 .1220E-03
   55         0.00  0.000  0.070  0.2333    0.1538 .2757E-01 .1186E-03    0.0002
.0000E+00 .1186E-03
   56         1.12  0.000  0.057  0.2899    0.1510 .2708E-01 .1167E-03    0.0002
.0000E+00 .1167E-03
   57         0.00  0.000  0.058  0.2760    1.0950 .1963     .7234E-03    0.0015
.0000E+00 .7234E-03
   58         0.00  0.000  0.064  0.2654    0.7196 .1290     .4903E-03    0.0010
.0000E+00 .4903E-03
   59         0.02  0.000  0.059  0.2576    0.5829 .1045     .4034E-03    0.0008
.0000E+00 .4034E-03
   60         0.00  0.000  0.074  0.2493    0.4283 .7680E-01 .3035E-03    0.0006
.0000E+00 .3035E-03
   61  *      0.00  0.000  0.058  0.2431    0.3107 .5572E-01 .2259E-03    0.0005
.0000E+00 .2259E-03
   62  *      0.00  0.000  0.064  0.2373    0.2302 .4128E-01 .1715E-03    0.0004
.0000E+00 .1715E-03
   63  *      0.00  0.000  0.055  0.2326    0.1702 .3051E-01 .1301E-03    0.0003
.0000E+00 .1301E-03
   64  *      0.45  0.000  0.038  0.2324    0.1296 .2324E-01 .1014E-03    0.0002
.0000E+00 .1014E-03
   65         0.00  0.000  0.022  0.2517    0.1007 .1805E-01 .8058E-04    0.0002
.0000E+00 .8058E-04
   66         0.00  0.000  0.067  0.2471    0.0838 .1502E-01 .6818E-04    0.0001
.0000E+00 .6818E-04
   67         0.00  0.000  0.068  0.2426    0.0843 .1511E-01 .6856E-04    0.0001
.0000E+00 .6856E-04
   68         0.00  0.000  0.085  0.2371    0.0885 .1586E-01 .7166E-04    0.0001
.0000E+00 .7166E-04
   69         0.00  0.000  0.069  0.2328    0.0566 .1015E-01 .4763E-04    0.0001
.0000E+00 .4763E-04
   70         0.00  0.000  0.086  0.2277    0.0339 .6075E-02 .3004E-04    0.0001
.0000E+00 .3004E-04
   71         0.00  0.000  0.084  0.2226    0.0482 .8634E-02 .4129E-04    0.0001
.0000E+00 .4129E-04
   72         0.00  0.000  0.076  0.2180    0.0466 .8362E-02 .4012E-04    0.0001
.0000E+00 .4012E-04
   73         1.02  0.000  0.073  0.2694    0.0402 .7200E-02 .3505E-04    0.0001
.0000E+00 .3505E-04
   74  *      0.00  0.000  0.063  0.2656    0.0295 .5297E-02 .2656E-04    0.0001
.0000E+00 .2656E-04
   75  *      0.00  0.000  0.071  0.2611    0.0620 .1111E-01 .5070E-04    0.0001
.0000E+00 .5070E-04
   76  *      0.00  0.000  0.075  0.2544    0.2711 .4861E-01 .1991E-03    0.0004
.0000E+00 .1991E-03
   77         0.00  0.000  0.088  0.2464    0.3248 .5824E-01 .2353E-03    0.0005
.0000E+00 .2353E-03
   78         0.66  0.000  0.072  0.2759    0.2707 .4854E-01 .1990E-03    0.0004
.0000E+00 .1990E-03
   79         0.00  0.000  0.087  0.2688    0.2316 .4153E-01 .1725E-03    0.0004
.0000E+00 .1725E-03
   80         0.11  0.000  0.112  0.2664    0.2340 .4196E-01 .1738E-03    0.0004
.0000E+00 .1738E-03
   81         0.00  0.000  0.089  0.2576    0.3940 .7065E-01 .2811E-03    0.0006
.0000E+00 .2811E-03
   82         1.90  0.177  0.084  0.3329    1.7374 .2600     .1094E-02    0.0023
.0000E+00 .1094E-02
   83         0.00  0.000  0.081  0.2990    4.6315 .5364     .2813E-02    0.0019
.0000E+00 .1753E-02
```

84		0.00	0.000	0.079	0.2761	1.8889	.3387	.1204E-02	0.0047	.0000E+00 .1461E-02
85	*	0.00	0.000	0.067	0.2623	1.0268	.1841	.6817E-03	0.0039	.0000E+00 .1314E-02
86		0.00	0.000	0.098	0.2506	0.6502	.1166	.4461E-03	0.0012	.0000E+00 .5050E-03
87		0.00	0.000	0.108	0.2406	0.4111	.7371E-01	.2921E-03	0.0008	.0000E+00 .3306E-03
88		0.05	0.000	0.100	0.2351	0.2857	.5122E-01	.2091E-03	0.0005	.0000E+00 .2298E-03
89		0.00	0.000	0.089	0.2280	0.2219	.3979E-01	.1659E-03	0.0004	.0000E+00 .1767E-03
90		0.00	0.000	0.077	0.2221	0.1760	.3155E-01	.1341E-03	0.0003	.0000E+00 .1420E-03
91		0.00	0.000	0.079	0.2166	0.1250	.2242E-01	.9815E-04	0.0002	.0000E+00 .1071E-03
92		0.00	0.000	0.087	0.2111	0.0741	.1328E-01	.6088E-04	0.0002	.0000E+00 .7019E-04
93		0.85	0.000	0.112	0.2509	0.0601	.1078E-01	.5047E-04	0.0001	.0000E+00 .5307E-04
94		0.01	0.000	0.067	0.2471	0.0647	.1160E-01	.5392E-04	0.0001	.0000E+00 .5306E-04
95		0.88	0.000	0.105	0.2890	0.0531	.9524E-02	.4509E-04	0.0001	.0000E+00 .4730E-04
96		0.52	0.000	0.085	0.2994	1.3506	.2422	.8799E-03	0.0010	.0000E+00 .6712E-03
97		0.00	0.000	0.129	0.2716	2.1063	.3777	.1333E-02	0.0023	.0000E+00 .1220E-02
98		0.01	0.000	0.115	0.2550	1.1066	.1984	.7308E-03	0.0022	.0000E+00 .8815E-03
99		0.00	0.000	0.159	0.2396	0.6792	.1218	.4645E-03	0.0012	.0000E+00 .5311E-03
100		0.00	0.000	0.142	0.2280	0.3916	.7022E-01	.2794E-03	0.0008	.0000E+00 .3257E-03
101		0.00	0.000	0.133	0.2181	0.2718	.4873E-01	.1997E-03	0.0005	.0000E+00 .2196E-03
102		0.00	0.000	0.154	0.2077	0.2044	.3666E-01	.1539E-03	0.0004	.0000E+00 .1653E-03
103		0.00	0.000	0.149	0.1979	0.1658	.2974E-01	.1270E-03	0.0003	.0000E+00 .1337E-03
104		0.00	0.000	0.143	0.1889	0.1178	.2112E-01	.9293E-04	0.0002	.0000E+00 .1015E-03
105		0.00	0.000	0.105	0.1824	0.0815	.1462E-01	.6651E-04	0.0002	.0000E+00 .7312E-04
106		0.00	0.000	0.107	0.1760	0.0578	.1036E-01	.4868E-04	0.0001	.0000E+00 .5314E-04
107		0.00	0.000	0.113	0.1694	0.0440	.7890E-02	.3806E-04	0.0001	.0000E+00 .4072E-04
108		0.00	0.000	0.083	0.1643	0.0482	.8648E-02	.4130E-04	0.0001	.0000E+00 .4049E-04
109		0.00	0.000	0.064	0.1606	0.0195	.3497E-02	.1821E-04	0.0001	.0000E+00 .2399E-04
110		0.00	0.000	0.054	0.1577	0.0025	.4159E-03	.2557E-05	0.0000	.0000E+00 .6471E-05
111		0.00	0.000	0.048	0.1550	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .6392E-06
112		0.00	0.000	0.044	0.1526	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
113		0.00	0.000	0.041	0.1504	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
114		0.00	0.000	0.038	0.1483	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
115		0.45	0.000	0.041	0.1707	0.0000	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00									
116	0.04	0.000	0.039	0.1707	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
117	2.42	0.257	0.039	0.2868	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
118	0.00	0.000	0.192	0.2685	0.7982	.1431	.5287E-03	0.0011		
.0000E+00	.5287E-03									
119	0.41	0.000	0.174	0.2730	0.8463	.1518	.5696E-03	0.0012		
.0000E+00	.5696E-03									
120	0.00	0.000	0.153	0.2599	0.4816	.8636E-01	.3380E-03	0.0007		
.0000E+00	.3380E-03									
121	0.00	0.000	0.218	0.2447	0.3347	.6002E-01	.2418E-03	0.0005		
.0000E+00	.2418E-03									
122	0.00	0.000	0.229	0.2305	0.1737	.3115E-01	.1322E-03	0.0003		
.0000E+00	.1322E-03									
123	0.00	0.000	0.251	0.2161	0.0650	.1166E-01	.5415E-04	0.0001		
.0000E+00	.5415E-04									
124	0.00	0.000	0.244	0.2019	0.0836	.1500E-01	.6794E-04	0.0001		
.0000E+00	.6794E-04									
125	0.30	0.000	0.163	0.2083	0.1129	.2024E-01	.8946E-04	0.0002		
.0000E+00	.8946E-04									
126	0.09	0.000	0.146	0.2043	0.0917	.1644E-01	.7400E-04	0.0002		
.0000E+00	.7400E-04									
127	0.17	0.000	0.170	0.2036	0.0702	.1258E-01	.5805E-04	0.0001		
.0000E+00	.5805E-04									
128	0.00	0.000	0.225	0.1908	0.0572	.1025E-01	.4822E-04	0.0001		
.0000E+00	.4822E-04									
129	0.04	0.000	0.179	0.1827	0.0475	.8524E-02	.4081E-04	0.0001		
.0000E+00	.4081E-04									
130	0.05	0.000	0.169	0.1761	0.0143	.2482E-02	.1297E-04	0.0000		
.0000E+00	.1297E-04									
131	0.00	0.000	0.104	0.1704	0.0037	.6714E-03	.4019E-05	0.0000		
.0000E+00	.4019E-05									
132	0.00	0.000	0.089	0.1655	0.0008	.8759E-04	.5635E-06	0.0000		
.0000E+00	.5635E-06									
133	0.00	0.000	0.080	0.1611	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
134	0.00	0.000	0.074	0.1571	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
135	0.00	0.000	0.079	0.1524	0.0412	.7396E-02	.3338E-04	0.0001		
.0000E+00	.3338E-04									
136	0.00	0.000	0.077	0.1479	0.0248	.4094E-02	.1844E-04	0.0000		
.0000E+00	.1844E-04									
137	0.00	0.000	0.080	0.1435	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
138	0.00	0.000	0.086	0.1388	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
139	0.05	0.000	0.091	0.1366	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
140	0.00	0.000	0.022	0.1354	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
141	0.00	0.000	0.016	0.1345	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
142	0.00	0.000	0.010	0.1340	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
143	0.00	0.000	0.002	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
144	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
145	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
146	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									

147	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
148	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
149	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
150	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
151	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
152	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
153	0.96	0.000	0.043	0.1840	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
154	0.03	0.000	0.105	0.1799	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
155	0.00	0.000	0.209	0.1685	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
156	0.00	0.000	0.232	0.1558	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
157	0.00	0.000	0.228	0.1433	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
158	0.42	0.000	0.186	0.1561	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
159	0.00	0.000	0.162	0.1473	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
160	0.00	0.000	0.115	0.1410	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
161	1.16	0.000	0.135	0.1970	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
162	0.04	0.000	0.190	0.1888	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
163	0.00	0.000	0.231	0.1762	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
164	0.00	0.000	0.222	0.1641	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
165	0.01	0.000	0.188	0.1543	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
166	0.29	0.000	0.181	0.1603	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
167	0.03	0.000	0.213	0.1503	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
168	0.00	0.000	0.252	0.1365	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
169	0.00	0.000	0.028	0.1350	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
170	0.00	0.000	0.021	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
171	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
172	0.07	0.000	0.034	0.1358	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
173	0.00	0.000	0.020	0.1347	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
174	0.00	0.000	0.011	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
175	0.00	0.000	0.004	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
176	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
177	0.73	0.000	0.108	0.1679	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
178	0.01	0.000	0.107	0.1626	0.0000	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00									
179	0.00	0.000	0.196	0.1519	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
180	1.58	0.021	0.241	0.2239	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
181	0.00	0.000	0.258	0.2098	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
182	0.00	0.000	0.267	0.1952	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
183	0.00	0.000	0.248	0.1816	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
184	0.00	0.000	0.274	0.1667	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
185	0.00	0.000	0.269	0.1520	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
186	0.00	0.000	0.212	0.1404	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
187	0.00	0.000	0.098	0.1350	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
188	0.44	0.000	0.111	0.1530	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
189	0.17	0.000	0.129	0.1552	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
190	0.00	0.000	0.166	0.1461	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
191	0.00	0.000	0.192	0.1356	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
192	0.00	0.000	0.026	0.1342	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
193	0.00	0.000	0.005	0.1340	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
194	0.21	0.000	0.039	0.1433	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
195	0.00	0.000	0.114	0.1371	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
196	0.00	0.000	0.043	0.1347	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
197	0.00	0.000	0.012	0.1341	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
198	0.00	0.000	0.003	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
199	0.02	0.000	0.021	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
200	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
201	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
202	0.04	0.000	0.037	0.1340	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
203	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
204	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
205	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
206	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
207	0.42	0.000	0.096	0.1515	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
208	0.00	0.000	0.110	0.1455	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
209	0.00	0.000	0.176	0.1359	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									

210	0.00	0.000	0.030	0.1343	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
211	0.00	0.000	0.006	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
212	0.17	0.000	0.043	0.1409	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
213	0.00	0.000	0.089	0.1360	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
214	1.60	0.021	0.141	0.2146	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
215	0.00	0.000	0.184	0.2046	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
216	0.01	0.000	0.142	0.1973	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
217	0.00	0.000	0.245	0.1839	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
218	0.00	0.000	0.241	0.1708	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
219	0.55	0.000	0.168	0.1917	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
220	0.00	0.000	0.215	0.1799	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
221	0.16	0.000	0.144	0.1808	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
222	0.00	0.000	0.229	0.1683	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
223	0.34	0.000	0.214	0.1751	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
224	0.02	0.000	0.209	0.1648	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
225	0.24	0.000	0.208	0.1665	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
226	0.47	0.000	0.196	0.1815	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
227	1.77	0.107	0.209	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
228	0.00	0.000	0.234	0.2483	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
229	0.00	0.000	0.209	0.2368	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
230	0.97	0.000	0.138	0.2823	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
231	0.00	0.000	0.234	0.2604	0.9315	.1670	.6222E-03	0.0013	.0000E+00
232	0.00	0.000	0.207	0.2448	0.4293	.7698E-01	.3040E-03	0.0006	.0000E+00
233	0.00	0.000	0.199	0.2306	0.3464	.6210E-01	.2496E-03	0.0005	.0000E+00
234	0.04	0.000	0.138	0.2222	0.3026	.5427E-01	.2205E-03	0.0005	.0000E+00
235	1.00	0.000	0.110	0.2685	0.2429	.4355E-01	.1801E-03	0.0004	.0000E+00
236	0.00	0.000	0.215	0.2531	0.3624	.6498E-01	.2553E-03	0.0005	.0000E+00
237	0.48	0.000	0.184	0.2629	0.6465	.1159	.4437E-03	0.0009	.0000E+00
238	0.00	0.000	0.261	0.2447	0.4046	.7254E-01	.2879E-03	0.0006	.0000E+00
239	0.00	0.000	0.216	0.2303	0.2612	.4684E-01	.1925E-03	0.0004	.0000E+00
240	0.00	0.000	0.199	0.2184	0.1090	.1954E-01	.8629E-04	0.0002	.0000E+00
241	0.00	0.000	0.163	0.2090	0.0442	.7925E-02	.3822E-04	0.0001	

.0000E+00	.3822E-04									
242	0.00	0.000	0.147	0.2003	0.0729	.1307E-01	.5997E-04	0.0001	.0000E+00	.5997E-04
243	0.00	0.000	0.189	0.1890	0.0920	.1650E-01	.7428E-04	0.0002	.0000E+00	.7428E-04
244	1.05	0.000	0.164	0.2367	0.0766	.1374E-01	.6286E-04	0.0001	.0000E+00	.6286E-04
245	0.00	0.000	0.223	0.2239	0.0608	.1091E-01	.5101E-04	0.0001	.0000E+00	.5101E-04
246	0.00	0.000	0.157	0.2149	0.0478	.8574E-02	.4102E-04	0.0001	.0000E+00	.4102E-04
247	0.00	0.000	0.167	0.2054	0.0369	.6625E-02	.3251E-04	0.0001	.0000E+00	.3251E-04
248	0.00	0.000	0.156	0.1968	0.0095	.1515E-02	.8030E-05	0.0000	.0000E+00	.8030E-05
249	0.00	0.000	0.173	0.1874	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
250	0.55	0.000	0.150	0.2092	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
251	0.00	0.000	0.158	0.2006	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
252	0.00	0.000	0.159	0.1919	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
253	0.13	0.000	0.095	0.1938	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
254	0.00	0.000	0.146	0.1858	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
255	0.00	0.000	0.164	0.1768	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
256	0.00	0.000	0.155	0.1684	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
257	0.00	0.000	0.163	0.1595	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
258	0.00	0.000	0.154	0.1510	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
259	0.00	0.000	0.131	0.1439	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
260	0.00	0.000	0.160	0.1351	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
261	0.22	0.000	0.078	0.1429	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
262	0.00	0.000	0.045	0.1404	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
263	0.77	0.000	0.087	0.1777	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
264	0.15	0.000	0.087	0.1812	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
265	0.00	0.000	0.080	0.1768	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
266	0.04	0.000	0.065	0.1754	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
267	0.12	0.000	0.099	0.1766	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
268	0.06	0.000	0.068	0.1761	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
269	1.17	0.003	0.104	0.2343	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
270	0.12	0.000	0.082	0.2363	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
271	0.11	0.000	0.089	0.2375	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
272	0.00	0.000	0.063	0.2341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

273	0.00	0.000	0.058	0.2309	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
274	0.00	0.000	0.044	0.2285	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
275	0.10	0.000	0.070	0.2301	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
276	0.00	0.000	0.030	0.2285	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
277	0.00	0.000	0.046	0.2259	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
278	0.00	0.000	0.039	0.2238	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
279	0.00	0.000	0.029	0.2222	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
280	0.06	0.000	0.049	0.2228	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
281	0.00	0.000	0.027	0.2213	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
282	0.16	0.000	0.067	0.2264	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
283	0.84	0.000	0.078	0.2681	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
284	0.00	0.000	0.051	0.2638	0.1500	.2689E-01	.1129E-03	0.0002	.1129E-03
285	0.00	0.000	0.047	0.2590	0.2299	.4123E-01	.1713E-03	0.0004	.1713E-03
286	0.00	0.000	0.045	0.2535	0.3049	.5467E-01	.2220E-03	0.0005	.2220E-03
287	0.00	0.000	0.051	0.2478	0.3025	.5425E-01	.2204E-03	0.0005	.2204E-03
288	0.35	0.000	0.087	0.2597	0.2524	.4526E-01	.1866E-03	0.0004	.1866E-03
289	0.02	0.000	0.032	0.2571	0.1988	.3565E-01	.1500E-03	0.0003	.1500E-03
290	0.78	0.000	0.074	0.2939	0.1735	.3111E-01	.1324E-03	0.0003	.1324E-03
291	0.18	0.000	0.071	0.2821	1.8099	.3245	.1157E-02	0.0024	.1157E-02
292	0.00	0.000	0.020	0.2715	0.9644	.1729	.6429E-03	0.0013	.6429E-03
293	0.02	0.000	0.026	0.2651	0.6124	.1098	.4222E-03	0.0009	.4222E-03
294	0.05	0.000	0.044	0.2617	0.3755	.6733E-01	.2686E-03	0.0006	.2686E-03
295	0.00	0.000	0.030	0.2578	0.2354	.4221E-01	.1751E-03	0.0004	.1751E-03
296	0.00	0.000	0.030	0.2538	0.2387	.4280E-01	.1773E-03	0.0004	.1773E-03
297	0.00	0.000	0.025	0.2502	0.2265	.4061E-01	.1690E-03	0.0004	.1690E-03
298	0.00	0.000	0.017	0.2473	0.1977	.3544E-01	.1492E-03	0.0003	.1492E-03
299	0.00	0.000	0.023	0.2444	0.1629	.2921E-01	.1250E-03	0.0003	.1250E-03
300	0.10	0.000	0.059	0.2452	0.1437	.2577E-01	.1115E-03	0.0002	.1115E-03
301	0.44	0.000	0.055	0.2650	0.1305	.2340E-01	.1021E-03	0.0002	.1021E-03
302	0.01	0.000	0.036	0.2624	0.1195	.2143E-01	.9421E-04	0.0002	.9421E-04
303	0.00	0.000	0.027	0.2598	0.1124	.2015E-01	.8909E-04	0.0002	.8909E-04
304	0.00	0.000	0.036	0.2572	0.0600	.1076E-01	.5027E-04	0.0001	

.0000E+00	.5027E-04									
305		0.00	0.000	0.030	0.2552	0.0426	.7636E-02	.3668E-04	0.0001	
.0000E+00	.3668E-04									
306		0.00	0.000	0.031	0.2520	0.1464	.2625E-01	.1132E-03	0.0002	
.0000E+00	.1132E-03									
307		0.02	0.000	0.048	0.2486	0.1966	.3526E-01	.1485E-03	0.0003	
.0000E+00	.1485E-03									
308		0.19	0.000	0.058	0.2539	0.1901	.3408E-01	.1439E-03	0.0003	
.0000E+00	.1439E-03									
309		0.00	0.000	0.052	0.2495	0.1606	.2879E-01	.1234E-03	0.0003	
.0000E+00	.1234E-03									
310		0.00	0.000	0.045	0.2456	0.1525	.2734E-01	.1177E-03	0.0002	
.0000E+00	.1177E-03									
311		0.25	0.000	0.062	0.2546	0.1242	.2227E-01	.9758E-04	0.0002	
.0000E+00	.9758E-04									
312		3.99	1.393	0.065	0.3808	1.6889	.2235	.1050E-02	0.0022	
.0000E+00	.1050E-02									
313		0.16	0.000	0.066	0.3554	14.2754	.5491	.8443E-02	0.0000	
.0000E+00	.0000E+00									
314		0.00	0.000	0.040	0.3229	10.4939	.5476	.6220E-02	0.0000	
.0000E+00	.0000E+00									
315		0.03	0.000	0.057	0.2914	5.6766	.5470	.3420E-02	0.0032	
.0000E+00	.1559E-02									
316		0.00	0.000	0.053	0.2687	2.0106	.3605	.1277E-02	0.0018	
.0000E+00	.8519E-03									
317		0.00	0.000	0.051	0.2561	1.0054	.1803	.6682E-03	0.0007	
.0000E+00	.3308E-03									
318		0.00	0.000	0.042	0.2484	0.5519	.9896E-01	.3833E-03	0.0003	
.0000E+00	.1547E-03									
319		0.00	0.000	0.033	0.2432	0.3413	.6120E-01	.2462E-03	0.0002	
.0000E+00	.1327E-03									
320		0.00	0.000	0.028	0.2394	0.2283	.4094E-01	.1702E-03	0.0037	
.0000E+00	.9223E-03									
321	*	0.03	0.000	0.039	0.2371	0.1826	.3274E-01	.1388E-03	0.0248	
.0000E+00	.3402E-02									
322		0.43	0.000	0.048	0.2565	0.1505	.2698E-01	.1163E-03	0.0418	
.0000E+00	.3403E-02									
323		0.00	0.000	0.033	0.2535	0.1297	.2325E-01	.1015E-03	0.0591	
.0000E+00	.3403E-02									
324		0.00	0.000	0.033	0.2508	0.0868	.1556E-01	.7023E-04	0.0747	
.0000E+00	.3404E-02									
325		0.00	0.000	0.040	0.2480	0.0566	.1015E-01	.4770E-04	0.0405	
.0000E+00	.3403E-02									
326		0.08	0.000	0.052	0.2484	0.1212	.2173E-01	.9537E-04	0.0015	
.0000E+00	.4077E-03									
327		0.12	0.000	0.050	0.2506	0.1664	.2983E-01	.1274E-03	0.0002	
.0000E+00	.1194E-03									
328		0.72	0.000	0.045	0.2859	0.1630	.2923E-01	.1251E-03	0.0003	
.0000E+00	.1257E-03									
329		0.01	0.000	0.043	0.2709	1.3338	.2392	.8694E-03	0.0010	
.0000E+00	.6833E-03									
330		0.46	0.000	0.055	0.2854	0.7787	.1396	.5273E-03	0.0015	
.0000E+00	.6128E-03									
331		0.21	0.000	0.052	0.2887	0.5466	.9800E-01	.3800E-03	0.0009	
.0000E+00	.4168E-03									
332		0.02	0.000	0.039	0.2824	0.5356	.9605E-01	.3731E-03	0.0008	
.0000E+00	.3748E-03									
333		0.00	0.000	0.027	0.2747	0.6322	.1134	.4348E-03	0.0008	
.0000E+00	.4194E-03									
334		0.23	0.000	0.049	0.2784	0.6351	.1139	.4367E-03	0.0009	
.0000E+00	.4363E-03									
335		0.81	0.001	0.043	0.3015	2.1467	.3418	.1349E-02	0.0019	
.0000E+00	.1121E-02									

336		0.42	0.000	0.045	0.2954	3.1294	.4842	.1936E-02	0.0039	.0000E+00 .2274E-02
337		0.00	0.000	0.030	0.2787	1.5334	.2750	.9903E-03	0.0021	.0000E+00 .9903E-03
338	*	0.00	0.000	0.025	0.2702	0.7213	.1293	.4910E-03	0.0010	.0000E+00 .4910E-03
339		0.00	0.000	0.030	0.2633	0.5386	.9657E-01	.3750E-03	0.0008	.0000E+00 .3750E-03
340		0.59	0.000	0.041	0.2888	0.4638	.8317E-01	.3267E-03	0.0007	.0000E+00 .3267E-03
341		0.00	0.000	0.027	0.2815	0.5862	.1051	.4029E-03	0.0008	.0000E+00 .4029E-03
342	*	0.00	0.000	0.024	0.2722	0.8145	.1460	.5499E-03	0.0011	.0000E+00 .5499E-03
343	*	0.00	0.000	0.022	0.2645	0.6668	.1196	.4569E-03	0.0010	.0000E+00 .4569E-03
344	*	0.05	0.000	0.028	0.2605	0.5176	.9280E-01	.3614E-03	0.0008	.0000E+00 .3614E-03
345	*	0.00	0.000	0.027	0.2552	0.3969	.7116E-01	.2829E-03	0.0006	.0000E+00 .2829E-03
346		0.00	0.000	0.029	0.2508	0.2866	.5140E-01	.2097E-03	0.0004	.0000E+00 .2097E-03
347	*	0.00	0.000	0.026	0.2474	0.2004	.3594E-01	.1511E-03	0.0003	.0000E+00 .1511E-03
348		0.00	0.000	0.030	0.2442	0.1539	.2760E-01	.1187E-03	0.0002	.0000E+00 .1187E-03
349	*	0.89	0.000	0.029	0.2440	0.1261	.2261E-01	.9893E-04	0.0002	.0000E+00 .9893E-04
350	*	0.00	0.000	0.024	0.2439	0.1226	.2199E-01	.9646E-04	0.0002	.0000E+00 .9646E-04
351	*	0.00	0.000	0.024	0.2439	0.1146	.2054E-01	.9065E-04	0.0002	.0000E+00 .9065E-04
352	*	0.00	0.000	0.025	0.2439	0.1051	.1885E-01	.8382E-04	0.0002	.0000E+00 .8382E-04
353	*	1.72	0.000	0.000	0.2441	0.0936	.1678E-01	.7540E-04	0.0002	.0000E+00 .7540E-04
354	*	0.10	0.000	0.000	0.2444	0.0783	.1404E-01	.6415E-04	0.0001	.0000E+00 .6415E-04
355		0.09	0.000	0.000	0.2448	0.0684	.1226E-01	.5669E-04	0.0001	.0000E+00 .5669E-04
356		0.91	0.928	0.000	0.3775	0.6354	.1139	.4123E-03	0.0009	.0000E+00 .4123E-03
357		0.00	0.000	0.041	0.3449	12.9833	.5484	.7679E-02	0.0000	.0000E+00 .0000E+00
358		0.00	0.000	0.039	0.3125	8.7255	.5474	.5189E-02	0.0000	.0000E+00 .0000E+00
359		0.00	0.000	0.038	0.2828	3.7884	.5035	.2321E-02	0.0026	.0000E+00 .1968E-02
360		0.26	0.000	0.045	0.2790	1.5755	.2825	.1016E-02	0.0015	.0000E+00 .7078E-03
361		0.00	0.000	0.037	0.2688	0.8277	.1484	.5578E-03	0.0007	.0000E+00 .3423E-03
362		0.00	0.000	0.031	0.2622	0.5057	.9068E-01	.3537E-03	0.0005	.0000E+00 .2449E-03
363		0.00	0.000	0.032	0.2576	0.2883	.5170E-01	.2105E-03	0.0043	.0000E+00 .9429E-03
364	*	0.00	0.000	0.027	0.2547	0.1443	.2588E-01	.1119E-03	0.0268	.0000E+00 .3402E-02
365	*	0.12	0.000	0.035	0.2542	0.1645	.2950E-01	.1261E-03	0.0440	.0000E+00 .3403E-02

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MONTHLY TOTALS (IN INCHES) FOR YEAR 1977

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.61	1.33	4.19	5.59	0.70	5.33
	1.47	7.65	4.49	3.11	6.95	5.96
RUNOFF	1.225	0.000	0.177	0.257	0.000	0.021
	0.000	0.127	0.003	0.000	1.393	0.929
EVAPOTRANSPIRATION	0.370	0.653	2.361	2.994	2.805	3.920
	2.730	5.878	3.679	1.368	1.364	0.853
LATERAL DRAINAGE COLLECTED	0.0000	1.2885	2.2901	1.6408	0.2006	0.0000
FROM LAYER 3	0.0000	0.7612	0.0414	1.2554	3.7804	4.5286
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0049	0.0098	0.0062	0.0009	0.0000
LAYER 4	0.0000	0.0030	0.0002	0.0049	0.0265	0.0265
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0049	0.0098	0.0063	0.0009	0.0000
LAYER 6	0.0000	0.0030	0.0002	0.0049	0.0264	0.0201

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.257	0.474	0.305	0.036	0.000
TOP OF LAYER 4	0.000	0.137	0.008	0.226	1.427	1.371
STD. DEVIATION OF DAILY	0.000	0.383	0.891	0.495	0.070	0.000
HEAD ON TOP OF LAYER 4	0.000	0.227	0.020	0.357	3.203	2.736
AVERAGE DAILY HEAD ON	0.000	0.000	0.001	0.000	0.000	0.000
TOP OF LAYER 6	0.000	0.000	0.000	0.000	0.009	0.003
STD. DEVIATION OF DAILY	0.000	0.001	0.001	0.001	0.000	0.000
HEAD ON TOP OF LAYER 6	0.000	0.000	0.000	0.000	0.019	0.009

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ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.38	2879013.500	100.00
RUNOFF	4.133	240989.469	8.37
EVAPOTRANSPIRATION	28.974	1689290.120	58.68

DRAINAGE COLLECTED FROM LAYER 3	15.7869	920429.562	31.97
PERC./LEAKAGE THROUGH LAYER 4	0.082995	4838.859	0.17
AVG. HEAD ON TOP OF LAYER 4	0.3534		
PERC./LEAKAGE THROUGH LAYER 6	0.076440	4456.688	0.15
AVG. HEAD ON TOP OF LAYER 6	0.0012		
CHANGE IN WATER STORAGE	0.409	23849.045	0.83
SOIL WATER AT START OF YEAR	172.720	10070133.000	
SOIL WATER AT END OF YEAR	173.063	10090156.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.066	3826.876	0.13
ANNUAL WATER BUDGET BALANCE	0.0000	-1.489	0.00

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HEAD #1: AVERAGE HEAD ON TOP OF LAYER 4
DRAIN #1: LATERAL DRAINAGE FROM LAYER 3 (RECIRCULATION AND COLLECTION)
LEAK #1: PERCOLATION OR LEAKAGE THROUGH LAYER 4
HEAD #2: AVERAGE HEAD ON TOP OF LAYER 6
DRAIN #2: LATERAL DRAINAGE FROM LAYER 5 (RECIRCULATION AND COLLECTION)
LEAK #2: PERCOLATION OR LEAKAGE THROUGH LAYER 6

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DAILY OUTPUT FOR YEAR 1978

DAY	AI	SOIL	RAIN IN.	RUNOFF IN.	ET IN.	E. ZONE WATER IN./IN.	HEAD #1 IN.	DRAIN #1 IN.	LEAK #1 IN.	HEAD #2 IN.	DRAIN #2 IN.	LEAK #2 IN.
1			0.04	0.000	0.035	0.2561	0.1916	.3435E-01	.1450E-03	0.0609	.0000E+00	.3403E-02
2			0.16	0.000	0.051	0.2603	0.1772	.3177E-01	.1350E-03	0.0345	.0000E+00	.3402E-02
3			0.04	0.000	0.047	0.2585	0.1523	.2731E-01	.1175E-03	0.0002	.0000E+00	.1466E-03
4	*		0.00	0.000	0.026	0.2557	0.1396	.2504E-01	.1086E-03	0.0002		

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.0000E+00 .1086E-03
    5  *      0.00  0.000  0.000  0.2543    0.1391 .2493E-01 .1082E-03    0.0002
.0000E+00 .1082E-03
    6  *      0.00  0.000  0.033  0.2515    0.1032 .1850E-01 .8236E-04    0.0002
.0000E+00 .8236E-04
    7         0.00  0.000  0.040  0.2488    0.0449 .8052E-02 .3865E-04    0.0001
.0000E+00 .3865E-04
    8         0.00  0.000  0.045  0.2461    0.0275 .4929E-02 .2487E-04    0.0001
.0000E+00 .2487E-04
    9         0.36  0.000  0.056  0.2621    0.0663 .1188E-01 .5505E-04    0.0001
.0000E+00 .5505E-04
   10  *      0.72  0.000  0.031  0.2622    0.0983 .1762E-01 .7881E-04    0.0002
.0000E+00 .7881E-04
   11         0.00  0.000  0.027  0.2662    0.1331 .2387E-01 .1039E-03    0.0002
.0000E+00 .1039E-03
   12  *      0.00  0.000  0.027  0.2663    0.0996 .1785E-01 .7972E-04    0.0002
.0000E+00 .7972E-04
   13  *      0.00  0.000  0.025  0.2665    0.0937 .1680E-01 .7540E-04    0.0002
.0000E+00 .7540E-04
   14  *      1.46  0.000  0.000  0.2667    0.0860 .1542E-01 .6963E-04    0.0001
.0000E+00 .6963E-04
   15  *      0.20  0.000  0.027  0.2659    0.1939 .3476E-01 .1465E-03    0.0003
.0000E+00 .1465E-03
   16  *      0.00  0.000  0.019  0.2646    0.2452 .4397E-01 .1818E-03    0.0004
.0000E+00 .1818E-03
   17  *      0.00  0.000  0.024  0.2633    0.2428 .4353E-01 .1801E-03    0.0004
.0000E+00 .1801E-03
   18  *      1.66  0.000  0.000  0.2621    0.2215 .3972E-01 .1656E-03    0.0003
.0000E+00 .1656E-03
   19  *      0.05  0.000  0.022  0.2613    0.1975 .3542E-01 .1491E-03    0.0003
.0000E+00 .1491E-03
   20  *  *   0.39  0.000  0.019  0.2600    0.1348 .2418E-01 .1049E-03    0.0002
.0000E+00 .1049E-03
   21  *  *   1.89  0.000  0.000  0.2594    0.0543 .9733E-02 .4591E-04    0.0001
.0000E+00 .4591E-04
   22  *  *   0.00  0.000  0.027  0.2592    0.0218 .3917E-02 .2023E-04    0.0000
.0000E+00 .2023E-04
   23     *   0.00  0.000  0.000  0.2591    0.0088 .1576E-02 .8992E-05    0.0000
.0000E+00 .8992E-05
   24     *   0.00  0.000  0.036  0.2591    0.0035 .6334E-03 .4038E-05    0.0000
.0000E+00 .4038E-05
   25     *   0.00  0.000  0.037  0.2591    0.0014 .2544E-03 .1838E-05    0.0000
.0000E+00 .1838E-05
   26     *   1.83  2.833  0.000  0.2795    0.0006 .1021E-03 .8522E-06    0.0000
.0000E+00 .8522E-06
   27     *   0.10  0.713  0.000  0.2920    0.0002 .4092E-04 .4057E-06    0.0000
.0000E+00 .4057E-06
   28     *   0.00  0.564  0.000  0.3011    0.0001 .1637E-04 .2008E-06    0.0000
.0000E+00 .2008E-06
   29     *   0.00  0.321  0.000  0.3080    0.0000 .6531E-05 .1054E-06    0.0000
.0000E+00 .1054E-06
   30     *   0.00  0.501  0.000  0.3140    0.0000 .2592E-05 .6017E-07    0.0000
.0000E+00 .6017E-07
   31     *   0.00  0.505  0.000  0.3192    0.0000 .1019E-05 .3812E-07    0.0000
.0000E+00 .3812E-07
   32     *   0.00  0.590  0.000  0.3238    0.0000 .3929E-06 .2654E-07    0.0000
.0000E+00 .1991E-07
   33     *   0.00  0.418  0.000  0.3278    0.0000 .1449E-06 .2138E-07    0.0000
.0000E+00 .2267E-07
   34         0.01  0.000  0.054  0.3061    3.6710 .3503     .2220E-02    0.0034
.0000E+00 .2220E-02
   35  *      0.00  0.000  0.042  0.2753    3.9806 .5198     .2433E-02    0.0031
.0000E+00 .1591E-02
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36	*		0.00	0.000	0.045	0.2564	1.6649	.2985	.1070E-02	0.0043	.0000E+00 .1912E-02
37	*		0.05	0.000	0.040	0.2484	0.8753	.1569	.5875E-03	0.0012	.0000E+00 .5875E-03
38	*	*	0.70	0.000	0.031	0.2440	0.4426	.7937E-01	.3123E-03	0.0007	.0000E+00 .3123E-03
39	*	*	0.06	0.000	0.032	0.2423	0.1783	.3197E-01	.1355E-03	0.0003	.0000E+00 .1355E-03
40	*	*	0.00	0.000	0.022	0.2416	0.0718	.1287E-01	.5914E-04	0.0001	.0000E+00 .5914E-04
41	*	*	0.00	0.000	0.023	0.2413	0.0289	.5181E-02	.2600E-04	0.0001	.0000E+00 .2600E-04
42	*	*	0.00	0.000	0.024	0.2412	0.0116	.2084E-02	.1152E-04	0.0000	.0000E+00 .1152E-04
43	*	*	0.00	0.000	0.026	0.2411	0.0047	.8380E-03	.5157E-05	0.0000	.0000E+00 .5157E-05
44	*	*	0.00	0.000	0.025	0.2411	0.0019	.3367E-03	.2337E-05	0.0000	.0000E+00 .2337E-05
45	*	*	0.31	0.000	0.026	0.2411	0.0008	.1352E-03	.1077E-05	0.0000	.0000E+00 .1077E-05
46	*	*	0.20	0.000	0.026	0.2411	0.0003	.5420E-04	.5078E-06	0.0000	.0000E+00 .5078E-06
47	*	*	0.00	0.000	0.025	0.2411	0.0001	.2170E-04	.2479E-06	0.0000	.0000E+00 .2479E-06
48	*	*	0.00	0.000	0.034	0.2411	0.0000	.8664E-05	.1275E-06	0.0000	.0000E+00 .1275E-06
49		*	0.00	0.019	0.016	0.2491	0.0000	.3445E-05	.7075E-07	0.0000	.0000E+00 .7075E-07
50		*	0.02	0.059	0.000	0.2598	0.0000	.1359E-05	.4335E-07	0.0000	.0000E+00 .4335E-07
51		*	0.00	0.301	0.000	0.2740	0.0000	.5281E-06	.2946E-07	0.0000	.0000E+00 .2946E-07
52		*	0.00	0.000	0.000	0.2740	0.0000	.1984E-06	.2211E-07	0.0000	.0000E+00 .1659E-07
53		*	0.00	0.000	0.000	0.2740	0.0000	.6745E-07	.2117E-07	0.0000	.0000E+00 .2141E-07
54		*	0.00	0.000	0.000	0.2740	0.0000	.1446E-07	.1960E-07	0.0000	.0000E+00 .1999E-07
55		*	0.00	0.000	0.000	0.2740	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .4900E-08
56		*	0.00	0.000	0.000	0.2740	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
57		*	0.00	0.000	0.000	0.2740	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
58		*	0.00	0.000	0.000	0.2740	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
59		*	0.00	0.000	0.000	0.2740	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
60	*	*	0.00	0.000	0.000	0.2740	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
61	*	*	0.01	0.000	0.010	0.2740	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
62		*	0.00	0.000	0.000	0.2740	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
63		*	0.59	0.382	0.007	0.2850	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
64			0.00	0.000	0.079	0.2707	1.0165	.1823	.6621E-03	0.0014	.0000E+00 .6621E-03
65	*		0.00	0.000	0.057	0.2605	0.7195	.1290	.4901E-03	0.0010	.0000E+00 .4901E-03
66			0.00	0.000	0.056	0.2516	0.5921	.1062	.4093E-03	0.0009	.0000E+00 .4093E-03
67			0.00	0.000	0.075	0.2430	0.4592	.8233E-01	.3236E-03	0.0007	

.0000E+00	.3236E-03									
68	0.16	0.000	0.094	0.2433	0.3383	.6067E-01	.2442E-03	0.0005		
.0000E+00	.2442E-03									
69	0.01	0.000	0.116	0.2351	0.2426	.4349E-01	.1799E-03	0.0004		
.0000E+00	.1799E-03									
70	0.02	0.000	0.115	0.2282	0.1774	.3181E-01	.1351E-03	0.0003		
.0000E+00	.1351E-03									
71	0.00	0.000	0.098	0.2213	0.1553	.2784E-01	.1196E-03	0.0002		
.0000E+00	.1196E-03									
72	0.00	0.000	0.091	0.2150	0.1407	.2523E-01	.1094E-03	0.0002		
.0000E+00	.1094E-03									
73	0.00	0.000	0.085	0.2090	0.1379	.2472E-01	.1073E-03	0.0002		
.0000E+00	.1073E-03									
74	0.44	0.000	0.093	0.2268	0.1134	.2033E-01	.8980E-04	0.0002		
.0000E+00	.8980E-04									
75	0.00	0.000	0.121	0.2194	0.0867	.1554E-01	.7032E-04	0.0001		
.0000E+00	.7032E-04									
76	0.57	0.000	0.141	0.2422	0.0670	.1201E-01	.5566E-04	0.0001		
.0000E+00	.5566E-04									
77	0.00	0.000	0.094	0.2365	0.0511	.9171E-02	.4360E-04	0.0001		
.0000E+00	.4360E-04									
78	0.00	0.000	0.113	0.2299	0.0396	.7105E-02	.3463E-04	0.0001		
.0000E+00	.3463E-04									
79	0.00	0.000	0.083	0.2251	0.0320	.5740E-02	.2858E-04	0.0001		
.0000E+00	.2858E-04									
80	0.00	0.000	0.115	0.2186	0.0208	.3738E-02	.1935E-04	0.0000		
.0000E+00	.1935E-04									
81	0.09	0.000	0.074	0.2194	0.0028	.4263E-03	.2626E-05	0.0000		
.0000E+00	.2626E-05									
82	0.05	0.000	0.072	0.2183	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
83	0.00	0.000	0.075	0.2142	0.0000	.1535E-05	.2541E-07	0.0000		
.0000E+00	.2541E-07									
84	0.00	0.000	0.075	0.2100	0.0080	.1442E-02	.8291E-05	0.0000		
.0000E+00	.8291E-05									
85	0.06	0.000	0.069	0.2094	0.0067	.1201E-02	.6957E-05	0.0000		
.0000E+00	.6957E-05									
86	1.62	0.040	0.067	0.2921	0.0051	.9218E-03	.5596E-05	0.0000		
.0000E+00	.5596E-05									
87	0.69	0.000	0.094	0.3097	1.5263	.2737	.9681E-03	0.0020		
.0000E+00	.9681E-03									
88	0.00	0.000	0.084	0.2848	2.0570	.3688	.1305E-02	0.0027		
.0000E+00	.1305E-02									
89	0.00	0.000	0.119	0.2657	1.2795	.2294	.8366E-03	0.0017		
.0000E+00	.8366E-03									
90	0.00	0.000	0.104	0.2535	0.6601	.1184	.4523E-03	0.0009		
.0000E+00	.4523E-03									
91	0.00	0.000	0.116	0.2431	0.4126	.7398E-01	.2932E-03	0.0006		
.0000E+00	.2932E-03									
92	0.00	0.000	0.093	0.2352	0.2855	.5120E-01	.2090E-03	0.0004		
.0000E+00	.2090E-03									
93	0.00	0.000	0.089	0.2281	0.2302	.4127E-01	.1715E-03	0.0004		
.0000E+00	.1715E-03									
94	0.04	0.000	0.102	0.2229	0.1794	.3218E-01	.1365E-03	0.0003		
.0000E+00	.1365E-03									
95	0.21	0.000	0.082	0.2283	0.1572	.2818E-01	.1210E-03	0.0003		
.0000E+00	.1210E-03									
96	0.00	0.000	0.100	0.2216	0.1231	.2208E-01	.9679E-04	0.0002		
.0000E+00	.9679E-04									
97	0.10	0.000	0.088	0.2214	0.0917	.1644E-01	.7401E-04	0.0002		
.0000E+00	.7401E-04									
98	0.04	0.000	0.106	0.2171	0.0684	.1227E-01	.5675E-04	0.0001		
.0000E+00	.5675E-04									

99	0.00	0.000	0.103	0.2110	0.0516	.9260E-02	.4398E-04	0.0001	.0000E+00	.4398E-04
100	0.00	0.000	0.138	0.2031	0.0408	.7307E-02	.3551E-04	0.0001	.0000E+00	.3551E-04
101	0.00	0.000	0.084	0.1982	0.0287	.5152E-02	.2590E-04	0.0001	.0000E+00	.2590E-04
102	0.12	0.000	0.082	0.2001	0.0205	.3681E-02	.1918E-04	0.0000	.0000E+00	.1918E-04
103	0.00	0.000	0.110	0.1939	0.0174	.3119E-02	.1654E-04	0.0000	.0000E+00	.1654E-04
104	0.00	0.000	0.110	0.1878	0.0141	.2524E-02	.1368E-04	0.0000	.0000E+00	.1368E-04
105	0.00	0.000	0.130	0.1805	0.0135	.2421E-02	.1316E-04	0.0000	.0000E+00	.1316E-04
106	0.00	0.000	0.139	0.1730	0.0004	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
107	0.00	0.000	0.083	0.1684	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
108	0.00	0.000	0.064	0.1649	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
109	0.00	0.000	0.054	0.1620	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
110	0.77	0.000	0.053	0.2012	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
111	0.47	0.000	0.115	0.2206	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
112	0.00	0.000	0.171	0.2113	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
113	0.00	0.000	0.162	0.2025	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
114	0.00	0.000	0.179	0.1927	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
115	0.00	0.000	0.134	0.1854	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
116	0.00	0.000	0.147	0.1773	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
117	0.00	0.000	0.085	0.1727	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
118	0.01	0.000	0.069	0.1695	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
119	0.00	0.000	0.056	0.1664	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
120	0.00	0.000	0.050	0.1636	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
121	0.00	0.000	0.047	0.1611	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
122	0.00	0.000	0.043	0.1588	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
123	0.00	0.000	0.040	0.1566	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
124	0.00	0.000	0.038	0.1545	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
125	0.42	0.000	0.040	0.1753	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
126	0.11	0.000	0.039	0.1791	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
127	0.03	0.000	0.039	0.1787	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
128	0.00	0.000	0.035	0.1767	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
129	0.32	0.000	0.041	0.1920	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
130	0.80	0.000	0.173	0.2263	0.0000	.0000E+00	.0000E+00	0.0000		

.0000E+00	.0000E+00									
131	0.00	0.000	0.155	0.2178	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
132	0.00	0.000	0.180	0.2079	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
133	0.00	0.000	0.210	0.1964	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
134	0.07	0.000	0.239	0.1872	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
135	0.73	0.000	0.184	0.2170	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
136	0.02	0.000	0.173	0.2086	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
137	0.68	0.000	0.167	0.2367	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
138	0.22	0.000	0.135	0.2414	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
139	0.08	0.000	0.115	0.2394	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
140	0.00	0.000	0.201	0.2284	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
141	0.00	0.000	0.217	0.2166	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
142	0.00	0.000	0.193	0.2060	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
143	0.00	0.000	0.200	0.1951	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
144	0.03	0.000	0.185	0.1866	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
145	2.45	0.225	0.259	0.2941	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
146	0.00	0.000	0.223	0.2733	0.8793	.1577	.5786E-03	0.0012	.0000E+00	.5786E-03
147	0.00	0.000	0.203	0.2555	0.6765	.1213	.4623E-03	0.0010	.0000E+00	.4623E-03
148	0.00	0.000	0.227	0.2388	0.4345	.7792E-01	.3076E-03	0.0006	.0000E+00	.3076E-03
149	0.00	0.000	0.231	0.2227	0.3482	.6243E-01	.2508E-03	0.0005	.0000E+00	.2508E-03
150	0.04	0.000	0.143	0.2143	0.2816	.5049E-01	.2063E-03	0.0004	.0000E+00	.2063E-03
151	0.00	0.000	0.237	0.1992	0.2246	.4027E-01	.1677E-03	0.0003	.0000E+00	.1677E-03
152	0.01	0.000	0.114	0.1918	0.1646	.2951E-01	.1261E-03	0.0003	.0000E+00	.1261E-03
153	0.00	0.000	0.267	0.1762	0.1129	.2025E-01	.8948E-04	0.0002	.0000E+00	.8948E-04
154	0.00	0.000	0.255	0.1612	0.1034	.1854E-01	.8243E-04	0.0002	.0000E+00	.8243E-04
155	0.13	0.000	0.202	0.1571	0.0169	.2280E-02	.1085E-04	0.0000	.0000E+00	.1085E-04
156	0.00	0.000	0.175	0.1475	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
157	0.18	0.000	0.141	0.1497	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
158	0.00	0.000	0.181	0.1398	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
159	0.16	0.000	0.109	0.1426	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
160	0.37	0.000	0.112	0.1567	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
161	0.01	0.000	0.082	0.1528	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

162	0.00	0.000	0.142	0.1450	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
163	0.00	0.000	0.169	0.1358	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
164	0.00	0.000	0.027	0.1343	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
165	0.06	0.000	0.032	0.1358	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
166	0.00	0.000	0.018	0.1348	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
167	0.00	0.000	0.013	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
168	0.00	0.000	0.003	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
169	0.08	0.000	0.030	0.1366	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
170	0.00	0.000	0.016	0.1357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
171	0.08	0.000	0.046	0.1376	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
172	0.00	0.000	0.022	0.1364	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
173	0.48	0.000	0.116	0.1563	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
174	0.00	0.000	0.117	0.1499	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
175	0.00	0.000	0.151	0.1416	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
176	0.00	0.000	0.122	0.1350	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
177	0.00	0.000	0.015	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
178	0.02	0.000	0.023	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
179	0.18	0.000	0.040	0.1417	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
180	0.00	0.000	0.094	0.1365	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
181	0.00	0.000	0.037	0.1345	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
182	0.00	0.000	0.009	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
183	0.00	0.000	0.002	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
184	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
185	3.66	0.687	0.153	0.2880	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
186	0.01	0.000	0.193	0.2682	0.9960	.1786	.6409E-03	0.0013	.0000E+00
187	0.00	0.000	0.274	0.2380	1.5523	.2783	.1002E-02	0.0021	.0000E+00
188	0.00	0.000	0.230	0.2170	0.8498	.1524	.5716E-03	0.0012	.0000E+00
189	0.00	0.000	0.241	0.1991	0.4789	.8587E-01	.3363E-03	0.0007	.0000E+00
190	0.00	0.000	0.221	0.1843	0.2807	.5033E-01	.2056E-03	0.0004	.0000E+00
191	0.00	0.000	0.294	0.1663	0.1960	.3515E-01	.1480E-03	0.0003	.0000E+00
192	0.04	0.000	0.239	0.1546	0.0776	.1392E-01	.6331E-04	0.0001	.0000E+00
193	0.00	0.000	0.172	0.1452	0.0066	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00									
194	0.00	0.000	0.157	0.1366	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
195	0.00	0.000	0.051	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
196	0.06	0.000	0.039	0.1350	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
197	0.00	0.000	0.012	0.1343	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
198	0.06	0.000	0.044	0.1352	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
199	0.18	0.000	0.048	0.1424	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
200	0.00	0.000	0.098	0.1371	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
201	0.00	0.000	0.043	0.1347	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
202	0.00	0.000	0.012	0.1341	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
203	0.00	0.000	0.003	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
204	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
205	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
206	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
207	0.10	0.000	0.043	0.1370	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
208	0.00	0.000	0.016	0.1361	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
209	0.25	0.000	0.100	0.1443	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
210	0.09	0.000	0.092	0.1442	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
211	0.00	0.000	0.126	0.1373	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
212	0.00	0.000	0.045	0.1348	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
213	0.82	0.000	0.087	0.1749	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
214	0.25	0.000	0.115	0.1823	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
215	0.00	0.000	0.173	0.1728	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
216	0.11	0.000	0.184	0.1688	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
217	0.02	0.000	0.174	0.1604	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
218	1.16	0.000	0.171	0.2144	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
219	0.80	0.000	0.159	0.2495	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
220	0.08	0.000	0.244	0.2405	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
221	0.00	0.000	0.188	0.2302	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
222	0.20	0.000	0.136	0.2338	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
223	0.14	0.000	0.185	0.2313	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
224	0.46	0.000	0.155	0.2480	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									

225	0.00	0.000	0.179	0.2382	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
226	0.00	0.000	0.271	0.2233	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
227	0.00	0.000	0.263	0.2090	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
228	0.00	0.000	0.269	0.1943	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
229	0.00	0.000	0.221	0.1822	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
230	0.00	0.000	0.239	0.1691	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
231	0.00	0.000	0.199	0.1583	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
232	0.00	0.000	0.244	0.1450	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
233	0.00	0.000	0.203	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
234	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
235	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
236	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
237	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
238	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
239	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
240	0.06	0.000	0.037	0.1351	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
241	2.33	0.166	0.119	0.2469	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
242	0.00	0.000	0.174	0.2374	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
243	0.00	0.000	0.176	0.2278	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
244	0.43	0.000	0.201	0.2403	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
245	0.40	0.000	0.172	0.2528	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
246	0.00	0.000	0.193	0.2422	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
247	0.00	0.000	0.168	0.2330	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
248	0.00	0.000	0.158	0.2244	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
249	0.00	0.000	0.145	0.2165	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
250	0.00	0.000	0.124	0.2097	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
251	0.00	0.000	0.139	0.2021	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
252	0.03	0.000	0.114	0.1975	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
253	0.00	0.000	0.170	0.1882	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
254	0.00	0.000	0.149	0.1801	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
255	0.00	0.000	0.171	0.1707	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
256	0.30	0.000	0.150	0.1789	0.0000	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00								
257	0.00	0.000	0.145	0.1710	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
258	0.00	0.000	0.134	0.1636	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
259	0.06	0.000	0.104	0.1612	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
260	0.19	0.000	0.124	0.1648	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
261	0.00	0.000	0.133	0.1575	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
262	0.34	0.000	0.098	0.1708	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
263	0.21	0.000	0.105	0.1765	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
264	0.00	0.000	0.105	0.1708	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
265	0.00	0.000	0.138	0.1633	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
266	0.06	0.000	0.087	0.1618	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
267	0.00	0.000	0.105	0.1560	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
268	0.00	0.000	0.125	0.1492	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
269	0.00	0.000	0.115	0.1429	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
270	0.00	0.000	0.096	0.1377	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
271	0.00	0.000	0.067	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
272	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
273	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
274	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
275	0.08	0.000	0.046	0.1357	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
276	0.00	0.000	0.009	0.1352	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
277	0.00	0.000	0.016	0.1343	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
278	0.08	0.000	0.047	0.1362	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
279	0.00	0.000	0.008	0.1357	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
280	0.09	0.000	0.050	0.1379	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
281	0.00	0.000	0.019	0.1369	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
282	0.00	0.000	0.022	0.1357	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
283	0.00	0.000	0.010	0.1351	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
284	0.00	0.000	0.011	0.1345	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
285	0.00	0.000	0.009	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
286	0.00	0.000	0.003	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
287	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								

288	0.06	0.000	0.035	0.1352	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
289	0.00	0.000	0.002	0.1352	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
290	0.40	0.000	0.054	0.1541	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
291	0.31	0.000	0.051	0.1682	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
292	0.00	0.000	0.022	0.1670	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
293	0.03	0.000	0.038	0.1666	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
294	0.00	0.000	0.017	0.1657	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
295	0.00	0.000	0.017	0.1647	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
296	0.00	0.000	0.015	0.1639	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
297	0.00	0.000	0.019	0.1628	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
298	0.00	0.000	0.019	0.1618	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
299	0.00	0.000	0.019	0.1608	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
300	0.00	0.000	0.033	0.1589	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
301	0.15	0.000	0.052	0.1643	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
302	0.00	0.000	0.024	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
303	0.00	0.000	0.027	0.1615	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
304	0.00	0.000	0.027	0.1601	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
305	0.00	0.000	0.038	0.1580	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
306	0.00	0.000	0.029	0.1564	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
307	0.00	0.000	0.035	0.1545	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
308	0.00	0.000	0.038	0.1524	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
309	0.00	0.000	0.034	0.1506	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
310	0.00	0.000	0.021	0.1494	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
311	0.00	0.000	0.020	0.1483	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
312	0.00	0.000	0.023	0.1470	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
313	0.00	0.000	0.027	0.1456	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
314	0.00	0.000	0.023	0.1443	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
315	0.00	0.000	0.018	0.1433	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
316	0.00	0.000	0.021	0.1421	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
317	0.00	0.000	0.028	0.1406	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
318	0.02	0.000	0.040	0.1395	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
319	0.00	0.000	0.031	0.1378	0.0000	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00									
320		0.09	0.000	0.053	0.1399	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
321		0.06	0.000	0.050	0.1404	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
322		0.15	0.000	0.057	0.1455	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
323		0.37	0.000	0.055	0.1627	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
324		0.00	0.000	0.026	0.1613	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
325		0.00	0.000	0.024	0.1600	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
326		0.00	0.000	0.018	0.1590	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
327		0.00	0.000	0.019	0.1580	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
328		0.10	0.000	0.047	0.1609	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
329		0.02	0.000	0.037	0.1600	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
330		0.00	0.000	0.024	0.1586	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
331		0.00	0.000	0.021	0.1575	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
332		0.86	0.000	0.047	0.2019	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
333		0.03	0.000	0.044	0.2012	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
334		0.49	0.000	0.056	0.2249	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
335		0.01	0.000	0.027	0.2240	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
336		0.00	0.000	0.017	0.2231	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
337		0.00	0.000	0.016	0.2222	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
338	*	0.11	0.000	0.033	0.2233	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
339		0.59	0.000	0.000	0.2586	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
340		0.41	0.000	0.047	0.2761	0.2409	.4320E-01	.1747E-03	0.0004	
.0000E+00	.1747E-03									
341		0.00	0.000	0.021	0.2725	0.2519	.4517E-01	.1863E-03	0.0004	
.0000E+00	.1863E-03									
342		0.00	0.000	0.017	0.2700	0.1562	.2802E-01	.1202E-03	0.0003	
.0000E+00	.1202E-03									
343		0.22	0.000	0.048	0.2764	0.3037	.5445E-01	.2210E-03	0.0005	
.0000E+00	.2210E-03									
344		1.91	0.280	0.049	0.3419	3.2055	.3822	.1964E-02	0.0026	
.0000E+00	.1473E-02									
345		0.00	0.000	0.022	0.3105	6.9523	.5472	.4160E-02	0.0025	
.0000E+00	.8129E-03									
346		0.00	0.000	0.018	0.2853	2.8142	.4409	.1750E-02	0.0022	
.0000E+00	.1362E-02									
347		0.00	0.000	0.024	0.2716	1.2593	.2258	.8242E-03	0.0026	
.0000E+00	.1003E-02									
348		0.00	0.000	0.029	0.2626	0.7605	.1364	.5159E-03	0.0132	
.0000E+00	.3402E-02									
349		0.00	0.000	0.025	0.2562	0.5101	.9146E-01	.3565E-03	0.0069	
.0000E+00	.1518E-02									
350		0.00	0.000	0.019	0.2517	0.3543	.6353E-01	.2548E-03	0.0005	
.0000E+00	.2548E-03									

```
  351         0.06  0.000  0.042  0.2501    0.2558 .4587E-01 .1889E-03    0.0004
.0000E+00 .1889E-03
  352         0.02  0.000  0.037  0.2473    0.1977 .3544E-01 .1492E-03    0.0003
.0000E+00 .1492E-03
  353         0.00  0.000  0.019  0.2447    0.1593 .2856E-01 .1224E-03    0.0003
.0000E+00 .1224E-03
  354  *      0.00  0.000  0.018  0.2425    0.1253 .2246E-01 .9835E-04    0.0002
.0000E+00 .9835E-04
  355         0.28  0.000  0.041  0.2545    0.1101 .1974E-01 .8743E-04    0.0002
.0000E+00 .8743E-04
  356  *      0.23  0.000  0.023  0.2546    0.1000 .1793E-01 .8010E-04    0.0002
.0000E+00 .8010E-04
  357  *      0.00  0.000  0.029  0.2547    0.0898 .1610E-01 .7264E-04    0.0002
.0000E+00 .7264E-04
  358  *      0.00  0.000  0.032  0.2549    0.0896 .1607E-01 .7250E-04    0.0002
.0000E+00 .7250E-04
  359  *      1.22  0.000  0.000  0.2552    0.0811 .1455E-01 .6623E-04    0.0001
.0000E+00 .6623E-04
  360         0.36  0.000  0.000  0.2870    0.3264 .5853E-01 .2236E-03    0.0005
.0000E+00 .2236E-03
  361  *      0.00  0.000  0.028  0.2697    1.8757 .3363     .1196E-02    0.0025
.0000E+00 .1196E-02
  362         0.00  0.000  0.031  0.2626    0.8261 .1481     .5566E-03    0.0012
.0000E+00 .5566E-03
  363         0.00  0.000  0.000  0.2867    0.4613 .8271E-01 .3249E-03    0.0007
.0000E+00 .3249E-03
  364         0.00  0.000  0.021  0.2877    0.4866 .8726E-01 .3410E-03    0.0007
.0000E+00 .3410E-03
  365         0.00  0.000  0.013  0.2950    0.6101 .1094     .4205E-03    0.0009
.0000E+00 .4205E-03

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                   MONTHLY TOTALS (IN INCHES) FOR YEAR 1978
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                                  JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
                                  ------- ------- ------- ------- ------- -------

 PRECIPITATION                     8.90    1.35    4.31    1.76    6.00    1.76
                                   4.45    6.43    2.02    1.20    2.19    5.42

 RUNOFF                            5.437   1.387   0.421   0.000   0.225   0.000
                                   0.687   0.166   0.000   0.000   0.000   0.280

 EVAPOTRANSPIRATION                0.655   0.490   2.475   3.092   4.613   2.871
                                   2.960   4.563   3.738   0.720   1.004   0.746

 LATERAL DRAINAGE COLLECTED        0.5162  1.4585  1.7815  0.3111  0.5101  0.0706
   FROM LAYER  3                   0.7946  0.0000  0.0000  0.0000  0.0000  3.0973

 PERCOLATION/LEAKAGE THROUGH       0.0022  0.0069  0.0067  0.0013  0.0020  0.0003
   LAYER  4                        0.0030  0.0000  0.0000  0.0000  0.0000  0.0145

 PERCOLATION/LEAKAGE THROUGH       0.0088  0.0069  0.0067  0.0013  0.0020  0.0003
   LAYER  6                        0.0030  0.0000  0.0000  0.0000  0.0000  0.0145
```

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.093	0.390	0.321	0.058	0.092	0.013
TOP OF LAYER 4	0.143	0.000	0.000	0.000	0.000	0.729
STD. DEVIATION OF DAILY	0.082	1.033	0.512	0.101	0.217	0.040
HEAD ON TOP OF LAYER 4	0.358	0.000	0.000	0.000	0.000	1.392
AVERAGE DAILY HEAD ON	0.003	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 6	0.000	0.000	0.000	0.000	0.000	0.001
STD. DEVIATION OF DAILY	0.012	0.001	0.001	0.000	0.000	0.000
HEAD ON TOP OF LAYER 6	0.000	0.000	0.000	0.000	0.000	0.003

ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.79	2669706.750	100.00
RUNOFF	8.604	501627.625	18.79
EVAPOTRANSPIRATION	27.928	1628292.370	60.99
DRAINAGE COLLECTED FROM LAYER 3	8.5398	497895.875	18.65
PERC./LEAKAGE THROUGH LAYER 4	0.036911	2152.038	0.08
AVG. HEAD ON TOP OF LAYER 4	0.1533		
PERC./LEAKAGE THROUGH LAYER 6	0.043466	2534.208	0.09
AVG. HEAD ON TOP OF LAYER 6	0.0005		
CHANGE IN WATER STORAGE	0.675	39356.098	1.47
SOIL WATER AT START OF YEAR	173.063	10090156.000	
SOIL WATER AT END OF YEAR	173.804	10133338.000	
SNOW WATER AT START OF YEAR	0.066	3826.876	0.14
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.525	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.59	1.88	4.09	3.03	3.85	4.50
	3.67	4.46	4.17	2.76	2.68	3.99
STD. DEVIATIONS	2.53	0.66	1.00	1.51	2.03	2.17
	1.95	2.49	2.07	1.21	2.63	1.78
RUNOFF						
TOTALS	1.600	0.910	0.414	0.059	0.054	0.040
	0.220	0.080	0.122	0.011	0.311	0.563
STD. DEVIATIONS	2.239	1.391	0.590	0.112	0.098	0.078
	0.315	0.076	0.267	0.013	0.609	0.660
EVAPOTRANSPIRATION						
TOTALS	0.745	0.951	2.308	3.013	4.265	4.033
	3.477	3.546	2.952	1.339	1.236	0.859
STD. DEVIATIONS	0.296	0.550	0.308	0.152	1.065	1.315
	1.306	1.605	1.130	0.383	0.181	0.104
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.8126	1.0435	1.9071	0.8414	0.1602	0.2819
	0.3916	0.1604	0.7476	0.7487	1.3500	1.8815
STD. DEVIATIONS	0.7106	0.8433	1.1303	0.8716	0.2123	0.5917
	0.5519	0.3363	1.1258	0.8328	1.5938	1.9556
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0032	0.0046	0.0087	0.0033	0.0007	0.0011
	0.0015	0.0006	0.0034	0.0029	0.0077	0.0097
STD. DEVIATIONS	0.0027	0.0038	0.0064	0.0033	0.0008	0.0023
	0.0021	0.0013	0.0054	0.0033	0.0110	0.0111
PERCOLATION/LEAKAGE THROUGH LAYER 6						
TOTALS	0.0045	0.0046	0.0086	0.0034	0.0007	0.0011
	0.0015	0.0006	0.0033	0.0031	0.0077	0.0084
STD. DEVIATIONS	0.0036	0.0038	0.0064	0.0034	0.0008	0.0023
	0.0021	0.0013	0.0052	0.0035	0.0110	0.0088

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.1462	0.2445	0.4280	0.1587	0.0289	0.0525
	0.0705	0.0289	0.1799	0.1368	0.4049	0.4898
STD. DEVIATIONS	0.1278	0.2088	0.3444	0.1656	0.0382	0.1100
	0.0994	0.0605	0.2945	0.1535	0.5968	0.5753

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.0008	0.0003	0.0007	0.0002	0.0000	0.0001
	0.0001	0.0000	0.0002	0.0002	0.0019	0.0010
STD. DEVIATIONS	0.0013	0.0002	0.0007	0.0002	0.0001	0.0002
	0.0001	0.0001	0.0004	0.0002	0.0038	0.0013

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES		CU. FEET	PERCENT
PRECIPITATION	43.67	(7.930)	2546103.2	100.00
RUNOFF	4.385	(3.6615)	255644.19	10.041
EVAPOTRANSPIRATION	28.725	(1.3948)	1674744.87	65.777
LATERAL DRAINAGE COLLECTED FROM LAYER 3	10.32653	(4.29501)	602070.000	23.64672
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.04737	(0.02470)	2761.827	0.10847
AVERAGE HEAD ON TOP OF LAYER 4	0.197	(0.107)		
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.04737	(0.02192)	2761.975	0.10848
AVERAGE HEAD ON TOP OF LAYER 6	0.000	(0.000)		
CHANGE IN WATER STORAGE	0.187	(0.3800)	10881.86	0.427

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PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	3.99	232629.953
RUNOFF	2.833	165145.2660
DRAINAGE COLLECTED FROM LAYER 3	0.54915	32017.00000

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PERCOLATION/LEAKAGE THROUGH LAYER  4       0.008443       492.23773

AVERAGE HEAD ON TOP OF LAYER  4           14.275

MAXIMUM HEAD ON TOP OF LAYER  4           21.926

LOCATION OF MAXIMUM HEAD IN LAYER  3
      (DISTANCE FROM DRAIN)               57.4 FEET

PERCOLATION/LEAKAGE THROUGH LAYER  6       0.003404       198.44305

AVERAGE HEAD ON TOP OF LAYER  6            0.075

SNOW WATER                                 5.87        342395.0310


MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.3808

MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.1339

 ***  Maximum heads are computed using McEnroe's equations.  ***

      Reference:  Maximum Saturated Depth over Landfill Liner
                  by Bruce M. McEnroe, University of Kansas
                  ASCE Journal of Environmental Engineering
                  Vol. 119, No. 2, March 1993, pp. 262-270.
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FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	1.6945	0.2832
2	3.6196	0.3014
3	0.0818	0.2734
4	0.0000	0.0000
5	113.4744	0.3050
6	51.2736	0.4270
SNOW WATER	0.000	

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\HELP3\HRSDS4.D4
TEMPERATURE DATA FILE:      C:\HELP3\HRSDS7.D7
SOLAR RADIATION DATA FILE:  C:\HELP3\HRSDS13.D13
EVAPOTRANSPIRATION DATA:    C:\HELP3\HRSDS11.D11
SOIL AND DESIGN DATA FILE:  C:\HELP3\HRSDSC02.D10
OUTPUT DATA FILE:           C:\HELP3\HRSDSOC2.OUT


TIME:  17:54     DATE:  11/20/2009


******************************************************************************

     TITLE:  Hay Road Sludge Drying Site Geocomposite Case 2

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  10
          THICKNESS                   =     15.20   CM
          POROSITY                    =      0.3980 VOL/VOL
          FIELD CAPACITY              =      0.2440 VOL/VOL
          WILTING POINT               =      0.1360 VOL/VOL
          INITIAL SOIL WATER CONTENT  =      0.2609 VOL/VOL
          EFFECTIVE SAT. HYD. COND.   =  0.119999997000E-03 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
                 FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                   LAYER  2
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            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  10
THICKNESS                    =     30.50   CM
POROSITY                     =      0.3980 VOL/VOL
FIELD CAPACITY               =      0.2440 VOL/VOL
WILTING POINT                =      0.1360 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2369 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.119999997000E-03 CM/SEC
```

LAYER 3

```
            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER   0
THICKNESS                    =      0.76   CM
POROSITY                     =      0.8500 VOL/VOL
FIELD CAPACITY               =      0.0100 VOL/VOL
WILTING POINT                =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.2288 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =   1.61000001000     CM/SEC
SLOPE                        =      5.00   PERCENT
DRAINAGE LENGTH              =    125.0    METERS
```

LAYER 4

```
            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  36
THICKNESS                    =      0.10   CM
POROSITY                     =      0.0000 VOL/VOL
FIELD CAPACITY               =      0.0000 VOL/VOL
WILTING POINT                =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.399999993000E-12 CM/SEC
FML PINHOLE DENSITY          =      0.50   HOLES/HECTARE
FML INSTALLATION DEFECTS     =      2.00   HOLES/HECTARE
FML PLACEMENT QUALITY        =  6 - W/ GEOTEXTILE
GEOTEXTILE TRANSMISSIVITY    =      0.300000 CM*CM/SEC
```

LAYER 5

```
          TYPE 1 - VERTICAL PERCOLATION LAYER
              MATERIAL TEXTURE NUMBER  24
THICKNESS                    =    945.00   CM
POROSITY                     =      0.3650 VOL/VOL
FIELD CAPACITY               =      0.3050 VOL/VOL
WILTING POINT                =      0.2020 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.3050 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.270000010000E-05 CM/SEC
```

LAYER 6

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	305.00	CM
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #10 WITH A GOOD STAND OF GRASS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 125. METERS.

SCS RUNOFF CURVE NUMBER	=	80.50	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	6.5000	HECTARES
EVAPORATIVE ZONE DEPTH	=	46.5	CM
INITIAL WATER IN EVAPORATIVE ZONE	=	11.366	CM
UPPER LIMIT OF EVAPORATIVE STORAGE	=	18.835	CM
LOWER LIMIT OF EVAPORATIVE STORAGE	=	6.219	CM
INITIAL SNOW WATER	=	0.000	CM
INITIAL WATER IN LAYER MATERIALS	=	429.826	CM
TOTAL INITIAL WATER	=	429.826	CM
TOTAL SUBSURFACE INFLOW	=	0.00	MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM WILMINGTON DELAWARE

STATION LATITUDE	=	39.80	DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50	
START OF GROWING SEASON (JULIAN DATE)	=	107	
END OF GROWING SEASON (JULIAN DATE)	=	298	
EVAPORATIVE ZONE DEPTH	=	18.3	INCHES
AVERAGE ANNUAL WIND SPEED	=	9.20	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	72.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	71.00	%

NOTE: PRECIPITATION DATA FOR PHILADELPHIA PENNSYLVANIA WAS ENTERED FROM THE DEFAULT DATA FILE.

HRSDSOC2

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR WILMINGTON DELAWARE

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
31.20	33.20	41.80	52.40	62.20	71.20
76.00	74.80	67.80	56.30	45.60	35.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR WILMINGTON DELAWARE
AND STATION LATITUDE = 39.80 DEGREES

HEAD #1: AVERAGE HEAD ON TOP OF LAYER 4
DRAIN #1: LATERAL DRAINAGE FROM LAYER 3 (RECIRCULATION AND COLLECTION)
LEAK #1: PERCOLATION OR LEAKAGE THROUGH LAYER 4
HEAD #2: AVERAGE HEAD ON TOP OF LAYER 6
DRAIN #2: LATERAL DRAINAGE FROM LAYER 5 (RECIRCULATION AND COLLECTION)
LEAK #2: PERCOLATION OR LEAKAGE THROUGH LAYER 6

****

DAILY OUTPUT FOR YEAR 1974

DAY	A I R	SOILI LEAK IN.	RAIN IN.	RUNOFF IN.	ET IN.	E. ZONE WATER IN./IN.	HEAD #1 IN.	DRAIN #1 IN.	LEAK #1 IN.	HEAD #2 IN.	DRAIN #2 IN.	LEAK #2 IN.
1			0.05	0.000	0.044	0.2444	0.0969	.1057E-01	.7785E-04	0.0002	.0000E+00	.8245E-04
2	*		0.00	0.000	0.031	0.2422	0.0784	.8552E-02	.6424E-04	0.0001	.0000E+00	.6764E-04
3	*		0.50	0.000	0.031	0.2429	0.0647	.7054E-02	.5395E-04	0.0001	.0000E+00	.5652E-04
4	*		0.15	0.000	0.027	0.2437	0.0531	.5792E-02	.4513E-04	0.0001	.0000E+00	.4733E-04
5	*		0.00	0.000	0.032	0.2445	0.0451	.4917E-02	.3892E-04	0.0001	.0000E+00	.4047E-04
6			0.00	0.000	0.010	0.2575	0.0370	.4030E-02	.3252E-04	0.0001	.0000E+00	.3412E-04
7	*		0.00	0.000	0.034	0.2584	0.0264	.2883E-02	.2406E-04	0.0001	.0000E+00	.2618E-04
8	*		0.00	0.000	0.040	0.2594	0.0270	.2942E-02	.2452E-04	0.0001		

```
.0000E+00 .2440E-04
    9         0.62  0.000  0.000  0.2981    0.4275 .4661E-01 .2798E-03    0.0003
.0000E+00 .2159E-03
   10  *      0.29  0.000  0.029  0.2867    2.0808 .2268     .1319E-02    0.0017
.0000E+00 .1059E-02
   11  *      0.50  0.000  0.000  0.2782    1.5946 .1738     .1028E-02    0.0024
.0000E+00 .1101E-02
   12  *      0.00  0.000  0.029  0.2720    1.2123 .1322     .7960E-03    0.0019
.0000E+00 .8540E-03
   13  *      0.02  0.000  0.029  0.2675    0.9295 .1013     .6217E-03    0.0015
.0000E+00 .6652E-03
   14  *      0.00  0.000  0.026  0.2643    0.7207 .7857E-01 .4909E-03    0.0012
.0000E+00 .5236E-03
   15  *      0.00  0.000  0.022  0.2619    0.5671 .6182E-01 .3933E-03    0.0009
.0000E+00 .4177E-03
   16  *      0.00  0.000  0.026  0.2603    0.4530 .4938E-01 .3196E-03    0.0007
.0000E+00 .3380E-03
   17  *      0.00  0.000  0.031  0.2592    0.3661 .3991E-01 .2626E-03    0.0006
.0000E+00 .2769E-03
   18  *      0.00  0.000  0.033  0.2585    0.2974 .3243E-01 .2170E-03    0.0005
.0000E+00 .2284E-03
   19         0.02  0.000  0.000  0.2805    0.2296 .2503E-01 .1711E-03    0.0004
.0000E+00 .1826E-03
   20         0.00  0.000  0.058  0.2760    0.2165 .2361E-01 .1621E-03    0.0003
.0000E+00 .1644E-03
   21         0.51  0.000  0.067  0.2980    0.3712 .4047E-01 .2653E-03    0.0004
.0000E+00 .2395E-03
   22         0.00  0.000  0.051  0.2879    1.2123 .1322     .7960E-03    0.0011
.0000E+00 .6633E-03
   23         0.00  0.000  0.063  0.2763    1.3665 .1490     .8901E-03    0.0018
.0000E+00 .8666E-03
   24         0.05  0.000  0.068  0.2686    1.1143 .1215     .7359E-03    0.0017
.0000E+00 .7745E-03
   25         0.00  0.000  0.056  0.2600    0.9322 .1016     .6233E-03    0.0014
.0000E+00 .6515E-03
   26         0.02  0.000  0.053  0.2537    0.7386 .8052E-01 .5022E-03    0.0012
.0000E+00 .5325E-03
   27         0.12  0.000  0.056  0.2538    0.5689 .6202E-01 .3944E-03    0.0009
.0000E+00 .4214E-03
   28         0.10  0.000  0.056  0.2537    0.4313 .4702E-01 .3055E-03    0.0007
.0000E+00 .3277E-03
   29         0.00  0.000  0.050  0.2489    0.3389 .3695E-01 .2447E-03    0.0006
.0000E+00 .2599E-03
   30         0.00  0.000  0.056  0.2441    0.2809 .3063E-01 .2059E-03    0.0005
.0000E+00 .2156E-03
   31         0.00  0.000  0.049  0.2400    0.2367 .2581E-01 .1760E-03    0.0004
.0000E+00 .1835E-03
   32  *      0.00  0.000  0.043  0.2363    0.2154 .2349E-01 .1614E-03    0.0004
.0000E+00 .1651E-03
   33  *      0.08  0.000  0.039  0.2363    0.1810 .1973E-01 .1376E-03    0.0003
.0000E+00 .1436E-03
   34         0.02  0.000  0.049  0.2350    0.1464 .1596E-01 .1134E-03    0.0003
.0000E+00 .1194E-03
   35  *      0.00  0.000  0.038  0.2322    0.1201 .1309E-01 .9461E-04    0.0002
.0000E+00 .9930E-04
   36  *      0.00  0.000  0.040  0.2294    0.0999 .1089E-01 .8004E-04    0.0002
.0000E+00 .8368E-04
   37  *      0.11  0.000  0.042  0.2300    0.0817 .8908E-02 .6666E-04    0.0002
.0000E+00 .7000E-04
   38         0.18  0.000  0.034  0.2402    0.0661 .7209E-02 .5502E-04    0.0001
.0000E+00 .5793E-04
   39         0.51  0.000  0.060  0.2645    0.0552 .6016E-02 .4670E-04    0.0001
.0000E+00 .4878E-04
```

40		0.00	0.000	0.055	0.2613	0.0338	.3688E-02	.2999E-04	0.0001	.0000E+00 .3417E-04
41		0.00	0.000	0.071	0.2573	0.0312	.3397E-02	.2784E-04	0.0001	.0000E+00 .2837E-04
42		0.00	0.000	0.076	0.2530	0.0270	.2942E-02	.2416E-04	0.0001	.0000E+00 .2508E-04
43		0.00	0.000	0.072	0.2481	0.1561	.1702E-01	.1199E-03	0.0002	.0000E+00 .9598E-04
44		0.01	0.000	0.067	0.2434	0.2521	.2748E-01	.1864E-03	0.0003	.0000E+00 .1698E-03
45		0.00	0.000	0.074	0.2377	0.2728	.2974E-01	.2005E-03	0.0004	.0000E+00 .1970E-03
46		0.00	0.000	0.071	0.2322	0.2699	.2942E-01	.1985E-03	0.0004	.0000E+00 .1990E-03
47		0.18	0.000	0.060	0.2373	0.2516	.2743E-01	.1861E-03	0.0004	.0000E+00 .1892E-03
48		0.00	0.000	0.066	0.2323	0.2283	.2489E-01	.1703E-03	0.0004	.0000E+00 .1742E-03
49		0.00	0.000	0.067	0.2274	0.2109	.2299E-01	.1583E-03	0.0003	.0000E+00 .1613E-03
50		0.34	0.000	0.058	0.2417	0.1762	.1921E-01	.1343E-03	0.0003	.0000E+00 .1403E-03
51		0.00	0.000	0.063	0.2374	0.1421	.1549E-01	.1103E-03	0.0003	.0000E+00 .1163E-03
52		0.00	0.000	0.075	0.2327	0.1148	.1251E-01	.9079E-04	0.0002	.0000E+00 .9567E-04
53		0.02	0.000	0.051	0.2304	0.0886	.9663E-02	.7175E-04	0.0002	.0000E+00 .7651E-04
54	*	0.00	0.000	0.052	0.2272	0.0659	.7180E-02	.5481E-04	0.0001	.0000E+00 .5905E-04
55		0.00	0.000	0.051	0.2241	0.0565	.6165E-02	.4775E-04	0.0001	.0000E+00 .4952E-04
56	*	0.69	0.000	0.036	0.2249	0.0477	.5197E-02	.4092E-04	0.0001	.0000E+00 .4263E-04
57		0.00	0.000	0.033	0.2269	0.0385	.4196E-02	.3373E-04	0.0001	.0000E+00 .3553E-04
58		0.00	0.000	0.003	0.2555	0.0325	.3540E-02	.2895E-04	0.0001	.0000E+00 .3014E-04
59		0.00	0.000	0.078	0.2519	0.1566	.1707E-01	.1129E-03	0.0001	.0000E+00 .9192E-04
60		0.07	0.000	0.062	0.2488	0.6001	.6542E-01	.4145E-03	0.0005	.0000E+00 .3391E-03
61	*	0.05	0.000	0.046	0.2459	0.5172	.5639E-01	.3612E-03	0.0008	.0000E+00 .3745E-03
62	*	0.00	0.000	0.000	0.2435	0.4110	.4480E-01	.2922E-03	0.0007	.0000E+00 .3094E-03
63		0.00	0.000	0.065	0.2380	0.3138	.3421E-01	.2279E-03	0.0005	.0000E+00 .2440E-03
64		0.00	0.000	0.085	0.2319	0.2536	.2765E-01	.1875E-03	0.0004	.0000E+00 .1976E-03
65		0.01	0.000	0.052	0.2283	0.2126	.2318E-01	.1595E-03	0.0004	.0000E+00 .1665E-03
66	*	0.00	0.000	0.057	0.2242	0.1604	.1749E-01	.1232E-03	0.0003	.0000E+00 .1323E-03
67		0.18	0.000	0.088	0.2285	0.1281	.1396E-01	.1004E-03	0.0002	.0000E+00 .1061E-03
68	*	0.19	0.000	0.056	0.2289	0.1045	.1139E-01	.8336E-04	0.0002	.0000E+00 .8761E-04
69		0.00	0.000	0.071	0.2308	0.0811	.8841E-02	.6621E-04	0.0002	.0000E+00 .7050E-04
70	*	0.00	0.000	0.065	0.2268	0.0697	.7602E-02	.5774E-04	0.0001	.0000E+00 .5985E-04
71	*	0.00	0.000	0.057	0.2233	0.0627	.6838E-02	.5245E-04	0.0001	

```
.0000E+00 .5377E-04
   72  *      0.00  0.000  0.044  0.2206    0.0488 .5325E-02 .4181E-04    0.0001
.0000E+00 .4447E-04
   73         0.00  0.000  0.079  0.2161    0.0337 .3676E-02 .2994E-04    0.0001
.0000E+00 .3291E-04
   74         0.00  0.000  0.086  0.2112    0.0306 .3331E-02 .2740E-04    0.0001
.0000E+00 .2804E-04
   75         1.02  0.000  0.077  0.2626    0.0335 .3657E-02 .2980E-04    0.0001
.0000E+00 .2920E-04
   76         0.00  0.000  0.058  0.2592    0.0274 .2989E-02 .2484E-04    0.0001
.0000E+00 .2608E-04
   77         0.00  0.000  0.068  0.2554    0.0198 .2158E-02 .1827E-04    0.0000
.0000E+00 .1991E-04
   78         0.06  0.000  0.096  0.2524    0.1561 .1701E-01 .1198E-03    0.0001
.0000E+00 .9441E-04
   79         0.00  0.000  0.110  0.2448    0.2634 .2872E-01 .1941E-03    0.0003
.0000E+00 .1755E-03
   80         1.42  0.029  0.074  0.3128    0.6702 .7307E-01 .4481E-03    0.0007
.0000E+00 .3846E-03
   81         0.00  0.000  0.107  0.2910    2.9399 .2902     .1826E-02    0.0026
.0000E+00 .1938E-02
   82         0.00  0.000  0.118  0.2739    1.7841 .1945     .1142E-02    0.0012
.0000E+00 .8563E-03
   83         0.00  0.000  0.112  0.2604    1.2255 .1336     .8040E-03    0.0020
.0000E+00 .8885E-03
   84         0.00  0.000  0.116  0.2484    0.9549 .1041     .6374E-03    0.0015
.0000E+00 .6791E-03
   85         0.00  0.000  0.127  0.2371    0.7159 .7805E-01 .4879E-03    0.0012
.0000E+00 .5253E-03
   86         0.00  0.000  0.106  0.2280    0.5586 .6090E-01 .3878E-03    0.0009
.0000E+00 .4128E-03
   87         0.00  0.000  0.113  0.2192    0.4329 .4720E-01 .3065E-03    0.0007
.0000E+00 .3269E-03
   88         0.36  0.000  0.117  0.2304    0.3531 .3849E-01 .2541E-03    0.0006
.0000E+00 .2672E-03
   89         1.28  0.007  0.114  0.2921    0.2719 .2964E-01 .1998E-03    0.0005
.0000E+00 .2134E-03
   90         0.27  0.000  0.104  0.2916    1.5894 .1733     .1025E-02    0.0013
.0000E+00 .8187E-03
   91         0.05  0.000  0.081  0.2818    1.3572 .1480     .8844E-03    0.0020
.0000E+00 .9195E-03
   92         0.11  0.000  0.104  0.2759    1.0359 .1129     .6874E-03    0.0016
.0000E+00 .7366E-03
   93         0.00  0.000  0.137  0.2643    0.6896 .7518E-01 .4712E-03    0.0012
.0000E+00 .5253E-03
   94         0.24  0.000  0.100  0.2685    0.5694 .6207E-01 .3947E-03    0.0009
.0000E+00 .4139E-03
   95         0.29  0.000  0.103  0.2759    0.4639 .5058E-01 .3267E-03    0.0008
.0000E+00 .3437E-03
   96         0.02  0.000  0.063  0.2711    0.4194 .4572E-01 .2977E-03    0.0007
.0000E+00 .3050E-03
   97         0.00  0.000  0.087  0.2641    0.3813 .4157E-01 .2726E-03    0.0006
.0000E+00 .2789E-03
   98         0.43  0.000  0.072  0.2821    0.2616 .2851E-01 .1928E-03    0.0005
.0000E+00 .2128E-03
   99  *      0.80  0.000  0.042  0.2808    0.3994 .4354E-01 .2845E-03    0.0005
.0000E+00 .2616E-03
  100         0.00  0.000  0.034  0.3108    1.4076 .1535     .9067E-03    0.0012
.0000E+00 .7512E-03
  101         0.00  0.000  0.123  0.2865    3.7953 .3198     .2326E-02    0.0044
.0000E+00 .2454E-02
  102         0.00  0.000  0.107  0.2675    2.1903 .2388     .1385E-02    0.0014
.0000E+00 .1137E-02
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103	0.46	0.000	0.116	0.2771	1.5386	.1677	.9942E-03	0.0025	.0000E+00 .1092E-02
104	0.00	0.000	0.123	0.2639	1.0762	.1173	.7124E-03	0.0018	.0000E+00 .7828E-03
105	0.00	0.000	0.115	0.2534	0.7091	.7730E-01	.4834E-03	0.0012	.0000E+00 .5407E-03
106	0.00	0.000	0.145	0.2421	0.5560	.6061E-01	.3862E-03	0.0009	.0000E+00 .4105E-03
107	0.00	0.000	0.184	0.2292	0.4796	.5229E-01	.3369E-03	0.0008	.0000E+00 .3492E-03
108	0.00	0.000	0.151	0.2184	0.4243	.4626E-01	.3009E-03	0.0007	.0000E+00 .3099E-03
109	0.10	0.000	0.151	0.2134	0.3664	.3994E-01	.2629E-03	0.0006	.0000E+00 .2724E-03
110	0.00	0.000	0.197	0.2007	0.3167	.3453E-01	.2299E-03	0.0005	.0000E+00 .2382E-03
111	0.00	0.000	0.209	0.1878	0.2486	.2711E-01	.1841E-03	0.0004	.0000E+00 .1955E-03
112	0.00	0.000	0.158	0.1780	0.1872	.2040E-01	.1419E-03	0.0003	.0000E+00 .1524E-03
113	0.27	0.000	0.110	0.1860	0.1372	.1495E-01	.1068E-03	0.0003	.0000E+00 .1156E-03
114	0.00	0.000	0.166	0.1763	0.1030	.1123E-01	.8229E-04	0.0002	.0000E+00 .8841E-04
115	0.00	0.000	0.085	0.1712	0.0660	.7194E-02	.5488E-04	0.0001	.0000E+00 .6173E-04
116	0.00	0.000	0.066	0.1674	0.0373	.4065E-02	.3275E-04	0.0001	.0000E+00 .3828E-04
117	0.00	0.000	0.052	0.1644	0.0201	.2196E-02	.1883E-04	0.0001	.0000E+00 .2231E-04
118	0.00	0.000	0.048	0.1617	0.0136	.1481E-02	.1322E-04	0.0000	.0000E+00 .1463E-04
119	0.00	0.000	0.047	0.1591	0.0027	.2677E-03	.2730E-05	0.0000	.0000E+00 .5353E-05
120	0.00	0.000	0.043	0.1568	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .6825E-06
121	0.00	0.000	0.040	0.1546	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
122	0.10	0.000	0.043	0.1577	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
123	0.47	0.000	0.042	0.1811	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
124	0.00	0.000	0.195	0.1704	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
125	0.00	0.000	0.038	0.1684	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
126	0.25	0.000	0.043	0.1797	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
127	0.00	0.000	0.220	0.1677	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
128	0.00	0.000	0.038	0.1656	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
129	0.22	0.000	0.045	0.1752	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
130	0.67	0.000	0.044	0.2094	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
131	0.00	0.000	0.180	0.1996	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
132	0.43	0.000	0.204	0.2119	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
133	0.00	0.000	0.244	0.1986	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
134	0.00	0.000	0.195	0.1879	0.0000	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00								
135	0.00	0.000	0.244	0.1746	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
136	0.00	0.000	0.211	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
137	0.11	0.000	0.140	0.1614	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
138	0.02	0.000	0.114	0.1563	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
139	0.00	0.000	0.103	0.1507	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
140	0.00	0.000	0.092	0.1456	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
141	0.00	0.000	0.080	0.1413	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
142	0.32	0.000	0.108	0.1529	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
143	0.43	0.000	0.118	0.1699	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
144	0.14	0.000	0.119	0.1710	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
145	0.00	0.000	0.166	0.1619	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
146	0.00	0.000	0.124	0.1552	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
147	0.00	0.000	0.154	0.1467	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
148	0.00	0.000	0.146	0.1388	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
149	0.03	0.000	0.096	0.1352	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
150	0.00	0.000	0.016	0.1343	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
151	0.02	0.000	0.027	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
152	0.06	0.000	0.025	0.1358	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
153	0.36	0.000	0.084	0.1509	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
154	0.00	0.000	0.106	0.1451	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
155	0.00	0.000	0.109	0.1392	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
156	0.00	0.000	0.072	0.1352	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
157	0.00	0.000	0.019	0.1342	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
158	0.05	0.000	0.027	0.1355	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
159	0.00	0.000	0.017	0.1346	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
160	0.00	0.000	0.009	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
161	0.00	0.000	0.003	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
162	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
163	0.01	0.000	0.010	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
164	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
165	0.56	0.000	0.074	0.1604	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								

166	0.00	0.000	0.108	0.1545	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
167	0.57	0.000	0.125	0.1789	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
168	0.20	0.000	0.159	0.1811	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
169	0.00	0.000	0.210	0.1696	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
170	0.00	0.000	0.203	0.1585	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
171	0.00	0.000	0.206	0.1473	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
172	0.88	0.000	0.247	0.1819	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
173	0.06	0.000	0.270	0.1704	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
174	1.20	0.000	0.187	0.2258	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
175	0.00	0.000	0.291	0.2099	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
176	0.06	0.000	0.240	0.2000	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
177	0.00	0.000	0.286	0.1844	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
178	0.00	0.000	0.275	0.1693	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
179	0.30	0.000	0.265	0.1713	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
180	0.00	0.000	0.238	0.1582	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
181	0.12	0.000	0.247	0.1513	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
182	0.05	0.000	0.212	0.1424	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
183	0.00	0.000	0.121	0.1358	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
184	0.00	0.000	0.029	0.1342	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
185	0.00	0.000	0.005	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
186	0.39	0.000	0.077	0.1510	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
187	0.00	0.000	0.123	0.1443	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
188	0.00	0.000	0.143	0.1365	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
189	0.00	0.000	0.039	0.1343	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
190	0.00	0.000	0.006	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
191	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
192	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
193	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
194	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
195	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
196	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
197	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00								
198	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
199	0.03	0.000	0.027	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
200	0.02	0.000	0.021	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
201	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
202	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
203	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
204	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
205	0.96	0.000	0.096	0.1811	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
206	0.00	0.000	0.185	0.1710	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
207	0.00	0.000	0.207	0.1597	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
208	0.09	0.000	0.115	0.1583	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
209	0.00	0.000	0.186	0.1481	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
210	0.34	0.000	0.190	0.1563	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
211	0.20	0.000	0.157	0.1586	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
212	0.00	0.000	0.186	0.1485	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
213	0.00	0.000	0.175	0.1389	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
214	0.24	0.000	0.127	0.1451	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
215	0.00	0.000	0.111	0.1390	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
216	0.05	0.000	0.104	0.1361	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
217	0.00	0.000	0.027	0.1346	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
218	0.00	0.000	0.010	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
219	0.45	0.000	0.087	0.1539	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
220	0.00	0.000	0.094	0.1488	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
221	0.00	0.000	0.138	0.1412	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
222	0.00	0.000	0.107	0.1354	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
223	0.00	0.000	0.022	0.1342	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
224	0.00	0.000	0.003	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
225	0.00	0.000	0.003	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
226	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
227	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
228	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								

229	0.07	0.000	0.043	0.1353	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
230	0.00	0.000	0.016	0.1345	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
231	0.00	0.000	0.008	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
232	0.00	0.000	0.002	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
233	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
234	0.17	0.000	0.042	0.1408	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
235	0.86	0.000	0.105	0.1821	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
236	1.70	0.095	0.140	0.2622	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
237	0.00	0.000	0.170	0.2529	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
238	0.00	0.000	0.225	0.2406	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
239	0.00	0.000	0.211	0.2291	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
240	0.04	0.000	0.128	0.2243	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
241	0.00	0.000	0.199	0.2132	0.0473	.5161E-02	.3979E-04	0.0001	.3979E-04
242	0.25	0.000	0.176	0.2164	0.1373	.1497E-01	.1069E-03	0.0002	.1069E-03
243	0.00	0.000	0.182	0.2056	0.1473	.1606E-01	.1140E-03	0.0002	.1140E-03
244	0.16	0.000	0.128	0.2065	0.1295	.1412E-01	.1014E-03	0.0002	.1014E-03
245	0.02	0.000	0.151	0.1987	0.1062	.1158E-01	.8462E-04	0.0002	.8462E-04
246	1.35	0.003	0.146	0.2639	0.0874	.9528E-02	.7086E-04	0.0001	.7086E-04
247	0.38	0.000	0.170	0.2750	0.0644	.7018E-02	.5363E-04	0.0001	.5363E-04
248	0.00	0.000	0.174	0.2652	0.0469	.5115E-02	.4031E-04	0.0001	.4031E-04
249	0.39	0.000	0.134	0.2782	0.1648	.1796E-01	.1252E-03	0.0003	.1252E-03
250	0.79	0.001	0.127	0.3034	2.1251	.1989	.1332E-02	0.0028	.1332E-02
251	0.00	0.000	0.135	0.2815	2.4356	.2655	.1530E-02	0.0032	.1530E-02
252	0.00	0.000	0.143	0.2637	1.6555	.1805	.1065E-02	0.0022	.1065E-02
253	0.00	0.000	0.155	0.2490	1.0496	.1144	.6958E-03	0.0014	.6958E-03
254	0.00	0.000	0.149	0.2368	0.6708	.7313E-01	.4593E-03	0.0010	.4593E-03
255	0.19	0.000	0.122	0.2375	0.5006	.5457E-01	.3505E-03	0.0007	.3505E-03
256	0.16	0.000	0.116	0.2376	0.3975	.4334E-01	.2833E-03	0.0006	.2833E-03
257	0.34	0.000	0.088	0.2494	0.3227	.3518E-01	.2339E-03	0.0005	.2339E-03
258	0.00	0.000	0.179	0.2380	0.2712	.2957E-01	.1994E-03	0.0004	.1994E-03
259	0.00	0.000	0.135	0.2293	0.2139	.2332E-01	.1603E-03	0.0003	.1603E-03
260	0.00	0.000	0.107	0.2225	0.1612	.1757E-01	.1238E-03	0.0003	

.0000E+00	.1238E-03									
261	0.00	0.000	0.143	0.2139	0.1222	.1332E-01	.9615E-04	0.0002	.0000E+00	.9615E-04
262	0.00	0.000	0.140	0.2057	0.0957	.1044E-01	.7699E-04	0.0002	.0000E+00	.7699E-04
263	0.00	0.000	0.117	0.1988	0.0741	.8083E-02	.6102E-04	0.0001	.0000E+00	.6102E-04
264	0.14	0.000	0.137	0.1987	0.0417	.4542E-02	.3618E-04	0.0001	.0000E+00	.3618E-04
265	0.00	0.000	0.130	0.1915	0.0136	.1362E-02	.1188E-04	0.0000	.0000E+00	.1188E-04
266	0.00	0.000	0.110	0.1856	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
267	0.00	0.000	0.106	0.1798	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
268	0.00	0.000	0.121	0.1732	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
269	0.00	0.000	0.110	0.1671	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
270	0.00	0.000	0.123	0.1604	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
271	0.76	0.000	0.109	0.1960	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
272	0.00	0.000	0.107	0.1902	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
273	0.00	0.000	0.077	0.1860	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
274	0.00	0.000	0.048	0.1833	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
275	0.00	0.000	0.057	0.1802	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
276	0.00	0.000	0.048	0.1776	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
277	0.00	0.000	0.068	0.1738	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
278	0.00	0.000	0.054	0.1709	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
279	0.00	0.000	0.071	0.1670	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
280	0.00	0.000	0.075	0.1629	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
281	0.00	0.000	0.070	0.1591	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
282	0.00	0.000	0.063	0.1556	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
283	0.00	0.000	0.041	0.1534	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
284	0.00	0.000	0.034	0.1515	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
285	0.00	0.000	0.046	0.1491	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
286	0.00	0.000	0.043	0.1467	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
287	0.00	0.000	0.043	0.1444	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
288	0.33	0.000	0.073	0.1584	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
289	1.60	0.025	0.063	0.2411	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
290	0.00	0.000	0.029	0.2395	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
291	0.00	0.000	0.038	0.2375	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

292	0.00	0.000	0.029	0.2359	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
293	0.00	0.000	0.036	0.2339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
294	0.00	0.000	0.041	0.2317	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
295	0.00	0.000	0.032	0.2299	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
296	0.00	0.000	0.027	0.2285	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
297	0.00	0.000	0.027	0.2270	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
298	0.00	0.000	0.028	0.2255	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
299	0.00	0.000	0.020	0.2244	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
300	0.00	0.000	0.043	0.2221	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
301	0.00	0.000	0.045	0.2196	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
302	0.00	0.000	0.039	0.2175	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
303	0.00	0.000	0.045	0.2150	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
304	0.00	0.000	0.045	0.2125	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
305	0.00	0.000	0.053	0.2096	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
306	0.06	0.000	0.058	0.2097	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
307	0.02	0.000	0.049	0.2081	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
308	0.00	0.000	0.045	0.2056	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
309	0.07	0.000	0.061	0.2061	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
310	0.00	0.000	0.059	0.2029	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
311	0.00	0.000	0.055	0.1999	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
312	0.00	0.000	0.058	0.1967	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
313	0.00	0.000	0.051	0.1939	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
314	0.00	0.000	0.062	0.1905	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
315	0.00	0.000	0.058	0.1873	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
316	0.34	0.000	0.067	0.2022	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
317	0.00	0.000	0.057	0.1991	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
318	0.00	0.000	0.051	0.1963	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
319	0.05	0.000	0.064	0.1956	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
320	0.00	0.000	0.058	0.1924	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
321	0.00	0.000	0.046	0.1899	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
322	0.00	0.000	0.039	0.1878	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
323	0.00	0.000	0.039	0.1856	0.0000	.0000E+00	.0000E+00	0.0000	

324		0.22	0.000	0.057	0.1945	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
325		0.02	0.000	0.044	0.1932	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
326		0.00	0.000	0.035	0.1913	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
327		0.00	0.000	0.032	0.1896	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
328		0.00	0.000	0.031	0.1879	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
329		0.03	0.000	0.049	0.1868	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
330		0.00	0.000	0.041	0.1846	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
331		0.00	0.000	0.033	0.1828	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
332		0.00	0.000	0.034	0.1809	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
333		0.00	0.000	0.042	0.1786	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
334		0.00	0.000	0.033	0.1768	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
335		0.66	0.000	0.051	0.2101	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
336		0.49	0.000	0.045	0.2344	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
337		0.00	0.000	0.034	0.2326	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
338		0.00	0.000	0.029	0.2310	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
339		0.00	0.000	0.030	0.2294	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
340		0.00	0.000	0.036	0.2274	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
341		0.07	0.000	0.045	0.2288	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
342		0.72	0.000	0.047	0.2656	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00
343		0.00	0.000	0.037	0.2627	0.1433	.1562E-01	.1082E-03	.0000E+00	.1082E-03
344		0.00	0.000	0.028	0.2592	0.3333	.3634E-01	.2408E-03	.0000E+00	.2408E-03
345	*	0.00	0.000	0.023	0.2554	0.4242	.4624E-01	.3008E-03	.0000E+00	.3008E-03
346	*	0.00	0.000	0.000	0.2528	0.4236	.4618E-01	.3005E-03	.0000E+00	.3005E-03
347	*	0.00	0.000	0.000	0.2505	0.3874	.4224E-01	.2768E-03	.0000E+00	.2768E-03
348	*	0.11	0.000	0.020	0.2495	0.3490	.3805E-01	.2514E-03	.0000E+00	.2514E-03
349	*	0.00	0.000	0.032	0.2488	0.2935	.3200E-01	.2144E-03	.0000E+00	.2144E-03
350		1.54	0.055	0.050	0.3216	1.1069	.1207	.7152E-03	.0000E+00	.7152E-03
351		0.00	0.000	0.039	0.3011	5.0260	.3325	.3044E-02	.0000E+00	.1529E-02
352		0.00	0.000	0.029	0.2845	2.5085	.2735	.1573E-02	.0000E+00	.1546E-02
353	*	0.00	0.000	0.025	0.2733	1.6249	.1771	.1046E-02	.0000E+00	.2551E-02
354	*	0.00	0.000	0.000	0.2666	1.1213	.1222	.7401E-03	.0000E+00	.5922E-03

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  355  *      0.00  0.000  0.000  0.2615    0.8555 .9326E-01 .5755E-03    0.0014
.0000E+00 .6167E-03
  356         0.00  0.000  0.029  0.2559    0.6597 .7192E-01 .4523E-03    0.0011
.0000E+00 .4831E-03
  357         0.00  0.000  0.037  0.2509    0.5076 .5534E-01 .3550E-03    0.0008
.0000E+00 .3793E-03
  358         0.00  0.000  0.043  0.2462    0.3863 .4211E-01 .2760E-03    0.0007
.0000E+00 .2957E-03
  359         0.14  0.000  0.054  0.2491    0.3126 .3407E-01 .2271E-03    0.0005
.0000E+00 .2393E-03
  360         0.00  0.000  0.040  0.2453    0.2668 .2908E-01 .1964E-03    0.0004
.0000E+00 .2041E-03
  361         0.00  0.000  0.040  0.2418    0.2266 .2471E-01 .1691E-03    0.0004
.0000E+00 .1759E-03
  362         0.00  0.000  0.049  0.2379    0.2043 .2227E-01 .1537E-03    0.0003
.0000E+00 .1576E-03
  363         0.00  0.000  0.045  0.2343    0.1812 .1975E-01 .1378E-03    0.0003
.0000E+00 .1418E-03
  364         0.00  0.000  0.046  0.2309    0.1506 .1641E-01 .1163E-03    0.0003
.0000E+00 .1217E-03
  365         0.31  0.000  0.048  0.2445    0.1224 .1334E-01 .9626E-04    0.0002
.0000E+00 .1013E-03

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                   MONTHLY TOTALS (IN INCHES) FOR YEAR 1974
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                                  JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
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 PRECIPITATION                     2.95    2.14    4.91    2.77    3.21    4.43
                                   2.08    3.83    4.68    1.93    0.81    4.04

 RUNOFF                            0.000   0.000   0.036   0.000   0.000   0.000
                                   0.000   0.095   0.004   0.025   0.000   0.055

 EVAPOTRANSPIRATION                1.158   1.524   2.531   3.219   3.628   4.111
                                   2.132   2.654   3.888   1.420   1.462   1.031

 LATERAL DRAINAGE COLLECTED        1.8659  0.3945  1.6077  2.0050  0.0000  0.0000
   FROM LAYER  3                   0.0000  0.0362  1.1391  0.0000  0.0000  1.7050

 PERCOLATION/LEAKAGE THROUGH       0.0116  0.0028  0.0101  0.0128  0.0000  0.0000
   LAYER  4                        0.0000  0.0003  0.0072  0.0000  0.0000  0.0116

 PERCOLATION/LEAKAGE THROUGH       0.0115  0.0028  0.0099  0.0130  0.0000  0.0000
   LAYER  6                        0.0000  0.0003  0.0072  0.0000  0.0000  0.0115


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                    MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)
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 AVERAGE DAILY HEAD ON             0.552   0.129   0.485   0.642   0.000   0.000
   TOP OF LAYER  4                 0.000   0.011   0.358   0.000   0.000   0.568
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STD. DEVIATION OF DAILY	0.524	0.081	0.641	0.797	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.036	0.634	0.000	0.000	0.990
AVERAGE DAILY HEAD ON	0.001	0.000	0.001	0.001	0.000	0.000
TOP OF LAYER 6	0.000	0.000	0.000	0.000	0.000	0.001
STD. DEVIATION OF DAILY	0.001	0.000	0.001	0.001	0.000	0.000
HEAD ON TOP OF LAYER 6	0.000	0.000	0.001	0.000	0.000	0.002

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ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.78	2202697.250	100.00
RUNOFF	0.215	12520.821	0.57
EVAPOTRANSPIRATION	28.758	1676701.000	76.12
DRAINAGE COLLECTED FROM LAYER 3	8.7533	510346.969	23.17
PERC./LEAKAGE THROUGH LAYER 4	0.056268	3280.614	0.15
AVG. HEAD ON TOP OF LAYER 4	0.2288		
PERC./LEAKAGE THROUGH LAYER 6	0.056268	3280.613	0.15
AVG. HEAD ON TOP OF LAYER 6	0.0003		
CHANGE IN WATER STORAGE	-0.003	-151.238	-0.01
SOIL WATER AT START OF YEAR	172.883	10079640.000	
SOIL WATER AT END OF YEAR	172.880	10079489.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.982	0.00

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HEAD #1: AVERAGE HEAD ON TOP OF LAYER 4
DRAIN #1: LATERAL DRAINAGE FROM LAYER 3 (RECIRCULATION AND COLLECTION)
LEAK #1: PERCOLATION OR LEAKAGE THROUGH LAYER 4
HEAD #2: AVERAGE HEAD ON TOP OF LAYER 6
DRAIN #2: LATERAL DRAINAGE FROM LAYER 5 (RECIRCULATION AND COLLECTION)
LEAK #2: PERCOLATION OR LEAKAGE THROUGH LAYER 6

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DAILY OUTPUT FOR YEAR 1975

DAY	A I R	S O I L	RAIN IN.	RUNOFF IN.	ET IN.	E. ZONE WATER IN./IN.	HEAD #1 IN.	DRAIN #1 IN.	LEAK #1 IN.	HEAD #2 IN.	DRAIN #2 IN.	LEAK #2 IN.
1			0.11	0.000	0.051	0.2471	0.0988	.1077E-01	.7919E-04	0.0002	.0000E+00	.8346E-04
2			0.00	0.000	0.034	0.2448	0.0806	.8783E-02	.6582E-04	0.0002	.0000E+00	.6916E-04
3		*	0.01	0.000	0.044	0.2426	0.0666	.7265E-02	.5541E-04	0.0001	.0000E+00	.5801E-04
4		*	0.02	0.000	0.044	0.2409	0.0556	.6065E-02	.4705E-04	0.0001	.0000E+00	.4914E-04
5			0.00	0.000	0.037	0.2386	0.0473	.5161E-02	.4066E-04	0.0001	.0000E+00	.4226E-04
6			0.42	0.000	0.051	0.2585	0.0408	.4451E-02	.3557E-04	0.0001	.0000E+00	.3685E-04
7			0.08	0.000	0.052	0.2599	0.0314	.3418E-02	.2805E-04	0.0001	.0000E+00	.2993E-04
8		*	0.12	0.000	0.038	0.2608	0.0242	.2635E-02	.2220E-04	0.0001	.0000E+00	.2366E-04
9		*	0.54	0.000	0.025	0.2618	0.0148	.1617E-02	.1434E-04	0.0000	.0000E+00	.1630E-04
10		*	0.00	0.000	0.026	0.2628	0.0087	.9510E-03	.8951E-05	0.0000	.0000E+00	.1030E-04
11		*	0.16	0.000	0.019	0.2637	0.0409	.4460E-02	.3471E-04	0.0000	.0000E+00	.2827E-04
12		*	0.01	0.000	0.026	0.2636	0.1853	.2020E-01	.1404E-03	0.0002	.0000E+00	.1140E-03
13		*	0.75	0.000	0.018	0.2630	0.2815	.3069E-01	.2063E-03	0.0004	.0000E+00	.1898E-03
14		*	0.00	0.000	0.019	0.2622	0.3111	.3391E-01	.2262E-03	0.0005	.0000E+00	.2212E-03
15		*	0.00	0.000	0.022	0.2615	0.3042	.3317E-01	.2216E-03	0.0005	.0000E+00	.2227E-03
16		*	0.00	0.000	0.026	0.2609	0.2817	.3071E-01	.2065E-03	0.0004	.0000E+00	.2102E-03
17		*	0.00	0.000	0.031	0.2604	0.2551	.2781E-01	.1885E-03	0.0004	.0000E+00	.1930E-03
18		*	0.71	0.000	0.000	0.2601	0.2304	.2512E-01	.1717E-03	0.0004	.0000E+00	.1759E-03
19			0.24	0.000	0.000	0.2771	0.2151	.2345E-01	.1612E-03	0.0003	.0000E+00	.1638E-03
20		*	0.37	0.000	0.032	0.2770	0.2010	.2192E-01	.1515E-03	0.0003	.0000E+00	.1539E-03
21			0.00	0.000	0.033	0.2780	0.2406	.2623E-01	.1780E-03	0.0003	.0000E+00	.1714E-03
22		*	0.00	0.000	0.031	0.2759	0.5252	.5725E-01	.3662E-03	0.0006	.0000E+00	.3192E-03
23		*	0.00	0.000	0.033	0.2732	0.6378	.6953E-01	.4384E-03	0.0008		

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.0000E+00 .4204E-03
   24  *  *   0.00  0.000  0.027  0.2701    0.5076 .5534E-01 .3548E-03    0.0008
.0000E+00 .3757E-03
   25  *  *   0.30  0.000  0.028  0.2683    0.2990 .3259E-01 .2179E-03    0.0006
.0000E+00 .2521E-03
   26  *  *   0.00  0.000  0.023  0.2673    0.1761 .1920E-01 .1341E-03    0.0004
.0000E+00 .1551E-03
   27  *  *   0.00  0.000  0.033  0.2666    0.1037 .1130E-01 .8272E-04    0.0002
.0000E+00 .9557E-04
   28  *  *   0.00  0.000  0.035  0.2663    0.0610 .6654E-02 .5113E-04    0.0001
.0000E+00 .5903E-04
   29  *  *   0.02  0.000  0.029  0.2661    0.0359 .3917E-02 .3168E-04    0.0001
.0000E+00 .3654E-04
   30  *  *   0.00  0.000  0.027  0.2659    0.0211 .2305E-02 .1968E-04    0.0001
.0000E+00 .2268E-04
   31  *  *   0.14  0.000  0.000  0.2658    0.0124 .1356E-02 .1226E-04    0.0000
.0000E+00 .1411E-04
   32     *   0.08  0.001  0.000  0.2703    0.0073 .7974E-03 .7661E-05    0.0000
.0000E+00 .8810E-05
   33  *  *   0.00  0.000  0.031  0.2703    0.0043 .4688E-03 .4804E-05    0.0000
.0000E+00 .5518E-05
   34  *  *   0.00  0.000  0.028  0.2703    0.0025 .2755E-03 .3025E-05    0.0000
.0000E+00 .3470E-05
   35  *  *   0.19  0.000  0.000  0.2703    0.0015 .1618E-03 .1915E-05    0.0000
.0000E+00 .2192E-05
   36  *  *   0.63  0.000  0.031  0.2702    0.0009 .9503E-04 .1219E-05    0.0000
.0000E+00 .1393E-05
   37  *  *   0.00  0.000  0.032  0.2702    0.0005 .5576E-04 .7816E-06    0.0000
.0000E+00 .8910E-06
   38     *   0.00  0.000  0.037  0.2702    0.0003 .3270E-04 .5058E-06    0.0000
.0000E+00 .5748E-06
   39     *   0.00  0.066  0.008  0.2790    0.0002 .1916E-04 .3311E-06    0.0000
.0000E+00 .3748E-06
   40     *   0.00  0.511  0.000  0.2918    0.0001 .1121E-04 .2199E-06    0.0000
.0000E+00 .2477E-06
   41     *   0.00  0.352  0.000  0.3010    0.0001 .6550E-05 .1488E-06    0.0000
.0000E+00 .1666E-06
   42     *   0.02  0.216  0.000  0.3079    0.0000 .3820E-05 .1031E-06    0.0000
.0000E+00 .1145E-06
   43     *   0.49  1.318  0.000  0.3151    0.0000 .2222E-05 .7343E-07    0.0000
.0000E+00 .8084E-07
   44  *  *   0.00  0.000  0.000  0.3151    0.0000 .1287E-05 .5410E-07    0.0000
.0000E+00 .5893E-07
   45  *  *   0.00  0.000  0.000  0.3151    0.0000 .7410E-06 .4134E-07    0.0000
.0000E+00 .4453E-07
   46  *  *   0.00  0.000  0.000  0.3151    0.0000 .4227E-06 .3274E-07    0.0000
.0000E+00 .3489E-07
   47     *   0.00  0.000  0.000  0.3151    0.0000 .2376E-06 .2661E-07    0.0000
.0000E+00 .2814E-07
   48  *  *   0.22  0.000  0.027  0.3151    0.0000 .1305E-06 .2215E-07    0.0000
.0000E+00 .2326E-07
   49  *  *   0.01  0.000  0.030  0.3151    0.0000 .6830E-07 .2127E-07    0.0000
.0000E+00 .2681E-07
   50  *  *   0.01  0.000  0.000  0.3151    0.0000 .3171E-07 .2114E-07    0.0000
.0000E+00 .2114E-07
   51     *   0.00  0.000  0.056  0.3151    0.0000 .1012E-07 .2105E-07    0.0000
.0000E+00 .2105E-07
   52     *   0.00  0.000  0.062  0.3151    0.0000 .1226E-09 .2226E-08    0.0000
.0000E+00 .1669E-08
   53  *  *   0.00  0.000  0.056  0.3151    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .5564E-09
   54  *  *   0.70  0.000  0.000  0.3151    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
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   55     *   0.56  0.598  0.000  0.3204    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   56  *  *   0.00  0.000  0.032  0.3204    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   57  *  *   0.00  0.000  0.031  0.3204    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   58     *   0.00  0.096  0.018  0.3230    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   59  *  *   0.00  0.000  0.033  0.3230    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   60  *  *   0.01  0.000  0.031  0.3230    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   61  *  *   0.00  0.000  0.035  0.3230    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   62  *  *   0.00  0.000  0.030  0.3230    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   63  *  *   0.00  0.000  0.030  0.3230    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   64  *  *   0.00  0.000  0.028  0.3230    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   65     *   0.00  0.108  0.057  0.3234    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   66     *   0.04  0.007  0.006  0.3249    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   67     *   0.00  0.000  0.000  0.3249    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   68     *   0.00  0.000  0.000  0.3249    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   69     *   0.13  0.074  0.006  0.3276    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   70     *   0.00  0.000  0.000  0.3276    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   71     *   0.38  0.315  0.006  0.3309    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   72     *   0.00  0.000  0.000  0.3309    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   73     *   0.71  0.648  0.006  0.3340    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   74     *   0.00  0.000  0.000  0.3340    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   75     *   0.00  0.000  0.000  0.3340    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   76         0.00  0.000  0.099  0.3166    4.0877 .2153     .2462E-02    0.0030
.0000E+00 .1571E-02
   77         0.00  0.000  0.110  0.2922    6.9056 .3327     .4133E-02    0.0027
.0000E+00 .8738E-03
   78         2.27  0.275  0.058  0.3797    7.2343 .3327     .4326E-02    0.0009
.0000E+00 .4082E-03
   79  *      0.02  0.000  0.074  0.3581   13.9393 .3338     .8243E-02    0.0004
.0000E+00 .1066E-03
   80  *      0.00  0.000  0.075  0.3354   11.6514 .3331     .6896E-02    0.0000
.0000E+00 .0000E+00
   81         0.12  0.000  0.091  0.3185    8.5118 .3328     .5064E-02    0.0004
.0000E+00 .2070E-03
   82         0.00  0.000  0.083  0.2956    5.8460 .3326     .3519E-02    0.0022
.0000E+00 .1384E-02
   83         0.60  0.000  0.085  0.3072    3.1058 .3006     .1923E-02    0.0031
.0000E+00 .1286E-02
   84         0.00  0.000  0.123  0.2871    2.2379 .2440     .1413E-02    0.0018
.0000E+00 .7598E-03
   85         0.00  0.000  0.136  0.2690    1.7740 .1934     .1136E-02    0.0012
.0000E+00 .5057E-03
   86         0.00  0.000  0.148  0.2529    1.3311 .1451     .8685E-03    0.0008
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.0000E+00	.3305E-03									
87	0.00	0.000	0.116	0.2408	0.9734	.1061	.6489E-03	0.0005		
.0000E+00	.2043E-03									
88	0.00	0.000	0.111	0.2303	0.7294	.7952E-01	.4964E-03	0.0004		
.0000E+00	.1472E-03									
89	0.40	0.000	0.089	0.2441	0.5457	.5949E-01	.3795E-03	0.0003		
.0000E+00	.1364E-03									
90	0.00	0.000	0.137	0.2341	0.4210	.4590E-01	.2988E-03	0.0003		
.0000E+00	.1622E-03									
91	0.00	0.000	0.105	0.2264	0.3241	.3533E-01	.2348E-03	0.0004		
.0000E+00	.2082E-03									
92	0.00	0.000	0.143	0.2172	0.2420	.2638E-01	.1795E-03	0.0185		
.0000E+00	.3402E-02									
93	0.55	0.000	0.167	0.2370	0.1783	.1944E-01	.1357E-03	0.0353		
.0000E+00	.3403E-02									
94	0.00	0.000	0.155	0.2277	0.1359	.1481E-01	.1059E-03	0.0526		
.0000E+00	.3403E-02									
95	0.00	0.000	0.126	0.2202	0.1045	.1139E-01	.8338E-04	0.0703		
.0000E+00	.3404E-02									
96	0.00	0.000	0.138	0.2122	0.0736	.8029E-02	.6066E-04	0.0883		
.0000E+00	.3404E-02									
97	0.00	0.000	0.108	0.2061	0.0429	.4680E-02	.3716E-04	0.1067		
.0000E+00	.3405E-02									
98	0.00	0.000	0.109	0.2000	0.0148	.1613E-02	.1421E-04	0.1253		
.0000E+00	.3405E-02									
99	0.00	0.000	0.142	0.1922	0.0006	.0000E+00	.0000E+00	0.1397		
.0000E+00	.3405E-02									
100	0.00	0.000	0.139	0.1846	0.0000	.0000E+00	.0000E+00	0.0977		
.0000E+00	.3404E-02									
101	0.00	0.000	0.124	0.1778	0.0000	.0000E+00	.0000E+00	0.0410		
.0000E+00	.3403E-02									
102	0.00	0.000	0.083	0.1733	0.0000	.0000E+00	.0000E+00	0.0014		
.0000E+00	.3313E-03									
103	0.00	0.000	0.064	0.1698	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
104	0.00	0.000	0.054	0.1669	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
105	0.20	0.000	0.052	0.1749	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
106	0.00	0.000	0.043	0.1726	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
107	0.00	0.000	0.039	0.1704	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
108	0.00	0.000	0.037	0.1684	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
109	0.05	0.000	0.039	0.1690	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
110	0.00	0.000	0.032	0.1673	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
111	0.00	0.000	0.031	0.1656	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
112	0.00	0.000	0.030	0.1639	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
113	0.00	0.000	0.030	0.1623	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
114	0.80	0.000	0.033	0.2042	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
115	1.37	0.030	0.109	0.2716	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
116	0.00	0.000	0.162	0.2616	0.1986	.2165E-01	.1456E-03	0.0003		
.0000E+00	.1456E-03									
117	0.00	0.000	0.160	0.2500	0.4750	.5178E-01	.3339E-03	0.0007		
.0000E+00	.3339E-03									

118	0.00	0.000	0.158	0.2385	0.4739	.5166E-01	.3332E-03	0.0007	.0000E+00	.3332E-03
119	0.00	0.000	0.166	0.2268	0.4345	.4737E-01	.3076E-03	0.0006	.0000E+00	.3076E-03
120	0.00	0.000	0.166	0.2155	0.3778	.4118E-01	.2704E-03	0.0006	.0000E+00	.2704E-03
121	0.18	0.000	0.165	0.2144	0.3173	.3460E-01	.2303E-03	0.0005	.0000E+00	.2303E-03
122	0.02	0.000	0.139	0.2064	0.2427	.2646E-01	.1801E-03	0.0004	.0000E+00	.1801E-03
123	0.00	0.000	0.182	0.1954	0.1762	.1921E-01	.1343E-03	0.0003	.0000E+00	.1343E-03
124	0.81	0.000	0.126	0.2320	0.1322	.1442E-01	.1033E-03	0.0002	.0000E+00	.1033E-03
125	0.00	0.000	0.205	0.2202	0.1043	.1137E-01	.8320E-04	0.0002	.0000E+00	.8320E-04
126	0.25	0.000	0.179	0.2236	0.0657	.7167E-02	.5462E-04	0.0001	.0000E+00	.5462E-04
127	0.00	0.000	0.188	0.2132	0.0202	.2208E-02	.1874E-04	0.0000	.0000E+00	.1874E-04
128	0.00	0.000	0.229	0.2007	0.0001	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
129	0.00	0.000	0.193	0.1902	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
130	0.00	0.000	0.189	0.1798	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
131	0.00	0.000	0.188	0.1695	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
132	0.62	0.000	0.097	0.1981	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
133	0.57	0.000	0.165	0.2202	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
134	0.00	0.000	0.173	0.2108	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
135	0.00	0.000	0.130	0.2037	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
136	0.71	0.000	0.085	0.2379	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
137	0.00	0.000	0.169	0.2287	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
138	0.01	0.000	0.160	0.2205	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
139	0.00	0.000	0.203	0.2094	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
140	0.00	0.000	0.228	0.1969	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
141	0.86	0.000	0.189	0.2336	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
142	0.06	0.000	0.194	0.2263	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
143	0.00	0.000	0.205	0.2151	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
144	0.00	0.000	0.206	0.2039	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
145	0.00	0.000	0.217	0.1920	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
146	0.00	0.000	0.230	0.1794	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
147	0.00	0.000	0.225	0.1671	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
148	0.00	0.000	0.231	0.1545	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
149	0.00	0.000	0.148	0.1465	0.0000	.0000E+00	.0000E+00	0.0000		

.0000E+00	.0000E+00									
150	0.90	0.000	0.129	0.1886	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
151	0.00	0.000	0.186	0.1784	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
152	1.42	0.016	0.170	0.2459	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
153	0.00	0.000	0.210	0.2344	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
154	0.00	0.000	0.206	0.2232	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
155	0.00	0.000	0.219	0.2112	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
156	2.10	0.132	0.227	0.3064	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
157	0.16	0.000	0.233	0.2895	2.1525	.2347	.1359E-02	0.0028		
.0000E+00	.1359E-02									
158	0.00	0.000	0.243	0.2654	1.8036	.1966	.1154E-02	0.0024		
.0000E+00	.1154E-02									
159	0.00	0.000	0.253	0.2449	1.1160	.1217	.7365E-03	0.0015		
.0000E+00	.7365E-03									
160	0.00	0.000	0.323	0.2234	0.6387	.6963E-01	.4388E-03	0.0009		
.0000E+00	.4388E-03									
161	0.00	0.000	0.277	0.2055	0.4452	.4854E-01	.3146E-03	0.0007		
.0000E+00	.3146E-03									
162	0.08	0.000	0.177	0.1980	0.3794	.4136E-01	.2714E-03	0.0006		
.0000E+00	.2714E-03									
163	1.42	0.008	0.232	0.2607	0.2928	.3192E-01	.2138E-03	0.0004		
.0000E+00	.2138E-03									
164	0.63	0.000	0.209	0.2825	0.2111	.2301E-01	.1583E-03	0.0003		
.0000E+00	.1583E-03									
165	0.00	0.000	0.216	0.2623	1.3906	.1516	.8977E-03	0.0019		
.0000E+00	.8977E-03									
166	0.00	0.000	0.241	0.2427	1.0860	.1184	.7181E-03	0.0015		
.0000E+00	.7181E-03									
167	0.43	0.000	0.196	0.2512	0.7083	.7722E-01	.4830E-03	0.0010		
.0000E+00	.4830E-03									
168	0.00	0.000	0.195	0.2375	0.5014	.5466E-01	.3510E-03	0.0007		
.0000E+00	.3510E-03									
169	0.00	0.000	0.222	0.2229	0.4064	.4431E-01	.2892E-03	0.0006		
.0000E+00	.2892E-03									
170	0.22	0.000	0.199	0.2220	0.3441	.3751E-01	.2481E-03	0.0005		
.0000E+00	.2481E-03									
171	0.00	0.000	0.241	0.2072	0.2646	.2885E-01	.1949E-03	0.0004		
.0000E+00	.1949E-03									
172	0.00	0.000	0.229	0.1935	0.1998	.2179E-01	.1507E-03	0.0003		
.0000E+00	.1507E-03									
173	0.00	0.000	0.258	0.1786	0.1383	.1508E-01	.1076E-03	0.0002		
.0000E+00	.1076E-03									
174	0.00	0.000	0.286	0.1626	0.0582	.6348E-02	.4881E-04	0.0001		
.0000E+00	.4881E-04									
175	0.00	0.000	0.238	0.1496	0.0048	.5174E-03	.4473E-05	0.0000		
.0000E+00	.4473E-05									
176	0.00	0.000	0.162	0.1407	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
177	0.10	0.000	0.140	0.1385	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
178	0.01	0.000	0.037	0.1370	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
179	0.13	0.000	0.065	0.1406	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
180	0.87	0.000	0.138	0.1806	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									

181	0.00	0.000	0.190	0.1702	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
182	0.00	0.000	0.210	0.1587	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
183	0.00	0.000	0.265	0.1442	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
184	0.15	0.000	0.210	0.1409	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
185	0.00	0.000	0.095	0.1357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
186	0.00	0.000	0.027	0.1342	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
187	0.00	0.000	0.005	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
188	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
189	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
190	0.09	0.000	0.042	0.1365	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
191	0.14	0.000	0.043	0.1418	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
192	0.00	0.000	0.104	0.1361	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
193	0.13	0.000	0.067	0.1396	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
194	1.87	0.055	0.158	0.2302	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
195	2.15	0.326	0.150	0.3203	0.2317	.2526E-01	.1550E-03	0.0003	.0000E+00	.1550E-03
196	0.16	0.000	0.183	0.3031	2.6583	.2898	.1662E-02	0.0035	.0000E+00	.1662E-02
197	0.00	0.000	0.238	0.2775	2.1049	.2295	.1334E-02	0.0028	.0000E+00	.1334E-02
198	0.00	0.000	0.280	0.2535	1.4522	.1583	.9419E-03	0.0020	.0000E+00	.9419E-03
199	0.00	0.000	0.251	0.2334	1.0546	.1150	.6991E-03	0.0015	.0000E+00	.6991E-03
200	0.00	0.000	0.259	0.2145	0.7969	.8688E-01	.5389E-03	0.0011	.0000E+00	.5389E-03
201	1.24	0.001	0.211	0.2671	0.6141	.6695E-01	.4233E-03	0.0009	.0000E+00	.4233E-03
202	0.04	0.000	0.288	0.2509	0.4311	.4700E-01	.3052E-03	0.0006	.0000E+00	.3052E-03
203	0.00	0.000	0.290	0.2337	0.2304	.2512E-01	.1714E-03	0.0004	.0000E+00	.1714E-03
204	0.00	0.000	0.284	0.2172	0.1498	.1633E-01	.1158E-03	0.0002	.0000E+00	.1158E-03
205	0.00	0.000	0.257	0.2020	0.1944	.2119E-01	.1469E-03	0.0003	.0000E+00	.1469E-03
206	0.35	0.000	0.216	0.2081	0.2222	.2422E-01	.1660E-03	0.0003	.0000E+00	.1660E-03
207	0.00	0.000	0.248	0.1934	0.1918	.2092E-01	.1452E-03	0.0003	.0000E+00	.1452E-03
208	0.00	0.000	0.276	0.1773	0.1683	.1835E-01	.1287E-03	0.0003	.0000E+00	.1287E-03
209	0.00	0.000	0.249	0.1631	0.0869	.9478E-02	.7035E-04	0.0001	.0000E+00	.7035E-04
210	0.00	0.000	0.251	0.1493	0.0104	.9820E-03	.7832E-05	0.0000	.0000E+00	.7832E-05
211	0.00	0.000	0.220	0.1373	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
212	0.00	0.000	0.063	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		

213	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
214	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
215	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
216	0.50	0.000	0.108	0.1553	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
217	0.00	0.000	0.120	0.1487	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
218	0.28	0.000	0.195	0.1534	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
219	0.00	0.000	0.161	0.1446	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
220	0.00	0.000	0.153	0.1362	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
221	0.00	0.000	0.035	0.1343	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
222	0.00	0.000	0.006	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
223	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
224	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
225	0.43	0.000	0.075	0.1533	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
226	0.00	0.000	0.107	0.1474	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
227	0.00	0.000	0.152	0.1391	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
228	0.76	0.000	0.152	0.1724	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
229	0.01	0.000	0.132	0.1657	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
230	0.00	0.000	0.140	0.1581	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
231	0.00	0.000	0.159	0.1494	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
232	0.10	0.000	0.113	0.1487	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
233	0.00	0.000	0.174	0.1391	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
234	0.00	0.000	0.083	0.1346	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
235	0.00	0.000	0.009	0.1341	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
236	0.13	0.000	0.061	0.1379	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
237	0.00	0.000	0.029	0.1363	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
238	0.00	0.000	0.035	0.1344	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
239	0.00	0.000	0.007	0.1340	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
240	0.00	0.000	0.002	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
241	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
242	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
243	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000

244	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
245	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
246	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
247	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
248	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
249	0.03	0.000	0.030	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
250	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
251	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
252	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
253	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
254	0.04	0.000	0.037	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
255	0.82	0.000	0.097	0.1736	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
256	0.00	0.000	0.125	0.1667	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
257	0.00	0.000	0.159	0.1580	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
258	0.00	0.000	0.087	0.1533	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
259	0.03	0.000	0.074	0.1509	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
260	0.00	0.000	0.083	0.1463	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
261	0.08	0.000	0.113	0.1445	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
262	0.12	0.000	0.114	0.1449	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
263	0.06	0.000	0.108	0.1423	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
264	0.02	0.000	0.081	0.1389	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
265	0.22	0.000	0.105	0.1452	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
266	2.75	0.287	0.107	0.2740	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
267	1.57	0.211	0.135	0.3334	1.7444	.1365	.1078E-02	0.0022	.0000E+00
268	0.28	0.000	0.113	0.3241	7.3217	.3327	.4374E-02	0.0005	.0000E+00
269	1.19	0.071	0.091	0.3619	8.4697	.3328	.5043E-02	0.0000	.0000E+00
270	0.00	0.000	0.070	0.3395	11.7412	.3331	.6948E-02	0.0000	.0000E+00
271	0.00	0.000	0.061	0.3176	9.0926	.3328	.5402E-02	0.0000	.0000E+00
272	0.00	0.000	0.079	0.2949	6.1456	.3326	.3693E-02	0.0031	.0000E+00
273	0.00	0.000	0.070	0.2738	3.6266	.3139	.2228E-02	0.0033	.0000E+00
274	0.00	0.000	0.027	0.2602	2.0253	.2208	.1286E-02	0.0014	.0000E+00
275	0.00	0.000	0.038	0.2500	1.3454	.1467	.8770E-03	0.0007	

.0000E+00	.3581E-03								
276	0.00	0.000	0.036	0.2426	0.9142	.9967E-01	.6121E-03	0.0004	
.0000E+00	.1983E-03								
277	0.00	0.000	0.052	0.2359	0.6373	.6947E-01	.4380E-03	0.0003	
.0000E+00	.1371E-03								
278	0.00	0.000	0.060	0.2299	0.4522	.4930E-01	.3190E-03	0.0002	
.0000E+00	.1337E-03								
279	0.00	0.000	0.053	0.2250	0.3468	.3780E-01	.2499E-03	0.0003	
.0000E+00	.1797E-03								
280	0.00	0.000	0.049	0.2207	0.2666	.2906E-01	.1962E-03	0.0031	
.0000E+00	.2551E-02								
281	0.00	0.000	0.033	0.2177	0.2009	.2191E-01	.1514E-03	0.0181	
.0000E+00	.3402E-02								
282	0.14	0.000	0.072	0.2205	0.1508	.1644E-01	.1164E-03	0.0352	
.0000E+00	.3403E-02								
283	0.00	0.000	0.035	0.2179	0.1147	.1250E-01	.9073E-04	0.0527	
.0000E+00	.3403E-02								
284	0.43	0.000	0.072	0.2369	0.0910	.9921E-02	.7351E-04	0.0704	
.0000E+00	.3404E-02								
285	0.00	0.000	0.044	0.2341	0.0739	.8061E-02	.6089E-04	0.0884	
.0000E+00	.3404E-02								
286	0.00	0.000	0.041	0.2315	0.0621	.6774E-02	.5200E-04	0.0970	
.0000E+00	.3404E-02								
287	0.00	0.000	0.050	0.2284	0.0504	.5492E-02	.4300E-04	0.0501	
.0000E+00	.3403E-02								
288	0.00	0.000	0.059	0.2250	0.0408	.4449E-02	.3556E-04	0.0040	
.0000E+00	.9302E-03								
289	0.00	0.000	0.040	0.2226	0.0333	.3633E-02	.2963E-04	0.0001	
.0000E+00	.3111E-04								
290	0.93	0.000	0.070	0.2694	0.0270	.2948E-02	.2455E-04	0.0001	
.0000E+00	.2582E-04								
291	0.46	0.000	0.075	0.2876	0.4802	.5236E-01	.3153E-03	0.0004	
.0000E+00	.2426E-03								
292	0.92	0.005	0.074	0.3180	3.3501	.2832	.2063E-02	0.0032	
.0000E+00	.2142E-02								
293	0.12	0.000	0.060	0.3040	3.5695	.3128	.2195E-02	0.0033	
.0000E+00	.2195E-02								
294	0.00	0.000	0.028	0.2902	2.0540	.2239	.1303E-02	0.0014	
.0000E+00	.9776E-03								
295	0.00	0.000	0.018	0.2796	1.6046	.1749	.1034E-02	0.0024	
.0000E+00	.1102E-02								
296	0.00	0.000	0.015	0.2711	1.2677	.1382	.8299E-03	0.0019	
.0000E+00	.8809E-03								
297	0.00	0.000	0.022	0.2639	1.0101	.1101	.6716E-03	0.0016	
.0000E+00	.7112E-03								
298	0.15	0.000	0.060	0.2641	0.7839	.8546E-01	.5308E-03	0.0013	
.0000E+00	.5660E-03								
299	0.00	0.000	0.024	0.2591	0.6100	.6650E-01	.4207E-03	0.0010	
.0000E+00	.4482E-03								
300	0.00	0.000	0.037	0.2543	0.4734	.5161E-01	.3329E-03	0.0008	
.0000E+00	.3548E-03								
301	0.00	0.000	0.038	0.2499	0.3774	.4114E-01	.2701E-03	0.0006	
.0000E+00	.2858E-03								
302	0.00	0.000	0.041	0.2460	0.2793	.3044E-01	.2048E-03	0.0005	
.0000E+00	.2211E-03								
303	0.09	0.000	0.055	0.2467	0.2024	.2207E-01	.1525E-03	0.0004	
.0000E+00	.1655E-03								
304	0.00	0.000	0.033	0.2439	0.1751	.1908E-01	.1335E-03	0.0003	
.0000E+00	.1382E-03								
305	0.00	0.000	0.039	0.2407	0.1692	.1844E-01	.1294E-03	0.0003	
.0000E+00	.1304E-03								
306	0.00	0.000	0.033	0.2380	0.1481	.1614E-01	.1146E-03	0.0003	
.0000E+00	.1183E-03								

307	0.00	0.000	0.033	0.2354	0.1313	.1432E-01	.1027E-03	0.0002	.0000E+00	.1056E-03
308	0.00	0.000	0.046	0.2321	0.1231	.1342E-01	.9679E-04	0.0002	.0000E+00	.9826E-04
309	0.00	0.000	0.037	0.2294	0.1120	.1222E-01	.8885E-04	0.0002	.0000E+00	.9083E-04
310	0.00	0.000	0.037	0.2268	0.1001	.1091E-01	.8018E-04	0.0002	.0000E+00	.8235E-04
311	0.00	0.000	0.042	0.2240	0.0904	.9857E-02	.7309E-04	0.0002	.0000E+00	.7487E-04
312	0.11	0.000	0.060	0.2262	0.0832	.9066E-02	.6775E-04	0.0001	.0000E+00	.6908E-04
313	0.00	0.000	0.027	0.2243	0.0769	.8388E-02	.6313E-04	0.0001	.0000E+00	.6428E-04
314	0.48	0.000	0.055	0.2471	0.0665	.7254E-02	.5533E-04	0.0001	.0000E+00	.5728E-04
315	0.00	0.000	0.041	0.2445	0.0596	.6500E-02	.5010E-04	0.0001	.0000E+00	.5141E-04
316	1.90	0.148	0.053	0.3341	0.5579	.6083E-01	.3624E-03	0.0004	.0000E+00	.2843E-03
317	0.34	0.000	0.048	0.3317	5.3851	.3325	.3252E-02	0.0018	.0000E+00	.1080E-02
318	0.00	0.000	0.033	0.3115	5.1265	.3325	.3102E-02	0.0030	.0000E+00	.1474E-02
319	0.00	0.000	0.038	0.2926	3.1920	.3068	.1974E-02	0.0036	.0000E+00	.2174E-02
320	0.00	0.000	0.037	0.2782	2.0639	.2250	.1309E-02	0.0017	.0000E+00	.1030E-02
321	0.00	0.000	0.036	0.2672	1.5114	.1648	.9778E-03	0.0074	.0000E+00	.2260E-02
322	0.00	0.000	0.038	0.2585	1.0966	.1196	.7249E-03	0.0140	.0000E+00	.3402E-02
323	0.00	0.000	0.040	0.2516	0.7954	.8672E-01	.5379E-03	0.0006	.0000E+00	.5480E-03
324	0.00	0.000	0.040	0.2459	0.5764	.6284E-01	.3992E-03	0.0008	.0000E+00	.3992E-03
325	0.28	0.000	0.053	0.2556	0.4394	.4790E-01	.3108E-03	0.0006	.0000E+00	.3108E-03
326	0.00	0.000	0.037	0.2515	0.3488	.3802E-01	.2512E-03	0.0005	.0000E+00	.2512E-03
327	0.00	0.000	0.027	0.2483	0.2798	.3051E-01	.2052E-03	0.0004	.0000E+00	.2052E-03
328 *	0.00	0.000	0.024	0.2456	0.2418	.2636E-01	.1794E-03	0.0004	.0000E+00	.1794E-03
329	0.00	0.000	0.035	0.2424	0.2029	.2212E-01	.1528E-03	0.0003	.0000E+00	.1528E-03
330	0.00	0.000	0.032	0.2399	0.1405	.1531E-01	.1091E-03	0.0002	.0000E+00	.1091E-03
331	0.03	0.000	0.050	0.2382	0.0980	.1069E-01	.7866E-04	0.0002	.0000E+00	.7866E-04
332	0.00	0.000	0.045	0.2351	0.0928	.1011E-01	.7481E-04	0.0002	.0000E+00	.7481E-04
333	0.00	0.000	0.045	0.2321	0.0845	.9210E-02	.6872E-04	0.0001	.0000E+00	.6872E-04
334	0.00	0.000	0.042	0.2294	0.0708	.7715E-02	.5851E-04	0.0001	.0000E+00	.5851E-04
335	0.10	0.000	0.056	0.2314	0.0640	.6981E-02	.5344E-04	0.0001	.0000E+00	.5344E-04
336	0.00	0.000	0.040	0.2289	0.0636	.6939E-02	.5315E-04	0.0001	.0000E+00	.5315E-04
337	0.00	0.000	0.047	0.2259	0.0578	.6301E-02	.4871E-04	0.0001	.0000E+00	.4871E-04
338	0.00	0.000	0.034	0.2238	0.0464	.5056E-02	.3990E-04	0.0001		

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.0000E+00 .3990E-04
  339         0.00  0.000  0.029  0.2220    0.0355 .3866E-02 .3133E-04    0.0001
.0000E+00 .3133E-04
  340         0.01  0.000  0.040  0.2202    0.0315 .3432E-02 .2816E-04    0.0001
.0000E+00 .2816E-04
  341         0.00  0.000  0.034  0.2182    0.0281 .3065E-02 .2542E-04    0.0001
.0000E+00 .2542E-04
  342  *      0.02  0.000  0.037  0.2171    0.0271 .2953E-02 .2460E-04    0.0001
.0000E+00 .2460E-04
  343  *      0.09  0.000  0.025  0.2180    0.0277 .3021E-02 .2510E-04    0.0001
.0000E+00 .2510E-04
  344  *      0.00  0.000  0.022  0.2189    0.0323 .3517E-02 .2878E-04    0.0001
.0000E+00 .2878E-04
  345  *      0.00  0.000  0.024  0.2175    0.0344 .3747E-02 .3047E-04    0.0001
.0000E+00 .3047E-04
  346  *      0.00  0.000  0.000  0.2173    0.0344 .3750E-02 .3049E-04    0.0001
.0000E+00 .3049E-04
  347  *      0.00  0.000  0.000  0.2171    0.0322 .3507E-02 .2871E-04    0.0001
.0000E+00 .2871E-04
  348  *      0.00  0.000  0.022  0.2158    0.0254 .2766E-02 .2318E-04    0.0000
.0000E+00 .2318E-04
  349  *      0.04  0.000  0.026  0.2164    0.0204 .2223E-02 .1907E-04    0.0000
.0000E+00 .1907E-04
  350  *      0.04  0.000  0.031  0.2167    0.0222 .2421E-02 .2059E-04    0.0000
.0000E+00 .2059E-04
  351         0.00  0.000  0.029  0.2150    0.0244 .2658E-02 .2238E-04    0.0000
.0000E+00 .2238E-04
  352  *      0.00  0.000  0.023  0.2136    0.0182 .1982E-02 .1720E-04    0.0000
.0000E+00 .1720E-04
  353  *      0.00  0.000  0.000  0.2135    0.0165 .1800E-02 .1579E-04    0.0000
.0000E+00 .1579E-04
  354  *      0.00  0.000  0.023  0.2122    0.0173 .1884E-02 .1645E-04    0.0000
.0000E+00 .1645E-04
  355  *      0.02  0.000  0.037  0.2111    0.0158 .1722E-02 .1518E-04    0.0000
.0000E+00 .1518E-04
  356         0.07  0.000  0.043  0.2125    0.0167 .1824E-02 .1598E-04    0.0000
.0000E+00 .1598E-04
  357         0.00  0.000  0.031  0.2107    0.0175 .1904E-02 .1659E-04    0.0000
.0000E+00 .1659E-04
  358         0.00  0.000  0.030  0.2090    0.0137 .1493E-02 .1337E-04    0.0000
.0000E+00 .1337E-04
  359         0.08  0.000  0.041  0.2111    0.0141 .1536E-02 .1371E-04    0.0000
.0000E+00 .1371E-04
  360  *      1.26  0.000  0.026  0.2121    0.0130 .1417E-02 .1276E-04    0.0000
.0000E+00 .1276E-04
  361  *      0.00  0.000  0.021  0.2131    0.0117 .1275E-02 .1162E-04    0.0000
.0000E+00 .1162E-04
  362  *      0.00  0.000  0.018  0.2141    0.0108 .1182E-02 .1086E-04    0.0000
.0000E+00 .1086E-04
  363  *  *   0.00  0.000  0.025  0.2141    0.0081 .8782E-03 .8342E-05    0.0000
.0000E+00 .8342E-05
  364     *   0.45  1.121  0.000  0.2381    0.0047 .5163E-03 .5228E-05    0.0000
.0000E+00 .5228E-05
  365     *   0.71  0.423  0.012  0.2531    0.0028 .3035E-03 .3290E-05    0.0000
.0000E+00 .3290E-05
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MONTHLY TOTALS (IN INCHES) FOR YEAR 1975

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.00	2.91	4.68	2.97	4.99	7.57
	6.32	2.21	7.21	3.24	3.14	2.89
RUNOFF	0.000	3.157	1.426	0.030	0.000	0.156
	0.382	0.000	0.569	0.005	0.148	1.545
EVAPOTRANSPIRATION	0.894	0.512	1.769	2.943	5.551	6.232
	5.441	2.210	1.938	1.411	1.205	0.826
LATERAL DRAINAGE COLLECTED	0.5882	0.0019	3.3871	0.3353	0.1154	1.3237
FROM LAYER 3	1.1552	0.0000	2.1145	2.3568	2.0360	0.0859
PERCOLATION/LEAKAGE THROUGH	0.0040	0.0000	0.0418	0.0022	0.0008	0.0081
LAYER 4	0.0070	0.0000	0.0288	0.0151	0.0151	0.0007
PERCOLATION/LEAKAGE THROUGH	0.0040	0.0000	0.0081	0.0360	0.0008	0.0081
LAYER 6	0.0070	0.0000	0.0044	0.0395	0.0151	0.0007

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.174	0.001	2.235	0.103	0.034	0.405
TOP OF LAYER 4	0.342	0.000	1.605	0.744	0.782	0.025
STD. DEVIATION OF DAILY	0.165	0.002	3.742	0.160	0.079	0.569
HEAD ON TOP OF LAYER 4	0.648	0.000	3.335	0.924	1.400	0.016
AVERAGE DAILY HEAD ON	0.000	0.000	0.001	0.026	0.000	0.001
TOP OF LAYER 6	0.000	0.000	0.000	0.014	0.001	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.001	0.043	0.000	0.001
HEAD ON TOP OF LAYER 6	0.001	0.000	0.001	0.028	0.003	0.000

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ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	52.13	3039347.750	100.00
RUNOFF	7.417	432407.312	14.23
EVAPOTRANSPIRATION	30.933	1803484.120	59.34
DRAINAGE COLLECTED FROM LAYER 3	13.5001	787102.375	25.90
PERC./LEAKAGE THROUGH LAYER 4	0.123657	7209.627	0.24

AVG. HEAD ON TOP OF LAYER 4	0.5375		
PERC./LEAKAGE THROUGH LAYER 6	0.123681	7211.030	0.24
AVG. HEAD ON TOP OF LAYER 6	0.0037		
CHANGE IN WATER STORAGE	0.157	9143.688	0.30
SOIL WATER AT START OF YEAR	172.880	10079489.000	
SOIL WATER AT END OF YEAR	173.037	10088632.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.940	0.00

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HEAD #1: AVERAGE HEAD ON TOP OF LAYER 4
DRAIN #1: LATERAL DRAINAGE FROM LAYER 3 (RECIRCULATION AND COLLECTION)
LEAK #1: PERCOLATION OR LEAKAGE THROUGH LAYER 4
HEAD #2: AVERAGE HEAD ON TOP OF LAYER 6
DRAIN #2: LATERAL DRAINAGE FROM LAYER 5 (RECIRCULATION AND COLLECTION)
LEAK #2: PERCOLATION OR LEAKAGE THROUGH LAYER 6

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DAILY OUTPUT FOR YEAR 1976

DAY	AI	SOILR	RAIN IN.	RUNOFF IN.	ET IN.	E. ZONE WATER IN./IN.	HEAD #1 IN.	DRAIN #1 IN.	LEAK #1 IN.	HEAD #2 IN.	DRAIN #2 IN.	LEAK #2 IN.
1		*	0.72	0.490	0.012	0.2650	0.0016	.1783E-03	.2080E-05	0.0000	.0000E+00	.2080E-05
2		*	0.00	0.000	0.000	0.2650	0.0010	.1047E-03	.1323E-05	0.0000	.0000E+00	.1323E-05
3		*	0.32	0.165	0.012	0.2729	0.0006	.6144E-04	.8469E-06	0.0000	.0000E+00	.8469E-06
4		*	0.00	0.000	0.000	0.2729	0.0003	.3603E-04	.5470E-06	0.0000	.0000E+00	.5470E-06
5		*	0.00	0.000	0.000	0.2729	0.0002	.2111E-04	.3573E-06	0.0000	.0000E+00	.3573E-06
6		*	0.00	0.000	0.000	0.2729	0.0001	.1236E-04	.2366E-06	0.0000	.0000E+00	.2366E-06

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    7     *   0.65  0.484  0.011  0.2813    0.0001 .7223E-05 .1595E-06    0.0000
.0000E+00 .1595E-06
    8  *  *   0.20  0.000  0.029  0.2813    0.0000 .4214E-05 .1100E-06    0.0000
.0000E+00 .1100E-06
    9  *  *   0.00  0.000  0.027  0.2813    0.0000 .2452E-05 .7792E-07    0.0000
.0000E+00 .7792E-07
   10  *  *   0.00  0.000  0.034  0.2813    0.0000 .1422E-05 .5704E-07    0.0000
.0000E+00 .5704E-07
   11     *   0.14  0.138  0.010  0.2869    0.0000 .8197E-06 .4329E-07    0.0000
.0000E+00 .4329E-07
   12     *   0.00  0.000  0.000  0.2869    0.0000 .4686E-06 .3408E-07    0.0000
.0000E+00 .3408E-07
   13     *   0.15  0.062  0.011  0.2912    0.0000 .2643E-06 .2760E-07    0.0000
.0000E+00 .2760E-07
   14     *   0.01  0.000  0.006  0.2913    0.0000 .1458E-06 .2273E-07    0.0000
.0000E+00 .1705E-07
   15     *   0.00  0.000  0.000  0.2913    0.0000 .7729E-07 .2130E-07    0.0000
.0000E+00 .2166E-07
   16         0.00  0.000  0.041  0.2839    0.8674 .9456E-01 .5563E-03    0.0006
.0000E+00 .4172E-03
   17         0.00  0.000  0.041  0.2705    1.8536 .2021     .1184E-02    0.0018
.0000E+00 .1027E-02
   18         0.00  0.000  0.039  0.2602    1.3720 .1496     .8934E-03    0.0022
.0000E+00 .9659E-03
   19         0.00  0.000  0.039  0.2519    1.0320 .1125     .6851E-03    0.0016
.0000E+00 .7372E-03
   20         0.15  0.000  0.055  0.2524    0.7777 .8478E-01 .5268E-03    0.0013
.0000E+00 .5664E-03
   21         0.08  0.000  0.050  0.2506    0.5791 .6313E-01 .4009E-03    0.0010
.0000E+00 .4324E-03
   22         0.00  0.000  0.048  0.2453    0.4482 .4886E-01 .3165E-03    0.0007
.0000E+00 .3376E-03
   23  *      0.00  0.000  0.038  0.2411    0.3464 .3777E-01 .2497E-03    0.0006
.0000E+00 .2664E-03
   24         0.00  0.000  0.048  0.2367    0.2938 .3203E-01 .2146E-03    0.0005
.0000E+00 .2233E-03
   25  *      0.00  0.000  0.037  0.2332    0.2552 .2782E-01 .1885E-03    0.0004
.0000E+00 .1950E-03
   26  *      0.36  0.000  0.029  0.2329    0.2222 .2422E-01 .1661E-03    0.0004
.0000E+00 .1717E-03
   27  *      1.64  0.000  0.000  0.2328    0.1937 .2112E-01 .1465E-03    0.0003
.0000E+00 .1514E-03
   28         0.08  0.000  0.000  0.2387    0.1765 .1924E-01 .1345E-03    0.0003
.0000E+00 .1375E-03
   29  *      0.00  0.000  0.033  0.2388    0.1531 .1669E-01 .1181E-03    0.0003
.0000E+00 .1222E-03
   30         0.00  0.000  0.000  0.2644    0.1290 .1406E-01 .1010E-03    0.0002
.0000E+00 .1053E-03
   31         0.00  0.000  0.000  0.3020    0.7454 .8126E-01 .4882E-03    0.0006
.0000E+00 .3914E-03
   32         0.34  0.006  0.000  0.3352    4.6381 .3060     .2814E-02    0.0024
.0000E+00 .1874E-02
   33         0.23  0.000  0.056  0.3262    7.9177 .3328     .4720E-02    0.0000
.0000E+00 .0000E+00
   34         0.00  0.000  0.044  0.3054    6.5919 .3326     .3951E-02    0.0016
.0000E+00 .7984E-03
   35         0.00  0.000  0.047  0.2853    3.7716 .3192     .2312E-02    0.0029
.0000E+00 .1550E-02
   36         0.05  0.000  0.052  0.2727    2.0795 .2267     .1318E-02    0.0033
.0000E+00 .1341E-02
   37         0.22  0.000  0.061  0.2730    1.3867 .1512     .9022E-03    0.0020
.0000E+00 .8450E-03
   38         0.00  0.000  0.051  0.2647    0.9264 .1010     .6195E-03    0.0014
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.0000E+00 .6123E-03
   39         0.00  0.000  0.055  0.2579    0.6417 .6995E-01 .4409E-03    0.0099
.0000E+00 .2485E-02
   40  *      0.00  0.000  0.045  0.2525    0.4898 .5340E-01 .3435E-03    0.0281
.0000E+00 .3402E-02
   41         0.00  0.000  0.057  0.2474    0.3286 .3582E-01 .2377E-03    0.0396
.0000E+00 .3403E-02
   42         0.00  0.000  0.052  0.2432    0.2200 .2398E-01 .1645E-03    0.0091
.0000E+00 .1635E-02
   43         0.00  0.000  0.061  0.2390    0.1604 .1749E-01 .1233E-03    0.0003
.0000E+00 .1233E-03
   44         0.00  0.000  0.075  0.2339    0.1534 .1673E-01 .1184E-03    0.0002
.0000E+00 .1184E-03
   45         0.03  0.000  0.054  0.2317    0.1605 .1750E-01 .1233E-03    0.0003
.0000E+00 .1233E-03
   46         0.00  0.000  0.060  0.2274    0.1659 .1808E-01 .1271E-03    0.0003
.0000E+00 .1271E-03
   47  *      0.00  0.000  0.047  0.2238    0.1593 .1737E-01 .1225E-03    0.0003
.0000E+00 .1225E-03
   48  *      0.09  0.000  0.049  0.2241    0.1347 .1469E-01 .1051E-03    0.0002
.0000E+00 .1051E-03
   49         0.30  0.000  0.017  0.2400    0.1187 .1294E-01 .9363E-04    0.0002
.0000E+00 .9363E-04
   50  *      0.00  0.000  0.053  0.2365    0.1076 .1174E-01 .8566E-04    0.0002
.0000E+00 .8566E-04
   51  *      0.00  0.000  0.054  0.2330    0.0934 .1019E-01 .7529E-04    0.0002
.0000E+00 .7529E-04
   52  *      0.00  0.000  0.057  0.2294    0.0770 .8392E-02 .6315E-04    0.0001
.0000E+00 .6315E-04
   53         0.40  0.000  0.075  0.2467    0.0694 .7568E-02 .5750E-04    0.0001
.0000E+00 .5750E-04
   54  *      0.00  0.000  0.062  0.2430    0.0613 .6679E-02 .5134E-04    0.0001
.0000E+00 .5134E-04
   55  *      0.00  0.000  0.062  0.2393    0.0485 .5292E-02 .4160E-04    0.0001
.0000E+00 .4160E-04
   56  *      0.00  0.000  0.058  0.2359    0.0439 .4784E-02 .3797E-04    0.0001
.0000E+00 .3797E-04
   57         0.00  0.000  0.064  0.2321    0.0398 .4339E-02 .3477E-04    0.0001
.0000E+00 .3477E-04
   58         0.00  0.000  0.069  0.2282    0.0309 .3372E-02 .2767E-04    0.0001
.0000E+00 .2767E-04
   59         0.00  0.000  0.075  0.2240    0.0114 .1239E-02 .1124E-04    0.0000
.0000E+00 .1124E-04
   60         0.00  0.000  0.063  0.2206    0.0007 .6759E-04 .7449E-06    0.0000
.0000E+00 .7449E-06
   61         0.00  0.000  0.072  0.2167    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   62  *      0.00  0.000  0.058  0.2135    0.0015 .1674E-03 .1789E-05    0.0000
.0000E+00 .1789E-05
   63         0.02  0.000  0.075  0.2104    0.0111 .1211E-02 .1108E-04    0.0000
.0000E+00 .1108E-04
   64         0.00  0.000  0.087  0.2055    0.0182 .1985E-02 .1723E-04    0.0000
.0000E+00 .1723E-04
   65         0.03  0.000  0.068  0.2033    0.0193 .2109E-02 .1819E-04    0.0000
.0000E+00 .1819E-04
   66         0.00  0.000  0.091  0.1982    0.0219 .2383E-02 .2029E-04    0.0000
.0000E+00 .2029E-04
   67         0.00  0.000  0.091  0.1931    0.0180 .1967E-02 .1704E-04    0.0000
.0000E+00 .1704E-04
   68         0.00  0.000  0.074  0.1890    0.0033 .3560E-03 .3693E-05    0.0000
.0000E+00 .3693E-05
   69         0.68  0.000  0.074  0.2222    0.0065 .7066E-03 .6871E-05    0.0000
.0000E+00 .6871E-05
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70		0.00	0.000	0.063	0.2186	0.0095	.1038E-02	.9673E-05	0.0000	.0000E+00 .9673E-05
71	*	0.03	0.000	0.056	0.2172	0.0025	.2525E-03	.2687E-05	0.0000	.0000E+00 .2687E-05
72	*	0.28	0.000	0.027	0.2183	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
73		0.50	0.000	0.000	0.2584	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
74	*	0.00	0.000	0.074	0.2543	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
75		0.00	0.000	0.091	0.2494	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
76		0.38	0.000	0.066	0.2661	0.0610	.6651E-02	.5013E-04	0.0001	.0000E+00 .5013E-04
77		0.00	0.000	0.074	0.2609	0.1915	.2088E-01	.1447E-03	0.0003	.0000E+00 .1447E-03
78		0.00	0.000	0.085	0.2550	0.2158	.2352E-01	.1615E-03	0.0003	.0000E+00 .1615E-03
79		0.00	0.000	0.080	0.2494	0.1878	.2048E-01	.1423E-03	0.0003	.0000E+00 .1423E-03
80		0.00	0.000	0.095	0.2426	0.2642	.2881E-01	.1946E-03	0.0004	.0000E+00 .1946E-03
81		0.06	0.000	0.078	0.2400	0.2811	.3065E-01	.2061E-03	0.0004	.0000E+00 .2061E-03
82		0.00	0.000	0.094	0.2331	0.2933	.3198E-01	.2143E-03	0.0004	.0000E+00 .2143E-03
83		0.00	0.000	0.102	0.2258	0.2811	.3065E-01	.2060E-03	0.0004	.0000E+00 .2060E-03
84		0.00	0.000	0.099	0.2191	0.2183	.2380E-01	.1633E-03	0.0003	.0000E+00 .1633E-03
85		0.00	0.000	0.106	0.2123	0.1685	.1837E-01	.1289E-03	0.0003	.0000E+00 .1289E-03
86		0.00	0.000	0.100	0.2058	0.1596	.1740E-01	.1227E-03	0.0003	.0000E+00 .1227E-03
87		0.15	0.000	0.096	0.2079	0.1412	.1540E-01	.1097E-03	0.0002	.0000E+00 .1097E-03
88	*	0.00	0.000	0.077	0.2031	0.1128	.1230E-01	.8936E-04	0.0002	.0000E+00 .8936E-04
89		0.00	0.000	0.094	0.1974	0.0898	.9786E-02	.7261E-04	0.0002	.0000E+00 .7261E-04
90		0.00	0.000	0.081	0.1925	0.0773	.8429E-02	.6341E-04	0.0001	.0000E+00 .6341E-04
91		0.25	0.000	0.072	0.2018	0.0649	.7074E-02	.5409E-04	0.0001	.0000E+00 .5409E-04
92		0.67	0.000	0.076	0.2340	0.0540	.5891E-02	.4583E-04	0.0001	.0000E+00 .4583E-04
93		0.04	0.000	0.087	0.2312	0.0441	.4813E-02	.3818E-04	0.0001	.0000E+00 .3818E-04
94		0.00	0.000	0.114	0.2247	0.0370	.4033E-02	.3255E-04	0.0001	.0000E+00 .3255E-04
95		0.19	0.000	0.100	0.2295	0.0267	.2906E-02	.2418E-04	0.0001	.0000E+00 .2418E-04
96		0.00	0.000	0.101	0.2239	0.0057	.5376E-03	.4993E-05	0.0000	.0000E+00 .4993E-05
97		0.00	0.000	0.127	0.2170	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
98		0.00	0.000	0.110	0.2110	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
99		0.07	0.000	0.099	0.2094	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
100		0.00	0.000	0.132	0.2022	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
101		0.00	0.000	0.148	0.1942	0.0000	.0000E+00	.0000E+00	0.0000	

102	0.00	0.000	0.145	0.1862	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
103	0.00	0.000	0.120	0.1797	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
104	0.00	0.000	0.147	0.1717	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
105	0.00	0.000	0.083	0.1671	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
106	0.00	0.000	0.064	0.1636	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
107	0.00	0.000	0.054	0.1607	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
108	0.00	0.000	0.048	0.1581	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
109	0.00	0.000	0.043	0.1557	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
110	0.00	0.000	0.040	0.1535	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
111	0.00	0.000	0.038	0.1514	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
112	0.30	0.000	0.042	0.1656	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
113	0.57	0.000	0.040	0.1945	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
114	0.00	0.000	0.199	0.1837	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
115	0.00	0.000	0.209	0.1723	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
116	0.21	0.000	0.131	0.1766	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
117	0.00	0.000	0.087	0.1718	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
118	0.00	0.000	0.069	0.1681	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
119	0.01	0.000	0.064	0.1651	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
120	0.00	0.000	0.053	0.1622	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
121	0.00	0.000	0.051	0.1594	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
122	1.77	0.036	0.052	0.2514	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
123	0.00	0.000	0.187	0.2411	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
124	0.00	0.000	0.173	0.2317	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
125	0.00	0.000	0.171	0.2223	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
126	0.00	0.000	0.187	0.2121	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
127	0.00	0.000	0.203	0.2010	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
128	0.59	0.000	0.177	0.2236	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
129	0.00	0.000	0.185	0.2135	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
130	0.00	0.000	0.219	0.2015	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
131	0.00	0.000	0.210	0.1900	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
132	0.44	0.000	0.126	0.2071	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000

133	0.17	0.000	0.109	0.2105	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
134	0.00	0.000	0.181	0.2006	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
135	0.00	0.000	0.202	0.1895	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
136	0.00	0.000	0.247	0.1761	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
137	0.00	0.000	0.204	0.1649	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
138	0.01	0.000	0.192	0.1549	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
139	0.83	0.000	0.137	0.1928	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
140	0.02	0.000	0.183	0.1839	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
141	0.07	0.000	0.163	0.1789	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
142	0.19	0.000	0.209	0.1778	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
143	0.00	0.000	0.223	0.1656	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
144	0.00	0.000	0.216	0.1538	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
145	0.00	0.000	0.218	0.1419	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
146	0.00	0.000	0.143	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
147	0.00	0.000	0.002	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
148	0.00	0.000	0.002	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
149	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
150	0.21	0.000	0.024	0.1440	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
151	0.05	0.000	0.088	0.1420	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
152	0.00	0.000	0.108	0.1360	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
153	1.32	0.000	0.169	0.1990	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
154	0.62	0.000	0.227	0.2205	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
155	0.00	0.000	0.269	0.2058	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
156	0.00	0.000	0.286	0.1901	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
157	0.00	0.000	0.262	0.1758	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
158	0.00	0.000	0.274	0.1608	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
159	0.00	0.000	0.235	0.1480	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
160	0.00	0.000	0.159	0.1393	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
161	0.00	0.000	0.073	0.1352	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
162	0.00	0.000	0.025	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
163	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
164	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00									
165	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
166	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
167	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
168	0.06	0.000	0.030	0.1355	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
169	0.14	0.000	0.037	0.1411	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
170	0.00	0.000	0.083	0.1366	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
171	0.00	0.000	0.037	0.1345	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
172	0.00	0.000	0.009	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
173	0.00	0.000	0.002	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
174	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
175	0.35	0.000	0.094	0.1479	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
176	0.00	0.000	0.095	0.1427	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
177	0.00	0.000	0.127	0.1358	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
178	0.02	0.000	0.050	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
179	0.72	0.000	0.068	0.1697	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
180	0.00	0.000	0.156	0.1612	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
181	0.00	0.000	0.167	0.1521	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
182	0.19	0.000	0.143	0.1546	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
183	0.00	0.000	0.160	0.1459	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
184	0.00	0.000	0.178	0.1361	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
185	0.63	0.000	0.134	0.1633	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
186	0.22	0.000	0.142	0.1675	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
187	0.00	0.000	0.199	0.1566	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
188	0.00	0.000	0.187	0.1464	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
189	0.33	0.000	0.167	0.1553	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
190	0.04	0.000	0.160	0.1487	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
191	0.00	0.000	0.163	0.1398	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
192	0.00	0.000	0.076	0.1357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
193	1.37	0.001	0.216	0.1987	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
194	0.03	0.000	0.255	0.1864	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
195	0.00	0.000	0.273	0.1715	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

196	0.00	0.000	0.283	0.1560	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
197	0.00	0.000	0.251	0.1423	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
198	0.07	0.000	0.178	0.1364	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
199	0.00	0.000	0.031	0.1347	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
200	0.00	0.000	0.012	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
201	0.00	0.000	0.002	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
202	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
203	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
204	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
205	0.62	0.000	0.111	0.1617	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
206	0.03	0.000	0.154	0.1549	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
207	0.00	0.000	0.194	0.1442	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
208	0.00	0.000	0.170	0.1349	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
209	0.00	0.000	0.015	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
210	0.00	0.000	0.002	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
211	0.70	0.000	0.074	0.1682	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
212	0.00	0.000	0.156	0.1597	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
213	0.00	0.000	0.213	0.1480	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
214	0.00	0.000	0.190	0.1376	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
215	0.00	0.000	0.061	0.1343	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
216	0.00	0.000	0.004	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
217	0.00	0.000	0.004	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
218	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
219	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
220	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
221	0.51	0.000	0.089	0.1569	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
222	1.17	0.001	0.120	0.2142	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
223	0.06	0.000	0.180	0.2077	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
224	0.00	0.000	0.223	0.1955	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
225	0.00	0.000	0.194	0.1849	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
226	0.15	0.000	0.150	0.1848	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
227	0.08	0.000	0.149	0.1811	0.0000	.0000E+00	.0000E+00	0.0000	

228	0.08	0.000	0.113	0.1793	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
229	0.00	0.000	0.197	0.1685	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
230	0.00	0.000	0.193	0.1580	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
231	0.00	0.000	0.214	0.1463	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
232	0.00	0.000	0.185	0.1361	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
233	0.00	0.000	0.037	0.1341	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
234	0.00	0.000	0.004	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
235	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
236	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
237	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
238	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
239	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
240	0.12	0.000	0.051	0.1376	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
241	0.00	0.000	0.019	0.1366	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
242	0.00	0.000	0.036	0.1346	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
243	0.00	0.000	0.011	0.1341	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
244	0.00	0.000	0.003	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
245	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
246	0.08	0.000	0.040	0.1360	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
247	0.00	0.000	0.014	0.1353	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
248	0.00	0.000	0.021	0.1341	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
249	0.00	0.000	0.003	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
250	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
251	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
252	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
253	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
254	0.18	0.000	0.054	0.1407	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
255	0.00	0.000	0.065	0.1372	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
256	0.00	0.000	0.042	0.1348	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
257	0.00	0.000	0.012	0.1342	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000
258	0.00	0.000	0.004	0.1340	0.0000	.0000E+00	.0000E+00	.0000E+00	.0000E+00	0.0000

259	0.01	0.000	0.011	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
260	0.90	0.000	0.063	0.1797	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
261	0.00	0.000	0.105	0.1740	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
262	0.00	0.000	0.122	0.1673	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
263	0.00	0.000	0.115	0.1610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
264	0.02	0.000	0.102	0.1565	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
265	0.04	0.000	0.081	0.1543	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
266	0.00	0.000	0.122	0.1477	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
267	0.00	0.000	0.116	0.1413	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
268	0.00	0.000	0.093	0.1362	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
269	0.00	0.000	0.038	0.1342	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
270	0.21	0.000	0.055	0.1427	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
271	0.06	0.000	0.068	0.1422	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
272	0.00	0.000	0.047	0.1397	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
273	0.00	0.000	0.044	0.1373	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
274	0.94	0.000	0.080	0.1843	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
275	0.05	0.000	0.105	0.1813	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
276	0.04	0.000	0.082	0.1790	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
277	0.27	0.000	0.106	0.1879	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
278	0.00	0.000	0.079	0.1836	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
279	0.00	0.000	0.083	0.1791	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
280	0.01	0.000	0.046	0.1771	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
281	0.00	0.000	0.074	0.1730	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
282	0.02	0.000	0.064	0.1706	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
283	0.77	0.000	0.090	0.2078	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
284	0.00	0.000	0.065	0.2042	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
285	0.00	0.000	0.057	0.2011	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
286	0.00	0.000	0.038	0.1990	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
287	0.00	0.000	0.050	0.1963	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
288	0.00	0.000	0.066	0.1927	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
289	0.00	0.000	0.044	0.1903	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
290	0.00	0.000	0.040	0.1881	0.0000	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00									
291		0.12	0.000	0.064	0.1912	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
292		0.00	0.000	0.022	0.1900	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
293		0.00	0.000	0.019	0.1889	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
294		1.41	0.012	0.064	0.2619	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
295	*	0.00	0.000	0.024	0.2605	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
296	*	0.00	0.000	0.022	0.2594	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
297		0.00	0.000	0.021	0.2582	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
298		0.22	0.000	0.061	0.2668	0.0105	.1140E-02	.9090E-05	0.0000	
.0000E+00	.9090E-05									
299		0.41	0.000	0.059	0.2839	0.3505	.3821E-01	.2448E-03	0.0005	
.0000E+00	.2448E-03									
300		0.20	0.000	0.067	0.2854	0.9636	.1051	.6429E-03	0.0013	
.0000E+00	.6429E-03									
301		0.00	0.000	0.049	0.2776	0.8590	.9364E-01	.5777E-03	0.0012	
.0000E+00	.5777E-03									
302		0.00	0.000	0.049	0.2707	0.7063	.7700E-01	.4818E-03	0.0010	
.0000E+00	.4818E-03									
303		0.00	0.000	0.045	0.2644	0.6436	.7016E-01	.4421E-03	0.0009	
.0000E+00	.4421E-03									
304		0.14	0.000	0.057	0.2649	0.6639	.7238E-01	.4551E-03	0.0009	
.0000E+00	.4551E-03									
305		0.64	0.000	0.065	0.2929	0.5784	.6305E-01	.4005E-03	0.0008	
.0000E+00	.4005E-03									
306		0.00	0.000	0.046	0.2772	2.1921	.2390	.1386E-02	0.0029	
.0000E+00	.1386E-02									
307		0.00	0.000	0.046	0.2643	1.7416	.1899	.1117E-02	0.0023	
.0000E+00	.1117E-02									
308		0.02	0.000	0.041	0.2557	1.2395	.1351	.8125E-03	0.0017	
.0000E+00	.8125E-03									
309		0.00	0.000	0.042	0.2482	0.8759	.9548E-01	.5882E-03	0.0012	
.0000E+00	.5882E-03									
310		0.00	0.000	0.042	0.2421	0.6301	.6870E-01	.4335E-03	0.0009	
.0000E+00	.4335E-03									
311		0.00	0.000	0.052	0.2365	0.4646	.5065E-01	.3272E-03	0.0007	
.0000E+00	.3272E-03									
312		0.00	0.000	0.038	0.2323	0.3452	.3763E-01	.2488E-03	0.0005	
.0000E+00	.2488E-03									
313		0.00	0.000	0.033	0.2290	0.2628	.2865E-01	.1937E-03	0.0004	
.0000E+00	.1937E-03									
314		0.00	0.000	0.032	0.2260	0.2075	.2262E-01	.1559E-03	0.0003	
.0000E+00	.1559E-03									
315		0.00	0.000	0.036	0.2230	0.1692	.1845E-01	.1294E-03	0.0003	
.0000E+00	.1294E-03									
316		0.00	0.000	0.038	0.2201	0.1414	.1542E-01	.1098E-03	0.0002	
.0000E+00	.1098E-03									
317		0.00	0.000	0.045	0.2169	0.1160	.1265E-01	.9173E-04	0.0002	
.0000E+00	.9173E-04									
318		0.00	0.000	0.035	0.2143	0.1131	.1234E-01	.8964E-04	0.0002	
.0000E+00	.8964E-04									
319		0.00	0.000	0.038	0.2116	0.1024	.1116E-01	.8185E-04	0.0002	
.0000E+00	.8185E-04									
320		0.00	0.000	0.043	0.2087	0.0895	.9754E-02	.7240E-04	0.0002	
.0000E+00	.7240E-04									
321		0.00	0.000	0.051	0.2054	0.0774	.8438E-02	.6346E-04	0.0001	
.0000E+00	.6346E-04									

322		0.00	0.000	0.044	0.2026	0.0663	.7225E-02	.5513E-04	0.0001	.0000E+00 .5513E-04
323		0.00	0.000	0.039	0.2002	0.0517	.5638E-02	.4404E-04	0.0001	.0000E+00 .4404E-04
324		0.00	0.000	0.038	0.1978	0.0418	.4553E-02	.3631E-04	0.0001	.0000E+00 .3631E-04
325		0.00	0.000	0.038	0.1956	0.0344	.3755E-02	.3053E-04	0.0001	.0000E+00 .3053E-04
326		0.00	0.000	0.027	0.1939	0.0290	.3161E-02	.2615E-04	0.0001	.0000E+00 .2615E-04
327		0.00	0.000	0.033	0.1920	0.0255	.2781E-02	.2331E-04	0.0000	.0000E+00 .2331E-04
328		0.00	0.000	0.029	0.1903	0.0231	.2518E-02	.2132E-04	0.0000	.0000E+00 .2132E-04
329		0.00	0.000	0.035	0.1882	0.0206	.2249E-02	.1927E-04	0.0000	.0000E+00 .1927E-04
330		0.00	0.000	0.042	0.1858	0.0202	.2202E-02	.1891E-04	0.0000	.0000E+00 .1891E-04
331		0.00	0.000	0.039	0.1836	0.0192	.2092E-02	.1807E-04	0.0000	.0000E+00 .1807E-04
332		0.01	0.000	0.035	0.1821	0.0172	.1875E-02	.1638E-04	0.0000	.0000E+00 .1638E-04
333	*	0.02	0.000	0.020	0.1821	0.0142	.1544E-02	.1377E-04	0.0000	.0000E+00 .1377E-04
334		0.27	0.000	0.044	0.1943	0.0135	.1470E-02	.1319E-04	0.0000	.0000E+00 .1319E-04
335		0.00	0.000	0.027	0.1928	0.0129	.1407E-02	.1268E-04	0.0000	.0000E+00 .1268E-04
336		0.00	0.000	0.029	0.1911	0.0129	.1409E-02	.1270E-04	0.0000	.0000E+00 .1270E-04
337		0.00	0.000	0.029	0.1895	0.0108	.1178E-02	.1081E-04	0.0000	.0000E+00 .1081E-04
338	*	0.00	0.000	0.025	0.1881	0.0037	.4074E-03	.4220E-05	0.0000	.0000E+00 .4220E-05
339	*	0.00	0.000	0.023	0.1868	0.0002	.4340E-05	.5716E-07	0.0000	.0000E+00 .5716E-07
340	*	0.00	0.000	0.000	0.1868	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
341	*	0.02	0.000	0.020	0.1868	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
342	*	0.97	0.000	0.021	0.1879	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
343	*	0.00	0.000	0.020	0.1890	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
344	*	0.00	0.000	0.029	0.1901	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
345		0.00	0.000	0.033	0.1911	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
346		0.00	0.000	0.001	0.2058	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
347	*	0.03	0.000	0.029	0.2069	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
348		0.00	0.000	0.023	0.2116	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
349	*	0.00	0.000	0.029	0.2127	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
350		0.00	0.000	0.009	0.2253	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
351	*	0.01	0.000	0.031	0.2264	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
352	*	0.00	0.000	0.029	0.2275	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
353	*	0.00	0.000	0.034	0.2262	0.0000	.0000E+00	.0000E+00	0.0000	

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.0000E+00 .0000E+00
  354  *      0.00  0.000  0.025  0.2249    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  355         0.30  0.000  0.042  0.2390    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  356         0.01  0.000  0.036  0.2375    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  357         0.00  0.000  0.030  0.2359    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  358         0.00  0.000  0.034  0.2341    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  359         0.00  0.000  0.036  0.2321    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  360         0.05  0.000  0.050  0.2321    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  361  *      0.15  0.000  0.028  0.2332    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  362  *      0.00  0.000  0.028  0.2343    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  363  *      0.01  0.000  0.027  0.2353    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  364  *  *   0.08  0.000  0.028  0.2353    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  365  *  *   0.00  0.000  0.028  0.2353    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
  366     *   0.00  0.000  0.035  0.2357    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
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MONTHLY TOTALS (IN INCHES) FOR YEAR 1976

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.50	1.66	2.38	2.06	4.35	3.42
	4.04	2.17	2.44	4.30	0.32	1.63
RUNOFF	1.338	0.006	0.000	0.000	0.036	0.000
	0.001	0.001	0.000	0.012	0.000	0.000
EVAPOTRANSPIRATION	0.649	1.575	2.403	2.817	4.742	3.080
	4.159	2.428	1.519	1.777	1.147	0.841
LATERAL DRAINAGE COLLECTED	1.0301	2.1311	0.3183	0.0182	0.0000	0.0000
FROM LAYER 3	0.0000	0.0000	0.0000	0.5206	0.9984	0.0030
PERCOLATION/LEAKAGE THROUGH	0.0064	0.0191	0.0022	0.0001	0.0000	0.0000
LAYER 4	0.0000	0.0000	0.0000	0.0033	0.0062	0.0000
PERCOLATION/LEAKAGE THROUGH	0.0063	0.0192	0.0022	0.0001	0.0000	0.0000
LAYER 6	0.0000	0.0000	0.0000	0.0033	0.0062	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.305	1.056	0.094	0.006	0.000	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.154	0.305	0.001
STD. DEVIATION OF DAILY	0.461	2.050	0.103	0.014	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.302	0.535	0.003
AVERAGE DAILY HEAD ON	0.000	0.004	0.000	0.000	0.000	0.000
TOP OF LAYER 6	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.001	0.009	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 6	0.000	0.000	0.000	0.000	0.001	0.000

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ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	33.27	1939749.250	100.00
RUNOFF	1.395	81327.422	4.19
EVAPOTRANSPIRATION	27.135	1582083.500	81.56
DRAINAGE COLLECTED FROM LAYER 3	5.0198	292669.687	15.09
PERC./LEAKAGE THROUGH LAYER 4	0.037410	2181.101	0.11
AVG. HEAD ON TOP OF LAYER 4	0.1601		
PERC./LEAKAGE THROUGH LAYER 6	0.037410	2181.101	0.11
AVG. HEAD ON TOP OF LAYER 6	0.0004		
CHANGE IN WATER STORAGE	-0.318	-18513.344	-0.95
SOIL WATER AT START OF YEAR	173.037	10088632.000	
SOIL WATER AT END OF YEAR	172.720	10070119.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.887	0.00

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HEAD #1: AVERAGE HEAD ON TOP OF LAYER 4
DRAIN #1: LATERAL DRAINAGE FROM LAYER 3 (RECIRCULATION AND COLLECTION)

LEAK #1: PERCOLATION OR LEAKAGE THROUGH LAYER 4
HEAD #2: AVERAGE HEAD ON TOP OF LAYER 6
DRAIN #2: LATERAL DRAINAGE FROM LAYER 5 (RECIRCULATION AND COLLECTION)
LEAK #2: PERCOLATION OR LEAKAGE THROUGH LAYER 6

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DAILY OUTPUT FOR YEAR 1977

DAY	A I R	S O I L	RAIN IN.	RUNOFF IN.	ET IN.	E. ZONE WATER IN./IN.	HEAD #1 IN.	DRAIN #1 IN.	LEAK #1 IN.	HEAD #2 IN.	DRAIN #2 IN.	LEAK #2 IN.
1	*	*	0.00	0.000	0.000	0.2357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
2	*	*	0.00	0.000	0.000	0.2357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
3	*	*	0.00	0.000	0.000	0.2357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
4	*	*	0.00	0.000	0.000	0.2357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
5		*	0.00	0.000	0.000	0.2357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
6		*	0.00	0.000	0.000	0.2357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
7		*	0.00	0.000	0.000	0.2357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
8		*	0.41	0.160	0.011	0.2488	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
9		*	0.00	0.000	0.000	0.2488	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
10		*	0.22	0.058	0.011	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
11	*	*	1.19	0.000	0.029	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
12	*	*	0.00	0.000	0.026	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
13	*	*	0.01	0.000	0.000	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
14	*	*	0.00	0.000	0.028	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
15	*	*	0.50	0.000	0.023	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
16	*	*	0.00	0.000	0.022	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
17	*	*	0.12	0.000	0.019	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
18	*	*	0.00	0.000	0.025	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
19	*	*	0.00	0.000	0.027	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
20	*	*	0.00	0.000	0.028	0.2571	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

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   21  *  *   0.00  0.000  0.022  0.2571    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   22  *  *   0.00  0.000  0.027  0.2571    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   23  *  *   0.00  0.000  0.029  0.2571    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   24     *   0.00  0.000  0.038  0.2571    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   25     *   0.16  0.177  0.000  0.2672    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   26     *   0.00  0.396  0.000  0.2774    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   27     *   0.00  0.128  0.005  0.2842    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   28     *   0.00  0.306  0.002  0.2913    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   29     *   0.00  0.000  0.000  0.2913    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   30     *   0.00  0.000  0.000  0.2913    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   31     *   0.00  0.000  0.000  0.2913    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   32     *   0.00  0.000  0.000  0.2913    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   33     *   0.00  0.000  0.000  0.2913    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   34     *   0.00  0.000  0.000  0.2913    0.0000 .0000E+00 .0000E+00    0.0000
.0000E+00 .0000E+00
   35         0.00  0.000  0.044  0.2834    0.9153 .9978E-01 .5850E-03    0.0012
.0000E+00 .5850E-03
   36  *      0.02  0.000  0.045  0.2718    1.7043 .1858     .1094E-02    0.0023
.0000E+00 .1094E-02
   37  *      0.02  0.000  0.053  0.2619    1.3490 .1471     .8794E-03    0.0018
.0000E+00 .8794E-03
   38  *      0.00  0.000  0.000  0.2557    1.0329 .1126     .6857E-03    0.0014
.0000E+00 .6857E-03
   39  *  *   0.00  0.000  0.000  0.2514    0.7161 .7806E-01 .4878E-03    0.0010
.0000E+00 .4878E-03
   40  *  *   0.00  0.000  0.000  0.2489    0.4218 .4599E-01 .2991E-03    0.0006
.0000E+00 .2991E-03
   41     *   0.00  0.000  0.000  0.2474    0.2484 .2709E-01 .1838E-03    0.0004
.0000E+00 .1838E-03
   42     *   0.00  0.000  0.000  0.2465    0.1463 .1595E-01 .1132E-03    0.0002
.0000E+00 .1132E-03
   43     *   0.00  0.000  0.000  0.2460    0.0861 .9391E-02 .6989E-04    0.0001
.0000E+00 .6989E-04
   44     *   0.01  0.000  0.006  0.2459    0.0507 .5528E-02 .4324E-04    0.0001
.0000E+00 .4324E-04
   45     *   0.00  0.000  0.000  0.2458    0.0298 .3254E-02 .2681E-04    0.0001
.0000E+00 .2681E-04
   46     *   0.00  0.000  0.000  0.2456    0.0176 .1914E-02 .1667E-04    0.0000
.0000E+00 .1667E-04
   47     *   0.00  0.000  0.000  0.2456    0.0103 .1126E-02 .1040E-04    0.0000
.0000E+00 .1040E-04
   48     *   0.00  0.000  0.000  0.2455    0.0061 .6622E-03 .6504E-05    0.0000
.0000E+00 .6504E-05
   49     *   0.00  0.000  0.000  0.2455    0.0036 .3893E-03 .4085E-05    0.0000
.0000E+00 .4085E-05
   50     *   0.00  0.000  0.000  0.2455    0.0021 .2287E-03 .2577E-05    0.0000
.0000E+00 .2577E-05
   51     *   0.00  0.000  0.000  0.2455    0.0012 .1344E-03 .1634E-05    0.0000
.0000E+00 .1634E-05
   52         0.14  0.000  0.070  0.2489    0.0693 .7550E-02 .5580E-04    0.0001
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.0000E+00 .5580E-04
   53         0.00  0.000  0.056  0.2448    0.1815 .1979E-01 .1379E-03    0.0003
.0000E+00 .1379E-03
   54         0.00  0.000  0.072  0.2395    0.2188 .2386E-01 .1638E-03    0.0003
.0000E+00 .1638E-03
   55         0.00  0.000  0.070  0.2343    0.2300 .2507E-01 .1714E-03    0.0004
.0000E+00 .1714E-03
   56         1.12  0.000  0.057  0.2910    0.2361 .2574E-01 .1756E-03    0.0004
.0000E+00 .1756E-03
   57         0.00  0.000  0.058  0.2800    1.3130 .1431     .8573E-03    0.0018
.0000E+00 .8573E-03
   58         0.00  0.000  0.064  0.2701    1.0747 .1172     .7116E-03    0.0015
.0000E+00 .7116E-03
   59         0.02  0.000  0.059  0.2621    0.9672 .1054     .6451E-03    0.0013
.0000E+00 .6451E-03
   60         0.00  0.000  0.074  0.2533    0.7907 .8620E-01 .5350E-03    0.0011
.0000E+00 .5350E-03
   61  *      0.00  0.000  0.058  0.2464    0.6233 .6796E-01 .4292E-03    0.0009
.0000E+00 .4292E-03
   62  *      0.00  0.000  0.064  0.2400    0.4867 .5306E-01 .3415E-03    0.0007
.0000E+00 .3415E-03
   63  *      0.00  0.000  0.055  0.2347    0.3749 .4087E-01 .2685E-03    0.0006
.0000E+00 .2685E-03
   64  *      0.45  0.000  0.038  0.2341    0.2902 .3164E-01 .2122E-03    0.0004
.0000E+00 .2122E-03
   65         0.00  0.000  0.022  0.2530    0.2258 .2462E-01 .1685E-03    0.0004
.0000E+00 .1685E-03
   66         0.00  0.000  0.067  0.2482    0.1822 .1987E-01 .1385E-03    0.0003
.0000E+00 .1385E-03
   67         0.00  0.000  0.068  0.2435    0.1636 .1784E-01 .1255E-03    0.0003
.0000E+00 .1255E-03
   68         0.00  0.000  0.085  0.2379    0.1585 .1727E-01 .1219E-03    0.0003
.0000E+00 .1219E-03
   69         0.00  0.000  0.069  0.2334    0.1187 .1294E-01 .9352E-04    0.0002
.0000E+00 .9352E-04
   70         0.00  0.000  0.086  0.2282    0.0810 .8836E-02 .6618E-04    0.0001
.0000E+00 .6618E-04
   71         0.00  0.000  0.084  0.2231    0.0867 .9456E-02 .7039E-04    0.0001
.0000E+00 .7039E-04
   72         0.00  0.000  0.076  0.2184    0.0821 .8946E-02 .6693E-04    0.0001
.0000E+00 .6693E-04
   73         1.02  0.000  0.073  0.2697    0.0726 .7916E-02 .5989E-04    0.0001
.0000E+00 .5989E-04
   74  *      0.00  0.000  0.063  0.2659    0.0582 .6341E-02 .4897E-04    0.0001
.0000E+00 .4897E-04
   75  *      0.00  0.000  0.071  0.2615    0.0861 .9388E-02 .6915E-04    0.0001
.0000E+00 .6915E-04
   76  *      0.00  0.000  0.075  0.2555    0.3246 .3538E-01 .2349E-03    0.0005
.0000E+00 .2349E-03
   77         0.00  0.000  0.088  0.2481    0.4375 .4770E-01 .3096E-03    0.0006
.0000E+00 .3096E-03
   78         0.66  0.000  0.072  0.2777    0.4178 .4555E-01 .2967E-03    0.0006
.0000E+00 .2967E-03
   79         0.00  0.000  0.087  0.2706    0.3832 .4177E-01 .2739E-03    0.0006
.0000E+00 .2739E-03
   80         0.11  0.000  0.112  0.2682    0.3796 .4138E-01 .2714E-03    0.0006
.0000E+00 .2714E-03
   81         0.00  0.000  0.089  0.2600    0.5617 .6123E-01 .3898E-03    0.0008
.0000E+00 .3898E-03
   82         1.90  0.164  0.084  0.3407    2.0112 .1746     .1260E-02    0.0026
.0000E+00 .1260E-02
   83         0.00  0.000  0.081  0.3178    7.3268 .3327     .4377E-02    0.0005
.0000E+00 .2303E-03
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84		0.00	0.000	0.079	0.2953	4.5319	.3312	.2756E-02	0.0024	.0000E+00 .1918E-02
85	*	0.00	0.000	0.067	0.2769	2.4438	.2664	.1535E-02	0.0029	.0000E+00 .1417E-02
86		0.00	0.000	0.098	0.2612	1.7224	.1878	.1105E-02	0.0022	.0000E+00 .1043E-02
87		0.00	0.000	0.108	0.2482	1.1877	.1295	.7808E-03	0.0015	.0000E+00 .2551E-02
88		0.05	0.000	0.100	0.2404	0.8360	.9114E-01	.5633E-03	0.0074	.0000E+00 .3402E-02
89		0.00	0.000	0.089	0.2319	0.6140	.6694E-01	.4233E-03	0.0028	.0000E+00 .9785E-03
90		0.00	0.000	0.077	0.2250	0.4608	.5024E-01	.3247E-03	0.0007	.0000E+00 .3247E-03
91		0.00	0.000	0.079	0.2186	0.3334	.3635E-01	.2410E-03	0.0005	.0000E+00 .2410E-03
92		0.00	0.000	0.087	0.2126	0.2245	.2447E-01	.1675E-03	0.0003	.0000E+00 .1675E-03
93		0.85	0.000	0.112	0.2519	0.1647	.1795E-01	.1262E-03	0.0003	.0000E+00 .1262E-03
94		0.01	0.000	0.067	0.2480	0.1434	.1563E-01	.1113E-03	0.0002	.0000E+00 .1113E-03
95		0.88	0.000	0.105	0.2896	0.1157	.1261E-01	.9143E-04	0.0002	.0000E+00 .9143E-04
96		0.52	0.000	0.085	0.3040	1.5573	.1698	.1005E-02	0.0021	.0000E+00 .1005E-02
97		0.00	0.000	0.129	0.2812	2.9090	.2872	.1808E-02	0.0021	.0000E+00 .1808E-02
98		0.01	0.000	0.115	0.2641	1.8911	.2062	.1206E-02	0.0025	.0000E+00 .1206E-02
99		0.00	0.000	0.159	0.2471	1.3843	.1509	.9008E-03	0.0019	.0000E+00 .9008E-03
100		0.00	0.000	0.142	0.2336	0.9506	.1036	.6347E-03	0.0013	.0000E+00 .6347E-03
101		0.00	0.000	0.133	0.2222	0.6894	.7516E-01	.4711E-03	0.0010	.0000E+00 .4711E-03
102		0.00	0.000	0.154	0.2108	0.5133	.5596E-01	.3587E-03	0.0007	.0000E+00 .3587E-03
103		0.00	0.000	0.149	0.2002	0.3979	.4338E-01	.2836E-03	0.0006	.0000E+00 .2836E-03
104		0.00	0.000	0.143	0.1907	0.2927	.3191E-01	.2138E-03	0.0004	.0000E+00 .2138E-03
105		0.00	0.000	0.105	0.1837	0.2113	.2304E-01	.1586E-03	0.0003	.0000E+00 .1586E-03
106		0.00	0.000	0.107	0.1769	0.1528	.1666E-01	.1179E-03	0.0002	.0000E+00 .1179E-03
107		0.00	0.000	0.113	0.1700	0.1135	.1237E-01	.8988E-04	0.0002	.0000E+00 .8988E-04
108		0.00	0.000	0.083	0.1649	0.0957	.1043E-01	.7691E-04	0.0002	.0000E+00 .7691E-04
109		0.00	0.000	0.064	0.1611	0.0535	.5827E-02	.4532E-04	0.0001	.0000E+00 .4532E-04
110		0.00	0.000	0.054	0.1580	0.0251	.2735E-02	.2291E-04	0.0000	.0000E+00 .2291E-04
111		0.00	0.000	0.048	0.1553	0.0093	.1009E-02	.9388E-05	0.0000	.0000E+00 .9388E-05
112		0.00	0.000	0.044	0.1529	0.0010	.8059E-04	.8676E-06	0.0000	.0000E+00 .8676E-06
113		0.00	0.000	0.041	0.1507	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
114		0.00	0.000	0.038	0.1486	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
115		0.45	0.000	0.041	0.1709	0.0000	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00								
116	0.04	0.000	0.039	0.1710	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
117	2.42	0.238	0.039	0.2882	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
118	0.00	0.000	0.192	0.2723	0.8881	.9682E-01	.5840E-03	0.0012	
.0000E+00	.5840E-03								
119	0.41	0.000	0.174	0.2782	1.1676	.1273	.7686E-03	0.0016	
.0000E+00	.7686E-03								
120	0.00	0.000	0.153	0.2648	0.8485	.9250E-01	.5711E-03	0.0012	
.0000E+00	.5711E-03								
121	0.00	0.000	0.218	0.2489	0.6594	.7189E-01	.4521E-03	0.0009	
.0000E+00	.4521E-03								
122	0.00	0.000	0.229	0.2338	0.4278	.4663E-01	.3030E-03	0.0006	
.0000E+00	.3030E-03								
123	0.00	0.000	0.251	0.2185	0.2526	.2754E-01	.1867E-03	0.0004	
.0000E+00	.1867E-03								
124	0.00	0.000	0.244	0.2038	0.2248	.2451E-01	.1678E-03	0.0003	
.0000E+00	.1678E-03								
125	0.30	0.000	0.163	0.2099	0.2293	.2500E-01	.1709E-03	0.0004	
.0000E+00	.1709E-03								
126	0.09	0.000	0.146	0.2057	0.1904	.2075E-01	.1441E-03	0.0003	
.0000E+00	.1441E-03								
127	0.17	0.000	0.170	0.2048	0.1512	.1648E-01	.1167E-03	0.0002	
.0000E+00	.1167E-03								
128	0.00	0.000	0.225	0.1918	0.1224	.1335E-01	.9632E-04	0.0002	
.0000E+00	.9632E-04								
129	0.04	0.000	0.179	0.1836	0.0925	.1008E-01	.7455E-04	0.0002	
.0000E+00	.7455E-04								
130	0.05	0.000	0.169	0.1769	0.0424	.4623E-02	.3670E-04	0.0001	
.0000E+00	.3670E-04								
131	0.00	0.000	0.104	0.1711	0.0217	.2360E-02	.2011E-04	0.0000	
.0000E+00	.2011E-04								
132	0.00	0.000	0.089	0.1661	0.0175	.1908E-02	.1655E-04	0.0000	
.0000E+00	.1655E-04								
133	0.00	0.000	0.080	0.1618	0.0019	.1494E-03	.1487E-05	0.0000	
.0000E+00	.1487E-05								
134	0.00	0.000	0.074	0.1577	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
135	0.00	0.000	0.079	0.1531	0.0486	.5300E-02	.3883E-04	0.0001	
.0000E+00	.3883E-04								
136	0.00	0.000	0.077	0.1487	0.0398	.3121E-02	.2266E-04	0.0000	
.0000E+00	.2266E-04								
137	0.00	0.000	0.080	0.1443	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
138	0.00	0.000	0.086	0.1396	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
139	0.05	0.000	0.091	0.1374	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
140	0.00	0.000	0.036	0.1354	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
141	0.00	0.000	0.016	0.1345	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
142	0.00	0.000	0.010	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
143	0.00	0.000	0.002	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
144	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
145	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
146	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								

147	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
148	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
149	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
150	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
151	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
152	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
153	0.96	0.000	0.044	0.1839	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
154	0.03	0.000	0.102	0.1800	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
155	0.00	0.000	0.209	0.1686	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
156	0.00	0.000	0.232	0.1559	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
157	0.00	0.000	0.228	0.1434	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
158	0.42	0.000	0.188	0.1561	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
159	0.00	0.000	0.163	0.1472	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
160	0.00	0.000	0.116	0.1409	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
161	1.16	0.000	0.138	0.1968	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
162	0.04	0.000	0.191	0.1885	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
163	0.00	0.000	0.231	0.1759	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
164	0.00	0.000	0.222	0.1638	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
165	0.01	0.000	0.159	0.1557	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
166	0.29	0.000	0.186	0.1614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
167	0.03	0.000	0.218	0.1511	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
168	0.00	0.000	0.259	0.1369	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
169	0.00	0.000	0.043	0.1346	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
170	0.00	0.000	0.013	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
171	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
172	0.07	0.000	0.034	0.1358	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
173	0.00	0.000	0.018	0.1348	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
174	0.00	0.000	0.013	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
175	0.00	0.000	0.003	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
176	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
177	0.73	0.000	0.108	0.1679	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
178	0.01	0.000	0.107	0.1626	0.0000	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00									
179	0.00	0.000	0.196	0.1519	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
180	1.58	0.016	0.241	0.2242	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
181	0.00	0.000	0.258	0.2100	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
182	0.00	0.000	0.267	0.1954	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
183	0.00	0.000	0.248	0.1819	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
184	0.00	0.000	0.274	0.1669	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
185	0.00	0.000	0.269	0.1523	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
186	0.00	0.000	0.211	0.1407	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
187	0.00	0.000	0.102	0.1352	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
188	0.44	0.000	0.113	0.1530	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
189	0.17	0.000	0.129	0.1552	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
190	0.00	0.000	0.166	0.1461	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
191	0.00	0.000	0.192	0.1356	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
192	0.00	0.000	0.026	0.1342	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
193	0.00	0.000	0.005	0.1340	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
194	0.21	0.000	0.039	0.1433	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
195	0.00	0.000	0.114	0.1371	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
196	0.00	0.000	0.043	0.1347	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
197	0.00	0.000	0.011	0.1341	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
198	0.00	0.000	0.003	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
199	0.02	0.000	0.021	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
200	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
201	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
202	0.04	0.000	0.037	0.1340	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
203	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
204	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
205	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
206	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
207	0.42	0.000	0.096	0.1515	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
208	0.00	0.000	0.110	0.1455	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
209	0.00	0.000	0.176	0.1359	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									

210	0.00	0.000	0.030	0.1343	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
211	0.00	0.000	0.006	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
212	0.17	0.000	0.043	0.1409	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
213	0.00	0.000	0.089	0.1360	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
214	1.60	0.016	0.141	0.2149	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
215	0.00	0.000	0.184	0.2048	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
216	0.01	0.000	0.143	0.1975	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
217	0.00	0.000	0.247	0.1840	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
218	0.00	0.000	0.241	0.1709	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
219	0.55	0.000	0.168	0.1918	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
220	0.00	0.000	0.215	0.1800	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
221	0.16	0.000	0.143	0.1809	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
222	0.00	0.000	0.230	0.1684	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
223	0.34	0.000	0.215	0.1752	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
224	0.02	0.000	0.209	0.1649	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
225	0.24	0.000	0.208	0.1666	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
226	0.47	0.000	0.196	0.1816	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
227	1.77	0.095	0.209	0.2618	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
228	0.00	0.000	0.236	0.2489	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
229	0.00	0.000	0.209	0.2375	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
230	0.97	0.000	0.138	0.2830	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
231	0.00	0.000	0.234	0.2637	1.0837	.1181	.7169E-03	0.0015	.0000E+00
232	0.00	0.000	0.207	0.2481	0.7029	.7663E-01	.4797E-03	0.0010	.0000E+00
233	0.00	0.000	0.199	0.2336	0.6131	.6684E-01	.4227E-03	0.0009	.0000E+00
234	0.04	0.000	0.138	0.2250	0.5460	.5953E-01	.3798E-03	0.0008	.0000E+00
235	1.00	0.000	0.110	0.2709	0.4599	.5014E-01	.3241E-03	0.0007	.0000E+00
236	0.00	0.000	0.215	0.2558	0.5487	.5982E-01	.3786E-03	0.0008	.0000E+00
237	0.48	0.000	0.184	0.2665	0.9098	.9918E-01	.6094E-03	0.0013	.0000E+00
238	0.00	0.000	0.261	0.2481	0.6989	.7619E-01	.4772E-03	0.0010	.0000E+00
239	0.00	0.000	0.216	0.2331	0.5252	.5726E-01	.3663E-03	0.0008	.0000E+00
240	0.00	0.000	0.199	0.2203	0.3157	.3442E-01	.2290E-03	0.0005	.0000E+00
241	0.00	0.000	0.163	0.2103	0.1850	.2017E-01	.1404E-03	0.0003	

.0000E+00	.1404E-03									
242	0.00	0.000	0.147	0.2013	0.1695	.1848E-01	.1296E-03	0.0003		
.0000E+00	.1296E-03									
243	0.00	0.000	0.189	0.1899	0.1717	.1872E-01	.1311E-03	0.0003		
.0000E+00	.1311E-03									
244	1.05	0.000	0.164	0.2375	0.1464	.1596E-01	.1134E-03	0.0002		
.0000E+00	.1134E-03									
245	0.00	0.000	0.223	0.2246	0.1201	.1309E-01	.9465E-04	0.0002		
.0000E+00	.9465E-04									
246	0.00	0.000	0.157	0.2154	0.0972	.1060E-01	.7807E-04	0.0002		
.0000E+00	.7807E-04									
247	0.00	0.000	0.167	0.2059	0.0693	.7555E-02	.5735E-04	0.0001		
.0000E+00	.5735E-04									
248	0.00	0.000	0.156	0.1972	0.0261	.2851E-02	.2367E-04	0.0000		
.0000E+00	.2367E-04									
249	0.00	0.000	0.173	0.1877	0.0015	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
250	0.55	0.000	0.150	0.2096	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
251	0.00	0.000	0.158	0.2010	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
252	0.00	0.000	0.159	0.1923	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
253	0.13	0.000	0.095	0.1942	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
254	0.00	0.000	0.146	0.1862	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
255	0.00	0.000	0.164	0.1772	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
256	0.00	0.000	0.155	0.1688	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
257	0.00	0.000	0.162	0.1599	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
258	0.00	0.000	0.162	0.1510	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
259	0.00	0.000	0.131	0.1439	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
260	0.00	0.000	0.160	0.1351	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
261	0.22	0.000	0.078	0.1429	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
262	0.00	0.000	0.045	0.1404	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
263	0.77	0.000	0.087	0.1777	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
264	0.15	0.000	0.087	0.1812	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
265	0.00	0.000	0.080	0.1768	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
266	0.04	0.000	0.064	0.1755	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
267	0.12	0.000	0.099	0.1766	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
268	0.06	0.000	0.068	0.1762	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
269	1.17	0.001	0.104	0.2344	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
270	0.12	0.000	0.082	0.2364	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
271	0.11	0.000	0.089	0.2376	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
272	0.00	0.000	0.062	0.2342	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									

273	0.00	0.000	0.058	0.2311	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
274	0.00	0.000	0.044	0.2286	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
275	0.10	0.000	0.070	0.2303	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
276	0.00	0.000	0.030	0.2286	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
277	0.00	0.000	0.046	0.2261	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
278	0.00	0.000	0.039	0.2240	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
279	0.00	0.000	0.028	0.2224	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
280	0.06	0.000	0.049	0.2230	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
281	0.00	0.000	0.027	0.2216	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
282	0.16	0.000	0.067	0.2266	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
283	0.84	0.000	0.078	0.2683	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00 .0000E+00
284	0.00	0.000	0.050	0.2636	0.3195	.3483E-01	.2264E-03	0.0005	.0000E+00 .2264E-03
285	0.00	0.000	0.047	0.2593	0.2899	.3160E-01	.2119E-03	0.0004	.0000E+00 .2119E-03
286	0.00	0.000	0.045	0.2547	0.3698	.4032E-01	.2651E-03	0.0006	.0000E+00 .2651E-03
287	0.00	0.000	0.051	0.2494	0.4195	.4573E-01	.2978E-03	0.0006	.0000E+00 .2978E-03
288	0.35	0.000	0.087	0.2614	0.3948	.4305E-01	.2816E-03	0.0006	.0000E+00 .2816E-03
289	0.02	0.000	0.032	0.2587	0.3423	.3732E-01	.2469E-03	0.0005	.0000E+00 .2469E-03
290	0.78	0.000	0.074	0.2954	0.3073	.3351E-01	.2236E-03	0.0005	.0000E+00 .2236E-03
291	0.18	0.000	0.071	0.2887	2.1136	.2304	.1339E-02	0.0028	.0000E+00 .1339E-02
292	0.00	0.000	0.020	0.2785	1.5262	.1664	.9867E-03	0.0021	.0000E+00 .9867E-03
293	0.02	0.000	0.026	0.2712	1.1574	.1262	.7624E-03	0.0016	.0000E+00 .7624E-03
294	0.05	0.000	0.044	0.2665	0.8346	.9099E-01	.5623E-03	0.0012	.0000E+00 .5623E-03
295	0.00	0.000	0.030	0.2613	0.5856	.6384E-01	.4051E-03	0.0008	.0000E+00 .4051E-03
296	0.00	0.000	0.030	0.2567	0.5078	.5536E-01	.3552E-03	0.0007	.0000E+00 .3552E-03
297	0.00	0.000	0.025	0.2526	0.4475	.4878E-01	.3160E-03	0.0007	.0000E+00 .3160E-03
298	0.00	0.000	0.017	0.2494	0.3847	.4194E-01	.2750E-03	0.0006	.0000E+00 .2750E-03
299	0.00	0.000	0.023	0.2462	0.3215	.3505E-01	.2331E-03	0.0005	.0000E+00 .2331E-03
300	0.10	0.000	0.059	0.2468	0.2776	.3026E-01	.2037E-03	0.0004	.0000E+00 .2037E-03
301	0.44	0.000	0.055	0.2663	0.2459	.2681E-01	.1822E-03	0.0004	.0000E+00 .1822E-03
302	0.01	0.000	0.036	0.2636	0.2206	.2405E-01	.1650E-03	0.0003	.0000E+00 .1650E-03
303	0.00	0.000	0.027	0.2609	0.2028	.2211E-01	.1527E-03	0.0003	.0000E+00 .1527E-03
304	0.00	0.000	0.036	0.2581	0.1381	.1505E-01	.1074E-03	0.0002	

									.0000E+00	.1074E-03
305		0.00	0.000	0.030	0.2559	0.1010	.1102E-01	.8080E-04	0.0002	.0000E+00 .8080E-04
306		0.00	0.000	0.031	0.2529	0.2049	.2234E-01	.1540E-03	0.0003	.0000E+00 .1540E-03
307		0.02	0.000	0.048	0.2497	0.2775	.3025E-01	.2036E-03	0.0004	.0000E+00 .2036E-03
308		0.19	0.000	0.058	0.2552	0.2896	.3157E-01	.2118E-03	0.0004	.0000E+00 .2118E-03
309		0.00	0.000	0.051	0.2508	0.2659	.2899E-01	.1958E-03	0.0004	.0000E+00 .1958E-03
310		0.00	0.000	0.045	0.2468	0.2557	.2787E-01	.1889E-03	0.0004	.0000E+00 .1889E-03
311		0.25	0.000	0.062	0.2557	0.2235	.2437E-01	.1670E-03	0.0003	.0000E+00 .1670E-03
312		3.99	1.350	0.065	0.3886	1.8384	.1432	.1143E-02	0.0024	.0000E+00 .1143E-02
313		0.16	0.000	0.066	0.3750	15.1895	.3342	.8986E-02	0.0000	.0000E+00 .0000E+00
314		0.00	0.000	0.040	0.3541	13.5598	.3336	.8019E-02	0.0000	.0000E+00 .0000E+00
315		0.03	0.000	0.057	0.3341	11.1339	.3330	.6592E-02	0.0000	.0000E+00 .0000E+00
316		0.00	0.000	0.053	0.3128	8.1681	.3328	.4865E-02	0.0008	.0000E+00 .4153E-03
317		0.00	0.000	0.051	0.2917	5.2501	.3325	.3174E-02	0.0033	.0000E+00 .2189E-02
318		0.00	0.000	0.041	0.2737	2.6241	.2861	.1641E-02	0.0017	.0000E+00 .8421E-03
319		0.00	0.000	0.033	0.2613	1.7704	.1930	.1134E-02	0.0008	.0000E+00 .4143E-03
320		0.00	0.000	0.028	0.2526	1.1871	.1294	.7804E-03	0.0003	.0000E+00 .1633E-03
321	*	0.03	0.000	0.039	0.2473	0.8106	.8837E-01	.5474E-03	0.0001	.0000E+00 .4510E-04
322		0.43	0.000	0.048	0.2647	0.5792	.6315E-01	.4010E-03	0.0000	.0000E+00 .9582E-05
323		0.00	0.000	0.032	0.2605	0.4039	.4403E-01	.2875E-03	0.0001	.0000E+00 .2977E-04
324		0.00	0.000	0.033	0.2567	0.3329	.3629E-01	.2407E-03	0.0002	.0000E+00 .8255E-04
325		0.00	0.000	0.040	0.2530	0.2476	.2700E-01	.1833E-03	0.0003	.0000E+00 .1456E-03
326		0.08	0.000	0.052	0.2536	0.1503	.1639E-01	.1161E-03	0.0150	.0000E+00 .3402E-02
327		0.12	0.000	0.050	0.2565	0.1598	.1742E-01	.1228E-03	0.0325	.0000E+00 .3402E-02
328		0.72	0.000	0.045	0.2899	0.5791	.6314E-01	.3879E-03	0.0482	.0000E+00 .3403E-02
329		0.01	0.000	0.043	0.2789	1.5439	.1683	.9972E-03	0.0573	.0000E+00 .3403E-02
330		0.46	0.000	0.055	0.2917	1.5511	.1691	.1002E-02	0.0599	.0000E+00 .3403E-02
331		0.21	0.000	0.052	0.2937	1.1068	.1207	.7312E-03	0.0642	.0000E+00 .3403E-02
332		0.02	0.000	0.039	0.2870	0.9425	.1028	.6298E-03	0.0718	.0000E+00 .3404E-02
333		0.00	0.000	0.027	0.2795	1.0146	.1106	.6744E-03	0.0802	.0000E+00 .3404E-02
334		0.23	0.000	0.049	0.2832	1.0337	.1127	.6863E-03	0.0880	.0000E+00 .3404E-02
335		0.81	0.001	0.043	0.3117	2.6898	.2435	.1672E-02	0.0894	.0000E+00 .3404E-02

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  336          0.42  0.000  0.045  0.3138    5.4926 .3326     .3314E-02    0.0763
.0000E+00 .3404E-02
  337          0.00  0.000  0.030  0.2953    3.2041 .3076     .1981E-02    0.0468
.0000E+00 .3403E-02
  338  *       0.00  0.000  0.025  0.2824    1.9202 .2093     .1223E-02    0.0184
.0000E+00 .3402E-02
  339          0.00  0.000  0.030  0.2722    1.4348 .1564     .9315E-03    0.0056
.0000E+00 .2743E-02
  340          0.59  0.000  0.041  0.2954    1.1262 .1228     .7432E-03    0.0008
.0000E+00 .5574E-03
  341          0.00  0.000  0.027  0.2874    1.0894 .1188     .7197E-03    0.0015
.0000E+00 .7256E-03
  342  *       0.00  0.000  0.023  0.2783    1.3117 .1430     .8568E-03    0.0016
.0000E+00 .8225E-03
  343  *       0.00  0.000  0.022  0.2702    1.1589 .1263     .7633E-03    0.0017
.0000E+00 .7867E-03
  344  *       0.05  0.000  0.028  0.2654    0.9670 .1054     .6450E-03    0.0015
.0000E+00 .6746E-03
  345  *       0.00  0.000  0.027  0.2594    0.7833 .8539E-01 .5304E-03    0.0012
.0000E+00 .5590E-03
  346          0.00  0.000  0.029  0.2541    0.6073 .6621E-01 .4190E-03    0.0010
.0000E+00 .4468E-03
  347  *       0.00  0.000  0.026  0.2500    0.4543 .4953E-01 .3204E-03    0.0008
.0000E+00 .3451E-03
  348          0.00  0.000  0.030  0.2463    0.3508 .3824E-01 .2525E-03    0.0006
.0000E+00 .2695E-03
  349  *       0.89  0.000  0.029  0.2457    0.2787 .3038E-01 .2044E-03    0.0005
.0000E+00 .2164E-03
  350  *       0.00  0.000  0.024  0.2453    0.2454 .2675E-01 .1819E-03    0.0004
.0000E+00 .1875E-03
  351  *       0.00  0.000  0.024  0.2450    0.2184 .2381E-01 .1635E-03    0.0004
.0000E+00 .1681E-03
  352  *       0.00  0.000  0.025  0.2449    0.1953 .2129E-01 .1476E-03    0.0003
.0000E+00 .1515E-03
  353  *       1.72  0.000  0.000  0.2450    0.1735 .1892E-01 .1324E-03    0.0003
.0000E+00 .1362E-03
  354  *       0.10  0.000  0.000  0.2452    0.1478 .1611E-01 .1144E-03    0.0003
.0000E+00 .1189E-03
  355          0.09  0.000  0.000  0.2455    0.1291 .1407E-01 .1011E-03    0.0002
.0000E+00 .1044E-03
  356          0.91  0.891  0.000  0.3823    0.6945 .7572E-01 .4529E-03    0.0006
.0000E+00 .3650E-03
  357          0.00  0.000  0.041  0.3613   14.2122 .3339     .8405E-02    0.0005
.0000E+00 .1132E-03
  358          0.00  0.000  0.039  0.3406   11.9690 .3332     .7082E-02    0.0000
.0000E+00 .0000E+00
  359          0.00  0.000  0.038  0.3200    9.1382 .3329     .5429E-02    0.0000
.0000E+00 .0000E+00
  360          0.26  0.000  0.045  0.3134    6.5254 .3326     .3913E-02    0.0026
.0000E+00 .1260E-02
  361          0.00  0.000  0.037  0.2938    3.7239 .3178     .2285E-02    0.0034
.0000E+00 .1628E-02
  362          0.00  0.000  0.031  0.2794    2.1188 .2310     .1342E-02    0.0015
.0000E+00 .7331E-03
  363          0.00  0.000  0.032  0.2697    1.3365 .1457     .8714E-03    0.0007
.0000E+00 .3507E-03
  364  *       0.00  0.000  0.027  0.2628    0.8930 .9735E-01 .5989E-03    0.0004
.0000E+00 .1840E-03
  365  *       0.12  0.000  0.035  0.2597    0.7055 .7691E-01 .4813E-03    0.0003
.0000E+00 .1784E-03
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MONTHLY TOTALS (IN INCHES) FOR YEAR 1977

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.61	1.33	4.19	5.59	0.70	5.33
	1.47	7.65	4.49	3.11	6.95	5.96
RUNOFF	1.224	0.000	0.164	0.238	0.000	0.016
	0.000	0.111	0.001	0.000	1.350	0.892
EVAPOTRANSPIRATION	0.370	0.653	2.362	2.994	2.819	3.920
	2.735	5.883	3.685	1.364	1.362	0.852
LATERAL DRAINAGE COLLECTED	0.0000	1.2027	2.3266	1.6199	0.2737	0.0000
FROM LAYER 3	0.0000	0.7555	0.0501	1.2436	3.7342	4.5335
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0074	0.0177	0.0101	0.0018	0.0000
LAYER 4	0.0000	0.0048	0.0004	0.0078	0.0445	0.0463
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0074	0.0177	0.0101	0.0018	0.0000
LAYER 6	0.0000	0.0048	0.0004	0.0078	0.0373	0.0274

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.394	0.888	0.504	0.081	0.000
TOP OF LAYER 4	0.000	0.224	0.015	0.368	2.427	2.429
STD. DEVIATION OF DAILY	0.000	0.512	1.508	0.690	0.149	0.000
HEAD ON TOP OF LAYER 4	0.000	0.321	0.039	0.476	4.077	3.521
AVERAGE DAILY HEAD ON	0.000	0.001	0.001	0.001	0.000	0.000
TOP OF LAYER 6	0.000	0.000	0.000	0.001	0.018	0.008
STD. DEVIATION OF DAILY	0.000	0.001	0.001	0.001	0.000	0.000
HEAD ON TOP OF LAYER 6	0.000	0.000	0.000	0.001	0.029	0.022

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ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	49.38	2879013.500	100.00
RUNOFF	3.997	233039.141	8.09
EVAPOTRANSPIRATION	28.998	1690693.370	58.72

DRAINAGE COLLECTED FROM LAYER 3	15.7398	917679.750	31.87
PERC./LEAKAGE THROUGH LAYER 4	0.140829	8210.806	0.29
AVG. HEAD ON TOP OF LAYER 4	0.6108		
PERC./LEAKAGE THROUGH LAYER 6	0.114757	6690.708	0.23
AVG. HEAD ON TOP OF LAYER 6	0.0024		
CHANGE IN WATER STORAGE	0.530	30912.764	1.07
SOIL WATER AT START OF YEAR	172.720	10070119.000	
SOIL WATER AT END OF YEAR	173.184	10097205.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.066	3826.876	0.13
ANNUAL WATER BUDGET BALANCE	0.0000	-2.270	0.00

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HEAD #1: AVERAGE HEAD ON TOP OF LAYER 4
DRAIN #1: LATERAL DRAINAGE FROM LAYER 3 (RECIRCULATION AND COLLECTION)
LEAK #1: PERCOLATION OR LEAKAGE THROUGH LAYER 4
HEAD #2: AVERAGE HEAD ON TOP OF LAYER 6
DRAIN #2: LATERAL DRAINAGE FROM LAYER 5 (RECIRCULATION AND COLLECTION)
LEAK #2: PERCOLATION OR LEAKAGE THROUGH LAYER 6

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DAILY OUTPUT FOR YEAR 1978

DAY	A I R	S O I L	RAIN IN.	RUNOFF IN.	ET IN.	E. ZONE WATER IN./IN.	HEAD #1 IN.	DRAIN #1 IN.	LEAK #1 IN.	HEAD #2 IN.	DRAIN #2 IN.	LEAK #2 IN.
1			0.04	0.000	0.035	0.2601	0.5761	.6281E-01	.3991E-03	0.0004	.0000E+00	.2084E-03
2			0.16	0.000	0.051	0.2633	0.4594	.5008E-01	.3238E-03	0.0005	.0000E+00	.2443E-03
3			0.04	0.000	0.047	0.2607	0.3655	.3985E-01	.2623E-03	0.0047	.0000E+00	.1491E-02
4		*	0.00	0.000	0.026	0.2575	0.3045	.3320E-01	.2218E-03	0.0276		

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.0000E+00 .3402E-02
    5  *      0.00  0.000  0.000  0.2558    0.2748 .2996E-01 .2018E-03    0.0434
.0000E+00 .3403E-02
    6  *      0.00  0.000  0.033  0.2527    0.2165 .2360E-01 .1621E-03    0.0595
.0000E+00 .3403E-02
    7         0.00  0.000  0.040  0.2497    0.1323 .1443E-01 .1033E-03    0.0764
.0000E+00 .3404E-02
    8         0.00  0.000  0.045  0.2467    0.0882 .9617E-02 .7147E-04    0.0940
.0000E+00 .3404E-02
    9         0.36  0.000  0.056  0.2627    0.1147 .1250E-01 .9072E-04    0.1087
.0000E+00 .3405E-02
   10  *      0.72  0.000  0.031  0.2628    0.1489 .1623E-01 .1151E-03    0.0718
.0000E+00 .3404E-02
   11         0.00  0.000  0.027  0.2671    0.1944 .2119E-01 .1469E-03    0.0180
.0000E+00 .2365E-02
   12  *      0.00  0.000  0.027  0.2671    0.1672 .1823E-01 .1280E-03    0.0003
.0000E+00 .1327E-03
   13  *      0.00  0.000  0.025  0.2673    0.1601 .1745E-01 .1230E-03    0.0003
.0000E+00 .1242E-03
   14  *      1.46  0.000  0.000  0.2675    0.1458 .1590E-01 .1129E-03    0.0002
.0000E+00 .1154E-03
   15  *      0.20  0.000  0.027  0.2670    0.2638 .2876E-01 .1943E-03    0.0003
.0000E+00 .1739E-03
   16  *      0.00  0.000  0.019  0.2660    0.3448 .3759E-01 .2486E-03    0.0005
.0000E+00 .2350E-03
   17  *      0.00  0.000  0.024  0.2649    0.3665 .3995E-01 .2629E-03    0.0005
.0000E+00 .2593E-03
   18  *      1.66  0.000  0.000  0.2638    0.3561 .3883E-01 .2561E-03    0.0005
.0000E+00 .2578E-03
   19  *      0.05  0.000  0.022  0.2629    0.3325 .3625E-01 .2404E-03    0.0005
.0000E+00 .2444E-03
   20  *  *   0.39  0.000  0.019  0.2613    0.2616 .2852E-01 .1928E-03    0.0005
.0000E+00 .2047E-03
   21  *  *   1.89  0.000  0.000  0.2604    0.1541 .1680E-01 .1187E-03    0.0003
.0000E+00 .1372E-03
   22  *  *   0.00  0.000  0.027  0.2598    0.0907 .9889E-02 .7325E-04    0.0002
.0000E+00 .8461E-04
   23     *   0.00  0.000  0.000  0.2595    0.0534 .5822E-02 .4530E-04    0.0001
.0000E+00 .5229E-04
   24     *   0.00  0.000  0.036  0.2593    0.0314 .3426E-02 .2809E-04    0.0001
.0000E+00 .3239E-04
   25     *   0.00  0.000  0.037  0.2592    0.0185 .2016E-02 .1746E-04    0.0000
.0000E+00 .2012E-04
   26     *   1.83  2.833  0.000  0.2796    0.0109 .1186E-02 .1088E-04    0.0000
.0000E+00 .1253E-04
   27     *   0.10  0.713  0.000  0.2921    0.0064 .6974E-03 .6807E-05    0.0000
.0000E+00 .7827E-05
   28     *   0.00  0.564  0.000  0.3011    0.0038 .4100E-03 .4273E-05    0.0000
.0000E+00 .4907E-05
   29     *   0.00  0.321  0.000  0.3080    0.0022 .2409E-03 .2694E-05    0.0000
.0000E+00 .3089E-05
   30     *   0.00  0.501  0.000  0.3140    0.0013 .1415E-03 .1707E-05    0.0000
.0000E+00 .1954E-05
   31     *   0.00  0.505  0.000  0.3192    0.0008 .8307E-04 .1089E-05    0.0000
.0000E+00 .1244E-05
   32     *   0.00  0.590  0.000  0.3238    0.0004 .4874E-04 .6997E-06    0.0000
.0000E+00 .7970E-06
   33     *   0.00  0.418  0.000  0.3278    0.0003 .2857E-04 .4540E-06    0.0000
.0000E+00 .5154E-06
   34         0.01  0.000  0.054  0.3136    3.8556 .2130     .2327E-02    0.0034
.0000E+00 .2227E-02
   35  *      0.00  0.000  0.042  0.2929    6.2149 .3326     .3733E-02    0.0009
.0000E+00 .6380E-03
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   36  *      0.00  0.000  0.045  0.2730    3.7281 .3178     .2287E-02    0.0043
.0000E+00 .2424E-02
   37  *      0.05  0.000  0.040  0.2609    2.1018 .2291     .1332E-02    0.0026
.0000E+00 .1274E-02
   38  *  *   0.70  0.000  0.031  0.2528    1.3545 .1477     .8823E-03    0.0012
.0000E+00 .2551E-02
   39  *  *   0.06  0.000  0.032  0.2480    0.7980 .8700E-01 .5393E-03    0.0018
.0000E+00 .1985E-02
   40  *  *   0.00  0.000  0.022  0.2452    0.4701 .5125E-01 .3305E-03    0.0007
.0000E+00 .3305E-03
   41  *  *   0.00  0.000  0.023  0.2436    0.2769 .3019E-01 .2031E-03    0.0004
.0000E+00 .2031E-03
   42  *  *   0.00  0.000  0.024  0.2426    0.1631 .1778E-01 .1250E-03    0.0003
.0000E+00 .1250E-03
   43  *  *   0.00  0.000  0.026  0.2420    0.0960 .1047E-01 .7714E-04    0.0002
.0000E+00 .7714E-04
   44  *  *   0.00  0.000  0.025  0.2417    0.0565 .6162E-02 .4770E-04    0.0001
.0000E+00 .4770E-04
   45  *  *   0.31  0.000  0.026  0.2415    0.0333 .3627E-02 .2956E-04    0.0001
.0000E+00 .2956E-04
   46  *  *   0.20  0.000  0.026  0.2413    0.0196 .2134E-02 .1837E-04    0.0000
.0000E+00 .1837E-04
   47  *  *   0.00  0.000  0.025  0.2413    0.0115 .1255E-02 .1145E-04    0.0000
.0000E+00 .1145E-04
   48  *  *   0.00  0.000  0.034  0.2412    0.0068 .7383E-03 .7158E-05    0.0000
.0000E+00 .7158E-05
   49     *   0.00  0.019  0.016  0.2492    0.0040 .4340E-03 .4491E-05    0.0000
.0000E+00 .4491E-05
   50     *   0.02  0.059  0.000  0.2599    0.0023 .2551E-03 .2830E-05    0.0000
.0000E+00 .2830E-05
   51     *   0.00  0.301  0.000  0.2741    0.0014 .1498E-03 .1793E-05    0.0000
.0000E+00 .1793E-05
   52     *   0.00  0.000  0.000  0.2741    0.0008 .8796E-04 .1142E-05    0.0000
.0000E+00 .1142E-05
   53     *   0.00  0.000  0.000  0.2741    0.0005 .5161E-04 .7334E-06    0.0000
.0000E+00 .7334E-06
   54     *   0.00  0.000  0.000  0.2741    0.0003 .3026E-04 .4753E-06    0.0000
.0000E+00 .4753E-06
   55     *   0.00  0.000  0.000  0.2741    0.0002 .1772E-04 .3117E-06    0.0000
.0000E+00 .3117E-06
   56     *   0.00  0.000  0.000  0.2741    0.0001 .1037E-04 .2075E-06    0.0000
.0000E+00 .2075E-06
   57     *   0.00  0.000  0.000  0.2741    0.0001 .6058E-05 .1409E-06    0.0000
.0000E+00 .1409E-06
   58     *   0.00  0.000  0.000  0.2741    0.0000 .3532E-05 .9793E-07    0.0000
.0000E+00 .9793E-07
   59     *   0.00  0.000  0.000  0.2741    0.0000 .2053E-05 .7010E-07    0.0000
.0000E+00 .7010E-07
   60  *  *   0.00  0.000  0.000  0.2741    0.0000 .1188E-05 .5191E-07    0.0000
.0000E+00 .5191E-07
   61  *  *   0.01  0.000  0.010  0.2741    0.0000 .6836E-06 .3988E-07    0.0000
.0000E+00 .3988E-07
   62     *   0.00  0.000  0.000  0.2741    0.0000 .3893E-06 .3173E-07    0.0000
.0000E+00 .3173E-07
   63     *   0.59  0.382  0.007  0.2851    0.0000 .2182E-06 .2585E-07    0.0000
.0000E+00 .2585E-07
   64         0.00  0.000  0.079  0.2742    1.1060 .1206     .7167E-03    0.0015
.0000E+00 .7167E-03
   65  *      0.00  0.000  0.057  0.2648    1.0400 .1134     .6901E-03    0.0014
.0000E+00 .6901E-03
   66         0.00  0.000  0.056  0.2560    0.9538 .1040     .6368E-03    0.0013
.0000E+00 .6368E-03
   67         0.00  0.000  0.075  0.2471    0.8140 .8874E-01 .5496E-03    0.0011
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.0000E+00	.5496E-03									
68	0.16	0.000	0.094	0.2468	0.6545	.7136E-01	.4491E-03	0.0009		
.0000E+00	.4491E-03									
69	0.01	0.000	0.116	0.2379	0.5067	.5524E-01	.3544E-03	0.0007		
.0000E+00	.3544E-03									
70	0.02	0.000	0.115	0.2304	0.3894	.4245E-01	.2780E-03	0.0006		
.0000E+00	.2780E-03									
71	0.00	0.000	0.098	0.2231	0.3234	.3526E-01	.2344E-03	0.0005		
.0000E+00	.2344E-03									
72	0.00	0.000	0.091	0.2165	0.2792	.3044E-01	.2047E-03	0.0004		
.0000E+00	.2047E-03									
73	0.00	0.000	0.085	0.2103	0.2561	.2792E-01	.1892E-03	0.0004		
.0000E+00	.1892E-03									
74	0.44	0.000	0.093	0.2279	0.2170	.2366E-01	.1625E-03	0.0003		
.0000E+00	.1625E-03									
75	0.00	0.000	0.121	0.2203	0.1745	.1902E-01	.1331E-03	0.0003		
.0000E+00	.1331E-03									
76	0.57	0.000	0.141	0.2429	0.1392	.1518E-01	.1083E-03	0.0002		
.0000E+00	.1083E-03									
77	0.00	0.000	0.094	0.2371	0.1096	.1195E-01	.8705E-04	0.0002		
.0000E+00	.8705E-04									
78	0.00	0.000	0.113	0.2304	0.0861	.9382E-02	.6988E-04	0.0001		
.0000E+00	.6988E-04									
79	0.00	0.000	0.083	0.2255	0.0690	.7519E-02	.5716E-04	0.0001		
.0000E+00	.5716E-04									
80	0.00	0.000	0.114	0.2189	0.0502	.5469E-02	.4280E-04	0.0001		
.0000E+00	.4280E-04									
81	0.09	0.000	0.074	0.2196	0.0235	.2558E-02	.2159E-04	0.0000		
.0000E+00	.2159E-04									
82	0.05	0.000	0.072	0.2184	0.0091	.9901E-03	.9248E-05	0.0000		
.0000E+00	.9248E-05									
83	0.00	0.000	0.075	0.2143	0.0096	.1048E-02	.9753E-05	0.0000		
.0000E+00	.9753E-05									
84	0.00	0.000	0.075	0.2101	0.0154	.1682E-02	.1486E-04	0.0000		
.0000E+00	.1486E-04									
85	0.06	0.000	0.069	0.2095	0.0135	.1470E-02	.1312E-04	0.0000		
.0000E+00	.1312E-04									
86	1.62	0.033	0.067	0.2925	0.0085	.9245E-03	.8700E-05	0.0000		
.0000E+00	.8700E-05									
87	0.69	0.000	0.094	0.3153	1.9747	.1778	.1231E-02	0.0026		
.0000E+00	.1231E-02									
88	0.00	0.000	0.084	0.2947	2.6691	.2910	.1668E-02	0.0035		
.0000E+00	.1668E-02									
89	0.00	0.000	0.119	0.2758	2.0666	.2253	.1311E-02	0.0027		
.0000E+00	.1311E-02									
90	0.00	0.000	0.104	0.2619	1.3789	.1503	.8974E-03	0.0019		
.0000E+00	.8974E-03									
91	0.00	0.000	0.116	0.2495	0.9956	.1085	.6626E-03	0.0014		
.0000E+00	.6626E-03									
92	0.00	0.000	0.093	0.2400	0.7299	.7957E-01	.4967E-03	0.0010		
.0000E+00	.4967E-03									
93	0.00	0.000	0.089	0.2318	0.5660	.6171E-01	.3926E-03	0.0008		
.0000E+00	.3926E-03									
94	0.04	0.000	0.102	0.2258	0.4354	.4746E-01	.3081E-03	0.0006		
.0000E+00	.3081E-03									
95	0.21	0.000	0.082	0.2306	0.3526	.3844E-01	.2538E-03	0.0005		
.0000E+00	.2538E-03									
96	0.00	0.000	0.100	0.2235	0.2782	.3033E-01	.2041E-03	0.0004		
.0000E+00	.2041E-03									
97	0.10	0.000	0.088	0.2229	0.2129	.2321E-01	.1596E-03	0.0003		
.0000E+00	.1596E-03									
98	0.04	0.000	0.106	0.2183	0.1618	.1764E-01	.1242E-03	0.0003		
.0000E+00	.1242E-03									

99	0.00	0.000	0.103	0.2120	0.1231	.1342E-01	.9680E-04	0.0002	.0000E+00	.9680E-04
100	0.00	0.000	0.138	0.2038	0.0953	.1039E-01	.7664E-04	0.0002	.0000E+00	.7664E-04
101	0.00	0.000	0.084	0.1989	0.0702	.7656E-02	.5808E-04	0.0001	.0000E+00	.5808E-04
102	0.12	0.000	0.082	0.2007	0.0511	.5566E-02	.4353E-04	0.0001	.0000E+00	.4353E-04
103	0.00	0.000	0.110	0.1944	0.0426	.4645E-02	.3697E-04	0.0001	.0000E+00	.3697E-04
104	0.00	0.000	0.110	0.1882	0.0315	.3439E-02	.2817E-04	0.0001	.0000E+00	.2817E-04
105	0.00	0.000	0.130	0.1810	0.0141	.1538E-02	.1356E-04	0.0000	.0000E+00	.1356E-04
106	0.00	0.000	0.139	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
107	0.00	0.000	0.083	0.1689	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
108	0.00	0.000	0.064	0.1654	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
109	0.00	0.000	0.054	0.1625	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
110	0.77	0.000	0.053	0.2017	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
111	0.47	0.000	0.115	0.2211	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
112	0.00	0.000	0.171	0.2118	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
113	0.00	0.000	0.162	0.2029	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
114	0.00	0.000	0.179	0.1932	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
115	0.00	0.000	0.134	0.1858	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
116	0.00	0.000	0.147	0.1778	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
117	0.00	0.000	0.085	0.1732	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
118	0.01	0.000	0.069	0.1699	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
119	0.00	0.000	0.056	0.1668	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
120	0.00	0.000	0.050	0.1641	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
121	0.00	0.000	0.047	0.1615	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
122	0.00	0.000	0.043	0.1592	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
123	0.00	0.000	0.040	0.1570	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
124	0.00	0.000	0.038	0.1550	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
125	0.42	0.000	0.040	0.1757	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
126	0.11	0.000	0.039	0.1796	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
127	0.03	0.000	0.039	0.1791	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
128	0.00	0.000	0.035	0.1772	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
129	0.32	0.000	0.041	0.1924	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
130	0.80	0.000	0.173	0.2267	0.0000	.0000E+00	.0000E+00	0.0000		

.0000E+00	.0000E+00								
131	0.00	0.000	0.155	0.2182	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
132	0.00	0.000	0.180	0.2084	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
133	0.00	0.000	0.210	0.1969	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
134	0.07	0.000	0.239	0.1877	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
135	0.73	0.000	0.184	0.2175	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
136	0.02	0.000	0.173	0.2091	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
137	0.68	0.000	0.167	0.2372	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
138	0.22	0.000	0.135	0.2418	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
139	0.08	0.000	0.115	0.2399	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
140	0.00	0.000	0.201	0.2289	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
141	0.00	0.000	0.217	0.2171	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
142	0.00	0.000	0.193	0.2065	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
143	0.00	0.000	0.200	0.1956	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
144	0.03	0.000	0.185	0.1871	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
145	2.45	0.206	0.259	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
146	0.00	0.000	0.223	0.2765	1.1438	.1247	.7397E-03	0.0015	
.0000E+00	.7397E-03								
147	0.00	0.000	0.203	0.2580	1.2370	.1349	.8108E-03	0.0017	
.0000E+00	.8108E-03								
148	0.00	0.000	0.227	0.2410	0.7713	.8409E-01	.5227E-03	0.0011	
.0000E+00	.5227E-03								
149	0.00	0.000	0.231	0.2249	0.5663	.6174E-01	.3928E-03	0.0008	
.0000E+00	.3928E-03								
150	0.04	0.000	0.143	0.2164	0.4764	.5194E-01	.3348E-03	0.0007	
.0000E+00	.3348E-03								
151	0.00	0.000	0.237	0.2011	0.4036	.4400E-01	.2874E-03	0.0006	
.0000E+00	.2874E-03								
152	0.01	0.000	0.114	0.1934	0.3208	.3498E-01	.2326E-03	0.0005	
.0000E+00	.2326E-03								
153	0.00	0.000	0.267	0.1774	0.2407	.2624E-01	.1787E-03	0.0004	
.0000E+00	.1787E-03								
154	0.00	0.000	0.220	0.1643	0.1750	.1908E-01	.1334E-03	0.0003	
.0000E+00	.1334E-03								
155	0.13	0.000	0.203	0.1600	0.0675	.6850E-02	.5091E-04	0.0001	
.0000E+00	.5091E-04								
156	0.00	0.000	0.175	0.1504	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
157	0.18	0.000	0.141	0.1526	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
158	0.00	0.000	0.181	0.1427	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
159	0.16	0.000	0.162	0.1426	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
160	0.37	0.000	0.113	0.1566	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								
161	0.01	0.000	0.082	0.1527	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00								

162	0.00	0.000	0.142	0.1449	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
163	0.00	0.000	0.167	0.1358	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
164	0.00	0.000	0.028	0.1343	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
165	0.06	0.000	0.032	0.1358	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
166	0.00	0.000	0.018	0.1348	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
167	0.00	0.000	0.013	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
168	0.00	0.000	0.003	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
169	0.08	0.000	0.030	0.1366	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
170	0.00	0.000	0.016	0.1357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
171	0.08	0.000	0.046	0.1376	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
172	0.00	0.000	0.023	0.1364	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
173	0.48	0.000	0.117	0.1562	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
174	0.00	0.000	0.118	0.1498	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
175	0.00	0.000	0.151	0.1415	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
176	0.00	0.000	0.121	0.1349	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
177	0.00	0.000	0.014	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
178	0.02	0.000	0.022	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
179	0.18	0.000	0.040	0.1417	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
180	0.00	0.000	0.094	0.1365	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
181	0.00	0.000	0.036	0.1345	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
182	0.00	0.000	0.009	0.1340	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
183	0.00	0.000	0.002	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
184	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
185	3.66	0.651	0.153	0.2900	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
186	0.01	0.000	0.193	0.2732	1.1303	.1232	.7216E-03	0.0015	.0000E+00
187	0.00	0.000	0.274	0.2458	2.0729	.2260	.1315E-02	0.0027	.0000E+00
188	0.00	0.000	0.230	0.2244	1.4793	.1613	.9583E-03	0.0020	.0000E+00
189	0.00	0.000	0.241	0.2051	1.0261	.1119	.6814E-03	0.0014	.0000E+00
190	0.00	0.000	0.221	0.1887	0.7057	.7694E-01	.4814E-03	0.0010	.0000E+00
191	0.00	0.000	0.294	0.1699	0.4570	.4983E-01	.3220E-03	0.0007	.0000E+00
192	0.04	0.000	0.239	0.1576	0.2447	.2668E-01	.1812E-03	0.0004	.0000E+00
193	0.00	0.000	0.172	0.1479	0.0528	.4270E-02	.3016E-04	0.0001	

.0000E+00	.3016E-04									
194	0.00	0.000	0.157	0.1393	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
195	0.00	0.000	0.100	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
196	0.06	0.000	0.039	0.1350	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
197	0.00	0.000	0.012	0.1343	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
198	0.06	0.000	0.044	0.1352	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
199	0.18	0.000	0.048	0.1424	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
200	0.00	0.000	0.098	0.1370	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
201	0.00	0.000	0.043	0.1347	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
202	0.00	0.000	0.011	0.1341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
203	0.00	0.000	0.003	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
204	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
205	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
206	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
207	0.10	0.000	0.043	0.1370	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
208	0.00	0.000	0.016	0.1361	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
209	0.25	0.000	0.101	0.1443	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
210	0.09	0.000	0.092	0.1442	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
211	0.00	0.000	0.126	0.1373	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
212	0.00	0.000	0.044	0.1348	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
213	0.82	0.000	0.105	0.1739	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
214	0.25	0.000	0.115	0.1813	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
215	0.00	0.000	0.173	0.1719	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
216	0.11	0.000	0.184	0.1678	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
217	0.02	0.000	0.175	0.1593	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
218	1.16	0.000	0.171	0.2134	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
219	0.80	0.000	0.159	0.2484	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
220	0.08	0.000	0.244	0.2395	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
221	0.00	0.000	0.188	0.2292	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
222	0.20	0.000	0.136	0.2328	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
223	0.14	0.000	0.185	0.2303	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
224	0.46	0.000	0.155	0.2469	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

225	0.00	0.000	0.179	0.2371	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
226	0.00	0.000	0.271	0.2223	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
227	0.00	0.000	0.263	0.2080	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
228	0.00	0.000	0.269	0.1933	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
229	0.00	0.000	0.221	0.1812	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
230	0.00	0.000	0.239	0.1681	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
231	0.00	0.000	0.199	0.1573	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
232	0.00	0.000	0.236	0.1443	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
233	0.00	0.000	0.192	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
234	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
235	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
236	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
237	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
238	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
239	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
240	0.06	0.000	0.038	0.1351	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
241	2.33	0.150	0.119	0.2477	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
242	0.00	0.000	0.174	0.2383	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
243	0.00	0.000	0.172	0.2289	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
244	0.43	0.000	0.201	0.2414	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
245	0.40	0.000	0.172	0.2538	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
246	0.00	0.000	0.193	0.2433	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
247	0.00	0.000	0.168	0.2341	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
248	0.00	0.000	0.158	0.2255	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
249	0.00	0.000	0.145	0.2175	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
250	0.00	0.000	0.124	0.2108	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
251	0.00	0.000	0.139	0.2032	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
252	0.03	0.000	0.114	0.1985	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
253	0.00	0.000	0.170	0.1892	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
254	0.00	0.000	0.149	0.1811	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
255	0.00	0.000	0.171	0.1718	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
256	0.30	0.000	0.150	0.1800	0.0000	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00									
257	0.00	0.000	0.145	0.1720	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
258	0.00	0.000	0.134	0.1647	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
259	0.06	0.000	0.104	0.1623	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
260	0.19	0.000	0.124	0.1659	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
261	0.00	0.000	0.132	0.1586	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
262	0.34	0.000	0.098	0.1718	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
263	0.21	0.000	0.105	0.1776	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
264	0.00	0.000	0.104	0.1719	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
265	0.00	0.000	0.137	0.1644	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
266	0.06	0.000	0.087	0.1629	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
267	0.00	0.000	0.105	0.1572	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
268	0.00	0.000	0.124	0.1504	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
269	0.00	0.000	0.115	0.1441	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
270	0.00	0.000	0.096	0.1388	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
271	0.00	0.000	0.088	0.1340	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
272	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
273	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
274	0.00	0.000	0.000	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
275	0.08	0.000	0.046	0.1357	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
276	0.00	0.000	0.009	0.1352	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
277	0.00	0.000	0.016	0.1343	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
278	0.08	0.000	0.047	0.1362	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
279	0.00	0.000	0.008	0.1357	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
280	0.09	0.000	0.050	0.1379	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
281	0.00	0.000	0.019	0.1369	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
282	0.00	0.000	0.022	0.1357	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
283	0.00	0.000	0.010	0.1351	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
284	0.00	0.000	0.011	0.1346	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
285	0.00	0.000	0.009	0.1341	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
286	0.00	0.000	0.004	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									
287	0.00	0.000	0.001	0.1339	0.0000	.0000E+00	.0000E+00	0.0000		
.0000E+00	.0000E+00									

288	0.06	0.000	0.035	0.1352	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
289	0.00	0.000	0.002	0.1351	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
290	0.40	0.000	0.054	0.1541	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
291	0.31	0.000	0.051	0.1682	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
292	0.00	0.000	0.022	0.1670	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
293	0.03	0.000	0.038	0.1666	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
294	0.00	0.000	0.017	0.1657	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
295	0.00	0.000	0.017	0.1648	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
296	0.00	0.000	0.015	0.1639	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
297	0.00	0.000	0.019	0.1629	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
298	0.00	0.000	0.019	0.1618	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
299	0.00	0.000	0.019	0.1608	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
300	0.00	0.000	0.033	0.1590	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
301	0.15	0.000	0.052	0.1644	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
302	0.00	0.000	0.024	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
303	0.00	0.000	0.027	0.1616	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
304	0.00	0.000	0.026	0.1601	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
305	0.00	0.000	0.038	0.1581	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
306	0.00	0.000	0.029	0.1565	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
307	0.00	0.000	0.035	0.1546	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
308	0.00	0.000	0.038	0.1525	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
309	0.00	0.000	0.034	0.1507	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
310	0.00	0.000	0.021	0.1495	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
311	0.00	0.000	0.020	0.1484	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
312	0.00	0.000	0.023	0.1471	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
313	0.00	0.000	0.027	0.1457	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
314	0.00	0.000	0.023	0.1444	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
315	0.00	0.000	0.018	0.1434	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
316	0.00	0.000	0.021	0.1423	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
317	0.00	0.000	0.027	0.1408	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
318	0.02	0.000	0.039	0.1397	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00
319	0.00	0.000	0.031	0.1380	0.0000	.0000E+00	.0000E+00	0.0000	

.0000E+00	.0000E+00									
320		0.09	0.000	0.053	0.1401	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
321		0.06	0.000	0.050	0.1406	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
322		0.15	0.000	0.057	0.1457	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
323		0.37	0.000	0.055	0.1629	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
324		0.00	0.000	0.029	0.1613	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
325		0.00	0.000	0.024	0.1600	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
326		0.00	0.000	0.018	0.1590	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
327		0.00	0.000	0.019	0.1580	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
328		0.10	0.000	0.047	0.1609	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
329		0.02	0.000	0.036	0.1600	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
330		0.00	0.000	0.024	0.1587	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
331		0.00	0.000	0.020	0.1576	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
332		0.86	0.000	0.047	0.2020	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
333		0.03	0.000	0.044	0.2012	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
334		0.49	0.000	0.056	0.2250	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
335		0.01	0.000	0.027	0.2241	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
336		0.00	0.000	0.017	0.2231	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
337		0.00	0.000	0.016	0.2223	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
338	*	0.11	0.000	0.033	0.2233	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
339		0.59	0.000	0.000	0.2587	0.0000	.0000E+00	.0000E+00	0.0000	
.0000E+00	.0000E+00									
340		0.41	0.000	0.048	0.2769	0.2628	.2865E-01	.1892E-03	0.0004	
.0000E+00	.1892E-03									
341		0.00	0.000	0.021	0.2738	0.3405	.3713E-01	.2458E-03	0.0005	
.0000E+00	.2458E-03									
342		0.00	0.000	0.017	0.2713	0.2643	.2881E-01	.1946E-03	0.0004	
.0000E+00	.1946E-03									
343		0.22	0.000	0.048	0.2781	0.4187	.4565E-01	.2971E-03	0.0006	
.0000E+00	.2971E-03									
344		1.91	0.263	0.049	0.3522	3.8403	.2406	.2335E-02	0.0034	
.0000E+00	.1663E-02									
345		0.00	0.000	0.022	0.3325	9.7083	.3329	.5761E-02	0.0023	
.0000E+00	.5549E-03									
346		0.00	0.000	0.018	0.3131	6.8376	.3327	.4094E-02	0.0014	
.0000E+00	.6624E-03									
347		0.00	0.000	0.024	0.2937	4.3732	.3283	.2663E-02	0.0032	
.0000E+00	.1609E-02									
348		0.00	0.000	0.028	0.2781	2.3469	.2559	.1477E-02	0.0035	
.0000E+00	.1457E-02									
349		0.00	0.000	0.025	0.2670	1.6274	.1774	.1048E-02	0.0022	
.0000E+00	.9551E-03									
350		0.00	0.000	0.019	0.2592	1.1303	.1232	.7456E-03	0.0016	
.0000E+00	.6984E-03									

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  351          0.06  0.000  0.042  0.2554    0.7953 .8671E-01 .5378E-03    0.0012
.0000E+00 .9878E-03
  352          0.02  0.000  0.037  0.2510    0.5766 .6286E-01 .3993E-03    0.0214
.0000E+00 .3402E-02
  353          0.00  0.000  0.019  0.2474    0.4301 .4689E-01 .3046E-03    0.0345
.0000E+00 .3402E-02
  354  *       0.00  0.000  0.017  0.2445    0.3227 .3517E-01 .2338E-03    0.0392
.0000E+00 .3403E-02
  355          0.28  0.000  0.041  0.2560    0.2575 .2807E-01 .1901E-03    0.0034
.0000E+00 .9474E-03
  356  *       0.23  0.000  0.023  0.2558    0.2147 .2341E-01 .1609E-03    0.0004
.0000E+00 .1682E-03
  357  *       0.00  0.000  0.029  0.2558    0.1827 .1992E-01 .1388E-03    0.0003
.0000E+00 .1444E-03
  358  *       0.00  0.000  0.032  0.2559    0.1679 .1831E-01 .1285E-03    0.0003
.0000E+00 .1311E-03
  359  *       1.22  0.000  0.000  0.2560    0.1503 .1638E-01 .1161E-03    0.0003
.0000E+00 .1192E-03
  360          0.36  0.000  0.000  0.2886    0.4055 .4421E-01 .2777E-03    0.0004
.0000E+00 .2373E-03
  361  *       0.00  0.000  0.028  0.2762    2.2527 .2456     .1421E-02    0.0018
.0000E+00 .1135E-02
  362          0.00  0.000  0.031  0.2690    1.3910 .1516     .9047E-03    0.0024
.0000E+00 .1034E-02
  363          0.00  0.000  0.000  0.2919    0.9537 .1040     .6367E-03    0.0016
.0000E+00 .7037E-03
  364          0.00  0.000  0.021  0.2923    0.8863 .9662E-01 .5947E-03    0.0013
.0000E+00 .6052E-03
  365          0.00  0.000  0.013  0.2997    0.9899 .1079     .6590E-03    0.0013
.0000E+00 .6430E-03

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                   MONTHLY TOTALS (IN INCHES) FOR YEAR 1978
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                                  JAN/JUL FEB/AUG MAR/SEP APR/OCT MAY/NOV JUN/DEC
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 PRECIPITATION                     8.90    1.35    4.31    1.76    6.00    1.76
                                   4.45    6.43    2.02    1.20    2.19    5.42

 RUNOFF                            5.438   1.387   0.415   0.000   0.206   0.000
                                   0.651   0.150   0.000   0.000   0.000   0.263

 EVAPOTRANSPIRATION                0.654   0.490   2.474   3.092   4.613   2.889
                                   3.009   4.560   3.758   0.719   1.004   0.745

 LATERAL DRAINAGE COLLECTED        0.6157  1.4519  1.6346  0.4536  0.5013  0.0872
   FROM LAYER  3                   0.7801  0.0000  0.0000  0.0000  0.0000  3.0188

 PERCOLATION/LEAKAGE THROUGH       0.0042  0.0120  0.0101  0.0030  0.0031  0.0006
   LAYER  4                        0.0047  0.0000  0.0000  0.0000  0.0000  0.0258

 PERCOLATION/LEAKAGE THROUGH       0.0302  0.0120  0.0101  0.0030  0.0031  0.0006
   LAYER  6                        0.0047  0.0000  0.0000  0.0000  0.0000  0.0256
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MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.182	0.686	0.495	0.139	0.148	0.027
TOP OF LAYER 4	0.231	0.000	0.000	0.000	0.000	1.327
STD. DEVIATION OF DAILY	0.153	1.509	0.700	0.247	0.340	0.078
HEAD ON TOP OF LAYER 4	0.514	0.000	0.000	0.000	0.000	2.172
AVERAGE DAILY HEAD ON	0.016	0.001	0.001	0.000	0.000	0.000
TOP OF LAYER 6	0.000	0.000	0.000	0.000	0.000	0.004
STD. DEVIATION OF DAILY	0.032	0.001	0.001	0.000	0.000	0.000
HEAD ON TOP OF LAYER 6	0.001	0.000	0.000	0.000	0.000	0.010

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ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	45.79	2669706.750	100.00
RUNOFF	8.510	496176.250	18.59
EVAPOTRANSPIRATION	28.007	1632904.250	61.16
DRAINAGE COLLECTED FROM LAYER 3	8.5431	498088.812	18.66
PERC./LEAKAGE THROUGH LAYER 4	0.063365	3694.378	0.14
AVG. HEAD ON TOP OF LAYER 4	0.2695		
PERC./LEAKAGE THROUGH LAYER 6	0.089272	5204.868	0.19
AVG. HEAD ON TOP OF LAYER 6	0.0019		
CHANGE IN WATER STORAGE	0.640	37331.285	1.40
SOIL WATER AT START OF YEAR	173.184	10097205.000	
SOIL WATER AT END OF YEAR	173.890	10138363.000	
SNOW WATER AT START OF YEAR	0.066	3826.876	0.14
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	1.335	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.59	1.88	4.09	3.03	3.85	4.50
	3.67	4.46	4.17	2.76	2.68	3.99
STD. DEVIATIONS	2.53	0.66	1.00	1.51	2.03	2.17
	1.95	2.49	2.07	1.21	2.63	1.78
RUNOFF						
TOTALS	1.600	0.910	0.408	0.054	0.049	0.035
	0.207	0.071	0.115	0.008	0.300	0.551
STD. DEVIATIONS	2.239	1.392	0.592	0.104	0.090	0.068
	0.298	0.068	0.254	0.010	0.591	0.659
EVAPOTRANSPIRATION						
TOTALS	0.745	0.951	2.308	3.013	4.271	4.047
	3.495	3.547	2.958	1.338	1.236	0.859
STD. DEVIATIONS	0.296	0.550	0.308	0.152	1.061	1.330
	1.313	1.606	1.134	0.383	0.180	0.105
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.8200	1.0364	1.8549	0.8864	0.1781	0.2822
	0.3871	0.1583	0.6607	0.8242	1.3537	1.8692
STD. DEVIATIONS	0.6903	0.8487	1.1226	0.8709	0.2127	0.5834
	0.5463	0.3342	0.9471	0.9969	1.5751	1.9436
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0052	0.0083	0.0164	0.0056	0.0011	0.0017
	0.0023	0.0010	0.0073	0.0052	0.0132	0.0169
STD. DEVIATIONS	0.0042	0.0076	0.0152	0.0055	0.0013	0.0036
	0.0033	0.0021	0.0124	0.0064	0.0186	0.0195
PERCOLATION/LEAKAGE THROUGH LAYER 6						
TOTALS	0.0104	0.0083	0.0096	0.0124	0.0011	0.0017
	0.0023	0.0010	0.0024	0.0101	0.0117	0.0131
STD. DEVIATIONS	0.0118	0.0076	0.0055	0.0141	0.0013	0.0036
	0.0033	0.0021	0.0033	0.0167	0.0156	0.0131

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.2426	0.4531	0.8393	0.2786	0.0528	0.0863
	0.1146	0.0469	0.3957	0.2532	0.7028	0.8700
STD. DEVIATIONS	0.2043	0.4274	0.8293	0.2775	0.0630	0.1784
	0.1618	0.0989	0.6930	0.3132	1.0153	1.0245

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.0036	0.0010	0.0006	0.0055	0.0001	0.0001
	0.0002	0.0001	0.0002	0.0030	0.0039	0.0027
STD. DEVIATIONS	0.0072	0.0015	0.0003	0.0114	0.0001	0.0002
	0.0002	0.0001	0.0002	0.0063	0.0077	0.0036

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES		CU. FEET	PERCENT
PRECIPITATION	43.67	(7.930)	2546103.2	100.00
RUNOFF	4.307	(3.6283)	251094.19	9.862
EVAPOTRANSPIRATION	28.766	(1.4128)	1677173.25	65.872
LATERAL DRAINAGE COLLECTED FROM LAYER 3	10.31122	(4.27759)	601177.562	23.61167
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.08431	(0.04519)	4915.305	0.19305
AVERAGE HEAD ON TOP OF LAYER 4	0.361	(0.200)		
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.08428	(0.03704)	4913.664	0.19299
AVERAGE HEAD ON TOP OF LAYER 6	0.002	(0.001)		
CHANGE IN WATER STORAGE	0.201	(0.3917)	11744.63	0.461

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PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	3.99	232629.953
RUNOFF	2.833	165148.7030
DRAINAGE COLLECTED FROM LAYER 3	0.33422	19486.29690

PERCOLATION/LEAKAGE THROUGH LAYER 4	0.008986	523.89026
AVERAGE HEAD ON TOP OF LAYER 4	15.190	
MAXIMUM HEAD ON TOP OF LAYER 4	24.747	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	75.2 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.003405	198.55032
AVERAGE HEAD ON TOP OF LAYER 6	0.140	
SNOW WATER	5.87	342395.0310

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3886
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1339

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	1.6945	0.2832
2	3.6972	0.3079
3	0.0902	0.3016
4	0.0000	0.0000
5	113.4746	0.3050
6	51.2736	0.4270
SNOW WATER	0.000	

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PURPOSE:

To assess the minimum geotextile specifications necessary to meet acceptable factors of safety. Three geotextile functions are applicable and will be evaluated. The applicable functions are filtration, separation, and puncture protection.

PROCEDURE:

The proposed cap system from top to bottom includes:

- six (6) inches of topsoil
- twelve (12) inches of cover soil
- non-woven geotextile (filtration and separation)
- geonet
- non-woven geotextile (puncture protection)
- geomembrane
- non-woven geotextile (puncture protection)

The primary function of the upper-most cap system geotextile is filtration and separation. The primary function of the geotextiles surrounding the geomembrane is puncture protection. Therefore, the following properties will be evaluated for the geotextile components:

A. Permittivity (Cross Plane Permeability)

B. Soil Retention (Apparent Opening Size, AOS)

C. Puncture Resistance

D. Burst Resistance

E. Tensile Strength

Reinforcement and drainage functions will not be evaluated since they are not applicable to the cap design.

Evaluation of geotextile properties listed above will be performed using the design by function method (Ref. 4). This method will use the required (design) property and a global factor of safety to determine the allowable (performance) property. Partial factors of safety will then be applied to the allowable property to adjust for site specific conditions and to determine the ultimate (laboratory-measured) property. The ultimate property will serve as the basis for determining geotextile specifications. The following is a summary generalizing the design by function equations:

i) allowable (performance) property = $FS_g \times$ required (design) property; where,

FS_g = global factor of safety

ii) ultimate (lab-measured) property = allowable (performance) property $\times FS_p$; where,

FS_p = sum of partial factors of safety

EVALUATION:

A. Permittivity (Cross-Plane Permeability)

1) Determine the **flow rate** through the cap system geotextile.

The required flow rate through the geotextile was determined using the Hydrologic Evaluation of Landfill Performance (HELP) Model. Calculation of the flow rate was performed for the Edge Moor Iron Rich Staging Area proposed cap configuration on the 5% slopes by TEC (Ref. 1).

From this analysis it was determined that approximately 2,463,638 $ft.^3$/year of precipitation is anticipated at the site. Of this, 7.452% is lost due to runoff and 67.81% to evapotranspiration. The remaining 24.80% will percolate through the soil cover. Assume that the geotextile will have to pass the entire percolation volume to the drainage layer below. Then the actual flow rate would be:

$$q = (2{,}463{,}638\ ft.^3/year)(0.248) / (365\ days/year)(24\ hours/day)(60\ min/hour)(60\ sec/min)$$

$$q = 0.0194\ ft.^3/sec$$

2) Calculate the **required permittivity** of the geotextile:

$$\psi_{req'd} = k/t = q/\Delta h\ A \qquad \text{(Ref. 4, p. 132, Eqn. 2.16)}$$

Where:

$\psi_{req'd}$ = Required Permittivity ($sec.^{-1}$/ft. Drain. Layer)

k = Permeability

t = Thickness of geotextile

q = Flow ($ft.^3$/sec.)

Δh = Thickness of Soil Cover

A = Cross-Sectional Area of Flow ($ft.^2$)

$$\psi_{req'd} = (0.0194\ ft.^3/sec.) / (18\ in.)(1\ ft./12\ in.)(1x1)$$

$$= 0.0129\ sec.^{-1}$$

3) Calculate the **allowable permittivity** of the upper cap system geotextile:

Assuming a Global Factor of Safety (FS_g) = 5.0 (Ref. 4, p. 266) for flow. The allowable permittivity would be:

$$\psi_{allow} = \psi_{req'd} \times 5.0$$

$$= 0.0645\ sec.^{-1}$$

4) Calculate **ultimate permittivity** (specified value) of the upper cap system geotextile:

$$\psi_{ult} = \psi_{allow} \times [FS_{IN} \times FS_{CR} \times FS_{CC} \times FS_{BC} \times FS_{SC}]$$ (Ref. 4, p. 159, Eqn. 2.25 modified)

Where:

FS_{IN} = Factor of Safety for intrusion into geotextile voids

FS_{CR} = Factor of Safety for creep reduction of voids

FS_{CC} = Factor of Safety for chemical clogging

FS_{BC} = Factor of Safety for biological clogging

FS_{SC} = Factor of Safety for soil clogging and binding

TABLE 2.13 RECOMMENDED PARTIAL FACTORS OF SAFETY VALUES FOR USE IN EQUATION 2.25 (Ref. 4, p. 160)

Various Partial Factors of Safety

Applications	Soil clogging & Binding	Creep reduction of voids	Intrusion into voids	Chemical clogging	Biological clogging
retaining wall filters	2.0 to 4.0	1.5 to 2.0	1.0 to 1.2	1.0 to 1.2	1.0 to 1.3
under drain filters	5.0 to 10.0	1.0 to 1.5	1.0 to 1.2	1.2 to 1.5	2.0 to 4.0
erosion control filters	**2.0 to 10.0**	**1.0 to 1.5**	**1.0 to 1.2**	**1.0 to 1.2**	**2.0 to 4.0**
landfill filters	5.0 to 10.0	1.5 to 2.0	1.0 to 1.2	1.2 to 1.5	2.0 to 50
gravity drainage	2.0 to 4.0	2.0 to 3.0	1.0 to 1.2	1.2 to 1.5	1.2 to 1.5
pressure drainage	2.0 to 3.0	2.0 to 3.0	1.0 to 1.2	1.1 to 1.3	1.1 to 1.3

From Table 2.13 (Ref. 4) partial factors of safety are selected for the geotextile based on an erosion control filter application. It is assumed that this application more closely represents the geotextile's function in a landfill cap situation than landfill filters used in primary and secondary leachate collection and removal systems.

a) FS for soil clogging and binding ($2.0 < FS_{SC} < 10.0$)

Conservatively, assume the geotextile has a high susceptibility to soil clogging. Therefore, a $FS_{SC} = 10.0$ is used.

b) FS for creep reduction of voids ($1.0 < FS_{CR} < 1.5$)

Assumed to be low for a geotextile in a capping situation. However, conservatively assume a $FS_{CR} = 1.2$.

c) FS for intrusion into voids ($1.0 < FS_{IN} < 1.2$)

Even though normal load will be low in the capping situation, a conservative $FS_{IN} = 1.2$ is used.

d) FS for chemical clogging ($1.0 < FS_{CC} < 1.2$)

Chemical clogging is not considered to be a concern in a capping system (i.e., no leachate encountered). Therefore, a $FS_{CC} = 1.0$ is used.

e) FS for biological clogging ($2.0 < FS_{BC} < 5.0$)

Biological clogging is not considered to be a concern in a capping situation (i.e., no leachate encountered). Therefore, a $FS_{BC} = 2.0$ is used.

Therefore, the **ultimate permittivity** for the cap system geotextile will be:

$$\psi_{ult} = 0.0645 \times [10.0 \times 1.2 \times 1.2 \times 1.0 \times 2.0]$$
$$= 1.86 \text{ sec}^{-1}$$

B. Soil Retention

Geotextile Standard, AASHTO M 288-96, recommends for soils with greater than 50 percent passing the No. 200 sieve, the Apparent Opening Size (AOS) of the geotextile should be greater than the No. 60 sieve. Typical cover soil to be brought on site should be similar to DelDOT specifications for Borrow Type C (Ref. 9) which contains less than 25% material passing No. 200 sieve. Since less than 50 percent passes the No. 200 sieve, using a minimum AOS for the geotextile of the No. 60 sieve will provide an additional factor of safety along with using a maximum AOS equivalent to the No. 100 sieve.

C. Puncture

It is anticipated that the cap system geotextile will be required to resist puncture during placement of the soil cover above the geotextile, since at all other times the load on the geotextile (due to weight of the cover soil) is minimal (< 2 lbs./in.^{2}).

The required puncture strength is given by:

$$F_{req'd} = p' d_a^2 S_1 S_2 S_3 \qquad \text{(Ref. 4, p. 165, Eqn. 2.30)}$$

Where:

$F_{req'd}$ = The required vertical force to be resisted

p' = The pressure exerted on the geotextile (approximately 100% of tire inflation pressure at the ground surface for small stone thickness)

d_a = The average diameter of the puncturing aggregate or sharp object

h_h = Protrusion height $\leq d_a$

S_1 = Protrusion factor = h_h/d_a

S_2 = Scale factor to adjust ASTM D 4833 test value using 5/16-in.-diameter puncture probe to actual puncturing object = $0.31/d_a$

S_3 = Shape factor to adjust flat puncture probe of ASTM D4833 to actual shape of puncturing object = 1 - A_p/A_c (values of A_p/A_c to be used range from 0.8 for Ottawa sand, 0.7 for run-of-bank gravel, 0.4 for crushed rock, and 0.3 for shot rock)

The load due to equipment during placement of the fill material to be 100 lb./in.^{2} (Ref. 4, p. 162). If a maximum allowable particle size of 3 inches is assumed for the cover soil material, then:

p' = Assume 100 lb./in.^{2}

d_a = 3 in.

h_h = Protrusion height of object; Assume $h_h = 3/4d_a$, thus h_h = 2.25 in.

S_1 = Protrusion factor = h_h/d_a = 2.25 in./3 in. = 0.75

S_2 = Scale factor per ASTM D 4833 = $0.31/d_a$; = 0.31/3 = 0.103

S_3 = For aggregate particles, the shape factor can be assumed to be (1.0-S), where S is the sphericity, S = A_p/A_c, where A_p is the projected area of the particle and A_c is the area of the smallest circumscribing circle around the particle; a typical value of S for crushed rock is 0.4 (Ref 3); thus, (1.0-S) = 1.0-0.4 = 0.6

$F_{req'd}$ = (100 lb./in.^{2})(3 in.)^2(0.75)(0.103)(0.6)

= 42 lbs.

Assuming a global factor of safety, FS_g= 3.0, then $F_{allow} = 42 \times 3.0 = 126$ lbs.

Assuming FS_g includes applicable partial factors of safety, then;

F_{ult} = F_{allow} = 126 lbs.

This value will be used for specification of the puncture strength that must be provided by the cap system geotextile. The geotextile will be required to provide sufficient puncture strength to be resistant to damage during installation. This value will be determined from the requirements of AASHTO M 288-96 for a high degree of survivability (see page 10 of 11).

D. Burst Resistance

It is anticipated that the geotextile will be required to provide resistance to burst during placement of the fill material, where the geotextile may be forced into the voids of the geonet by construction equipment loads. This may also occur if geotextile is used in the stabilization of cap access roadways where the geotextile may be forced into the voids of an overlying stone base.

The required burst strength is given by:

$T_{req'd}$ = $1/2\ p'\ d_v\ [f_{(\in)}]$ (Ref. 4, p. 160 Eqn 2.26)

Where:

$T_{req'd}$ = The required fabric strength

p' = The stress at the fabric's surface ≤ p, the tire inflation pressure

d_v = The maximum void diameter ≅ 0.33 d_a

d_a = The average stone diameter

$f_{(\in)}$ = The strain function of the deformed geotextile

This situation is analogous to the ASTM D 3786 (Mullen) burst test (Ref. 4). Thus, the adapted form of the above equation becomes;

T_{ult} = $1/2\ p_{test}\ d_{test}\ [f_{(\in)}]$ (Ref. 4, p. 161 Eqn 2.27)

Where:

T_{ult} = The ultimate fabric strength (lb/in)

p_{test} = The burst test pressure

d_{test} = The diameter of the burst test device (= 1.2 in)

$f_{(\in)}$ = The strain function of the deformed geotextile

Knowing that $T_{allow} = T_{ult} /(FS_p)$, we can formulate an expression for the global factor of safety (FS_g) as;

FS_g = $T_{allow}/T_{req'd}$

Therefore,

FS_g = $[1/2\ p_{test}\ d_{test}\ [f_{(\in)}] /FS_p] / 1/2\ p'\ d_v\ [f_{(\in)}]$

FS_g = $p_{test}\ d_{test} / FS_p\ p'\ d_v$

Solving for p_{test} = ultimate burst strength (lb/in^2)

p_{test} = $(FS_g)(FS_p)\ p'\ d_v / d_{test}$

Assuming a load due to equipment during placement of the cover soil of 100 lb/in^2 , then:

p_{test} = burst test pressure = ultimate burst strength (lb/in^2)

d_{test} = 1.2 in.

FS_p = Assume a partial factor of safety of 1.5 (Ref. 4, p. 162)

FS_g = Assume a global factor of safety of 2.0 (Ref. 4, p. 162)

p' = 100 lb/in^2

d_a = assume a maximum diameter particle size of 3.0 inches, then;

d_v = $0.33\ d_a = (0.33)(3\text{ in.}) = 1.0\text{ in.}$

Thus,

p_{test} = $(1.5)(100\text{ lb/in}^2)(1.0\text{ in.})(2.0) / 1.2\text{ in.}$

= 250 lb/in^2

This value will be used for specification of burst strength in the cap system geotextile.

E. Tensile Strength

1) Tensile stress induced by cover soil deformation

Tensile stress can also be induced in the geotextile by in-plane deformation. This phenomenon occurs when the geotextile is locked in place by the stone base above it and the soil sub-base below it. An in-plane deformation occurs when an upper piece of aggregate is forced between two lower pieces of aggregate against the geotextile (Ref. 4). This causes the stones to slide along the geotextile interface in opposite directions and creates tension. In particular, this may occur if the geotextile is used in the stabilization of cap access roadways.

The required tensile strength is given by:

$T_{req'd}$ = $p'\ d_v^{\ 2}[f_{(\in)}]$ (Ref. 4, p. 164 Eqn 2.29)

Where:

$T_{req'd}$ = The required fabric strength

p' = The stress at the fabric's surface ≤ p, the tire inflation pressure

d_v = The maximum void diameter ≅ $0.33\ d_a$

d_a = The average stone diameter

$f_{(\in)}$ = The strain function of the deformed geotextile

Assume load due to equipment during placement of the soil cover is 100 lbs./in.^{2} (Ref. 3).

p' = 100 lb/in^2

$f_{(\in)}$ = the strain function of the deformed textile = $1/4\ (2y/b + b/2y)$

y = deformation into the opening (or void).

b = width of opening (or void).

d_a = assume max. particle size for the cover soil material has an average diameter of 3.0 in.

d_v = (0.33) (3.0 in)

= 1.0 in

If a maximum allowable strain of 33% is assumed, then 2y/b = 1.33 and $f_{(\in)}$ = 1/4 (1.33 + 0.75) thus; $f_{(\in)}$ = 0.52

Assuming a global factor of safety of 3.0 (Ref. 3, p. 128):

$$T_{req'd} = (100\ lb/in^2)(1.0\ in)^2\ (0.52)$$
$$= 52\ lbs.$$
$$T_{allow} = T_{req'd} \times FS_g;$$
$$= (52\ lbs.)(3.0) = 156\ lbs.$$

Assuming the global factor of safety includes the applicable partial factors of safety:

$$T_{ult} = T_{allow} = 156\ lbs.$$

2) Tensile Stress Induced by the Geonet

It is anticipated that the geotextile will be required to provide resistance to tensile stress induced by intrusion of the geotextile into the apertures of the geonet.

The tensile stress induced by intrusion is given by the following equations:

$$y_{max.} = W(3\sigma_v W / 64EA)^{1/3} \qquad \text{(Ref. 5, p. 37, Eqn 2.5)}$$
$$\sigma_T t = (\sigma_v W^2 / 8y_{max.}) \qquad \text{(Ref. 5, p. 37, Eqn 2.6)}$$

Where:

$y_{max.}$ = Maximum allowable deformation (intrusion) of the geotextile into the apertures of the geonet (inches)

W = Width between adjacent ribs (inches)

σ_v = Applied vertical stress (lb./in.^{2})

E = Modulus of elasticity of the geotextile (lb./in.^{2})

A = Area of the geotextile cross-section = t x 1

σ_T = Tensile stress in the geotextile (lb./in.^{2})

t = Thickness of geotextile (inches)

Assume load due to equipment during placement of the soil cover is 100 lb./in.^{2}.

$$\sigma_V = 100\ lb./in.^2$$

Choose W = 0.4 in. (typical spacing for geonet ribs, Ref. 5)

Assuming a needle-punched, non-woven geotextile will be specified, the following minimum properties are determined from Ref. 6:

Thickness (mils)	110
Modulus (lb./in.^{2})	1423

For the needle-punched, non-woven, the required tensile stress is:

$$A = 0.110 \times 1 = 0.110 \text{ in}^2$$

$$y_{max.} = 0.4[3(100)(0.4)/64(1423)(0.110)]^{1/3}$$

$$= 0.091 \text{ in.}$$

$$\sigma_T = (100)(0.4)^2/8\ (0.091)(0.110)$$

$$= 200 \text{ lb./in.}^2$$

$$T_{req'd} = \sigma_T\ (\text{width} \times t)$$

Assuming an 8 inch wide test sample and a $FS_g = 1.0$:

$$T_{ult} = (200)(8)(0.110) = 176 \text{ lbs.}$$

Since the above calculated value for tensile strength is greater than that induced by cover soil deformation, it will be used for specification of tensile strength in the cap system geotextile.

CONCLUSIONS:

According to Reference 5, a non-woven geotextile is customarily used for filtration in those situations where the soil particles above the geotextile are sands, silts, or clays. According to Reference 3, a needle-punched non-woven geotextile is the most likely choice for protection against puncture when providing separation. Since a non-woven geotextile is recommended for both functions evaluated, a needle-punched non-woven geotextile will be specified.

Based on the previous calculations the following minimum specifications should be required for each geotextile:

Property	Geotextile
Permittivity	1.86 sec^{-1}
Soil Retention, AOS	Sieve No. 60 (min.), No. 100 (max.)
Puncture Strength	126 lbs.
Burst Strength	250 lb/in^2
Grab Tensile Strength	176 lbs.

Based on the anticipated installation conditions, it is recommended that the required degree of survivability, by AASHTO M 288-96, be high (Ref. 9). Therefore, for a high degree of survivability the following minimum specifications are recommended:

PROPERTY	TEST VALUE
Grab Strength	200 lbs
Puncture Strength	80 lbs
Burst Strength	250 psi
Trapezoidal Tear Strength	80 lbs

The more conservative of the calculated minimum specification requirements and the survivability minimum specification requirements should be chosen. The following table summarizes the properties and test values to be specified:

PROPERTY	TEST VALUE
Apparent Opening Size, AOS	U.S. standard sieve No. 60 (min.), No. 100 (max.)
Permittivity	1.86 sec^{-1}
Grab Strength	200 lbs
Puncture Strength	126 lbs
Trapezoidal Tear Strength	80 lbs
Burst Strength	250 psi
Ultraviolet Degradation at 150 hours	70% strength retained

REFERENCES:

1. HELP Analysis calculation for the Hay Road Landfill Sludge Drying Site (DE-0024), performed by TEC, URS, 2/5/03.

2. Koerner, Robert M., “Durability and Aging of Geosynthetics,” 1989.

3. Koerner, Robert M., “Designing with Geosynthetics, 2nd edition,” 1990.

4. Koerner, Robert M., “Designing with Geosynthetics, 3rd edition,” 1994.

5. Hwu, Bao-Lin, "Design, Evaluation, and Behavior of Geosynthetic Drainage Systems," August 1990.

6. Wide-Width tensile test data provided by Hoechst Celanese Corporation, Tech Note 005, February 22, 1996.

7. Cap Stability calculation for the Hay Road Landfill Sludge Drying Site (DE-0024), performed by EEB, URS, 2/3/03.

8. AASHTO, *Standard Specification for Geotextiles*, M 288-96, February 2, 1995.

9. The State of Delaware Department of Transportation, *Standard Specifications*, January 1998.

PURPOSE:

To assess the quantity of precipitation that percolates through the proposed cap system, as well as the volume of flow from the cap drainage layer, using the Hydrologic Evaluation of Landfill Performance (HELP) model, version 3.01, developed by the United States Army Corp of Engineers (USACOE) for the U.S. Environmental Protection Agency (USEPA) (Ref. 1).

PROCEDURE:

The proposed cap configuration will be evaluated using the HELP model. The components of the cap system and corresponding assumptions used for the HELP model are described below:

GENERAL:

- Good grass cover
- Estimated total cap area = 16 acres
- Minimum surface/drainage layer slope = 4%
- Maximum surface/drainage layer slope length = 385 feet
- Default climatological data for Wilmington, Delaware (supplied by program)
- Thorough construction QA/QC during installation

CAP CONFIGURATION:

- 6" Topsoil (*assume HELP soil texture #10, k= 2.7x10^{-6} cm/sec)*
- 12" Soil Cover *(assume HELP soil texture #10, k= 2.7x10^{-6} cm/sec*)
- Geotextile (not part of HELP model)
- Geonet *(assume HELP geosynthetic type #20* [Drainage Net], *k=10 cm/sec)*
- Geomembrane *(assume HELP geosynthetic type #36, k=4x10^{-13} cm/sec, 0.5 manufacturing pinholes/acre, good installation quality, 2 installation defects/acre [typical values listed in HELP user's guide])*
- Geotextile (not part of HELP model)
- 12" Soil Barrier Material *(assume HELP soil texture #14, k=2.5x10^{-5}cm/sec)*

EVALUATION:

Using the cap system components, the HELP model was run to determine average annual runoff, evapotranspiration, lateral drainage, and percolation or leakage over 5 years. Computer-generated output is attached to this calculation.

It should be noted that the HELP model is a "quasi-two-dimensional hydrologic model of water movement across, into, through, and out of landfills" (Ref. 1). The primary purpose of the HELP model is "to assist in the comparison of design alternatives as judged by their water balances" (Ref. 1).

CONCLUSIONS:

The following table summarizes the results of the HELP analysis:

Average Annual Totals*	Percent
Precipitation	100.00
Runoff	7.452
Evapotranspiration	67.81
Lateral Drainage from Layer 3	24.80
Percolation/Leakage Through	**0.0020**
Change in Water Storage	-0.065
Infiltration Reduction(%)	99.99

* Totals may not add up to 100 percent due to rounding and to water storage capacity of some cap components

Lateral drainage data developed using the HELP analysis will be used to calculate transmissivity of the geonet component of the drainage layer and permittivity for the geotextile portion of the drainage layer.

REFERENCES:

1. Schroeder, P. R., Dozier, T. S., Zappi, P. A., McEnroe, B. M., Sjostrom, J. W., and Peyton, R. Ll (1994). "The Hydrologic Evaluation of Landfill Performance (HELP) Model: Engineering Documentation for Version 3,' EPA/600/R-94/168b, September 1994, U.S. Environmental Protection Agency Office of research and Development, Washington, D.C.

2. Koerner, Jamie R., Soong, Te-Yang, and Koerner, Robert M., "A Survey of Solid Waste Landfill Liner and Cover Regulations: Part I - USA Status," Geosynthetic Research Institute Report #21, December, 1998.

Purpose: To estimate the primary settlement that may occur due to the maximum amount of fill and cover soil over the deepest thickness of Staged Iron Rich Material (Staged IRM), and over the staging area perimeter, during the first month after cap placement.

Methodology: According to Ref. 1, primary mechanical settlement typically occurs rapidly and is "complete in less than 1 month." Ref. 1, p. 15, provides the following equation to estimate the amount of settlement that will occur during the first month:

$$S = \frac{H \times C_c}{(1+e_o)} \times \log \frac{\sigma_o' + \Delta\sigma}{\sigma_o'}$$, where:

S = Settlement (feet),

H = Initial thickness of Staged IRM (feet),

C_C = Compression index = $0.15e_O$ for low organic matter fills, or
= $0.55e_O$ for high organic matter fills,

σ_O' = Stress at midpoint of Staged IRM layer (psf),

$\Delta\sigma$ = Additional stress due to cover material (psf),

e_O = Initial void ratio.

Introduction:

After completion of the consolidation operations and final regrading the Staged IRM will range in thickness from 2 to 37 feet (Ref.5). Primary settlement calculations presented here evaluate settlement at the center of the staging area which is the location of anticipated maximum Staged IRM thickness.

A – Center of Staging Area

Parameters:

H The maximum Staged IRM thickness would be approximately **37 feet**. This depth may change slightly due to final regrading expected at the site.

C_C The site was used for the staging of iron rich material. Staged IRM is a byproduct of titanium dioxide. Assume Staged IRM contains a low organic content $\mathbf{0.15e_O}$.

σ_O' Equals the average overburden stress within the Staged IRM layer, or $\frac{1}{2}\gamma H$. According to Ref. 4, the Staged IRM has been tested to have a density ranging from **45 pcf to 55 pcf**.

$\Delta\sigma$ Equals the incremental increase in stress (loading) due to fill placement. Assume a compacted unit weight of **110 pcf** for the cover soil material. The maximum thickness of

the cover will be approximately 6 inches of topsoil plus 12 inches of cover soil for a total cover of **1.5 feet** (the thickness of the geosynthetics is considered negligible).

e_o According to Ref. 1, void ratios typically vary from 15 (uncompacted) to 2 (well compacted). Assume an initial void ratio of **7.5** (based on anticipated regrading operations). Also check for values of 5 and 12.

Calculations:

From the equation on page 1,

For unit weight of Staged IRM = 45 pcf:

$$S = \frac{37\,feet \times (0.15 \times 7.5)}{(1+7.5)} \times \log \frac{(45\,pcf \times 18.5\,feet) + (110\,pcf \times 1.5\,feet)}{(45\,pcf \times 18.5\,feet)} = \mathbf{0.39\ feet},$$

For unit weight of Staged IRM = 55 pcf:

$$S = \frac{37\,feet \times (0.15 \times 7.5)}{(1+7.5)} \times \log \frac{(55\,pcf \times 18.5\,feet) + (110\,pcf \times 1.5\,feet)}{(55\,pcf \times 18.5\,feet)} = \mathbf{0.32\ feet}.$$

Assuming an initial void ratio of 7.5 and a low iron rich density, estimated to be conservative, the primary settlement during the first month in the center of the staging area is estimated to be between 0.32 and 0.39 feet and should occur during the time period that regrading of Staged IRM occurs.

To analyze the effect of variation in void ratio, assume above average stabilized material density (i.e. 55 pcf) and:

For initial void ratio of 5:

$$S = \frac{37\,feet \times (0.15 \times 5)}{(1+5)} \times \log \frac{(55\,pcf \times 18.5eet) + (110\,pcf \times 1.5\,feet)}{(55\,pcf \times 18.5\,feet)} = \mathbf{0.30\ feet},$$

For initial void ratio of 7.5:

$$S = \frac{37\,feet \times (0.15 \times 7.5)}{(1+7.5)} \times \log \frac{(55\,pcf \times 18.5\,feet) + (110\,pcf \times 1.5\,feet)}{(55\,pcf \times 18.5\,feet)} = \mathbf{0.32\ feet}.$$

For initial void ratio of 12:

$$S = \frac{37\,feet \times (0.15 \times 12)}{(1+12)} \times \log \frac{(55\,pcf \times 18.5\,feet) + (110\,pcf \times 1.5\,feet)}{(55\,pcf \times 18.5\,feet)} = \mathbf{0.33\ feet}.$$

Based on the above analysis, varying the initial void ratio produces relatively insignificant changes in estimated primary settlements.

Conclusion:

The primary settlement of Staged IRMs expected during the first month for the center of the cap system is estimated to be in the range of approximately 0.32 - 0.39 feet. This settlement should occur during the time period it will take to recompact the Staged IRM during cap construction. Note that primary settlement of fill and cap system soils would likely be negligible due to the use of a controlled compaction effort.

References:

1. Landva and Knowles, ed., "Settlement and Engineering Considerations in Landfill and Final Covers," Geotechnics of Waste Fills Theory and Practice, ASTM Std. 1070.
2. Haausmann, Manfred R., "Engineering Principles of Ground Modification", McGraw-Hill Publishing Company, New York, 1990.
3. Das, Braja M., *Principles of Geotechnical Engineering*, Third Edition, PWS Publishing Company, Boston, 1994.
4. Cherry Island Landfill – Iron Rich Pile Cap Design, *Laboratory Testing Data Summary*, URS Geotechnical Laboratory, Totowa, New Jersey, March 8, 2002.
5. "EdgeMoor Facility Topographic Plan", Drawing CELL 4ASB, URS Corporation, February 4, 2003.

Purpose: To estimate the range of secondary settlement of the iron rich staging area which may occur after cap system construction during a 30-year post-construction period.

Methodology: It is conservatively assumed that the site has not undergone secondary settlement.

The primary settlement of the site has been estimated in Ref. 1. Primary and secondary settlement of the fill and cap material is assumed to be negligible, because these soils will be specified to be compacted to 90% maximum standard proctor density. Thus, this calculation will consider only the anticipated secondary settlement of the iron rich material below the cap system.

The secondary settlement of the iron rich material due to decomposition can be estimated by the following equation (Ref. 2):

$$\Delta H = \frac{\alpha \times H_f \times \log(t_2/t_1)}{1+e_o}$$, where:

α = Settlement coefficient = $0.03e_o$ for unfavorable decay conditions,
$0.09e_o$ for favorable decay conditions,

e_o = Initial void ratio,

H_f = Height of fill (feet),

t_1 ,t_2 = Time at beginning and end of settlement period (months).

Secondary settlement of the iron rich staging area will be estimated based on the maximum anticipated thickness of iron rich material present in the center of the staging area. After reviewing past and present information available it is assumed that this area is the location of the thickest iron rich material (Ref.3). The iron rich material thickness is conservatively estimated to be **37 feet**.

Introduction:

Based on a review of the past and present site topography the area of anticipated maximum iron rich thickness is found in the center of the staging area. Secondary settlement calculations presented here evaluate settlement at this anticipated maximum iron rich material thickness location.

Parameters:

α — The site was used for the staging of iron rich material which is a byproduct of titanium dioxide. Assume little organic material, thus conditions unfavorable to decay (**0.03*e_o**)

e_o — According to Ref. 2, initial void ratios typically range from 15 (uncompacted) to 2 (well compacted). Assume initial void ratio of **7.5**, but also check for values of 5 and 12.

H_f — A review of the past and present topography finds a maximum depth of **37 feet** (Ref. 3) which is considered the maximum for the site.

t_1 ,t_2 — The regrading operations were completed at the end of the July 2002 (t=0). t_1 will be the point at which cap construction and the corresponding primary settlement is complete - assume the end of October 2003 (t = **15 months**). t_2 will be at the end of the 30-year post-construction period (t = **375 months)**.

Calculations:

For Center of Staging Area (37 feet of waste):

$$\Delta H = \frac{0.03 \times 7.5 \times 37\ feet \times \log(375/15)}{1+7.5} = 1.37\ feet$$

Replacing the initial void ratio with 5 and 12 yields settlements of 1.29 and 1.43 feet, respectively. It is thus assumed that the void ratio has little significant effect on the amount of settlement.

For Perimeter of Staging Area (2 feet of waste):

$$\Delta H = \frac{0.03 \times 7.5 \times 2\ feet \times \log(375/15)}{1+7.5} = 0.07\ feet$$

Replacing the initial void ratio with 5 and 12 yields settlements of 0.07 and 0.08 feet, respectively. It is thus assumed that the void ratio has little significant effect on the amount of settlement.

Conclusions:

Based on the above calculations, it is estimated that the Iron Rich Staging Area will undergo secondary settlement in the range of approximately 0.07 to 1.43 feet. Therefore, the overall settlement from the center of the landfill to the perimeter would be 1.36 feet (i.e., 1.43-0.07 = 1.36'). Based on this settlement differential it is estimated that the cap system grade may be reduced 0.27% (i.e., 1.36 ft./ 500 ft.) over the 30 year post-construction period.

Due to the minor differential settlement estimated, tension cracking may occur on the cap cover soil surface, and periodic maintenance may be required.

References:

1. "Primary Settlement for the Hay Road Landfill Sludge Drying Site (DE-0024)," calc. by TEC, 2/6/03.
2. "Settlement of Waste Disposal Fills," G.F. Sowers, Proceedings of the 8th International Conference on Soil Mechanics and Foundation Engineers, 1973.
3. "EdgeMoor Facility Topographic Plan", Drawing CELL 4ASB, URS Corporation, February 4, 2003.

PURPOSE:

To assess the minimum specifications necessary to meet acceptable factors of safety for geotextile utilized on the cap access roadway. Geotextile used in roads generally serves two purposes; separation and reinforcement. However, in order for the geotextile to act as reinforcement the tensile strength of the geotextile must be mobilized by sufficient deformation of the underlying subsoil [Ref. 1]. For the purpose of this calculation it is assumed that the roadway subgrade will be constructed of well-graded, granular select fill that has been placed and adequately compacted to minimize deformation (CBR > 10). Therefore, only properties associated with the separation function will be evaluated. According to Reference 1, a needle-punched non-woven geotextile is the most likely choice for protection against puncture when providing separation.

PROCEDURE:

The following properties will be evaluated for the geotextile:

- Burst Resistance
- Tensile Strength
- Puncture Resistance
- Tear Resistance

Evaluation of geotextile properties listed above will be performed using the design by function method [Ref. 1]. This method consists of calculating the required numerical value of a particular property and applying a factor of safety to obtain the allowable property for the primary function of the geotextile.

$$\text{Allowable property} = \text{required property} \times \text{FS}$$

Where,

Allowable property	=	a numeric value based on laboratory test results (ultimate value) adjusted by reduction factors that simulate site-specific considerations (i.e., Allowable property = Ultimate property/ΠRF)
Required property	=	a numeric value obtained from a design method that models the actual situation
FS	=	factor of safety against unknown loads and/or uncertainties in the analytic or testing process
ΠRF	=	product of applicable reduction factors

The following procedure will be used to evaluate each geotextile property.

1. Determine appropriate factor of safety and reduction factors for the property based on the primary function
2. Calculate required property value

3. Calculate allowable property value by applying factor of safety to the calculated required property value
4. Calculate ultimate property value (i.e., specified value) by applying reduction factors to the calculated allowable property value.
5. If applicable, compare the calculated allowable property value to recommended minimum property for installation survivability. The more conservative value will govern as the basis for the property specification.
6. Compare the specified property value to commercial product data to verify that a product meeting the specified property value is readily available.

EVALUATION OF DESIGN PROPERTIES:

A. Burst Resistance

It is anticipated that the geotextile used in the stabilization of cap access roadways will be required to provide resistance to burst as construction equipment loads force the geotextile into the voids of an overlying stone base.

1. Determine Appropriate Factor of Safety (FS) and Reduction Factors (ΠRF)

$FS = 2$ [Ref. 1, pg.153]

$\Pi RF = RF_{ID} \times RF_{CR} \times RF_{CD} \times RF_{BD}$ [Ref. 1, pg.147]

where,

RF_{ID} = reduction factor for installation damage
RF_{CR} = reduction factor for creep
RF_{CD} = reduction factor for chemical degradation
RF_{BD} = reduction factor for biological degradation

From Table 2.11 [Ref. 1, pg. 149] the following reduction factors will be assumed.

RF_{ID} = 1.5
RF_{CR} = not an issue for separation application
RF_{CD} = 1
RF_{BD} = 1

$\Pi RF = 1.5 \times 1 \times 1$

$= 1.5$

2. Calculate Required Burst Strength

The required burst strength is given by:

$T_{req'd} = 1/2\ p'\ d_v\ [f(\in)]$ [Ref. 1, p151 Eqn 2.26]

where:

$T_{req'd}$ = The required fabric burst strength
p' = The stress at the fabric's surface ≤ p, the tire inflation pressure
d_v = The maximum void diameter ≅ 0.33 d_a
d_a = The average stone diameter
$f(\in)$ = The strain function of the deformed geotextile

3. Calculate Allowable Burst Strength

$$T_{allow} = T_{req'd} \times FS$$
$$= 1/2\ p'\ d_v\ [f(\in)] \times FS$$

4. Calculate Ultimate Burst Strength

The field situation is analogous to the ASTM D3786 (Mullen) burst test [Ref. 1, pg. 152]. Thus, the adapted form of the above equation becomes;

$$T_{ult} = 1/2\ p_{test}\ d_{test}\ [f(\in)] \qquad \text{[Ref. 1, p152 Eqn 2.27]}$$

where:

T_{ult} = The ultimate fabric strength (lb/in)
p_{test} = The burst test pressure
d_{test} = The diameter of the burst test device (= 1.2 in)
$f(\in)$ = The strain function of the deformed geotextile

Knowing that $T_{allow} = T_{ult} / \Pi RF$ and substituting into the design by function equation:

$$T_{ult} / \Pi RF = 1/2\ p' \times (0.33d_a) \times [f(\in)] \times FS$$

$$1/2\ p_{test}\ d_{test}\ [f(\in)] / \Pi RF = 1/2\ p' \times (0.33d_a) \times [f(\in)] \times FS$$

$$p_{test} = \frac{p' \times (0.33d_a) \times FS \times \Pi RF}{d_{test}}$$

$$p_{test} = \frac{p' \times (0.33d_a) \times 2 \times 1.5}{1.2}$$

$$p_{test} = 0.825\ p'\ d_a$$

Assuming:

$p' \leq p$, the tire inflation pressure = 100 psi

d_a = 1 ½ in. based on maximum stone size for Delaware #57 stone and crusher run [Ref. 2] typically used in local temporary road construction

Then, the ultimate burst strength is given by:

$p_{test} = 0.825 \times 100 \times 1.5$

$p_{test} = 123.75$ psi (853 kPa)

5. Compare Calculated Value to Recommended Minimum Property for Installation Survivability

From Table 2.22 [Ref. 1, pg. 293] the required degree of survivability is "High" for equipment with ground pressure > 7.25 psi (50 kPa) operating on a 6-inch to 12-inch lift thickness and a subgrade that has been cleared of all obstacles and is smooth and level. This translates to a Class 2 requirement [Ref. 1, pg. 292]. These conditions are reasonably expected for an access road on a prepared surface such as a landfill cap.

From Table 2.2a [Ref. 1, pg. 72] the recommended minimum burst strength for installation survivability is 189 psi (1,300 kPa) for a nonwoven geotextile.

The recommended minimum burst strength for installation survivability is more conservative than the required burst resistance due to traffic load. Therefore, the recommended minimum burst strength for installation survivability governs.

6. Compare the Specified Property Value to Commercial Product Data

From Table 2.10 [Ref. 1, pg. 148] the typical range for burst strength of currently available geotextiles is 50 – 754 psi (350 – 5,200 kPa). Geotextile with the proposed burst strength is commercially available.

Therefore, the specified minimum burst strength will be 189 psi for nonwoven geotextile.

B. Tensile Strength

Geotextile used in the stabilization of cap access roadways may be subject to tensile stress mobilized by lateral deformation. Lateral deformation can occur in a geotextile that is "locked" in place by the overlying stone base and the soil sub-base when an upper piece of aggregate is forced between two lower pieces of aggregate that are in contact with the geotextile [Ref. 1]. This causes the lower pieces of aggregate to slide along the geotextile interface in opposite directions, creating tension.

1. Determine Appropriate Factor of Safety (FS) and Reduction Factors (ΠRF)

FS = 2 [Ref. 1, pg.155]

ΠRF = 1.5 assuming similar conditions described in Step A1

2. Calculate Required Tensile Strength

The required tensile strength is given by:

$T_{req'd} = p'(d_v)^2 [f(\in)]$ [Ref. 1, p155 Eqn 2.29]

where:

$T_{req'd}$ = required grab tensile force
p' = applied pressure, the tire inflation pressure
d_v = maximum void diameter ≅ 0.33 d_a
d_a = average stone diameter
$f(\in)$ = strain function of the deformed geotextile = ¼ (2y/b+b/2y), where
b = width of stone void
y = deformation into stone void

Assuming:

p' = 100 psi

d_a = 1 ½ in. based on maximum stone size for Delaware #57 stone and crusher run [Ref. 2] typically used in local temporary road construction

b = d_v = 0.33 d_a = l_o (initial geotextile length)

2y/b = l_f (deformed geotextile length)

Based on a maximum allowable stress = 33% [Ref. 1, pg. 154] then

$$\varepsilon = \frac{l_f - l_o}{l_o}(100)$$

$$= \frac{2y/b - b}{b}(100)$$

$$0.33 = \frac{2y/b - 0.33(1.5)}{0.33(1.5)}$$

$$2y/b = 0.658$$

Substituting into equation for $f(\in)$;

$$f(\in) = ¼\,(2y/b + b/2y)$$

$$= ¼\,(0.658 + 1.5)$$

$$= 0.54$$

Then,

$$T_{req'd} = p'(d_v)^2\,[f(\in)]$$

$$= 100\ \text{lbs/in}^2 \times (0.5\ \text{in})^2 \times 0.54$$

$$\boxed{T_{req'd} = 13.5\ \text{lbs.}}$$

3. Calculate Allowable Tensile Strength

$$T_{allow} = T_{req'd} \times FS$$
$$= T_{req'd} \times FS$$
$$= 13.5 \times 2$$
$$\boxed{T_{allow} = 27 \text{ lbs.}}$$

4. Calculate Ultimate Tensile Strength

$$T_{ult} = T_{allow} \times \Pi RF$$
$$= 27 \text{ lbs} \times 1.5$$
$$\boxed{T_{ult} = 40.5 \text{ lbs.}}$$

5. Compare Calculated Value to Recommended Minimum Property for Installation Survivability

From Table 2.2a [Ref. 1, pg. 72] the recommended minimum grab tensile strength for a "High" degree of installation survivability is 157 lbs. (700 N) for a nonwoven geotextile.

The recommended minimum grab tensile strength for installation survivability is more conservative than the required grab tensile strength due to stress mobilized by lateral deformation. Therefore, the recommended minimum grab tensile strength for installation survivability governs.

6. Compare the Specified Property Value to Commercial Product Data

From Table 2.10 [Ref. 1, pg. 148] the typical range for grab tensile strength of currently available geotextiles is 101 – 1,012 lbs. (0.45 – 4.5 kN). Geotextile with the proposed grab tensile strength is commercially available.

Therefore, the specified minimum grab tensile strength will be 157 lbs. for nonwoven geotextile.

C. Puncture Resistance

It is anticipated that the geotextile used in the stabilization of cap access roadways will be required to resist puncture during installation and periodically as vehicles traverse the roadway. The dead load due to the weight of the roadway aggregate is minimal (< 2 psi).

1. Determine Appropriate Factor of Safety (FS) and Reduction Factors (ΠRF)

From Reference 1 (pg. 157) assume,

$$FS = 2$$
$$\Pi RF = 1.5$$

2. Calculate Required Puncture Resistance

The required puncture strength is given by:

$$F_{req'd} = p' d_a^2 S_1 S_2 S_3$$ [Ref. 1, pg. 156, Eqn. 2.30]

where:

$F_{req'd}$ = required vertical force to be resisted
p' = pressure exerted on the geotextile (approximately 100% of tire inflation pressure at the ground surface for small stone thickness)
d_a = average diameter of the puncturing aggregate or sharp object
h_h = Protrusion height $\leq d_a$,
S_1 = Protrusion factor = h_h/d_a
S_2 = Scale factor to adjust ASTM D4833 test value using 5/16-in.-diameter puncture probe to actual puncturing object = $0.31/d_a$
S_3 = Shape factor to adjust flat puncture probe of ASTM D4833 to actual shape of puncturing object = $1 - A_p/A_c$, where A_p is the projected area of the particle and A_c is the area of the smallest circumscribing circle around the particle

Assuming:

p' = 100 psi

d_a = 1 ½ in. based on maximum stone size for Delaware #57 stone and crusher run [Ref. 2] typically used in local temporary road construction

h_h = ¾ d_a = 1.125 in.

A_p/A_c = 0.4 for crushed rock [Ref. 1]

Then,

$$S_1 = h_h/d_a = 1.125 \text{ in} / 1.5 \text{ in} = 0.75$$

$$S_2 = 0.31/d_a = 0.31 \text{ in} / 1.5 \text{ in} = 0.21$$

$$S_3 = 1 - A_p/A_c = 1 - 0.4 = 0.6$$

Substituting into equation for $F_{req'd}$,

$F_{req'd} = p'd_a^2 S_1 S_2 S_3$

$= (100 \text{ lb/in}^2)(1.5 \text{ in})^2(0.75)(0.21)(0.6)$

$F_{req'd} = 21.26$ lbs.

3. Calculate Allowable Puncture Resistance

$T_{allow} = T_{req'd} \times FS$

$= T_{req'd} \times FS$

$= 21.26 \times 2$

$T_{allow} = 42.5$ lbs.

4. Calculate Ultimate Puncture Resistance

$T_{ult} = T_{allow} \times \Pi RF$

$= 42.5 \text{ lbs.} \times 1.5$

$T_{ult} = 63.75$ lbs. (use 64 lbs.)

5. Compare Calculated Value to Recommended Minimum Property for Installation Survivability

From Table 2.2a [Ref. 1, pg. 72] the recommended minimum puncture strength for a "High" degree of installation survivability is 56 lbs. (250 N) for a nonwoven geotextile.

For a nonwoven geotextile the required puncture strength is more conservative than the recommended minimum puncture strength for installation survivability. Therefore T_{ult} governs for a nonwoven geotextile.

6. Compare the Specified Property Value to Commercial Product Data

From Table 2.10 [Ref. 1, pg. 148] the typical range for puncture strength of currently available geotextiles is 10 – 101 lbs. (45 – 450 N). Geotextile with the proposed puncture strength is commercially available.

Therefore, the specified minimum puncture strength will be 64 lbs. for nonwoven geotextile.

D. Tear Resistance

Considering the primary function of the geotextile is separation and that installation is the only time the geotextile may be exposed to tear, the specification for tear resistance will be based on recommended minimum tear strength for installation survivability.

From Table 2.2a [Ref. 1, pg. 72] the recommended minimum tear strength for installation survivability is 56 lbs. (250 N) for a nonwoven geotextile.

From Table 2.10 [Ref. 1, pg. 148] the typical range for tear strength of currently available geotextiles is 20 – 292 lbs. (90 – 1,300 N). Geotextile with the proposed tear strength is commercially available.

Therefore, the specified minimum puncture strength will be 56 lbs. for nonwoven geotextile.

CONCLUSIONS:

The results for the properties evaluated in this calculation verify that a needle-punched non-woven geotextile is appropriate for use in the cap access road. The following minimum specifications will be required for geotextile used in the cap access road:

A. Burst Strength	189 lbs/in^2
B. Grab Strength (Tensile)	157 lbs
C. Puncture Strength	64 lbs
D. Trapezoidal Tear	56 lbs

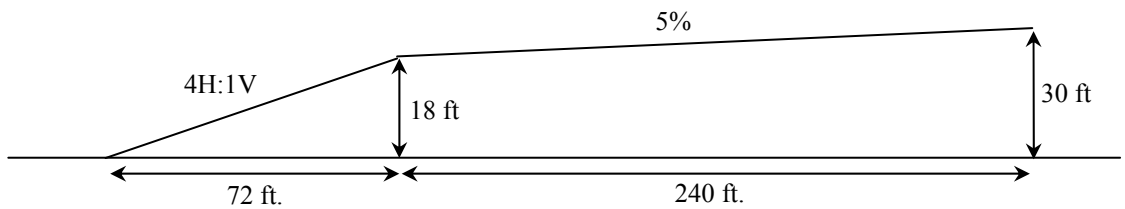
REFERENCES:

1. Koerner, Robert M., "Designing with Geosynthetics," 4th edition, 1998.

2. The State of Delaware Department of Transportation Standard Specifications, January 1998.

PURPOSE:

To evaluate the required geomembrane runout length, which will prevent pullout of the geomembrane without anchor trenches. The typical slopes of the proposed Iron Rich Staging Area cap consist of side slopes of approximately 72 horizontal feet at 4H:1V slope and a "crown" of approximately 240 horizontal feet at 5 percent slope as shown below [Ref.1].



PROCEDURE:

According to Reference 2 [Eqn. 5.25, pg. 488], the required geomembrane runout length can be determined from the following equation:

$$L_{RO} = \frac{T_{allow}(\cos\beta - \sin\beta \tan\delta_l)}{\sigma_n(\tan\delta_u + \tan\delta_l)}$$

Where;

L_{RO} = required runout length
T_{allow} = allowable force in geomembrane stress = $\sigma_{alllow}t$, where
σ_{allow} = allowable stress in geomembrane
t = thickness in geomembrane
β = side slope angle
δ_l = angle of shearing resistance between textured geomembrane and geotextile
δ_u = angle of shearing resistance between textured geomembrane and geocomposite
σ_n = applied normal stress from cover soil

It is assumed that the frictional resistance above the geomembrane will be negligible due to deformation of the cover soil during pullout, should it occur. Therefore, $\delta_u = 0$ and the equation becomes:

$$L_{RO} = \frac{T_{allow}(\cos\beta - \sin\beta \tan\delta_l)}{\sigma_n(\tan\delta_l)}$$

The following figure presents the situation graphically [Ref. 2, Figure 5.30, pg. 488]:

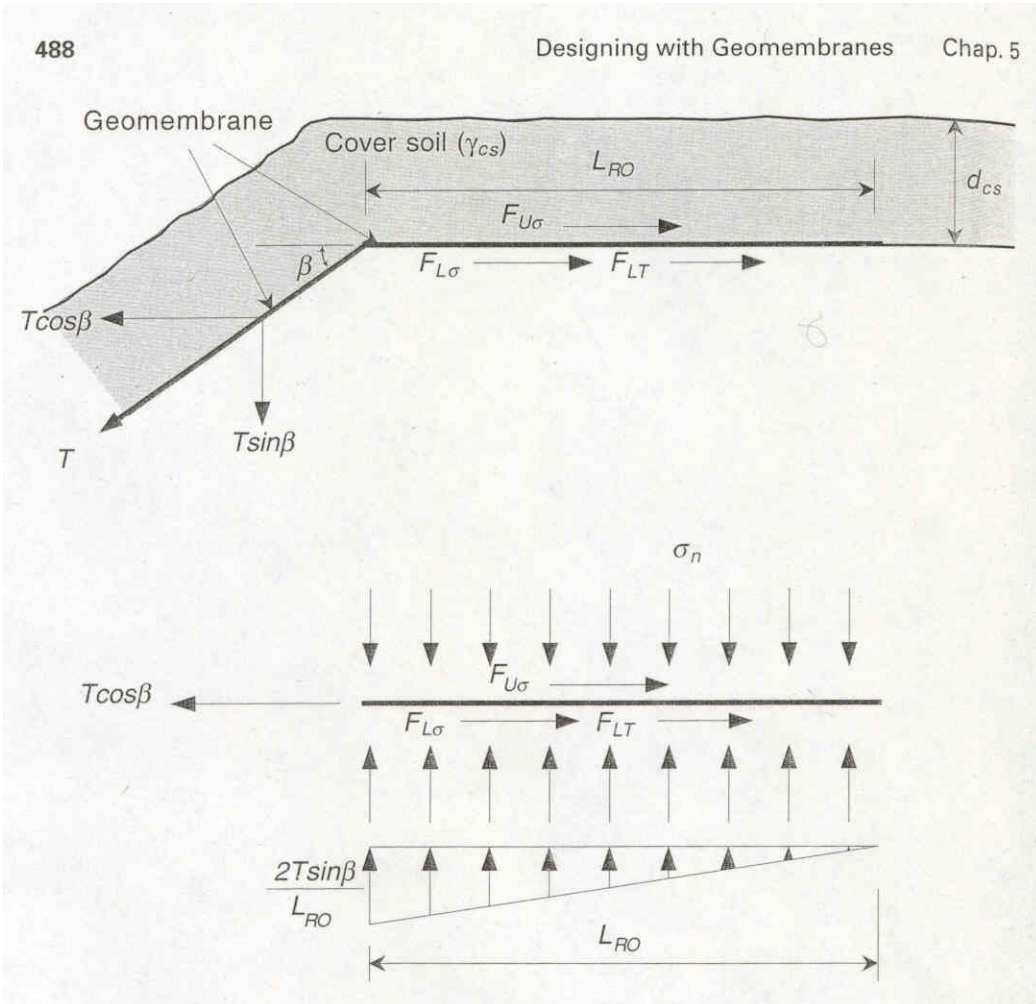


Figure 5.30 Cross section of geomembrane runout section and related stresses and forces involved.

The following procedure will be used to evaluate the geomembrane runout length.

1. Determine the allowable force in the geomembrane.
2. Determine the applied normal stress from the cover soil.
3. Calculate the required runout length for the side slope (4H:1V)
4. Calculate the equivelent runout length required along landfill "crown" (5% slope)
5. Calculate the Factor of Safety against pullout

EVALUATION:

Assumptions:

σ_{allow} = 1,495 psi [Ref. 2, Table 5.5c, pg. 430]
t = 40 mil LDPE
β = maximum 4H:1V = 14.04º
δ_1 = 25º [Ref. 3]
D = depth of cover soil = 1.5 feet
γ_s = unit weight of cover soil = 110 pcf

1. Determine the allowable force in the geomembrane.

$$T_{allow} = \sigma_{allow} t$$
$$= 1{,}495 \text{ psi} \times 0.040 \text{ in.}$$
$$= 59.8 \text{ lb/in}$$

Assuming a FS = 1.5, then;

$$Tult = T_{allow} \times FS$$
$$= 59.8 \text{ lb/in} \times 1.5$$
$$= 89.7 \text{ lb/in} = 1{,}076.4 \text{ lb/ft}$$

2. Determine the applied normal stress from the cover soil.

$$\sigma_n = D\gamma_s$$
$$= 1.5 \text{ feet} \times 110 \text{ pcf}$$
$$= 165 \text{ psf}$$

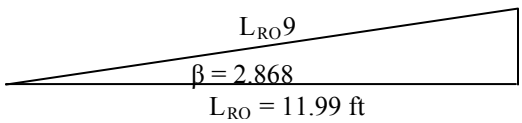
3. Calculate the required runout length for the side slope (4H:1V)

$$L_{RO} = \frac{T_{allow}(\cos\beta - \sin\beta \tan\delta_1)}{\sigma_n (\tan \delta_1)}$$
$$= \frac{(1{,}076 \text{ lb/ft})(\cos 14.04º - \sin 14.04º \tan 25º)}{165 \text{ psf} (\tan 25º)}$$
$$= \frac{922.48 \text{ lb/ft}}{76.94 \text{ psf}}$$
$$L_{RO} = 11.99 \text{ ft}$$

4. Calculate the equivelent runout length required along landfill "crown".

As previously described, the "crown" of the landfill above the 4:1 slopes is comprised of gentle grades with an elevation change of 12 feet over a 240 foot long section, or an approximately 5% slope. The required runout would be increased in length at a 5% slope as compared to a flat runout section.

This is represented graphically as:



$$\cos\beta = L_{RO} / L_{RO}9$$

$$L_{RO}9 = L_{RO} / \cos\beta$$

$$= 11.99 \text{ ft.} / \cos 2.868$$

$$= 12 \text{ ft}$$

5. Calculate the Factor of Safety against pullout

$$FS = L_{RO\,(provided)} / L_{RO\,(required)}$$

Where;

$$L_{RO\,(provided)} = 240 \text{ ft} / \cos 2.868$$

$$= 240.3 \text{ ft}$$

Then;

$$FS = 240.3 \text{ ft} / 12 \text{ ft}$$

$$= 20$$

CONCLUSION:

Based on the long sections of moderate grade present along the "crown" of the Iron Rich staging area, sufficient anchorage is provided through runout length to ensure the stability of the constructed cap system. In addition, the cap system has been designed to incorporate geosynthetic components that will have sufficient interface friction to prevent sliding on slopes less than or equal to 4H:1V with a factor of safety of 1.5 [Ref. 4]. Therefore, it is not anticipated that the geomembrane or any other geosynthetic component will be placed in tension. Since tension must be mobilized in the geosynthetic components before pullout can occur, it is unlikely that pullout resistance will be needed.

REFERENCES:

1. URS Corporation. "Edge Moor Facility Topographic Plan", Drawing CELL 4ASB. February 4, 2003.
2. Koerner, R.M., "Designing with Geosynthetics," 4th edition, 1998.
3. Geomembrane Evaluation for Hay Road Landfill Sludge Drying Site (DE-0024), performed by EEB, URS, 2/10/03.
4. Cap Stability calculation for Hay Road Landfill Sludge Drying Site (DE-0024), performed by EEB, URS, 2/5/03.

PURPOSE:

To estimate the potential sediment loss from the Hay Road Landfill Sludge Drying Site (DE-0024) to determine the need for erosion controls both during and after construction.

PROCEDURE:

The universal soil loss equation (USLE) will be used to estimate sediment loss from the site taking into consideration representative slope conditions proposed for the cap. The USLE is an empirical model developed by W.H. Wischmeier and D.D. Smith of the U.S. Department of Agriculture (USDA) [Ref. 1] to estimate sheet and rill erosion. The USLE will be used to calculate the maximum allowable length of slope for a given slope angle. This allowable slope length will be compared against actual proposed slope lengths to determine if erosion controls will be necessary.

The following steps will be performed in the analysis:

1. Determine the rainfall factor, R, for the site
2. Determine the soil-erodibility factor, K, for the proposed cover soil material for cap system
3. Determine the cover index, C
4. Determine the erosion control factor, P
5. Determine the permissible topographic factor, LS
6. Determine the maximum allowable slope length for slopes of 3%, 5%, 9%, 20% (5H:1V), 25% (4H:1V), and 33% (3H:1V)
7. Compare the allowable slope length to the actual slope length for each different slope

EVALUATION:

The maximum allowable slope length can be determined by using the USLE. For slopes exceeding 5 percent, the maximum erosion rate should not exceed 2 tons/acre/year [Ref. 2].

Using the USLE [Ref. 1], sediment loss can be calculated by:

$$A = R \times K \times LS \times C \times P$$

where:

A = sediment loss (tons/acre/year)
R = rainfall erosion factor
K = soil-erodibility factor
LS = topographic factor
C = cover index
P = erosion control factor

To determine maximum allowable slope length the equation is solved for LS as given below:

LS = A/(R x K x C x P)

1. Determine the Rainfall Factor, R, for the site

The Hay Road Sludge Drying Site (DE-0024) is near Wilmington, Delaware

R = 180 [Ref. 1, Figure 1, see Sheet 4]

2. Determine the soil erodibility factor, K, for the proposed fill material for cap construction

It is anticipated that topsoil imported from local sources will be used to establish a suitable growth platform for vegetative cover on the cap. Local topsoil typically consists of silty loam, clay loam, sandy loam, silty-clay loams, and sandy-clay loams and meet the following physical property requirements [Ref. 3 and 4]:

Sand	15% – 65%
Silt	10% - 60%
Clay	5% - 40%
Organic content	2% - 30%

Using the soil-erodibility nomograph [Ref. 1, Figure 3, see Sheet 5] for topsoil consisting of 60% silt and clay, 30% sand, 2% organic content, with a fine granular soil structure and moderate permeability, the soil-erodibility factor, K, is:

K = 0.38

3. Determine the cover index, C

The cap will be permanently seeded upon completion of grading to reduce erosion. Final land cover will consist primarily of grasses and weeds and will cover greater than 85% of the landfill. Therefore, the value for C is chosen to be 0.006 [Ref .5, Table 5.4, see Sheet 6]

4. Determine the erosion control factor, P

No erosion control practices are anticipated once the landfill cap surface is seeded. Therefore, for long term conditions, P = 1.0.

5. Determine the permissible topographic factor, LS, for a maximum sediment loss of 2.0 tons/acre/year

Summarizing the values for long term (i.e. post-construction) conditions:

A	=	2.0 tons/acre/year	[Ref. 2]
R	=	180	[Step 1]
K	=	0.38	[Step 2]
C	=	0.006	[Step 3]
P	=	1.0	[Step 4]

Using these factors to solve the rearranged USLE, the permissible topographic factor, LS, is determined to be:

$$LS = 2.0 / (180 \times 0.38 \times 0.006 \times 1.0)$$
$$= 4.87$$

6. Determine the maximum allowable slope length for slopes of 3%, 5%, 9%, 20% (5H:1V), 25% (4H:1V), and 33% (3H:1V)

From the slope-effect chart [Ref. 1, Figure 4, see Sheet 7], the following allowable slopes were determined:

3% slope	-	Maximum length > 1,000 ft.
5% slope	-	Maximum length > 1,000 ft.
9% slope	-	Maximum length > 1,000 ft.
20% slope	-	Maximum length = 140 ft.
25% slope	-	Maximum length = 66 ft.
33% slope	-	Maximum length = 28 ft.

7. Compare the allowable slope length to the actual slope length for each different slope

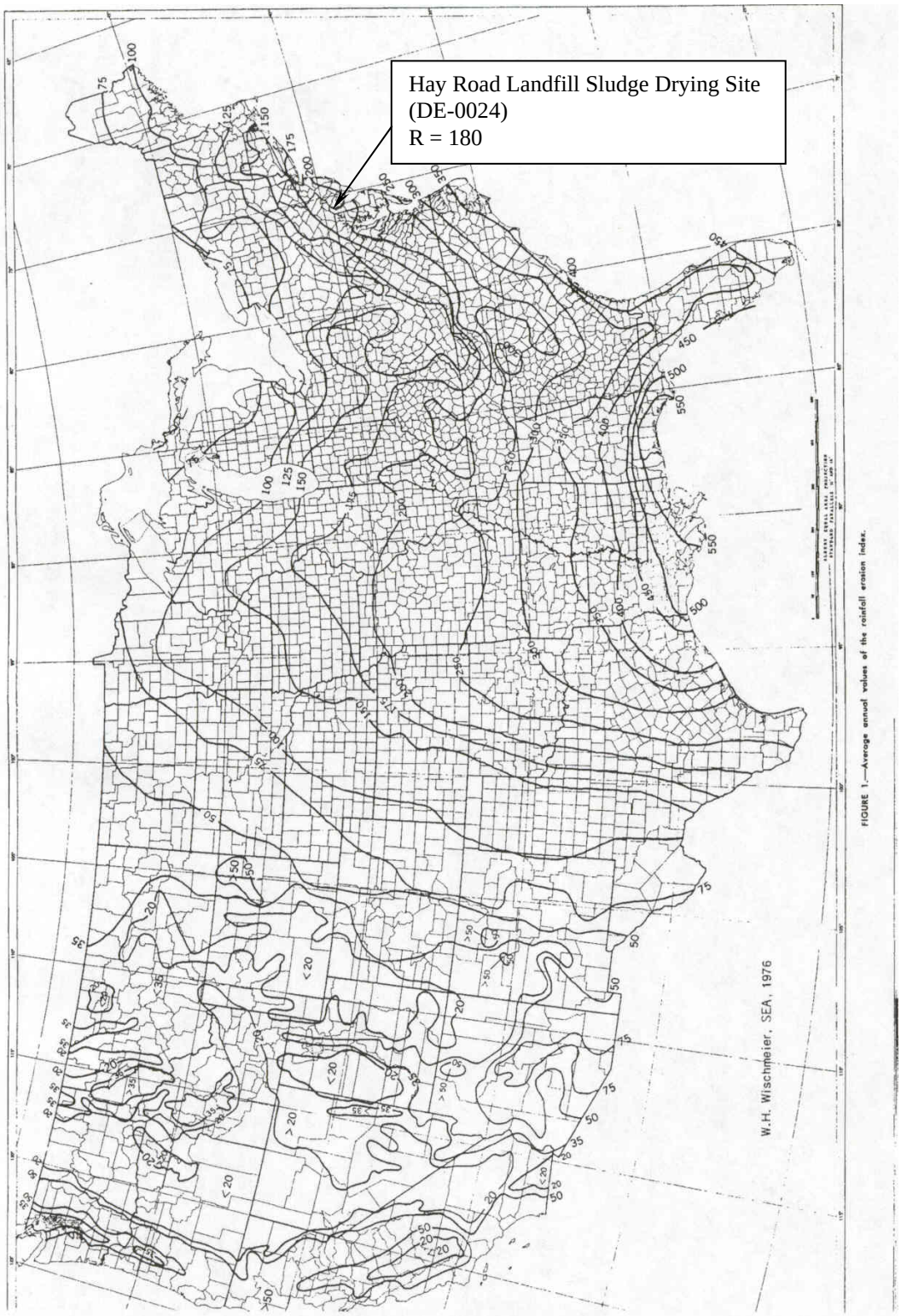
The calculated maximum slope lengths are supported by visual observations of the adjacent closed Hay Road Landfill (formerly the DuPont Cherry Island Landfill) Cells 1, 2, and 3 where a good stand of vegetation has been established and minimal signs of erosion are evident. Slopes as steep as 2H:1V have shown good performance to date.

It is anticipated that slopes for the Hay Road Landfill Sludge Drying Site (DE-0024) cap will not exceed 4H:1V. The Delaware Erosion and Sediment Control Handbook for Development [Ref. 3] requires that 4H:1V slopes exceeding 40 feet in vertical height that are not protected using special erosion control materials or stabilization methods must be divided using diversions (i.e., benches).

Permanent erosion controls such as the use of permanent erosion control mats, riprap, or a combination of similar controls will be considered when the proposed slopes are longer than the maximum allowable slope length determined above, or when the vertical height exceeds 40 feet, and for all slopes steeper than or equal to 4H:1V.

Temporary erosion controls such as but not limited to silt fence, hay bales, diversion ditches/berms, and sedimentation traps will be considered for use during construction.

REFERENCE 1, FIGURE 1



REFERENCE 1, FIGURE 3

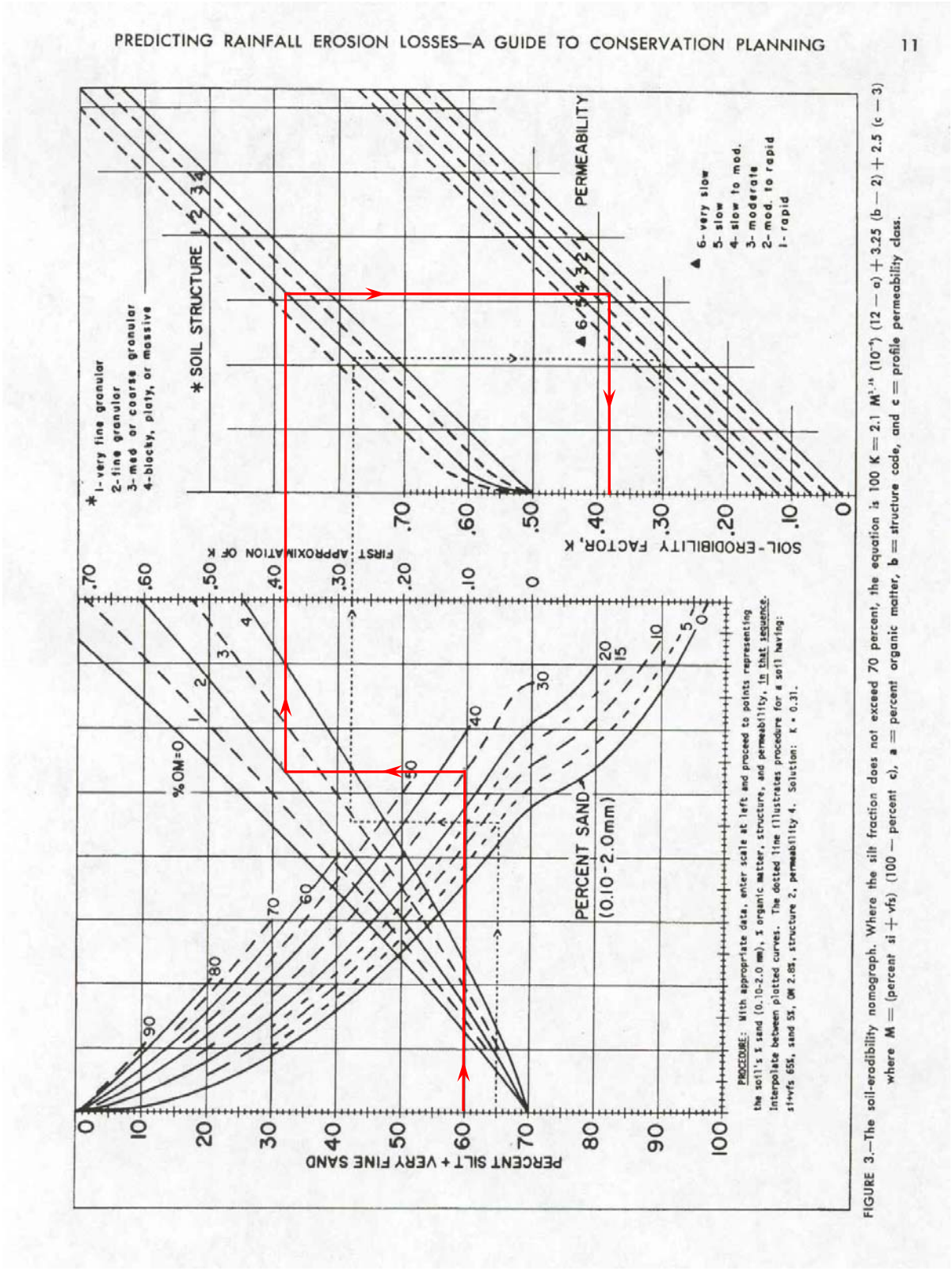


FIGURE 3.—The soil-erodibility nomograph. Where the silt fraction does not exceed 70 percent, the equation is $100\ K = 2.1\ M^{1.14}\ (10^{-4})\ (12 - a) + 3.25\ (b - 2) + 2.5\ (c - 3)$ where M = (percent si + vfs) (100 — percent c), a = percent organic matter, b = structure code, and c = profile permeability class.

REFERENCE 5, TABLE 5.4

TABLE 5.4 Values of *C* for Cropland, Pasture, and Woodland

Land Cover or Land Use	*C*
Continuous fallow tilled up and down slope	1.0
Shortly after seeding prior to harvesting	0.3–0.8
For crops during main part of growing season	
Corn	0.1–0.3
Wheat	0.05–0.15
Cotton	0.4
Soybean	0.2–0.3
Meadow	0.01–0.02
For permanent pasture, idle land, unmanaged woodland	
Ground cover 85%–100%	
As grass	0.003
As weeds	0.01
Ground cover 80%	
As grass	0.01
As weeds	0.04
Ground cover 60%	
As grass	0.04
As weeds	0.09
For managed woodland	
Tree canopy of 75%–100%	0.001
40%–75%	0.002–0.004
20%–40%	0.003–0.01

Assume Mixture C=0.006

Sources: Based on data from Stewart et al. (1975); Wischmeier and Smith (1965), and Wischmeier (1972).

REFERENCE 1, FIGURE 4

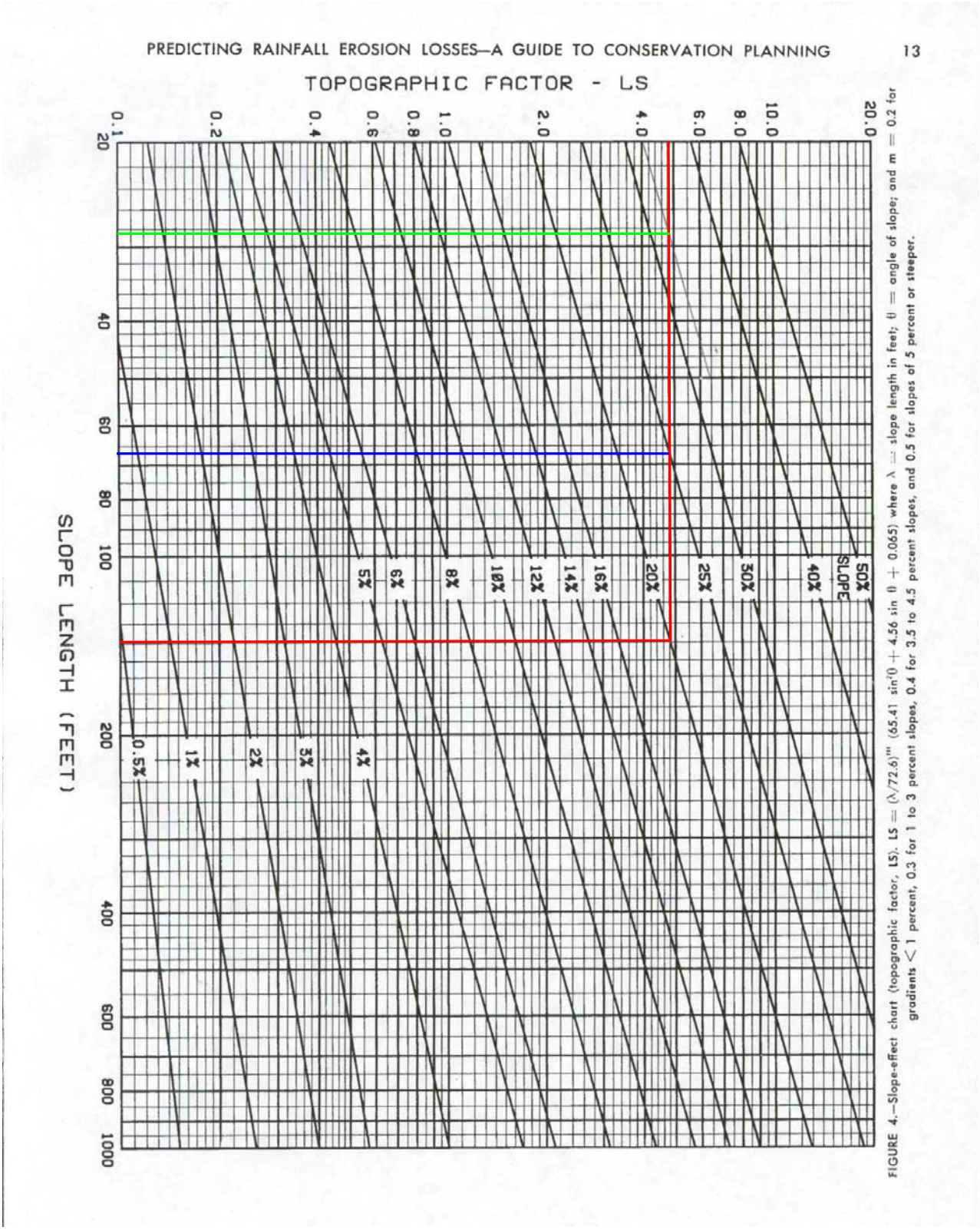


FIGURE 4.—Slope-effect chart (topographic factor, LS). $LS = (\lambda/72.6)^m (65.41 \sin^2\theta + 4.56 \sin\theta + 0.065)$ where λ = slope length in feet; θ = angle of slope; and m = 0.2 for gradients < 1 percent, 0.3 for 1 to 3 percent slopes, 0.4 for 3.5 to 4.5 percent slopes, and 0.5 for slopes of 5 percent or steeper.

REFERENCES:

1. United States Department of Agriculture (USDA), Science and Education Administration. Agricultural Handbook Number 537, "Predicting Rainfall Erosion Losses, A Guide To Conservation Planning". December 1978.
2. United States Environmental Protection Agency (EPA), Office of Solid Waste and Emergency Response. "Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments". July 1989.
3. Delaware Department of Natural Resources and Environmental Control (DNREC), Division of Soil and Water Conservation. "Delaware Erosion and Sediment Control Handbook for Development". 1989.
4. The State of Delaware Department of Transportation (DelDOT). "Standard Specifications". January 1998.
5. Novotny, Vladimir, Olem, Harvey. "Water Quality Prevention, Identification, and Management of Diffuse Pollution". Van Nostrand Reinhold, Inc. 1994.

Appendix B

Technical Specifications

SECTION 01100

SUMMARY

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. A brief description of the major construction activities included under this contract. Individual activities are more thoroughly described in subsequent sections of the Technical Specifications.

1.02 PRICE AND PAYMENT PROCEDURES

Not Used

1.03 REFERENCES

A. Abbreviations and Acronyms

1. CRG – DuPont Corporate Remediation Group
2. DuPont – E. I. DuPont de Nemours Company
3. DSR – DuPont Site Representative
4. HASP – Health and Safety Plan
5. IRM – Iron-Rich Material

B. Definitions

1. Contractor – the general contractor or subcontractor at any tier. This section and the section in which it is used provide context for defining Contractor.
2. CRG – DuPont organization undertaking the Work through the Contractor, Engineer, and DSR.
3. DSR – the on-site representative of DuPont, or their designee, responsible for daily on-site construction monitoring, coordination with DuPont or other DuPont representatives, and quality assurance.
4. Engineer – the developer of the Contract Drawings and Technical Specifications for DuPont and will be responsible for review of appropriate submittals for conformance with the Contract documents during construction.

5. Site – the area of the Work including the existing grounds, proposed additions to the grounds, staging areas, storage areas, and access roads.
6. Plant – the DuPont Edge Moor White Pigments Plant.
7. Furnish – supply required items.
8. Provide – furnish and install complete, in place and ready for operation and use.

1.04 WORK COVERED BY CONTRACT DOCUMENTS

A. Location of Work

The Work of this Contract is located at the Hay Road Sludge Drying Site (DE-0024) adjacent to the DuPont Hay Road Landfill property approximately one mile south of the DuPont Edge Moor White Pigments Plant in Edgemoor, Delaware. The site is bounded on the north by Shellpot Creek, on the east by the Delaware River, on the south by the 12th Street extension, and on the west by Hay Road. A location map is provided on the cover of the Drawings.

B. General Requirements

1. Provide equipment, labor, and materials to execute work activities for final acceptance. Provide materials, equipment, and incidentals that are reasonably and properly inferable and necessary for the proper completion of the Work, whether specifically indicated in the contract documents or not.
2. Comply with federal, state, and local rules and regulations.
3. Notify proper federal, state, and local agencies of the nature and timing of work on-site.
4. Obtain permits required to construct the Work except for the following that will be obtained by DuPont:
   a. Erosion and Sediment Control Notice of Intent
5. Coordinate with jurisdictional transportation officials; coordinate traffic flow resulting from the Work; and repair roads in compliance with the requirements of jurisdictional transportation officials.
6. Protect and maintain survey and grid stakes, existing monitoring wells, and site structures against damage. Repair damage.
7. Protect utility lines and appurtenances that are to remain.
   a. Utility locations have been shown based on historical facility information and have not been field verified.
   b. Locate and verify existing utilities.
   c. Contact the national construction alert system for utilities at 811.
   d. Apply appropriate surface geophysical methods to locate subsurface utilities.

e. Repair damage except when utility is to be abandoned in place.

8. Materials and equipment shall not be stored or used in such a manner as to create unsafe conditions and shall meet requirements of applicable codes.

C. Description of Work

1. Mobilize equipment, material, personnel, and tools to the site and relocate the same within the site to the necessary work areas as the Work progresses.
2. Construct and provide temporary erosion and sediment control structures prior to earth disturbance or earth moving activities; maintain controls throughout construction; remove and dispose of controls at the specified time or at the end of the Contract Period if a time is not specified; and establish vegetation.
3. Clear and grub disturbance areas.
4. Improve existing and construct new access and haul roads to accommodate required traffic.
5. Construct, provide, operate, and maintain stormwater management structures, equipment, and materials during construction.
6. Modify existing concrete stormwater outlet structure.
7. Provide cover soil and topsoil.
8. Construct intermediate and final grades.
9. Construct ditches lined with erosion control blankets.
10. Construct engineered geosynthetic cap system.
11. Restore vegetated areas disturbed by construction operations.
12. Repair or replace damaged structures and paved and stone surfaces.

D. Incidental Work

1. Temporary Site Facilities – provide and maintain temporary site facilities including offices, staging areas, security and communication operations, personnel and equipment decontamination facilities, and project signs throughout Contract Period.
2. Temporary Site Utilities – provide, operate, and maintain temporary site utilities including telephone, electricity, water, and sanitation to the temporary site facilities throughout Contract Period.
3. Plan Submittal – develop, implement, and revise required Contractor plans.
4. Security – provide, operate, and maintain necessary security personnel, supplies, materials, and equipment to maintain control of the site.

5. Quality Control – implement the Contractor's quality control program.
6. Safety – provide, operate, and maintain required personnel, supplies, materials, and equipment to implement the project HASP.
7. Waste Management – provide, operate, and maintain required personnel, supplies, materials, and equipment to manage Contractor generated waste and sediment filter bags during the Contract Period.
8. Project Documentation – document Work including work associated with health and safety, quality control, field engineering, and as-built documentation.
9. Project Closeout – decontaminate and remove Contractor equipment, remove temporary construction facilities, disconnect temporary utilities, and transfer records, drawings, and other project-related material to the DSR.

1.05 WORK BY OWNER

DuPont will not furnish or provide Work.

1.06 WORK RESTRICTIONS

A. Access to Site

1. Limit Site access to:
   a. Contractor employees directly involved with the Work.
   b. Deliveries required to complete the Work.
   c. Plant personnel requiring access to existing operating facilities within the work area.
   d. CRG or other DuPont personnel approved by the DSR
   e. Regulatory Agencies
   f. Visitors approved by the DSR and the Plant representative.
2. All personnel entering the site must receive the appropriate level of orientation prior to entrance. Visitors must be escorted at all times.
3. Time Restrictions for Performing Work:
   a. Construction activity will be limited to 10 hours per day between 7 a.m. and 5 p.m. Work shall not be conducted overnight, unless otherwise approved by the DSR.
   b. Work shall not be conducted on Saturdays, Sundays or Holidays unless written approval is provided by the DSR. Contractor may propose Saturday work in their bid for consideration by DuPont.
   c. Requests to the DSR to perform work outside of these hours must be provided with a minimum of 48 hours advanced written notice.

B. Coordination with Occupants

1. DuPont will occupy the site during the entire period of construction for the conduct of normal operations.
2. Cooperate with DuPont to minimize conflict and to facilitate the operations. Coordinate activities with DuPont and their authorized representatives.
3. Schedule the Work to accommodate DuPont occupancy.

C. Use of Site

1. Contractor will not have complete and exclusive use of the site for execution of the work. The Contractor shall share the site with DuPont and their authorized representatives including the DSR, Engineer and regulatory authorities who have received prior approval for site entrance by DuPont.
2. Construction operations shall be limited to the indicated Limit of Disturbance noted on the Drawings.
3. Formally document acceptance of the HASP prior to using the Site.
4. Locations of temporary site facilities, staging and laydown areas, and office facilities shall be approved by the DSR prior to using the Site.
5. No construction activity will be allowed until the Contractor's submittals for that activity have been accepted by the DSR or the Engineer as required by the individual sections of these Technical Specifications.
6. Assume full responsibility for the protection and safekeeping of equipment and materials located on-site.
7. Assume full responsibility for the health and safety of all on-site personnel under Contractor's control.

1.07 PROJECT UTILITY SOURCES

A. Utilities are available at the entrance to the Hay Road Landfill Site.

B. Provide utility connections for Contractor's use.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01310

PROJECT MANAGEMENT AND COORDINATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. General administrative requirements.
2. Requirements for coordination between Project participants.
3. Project meetings and weekly field safety audit requirements.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. The requirements of this Section are integral to each feature of work and separate measurement and payment will not be made for these requirements.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. CPM – Construction Project Manager
2. DuPont – E. I. DuPont de Nemours Company
3. DSR – DuPont Site Representative
4. HASP – Health and Safety Plan
5. PSA – Project Safety Analysis
6. QC – Quality Control
7. SSHO – Site Safety and Health Officer

B. Definitions

1. CPM – the designated contract administrator for DuPont.
2. DSR – the on-site representative of DuPont, or their designee, responsible for daily on-site construction monitoring, coordination with DuPont or other DuPont representatives, and quality assurance.
3. Engineer – the developer of the Contract Drawings and Technical Specifications for DuPont and will be responsible for review of

appropriate submittals for conformance with the Contract documents during construction.

4. Furnish – supply required items.

5. Provide – furnish and install complete, in place and ready for operation and use.

C. Reference Standards

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. DuPont Corporate Remediation Group (CRG)
   a. CRG Standard HS-200 Field Audits

1.04 SUBMITTALS

Engineer review is required for submittals designated as “Action Submittals”. Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

A. Action Submittals

Not Used

B. Informational Submittals

1. Special Procedure Submittals
   a. List of emergency contacts.

2. Qualification Statements
   a. Project Manager resume.
   b. Project Superintendent resume.

C. Closeout Submittals

Not Used

1.05 COORDINATION

A. Coordinate with the CPM to:

1. Furnish documentation supporting pay quantities, applications for payment, and requests for change orders.

2. Furnish construction progress documentation in accordance with Section 01320 – CONSTRUCTION PROGRESS DOCUMENTATION.

3. Furnish Contract closeout documents in accordance with Section 01780 – CLOSEOUT SUBMITTALS.

B. Coordinate with the DSR to:

1. Furnish list of Contractor and Subcontractor emergency contact personnel, addresses, and telephone numbers. Update list and resubmit as changes occur.
2. Furnish documentation demonstrating adherence to the HASP.
3. Furnish documentation verifying that necessary approvals from regulatory agencies have been obtained.
4. Furnish documentation demonstrating compliance with Contract Documents, Drawings and Specifications.
5. Furnish documentation demonstrating that the quality control program is in compliance with the Technical Specifications.
6. Furnish daily documentation of work completed under time and materials contract terms including labor hours, materials and equipment used.
7. Assist with scheduling and attend project meetings.

C. Coordinate with the Engineer to:

1. Furnish submittals for verification of compliance with the Contract Documents.
2. Submit proposed changes or substitutions in specified construction materials or procedures for review.
3. Submit proposed field design changes for review.
4. Respond to design change requests from the Engineer.

1.06 CONTRACTOR'S RESPONSIBILITIES

A. Perform work in accordance with the Contract Documents.

B. Coordinate the Work and the work of all subcontractors, delivery and staging of materials, access to work locations, and coordinate with other contractors performing work on-site not related to the subject project.

C. Supervise and direct the Work. Contractor will be solely responsible for the means, methods, techniques, procedures and sequences, except erosion and sediment control sequence of construction, which will be conducted in accordance with the erosion and sediment control plan and details, and the Delaware Sediment and Erosion Control Handbook.

1.07 SUPERVISION

A. Furnish at least one qualified Project Manager and one on-site Project Superintendent with a minimum 10 years experience in management of projects similar in size and complexity to this project.

B. Furnish resumes for the proposed Project Manager and Project Superintendent describing their experience with references and qualifications.

C. Project Manager and Project Superintendent shall be approved by DuPont prior to start of construction.

D. DuPont reserves the right to interview the proposed Project Manager and Project Superintendent at any time in order to verify the submitted qualifications.

E. Project Manager and Project Superintendent are subject to removal by DuPont for non-compliance with requirements specified in the contract and for failure to manage the project to insure timely completion.

F. CPM or DSR may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time, for excess costs, or damages by the Contractor.

1.08 PROJECT MEETINGS

A. Attend pre-construction conference, site mobilization meeting, periodic progress meetings, and specially called meetings throughout progress of the work.

B. Representatives of contractor, subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.

C. Contractor shall schedule and administer a quality control coordination meeting to ascertain that work is implemented consistent with the Contract Documents and construction schedules.

1.09 PRE-CONSTRUCTION CONFERENCE

A. Attend the pre-construction conference scheduled by the CPM. Work shall not commence prior to the conference.

B. Attendees:

1. Required Contractor Participants
   a. Contractor’s Superintendent
   b. SSHO
   c. QC Supervisor

d. Major Subcontractors

2. Optional Contractor Participants
   a. Major Suppliers
   b. Utility Representatives

C. Address project orientation, personnel contact, safety issues, permits, project coordination issues, schedule, deficiencies, and the location of the Contractor's site office.

D. Attend the PSA and address specific safety hazards associated with selected construction means and methods and assist DuPont in developing plans to mitigate these hazards.

1.10 SITE MOBILIZATION MEETING

A. Attend a site mobilization meeting scheduled by the DSR prior to mobilization activities.

B. Attendees:

1. Required Contractor Participants
   a. Contractor’s Superintendent
   b. SSHO
   c. QC Supervisor
   d. All personnel that will be working on site during any portion of the project

2. Optional Contractor Participants
   a. Others as appropriate

C. Address HASP orientation, PSA review, safety expectations, emergency procedures, and site conditions.

1.11 PROGRESS MEETINGS

A. Attend weekly project meetings scheduled by the DSR. In addition to the regularly scheduled meetings, the DSR may schedule additional meetings at his/her discretion, at the request of government agency representatives, or at the request of the Contractor. The Contractor may initiate a meeting by addressing a request to the DSR.

B. Progress meetings shall be held at the Project Site.

C. Attendees:

1. Required Contractor Participants
   a. Contractor’s Superintendent
   b. SSHO

c. QC Supervisor

2. Optional Contractor Participants
   a. Subcontractor representatives
   b. Suppliers appropriate to the agenda

D. Address:

1. Health and safety issues
2. Work progress since previous meeting
3. Projected progress during succeeding work period
4. Field observations, problems, and conflicts
5. Problems that impede construction schedule and proposed corrective actions
6. Revisions to construction schedule
7. Off-site delivery schedules
8. Submittal schedules
9. Quality control
10. Proposed changes for effect on construction schedule and on completion date, and effect on other contracts of the project
11. Other business as appropriate

1.12 DAILY SAFETY AND COORDINATION MEETINGS

A. Daily safety and coordination meetings are for the purposes of reviewing the planned work for the day, identifying and reviewing safety issues and procedures relevant to the work, and obtaining required daily or special (e.g., hot work, excavation) work permits as required in the Site Conditions.

B. Schedule and administer meetings throughout the progress of Work on a daily basis prior to starting work activities and such additional meetings as necessary to meet project needs.

C. The DSR may conduct additional meetings at his/her discretion or at the request of the Contractor.

D. Daily safety and coordination meetings shall be held at the Project Site.

E. Attendees:

1. Required Contractor Participants
   a. Contractor’s Superintendent
   b. SSHO
   c. QC Supervisor

d. All personnel that will be working on site that day

F. Address:

1. Health and safety issues
2. Work planned for the day
3. Review of scheduled deliveries and visitors
4. Quality control issues
5. Review and issuance of required work permits
6. Other business as appropriate

G. Record minutes and include them in the required progress reports in accordance with Section 01320 – CONSTRUCTION PROGRESS DOCUMENTATION.

1.13 WEEKLY FIELD SAFETY AUDIT

A. CRG personnel will schedule and administer field safety audits throughout the progress of Work on a weekly basis in accordance with CRG Standard HS-200.

B. In addition to the regularly scheduled audits, the DSR may conduct additional audits at their discretion.

C. The Contractor's Superintendent, SSHO, or site personnel shall be available to participate in these audits.

D. The CRG safety audit team will record audit results and provide the results to the DSR for review with all Contractor employees.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01320

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Construction progress schedule.
2. Submittal schedule.
3. Survey and layout data.
4. Construction progress reporting.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. The requirements of this Section is integral to each feature of work and separate measurement and payment will not be made for these requirements.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. CPM – Construction Project Manager
2. DuPont – E. I. DuPont de Nemours Company
3. NTP – Notice to Proceed

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Designate an authorized representative to be responsible for the preparation of the schedule and all required updating (activity status) and preparation of reports.
2. The authorized representative shall be experienced in scheduling projects similar in nature and complexity to this project and shall be experienced in the use of the scheduling software that meets the requirements of this specification.

1.05 SUBMITTALS

Engineer review is required for submittals designated as “Action Submittals”. Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

A. Action Submittals

1. Initial project schedule
2. Initial submittal schedule

B. Informational Submittals

1. Periodic schedule updates
2. Periodic submittal schedule updates
3. Equipment delivery schedule

C. Closeout Submittals

1. Record Documentation
   a. Record schedule
   b. Record submittal schedule

1.06 PROJECT SCHEDULE REQUIREMENTS

A. General Requirements

1. Prepare Project Schedule for approval.
2. Show the sequence in which the Work will be performed and start and completion dates for each schedule activity.
3. Schedule the entire project.
4. Construction scheduling is the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Subcontractors and suppliers shall also contribute in developing and maintaining an accurate Project Schedule.
5. Use the Project Schedule to plan and monitor progress of the Work.

B. Approved Project Schedule

1. The approved Project Schedule will be used to measure the progress of the work and to aid in evaluating time extensions.
2. The schedule in conjunction with the Schedule of Values will provide the basis for all progress payments.

3. If the Contractor fails to submit any schedule within the time prescribed, the CPM may withhold approval of progress payments until the Contractor submits the required schedule.

C. Schedule Corrective Action

1. Show necessary corrective action to improve progress including increasing the number of shifts, overtime operations, days of work, and the quantity of construction resources to regain compliance with the approved Project Schedule.

2. Submit for approval supplementary schedule or schedules to demonstrate how the approved rate of progress will be regained.

D. Default Terms

1. Failure to take corrective action to maintain the approved Project Schedule will be grounds for determination that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the contract.

2. Upon making this determination, the CPM may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of the Contract.

E. Critical Path Method

1. Use the Critical Path Method of network calculation to generate the Project Schedule.

2. Prepare the Project Schedule using the Precedence Diagram Method.

F. Level of Detail Required

Develop the Project Schedule to the following level of detail:

1. Activity Duration
   a. Duration that allows the progress of ongoing activities to be accurately determined between update periods.
   b. Less than 2 percent of all non-procurement activities shall have original duration’s greater than 20 workdays or 30 calendar days.

2. Procurement Activities
   a. Activities associated with the submittal, approval, procurement, fabrication and delivery of long lead materials, equipment, fabricated assemblies and supplies.
   b. Long lead procurement activities are those with an anticipated procurement sequence of over 90 calendar days.
   c. A typical procurement sequence includes the string of activities: submit, approve, procure, fabricate, and deliver.

3. Mandatory Tasks
   a. Submission and approval of as-built drawings
   b. Performance Verification testing
   c. Contractor's pre-final inspection
   d. Correction of punchlist from Contractor's pre-final inspection
   e. DuPont pre-final inspection
   f. Correction of punch list from the DuPont pre-final inspection
   g. Final inspection

4. DuPont Activities
   a. Show DuPont and other agency activities that could impact progress. Examples: approvals, environmental permit approvals by State regulators, inspections, utility tie-in, DuPont furnished equipment and NTP for phasing requirements.
   b. Label responsibility for DuPont activities to DuPont or the agency responsible for performing the activity.

5. Contract Changes
   a. Show activity or sequence of activities added to the schedule as a result of a Contract Modification, at the time the modification is approved.
   b. Add activities or sequence of activities resulting from alleged constructive changes made by DuPont to the current schedule. Addition of these activities does not indicate DuPont accepts responsibility or liability for such activities and associated impacts to the schedule, but rather DuPont recognizes such activities are appropriately added to the schedule for the purpose of maintaining a realistic and meaningful schedule.

G. Scheduled Project Completion and Activity Calendars

1. Schedule Interval: from NTP date to the required contract completion date.

2. Contract Completion Activity (End Project): based on the required contract duration in the accepted contract proposal, adjusted for approved contract time extensions.

3. First Scheduled Work Period: the day after the Contractor acknowledges NTP.

4. Schedule activities on a calendar to which the activity logically belongs.

5. Activities may be assigned to a 7-day calendar when the contract assigns calendar day duration for the activity such as a DuPont Acceptance activity.

6. Schedule physical work less than seven days per week on a calendar with non-work periods identified including weekends and holidays.

7. Account for anticipated normal adverse weather.

8. Work periods not identified as non-work periods shall indicate that the Contractor intends to perform work during those periods.

1.07 PROJECT SCHEDULE SUBMISSIONS

A. Initial Project Schedule Submission

1. Submit the Initial Project Schedule for approval within 14 calendar days after NTP.
2. The schedule shall demonstrate a reasonable and realistic sequence of activities that represents the Work through the entire contract performance period.
3. The Initial Schedule shall be at the level of detail specified in Paragraph LEVEL OF DETAIL REQUIRED.

C. Periodic Schedule Updates

1. Submit complete updates of the Project Schedule containing approved progress, revisions, and adjustments every two weeks.
2. Updated schedule shall be subject to the approval of DuPont.
4. Address the following items on an activity by activity basis during each progress meeting.
   a. Start and Finish Dates – Accurately show the status of the Actual Start and/or Actual Finish dates for each activity currently in-progress or completed since the last update. Only assign Actual Start dates when actual progress occurs on an activity.
   b. Remaining Duration – Update the estimated Remaining Duration for incomplete activities independent of Percent Complete.
   c. Percent Complete – Update the percent complete for each activity started, based on the realistic assessment of earned value.
   d. Logic Changes – Identify and discuss logic changes pertaining to NTP on change orders, change orders to be incorporated into the schedule, Contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, and other changes that have been made pursuant to contract provisions. DuPont will only approve logic revisions for the purpose of keeping the schedule valid in terms of its usefulness in calculating a realistic completion date, correcting erroneous logic ties, and accurately sequencing the work.
   e. Other Changes – Other changes required due to delays in completion of an activity or group of activities include:
      1) Delays beyond the Contractor's control, such as strikes and unusual weather.

2) Delays encountered due to submittal reviews, DuPont Activities, deliveries or work stoppages that make re-planning the work necessary.

3) Changes required to correct a schedule that does not represent the actual or planned prosecution and progress of the work.

5. Failure or refusal to furnish project schedule data necessary to verify the Contractor's progress shall be deemed as the Contractor not providing an estimate upon which progress payment can be made.

D. Record Schedule

1. Submit the Record Project Schedule for approval within 14 calendar days after approval of as-built drawings.

2. The Record Project Schedule shall be subject to the approval of DuPont and shall contain all approved revisions and adjustments, Actual Start Dates, Actual Finish Dates, and indicate 100 Percent Complete for all activities.

1.08 REQUESTS FOR TIME EXTENSIONS

A. Furnish justification, project schedule data, and supporting evidence for events in which the Contractor believes it is entitled to an extension of the contract performance period, completion date, or any interim milestone date.

B. Submission of proof of excusable delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is a condition precedent to any approvals by DuPont.

C. Submit a schedule impact analysis demonstrating whether or not Engineering Change Requests issued by DuPont impact the critical path.

D. Justification of Delay

1. Clearly display that the Contractor has used, in full, all the float time available for the work involved with the delay request.

2. The CPM’s determination as to the number of allowable days of contract extension will be based upon the project schedule updates in effect for the time period in question and other factual information.

3. Actual delays that are found to be caused by the Contractor's own actions, which result in a calculated schedule delay, will not be a cause for an extension to the performance period, completion date, or any interim milestone date.

E. Submission Requirements

1. Submit justification for each request for a change in the contract completion date of less than 2 weeks based upon the most recent schedule update at the time of the NTP or constructive direction issued for the change.

2. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:
   a. A list of affected activities, with their associated project schedule activity number.
   b. A brief explanation of the causes of the change.
   c. An analysis of the overall impact of the changes proposed.
   d. A sub-network of the affected area.

3. Identify activities impacted in each justification for change by a unique activity code contained in the required data file.

F. Additional Submission Requirements

1. Provide within 4 days of the CPM's request, an interim update with revised activities for any requested time extension of over 2 weeks.

1.09 DIRECTED CHANGES

A. Submit proposed schedule revisions for changes in which the NTP is issued prior to settlement of price and/or time to the CPM within 2 weeks of the NTP being issued.

B. Proposed revisions to the schedule shall be approved by the CPM prior to inclusion of those changes within the project schedule.

C. Failure to submit proposed revisions shall be basis for the CPM, at their discretion, to furnish the Contractor with suggested revisions to the project schedule. Include CPM suggested revisions in the project schedule until revisions are submitted and final changes and impacts have been negotiated.

D. Submit objections to the CPM furnished revisions and proposed alternative within 2 weeks of receipt of the CPM revisions. Continue to update the schedule with the CPM's revisions until a mutual agreement in the revisions is reached.

E. Failure to submit alternative revisions within 2 weeks of receipt of the CPM's proposed revisions shall indicate that the Contractor concurs with the CPM's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

1.10 OWNERSHIP OF FLOAT

A. Float available in the schedule, at any time, shall not be considered for the exclusive use of either DuPont or the Contractor.

1.11 SUBMITTAL SCHEDULE REQUIREMENTS

A. Submit a Project Submittal Schedule showing full coordination with the project schedule.

B. Indicate the proposed submittal number, referenced specification section, submittal description, proposed date of submittal, and date that review is required by.

C. Prioritize and link to the progress schedule, products and tests under each submittal number.

D. Periodic Submittal Schedule Updates

1. Submit a complete update of the Project Submittal Schedule indicating status of review and revisions biweekly.
2. Update information including proposed submittal date, actual submittal dates, actual review completion dates, disposition of reviewed submittals, and status of items requiring revision and re-submittal. Clearly indicate submittals that are beyond the allotted review period.

E. Record Submittal Schedule

1. Submit the Record Project Submittal Schedule for approval within 14 calendar days after approval of as-built drawings.
2. The Record Project Submittal Schedule shall be subject to the approval of DuPont and shall contain all actual submittal dates, actual review completion dates, and final disposition.

1.12 EQUIPMENT DELIVERY SCHEDULE

A. Submit a schedule showing procurement plans for materials and equipment within 14 calendar days after acceptance of the proposed construction schedule.

B. Submit the following information:

1. Description.
2. Date of the purchase order.
3. Promised shipping date.
4. Name of the manufacturer or supplier.

5. Date delivery is expected.

6. Date the material or equipment is required, according to the current construction schedule.

C. When the expected delivery date exceeds the date required, submit a description of the effect that delayed delivery date will have on the contract completion date and a summary of efforts made by the Contractor to expedite the delayed delivery date to bring it in line with the needed delivery date, including efforts made to place the order (or subcontract) with other suppliers.

D. Update the equipment delivery schedule at monthly intervals or when the schedule has been revised. Reflect any changes occurring since the last update.

E. Submit copies of the purchase orders and confirmation of the delivery dates as directed.

1.13 SURVEY AND LAYOUT DATA REQUIREMENTS

A. Maintain a complete and accurate log of control and survey work as it progresses.

B. On completion of major site improvements, prepare a certified survey illustrating dimensions, locations, angles, and elevations of construction and site work.

C. Provide Digital Terrain Models (DTM) and topographic maps at the same scale provided in the Drawings with a 1-foot contour interval corresponding to the United States National Map Accuracy Standards. All survey shall be tied to the Delaware State Plane Coordinate System. The DTM AutoCAD file must be compatible for use with the AutoCAD Land Development software package.

D. Topographic maps shall be provided in electronic format (i.e. AutoCAD 2008) and reproductive paper prints. All elevation information in the AutoCAD file must be at appropriate 3-D elevations. The vertical datum shall be the North American Vertical Datum (NAVD) of 1988. All horizontal data in the AutoCAD file shall reference the Delaware State Plane Coordinate System. All entries in the AutoCAD file shall be placed on layers named adequately to describe the entity being mapped.

1.14 CONSTRUCTION PROGRESS REPORTING REQUIREMENTS

A. Submit biweekly Progress Reports addressing potential factors of delay, deficiencies, material delivery schedules, submittals, and safety issues.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. General procedures regarding submittals called for in other sections of the specifications.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. The requirements of this Section is integral to each feature of work and separate measurement and payment will not be made for these requirements.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. CPM – Construction Project Manager
2. DuPont – E. I. DuPont de Nemours Company
3. MSDS – Material Safety Data Sheet
4. O&M – Operations and Maintenance
5. QC – Quality Control

B. Definitions

1. Submittals – data normally submitted for review to establish conformance with the design concept and contract documents.
2. Preconstruction Submittals – submittals that are required prior to a notice to proceed on a new contract.
3. Shop Drawings – drawings, diagrams and schedules specifically prepared to illustrate some portion of the work. Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project. Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

4. Product Data – Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work. Samples of warranty language when the contract requires extended product warranties.

5. Samples – Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged. Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project. Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies that are to be incorporated into the project and those which will be removed at conclusion of the work.

6. Design Data – Design calculations, mix designs, analyses or other data pertaining to a part of work.

7. Test Reports – Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within three years of date of contract award for the project.) Report that includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site. Report that includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

8. Certificates – Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project. Document required of Contractor, or of a manufacturer, supplier, installer or subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

9. Manufacturer's Instructions – Preprinted material describing installation of a product, system or material, including special notices and MSDSs concerning impedances, hazards and safety precautions.

10. Manufacturer's Field Reports – Documentation of the testing and verification actions taken by manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be

signed by an authorized official of a testing laboratory or agency and must state the test results; and indicate whether the material, product, or system has passed or failed the test.

11. Operation and Maintenance Data – Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item. This Data is intended to be incorporated in an operations and maintenance manual or control system.

12. Closeout Submittals – Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism. Special requirements necessary to properly close out a construction contract. For example, Record Drawings, manufacturer's help and product lines necessary to maintain and install equipment. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

13. Approving Authority – Office or designated person authorized to approve submittal.

14 Work – As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Make submittals as required by the specifications.

2. The CPM may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections.

3. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings.

4. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements.

5. Prior to submittal, each item shall be checked and approved by the Contractor's QC System Manager, if applicable, and each item shall be stamped, signed, and dated by the Contractor’s QC System Manager indicating action taken.

6. Clearly identify proposed deviations from the contract requirements.

7. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to)

catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals.

8. Submittals requiring Engineer review shall be scheduled and made prior to the acquisition of the material or equipment covered thereby.

9. Pick up and dispose of samples remaining upon completion of the work in accordance with manufacturer's MSDS and in compliance with existing laws and regulations.

B. Scheduling

1. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential requirements to resubmit.

2. Except as specified otherwise, allow review period, beginning with receipt by approving authority, that includes sufficient working days for submittals for QC Manager approval and an additional 15 working days for submittals for Engineer review.

3. Period of review for submittals with Engineer review begins when Engineer receives submittal from QC organization.

4. Period of review for each re-submittal is the same as for initial submittal.

5. No delay damages or time extensions will be allowed for time lost in late submittals.

1.05 SUBMITTALS

Not Used

1.06 PROCEDURES FOR SUBMITTALS

A. Reviewing, Certifying, Approving Authority

1. QC organization shall be responsible for reviewing and certifying that submittals are in compliance with contract requirements.

2. Approving authority on submittals is QC manager unless otherwise specified for specific submittal.

B. Constraints

1. Submittals shall be complete for each definable feature of work; components of definable feature interrelated as a system shall be submitted at same time.

2. When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, submittal will be returned without review.

3. Approval of a separate material, product, or component does not imply approval of assembly in which item functions.

C. Variations

1. Variations from contract requirements require Engineer approval and will be considered where advantageous to DuPont.

2. Discussion with CPM prior to submission will help ensure functional and quality requirements are met and minimize rejections and re-submittals.

3. Proposing Variations
   a. When proposing variation, deliver written request to the CPM, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to DuPont.
   b. If lower cost is a benefit, also include an estimate of the cost saving.
   c. In addition to documentation required for variation, include the submittals required for the item.
   d. Clearly mark the proposed variation in all documentation.

4. Warranting That Variations Are Compatible
   a. When delivering a variation for approval, Contractor warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

5. Review Schedule Is Modified
   a. In addition to normal submittal review period, a period of 10 working days will be allowed for consideration by DuPont of submittals with variations.

D. Contractor's Responsibilities

1. Determine and verify field measurements, materials, and field construction criteria; review each submittal; and check and coordinate each submittal with requirements of the work and contract documents.

2. Transmit submittals to QC organization in accordance with schedule on approved Submittal Register, and to prevent delays in the work, delays to DuPont, or delays to separate Contractors.

3. Advise CPM of variation, as required by paragraph entitled "Variations."

4. Correct and resubmit submittal as directed by approving authority. When resubmitting disapproved transmittals or transmittals noted for resubmittal, the Contractor shall provide copy of that previously submitted transmittal including all reviewer comments for use by approving authority. Direct

specific attention in writing or on resubmitted submittal, to revisions not requested by approving authority on previous submissions.

5. Furnish additional copies of submittal when requested by CPM, to a limit of 20 copies per submittal.

6. Complete work that must be accomplished as basis of a submittal in time to allow submittal to occur as scheduled.

7. Ensure no work has begun until submittals for that work have been returned as "Furnish As Submitted" or "Furnish As Corrected", except to the extent that a portion of work must be accomplished as basis of submittal.

E. QC Organization Responsibilities

1. Note date on which submittal was received from Contractor on each submittal.

2. Review each submittal; and check and coordinate each submittal with requirements of work and contract documents.

3. Review submittals for conformance with project design concepts and compliance with contract documents.

4. Act on submittals, determining appropriate action based on QC organization's review of submittal.
   a. When QC manager is approving authority, take appropriate action on submittal from the possible actions defined in paragraph entitled, "Actions Possible."
   b. When DuPont is approving authority or when variation has been proposed, forward submittal to DuPont with certifying statement or return submittal marked "not reviewed" or "revise and resubmit" as appropriate. The QC organization's review of submittal determines appropriate action.

5. Ensure that material is clearly legible.

6. Stamp each sheet of each submittal with QC certifying statement or approving statement, except that data submitted in bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only.
   a. When approving authority is DuPont, QC organization will certify submittals forwarded to DuPont with the following certifying statement:
   "I hereby certify that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract Number [_____], is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is submitted for DuPont approval.

Certified by Submittal Reviewer _____, Date _____

(Signature when applicable)

Certified by QC Manager _____, Date _____"

(Signature)

b. When approving authority is QC Manager, QC Manager will use the following approval statement when returning submittals to Contractor as "Approved" or "Approved as Noted."
"I hereby certify that the (material) (equipment) (article) shown and marked in this submittal and proposed to be incorporated with contract Number [_____], is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is [_____] approved for use.

Certified by Submittal Reviewer _____, Date _____

(Signature when applicable)

Approved by QC Manager _____, Date _____"

(Signature)

7. Sign certifying statement or approval statement. The person signing certifying statements shall be QC organization member designated in the approved QC plan. The signatures shall be in original ink. Stamped signatures are not acceptable.

8. Update submittal register as submittal actions occur and maintain the submittal register at project site until final acceptance of all work by CPM.

9. Retain a copy of approved submittals at project site, including Contractor's copy of approved samples.

F. DuPont Responsibilities – When approving authority is DuPont, DuPont will:

1. Note date on which submittal was received from QC manager, on each submittal for which the DuPont is approving authority.

2. Review submittals for approval within scheduling period specified and only for conformance with project design concepts and compliance with contract documents.

3. Identify returned submittals with one of the actions defined in paragraph entitled "Actions Possible" and with markings appropriate for action indicated.

G. Actions Possible – Submittals will be returned with one of the following notations:

1. Submittals marked "not reviewed" will indicate submittal has been previously reviewed and approved, is not required, does not have evidence

of being reviewed and approved by Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

2. Submittals marked "furnish as submitted" authorize Contractor to proceed with work covered.

3. Submittals marked "furnish as corrected" authorize Contractor to proceed with work as noted provided Contractor takes no exception to the notations.

4. Submittals marked "revise and resubmit" indicate submittal is incomplete or does not comply with design concept or requirements of the contract documents and shall be resubmitted with appropriate changes. No work shall proceed for this item until re-submittal is reviewed and returned with an action of “furnish as submitted” or “furnish as corrected”.

5. Submittals marked "rejected" indicate submittal does not comply with design concept or requirements of the contract documents and no work shall proceed for this item. The Contractor must make an entirely new submittal for review.

1.07 FORMAT OF SUBMITTALS

A. Transmittal Form

1. Transmit each submittal, except sample installations and sample panels, to office of approving authority.

2. Transmit submittals with transmittal form prescribed by CPM and standard for project.

3. The transmittal form shall identify Contractor, indicate date of submittal, and include information prescribed by transmittal form and required in paragraph entitled "Identifying Submittals."

4. Process transmittal forms to record actions regarding sample panels and sample installations.

B. Identifying Submittals

1. Identify submittals, except sample panel and sample installation, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form.

2. Mark each copy of each submittal identically, with the following:
   a. Project title and location.
   b. Construction contract number.

c. Section number of the specification section by which submittal is required.
d. Submittal number of each component of submittal.
e. When a resubmission, add alphabetic suffix on submittal description, for example, 10A, to indicate resubmission.
f. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other second tier Contractor associated with submittal.
g. Product identification and location in project.

C. Format for Shop Drawings

1. Shop drawings shall not be less than A4 8 1/2 by 11 inches (297 by 210-mm) nor more than AO 30 by 42 inches (1189 by 841 mm).

2. Present A4 8 1/2 by 11 inches (297 by 210-mm) sized shop drawings as part of the bound volume for submittals required by section.

3. Present larger drawings in sets.

4. Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in paragraph entitled "Identifying Submittals."

5. Dimension drawings, except diagrams and schematic drawings; prepare drawings demonstrating interface with other trades to scale. Shop drawing dimensions shall be the same unit of measure as indicated on the contract drawings. Identify materials and products for work shown.

6. Drawings shall include the nameplate data, size and capacity. Also include applicable federal, military, industry and technical society publication references.

D. Format of Product Data and Manufacturer's Instruction

1. Present product data submittals for each section as a complete, bound volume. Include table of contents, listing page and catalog item numbers for product data.

2. Indicate, by prominent notation, each product that is being submitted; indicate specification section number and paragraph number to which it pertains.

3. Supplement product data with material prepared for project to satisfy submittal requirements for which product data does not exist. Identify this material as developed specifically for project, with information and format as required for submission of Certificates.

4. Provide product data in English unit dimensions. Where product data are included in preprinted catalogs with metric only, submit English unit dimensions on separate sheet.

5. Product data shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Submittals shall also include applicable federal, military, industry and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for Certificates.

6. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), ASTM International (ASTM), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the CPM. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

7. Submit manufacturer's instruction prior to installation.

E. Format of Samples

1. Furnish samples in sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately same size as specified:
   a. Sample of Equipment or Device: Full size.
   b. Sample of Materials Less Than 2 by 3 inches: Built up to A4 (297 by 210 mm) 8 1/2 by 11 inches.
   c. Sample of Materials Exceeding A4 (297 by 210 mm) 8 1/2 by 11 inches: Cut down to A4 (297 by 210 mm) 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.
   d. Sample of Linear Devices or Materials: 10 inch (250 mm) length or length to be supplied, if less than 10 inches (250 mm). Examples of linear devices or materials are conduit and handrails.
   e. Sample of Non-Solid Materials: Pint (750 ml). Examples of non-solid materials are sand and paint.
   f. Color Selection Samples: 2 by 4 inches (50 by 100 mm).
   g. Sample Panel: 4 by 4 feet (1200 by 1200 mm).
   h. Sample Installation: 100 square feet (10 square meters).

2. Samples Showing Range of Variation: Where variations are unavoidable due to nature of the materials, submit sets of samples of not less than three units showing extremes and middle of range.

3. Reusable Samples: Incorporate returned samples into work only if so specified or indicated. Incorporated samples shall be in undamaged condition at time of use.

4. Recording of Sample Installation: Note and preserve the notations of area constituting sample installation but remove notation at final clean up of project.

5. When color, texture or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

F. Format of Design Data and Certificates

1. Provide design data and certificates on 8 1/2 by 11 inches (297 by 210-mm) paper. Provide a bound volume for submittals containing numerous pages.

G. Format of Test Reports and Manufacturer's Field Reports

1. Provide reports on 8 1/2 by 11 inches (297 by 210-mm) paper in a complete bound volume.

2. Indicate by prominent notation, each report in the submittal. Indicate specification number and paragraph number to which it pertains.

H Format of O&M Data

1. O&M Data format shall comply with the requirements specified in Section 01 78 00 –CLOSEOUT SUBMITTALS

I. Format of Preconstruction Submittals and Closeout Submittals

1. When submittal includes a document that is to be used in project or become part of project record, other than as a submittal, do not apply Contractor's approval stamp to document, but to a separate sheet accompanying document.

2. Provide all dimensions in administrative submittals in English units. Where data are included in preprinted material with metric only, submit English unit dimensions on separate sheet.

1.08 QUANTITY OF SUBMITTALS

A. Number of Copies of Shop Drawings

1. In addition to the number of copies necessary for Contractor use, submit two copies of submittals of shop drawings requiring review and approval only by QC organization and four copies of shop drawings requiring review and approval by DuPont.

B. Number of Copies of Product Data and Manufacturer's Instructions

1. Submit in compliance with quantity requirements specified for shop drawings.

C. Number of Samples

1. Submit two samples, or two sets of samples showing range of variation, of each required item. Approving authority will retain one approved sample or set of samples and one will be returned to Contractor.

2. Submit one sample panel. Include components listed in technical section or as directed.

3. Submit one sample installation, where directed.

4. Submit one sample of non-solid materials.

D. Number of Copies Design Data and Certificates

1. Submit in compliance with quantity requirements specified for shop drawings.

E. Number of Copies Test Reports and Manufacturer's Field Reports

1. Submit in compliance with quantity with quality requirements specified for shop drawings.

F. Number of Copies of O&M Data

1. Submit three copies of O&M Data to the CPM for review and approval.

G. Number of Copies of Preconstruction Submittals and Closeout Submittals

1. Unless otherwise specified, submit administrative submittals in compliance with quantity requirements specified for shop drawings.

1.09 SUBMITTAL CLASSIFICATION

A. Action Submittal

1. DuPont approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the CPM.

2. DuPont approval is required for any deviations from the Solicitation or Accepted Proposal and other items as designated by the CPM.

B. Informational Submittal

1. All submittals not requiring DuPont approval will be for information only.

2. Normally submittals for information only will not be returned.

3. DuPont reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent DuPont from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the DuPont laboratory or for check testing by DuPont in those instances where the technical specifications so prescribe.

C. Closeout Submittals

1. DuPont will review and approve Closeout Submittals and O&M Data to verify the submittals comply with the contract requirements; submit data specified for a given item within 30 calendar days after the item is delivered to the contract site.

2. In the event the Contractor fails to deliver Closeout Submittals and O&M Data within the time limits specified, the CPM may withhold from progress payments 50 percent of the price of the item with which such submittals are applicable.

1.10 APPROVED SUBMITTALS

A. DuPont approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory design, general method of construction, materials, detailing and other information appear to meet the Solicitation and Accepted Proposal.

B. Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor QC requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work.

C. After submittals have been approved by DuPont, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.11 DISAPPROVED SUBMITTALS

A. The Contractor shall make all corrections required by DuPont and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal.

B. Any "information only" submittal found to contain errors or unapproved deviations from the Solicitation or Accepted Proposal shall be resubmitted as one requiring "approval" action, requiring DuPont approval.

C. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the Contract shall be given promptly to the CPM.

1.12 WITHHOLDING OF PAYMENT

A. Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

B. No payment will be made for any materials incorporated into the work for any conformance review submittals or information only submittals found to contain errors or deviations from the Solicitation or Accepted Proposal.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01351

HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Health and safety documents and procedures in accordance with requirements specified in 29 CFR 1910.120/29 CFR 1926.65 for safety

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. The requirements of this Section are integral to each feature of work and separate measurement and payment will not be made for these requirements.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. CPM – Construction Project Manager
2. CRZ – Contamination Reduction Zone
3. CSP – Certified Safety Professional
4. DuPont – E. I. DuPont de Nemours Company
5. DSR – DuPont Site Representative
6. EZ – Exclusion Zone
7. HASP – Health and Safety Plan
8. OSHA – Occupational Safety and Health Administration
9. PPE – Personal Protective Equipment
10. SSHO – Site Safety and Health Officer
11. SZ – Support Zone

C. Reference Standards

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. American National Standards Institute (ANSI)
   a. ANSI Z358.1 (2004) Standard for Emergency Eyewash and Shower Equipment
2. National Institute for Occupational Safety and Health (NIOSH)
   a. NIOSH 85-115 (1985) Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities
3. U.S. National Archives and Records Administration (NARA)
   a. 29 CFR 1904 Recording and Reporting Occupational Injuries and Illnesses
   b. 29 CFR 1910 Occupational Safety and Health Standards
   c. 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response
   d. 29 CFR 1926 Safety and Health Regulations for Construction
   e. 29 CFR 1926.65 Hazardous Waste Operations and Emergency Response

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Provide the required personnel and execute the project in accordance with the site HASP, Site procedures, and applicable Contractor programs and procedures. The HASP is provided as part of the Contract Documents.
2. Comply with the requirements in the HASP.
3. Work with the DSR and appropriate representatives of DuPont to resolve discrepancies found between the HASP and Site or Contractor programs and procedures.
4. Comply with procedures prescribed for control and safety of persons visiting the project site.
5. Maintain responsibility for personnel and familiarize each subcontractor with safety requirements.
6. Advise the DSR of any special safety restriction established so that DuPont personnel can be notified of these restrictions.

B. Preinstallation Meetings

1. Pre-construction Safety Conference

a. A pre-construction safety conference shall be conducted prior to the start of site activities.
b. The objective of the meeting will be to discuss health and safety concerns related to the impending work, discuss project health and safety organization and expectations, review and answer comments and concerns regarding the HASP or other health and safety concerns the Contractor may have.
c. The Contractor shall ensure that those individuals responsible for health and safety at the project level are available and attend this meeting.

1.05 SUBMITTALS

Engineer review is required for submittals designated as “Action Submittals”. Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

A. Action Submittals

1. Contractor shall submit Subcontractor Safety Data Forms for each subcontractor to the DuPont Site Representative for approval a minimum of 10 working days prior to use of the subcontractor.

B. Informational Submittals

1. Certificates
   a. Employee Certificates
      A certificate for each worker performing cleanup operations with potential for contaminant-related occupational exposure signed by the safety and health manager and the occupational physician indicating the workers meet the training and medical surveillance requirements of this contract.

2. Special Procedure Submittals
   a. The Contractor shall submit a daily Health & Safety report, which summarizes H&S activities, including the topic discussed at the daily health and safety meeting and air monitoring results. This report shall be submitted on the first work day following the date of the report.
   b. Contractor’s corporate Health and Safety Program or at a minimum, all sections that relate to this project, available at the Site for review.
   c. Overhead and Underground Obstructions Plan

3. Qualification Statements
   a. SSHO qualifications

b. Occupational Physician qualifications

C. Closeout Submittals

Not Used

1.06 QUALITY ASSURANCE

A. Regulatory Requirements

1. Comply with OSHA requirements in 29 CFR 1910 and 29 CFR 1926, especially OSHA Standards 29 CFR 1926.65 and 29 CFR 1910.120 and state specific OSHA requirements, where applicable.
2. Comply with other applicable federal, state, and local laws, regulations, ordinances, codes, and orders relating to safety and health.
3. Submit matters of interpretation of standards to the DSR for resolution before starting work.
4. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements shall apply.

B. Qualifications

1. Safety and Health Manager
   a. A minimum of 3 years experience in developing and implementing safety and health programs at hazardous waste sites.
   b. Documented experience in supervising professional and technician level personnel.
   c. Documented experience in developing worker exposure assessment programs and air monitoring programs and techniques.
   d. Documented experience in managing personal protective equipment programs and conducting PPE hazard evaluations for the types of activities and hazards likely to be encountered on the project.
   e. Working knowledge of state and Federal occupational safety and health regulations.
2. CSP
   a. Certified Safety Professional certification by the Board of Certified Safety Professionals (BCSP).
   b. Documented experience in supervising professional and technician level personnel.
   c. Documented experience in managing personal protective equipment programs and conducting PPE hazard evaluations for the types of activities and hazards likely to be encountered on the project.

d. Working knowledge of state and Federal occupational safety and health regulations.

3. SSHO
   a. A minimum of 2 years experience in implementing safety and health programs at hazardous waste sites where Level C or higher personal protective equipment was required.
   b. 30-hour OSHA construction safety class or equivalent within the last 3 years. Documented experience in construction techniques and construction safety procedures may be submitted for consideration as a substitute for education requirement.
   c. Competent person training as needed.
   d. Working knowledge of Federal and state occupational safety and health regulations.
   e. Specific training in personal and respiratory protective equipment, confined space entry and in the proper use of air monitoring instruments and air sampling methods.

1.07 WORK PLANS

A. HASP

1. Implement the HASP.
2. The HASP addresses occupational safety and health hazards (traditional construction as well as contaminant-related hazards) associated with cleanup operations.
3. Acceptance and Modifications
   a. Accept the HASP prior to starting on-site work.
   b. Notify the DSR of deficiencies or discrepancies in the HASP at the pre-construction conference. DuPont will revise the plan to correct deficiencies and re-submit it for use.
   c. Maintain one copy of the HASP on the Site.
   d. The HASP is a dynamic document, subject to change as project operations/execution change. The HASP will require modification to address changing and previously unidentified health and safety conditions. It is the Contractor's responsibility to ensure that updates to the HASP regarding the Contractor’s means and methods are provided to DuPont accordingly. Amendments to the HASP will be submitted to the Contractor as the HASP is updated.
   e. Changes and modifications to the accepted HASP shall be made with the knowledge and concurrence of the Safety and Health Manager, the Site Superintendent, DSR and the CPM.
   f. Notify the SSHO, Safety and Health Manager, the Site Superintendent, DSR, and the CPM of unforeseen hazards that become evident during the performance of the work. Take necessary action to re-establish and maintain safe working

conditions in order to safeguard on-site personnel, visitors, the public, and the environment until the hazard can be resolved.

g. Disregard for the provisions of this specification or the accepted HASP shall be cause for stopping work until the matter has been rectified.

4. Availability

a. Make the HASP available in accordance with 29 CFR 1910.120, (b)(1)(v) and 29 CFR 1926.65, (b)(1)(v).

B. Overhead and Underground Obstructions Plans

1. Submit an Overhead and Underground Obstructions Plans prior to mobilization.

2. Include:

a. List of obstructions located in the immediate work area and potential routes of vehicular access to the site. Examples: electrical wires and other overhead utilities, pipe racks and associated piping, low-clearance structures such as roof overhangs and bridges, buried utilities and pipelines, structural foundations, and vibration sensitive structures and equipment.

b. List of equipment with potential for contacting overhead or underground obstructions in prioritized order by frequency of usage and potential hazard. Examples: dump trucks and other equipment with beds capable of being raised, drill rigs, cranes and other rigging equipment, excavators and other bucket type heavy equipment, and high clearance loads including tanks, columns, storage silos, and treatment systems.

c. List of the proposed measures for mitigating each identified hazard. Examples: utility removal or relocation, utility shut-off, locking out of pipelines, temporary shut-down of adjacent processes, and shoring/bracing of adjacent structures.

d. List of procedures to be used or followed. Examples: use of “soft dig” technologies, use of spotters and driver duties.

e. List of the control systems to be used. Examples: isolation of hazards using curbing or barricades, marking traffic routes, use of stop signs, warning signs, warning sensors, electric eyes, warning chains or false work, and additional visual and audible alarms.

1.08 FIELD CONDITIONS

A. Ambient Conditions

1. The project site is located near natural waterways and wildlife habitats; therefore, biological hazards may be encountered. The primary biological hazards are mosquitoes and stinging insects. Although unlikely, snakes, fox, rodents, and other feral animals may migrate onto the site from

surrounding areas. Geese, ducks, seagulls, and other waterfowl are frequently present and occasionally nest within the work area. Avoid all wildlife and waterfowl on the site. Notify the DSR if nesting sites are encountered.

B. Existing Conditions

1. The Contractor shall refer to the information provided in the HASP for the site description and contamination characterization.

2. Personnel and equipment may be required to operate on top of stabilized material. This material may be slippery or soft in areas and subject to sudden movement or differential settlement when heavy equipment is placed on it.

1.09 TASK SPECIFIC HAZARDS, INITIAL PPE, HAZWOPER MEDICAL SURVEILLANCE AND TRAINING APPLICABILITY

A. Task specific occupational hazards, task specific HAZWOPER medical surveillance and training applicability and task specific initial PPE requirements for the project are listed in the HASP.

B. Reevaluate occupational safety and health hazards as the work progresses and adjust the PPE and onsite operations, if necessary, so that the work is performed safely and in compliance with occupational safety and health regulations.

C. DuPont Corporate lifting guideline restricts lifting by personnel to a maximum 50-pound limit.

1.10 STAFF ORGANIZATION AND RESPONSIBILITIES

A. Safety and Health Manager Responsibilities

1. Be responsible for the implementation, oversight, and enforcement of the HASP.

2. Sign and date the HASP acceptance sheet prior to initiation of field activities.

3. Conduct initial site-specific training.

4. Be available for consultation during the first 3 days of remedial activities and at the startup of each new major phase of work.

5. Visit the site as needed and at least once per month for the duration of activities, to audit the effectiveness of the HASP.

6. Be available for emergencies.

7. Provide onsite consultation as needed to ensure the HASP is fully implemented.

8. Coordinate any modifications to the HASP with the Site Superintendent, the SSHO, DSR and the CPM.
9. Provide continued support for upgrading/downgrading of the level of personal protection.
10. Be responsible for evaluating air monitoring data and recommending changes to engineering controls, work practices, and PPE.
11. Review accident reports and results of daily inspections.
12. Serve as a member of the Contractor's quality control staff.

B. CSP

1. Contractor shall review project hazards and the safety and health manager's certification requirements.
2. If project hazards warrant and if the safety and health manager will not possess the certification, knowledge and experience to address all occupational safety and health problems expected to be encountered, the Contractor shall provide a CSP to oversee safety and occupational health management, surveillance, inspections, and safety enforcement for the Contractor. If qualified, the Contractor’s Safety and Health Manager may perform this role for projects associated with work on hazardous waste site cleanup projects.
3. Serve as the safety and occupational health "competent person".
4. Shall have no other duties other than safety and occupational health management, inspections, and enforcement on this contract. If the CSP is appointed as the SSHO all duties of that position shall also be performed.
5. Conduct and document audits of daily safety and health inspections.

C. Site Safety and Health Officer (SSHO)

1. An individual and one alternate shall be designated the SSHO.
2. The name, qualifications (education and training summary and documentation), and work experience of the SSHO and alternate shall be submitted to the DSR for review.
3. The SSHO shall:
   a. Assist and represent the Safety and Health Manager in onsite training and the day to day onsite implementation and enforcement of the accepted HASP.
   b. Be assigned to the site on a full time basis for the duration of field activities. The SSHO can have collateral duties in addition to Safety and Health related duties. If operations are performed during more than 1 work shift per day, a site SSHO shall be present for each shift.

c. Have authority to ensure site compliance with specified safety and health requirements, Federal, state and OSHA regulations and all aspects of the HASP including, but not limited to, activity hazard analyses, air monitoring, use of PPE, decontamination, site control, standard operating procedures used to minimize hazards, safe use of engineering controls, the emergency response plan, confined space entry procedures, spill containment program, and preparation of records by performing a daily safety and health inspection and documenting results on the Daily Safety Inspection Log in accordance with 29 CFR 1904.

d. Have authority to stop work if unacceptable health or safety conditions exist, and take necessary action to re-establish and maintain safe working conditions.

e. Consult with and coordinate any modifications to the HASP with the Safety and Health Manager, the Site Superintendent, DSR and the CPM.

f. Serve as a member of the Contractor's quality control staff on matters relating to safety and health.

g. Conduct accident investigations and prepare accident reports.

h. Conduct daily safety inspection and document safety and health findings into the Daily Safety Inspection Log. Track noted safety and health deficiencies to ensure that they are corrected.

i. In coordination with site management and the Safety and Health Manager, recommend corrective actions for identified deficiencies and oversee the corrective actions.

D. Occupational Physician

1. The services of a licensed physician, who is certified in occupational medicine by the American Board of Preventative Medicine, or who, by necessary training and experience is Board eligible, shall be utilized.

2. The physician shall be familiar with this site's hazards and the scope of this project.

3. The medical consultant's name, qualifications, and knowledge of the site's conditions and proposed activities shall be submitted to the DSR for review.

4. The physician shall be responsible for the determination of medical surveillance protocols and for review of examination/test results performed in compliance with 29 CFR 1910.120, (f) and 29 CFR 1926.65, (f) and paragraph MEDICAL SURVEILLANCE.

E. Persons Certified in First Aid and CPR

1. At least two persons who are currently certified in first aid and CPR by the American Red Cross or other approved agency shall be onsite at all times during site operations.

2. They shall be trained in universal precautions and the use of PPE as described in the Bloodborne Pathogens Standard of 29 CFR 1910, Section .1030.

3. These persons may perform other duties but shall be immediately available to render first aid when needed.

F. Safety and Health Technicians

1. As deemed necessary by the SSHO, for each work crew in the exclusion zone, one person, designated as a Safety and Health technician, shall perform activities such as air monitoring, decontamination, and safety oversight on behalf of the SSHO.

2. They shall have appropriate training equivalent to the SSHO in each specific area for which they have responsibility and shall report to and be under the supervision of the SSHO.

1.11 TRAINING

A. The Contractor's training program for workers performing cleanup operations and who will be exposed to contaminants shall meet the following requirements.

B. General Hazardous Waste Operations Training

1. All Personnel performing duties with potential for exposure to onsite contaminants shall meet and maintain the following 29 CFR 1910.120/29 CFR 1926.65 (e) training requirements:
   a. 40 hours of off site hazardous waste instruction.
   b. 3 days actual field experience under the direct supervision of a trained, experienced supervisor.
   c. 8 hours refresher training annually.
   d. Onsite supervisors shall have an additional 8 hours management and supervisor training specified in 29 CFR 1910.120/29 CFR 1926.65 (e) (4).

C. Pre-entry Briefing

1. Prior to commencement of onsite field activities, all site employees, including those assigned only to the Support Zone, shall attend a site-specific safety and health training session.

2. This session shall be conducted by the Safety and Health Manager and the SSHO to ensure that all personnel are familiar with requirements and responsibilities for maintaining a safe and healthful work environment.

3. Procedures and contents of the accepted HASP shall be thoroughly discussed.

4. Each employee shall sign a training log to acknowledge attendance and understanding of the training.

5. The DSR shall be notified at least 5 days prior to the initial site-specific training session so DuPont personnel involved in the project may attend.

D. Periodic Sessions

1. Periodic onsite training shall be conducted by the SSHO at least weekly for personnel assigned to work at the site during the following week.
2. The training shall address safety and health procedures, work practices, any changes in the HASP, activity hazard analyses, work tasks, or schedule; results of previous week's air monitoring, and review of safety discrepancies and accidents.
3. Should an operational change affecting onsite fieldwork be made, a meeting prior to implementation of the change shall be convened to explain safety and health procedures.
4. Site-specific training sessions for new personnel, visitors, and suppliers shall be conducted by the SSHO using the training curriculum outlines developed by the Safety and Health Manager.
5. Each employee shall sign a training log to acknowledge attendance and understanding of the training.

E. Other Training

1. Special site specific training requirements are detailed in the HASP.

1.12 PERSONAL PROTECTIVE EQUIPMENT

A. Site Specific PPE Program

1. Onsite personnel exposed to contaminants shall be provided with appropriate personal protective equipment.
2. Components of levels of protection (B, C, D and modifications) must be relevant to site-specific conditions, including heat and cold stress potential and safety hazards.
3. Only respirators approved by NIOSH shall be used.
4. Commercially available PPE, used to protect against chemical agent, shall be approved by DuPont.
5. Protective equipment and clothing shall be kept clean and well maintained.
6. The PPE section of the HASP includes site-specific procedures to determine PPE program effectiveness and for onsite fit-testing of respirators, cleaning, maintenance, inspection, and storage of PPE.

B. Levels of Protection

1. The Safety and Health Manager shall establish and evaluate as the work progresses the levels of protection for each work activity.

2. The Safety and Health Manager shall also establish action levels for upgrade or downgrade in levels of PPE.

3. Protocols and the communication network for changing the level of protection is described in the HASP.

4. The PPE evaluation protocol addresses air monitoring results, potential for exposure, changes in site conditions, work phases, job tasks, weather, temperature extremes, individual medical considerations, etc.

5. Initial PPE Components

   The items that constitute initial minimum protective clothing and equipment ensembles for Level D, Modified Level D, Level C, and Level B are provided in the HASP.

1.13 MEDICAL SURVEILLANCE PROGRAM

A. The Contractor's medical surveillance program for workers performing cleanup operations and who will be exposed to contaminants shall meet 29 CFR 1910.120/29 CFR 1926.65 (f) and the following requirements.

B. The Contractor shall assure the Occupational Physician or the physician's designee performs the physical examinations and reviews examination results.

C. Participation in the medical surveillance program shall be without cost to the employee, without loss of pay and at a reasonable time and place.

D. Frequency of Examinations

1. Medical surveillance program participants shall receive medical examinations and consultations on the following schedule:
   a. Every 12 months
   b. If and when the participant develops signs and symptoms indicating a possible overexposure due to an uncontrolled release of a hazardous substance on the project.
   c. Upon termination or reassignment to a job where medical surveillance program participation is not required, unless his/her previous annual examination/consultation was less than 6 months prior to reassignment or termination.
   d. On a schedule specified by the occupational physician.

E. Content of Examinations

1. The physical examination/consultation shall verify the following information about medical surveillance program participants:
   a. Baseline health conditions and exposure history.
   b. Allergies/sensitivity/susceptibility to hazardous substances exposure.
   c. Ability to wear personal protective equipment inclusive of NIOSH certified respirators under extreme temperature conditions.
   d. Fitness to perform assigned duties.

2. The Contractor shall provide the occupational physician with the following information for each medical surveillance program participant:
   a. Information on the employee's anticipated or measured exposure.
   b. A description of any PPE used or to be used.
   c. A description of the employee's duties as they relate to the employee's exposures (including physical demands on the employee and heat/cold stress).
   d. A copy of 29 CFR 1910.120, or 29 CFR 1926.65.
   e. Information from previous examinations not readily available to the examining physician.
   f. A copy of Section 5.0 of NIOSH 85-115.
   g. Information required by 29 CFR 1910 Section .134.

F. Physician's Written Opinion

1. A copy of the physician's written opinion for each employee shall be obtained and furnished to the Safety and Health Manager; and the employee before work begins.

2. The opinion shall address the employee's ability to perform hazardous waste site remediation work and shall contain the following:
   a. The physician's verification of the employee's fitness to perform duties as well as recommended limitations upon the employee's assigned work and/or PPE usage.
   b. The physician's opinion about increased risk to the employee's health resulting from work.
   c. A statement that the employee has been informed and advised about the results of the examination.

G. Employee Certificates

1. Documentation that employees have received medical examinations shall be provided on employee certificates.

H. Site Specific Medical Surveillance

Prior to onsite work, medical surveillance program participants shall undergo the medical testing prescribed in the HASP.

1.14 EXPOSURE MONITORING/AIR SAMPLING PROGRAM

A. The Safety and Health Manager shall prepare and implement an exposure monitoring/air sampling program to identify and quantify safety and health hazards and airborne levels of hazardous substances in order to assure proper selection of engineering controls, work practices and personal protective equipment for affected site personnel.

B. Include action levels for upgrading/downgrading PPE in the program.

C. The Contractor shall monitor for the gasses, vapors and aerosolized contaminants identified in the HASP.

1.15 HEAT STRESS MONITORING AND MANAGEMENT

A. The Contractor shall implement the procedures and practices in the HASP to monitor and manage heat stress.

1.16 SPILL AND DISCHARGE CONTROL

A. Written spill and discharge containment/control procedures shall be developed and implemented.

B. These procedures shall address, as applicable, radioactive wastes, shock sensitive wastes, laboratory waste packs, material handling equipment, as well as drum and container handling, opening, sampling, shipping and transport.

C. These procedures shall describe prevention measures, such as building berms or dikes; spill control measures and material to be used (e.g. booms, vermiculite); location of the spill control material; personal protective equipment required to cleanup spills; disposal of contaminated material; and who is responsible to report the spill.

D. Storage of contaminated material or hazardous materials shall be appropriately bermed, diked and/or contained to prevent any spillage of material on uncontaminated soil.

E. If the spill or discharge is reportable, and/or human health or the environment is threatened, the National Response Center, the state, and the CPM shall be notified as soon as possible.

1.17 SITE CONTROL MEASURES

A. Work Zones

1. Delineation of work zone boundaries shall be based on the contamination characterization data and the hazard/risk analysis to be performed as described in paragraph: HAZARD/RISK ANALYSIS.
2. As work progresses and field conditions are monitored, work zone boundaries may be modified with approval of the DSR.
3. Work zones shall be clearly identified and marked in the field (using fences, tape, signs, etc.).
4. Work zones shall consist of the following:
   a. Exclusion Zone (EZ): The exclusion zone is the area where hazardous contamination is either known or expected to occur and the greatest potential for exposure exists. Entry into this area shall be controlled and exit may only be made through the CRZ.
   b. Contamination Reduction Zone (CRZ): The CRZ is the transition area between the Exclusion Zone and the Support Zone. The personnel and equipment decontamination areas shall be separate and unique areas located in the CRZ.
   c. Support Zone (SZ): The Support Zone is defined as areas of the site, other than exclusion zones and contamination reduction zones, where workers do not have the potential to be exposed to hazardous substances or dangerous conditions resulting from hazardous waste operations. The Support Zone shall be secured against active or passive contamination. Site offices, parking areas, and other support facilities shall be located in the Support Zone.

B. Site Control Log

1. A log of personnel visiting, entering, or working on the site shall be maintained.
2. The log shall include the following: date, name, agency or company, time entering and exiting site, time entering and exiting the exclusion zone (if applicable).
3. Before visitors are allowed to enter the Contamination Reduction Zone or Exclusion Zone, they shall show proof of current training, medical surveillance and respirator fit testing (if respirators are required for the tasks to be performed) and shall fill out a Certificate of Worker or Visitor Acknowledgment. This visitor information, including date, shall be recorded in the log.

C. Communication

1. An employee alarm system that has adequate means of on and off site communication shall be provided and installed in accordance with 29 CFR 1910 Section .165.
2. The means of communication shall be able to be perceived above ambient noise or light levels by employees in the affected portions of the workplace.
3. The signals shall be distinctive and recognizable as messages to evacuate or to perform critical operations.

D. Site Security

1. Signs shall be printed in bold large letters on contrasting backgrounds.
2. Signs shall be visible from all points where entry might occur and at such distances from the restricted area that employees may read the signs and take necessary protective steps before entering.

1.18 PERSONAL HYGIENE AND DECONTAMINATION

A. Personnel entering the EZ or CRZ or otherwise exposed to hazardous chemical vapors, gases, liquids, or contaminated solids shall decontaminate themselves and their equipment prior to exiting the CRZ and entering the support zone.

B. Chapter 10.0 of NIOSH 85-115 shall be consulted when preparing decontamination procedures.

C. A detailed discussion of personal hygiene and decontamination facilities and procedures to be followed by site workers is included in the HASP.

D. Employees shall be trained in the procedures and the procedures shall be enforced throughout site operations.

E. Decontamination Facilities

1. The Contractor shall initially set up a decontamination line in the CRZ.
2. Employees shall exit the exclusion zone through the CRZ and shall implement the following decontamination procedures and techniques:
   a. Scrub and rinse water proof outer garments
   b. Remove all outer garments
   c. Hand and face wash
3. Showers, if needed, must comply with 29 CFR 1910, Section.141.
4. Additional decontamination procedures Contractor personnel are to follow are identified in the HASP.

5. It is the SSHO's responsibility to recommend techniques to improve personnel decontamination procedures, if necessary.

6. Initial personnel decontamination equipment is identified in the HASP.

F. Equipment Decontamination

1. Vehicles and equipment used in the EZ shall be decontaminated in the CRZ prior to leaving the site.

2. Facilities for Equipment and Personnel
   a. A vehicle/equipment decontamination station shall be provided within the CRZ for decontaminating vehicles and equipment leaving the EZ.
   b. Complete dry decontamination using a broom to remove dry/loose spilled materials on accessible surfaces.
   c. Provide a designated "clean area" in the CRZ for performing equipment maintenance. This area shall be used when personnel are required by normal practices to come in contact with the ground, i.e., crawling under a vehicle to change engine oil.
   d. Equipment within the EZ or CRZ shall be decontaminated before maintenance is performed.

3. Procedures
   a. Procedures for equipment decontamination shall be developed and utilized to prevent the spread of contamination into the SZ and offsite areas.
   b. These procedures shall address disposal of contaminated products and spent materials used on the site, including containers, fluids, oils, etc.
   c. Any item taken into the EZ shall be assumed to be contaminated and shall be inspected and decontaminated before entering the SZ.
   d. Vehicles, equipment, and materials shall be cleaned and decontaminated prior to leaving the site.
   e. Construction material shall be handled in such a way as to minimize the potential for contaminants being spread and/or carried offsite.
   f. Prior to exiting the site, vehicles and equipment shall be monitored to ensure the adequacy of decontamination.

1.19 EMERGENCY EQUIPMENT AND FIRST AID REQUIREMENTS

A. The following items, as a minimum, shall be maintained onsite and available for immediate use:

1. First aid equipment and supplies approved by the consulting physician.

2. Emergency eyewashes and showers that comply with ANSI Z358.1.

3. Emergency-use respirators (if required). For escape purposes, 5- to 15-minute emergency escape masks shall be supplied. For rescue purposes, [2] positive pressure self-contained breathing apparatus (SCBA) shall be supplied. These shall be dedicated for emergency use only and maintained onsite in the CRZ.
4. Fire extinguishers of sufficient size and type shall be provided at site facilities and in all vehicles and at any other site locations where flammable or combustible materials present a fire risk.
5. Spill Control Kit

1.20 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

A. Emergency response planning, based on the requirements of 29 CFR 1910.120 (l) and 29 CFR 1926.65 (l), has been incorporated in the HASP.

B. In the event of any emergency associated with remedial action, the Contractor shall, without delay

1. Alert all onsite employees and as necessary offsite emergency responders that there is an emergency situation
2. Take action to remove or otherwise minimize the cause of the emergency
3. Alert the DSR
4. Institute measures necessary to prevent repetition of the conditions or actions leading to, or resulting in, the emergency.

C. Employees that are required to respond to hazardous emergency situations shall be trained to their level of responsibility according to 29 CFR 1910.120 (q) and 29 CFR 1926.65 (q) requirements.

D. The plan shall be rehearsed regularly as part of the overall training program for site operations.

E. The plan shall be reviewed periodically and revised as necessary to reflect new or changing site conditions or information.

F. Site-support vehicles shall be equipped with route maps to nearest pre-notified medical facility. At the beginning of project operations, drivers of the support vehicles shall become familiar with the emergency route and the travel time required.

G. Post emergency alerting and response procedures including instructions and a list of names and telephone numbers of emergency contacts (physician, nearby medical facility, fire and police departments, ambulance service, Federal, state, and local environmental agencies; as well as Safety and Health Manager, the Site Superintendent, the DSR, the CPM and/or their alternates).

H. In the event that an incident such as an explosion or fire, or a spill or release of toxic materials occurs during the course of the project, the DSR and CPM shall be verbally notified immediately and receive a written notification within 24 hours. The report shall include the following items:

1. Name, organization, telephone number, and location of the Contractor
2. Name and title of the person(s) reporting
3. Date and time of the incident
4. Location of the incident, i.e., site location, facility name
5. Brief summary of the incident giving pertinent details including type of operation ongoing at the time of the incident.
6. Cause of the incident, if known
7. Casualties (fatalities, disabling injuries)
8. Details of any existing chemical hazard or contamination
9. Estimated property damage, if applicable
10. Nature of damage, effect on contract schedule
11. Action taken to ensure safety and security
12. Other damage or injuries sustained, public or private

1.21 CERTIFICATE OF WORKER/VISITOR ACKNOWLEDGEMENT

A. A copy of a Contractor-generated certificate of worker/visitor acknowledgement shall be completed and submitted for each visitor allowed to enter contamination reduction or exclusion zones, and for each employee.

1.22 INSPECTIONS

A. The SSHO's Daily Inspection Logs shall be attached to and submitted with the Daily Quality Control reports.

B. Each entry shall include the following:

1. Date
2. Work area checked
3. Employees present in work area
4. PPE and work equipment being used in each area
5. Special safety and health issues and notes
6. Signature of preparer

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01354

ENVIRONMENTAL PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Environmental protection requirements, spill and discharge response procedures, and corrective action procedures.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. The requirements of this Section are integral to each feature of work and separate measurement and payment will not be made for these requirements.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. DNREC –Department of Natural Resources and Environmental Control
2. DuPont – E. I. DuPont de Nemours Company
3. DSR – DuPont Site Representative
4. MSDS – Material Safety Data Sheet
5. NPDES – National Pollutant Discharge Elimination System
6. SPDES – State Pollutant Discharge Elimination System

B. Reference Standards

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. American National Standards Institute (ANSI)
   a. ANSI Z400.1 (2004) Hazardous Industrial Chemicals - Material Safety Data Sheets - Preparation
2. U.S. Environmental Protection Agency (EPA)
   a. NPDES (1972; R 2005) National Pollutant Discharge Elimination System

3. U.S. National Archives and Records Administration (NARA)
   a. 40 CFR Protection of Environment
   b. 40 CFR 261 Identification and Listing of Hazardous Waste

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Meet with the DSR to review and alter proposed means and methods, as needed, to comply with the environmental pollution control program.
2. Direct agents of the press and regulatory officials to the DSR. Communicate with regulatory officials or agents of the press only as approved by the DSR.

1.05 SUBMITTALS

Engineer review is required for submittals designated as “Action Submittals”. Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

A. Action Submittals

1. Pre-construction Condition Survey

B. Informational Submittals

1. MSDS

C. Closeout Submittals

Not Used

1.06 QUALITY ASSURANCE

A. Regulatory Requirements

1. Comply with federal, state, and local regulatory requirements pertaining to legal disposal of all construction and demolition waste materials.
2. Maintain records of permits, licenses, certificates, and other environmental regulatory requirement correspondences.

B. Pre-construction Condition Survey

1. Conduct a joint Pre-construction Condition Survey with the DSR prior to starting on-site construction activities.
2. Prepare a report, immediately after completing the survey, with hand sketches, photographs, or video recordings that indicate the condition of

trees and shrubs, grassed and wetland areas, and existing features immediately adjacent to the work site, adjacent to assigned storage areas, and contiguous to access routes.

3. Submit the Pre-construction Condition Survey report to the DSR for signature and approval within 5 working days of conducting the Pre-construction Condition Survey. The Contractor, DSR, and Plant will sign this report upon mutual agreement as to its accuracy and completeness.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Material Safety Data Sheets (MSDS)

1. Submit an MSDS for each product specified in other sections or required by OSHA to have an MSDS.
2. MSDS shall be prepared within the previous five years.
3. Include information for MSDS Sections 1 through 16 in accordance with ANSI Z400.1 and as follows:
   a. Section 11: Include data used to determine the hazards cited in Section 3. Identify acute data, carcinogenicity, reproductive effects, and target organ effects.
   b. Section 12: Include data regarding environmental impacts during raw materials acquisition, manufacture, and use. Include data regarding environmental impacts in the event of an accidental release.
   c. Section 13: Include data regarding the proper disposal of the chemical. Include information regarding recycling and reuse. Indicate whether or not the product is considered to be "hazardous waste" according to 40 CFR 261.
   d. Section 14: Identify hazard class for shipping.
   e. Section 15: Identify federal, state, and local regulations applicable to the material.
   f. Section 16: Include additional information relative to recycled content, biobased content, and other information regarding environmental and health impacts.

B. Packaging Waste Management

1. When possible, furnish products with minimal and easily recyclable packaging and use manufacturers with policies that take back product packaging.

1.08 PROTECTION OF NATURAL RESOURCES

A. Preserve the natural resources within the project boundaries and outside the limits of permanent work in their existing condition or restore to an equivalent condition approved by the DSR.

B. Control noise, dust, vectors, and the disposal of materials and other pollutants.

C. General Disturbance

1. Confine demolition and construction activities to work area limits indicated on the Drawings.
2. Remove debris, rubbish, and other waste materials resulting from demolition and construction operations from site in accordance with the Waste Management Plan.
3. Transport materials with appropriate vehicles and dispose of them off site to areas that are approved for disposal by governing authorities having jurisdiction.
4. Avoid spillage by covering and securing loads when hauling on or adjacent to public streets or highways.
5. Remove spillage and sweep, wash, or otherwise clean project site, streets, or highways.
6. Burning is prohibited.

D. Water Resources

1. Comply with requirements of the NPDES and the applicable SPDES.
2. Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water.
3. Store and service construction equipment at areas designated for collection of oil wastes.
4. Prevent ponding of stagnant water conducive to mosquito breeding habitat.
5. Prevent run-off from site during demolition and construction operations.
6. Equipment will not be permitted to ford live streams.

E. Land Resources

1. Prior to construction, identify land resources to be preserved within the work area.
2. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and landforms without permission from the DSR.
3. Coordinate protection practices with work specified in other sections of the Technical Specifications.
4. Erodible Soils

a. Plan and conduct earthwork to minimize the duration of exposure of unprotected soils, except where the constructed feature obscures borrow areas, quarries, and waste material areas.
b. Clear areas in reasonably sized increments only as needed to use the areas developed.
c. Form earthwork to final grade as shown.
d. Immediately protect side slopes and back slopes upon completion of rough grading.

5. Erosion and Sedimentation Control Devices

   Construct or install temporary and permanent erosion and sedimentation control features as required.

6. Tree and Plant Protection
   a. Prior to start of construction, tag each tree and plant scheduled to remain.
   b. Protect trees and plants scheduled to remain from damage.
   c. In the event of damage to tree or plant, DuPont may deduct the indicated value of the damaged tree or plant from the Contract Sum.

F. Air Resources

1. Prevent creation of dust, air pollution, and odors.
2. Sequence construction to avoid unnecessary disturbance to site.
3. Use mulch, water sprinkling, temporary enclosures, and other appropriate methods as needed to limit dust and dirt rising and scattering in air. Do not use water when it may create hazardous or other adverse conditions such as flooding and pollution.
4. Store volatile liquids, including fuels and solvents, in closed containers. Do not store with materials that have a high capacity to adsorb VOC emissions or in occupied spaces.
5. Properly maintain equipment to reduce gaseous pollutant emissions.

G. Fish and Wildlife Resources

1. Manage and control construction activities to minimize interference with and damage to fish and wildlife.
2. Do not disturb fish and wildlife.
3. Do not alter water flows or otherwise significantly disturb the native habitat related to the project and critical to the survival of fish and wildlife, except as indicated or specified.

1.09 NOISE AND VECTOR CONTROL

A. Control noise pollution at the site to avoid causing a hazard or nuisance and comply with local regulations.

B. Provide methods, means, and facilities to prevent pests and insects from posing a safety hazard or damaging the Work.

C. Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

1.10 SPILL AND DISCHARGE RESPONSE

A. Develop, implement, maintain, supervise, and be responsible for Environmental Protection and Spill and Discharge Control Procedures.

B. Keep spill response materials on site in sufficient quantity to control spills from Contractor equipment and storage containers through the duration of construction.

C. Notify the DSR immediately of any spill or discharge.

D. Be solely responsible for any and all spills or discharges that occur as a result of, or are contributed to by the actions of employees or subcontractors.

E. Cleanup such spills or leaks to the satisfaction of the DSR and in a manner that complies with applicable federal, state, and local laws and regulations.

F. Provide equipment and personnel to perform emergency measures required to contain spills and to remove spilled materials and soils and liquids that become contaminated due to spill. Properly dispose of collected spill material.

G. Provide equipment and personnel to perform decontamination measures that may be required to remove spilled material from previously uncontaminated structures, equipment, or material.

1. Determine the acceptable level of decontamination in consultation with the DSR, and as necessary, the DNREC.
2. Remove contaminated soils to complete cleanup.
3. Decontamination personnel using showers and cleansing or disposing of clothing and equipment in accordance with the HASP, Section 01351 – OWNER SAFETY REQUIREMENTS, Section 01352 – HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES, and the Waste Management Plan.

4. Properly containerize, label, and dispose of contaminated materials such as soil and wood that cannot be decontaminated in accordance with applicable laws and regulations.

5. Pay for decontamination procedures and disposal of residues.

H. Spill Incident Report

1. Report spill incidents in accordance with Section 01352 – HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES.

2. Comply with requirements specified in the Waste Management Plan and participate in the incident investigation.

3. Document spills on the Project Record Drawings and submit to the Engineer as specified in Section 01780 – CLOSEOUT SUBMITTALS.

1.11 CORRECTIVE ACTION

A. Take immediate corrective action upon receipt of a notice in writing from the DSR of any noncompliance with the foregoing provisions.

B. Failure or refusal to comply promptly will be basis for the DSR to issue an order stopping all or part of the work until satisfactory corrective action has been taken.

C. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs of damages by the Contractor unless it was later determined that the Contractor was in compliance.

1.12 POST-CONSTRUCTION CLEANUP

A. Remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work, unless otherwise instructed in writing by the DSR.

B. Grade and fill disturbed areas and seed the entire area in accordance with Section 02300 – EARTHWORK and Section 02900 – PLANTING.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01400

QUALITY REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Contractor quality control requirements including quality control organization, documentation requirements, enforcement procedure, and notification of noncompliance procedure.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. The requirements of this Section are integral to each feature of work and separate measurement and payment will not be made for these requirements.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. CPM – Construction Project Manager
2. DFOW – Definable feature of work
3. DuPont – E. I. DuPont de Nemours Company
4. DSR – DuPont Site Representative
5. EPA – Environmental Protection Agency
6. OSHA – Occupational Safety and Health Administration
7. QC – Quality Control

1.04 ADMINISTRATIVE REQUIREMENTS

A. Establish and maintain an effective QC program.

B. The QC program shall consist of a QC Manager, plans, procedures, and organization necessary to produce an end product that complies with the Contract requirements. The QC program shall cover all construction operations, both on-site and off-site, and shall be keyed to the proposed construction sequence.

C. Furnish qualified personnel, appropriate facilities, instruments, and testing devices necessary for the performance of the QC function.

D. No work or testing may be performed unless the QC Manager or designated QC Staff is on the work site.

E. The DSR reserves the right to require changes in the QC program and operations as necessary, including removal of personnel, to ensure the specified quality of work. The DSR reserves the right to interview any member of the QC organization at any time in order to verify the submitted qualifications.

F. Notify the DSR, in writing, of proposed changes in the QC organization personnel a minimum of seven calendar days prior to a proposed change. Proposed changes shall be subject to the acceptance by the DSR.

G. Complete sufficient inspections and tests of items of work, including that of subcontractors, to ensure conformance to applicable Drawings and Technical Specifications.

1.05 SUBMITTALS

Engineer review is required for submittals designated as “Action Submittals”. Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

A. Action Submittals

1. Proposed changes to the QC Program

B. Informational Submittals

1. Certificates
   a. Testing laboratory Certificate of Accreditation and Scope of Accreditation
   b. QC Certifications: As required by Article QC CERTIFICATIONS.
2. Field Quality Control Submittals
   a. Field Test Reports: One copy, within two working days after the test is performed, attached to the Contractor’s daily report

C. Closeout Submittals

1. Record Documentation
   a. Certificate attesting to the accuracy of the as-built drawings

1.06 QUALITY ASSURANCE

A. Regulatory Requirements

1. Provide labor, materials, services, apparatus, and drawings required to comply with applicable federal, state and local laws, ordinances, rules and regulations, specifications and standards.
2. All references to laws, ordinances, rules and regulations, specifications and standards in the Contract Documents shall always imply the latest issue in effect, including all amendments and errata at the time bids are taken, unless otherwise stated.
3. Give necessary notices, obtain permits (except as otherwise noted) and pay governmental taxes, fees, and other costs in connection with the Work.
4. File necessary plans, prepare documents and obtain necessary approvals of governmental departments having jurisdiction.
5. Obtain required Certificates of Inspection and Approval for the work and deliver the same to the DSR, except as otherwise noted herein.

1.07 QUALITY CONTROL ORGANIZATION

A. QC Manager

1. Provide a QC Manager at the work site to implement and manage the QC program. The QC Manager may perform the duties of project superintendent.
2. The QC Manager shall be qualified to perform the inspection and testing required and have a minimum of 10 years combined experience as a superintendent, inspector, QC Manager, project manager, or construction manager on similar size and type construction contracts that included the major trades that are part of this contract.
3. The QC Manager is required to conduct QC meetings, perform the three phases of control, perform submittal review and approval, ensure testing is performed and provide QC certifications and documentation required in this contract.
4. The QC Manager is responsible for managing and coordinating the three phases of control and documentation performed by others.

B. Alternate QC Manager

1. Designate an alternate for the QC Manager to serve in the event of the designated QC Manager's absence.

2. The period of absence may not exceed two weeks at one time, and not more than 30 workdays during a calendar year.

3. The qualification requirements for the Alternate QC Manager shall be the same as for the QC Manager.

C. QC Staff

1. Provide personnel to ensure adequate QC coverage of all work phases, work shifts, and work crews involved in the construction.

2. The QC staff shall be under the direction of the QC Manager to perform QC activities. The staff shall have no other duties on site.

3. The actual strength of the QC staff may vary during any specific work period to cover the needs of the work period. Add additional staff when necessary for a proper QC organization.

4. The QC staff shall be fully qualified by experience and technical training to perform their assigned QC responsibilities and shall be allowed sufficient time to carry out these responsibilities.

5. The QC program shall clearly identify the duties and responsibilities of each staff member.

6. The QC staff shall be at the site of work during construction activities and they shall have the authority to take action necessary to ensure compliance with the contract.

7. Fulfillment of the minimum QC staff in no way relieves the Contractor of meeting the basic requirements of quality construction in accordance with this contract.

8. QC staff members shall be subject to acceptance by the DSR.

D. Testing Laboratory

1. Perform testing specified in individual specifications by an approved commercial testing laboratory.

2. Construction materials testing laboratories shall be accredited by a laboratory accreditation authority and shall be required to submit a copy of the Certificate of Accreditation and Scope of Accreditation.

3. Laboratory Accreditation Authorities include:
   a. National Voluntary Laboratory Accreditation Program (NVLAP) administered by the National Institute of Standards and Technology
   b. American Association of State Highway and Transportation Officials (AASHTO)
   c. International Accreditation Services, Inc. (IAS)
   d. U. S. Army Corps of Engineers Materials Testing Center (MTC)

e. American Association for Laboratory Accreditation (A2LA)
f. Geosynthetic Accreditation Institute (GAI).

4. The laboratory's scope of accreditation shall include the appropriate ASTM standards (e.g., D 3666) listed in the technical sections of the specifications.

5. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA.

6. The policy applies to the specific laboratory performing the actual testing, not just the "Corporate Office."

7. Capability Check and Recheck
   a. The DSR retains the right to check laboratory equipment in the proposed laboratory and the laboratory technician's testing procedures, techniques, and other items pertinent to testing, for compliance with the standards set forth in this contract.
   b. If the selected laboratory fails the capability check, the Contractor will be assessed the actual cost for the recheck to reimburse DuPont for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

E. Organizational Changes

1. Obtain the DSR's approval before replacing any member of the QC staff. Requests shall include the names, qualifications, duties, and responsibilities of each proposed replacement.

1.08 THREE PHASES OF CONTROL

A. The three phases of control shall adequately cover both on-site and off-site work and shall include the following for each definable feature of work.

B. Preparatory Phase

1. Conduct the preparatory phase with the superintendent and the foreman responsible for the DFOW.

2. Document the results of the preparatory phase actions in the daily report.

3. Perform the following prior to beginning work on each DFOW:
   a. Review each paragraph of the applicable specification sections
   b. Review the contract drawings
   c. Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required
   d. Review the testing requirements and ensure that provisions have been made to provide the required QC testing

e. Examine the work area to ensure that the required preliminary work has been completed
f. Examine the required materials, equipment and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data
g. Review the HASP and the appropriate PSA to ensure that applicable safety requirements are met, and that required MSDS are submitted
h. Discuss construction methods and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each DFOW

C. Initial Phase

1. Conduct the Initial Phase with the foreman responsible for a DFOW when construction crews are ready to start work on that DFOW.

2. Observe the initial segment of the work to ensure that it complies with contract requirements.

3. Document the results of the Initial Phase in the daily report.

4. Perform the following for each DFOW:
   a. Establish the quality of workmanship required.
   b. Resolve conflicts.
   c. Ensure that the approved laboratory performs testing.
   d. Check work procedures for compliance with the HASP and the appropriate PSA to ensure that applicable safety requirements are met.

D. Follow-Up Phase

1. Perform daily checks to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work.

2. Record the checks in the CQC documentation.

3. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of work which may be affected by the deficient work.

4. Do not build upon nor conceal non-conforming work.

E. Additional Preparatory and Initial Phases

1. Conduct additional preparatory and initial phases on the same definable features of work if:
   a. The quality of on-going work is unacceptable.
   b. There are changes in the applicable CQC staff, onsite production supervision or work crew

c. Work on a definable feature is resumed after a substantial period of inactivity
d. Other problems develop.

1.09 TESTING OF MATERIALS

A. Perform required sampling and testing. The DSR retains the right to perform additional tests on materials and equipment.

B. Submit materials for testing, taking into consideration when the materials will be incorporated in the work and the capabilities and capacities of the testing laboratory.

C. Furnish to the DSR duplicate certified copies of all routine tests made by the mill, shop, or factory at which material or equipment has been fabricated or manufactured for the project.

D. Perform tests specified or required to verify that control measures are adequate to provide a product that conforms to contract requirements. Testing includes operation and/or acceptance tests when specified.

E. The QC Manager shall perform the following activities and record and provide the following data:

1. Verify that testing procedures comply with contract requirements
2. Verify that facilities and testing equipment are available and comply with testing standards
3. Check test instrument calibration data against certified standards
4. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared
5. Record all, both passing and failing, tests taken on the QC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test will be given. Actual test reports for tests performed off-site may be submitted later with a reference to the test number and date taken.

F. Test Results

1. Cite applicable Contract requirements, tests or analytical procedures used.
2. Provide actual results and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, notify the DSR immediately.
3. Conspicuously stamp the cover sheet for each report in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, whichever is applicable.

4. A testing laboratory representative authorized to sign certified test reports shall sign test results.
5. Furnish the signed reports, certifications, and other documentation to the DSR via the QC Manager.
6. Failure to submit timely test reports, as stated, may result in nonpayment for related work performed and disapproval of the test facility for this contract.

1.10 QC CERTIFICATIONS

A. Contractor Quality Control Report Certification

Each daily report shall contain the following statement: "On behalf of the Contractor, I certify that this report is complete and correct and equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge except as noted in this report."

B. Invoice Certification

Furnish a certificate to the DSR with each payment request, signed by the QC Manager, attesting that as-built drawings are current and attesting that the work for which payment is requested, including stored material, is in compliance with contract requirements.

C. Completion Certification

Upon completion of work under this contract, the QC Manager shall furnish a certificate to the DSR attesting that "the work has been completed, inspected, tested and is in compliance with the contract."

1.11 DOCUMENTATION

A. Records

1. Maintain current records of on-site and off-site QC operations, activities, and tests performed, including the work of subcontractors and suppliers.
2. Furnish records on an acceptable form and include factual evidence that required QC activities and/or tests have been performed.
3. Records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract.
4. Reports are required for each day work is performed. Account for each calendar day throughout the life of the contract. Prepare and submit one

report for every 7 days of no work and on the last day of a no work period. The first report following a day of no work shall be for that day only.

5. Fill in every space on forms. Use N/A if nothing can be reported in one of the spaces.

6. The superintendent and the QC Manager shall prepare and sign the Contractor daily reports, respectively.

7. The reporting of work shall be identified by terminology consistent with the construction schedule.

8. The "remarks" section of reports will contain pertinent information including directions received, problems encountered during construction, work progress and delays, conflicts or errors in the drawings or specifications, field changes, safety hazards encountered, instructions given and corrective actions taken, delays encountered and a record of visitors to the work site.

9. For each remark given, identify the Schedule Activity No. that is associated with the remark.

B. Quality Control Validation

Establish and maintain the following in a series of three ring binders. Binders shall be divided and tabbed as shown below. These binders shall be readily available to the DSR during all business hours.

1. All milestone inspections arranged by Activity/Event Number.

2. A current up-to-date copy of the Testing Plan and Log with supporting field test reports, arranged by specification section.

3. Copies of all contract modifications, arranged in numerical order. Also include documentation that modified work was accomplished.

4. A current up-to-date copy of the Rework Items List.

5. Maintain up-to-date copies of all punch lists issued by the QC Staff on the Contractor and Sub-Contractors and all punch lists issued by DuPont.

C. As-Built Drawings

1. The QC Manager is required to review the as-built drawings, required by Section 01780 – CLOSEOUT SUBMITTALS, are kept current on a daily basis and marked to show deviations, which have been made from the Contract drawings.

2. Ensure each deviation has been identified with the appropriate modifying documentation number.

3. The QC Manager shall initial each deviation or revision.

4. Upon completion of work, the QC Manager shall submit a certificate attesting to the accuracy of the as-built drawings prior to submission to the DSR.

1.12 NOTIFICATION OF NONCOMPLIANCE

A. The DSR will notify the Contractor of any detected noncompliance with the foregoing requirements.

B. Immediately take corrective action after receipt of such notice.

C. Such notice, when delivered to the Contractor at the site of the work, shall be deemed sufficient for the purpose of notification.

D. Failure or refusal to comply promptly shall be basis for the DSR to issue an order stopping all or part of the work until satisfactory corrective action has been taken.

E. The Contractor shall make no claim for extension of time or for excess costs or damages based on such stop orders.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES AND CONRTOLS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Temporary construction facilities, utilities, and controls including access roads during construction, parking requirements, and temporary buildings.

1.02 PRICE AND PAYMENT PROCEDURES

D. Measurement and Payment

1. Measurement: Lump Sum
2. Payment: Based on the submitted Schedule of Values for completion of the mobilization and demobilization as determined by the DSR with 60 percent of the payment to follow completion and acceptance of the mobilization and 40 percent to follow the completion and acceptance of the demobilization.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. DuPont – E. I. DuPont de Nemours Company
2. DSR – DuPont Site Representative
3. OSHA – Occupational Safety and Health Administration

B. Reference Standards

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. U.S. National Archives and Records Administration (NARA)
   a. 29 CFR 1926 Safety and Health Regulations for Construction
   b. 29 CFR 1926.51 Sanitation
   c. 29 CFR 1926.56 Illumination

1.04 ADMINISTRATIVE REQUIREMENTS

Not Used

1.05 SUBMITTALS

Not Used

1.06 FIELD OFFICES AND SHEDS

A. Provide portable or mobile buildings, or buildings constructed with floors raised above ground shall be securely fixed to foundations with steps and landings securely fixed to the structure at entrance doors prior to use.

B. Provide additional structures required. Existing DuPont structures on the site may not be used by the Contractor during the length of the project without the written consent of DuPont.

C. Obtain written permission from DuPont prior to siting temporary structures on the site. Provide off site facilities for office and storage spaces to meet Contractor's needs.

D. Fill and grade sites for temporary structures to provide drainage away from buildings.

E. Construction: Structurally sound, secure, weather tight enclosures for office and storage spaces with lighting, electrical outlets, heating, cooling and ventilating equipment as specified.

F. Size sheds to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and for inspection of products.

G. Interior Materials in Storage Sheds: As required to provide specified conditions for storage of products.

H. Locate offices and sheds a minimum distance of 30 feet from existing and new structures.

I. Fire Extinguishers: Appropriate type fire extinguisher at each office and each storage area. Minimum required: 10-lb. capacity, rated A, B, C.

J. Heating, Cooling, and Ventilating for Offices: Automatic equipment to maintain comfort conditions in conformance with Article TEMPORARY HEATING, COOLING AND VENTILATION.

K. Heating, Cooling, and Ventilating for Storage Spaces: Heating and ventilation as needed to maintain Products in accordance with Contract Documents; adequate

lighting for maintenance and inspection of Products in conformance with Article TEMPORARY HEATING, COOLING AND VENTILATION.

L. Install office spaces ready for occupancy prior to mobilization.

M. Employee Residential Occupancy: Not allowed on DuPont property.

N. Contractor Office and Facilities:

1. Size: For Contractor's needs.
2. Telephone & Fax: For Contractor’s needs.
3. Other Furnishings: Contractor's option.
4. Equipment: Six adjustable band protective helmets, six pairs of side shield safety glasses with clear lenses, and six Department of Transportation (DOT) compliant high-visibility safety vests for visitors.

O. Provide the following furnishings in an easily accessible area for use by Contractor:

1. One industrial first aid kit, Mr. First Aid Kit No. 8029, or equal
2. One outside thermometer (high/low recording type)
3. Provide potable water dispenser with dual temperature (warm/cool) spigots.

P. The Contractor shall maintain temporary field offices and furnishings for the Contractor during the entire construction period.

1.07 ACCESS ROADS

A. Construct temporary all-weather access roads from public thoroughfares to serve construction area, of a width and load bearing capacity to provide unimpeded traffic for construction purposes.

B. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow.

C. Provide and maintain access to fire hydrants and control valves free of obstructions.

D. Provide means of removing mud from vehicle wheels before entering streets (e.g., stabilized construction entrance).

E. Designated existing on-site roads may be used for construction traffic.

F. Tracked vehicles are not permitted on any paved areas.

1.08 PARKING

A. Improve the existing parking areas to accommodate construction personnel.

B. When site space is not adequate, provide additional off-site parking.

1.09 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to allow for DuPont use of site, and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide protection for plants designated to remain. Replace damaged plants.

C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.10 TEMPORARY ELECTRICITY AND LIGHTING FOR CONSTRUCTION

A. Comply with National Electric Code, Federal, State, and local codes and regulations, and utility company requirements.

B. Complement existing power service capacity and characteristics as required. Determine actual power requirements associated with site work activities and arrange with the local utilities for installation and service of additional supply. Coordinate with the Power Company to assure that the system is sufficient and adequate for temporary power needs and that existing power lines and poles are relocated to accommodate excavation and all other construction activities.

C. Installation: Work shall be by personnel familiar with code requirements and qualified for the work to be performed. Install circuit and branch wiring with area distribution boxes located so that power and lighting are available, if required, throughout the construction site by the use of construction-type power cords. Temporary wiring shall be guarded, buried, or isolated by elevation to prevent accidental contact by equipment.

D. Grounding System: protect circuits with ground fault interrupters.

E. Lighting: Maintain lighting and provide routine repairs. Provide adequate artificial lighting for work areas when natural light is not adequate for work. Light work areas to not less than the minimum illumination intensities listed in OSHA Standard 29 CFR 1926.56.

1.11 TEMPORARY HEATING, COOLING, AND VENTILATION

A. Provide heating, cooling, and ventilation devices and heat, cool, and ventilate as needed to maintain specified conditions for construction operations.

B. Prior to operation of equipment for temporary heating, cooling, or ventilation purposes, verify installation is approved for operation, equipment is lubricated and filters are in place. Provide for operation, maintenance, and regular replacement of filters and worn or consumed parts.

C. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

D. Utilize existing ventilation equipment. Extend and supplement equipment with temporary fan units as required to maintain clean air for construction operations.

1.12 TEMPORARY WATER SERVICE

A. Provide water for construction purposes. DuPont will not furnish water for Contractor use.

B. Provide installation, maintenance, usage, and removal of all temporary water lines and equipment.

1.13 TEMPORARY SANITARY FACILITIES

A. Provide at time of project mobilization and maintain required facilities and enclosures.

B. Provide sanitary facilities of the chemical toilet type complying with OSHA Standard 29 CFR 1926.51 unless otherwise approved by the DSR.

C. Collect and remove sanitary wastes from the site in an appropriate manner.

D. Remove sanitary facilities from the site after Final Acceptance unless otherwise directed by the DSR.

1.14 PROTECTION OF INSTALLED WORK

A. Protect installed Work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to prevent damage.

C. Prohibit traffic from landscaped areas.

1.15 SECURITY

A. Provide supplemental security and facilities to protect the Work and Contractor's operations from unauthorized entry, vandalism, or theft.

B. Coordinate with the DuPont security program at project mobilization. The Work is being performed within an operating facility and, therefore, the Contractor shall comply with all security procedures required by DuPont.

C. Contact the local emergency response agencies to ascertain the type of response required to any emergency situation and to coordinate the responses of the various units.

D. Prepare a list of emergency points of contact, telephone numbers, radio frequencies, and call signs so that dependable responses can be executed.

E. Maintain program throughout construction period until DuPont acceptance precludes the need for Contractor security.

F. Restrict entrance of persons and vehicles into Project site. Allow entrance only to authorized persons with proper identification.

G. Maintain a list of accredited persons, submit copy to DSR on request.

H. Require personnel to sign in upon entering the site and to sign out when leaving.

I. Minimize personnel on-site. Off-duty personnel shall leave the site as soon as possible.

J. Allow no visitors without the approval of the DSR except for properly identified regulatory personnel.

K. Visitors shall not be permitted to enter active work areas without the expressed permission of the DSR.

L. Maintain log of visitors which shall include name, affiliation, and purpose of visit. Make available to DuPont on request.

M. Require signature of visitors on a form relieving DuPont, the Engineer, and the DSR of the liability of any consequences related to potential hazards associated with the site.

1.16 REMOVAL OF FACILITIES, UTILITIES AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials prior to Final inspection.

B. Remove underground installations to a minimum depth of 2 feet below final grade. Grade site as indicated.

C. Clean and repair damage caused by installation or use of temporary Work.

D. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

E. Any structures, office trailers, or other DuPont property that was utilized during the project will remain on site unless other arrangements are made between the Contractor and DuPont.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01600

PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Product transportation, handling, storage, protection, and support requirements.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. The requirements of this Section are integral to each feature of work and separate measurement and payment will not be made for these requirements.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. DuPont – E. I. DuPont de Nemours Company

B. Definitions

1. Engineer – the developer of the Contract Drawings and Technical Specifications for DuPont and will be responsible for review of appropriate submittals for conformance with the Contract documents during construction.
2. Furnish – supply required items.
3. Product – new material, machinery, components, equipment, fixtures, and systems forming the Work, excluding machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.
4. Provide – furnish and install complete, in place and ready for operation and use.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Coordinate the delivery and installation of products with the Work of other sections.
2. Electrical Interface: Install or mount electrical components or apparatus as required for the equipment specified.
3. Start-up and testing: Coordinate start-up and testing with work of other sections and ensure that required utilities and water supply are available.

1.05 SUBMITTALS

Engineer review is required for submittals designated as “Action Submittals”. Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

A. Action Submittals

Not Used

B. Informational Submittals

1. Qualification Statements
   a. Qualification of Manufacturer Representative

C. Closeout Submittals

Not Used

1.06 QUALITY ASSURANCE

A. Qualifications

1. Manufacturer Representative
   a. Endorsed by the product manufacturer to review installation, perform pre-start-up checks, start-up, test, adjust, demonstrate, and provide instruction for the product.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements

1. Transport products in accordance with supplier and manufacturer written instructions.
2. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.
3. Provide special lifting harness or apparatus as may be required by manufacturer to unload products.

B. Storage and Handling Requirements

1. Handle products in accordance with supplier and manufacturer written instructions to prevent soiling, disfigurement, or damage.
2. Store and protect products in accordance with manufacturer instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures.
3. Place fabricated products for exterior storage on sloped supports, above ground.
4. Provide off-site storage and protection when on-site storage or protection is not available or allowed.
5. Cover products subject to deterioration with appropriate covering to prevent damage.
6. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
7. Arrange storage of products to allow access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.

C. Packaging Waste Management

1. When possible, furnish products with minimal and easily recyclable packaging and use manufacturers with policies that take back product packaging.
2. Dispose of product packaging in accordance with the Waste Management Plan.

1.08 PRODUCT OPTIONS

A. Products specified by reference standards or by description only: Any product meeting those standards or description.

B. Products specified by naming one or more manufacturer: Products of manufacturer(s) named and meeting specifications, no options or substitutions allowed.

C. Products specified by naming one or more manufacturers with a provision for substitutions: Submit a request for substitution for any manufacturer not named.

D. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

E. Provide interchangeable components of the same manufacturer for similar components.

1.09 SUBSTITUTIONS

A. The products specified establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution to become an "or equal" item.

B. Submit written request for approval for each proposed substitution at least ten (10) days prior to the date for receipt of Bids. Substitutions received by Engineer after this time will not be considered.

C. Proposed substitution requests shall include:

1. Name of the product that substitution is requested for.
2. A complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation.
3. A statement setting forth any changes in other materials, equipment or Work that incorporation of the substitute would require.

D. The burden of proof of the merit of the proposed substitute is upon the Bidder. The Engineer's decision of approval or disapproval of a proposed substitution shall be final. If Engineer approves any proposed substitution, such approval will be set forth in an Addendum issued to all prospective Bidders. Bidders shall not rely upon approvals made in any other manner.

E. After bidding substitutions may be considered when a product becomes unavailable through no fault of the Contractor by following the procedure described in the following paragraphs.

F. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.

G. A request constitutes a representation that the Bidder:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the Substitution as for the specified product.
3. Will coordinate installation and make changes to other Work, which may be required for the Work to be complete with no additional cost to DuPont.
4. Waives claims for additional costs or time extension, which may subsequently become apparent.

H. Substitutions will not be considered when they are indicated or implied on product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

I. Substitution Submittal Procedure:

1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
2. Submit supporting documentation demonstrating the proposed product equivalence.
3. The Engineer will notify Bidder, in writing, of decision to accept or reject request prior to closing date for bids.

1.10 INSTALLATION REQUIREMENTS

A. Check all dimensions indicated immediately after award of the Contract. Advise the Engineer promptly of discrepancies or interference and obtain such measurements and information as may be required to satisfactorily install the work.

B. Verify all measurements and elevations are correct before ordering material or doing work. Submit differences found between field measurements and elevations and those indicated promptly to the Engineer for adjustment and approval before proceeding with the work.

C. Verify that site conditions are ready to receive the Work.

D. Accurately lay out work and establish heights and grades in strict accordance with the Drawings, buildings and finished site grades.

E. Verify that required utilities are available and of the correct characteristics.

F. Align, level and adjust equipment for satisfactory operation. Install so that connection and disconnection of piping and accessories can be done readily, and so that parts are easily accessible for inspection, operation and maintenance.

G. Install products in accordance with manufacturer written instructions and recommendations.

H. Furnish and apply initial grease or oil recommended by manufacturer before start-up.

I. In the event that installation requirements need clarification as to Contract responsibility, Engineer will be final judge in delineation of responsibility. In no case shall need for clarification result in extension of Contract Time or change in Contract Price.

1.11 MANUFACTURER'S REPRESENTATIVE

A. Provide qualified Manufacturer Representative to review product installation, perform pre-start-up checks, start-up, test, adjust and demonstrate the product and provide written certification that product and its installation meet manufacturer recommendations and comply with the Technical Specifications.

B. Provide instruction in operation and maintenance procedures after the Final Acceptance Test has been successfully completed.

C. Instruction shall include review of start-up, operation and shut down procedures, alternate modes of operation, anticipated adjustments, maintenance procedures and schedules, troubleshooting methods and manufacturer operation and maintenance literature. DuPont reserves right to videotape instruction sessions.

D. Provide services of Manufacturer Representative for the minimum period of time indicated in the Technical Specification for each product. Times indicated shall not include travel time. Extend time as necessary to correct deficiencies and retest. Provide time for instruction in addition to hours provided for start-up, testing, correction of deficiencies, and demonstrations during non-instructive time. Time spent in these other activities will not be considered training hours.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01710

EXAMINATION AND PREPARATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Mobilization
2. Acceptance of conditions
3. Field engineering

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. The requirements of this Section are integral to each feature of work and separate measurement and payment will not be made for these requirements.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. DSR – DuPont Site Representative
2. DuPont – E. I. DuPont de Nemours Company

B. Definitions

1. Demobilization – disassembly and removal from the site of equipment, tools, materials, and supplies that are not incorporated in the Work, restoration on of the work area, and services preparatory to closeout of the Work.
2. Mobilization – assembly and delivery to the site of equipment, tools, materials, and supplies necessary for the prosecution of work that are not intended to be incorporated in the Work, preparation of the work area, and services preparatory to commencement of the Work.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Furnish information to local utility and DuPont that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
2. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.05 SUBMITTALS

Engineer review is required for submittals designated as “Action Submittals”. Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

A. Action Submittals

1. Shop Drawings
   a. Layout of temporary fences, points of access, roads, parking areas, buildings, and staging and storage areas prior to mobilization.
   b. Pre-construction Survey
   c. Surveys for Measurement and Payment

B. Informational Submittals

1. Field Quality Control Submittals
   a. Submit documentation to verify the accuracy of field engineering work upon the request of the DSR or Engineer.
2. Special Procedure Submittals
   a. Submit copies of original field notes, computations, and other survey records to the extent necessary to determine the proper amounts of progress and final payments to the DSR.
3. Qualification Statements
   a. Submit name, address, and telephone number of Surveyor and Engineers before starting Work.

C. Closeout Submittals

1. Record Documentation
   a. Log of control and survey work.
   b. Certified survey illustrating dimensions, locations, angles, and elevations of construction and site work.
   c. Two (2) copies of all original surveyor notes, records, and calculations used/developed by the licensed surveyor. Submit data in a bound book organized chronologically and fully indexed.

d. Description and recovery sketches of permanent control survey monuments established during the Contract.
e. Record drawings to be used for determining Work quantities and documenting construction.

1.06 QUALITY ASSURANCE

A. Qualifications

1. Licensed Professional
   a. Land Surveyor registered in the State of Delaware and acceptable to DuPont.
   b. Professional engineering services licensed in the State of Delaware.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements

1. Deliver construction tools, equipment, plant, temporary buildings, materials and supplies to the site in conformance with local governing ordinances and regulations.

1.08 FIELD CONDITIONS

A. Existing Conditions

1. Investigate and verify the existence and location of mechanical and electrical systems, underground utilities, and other construction affecting the Work.
2. Investigate and verify points of connection of utility services including the invert elevation at points of connection for sanitary sewer, storm sewer, and water-service piping; and underground electrical services.

1.09 MOBILIZATION AND DEMOBILIZATION

A. Provide construction tools, equipment, materials, and supplies of the types and quantities necessary to facilitate the timely execution of the Work.

B. Provide personnel, products, construction materials, equipment, tools, and supplies at the site at the time they are scheduled to be installed or utilized.

C. Locate plant or plants appropriately close to the portion of the Work for which it will be used.

D. Remove construction tools, apparatus, equipment mobile units and buildings, unused materials and supplies, plant, and personnel from the site upon completion of the Work.

E. Restore areas utilized for mobilization to their original, natural state, or as indicated in the Contract Documents.

1.10 ACCEPTANCE OF CONDITIONS

A. Examine substrates, areas, and conditions with Installer or Applicator present for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

B. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Submit a written report listing conditions detrimental to performance of the Work that includes the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

E. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.

F. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

1.11 PREPARATION

A. Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication.

B. Verify space requirements and dimensions of items shown diagrammatically on Drawings.

C. Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

1.12 CONSTRUCTION LAYOUT

A. Before proceeding to lay out the Work, verify layout information shown on Drawings in relation to the property survey and existing benchmarks. Notify DSR promptly if discrepancies are discovered.

B. Provide a qualified land surveyor to lay out the Work using accepted surveying practices.

C. Establish benchmarks and control points to set lines and levels to locate each element of Project.

D. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

E. Inform installers of lines and levels to which they must comply.

F. Notify DSR when deviations from required lines and levels exceed allowable tolerances.

G. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

H. Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

I. Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

J. Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by DSR and Engineer.

1.13 FIELD ENGINEERING

A. Existing benchmarks, control points, and property corners are identified on the Drawings.

B. Reference Points

1. Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work.

2. Preserve and protect permanent benchmarks and control points during construction operations.
3. Do not change or relocate existing benchmarks or control points without prior written approval of the DSR.
4. Report lost or destroyed permanent benchmarks or control points promptly.
5. Report the need to relocate permanent benchmarks or control points to the DSR before proceeding.
6. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks

1. Establish and maintain a minimum of 2 permanent benchmarks on site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
2. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
3. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
4. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Provide qualified civil, structural, and other professional engineering services as specified or required to execute the Contractor's construction methods.

1.14 SUBSURFACE UTILITY ENGINEERING REQUIREMENTS

A. Provide qualified subsurface utility engineering services to:

1. Advise the Contractor of the known or foreseeable risks and impacts that existing subsurface utilities may create on the project.
2. Educate the Contractor regarding utility quality levels and reliability of data for each quality level, including a discussion of costs and benefits associated with obtaining quality levels.
3. Suggest mitigation measures for these impacts.
4. Recommend a scope for utility investigations including a listing of types of utilities for detection and depiction and the desired utility data quality level.

5. Select appropriate suite of surface geophysical methods to search for utilities within the project limits.
6. Apply appropriate surface geophysics within the project limits.
7. Interpret the surface geophysics.
8. Mark the indications of utilities on the ground surface for subsequent survey of those markings.

B. Survey the markings of the indicated utilities and include the depictions on the Record Drawings.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01740

CLEANING AND WASTE MANAGEMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Progress cleaning.
2. Site maintenance.
3. Waste management.
4. Final cleaning.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. The requirements of this Section are integral to each feature of work and separate measurement and payment will not be made for these requirements.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. DuPont – E. I. DuPont de Nemours Company
2. DSR – DuPont Site Representative
3. HASP – Health and Safety Plan
4. IRM – Iron Rich Material

B. Reference Standards

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. U.S. National Archives and Records Administration (NARA)
   a. 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response

1.04 ADMINISTRATIVE REQUIREMENTS

Not Used

1.05 SUBMITTALS

Engineer review is required for submittals designated as “Action Submittals”. Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

A. Action Submittals

1. Cleaning procedures within 7 calendar days of mobilization.

B. Informational Submittals

Not Used

C. Closeout Submittals

Not Used

1.06 PROGRESS CLEANING

A. General Cleaning

1. Provide, operate, and maintain the equipment and materials required to execute the cleaning procedures.
2. Provide weekly janitorial services for offices and periodic cleaning for office and storage areas. Sweep floor and dust furnishings daily.
3. Use a potable water supply for cleaning. Under no circumstances shall on-site surface water be used for the purposes of cleaning.
4. Provide a reduced-pressure backflow preventer for the water supply line that satisfies the requirements of the water supplier and applicable local codes.
5. Provide scrub brushes and other equipment and supplies necessary to execute the approved cleaning procedures.
6. Dispose of expendable materials.

B. Cleaning of Vehicles, Equipment, and Debris

1. Develop and submit cleaning procedures for vehicles, equipment, debris and personnel to the DSR for approval.

2. Control cleaning water so that it drains properly onto the IRM staging area. Construct the decontamination pad such that it is sloped to drain water to the IRM staging area.
3. Provide portable low volume, high-pressure washers at the decontamination area to fully execute the approved cleaning procedures.
4. Provide necessary pipe, hose, and appurtenances necessary to connect pressure washers to the water supply connection.
5. Clean vehicles and equipment that are:
   a. Used within the limit of the Sludge Drying Site indicated on the Drawings.
   b. In direct contact with material contained within the IRM staging area including IRM, stormwater, and debris.
6. Clean vehicles and equipment on the decontamination pad prior to leaving the site.
7. Clean vehicles and equipment using the following procedures:
   a. Physically remove solid materials
   b. Complete pressure wash cleaning
   c. Complete detergent rinse
   d. Final pressure wash rinse
8. The DSR will visually inspect all vehicles and equipment requiring cleaning prior to release from the Site. Repeat cleaning procedures as directed by the DSR.
9. The decontamination pad will be left in place after all construction is complete.

C. Personnel Cleaning

1. Procedures shall comply with the requirements of 29 CFR 1910.120(k).
2. Communicate the procedures to all on-site personnel.
3. Ensure that procedures are implemented prior to commencing work in areas where potential for exposure to hazardous substances exists.
4. Complete in accordance with Section 01352 – Health Safety and Emergency Response Procedures for Contaminated Sites and the HASP.
5. Personnel entering or working within the Exclusion Zone shall complete personnel cleaning procedures prior to entering the Support Zone.
6. Clean personnel using the following procedures:
   a. Physically remove solid materials.
   b. Complete detergent wash cleaning.
   c. Complete water rinse.
   d. Remove and dispose of outer protective clothing.

e. Remove, clean, and properly store respiratory protection equipment (if required).
f. Remove and dispose of inner protective gloves.

1.07 SITE MAINTENANCE

A. Provide periodic maintenance for office and storage areas.

B. Furnish, replace and replenish light bulbs, fluorescent tubes, toilet paper, paper towels, soap, bottled water, and other products required to maintain field offices in a clean condition.

C. Maintain approach walks, parking areas, and access roads free of mud, water, ice, and snow.

1.08 WASTE MANAGEMENT

A. Manage waste in accordance with the Edge Moor Site Conditions and the Waste Management Plan.

B. Remove any waste material dumped in unauthorized areas and restore the area to the condition of the adjacent undisturbed areas.

C. Remove material for disposal from the site in accordance with the Waste Management Plan.

D. No material shall be removed from the site without written permission from the DSR.

E. Material associated with the project shall not be burned.

F. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.09 FINAL CLEANING

A. Execute final cleaning prior to final acceptance inspection.

B. Leave premises "broom clean."

C. Clean debris from drainage systems.

D. Disconnect and remove all temporary utilities in accordance with Section 01500 – TEMPORARY FACILITIES AND CONTROLS.

E. Dismantle and properly dispose of all temporary facilities in accordance with Section 01500 – TEMPORARY FACILITIES AND CONTROLS.

F. Inspect the perimeter and security fence and repair any damaged portions of the fence or gates.

G. Sweep paved areas and rake clean landscaped areas.

H. Remove waste and surplus materials, rubbish and construction facilities from the site.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01770

CLOSEOUT PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Contract closeout procedures.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. The requirements of this Section are integral to each feature of work and separate measurement and payment will not be made for these requirements.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. DuPont – E. I. DuPont de Nemours Company
2. DSR – DuPont Site Representative

1.04 ADMINISTRATIVE REQUIREMENTS

Not Used

1.05 SUBMITTALS

Engineer review is required for submittals designated as “Action Submittals”. Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

A. Action Submittals

Not Used

B. Informational Submittals

1. Certificates

a. Certification that Contract Documents are complete and ready for Engineer's review

2. Special Procedure Submittals
   a. Punch-Out Inspection Punch List.
   b. Notice to schedule the Pre-final Inspection.
   c. Notice to schedule the Final Acceptance Inspection.
   d. Release of Liens and Claims.

C. Closeout Submittals

Not Used

1.06 COMPLETION INSPECTIONS

A. Punch-Out Inspection

1. Near the completion of Work or any increment thereof established by a completion time stated in the Contract or stated elsewhere in the specifications, the QC Manager shall inspect the work and develop a punch list of items that do not conform to the approved drawings and specifications.
2. Include in the punch list any remaining items requiring rework that were not corrected prior to the Punch-Out inspection.
3. Include the estimated date that the deficiencies will be corrected on the punch list.
4. Submit a copy of the punch list to the DSR.
5. Complete additional inspections to ascertain that all deficiencies have been corrected. Once this is accomplished, notify the DSR that the facility is ready for the "Pre-Final Inspection".

B. Pre-Final Inspection

1. The DSR will perform this inspection to verify that the facility is complete and ready to be occupied.
2. The DSR may develop a pre-final punch list as a result of this inspection.
3. Ensure that all items on this list are corrected prior to notifying the DSR that a "Final" inspection with DuPont can be scheduled.
4. Correct items noted on the "Pre-Final" inspection in a timely manner and prior to the contract completion date for the work or any particular increment thereof if the project is divided into increments by separate completion dates.

C. Final Acceptance Inspection

1. Notify the DSR at least 14 days prior to the desired Final Acceptance Inspection date.
2. State in the notice that all specific items previously identified to the Contractor as being unacceptable will be complete by the date scheduled for the final acceptance inspection.
3. The DSR will formally schedule the Final Acceptance Inspection based upon results of the "Pre-Final Inspection".
4. The QC Manager, the superintendent, or other Contractor management personnel shall attend the Final Acceptance Inspection. The DSR and the Engineer will attend this inspection. Additional DuPont personnel may attend at their discretion.
5. Failure to have all contract work acceptably complete for this inspection will be cause for the DSR to bill the Contractor for additional inspection cost in accordance with the Contract.

1.07 CLOSEOUT PROCEDURES

A. DuPont will occupy the site as specified in Section 01100 – SUMMARY.

B. Conduct completion inspections, including Pre-final and Final Acceptance Inspections.

C. Submit final periodic Application for Payment in accordance with Section 01200 – PRICE AND PAYMENT PROCEDURES

D. Submit draft project record documents to DSR for review in accordance with Section 01780 – CLOSEOUT SUBMITTALS

E. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer’s review.

F. Execute warranty documents in accordance with Section 01780 – CLOSEOUT SUBMITTALS.

G. DSR will return reviewed draft project record documents to Contractor for revisions as specified in Section 01780 – CLOSEOUT SUBMITTALS.

H. Complete demobilization and remove temporary utilities, facilities, and controls as specified in Section 01500 – TEMPORARY FACILITIES AND CONTROLS.

I. Submit final project record documents and warranty information to DSR in accordance with Section 01780 – CLOSEOUT SUBMITTALS.

J. Submit Release of Liens and Claims from all Subcontractors and Suppliers.

K. Submit final Application for Payment requesting release of retainage and identifying total adjusted Contract Sum, previous payments, and sum remaining due.

L. DSR will conduct Final Application for Payment inspection to confirm demobilization is complete and acceptable.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 01780

CLOSEOUT SUBMITTALS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Record Documents and document maintenance.
2. Warranties.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. The requirements of this Section are integral to each feature of work and separate measurement and payment will not be made for these requirements.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. DuPont – E. I. DuPont de Nemours Company
2. DSR – DuPont Site Representative

1.04 ADMINISTRATIVE REQUIREMENTS

A. Prepare, maintain and submit project record documents as required by the Specifications.

B. Maintain three sets of the following record documents:

1. Drawings
   a. Contract Drawings as issued for construction
   b. As-built (red line) drawings
2. Specifications
3. Addenda
4. Change Orders and other modifications to the Contract
5. Reviewed Submittals
6. Survey notes, records, and calculations

7. DSR field orders and written instructions
8. Daily progress reports
9. Spill incident reports
10. Approved site-specific Health and Safety Plan and addenda
11. Approved Project Specific Waste Management Plan and addenda
12. Manufacturer's instruction for assembly, installation, and adjusting
13. Daily QC reports
14. Daily Safety Logs
15. Lab analytical results
16. Daily Work Activity Summary Reports
17. Other items as required by DSR

C. Record actual revisions to the Work concurrent with construction progress.

D. Ensure entries are complete, legible, and accurate, enabling future reference.

E. Store a minimum of one set of documents and samples in the Contractor's field office apart from documents used for work.

F. File documents and samples to facilitate retrieval.

G. Maintain documents in a clean, dry, legible condition in good order.

H. Record documents shall not be used for work purposes.

I. Make documents available at all times for inspection by the DSR. Bring one copy of the current as-built drawings to every other weekly progress meeting for the DSR to review.

1.05 SUBMITTALS

Engineer review is required for submittals designated as "Action Submittals". Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

A. Action Submittals

1. Draft Submittal
   a. Submit 2 draft copies of completed record documents including as-built (red line) drawings to the DSR following Substantial

Completion of construction and at least 15 days prior to the Final Acceptance Inspection.

b. The draft record documents shall be neat, legible, and accurate.

c. If upon review, the draft record drawings are found to contain errors and/or omissions, they shall be returned to the Contractor for corrections. Complete the corrections and return the draft record documents to the DSR within 10 calendar days.

d. One copy of the approved draft record documents with Engineer comments will be returned to the Contractor after the Final Acceptance Inspection for use in preparation of final record documents.

B. Informational Submittals

Not Used

C. Closeout Submittals

1. Warranty Documentation
   a. Equipment/Product Warranty List
   b. Provide three sets of notarized copies of warranties required in individual Specification sections.

2. Record Documentation
   a. Submit final record documents to DSR with final Application for Payment.

1.06 RECORD DOCUMENTS

A. Specifications

1. Legibly mark and record at each product reference the description of actual Products installed, including the following:
   a. Manufacturer's name and product model and number
   b. Product substitutions or alternates utilized
   c. Changes made by Addenda and modifications. Include reference to approved Engineering Change Order or Contract Change Order.

2. Legibly mark and record changes to execution methods specified. Include reference to approved Engineering Change Order.

B. Contractor’s Pre-Construction Submittals

1. Legibly mark and record alternate vendors and subcontractors used.

2. Legibly mark and record changes to environmental protection, spill and discharge control procedures.

3. Legibly mark and record changes to the Submittal Register including:
   a. Date of submittal
   b. Date submittal was approved

c. Additional submittals required

4. Legibly mark and record changes to the following:
   a. Contractor's Quality Control Plan
   b. Overhead and Underground Obstructions Plan
   c. Sample Forms

C. Approved site-specific Health and Safety Plan and addenda

1. Legibly mark and record approved changes to the Health and Safety Plan and addenda.

D. Manufacturer's instruction for assembly, installation, and adjusting

1. Legibly mark and record variances from Manufacturer's instructions, including the following:
   a. Description of variance
   b. Reason for variance
   c. Effect of variance on manufacturer's guarantee or warranty
   d. Additional considerations or procedures required due to variance

2. Provide all correspondence regarding Manufacturer's recommendations in support of or against the variance.

1.07 RECORD DRAWINGS

A. Keep record drawings current and available on the job site at all times, 3 sets of marked drawings (paper prints) showing as-built conditions.

B. Accurately and neatly record changes from the Contract Plans that are made in the Work or additional information that might be uncovered in the course of construction as they occur by means of details and notes.

C. Legibly mark drawings to record actual construction, including:

1. Field changes of dimension and detail including:
   a. Correct grade or alignment of pipelines or utilities if changes were made from Contract Plans.
   b. Correct elevations if changes were made in site grading.
   c. Design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor including but not limited to, fabrication, installation plans and placing details, pipe sizes, etc.

2. Changes made by field order or by change order.

3. Details not on original Contract Drawings.

4. The location and description of utilities and appurtenances or other installations of any kind or description known to exist within the

construction area. Location shall include measured horizontal and vertical dimensions referenced to permanent surface features.

5. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.

6. The topography and grades of installed or affected Work as a part of the project construction.

7. Changes or modifications that result from the final inspection.

8. Show only the option selected for construction on the as-built drawings where Contract Drawings or specifications allow options.

1.09 WARRANTY REQUIREMENTS

A. Equipment/Product Warranty List

1. Submit a bound and indexed notebook containing written warranties for equipment/products furnished and prepare a complete listing of such equipment/products.

2. The equipment/products list shall state the specification section applicable to the equipment/product, duration of the warranty therefor, start date of the warranty, ending date of the warranty, and the point of contact for fulfillment of the warranty.

3. The warranty period shall begin on the same date as project acceptance and shall continue for the full product warranty period.

4. Execute the full list and submit prior to final acceptance of the facility.

B. Equipment Warranty Tags and Guarantor's Local Representative

1. Submit with each warranty the name, address, and telephone number of the guarantor's representative nearest to the location where the equipment and appliances are installed.

2. The guarantor's representative shall honor the warranty during the warranty period, and shall provide the services prescribed by the terms of the warranty.

3. At the time of installation, tag each item of warranted equipment with a durable, oil- and water-resistant tag.

4. Attach tag with copper wire and spray with a clear silicone waterproof coating.

5. Leave the date of acceptance and QC's signature blank until project is accepted for beneficial occupancy.

6. Tag shall show the following information:

EQUIPMENT/PRODUCT WARRANTY TAG

Type of Equipment/Product _____
Warranty Period _____ From _____ To _____
Contract No. _____
Inspector's Signature _____ Date Accepted _____
Construction Contractor:
Name: _____
Address: _____
Telephone: _____
Warranty Contact: _____
Name: _____
Address: _____
Telephone: _____

DUPONT PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 02073

GEOTEXTILES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements for geotextiles used in the cap system (excluding geotextile component of the geocomposite drainage layer), erosion and sediment control structures, roadways, and site improvements.

1.02 PRICE AND PAYMENT PROCEDURES

A. Allowances

1. Allowance for geotextile in anchor and drainage trenches, waste, overlaps, damaged materials, repairs, or materials used for the convenience of the Contractor shall be made under the Measurement and Payment provisions of this section.

B. Measurement and Payment

1. Measurement: Lump Sum.
2. Payment: The payment shall be made on a progress basis, as determined by the DSR based on the percentage of work completed and the submitted Schedule of Values.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. DuPont – E. I. DuPont de Nemours Company
2. DSR – DuPont Site Representative
3. GAI – Geosynthetic Accreditation Institute
4. IRM – Iron Rich Material
5. MARV – Minimum Average Roll Value
6. QC – Quality Control

B. Definitions

1. Installer – The person or corporation hired by the Contractor who is responsible for field handling, deploying, seaming and anchoring of the geotextile.

2. Independent Laboratory – The approved GAI certified laboratory hired by the Contractor, independent from the Contractor, manufacturer, fabricator, and installer who is responsible for laboratory quality control testing of the geotextile.

3. MARV – For geosynthetics, a manufacturing quality control tool used to allow manufacturers to establish published values such that the user/purchaser will have a 97.7% confidence that the property in question will meet published values. For normally distributed data, "MARV" is calculated as the typical value minus two (2) standard deviations from documented quality control test results for a defined population from one specific test method associated with one specific property.

4. Maximum Value – The highest sample value from documented manufacturing quality control test results for a defined population from one test method associated with one specific property.

5. Minimum Value – The lowest sample value from documented manufacturing quality control test results for a defined population from one test method associated with one specific property.

6. QC Contractor – The person or corporation hired by the Contractor who is responsible for monitoring and documenting activities related to the quality control of the geotextile from manufacturing through installation. The QC Contractor shall review manufacturer's test data to verify that the delivered geotextile meets the material properties required by these specifications. In addition, the QC Contractor shall be responsible for verifying that the geotextile has been installed in accordance with these specifications.

7. Separation – The placement of a flexible porous geosynthetic between dissimilar materials so the integrity and functioning of both materials can remain intact or be improved.

C. Reference Standards

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. ASTM International (ASTM)

a. ASTM D4355 Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
b. ASTM D4491 Test Method for Water Permeability of Geotextiles by Permittivity
c. ASTM D4533 Test Method for Trapezoidal Tearing Strength of Geotextiles
d. ASTM D4632 Test Method for Grab Breaking Load and Elongation of Geotextiles
e. ASTM D4751 Test Method for Determining the Apparent Opening Size of a Geotextile
f. ASTM D4759 Practice for Determining the Specification Conformance of Geosynthetics
g. ASTM D4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
h. ASTM D4873 (2002) Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
i. ASTM D5261 Test Method for Measuring Mass per Unit Area of Geotextiles
j. ASTM D6241 Test Method for Static Puncture Strength of Geotextiles and Geotextile Related Product Using a 50-mm Probe

2. American Association of State Highway and Transportation Officials (AASHTO)
   a. AASHTO M288 Standard Specification for Geotextiles for Highway Applications

1.04 ADMINISTRATIVE REQUIREMENTS

Not Used

1.05 SUBMITTALS

Engineer review is required for submittals designated as “Action Submittals”. Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

A. Action Submittals

1. Product Data
   a. Geotextile material property data sheets.
2. Samples
   a. Submit one sample of the geotextile along with appropriate identification for permanent record of actual furnished material.

b. Submit one sample of geotextile for quality assurance testing. The sample shall be at least three (3) feet long by the width of the roll. The sample shall be taken at least three (3) feet from the end of a roll.

B. Informational Submittals

1. Certificates
   a. Geotextile certificate of compliance
2. Manufacturer Instructions
   a. Geotextile installation procedures
3. Source Quality Control Submittals
   a. Copies of Manufacturer quality control test results, including calibration curves and results of calibration tests.
4. Field Quality Control Submittals
   a. Within 24 hours of conclusion of physical tests, copies of test results, including calibration curves and results of calibration tests.
5. Manufacturer Reports
   a. Manufacturer quality control manual
6. Qualification Statements
   a. Qualification of the Contractor's validated testing facilities.
   b. Qualification of the Installer.

C. Closeout Submittals

Not Used

D. Maintenance Material Submittals

Not Used

1.06 QUALITY ASSURANCE

A. Qualifications

1. Manufacturer
   a. Manufacturer shall be an industry recognized manufacturer of geotextile similar to that required under these specifications.
2. Installer
   a. Installer shall have installed the proposed geotextile material for at least five completed projects totaling a minimum of two million square feet.
   b. Provide name and telephone number of a facility contact for each project.

c. Provide the services of a competent field installation supervisor who shall remain on site and be in charge throughout the geotextile installation.

3. Testing Agency
   a. The laboratory shall carry current accreditation via the GAI Laboratory Accreditation Program for the tests it will be required to perform.

4. Earthworks Contractor
   a. The Contractor shall have demonstrated ability for successfully placing soil above a geosynthetic cap system as required by these specifications for a minimum of three completed projects totaling two million square feet of geosynthetic cap system placement.

B. Certifications

1. Provide to the Engineer a certificate stating the name of the manufacturer, product name, style number, chemical composition of the filaments or yarns, and other pertinent information to fully describe the geotextile.

2. The manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available upon request.

3. The manufacturer's certificate shall state that the finished geotextile meets MARV requirements of the specification as evaluated under the manufacturer's quality control program. A person having legal authority to bind the manufacturer shall attest to the certificate.

4. Either mislabeling or misrepresentation of materials shall be reason to reject those geotextile products.

5. For needle punched geotextiles, the manufacturer shall also certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles, which could damage other geosynthetic layers.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements

1. Deliver materials only after the required submittals have been received and approved.

2. Deliver, store, and handle geotextile in accordance with ASTM D4873.

3. Notify the DSR a minimum of 24 hours prior to delivery and unloading of geotextile rolls packaged in an opaque, waterproof, protective plastic wrapping. The plastic wrapping shall not be removed until deployment.

4. Label each roll with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, gross weight), and date manufactured.
5. No materials shall be dropped or dumped.
6. Replace damaged material with new material.

B. Storage and Handling Requirements

1. If quality assurance samples are collected, immediately rewrap rolls with the plastic wrapping. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed.
2. Protect rolls of geotextile from construction equipment, chemicals, sparks and flames, temperatures in excess of 160 degrees F, and other environmental conditions that may damage the physical properties of the geotextile.
3. Protect geotextile from becoming saturated by elevating the rolls off the ground or placing them on a sacrificial sheet of plastic in an area where water will not accumulate.
4. Handle and unload geotextile rolls with load carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 – PRODUCTS

2.01 OWNER-FURNISHED PRODUCTS

Not Used

2.02 GEOTEXTILE FOR GEOMEMBRANE PROTECTION

A. Description

1. Geotextile for use as a protective (or cushioning) covering or underlayment of a geomembrane against puncture or tear due to rock, stones, concrete and other hard surfaces and objects.

B. Materials

1. Provide geotextile that is a nonwoven pervious sheet of polymeric material consisting of long-chain synthetic polymers composed of at least 95 percent by weight polyolefins, polyesters, or polyamides.
2. The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) will not be allowed.

3. Add stabilizers and/or inhibitors to the base polymer, as needed, to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure.
4. Regrind material, which consists of edge trimmings and other scraps that have never reached the consumer, may be used to produce the geotextile.
5. Post-consumer recycled material shall not be used. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges.
6. The geotextiles for use as protection (or cushioning) materials shall conform to Table 1.
7. The finished geotextile shall have good appearance qualities. It shall be free from such defects that would affect the specific properties of the geotextile, or its proper functioning.
8. General manufacturing procedures shall be performed in accordance with the manufacturer's internal quality control guide or documents.

2.03 SEPARATION GEOTEXTILE

A. Description

1. Geotextile for use as separation between subgrade soil and aggregate predominantly in pavement systems.

B. Materials

1. Provide geotextile that is a nonwoven pervious sheet of polymeric material consisting of long-chain synthetic polymers composed of at least 95 percent by weight polyolefins, polyesters, or polyamides.
2. The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) will not be allowed.
3. Add stabilizers and/or inhibitors to the base polymer, as needed, to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure.
4. Regrind material, which consists of edge trimmings and other scraps that have never reached the consumer, may be used to produce the geotextile.
5. Post-consumer recycled material shall not be used. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges.
6. The geotextiles for use as separator materials shall conform to Table 2.
7. The finished geotextile shall have good appearance qualities. It shall be free from such defects that would affect the specific properties of the geotextile, or its proper functioning.

8. General manufacturing procedures shall be performed in accordance with the manufacturer's internal quality control guide or documents.

2.04 SOURCE QUALITY CONTROL

A. Tests

1. Verify conformance with this specification using manufacturer's certifications as a result of testing by the manufacturer of quality assurance samples obtained using the procedure for Sampling for Manufacturer's Quality Assurance (MQA) Testing. A lot size shall be considered to be the shipment quantity of the given product or a truckload of the given product, whichever is smaller.
2. Perform testing in accordance with the method referenced in this specification for the indicated application. The number of specimens to test per sample is specified by each test method. Geotextile product acceptance shall be based on ASTM D4759. Product acceptance is determined by comparing the average test results of all specimens within a given sample to the specification MARV.
3. If the results of any test do not conform to the requirements of this specification, retest to determine conformance or rejection in accordance with the manufacturing protocol as set forth in the manufacturer's quality manual.

PART 3 – EXECUTION

3.01 PREPARATION

A. Surface Preparation

1. Prior to placement, the geotextile surface shall be cleaned of all soil, rock, excessive dust, and other debris as determined by the QC Contractor and DuPont Site Representative.
2. The area to be covered shall be graded to a smooth condition in accordance with Section 02300 – EARTHWORK and all depressions filled.

3.02 INSTALLATION

A. Special Techniques

1. Maintain geotextile free of dirt, mud, or any other foreign materials at all times. Clean or replace rolls that are contaminated with these materials.
2. Deploy the geotextile carefully such that the geotextile and underlying materials are not damaged. Replace faulty or damaged geotextile.

3. Place geotextile on the prepared surface in a fairly loose and unstretched condition to minimize shifting, puncture and/or tearing. Adjacent roll edges and roll ends shall be overlapped a minimum of 18-inches. The direction of the fabric laying operation shall be up and down the slope, and overlap direction at roll ends shall be upslope over downslope. Geotextile edges and ends shall be continuously heat tacked.
4. Precautions shall be taken to protect the integrity of the geotextile. If the geotextile is damaged, the damaged area shall be covered by an additional layer of geotextile that extends a minimum of 12-inches beyond the damaged area in all directions and shall be placed over the damaged geotextile and heat tacked.
5. Prior to and during installation, the geotextile may be exposed to sunlight for a period not exceeding 14 days. When possible the geotextile should be covered on the same day it is installed.
6. Geotextile installations shall be subject to the approval of the DSR before covering.

B. Interface with Other Work

1. Geotextile penetration details shall be as recommended by the geotextile manufacturer and as approved by the DSR.

3.03 FIELD QUALITY CONTROL

A. Field Tests

1. Sample the geotextile immediately upon delivery to the site. One sample shall be collected every 50,000 square feet and tested for the physical properties listed in Tables 1 or 2 excluding ASTM D 4355 for ultraviolet degradation.
2. Identify samples submitted for testing by brand name, type of fabric, location and date manufactured, lot identification, length and width.
3. Prior to field placement of the geotextile, submit the test results and certify that all tests were conducted in accordance with the specified procedures.

B. Non-Conforming Work

1. If the certified test results indicate values less than those specified, the roll from which the sample was obtained will be rejected.
2. Rolls before and after the rejected roll will also be tested to determine the limit of material to be rejected.
3. Replace rejected material with acceptable material.

3.04 PROTECTION

A. The geotextile shall be covered with the required materials (e.g., geomembrane, cover soil) within three days of acceptance in accordance with the Drawings and Section 02300 – Earthwork.

B. In an area of exposed geotextile has not been accepted within 14 days of placement, it shall be temporarily covered to prevent exposure to sunlight while still allowing access for necessary inspection.

C. Under no circumstances shall the geotextile be left uncovered, either temporarily or permanently, longer than 14 days from placement.

3.05 ATTACHMENTS

A. Tables

1. Required Properties, Test Methods and Values for Geotextiles Used as Geomembrane Protection (or Cushioning) Materials

Property(1)	Test Method ASTM	Value
Mass per unit area	D5261	10 oz/yd^2
Grab tensile strength	D4632	230 lb
Grab tensile elongation	D4632	50%
Trapezoidal tear strength	D4533	95 lb
Puncture (pin) strength	D4833	120 lb
UV resistance(2)	D4355	70%

Notes:
(1) All values are MARV except UV resistance; it is a minimum value.
(2) Evaluation to be on 2.0 inch strip tensile specimens after 500 hours exposure.

2. Geotextile Properties Class 1 (High Survivability) for Separation Geotextile

Property(1)	Test Method ASTM	Value (Elongation ≥ 50%)
Grab Tensile Strength	D4632	203 lb
Trapezoid Tear Strength	D4533	79 lb
CBR Puncture Strength	D6241	440 lb
Permittivity	D4491	0.02 sec^{-1}
Apparent Opening Size	D4751	#30 Sieve
Ultraviolet Stability(2)	D4355	50% Ret. @ 500 hrs

Notes:

(1) All values are minimum average roll values (MARV) except AOS which is a maximum average roll value (MaxARV) and UV stability which is a minimum average value.

(2) Evaluation to be on 50 mm strip tensile specimens after 500 hours.

END OF SECTION

SECTION 02077

GEOCOMPOSITE DRAINAGE LAYER

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Geocomposite drainage layer as part of the cap system.

1.02 PRICE AND PAYMENT PROCEDURES

A. Allowances

1. Allowance for geocomposite waste, overlaps, damaged materials, repairs, or materials used for the convenience of the Contractor shall be made under the Measurement and Payment provisions of this section.

B. Measurement and Payment

1. Measurement: Lump Sum.
2. Payment: The payment shall be made on a progress basis, as determined by the DSR based on the percentage of work completed and the submitted Schedule of Values.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. DuPont – E. I. DuPont de Nemours Company
2. DSR – DuPont Site Representative
3. GAI – Geosynthetic Accreditation Institute
4. MARV – Minimum Average Roll Value
5. QC – Quality Control

B. Definitions

1. Installer – The person or corporation hired by the Contractor who is responsible for field handling, deploying, seaming and anchoring of the geotextile.
2. Independent Laboratory – The approved GAI certified laboratory hired by the Contractor, independent from the Contractor, manufacturer, fabricator,

and installer who is responsible for laboratory quality control testing of the geotextile.

3. MARV – For geosynthetics, a manufacturing quality control tool used to allow manufacturers to establish published values such that the user/purchaser will have a 97.7% confidence that the property in question will meet published values. For normally distributed data, "MARV" is calculated as the typical value minus two (2) standard deviations from documented quality control test results for a defined population from one specific test method associated with one specific property.

4. Maximum Value – The highest sample value from documented manufacturing quality control test results for a defined population from one test method associated with one specific property.

5. Minimum Value – The lowest sample value from documented manufacturing quality control test results for a defined population from one test method associated with one specific property.

6. QC Contractor – The person or corporation hired by the Contractor who is responsible for monitoring and documenting activities related to the quality control of the geotextile from manufacturing through installation. The QC Contractor shall review manufacturer's test data to verify that the delivered geotextile meets the material properties required by these specifications. In addition, the QC Contractor shall be responsible for verifying that the geotextile has been installed in accordance with these specifications.

C. Reference Standards

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. ASTM International (ASTM)
   a. ASTM D1505 (2003) Density of Plastics by the Density-Gradient Technique
   b. ASTM D 1603 (2006) Carbon Black Content in Olefin Plastics
   c. ASTM D4218 (1996; R 2008) Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
   d. ASTM D4355 (2007) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
   e. ASTM D4491 (1999a; R 2004e1) Water Permeability of Geotextiles by Permittivity
   f. ASTM D4533 (2004) Trapezoid Tearing Strength of Geotextiles
   g. ASTM D4632 (2008) Grab Breaking Load and Elongation of Geotextiles

h. ASTM D4716 (2008) Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
i. ASTM D4751 (2004) Determining Apparent Opening Size of a Geotextile
j. ASTM D4833 (2007) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
k. ASTM D5035 (2006; R 2008e1) Breaking Force and Elongation of Textile Fabrics (Strip Method)
l. ASTM D5199 (2001; R 2006) Measuring Nominal Thickness of Geosynthetics
m. ASTM D5261 (1992; R 2003) Measuring Mass Per Unit Area of Geotextiles
n. ASTM D7005 (2003; R 2008) Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites

2. American Association of State Highway and Transportation Officials (AASHTO)
   a. AASHTO M288 Standard Specification for Geotextiles

1.04 ADMINISTRATIVE REQUIREMENTS

Not Used

1.05 SUBMITTALS

Engineer review is required for submittals designated as “Action Submittals”. Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

A. Action Submittals

1. Product Data
   a. Geocomposite material property data sheets.

2. Samples
   a. Submit one sample of the composite along with appropriate identification for permanent record of actual furnished material.
   b. Submit one sample of each component of the composite (i.e., for the geonet and geotextile) for quality assurance testing. The sample size shall be three (3) feet in length by the width of the roll to conduct the specified tests. The sample should be taken at least 3 feet from the end of a roll.

B. Informational Submittals

1. Certificates
   a. Geocomposite certificate of compliance.
2. Manufacturer Instructions
   a. Geocomposite installation procedures.
3. Source Quality Control Submittals
   a. Copies of Manufacturer quality control test results, including calibration curves and results of calibration tests.
4. Field Quality Control Submittals
   a. Within 24 hours of conclusion of physical tests, copies of test results, including calibration curves and results of calibration tests.
5. Manufacturer Reports
   a. Manufacturer quality control manual.
6. Qualification Statements
   a. Qualification of the Contractor's validated testing facilities.
   b. Qualification of the Installer.

C. Closeout Submittals

Not Used

D. Maintenance Material Submittals

Not Used

1.06 QUALITY ASSURANCE

A. Qualifications

1. Manufacturer
   a. Manufacturer shall be an industry recognized processor of the proposed geocomposite drainage layer.
2. Installer
   a. Installer shall have installed the proposed geocomposite material for at least 5 completed projects totaling a minimum of 1 million square feet.
   b. Provide name and telephone number of a facility contact for each project.
   c. Provide services of a competent field installation supervisor that shall remain on site and be in charge throughout the geocomposite installation.
3. Testing Agency

a. The laboratory shall carry current accreditation via the GAI Laboratory Accreditation Program for the tests it will be required to perform.

4. Earthworks Contractor
   a. The Contractor shall have demonstrated ability for successfully placing soil above a geosynthetic cap system as required by these specifications for a minimum of three completed projects totaling two million square feet of geosynthetic cap system placement.

C. Certifications

1. Provide to the Engineer a certificate stating the name of the manufacturer, product name, style number, chemical composition of the geonet and geotextile, and other pertinent information to fully describe the geocomposite.
2. The manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available upon request.
3. The manufacturer's certificate shall state that the finished geocomposite and the individual components meet MARV requirements of the specification as evaluated under the manufacturer's quality control program. A person having legal authority to bind the manufacturer shall attest to the certificate.
4. Either mislabeling or misrepresentation of materials shall be reason to reject those geocomposite products.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements

1. Accept delivery of material only after the required submittals have been approved.
2. The QC inspector shall be present during delivery and unloading of the geosynthetic drainage layer.
3. Ensure the drainage layer material has not been damaged during shipping, storage, or handling.
4. Each roll shall be labeled with the manufacturer's name, product identification, lot number, roll number, and roll dimensions.
5. Rolls shall be individually wrapped in plastic. The plastic wrapping shall not be removed until deployment.
6. No materials shall be dropped or dumped.
7. Repair or replace damaged drainage layer material.

B. Storage and Handling Requirements

1. Protect rolls from construction equipment, chemicals, sparks and flames, temperatures in excess of 160 degrees F, and other environmental conditions that may damage the physical properties of the geocomposite.
2. Protect geocomposite from becoming saturated by elevating the rolls off the ground or placing them on a sacrificial sheet of plastic in an area where water will not accumulate.
3. Handle and unload geocomposite rolls with load carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 – PRODUCTS

2.01 OWNER-FURNISHED PRODUCTS

Not Used

2.02 GEOCOMPOSITE DRAINAGE LAYER

A. Description

1. The geocomposite drainage layer shall be composed of a geonet covered on both sides with nonwoven geotextile.

B. Materials

1. The polymer used to manufacture the geonet component of the geosynthetic drainage layer shall be polyethylene which is clean and free of any foreign contaminants.
2. Regrind material which consists of edge trimmings and other scraps may be used to manufacture the geonet; however, post-consumer recycled materials shall not be used.
3. Conform the geosynthetic drainage layer to the property requirements listed in Table 1.
4. Component criteria for the geonet alone and geotextile alone are also listed in Table 1.

C. Assembly/Fabrication/Mixes

1. Factory Assembly
   a. Create geocomposite by heat bonding geotextile to the geonet.
   b. The geotextile shall not be bonded to the drainage net within 6 inches of the edges of the rolls.

2.04 SOURCE QUALITY CONTROL

A. Tests

1. Randomly sample and test in accordance with the manufacturer's quality control manual to evaluate the required physical properties. Frequencies shall be at a minimum, in accordance with the requirements specified in Table 1. Certified test results on each component and the composite shall be submitted to the DSR.

PART 3 – EXECUTION

3.01 PREPARATION

A. Surface Preparation

1. Prior to placement of the geocomposite, the surface of the geomembrane shall be cleaned of all soil, rock, excessive dust, and other debris as determined by the QC Inspector and the DSR.

3.02 INSTALLATION

A. Special Techniques

1. Maintain geocomposite free of dirt, mud, or any other foreign materials. Clean or replace rolls that are contaminated with these materials.
2. Deploy the geocomposite carefully such that the geomembrane and underlying materials are not damaged. Replace or repair faulty or damaged geocomposite as specified in Article REPAIR.
3. Unroll geocomposite downslope keeping the net in slight tension to minimize wrinkles and folds. The machine direction of the geonet shall be placed parallel to the slope surface. In the corners of side slopes, where overlaps between rolls of nets are staggered, an extra layer of geocomposite shall be installed above the overlaps from the top to the bottom of the slope. Adjacent rolls shall be overlapped a minimum of 4 inches.
4. Fasteners, as recommended by the Manufacture, shall be used to join adjacent rolls. Metallic fasteners shall not be allowed. Fasteners shall be spaced a maximum of 4 feet along down-slope roll overlaps and a maximum of 2 feet along cross slope roll overlaps. Fasteners shall be of contrasting color from the geonet to facilitate visual inspection. Geocomposites shall not be welded to geomembranes.
5. Adequate loading (e.g. sandbags) shall be placed to prevent uplift by wind.

6. The top surface geotextile shall be overlapped a minimum of 3 inches and continuously sewn together. Seams shall be prayer-type seams, constructed parallel to the slope direction.

B. Interface with Other Work

1. Geocomposite penetration details shall be as recommended by the geocomposite manufacturer.

3.03 REPAIR

A. Holes or tears in the geocomposite shall be repaired by placing a patch of geocomposite extending a minimum of 2 feet beyond the edges of the hole or tear.

B. Approved fasteners, spaced every 6 inches around the patch, shall be used to fasten the patch to the original roll.

C. Alternate means of repair shall be as recommended by the manufacturer.

3.04 FIELD QUALITY CONTROL

A. Field Tests

1. Sample the geocomposite immediately upon delivery to the site. One sample shall be collected every 100,000 square feet and tested for the physical properties specified in Table 1.

2. Samples submitted for testing shall be identified by brand name, type of fabric, location and date manufactured, lot identification, length and width.

3. Prior to field placement of the geocomposite, submit the test results and certify that all tests were in accordance with the appropriate procedures identified in Table 1

B. Non-Conforming Work

1. If the certified test results indicate values less than those specified, the roll from which the sample was obtained will be rejected.

2. In addition, rolls before and after the rejected roll shall also be tested to determine the limit of material to be rejected.

3. Replace rejected material with acceptable material.

3.05 PROTECTION

A. The geocomposite shall be covered with the required materials within 10 days of acceptance in accordance with the Drawings and Section 02300 – EARTHWORK.

3.06 ATTACHMENTS

A. Tables

1. Geosynthetic Drainage Layer Properties

Property	Test Method	Test Value	Minimum MQC Testing Frequency
Geonet			
Thickness, minimum avg, Note 1	ASTM D5199	300 mil	100,000 SF
Polymer Density, minimum avg	ASTM D1505	0.940 g/cc	100,000 SF
Carbon Black Content	ASTM D1603 ASTM D4218	1-3 percent	100,000 SF
Tensile Strength, minimum avg, Note 2	ASTM D5035	45 lbs/in	100,000 SF
Geotextile			
Mass/Unit Area, MARV	ASTM D5261	4.0 oz/SY	100,000 SF
Grab Strength, MARV	ASTM D4632	120 lbs	100,000 SF
Grab Elongation, MARV	ASTM D4632	50 percent	100,000 SF
Tear Strength, MARV	ASTM D4533	55 lbs	100,000 SF
Puncture Strength, MARV	ASTM D4833	55 lbs	100,000 SF
Permittivity, MARV	ASTM D4491	0.2 sec^{-1}	500,000 SF
AOS(O95), MaxARV	ASTM D4751	0.25 mm	500,000 SF
UV Stability, percent retained (500 hrs)	ASTM D4355	50 percent	Note 3
Geocomposite			
Transmissivity, min, including attached geotextiles Note 4	ASTM D4716	12 gal/min-foot	200,000 SF
Geonet/Geotextile Adhesion, minimum avg, Note 5	ASTM D7005	0.5 lbs/inch	100,000 SF

Note 1: The diameter of the presser foot shall be 2.22 inches and the pressure shall be 2.9 psi. For other thickness options, see manufacturer's literature.

Note 2: This is the average peak value for five equally spaced machine direction tests across the roll width.

Note 3: Manufacturer's historical data.

Note 4: Measure manufacturing quality control transmissivity tests using a gradient of 0.1 under a normal pressure of 14.5 psi. Use a minimum seating period of 15 minutes. Perform the test between rigid end platens.

Note 5: Average of five tests across the roll width. Discounting the outer 305 mm of each side of the roll, collect samples at the 10, 30, 50, 70, and 90 percent positions across the roll width. Test both sides for double sided geocomposites.

END OF SECTION

SECTION 02079

GEOMEMBRANES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Geomembrane within cap system

1.02 PRICE AND PAYMENT PROCEDURES

A. Allowances

1. Allowance for geomembrane waste, overlaps, damaged materials, repairs, or materials used for the convenience of the Contractor shall be made under the Measurement and Payment provisions of this section.

B. Measurement and Payment

1. Measurement: Lump Sum.
2. Payment: The payment shall be made on a progress basis, as determined by the DSR based on the percentage of work completed and the submitted Schedule of Values.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. DuPont – E. I. DuPont de Nemours Company
2. DSR – DuPont Site Representative
3. GAI – Geosynthetic Accreditation Institute
4. MARV – Minimum Average Roll Value
5. QC – Quality Control

B. Reference Standards

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. ASTM International (ASTM)
   a. ASTM D638 Tensile Properties of Plastics

b. ASTM D792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
c. ASTM D1004 Initial Tear Resistance of Plastic Film and Sheeting
d. ASTM D1505 Density of Plastics by the Density-Gradient Technique
e. ASTM D1603 Carbon Black in Olefin Plastics
f. ASTM D4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
g. ASTM D4437 Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes
h. ASTM D4833 Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
i. ASTM D5199 Measuring Nominal Thickness of Geotextiles and Geomembranes
j. ASTM D5596 Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
k. ASTM D6392 Determining the Integrity of Non-reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
l. ASTM D6497 Mechanical Attachment of Geomembrane to Penetrations or Structures

2. Geosynthetic Research Institute (GRI)
   a. GRI GM-6 Pressurized Air Channel Test for Dual Seamed Geomembranes
   b. GRI GM-7 Accelerated Curing of Geomembrane Test Strip Seams Made by Chemical Fusion Methods
   c. GRI GM-9 Cold Weather Seaming of Geomembranes
   d. GRI GM-14 Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes
   e. GRI GM-17 Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes
   f. GRI GM-19 Seam Strengths and Related Properties of Thermally Bonded Polyolefin Geomembranes

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. These specifications are the minimum standards for the project but may be superseded in part by more stringent specifications of the manufacturer or installer.

2. Equipment used in performance of the work shall be in accordance with the geomembrane manufacturer's recommendations and shall be maintained in satisfactory working condition.

1.05 SUBMITTALS

Engineer review is required for submittals designated as “Action Submittals”. Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

A. Action Submittals

1. Shop Drawings
   a. Geomembrane panel layout
   b. Anchorage details
   c. Seaming details
   d. Penetration details

2. Samples
   a. Trial seams
   b. Geomembrane
   c. Destructive seam test

B. Informational Submittals

1. Certificates
   a. Geomembrane certificate of compliance.
   b. Certification from the QC Contractor and installer of the acceptability of the surface on which the geomembrane is to be placed, immediately prior to geomembrane placement.

2. Test and Evaluation Reports
   a. Manufacturer's certified raw and sheet material test reports.
   b. Daily reports of the total amount and location of geomembrane placed, total amount and location of seams completed, type and number of seamers used, changes in the geomembrane panel layout, results of test seams including non-destructive and destructive test data, and the location and results of any repairs.

3. Field Quality Control Submittals
   a. Non-destructive field seam continuity test results within 24 hours of conclusion of physical tests.
   2. Destructive field seam test results within 24 hours of conclusion of physical tests.
   3. Destructive seam test repair results within 24 hours of conclusion of physical tests.

4. Manufacturer Reports
   a. Manufacturer's and fabricator's quality control manual
   b. Installer's quality control manual

5. Special Procedure Submittals
   a. Descriptive data of field quantitative tensiometer used for testing of specimens from trial welds and destructive seam samples.

6. Qualification Statements
   a. Qualification of the Contractor's validated testing facilities.
   b. Qualification of the Installer.

C. Closeout Submittals

1. Warranty Documentation
   a. Executed manufacturer’s and installer’s warranties.

2. Record Documentation
   a. As-built drawings of geomembrane installation and topographical survey.

D. Maintenance Material Submittals

Not Used

1.06 QUALITY ASSURANCE

A. Qualifications

1. Manufacturer
   a. Manufacturer shall be an industry-recognized producer of the proposed geomembrane.
   b. Manufacturer shall have produced the proposed geomembrane sheets for at least 5 completed projects having a total minimum area of 10 million square feet.

2. Fabricator
   a. The fabricator is responsible for seaming geomembrane sheets into panels.
   b. Fabricator shall have fabricated the proposed geomembrane panels for at least 5 completed projects having a total minimum area of 2 million square feet.

3. Installer
   a. The installer is responsible for field handling, deploying, seaming, anchoring, and field QC testing of the geomembrane.
   b. The installer shall have installed the proposed geomembrane material for at least 5 completed projects having a total minimum area of 2 million square feet. A name and telephone number of a facility contact for each project shall be provided.

c. The installer shall furnish the services of a competent field installation supervisor that shall remain on site and be in charge throughout the geomembrane installation, for panel layout, seaming, patching, testing, repairs and all other activities of the installer.

d. At least one seamer shall have experience seaming a minimum of 2 million square feet of the proposed geomembrane using the same type of seaming equipment and geomembrane thickness specified for this project.

e. All other personnel performing seaming operations shall be qualified by similar experience with a minimum of 500,000 square feet of seaming experience and will be required to pass a seaming test in accordance with Article TRIAL SEAMS

4. Testing Agency

a. The laboratory shall carry current accreditation via the GAI Laboratory Accreditation Program for the tests it will be required to perform.

5. Earthworks Contractor

a. The Contractor shall have demonstrated ability for successfully placing soil above a geosynthetic cap system as required by these specifications for a minimum of three completed projects totaling two million square feet of geosynthetic cap system placement.

B. Field Samples

1. One QC sample, 36 inches in length, for the entire width of a roll, shall be obtained at the frequency specified in Section 01440 – Contractor Quality Control.

2. Samples shall not be obtained from the first three feet of the roll.

3. For accordion folded geomembranes, samples of equivalent size shall be collected from approved locations.

4. The samples shall be identified by manufacturer's name, product identification, and lot and roll/panel number. The date, a unique sample number, and the machine direction shall also be noted.

5. In addition, a 12-inch by 12-inch QA sample shall be collected, labeled, and submitted to the DuPont Site Representative each time QC samples are collected.

6. The Contractor shall provide all QC samples to the QC laboratory to determine density, thickness, tensile strength at break, elongation at break, tear resistance, and puncture resistance in accordance with the methods specified in Table 1.

7. Samples not meeting the specified requirements shall result in the rejection of applicable rolls/panels.

8. As a minimum, rolls/panels produced immediately prior to and immediately after the failed roll/panel shall be tested for the same failed parameter.
9. Testing shall continue until a minimum of three successive rolls/panels on both sides of the original failing roll/panel pass the failed parameter.
10. Additional testing and replacement of inferior products shall be at no additional cost to DuPont.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements

1. Geomembrane materials shall be delivered only after the required submittals have been received and approved by DuPont or, as applicable, the Engineer.
2. The QC Contractor shall be present during delivery and unloading of the geomembrane.
3. Each geomembrane roll/panel shall be labeled with the manufacturer's name, product identification number, roll/panel number, and roll dimensions.

B. Storage and Handling Requirements

1. Temporary storage at the project site shall be on a level, prepared surface that is lined with geotextile, is free of sharp objects, and where water cannot accumulate.
2. The geomembrane shall be protected from puncture, abrasion, excessive heat and cold, material degradation, and other damaging circumstances.
3. Storage shall not result in crushing the core of roll goods or flattening of the rolls.
4. Rolls shall not be stored more than two high or on pallets.
5. Ultraviolet sensitive materials shall be covered with a sacrificial opaque and waterproof covering or placed in a temporary shelter.
6. Damaged geomembrane shall be removed from the site and replaced with geomembrane that meets the specified requirements at no additional cost to DuPont.
7. Rolls/panels shall not be dragged, lifted by one end, or dropped.
8. A pipe or solid bar, of sufficient strength to support the full weight of a roll without significant bending, shall be used for all handling activities. The diameter of the pipe or solid bar shall be small enough to be easily inserted through the core of the roll. Rigging straps shall be used to link the ends of the pipe or bar to the ends of a spreader bar. The spreader bar

shall be wide enough to prevent the chains from rubbing against the ends of the roll.

9. Alternatively, a stinger bar protruding from the end of a forklift or other equipment may be used. The stinger bar shall be at least three-fourths the length of the core and also must be capable of supporting the full weight of the roll without significant bending.

10. If recommended by the manufacturer, a sling handling method utilizing appropriate loading straps may be used.

1.08 FIELD CONDITIONS

A. Ambient Conditions

1. As determined by the QC Contractor and the DSR, geomembrane shall not be deployed or field-seamed in the presence of any of the following conditions.
   a. Excess moisture (i.e., rain, fog, and dew)
   b. In areas of ponded water
   c. Sustained winds of 15 mph or greater
   d. Wind gusts greater than or equal to 20 mph

2. Unless authorized by the DuPont Site Representative, no placement or seaming shall be attempted at ambient temperatures below 35 degrees F or above 104 degrees F.

3. Ambient temperature shall be measured at a height no greater than 6 inches above the ground or geomembrane surface.

4. If seaming is allowed below 32 degrees F, the procedures outlined in GRI GM-9 shall be followed.

5. In marginal conditions, as determined by the QC Contractor, trial seams shall be made with the QC Contractor present to decide if production seaming can proceed. Otherwise, seaming shall cease unless destructive field seam tests, conducted by the QC laboratory, confirm that seam properties meet the requirements listed in Table 2.

6. Tests shall be conducted in accordance with Article TRIAL SEAMS and Article DESTRUCTIVE FIELD SEAM TESTING.

1.09 WARRANTY

A. Manufacturer Warranty

1. Written warranties addressing geomembrane material and installation workmanship shall be submitted to and approved by DuPont.

2. The manufacturer's warranty shall state that if the installed material meets all requirements of the Drawings and Specifications that under typical

local atmospheric conditions and weather aging, the sheet material is warranted for 5 years.

B. Special Warranty

1. The installer's warranty shall state that the geomembrane field and factory seams will not fail within 5 years of the installation under similar conditions, and that all clamps, clips, bolts, nuts, or other fasteners used to secure the geomembrane around any appurtenance is warranted for the same time period.

PART 2 – PRODUCTS

2.01 OWNER-FURNISHED PRODUCTS

Not Used

2.02 MATERIALS

A. Materials

1. Raw Materials
   a. Resin used in manufacturing geomembrane sheets shall be made of virgin uncontaminated low-density polyethylene (LDPE).
   b. No more than 2 percent regrind, reworked, or trim material in the form of chips or edge strips shall be used to manufacture the geomembrane sheets.
   c. All regrind, reworked, or trim materials shall be from the same manufacturer and exactly the same formulation as the geomembrane sheet being produced.
   d. No post consumer materials or water-soluble ingredients shall be used to produce the geomembrane.
   e. For geomembranes with plasticizers, only primary plasticizers that are resistant to migration shall be used. No fatty acid residues, epoxy or secondary plasticizers shall be used.
   f. The Contractor shall submit a copy of the test reports and QC certificates for materials used in the manufacturing of the geomembrane shipped to the site.
2. Sheet Materials
   a. Geomembrane sheets shall be manufactured in the United States.
   b. Geomembrane sheets shall be unreinforced and manufactured as wide as possible to minimize field seams.
   c. Geomembrane sheets shall be uniform in color, thickness, and surface texture.

d. The sheets shall be free of and resistant to fungal or bacterial attack and free of cuts, abrasions, holes, blisters, contaminants and other imperfections.

e. Geomembrane sheets and factory seams shall conform to the requirements listed in Tables 1 and 2 for Manufacturing Quality Control (MQC).

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verification of Conditions

1. Each day during placement of geomembrane, the QC Contractor and installer shall, prior to placement, inspect the surface on which geomembrane is to be placed and certify in writing that the surface is acceptable.

3.02 PREPARATION

A. Surface Preparation

1. Prepare surface in accordance with Section 02300 – EARTHWORK and Section 02273 – GEOTEXTILES.

2. Repair subgrade prior to placing geomembrane.

3.03 INSTALLATION

A. Deployment

1. Personnel working on the geomembrane shall not smoke or wear shoes that could puncture or otherwise damage the geomembrane.

2. The geomembrane shall be placed over the prepared surfaces with minimum handling.

3. The procedures and equipment used shall not elongate, wrinkle, scratch, or otherwise damage the geomembrane, other geosynthetic layers, or the underlying subgrade as determined by the DuPont Site Representative.

4. Geomembrane damaged during installation shall be replaced or repaired, at the QC Contractor's or DuPont Site Representative’s discretion as specified in Article 3.5: Defects and Repairs, at no additional cost to DuPont.

5. Only geomembrane panels that can be anchored and seamed together the same day shall be deployed.

6. Adequate ballast (i.e., sandbags) shall be placed on the geomembrane, without damaging the geomembrane, to prevent uplift by wind.

7. No vehicular traffic will be allowed directly on the geomembrane.
8. No equipment shall be operated on the top surface of the geomembrane without permission from the DuPont Site Representative.
9. Seams shall be oriented parallel to the line of maximum slope.
10. All panels/sheets shall be oriented so as to eliminate the potential of horizontal seams on slopes (No horizontal seams shall be permitted within 10 feet of the toe of a slope except where approved by the DuPont Site Representative).
11. Where seams can only be oriented across the slope, the upper panel shall be lapped over the lower panel.
12. Wrinkles
    a. The methods used to deploy and backfill over the geomembrane shall minimize wrinkles and tensile stresses in the geomembrane.
    b. The geomembrane shall have adequate slack to prevent the creation of tensile stress.
    c. The wrinkle height to width ratio for installed geomembrane shall not exceed 0.5.
    d. In addition, geomembrane wrinkles shall not exceed 6 inches in height.
    e. Wrinkles that do not meet the above criteria shall be cut out and repaired in accordance with the installer's approved QC manual.

B. Field Seaming

1. Trial Seams
    a. Trial seams shall be made at a random location selected by the DSR in the area to be seamed and in contact with the subgrade.
    b. Trial seams shall be made under field conditions on strips of excess geomembrane.
    c. Trial seams shall be made each day prior to production seaming;
        (1) When there is a change in seaming personnel or seaming equipment,
        (2) at least once every four hours by each seamer and each piece of seaming equipment used that day for every material combination (e.g., smooth to smooth, smooth to textured, textured to textured),
        (3) At the discretion of the DSR.
    d. Trial seam samples shall be collected and tested in accordance with ASTM D6392 as specified in Article 3.4B: Trial Seam Testing.
2. Field Seams
    a. Panels shall be seamed in accordance with the geomembrane manufacturer's recommendations.

b. All panels/sheets shall be overlapped a minimum of 4 inches.
c. In sumps, corners and odd-shaped geometric locations, the number of field seams shall be minimized.
d. Seaming shall extend to the outside edge of panels.
e. Soft subgrades shall be compacted and approved prior to seaming.
f. The seam area shall be free of moisture, dust, dirt, and foreign material at the time of seaming.
g. Fish mouths in seams shall be repaired.
h. The Contractor shall ensure that there are enough working seaming machines to perform the work within the schedule. The Contractor shall also ensure that at least two working back-up machines are available, if needed.
i. Polyethylene Seams
   (1) Polyethylene geomembranes shall be seamed by thermal fusion methods.
   (2) Extrusion welding shall only be used for patching and seaming in locations where thermal fusion methods are not feasible.
   (3) Seam overlaps that are to be attached using extrusion welds shall be ground prior to welding and overlapped a minimum of 6-inches.
   (4) Grinding marks shall be oriented perpendicular to the seam direction and no marks shall extend beyond the extrudate after placement.
   (5) Extrusion welding shall begin within 10 minutes after grinding.
   (6) Where extrusion welds are temporarily terminated long enough to cool, they shall be ground prior to applying new extrudate over the existing seam.
   (7) The total depth of the grinding marks shall be no greater than 10 percent of the sheet thickness.

C. Penetrations

1. Geomembrane penetration details shall be in accordance with ASTM D6497 or as recommended by the geomembrane manufacturer.
2. Factory fabricated boots shall be used wherever possible.
3. Factory constructed boots shall be leak tested at the factory and arrive with a certification of testing and acceptance.
4. Field constructed boots shall be constructed to allow for non-destructive testing (spark testing).

5. Field seams for penetrations shall be non-destructively tested in accordance with the installer's approved QC manual.

6. Seams that fail non-destructive testing shall be repaired in accordance with the installer's approved QC manual and non-destructively tested prior to acceptance.

3.04 REPAIR

A. Destructive Seam Test Repairs

1. Seam lengths that fail destructive seam testing may be overlaid with a strip of new material that overlaps the geomembrane seam by 6 inches in all directions and seamed (cap stripped).

2. Alternatively, the seaming path shall be retraced to an intermediate location a minimum of 10 feet on each side of the failed seam location.

3. At each location a 12 by 18-inch minimum size seam sample shall be taken for 2 additional shear strength and 2 additional peel adhesion tests using an approved quantitative field tensiometer.

4. If these field tests pass, an additional 12-inch wide by 28-inch long sample portion will be taken and given to the DuPont Site Representative for QA testing and/or permanent record. The installer’s remaining seam sample portion shall be sent to the QC laboratory for 5 shear strength and 5 peel adhesion tests in accordance with the QC laboratory's approved procedures.

5. To be acceptable, 4 out of 5 replicate test specimens must meet specified seam strength requirements.

6. If these laboratory tests pass, then the seam shall be cap stripped or repaired using other approved methods between that location and the original failed location.

7. If field or laboratory tests fail, the process shall be repeated.

8. After repairs are completed, the repaired seam shall be non-destructively tested in accordance with Article 3.4C: Non-Destructive Field Seam Continuity Testing.

9. Test results on all repaired seams shall be submitted to and approved by the DuPont Site Representative in accordance with Section 01300 – Submittals prior to covering the seamed areas.

B. Patches

1. Tears, holes, blisters, “T” connections, and other defects shall be repaired with patches.

2. Patches shall have rounded corners, be made of the same geomembrane, and extend a minimum of 6 inches beyond the edge of defects.

3. Minor localized flaws shall be repaired by spot welding or seaming as determined by the QC Contractor.

4. Repairs shall be non-destructively tested in accordance with Article 3.4C: Non-Destructive Field Seam Continuity Testing.

5. The DuPont Site Representative or the QC Contractor may also elect to perform destructive seam tests on suspect areas.

3.05 FIELD QUALITY CONTROL

A. Field Tests

1. Trial Seam Testing
   a. One sample shall be obtained from each trial seam.
   b. This sample shall be at least 36 inches long by 14 inches wide with the seam centered lengthwise.
   c. Ten random specimens 1 inch wide shall be cut from the sample.
   d. Two seam specimens shall be field tested for shear strength and 3 seam specimens shall be field tested for peel adhesion using an approved quantitative tensiometer. Both tracks of a double-wedge seam shall be tested for peel adhesion. Jaw separation speed for field tests may be increased to 20 inches per minute.
   e. To be acceptable, all test specimens shall meet seam strength requirements specified in Table 2.
   f. If the field tests fail to meet these requirements, the entire operation shall be repeated.
   g. If the additional trial seam fails, the seaming apparatus or seamer shall not be used until the installer corrects the deficiencies and 2 consecutive successful trial seams are achieved.
   h. The QC Contractor shall record all test seam results in the Contractor's daily quality control reports and report the results to the DuPont Site Representative daily.

2. Non-Destructive Field Seam Continuity Testing
   a. Field seams shall be non-destructively tested for continuity over their full length in accordance with the following methods:
      (1) Double-wedge seams shall be tested using the pressurized air-channel test method in accordance with GRI GM-6. The seam shall be initially pressurized to 30 psi. Pressure loss of less than 3 psi over 5 minutes will be considered passing.

      (2) For extrusion welds, seams shall be tested using the vacuum method and visually inspected in accordance with the procedures defined by ASTM D4437.

   b. Seam testing shall be performed as the seaming work progresses, not at the completion of field seaming.

c. Any seams which fail shall be documented and repaired in accordance with Article 3.5: Defects and Repairs.

d. All non-destructive test results are to be recorded by the QC Contractor and reported to the DuPont Site Representative daily.

3. Destructive Field Seam Testing

a. A minimum of one destructive test sample per 500 feet of field seam shall be obtained at locations specified by the QC Contractor.

b. Sample locations shall not be identified prior to seaming.

c. Samples shall be a minimum of 14 inches wide by 42 inches long with the seam centered lengthwise.

d. Each sample shall be cut into 3 equal pieces, with one piece retained by the installer, one piece given to the QC laboratory, and the remaining piece given to the DuPont Site Representative for QA testing and/or permanent record.

e. Each sample shall be numbered and cross referenced to a field log which identifies:

(1) Project name

(2) Project number

(3) Panel number

(4) Seam number

(5) Date and time cut

(6) Ambient temperature within 6 inches above the geomembrane

(7) Seaming unit designation

(8) Name of seamer

(9) Seaming apparatus temperature and pressures (where applicable)

f. Ten 1-inch wide replicate specimens shall be cut from the installer's sample.

g. Five specimens shall be tested for shear strength and 5 for peel adhesion using an approved field quantitative tensiometer. Both tracks of a double-wedge seam shall be tested for peel adhesion.

h. Jaw separation speed for field tests may be increased to 20 inches per minute.

i. To be acceptable, 4 out of 5 replicate test specimens shall meet the seam strength requirements specified in Table 2.

j. If the field tests pass, 5 specimens shall be tested at the QC laboratory for shear strength and 5 for peel adhesion in accordance with the QC laboratory's approved procedures. Jaw separation speed for laboratory tests shall be 20 inches per minute.

k. If the field tests are not acceptable, then the laboratory tests shall not be performed and the failed seam section shall be tracked and repaired in accordance with Article 3.5A: Destructive Seam Test Repairs.

l. To be acceptable, 4 out of 5 replicate test specimens shall meet the seam strength requirements specified in Table 2 or Table 4.

m. If the field or laboratory tests fail, the seam shall be repaired in accordance with Article 3.5A: Destructive Seam Test Repairs.

n. Holes for destructive seam samples shall be repaired the same day they are cut.

o. Certified test results on all field seams shall be submitted to and approved by the DuPont Site Representative prior to acceptance of the seam.

p. The minimum field seam length for destructive sampling may be increased or decreased by the DuPont Site Representative based on the criteria set forth in the GRI Standard GRI GM-14. This standard can be found on www.geosynthetic-institute.org under the heading GRI Specifications and Guides.

q. At any time, the DuPont Site Representative may request additional destructive sampling regardless of the established frequency.

B. Field Inspections

1. Immediately after geomembrane placement (unrolling) the geomembrane sheets shall be visually inspected by the QC Contractor for any holes or manufacturers defects.

2. The QC Contractor shall mark the role number, panel number, and damaged areas immediately after each panel is placed.

3. Immediately prior to covering, the QC Contractor and DuPont Site Representative shall visually inspect the geomembrane, seams, and non-seam areas for defects, holes, or damage due to weather conditions or construction activities.

4. At the DuPont Site Representative’s or the QC Contractor's discretion, the surface of the geomembrane shall be brushed, blown, or washed by the installer if the amount of dust, mud, or foreign material inhibits inspection or functioning of the overlying material.

5. Each suspect location shall be non-destructively tested in accordance with Article 3.4C: Non-Destructive Field Seam Continuity Testing.

6. Each location that fails non-destructive testing shall be repaired in accordance with Article 3.5B: Patches and non-destructively re-tested.

3.06 CLOSEOUT ACTIVITIES

A. Final as-built drawings of the geomembrane installation shall be prepared.

B. These drawings shall indicate the location of all destructive samples, repairs, penetrations, and revisions to details and layout plan. All seam numbers, repair numbers, panel numbers and roll numbers shall be noted on the drawings.

C. A topographical survey detailing the finished grade of the geomembrane liner and cover soil shall be prepared.

3.07 PROTECTION

A. The deployed and seamed geomembrane shall be covered with the required materials within 5 calendar days of acceptance in accordance with the Drawings and Specification.

B. Wrinkles in the geomembrane shall be prevented from folding over during placement of cover materials.

C. Cover soil shall not be dropped onto the geomembrane or overlying geosynthetics from a height greater than 3 feet.

D. The soil shall be pushed out over the geomembrane or overlying geosynthetics in an upward tumbling motion.

E. Soil shall be placed from the bottom of the slope upward.

F. Equipment with ground pressures less than 7 psi shall be used to place material over the geomembrane.

G. Equipment placing cover soil shall not stop abruptly, make sharp turns, spin their tracks, or travel at speeds exceeding 5 mph.

3.08 ATTACHMENTS

A. Tables

1. Textured LDPE Geomembrane Properties

Property	Test Value	Test Method
Thickness (nominal)	40 mils ± 4 mils	ASTM D5994
Density (max)	0.939 g/cc	ASTM D1505 / D792
Tensile Properties (min avg.) Break strength Break elongation	 81 lb./in 250 percent	ASTM D6693 Type IV @ 2.0 inches/min.
Tear Resistance (min avg.)	22 lb.	ASTM D1004

Puncture Resistance (min avg.)	44 lb.	ASTM D4833
Asperity Height	10 mils	ASTM D7476
Carbon Black Content	2.0-3.0 percent	ASTM D1603
Carbon Black Dispersion	A1 or A2	ASTM D5596

2. Seam Strength and Related Properties of Thermally Bonded Textured Low Density Polyethylene (LDPE) Geomembranes

Geomembrane Nominal Thickness	40 mils
Hot Wedge Seams (1) shear strength (2), lb./ in. shear elongation at break (3), % peel strength (2), lb./ in. Peel separation, (4)	 60 50 50 FTB
Extrusion Fillet Seams shear strength (2), lb./ in.	 60
shear elongation at break (3), %	50
peel strength (2), lb./ in.	44
Peel separation, (4)	FTB

Notes:
1. Also for hot air and ultrasonic seaming methods
2. Value listed for shear and peel strengths are for 4 out of 5 test specimens; the 5th specimen shall not be lower then 80% of the listed values
3. Elongation measurements should be omitted for field-testing
4. Film Tear Bond (FTB) – A failure where one of the sheets on either side of the seam fails prior to the seam delaminating

END OF SECTION

SECTION 02140

LANDFILL CONSTRUCTION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Landfill cap system requirements.

B. Related Requirements

1. Section 02073 – GEOTEXTILES
2. Section 02077 – GEOCOMPOSITE DRAINAGE LAYER
3. Section 02079 – GEOMEMBRANES
4. Section 02300 – EARTHWORK

C. Multi-Section Assembly Requirements

1. Components of the constructed cap system will consist of:
   a. Vegetative cover soil
   b. Cover soil
   c. Geocomposite drainage layer
   d. Geomembrane
   e. Geotextile
2. The specific requirements of the individual components of the cap system are given in the appropriate sections.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. Measurement and payment will be made under the individual components of the landfill cap system.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. DuPont – E. I. DuPont de Nemours Company
2. DSR – DuPont Site Representative
3. IRM – Iron Rich Material

B. Reference Standards

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. ASTM International (ASTM)
   a. ASTM D5321 (2008) Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method

1.04 ADMINISTRATIVE REQUIREMENTS

Not Used

1.05 SUBMITTALS

Engineer review is required for submittals designated as “Action Submittals”. Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

A. Action Submittals

Not Used

B. Informational Submittals

1. Test and Evaluation Reports
   a. Interface Friction Testing: Certified laboratory interface friction test results including description of equipment and test method, a minimum of 7 days prior to geosynthetic shipment.
2. Qualification Statements
   a. QC laboratory's qualification statements including resumes of key personnel involved in the project a minimum of 7 days prior to testing. Include verification that the laboratory is accredited via the Geosynthetic Accreditation Institute's Laboratory Accreditation Program (GAI-LAP) for the tests the QC laboratory will be required to perform.

C. Closeout Submittals

Not Used

D. Maintenance Material Submittals

Not Used

1.06 QUALITY ASSURANCE

A. Qualifications

1. Testing Agency
   a. The QC laboratory shall be accredited via the Geosynthetic Accreditation Institute's Laboratory Accreditation Program (GAI-LAP) for the tests the QC laboratory will be required to perform.

B. Preconstruction Testing

1. Interface Friction Testing
   a. Provide laboratory interface friction tests on the following interfaces:
      1) Cover soil/geocomposite
      2) Geocomposite/geomembrane
      3) Geomembrane/geotextile
      4) Geotextile/IRM
   b. The frequency of testing for each interface shall be 1 series per interface of the project.
   c. Conduct tests in accordance with ASTM D5321.
   d. Test using normal stresses of 125, 250, and 500 psf.
   e. Interfaces tested shall be saturated.
   f. Soil components shall be the same as used for full scale construction and shall be compacted to the same moisture-density requirements specified for full scale field placement.
   g. Geosynthetics shall be the same materials as those proposed for use during full scale construction.
   h. Geosynthetics shall be oriented such that the shear force is parallel to the down slope orientation of these components in the field.
   i. A minimum peak interface friction angle of 20.6 degrees is required for each interface.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.01 PREPARATION

A. Protection of In-place Conditions

1. Carefully maintain and protect cap system structures and existing monitoring wells during all phases of construction.

2. Equipment shall not accelerate or brake suddenly, turn sharply, or be operated at speeds exceeding 5.0 miles per hour on the landfill cap system.
3. Equipment shall not be operated directly on the top surface of geosynthetics.
4. Storage or stockpiling of material on the geosynthetics or the completed surface of the select fill or topsoil layers will not be permitted.

B. Surface Preparation

1. Prepare surface in accordance with Section 02300 – EARTHWORK.
2. Remove rocks larger than ½ inch in diameter and other material that could damage the geosynthetics from the surface to be covered with the geosynthetics.
3. Repair construction equipment tire or track deformations beneath the geosynthetics greater than 1.0 inch in depth.
4. Each day during placement of geosynthetics, the QC Inspector and installer shall inspect the surface on which geosynthetics are to be placed and certify in writing that the surface is acceptable.
5. Repair unacceptable conditions prior to placing geosynthetics.

3.02 REPAIR/RESTORATION

A. Repair settlement or erosion that occurs prior to acceptance of work and re-establish grades to the required elevations.

B. Notify the DSR of areas requiring repair so that the Engineer can investigate the cause of displacement.

C. If settlement of 18 inches or greater occurs over a 10-foot square or larger area, or if investigation reveals that a malfunction of the cap system has occurred, repair or replace the defective components and grade the area to the original specified elevations.

D. If erosion or settlement to a lesser degree occurs, place suitable soil cover and compact the area to re-establish the original grade.

END OF SECTION

SECTION 02200

SITE PREPARATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Clearing and disposal of trees, stumps, clearing fences, buildings, and other structures and disposal of debris, trash, and materials resulting from clearing operations.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. Measurement: Lump Sum.
2. Payment: The payment shall be made on a progress basis, as determined by the DSR based on the percentage of work completed and the submitted Schedule of Values.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. DuPont – E. I. DuPont de Nemours Company
2. DSR – DuPont Site Representative

B. Definitions

1. Brush – Brush is that growth that is less than 2 inches in diameter measured 6 inches from the ground on the uphill side and is less than 6 feet in height measured from the ground on the uphill side.
2. Clearing – Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.
3. Grubbing – Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas.

4. Structures – The term "structures" shall include buildings or portions thereof, walls, fences, pavement, concrete vaults, etc. Structures shall be removed or filled to the ground surface.

5. Trees – Trees, for the purpose of distinguishing clearing requirements, are woody growth not falling within the limits of brush as defined above.

1.04 ADMINISTRATIVE REQUIREMENTS

Not Used

1.05 SUBMITTALS

Not Used

PART 2 – PRODUCTS

2.01 OWNER-FURNISHED PRODUCTS

A. DuPont will not furnish products for this section.

2.02 ACCESSORY PRODUCTS

A. Tree Wound Paint

1. Bituminous based paint of standard manufacture specially formulated for tree wounds.

PART 3 – EXECUTION

3.01 INSTALLERS

Not Used

3.02 EXAMINATION

Not Used

3.03 PREPARATION

A. Protection of In-place Conditions

1. Roads and Walks
   a. Keep roads and walks free of dirt and debris at all times.

2. Trees, Shrubs, and Existing Facilities
   a. Protection trees, shrubs, and existing facilities in accordance with Section 01354 – ENVIRONMENTAL PROCEDURES.

b. Protect trees and vegetation to be left standing from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3. Utility Lines
   a. Protect existing utility lines that are indicated to remain from damage.
   b. Notify the DSR immediately of damage to or an encounter with an unknown existing utility line.
   c. Repair damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations.
   d. Notify the DSR in ample time to minimize interruption of the service when utility lines that are to be removed are encountered within the area of operations.
   e. Contact the national construction alert system for utilities at 811.
   e. Apply appropriate surface geophysical methods to locate subsurface utilities in accordance with Section 01710 – EXAMINATION AND PREPARATION prior to start of clearing and grubbing operations.

4. Erosion and Sedimentation Controls
   a. Install erosion and sedimentation control measures prior to site clearing activity in accordance with Section 02370 – EROSION AND SEDIMENTATION CONTROL.

B. Surface Preparation

1. Dispose of loose rocks, boulders, or rock piles present on the surface of areas designated to be cleared on site at the direction of the DSR.

2. Stockpile stone that can be economically used in the project in a designated area adjacent to the location of its intended use.

C. Demolition/Removal

1. Remove and dispose of structures that obtrude, encroach upon, or otherwise obstruct the work.

3.04 CLEARING

A. Cut off trees, stumps, roots, brush, and other vegetation in areas to be cleared flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing.

B. Trim trees designated to be left standing within the cleared areas of dead branches 1-1/2 inches or more in diameter and trim branches to the heights indicated or directed.

C. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches.

D. Paint cuts more than 1-1/2 inches in diameter with an approved tree-wound paint.

3.05 GRUBBING

A. Remove material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes to a depth of not less than 18 inches below the original ground surface level in construction areas.

B. Fill depressions made by grubbing with suitable material and compact to make the surface conform with the original adjacent ground surface.

3.06 CLEANING

A. Waste Management

1. Dispose of materials and debris from structures in the designated waste disposal area, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed.
2. Chip or shred felled trees, shrubs, downed timber, snags, brush, stumps, roots, logs, rotten wood, and other vegetative refuse from the clearing and grubbing operations.
3. Stockpile chipped and shredded, cleared and grubbed material on-site in a location designated by the DSR.
4. Chipped material may be used as mulch in areas approved by the DSR.
5. Grubbed material or material taken from the clearing areas shall not be removed from the site or sold.

END OF SECTION

SECTION 02300

EARTHWORK

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Earthwork activities for site grading, utilities, roadways, and select fill and vegetative cover (topsoil) layers for landfill cover system.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. Earthwork activities for general site grading, utilities, roadways and landfill cover system.
   a. Measurement: Lump Sum.
   b. Payment: The payment shall be made on a progress basis, as determined by the DSR based on the percentage of work completed and the submitted Schedule of Values.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. DuPont – E. I. DuPont de Nemours Company
2. DSR – DuPont Site Representative
3. EPA – Environmental Protection Agency
4. IRM – Iron-Rich Material
5. VOCs – Volatile organic compounds

B. Definitions

1. Cohesionless and Cohesive Materials
   a. Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP.
   b. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH.
   c. Materials classified as GM and SM will be identified as cohesionless only when the fines are non-plastic.

d. Perform testing, required for classifying materials, in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

2. Degree of Compaction
   a. Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density.
   b. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the ¾-inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the ¾-inch sieve as a percentage of the maximum density in accordance with AASHTO T 180 and corrected with AASHTO T 224.
   c. To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in AASHTO T 180.

3. Hard/Unyielding Materials
   a. Hard/Unyielding materials comprise weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" with stones greater than 3-inch in any dimension or as defined by the pipe manufacturer, whichever is smaller.
   b. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

4. Rock
   a. Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding ½-cubic yard in volume.
   b. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

5. Satisfactory Materials
   a. Satisfactory materials comprise any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, CL, ML, or CL-ML.
   b. Satisfactory materials for grading comprise stones less than 8 inches, except for fill material for pavements, which comprise stones less than 3 inches in any dimension.

6. Select Granular Material
   a. Select granular material consists of satisfactory materials classified as CL, SC, or GC by ASTM D2487, free of angular rocks.

7. Unsatisfactory Materials
   a. Materials that do not comply with the requirements for satisfactory materials are unsatisfactory.
   b. Unsatisfactory materials also include man-made fills; trash; refuse; backfill from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material.
   c. Notify the DSR when encountering any contaminated materials.

8. Unstable Material
   a. Unstable material is too wet to properly support the utility pipe, conduit, or appurtenant structure.

9. Vegetative Cover Soil (Topsoil)
   a. Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Additional requirements such as pH value and necessary soil conditioning, according to applicable provisions of Section 02900 – PLANTING.

C. Reference Standards

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. ASTM International (ASTM)
   a. ASTM D422 (1963; R 2007) Particle-Size Analysis of Soils
   b. ASTM D698 (2007e1) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))
   c. ASTM D1556 (2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
   d. ASTM D2216 (2005) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
   e. ASTM D2487 (2006e1) Soils for Engineering Purposes (Unified Soil Classification System)
   f. ASTM D4318 (2005) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
   g. ASTM D6938 (2007a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

2. U.S. Environmental Protection Agency (EPA)

a. EPA SW-846.3-3 (1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

1.04 ADMINISTRATIVE REQUIREMENTS

Not Used

1.05 SUBMITTALS

Engineer review is required for submittals designated as “Action Submittals”. Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

A. Action Submittals

Not Used

B. Informational Submittals

1. Certificates
   a. Certification of clean fill for commercial borrow sources.
2. Source Quality Control Submittals
   a. Within 24 hours of conclusion of physical tests, 3 copies of test results, including calibration curves and results of calibration tests.
3. Field Quality Control Submittals
   a. Within 24 hours of conclusion of physical tests, 3 copies of test results, including calibration curves and results of calibration tests.
4. Special Procedure Submittals
   a. Rock or Construction Material Debris Excavation
      Notification of encountering rock or construction material debris in the project.
   b. Opening of any Excavation or Borrow Pit
      1) Proposed sources of borrow material.
      2) Advance notices on the opening of excavation or borrow areas.
5. Qualification Statements
   a. Qualification of the Contractor's validated testing facilities.

C. Closeout Submittals

1. Record Documentation
   a. As-built surveys

D. Maintenance Material Submittals

Not Used

1.06 QUALITY ASSURANCE

A. Qualifications

1. Testing Agency
   a. Perform testing by a DuPont validated commercial testing laboratory or the Contractor's validated testing facility.
   b. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, DuPont validated and approved by the DSR.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store materials in a manner to prevent contamination, segregation, freezing, and other damage.

1.08 FIELD CONDITIONS

A. Existing Conditions

1. Classification of Excavation
   a. No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.
   b. Groundwater is not expected to impact work.
   c. Hard materials and rock are not expected to be encountered .

PART 2 – PRODUCTS

2.01 OWNER-FURNISHED PRODUCTS

Not Used

2.02 GENERAL FILL

A. Description

1. Backfill for site grading, utilities, roadway subgrade, drainage features, and intermediate cap grading (i.e., below geosynthetics).

B. Materials

1. In compliance with the requirements for satisfactory material defined in Article – DEFINITIONS.
2. Excavated IRM and underlying dredge material may be used as fill below the geosynthetics within the “Limits of IRM” indicated on the Drawings.

2.03 SELECT FILL FOR COVER SOIL

A. Description

1. Backfill for constructing the cover soil layer of the cap.
2. Select fill for cover soil may be used as vegetative cover soil provided that it is modified to comply with the requirements of Section 02900 – PLANTING.

B. Materials

1. In compliance with the requirements for select granular material defined in Article – DEFINITIONS and having a maximum particle size of 1.0 inches by ASTM D422.

2.04 SOURCE QUALITY CONTROL

A. Tests

1. Requirements for Offsite Soils
   a. Borrow material shall be obtained from approved commercial sources.
   b. Prior to use of clean fill, the material supplier shall certify the origin of the fill material and results of analytical testing to qualify the material as clean fill in accordance with Delaware requirements. This certification shall be provided to and must be retained by the owner of the property receiving the fill.
   c. Documentation shall be provided that source sampling and testing was performed in accordance with the most current version of the EPA RCRA Manual, SW-846 (*Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. Office of Solid Waste and Emergency Response*).
   d. Materials shall not be blended or mixed to become clean fill.
   e. Clean fill may not contain any free liquids based on visual inspection, and shall not create public nuisances (for example objectionable odors) to users of the receiving property or adjacent properties.
   f. Do not bring material onsite until tests have been approved by the DSR.
   g. The Contractor shall obtain from the property owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling.
2. Classification Testing
   a. Borrow source assessment tests shall be performed on each principal type or combination of materials proposed for use in the select fill layer to ensure compliance with specified requirements.

b. At least one set of borrow assessment tests shall be performed on each borrow source proposed for use.
c. A set of borrow source assessment tests shall consist of Atterberg limits (ASTM D4318), particle size analysis (ASTM D422), and moisture content (ASTM D2216).
d. Based on borrow source assessment testing, soils shall be classified in accordance with ASTM D2487.

3. Optimum Moisture and Laboratory Maximum Density
   a. A representative sample from each principal type or combination of borrow materials shall be tested to establish compaction curves using ASTM D698.
   b. At least one compaction test shall be performed on each borrow source proposed.
   c. A minimum of 5 points shall be used to develop each compaction curve.
   d. During construction, placement of select fill shall conform to the following requirements:
      (1) The minimum allowable dry density shall be no less than 90 percent of maximum dry density.
      (2) The allowable moisture content range shall be +/- 3 percent of optimum.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Evaluation and Assessment

1. Prior to placement of cover soil over the cap system geosynthetics, the geosynthetics shall be inspected and approved by the Contractor's quality control contractor and the DSR.

3.02 PREPARATION

A. Protection of In-place Conditions

1. Drainage and Dewatering
   a. Provide for the collection and disposal of surface and subsurface water encountered during construction.
   b. Completely drain construction site during periods of construction to keep soil materials sufficiently dry.
   c. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and provide temporary ditches,

swales, and other drainage features and equipment as required to maintain dry soils.

d. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein.

e. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

f. Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction.

g. Do not permit French drains, sumps, ditches or trenches within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made.

h. Take control measures by the time the excavation reaches the water level in order to maintain the integrity of the in situ material.

2. Underground Utilities

a. The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction.

b. Perform work adjacent to non-DuPont utilities as indicated in accordance with procedures outlined by utility company.

c. Excavation made with power-driven equipment is not permitted within two feet of known DuPont-owned utility or subsurface construction.

d. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand.

e. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured.

f. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the DSR.

g. Report damage to utility lines or subsurface construction immediately to the DSR.

3. Existing Monitoring Wells

a. Existing monitoring wells are present around the site.

b. Any monitoring wells or other structures not shown on the Drawings, which are located during construction activities, should be reported to the DSR for evaluation.

c. The existing monitoring wells and any other monitoring wells encountered, shall be clearly marked, protected and shall not be disturbed in any manner.

B. Surface Preparation

1. Stripping of Topsoil
   a. Where indicated or directed, strip topsoil to a depth of 6-inches.
   b. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified.
   c. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2-inch in diameter, and other materials that would interfere with planting and maintenance operations.
   d. Stockpile on site any surplus of topsoil from excavations and grading.

2. Ground Surface Preparation
   a. Remove and replace unsatisfactory material with satisfactory materials, as directed by the DSR, in surfaces to receive fill or in excavated areas.
   b. Scarify the surface to a depth of 6 inch before the fill is started.
   c. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material.
   d. When the subgrade is less than the specified density, break up the ground surface to a minimum depth of 6 inch, pulverizing, and compacting to the specified density.
   e. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inch and compact it as specified for the adjacent fill.
   f. Frozen Material
      1) Do not place material on surfaces that are muddy, frozen, or contain frost.
      2) Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted.
      3) Moisten material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

3. Cap Intermediate Grade Preparation
   a. Remove IRM sediment from ditches and from outside of silt fence and place back on pile.

b. Remove rocks larger than 3 inches in diameter and other material that could damage the geosynthetic components from the surface to be covered by the cap system.
c. Grade in a manner and sequence that will utilize all suitable material prior to geosynthetic placement.
d. Bury unsuitable material at least 3 feet from the finished surface that will receive geosynthetic materials.
e. No material shall be deposited in any manner that may be determined to harm the completed work.
f. Suitable materials shall be placed in 12-inch loose lifts and then compacted using four passes of a smooth drum vibrating soil compactor specified in paragraph SUBSEQUENT LIFTS OF SELECT FILL.

3.03 EXCAVATION

A. Perform excavation of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified.

B. Perform the grading in accordance with the typical sections shown and the tolerances specified in Article FINISHING.

C. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work.

D. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials. Include such excavated material and the satisfactory material ordered as replacement in excavation.

E. Notify the DSR immediately in writing if it becomes necessary to remove rock or hard, unstable, or otherwise unsatisfactory material to a depth greater than indicated.

F. Dispose surplus satisfactory excavated material not required for fill or embankment in areas approved for surplus material storage or designated waste areas.

G. Dispose unsatisfactory excavated material in designated waste or spoil areas.

H. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times.

I. Ditches, Gutters, and Channel Changes

1. Finish excavation of ditches, gutters, and channel changes by cutting accurately to the cross sections, grades, and elevations shown on Drawings.

2. Do not excavate ditches and gutters below grades shown.
3. Backfill the excessive open ditch or gutter excavation with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown.
4. Dispose excavated material as shown or as directed, except in no case allow material be deposited a maximum 4 feet from edge of a ditch.
5. Maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

J. Stockpiles

1. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times.
2. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials.
3. Protect stockpiles of satisfactory materials from contamination, which may destroy the quality and fitness of the stockpiled material.
4. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

3.04 BACKFILLING AND COMPACTION FOR GENERAL CONSTRUCTION

A. Construct earth embankments and fills from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches.

B. Place the material in successive horizontal layers of loose material not more than 12 inch in depth.

C. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed.

D. After spreading, plow, disk, or otherwise brake up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials.

E. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

F. Do not vary the elevation of the finish grade more than 0.05 foot from the established grade and cross section.

3.05 COVER SOIL PLACEMENT AND COMPACTION

A. No equipment shall be operated directly on the top surface of geosynthetics.

B. Soil shall not be stockpiled on geosynthetics.

C. Select fill shall be pushed out over geosynthetics in an upward tumbling motion so that wrinkles in geosynthetics do not fold over.

D. Select fill shall not be pushed over distances greater than 50 feet across the geosynthetics.

E. Soil shall not be dropped directly onto geosynthetics from a height greater than 3 feet.

F. On slopes, select fill shall be placed from the bottom of the slope upward.

G. Initial Lift of Select Fill Placed Over Geosynthetics

1. The first lift of soil placed over geosynthetics shall be a minimum of 12 inches in loose thickness.
2. Equipment with ground pressures less than 7 psi shall be used to place and traffic compact the first lift of select fill. More stringent geocomposite manufacturer recommended maximum equipment weight shall not be exceeded.
3. Traffic compaction shall consist of a minimum of 2 passes over all areas.

H. Subsequent Lifts of Select Fill

1. The loose lift thickness of each subsequent lift shall be no greater than 8 inches.
2. Full scale placement and compaction equipment shall be allowed on areas underlain by geosynthetics after the second loose lift of soil has been placed.
3. Operate compaction equipment so that the strip being traversed overlaps the rolled adjacent strip not less than 1 foot.
4. Each lift of cover soil fill shall be compacted with a minimum of 4 complete passes of a smooth-drum vibratory soil compactor with a minimum operating weight of 25,000 pounds.

I. Repair damaged geosynthetics.

3.06 VEGETATIVE COVER SOIL PLACEMENT AND COMPACTION

A. Vegetative cover soil shall not be placed when the subgrade is frozen, excessively wet, extremely dry or in a condition otherwise detrimental to proper grading or the proposed planting.

B. Vegetative cover soil shall be placed in one lift and shall be evenly spread to a final compacted thickness of 6 inches.

C. Vegetative cover soil shall be traffic compacted using approved placement equipment.

E. On slopes, vegetative cover soil shall be placed from the bottom of the slope upward.

3.07 FINISHING

A. General Earthwork

1. Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown.
2. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated.
3. Finish gutters and ditches in a manner that will result in effective drainage.
4. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turfing materials.
5. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

B. Subgrade and Embankments

1. During construction, keep embankments and excavations shaped and drained.
2. Maintain ditches and drains along subgrade to drain effectively at all times.
3. Do no disturb the finished subgrade by traffic or other operation.
4. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed.
5. Do not permit the storage or stockpiling of materials on the finished subgrade.
6. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

C. Cover Soil and Vegetative Cover Soil

1. Finished surfaces shall be uniformly graded and shall be free from depressions, mounds, or windrows.
2. The top surface of the select fill layer and topsoil layer shall be no greater than 3 inches above the lines and grades shown on the drawings.
3. No minus tolerance will be permitted.
4. Rigid grade stakes shall not be driven into the select fill layer to control placement.

3.08 REPAIR

A. Repair erosion rills and other damage that occurs and re-establish grades.

B. Document repairs to the select fill layer or vegetative cover layer including location and volume of soil affected, corrective action taken, and results of retests.

3.09 FIELD QUALITY CONTROL

A. Field Tests

1. In-Place Densities
   a. Determine field in-place density in accordance with ASTM D6938. When ASTM D6938 is used, check the calibration curves and adjust using only the sand cone method as described in ASTM D1556. ASTM D6938 results in a wet unit weight of soil in determining the moisture content of the soil when using this method.
   b. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D6938; check the calibration of both the density and moisture gauges at the beginning of a job on each different type of material encountered and at intervals as directed by the DSR.
   c. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests.
   d. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.
2. Moisture Contents
   a. In the stockpile, excavation, or borrow areas, perform a minimum of two tests per day per type of material or source of material being placed during stable weather conditions.
   b. During unstable weather, perform tests as dictated by local conditions and approved by the DSR.

B. Field Inspections

1. Tolerance Tests for Subgrade
   a. Perform continuous checks on the degree of finish specified in Article FINISHING during construction of the subgrade.

2. Lift Depth Check by Hand-Auger Boring or Other Manual Method
   a. 1 per 400 ft centers per lift

C. Non-Conforming Work

1. Compaction Testing
   a. When test results indicate, as determined by the DSR, that compaction is not as specified, remove the material, replace and re-compact to meet specification requirements.
   b. Perform tests on re-compacted areas to determine conformance with specification requirements.

3.10 CLEANING

A. Disposition of Surplus Materials

1. Provide surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber as wasted in DuPont disposal area, which is located within a haul distance of 2.5 miles.

3.11 CLOSEOUT ACTIVITIES

A. As-built Survey

1. Submit as-built surveys of the completed intermediate grade (subgrade), cover soil, and final cap system (vegetative cover) surface to the DSR.

2. The as-built survey of the intermediate grade shall be supplied to the DSR prior to the placement of the cap system geosynthetics.

3. Similar to the previous layer, the as-built survey of the cover soil shall be supplied to the DSR prior to the placement of the topsoil.

4. The survey of the final cap system shall be submitted in accordance with Section 01780 – CLOSEOUT SUBMITTALS.

5. Survey vertical elevations of the cap on a 50-foot grid and at slope changes.

3.12 ATTACHMENTS

A. Tables

1. Source Quality Control Testing

Test	Test Method	Minimum Frequency
Atterberg Limits	ASTM D4318	1 per material
Particle Size Analysis	ASTM D422	1 per material
Moisture Content	ASTM D2216	1 per material
Soil Classification	ASTM D2487	1 per material
Optimum Moisture and Laboratory Maximum Density	ASTM D698	1 set per material

2. Field Quality Control Testing

Test	Test Method	Minimum Frequency
Visual Field Classification	ASTM D2488	1 per 400 ft centers per lift
Nuclear moisture content	ASTM D6938	1 per 10,000 sf per lift
Standard moisture content	ASTM D2216	1 per 20 nuclear tests
Nuclear density	ASTM D6938	1 per 10,000 sf per lift
Standard density	ASTM D1556	1 per 20 nuclear tests

END OF SECTION

SECTION 02370

EROSION AND SEDIMENTATION CONTROL

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Soil surface erosion control requirements.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. Measurement: Lump Sum.
2. Payment: The payment shall be made on a progress basis, as determined by the DSR based on the percentage of work completed and the submitted Schedule of Values.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. DuPont – E. I. DuPont de Nemours Company
2. DSR – DuPont Site Representative

B. Definitions

1. Silt Fence – A temporary sediment barrier consisting of a sediment trapping geotextile fence that reduces the off-site transport of sediment via ponding of runoff allowing sediment to filter out on the upstream side of the fence.
2. Filter Bag – A small sediment filtering device to be used during excavation dewatering operations.
3. Stabilized Construction Entrance – A stabilized pad of aggregate placed over a geotextile to reduce the amount of soil and mud tracked off site by construction related traffic.
4. Riprap – Specifically selected and graded quarried stone placed for pipe inlet/outlet protection and for temporary ditch protection during construction.

5. Rock Inlet/Outlet Protection – Structurally lined aprons placed at the inlets and/or outlets of pipe culverts or ditches to dissipate the energy of runoff flow.

6. Erosion Control Blanket (ECB) – A temporary, degradable rolled erosion control product made of natural fibers attached to synthetic netting and used to protect newly seeded areas from environmental forces such as wind, rain and intense sunlight, and to enhance the growth of vegetation.

7. Sediment Trap – A temporary settling pond used to collect sediment-laden runoff and trap sediment while discharging clean water through a simple spillway outlet structure stabilized with geotextile and riprap.

8. Stone Check Dam – Check dams are small stone dams constructed in ditches to reduce the velocity of concentrated flow, thereby reducing erosion within the ditch.

9. Responsible Personnel – A foreman or superintendent who is in charge of on-site clearing and land disturbing activities for sediment and stormwater control associated with a construction project.

C. Reference Standards

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. Delaware Department of Natural Resources and Environmental Control (DNREC)
   a. Delaware Sediment and Stormwater Regulations, Department of Natural Resources and Environmental Control, Division of Water Resources, Division of Soil and Water Conservation, March 11, 1993
   b. Delaware Erosion and Sediment Control Handbook for Development 1989

2. State of Delaware Department of Transportation (DelDOT)
   a. DelDOT Standard Specifications 1998

3. ASTM International (ASTM)
   a. ASTM C136 – Method for Sieve Analysis of Fine and Coarse Aggregates
   b. ASTM D123 – Terminology Relating to Textiles Materials
   c. ASTM D488 – Standard Classification for Sizes of Aggregate for Road and Bridge Construction
   d. ASTM D3786 – Test Method for Hydraulic Bursting Strength of Knitted Goods and Non-woven Fabrics: Diaphragm Bursting Strength Tester Method
   e. ASTM D4354 – Practice for Sampling of Geotextiles for Testing

f. ASTM D4355 – Deterioration of Geotextiles From Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
g. ASTM D4491 – Water Permeability of Geotextiles by Permitivity
h. ASTM D4632 – Grab Breaking Load and Elongation of Geotextiles
i. ASTM D4751 – Determining Apparent Opening Size of a Geotextile
j. ASTM D 4759 – Test Method for Determining the Specification Conformance of Geosynthetics

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sequencing

1. Following soil disturbance or redisturbance, permanent or temporary stabilization shall be completed within 14 calendar days as to the surface of all perimeter sediment controls, topsoil stockpiles, and all other disturbed or graded areas on the project site. These requirements do not apply to those areas that are shown on the plan and are currently being used for material storage, or for those areas on which actual earth moving activities are currently being performed.

B. Scheduling

1. The Contractor shall submit a construction work sequence schedule, with the approved erosion control plan prior to start of construction.
2. The work schedule shall coordinate the timing of land disturbing activities with the provision of erosion control measures.

1.05 SUBMITTALS

Engineer review is required for submittals designated as “Action Submittals”. Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

A. Action Submittals

1. Product Data
   a. Geotextile
   b. Erosion control blanket
   c. Silt fence

B. Informational Submittals

1. Manufacturer Instructions
   a. Erosion control blanket installation instructions.

2. Qualification Statements
   a. Installer qualification statement.

C. Closeout Submittals

1. Operation and Maintenance Data
   a. Maintenance record for erosion controls.
2. Warranty Documentation
3. Record Documentation
   a. As-built location of installed erosion controls.

D. Maintenance Material Submittals

Not Used

1.06 QUALITY ASSURANCE

A. Qualifications

1. Installer
   a. Contractor shall provide Responsible Personnel to oversee installation of erosion and sediment control measures in accordance with the Delaware Sediment and Stormwater Regulations.
   b. One responsible person on site directing erosion and sediment control installation will have a Certification of Training at a Delaware Department of Natural Resources and Environmental Control sponsored or approved training program for the control of erosion and sediment control before initiation of any land disturbing activity.
   c. The installer shall be certified by the manufacturer for training and experience installing the material.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements

1. Do not drop containers from trucks.
2. Material shall be free of defects that would void required performance or warranty.
3. Deliver geosynthetic binders and synthetic soil binders in the manufacturer's original sealed containers and stored in a secure area.
   a. Furnish erosion control blankets and geotextile fabric in rolls with suitable wrapping to protect against moisture and extended ultraviolet exposure prior to placement. Label erosion control blanket and geotextile fabric rolls to provide identification sufficient for inventory and quality control purposes.

b. All synthetic grids, synthetic sheets, and articulating cellular concrete block grids shall be sound and free of defects that would interfere with the proper placing of the block or impair the strength or permanence of the construction. Minor cracks in synthetic grids and concrete cellular block, incidental to the usual methods of manufacture, or resulting from standard methods of handling in shipment and delivery, will not be deemed grounds for rejection.

c. Inspect seed upon arrival at the jobsite for conformity to species and quality. Seed that is wet, moldy, or bears a test date five months or older, shall be rejected.

B. Storage and Handling Requirements

1. Store materials in designated areas and as recommended by the manufacturer protected from the elements, direct exposure, and damage.

1.08 FIELD CONDITIONS

A. Ambient Conditions

1. Erosion control operations shall be performed under favorable weather conditions; when excessive moisture, frozen ground or other unsatisfactory conditions prevail, the work shall be stopped as directed.

2. When special conditions warrant a variance to earthwork operations, a revised construction schedule shall be submitted for approval.

3. Erosion control materials shall not be applied in adverse weather conditions which could affect their performance.

B. Existing Conditions

1. When obstructions below ground affect the work, shop drawings showing proposed adjustments to placement of erosion control material shall be submitted for approval

1.09 WARRANTY [OR] BOND

A. Manufacturer Warranty

1. Erosion control material shall have a warranty for use and durable condition for project specific installations.

2. Temporary erosion control materials shall carry a minimum eighteen month warranty.

3. Permanent erosion control materials shall carry a minimum three year warranty.

PART 2 – PRODUCTS

2.01 OWNER-FURNISHED PRODUCTS

Not Used

2.02 SILT FENCE

A. Silt fence shall consist of geotextile material attached to a 2-inch by 2-inch hardwood or steel stake of sound quality with a minimum length of 36 inches, and stakes for the reinforced silt fence with a minimum length of 48 inches.

B. The maximum spacing between stakes shall be 10 feet.

C. Stakes shall be either wood or steel having sufficient strength to resist damage during installation and to support applied loads.

D. For wooden posts, fasteners shall be either wire staples or nails. DuPont shall approve steel or synthetic post fasteners.

E. Woven wire fencing, if used, shall be a minimum of 14-½ gage with maximum 6-inch mesh openings or as approved by the DSR. Minimum height of support fencing shall be 18 inches.

F. The edges of the geotextile shall be fabricated to prevent the outer yarn from pulling away from the fabric.

G. Minimum height of the geotextile shall be 24 inches.

H. The geotextile component of the silt fence shall conform to type GD-1 in accordance with the Delaware Erosion and Sediment Control Handbook for Development.

2.03 EROSION CONTROL BLANKET (ECB)

A. Grass-Lined Ditch Protection

1. The ECB shall consist of a rolled erosion control product of uniform thickness manufactured from natural or synthetic fibers attached or woven into 2 continuous UV-stabilized synthetic netting structures.

2. The ECB must be capable of withstanding a limited shear stress of 1.5 lbs/sf in an un-vegetated state.

B. Staples

1. ECB shall be anchored with “U”-shaped 11-gauge wire staples with a minimum top width of 1 inch and length as determined by the soil type and approved by the manufacturer and DuPont.
2. Staples for ECB shall not damage underlying geosynthetics.

PART 3 – EXECUTION

3.01 PREPARATION

A. Protection of In-place Conditions

1. The location of underground utilities and facilities in the area of the work shall be verified and marked.
2. Damage to underground utilities and facilities shall be repaired at the Contractor's expense.

B. Surface Preparation

1. Surfaces of ditches and slopes shall conform to the lines, grades, and cross-sections shown on the Drawings.
2. Surfaces and slopes shall be finished to a smooth and even condition with all debris, roots, stones, and clods greater than 3 inches in diameter raked out or removed prior to the placement of erosion control measures as applicable.
3. Correct subgrade irregularities exceeding previously specified limit to the DuPont Site Representative’s satisfaction either by removing or adding material as required, followed by rolling until satisfactorily compacted.

3.02 SILT FENCE INSTALLATION

A. Silt fence shall be constructed before upslope land disturbance begins.

B. Remove existing silt fence from around the Iron-Rich pile as needed during construction. Remove all silt fence after installation of permanent erosion and sediment controls and cap construction is complete.

C. All silt fence shall be placed as close to the contour as possible so that water will not concentrate at low points in the fence and so that small swales or depressions that may carry small concentrated flows to the silt fence are dissipated along its length.

D. To prevent water ponded by the silt fence from flowing around the ends, each end shall be constructed upslope so that the ends are at a higher elevation.

E. Where possible, silt fence shall be placed on the flattest area available, offset a minimum distance of 5 feet from the upstream slope.

F. Where possible, vegetation shall be preserved for 5 feet (or as much as possible) upslope from the silt fence. If vegetation is removed, it shall be re-established within 7 days from the installation of the silt fence.

G. The depth of the silt fence stake shall be 16 inches below the original ground surface, and 18 inches below the original ground surface for the reinforced silt fence.

H. The silt fence shall be placed in a trench cut a minimum of 8 inches deep and 6 inches wide. The trench shall be cut with a trencher, cable laying machine, or other suitable device that will ensure an adequately uniform trench depth.

I. The silt fence shall be placed with the stakes on the downslope side of the geotextile and such that 8 inches of cloth are below the ground surface. Excess material shall lie on the bottom of the 8-inch deep trench. The trench shall be backfilled and compacted in accordance with Section 02200 – Earthwork.

J. Seams between sections of silt fence shall be overlapped a minimum of 6 inches with the end stakes of each section wrapped together before driving into the ground.

K. Silt fence shall allow runoff to pass only as diffuse flow through the geotextile. If runoff overtops the silt fence, flows under or around the ends, or in any other way becomes a concentrated flow, one or more of the following shall be performed, as appropriate:

1. The layout of the silt fence shall be changed
2. Accumulated sediment shall be removed
3. Other practices shall be installed

L. Upslope areas shall be permanently stabilized prior to removing the silt fence.

M. Where wire support fence is used, the wire mesh fabric shall be fastened securely down slope of the geotextile on the upslope side of the stake. The wire shall extend into the trench a minimum of 2 inches and extend a maximum of 36 inches above the original ground surface.

3.03 EROSION CONTROL BLANKET (ECB) INSTALLATION

A. ECB shall be placed in ditches as indicated on the Drawings.

B. Grass-lined Ditch Protection

1. Prepare soil before installing blankets, including application of lime, fertilizer, seed, and mulch.
2. Begin at the top of the ditch by anchoring the blanket in a 6-inch deep by 6-inch deep wide trench. Backfill and compact the trench after stapling.
3. Roll center blanket in direction of water flow on bottom of ditch.
4. Place blankets end over end (shingle style) with 6 inch overlap. Use a double row of staggered staples 4 inches apart to secure blankets.
5. Full-length edge of blankets at top of side slopes shall be anchored in a 6-inch deep by 6-inch deep wide trench. Backfill and compact the trench after stapling.
6. Blankets on side slopes shall be overlapped 4 inches over the center blanket and stapled.
7. In ditch applications, a staple check slot shall be used every 25 feet. Use a row of staples 4 inches apart over entire width of ditch. Place a second row 4 inches below the first row in a staggered pattern.
8. The terminal end of the blankets shall be anchored in a 6-inch by 6-inch wide trench. Backfill and compact the trench after stapling.
9. Staple pattern shall be per manufacturer's recommendations.

C. Adjustments

1. If any staples become loosened or raised, or if any matting becomes loose, torn, or undermined, Contractor shall immediately make satisfactory repairs.
2. Contractor shall maintain areas mulched at no additional cost to DuPont, until the completion of the first year of post-construction maintenance period or until vegetation is adequately established. The Contractor shall be responsible for the maintenance and repair of the ECB through its protection period.

3.04 STONE CHECK DAM CONSTRUCTION

A. Check dams shall be constructed the full width of the ditch.

B. The top of the check dam shall be constructed so that the center is approximately 6 inches lower than the outer edges, to direct flow across the center of the check dam and not around the ends.

C. Spacing between check dams shall be as indicated on the Drawings.

3.05 STABILIZED CONSTRUCTION ENTRANCE INSTALLATION

A. The stabilized construction entrance shall be installed as soon as practicable once mobilization begins.

B. Dimensions of the entrance shall be as indicated on the Drawings.

C. A geotextile shall be placed over the entrance subgrade prior to placing aggregate. The geotextile shall meet the same properties specified in Section 02274 – Geotextile.

D. Top dressing of additional stone shall be applied as detailed on the Drawings. Mud spilled, dropped, washed or tracked onto public roads, or any surface where runoff is not checked by sediment controls, shall be removed immediately. Removal shall be accomplished by scraping or sweeping.

E. Construction entrances shall not be relied upon to remove mud from vehicles and prevent off-site tracking. Vehicles that enter and leave the construction site shall be restricted from muddy areas.

3.06 FIELD QUALITY CONTROL

A. Field Inspections

1. The integrity of the erosion control devices shall be maintained as long as they are necessary to contain sediment runoff associated with the work to be performed.
2. Erosion controls shall be inspected, at a minimum, once every 7 days and within 24 hours of a rainfall event of 0.5 inches or greater.

3.07 CLEANING

A. Excess material, debris, and waste materials shall be disposed offsite at an approved landfill or recycling center.

B. Adjacent paved areas shall be cleared.

C. Immediately upon completion of the installation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required or as directed.

3.08 MAINTENANCE

B. Maintenance shall include eradicating weeds; protecting embankments and ditches from surface erosion; maintaining the performance of the erosion control materials and mulch; protecting installed areas from traffic.

C. Written instructions containing drawings and other necessary information shall be furnished, describing the care of the installed material; including, when and where maintenance should occur, and the procedures for material replacement.

D. Unless otherwise directed, material shall be placed, seamed or patched as recommended by the manufacturer.

E. Material not meeting the required performance as a result of placement, seaming or patching shall be removed from the site.

F. The Contractor shall replace the unacceptable material at no additional cost to DuPont.

G. A record shall be furnished describing the maintenance work performed, record of measurements and findings for product failure, recommendations for repair, and products replaced.

END OF SECTION

SECTION 02730

AGGREGATE SURFACING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Aggregate surfaced roadways on and off of the cap system.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. Measurement: Lump Sum.
2. Payment: The payment shall be made on a progress basis, as determined by the DSR based on the percentage of work completed and the submitted Schedule of Values.

1.03 REFERENCES

A. Abbreviations and Acronyms

1. DuPont – E. I. DuPont de Nemours Company
2. DSR – DuPont Site Representative

B. Reference Standards

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. ASTM International (ASTM)
   a. ASTM C88 – Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
   b. ASTM C117 (1995) – Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
   c. ASTM C131 (1996) – Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
   d. ASTM C136 (1996a) – Sieve Analysis of Fine and Coarse Aggregates
   e. ASTM D75 (1987; R 1997) – Sampling Aggregates
   f. ASTM D422 (1963; R 1998) – Particle-Size Analysis of Soils

g. ASTM E11 (1995) – Wire-Cloth Sieves for Testing Purposes

1.04 ADMINISTRATIVE REQUIREMENTS

Not Used

1.05 SUBMITTALS

Engineer review is required for submittals designated as “Action Submittals”. Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

A. Action Submittals

1. Product Data
   a. The source of the material to be used for producing aggregates shall be selected 30 days prior to the time the material will be required in the work.

B. Informational Submittals

1. Source Quality Control Submittals
   a. Test results from samples, not less than 30 days before material is required for the work, as required in Article SAMPLING AND TESTING.
2. Field Quality Control Submittals
   a. Within 24 hours of conclusion of physical tests, copies of test results, including calibration curves and results of calibration tests.

C. Closeout Submittals

Not Used

D. Maintenance Material Submittals

Not Used

1.06 FIELD CONDITIONS

A. Ambient Conditions

A. Aggregate surface courses shall not be constructed when the ambient temperature is below 35 degrees F and on subgrades that are frozen or contain frost.

B. It shall be the responsibility of the Contractor to protect, by approved method or methods, all areas of surfacing that have not been accepted by the DuPont Site Representative.

C. The Contractor shall bring surfaces damaged by frost, rainfall, or other weather conditions to a satisfactory condition.

PART 2 – PRODUCTS

2.01 OWNER-FURNISHED PRODUCTS

Not Used

2.02 AGGREGATE

A. Roadway aggregate shall meet the minimum requirements for graded aggregate Type B (crusher run), as specified in The State of Delaware Department of Transportation's Standard Specifications, Section 821.03(c) – Graded Aggregates.

B. Aggregates shall consist of clean, sound, durable particles of natural gravel, crushed gravel, crushed stone, sand, Portland cement concrete fragments or other approved materials processed and blended or naturally combined.

C. Aggregates shall be free of silt, clay, organic matter, overburden material, soil, reinforcement, objectionable coatings, and other deleterious materials.

D. The Contractor shall be responsible for obtaining materials that meet the specification and can be used to meet the grade and smoothness requirements specified herein after all compaction and proof rolling operations have been completed.

E. Gradation Requirements

1. Gradation requirements specified in Table 02505-1 shall apply to the completed aggregate surface.
2. It shall be the responsibility of the Contractor to obtain materials that will meet the gradation requirements after mixing, placing, compacting, and other operations.
3. Table 02505-1 shows permissible grading for granular material used in aggregate surface roads.
4. Sieves shall conform to ASTM E11.

2.03 SOURCE QUALITY CONTROL

A. Tests

1. Aggregate gradation shall be made in conformance with ASTM C117, ASTM C136, and ASTM D422. Sieves shall conform to ASTM E11.

PART 3 – EXECUTION

3.01 PREPARATION

A. Surface Preparation

1. The subgrade shall be cleaned of all foreign substances and vegetation prior to placing the geotextile and aggregate.
2. The aggregate roadway shall not be constructed on a wet, frozen, or unsuitable subgrade. Unsuitable subgrade material is any material that is not capable of meeting the requirements of Article 3.5: Proof Rolling.
3. Unsuitable subgrade material shall be removed and replaced with approved material at the direction of the DuPont Site Representative.
4. The subgrade shall be proof rolled thoroughly, prior to the placement of geotextile, in accordance with Article 3.5: Proof Rolling.
5. The completed subgrade shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the surface course is placed.

3.02 MATERIAL PLACEMENT

A. Placement of Geotextile

1. The geotextile shall be unrolled as smoothly as possible with no wrinkles or folds on the prepared subgrade in the direction of construction traffic, and to the full width of the base.
2. Adjacent geotextile rolls shall be overlapped perpendicular to the centerline of the road with a minimum overlap of 24 inches.
3. For curves, the geotextile shall be folded or cut and overlapped in the direction of the turn. Overlaps shall meet the minimum overlap requirements of 24 inches.
4. Folds in geotextile shall be stapled or pinned 5 feet on center.
5. Placed geotextile shall be covered with aggregate the same day it is placed.

B. Placement of Aggregate

1. During construction, the lines and grades including crown and cross slope indicated for the aggregate surface course shall be maintained by means of line and grade stakes placed by the Contractor.
2. The materials shall be mixed to obtain a uniform mixture and optimum water content of the material to facilitate compaction.

3. The aggregate material shall be placed over the geotextile in layers of uniform thickness.

4. When a compacted layer of 6 inches or less is specified, the material may be placed in a single layer; when a compacted thickness of more than 6 inches is required, no layer shall exceed 6 inches nor be less than 3 inches when compacted.

5. The Contractor shall make adjustments in mixing, placing procedures, or in equipment to obtain the true grades, to minimize segregation and degradation, to obtain the desired water content, and to ensure a satisfactory surface course.

3.03 COMPACTION

A. Each layer of the aggregate surface course shall be compacted with compaction equipment approved by the DuPont Site Representative.

B. The water content during the compaction procedure shall be maintained at optimum or at the percentage specified by the DuPont Site Representative.

C. The rolling shall begin at the sides and progress to the center and continue until the material does not creep or wave ahead of the roller.

D. The rolling shall be parallel with the centerline of the roadway and each preceding track shall be uniformly overlapped ensuring that the entire surface is traversed with the rear wheels.

E. In locations not accessible to the rollers, the mixture shall be compacted with mechanical tampers.

F. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked to produce a satisfactory material.

G. Red flags, or other approved markers, shall be placed at the limits of satisfactorily compacted aggregate. The flags shall be moved ahead by the Contractor as additional material is compacted.

3.04 FIELD QUALITY CONTROL

A. Field Tests

1. Smoothness Test
   a. The Contractor shall test the surface smoothness in the presence of a representative of the DuPont Site Representative at intervals as directed by the DuPont Site Representative.
   b. The surface of each layer shall not show any deviations in excess of 1-1/2 inches when tested with a 10-foot straightedge applied

both parallel with and at right angles to the centerline of the area to be paved.

c. The Contractor shall correct deviations exceeding this amount by removing material, replacing with new material, or reworking existing material and compacting, as directed by the DuPont Site Representative.

2. Aggregate gradation shall be made in conformance with ASTM C117, ASTM C136, and ASTM D422. Sieves shall conform to ASTM E11.

B. Field Inspections

1. Thickness Control

a. The Contractor shall control his operations by measurements to insure placement of materials to the thickness specified.

b. The completed thickness of the aggregate surface course shall be within plus or minus 1/2 inch of the thickness indicated on plans.

c. One depth measurement shall be made for each 1,000 square yards of the aggregate surface course, or part thereof.

d. The thickness measurement shall be made by test holes at least 3 inches in diameter through the aggregate surface course.

e. When the measured thickness of the aggregate surface course is more than 1/2 inch deficient in thickness, the Contractor, at no additional expense to DuPont, shall correct such areas by scarifying, adding mixture of proper gradation, reblading, and recompacting, as directed.

f. Where the measured thickness of the aggregate surface course is more than 1/2 inch thicker than that indicated, it shall be considered as conforming with the specified thickness requirements plus 1/2 inch.

g. The average job thickness shall be the average of the job measurements determined as specified above, but shall be within 1/4 inch of the thickness indicated.

h. When the average job thickness fails to meet this criterion, the Contractor shall, at no additional expense to DuPont, make corrections by scarifying, adding or removing mixture of proper gradation, and reblading and recompacting, as directed.

3.05 MAINTENANCE

A. The aggregate surface course shall be maintained in a condition that will meet all specification requirements until accepted.

B. Holes, tears, or otherwise damaged geotextiles, as determined by the DuPont Site Representative, shall be repaired immediately at no additional expense to DuPont.

C. The damaged area shall be cleared of all fill material, a suitable distance from the damaged area, to allow placement of a geotextile patch that extends 3 feet beyond the perimeter of the damaged area.

D. Aggregate removed shall be replaced to the specified thickness and compacted as specified above.

3.06 ATTACHMENTS

A. Tables

1. Gradation for Aggregate Surface Courses

Sieve Designation	Weight Percentage Passing
1 ½ in.	100
¾ in.	50-95
No. 4	20-50
No. 10	15-40
No. 100	2-20

END OF SECTION

SECTION 02900

PLANTING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Temporary seeding
2. Permanent seeding
3. Mulching

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. Measurement: Lump Sum.
2. Payment: The payment shall be made on a progress basis, as determined by the DSR based on the percentage of work completed and the submitted Schedule of Values.

1.03 REFERENCES

A. Reference Standards

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. ASTM International (ASTM)
   a. ASTM C602 (1995a) – Agricultural Liming Materials
   b. ASTM D2028 (1976; R 1997) – Cutback Asphalt (Rapid-Curing Type)
   c. ASTM D4972 (1995a) – pH of Soils
   d. ASTM D5268 (1992; R 1996) – Topsoil Used for Landscaping Purposes
   e. ASTM D5883 (1996el) – Use of Rotary Kiln Produced Expanded Shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes
   f. ASTM D977 (1998) – Emulsified Asphalt
2.
   a. AMS Seed Act (1995) – Federal Seed Act Regulations Part 201

3. State of Delaware Department of Transportation (DelDOT)
   a. DelDOT Standard Specifications (January 1998)

1.04 ADMINISTRATIVE REQUIREMENTS

Not Used

1.05 SUBMITTALS

Engineer review is required for submittals designated as “Action Submittals”. Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

A. Action Submittals

Not Used

B. Informational Submittals

1. Certificates
   a. Certification of calibration tests conducted on the equipment used in the seeding operation.
   b. Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.
   c. Prior to the delivery of materials, certificates of compliance attesting that the material meets the specified requirements.
   d. Material certificates shall include the following:
      (1) Seed: Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested
      (2) Limestone: Calcium carbonate equivalent and sieve analysis
      (3) Mulch: Composition and source

2. Manufacturer Instructions
   a. Manufacturer's literature including physical characteristics, application and installation instructions for equipment, surface erosion control material and chemical treatment material.

3. Special Procedure Submittals
   a. Listing of equipment to be used for the seeding operation.

b. Bag count or bulk weight measurements of material used compared with area covered to determine the application rate and quantity installed
c. Calendar time period for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described.
d. Maintenance work performed, area repaired or reinstalled, diagnosis for unsatisfactory stand of grass plants

C. Closeout Submittals

Not Used

D. Maintenance Material Submittals

Not Used

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements

1. A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.
2. Delivered Topsoil
   a. The source of delivered topsoil shall be subject to inspection. Provide a weed inventory from the source area.
   b. Prior to the delivery of any topsoil, its availability shall be verified in Article 2.3: Vegetative Soil/Topsoil.
   c. A soil test shall be provided for topsoil delivered to the site.
3. Soil Amendments
   a. Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis.
   b. In lieu of containers, soil amendments may be furnished in bulk.
   c. A chemical analysis shall be provided for bulk deliveries.
4. Seed shall be inspected upon arrival at the job site for conformity to species and quality.
5. Seed that is wet, moldy, or bears a test date five months or older, shall be rejected.
6. Other materials shall be inspected for compliance with specified requirements.
7. The following shall be rejected:
   a. Open soil amendment containers or wet soil amendments
   b. Topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 1-1/2 inch diameter
   c. Topsoil that contains viable plants and plant parts

8. Unacceptable materials shall be removed from the job site.

B. Storage and Handling Requirements

1. Materials shall be stored in designated areas.
2. Seed and lime shall be stored in cool, dry locations away from contaminants.
3. Chemical treatment material shall be stored according to manufacturer's instructions and not with seeding operation materials.
4. Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.
5. Hydroseeding time limitation for holding seed in the slurry shall be a maximum 24 hours.

PART 2 – PRODUCTS

2.01 OWNER-FURNISHED PRODUCTS

Not Used

2.02 SEED

A. Seed Classification

1. State-certified seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material.
2. Labels shall be in conformance with AMS Seed Act and applicable state seed laws.

B. Temporary seed species for surface erosion control or overseeding shall be as follows:

Botanical Name	Common Name	Max. % Weed Seeds	Min. % Purity	Min. % Germination	Seeding Rate (lbs/ac)
Lolium multiflorum	Annual Ryegrass	0.15	95	90	40
For Seeding Periods from 10/15 to 3/1 Add					
Secale cereale	Winter Rye				65

C. Permanent seed species shall be native grasses similar to plantings on the adjacent closed landfill cells.

D. No Johnsongrass seed (Sorghum halapense) or Canada Thistle (Cirsium arvense) shall be allowed in accordance with Section 1, Chapter 24, Title 3 of the Delaware Code.

F. The seed supplier shall mix the seed prior to delivery on site. Legume seed shall be inoculated with the required bacterial culture prior to delivery to the site.

G. Substitutions will not be allowed without written request and approval from the DuPont Site Representative.

2.03 SEED INOCULANT

A. The inoculant shall be a pure culture of nitrogen fixing bacteria selected for maximum vitality and for the ability to transform nitrogen from the air into soluble nitrates and deposit them in the soil.

B. Inoculant shall consist of purely bred cultures and shall not be used later than the date indicated on the container.

C. Four times the normal amount of inoculant as indicated on the packaging shall be used for wet application.

D. The inoculant shall be kept as cool as possible until used.

E. The Contractor shall take every precaution possible while handling the inoculant because temperatures above 75 to 80 °F (24 to 27 °C) weaken the bacteria.

2.04 VEGETATIVE COVER/TOPSOIL

A. Vegetative cover/topsoil shall be as defined in ASTM D5268 and in accordance with Section 02300 – EARTHWORK.

B. When available, the topsoil shall be the existing surface soil stripped and stockpiled onsite in accordance with Section 02300 – EARTHWORK. Treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stripping topsoil.

C. When additional topsoil is required beyond the available topsoil from the stripping operation, topsoil shall be delivered and amended as recommended by the soil test for the seed specified.

D. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 1-1/2 inch diameter.

E. Topsoil shall be free from viable plants and plant parts.

2.05 SOIL AMENDMENTS

A. Soil amendments shall consist of limestone meeting the following requirements.

B. Vermiculite shall not be used.

C. Limestone

1. Limestone shall be used to create a favorable soil pH for the plant material specified. If not specified, amend soil to pH range between 5.5 and 6.0.
2. Limestone shall be ground agricultural limestone.
3. Limestone material shall contain a minimum calcium and magnesium carbonate equivalent of 85 percent.
4. Dolomitic lime or magnesium lime shall contain at least 10% magnesium oxide.
5. Limestone shall be ground to meet the following gradation:

Sieve Size	Percent Passing
#10	100
#20	90
#100	50

2.06 MULCH

A. Straw shall be stalks from oats, wheat, rye, barley, or other approved grain crops native to the region.

B. Hay shall be native hay, sudan-grass hay, broomsedge hay, or other herbaceous mowings.

C. Mulch materials shall be free of weeds, mold, decomposed material, brittle weed mat, and shall be free of noxious weeds such as; thistles, Johnsongrass, and quackgrass.

D. Mulch materials shall be furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment.

E. Paper fiber mulch shall be recycled newsprint that is shredded for the purpose of mulching seed.

2.07 WATER

A. Water shall be the responsibility of the Contractor, unless otherwise noted.

B. Water shall not contain elements toxic to plant or aquatic life.

PART 3 – EXECUTION

3.01 INSTALLING SEED TIME AND CONDITIONS

A. Seeding Time

1. Seeding times have been segregated as follows into three periods in accordance with the State of Delaware Department of Transportation Standard Specifications dated January 1998.
   a. February 16th through April 15th
   b. April 16th through August 15th
   c. August 16th through February 15th
2. Variations in the required seed mixtures for each seeding period are specified in Article SEED.

B. Seeding Conditions

1. Seeding operations shall be performed only during periods when beneficial results can be obtained.
2. When drought, excessive moisture, or other unsatisfactory conditions prevail, the work shall be stopped when directed.
3. When special conditions warrant a variance to the seeding operations, proposed alternate times shall be submitted for approval.

C. Equipment Calibration

1. Immediately prior to the commencement of seeding operations, calibration tests shall be conducted on the equipment to be used.
2. These tests shall confirm that the equipment is operating within the manufacturer's specifications and will meet the specified criteria.
3. The equipment shall be calibrated a minimum of once every day during the operation.
4. The calibration test results shall be provided within 1 week of testing.

D. Soil Test

1. Delivered topsoil, existing soil in smooth graded areas, and stockpiled topsoil shall be tested in accordance with ASTM D5268 and ASTM

D4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, soluble salts analysis, and mechanical analysis.

2. Sample collection on site shall be random over the entire site.
3. Sample collection for stockpiled topsoil shall be at different levels in the stockpile.
4. The soil shall be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth.
5. The test shall determine the quantities and type of soil amendments required to meet local growing conditions for the seed species specified.

3.02 SITE PREPARATION

A. Finished Grade and Topsoil

1. The Contractor shall verify that finished grades are as indicated on drawings, and the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 02300 – EARTHWORK, prior to the commencement of the seeding operation.

B. Application of Soil Amendments

1. Applying Limestone
   a. Limestone shall be applied as recommended by the soil test.
   b. Limestone shall be incorporated into the soil to a maximum 4-inch depth or may be incorporated as part of the tillage operation.

C. Tillage

1. Soil on slopes up to a maximum 3H: 1V shall be tilled to a minimum 4-inch depth.
2. On slopes between 3H: 1V and 1H: 1V, the soil shall be tilled to a minimum 2-inch depth by scarifying with heavy rakes, or other method.
3. Rototillers shall be used where soil conditions and length of slope permit.
4. On slopes 1H: 1V and steeper, no tillage is required.
5. Drainage patterns shall be maintained as indicated on drawings.
6. Areas compacted by construction operations shall be completely pulverized by tillage.
7. Soil used for repair of surface erosion or grade deficiencies shall conform to topsoil requirements.
8. The limestone may be applied during this procedure.

D. Prepared Surface

1. Preparation
   a. The prepared surface shall be a maximum 1-inch below the adjoining grade of any surfaced area.
   b. New surfaces shall be blended to existing areas.
   c. The prepared surface shall be completed with a light raking to remove debris.

2. Debris and stones over a minimum 3-inch in any dimension shall be removed from the surface.

3. Areas with the prepared surface shall be protected from compaction or damage by vehicular or pedestrian traffic and surface erosion.

3.03 INSTALLATION

A. Prior to installing seed, any previously prepared surface compacted or damaged shall be reworked to meet the requirements of Article 3.2: Site Preparation.

B. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

C. Installing Seed

1. Seeding method shall be Broadcast Seeding, Drill Seeding, or Hydroseeding.

2. Seeding procedure shall ensure even coverage.

3. Gravity feed applicators, which drop seed directly from a hopper onto the prepared soil, shall not be used because of the difficulty in achieving even coverage, unless otherwise approved.

4. Broadcast Seeding
   a. Seed shall be uniformly broadcast at the rate specified in Article 2.1: Seed using broadcast seeders.
   b. Half the total rate of seed application shall be broadcast in 1 direction, with the remainder of the seed rate broadcast at 90 degrees from the first direction.
   c. Seed shall be covered a maximum 1/4 inch depth by disk harrow, steel mat drag, cultipacker, or other approved device.

5. Drill Seeding
   a. Seed shall be uniformly drilled to a maximum ½-inch depth and at the rate specified in Article 2.1: Seed using equipment having drills a maximum 7 inches distance apart.
   b. Row markers shall be used with the drill seeder.

c. Half the total rate of seed application shall be drilled in 1 direction, with the remainder of the seed rate drilled at 90 degrees from the first direction.
d. The drilling equipment shall be maintained with half full seed boxes during the seeding operations.

6. Rolling
a. The entire area shall be firmed with a roller not exceeding 90 pounds per foot roller width.
b. Slopes over a maximum 3H: 1V shall not be rolled.
c. Areas seeded with seed drills equipped with rollers shall not be rolled.

D. Hydroseeding

1. Seed shall be mixed to ensure broadcast at the rate specified in Article 2.1: Seed.

2. Seed shall be added to water and thoroughly mixed to meet the rates specified.

3. The time period for the seed to be held in the slurry shall be a maximum 24 hours.

4. Slurry shall be uniformly applied under pressure over the entire area.

5. The hydroseeded area shall not be rolled.

E. Mulching

1. Hay or Straw Mulch
a. Hay or straw mulch shall be spread uniformly at the rate of 2 tons per acre. Mulch shall be spread by hand, blower-type mulch spreader, or other approved method.
b. Mulching shall be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered.
c. The mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface.
d. All areas installed with seed shall be mulched on the same day as the seeding.
e. Mulch shall be anchored immediately following spreading.

2. Mechanical Anchor
a. Mechanical anchor shall be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

3. Paper Fiber and Recycled Paper
a. Paper fiber or recycled paper shall be applied immediately following the application of mulch.

b. The mulch shall be mixed and applied in accordance with the manufacturer's recommendations.

F. Watering Seed

1. Watering shall be started immediately after completing the seeding of an area.
2. Water shall be applied to supplement rainfall at a rate sufficient to ensure moist soil conditions to a minimum 1-inch depth.
3. Run-off and puddling shall be prevented.
4. Watering trucks shall not be driven over turf areas, unless otherwise directed.
5. Watering of other adjacent areas or plant material shall be prevented.

3.04 SURFACE EROSION CONTROL

A. Surface Erosion Control Material

1. Where indicated or as directed, surface erosion control material shall be installed in accordance with manufacturer's instructions and Section 02370 – EROSION AND SEDIMENTATION CONTROL.
2. Placement of the material shall be accomplished without damage to installed material or without deviation to finished grade.

B. Temporary Seeding

1. When directed during contract delays affecting the seeding operation or when a quick cover is required to prevent surface erosion, the areas designated shall be seeded in accordance with temporary seed species listed under Article 2.1: Seed.
2. Soil Amendments
   a. When soil amendments have not been applied to the area, the quantity of ½ of the required soil amendments shall be applied and the area tilled in accordance with Article 3.2: Site Preparation.
   b. The area shall be watered in accordance with Article 3.3F: Watering Seed.
3. Remaining Soil Amendments
   a. The remaining soil amendments shall be applied in accordance with the Article 3.2C: Tillage when the surface is prepared for installing seed.

3.05 QUANTITY CHECK

A. For materials provided in bags, the empty bags shall be retained for recording the amount used.

B. For materials provided in bulk, the weight certificates shall be retained as a record of the amount used.

C. The amount of material used shall be compared with the total area covered to determine the rate of application used.

D. Differences between the quantity applied and the quantity specified shall be adjusted as directed.

3.06 RESTORATION AND CLEAN UP

A. Restoration

1. Existing turf areas, pavements, and facilities that have been damaged from the seeding operation shall be restored to original condition at Contractor's expense.

B. Clean Up

1. Excess and waste material shall be removed from the seeded areas and shall be disposed offsite.
2. Adjacent paved areas shall be cleaned.

3.07 PROTECTION OF INSTALLED AREAS

A. Immediately upon completion of the seeding operation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed.

3.08 SEED ESTABLISHMENT PERIOD

A. Commencement

1. The seed establishment period to obtain a healthy stand of grass plants shall begin on the first day of seeding work under this contract and shall continue through the remaining life of the contract and end 12 months after the last day of the seeding operation required by this contract.
2. Written calendar time period shall be furnished for the seed establishment period.
3. When there is more than 1 seed establishment period, the boundaries of the seeded area covered for each period shall be described.
4. The seed establishment period shall be modified for inclement weather, shut down periods, or for separate completion dates of areas.

B. Satisfactory Stand of Grass Plants

1. Grass plants shall be evaluated for species and health when the grass plants are a minimum 1-inch high.
2. The total bare spots shall not exceed 10 percent of the total seeded area.

C. Maintenance During Establishment Period

1. Maintenance of the seeded areas shall include eradicating weeds, insects and diseases; protecting embankments and ditches from surface erosion; maintaining erosion control materials and mulch; protecting installed areas from traffic; mowing; watering; and post-fertilization.
2. Mowing
   a. Field areas shall be mowed once during the season to a minimum 8-inch height.
   b. Clippings shall be removed when the amount cut prevents sunlight from reaching the ground surface.
3. Unsatisfactory stand of grass plants and mulch shall be repaired or reinstalled, and eroded areas shall be repaired in accordance with Article 3.2: Site Preparation.
4. A record of each site visit shall be furnished, describing the maintenance work performed; areas repaired or reinstalled; and diagnosis for unsatisfactory stand of grass plants.

END OF SECTION

Appendix C

Erosion and Sediment Control Plan

SEDIMENT AND STORMWATER MANAGEMENT PLAN

DUPONT HAY ROAD SLUDGE DRYING SITE (DE-0024)

WILMINGTON, DELAWARE

Prepared for:

DuPont Corporate Remediation Group

For submittal to:

Delaware Department of Natural Resources and Environmental Control

December 2009

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1.0
INTRODUCTION

This report presents the project Sediment and Stormwater Management plan (SSMP) for construction activities associated with the closure of the E.I. de Nemours and Company (DuPont) Hay Road Sludge Drying Site (DE-0024), which is located in Wilmington, Delaware.

The purpose of this report is to discuss specific erosion and sediment control measures and stormwater management methods required for construction of an engineered cap system for the Hay Road Sludge Drying Site. Furthermore, this document is an operating component of the *Design Report*, design computations (see Appendix A), technical specifications (see Appendix B), construction quality control plan, and design drawings (see Appendix C) and is a part of the contract to the Bidders. To satisfy all pertinent sediment and stormwater management requirements, this SSMP has been prepared in accordance with the Delaware Department of Natural Resources and Environmental Control (DNREC) *Delaware Erosion and Sediment Control Handbook* (2003) and the *Delaware Sediment and Stormwater Regulations* (2005).

2.0
PROJECT DESCRIPTION

Closure of the sludge drying site will require the construction of an engineered cap over consolidated Staged Iron Rich Material (Staged IRM). The cap will cover approximately 16 acres and involve some additional grading to provide drainage, erosion, and sediment control. This SSMP was developed to identify and detail procedures and institutional controls to minimize sediment and manage stormwater for this project.

2.1 Site Description

DuPont owns 108 acres of property (Hay Road property) on Cherry Island in Wilmington, Delaware, as shown in the Location Map (see Figure 1). The Hay Road Sludge Drying Site (DE-0024) is a 23-acre parcel contained within the Hay Road property. The entire Hay Road Sludge Drying Site is underlain by made-land created by the United States Army Corps of Engineers river dredging activities. Beginning in 1997 and continuing to mid-2001, the plant generated approximately 500,000 tons of Iron Rich Material, which was transported as a saleable product and staged at the Hay Road Sludge Drying Site in preparation for sale as a soil substitute. In mid-2001, DuPont discontinued marketing the product and ceased sending materials to the Hay Road Sludge Drying Site.

The Hay Road Sludge Drying Site is bordered by Shellpot Creek to the north, the Delaware River to the east, the 12th Street Extension to the south, and the closed Hay Road Landfill to the west. The DuPont Edge Moor Plant is located 1 mile north of the Hay Road property.

DuPont conducted a DNREC-approved interim measure in 2002 to consolidate the areal extent of the Staged IRM from 22.7 acres to 15.9 acres. The interim measure also involved the application of a temporary cover over the staged materials to minimize potential water infiltration and airborne particle generation. Reapplication of the temporary cover over the Staged IRM has been completed on an as-needed basis, based on observations during monthly inspections. In 2007, DNREC approved a change in the temporary cover material from the Soil Sement® polymer to fiber-reinforced cement (Posi–Shell®). Additional Posi–Shell applications were completed in the spring of 2008 and the summer of 2009. DuPont conducts monthly inspections to monitor the continued integrity of the Posi-Shell coating and the effectiveness of the surrounding sediment and erosion control measures. The Posi-Shell covering continues to minimize potential human and ecological exposures to the Staged IRM.

2.2 Site Soils and Ground Cover

The hydrologic soil classification of the site is comprised of types C and D soils and is based on the texture of the existing conditions (stabilized material) and information from the Soil Conservation Service (SCS) Soils Survey. The entire site is identified as “Ou – Othello-Fallsington – Urban Land Complex” in the SCS Soil Survey of New Castle County, Delaware (SCS, 1970). During post-development conditions, borrow material and topsoil will be placed. To be conservative, it was assumed that the soil would be classified as Type D. The Hydrologic Soil Group (HSG) designation was determined from the SCS Soil Survey.
Figure 1 Location Map (to be provided separately)

FIGURE 1
LOCATION MAP

SCALE

2500 0 2500'

REFERENCE:

USGS QUADRANGLE: WILMINGTON SOUTH, DE–NJ (1997)

The current site is predominantly comprised of Staged IRM with limited vegetative cover. The surrounding area includes open space, brush, and gravel road.

The proposed land uses within the watershed match existing conditions except that stabilized material areas will be replaced with a vegetated cap that was modeled as Open Space in good condition with a grass cover of 75%.

2.3 Erosion and Sediment Control Measures

The SCS methodologies were followed during design of the erosion and sediment control measures. All erosion and sediment controls will be constructed and maintained according to the standards and specifications of the *Delaware Erosion and Sediment Control Handbook* (DNREC, 2003) and the *Delaware Sediment and Stormwater Regulations* (DNREC, 2005).

3.0
STORMWATER MANAGEMENT

3.1 Stormwater

Presently the site runoff is conveyed through waterways along the toe of the pile to a stormwater detention basin and eventually discharges into the Delaware River. Construction of the cap will not change the general drainage pattern on-site. The land use after construction will change from newly graded areas as shown on the Existing Conditions Plan to a vegetated condition following construction activities. The land-use change will result in a decrease in peak discharge. The stormwater runoff during existing conditions has been controlled using an existing outlet structure and is directed into tidal waters (Delaware River), which allows for a waiver or variance of stormwater management for water quantity control.

Stormwater management for this project consists of collecting and redirecting runoff in a non-erosive manner from the engineered cap area. The stormwater calculations assess the post-construction site runoff conditions for the 1, 10, 25, and 100-year/24-hour storm events.

The stormwater management computations are presented in Appendix A.

The surface of the cap will have a crown slope of approximately 5% and side slopes of 4H:1V to promote drainage and prevent ponding if any incidental settlement of the capped material occurs.

The stormwater calculations were conducted using the DNREC-approved hydrologic and hydraulic models. Peak flows for the storm events were computed with *WinTR-55*. Ditch computations were calculated with Autodesk's *Hydraflow* software. Pond computations were calculated with Bentley's *Pondpack*. All calculations are presented in Appendix A.

3.2 Collection Ditches

The drainage design focused on conveying all cap runoff in a stabilized non-erosive manner. Drainage ditches were designed for the peak flow from a 10-year/24-hour storm event. The design drawings depict the final topographic contours and drainage channels associated with the engineered cap system.

The ditches have trapezoidal sections and are designed to have a minimum of 3 inches of freeboard for the design flow. The objective of the drainage design was to provide a non-erosive means of directing stormwater from the cap to a stable outfall.

All ditches have been designed to be stable for the expected design flow conditions. The installation of erosion control matting throughout the ditches will also promote a stable and "self-healing" system that will reduce future maintenance at the facility.

The typical ditch details, layout, and profiles are presented in Appendix C. Calculations for selecting the channel protection from the channel shear analysis are presented in Appendix A.

3.3 Stormwater Basin

The existing stormwater management basin is located at the southeastern corner of the site and detains the runoff from the entire site prior to discharging into the Delaware River. Presently, a relatively flat grade within the basin causes water ponding in isolated areas.

During construction, the existing basin will function as a sediment basin by modifying the existing outlet structure and regrading the basin to provide the required wet/dry storage volume to comply with the *Delaware Erosion and Sediment Control Handbook*. The regrading will also provide positive drainage and divert the water to the outlet.

After the entire site is stabilized, the sediment basin will be converted back to a stormwater management basin. The basin has been designed to safely pass the runoff from a 100-year storm event without impacting the cap and overtopping the perimeter road. Computations for the facility are presented in Appendix A.

4.0
TEMPORARY EROSION CONTROLS

Temporary erosion controls will be implemented to stabilize all sediment-producing areas on a short-term basis. The erosion controls are applicable for any area of exposed soil where construction activity will not occur for a period longer than 14 days. Additional controls that may be required during construction activities will be implemented as needed by the owner's representative. The temporary erosion and sediment controls to be implemented for the DuPont Hay Road Sludge Drying Site project are presented in the following sections. Refer to the drawings (see Appendix C) for the soil erosion and sediment control project notes, plans, and details associated with the proposed engineered cap construction.

4.1 Sediment Basin

The existing stormwater management basin will be used as a sediment basin during construction activities to reduce the quantity of sediment-laden runoff from leaving the site. The sediment basin, which will be used as a permanent stormwater facility after construction, was designed with a sediment storage volume to collect the estimated sediment yield from the contributing drainage area.

The sediment basin was designed to provide 245,110 cubic feet of temporary storage and 23,520 cubic feet of permanent wet storage at a pool elevation of 11.74 feet. The existing outlet structure will be revised by lowing the two 2-feet wide rectangular weirs to the elevation of 13.8 feet. The two 1-foot tall stop gates will be closed during construction to maintain the required storage for settling sediments. The principle spillway will be able to handle the peak flow from a 10-year/24-hour rainfall with a minimum 1 foot of free board per the *Delaware Erosion and Sediment Control Handbook*.

Computations for the facility are presented in Appendix A.

4.2 Erosion Control Blanket

The erosion control blanket (ECB) will be placed along the side slopes of the cap during construction to stabilize the slope until vegetation is established and provide additional support to the vegetative cover once developed. The ECB mats will be placed parallel to the flow direction and will be overlapped and stapled to the soil. Appendix C presents the detail of the ECB.

Temporary photodegradable ECB will also be installed in all permanent grassed waterways during construction to reduce erosion and ensure channel stability as the vegetation is established in the ditches. All ECB types will comply with Section 02370 of the Technical Specifications.

4.3 Silt Fence

The silt fence is a temporary barrier with a typical life expectancy of 6 months or less. For this project, the silt fence will be installed to capture eroded sediment from sheet flow over disturbed areas. The silt fence will be installed perpendicular to the grade of the ground surface. The

existing super silt fence along the toe of the pile will be maintained during the construction. The location of the silt fence is presented in the drawings in Appendix C. An additional silt fence may be required during construction to replace damaged sections or augment existing controls.

The silt fence acceptable for use on this project will consist of a pervious synthetic woven geotextile with physical properties and must be installed as specified in Section 02370 of the Technical Specifications. Furthermore, the geotextile will be constructed of long-chain polymeric filaments or yarns such as polypropylene, polyethylene, or polyester. The geotextile will be fixed so that the filaments or yarns retain their structure upon loading. The geotextile will also be resistant to commonly encountered chemicals, mildew, rot, insects, and rodents. The silt fence will be installed as presented on the drawings in Appendix C.

4.4 Mulching

Mulching consists of the application of materials such as straw, hay, wood chips, or shredded bark to the soil surface. Application of mulches conserves soil moisture, prevent surface crusting and desiccation, control weeds, and help protect against erosion. Mulch may be applied alone to bare soil to prevent erosion during periods where weather conditions do not permit seeding with temporary or permanent vegetation. Mulch will be used as a step in the overall seeding process.

Mulch will be applied to bare or other areas requiring temporary or permanent stabilization and seeding. Acceptable mulch type and application method will be in accordance with Section 02900 of the Technical Specifications located in Appendix B of this report. Furthermore, mulch will consist of weed free straw and hay mulch with at least 50%, by weight of the fiber length being 10 inches or longer. Dry straw, which breaks in the crimping process, will not be acceptable. Native hay mulch will consist of clean field or marsh hay that does not contain noxious weeds. Decomposed or partially decomposed straw is not acceptable.

The preferred straw for mulches is sorghum, and 120-day milo is preferred over wheat and barley. Desirable hay species include sedges, rushes, western wheatgrass, and native tall grasses. Unacceptable species include smooth brome, orchard-grass, timothy, and intermediate wheatgrass. Hay and straw mulches will be applied at the rate of 2 tons per acre with seeding and 3 tons per acre if used alone for temporary measures.

Immediately following the spreading of mulch, a paper fiber mulch will be sprayed over the straw or hay mulch to form an absorbent cover or the mulch will be anchored into the soil by a minimum depth of 3 inches with dull coulter-type discs. The mulch will be secured to the soil in accordance with Section 02900 of the Technical Specifications.

4.5 Temporary Seeding

Temporary seeding and mulching will help stabilize sediment-producing areas and prevent erosion on a short-term basis. All topsoil piles, borrow areas, cleared land, cut-and-fill slopes waiting for final grading, and bare or recently disturbed areas where no construction activity is anticipated for a period of longer than 14 days, but less than 1 year, will receive temporary seeding and mulching.

Areas to be temporarily seeded will be roughened to a depth of 1 inch, fertilized, and seeded by hydroseeding or manual seeding methods. Acceptable seed for temporary seeding and application will be in accordance with Section 02900 of the Technical Specifications and will consist of annual ryegrass, rye, and perennial ryegrass applied at rates of 125 pounds per acre. Temporary seeding times occur from February 1 to April 30 and August 15 to October 31. During construction, DuPont may propose alternate seed types and application rates based on project activities and time of year. Alternates proposed by DuPont will be in accordance with the *Delaware Erosion and Sediment Control Handbook*. After seeding, mulch will be applied to all newly seeded areas according to Section 02900 of the Technical Specifications and Section 4.4 of this report.

4.6 Dust Control

Dust control will be implemented in accordance with Section 01354 of the Technical Specifications to reduce surface and air movement of dust during construction activities. To control dust generated from site activities, a minimum amount of bare and unstabilized soil will be exposed at a given time. Furthermore, additional measures include use of the existing stone roadways to limit truck and heavy traffic on unprotected soil, rapid mulching and seeding of bare areas, and irrigation with water trucks.

4.7 Construction Entrance/Decontamination Pad

A stabilized construction entrance (SCE) will be located at the entrance to the site. The SCE will consist of a minimum10-foot wide stone bed with a flared end to reduce the tracking of mud from the disturbed construction areas to the state roadway. See Appendix C for further details on the SCE.

A decontamination pad will also be provided to allow for the decontamination of all equipment, vehicles, and bulk debris as presented in Section 01351 of the Technical Specifications.

4.8 Stone Check Dams

Stone check dams have been incorporated into the design to dissipate runoff velocity during construction. The drawings show the detail of the stone check dams (see Appendix C). They are installed with an inner permeable and porous core protected by an outer layer of smaller stone to aid in filtration.

4.9 Filter Bag

A filter bag may be used to filter any water pumped from disturbed areas prior to discharging to the outlet structure or adjacent areas. The filter bag will be made from non-woven geotextile material sewn with high strength, double stitched “J” type seams. It will be capable of trapping particles larger than 150 microns. The filter bag will be inspected daily. When the bag has been filled to half of its total capacity, it should be replaced with a new bag and properly disposed of. See the drawings in Appendix C for further details on filter bag installation.

5.0
PERMANENT EROSION CONTROLS

Permanent controls are applied to stabilize sediment-producing areas on a long-term basis. Long-term stabilization controls are applicable for disturbed areas where construction is not expected to occur for more than one year and any final graded areas where work has been completed. The selected permanent controls will reduce sediment loss, reduce maintenance, and improve appearance.

5.1 Vegetative Layer/Topsoil

Vegetative layer/topsoil is a soil material that will promote vigorous plant growth as defined in Section 02300 of the Technical Specifications. Topsoil is required to improve the soil medium for plant growth on areas that are disturbed by construction or otherwise supporting an inadequate vegetative cover. The entire cap system will receive a 6-inch vegetative layer/topsoil. The use of topsoil will shorten the time required to sustain a satisfactory vegetative cover and reduce the care and maintenance of the cap soil cover and drainage system.

Topsoil Stockpile

If conditions warrant, DuPont may elect to purchase and stockpile topsoil at the site prior to closure construction activities. If topsoil is to be stockpiled at the site, it will be seeded, mulched, and be surrounded by a silt fence.

Vegetative Layer/Topsoil Placement

After the subsoil has been brought to 6 inches below final design grade and prior to placement of the topsoil, the subsoil will be disked or scarified to a depth of 3 inches to loosen the subgrade. This will develop a better bond between the vegetative layer/topsoil and subsoil.

Topsoil spreading should occur when soil conditions are favorable. Frozen or excessively wet topsoil will not be placed. For highly acidic areas and areas deficient in plant nutrients, based on a nutrient soil test, lime and fertilizer will be added prior to spreading the topsoil. Topsoil will be spread uniformly in a single 6-inch layer over the designated area and will be permanently seeded and mulched as soon as possible after spreading. Special attention will be given to maintaining established grades in waterways, outlets, and diversions when placing topsoil.

5.2 Permanent Seeding

Permanent seeding with herbaceous plants will stabilize the cap system and other soils, reduce erosion, reduce runoff velocity, lower the peak runoff, improve appearance, reduce long-term maintenance, and provide cover for wildlife. Permanent seeding materials, methods, and installation will be in accordance with Section 02900 of the Technical Specifications.

Seedbed Preparation

Once the topsoil has been placed, the seedbed will be prepared by applying lime and fertilizer and then tilled to a depth of 4 inches with a disk harrow, spring-tooth harrow, or other approved field implements.

Lime and Fertilizer

Lime and fertilizer will be applied to the seedbed based on the results of a soil test. Lime should be applied to adjust the pH to within a 6.0 to 7.5 range. A soil test must be conducted prior to the application of lime and fertilizer. The required amount of lime and fertilizer will be applied when the soil test results and recommendations are available.

Permanent Seeding

The acceptable permanent seed mixture shall consist of the seeding mixture outlined in Section 02900 of the Technical Specifications.

Seed will be sown by hydroseeding or manual seeding. All spreaders will be calibrated before use. Seed will be divided in half and spread in perpendicular directions to ensure an even distribution.

The optimum seeding season for this mixture of seed is from February 1 to April 30 or August 15 to October 31. During construction, DuPont may propose alternate seed types and application rates based on project activities and time of year. Alternates proposed by DuPont will be in accordance with the *Delaware Erosion and Sediment Control Handbook*.

Mulching

Mulch immediately after seeding per Section 02900 of the Technical Specifications.

5.3 Channel Protection

The different types of channels and appropriate protection methods are discussed in Sections 3.2 and 4.2 of this report. Temporary erosion control measures for channel protection include erosion control blankets.

This protection method has been designed to accommodate the design storm peak flow and meet with DNREC standards. The location and types of channel protection methods are shown on the Design Drawings. Design calculations for the channel linings are presented in the ditch design section of Appendix A of this report.

6.0
MAINTENANCE

A post-closure monitoring plan that addresses specific long-term maintenance and monitoring activities will be prepared after site remediation activities. The post-closure monitoring plan will be submitted to DNREC for approval. With respect to erosion and sediment control, the plan will include periodic inspections, de-silting of permanent erosion controls, repairing erosion features with acceptable methods and procedures, topsoiling, and revegetation. These activities include the following:

1. All erosion and sediment control practices will be checked for stability and operation following every rainfall event but in no case less than once every week. Any needed repairs will be made immediately.

2. The sediment basin will be cleaned out when the level of sediment reaches the elevation indicated on the design drawings in Appendix C.

3. Sediment will be removed from behind the silt fence when it accumulates to approximately ½ of the height of the fence. The silt fence will be repaired as necessary to maintain a barrier.

4. All seeded areas will be fertilized, reseeded as necessary, and mulched according to the drawings for all areas with poor vegetation cover to maintain a vigorous, dense vegetative cover. Maintenance operations will begin immediately after seeding a given area and will continue through construction. The Contractor will keep seed continually moist for proper germination and water thereafter, as necessary, to prevent drying out or burning. The Contractor will re-seed areas not showing a prompt catch of grass, correct depressions, and irregularities and re-seed, as necessary, until complete (100%) coverage is obtained.

5. DuPont will retain the right to require that the Contractor re-seed all areas where a satisfactory stand of grass does not exist after the first full growing season (following the final permanent seeding). A satisfactory stand of grass is defined as 90% coverage of every 5 acre area having a 3-inch stand of grass, as determined by the step transect method that estimates the percentage of vegetative cover using at least 100 systematically located observation points within the seeded area.

7.0
EROSION CONTROL CONSTRUCTION SEQUENCE

The preferred construction sequence described below will minimize erosion and exposure of bare areas before, during, and after construction activities. As a management strategy, all infrastructure and erosion and sediment controls on the perimeter of the site will be constructed prior to cap construction.

General Construction Sequence

1. Hold a pre-construction meeting with the owner, engineer, and appropriate agencies at least 1 week prior to starting construction activities.
2. Mark the limits of disturbance.
3. Install perimeter erosion and sediment controls (as shown), decontamination pad, and stabilized construction entrance prior to any site disturbance. Repair or relocate existing super silt fence as needed.
4. Clear and grub sediment basin area.
5. Construct sediment basin as shown on the plans and details and make outlet structure modifications.
6. Establish intermediate grades for Staged IRM.
7. Install geosynthetic components of the cap system. The subgrade material must be protected from damage and remain in an approved condition prior to placement of geosynthetics. The upper 6 inches of subgrade material will be free of angular material and sharp objects larger than 1 inch in diameter. The subgrade surface will be proof rolled smooth prior to the placement of geosynthetics. After geosynthetics are deployed, the Contractor will prevent the migration of stormwater under geosynthetic components.
8. Construct final grades of cap system including the cap access road. Any borrow material or topsoil must be stored in areas approved by the DuPont Site Representative (DSR).
9. Construct and permanently stabilize all final ditches and the culvert.
10. Stabilize all disturbed areas and seed and mulch.
11. Once the contributing drainage area is stabilized and approved by the owner and DNREC, dewater the sediment basin and remove and dispose of any sediment deposits as directed by the DSR. Convert outlet structure from the sediment basin to permanent stormwater detention basin structure. Topsoil, seed, and mulch disturbed area.
12. All erosion and sediment (E&S) control measures shall be inspected weekly and after rainfall events. All needed repairs shall be made immediately.
13. Remove E&S control measures when all areas are stabilized and when final approval has been obtained from the owner and DNREC.

The complete sequence of construction is also shown on the plans in Appendix C.

8.0
REFERENCES

Autodesk, Inc. 2007. "*Hydraflow*". Version 6.052.

Bentley System, Inc. 2008. "*PondPack*". Version 10.01.04.00.

DNREC. 2005. *Delaware Sediment and Stormwater Regulations*. Division of Water Resources & Division of Soil and Water Conservation.

DNREC. 2003. *Delaware Erosion and Sediment Control Handbook*. Division of Soil and Water Conservation. December.

Federal Highway Administration. 2008. "*HY-8*". Culvert Analysis, Version 7.1.0.

U.S. Dept. of Agriculture. 2004. *"WinTR-55"*. Small Watershed Hydrology, Version. 1.00.08, Soil Conservation Service.

U.S. Dept. of Agriculture. 1986. *Urban Hydrology for Small Watersheds*. Soil Conservation Service, Engineering Division. Technical Release 55. June.

U.S. Dept. of Agriculture. 1970. *Soil Survey of New Castle County, Delaware*. Soil Conservation Service in cooperation with Delaware Agricultural Experiment Station. October.

APPENDIX A
DESIGN COMPUTATIONS

SEDIMENT BASIN/SW DETENTION BASIN DESIGN
DITCH DESIGN

PURPOSE:

The purpose of this evaluation is to reduce the discharge of sediment laden runoff to the Delaware River during construction with the installation of a sediment basin. After the site is stabilized, the sediment basin will be converted to a stormwater detention basin. The basin will continue to provide settling time for the runoff while managing the high water level to prevent any adverse effects on the engineered cap.

PROCEDURE:

Presently the runoff from the entire site drains to a stormwater detention basin prior to discharging into the Delaware River. The construction of the cap will not change the general drainage pattern. During construction, the basin will be converted into a sediment basin to reduce the discharge of sediment laden runoff to the Delaware River. After the site is stabilized, the sediment basin will be dewatered and modified to a stormwater detention basin.

The *SCS Technical Release 55* (Ref. 1) will be used to estimate time of concentration (Tc) and runoff curve numbers (RCN) of the drainage area. The design criteria are based on the *Delaware Erosion and Sediment Control Handbook* (Ref. 2). The sediment basin will be able to pass runoff from a 10-year/24-hour storm while maintaining the required storage volume. The permanent stormwater detention basin will be able to pass the runoff from a 100-year/24-hour storm. *PondPack* (Ref. 4) was used to calculate the peak flows to the basins, model the sediment basin/stormwater detention basin and determine the high water surface elevations (WSEL) and detention time.

The following steps were taken:

1) Using the final grading plan, delineate the areas draining to the basin.

2) Estimate the time of concentration (T_C) for the drainage area.

3) Estimate the runoff curve number for the drainage area.

4) Calculate peak flow within the drainage area.

5) Determine pond volume and outlet structure configuration to meet the design criteria.

1. Delineate and Estimate Size of Drainage Area to the Stormwater Facility

The watershed area was delineated on a 1" = 60' drawing of the cap grading plan. Appendix 1 contains a reduced version of this drawing with the basin watershed area delineated. The area was calculated using the AutoCAD area command.

2. Estimate Travel Times and Time of Concentration

Travel time (T_T) is the time it takes water to travel from one location to another within a watershed. T_T is a component of the T_C. T_C is defined as the time it takes for the entire watershed to contribute runoff and is quantified as the hydraulically most distant point within the watershed from its outfall point. It is calculated by summing the travel times of runoff within the watershed and includes sheet flow, overland flow, and/or channel flow.

Computations for travel time and time of concentration were developed using *WinTR-55* (Ref. 3). Computer output for T_C appears in Appendix 2.

3. Determine Runoff Curve Number

The runoff curve number (RCN) rates the watershed areas for potential runoff according to soil type and land use. The sediment basin calculations assume the construction area is newly graded area, gravel roads and the surrounding vegetated area as open space < 50% vegetative cover. The proposed cover of the landfill (post closure) was modeled as open space in good condition since the entire surface will be vegetated.

The hydrologic soil classification of the site is comprised of types C and D soils and is based on the texture of the existing conditions (stabilized material) and information from the SCS Soils Survey. The entire site is identified as "Ou – Othello-Fallsington – Urban Land Complex" in the SCS Soil Survey of New Castle County, Delaware (Ref. 5). During post development conditions, borrow material and topsoil will be placed. To be conservative, the evaluation was assumed the soil as Type D. The Hydrologic Soil Group (HSG) designation was determined from the SCS Soil Survey.

The watershed areas were then evaluated to determine the percentage of cover type (i.e., open space, woods, etc.) throughout the specific drainage area. A composite curve number (RCN) was then calculated for each watershed area using the *WinTR-55* computer program for the specific cover types (see Appendix 2).

Displayed below is a summary of the drainage area information for steps 2 and 3.

BASIN HYDROLOGIC CONDITIONS			
Watershed	Area (ac)	RCN	Tc (hr)
Sediment Basin	30.07	93	0.24
SW Detention Basin-Post Closure	30.07	83	0.40

4. Calculate Peak Discharge for Required Frequency 24-Hour Storm Events

According to Reference 1, a Type II rainfall distribution was assumed for this region of the country. Precipitation amounts for the 1, 10, 25, & 100-year/24-hour storm event for New Castle County is 2.7, 4.8, 6.0 and 8.0 inches, respectively.

The hydrology data calculated above was then entered into a *PondPack* (Ref. 4) model to determine the approximate peak runoff to the basin during/post construction (see Appendix 3). Peak flows to the basins are detailed in the following table:

PEAK FLOWS (CFS)				
Basin	1-year	10-year	25-year	100-year
Sediment Basin	70.6	138.6	N/A	N/A
SW Detention Basin – Post Closure	34.7	86.4	117.2	168.9

5. Determine Basin Storage Volume and Outlet Structure Configuration

Construction Phase

During the construction, the existing outlet structure will be modified and the basin will function as a sediment basin.

The sediment basin was designed in accordance with the Delaware Erosion and Sediment Control Handbook. The required temporary storage volume for the sediment basin is 108,000 cubic feet, which equals 3,600 cubic feet of temporary storage per disturbed acre. The principal spillway was designed to handle the peak flow from a 10-year/24-hour rainfall with a minimum 1 foot of free board per the Handbook. To facilitate the construction, the highest WSEL during the 10-year/24-hour storm shall not exceed the toe elevation of the cap (16.5').

The rating table for the sediment basin was formulated using *PondPack*. The sediment basin was graded at bottom elevation of 10 ft to provide 245,110 cubic feet of temporary storage and 23,520 cubic feet of permanent wet storage at a pool elevation of 11.74 ft.

The existing outlet structure was revised by lowering the two 2-ft wide rectangular weirs to the elevation of 13.8 ft. The two 1-ft tall stop gates will be closed during construction to maintain the required storage for settling sediments. Therefore, the outlet structure of the sediment basin was modeled with a 6 inch orifice at elevation 11.74 ft, a 3 inch orifice at elevation 15.14 ft, an inlet box with an orifice area of 12 square feet at elevation 17.34 ft and an outfall culvert. In addition, a 4-ft rectangular weir at elevation 14.8 ft was assumed as the principle spillway for the sediment basin.

It was assumed that 50% of the available temporary storage would be full prior to cleaning the sediment basin. Therefore the highest sediment level of 13.2 ft shall be marked on the riser per Delaware E&S Control Handbook.

Post-construction Phase

During the post construction conditions, the sediment basin will be dewatered and converted to a stormwater detention basin.

The permanent stormwater detention basin was designed in accordance with NRCS Pond Code No. 378 (approved by Delaware Department of Natural Resources and Environmental Control). The principal spillway was designed to handle the peak flow from a 100-year/24-hour rainfall with a minimum 1 foot of free board. The highest WSEL of design storm shall not exceed the toe elevation of the cap to minimize the adverse effect on the cap.

The rating tables for the stormwater detention basin was formulated using *PondPack*. The permanent stormwater detention basin was regraded to fill the pool area and provide a volume of 792,130 cubic feet of storage at elevation of 17 ft (1 ft below the embankment).

During the post construction conditions, the stop gates at the outlet structure will be opened to facilitate stormwater discharge and prevent a high water level condition from impacting the cap. Therefore, the outlet structure of the basin was modeled with a 6 inch orifice at elevation 11.74 ft, a 4-ft rectangular weir at elevation 13.8 ft, a 3 inch orifice at elevation 15.14 ft, an inlet box with an orifice area of 12 square feet at elevation 17.34 ft and an outfall culvert.

The *PondPack* computer output appears in Appendix 3.

SEDIMENT BASIN WSEL	
Storm Event	WSEL (ft)
1-yr Storm Event	14.33
10-yr Storm Event	15.18

PERMANENT STORMWATER DETENTION BASIN WSEL	
Storm Event	WSEL (ft)
1-yr Storm Event	13.82
10-yr Storm Event	14.55
25-yr Storm Event	14.90
100-yr Storm Event	15.44

CONCLUSION:

The sediment basin is designed to retain sediment carried by runoff during construction and to slowly release the runoff over a period of time (24 hours minimum). The following table indicates the detention period for the sediment basin during a 1-year storm event.

SEDIMENT BASIN DETENTION TIME FOR 1-YR/24-HR STORM EVENT	
Condition	Hours
Sediment Basin	26.7

The peak WSEL within the sediment basin during a 10-year storm event is 15.18 ft. The top of embankment elevation is 18 ft along the existing access road, which provides 2.82 feet of freeboard. During post construction conditions, a 100-year storm event has a WSEL of 15.44 ft, which is also contained within the berm with a freeboard of 2.56 ft. Under both conditions, the water level in the basin will not exceed the lowest elevation of 16.5 ft at the toe of the cap.

REFERENCES:

1) "Urban Hydrology for Small Watersheds," U.S. Dept. of Agriculture, Soil Conservation Service, Engineering Division, Technical Release 55, June 1986.

2) "Delaware Erosion and Sediment Control Handbook," Delaware Department of Natural Resources and Environmental Control, Division of Soil and Water Conservation, December 2003.

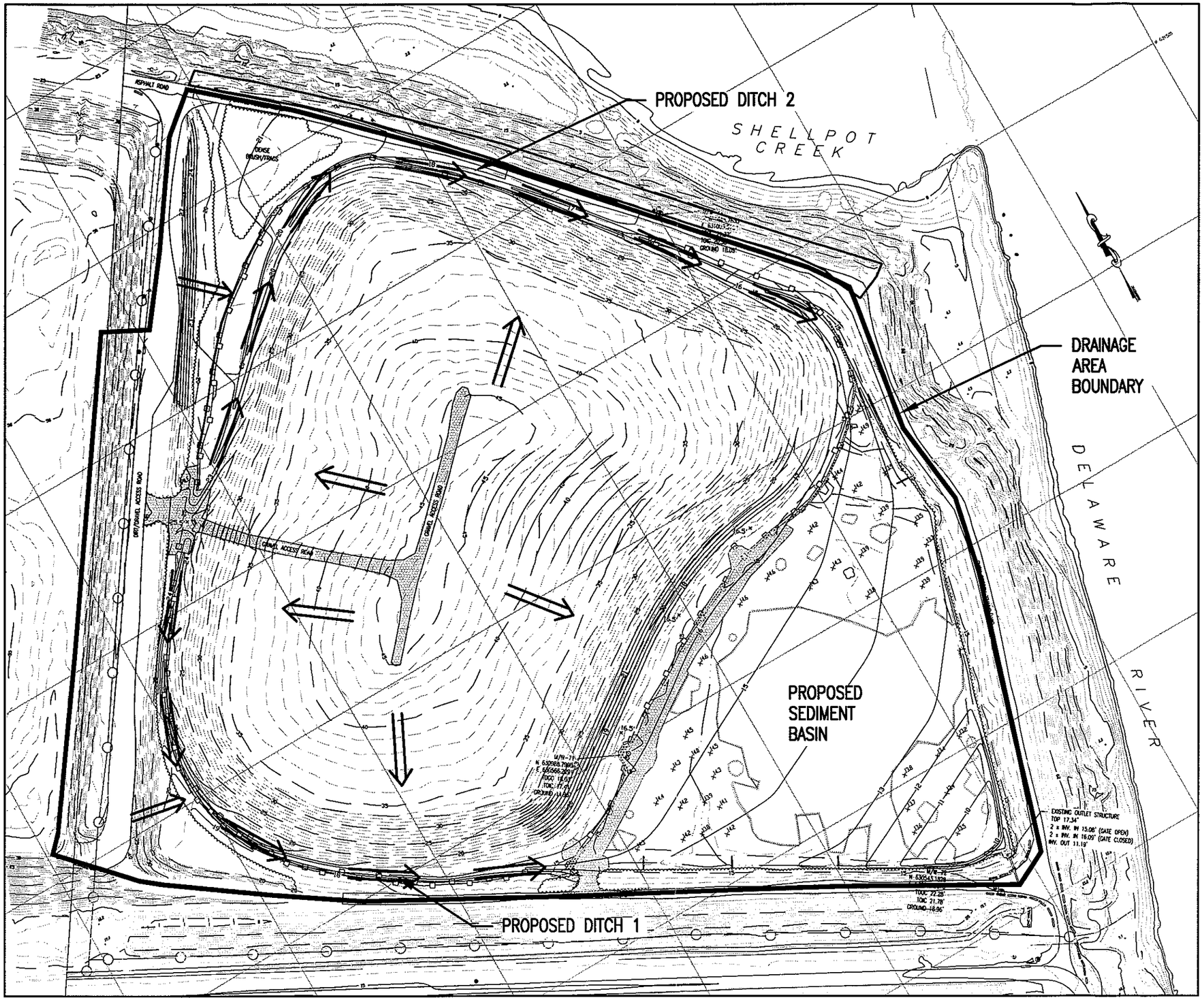
3) *"WinTR-55"*, Small Watershed Hydrology, Version. 1.00.08, U.S. Dept. of Agriculture, Soil Conservation Service, 2004.

4) "*PondPack*", Version 10.01.04.00, developed by Bentley System, Inc., 2008.

5) "Soil Survey of New Castle County, Delaware" U.S. Dept. of Agriculture, Soil Conservation Service, in cooperation with Delaware Agricultural Experiment Station, October 1970.

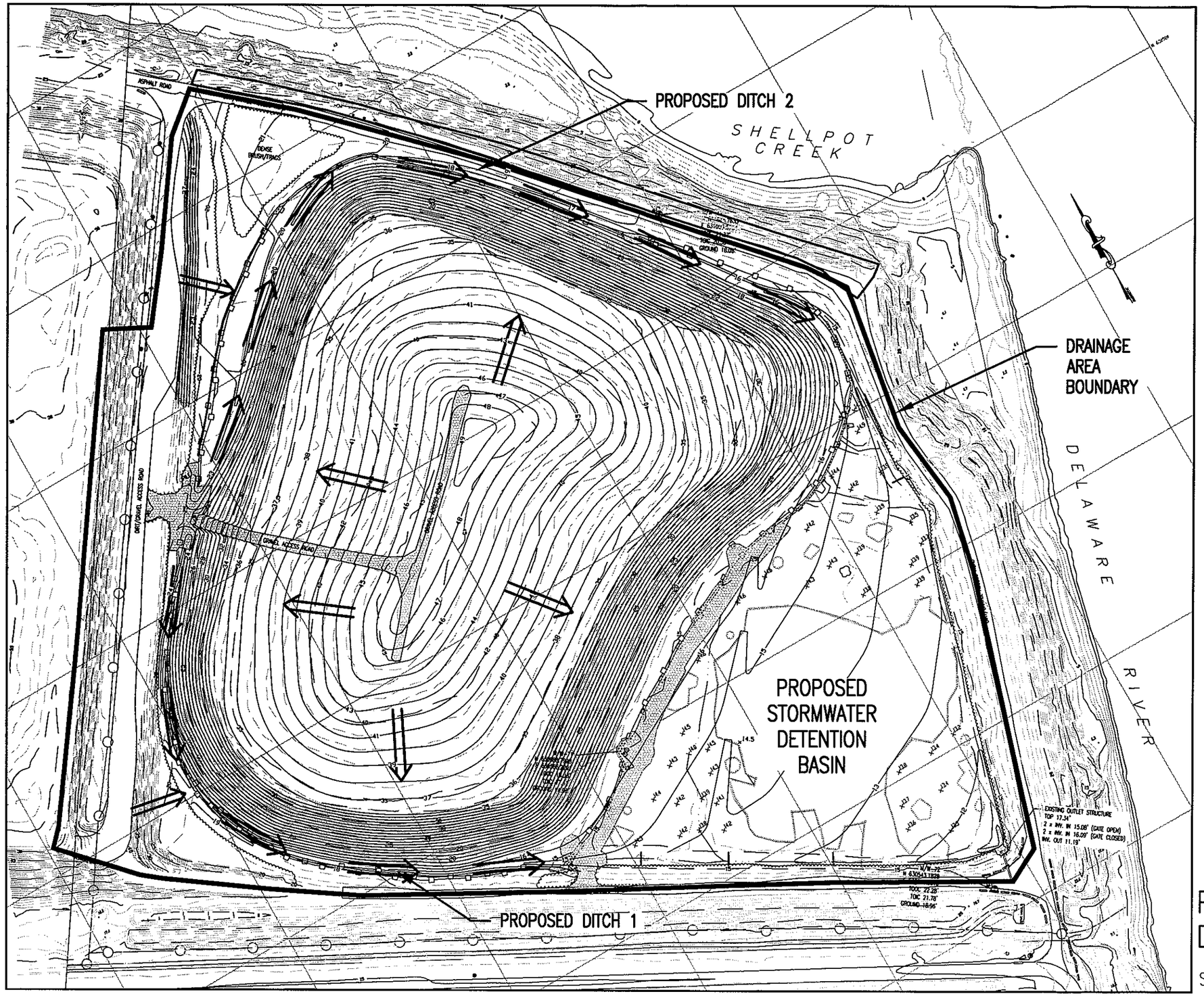
APPENDIX 1

DRAINAGE AREA MAP
(During Construction & Post Construction)



DRAINAGE AREA MAP DURING CONSTRUCTION

SCALE: 1" = 150'



POST CONSTRUCTION DRAINAGE AREA MAP

SCALE: 1" = 150'

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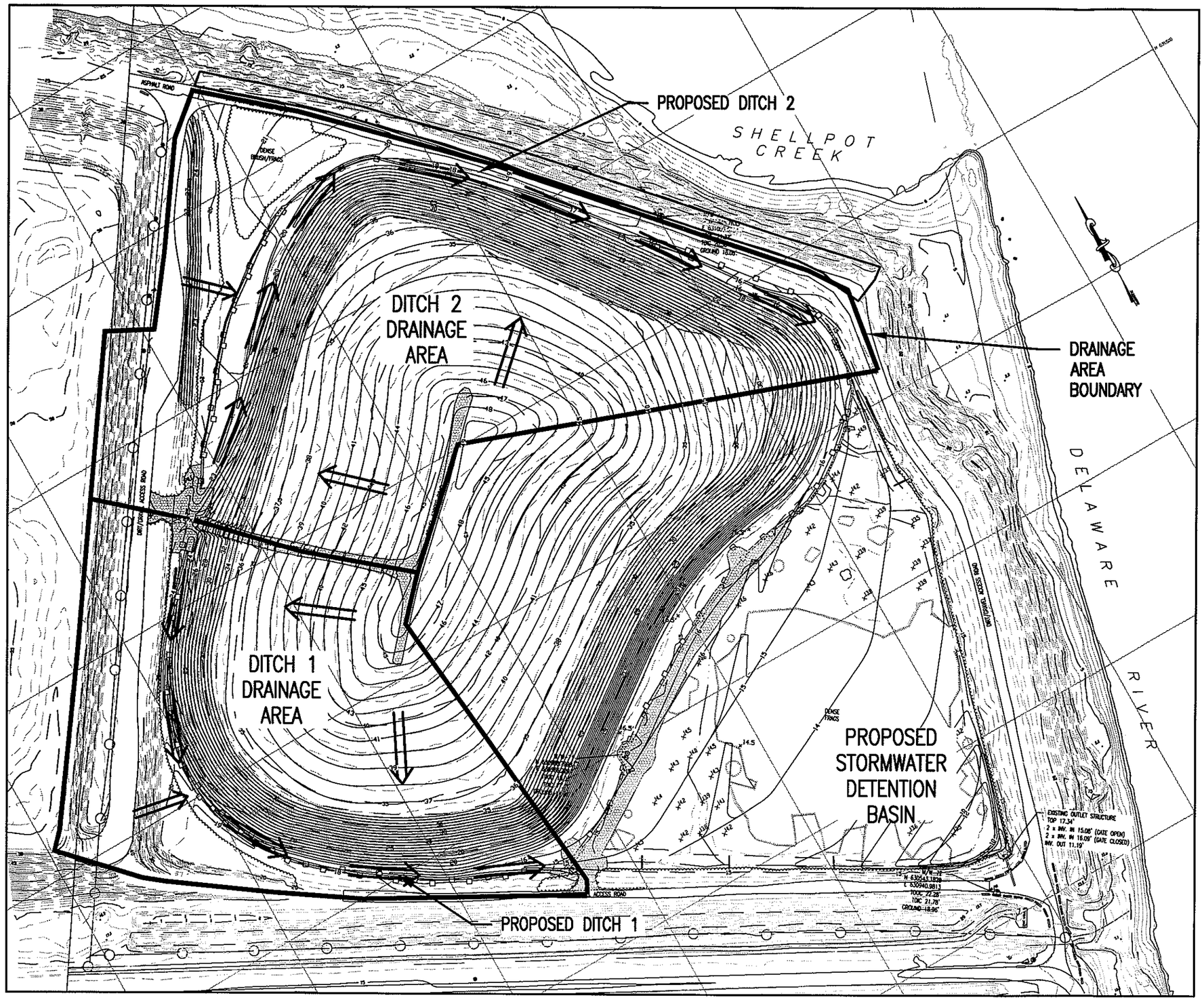

DITCH MAP

SCALE: 1" = 150'

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APPENDIX 2

HYDROLOGY CALCULATIONS

Sediment Basin

WinTR-55 Current Data Description

--- Identification Data ---

User: KD
Project: Hay Road Landfill SDS Cap
SubTitle: During Construction
State: Delaware
County: New Castle
Filename: R:\DIA\18985726\Eng_Data\Sediment & Stormwater\TR-55\Construction Stage.w55

Date: 8/6/2009
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
Constr		Outlet	30.07	93	0.241

Total area: 30.07 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.2	4.1	4.8	6.0	6.9	8.0	2.7

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type II
Dimensionless Unit Hydrograph: <standard>

KD

Hay Road Landfill SDS Cap
During Construction
New Castle County, Delaware

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	25-Yr (cfs) (hr)	100-Yr (cfs) (hr)	1-Yr (cfs) (hr)
SUBAREAS					
Constr	89.09 12.03	141.79 12.03	180.95 12.03	245.47 12.02	72.30 12.02
REACHES					
OUTLET	89.09	141.79	180.95	245.47	72.30

KD

Hay Road Landfill SDS Cap
During Construction
New Castle County, Delaware

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Constr							
SHEET	100	0.0500	0.011				0.014
SHALLOW	160	0.0500	0.050				0.012
SHALLOW	90	0.1710	0.050				0.004
CHANNEL	1670	0.0050	0.035	5.00	8.00	2.199	0.211
						Time of Concentration	0.241

KD

Hay Road Landfill SDS Cap
During Construction
New Castle County, Delaware

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Constr	Open space; grass cover < 50%	(poor)	D	5.71	89
	Gravel (w/ right-of-way)		D	1.98	91
	Newly graded area (pervious only)		D	22.38	94
	Total Area / Weighted Curve Number			30.07	93
				=====	==

SW Detention Basin

WinTR-55 Current Data Description

--- Identification Data ---

User: KD
Project: Hay Road Landfill SDS Cap
SubTitle: Post Construction
State: Delaware
County: New Castle
Filename: R:\DIA\18985726\Eng_Data\Sediment & Stormwater\TR-55\Post Construction.w55

Date: 8/6/2009
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
Post-Const		Outlet	30.07	83	0.401

Total area: 30.07 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.2	4.1	4.8	6.0	6.9	8.0	2.7

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type II
Dimensionless Unit Hydrograph: <standard>

KD

Hay Road Landfill SDS Cap
Post Construction
New Castle County, Delaware

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	25-Yr (cfs) (hr)	100-Yr (cfs) (hr)	1-Yr (cfs) (hr)
SUBAREAS					
Post-Const	48.36 12.14	90.02 12.12	122.11 12.11	176.38 12.13	36.09 12.14
REACHES					
OUTLET	48.36	90.02	122.11	176.38	36.09

KD

Hay Road Landfill SDS Cap
Post Construction
New Castle County, Delaware

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Post-Const							
SHEET	100	0.0500	0.240				0.165
SHALLOW	160	0.0500	0.050				0.012
SHALLOW	90	0.1710	0.050				0.004
CHANNEL	1670	0.0050	0.035	5.00	8.50	2.109	0.220
						Time of Concentration	0.401

KD

Hay Road Landfill SDS Cap
Post Construction
New Castle County, Delaware

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Post-Const	Open space; grass cover < 50%	(poor)	D	5.71	89
	Open space; grass cover > 75%	(good)	D	21.93	80
	Gravel (w/ right-of-way)		D	2.43	91
	Total Area / Weighted Curve Number			30.07	83
				=====	==

APPENDIX 3

POND MODELING

==========
JOB TITLE
==========

Project Date: 8/2/2009
Project Engineer: kd
Project Title: DuPont Edge Moor Hay Road Landfill SDS Cap
Project Comments:
-Regrade the existing basin into a sediment basin during the construction. Provide wet storage.
-Modify the weir elevation. During construction, close the gate. Post construction, open the gate.
- Open the bottom orifice.

MASTER DESIGN STORM SUMMARY

Network Storm Collection: Edge Moor

Return Event	Total Depth in	Rainfall Type	RNF ID
1	2.7000	Synthetic Curve	TypeII 24hr
2	3.2000	Synthetic Curve	TypeII 24hr
10	4.8000	Synthetic Curve	TypeII 24hr
25	6.0000	Synthetic Curve	TypeII 24hr
50	6.9000	Synthetic Curve	TypeII 24hr
100	8.0000	Synthetic Curve	TypeII 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
CONSTRUCTION	AREA	1	4.932		12.0200	70.64		
CONSTRUCTION	AREA	2	6.129		12.0200	86.91		
CONSTRUCTION	AREA	10	10.027		12.0200	138.56		
CONSTRUCTION	AREA	25	12.986		12.0200	176.87		
CONSTRUCTION	AREA	50	15.216		12.0200	205.43		
CONSTRUCTION	AREA	100	17.948		12.0200	240.17		
*OUT 10	JCT	1	4.932		18.4000	1.14		
*OUT 10	JCT	2	6.128		18.0400	1.19		
*OUT 10	JCT	10	10.027		15.3800	3.91		
*OUT 10	JCT	25	12.986		13.7200	8.00		
*OUT 10	JCT	50	15.215		13.3600	11.60		
*OUT 10	JCT	100	17.948		13.0400	16.37		

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
*OUT 20	JCT	1	3.029		16.3200	1.33		
*OUT 20	JCT	2	4.032		14.8000	2.48		
*OUT 20	JCT	10	7.501		13.1000	9.03		
*OUT 20	JCT	25	10.251		12.9000	15.39		
*OUT 20	JCT	50	12.362		12.8600	18.71		
*OUT 20	JCT	100	14.978		12.8200	24.74		
POST BASIN IN	POND	1	3.030		12.1400	34.69		
POST BASIN IN	POND	2	4.032		12.1400	46.50		
POST BASIN IN	POND	10	7.502		12.1400	86.40		
POST BASIN IN	POND	25	10.252		12.1400	117.15		
POST BASIN IN	POND	50	12.362		12.1200	140.38		
POST BASIN IN	POND	100	14.978		12.1200	168.87		
POST BASIN OUT	POND	1	3.029		16.3200	1.33	13.82	1.936
POST BASIN OUT	POND	2	4.032		14.8000	2.48	14.02	2.453
POST BASIN OUT	POND	10	7.501		13.1000	9.03	14.55	4.143
POST BASIN OUT	POND	25	10.252		12.9000	15.39	14.90	5.560
POST BASIN OUT	POND	50	12.362		12.8600	18.71	15.16	6.724
POST BASIN OUT	POND	100	14.978		12.8200	24.74	15.44	8.150
POST-CONST	AREA	1	3.030		12.1400	34.69		
POST-CONST	AREA	2	4.032		12.1400	46.50		
POST-CONST	AREA	10	7.502		12.1400	86.40		
POST-CONST	AREA	25	10.252		12.1400	117.15		
POST-CONST	AREA	50	12.362		12.1200	140.38		
POST-CONST	AREA	100	14.978		12.1200	168.87		
SED BASIN IN	POND	1	4.932		12.0200	70.64		
SED BASIN IN	POND	2	6.129		12.0200	86.91		
SED BASIN IN	POND	10	10.027		12.0200	138.56		
SED BASIN IN	POND	25	12.986		12.0200	176.87		
SED BASIN IN	POND	50	15.216		12.0200	205.43		
SED BASIN IN	POND	100	17.948		12.0200	240.17		

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
SED BASIN	OUT POND	1	4.932		18.4000	1.14	14.33	4.262
SED BASIN	OUT POND	2	6.128		18.0400	1.19	14.62	5.313
SED BASIN	OUT POND	10	10.027		15.3800	3.91	15.18	7.712
SED BASIN	OUT POND	25	12.986		13.7200	8.00	15.48	9.250
SED BASIN	OUT POND	50	15.215		13.3600	11.60	15.71	10.484
SED BASIN	OUT POND	100	17.948		13.0400	16.37	15.98	12.055

Elevation (ft)	Planimeter (sq.in)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	Volume (ac-ft)	Volume Sum (ac-ft)
11.74	-----	.0110	.0000	.000	.000
12.00	-----	.1800	.2355	.020	.020
13.00	-----	1.0420	1.6551	.552	.572
14.00	-----	2.7200	5.4455	1.815	2.387
15.00	-----	4.5800	10.8295	3.610	5.997
16.00	-----	6.0380	15.8767	5.292	11.289
17.00	-----	7.7910	20.6877	6.896	18.185
18.00	-----	8.2900	24.1176	8.039	26.224

POND VOLUME EQUATIONS

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

Elevation (ft)	Planimeter (sq.in)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	Volume (ac-ft)	Volume Sum (ac-ft)
10.00	-----	.1240	.0000	.000	.000
11.00	-----	.3157	.6376	.213	.213
12.00	-----	.5900	1.3373	.446	.658
13.00	-----	1.0420	2.4161	.805	1.464
14.00	-----	2.7200	5.4455	1.815	3.279
15.00	-----	4.5800	10.8295	3.610	6.889
16.00	-----	6.0380	15.8767	5.292	12.181
17.00	-----	7.7910	20.6877	6.896	19.077
18.00	-----	8.2900	24.1176	8.039	27.116

POND VOLUME EQUATIONS

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 11.74 ft
Increment = .25 ft
Max. Elev.= 18.00 ft

```
*********************************************
                OUTLET CONNECTIVITY
*********************************************

 ---> Forward Flow Only (UpStream to DnStream)
<---  Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed
```

Structure	No.		Outfall	E1, ft	E2, ft
Weir-Rectangular	W0	--->	C0	13.800	18.000
Orifice-Circular	O0	--->	C0	15.180	18.000
Inlet Box	IB	--->	C0	17.340	18.000
Orifice-Circular	O2	--->	C0	11.740	18.000
Culvert-Circular	C0	--->	TW	11.190	18.000
TW SETUP, DS Channel					

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = W0
Structure Type     = Weir-Rectangular
-----------------------------------
# of Openings      =         1
Crest Elev.        =     13.80 ft
Weir Length        =      4.00 ft
Weir Coeff.        =  3.100000

Weir TW effects      (Use adjustment equation)
```

```
Structure ID       = O0
Structure Type     = Orifice-Circular
-----------------------------------
# of Openings      =         1
Invert Elev.       =     15.18 ft
Diameter           =     .2500 ft
Orifice Coeff.     =      .600
```

```
Structure ID       = IB
Structure Type     = Inlet Box
-----------------------------------
# of Openings      =         1
Invert Elev.       =     17.34 ft
Orifice Area       =   12.0000 sq.ft
Orifice Coeff.     =      .600
Weir Length        =     16.00 ft
Weir Coeff.        =     3.100
K, Reverse         =     1.000
Mannings n         =     .0000
Kev,Charged Riser  =      .000
Weir Submergence   = No
```

OUTLET STRUCTURE INPUT DATA

```
Structure ID      = O2
Structure Type    = Orifice-Circular
-----------------------------------
# of Openings     =         1
Invert Elev.      =     11.74 ft
Diameter          =     .5000 ft
Orifice Coeff.    =      .600


Structure ID      = C0
Structure Type    = Culvert-Circular
-----------------------------------
No. Barrels       =         1
Barrel Diameter   =    4.6000 ft
Upstream Invert   =     11.19 ft
Dnstream Invert   =     11.08 ft
Horiz. Length     =     80.00 ft
Barrel Length     =     80.00 ft
Barrel Slope      =    .00137 ft/ft

OUTLET CONTROL DATA...
Mannings n        =     .0240
Ke                =     .5000  (forward entrance loss)
Kb                =   .013933  (per ft of full flow)
Kr                =     .5000  (reverse entrance loss)
HW Convergence    =      .001  +/- ft

INLET CONTROL DATA...
Equation form     =         1
Inlet Control K   =     .0078
Inlet Control M   =    2.0000
Inlet Control c   =    .03790
Inlet Control Y   =     .6900
T1 ratio (HW/D)   =     1.135
T2 ratio (HW/D)   =     1.296
Slope Factor      =     -.500

Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use   submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...
At T1 Elev =     16.41 ft  --->  Flow =    124.75 cfs
At T2 Elev =     17.15 ft  --->  Flow =    142.58 cfs
```

OUTLET STRUCTURE INPUT DATA

Structure ID = TW
Structure Type = TW SETUP, DS Channel

FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations= 30
Min. TW tolerance = .01 ft
Max. TW tolerance = .01 ft
Min. HW tolerance = .01 ft
Max. HW tolerance = .01 ft
Min. Q tolerance = .10 cfs
Max. Q tolerance = .10 cfs

***** COMPOSITE OUTFLOW SUMMARY ****

WS Elev, Total Q			Notes	
		Converge		
Elev. ft	Q cfs	TW Elev ft	Error +/-ft	Contributing Structures
11.74	.00	Free Outfall		(no Q: W0,O0,IB,O2,C0)
11.99	.11	Free Outfall		O2,C0 (no Q: W0,O0,IB)
12.24	.47	Free Outfall		O2,C0 (no Q: W0,O0,IB)
12.49	.67	Free Outfall		O2,C0 (no Q: W0,O0,IB)
12.74	.82	Free Outfall		O2,C0 (no Q: W0,O0,IB)
12.99	.90	Free Outfall		O2,C0 (no Q: W0,O0,IB)
13.24	.95	Free Outfall		O2,C0 (no Q: W0,O0,IB)
13.49	1.15	Free Outfall		O2,C0 (no Q: W0,O0,IB)
13.74	1.22	Free Outfall		O2,C0 (no Q: W0,O0,IB)
13.80	1.22	Free Outfall		O2,C0 (no Q: W0,O0,IB)
13.99	2.13	Free Outfall		W0,O2,C0 (no Q: O0,IB)
14.24	4.70	Free Outfall		W0,O2,C0 (no Q: O0,IB)
14.49	8.08	Free Outfall		W0,O2,C0 (no Q: O0,IB)
14.74	12.02	Free Outfall		W0,O2,C0 (no Q: O0,IB)
14.99	17.20	Free Outfall		W0,O2,C0 (no Q: O0,IB)
15.18	18.94	Free Outfall		W0,O2,C0 (no Q: O0,IB)
15.24	19.51	Free Outfall		W0,O0,O2,C0 (no Q: IB)
15.49	26.03	Free Outfall		W0,O0,O2,C0 (no Q: IB)
15.74	30.78	Free Outfall		W0,O0,O2,C0 (no Q: IB)
15.99	35.48	Free Outfall		W0,O0,O2,C0 (no Q: IB)
16.24	40.21	Free Outfall		W0,O0,O2,C0 (no Q: IB)
16.49	44.92	Free Outfall		W0,O0,O2,C0 (no Q: IB)
16.74	49.61	Free Outfall		W0,O0,O2,C0 (no Q: IB)
16.99	54.31	Free Outfall		W0,O0,O2,C0 (no Q: IB)
17.24	59.01	Free Outfall		W0,O0,O2,C0 (no Q: IB)
17.34	59.01	Free Outfall		W0,O0,O2,C0 (no Q: IB)
17.49	66.59	Free Outfall		W0,O0,IB,O2,C0
17.74	79.20	Free Outfall		W0,O0,IB,O2,C0
17.99	94.17	Free Outfall		W0,O0,IB,O2,C0
18.00	94.17	Free Outfall		W0,O0,IB,O2,C0

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 10.00 ft
Increment = .25 ft
Max. Elev.= 18.00 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	El, ft	E2, ft
Weir-Rectangular	W0	--->	C0	14.800	18.000
Orifice-Circular	O0	--->	C0	15.180	18.000
Inlet Box	IB	--->	C0	17.340	18.000
Orifice-Circular	O1	--->	C0	11.740	18.000
Culvert-Circular	C0	--->	TW	11.190	18.000

TW SETUP, DS Channel

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = W0
Structure Type     = Weir-Rectangular
-----------------------------------
# of Openings      =         1
Crest Elev.        =     14.80 ft
Weir Length        =      4.00 ft
Weir Coeff.        =  3.100000

Weir TW effects      (Use adjustment equation)
```

```
Structure ID       = O0
Structure Type     = Orifice-Circular
-----------------------------------
# of Openings      =         1
Invert Elev.       =     15.18 ft
Diameter           =     .2500 ft
Orifice Coeff.     =      .600
```

```
Structure ID       = IB
Structure Type     = Inlet Box
-----------------------------------
# of Openings      =         1
Invert Elev.       =     17.34 ft
Orifice Area       =   12.0000 sq.ft
Orifice Coeff.     =      .600
Weir Length        =     16.00 ft
Weir Coeff.        =     3.100
K, Reverse         =     1.000
Mannings n         =     .0000
Kev,Charged Riser  =      .000
Weir Submergence   = No
```

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = O1
Structure Type     = Orifice-Circular
-----------------------------------
# of Openings      =         1
Invert Elev.       =     11.74 ft
Diameter           =     .5000 ft
Orifice Coeff.     =      .500


Structure ID       = C0
Structure Type     = Culvert-Circular
-----------------------------------
No. Barrels        =         1
Barrel Diameter    =    4.6000 ft
Upstream Invert    =     11.19 ft
Dnstream Invert    =     11.08 ft
Horiz. Length      =     80.00 ft
Barrel Length      =     80.00 ft
Barrel Slope       =    .00137 ft/ft

OUTLET CONTROL DATA...
Mannings n         =     .0240
Ke                 =     .5000  (forward entrance loss)
Kb                 =   .013933  (per ft of full flow)
Kr                 =     .5000  (reverse entrance loss)
HW Convergence     =      .001  +/- ft

INLET CONTROL DATA...
Equation form      =         1
Inlet Control K    =     .0078
Inlet Control M    =    2.0000
Inlet Control c    =    .03790
Inlet Control Y    =     .6900
T1 ratio (HW/D)    =      .000
T2 ratio (HW/D)    =     1.296
Slope Factor       =     -.500
```

Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...
At T1 Elev = 11.19 ft ---> Flow = 124.75 cfs
At T2 Elev = 17.15 ft ---> Flow = 142.58 cfs

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = TW
Structure Type     = TW SETUP, DS Channel
-----------------------------------
FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations=    30
Min. TW tolerance =    .01 ft
Max. TW tolerance =    .01 ft
Min. HW tolerance =    .01 ft
Max. HW tolerance =    .01 ft
Min.  Q tolerance =    .10 cfs
Max.  Q tolerance =    .10 cfs
```

***** COMPOSITE OUTFLOW SUMMARY ****

WS Elev, Total Q		Notes		
		Converge		
Elev. ft	Q cfs	TW Elev ft	Error +/-ft	Contributing Structures
10.00	.00	Free Outfall		(no Q: W0,O0,IB,O1,C0)
10.25	.00	Free Outfall		(no Q: W0,O0,IB,O1,C0)
10.50	.00	Free Outfall		(no Q: W0,O0,IB,O1,C0)
10.75	.00	Free Outfall		(no Q: W0,O0,IB,O1,C0)
11.00	.00	Free Outfall		(no Q: W0,O0,IB,O1,C0)
11.19	.00	Free Outfall		(no Q: W0,O0,IB,O1,C0)
11.25	.00	Free Outfall		(no Q: W0,O0,IB,O1,C0)
11.50	.00	Free Outfall		(no Q: W0,O0,IB,O1,C0)
11.74	.00	Free Outfall		(no Q: W0,O0,IB,O1,C0)
11.75	.04	Free Outfall		O1,C0 (no Q: W0,O0,IB)
12.00	.11	Free Outfall		O1,C0 (no Q: W0,O0,IB)
12.25	.40	Free Outfall		O1,C0 (no Q: W0,O0,IB)
12.50	.56	Free Outfall		O1,C0 (no Q: W0,O0,IB)
12.75	.69	Free Outfall		O1,C0 (no Q: W0,O0,IB)
13.00	.75	Free Outfall		O1,C0 (no Q: W0,O0,IB)
13.25	.80	Free Outfall		O1,C0 (no Q: W0,O0,IB)
13.50	.96	Free Outfall		O1,C0 (no Q: W0,O0,IB)
13.75	1.02	Free Outfall		O1,C0 (no Q: W0,O0,IB)
14.00	1.07	Free Outfall		O1,C0 (no Q: W0,O0,IB)
14.25	1.13	Free Outfall		O1,C0 (no Q: W0,O0,IB)
14.50	1.17	Free Outfall		O1,C0 (no Q: W0,O0,IB)
14.75	1.22	Free Outfall		O1,C0 (no Q: W0,O0,IB)
14.80	1.23	Free Outfall		O1,C0 (no Q: W0,O0,IB)
15.00	2.35	Free Outfall		W0,O1,C0 (no Q: O0,IB)
15.18	3.96	Free Outfall		W0,O1,C0 (no Q: O0,IB)
15.25	4.79	Free Outfall		W0,O0,O1,C0 (no Q: IB)
15.50	8.28	Free Outfall		W0,O0,O1,C0 (no Q: IB)
15.75	12.27	Free Outfall		W0,O0,O1,C0 (no Q: IB)
16.00	16.75	Free Outfall		W0,O0,O1,C0 (no Q: IB)
16.25	21.57	Free Outfall		W0,O0,O1,C0 (no Q: IB)
16.50	26.68	Free Outfall		W0,O0,O1,C0 (no Q: IB)
16.75	32.08	Free Outfall		W0,O0,O1,C0 (no Q: IB)
17.00	39.09	Free Outfall		W0,O0,O1,C0 (no Q: IB)
17.25	42.26	Free Outfall		W0,O0,O1,C0 (no Q: IB)
17.34	43.40	Free Outfall		W0,O0,O1,C0 (no Q: IB)
17.50	51.42	Free Outfall		W0,O0,IB,O1,C0
17.75	65.50	Free Outfall		W0,O0,IB,O1,C0
18.00	82.03	Free Outfall		W0,O0,IB,O1,C0

DETENTION TIMES SUMMARY

```
HYG Dir          = R:\DIA\18985726\Eng_Data\Sediment & Stormwater\PondPack\
Inflow  HYG file = NONE STORED - POST  BASIN  IN  1
Outflow HYG file = NONE STORED - POST  BASIN  OUT 1

Pond Node   Data = POST  BASIN
Pond Volume Data = POST  BASIN
Pond Outlet Data = PostBasin Outlet

No Infiltration

APPROXIMATE DETENTION TIME
--------------------------------------
Tp, Outflow + Infilt.   =   16.7800 hrs
Tp, Total Inflow        =   12.1400 hrs
Peak to Peak            =    4.6400 hrs

Qout+Infilt. Centroid   =   27.2669 hrs
Inflow Centroid         =   14.1927 hrs
Centroid to Centroid    =   13.0742 hrs

Weighted Avg. Plug Time =   13.1744 hrs
Max.Plug Vol. Plug Time =    6.8864 hrs
Max.Inflow Plug Volume  =      .057 ac-ft   (From 12.1200 to 12.1400 hrs)
--------------------------------------
```

DETENTION TIMES SUMMARY

```
HYG Dir          = R:\DIA\18985726\Eng_Data\Sediment & Stormwater\PondPack\
Inflow  HYG file = NONE STORED - SED BASIN    IN  1
Outflow HYG file = NONE STORED - SED BASIN    OUT 1

Pond Node   Data = SED BASIN
Pond Volume Data = SED BASIN
Pond Outlet Data = Rev. Sed Outlet

No Infiltration

APPROXIMATE DETENTION TIME
--------------------------------------
Tp, Outflow + Infilt.   =   19.4800 hrs
Tp, Total Inflow        =   12.0200 hrs
Peak to Peak            =    7.4600 hrs

Qout+Infilt. Centroid   =   39.8465 hrs
Inflow Centroid         =   13.3577 hrs
Centroid to Centroid    =   26.4888 hrs

Weighted Avg. Plug Time =   26.7170 hrs
Max.Plug Vol. Plug Time =   19.3378 hrs
Max.Inflow Plug Volume  =      .116 ac-ft   (From 12.0200 to 12.0400 hrs)
--------------------------------------
```

PURPOSE:

The purpose of this study is to assess the conveyance of runoff through the site for a 10-year/24-hour storm event. Quantification of peak flows will be performed to evaluate the effects of flow in the proposed drainage ways at the Sludge Drying site. Results of the analyses will determine channel configurations and linings.

PROCEDURE:

The SCS Technical Release 55 (TR-55, Ref. 1) will be used to estimate time of concentration (Tc), runoff curve numbers (RCN) and peak flows. The design criteria are based on the Delaware Erosion and Sediment Control Handbook (Ref. 2).

The following steps will be taken:

1) Using the final grading plan, divide the site into drainage areas with the points of analyses taken at locations along the proposed ditch alignments.
2) Estimate the time of concentration (T_C) of runoff for each drainage area.
3) Estimate the appropriate runoff curve number for each drainage area based on the final cap cover system and surrounding run-on land use and soil characteristics.
4) Calculate peak flows to each ditch based on the 10-year/24-hour storm event.
5) Size ditch section and slope to convey the 10-year peak discharge which corresponds with the Delaware E&S requirements of designing channels for the 10-year peak discharge.
6) Determine appropriate channel protection based on requirements.

The computer program, *WinTR-55* (Ref. 3), developed by the United States Department of Agriculture - Soil Conservation Service, will be used to perform the calculations for Steps 2 – 4. *Hydraflow* (Ref.4) will be used to determine channel geometry.

1. Delineate and Estimate Size of Watershed Areas

The watershed areas were delineated on the final grading plan. The areas were determined using the AutoCAD area command. The AutoCAD areas in acreage are displayed in the following table:

DITCH DRAINAGE AREAS		
Watershed	Location	Area (acres)
Ditch 1-Up	Southern ditch along cap	4.57
Ditch 1-Down	Southern ditch along cap	7.13
Ditch 2-Up	Northern ditch along cap	6.35
Ditch 2-Down	Northern ditch along cap	10.74

The remaining area of the site drains directly into the stormwater detention basin.

2. Estimate Travel Times and Time of Concentration

Travel time (T_T) is the time it takes water to travel from one location to another within a watershed. T_T is a component of the time of concentration (T_c). T_c is defined as the time it takes for the entire watershed to contribute runoff and is quantified as the hydraulically most distant point within the watershed from its outfall point. It is calculated by summing the travel times of runoff within the watershed and includes sheet flow, overland flow, and/or channel flow

Computations for travel time and time of concentration were developed using *TR-55* (Ref. 3). Computer output appears in Appendix 2.

3. Determine Runoff Curve Number and Rainfall Distribution

The curve number (CN) rates the watershed areas for potential runoff according to soil type and the amount and type of vegetative cover. The proposed cap was modeled as open space in good condition since the entire cap surface will be vegetated. The remainder of the site is modeled as gravel and open space with poor grass cover.

The hydrologic soil classification of the site is comprised of types C and D soils and is based on the texture of the existing conditions (stabilized material) and information from the SCS Soils Survey. The entire site is identified as "Ou – Othello-Fallsington – Urban Land Complex" in the SCS Soil Survey of New Castle County, Delaware (Ref. 5). During post development conditions, borrow material and topsoil will be placed. To be conservative, it was assumed the soil as Type D. The Hydrologic Soil Group (HSG) designation was determined from the SCS Soil Survey.

The current site has limited vegetative cover and is predominantly comprised of iron rich material, posi-shell cover and gravel.

The proposed land uses within the watershed match existing conditions except that stabilized material areas will be replaced with a vegetated cap that was modeled as Open Space in good condition with a grass cover of 75 percent.

A composite curve number (RCN) was then calculated for each watershed area using the *WinTR-55* computer program for the specific cover types (see Appendix 2).

The following table is a summary of the drainage area information for the ditch calculations.

DRAINAGE DITCH CONDITIONS SUMMARY			
Watershed	Area (ac)	RCN	Tc
Ditch 1-Up	4.57	84	0.22
Ditch 1-Down	7.13	84	0.31
Ditch 2-Up	4.05	82	0.22
Ditch 2-Down	10.74	82	0.40

4. Calculate Peak Discharge for 10-Year/24-Hour Storm Event

According to Reference 1, assume a Type II rainfall distribution for this region of the country. Precipitation amounts for the 10-year/24-hour storm event for New Castle County is 4.8 inches.

The data calculated above was entered into the *WinTR-55* computer program (Ref. 3) to determine approximate peak flows from site runoff. Computer output appears in Appendix 2. The tables below summarize the results:

DITCH PEAK FLOWS (CFS)	
Watershed	10-year/24-hour
Ditch 1-Up	18.0
Ditch 1-Down	24.9
Ditch 2-Up	15.0
Ditch 2-Down	31.1

5. Determine Channel Geometry

Using the computer program, *Hydraflow* (Ref. 4), Manning's equation was solved for velocity with various channel geometries to determine the most appropriate cross-section. The calculated channel depths were then used to determine the total depth of the channel which included a minimum of 0.25 foot freeboard above the computed water surface. Computer output appears in Appendix 3.

DITCH INFORMATION FOR 10-YEAR STORM EVENT					
Watershed	Type	Channel Side slopes	Bottom Width (ft)	Flow Depth (ft)	Channel Lining Depth (ft)
Ditch 1-Up	Trapezoidal	3H:1V	2.0	1.04	1.5
Ditch 1-Down	Trapezoidal	3H:1V	2.0	1.47	2.0
Ditch 2-Up	Trapezoidal	3H:1V	2.0	1.18	1.5
Ditch 2-Down	Trapezoidal	3H:1V	2.0	1.62	2.0

6. Determine Channel Protection

Channel protection will be specified that is sufficient to handle the shear stress and velocities from the 10-year/24-hour storm event.

The shear stress on the channel is given by:

$$\tau = \gamma_w dS$$

Where:

τ = the channel shear stress (psf)
γ_w = water desity (62.4 pcf)
d = flow depth in center of channel (ft)
S = channel slope (ft/ft)

This evaluation will determine the shear stress for each channel based on the peak flows from the 10-year/24-hour storm event. Delaware E&S Control Handbook (Ref. 2) requires that the maximum design shear stress for vegetated channels shall be less than 2 psf.

The following table displays a summary of the channel shear stresses:

DITCH LINING INFORMATION				
Ditch/Section	Flow Depth (ft)	Slope (%)	Flow Velocity (fps)	Calculated Shear Stress (psf)
Ditch 1-Up	1.04	1.25	3.39	0.81
Ditch 1-Down	1.47	0.5	2.64	0.46
Ditch 2-Up	1.18	0.5	2.30	0.37
Ditch 2-Down	1.62	0.5	2.80	0.51

The design shear stresses for all the proposed ditches are less than 2 psf. Therefore, no additional linings are required. To facilitate the establishment of vegetation, the channels shall be lined with temporary erosion control blankets (ECB) designed to withstand the shear stress of 2 psf.

REFERENCES:

1) "Urban Hydrology for Small Watersheds," U.S. Dept. of Agriculture, Soil Conservation Service, Engineering Division, Technical Release 55, June 1986.

2) "Delaware Erosion and Sediment Control Handbook," Delaware Department of Natural Resources and Environmental Control, Division of Soil and Water Conservation, December 2003.

3) *"WinTR-55"*, Small Watershed Hydrology, Version. 1.00.08, U.S. Dept. of Agriculture, Soil Conservation Service, 2004.

4) "*Hydraflow*", Version 6.052, developed by Autodesk, Inc., 2007.

5) "Soil Survey of New Castle County, Delaware" U.S. Dept. of Agriculture, Soil Conservation Service, in cooperation with Delaware Agricultural Experiment Station, October 1970.

APPENDIX 1

MAP OF PROPOSED DITCHES

APPENDIX 2

WINTR-55 OUTPUT

WinTR-55 Current Data Description

--- Identification Data ---

User: KD
Project: Hay Road Landfill SDS Cap
SubTitle: Ditch 1 Up-- Post Construction
State: Delaware
County: New Castle
Filename: R:\DIA\18985726\Eng_Data\Sediment & Stormwater\TR-55\Ditch 1 Up--Post.w55

Date: 8/6/2009
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
Dit1 Up-Po		Outlet	4.57	84	0.221

Total area: 4.57 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.2	4.1	4.8	6.0	6.9	8.0	2.7

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type II
Dimensionless Unit Hydrograph: <standard>

KD

Hay Road Landfill SDS Cap
Ditch 1 Up-- Post Construction
New Castle County, Delaware

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	25-Yr (cfs) (hr)	100-Yr (cfs) (hr)	1-Yr (cfs) (hr)
SUBAREAS					
Ditl Up-Po	9.94 12.03	18.07 12.02	24.27 12.02	34.66 12.01	7.52 12.03
REACHES					
OUTLET	9.94	18.07	24.27	34.66	7.52

KD

Hay Road Landfill SDS Cap
Ditch 1 Up-- Post Construction
New Castle County, Delaware

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Ditl Up-Po							
SHEET	100	0.0500	0.240				0.165
SHALLOW	160	0.0500	0.050				0.012
SHALLOW	90	0.1710	0.050				0.004
CHANNEL	480	0.0125	0.035	5.00	8.50	3.333	0.040
					Time of Concentration		0.221

KD

Hay Road Landfill SDS Cap
Ditch 1 Up-- Post Construction
New Castle County, Delaware

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Dit1 Up-Po	Open space; grass cover < 50%	(poor)	D	1.72	89
	Open space; grass cover > 75%	(good)	D	2.56	80
	Gravel (w/ right-of-way)		D	.29	91
	Total Area / Weighted Curve Number			4.57	84
				====	==

WinTR-55 Current Data Description

--- Identification Data ---

User: KD
Project: Hay Road Landfill SDS Cap
SubTitle: Ditch 1 (Southern Ditch)-- Post Construction
State: Delaware
County: New Castle
Filename: R:\DIA\18985726\Eng_Data\Sediment & Stormwater\TR-55\Ditch 1--Post.w55

Date: 8/6/2009
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
Ditl-Post		Outlet	7.13	84	0.310

Total area: 7.13 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.2	4.1	4.8	6.0	6.9	8.0	2.7

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type II
Dimensionless Unit Hydrograph: <standard>

KD

Hay Road Landfill SDS Cap
Ditch 1 (Southern Ditch)-- Post Construction
New Castle County, Delaware

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	25-Yr (cfs) (hr)	100-Yr (cfs) (hr)	1-Yr (cfs) (hr)
SUBAREAS					
Ditl-Post	13.64 12.09	24.92 12.07	33.50 12.08	47.87 12.08	10.32 12.08
REACHES					
OUTLET	13.64	24.92	33.50	47.87	10.32

KD

Hay Road Landfill SDS Cap
Ditch 1 (Southern Ditch)-- Post Construction
New Castle County, Delaware

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Dit1-Post							
SHEET	100	0.0500	0.240				0.165
SHALLOW	160	0.0500	0.050				0.012
SHALLOW	90	0.1710	0.050				0.004
CHANNEL	480	0.0125	0.035	5.00	8.50	3.333	0.040
CHANNEL	680	0.0050	0.035	5.00	8.50	2.122	0.089
						Time of Concentration	0.310

KD

Hay Road Landfill SDS Cap
Ditch 1 (Southern Ditch)-- Post Construction
New Castle County, Delaware

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Dit1-Post	Open space; grass cover < 50%	(poor)	D	2.09	89
	Open space; grass cover > 75%	(good)	D	4.45	80
	Gravel (w/ right-of-way)		D	.59	91
	Total Area / Weighted Curve Number			7.13	84
				====	==

WinTR-55 Current Data Description

--- Identification Data ---

User: KD
Project: Hay Road Landfill SDS Cap
SubTitle: Ditch 2 Up -- Post Construction
State: Delaware
County: New Castle
Filename: R:\DIA\18985726\Eng_Data\Sediment & Stormwater\TR-55\Ditch 2 Up--Post.w55

Date: 8/6/2009
Units: English
Areal Units: Acres

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
Dit2-Up Po		Outlet	4.05	82	0.224

Total area: 4.05 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.2	4.1	4.8	6.0	6.9	8.0	2.7

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type II
Dimensionless Unit Hydrograph: <standard>

KD

Hay Road Landfill SDS Cap
Ditch 2 Up -- Post Construction
New Castle County, Delaware

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	25-Yr (cfs) (hr)	100-Yr (cfs) (hr)	1-Yr (cfs) (hr)
SUBAREAS					
Dit2-Up Po	8.03 12.03	15.05 12.02	20.52 12.02	29.69 12.02	5.96 12.03
REACHES					
OUTLET	8.03	15.05	20.52	29.69	5.96

KD

Hay Road Landfill SDS Cap
Ditch 2 Up -- Post Construction
New Castle County, Delaware

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Dit2-Up Po							
SHEET	100	0.0500	0.240				0.165
SHALLOW	160	0.0500	0.050				0.012
SHALLOW	90	0.1710	0.050				0.004
CHANNEL	200	0.0125	0.035	5.00	8.50	3.268	0.017
CHANNEL	200	0.0050	0.035	5.00	8.50	2.137	0.026
						Time of Concentration	0.224

KD

Hay Road Landfill SDS Cap
Ditch 2 Up -- Post Construction
New Castle County, Delaware

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Dit2-Up Po	Open space; grass cover < 50%	(poor)	D	.49	89
	Open space; grass cover > 75%	(good)	D	3.2	80
	Gravel (w/ right-of-way)		D	.36	91
	Total Area / Weighted Curve Number			4.05	82
				====	==

WinTR-55 Current Data Description

--- Identification Data ---

User: KD
Date: 8/6/2009
Project: Hay Road Landfill SDS Cap
Units: English
SubTitle: Ditch 2 (Northern Ditch) -- Post Construction
Down
Areal Units: Acres
State: Delaware
County: New Castle
Filename: R:\DIA\18985726\Eng_Data\Sediment & Stormwater\TR-55\Ditch 2--Post.w55

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
Dit2-Post		Outlet	10.74	82	0.401

Total area: 10.74 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.2	4.1	4.8	6.0	6.9	8.0	2.7

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type II
Dimensionless Unit Hydrograph: <standard>

KD

Hay Road Landfill SDS Cap
Ditch 2 (Northern Ditch) -- Post Construction
New Castle County, Delaware

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	10-Yr (cfs) (hr)	25-Yr (cfs) (hr)	100-Yr (cfs) (hr)	1-Yr (cfs) (hr)
SUBAREAS					
Dit2-Post	16.46 12.12	31.13 12.11	42.69 12.12	61.98 12.12	12.14 12.15
REACHES					
OUTLET	16.46	31.13	42.69	61.98	12.14

KD

Hay Road Landfill SDS Cap
Ditch 2 (Northern Ditch) -- Post Construction
New Castle County, Delaware

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Dit2-Post							
SHEET	100	0.0500	0.240				0.165
SHALLOW	160	0.0500	0.050				0.012
SHALLOW	90	0.1710	0.050				0.004
CHANNEL	1670	0.0050	0.035	5.00	8.50	2.109	0.220
						Time of Concentration	0.401

KD

Hay Road Landfill SDS Cap
Ditch 2 (Northern Ditch) -- Post Construction
New Castle County, Delaware

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Dit2-Post	Open space; grass cover < 50%	(poor)	D	1.28	89
	Open space; grass cover > 75%	(good)	D	8.55	80
	Gravel (w/ right-of-way)		D	.91	91
	Total Area / Weighted Curve Number			10.74	82
				=====	==

APPENDIX 3

DITCH COMPUTATIONS

Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. Thursday, Aug 6 2009

Ditch 1 Up

Trapezoidal

Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 23.00
Slope (%)	= 1.25
N-Value	= 0.035

Calculations

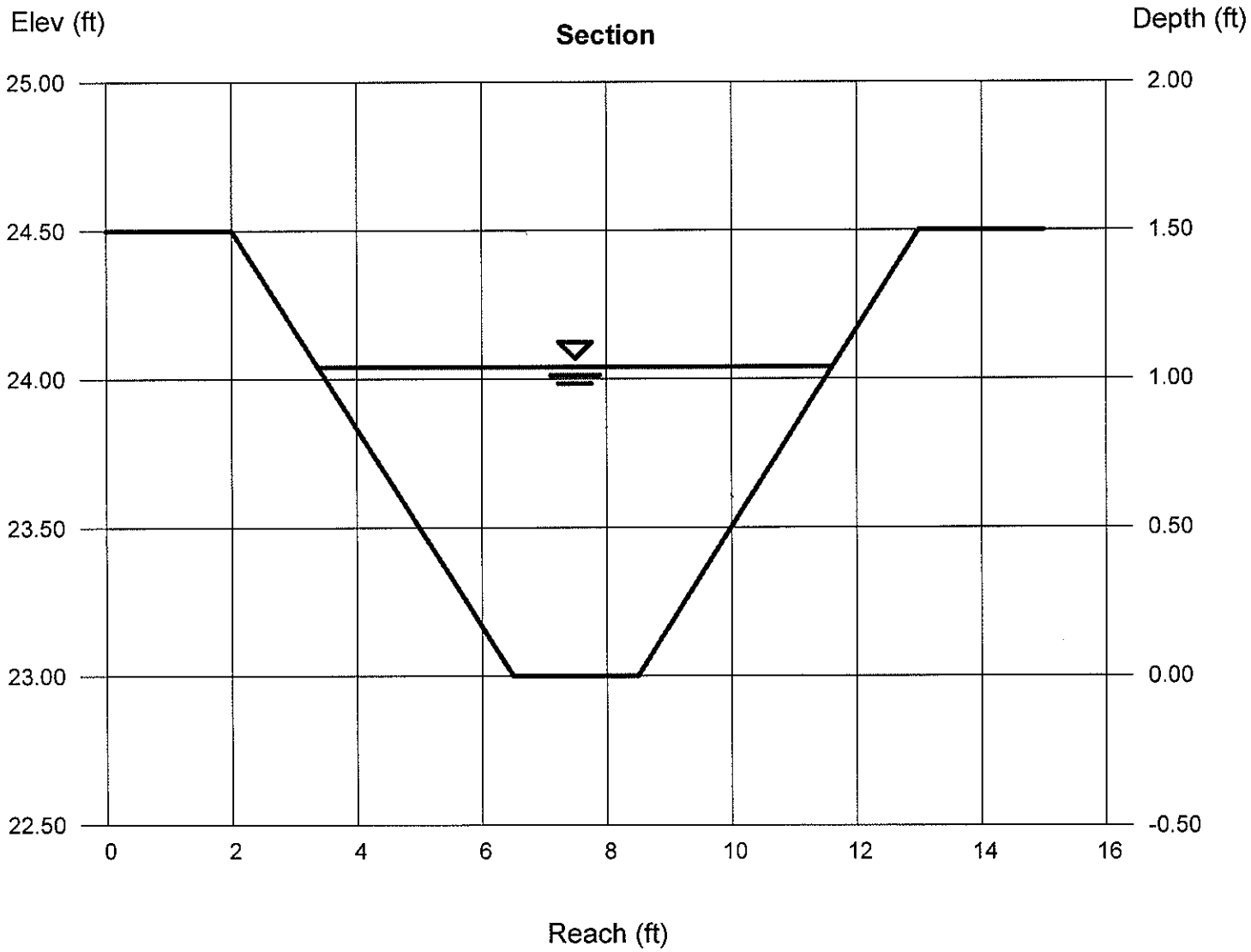
Compute by:	Known Q
Known Q (cfs)	= 18.07

Highlighted

Depth (ft)	= 1.04
Q (cfs)	= 18.07
Area (sqft)	= 5.32
Velocity (ft/s)	= 3.39
Wetted Perim (ft)	= 8.58
Crit Depth, Yc (ft)	= 0.90
Top Width (ft)	= 8.24
EGL (ft)	= 1.22

F.B = 0.46'

Shear Stress $\tau = \gamma_w d S = 62.4 \times 1.04 \times 0.0125 = 0.81$ psf < 2.0 psf



Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. Thursday, Aug 6 2009

Ditch 1 Down

Trapezoidal

Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 17.00
Slope (%)	= 0.50
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 24.92

Highlighted

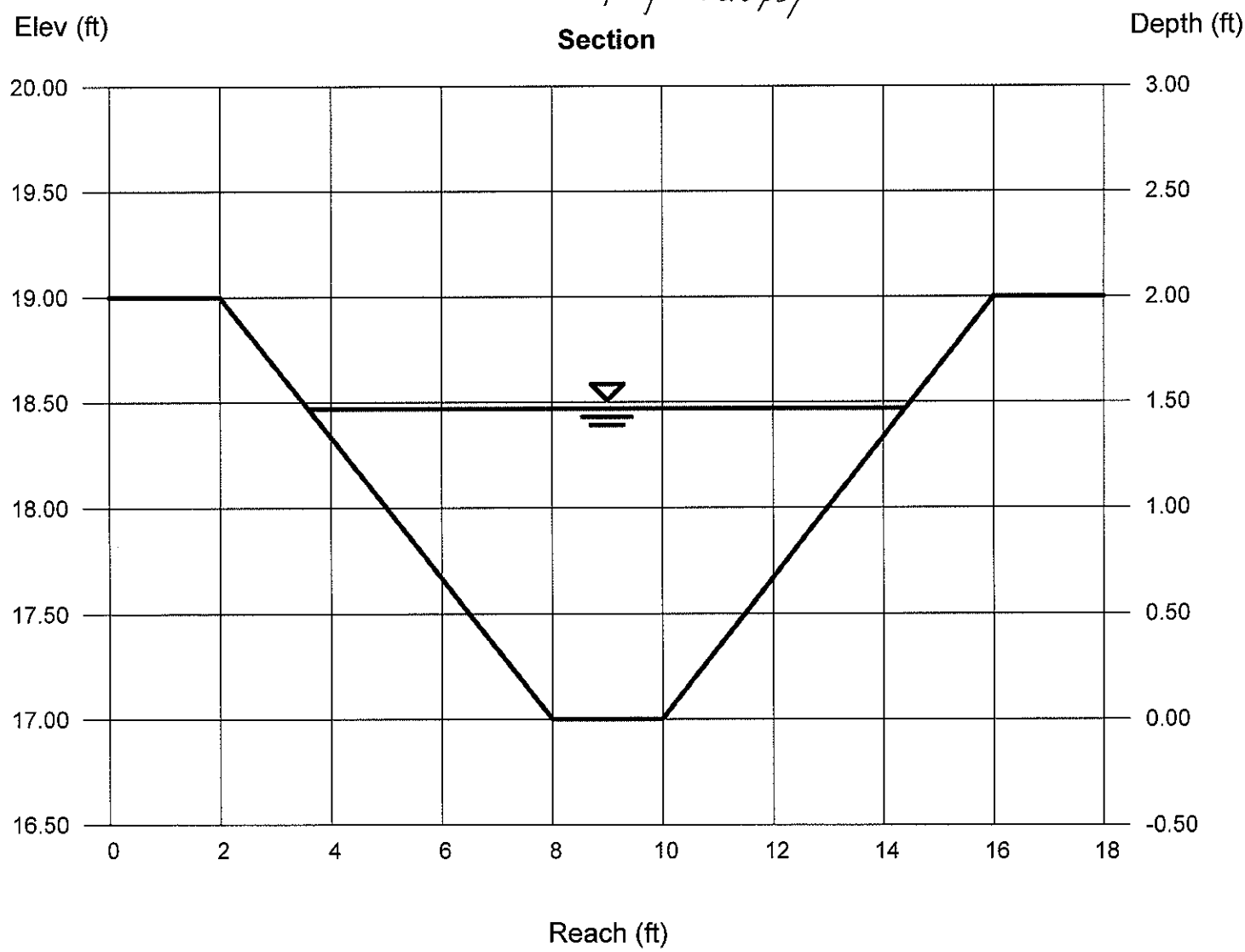
Depth (ft)	= 1.47
Q (cfs)	= 24.92
Area (sqft)	= 9.42
Velocity (ft/s)	= 2.64
Wetted Perim (ft)	= 11.30
Crit Depth, Yc (ft)	= 1.06
Top Width (ft)	= 10.82
EGL (ft)	= 1.58

F.B = 0.53'

Shear Stress $\tau = \gamma_w d s$

$= 62.4 \times 1.47 \times 0.005$

$= 0.46$ psf < 2.0 psf



Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. Thursday, Aug 6 2009

Ditch 2 Up

Trapezoidal

Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 17.00
Slope (%)	= 0.50
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 15.05

Highlighted

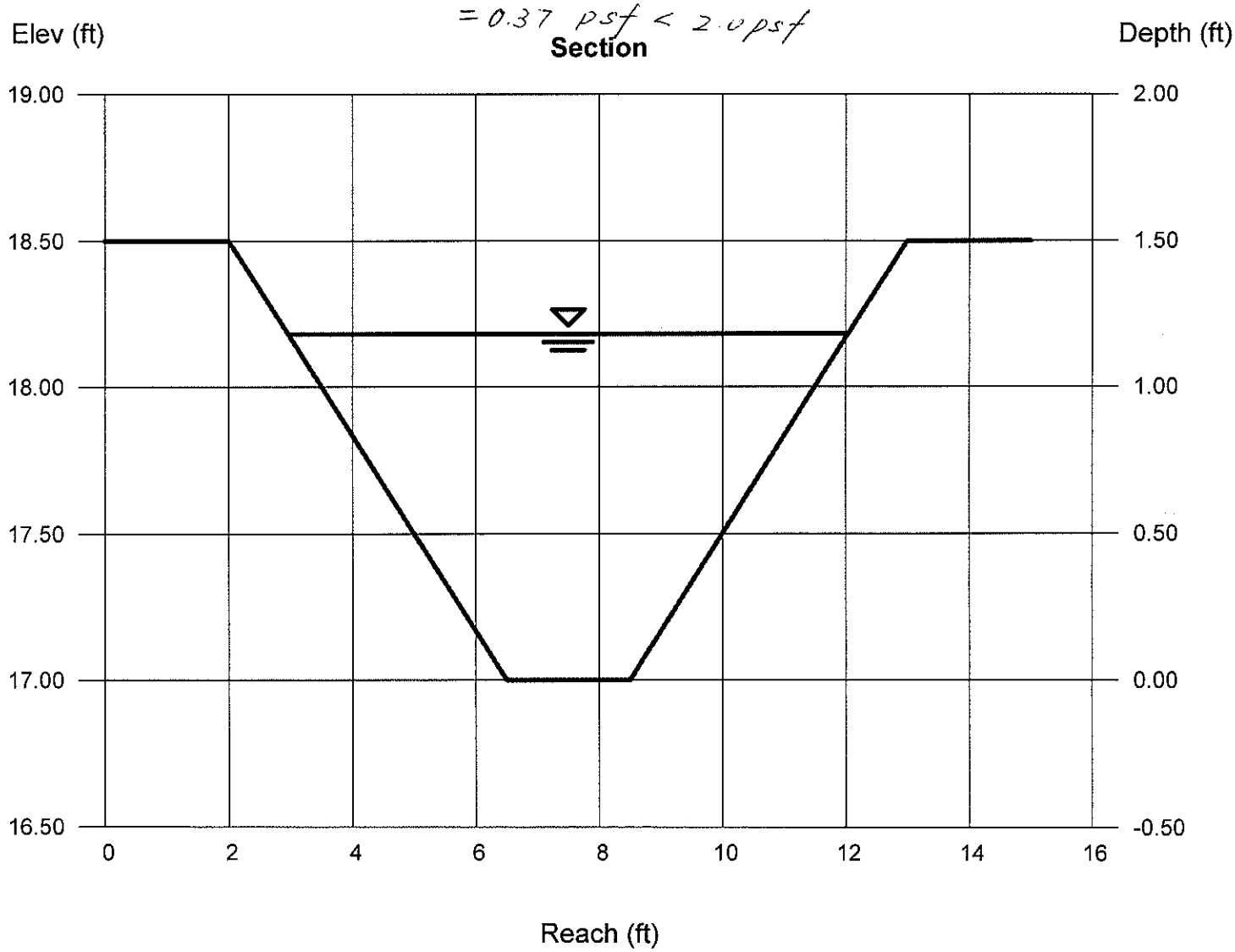
Depth (ft)	= 1.18
Q (cfs)	= 15.05
Area (sqft)	= 6.54
Velocity (ft/s)	= 2.30
Wetted Perim (ft)	= 9.46
Crit Depth, Yc (ft)	= 0.82
Top Width (ft)	= 9.08
EGL (ft)	= 1.26

F.B. = 0.32'

Shear Stress $\tau = \gamma w\, ds$

$= 62.4 \times 1.18 \times 0.005$

$= 0.37$ psf < 2.0 psf



Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. Thursday, Aug 6 2009

Ditch 2 DOWN

Trapezoidal

Bottom Width (ft)	=	2.00
Side Slopes (z:1)	=	3.00, 3.00
Total Depth (ft)	=	2.00
Invert Elev (ft)	=	17.00
Slope (%)	=	0.50
N-Value	=	0.035

Calculations

Compute by:		Known Q
Known Q (cfs)	=	31.13

Highlighted

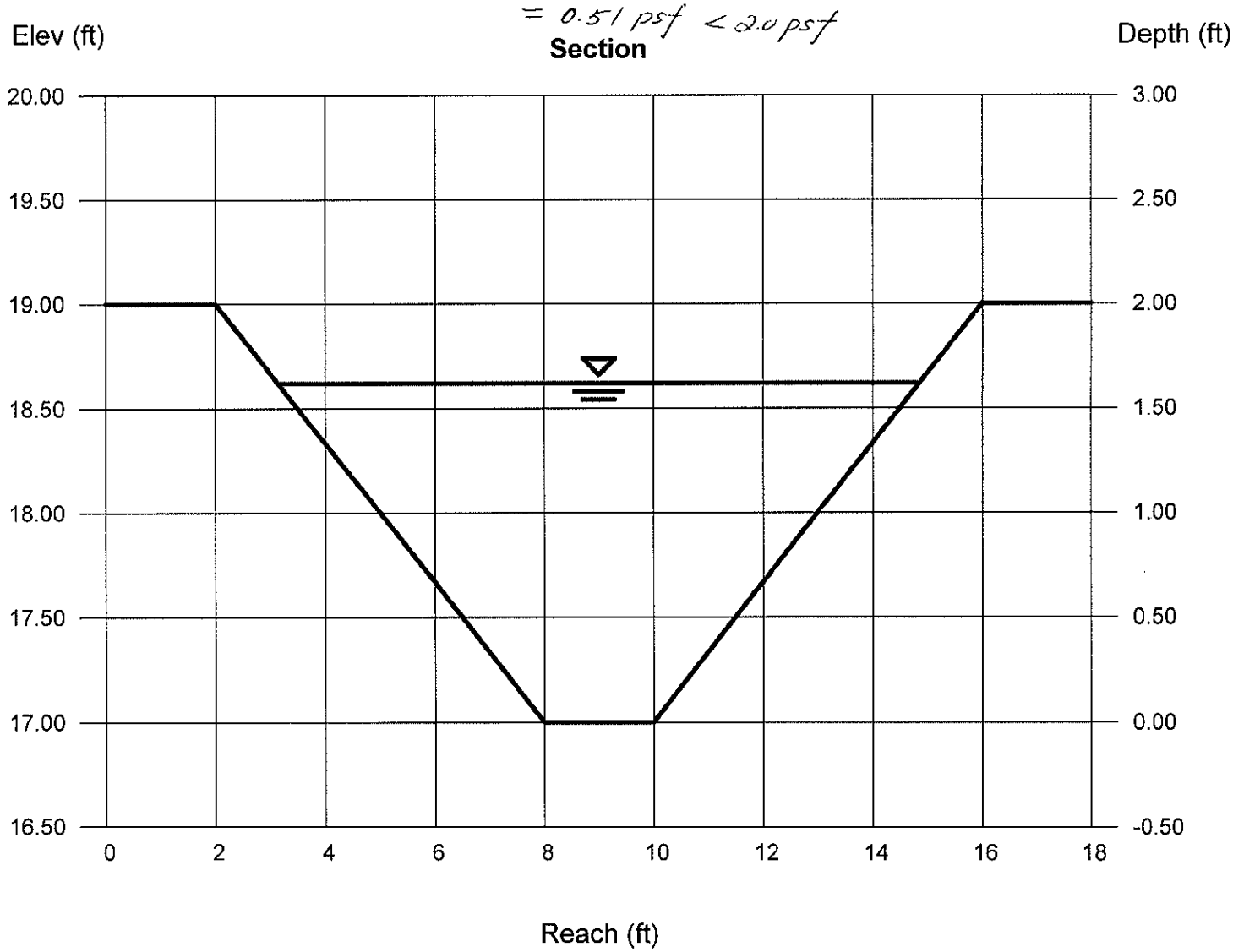
Depth (ft)	=	1.62
Q (cfs)	=	31.13
Area (sqft)	=	11.11
Velocity (ft/s)	=	2.80
Wetted Perim (ft)	=	12.25
Crit Depth, Yc (ft)	=	1.18
Top Width (ft)	=	11.72
EGL (ft)	=	1.74

F.B. = 0.38'

Shear Stress $\tau = \gamma_w d s$

$= 62.4 \times 1.62 \times 0.005$

$= 0.51$ psf < 2.0 psf



APPENDIX B
SELECTED TECHNICAL SPECIFICATIONS

01100 – Summary
01351 – Health, Safety and Emergency Response
01354 – Environmental Procedures
02073 – Geotextiles
02200 – Site Preparation
02300 – Earthwork
02370 – Erosion and Sedimentation Control
02900 – Planting

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CONSTRUCTION DRAWINGS

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INTERMEDIATE GRADING PLAN (SHEET 7)
FINAL GRADING PLAN (SHEET 8)
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Appendix D

Construction Quality Assurance Plan

Construction Quality Assurance Plan
DuPont Hay Road Sludge Drying Site (DE-0024)
Wilmington, Delaware

Date: December 2009 Project No.: 18985726.9001D

URS Corporation
Iron Hill Corporate Center
4051 Ogletown Road, Suite 300
Newark, DE 19713

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Table 1 Quality Assurance Summary Table of Soil and Geosynthetics Testing

1.0 Introduction

This Construction Quality Assurance (CQA) Plan presents the principles and practices of quality assurance (QA) that will be implemented during cap construction and related work during the DuPont Hay Road Sludge Drying Site (DE-0024) capping project. QA, in the context of this CQA Plan, is defined as the planned and systematic actions necessary to provide adequate confidence that design requirements are met. This includes the continuing evaluation of the quality control (QC) program through observations, inspections, tests, measurements, and audits of the means employed to control and measure the quality of the constructed component. QA will also include the initiation of corrective measures when necessary. Once approved, the Contractor's Construction Quality Control Plan (CQC Plan) is hereby included by reference.

The CQA Plan has been prepared in accordance with the Delaware Regulations Governing Hazardous Waste, Delaware Administrative Code, Title 7, Section 1302, Part 264, Subpart A – General, Section 264.19, Construction QA Program and the U.S. Environmental Protection Agency (EPA) Technical Guidance Document: Construction QA for Hazardous Waste Land Disposal Facilities (EPA/530-SW-86-031, October 1986). The CQA Plan includes the following five primary elements:

- Responsibility and authority
- QA personnel qualifications
- Monitoring activities
- Sampling strategies
- Documentation

Responsibility and authority and personnel qualifications are discussed in Sections 2.0 and 3.0, respectively. Sections 4.0, 5.0, and 6.0 describe the monitoring activities, sampling strategies, and documentation requirements.

2.0 Responsibility and Authority

The principal parties involved in the QA of the construction of the Hay Road Sludge Drying Site (DE-0024) cap project include the DuPont Corporate Remediation Group (CRG), DuPont Site Representative (DSR), Quality Assurance Team (QAT), Contractor, and the Contractor's QC Contractor. The following paragraphs describe the general responsibilities and authorities of each of these parties with regard to QA. The responsibility and/or authority of a given party may be modified or expanded as dictated by specific project needs during construction meetings.

2.1 DuPont Corporate Remediation Group

DuPont CRG is responsible for the design and construction of the cap system and related work of the Hay Road Sludge Drying Site (DE-0024) capping project. DuPont has the authority to select and dismiss parties charged with QA and construction activities. DuPont also has the authority to accept or reject reports and recommendations of the DSR and the materials and workmanship of the Contractor and any subcontractor at any tier.

2.2 DuPont Site Representative

The DSR is the official on-site representative of DuPont and is responsible for coordinating field activities. The DSR has authority to direct contractors hired by DuPont and is responsible for communications between DuPont, the QAT, the Design Engineer, and the Contractor.

2.3 Quality Assurance Team

URS Corporation (URS) has prepared the design for DuPont and may serve as the QAT responsible for on-site monitoring of the cap system construction to verify that construction is in accordance with the approved design. The CQA program will be implemented under the direction of a CQA Officer who is a registered professional engineer. The QAT's responsibilities are described in the following paragraphs.

During construction, the Design Engineer will be responsible for reviewing proposed field changes to the Technical Specifications and Contract Drawings for technical acceptance. As the Design Engineer, URS may evaluate or modify elements of the design due to unforeseen site conditions or changes in construction methodology. Substantive changes in the design and modifications to the Contract Drawings and Technical Specifications will be incorporated into the contract documents after the State of Delaware Department of Natural Resources and Environmental Control's (DNREC) approval by issuing amendments to the Contract Drawings and Technical Specifications. URS will also be responsible for evaluating materials that deviate from the Technical Specifications in order to evaluate their acceptability for the specified work.

The QAT will be responsible for observing and documenting activities related to the QA of the cap system construction and related work as outlined in the CQA Plan. The QAT

will be independent from the Contractor or any subcontractor, including any manufacturer, fabricator, installer, or other Subcontractor.

In general, the responsibilities and authorities of the QAT include the following:

- Scheduling, coordinating, and performing QA activities in accordance with this approved CQA Plan
- Performing independent on-site observation of the work in progress to assess compliance with Contract Drawings and Technical Specifications
- Reviewing Contractor submittals (including the CQC Plan) to assure compliance with the Technical Specifications and either returning the submittals not meeting the requirements of the Technical Specifications for correction and re-submittal or approving the submittals
- Verifying that QC test equipment meets testing and calibration requirements and that QC tests are conducted according to standardized procedures defined in the Technical Specifications and the approved CQC Plan
- Performing independent sampling and testing to assess Contractor QC sampling and testing protocol
- Collecting and maintaining material samples, including field welds of geomembrane, for the CRG
- Identifying Contractor CQC-tested work that should be accepted, rejected, or further evaluated
- Verifying that corrective measures are implemented
- Documenting and reporting QA activities
- Maintaining open lines of communications with all other parties involved in the construction

The QAT will also be responsible for issuing a certification report after construction of the cap system. This report will state that the cap system and ancillary components have been constructed in accordance with the Contract Documents and that the constructed product meets the intent of the design. The report will be signed and sealed by a Professional Engineer registered in the State of Delaware and submitted to DNREC.

2.4 Contractor

The Contractor is responsible for the construction of the cap system and related work. It is the responsibility of the Contractor that the construction be performed using the procedures and equipment necessary to produce results in conformance with the requirements of the CQC Plan, the Contract Drawings, and the Technical Specifications. If the Contractor subcontracts the construction of individual components of the cap system or related work, the Contractor retains responsibility for the quality of the materials and workmanship of the constructed component. The Contractor is additionally responsible for ensuring the QC procedures are implemented appropriately. To this end, the Contractor will retain a QC Contractor as required by the Technical Specifications.

3.0 Qualifications of QA Team and Laboratories

The following qualifications will be required of the key personnel and organizations involved in QA for the construction of the cap system and related work.

3.1 Quality Assurance Team

The QAT will be a qualified engineering firm with experience in construction QA/QC, particularly on similar projects involving cap systems. The QAT will be capable of assigning technically qualified personnel to the project, including a CQA Officer and QA monitors, as needed. The person designated as the CQA Officer will possess an engineering degree and be a Registered Professional Engineer in the State of Delaware.

The QAT will provide experienced personnel to perform the QA functions required by the Technical Specifications. The QAT shall provide QA monitors to observe the construction activities on-site and document compliance with the plans and Technical Specifications, including the placement of soil and the installation of all of the components of the capping system, including geomembrane, geotextile, geocomposite, erosion control blanket (ECB), etc.

The QAT will procure qualified geotechnical and geosynthetic testing laboratories to evaluate the characteristics of the soils, aggregates, and geosynthetics that will be used during the construction of the cap system and related work.

3.1.1 Geotechnical QA Laboratory

The geotechnical QA laboratory will be a qualified laboratory independent from the Owner, Contractor, Manufacturer, and Geosynthetics Installer, with experience in performing laboratory tests to determine soils characteristics as required by the Technical Specifications. The geotechnical QA laboratory will demonstrate that it follows the standard test methods listed in the Technical Specifications and maintains the appropriate, calibrated equipment to perform the tests. The geotechnical QA laboratory will also demonstrate that it adheres to a formal in-house QA/QC control program and can provide the required analytical documentation and reports. The QAT may perform an audit of the geotechnical QA laboratory before, during, or after construction is completed.

3.1.2 Geosynthetics QA Laboratory

QA geosynthetic laboratory testing will be performed at a Geosynthetic Accreditation Institute (GAI)-certified laboratory independent from the Owner, Contractor, Manufacturer, and Geosynthetics Installer, with experience in performing laboratory tests to determine geosynthetics characteristics as required by the Technical Specifications. GAI is the geosynthetic laboratory accreditations arm of the Geosynthetics Institute (GSI), a recognized leader in the geosynthetics industry. The geosynthetics QA laboratory will demonstrate that it follows the standard test methods listed in the

Technical Specifications and maintains the appropriate, calibrated equipment to perform the tests. The geosynthetics laboratory will also demonstrate that it is certified for all the required geosynthetics testing, adheres to a formal in-house QA/QC control program, and can provide the required analytical documentation and reports. The QAT may perform an audit of the geosynthetics QA laboratory before, during, or after construction is completed.

4.0 Monitoring and Testing

This section of the CQA Plan addresses the monitoring activities and testing associated with the QA of the individual components of the cap system and related work. These activities are necessary to ensure the individual components have been constructed to meet or exceed all design criteria, plans, and Technical Specifications.

QA monitoring and testing is described for the construction and installation of the soil and soil-like components [i.e., Staged Iron Rich Material (Staged IRM), cover soil, and vegetative cover]; drainage ditches; cap access road; geomembrane; geotextile; geocomposite drainage layer; seeding; fence; culverts; drainage ditch and slope protection; and erosion and sediment (E&S) controls.

4.1 Soils

The soil components of the cap system will meet requirements related to material characteristics and construction quality. The Contractor will perform advance laboratory tests prior to construction to evaluate if the characteristics of the soil from proposed sources meet the material acceptance requirements of the Technical Specifications. The QAT will review the laboratory results and document that the soil meets the requirements of the Technical Specifications. Throughout construction, the Contractor will periodically perform additional field and laboratory testing to evaluate if the placed material meets the requirements of the Technical Specifications with regard to material acceptance and construction quality. The QAT will conduct the appropriate QA procedures to determine and document the quality of the constructed component. Appropriate QA procedures are described below, and documentation is described in Section 6.0.

Construction of the individual soil components will involve standard earthwork construction practices including fill placement, compaction, and implementation of E&S controls. Adequate QA during this construction will identify problems resulting from inadequate construction methodologies or materials that could result in cap system failure from slope instability, settlement, or erosion.

The QAT will monitor the placement and compaction of these soil components through continuous observation and regular testing as follows:

- Measurement of loose lift thickness
- Observation of clod size reduction and material homogenization operations, as appropriate
- Observation and testing of compacted fill moisture content and dry density
- Observation of type of compaction equipment, number of passes, speed, and weight to document that all correspond to the approved methods
- Observation of dust control measures
- Observation of temporary E&S control measures

- Observation of uniformity of coverage by compaction equipment, especially at compacted fill edges, in equipment turnaround areas and at the top and bottom of slopes
- Observation of repairs of penetrations or holes resulting from the collection of undisturbed soil samples or the use of density or moisture probes using the same materials and methods for repairs on the compacted fill

The specific tests will be in accordance with the approved CQC Plan and the Technical Specifications. Section 5.0 describes the strategies for determining the sampling frequency and location.

4.2 Drainage Ditches

4.2.1 Earthwork

During the construction of the drainage ditches and sediment control structures, the QAT will follow the QA procedures for soil placement described in Paragraph 4.1 – Soils.

4.2.2 Geotextile

During the construction of the drainage ditches and sediment control structures, the QAT will follow the QA procedures for geotextile placement described in Paragraph 4.5 – Geotextile.

4.2.3 Erosion Control Blanket

The Contractor will install the ECB to prevent erosion and promote vegetation establishment as required by the Contract Documents and field conditions. The QAT will review the manufacturer's data and verify that the material meets the requirements of the Technical Specifications. The QAT will observe installation and document that the erosion control blanket is anchored and otherwise installed in accordance with the Technical Specifications. The QAT will report any deviations to the DSR.

4.2.4 Riprap/Stone

The Contractor will place riprap and/or stone where needed along sections of the drainage ditches and at sediment trap outlet spillways. The QAT will review the Contractor's data and verify that the riprap and stone meets the requirements of the Technical Specifications and placement is as indicated on the Contract Drawings. During placement, the QAT will document that the riprap and/or stone are placed such that the underlying geotextile is not damaged and that equipment does not operate directly on the geotextile. The QAT will report any deviations from the Technical Specifications to the DSR.

4.3 Cap Access Road Construction

The Contractor will construct, repair, and maintain a cap access roadway as presented on the drawings. During roadway construction, the QAT will focus QA monitoring on the installation and construction of the geotextile and aggregates.

4.3.1 Geotextile

The QAT will follow the QA procedures for geotextile placement during the construction of the access roadways as described in Paragraph 4.5 – Geotextile.

4.3.2 Aggregate

The QAT will review the grain-size curves of the aggregates prior to use in roadway construction and report any non-compliance with the Technical Specifications to the DSR.

4.4 Geomembrane

The Contractor will install the geomembrane within the cap system in accordance with the Technical Specifications and as indicated on the Contract Drawings. QC/QA during the manufacturing and fabrication; handling and storage; and installation of the geomembrane are important to increase the likelihood that the geomembrane will function as intended. The QA measures that are necessary to detect defects, or potential defects, are discussed below.

4.4.1 Manufacturing and Fabrication

Prior to shipment, the Contractor’s QC Contractor will provide documentation to the QAT indicating that the geomembrane material conforms to the Technical Specifications. The QAT will examine the Contractor's documentation to verify that the material to be delivered to the site meets the requirements of the Technical Specifications. The QAT will also verify that the QC certificates have been provided at the specified frequency for all rolls and that each certificate identifies the rolls related to it. The QAT will review the QC certificates and verify that the certified roll properties meet the requirements in the Technical Specifications.

If the geomembrane requires factory seaming, the seams should be 100% non-destructively tested. Rejected seams not meeting the seaming requirements will be documented and repaired. The QAT will be responsible for reviewing the fabricator's QC documentation and documenting that the geomembrane material, including the seams, meets the Technical Specifications. The QAT will report any problems to the DSR.

4.4.2 Handling and Storage

Upon delivery, the QAT will observe the surface of the geomembrane rolls without unrolling unless a defect or damage is found or suspected. The geomembrane should be evaluated for any damage, including any puncture and tears from equipment, unusable

material from exposure to temperature extremes, bonding of adjacent geomembrane layers from excessive heat, creasing, or tearing from inadequate packaging support. The QAT will indicate to the DSR the following:

- Rolls, or portions thereof, that should be rejected and removed from the site because they have severe flaws or significant damage
- Rolls that have minor repairable flaws or damage

Immediately upon delivery of the geomembrane rolls, the QAT will verify that samples are removed at the specified size and frequency and forwarded to the geosynthetic laboratory for testing to verify conformance with the Technical Specifications and the geomembrane manufacturer's list of guaranteed properties. The QAT will examine the results from the laboratory conformance testing and will report any non-conformance to the DSR.

The QAT will document that storage of the geomembrane provides adequate protection against dirt, shock, ultraviolet light, heavy winds, precipitation, temperature extremes, or vandals.

4.4.3 Installation

During the installation of the geomembrane, the QAT will document the following:

- The prepared subgrade surface is smooth and even (free from clods of soil, rocks in excess of 1 inch in any dimension, roots, sudden changes of grade, or standing water) and is acceptable immediately prior to geomembrane placement.
- The prepared subgrade surface provides a firm and dry foundation for geotextile deployment prior to geomembrane installation.
- The geomembrane panel installation generally follows the panel layout plan, and each panel is placed in such a manner that it is unlikely to be damaged.
- Any tears, punctures, holes, thin spots, etc. are either marked for repair or the panel is rejected.
- The weather conditions are acceptable for geomembrane installation as described in the Technical Specifications.
- Installation of the geomembrane in appurtenance areas and connection of the geomembrane to appurtenances have been made in accordance with the Technical Specifications.
- Extreme care is taken while seaming around appurtenances since neither non-destructive nor destructive testing may be feasible in these areas.
- The geomembrane is not visibly damaged while making connections to appurtenances.
- The overlaps of adjacent sheets meet the requirements of the Technical Specifications.
- The geomembrane is free from dirt, dust, and moisture so that the adjacent sheets can be properly seamed.

- The seaming materials and equipment meet the requirements of the Technical Specifications.
- The temperatures, pressures, speed of seaming, and ambient conditions are in accordance with the seaming protocol established during the test seam conducted at the beginning of that particular seaming period.
- The installation procedures and other construction activities around the geomembrane installation do not damage the geomembrane.

The QAT will report any deviations from the above to the DSR.

The field seams will be tested to document that a homogeneous bond is formed. The QAT will observe that the Contractor's QC personnel perform both non-destructive and destructive testing on the field seams for conformance to the Technical Specifications. The QAT will take additional destructive tests at locations where unacceptable seams are suspected due to the presence of dirt or moisture, a change in seaming materials, an increase in failed non-destructive tests, or any other cause. The QAT will use the geosynthetics QA laboratory, identified in Section 3.0, to test material and seam properties and document conformance with the Technical Specifications. The QAT will document that all repairs are performed as soon as possible after discovery and in accordance with the Technical Specifications, including retesting. The QAT will report any deviations to the DSR.

4.5 Geotextiles

The Contractor will install geotextile in the cap system, access roadways, drainage ditches, and as indicated in the Technical Specifications and drawings. Prior to delivery, the Contractor’s QC Contractor will provide documentation and test results from the geotextile manufacturer that demonstrate that the property values of the material meet the requirements of the Technical Specifications. The QAT will examine the Contractor's documentation to verify that the geotextile meets the Technical Specifications' requirements relative to material properties. Deviations will be reported to the DSR.

Upon delivery, the QAT will examine rolls and report any damage to the DSR. The QAT will verify that the samples are removed and forwarded to the geosynthetic QA laboratory for testing to verify conformance with the Technical Specifications and the list of guaranteed properties. The QAT will examine results of the laboratory conformance testing and will report any non-conformance to the DSR.

The QAT will observe placement of the geotextile and document that the Technical Specifications are followed, including adequate overlap, and, when appropriate, heat tacking and seaming is performed without damaging the parent material. Also, the QAT will observe and document that the geotextile is not damaged during placement and during subsequent construction activities. The QAT will report any deviations from the above to the DSR.

4.6 Geocomposite Drainage Layer

The Contractor will install the geocomposite drainage layer in the cap system as indicated in the Technical Specifications and Contract Drawings. Prior to delivery, the Contractor's QC Contractor will provide documentation and test results from the geocomposite manufacturer that demonstrate that the property values of the geonet, geotextile, and the geocomposite of these materials meet the requirements of the Technical Specifications. The QAT will examine the Contractor's documentation to verify that the individual components of the geocomposite drainage layer, as well as the geocomposite drainage layer, meet the Technical Specifications' requirements relative to material properties. Deviations will be reported to the DSR.

Upon delivery, the QAT will examine the material and report any damage to the DSR. The QAT will verify that samples are removed and forwarded to the geosynthetic QA laboratory for testing to verify conformance with the Technical Specifications and the list of guaranteed properties. The QAT will examine results of the laboratory conformance testing and report any non-conformance to the DSR.

The QAT will observe placement of the geocomposite and document that the Technical Specifications are followed, including adequate overlap and, when appropriate, heat tacking or seaming of the upper geotextile and tying the geonet together. Also, the QAT will observe and document that the geocomposite is not damaged during placement and during subsequent construction activities. The QAT will report any deviations from the above to the DSR.

4.7 Seeding

The Contractor will apply temporary and permanent seeding to areas disturbed during construction in accordance with the Technical Specifications. The Contractor is responsible for conducting a soil analysis of the vegetative cover and submitting the results including the recommendations to the QAT. The QAT will review this submittal and advise the DSR of any problems. The QAT will also examine the manufacturer's seed certification and verify that the seed mixture, seed purity percentage, seed germination percentage, and weed seed content percentage conform with the requirements of the Technical Specifications. The QAT will notify the DSR if there is any deviation from the Technical Specifications. The QAT will observe the delivery, handling, and storage of the seed and report any deviations from the requirements described in the Technical Specifications to the DSR.

4.8 Erosion and Sediment Controls

The Contractor will install E&S control measures, including but not limited to straw bale sediment barriers, silt fence, riprap protection, ECB, and sediment traps, throughout the site as indicated on the Contract Drawings. The QAT will observe the installation of these measures and will verify that the requirements of the Technical Specifications and the E&S Control Plan are met. The QAT will also verify that maintenance and inspection of the E&S control measures is conducted in accordance with the Technical

Specifications and the E&S Control Plan. The QAT will report any deviations to the DSR.

5.0 Sampling Strategies

Table 1 presents the required standard tests and the minimum frequencies at which QA tests will be performed for the major components of construction, soils and aggregates, and geomembrane, geotextile, and geocomposite drainage layer. The actual frequency of testing will be determined by the QAT based on observed construction conditions. QAT personnel will be responsible for the collection of QA samples. The paragraphs below describe the sampling strategies for the major construction components listed above.

5.1 Soils and Aggregates

Three types of sampling strategies will be used for the various soil and aggregate components:

- Evaluate material characteristics prior to the use of the material in construction and confirm that those characteristics do not change significantly during construction (i.e., no longer meet Technical Specifications or require changes in construction methodology), as required by the QAT
- Use specific bulk volumes of material in stockpiles (e.g., one sample per 5,000 cy)
- Establish sampling points on nodes or sampling blocks using a grid pattern. For example:
  - "On a 100-foot grid" means that a grid pattern with line spacings of 100 feet will be superimposed on a plan of the area to be sampled. Each node (intersection of perpendicular grid lines) represents a sample location.
  - "One per 100-foot grid" also means that a grid pattern with line spacings of 100 feet will be superimposed on the area to be sampled. However, one sample location may be selected at random coordinates within the 100-foot by 100-foot grid section (sampling block) rather than at the nodes.

Grid pattern sampling strategies will be used on placed material and offer several advantages over sampling strategies which require that samples be collected on a “per acre” or “per 10,000 square feet” basis:

- Grid patterns can be superimposed and sampling locations plotted on plans for areas to be sampled prior to construction. Sampling can thus be conducted systematically. Samples and sample locations can be labeled in accordance with the grid pattern, increasing the effectiveness of documentation.
- The size of the sampling block can be increased to decrease the frequency of sampling without changing the grid pattern. For example, the same 100-foot grid pattern can be used to select sample locations for frequencies of one per 10,000 square feet (one per one 100-foot grid section), one per one 40,000 square feet (one per four 100-foot grid sections or one per 200-foot grid section), one per 90,000 square feet (one per nine 100-foot grid sections or one per 300-foot grid section), etc.

- Sample frequency terminology can be used and applied consistently. For example, the following commonly used sample frequency terms can be replaced with equal or approximate grid frequencies:
  - One per 10,000 square feet equals one per 100-foot grid section.
  - One per acre is approximately equivalent to one per 200-foot grid section.
  - One per 5,000 cy is approximately equivalent to one per 500-foot grid section per 6-inch lift.

The QAT, at a minimum, will sample and test the soil and aggregates once per every ten QC samples and tests performed, for every type test unless otherwise indicated in Table 1.

5.2 Geomembrane

The QAT will employ two types of sampling strategies: one for non-destructive sampling and one for destructive sampling. During non-destructive sampling, the QAT will monitor the QC test every linear feet of seam and verify that the methods and results are in accordance with the Technical Specifications. The QAT will report any deviations to the DSR.

Destructive seam testing will be performed at selected locations to evaluate seam strength. Seam strength testing will be performed as the seaming work progresses, not at the completion of all field seaming. Test locations will be determined during installation at the QAT's discretion. The QAT will collect a sample during every test performed by the Contractor's QC personnel. Collected samples will be sent to the geosynthetic QA laboratory for testing. The QAT will review the results and report any deviations to the DSR.

5.3 Geotextile

The QAT will collect samples and may conduct a test for every ten tests conducted by the Contractor’s QC personnel for the geotextile layer. Samples will be collected from the rolls delivered to the site.

5.4 Geocomposite Drainage Layer

The QAT will collect a sample and may conduct a test for every ten tests conducted by the Contractor's QC personnel for the geocomposite drainage layer. Samples will be collected from the rolls delivered to the site.

6.0 Documentation

An effective CQA Plan depends largely on recognition of all construction activities that should be monitored and on assigning responsibilities for the monitoring of each activity. This is most effectively accomplished and verified by the documentation of QA activities. The QAT will document that QA requirements have been addressed and satisfied.

The QAT will provide the Design Engineer with signed descriptive remarks, data sheets, and logs to verify that all monitoring activities have been completed. The QAT will also maintain, at the job site, a complete file of Contract Drawings and Technical Specifications, the CQA Plan, checklists, test procedures, daily logs, and other pertinent documents.

6.1 Daily Recordkeeping

Standard reporting procedures will include preparation of a daily CQA report, which, at a minimum, will consist of the following: a daily summary report, including memoranda of meetings and discussions with the site contractors; observation logs; and test data sheets. Other forms of daily recordkeeping to be used as appropriate include construction problem and solution data sheets and photographic reporting data sheets. This information will be regularly submitted to and reviewed by the DSR.

6.1.1 Daily Summary Report

The QAT will prepare a daily summary report that will include the following information as appropriate:

- An identifying sheet number for cross-referencing and document control
- Date, project name, location, and other identification
- Data on weather conditions
- Information on meetings held or discussions that took place
  - Names of parties to discussion
  - Relevant subject matter or issues
  - Decisions reached
  - Activities planned and their schedule
- A reduced-scale site plan showing work areas and test locations
- Descriptions and locations of ongoing construction
- Descriptions and specific locations of areas, or units, of work being tested and/or observed and documented
- Locations where tests and samples were taken or reference to specific observation logs and/or test data sheets where such information can be found

- A summary of field/laboratory test results or reference to specific observation logs and/or test data sheets
- Calibrations or recalibration of test equipment and actions taken as a result of recalibration or reference to specific observation logs and/or test data sheets
- Off-site materials received, including quality verification documentation
- Decisions made regarding acceptance of units of work and/or corrective actions to be taken in instances of substandard quality
- The QAT representative's signature

6.1.2 Observation Logs and Test Data Sheets

The QAT's monitoring staff will record observations of construction and QA-related activities on project-specific logs and data sheets. At a minimum, the logs and data sheets will include the following information:

- An identifying sheet numbered for cross-referencing and document control
- Date, project name, location, and other identification
- Description or title of activity monitored
- Data on weather conditions
- Location of activity and locations of samples collected
- Descriptions and locations of ongoing construction
- Equipment used
- Locations of field tests performed and their results
- Results of laboratory tests received
- Results of monitoring activity in comparison to the Technical Specifications

6.1.3 Construction Problem and Solution Report

Reports describing special construction situations will be prepared by the QAT and cross-referenced to specific observation logs and test data sheets. These reports will include the following information:

- An identifying sheet number for cross-referencing and document control
- A detailed description of the situation or deficiency
- The location and probable cause of the situation or deficiency
- How and when the situation or deficiency was found or located
- Documentation of the response to the situation or deficiency
- Final results of any responses
- Any measures taken to prevent a similar situation from occurring in the future

- The signature of the DSR

The DSR will be notified of any recurring non-conformance with Technical Specifications. The DSR will then determine the cause of the non-conformance and recommend appropriate changes in procedures or Technical Specifications. When this type of evaluation is made, the results will be documented, and any revision to procedures or Technical Specifications will be approved by DuPont, the Design Engineer, and DNREC, as applicable.

6.1.4 Photographic Reporting Data Sheets

Documentation of the cap construction will be obtained through photographs. These photographs will serve as a pictorial record of work progress, problems, and mitigation activities. The basic file will contain a set of digital photographs stored in a separate file in chronological order. Construction photographs will be labeled with the project name, date of exposure, name of photographer, and a description of the photograph.

6.1.5 Design and Technical Specifications Changes

Design and/or Technical Specifications changes may be required during construction. In such cases, the QAT will notify the DSR who will subsequently notify the CRG. Design and/or Technical Specifications changes will be made only with the written agreement of the DSR, DuPont, or the Design Engineer and will take the form of an addendum to the Technical Specifications. All proposed major changes will be reviewed with a DNREC representative prior to implementation.

6.2 Reports

The QAT will prepare periodic reports that summarize construction activities and the results of observations and tests. Progress reports will be prepared at regular time intervals to document the status of the work, as required by the DSR. At the completion of the work, final documentation will be prepared and will include a Delaware Professional Engineer's seal and supporting field and laboratory test results.

6.2.1 Progress Reports

The QAT will prepare a progress report at time intervals established at the pre-construction meeting and submit it to the DSR. As a minimum, this report will include the following information:

- A unique identifying sheet number for cross-referencing and document control
- The data, project name, location, and other information
- A summary of work activities during progress reporting period
- A summary of construction situations, deficiencies, and/or defects occurring during the progress reporting period
- A summary of corrective actions

- A summary of test results, failures, and retests
- The signature of the QAT's representative

The DSR may distribute copies of the Progress Reports to the CRG, the regulatory agencies, and the Contractor upon request or as described at the pre-construction meeting.

6.2.2 Final Documentation

At the completion of the work, the QAT will prepare a final report that, at a minimum, will include the following:

- Summaries of all construction activities
- Observation logs and test data sheets, including sample location plans and supporting field and laboratory test results
- QA/QC testing data
- Changes from design and material Technical Specifications
- Contract Drawings
- A summary statement sealed and signed by a Professional Engineer registered in the State of Delaware

The Contract Drawings will include scale drawings depicting the location of the construction and details pertaining to the extent of construction (e.g., depths, plan dimensions, elevations, soil component thickness, etc.). The Contract Drawings will incorporate the Contractor's as-built drawings. Surveying and base maps required for development of the as-built drawings will be performed by the Contractor’s land surveyor.

Final documentation submitted to the DSR, as part of the CQA Plan documentation, does not sanction the CQA Plan as a guarantee of facility construction and performance. Rather, the primary purpose of the final documentation is to improve confidence in the constructed facility through written evidence that the CQA Plan was implemented as proposed and that the construction proceeded in accordance with design intent, criteria, Contract Drawings, and Technical Specifications.

6.3 Storage of Records

During construction, all handwritten data sheet originals, especially those containing signatures, will be stored at the QAT office with a copy stored on-site. Other reports may be stored by any standard method that will allow for easy access.

Tables

TABLE 1
QUALITY ASSURANCE
SUMMARY TABLE OF SOIL AND GEOSYNTHETICS TESTING

COMPONENT	REQUIRED TEST	MINIMUM QA FREQUENCY [MINIMUM QC FREQUENCY]	ACCEPTANCE CRITERIA
Cover Soil	Moisture Content (ASTM D 2216)	1 per 10 QC Tests [Advance Test: 1 per material]	N/A
	Laboratory Classification (ASTM D 2487)	1 per 10 QC Tests [Advance Test: 1 per material]	Soil classification CL, SC, or GC
	Visual Field Classification (ASTM D 2488)	1 per 10 QC Tests [Constr Test: 1 per 400 ft centers per lift]	Maximum particle size of 1 inch
	Sieve Analysis (ASTM D 422)	1 per 10 QC Tests [Advance Test: 1 per material]	Maximum particle size of 1 inch
	Lift Depth Check by Hand-Auger Boring or Other Manual Method	Visual Monitoring of QC Tests [Constr Test: 1 per 400 ft centers per lift]	$\geq$18 inches in depth (compacted)
	Liquid Limit, Plastic Limit, Plasticity Index (ASTM D 4318)	1 per 10 QC Tests [Advance Test: 1 per material]	N/A
	Grade Verification	Visual Monitoring of QC Tests [Vertical elevations on a 50-foot grid and at all slope changes]	± 0.1 feet

TABLE 1
QUALITY ASSURANCE
SUMMARY TABLE OF SOIL AND GEOSYNTHETICS TESTING
(Continued)

COMPONENT	REQUIRED TEST	MINIMUM QA FREQUENCY [MINIMUM QC FREQUENCY]	ACCEPTANCE CRITERIA
Topsoil	Laboratory Classification (ASTM D 2487)	1 per 10 QC Tests [Advance Test: 1 every 5,000 cy]	Soil classification SW, SP, SC, ML, CL, CH, and SM
	Visual Field Classification (ASTM D 2488)	1 per 10 QC Tests [Constr Test: 1 every 5,000 cy]	Maximum particle size of 3 inches
	Sieve Analysis (ASTM D 422)	1 per 10 QC Tests [Advance Test: 1 every 5,000 cy Constr Test: 1 every 5,000 cy]	100% passing 3-inch sieve, a minimum of 90% passing 1-inch sieve, a minimum of 70% passing No. 10 sieve, and a maximum of 40% passing No. 200 sieve
	Lift Depth Check by Hand-Auger Boring or Other Manual Method	Visual Monitoring of QC Tests [Constr Test: 1 per 200 ft centers per lift]	Minimum 6 inches in depth (compacted)
	Liquid Limit, Plastic Limit, Plasticity Index (ASTM D 4318)	1 per 10 QC Tests [Advance Test: 1 every 5,000 cy Constr Test: 1 every 5,000 cy]	N/A

TABLE 1
QUALITY ASSURANCE
SUMMARY TABLE OF SOIL AND GEOSYNTHETICS TESTING
(Continued)

COMPONENT	REQUIRED TEST	MINIMUM QA FREQUENCY [MINIMUM QC FREQUENCY]	ACCEPTANCE CRITERIA
	Organic Content (ASTM D 2974)	1 per 10 QC Tests [Advance Test: 1 every 5,000 cy Constr Test: 1 every 5,000 cy]	3%<org. content<20%
	pH	1 per 10 QC Tests [Advance Test: 1 every 5,000 cy Constr Test: 1 every 5,000 cy]	6.0<pH<7.5
Roadway Aggregate	Aggregate Gradation (ASTM C 136 and ASTM D 422)	1 per Source [Advance Test: 1 per Source Constr Test: 1 every 1,000 sy]	100% passing 1” sieve, 50-90% passing ¾” sieve, 20-50% passing No.4 sieve, 15-40% passing No. 10 sieve, and 2-20% passing No. 100 sieve
	Wear (LA Abrasion) Test (ASTM C 131)	1 per Source [Advance Test: 1 per Source]	Per DelDOT Specifications
	Soundness (ASTM C 88)	1 per Source [Advance Test: 1 per Source]	Per DelDOT Specifications

TABLE 1
QUALITY ASSURANCE
SUMMARY TABLE OF SOIL AND GEOSYNTHETICS TESTING
(Continued)

COMPONENT	REQUIRED TEST	MINIMUM QA FREQUENCY [MINIMUM QC FREQUENCY]	ACCEPTANCE CRITERIA
LDPE Geomembrane			
	Thickness (ASTM D 5199)	1 per 200,000 sf [1 per 50,000 sf]	40 mil (nominal) 36 mil (minimum)
	Sheet Density, maximum (ASTM D 1505)	1 per 200,000 sf [1 per 50,000 sf]	.939 g/cm^3
	Tensile, minimum (ASTM D 638)	1 per 200,000 sf [1 per 50,000 sf]	
	Yield Strength at Break		122 lbs./in.
	Elongation at Break		800 %
	Tear Resistance, minimum (ASTM D 1004, Die C)	1 per job [3 per job]	15 lbs.
	Puncture Resistance (ASTM D 4833)	1 per job [3 per job]	38 lbs.

TABLE 1
QUALITY ASSURANCE
SUMMARY TABLE OF SOIL AND GEOSYNTHETICS TESTING
(Continued)

COMPONENT	REQUIRED TEST	MINIMUM QA FREQUENCY [MINIMUM QC FREQUENCY]	ACCEPTANCE CRITERIA
LDPE Geomembrane			
	DESTRUCTIVE TESTING OF WELDED FIELD SEAMS		
	Shear Test, minimum (ASTM D 4437)	1 every QC Test [1 every 500 LF (on average) *]	53 lbs./in. or 12-inch elongation
	Peel Test, minimum (ASTM D 4437)	1 every QC Test [1 every 500 LF (on average) *]	44 lbs./in. and Film Tear Bond (FTB)

Test Seams shall meet the destructive seam strength requirements in three out of three replicate test specimens, per Section: Geomembrane.

* QC Frequency may be decreased per specifications if Contractor demonstrates successive acceptable nondestructive and destructive testing during the course of the job.

TABLE 1
QUALITY ASSURANCE
SUMMARY TABLE OF SOIL AND GEOSYNTHETICS TESTING
(Continued)

COMPONENT	REQUIRED TEST	MINIMUM QA FREQUENCY [MINIMUM QC FREQUENCY]	ACCEPTANCE CRITERIA
LDPE Geomembrane			
	NON-DESTRUCTIVE TESTING OF WELDED FIELD SEAMS[(a)]	Visual Monitoring of QC Testing [Every linear feet of seam]	
	Air-Pressure		For 40-mil LDPE, a 3 psi pressure differential is acceptable after pressuring the seam with 27 to 30 psi for 5 minutes.
	Vacuum		Examine the 40-mil LDPE for 15 seconds through the window of the vacuum box. If no bubbles appear the seam is acceptable.

Note: [(a)] Air pressure test is to be used for dual-track fusion welded seams. Vacuum testing is to be used for extrusion welded seams.

TABLE 1
QUALITY ASSURANCE
SUMMARY TABLE OF SOIL AND GEOSYNTHETICS TESTING
(Continued)

COMPONENT	REQUIRED TEST	MINIMUM QA FREQUENCY [MINIMUM QC FREQUENCY]	ACCEPTANCE CRITERIA
HDPE Geomembrane			
	Thickness (ASTM D 5199)	1 per 200,000 sf [1 per 50,000 sf]	60 mil (nominal) 54 mil (minimum)
	Sheet Density, maximum (ASTM D 1505)	1 per 200,000 sf [1 per 50,000 sf]	.940 g/cm^3
	Tensile, minimum (ASTM D 638)	1 per 200,000 sf [1 per 50,000 sf]	
	Yield Strength at Break		228 lbs./in.
	Elongation at Break		700 %
	Tear Resistance, minimum (ASTM D 1004, Die C)	1 per job [3 per job]	42 lbs.
	Puncture Resistance (ASTM D 4833)	1 per job [3 per job]	108 lbs.

TABLE 1
QUALITY ASSURANCE
SUMMARY TABLE OF SOIL AND GEOSYNTHETICS TESTING
(Continued)

COMPONENT	REQUIRED TEST	MINIMUM QA FREQUENCY [MINIMUM QC FREQUENCY]	ACCEPTANCE CRITERIA
HDPE Geomembrane			
	DESTRUCTIVE TESTING OF WELDED FIELD SEAMS		
	Shear Test, minimum (ASTM D 4437)	1 every QC Test [1 every 500 LF (on average) *]	120 lbs./in.
	Peel Test, minimum (ASTM D 4437)	1 every QC Test [1 every 500 LF (on average) *]	78 lbs./in. and Film Tear Bond (FTB)

Test Seams shall meet the destructive seam strength requirements in three out of three replicate test specimens, per Section: Geomembrane.

* QC Frequency may be decreased per specifications if Contractor demonstrates successive acceptable nondestructive and destructive testing during the course of the job.

TABLE 1
QUALITY ASSURANCE
SUMMARY TABLE OF SOIL AND GEOSYNTHETICS TESTING
(Continued)

COMPONENT	REQUIRED TEST	MINIMUM QA FREQUENCY [MINIMUM QC FREQUENCY]	ACCEPTANCE CRITERIA
HDPE Geomembrane			
	NON-DESTRUCTIVE TESTING OF WELDED FIELD SEAMS[(a)]	Visual Monitoring of QC Testing [Every linear feet of seam]	
	Air-Pressure		For 60-mil HDPE, a 3 psi pressure differential is acceptable after pressuring the seam with 27 to 30 psi for 5 minutes.
	Vacuum		Examine the 60-mil HDPE for 15 seconds through the window of the vacuum box. If no bubbles appear the seam is acceptable.

Note: [(a)] Air pressure test is to be used for dual-track fusion welded seams. Vacuum testing is to be used for extrusion welded seams.

TABLE 1
QUALITY ASSURANCE
SUMMARY TABLE OF SOIL AND GEOSYNTHETICS TESTING
(Continued)

COMPONENT	REQUIRED TEST	MINIMUM QA FREQUENCY [MINIMUM QC FREQUENCY]	ACCEPTANCE CRITERIA
Geotextiles			
	Apparent Opening Size, minimum (ASTM D 4751)	1 per 500,000 sf [1 per 50,000 sf]	U.S. Std. sieve No. 60 (min.) and sieve No. 100 (max.)
	Grab Strength, minimum (ASTM D 4632)	1 per 500,000 sf [1 per 50,000 sf]	200 lbs.
	Puncture Strength, minimum (ASTM D 4833)	1 per 500,000 sf [1 per 50,000 sf]	126 lbs.
	Trapezoidal Tear Strength, minimum (ASTM D 4533)	1 per 500,000 sf [1 per 50,000 sf]	80 lbs.
	Burst Strength, minimum (ASTM D 3786)	1 per 500,000 sf [1 per 50,000 sf]	250 psi
	Permittivity, minimum (ASTM D 4491)	1 per 500,000 sf [1 per 50,000 sf]	0.6 sec^{-1}
	Ultraviolet Light Resistance (ASTM D 4355)	By Manufacturer [By Manufacturer]	70% Strength Retained after 150 hours

TABLE 1
QUALITY ASSURANCE
SUMMARY TABLE OF SOIL AND GEOSYNTHETICS TESTING
(Continued)

COMPONENT	REQUIRED TEST	MINIMUM QA FREQUENCY [MINIMUM QC FREQUENCY]	ACCEPTANCE CRITERIA
Geocomposite	Transmissivity, minimum (ASTM D 4716)	1 per 300,000 [1 per 50,000 sf]	1.7×10^{-4} m^2/sec
	Permittivity, minimum (ASTM D 4491)	1 per 300,000 [1 per 50,000 sf]	0.6 sec^{-1}
	Ply Adhesion (ASTM D 413)	1 per 300,000 [1 per 50,000 sf]	2.0 lbs./in.

Appendix E

Operation and Maintenance Plan

Operations and Maintenance Plan DuPont Hay Road Sludge Drying Site (DE-0024)

Date: December 2009 Project No.: 18985726.9001D

URS Corporation
Iron Hill Corporate Center
4051 Ogletown Rd, Suite 300
Newark, DE 19713

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Table 1 DuPont Hay Road Sludge Drying Site Capping System Post-Closure Site Inspection Checklist

1.0 Scope and Purpose of Plan

As part of the remedial design plan for the E.I. du Pont de Nemours and Company (DuPont) Hay Road Sludge Drying Site, this Operations and Maintenance (O&M) Plan was developed for implementation following final closure activities. The procedures used to develop this O&M Plan are consistent with Delaware's Hazardous Substances Control Act Guidance Document.

This O&M Plan provides a comprehensive discussion of the necessary site monitoring, routine maintenance, emergency contingencies, personnel, record keeping, and reporting associated with a 30-year post-closure care period. This O&M Plan is a "living" document that may be revised with agency approval to reflect repairs and modifications made to the completed work throughout the life of the site. This plan will be incorporated into the Hay Road site-wide O&M program.

The components of the site remedial design described in Section 3.0 that will require a regular long-term maintenance program are the cap system and surface-water control system. Regular site inspections and routine (scheduled) maintenance plans for these features are also described in Section 4.0.

2.0 Site Description and History

2.1 Hay Road Property Location and Description

DuPont owns 108 acres of property (Hay Road property) on Cherry Island in Wilmington, Delaware. The closed Hay Road Landfill, formerly known as the Cherry Island Landfill, occupies approximately 30 acres of the Hay Road property. The Sludge Drying Site occupies approximately 23 acres of the Hay Road property. Undeveloped, unused land comprises the remaining 55 acres.

The Sludge Drying Site is bordered by Shellpot Creek to the north, the Delaware River to the east, the 12th Street Extension to the south, and the closed Hay Road Landfill to the west. The DuPont Edge Moor Plant (Plant) is located 1 mile north of the Hay Road Property.

2.2 Hay Road Property Operational History

DuPont purchased the 108-acre Hay Road property from the American Dredge Company in 1956. Prior to being purchased by DuPont, the property was used by the United States Army Corps of Engineers (USACE) for placement of dredge material originating from the Delaware and Christina Rivers. From 1958 to 1996, DuPont operated an industrial solid waste landfill (the Hay Road Landfill) for the disposal of industrial solid wastes generated by the Plant. Closure of the Hay Road Landfill was completed under DNREC Permit SW-93/01 between 1993 and 1996 and approved by DNREC in 1997. Post-closure care and monitoring of the closed landfill is currently conducted under DNREC Post-Closure Permit SW-93/01. Drainage from the site is currently permitted under the Post-Closure Permit SW-93/01.

Adjacent to the closed landfill is a 23-acre parcel of land known as the Hay Road Sludge Drying Site (DE-0024). Beginning in the early 1980s and continuing through 1996, waste sludge from the Plant was placed within bermed drying beds to dewater the solids prior to stabilization and disposal in the adjacent landfill. Sludge drying activities ceased in 1996 when the solid waste landfill was closed. During the landfill closure, the sludge drying beds were cleaned out, and the excavated, dewatered solids were stabilized and placed in the landfill for final disposal.

Beginning in 1997 and continuing to mid-2001, the Plant generated approximately 500,000 tons of Iron Rich Material, which was transported as a saleable product and staged at the Sludge Drying Site in preparation for sale as a soil substitute. In mid-2001, DuPont discontinued marketing the product and ceased sending materials to the Sludge Drying Site.

DNREC published an approved Final Plan of Remedial Action on January 16, 2009 under Secretary's Order No. 2009-A-0005 to implement a cap-in-place remedy for the Sludge Drying Site. Additional site history is discussed in the *Remedial Design Report* for the Hay Road Sludge Drying Site (DE-0024) (DuPont, 2009).

3.0 Cap System Components

The Staged Iron Rich Material (Staged IRM) cap system consists of a geosynthetic capping system. The cap consists of the following components (from top to bottom):

- A 6-inch vegetative soil layer
- A 12-inch cover soil layer
- A geocomposite drainage layer
- A 40-mil LDPE geomembrane
- A 10-ounce/square yard non-woven geotextile
- Regraded Staged IRM

The geotextile cushion layer provides a barrier between the subgrade materials and the geomembrane component of the capping system. The geomembrane serves as the low permeability layer while the geosynthetic drainage composite provides a smooth drainage path to divert stormwater away from the geomembrane. The soil cover layer provides protection to the capping system geosynthetics with the vegetative cover soil layer providing slope protection from erosion.

4.0 Site Maintenance

4.1 General Maintenance

Site maintenance covers the routine inspection and upkeep of all major site components during a 30-year post-closure care period. DuPont will perform routine inspections according to the following schedule guideline:

- Weekly prior to vegetation establishment
- Monthly for two growing seasons (April through November) following vegetation establishment
- Semi-annually/quarterly based on the general condition of site features and maintenance history
- Immediately following rainfall events in excess of 1 inch in 24 hours

All records (i.e., inspection reports and maintenance repair summaries) will be submitted to the DNREC Site Investigation and Restoration Branch (SIRB) as discussed in Section 6.0.

DuPont or an authorized representative will perform the following maintenance activities:

- Cutting the vegetation on the final cover and in ditches and swales, shall be performed as follows:
  - First Growing Season: The vegetated area will be mowed once to reduce annual weed invasion.
  - Second and Subsequent Growing Seasons: The vegetated areas will be mowed on a 3-year rotational cycle during the February to March period to allow the grasses to go to seed and avoid the wildlife nesting period. Rotational mowing divides an area into strips, one-third of which are mowed each year. This schedule ensures that one-, two-, and three-year-old growth will be available at all times, which provides slightly different wildlife habitat in each strip.
- Fertilizing and reseeding areas where insufficient growth has been established. When routine inspections indicate areas where sufficient vegetative cover has not been established, those areas will be reseeded as per the original Technical Specifications.
- Drainage swales shall be maintained to minimize the accumulation of debris within the channel. Failure to maintain swales may result in scouring, clogging, and/or breaching of the swale channel.

4.2 Maintenance and Repair of the Cap System

The cap system is a multilayer system consisting of natural and synthetic materials. Careful routine inspections will be necessary to assess the condition of the underlying layers.

Any signs of erosion, settlement cracking, or other site maintenance problems identified during site inspections will be corrected as soon as possible. A qualified reviewer shall perform the following:

- Determine the nature and extent of the problem.
- Identify the cause of the problem.
- Determine the remedial measures necessary to repair the problem.
- Schedule repair.
- Observe and document repair.

4.2.1 Erosion Rills

All erosion will be filled, restoring the cap system to the original lines as shown on the project design documents. All materials shall conform and be installed as per the original project design documents. All repaired erosion shall be seeded and fertilized in a manner that will enable vegetative growth in a reasonable time period.

4.2.2 Settlement

A qualified reviewer will evaluate on a case-by-case basis repairs due to settlement subsidence. Where subsidence is evident enough to allow ponding of surface water or concentrated flows, the area will be repaired by placing additional vegetative cover soil (topsoil) to lines and grades, allowing for positive drainage. Materials and methods used to place such material shall adhere to the project design documents.

4.2.3 Geosynthetic Component (Geotextile, Geomembrane, and Geocomposite) Repairs

Repair to damaged geosynthetics will first require the damaged area to carefully be exposed to reveal the entire extent of the damage. The geosynthetic materials will be cleaned a minimum of 3 feet in each direction beyond the damaged area, allowing ample room for repairs.

Each component will be evaluated for the necessary repairs to be made. All repair materials, workmanship, and quality control will be as described in the original project design documents for each of the geosynthetic components.

Following successful repair and inspection of the repairs to the geosynthetics, the soil cover and vegetative support layer (topsoil) shall be replaced using the approved materials and methods indicated in the design documents. The area will then be fertilized and seeded to enable vegetative growth in a reasonable time period.

4.2.4 Vermin Control

The cap system will be inspected for burrows during the prescribed inspections. Damage caused by burrowing animals will be repaired by filling the hole with approved soil material, regrading the surface, and restoring the vegetative cover. The depth of the burrow will be evaluated prior to repair to determine if the underlying geosynthetic materials have been impacted. If necessary, removal of burrowing animals may be accomplished using a licensed pest removal contractor.

4.3 Maintenance to Erosion Control and Drainage Structures

All erosion control structures, such as perimeter channels and outlets, are included in the maintenance work. Each structure will be inspected for irregularities such as displaced channel protection (rip-rap), eroded areas, sediment build-up, or scouring and settlement.

Periodic cleaning and removal of sediment and debris from the drainage structures may be required, especially during the initial stages of the site vegetative support layer development. Continuous impact to the structures will be evaluated to determine if additional measures, such as energy dissipaters or larger rip-rap slope protection, are needed.

4.4 Reuse of Cap Materials

Materials removed during remedial repair measures may be reused providing the materials have not been impacted or altered. It is anticipated that soil material may be reused provided it is not impacted with other material. Any materials that cannot be reused will be removed from the site and disposed of at a DuPont-approved facility.

5.0 Environmental Monitoring

Based on discussions with DuPont and DNREC, it is currently anticipated that the groundwater monitoring wells (MW-71, 72, and 73) installed during the Supplemental Investigation will be incorporated into the monitoring requirements of the existing Post-Closure Permit for the Hay Road Landfill Closed Cells 1, 2, and 3 (SW-93/01, last modified July 25, 2008) in accordance with the requirements in the Voluntary Cleanup Program Scope of Work.

6.0 Recordkeeping

DuPont will maintain all maintenance and monitoring records throughout the post-closure period at the DuPont Edge Moor Plant. A site inspection checklist is included as Table 1. A copy of the site plan will be included with the site inspection checklist to document locations of any problem areas requiring maintenance.

The inspection observations and maintenance performed to mitigate any deficiencies will be summarized and incorporated into the semi-annual and annual reporting requirements for the Hay Road Landfill submitted to DNREC SIRB.

7.0 Personnel

It is anticipated that DuPont will subcontract all routine and corrective maintenance work to qualified, approved DuPont subcontractors. All contractors will have experience with maintenance of multi-layered capping systems.

7.1 Health and Safety

All DuPont employees and subcontractors are given site-specific training regarding emergency procedures, on the job safety, and hazard communication (right to know). All monitoring and maintenance activities will be reviewed for potential safety hazards prior to field mobilization.

8.0 References

DNREC. 2004. *Proposed Plan of Remedial Action, Hay Street Sludge Drying Site/Cherry Island Landfill – Iron Rich Staging Area, Wilmington, Delaware*. DNREC Project No. DE-0024.

DuPont. 2009. *Remedial Design Report.* Hay Road Sludge Drying Site (DE-0024), Wilmington, Delaware. December.

DuPont. 2008. *Remedial Investigation and Risk Assessment Report Addendum.* December 8.

DuPont. 2007. *Supplemental Investigation Work Plan, Hay Road Sludge Drying Site (DE-0024), DuPont Edge Moor Plant, Edgemoor, Delaware*. August.

DuPont. 2004a. *Final Remedial Investigation/Risk Assessment Report, Cherry Island Landfill—Iron Rich Staging Area/Hay Street Sludge Drying Site (DE-024), Wilmington, Delaware.* May 14.

DuPont. 2004b. *Focused Feasibility Study, Cherry Island Landfill—Iron Rich Staging Area/Hay Street Sludge Drying Site (DE-024), Wilmington, Delaware.* June 18.

Tables

Table 1
DuPont Hay Road Sludge Drying Site Capping System
Post-Closure Site Inspection Checklist

Item	Maintenance Required	Location	Maintenance Performed	Remarks
Access Roads				
Drainage Swales				
Outfall Structures				
Rip-Rap Protection				
Cap System Vegetative Cover Erosion				
Cap System Geosynthetics				
Cap System Slopes (Stability)				
Cap System Subsidence				
Fencing and Gates				

Comments:

Inspected by:_____ Date:_____

Appendix F

Contingency Plan

Contingency Plan for DuPont Hay Road Sludge Drying Site (DE-0024) Wilmington, Delaware

Date: December 2009 Project No.: 18985726.9001D

URS Corporation
Iron Hill Corporate Center
4051 Ogletown Rd, Suite 300
Newark, DE 19713

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Table 1 Emergency Response Contacts

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Figure 1 Site Location Map
Figure 2 Site Layout

1.0 Introduction

1.1 Purpose and Implementation of the Contingency Plan

This Contingency Plan (Plan) describes the safety and emergency response procedures that are to be followed at the E.I. du Pont de Nemours and Company (DuPont) Hay Road Sludge Drying Site (DE-0024) in Wilmington, Delaware. The Plan has been prepared as required by the State of Delaware's Department of Natural Resources and Environmental Control (DNREC) Regulations Governing Hazardous Substance Cleanup dated September 1996.

The Plan is designed to minimize hazards to human health or the environment from fires, explosions, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface water. The provisions of the Plan must be carried out immediately whenever there is a fire, explosion, or release of hazardous waste or hazardous waste constituents that could threaten human health or the environment.

The information in the Plan is to be used by the personnel who will oversee and provide implementation of the remedial action, operations and maintenance (O&M) services, and the emergency response personnel who may be called to the site in the event of an emergency.

1.2 Amendment of the Contingency Plan

The Plan must be reviewed and immediately amended, if necessary, whenever:

- The facility permit is revised
- The Plan fails in an emergency
- The facility changes in its design, construction, operation, maintenance, or other circumstances in a way that materially increases the potential for fires, explosions, or releases of hazardous waste or hazardous waste constituents or changes the response necessary in an emergency
- The list of emergency coordinators changes
- The list of emergency equipment changes

1.3 Site Description

DuPont owns 108 acres of property (Hay Road property) on Cherry Island in Wilmington, Delaware, as shown in Figure 1. The closed Hay Road Landfill, formerly known as the Cherry Island Landfill, occupies approximately 30 acres of the Hay Road property. The Sludge Drying Site occupies approximately 23 acres of the Hay Road property, as shown in Figure 2. Undeveloped, unused land comprises the remaining 55 acres.

The Sludge Drying Site is bordered by Shellpot Creek to the north, the Delaware River to the east, the 12th Street Extension to the south, and the closed Hay Road Landfill to the west. The DuPont Edge Moor Plant (Plant) is located one mile north of the Hay Road Property.

1.4 Site History

DuPont purchased the 108-acre Hay Road property from the American Dredge Company in 1956. Prior to being purchased by DuPont, the property was used by the United States Army Corps of Engineers (USACE) for placement of dredge material originating from the Delaware and Christina Rivers. From 1958 to 1996, DuPont operated an industrial solid waste landfill (the Hay Road Landfill) for the disposal of industrial solid wastes generated by the Plant. Closure of the Hay Road Landfill was completed under DNREC Permit SW-93/01 between 1993 and 1996 and approved by DNREC in 1997. Post-closure care and monitoring of the closed landfill is currently conducted under DNREC Post-Closure Permit SW-93/01. Drainage from the site is currently permitted under the Post-Closure Permit SW-93/01.

Adjacent to the closed landfill is a 23-acre parcel of land known as the Hay Road Sludge Drying Site (DE-0024). Beginning in the early 1980s and continuing through 1996, waste sludge from the Plant was placed within bermed drying beds to dewater the solids prior to stabilization and disposal in the adjacent landfill. Sludge drying activities ceased in 1996 when the solid waste landfill was closed. During the landfill closure, the sludge drying beds were cleaned out, and the excavated, dewatered solids were stabilized and placed in the landfill for final disposal.

Beginning in 1997 and continuing to mid-2001, the Plant generated approximately 500,000 tons of Iron Rich Material, which was transported as a saleable product and staged at the Sludge Drying Site in preparation for sale as a soil substitute. In mid-2001, DuPont discontinued marketing the product and ceased sending materials to the Sludge Drying Site.

DNREC published an approved Final Plan of Remedial Action on January 16, 2009 under Secretary’s Order No. 2009-A-0005 to implement a cap-in-place remedy for the Sludge Drying Site. Additional site history is discussed in the *Remedial Design Report* for the Hay Road Sludge Drying Site (DE-0024) (DuPont, 2009).

2.0 Emergency Coordinator

At least one employee designated as the Emergency Coordinator will be on the premises or on call at all times. This person will be available to respond to an emergency by reaching the facility within a short period of time. The Emergency Coordinator will have the responsibility for coordinating all emergency response measures with the DuPont Edge Moor Plant Security Department and the plant's designated Emergency Coordinator.

The Emergency Coordinator will be thoroughly familiar with all aspects of this Plan, all operations and activities at the Hay Road Sludge Drying Site, the location and characteristics of waste handled at the facility, the location of all records within the facility, and the facility layout. In addition, the designated person will have the authority to commit the resources needed to carry out the Plan.

A list containing the emergency contact information of the designated Hay Road Sludge Drying Site Emergency Coordinator and other facility contacts is provided in Table 1. This table will be revised to include specific construction contact personnel prior to initiation of construction activities. This list will be updated as necessary, maintained at the Hay Road Sludge Drying Site field office during construction and at the DuPont Edge Moor Plant following construction completion, and submitted to all local emergency response teams that may be called upon to provide emergency services. DuPont will maintain additional facility records at the DuPont Edge Moor Plant following construction completion.

3.0 Emergency Procedures

Whenever there is an imminent or actual emergency situation, the Emergency Coordinator or their designee will immediately activate internal alarms or communication systems to notify all personnel and notify the appropriate state and local agencies with designated response roles, as necessary. Whenever there is a release, fire, or explosion, the Emergency Coordinator will immediately identify the character, source, amount, and extent of any released materials. This might be done by observation or review of records or manifests or by chemical analysis, if necessary. The Emergency Coordinator will concurrently assess possible hazards to human health or the environment, considering both the direct and indirect effects of the release, fire, or explosion.

If the Emergency Coordinator determines that the release, fire, or explosion threatens human health or the environment outside the facility, he or she will report the findings as follows:

- Notify appropriate local authorities if the assessment indicates that the evacuation of local areas may be advisable. The Emergency Coordinator will remain available to help the appropriate officials decide whether local areas should be evacuated.
- Immediately notify either the government official designated as the on-scene coordinator in the Plan or the National Response Center (800-424-8802) and DNREC (800-662-8802) or (302-739-5072). The report will include the following:
    - Name and telephone number of reporter
    - Name and address of facility
    - Time and type of incident (e.g., release, fire)
    - Name and quantity of material(s) involved, to the extent known
    - The extent of injuries, if any
    - The possible hazards to human health or the environment outside the facility

During an emergency, the Emergency Coordinator will take all reasonable measures necessary to ensure that fires, explosions, and releases do not occur, recur, or spread to other areas of the site. These measures will include, where applicable, stopping processes and operations, collecting and containing released waste, and removing or isolating containers.

If the operations stop in response to a fire, explosion, or release, the Emergency Coordinator will monitor for leaks, pressure build-up, gas generation, or ruptures in valves, pipes, or other equipment, wherever this is appropriate.

Immediately after an emergency, the Emergency Coordinator will provide for treating, storing, or disposing of recovered waste, contaminated soil or surface water, or any other material resulting from the release, fire, or explosion.

The Emergency Coordinator will ensure the following in the affected area(s) of the facility:

- Waste that may be incompatible with the released material is treated, stored, or disposed of until cleanup procedures are completed.
- All emergency equipment listed in the Plan is cleaned and fit for its intended use before operations are resumed.

DuPont will notify the DNREC Secretary and appropriate state and local authorities that the Hay Road Sludge Drying Site is in compliance with the previous paragraph before operations are resumed in the affected area(s) of the facility.

DuPont will note in the operating record the time, date, and details of any incident that requires implementing the Plan. Within 15 days after the incident, DuPont will submit a written report on the incident to the Secretary. The report will include the following:

- Name, address, and telephone number of the owner or operator
- Name, address, and telephone number of the facility
- Date, time, and type of incident (e.g., fire, explosion)
- Name and quantity of material(s) involved
- The extent of injuries, if any
- An assessment of actual or potential hazards to human health or the environment, where this is applicable
- Estimated quantity and disposition of recovered material that resulted from the incident

4.0 Local Emergency Response Agencies

In the event of an emergency, the Emergency Coordinator will contact the DuPont Edge Moor Plant Security Department at the main entrance guardhouse to initiate a response from local emergency response agencies. New Castle County, Delaware, operates an Emergency Communications Center (911 Center) for the centralized receipt of requests for emergency fire, medical, and police services and subsequent dispatch of these services. The DuPont Edge Moor Plant Security Department will be responsible for contacting the 911 Center, as well as initiating the appropriate response of plant emergency resources in accordance with the Plan. A list of the telephone numbers of the appropriate Emergency Response Contacts is presented in Table 1.

If the emergency incident escalates, the local emergency response agency's Incident Commander may request the initiation of the New Castle County Emergency Operations Plan or the Delaware Emergency Operations Plan through their agency's established procedures.

5.0 Emergency Equipment

During construction activities, the emergency equipment at the Hay Road Sludge Drying Site will include fire extinguishers, spill control equipment, communication and alarm systems, and decontamination equipment. During inspection and maintenance activities, emergency equipment appropriate to the task will be provided by the contractor or personnel performing the task.

A list of relevant on-site safety and emergency equipment and location will be developed and maintained by the Emergency Coordinator. The basic procedures for operating and using the safety and emergency equipment will be posted near the respective equipment. All equipment will be maintained in a ready state at all times. Basic first-aid procedures will be posted at strategic locations throughout the facility.

6.0 Evacuation Plan

It is not anticipated that evacuation of the Hay Road Sludge Drying Site will be necessary because the area does not contain hazardous materials and operations at the site will be limited to closure and post-closure care activities. However, a release, fire, or explosion at one of the industries surrounding the site could potentially require an evacuation of the site. All personnel working on-site will be trained on the evacuation plan.

If evacuation of the site becomes necessary, all personnel on-site will be notified via on-site radio communication or air horn alerting measures in accordance with the Health and Safety Plan for construction activities. Cell phone notification may also be used to alert small or remote crews during O&M activities. Upon notification of evacuation, all personnel will report to the primary rally spot at the Hay Road entrance gate for accountability and further direction. In the event that the primary rally spot is inaccessible or impacted by a release or fire, personnel will report to the secondary rally spot in the southeastern corner of the Hay Road Sludge Drying Site (near the intersection of the 12th Street Extension and the Delaware River).

If further evacuation is deemed necessary, all personnel will proceed from the rally spot to the main guardhouse at the DuPont Edge Moor Plant. The route of travel from the primary rally spot will be north along Hay Road to Edgemoor Road, turning right at Edgemoor Road into the plant entrance. The egress route from the secondary rally spot will be west along the 12th Street Extension, turning right on Hay Road, and following the route of travel from the primary rally spot.

If the primary egress route from either rally spot is impassable or blocked by a release or fire, the alternate egress route will be south on Hay Road, turning west on 12th Street to Interstate 495 North, exiting at the Edgemoor Road off-ramp, turning right at the off ramp (Edgemoor Road), and staying straight into the Plant entrance.

7.0 References

DuPont. 2009. *Remedial Design Report*. Hay Road Sludge Drying Site (DE-0024), Wilmington, Delaware. December.

DuPont. 2008. *Remedial Investigation and Risk Assessment Report Addendum*. Hay Road Sludge Drying Site (DE-24). Wilmington, DE. December 8.

DuPont. 2007. *Supplemental Investigation Work Plan, Hay Road Sludge Drying Site (DE-0024), DuPont Edge Moor Plant, Edgemoor, Delaware*. August.

DuPont. 2004a. *Final Remedial Investigation/Risk Assessment Report, Cherry Island Landfill—Iron Rich Staging Area/Hay Street Sludge Drying Site (DE-024), Wilmington, Delaware*. May 14.

DuPont. 2004b. *Focused Feasibility Study, Cherry Island Landfill—Iron Rich Staging Area/Hay Street Sludge Drying Site (DE-024), Wilmington, Delaware*. June 18.

DNREC. 2004. *Proposed Plan of Remedial Action, Hay Street Sludge Drying Site/Cherry Island Landfill – Iron Rich Staging Area, Wilmington, Delaware*. DNREC Project No. DE-0024.

DNREC. 2001. *Delaware Regulations Governing Hazardous Waste, Part 264, Subpart D – Contingency Plan and Emergency Procedures*. April.

DNREC. 1996. *Regulations Governing Hazardous Substance Cleanup*. September.

Tables

Table 1
Emergency Response Contacts
Contingency Plan for DuPont Hay Road Sludge Drying Site (DE-0024)
Wilmington, Delaware

Contact	Name	Number
Emergency Coordinator	Thomas S. Andersen	(302) 761-2298
Security		(302) 761-2218
Fire/Police/Ambulance		911
Plant Medical		(302) 761-2371
Hospital	Christiana Hospital 4755 Ogletown-Stanton Rd Newark, DE 19713	(302) 733-1000
Plant Environmental Manager	Thomas S. Andersen	(302) 761-2298
Environmental Release Contact	Thomas S. Andersen	(302) 761-2298
CRG Project Director	Michelle Thomson	(302) 999-6195
CRG Safety Manager	Mary Glowacki	(302) 999-2827
URS Project Manager	James Whitty	(215) 367-2607
URS Safety Manager	Kathryn A. Sova	(973) 492-7708

Figures

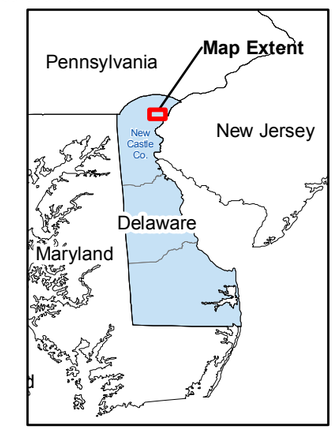
Legend

Iron Rich Material Footprint

Property Boundary

Topographic map source: 1993 Topographic map, Wilmington South USGS quadrangle, 7.5 Minute series provided by Delaware State, DRG and DLG Server Homepage, http://www.rdms.udel.edu/drgdlg/, downloaded 08/05/08

DuPont Property Boundary: New Castle County Tax Parcels, downloaded from the Delaware DataMIL (datamil.delaware.gov), retrieved 08/06/08



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Iron Hill Corporate Center
4051 Ogletown Road, Suite 300
Newark, DE 19713

Site Location Map
Contingency Plan
Hay Road Sludge Drying Site (DE-0024)
Wilmington, DE

Created: CA	DuPont Project Number: 508795
Date: 09/17/2009	URSD Project Number: 18985726.9001D
DQC: ND 12/03/2009	Figure Number: 1
File Name: S:\URS Barley Mill\Hay_Road\GIS\ContingencyPlan\Hay_Fig_1_SiteLocMap.mxd	

Legend

- Sea Wall
- Staged Iron Rich Material Footprint
- Property Boundary
- Sludge Drying Site

Notes:
All locations and boundaries are approximate, digitized in GIS from scanned images or CAD drawings georeferenced to DE State Plane NAD83 (ft) coordinate system or manually digitized using landmarks on hardcopy maps.

Staged Iron-Rich Material footprint digitized in GIS from georeferenced 2006 aerial provided by Delaware Solid Waste Authority.

Aerial photo source: 2008 aerial photo from Delaware Solid Waste Authority.

DuPont Property Boundary: New Castle County Tax Parcels, downloaded from the Delaware DataMIL (datamil.delaware.gov), retrieved 08/06/08

N
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0 50 100 200
Meters

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Newark, DE 19713

Site Map
Contingency Plan
Hay Road Sludge Drying Site (DE-0024)
Wilmington, DE

Created: ND	DuPont Project Number: 508795
Date: 09/17/2009	URSD Project Number: 18985726.9001D
DQC: ML 12/03/2009	Figure Number: 2

File Name: S:\URS Barley Mill\Hay_Road\GIS\ContingencyPlan\Hay_Fig_2_SiteMap.mxd

Appendix G

Cost Estimate and Schedule

Appendix G-1

Preliminary Annual O&M Cost Estimate

Appendix G-1
Operations and Maintenance Estimates
Hay Road Sludge Drying Site (DE-0024)
Remedial Design

Item Description	Unit	Quantity	Unit Cost	Item Cost
Year 1 Operation and Maintenance Cost				
Ground Water Monitoring	Annual	1	$10,720	$10,720
New GW Monitoring Well Installation/Development	LS	1	$8,000	$8,000
Weed Control/Mowing/Inspections/Reporting	LS	1	$10,925	$10,925
	Year 1 Subtotal			**$29,645**
Years 2 Through 30 Annual Operation and Maintenance Cost				
Ground Water Monitoring	Annual	1	$10,720	$10,720
Weed Control/Mowing/Inspections/Reporting	Annual	1	$6,500	$6,500
	Year 2 through 30 Annual Cost Subtotal			**$17,220**
Total Operation and Maintenance Cost				**$529,025**

Assumptions:

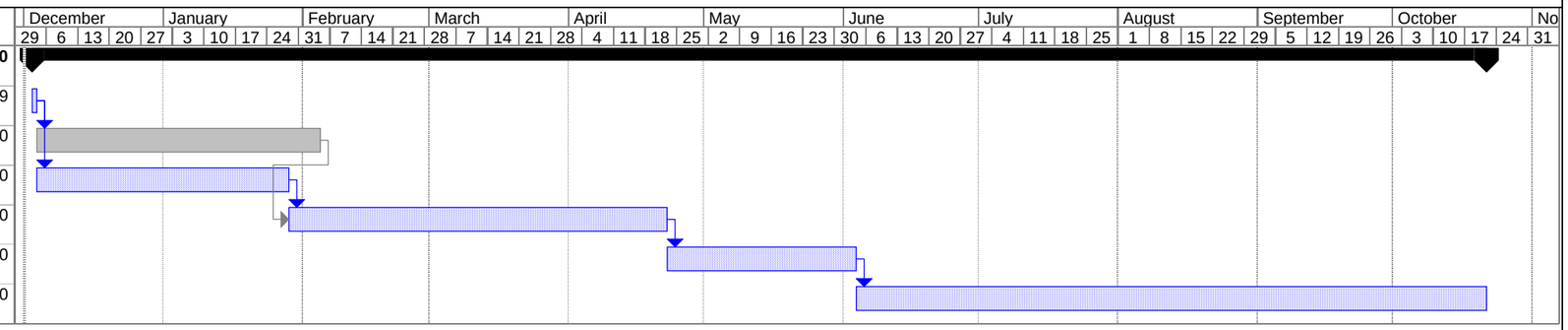
1. Based on DNREC Final Plan of Remedial Action dated January 16, 2009.
2. Reporting consists of forwarding electronic analytical results to DNREC once annually.

Appendix G-2

Project Schedule

Hay Road Landfill Sludge Drying Site (DE-0024)
Cap Construction Schedule
December 3, 2009

ID		Task Name	Duration	Start	Finish
1		**Hay Road SDS Cap Construction**	**231 days**	**Thu 12/3/09**	**Thu 10/21/10**
2		Submit Remedial Design to DNREC	1 day	Thu 12/3/09	Thu 12/3/09
3		DNREC Review and Approval	45 days	Fri 12/4/09	Thu 2/4/10
4		Bid Package Preparation	40 days	Fri 12/4/09	Thu 1/28/10
5		Bid Process	60 days	Fri 1/29/10	Thu 4/22/10
6		Construction Contract Prep/Execution	30 days	Fri 4/23/10	Thu 6/3/10
7		Cap Construction	100 days	Fri 6/4/10	Thu 10/21/10



Project: Hay Road1Sludge Drying Site
Date: Tue 12/1/09

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

Appendix H

Design Drawings
(Provided under Separate Cover)

THIS DRAWING DOES NOT INCLUDE NECESSARY COMPONENTS FOR CONSTRUCTION SAFETY. ALL CONSTRUCTION MUST BE DONE IN COMPLIANCE WITH THE CURRENT OCCUPATIONAL SAFETY AND HEALTH ACT AND ALL RULES AND REGULATIONS THERETO AND APPURTENANT.

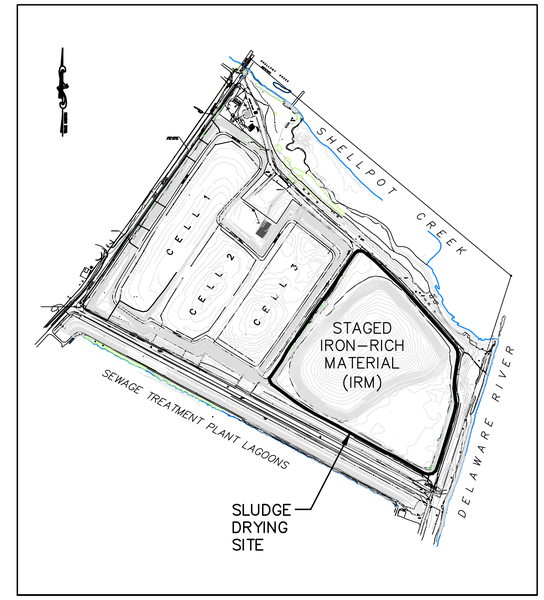
LOCATION MAP

SCALE
2500 0 2500'

REFERENCE:
USGS QUADRANGLE: WILMINGTON SOUTH, DE–NJ (1997)

LIST OF DRAWINGS

SHEET NUMBER	DRAWING TITLE
1	COVER SHEET
2	LEGEND AND NOTES
3	EXISTING CONDITIONS
4	EROSION AND SEDIMENT CONTROL PLAN
5	EROSION AND SEDIMENT CONTROL DETAILS (SHEET 1 OF 2)
6	EROSION AND SEDIMENT CONTROL DETAILS (SHEET 2 OF 2)
7	INTERMEDIATE GRADING PLAN
8	FINAL GRADING PLAN
9	CROSS SECTIONS
10	CAP SYSTEM DETAILS
11	DRAINAGE DITCH PROFILES



SITE MAP

SCALE
500 0 500

REFERENCE:
AERIAL PHOTOGRAPHY BY 3Di TAKEN ON 01/03/01. SITE CONTROL PROVIDED BY URS CORPORATION ON 01/03/01. INITIAL AS–BUILT SURVEY OF REGRADED IRON–RICH MATERIAL PROVIDED BY URS ON 1/28/03 AND 2/13/03.
ADDITIONAL AS–BUILT SURVEY OF SLUDGE DRYING SITE PERFORMED BY URS ON OCTOBER 5TH THROUGH 8TH 2004 AND MAY 27TH THROUGH JUNE 2ND 2009. SITE GPS COORDINATE CONTROL ESTABLISHED BY LAURENCE R. McBRIDE, INC. GLOBAL POSITIONING SYSTEM SURVEYOR.

DUPONT HAY ROAD
SLUDGE DRYING SITE (DE-0024)
WILMINGTON, DELAWARE

PREPARED FOR

DUPONT CORPORATE REMEDIATION GROUP

811 Know what's below. Call before you dig.

REV	DESCRIPTION OF REVISION	REVISED BY/DATE	CHECKED BY/DATE
2	ISSUED FOR BID	SCD 3-9-10	TOS 3-9-10
1	ISSUED FOR DNREC REVIEW	SCD 11-23-09	EEB 11-23-09

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

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Iron Hill Corporate Center
4051 Ogletown Road, Suite 300
Newark, DE 19713
Tel: 302.781.5900
Fax: 302.781.5901

APPROVED BY:

SCALE	AS NOTED
DESIGNED	EEB
DRAWN	SCD
CHECKED	CTC
DATE	8/7/09

COVER SHEET

DuPONT HAY ROAD
SLUDGE DRYING SITE
(DE–0024)

REVISION 0
PROJECT 18985726
DRAWING
SHEET 1

THIS DRAWING DOES NOT INCLUDE NECESSARY COMPONENTS FOR CONSTRUCTION SAFETY. ALL CONSTRUCTION MUST BE DONE IN COMPLIANCE WITH THE CURRENT OCCUPATIONAL SAFETY AND HEALTH ACT AND ALL RULES AND REGULATIONS THERETO AND APPURTENANT.

LEGEND

	PROPERTY LINE
x x	FENCE LINES
	CENTER LINE SWALE
20	MAJOR CONTOUR
19	MINOR CONTOUR
	PORTABLE WALL
	BRUSH LINE
	100-YEAR FLOODPLAIN
DIA.	DIAMETER
(TYP.)	TYPICAL
STA.	STATION
(N.T.S.)	NOT TO SCALE
OZ.	OUNCE
INV.	INVERT
L.F.	LINEAR FEET
D.I.P.	DUCTILE IRON PIPE
DI	DUCTILE IRON
W.S.E.	WATER SURFACE ELEVATION
	EDGE OF CAP
	PROPOSED RIP RAP
	EXISTING GRAVEL ROAD
	PROPOSED GRAVEL ROAD

SECTION 10 — SECTION NO.
10 | 11
DRAWING WHERE SECTION IS CUT
DRAWING WHERE SECTION IS SHOWN

SCD	STONE CHECK DAM
SCE	STABILIZED CONSTRUCTION ENTRANCE
SM-C	STABILIZATION MATTING – CHANNEL
SM-S	STABILIZATION MATTING – SLOPE
VC-T	VEGETATED CHANNEL – TRAP.
LOD	LIMIT OF DISTURBANCE
SF	SILT FENCE
	EXISTING SUPER SILT FENCE
SSF	RELOCATED SUPER SILT FENCE

GENERAL CONSTRUCTION SEQUENCE

1. THE CONTRACTOR SHALL HOLD A PRE–CONSTRUCTION MEETING WITH THE OWNER, ENGINEER AND APPROPRIATE AGENCIES AT LEAST ONE WEEK PRIOR TO STARTING CONSTRUCTION ACTIVITIES.
2. CONTRACTOR SHALL MARK THE LIMITS OF DISTURBANCE.
3. INSTALL PERIMETER EROSION AND SEDIMENT CONTROLS, AS SHOWN, DECONTAMINATION PAD AND STABILIZED CONSTRUCTION ENTRANCE. A PERIMETER INSPECTION BY DNREC SEDIMENT & STORMWATER PROGRAM REPRESENTATIVE AFTER INSTALLATION OF CONTROLS AND PRIOR TO THE START OF ANY FURTHER SITE DISTURBANCE. REPAIR OR RELOCATE EXISTING SUPER SILT FENCE AS NEEDED.
4. CLEAR SEDIMENT BASIN AREA.
5. CONSTRUCT SEDIMENT BASIN AS SHOWN ON THE PLANS AND DETAILS AND MAKE OUTLET STRUCTURE MODIFICATIONS.
6. CLEAR AND GRUB STAGED IRON–RICH MATERIAL.
7. ESTABLISH INTERMEDIATE GRADES FOR STAGED IRON–RICH MATERIAL.
8. INSTALL GEOSYNTHETIC COMPONENTS OF THE CAP SYSTEM. THE SUBGRADE MATERIAL MUST BE PROTECTED FROM DAMAGE AND REMAIN IN AN APPROVED CONDITION PRIOR TO PLACEMENT OF GEOSYNTHETICS. THE UPPER SIX INCHES OF SUBGRADE MATERIAL SHALL BE FREE OF ANGULAR MATERIAL AND/OR SHARP OBJECTS LARGER THAN 1 INCH IN DIAMETER. THE SUBGRADE SURFACE SHALL BE PROOF ROLLED SMOOTH PRIOR TO THE PLACEMENT OF GEOSYNTHETICS. AFTER GEOSYNTHETICS ARE DEPLOYED, THE CONTRACTOR SHALL PREVENT THE MIGRATION OF STORMWATER UNDER GEOSYNTHETIC COMPONENTS.
9. CONSTRUCT FINAL GRADES OF CAP SYSTEM INCLUDING THE CAP ACCESS ROAD. ANY BORROW MATERIAL OR VEGETATIVE COVER MUST BE STORED IN AREAS APPROVED BY THE DUPONT SITE REPRESENTATIVE.
10. CONSTRUCT AND PERMANENTLY STABILIZE ALL FINAL DITCHES AND THE CULVERTS.
11. STABILIZE ALL DISTURBED AREAS, SEED, AND MULCH.
12. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSPECTED WEEKLY AND AFTER RAINFALL EVENTS. ALL NEEDED REPAIRS SHALL BE MADE IMMEDIATELY.
13. ONCE THE CONTRIBUTING DRAINAGE AREA IS STABILIZED AND APPROVED BY THE OWNER AND DNREC, DEWATER THE SEDIMENT BASIN. REMOVE AND DISPOSE OF ANY SEDIMENT DEPOSITS AS DIRECTED BY DUPONT SITE REPRESENTATIVE. CONVERT OUTLET STRUCTURE FROM THE SEDIMENT BASIN TO PERMANENT STORMWATER DETENTION BASIN STRUCTURE. TOPSOIL, SEED & MULCH DISTURBED AREA.
14. REMOVE E&S CONTROL MEASURES WHEN ALL AREAS ARE STABILIZED AND WHEN FINAL APPROVAL HAS BEEN OBTAINED FROM THE OWNER AND DNREC.

TOPOGRAPHY REFERENCE

1. AERIAL PHOTOGRAPHY AND MAPPING OF AREA OUTSIDE STAGED IRON–RICH MATERIAL PROVIDED BY 3Di, LLC. FLOWN ON JANUARY 3, 2001.
2. INITIAL AS–BUILT SURVEY OF REGRADED STAGED IRON–RICH MATERIAL PROVIDED BY URS ON JANUARY 28, 2003 AND FEBRUARY 13, 2003. ADDITIONAL AS–BUILT SURVEY OF SLUDGE DRYING SITE PERFORMED BY URS ON OCTOBER 5TH THROUGH 8TH 2004 AND MAY 27TH THROUGH JUNE 2ND 2009.
3. SITE GPS COORDINATE CONTROL ESTABLISHED BY LAURENCE R. McBRIDE, INC. GLOBAL POSITIONING SYSTEM SURVEYOR.
4. COORDINATE GRID IS 250' X 250'.
5. SURVEY INFORMATION IS IN THE NAD83 AND NAVD88 DELAWARE STATE PLANE COORDINATE SYSTEM.
6. SITE BENCHMARKS:

SITE BENCHMARK #1	SITE BENCHMARK #2	SITE BENCHMARK #3
CHISEL X	IRON PIPE	IRON PIPE
ELEV. 17.90	ELEV. 52.76	ELEV. 17.78
N 631643.3897	N 631825.0616	N 630838.0408
E 631003.2003	E 630151.5878	E 630443.7167

STORMWATER WAIVER REQUEST

A WAIVER IS REQUESTED FOR THE STORMWATER QUANTITATIVE REQUIREMENT. THIS WAIVER IS REQUESTED PER SECTION 3.2.2.2 OF THE "DELAWARE SEDIMENT AND STORMWATER REGULATIONS", LAST REVISED APRIL 11, 2005 WHICH STATES THAT A PROJECT MAY BE ELIGIBLE FOR A WAIVER OR VARIANCE OF STORMWATER MANAGEMENT FOR WATER QUANTITY CONTROL IF PROVISIONS WILL BE MADE OR EXIST FOR A NONEROSIVE CONVEYANCE SYSTEM TO TIDEWATER BY EITHER A CLOSED DRAINAGE SYSTEM OR BY OPEN CHANNEL FLOW THAT HAS ADEQUATE CAPACITY TO CONTAIN THE RUNOFF EVENTS BEING CONSIDERED AS A REQUIREMENT OF THE REGULATIONS.

OWNER'S CERTIFICATION

I, THE UNDERSIGNED, CERTIFY THAT ALL LAND CLEARING, CONSTRUCTION AND DEVELOPMENT SHALL BE DONE PURSUANT TO THE APPROVED PLAN.

TUSHAR DURVE
ENVIRONMENTAL MANAGER

GENERAL NOTES

1. PLAN LOCATIONS AND DIMENSIONS SHALL BE STRICTLY ADHERED TO UNLESS OTHERWISE DIRECTED BY OWNER OR DUPONT SITE REPRESENTATIVE.
2. CONTRACTOR SHALL FIELD VERIFY EXISTING CONDITIONS AND DIMENSIONS PRIOR TO ORDERING AND/OR FABRICATION OF ANY MATERIALS.
3. CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR INITIATING, MAINTAINING AND SUPERVISING ALL SAFETY PRECAUTIONS AND PROGRAMS IN CONNECTION WITH THE WORK.
4. CONTRACTOR SHALL SUPERVISE AND DIRECT THE WORK. THE CONTRACTOR WILL BE SOLELY RESPONSIBLE FOR THE MEANS, METHODS, TECHNIQUES, PROCEDURES AND SEQUENCES, EXCEPT FOR EROSION & SEDIMENT SEQUENCE OF CONSTRUCTION WHICH WILL BE CONDUCTED IN ACCORDANCE WITH THE APPROVED SEDIMENT AND STORMWATER MANAGEMENT PLAN.
5. CONTRACTOR SHALL PATCH, REPAIR AND FINISH ALL DAMAGED SURFACES CAUSED BY THE WORK, USING SAME MATERIALS AND AS DIRECTED BY THE DUPONT SITE REPRESENTATIVE.
6. FABRICATION AND INSTALLATION OF ALL MATERIALS, FINISHES, ETC. SHALL BE IN ACCORDANCE WITH MANUFACTURER'S WRITTEN INSTRUCTIONS.
7. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING THE EXACT LOCATION OF UNDERGROUND UTILITIES, WHETHER SHOWN OR NOT SHOWN ON THE DRAWINGS, AND SHALL BE RESPONSIBLE FOR ALL COSTS INCURRED IN THE REPAIR OF ANY DAMAGE TO SAME RESULTING FROM THE CONTRACTOR'S WORK ASSOCIATED WITH THIS PROJECT.
8. THE CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PROTECT THE EXISTING UTILITIES AND MAINTAIN UNINTERRUPTED SERVICE AND ANY DAMAGE DONE DUE THE CONTRACTOR'S NEGLIGENCE SHALL BE IMMEDIATELY AND COMPLETELY REPAIRED AT THE CONTRACTOR'S EXPENSE.
9. ALL EXCAVATION, EXCEPT THE SEDIMENT BASINS, SHALL BE KEPT DRY AT ALL TIMES.
10. ALL DIMENSIONS ARE TO CENTERLINE OF UTILITY UNLESS OTHERWISE NOTED.
11. CONTRACTOR WILL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS REQUIRED FOR CONSTRUCTION, INCLUDING WORK PERMITS FROM THE DUPONT EDGE MOOR PLANT, PRIOR TO INITIATION OF WORK.
12. THESE PLANS ARE BASED ON INFORMATION AVAILABLE AT THE TIME THEY WERE PREPARED. ACTUAL CONDITIONS MAY VARY. SOUND ENGINEERING JUDGMENT SHOULD BE EXERCISED DURING CONSTRUCTION TO ASSURE THAT THE DESIGN IS COMPATIBLE WITH THE ACTUAL CONDITIONS.
13. CONSTRUCTION SURVEY STAKING TO BE PROVIDED BY THE CONTRACTOR.
14. ALL WORK SHALL BE IN ACCORDANCE WITH THE TECHNICAL SPECIFICATIONS OF THIS PROJECT UNLESS OTHERWISE AUTHORIZED BY THE OWNER OR DUPONT SITE REPRESENTATIVE.
15. CONTRACTOR SHALL FIELD LOCATE AND VERIFY ALL UTILITIES WITHIN PROJECT AREA. OVERHEAD ELECTRIC LINES ARE NOT TO BE DISTURBED DURING CONSTRUCTION.

SEEDING AND MULCHING INFORMATION:

1. ALL SEEDING AND MULCHING SHALL BE PERFORMED IN ACCORDANCE WITH SECTION 02900. PLANTING OF THE TECHNICAL SPECIFICATIONS.
2. ANY DISTURBED AREA ON WHICH ACTIVITY HAS CEASED AND WHICH WILL REMAIN EXPOSED FOR MORE THAN 14 DAYS SHALL BE SEEDED AND MULCHED. DURING NON–GERMINATING PERIODS, MULCH SHALL BE APPLIED AT THE RECOMMENDED RATES IN THE SPECIFICATIONS. DISTURBED AREAS WHICH ARE NOT AT FINISHED GRADE AND WHICH WILL BE REDISTURBED WITHIN 1 YEAR MAY BE SEEDED AND MULCHED WITH A QUICK GROWING TEMPORARY SEEDING MIXTURE AND MULCH. DISTURBED AREAS WHICH ARE EITHER AT FINISHED GRADE OR WILL NOT BE REDISTURBED WITHIN 1 YEAR SHALL BE SEEDED AND MULCHED WITH A PERMANENT SEED MIXTURE AND MULCH.
3. DIVERSIONS, CHANNELS, AND STOCKPILES SHALL BE SEEDED AND MULCHED IMMEDIATELY.
4. HAY OR STRAW MULCH SHALL BE APPLIED AT RATES OF AT LEAST 2.0 TONS PER ACRE WHEN USED WITH SEED, OR 3.0 TONS PER ACRE IF USED ALONE AS A TEMPORARY MEASURE. MULCH BINDER AT A RATE RECOMMENDED BY MANUFACTURER IMMEDIATELY AFTER PLACEMENT OF MULCH.

Temporary Seed:

Scientific Name	Common Name	Max. % Weed Seeds	Min. % Purity	Min. % Germination	Seeding Rate (lbs/ac)
Lolium multiflorum	Annual Ryegrass	0.15	95	90	40
For Seeding Periods from 10/15 to 3/1 Add					
Secale cereale	Winter Rye				65

Permanent Seed:

IRM Cover Mix–above elevation 16

Scientific Name	Common Name	Seeding Rate (lbs/acre)
Andropogon gerardii	Big bluestem	3
Andropogon scoparius	Little bluestem	2
Sorghastrum nutans	Indian grass	2
Rudbeckia hirta	Black eyed Susan	0.5
Coreopsis lanceolata	Lanceleaved coreopsis	
Echinacea purpurea	Purple coneflower	
Coreopsis tinctoria	Tickseed	
Chamaecrista fasciculata	Partridge pea	

Supplemental IRM Cover Mix: provide 100 lbs of this mix in conjunction with the IRM Cover Mix and interseed in patches throughout the cap.

Scientific Name	Common Name	Percent of Mix
Andropogon gerardii	Big bluestem	4
Aster laevis	Smooth blue aster	1
Baptisia australis	Blue false indigo	2
grama Bouteloua curtipendula	Side oats	10
Chamaecrista fasciculata	Partridge pea	5
Elymus virginicus	Virginia wild rye	10
Euthamia graminifolia	Grass leaved glodenrod	2
Heliopsis helianthoides	Ox eye sunflower	2
Liatris spicata	Marsh dense blazing star	1
Monarda fistulosa	Wild bergamot	2
Penstemen digitalis	Tall white beard tongue	5
Rudbeckia hirta	Black eyed Susan	5
Schizachyrium scoparium	Little bluestem	25
Senna hebecarpa	Wild senna	4
Senna marilandica	Maryland senna	2
Silphium trifoliatum	Whorled rosinweed	1
Sorghastrum nutans	Indiangrass	11
Tradescantia ohiensis	Ohio spiderwort	4
Zizia aurea	Golden alexanders	4

Transition Zone–between elevation 14 and 16

Scientific Name	Common Name	Percent of Mix
Elymus virginicus	Virginia wild rye	25
Panicum clandestinum	Deer tongue	25
Carex vulpinoidea	Fox sedge	20
Agrostis perennans	Autumn bentgrass	15
Agrostis scabra	Ticklegrass	15

Wet Zone–below elevation 14

Scientific Name	Common Name	Percent of Mix
Carex vulinoidea	Fox sedge	25
Elyus virginicus	Virginia wild rye	25
Poa palustris	Fowl bluegrass	25
Agrostis scabra	Ticklegrass	6
Sparganium eurycarpum	Giant bur reed	3
Verbena hastate	Blue vervain	3
Juncus effusus	Soft rush	2
Scirpus atrovirens	Green bulrush	2
Scirpus cyperiunus	Wool grass	2
Scirpus polyphyllus	Many leaved bulrush	2
Carex scoparia	Blunt broom sedge	1
Helenium autumnale	Common sneezeweed	1
Iris versicolor	Blue flag	1
Juncus tenus	Path rush	1
Mimulus ringens	Square stemmed monkey flower	1

Seed at a rate of 15 lbs/acre.

EROSION AND SEDIMENT CONTROL

1. ALL SOIL EROSION AND SEDIMENT CONTROL PRACTICES SHALL COMPLY WITH THE DELAWARE EROSION AND SEDIMENT CONTROL HANDBOOK, 2003.
2. AREA OF DISTURBANCE = 26.13± ACRES.
3. A COPY OF THE APPROVED SEDIMENT AND STORMWATER MANAGEMENT PLAN WILL BE MAINTAINED ON SITE FOR THE DURATION OF THE PROJECT.
4. DNREC SEDIMENT AND STORMWATER MANAGEMENT PROGRAM MUST BE NOTIFIED IN WRITING FIVE (5) DAYS PRIOR TO COMMENCING WITH CONSTRUCTION. FAILURE TO DO SO CONSTITUTES A VIOLATION OF THE APPROVED SEDIMENT AND STORMWATER MANAGEMENT PLAN.
5. REVIEW AND/OR APPROVAL OF THE SEDIMENT AND STORMWATER MANAGEMENT PLAN SHALL NOT RELIEVE THE CONTRACTOR FROM RESPONSIBILITY FOR COMPLIANCE WITH THE SEDIMENT AND STORMWATER REGULATIONS, NOR SHALL IT RELIEVE THE CONTRACTOR FROM ERRORS OR OMISSIONS ON THE APPROVED PLAN.
6. IF THE APPROVED PLAN NEEDS TO BE MODIFIED, ADDITIONAL SEDIMENT AND STORMWATER CONTROL MEASURES MAY BE REQUIRED AS DEEMED NECESSARY BY DNREC.
7. THE CONTRACTOR SHALL HAVE ON–SITE PERSONNEL THAT ARE RESPONSIBLE FOR E & S CONTROLS COMPLETE FOR DELAWARE SEDIMENT AND STORMWATER BLUE CARD CERTIFICATION PROGRAM PRIOR TO CONSTRUCTION.
8. FOLLOWING SOIL DISTURBANCE OR REDISTURBANCE, TEMPORARY OR PERMANENT STABILIZATION SHALL BE COMPLETED WITHIN 14 CALENDAR DAYS TO ALL PERIMETER SEDIMENT CONTROLS, SOIL STOCKPILES AND OTHER DISTURBED OR GRADED AREAS ON THE PROJECT SITE.
9. ALL DISTURBED SOIL SURFACES, INCLUDING SOIL STOCKPILES, SHALL BE TEMPORARILY STABILIZED OR OTHERWISE PROTECTED WITH EROSION AND SEDIMENTATION CONTROLS PRIOR TO THE END OF WORK EACH DAY. SOIL STOCKPILE AREAS SHALL BE LOCATED ON AREAS WITH LITTLE TO NO SLOPE, WHEN FEASIBLE. THE CONTRACTOR SHALL IMPLEMENT APPROPRIATE CONTROL PRACTICES TO PREVENT THE MIGRATION OF SEDIMENT FROM ALL STOCKPILE AREAS. STOCKPILE HEIGHTS SHALL NOT EXCEED 35 FEET. STOCKPILE SLOPES SHALL BE 2H:1V OR LESS.
10. EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSPECTED BY THE CONTRACTOR PERIODICALLY AND AFTER EACH RAINFALL. MAINTENANCE SHALL BE PERFORMED AFTER EACH INSPECTION AS NECESSARY. ANY ERODED AREAS SHALL BE IMMEDIATELY STABILIZED.
11. THE CONTRACTOR SHALL IMPLEMENT APPROPRIATE DUST CONTROL TECHNIQUES IN ACCORDANCE WITH DELAWARE EROSION & SEDIMENT CONTROL HANDBOOK. THE METHODS INCLUDE MULCHES, VEGETATIVE COVER, SPRINKLING AND ETC.
12. THE CONTRACTOR SHALL NOT INITIATE CONSTRUCTION ACTIVITIES PRIOR TO THE SATISFACTORY INSPECTION OF THE PERIMETER EROSION AND SEDIMENT CONTROLS BY THE ENGINEER, DUPONT SITE REPRESENTATIVE, OR DNREC.
13. MAINTENANCE OF ALL SOIL EROSION AND SEDIMENT CONTROL MEASURES ON THE PROJECT SITE SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR UNTIL THE PROJECT IS 100% COMPLETE, FULLY STABILIZED, AND ACCEPTED BY THE ENGINEER AND DNREC.
14. THE SILT FENCE SHALL BE CLEANED WHEN SEDIMENT DEPOSITS REACH APPROXIMATELY ONE–HALF THE ABOVE GROUND HEIGHT OF THE FENCE.
15. REMOVE EROSION AND SEDIMENT CONTROL MEASURES WHEN FINAL STABILIZATION APPROVAL HAS BEEN OBTAINED FROM THE OWNER AND DNREC.

811 Know what's below. Call before you dig.

REV	DESCRIPTION OF REVISION	REVISED BY/DATE	CHECKED BY/DATE
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URS
Iron Hill Corporate Center
4051 Ogletown Road, Suite 300
Newark, DE 19713
Tel: 302.781.5900
Fax: 302.781.5901

APPROVED BY:

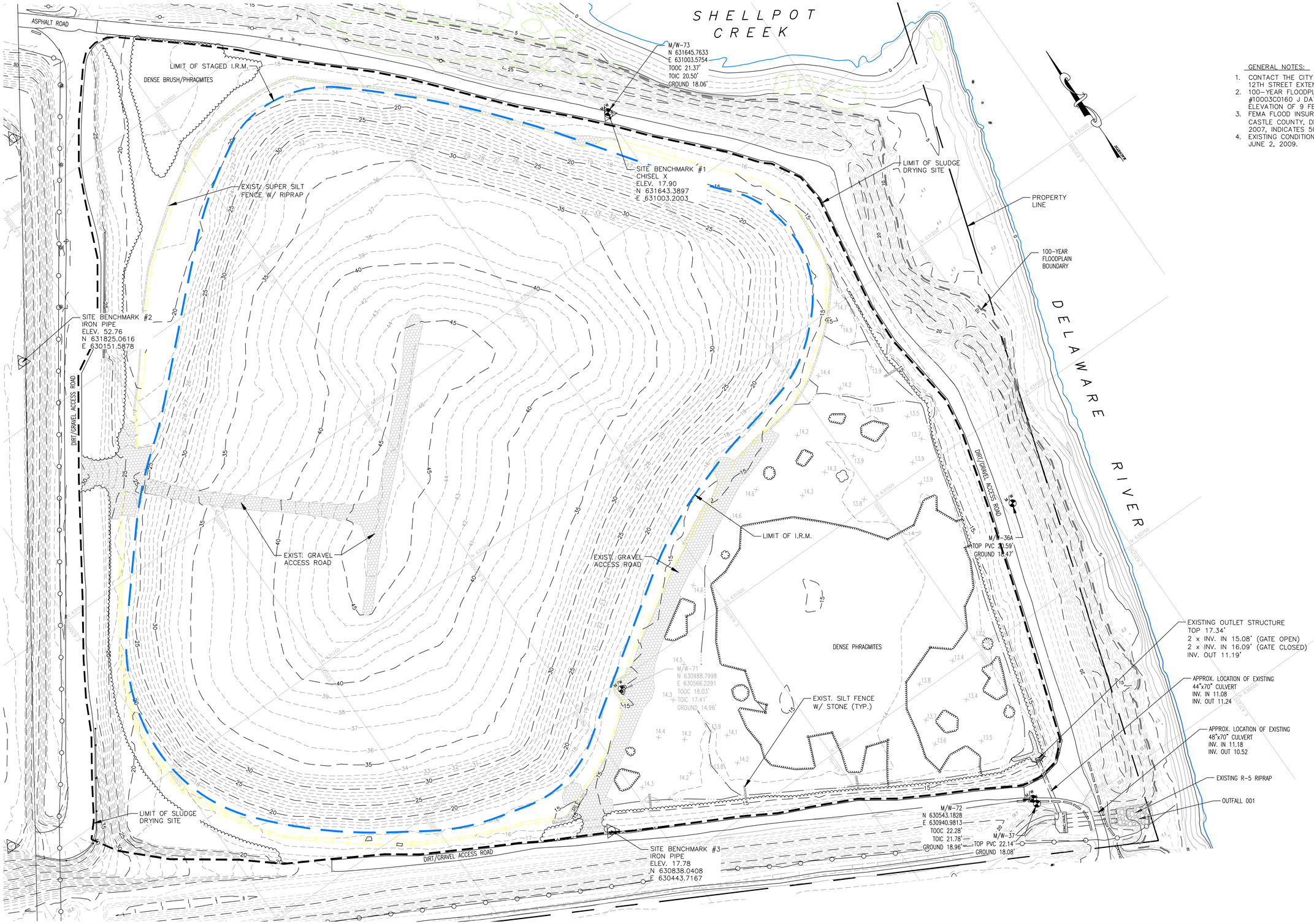
SCALE	AS NOTED
DESIGNED	EEB
DRAWN	SCD
CHECKED	CTC
DATE	8/7/09

NOTES & LEGEND

DuPONT HAY ROAD
SLUDGE DRYING SITE
(DE–0024)

REVISION 0
PROJECT 18985726
DRAWING
SHEET 2

THIS DRAWING DOES NOT INCLUDE NECESSARY COMPONENTS FOR CONSTRUCTION SAFETY. ALL CONSTRUCTION MUST BE DONE IN COMPLIANCE WITH THE CURRENT OCCUPATIONAL SAFETY AND HEALTH ACT AND ALL RULES AND REGULATIONS THERETO AND APPURTENANT.



GENERAL NOTES:

1. CONTACT THE CITY OF WILMINGTON PRIOR TO WORKING ALONG 12TH STREET EXTENSION.
2. 100-YEAR FLOODPLAIN BOUNDARY BASED ON FEMA FIRM MAP #10003C0160 J DATED JANUARY 17, 2007. 100-YEAR ELEVATION OF 9 FEET IN NAVD88 AS REPORTED IN FIRM MAP.
3. FEMA FLOOD INSURANCE STUDY OF CITY OF WILMINGTON, NEW CASTLE COUNTY, DELAWARE (10003CV0008), DATED JANUARY 17, 2007, INDICATES 500-YEAR FLOOD ELEVATION IS 10.7 FEET.
4. EXISTING CONDITIONS SURVEY COMPLETED BY URS MAY 27 TO JUNE 2, 2009.

811 Know what's below. Call before you dig.

REV	DESCRIPTION OF REVISION	REVISED BY/DATE	CHECKED BY/DATE
3	ISSUED FOR BID	SCD 3-9-10	TOS 3-9-10
2	ISSUED FOR DNREC REVIEW	SCD 11-23-09	EEB 11-23-09
1			
0			

WARNING: 0 1/2 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

ACEC — American Council of Engineering Companies

URS — Iron Hill Corporate Center, 4051 Ogletown Road, Suite 300, Newark, DE 19713, Tel: 302.781.5900, Fax: 302.781.5901

APPROVED BY:

SCALE	1" = 60'
DESIGNED	EEB
DRAWN	SCD
CHECKED	CTC
DATE	8/7/09

EXISTING CONDITIONS

DuPONT HAY ROAD
SLUDGE DRYING SITE
(DE-0024)

REVISION 0
PROJECT 18985726
DRAWING
SHEET 3

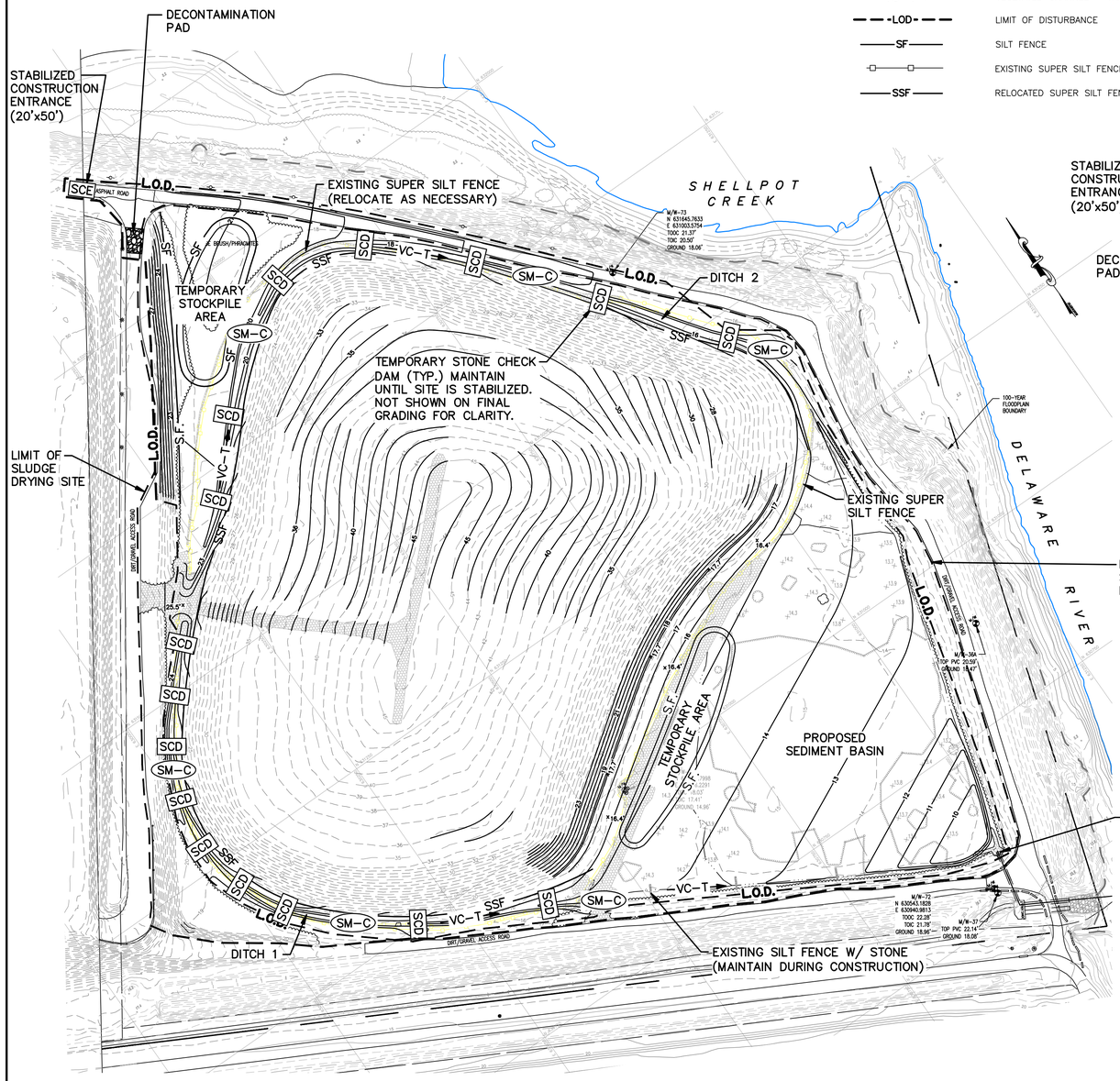
THIS DRAWING DOES NOT INCLUDE NECESSARY COMPONENTS FOR CONSTRUCTION SAFETY. ALL CONSTRUCTION MUST BE DONE IN COMPLIANCE WITH THE CURRENT OCCUPATIONAL SAFETY AND HEALTH ACT AND ALL RULES AND REGULATIONS THERETO AND APPURTENANT.

EROSION AND SEDIMENT CONTROL LEGEND

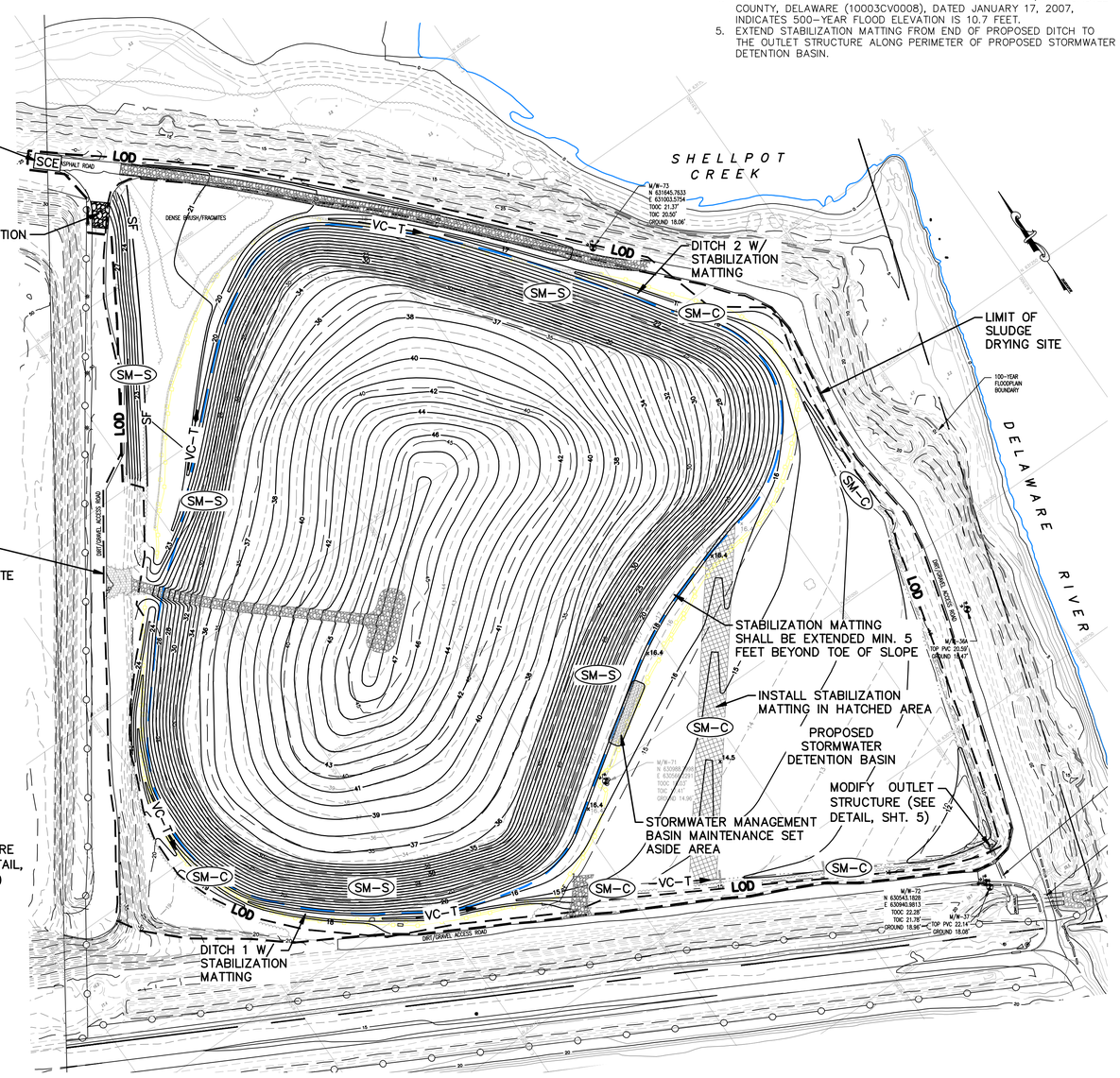
SCD	STONE CHECK DAM
SCE	STABILIZED CONSTRUCTION ENTRANCE
SM–C	STABILIZATION MATTING – CHANNEL
SM–S	STABILIZATION MATTING – SLOPE
–VC–T–►	VEGETATED CHANNEL – TRAP.
–LOD–	LIMIT OF DISTURBANCE
SF	SILT FENCE
	EXISTING SUPER SILT FENCE
SSF	RELOCATED SUPER SILT FENCE

GENERAL NOTES:

1. FOLLOWING SOIL DISTURBANCE OR REDISTURBANCE, TEMPORARY OR PERMANENT STABILIZATION SHALL BE COMPLETED WITHIN 14 CALENDAR DAYS TO ALL PERIMETER SEDIMENT CONTROLS, SOIL STOCKPILES AND OTHER DISTURBED OR GRADED AREAS ON THE PROJECT SITE.
2. ALL SOILS ARE CLASSIFIED AS Ou: (OTHELLO–FALLSINGTON–URBAN LAND COMPLEX)
3. 100–YEAR FLOODPLAIN BOUNDARY BASED ON FEMA FIRM MAP #10003C0160 J DATED JANUARY 17, 2007. 100–YEAR ELEVATION OF 9 FEET IN NAVD88 AS REPORTED IN FIRM MAP.
4. FEMA FLOOD INSURANCE STUDY OF CITY OF WILMINGTON, NEW CASTLE COUNTY, DELAWARE (10003CV0008), DATED JANUARY 17, 2007, INDICATES 500–YEAR FLOOD ELEVATION IS 10.7 FEET.
5. EXTEND STABILIZATION MATTING FROM END OF PROPOSED DITCH TO THE OUTLET STRUCTURE ALONG PERIMETER OF PROPOSED STORMWATER DETENTION BASIN.



INTERMEDIATE GRADING
EROSION AND SEDIMENT CONTROL PLAN



FINAL GRADING
EROSION AND SEDIMENT CONTROL PLAN

GRAPHIC SCALE
(IN FEET)
1 inch = 100 ft.

1' CONTOUR INTERVAL

811 Know what's below. Call before you dig.

REV	DESCRIPTION OF REVISION	REVISED BY/DATE	CHECKED BY/DATE
B	ISSUED FOR BID	SCD 3-9-10	TOS 3-9-10
A	ISSUED FOR DNREC REVIEW	SCD 11-23-09	EEB 11-23-09

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

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URS

Iron Hill Corporate Center
4051 Ogletown Road, Suite 300
Newark, DE 19713
Tel: 302.781.5900
Fax: 302.781.5901

APPROVED BY:

SCALE	1" = 100'
DESIGNED	EEB
DRAWN	SCD
CHECKED	CTC
DATE	8/7/09

EROSION AND SEDIMENT CONTROL PLAN

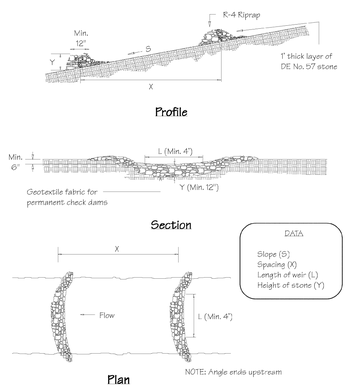
DuPONT HAY ROAD
SLUDGE DRYING SITE
(DE–0024)

REVISION	0
PROJECT	18985726
DRAWING	SHEET 4

THIS DRAWING DOES NOT INCLUDE NECESSARY COMPONENTS FOR CONSTRUCTION SAFETY. ALL CONSTRUCTION MUST BE DONE IN COMPLIANCE WITH THE CURRENT OCCUPATIONAL SAFETY AND HEALTH ACT AND ALL RULES AND REGULATIONS THERETO AND APPURTENANT.

Standard Detail & Specifications

Stone Check Dam



Source:	Symbol:	Detail No.
Adapted from MD Stds. & Specs. for ESC	SCD	DE-ESC-3.3.6 Sheet 1 of 2 Date: 6/05

Standard Detail & Specifications

Stone Check Dam

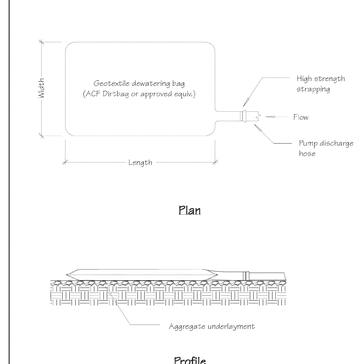
Construction Notes:

1. Swales and channels shall be prepared in accordance with the construction specifications described in the **Standards and Specifications for Temporary Berm**, **Temporary Swale**, **Vegetated Channel**, or **Diversions**.
2. The check dam shall be constructed of 4" to 8" riprap. The riprap shall be placed so that it completely covers the width of the channel.
3. The top of the check dam shall be constructed so that the center is approximately 6" lower than the outer edges, forming a weir that the water can flow across. The minimum length of weir shall be 4'.
4. The maximum height of the check dam at the center of the weir must not exceed two (2) feet.
5. Maximum spacing between dams should be the distance in the channel where the toe of the upstream dam is at the same elevation as the top of the downstream dam. (See **Standard & Specifications for Check Dams** for design chart.)

Source:	Symbol:	Detail No.
Adapted from MD Stds. & Specs. for ESC	SCD	DE-ESC-3.3.6 Sheet 2 of 2 Date: 6/05

Standard Detail & Specifications

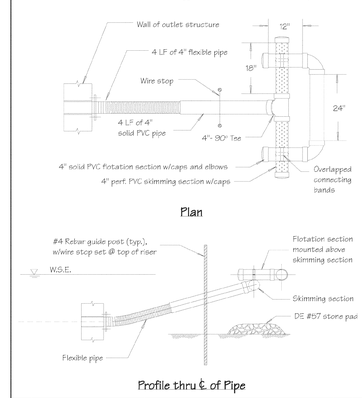
Geotextile Dewatering Bag



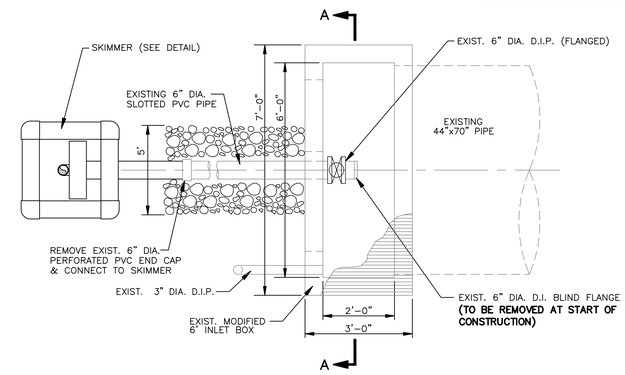
Source:	Symbol:	Detail No.
Adapted from ACF Products, Inc.	GB	DE-ESC-3.2.1.2 Sheet 1 of 2 Date: 12/03

Standard Detail & Specifications

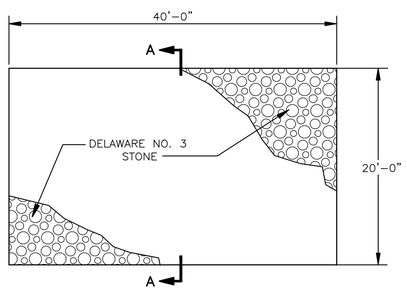
Skimmer Dewatering Device



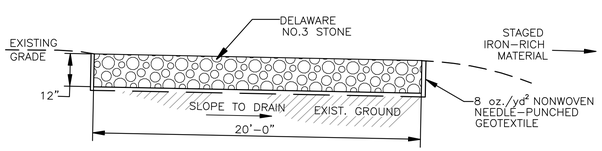
Source:	Symbol:	Detail No.
Adapted from drawing by Vandemark & Lynch, Inc.	SDD	DE-ESC-3.2.3.1 Sheet 1 of 2 Date: 12/03



PLAN



PLAN VIEW OF DECONTAMINATION PAD



SECTION A–A
CROSS SECTION VIEW OF DECONTAMINATION PAD

DECONTAMINATION PAD DETAIL

(N.T.S.)

GENERAL NOTES:

1. CONTRACTOR MAY SUBMIT ALTERNATE DECONTAMINATION PAD DESIGN FOR APPROVAL BY THE DUPONT SITE REPRESENTATIVE.
2. SUBGRADE AND SURFACE OF DECONTAMINATION PAD SHALL BE SLOPED TO DRAIN TOWARD THE STAGED IRON–RICH MATERIAL.

Standard Detail & Specifications

Geotextile Dewatering Bag

Construction Notes:

1. The dewatering bag should be placed so the incoming water flows into and through the bag, and then flow off the site without creating more erosion. The neck should be tied off tightly to stop the water from flowing out of the bag without going through the walls. The dewatering bag should be placed on a gravel bed to allow water to flow in all directions.
2. The dewatering bag is considered full and should be disposed when it is impractical for the bag to filter the sediment out at a reasonable flow rate. At this point, it should be replaced with a new bag.
3. Disposal may be accomplished as directed by the construction reviewer. If the site allows, the bag may be buried on site and seeded, visible fabric removed and seeded or removed from site to a proper disposal area.

Materials:

1. The geotextile fabric shall be a Type GD-IV.
2. The dewatering bag shall be sewn with a double needle machine using high strength thread. All structural seams will be sewn with high strength, double stitched "J" type. Seam strength test will have the following minimum average roll values:

Type	TEST METHOD	TEST RESULT
Heavy duty	ASTM D-4884	100 lb / in

3. The dewatering bag shall have an opening large enough to accommodate a four (4) inch discharge hose with attached strap to tie off the hose to prevent the pumped water from escaping from the bag without being filtered.

Source:	Symbol:	Detail No.
Adapted from ACF Products, Inc.	GB	DE-ESC-3.2.1.2 Sheet 2 of 2 Date: 12/03

Standard Detail & Specifications

Skimmer Dewatering Device

Construction Notes:

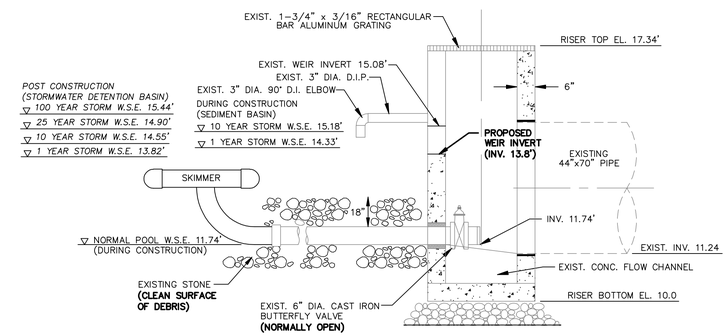
1. Pipe flotation section shall be solvent welded to ensure an airtight assembly. Contractor to conduct a test to check for leaks prior to installation.
2. Skimmer section shall have (12) rows of 1/2" dia. holes, 1-1/4" on center. If additional filtration is necessary, the filtering media shall consist of a Type GD-II geotextile fabric wrapped around the perforated portion of the skimmer and attached with plastic snap ties, bands, etc.
3. Flexible pipe shall be inserted into solid pipe and fastened with (2) #8 wood screws.
4. At a minimum, the structure shall be inspected after each rain and repairs made as needed. If vandalism is a problem, more frequent inspection may be necessary.
5. Construction operations shall be carried out in such a manner that erosion and water pollution are minimized.
6. The structure shall only be removed when the contributing drainage area has been properly stabilized.

Materials:

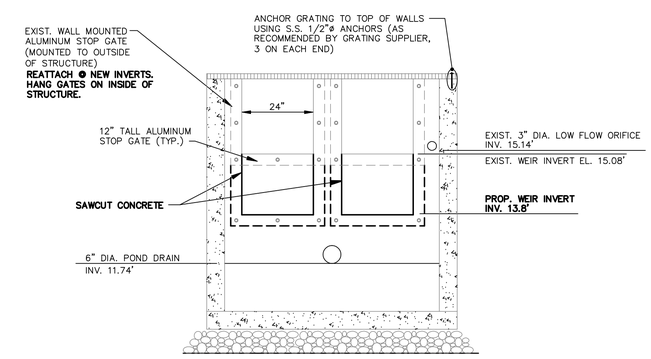
1. Solid pipe - 4" Sched. 40 PVC
2. Perforated pipe - 4" Sched. 40 PVC
3. 90° Tee (1 ea.) - 4" Sched. 40 PVC
4. 90° Elbow (2 ea.) - 4" Sched. 40 PVC
5. Cap (4 ea.) - 4" Sched. 40 PVC, solid
6. Flexible pipe - 4" corrugated plastic tubing (non-perforated)

Source:	Symbol:	Detail No.
Delaware ESC Handbook	SDD	DE-ESC-3.2.3.1 Sheet 2 of 2 Date: 12/03

GENERAL NOTE:
FOLLOWING SOIL DISTURBANCE OR REDISTURBANCE, TEMPORARY OR PERMANENT STABILIZATION SHALL BE COMPLETED WITHIN 14 CALENDAR DAYS TO ALL PERIMETER SEDIMENT CONTROLS, SOIL STOCKPILES AND OTHER DISTURBED OR GRADED AREAS ON THE PROJECT SITE.



ELEVATION



SECTION A–A

NOTES:
1. INSTALL SKIMMER PER MANUFACTURER'S INSTRUCTIONS.
2. KEEP GATES CLOSED FOR SEDIMENT BASIN DURING CONSTRUCTION. AFTER THE SITE IS STABILIZED, REMOVE GATES AND SKIMMER AND CONVERT THE SEDIMENT BASIN INTO STORMWATER DETENTION BASIN.

EXISTING OUTLET STRUCTURE MODIFICATIONS

(N.T.S.)

Know what's below. Call before you dig.

REV	DESCRIPTION OF REVISION	REVISED BY/DATE	CHECKED BY/DATE
B	ISSUED FOR BID	SCD 3-9-10	TOS 3-9-10
A	ISSUED FOR DNREC REVIEW	SCD 11-23-09	EEB 11-23-09

WARNING
0 1/2 1
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URS

Iron Hill Corporate Center
4051 Ogletown Road, Suite 300
Newark, DE 19713
Tel: 302.781.5900
Fax: 302.781.5901

APPROVED BY:

SCALE	AS NOTED
DESIGNED	EEB
DRAWN	SCD
CHECKED	CTC
DATE	8/7/09

EROSION AND SEDIMENT CONTROL DETAILS (SHEET 1 OF 2)

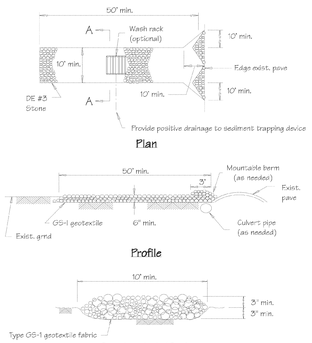
DuPONT HAY ROAD
SLUDGE DRYING SITE
(DE–0024)

REVISION 0
PROJECT 18985726
DRAWING
SHEET 5

THIS DRAWING DOES NOT INCLUDE NECESSARY COMPONENTS FOR CONSTRUCTION SAFETY. ALL CONSTRUCTION MUST BE DONE IN COMPLIANCE WITH THE CURRENT OCCUPATIONAL SAFETY AND HEALTH ACT AND ALL RULES AND REGULATIONS THERETO AND APPURTENANT.

Standard Detail & Specifications

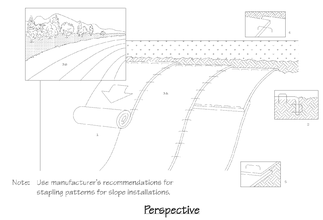
Stabilized Construct. Entrance



Source:	Symbol:	Detail No.
Adapted from VA ESC Handbook	SCE	DE-ESC-3.4.7 Sheet 1 of 2 Date: 12/03

Standard Detail & Specifications

Stabilization Matting - Slope



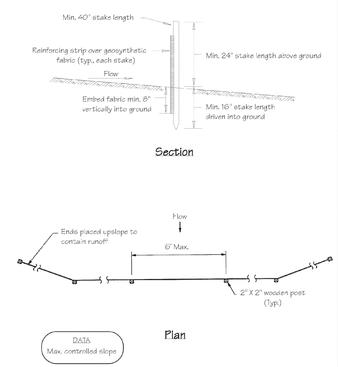
Construction Notes:

1. Prepare soil before installing matting, including application of lime, fertilizer, and seed.
2. Begin at the top of the slope by anchoring the mat in a 6" deep X 6" wide trench. Backfill and compact trench after stapling.
3. Roll the mats (A) down or (B) horizontally across the slope.
4. The edges of parrallel mats must be stapled with approx. 2" overlap.
5. When mats must be spliced down the slope, place mats end over end (shingle style) with approx. 4" overlap. Staple through overlapped area, approx. 12" apart.

Source:	Symbol:	Detail No.
Adapted from North American Green, Inc.	SM-S	DE-ESC-3.4.6.1 Sheet 1 of 2 Date: 6/05

Standard Detail & Specifications

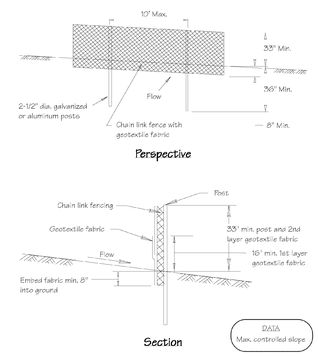
Silt Fence



Source:	Symbol:	Detail No.
Adapted form MD Stds. & Specs. for ESC	SF	DE-ESC-3.1.2.1 Sheet 1 of 2 Date: 6/05

Standard Detail & Specifications

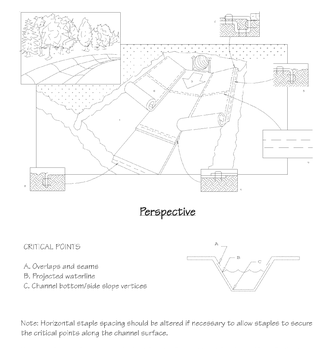
Super Silt Fence



Source:	Symbol:	Detail No.
Adapted from MD Stds. & Specs. for ESC	SSF	DE-ESC-3.1.2.3 Sheet 1 of 2 Date: 12/03

Standard Detail & Specifications

Stabilization Matting - Channel



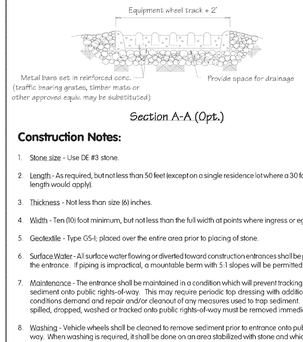
Note: Horizontal staple spacing should be altered if necessary to allow staples to secure the critical points along the channel surface.

Use manufacturer's recommendations for stapling patterns for channel installations.

Source:	Symbol:	Detail No.
Adapted from North American Green, Inc.	SM-C	DE-ESC-3.4.6.2 Sheet 1 of 3 Date: 6/05

Standard Detail & Specifications

Stabilized Construct. Entrance



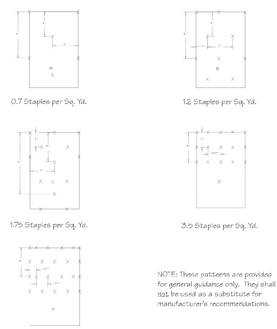
Construction Notes:

1. Stone size - Use DE #3 stone.
2. Length - As required, but not less than 50 feet (except on a single residence lot where a 30 foot minimum length would apply).
3. Thickness - Not less than size (6) inches.
4. Width - Ten (10) foot minimum, but not less than the full width at points where ingress or egress occurs.
5. Geotextile - Type GS-1, placed over the entire area prior to placing of stone.
6. Surface Water - All surface water flowing or diverted toward construction entrances shall be piped across the entrance. If piping is impractical, a mountable berm with 5:1 slopes will be permitted.
7. Maintenance - The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic top dressing with additional stone as conditions demand and repair and/or cleanout of any measures used to trap sediment. All sediment spilled, dropped, washed or tracked onto public rights-of-way must be removed immediately.
8. Washing - Vehicle wheels shall be cleaned to remove sediment prior to entrance onto public rights-of-way. When washing is required, it shall be done on an area stabilized with stone and which drains into an approved sediment trapping device.
9. Inspection - Periodic inspection and needed maintenance shall be provided after each rain.

Source:	Symbol:	Detail No.
Adapted from VA ESC Handbook	SCE	DE-ESC-3.4.7 Sheet 2 of 2 Date: 12/03

Standard Detail & Specifications

Stabilization Matting - Slope



NOTE: These patterns are provided for general guidance only. They shall not be used as a substitute for manufacturer's recommendations.

Stapling Patterns

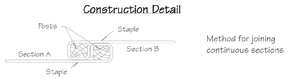
Source:	Symbol:	Detail No.
Adapted from North American Green, Inc.	SM-S	DE-ESC-3.4.6.1 Sheet 2 of 2 Date: 6/05

EROSION CONTROL BLANKETS SHALL BE INSTALLED ON ALL SLOPES STEEPER THAN 8H:1V. EROSION CONTROL BLANKETS SHALL BE NORTH AMERICAN GREEN S150 OR APPROVED EQUAL.

Standard Detail & Specifications

Silt Fence

Construction Detail



Construction Notes:

1. Geosynthetic fabric to be fastened securely to fence posts with wire ties or staples.
2. When two sections of filter cloth adjoin each other they shall be overlapped by six inches and folded.
3. Maintenance shall be performed as needed and material removed when "bulges" develop in the silt fence.

Materials:

1. Stakes: Steel (either T or U) or 2" x 2" hardwood
2. Geosynthetic Fabric: Type GD-I
3. Reinforcing strip: Wooden lath, plastic strip or other approved equivalent
4. Prefabricated Unit: Geofab, Envirofence, or approved equivalent

Source:	Symbol:	Detail No.
Adapted from MD Stds. & Specs. for ESC	SF	DE-ESC-3.1.2.1 Sheet 2 of 2 Date: 6/05

Standard Detail & Specifications

Super Silt Fence

Construction Notes:

1. The poles do not need to be set in concrete.
2. Chain link fence shall be fastened securely to the fence posts with wire ties or staples.
3. Geotextile fabric shall be fastened securely to the chain link fence with ties spaced every 24" at the top and mid section.
4. Geotextile fabric shall be embedded a minimum of 8" into the ground.
5. When two sections of geotextile fabric adjoin each other, they shall be overlapped by 6" and folded.
6. Maintenance shall be performed as needed and silt buildups removed when "bulges" develop in the silt fence.

Materials:

1. Fencing: Fencing shall be 42 inches in height and constructed in accordance with the latest Delaware Department of Transportation (Del-DOT) Specifications for Chain Link Fencing (Section 728). The Del-DOT specification for a 6 foot fence shall be used, substituting 42 inch fabric and 6 foot length posts.
2. Geosynthetic Fabric: Type GD-I

Source:	Symbol:	Detail No.
Adapted from MD Stds. & Specs. for ESC	SSF	DE-ESC-3.1.2.3 Sheet 2 of 2 Date: 12/03

Standard Detail & Specifications

Stabilization Matting - Channel

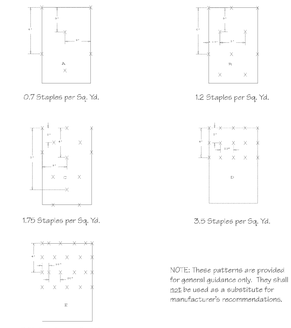
Construction Notes:

1. Prepare soil before installing matting, including application of lime, fertilizer, and seed.
2. Begin at the top of the channel by anchoring the mat in a 6" deep X 6" wide trench. Backfill and compact the trench after stapling.
3. Roll center mat in direction of water flow on bottom of channel.
4. Place mats end over end (shingle style) with a 6" overlap, use a double row of staggered staples 4" apart to secure mats.
5. Full Length edge of mats at top of side slopes must be anchored in 6" deep X 6" wide trench; backfill and compact the trench after stapling.
6. Mats on side slopes must be overlapped 4" over the center mat and stapled.
7. In high flow channel applications, a staple check slot is recommended at 30 to 40 foot intervals. Use a row of staples 4" apart over entire width of the channel. Place a second row 4" below the first row in a staggered pattern.
8. The terminal end of the mats must be anchored in a 6" X 6" wide trench. Backfill and compact the trench after stapling.

Source:	Symbol:	Detail No.
Adapted from North American Green, Inc.	SM-C	DE-ESC-3.4.6.2 Sheet 2 of 3 Date: 6/05

Standard Detail & Specifications

Stabilization Matting - Channel



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Stapling Patterns

Source:	Symbol:	Detail No.
Adapted from North American Green, Inc.	SM-C	DE-ESC-3.4.6.2 Sheet 3 of 3 Date: 6/05

EROSION CONTROL BLANKETS FOR CHANNEL PROTECTION SHALL BE NORTH AMERICAN GREEN S150 OR APPROVED EQUAL.

GENERAL NOTE:

FOLLOWING SOIL DISTURBANCE OR REDISTURBANCE, TEMPORARY OR PERMANENT STABILIZATION SHALL BE COMPLETED WITHIN 14 CALENDAR DAYS TO ALL PERIMETER SEDIMENT CONTROLS, SOIL STOCKPILES AND OTHER DISTURBED OR GRADED AREAS ON THE PROJECT SITE.

811 Know what's below. Call before you dig.

REV	DESCRIPTION OF REVISION	REVISED BY/DATE	CHECKED BY/DATE
3	ISSUED FOR BID	SCD 3-9-10	TOS 3-9-10
2	ISSUED FOR DNREC REVIEW	SCD 11-23-09	EEB 11-23-09

WARNING: 0 1/2 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

ACEC American Council of Engineering Companies

URS

Iron Hill Corporate Center
4051 Ogletown Road, Suite 300
Newark, DE 19713
Tel: 302.781.5900
Fax: 302.781.5901

APPROVED BY:

SCALE	AS NOTED
DESIGNED	EEB
DRAWN	SCD
CHECKED	CTC
DATE	8/7/09

EROSION AND SEDIMENT CONTROL DETAILS (SHEET 2 OF 2)

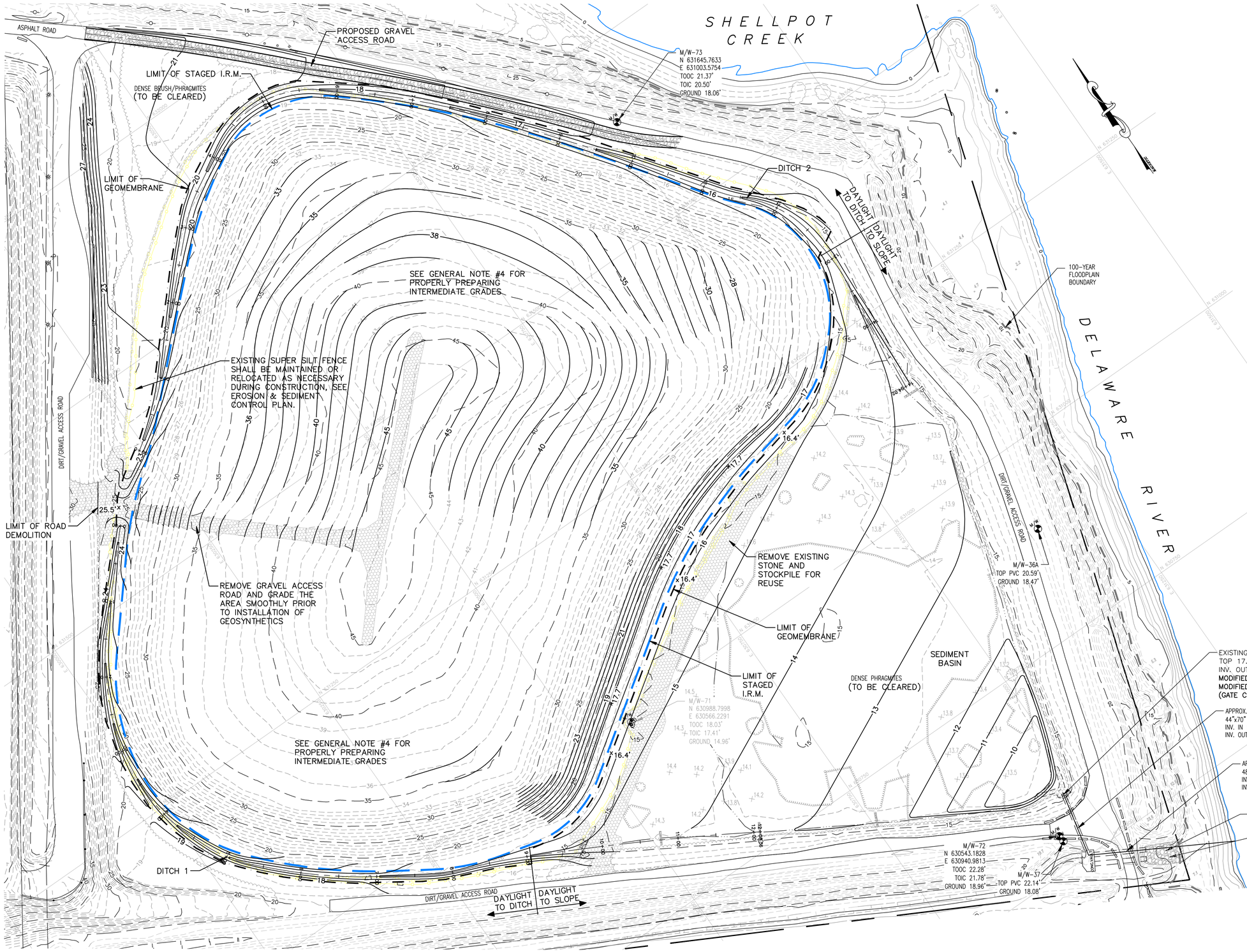
DuPONT HAY ROAD SLUDGE DRYING SITE (DE-0024)

REVISION 0

PROJECT 18985726

DRAWING SHEET 6

THIS DRAWING DOES NOT INCLUDE NECESSARY COMPONENTS FOR CONSTRUCTION SAFETY. ALL CONSTRUCTION MUST BE DONE IN COMPLIANCE WITH THE CURRENT OCCUPATIONAL SAFETY AND HEALTH ACT AND ALL RULES AND REGULATIONS THERETO AND APPURTENANT.



GENERAL NOTES:

1. 100-YEAR FLOODPLAIN BOUNDARY BASED ON FEMA FIRM MAP #10003C0160 J DATED JANUARY 17, 2007. 100-YEAR ELEVATION OF 9 FEET IN NAVD88 AS REPORTED IN FIRM MAP.
2. FEMA FLOOD INSURANCE STUDY OF CITY OF WILMINGTON, NEW CASTLE COUNTY, DELAWARE (10003CV0008), DATED JANUARY 17, 2007, INDICATES 500-YEAR FLOOD ELEVATION IS 10.7 FEET.
3. REMOVE EXISTING 6" OF TOPSOIL FROM PROPOSED SEDIMENT BASIN, STOCKPILE FOR REUSE.
4. THE INTERMEDIATE GRADES WITHIN THE CAP SHOWN HERE ARE APPROXIMATE. UNIFORMLY CONTOUR INTERMEDIATE GRADES TO MEET THE FOLLOWING REQUIREMENTS.

A. MAXIMUM SLOPE: 4H:1V
B. MINIMUM SLOPE: 3%

5. SUBMIT INTERMEDIATE GRADING AS-BUILT DRAWING FOR APPROVAL PRIOR TO INSTALLATION OF GEOSYNTHETICS.

LEGEND:

— — -35- — — EXISTING CONTOUR

———35——— PROPOSED INTERMEDIATE GRADE

1' CONTOUR INTERVAL

GRAPHIC SCALE

60 0 30 60 120 240

(IN FEET)
1 inch = 60 ft.

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APPROVED BY:

SCALE	1" = 60'
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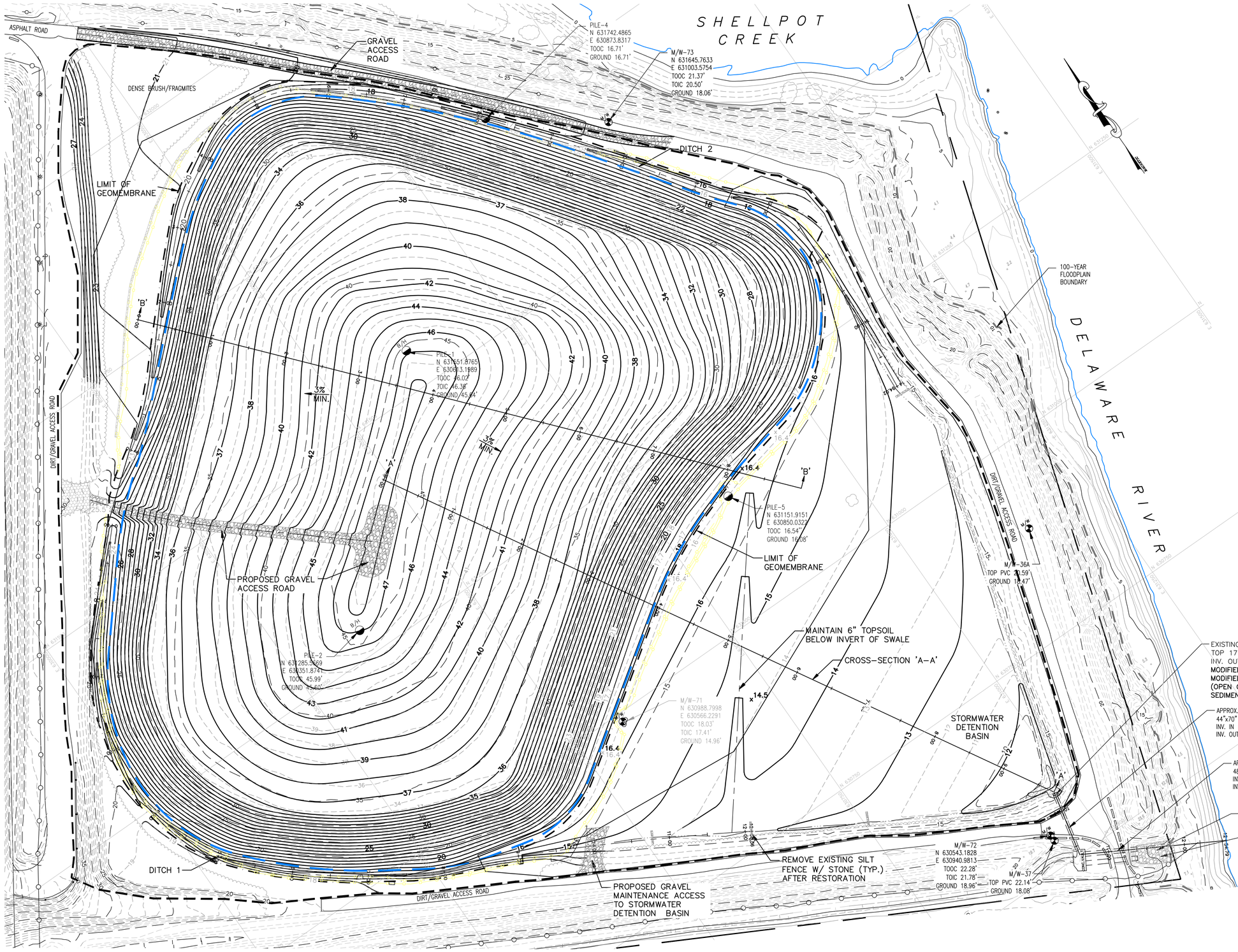
DATE	8/7/09

INTERMEDIATE GRADING PLAN

DuPONT HAY ROAD
SLUDGE DRYING SITE
(DE-0024)

REVISION 0
PROJECT 18985726
DRAWING
SHEET 7

THIS DRAWING DOES NOT INCLUDE NECESSARY COMPONENTS FOR CONSTRUCTION SAFETY. ALL CONSTRUCTION MUST BE DONE IN COMPLIANCE WITH THE CURRENT OCCUPATIONAL SAFETY AND HEALTH ACT AND ALL RULES AND REGULATIONS THERETO AND APPURTENANT.



GENERAL NOTES:

1. DESIGN CRITERIA FOR COVER THICKNESS: 18" MINIMUM COVER SHALL BE MAINTAINED OVER THE IRON-RICH MATERIAL INSIDE THE "EDGE OF CAP" BOUNDARY. A 5% MINIMUM CROSS SLOPE SHALL BE MAINTAINED OVER THE TOP OF THE IRON-RICH MATERIAL.
2. 100-YEAR FLOODPLAIN BOUNDARY BASED ON FEMA FIRM MAP #10003C0160 J DATED JANUARY 17, 2007. 100-YEAR ELEVATION OF 9 FEET IN NAVD88 AS REPORTED IN FIRM MAP.
3. FEMA FLOOD INSURANCE STUDY OF CITY OF WILMINGTON, NEW CASTLE COUNTY, DELAWARE (10003CV0008), DATED JANUARY 17, 2007, INDICATES 500-YEAR FLOOD ELEVATION IS 10.7 FEET.
4. THE FINAL GRADES WITHIN THE CAP SHOWN HERE ARE APPROXIMATE. UNIFORMLY CONTOUR FINAL GRADES TO MEET THE FOLLOWING REQUIREMENTS:
   A. MAXIMUM SLOPE: 4H:1V
   B. MINIMUM SLOPE: 3%
   C. MINIMUM COVER ABOVE INTERMEDIATE GRADE: 18"
5. CONTRACTOR SHALL MAINTAIN SMOOTH CAP SURFACE AND PREVENT PONDING AND CONCENTRATED RUNOFF ON THE CAP.

LEGEND:

— — —35— — — EXISTING CONTOUR

———35——— PROPOSED FINAL GRADE

811 Know what's below. Call before you dig.

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FINAL GRADING PLAN

DuPONT HAY ROAD
SLUDGE DRYING SITE
(DE-0024)

REVISION 0
PROJECT 18985726
DRAWING
SHEET 8

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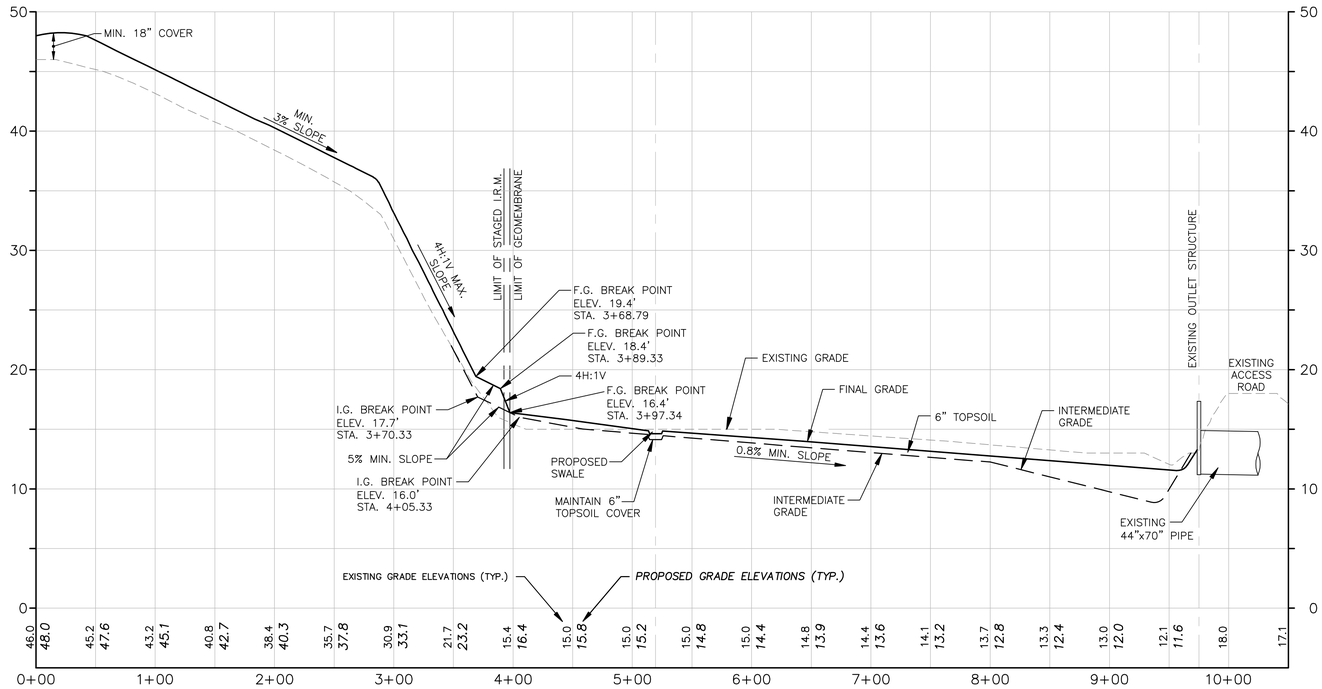
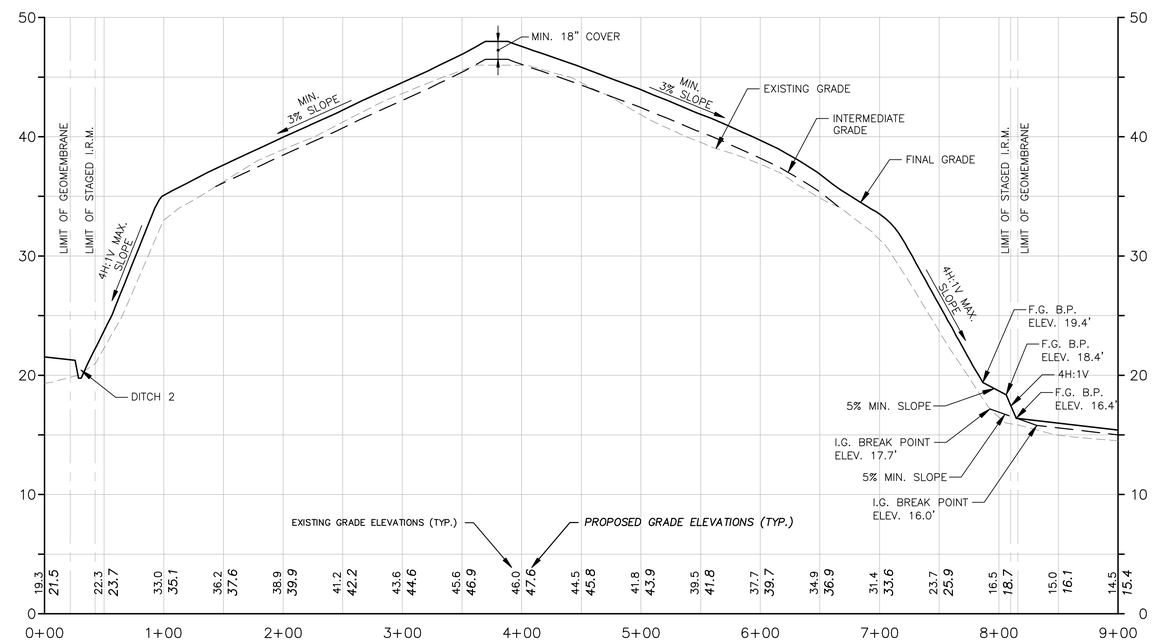


CROSS–SECTION A–A

SCALE: HORIZ. 1" = 60'
VERT. 1" = 6'



CROSS–SECTION B–B

SCALE: HORIZ. 1" = 60'
VERT. 1" = 6'

10X VERTICAL EXAGGERATION

HORIZONTAL SCALE

VERTICAL SCALE

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CROSS–SECTIONS

DuPONT HAY ROAD
SLUDGE DRYING SITE
(DE–0024)

REVISION 0
PROJECT 18985726
DRAWING
SHEET 9

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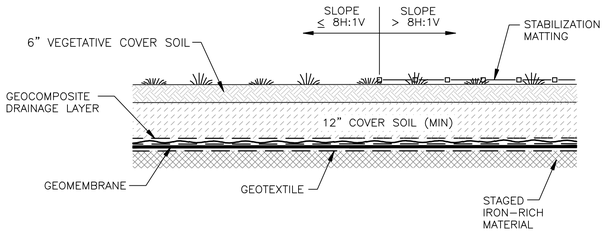
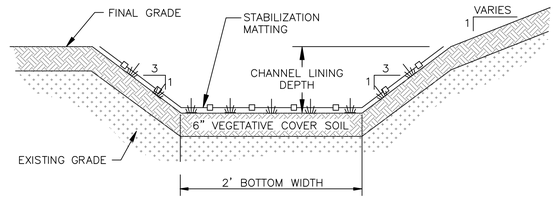


DETAIL 1

CAP SYSTEM CROSS-SECTION (TYP.)

(N.T.S.)

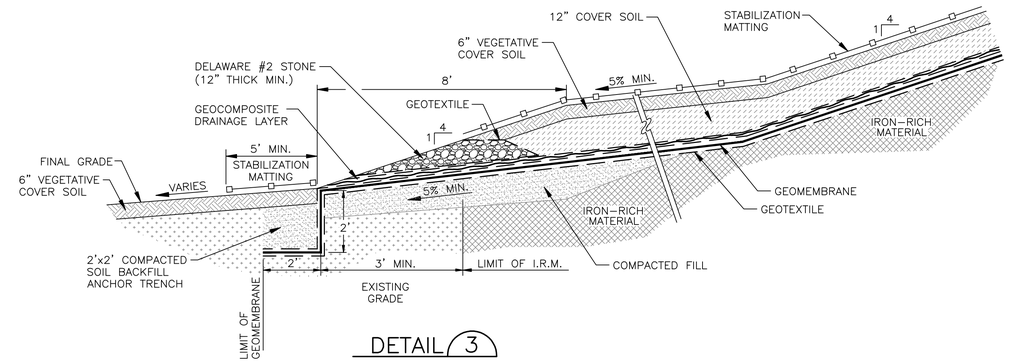


DITCH SCHEDULE			
DITCH	START	END	CHANNEL LINING DEPTH (FT)
1	0+00 5+10	5+10 9+50	1.5' 2.0'
2	0+00 1+80	1+80 13+00	1.5' 2.0'

DETAIL 2

GRASS-LINED DITCH

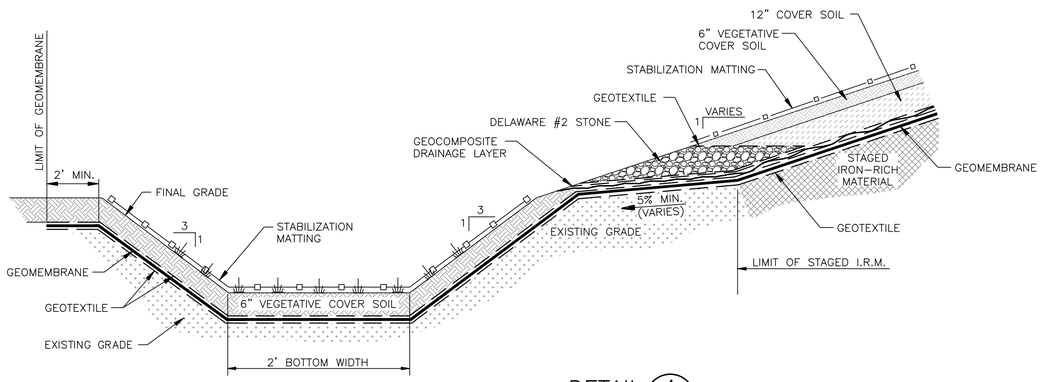
(N.T.S.)



DETAIL 3

TERMINATION DETAIL DAYLIGHT TO SLOPE

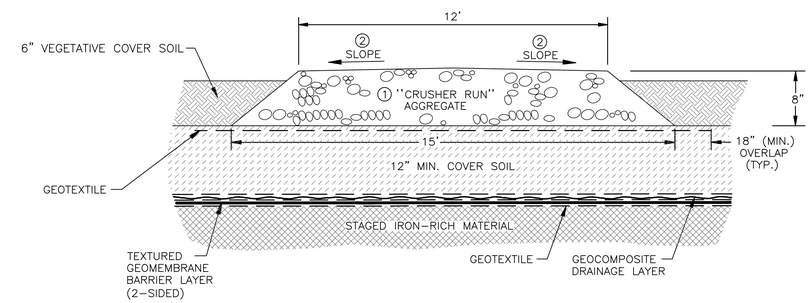
(N.T.S.)



DETAIL 4

TERMINATION DETAIL DAYLIGHT TO DITCH

(N.T.S.)



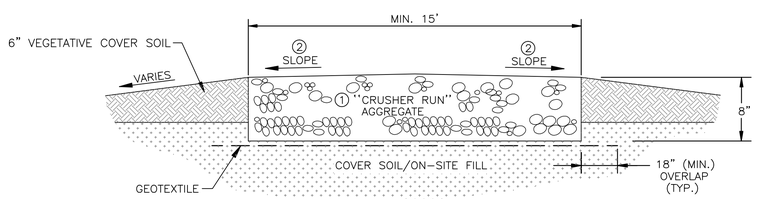
SPECIFIC NOTES:

1. AGGREGATE SHALL BE AS SPECIFIED IN SECTION 02730: AGGREGATE SURFACING OF THE TECHNICAL SPECIFICATIONS.
2. SEE FINAL GRADING PLAN FOR CROSS SLOPE DIRECTION.

DETAIL 5

TYPICAL GRAVEL ACCESS ROADWAY (ON-CAP)

(N.T.S.)



SPECIFIC NOTES:

1. AGGREGATE SHALL BE AS SPECIFIED IN SECTION 02730: AGGREGATE SURFACING OF THE TECHNICAL SPECIFICATIONS.
2. SEE FINAL GRADING PLAN FOR CROSS SLOPE DIRECTION.

DETAIL 6

TYPICAL GRAVEL ACCESS ROADWAY (OFF-CAP)

(N.T.S.)

GENERAL NOTES:

1. GEOTEXTILE SHALL BE AS SPECIFIED IN SECTION 02073: GEOTEXTILES OF THE TECHNICAL SPECIFICATIONS.
2. GEOCOMPOSITE DRAINAGE LAYER SHALL BE AS SPECIFIED IN SECTION 02077: GEOCOMPOSITE DRAINAGE LAYER OF THE TECHNICAL SPECIFICATIONS.
3. GEOMEMBRANE SHALL BE AS SPECIFIED IN SECTION 02079: GEOMEMBRANES OF THE TECHNICAL SPECIFICATIONS.

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CAP SYSTEM DETAILS

DuPONT HAY ROAD
SLUDGE DRYING SITE
(DE-0024)

REVISION	0
PROJECT	18985726
DRAWING	SHEET 10

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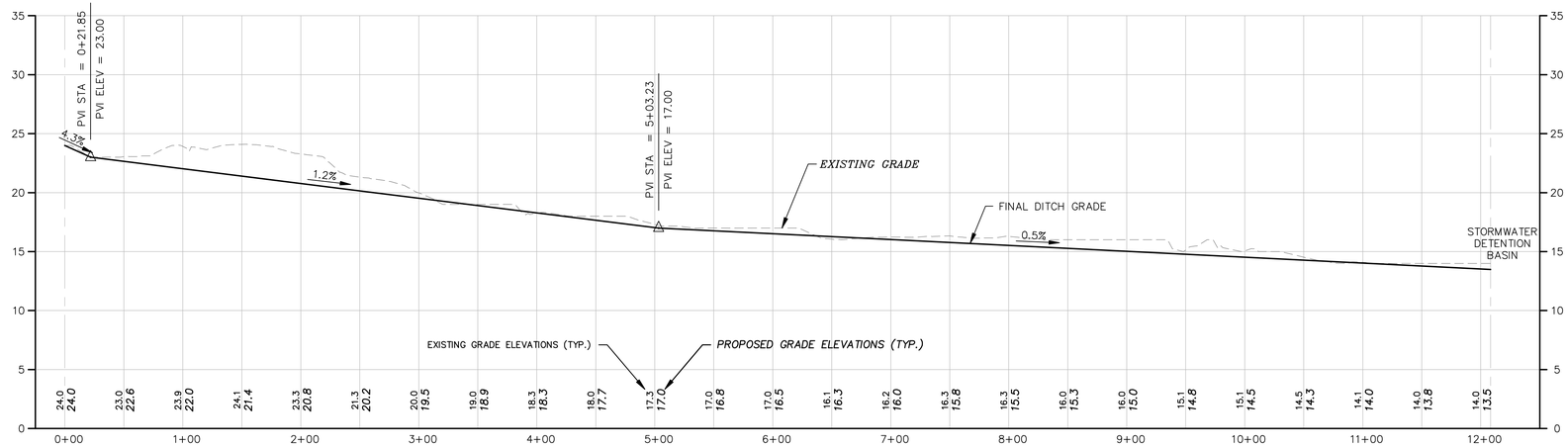
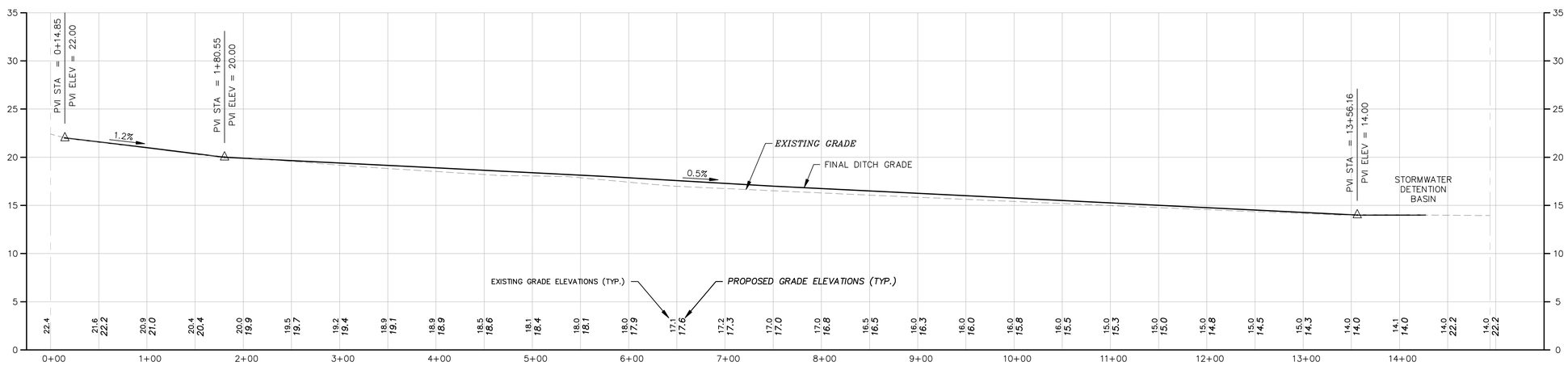
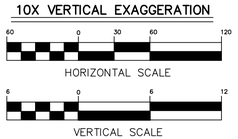


DITCH 1 PROFILE



DITCH 2 PROFILE

10X VERTICAL EXAGGERATION



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DRAINAGE DITCH PROFILES

DuPONT HAY ROAD
SLUDGE DRYING SITE
(DE-0024)

REVISION 0
PROJECT 18985726
DRAWING
SHEET 11