WENCK File 3053-0046
October 2016

SKB Lansing Run-on/Run-off Control and Closure Plan and Post Closure Plan Updates

Prepared for:

SKB (Austin) Environmental, LLC

251 Starkey Street
St. Paul, Minnesota
55107

WENCK ASSOCIATES

Responsive partner.
Exceptional outcomes.

Prepared by:

WENCK Associates, Inc.
1800 Pioneer Creek Center
Maple Plain, MN 55359
Phone: 763-479-4200
Fax: 763-479-4242

Table of Contents

Table of Contents (cont.)

FIGURES

APPENDICES

1.0 Introduction

1.1 PURPOSE

This report consists of the following documents that meet the requirements of the new federal rules regarding land disposal of a Coal Combustion Residual (CCR) material.

- Section 2 - Run-on and Run-off Control Plan (Rule § 257.81)
- Section 3 – Criteria for Conducting Closure or Retrofit of CCR units (Rule § 257.102)
- Section 4 - Post Closure Care Requirements (Rule § 257.104)

Many requirements of this report are addressed by the Facility Closure Plan, Facility Post-Closure Plan and Contingency Action Plan, Sections 7.0, 8.0, and 9.0 of the Permit Renewal and Modification Report (June 2016 Plan) respectively, prepared and submitted for the SKB Lansing Landfill (Lansing) facility as part of the State solid waste permit submittal. Where requirements of this report are addressed in this plan, the section within that plan that addresses the rule requirement is referenced.

1.2 FACILITY DESCRIPTION

SKB (Austin) Environmental, LLC owns and operates the Lansing Landfill. The site is a Class III demolition landfill, which is also permitted to accept industrial solid waste, located on an approximately 40 acre parcel of land located at Section 21, Township 103 North, Range 18 West, Mower County with a street address of 52563 243rd St in Austin, Minnesota.

The facility is operating under the MPCA Solid Waste Permit SW-514, last issued on December 12, 2011. A permit renewal application was submitted to the MPCA in June 2016.

The landfill facility, as permitted, will be developed in five (5) Phases. Phase 1 has been inactive since 2011. Filling is currently in progress in Phase 2. Phase 3 is under construction in summer 2016. Phases 4-5 will be excavated as needed for development. As specified in MPCA Permit SW-514, the landfill is currently permitted to receive 1,930,000 cubic yards (Phases 1 through 5) of industrial waste co-disposed with demolition and construction debris. A permit modification application has been submitted to the MPCA to design the final cover slopes to 4H:1V rather than the permitted 5H:1V, which would result in an ultimate capacity of 2,519,000 cubic yards (to top of final cover). CCR materials are disposed of under the sites Industrial Solid Waste Management Plan.

The attached Figure 1 presents a site location and a site layout is provided on Figure 2.

2.0 Run-on and Run-off Control (Rule § 257.81)

2.1 RUN-ON AND RUN-OFF CONTROL SYSTEMS

Lansing has developed a run-on and run-off control system to prevent flow onto and off of the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm in accordance with this requirement.

This section satisfies the requirements of Rule 257.81(a)(1) and Rule 257.81(a)(2).

2.2 RUN-OFF HANDLING REQUIREMENTS

Run-off from the active portion of the CCR unit will be handled in accordance with the surface water requirements under Rule 257.3-3, by complying with the following requirements.

The facility will comply with the requirements of its National Pollutant Discharge Elimination System (NPDES) permit and their MPCA Solid Waste Permit (SW-514). Lansing shall not cause a discharge of dredged material or fill material to waters of the United States that is in violation of the requirements under section 404 of the Clean Water Act, as amended, nor will it cause non-point source pollution of waters of the United States that violates applicable legal requirements implementing an area wide or Statewide water quality management plan that has been approved by the Administrator under section 208 of the Clean Water Act, as amended.

This section satisfies the requirements of Rule 257.81(b).

2.3 RUN-ON AND RUN-OFF CONTROL SYSTEM PLAN

2.3.1 Initial Plan

Lansing has prepared initial run-on and run-off control system plans for the CCR disposal areas. They will amend the plan whenever there is a change that would substantially affect this plan and will revise the plan every five years beginning with the effective date of this plan. The effective date of this plan is the date it is placed into the facility's operating record as required by Rule 257.105(g)(3).

Calculations and figures demonstrating that the sites run-on and run-off control systems manage the peak discharge from a 25 year 24 hour storm event are provided in the June 2016 Plan, which is included as Appendix A.

This section satisfies the requirements of Rule 257.81(c)(1).

2.3.2 Amendment of the Plan

Amendments to the plan will be made whenever there's a change that would substantially affect this plan.

This section satisfies the requirements of Rule 257.81(c)(2).

2.3.3 Timeframes for Preparing the Initial Plan

The site meets the definition of an Existing CCR Landfill and therefore this plan will be placed into the facilities operating record on or before October 17, 2016 as required by Rule 257.281(c)(3).

2.3.4 Frequency for Revising the Plan

This plan will be revised every 5 years as required by Rule 257.281(c)(4) and placed into the facilities operating record as required by Rule 257.281(g)(3).

2.3.5 Certification

This report, including the initial run-on and run-off control plan is signed by a professional engineer registered in the state of Minnesota, meeting the certification requirements of Rule 257.81(c)(5).

2.4 RECORDKEEPING REQUIREMENTS

Recordkeeping requirements are outlined in Section 5 of this report.

3.0 Closure of CCR Units (Rule § 257.102)

3.1 CLOSURE AND POST CLOSURE PLAN

Closure of the landfill will be completed by leaving the CCR in place and installing a final cover system, in accordance with Rule 257.102(b) and 257.102 (d)-(j). Rule 257.102(c) addresses closure by removal of CCR. This rule is not applicable to the site and is not discussed further herein.

Section 4.8 of the June 2016 Plan describes the final cover system proposed.

3.2 CONTENT OF CLOSURE PLAN

The content of the Closure Plan is discussed below.

3.2.1 Rule 257.102(b)(1)(i) Closure Narrative

Closure of the CCR unit will be in accordance with the procedures described in Section 5.4 of the June 2016 Plan and as described in the subsequent portions of Section 3.1.1 of this Plan.

3.2.2 Rule 257.102(b)(1)(ii) Removal of CCR

Lansing does not plan to complete the closure through removal of CCR and decontamination of the unit. If, in the future, Lansing decides to consider closure in this manner, the Plan will be amended to include a new procedure for the closure.

3.2.3 Rule 257.102(b)(1)(iii) Leaving CCR in Place

Closure of the landfill will be completed by leaving the CCR in place and installing a final cover system, as described in Sections 5.4 and 7.0 of the June 2016 Plan.

3.2.4 Rule 257.102(b)(1)(iv) Volume of CCR

Lansing began accepting CCR in the year 2015. The estimated maximum inventory of CCR ever on site over the active life of the unit is 120,000 cubic yards, which is based on an assumed disposal rate of 20,000 cubic yards per year over the remaining six years of permitted site life. There are currently five years of permitted capacity remaining, however it should be noted that the site is seeking a vertical expansion.

3.2.5 Rule 257.102(b)(1)(v) Largest Closure Area

The site may be closed in phases, however the largest closure area anticipated over the life of the site is approximately 13.2 acres.

3.2.6 Rule 257.102(b)(1)(vi) Schedule

The CCR unit at Lansing Landfill will be closed in phases as fill progresses to final waste grades. Each closure project's anticipated milestone schedule is shown below.

MILESTONE	DURATION
Prepare Construction Documents	2 months
Submit for Review	2 Weeks
Solicit bids/retain contractor (concurrent with MPCA review)	1 month
Complete Construction	2-3 months
Prepare Certification Report and Place in facility Operating Record	2 Weeks
Obtain MPCA Approval of Certification Report	2 Weeks

The MPCA will be provided a copy of the plans and specifications for each closure project in accordance with the requirements of Solid Waste Permit SW-514 and each closure project is anticipated to take two (2) to three (3) months to complete.

Final closure is anticipated in 2021 pending approval of the permit modification allowing for a vertical expansion.

3.2.7 Timeframe for Preparing the Initial Closure Plan

The site meets the definition of an Existing CCR Landfill and therefore this Plan will be placed into the facilities operating record on or before October 17, 2016 as required by Rule 257.102(b)(2).

3.2.8 Amendment of Closure Plan

Lansing will amend this Plan whenever:

- There is a change in the operation of the CCR unit that would substantially affect the written closure plan in effect; or
- Before or after closure activities have commenced; or
- Unanticipated events necessitate a revision of the written closure plan.

Lansing will amend this plan at least 60 days prior to a planned change in the operation of the landfill, or no later than 60 days after an unanticipated event requires the need to revise the existing Closure Plan.

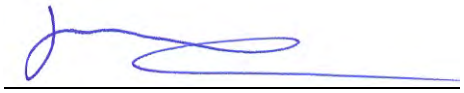
If this Plan is revised after closure activities have commenced, Lansing will amend this Closure Plan within 30 days of the triggering event. Additionally at a minimum, the Closure Plan will be reviewed and updated, if needed, at the time of MPCA Solid Waste Permit renewal (every 10 years).

This section satisfies the requirements of Rule 257.81(102)(b)(3).

3.2.9 Professional Engineer Certification

This report is signed by a professional engineer, meeting the certification requirements of Rule 257.102 (b)(4) as provided below:

I hereby certify that this engineering document was prepared by me or under my direct supervision and that I am a duly registered Professional Engineer under the laws of the State of Minnesota.



David M. Parenteau October 11, 2016
PE # 41243

3.3 CLOSURE PERFORMANCE STANDARD WHEN LEAVING CCR IN PLACE

3.3.1 Manner of Closure

The planned closure meets the requirements of subparts i-iv of Rule 257.102(d)(1), as described below.

3.3.1.1 Rule 257.102(d)(1)(i) Minimize Infiltration

The final cover system described within the June 2016 Plan above is designed to minimize infiltration of liquids into the waste to the extent possible. Stormwater generated by the landfill will be controlled on-site. Runoff will be controlled and routed by drainage swales, downslope structures, and four infiltration basins as shown in the drawings. Drainage routing features have all been sized to minimize erosion from the site.

3.3.1.2 Rule 257.102(d)(1)(ii) Future Impoundment

The expected differential settlement that could result in future impoundment of water on the final cover is minimized by the final cover geometry (slopes ranging from 2% to 25%) and the fact that there is negligible settlement of the waste expected.

3.3.1.3 Rule 257.102(d)(1)(iii) Slope Stability

The final cover system utilizes a textured geomembrane and a double sided geonet geocomposite drainage layer on the side slopes, resulting in a final cover system that typically provides a factor of safety of 1.5 or greater against sloughing or movement of the final cover system over the life of the site.

3.3.1.4 Rule 257.102(d)(1)(iv) Maintenance

All closure systems, including but not limited to: the final cover system, the leachate collection system, the groundwater monitoring system and the infiltration basin system, are designed to require as little future maintenance as possible. Regular inspections will be completed to identify any maintenance requirements to fix any issues in a timely manner.

In addition, the MPCA requires that there be financial assurance and contingency action plans in place for the duration of the 20 year post closure care period.

3.3.1.5 Rule 257.102(d)(1)(v) Schedule

The closure will be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices.

3.4 STABILIZATION OF WASTE FOR CCR IMPOUNDMENT

The requirement of rule 257.102(d)(2) is not applicable. Lansing does not operate a CCR surface impoundment.

3.5 FINAL COVER SYSTEM

3.6 RULE 257.102(D)(3)(I) FINAL COVER SYSTEM DESIGN

Lansing is proposing an alternate final cover system, therefore the requirements of Rule 257.102(d)(3)(i) are replaced with the requirements Rule 257.102(d)(3)(ii) described in the next paragraphs.

3.6.1 Rule 257.102(d)(3)(ii) Alternate Final Cover System Design

The proposed final cover system is designed to minimize infiltration and erosion, and at a minimum, meets the requirements of Rule 257.102(d)(3)(ii) for an alternate final cover system.

Rule 257.102(d)(3)(ii) requires the alternate final cover system to meet the following criteria:

- Infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in Rule 257.102(d)(3)(i)(A) and (B).
- Erosion layer that provides equivalent protection from wind or water erosion as the erosion layer specified in Rule 257.102(d)(3)(i)(C).
- Rule 257.102(d)(The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.

Rule 257.102(d)(3)(i)(A) requires that the permeability of the final cover system must be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1x10-5 cm/sec, whichever is less.

This requirement is met by the use of a 40 mil LLDPE geomembrane or proposed clay barrier layer component.

Rule 257.102(d)(3)(i)(B) requires that the infiltration of liquids through the closed CCR unit must be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.

This requirement is met due to the proposed final cover systems each having an efficiency that approaches 99% and include 18 inches of cover soils above the LLDPE or clay barrier, and the final cover system includes a drainage layer.

Rule 257.102(d)(3)(i)(C) requires that erosion of the final cover system must be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

The proposed 6" topsoil layer within the final cover system meets this requirement.

Due to the nature of the site soils and the waste, settlement and subsidence at the site are expected to be minimal with negligible effects on the final cover system.

3.6.2 Rule 257.102(d)(3)(iii) Certification

The design of the final cover system in the site permitting documents was signed by a professional engineer and this plan will also be signed by a professional engineer.

3.7 INITIATION OF CLOSURE ACTIVITIES

Closure time frames were discussed in Section 3.1.1.1 of this report, meeting the requirements of Rule 257.102(e)(1). Since the timeframes of Rule 257.102(e)(1) will be met, the requirements of Rule 257.102(e)(2) do not apply.

Should Lansing anticipate a period of 2 years or longer without receipt of CCR, and without commencing closure, this Plan may be amended, with the appropriate documentation and justification.

According to Rule 257.102(e)(3) closure commencement occurs when Lansing performs as any of the following:

i. Takes any steps necessary to implement the written closure plan
ii. Submits a completed application for any required state or agency permit or permit modification; or
iii. Takes any steps necessary to comply with any state or other agency standards that are a prerequisite, or are otherwise applicable, to initiating or completing the closure of a CCR unit.

3.7.1 Rule 257.102(e)(4) Timeframe Exceptions

Rule 257.102(e)(4) states that the timeframes outlined above do not apply to any of the following owners or operators:

i. An owner or operator of an inactive CCR surface impoundment closing the CCR unit as required by Rule 257.100(b);
ii. An owner or operator of an existing unlined CCR surface impoundment closing the CCR unit as required by Rule 257.101(a);
iii. An owner or operator of an existing CCR surface impoundment closing the CCR unit as required by Rule 257.101(b);
iv. An owner or operator of a new CCR surface impoundment closing the CCR unit as required by Rule 257.101(c); or
v. An owner or operator of an existing CCR landfill closing the CCR unit as required by Rule 257.101(d).

Subparts (e)(4)(i) through (iv) do not apply as Lansing does not operate a CCR surface impoundment. Subpart (e)(4)(v) does not apply because Lansing is in compliance with the location restriction for unstable areas specified in Rule 257.64(a).

This section meets the requirements of Rule 257.102(e) and its subparts.

3.8 COMPLETION OF CLOSURE ACTIVITIES

The closure schedules described herein meet the requirements of Rule 257.102(f)(i) for existing CCR landfills. Should an extension be required, the procedures outlined in Rule 257.102(f)(ii) will be followed.

3.8.1 Rule 257.102(f)(3) Professional Engineer Certification

Upon completion of the closure a professional engineer will certify a report, verifying that the closure was completed in accordance with this closure plan and other approved closure plan documents.

3.9 NOTIFICATION OF INTENT TO CLOSE A CCR UNIT

As required by Rule 257.102(g); Prior to closure of a CCR unit, Lansing will complete the notification of intent to close a CCR unit, including the professional engineer certification as required.

3.10 NOTIFICATION OF CLOSURE

As required by Rule 257.102(h); within 30 days of completion of closure of a CCR unit, Lansing will complete the notification of closure of a CCR unit, including the professional engineer certification as required. The notification will be placed into the facility's operating record as required by Rule 257.105(i)(8).

3.11 DEED NOTATIONS

As required by Rule 257.102(i), the following notations will be made on the deed or other instrument normally examined during a title search:

- The notation on the deed will in perpetuity notify any potential purchaser of the property that:
  (i) The land has been used as a CCR unit; and
  (ii) Its use is restricted under the post- closure care requirements as provided by Rule 257.104(d)(1)(iii).
- Within 30 days of recording a notation on the deed to the property, Lansing will prepare a notification stating that the notation has been recorded. The notification is complete when it has been placed in the facility's operating record as required by Rule 257.105(i)(9).

3.12 RULE 257.102(J) RECORDKEEPING

Recordkeeping requirements are outlined in Section 5 of this report.

4.0 Post-Closure Care Requirements (Rule § 257.104)

4.1 APPLICABILITY

Lansing is not closing by removing the CCR, and is not an inactive surface impoundment, therefore the requirements of Rule 257.104 apply.

4.2 RULE 257.104(B) POST-CLOSURE CARE MAINTENANCE REQUIREMENTS

Following closure of the landfill, Lansing will conduct post-closure care for the site which is described in Section 8.0 of the June 2016 Plan.

4.2.1 Rule 257.104(b)(1) Final Cover System

Section 4.8 of the June 2016 Plan addresses this requirement.

4.2.2 Rule 257.104(b)(2) Leachate Collection and Removal System

Section 4.6 of the June 2016 Plan addresses this requirement.

4.2.3 Rule 257.104(b)(3) Groundwater Monitoring System

There are five (5) downgradient wells from the fill area as well as two (2) upgradient wells serving as the environmental monitoring system. The relative position of each monitoring point to the existing and future waste disposal areas is based on the predominant southeasterly groundwater flow direction. The existing MPCA approved monitoring system, along with any modifications, will continue to provide for groundwater quality monitoring and early detection of potential detections that may be related to waste disposal at the facility.

Any revisions and enhancements to the sites monitoring network, sampling and analysis plan and Contingency Action Plans, required to meet the requirements of Rules 257.90 through 257.98 will be implemented no later than October 17, 2017.

4.3 POST-CLOSURE CARE PERIOD

4.3.1 Rule 257.104(c)(1) Post-Closure Care Timeframe

Lansing will conduct post-closure care for 30 years in accordance with this section.

4.3.2 Rule 257.104(c)(2) Assessment Monitoring Requirement

If assessment monitoring in accordance with Rule 257.95 becomes necessary, Lansing will continue to conduct post-closure care and follow the Contingency Action Plan until the site can return to routine detection monitoring.

4.4 RULE 257.104(D) WRITTEN POST-CLOSURE PLAN

4.4.1 Rule 257.104(d)(1) Content of the Plan

Lansing has prepared this written post-closure plan that includes, the information specified in Rule 257.104(d)(1)(i) through (iii).

i. A description of the monitoring and maintenance activities required for the CCR unit, and the frequency at which these activities will be performed;

   This is presented in Table 4 of the June 2016 Plan.

ii. Contact after closure is:
   Mr. John Domke
   Division Vice President
   SKB (Austin) Environmental, LLC
   251 Starkey Street
   St. Paul, MN 55107

iii. Ultimate Land Use

Currently it is assumed that SKB will retain control of the site, so there will be no disturbance to the covers, base liner, leachate collection system, or monitoring system unless approval is obtained from the MPCA. If the property is sold, the deed will document any restrictions.

4.4.2 Rule 257.104(d)(2) Deadline to Prepare Initial Written Post-Closure Plan

Lansing will prepare the initial written closure plan prior to October 17, 2016. The written post-closure plan, with certification, will be placed in the facility's operating record once complete.

4.4.3 Rule 257.104(d)(3) Amendment of a Written Post-Closure Plan

Lansing will amend the written post-closure plan whenever:

- There is a change in the operation of the landfill that would substantially affect the written post-closure plan in effect; or
- After post-closure activities have commenced, unanticipated events necessitate a revision of the written post-closure plan.

Lansing will amend the Post Closure plan at least 60 days prior to a planned change in the operation of the landfill, or no later than 60 days after an unanticipated event requires the need to revise the existing Post Closure Plan.

If a written closure plan is revised after closure activities have commenced, Lansing will amend this Post Closure Plan within 30 days of the triggering event. Additionally at a minimum, the Closure Plan will be reviewed and updated, if needed, at the time of MPCA Solid Waste Permit renewal (every 10 years).

This section satisfies the requirements of Rule 257.81(104)(d)(3).

4.4.4 Rule 257.104(d)(4) Professional Engineer Certification

This report, is signed by a professional engineer, meeting the certification requirements of Rule 257.104(d)(4).

4.5 RULE 257.104(E) NOTIFICATION OF COMPLETION OF POST-CLOSURE CARE PERIOD

As required by Rule 257.104(e); Within 60 days of completion of Post Closure Care period, Lansing will complete a notification that Post Closure Care has been completed The notification will include the certification by a professional engineer verifying that post-closure care has been completed in accordance with the Closure Plan and the Post Closure Plan. The owner or operator has will place the notification in the facility's operating record as required by Rule 257.105(i)(13).

4.6 RULE 257.104(F) RECORDKEEPING

Recordkeeping requirements are outlined in Section 5 of this report.

5.0 Recordkeeping Requirements (Rule § 257.105(g))

5.1 RECORD KEEPING REQUIREMENTS

As required by Rule 257.105 (g), the owner or operator of a CCR unit subject to this subpart must place the following information, as it becomes available, in the facility's operating record:

- The Runoff/Run-on Control Plan, Closure Plan and Post Closure Plan, and any subsequent amendment of the plans, except that only the most recent plans must be maintained in the facility's operating record.

Each owner or operator of a CCR unit subject to the requirements of this subpart must maintain files of all information required by this section in a written operating record at their facility.

- Unless specified otherwise, each file must be retained for at least five years following the date of each occurrence, measurement, maintenance, corrective action, report, record, or study.
- An owner or operator of more than one CCR unit subject to the provisions of this subpart may comply with the requirements of this section in one recordkeeping system provided the system identifies each file by the name of each CCR unit. The files may be maintained on microfilm, on a computer, on computer disks, on a storage system accessible by a computer, on magnetic tape disks, or on microfiche.

The owner or operator of a CCR unit must submit to the State Director and/or appropriate Tribal authority any demonstration or documentation required by this subpart, if requested, when such information is not otherwise available on the owner or operator's publicly accessible Internet site.

5.2 NOTIFICATION REQUIREMENTS

As required by Rule 257.106(g), the owner or operator of a CCR unit subject to this subpart must notify the State Director and/or appropriate Tribal authority when information has been placed in the operating record and on the owner or operator's publicly accessible internet site. The owner or operator must:

- Provide notification of the availability of the Runoff/Run-on Control Plan, Closure Plan and Post Closure Plan, and any subsequent amendment of the plans.

The notifications must be sent to the relevant State Director and/or appropriate Tribal authority before the close of business on the day the notification is required to be completed. Before the close of business means the notification must be postmarked or sent by electronic mail (email). If a notification deadline falls on a weekend or federal holiday, the notification deadline is automatically extended to the next business day.

5.3 INTERNET REQUIREMENTS

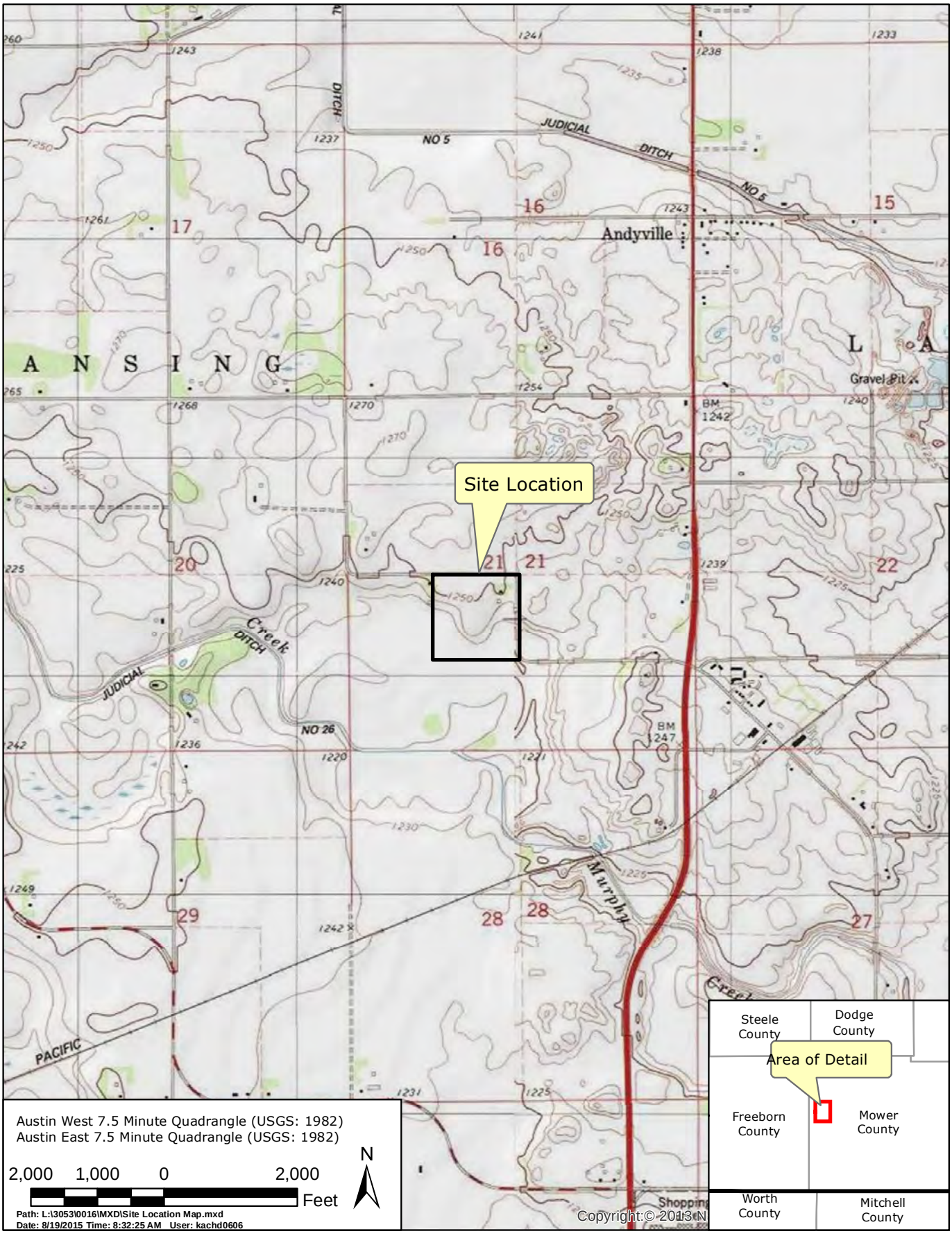
As required by Rule 257.107(g), the owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

- The Runoff/Run-on Control Plan, Closure Plan and Post Closure Plan, and any subsequent amendment of the plans, except that only the most recent plans must be maintained in the facility's operating record.

The owner or operator's Web site must be titled "CCR Rule Compliance Data and Information." The same internet site may be used for multiple CCR units provided the CCR Web site clearly delineates information by the name or identification number of each unit.

The information required to be posted to the CCR Web site must be made available to the public for at least five years following the date on which the information was first posted to the CCR Web site. The information must be posted to the CCR Web site within 30 days of placing the pertinent information in the operating record.

Figures



SKB LANSING LANDFILL	WENCK ASSOCIATES Responsive partner. Exceptional outcomes.	SEP 2016
Site Location Map		Figure 1

Appendix A

July 2016, Closure Post Closure Plan

WENCK File #3053-0042
June 2016

Permit Renewal and Modification Report for SKB Lansing Landfill Permit No. SW-514

Prepared for:

SKB (Austin) Environmental, LLC

251 Starkey Street
St. Paul, Minnesota
55107

WENCK ASSOCIATES

Responsive partner.
Exceptional outcomes.

Prepared by:

WENCK Associates, Inc.
1800 Pioneer Creek Center
Maple Plain, MN 55359
Phone: 763-479-4200
Fax: 763-479-4242

Table of Contents

Table of Contents (Cont.)

Table of Contents (Cont.)

TABLES

FIGURES

APPENDICES

1.0 Introduction

1.1 SITE INTRODUCTION

This Permit Renewal and Modification submittal prepared by Wenck Associates on behalf of SKB (Austin) Environmental, LLC (SKB) is intended to provide an updated permit application for the reissuance of the SKB Lansing Landfill, SW-514 (Landfill) as well as a permit modification document to increase the final cover slopes at the Landfill from 5H:1V to 4H:1V and an increase in final cover elevation from 1297 feet MSL to 1362 feet MSL. This application contains the following information:

- Site Analysis
- Engineering Design Report
- Site Development Plan
- Operations Plan
- Facility Closure Plan
- Facility Post-Closure Plan
- Contingency Action Plan

This report provides a discussion of the site information and presented in a format designed to facilitate the Minnesota Pollution Control Agency (MPCA) review of the drawings, hydrogeology, operations, design, closure, and post-closure care for the permit reissuance of the SKB Lansing Landfill in accordance MPCA Solid Waste Management Rules, Mower County, and Lansing Township.

1.2 PERMIT HISTORY

Permit SW-514 was issued to Lansing Landfill Facility by the MPCA on June 3, 1996. On August 8, 2001, a Permit Reissuance Application was signed and sent to the MPCA on behalf of the previous owner, Richard L. Wehner, the President and CEO of Lansing Landfill, Inc. On December 21, 2001, SKB purchased Lansing Landfill Facility from Richard L. Wehner. Following the Landfill purchase by SKB, a Permit Renewal Application for SKB Lansing Landfill Facility dated March 14, 2002 was submitted to replace the August 8, 2001, Permit Reissuance application.

The MPCA modified the permit in 2005 to add electronic data submission of groundwater data to the permit and again in 2007 to alter the monitoring frequency of a few groundwater parameters.

SKB submitted permit applications to the MPCA in May of 2007 and September of 2011. The MPCA issued a new permit on December 12, 2011. In the 2011 permit, the MPCA authorized a change in Facility to install a liner and leachate collection system and become a Class III demolition debris landfill per the MPCA August 2005 guidance document.

This submittal is based on current MPCA guidance document for Class III demolition debris disposal landfills and in accordance with the demolition debris MPCA design rules in Minnesota Rules (MR) 7035.2825.

1.3 GENERAL SITE DESCRIPTION

Facility:	SKB Lansing Landfill, SW-514 52563 243rd Street Austin, MN 55912
Site Permittee and Operator:	SKB (Austin) Environmental, LLC 251 Starkey Street St. Paul, MN 55107 (651) 224-6329
Primary Contact:	John Domke, Division Vice President Geoffrey Strack, P.E., Regional Engineer
Land Owner:	SKB (Austin) Environmental, LLC 251 Starkey Street St. Paul, MN 55107 (651) 224-6329
Engineering Consultant:	Wenck Associates, Inc. 1800 Pioneer Creek Center Maple Plain, MN 55359
Contact:	Thomas J. Shustarich, P.E., Senior Project Manager 763-479-4200 tshustarich@wenck.com
Area Served:	Southern Minnesota area around Austin, MN
Waste Types:	Construction and demolition (C&D) debris and industrial solid waste as outlined in the approved Industrial Solid Waste Management Plan (ISWMP)
Zoning:	Agricultural, Conditional Use Permit (CUP) for a landfill
Landfill Size:	40 acres
General Location:	Northeast Quarter Southwest Quarter Section 21, Township 103 North, Range18 West, Lansing Township, Mower County
Current Ultimate Site Life:	5.5 years as of November 2015
Proposed Ultimate Site Life:	8 years as of November 2015

Current Ultimate Capacity:	1,930,000 cubic yards of airspace
Proposed Ultimate Capacity:	2,519,000 cubic yards (top of drainage layer to top of final cover
Estimated Annual Waste Volume:	224,000 in place cubic yards (based on 2015 annual report)

1.4 SCOPE OF SUBMITTAL

This submittal serves as a permit renewal application and also modifies the landfill design capacity by requesting a variance to design the final cover slopes to 4H:1V rather than the permitted 5H:1V. In addition, this application proposes to raise the final height of the landfill from 1297 feet MSL to 1362 feet MSL. These two changes increase the ultimate design volume by 589,000 cubic yards. The sequence of disposal is also revised to reflect a more efficient operating sequence that will help to reach final grades in a more expedient manner.

2.0 Site Analysis

2.1 LOCATION CRITERIA

There are no lakes or ponds or floodplains, karst features, parks or wildlife refuges, recreational areas, or historical or archeological areas within a one-mile radius of the property. The property is currently zoned agricultural with a Conditional Use permit for landfill activities.

The Austin Municipal Airport is about 4 miles southeast of the site from an aerial view or over 5 miles by road. Murphy Creek runs approximately 1/4 mile to the south of the parcel. State Highway 218 is approximately one-half mile east of the parcel and Lansing Township Road T-378 (243rd Street) is adjacent to the eastern and northern sides of the site.

The following figures and related information are located in Appendix A:

- Karst Features within 1 mile
- Park, Recreational areas and Refugees located within 1 mile
- Water Features within 1 mile
- Wells within 1 mile with owners
- Zoning
- Adjacent Property Owners with addresses

2.2 HYDROGEOLOGIC CONDITIONS

A Water Monitoring System Work Plan for the Landfill was prepared by Northern Environmental, Inc. and submitted to MPCA in August 2001 and subsequently approved by the MPCA.

In June 2011, additional monitoring wells were installed. The additional wells monitor both the shallow groundwater and a deeper saturated sand layer.

The groundwater level database including the piezometer data has been reviewed under another contract. The groundwater contour map for April 2015 represents the high groundwater table, which is reflected on the permit drawings (Appendix B).

The following hydrogeology and geology information has been excerpted from previous permit submittals. Additional information on the geology for this site was presented to the MPCA in 2011 in support of replacing two groundwater monitoring wells. Additionally, SKB has submitted detailed hydrogeology and geology information in two reports for the land it owns west of this Facility. These reports are dated December 2013 and October 2014. These reports may also be referenced for more detailed information. These three submittals can be referenced by the MPCA for more information.

Bedrock Hydrogeology and Geology

Review of available information from the Minnesota Geological Survey indicates that the first bedrock unit encountered is the Basset Member of the Cedar Formation and the Pinicon Ridge Formation, which are undivided in Mower County and are Middle Devonian in age. The

unit is composed of dolostone with thin beds of shale and siltstone noted in the Pinicon Ridge formation. The Bassett Member is relatively permeable and forms a minor aquifer in Mower County. The shaley dostone and shale in the upper and lower parts of the Pinicon Ridge Formation may locally form a confining unit. The upper bedrock unit ranges in elevation from approximately 1100 to 1150 feet relative to the National Geodetic Vertical Datum of 1929 (NGVD). This corresponds to an approximate depth below ground surface of 68 to 160 feet. The average depth to the upper bedrock unit is approximately 120 feet.

Underlying the Pinicon Ridge Formation is the Spillville formation of Devonian Age. Underlying the Spillville formation is the Maquokata Formation of Ordovician age. The lower portion of the Maquokata Formation is shaley and forms a regional confining unit with the underlying Dubuque Formation.

There are no known geologic hazards such as sinkholes or other karst features that have been identified beneath or near the Landfill.

Surficial Hydrogeology and Geology

There are three Pleistocene-aged till units recognized in the area of the site. All three units are fined-grained tills with a loam texture. Review of information available from the Minnesota Geological Survey, supplemented with limited field data, indicates that the Sheldon Creek till member of the New Ulm Formation is the upper-most glacial unit at the site. Underlying the New Ulm Formation is less than 20 feet of the Rose Creek Formation. The Rose Creek till is patchy in this area. Underlying the Rose Creek Formation is more than 1O feet of the Elmdale Formation. Site investigations to date have not differentiated these Pleistocene till formations at the site, which is not uncommon because the differences are subtle. There are basal sand beds noted in parts of the county, but they are unlikely to be present at the site. Based on surface and bedrock topography, there are 68 to 160 feet of fine- grained glacial sediments at the site.

The first groundwater is encountered within the upper Sheldon Creek till member. During the fall quarter of 2006 the water table elevation at the facility ranged from 1238.44 to 1211.65 feet NGVD. A groundwater contour map for November 2006 is provided in Drawing No. 4. Groundwater flow at the water table is generally to the southwest.

Soils

Soil information from the United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS) indicates that soils at the Landfill range from silty clay loam to silt loam, with silt soils predominating the area. Specific soil series at the Landfill include Blooming silt Loam, Havana silt loam, Newry silt loam, Maxcreek silty clay loam and Floyd silt loam. These soils develop on glacial till such as the sediments that underlay the Landfill. Site specific work identified a small area of organic soil in the southwest portion of the Landfill that may belong to the Palms Muck soil type that is found in the general area.

Environmental Monitoring Plan

An environmental monitoring plan for the landfill includes monitoring well locations and a sampling schedule. Field parameters (pH, specific conductivity and temperature along with groundwater elevation) will be collected three times per year in accordance with the existing

site permit. Additionally, during the summer sampling event, inorganic and metal analytes listed in Solid Waste Rule 7035.2815 subpart 14C table 1; and VOCs (listed in current Minnesota Department of Health method 465) will be collected for laboratory analyses. SKB samples for the analytes as listed in the current site permit.

2.3 VEHICLUAR FLOW AND ACCESS ROADS

The major haul road is State Highway 218 and County State Highway 45 is the secondary haul road. The primary access will be through Lansing Township Road T-378 (243nd Street) to the main entrance of the Landfill on the northern side of the parcel (Entrance No. I). It is anticipated that the entrance infrastructure will be moved to the south east corner of the adjacent Austin Landfill. Access to the new entrance infrastructure would still be from T-378 (243rd Street) and access to this Facility will still be from 243rd Street on the north side of the property.

The primary vehicles using the site will be semi tractors with walking floor trailers or end dump trailers, dump trucks, roll-off trucks, and pick-up trucks carrying demolition debris, recycling, or industrial waste. The Landfill will have the capacity to receive 100 vehicles per day and expects to receive an average of 65 vehicles per day.

Traffic routed within the Landfill will utilize the site access roads. Vehicles entering the Landfill will check in and be inspected at the office building prior to disposal. They will then be routed to the Landfill working face where they will off-load. Once empty, the vehicle will continue on the access road within the Landfill to either the exit at the north. Limited parking, if needed, will be available adjacent to the office.

2.4 UTILITIES

The utilities and services needed to effectively operate the Landfill are electrical service, telephone, and restroom facilities. The Landfill operations do not place unusual demands on the local utility systems.

The only electrical demand is for electrical service to the small office building and to run the pumps for the leachate sumps and leachate storage tank. In addition, electrical service would be required for area lighting.

The office on-site is heated with electric heat.

A portable restroom is located adjacent to the office.

Bottled drinking water is available at the office for personnel and visitors. The on-site domestic well at the old on-site residence building area will be abandoned. Water for dust control and any other minor water needs (i.e. equipment maintenance, landscaping, etc.) will either be taken from the domestic well on the 50 acre property west of this Facility or one of the domestic wells at the Austin Landfill site.

2.5 EQUIPMENT

Typical equipment maintained on-site consists of motor grader, a front-end loader, landfill compactor, dozer, skid loader, water truck and roll-off truck. SKB has additional equipment that can be mobilized to the Site as needed to perform the landfill operations.

3.0 Soils for Construction

3.1 INTRODUCTION

The various · soils required have been evaluated. The soils and aggregates for construction and development are as follows:

- Common fill: used for berm and subgrade construction
- Clay barrier layer: used to protect composite liner systems
- Sand protective layer: used for composite liner systems drainage layer
- Coarse aggregate: used for leachate pipe bedding and collection sumps
- Pea gravel: used for filter aggregate between the sand drainage layer and the coarse aggregate in the leachate collection trenches and sumps
- Cover soils: used for final cover system to establish vegetative growth

Construction documentation will include documenting of site activities, such as equipment used and weather conditions. Documentation will consist of survey data, daily logs, photographs, and other testing or construction. Construction activities will be performed in accordance with the technical specifications (Appendix C) and the Construction Quality Assurance Manual (Appendix D).

3.2 SOIL COMPONENTS

Common Fill

Common fill will be used for the construction of the berms and subgrade. This fill material will be from onsite soils.

Clay Barrier Layer

The clay barrier layer is the soil components of the composite liner system. To date, the on-site clay has been suitable for clay barrier construction. Clay barrier layer soils will have a hydraulic conductivity of 1 x $l0^{-7}$ cm/ sec or less.

Sand Protective Layer

The sand material will be used as a protective layer over the bottom liner system and below the final cover liner system.

It should be noted that a geonet drainage composite will be used with the sand protective layer in the bottom liner system.

To date, all the sand required for the construction of the Facility has been obtained from a local sand pit north of the Facility.

Coarse Aggregate

Coarse aggregate will be used in the leachate collection trenches. It provides a highly

permeable drainage medium and a bedding material for the leachate collection pipes. Coarse aggregate has been obtained from off-site sources.

Pea Gravel

Pea gravel will be used in the leachate collection trenches between the sand protective layer and the coarse aggregate. It provides a highly permeable drainage medium and filter material between the finer grained sand drainage layer and the coarse aggregate.

Pea Gravel has been obtained from off-site sources for the construction of the Facility.

Cover Soils

Cover soils will be used for the final cover at the facility. These soils will provide a buffer soil layer zone and topsoil layer for the final cover vegetation. The soil thickness of the final cover is two feet with 6 inches of that material being topsoil.

4.0 Design

4.1 INTRODUCTION

The design for the Landfill exceeds the requirements for a demolition debris landfill as described in MR 7035.2825. The landfill design includes a composite liner with leachate collection as well as a final cover system that incorporates a geosynthetic liner and drainage layer.

4.2 EXISTING CONDITIONS

The existing site conditions and topography of the landfill in shown on the Permitting Plans (Appendix B) There is a benchmark located in the northwest comer of the site (5/8 inch diameter, 16 inch capped RLS 13807).

The waste volume and final cover volume currently in place is approximately 696,500 cubic yards based on the 2015 Annual Report. The existing waste is located within Phase 1 and Phase 2. Phase 3 is planned for construction in 2016.

One barn has already been removed to make way for the 2015 construction and the last storage structure will be removed this year to make way for the planned construction.

4.3 WASTE FLOWS/SITE CAPACITY/PHASING

In 2015, SKB utilized 224,100 CY of airspace for construction and demolition debris and cover materials. With this permit modification and renewal, SKB is proposing to increase the design capacity of the landfill from the current ultimate design capacity of 1,930,000 CY of airspace to 2,519,000 cubic yards of airspace by increasing the final cover slopes to 4H;1V and increasing the final cover elevation to 1362 feet MSL.

Phase 2 has been developed with multiple cells, whereas, Phases 3, 4, and 5 will be one cell each. As each individual cell or phase reaches final grade, the exterior slopes of the cell will be final covered and all interior slopes of the cell will receive intermediate cover. A phasing plan detailing development of the facility is provided on the drawings.

4.4 BASE GRADES

The top of liner/ top of clay grades are shown on the permit drawings and have been designed to keep a five foot separation from the water table. The high water table contours as determined in April 2015 are also included on Figure 1.

4.5 LINER DESIGN

The approved liner will provide a composite liner for all future development at the site. The composite liner consists of one 60 mil (0.060 inch) HDPE liner, overlying a 2-foot clay barrier layer. The clay barrier liner will have a maximum hydraulic conductivity of $1x10^{-7}$ cm/ sec. As an alternate, the MPCA has approved a liner option of a geosynthetic clay liner (GCL) in place of the 2-foot clay layer. The GCL will be a needle punched material having a maximum permeability of $1x10^{-9}$ cm/sec at 4 psi confining pressure.

The HDPE liner will be overlain by a geonet drainage composite and a minimum one foot of sand protective soil layer. On all side slopes steeper than 10 percent and a length of 10 feet, a textured HDPE membrane will be utilized to improve stability of the geomembrane clay interface and geomembrane/ drainage layer interface.

The drainage layer system collects leachate and provides drainage to the perforated leachate collection pipes installed in the leachate collection trenches. To protect the pipes from damage, and to provide increased flow performance, they will be embedded in coarse aggregate. Overlain by a one-foot layer of pea gravel, the granular drainage layer also functions as a protective layer to prevent equipment from damaging the HDPE liner. Crushed aggregate will not be used for this reason. The base liner for the landfill will be sloped at 2 percent or greater to promote the flow of leachate through the drainage layer. Leachate collection trenches are included in the liner at no more than 200 foot separation for a 2% slope. As in the approved 2011 design, a portion of Phases 4 and 5 are at a steeper slope of 4.5%.

4.6 LEACHATE COLLECTION SYSTEM

The leachate collection system has been designed to collect and convey leachate from the liner system to one of two collection sumps. The sumps incorporate side-slope risers to eliminate penetration of the liner.

Collection Pipes

The collection pipes in will be 6-inch diameter, perforated, (SDR)-11, HDPE pipe. Pipe strength calculations are presented in Appendix E and were completed using a waste thickness of approximately 128 feet, which generally corresponds to the final cover grades. The pipe is acceptable for buckling, deflection and crushing.

HDPE pipe and geotextile will be placed in the pipe trenches as specified in the Technical Specifications (Appendix C). A layer of coarse aggregate will be placed in the trench and the pipe will be placed and aligned. The remaining coarse aggregate will be placed after the pipe is fully installed. A one-foot thick layer of pea gravel will then be placed over the coarse aggregate to provide a filter. This pea gravel will help stop migration of particles that might otherwise clog the collection pipe. The granular drainage layer material will then be placed over the trench.

Leachate Head Build-Up

Hydrologic Evaluation of Landfill Performance (HELP) model analyses are presented in Appendix F. The analysis completed for the site suggests an average head of leachate on the base liner of less than 1inch during an anticipated peak daily event during the open condition. Leachate head will be monitored on a regular basis at the riser by a pressure transducer located on the sideslope riser pump. The transducer will relay a digital display of liquid depth on the liner.

Leachate Collection Sump

Leachate collection pipes will convey leachate to the sump located at the southwest comer of Phase 2 and on the west side of Phase 3. The sump is a depression in the liner system.

The sump proposed for Phase 3 will be designed with a bottom footprint of approximately 30 by 90 feet. The sump will be filled with coarse aggregate, with an interstitial porosity of approximately 0.3. This provides a total storage volume for leachate of approximately 65,900 gallons. As an added measure of protection, a layer of GCL has been added to the liner profile in the sump area providing a triple barrier.

Sideslope Risers and Leachate Forcemain

A sideslope riser will be placed in the leachate trench with the lower 7 feet being perforated. It will consist of a 24-inch, SDR-17, HDPE pipe and extend up the entire sideslope. This sideslope riser pipe contains a sideslope riser pump, with a 3-inch diameter, SDR-11, HDPE discharge pipe running the length of the 24-inch riser to the top of the slope, where it will transfer leachate to a pumping vault immediately next to the riser. Leachate will be pumped to an above: ground storage tank (AST) that is located in the northwest comer of the Site.

Leachate Volumes

Upon initial landfill cell construction and prior to several lifts of waste placed over the liner, significant leachate volumes may be generated because there is no waste to absorb some of the precipitation that falls on the liner system. As waste is placed over the constructed cell, the leachate volumes are reduced during the "open condition", which was modeled by the HELP model with a waste depth of 25 feet. Leachate volumes are then further reduced with the placement of final cover systems. With each phase of cell construction; however, leachate volumes will temporarily increase because there is more liner area contributing to the total volumes and little waste over the top of the liner system.

The HELP model predicts that, in the open condition, (25 feet of waste depth) the peak leachate flow will be 8,712 gallons per day for Phase 2, Cell 1 (2,560 gallons/ acre/ day).

In the final closed condition, the leachate generation rate reduces to a peak leachate flow of 15 gallons per day.

SKB has prepared for higher leachate generation rates with the construction of a 225,000 gallon above ground storage tank located in the northwest corner of the landfill area.

4.7 INTERMITTENT AND INTERMEDIATE COVER

Intermittent cover will be placed in all areas that receive waste on at least a monthly basis, unless the wastes will be covered by a subsequent layer of waste within 30-days and are part of the active working face of the landfill. Intermittent cover will consist of at least 6 inches compacted soils or approved alternative cover material.

Intermediate cover will be placed on any cell or phase, which is not part of the active working face of the landfill and will not be covered by a subsequent layer of waste within 120 days. Intermediate cover will consist of at least 12 inches of compacted soils which includes the 6 inches of intermittent cover.

4.8 FINAL COVER DESIGN

The placement of final cover for the landfill phases will be in accordance with the final contour plan. Final cover will be applied to portions of the landfill that have reached final

grades. If significant portions of the fill area have not reached final grades at the end of the year, the final cover requirements will be evaluated the following year.

The final cover is designed to contain and divert precipitation over filled areas of the site, thus reducing infiltration into the waste. A typical section for the final cover consists of (from the bottom up) a 40 mil LLDPE membrane, geonet drainage composite, and 18 inches of common borrow and 6 inches of topsoil. The HELP model results for the final cover design is included in Appendix F.

Slopes on the final cover of the facility will range from 2 percent on top to 25 percent on the side slopes. The existing permitted maximum elevation was 1,297 feet MSL. With this permit renewal and modification, SKB proposes to increase the maximum landfill height to 1362 feet MSL.

The erosion potential of the final cover is considered minimal due to the uniform construction and adequate turf establishment on the final cover slopes. An adequate turf will be established on the final covered areas according to 7035.2825, Subp. 11 by using appropriate fertilizer and mulch.

The following will be monitored during the placement of the topsoil and soil layer:

- Removal of roots, rocks, rubbish, from the soil layer or off-specification material from the topsoil
- Identification of changes in topsoil characteristics
- Adequate spreading of soil material to obtain complete coverage and final cover layer thickness
- Adequate blending of repaired and undisturbed sections of the soil layer in new areas of final cover.

Care will be taken when performing work during and after rainfall, during very hot or windy conditions, or during freezing weather.

Atmospheric conditions should be observed and recorded by Construction Quality Assurance (CQA) representatives, and appropriate actions should be taken when unsuitable weather conditions exist.

4.9 SURFACE WATER MANAGEMENT

Currently, off-site storm water from the surrounding area enters the property via a 36-inch culvert on the southeast comer of the property and is routed along the southern portion of the property to the southwest corner of the Facility. Storm water generated from the Landfill and also discharges from the southwest comer of the site.

The storm water management system consists of a perimeter ditch and a sedimentation basin. The perimeter ditch captures all on-site runoff and directs it to the sedimentation basin. The basin is designed with an outlet structure that normalizes the flow of water from the site. This normalized flow from the basin reduced the amount of water that had previously discharged to the adjacent property during storm events. The existing outlet structure of this basin consists of an 18-inch standpipe and an 18-inch orifice outlet along with an emergency spillway for flows greater than the 25-year storm. The top of the existing standpipe elevation is 1222 feet and the outlet elevation is 1219 feet, with

the emergency spillway at 1223.4 feet. The system is able to manage the required MPCA 25-year, 24- hour storm event.

The drainage ditch constructed along the southern boundary of the property routes the off-site waters entering the SE comer of the site to their historical discharge point in the southwest comer of the property. These waters do not enter the sedimentation basin, thus keeping the on-site and off-site flows segregated.

Surface water management calculations are provided in Appendix G.

5.0 Site Development Plan

5.1 INTRODUCTION

The objectives of the landfill development are to:

- Provide a logical sequence of filling that will bring the areas to final grade as soon as possible,
- Minimize challenges associated with access to the working face, and
- Provide for adequate surface water drainage during the filling process.

5.2 PHASED CONSTRUCTION

The site will be constructed in five phases. The first phase, which has been inactive since 2011, includes the area with existing unlined area in the southwest section of the 40 acres. The second phase is in the southeast corner of the parcel. The third, fourth and fifth phases will progress sequentially northward from the tie-in to Phases 1 and 2. The phases will be constructed in approximate 150 foot widths.

The Site infrastructure is located along the access road on the route to the working face. This will ultimately be moved to a different location at a future date.

5.3 FILL PROGRESSION

The final contour plan is presented in the permit drawings. The final contours were developed to enable continued filling within the fill boundaries to elevations that provide approximately 25 percent side slopes, which is a proposed increase to the currently permitted final cover contours of 20 percent. The increase in final cover slope, which is consistent with MPCA approvals at other demolition facilities, is proposed to promote surface water run-off of incident precipitation and also reduce the potential for post-closure drainage problems due to erosion.

The continuous disposal of waste at the site will occur until the proposed final elevations are achieved in each phase of the total landfill area. Final cover will be applied to portions of the landfill that have reached final grades.

Vertical and horizontal control of landfill development is maintained by grade and line staking conducted by the use of on-site staff using GPS equipment, which is verified each year during the annual survey.

5.4 CLOSURE

The phases will be closed progressively as each phase or portions of phases reach final capacity. Detailed phase closure actions include the preparation of the waste surface. Proper screening, compaction, slope, and grading of the waste are necessary to ensure the integrity of the final cover design. The phases will be shaped and contoured to conform to the final grading plan. The contouring of the waste will reduce the subsequent need to add fill material, facilitate grading of the final soil layer, and reduce possible formation of depressions that could pond water.

6.0 Operations Plan

6.1 INTRODUCTION

The unloading of waste is confined to as small an area as practical along the working face. The waste is spread and compacted progressing horizontally along the slopes. Disposal operations during periods of wet weather are confined to as small an area as possible to avoid access problems.

Access roads to the working face will be modified as necessary as the Landfill is developed. Access ramps to the final lifts of waste will be by means of ramps constructed in such a way to allow truck travel. Access ramps inside the fill boundary are constructed with suitable waste material. Additional material is placed as needed to maintain all-weather access. Roads and ramps within the fill area will be modified as each phase is completed. Cover soil stockpiles will be maintained on-site in manageable quantities.

Vertical and horizontal control of Landfill development is maintained by grade and line staking conducted by a registered land surveyor. The site is cross-sectioned annually to enable volume calculations to be made consistent with the annual report preparation.

6.2 HOURS OF OPERATION

The proposed hours for the Landfill are from 7:00 a.m. to 7:00 p.m., Monday through Saturday. However, normal operating hours are expected to be 7:00 a.m. to 5:00 p.m. In certain circumstances it may be necessary to operate outside these hours, in which case Mower County and Lansing Township will be notified.

6.3 ACCEPTABLE WASTES

The Landfill will accept demolition debris from demolition projects and similar debris from new construction or remodeling projects in accordance with the MPCA approved Industrial Solid Waste Management Plan (Appendix H) and the definition of Demolition Debris set forth in 7035.0300, subpart 30. Acceptable debris consists primarily of scrap metal, wood, incidental brush, incidental cardboard, plastics, incidental soil, tin, incidental carpet, concrete, brick, asphalt, stucco, rock, gravel, roofing, sheetrock, tile, insulation, and similar materials generated from the construction, remodeling, or demolition of buildings, roads, and other man-made structures.

The Landfill may also accept sheetrock, grade lumber, metal, ceramic, linoleum, particle board, plywood, press board, ceiling tile, shingles, electric wire, masonry, and insulation wastes as outlined in the Landfill's ISWMP.

SKB Lansing also plans to recycle such materials as metals, concrete for crushing, recycled wood products, pallets, and brick and block. Some of the products such as brick, block and concrete may be crushed and used as road base.

SKB will accept tree waste and root balls generated from storm damage or other activities.

6.4 PROHIBITED WASTES

Following MPCA guidelines for prohibited material in demolition landfills, wastes unacceptable for filling include, but are not limited to, mixed municipal solid wastes (MSW) from household, agricultural or commercial generators, dead animals, food and beverage containers, yard wastes, liquids, septic tank pumpings, sludges, vehicles, tires, machinery and appliances, fertilizers, or hazardous wastes. On-site personnel will be responsible for visually inspecting all loads to insure that prohibited materials are not unloaded on-site.

6.5 LOAD INSPECTION/WASTE SCREENING

Loads containing only acceptable material may be deposited directly into the tipping area. Any load containing other materials or unacceptable materials or industrial waste must first be dumped in a Waste Screening Area (WSA) to remove unacceptable materials prior to pushing the waste into the working face.

The operator should pre-inspect each load before it enters the WSA. Loads containing unacceptable materials should be diverted to another waste facility authorized to accept those materials, or the load may be dumped in the WSA for the removal of unacceptable material.

The WSA does not need to be in a fixed location, but can be moved as the site is developed. The WSA should be located within 50 feet of the active working face.

The operator shall inspect and remove unacceptable material from the waste dumped in the WSA, and move the inspected acceptable waste to the working face on at least a weekly basis.

Upon discovery, unacceptable wastes must be removed from the loads and stored appropriately. The determination of acceptable/unacceptable wastes will be at the discretion of the certified landfill operator.

6.6 TRANSPORTATION ROUTES

The major haul road to SKB Lansing will be State Highway 218 and County State Highway 45 is the secondary haul road. The two access locations will be through Lansing Township Road T-378 (also 243rd Street) Entrance No. 2 on 243 Street on the northern side. Traffic will exit to 243 Street on the north.

Vehicles entering the Landfill will be inspected at the office building prior to disposal. They will then proceed to the working face where they will off-load. Once empty, the vehicle will continue on the access road within the Landfill to the exit. Limited parking, if needed, will be available adjacent to the office.

SKB will control dust and litter on 243rd Street from State Highway 218 around the site to Entrance No. 2. off 243 Street.

6.7 POTENTIAL VEHICLE TYPES AND QUANTITIES

The primary vehicles to use the site will be dump trucks, roll-off trucks, and pick-up trucks carrying demolition debris, recycling, or industrial waste. The Landfill will have the capacity to receive 100 vehicles per day and expects to receive an average of 65 vehicles per day.

6.8 ACCESS REGULATING AND REPORTING

Site security will consist of entrance gates that will remain locked during non-operational hours.

The entrance gate and driveway having access into and out of site are indicated on Drawing No. 2.

A gate attendant and certified operator are on duty during all operating hours. However, during times of low traffic volumes, these two positions may be filled by the same person. The attendant shall be responsible for checking and approving each load of material as it is brought to the Landfill.

Records are kept on the generator, type and quantity of material accepted, and any materials refused at the facility.

Operational reports will be kept at the office on-site as required and in the corporate office in St. Paul.

6.9 AUTHORIZED CUSTOMERS

Use of the site will be limited to those companies, agencies, or institutions approved by SKB.

6.10 ESTIMATED CONSTRUCTION SCHEDULE AND COMPLETION DATE

The time required to reach permitted capacity of each phase is highly dependent on disposal demand and the extent and success of recycling efforts implemented at the Landfill. Based on information for waste flows from the 2015 Annual Report, the estimated completion date will be approximately year 2023.

6.11 EQUIPMENT

SKB will provide and maintain adequate equipment during operation of the Landfill. SKB has equipment for daily operations as well as closure and emergency operations.

The equipment currently maintained at the site includes:

- Cat. Motor Grader
- 4000 Gal Water Truck
- Cat. 826 landfill Compactor
- Skid Loader
- 40-yard dumpster for tires
- 40-yard dumpster for recyclables

- 40-yard for unacceptables
- Additional tools and equipment as needed

In case of equipment breakdown or ineffectiveness, more equipment can be made available as needed from other landfill sites or from a local contractor.

6.12 STAKING, SLOPES, AND DRAINAGE

A registered land surveyor will certify the elevations at least once per year as required by MPCA Rule 7035.2825, Subpart 9K.

6.13 PHASING, LIFT HEIGHT, AND SIZE OF WORKING FACE

Each phase is filled in 15- to 20-foot deep (maximum) stages. Filling is currently in Phase 2. Phase 3 is currently under construction (summer 2016). Future phases (Phases 4-5) will be excavated as needed for development. As each phase is complete, final cover will be placed. With the sequential site phasing from south to north, the working face of the landfill can be keep as small as practical to limit leachate generation. As areas are brought to grade and prior to final closure, intermittent cover soils will be seeded for erosion control.

6.14 PERSONNEL

Personnel for Landfill operations include, at a minimum, one certified operator and/or the Landfill Manager who is responsible for machine maintenance and repair and other miscellaneous tasks. This employee is also responsible for the daily operations at the site. Responsibilities include directing disposal at the working face of the Landfill, inspecting the wastes to determine its suitability for disposal in the Landfill, and directing any other site operations. Furthermore, the Landfill operator is responsible for the progression of filling in accordance with development plans, compacting the wastes, and ensuring that the wastes are adequately covered according to State and Local requirements.

If Landfill traffic warrants, additional operators/attendants may be called in. The Operations and Maintenance Manual is kept at the on-site office.

6.15 PERSONNEL TRAINING

Operating personnel are required to be working under the direction of a certified landfill operator. SKB will provide the opportunity for operators to obtain the appropriate training from the MPCA.

An employee training log and schedule is filed at the on-site office. Landfill operators are required to update their training as necessary to maintain MPCA certification.

6.16 SITE SAFETY AND EMERGENCY PROCEDURES

Communication equipment on-site includes a telephone in the facility office, cell phones and two way radios.

Minor fires such as equipment fires, or fires within the roll-off boxes or dumpsters will be handled by on-site fire extinguishers or equipment fire suppression equipment. Fire extinguishers are kept in the office, at the fuel barrel and on all on-site equipment; or with the site water truck.

Fires, other than equipment fires, will be handled by the Local Fire Department. Since the waste accepted at the Landfill is mostly inorganic, the volume of methane gas produced is expected to be low; therefore, the risk of subsurface fires due to methane gas is low.

SKB strives to maintain a safe environment for the employees and customers.

6.17 NUISANCE CONTROL (NOISE, DUST, AND PAPER)

Noise effects on the surrounding area and neighbors will be minimized through strategic management of the working face.

Dust is controlled by addition of water and/or calcium chloride (or other longer term dust suppression additive) to the access roads at the discretion of the Landfill operator.

Landfill users may be assessed a surcharge for their waste loads if the load is not adequately covered to protect against spillage or blowing litter. This policy has been successfully employed at other facilities in an attempt to reduce the occurrence of litter on haul routes to the site. Because of the dense and bulky nature of the waste deposited at the site, litter problems are not prevalent. However, occasional paper litter that may appear will be promptly collected and disposed by the operator/attendant.

6.18 STORED WASTE

Waste that will not go into the Landfill will be stored on-site in stockpiles or 40-cy containers. The stockpiles will be maintained in a manageable quantity. The 40-cy container will be shipped to the proper disposal facility when the container is full. Such wastes include:

- White goods
- Tires
- Recyclables--metals; concrete for crushing; tree waste; brick and block to be crushed for use in road base
- Wood waste

6.19 GENERAL INSPECTION

Site inspections for inspecting monitoring equipment, safety and emergency equipment, security devices, survey monuments, and drainage systems are performed and recorded on a routine basis.

6.20 PREVENTATIVE MAINTENANCE

The following preventative maintenance tasks will be performed on a regular basis:

- Equipment is inspected before and after each use to assure that it is in the proper working order.
- Visual inspection, check fluid levels, etc.

7.0 Facility Closure Plan

7.1 INTRODUCTION

The owner or operator of the Landfill will be responsible for closure of the site when areas are sequentially brought to final grade. A summary of the final closure requirements are provided in the following sections.

A copy of the approved Closure Plan and all revisions to the plan will be kept at the facility until final closure is completed and certified. This Closure Plan supersedes any previous closure plans prepared for this site

7.2 NOTIFICATION OF CLOSURE

The MPCA will be notified in writing of the scheduled final site closure at least 60 days prior to the termination date of waste acceptance. The planned closure date will be included in the notification. Regular customers of Landfill will also be notified in writing at this time. In addition, a notice will be posted at the entrance of the Landfill indicating the date of closure and provide a listing of alternative demolition waste facilities accepting similar wastes. Not less than 30 days before closure, a notice of closure will be published in a local newspaper. A copy of the notice will be sent to the MPCA and Mower County within 10 days of its publication.

7.3 ACCESS CONTROL AND SECURITY

Access to the site is through Entrance No. 2 on the north side of the property, and is associated with the office, scale, and disposal areas. Locked gates at the entrance along 243rd Street will be maintained through the closure and post-closure periods to prevent unauthorized entry into the site.

7.4 EROSION CONTROL

The final contour plan and corresponding slopes are designed to promote moderate sheet flow drainage of the surface water to minimize erosion potential. If erosion problems on completed fill areas are prevalent, regrading and turf establishment and/or other approved measures will be employed.

The topography of land surrounding the Landfill is generally lower than the final contour elevations for the completed fill area. Drainage ways will be utilized for conveying surface water towards the sedimentation basin that is designed on the west and southern sides of the Landfill.

7.5 VEGETATION

Vegetation will be established on final covered fill areas immediately after final cover placement. These areas will be completed during the remaining active life of the site. Within 180 days after the site has ceased to accept wastes, the finished surface will be seeded, mulched, and fertilized in accordance with this plan and permit conditions.

Areas previously covered and seeded will be re-inspected at this time for adequacy of turf cover. Those areas lacking adequate vegetation will be reassessed and procedures taken (reseeding, fertilization, mulching, etc.) to ensure adequate establishment of turf.

In the event of adverse weather conditions and upon approval of the MPCA, the 60-day requirements for completion of turf establishment may be extended.

During certain times of the year, based on weather conditions, it may be necessary to irrigate newly seeded areas. This will be accomplished sparingly on an as-needed basis.

In general, fibrous, shallow, laterally growing roots will characterize the vegetation types that comprise the final turf material. An alternate seed mixture may be used based on seasonal requirements. The MPCA will be advised prior to any change in this program. The turf cover will be regularly inspected by the Landfill operator to determine seeding, mulching, and/or fertilizing needs for maintaining adequate vegetation.

7.6 CERTIFICATION

Upon completion of the activities listed above, the MPCA will be provided with a certification by a Professional Engineer registered in the State of Minnesota that the Landfill has been closed in accordance with the approved plans and requirements with all exceptions noted. The certification will be submitted no later than 60 days following completion of said Landfill closure activities.

SKB will submit a detailed description of the Landfill site to the MPCA for approval within 30 days of the final closure. After approval, it will be submitted to the County Recorder for recording. This description shall include the general type, quantity and locations of deposited waste, the estimated depth of waste fill and final terrain descriptions, and other pertinent characteristics of the completed Landfill site.

7.7 COST ESTIMATES

The Closure cost estimate is presented in Appendix A on Table 3. The cost estimate was calculated assuming closure activities will be completed by an outside contractor or consultant.

If deemed necessary, the closure cost estimate will be updated annually to adjust for inflation and actual incurred costs that are higher or lower than previous estimates, and to account for decreases in the area of the Landfill requiring closure.

8.0 Facility Post-Closure Plan

8.1 INTRODUCTION

The owner or operator of the Landfill will be responsible for post-closure care of the site for a period of 20 years following final site closure. A summary of the post-closure program is provided in the following sections.

It is noted that the length of the post-closure care period for demolition landfills is not specified in the MPCA Solid Waste Rules. Due to the inert nature of the waste accepted by demolition landfills, a post-closure period of 20 years is generally accepted.

8.2 INSPECTIONS

Routine inspection of the site will be performed two times per year (i.e., April and September) throughout the 20-year post-closure period. The inspections will include observations related to:

- Settling and erosion of cover materials.
- Quality of vegetation.
- Damage to monitoring wells.
- Drainage route erosion or sediment accumulation.
- Site security.

A summary of the inspection results will be prepared and will include a discussion of items requiring maintenance, an evaluation of the significance of any problems identified, and an outline of required corrective measures.

8.3 MAINTENANCE

If inspection of the site reveals problems with the cover material or the vegetation, corrective measures will be taken as soon as possible. Any Landfill structures found to need repair during a routine inspection will likewise be serviced. This includes buildings, security fences, gates, any monitoring devices and run-off structures.

8.4 SETTLEMENT

In the event that settling, gullying or excessive erosion occurs, additional cover soil will be placed in accordance with the final cover specifications and measures taken to prevent future occurrence of the problem.

8.5 VEGETATION

If routine inspection reveals areas of cover vegetation that are poorly established or otherwise stressed, re-seeding and/or growth and development measures will be instituted to establish an adequate turf.

8.6 VECTOR CONTROL

Flies, other insects, rodents, or other vermin do not result from activities at the site due to the inert nature of the waste received. Rodents may occasionally be brought in on incoming loads but likely will not still be around during post-closure activities. If nuisance problems develop, the remedial measures such as spraying for insects or rodent baiting programs will be employed.

8.7 GROUNDWATER MONITORING

Groundwater quality monitoring will be performed at the Landfill three times a year throughout the post-closure period. If approved by the MPCA, monitoring requirements may be reduced. Sampling procedures and analytical requirements are as specified in the MPCA quarterly groundwater monitoring reports. Monitoring results are reported to the MPCA in a timely and organized fashion and will include quarterly monitoring reports following each sampling event and an annual summary report.

8.8 POST-CLOSURE COST ESTIMATE

The post-closure care cost estimate is presented on Table 4. The cost estimate was calculated assuming that the work will be completed by an outside contractor or consultant and that the post-closure care period will last 20 years.

If deemed necessary, the post-closure cost estimate will be updated annually to adjust for inflation and to account for differences between estimated and actual post-closure care costs.

9.0 Contingency Action Plan

9.1 INTRODUCTION

This Contingency Action Plan (Plan) has been prepared in response to the requirements of Minn. Rules pt. 7035.2615. The purpose of the plan is to discuss events that would require corrective actions, including the following:

- Illegal dumping of prohibited wastes
- Fire
- Exceedance of a groundwater intervention standard
- Failure of drainage structures and erosion
- Landfill gas migration
- Settlement of completed areas
- Monitoring well replacement

9.2 ILLEGAL DUMPING OF PROHIBITED WASTES

Each load of debris arriving at the Landfill will be checked by the gate attendant prior to acceptance. A second inspection will be performed by the operator as the load is tipped on the working face/waste screening area. A final inspection will be performed by the dozer/compactor operator as it is layered onto the working face of the Landfill.

SKB's past policies relating to prohibited materials have depended and will continue to depend on the types of prohibited material deposited accidentally or intentionally at the Landfill.

Any prohibited material, despite the quantity, remains the property and responsibility of the hauler attempting disposal and the generator. Such materials will be marked by SKB personnel as prohibited waste. The hauler will be required to remove that material and any adjacent material that may have become intermixed with the prohibited material, at the haulers expense. The hauler will be required to respond by removing such material in that same working day as the material was deposited. Should the questionable material be determined by SKB personnel to be hazardous to health or the environment, or where the hazards are unknown, county and state authorities will be immediately notified, and an appropriate testing or storage/disposal plan will be determined by those agencies, the hauler, the actual material owner, and SKB.

9.3 FIRE

IF an event occurs involving a fire and/or explosion the Emergency Contact List located at the on-site office will be referenced. The local fire dispatcher will be notified immediately and other relevant contacts from the Emergency Contact List. Access to the area will be controlled and all non-essential personnel will be cleared from the area. The operator will use a fire extinguisher or other immediate action, if it is deemed safe, to control the emergency until the local fire department arrives.

The operator will take all reasonable measures necessary to ensure that subsequent fires, explosions, or releases do not occur or spread to other areas of the site. These measures may include, but are not limited to, the possible removal of unaffected trucks and other mobile equipment from the area and the dowsing of adjacent areas with water.

Cleanup of fire residuals involving waste will be focused on collecting as much of the waste as possible for disposal in as timely a manner as possible. Procedures may require the use of sorbents, portable pumps, tank trucks, and/or soil removal equipment. Similarly, the type of personal protective equipment used will depend upon the type of material(s) involved.

9.4 EXCEEDANCE OF A GROUNDWATER INTERVENTION STANDARD

SKB believes that it is unlikely that leachate will contaminate the ground water due to the leachate being of relatively good quality. This potential contingency response is prepared under the assumption that the ground water intervention limit is exceeded by impacts from the landfill or other off-site sources.

Actions to be Taken - The steps for this contingency action are as follows:

- In the event of a confirmed exceedance, SKB will notify the MPCA.
- Prior to any notification to the regulatory agency, the laboratory will re-evaluate their QA/QC procedures to ensure that laboratory problems have not created a false positive reading that a contaminant had been detected. If it is determined that a false positive reading was detected, no further action will be taken.
- Re-sample for parameter during next sampling round to confirm.
- If the exceedance is confirmed, SKB will send a letter to the MPCA to notify them of the possible exceedance of the intervention limits and will discuss how to resolve the situation.

9.5 FAILURE OF DRAINAGE STRUCTURES AND EROSION

Failure of drainage structures, which then result in erosion control failure or vegetation cover loss, may be caused by such events as the following:

- Heavy rains or spring thaw
- Drought
- Maintenance vehicle traffic
- Presence of methane or leachate (although unlikely in a demo landfill)

The following procedures will be used to correct the problem:

- If minor erosion has occurred, the soil will be replaced and seeded. If the problem persists or is severe, additional measures such as riprap, hay bales, erosion mat, sod or regrading will be reviewed as options to be implemented.
- Localized stress of the vegetated cover will be replaced. The cause for the loss will be investigated. Small repairs will be made by Landfill staff, larger problem areas may be corrected by an earthwork contractor.
- Severe erosion problems or vegetated cover loss will be reported to the MPCA.

9.6 LANDFILL GAS MIGRATION

Demolition landfills have generally not exhibited a propensity to generate large volumes of landfill gases. Should it become suspected due to the die-off of perimeter vegetation, or observable venting that gasses are present, a testing program will be implemented by SKB Lansing to identify the types and quantities of gases present and the extent of the gas migration. Should it be determined that the Landfill is generating gases that are migrating off-site, a system will be designed and installed which will retain the venting of the gases within SKB Lansing's compliance boundary.

9.7 SETTLEMENT OF COMPLETED AREAS

During the life of the Landfill, areas of settlement will be routinely corrected. After closure of the Landfill, the area will be inspected for settlement as part of the post-closure care. Areas of settlement that disrupt surface water drainage will be corrected by placing additional soils in the area, and re-establishing vegetation if required. Corrective measures of other settled areas will involve restoring the settled area to promote positive drainage.

9.8 MONITORING WELL REPLACEMENT

Should it be determined during routine sampling of the monitoring wells that a well has collapsed, due to accident or vandalism been destroyed or its use impaired beyond repair, or has otherwise become unusable, SKB Lansing will close that well in accordance with MPCA rules 7035.2815 Subp 10, and replace that well before the next routine sampling round.

9.9 COST ESTIMATE

An estimated cost for addressing each event listed in the Contingency Action Plan is provided on Table 5. The actions listed on the cost estimate are considered to be occurrences above and beyond routine maintenance performed during site operation and the post-closure care period.

9.10 PLAN AMENDMENTS

The Contingency Action Plan will be amended whenever the following occurs:

- The Landfill permit is revised
- The plan fails in an emergency
- The Landfill changes its design, construction, operation, maintenance, or other circumstances in a way that significantly changes the potential for fires, explosions, or releases of wastes or waste constituents, or changes the response necessary in an emergency

Tables

SKB Lansing Landfill
2016 Solid Waste Permit Modification and Renewal
Demolition Debris Disposal Facility
Table 1
Site Volume Summary

Cell / Phase	Design Capacity (CY)	Base Liner Area (AC)	12" Thick Granular Drainage Layer Volume (CY)	Closure Area (AC)	12" Thick Buffer Layer Volume (CY)	18" Thick Rooting Zone Layer Volume (CY)	6" Thick Topsoil Layer Volume (CY)	Waste Volume (Operational Volume) [3] (cy)	Estimated Year Cell Built	Estimated Site Life [4] (yrs)
In-Place Volume Phases 1 -2 [1]	696,500	18.0	29,040	3.9	6,292	9,438	3,146	677,624	--	--
Remaining Constructed Capacity [1][2]	275,985	0	0	14.1	22,748	34,122	11,370	207,745	--	1
Phases 3-5	1,546,515	11.3	18,230	12.1	19,521	29,282	9,760	1,487,952	2016	7
TOTALS:	**2,519,000**	**29.3**	**47,270**	**30.1**	**48,561**	**72,842**	**24,276**	**2,373,321**		**8**

(1) Based on November 2015 survey data and 2015 annual report volumes.
(2) From 2015 Annual report
(3) Design capacity less final cover. Includes waste, intermittent, and intermediate cover.
(4) Based on an estimated future annual inflow rate of 224,000 cubic yards

TABLE 2

Environmental Monitoring Plan
SKB Lansing Landfill Austin, Minnesota

Monitoring Well ID	Sampling Frequency		
	Field Parameters	*VOCs, Eh, pH, Conductivity*	*Metals and Inorganics*
Upgradient Water Table MW-1	3 times/year	3 times/year	1 time/year
Downgradient Water Table MW-2 MW-3 MW-4	3 times/year 3 times/year 3 times/year	3 times/year 3 times/year 3 times/year	1 time/year 1 time/year 1 time/year
Upgradient Deep Well MW-IRD	3 times/year	3 times/year	1 time/year
Downgradient Deep Well MW-2RD MW-3RD	3 times/year 3 times/year	3 times/year 3 times/year	1 time/year 1 time/year
*Leachate Monitoring	Currently quarterly		

*In accordance with the current City of Austin leachate treatment agreement.

Table 3
Final Cover Cost Estimate Breakdown
SKB Lansing Landfill
May 2016

Item	Description	Unit	Unit Price	Quantity	Justification	Cost
1	Mobilization	LS	$3,100.00	1	5% of construction	$3,100.00
2	Geosynthetics	SF	$0.65	43,560		$28,314.00
3	18 inch General Cover Soils	CY	$4.50	2,420	On-site soils	$10,890.00
4	Topsoil (6 inches)	CY	$6.00	806		$4,800.00
5	Seed, mulch, fertilize	AC	$1,000.00	1		$1,000.00
6	Surface Water Features	24	$10,000.00	1		$10,000.00
7	Sedimentation pond upgrade	LS	$7,500.00	1	cleaning and disposal	$7,500.00
8	Engineering (QA/QC)	LS	$6,560.40	1	10% of construction costs	$6,600.00
	TOTAL per acre closure					$72,204.00
9	Legal Documents	LS	$8,000.00	1	Site survey, Plat, waste record, etc	$8,000.00

Notes:
1-acre final closure area
cost rounded to nearest $100

Final Closure Area (acres)	13.2
Total Closure Cost	$961,092.80

Table 4
Post-Closure Cost Estimate Breakdown
SKB Lansing Landfill
May 2016

Item	Description	Quantity	Unit	Unit Cost	Extension	Subtotal
1	Facility Inspection Costs					$3,000.00
	Geosynthetics	60	0.65	$50.00	$3,000.00	
2	Routine Maintenance and Repair Costs					$6,700.00
	Mowing (assume 1x/yr)	24	HR	$120.00	$2,880.00	
	Cover Maintenance	1	LS	$1,500.00	$1,500.00	
	Fence Repair	1	LS	$600.00	$600.00	
	Surface Water Management and Maintenance	1	LS	$1,000.00	$1,000.00	
	Access Road Maintenance	1	LS	$500.00	$500.00	
	Rodent Control	1	LS	$200.00	$200.00	
					$6,680.00	
3	Groundwater Monitoring					$7,200.00
	a. Sample Collection	3	EVENT	$550.00	$1,650.00	
	b. Sample Analysis	12	EA	$125.00	$1,500.00	
	c. Evaluation and Report	1	LS	$4,000.00	$4,000.00	
					$7,150.00	
4	Leachate Collection System					$20,000.00
	Maintenance	1	LS	$5,000.00	$5,000.00	
	Disposal	1	LS	$10,000.00	$15,000.00	
	TOTAL[a]					**$36,900.00**

(a) Total rounded to nearest $100.

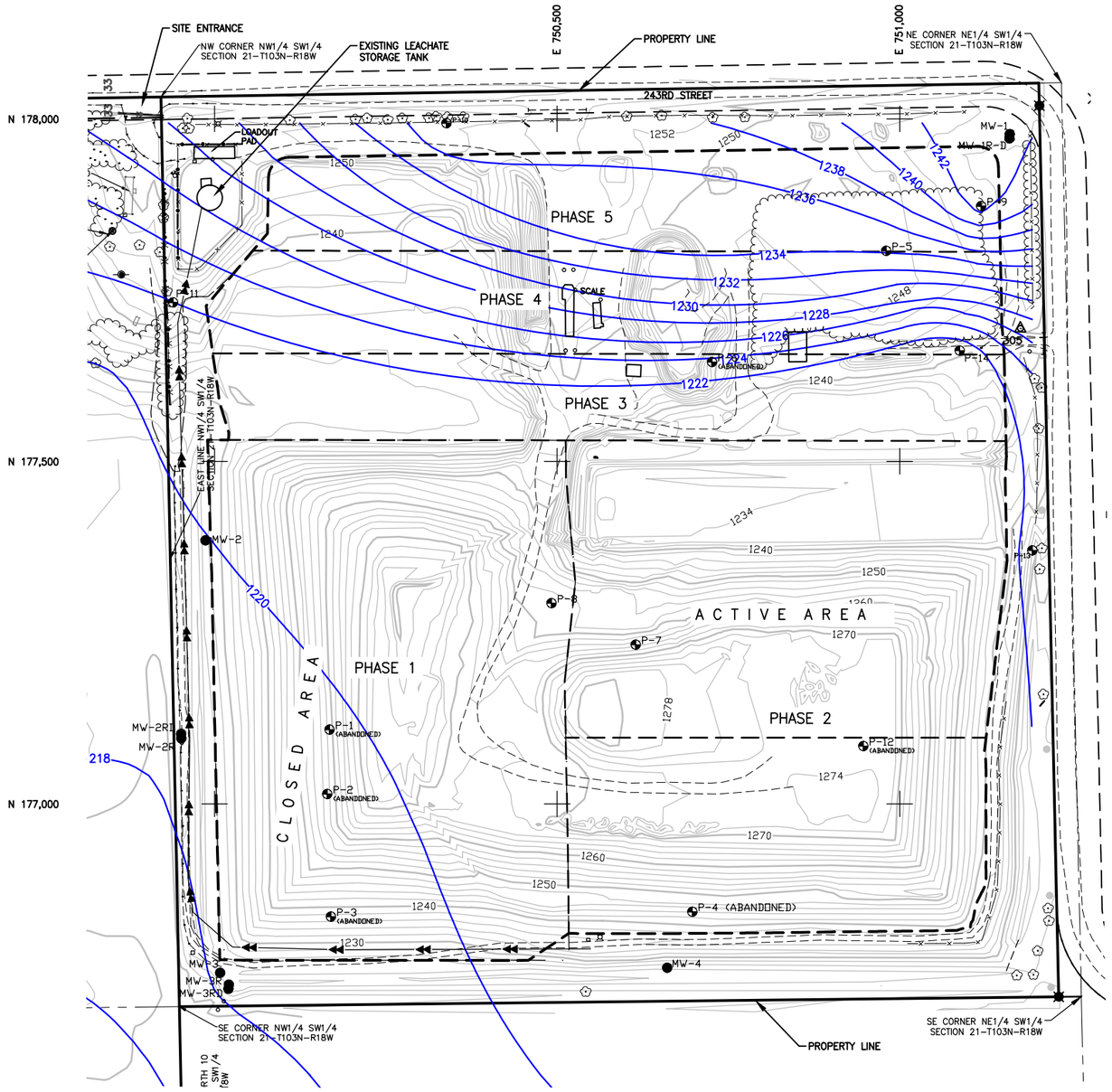
Table 5
Contingency Action Itemized Cost Estimates
SKB Lansing Landfill
May 2016

Item	Description	Quantity	Unit	Unit Cost	Extension	Subtotal	Comments
1	Geosynthetics		0.65			$1,300.00	
	a. Fence Repair	1	LS	$600.00	$600.00		
	b. sign repair	1	LS	$200.00	$200.00		
	c. equipment	1	LS	$500.00	$500.00		
		24			$1,300.00		
2	Severe Erosion					$14,600.00	
	a. Cover Fill	2420	CY	$4.50	$10,890.00		1 acre
	b. Revegetation	1	AC	$1,000.00	$1,000.00		affected
	c. Clean Surface Water Controls	200	LF	$1.00	$200.00		(18" deep)
	d. Clean up	1	LS	$2,500.00	$2,500.00		
					$14,590.00		
3	Major Cover Damage					$15,000.00	
	a. Repair Cost	1	AC	$15,000.00	$15,000.00		1 acres
					$15,000.00		affected
4	Grass Fire and Revegetation					$6,000.00	
	a. Fire Fighting	8	HR	$500.00	$4,000.00		1 acre
	b. Revegetation	2	AC	$1,000.00	$2,000.00		affected
					$6,000.00		2 acre to
							reseed
5	Subsurface Fire					$38,000.00	
	a. Fire Fighting	2	DAY	$4,000.00	$8,000.00		
	b. Rework Cap	2	AC	$15,000.00	$30,000.00		
	b. Rework				$38,000.00		
6	Groundwater Assessment					$23,400.00	
	a. Work Plan	1	LS	$3,500.00	$3,500.00		
	b. Install Additional Wells	3	EA	$2,000.00	$6,000.00		
	c. Sample Collection	3	EVENT	$550.00	$1,650.00		
	d. Sample Analysis	18	EA	$125.00	$2,250.00		
	e. Evaluation and Report	1	LS	$10,000.00	$10,000.00		
					$23,400.00		
7	Groundwater Corrective Action[(b)]					$217,500.00	
	a. Capital	1	LS	$50,000.00	$50,000.00		
	b. O&M	10	YR	$8,000.00	$80,000.00		
	c. Corrective Action Monitoring	10	YR	$8,000.00	$80,000.00		
	d. Reporting	1	LS	$7,500.00	$7,500.00		
					$217,500.00		
	TOTAL Cost Estimate for Contingency Action					**$315,800.00**	
	Contingency Action costs (15%)					**$47,370.00**	
	Total Contingency Action Estimate					**$363,170.00**	
	TOTAL Expected Value for Contingency Action (60% of total)					**$217,900.00**	

(a) Subtotal rounded to the nearest $100.
(b) Includes installation of pump, piping and installation of a small Ground water treatment system.

Figures

Plot Date & Time: 13 June 2016 7:52 AM



N

0 100 200
GRAPHIC SCALE IN FEET

MAPPING NOTE:
PHOTOGRAMMETRY MAPPING COMPILED BY CONTINENTAL MAPPING CONSULTANTS, INC. NOVEMBER 2, 2015.
HORIZONTAL COORDINATE SYSTEM MOWER COUNTY.
VERTICAL DATUM NAVD 88

LEGEND

- EXISTING CONTOURS
- EXISTING GROUNDWATER CONTOURS (APRIL 2015)
- EXISTING GRAVEL ROAD
- EXISTING FENCE
- EXISTING TREE LINE
- EXISTING TREE
- EXISTING CULVERT
- MW-1 EXISTING MONITORING WELL
- P-9 EXISTING PIEZOMETER
- EXISTING BOLLARD
- WASTE LIMITS OF ACTIVE FILL AREA
- PROPERTY LINE
- RIGHT OF WAY
- SECTION LINE
- EXISTING FORCEMAIN

REV	REVISION DESCRIPTION	DWN	APP	REV DATE
0	ISSUED FOR AGENCY REVIEW	JVB	TJS	06/13/16

SEAL
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.
PRINT NAME THOMAS J. SHUSTARICH
SIGNATURE
DATE JUNE 8, 2016 LICENSE # 21210

SUB CONSULTANT

PRIME CONSULTANT
WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.
1800 PIONEER CREEK CENTER MAPLE PLAIN, MINNESOTA
763-479-4200 763-479-4242

PROJECT TITLE
PERMIT RENEWAL AND MODIFICATION
SKB LANSING LANDFILL

SKB LANSING LANDFILL
AUSTIN, MINNESOTA

SHEET TITLE
HIGH WATER TABLE CONTOUR MAP
APRIL 2015

DWN BY	CHK'D	APP'D	DWG DATE
JVB	JCL	TJS	MAY 2016

SCALE AS NOTED

PROJECT NO.	SHEET NO.	REV NO.
3053-0041	FIGURE 1	0

M:\3053\0042\cad\civ\figure 1 Groundwater Map.dwg

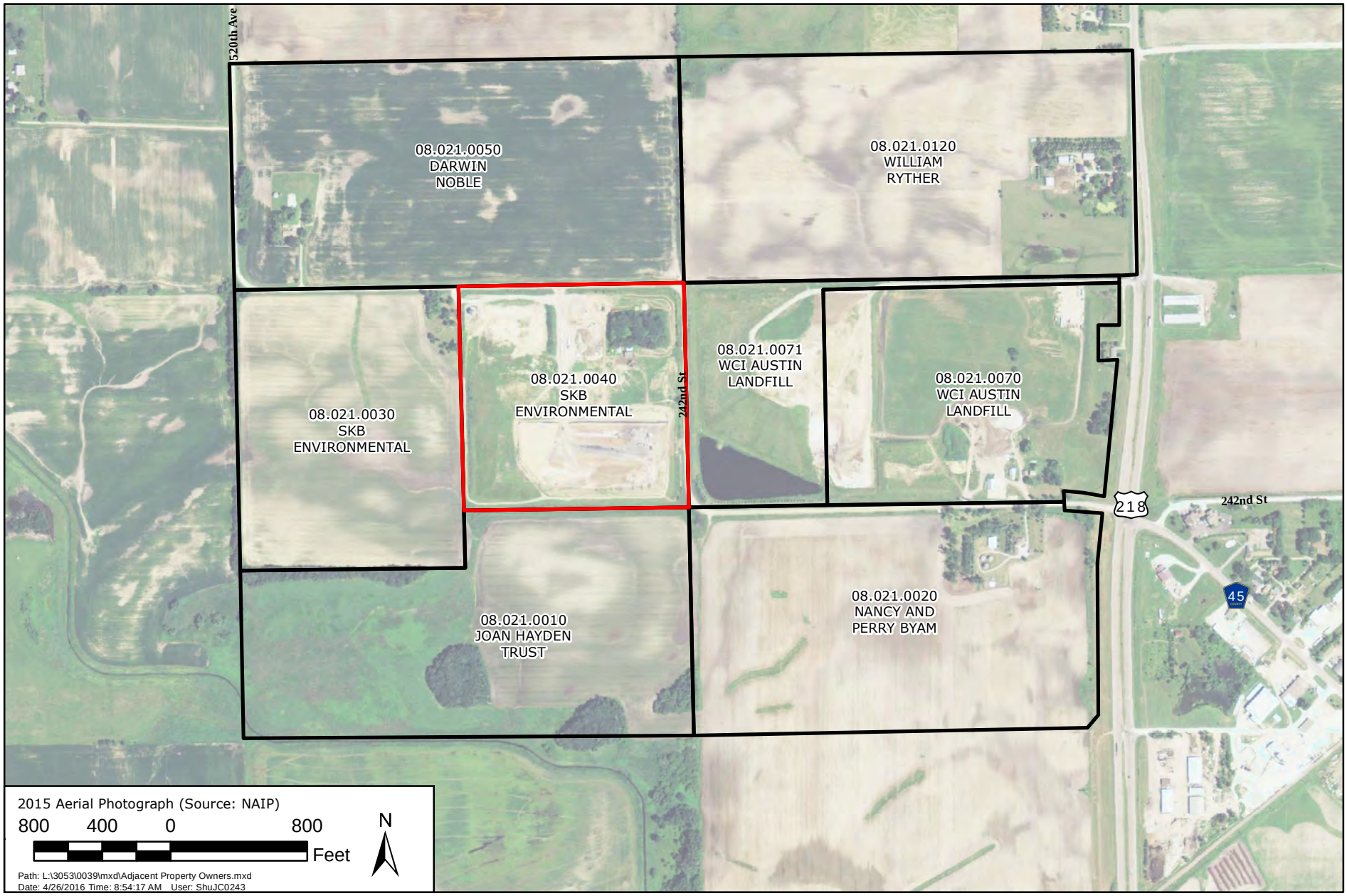
Appendix A

Locational Information

Parcel ID	Owner Name	Owner Address	Owner Address2
08.021.0010	JOAN K HAYDEN REVOCABLE TRUST	56871 205TH ST	AUSTIN MN 55912
08.021.0020	BYAM PERRY B & NANCY	52901 243RD ST	AUSTIN MN 55912
08.021.0030	SKB (AUSTIN) ENVIRONMENTAL LLC	3 WATERWAY SQUARE PLACE STE 110	THE WOODLANDS TX 77380
08.021.0040	SKB (AUSTIN) ENVIRONMENTAL LLC	3 WATERWAY SQUARE PLACE STE 110	THE WOODLANDS TX 77380
08.021.0050	NOBLE DARWIN RONALD	1024 DELAWARE AVE	PLATTE SD 57369
08.021.0070	WCI AUSTIN LANDFILL LLC	3 WATERWAY SQUARE PLACE STE 110	THE WOODLANDS TX 77380
08.021.0071	WCI AUSTIN LANDFILL LLC	3 WATERWAY SQUARE PLACE STE 110	THE WOODLANDS TX 77380
08.021.0120	RYTHER WILLIAM H	24593 US HWY 218	AUSTIN MN 55912

CWI Field Verified Wells within 1 mile
SKB Lansing Landfill, June 2016

UNIQUE_NO	WELLNAME	TOWNSHIP	RANGE	RANGE_DIR	SECTION	ELEVATION	LOC_SRC	DEPTH_DRLL	DEPTH_COMP	DATE_DRLL	CASE_DIAM	CASE_DEPTH
763180	BUSTAD, WALLACE	103	18	W	22	1241	MGS	300	300	20090206	4	235
248108	CITY LIMITS WELL	103	18	W	22	1239	MDH	0	0	0	0	0
260608	AUSTIN READY MIX COMPANY	103	18	W	27	1244	MDH	0	0	0	0	0
260615	WALLACE BUSTAD CRANE SER	103	18	W	27	1246	MDH	0	0	0	0	0
221180	KLIMEK TRANSFER & STORAG	103	18	W	22	1242	MGS	118	118	19711102	5	96
623317	MW-1	103	18	W	21	1239	MDH	21	15	19981124	0	5
260610	KIKER BROTHERS, INC. 1	103	18	W	22	1241	MDH	0	0	0	0	0
226593	RANOM, ARNOLD	103	18	W	21	1245	MGS	155	155	0	5	147
249372	UNITED BUILDING CENTERS,	103	18	W	22	1234	MDH	0	0	0	0	0
103534	NOBLE, RALPH	103	18	W	20	1232	MGS	140	140	19761119	5	108
459864	SHEELY, DEAN	103	18	W	22	1242	SWCD	130	130	19900328	5	112
623320	MW-4	103	18	W	21	1240	MDH	21	15	19981124	0	5
226605	TUCKER, MIKE	103	18	W	15	1242	MGS	150	150	19560527	4	117
623319	MW-3	103	18	W	21	1235	MDH	21	17.5	19981124	0	7.5
623318	MW-2	103	18	W	21	1228	MDH	21	15	19981124	0	5
160872	RANUM, THEODORE	103	18	W	21	1248	SWCD	140	140	19801010	4	128
152834	TORGERSON, DON	103	18	W	20	1240	MGS	141	141	19790710	4	128
577732	NOBLES, RONALD	103	18	W	21	1261	MGS	175	140	19960816	5	111
152813	TORGERSON, STEVE	103	18	W	20	1232	MGS	141	141	19790511	5	120
785084	MW-3RD	103	18	W	21	1226	MGS	48	45.5	20110531	2	40.5
785087	MW-1R-D	103	18	W	21	1223	MGS	76	76	20110602	2	71



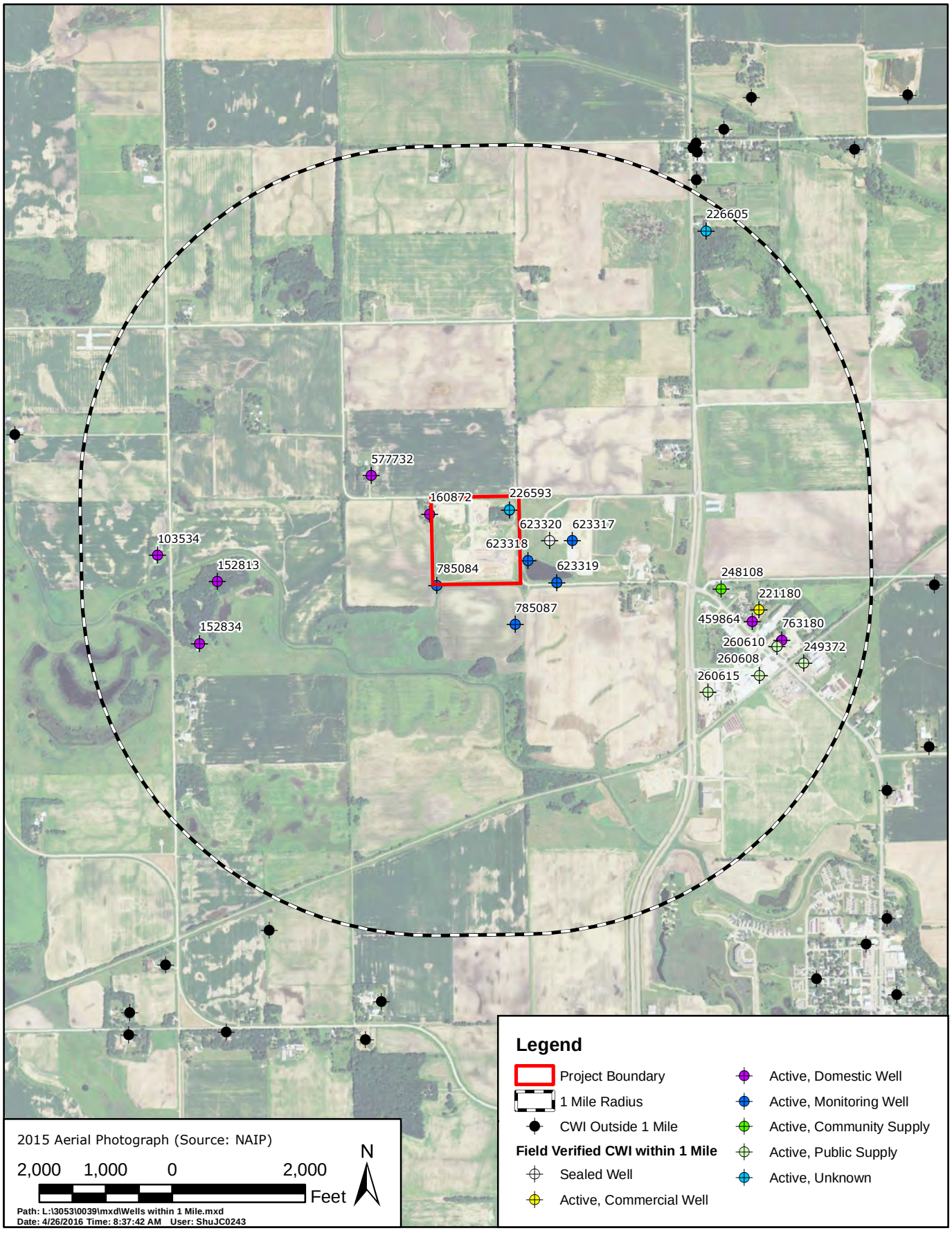
SKB LANSING INDUSTRIAL LANDFILL

Adjacent Property Owners

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

APR 2016

Figure 1



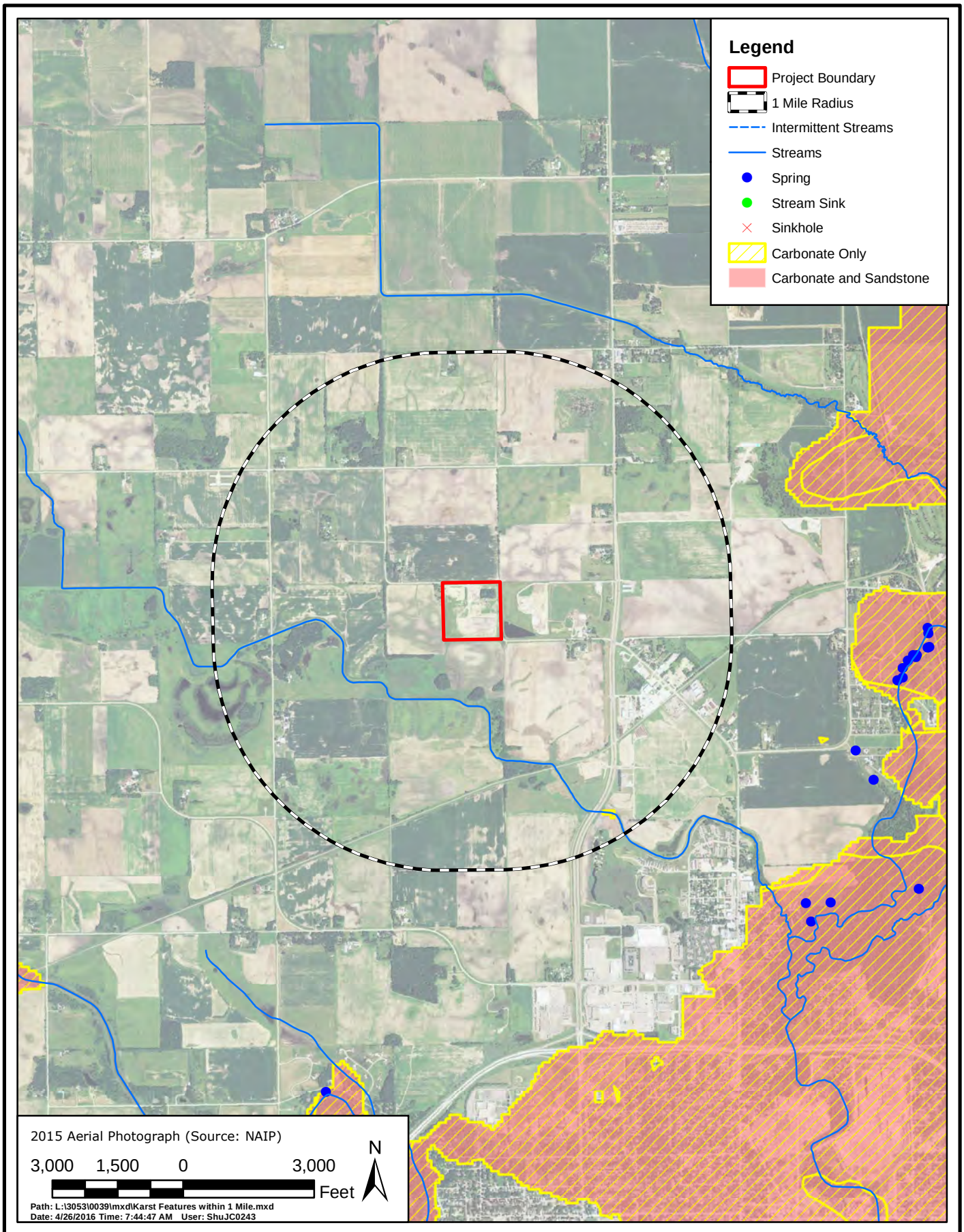
SKB LANSING INDUSTRIAL LANDFILL

Wells within 1 Mile

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

APR 2016

Figure 1



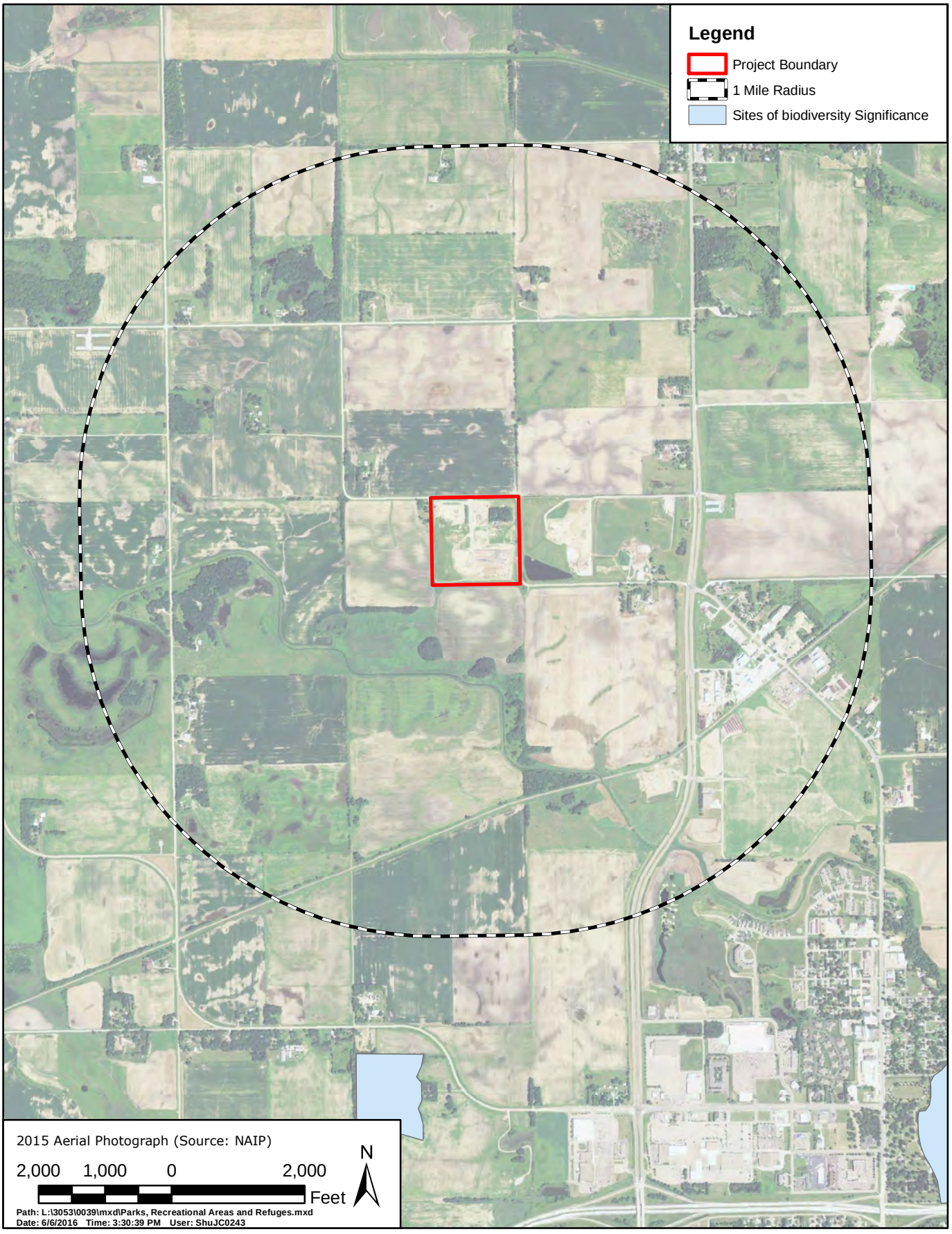
SKB LANSING INDUSTRIAL LANDFILL

Karst Features within 1 Mile

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

APR 2016

Figure 1



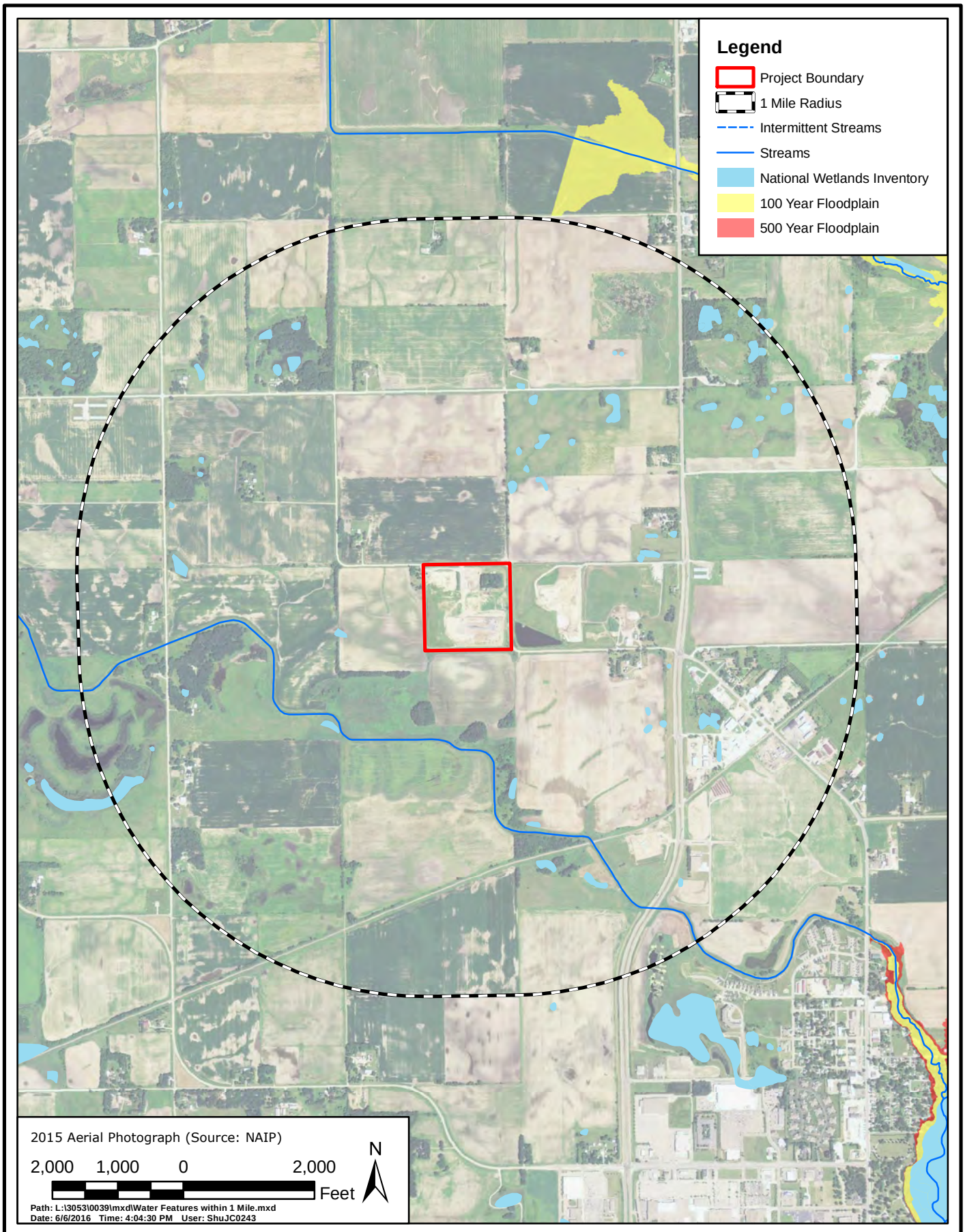
SKB LANSING INDUSTRIAL LANDFILL

Parks, Recreational Areas and Refuges

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

APR 2016

Figure 1



SKB LANSING INDUSTRIAL LANDFILL

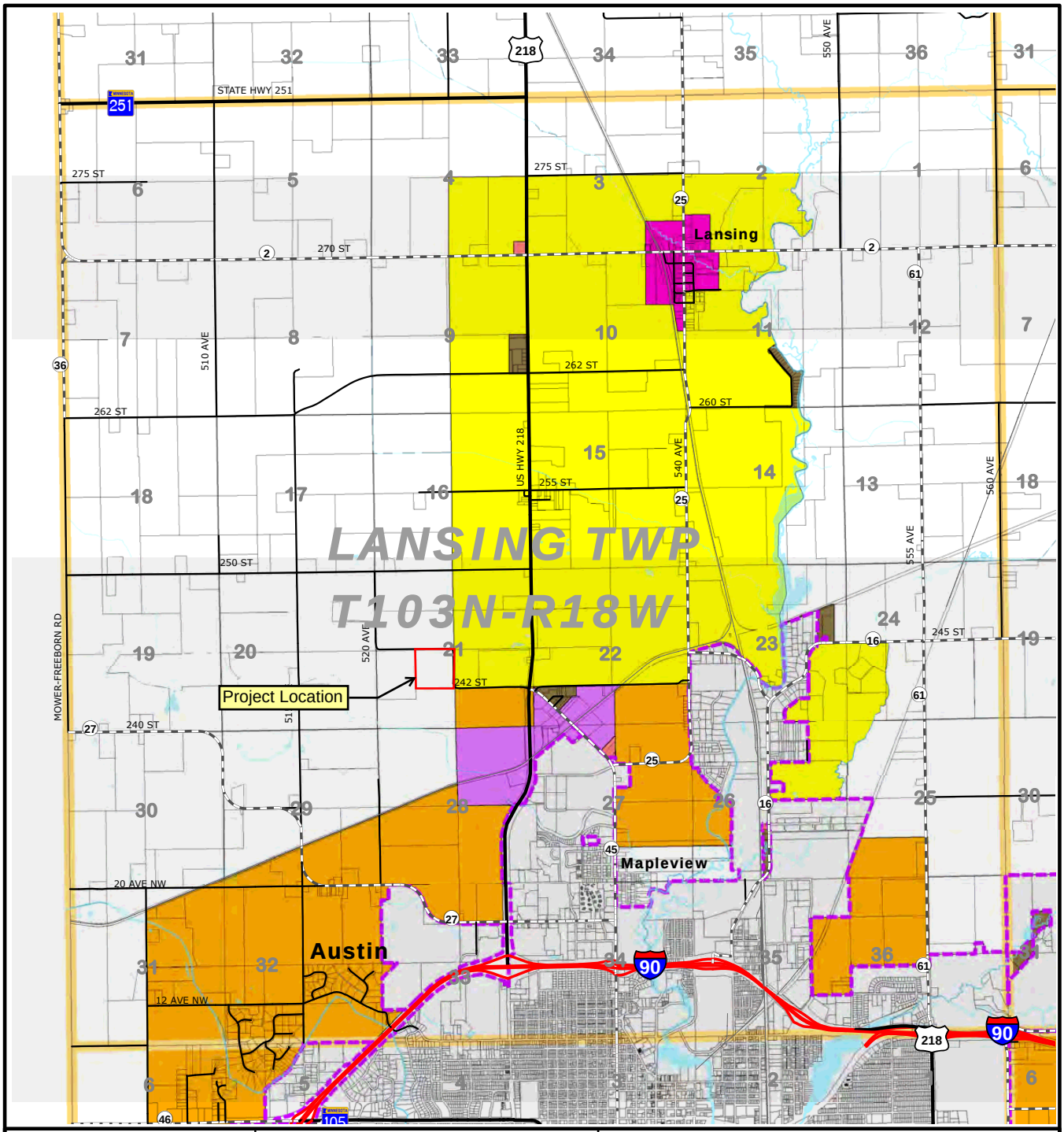
Karst Features within 1 Mile

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

APR 2016

Figure 1



Existing Residential Plats - Whether or not they are so designated on the zoning map, residential plats where were approved prior to the effective date of this ordinance shall be considered as though zoned Residential regardless of the primary or underlying zoning district in which they are located.

N

Mower County GIS
Date 7/6/2015

UDOLPHO 104-18 Page: 1	WALTHAM 104-17 Page: 2	SARGEANT 104-16 Page: 3	PLEASANT VALLEY 104-15 Page: 4	RACINE 104-14 Page: 5
LANSING 103-18 Page: 6	RED ROCK 103-17 Page: 7	DEXTER 103-16 Page: 8	GRAND MEADOW 103-15 Page: 9	FRANKFORD 103-14 Page: 10
AUSTIN 102-18 Page: 11	WINDOM 102-17 Page: 12	MARSHALL 102-16 Page: 13	CLAYTON 102-15 Page: 14	BENNINGTON 102-14 Page: 15
LYLE 101-18 Page: 16	NEVADA 101-17 Page: 17	ADAMS 101-16 Page: 18	LODI 101-15 Page: 19	LE ROY 101-14 Page: 20

Legend

- Township Boundary
- City Limits

Zoning Designations

- Agricultural
- Business
- Freeway Interchange Management
- Industrial
- Planned Unit Development
- R-1
- Rural Management
- Rural Service Center
- Urban Expansion

SKB LANSING INDUSTRIAL LANDFILL

Lansing Township Zoning Map

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

APR 2016

Figure 1

Appendix B

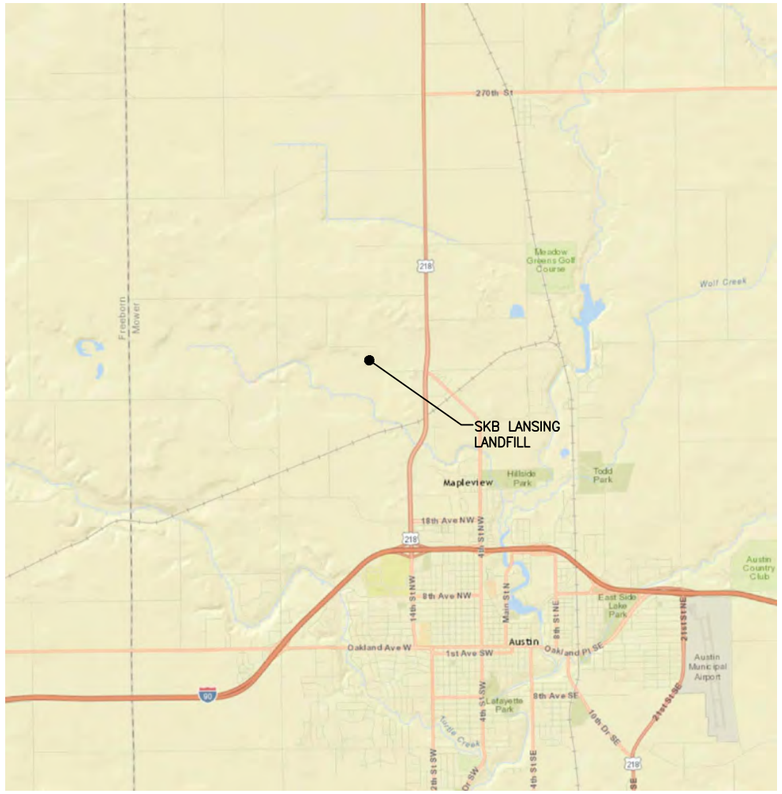
Permit Drawings

PERMIT RENEWAL AND MODIFICATIONS

SKB LANSING LANDFILL SW-514
PREPARED FOR
SKB (AUSTIN) ENVIRONMENTAL, LLC
AUSTIN, MINNESOTA

JUNE, 2016

PROJECT LOCATION MAP



VICINITY MAP

INDEX OF SHEETS

N
0 400 800
GRAPHIC SCALE IN FEET

N
0 4000 8000
GRAPHIC SCALE IN FEET

REV	REVISION DESCRIPTION	DWN	APP	REV DATE
0	ISSUED FOR AGENCY REVIEW	JVB	TJS	06/13/16

SEAL

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

PRINT NAME THOMAS J. SHUSTARICH

SIGNATURE

DATE JUNE 8, 2016 LICENSE # 21210

PRIME CONSULTANT
WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.
1800 PIONEER CREEK CENTER
MAPLE PLAIN, MINNESOTA
P. 763-479-4200
F. 763-479-4242

PROJECT TITLE
PERMIT RENEWAL AND MIDIFICATIONS
SKB LANSING LANDFILL

SKB LANSING LANDFILL
AUSTIN, MINNESOTA

SHEET TITLE
TITLE AND INDEX SHEET

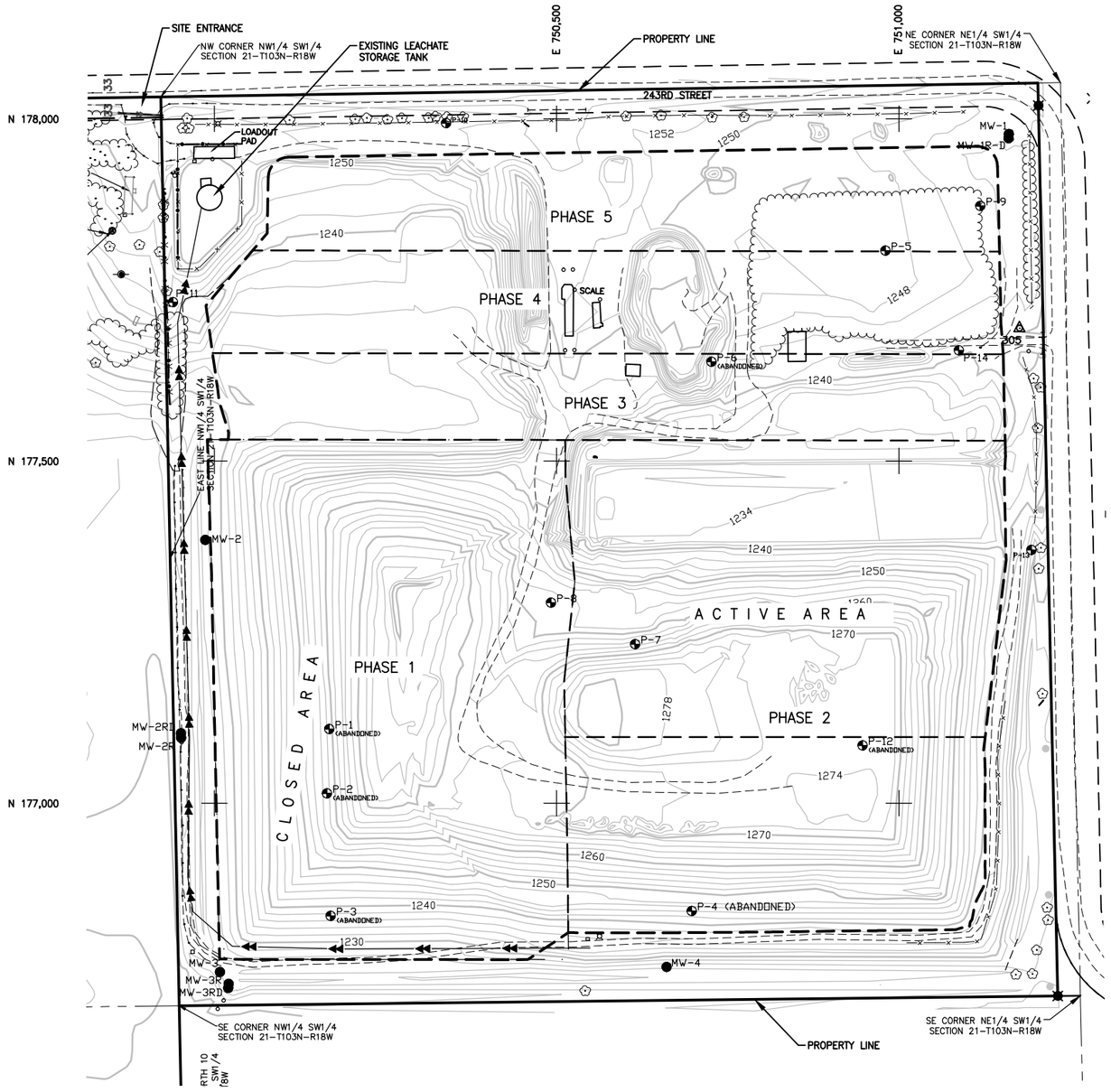
DWN BY	CHK'D	APP'D	DWG DATE
JVB	JCL	JCL	JUNE 2016

SCALE AS SHOWN

PROJECT NO. 5053-0042

SHEET NO. G-101

REV NO. 0



N

0 100 200

GRAPHIC SCALE IN FEET

MAPPING NOTE:
PHOTOGRAMMETRY MAPPING COMPILED BY CONTINENTAL MAPPING CONSULTANTS, INC. NOVEMBER 2, 2015.
HORIZONTAL COORDINATE SYSTEM MOWER COUNTY.
VERTICAL DATUM NAVD 88

LEGEND

- EXISTING CONTOURS
- EXISTING GRAVEL ROAD
- EXISTING FENCE
- EXISTING TREE LINE
- EXISTING TREE
- EXISTING CULVERT
- MW-1 EXISTING MONITORING WELL
- P-9 EXISTING PIEZOMETER
- EXISTING BOLLARD
- WASTE LIMITS OF ACTIVE FILL AREA
- PROPERTY LINE
- RIGHT OF WAY
- SECTION LINE
- EXISTING FORCEMAIN

REV	REVISION DESCRIPTION	DWN	APP	REV DATE
0	ISSUED FOR AGENCY REVIEW	JVB	TJS	06/13/16

SEAL

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

PRINT NAME THOMAS J. SHUSTARICH

SIGNATURE

DATE JUNE 8, 2016 LICENSE # 21210

SUB CONSULTANT

PRIME CONSULTANT

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.
1800 PIONEER CREEK CENTER 763-479-4200
MAPLE PLAIN, MINNESOTA 763-479-4242

PROJECT TITLE
PERMIT RENEWAL AND MODIFICATION
SKB LANSING LANDFILL

SKB LANSING LANDFILL
AUSTIN, MINNESOTA

SHEET TITLE
EXISTING CONDITIONS MAP

DWN BY	CHK'D	APP'D	DWG DATE
JVB	JCL	TJS	MAY 2016

SCALE AS NOTED

PROJECT NO.	SHEET NO.	REV NO.
3053-0041	C-101	0

Plot Date & Time: 13 June 2016 10:22 AM

E 750,000

E 750,500

E 751,000

N 178,000

N 177,500

SITE ENTRANCE

243RD STREET

LOADOUT PAD

EXISTING LEACHATE STORAGE TANK

SUMP

SLOPE 4.6%

SLOPE 4.6%

SLOPE 0.5%

AREA CURRENTLY UNDER CONSTRUCTION

SLOPE 2.1%

SEE LINER DETAIL FOR THIS AREA 5 D-101

2 D-101 3 D-101

1250

1248

1246

1244

1242

1240

1238

1236

1234

1232

1230

1228

MW-1

MW-2

P-8

P-9

P-10

P-11

P-13

0 50 100

GRAPHIC SCALE IN FEET

MAPPING NOTE:
PHOTOGRAMMETRY MAPPING COMPILED BY CONTINENTAL MAPPING CONSULTANTS, INC. NOVEMBER 2, 2015.
HORIZONTAL COORDINATE SYSTEM MOWER COUNTY.
VERTICAL DATUM NAVD 88

LEGEND

- EXISTING CONTOURS
- PROPOSED TOP OF LINER CONTOURS
- EXISTING GRAVEL ROAD
- EXISTING FENCE
- EXISTING TREE LINE
- EXISTING TREE
- EXISTING CULVERT
- MW-1 EXISTING MONITORING WELL
- P-9 EXISTING PIEZOMETER
- EXISTING BOLLARD
- WASTE LIMITS
- PROPERTY LINE
- RIGHT OF WAY
- SECTION LINE
- EXISTING FORCEMAIN

REV	REVISION DESCRIPTION	DWN	APP	REV DATE
0	ISSUED FOR AGENCY REVIEW	JVB	TJS	06/13/16

SEAL

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

PRINT NAME THOMAS J. SHUSTARICH

SIGNATURE

DATE JUNE 8, 2016 LICENSE # 21210

SUB CONSULTANT

PRIME CONSULTANT

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

1800 PIONEER CREEK CENTER MAPLE PLAIN, MINNESOTA

763-479-4200 763-479-4242

PROJECT TITLE
PERMIT RENEWAL AND MODIFICATIONSS FOR SKB LANSING LANDFILL

SKB LANSING LANDFILL
AUSTIN, MINNESOTA

SHEET TITLE
BASE GRADING PLAN

DWN BY	CHK'D	APP'D	DWG DATE
JVB	JCL	TJS	MAY 2016

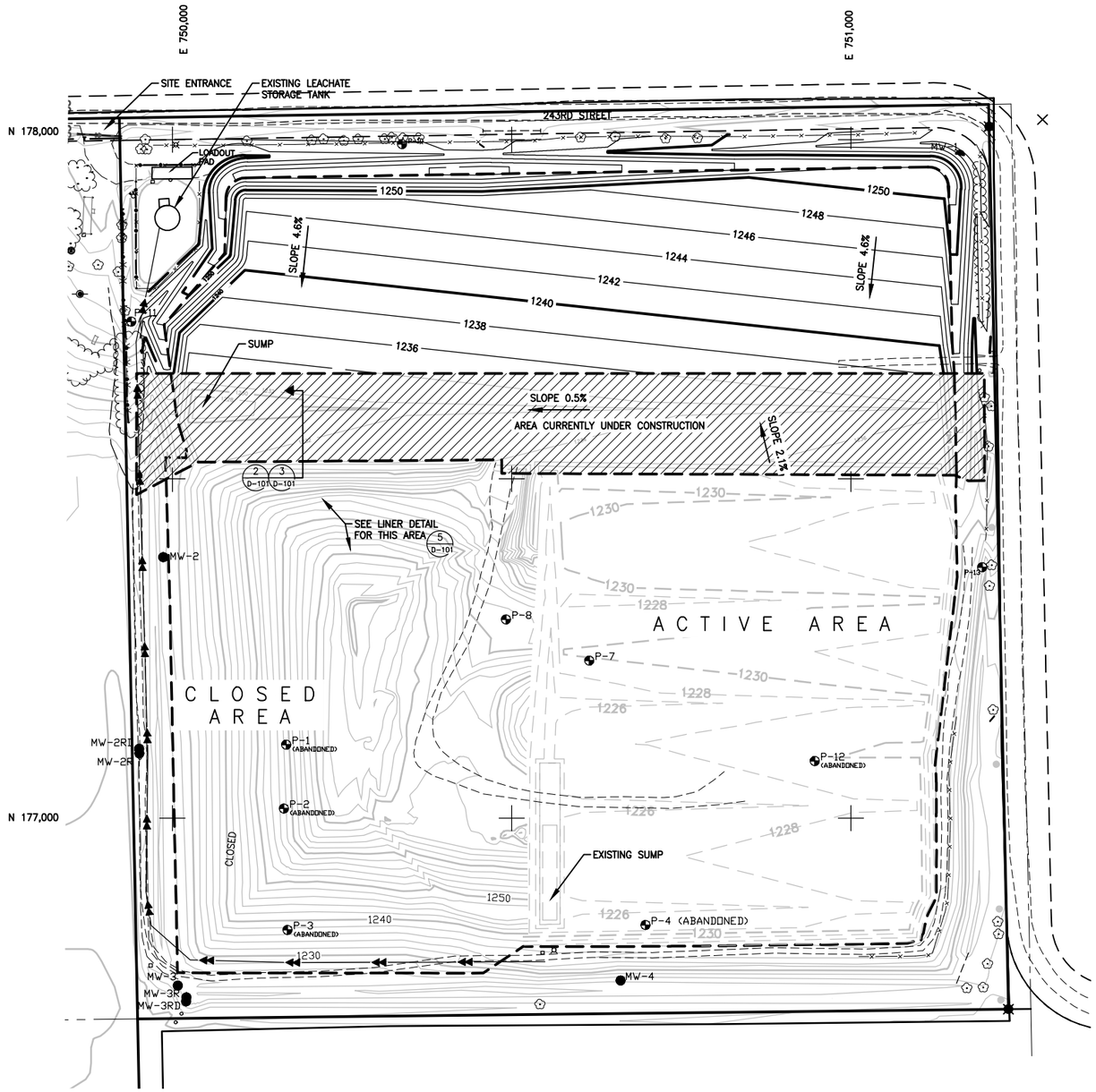
SCALE AS NOTED

PROJECT NO. 3053-0041

SHEET NO. C-102

REV NO. 0

M:\3053\0042\cad\civil\C-102_Base Grading.dwg



N

0 50 100
GRAPHIC SCALE IN FEET

MAPPING NOTE:
PHOTOGRAMMETRY MAPPING COMPILED BY CONTINENTAL MAPPING CONSULTANTS, INC. NOVEMBER 2, 2015.
HORIZONTAL COORDINATE SYSTEM MOWER COUNTY.
VERTICAL DATUM NAVD 88

LEGEND

- EXISTING CONTOURS
- PROPOSED TOP OF LINER CONTOURS
- EXISTING GRAVEL ROAD
- EXISTING FENCE
- EXISTING TREE LINE
- EXISTING TREE
- EXISTING CULVERT
- MW-1 EXISTING MONITORING WELL
- P-9 EXISTING PIEZOMETER
- EXISTING BOLLARD
- WASTE LIMITS
- PROPERTY LINE
- RIGHT OF WAY
- SECTION LINE
- EXISTING FORCEMAIN

REV	REVISION DESCRIPTION	DWN	APP	REV DATE
0	ISSUED FOR AGENCY REVIEW	JVB	TJS	06/13/16

SEAL
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.
PRINT NAME THOMAS J. SHUSTARICH
SIGNATURE
DATE JUNE 8, 2016 LICENSE # 21210

SUB CONSULTANT

PRIME CONSULTANT
WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.
1800 PIONEER CREEK CENTER 763-479-4200
MAPLE PLAIN, MINNESOTA 763-479-4242

PROJECT TITLE
PERMIT RENEWAL AND MODIFICATIONSS FOR SKB LANSING LANDFILL

SKB LANSING LANDFILL
AUSTIN, MINNESOTA

SHEET TITLE
PROPOSED AND PREVIOUSLY CONSTRUCTED BASE GRADES

DWN BY	CHK'D	APP'D	DWG DATE
JVB	JCL	TJS	MAY 2016

SCALE AS NOTED

PROJECT NO.	SHEET NO.	REV NO.
3053-0041	C-102A	0

Plot Date & Time: 13 June 2016 11:05 AM

E 750,000

E 750,500

E 751,000

N 178,000

N 177,500

SITE ENTRANCE

EXISTING LEACHATE STORAGE TANK

243RD STREET

LOADOUT PAD

P-10

MW-1

1250

1248

1246

1244

1242

1240

1238

1236

1234

1232

1230

SLOPE 4.6%

SLOPE 4.6%

PROPOSED FORCEMAIN SEE DETAIL 4 D-104

LEACHATE PUMPING STATION STRUCTURE SEE DETAILS 1 D-104, 2 D-104, 3 D-104

P-11

24" SUMP SIDE SLOPE RISER PIPE

5 D-103

1 D-103

SUMP

1070 LF OF 6" PERFORATED LEACHATE COLLECTION PIPE AT 0.50% SLOPE

AREA CURRENTLY UNDER CONSTRUCTION

1 D-101, 4 D-101

1 D-102, 2 D-102

6" SIDE SLOPE RISER PIPE

2 D-101, 3 D-101

SEE LINER DETAIL FOR THIS AREA 5 D-101

ACTIVE AREA

MW-2

CLOSED AREA

P-8

P-13

N

0 50 100

GRAPHIC SCALE IN FEET

MAPPING NOTE:
PHOTOGRAMMETRY MAPPING COMPILED BY CONTINENTAL MAPPING CONSULTANTS, INC. NOVEMBER 2, 2015.
HORIZONTAL COORDINATE SYSTEM MOWER COUNTY.
VERTICAL DATUM NAVD 88

LEGEND

- EXISTING CONTOURS
- PROPOSED TOP OF LINER CONTOURS
- EXISTING GRAVEL ROAD
- EXISTING FENCE
- EXISTING TREE LINE
- EXISTING TREE
- EXISTING CULVERT
- MW-1 EXISTING MONITORING WELL
- P-9 EXISTING PIEZOMETER
- EXISTING BOLLARD
- WASTE LIMITS
- PROPERTY LINE
- RIGHT OF WAY
- SECTION LINE
- EXISTING FORCEMAIN

REV	REVISION DESCRIPTION	DWN	APP	REV DATE
0	ISSUED FOR AGENCY REVIEW	JVB	TJS	06/13/16

SEAL

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

PRINT NAME THOMAS J. SHUSTARICH

SIGNATURE

DATE JUNE 8, 2016 LICENSE # 21210

SUB CONSULTANT

PRIME CONSULTANT

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

1800 PIONEER CREEK CENTER 763-479-4200
MAPLE PLAIN, MINNESOTA 763-479-4242

PROJECT TITLE
PERMIT RENEWAL AND MODIFICATIONS
SKB LANSING LANDFILL

SKB LANSING LANDFILL
AUSTIN, MINNESOTA

SHEET TITLE
LEACHATE COLLECTION PLAN

DWN BY	CHK'D	APP'D	DWG DATE
JVB	JCL	TJS	MAY 2016

SCALE AS NOTED

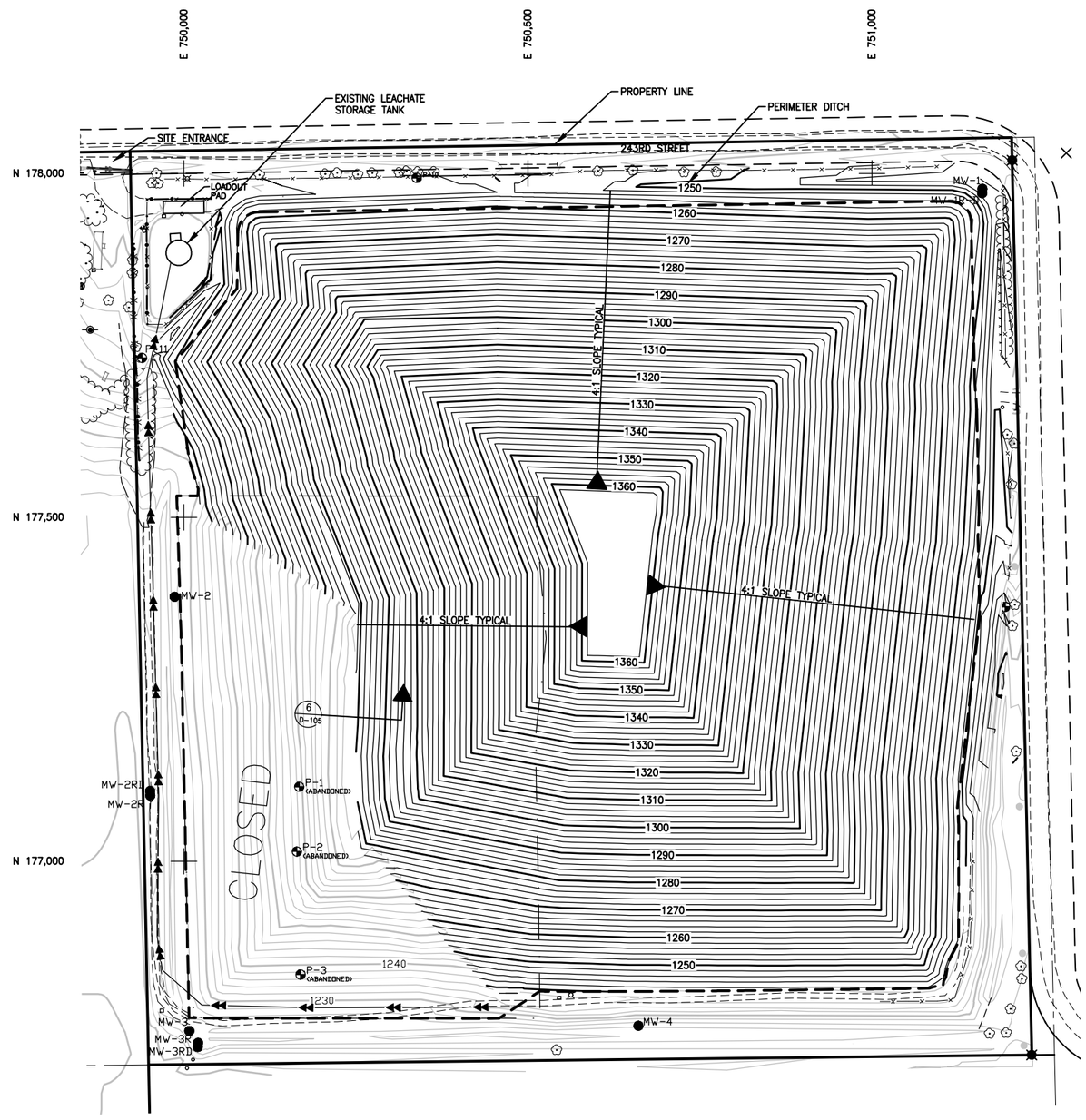
PROJECT NO. 3053-0041

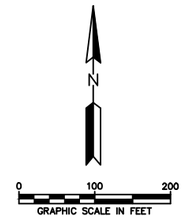
SHEET NO. C-103

REV NO. 0

M:\3053\0042\cad\civil\C-103_LEACHATE COLLECTION.dwg

Plot Date & Time: 13 June 2016 12:19 PM





MAPPING NOTE:
PHOTOGRAMMETRY MAPPING COMPILED BY CONTINENTAL MAPPING CONSULTANTS, INC. NOVEMBER 2, 2015.
HORIZONTAL COORDINATE SYSTEM MOWER COUNTY.
VERTICAL DATUM NAVD 88

LEGEND

- EXISTING CONTOURS
- PROPOSED FINAL COVER CONTOURS
- EXISTING GRAVEL ROAD
- EXISTING FENCE
- EXISTING TREE LINE
- EXISTING TREE
- EXISTING CULVERT
- MW-1 EXISTING MONITORING WELL
- P-9 EXISTING PIEZOMETER
- EXISTING BOLLARD
- WASTE LIMITS
- PROPERTY LINE
- RIGHT OF WAY
- SECTION LINE
- EXISTING FORCEMAIN

REV	REVISION DESCRIPTION	DWN	APP	REV DATE
0	ISSUED FOR AGENCY REVIEW	JVB	TJS	06/13/16

SEAL

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

PRINT NAME THOMAS J. SHUSTARICH

SIGNATURE

DATE JUNE 8, 2016 LICENSE # 21210

SUB CONSULTANT

PRIME CONSULTANT

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

1800 PIONEER CREEK CENTER MAPLE PLAIN, MINNESOTA 763-479-4200 763-479-4242

PROJECT TITLE
PERMIT RENEWAL AND MODIFICATIONS
SKB LANSING LANDFILL

SKB LANSING LANDFILL
AUSTIN, MINNESOTA

SHEET TITLE
FINAL COVER PLAN

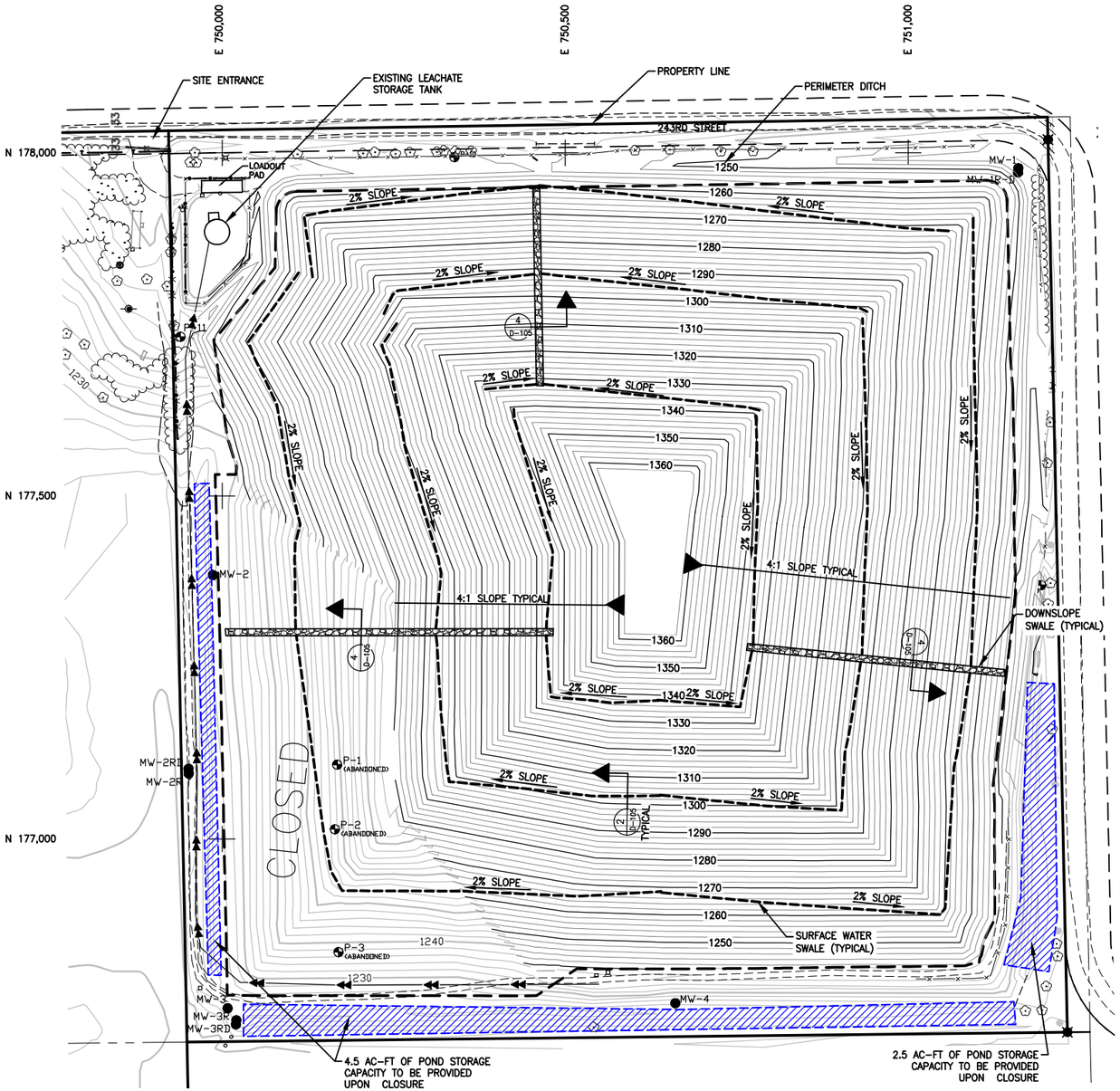
DWN BY	CHK'D	APP'D	DWG DATE
JVB	JCL	TJS	MAY 2016

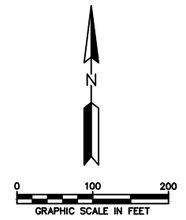
SCALE AS NOTED

PROJECT NO.	SHEET NO.	REV NO.
3053-0041	C-104	0

M:\3053\0042\cad\civ\C-104_FINAL COVER.dwg

Plot Date & Time: 13 June 2016 11:37 AM





MAPPING NOTE:
PHOTOGRAMMETRY MAPPING COMPILED BY CONTINENTAL MAPPING CONSULTANTS, INC. NOVEMBER 2, 2015.
HORIZONTAL COORDINATE SYSTEM MOWER COUNTY.
VERTICAL DATUM NAVD 88

LEGEND

- EXISTING CONTOURS
- PROPOSED FINAL COVER CONTOURS
- EXISTING GRAVEL ROAD
- EXISTING FENCE
- EXISTING TREE LINE
- EXISTING TREE
- EXISTING CULVERT
- MW-1 EXISTING MONITORING WELL
- P-9 EXISTING PIEZOMETER
- EXISTING BOLLARD
- WASTE LIMITS
- PROPERTY LINE
- RIGHT OF WAY
- SECTION LINE
- EXISTING FORCEMAIN

REV	REVISION DESCRIPTION	DWN	APP	REV DATE
0	ISSUED FOR AGENCY REVIEW	JVB	TJS	06/13/16

SEAL

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

PRINT NAME THOMAS J. SHUSTARICH

SIGNATURE

DATE JUNE 8, 2016 LICENSE # 21210

SUB CONSULTANT

PRIME CONSULTANT

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.
1800 PIONEER CREEK CENTER 763-479-4200
MAPLE PLAIN, MINNESOTA 763-479-4242

PROJECT TITLE
PERMIT RENEWAL AND MODIFICATIONS
SKB LANSING LANDFILL

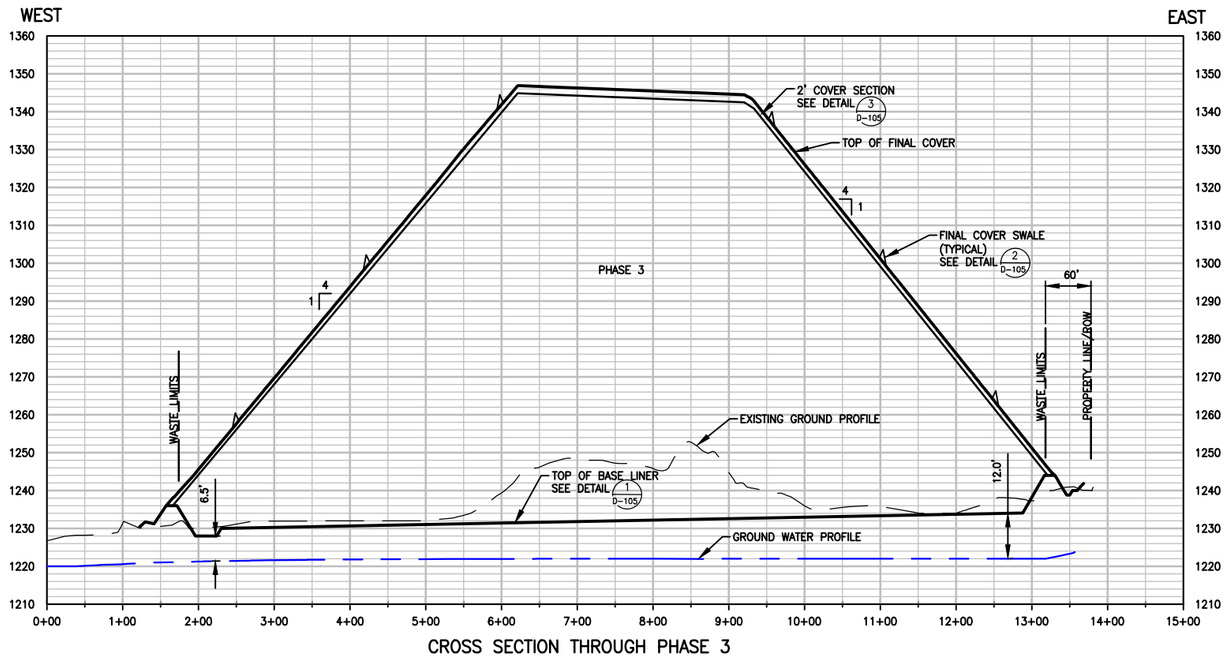
SKB LANSING LANDFILL
AUSTIN, MINNESOTA

SHEET TITLE
SURFACE WATER MANAGEMENT SYSTEM

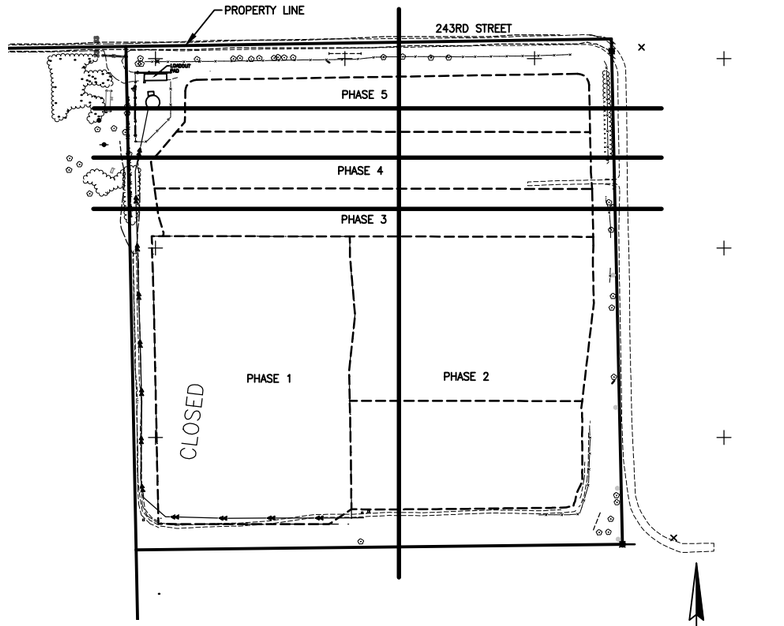
DWN BY	CHK'D	APP'D	DWG DATE	MAY 2016
JVB	JCL	TJS	SCALE	AS NOTED

PROJECT NO.	SHEET NO.	REV NO.
3053-0041	C-105	0

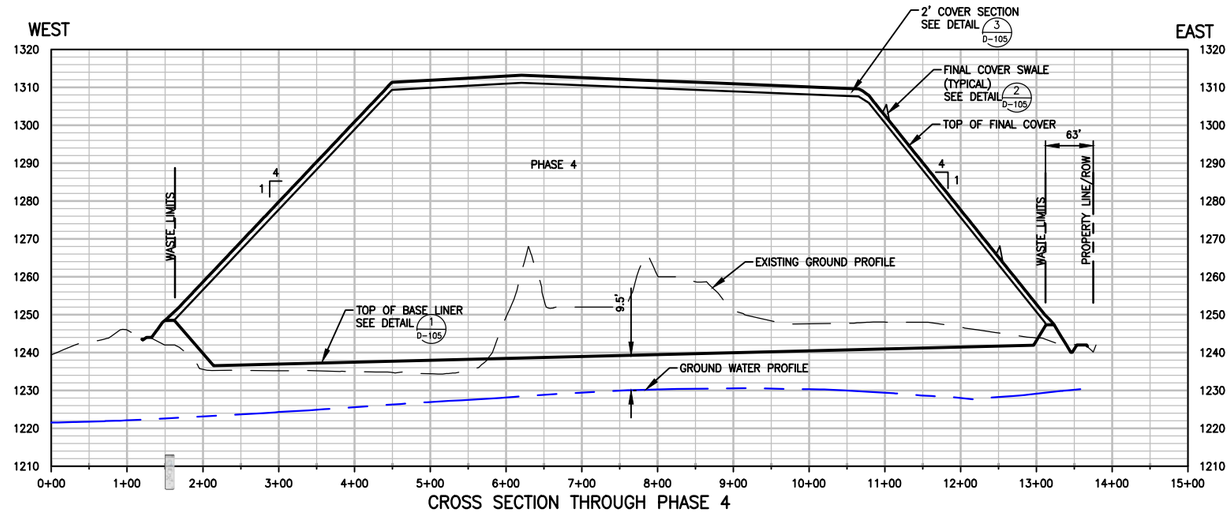
M:\3053\0042\cad\civil\C-105_SURFACE WATER.dwg



CROSS SECTION THROUGH PHASE 3



CROSS SECTION LOCATION MAP



CROSS SECTION THROUGH PHASE 4

REV	REVISION DESCRIPTION	DWN	APP	REV DATE
0	ISSUED FOR AGENCY REVIEW	JVB	TJS	06/13/16

SEAL

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

PRINT NAME THOMAS J. SHUSTARICH

SIGNATURE

DATE JUNE 8, 2016 LICENSE # 21210

SUB CONSULTANT

PRIME CONSULTANT

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

1800 PIONEER CREEK CENTER 763-479-4200
MAPLE PLAIN, MINNESOTA 763-479-4242

PROJECT TITLE
PERMIT RENEWAL AND MODIFICATIONS
SKB LANSING LANDFILL

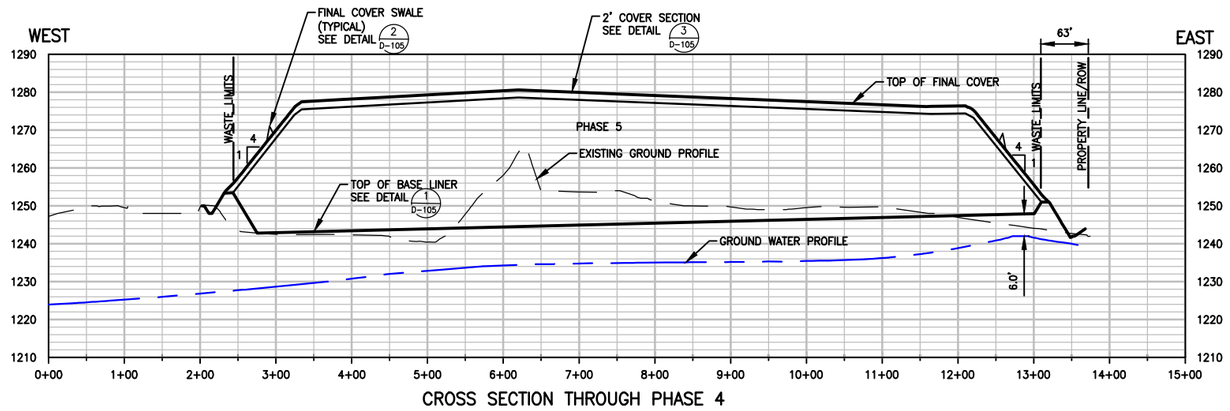
SKB LANSING LANDFILL
AUSTIN, MINNESOTA

SHEET TITLE
CROSS SECTIONS

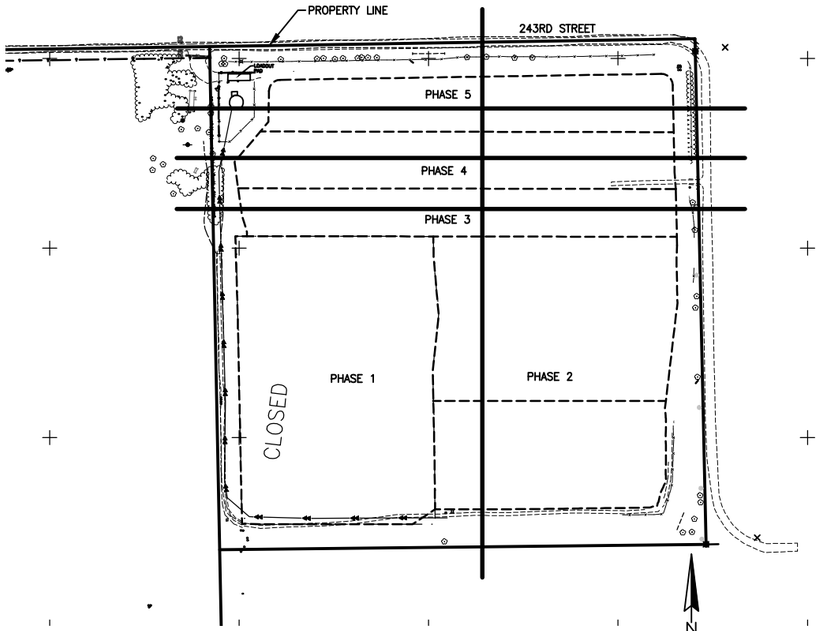
DWN BY	CHK'D	APP'D	DWG DATE
JVB	JCL	TJS	MAY 2016

SCALE AS NOTED

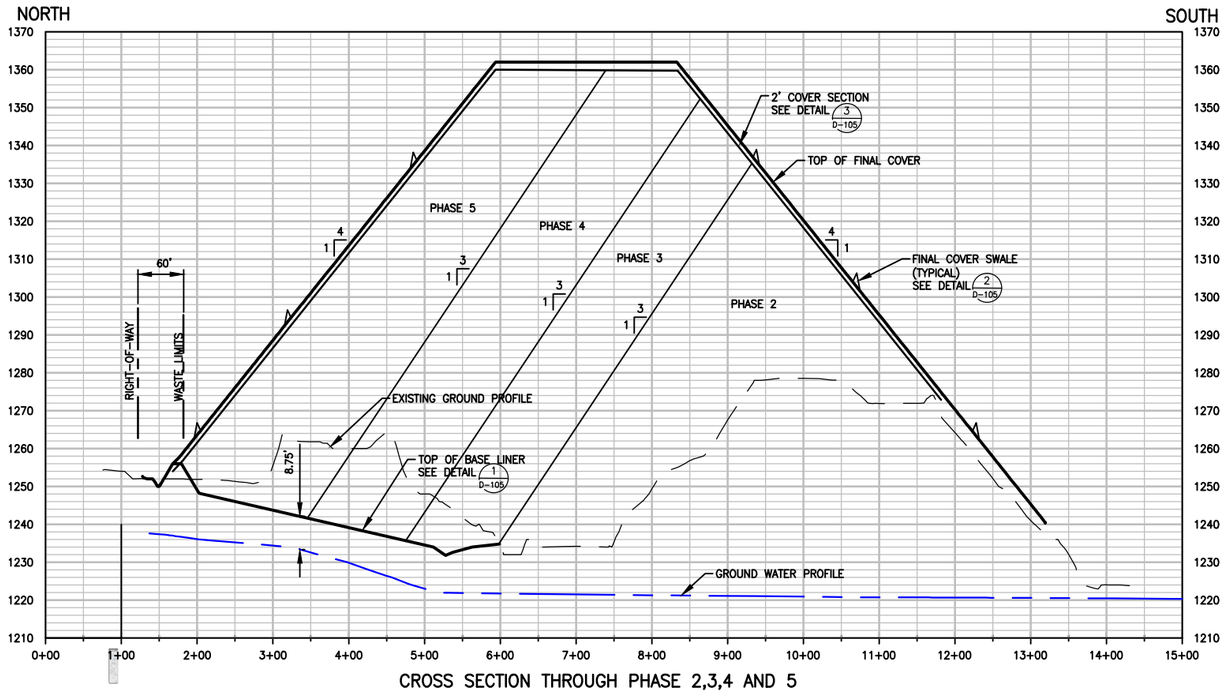
PROJECT NO.	SHEET NO.	REV NO.
3053-0041	C-106	0



CROSS SECTION THROUGH PHASE 4



CROSS SECTION LOCATION MAP



CROSS SECTION THROUGH PHASE 2,3,4 AND 5

REV	REVISION DESCRIPTION	DWN	APP	REV DATE
0	ISSUED FOR AGENCY REVIEW	JVB	TJS	06/13/16

SEAL

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

PRINT NAME THOMAS J. SHUSTARICH

SIGNATURE

DATE JUNE 8, 2016 LICENSE # 21210

SUB CONSULTANT

PRIME CONSULTANT

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

1800 PIONEER CREEK CENTER MAPLE PLAIN, MINNESOTA 763-479-4200 763-479-4242

PROJECT TITLE

PERMIT RENEWAL AND MODIFICATIONS
SKB LANSING LANDFILL

SKB LANSING LANDFILL
AUSTIN, MINNESOTA

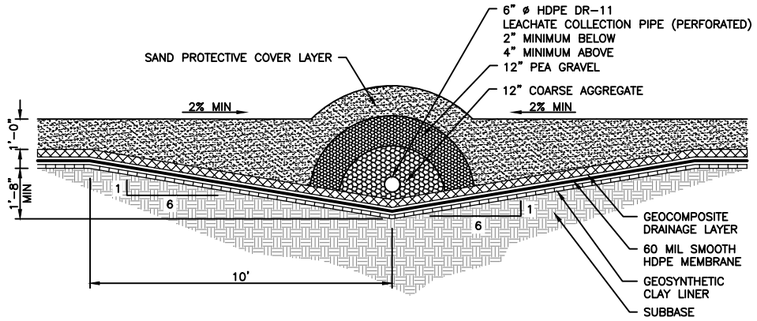
SHEET TITLE

CROSS SECTIONS

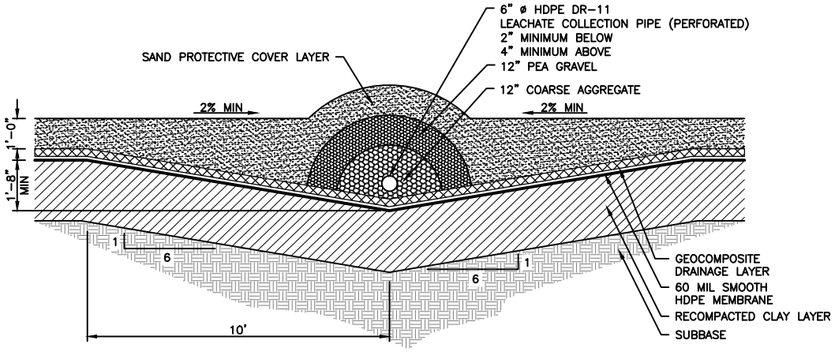
DWN BY	CHK'D	APP'D	DWG DATE
JVB	JCL	TJS	MAY 2016

SCALE AS NOTED

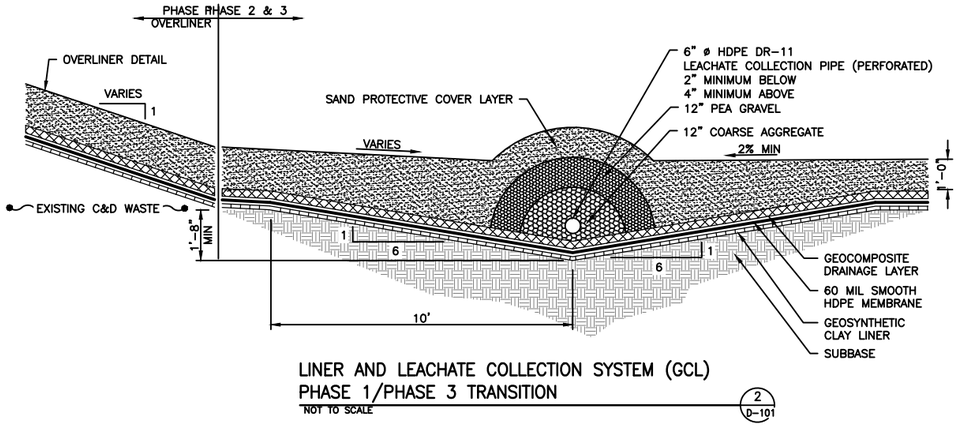
PROJECT NO.	SHEET NO.	REV NO.
3053-0041	C-107	A



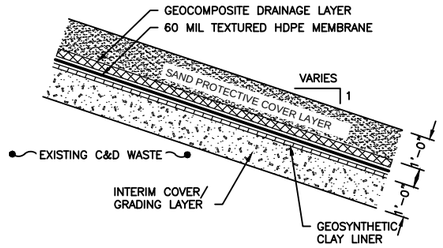
LINER AND LEACHATE COLLECTION SYSTEM (GCL)
NOT TO SCALE — 1 / D-101



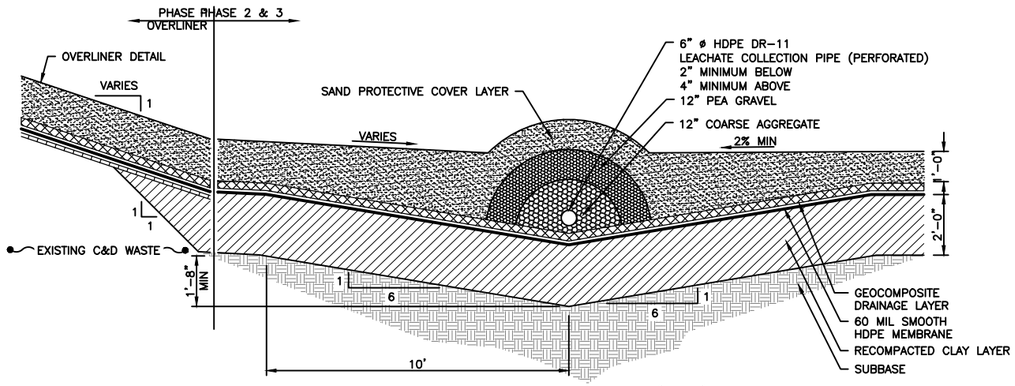
LINER AND LEACHATE COLLECTION SYSTEM (CLAY)
NOT TO SCALE — 4 / D-101



LINER AND LEACHATE COLLECTION SYSTEM (GCL)
PHASE 1/PHASE 3 TRANSITION
NOT TO SCALE — 2 / D-101



LINER AND LEACHATE COLLECTION SYSTEM (GCL)
PHASE 1 SIDE SLOPES
NOT TO SCALE — 5 / D-101



LINER AND LEACHATE COLLECTION SYSTEM (CLAY)
PHASE 1/PHASE 3 TRANSITION
NOT TO SCALE — 3 / D-101

DISCLAIMER NOTE;
DETAILS DESIGNED BY CONESTOGA-ROVERS AND ASSOCIATES AS PART OF CONSTRUCTION OF PHASE 1 FINAL COVER SYSTEM AND PHASE 2 CELL 1 LINER SYSTEM PLAN DRAWINGS DATED AUGUST 2011.

REV	REVISION DESCRIPTION	DWN	APP	REV DATE
0	ISSUED FOR AGENCY REVIEW	JVB	TJS	06/13/16

SEAL
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.
PRINT NAME THOMAS J. SHUSTARICH
SIGNATURE
DATE JUNE 8, 2016 LICENSE # 21210

SUB CONSULTANT

PRIME CONSULTANT
WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.
1800 PIONEER CREEK CENTER 763-479-4200
MAPLE PLAIN, MINNESOTA 763-479-4242

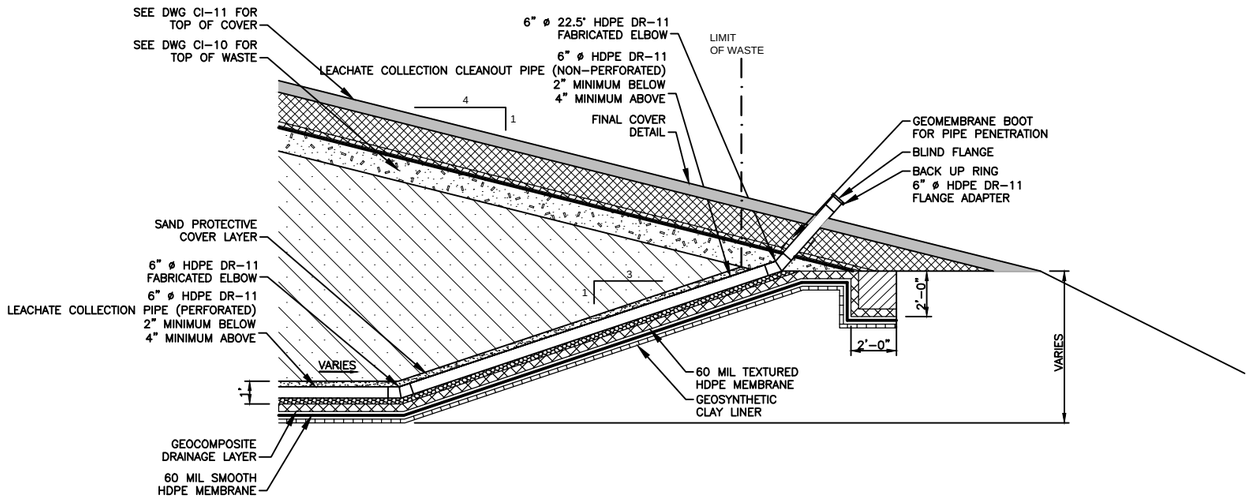
PROJECT TITLE
PERMIT RENEWAL AND MODIFICATIONS
SKB LANSING LANDFILL

SKB LANSING LANDFILL
AUSTIN, MINNESOTA

SHEET TITLE
LINER AND LEACHATE COLLECTION SYSTEM DETAILS

DWN BY	CHK'D	APP'D	DWG DATE	MAY 2016
JVB	JCL	TJS	SCALE	AS NOTED

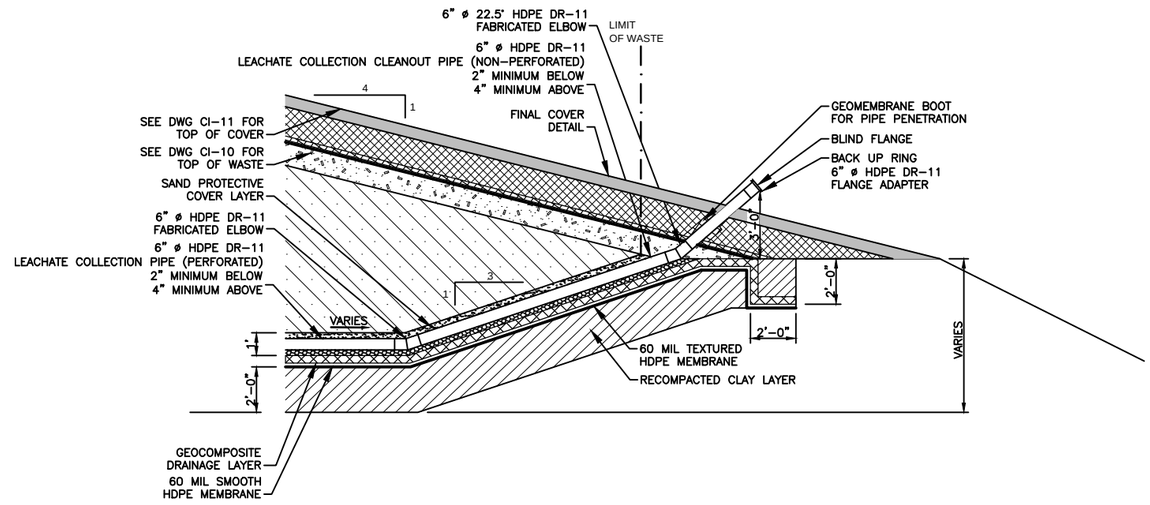
PROJECT NO.	SHEET NO.	REV NO.
3053-0041	D-101	0



LEACHATE COLLECTION SYSTEM CLEANOUT RISER PIPE TYPICAL (GCL)

NOT TO SCALE

1 / D-102



LEACAHTE COLLECTION SYSTEM CLEANOUT RISER PIPE TYPICAL (CLAY)

NOT TO SCALE

2 / D-102

DISCLAIMER NOTE;
DETAILS DESIGNED BY CONESTOGA-ROVERS AND ASSOCIATES AS PART OF CONSTRUCTION OF PHASE 1 FINAL COVER SYSTEM AND PHASE 2 CELL 1 LINER SYSTEM PLAN DRAWINGS DATED AUGUST 2011.

REV	REVISION DESCRIPTION	DWN	APP	REV DATE
0	ISSUED FOR AGENCY REVIEW	JVB	TJS	06/13/16

SEAL

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

PRINT NAME THOMAS J. SHUSTARICH

SIGNATURE

DATE JUNE 8, 2016 LICENSE # 21210

SUB CONSULTANT

PRIME CONSULTANT

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

1800 PIONEER CREEK CENTER MAPLE PLAIN, MINNESOTA 763-479-4200 763-479-4242

PROJECT TITLE
PERMIT RENEWAL AND MODIFICATIONS
SKB LANSING LANDFILL

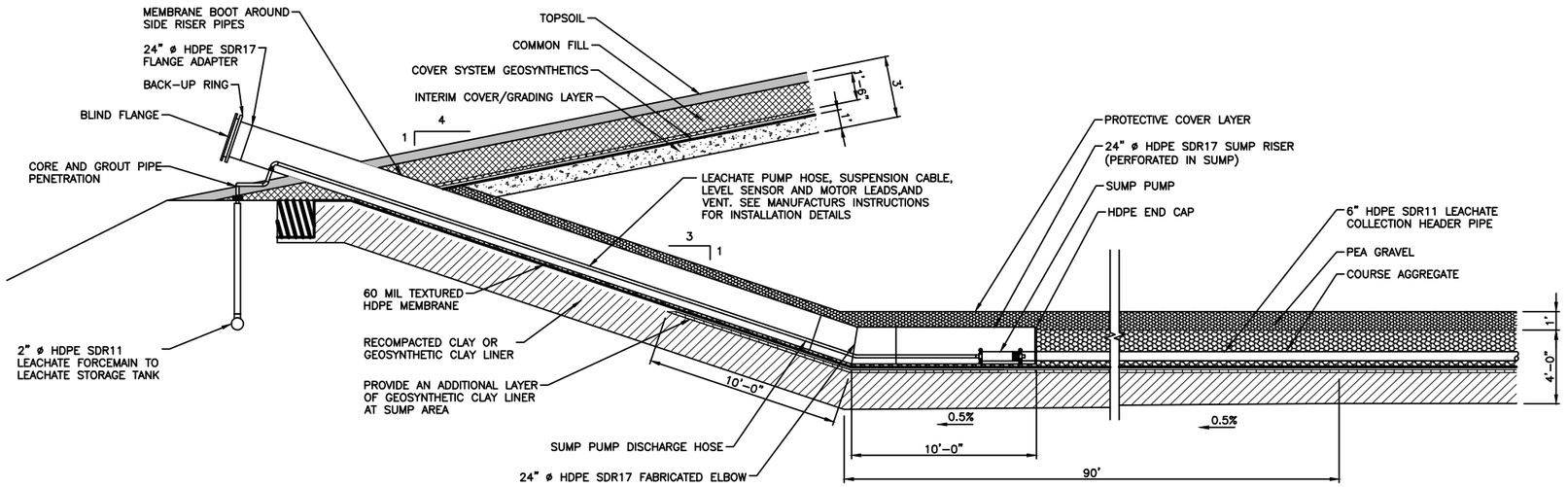
SKB LANSING LANDFILL
AUSTIN, MINNESOTA

SHEET TITLE
LINER AND LEACHATE COLLECTION SYSTEM DETAILS

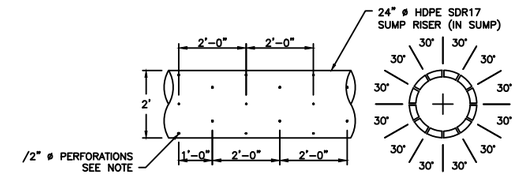
DWN BY	CHK'D	APP'D	DWG DATE
JVB	JCL	TJS	MAY 2016

SCALE AS NOTED

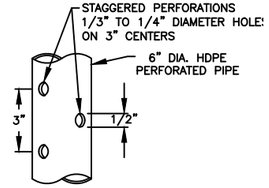
PROJECT NO.	SHEET NO.	REV NO.
3053-0041	D-102	0



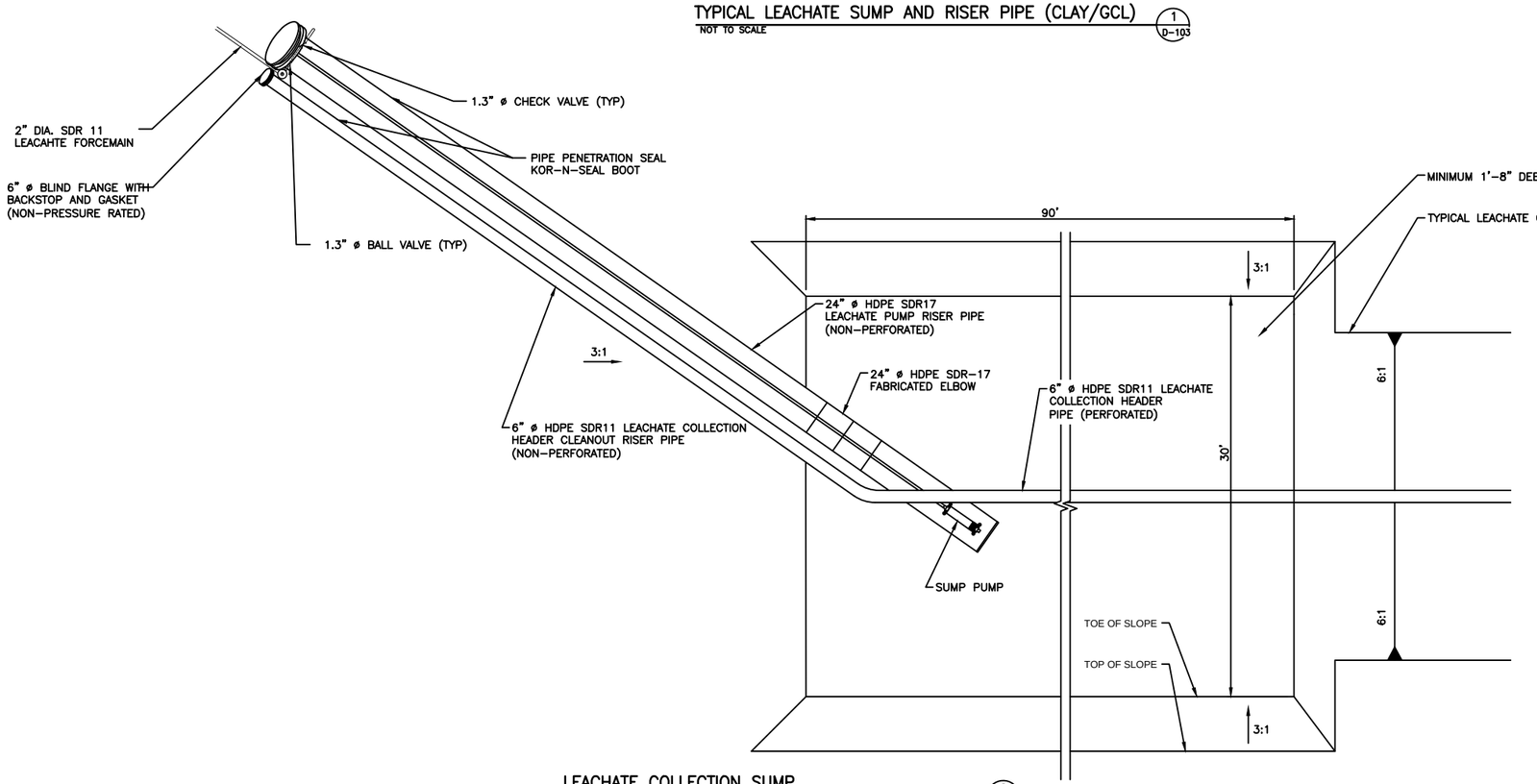
TYPICAL LEACHATE SUMP AND RISER PIPE (CLAY/GCL) 1 D-103
NOT TO SCALE



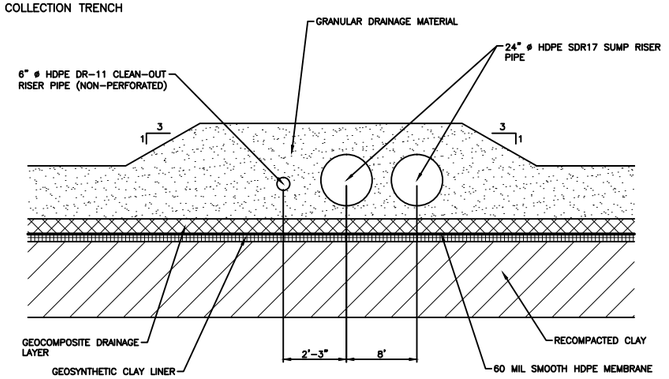
LEACHATE COLLECTION/RISER PIPE PERFORATIONS 3 D-103
NOT TO SCALE



LEACHATE COLLECTION/HEADER PIPE PERFORATIONS 4 D-103
NOT TO SCALE



LEACHATE COLLECTION SUMP 2 D-103
NOT TO SCALE



RISER PIPES ON SIDE SLOPES (CLAY/GCL) 5 D-103
NOT TO SCALE

DISCLAIMER NOTE;
DETAILS DESIGNED BY CONESTOGA-ROVERS AND ASSOCIATES AS PART OF CONSTRUCTION OF PHASE 1 FINAL COVER SYSTEM AND PHASE 2 CELL 1 LINER SYSTEM PLAN DRAWINGS DATED AUGUST 2011.

REV	REVISION DESCRIPTION	DWN	APP	REV DATE
0	ISSUED FOR AGENCY REVIEW	JVB	TJS	06/13/16

SEAL
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.
PRINT NAME THOMAS J. SHUSTARICH
SIGNATURE
DATE JUNE 8, 2016 LICENSE # 21210

SUB CONSULTANT

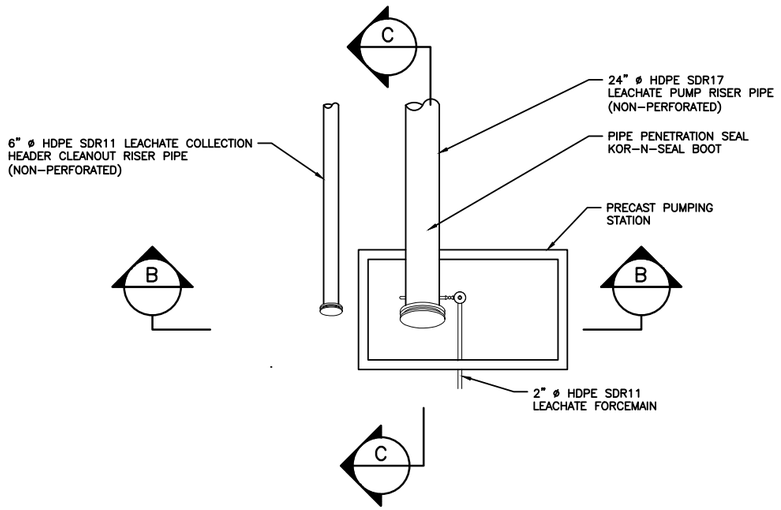
PRIME CONSULTANT
WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.
1800 PIONEER CREEK CENTER 763-479-4200
MAPLE PLAIN, MINNESOTA 763-479-4242

PROJECT TITLE
PERMIT RENEWAL AND MODIFICATIONS
SKB LANSING LANDFILL
SKB LANSING LANDFILL
AUSTIN, MINNESOTA

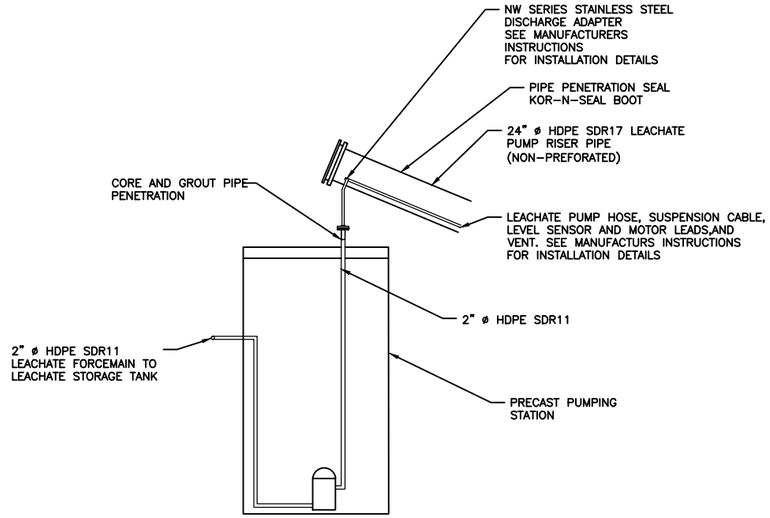
SHEET TITLE
LEACHATE COLLECTION SYSTEM SUMP AND SUMP RISER PIPE DETAILS

DWN BY	CHK'D	APP'D	DWG DATE
JVB	JCL	TJS	MAY 2016
			SCALE AS NOTED

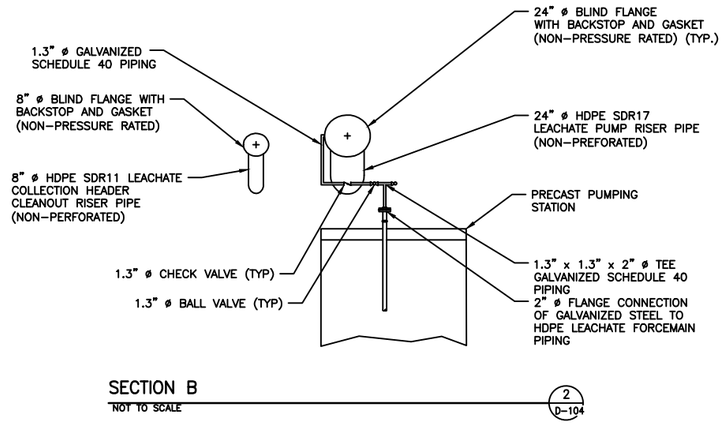
PROJECT NO.	SHEET NO.	REV NO.
3053-0041	D-103	A



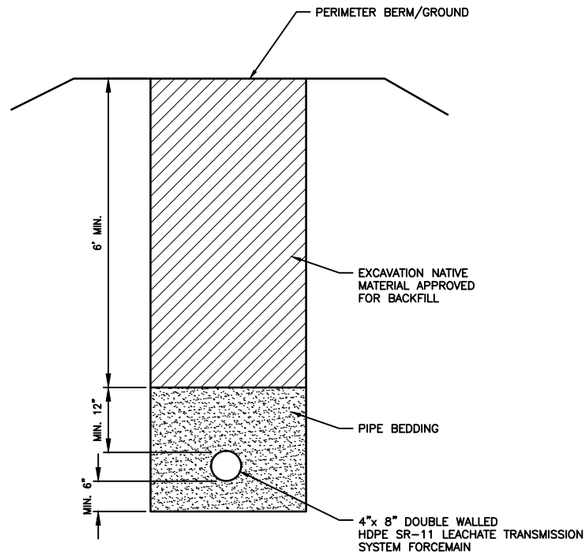
LEACHATE PUMPING STATION
NOT TO SCALE — 1 / D-104



SECTION C
NOT TO SCALE — 3 / D-104



SECTION B
NOT TO SCALE — 2 / D-104



TYPICAL LEACHATE FORCEMAIN
NOT TO SCALE — 4 / D-104

REV	REVISION DESCRIPTION	DWN	APP	REV DATE
0	ISSUED FOR AGENCY REVIEW	JVB	TJS	06/13/16

SEAL

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

PRINT NAME THOMAS J. SHUSTARICH

SIGNATURE

DATE JUNE 8, 2016 LICENSE # 21210

SUB CONSULTANT

PRIME CONSULTANT

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

1800 PIONEER CREEK CENTER 763-479-4200
MAPLE PLAIN, MINNESOTA 763-479-4242

PROJECT TITLE
PERMIT RENWAL AND MODIFICATIONS
SKB LANSING LANDFILL

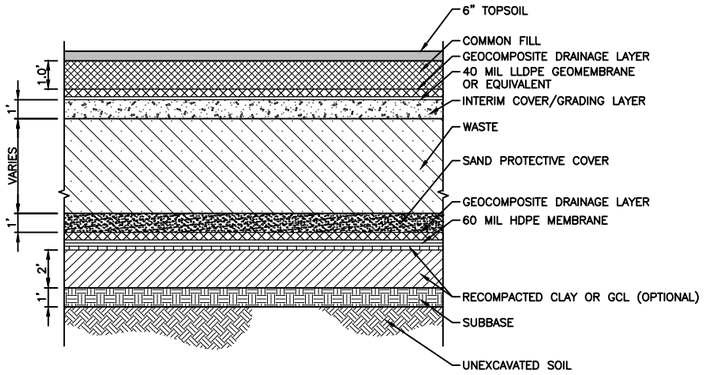
SKB LANSING LANDFILL
AUSTIN, MINNESOTA

SHEET TITLE
LEACHATE TRANSMITION SYSTEM DETAILS

DWN BY	CHK'D	APP'D	DWG DATE
JVB	JCL	TJS	MAY 2016

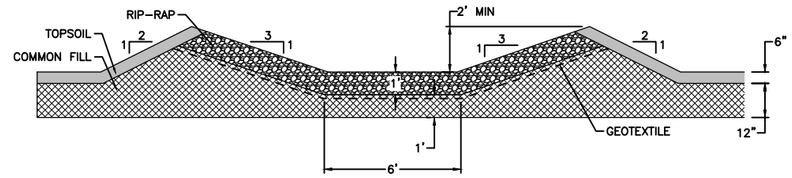
SCALE AS NOTED

PROJECT NO.	SHEET NO.	REV NO.
3053-0041	D-104	0



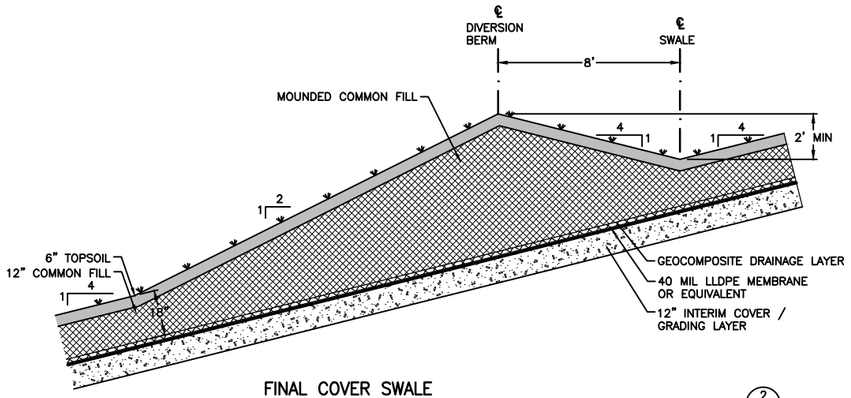
TYPICAL CAP AND BASE SECTION

NOT TO SCALE — 1 / D-105



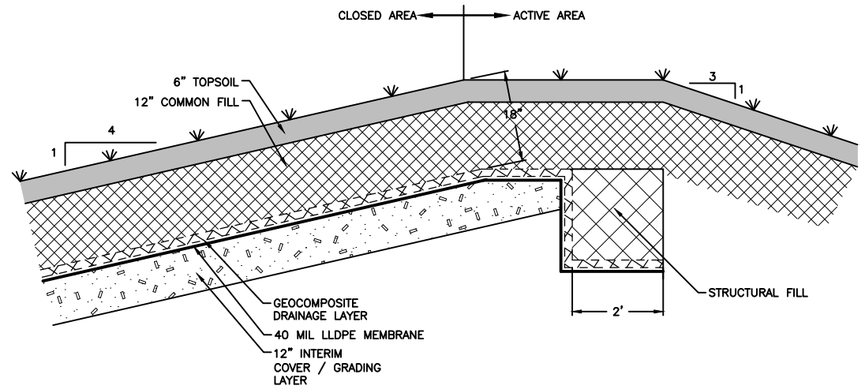
DOWNSLOPE STRUCTURE DETAIL

NOT TO SCALE — 4 / D-105



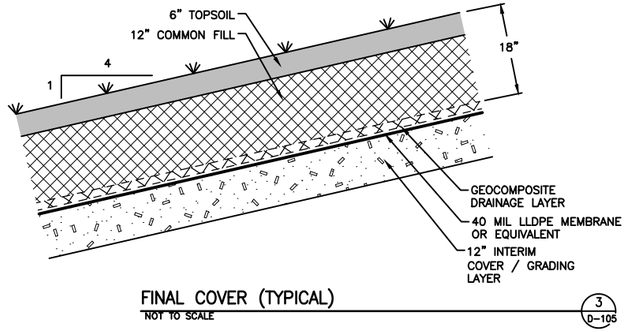
FINAL COVER SWALE

NOT TO SCALE — 2 / D-105



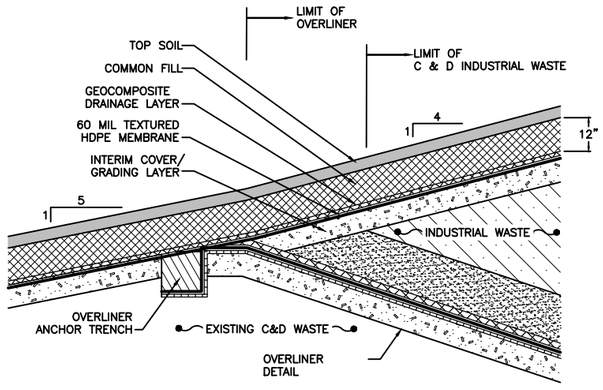
TERMINATION OF FINAL COVER SYSTEM

NOT TO SCALE — 5 / D-105



FINAL COVER (TYPICAL)

NOT TO SCALE — 3 / D-105



OVERLAP TERMINATION WITH FINAL COVER ON PHASE 1 SIDE SLOPE

NOT TO SCALE — 6 / D-105

DISCLAIMER NOTE;
DETAILS DESIGNED BY CONESTOGA-ROVERS AND ASSOCIATES AS PART OF CONSTRUCTION OF PHASE 1 FINAL COVER SYSTEM AND PHASE 2 CELL 1 LINER SYSTEM PLAN DRAWINGS DATED AUGUST 2011.

REV	REVISION DESCRIPTION	DWN	APP	REV DATE
0	ISSUED FOR AGENCY REVIEW	JVB	TJS	06/13/16

SEAL

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

PRINT NAME THOMAS J. SHUSTARICH

SIGNATURE

DATE JUNE 8, 2016 LICENSE # 21210

SUB CONSULTANT

PRIME CONSULTANT

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

1800 PIONEER CREEK CENTER 763-479-4200
MAPLE PLAIN, MINNESOTA 763-479-4242

PROJECT TITLE
PERMIT RENEWAL AND MODIFICATIONS
SKB LANSING LANDFILL

SKB LANSING LANDFILL
AUSTIN, MINNESOTA

SHEET TITLE
FINAL COVER DETAILS

DWN BY	CHK'D	APP'D	DWG DATE
JVB	JCL	TJS	MAY 2016

SCALE AS NOTED

PROJECT NO. 3053-0041

SHEET NO. D-105

REV NO. 0

Appendix C

Technical Specifications

SECTION 02201

GRANULAR DRAINAGE LAYER (Fine Aggregate Protective Cover)

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes descriptions and requirements for the supply and installation of the granular drainage layer placed, as shown on the Drawings, directly over the liner system for cell construction.

B. This section has applicability to both the closure and cell construction.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D422 - Standard Test Method for Particle Size Analysis of Soils.
2. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft^3 (600kN-m/m^3)).
3. ASTM D2434 – Standard Test Method for Permeability of Granular Soils (constant head).
4. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

1.03 SUBMITTALS

A. Location of off-site source of materials.

B. Method of off-site source soils material sampling and analyses.

C. Off-site source material analyses.

D. Source testing results shall be provided at least 21 days prior to installation.

1.04 SOIL MATERIAL QUALITY ASSURANCE

A. Independent testing CONTRACTOR shall be approved by OWNER.

B. Source testing to be performed by CONTRACTOR at no cost to the OWNER.

C. Provide the following test results for granular drainage layer material test requirements:

Property	Test Method	Frequency
Constant Head Permeability	ASTM D2434	5 test results /source
Grain Size Analysis	ASTM D422	5 test results/source
USCS Soil Classification	ASTM D2487	5 test results/source

PART 2 – PRODUCTS

2.01 SOURCE OF MATERIAL

A. The CONTRACTOR is responsible for providing soil for the granular drainage layer that conforms to the Technical Specifications. Upon request of OWNER or ENGINEER, the CONTRACTOR shall provide access to the soil source to allow OWNER or ENGINEER the opportunity to review the material source and collect samples for OWNER's CQA program.

2.02 Granular Drainage Layer: Durable, washed, coarse rounded to subangular gravel exhibiting the following:

A. Grain Size: 100% passing 3/8-inch sieve and maximum 5% by weight which passes the #200 Sieve.

PART 3 - EXECUTION

3.01 FILL USAGE

A. Directly over primary geomembrane for cell construction or compacted clay for closure construction as shown on Drawings.

3.02 PREPARATION

A. CONTRACTOR to receive ENGINEER's permission to begin installation of granular drainage layer.

B. CONTRACTOR shall be responsible for surface water control within construction limits and shall keep the construction well drained and minimize surface water ponding.

C. Subgrade elevation shall be documented by the CONTRACTOR and approved by ENGINEER for conformance, prior to placement of granular drainage layer material.

3.03 PLACEMENT

A. Placement of granular materials on geomembrane shall not proceed at ambient temperatures below 5°C (40°F), or above 40°C (100°F) without written consent from ENGINEER.

B. Spread with one pass of low ground pressure tracked equipment or equivalent as approved by ENGINEER prior to placement. CONTRACTOR to provide spotter during spreading of sand over geomembrane. Do not allow rubber-tired vehicles on granular blanket after placement. Operation of hauling equipment will be allowed only on areas with a 3-foot minimum thickness. No hauling equipment will be allowed on slopes.

C. Spread upslope (90^{o} to slope) only. No abrupt stops or starts on slope. No stockpiling on slope.

D. Do not compact material on geosynthetics.

E. Protect buried pipes, geotextiles, geosynthetics, and similar installations.

F. CONTRACTOR shall place granular material by such method as to prevent wrinkling and possible damage to the geomembrane liner(s). It shall be the CONTRACTOR'S responsibility to ensure that the geosynthetics are not damaged. Should they become damaged, the CONTRACTOR shall at his own expense:

1. Immediately notify the Engineer, and
2. Coordinate with the geosynthetic installer to make any necessary repairs at the CONTRACTOR'S expense.

3.04 LINER LEAK TESTING ISOLATION **(CELL CONSTRUCTION PROJECT ONLY)**

A. Before and during testing, Contractor shall maintain the sand cover in a moist, electrically conductive condition. Moisture shall be maintained by applying water to the sand at a rate sufficient to maintain the moisture content required for good electrical conductivity and to provide complete aerial coverage.

3.05 SURVEY QUALITY CONTROL

A. Granular Drainage Layer shall be graded to the minimum thicknesses as shown on Drawings and specified herein. Thickness tolerance of the Granular Drainage Layer must be between –0.0 and +0.2 feet.

3.06 ADJUSTMENT AND CLEANING

A. Remove excess material not suitable for use from the Site.

3.07 GRANULAR DRAINAGE LAYER MAINTENANCE

A. CONTRACTOR shall be responsible for granular drainage layer thickness, grade, and material quality until punch list items are completed and OWNER accepts ownership of the product.

B. CONTRACTOR shall be responsible for retesting material that has been displaced and removing and replacing material, which does not meet specifications at no additional cost to OWNER.

PART 4 – CONSTRUCTION QUALITY TESTING

4.01 SOIL MATERIAL QUALITY ASSURANCE

A. In-place testing to be completed by an approved independent testing CONTRACTOR. Laboratory testing shall be in accordance with Section 01410.

B. Quality assurance retesting of material not meeting Technical Specifications shall be performed by CONTRACTOR at no additional cost to the OWNER. CONTRACTOR is responsible for all costs related to retests of material.

C. Provide the following test results from in-place material at locations selected by ENGINEER:

Property	Test Method	Frequency
Constant Head Permeability	ASTM D2434	1 test per acre
Grain Size Analysis	ASTM D422	1 test per 1,000 cubic yards
USCS Soil Classification	ASTM D2487	1 test per 1,000 cubic yards

END OF SECTION

SECTION 02202

COARSE AGGREGATE

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes descriptions and requirements for the supply and installation of the coarse aggregate as shown on the Drawings in the leachate collection system and in the secondary collection system pipe trench.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D422- Standard Test Method for Particle Size Analysis of Soils.
2. ASTM D2487- Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
3. ASTM D4373- Standard Test Method for Rapid Determination of Carbonate Content of Soils.

1.03 SUBMITTALS

A. Location of off-site source of materials.

B. Method of off-site source soils material sampling and analyses.

C. Off site source material quality control analyses shall be submitted at least 14 days prior to installation.

D. Proposed haul road planned for transportation of all off-site materials to the project site.

1.04 SOIL MATERIAL SOURCE QUALITY ASSURANCE

A. Independent testing contractor to be approved by OWNER.

B. Source testing to be performed by CONTRACTOR at no cost to the OWNER.

C. Provide the following test results for material test requirements:

Property	Test Method	Frequency
Grain Size Analysis	ASTM D422	3 test results/source
USCS Soil Classification and Uniformity Coefficient	ASTM D2487	3 test results/source
Calcium Carbonate Content	ASTM D4373	1 test result/source

PART 2 - PRODUCTS

2.01 SOURCE OF MATERIALS

A. The CONTRACTOR is responsible for providing coarse aggregate material that conforms to the Technical Specifications. Upon request of OWNER or ENGINEER, the CONTRACTOR shall provide access to the soil source to allow OWNER or ENGINEER the opportunity to review the material source and collect samples for OWNER's CQA program.

2.02 Coarse Aggregate**:** Granular material, bank-run gravel, consisting of sub-angular to rounded particle material, durable particles (no limestone source rock).

A. Calcium carbonate content of maximum 15% by weight.

B. Uniformity coefficient: Less than 4.

C. Grain Size: Range from maximum diameter of 1.5-inch to minimum diameter of 5/8 inch (maximum 5% by weight passing 5/8 inch sieve.)

D. In the event that rounded to subrounded aggregate is not readily available, crushed aggregate may be allowed provided the underlying geotextile consists of a nonwoven fabric with a minimum puncture resistance of 290 lbs. OWNER will have final decision regarding the angularity/geotextile relationship.

PART 3 – EXECUTION

3.01 FILL USAGE

A. Leachate collection trench and secondary collection trench as shown on Drawings.

3.02 PREPARATION

A. CONTRACTOR shall receive OWNER'S permission to begin installation of coarse aggregate.

3.03 PLACEMENT

A. Transport material into landfill cell in a manner that will not damage underlying soil or synthetic layers. Operation of hauling equipment will be allowed only on areas with a 3-foot minimum thickness of granular drainage material. The temporary usage of finer grained soils to construct access roads into the landfill cell will not be allowed.

B. Any vehicle traffic over the synthetic liner system without a 3-foot minimum granular drainage thickness must be approved by ENGINEER prior to work being initiated.

C. Do not compact.

D. CONTRACTOR shall place coarse aggregate by such method as to prevent wrinkling and possible damage to the underlying geosynthetics. It shall be the CONTRACTOR'S responsibility to ensure that the geosynthetics are not damaged. Should they become damaged, the CONTRACTOR shall at his own expense:

1. Immediately notify OWNER
2. Make any necessary repairs at the CONTRACTOR'S expense.

E. If a rock box is used, the minimum granular drainage layer thickness beneath the box shall be 3 feet.

3.04 ADJUSTMENT AND CLEANING

A. Remove excess material not suitable for use for any part of the Project from the Site.

PART 4 – CONSTRUCTION QUALITY TESTING

4.01 SOIL MATERIAL QUALITY ASSURANCE

A. Independent testing contractor to be approved by OWNER.

B. Quality assurance retesting of material not meeting Technical Specifications shall be performed by CONTRACTOR at no additional cost to the OWNER. CONTRACTOR is responsible for all costs related to retests of material.

C. Provide the following test results from in-place material:

Property	Test Method	Frequency
Grain Size Analysis	ASTM D422	1 per 2,000 cubic yards (3 min.)
USCS Soil Classification and Uniformity Coefficient	ASTM D2487	1 per 2,000 cubic yards (3 min.)

END OF SECTION

SECTION 02204

ROOTING ZONE

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes the supply and installation of the rooting zone soils as shown on the project drawings.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D422 - Standard Test Method for Particle Size Analysis of Soils.
2. ASTM D1140 - Standard Test Methods for Determining the Amount of Material in Soils Finer than the 75 um (No. 200) Sieve in Soils by Washing.
3. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in-Place by the Sand-Cone Method.
4. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3)
5. ASTM D1587 - Standard Practice for Thin-Walled Tube Sampling of Fine-Grained Soils for Geotechnical Purposes.
6. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in-Place by the Rubber Balloon Method.
7. ASTM D2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
8. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
9. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
10. ASTM D6938 – Standard Test Method for In-place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.03 SUBMITTALS

A. Location of off-site source of materials.

B. Name, address, telephone number and contact person of independent soils laboratory.

C. Method of off-site source soils material sampling and analyses.

D. Off-site source material analyses.

E. Source testing results shall be provided at least 7 days prior to installation.

F. Documentation survey information as outlined in Part 3 of this Section.

1.04 QUALITY ASSURANCE

A. OWNER will perform quality control and quality assurance in accordance with the approved Quality Assurance Manual for this project and included in Appendix A of this Specification.

B. CONTRACTOR shall comply with the ENGINEER in conducting tests as required in the Quality Assurance Manual.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. Rooting Zone to be provided by CONTRACTOR from off-site sources.

1. Friable soil; Horizon B soils, suitable for establishment of rooting system of grass and plants.
2. Free from gravel, cinders, stone over 1 inch in any dimension and other undesirable material.
3. CONTRACTOR shall be responsible for providing suitable rooting zone material selected from the on-site stockpile.

B. CONTRACTOR to supply 3 grain size distribution tests (ASTM D-422) for each source.

PART 3 - EXECUTION

3.01 FILL USAGE

A. Rooting zone material: Directly on top of drainage layer as shown on Drawings.

3.02 PREPARATION

A. Surface Water Control:

1. CONTRACTOR responsible for surface water control within construction limits.
2. Keep construction and borrow areas well drained and minimize surface water pooling.

3.03 PLACEMENT OF ROOTING ZONE

A. Construct to limits and thicknesses as shown on Drawings.

B. Spread with one pass of low ground pressure tracked equipment or equivalent as approved by ENGINEER prior to placement. Do not allow rubber-tired vehicles on granular blanket after placement. Operation of hauling equipment will be allowed only on areas with a 3-foot minimum thickness on slopes and limited to slopes less than 10:1.

C. Do not compact material on geosynthetics.

D. On slopes exceeding 5H:1V, Rooting Zone soil shall be pushed over the granular drainage layer or geonet geocomposite in an up-slope direction, no more than 40 degrees from the direction of maximum slope, beginning at the bottom of the closure slope with a buttress of material established downslope of the fill area to prevent wrinkling of the underlying geocomposite (where that alternate is used). Material shall be spread by pushing dumping locations along designated traffic areas, and pushing the materials outward over that material already placed.

E. If the geonet geocomposite drainage layer alternate is used, a spotter shall be assigned to work full time with each piece of earth moving equipment used for the soil placement over the geocomposite. The spotter shall be positioned to observe the location of the blade or bucket relative to the geocomposite and relay this information to the equipment operator to prevent damage to the geocomposite. The spotter shall also track and minimize the formation and propagation of wrinkles in the geocomposite and communicate this information to the operator. Measures shall be taken to stop wrinkle formation and propagation.

F. Protect buried pipes, geotextiles, geosynthetics, and similar installations. Use only square-nosed shovels over the geocomposite, the use of pointed-nose shoves or spades shall not be allowed while placing soil over the geocomposite.

G. CONTRACTOR shall place granular material by such method as to prevent wrinkling and possible damage to the LLDPE liner or geonet geocomposite. Once the geosynthetic lining system has been accepted by the ENGINEER. It shall be the CONTRACTOR'S responsibility to ensure that the geosynthetics are not damaged. Should they become damaged, the CONTRACTOR shall at his own expense:

1. Immediately notify the ENGINEER, and
2. Have the geosynthetic installer make any necessary repairs at the CONTRACTOR'S expense.

3.04 FIELD QUALITY CONTROL

A. Comply with approved Quality Assurance Manual. Cooperate with quality control program.

B. Specified soil layers shall be graded to the minimum thicknesses as shown on drawings and specified herein. Thickness tolerance of the soil layers must be between –0.0 and +0.2 feet.

C. Testing:

1. Tests performed and frequency of tests specified in the Quality Assurance Manual.
2. CONTRACTOR is responsible for all costs related to retests of materials not meeting specifications.

D. Survey Requirements: CONTRACTOR shall be responsible for providing documentation survey performed by a qualified land surveyor in accordance with Section 01050-Field Engineering, the approved Quality Assurance Manual.

3.05 ADJUSTMENT AND CLEANING

A. Remove excess material not suitable for use from the Site.

*** END OF SECTION ***

SECTION 02205

CLAY BARRIER LAYER

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes descriptions and requirements for furnishing and installation of the clay barrier layer, as shown on the Drawings.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D422 - Standard method for particle size analysis of soils.
2. ASTM D1140 - Standard test method for amount of material in soils finer than the 75 um (No. 200) sieve.
3. ASTM D1556 - Standard test method for density and unit weight of soil in-place by the sand cone method.
4. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3)
5. ASTM D1587 - Standard practice for thin-walled tube sampling of fine-grained soils for geotechnical purposes.
6. ASTM D2216 - Standard test method for laboratory determination of water (moisture) content of soil and rock by mass.
7. ASTM D2487 - Standard practice for classification of soils for engineering purposes (Unified Soil Classification System).
8. ASTM D2488 - Standard practice for description and identification of soils (visual-manual procedure).
9. ASTM D4318 - Standard test method for liquid limit, plastic limit, and plasticity index of soils.
10. ASTM D5084 - Standard test method for measurement of hydraulic conductivity of saturated porous materials using a flexible wall permeameter.
11. ASTM D6938 – Standard Test Method for In-place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

B. U.S. Army Corps of Engineers/U.S. Department of Interior.

1. Permeability test: U.S. Army Corps of Engineers (WES), 1970, “Laboratory Testing Manual,” Engineering Manual 1110-2-1906.

1.03 SUBMITTALS

A. Description of proposed blending and compaction equipment 14 days prior to clay placement.

1 Blending equipment shall consist of an off-set disk harrow or similar equipment, approved by the ENGINEER, necessary to turn the clay and uniformly incorporate moisture throughout the entire lift.

2 Compaction equipment shall consist of sheepsfoot compactor, or similar kneading type compactor capable of influencing entire lift. Minimum dead weight of machine shall be 30,000 lbs. Tow behind style drum compactors shall NOT be acceptable.

B. Name, address, telephone number and contact person of independent testing contractor.

C. Location of off-site source of materials.

D. Method of off-site source materials sampling and analysis.

E. Off-site source material analyses.

F. Proposed haul road planned for transportation of all off-site materials to the project site.

1.04 SOIL MATERIAL QUALITY ASSURANCE

A. Independent testing contractor shall be approved by OWNER.

B. CONTRACTOR shall provide Engineer with borrow source analyses for CONTRACTOR supplied material. Additional pre-placement testing may be performed by CONTRACTOR at no cost to the OWNER.

C. CONTRACTOR shall provide location and source testing of the clay barrier layer borrow source at least 14 days prior to installation at the following frequencies:

Property	**Test Method**	**Frequency**
Hydraulic Conductivity (Permeability)	ASTM 5084	1 per 5,000 cubic yards
Grain Size Analysis w/ Hydrometer	ASTM D422/D1140	1 per 3,000 cubic yards
Atterberg Limits	ASTM D4318	1 per 3,000 cubic yards
USCS Soil Classification	ASTM D2487	1 per 3,000 cubic yards
Standard Proctor	ASTM D698	1 per 3,000 cubic yards

PART 2 - PRODUCTS

2.01 SOURCE OF MATERIAL

A. The CONTRACTOR is responsible for providing soil for the clay barrier layer that conforms to the Technical Specifications. Upon request of OWNER or Engineer, the Contractor shall provide access to the soil source to allow OWNER or Engineer the opportunity to review the material source and collect samples for OWNER's CQA program.

2.02 CLAY BARRIER LAYER

A. Clay barrier layer material shall have a USCS classification of SC, CL, or CH exhibiting the following:

1. In-place permeability: $1x10^{-7}$ cm/sec or less when compacted to 95% of Standard Proctor dry density at a moisture content of 0 to 5% wet of optimum.
2. Grain size:
   a. P200 content 50% by weight or greater
   b. Maximum gravel content 5% by weight.
   c. Minimum clay content: 25% by weight.
3. Atterberg Limits
   a. Liquid limit: 25% or greater.
   b. Plasticity index: 10 or greater.

B. Clay barrier layer material shall contain no clods larger than 2 inches and be free of debris, roots, organic material, solid mineral material larger than 1 inch in diameter, angular stones of any diameter and other materials considered deleterious to the overlying geomembrane liner.

.

PART 3 – EXECUTION

3.01 FILL USAGE

A. Clay barrier layer: Directly above prepared subgrade and below geomembrane liner(s) and/or GCL for cell construction.

B. The layer thickness shown on Drawings is the compacted thickness, after fine grading and surface preparation.

3.02 PREPARATION

A. Prepare surface to lines and grades as shown on Drawings.

B. CONTRACTOR shall be responsible for surface water control within construction limits and shall keep the construction well drained and minimize surface water ponding.

C. Proofroll surfaces to receive fill and subgrades within limits of excavation to determine existence of soft areas, areas loosened by frost action, softened by flooding, softened by weather or of unsuitable materials.

1 Determination of soft, wet or loose areas will be based on ENGINEER's judgment.
2. Soft areas will generally be detected by soil deflection of greater than 2 inches and accompanied with stress cracks in soil when rolled over by heavy construction equipment intended for the placement and compaction of clay.

D. Replace materials determined to be unsuitable or soft soils by subcutting 2 feet and replacing with common fill or other material approved by ENGINEER in writing.

E. Subgrade elevation shall be documented by CONTRACTOR, and elevations reviewed by OWNER for conformance, prior to placement of clay barrier layer material.

3.03 PLACEMENT

A. Place clay barrier layer material as follows:

1. Maximum Compacted Lift Thickness: 6 inches.
2. Minimum Compaction: 95% of Standard Proctor dry density,
3. Moisture Content: 0 to 5% wet of optimum,
4. Maximum Clod Size: 2 inches.
5. Maximum Permeability: $1x10^{-7}$ cm/sec,

B. Clay conditioning may be performed in the area designated by the ENGINEER. Over-wetted clay shall not be used for construction of the clay barrier. Clay shall be determined to be over-wetted if displacement of the clay occurs under the weight of vehicle traffic or if the required compaction cannot be achieved with a reasonable number of passes with compaction equipment.

C. Material distribution and gradation throughout the clay barrier shall be such that material is free from lenses, pockets, streaks or layers of material differing substantially in texture or gradation from surrounding material. Blend clay prior to compaction.

D. Uniformly distribute moisture content of clay material prior to and during compaction throughout each lift of material. Dry excavated materials too wet for immediate compaction to permit compaction at the proper moisture content. Do not place clay at moisture content less than optimum as defined by ASTM D698. No additional payment will be made for drying or wetting materials for use in liner.

E. Place layers of clay to form continuous monolithic material. Remove excessively dry or wet soil before placement of additional lifts. Knead each lift into previously placed lift.

F. Place clay so that each compacted lift is not greater than 6 inches thick.

G. Final surface shall be smooth-rolled prior to HDPE liner placement. Finished surface will be smooth and even with no sheepsfoot roller indentations.

H. Construct sidewall liners by pushing clay material up the sidewall from the cell base. Placement or movement of clay down from the top of the sidewall will not be allowed. Placement and compaction of sidewall liner shall be performed in accordance with the specifications.

I. Do not place clay below air temperatures of 32^{o}F, unless CONTRACTOR can demonstrate fill material temperature above freezing, and Engineer approves placement.

J. CONTRACTOR shall be responsible for the integrity of the clay barrier layer and shall not allow the surface to dry or desiccate. The finished clay barrier surface shall be maintained in a moist condition until the cover materials are placed. Frequent water application may be required, especially during hot, dry, or windy weather. If desiccation cracks are present in the clay surface that exceed 3/8-inch in depth at the time of cover

material placement, the clay surface shall remoistened and reworked to produce a smooth, moist surface prior to cover placement.

K. Surface of clay barrier layer must be approved by the Engineer prior to installation of HDPE liner. Surface rutting or drying will not be acceptable. Surface must be smooth and free of debris, roots, and angular or sharp rocks larger than 3/8 inches in diameter to a depth of 4 inches below surface to be lined.

3.04 TRANSPORTATION AND HAUL ROADS

A. Observe State, County, and Local traffic rules and weight restrictions.

B. All vehicle trips loaded or unloaded shall be on designated haul roads only.

C. CONTRACTOR to coordinate selection of haul roads with the appropriate governing body and acquire any necessary permits.

3.05 SURVEY QUALITY CONTROL

A. Clay Barrier Layer shall be graded to the minimum thicknesses as shown on Drawings and specified herein. Thickness tolerance of the Clay Barrier Layer must be between -0.0 and +0.2 feet as defined in Section 01050.

3.06 ADJUSTMENT AND CLEANING

A. Remove excess material not suitable for use from the Site. Material shall be removed from the Site unless directed by the OWNER that stockpiling onsite is acceptable. No additional compensation shall be made for excess material stockpiled onsite.

PART 4 – CONSTRUCTION QUALITY TESTING

4.01 FIELD QUALITY CONTROL

A. Laboratory testing of in-place clay to be completed by Soils Engineering Testing. Laboratory testing shall be in accordance with Section 01410. Field testing of in-place clay shall be tested by the approved independent testing contractor.

B. CONTRACTOR shall notify ENGINEER a minimum of 24-hours prior to testing.

4.02 IN-PLACE DENSITY TESTING

A. CONTRACTOR shall be responsible for performing density testing at a minimum frequency of 5 tests per acre per lift offset each lift. Testing shall be performed at locations as determined by Engineer. Testing shall be performed in accordance with the ASTM D6938 standard.

B. Density testing technician shall meet the requirements specified in section 01410.

4.03 IN-PLACE MATERIAL TESTING

A. CONTRACTOR shall be responsible for completing material testing as required in the table below. CONTRACTOR shall be responsible for sample collection and all laboratory services. Samples shall be collected at locations as determined by ENGINEER. Testing shall be performed in accordance with the applicable ASTM standard as listed below.

Property	**Test Method**	**Frequency**
Hydraulic Conductivity (Permeability)	ASTM 5084	1 per acre per foot
Grain Size Analysis w/ Hydrometer	ASTM D422/D1140	1 per acre per foot
Atterberg Limits	ASTM D4318	1 per acre per foot
USCS Soil Classification	ASTM D2487	1 per acre per foot
Standard Proctor	ASTM D698	1 per acre per foot

B. CONTRACTOR shall notify OWNER a minimum of 24-hours prior to sample collection.

C. CONTRACTOR is responsible for all costs related to retests of materials not meeting specifications.

D. CONTRACTOR shall backfill all perforations of the clay barrier layer by probe or sample tube with a 50-50 sand-bentonite mixture. The mixture shall be compacted in-place with a tamping rod, or hand tamper, depending on the size of the perforation.

4.04 TEST LOCATION SURVEYING

A. Material sampling and in-place density testing locations shall be documented by the CONTRACTOR GPS survey methods.

4.05 IN-PLACE DENSITY TEST REPORTING

A. CONTRACTOR shall complete the OWNER's "Contractor Material Testing Acceptance Form" at the end of each day documenting the number of density tests taken, the number of passing density tests, material proctors used, and the location of the tests. The tests recorded each day will not be accepted until all required signatures are captured on the "Contractor Material Testing Acceptance Form".

B. All testing reports shall be provided to OWNER concurrently with CONTRACTOR.

4.06 IN-PLACE MATERIAL TEST REPORTING

A. CONTRACTOR shall notify Engineer 24-hours prior to collecting in-place material samples. CONTRACTOR shall report the types of materials to be sampled and number of samples being collected.

B. All testing reports shall be provided to OWNER concurrently with CONTRACTOR.

*** END OF SECTION ***

SECTION 02206

BUFFER SOILS

PART 1 - GENERAL

1.01 SUMMARY

A. This section includes the placement and preparation of the buffer soils as shown on the Drawings.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D422 - Standard Method for Particle Size Analysis of Soils.
2. ASTM D1140 - Standard Test Method for Amount of Material in Soils Finer than the 75 um (No. 200) Sieve.
3. ASTM D1556 - Standard Test Method for Density of Soil in-Place by the Cone Method.
4. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3)
5. ASTM D1587 - Standard Practice for Thin-Walled Tube Sampling of Soils.
6. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in-Place by the Rubber Balloon Method.
7. ASTM D2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
8. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes.
9. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
10. ASTM D6938 - Standard Test Method for In-place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.03 SUBMITTALS

A. Documentation survey information as outlined in Part 3 of this Section.

1.04 QUALITY ASSURANCE

A. OWNER will perform quality control and quality assurance in accordance with the approved Quality Assurance Manual for this project and included in Appendix A of this Specification.

B. CONTRACTOR shall comply with the ENGINEER in conducting tests as required in the Quality Assurance Manual.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. Buffer Soils are already in place as intermediate cover from owner operations.

PART 3 - EXECUTION

3.01 PREPARATION OF BUFFER SOILS FOR GEOMEMBRANE PLACEMENT

A. Grade existing soils to grades, limits and to the elevations as shown on Drawings.

B. Compact using MN/DOT ordinary compaction method.

C. Final surface must be firm and free of stones greater than ½ -inch diameter and any other material which would be deleterious to the overlying geomembrane liner.

D. Smooth drum surface to provide smooth surface for geomembrane installation. Remove and replace excessively soft or wet areas.

E. Surface Water Control:

1. CONTRACTOR responsible for surface water control within construction limits.
2. Keep construction and borrow areas well drained and minimize surface water pooling.

3.02 FIELD QUALITY CONTROL

A. Comply with approved Quality Assurance Manual. Cooperate with quality control program.

B. Specified soil layers shall be graded to the minimum thicknesses as shown on drawings and specified herein. Thickness tolerance of the soil layers must be between -0.2 and +0.0 feet.

C. Testing:

1. Tests performed and frequency of tests specified in the Quality Assurance Manual.
2. CONTRACTOR is responsible for all costs related to retests of materials not meeting specifications.

D. Survey Requirements: CONTRACTOR shall be responsible for providing documentation survey performed by a qualified land surveyor in accordance with Section 01050- Field Engineering.

3.03 ADJUSTMENT AND CLEANING

A. Remove excess material not suitable for use from the Site.

*** END OF SECTION **

SECTION 02207

CONTROLLED FILL

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes descriptions and requirements for construction with controlled fill soils.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D422 - Standard Method for Particle Size Analysis of Soils.
2. ASTM D1140- Standard Test Method for Amount of Material in Soils Finer than the 75 um (No. 200) Sieve.
3. ASTM D1556- Standard Test Method for Density of Soil in-Place by the Sand Cone Method.
4. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3)
5. ASTM D1587- Standard Practice for Thin-Walled Tube Sampling of Soils for geotechnical purposes.
6. ASTM D2216- Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
7. ASTM D2487- Standard Practice for Classification of Soils for Engineering Purposes.
8. ASTM D4318- Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
9. ASTM D6938 - Standard Test Method for In-place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.03 SUBMITTALS

A. Location of off-site source of materials.

B. Method of off-site source soils material sampling and analyses.

C. Off-site source material analyses.

1.04 SOIL MATERIAL SOURCE QUALITY ASSURANCE

A. Three (3) of each of the following:

1. USCS Soil Classification.
2. Standard Proctor

PART 2 - PRODUCTS

2.01 SOURCE OF MATERIAL

A. On-site soils are available for use as controlled fill material. Some on-site soils (friable rock) will require processing prior to placement as controlled fill. CONTRACTOR is responsible for selecting material for use that conforms to these Technical Specifications. Only on-site material that meets, or has been processed to meet, these Technical Specifications shall be used for controlled fill material. CONTRACTOR is responsible for processing on-site materials in accordance with Subpart 3.03 of this Section as needed, to meet material requirements specified in Subpart 2.02 of this Section.

2.02 CONTROLLED FILL

A. Natural soils determined by ENGINEER's visual observation in the field to be CL, GM, SW, SP, SC, SM or ML soils, free of organic and other deleterious material.

B. Excavated subsoil from designated borrow and excavation areas, processed as required, to be used for embankments, backfill, and subgrade excavation replacement where applicable.

C. Material free from roots, debris, and stones, or cemented sandstone clods, larger than six (6) inches.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine and verify acceptability of surface to receive installation of material.

B. Proof roll and examine surfaces to receive fill and subgrades within influence zone to determine existence of soft areas, areas loosened by frost action or softened by flooding, groundwater or weather or existence of unsuitable materials.

3.02 PREPARATION

A. Sample, test, and submit test results of source soils.

B. Prepare surfaces to receive materials to lines and grades shown on Drawings prior to placement.

3.03 MATERIAL PROCESSING

A. Notify ENGINEER prior to beginning material processing.

B. CONTRACTOR shall be responsible for processing excavated on-site material prior to material being placed as controlled fill.

C. Excavated on-site soil shall be processed outside the location it will be placed if needed to process/crush material to the specified controlled fill.

D. CONTRACTOR shall ensure material meets requirements of Subpart 2.02 of this Section prior to it being placed as controlled fill.

3.04 BACKFILLING AND COMPACTION

A. Notify ENGINEER before placing fill material.

B. Do not use frozen material or place fill on frozen subgrade.

C. Where pipes or electrical conduits leave structures, protect by backfilling pipe or duct influence zone down to undisturbed soil with controlled fill.

D. Place controlled fill simultaneously on both sides of free-standing structures.

E. Provide mechanical compaction for cohesive material and vibratory compaction for granular materials. When approved by ENGINEER, jetting, flooding, puddling, or vibroflotation methods may be used for compacting if CONTRACTOR furnishes test results to confirm required degree of compaction being obtained uniformly throughout entire mass.

F. Lift Thickness and Compaction: Place and compact fill material in maximum lift thickness and to minimum densities listed below.

	Fill Placement	**Maximum Compacted Lift Thickness (inches)**	**Standard Proctor (%)**
A	Controlled Fill for Anchor Trench Backfill	8	95
B	Controlled Fill for Subgrade and Berm Construction	12	95
C	Controlled Fill for Subcut Replacement	8	100

3.05 TRANSPORTATION AND HAUL ROADS

A. Observe State, County, and Local traffic rules and weight restrictions.

B. All vehicle trips loaded or unloaded shall be on designated haul roads only.

C. CONTRACTOR to coordinate selection of haul roads with the appropriate governing body and acquire any necessary permits.

PART 4 – CONSTRUCTION QUALITY TESTING

4.01 FIELD QUALITY CONTROL

A. In-place testing shall be performed by CONTRACTOR at locations selected by OWNER. All testing shall be performed in accordance with the Technical Specifications. Density testing shall be performed in accordance with the ASTM D6938 standard.

B. CONTRACTOR shall notify OWNER a minimum of 24-hours prior to testing.

4.02 IN-PLACE DENSITY TESTING

A. CONTRACTOR shall be responsible for performing in-place density testing on all controlled fill material at the minimum frequencies as listed below. Testing shall be performed at locations as determined by OWNER.

	Fill Placement	**Minimum Testing Frequency**
A	Controlled Fill for Anchor Trench Backfill	1 per 100 LF of Anchor Trench
B	Controlled Fill for Subgrade and Berm Construction	1 per 1,500 CY placed min 1 per lift
C	Controlled Fill for Subcut Replacement	1 per lift

B. In-place density testing technician shall meet the requirements specified in section 01410. CONTRACTOR shall be responsible for any retesting of material not meeting specification at no additional cost to OWNER.

4.03 IN-PLACE DENSITY TEST SURVEYING

A. In-place density testing locations shall be documented by the CONTRACTOR using GPS survey methods.

4.04 IN-PLACE DENSITY TEST REPORTING

A. CONTRACTOR shall notify OWNER at the end of each day the number of density tests taken, the number of passing density tests, material proctors used, and the location of the tests. CONTRACTOR shall complete the OWNER's "Contractor Material Testing Acceptance Form" at the end of each day documenting the test results. The tests recorded each day will not be accepted until all required signatures are captured on the "Contractor Material Testing Acceptance Form".

B. All testing reports shall be provided to OWNER concurrently with CONTRACTOR.

END OF SECTION

SECTION 02208

GRANULAR BEDDING

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes descriptions and requirements of the granular bedding material required for bedding the leachate gravity drain line piping outside the landfill cell and culverts as shown on the Drawings.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D422 - Standard Method for Particle Size Analysis of Soils.
2. ASTM D1140 - Standard test method for amount of material in soils finer than the 75 um (No. 200) sieve.

1.03 SUBMITTALS

A. Location of off-site source of materials.

B. Method of off-site source soils material sampling and analysis.

C. Off-site source material analyses.

D. Source testing results shall be provided at least 21 days prior to installation.

1.04 SOIL MATERIAL SOURCE QUALITY ASSURANCE

A. Independent soils laboratory shall be approved by OWNER.

B. Source testing to be performed by CONTRACTOR at no cost to the OWNER.

C. Provide the following test results for granular drainage layer material test requirements:

Property	**Test Method**	**Frequency**
Grain Size Analysis	ASTM D422/D1140	3 test results/source

PART 2 - PRODUCTS

2.01 SOURCE OF MATERIAL

A. The CONTRACTOR is responsible for providing soil for granular bedding that conforms to the specifications. Upon request of OWNER or Engineer, the Contractor shall provide access to

the soil source to allow OWNER or Engineer the opportunity to review the material source and collect samples for OWNER's CQA program.

2.02 GRANULAR BEDDING

A. Granular material, consisting of durable particles ranging in size from fine to coarse in substantially uniform combination. Unwashed bank-run sand and crushed bank-run gravel will be considered.

B. Meet gradation requirements of Standard Specifications Section 3149.2.G.3 (Conduit Aggregate Bedding).

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive granular bedding to determine existence of areas loosened by frost action, softened by flooding or weather or of unsuitable materials.

3.02 PLACING GRANULAR BEDDING

A. Notify ENGINEER before placing granular bedding material.

B. Do not use frozen material or place material on frozen subgrade.

C. Granular Bedding Material Limits for Pipe Bedding:

a. Minimum of 6 inches below, to spring line, and entire trench width.

D. Place fill simultaneously on both sides of free-standing structures.

E. Use vibratory compaction methods. When approved by ENGINEER, jetting, flooding, puddling, or vibroflotation methods may be used for compacting if CONTRACTOR furnishes test results to confirm required degree of compaction being obtained uniformly throughout entire mass.

F. Lift Thickness and Compaction: Place and compact fill material in maximum lift thickness and to minimum densities listed below.

Type of Fill Placement	**Maximum Compacted Lift Thickness (inches)**	**Standard Proctor (%)**
Pipe Bedding and Cover	6	95

3.04 TRANSPORTATION AND HAUL ROADS

A. Observe State, County, and Local traffic rules and weight restrictions.

B. All vehicle trips loaded or unloaded shall be on designated haul roads only.

C. CONTRACTOR to coordinate selection of haul roads with the appropriate governing body and acquire any necessary permits.

PART 4 – CONSTRUCTION QUALITY TESTING

4.01 FIELD QUALITY CONTROL

A. In-place testing shall be performed by CONTRACTOR at locations selected by OWNER. All testing shall be performed in accordance with the Technical Specifications. Density testing shall be performed in accordance with the ASTM D6938 standard.

B. CONTRACTOR shall notify OWNER a minimum of 24-hours prior to testing.

4.02 IN-PLACE DENSITY TESTING

A. CONTRACTOR shall be responsible for performing in-place density testing on all granular bedding material at the minimum frequencies as listed below. Testing shall be performed at locations as determined by OWNER.

	Fill Placement	**Minimum Testing Frequency**
A	Pipe Bedding	1 per 100 LF of Pipe Requiring Granular Bedding

B. In-place density testing technician shall meet the requirements specified in section 01410. CONTRACTOR shall be responsible for any retesting of material not meeting specification at no additional cost to OWNER.

4.03 IN-PLACE DENSITY TEST SURVEYING

A. In-place density testing locations shall be documented by the CONTRACTOR using GPS survey methods.

4.04 IN-PLACE DENSITY TEST REPORTING

A. CONTRACTOR shall notify OWNER at the end of each day the number of density tests taken, the number of passing density tests, material proctors used, and the location of the tests. CONTRACTOR shall complete the OWNER's "Contractor Material Testing Acceptance Form" at the end of each day documenting the test results. The tests recorded each day will not be accepted until all required signatures are captured on the "Contractor Material Testing Acceptance Form".

B. All testing reports shall be provided to OWNER concurrently with CONTRACTOR.

END OF SECTION

SECTION 02209

STRUCTURAL FILL

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes descriptions and requirements for construction with structural fill soils. Structural fill will be used as backfill in the over-excavated subgrade to correct fracture locations. As subgrade fractures are encountered in the field, they shall be corrected by the CONTRACTOR at the direction of OWNER.

B. Work completed on fracture over-excavation shall not be included in CONTRACTOR's lump sum bid price and shall be paid as time and materials for actual work performed. Time and material quantities shall be agreed upon at the end of each working day by CONTRACTOR and OWNER and shall be signed off on a form agreed upon by the Contractor and OWNER. CONTRACTOR shall receive no compensation for work performed on over-excavation unless directed by OWNER.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D422 - Standard Method for Particle Size Analysis of Soils.
2. ASTM D1140- Standard Test Method for Amount of Material in Soils Finer than the 75 um (No. 200) Sieve.
3. ASTM D1556- Standard Test Method for Density of Soil in-Place by the Sand Cone Method.
4. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3)
5. ASTM D1587- Standard Practice for Thin-Walled Tube Sampling of Soils for geotechnical purposes.
6. ASTM D2216- Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
7. ASTM D2487- Standard Practice for Classification of Soils for Engineering Purposes.
8. ASTM D4318- Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
9. ASTM D6938 - Standard Test Method for In-place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.03 SUBMITTALS

A. Location of off-site source of materials.

B. Name, address, telephone number and contact person of independent soils laboratory.

C. Method of off-site source soils material sampling and analyses.

D. Off-site source material analyses.

1.04 SOIL MATERIAL SOURCE QUALITY ASSURANCE

A. Three (3) of each of the following:

1. USCS Soil Classification.
2. Standard Proctor

PART 2 - PRODUCTS

2.01 SOURCE OF MATERIAL

A. On-site soils are available for use as structural fill material. Some on-site soils (friable rock) will require processing prior to placement as structural fill. Contractor is responsible for selecting material for use that conforms to these Technical Specifications. Only on-site material that meets, or has been processed to meet, these Technical Specifications can be used for structural fill material. CONTRACTOR is responsible for processing of on-site materials in accordance with Subpart 3.03 of this Section, as needed, to meet material requirements specified in Subpart 2.02 of this Section

2.02 STRUCTURAL FILL

A. Natural soils determined by ENGINEER's visual observation in the field to be CL, GM, SW, SP, SC, SM or ML soils, free of organic and other deleterious material.

B. Excavated subsoil from designated borrow and excavation areas, processed as required, to be used for embankments, backfill, and subgrade excavation replacement where applicable.

C. Material free from roots, debris, and stones or cemented sandstone clods larger than two (2) inches.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine and verify acceptability of surface to receive installation of material.

B. Proofroll and examine surfaces to receive fill and subgrades within influence zone to determine existence of soft areas, areas loosened by frost action or softened by flooding, groundwater or weather or existence of unsuitable materials.

3.02 PREPARATION

A. Sample, test, and submit test results of off-site soils.

B. Prepare surfaces to receive materials to lines and grades shown on Drawings prior to placement.

3.03 MATERIAL PROCESSING

A. Notify ENGINEER prior to beginning material processing.

B. CONTRACTOR shall be responsible for processing excavated on-site material prior to material being placed as structural fill.

C. Excavated on-site soil shall be processed outside the location it will be placed if needed to process/crush material to the specified controlled fill.

D. CONTRACTOR shall verify with ENGINEER that material meets requirements of Subpart 2.02 of this Section prior to it being placed as structural fill.

3.03 BACKFILLING AND COMPACTION

A. Notify ENGINEER before placing structural fill material.

B. Do not use frozen material or place structural fill on frozen subgrade.

C. Provide vibratory compaction. When approved by ENGINEER, jetting, flooding, puddling, or vibroflotation methods may be used for compacting if CONTRACTOR furnishes test results to confirm required degree of compaction is being obtained uniformly throughout entire mass.

E. Lift Thickness and Compaction: Place and compact fill material in maximum lift thickness and to minimum densities listed below.

	Fill Placement	**Maximum Compacted Lift Thickness (inches)**	**Standard Proctor (%)**
A	Structural Fill	8	100

3.04 TRANSPORTATION AND HAUL ROADS

A. Observe State, County, and Local traffic rules and weight restrictions.

B. All vehicle trips loaded or unloaded shall be on designated haul roads only.

C. CONTRACTOR to coordinate selection of haul roads with the appropriate governing body and acquire any necessary permits.

PART 4 – CONSTRUCTION QUALITY TESTING

4.01 FIELD QUALITY CONTROL

A. In-place testing shall be performed by CONTRACTOR at locations selected by OWNER. All testing shall be performed in accordance with the Technical Specifications. Density testing shall be performed in accordance with the ASTM D6938 standard.

B. CONTRACTOR shall notify OWNER a minimum of 24-hours prior to testing.

4.02 IN-PLACE DENSITY TESTING

A. CONTRACTOR shall be responsible for performing in-place density testing on all structural fill material at the minimum frequencies as listed below. Testing shall be performed at locations as determined by OWNER.

	Fill Placement	**Minimum Testing Frequency**
A	Structural Fill	1 per 300 CY (Min 1/lift)

B. In-place density testing technician shall meet the requirements specified in section 01410. CONTRACTOR shall be responsible for all retesting of materials failing to meet Technical Specifications at no additional cost to OWNER.

4.03 IN-PLACE DENSITY TEST REPORTING

A. CONTRACTOR shall notify OWNER at the end of each day the number of density tests taken, the number of passing density tests, material proctors used, and the location of the tests. CONTRACTOR shall complete the OWNER's "Contractor Material Testing Acceptance Form" at the end of each day documenting the test results. The tests recorded each day will not be accepted until all required signatures are captured on the "Contractor Material Testing Acceptance Form".

B. All testing reports shall be provided to OWNER concurrently with CONTRACTOR.

END OF SECTION

SECTION 02211

SITE PREPARATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the requirements for salvaged topsoil, demolition, and miscellaneous surface features.

1.02 PROJECT/SITE CONDITIONS

A. Provide 72 hour notice, prior to beginning construction, to OWNERS of utilities, structures, and surface features.

1.03 COORDINATION

A. Coordinate work with ENGINEER before performing work at Project Site.

1.04 OWNERSHIP OF MATERIALS

A. All soil materials, raw or processed, produced by CONTRACTOR's work under this section shall remain the property of OWNER except as specified otherwise.

B. CONTRACTOR shall manage materials produced under this section by stockpiling, incorporating into the Work or removing from Site, as further directed in these Technical Specifications.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.01 REVIEW AND ACCEPTANCE OF EXISTING TOPOGRAPHIC CONDITIONS

A. CONTRACTOR shall satisfy itself that the existing topographic conditions in the construction area shown on the Drawings are an accurate representation and shall formally acknowledge and accept such existing conditions as the basis for CONTRACTOR's bid by completing the "Existing Topographic Conditions Acceptance Form."

B. If CONTRACTOR contends that existing topographic conditions are different from that shown on the Drawings, CONTRACTOR shall submit survey data from a land surveyor registered in the state of Minnesota to document actual topographic conditions, and shall identify with such submission additional work required which was not accounted

for in CONTRACTOR's bid. Following negotiation with OWNER regarding additional work and execution of a change order, CONTRACTOR shall acknowledge and accept such revised existing conditions as the basis for CONTRACTOR's bid and change order by completing the "Existing Topographic Conditions Acceptance Form."

C. There shall be no opportunity for a claim for extra work due to differing topographic conditions once stripping or excavation work has started or if the CONTRACTOR does not sign and complete the form.

3.02 PREPARATION

A. Provide protection and support during construction for existing utilities, structures, and surface features adjacent to construction area or easements and rights-of-way.

B. Remove obstructions such as mounds of dirt, stone or debris located within working limits.

C. Obstructions such as street signs, small culverts, and guard posts located within construction easements of rights-of-way may be removed if promptly replaced to original condition unless otherwise specified.

3.03 SALVAGED TOPSOIL

A. Excavate and temporarily stockpile salvaged topsoil in quantities adequate to restore areas disturbed by construction.

B. All material stockpile areas shall be stripped of topsoil prior to stockpiling except for areas in which topsoil will be stockpiled.

C. Provide transportation of material and sites for stockpiles if adequate areas not available within the construction limits, as shown on the Drawings.

3.04 RESTORATION

A. Restore existing utilities, surface features, and structures to conditions equal to or exceeding the condition, which existed prior to construction.

3.05 MAINTENANCE AND RESTORATION OF ON-SITE AND OFF-SITE HAUL ROADS

A. While hauling operations are in progress, CONTRACTOR shall maintain haul roads in condition satisfactory to the ENGINEER. Work shall include any or all of the following items:

1. Application of water
2. Bituminous material
3. Calcium chloride
4. Sweeping
5. Others as necessary

B. When hauling operations are completed, CONTRACTOR shall:

1. Restore to condition that existed at the time hauling operations were started;
   or
2. Compensate the local road authority in the amount satisfactory to that road authority.

C. The OWNER shall make the determination as to the kind and amount of Work required to restore the haul road to a condition equal to the time hauling operations began.

D. When hauling operations are complete and restoration is complete to the satisfaction of the OWNER, the CONTRACTOR will be relieved of any additional obligation in connection to the maintenance and restoration of the haul road.

END OF SECTION

SECTION 02220

EXCAVATION

PART 1 - GENERAL

1.01 SUMMARY

A. Work described in this section includes excavation activities for landfill cell and anchor trench construction, as shown on the Drawings.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D422 - Standard Method for Particle Size Analysis of Soils.
2. ASTM D1140- Standard Test Method for Amount of Material in Soils Finer than the 75 um (No. 200) Sieve.
3. ASTM D1556- Standard Test Method for Density of Soil in-Place by the Sand Cone Method.
4. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3)
5. ASTM D2487- Standard Practice for Classification of Soils for Engineering Purposes.
6. ASTM D6938 – Standard Test Method for In-place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.03 SUBMITTALS

A. Shoring, Bracing, and Sheeting Layout and Details: ENGINEER will review submitted material to ascertain effect on new construction. ENGINEER will not review shoring, bracing, and sheeting for structural integrity or effect on existing facilities.

B. Additional soil testing results as may be required.

1.04 SITE CONDITIONS

A. Regulatory Requirements: Work shall be in accordance with any permit conditions and practices incorporated into the Project. All excavations shall be in accordance with applicable laws and regulations.

B. It shall be solely the CONTRACTOR's responsibility to review available tests and reports, conduct additional tests, and otherwise determine to its own satisfaction the location and nature of all surface and subsurface features and the soil and water conditions that may be encountered. OWNER's information on Site conditions may be reviewed at OWNER's offices as scheduled with OWNER.

C. Use of explosives will not be permitted.

D. CONTRACTOR shall be solely responsible for determining the means and methods for meeting the compaction requirements outlined in these Technical Specifications unless otherwise specified herein. CONTRACTOR shall be solely responsible for utilizing means and methods that protect adjacent structures and utilities from damage resulting from CONTRACTOR's operations, specifically including, but not limited to, settlement, consolidation, displacement, cracking, vibration, undermining, washout, and uplift caused by excavating, compaction, dewatering, or any other operation. If requested by CONTRACTOR, OWNER will acOWNER CONTRACTOR in examination of existing adjacent structures prior to beginning the Work. Examination will be intended to provide CONTRACTOR opportunity to document relevant existing structural damage or problems.

E. Provide all shoring, bracing, sheet piling, trench boxes, tie backs, and other measures required to perform all Work in accordance with laws and regulations. Specifically, all excavations shall conform to the requirements of OSHA set forth in 29 CFR 1926, Subpart P (Occupational Safety and Health Standards-Excavations).

1.05 FIELD MEASUREMENTS

A. Verify control monuments and intended elevations for Work as shown on Drawings.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine and verify acceptability and condition of surfaces to perform Work.

3.02 PREPARATION

A. Identify required lines, grades, levels, contours, and datum.

B. Protect benchmarks, structures, equipment, and partially completed Work.

C. Overexcavate soft areas of subgrade not capable of in-situ compaction as directed by ENGINEER.

D. Notify corporations, companies, individuals, or authorities owning above- or belowground conduits, wires, pipes, or other utilities running to property or encountered during excavating operations.

E. Cap or remove and relocate services in accordance with instructions by owners of services.

F. Protect, support, and maintain conduits, wires, pipes, and other remaining utilities in accordance with requirements of owners of said services.

G. Keep construction site free-draining.

H. Fill settled areas where excavations or trenches were backfilled and holes made by demolition, tree removal, and site preparation work.

I. Remove all topsoil, organic material, and soft, wet, or loose soils below proposed construction areas. During excavation or exposure of in-situ soils, the CONTRACTOR shall subcut 2 feet beneath plan subgrade if soft, wet, or loose soils are encountered. Replace unsuitable materials with controlled fill material. Soft, wet, loose, and competent soils will be determined by the ENGINEER.

J. Disc level surfaces.

K. The CONTRACTOR shall stage construction to prevent slippage or sloughing of material during construction.

3.03 COMMON EXCAVATION

A. Excavations shall conform to lines and grades as staked, and as shown on Drawings.

B. Excavations beyond those lines and grades without the ENGINEER's authorization will be considered unauthorized work.

C. Method of excavation shall be consistent with soil types encountered and result in competent subgrade.

D. Remove stumps, roots, debris, large stones or boulders, and any other deleterious material from excavated materials to be used in embankments.

E. Do not excavate within influence zone of existing footings or foundations without prior approval of ENGINEER.

F. Upon completion of excavation, notify ENGINEER before proceeding with further work.

3.04 SUBGRADE FRACTURE OVER-EXCAVATION

A. As subgrade fractures are encountered in the field, the fractures shall be corrected by the CONTRACTOR at the direction of the Engineer. Work completed on fracture over-excavation shall not be included in CONTRACTOR's lump sum bid price and shall be paid as time and materials for actual work performed. Time and material quantities shall be agreed upon at the end of each working day by CONTRACTOR and Engineer and shall be signed off upon on the "Extra Work Authorization Form" (to be supplied by Contractor or OWNER). CONTRACTOR shall receive no compensation for work performed on over-excavation unless directed by Engineer.

B. Areas to be excavated will be identified in the field by the Engineer. CONTRACTOR shall be responsible for excavating fracture site to the dimensions and depths as required by the Engineer.

C. Over-excavation areas shall be backfilled with structural fill in accordance with Section 02209.

3.05 ANCHOR TRENCH EXCAVATION

A. Excavate anchor trench to elevations and dimensions necessary to anchor geomembrane as shown on Drawings. Backfill anchor trench with controlled fill in accordance with Section 02207.

3.06 FIELD QUALITY CONTROL

A. Subgrade elevations shall be surveyed prior to placement of clay barrier material. Elevations of subgrade to be as shown on Drawings.

B. Subgrade elevations shall be between –0.2 and +0.0 feet.

END OF SECTION

SECTION 02221

TRENCHING

PART 1 - GENERAL

1.01 SUMMARY

A. Work described in this section includes trenching for culvert or leachate pipe installation outside the cell limits.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D422 - Standard Method for Particle Size Analysis of Soils.
2. ASTM D1140- Standard Test Method for Amount of Material in Soils Finer than the 75 um (No. 200) Sieve.
3. ASTM D1556- Standard Test Method for Density of Soil in-Place by the Sand Cone Method.
4. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3)
5. ASTM D2487- Standard Practice for Classification of Soils for Engineering Purposes.
6. ASTM D6938 – Standard Test Method for In-place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.03 SUBMITTALS

A. Additional soil testing results as may be required.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Work shall be in accordance with any permit conditions and practices incorporated into the Project and in accordance with applicable laws and regulations.

B. Contractor shall abide by OWNER's safety policy for excavations and trenching.

1.05 FIELD MEASUREMENTS

A. Verify control monuments and intended elevations for Work as shown on Drawings.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine and verify acceptability and condition of surfaces to perform Work.

3.02 PREPARATION

A. Keep construction site free-draining.

B. Fill settled areas where excavations or trenches were backfilled and holes made by demolition, tree removal, and site preparation work.

C. Remove all topsoil, organic material, and soft, wet, or loose soils below proposed berm and roadway areas. During excavation or exposure of in-situ soils, the CONTRACTOR shall subcut 2 feet beneath plan subgrade if soft, wet, or loose soils are encountered. Replace unsuitable materials with controlled fill material. Soft, wet, loose, and competent soils will be determined by the ENGINEER.

3.03 TRENCHING

A. Excavate to elevations and dimensions necessary to complete construction.

B. Comply with applicable OSHA and OWNER Health and Safety Standards.

C. Trenching Tolerances:

1. Excavate so pipes, ducts, and conduits can be laid straight at uniform grade, without sags or humps, between elevations shown on Drawings.
2. Maximum width of excavation on top of pipe shall be outside diameter of pipe plus 24 inches. When stringers and sheathing are required, width of trench may be increased to allow for their use, provided provisions for this excess width of trench are met.
3. Where trench width for that portion of trench depth between trench bottom and outside top of pipe barrel, for any reason within CONTRACTOR'S control, exceeds specified limits, CONTRACTOR, at his expense, shall furnish pipe with strength adequate for actual trench width.

D. Do not advance excavation of trenches more than 300 feet ahead of completed pipe installation.

E. Do not excavate for manholes and other structures until scheduled for construction.

3.04 ADJUSTMENT AND CLEANING

A. Remove and re-use excess material suitable for backfilling or site grading. Remove unsuitable materials from Site.

END OF SECTION

SECTION 02271

RIPRAP

PART 1 - GENERAL

1.01 SUMMARY

A. Work described in the Section includes riprap for erosion protection as shown on Drawings.

1.02 SUBMITTALS

A. Location of source of riprap material.

B. Test results.

1.03 QUALITY ASSURANCE

A. Testing shall be provided by CONTRACTOR in accordance with this section.

1. One gradation for each source and class of riprap.
2. One test on each source and class of riprap for soundness as required herein.

B. Test results shall meet requirements for the class of riprap defined on the Drawings in accordance with Standard Specification Section 3601.

PART 2 - PRODUCTS

2.01 SOURCE OF MATERIAL

A. The CONTRACTOR is responsible for providing riprap material that conforms to the Technical Specifications.

2.02 MATERIALS

A. Class of Riprap shall be as shown on Drawings and in accordance with Standard Specification Section 3601.

B. Geotextile in accordance with Section 02921 of these Specifications.

PART 3 - EXECUTION

3.01 USAGE

A. For use in erosion control, as shown on the Drawings.

3.02 PREPARATION

A. Areas on which bedding material and riprap are to be placed shall be graded and dressed to lines and grades shown on Drawings or as required by ENGINEER.

B. Culvert aprons shall be shaped to the approximate cross sections and profiles as shown on Mn/Dot standard plate 3134

C. CONTRACTOR shall place geotextile under riprap and cover completely. No fabric shall be exposed along edges or under riprap. CONTRACTOR shall place riprap so geotextile is not damaged.

D. The geotextile shall conform to the requirements of section 02921.

3.03 INSTALLATION

A. Place riprap in areas as shown on Drawings and in accordance with "Standard Specifications." Section 02511

END OF SECTION

SECTION 02273

GEOSYNTHETIC CLAY LINER

PART 1 - GENERAL

1.01 SUMMARY

A. Work covered under this section includes the manufacture, fabrication (if needed), and supply and installation of the geosynthetic clay liner (GCL). As part of the landfill composite liner system, all work shall be performed in accordance with the lines, grades, cross-sections, and dimensions on the DRAWINGS, or as directed by OWNER.

B. Sufficient geosynthetic clay liner and accessory bentonite shall be furnished to cover all areas to be lined as shown on the DRAWINGS, including overlaps at field seams and anchor trenches.

C. It is the intent of these Technical Specifications to ensure that the performance criteria for these Projects are achieved. It shall be the CONTRACTOR's responsibility to ensure that these criteria are met.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
2. ASTM D5321 - Standard test method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear.
3. ASTM D6243 - Standard Test Method for Determining the Internal and Interface Shear Strength of Geosynthetic Clay Liner by the Direct Shear Method.
4. ASTM D6495 - Standard Guide for Acceptance Testing Requirements for Geosynthetic Clay Liners.

1.03 SEQUENCING AND SCHEDULING

A. Submit material delivery and installation schedule for incorporation into the project schedule.

1.04 SUBMITTALS

A. CONTRACTOR shall submit certification in writing that the surface upon which the geosynthetic clay liner is to be installed is acceptable (complete form contained at the end of this Section).

B. CONTRACTOR shall submit Certificate of Compliance from supplier for each roll of geosynthetic clay liner delivered to the Site, indicating material compliance with the specified manufacturer specifications prior to or at the time of delivery of the material.

C. Test methods and results defining physical properties as specified herein, of the GCL to be used for this Project. Test results shall be representative of each roll of GCL furnished for this Project (e.g., a test sample taken between two consecutive rolls from a continuous run will be considered representative of both rolls). Test results shall be reported with corresponding roll identification numbers.

D. Statement of the GCL manufacturer's quality control procedures and frequency of sampling

E. CONTRACTOR shall submit certified test results from the supplier to OWNER to obtain approval for use of the product prior to mobilization of the product to the Project Site. Any proposed alternate geosynthetic clay liner not approved by OWNER shall not be used.

F. CONTRACTOR shall submit a plan for installation layout identifying placement patterns and overlap orientations prior to placement. The layout diagram shall be to scale and used as a construction plan and shall include all necessary dimensions and details. The layout diagram shall be compatible with the panel and seam layout requirements specified in Article 3.02 of this Section.

G. Submit for documentation a material and workmanship warranty prior to substantial completion.

1.05 EXPERIENCE

A. The GCL installation shall be performed under the direct supervision of a single field supervisor who must remain on-site throughout installation, including inspection of the surface upon which the GCL is to be installed, GCL handling and storage, panel layout and placement, seaming, seam testing, panel and seam repair, installation of appurtenances, anchorage and other GCL-related work. The field supervisor shall have a personal GCL installation record totaling at least 1 million square feet.

B. The GCL manufacturer shall have at least 5 years continuous experience in manufacturing GCL rolls and/or a manufacturing record totaling not less than 5 million square feet of GCL. The manufacturer shall have produced GCL for at least 10 completed facilities similar in scope to this Project.

C. The CONTRACTOR shall have at least 5 years continuous experience in the installation of GCL and an installation record totaling at least 5 million square feet. CONTRACTOR shall have installed GCL for at least 10 completed sites similar in scope to this Project.

D. The GCL manufacturer and any GCL installation subcontractors to the CONTRACTOR must be approved by OWNER prior to mobilization for GCL installation. OWNER has the right to reject any CGL manufacturer or Installer, and request that Contractor select an alternate.

1.06 Pre-Installation Meeting

A. Representatives of the CONTRACTOR and any GCL subcontractors shall attend a meeting prior to installation of the geomembrane to discuss details of the proposed design, installation, quality control documentation requirements and schedule.

PART 2 - PRODUCTS

2.01 GEOSYNTHETIC CLAY LINER (GCL)

A. The GCL must meet the requirements of ASTM D-6495. The CONTRACTOR shall submit certified test results from the supplier to OWNER to obtain approval for use of the product prior to mobilization of the product to the Project Site. Any proposed alternate GCL not approved by OWNER shall not be used.

B. The GCL shall have an internal friction coefficient of not less than 15 degrees as determined by ASTM D-5321 test method for measurement of the friction angle against the subgrade soil used in the analysis. The GCL supplier can submit testing that has been performed on soil materials having the same soil type to the subgrade soils used for the construction to demonstrate the minimum friction angle requirement is met.

C. No disassociation of geotextile components from the bentonite core shall occur. A sample of the bentonite geosynthetic placed in 70°F tap water for one hour shall not delaminate.

D. The geosynthetic clay liner shall be manufactured utilizing a minimum of 0.75 pound per square foot of high swelling sodium bentonite at 0 percent moisture content. If the material is manufactured at a higher moisture content, it shall have the minimum of 0.75 pound per square foot of bentonite when adjusted to 0 percent moisture level.

E. GCLs shall consist of natural sodium bentonite between polypropylene geotextiles that are connected by needle-punching.

F. Rolls shall be a minimum of 12 feet wide and 80 feet long. A 6-inch lap line and a 9-inch match line shall be printed or marked in the field on both edges of the upper geotextile of the GCL (as installed) to assist in overlap quality control.

G. Each roll shall be marked with the following information:
   I. Manufacturer's name and brand name.
   II. Lot and roll number.
   III. Roll length and width.
   IV. Total roll weight.

H. All rolls shall be bagged in packaging that water resistant and UV resistant.

I. GCL Properties:

1. General Properties
   i. Bentonite Swell Index: 24 mL/2g minimum (ASTM D5890).
   ii. Bentonite Fluid Loss: 18 mL maximum (ASTM D5891).
   iii. Bentonite Mass/Area: 0.75 lb/ft2 0 percent moisture content (ASTM D5993).
   iv. GCL Panel and Seam Permeability: 5x10-9 cm/s maximum (ASTM D5887).
   v. GCL Hydrated Internal and Interface Shear Strength: 150 lb/ft2 at 200 lb/ft2 normal stress (ASTM D5321 and D6243).
   vi. GCL Tensile Strength: 30 lb/in minimum (ASTM D6768).
   vii. GCL Peel Strength: 1 lb/in minimum (ASTM D6496).

J. Accessory bentonite used to augment seam overlaps, penetrations, and panel edges at structures shall be powdered or granulated bentonite of the same type used in the manufacture of the GCL.

PART 3 - EXECUTION

3.01 SUBGRADE INSPECTION

A. CONTRACTOR shall certify in writing that the surface upon which the GCL is to be installed is acceptable (acceptance form contained at the end of this Section).

B. The subgrade shall be prepared and compacted in accordance with Section 02205. Debris, roots, solid mineral particles larger than 1/2-inch diameter, and other material that may damage the GCL shall be removed. Prior to the deployment of the GCL, the subgrade shall be final-graded to fill any voids or cracks and rolled to provide a smooth surface for the installation of the GCL.

C. After subgrade surface has been accepted by CONTRACTOR, it shall be CONTRACTOR'S responsibility to identify any change in subgrade condition that may require repair work. Special care shall be taken to maintain prepared GCL subgrade (i.e., dry and free of foreign matter). Daily observations shall ascertain the integrity of subgrade. Damage to subgrade caused by precipitation and desiccation shall be repaired at Contractor's expense. Damage to subgrade caused by CONTRACTOR shall be repaired at CONTRACTOR's expense. GCL placement over subgrades having damage or excessive moisture as determined by OWNER is not acceptable.

D. Particular attention shall be paid to subgrade condition at the panel edges. Panel edges shall lay flat against the subgrade with no puckering, creasing, or curling.

3.02 HANDLING, TRANSPORTATION, STORAGE, AND PLACEMENT

A. GCL rolls shall be packaged and labeled prior to transporting to the Site. GCL rolls delivered to the Site shall be wrapped in an impermeable and opaque protective cover. Rolls shall be stored on a flat dry surface raised several inches above the ground. Tarping stored materials is suggested to avoid any unnecessary stress on the packaging and to protect materials from moisture in the event of rain.

B. Rolls shall be handled utilizing a solid steel bar inserted through the core bar and slings or chains attached to the ends of the bar. The core bar shall be suspended from a spreader bar so that the edges of the GCL are not damaged by the suspending straps or chains. Where the GCL has a non-woven geotextile on one side and a woven geotextile on the other, panels shall be placed with the non-woven side against the subgrade, and the woven side oriented upwards.

C. On-site storage of the GCL rolls shall be in a safe manner according to manufacturer's recommendations, with rolls protected from grease, dirt, moisture, excessive heat, direct sunlight, vehicle traffic, and other possible sources of damage including theft and vandalism. Storage areas shall be at the location approved by the OWNER. In addition, the on-site storage of the GCL is subject to OWNER's approval of storage arrangement, including pallets, timbers, or other support and separation from ground, stacking height, packaging/covering, etc.

D. GCL and appurtenant materials delivered to the Site shall be checked for proper labeling and visually inspected for transport or manufacturing damage. OWNER reserves the right to reject any unacceptable material at no cost to OWNER.

E. Only that quantity of GCL that is to be placed on a particular day shall be removed from the packaging. GCL rolls shall be transported from the storage area to the construction area using wide lifting straps and properly sized forklifts, front-end loaders, or other appropriate equipment. Under no circumstances shall any heavy equipment be allowed directly on the GCL. Prior to placement, the GCL shall be visually inspected for damage and manufacturing defects. GCL material that, in the opinion of OWNER or ENGINEER, is damaged or otherwise unsuitable shall not be used for the Project.

3.03 INSTALLATION

A. Edge seams shall be perpendicular to the toe of the slope at all times.

B. Seam areas or runs shall also be flat and clear of any large rocks, debris or ruts. Contacting surfaces shall be clean and clear of dirt or native soil with all edges pulled tight to maximize contact and to smooth out any wrinkles or creases. Edge overlaps shall be a minimum of 6 inches and verified by OWNER. A proper seam shall cover the 6-inch lap line and leave the 9-inch match line exposed. End overlaps shall be a minimum of 3 feet and in a rainlap orientation and verified by OWNER.

C. All seams shall be augmented with granular bentonite to ensure seam integrity as necessary or as required by manufacturer's recommendations. Granular bentonite,

where required, shall be dispersed evenly from the panel edge to the lap line at a minimum rate of 1/4 pound per lineal foot continuously along all seams or overlap areas. Accessory bentonite shall be of the same type as the material within the geosynthetic clay liner.

D. The CONTRACTOR shall only work on an area that can be completed in one working day or before an inclement weather condition. Completion can be defined as the full installation and anchoring of the bentonite blanket and placement of the overlying geomembrane. Any GCL that is hydrated prior to placement of the geomembrane will be removed and replaced at the CONTRACTOR'S expense.

E. Large rips or tears or thin worn areas shall be repaired by completely exposing the affected area, removing all foreign objects or soil, and by then placing a patch over the damage. The patch shall overlap the GCL at least 12 inches on all edges. Accessory bentonite shall be placed between the patch and the repaired material at a rate of 1/2 pound per lineal foot of edge, spread in a 6-inch width. The above procedures shall also be implemented in the event that a rip or tear or thin worn area occurs on a sloped surface. In this instance, the edges of the patch shall be fastened to the repaired liner with construction adhesive, as recommended by the GCL supplier in addition to the bentonite-enhanced seam.

F. During start-up of the geosynthetic clay liner installation, an agent or representative of the manufacturer shall provide on-site assistance as needed and instruction to the CONTRACTOR and OWNER regarding product application techniques.

3.04 PROTECTION AFTER INSTALLATION

A. Prevent movement of GCL after installation by sandbagging or other approved methods.

B. The GCL shall be kept clean and free of soil, debris, and foreign material until covered by the geomembrane. The geomembrane shall be installed in direct contact with the GCL.

C. No vehicle traffic will be permitted directly on the GCL. Only soft-soled/rubber-soled boots and shoes shall be worn on the GCL. Tracked vehicles and trucks with low-pressure tires will be permitted to travel on a minimum of 12-inch thickness of cover soil over the GCL. Vehicles with high-pressure tires will be permitted to travel on a minimum of 3-foot thickness of cover soil over the GCL.

D. GCL Installer shall coordinate with Contractor and geomembrane Installer regarding deployment, seaming, and testing of geomembrane and placement of cover soils over GCL such that geomembrane installation and cover soil placement occurs expeditiously and without damage to the GCL.

E. Geomembrane deployment and positioning shall be done such that no disruption of the GCL occurs, particularly at the overlapped seams.

3.05 CLEANUP

A. CONTRACTOR shall place ALL material scraps in OWNER designated area at the end of each working day. Disposal of scraps in the anchor trenches will not be acceptable. No scraps of materials shall be allowed to be left on top of GCL.

B. Once the installation is complete the CONTRACTOR shall:

1. Remove all sand bags from site; or
2. Remove all sand bags and place in OWNER designated area.

PART 4 - WARRANTY

4.01 MATERIAL/WORKMANSHIP WARRANTY

A. 5-year material and 1-year workmanship warranty shall be provided by the CONTRACTOR.

END OF SECTION

Attachment 1 to Section 02273

Certificate of Acceptance of
GCL Subgrade Surface by CONTRACTOR

DESCRIPTION OF AREA TO BE CERTIFIED:_____

_____

LOCATION:_____
PROJECT:_____
ADDRESS:_____

The undersigned, _____ certifies that he is a representative of _____ _____, duly authorized to execute this certificate, that he visually inspected the subgrade surface described above on _____ and found the surface to be acceptable for installation of the geosynthetic clay liner (GCL).

This certification is based on observations of the surface of the subgrade only. No sub terrain inspections or tests have been performed and_____ (OWNER) makes no representations or warranties regarding conditions which may exist below the surface of the subgrade.

Date: _____ Signature: _____
Name: _____ Title:_____

CERTIFICATE RECEIVED BY CONTRACTOR CERTIFICATE RECEIVED BY OWNER

Date:_____ OWNER:_____
Name:_____ Name:_____
Signature_____ Signature_____
Title_____ Title:_____

SECTION 02276

EROSION CONTROL

PART 1 - GENERAL

1.01 SUMMARY

A. Work includes the furnishing of the permanent and temporary erosion control as required by the Erosion Control Plan as shown on the Drawings and Stormwater Pollution Prevention Plan (SWPPP).

B. Heavy-duty silt fence and bale checks shall be installed for erosion control where required by the Erosion Control plans and as shown on the Drawings.

C. Erosion control blanket and stabilization mat shall be installed as detailed on the Drawings.

D. CONTRACTOR shall sign the NPDES construction activity permit for each construction Site.

1.02 SUBMITTALS

A. Manufacturer's certificates indicating specification conformance test results of furnished material.

PART 2 – PRODUCTS

2.01 HEAVY DUTY SILT FENCE

A. Machine Sliced (MS) silt fence shall conform to "Standard Specification" Section 3886

2.02 EROSION CONTROL BLANKET and TURF REINFORCEMENT MAT

A. Erosion Control Blanket - Category of Erosion Control Blanket as shown on Drawings and in accordance with the “Standard Specification” Section 3885.

B. Turf Reinforcement Mat – Category of Turf Reinforcement Mat as shown on Drawings and in accordance with the “Standard Specification” section 3885.

2.03 SEDIMENT CONTROL LOG

A. Wood Fiber Log in accordance with the “Standard Specification” Section 3897.2.A.

PART 3 – EXECUTION

3.01 USAGE

A. Silt fence where shown on NPDES Construction Permit Application, as required in project SWPPP, and as shown on Drawings.

B. Erosion Control Blanket: On the final cover as shown on drawings

3.02 SILT FENCE INSTALLATION

A. Erosion control measures to be installed prior to Site disturbance.

B. Silt fence shall be trenched in with a minimum of six inches of fabric buried.

C. Silt fence to be installed using the static slicing method or approved equivalent installation method.

D. CONTRACTOR shall be responsible for maintenance and repair of silt fence until final acceptance of the Project.

3.03 REMOVAL OF SILT FENCE

A. CONTRACTOR shall remove and dispose of silt fence after completion of Project and the establishment of vegetation and all conditions of NPDES permit have been met.

3.04 EROSION CONTROL BLANKET and EROSION STABILIZATION MAT

A. Place in accordance with Manufacturer's recommendations.
B. At a minimum, anchor upstream edges of all materials at least 4 inches into the soil to prevent underflow. Hand rake topsoil as necessary to prevent a ridge or depression along upstream edge
C. Shingle materials downslope.
D. Overlaps shall be as follows:
   1. End lap – 24 inches minimum.
   2. Edges – 4 inches minimum.
E. Staple sizes and spacing to be in accordance with "Standard Specification" Section 3885.

3.05 SEDIMENT CONTROL LOG

A. Place in accordance with Manufacturer's recommendations.

B. Wood Stakes to be in accordance with "Standard Specification" Section 3897.2.B(6).

END OF SECTION

SECTION 02486

TURF RESTORATION

PART 1 - GENERAL

1.01 SUMMARY

A. This section contains requirements for topsoil, seeding, fertilizing, and mulching.

B. Seed all areas disturbed by construction activities at the Sites.

1.02 REFERENCES

A. Standard Specifications are defined as the "Standard Specifications for Construction", State of Minnesota Department of Transportation, 2014 Edition with latest supplements.

1.03 SUBMITTALS

A. Test Results:

1. Suppliers analysis for standard products and seed composition.

B. Submit in accordance with Section 01300.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Delivery:

1. Deliver fertilizer to Site in original, unopened containers bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark, and conformance to state law.
2. Deliver seed to Site in unopened, original bags bearing supplier's name and address, type of seed contained, percentage of purity and germination.
3. Fertilizer and seed delivered to Site shall be stored in a waterproof location as directed by OWNER.
4. Locate mulch on Site where indicated by OWNER.

1.05 GUARANTEE

A. Guarantee seeded area for duration of one year after seeding to be alive and in satisfactory growth at end of guarantee period.

1. For purpose of establishing acceptable standard, scattered bare spots, none larger than 1 square foot will be allowed up to maximum of 3 percent of seeded area.

2. Acceptance will be based upon meeting this standard one year after initial seeding or reseeding.

PART 2 - PRODUCTS

2.01 TOPSOIL

A. The CONTRACTOR shall use salvaged topsoil from on-site excavation activities for restoration. Additional topsoil (if required) shall be supplied by CONTRACTOR. The CONTRACTOR is responsible for selecting material for use that conforms to these Technical Specifications.

B. Friable soil; Horizon B soils, suitable soil used as a medium for establishing and sustaining healthy plant growth.

C. Imported Topsoil: Imported topsoil, if required shall be in conformance with the "Standard Specifications" section 3877.2.A

2.02 FERTILIZER

A. Contractor shall collect topsoil samples for analysis to determine the appropriate fertilizer recommendations. Contractor shall submit results with fertilizer recommendations to OWNER.

B. Contain minimum percentage by weight of:
   1. Prior to Seeding (6-24-24):
      Nitrogen
      Phosphorus
      Potash
   2. After Seeding (18-5-9):
      Nitrogen
      Phosphorus
      Potash

2.03 GRASS SEED

A. General

1. Local nursery grown seed sources in the specified seed mix.
2. Weeds shall not exceed 0.25%.
3. Comply with current U.S. Department of Agriculture rules and regulations.
4. Mix grass seeds in proportions by weight to meet or exceed minimum percentages of purity and germination as required in Standard Specification Section 3876.D.1 for Seed Mix 3 25-131. Include cover crop according to Standard Specification 3876.D.1 Mix 21-111 or 21-112. Apply at the rates specified therein.

2.04 WATER

A. CONTRACTOR shall be responsible for water.

2.05 MULCH

A. Type 1 or Type 5 per Standard Specifications Section 3882.

PART 3 - EXECUTION

3.01 SITE PREPARATION FOR SEEDING

A. Topsoil

1. Scarify subgrade to depth of 3 inches for bonding of subsoil with topsoil.
2. No topsoil shall be placed or worked in frozen or muddy condition.
3. Prepare areas to be seeded to required depth of approximately 3 inches by disking, rototilling, harrowing or other approved means.
4. Remove and dispose of rock, trash, or other materials brought to surface from preparation activities.

3.02 TOPSOIL/FINISH GRADING

A. Topsoil/Finish grade is established final grade as shown on the Drawings. Grades not otherwise indicated are uniform levels or slopes between points where elevations are given or between such points and existing finished grades. Finish grade shall be approved by the ENGINEER prior to seeding.

B. Grade, rake, and roll with roller weighing not more than 100 lbs./lf and not less than 25 lbs./lf.

3.03 APPLYING FERTILIZER

A. Apply fertilizer uniformly over the designated area using mechanical spreading devices. Mix thoroughly with disk into upper 2 inches of soil.

B. Apply at a rate shown in Section 2.02.A.

C. Apply fertilizer no more than 48 hours prior to seeding.

3.04 SEEDING

A. Do not seed on saturated or frozen soil.

B. Do not seed when wind velocity exceeds 6 mph.

C. Seed all areas disturbed by construction.

D. The grass seed shall be drilled horizontally across the slope.

3.05 MULCHING

A. Mulch seeded areas within 3 days after seeding is complete.

B. Application rate shall be 2 tons per acre or no more than 1 inch in depth.

C. Mulch shall be spread uniformly in a continuous blanket. Mulch shall be started on the windward side of relatively flat area or on the upper part of a steep slope and continued uniformly until area is covered. The mulch shall not be bunched.

D. Do not mulch during periods of excessively high winds.

E. Immediately following the spreading of the mulch, the material shall be anchored securely into the soil a minimum of 3-inches by means of a mulch anchoring machine equipped with large coulter-type discs spaced on approximate 8-inch centers. All anchoring shall be at right angles to slope. Edges of the discs shall be dull to prevent cutting of the mulching and equipment operation shall be such as to embed the mulch to the required depth. In areas where equipment cannot be used, mulch shall be secured by shallow covering of earth or by embedding with approved hand methods, including straight-bladed spade with dull edge.

3.06 CLEANUP

A. Paved surface and other site areas shall be kept clean of seeding, fertilizing, and mulching materials.

B. Clean up shall occur at the end of each work day or as required by OWNER. Pavement shall be swept with a street sweeper as directed by ENGINEER throughout the project.

C. Restore existing utilities, surface features, and structures to condition equal to condition, which existed prior to construction.

D. Replace to original condition or better, damaged vegetation or landscape work.

3.07 MAINTENANCE OF SEEDED AREA

A. Maintenance of seeded areas shall begin immediately following last seeding application. Continue until Work is accepted.

B. Maintain seeded area by watering, mowing, and replanting as necessary to produce uniform stand of grass until Work is accepted.

C. Rework/replace topsoil where original topsoil has eroded or washed away as directed by ENGINEER.

D. Re-mulch any areas where the original mulch has washed away as directed by the ENGINEER.

E. Implement erosion control measures as required to keep area free of rutted and eroded soils.

3.08 ACCEPTANCE OF SEEDED AREAS

A. CONTRACTOR shall notify OWNER in writing 7 days prior to inspecting seeded area for acceptance.

B. CONTRACTOR and OWNER shall inspect seeded areas for contract compliance and acceptance of work. Upon completion of inspecting seeded areas, OWNER shall provide written acceptance or rejection to CONTRACTOR with further requirement for completing the seeding work. Seeding work remaining to be completed shall be re-inspected by OWNER before final acceptance.

3.09 FIELD QUALITY CONTROL

A. Topsoil layer shall be graded to the minimum thicknesses as shown on Drawings and specified in the Construction Quality Assurance Manual.

END OF SECTION

SECTION 02511

AGGREGATE ROAD SURFACING

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes the furnishing and installation of aggregate road surfacing to construct access roads or as required to repair damage to existing unpaved roads as shown on the Drawings.

1.02 SUBMITTALS

A. CONTRACTOR to provide at least one sample and gradation report for each source of material prior to material being brought on-site.

B. Provide haul route to the Site prior to any materials being hauled.

1.03 PRODUCT DELIVERY, SEQUENCING, AND SCHEDULING

A. Include road restoration construction activities in the Project schedule.

PART 2 - PRODUCTS

2.01 AGGREGATE

A. The CONTRACTOR is responsible for providing aggregate road surfacing that conforms to the Technical Specifications.

B. Material: Class 5, as specified in "Standard Specifications" Section 3138.

C. Remove oversize material encountered in deposits from which material is taken by screening or crushing to required sizes.

D. Composite material shall be substantially free from shale and lumps or balls of clay and shall conform to pertinent gradation requirements.

PART 3 - EXECUTION

3.01 GENERAL

A. Construct to original width of road as shown on the Drawings, in 6-inch lift thickness as indicated on the Drawings.

B. Place materials when surface is dry and atmospheric temperature is above 40 degrees F.

3.02 SUBGRADE

A. Prepare subgrade in conformance with Section 02207.

B. Provide water, if required, for compaction.

C. Install reinforcement geotextile in accordance with Section 02921, where required.

3.03 ROAD SURFACING

A. Construct road surfacing in accordance with "Standard Specifications" Section 2211.3.

END OF SECTION

SECTION 02610

HIGH DENSITY POLYETHYLENE PIPE

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes groundwater collection and leachate collection.

B. This section applies to cell construction project.

C. Extent of pipe and fittings required by this section indicated on Drawings.

1.02 REFERENCES

A. American Water Works Association (AWWA).

B. American Society for Testing and Materials (ASTM):

1. ASTM D638 – Standard Test Method for Tensile Properties of Plastics.
2. ASTM D790 – Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
3. ASTM D1238 – Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
4. ASTM D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
5. ASTM D1505) – Standard Test Method for Density of Plastics by the Density-Gradient Technique
6. ASTM D1693 – Standard Test Method for Environmental Stress Cracking of Ethylene Plastics.
7. ASTM D2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
8. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Material.
9. ASTM D2122 - Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings.
10. ASTM D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
11. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
12. ASTM F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter

1.03 SUBMITTALS

A. Manufacturer's certificates indicating conformance test results of furnished material to Technical Specifications.

B. Provide information where applicable as follows:

1. Manufacturer's name.
2. Nominal pipe size.
3. High density polyethylene (HDPE) classification, ASTM D3350.
4. Use for each type and size of pipe.
5. Extrusion date.
6. Lot number.

C. Stock density, melt flow, flexural modulus tensile strength, coloration, resin type and cell classification where applicable.

D. Provide instructions on special handling during transportation and storage.

E. Aforementioned submittals provided to OWNER a minimum of 30 days prior to beginning Work.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Handle and protect product to ensure product is not damaged.

B. Elevate material above grade.

C. Store and handle in such a manner as to prevent soil from entering or becoming lodged in the pipe.

D. Provide protection for flanges and fittings by storing inside or packaging with impermeable opaque material.

PART 2 - PRODUCTS

A. Physical Properties - Dimensions as shown on Drawings.

Density	ASTM D1505	not less than 0.941 – 0.955 g/cm^3
Melt Flow	ASTM D1238 – Condition E	not greater than 0.4 gm/10 min
Flexural Modulus	ASTM D790	110,000 to less than 160,000 psi.
Tensile Strength at Yield	ASTM D638	3,000 to less than 3,500 psi
Environmental Stress Crack Resistance	ASTM D1693 - Condition C	shall be in excess of 1,000 hrs (5,000 hrs) with zero failures
Hydrostatic Design Basis	ASTM D2837	1,600 psi at 230C

B. Pipe

1. Acceptable Manufacturers:
   a. Phillips Driscopipe, Inc., Dallas, Texas.
   b. Poly Pipe Industries, Gainesville, Texas.
   c. Or approved equal.
2. High performance, high molecular weight, high density polyethylene pipe.
3. Material designation PPI-PE 3408.
4. ASTM D3350, minimum cell classification value 345444C.
5. Marking: Intervals of 5 feet or less.
   a. Manufacturer's name or trademark.
   b. Nominal pipe size.
   c. HDPE cell classification, ASTM D3350.
   d. Legend: Industrial pipe SDR 11, SDR 17, or SDR 26 as indicated on Drawings.
   e. ASTM F714.
   f. Extrusion date, period of manufacture or lot number.
6. Perforated pipe to be pre-drilled prior to delivery to site.
   a. Pattern as shown on Drawings.

C. Fittings

1. Molded from polyethylene compound having cell classification equal or exceeding compound used in pipe to insure compatibility of resins.
2. Be of same manufacture as pipe.
3. Fusion weld joints.
4. Markings:
   a. Manufacturer's name or trademark.
   b. Nominal size.
   c. Material designation "HDPE".
   d. ASTM D3261.

PART 3 - EXECUTION

3.01 EXECUTION

A. Examine and verify acceptability of surface to receive product.

3.02 HDPE PIPE INSTALLATION

A. Location, lines, and grades as shown on Drawings.

B. Welded joints.

1. Weld in accordance with manufacturer's recommendations for butt fusion methods.

2. Butt fusion equipment used in joining procedures capable of meeting conditions recommended by manufacturer, including, but not limited to: temperature required, alignment, and fusion pressures.

C. No defective pipe shall be installed. Defective pipe shall be removed from Site and replaced at CONTRACTOR'S expense.

D. Install coarse aggregate, geotextile and granular bedding as shown on Drawings and without damage to the geomembrane liner or geonet geocomposite.

E. Perforations:
1. Perforate pipe in pattern shown on Drawings.
2. Flush pipe prior to placement.

3.03 EXCAVATION AND PREPARATION OF SUBGRADE

A. Excavate and prepare subgrade as specified in Section 02211 and Section 02220 and as shown on Drawings.

3.04 BACKFILL

A. Backfill with required pipe bedding and cover material to spring line of incoming pipe as shown on Drawings.

3.05 FIELD QUALITY CONTROL

A. Pipe may be rejected for failure to conform to specification:

1. Fractures or cracks passing through pipe wall, except single crack not exceeding 2 inches in length at either end of pipe which could be cut off and discarded. Pipes within one shipment will be rejected if defects exist in more than 5 percent of shipment or delivery.
2. Cracks sufficient to impair strength, durability or serviceability of pipe.
3. Defects indicating improper proportioning, mixing, and molding.
4. Damaged ends, where damage would prevent making satisfactory joint.
5. Noticeable variations from true alignment and grade sufficient cause for rejection of Work.

B. Acceptance of fittings, stubs or other specially fabricated pipe sections based on visual inspection at Site and documentation that they conform to these Technical Specifications.

END OF SECTION

SECTION 02611

PVC PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes all buried PVC piping and fittings as indicated on the Drawings.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D1505- Test Method for Density of Plastics by the Density-Gradient Technique.
2. ASTM D1784 – Standard Specifications for Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds.
3. ASTM D1785 – Standard Specifications for Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
4. ASTM D2837- Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
5. ASTM D2122 - Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
6. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
7. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
8. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
9. ASTM D2564 - Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
10. ASTM D2855 – Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly Vinyl Chloride (PVC) or Chlorinated Poly Vinyl Chloride (CPVC) Pipe and Piping Components with Tapered Sockets.
11. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

1.03 SUBMITTALS

A. Submit in accordance with Section 01300 – Submittals.

B. Submit shop drawings including layout, materials, and dimensions for: piping connections; controls; environmental Class and Division rating; and other pertinent data not specifically mentioned here.

C. Manufacturer's certificates indicating conformance test results of furnished material to Specifications.

D. Provide information where applicable as follows:

1. Manufacturer's name.
2. Nominal pipe size.
3. Poly vinyl chloride (PVC) pipe classification.
4. Use for each type and size of pipe.
5. Extrusion date.
6. Lot number.

E. Stock density, melt flow, flexural modulus tensile strength, coloration, resin type and cell classification where applicable.

F. Provide instructions on special handling during transportation and storage.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Handle and protect product to ensure product is not damaged.

B. Pipe shall be tarped during transportation and storage.

C. Provide protection for flanges and fittings by storing inside or packaging with impermeable opaque material.

PART 2 - PRODUCTS

2.01 PVC

A. Resin

1. Shall meet the requirements set forth in ASTM D1784.

B. Pipe

1. Polyvinyl Chloride Pipe (PVC) for Sanitary Sewer
   a. PVC shall conform to the requirements of ASTM D3034.
   b. Diameters and wall thickness (SDR) as shown on Drawings.
   c. Pipes shall be equipped with push-on connections using elastomeric gasketed joints that are bonded to the inner wall of the gasket recess of the bell socket.
2. Markings: Intervals of 5 feet or less
   a. Manufacturer's name or trademark.
   b. Nominal pipe size.
   c. ASTM Designation.
   d. Legend: SDR or Schedule as indicated on Drawings.
   e. PVC cell classification.

C. Fittings

1. Molded from compound having cell classification equal or exceeding compound used in pipe to insure compatibility of resins.
2. Be of same manufacture as pipe.
3. Markings:
   a. Manufacturer's name or trademark.
   b. Nominal size.
   c. Material designation “PVC”.

2.02 BEDDING AND BACKFILL

A. Bedding and cover materials shall conform to Section 02208.

B. Backfill materials shall conform to Section 02220.

PART 3 - EXECUTION

3.01 PVC PIPE INSTALLATION

A. Examine and verify acceptability of surface to receive product.

B. Locations, lines, and grades as shown on Drawings.

C. Install as defined in ASTM D2321.

D. Joints.

1. Join pipes in accordance with manufacturer’s recommendations.
2. All joints shall be watertight.
3. For elastomeric gasketed joints, coat rubber gasket and joint with lubricant immediately prior to closing joint.

E. No defective pipe installed. Defective pipe removed from site and replaced at CONTRACTOR'S expense.

3.02 EXCAVATION AND PREPARATION OF SUBGRADE

A. Excavate and prepare subgrade as specified in Section 02220, and as shown on Drawings.

B. Install granular bedding and cover material as specified in Section 02208 and as shown on Drawings.

3.03 BACKFILL

A. Above the granular bedding material, backfill as specified in Section 02220.

3.04 FIELD QUALITY CONTROL

A. Pipe may be rejected for failure to conform to specification, or:

1. Fractures or cracks passing through pipe wall, except single crack not exceeding 2 inches in length at either end of pipe which could be cut off and discarded. Pipes within one shipment will be rejected if defects exist in more than 5 percent of shipment or delivery.
2. Cracks sufficient to impair strength, durability or serviceability of pipe.
3. Defects indicating improper proportioning, mixing, and molding.
4. Damaged ends, where damage would prevent making satisfactory joint.
5. Noticeable variations from true alignment and grade will be sufficient cause for rejection of Work.

B. Acceptance of fittings, stubs or other specially fabricated pipe sections based on visual inspection at site and documentation that they conform to these specifications.

END OF SECTION

SECTION 02623

PERFORATED AND NON-PERFORATED DRAIN PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish and install perforated and non-perforated corrugated polyethylene pipe (CPEP) and appurtenances as shown on the Drawings.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO).

1. AASHTO M252 – Standard Specification for Corrugated Polyethylene Drainage Pipe.

B. American Society for Testing and Materials (ASTM)

1. ASTM F667 – Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings.

1.03 SEQUENCING AND SCHEDULING

A. Include piping activities in the Project schedule.

1.04 SUBMITTALS

A. The CONTRACTOR shall submit to the OWNER the manufacturer's literature that describes the physical characteristics of the pipe provided, the recommended installation procedures, and allowable pipe bend radius.

PART 2 - PRODUCTS

2.01 CORRUGATED POLYETHYLENE PIPE, DRAINAGE TUBING (CPEP), AND FITTINGS

A. CPEP and fittings shall meet the requirements of ASTM F667 or AASHTO M252. The pipe shall meet the dimensional requirements indicated on the Drawings and be manufactured by Prinsco, ADS, Hancor, or other approved manufacturer.

B. CPEP used for surface water control (culverts or piping) shall be of double-wall construction with a smooth inner bore, and shall have watertight gasketed joints.

C. All CPEP used for surface water control (culverts) shall have flared end sections, both ends.

D. Perforated pipe shall be factory perforated with a minimum inlet area of 1 square inch/ft.

E. Fittings shall be from the same manufacturer as the pipe.

PART 3 - EXECUTION

3.01 CPEP AND FITTINGS

A. Install perforated and non-perforated CPEP of the size and in the locations and to the elevations and grades shown on the Drawings.

B. Do not install pipe with bends of smaller radius than the minimum recommended by the manufacturer.

3.02 FILL PLACEMENT AROUND PIPES

A. CONTRACTOR shall mechanically tamp bedding material around the piping in lifts.

B. The CONTRACTOR shall notify Engineer before placing fill around pipes.

C. Do not use frozen fill material or place on frozen subgrade.

D. Pipe installed outside the boundaries of the geomembrane:

1. Install bedding and cover soils making sure pipe haunches are properly shaped.

3.03 FIELD QUALITY CONTROL

A. Pipe and pipe installation will be subject to rejection for any of the following reasons:

1. Failure to conform to the Technical Specifications, particularly compaction under and around the pipe.
2. Fractures or cracks passing through pipe wall or socket.
3. Cracks, which in the opinion of the Engineer, may impair strength, durability, or serviceability of pipe.
4. Defects indicating improper proportioning, mixing, or molding.
5. Damaged ends where such damage would prevent making a satisfactory joint.

B. Survey Requirements:

1. CONTRACTOR to provide survey documentation of all inverts and alignments of piping and in accordance with Section 01050.

END OF SECTION

SECTION 02920

HIGH DENSITY POLYETHYLENE GEOMEMBRANE (HDPE)

PART 1 - GENERAL

1.01 SUMMARY

A. Work includes manufacture, fabrication (if needed), supply, and installation of textured High Density Polyethylene (HDPE) geomembrane liner system. Textured geomembrane shall have a smooth edge for seaming.

B. Performing on-site quality control testing for geomembrane installation and providing daily quality control documentation to OWNER or ENGINEER.

C. Union requirements for geomembrane installation personnel.

1.02 DEFINITIONS/REFERENCES

A. American Society for Testing and Materials (ASTM) Standards specifically referenced in this Section:

1. ASTM D6693 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
2. ASTM D751 Standard Test Methods for Coated Fabrics
3. ASTM D792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
4. ASTM D1004 Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
5. ASTM D1238 Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
6. ASTM D1505 Standard Test Method for Density of Plastics by the Density Gradient Technique.
7. ASTM D1603 Standard Test Method for Carbon Black Content in Olefin Plastics.
8. ASTM D3895 Standard Test Method for Oxidative Induction Time of Polyolefins by Differential Scanning Calorimetry.
9. ASTM D4218 Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
10. ASTM D4437 Standard Practice for Non-destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes.
11. ASTM D4833 Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
12. ASTM D5199 Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
13. ASTM D5397 Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
14. ASTM D5596 Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.

15. ASTM D5641 Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
16. ASTM D5721 Standard Practice for Air-Oven Aging of Polyolefin Geomembranes.
17. ASTM D5885 Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry.
18. ASTM D5994 Standard Test Method for Measuring Core Thickness of Textured Geomembranes.
19. ASTM D6365 Standard Practice for the Nondestructive Testing of Geomembrane Seams using the Spark Test.
20. ASTM D6747 Standard Guide for Selection of Techniques for Electrical Leak Location of Leaks in Geomembrane
21. ASTM D6392 Standard Test Method for Determining the Integrity of Non-reinforced Geomembrane Seams Produced Using Thermo-fusion Methods
22. ASTM D7002 Standard Practice for Electrical Leak Location on Exposed Geomembranes Using the Water Puddle Method
23. ASTM D7007 Standard Practices for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earthen Materials
24. ASTM D7238 Standard Test Method for Effect of Exposure of Un-reinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus
25. ASTM D7466 Standard Test Method for Measuring the Asperity Height of Textured Geomembrane s
26. ASTM D3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

B. Geosynthetic Research Institute (GRI) Standards:

1. GRI GM 6: Pressurized Air Channel Test for Dual Seamed Geomembranes
2. GRI GM 9: Cold Weather Seaming of Geomembranes
3. GRI GM10: The Stress Crack Resistance of HDPE Geomembrane Sheet.
4. GRI GM13: Test Methods, Properties and Testing Frequency for HDPE Smooth and Textured Geomembranes.
5. GRI GM 14: Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes
6. GRI GM 19: Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes

C. U.S. Environmental Protection Agency Technical Guidance Document “Quality Assurance and Quality Control for Waste Containment Facilities,” EPA/600/R-93/182, September 1993, 305 pgs.

1.03 SUBMITTALS

A. The following submittals shall be provided to and approved by OWNER prior to delivery of geomembrane to the Site or mobilization of the CONTRACTOR’S geomembrane crew or equipment:

1. CONTRACTOR shall supply information from the resin manufacturer regarding the resin type, properties as specified herein, and production dates of the resin used for this project. The resin type identification shall include the cell classification of the resin in accordance with the requirements of the latest ASTM Designation D3350.

2. CONTRACTOR shall submit from the geomembrane sheet manufacturer, test methods and results defining physical properties as specified herein, of the geomembrane to be used for this project. Test results shall be submitted for all geomembrane furnished for the project at the frequencies as specified in the GRI Standards. Tests results shall be reported with the corresponding roll identification numbers to those rolls delivered to the site.
3. CONTRACTOR shall supply a statement of the geomembrane manufacturer's quality control procedures, identification of any resin admixtures, frequency of sampling, methods of material transportation and storage, and acceptance criteria for roll goods delivered to the site.
4. CONTRACTOR shall provide submittals describing the geomembrane sheet manufacturer's details of any factory seaming process proposed. Roll test results which may not be available prior to construction (i.e., environmental stress crack) shall be presented as preliminary prior to construction, with final test results submitted or affected rolls within the construction time frame.
5. CONTRACTOR shall submit from the extrudate weld rod manufacturer, verification that the weld rod was manufactured using the same resin as was used in the geomembrane sheets prior to using material.
6. CONTRACTOR shall submit a proposed panel and seam layout diagram specifying the type and location of all field and factory seams. The layout diagram shall be to scale and used as a construction Plan and shall include all necessary dimensions and details. The layout diagram shall be compatible with the panel and seam layout requirements specified in this Section.
7. CONTRACTOR shall submit an installation schedule.
8. CONTRACTOR shall submit a list of personnel performing field supervision, and quality control, along with experience records and resumes.
9. CONTRACTOR shall submit a list of equipment types proposed to be used in panel layout, membrane seaming, and destructive and nondestructive testing, and calibration verification.

B. The CONTRACTOR shall remit the following during geomembrane Installation:

1. CONTRACTOR shall, at the end of each working day provide a detailed report of work completed that day, including:
   a) Panel Placement
   b) Trial Welds Results
   c) Subgrade Acceptance Form
   d) Seams
   e) Seam Testing (air and vacuum tests)
   f) Destructive Tests
   g) Repair Log

2. OWNER shall review with the CONTRACTOR and sign the above report at the end of each day. OWNER shall be provided with a copy not more than 24 hours from the date of the report.

C. CONTRACTOR shall update their liner layout drawings on a daily basis. The drawings shall include all panel locations and numbering, seam locations and numbering, and test locations and numbering. The CONTRACTOR shall maintain a current liner layout drawing on the

construction Site at all times. At the request of OWNER a copy of the current liner layout drawing will be submitted with 24 hours.

D. CONTRACTOR shall submit final as-built liner layout drawing(s) to OWNER within 14 calendar days of completion of the liner work. Drawings shall be submitted in paper and digital form. The as-built liner layout drawing shall be prepared based on GPS survey of the panel seams.

E. Quality control certificates indicating resin type, properties as specified herein, and production dates shall be provided with each shipment of extrudate rods delivered to the Site no later than the time of delivery.

F. Prior to the installation of any geomembrane, the CONTRACTOR shall submit CONTRACTOR'S certification in writing that the surface upon which the geomembrane is to be installed is acceptable (complete form contained at end of this Section).

G. The Contractor shall satisfy all union labor requirements with the appropriate union hall prior to beginning placement of the geomembrane and submit union agreement documentation to OWNER.

1.04 EXPERIENCE

A. The geomembrane installation shall be performed under the direct supervision of a single field supervisor who must remain on-site throughout installation, including inspection of the surface upon which the geomembrane is to be installed, geomembrane handling and storage, panel layout and placement, seaming, seam testing, panel and seam repair, installation of appurtenances, anchorage and other geomembrane-related work. The field supervisor shall have a personal HDPE or geomembrane installation record totaling at least 1 million square feet.

B. The geomembrane manufacturer shall have at least 5 years continuous experience in manufacturing smooth and textured polyethylene geomembrane rolls and/or a manufacturing record totaling not less than 5 million square feet of polyethylene geomembrane. The manufacturer shall have produced polyethylene geomembrane for at least 10 completed facilities similar in scope to this Project.

C. The CONTRACTOR shall have at least 5 years continuous experience in the installation of polyethylene geomembranes and an installation record totaling at least 5 million square feet. CONTRACTOR shall have installed polyethylene geomembrane for at least 10 completed sites similar in scope to this Project.

D. Field seaming of geomembrane panels shall be performed under the direction of a seaming supervisor who may or may not be the same person as the field supervisor. The seaming supervisor shall have a personal polyethylene geomembrane installation record totaling at least 1 million square feet with the mil-thicknesses and using the seaming methods proposed for this Project.

E. The designated quality control technician shall have a personal polyethylene geomembrane installation record totaling at least 1 million square feet with the mil-thicknesses and using the

seaming methods proposed for this Project. The quality control technician shall be responsible for providing the daily installation documentation identified in this section.

F. The geomembrane manufacturer and any geomembrane installer subcontractors to the CONTRACTOR must be approved by OWNER prior to mobilization for geomembrane installation. OWNER has the right to reject any geomembrane manufacturer or Installer, and request that Contractor select an alternate.

1.05 Pre-Installation Meeting

A. Representatives of the CONTRACTOR and any geomembrane subcontractors shall attend a meeting prior to installation of the geomembrane to discuss details of the proposed design, installation, quality control documentation requirements and schedule.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Raw Materials:

1. Textured HDPE geomembrane, and extrudate rods used for this project shall be manufactured of new, first quality resins, designed specifically for use in flexible membrane liner installations.
2. HDPE resin used in manufacturing geomembranes used for this Project shall meet requirements set forth in the latest revision of the Geosynthetics Research Institute (GRI) for HDPE (GRI GM 13).
3. Recycled Polymer shall not be added to the resin. However, the resin may contain polymer reclaimed during the manufacturing process if reclaimed polymer content does not exceed 10 percent by weight.

B. Geomembrane Roll Goods:

1. HDPE geomembrane sheets used for this project shall meet the requirements set forth in the latest revision of the Geosynthetics Research Institute (GRI) for HDPE, both smooth and textured (GRI GM 13).
2. The geomembranes shall consist of unreinforced high density polyethylene containing at a maximum 3 percent by weight additives, fillers, or extenders.
3. The geomembranes shall be free of holes, blisters, striations, undispersed raw material, and contamination by foreign matter.
4. The geomembranes shall be supplied as a continuous sheet with no factory seams in rolls. Each roll shall be identified and labeled with the thickness of the geomembrane, length and width, manufacturer, lot number, and roll identification number. This identification number shall be used to identify roll location on the panel layout record drawing.

C. Extrudate: Resin used in the polyethylene extrudate shall be the same as that used to manufacture the geomembrane sheets. Extrudate rods are to be delivered in original

containers with the manufacturer's labeling. Extrudate rods shall be free of dirt, grease, moisture, other contaminants, and shall be free of damage.

D. Neoprene Foam: Closed cell, weatherproof, black neoprene foam with adhesive backing suitable for long-term sun and liquid exposure. Dimensions shall be as specified on the DRAWINGS.

E. Clamped Boots: Boots required to seal the HDPE geomembrane to the structures passing through it shall be made of the same materials as the geomembrane. The boots shall be fabricated so that all field assembly, welding, and seam testing can be accomplished using equipment and procedures regularly employed in the field for equipment and HDPE geomembrane installation. Smooth geomembrane shall be used in all geomembrane boots.

F. Banding Straps: Type 302 stainless steel banding straps suitable for use on the pipe diameters shown on the DRAWINGS. Banding strap dimensions shall be as specified on the DRAWINGS. All surfaces of the banding straps shall be machined smooth to prevent tearing or puncturing of the HDPE pipe boots. Outer lip of boot shall be sealed with silicone sealant as shown on Drawings.

2.02 EQUIPMENT

A. Extruding equipment shall be equipped with a temperature gauge at the barrel and nozzle.

B. Fusion equipment shall be equipped with a temperature gauge capable of continuous monitoring.

C. Provide digital or dial continuous temperature recording instruments, in satisfactory working condition, with each welding unit. Welding equipment shall not be operated without functioning temperature recording instruments for measuring geomembrane sheet temperature.

D. A coupon cutter and a calibrated tensiometer shall be provided for in-field seaming pre-qualification testing and destructive sample testing.

E. Store, transport, and operate all equipment to avoid damage to geomembranes.

F. Glass top of each vacuum box must be clear and free of scratches for easy reading of pressure gauge. The sealing gasket shall be intact and functioning to form close seals during testing.

G. OWNER reserves the right to order the CONTRACTOR to remove any equipment that in OWNER'S opinion is not satisfactory. The CONTRACTOR will remove the equipment promptly from the construction site and replace the unsatisfactory equipment with suitable equipment within 24 hours.

PART 3 - EXECUTION

3.01 SUBGRADE INSPECTION

A. CONTRACTOR shall certify in writing that the surface upon which the geomembrane is to be installed is acceptable (acceptance form contained at end of this Section).

B. CONTRACTOR shall provide daily written acceptance for the surface to be covered by the geomembrane in that day's operations. The surface shall be maintained in a manner during geomembrane installation to ensure subgrade suitability.

C. After subsurface has been accepted by ENGINEER, it shall be CONTRACTOR'S responsibility to indicate to ENGINEER any change in subsurface conditions that may require repair work and perform required repair work. Damage to subsurface caused by work involved in installing geomembrane shall be repaired at CONTRACTOR'S expense. Geomembrane placement over damaged subsurface, as determined by OWNER or ENGINEER, is not acceptable. Nothing will waive CONTRACTOR'S contractual requirements with respect to warranty on installed system.

3.02 CREST ANCHORAGE SYSTEM

A. Backfilling of Anchor Trench:

1. Backfill and compaction of anchor trench shall be performed by the CONTRACTOR.
2. CONTRACTOR shall monitor the backfilling of anchor trench to ensure proper method is employed. Any damage noticed shall be reported to OWNER.

3.03 HANDLING, TRANSPORTATION, AND STORAGE

A. Geomembrane rolls shall be packaged and labeled prior to transporting to the site. Geomembrane rolls delivered to the site shall be wrapped in a relatively impermeable and opaque protective cover, which may consist of a sacrificial wrap of geomembrane. The sacrificial wrap shall be removed prior to geomembrane installation.

B. Geomembrane transportation shall be in a manner that minimizes the possibility of material damage during shipment. When offloading geomembrane from the truck, straps and a spanbar shall be used. Direct contact with forklifts or front end loaders to offload the material will not be allowed without written consent from OWNER.

C. On-site storage of the geomembrane rolls shall be in a safe manner, with rolls protected from grease, dirt, moisture, excessive heat, direct sunlight, vehicle traffic, and other possible sources of damage including theft and vandalism. The rolls will be placed in neat order and placed such that identification tags for each roll can be read. Storage areas shall be at the OWNER'S designated location.

D. Geomembrane and appurtenant materials delivered to the site shall be checked for proper labeling and visually inspected for transport or manufacturing damage. OWNER

reserves the right to reject any unacceptable material at no cost to OWNER. Any roll that arrives on Site without factory roll identification will not be used for the work and will be removed from the Site promptly.

E. Only that quantity of geomembrane that is to be placed on a particular day shall be removed from the packaging. Geomembrane rolls shall be transported from the storage area to the construction area and deployed using wide lifting straps and properly sized forklifts, front-end loaders, or other appropriate equipment.

F. Under no circumstances shall any heavy equipment be allowed directly on the geomembranes unless approved by OWNER.

G. Prior to placement, the geomembranes shall be visually inspected for compliance with this Section. Geomembrane material, which in the opinion of the OWNER, is damaged or does not meet the Technical Specifications will be rejected by the OWNER. Minor damage may be repaired as specified in this Section. Damage to geomembranes caused by CONTRACTOR during handling shall be repaired or replaced at CONTRACTOR'S expense.

3.04 PANEL LAYOUT AND PLACEMENT

A. Panel and Seam Layout Diagram:

1. Prepare panel and seam layout diagram so that panel seams run parallel to the direction of maximum slope (i.e., down the slope).
2. All slopes steeper than or equal to 10H:1V shall use geomembrane textured on both sides, unless specifically identified otherwise on the DRAWINGS. Textured geomembrane may be used in the leachate collection trench. A single panel should run along the entire length of each trench and be centered about the trench centerline, minimizing seaming and/or repairs within the trench unless required by site geometry and approved by OWNER.
3. The textured slope panels shall extend past top or bottom grade-break lines as shown on the DRAWINGS no less than ten feet.
4. On slopes steeper than 4H:1V, cross seams will not be allowed. There must be one continuous panel placed from the anchor trench to 5 feet past the toe of slope.
5. Slope panels shall not be constructed from more than two pieces of geomembrane (i.e., not more than one cross-seam shall be permitted on any one slope panel).
6. Cross seams in slope panels, where allowed, shall be oriented at 45^{o}. Cross seams shall be located on at least the bottom half of the slope, wherever possible.
7. Cross seams in adjacent panels shall be staggered.
8. Assign identification number to each seam for reference to test results and record Drawings.
9. Seams shall not be located at low points in the subgrade unless required by site geometry and approved by OWNER.

B. PANEL PLACEMENT:

1. Panel size and placement shall be in general accordance with the panel layout diagram submitted to OWNER as defined in this Technical Specification.
2. Geomembrane shall be anchored with sand bags or other approved methods to prevent uplift and damage by wind.
3. A panel identification number shall be assigned to each panel for reference to test results and Record Drawings. The panel identification number and geomembrane roll number shall be written on each panel by the CONTRACTOR with a grease pencil or fluorescent spray paint, immediately following deployment of the panel. CONTRACTOR shall insure panel identification is in a location as to not impact panel seaming.
4. **SMOKING DURING PLACEMENT OF PANELS IS PROHIBITED.** Wearing damaging shoes or engaging in any behavior which may damage the geomembrane is prohibited.
5. Eating, drinking, disposal of food wraps, drinking bottles and cans on top of geomembrane is not allowed.
6. Place panels with appropriate slack incorporated into geomembrane to accommodate expansion and contraction without jeopardizing the integrity of the geomembrane.
7. If CONTRACTOR plans to use ATV's or other lightweight equipment to traffic over geosynthetics as a means of panel deployment the CONTRACTOR MUST outline this in their plan of execution and obtain written consent of the OWNER.

C. OWNER and CONTRACTOR will visually inspect in-place panels prior to seaming. Any damaged panels shall be repaired, and if requested by OWNER, replaced at no additional cost to OWNER. Repairs shall be performed as specified in this Section. All damages and repairs shall be recorded on the Record Drawings.

3.05 SEAMING

A. Seaming Methods: All seams shall be joined using a heat extrusion or hot fusion (split wedge) weld process in accordance with the geomembrane manufacturer's recommendations. The CONTRACTOR shall maintain in working order at the site at least one spare seaming apparatus for each type of welder used. The hot fusion weld process will be used whenever possible. The use of extrusion welded seams shall be limited to repairs and any areas or seam configuration inaccessible to fusion welding equipment.

B. Factory and field seams shall meet the minimum specifications set forth by the latest revision of the GRI.

C. Seam Configuration and Preparation:

1. Overlap panels to be seamed at least 3 inches but not more than 6 inches. The loose end of the upper panel shall extend no more than 3 inches from the weld. All seams shall be made in a rainflap manner with the loose end of the upper panel shingled over the downgradient panel.

2. Cross seams on slopes, where allowed, shall be made at a 45 degree angle to the edge of the panel.
3. The contact area between panels shall be clean and free of moisture, dust, dirt, debris, and foreign material. A protective layer of filter fabric or a sacrificial HDPE strip shall be used directly beneath each seam overlap to achieve proper support and a clean work surface, if necessary.
4. Where extrusion welding is used, the contact surfaces between panels shall be ground to remove oxidation prior to welding. Grinding shall not result in grooving of the liner or reduction of the liner thickness by more than 10 percent. The grinding motion shall be made perpendicular to the seam. Grinding in a direction parallel to the seam shall not be permitted. All ground areas shall be covered completely with extrudate.
5. Seams shall be aligned to minimize the number and size of wrinkles.

D. Test Seam:

1. A prequalification test seam sample shall be prepared with each piece of seaming equipment/seamer approximately every four hours at the beginning of each seaming period (usually morning and afternoon), unless otherwise directed by OWNER. Each sample shall be prepared by the operator of the equipment for that seaming period and shall be at least 6 feet long (in the direction of the seam) by at least 1 foot wide and may be performed on scrap pieces of geomembrane.
2. Six 1-inch wide specimens (coupons) from each test seam sample shall be prepared for on-site field testing for shear and peel strength. For dual wedge welding equipment, both tracks shall be tested for peel. Coupons shall be prepared using a sheet cutter so that consistent, uniform 1-inch wide coupons are obtained. Samples should be distributed evenly over the 6 feet length.
3. Each specimen shall be labeled with an equipment and operator identification number, date, ambient air temperature, operating temperature, speed of seaming equipment, and field test results.
4. The CONTRACTOR will make these test seams in the presence of OWNER.
5. The extension rates for these tests will not exceed 2-inches per minute unless permission from the OWNER is given.
6. Three coupons shall be tested in shear and three in peel. All coupons shall exhibit the required strength at yield and failure mechanism FTB as set forth in *Section 3.05B*. Seam separation equal to or greater than 10% of the track width shall be considered a failing test. If any of the coupons fail, the reason for the failure shall be identified and corrected prior to preparing another test seam. The new test seam shall be prepared reflecting adjustments made to the seamer/seaming equipment and a new set of coupons shall be cut and tested.
7. The Seaming equipment/seaming personnel combination shall not be used until satisfactory prequalification test seams have been prepared and witnessed by OWNER.
8. The test results on all prequalification test seams will be reported by the CONTRACTOR and reported to OWNER.

E. Climatic Conditions for Seaming:

1. Seaming shall be performed only when panel temperatures are between 32°F and 170°F, unless otherwise approved by OWNER. If seaming is permitted to be performed at panel temperatures below 32°F, the panel contact surface shall be preheated and CONTRACTOR shall certify in writing that the low-temperature seaming procedures will not cause any short-term or long-term damage to the geomembrane or the welded seam. CONTRACTOR shall demonstrate to OWNER that field seams comply with project specifications using pre-qualification test seams. CONTRACTOR shall submit to OWNER, for approval, detailed procedures for seaming at low temperatures, including the following:
    a. Preheating of the geomembrane
    b. Provision of a tent or other device if necessary to prevent heat losses during seaming and rapid heat losses subsequent to seaming.
    c. Number of additional test welds to determine appropriate seaming parameters.
2. Seaming during rainy weather or when dew is present on panels shall not be allowed.
3. CONTRACTOR shall provide any special lighting required for seaming during low-light or dark hours.
4. CONTRACTOR shall leave slack in the geomembrane as necessary to account for thermal expansion or contraction of geomembrane. Stress on panels due to thermal expansion and contraction shall be minimized by performing field seaming operations during the coolest parts of the day or night, if necessary. Special scheduling or extended hours of operation require approval by OWNER.

F. All welding shall provide a tight, leak proof, homogeneous bond between panels. All seams shall extend to ends of panels.

G. Welding equipment shall be continuously monitored to control the temperature of extrudate and wedge. If recording equipment allows for a hard copy of the monitoring, a copy of the monitoring labeled with the weld identification number will be submitted to OWNER.

3.06 PIPE AND STRUCTURE PENETRATION SEALING SYSTEM

A. Penetration sealing systems shall be constructed from the base geomembrane material, flat stock, prefabricated boots and accessories as shown on the Drawings.

B. All penetration sealing systems must be tested. Where field non-destructive testing cannot be performed, field spark testing shall be performed using standard holiday leak detectors in accordance with ASTM 6365. Spark testing should be performed in areas where both air pressure testing and vacuum testing are not possible.

3.07 DEFECTS AND REPAIRS

A. Identification: Broom or wash geomembrane if amount of dust or mud inhibits inspection.

B. Evaluation: Non-destructively test each suspect location in seam and non-seam areas. Repair each location failing nondestructive testing.

C. Repair Procedures:

1. Repair defective seams by reconstruction.
2. Repair tears or pinholes by seaming or patching.
3. Repair blisters, larger holes, undispersed raw materials, and contamination by foreign matter with patches.
4. Surfaces of geomembrane to be patched shall be abraded no more than 1 hour prior to repair.
5. Seams used in repairing patches shall be approved extrusion welded seams and may be subjected to same destructive test procedures as outlined for other seams.
6. Patches shall be made of same geomembrane, extend minimum of 150 mm (6 in.) beyond edge of defects, and applied using approved extrusion welding methods only. Report areas of repair to OWNER immediately.
7. Wrinkles in the geomembrane shall be removed or repaired as directed by OWNER or field engineer.
   a. Wrinkles shall be repaired by cutting the geomembrane at the top edge of the wrinkle and overlapping the cut panels. The cut panels shall be repaired in accordance with Subpart 3.07 of this section.

D. SEAM RECONSTRUCTION PROCEDURES:

1. Seam reconstruction for extrusion welding process shall be achieved by installing a cap strip over the defective weld a minimum of 6 inches either side of the weld and extrusion welding.
2. Seam reconstruction for fusion process shall be achieved by cutting out existing seam and welding in replacement strip or by welding a cap strip over the defective seam length.

E. Verification of Repairs: Test each repair non-destructively. Repairs passing nondestructive test shall be taken as indication of adequate repair. Failed tests indicate repair shall be redone and retested until passing test results.

3.08 GEOMEMBRANE ACCEPTANCE

A. CONTRACTOR shall retain ownership and responsibility for geomembrane until acceptance by OWNER. Geomembrane liner will be accepted by OWNER when:

1. Written certification letter, including "as-built" drawings, is received by OWNER.
2. Installation of the geomembrane is complete.

3. All required documentation of installation is submitted to OWNER, including inspector's final report.
4. Verification of adequacy of field seams and repairs, including associated testing, and associated survey information is complete and all paperwork accepted and approved by OWNER.
5. The five-year material and one-year workmanship warranties are received.

3.09 CLEANUP

A. The CONTRACTOR shall place ALL material scraps in OWNER designated area at the end of each working day. Disposal of scraps in the anchor trenches will not be acceptable. No scraps of materials will be allowed to be left on top of liner.

B. Once liner installation is complete the CONTRACTOR shall:

1. Remove all excess geomembrane and geomembrane scraps from site.
2. Remove all sand bags from site; or
3. Remove all sand bags and place in OWNER designated area; or
4. If sand in sand bags is acceptable as a drainage layer material the CONTRACTOR may empty each bag and remove and dispose of the empty bags. This will only be allowed if the material meets the criteria for a granular drainage layer. The CONTRACTOR must receive permission from OWNER prior to emptying the sand bags onto the liner.

PART 4 – CONSTRUCTION QUALITY TESTING

4.01 NONDESTRUCTIVE TESTING OF PRODUCTION SEAMS

A. All field seams shall be non-destructively tested by the CONTRACTOR over the full seam length before the seams are covered. Each seam shall be numbered or otherwise designated. The location, date, test unit, name of test, and outcome of all non-destructive testing shall be recorded and submitted to the OWNER.

B. Nondestructive testing of seams shall be completed no later than 1 day after the seaming is completed. Documentation of the test results shall be tabulated and submitted to the OWNER or ENGINEER on the same day testing is completed. Additional geomembrane shall not be deployed until the results of the previous day's nondestructive testing have been submitted and approved by the OWNER or ENGINEER unless otherwise approved by the OWNER. All defects found during testing shall be numbered and marked immediately after detection. All defects found shall be repaired, retested and re-marked to indicated acceptable completion of the repair.

C. Non-destructive tests shall be performed by experienced technicians familiar with the specified test methods.

D. Visual Inspection: A visual inspection of all seams shall be performed. This inspection shall look for obvious flaws in seaming patches, penetration sealing, material defects, or

other problems. Deviations from acceptable workmanship standards shall be noted and corrected.

E. Pressure Testing (Double-Fusion Welds): Where a double-fusion weld seaming system is employed, the continuity of the seam shall be tested with air pressure in accordance with the following procedure. The flow channel must not be obstructed by foreign objects or geomembrane material throughout the length of seam being tested. The vacuum test described in *Section 4.01F* must be employed for testing of all seams that do not have a continuous flow channel.

1. A test device consisting of an inflation needle and pressure gauge mounted on a "T" fitting shall be used for air pressure testing. Insert the needle into the flow channel and seal the end of the channel around the needle. Connect a pump (such as a small bicycle pump) to the test device.
2. Ascertain that the flow channel is continuous by leaving the other end of the channel open and pumping air through the channel. If air does not pass through the channel the test length must be shortened until a continuous length of flow channel is found.
3. Seal and clamp both ends of the flow channel to assure an airtight seal. Inflate the flow channel to 25 to 30 psig. Allow one minute for the seam to stabilize.
4. Re-inflate as needed to achieve 25 to 30 psig on the seam and test for a period of five minutes.
5. At the end of the test period, if the pressure has not dropped more than 2 psi, the test shall be considered a pass and the following procedure will be implemented;
    a. Remove the test device and clamps.
    b. Make any repairs, if necessary, to the area where the flow channel was clamped or inflated.
    c. Record the test results, mark the seam as a pass, the date tested, and proceed to the next seam.
6. If the pressure drops below the 2 psi allowance, the test shall be considered a failure and the following procedure shall be implemented to identify the failure:
    a. Check to determine if there is excessive seepage around the inflation needle.
    b. Check both ends of the seam to ensure the flow channel is completely sealed off.
    c. Walk the length of the seam; look and listen for air leaks.
    d. If either of these procedures fail to identify the leak, trim the seam overlap and vacuum test the seam to locate the leak.
    e. Once the leak is identified, make the necessary repairs and retest the seam.
7. Seam to be approved before testing by OWNER; test to be performed in presence of OWNER personnel.

F. Vacuum Testing: Vacuum testing shall be used to test the continuity of extrusion welded and mechanical seams. A clear topped vacuum box, supplied by CONTRACTOR, shall be placed over the seam to be tested after application of a soapy solution. Upon

evacuation, bubbles will be evident through the viewing window if the seam lacks integrity. The following procedure shall be followed:

1. Wet seam to be tested with a soapy solution mixed at a ratio of 1 ounce soap to 1 gallon water. No antifreeze solution is allowed to be added to the water.
2. Place vacuum box over seam to be tested, evacuate box to a vacuum equal to 3 to 5 inches water column, and tug up to ensure a leak tight seal has been developed.
3. Examine the seam for 5 to 10 seconds to detect soap bubbles.
4. If the bubbles are not evident, move to next test location. Adjacent test sections are to overlap by at least 1 inch.
5. If bubbles are present, mark area clearly for repair.
6. If the vacuum testing indicates leakage, the area shall be spot patched; or if major leaks are detected, the entire seam shall be reworked.
7. Seam to be visually inspected and approved for air testing by ENGINEER before air testing; test to be done in presence of OWNER personnel.

4.02 DESTRUCTIVE TESTING OF PRODUCTION SEAMS

A. The purpose of destructive testing is to verify that the seaming process has produced seams of acceptable mechanical integrity. One seam sample shall be taken at random for each 500 feet of seam. Sample locations shall be designated by OWNER. Each sample shall be shown on the panel layout drawing. The collection of samples for destructive seam testing shall be completed the same day the seaming is completed. All holes in the installed geomembrane resulting from obtaining samples shall be repaired immediately. The sample ID number shall be marked on the patch. All repairs shall be 100 percent vacuum tested or spark tested for continuity.

B. *Maximum frequency of test locations shall be agreed upon by the CONTRACTOR and OWNER prior to commencement of installation*. Additional test locations, not to exceed agreed upon maximum frequency, shall be determined during seaming at OWNER'S discretion. Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset welds or other potential cause of imperfect welding.

C. CONTRACTOR shall not be informed in advance of locations where seam samples will be taken.

D. Number each sample and identify sample number and location on panel layout drawing.

E. Samples shall be 0.4 m (16 in.) wide by 2.1 m (44 in.) long with seam centered lengthwise. Cut one 25 mm (1 in.) wide strip from each end of sample and test in field, by hand or tensiometer, for peel and shear respectively. The tested sample shall not fail through the seam. If tensiometer is not available and if 25 mm (1.0 in.) wide specimen is too difficult to test by hand, 10 mm (0.5 in.) wide specimen is acceptable. Cut remaining sample into 3 parts and distribute as follows.

1. One portion to CONTRACTOR for field documentation testing, 0.40 m by 0.38 m (16 in. by 15 in.).

2. One portion to CONTRACTOR for independent laboratory testing, 0.40 m by 0.38 m (16 in. by 15 in.) if required.
3. One portion to OWNER for archive storage, 0.40 m by 0.30 m (16 in. by 12 in.).

F. For field testing, the CONTRACTOR shall cut 10 identical 1-inch wide replicated specimens from the sample. The CONTRACTOR shall test five specimens for seam shear strength and five for peel strength. Peel tests shall be performed on both inside and outside weld tracks. To be acceptable 4 out of five specimens must pass the test criteria with less than 10% separation. The CONTRACTOR shall submit field documentation test results to the OWNER as soon as they become available, but no later than 1 working day after the sample was taken. Field seams shall meet the minimum specifications of GRI GM 19:

Note: All seams must exhibit a film tear bond (FTB).

G. CONTRACTOR shall be responsible for submitting destructive sample to an independent laboratory testing agency as outlined in Section 01410. CONTRACTOR shall notify OWNER prior to samples being sent to laboratory and laboratory shall report results to OWNER concurrently with reporting results to CONTRACTOR.

H. All testing equipment required for these quality control tests shall be provided by CONTRACTOR. Any seams failing the quality control tests shall be repaired at CONTRACTOR'S expense until passing test results are obtained. At all times, care shall be exercised to avoid damaging the geomembrane.

I. ENGINEER shall be present for all field documentation testing of seam strength.

J. CONTRACTOR shall submit results of test it performs as a result of its quality control assurance program to OWNER.

4.03 PROCEDURES FOR DESTRUCTIVE TEST FAILURE

A. The following procedures shall apply when sample fails destructive test.

1. Obtain additional destructive test samples at locations approximately 10 feet on either side of the failed test location.
2. Perform destructive tests.
3. If test passes, the seam shall be considered adequate.
4. If tests fail, all seams represented by the original destructive test shall be repaired with a cap-strip extrusion welded to all sides of the capped area. All cap-strip seams shall be non-destructively tested until adequacy of the seams is achieved. Cap strip seams exceeding 150 feet in length shall be destructively tested.

B. In any case, acceptable seams shall be bounded by 2 passed test locations (i.e., above procedure shall be followed in both directions from original failed location), and one sample for destructive testing shall be taken within reconstructed area.

C. If sample fails laboratory destructive test (whether conducted by independent laboratory or by CONTRACTOR'S laboratory), above procedures shall be followed

considering laboratory tests exclusively. Since final seam must be bounded by 2 passed test locations, it may be necessary to take one or more new samples for laboratory testing in addition to one required in reconstructed seam area.

4.04 SURVEY DOCUMENTATION

A. CONTRACTOR shall be responsible for performing a GPS survey of all documentation locations and shall submit results of survey to OWNER as part of record documents.

B. CONTRACTOR shall comply with Section 01050 when completing documentation survey.

C. Documentation survey shall include the following at a minimum. CONTRACTOR shall survey any additional documentation points as requested by OWNER needed for completing record drawings.

i. Panel Intersections
ii. Repair Locations
iii. Destruct Locations
iv. Shoulder of anchor trench
v. Edge of geomembrane
vi. Tie in locations

4.05 GEOMEMBRANE ACCEPTANCE AND WARRANTY

A. Contractor shall retain all responsibility for the geomembrane and related work until final acceptance is received from OWNER.

B. A 20-year material and 5-year workmanship warranty shall be provided by Contractor.

END OF SECTION

Certificate of Acceptance of
Geomembrane Subgrade Surface by CONTRACTOR

DESCRIPTION OF AREA TO BE CERTIFIED:_____

_____

LOCATION:_____

PROJECT:_____

ADDRESS:_____

The undersigned, _____ certifies that he is a representative of _____ _____, duly authorized to execute this certificate, that he visually inspected the subgrade surface described above on _____ and found the surface to be acceptable for installation of the geomembrane.

This certification is based on observations of the surface of the subgrade only. No sub terrain inspections or tests have been performed and_____ (OWNER) makes no representations or warranties regarding conditions which may exist below the surface of the subgrade.

Date: _____ Signature: _____

Name:_____ Title:_____

CERTIFICATE RECEIVED BY CONTRACTOR

Date:_____

Contractor:_____

Name:_____

Signature_____

Title_____

CERTIFICATE RECEIVED BY OWNER

Date:_____

OWNER:_____

Name: _____

Signature_____

Title:_____

SECTION 02921

GEOTEXTILE

PART 1 - GENERAL

1.01 SUMMARY

A. Work under this section includes manufacture, fabrication (if needed), furnishing and installation of geotextile, as required, for reinforcement of:

1. Structural fill placed as backfill in areas of over excavation due to observed fractures
2. Coarse aggregate underlayment in leachate collection trench
3. Riprap underlayment

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D3776—Standard Test Methods for Mass per Unit Area (Weight) of Fabric.
2. ASTM D4491—Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
3. ASTM D4533—Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
4. ASTM D4632—Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
5. ASTM D4751—Standard Test Method for Determining Apparent Opening Size of a Geotextile.
6. ASTM D4833—Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.

B. Geosynthetics Research Institute (GRI)

1. GT7 – Determination of Long-Term Design Strength of Geotextiles
2. GT8 – Fine Fraction Filtration Using Geotextile Filters.
3. GT12a – Test Methods and Properties for Nonwoven Geotextiles Used as Protection (or Cushioning) Materials
4. GT13a – Test Methods and Properties for Geotextiles Used as Separation between Subgrade Soil and Aggregate.

C. Standard Specifications are defined as the "Standard Specifications for Construction", State of Minnesota Department of Transportation, 2016 Edition with latest supplements.

1.03 SUBMITTALS

A. Manufacturer's certificates indicating conformance test results of furnished material to the Technical Specifications.

1.04 QUALITY ASSURANCE AND MATERIAL HANDLING

A. Roll Identification:

1. Provide geotextiles in rolls wrapped in relatively impermeable and opaque protective covers and marked or tagged with following information:
   a. Manufacturer's name
   b. Product identification
   c. Lot number
   d. Roll number
   e. Roll dimensions
2. Indicate special handling marked on geotextile itself, e.g., "This Side Up".
3. Conformance testing indicating conformance with Technical Specifications.

B. Handle geotextiles in such manner as to insure geotextiles are not damaged.

PART 2 - PRODUCT

2.01 GENERAL

A. Unless otherwise noted on the Drawings, furnish materials whose minimum average roll values as defined by GRI, meet or exceed Geotextile Fabric Properties.

B. Except when specifically authorized, supplier shall not furnish special run or value added products.

C. Orient polymeric yarns or fibers into stable network to retain relative structure during handling placement, and long-term service.

D. Unless longer durability is specified, geotextiles shall be capable of withstanding direct exposure to sunlight for 30 days with no measurable deterioration.

2.02 GEOTEXTILE FABRIC MINIMUM PROPERTIES: All properties listed are Minimum Average Roll Values (MARV)

A. Riprap underlayment

1. Shall be a Type 5, Nonwoven, Polypropylene Fabric in accordance with Section 3733 in Standard Specifications.

B. Fracture over-excavation reinforcement.

1. Shall be a Type 5, Woven, Polypropylene Fabric in accordance with Section 3733 in Standard Specifications.

C. Coarse Aggregate Underlayment.

1. Minimum general:
   a. Nonwoven.
   b. Polypropylene.
2. Minimum puncture resistance:
   a. 125 lbs (ASTM D4833).
3. Minimum permeability/filtration:
   a. Apparent opening size - 100 U.S. Standard Sieve (ASTM D4751).
   b. Permittivity – 85 gal/min/square foot. (ASTM D4491)

PART 3 - EXECUTION

3.01 GEOTEXTILES INSTALLATION

A. General

1. On Slopes, roll down slope in such manner as to continually keep geotextile sheet in tension.
2. In presence of wind, weight geotextiles with sandbags or equivalent. Install sandbags during placement and keep in place until replaced with cover materials.
3. Take necessary precautions to prevent damage to underlying layers during placement of geotextile.
4. During placement of geotextiles, care shall be taken not to entrap in geotextile, stones, excessive dust or moisture that could damage geomembrane or hamper subsequent seaming.
5. Do not expose geotextiles to precipitation prior to being installed and do not expose to direct sunlight for more than 15 days, unless otherwise specified.

B. Seams and Overlaps:

1. On slopes steeper than 10:1, seam geotextiles:
   a. Seam by sewing, adhesive, fusion or other approved means.
   b. Continuously seam; do not spot seam.
   c. Overlap geotextile 6 inches prior to seaming.
   d. Sew horizontal seams along slope, not across slope.
   e. Using polymeric thread with properties equal to or exceeding those of geotextile.

2. On slopes less than 10:1, seam or overlap geotextile:
    a. Overlap 18 inches.
    b. Spot seaming when overlapping may be considered as a measure to mitigate against wind uplift.
    c. Orient overlaps in direction of earth placement equipment travel.

C. Geotextile Repair:

1. On slopes:
    a. Sew fabric patch into place using double sewn lock stitch, seams 1/4 to 3/4 in. apart and no closer than 1 in. from any edge.
    b. Should any tear exceed 10% of width of roll, remove roll from slope and replace.
2. On non-slope areas: spot seam a fabric patch in place with minimum of 24 inch overlap in each direction.
3. Remove soil or other material that may have penetrated torn geotextile.

D. Appurtenances:

1. Install geotextile around appurtenances protruding through geotextile as shown on the Drawings.
2. After material is placed and seamed, complete final field seam connection between appurtenance sleeve or shield or geotextile. Maintain sufficient initial overlap of appurtenance sleeve so shifts in location of geotextile can be accommodated.
3. Care shall be taken while welding around appurtenances since both nondestructive and destructive testing might not be feasible. Do not damage geotextile while making connections to sumps and appurtenances.

END OF SECTION

SECTION 02922

LINEAR LOW DENSITY POLYETHYLENE GEOMEMBRANE (LLDPE)

PART 1 - GENERAL

1.01 SUMMARY

A. Work includes manufacture, fabrication (if needed), supply, and installation of textured Linear Low Density Polyethylene (LLDPE) geomembrane liner system. Textured geomembrane shall have a smooth edge for seaming.

1.02 DEFINITIONS/REFERENCES

A. American Society for Testing and Materials (ASTM) Standards specifically referenced in this Section:

1. ASTM D638 Standard Test Method for Tensile Properties of Plastics.
2. ASTM D792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
3. ASTM D1004 Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
4. ASTM D1238 Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
5. ASTM D1505 Standard Test Method for Density of Plastics by the Density Gradient Technique.
6. ASTM D1603 Standard Test Method for Carbon Black Content in Olefin Plastics.
7. ASTM D3895 Standard Test Method for Oxidative Induction Time of Polyolefins by Differential Scanning Calorimetry.
8. ASTM D4218 Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
9 ASTM D4437 Standard Practice for Non-destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes.
10. ASTM D4833 Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
11. ASTM D5199 Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
12. ASTM D5323 Standard Practice for Determination of 2% Secant Modulus for Polyethylene Geomembranes.
13. ASTM D5596 Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
14. ASTM D5617 Standard Test Method for Multi-Axial Tension Test for Geosynthetics
15. ASTM D5641 Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
16. ASTM D5721 Standard Practice for Air-Oven Aging of Polyolefin Geomembranes.
17. ASTM D5885 Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry.

18. ASTM D5994 Standard Test Method for Measuring Core Thickness of Textured Geomembranes.
19. ASTM D6365 Standard Practice for the Nondestructive Testing of Geomembrane Seams using the Spark Test.
20. ASTM D6392 Standard Test Method for Determining the Integrity of Non-Reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
21. ASTM D7238 Standard Test Method for Effect of Exposure of Un-reinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus
22. ASTM D7466 Standard Test Method for Measuring Asperity Height of Textured Geomembranes

B. Geosynthetic Research Institute (GRI) Standards:

1. GRI GM 6: Pressurized Air Channel Test for Dual Seamed Geomembranes
2. GRI GM 9: Cold Weather Seaming of Geomembranes
3. GRI GM10: The Stress Crack Resistance of HDPE Geomembrane Sheet.
4. GRI GM17: Test Methods, Properties and Testing Frequency for LLDPE Smooth and Textured Geomembranes.
5. GRI GM 14: Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes
6. GRI GM 19: Seam Strengths and Related Properties of Thermally Bonded Polyolefin Geomembranes

C. U.S. Environmental Protection Agency Technical Guidance Document "Quality Assurance and Quality Control for Waste Containment Facilities," EPA/600/R-93/182, September 1993, 305 pgs.

1.03 SUBMITTALS

A. The following submittals shall be provided to and approved by OWNER prior to delivery of geomembrane to the site or mobilization of the geomembrane INSTALLER'S crew or equipment:

1. INSTALLER shall supply information from the resin manufacturer regarding the resin type, properties as specified herein, and production dates of the resin used for this project. The resin type identification shall include the cell classification of the resin in accordance with the requirements of the latest ASTM Designation D3350.
2. INSTALLER shall submit from the geomembrane sheet manufacturer, test methods and results defining physical properties as specified herein, of the geomembrane to be used for this project. Test results at the frequency specified in the GRI standards of geomembrane furnished for this project shall be submitted, and test results shall be reported with corresponding roll identification numbers.
3. INSTALLER shall supply a statement of the geomembrane manufacturer's quality control procedures, identification of any resin admixtures, frequency of sampling, methods of material transportation and storage, and acceptance criteria for roll goods delivered to the site.

4. INSTALLER shall provide submittals describing the geomembrane sheet manufacturer's details of any factory seaming process proposed. Roll test results which may not be available prior to construction (i.e., environmental stress crack) shall be presented as preliminary prior to construction, with final test results submitted or affected rolls within the construction time frame.
5. INSTALLER shall submit from the extrudate weld rod manufacturer, verification that the weld rod was manufactured using the same resin as was used in the geomembrane sheets prior to using material.
6. INSTALLER shall submit a proposed panel and seam layout diagram specifying the type and location of all field and factory seams. The layout diagram shall be to scale and used as a construction Plan and shall include all necessary dimensions and details. The layout diagram shall be compatible with the panel and seam layout requirements specified in this Section.
7. INSTALLER shall submit an installation schedule.
8. INSTALLER shall submit a list of personnel performing field supervision, and quality control, along with experience records and resumes.
9. INSTALLER shall submit a list of equipment types proposed to be used in panel layout, membrane seaming, and destructive and nondestructive testing.

B. The INSTALLER shall remit the following during geomembrane installation:

1. INSTALLER shall, at the end of each working day provide a detailed report of work completed that day, including:
   a) Panel Placement
   b) Trial Welds Results
   c) Subgrade Acceptance Form
   d) Seams
   e) Seam Testing (air and vacuum tests)
   f) Destructive Tests
   g) Repair Log
2. OWNER shall review with the INSTALLER and sign the above report at the end of each day. OWNER shall be provided with a copy not more than 24 hours from the date of the report.

C. INSTALLER shall update their liner layout drawings on a daily basis. The drawings shall include all panel locations and numbering, seam locations and numbering, and test locations and numbering. The INSTALLER shall maintain a current liner layout drawing on the construction site at all times. At the request of OWNER a copy of the current liner layout drawing will be submitted with 24 hours.

D. INSTALLER shall submit final as-built liner layout drawing(s) to OWNER within 14 calendar days of completion of the liner work. Drawings shall be submitted in paper and digital form.

E. Quality control certificates indicating resin type, properties as specified herein, and production dates shall be provided with each shipment of extrudate rods delivered to the site no later than the time of delivery.

F. Prior to the installation of any geomembrane, the INSTALLER shall submit INSTALLER'S certification in writing that the surface upon which the geomembrane is to be installed is acceptable (complete form contained at end of this Section).

G. Submit material delivery and installation schedule for incorporation into the Project schedule.

1.04 EXPERIENCE

A. The geomembrane installation shall be performed under the direct supervision of a single field supervisor who must remain on-site throughout installation, including inspection of the surface upon which the geomembrane is to be installed, geomembrane handling and storage, panel layout and placement, seaming, seam testing, panel and seam repair, installation of appurtenances, anchorage and other geomembrane-related work. The field supervisor shall have a personal LLDPE or geomembrane installation record totaling at least 1 million square feet.

1.05 Pre-Installation Meeting

A. Representatives of the INSTALLER shall attend a meeting prior to installation of the geomembrane to discuss details of the proposed design, installation, and schedule.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Raw Materials:

1. Smooth and textured LLDPE geomembrane, and extrudate rods used for this project shall be manufactured of new, first quality resins, designed specifically for use in flexible membrane liner installations.
2. LLDPE resin used in manufacturing geomembranes used for this Project shall meet requirements set forth in the latest revision of the Geosynthetics Research Institute (GRI) for LLDPE (GRI GM 17).
3. Recycled Polymer shall not be added to the resin. However, the resin may contain polymer reclaimed during the manufacturing process if reclaimed polymer content does not exceed 10 percent by weight.

B. Geomembrane Roll Goods:

1. LLDPE geomembrane sheets used for this project shall meet the requirements set forth in the latest revision of the Geosynthetics Research Institute (GRI) for LLDPE, both smooth and textured (GRI GM 17).
2. The geomembranes shall consist of unreinforced high density polyethylene containing at a maximum 3 percent by weight additives, fillers, or extenders.
3. The geomembranes shall be free of holes, blisters, striations, undispersed raw material, and contamination by foreign matter.

4. The geomembranes shall be supplied as a continuous sheet with no factory seams in rolls. Each roll shall be identified and labeled with the thickness of the geomembrane, length and width, manufacturer, lot number, and roll identification number. This identification number shall be used to identify roll location on the panel layout record drawing.

C. Extrudate: Resin used in the polyethylene extrudate shall be the same as that used to manufacture the geomembrane sheets. Extrudate rods are to be delivered in original containers with the manufacturer's labeling. Extrudate rods shall be free of dirt, grease, moisture, other contaminants, and shall be free of damage.

2.02 EQUIPMENT

A. Extruding equipment shall be equipped with a temperature gauge at the barrel and nozzle.

B. Fusion equipment shall be equipped with a temperature gauge capable of continuous monitoring.

C. Provide digital or dial continuous temperature recording instruments, in satisfactory working condition, with each welding unit. Welding equipment shall not be operated without functioning temperature recording instruments for measuring geomembrane sheet temperature.

D. A coupon cutter and a calibrated tensiometer shall be provided for in-field seaming pre-qualification testing and destructive sample testing.

E. Store, transport, and operate all equipment to avoid damage to geomembranes.

F. Glass top of each vacuum box must be clear and free of scratches for easy reading of pressure gauge. The sealing gasket shall be intact and functioning to form close seals during testing.

G. OWNER reserves the right to order the INSTALLER to remove any equipment that in OWNER'S opinion is not satisfactory. The INSTALLER will remove the equipment promptly from the construction site and replace the unsatisfactory equipment with suitable equipment within 24 hours.

PART 3 - EXECUTION

3.01 SUBGRADE INSPECTION

A. INSTALLER shall certify in writing that the surface upon which the geomembrane is to be installed is acceptable (acceptance form contained at end of this Section).

B. INSTALLER shall provide daily written acceptance for the surface to be covered by the geomembrane in that day's operations. The surface shall be maintained in a manner during geomembrane installation to ensure subgrade suitability.

C. After subsurface has been accepted by INSTALLER, it shall be INSTALLER'S responsibility to indicate to CONTRACTOR any change in subsurface conditions that may require repair work and perform required repair work. Damage to subsurface caused by work involved in installing geomembrane shall be repaired at INSTALLER'S expense. Geomembrane placement over damaged subsurface, as determined by ENGINEER or INSTALLER, is not acceptable. Nothing will waive INSTALLER'S and CONTRACTOR'S contractual requirements with respect to warranty on installed system.

3.02 ANCHORAGE SYSTEM

A. Backfilling of Anchor Trench:

1. Backfill of anchor trench and compact will be performed by the earthwork CONTRACTOR.
2. INSTALLER shall monitor the backfilling of anchor trench to ensure proper method is employed. Any damage noticed shall be reported to OWNER.

3.03 HANDLING, TRANSPORTATION, AND STORAGE

A. Geomembrane rolls shall be packaged and labeled prior to transporting to the site. Geomembrane rolls delivered to the site shall be wrapped in a relatively impermeable and opaque protective cover which may consist of a sacrificial wrap of geomembrane. The sacrificial wrap shall be removed prior to geomembrane installation.

B. Geomembrane transportation shall be in a manner that minimizes the possibility of material damage during shipment. When offloading geomembrane from the truck, straps and a spanbar shall be used. Direct contact with forklifts or front end loaders to offload the material will not be allowed without written consent from OWNER.

C. On-site storage of the geomembrane rolls shall be in a safe manner, with rolls protected from grease, dirt, moisture, excessive heat, direct sunlight, vehicle traffic, and other possible sources of damage including theft and vandalism. The rolls will be placed in neat order and placed such that identification tags for each roll can be read. Storage areas shall be at the OWNER'S designated location.

D. Geomembrane and appurtenant materials delivered to the site shall be checked for proper labeling and visually inspected for transport or manufacturing damage. OWNER reserves the right to reject any unacceptable material at no cost to OWNER. Any roll that arrives on site without factory roll identification will not be used for the work and will be removed from the site promptly.

E. Only that quantity of geomembrane that is to be placed on a particular day shall be removed from the packaging. Geomembrane rolls shall be transported from the storage

area to the construction area and deployed using wide lifting straps and properly sized forklifts, front end loaders, or other appropriate equipment.

F. Under no circumstances shall any heavy equipment be allowed directly on the geomembranes unless approved by OWNER.

G. Prior to placement, the geomembranes shall be visually inspected for compliance with this Section. Geomembrane material which, in the opinion of the OWNER is damaged or does not meet Specifications will be rejected by the OWNER. Minor damage may be repaired as specified in this Section. Damage to geomembranes caused by INSTALLER during handling shall be repaired or replaced at INSTALLER'S expense.

3.04 PANEL LAYOUT AND PLACEMENT

A. Panel and Seam Layout Diagram:

1. Prepare panel and seam layout diagram so that panel seams run parallel to the direction of maximum slope (i.e., down the slope).
2. Slope panels shall not be constructed from more than two pieces of geomembrane (i.e., not more than one cross-seam shall be permitted on any one slope panel).
3 Cross seams in slope panels, where allowed, shall be oriented at 45^{o}. Cross seams shall be located on at least the bottom half of the slope, wherever possible.
4. Cross seams in adjacent panels shall be staggered.
5. Assign identification number to each seam for reference to test results and record Drawings.

B. PANEL PLACEMENT:

1. Panel size and placement shall be in general accordance with the panel layout diagram submitted to OWNER as defined in this Specification.
2. Geomembrane shall be anchored with sand bags or other approved methods to prevent uplift and damage by wind.
3. A panel identification number shall be assigned to each panel for reference to test results and Record Drawings. The panel identification number and geomembrane roll number shall be written on each panel with a grease pencil, immediately following deployment of the panel.
4. Smoking during placement of panels is prohibited. Wearing damaging shoes or engaging in any behavior which may damage the geomembrane is prohibited.
5. Eating, drinking, disposal of food wraps, drinking bottles and cans on top of geomembrane is not allowed.
6. Place panels with appropriate slack incorporated into geomembrane to accommodate expansion and contraction without jeopardizing the integrity of the geomembrane.
7. Vehicle traffic over geosynthetics as a means of panel deployment is expressly prohibited without the consent of the OWNER.

C. OWNER and INSTALLER will visually inspect in-place panels prior to seaming. Any damaged panels shall be repaired, and if requested by OWNER, replaced at no additional cost to OWNER. Repairs shall be performed as specified in this Section. All damages and repairs shall be recorded on the Record Drawings.

3.05 SEAMING

A. Seaming Methods: All seams shall be joined using a heat extrusion or hot fusion (split wedge) weld process in accordance with the geomembrane manufacturer's recommendations. The INSTALLER shall maintain in working order at the site at least one spare seaming apparatus for each type of welder used. The hot fusion weld process will be used whenever possible. The use of extrusion welded seams shall be limited to repairs and any areas or seam configuration inaccessible to fusion welding equipment.

B. Factory and field seams shall meet the minimum specifications set forth by the latest revision of the GRI.

C. Seam Configuration and Preparation:

1. Overlap panels to be seamed at least 3 inches but not more than 6 inches. The loose end of the upper panel shall extend no more than 3 inches from the weld. All seams shall be made in a rainlap manner with the loose end of the upper panel downgradient of potential water flow.
2. Cross seams on slopes, where allowed, shall be made at a 45 degree angle to the edge of the panel.
3. The contact area between panels shall be clean and free of moisture, dust, dirt, debris, and foreign material. A protective layer of filter fabric or a sacrificial geomembrane strip shall be used directly beneath each seam overlap to achieve proper support and a clean work surface, if necessary.
4. Where extrusion welding is used, the contact surfaces between panels shall be ground to remove oxidation prior to welding. Grinding shall not result in grooving of the liner nor reduction of the liner thickness by more than 10 percent. The grinding motion shall be made perpendicular to the seam. Grinding in a direction parallel to the seam shall not be permitted. All ground areas shall be covered completely with extrudate.
5. Seams shall be aligned to minimize the number and size of wrinkles.

D. Test Seam:

1. A prequalification test seam sample shall be prepared with each piece of seaming equipment/seamer approximately every four hours at the beginning of each seaming period (usually morning and afternoon), unless otherwise directed by OWNER. Each sample shall be prepared by the operator of the equipment for that seaming period and shall be at least 6 feet long (in the direction of the seam) by at least 1 foot wide and may be performed on scrap pieces of geomembrane.

2. Six 1-inch wide specimens (coupons) from each test seam sample shall be prepared for on-site field testing for shear and peel strength. Coupons shall be prepared using a sheet cutter so that consistent, uniform 1-inch wide coupons are obtained. Samples should be distributed evenly over the 6 feet length.
3. The INSTALLER will make these test seams in the presence of OWNER.
4. The extension rates for these tests will not exceed 2-inches per minute unless permission from the OWNER is given.
5. Three coupons shall be tested in shear and three in peel. All coupons shall exhibit the required strength at yield and failure mechanism FTB as set forth in Paragraph 3.05B. Seam separation equal to or greater than 10% of the track width shall be considered a failing test. If any of the coupons fail, the reason for the failure shall be identified and corrected prior to preparing another test seam. The new test seam shall be prepared reflecting adjustments made to the seamer/seaming equipment and a new set of coupons shall be cut and tested.
6. Seaming equipment shall not be used until satisfactory prequalification test seams have been prepared, witnessed by OWNER.
7. The test results on all prequalification test seams will be reported to OWNER.

E. Climatic Conditions for Seaming:

1. Seaming shall be performed only when panel temperatures are between 32°F and 170°F, unless otherwise approved by OWNER. If seaming is permitted to be performed at panel temperatures below 32°F, the panel contact surface shall be preheated and INSTALLER shall certify in writing that the low-temperature seaming procedures will not cause any short-term or long-term damage to the geomembrane or the welded seam. INSTALLER shall demonstrate to OWNER that field seams comply with project specifications using pre-qualification test seams. INSTALLER shall submit to OWNER, for approval, detailed procedures for seaming at low temperatures, including the following:
    a. Preheating of the geomembrane
    b. Provision of a tent or other device if necessary to prevent heat losses during seaming and rapid heat losses subsequent to seaming.
    c. Number of additional test welds to determine appropriate seaming parameters.
2. Seaming during rainy weather or when dew is present on panels shall not be allowed.
3. INSTALLER shall provide any special lighting required for seaming during low-light or dark hours.
4. INSTALLER shall leave slack in the geomembrane as necessary to account for thermal expansion or contraction of geomembrane. Stress on panels due to thermal expansion and contraction shall be minimized by performing field seaming operations during the coolest parts of the day or night, if necessary. Special scheduling or extended hours of operation require approval by OWNER.

F. All welding shall provide a tight, leak proof, homogeneous bond between panels. All seams shall extend to ends of panels.

G. Welding equipment shall be continuously monitored to control the temperature of extrudate and wedge. If recording equipment allows for a hard copy of the monitoring, a copy of the monitoring labeled with the weld identification number will be submitted to OWNER.

3.06 NONDESTRUCTIVE TESTING OF PRODUCTION SEAMS

A. All field seams shall be non-destructively tested by the INSTALLER over the full seam length before the seams are covered. Each seam shall be numbered or otherwise designated. The location, date, test unit, name of test, and outcome of all non-destructive testing shall be recorded and submitted to the OWNER.

B. Testing shall be done as the seaming work progresses, not at the completion of all field seaming. All defects found during testing shall be numbered and marked immediately after detection. All defects found shall be repaired, retested and remarked to indicated acceptable completion of the repair.

C. Non-destructive tests shall be performed by experienced technicians familiar with the specified test methods.

D. Visual Inspection: A visual inspection of all seams shall be performed. This inspection shall look for obvious flaws in seaming patches, penetration sealing, material defects, or other problems. Deviations from acceptable workmanship standards shall be noted and corrected.

E. Pressure Testing (Double-Fusion Welds): Where a double-fusion weld seaming system is employed, the continuity of the seam shall be tested with air pressure in accordance with the following procedure. The flow channel must not be obstructed by foreign objects or geomembrane material throughout the length of seam being tested. The vacuum test described in Paragraph 3.07F must be employed for testing of all seams that do not have a continuous flow channel.

1. A test device consisting of an inflation needle and pressure gauge mounted on a "T" fitting shall be used for air pressure testing. Insert the needle into the flow channel and seal the end of the channel around the needle. Connect a pump (such as a small bicycle pump) to the test device.
2. Ascertain that the flow channel is continuous by leaving the other end of the channel open and pumping air through the channel. If air does not pass through the channel the test length must be shortened until a continuous length of flow channel is found.
3. Seal and clamp both ends of the flow channel to assure an airtight seal. Inflate the flow channel to 25 to 30 psig. Allow one minute for the seam to stabilize.
4. Re-inflate as needed to achieve 25 to 30 psig on the seam and test for a period of five minutes.
5. At the end of the test period, if the pressure has not dropped more than 2 psi, the test shall be considered a pass and the following procedure will be implemented;

a. Remove the test device and clamps.
b. Make any repairs, if necessary, to the area where the flow channel was clamped or inflated.
c. Record the test results, mark the seam as a pass, the date tested, and proceed to the next seam.

6. If the pressure drops below the 2 psi allowance, the test shall be considered a failure and the following procedure shall be implemented to identify the failure:
   a. Check to determine if there is excessive seepage around the inflation needle.
   b. Check both ends of the seam to ensure the flow channel is completely sealed off.
   c. Walk the length of the seam; look and listen for air leaks.
   d. If either of these procedures fail to identify the leak, trim the seam overlap and vacuum test the seam to locate the leak.
   e. Once the leak is identified, make the necessary repairs and retest the seam.
7. Seam to be approved before testing by OWNER; test to be performed in presence of OWNER personnel.

F. Vacuum Testing: Vacuum testing shall be used to test the continuity of extrusion welded and mechanical seams. A clear topped vacuum box, supplied by INSTALLER, shall be placed over the seam to be tested after application of a soapy solution. Upon evacuation, bubbles will be evident through the viewing window if the seam lacks integrity. The following procedure shall be followed:

1. Wet seam to be tested with a soapy solution mixed at a ratio of 1 ounce soap to 1 gallon water. No antifreeze solution is allowed to be added to the water.
2. Place vacuum box over seam to be tested, evacuate box to a vacuum equal to 3 to 5 inches water column, and tug up to ensure a leak tight seal has been developed.
3. Examine the seam for 5 to 10 seconds to detect soap bubbles.
4. If the bubbles are not evident, move to next test location. Adjacent test sections are to overlap by at least 1 inch.
5. If bubbles are present, mark area clearly for repair.
6. If the vacuum testing indicates leakage, the area shall be spot patched; or if major leaks are detected, the entire seam shall be reworked.
7. Seam to be approved before testing by OWNER; test to be done in presence of OWNER personnel.

3.07 DESTRUCTIVE TESTING OF PRODUCTION SEAMS

A. The purpose of destructive testing is to verify that the seaming process has produced seams of acceptable mechanical integrity. One seam sample shall be taken at random for each 500 feet of seam. Sample locations shall be designated by OWNER. Each sample shall be shown on the panel layout drawing. All holes in the installed geomembrane resulting from obtaining samples shall be repaired immediately. The

sample ID number shall be marked on the patch. All repairs shall be 100 percent vacuum tested or spark tested for continuity.

B. Maximum frequency of test locations shall be agreed upon by the INSTALLER and OWNER prior to commencement of installation. Additional test locations, not to exceed agreed upon maximum frequency, shall be determined during seaming at OWNER'S discretion. Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset welds or other potential cause of imperfect welding.

C. INSTALLER shall not be informed in advance of locations where seam samples will be taken.

D. Cut samples as seaming progresses in order to obtain documentation test results prior to completion of liner installation. Number each sample and identify sample number and location on panel layout drawing.

E. Samples shall be 0.4 m (16 in.) wide by 2.1 m (44 in.) long with seam centered lengthwise. Cut one 25 mm (1 in.) wide strip from each end of sample and test in field, by hand or tensiometer, for peel and shear respectively. The tested sample shall not fail through the seam. If tensiometer is not available and if 25 mm (1.0 in.) wide specimen is too difficult to test by hand, 10 mm (0.5 in.) wide specimen is acceptable. Cut remaining sample into 3 parts and distribute as follows.

1. One portion to INSTALLER for field documentation testing, 0.40 m by 0.38 m (16 in. by 15 in.).
2. One portion to OWNER independent laboratory testing, 0.40 m by 0.38 m (16 in. by 15 in.) if required.
3. One portion to OWNER for archive storage, 0.40 m by 0.30 m (16 in. by 12 in.).

F. For field testing, the INSTALLER shall cut 10 identical 1-inch wide replicated specimens from his sample. The INSTALLER shall test five specimens for seam shear strength and five for peel strength. Peel tests shall be performed on both inside and outside weld tracks. To be acceptable 4 out of 5 specimens must pass the test criteria with less than 10% separation. The INSTALLER shall submit field documentation test results to the OWNER as soon as they become available, but no later than 2 working days after the sample was taken. Field seams shall meet the minimum specifications of GRI GM19.

G. All testing equipment required for these quality control tests shall be provided by INSTALLER. Any seams failing the quality control tests shall be repaired at INSTALLER'S expense until passing test results are obtained. At all times, care shall be exercised to avoid damaging the geomembrane.

H. ENGINEER shall be present for all field documentation testing of seam strength.

I. INSTALLER shall submit results of test it performs as a result of its quality control assurance program to OWNER.

3.08 PROCEDURES FOR DESTRUCTIVE TEST FAILURE

A. The following procedures shall apply when sample fails field or lab destructive test.

1. Obtain additional destructive test samples at locations approximately 10 feet on either side of the failed test location.
2. Perform destructive tests.
3. If test passes, the seam shall be considered adequate.
4. If tests fail, all seams represented by the original destructive test shall be repaired with a cap-strip extrusion welded to all sides of the capped area. All cap-strip seams shall be non-destructively tested until adequacy of the seams is achieved. Cap strip seams exceeding 150 feet in length shall be destructively tested.

B. In any case, acceptable seams shall be bounded by 2 passed test locations (i.e., above procedure shall be followed in both directions from original failed location), and one sample for destructive testing shall be taken within reconstructed area.

C. If sample fails laboratory destructive test (whether conducted by independent laboratory or by INSTALLER'S laboratory), above procedures shall be followed considering laboratory tests exclusively. Since final seam must be bounded by 2 passed test locations, it may be necessary to take one or more new samples for laboratory testing in addition to one required in reconstructed seam area.

3.09 DEFECTS AND REPAIRS

A. Identification: Broom or wash geomembrane if amount of dust or mud inhibits inspection.

B. Evaluation: Non-destructively test each suspect location in seam and non-seam areas. Repair each location failing nondestructive testing.

C. Repair Procedures:

1. Repair defective seams by reconstruction.
2. Repair tears or pinholes by seaming or patching.
3. Repair blisters, larger holes, undispersed raw materials, and contamination by foreign matter with patches.
4. Surfaces of geomembrane to be patched shall be abraded no more than 1 hour prior to repair.
5. Seams used in repairing patches shall be approved extrusion welded seams and may be subjected to same destructive test procedures as outlined for other seams.
6. Patches shall be made of same geomembrane, extend minimum of 150 mm (6 in.) beyond edge of defects, and applied using approved extrusion welding methods only. Report areas of repair to OWNER immediately.

D. SEAM RECONSTRUCTION PROCEDURES:

1. Seam reconstruction for extrusion welding process shall be achieved by installing a cap strip over the defective weld a minimum of 6 inches either side of the weld and extrusion welding.
2. Seam reconstruction for fusion process shall be achieved by cutting out existing seam and welding in replacement strip by welding a cap strip over the defective seam length.

E. Verification of Repairs: Test each repair non-destructively. Repairs passing nondestructive test shall be taken as indication of adequate repair. Failed tests indicate repair shall be redone and retested until passing test results.

3.10 GEOMEMBRANE ACCEPTANCE

A. INSTALLER shall retain ownership and responsibility for geomembrane until acceptance by OWNER. Geomembrane liner will be accepted by OWNER when:

1. Written certification letter, including "as-built" drawings, is received by OWNER.
2. Installation of the geomembrane is complete.
3. All required documentation of installation is submitted to OWNER, including inspector's final report.
4. Verification of adequacy of field seams and repairs, including associated testing, is complete and all paperwork accepted and approved by OWNER.
5. The five year material and one-year workmanship warranties are received.

3.12 CLEANUP

A. The INSTALLER shall place ALL material scraps in OWNER designated area at the end of each working day. Disposal of scraps in the anchor trenches will not be acceptable. No scraps of materials will be allowed to be left on top of liner.

B. Once liner installation is complete the INSTALLER shall:

1. Remove all excess geomembrane and geomembrane scraps from site.
2. Remove all sand bags from site; or
3. Remove all sand bags and place in OWNER designated area; or
4. If sand in sand bags is acceptable as a drainage layer material the INSTALLER may empty each bag and remove and dispose of the empty bags. This will only be allowed if the material meets the criteria for a granular drainage layer. The INSTALLER must receive permission from OWNER prior to emptying the sand bags onto the liner.

END OF SECTION

Attachment 1 to Section 02922

Certificate of Acceptance of
Geomembrane Subgrade Surface by INSTALLER

DESCRIPTION OF AREA TO BE CERTIFIED:_____

_____

LOCATION:_____
PROJECT:_____
ADDRESS:_____

The undersigned, _____ certifies that he is a representative of _____ _____, duly authorized to execute this certificate, that he visually inspected the subgrade surface described above on _____ and found the surface to be acceptable for installation of the geomembrane.

This certification is based on observations of the surface of the subgrade only. No sub terrain inspections or tests have been performed and_____ (company) makes no representations or warranties regarding conditions which may exist below the surface of the subgrade.

Date: _____ Signature: _____
Name:_____ Title:_____

CERTIFICATE RECEIVED BY CONTRACTOR
Date:_____
Contractor:_____
Name:_____
Signature_____
Title_____

CERTIFICATE RECEIVED BY OWNER
Date:_____
Company:_____
Name: _____
Signature_____
Title:_____

Date of Work	Initials

Date of Work	Initials

SECTION 02924

GEONET GEOCOMPOSITE

PART 1 - GENERAL

1.01 SUMMARY

A. Work includes manufacture, fabrication (if needed), supply, and installation of the Geonet Geocomposite for cell construction.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM) Standards:

1. ASTM D792 – Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
2. ASTM D1238 – Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
3. ASTM D1505 – Standard Test Method for Density of Plastics by the Density Gradient Technique
4. ASTM D1603 – Standard Test Method for Carbon Black Content in Olefin Plastics
5. ASTM D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity
6. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
7. ASTM D4716 – Standard Test Method for Determining the (In plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
8. ASTM D4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile
9. ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
10. ASTM D5035 – Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
11. ASTM D5199 – Standard Test Method for Measuring the Nominal Thickness of Geosynthetics
12. ASTM D5261 – Standard Test Method for Measuring Mass per Unit Area of Geotextiles
13. ASTM D7005 – Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites
14. ASTM D7179 – Standard Test Method for Determining Geonet Breaking Force

1.03 SUBMITALS

A. Raw Materials

1. Copy of quality control certificates issued by HDPE resin supplier.
2. Production date(s) of HDPE resin.

3. Statement that no reclaimed polymer added to resin during manufacture of Geonet for this project.

B. Copy of quality control certificates for each roll. The certificates to include:

1. Manufacturer's name.
2. Product identification.
3. Lot number.
4. Roll number.
5. Roll dimensions.
6. Installation layout, certifying placement patterns and seams delivery, storage, and handling.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Transportation

1. Handle rolls by appropriate means to prevent damage from occurring.

B. On-Site Storage

1. Storage of geonet shall be CONTRACTOR'S responsibility.
2. Protect geonet from damage, maintain roll package integrity, and keep rolls out of water, mud or dust. Geonet that becomes clogged or damaged may be repaired or replaced at Contractor's expense.

1.05 SEQUENCING AND SCHEDULING

A. Submit material delivery and installation schedule for incorporation into the Project schedule

PART 2 - PRODUCTS

2.01 GEOCOMPOSITE

A. The geocomposite shall consist of an HDPE drainage net heat bonded to two layers (sandwiched) of geotextiles to create double-sided geocomposite or to one layer to create single-sided geocomposite. The geotextiles shall extend a minimum of 6 inches beyond the edges of drainage net on both sides of the geocomposite roll. The geotextile shall not be bonded to the drainage net within 6 inches from the edges of the rolls.

B. The compound of the geocomposite rolls shall meet the following specifications:

1. Drainage Net.

The drainage net shall be manufactured by extruding two sets of polyethylene strands to form a three dimensional structure to provide for planar flow. The drainage net shall be manufactured of polyethylene resin produced in the United

States and compounded and manufactured specifically for the intended application. The natural polyethylene resin without the carbon black shall meet the following requirements:

Property	Test Method	Requirements
Density, g/cc	ASTM D 1505 or ADTM D 792	0.945 – 0.955
Melt Index, g/10 min.	ASTM D 1238 Condition E	< 1.0

Labels on each roll shall identify the thickness of the material, the width and length of the roll, lot and roll numbers, and name of the manufacturer. The drainage net rolls shall meet the requirements specified below.

Drainage Net Material Properties

Property	Test Method	English Units	Metric Units
Thickness	ASTM D 5199	200 mils	5 mm
Density, min.	ASTM D 1505	0.940 g/cc	0.940 g/cc
Carbon Black Content, min.	ASTM D 1603	2%	2%
Tensile Strength (MD)	ASTM D 5035 or ASTM D7179	45 lb/in	7.9 kN/m

2. Geotextile.

The geotextile heat bonded to each side of the drainage net shall be an 8 oz/s.y. geotextile meeting the following requirements:

Geotextile Material Properties

Property	Test Method	English Units	Metric Units
Unit Weight	ASTM D 5261	8 oz/yd^2	271 g/m^2
Grab Tensile	ASTM D 4632	203 lb	900 N
Puncture	ASTM D 4833	120 lb	535 N
AOS	ASTM D 4751	80 sieve	.180 mm
Flow Rate	ASTM D 4491	95 gal/min. ft^2	3,870 L/min.m^2

3. Geocomposite.

The complete geocomposite shall meet the following properties:

Property	Test Method	English Units	Metric Units
Transmissivity, (MD), (1)/metal plate	ASTM D 4716	2.4 gal/min/ft.	5×10^{-4} m^2/sec
Ply Adhesion, lb/in	ASTM D 7005	1 lb/in.	1.75 N/cm

NOTE 1: This hydraulic transmissivity shall be determined at a minimum compressive stress of 15,000 lbs/ft^2 (714 KPA), a minimum hydraulic gradient of .1, and a minimum test duration long enough to equalize flow. The hydraulic transmissivity test shall be performed with a metal plate against one boundary of the geonet and a metal plate against the other.

PART 3 - EXECUTION

3.01 GEOCOMPOSITE HANDLING AND PLACEMENT

A. The CONTRACTOR shall handle all geocomposites in such a manner as to ensure the geocomposites are not damaged in any way. Comply with the following:

1. On slopes, the geocomposites shall be secured in the anchor trench and then rolled down the slope in such a manner as to continually keep the drainage net sheet in tension. If necessary, the geocomposites shall be positioned by hand after being unrolled to minimize wrinkles. Geocomposites can be placed in the horizontal direction (i.e., across the slope) in some special locations at the approval of the Engineer (e.g., if an extra layer of geocomposite is required at the toe of a slope, this extra layer of geocomposite can be placed in the horizontal direction).
2. In the presence of wind, all geocomposite shall be weighted with sandbags or the equivalent. Such sandbags shall be installed during placement and shall remain until replaced with overlying material.
3. Geonets shall only be cut using scissors.
4. The Contractor shall take any necessary precautions to prevent damage to underlying layers during placement of the geocomposite.
5. During placement of geocomposite, care shall be taken not to entrap in the geonet, dirt or excessive dust that could cause clogging of the geocomposite and/or stones that could damage the adjacent geomembrane. If dirt or excessive dust is entrapped in the geocomposite, it shall be hosed clean prior to placement of the next material on top of it. In this regard, care shall be taken with the handling of sandbags to prevent rupture or damage of the sandbag.

6. Contractor shall ensure that no sand or material which may reduce the friction interface between geomembrane and geocomposite is present on geomembrane during installation.
7. Care shall be taken not to leave tools on or in the geocomposite.
8. Orient seams of fabric covering to overlap in the direction of earth filling.

3.02 TACKING AND JOINING

A. Adjacent geonets and geocomposites shall be joined according to the approved panel drawings and specifications. At a minimum, the following requirements shall be met:

1. Adjacent rolls shall be overlapped by at least 4 inches.
2. Geonet overlaps shall be secured by tying.
3. Tying shall be achieved by strings, plastic fasteners, or polymer braid. Tying devices shall be white or yellow for easy observation. Metallic devices are not allowed.
4. Tying shall be every 5 ft along the slope greater than 5 percent, every 2 feet across the slope, and every 6 inches in the anchor trench. Tying shall be every 10 feet on slopes less than 5 percent.
5. In the corners of the side slopes of rectangular landfills, where overlaps between perpendicular geonet strips are required, an extra layer of geonet shall be unrolled along the slope, on top of the previously installed drainage nets, from top to bottom of the slope.
6. The fabric covering on the geonet shall be heat sealed (leistered or stitched) to adjacent slabs to prevent foreign material from entering the geonet, and provide a smooth surface for subsequent HDPE installation.
7. At bottom, minimum overlap shall be 2 inches in a shingle configuration.

3.03 GEONET REPAIR

A. Any holes or tears in the geonet shall be repaired by placing a patch extending 2 feet beyond edges of the hole or tear. The patch shall be secured to the original geonet by tying every 6 inches or a minimum of 4 ties, whichever is greater. If the hole or tear width across the roll is more than 50 percent the width of the roll, the damaged area shall be cut out and the two portions of the geonet shall be joined as indicated in Paragraph 3.02.

3.04 GEOCOMPOSITE REPAIR

A. Any holes or tears in the geotextile covering shall be repaired by placing a patch extending 12 inches beyond edges of hole or tear. The patch shall be secured to original geotextile using approved thermal bonding techniques.

B. Any holes or tears in the geonet shall be repaired in accordance with paragraph 3.03 of this Section.

C. If a hole or tear exceeds 50% of the roll width, remove and replace panel.

3.05 CLEANUP

A. The Contractor shall place ALL material scraps in OWNER designated area at the end of each working day. Disposal of scraps in the anchor trenches will not be acceptable. No scraps of materials will be allowed to be left on top of geonet or geotextile.

B. Once liner installation is complete the Contractor shall:

1. Remove all sand bags from site; or
2. Remove all sand bags and place in OWNER designated area; or
3. If sand in sand bags is acceptable as a drainage layer material the Contractor may empty each bag and remove and dispose of the empty bags. This will only be allowed if the material meets the criteria for a granular drainage layer. The Contractor must receive permission from OWNER prior to emptying the sand bags onto the liner.

END OF SECTION

Appendix D

Construction Quality Assurance Manual

WENCK File #0218-0040
June 2016

Construction Quality Assurance Plan
Cell Construction and Closures

Prepared for:

SKB (Austin) Environmental, LLC

251 Starkey Street
St. Paul, Minnesota
55107

WENCK ASSOCIATES

Responsive partner.
Exceptional outcomes.

Prepared by:

WENCK Associates, Inc.
1800 Pioneer Creek Center
Maple Plain, MN 55359
Phone: 763-479-4200
Fax: 763-479-4242

Table of Contents

Table of Contents (Cont.)

Table of Contents (Cont.)

TABLES

1.0 Information

1.1 SCOPE

This CQA Plan outlines the necessary procedures, standards and methods for appropriate monitoring and documentation of the installation of a base liner system. The overall goals of this construction quality assurance program are to ensure that proper construction techniques and procedures are implemented and to verify that materials and installation techniques used meet the project design requirements. At the completion of the work, the program will culminate in a certification report which documents that the grading, liner, and piping systems have been constructed in accordance with design standards and specifications.

This plan also outlines the responsibilities of the various key parties involved in landfill construction. This plan is intended in conjunction with the project drawings, specifications and other project documents to comprise the CQA program.

1.2 DEFINITIONS

Quality Assurance: Means and actions employed by Owner to assure conformity of the lining system production and installation with the approved drawings, specifications and other project requirements.

Quality Control: Actions taken by the liner manufacturer, installer, earthwork contractor to ensure that materials and workmanship meet the requirements of the drawings, specifications, and other project requirements.

Lining System: Refers to a base liner system.

Cover System: Refers to a final cover system

Technical Specifications: A document produced by the Designer declaring minimum values of performance of construction materials.

Subgrade: The surface of the underlying soil prepared to receive the lining system.

Certification Report: A report documenting that construction was carried out according to approved drawings and specifications, and this CQA plan.

1.3 PARTIES

The parties discussed in this section are associated with the ownership, design, supply, manufacture, transportation, installation, and quality assurance of a lining system. The parties involved and their functions are described below:

Owner: The party that owns and operates the facility that is responsible for the overall coordination of CQA activities. The Owner is also responsible for selecting the necessary parties associated with construction.

Designer: The firm responsible for preparing the engineering design, associated plans, and specifications for the facility. The Designer for the project shall be a registered professional engineer in the State of Minnesota. The Designer may provide clarification necessitated during construction.

Quality Assurance Contractor (QAC): A person designated by OWNER to observe tests and document construction activities on behalf of the Owner. The QAC will identify and notify the Owner of any deviations or problems that arise during construction and assist in resolution. The QAC is also responsible for preparation of the construction certification report required for submittal to the MPCA. The QAC will have an individual identified as the CQA Officer. The CQA Officer will be a registered professional engineer in the State of Minnesota. The QAC may also be denoted as the engineer in the Technical Specifications.

Earthwork Contractor (EC): This firm is mainly responsible for the earthwork preparation and construction of the soil components of the lining system. The EC typically prepares the subgrade or foundation soil on which the geosynthetics are placed. The EC is also responsible for placing the soil materials over the lining system. In addition, the EC may install the leachate collection piping and trench backfill material.

Geosynthetic Manufacturer (GM): The GM is the firm or firms responsible for the production and supply of the various geosynthetic components. The geosynthetic manufacturer will be responsible for providing QC documentation that the materials meet the requirements of the drawings, specifications, and other project requirements. The GM is responsible for the condition of the product until the material is accepted by the Owner on-site.

Geosynthetic Installer (GI): The GI is responsible for field handling, storing, placing, seaming, loading, and other aspects of the installation of geosynthetics.

Quality Assurance Laboratory (QAL): Firm which performs necessary testing on samples taken from the site.

Land Surveyor (LS): registered, land surveyor that is responsible for documenting the subgrade and liner or cover system component thicknesses.

1.4 COMMUNICATIONS

The various meetings and typical content necessary to achieve the project goals are described below:

Preconstruction Meeting: A preconstruction meeting will be held at the site prior to beginning installation of liner system components. Typically, the Owner, QAC, GI, EC, and LS will have a representative at the preconstruction meeting. Major topics will be as follows:

- Lines of communication
- Responsibilities of each firm
- Review project documents; provide clarification, if necessary
- Review intended construction procedures
- Corrections of defective work
- Documentation of the work
- Site requirements

The QAC will record the minutes of the meeting and provide copies to the attendees for their records.

Progress Meeting: The Owner will typically schedule progress meetings at regular intervals. The Owner will determine the attendees at the progress meetings. Topics of discussion at the progress meetings will be:

- Work completed to-date
- Schedules
- Documentation and any CQA testing completed to-date.
- Work anticipated to be completed prior to the next scheduled meeting

The QAC shall log any problems, decisions, or questions arising at the meeting in his report.

Resolution Meeting: The Owner or QAC may call for a resolution meeting whenever there is a clarification needed to the project documents or there has been an unforeseen problem in construction. The result of this meeting will be a formal resolution agreed to by all relevant parties.

2.0 Documentation

2.1 GENERAL

The QAC will be on site to document construction activities. The QAC will prepare the daily activity logs, assemble the test reports, prepare the record drawings, and prepare the certification report. This section addresses the content of the various reports.

2.2 DOCUMENTATION REPORTS

Daily Activity Log: The QAC will prepare daily activity logs which will contain at a minimum the following:

- Name and title of construction supervisor
- Date of activity
- Weather, including maximum and minimum temperatures and amount of precipitation, if any
- Type of activity conducted
- Summary of all quality assurance tests conducted, indicating which tests passed and failed specifications
- Documentation of all repairs made on the liner system

Test Reports: The quality assurance laboratory will prepare a test report for each sample tested and provide copies to the QAC.

The test reports will contain the following information.

- Date
- Sample I.D.
- Project name and location
- Sample size and description
- Test being performed
- Applicable ASTM standards
- Method of sample preparation
- Test results, including a statement that the test either passed or failed the project requirements

The test results will be signed by a representative of the laboratory certifying their accuracy and compliance with relevant standards.

Record Drawings: The QAC will prepare record drawings to document the construction of a liner system. The plans will have elevations that are referenced to a U.S.G.S. datum. The record drawings will contain the following at a minimum:

- Dimensions; maximum elevation and minimum elevation of the liner system constructed
- Location and elevation of all sumps and all gravity pipes and drainage facilities
- Quality assurance test locations and repair locations

The QAC will work closely with the GI to ensure that panel numbers, seam locations, and destructive test numbers and locations are correctly located on the as-built drawings

Certification Report: The QAC will prepare a certification report that documents landfill construction and includes certification from a professional engineer registered in the State of Minnesota that the construction was in accordance with this CQA plan, engineering drawings, and specifications.
The report shall include:

- Daily activity log
- Compacted clay barrier and final cover records
- Flexible Membrane Liner records
- Leachate collection systems records
- Record drawings containing the information previously listed.

3.0 Foundation and Berms

3.1 GENERAL

The foundation and berms serve as the components on which the liner systems are constructed.

3.2 MATERIAL QUALITY CONTROL

Material used for foundation and berms will be on-site material. Testing may be required prior to use, depending on use. Minimum frequencies are listed in Table 1, and acceptability criteria are listed in the technical specifications.

3.3 OBSERVATION AND DOCUMENTATION

No unsuitable material will be placed in this layer. Construction activities will be documented. The EC or LS shall document the grades and elevations after surface preparation.

3.4 TESTING

The material will be tested in accordance with the project requirements. The surface will be prepared to be capable of supporting construction of the overlaying layers.

Subgrade fill material shall be compacted to greater than or equal to 96% of standard proctor. Excessively dry or wet soil shall be removed before placement of additional lifts. Nuclear density methods will be preferred for moisture and density testing due to the ease of testing and the relatively large number of tests which can be run in a given period of time. Questions concerning the accuracy of any single test will be addressed by retesting in the same location until a passing test is obtained.

CQA testing will be conducted on samples taken from the material during the course of construction. Sampling locations will be selected by QAC according to the number of required tests. Locations of tests will be documented for report purposes.

A special testing frequency will be used when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- Lift thickness is greater than specified
- Earthfill is at variable moisture content
- Dirt-clogged rollers are used to compact the material
- Rollers may not have used optimum ballast
- The degree of compaction is doubtful

During construction, the frequency of testing may also be increased in the following situations:

- Adverse weather conditions

- Breakdown of equipment
- At the start and finish of grading
- Material fails to meet specifications
- The work area is increased

3.5 SURVEY

The survey of specific locations will provide the basis for record drawings. The survey will be performed by a qualified LS. The survey will be conducted on a grid and at major breaks. Grading tolerances are provided in Table 3.

4.0 Clay Barrier Layer

4.1 GENERAL

The clay barrier layer serves as the earthen barrier in the base liner or cover system.

4.2 MATERIAL QUALITY CONTROL

Samples of the material will be tested for USCS classification, moisture density, relationship, and hydraulic conductivity. Minimum frequencies are listed in Table 1, and acceptability criteria are listed in the technical specifications.

4.3 SUBGRADE

The EC shall be responsible for preparing and documenting that the subgrade for the clay barrier conforms to the project plans. Once complete, the QAC shall examine the surface, and verify the adequacy of the survey data provided. When the QAC deems the surface acceptable, the QAC shall prepare an acceptance certificate for the Owner. The acceptance certificate shall state the following at a minimum:

1. The required survey has been performed by a qualified land surveyor and the results meet the specifications.
2. The subgrade has been tested and meets the project requirements.

At any time during construction of the clay barrier, the QAC shall inform the Owner of any areas that are unacceptable. Such defects in the subgrade shall be corrected by the EC such that repaired areas meet the project specifications.

4.4 OBSERVATION AND DOCUMENTATION

The QAC shall document the following during the construction of the clay barrier:

Excavation: The QAC shall document the slope and the depth of the excavation and document that the subgrade surface meets specification.

Borrow Sources: For each borrow source the QAC shall document: the following:

- Location
- Description of soil
- Moisture-density-hydraulic conductivity relationship
- Removal of deleterious or off-specification material
- Placed and compacted volume of soil.

Compaction: The following will be documented during compaction of the soil:

- Type and weight of compaction equipment
- Method of surface preparation
- Method of adjusting soil moisture and controlling desiccation

- Compacted lift thickness
- General number of passes and uniformity of coverage
- Reduction in clod size
- Repair
- Observation of the thickness of lifts as loosely placed and as compacted
- Observation of the action of the compaction and heavy hauling equipment on the construction surface (sheepsfoot penetration, pumping, cracking, etc.).
- Verification that all frozen soil is removed prior to placement of subsequent material.
- Verification that frozen soil is not placed.

4.5 TESTING

Laboratory test methods and frequencies to develop data upon which acceptability evaluations can be based will be as provided in Table 1. Hydraulic Conductivity tests shall be performed on remolded samples in order to establish the moisture-density-permeability characteristics of the soil.

Clay barrier material will be thoroughly and uniformly compacted at a moisture content that is greater than or equal to optimum and shall be compacted to greater than or equal to 95% of standard proctor. Each lift will be integrated into the previous lift by techniques such as scarifying each lift and by using compaction equipment that is capable of penetrating the thickness of each compacted lift. EC shall compact with sheepsfoot roller, or similar kneading-type compactor. Feet of compactor shall be greater than the thickness of each lift. Layers of clay to form continuous monolithic material with excessively dry or wet soil removed before placement of additional lifts. Knead each lift into previously placed lift. Nuclear density methods will be preferred for moisture and density testing due to the ease of testing and the relatively large number of tests which can be run in a given period of time. Questions concerning the accuracy of any single test will be addressed by retesting in the same location until a passing test is obtained.

Final surface shall be smooth-rolled prior to HDPE placement. Finished surface will be smooth and even with no sheepsfoot roller indentations. Surface must be smooth and free of debris, roots, and stones or rocks larger than 3/8 inch in diameter or angular stone of any size or any other material that would be deleterious to the overlying geomembrane liner. EC shall be responsible for the integrity of the clay liner and shall not allow the surface to dry or desiccate. EC shall maintain the subgrade in an acceptable condition and make repairs, as needed, until the geosynthetic materials are placed, tested, and approved by the Owner.

CQA testing will be conducted on samples taken from the material during the course of construction. Sampling locations will be selected by QAC according to the number of required tests. Locations of tests will be documented for report purposes.

A special testing frequency will be used when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- Lift thickness is greater than specified
- Earthfill is at variable moisture content
- Dirt-clogged rollers are used to compact the material
- Rollers may not have used optimum ballast

- The degree of compaction is doubtful

During construction, the frequency of testing may also be increased in the following situations:

- Adverse weather conditions
- Breakdown of equipment
- At the start and finish of grading
- Material fails to meet specifications
- The work area is increased

Perforations in the clay barrier will occur during construction due to testing. The perforation would be caused by:

1. Nuclear density test probe locations
2. Permeability sampling locations

Unless otherwise directed by the QAC or Owner, all perforations of the clay barrier by probe or sample tube shall be backfilled with a soil-bentonite mixture. The mixture shall be compacted in-place with a tamping rod, or hand tamper, depending on the size of the perforation.

Hydraulic conductivity testing will be performed at the frequencies provided in Table 1. The test locations will be on a grid that will maximize the coverage of the construction area, or as directed by the QAC to test suspect areas. Soil density and moisture content will be documented for each lift on an offset grid to provide adequate coverage of the construction.

4.6 DAMAGE AND REPAIR

Should the subgrade become damaged during construction due to precipitation, the unsuitable material will be removed and the Owner may choose to either replace the removed material with native fill and document the grades; or, replace the material with the same soil used in the clay barrier documenting the additional thickness in the affected area.

Areas of the clay barrier that become damaged, due to precipitation or desiccation, will be reworked and retested until satisfactory results are obtained. If it appears unlikely to correct the damage by reworking the soil, the affected area will be removed, replaced, and tested.

4.7 SURVEY

The survey of specific locations will provide the basis for the record drawings and provide documentation of clay barrier thicknesses. The survey will be performed by the LS. The major components of the survey will include the following at a minimum:

1. Top of subgrade
2. Top of clay barrier

The survey will be conducted on a grid with survey points at major breaks in slope (i.e., top and toe of slope) and top and base of sumps. The grid will be extended vertically to enable calculation of vertical thicknesses of the liner or cover component. Grading tolerances are provided in Table 3.

4.8 CONFORMANCE WITH PROJECT SPECIFICATIONS

The QAC shall document that the clay liner installation was done in accordance with the project specifications.

5.0 Geomembrane

5.1 GENERAL

Geomembranes are the geosynthetic component of the composite base liner system. This section is applicable to the Polyethylene (PE) geomembranes used in base liner or final cover systems. Material specifications for the geomembrane are displayed in Table 2.

5.2 MATERIAL QUALITY CONTROL

5.2.1 Raw Material

The resin used to make geomembrane sheet shall be tested in accordance with the manufacturer's guidelines. Material ingredients of the geomembrane shall be randomly sampled by the manufacturing plant to ensure compliance with these specifications. Test reports of quality control tests, such as specific grading, meet flow index and carbon black content will be provided.

5.2.2 Geomembrane Material Specifications

The GI shall provide the QAC with the following:

1. A quality control certificate including the specified measure using test methods indicated at a frequency to meet conformance with the Geosynthetics Research Institute's (GRI) GM 13 for HDPE.
2. Certification that property values given in the properties sheet are guaranteed by the GI.
3. Certification that 100 percent of every roll has been visually inspected for holes, cracks, thin spots, tears, punctures, blisters or any other foreign material.

The GI shall provide the following information to the QAC for each roll delivered to the site:

- Name of the manufacturer and fabricator
- Name and type of liner
- Thickness of liner
- Batch code
- Date of fabrication
- Physical dimensions
- Panel number
- Location and method of storage at the site

This information shall accompany each roll delivered to the job site.

The QAC will examine results and report any nonconformance to Owner. QC results will be reviewed and accepted or rejected by the QAC prior to deployment.

5.3 SUBGRADE

When the geomembrane is placed on a soil subgrade, the EC shall be responsible for preparing the subgrade for the geomembrane. Once complete, the QAC shall examine the surface, and verify the adequacy of the survey data provided. When the QAC deems the surface acceptable the QAC shall prepare an acceptance certificate for the Owner. The acceptance certificate shall state the following at a minimum:

1. The required survey has been done by a qualified land surveyor and the results meet the specifications.
2. The subgrade has been tested and meets the project requirements.

When the geomembrane is placed on a geosynthetic subgrade, the GI shall be responsible for preparing the subgrade for the geomembrane. Once complete, the QAC shall examine the surface, and verify the adequacy of the documentation completed and any test data required. When the QAC deems the surface acceptable the QAC shall prepare an acceptance certificate for the Owner. The acceptance certificate shall state the following at a minimum:

1. Documentation of the underlying geosynthetics is complete, and any necessary tests show satisfactory results.

The GI will also inspect the subgrade and will sign the subgrade acceptance forms.

At any time during installation of the geomembrane, the QAC shall inform the Owner of any areas that are unacceptable. Such defects in the subgrade shall be corrected by the appropriate contractor such that repaired areas meet the project specifications. If additional work is required on a soil subgrade it is the GI's responsibility to notify the EC and owner of such work and also provide this notification to the QAC.

5.4 OBSERVATIONS AND DOCUMENTATION

5.4.1 Roll Inspections

Prior to placement of any lining material, rolls shall be observed for defects and damage by both the QAC and the GI. Storage of the rolls shall be in a location that minimizes on-site handling and the possibility of damage.

Each roll shall have a roll label which clearly identifies the manufacturing information. This information, along with the panel number and location/method of on-site storage, shall be recorded by the QAC.

The QAC shall also visually observe each roll for imperfections or damage including holes, cracks, thin spots, tears, punctures, blisters or the presence of foreign material.

5.4.2 Placement

5.4.2.1 Installation Equipment

The installer shall use equipment that does not damage the geomembrane by handling, trafficking, excessive heat, leakage of oils or other means. The method and equipment used

to unroll the material shall not cause scratches, crimps or any damage to the underlying geosynthetics, or excessive rutting of the soil subgrade.

5.4.2.2 Method of Deployment

No personnel working on the geosynthetic liner shall smoke, wear damaging shoes or engage in other activities that could damage the geomembrane. The method used to place the panels shall minimize wrinkles.

Adequate temporary loading and/or anchoring shall be provided to prevent uplift of the liner by wind. The anchoring system shall not damage the liner.

The installer shall inspect each panel after placement and prior to seaming for damage. Damaged panels or portions of damaged panels that have been rejected shall be marked and their removal from the work area recorded.

5.4.2.3 Crest Anchorage System

The anchor trench shall be excavated to the lines and widths shown on the drawings, prior to geomembrane placement. The trench shall be drained to prevent ponding or softening of adjacent soils where trench is open. The corners of the trench shall be slightly rounded to avoid sharp bends in the geomembrane. The trench shall be backfilled and compacted by light compaction equipment to the required grade.

Since backfilling the anchor trench can affect material bridging at the toe of slope, consideration should be given to backfilling the liner at its most contracted state; preferably during the cool of the morning or extended period of overcast skies. Care should be taken when backfilling the trenches to prevent damage to the geosynthetics.

5.4.3 Field Seaming

To verify that seaming conditions are adequate, trial seams shall be performed on fragmented pieces of geomembrane. Trial seams shall be made as follows:

1. Every 4-hours
2. Anytime equipment is turned off
3. For each seaming apparatus
4. Other times as deemed necessary by the QAC

A test weld, long enough to obtain required samples shall be run at the frequency described above (typically at least 5 feet).

The test weld shall be recorded on the GI's trial weld log with date, ambient temperature, and welding machine number.

Two adjoining specimens each 1-inch wide shall be cut from the trial seam sample. The specimens shall be tested respectively in shear and in peel using a field tensiometer and they shall not fail in the seam. If either specimen fails, the entire operation shall be repeated. If the additional specimen fails, the seaming apparatus and seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two

consecutive successful full trial welds are achieved. The QAC will observe and document results of trial seam procedures.

5.4.4 Field Seaming

5.4.4.1 Seam Layout

Prior to liner installation, panel layout drawings shall be submitted and approved by the QAC and Owner. Seams should typically be oriented parallel to the line of maximum slope. All seam-numbering and panel-numbering systems shall be agreed upon prior to installation. Individual liner panels shall be laid out and overlapped as required prior to welding. The area to be welded shall be cleaned prior to welding. Panel locations shall be recorded by the QAC on the record drawings.

5.4.4.2 Seaming Equipment and Accessories

The fusion welding apparatus will be an automated, vehicle-mounted device that produces a double seam enclosing a void. This apparatus shall be equipped with gauges permitting a direct reading of the applicable temperatures.

The extrusion welding apparatus shall be equipped with gauges giving the temperatures of the apparatus at the nozzle.

5.4.4.3 Weather Conditions for Seaming

Seaming shall not take place during precipitation, in the presence of excess moisture or in the presence of excessive winds. Excessive moisture is a condition where condensation or other moisture on the sheet is the cause of poor seams or seams failing non-destructive or destructive testing. Excessive winds shall be determined by the GI, but if the QAC feels panel deployment poses a safety concern with the wind or that the geomembrane cannot be adequately held in place with sand bags, deployment shall cease until wind conditions allow further seaming. Seaming shall not take place at ambient temperatures less than 40^{o}F unless authorized by the Owner and QAC.

5.4.4.4 General Seaming Procedures

The rolls of geomembrane shall be overlapped as required by the manufacturer’s specifications.

A base T-seam shall not be closer than 10 feet from the toe of the slope. Seams shall be aligned with the least possible number of wrinkles and "fish mouths". Excessively large wrinkles and all fish mouths shall be relieved and cap-stripped.

The QAC shall document field seam locations and panel overlaps. Panels that are factory fabricated or factory seamed will undergo the same observation and documentation as panels that are field seamed.

5.5 TESTING

5.5.1 Nondestructive Seam Continuity Testing

The installer shall nondestructively test all field fusion seams over their full length by air-pressure testing. Extrusion-welded seams shall be tested by vacuum gauge.

5.5.1.1 Air Pressure Testing

This type of testing will be performed on the majority of the seams, since the double fusion-seaming method is the method of choice.

Generally, the equipment shall be comprised of the following:

- An air pump capable of providing a pressure between 25 and 30 pounds per square inch (psi).
- A rubber hose with fittings and connections.
- A sharp hollow needle or other approved pressure-feed device.

The following procedures shall be followed:

a) Seal both ends of the seam to be tested.
b) Insert needle or other approved pressure-feed device into the tunnel created by the fusion weld.
c) Energize the air pump to 25-30 psi; close the valve and sustain pressure for a minimum of five minutes.
d) If loss of pressure exceeds 2 psi or does not stabilize, locate the faulty area, repair, and retest (either vacuum or air test).

5.5.1.2 Vacuum Testing

The equipment shall be comprised of the following:

- A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly, and a gauge to indicate chamber vacuum
- A pump assembly equipped with a pressure controller and pipe connections
- A rubber pressure/vacuum hose with fittings and connections
- A bucket and wide brush or spray assembly
- A soapy solution

The following procedures will generally be followed:

a) Wet a strip of geomembrane approximately 12 x 48 inches with the soapy solution.
b) Place the box over the wetted area.
c) Close the bleed valve and open the vacuum valve.
d) Ensure that a leak-tight seal is created.
e) Energize the vacuum pump and reduce the tank pressure to approximately 5 psi.
f) For a period of approximately 10 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.

If no bubble appears after 10 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum of 1-inch overlap, and repeat the process.
Areas where soap bubbles appear shall be marked and repaired in accordance with Section 5.6.

The QAC shall document the following for each non-destructive seam test:

- Date
- Seam number
- Welder I.D.
- Seamer
- Air Pressure

5.5.2 Destructive Testing

Destructive seam tests shall be performed every 500 lineal feet of seam, or at least one per seaming device per crew per day. The purpose of these tests is to check that welds are fully integrated with each other and to evaluate seam strength. Seam strength testing shall be done as the seaming work progresses, not at the completion of field seaming.

5.5.2.1 Location and Frequency

The QAC shall select locations where seam samples will be cut. These locations shall be estimated as follows:

a) A minimum frequency of one test location per 500 feet of seam length, or at least one per seaming device per crew per day. This minimum frequency is to be determined as an average taken throughout the entire facility.
b) The seaming technician shall not be informed in advance of the locations where the seam samples will be taken.

Sampling Procedure

Sampling shall be cut by the installer as the seaming progresses in order to have laboratory test results before the geomembrane is covered by another material. The GI shall:

a) Cut samples.
b) Assign a number to each sample that is to be based upon seam and sample number and mark it accordingly.
c) Record sample location on construction record drawings.
d) All holes in the geomembrane resulting from destructive seam sampling shall be immediately repaired in accordance with repair procedures described in Section 5.6. The continuity of the new seams in the repaired area shall be tested according to this section.

5.5.2.2 Size of Samples

Samples shall be 16 X 44 inches wide for testing. The first two samples for field-testing shall be taken by the installer. Each of these samples shall be 1 inch wide with the seam-

centered perpendicular to the length. The distance between these two samples shall be at minimum 38 inches.

If both samples pass the field tensiometer test, the remaining portion between the initial samples shall be cut into three parts and distributed as follows:

1. One portion to INSTALLER for field documentation testing (16 in. by 15 in.).
2. One portion to OWNER independent laboratory testing (16 in. by 15 in.).
3. One portion to OWNER for archive storage (16 in. by 12 in.).

Final determination of the sample sizes shall be determined prior to liner installation at the preconstruction meeting.

5.5.3 Field Testing

The two 1-inch wide strips shall be tested in the field for peel and shear and shall not fail in the seam. For field testing, the INSTALLER shall cut 10 identical 1-inch wide replicated specimens from his sample. The INSTALLER shall test five specimens for seam shear strength and five for peel strength. Peel tests shall be performed on both inside and outside weld tracks. To be acceptable 4 out of 5 specimens must pass the test criteria with less than 10% separation. If any field test sample fails to pass, then the procedures outlined in this section shall be followed.

5.5.4 Laboratory Testing

Passing tensiometer testing in the field qualifies the sample for laboratory testing.

Destructive test samples shall be packaged and shipped to the geomembrane testing laboratory consultants by overnight mail. The laboratory shall provide verbal test results to the QAC.

Destructive testing involves two techniques: 1) shear testing, and 2) peel testing. Shear testing applies a tensile stress from the top sheet through the weld and into the bottom sheet. Peel testing peels the top sheet back against the overlapped edge of the bottom sheet in order to observe how separation occurs. The peel test indicates whether or not the sheets are continuously and homogeneously connected through the seam. A total of 10 coupons will be subject to testing, for which five will be tested in shear and 5 in peel (ASTM 6392). Fusion seam specimens will have both tracks tested in peel.

Both tests (shear and peel) must have a Film Tearing Bond (FTB) type of separation to pass. With an FTB, the polymer material tears indicating a fully integrated connection between top and bottom sheets. It is important that no weld bead/sheet or sheet/sheet interface exists as such an interface might be separated by absorbed chemicals, causing failure of the seam.

The QAC shall document the following for each non-destructive seam test:

- Location
- Seam number
- Welder I.D.
- Seamer

- Sample I.D.

5.5.5 Procedures for Destructive Test Failure

The following procedures shall apply whenever a sample fails a destructive test. The GI has two options:

1. Reconstruct the seam between the two adjacent passed test locations.

2. Trace the welding path to intermediate locations (10 feet minimum from the point of the failed test in each direction) and take a sample for an additional field test at each location. If these additional samples pass the field test, then full laboratory samples shall be taken. If these laboratory samples pass the tests, then the seam is reconstructed between these locations. If either laboratory sample fails, then the process is repeated to establish the zone in which the seam shall be reconstructed.

All acceptable seams must be bound by two locations from which samples passing laboratory destructive tests have been taken.

The GI shall document all actions taken in conjunction with destructive test failures; e.g., capping of failed seam area.

5.6 DEFECT AND REPAIRS

All seams and non-seam areas of the geomembrane shall be examined by the installer for identification of defects, holes, blisters, un-dispersed raw materials and any sign of contamination by foreign matter.

5.6.1 Evaluation

Each suspect location both in seam and non-seam areas shall be nondestructively tested using the methods described in this section as appropriate. Each location that fails the nondestructive testing shall be marked by the GI and repaired. Work shall not proceed with any materials that will cover locations that have been repaired until non-destructive test results are recorded.

5.6.2 Repair Procedures

All portions of the geomembrane exhibiting a flaw or failing a destructive or nondestructive test shall be repaired. Several procedures exist for the repair of these areas. The final decision as to the appropriate repair procedure shall be agreed upon between the QAC, GI, and Owner. The procedures available include:

1. Patching: Used to repair large holes, tears, and contamination by foreign matter.
2. Buffing and re-welding: Used to repair small sections of extruded seams.
3. Spot welding or seaming: Used to repair small tears, pinholes, or other minor localized flaws.
4. Capping: Used to repair areas of inadequate seams that have an exposed edge.

In addition, the following provisions shall be satisfied:

1. Surfaces of the geomembrane that are to be repaired shall be abraded no more than one hour prior to the repair.
2. Surfaces must be clean and dry at the time of repair.
3. Seaming equipment used in repairing procedures must be approved.

The repair procedures, materials, and techniques shall be approved in advance of the specific repair by the QAC.

Patches or caps shall extend at least 6 inches beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least 3 inches.

5.6.3 Verification of Repairs

Each major repair requiring a patch or cap shall be identified in the GI's repair. Each repair shall use nondestructive test methods described in this section as appropriate. Repairs that pass the nondestructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be re-done and re-tested until a passing test results are obtained. The QAC may choose to take a destructive test in an area of repair. The QAC shall document the location of each type of repair and the type of repair made.

5.7 FINAL ACCEPTANCE

The geomembrane must be observed for completion of liner construction activities. The final inspection shall be performed by the QAC, GI and Owner. The QAC and GI shall document completion or incompletion. The GI shall repair or complete any testing that has been determined incomplete. The QAC and GI shall then re-inspect the repairs and observe testing to complete final inspection.

Geomembrane material shall be final inspected prior to being covered by overlying geosynthetic materials or soil layers. Vehicle use directly over the geomembrane is prohibited as a standard means of deployment. The QAC will be performing an electric liner leak location survey on the primary geomembrane once the granular drainage layer is placed. Leaks found during the liner leak location survey shall be repaired by the GI in accordance with Section 5.6 of this document.

The geosynthetic lining system shall be accepted when the liner leak location survey, leaks found during that survey are repaired and final observation and documentation is complete and approved by the QAC and Owner.

5.8 CONFORMANCE WITH PROJECT SPECIFICATIONS

The QAC shall document that the installation and necessary repairs were done in accordance with the project specifications

6.0 Geonet/Geotextile Composite

6.1 GENERAL

A geonet/geotextile geocomposite consists of a HDPE geonet with a geotextile heat-bonded to one or both sides. This geocomposite is used as a synthetic drainage layer in the secondary collection system of the composite base liner.

6.2 MATERIAL QUALITY CONTROL

The manufacturer shall provide a list of guaranteed minimum average roll value properties for the specified geotextile and geonet to be installed. The manufacturer shall also provide a list of guaranteed minimum average roll value properties for the specified geocomposite to be installed. Each roll of geocomposite shall bear a label that identifies the properties

The QAC will examine results and report any nonconformance to Owner. QC results will be reviewed and accepted or rejected by the QAC prior to deployment.

6.3 SUBGRADE

The GI shall be responsible for preparing the subgrade for the geocomposite. Once complete, the QAC shall examine the surface, and verify the adequacy of the documentation completed and any test data required. When the QAC deems the surface acceptable the QAC shall prepare an acceptance certificate for the Owner. The acceptance certificate shall state the following at a minimum:

1. Documentation of the underlying geosynthetics is complete, and any necessary tests show satisfactory results.

At any time during installation of the geonet, the QAC shall inform the Owner of any areas that are unacceptable. The GI shall correct such defects in the subgrade such that repaired areas meet the project specifications. The subgrade for the geocomposite will be clear of any clay, stones, or other debris that could clog or damage the geocomposite.

6.4 OBSERVATION AND DOCUMENTATION

6.4.1 Roll Inspection

Prior to placement, the QAC and GI shall inspect rolls for damage and defects.

During shipment and storage, geocomposite shall be protected from ultraviolet light exposure, precipitation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions. Consistent with these objectives, geocomposite rolls shall be shipped and stored in relatively opaque and watertight wrappings. The GI shall be responsible for proper on-site storage of all geosynthetic materials.

6.4.2 Placement

Geocomposites shall be handled in such a manner as to ensure they are not damaged. On slopes, geocomposites shall be anchored in the anchor trench; then rolled down the slope in such a manner as to minimize wrinkles.

In the presence of wind, the materials shall be weighted with sandbags until final covers are installed. Care shall be taken to ensure that any underlying liners/layers are not damaged during placement of geocomposites.

Care shall be taken to ensure that stones, mud, dirt and debris are not entrapped beneath the geocomposites during placement and seaming operations that cause damage.

6.4.3 Seaming

6.4.3.1 Geonet

Geonets may be butt-jointed or lapped in accordance with manufacturer's specifications. Nylon cable ties shall be applied to the net edge at 5-foot intervals along the edge.

End splices shall be made as follows: On slopes, the ends shall overlap 2 feet, in a shingle configuration, and two rows of cable ties applied at each overlap.

On bottoms, the ends shall overlap a minimum of 2 inches, in a shingle configuration, and one row of three cable ties applied.

6.4.3.2 Geotextile

Geotextiles shall be sealed by overlapping 4 inches and sewing or by an alternate method as approved by the QAC.
Sewing threads shall be a polymeric material with chemical resistance similar to the geotextile.

The QAC shall document that the panel overlap meets the project specifications and that there are no excessive folds or wrinkles in the geocomposite.

6.5 DAMAGE AND REPAIRS

6.5.1 Geonet

Any holes or tears in defects shall be repaired by patching with the same geonet. The patch shall extend beyond the damaged area a minimum of 2 feet and shall be tied in place using nylon cable ties every 6 inches (four minimum).

6.5.2 Geotextile

Any holes or tears in geotextiles shall be repaired by patching with the same geonet. The patch shall be tied in place using a minimum of four nylon cable ties. The QAC shall document that any holes or defects are repaired.

6.6 DAMAGE AND REPAIRS

The QAC shall document that the installation and necessary repairs were done in accordance with the project specifications.

7.0 Granular Drainage Media

7.1 GENERAL

The granular drainage media consists of natural material used as a drainage layer in the base liner or cover system.

7.2 MATERIAL QUALITY CONTROL

Samples of the granular drainage media will be tested for grain size distribution and hydraulic conductivity. Frequencies are provided in Table 1. and acceptability criteria are listed in the technical specifications.

The QAC shall examine the results and report any nonconformance to the Owner. QC results shall be reviewed and accepted or rejected by the QAC prior to installation.

7.3 OBSERVATION AND DOCUMENTATION

Observations of the construction work by QAC or Owner include the following:

- Hauling of material to ensure no damage to underlying geosynthetics
- Spreading of granular drainage media material to ensure excess wrinkling of underlying geosynthetics does not occur.
- Placement of filter aggregates to ensure pipes are properly bedded and covered.
- Documentation will include; laboratory test data, material information, placement methods and thicknesses, and construction procedures used to prevent migration of fines by run-off into the leachate collection system.

7.4 TESTING

Laboratory test methods and frequencies to develop data upon which acceptability evaluations can be based will be as provided in Table 1.

CQA testing will be conducted on samples taken from the material during the course of construction. Sampling locations will be selected by QAC or Owner according to the number of required tests. Locations of all tests will be documented for report purposes.

7.5 DAMAGE AND REPAIRS

Granular drainage media that does not meet the requirements of the CQA Plan or the Specifications will be removed and replaced with suitable material.

7.6 SURVEY

The minimum thickness of soil drainage media shall be as shown on the drawings and extending over the lining system. The thickness of granular drainage media shall be verified on a grid spacing as specified in Table 3 using consistent methods that shall not damage the liner. Grading tolerances are provided in Table 3.

7.7 CONFORMACE WITH PROJECT SPECIFICATIONS

The QAC shall document that the granular drainage media installation was done in accordance with the project specifications.

8.0 Piping Systems

8.1 GENERAL

This section addresses the HDPE piping installed for the leachate collection system.

8.2 MATERIAL QUALITY CONTROL

The EC (or other piping contractor, if applicable) shall inspect all piping and fittings received at the site and shall verify that piping materials are:

1) In accordance with drawings and specifications (size, SDR ratio, material)
2) Free of material defects
3) Undamaged

EC shall be responsible for storing piping materials in a protected location where they will not be damaged.

The QAC shall examine the results and report any nonconformance to the Owner. QC results shall be reviewed and accepted or rejected by the QAC prior to installation.

8.3 OBSERVATION AND DOCUMENTATION

8.3.1 Installation

EC shall install piping at locations and elevations as shown on drawings. All piping connections shall be made in accordance with manufacturer's recommendations. Installation of backfill around piping shall be done carefully to ensure damage to the piping does not occur. QAC will document piping types installed, methods of connection/fitting types, and backfilling procedures. Documentation of the piping will include information on the method used to join sections of the pipe.

The sumps and any leachate removal/detection equipment will be documented by the QAC, including; material and equipment, coatings and electrical/mechanical requirements.

8.4 DAMAGE AND REPAIRS

Damaged or defective portions, as determined by QAC of the piping, will be removed and replaced.

8.5 SURVEY

The piping trenches will be surveyed for horizontal and vertical position. Critical points of the leachate piping will be surveyed. Invert tolerances are provided in Table 3.

8.6 CONFORMANCE WITH PROJECT SPECIFICATIONS

The QAC shall document that the piping installation was done in accordance with the project specifications.

9.0 Vegetative Soils

9.1 GENERAL

The vegetative layer will be topsoil capable of sustaining vegetative grasses over areas disturbed during construction.

9.2 OBSERVATION AND DOCUMENTATION

The QAC will observe and document the placement methods of the vegetative soils. The EC (or other contractor, if applicable) shall ensure conformance to the project requirements regarding topsoil quality and placement, fertilizer content and application, seed mixture, seeding operations, mulching, and reseeding/repair work to sustain vegetation.

The QAC shall examine the results and report any nonconformance to the Owner. QC results shall be reviewed and accepted or rejected by the QAC prior to installation.

9.3 DAMAGE AND REPAIR

Seeded areas must be guaranteed by the EC to be alive and in satisfactory growth for a period of 1 year. If areas of non-growth or spotty growth are present, they will be reseeded.

Tables

TABLE 1

Soils Quality Assurance Testing Requirements

Subgrade		
Test	**ASTM Method**	**Frequency**
Standard Proctor	D698	Minimum 1
Moisture/Density	D2922-81 (nuclear) D3017-78 (nuclear)	1/Acre
USCS Classification	D2487	1/Acre

Clay Barrier Testing		
Test	**ASTM Method**	**Frequency**
Grain Size	D422 and D1140	1 per acre/foot
Atterberg Limits	D4318	
USCS Classification	D2487	
Standard Proctor	D698	
Hydraulic Conductivity	D5084 or Corps of Engineers Method	
Dry Density and Moisture Content	D2922-81 (nuclear) D3017-78 (nuclear)	Test on 100 foot grid pattern Offset every lift-min 5 tests/acre

Granular Drainage Layer Testing		
Test	**Method**	**Number of Tests**
Grain Size	D422 and D1140	1/1000 cubic yards
USCS Classification	D2487	
Hydraulic Conductivity	D2434	1 per acre

Coarse and Intermediate Aggregate Testing		
Test	**Method**	**Number of Tests**
Grain Size	D422	1/1000 lineal foot pipe (minimum 3)
USCS Classification	D2487	1/1000 lineal foot pipe (minimum 3)

TABLE 2

Geomembrane Quality Assurance Testing Requirements

HDPE Geomembrane Testing		
Test	**Reference**	**Frequency**
Material Properties	GRI GM 13	By manufacturer Every roll provided
Visual Inspection	--	Entire sheet
Trial Seam Welding	CQA Plan Section 5.4.3	Start of seaming process, any time equipment turned off, at the end of each work day, every 4 hours minimum, each seamer or seaming apparatus
Non-Destructive Seam Testing	CQA Plan Section 5.5.1	All seams/patches
Destructive Seam Strength Test	GRI GM 19 ASTM D 6392 Pass Fail Criteria in Accordance with GRI GM 19 Table 1A	1 test per 500 L.F. seam minimum

TABLE 3

Grading Tolerances

Soil Layer/Surface	Measurement	Method	Pass/Fail Criteria	Frequency
Top of Subgrade	Elevation	Survey	-0.2’ to 0.0’	50’ Grid and Breaklines
Top of Clay Barrier Layer	Thickness	Survey	0.0’ to +0.2’	50’ Grid and Breaklines
Top of Protective Soil Layer	Thickness	Survey	0.0’ to +0.2’	50’ Grid and break lines
Top of Cover Soil Layer	Thickness	Survey	0.0’ to +0.2’	50’ Grid and Breaklines
Top of Final Cover	Elevation	Survey	-0.2’ to +0.4’	50’ Grid and Breaklines

Appendix E

Pipe Strength Calculations

Excerpted from "Permit Issuance and Design Report", prepared by Conestoga Rover and Associates, August 2011.

Pipe Loading Calculations - Piping

Site: SKB Lansing
Location: Austin, MN
Client: SKB
Project #: 75704-5000

Reference: Plastic Pipe Manual, Chapter 6

Design Criteria

Material	Density (pcf)	Depth (ft)	Load (psf)
Final Cover Soil	110	2	220
Refuse	65	124	8,060
Coarse Aggregate	130	2	260
Total Load			8,540

Total Load (vertical) = 8,540 psf
Total Load (vertical) = 59.3 psi

Dynamic Load

CAT D4 =	580 psf	Load Duration =	50 yr	lbs/in^2
Dynamic Factor =	1.3	Temperature (F) =	100	
Total dynamic load =	754 psf	E =	20,440	
Total dynamic load =	5.2 psi			

Soil E' =	2,000 lbs/in^2	Soil Type =	Type III
SDR =	11	Compaction =	<85%
Do =	6.625 in	Pipe Outside Diameter	
t =	0.60 in	Pipe Wall Thickness	

Wall Compression

$$S = \frac{P_t * D_o}{288\ t}$$

Equation (3-13)

S = 355.14 lbs/in^2
FS = 2.82

S = pipe wall compressive stress, psi
Allowable compressive stress of PE3408 or PE3608 is 1,000 psi
(Reference Table C.1 in Chapter 3 of reference)

Elastic Modulus (E) from Polyethylene Pipe, Chapter 3, Table B.1.1
(Includes temperature compensating multipliers per Table B.1.2 for temp's other than 73-degrees)

Load Duration	Elastic Modulus, 1000 psi, at Temperature (F)							
	-20	0	40	60	73	100	120	140
Short-Term								
10h	157.48	135.16	92.38	73.16	62	45.26	35.96	26.66
100h	132.08	113.36	77.48	61.36	52	37.96	30.16	22.36
1000h	111.76	95.92	65.56	51.92	44	32.12	25.52	18.92
1 yr	96.52	82.84	56.62	44.84	38	27.74	22.04	16.34
10 yr	81.28	69.76	47.68	37.76	32	23.36	18.56	13.76
50 yr	71.12	61.04	41.72	33.04	28	20.44	16.24	12.04

E' Values for Iowa Formula (Table 3-7 in reference)

Soil Type	E' for Degree of Compaction (psi)			
	Dumped (NA)	Slight <85%	Moderate 48%-95%	High >95%
Type I	50	200	400	1,000
Type II	100	400	1,000	2,000
Type III	200	1,000	2,000	3,000
Crushed Rock	1,000	3,000	3,000	3,000

Notes:
Type I = LL<50; CL, ML, CL-ML, w/<25% coarse grained
Type II = LL<50; CL, ML, CL-ML, w/>25% coarse grained
GM, GC, SM, SC; w/>12% fines
Type III = GW, GP, SW, SP; <12% fines

R = buoyancy reduction factor
H' = groundwater height above pipe, ft
H = cover above pipe, ft
B' = elastic support factor

Wall Buckling (Constrained Pipe); Luscher Equation (3-15)

$$P_{WC} = \left(\frac{5.65}{N}\right)\sqrt{RB'E'\left(\frac{E}{12*(DR-1)^3}\right)}$$

R = 1 - 0.33*(H'/H)
B' = (1/(1+4exp(-0.065*H))

H' = 0 ft (ht of groundwater)
H = 128 ft

R =	1		Buoyancy reduction factor
B' =	0.9990266		Soil support factor
N =	2		Factor of Safety
P_{WC} =	164.81	lbs/in^2	Allowable constrained buckling pressure, psi
P_{WC} =	23,732.00	lbs/ft^2	
Pt =	9,120.00	lbs/ft^2	(Account for groundwater, if present)

Conclusion: The allowable buckling pressure is greater than the applied load pressure, therefore, HDPE SDR 11 is satisfactory for this installation.

Ring Deflection

Using Spangler's Modified Iowa Formula for solid wall PE pipe
Equation (3-10) in reference

$$\frac{\Delta X}{D_l} = \left(\frac{P_l}{144}\right)\frac{K*L}{\frac{2*E}{3*(DR-1)^3} + 0.061*E'}$$

K = 0.1 bedding factor
L = 1 deflection lag factor

Delta X/Dl = 0.0466968
% Deflection = 4.6696815

Conclusion: The ring deflection is less than the safe pipe deflection of 7.5% for non-pressure piping (Chapter 6, page 218); or 5% for pressure piping for DR 11 piping (Table 3-11)

Appendix F

HELP Model

WATER BALANCE SUMMARY

Water balance calculations were performed on the lined landfill area to estimate the quantity of leachate generated. The water balance was calculated using the Hydrologic Evaluation of Landfill Performance (HELP) model, Version 3.07 (1 November 1997), developed for the United States Environmental Protection Agency (EPA). The HELP model is generally used more as a qualitative model for determining landfill performance efficiencies rather than a quantitative model for actual leachate generation rates and has many limitations for this type of analysis. However, it is one of the few models available which is generally accepted as a standard tool for estimating leachate volumes.

1.0 GENERAL CONDITIONS FOR THE HELP MODEL

The input data for the HELP model such as climatological parameters, soil layer characteristics, liner leakage inputs, and other model design criteria required are described in the following sections:

1.1 CLIMATOLOGICAL DATA

The temperature, solar radiation, and precipitation data used for the water balance is synthetically generated within the model based on climatological patterns for St. Cloud, Minnesota. These data were used for the model simulation for both the active and closed conditions.

All modeling was performed for leachate generation and surface water runoff on a per acre basis. For conservatism, it was assumed that the landfill was in the open condition with daily cover in-place.

All modeling was performed for leachate generation on a per acre basis.

1.2 SOIL LAYER CHARACTERISTICS

Since leachate will be collected from phases with varied states of cover configurations, two unique sets of soil characteristics were utilized. The model was run to show the effects of the active landfill case with intermediate cover and the effects after the final cover is placed. The attached tables specify the HELP model criteria that were used.

2.0 SUMMARY

The average and peak heads on the liner were both less than 1 inch for both open and closed conditions. The coverage liner efficiency was over 99 percent.

75704 HELP MODEL ASSESSMENT
34 ACRE FINAL COVER - CLOSED CONDITION

Nearby City: Minneapolis MN
Latitude: 43.39 (adjusted to Austin)
Evaporative Zone Depth: 12 inches
Maximum Leaf Area Index: 2 (0=bare, 1=Poor Stand of Grass, 2=Fair Stand of Grass, 3.5=Good Stand of Grass, 5=Excellent Stand of Grass) .
[This is different from the Vegetative cover for the Run-off Coefficient calculation]
Growing Season Start Date: 128 – Based on St. Cloud MN
Growing Season End Date: 271 – Based on St. Cloud MN
Average Wind Speed: 8.0 m/h – Based on St. Cloud MN
Q1 Relative Humidity: 72% – Based on St. Cloud MN
Q2 Relative Humidity: 66% – Based on St. Cloud MN
Q3 Relative Humidity: 72% – Based on St. Cloud MN
Q4 Relative Humidity: 74% – Based on St. Cloud MN
Vegetation = 3 (Fair Stand of Grass)
Percent of Surface Area Where Runoff is Possible: 100

Precipitation
Default: St. Cloud MN
Modeled 1974 - 1978

Solar Radiation and Temperature Data
Generated synthetically using St. Cloud MN as nearby city and latitude adjusted to 43.39 (Austin)
Modeled over 5 years

OUTPUT FILE	Layer Profile No.	Type	Description	K (cm/s)	Slope	Slope Length (ft)	Depth (inches)	Maximum Head on Layer During Peak (inches)	Average Head on Layer During Peak (inches)	Drainage Collected Peak Daily Volume Years 1-5 (gal)
75704X6	1	Vertical Percolation	Top Soil [HELP default 8 (ML)]	3.7×10^{-4}			6			
	2	Vertical Percolation	Cover Soil [HELP default 12 (CL)]	4.2×10^{-5}			18			
	3	Lateral Drainage	Drainage Net: [HELP Default 34 (0.6mm)]	39.4 cm/s	2.0%	100	0.2			544,309
	4	Geomembrane Liner	40mil LDPE: [HELP Default 36][2]	4.0×10^{-13}			0.04	0.026	0.014	
	5	Vertical Percolation	Sand: [HELP default 1 (SP)]	1.0×10^{-2}			12			
	6	Vertical Percolation	Waste [HELP default 31][1]	0.0041			1200			
	7	Vertical Percolation	Sand: [HELP default 1 (SP)]	1.0×10^{-2}			12			
	8	Lateral Drainage	Drainage Net: [HELP Default 34 (0.6mm)]	39.4 cm/s	2.0%	100	0.2			14.51370
	9	Geomembrane Liner	60mil HDPE: [HELP Default 35][2]	2×10^{-13}			0.06	0.001	0.000	
	10	Barrier Soil Layer	Barrier Soil: [HELP Default 16]	1×10^{-7}			24			

Notes

(1) - IWEM Technical Background Document Section 4.0, Table 4.8 "Moisture Retention Parameters for the Modeled WP Materials" Waste Type: Moderate Permeability

(2) - Pinhole Density = 1/acre, Installation Defects = 4/acre (Good Installation Quality), Placement Quality = 3 (Good).

75704 HELP MODEL ASSESSMENT
5 ACRE ACTIVE MOUND - OPEN CONDITION

Nearby City: Minneapolis MN
Latitude: 43.39 (adjusted to Austin)
Evaporative Zone Depth: 8 inches (Bare Ground)
Maximum Leaf Area Index: 0 (0=bare, 1=Poor Stand of Grass, 2=Fair Stand of Grass, 3.5=Good Stand of Grass, 5=Excellent Stand of Grass) . This is different from the Vegetative cover for the Run-off Coefficient calculation
Growing Season Start Date: 128 - Based on St. Cloud MN
Growing Season End Date: 271 - Based on St. Cloud MN
Average Wind Speed: 8.0 m/h - Based on St. Cloud MN
Q1 Relative Humidity: 72% - Based on St. Cloud MN
Q2 Relative Humidity: 66% - Based on St. Cloud MN
Q3 Relative Humidity: 72% - Based on St. Cloud MN
Q4 Relative Humidity: 74% - Based on St. Cloud MN
Vegetation Cover = 1 (Bare Ground)
Percent of Surface Area Where Runoff is Possible: 0

Precipitation
Default: St. Cloud MN
Modeled 1974 - 1978

Solar Radiation and Temperature Data
Generated synthetically using St. Cloud MN as nearby city and latitude adjusted to 43.39 (Austin)
Modeled over 5 years

OUTPUT FILE	Layer Profile No.	Type	Description	K (cm/s)	Slope	Slope Length (ft)	Depth (inches)	Maximum Head on Layer During Peak (inches)	Average Head on Layer During Peak (inches)	Drainage Collected Peak Daily Volume Years 1-5 (gal)
75704X4	1	Vertical Percolation	Cover Material [HELP default (CL)]	4.2×10^{-5}			12			8712
	2	Vertical Percolation	Waste[1]	0.0041			300	0.001	0.001	
	3	Vertical Percolation	Sand: [HELP default (SP)]	1.0×10^{-2}			12			
	4	Lateral Drainage	Drainage Net: [HELP Default 34 (0.6mm)]	39.4 cm/s	2.0%	100	0.2			
	5	Geomembrane Liner	60mil HDPE: [HELP Default][2]	2×10^{-13}			0.06			
	6	Barrier Soil Layer	Barrier Soil: [HELP Default]	1×10^{-7}			24			

Notes
(1) - IWEM Technical Background Document Section 4.0, Table 4.8 "Moisture Retention Parameters for the Modeled WP Materials" Waste Type: Moderate Permeability
(2) - Pinhole Density = 1/acre, Installation Defects = 4/acre (Good Installation Quality), Placement Quality = 3 (Good).

WARNING: TEMPERATURE FOR YEAR 1 USED WITH PRECIPITATION FOR YEAR 1974

WARNING: SOLAR RADIATION FOR YEAR 1 USED WITH PRECIPITATION FOR YEAR 1974

```
**********************************************************************************
**********************************************************************************
**                                                                              **
**                                                                              **
**              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:     I:\SOFTWARE\HELP3\75704p4.D4
TEMPERATURE DATA FILE:       i:\software\help3\75704t4.D7
SOLAR RADIATION DATA FILE:   i:\software\help3\75704r4.D13
EVAPOTRANSPIRATION DATA:     i:\software\help3\75704e4.D11
SOIL AND DESIGN DATA FILE:   I:\SOFTWARE\HELP3\75704s4.D10
OUTPUT DATA FILE:            i:\software\help3\75704x4.OUT

TIME:  12:59     DATE:   8/29/2011

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

     TITLE:  75704-5000 Open Condition

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

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


                                  LAYER  1
                                  --------

                TYPE 1 - VERTICAL PERCOLATION LAYER
                    MATERIAL TEXTURE NUMBER  12
          THICKNESS                    =     12.00   INCHES
          POROSITY                     =      0.4710 VOL/VOL
          FIELD CAPACITY               =      0.3420 VOL/VOL
          WILTING POINT                =      0.2100 VOL/VOL
          INITIAL SOIL WATER CONTENT   =      0.2942 VOL/VOL
          EFFECTIVE SAT. HYD. COND.    =  0.419999997000E-04 CM/SEC
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 31

THICKNESS	=	300.00	INCHES
POROSITY	=	0.5780	VOL/VOL
FIELD CAPACITY	=	0.0760	VOL/VOL
WILTING POINT	=	0.0250	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0937	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.410000002000E-02	CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 1

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0450	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999978000E-02	CM/SEC

LAYER 4

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.20	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	39.4000015000	CM/SEC
SLOPE	=	2.00	PERCENT
DRAINAGE LENGTH	=	100.0	FEET

LAYER 5

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL

WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY	=	1.00 HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00 HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD

LAYER 6

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	24.00 INCHES
POROSITY	=	0.4270 VOL/VOL
FIELD CAPACITY	=	0.4180 VOL/VOL
WILTING POINT	=	0.3670 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #12 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 100. FEET.

SCS RUNOFF CURVE NUMBER	=	95.30	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	5.000	ACRES
EVAPORATIVE ZONE DEPTH	=	8.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	2.162	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	3.768	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.680	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	42.434	INCHES
TOTAL INITIAL WATER	=	42.434	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ST. CLOUD MINNESOTA

STATION LATITUDE	=	43.39 DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00

START OF GROWING SEASON (JULIAN DATE) = 128
END OF GROWING SEASON (JULIAN DATE) = 271
EVAPORATIVE ZONE DEPTH = 8.0 INCHES
AVERAGE ANNUAL WIND SPEED = 8.00 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 72.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 66.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 72.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 74.00 %

NOTE: PRECIPITATION DATA FOR ST. CLOUD MINNESOTA
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR MINNEAPOLIS MINNESOTA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
11.20	17.50	29.20	46.00	58.50	68.10
73.10	70.60	60.60	49.60	33.20	19.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR MINNEAPOLIS MINNESOTA
AND STATION LATITUDE = 43.39 DEGREES

WARNING: TEMPERATURE FOR YEAR 1 USED WITH PRECIPITATION FOR YEAR 1974

WARNING: SOLAR RADIATION FOR YEAR 1 USED WITH PRECIPITATION FOR YEAR 1974

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

****

DAILY OUTPUT FOR YEAR 1974

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.
---	-	-	-----	------	------	-------	---------	---------	---------

1	*	*	0.00	0.000	0.000	0.2703	0.0000	.1505E-04	.6807E-08
2	*	*	0.00	0.000	0.000	0.2703	0.0000	.1504E-04	.6807E-08
3	*	*	0.00	0.000	0.000	0.2703	0.0000	.1504E-04	.6807E-08
4	*	*	0.00	0.000	0.000	0.2703	0.0000	.1504E-04	.6807E-08
5	*	*	0.00	0.000	0.000	0.2703	0.0000	.1503E-04	.6807E-08
6	*	*	0.00	0.000	0.000	0.2703	0.0000	.1503E-04	.6807E-08
7	*	*	0.00	0.000	0.000	0.2703	0.0000	.1502E-04	.6807E-08
8	*	*	0.01	0.000	0.010	0.2703	0.0000	.4225E-06	.3141E-09
9	*	*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
10	*	*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
11	*	*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
12	*	*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
13	*	*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
14	*	*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
15	*	*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
16	*	*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
17	*	*	0.01	0.000	0.010	0.2703	0.0000	.0000E+00	.0000E+00
18	*	*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
19	*	*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
20	*	*	0.02	0.000	0.020	0.2703	0.0000	.0000E+00	.0000E+00
21		*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
22	*	*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
23		*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
24		*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
25	*	*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
26	*	*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
27	*	*	0.01	0.000	0.010	0.2703	0.0000	.0000E+00	.0000E+00
28	*	*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
29	*	*	0.04	0.000	0.024	0.2703	0.0000	.0000E+00	.0000E+00
30	*	*	0.00	0.000	0.016	0.2703	0.0000	.0000E+00	.0000E+00
31	*	*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
32	*	*	0.12	0.000	0.019	0.2703	0.0000	.0000E+00	.0000E+00
33	*	*	0.16	0.000	0.015	0.2703	0.0000	.0000E+00	.0000E+00
34	*	*	0.00	0.000	0.019	0.2703	0.0000	.0000E+00	.0000E+00
35	*	*	0.19	0.000	0.013	0.2703	0.0000	.0000E+00	.0000E+00
36	*	*	0.07	0.000	0.013	0.2703	0.0000	.0000E+00	.0000E+00
37	*	*	0.00	0.000	0.016	0.2703	0.0000	.0000E+00	.0000E+00
38	*	*	0.00	0.000	0.000	0.2703	0.0000	.0000E+00	.0000E+00
39	*	*	0.00	0.000	0.026	0.2703	0.0000	.0000E+00	.0000E+00
40	*	*	0.04	0.000	0.024	0.2703	0.0000	.0000E+00	.0000E+00
41		*	0.00	0.000	0.001	0.3099	0.0000	.0000E+00	.0000E+00
42		*	0.00	0.000	0.035	0.3202	0.0000	.0000E+00	.0000E+00
43	*	*	0.00	0.000	0.000	0.3202	0.0000	.0000E+00	.0000E+00
44		*	0.00	0.000	0.000	0.3202	0.0000	.0000E+00	.0000E+00
45		*	0.02	0.000	0.001	0.3225	0.0000	.0000E+00	.0000E+00
46		*	0.04	0.000	0.001	0.3274	0.0000	.0000E+00	.0000E+00
47	*	*	0.00	0.000	0.000	0.3274	0.0000	.0000E+00	.0000E+00
48	*	*	0.00	0.000	0.000	0.3274	0.0000	.0000E+00	.0000E+00
49	*	*	0.00	0.000	0.000	0.3274	0.0000	.0000E+00	.0000E+00
50	*	*	0.00	0.000	0.000	0.3274	0.0000	.0000E+00	.0000E+00
51	*	*	0.04	0.000	0.032	0.3274	0.0000	.0000E+00	.0000E+00
52	*	*	0.14	0.000	0.033	0.3274	0.0000	.0000E+00	.0000E+00
53	*	*	0.00	0.000	0.028	0.3274	0.0000	.0000E+00	.0000E+00
54	*	*	0.00	0.000	0.026	0.3274	0.0000	.0000E+00	.0000E+00
55	*	*	0.00	0.000	0.030	0.3274	0.0000	.0000E+00	.0000E+00
56	*	*	0.00	0.000	0.021	0.3274	0.0000	.0000E+00	.0000E+00

57	*	*	0.00	0.000	0.010	0.3274	0.0000	.0000E+00	.0000E+00
58	*	*	0.00	0.000	0.000	0.3274	0.0000	.0000E+00	.0000E+00
59	*	*	0.01	0.000	0.010	0.3274	0.0000	.0000E+00	.0000E+00
60	*	*	0.00	0.000	0.000	0.3274	0.0000	.0000E+00	.0000E+00
61	*	*	0.00	0.000	0.000	0.3274	0.0000	.0000E+00	.0000E+00
62	*	*	0.00	0.000	0.000	0.3274	0.0000	.0000E+00	.0000E+00
63	*	*	0.00	0.000	0.000	0.3274	0.0000	.0000E+00	.0000E+00
64	*	*	0.00	0.000	0.000	0.3274	0.0000	.0000E+00	.0000E+00
65	*	*	0.00	0.000	0.000	0.3274	0.0000	.0000E+00	.0000E+00
66	*	*	0.00	0.000	0.000	0.3274	0.0000	.0000E+00	.0000E+00
67	*	*	0.00	0.000	0.000	0.3274	0.0000	.0000E+00	.0000E+00
68	*	*	0.00	0.000	0.000	0.3274	0.0000	.0000E+00	.0000E+00
69	*	*	0.00	0.000	0.000	0.3274	0.0000	.0000E+00	.0000E+00
70	*	*	0.00	0.000	0.000	0.3274	0.0000	.0000E+00	.0000E+00
71	*	*	0.00	0.000	0.000	0.3274	0.0000	.0000E+00	.0000E+00
72	*	*	0.00	0.000	0.000	0.3274	0.0000	.0000E+00	.0000E+00
73	*	*	0.26	0.000	0.019	0.3274	0.0000	.0000E+00	.0000E+00
74	*	*	0.03	0.000	0.022	0.3274	0.0000	.0000E+00	.0000E+00
75		*	0.00	0.000	0.038	0.3537	0.0000	.0000E+00	.0000E+00
76		*	0.00	0.000	0.000	0.3537	0.0000	.0000E+00	.0000E+00
77	*	*	0.00	0.000	0.000	0.3537	0.0000	.0000E+00	.0000E+00
78		*	0.00	0.000	0.000	0.3537	0.0000	.0000E+00	.0000E+00
79		*	0.00	0.000	0.000	0.3537	0.0000	.0000E+00	.0000E+00
80		*	0.00	0.000	0.000	0.3537	0.0000	.0000E+00	.0000E+00
81		*	0.06	0.000	0.001	0.3611	0.0000	.0000E+00	.0000E+00
82	*	*	0.00	0.000	0.000	0.3611	0.0000	.0000E+00	.0000E+00
83	*	*	0.00	0.000	0.000	0.3611	0.0000	.0000E+00	.0000E+00
84		*	0.00	0.000	0.000	0.3611	0.0000	.0000E+00	.0000E+00
85		*	0.00	0.000	0.000	0.3611	0.0000	.0000E+00	.0000E+00
86		*	0.00	0.000	0.000	0.3611	0.0000	.0000E+00	.0000E+00
87		*	0.00	0.000	0.000	0.3611	0.0000	.0000E+00	.0000E+00
88		*	0.04	0.000	0.001	0.3660	0.0000	.0000E+00	.0000E+00
89		*	0.00	0.000	0.000	0.3660	0.0000	.0000E+00	.0000E+00
90		*	0.49	0.000	0.001	0.4272	0.0000	.0000E+00	.0000E+00
91		*	0.16	0.000	0.001	0.4471	0.0000	.0000E+00	.0000E+00
92		*	0.00	0.000	0.000	0.4471	0.0000	.0000E+00	.0000E+00
93		*	0.02	0.000	0.001	0.4495	0.0000	.0000E+00	.0000E+00
94		*	0.00	0.000	0.000	0.4495	0.0000	.0000E+00	.0000E+00
95	*	*	0.00	0.000	0.000	0.4495	0.0000	.0000E+00	.0000E+00
96	*	*	0.00	0.000	0.000	0.4495	0.0000	.0000E+00	.0000E+00
97	*	*	0.00	0.000	0.000	0.4495	0.0000	.0000E+00	.0000E+00
98	*	*	0.00	0.000	0.000	0.4495	0.0000	.0000E+00	.0000E+00
99	*	*	0.00	0.000	0.000	0.4495	0.0000	.0000E+00	.0000E+00
100		*	0.00	0.000	0.000	0.4495	0.0000	.0000E+00	.0000E+00
101	*	*	0.33	0.000	0.041	0.4495	0.0000	.0000E+00	.0000E+00
102	*	*	0.25	0.000	0.041	0.4495	0.0000	.0000E+00	.0000E+00
103		*	0.00	0.000	0.047	0.4710	0.0000	.0000E+00	.0000E+00
104		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
105		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
106		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
107		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
108		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
109		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
110			0.03	0.000	0.245	0.3705	0.0000	.8603E-05	.3910E-08
111			0.16	0.000	0.254	0.3471	0.0000	.0000E+00	.0000E+00
112			0.02	0.000	0.124	0.3272	0.0000	.0000E+00	.0000E+00
113			0.00	0.000	0.131	0.3069	0.0000	.0000E+00	.0000E+00

114	0.00	0.000	0.142	0.2862	0.0000	.0000E+00	.0000E+00
115	0.00	0.000	0.134	0.2694	0.0000	.0000E+00	.0000E+00
116	0.08	0.000	0.152	0.2604	0.0000	.0000E+00	.0000E+00
117	0.01	0.000	0.141	0.2440	0.0000	.0000E+00	.0000E+00
118	0.00	0.000	0.109	0.2303	0.0000	.0000E+00	.0000E+00
119	0.10	0.000	0.142	0.2250	0.0000	.0000E+00	.0000E+00
120	0.00	0.000	0.086	0.2143	0.0000	.0000E+00	.0000E+00
121	0.00	0.000	0.021	0.2116	0.0000	.0000E+00	.0000E+00
122	0.01	0.000	0.016	0.2109	0.0000	.0000E+00	.0000E+00
123	0.00	0.000	0.004	0.2104	0.0000	.0000E+00	.0000E+00
124	0.02	0.000	0.007	0.2120	0.0000	.0000E+00	.0000E+00
125	0.00	0.000	0.005	0.2114	0.0000	.0000E+00	.0000E+00
126	0.00	0.000	0.008	0.2104	0.0000	.0000E+00	.0000E+00
127	0.00	0.000	0.003	0.2101	0.0000	.0000E+00	.0000E+00
128	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
129	0.28	0.000	0.015	0.2431	0.0000	.0000E+00	.0000E+00
130	0.60	0.000	0.023	0.3153	0.0000	.0000E+00	.0000E+00
131	0.26	0.000	0.146	0.3296	0.0000	.0000E+00	.0000E+00
132	0.00	0.000	0.207	0.3037	0.0000	.0000E+00	.0000E+00
133	0.34	0.000	0.223	0.3183	0.0000	.0000E+00	.0000E+00
134	0.29	0.000	0.177	0.3324	0.0000	.0000E+00	.0000E+00
135	0.04	0.000	0.241	0.3072	0.0000	.0000E+00	.0000E+00
136	0.00	0.000	0.192	0.2833	0.0000	.0000E+00	.0000E+00
137	0.01	0.000	0.139	0.2671	0.0000	.0000E+00	.0000E+00
138	0.01	0.000	0.084	0.2579	0.0000	.0000E+00	.0000E+00
139	0.00	0.000	0.063	0.2500	0.0000	.0000E+00	.0000E+00
140	0.00	0.000	0.053	0.2434	0.0000	.0000E+00	.0000E+00
141	0.24	0.000	0.048	0.2673	0.0000	.0000E+00	.0000E+00
142	0.06	0.000	0.043	0.2695	0.0000	.0000E+00	.0000E+00
143	0.00	0.000	0.038	0.2647	0.0000	.0000E+00	.0000E+00
144	0.00	0.000	0.035	0.2603	0.0000	.0000E+00	.0000E+00
145	0.00	0.000	0.033	0.2561	0.0000	.0000E+00	.0000E+00
146	0.00	0.000	0.032	0.2522	0.0000	.0000E+00	.0000E+00
147	0.00	0.000	0.030	0.2484	0.0000	.0000E+00	.0000E+00
148	0.12	0.000	0.030	0.2597	0.0000	.0000E+00	.0000E+00
149	0.02	0.000	0.029	0.2585	0.0000	.0000E+00	.0000E+00
150	0.96	0.000	0.028	0.3750	0.0000	.0000E+00	.0000E+00
151	0.00	0.000	0.220	0.3474	0.0000	.0000E+00	.0000E+00
152	0.14	0.000	0.256	0.3329	0.0000	.0000E+00	.0000E+00
153	0.00	0.000	0.229	0.3038	0.0000	.2275E-05	.9455E-09
154	0.63	0.000	0.191	0.3570	0.0000	.4127E-05	.1830E-08
155	0.05	0.000	0.147	0.3445	0.0000	.1166E-04	.5044E-08
156	0.00	0.000	0.132	0.3279	0.0000	.9682E-05	.4416E-08
157	0.96	0.000	0.226	0.4196	0.0000	.4271E-06	.1280E-09
158	0.00	0.000	0.188	0.3733	0.0000	.0000E+00	.0000E+00
159	0.00	0.000	0.249	0.3305	0.0000	.1296E-04	.5673E-08
160	1.16	0.000	0.227	0.4395	0.0000	.1538E-04	.6807E-08
161	0.37	0.000	0.122	0.4227	0.0000	.1196E-04	.5111E-08
162	0.00	0.000	0.127	0.3792	0.0000	.1495E-04	.6746E-08
163	0.08	0.000	0.195	0.3531	0.0000	.1182E-04	.5233E-08
164	0.00	0.000	0.228	0.3176	0.0000	.4271E-06	.1280E-09
165	0.01	0.000	0.137	0.2993	0.0000	.0000E+00	.0000E+00
166	0.00	0.000	0.245	0.2648	0.0000	.0000E+00	.0000E+00
167	0.00	0.000	0.171	0.2429	0.0000	.0000E+00	.0000E+00
168	0.00	0.000	0.207	0.2170	0.0000	.0000E+00	.0000E+00
169	0.06	0.000	0.073	0.2154	0.0000	.0000E+00	.0000E+00
170	0.00	0.000	0.012	0.2139	0.0000	.0000E+00	.0000E+00

171	0.82	0.000	0.044	0.3109	0.0000	.0000E+00	.0000E+00
172	0.00	0.000	0.220	0.2834	0.0000	.0000E+00	.0000E+00
173	0.00	0.000	0.266	0.2502	0.0000	.0000E+00	.0000E+00
174	0.00	0.000	0.188	0.2267	0.0000	.0000E+00	.0000E+00
175	0.00	0.000	0.081	0.2166	0.0000	.0000E+00	.0000E+00
176	0.00	0.000	0.038	0.2118	0.0000	.0000E+00	.0000E+00
177	0.00	0.000	0.015	0.2100	0.0000	.0000E+00	.0000E+00
178	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
179	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
180	0.08	0.000	0.005	0.2194	0.0000	.0000E+00	.0000E+00
181	0.00	0.000	0.015	0.2175	0.0000	.0000E+00	.0000E+00
182	0.00	0.000	0.018	0.2152	0.0000	.0000E+00	.0000E+00
183	0.10	0.000	0.023	0.2249	0.0000	.0000E+00	.0000E+00
184	0.07	0.000	0.016	0.2316	0.0000	.0000E+00	.0000E+00
185	0.00	0.000	0.013	0.2299	0.0000	.0000E+00	.0000E+00
186	0.00	0.000	0.019	0.2275	0.0000	.0000E+00	.0000E+00
187	0.11	0.000	0.020	0.2388	0.0000	.0000E+00	.0000E+00
188	0.00	0.000	0.016	0.2367	0.0000	.0000E+00	.0000E+00
189	0.04	0.000	0.020	0.2393	0.0000	.0000E+00	.0000E+00
190	0.00	0.000	0.021	0.2367	0.0000	.0000E+00	.0000E+00
191	0.02	0.000	0.019	0.2368	0.0000	.0000E+00	.0000E+00
192	0.00	0.000	0.019	0.2344	0.0000	.0000E+00	.0000E+00
193	0.17	0.000	0.018	0.2534	0.0000	.0000E+00	.0000E+00
194	0.43	0.000	0.020	0.3046	0.0000	.0000E+00	.0000E+00
195	0.00	0.000	0.241	0.2745	0.0000	.0000E+00	.0000E+00
196	0.00	0.000	0.020	0.2720	0.0000	.0000E+00	.0000E+00
197	0.12	0.000	0.021	0.2843	0.0000	.0000E+00	.0000E+00
198	0.09	0.000	0.021	0.2930	0.0000	.0000E+00	.0000E+00
199	0.00	0.000	0.018	0.2907	0.0000	.0000E+00	.0000E+00
200	0.00	0.000	0.018	0.2884	0.0000	.0000E+00	.0000E+00
201	0.00	0.000	0.019	0.2860	0.0000	.0000E+00	.0000E+00
202	0.13	0.000	0.021	0.2996	0.0000	.0000E+00	.0000E+00
203	0.00	0.000	0.018	0.2974	0.0000	.0000E+00	.0000E+00
204	0.53	0.000	0.020	0.3611	0.0000	.0000E+00	.0000E+00
205	0.44	0.000	0.232	0.3872	0.0000	.0000E+00	.0000E+00
206	0.00	0.000	0.267	0.3537	0.0000	.0000E+00	.0000E+00
207	0.00	0.000	0.240	0.3218	0.0000	.0000E+00	.0000E+00
208	0.00	0.000	0.125	0.2999	0.0000	.0000E+00	.0000E+00
209	0.00	0.000	0.143	0.2778	0.0000	.3647E-05	.1513E-08
210	0.00	0.000	0.083	0.2659	0.0000	.1577E-04	.6807E-08
211	0.00	0.000	0.064	0.2579	0.0000	.1577E-04	.6807E-08
212	0.00	0.000	0.054	0.2512	0.0000	.1576E-04	.6807E-08
213	0.12	0.000	0.050	0.2600	0.0000	.1576E-04	.6807E-08
214	1.67	0.000	0.045	0.4406	0.0000	.1575E-04	.6807E-08
215	0.48	0.000	0.218	0.4336	0.0000	.7069E-05	.2793E-08
216	0.00	0.000	0.160	0.3760	0.0000	.1569E-04	.6807E-08
217	0.01	0.000	0.141	0.3476	0.0000	.1575E-04	.6807E-08
218	0.00	0.000	0.154	0.3213	0.0000	.2483E-05	.1012E-08
219	0.02	0.000	0.200	0.2941	0.0000	.0000E+00	.0000E+00
220	0.00	0.000	0.204	0.2654	0.0000	.0000E+00	.0000E+00
221	0.44	0.000	0.126	0.3047	0.0000	.0000E+00	.0000E+00
222	0.16	0.000	0.190	0.3010	0.0000	.0000E+00	.0000E+00
223	0.11	0.000	0.180	0.2922	0.0000	.0000E+00	.0000E+00
224	0.04	0.000	0.191	0.2733	0.0000	.0000E+00	.0000E+00
225	0.00	0.000	0.111	0.2595	0.0000	.0000E+00	.0000E+00
226	0.00	0.000	0.099	0.2471	0.0000	.0000E+00	.0000E+00
227	0.00	0.000	0.151	0.2281	0.0000	.0000E+00	.0000E+00

228	0.00	0.000	0.098	0.2120	0.0000	.0000E+00	.0000E+00
229	0.01	0.000	0.021	0.2107	0.0000	.0000E+00	.0000E+00
230	0.00	0.000	0.004	0.2102	0.0000	.0000E+00	.0000E+00
231	0.00	0.000	0.002	0.2100	0.0000	.0000E+00	.0000E+00
232	0.08	0.000	0.007	0.2191	0.0000	.0000E+00	.0000E+00
233	0.06	0.000	0.022	0.2238	0.0000	.0000E+00	.0000E+00
234	0.00	0.000	0.018	0.2216	0.0000	.0000E+00	.0000E+00
235	0.00	0.000	0.022	0.2189	0.0000	.0000E+00	.0000E+00
236	0.00	0.000	0.025	0.2158	0.0000	.0000E+00	.0000E+00
237	0.00	0.000	0.023	0.2129	0.0000	.0000E+00	.0000E+00
238	0.00	0.000	0.017	0.2108	0.0000	.0000E+00	.0000E+00
239	0.00	0.000	0.005	0.2102	0.0000	.0000E+00	.0000E+00
240	0.00	0.000	0.001	0.2101	0.0000	.0000E+00	.0000E+00
241	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
242	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
243	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
244	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
245	0.03	0.000	0.005	0.2132	0.0000	.0000E+00	.0000E+00
246	0.00	0.000	0.002	0.2129	0.0000	.0000E+00	.0000E+00
247	0.00	0.000	0.006	0.2122	0.0000	.0000E+00	.0000E+00
248	0.00	0.000	0.004	0.2117	0.0000	.0000E+00	.0000E+00
249	0.07	0.000	0.007	0.2196	0.0000	.0000E+00	.0000E+00
250	0.00	0.000	0.010	0.2184	0.0000	.0000E+00	.0000E+00
251	0.21	0.000	0.012	0.2431	0.0000	.0000E+00	.0000E+00
252	1.47	0.000	0.020	0.4215	0.0000	.0000E+00	.0000E+00
253	0.00	0.000	0.130	0.3818	0.0000	.0000E+00	.0000E+00
254	0.08	0.000	0.122	0.3641	0.0000	.1487E-04	.6240E-08
255	0.09	0.000	0.100	0.3554	0.0000	.1606E-04	.6807E-08
256	0.00	0.000	0.088	0.3390	0.0000	.1606E-04	.6807E-08
257	0.00	0.000	0.092	0.3234	0.0000	.1606E-04	.6807E-08
258	0.00	0.000	0.137	0.3043	0.0000	.1605E-04	.6807E-08
259	0.00	0.000	0.110	0.2905	0.0000	.1189E-04	.5044E-08
260	0.00	0.000	0.105	0.2774	0.0000	.0000E+00	.0000E+00
261	0.00	0.000	0.132	0.2609	0.0000	.0000E+00	.0000E+00
262	0.02	0.000	0.137	0.2462	0.0000	.0000E+00	.0000E+00
263	0.00	0.000	0.117	0.2316	0.0000	.0000E+00	.0000E+00
264	0.00	0.000	0.082	0.2214	0.0000	.0000E+00	.0000E+00
265	0.00	0.000	0.063	0.2134	0.0000	.0000E+00	.0000E+00
266	0.00	0.000	0.027	0.2100	0.0000	.0000E+00	.0000E+00
267	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
268	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
269	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
270	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
271	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
272	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
273	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
274	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
275	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
276	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
277	0.11	0.000	0.008	0.2228	0.0000	.0000E+00	.0000E+00
278	0.12	0.000	0.013	0.2362	0.0000	.0000E+00	.0000E+00
279	0.02	0.000	0.012	0.2372	0.0000	.0000E+00	.0000E+00
280	0.00	0.000	0.016	0.2352	0.0000	.0000E+00	.0000E+00
281	0.00	0.000	0.016	0.2332	0.0000	.0000E+00	.0000E+00
282	0.00	0.000	0.015	0.2313	0.0000	.0000E+00	.0000E+00
283	0.00	0.000	0.015	0.2294	0.0000	.0000E+00	.0000E+00
284	0.00	0.000	0.015	0.2276	0.0000	.0000E+00	.0000E+00

285		0.00	0.000	0.014	0.2258	0.0000	.0000E+00	.0000E+00
286		0.00	0.000	0.014	0.2241	0.0000	.0000E+00	.0000E+00
287		0.00	0.000	0.014	0.2224	0.0000	.0000E+00	.0000E+00
288		0.00	0.000	0.013	0.2207	0.0000	.0000E+00	.0000E+00
289		0.00	0.000	0.013	0.2191	0.0000	.0000E+00	.0000E+00
290		0.00	0.000	0.013	0.2175	0.0000	.0000E+00	.0000E+00
291		0.00	0.000	0.011	0.2161	0.0000	.0000E+00	.0000E+00
292		0.00	0.000	0.014	0.2144	0.0000	.0000E+00	.0000E+00
293		0.00	0.000	0.015	0.2126	0.0000	.0000E+00	.0000E+00
294		0.00	0.000	0.016	0.2105	0.0000	.0000E+00	.0000E+00
295		0.00	0.000	0.003	0.2101	0.0000	.0000E+00	.0000E+00
296		0.00	0.000	0.001	0.2100	0.0000	.0000E+00	.0000E+00
297	*	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
298		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
299		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
300		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
301		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
302		0.35	0.000	0.009	0.2527	0.0000	.0000E+00	.0000E+00
303		0.00	0.000	0.011	0.2513	0.0000	.0000E+00	.0000E+00
304		0.98	0.000	0.015	0.3720	0.0000	.0000E+00	.0000E+00
305		0.86	0.000	0.071	0.4460	0.0000	.0000E+00	.0000E+00
306		0.00	0.000	0.053	0.3875	0.0000	.1251E-04	.5106E-08
307		0.00	0.000	0.060	0.3665	0.0000	.1647E-04	.6807E-08
308		0.00	0.000	0.068	0.3503	0.0000	.1647E-04	.6807E-08
309		0.00	0.000	0.063	0.3369	0.0000	.1312E-04	.5423E-08
310		0.00	0.000	0.074	0.3231	0.0000	.1372E-05	.5062E-09
311		0.00	0.000	0.058	0.3123	0.0000	.0000E+00	.0000E+00
312		0.00	0.000	0.064	0.3027	0.0000	.0000E+00	.0000E+00
313		0.04	0.000	0.067	0.2993	0.0000	.0000E+00	.0000E+00
314		0.11	0.000	0.080	0.3031	0.0000	.0000E+00	.0000E+00
315		0.00	0.000	0.080	0.2929	0.0000	.0000E+00	.0000E+00
316		0.00	0.000	0.073	0.2838	0.0000	.0000E+00	.0000E+00
317		0.00	0.000	0.053	0.2772	0.0000	.0000E+00	.0000E+00
318		0.00	0.000	0.047	0.2713	0.0000	.0000E+00	.0000E+00
319		0.00	0.000	0.072	0.2622	0.0000	.0000E+00	.0000E+00
320		0.00	0.000	0.070	0.2535	0.0000	.0000E+00	.0000E+00
321		0.00	0.000	0.054	0.2467	0.0000	.0000E+00	.0000E+00
322		0.02	0.000	0.035	0.2448	0.0000	.0000E+00	.0000E+00
323		0.04	0.000	0.048	0.2438	0.0000	.0000E+00	.0000E+00
324		0.00	0.000	0.042	0.2385	0.0000	.0000E+00	.0000E+00
325	*	0.00	0.000	0.026	0.2353	0.0000	.0000E+00	.0000E+00
326	*	0.00	0.000	0.026	0.2321	0.0000	.0000E+00	.0000E+00
327	*	0.00	0.000	0.000	0.2321	0.0000	.0000E+00	.0000E+00
328	*	0.00	0.000	0.000	0.2321	0.0000	.0000E+00	.0000E+00
329		0.00	0.000	0.034	0.2278	0.0000	.0000E+00	.0000E+00
330		0.20	0.000	0.044	0.2474	0.0000	.0000E+00	.0000E+00
331	*	0.00	0.000	0.026	0.2442	0.0000	.0000E+00	.0000E+00
332	*	0.00	0.000	0.025	0.2410	0.0000	.0000E+00	.0000E+00
333		0.02	0.000	0.046	0.2377	0.0000	.0000E+00	.0000E+00
334	*	0.00	0.000	0.028	0.2342	0.0000	.0000E+00	.0000E+00
335		0.00	0.000	0.031	0.2303	0.0000	.0000E+00	.0000E+00
336	*	0.00	0.000	0.000	0.2303	0.0000	.0000E+00	.0000E+00
337	*	0.00	0.000	0.028	0.2269	0.0000	.0000E+00	.0000E+00
338	*	0.00	0.000	0.000	0.2269	0.0000	.0000E+00	.0000E+00
339	*	0.00	0.000	0.000	0.2269	0.0000	.0000E+00	.0000E+00
340	*	0.00	0.000	0.028	0.2233	0.0000	.0000E+00	.0000E+00
341	*	0.00	0.000	0.023	0.2205	0.0000	.0000E+00	.0000E+00

342	*		0.00	0.000	0.023	0.2176	0.0000	.0000E+00	.0000E+00
343	*		0.00	0.000	0.028	0.2141	0.0000	.0000E+00	.0000E+00
344	*		0.00	0.000	0.000	0.2141	0.0000	.0000E+00	.0000E+00
345	*		0.00	0.000	0.000	0.2141	0.0000	.0000E+00	.0000E+00
346	*		0.00	0.000	0.000	0.2141	0.0000	.0000E+00	.0000E+00
347	*	*	0.10	0.000	0.006	0.2141	0.0000	.0000E+00	.0000E+00
348	*	*	0.05	0.000	0.006	0.2141	0.0000	.0000E+00	.0000E+00
349	*	*	0.16	0.000	0.000	0.2141	0.0000	.0000E+00	.0000E+00
350	*	*	0.02	0.000	0.000	0.2141	0.0000	.0000E+00	.0000E+00
351		*	0.00	0.000	0.005	0.2349	0.0000	.0000E+00	.0000E+00
352	*	*	0.17	0.000	0.016	0.2349	0.0000	.0000E+00	.0000E+00
353	*	*	0.01	0.000	0.013	0.2349	0.0000	.0000E+00	.0000E+00
354	*	*	0.00	0.000	0.007	0.2349	0.0000	.0000E+00	.0000E+00
355	*	*	0.00	0.000	0.007	0.2349	0.0000	.0000E+00	.0000E+00
356	*	*	0.03	0.000	0.000	0.2349	0.0000	.0000E+00	.0000E+00
357	*	*	0.00	0.000	0.024	0.2349	0.0000	.0000E+00	.0000E+00
358		*	0.00	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
359		*	0.00	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
360		*	0.00	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
361		*	0.00	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
362		*	0.00	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
363		*	0.00	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
364		*	0.00	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
365	*	*	0.00	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00

****

****

MONTHLY TOTALS (IN INCHES) FOR YEAR 1974

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.09	0.83	0.88	1.16	3.26	4.36
	2.25	3.20	1.97	1.58	1.29	0.54
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.090	0.373	0.082	1.790	2.195	4.234
	1.869	2.483	1.508	0.284	1.488	0.243
LATERAL DRAINAGE COLLECTED FROM LAYER 4	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001
	0.0001	0.0001	0.0001	0.0000	0.0001	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.000	0.000

****

****

ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	21.41	388591.594	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	16.638	301981.781	77.71
DRAINAGE COLLECTED FROM LAYER 4	0.0005	8.791	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.004	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	4.771	86600.922	22.29
SOIL WATER AT START OF YEAR	42.434	770171.687	
SOIL WATER AT END OF YEAR	47.205	856772.562	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.102	0.00

****

WARNING: TEMPERATURE FOR YEAR 2 USED WITH PRECIPITATION FOR YEAR 1975

WARNING: SOLAR RADIATION FOR YEAR 2 USED WITH PRECIPITATION FOR YEAR 1975

HEAD #1: AVERAGE HEAD ON TOP OF LAYER 5
DRAIN #1: LATERAL DRAINAGE FROM LAYER 4 (RECIRCULATION AND COLLECTION)

LEAK #1: PERCOLATION OR LEAKAGE THROUGH LAYER 6

****

DAILY OUTPUT FOR YEAR 1975

DAY	AIR	SOIL	RAIN IN.	RUNOFF IN.	ET IN.	E. ZONE WATER IN./IN.	HEAD #1 IN.	DRAIN #1 IN.	LEAK #1 IN.
1	*	*	0.00	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
2	*	*	0.22	0.000	0.016	0.2713	0.0000	.0000E+00	.0000E+00
3	*	*	0.02	0.000	0.015	0.2713	0.0000	.0000E+00	.0000E+00
4	*	*	0.00	0.000	0.013	0.2713	0.0000	.0000E+00	.0000E+00
5	*	*	0.03	0.000	0.017	0.2713	0.0000	.0000E+00	.0000E+00
6	*	*	0.02	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
7	*	*	0.01	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
8	*	*	0.13	0.000	0.014	0.2713	0.0000	.0000E+00	.0000E+00
9	*	*	0.33	0.000	0.008	0.2713	0.0000	.0000E+00	.0000E+00
10	*	*	0.60	0.000	0.009	0.2713	0.0000	.0000E+00	.0000E+00
11	*	*	0.27	0.000	0.006	0.2713	0.0000	.0000E+00	.0000E+00
12	*	*	0.00	0.000	0.009	0.2713	0.0000	.0000E+00	.0000E+00
13	*	*	0.00	0.000	0.005	0.2713	0.0000	.0000E+00	.0000E+00
14	*	*	0.04	0.000	0.006	0.2713	0.0000	.0000E+00	.0000E+00
15	*	*	0.00	0.000	0.007	0.2713	0.0000	.0000E+00	.0000E+00
16	*	*	0.00	0.000	0.009	0.2713	0.0000	.0000E+00	.0000E+00
17	*	*	0.04	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
18	*	*	0.00	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
19	*	*	0.00	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
20	*	*	0.01	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
21	*	*	0.02	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
22	*	*	0.00	0.000	0.012	0.2713	0.0000	.0000E+00	.0000E+00
23	*	*	0.04	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
24	*	*	0.18	0.000	0.010	0.2713	0.0000	.0000E+00	.0000E+00
25	*	*	0.11	0.000	0.010	0.2713	0.0000	.0000E+00	.0000E+00
26	*	*	0.00	0.000	0.008	0.2713	0.0000	.0000E+00	.0000E+00
27	*	*	0.00	0.000	0.013	0.2713	0.0000	.0000E+00	.0000E+00
28	*	*	0.18	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
29	*	*	0.11	0.000	0.011	0.2713	0.0000	.0000E+00	.0000E+00
30	*	*	0.00	0.000	0.009	0.2713	0.0000	.0000E+00	.0000E+00
31	*	*	0.03	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
32	*	*	0.00	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
33	*	*	0.03	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
34	*	*	0.00	0.000	0.012	0.2713	0.0000	.0000E+00	.0000E+00
35	*	*	0.10	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
36	*	*	0.05	0.000	0.014	0.2713	0.0000	.0000E+00	.0000E+00
37	*	*	0.00	0.000	0.015	0.2713	0.0000	.0000E+00	.0000E+00
38	*	*	0.00	0.000	0.019	0.2713	0.0000	.0000E+00	.0000E+00
39	*	*	0.00	0.000	0.020	0.2713	0.0000	.0000E+00	.0000E+00
40		*	0.00	0.000	0.028	0.2713	0.0000	.0000E+00	.0000E+00
41	*	*	0.05	0.000	0.024	0.2713	0.0000	.0000E+00	.0000E+00
42	*	*	0.00	0.000	0.021	0.2713	0.0000	.0000E+00	.0000E+00
43	*	*	0.00	0.000	0.023	0.2713	0.0000	.0000E+00	.0000E+00
44	*	*	0.02	0.000	0.014	0.2713	0.0000	.0000E+00	.0000E+00
45	*	*	0.00	0.000	0.010	0.2713	0.0000	.0000E+00	.0000E+00

46	*	*	0.00	0.000	0.014	0.2713	0.0000	.0000E+00	.0000E+00
47	*	*	0.00	0.000	0.018	0.2713	0.0000	.0000E+00	.0000E+00
48	*	*	0.09	0.000	0.011	0.2713	0.0000	.0000E+00	.0000E+00
49	*	*	0.06	0.000	0.011	0.2713	0.0000	.0000E+00	.0000E+00
50	*	*	0.00	0.000	0.016	0.2713	0.0000	.0000E+00	.0000E+00
51	*	*	0.00	0.000	0.017	0.2713	0.0000	.0000E+00	.0000E+00
52	*	*	0.00	0.000	0.017	0.2713	0.0000	.0000E+00	.0000E+00
53	*	*	0.00	0.000	0.012	0.2713	0.0000	.0000E+00	.0000E+00
54	*	*	0.00	0.000	0.016	0.2713	0.0000	.0000E+00	.0000E+00
55	*	*	0.00	0.000	0.017	0.2713	0.0000	.0000E+00	.0000E+00
56	*	*	0.00	0.000	0.014	0.2713	0.0000	.0000E+00	.0000E+00
57	*	*	0.00	0.000	0.014	0.2713	0.0000	.0000E+00	.0000E+00
58	*	*	0.00	0.000	0.019	0.2713	0.0000	.0000E+00	.0000E+00
59	*	*	0.00	0.000	0.014	0.2713	0.0000	.0000E+00	.0000E+00
60	*	*	0.00	0.000	0.012	0.2713	0.0000	.0000E+00	.0000E+00
61	*	*	0.00	0.000	0.015	0.2713	0.0000	.0000E+00	.0000E+00
62	*	*	0.00	0.000	0.011	0.2713	0.0000	.0000E+00	.0000E+00
63	*	*	0.02	0.000	0.010	0.2713	0.0000	.0000E+00	.0000E+00
64	*	*	0.05	0.000	0.009	0.2713	0.0000	.0000E+00	.0000E+00
65	*	*	0.00	0.000	0.000	0.2713	0.0000	.0000E+00	.0000E+00
66		*	0.00	0.000	0.005	0.2960	0.0000	.0000E+00	.0000E+00
67		*	0.00	0.000	0.000	0.3605	0.0000	.0000E+00	.0000E+00
68		*	0.04	0.000	0.000	0.3922	0.0000	.0000E+00	.0000E+00
69	*	*	0.00	0.000	0.028	0.3922	0.0000	.0000E+00	.0000E+00
70	*	*	0.25	0.000	0.023	0.3922	0.0000	.0000E+00	.0000E+00
71		*	0.04	0.000	0.000	0.4457	0.0000	.0000E+00	.0000E+00
72		*	0.00	0.000	0.000	0.4710	0.0000	.7043E-05	.2647E-08
73		*	0.00	0.000	0.000	0.4710	0.0000	.1770E-04	.6808E-08
74	*	*	0.00	0.000	0.000	0.4710	0.0000	.1655E-04	.6368E-08
75		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
76		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
77		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
78	*	*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
79	*	*	0.08	0.000	0.032	0.4710	0.0000	.0000E+00	.0000E+00
80	*	*	0.00	0.000	0.034	0.4710	0.0000	.0000E+00	.0000E+00
81	*	*	0.00	0.000	0.015	0.4710	0.0000	.0000E+00	.0000E+00
82	*	*	0.50	0.000	0.026	0.4710	0.0000	.0000E+00	.0000E+00
83		*	0.31	0.000	0.000	0.4710	0.0000	.9047E-05	.3404E-08
84		*	0.00	0.000	0.000	0.4710	0.0000	.8727E-05	.3343E-08
85		*	0.12	0.000	0.001	0.4710	0.0000	.0000E+00	.0000E+00
86		*	0.27	0.000	0.001	0.4710	0.0000	.1202E-04	.4539E-08
87		*	0.01	0.000	0.001	0.4710	0.0000	.3299E-05	.1263E-08
88		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
89		*	0.03	0.000	0.001	0.4710	0.0000	.0000E+00	.0000E+00
90		*	0.03	0.000	0.001	0.4710	0.0000	.0000E+00	.0000E+00
91		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
92		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
93		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
94		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
95		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
96		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
97			0.00	0.000	0.094	0.3832	0.0000	.1258E-04	.4728E-08
98			0.00	0.000	0.101	0.3578	0.0000	.8284E-05	.3154E-08
99			0.05	0.000	0.139	0.3392	0.0000	.0000E+00	.0000E+00
100			0.00	0.000	0.123	0.3183	0.0000	.0000E+00	.0000E+00
101			0.00	0.000	0.130	0.2986	0.0000	.0000E+00	.0000E+00
102			0.00	0.000	0.254	0.2647	0.0000	.0000E+00	.0000E+00

103		0.00	0.000	0.208	0.2386	0.0000	.0000E+00 .0000E+00
104		0.08	0.000	0.156	0.2291	0.0000	.0000E+00 .0000E+00
105		0.00	0.000	0.127	0.2132	0.0000	.0000E+00 .0000E+00
106		0.00	0.000	0.019	0.2108	0.0000	.0000E+00 .0000E+00
107		0.21	0.000	0.041	0.2320	0.0000	.0000E+00 .0000E+00
108		0.00	0.000	0.028	0.2285	0.0000	.0000E+00 .0000E+00
109		0.02	0.000	0.037	0.2264	0.0000	.0000E+00 .0000E+00
110		0.00	0.000	0.034	0.2222	0.0000	.0000E+00 .0000E+00
111		0.00	0.000	0.027	0.2188	0.0000	.0000E+00 .0000E+00
112		0.64	0.000	0.028	0.2953	0.0000	.0000E+00 .0000E+00
113		0.00	0.000	0.168	0.2742	0.0000	.0000E+00 .0000E+00
114		0.08	0.000	0.203	0.2588	0.0000	.0000E+00 .0000E+00
115		0.00	0.000	0.142	0.2411	0.0000	.0000E+00 .0000E+00
116		1.07	0.000	0.078	0.3652	0.0000	.0000E+00 .0000E+00
117		1.18	0.000	0.109	0.4524	0.0000	.0000E+00 .0000E+00
118	*	0.21	0.000	0.100	0.3957	0.0000	.1724E-04 .6430E-08
119		0.14	0.000	0.138	0.3928	0.0000	.1139E-04 .4288E-08
120		0.01	0.000	0.168	0.3628	0.0000	.0000E+00 .0000E+00
121		0.00	0.000	0.159	0.3394	0.0000	.0000E+00 .0000E+00
122		0.16	0.000	0.138	0.3400	0.0000	.0000E+00 .0000E+00
123		0.00	0.000	0.146	0.3176	0.0000	.0000E+00 .0000E+00
124		0.19	0.000	0.168	0.3168	0.0000	.0000E+00 .0000E+00
125		0.00	0.000	0.220	0.2885	0.0000	.0000E+00 .0000E+00
126		0.00	0.000	0.167	0.2675	0.0000	.0000E+00 .0000E+00
127		0.57	0.000	0.189	0.3150	0.0000	.0000E+00 .0000E+00
128		0.03	0.000	0.230	0.2901	0.0000	.0000E+00 .0000E+00
129		0.00	0.000	0.150	0.2714	0.0000	.0000E+00 .0000E+00
130		0.00	0.000	0.142	0.2537	0.0000	.0000E+00 .0000E+00
131		0.00	0.000	0.162	0.2335	0.0000	.0000E+00 .0000E+00
132		0.00	0.000	0.166	0.2128	0.0000	.0000E+00 .0000E+00
133		0.00	0.000	0.022	0.2100	0.0000	.0000E+00 .0000E+00
134		0.21	0.000	0.035	0.2318	0.0000	.0000E+00 .0000E+00
135		0.00	0.000	0.027	0.2285	0.0000	.0000E+00 .0000E+00
136		0.00	0.000	0.036	0.2240	0.0000	.0000E+00 .0000E+00
137		0.00	0.000	0.032	0.2200	0.0000	.0000E+00 .0000E+00
138		0.00	0.000	0.029	0.2164	0.0000	.0000E+00 .0000E+00
139		0.23	0.000	0.027	0.2417	0.0000	.0000E+00 .0000E+00
140		0.73	0.000	0.031	0.3291	0.0000	.0000E+00 .0000E+00
141		0.00	0.000	0.166	0.3083	0.0000	.0000E+00 .0000E+00
142		0.36	0.000	0.180	0.3309	0.0000	.0000E+00 .0000E+00
143		0.02	0.000	0.193	0.3092	0.0000	.0000E+00 .0000E+00
144		0.00	0.000	0.169	0.2881	0.0000	.0000E+00 .0000E+00
145		0.51	0.000	0.175	0.3299	0.0000	.0000E+00 .0000E+00
146		0.00	0.000	0.221	0.3023	0.0000	.0000E+00 .0000E+00
147		0.01	0.000	0.213	0.2769	0.0000	.0000E+00 .0000E+00
148		0.00	0.000	0.224	0.2489	0.0000	.0000E+00 .0000E+00
149		0.00	0.000	0.180	0.2264	0.0000	.0000E+00 .0000E+00
150		0.00	0.000	0.083	0.2161	0.0000	.0000E+00 .0000E+00
151		0.00	0.000	0.048	0.2100	0.0000	.0000E+00 .0000E+00
152		0.00	0.000	0.000	0.2100	0.0000	.0000E+00 .0000E+00
153		0.05	0.000	0.005	0.2156	0.0000	.0000E+00 .0000E+00
154		0.00	0.000	0.010	0.2144	0.0000	.0000E+00 .0000E+00
155		0.21	0.000	0.018	0.2384	0.0000	.0000E+00 .0000E+00
156		0.00	0.000	0.017	0.2363	0.0000	.0000E+00 .0000E+00
157		0.00	0.000	0.023	0.2334	0.0000	.0000E+00 .0000E+00
158		0.00	0.000	0.022	0.2307	0.0000	.0000E+00 .0000E+00
159		0.00	0.000	0.021	0.2280	0.0000	.0000E+00 .0000E+00

160	0.14	0.000	0.021	0.2429	0.0000	.0000E+00	.0000E+00
161	0.00	0.000	0.023	0.2400	0.0000	.0000E+00	.0000E+00
162	1.13	0.000	0.026	0.3780	0.0000	.0000E+00	.0000E+00
163	0.06	0.000	0.222	0.3578	0.0000	.0000E+00	.0000E+00
164	0.20	0.000	0.245	0.3521	0.0000	.0000E+00	.0000E+00
165	0.74	0.000	0.151	0.4252	0.0000	.3093E-05	.1713E-08
166	0.28	0.000	0.239	0.4017	0.0000	.4125E-05	.1652E-08
167	0.08	0.000	0.193	0.3786	0.0000	.1822E-04	.6558E-08
168	0.33	0.000	0.190	0.3883	0.0000	.1856E-04	.6808E-08
169	0.00	0.000	0.175	0.3607	0.0000	.1856E-04	.6808E-08
170	0.01	0.000	0.230	0.3307	0.0000	.1855E-04	.6808E-08
171	0.16	0.000	0.236	0.3188	0.0000	.1220E-04	.4478E-08
172	0.83	0.000	0.177	0.3958	0.0000	.9956E-05	.3532E-08
173	0.07	0.000	0.196	0.3787	0.0000	.1855E-04	.6808E-08
174	0.00	0.000	0.250	0.3392	0.0000	.8636E-06	.4451E-09
175	0.00	0.000	0.157	0.3139	0.0000	.1571E-04	.5551E-08
176	0.00	0.000	0.167	0.2889	0.0000	.1830E-04	.6747E-08
177	0.23	0.000	0.201	0.2891	0.0000	.1562E-04	.5673E-08
178	0.00	0.000	0.126	0.2731	0.0000	.9103E-05	.3343E-08
179	0.00	0.000	0.219	0.2458	0.0000	.0000E+00	.0000E+00
180	0.00	0.000	0.282	0.2105	0.0000	.0000E+00	.0000E+00
181	1.26	0.000	0.143	0.3501	0.0000	.0000E+00	.0000E+00
182	0.02	0.000	0.172	0.3312	0.0000	.0000E+00	.0000E+00
183	0.00	0.000	0.236	0.3016	0.0000	.0000E+00	.0000E+00
184	0.00	0.000	0.271	0.2678	0.0000	.0000E+00	.0000E+00
185	0.00	0.000	0.272	0.2337	0.0000	.0000E+00	.0000E+00
186	0.00	0.000	0.151	0.2148	0.0000	.0000E+00	.0000E+00
187	0.00	0.000	0.039	0.2100	0.0000	.0000E+00	.0000E+00
188	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
189	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
190	0.19	0.000	0.021	0.2311	0.0000	.0000E+00	.0000E+00
191	0.00	0.000	0.018	0.2288	0.0000	.0000E+00	.0000E+00
192	0.00	0.000	0.026	0.2255	0.0000	.0000E+00	.0000E+00
193	0.00	0.000	0.025	0.2224	0.0000	.0000E+00	.0000E+00
194	0.00	0.000	0.023	0.2196	0.0000	.0000E+00	.0000E+00
195	0.00	0.000	0.022	0.2168	0.0000	.0000E+00	.0000E+00
196	0.00	0.000	0.021	0.2142	0.0000	.0000E+00	.0000E+00
197	0.00	0.000	0.016	0.2122	0.0000	.0000E+00	.0000E+00
198	0.00	0.000	0.013	0.2106	0.0000	.0000E+00	.0000E+00
199	0.00	0.000	0.004	0.2101	0.0000	.0000E+00	.0000E+00
200	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
201	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
202	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
203	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
204	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
205	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
206	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
207	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
208	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
209	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
210	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
211	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
212	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
213	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
214	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
215	0.06	0.000	0.003	0.2171	0.0000	.0000E+00	.0000E+00
216	0.00	0.000	0.008	0.2161	0.0000	.0000E+00	.0000E+00

217	0.07	0.000	0.010	0.2237	0.0000	.0000E+00	.0000E+00
218	0.00	0.000	0.009	0.2226	0.0000	.0000E+00	.0000E+00
219	0.00	0.000	0.008	0.2217	0.0000	.0000E+00	.0000E+00
220	0.00	0.000	0.010	0.2204	0.0000	.0000E+00	.0000E+00
221	0.00	0.000	0.011	0.2190	0.0000	.0000E+00	.0000E+00
222	0.00	0.000	0.011	0.2176	0.0000	.0000E+00	.0000E+00
223	0.00	0.000	0.011	0.2163	0.0000	.0000E+00	.0000E+00
224	0.02	0.000	0.013	0.2171	0.0000	.0000E+00	.0000E+00
225	0.00	0.000	0.011	0.2158	0.0000	.0000E+00	.0000E+00
226	0.00	0.000	0.010	0.2146	0.0000	.0000E+00	.0000E+00
227	0.00	0.000	0.010	0.2133	0.0000	.0000E+00	.0000E+00
228	0.05	0.000	0.012	0.2180	0.0000	.0000E+00	.0000E+00
229	0.02	0.000	0.010	0.2192	0.0000	.0000E+00	.0000E+00
230	0.00	0.000	0.007	0.2184	0.0000	.0000E+00	.0000E+00
231	0.11	0.000	0.009	0.2311	0.0000	.0000E+00	.0000E+00
232	2.36	0.000	0.017	0.4116	0.0000	.0000E+00	.0000E+00
233	0.00	0.000	0.185	0.4454	0.0000	.6417E-05	.1726E-08
234	1.02	0.000	0.200	0.4473	0.0000	.1782E-04	.6058E-08
235	0.27	0.000	0.194	0.4072	0.0000	.1319E-04	.4795E-08
236	0.35	0.000	0.186	0.4145	0.0000	.0000E+00	.0000E+00
237	0.00	0.000	0.193	0.3721	0.0000	.0000E+00	.0000E+00
238	0.00	0.000	0.196	0.3367	0.0000	.0000E+00	.0000E+00
239	0.00	0.000	0.173	0.3078	0.0000	.0000E+00	.0000E+00
240	0.50	0.000	0.209	0.3392	0.0000	.0000E+00	.0000E+00
241	0.00	0.000	0.154	0.3181	0.0000	.0000E+00	.0000E+00
242	0.00	0.000	0.179	0.2958	0.0000	.0000E+00	.0000E+00
243	0.00	0.000	0.204	0.2703	0.0000	.0000E+00	.0000E+00
244	0.00	0.000	0.213	0.2437	0.0000	.0000E+00	.0000E+00
245	0.00	0.000	0.186	0.2205	0.0000	.0000E+00	.0000E+00
246	0.00	0.000	0.084	0.2100	0.0000	.0000E+00	.0000E+00
247	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
248	0.23	0.000	0.037	0.2341	0.0000	.0000E+00	.0000E+00
249	0.45	0.000	0.042	0.2852	0.0000	.0000E+00	.0000E+00
250	0.00	0.000	0.078	0.2754	0.0000	.0000E+00	.0000E+00
251	0.00	0.000	0.131	0.2590	0.0000	.0000E+00	.0000E+00
252	0.09	0.000	0.145	0.2521	0.0000	.0000E+00	.0000E+00
253	0.45	0.000	0.079	0.2985	0.0000	.0000E+00	.0000E+00
254	0.09	0.000	0.141	0.2921	0.0000	.0000E+00	.0000E+00
255	0.00	0.000	0.159	0.2723	0.0000	.0000E+00	.0000E+00
256	0.00	0.000	0.165	0.2517	0.0000	.0000E+00	.0000E+00
257	0.00	0.000	0.076	0.2422	0.0000	.0000E+00	.0000E+00
258	0.00	0.000	0.058	0.2349	0.0000	.0000E+00	.0000E+00
259	0.00	0.000	0.049	0.2288	0.0000	.0000E+00	.0000E+00
260	0.00	0.000	0.043	0.2234	0.0000	.0000E+00	.0000E+00
261	0.68	0.000	0.044	0.3029	0.0000	.0000E+00	.0000E+00
262	0.17	0.000	0.114	0.3099	0.0000	.0000E+00	.0000E+00
263	0.11	0.000	0.119	0.3088	0.0000	.0000E+00	.0000E+00
264	0.00	0.000	0.093	0.2971	0.0000	.0000E+00	.0000E+00
265	0.00	0.000	0.072	0.2881	0.0000	.0000E+00	.0000E+00
266	0.00	0.000	0.108	0.2746	0.0000	.0000E+00	.0000E+00
267	0.00	0.000	0.137	0.2574	0.0000	.0000E+00	.0000E+00
268	0.00	0.000	0.080	0.2474	0.0000	.0000E+00	.0000E+00
269	0.00	0.000	0.062	0.2397	0.0000	.0000E+00	.0000E+00
270	0.00	0.000	0.052	0.2331	0.0000	.0000E+00	.0000E+00
271	0.00	0.000	0.046	0.2274	0.0000	.0000E+00	.0000E+00
272	0.00	0.000	0.041	0.2222	0.0000	.0000E+00	.0000E+00
273	0.00	0.000	0.038	0.2174	0.0000	.0000E+00	.0000E+00

274		0.00	0.000	0.037	0.2129	0.0000	.0000E+00	.0000E+00
275		0.00	0.000	0.023	0.2100	0.0000	.0000E+00	.0000E+00
276		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
277		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
278		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
279		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
280		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
281		0.10	0.000	0.004	0.2220	0.0000	.0000E+00	.0000E+00
282		0.00	0.000	0.011	0.2207	0.0000	.0000E+00	.0000E+00
283		0.00	0.000	0.012	0.2192	0.0000	.0000E+00	.0000E+00
284		0.00	0.000	0.015	0.2173	0.0000	.0000E+00	.0000E+00
285		0.00	0.000	0.015	0.2154	0.0000	.0000E+00	.0000E+00
286		0.00	0.000	0.015	0.2134	0.0000	.0000E+00	.0000E+00
287		0.00	0.000	0.015	0.2116	0.0000	.0000E+00	.0000E+00
288		0.00	0.000	0.011	0.2102	0.0000	.0000E+00	.0000E+00
289		0.00	0.000	0.001	0.2101	0.0000	.0000E+00	.0000E+00
290		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
291		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
292		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
293		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
294		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
295		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
296		0.96	0.000	0.014	0.3282	0.0000	.0000E+00	.0000E+00
297		0.01	0.000	0.017	0.3274	0.0000	.0000E+00	.0000E+00
298		0.00	0.000	0.017	0.3252	0.0000	.0000E+00	.0000E+00
299		0.00	0.000	0.017	0.3231	0.0000	.0000E+00	.0000E+00
300		0.01	0.000	0.019	0.3220	0.0000	.2586E-05	.1701E-08
301		0.00	0.000	0.017	0.3199	0.0000	.2014E-04	.6808E-08
302	*	0.00	0.000	0.016	0.3179	0.0000	.2013E-04	.6808E-08
303	*	0.00	0.000	0.017	0.3158	0.0000	.2012E-04	.6808E-08
304		0.00	0.000	0.016	0.3138	0.0000	.2011E-04	.6808E-08
305		0.00	0.000	0.016	0.3117	0.0000	.2011E-04	.6808E-08
306	*	0.00	0.000	0.016	0.3097	0.0000	.2010E-04	.6808E-08
307		0.00	0.000	0.016	0.3078	0.0000	.2009E-04	.6808E-08
308		0.00	0.000	0.016	0.3058	0.0000	.2008E-04	.6808E-08
309		0.00	0.000	0.015	0.3039	0.0000	.2008E-04	.6808E-08
310		0.00	0.000	0.015	0.3020	0.0000	.2007E-04	.6808E-08
311		0.00	0.000	0.015	0.3001	0.0000	.2006E-04	.6808E-08
312		0.00	0.000	0.015	0.2983	0.0000	.2006E-04	.6808E-08
313	*	0.28	0.000	0.016	0.3007	0.0000	.2005E-04	.6808E-08
314		0.00	0.000	0.005	0.3307	0.0000	.2004E-04	.6808E-08
315		0.50	0.000	0.017	0.3911	0.0000	.2003E-04	.6808E-08
316		0.16	0.000	0.040	0.4061	0.0000	.2003E-04	.6808E-08
317	*	0.00	0.000	0.000	0.3921	0.0000	.2002E-04	.6808E-08
318	*	0.00	0.000	0.031	0.3741	0.0000	.2001E-04	.6808E-08
319		0.00	0.000	0.041	0.3610	0.0000	.2001E-04	.6808E-08
320		0.00	0.000	0.047	0.3496	0.0000	.2000E-04	.6808E-08
321		0.00	0.000	0.035	0.3405	0.0000	.1999E-04	.6808E-08
322		0.21	0.000	0.033	0.3586	0.0000	.1999E-04	.6808E-08
323		0.78	0.000	0.043	0.4451	0.0000	.1869E-04	.6497E-08
324		1.11	0.000	0.040	0.4516	0.0000	.1572E-04	.5301E-08
325		0.00	0.000	0.039	0.3889	0.0000	.1036E-04	.3532E-08
326		0.00	0.000	0.041	0.3698	0.0000	.0000E+00	.0000E+00
327	*	0.00	0.000	0.000	0.3620	0.0000	.0000E+00	.0000E+00
328	*	0.00	0.000	0.000	0.3561	0.0000	.0000E+00	.0000E+00
329		0.00	0.000	0.031	0.3479	0.0000	.0000E+00	.0000E+00
330	*	0.00	0.000	0.025	0.3410	0.0000	.0000E+00	.0000E+00

331			0.00	0.000	0.037	0.3329	0.0000	.0000E+00 .0000E+00
332			0.00	0.000	0.046	0.3248	0.0000	.0000E+00 .0000E+00
333			0.17	0.000	0.051	0.3391	0.0000	.0000E+00 .0000E+00
334			0.03	0.000	0.043	0.3375	0.0000	.0000E+00 .0000E+00
335			0.03	0.000	0.043	0.3354	0.0000	.0000E+00 .0000E+00
336			0.00	0.000	0.045	0.3298	0.0000	.0000E+00 .0000E+00
337			0.00	0.000	0.054	0.3230	0.0000	.0000E+00 .0000E+00
338			0.00	0.000	0.032	0.3190	0.0000	.0000E+00 .0000E+00
339	*		0.00	0.000	0.000	0.3190	0.0000	.0000E+00 .0000E+00
340	*		0.00	0.000	0.027	0.3156	0.0000	.0000E+00 .0000E+00
341			0.00	0.000	0.028	0.3121	0.0000	.0000E+00 .0000E+00
342	*		0.00	0.000	0.000	0.3121	0.0000	.0000E+00 .0000E+00
343	*		0.00	0.000	0.000	0.3121	0.0000	.0000E+00 .0000E+00
344	*		0.00	0.000	0.000	0.3121	0.0000	.0000E+00 .0000E+00
345	*		0.00	0.000	0.000	0.3121	0.0000	.0000E+00 .0000E+00
346	*	*	0.00	0.000	0.000	0.3121	0.0000	.0000E+00 .0000E+00
347	*	*	0.05	0.000	0.008	0.3121	0.0000	.0000E+00 .0000E+00
348	*	*	0.10	0.000	0.011	0.3121	0.0000	.0000E+00 .0000E+00
349	*	*	0.00	0.000	0.009	0.3121	0.0000	.0000E+00 .0000E+00
350	*	*	0.00	0.000	0.011	0.3121	0.0000	.0000E+00 .0000E+00
351	*	*	0.00	0.000	0.018	0.3121	0.0000	.0000E+00 .0000E+00
352	*	*	0.00	0.000	0.012	0.3121	0.0000	.0000E+00 .0000E+00
353	*	*	0.08	0.000	0.008	0.3121	0.0000	.0000E+00 .0000E+00
354	*	*	0.00	0.000	0.011	0.3121	0.0000	.0000E+00 .0000E+00
355	*	*	0.00	0.000	0.013	0.3121	0.0000	.0000E+00 .0000E+00
356	*	*	0.00	0.000	0.017	0.3121	0.0000	.0000E+00 .0000E+00
357	*	*	0.00	0.000	0.020	0.3121	0.0000	.0000E+00 .0000E+00
358	*	*	0.00	0.000	0.018	0.3121	0.0000	.0000E+00 .0000E+00
359	*	*	0.00	0.000	0.015	0.3121	0.0000	.0000E+00 .0000E+00
360	*	*	0.00	0.000	0.011	0.3121	0.0000	.0000E+00 .0000E+00
361	*	*	0.00	0.000	0.009	0.3121	0.0000	.0000E+00 .0000E+00
362	*	*	0.00	0.000	0.007	0.3121	0.0000	.0000E+00 .0000E+00
363	*	*	0.02	0.000	0.011	0.3121	0.0000	.0000E+00 .0000E+00
364	*	*	0.00	0.000	0.020	0.3121	0.0000	.0000E+00 .0000E+00
365	*	*	0.00	0.000	0.020	0.3121	0.0000	.0000E+00 .0000E+00

****

****

MONTHLY TOTALS (IN INCHES) FOR YEAR 1975

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.39	0.40	1.75	3.69	3.02	5.78
	0.21	4.83	2.27	1.08	3.24	0.28
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.208	0.411	0.223	2.652	4.127	3.985
	1.331	2.251	2.693	0.310	0.784	0.478

LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0001	0.0000	0.0000	0.0002
FROM LAYER 4	0.0000	0.0000	0.0000	0.0001	0.0004	0.0000
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.000	0.000

****

****

ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.94	525261.125	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	19.453	353069.594	67.22
DRAINAGE COLLECTED FROM LAYER 4	0.0008	15.089	0.00
PERC./LEAKAGE THROUGH LAYER 6	0.000000	0.005	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	9.486	172176.156	32.78
SOIL WATER AT START OF YEAR	47.205	856772.562	
SOIL WATER AT END OF YEAR	56.691	1028948.750	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.276	0.00

****

WARNING: TEMPERATURE FOR YEAR 3 USED WITH PRECIPITATION FOR YEAR 1976

WARNING: SOLAR RADIATION FOR YEAR 3 USED WITH PRECIPITATION FOR YEAR 1976

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

****

DAILY OUTPUT FOR YEAR 1976

DAY	AIR	SOIL	RAIN IN.	RUNOFF IN.	ET IN.	E. ZONE WATER IN./IN.	HEAD #1 IN.	DRAIN #1 IN.	LEAK #1 IN.
1	*	*	0.17	0.000	0.021	0.3121	0.0000	.0000E+00	.0000E+00
2	*	*	0.12	0.000	0.024	0.3121	0.0000	.0000E+00	.0000E+00
3	*	*	0.00	0.000	0.019	0.3121	0.0000	.0000E+00	.0000E+00
4	*	*	0.00	0.000	0.020	0.3121	0.0000	.0000E+00	.0000E+00
5	*	*	0.00	0.000	0.015	0.3121	0.0000	.0000E+00	.0000E+00
6	*	*	0.05	0.000	0.018	0.3121	0.0000	.0000E+00	.0000E+00
7	*	*	0.00	0.000	0.016	0.3121	0.0000	.6303E-05	.2458E-08
8	*	*	0.00	0.000	0.010	0.3121	0.0000	.2089E-04	.6808E-08
9	*	*	0.00	0.000	0.008	0.3121	0.0000	.2088E-04	.6808E-08
10	*	*	0.32	0.000	0.011	0.3121	0.0000	.2088E-04	.6808E-08
11	*	*	0.00	0.000	0.017	0.3121	0.0000	.2087E-04	.6808E-08
12	*	*	0.00	0.000	0.017	0.3121	0.0000	.2086E-04	.6808E-08
13	*	*	0.00	0.000	0.015	0.3121	0.0000	.2085E-04	.6808E-08
14	*	*	0.00	0.000	0.019	0.3121	0.0000	.2085E-04	.6808E-08
15	*	*	0.06	0.000	0.016	0.3121	0.0000	.2084E-04	.6808E-08
16	*	*	0.00	0.000	0.019	0.3121	0.0000	.2083E-04	.6808E-08
17	*	*	0.00	0.000	0.017	0.3121	0.0000	.2082E-04	.6808E-08
18	*	*	0.00	0.000	0.015	0.3121	0.0000	.2082E-04	.6808E-08
19	*	*	0.00	0.000	0.014	0.3121	0.0000	.2081E-04	.6808E-08
20	*	*	0.13	0.000	0.000	0.3121	0.0000	.2080E-04	.6808E-08
21	*	*	0.00	0.000	0.018	0.3121	0.0000	.2079E-04	.6808E-08
22	*	*	0.00	0.000	0.019	0.3121	0.0000	.2079E-04	.6808E-08
23	*	*	0.00	0.000	0.015	0.3121	0.0000	.2078E-04	.6808E-08
24	*	*	0.00	0.000	0.019	0.3121	0.0000	.2077E-04	.6808E-08
25	*	*	0.00	0.000	0.012	0.3121	0.0000	.2076E-04	.6808E-08
26	*	*	0.00	0.000	0.011	0.3121	0.0000	.2076E-04	.6808E-08
27	*	*	0.00	0.000	0.011	0.3121	0.0000	.2075E-04	.6808E-08
28	*	*	0.00	0.000	0.015	0.3121	0.0000	.2074E-04	.6808E-08
29	*	*	0.00	0.000	0.012	0.3121	0.0000	.2073E-04	.6808E-08
30	*	*	0.00	0.000	0.000	0.3121	0.0000	.2073E-04	.6808E-08
31	*	*	0.00	0.000	0.024	0.3121	0.0000	.2072E-04	.6808E-08
32	*	*	0.00	0.000	0.026	0.3121	0.0000	.2071E-04	.6808E-08
33	*	*	0.00	0.000	0.023	0.3121	0.0000	.2070E-04	.6808E-08
34	*	*	0.18	0.000	0.018	0.3121	0.0000	.2070E-04	.6808E-08

35	*	*	0.00	0.000	0.018	0.3121	0.0000	.2069E-04	.6808E-08
36	*	*	0.01	0.000	0.016	0.3121	0.0000	.2068E-04	.6808E-08
37	*	*	0.00	0.000	0.025	0.3121	0.0000	.2067E-04	.6808E-08
38	*	*	0.00	0.000	0.019	0.3121	0.0000	.2067E-04	.6808E-08
39	*	*	0.00	0.000	0.022	0.3121	0.0000	.2066E-04	.6808E-08
40	*	*	0.00	0.000	0.015	0.3121	0.0000	.2065E-04	.6808E-08
41	*	*	0.05	0.000	0.000	0.3121	0.0000	.2064E-04	.6808E-08
42	*	*	0.00	0.000	0.020	0.3121	0.0000	.2064E-04	.6808E-08
43	*	*	0.00	0.000	0.025	0.3121	0.0000	.2063E-04	.6808E-08
44		*	0.00	0.000	0.005	0.3518	0.0000	.2062E-04	.6808E-08
45	*	*	0.53	0.000	0.021	0.3518	0.0000	.2061E-04	.6808E-08
46	*	*	0.00	0.000	0.026	0.3518	0.0000	.2061E-04	.6808E-08
47	*	*	0.03	0.000	0.017	0.3518	0.0000	.2060E-04	.6808E-08
48	*	*	0.00	0.000	0.014	0.3518	0.0000	.2059E-04	.6808E-08
49	*	*	0.00	0.000	0.019	0.3518	0.0000	.2058E-04	.6808E-08
50	*	*	0.03	0.000	0.013	0.3518	0.0000	.2058E-04	.6808E-08
51	*	*	0.00	0.000	0.014	0.3518	0.0000	.2057E-04	.6808E-08
52	*	*	0.00	0.000	0.015	0.3518	0.0000	.2056E-04	.6808E-08
53	*	*	0.00	0.000	0.021	0.3518	0.0000	.2055E-04	.6808E-08
54	*	*	0.00	0.000	0.016	0.3518	0.0000	.2055E-04	.6808E-08
55	*	*	0.00	0.000	0.013	0.3518	0.0000	.2054E-04	.6808E-08
56	*	*	0.00	0.000	0.014	0.3518	0.0000	.2053E-04	.6808E-08
57	*	*	0.00	0.000	0.021	0.3518	0.0000	.2052E-04	.6808E-08
58	*	*	0.00	0.000	0.024	0.3518	0.0000	.2052E-04	.6808E-08
59	*	*	0.00	0.000	0.026	0.3518	0.0000	.2051E-04	.6808E-08
60	*	*	0.00	0.000	0.023	0.3518	0.0000	.2050E-04	.6808E-08
61	*	*	0.29	0.000	0.019	0.3518	0.0000	.2050E-04	.6808E-08
62	*	*	0.00	0.000	0.013	0.3518	0.0000	.2049E-04	.6808E-08
63		*	0.00	0.000	0.029	0.3518	0.0000	.2048E-04	.6808E-08
64	*	*	0.18	0.000	0.021	0.3518	0.0000	.2047E-04	.6808E-08
65	*	*	0.08	0.000	0.015	0.3518	0.0000	.2047E-04	.6808E-08
66	*	*	0.00	0.000	0.025	0.3518	0.0000	.2046E-04	.6808E-08
67	*	*	0.00	0.000	0.022	0.3518	0.0000	.2045E-04	.6808E-08
68	*	*	0.00	0.000	0.023	0.3518	0.0000	.2044E-04	.6808E-08
69		*	0.03	0.000	0.000	0.4496	0.0000	.2044E-04	.6808E-08
70	*	*	0.00	0.000	0.000	0.4496	0.0000	.2043E-04	.6808E-08
71	*	*	0.35	0.000	0.016	0.4496	0.0000	.2042E-04	.6808E-08
72	*	*	0.43	0.000	0.007	0.4496	0.0000	.2041E-04	.6808E-08
73	*	*	0.00	0.000	0.019	0.4496	0.0000	.2041E-04	.6808E-08
74	*	*	0.00	0.000	0.016	0.4496	0.0000	.2040E-04	.6808E-08
75	*	*	0.02	0.000	0.000	0.4496	0.0000	.2039E-04	.6808E-08
76	*	*	0.00	0.000	0.017	0.4496	0.0000	.2039E-04	.6808E-08
77	*	*	0.00	0.000	0.022	0.4496	0.0000	.2038E-04	.6808E-08
78	*	*	0.00	0.000	0.027	0.4496	0.0000	.2037E-04	.6808E-08
79	*	*	0.00	0.000	0.025	0.4496	0.0000	.2036E-04	.6808E-08
80	*	*	0.00	0.000	0.031	0.4496	0.0000	.2036E-04	.6808E-08
81	*	*	0.00	0.000	0.023	0.4496	0.0000	.2035E-04	.6808E-08
82	*	*	0.00	0.000	0.031	0.4496	0.0000	.2034E-04	.6808E-08
83	*	*	0.00	0.000	0.024	0.4496	0.0000	.2033E-04	.6808E-08
84		*	0.01	0.000	0.000	0.4710	0.0000	.2033E-04	.6808E-08
85		*	0.00	0.000	0.000	0.4710	0.0000	.2032E-04	.6808E-08
86	*	*	0.02	0.000	0.020	0.4710	0.0000	.2031E-04	.6808E-08
87	*	*	0.00	0.000	0.000	0.4710	0.0000	.2031E-04	.6808E-08
88	*	*	0.29	0.000	0.015	0.4710	0.0000	.2030E-04	.6808E-08
89	*	*	0.08	0.000	0.000	0.4710	0.0000	.2029E-04	.6808E-08
90	*	*	0.00	0.000	0.032	0.4710	0.0000	.2028E-04	.6808E-08
91		*	0.00	0.000	0.030	0.4710	0.0000	.3814E-06	.1280E-09

92		*	0.00	0.000	0.057	0.4710	0.0000	.7038E-05	.2270E-08
93		*	0.00	0.000	0.000	0.4710	0.0000	.2055E-04	.6808E-08
94	*	*	0.16	0.000	0.081	0.4710	0.0000	.2055E-04	.6808E-08
95		*	0.00	0.000	0.079	0.4710	0.0000	.2054E-04	.6808E-08
96	*	*	0.00	0.000	0.000	0.4710	0.0000	.2053E-04	.6808E-08
97		*	0.00	0.000	0.000	0.4710	0.0000	.3237E-05	.1074E-08
98	*	*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
99		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
100		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
101		*	0.04	0.000	0.001	0.4710	0.0000	.0000E+00	.0000E+00
102		*	0.00	0.000	0.000	0.4710	0.0000	.9565E-05	.2965E-08
103		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
104		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
105		*	0.49	0.000	0.001	0.4710	0.0000	.6979E-05	.2081E-08
106		*	0.00	0.000	0.000	0.4710	0.0000	.2218E-04	.6809E-08
107		*	0.06	0.000	0.001	0.4710	0.0000	.4171E-06	.1280E-09
108		*	0.00	0.000	0.000	0.4710	0.0000	.8713E-05	.2587E-08
109		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
110		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
111		*	0.00	0.000	0.000	0.4710	0.0000	.0000E+00	.0000E+00
112			0.00	0.000	0.198	0.3729	0.0000	.1703E-04	.4918E-08
113			0.00	0.000	0.160	0.3407	0.0000	.6261E-05	.1830E-08
114			0.13	0.000	0.185	0.3265	0.0000	.0000E+00	.0000E+00
115			0.00	0.000	0.208	0.2956	0.0000	.0000E+00	.0000E+00
116			0.00	0.000	0.204	0.2676	0.0000	.0000E+00	.0000E+00
117			0.00	0.000	0.196	0.2432	0.0000	.0000E+00	.0000E+00
118			0.00	0.000	0.226	0.2149	0.0000	.0000E+00	.0000E+00
119			0.00	0.000	0.039	0.2100	0.0000	.0000E+00	.0000E+00
120			0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
121			0.04	0.000	0.006	0.2142	0.0000	.0000E+00	.0000E+00
122			0.00	0.000	0.005	0.2137	0.0000	.0000E+00	.0000E+00
123			0.01	0.000	0.011	0.2135	0.0000	.0000E+00	.0000E+00
124			0.00	0.000	0.006	0.2128	0.0000	.0000E+00	.0000E+00
125			0.00	0.000	0.009	0.2116	0.0000	.0000E+00	.0000E+00
126			0.01	0.000	0.007	0.2120	0.0000	.0000E+00	.0000E+00
127			0.00	0.000	0.003	0.2116	0.0000	.0000E+00	.0000E+00
128			0.00	0.000	0.006	0.2109	0.0000	.0000E+00	.0000E+00
129			0.00	0.000	0.005	0.2102	0.0000	.0000E+00	.0000E+00
130			0.00	0.000	0.001	0.2100	0.0000	.0000E+00	.0000E+00
131			0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
132			0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
133			0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
134			0.01	0.000	0.003	0.2109	0.0000	.0000E+00	.0000E+00
135			0.00	0.000	0.002	0.2106	0.0000	.0000E+00	.0000E+00
136			0.00	0.000	0.004	0.2102	0.0000	.0000E+00	.0000E+00
137			0.00	0.000	0.001	0.2100	0.0000	.0000E+00	.0000E+00
138			0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
139			0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
140			0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
141			0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
142			0.02	0.000	0.002	0.2122	0.0000	.0000E+00	.0000E+00
143			0.00	0.000	0.002	0.2120	0.0000	.0000E+00	.0000E+00
144			0.00	0.000	0.004	0.2115	0.0000	.0000E+00	.0000E+00
145			0.00	0.000	0.003	0.2111	0.0000	.0000E+00	.0000E+00
146			0.00	0.000	0.003	0.2107	0.0000	.0000E+00	.0000E+00
147			0.00	0.000	0.003	0.2103	0.0000	.0000E+00	.0000E+00
148			0.84	0.000	0.013	0.3136	0.0000	.7126E-05	.1703E-08

149	0.04	0.000	0.016	0.3167	0.0000	.3250E-04	.6811E-08
150	0.00	0.000	0.016	0.3146	0.0000	.3248E-04	.6811E-08
151	0.00	0.000	0.016	0.3126	0.0000	.3246E-04	.6811E-08
152	0.00	0.000	0.017	0.3105	0.0000	.3245E-04	.6811E-08
153	0.00	0.000	0.017	0.3085	0.0000	.3243E-04	.6811E-08
154	0.00	0.000	0.016	0.3064	0.0000	.3241E-04	.6811E-08
155	0.00	0.000	0.016	0.3044	0.0000	.3239E-04	.6811E-08
156	0.00	0.000	0.016	0.3024	0.0000	.3238E-04	.6811E-08
157	0.00	0.000	0.016	0.3005	0.0000	.3236E-04	.6811E-08
158	0.00	0.000	0.016	0.2985	0.0000	.3234E-04	.6811E-08
159	0.00	0.000	0.015	0.2966	0.0000	.3233E-04	.6811E-08
160	0.00	0.000	0.015	0.2947	0.0000	.3231E-04	.6811E-08
161	1.28	0.000	0.016	0.4527	0.0000	.3229E-04	.6811E-08
162	0.00	0.000	0.210	0.3711	0.0000	.3227E-04	.6811E-08
163	0.00	0.000	0.175	0.3375	0.0000	.3226E-04	.6811E-08
164	0.57	0.000	0.211	0.3751	0.0000	.3224E-04	.6811E-08
165	0.00	0.000	0.225	0.3421	0.0000	.3222E-04	.6811E-08
166	0.00	0.000	0.189	0.3168	0.0000	.3221E-04	.6811E-08
167	0.04	0.000	0.239	0.2919	0.0000	.1492E-04	.3094E-08
168	0.02	0.000	0.220	0.2670	0.0000	.0000E+00	.0000E+00
169	0.13	0.000	0.260	0.2507	0.0000	.0000E+00	.0000E+00
170	0.00	0.000	0.201	0.2256	0.0000	.0000E+00	.0000E+00
171	0.00	0.000	0.075	0.2152	0.0000	.0000E+00	.0000E+00
172	0.00	0.000	0.039	0.2103	0.0000	.0000E+00	.0000E+00
173	0.00	0.000	0.002	0.2101	0.0000	.0000E+00	.0000E+00
174	0.00	0.000	0.001	0.2100	0.0000	.0000E+00	.0000E+00
175	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
176	1.61	0.000	0.041	0.3909	0.0000	.0000E+00	.0000E+00
177	0.00	0.000	0.276	0.3717	0.0000	.0000E+00	.0000E+00
178	0.93	0.000	0.258	0.4435	0.0000	.4167E-05	.6348E-09
179	0.00	0.000	0.211	0.3707	0.0000	.2338E-04	.4163E-08
180	0.23	0.000	0.225	0.3599	0.0000	.3769E-04	.6812E-08
181	0.03	0.000	0.199	0.3315	0.0000	.2792E-04	.5048E-08
182	0.00	0.000	0.165	0.3063	0.0000	.0000E+00	.0000E+00
183	0.42	0.000	0.109	0.3434	0.0000	.0000E+00	.0000E+00
184	0.00	0.000	0.218	0.3162	0.0000	.0000E+00	.0000E+00
185	0.00	0.000	0.227	0.2878	0.0000	.0000E+00	.0000E+00
186	0.00	0.000	0.228	0.2593	0.0000	.0000E+00	.0000E+00
187	0.00	0.000	0.174	0.2375	0.0000	.0000E+00	.0000E+00
188	0.03	0.000	0.240	0.2110	0.0000	.0000E+00	.0000E+00
189	0.00	0.000	0.004	0.2104	0.0000	.0000E+00	.0000E+00
190	0.00	0.000	0.002	0.2102	0.0000	.0000E+00	.0000E+00
191	0.00	0.000	0.001	0.2101	0.0000	.0000E+00	.0000E+00
192	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
193	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
194	0.02	0.000	0.005	0.2118	0.0000	.0000E+00	.0000E+00
195	0.00	0.000	0.003	0.2114	0.0000	.0000E+00	.0000E+00
196	0.00	0.000	0.006	0.2106	0.0000	.0000E+00	.0000E+00
197	0.60	0.000	0.016	0.2836	0.0000	.0000E+00	.0000E+00
198	0.00	0.000	0.027	0.2802	0.0000	.0000E+00	.0000E+00
199	0.00	0.000	0.026	0.2770	0.0000	.0000E+00	.0000E+00
200	0.00	0.000	0.024	0.2740	0.0000	.0000E+00	.0000E+00
201	0.07	0.000	0.028	0.2793	0.0000	.0000E+00	.0000E+00
202	0.00	0.000	0.025	0.2762	0.0000	.0000E+00	.0000E+00
203	0.00	0.000	0.024	0.2731	0.0000	.0000E+00	.0000E+00
204	0.00	0.000	0.025	0.2700	0.0000	.0000E+00	.0000E+00
205	0.36	0.000	0.025	0.3119	0.0000	.0000E+00	.0000E+00

206	0.00	0.000	0.229	0.2833	0.0000	.0000E+00	.0000E+00
207	0.06	0.000	0.026	0.2876	0.0000	.0000E+00	.0000E+00
208	0.00	0.000	0.023	0.2847	0.0000	.0000E+00	.0000E+00
209	0.15	0.000	0.023	0.3006	0.0000	.1167E-05	.3782E-09
210	0.00	0.000	0.184	0.2775	0.0000	.5387E-04	.6816E-08
211	0.21	0.000	0.023	0.3009	0.0000	.5424E-04	.6816E-08
212	0.00	0.000	0.211	0.2745	0.0000	.5419E-04	.6816E-08
213	0.00	0.000	0.022	0.2718	0.0000	.5415E-04	.6816E-08
214	0.00	0.000	0.021	0.2692	0.0000	.5410E-04	.6816E-08
215	0.00	0.000	0.021	0.2666	0.0000	.5406E-04	.6816E-08
216	0.00	0.000	0.020	0.2640	0.0000	.5402E-04	.6816E-08
217	0.06	0.000	0.022	0.2688	0.0000	.5397E-04	.6816E-08
218	0.00	0.000	0.019	0.2664	0.0000	.5393E-04	.6816E-08
219	0.00	0.000	0.019	0.2640	0.0000	.5388E-04	.6816E-08
220	0.00	0.000	0.019	0.2616	0.0000	.5384E-04	.6816E-08
221	0.00	0.000	0.018	0.2593	0.0000	.5379E-04	.6816E-08
222	0.00	0.000	0.018	0.2570	0.0000	.5375E-04	.6816E-08
223	0.15	0.000	0.020	0.2733	0.0000	.5371E-04	.6816E-08
224	0.02	0.000	0.020	0.2733	0.0000	.5366E-04	.6816E-08
225	0.00	0.000	0.017	0.2711	0.0000	.5362E-04	.6816E-08
226	0.14	0.000	0.019	0.2862	0.0000	.5358E-04	.6816E-08
227	0.00	0.000	0.017	0.2841	0.0000	.5353E-04	.6816E-08
228	0.00	0.000	0.016	0.2821	0.0000	.5349E-04	.6816E-08
229	0.00	0.000	0.016	0.2801	0.0000	.5344E-04	.6816E-08
230	0.00	0.000	0.016	0.2782	0.0000	.5340E-04	.6816E-08
231	0.00	0.000	0.015	0.2763	0.0000	.5336E-04	.6816E-08
232	0.00	0.000	0.016	0.2743	0.0000	.5331E-04	.6816E-08
233	0.00	0.000	0.016	0.2724	0.0000	.5327E-04	.6815E-08
234	0.00	0.000	0.015	0.2704	0.0000	.5323E-04	.6815E-08
235	0.00	0.000	0.014	0.2687	0.0000	.5319E-04	.6815E-08
236	0.00	0.000	0.014	0.2669	0.0000	.5314E-04	.6815E-08
237	0.00	0.000	0.014	0.2652	0.0000	.5310E-04	.6815E-08
238	0.00	0.000	0.013	0.2636	0.0000	.5306E-04	.6815E-08
239	0.00	0.000	0.013	0.2619	0.0000	.5301E-04	.6815E-08
240	0.00	0.000	0.013	0.2603	0.0000	.5297E-04	.6815E-08
241	0.00	0.000	0.013	0.2586	0.0000	.5293E-04	.6815E-08
242	0.00	0.000	0.013	0.2570	0.0000	.5288E-04	.6815E-08
243	0.00	0.000	0.013	0.2554	0.0000	.5284E-04	.6815E-08
244	0.23	0.000	0.015	0.2823	0.0000	.5280E-04	.6815E-08
245	0.00	0.000	0.013	0.2807	0.0000	.5276E-04	.6815E-08
246	0.02	0.000	0.016	0.2812	0.0000	.5271E-04	.6815E-08
247	0.00	0.000	0.013	0.2795	0.0000	.5267E-04	.6815E-08
248	0.00	0.000	0.013	0.2779	0.0000	.5263E-04	.6815E-08
249	0.00	0.000	0.013	0.2763	0.0000	.5259E-04	.6815E-08
250	0.00	0.000	0.013	0.2747	0.0000	.5255E-04	.6815E-08
251	0.00	0.000	0.013	0.2731	0.0000	.5250E-04	.6815E-08
252	0.17	0.000	0.015	0.2924	0.0000	.5246E-04	.6815E-08
253	0.00	0.000	0.013	0.2909	0.0000	.5242E-04	.6815E-08
254	0.00	0.000	0.013	0.2893	0.0000	.5238E-04	.6815E-08
255	0.00	0.000	0.012	0.2878	0.0000	.5234E-04	.6815E-08
256	0.00	0.000	0.012	0.2862	0.0000	.5229E-04	.6815E-08
257	0.09	0.000	0.015	0.2955	0.0000	.5225E-04	.6815E-08
258	0.00	0.000	0.012	0.2940	0.0000	.5221E-04	.6815E-08
259	0.00	0.000	0.012	0.2925	0.0000	.5217E-04	.6815E-08
260	0.00	0.000	0.012	0.2910	0.0000	.5213E-04	.6815E-08
261	0.00	0.000	0.012	0.2895	0.0000	.5209E-04	.6815E-08
262	0.59	0.000	0.014	0.3615	0.0000	.5204E-04	.6815E-08

263		0.23	0.000	0.086	0.3795	0.0000	.5200E-04	.6815E-08
264		0.00	0.000	0.108	0.3660	0.0000	.5196E-04	.6815E-08
265		0.00	0.000	0.078	0.3563	0.0000	.5192E-04	.6815E-08
266		0.00	0.000	0.110	0.3382	0.0000	.5188E-04	.6815E-08
267		0.00	0.000	0.100	0.3203	0.0000	.5184E-04	.6815E-08
268		0.00	0.000	0.080	0.3061	0.0000	.5180E-04	.6815E-08
269		0.00	0.000	0.075	0.2944	0.0000	.5176E-04	.6815E-08
270		0.24	0.000	0.105	0.3111	0.0000	.5172E-04	.6815E-08
271		0.03	0.000	0.100	0.3024	0.0000	.5167E-04	.6815E-08
272		0.00	0.000	0.092	0.2909	0.0000	.5163E-04	.6815E-08
273		0.00	0.000	0.055	0.2841	0.0000	.5159E-04	.6815E-08
274		0.00	0.000	0.096	0.2720	0.0000	.5155E-04	.6815E-08
275		0.00	0.000	0.083	0.2617	0.0000	.3531E-04	.4672E-08
276		0.00	0.000	0.064	0.2537	0.0000	.0000E+00	.0000E+00
277		0.15	0.000	0.056	0.2654	0.0000	.0000E+00	.0000E+00
278		0.17	0.000	0.050	0.2805	0.0000	.0000E+00	.0000E+00
279		0.00	0.000	0.043	0.2751	0.0000	.0000E+00	.0000E+00
280		0.00	0.000	0.039	0.2702	0.0000	.0000E+00	.0000E+00
281		0.00	0.000	0.037	0.2656	0.0000	.0000E+00	.0000E+00
282		0.02	0.000	0.036	0.2636	0.0000	.0000E+00	.0000E+00
283		0.00	0.000	0.033	0.2595	0.0000	.0000E+00	.0000E+00
284		0.00	0.000	0.029	0.2558	0.0000	.0000E+00	.0000E+00
285		0.00	0.000	0.030	0.2521	0.0000	.0000E+00	.0000E+00
286		0.00	0.000	0.028	0.2486	0.0000	.0000E+00	.0000E+00
287		0.00	0.000	0.027	0.2452	0.0000	.0000E+00	.0000E+00
288		0.00	0.000	0.022	0.2424	0.0000	.0000E+00	.0000E+00
289		0.00	0.000	0.025	0.2392	0.0000	.0000E+00	.0000E+00
290		0.00	0.000	0.025	0.2361	0.0000	.0000E+00	.0000E+00
291		0.00	0.000	0.024	0.2331	0.0000	.0000E+00	.0000E+00
292		0.10	0.000	0.025	0.2425	0.0000	.0000E+00	.0000E+00
293	*	0.00	0.000	0.000	0.2425	0.0000	.0000E+00	.0000E+00
294	*	0.00	0.000	0.000	0.2425	0.0000	.0000E+00	.0000E+00
295	*	0.00	0.000	0.000	0.2425	0.0000	.0000E+00	.0000E+00
296	*	0.00	0.000	0.000	0.2425	0.0000	.0000E+00	.0000E+00
297	*	0.00	0.000	0.000	0.2425	0.0000	.0000E+00	.0000E+00
298	*	0.00	0.000	0.023	0.2396	0.0000	.0000E+00	.0000E+00
299		0.00	0.000	0.022	0.2369	0.0000	.0000E+00	.0000E+00
300		0.00	0.000	0.022	0.2342	0.0000	.0000E+00	.0000E+00
301		0.00	0.000	0.021	0.2315	0.0000	.0000E+00	.0000E+00
302		0.00	0.000	0.021	0.2289	0.0000	.0000E+00	.0000E+00
303		0.00	0.000	0.020	0.2264	0.0000	.0000E+00	.0000E+00
304		0.00	0.000	0.017	0.2242	0.0000	.0000E+00	.0000E+00
305		0.00	0.000	0.018	0.2220	0.0000	.0000E+00	.0000E+00
306		0.00	0.000	0.019	0.2197	0.0000	.0000E+00	.0000E+00
307		0.00	0.000	0.019	0.2173	0.0000	.0000E+00	.0000E+00
308	*	0.00	0.000	0.018	0.2150	0.0000	.0000E+00	.0000E+00
309		0.00	0.000	0.018	0.2127	0.0000	.0000E+00	.0000E+00
310		0.00	0.000	0.018	0.2105	0.0000	.0000E+00	.0000E+00
311		0.00	0.000	0.004	0.2100	0.0000	.0000E+00	.0000E+00
312		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
313	*	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
314	*	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
315	*	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
316		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
317		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
318	*	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
319		0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00

320			0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
321			0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
322			0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
323			0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
324			0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
325			0.01	0.000	0.003	0.2109	0.0000	.0000E+00	.0000E+00
326	*		0.00	0.000	0.000	0.2109	0.0000	.0000E+00	.0000E+00
327	*		0.00	0.000	0.001	0.2107	0.0000	.0000E+00	.0000E+00
328	*		0.00	0.000	0.000	0.2107	0.0000	.0000E+00	.0000E+00
329			0.00	0.000	0.002	0.2104	0.0000	.0000E+00	.0000E+00
330			0.13	0.000	0.008	0.2257	0.0000	.0000E+00	.0000E+00
331			0.00	0.000	0.006	0.2249	0.0000	.0000E+00	.0000E+00
332	*		0.00	0.000	0.000	0.2249	0.0000	.0000E+00	.0000E+00
333	*		0.00	0.000	0.000	0.2249	0.0000	.0000E+00	.0000E+00
334	*		0.00	0.000	0.000	0.2249	0.0000	.0000E+00	.0000E+00
335	*		0.00	0.000	0.000	0.2249	0.0000	.0000E+00	.0000E+00
336	*		0.00	0.000	0.000	0.2249	0.0000	.0000E+00	.0000E+00
337	*		0.00	0.000	0.000	0.2249	0.0000	.0000E+00	.0000E+00
338	*		0.03	0.000	0.015	0.2269	0.0000	.0000E+00	.0000E+00
339	*		0.00	0.000	0.000	0.2269	0.0000	.0000E+00	.0000E+00
340	*	*	0.14	0.000	0.005	0.2269	0.0000	.0000E+00	.0000E+00
341	*	*	0.02	0.000	0.005	0.2269	0.0000	.0000E+00	.0000E+00
342	*	*	0.00	0.000	0.007	0.2269	0.0000	.0000E+00	.0000E+00
343	*	*	0.00	0.000	0.007	0.2269	0.0000	.0000E+00	.0000E+00
344	*	*	0.00	0.000	0.012	0.2269	0.0000	.0000E+00	.0000E+00
345	*	*	0.00	0.000	0.016	0.2269	0.0000	.0000E+00	.0000E+00
346	*	*	0.00	0.000	0.019	0.2269	0.0000	.0000E+00	.0000E+00
347	*	*	0.00	0.000	0.014	0.2269	0.0000	.0000E+00	.0000E+00
348	*	*	0.00	0.000	0.018	0.2269	0.0000	.0000E+00	.0000E+00
349	*	*	0.00	0.000	0.015	0.2269	0.0000	.0000E+00	.0000E+00
350	*	*	0.00	0.000	0.018	0.2269	0.0000	.0000E+00	.0000E+00
351	*	*	0.00	0.000	0.013	0.2269	0.0000	.0000E+00	.0000E+00
352	*	*	0.00	0.000	0.011	0.2269	0.0000	.0000E+00	.0000E+00
353	*	*	0.00	0.000	0.000	0.2269	0.0000	.0000E+00	.0000E+00
354	*	*	0.00	0.000	0.000	0.2269	0.0000	.0000E+00	.0000E+00
355	*	*	0.00	0.000	0.000	0.2269	0.0000	.0000E+00	.0000E+00
356	*	*	0.00	0.000	0.000	0.2269	0.0000	.0000E+00	.0000E+00
357	*	*	0.00	0.000	0.000	0.2269	0.0000	.0000E+00	.0000E+00
358	*	*	0.00	0.000	0.000	0.2269	0.0000	.0000E+00	.0000E+00
359	*	*	0.00	0.000	0.000	0.2269	0.0000	.0000E+00	.0000E+00
360	*	*	0.00	0.000	0.000	0.2269	0.0000	.0000E+00	.0000E+00
361	*	*	0.11	0.000	0.011	0.2269	0.0000	.9672E-04	.4366E-08
362	*	*	0.00	0.000	0.011	0.2269	0.0000	.5206E-03	.6899E-08
363	*	*	0.00	0.000	0.010	0.2269	0.0000	.9670E-03	.6970E-08
364	*	*	0.01	0.000	0.010	0.2269	0.0000	.1406E-02	.7037E-08
365	*	*	0.00	0.000	0.011	0.2269	0.0000	.1836E-02	.7100E-08
366	*	*	0.00	0.000	0.010	0.2269	0.0001	.2253E-02	.7161E-08

****

****

MONTHLY TOTALS (IN INCHES) FOR YEAR 1976

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.85	0.83	1.78	0.92	0.93	4.84
	1.92	0.60	1.37	0.44	0.14	0.31
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.465	0.528	0.522	1.642	0.160	3.564
	2.180	0.516	1.321	0.840	0.116	0.239
LATERAL DRAINAGE COLLECTED	0.0005	0.0006	0.0006	0.0002	0.0001	0.0006
FROM LAYER 4	0.0002	0.0017	0.0016	0.0000	0.0000	0.0071
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.000	0.000

****

****

ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.93	270979.531	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	12.094	219500.000	81.00
DRAINAGE COLLECTED FROM LAYER 4	0.0131	238.312	0.09
PERC./LEAKAGE THROUGH LAYER 6	0.000001	0.023	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0000		
CHANGE IN WATER STORAGE	2.823	51241.074	18.91
SOIL WATER AT START OF YEAR	56.691	1028948.750	
SOIL WATER AT END OF YEAR	59.459	1079173.000	

SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.056	1016.872	0.38
ANNUAL WATER BUDGET BALANCE	0.0000	0.108	0.00

****

WARNING: TEMPERATURE FOR YEAR 4 USED WITH PRECIPITATION FOR YEAR 1977

WARNING: SOLAR RADIATION FOR YEAR 4 USED WITH PRECIPITATION FOR YEAR 1977

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

****

DAILY OUTPUT FOR YEAR 1977

DAY	AIR	SOIL	RAIN IN.	RUNOFF IN.	ET IN.	E. ZONE WATER IN./IN.	HEAD #1 IN.	DRAIN #1 IN.	LEAK #1 IN.
1	*	*	0.00	0.000	0.015	0.2269	0.0001	.2657E-02	.7218E-08
2	*	*	0.00	0.000	0.015	0.2269	0.0001	.3046E-02	.7272E-08
3	*	*	0.03	0.000	0.011	0.2269	0.0001	.3419E-02	.7324E-08
4	*	*	0.03	0.000	0.016	0.2269	0.0001	.3774E-02	.7372E-08
5	*	*	0.00	0.000	0.013	0.2269	0.0001	.4111E-02	.7417E-08
6	*	*	0.00	0.000	0.021	0.2269	0.0001	.4429E-02	.7460E-08
7	*	*	0.00	0.000	0.019	0.2269	0.0001	.4729E-02	.7500E-08
8	*	*	0.13	0.000	0.023	0.2269	0.0001	.5010E-02	.7537E-08
9	*	*	0.00	0.000	0.016	0.2269	0.0001	.5274E-02	.7572E-08
10	*	*	0.00	0.000	0.018	0.2269	0.0001	.5519E-02	.7604E-08
11	*	*	0.00	0.000	0.017	0.2269	0.0001	.5747E-02	.7634E-08
12	*	*	0.02	0.000	0.012	0.2269	0.0001	.5958E-02	.7661E-08
13	*	*	0.00	0.000	0.011	0.2269	0.0001	.6154E-02	.7686E-08
14	*	*	0.04	0.000	0.014	0.2269	0.0001	.6335E-02	.7710E-08
15	*	*	0.07	0.000	0.012	0.2269	0.0001	.6501E-02	.7731E-08
16	*	*	0.00	0.000	0.010	0.2269	0.0001	.6654E-02	.7751E-08
17	*	*	0.00	0.000	0.009	0.2269	0.0002	.6794E-02	.7769E-08
18	*	*	0.00	0.000	0.006	0.2269	0.0002	.6923E-02	.7785E-08
19	*	*	0.00	0.000	0.010	0.2269	0.0002	.7041E-02	.7800E-08
20	*	*	0.12	0.000	0.000	0.2269	0.0002	.7149E-02	.7814E-08
21	*	*	0.00	0.000	0.010	0.2269	0.0002	.7247E-02	.7826E-08
22	*	*	0.00	0.000	0.007	0.2269	0.0002	.7337E-02	.7838E-08

23	*	*	0.03	0.000	0.010	0.2269	0.0002	.7419E-02	.7848E-08
24	*	*	0.00	0.000	0.011	0.2269	0.0002	.7493E-02	.7858E-08
25	*	*	0.05	0.000	0.000	0.2269	0.0002	.7561E-02	.7866E-08
26	*	*	0.00	0.000	0.018	0.2269	0.0002	.7622E-02	.7874E-08
27	*	*	0.05	0.000	0.000	0.2269	0.0002	.7679E-02	.7881E-08
28	*	*	0.01	0.000	0.000	0.2269	0.0002	.7729E-02	.7887E-08
29	*	*	0.00	0.000	0.024	0.2269	0.0002	.7776E-02	.7893E-08
30		*	0.00	0.000	0.000	0.2625	0.0002	.7817E-02	.7899E-08
31	*	*	0.00	0.000	0.003	0.2625	0.0002	.7855E-02	.7903E-08
32	*	*	0.00	0.000	0.000	0.2625	0.0002	.7890E-02	.7908E-08
33	*	*	0.00	0.000	0.000	0.2625	0.0002	.7921E-02	.7912E-08
34	*	*	0.00	0.000	0.000	0.2625	0.0002	.7949E-02	.7915E-08
35	*	*	0.00	0.000	0.000	0.2625	0.0002	.7975E-02	.7918E-08
36	*	*	0.04	0.000	0.024	0.2625	0.0002	.7998E-02	.7921E-08
37	*	*	0.00	0.000	0.016	0.2625	0.0002	.8018E-02	.7924E-08
38	*	*	0.00	0.000	0.000	0.2625	0.0002	.8037E-02	.7926E-08
39	*	*	0.00	0.000	0.000	0.2625	0.0002	.8054E-02	.7928E-08
40	*	*	0.00	0.000	0.000	0.2625	0.0002	.8069E-02	.7930E-08
41	*	*	0.00	0.000	0.000	0.2625	0.0002	.8083E-02	.7932E-08
42	*	*	0.00	0.000	0.000	0.2625	0.0002	.8095E-02	.7933E-08
43	*	*	0.00	0.000	0.000	0.2625	0.0002	.8106E-02	.7935E-08
44		*	0.04	0.000	0.002	0.2673	0.0002	.8115E-02	.7936E-08
45		*	0.00	0.000	0.000	0.2673	0.0002	.8124E-02	.7937E-08
46	*	*	0.00	0.000	0.000	0.2673	0.0002	.8131E-02	.7938E-08
47	*	*	0.00	0.000	0.000	0.2673	0.0002	.8138E-02	.7939E-08
48	*	*	0.00	0.000	0.000	0.2673	0.0002	.8144E-02	.7940E-08
49	*	*	0.00	0.000	0.000	0.2673	0.0002	.8149E-02	.7940E-08
50	*	*	0.00	0.000	0.000	0.2673	0.0002	.8153E-02	.7941E-08
51	*	*	0.00	0.000	0.000	0.2673	0.0002	.8157E-02	.7941E-08
52	*	*	0.00	0.000	0.000	0.2673	0.0002	.8160E-02	.7942E-08
53		*	0.00	0.000	0.000	0.2673	0.0002	.8162E-02	.7942E-08
54	*	*	0.00	0.000	0.000	0.2673	0.0002	.8164E-02	.7942E-08
55	*	*	0.80	0.000	0.021	0.2673	0.0002	.8166E-02	.7942E-08
56	*	*	0.10	0.000	0.024	0.2673	0.0002	.8167E-02	.7943E-08
57	*	*	0.00	0.000	0.022	0.2673	0.0002	.8168E-02	.7943E-08
58	*	*	0.00	0.000	0.022	0.2673	0.0002	.8168E-02	.7943E-08
59	*	*	0.00	0.000	0.021	0.2673	0.0002	.8168E-02	.7943E-08
60	*	*	0.00	0.000	0.018	0.2673	0.0002	.8168E-02	.7943E-08
61	*	*	0.00	0.000	0.018	0.2673	0.0002	.8167E-02	.7943E-08
62	*	*	0.11	0.000	0.013	0.2673	0.0002	.8166E-02	.7942E-08
63	*	*	0.20	0.000	0.011	0.2673	0.0002	.8165E-02	.7942E-08
64	*	*	0.14	0.000	0.010	0.2673	0.0002	.8163E-02	.7942E-08
65	*	*	0.00	0.000	0.016	0.2673	0.0002	.8161E-02	.7942E-08
66	*	*	0.00	0.000	0.000	0.2673	0.0002	.8159E-02	.7942E-08
67	*	*	0.00	0.000	0.019	0.2673	0.0002	.8157E-02	.7941E-08
68	*	*	0.00	0.000	0.019	0.2673	0.0002	.8155E-02	.7941E-08
69	*	*	0.00	0.000	0.000	0.2673	0.0002	.8152E-02	.7941E-08
70	*	*	0.00	0.000	0.019	0.2673	0.0002	.8149E-02	.7940E-08
71	*	*	1.13	0.000	0.019	0.2673	0.0002	.8146E-02	.7940E-08
72	*	*	0.34	0.000	0.000	0.2673	0.0002	.8143E-02	.7940E-08
73	*	*	0.00	0.000	0.018	0.2673	0.0002	.8140E-02	.7939E-08
74	*	*	0.00	0.000	0.022	0.2673	0.0002	.8137E-02	.7939E-08
75	*	*	0.06	0.000	0.013	0.2673	0.0002	.8133E-02	.7938E-08
76	*	*	0.00	0.000	0.019	0.2673	0.0002	.8129E-02	.7938E-08
77	*	*	0.15	0.000	0.014	0.2673	0.0002	.8125E-02	.7937E-08
78	*	*	0.00	0.000	0.000	0.2673	0.0002	.8122E-02	.7937E-08
79		*	0.00	0.000	0.026	0.2745	0.0002	.8117E-02	.7936E-08

80		*	0.00	0.000	0.025	0.2810	0.0002	.8113E-02	.7936E-08
81		*	0.00	0.000	0.000	0.3649	0.0002	.8109E-02	.7935E-08
82	*	*	0.04	0.000	0.021	0.3657	0.0002	.8105E-02	.7935E-08
83		*	0.00	0.000	0.000	0.4275	0.0002	.8100E-02	.7934E-08
84	*	*	0.00	0.000	0.025	0.4275	0.0002	.8095E-02	.7934E-08
85	*	*	0.00	0.000	0.020	0.4275	0.0002	.8091E-02	.7933E-08
86	*	*	0.21	0.000	0.015	0.4275	0.0002	.8086E-02	.7932E-08
87	*	*	0.00	0.000	0.028	0.4275	0.0002	.8081E-02	.7932E-08
88		*	0.33	0.000	0.000	0.4461	0.0002	.8076E-02	.7931E-08
89		*	0.32	0.000	0.000	0.4461	0.0002	.8071E-02	.7930E-08
90		*	0.00	0.000	0.000	0.4461	0.0002	.8066E-02	.7930E-08
91	*	*	0.00	0.000	0.027	0.4461	0.0002	.8061E-02	.7929E-08
92	*	*	0.04	0.000	0.000	0.4461	0.0002	.8056E-02	.7929E-08
93	*	*	0.02	0.000	0.000	0.4461	0.0002	.8050E-02	.7928E-08
94		*	0.20	0.000	0.000	0.4461	0.0002	.8045E-02	.7927E-08
95	*	*	0.08	0.000	0.000	0.4461	0.0002	.8039E-02	.7926E-08
96		*	0.04	0.000	0.000	0.4461	0.0002	.8034E-02	.7926E-08
97		*	0.00	0.000	0.107	0.4461	0.0002	.8028E-02	.7925E-08
98		*	0.00	0.000	0.139	0.4461	0.0002	.8023E-02	.7924E-08
99		*	0.00	0.000	0.150	0.4461	0.0002	.8017E-02	.7924E-08
100		*	0.00	0.000	0.169	0.4461	0.0002	.8011E-02	.7923E-08
101		*	0.00	0.000	0.143	0.4461	0.0002	.8005E-02	.7922E-08
102		*	0.01	0.000	0.117	0.4461	0.0002	.7999E-02	.7921E-08
103		*	0.03	0.000	0.124	0.4710	0.0002	.8366E-02	.7967E-08
104		*	0.00	0.000	0.000	0.4710	0.0002	.8500E-02	.7984E-08
105	*	*	0.82	0.000	0.046	0.4710	0.0000	.1822E-02	.6853E-08
106	*	*	0.19	0.000	0.030	0.4710	0.0001	.3340E-02	.7312E-08
107	*	*	0.00	0.000	0.038	0.4710	0.0001	.5300E-02	.7575E-08
108		*	0.32	0.000	0.000	0.4710	0.0003	.1208E-01	.8414E-08
109		*	0.88	0.000	0.002	0.4710	0.0002	.7167E-02	.7809E-08
110		*	0.00	0.000	0.000	0.4710	0.0002	.7404E-02	.7846E-08
111		*	0.52	0.000	0.002	0.4710	0.0002	.1113E-01	.8296E-08
112		*	0.00	0.000	0.000	0.4710	0.0002	.8666E-02	.7808E-08
113		*	0.00	0.000	0.000	0.4710	0.0002	.9166E-02	.8067E-08
114		*	0.00	0.000	0.000	0.4710	0.0002	.9789E-02	.8144E-08
115		*	0.00	0.000	0.000	0.4710	0.0002	.1024E-01	.8200E-08
116		*	0.00	0.000	0.000	0.4710	0.0002	.1056E-01	.8238E-08
117			0.00	0.000	0.109	0.3816	0.0004	.1654E-01	.8948E-08
118			0.00	0.000	0.153	0.3500	0.0002	.9581E-02	.8113E-08
119			0.02	0.000	0.168	0.3244	0.0002	.9019E-02	.8049E-08
120			0.00	0.000	0.154	0.2996	0.0002	.9337E-02	.8088E-08
121			0.00	0.000	0.106	0.2831	0.0002	.9558E-02	.8116E-08
122			0.02	0.000	0.193	0.2609	0.0002	.9698E-02	.8133E-08
123			0.00	0.000	0.238	0.2311	0.0002	.9773E-02	.8142E-08
124			0.00	0.000	0.169	0.2100	0.0002	.9795E-02	.8145E-08
125			0.06	0.000	0.019	0.2152	0.0002	.9774E-02	.8142E-08
126			0.07	0.000	0.014	0.2222	0.0002	.9719E-02	.8136E-08
127			0.00	0.000	0.027	0.2189	0.0002	.9636E-02	.8125E-08
128			0.00	0.000	0.032	0.2148	0.0002	.9533E-02	.8113E-08
129			0.00	0.000	0.028	0.2113	0.0002	.9413E-02	.8098E-08
130			0.00	0.000	0.008	0.2103	0.0002	.9281E-02	.8081E-08
131			0.00	0.000	0.001	0.2101	0.0002	.9140E-02	.8064E-08
132			0.00	0.000	0.000	0.2100	0.0002	.8992E-02	.8046E-08
133			0.00	0.000	0.000	0.2100	0.0002	.8840E-02	.8027E-08
134			0.00	0.000	0.000	0.2100	0.0002	.8686E-02	.8007E-08
135			0.00	0.000	0.000	0.2100	0.0002	.8531E-02	.7988E-08
136			0.15	0.000	0.014	0.2270	0.0002	.8375E-02	.7969E-08

137	0.00	0.000	0.012	0.2255	0.0002	.8221E-02	.7949E-08
138	0.20	0.000	0.015	0.2486	0.0002	.8151E-02	.7941E-08
139	0.00	0.000	0.018	0.2463	0.0002	.8891E-02	.8033E-08
140	0.66	0.000	0.019	0.3264	0.0002	.9540E-02	.8113E-08
141	0.20	0.000	0.166	0.3306	0.0002	.9898E-02	.8158E-08
142	0.45	0.000	0.154	0.3677	0.0002	.1004E-01	.8175E-08
143	0.21	0.000	0.223	0.3660	0.0002	.1000E-01	.8171E-08
144	0.00	0.000	0.241	0.3359	0.0002	.9492E-02	.8108E-08
145	0.00	0.000	0.220	0.3083	0.0002	.8882E-02	.8032E-08
146	0.01	0.000	0.231	0.2807	0.0002	.8341E-02	.7964E-08
147	0.19	0.000	0.202	0.2792	0.0002	.7858E-02	.7904E-08
148	0.45	0.000	0.085	0.3248	0.0002	.7425E-02	.7849E-08
149	0.01	0.000	0.153	0.3069	0.0002	.7034E-02	.7799E-08
150	0.00	0.000	0.166	0.2862	0.0001	.6679E-02	.7754E-08
151	0.80	0.000	0.203	0.3608	0.0001	.6356E-02	.7712E-08
152	0.09	0.000	0.212	0.3456	0.0001	.6062E-02	.7674E-08
153	0.10	0.000	0.173	0.3364	0.0001	.5791E-02	.7639E-08
154	0.00	0.000	0.202	0.3112	0.0001	.5542E-02	.7607E-08
155	0.00	0.000	0.167	0.2904	0.0001	.5312E-02	.7577E-08
156	0.63	0.000	0.203	0.3438	0.0001	.5100E-02	.7549E-08
157	0.00	0.000	0.242	0.3135	0.0001	.4902E-02	.7523E-08
158	0.00	0.000	0.241	0.2834	0.0001	.4719E-02	.7499E-08
159	0.03	0.000	0.203	0.2618	0.0001	.4547E-02	.7476E-08
160	0.02	0.000	0.085	0.2537	0.0001	.4387E-02	.7454E-08
161	0.02	0.000	0.066	0.2479	0.0001	.4237E-02	.7434E-08
162	0.00	0.000	0.054	0.2412	0.0001	.4096E-02	.7415E-08
163	0.00	0.000	0.047	0.2353	0.0001	.3891E-02	.7388E-08
164	0.00	0.000	0.041	0.2302	0.0001	.3364E-02	.7316E-08
165	0.00	0.000	0.038	0.2255	0.0001	.2812E-02	.7240E-08
166	0.00	0.000	0.028	0.2220	0.0001	.2278E-02	.7164E-08
167	0.75	0.000	0.037	0.3110	0.0000	.2091E-02	.7126E-08
168	0.48	0.000	0.260	0.3384	0.0000	.1103E-02	.6991E-08
169	0.45	0.000	0.271	0.3605	0.0000	.1198E-02	.6693E-08
170	0.00	0.000	0.249	0.3294	0.0000	.3378E-03	.2580E-08
171	0.08	0.000	0.267	0.3059	0.0000	.6634E-04	.1380E-09
172	0.00	0.000	0.194	0.2816	0.0000	.0000E+00	.0000E+00
173	0.00	0.000	0.074	0.2724	0.0000	.0000E+00	.0000E+00
174	0.10	0.000	0.066	0.2766	0.0000	.0000E+00	.0000E+00
175	0.00	0.000	0.054	0.2699	0.0000	.0000E+00	.0000E+00
176	0.00	0.000	0.047	0.2640	0.0000	.0000E+00	.0000E+00
177	0.00	0.000	0.042	0.2588	0.0000	.0000E+00	.0000E+00
178	0.00	0.000	0.036	0.2543	0.0000	.0000E+00	.0000E+00
179	0.65	0.000	0.039	0.3307	0.0000	.0000E+00	.0000E+00
180	0.00	0.000	0.249	0.2996	0.0000	.0000E+00	.0000E+00
181	0.10	0.000	0.037	0.3075	0.0000	.0000E+00	.0000E+00
182	0.07	0.000	0.035	0.3119	0.0000	.0000E+00	.0000E+00
183	0.00	0.000	0.198	0.2872	0.0000	.0000E+00	.0000E+00
184	0.35	0.000	0.033	0.3267	0.0000	.0000E+00	.0000E+00
185	1.10	0.000	0.273	0.4301	0.0000	.0000E+00	.0000E+00
186	0.00	0.000	0.238	0.3681	0.0000	.5212E-03	.1214E-08
187	0.00	0.000	0.264	0.3237	0.0001	.2555E-02	.7204E-08
188	0.05	0.000	0.238	0.2932	0.0000	.1992E-02	.7123E-08
189	0.05	0.000	0.259	0.2627	0.0000	.1623E-02	.7069E-08
190	0.00	0.000	0.257	0.2301	0.0000	.1440E-02	.7042E-08
191	0.00	0.000	0.159	0.2103	0.0000	.1434E-02	.7041E-08
192	0.00	0.000	0.002	0.2101	0.0000	.1597E-02	.7065E-08
193	0.77	0.000	0.046	0.3006	0.0000	.2669E-03	.2063E-08

194	0.00	0.000	0.170	0.2794	0.0000	.0000E+00	.0000E+00
195	0.00	0.000	0.169	0.2583	0.0000	.0000E+00	.0000E+00
196	0.00	0.000	0.183	0.2354	0.0000	.1679E-03	.2237E-08
197	0.03	0.000	0.078	0.2293	0.0000	.1039E-02	.4324E-08
198	0.00	0.000	0.062	0.2216	0.0001	.5633E-02	.7617E-08
199	0.00	0.000	0.052	0.2151	0.0002	.9551E-02	.8114E-08
200	0.00	0.000	0.030	0.2114	0.0003	.1262E-01	.8488E-08
201	0.00	0.000	0.011	0.2100	0.0003	.1539E-01	.8818E-08
202	0.00	0.000	0.000	0.2100	0.0004	.1706E-01	.9015E-08
203	0.00	0.000	0.000	0.2100	0.0004	.1785E-01	.9107E-08
204	0.00	0.000	0.000	0.2100	0.0004	.1805E-01	.9129E-08
205	0.30	0.000	0.016	0.2455	0.0004	.1785E-01	.9106E-08
206	0.00	0.000	0.021	0.2428	0.0004	.1740E-01	.9054E-08
207	0.00	0.000	0.020	0.2403	0.0004	.1680E-01	.8984E-08
208	0.00	0.000	0.019	0.2380	0.0004	.1613E-01	.8905E-08
209	1.08	0.000	0.025	0.3698	0.0003	.1541E-01	.8821E-08
210	0.00	0.000	0.220	0.3423	0.0003	.1469E-01	.8735E-08
211	0.00	0.000	0.223	0.3144	0.0003	.1397E-01	.8650E-08
212	0.54	0.000	0.237	0.3523	0.0003	.1327E-01	.8567E-08
213	0.00	0.000	0.239	0.3223	0.0003	.1298E-01	.8530E-08
214	0.00	0.000	0.253	0.2908	0.0003	.1178E-01	.8388E-08
215	0.02	0.000	0.204	0.2678	0.0003	.1123E-01	.8320E-08
216	0.00	0.000	0.083	0.2574	0.0002	.1068E-01	.8254E-08
217	0.02	0.000	0.067	0.2516	0.0002	.1016E-01	.8190E-08
218	0.00	0.000	0.054	0.2449	0.0002	.9673E-02	.8130E-08
219	0.09	0.000	0.050	0.2499	0.0002	.9216E-02	.8073E-08
220	0.02	0.000	0.045	0.2468	0.0002	.8789E-02	.8020E-08
221	0.00	0.000	0.039	0.2419	0.0002	.8394E-02	.7971E-08
222	0.05	0.000	0.040	0.2432	0.0002	.8030E-02	.7925E-08
223	0.00	0.000	0.034	0.2389	0.0002	.7697E-02	.7883E-08
224	0.00	0.000	0.033	0.2349	0.0002	.7397E-02	.7845E-08
225	0.04	0.000	0.034	0.2356	0.0002	.7286E-02	.7830E-08
226	0.06	0.000	0.031	0.2391	0.0002	.6818E-02	.7772E-08
227	0.00	0.000	0.028	0.2356	0.0001	.6628E-02	.7747E-08
228	0.32	0.000	0.030	0.2718	0.0001	.6469E-02	.7727E-08
229	0.04	0.000	0.029	0.2732	0.0001	.6339E-02	.7710E-08
230	0.00	0.000	0.025	0.2700	0.0001	.6239E-02	.7697E-08
231	0.00	0.000	0.025	0.2669	0.0001	.6169E-02	.7688E-08
232	0.00	0.000	0.024	0.2639	0.0001	.6129E-02	.7683E-08
233	0.00	0.000	0.023	0.2610	0.0001	.6117E-02	.7682E-08
234	0.00	0.000	0.023	0.2582	0.0001	.6133E-02	.7684E-08
235	0.00	0.000	0.022	0.2554	0.0001	.6176E-02	.7689E-08
236	0.00	0.000	0.022	0.2527	0.0001	.6245E-02	.7698E-08
237	0.00	0.000	0.021	0.2501	0.0001	.6338E-02	.7710E-08
238	0.35	0.000	0.024	0.2908	0.0001	.6454E-02	.7725E-08
239	1.95	0.000	0.024	0.4602	0.0001	.6591E-02	.7743E-08
240	1.05	0.000	0.196	0.4537	0.0002	.9330E-02	.8086E-08
241	0.00	0.000	0.172	0.3752	0.0001	.4150E-02	.3546E-08
242	0.00	0.000	0.139	0.3457	0.0000	.0000E+00	.0000E+00
243	1.25	0.000	0.089	0.4537	0.0000	.1650E-02	.6120E-08
244	0.84	0.000	0.120	0.4444	0.0003	.1170E-01	.7353E-08
245	0.16	0.000	0.141	0.3987	0.0001	.5314E-02	.7576E-08
246	0.00	0.000	0.190	0.3628	0.0002	.8303E-02	.7959E-08
247	0.08	0.000	0.131	0.3518	0.0002	.1059E-01	.8243E-08
248	0.08	0.000	0.102	0.3436	0.0003	.1228E-01	.8447E-08
249	0.00	0.000	0.097	0.3267	0.0003	.1346E-01	.8589E-08
250	0.00	0.000	0.145	0.3052	0.0003	.1424E-01	.8682E-08

251		0.00	0.000	0.155	0.2851	0.0003	.1470E-01	.8737E-08
252		0.10	0.000	0.104	0.2847	0.0003	.1493E-01	.8764E-08
253		0.00	0.000	0.123	0.2693	0.0003	.1498E-01	.8770E-08
254		0.00	0.000	0.064	0.2613	0.0003	.1490E-01	.8760E-08
255		0.12	0.000	0.114	0.2621	0.0003	.1472E-01	.8740E-08
256		0.00	0.000	0.125	0.2465	0.0003	.1448E-01	.8711E-08
257		0.00	0.000	0.112	0.2325	0.0003	.1420E-01	.8678E-08
258		0.00	0.000	0.132	0.2143	0.0003	.1389E-01	.8640E-08
259		0.00	0.000	0.033	0.2102	0.0003	.1355E-01	.8601E-08
260		0.00	0.000	0.001	0.2101	0.0003	.1322E-01	.8561E-08
261		0.03	0.000	0.009	0.2127	0.0003	.1287E-01	.8519E-08
262		0.07	0.000	0.008	0.2204	0.0003	.1326E-01	.8565E-08
263		0.00	0.000	0.020	0.2179	0.0003	.1517E-01	.8792E-08
264		0.00	0.000	0.024	0.2150	0.0004	.1608E-01	.8900E-08
265		0.41	0.000	0.030	0.2625	0.0004	.1585E-01	.8872E-08
266		0.05	0.000	0.091	0.2574	0.0003	.1438E-01	.8699E-08
267		0.60	0.000	0.035	0.3280	0.0003	.1309E-01	.8546E-08
268		0.20	0.000	0.138	0.3357	0.0003	.1201E-01	.8415E-08
269		0.21	0.000	0.096	0.3500	0.0002	.1107E-01	.8302E-08
270		0.00	0.000	0.136	0.3330	0.0002	.1027E-01	.8203E-08
271		0.00	0.000	0.099	0.3207	0.0002	.9567E-02	.8117E-08
272		0.20	0.000	0.091	0.3343	0.0002	.8948E-02	.8040E-08
273		0.00	0.000	0.091	0.3229	0.0002	.8400E-02	.7972E-08
274		0.03	0.000	0.144	0.3087	0.0002	.7911E-02	.7910E-08
275		0.00	0.000	0.096	0.2966	0.0002	.7472E-02	.7855E-08
276		0.00	0.000	0.093	0.2851	0.0002	.7076E-02	.7805E-08
277		0.00	0.000	0.087	0.2742	0.0002	.6718E-02	.7759E-08
278		0.02	0.000	0.103	0.2638	0.0001	.6392E-02	.7717E-08
279		0.00	0.000	0.063	0.2559	0.0001	.5611E-02	.7616E-08
280		0.00	0.000	0.038	0.2511	0.0001	.4087E-02	.7414E-08
281		1.54	0.000	0.061	0.4259	0.0001	.2641E-02	.7215E-08
282		0.17	0.000	0.067	0.4155	0.0000	.2218E-02	.6951E-08
283		0.00	0.000	0.090	0.3831	0.0001	.5772E-02	.7637E-08
284		0.15	0.000	0.101	0.3770	0.0001	.3188E-02	.7290E-08
285		0.15	0.000	0.114	0.3742	0.0000	.3582E-03	.3263E-08
286		0.00	0.000	0.099	0.3566	0.0000	.0000E+00	.0000E+00
287		0.00	0.000	0.092	0.3411	0.0000	.0000E+00	.0000E+00
288		0.00	0.000	0.105	0.3253	0.0000	.0000E+00	.0000E+00
289		0.00	0.000	0.104	0.3111	0.0000	.0000E+00	.0000E+00
290		0.00	0.000	0.071	0.3019	0.0000	.0000E+00	.0000E+00
291		0.00	0.000	0.079	0.2920	0.0000	.0000E+00	.0000E+00
292		0.00	0.000	0.092	0.2805	0.0000	.0000E+00	.0000E+00
293		0.00	0.000	0.053	0.2739	0.0000	.6641E-04	.9571E-09
294	*	0.00	0.000	0.039	0.2691	0.0001	.3310E-02	.7304E-08
295		0.00	0.000	0.045	0.2634	0.0002	.7540E-02	.7863E-08
296		0.00	0.000	0.061	0.2558	0.0002	.1077E-01	.8265E-08
297		0.00	0.000	0.074	0.2465	0.0003	.1313E-01	.8550E-08
298		0.00	0.000	0.063	0.2386	0.0003	.1506E-01	.8779E-08
299	*	0.00	0.000	0.035	0.2342	0.0004	.1820E-01	.9146E-08
300	*	0.00	0.000	0.034	0.2300	0.0004	.1983E-01	.9335E-08
301		0.00	0.000	0.042	0.2248	0.0005	.2011E-01	.9366E-08
302	*	0.00	0.000	0.033	0.2206	0.0004	.1984E-01	.9335E-08
303		0.00	0.000	0.045	0.2150	0.0004	.1836E-01	.9165E-08
304	*	0.59	0.000	0.024	0.2175	0.0004	.1725E-01	.9036E-08
305	*	0.31	0.000	0.019	0.2199	0.0004	.1599E-01	.8888E-08
306	*	0.00	0.000	0.020	0.2224	0.0003	.1466E-01	.8732E-08
307		0.00	0.000	0.027	0.2248	0.0003	.1331E-01	.8572E-08

308			0.00	0.000	0.000	0.3163	0.0003	.1198E-01	.8411E-08
309			0.00	0.000	0.044	0.3109	0.0002	.1066E-01	.8252E-08
310			0.00	0.000	0.070	0.3021	0.0002	.9400E-02	.8096E-08
311			0.02	0.000	0.057	0.2975	0.0002	.8196E-02	.7946E-08
312			0.02	0.000	0.057	0.2929	0.0002	.7069E-02	.7804E-08
313			0.20	0.000	0.075	0.3085	0.0001	.6035E-02	.7671E-08
314			2.02	0.000	0.084	0.4610	0.0001	.5114E-02	.7551E-08
315			0.04	0.000	0.062	0.4341	0.0002	.1031E-01	.7723E-08
316			0.00	0.000	0.061	0.3870	0.0002	.8785E-02	.8019E-08
317			0.00	0.000	0.070	0.3647	0.0000	.3105E-03	.3612E-09
318			0.00	0.000	0.061	0.3496	0.0000	.0000E+00	.0000E+00
319			0.00	0.000	0.039	0.3392	0.0000	.0000E+00	.0000E+00
320			0.02	0.000	0.034	0.3331	0.0000	.1044E-03	.1342E-08
321	*		0.00	0.000	0.000	0.3298	0.0001	.3672E-02	.7354E-08
322	*		0.02	0.000	0.019	0.3275	0.0002	.8084E-02	.7931E-08
323	*		0.00	0.000	0.027	0.3232	0.0003	.1142E-01	.8343E-08
324	*		0.25	0.000	0.019	0.3250	0.0003	.1381E-01	.8631E-08
325	*		0.60	0.000	0.022	0.3275	0.0003	.1544E-01	.8824E-08
326			0.00	0.000	0.000	0.4107	0.0004	.1646E-01	.8944E-08
327			0.06	0.000	0.012	0.4120	0.0004	.1702E-01	.9010E-08
328			0.13	0.000	0.034	0.4052	0.0005	.2452E-01	.9859E-08
329	*		0.09	0.000	0.019	0.3935	0.0006	.2561E-01	.9990E-08
330			0.00	0.000	0.027	0.3835	0.0005	.2168E-01	.9546E-08
331			0.10	0.000	0.038	0.3827	0.0001	.4287E-02	.7360E-08
332			0.15	0.000	0.031	0.3919	0.0001	.5459E-02	.7595E-08
333	*		0.00	0.000	0.000	0.3874	0.0002	.8258E-02	.7954E-08
334	*		0.00	0.000	0.000	0.3780	0.0002	.1041E-01	.8220E-08
335	*		0.02	0.000	0.030	0.3681	0.0003	.1200E-01	.8414E-08
336	*		0.03	0.000	0.018	0.3639	0.0003	.1312E-01	.8549E-08
337	*		0.00	0.000	0.000	0.3590	0.0003	.1387E-01	.8638E-08
338	*		0.00	0.000	0.000	0.3553	0.0003	.1432E-01	.8692E-08
339	*		0.22	0.000	0.011	0.3544	0.0003	.1455E-01	.8719E-08
340	*		0.00	0.000	0.019	0.3538	0.0003	.1461E-01	.8726E-08
341	*		0.00	0.000	0.015	0.3542	0.0003	.1454E-01	.8718E-08
342	*		0.10	0.000	0.016	0.3548	0.0003	.1438E-01	.8699E-08
343	*	*	0.00	0.000	0.012	0.3548	0.0003	.1423E-01	.8682E-08
344	*	*	0.00	0.000	0.010	0.3548	0.0003	.1386E-01	.8638E-08
345	*	*	0.00	0.000	0.009	0.3548	0.0003	.1358E-01	.8603E-08
346	*	*	0.00	0.000	0.012	0.3548	0.0003	.1327E-01	.8566E-08
347	*	*	0.00	0.000	0.018	0.3548	0.0003	.1448E-01	.8711E-08
348	*	*	0.00	0.000	0.014	0.3548	0.0003	.1423E-01	.8678E-08
349	*	*	0.00	0.000	0.019	0.3548	0.0003	.1307E-01	.8541E-08
350	*	*	0.00	0.000	0.013	0.3548	0.0004	.1673E-01	.8976E-08
351	*	*	0.03	0.000	0.010	0.3548	0.0004	.1581E-01	.8868E-08
352	*	*	0.60	0.000	0.010	0.3548	0.0003	.1429E-01	.8688E-08
353	*	*	0.03	0.000	0.010	0.3548	0.0003	.1302E-01	.8536E-08
354	*	*	0.01	0.000	0.008	0.3548	0.0003	.1194E-01	.8407E-08
355	*	*	0.00	0.000	0.009	0.3548	0.0002	.1102E-01	.8295E-08
356	*	*	0.00	0.000	0.000	0.3548	0.0002	.1022E-01	.8197E-08
357		*	0.00	0.000	0.026	0.3548	0.0002	.9523E-02	.8111E-08
358		*	0.10	0.000	0.000	0.3991	0.0002	.8910E-02	.8035E-08
359		*	0.07	0.000	0.000	0.4273	0.0002	.8365E-02	.7967E-08
360		*	0.00	0.000	0.021	0.4321	0.0002	.7880E-02	.7906E-08
361	*	*	0.00	0.000	0.020	0.4321	0.0002	.7444E-02	.7851E-08
362	*	*	0.00	0.000	0.025	0.4321	0.0002	.7051E-02	.7801E-08
363	*	*	0.00	0.000	0.018	0.4321	0.0001	.6695E-02	.7756E-08
364	*	*	0.00	0.000	0.018	0.4321	0.0001	.5579E-02	.7611E-08

365 * * 0.02 0.000 0.014 0.4321 0.0001 .2413E-02 .7181E-08

****

****

MONTHLY TOTALS (IN INCHES) FOR YEAR 1977

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.58	0.98	3.03	3.17	3.48	3.50
	4.34	5.26	3.15	2.65	4.03	1.23
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.351	0.152	0.408	1.678	2.958	3.921
	3.539	2.120	2.756	2.246	1.026	0.405
LATERAL DRAINAGE COLLECTED	0.1908	0.2266	0.2519	0.2544	0.2756	0.0718
FROM LAYER 4	0.2343	0.2273	0.3804	0.2229	0.3080	0.3650
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.000	0.000

****

****

ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	35.40	642510.000	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	21.560	391316.156	60.90

DRAINAGE COLLECTED FROM LAYER 4	3.0091	54614.414	8.50
PERC./LEAKAGE THROUGH LAYER 6	0.000003	0.048	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0002		
CHANGE IN WATER STORAGE	10.831	196579.297	30.60
SOIL WATER AT START OF YEAR	59.459	1079173.000	
SOIL WATER AT END OF YEAR	70.220	1274498.000	
SNOW WATER AT START OF YEAR	0.056	1016.872	0.16
SNOW WATER AT END OF YEAR	0.125	2271.118	0.35
ANNUAL WATER BUDGET BALANCE	0.0000	0.090	0.00

****

WARNING: TEMPERATURE FOR YEAR 5 USED WITH PRECIPITATION FOR YEAR 1978

WARNING: SOLAR RADIATION FOR YEAR 5 USED WITH PRECIPITATION FOR YEAR 1978

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

****

DAILY OUTPUT FOR YEAR 1978

DAY	AIR	SOIL	RAIN IN.	RUNOFF IN.	ET IN.	E. ZONE WATER IN./IN.	HEAD #1 IN.	DRAIN #1 IN.	LEAK #1 IN.
1	*	*	0.19	0.000	0.017	0.4321	0.0000	.1242E-03	.1912E-08
2	*	*	0.00	0.000	0.021	0.4321	0.0000	.0000E+00	.0000E+00
3	*	*	0.00	0.000	0.017	0.4321	0.0000	.0000E+00	.0000E+00
4	*	*	0.00	0.000	0.010	0.4321	0.0000	.0000E+00	.0000E+00
5	*	*	0.00	0.000	0.008	0.4321	0.0000	.0000E+00	.0000E+00
6	*	*	0.00	0.000	0.014	0.4321	0.0000	.0000E+00	.0000E+00
7	*	*	0.04	0.000	0.000	0.4321	0.0000	.0000E+00	.0000E+00
8	*	*	0.00	0.000	0.021	0.4321	0.0000	.0000E+00	.0000E+00
9	*	*	0.00	0.000	0.024	0.4321	0.0000	.0000E+00	.0000E+00
10	*	*	0.00	0.000	0.012	0.4321	0.0000	.0000E+00	.0000E+00
11	*	*	0.00	0.000	0.017	0.4321	0.0000	.0000E+00	.0000E+00

12	*	*	0.00	0.000	0.011	0.4321	0.0000	.1103E-02	.4903E-08
13	*	*	0.00	0.000	0.010	0.4321	0.0001	.5465E-02	.7595E-08
14	*	*	0.01	0.000	0.014	0.4321	0.0002	.1001E-01	.8170E-08
15	*	*	0.01	0.000	0.012	0.4321	0.0003	.1429E-01	.8687E-08
16	*	*	0.02	0.000	0.007	0.4321	0.0004	.1812E-01	.9137E-08
17	*	*	0.00	0.000	0.010	0.4321	0.0005	.2141E-01	.9516E-08
18	*	*	0.00	0.000	0.011	0.4321	0.0005	.2415E-01	.9826E-08
19	*	*	0.04	0.000	0.007	0.4321	0.0006	.2638E-01	.1008E-07
20	*	*	0.00	0.000	0.007	0.4321	0.0006	.2814E-01	.1027E-07
21	*	*	0.00	0.000	0.008	0.4321	0.0007	.2952E-01	.1043E-07
22	*	*	0.00	0.000	0.011	0.4321	0.0007	.3060E-01	.1054E-07
23	*	*	0.00	0.000	0.020	0.4321	0.0007	.3142E-01	.1063E-07
24	*	*	0.00	0.000	0.019	0.4321	0.0007	.3206E-01	.1070E-07
25	*	*	0.01	0.000	0.020	0.4321	0.0007	.3254E-01	.1076E-07
26	*	*	0.04	0.000	0.026	0.4321	0.0007	.3291E-01	.1080E-07
27		*	0.01	0.000	0.000	0.4357	0.0007	.3318E-01	.1083E-07
28	*	*	0.00	0.000	0.032	0.4357	0.0007	.3339E-01	.1085E-07
29	*	*	0.00	0.000	0.027	0.4357	0.0008	.3355E-01	.1087E-07
30	*	*	0.00	0.000	0.031	0.4357	0.0008	.3366E-01	.1088E-07
31	*	*	0.01	0.000	0.032	0.4357	0.0008	.3373E-01	.1089E-07
32		*	0.00	0.000	0.001	0.4357	0.0008	.3378E-01	.1089E-07
33		*	0.00	0.000	0.000	0.4357	0.0008	.3381E-01	.1090E-07
34	*	*	0.00	0.000	0.000	0.4357	0.0008	.3382E-01	.1090E-07
35	*	*	0.00	0.000	0.000	0.4357	0.0008	.3381E-01	.1090E-07
36	*	*	0.01	0.000	0.010	0.4357	0.0008	.3380E-01	.1089E-07
37	*	*	0.00	0.000	0.000	0.4357	0.0008	.3377E-01	.1089E-07
38	*	*	0.00	0.000	0.000	0.4357	0.0008	.3373E-01	.1089E-07
39	*	*	0.00	0.000	0.000	0.4357	0.0008	.3368E-01	.1088E-07
40	*	*	0.00	0.000	0.000	0.4357	0.0008	.3363E-01	.1088E-07
41	*	*	0.00	0.000	0.000	0.4357	0.0008	.3357E-01	.1087E-07
42	*	*	0.00	0.000	0.000	0.4357	0.0008	.3351E-01	.1086E-07
43	*	*	0.03	0.000	0.018	0.4357	0.0007	.3344E-01	.1086E-07
44	*	*	0.00	0.000	0.012	0.4357	0.0007	.3337E-01	.1085E-07
45	*	*	0.00	0.000	0.000	0.4357	0.0007	.3330E-01	.1084E-07
46	*	*	0.00	0.000	0.000	0.4357	0.0007	.3322E-01	.1083E-07
47	*	*	0.00	0.000	0.000	0.4357	0.0007	.3314E-01	.1082E-07
48	*	*	0.00	0.000	0.000	0.4357	0.0007	.3305E-01	.1081E-07
49	*	*	0.00	0.000	0.000	0.4357	0.0007	.3296E-01	.1080E-07
50	*	*	0.00	0.000	0.000	0.4357	0.0007	.3288E-01	.1079E-07
51		*	0.03	0.000	0.001	0.4393	0.0007	.3278E-01	.1078E-07
52	*	*	0.01	0.000	0.010	0.4393	0.0007	.3269E-01	.1077E-07
53	*	*	0.00	0.000	0.000	0.4393	0.0007	.3260E-01	.1076E-07
54	*	*	0.07	0.000	0.051	0.4393	0.0007	.3250E-01	.1075E-07
55		*	0.00	0.000	0.019	0.4393	0.0007	.3240E-01	.1074E-07
56	*	*	0.00	0.000	0.000	0.4393	0.0007	.3231E-01	.1073E-07
57	*	*	0.00	0.000	0.000	0.4393	0.0007	.3221E-01	.1072E-07
58	*	*	0.00	0.000	0.000	0.4393	0.0007	.3211E-01	.1071E-07
59	*	*	0.02	0.000	0.020	0.4393	0.0007	.3201E-01	.1070E-07
60	*	*	0.00	0.000	0.000	0.4393	0.0007	.3190E-01	.1069E-07
61	*	*	0.00	0.000	0.000	0.4393	0.0007	.3180E-01	.1068E-07
62	*	*	0.10	0.000	0.042	0.4393	0.0007	.3170E-01	.1066E-07
63	*	*	0.00	0.000	0.031	0.4393	0.0007	.3159E-01	.1065E-07
64	*	*	0.00	0.000	0.028	0.4393	0.0007	.3149E-01	.1064E-07
65	*	*	0.00	0.000	0.000	0.4393	0.0007	.3138E-01	.1063E-07
66	*	*	0.00	0.000	0.000	0.4393	0.0007	.3128E-01	.1062E-07
67	*	*	0.00	0.000	0.000	0.4393	0.0007	.3117E-01	.1061E-07
68		*	0.00	0.000	0.000	0.4393	0.0007	.3107E-01	.1060E-07

69		*	0.00	0.000	0.000	0.4393	0.0007	.3096E-01	.1058E-07
70		*	0.00	0.000	0.000	0.4393	0.0007	.3085E-01	.1057E-07
71		*	0.00	0.000	0.000	0.4393	0.0007	.3075E-01	.1056E-07
72		*	0.00	0.000	0.000	0.4393	0.0007	.3064E-01	.1055E-07
73		*	0.65	0.000	0.001	0.4710	0.0007	.3062E-01	.1055E-07
74		*	0.00	0.000	0.000	0.4710	0.0007	.3155E-01	.1065E-07
75		*	0.00	0.000	0.000	0.4710	0.0007	.3013E-01	.1049E-07
76		*	0.00	0.000	0.000	0.4710	0.0007	.2939E-01	.1041E-07
77		*	0.00	0.000	0.000	0.4710	0.0007	.2908E-01	.1038E-07
78		*	0.00	0.000	0.000	0.4710	0.0006	.2903E-01	.1037E-07
79		*	0.00	0.000	0.000	0.4710	0.0007	.2912E-01	.1038E-07
80		*	0.06	0.000	0.001	0.4710	0.0005	.2237E-01	.9621E-08
81	*	*	0.00	0.000	0.000	0.4710	0.0008	.3731E-01	.1127E-07
82	*	*	0.00	0.000	0.000	0.4710	0.0008	.3362E-01	.1087E-07
83	*	*	0.00	0.000	0.000	0.4710	0.0007	.3063E-01	.1055E-07
84	*	*	0.00	0.000	0.000	0.4710	0.0006	.2812E-01	.1027E-07
85	*	*	0.00	0.000	0.000	0.4710	0.0006	.2670E-01	.1011E-07
86	*	*	0.00	0.000	0.000	0.4710	0.0006	.2605E-01	.1004E-07
87		*	0.00	0.000	0.000	0.4710	0.0007	.3287E-01	.1079E-07
88	*	*	0.00	0.000	0.000	0.4710	0.0008	.3542E-01	.1107E-07
89	*	*	0.00	0.000	0.000	0.4710	0.0008	.3559E-01	.1109E-07
90	*	*	0.00	0.000	0.000	0.4710	0.0008	.3457E-01	.1098E-07
91	*	*	0.00	0.000	0.000	0.4710	0.0007	.3303E-01	.1081E-07
92	*	*	0.00	0.000	0.000	0.4710	0.0007	.3131E-01	.1062E-07
93	*	*	0.33	0.000	0.021	0.4710	0.0007	.2960E-01	.1043E-07
94		*	0.21	0.000	0.023	0.4710	0.0007	.3080E-01	.1056E-07
95	*	*	0.00	0.000	0.000	0.4710	0.0007	.3091E-01	.1058E-07
96	*	*	0.07	0.000	0.044	0.4710	0.0005	.2449E-01	.9863E-08
97	*	*	0.66	0.000	0.034	0.4710	0.0002	.1050E-01	.8227E-08
98	*	*	0.28	0.000	0.000	0.4710	0.0002	.9892E-02	.8155E-08
99	*	*	0.00	0.000	0.030	0.4710	0.0004	.1847E-01	.9176E-08
100	*	*	0.41	0.000	0.000	0.4710	0.0006	.2562E-01	.9991E-08
101	*	*	0.00	0.000	0.027	0.4710	0.0007	.2928E-01	.1040E-07
102	*	*	0.10	0.000	0.024	0.4710	0.0007	.3069E-01	.1055E-07
103		*	0.18	0.000	0.000	0.4710	0.0009	.3998E-01	.1155E-07
104	*	*	0.00	0.000	0.039	0.4710	0.0007	.3052E-01	.1050E-07
105	*	*	0.00	0.000	0.040	0.4710	0.0004	.1933E-01	.9277E-08
106	*	*	0.00	0.000	0.042	0.4710	0.0005	.2164E-01	.9542E-08
107	*	*	0.00	0.000	0.044	0.4710	0.0005	.2281E-01	.9675E-08
108		*	0.01	0.000	0.000	0.4710	0.0005	.2321E-01	.9719E-08
109		*	0.52	0.000	0.000	0.4710	0.0007	.3203E-01	.1069E-07
110		*	0.00	0.000	0.084	0.4710	0.0004	.1940E-01	.9267E-08
111		*	0.09	0.000	0.001	0.4710	0.0004	.1682E-01	.8986E-08
112		*	0.00	0.000	0.000	0.4710	0.0004	.1781E-01	.9102E-08
113		*	0.14	0.000	0.001	0.4710	0.0004	.1831E-01	.9160E-08
114		*	0.39	0.000	0.001	0.4710	0.0006	.2773E-01	.1022E-07
115		*	0.07	0.000	0.001	0.4710	0.0003	.1434E-01	.8683E-08
116		*	0.00	0.000	0.000	0.4710	0.0003	.1348E-01	.8592E-08
117		*	0.00	0.000	0.000	0.4710	0.0003	.1449E-01	.8712E-08
118		*	0.00	0.000	0.000	0.4710	0.0003	.1512E-01	.8786E-08
119		*	0.01	0.000	0.001	0.4710	0.0003	.1545E-01	.8825E-08
120		*	0.02	0.000	0.001	0.4710	0.0003	.1556E-01	.8838E-08
121		*	0.00	0.000	0.000	0.4710	0.0003	.1551E-01	.8832E-08
122		*	0.00	0.000	0.000	0.4710	0.0003	.1534E-01	.8813E-08
123	*	*	0.00	0.000	0.000	0.4710	0.0003	.1510E-01	.8784E-08
124		*	0.00	0.000	0.000	0.4710	0.0004	.1589E-01	.8877E-08
125			0.00	0.000	0.083	0.3844	0.0005	.2017E-01	.9369E-08

126	0.00	0.000	0.115	0.3572	0.0004	.1590E-01	.8865E-08
127	0.00	0.000	0.180	0.3273	0.0002	.8502E-02	.7985E-08
128	0.48	0.000	0.215	0.3547	0.0002	.9393E-02	.8095E-08
129	0.32	0.000	0.248	0.3600	0.0002	.1006E-01	.8178E-08
130	0.00	0.000	0.195	0.3355	0.0002	.1055E-01	.8237E-08
131	0.00	0.000	0.141	0.3178	0.0002	.1088E-01	.8278E-08
132	0.00	0.000	0.162	0.2975	0.0002	.1109E-01	.8303E-08
133	0.25	0.000	0.203	0.3033	0.0003	.1120E-01	.8317E-08
134	0.00	0.000	0.239	0.2735	0.0003	.1123E-01	.8320E-08
135	0.00	0.000	0.191	0.2496	0.0003	.1123E-01	.8320E-08
136	0.00	0.000	0.171	0.2283	0.0003	.1285E-01	.8514E-08
137	0.00	0.000	0.143	0.2100	0.0003	.1380E-01	.8625E-08
138	0.00	0.000	0.000	0.2100	0.0004	.1572E-01	.8857E-08
139	0.00	0.000	0.000	0.2100	0.0003	.1488E-01	.8758E-08
140	0.08	0.000	0.006	0.2192	0.0003	.1351E-01	.8596E-08
141	0.01	0.000	0.023	0.2176	0.0003	.1236E-01	.8458E-08
142	0.00	0.000	0.027	0.2142	0.0003	.1138E-01	.8339E-08
143	0.00	0.000	0.017	0.2121	0.0002	.1053E-01	.8236E-08
144	0.00	0.000	0.008	0.2111	0.0002	.9798E-02	.8145E-08
145	0.00	0.000	0.007	0.2103	0.0002	.9152E-02	.8066E-08
146	0.00	0.000	0.002	0.2101	0.0002	.8581E-02	.7994E-08
147	0.04	0.000	0.004	0.2146	0.0002	.8073E-02	.7931E-08
148	0.88	0.000	0.022	0.3218	0.0002	.7618E-02	.7873E-08
149	0.73	0.000	0.187	0.3897	0.0002	.7208E-02	.7821E-08
150	0.35	0.000	0.198	0.4084	0.0002	.6837E-02	.7774E-08
151	0.00	0.000	0.212	0.3698	0.0001	.6264E-02	.7700E-08
152	0.06	0.000	0.107	0.3525	0.0001	.3682E-02	.7326E-08
153	0.00	0.000	0.230	0.3165	0.0001	.5939E-02	.7658E-08
154	0.00	0.000	0.216	0.2865	0.0000	.9568E-03	.3334E-08
155	0.00	0.000	0.236	0.2535	0.0000	.0000E+00	.0000E+00
156	0.00	0.000	0.203	0.2282	0.0000	.0000E+00	.0000E+00
157	0.00	0.000	0.141	0.2100	0.0000	.0000E+00	.0000E+00
158	0.00	0.000	0.000	0.2100	0.0000	.0000E+00	.0000E+00
159	0.35	0.000	0.028	0.2503	0.0000	.0000E+00	.0000E+00
160	0.00	0.000	0.036	0.2458	0.0000	.0000E+00	.0000E+00
161	0.00	0.000	0.032	0.2418	0.0000	.0000E+00	.0000E+00
162	0.00	0.000	0.029	0.2382	0.0000	.0000E+00	.0000E+00
163	0.27	0.000	0.028	0.2685	0.0001	.4063E-02	.5302E-08
164	0.00	0.000	0.030	0.2647	0.0004	.1628E-01	.8920E-08
165	0.00	0.000	0.030	0.2610	0.0005	.2361E-01	.9765E-08
166	0.02	0.000	0.028	0.2600	0.0006	.2709E-01	.1016E-07
167	0.21	0.000	0.027	0.2828	0.0006	.2830E-01	.1029E-07
168	1.14	0.000	0.198	0.4006	0.0006	.2821E-01	.1028E-07
169	0.00	0.000	0.193	0.3727	0.0006	.2767E-01	.1022E-07
170	0.00	0.000	0.270	0.3274	0.0006	.2669E-01	.1011E-07
171	0.08	0.000	0.227	0.3017	0.0007	.3152E-01	.1064E-07
172	0.00	0.000	0.222	0.2695	0.0006	.2832E-01	.1029E-07
173	0.00	0.000	0.255	0.2369	0.0005	.2134E-01	.9507E-08
174	0.34	0.000	0.202	0.2541	0.0004	.1812E-01	.9138E-08
175	0.00	0.000	0.083	0.2438	0.0003	.1522E-01	.8798E-08
176	0.00	0.000	0.064	0.2355	0.0003	.1431E-01	.8423E-08
177	2.19	0.000	0.055	0.4165	0.0006	.2509E-01	.9931E-08
178	0.02	0.000	0.274	0.4329	0.0006	.2805E-01	.1021E-07
179	0.00	0.000	0.283	0.3617	0.0010	.4633E-01	.1221E-07
180	0.17	0.000	0.261	0.3390	0.0008	.3629E-01	.1116E-07
181	0.00	0.000	0.242	0.3021	0.0003	.1396E-01	.8348E-08
182	1.25	0.000	0.268	0.4209	0.0008	.3685E-01	.1122E-07

183	0.90	0.000	0.188	0.4449	0.0014	.6247E-01	.1388E-07
184	0.00	0.000	0.194	0.3732	0.0010	.4323E-01	.1184E-07
185	0.00	0.000	0.175	0.3395	0.0007	.3280E-01	.1078E-07
186	0.00	0.000	0.242	0.3018	0.0009	.3984E-01	.1155E-07
187	0.03	0.000	0.267	0.2671	0.0009	.4178E-01	.1175E-07
188	0.65	0.000	0.223	0.3194	0.0009	.4115E-01	.1169E-07
189	0.56	0.000	0.234	0.3598	0.0009	.3936E-01	.1149E-07
190	0.03	0.000	0.215	0.3367	0.0008	.3713E-01	.1126E-07
191	0.00	0.000	0.251	0.3047	0.0008	.3483E-01	.1101E-07
192	0.00	0.000	0.260	0.2722	0.0007	.3261E-01	.1076E-07
193	0.00	0.000	0.226	0.2440	0.0007	.3121E-01	.1061E-07
194	1.30	0.000	0.272	0.3725	0.0007	.3320E-01	.1083E-07
195	0.00	0.000	0.237	0.3428	0.0007	.2997E-01	.1047E-07
196	0.00	0.000	0.274	0.3086	0.0006	.2761E-01	.1021E-07
197	0.00	0.000	0.284	0.2731	0.0006	.2854E-01	.1032E-07
198	0.00	0.000	0.283	0.2377	0.0006	.2516E-01	.9939E-08
199	0.00	0.000	0.222	0.2100	0.0005	.2170E-01	.9548E-08
200	0.00	0.000	0.000	0.2100	0.0004	.1903E-01	.9243E-08
201	0.00	0.000	0.000	0.2100	0.0004	.1692E-01	.8997E-08
202	0.00	0.000	0.000	0.2100	0.0003	.1520E-01	.8796E-08
203	0.27	0.000	0.024	0.2407	0.0003	.1350E-01	.8594E-08
204	0.63	0.000	0.034	0.3152	0.0002	.9556E-02	.8114E-08
205	0.00	0.000	0.189	0.2916	0.0001	.5348E-02	.7580E-08
206	0.00	0.000	0.207	0.2658	0.0000	.1657E-02	.7066E-08
207	0.02	0.000	0.194	0.2440	0.0000	.3588E-28	.6776E-19
208	0.00	0.000	0.080	0.2340	0.0000	.0000E+00	.0000E+00
209	0.00	0.000	0.062	0.2263	0.0000	.0000E+00	.0000E+00
210	0.04	0.000	0.054	0.2245	0.0000	.0000E+00	.0000E+00
211	0.00	0.000	0.045	0.2189	0.0000	.0000E+00	.0000E+00
212	0.00	0.000	0.040	0.2139	0.0000	.2503E-03	.2311E-08
213	0.00	0.000	0.020	0.2113	0.0001	.3953E-02	.7392E-08
214	0.72	0.000	0.028	0.2978	0.0002	.9298E-02	.8082E-08
215	0.00	0.000	0.163	0.2774	0.0003	.1493E-01	.8763E-08
216	0.00	0.000	0.032	0.2735	0.0005	.2039E-01	.9398E-08
217	0.00	0.000	0.030	0.2697	0.0006	.2534E-01	.9959E-08
218	0.00	0.000	0.028	0.2662	0.0007	.2958E-01	.1043E-07
219	0.00	0.000	0.027	0.2628	0.0007	.3307E-01	.1081E-07
220	0.00	0.000	0.026	0.2596	0.0008	.3585E-01	.1112E-07
221	0.00	0.000	0.025	0.2565	0.0009	.3803E-01	.1135E-07
222	0.00	0.000	0.024	0.2535	0.0009	.3970E-01	.1153E-07
223	0.00	0.000	0.023	0.2506	0.0009	.4098E-01	.1167E-07
224	0.00	0.000	0.023	0.2478	0.0009	.4195E-01	.1177E-07
225	0.00	0.000	0.022	0.2450	0.0010	.4269E-01	.1185E-07
226	0.00	0.000	0.021	0.2424	0.0010	.4324E-01	.1191E-07
227	0.32	0.000	0.023	0.2795	0.0010	.4366E-01	.1195E-07
228	0.39	0.000	0.023	0.3253	0.0010	.4396E-01	.1199E-07
229	0.07	0.000	0.186	0.3108	0.0010	.4419E-01	.1201E-07
230	0.31	0.000	0.201	0.3244	0.0010	.4435E-01	.1203E-07
231	0.01	0.000	0.175	0.3037	0.0010	.4445E-01	.1204E-07
232	0.00	0.000	0.195	0.2793	0.0010	.4452E-01	.1204E-07
233	0.00	0.000	0.083	0.2690	0.0010	.4455E-01	.1205E-07
234	0.00	0.000	0.064	0.2610	0.0010	.4455E-01	.1205E-07
235	0.00	0.000	0.053	0.2544	0.0010	.4453E-01	.1205E-07
236	0.42	0.000	0.049	0.3008	0.0010	.4449E-01	.1204E-07
237	0.00	0.000	0.042	0.2956	0.0010	.4443E-01	.1204E-07
238	0.00	0.000	0.038	0.2908	0.0010	.4435E-01	.1203E-07
239	0.09	0.000	0.038	0.2973	0.0010	.4426E-01	.1202E-07

240		0.47	0.000	0.037	0.3514	0.0010	.4417E-01	.1201E-07
241		0.01	0.000	0.171	0.3313	0.0010	.4406E-01	.1200E-07
242		0.00	0.000	0.163	0.3109	0.0010	.4394E-01	.1198E-07
243		0.00	0.000	0.120	0.2960	0.0010	.4381E-01	.1197E-07
244		0.07	0.000	0.179	0.2823	0.0010	.4368E-01	.1196E-07
245		0.00	0.000	0.083	0.2719	0.0010	.4355E-01	.1194E-07
246		0.00	0.000	0.063	0.2641	0.0010	.4341E-01	.1193E-07
247		0.00	0.000	0.049	0.2580	0.0010	.4326E-01	.1191E-07
248		0.00	0.000	0.046	0.2522	0.0010	.4311E-01	.1190E-07
249		0.00	0.000	0.043	0.2469	0.0010	.4295E-01	.1188E-07
250		0.00	0.000	0.039	0.2419	0.0010	.4280E-01	.1186E-07
251		0.00	0.000	0.037	0.2374	0.0010	.4263E-01	.1184E-07
252		0.00	0.000	0.034	0.2330	0.0010	.4249E-01	.1183E-07
253		0.00	0.000	0.033	0.2290	0.0009	.4229E-01	.1181E-07
254		0.00	0.000	0.031	0.2251	0.0009	.4213E-01	.1179E-07
255		1.23	0.000	0.033	0.3748	0.0009	.4197E-01	.1177E-07
256		0.98	0.000	0.135	0.4478	0.0009	.4180E-01	.1176E-07
257		0.97	0.000	0.116	0.4479	0.0010	.4305E-01	.1189E-07
258		0.00	0.000	0.100	0.3827	0.0009	.3840E-01	.1138E-07
259		0.00	0.000	0.109	0.3566	0.0005	.2411E-01	.9783E-08
260		0.70	0.000	0.141	0.4189	0.0011	.5077E-01	.1270E-07
261		0.00	0.000	0.120	0.3808	0.0014	.6417E-01	.1408E-07
262		0.62	0.000	0.105	0.4324	0.0012	.5287E-01	.1291E-07
263		0.00	0.000	0.112	0.3816	0.0013	.5916E-01	.1354E-07
264		0.00	0.000	0.072	0.3600	0.0008	.3785E-01	.1133E-07
265		0.00	0.000	0.114	0.3384	0.0009	.4052E-01	.1162E-07
266		0.00	0.000	0.078	0.3232	0.0009	.4036E-01	.1160E-07
267		0.00	0.000	0.089	0.3078	0.0009	.3886E-01	.1144E-07
268		0.00	0.000	0.117	0.2907	0.0008	.3682E-01	.1122E-07
269		0.00	0.000	0.105	0.2775	0.0008	.3463E-01	.1098E-07
270		0.09	0.000	0.094	0.2771	0.0007	.3248E-01	.1075E-07
271		0.00	0.000	0.105	0.2639	0.0007	.3046E-01	.1053E-07
272		0.00	0.000	0.094	0.2522	0.0006	.2859E-01	.1032E-07
273		0.00	0.000	0.092	0.2406	0.0006	.2804E-01	.1026E-07
274		0.00	0.000	0.122	0.2254	0.0007	.3051E-01	.1053E-07
275		0.00	0.000	0.123	0.2100	0.0006	.2544E-01	.9968E-08
276		0.02	0.000	0.013	0.2109	0.0006	.2710E-01	.1016E-07
277		0.00	0.000	0.004	0.2104	0.0006	.2592E-01	.1002E-07
278		0.04	0.000	0.010	0.2142	0.0005	.2228E-01	.9614E-08
279		0.00	0.000	0.005	0.2136	0.0004	.1948E-01	.9295E-08
280		0.00	0.000	0.013	0.2119	0.0004	.1728E-01	.9039E-08
281		0.00	0.000	0.007	0.2111	0.0003	.1549E-01	.8831E-08
282		0.00	0.000	0.007	0.2102	0.0003	.1403E-01	.8657E-08
283		0.00	0.000	0.001	0.2101	0.0003	.1280E-01	.8510E-08
284		0.00	0.000	0.000	0.2100	0.0002	.1090E-01	.8280E-08
285		0.00	0.000	0.000	0.2100	0.0001	.6481E-02	.7727E-08
286		0.00	0.000	0.000	0.2100	0.0001	.2262E-02	.7158E-08
287		0.00	0.000	0.000	0.2100	0.0000	.1964E-04	.6988E-09
288		0.02	0.000	0.004	0.2120	0.0000	.0000E+00	.0000E+00
289		0.01	0.000	0.004	0.2127	0.0000	.0000E+00	.0000E+00
290		0.00	0.000	0.002	0.2124	0.0000	.0000E+00	.0000E+00
291		0.00	0.000	0.005	0.2118	0.0000	.0000E+00	.0000E+00
292	*	0.00	0.000	0.000	0.2118	0.0000	.0000E+00	.0000E+00
293	*	0.00	0.000	0.004	0.2112	0.0000	.1123E-03	.1343E-08
294		0.00	0.000	0.004	0.2107	0.0001	.3874E-02	.7380E-08
295	*	0.00	0.000	0.000	0.2107	0.0002	.9787E-02	.8142E-08
296	*	0.00	0.000	0.000	0.2107	0.0004	.1580E-01	.8866E-08

297	*	0.00	0.000	0.000	0.2107	0.0005	.2145E-01	.9519E-08
298	*	0.00	0.000	0.004	0.2102	0.0006	.2642E-01	.1008E-07
299		0.00	0.000	0.001	0.2100	0.0007	.3057E-01	.1054E-07
300	*	0.00	0.000	0.000	0.2100	0.0008	.3390E-01	.1091E-07
301		0.00	0.000	0.000	0.2100	0.0008	.3651E-01	.1119E-07
302		0.05	0.000	0.004	0.2158	0.0009	.3851E-01	.1140E-07
303		0.00	0.000	0.009	0.2147	0.0009	.4002E-01	.1157E-07
304		0.00	0.000	0.009	0.2135	0.0009	.4116E-01	.1169E-07
305		0.00	0.000	0.010	0.2122	0.0009	.4201E-01	.1178E-07
306		0.00	0.000	0.004	0.2117	0.0010	.4264E-01	.1185E-07
307		0.00	0.000	0.004	0.2113	0.0010	.4311E-01	.1190E-07
308		0.00	0.000	0.003	0.2109	0.0010	.4346E-01	.1193E-07
309		0.00	0.000	0.003	0.2105	0.0010	.4371E-01	.1196E-07
310	*	0.00	0.000	0.003	0.2101	0.0010	.4389E-01	.1198E-07
311	*	0.00	0.000	0.001	0.2100	0.0010	.4401E-01	.1199E-07
312	*	0.00	0.000	0.000	0.2100	0.0010	.4409E-01	.1200E-07
313	*	0.00	0.000	0.000	0.2100	0.0010	.4413E-01	.1200E-07
314	*	0.00	0.000	0.000	0.2100	0.0010	.4413E-01	.1200E-07
315	*	0.15	0.000	0.025	0.2125	0.0010	.4412E-01	.1200E-07
316	*	0.00	0.000	0.028	0.2149	0.0010	.4408E-01	.1200E-07
317		0.20	0.000	0.000	0.2472	0.0010	.4402E-01	.1199E-07
318		0.32	0.000	0.014	0.2855	0.0010	.4395E-01	.1198E-07
319		0.00	0.000	0.014	0.2837	0.0010	.4387E-01	.1198E-07
320		0.00	0.000	0.014	0.2820	0.0010	.4377E-01	.1197E-07
321		0.00	0.000	0.015	0.2802	0.0010	.4367E-01	.1195E-07
322		0.07	0.000	0.017	0.2869	0.0010	.4355E-01	.1194E-07
323		0.00	0.000	0.015	0.2850	0.0010	.4343E-01	.1193E-07
324		0.00	0.000	0.014	0.2832	0.0010	.4330E-01	.1192E-07
325		0.01	0.000	0.017	0.2823	0.0010	.4317E-01	.1190E-07
326		0.00	0.000	0.015	0.2805	0.0010	.4303E-01	.1189E-07
327		0.03	0.000	0.016	0.2823	0.0010	.4289E-01	.1187E-07
328		0.03	0.000	0.016	0.2841	0.0010	.4274E-01	.1186E-07
329		0.00	0.000	0.014	0.2824	0.0010	.4259E-01	.1184E-07
330		0.00	0.000	0.013	0.2807	0.0010	.4243E-01	.1182E-07
331		0.00	0.000	0.014	0.2789	0.0009	.4227E-01	.1181E-07
332		0.13	0.000	0.016	0.2932	0.0009	.4211E-01	.1179E-07
333		0.01	0.000	0.015	0.2925	0.0009	.4195E-01	.1177E-07
334		0.00	0.000	0.014	0.2908	0.0009	.4179E-01	.1175E-07
335	*	0.00	0.000	0.014	0.2891	0.0009	.4162E-01	.1174E-07
336	*	0.00	0.000	0.000	0.2891	0.0009	.4145E-01	.1172E-07
337	*	0.00	0.000	0.000	0.2891	0.0009	.4128E-01	.1170E-07
338	*	0.32	0.000	0.013	0.2916	0.0009	.4111E-01	.1168E-07
339	*	0.02	0.000	0.000	0.2941	0.0009	.4094E-01	.1166E-07
340	*	0.00	0.000	0.021	0.2965	0.0009	.4077E-01	.1165E-07
341		0.00	0.000	0.003	0.3226	0.0009	.4060E-01	.1163E-07
342	*	0.00	0.000	0.021	0.3245	0.0009	.4043E-01	.1161E-07
343	*	0.00	0.000	0.014	0.3228	0.0009	.4025E-01	.1159E-07
344	*	0.00	0.000	0.013	0.3211	0.0009	.4008E-01	.1157E-07
345		0.00	0.000	0.013	0.3195	0.0009	.3990E-01	.1155E-07
346	*	0.00	0.000	0.000	0.3195	0.0009	.3973E-01	.1153E-07
347		0.00	0.000	0.013	0.3178	0.0009	.3956E-01	.1152E-07
348		0.00	0.000	0.013	0.3162	0.0009	.3938E-01	.1150E-07
349		0.00	0.000	0.013	0.3146	0.0009	.3921E-01	.1148E-07
350	*	0.00	0.000	0.000	0.3146	0.0009	.3903E-01	.1146E-07
351	*	0.00	0.000	0.000	0.3146	0.0009	.3886E-01	.1144E-07
352		0.00	0.000	0.013	0.3129	0.0009	.3869E-01	.1142E-07
353	*	0.00	0.000	0.000	0.3129	0.0009	.3851E-01	.1140E-07

354	*		0.23	0.000	0.015	0.3154	0.0009	.3834E-01	.1139E-07
355	*		0.14	0.000	0.015	0.3179	0.0009	.3817E-01	.1137E-07
356	*		0.00	0.000	0.009	0.3203	0.0009	.3800E-01	.1135E-07
357	*		0.00	0.000	0.012	0.3228	0.0008	.3783E-01	.1133E-07
358	*	*	0.02	0.000	0.014	0.3228	0.0008	.3766E-01	.1131E-07
359	*	*	0.00	0.000	0.013	0.3228	0.0008	.3749E-01	.1129E-07
360	*	*	0.02	0.000	0.000	0.3228	0.0008	.3732E-01	.1128E-07
361	*	*	0.01	0.000	0.013	0.3228	0.0008	.3715E-01	.1126E-07
362	*	*	0.06	0.000	0.000	0.3228	0.0008	.3698E-01	.1124E-07
363	*	*	0.11	0.000	0.000	0.3228	0.0008	.3682E-01	.1122E-07
364	*	*	0.09	0.000	0.000	0.3228	0.0008	.3665E-01	.1120E-07
365	*	*	0.00	0.000	0.022	0.3228	0.0008	.3649E-01	.1119E-07

****

****

MONTHLY TOTALS (IN INCHES) FOR YEAR 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.38	0.17	0.81	3.49	3.14	4.85
	5.68	2.81	4.66	0.14	0.95	1.02
RUNOFF	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.476	0.142	0.102	0.457	2.996	4.228
	5.243	2.153	2.568	0.357	0.332	0.276
LATERAL DRAINAGE COLLECTED	0.5057	0.9279	0.9588	0.6826	0.3606	0.4711
FROM LAYER 4	0.7209	1.1713	1.2372	0.5281	1.2979	1.2103
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.001	0.001	0.001	0.000	0.000
TOP OF LAYER 5	0.001	0.001	0.001	0.000	0.001	0.001
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 5	0.000	0.000	0.000	0.000	0.000	0.000

****

****

ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.10	510015.062	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	19.330	350837.000	68.79
DRAINAGE COLLECTED FROM LAYER 4	10.0724	182813.719	35.84
PERC./LEAKAGE THROUGH LAYER 6	0.000003	0.063	0.00
AVG. HEAD ON TOP OF LAYER 5	0.0006		
CHANGE IN WATER STORAGE	-1.302	-23635.791	-4.63
SOIL WATER AT START OF YEAR	70.220	1274498.000	
SOIL WATER AT END OF YEAR	68.555	1244274.750	
SNOW WATER AT START OF YEAR	0.125	2271.118	0.45
SNOW WATER AT END OF YEAR	0.488	8858.555	1.74
ANNUAL WATER BUDGET BALANCE	0.0000	0.082	0.00

****

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.86	0.64	1.65	2.49	2.77	4.67
	2.88	3.34	2.68	1.18	1.93	0.68
STD. DEVIATIONS	0.90	0.34	0.90	1.34	1.04	0.83
	2.15	1.85	1.28	0.99	1.64	0.43
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000

	0.000	0.000	0.000	0.000	0.000	0.000

EVAPOTRANSPIRATION

TOTALS	0.318	0.321	0.267	1.644	2.487	3.987
	2.832	1.905	2.169	0.807	0.749	0.328
STD. DEVIATIONS	0.167	0.169	0.193	0.782	1.473	0.275
	1.575	0.789	0.695	0.836	0.547	0.108

LATERAL DRAINAGE COLLECTED FROM LAYER 4

TOTALS	0.1394	0.2310	0.2423	0.1874	0.1273	0.1087
	0.1911	0.2801	0.3239	0.1502	0.3213	0.3165
STD. DEVIATIONS	0.2208	0.4017	0.4151	0.2979	0.1768	0.2049
	0.3131	0.5078	0.5364	0.2322	0.5620	0.5238

PERCOLATION/LEAKAGE THROUGH LAYER 6

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 5

AVERAGES	0.0001	0.0002	0.0002	0.0001	0.0001	0.0001
	0.0001	0.0002	0.0002	0.0001	0.0002	0.0002
STD. DEVIATIONS	0.0002	0.0003	0.0003	0.0002	0.0001	0.0002
	0.0002	0.0004	0.0004	0.0002	0.0004	0.0004

****

****

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

	INCHES		CU. FEET	PERCENT
PRECIPITATION	25.76	(7.822)	467471.4	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	17.815	(3.6442)	323340.91	69.168
LATERAL DRAINAGE COLLECTED	2.61918	(4.36483)	47538.062	10.16919

FROM LAYER 4				
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.00000	(0.00000)	0.029	0.00001
AVERAGE HEAD ON TOP OF LAYER 5	0.000	(0.000)		
CHANGE IN WATER STORAGE	5.322	(4.9527)	96592.33	20.663

****

****

PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	2.36	42834.000
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 4	0.06417	1164.62927
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000000	0.00026
AVERAGE HEAD ON TOP OF LAYER 5	0.001	
MAXIMUM HEAD ON TOP OF LAYER 5	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 4 (DISTANCE FROM DRAIN)	70.5 FEET	
SNOW WATER	2.69	48754.1328

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4710
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.2100

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

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

****

****

FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	3.9501	0.3292
2	52.9049	0.1763
3	1.4494	0.1208
4	0.0027	0.0134
5	0.0000	0.0000
6	10.2480	0.4270
SNOW WATER	0.488	

****
****

WARNING: TEMPERATURE FOR YEAR 1 USED WITH PRECIPITATION FOR YEAR 1974

WARNING: SOLAR RADIATION FOR YEAR 1 USED WITH PRECIPITATION FOR YEAR 1974

```
**********************************************************************
**********************************************************************
**                                                                  **
**                                                                  **
**          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:     I:\SOFTWARE\HELP3\75704p4.D4
TEMPERATURE DATA FILE:       i:\software\help3\75704t4.D7
SOLAR RADIATION DATA FILE:   i:\software\help3\75704r4.D13
EVAPOTRANSPIRATION DATA:     i:\software\help3\75704e6.D11
SOIL AND DESIGN DATA FILE:   I:\SOFTWARE\HELP3\75704s6.D10
OUTPUT DATA FILE:            i:\software\help3\75704x6.OUT

TIME:  13:40     DATE:   8/29/2011

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

     TITLE:  75704-5000 Closed Condition (Final Cover)

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

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


                                LAYER  1
                                --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER   8
          THICKNESS                     =      6.00   INCHES
          POROSITY                      =      0.4630 VOL/VOL
          FIELD CAPACITY                =      0.2320 VOL/VOL
          WILTING POINT                 =      0.1160 VOL/VOL
          INITIAL SOIL WATER CONTENT    =      0.2056 VOL/VOL
          EFFECTIVE SAT. HYD. COND.     =  0.369999994000E-03 CM/SEC
        NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 12

THICKNESS	=	18.00	INCHES
POROSITY	=	0.4710	VOL/VOL
FIELD CAPACITY	=	0.3420	VOL/VOL
WILTING POINT	=	0.2100	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3337	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.419999997000E-04	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.20	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	39.4000015000	CM/SEC
SLOPE	=	2.00	PERCENT
DRAINAGE LENGTH	=	100.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 36

THICKNESS	=	0.04	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.399999993000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 5

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 1

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0450	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999978000E-02	CM/SEC

LAYER 6

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 31

THICKNESS	=	1200.00	INCHES
POROSITY	=	0.5780	VOL/VOL
FIELD CAPACITY	=	0.0760	VOL/VOL
WILTING POINT	=	0.0250	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0760	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.410000002000E-02	CM/SEC

LAYER 7

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 1

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4170	VOL/VOL
FIELD CAPACITY	=	0.0450	VOL/VOL
WILTING POINT	=	0.0180	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0450	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999978000E-02	CM/SEC

LAYER 8

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.20	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0100	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	39.4000015000	CM/SEC
SLOPE	=	2.00	PERCENT
DRAINAGE LENGTH	=	100.0	FEET

LAYER 9

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	4.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 10

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 16

THICKNESS	=	24.00	INCHES
POROSITY	=	0.4270	VOL/VOL
FIELD CAPACITY	=	0.4180	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4270	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000E-06	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 8 WITH A FAIR STAND OF GRASS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 100. FEET.

SCS RUNOFF CURVE NUMBER	=	80.40	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	34.000	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.137	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	5.604	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	1.956	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	109.773	INCHES
TOTAL INITIAL WATER	=	109.773	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
ST. CLOUD MINNESOTA

STATION LATITUDE	=	43.39	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	
START OF GROWING SEASON (JULIAN DATE)	=	128	
END OF GROWING SEASON (JULIAN DATE)	=	271	
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	8.00	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	72.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	66.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	72.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	74.00	%

NOTE: PRECIPITATION DATA FOR ST. CLOUD MINNESOTA
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR MINNEAPOLIS MINNESOTA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
11.20	17.50	29.20	46.00	58.50	68.10
73.10	70.60	60.60	49.60	33.20	19.20

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR MINNEAPOLIS MINNESOTA
AND STATION LATITUDE = 43.39 DEGREES

WARNING: TEMPERATURE FOR YEAR 1 USED WITH PRECIPITATION FOR YEAR 1974

WARNING: SOLAR RADIATION FOR YEAR 1 USED WITH PRECIPITATION FOR YEAR 1974

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 9
DRAIN #2: LATERAL DRAINAGE FROM LAYER 8 (RECIRCULATION AND COLLECTION)
LEAK #2: PERCOLATION OR LEAKAGE THROUGH LAYER 10

****

DAILY OUTPUT FOR YEAR 1974

DAY	AIR	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	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.1507E-04	.7710E-09
2	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.1507E-04	.7710E-09
3	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.1507E-04	.7710E-09
4	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.1506E-04	.7710E-09
5	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.1506E-04	.7710E-09
6	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.1505E-04	.7709E-09
7	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.1505E-04	.7709E-09
8	*	*	0.01	0.000	0.010	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.1504E-04	.7709E-09
9	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.1504E-04	.7709E-09
10	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.1504E-04	.7709E-09
11	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.1503E-04	.7709E-09
12	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.7783E-05	.3993E-09
13	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
14	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
15	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
16	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
17	*	*	0.01	0.000	0.010	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
18	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
19	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
20	*	*	0.02	0.000	0.020	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
21		*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
22	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
23		*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
24		*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
25	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
26	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
27	*	*	0.01	0.000	0.010	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
28	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
29	*	*	0.04	0.000	0.024	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
30	*	*	0.00	0.000	0.016	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
31	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
32	*	*	0.12	0.000	0.019	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
33	*	*	0.16	0.000	0.015	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
34	*	*	0.00	0.000	0.019	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
35	*	*	0.19	0.000	0.013	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
36	*	*	0.07	0.000	0.013	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
37	*	*	0.00	0.000	0.016	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
38	*	*	0.00	0.000	0.000	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
39	*	*	0.00	0.000	0.026	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
40	*	*	0.04	0.000	0.024	0.2614	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
41		*	0.00	0.099	0.001	0.2795	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
42		*	0.00	0.010	0.035	0.2855	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
43	*	*	0.00	0.000	0.000	0.2855	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
44		*	0.00	0.000	0.000	0.2855	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
45		*	0.02	0.000	0.007	0.2866	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
46		*	0.04	0.000	0.007	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
47	*	*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
48	*	*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
49	*	*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
50	*	*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
51	*	*	0.04	0.000	0.032	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
52	*	*	0.14	0.000	0.033	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
53	*	*	0.00	0.000	0.028	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
54	*	*	0.00	0.000	0.026	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
55	*	*	0.00	0.000	0.030	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

56	*	*	0.00	0.000	0.021	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
57	*	*	0.00	0.000	0.010	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
58	*	*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
59	*	*	0.01	0.000	0.010	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
60	*	*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
61	*	*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
62	*	*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
63	*	*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
64	*	*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
65	*	*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
66	*	*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
67	*	*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
68	*	*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
69	*	*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
70	*	*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
71	*	*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
72	*	*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
73	*	*	0.26	0.000	0.019	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
74	*	*	0.03	0.000	0.022	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
75		*	0.00	0.081	0.038	0.3002	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
76		*	0.00	0.000	0.000	0.3002	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
77	*	*	0.00	0.000	0.000	0.3002	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
78		*	0.00	0.000	0.000	0.3002	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
79		*	0.00	0.000	0.000	0.3002	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
80		*	0.00	0.000	0.000	0.3002	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
81		*	0.06	0.000	0.006	0.3046	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
82	*	*	0.00	0.000	0.000	0.3046	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
83	*	*	0.00	0.000	0.000	0.3046	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
84		*	0.00	0.000	0.000	0.3046	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
85		*	0.00	0.000	0.000	0.3046	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
86		*	0.00	0.000	0.000	0.3046	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
87		*	0.00	0.000	0.000	0.3046	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
88		*	0.04	0.000	0.006	0.3075	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
89		*	0.00	0.000	0.000	0.3075	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
90		*	0.49	0.292	0.006	0.3235	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
91		*	0.16	0.048	0.006	0.3324	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
92		*	0.00	0.000	0.000	0.3324	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
93		*	0.02	0.000	0.005	0.3336	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
94		*	0.00	0.000	0.000	0.3336	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
95	*	*	0.00	0.000	0.000	0.3336	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
96	*	*	0.00	0.000	0.000	0.3336	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
97	*	*	0.00	0.000	0.000	0.3336	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
98	*	*	0.00	0.000	0.000	0.3336	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
99	*	*	0.00	0.000	0.000	0.3336	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
100		*	0.00	0.000	0.000	0.3336	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
101	*	*	0.33	0.000	0.041	0.3336	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
102	*	*	0.25	0.000	0.041	0.3336	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
103		*	0.00	0.345	0.047	0.3425	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
104		*	0.00	0.000	0.000	0.3425	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
105		*	0.00	0.000	0.000	0.3425	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
106		*	0.00	0.000	0.000	0.3425	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
107		*	0.00	0.000	0.000	0.3425	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
108		*	0.00	0.000	0.000	0.3425	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
109		*	0.00	0.000	0.000	0.3425	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
110			0.03	0.000	0.233	0.3256	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
111			0.16	0.000	0.241	0.3110	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
112			0.02	0.000	0.119	0.2970	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
113			0.00	0.000	0.122	0.2821	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
114			0.00	0.000	0.137	0.2675	0.0000	.3177E-03	.4660E-06	0.0000	.4652E-06	.7667E-09
115			0.00	0.000	0.124	0.2547	0.0001	.4222E-02	.3812E-05	0.0000	.3811E-05	.7686E-09
116			0.08	0.000	0.147	0.2463	0.0001	.3056E-02	.3492E-05	0.0000	.3491E-05	.7685E-09
117			0.01	0.000	0.135	0.2340	0.0004	.1638E-01	.1357E-04	0.0000	.1455E-05	.7680E-09
118			0.00	0.000	0.107	0.2244	0.0007	.3031E-01	.2170E-04	0.0000	.0000E+00	.0000E+00
119			0.10	0.000	0.137	0.2213	0.0008	.3362E-01	.2358E-04	0.0000	.0000E+00	.0000E+00
120			0.00	0.000	0.128	0.2106	0.0007	.2953E-01	.2137E-04	0.0000	.0000E+00	.0000E+00
121			0.00	0.000	0.067	0.2051	0.0006	.2630E-01	.1957E-04	0.0000	.0000E+00	.0000E+00
122			0.01	0.000	0.079	0.1993	0.0005	.2370E-01	.1808E-04	0.0000	.0000E+00	.0000E+00
123			0.00	0.000	0.058	0.1945	0.0005	.2154E-01	.1682E-04	0.0000	.0000E+00	.0000E+00
124			0.02	0.000	0.055	0.1916	0.0004	.1974E-01	.1574E-04	0.0000	.0000E+00	.0000E+00
125			0.00	0.000	0.045	0.1876	0.0003	.1523E-01	.1266E-04	0.0000	.2407E-05	.7683E-09
126			0.00	0.000	0.040	0.1843	0.0004	.1734E-01	.1426E-04	0.0000	.8107E-06	.7676E-09

127	0.00	0.000	0.037	0.1812	0.0004	.1612E-01	.1349E-04	0.0000	.1585E-05	.7680E-09
128	0.00	0.000	0.035	0.1773	0.0002	.1038E-01	.8725E-05	0.0000	.6354E-05	.7692E-09
129	0.28	0.000	0.038	0.1975	0.0003	.1517E-01	.1289E-04	0.0000	.2194E-05	.7682E-09
130	0.60	0.000	0.036	0.2439	0.0002	.9727E-02	.8181E-05	0.0000	.6902E-05	.7693E-09
131	0.26	0.000	0.167	0.2516	0.0003	.1369E-01	.1180E-04	0.0000	.3280E-05	.7685E-09
132	0.00	0.000	0.215	0.2337	0.0003	.1328E-01	.1165E-04	0.0000	.3439E-05	.7685E-09
133	0.34	0.000	0.232	0.2427	0.0003	.1255E-01	.1116E-04	0.0000	.3929E-05	.7687E-09
134	0.29	0.000	0.178	0.2520	0.0003	.1189E-01	.1071E-04	0.0000	.4376E-05	.7688E-09
135	0.04	0.000	0.239	0.2352	0.0002	.9404E-02	.8707E-05	0.0000	.6384E-05	.7692E-09
136	0.00	0.000	0.192	0.2192	0.0002	.1081E-01	.9945E-05	0.0000	.5147E-05	.7689E-09
137	0.01	0.000	0.115	0.2105	0.0002	.1013E-01	.9449E-05	0.0000	.5645E-05	.7691E-09
138	0.01	0.000	0.117	0.2016	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
139	0.00	0.000	0.076	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
140	0.00	0.000	0.058	0.1904	0.0000	.3535E-08	.2814E-09	0.0000	.0000E+00	.0000E+00
141	0.24	0.000	0.054	0.2058	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
142	0.06	0.000	0.050	0.2067	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
143	0.00	0.000	0.042	0.2032	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
144	0.00	0.000	0.038	0.2000	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
145	0.00	0.000	0.039	0.1968	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
146	0.00	0.000	0.036	0.1938	0.0000	.0000E+00	.0000E+00	0.0000	.3732E-08	.7499E-09
147	0.00	0.000	0.035	0.1909	0.0000	.0000E+00	.0000E+00	0.0000	.1201E-07	.7631E-09
148	0.12	0.000	0.039	0.1976	0.0000	.0000E+00	.0000E+00	0.0000	.2029E-07	.7650E-09
149	0.02	0.000	0.038	0.1962	0.0000	.0000E+00	.0000E+00	0.0000	.2857E-07	.7658E-09
150	0.96	0.000	0.041	0.2728	0.0000	.0000E+00	.0000E+00	0.0000	.3685E-07	.7662E-09
151	0.00	0.000	0.209	0.2554	0.0000	.0000E+00	.0000E+00	0.0000	.4512E-07	.7665E-09
152	0.14	0.000	0.237	0.2473	0.0000	.0000E+00	.0000E+00	0.0000	.5338E-07	.7667E-09
153	0.00	0.000	0.222	0.2288	0.0000	.0000E+00	.0000E+00	0.0000	.1354E-06	.1645E-08
154	0.63	0.000	0.186	0.2658	0.0000	.0000E+00	.0000E+00	0.0000	.1334E-04	.2199E-08
155	0.05	0.000	0.144	0.2579	0.0000	.0000E+00	.0000E+00	0.0000	.1509E-04	.7710E-09
156	0.00	0.000	0.125	0.2475	0.0000	.0000E+00	.0000E+00	0.0000	.1508E-04	.7710E-09
157	0.96	0.000	0.226	0.3087	0.0000	.0000E+00	.0000E+00	0.0000	.1508E-04	.7710E-09
158	0.00	0.000	0.186	0.2932	0.0000	.0000E+00	.0000E+00	0.0000	.1508E-04	.7710E-09
159	0.00	0.000	0.245	0.2728	0.0000	.6627E-04	.8007E-07	0.0000	.1500E-04	.7703E-09
160	1.16	0.001	0.230	0.3502	0.0000	.0000E+00	.0000E+00	0.0000	.1505E-04	.7716E-09
161	0.37	0.000	0.124	0.3672	0.0000	.0000E+00	.0000E+00	0.0000	.1506E-04	.7710E-09
162	0.00	0.000	0.125	0.3357	0.0000	.0000E+00	.0000E+00	0.0000	.1506E-04	.7710E-09
163	0.08	0.000	0.198	0.3132	0.0000	.0000E+00	.0000E+00	0.0000	.1505E-04	.7709E-09
164	0.00	0.000	0.239	0.2861	0.0002	.7131E-02	.5315E-05	0.0000	.1062E-04	.7249E-09
165	0.01	0.000	0.173	0.2686	0.0010	.4267E-01	.2822E-04	0.0000	.1416E-04	.8406E-09
166	0.00	0.000	0.250	0.2439	0.0010	.4429E-01	.2901E-04	0.0000	.1505E-04	.7709E-09
167	0.00	0.000	0.175	0.2259	0.0011	.5019E-01	.3190E-04	0.0000	.1504E-04	.7709E-09
168	0.00	0.000	0.212	0.2064	0.0013	.5973E-01	.3655E-04	0.0000	.1504E-04	.7709E-09
169	0.06	0.000	0.187	0.1956	0.0015	.6594E-01	.3936E-04	0.0000	.1503E-04	.7709E-09
170	0.00	0.000	0.154	0.1827	0.0012	.5396E-01	.3374E-04	0.0000	.1134E-04	.6422E-09
171	0.82	0.000	0.108	0.2396	0.0008	.2489E-01	.1495E-04	0.0000	.1298E-06	.7654E-09
172	0.00	0.000	0.273	0.2169	0.0010	.4439E-01	.2894E-04	0.0000	.0000E+00	.0000E+00
173	0.00	0.000	0.291	0.1927	0.0009	.3829E-01	.2602E-04	0.0000	.0000E+00	.0000E+00
174	0.00	0.000	0.174	0.1781	0.0007	.3311E-01	.2330E-04	0.0000	.0000E+00	.0000E+00
175	0.00	0.000	0.126	0.1676	0.0007	.2913E-01	.2115E-04	0.0000	.0000E+00	.0000E+00
176	0.00	0.000	0.044	0.1640	0.0006	.2598E-01	.1939E-04	0.0000	.0000E+00	.0000E+00
177	0.00	0.000	0.011	0.1630	0.0005	.2343E-01	.1793E-04	0.0000	.0000E+00	.0000E+00
178	0.00	0.000	0.000	0.1630	0.0005	.2133E-01	.1669E-04	0.0000	.0000E+00	.0000E+00
179	0.00	0.000	0.000	0.1630	0.0004	.1956E-01	.1563E-04	0.0000	.0000E+00	.0000E+00
180	0.08	0.000	0.016	0.1683	0.0004	.1805E-01	.1470E-04	0.0000	.4306E-06	.7672E-09
181	0.00	0.000	0.019	0.1668	0.0004	.1675E-01	.1390E-04	0.0000	.1243E-05	.7679E-09
182	0.00	0.000	0.027	0.1645	0.0003	.1563E-01	.1318E-04	0.0000	.1963E-05	.7681E-09
183	0.10	0.000	0.023	0.1709	0.0003	.1464E-01	.1254E-04	0.0000	.2604E-05	.7683E-09
184	0.07	0.000	0.045	0.1729	0.0003	.1376E-01	.1197E-04	0.0000	.3180E-05	.7685E-09
185	0.00	0.000	0.037	0.1698	0.0003	.1298E-01	.1145E-04	0.0000	.3701E-05	.7686E-09
186	0.00	0.000	0.041	0.1664	0.0003	.1228E-01	.1098E-04	0.0000	.4174E-05	.7687E-09
187	0.11	0.000	0.041	0.1722	0.0003	.1162E-01	.1053E-04	0.0000	.4627E-05	.7688E-09
188	0.00	0.000	0.043	0.1685	0.0002	.1109E-01	.1016E-04	0.0000	.4998E-05	.7689E-09
189	0.04	0.000	0.055	0.1673	0.0002	.1057E-01	.9794E-05	0.0000	.5362E-05	.7690E-09
190	0.00	0.000	0.012	0.1663	0.0000	.1987E-02	.1854E-05	0.0000	.1727E-05	.7682E-09
191	0.02	0.000	0.027	0.1657	0.0000	.1066E-03	.2309E-06	0.0000	.1111E-06	.7673E-09
192	0.00	0.000	0.012	0.1647	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
193	0.17	0.000	0.044	0.1752	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
194	0.43	0.000	0.060	0.2060	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
195	0.00	0.000	0.202	0.1891	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
196	0.00	0.000	0.099	0.1809	0.0000	.2949E-04	.7013E-07	0.0000	.0000E+00	.0000E+00
197	0.12	0.000	0.117	0.1811	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

198	0.09	0.000	0.116	0.1789	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
199	0.00	0.000	0.047	0.1750	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
200	0.00	0.000	0.052	0.1707	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
201	0.00	0.000	0.064	0.1653	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
202	0.13	0.000	0.042	0.1727	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
203	0.00	0.000	0.062	0.1675	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
204	0.53	0.000	0.083	0.2047	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
205	0.44	0.000	0.181	0.2263	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
206	0.00	0.000	0.203	0.2094	0.0000	.0000E+00	.0000E+00	0.0000	.3760E-08	.7506E-09
207	0.00	0.000	0.205	0.1924	0.0000	.0000E+00	.0000E+00	0.0000	.1207E-07	.7633E-09
208	0.00	0.000	0.119	0.1824	0.0000	.1611E-03	.2918E-06	0.0000	.3139E-06	.3151E-08
209	0.00	0.000	0.136	0.1711	0.0000	.0000E+00	.0000E+00	0.0000	.2976E-07	.7659E-09
210	0.00	0.000	0.083	0.1642	0.0000	.1794E-04	.5121E-07	0.0000	.8924E-07	.7672E-09
211	0.00	0.000	0.010	0.1634	0.0000	.0000E+00	.0000E+00	0.0000	.4631E-07	.7666E-09
212	0.00	0.000	0.004	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.5461E-07	.7668E-09
213	0.12	0.000	0.031	0.1705	0.0000	.0000E+00	.0000E+00	0.0000	.6290E-07	.7669E-09
214	1.67	0.028	0.126	0.2968	0.0000	.0000E+00	.0000E+00	0.0000	.7119E-07	.7670E-09
215	0.48	0.000	0.200	0.3201	0.0000	.0000E+00	.0000E+00	0.0000	.7948E-07	.7671E-09
216	0.00	0.000	0.161	0.3067	0.0000	.0000E+00	.0000E+00	0.0000	.8776E-07	.7672E-09
217	0.01	0.000	0.144	0.2955	0.0000	.0000E+00	.0000E+00	0.0000	.9603E-07	.7672E-09
218	0.00	0.000	0.178	0.2806	0.0000	.7812E-03	.7596E-06	0.0000	.8635E-06	.7679E-09
219	0.02	0.000	0.203	0.2653	0.0000	.5577E-03	.6910E-06	0.0000	.8024E-06	.7679E-09
220	0.00	0.000	0.211	0.2456	0.0000	.5126E-03	.5062E-06	0.0000	.6251E-06	.7679E-09
221	0.44	0.000	0.129	0.2687	0.0000	.0000E+00	.0000E+00	0.0000	.4637E-05	.7999E-09
222	0.16	0.000	0.195	0.2638	0.0000	.0000E+00	.0000E+00	0.0000	.1515E-04	.7710E-09
223	0.11	0.000	0.184	0.2571	0.0002	.9264E-02	.7937E-05	0.0000	.8060E-05	.7696E-09
224	0.04	0.000	0.196	0.2441	0.0003	.1405E-01	.1216E-04	0.0000	.1228E-04	.7704E-09
225	0.00	0.000	0.116	0.2344	0.0003	.1326E-01	.1164E-04	0.0000	.1175E-04	.7703E-09
226	0.00	0.000	0.111	0.2252	0.0003	.1254E-01	.1115E-04	0.0000	.1126E-04	.7702E-09
227	0.00	0.000	0.160	0.2119	0.0003	.1188E-01	.1071E-04	0.0000	.1081E-04	.7701E-09
228	0.00	0.000	0.177	0.1972	0.0003	.1129E-01	.1030E-04	0.0000	.1040E-04	.7700E-09
229	0.01	0.000	0.214	0.1801	0.0002	.1075E-01	.9925E-05	0.0000	.1003E-04	.7700E-09
230	0.00	0.000	0.206	0.1630	0.0001	.5829E-02	.5445E-05	0.0000	.5546E-05	.7690E-09
231	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1059E-06	.7673E-09
232	0.08	0.000	0.033	0.1669	0.0000	.0000E+00	.0000E+00	0.0000	.1142E-06	.7673E-09
233	0.06	0.000	0.036	0.1689	0.0000	.0000E+00	.0000E+00	0.0000	.4465E-05	.2840E-08
234	0.00	0.000	0.037	0.1658	0.0000	.0000E+00	.0000E+00	0.0000	.1515E-04	.1905E-08
235	0.00	0.000	0.028	0.1635	0.0000	.1830E-06	.9846E-08	0.0000	.1514E-04	.7709E-09
236	0.00	0.000	0.005	0.1631	0.0000	.6516E-08	.3152E-09	0.0000	.1514E-04	.7710E-09
237	0.00	0.000	0.001	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1514E-04	.7710E-09
238	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1513E-04	.7710E-09
239	0.00	0.000	0.000	0.1630	0.0000	.4336E-05	.1030E-07	0.0000	.1512E-04	.7709E-09
240	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1512E-04	.7710E-09
241	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1512E-04	.7710E-09
242	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1511E-04	.7710E-09
243	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1511E-04	.7710E-09
244	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1511E-04	.7710E-09
245	0.03	0.000	0.022	0.1636	0.0000	.0000E+00	.0000E+00	0.0000	.1510E-04	.7710E-09
246	0.00	0.000	0.004	0.1633	0.0000	.0000E+00	.0000E+00	0.0000	.1510E-04	.7710E-09
247	0.00	0.000	0.002	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	.1509E-04	.7710E-09
248	0.00	0.000	0.001	0.1630	0.0000	.1493E-07	.9005E-08	0.0000	.1508E-04	.7709E-09
249	0.07	0.000	0.026	0.1667	0.0000	.2597E-09	.1628E-09	0.0000	.1508E-04	.7710E-09
250	0.00	0.000	0.004	0.1663	0.0000	.0000E+00	.0000E+00	0.0000	.1508E-04	.7710E-09
251	0.21	0.000	0.040	0.1805	0.0000	.0000E+00	.0000E+00	0.0000	.1508E-04	.7710E-09
252	1.47	0.012	0.051	0.2977	0.0000	.7256E-05	.3659E-07	0.0000	.1504E-04	.7706E-09
253	0.00	0.000	0.102	0.2892	0.0000	.0000E+00	.0000E+00	0.0000	.1506E-04	.7713E-09
254	0.08	0.000	0.121	0.2858	0.0000	.0000E+00	.0000E+00	0.0000	.1506E-04	.7710E-09
255	0.09	0.000	0.102	0.2848	0.0000	.0000E+00	.0000E+00	0.0000	.1506E-04	.7710E-09
256	0.00	0.000	0.075	0.2786	0.0000	.0000E+00	.0000E+00	0.0000	.1506E-04	.7710E-09
257	0.00	0.000	0.077	0.2721	0.0000	.0000E+00	.0000E+00	0.0000	.1505E-04	.7709E-09
258	0.00	0.000	0.119	0.2622	0.0000	.0000E+00	.0000E+00	0.0000	.1505E-04	.7709E-09
259	0.00	0.000	0.093	0.2545	0.0000	.0000E+00	.0000E+00	0.0000	.1504E-04	.7709E-09
260	0.00	0.000	0.083	0.2476	0.0000	.0000E+00	.0000E+00	0.0000	.1504E-04	.7709E-09
261	0.00	0.000	0.108	0.2386	0.0000	.4060E-04	.6472E-07	0.0000	.1498E-04	.7704E-09
262	0.02	0.000	0.116	0.2306	0.0000	.1015E-03	.1641E-06	0.0000	.1488E-04	.7701E-09
263	0.00	0.000	0.093	0.2228	0.0000	.1792E-03	.2807E-06	0.0000	.6711E-05	.6432E-09
264	0.00	0.000	0.109	0.2137	0.0000	.4236E-04	.6747E-07	0.0000	.1000E-06	.2960E-08
265	0.00	0.000	0.082	0.2069	0.0000	.0000E+00	.0000E+00	0.0000	.1112E-07	.1265E-09
266	0.00	0.000	0.062	0.2017	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
267	0.00	0.000	0.059	0.1968	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
268	0.00	0.000	0.068	0.1911	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

269		0.00	0.000	0.057	0.1863	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
270		0.00	0.000	0.051	0.1821	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
271		0.00	0.000	0.046	0.1783	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
272		0.00	0.000	0.038	0.1751	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
273		0.00	0.000	0.035	0.1722	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
274		0.00	0.000	0.033	0.1694	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
275		0.00	0.000	0.031	0.1668	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
276		0.00	0.000	0.030	0.1644	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
277		0.11	0.000	0.034	0.1707	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
278		0.12	0.000	0.026	0.1785	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
279		0.02	0.000	0.022	0.1783	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
280		0.00	0.000	0.011	0.1774	0.0000	.2378E-06	.1248E-07	0.0000	.1175E-07	.7233E-09
281		0.00	0.000	0.013	0.1763	0.0000	.5595E-08	.3059E-09	0.0000	.8714E-10	.2187E-09
282		0.00	0.000	0.016	0.1750	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
283		0.00	0.000	0.015	0.1737	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
284		0.00	0.000	0.015	0.1724	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
285		0.00	0.000	0.015	0.1712	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
286		0.00	0.000	0.014	0.1700	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
287		0.00	0.000	0.014	0.1689	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
288		0.00	0.000	0.014	0.1677	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
289		0.00	0.000	0.013	0.1666	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
290		0.00	0.000	0.013	0.1655	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
291		0.00	0.000	0.013	0.1645	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
292		0.00	0.000	0.012	0.1635	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
293		0.00	0.000	0.004	0.1632	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
294		0.00	0.000	0.001	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
295		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
296		0.00	0.000	0.000	0.1630	0.0000	.5893E-05	.1294E-07	0.0000	.1221E-07	.7248E-09
297	*	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
298		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
299		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
300		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
301		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
302		0.35	0.000	0.022	0.1904	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
303		0.00	0.000	0.007	0.1898	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
304		0.98	0.000	0.025	0.2694	0.0000	.1460E-06	.6878E-08	0.0000	.6187E-08	.6907E-09
305		0.86	0.005	0.058	0.3357	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
306		0.00	0.000	0.037	0.3326	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
307		0.00	0.000	0.043	0.3236	0.0000	.1429E-04	.2513E-07	0.0000	.2439E-07	.7451E-09
308		0.00	0.000	0.049	0.3115	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
309		0.00	0.000	0.046	0.3023	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
310		0.00	0.000	0.055	0.2933	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
311		0.00	0.000	0.043	0.2860	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
312		0.00	0.000	0.047	0.2790	0.0002	.6833E-02	.6717E-05	0.0000	.6716E-05	.7693E-09
313		0.04	0.000	0.061	0.2747	0.0003	.1528E-01	.1289E-04	0.0000	.2139E-05	.7682E-09
314		0.11	0.000	0.072	0.2755	0.0005	.2092E-01	.1635E-04	0.0000	.0000E+00	.0000E+00
315		0.00	0.000	0.060	0.2693	0.0008	.3434E-01	.2392E-04	0.0000	.0000E+00	.0000E+00
316		0.00	0.000	0.055	0.2635	0.0007	.3043E-01	.2183E-04	0.0000	.0000E+00	.0000E+00
317		0.00	0.000	0.046	0.2593	0.0008	.3594E-01	.2476E-04	0.0000	.0000E+00	.0000E+00
318		0.00	0.000	0.035	0.2564	0.0008	.3500E-01	.2430E-04	0.0000	.0000E+00	.0000E+00
319		0.00	0.000	0.055	0.2518	0.0007	.3070E-01	.2200E-04	0.0000	.0000E+00	.0000E+00
320		0.00	0.000	0.053	0.2473	0.0006	.2723E-01	.2009E-04	0.0000	.0000E+00	.0000E+00
321		0.00	0.000	0.041	0.2439	0.0005	.2445E-01	.1852E-04	0.0000	.0000E+00	.0000E+00
322		0.02	0.000	0.035	0.2427	0.0005	.2217E-01	.1719E-04	0.0000	.0000E+00	.0000E+00
323		0.04	0.000	0.047	0.2422	0.0005	.2027E-01	.1606E-04	0.0000	.0000E+00	.0000E+00
324		0.00	0.000	0.032	0.2395	0.0004	.1866E-01	.1508E-04	0.0000	.8616E-08	.7343E-09
325	*	0.00	0.000	0.020	0.2378	0.0004	.1728E-01	.1423E-04	0.0000	.8667E-06	.7677E-09
326	*	0.00	0.000	0.020	0.2361	0.0004	.1609E-01	.1347E-04	0.0000	.1624E-05	.7680E-09
327	*	0.00	0.000	0.000	0.2361	0.0003	.1504E-01	.1280E-04	0.0000	.2296E-05	.7682E-09
328	*	0.00	0.000	0.000	0.2361	0.0003	.1412E-01	.1220E-04	0.0000	.2899E-05	.7684E-09
329		0.00	0.000	0.026	0.2340	0.0003	.1330E-01	.1166E-04	0.0000	.3442E-05	.7685E-09
330		0.20	0.000	0.043	0.2470	0.0003	.1257E-01	.1117E-04	0.0000	.3934E-05	.7687E-09
331	*	0.00	0.000	0.020	0.2453	0.0002	.1085E-01	.9920E-05	0.0000	.5188E-05	.7690E-09
332	*	0.00	0.000	0.019	0.2437	0.0003	.1133E-01	.1032E-04	0.0000	.4791E-05	.7689E-09
333		0.02	0.000	0.044	0.2417	0.0002	.1088E-01	.1002E-04	0.0000	.5096E-05	.7689E-09
334	*	0.00	0.000	0.022	0.2397	0.0002	.7615E-02	.7539E-05	0.0000	.7454E-05	.7694E-09
335		0.00	0.000	0.024	0.2374	0.0002	.6967E-02	.7139E-05	0.0000	.7054E-05	.7694E-09
336	*	0.00	0.000	0.000	0.2374	0.0000	.1442E-03	.1471E-06	0.0000	.6654E-07	.7669E-09
337	*	0.00	0.000	0.022	0.2356	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
338	*	0.00	0.000	0.000	0.2356	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
339	*	0.00	0.000	0.000	0.2356	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

340	*		0.00	0.000	0.022	0.2338	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
341	*		0.00	0.000	0.018	0.2323	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
342	*		0.00	0.000	0.018	0.2308	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
343	*		0.00	0.000	0.021	0.2290	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
344	*		0.00	0.000	0.000	0.2290	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
345	*		0.00	0.000	0.000	0.2290	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
346	*		0.00	0.000	0.000	0.2290	0.0000	.0000E+00	.0000E+00	0.0000	.1692E-08	.4980E-09
347	*	*	0.10	0.000	0.006	0.2290	0.0000	.0000E+00	.0000E+00	0.0000	.9440E-08	.7618E-09
348	*	*	0.05	0.000	0.006	0.2290	0.0000	.0000E+00	.0000E+00	0.0000	.1773E-07	.7646E-09
349	*	*	0.16	0.000	0.000	0.2290	0.0000	.0000E+00	.0000E+00	0.0000	.2602E-07	.7656E-09
350	*	*	0.02	0.000	0.000	0.2290	0.0000	.0000E+00	.0000E+00	0.0000	.3431E-07	.7662E-09
351		*	0.00	0.010	0.005	0.2421	0.0000	.0000E+00	.0000E+00	0.0000	.4259E-07	.7665E-09
352	*	*	0.17	0.000	0.016	0.2421	0.0000	.0000E+00	.0000E+00	0.0000	.5087E-07	.7667E-09
353	*	*	0.01	0.000	0.013	0.2421	0.0000	.0000E+00	.0000E+00	0.0000	.5914E-07	.7669E-09
354	*	*	0.00	0.000	0.007	0.2421	0.0000	.0000E+00	.0000E+00	0.0000	.6741E-07	.7670E-09
355	*	*	0.00	0.000	0.007	0.2421	0.0000	.0000E+00	.0000E+00	0.0000	.7567E-07	.7671E-09
356	*	*	0.03	0.000	0.000	0.2421	0.0000	.0000E+00	.0000E+00	0.0000	.8106E-05	.1257E-08
357	*	*	0.00	0.000	0.024	0.2421	0.0000	.0000E+00	.0000E+00	0.0000	.1511E-04	.7710E-09
358		*	0.00	0.064	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1510E-04	.7710E-09
359		*	0.00	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1510E-04	.7710E-09
360		*	0.00	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1510E-04	.7710E-09
361		*	0.00	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1509E-04	.7710E-09
362		*	0.00	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1509E-04	.7710E-09
363		*	0.00	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1508E-04	.7710E-09
364		*	0.00	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1508E-04	.7710E-09
365	*	*	0.00	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1507E-04	.7710E-09

****

****

MONTHLY TOTALS (IN INCHES) FOR YEAR 1974

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.09	0.83	0.88	1.16	3.26	4.36
	2.25	3.20	1.97	1.58	1.29	0.54
RUNOFF	0.000	0.110	0.373	0.392	0.000	0.001
	0.000	0.028	0.012	0.000	0.005	0.074
EVAPOTRANSPIRATION	0.090	0.385	0.097	1.772	2.699	4.699
	2.295	3.081	1.847	0.414	1.185	0.207
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.1174	0.2570	0.6189
FROM LAYER 3	0.1049	0.0907	0.0004	0.0000	0.4513	0.0071
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0001	0.0002	0.0004
LAYER 4	0.0001	0.0001	0.0000	0.0000	0.0004	0.0000
LATERAL DRAINAGE COLLECTED	0.0002	0.0000	0.0000	0.0000	0.0001	0.0002
FROM LAYER 8	0.0000	0.0003	0.0003	0.0000	0.0000	0.0002
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 9	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 9	0.000	0.000	0.000	0.000	0.000	0.000

ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	21.41	2642423.000	100.00
RUNOFF	0.995	122817.898	4.65
EVAPOTRANSPIRATION	18.771	2316670.500	87.67
DRAINAGE COLLECTED FROM LAYER 3	1.6477	203362.109	7.70
PERC./LEAKAGE THROUGH LAYER 4	0.001254	154.760	0.01
AVG. HEAD ON TOP OF LAYER 4	0.0001		
DRAINAGE COLLECTED FROM LAYER 8	0.0013	156.095	0.01
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.017	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.005	-584.746	-0.02
SOIL WATER AT START OF YEAR	110.313	13614799.000	
SOIL WATER AT END OF YEAR	110.308	13614214.000	
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	1.073	0.00

WARNING: TEMPERATURE FOR YEAR 2 USED WITH PRECIPITATION FOR YEAR 1975

WARNING: SOLAR RADIATION FOR YEAR 2 USED WITH PRECIPITATION FOR YEAR 1975

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 9
DRAIN #2: LATERAL DRAINAGE FROM LAYER 8 (RECIRCULATION AND COLLECTION)
LEAK #2: PERCOLATION OR LEAKAGE THROUGH LAYER 10

****

DAILY OUTPUT FOR YEAR 1975

DAY	AIR	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	*	*	0.00	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1507E-04	.7710E-09
2	*	*	0.22	0.000	0.016	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1507E-04	.7710E-09
3	*	*	0.02	0.000	0.015	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1506E-04	.7710E-09
4	*	*	0.00	0.000	0.013	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1506E-04	.7710E-09
5	*	*	0.03	0.000	0.017	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1505E-04	.7709E-09
6	*	*	0.02	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1505E-04	.7709E-09
7	*	*	0.01	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1505E-04	.7709E-09
8	*	*	0.13	0.000	0.014	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1504E-04	.7709E-09
9	*	*	0.33	0.000	0.008	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1504E-04	.7709E-09
10	*	*	0.60	0.000	0.009	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1503E-04	.7709E-09
11	*	*	0.27	0.000	0.006	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.1189E-04	.6423E-09
12	*	*	0.00	0.000	0.009	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
13	*	*	0.00	0.000	0.005	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
14	*	*	0.04	0.000	0.006	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
15	*	*	0.00	0.000	0.007	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
16	*	*	0.00	0.000	0.009	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
17	*	*	0.04	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
18	*	*	0.00	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
19	*	*	0.00	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
20	*	*	0.01	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
21	*	*	0.02	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
22	*	*	0.00	0.000	0.012	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
23	*	*	0.04	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
24	*	*	0.18	0.000	0.010	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
25	*	*	0.11	0.000	0.010	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
26	*	*	0.00	0.000	0.008	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
27	*	*	0.00	0.000	0.013	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
28	*	*	0.18	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
29	*	*	0.11	0.000	0.011	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
30	*	*	0.00	0.000	0.009	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
31	*	*	0.03	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
32	*	*	0.00	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
33	*	*	0.03	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
34	*	*	0.00	0.000	0.012	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
35	*	*	0.10	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

36	*	*	0.05	0.000	0.014	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
37	*	*	0.00	0.000	0.015	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
38	*	*	0.00	0.000	0.019	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
39	*	*	0.00	0.000	0.020	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
40		*	0.00	0.000	0.028	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
41	*	*	0.05	0.000	0.024	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
42	*	*	0.00	0.000	0.021	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
43	*	*	0.00	0.000	0.023	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
44	*	*	0.02	0.000	0.014	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
45	*	*	0.00	0.000	0.010	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
46	*	*	0.00	0.000	0.014	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
47	*	*	0.00	0.000	0.018	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
48	*	*	0.09	0.000	0.011	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
49	*	*	0.06	0.000	0.011	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
50	*	*	0.00	0.000	0.016	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
51	*	*	0.00	0.000	0.017	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
52	*	*	0.00	0.000	0.017	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
53	*	*	0.00	0.000	0.012	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
54	*	*	0.00	0.000	0.016	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
55	*	*	0.00	0.000	0.017	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
56	*	*	0.00	0.000	0.014	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
57	*	*	0.00	0.000	0.014	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
58	*	*	0.00	0.000	0.019	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
59	*	*	0.00	0.000	0.014	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
60	*	*	0.00	0.000	0.012	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
61	*	*	0.00	0.000	0.015	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
62	*	*	0.00	0.000	0.011	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
63	*	*	0.02	0.000	0.010	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
64	*	*	0.05	0.000	0.009	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
65	*	*	0.00	0.000	0.000	0.2610	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
66		*	0.00	0.035	0.005	0.2746	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
67		*	0.00	0.272	0.000	0.2949	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
68		*	0.04	0.087	0.000	0.3088	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
69	*	*	0.00	0.000	0.028	0.3088	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
70	*	*	0.25	0.000	0.023	0.3088	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
71		*	0.04	0.240	0.000	0.3245	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
72		*	0.00	0.866	0.000	0.3408	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
73		*	0.00	0.000	0.000	0.3408	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
74	*	*	0.00	0.000	0.000	0.3408	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
75		*	0.00	0.000	0.000	0.3408	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
76		*	0.00	0.000	0.000	0.3408	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
77		*	0.00	0.000	0.000	0.3408	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
78	*	*	0.00	0.000	0.000	0.3408	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
79	*	*	0.08	0.000	0.032	0.3408	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
80	*	*	0.00	0.000	0.034	0.3408	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
81	*	*	0.00	0.000	0.015	0.3408	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
82	*	*	0.50	0.000	0.026	0.3408	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
83		*	0.31	0.631	0.000	0.3535	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
84		*	0.00	0.000	0.000	0.3535	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
85		*	0.12	0.040	0.004	0.3599	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
86		*	0.27	0.166	0.004	0.3682	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
87		*	0.01	0.000	0.004	0.3687	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
88		*	0.00	0.000	0.000	0.3687	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
89		*	0.03	0.001	0.004	0.3708	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
90		*	0.03	0.001	0.004	0.3729	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
91		*	0.00	0.000	0.000	0.3729	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
92		*	0.00	0.000	0.000	0.3729	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
93		*	0.00	0.000	0.000	0.3729	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
94		*	0.00	0.000	0.000	0.3729	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
95		*	0.00	0.000	0.000	0.3729	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
96		*	0.00	0.000	0.000	0.3729	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
97			0.00	0.000	0.088	0.3397	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
98			0.00	0.000	0.095	0.3167	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
99			0.05	0.000	0.135	0.3020	0.0003	.1159E-01	.9076E-05	0.0000	.5952E-05	.7691E-09
100			0.00	0.000	0.117	0.2866	0.0010	.4320E-01	.2899E-04	0.0000	.0000E+00	.0000E+00
101			0.00	0.000	0.126	0.2721	0.0014	.6438E-01	.3864E-04	0.0000	.0000E+00	.0000E+00
102			0.00	0.000	0.188	0.2544	0.0017	.7495E-01	.4331E-04	0.0000	.0000E+00	.0000E+00
103			0.00	0.000	0.203	0.2345	0.0011	.5052E-01	.3221E-04	0.0000	.0000E+00	.0000E+00
104			0.08	0.000	0.150	0.2266	0.0013	.5632E-01	.5364E-05	0.0000	.5324E-05	.7690E-09
105			0.00	0.000	0.166	0.2122	0.0014	.6077E-01	.3707E-04	0.0000	.4379E-05	.2246E-09
106			0.00	0.000	0.146	0.2000	0.0012	.5473E-01	.2881E-04	0.0000	.0000E+00	.0000E+00

107		0.21	0.000	0.081	0.2108	0.0010	.4488E-01	.2935E-04	0.0000	.0000E+00	.0000E+00
108		0.00	0.000	0.060	0.2048	0.0006	.2821E-01	.2057E-04	0.0000	.0000E+00	.0000E+00
109		0.02	0.000	0.055	0.2018	0.0008	.3569E-01	.2467E-04	0.0000	.0000E+00	.0000E+00
110		0.00	0.000	0.045	0.1981	0.0007	.3113E-01	.2224E-04	0.0000	.0000E+00	.0000E+00
111		0.00	0.000	0.039	0.1948	0.0006	.2758E-01	.2029E-04	0.0000	.0000E+00	.0000E+00
112		0.64	0.000	0.041	0.2446	0.0005	.2410E-01	.1829E-04	0.0000	.0000E+00	.0000E+00
113		0.00	0.000	0.194	0.2284	0.0005	.2252E-01	.1740E-04	0.0000	.0000E+00	.0000E+00
114		0.08	0.000	0.230	0.2159	0.0005	.2057E-01	.1624E-04	0.0000	.0000E+00	.0000E+00
115		0.00	0.000	0.150	0.2034	0.0004	.1845E-01	.1481E-04	0.0000	.3267E-06	.7669E-09
116		1.07	0.000	0.145	0.2805	0.0004	.1758E-01	.1441E-04	0.0000	.7238E-06	.7676E-09
117		1.18	0.050	0.115	0.3651	0.0004	.1635E-01	.1364E-04	0.0000	.1502E-05	.7680E-09
118	*	0.21	0.000	0.100	0.3459	0.0001	.5493E-02	.4635E-05	0.0000	.4521E-05	.7688E-09
119		0.14	0.000	0.138	0.3389	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
120		0.01	0.000	0.163	0.3165	0.0001	.5564E-02	.4771E-05	0.0000	.4668E-05	.7689E-09
121		0.00	0.000	0.152	0.2983	0.0015	.6639E-01	.3909E-04	0.0000	.1503E-04	.7709E-09
122		0.16	0.000	0.134	0.2983	0.0021	.9205E-01	.5064E-04	0.0000	.1179E-04	.6423E-09
123		0.00	0.000	0.140	0.2843	0.0015	.6581E-01	.3953E-04	0.0000	.0000E+00	.0000E+00
124		0.19	0.000	0.163	0.2838	0.0012	.5229E-01	.3287E-04	0.0000	.0000E+00	.0000E+00
125		0.00	0.000	0.211	0.2630	0.0010	.4330E-01	.2849E-04	0.0000	.0000E+00	.0000E+00
126		0.00	0.000	0.175	0.2462	0.0012	.5206E-01	.3319E-04	0.0000	.0000E+00	.0000E+00
127		0.57	0.000	0.186	0.2776	0.0013	.5968E-01	.3643E-04	0.0000	.0000E+00	.0000E+00
128		0.03	0.000	0.223	0.2615	0.0012	.5392E-01	.3375E-04	0.0000	.0000E+00	.0000E+00
129		0.00	0.000	0.143	0.2492	0.0009	.4163E-01	.2769E-04	0.0000	.0000E+00	.0000E+00
130		0.00	0.000	0.136	0.2379	0.0008	.3777E-01	.2574E-04	0.0000	.0000E+00	.0000E+00
131		0.00	0.000	0.191	0.2220	0.0007	.3347E-01	.2350E-04	0.0000	.0000E+00	.0000E+00
132		0.00	0.000	0.169	0.2079	0.0007	.2935E-01	.2127E-04	0.0000	.0000E+00	.0000E+00
133		0.00	0.000	0.177	0.1932	0.0006	.2616E-01	.1949E-04	0.0000	.0000E+00	.0000E+00
134		0.21	0.000	0.084	0.2037	0.0005	.2357E-01	.1801E-04	0.0000	.0000E+00	.0000E+00
135		0.00	0.000	0.062	0.1986	0.0005	.2144E-01	.1676E-04	0.0000	.0000E+00	.0000E+00
136		0.00	0.000	0.052	0.1942	0.0004	.1966E-01	.1569E-04	0.0000	.0000E+00	.0000E+00
137		0.00	0.000	0.046	0.1904	0.0004	.1814E-01	.1476E-04	0.0000	.5079E-06	.7673E-09
138		0.00	0.000	0.042	0.1869	0.0004	.1683E-01	.1394E-04	0.0000	.1327E-05	.7679E-09
139		0.23	0.000	0.042	0.2026	0.0004	.1569E-01	.1322E-04	0.0000	.2052E-05	.7682E-09
140		0.73	0.000	0.040	0.2599	0.0003	.1214E-01	.9909E-05	0.0000	.5365E-05	.7690E-09
141		0.00	0.000	0.176	0.2452	0.0003	.1412E-01	.1221E-04	0.0000	.3070E-05	.7685E-09
142		0.36	0.000	0.188	0.2595	0.0003	.1331E-01	.1167E-04	0.0000	.3613E-05	.7686E-09
143		0.02	0.000	0.196	0.2448	0.0003	.1257E-01	.1118E-04	0.0000	.4106E-05	.7687E-09
144		0.00	0.000	0.165	0.2311	0.0003	.1187E-01	.1070E-04	0.0000	.4586E-05	.7688E-09
145		0.51	0.000	0.173	0.2592	0.0003	.1133E-01	.1032E-04	0.0000	.4962E-05	.7689E-09
146		0.00	0.000	0.218	0.2410	0.0002	.1060E-01	.9751E-05	0.0000	.5535E-05	.7690E-09
147		0.01	0.000	0.217	0.2238	0.0002	.6881E-02	.6403E-05	0.0000	.6145E-05	.7692E-09
148		0.00	0.000	0.221	0.2054	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
149		0.00	0.000	0.179	0.1905	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
150		0.00	0.000	0.083	0.1836	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
151		0.00	0.000	0.065	0.1782	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
152		0.00	0.000	0.057	0.1735	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
153		0.05	0.000	0.053	0.1732	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
154		0.00	0.000	0.047	0.1693	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
155		0.21	0.000	0.048	0.1827	0.0000	.7199E-03	.6677E-06	0.0000	.4726E-06	.7678E-09
156		0.00	0.000	0.028	0.1801	0.0001	.3531E-02	.3264E-05	0.0000	.3075E-05	.7685E-09
157		0.00	0.000	0.027	0.1779	0.0000	.8912E-06	.3272E-08	0.0000	.0000E+00	.0000E+00
158		0.00	0.000	0.026	0.1757	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
159		0.00	0.000	0.027	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
160		0.14	0.000	0.032	0.1824	0.0000	.6707E-06	.2686E-08	0.0000	.0000E+00	.0000E+00
161		0.00	0.000	0.027	0.1802	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
162		1.13	0.000	0.032	0.2716	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
163		0.06	0.000	0.209	0.2592	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
164		0.20	0.000	0.227	0.2569	0.0000	.7530E-04	.1410E-06	0.0000	.1786E-07	.7647E-09
165		0.74	0.000	0.148	0.3063	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
166		0.28	0.000	0.237	0.3099	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
167		0.08	0.000	0.190	0.3007	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
168		0.33	0.000	0.192	0.3122	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
169		0.00	0.000	0.178	0.2973	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
170		0.01	0.000	0.241	0.2780	0.0000	.1164E-02	.1391E-05	0.0000	.1317E-05	.7681E-09
171		0.16	0.000	0.239	0.2714	0.0000	.5238E-03	.5855E-06	0.0000	.5194E-06	.7678E-09
172		0.83	0.000	0.180	0.3256	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
173		0.07	0.000	0.199	0.3148	0.0000	.1053E-03	.1138E-06	0.0000	.6410E-07	.7670E-09
174		0.00	0.000	0.255	0.2935	0.0000	.1685E-03	.1778E-06	0.0000	.1364E-06	.7674E-09
175		0.00	0.000	0.166	0.2797	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
176		0.00	0.000	0.171	0.2636	0.0000	.3315E-03	.4137E-06	0.0000	.3888E-06	.7677E-09
177		0.23	0.000	0.204	0.2624	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

178	0.00	0.000	0.129	0.2488	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
179	0.00	0.000	0.241	0.2269	0.0000	.6999E-03	.5262E-06	0.0000	.5259E-06	.7678E-09
180	0.00	0.000	0.298	0.2021	0.0004	.1635E-01	.1364E-04	0.0000	.1364E-04	.7707E-09
181	1.26	0.000	0.249	0.2863	0.0003	.1534E-01	.1299E-04	0.0000	.1299E-04	.7705E-09
182	0.02	0.000	0.190	0.2722	0.0003	.1438E-01	.1238E-04	0.0000	.1236E-04	.7704E-09
183	0.00	0.000	0.293	0.2477	0.0003	.1354E-01	.1182E-04	0.0000	.1180E-04	.7703E-09
184	0.00	0.000	0.281	0.2243	0.0003	.1278E-01	.1131E-04	0.0000	.1129E-04	.7702E-09
185	0.00	0.000	0.278	0.2011	0.0003	.1210E-01	.1086E-04	0.0000	.1083E-04	.7701E-09
186	0.00	0.000	0.280	0.1778	0.0003	.1149E-01	.1044E-04	0.0000	.1041E-04	.7700E-09
187	0.00	0.000	0.178	0.1630	0.0002	.1093E-01	.1005E-04	0.0000	.1002E-04	.7700E-09
188	0.00	0.000	0.000	0.1630	0.0002	.9505E-02	.8833E-05	0.0000	.8799E-05	.7697E-09
189	0.00	0.000	0.000	0.1630	0.0000	.5053E-08	.3000E-09	0.0000	.0000E+00	.0000E+00
190	0.19	0.000	0.048	0.1749	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
191	0.00	0.000	0.057	0.1701	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
192	0.00	0.000	0.065	0.1647	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
193	0.00	0.000	0.017	0.1632	0.0000	.0000E+00	.0000E+00	0.0000	.3760E-08	.7518E-09
194	0.00	0.000	0.002	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	.1214E-07	.7636E-09
195	0.00	0.000	0.001	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.2052E-07	.7653E-09
196	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.2890E-07	.7660E-09
197	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.3727E-07	.7664E-09
198	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.4564E-07	.7667E-09
199	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.5400E-07	.7669E-09
200	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.6236E-07	.7670E-09
201	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.7072E-07	.7671E-09
202	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.7907E-07	.7672E-09
203	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.8741E-07	.7672E-09
204	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.9576E-07	.7673E-09
205	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1041E-06	.7673E-09
206	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1124E-06	.7674E-09
207	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1208E-06	.7674E-09
208	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1291E-06	.7674E-09
209	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1374E-06	.7675E-09
210	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1457E-06	.7675E-09
211	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1540E-06	.7675E-09
212	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1623E-06	.7675E-09
213	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1706E-06	.7676E-09
214	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1789E-06	.7676E-09
215	0.06	0.000	0.017	0.1665	0.0000	.0000E+00	.0000E+00	0.0000	.1872E-06	.7676E-09
216	0.00	0.000	0.009	0.1658	0.0000	.0000E+00	.0000E+00	0.0000	.1955E-06	.7676E-09
217	0.07	0.000	0.033	0.1688	0.0000	.1027E-07	.3483E-09	0.0000	.2041E-06	.7676E-09
218	0.00	0.000	0.027	0.1666	0.0000	.7545E-07	.7611E-08	0.0000	.2197E-06	.7676E-09
219	0.00	0.000	0.027	0.1643	0.0000	.4888E-09	.1928E-09	0.0000	.2205E-06	.7676E-09
220	0.00	0.000	0.009	0.1636	0.0000	.0000E+00	.0000E+00	0.0000	.2286E-06	.7676E-09
221	0.00	0.000	0.004	0.1632	0.0000	.0000E+00	.0000E+00	0.0000	.2368E-06	.7677E-09
222	0.00	0.000	0.002	0.1631	0.0000	.4223E-04	.1097E-06	0.0000	.3547E-06	.7678E-09
223	0.00	0.000	0.001	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.2532E-06	.7677E-09
224	0.02	0.000	0.017	0.1633	0.0000	.8442E-05	.1694E-07	0.0000	.1524E-04	.7724E-09
225	0.00	0.000	0.002	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	.1528E-04	.7710E-09
226	0.00	0.000	0.001	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1528E-04	.7710E-09
227	0.00	0.000	0.000	0.1630	0.0000	.8966E-08	.8901E-08	0.0000	.1526E-04	.7710E-09
228	0.05	0.000	0.019	0.1656	0.0000	.1217E-09	.1278E-09	0.0000	.1527E-04	.7710E-09
229	0.02	0.000	0.017	0.1658	0.0000	.0000E+00	.0000E+00	0.0000	.1526E-04	.7710E-09
230	0.00	0.000	0.007	0.1652	0.0000	.0000E+00	.0000E+00	0.0000	.1526E-04	.7710E-09
231	0.11	0.000	0.026	0.1722	0.0000	.0000E+00	.0000E+00	0.0000	.1525E-04	.7710E-09
232	2.36	0.171	0.081	0.3479	0.0000	.0000E+00	.0000E+00	0.0000	.1525E-04	.7710E-09
233	0.00	0.000	0.179	0.3317	0.0000	.0000E+00	.0000E+00	0.0000	.1525E-04	.7710E-09
234	1.02	0.004	0.204	0.3873	0.0000	.7476E-03	.5823E-06	0.0000	.1466E-04	.7709E-09
235	0.27	0.000	0.198	0.3540	0.0000	.1146E-02	.8227E-06	0.0000	.1441E-04	.7708E-09
236	0.35	0.000	0.189	0.3542	0.0007	.3286E-01	.2082E-04	0.0000	.1523E-04	.7710E-09
237	0.00	0.000	0.199	0.3292	0.0021	.9434E-01	.4937E-04	0.0000	.1523E-04	.7710E-09
238	0.00	0.000	0.202	0.3014	0.0023	.1034	.5483E-04	0.0000	.1523E-04	.7710E-09
239	0.00	0.000	0.179	0.2794	0.0030	.1322	.6674E-04	0.0000	.1522E-04	.7710E-09
240	0.50	0.000	0.213	0.2983	0.0027	.1188	.6151E-04	0.0000	.1522E-04	.7710E-09
241	0.00	0.000	0.160	0.2812	0.0023	.1009	.5438E-04	0.0000	.1521E-04	.7710E-09
242	0.00	0.000	0.184	0.2629	0.0019	.8509E-01	.4776E-04	0.0000	.1521E-04	.7710E-09
243	0.00	0.000	0.210	0.2440	0.0018	.8024E-01	.4568E-04	0.0000	.1520E-04	.7710E-09
244	0.00	0.000	0.220	0.2257	0.0017	.7383E-01	.4287E-04	0.0000	.1520E-04	.7710E-09
245	0.00	0.000	0.194	0.2095	0.0013	.5719E-01	.3546E-04	0.0000	.1520E-04	.7710E-09
246	0.00	0.000	0.179	0.1946	0.0010	.4656E-01	.3016E-04	0.0000	.1519E-04	.7710E-09
247	0.00	0.000	0.205	0.1774	0.0009	.3918E-01	.2648E-04	0.0000	.1519E-04	.7710E-09
248	0.23	0.000	0.175	0.1820	0.0008	.3378E-01	.2366E-04	0.0000	.1518E-04	.7710E-09

249		0.45	0.000	0.124	0.2076	0.0006	.2104E-01	.1453E-04	0.0000	.1453E-04	.7708E-09
250		0.00	0.000	0.056	0.2029	0.0007	.2962E-01	.2140E-04	0.0000	.1517E-04	.7710E-09
251		0.00	0.000	0.099	0.1947	0.0006	.2615E-01	.1948E-04	0.0000	.1517E-04	.7710E-09
252		0.09	0.000	0.134	0.1910	0.0005	.2357E-01	.1800E-04	0.0000	.1517E-04	.7710E-09
253		0.45	0.000	0.108	0.2195	0.0005	.2144E-01	.1676E-04	0.0000	.1516E-04	.7710E-09
254		0.09	0.000	0.131	0.2161	0.0004	.1965E-01	.1568E-04	0.0000	.1516E-04	.7710E-09
255		0.00	0.000	0.135	0.2048	0.0004	.1808E-01	.1472E-04	0.0000	.1466E-04	.7709E-09
256		0.00	0.000	0.128	0.1941	0.0004	.1679E-01	.1392E-04	0.0000	.1385E-04	.7707E-09
257		0.00	0.000	0.107	0.1852	0.0004	.1570E-01	.1323E-04	0.0000	.1316E-04	.7706E-09
258		0.00	0.000	0.072	0.1791	0.0003	.1470E-01	.1258E-04	0.0000	.1250E-04	.7704E-09
259		0.00	0.000	0.073	0.1731	0.0003	.1382E-01	.1200E-04	0.0000	.1192E-04	.7703E-09
260		0.00	0.000	0.060	0.1681	0.0003	.1303E-01	.1148E-04	0.0000	.1139E-04	.7702E-09
261		0.68	0.000	0.068	0.2191	0.0003	.1233E-01	.1101E-04	0.0000	.1092E-04	.7701E-09
262		0.17	0.000	0.105	0.2245	0.0003	.1169E-01	.1058E-04	0.0000	.1048E-04	.7700E-09
263		0.11	0.000	0.106	0.2248	0.0002	.1112E-01	.1018E-04	0.0000	.1008E-04	.7700E-09
264		0.00	0.000	0.067	0.2192	0.0002	.1060E-01	.9816E-05	0.0000	.9713E-05	.7699E-09
265		0.00	0.000	0.049	0.2151	0.0001	.2631E-02	.2473E-05	0.0000	.2371E-05	.7683E-09
266		0.00	0.000	0.076	0.2087	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
267		0.00	0.000	0.100	0.2003	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
268		0.00	0.000	0.093	0.1926	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
269		0.00	0.000	0.064	0.1873	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
270		0.00	0.000	0.073	0.1812	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
271		0.00	0.000	0.057	0.1765	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
272		0.00	0.000	0.047	0.1726	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
273		0.00	0.000	0.041	0.1691	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
274		0.00	0.000	0.038	0.1659	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
275		0.00	0.000	0.027	0.1637	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
276		0.00	0.000	0.008	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
277		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1263E-10	.2350E-09
278		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.5596E-08	.7587E-09
279		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1401E-07	.7643E-09
280		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.2241E-07	.7656E-09
281		0.10	0.000	0.015	0.1701	0.0000	.0000E+00	.0000E+00	0.0000	.3082E-07	.7662E-09
282		0.00	0.000	0.011	0.1692	0.0000	.0000E+00	.0000E+00	0.0000	.3922E-07	.7665E-09
283		0.00	0.000	0.011	0.1683	0.0000	.0000E+00	.0000E+00	0.0000	.4761E-07	.7668E-09
284		0.00	0.000	0.015	0.1670	0.0000	.0000E+00	.0000E+00	0.0000	.5600E-07	.7669E-09
285		0.00	0.000	0.015	0.1658	0.0000	.0000E+00	.0000E+00	0.0000	.6439E-07	.7670E-09
286		0.00	0.000	0.015	0.1645	0.0000	.0000E+00	.0000E+00	0.0000	.7277E-07	.7671E-09
287		0.00	0.000	0.006	0.1641	0.0000	.0000E+00	.0000E+00	0.0000	.8115E-07	.7672E-09
288		0.00	0.000	0.005	0.1636	0.0000	.0000E+00	.0000E+00	0.0000	.8952E-07	.7673E-09
289		0.00	0.000	0.004	0.1633	0.0000	.0000E+00	.0000E+00	0.0000	.9789E-07	.7673E-09
290		0.00	0.000	0.003	0.1631	0.0000	.2840E-04	.8514E-07	0.0000	.1771E-06	.8720E-09
291		0.00	0.000	0.001	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1288E-06	.7124E-09
292		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1229E-06	.7674E-09
293		0.00	0.000	0.000	0.1630	0.0000	.6206E-06	.1078E-07	0.0000	.1402E-06	.7782E-09
294		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1414E-06	.7582E-09
295		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1479E-06	.7675E-09
296		0.96	0.000	0.025	0.2409	0.0000	.1442E-06	.7772E-08	0.0000	.1627E-06	.7740E-09
297		0.01	0.000	0.040	0.2384	0.0000	.0000E+00	.0000E+00	0.0000	.1659E-06	.7617E-09
298		0.00	0.000	0.039	0.2352	0.0000	.0000E+00	.0000E+00	0.0000	.1729E-06	.7676E-09
299		0.00	0.000	0.047	0.2313	0.0000	.0000E+00	.0000E+00	0.0000	.1812E-06	.7676E-09
300		0.01	0.000	0.052	0.2278	0.0000	.0000E+00	.0000E+00	0.0000	.1895E-06	.7676E-09
301		0.00	0.000	0.039	0.2245	0.0000	.0000E+00	.0000E+00	0.0000	.1978E-06	.7676E-09
302	*	0.00	0.000	0.032	0.2218	0.0000	.0000E+00	.0000E+00	0.0000	.2061E-06	.7676E-09
303	*	0.00	0.000	0.028	0.2195	0.0000	.0000E+00	.0000E+00	0.0000	.2144E-06	.7676E-09
304		0.00	0.000	0.028	0.2172	0.0000	.5420E-08	.3040E-09	0.0000	.2230E-06	.7678E-09
305		0.00	0.000	0.032	0.2145	0.0000	.2471E-06	.2174E-08	0.0000	.2329E-06	.7687E-09
306	*	0.00	0.000	0.025	0.2124	0.0000	.0000E+00	.0000E+00	0.0000	.2397E-06	.7665E-09
307		0.00	0.000	0.027	0.2102	0.0000	.0000E+00	.0000E+00	0.0000	.2476E-06	.7677E-09
308		0.00	0.000	0.030	0.2077	0.0000	.7493E-05	.3516E-07	0.0000	.2852E-06	.7854E-09
309		0.00	0.000	0.029	0.2053	0.0000	.0000E+00	.0000E+00	0.0000	.2700E-06	.7526E-09
310		0.00	0.000	0.029	0.2029	0.0000	.0000E+00	.0000E+00	0.0000	.2724E-06	.7677E-09
311		0.00	0.000	0.028	0.2006	0.0000	.0000E+00	.0000E+00	0.0000	.2807E-06	.7677E-09
312		0.00	0.000	0.026	0.1984	0.0000	.0000E+00	.0000E+00	0.0000	.2889E-06	.7677E-09
313	*	0.28	0.000	0.016	0.2000	0.0000	.0000E+00	.0000E+00	0.0000	.2972E-06	.7677E-09
314		0.00	0.000	0.005	0.2200	0.0000	.0000E+00	.0000E+00	0.0000	.3054E-06	.7677E-09
315		0.50	0.000	0.038	0.2585	0.0000	.0000E+00	.0000E+00	0.0000	.1508E-04	.1955E-08
316		0.16	0.000	0.040	0.2686	0.0000	.0000E+00	.0000E+00	0.0000	.1533E-04	.7710E-09
317	*	0.00	0.000	0.000	0.2686	0.0000	.0000E+00	.0000E+00	0.0000	.1533E-04	.7710E-09
318	*	0.00	0.000	0.023	0.2666	0.0000	.0000E+00	.0000E+00	0.0000	.1532E-04	.7710E-09
319		0.00	0.000	0.030	0.2641	0.0000	.0000E+00	.0000E+00	0.0000	.1532E-04	.7710E-09

320		0.00	0.000	0.034	0.2613	0.0000	.0000E+00	.0000E+00	0.0000	.1532E-04	.7710E-09
321		0.00	0.000	0.025	0.2592	0.0000	.0000E+00	.0000E+00	0.0000	.1531E-04	.7710E-09
322		0.21	0.000	0.033	0.2739	0.0000	.0000E+00	.0000E+00	0.0000	.1531E-04	.7710E-09
323		0.78	0.000	0.042	0.3355	0.0000	.0000E+00	.0000E+00	0.0000	.1530E-04	.7710E-09
324		1.11	0.079	0.040	0.3959	0.0000	.2885E-03	.2444E-06	0.0000	.1505E-04	.7709E-09
325		0.00	0.000	0.029	0.3430	0.0000	.1990E-02	.1452E-05	0.0000	.1384E-04	.7707E-09
326		0.00	0.000	0.030	0.3257	0.0037	.1646	.7830E-04	0.0000	.1529E-04	.7710E-09
327	*	0.00	0.000	0.000	0.3173	0.0041	.1848	.8608E-04	0.0000	.1529E-04	.7710E-09
328	*	0.00	0.000	0.000	0.3114	0.0032	.1420	.7045E-04	0.0000	.1528E-04	.7710E-09
329		0.00	0.000	0.022	0.3048	0.0025	.1138	.5958E-04	0.0000	.1528E-04	.7710E-09
330	*	0.00	0.000	0.019	0.2997	0.0022	.9612E-01	.5238E-04	0.0000	.1527E-04	.7710E-09
331		0.00	0.000	0.027	0.2944	0.0018	.7867E-01	.4498E-04	0.0000	.1527E-04	.7710E-09
332		0.00	0.000	0.034	0.2889	0.0015	.6711E-01	.3989E-04	0.0000	.1527E-04	.7710E-09
333		0.17	0.000	0.048	0.2963	0.0013	.5693E-01	.3532E-04	0.0000	.1526E-04	.7710E-09
334		0.03	0.000	0.042	0.2931	0.0012	.5394E-01	.3285E-04	0.0000	.1526E-04	.7710E-09
335		0.03	0.000	0.042	0.2902	0.0011	.4977E-01	.3168E-04	0.0000	.1525E-04	.7710E-09
336		0.00	0.000	0.034	0.2862	0.0011	.5016E-01	.3197E-04	0.0000	.1525E-04	.7710E-09
337		0.00	0.000	0.041	0.2819	0.0010	.4670E-01	.3022E-04	0.0000	.1524E-04	.7710E-09
338		0.00	0.000	0.024	0.2798	0.0010	.4629E-01	.3005E-04	0.0000	.1524E-04	.7710E-09
339	*	0.00	0.000	0.000	0.2798	0.0009	.3995E-01	.2687E-04	0.0000	.1524E-04	.7710E-09
340	*	0.00	0.000	0.020	0.2781	0.0008	.3435E-01	.2396E-04	0.0000	.1523E-04	.7710E-09
341		0.00	0.000	0.021	0.2764	0.0007	.3010E-01	.2168E-04	0.0000	.1523E-04	.7710E-09
342	*	0.00	0.000	0.000	0.2764	0.0006	.2675E-01	.1982E-04	0.0000	.1522E-04	.7710E-09
343	*	0.00	0.000	0.000	0.2764	0.0005	.2406E-01	.1829E-04	0.0000	.1522E-04	.7710E-09
344	*	0.00	0.000	0.000	0.2764	0.0005	.2185E-01	.1700E-04	0.0000	.1521E-04	.7710E-09
345	*	0.00	0.000	0.000	0.2764	0.0004	.2000E-01	.1589E-04	0.0000	.1521E-04	.7710E-09
346	* *	0.00	0.000	0.000	0.2764	0.0004	.1843E-01	.1494E-04	0.0000	.1490E-04	.7709E-09
347	* *	0.05	0.000	0.008	0.2764	0.0004	.1708E-01	.1410E-04	0.0000	.1406E-04	.7707E-09
348	* *	0.10	0.000	0.011	0.2764	0.0004	.1591E-01	.1336E-04	0.0000	.1331E-04	.7706E-09
349	* *	0.00	0.000	0.009	0.2764	0.0003	.1489E-01	.1270E-04	0.0000	.1265E-04	.7705E-09
350	* *	0.00	0.000	0.011	0.2764	0.0003	.1398E-01	.1211E-04	0.0000	.1205E-04	.7704E-09
351	* *	0.00	0.000	0.018	0.2764	0.0003	.1318E-01	.1158E-04	0.0000	.1152E-04	.7703E-09
352	* *	0.00	0.000	0.012	0.2764	0.0003	.1246E-01	.1110E-04	0.0000	.1103E-04	.7702E-09
353	* *	0.08	0.000	0.008	0.2764	0.0003	.1181E-01	.1066E-04	0.0000	.1059E-04	.7701E-09
354	* *	0.00	0.000	0.011	0.2764	0.0003	.1123E-01	.1026E-04	0.0000	.1018E-04	.7700E-09
355	* *	0.00	0.000	0.013	0.2764	0.0002	.1070E-01	.9886E-05	0.0000	.9806E-05	.7699E-09
356	* *	0.00	0.000	0.017	0.2764	0.0001	.4693E-02	.4389E-05	0.0000	.4310E-05	.7688E-09
357	* *	0.00	0.000	0.020	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
358	* *	0.00	0.000	0.018	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
359	* *	0.00	0.000	0.015	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
360	* *	0.00	0.000	0.011	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
361	* *	0.00	0.000	0.009	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
362	* *	0.00	0.000	0.007	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
363	* *	0.02	0.000	0.011	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
364	* *	0.00	0.000	0.020	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
365	* *	0.00	0.000	0.020	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

****

****

MONTHLY TOTALS (IN INCHES) FOR YEAR 1975

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.39	0.40	1.75	3.69	3.02	5.78
	0.21	4.83	2.27	1.08	3.24	0.28
RUNOFF	0.000	0.000	2.338	0.050	0.000	0.000
	0.000	0.175	0.000	0.000	0.079	0.000
EVAPOTRANSPIRATION	0.208	0.411	0.240	2.972	4.447	4.358

	1.690	2.419	3.149	0.503	0.802	0.433
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.7146	0.8620	0.0390
FROM LAYER 3	0.0847	0.7499	0.5325	0.0000	0.9603	0.5344
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0004	0.0006	0.0000
LAYER 4	0.0001	0.0004	0.0004	0.0000	0.0005	0.0004
LATERAL DRAINAGE COLLECTED	0.0002	0.0000	0.0000	0.0000	0.0001	0.0000
FROM LAYER 8	0.0001	0.0003	0.0003	0.0000	0.0003	0.0003
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.001	0.001	0.000
TOP OF LAYER 4	0.000	0.001	0.000	0.000	0.001	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.001	0.001	0.000
HEAD ON TOP OF LAYER 4	0.000	0.001	0.000	0.000	0.001	0.000
AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 9	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 9	0.000	0.000	0.000	0.000	0.000	0.000

****

****

ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.94	3571775.500	100.00
RUNOFF	2.642	326082.500	9.13
EVAPOTRANSPIRATION	21.633	2669964.500	74.75
DRAINAGE COLLECTED FROM LAYER 3	4.4774	552598.062	15.47
PERC./LEAKAGE THROUGH LAYER 4	0.002824	348.523	0.01
AVG. HEAD ON TOP OF LAYER 4	0.0003		
DRAINAGE COLLECTED FROM LAYER 8	0.0016	192.942	0.01
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.019	0.00

AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	0.186	22936.918	0.64
SOIL WATER AT START OF YEAR	110.308	13614214.000	
SOIL WATER AT END OF YEAR	110.494	13637151.000	
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	0.601	0.00

****

WARNING: TEMPERATURE FOR YEAR 3 USED WITH PRECIPITATION FOR YEAR 1976

WARNING: SOLAR RADIATION FOR YEAR 3 USED WITH PRECIPITATION FOR YEAR 1976

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 9
DRAIN #2: LATERAL DRAINAGE FROM LAYER 8 (RECIRCULATION AND COLLECTION)
LEAK #2: PERCOLATION OR LEAKAGE THROUGH LAYER 10

****

DAILY OUTPUT FOR YEAR 1976

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	*	*	0.17	0.000	0.021	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.2948E-08	.7439E-09
2	*	*	0.12	0.000	0.024	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.1139E-07	.7637E-09
3	*	*	0.00	0.000	0.019	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.1984E-07	.7655E-09
4	*	*	0.00	0.000	0.020	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.2828E-07	.7661E-09
5	*	*	0.00	0.000	0.015	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.3673E-07	.7665E-09
6	*	*	0.05	0.000	0.018	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.4517E-07	.7668E-09
7	*	*	0.00	0.000	0.016	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.5360E-07	.7669E-09
8	*	*	0.00	0.000	0.010	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.6203E-07	.7671E-09
9	*	*	0.00	0.000	0.008	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.7045E-07	.7672E-09
10	*	*	0.32	0.000	0.011	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.7887E-07	.7672E-09
11	*	*	0.00	0.000	0.017	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.8729E-07	.7673E-09
12	*	*	0.00	0.000	0.017	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.9570E-07	.7673E-09
13	*	*	0.00	0.000	0.015	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.1041E-06	.7674E-09
14	*	*	0.00	0.000	0.019	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.1125E-06	.7674E-09
15	*	*	0.06	0.000	0.016	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.1209E-06	.7674E-09

16	*	*	0.00	0.000	0.019	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.1293E-06	.7675E-09
17	*	*	0.00	0.000	0.017	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.1377E-06	.7675E-09
18	*	*	0.00	0.000	0.015	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.1461E-06	.7675E-09
19	*	*	0.00	0.000	0.014	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.1544E-06	.7675E-09
20	*	*	0.13	0.000	0.000	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.1628E-06	.7676E-09
21	*	*	0.00	0.000	0.018	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.1712E-06	.7676E-09
22	*	*	0.00	0.000	0.019	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.1795E-06	.7676E-09
23	*	*	0.00	0.000	0.015	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.1879E-06	.7676E-09
24	*	*	0.00	0.000	0.019	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.1963E-06	.7676E-09
25	*	*	0.00	0.000	0.012	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.2046E-06	.7676E-09
26	*	*	0.00	0.000	0.011	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.2130E-06	.7676E-09
27	*	*	0.00	0.000	0.011	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.2213E-06	.7677E-09
28	*	*	0.00	0.000	0.015	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.2296E-06	.7677E-09
29	*	*	0.00	0.000	0.012	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.2380E-06	.7677E-09
30	*	*	0.00	0.000	0.000	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.2463E-06	.7677E-09
31	*	*	0.00	0.000	0.024	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.2546E-06	.7677E-09
32	*	*	0.00	0.000	0.026	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.2629E-06	.7677E-09
33	*	*	0.00	0.000	0.023	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.2712E-06	.7677E-09
34	*	*	0.18	0.000	0.018	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.2796E-06	.7677E-09
35	*	*	0.00	0.000	0.018	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.2879E-06	.7677E-09
36	*	*	0.01	0.000	0.016	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.2962E-06	.7677E-09
37	*	*	0.00	0.000	0.025	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.3044E-06	.7677E-09
38	*	*	0.00	0.000	0.019	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.3127E-06	.7677E-09
39	*	*	0.00	0.000	0.022	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.3210E-06	.7678E-09
40	*	*	0.00	0.000	0.015	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.3293E-06	.7678E-09
41	*	*	0.05	0.000	0.000	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.3376E-06	.7678E-09
42	*	*	0.00	0.000	0.020	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.3458E-06	.7678E-09
43	*	*	0.00	0.000	0.025	0.2764	0.0000	.0000E+00	.0000E+00	0.0000	.3541E-06	.7678E-09
44		*	0.00	0.087	0.005	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.3624E-06	.7678E-09
45	*	*	0.53	0.000	0.021	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.3706E-06	.7678E-09
46	*	*	0.00	0.000	0.026	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.3789E-06	.7678E-09
47	*	*	0.03	0.000	0.017	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.3871E-06	.7678E-09
48	*	*	0.00	0.000	0.014	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1392E-04	.9499E-09
49	*	*	0.00	0.000	0.019	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1541E-04	.7710E-09
50	*	*	0.03	0.000	0.013	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1541E-04	.7710E-09
51	*	*	0.00	0.000	0.014	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1541E-04	.7710E-09
52	*	*	0.00	0.000	0.015	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1540E-04	.7710E-09
53	*	*	0.00	0.000	0.021	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1540E-04	.7710E-09
54	*	*	0.00	0.000	0.016	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1539E-04	.7710E-09
55	*	*	0.00	0.000	0.013	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1539E-04	.7710E-09
56	*	*	0.00	0.000	0.014	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1538E-04	.7710E-09
57	*	*	0.00	0.000	0.021	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1538E-04	.7710E-09
58	*	*	0.00	0.000	0.024	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1538E-04	.7710E-09
59	*	*	0.00	0.000	0.026	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1537E-04	.7710E-09
60	*	*	0.00	0.000	0.023	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1537E-04	.7710E-09
61	*	*	0.29	0.000	0.019	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1536E-04	.7710E-09
62	*	*	0.00	0.000	0.013	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1536E-04	.7710E-09
63		*	0.00	0.000	0.029	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1535E-04	.7710E-09
64	*	*	0.18	0.000	0.021	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1535E-04	.7710E-09
65	*	*	0.08	0.000	0.015	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1535E-04	.7710E-09
66	*	*	0.00	0.000	0.025	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1534E-04	.7710E-09
67	*	*	0.00	0.000	0.022	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1534E-04	.7710E-09
68	*	*	0.00	0.000	0.023	0.2956	0.0000	.0000E+00	.0000E+00	0.0000	.1533E-04	.7710E-09
69		*	0.03	0.491	0.000	0.3198	0.0000	.0000E+00	.0000E+00	0.0000	.1533E-04	.7710E-09
70	*	*	0.00	0.000	0.000	0.3198	0.0000	.0000E+00	.0000E+00	0.0000	.1532E-04	.7710E-09
71	*	*	0.35	0.000	0.016	0.3198	0.0000	.0000E+00	.0000E+00	0.0000	.1532E-04	.7710E-09
72	*	*	0.43	0.000	0.007	0.3198	0.0000	.0000E+00	.0000E+00	0.0000	.1532E-04	.7710E-09
73	*	*	0.00	0.000	0.019	0.3198	0.0000	.0000E+00	.0000E+00	0.0000	.1531E-04	.7710E-09
74	*	*	0.00	0.000	0.016	0.3198	0.0000	.0000E+00	.0000E+00	0.0000	.1531E-04	.7710E-09
75	*	*	0.02	0.000	0.000	0.3198	0.0000	.0000E+00	.0000E+00	0.0000	.1530E-04	.7710E-09
76	*	*	0.00	0.000	0.017	0.3198	0.0000	.0000E+00	.0000E+00	0.0000	.1530E-04	.7710E-09
77	*	*	0.00	0.000	0.022	0.3198	0.0000	.0000E+00	.0000E+00	0.0000	.1529E-04	.7710E-09
78	*	*	0.00	0.000	0.027	0.3198	0.0000	.0000E+00	.0000E+00	0.0000	.1529E-04	.7710E-09
79	*	*	0.00	0.000	0.025	0.3198	0.0000	.0000E+00	.0000E+00	0.0000	.1529E-04	.7710E-09
80	*	*	0.00	0.000	0.031	0.3198	0.0000	.0000E+00	.0000E+00	0.0000	.1528E-04	.7710E-09
81	*	*	0.00	0.000	0.023	0.3198	0.0000	.0000E+00	.0000E+00	0.0000	.1528E-04	.7710E-09
82	*	*	0.00	0.000	0.031	0.3198	0.0000	.0000E+00	.0000E+00	0.0000	.1527E-04	.7710E-09
83	*	*	0.00	0.000	0.024	0.3198	0.0000	.0000E+00	.0000E+00	0.0000	.1527E-04	.7710E-09
84		*	0.01	0.348	0.000	0.3368	0.0000	.0000E+00	.0000E+00	0.0000	.1526E-04	.7710E-09
85		*	0.00	0.000	0.000	0.3368	0.0000	.0000E+00	.0000E+00	0.0000	.1526E-04	.7710E-09
86	*	*	0.02	0.000	0.020	0.3368	0.0000	.0000E+00	.0000E+00	0.0000	.1526E-04	.7710E-09

87	*	*	0.00	0.000	0.000	0.3368	0.0000	.0000E+00	.0000E+00	0.0000	.1525E-04	.7710E-09
88	*	*	0.29	0.000	0.015	0.3368	0.0000	.0000E+00	.0000E+00	0.0000	.1525E-04	.7710E-09
89	*	*	0.08	0.000	0.000	0.3368	0.0000	.0000E+00	.0000E+00	0.0000	.1524E-04	.7710E-09
90	*	*	0.00	0.000	0.032	0.3368	0.0000	.0000E+00	.0000E+00	0.0000	.1524E-04	.7710E-09
91		*	0.00	0.036	0.030	0.3429	0.0000	.0000E+00	.0000E+00	0.0000	.1523E-04	.7710E-09
92		*	0.00	0.070	0.057	0.3475	0.0000	.0000E+00	.0000E+00	0.0000	.1523E-04	.7710E-09
93		*	0.00	0.000	0.000	0.3475	0.0000	.0000E+00	.0000E+00	0.0000	.1523E-04	.7710E-09
94	*	*	0.16	0.000	0.081	0.3475	0.0000	.0000E+00	.0000E+00	0.0000	.1522E-04	.7710E-09
95		*	0.00	0.000	0.079	0.3475	0.0000	.0000E+00	.0000E+00	0.0000	.1522E-04	.7710E-09
96	*	*	0.00	0.000	0.000	0.3475	0.0000	.0000E+00	.0000E+00	0.0000	.1521E-04	.7710E-09
97		*	0.00	0.000	0.000	0.3475	0.0000	.0000E+00	.0000E+00	0.0000	.1521E-04	.7710E-09
98	*	*	0.00	0.000	0.000	0.3475	0.0000	.0000E+00	.0000E+00	0.0000	.1520E-04	.7710E-09
99		*	0.00	0.000	0.000	0.3475	0.0000	.0000E+00	.0000E+00	0.0000	.1520E-04	.7710E-09
100		*	0.00	0.000	0.000	0.3475	0.0000	.0000E+00	.0000E+00	0.0000	.1520E-04	.7710E-09
101		*	0.04	0.000	0.005	0.3504	0.0000	.0000E+00	.0000E+00	0.0000	.1519E-04	.7710E-09
102		*	0.00	0.000	0.000	0.3504	0.0000	.0000E+00	.0000E+00	0.0000	.1519E-04	.7710E-09
103		*	0.00	0.000	0.000	0.3504	0.0000	.0000E+00	.0000E+00	0.0000	.1518E-04	.7710E-09
104		*	0.00	0.000	0.000	0.3504	0.0000	.0000E+00	.0000E+00	0.0000	.1518E-04	.7710E-09
105		*	0.49	0.347	0.005	0.3618	0.0000	.0000E+00	.0000E+00	0.0000	.1518E-04	.7710E-09
106		*	0.00	0.000	0.000	0.3618	0.0000	.0000E+00	.0000E+00	0.0000	.1517E-04	.7710E-09
107		*	0.06	0.008	0.005	0.3657	0.0000	.0000E+00	.0000E+00	0.0000	.1517E-04	.7710E-09
108		*	0.00	0.000	0.000	0.3657	0.0000	.0000E+00	.0000E+00	0.0000	.1516E-04	.7710E-09
109		*	0.00	0.000	0.000	0.3657	0.0000	.0000E+00	.0000E+00	0.0000	.1516E-04	.7710E-09
110		*	0.00	0.000	0.000	0.3657	0.0000	.0000E+00	.0000E+00	0.0000	.1515E-04	.7710E-09
111		*	0.00	0.000	0.000	0.3657	0.0000	.0000E+00	.0000E+00	0.0000	.1515E-04	.7710E-09
112			0.00	0.000	0.185	0.3321	0.0000	.0000E+00	.0000E+00	0.0000	.1515E-04	.7710E-09
113			0.00	0.000	0.149	0.3066	0.0000	.0000E+00	.0000E+00	0.0000	.1514E-04	.7710E-09
114			0.13	0.000	0.177	0.2953	0.0000	.0000E+00	.0000E+00	0.0000	.1514E-04	.7710E-09
115			0.00	0.000	0.206	0.2725	0.0003	.1169E-01	.9989E-05	0.0000	.1009E-04	.7700E-09
116			0.00	0.000	0.167	0.2556	0.0011	.5091E-01	.3164E-04	0.0000	.1513E-04	.7710E-09
117			0.00	0.000	0.187	0.2374	0.0011	.4756E-01	.3056E-04	0.0000	.1513E-04	.7710E-09
118			0.00	0.000	0.212	0.2175	0.0011	.4802E-01	.3087E-04	0.0000	.1512E-04	.7710E-09
119			0.00	0.000	0.205	0.1999	0.0013	.5853E-01	.3590E-04	0.0000	.1512E-04	.7710E-09
120			0.00	0.000	0.159	0.1867	0.0012	.5213E-01	.3280E-04	0.0000	.1512E-04	.7710E-09
121			0.04	0.000	0.085	0.1830	0.0010	.4311E-01	.2846E-04	0.0000	.1511E-04	.7710E-09
122			0.00	0.000	0.061	0.1779	0.0008	.3669E-01	.2519E-04	0.0000	.1511E-04	.7710E-09
123			0.01	0.000	0.054	0.1742	0.0007	.3189E-01	.2265E-04	0.0000	.1510E-04	.7710E-09
124			0.00	0.000	0.045	0.1683	0.0002	.1030E-01	.7471E-05	0.0000	.7476E-05	.7694E-09
125			0.00	0.000	0.041	0.1649	0.0007	.2947E-01	.2117E-04	0.0000	.1510E-04	.7710E-09
126			0.01	0.000	0.025	0.1637	0.0006	.2673E-01	.1981E-04	0.0000	.1509E-04	.7710E-09
127			0.00	0.000	0.004	0.1633	0.0005	.2405E-01	.1828E-04	0.0000	.1509E-04	.7710E-09
128			0.00	0.000	0.003	0.1631	0.0005	.2183E-01	.1699E-04	0.0000	.1509E-04	.7710E-09
129			0.00	0.000	0.001	0.1630	0.0004	.1999E-01	.1589E-04	0.0000	.1508E-04	.7710E-09
130			0.00	0.000	0.000	0.1630	0.0004	.1841E-01	.1493E-04	0.0000	.1488E-04	.7709E-09
131			0.00	0.000	0.000	0.1630	0.0004	.1707E-01	.1410E-04	0.0000	.1404E-04	.7707E-09
132			0.00	0.000	0.000	0.1630	0.0004	.1591E-01	.1336E-04	0.0000	.1330E-04	.7706E-09
133			0.00	0.000	0.000	0.1630	0.0003	.1488E-01	.1270E-04	0.0000	.1264E-04	.7705E-09
134			0.01	0.000	0.006	0.1633	0.0003	.1398E-01	.1211E-04	0.0000	.1204E-04	.7704E-09
135			0.00	0.000	0.002	0.1631	0.0003	.1318E-01	.1158E-04	0.0000	.1150E-04	.7702E-09
136			0.00	0.000	0.001	0.1631	0.0003	.1246E-01	.1110E-04	0.0000	.1102E-04	.7702E-09
137			0.00	0.000	0.000	0.1630	0.0003	.1181E-01	.1066E-04	0.0000	.1057E-04	.7701E-09
138			0.00	0.000	0.000	0.1630	0.0003	.1123E-01	.1025E-04	0.0000	.1017E-04	.7700E-09
139			0.00	0.000	0.000	0.1630	0.0002	.1070E-01	.9884E-05	0.0000	.9795E-05	.7699E-09
140			0.00	0.000	0.000	0.1630	0.0001	.4635E-02	.4336E-05	0.0000	.4247E-05	.7688E-09
141			0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
142			0.02	0.000	0.006	0.1641	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
143			0.00	0.000	0.002	0.1640	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
144			0.00	0.000	0.003	0.1637	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
145			0.00	0.000	0.003	0.1634	0.0000	.2021E-06	.1097E-07	0.0000	.0000E+00	.0000E+00
146			0.00	0.000	0.003	0.1632	0.0000	.5549E-08	.3054E-09	0.0000	.0000E+00	.0000E+00
147			0.00	0.000	0.001	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
148			0.84	0.000	0.013	0.2320	0.0000	.5646E-07	.1511E-08	0.0000	.0000E+00	.0000E+00
149			0.04	0.000	0.020	0.2337	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
150			0.00	0.000	0.015	0.2324	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
151			0.00	0.000	0.015	0.2312	0.0000	.3428E-07	.5052E-09	0.0000	.1058E-08	.4882E-09
152			0.00	0.000	0.017	0.2298	0.0000	.0000E+00	.0000E+00	0.0000	.8090E-08	.7513E-09
153			0.00	0.000	0.017	0.2284	0.0000	.0000E+00	.0000E+00	0.0000	.1632E-07	.7645E-09
154			0.00	0.000	0.017	0.2270	0.0000	.0000E+00	.0000E+00	0.0000	.2464E-07	.7656E-09
155			0.00	0.000	0.017	0.2256	0.0000	.0000E+00	.0000E+00	0.0000	.3296E-07	.7661E-09
156			0.00	0.000	0.017	0.2241	0.0000	.0000E+00	.0000E+00	0.0000	.4127E-07	.7665E-09
157			0.00	0.000	0.017	0.2228	0.0000	.0000E+00	.0000E+00	0.0000	.4958E-07	.7667E-09

158	0.00	0.000	0.017	0.2213	0.0000	.0000E+00	.0000E+00	0.0000	.5789E-07	.7669E-09
159	0.00	0.000	0.017	0.2199	0.0000	.0000E+00	.0000E+00	0.0000	.6618E-07	.7670E-09
160	0.00	0.000	0.016	0.2185	0.0000	.0000E+00	.0000E+00	0.0000	.7448E-07	.7671E-09
161	1.28	0.002	0.023	0.3231	0.0000	.0000E+00	.0000E+00	0.0000	.8277E-07	.7672E-09
162	0.00	0.000	0.196	0.3068	0.0000	.0000E+00	.0000E+00	0.0000	.9106E-07	.7672E-09
163	0.00	0.000	0.169	0.2927	0.0000	.0000E+00	.0000E+00	0.0000	.9934E-07	.7673E-09
164	0.57	0.000	0.209	0.3229	0.0000	.0000E+00	.0000E+00	0.0000	.1076E-06	.7673E-09
165	0.00	0.000	0.218	0.3029	0.0000	.8387E-03	.8941E-06	0.0000	.8565E-06	.5980E-08
166	0.00	0.000	0.184	0.2841	0.0000	.0000E+00	.0000E+00	0.0000	.2689E-06	.4071E-08
167	0.04	0.000	0.237	0.2650	0.0000	.6338E-03	.4880E-06	0.0000	.5340E-06	.4688E-08
168	0.02	0.000	0.209	0.2484	0.0002	.8636E-02	.7615E-05	0.0000	.7853E-05	.2119E-08
169	0.13	0.000	0.264	0.2359	0.0001	.4704E-02	.3883E-05	0.0000	.4021E-05	.7687E-09
170	0.00	0.000	0.199	0.2194	0.0004	.1570E-01	.1322E-04	0.0000	.1336E-04	.7706E-09
171	0.00	0.000	0.078	0.2129	0.0003	.1470E-01	.1258E-04	0.0000	.1271E-04	.7705E-09
172	0.00	0.000	0.069	0.2071	0.0003	.1382E-01	.1200E-04	0.0000	.1213E-04	.7704E-09
173	0.00	0.000	0.068	0.2015	0.0003	.1303E-01	.1148E-04	0.0000	.1160E-04	.7703E-09
174	0.00	0.000	0.063	0.1962	0.0003	.1233E-01	.1101E-04	0.0000	.1113E-04	.7702E-09
175	0.00	0.000	0.056	0.1916	0.0003	.1169E-01	.1058E-04	0.0000	.1069E-04	.7701E-09
176	1.61	0.017	0.057	0.3195	0.0002	.1112E-01	.1018E-04	0.0000	.1029E-04	.7700E-09
177	0.00	0.000	0.280	0.2962	0.0002	.1060E-01	.9815E-05	0.0000	.9923E-05	.7699E-09
178	0.93	0.000	0.262	0.3518	0.0001	.2611E-02	.2453E-05	0.0000	.2561E-05	.7684E-09
179	0.00	0.000	0.215	0.3299	0.0000	.0000E+00	.0000E+00	0.0000	.1158E-06	.7674E-09
180	0.23	0.000	0.229	0.3181	0.0000	.0000E+00	.0000E+00	0.0000	.1240E-06	.7674E-09
181	0.03	0.000	0.202	0.2964	0.0000	.0000E+00	.0000E+00	0.0000	.1323E-06	.7674E-09
182	0.00	0.000	0.170	0.2771	0.0000	.9614E-03	.7782E-06	0.0000	.1367E-05	.1142E-08
183	0.42	0.000	0.111	0.2998	0.0002	.9086E-02	.8674E-05	0.0000	.8817E-05	.7697E-09
184	0.00	0.000	0.223	0.2783	0.0003	.1504E-01	.1245E-04	0.0000	.1259E-04	.7705E-09
185	0.00	0.000	0.232	0.2571	0.0006	.2899E-01	.2105E-04	0.0000	.1517E-04	.7710E-09
186	0.00	0.000	0.233	0.2377	0.0010	.4610E-01	.2993E-04	0.0000	.1516E-04	.7710E-09
187	0.00	0.000	0.179	0.2228	0.0009	.3909E-01	.2643E-04	0.0000	.1516E-04	.7710E-09
188	0.03	0.000	0.249	0.2046	0.0008	.3371E-01	.2362E-04	0.0000	.1515E-04	.7710E-09
189	0.00	0.000	0.240	0.1845	0.0007	.2960E-01	.2140E-04	0.0000	.1515E-04	.7710E-09
190	0.00	0.000	0.155	0.1716	0.0006	.2636E-01	.1960E-04	0.0000	.1515E-04	.7710E-09
191	0.00	0.000	0.069	0.1630	0.0004	.1722E-01	.1281E-04	0.0000	.1288E-04	.7705E-09
192	0.00	0.000	0.000	0.1630	0.0006	.2542E-01	.1907E-04	0.0000	.1514E-04	.7710E-09
193	0.00	0.000	0.000	0.1630	0.0005	.2297E-01	.1766E-04	0.0000	.1513E-04	.7710E-09
194	0.02	0.000	0.018	0.1632	0.0005	.2094E-01	.1646E-04	0.0000	.1513E-04	.7710E-09
195	0.00	0.000	0.001	0.1631	0.0004	.1923E-01	.1543E-04	0.0000	.1513E-04	.7710E-09
196	0.00	0.000	0.001	0.1630	0.0004	.1777E-01	.1453E-04	0.0000	.1456E-04	.7708E-09
197	0.60	0.000	0.049	0.2090	0.0004	.1651E-01	.1374E-04	0.0000	.1376E-04	.7707E-09
198	0.00	0.000	0.069	0.2032	0.0003	.1541E-01	.1304E-04	0.0000	.1306E-04	.7706E-09
199	0.00	0.000	0.074	0.1970	0.0003	.1445E-01	.1242E-04	0.0000	.1243E-04	.7704E-09
200	0.00	0.000	0.086	0.1898	0.0003	.1359E-01	.1186E-04	0.0000	.1186E-04	.7703E-09
201	0.07	0.000	0.107	0.1868	0.0003	.1283E-01	.1135E-04	0.0000	.1135E-04	.7702E-09
202	0.00	0.000	0.083	0.1799	0.0003	.1215E-01	.1089E-04	0.0000	.1088E-04	.7701E-09
203	0.00	0.000	0.112	0.1705	0.0003	.1153E-01	.1047E-04	0.0000	.1046E-04	.7700E-09
204	0.00	0.000	0.065	0.1651	0.0002	.1097E-01	.1008E-04	0.0000	.1007E-04	.7700E-09
205	0.36	0.000	0.078	0.1886	0.0002	.1029E-01	.9577E-05	0.0000	.9562E-05	.7699E-09
206	0.00	0.000	0.114	0.1790	0.0000	.9904E-03	.1181E-05	0.0000	.1169E-05	.7680E-09
207	0.06	0.000	0.102	0.1755	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
208	0.00	0.000	0.102	0.1670	0.0000	.0000E+00	.0000E+00	0.0000	.3615E-08	.7498E-09
209	0.15	0.000	0.047	0.1756	0.0000	.0000E+00	.0000E+00	0.0000	.1194E-07	.7633E-09
210	0.00	0.000	0.055	0.1711	0.0000	.0000E+00	.0000E+00	0.0000	.2027E-07	.7651E-09
211	0.21	0.000	0.064	0.1832	0.0000	.3662E-05	.9089E-08	0.0000	.3768E-07	.7664E-09
212	0.00	0.000	0.100	0.1749	0.0000	.0000E+00	.0000E+00	0.0000	.3691E-07	.7663E-09
213	0.00	0.000	0.087	0.1676	0.0000	.0000E+00	.0000E+00	0.0000	.4523E-07	.7666E-09
214	0.00	0.000	0.041	0.1642	0.0000	.0000E+00	.0000E+00	0.0000	.5354E-07	.7668E-09
215	0.00	0.000	0.012	0.1632	0.0000	.3917E-04	.8658E-07	0.0000	.1484E-06	.7675E-09
216	0.00	0.000	0.002	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	.7006E-07	.7670E-09
217	0.06	0.000	0.022	0.1662	0.0000	.2004E-04	.3241E-07	0.0000	.1108E-06	.7673E-09
218	0.00	0.000	0.010	0.1654	0.0000	.0000E+00	.0000E+00	0.0000	.8663E-07	.7672E-09
219	0.00	0.000	0.022	0.1636	0.0000	.0000E+00	.0000E+00	0.0000	.9492E-07	.7673E-09
220	0.00	0.000	0.006	0.1631	0.0000	.1534E-06	.8251E-08	0.0000	.1115E-06	.7673E-09
221	0.00	0.000	0.001	0.1630	0.0000	.5663E-08	.3066E-09	0.0000	.1118E-06	.7673E-09
222	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1198E-06	.7674E-09
223	0.15	0.000	0.024	0.1735	0.0000	.0000E+00	.0000E+00	0.0000	.1280E-06	.7674E-09
224	0.02	0.000	0.067	0.1695	0.0000	.0000E+00	.0000E+00	0.0000	.1363E-06	.7674E-09
225	0.00	0.000	0.051	0.1653	0.0000	.0000E+00	.0000E+00	0.0000	.1446E-06	.7675E-09
226	0.14	0.000	0.036	0.1740	0.0000	.0000E+00	.0000E+00	0.0000	.1528E-06	.7675E-09
227	0.00	0.000	0.065	0.1686	0.0000	.0000E+00	.0000E+00	0.0000	.8339E-05	.3284E-08
228	0.00	0.000	0.051	0.1643	0.0000	.0000E+00	.0000E+00	0.0000	.1518E-04	.7710E-09

229		0.00	0.000	0.010	0.1634	0.0000	.0000E+00	.0000E+00	0.0000	.1518E-04	.7710E-09
230		0.00	0.000	0.004	0.1632	0.0000	.0000E+00	.0000E+00	0.0000	.1517E-04	.7710E-09
231		0.00	0.000	0.001	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	.1517E-04	.7710E-09
232		0.00	0.000	0.001	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1517E-04	.7710E-09
233		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1516E-04	.7710E-09
234		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1516E-04	.7710E-09
235		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1515E-04	.7710E-09
236		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1515E-04	.7710E-09
237		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1515E-04	.7710E-09
238		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1514E-04	.7710E-09
239		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1514E-04	.7710E-09
240		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1513E-04	.7710E-09
241		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1513E-04	.7710E-09
242		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1512E-04	.7710E-09
243		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1512E-04	.7710E-09
244		0.23	0.000	0.050	0.1780	0.0000	.0000E+00	.0000E+00	0.0000	.1512E-04	.7710E-09
245		0.00	0.000	0.028	0.1757	0.0000	.0000E+00	.0000E+00	0.0000	.1511E-04	.7710E-09
246		0.02	0.000	0.046	0.1735	0.0000	.0000E+00	.0000E+00	0.0000	.1511E-04	.7710E-09
247		0.00	0.000	0.047	0.1696	0.0000	.0000E+00	.0000E+00	0.0000	.1510E-04	.7710E-09
248		0.00	0.000	0.046	0.1658	0.0000	.0000E+00	.0000E+00	0.0000	.1510E-04	.7710E-09
249		0.00	0.000	0.025	0.1637	0.0000	.0000E+00	.0000E+00	0.0000	.1510E-04	.7710E-09
250		0.00	0.000	0.006	0.1633	0.0000	.0000E+00	.0000E+00	0.0000	.1509E-04	.7710E-09
251		0.00	0.000	0.002	0.1631	0.0000	.3112E-04	.9326E-07	0.0000	.1501E-04	.7702E-09
252		0.17	0.000	0.021	0.1755	0.0000	.0000E+00	.0000E+00	0.0000	.1507E-04	.7717E-09
253		0.00	0.000	0.019	0.1739	0.0000	.0000E+00	.0000E+00	0.0000	.1508E-04	.7710E-09
254		0.00	0.000	0.027	0.1717	0.0000	.0000E+00	.0000E+00	0.0000	.1507E-04	.7710E-09
255		0.00	0.000	0.029	0.1692	0.0000	.0000E+00	.0000E+00	0.0000	.1507E-04	.7710E-09
256		0.00	0.000	0.023	0.1673	0.0000	.0000E+00	.0000E+00	0.0000	.1507E-04	.7710E-09
257		0.09	0.000	0.048	0.1708	0.0000	.0000E+00	.0000E+00	0.0000	.1506E-04	.7710E-09
258		0.00	0.000	0.027	0.1686	0.0000	.0000E+00	.0000E+00	0.0000	.1506E-04	.7710E-09
259		0.00	0.000	0.016	0.1673	0.0000	.5328E-05	.2764E-07	0.0000	.1503E-04	.7707E-09
260		0.00	0.000	0.020	0.1656	0.0000	.0000E+00	.0000E+00	0.0000	.1505E-04	.7712E-09
261		0.00	0.000	0.016	0.1643	0.0000	.0000E+00	.0000E+00	0.0000	.1505E-04	.7709E-09
262		0.59	0.000	0.032	0.2109	0.0000	.0000E+00	.0000E+00	0.0000	.1504E-04	.7709E-09
263		0.23	0.000	0.068	0.2244	0.0000	.0000E+00	.0000E+00	0.0000	.1504E-04	.7709E-09
264		0.00	0.000	0.082	0.2175	0.0000	.0000E+00	.0000E+00	0.0000	.1503E-04	.7709E-09
265		0.00	0.000	0.058	0.2127	0.0000	.0000E+00	.0000E+00	0.0000	.1266E-04	.6492E-09
266		0.00	0.000	0.085	0.2056	0.0000	.0000E+00	.0000E+00	0.0000	.2408E-22	.5551E-16
267		0.00	0.000	0.079	0.1990	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
268		0.00	0.000	0.067	0.1935	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
269		0.00	0.000	0.062	0.1883	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
270		0.24	0.000	0.100	0.2000	0.0000	.2783E-05	.1925E-07	0.0000	.1852E-07	.7384E-09
271		0.03	0.000	0.094	0.1946	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
272		0.00	0.000	0.063	0.1893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
273		0.00	0.000	0.039	0.1861	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
274		0.00	0.000	0.076	0.1798	0.0000	.4131E-08	.2892E-09	0.0000	.7913E-10	.2101E-09
275		0.00	0.000	0.084	0.1728	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
276		0.00	0.000	0.080	0.1661	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
277		0.15	0.000	0.045	0.1748	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
278		0.17	0.000	0.047	0.1850	0.0000	.6594E-03	.9091E-06	0.0000	.9083E-06	.7674E-09
279		0.00	0.000	0.046	0.1811	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
280		0.00	0.000	0.033	0.1783	0.0000	.5221E-03	.8319E-06	0.0000	.8312E-06	.7674E-09
281		0.00	0.000	0.031	0.1758	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
282		0.02	0.000	0.038	0.1743	0.0000	.6845E-08	.3184E-09	0.0000	.9332E-10	.2251E-09
283		0.00	0.000	0.025	0.1721	0.0000	.3758E-07	.5889E-09	0.0000	.2556E-09	.3333E-09
284		0.00	0.000	0.024	0.1701	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
285		0.00	0.000	0.022	0.1683	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
286		0.00	0.000	0.021	0.1665	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
287		0.00	0.000	0.019	0.1649	0.0000	.2634E-05	.1060E-07	0.0000	.9884E-08	.7160E-09
288		0.00	0.000	0.016	0.1635	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
289		0.00	0.000	0.004	0.1632	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
290		0.00	0.000	0.001	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
291		0.00	0.000	0.001	0.1630	0.0000	.1988E-04	.3222E-07	0.0000	.3147E-07	.7500E-09
292		0.10	0.000	0.016	0.1700	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
293	*	0.00	0.000	0.000	0.1700	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
294	*	0.00	0.000	0.000	0.1700	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
295	*	0.00	0.000	0.000	0.1700	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
296	*	0.00	0.000	0.000	0.1700	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
297	*	0.00	0.000	0.000	0.1700	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
298	*	0.00	0.000	0.010	0.1692	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
299		0.00	0.000	0.015	0.1680	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

300			0.00	0.000	0.015	0.1667	0.0000	.5510E-07	.2879E-08	0.0000	.2273E-08	.6062E-09
301			0.00	0.000	0.015	0.1655	0.0000	.5597E-08	.3059E-09	0.0000	.8715E-10	.2188E-09
302			0.00	0.000	0.014	0.1643	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
303			0.00	0.000	0.011	0.1634	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
304			0.00	0.000	0.003	0.1632	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
305			0.00	0.000	0.001	0.1631	0.0000	.1615E-05	.1435E-07	0.0000	.1363E-07	.7289E-09
306			0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
307			0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
308	*		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
309			0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
310			0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
311			0.00	0.000	0.000	0.1630	0.0000	.3730E-08	.2841E-09	0.0000	.7671E-10	.2073E-09
312			0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
313	*		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
314	*		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
315	*		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
316			0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
317			0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
318	*		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
319			0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
320			0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
321			0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
322			0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
323			0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
324			0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
325			0.01	0.000	0.008	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
326	*		0.00	0.000	0.000	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
327	*		0.00	0.000	0.001	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
328	*		0.00	0.000	0.000	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
329			0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
330			0.13	0.000	0.015	0.1726	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
331			0.00	0.000	0.006	0.1721	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
332	*		0.00	0.000	0.000	0.1721	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
333	*		0.00	0.000	0.000	0.1721	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
334	*		0.00	0.000	0.000	0.1721	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
335	*		0.00	0.000	0.000	0.1721	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
336	*		0.00	0.000	0.000	0.1721	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
337	*		0.00	0.000	0.000	0.1721	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
338	*		0.03	0.000	0.015	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
339	*		0.00	0.000	0.000	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
340	*	*	0.14	0.000	0.005	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
341	*	*	0.02	0.000	0.005	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
342	*	*	0.00	0.000	0.007	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
343	*	*	0.00	0.000	0.007	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
344	*	*	0.00	0.000	0.012	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
345	*	*	0.00	0.000	0.016	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
346	*	*	0.00	0.000	0.019	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
347	*	*	0.00	0.000	0.014	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
348	*	*	0.00	0.000	0.018	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
349	*	*	0.00	0.000	0.015	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
350	*	*	0.00	0.000	0.018	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
351	*	*	0.00	0.000	0.013	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
352	*	*	0.00	0.000	0.011	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
353	*	*	0.00	0.000	0.000	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
354	*	*	0.00	0.000	0.000	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
355	*	*	0.00	0.000	0.000	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
356	*	*	0.00	0.000	0.000	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
357	*	*	0.00	0.000	0.000	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
358	*	*	0.00	0.000	0.000	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
359	*	*	0.00	0.000	0.000	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
360	*	*	0.00	0.000	0.000	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
361	*	*	0.11	0.000	0.011	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
362	*	*	0.00	0.000	0.011	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
363	*	*	0.00	0.000	0.010	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
364	*	*	0.01	0.000	0.010	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
365	*	*	0.00	0.000	0.011	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
366	*	*	0.00	0.000	0.010	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

****

****

MONTHLY TOTALS (IN INCHES) FOR YEAR 1976

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.85	0.83	1.78	0.92	0.93	4.84
	1.92	0.60	1.37	0.44	0.14	0.31
RUNOFF	0.000	0.087	0.876	0.426	0.000	0.019
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.465	0.528	0.522	1.965	0.342	3.791
	3.103	0.475	1.349	0.640	0.031	0.239
LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.3120	0.3452	0.1214
FROM LAYER 3	0.4703	0.0001	0.0000	0.0012	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0002	0.0003	0.0001
LAYER 4	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED	0.0000	0.0002	0.0005	0.0005	0.0002	0.0001
FROM LAYER 8	0.0003	0.0003	0.0003	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 9	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 9	0.000	0.000	0.000	0.000	0.000	0.000

****

****

ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	14.93	1842660.750	100.00
RUNOFF	1.408	173818.953	9.43
EVAPOTRANSPIRATION	13.450	1660023.120	90.09
DRAINAGE COLLECTED FROM LAYER 3	1.2501	154285.984	8.37
PERC./LEAKAGE THROUGH LAYER 4	0.000945	116.688	0.01
AVG. HEAD ON TOP OF LAYER 4	0.0001		
DRAINAGE COLLECTED FROM LAYER 8	0.0024	292.269	0.02
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.027	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-1.181	-145759.516	-7.91
SOIL WATER AT START OF YEAR	110.494	13637151.000	
SOIL WATER AT END OF YEAR	109.257	13484477.000	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.056	6914.730	0.38
ANNUAL WATER BUDGET BALANCE	0.0000	-0.074	0.00

****

WARNING: TEMPERATURE FOR YEAR 4 USED WITH PRECIPITATION FOR YEAR 1977

WARNING: SOLAR RADIATION FOR YEAR 4 USED WITH PRECIPITATION FOR YEAR 1977

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 9
DRAIN #2: LATERAL DRAINAGE FROM LAYER 8 (RECIRCULATION AND COLLECTION)
LEAK #2: PERCOLATION OR LEAKAGE THROUGH LAYER 10

****

DAILY OUTPUT FOR YEAR 1977

DAY	AIR	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	*	*	0.00	0.000	0.015	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
2	*	*	0.00	0.000	0.015	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
3	*	*	0.03	0.000	0.011	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
4	*	*	0.03	0.000	0.016	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
5	*	*	0.00	0.000	0.013	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
6	*	*	0.00	0.000	0.021	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
7	*	*	0.00	0.000	0.019	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
8	*	*	0.13	0.000	0.023	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
9	*	*	0.00	0.000	0.016	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
10	*	*	0.00	0.000	0.018	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
11	*	*	0.00	0.000	0.017	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
12	*	*	0.02	0.000	0.012	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
13	*	*	0.00	0.000	0.011	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
14	*	*	0.04	0.000	0.014	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
15	*	*	0.07	0.000	0.012	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
16	*	*	0.00	0.000	0.010	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
17	*	*	0.00	0.000	0.009	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
18	*	*	0.00	0.000	0.006	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
19	*	*	0.00	0.000	0.010	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
20	*	*	0.12	0.000	0.000	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
21	*	*	0.00	0.000	0.010	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
22	*	*	0.00	0.000	0.007	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
23	*	*	0.03	0.000	0.010	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
24	*	*	0.00	0.000	0.011	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
25	*	*	0.05	0.000	0.000	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
26	*	*	0.00	0.000	0.018	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
27	*	*	0.05	0.000	0.000	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
28	*	*	0.01	0.000	0.000	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
29	*	*	0.00	0.000	0.024	0.1734	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
30		*	0.00	0.051	0.000	0.1929	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
31	*	*	0.00	0.000	0.003	0.1929	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
32	*	*	0.00	0.000	0.000	0.1929	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
33	*	*	0.00	0.000	0.000	0.1929	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
34	*	*	0.00	0.000	0.000	0.1929	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
35	*	*	0.00	0.000	0.000	0.1929	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
36	*	*	0.04	0.000	0.024	0.1929	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
37	*	*	0.00	0.000	0.016	0.1929	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
38	*	*	0.00	0.000	0.000	0.1929	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
39	*	*	0.00	0.000	0.000	0.1929	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
40	*	*	0.00	0.000	0.000	0.1929	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
41	*	*	0.00	0.000	0.000	0.1929	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
42	*	*	0.00	0.000	0.000	0.1929	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
43	*	*	0.00	0.000	0.000	0.1929	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
44		*	0.04	0.000	0.013	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
45		*	0.00	0.000	0.000	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
46	*	*	0.00	0.000	0.000	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
47	*	*	0.00	0.000	0.000	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
48	*	*	0.00	0.000	0.000	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
49	*	*	0.00	0.000	0.000	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
50	*	*	0.00	0.000	0.000	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
51	*	*	0.00	0.000	0.000	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
52	*	*	0.00	0.000	0.000	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
53		*	0.00	0.000	0.000	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
54	*	*	0.00	0.000	0.000	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
55	*	*	0.80	0.000	0.021	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
56	*	*	0.10	0.000	0.024	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
57	*	*	0.00	0.000	0.022	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
58	*	*	0.00	0.000	0.022	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
59	*	*	0.00	0.000	0.021	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
60	*	*	0.00	0.000	0.018	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
61	*	*	0.00	0.000	0.018	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
62	*	*	0.11	0.000	0.013	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
63	*	*	0.20	0.000	0.011	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
64	*	*	0.14	0.000	0.010	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
65	*	*	0.00	0.000	0.016	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

66	*	*	0.00	0.000	0.000	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
67	*	*	0.00	0.000	0.019	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
68	*	*	0.00	0.000	0.019	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
69	*	*	0.00	0.000	0.000	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
70	*	*	0.00	0.000	0.019	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
71	*	*	1.13	0.000	0.019	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
72	*	*	0.34	0.000	0.000	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
73	*	*	0.00	0.000	0.018	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
74	*	*	0.00	0.000	0.022	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
75	*	*	0.06	0.000	0.013	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
76	*	*	0.00	0.000	0.019	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
77	*	*	0.15	0.000	0.014	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
78	*	*	0.00	0.000	0.000	0.1952	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
79		*	0.00	0.000	0.026	0.2000	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
80		*	0.00	0.000	0.025	0.2043	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
81		*	0.00	0.375	0.000	0.2290	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
82	*	*	0.04	0.000	0.021	0.2296	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
83		*	0.00	0.262	0.000	0.2489	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
84	*	*	0.00	0.000	0.025	0.2489	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
85	*	*	0.00	0.000	0.020	0.2489	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
86	*	*	0.21	0.000	0.015	0.2489	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
87	*	*	0.00	0.000	0.028	0.2489	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
88		*	0.33	0.029	0.000	0.2589	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
89		*	0.32	1.659	0.000	0.2786	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
90		*	0.00	0.013	0.047	0.2808	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
91	*	*	0.00	0.000	0.000	0.2808	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
92	*	*	0.04	0.000	0.036	0.2808	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
93	*	*	0.02	0.000	0.024	0.2808	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
94		*	0.20	0.084	0.013	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
95	*	*	0.08	0.000	0.060	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
96		*	0.04	0.000	0.060	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
97		*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
98		*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
99		*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
100		*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
101		*	0.00	0.000	0.000	0.2893	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
102		*	0.01	0.000	0.007	0.2896	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
103		*	0.03	0.000	0.012	0.2911	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
104		*	0.00	0.000	0.000	0.2911	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
105	*	*	0.82	0.000	0.046	0.2911	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
106	*	*	0.19	0.000	0.030	0.2911	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
107	*	*	0.00	0.000	0.038	0.2911	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
108		*	0.32	1.043	0.000	0,3055	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
109		*	0.88	0.734	0.013	0.3166	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
110		*	0.00	0.000	0.000	0.3166	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
111		*	0.52	0.399	0.013	0.3255	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
112		*	0.00	0.000	0.000	0.3255	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
113		*	0.00	0.000	0.000	0.3255	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
114		*	0.00	0.000	0.000	0.3255	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
115		*	0.00	0.000	0.000	0.3255	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
116		*	0.00	0.000	0.000	0.3255	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
117			0.00	0.000	0.072	0.3195	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
118			0.00	0.000	0.128	0.3088	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
119			0.02	0.000	0.150	0.2956	0.0000	.1989E-03	.2294E-06	0.0000	.2286E-06	.7653E-09
120			0.00	0.000	0.125	0.2799	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
121			0.00	0.000	0.084	0.2694	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
122			0.02	0.000	0.172	0.2538	0.0000	.3597E-04	.5042E-07	0.0000	.4966E-07	.7563E-09
123			0.00	0.000	0.202	0.2338	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
124			0.00	0.000	0.204	0.2148	0.0001	.3213E-02	.3479E-05	0.0000	.3478E-05	.7685E-09
125			0.06	0.000	0.200	0.2029	0.0005	.2230E-01	.1707E-04	0.0000	.0000E+00	.0000E+00
126			0.07	0.000	0.093	0.2010	0.0005	.2383E-01	.1816E-04	0.0000	.0000E+00	.0000E+00
127			0.00	0.000	0.061	0.1959	0.0005	.2166E-01	.1689E-04	0.0000	.0000E+00	.0000E+00
128			0.00	0.000	0.050	0.1917	0.0004	.1984E-01	.1580E-04	0.0000	.0000E+00	.0000E+00
129			0.00	0.000	0.043	0.1882	0.0004	.1829E-01	.1485E-04	0.0000	.1948E-06	.7662E-09
130			0.00	0.000	0.041	0.1847	0.0004	.1696E-01	.1403E-04	0.0000	.1025E-05	.7678E-09
131			0.00	0.000	0.037	0.1811	0.0003	.1248E-01	.1042E-04	0.0000	.4633E-05	.7688E-09
132			0.00	0.000	0.036	0.1781	0.0003	.1543E-01	.1306E-04	0.0000	.2001E-05	.7682E-09
133			0.00	0.000	0.034	0.1753	0.0003	.1447E-01	.1243E-04	0.0000	.2629E-05	.7683E-09
134			0.00	0.000	0.033	0.1725	0.0003	.1328E-01	.1154E-04	0.0000	.3526E-05	.7686E-09
135			0.00	0.000	0.031	0.1699	0.0003	.1291E-01	.1140E-04	0.0000	.3660E-05	.7686E-09
136			0.15	0.000	0.043	0.1788	0.0003	.1222E-01	.1094E-04	0.0000	.4129E-05	.7687E-09

137	0.00	0.000	0.029	0.1763	0.0003	.1160E-01	.1051E-04	0.0000	.4557E-05	.7688E-09
138	0.20	0.000	0.041	0.1894	0.0002	.9737E-02	.8925E-05	0.0000	.6145E-05	.7692E-09
139	0.00	0.000	0.028	0.1871	0.0002	.1048E-01	.9662E-05	0.0000	.5409E-05	.7690E-09
140	0.66	0.000	0.035	0.2391	0.0001	.4489E-02	.4185E-05	0.0000	.4143E-05	.7687E-09
141	0.20	0.000	0.141	0.2441	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
142	0.45	0.000	0.130	0.2707	0.0000	.1083E-05	.3755E-08	0.0000	.0000E+00	.0000E+00
143	0.21	0.000	0.195	0.2720	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
144	0.00	0.000	0.193	0.2558	0.0000	.4531E-06	.6597E-08	0.0000	.0000E+00	.0000E+00
145	0.00	0.000	0.187	0.2402	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
146	0.01	0.000	0.198	0.2246	0.0000	.0000E+00	.0000E+00	0.0000	.3761E-08	.7499E-09
147	0.19	0.000	0.183	0.2252	0.0000	.0000E+00	.0000E+00	0.0000	.1203E-07	.7630E-09
148	0.45	0.000	0.095	0.2547	0.0000	.0000E+00	.0000E+00	0.0000	.2030E-07	.7650E-09
149	0.01	0.000	0.135	0.2443	0.0000	.0000E+00	.0000E+00	0.0000	.2856E-07	.7658E-09
150	0.00	0.000	0.143	0.2325	0.0000	.0000E+00	.0000E+00	0.0000	.3683E-07	.7662E-09
151	0.80	0.000	0.196	0.2828	0.0000	.0000E+00	.0000E+00	0.0000	.1448E-04	.1949E-08
152	0.09	0.000	0.201	0.2736	0.0000	.0000E+00	.0000E+00	0.0000	.1507E-04	.7710E-09
153	0.10	0.000	0.165	0.2682	0.0000	.9941E-04	.1089E-06	0.0000	.1495E-04	.7709E-09
154	0.00	0.000	0.181	0.2531	0.0000	.0000E+00	.0000E+00	0.0000	.1506E-04	.7710E-09
155	0.00	0.000	0.169	0.2390	0.0000	.0000E+00	.0000E+00	0.0000	.1505E-04	.7709E-09
156	0.63	0.000	0.191	0.2757	0.0000	.0000E+00	.0000E+00	0.0000	.1505E-04	.7709E-09
157	0.00	0.000	0.214	0.2578	0.0000	.0000E+00	.0000E+00	0.0000	.1504E-04	.7709E-09
158	0.00	0.000	0.221	0.2394	0.0000	.0000E+00	.0000E+00	0.0000	.1504E-04	.7709E-09
159	0.03	0.000	0.205	0.2248	0.0000	.0000E+00	.0000E+00	0.0000	.1504E-04	.7709E-09
160	0.02	0.000	0.180	0.2114	0.0000	.0000E+00	.0000E+00	0.0000	.1503E-04	.7709E-09
161	0.02	0.000	0.101	0.2047	0.0000	.0000E+00	.0000E+00	0.0000	.8000E-05	.4104E-09
162	0.00	0.000	0.082	0.1979	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
163	0.00	0.000	0.074	0.1917	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
164	0.00	0.000	0.070	0.1859	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
165	0.00	0.000	0.071	0.1799	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
166	0.00	0.000	0.071	0.1740	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
167	0.75	0.000	0.085	0.2294	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
168	0.48	0.000	0.266	0.2471	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
169	0.45	0.000	0.241	0.2646	0.0000	.1350E-02	.1276E-05	0.0000	.1275E-05	.7677E-09
170	0.00	0.000	0.234	0.2451	0.0000	.2056E-03	.1890E-06	0.0000	.1882E-06	.7648E-09
171	0.08	0.000	0.255	0.2305	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
172	0.00	0.000	0.214	0.2126	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
173	0.00	0.000	0.253	0.1915	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
174	0.10	0.000	0.241	0.1798	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
175	0.00	0.000	0.130	0.1689	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
176	0.00	0.000	0.063	0.1637	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
177	0.00	0.000	0.006	0.1632	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
178	0.00	0.000	0.002	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
179	0.65	0.000	0.066	0.2117	0.0000	.6404E-05	.3113E-07	0.0000	.3038E-07	.7494E-09
180	0.00	0.000	0.173	0.1973	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
181	0.10	0.000	0.136	0.1943	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
182	0.07	0.000	0.235	0.1805	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
183	0.00	0.000	0.095	0.1726	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
184	0.35	0.000	0.116	0.1921	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
185	1.10	0.000	0.219	0.2655	0.0000	.7625E-04	.8905E-07	0.0000	.8828E-07	.7613E-09
186	0.00	0.000	0.210	0.2480	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
187	0.00	0.000	0.250	0.2272	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
188	0.05	0.000	0.232	0.2120	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
189	0.05	0.000	0.257	0.1947	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
190	0.00	0.000	0.254	0.1735	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
191	0.00	0.000	0.092	0.1659	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
192	0.00	0.000	0.033	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
193	0.77	0.000	0.120	0.2172	0.0000	.5433E-09	.4376E-09	0.0000	.1588E-09	.2787E-09
194	0.00	0.000	0.144	0.2052	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
195	0.00	0.000	0.159	0.1920	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
196	0.00	0.000	0.222	0.1735	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
197	0.03	0.000	0.119	0.1661	0.0000	.3773E-08	.2304E-08	0.0000	.1728E-08	.5759E-09
198	0.00	0.000	0.028	0.1637	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
199	0.00	0.000	0.008	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
200	0.00	0.000	0.000	0.1630	0.0000	.2919E-09	.7146E-09	0.0000	.3445E-09	.3701E-09
201	0.00	0.000	0.000	0.1630	0.0000	.9164E-11	.4424E-10	0.0000	.2410E-11	.4183E-10
202	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
203	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
204	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
205	0.30	0.000	0.095	0.1801	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
206	0.00	0.000	0.069	0.1743	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
207	0.00	0.000	0.094	0.1665	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

208	0.00	0.000	0.031	0.1639	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
209	1.08	0.000	0.159	0.2407	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
210	0.00	0.000	0.208	0.2234	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
211	0.00	0.000	0.193	0.2073	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
212	0.54	0.000	0.224	0.2336	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
213	0.00	0.000	0.229	0.2145	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
214	0.00	0.000	0.253	0.1934	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
215	0.02	0.000	0.216	0.1771	0.0000	.5420E-03	.5508E-06	0.0000	.5501E-06	.7669E-09
216	0.00	0.000	0.124	0.1667	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
217	0.02	0.000	0.055	0.1638	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
218	0.00	0.000	0.010	0.1630	0.0000	.3325E-04	.4751E-07	0.0000	.4675E-07	.7556E-09
219	0.09	0.000	0.039	0.1672	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
220	0.02	0.000	0.033	0.1662	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
221	0.00	0.000	0.031	0.1636	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
222	0.05	0.000	0.039	0.1645	0.0000	.9367E-07	.9961E-08	0.0000	.9248E-08	.7129E-09
223	0.00	0.000	0.010	0.1637	0.0000	.2444E-08	.2642E-09	0.0000	.6766E-10	.1966E-09
224	0.00	0.000	0.005	0.1632	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
225	0.04	0.000	0.037	0.1635	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
226	0.06	0.000	0.040	0.1651	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
227	0.00	0.000	0.013	0.1641	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
228	0.32	0.000	0.100	0.1825	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
229	0.04	0.000	0.099	0.1775	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
230	0.00	0.000	0.104	0.1689	0.0000	.9432E-08	.3823E-09	0.0000	.1271E-09	.2552E-09
231	0.00	0.000	0.051	0.1646	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
232	0.00	0.000	0.013	0.1636	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
233	0.00	0.000	0.005	0.1632	0.0000	.1423E-04	.5342E-07	0.0000	.5266E-07	.7570E-09
234	0.00	0.000	0.002	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
235	0.00	0.000	0.001	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
236	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
237	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
238	0.35	0.000	0.079	0.1856	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
239	1.95	0.102	0.124	0.3293	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
240	1.05	0.078	0.191	0.3912	0.0000	.5898E-03	.4970E-06	0.0000	.4962E-06	.7668E-09
241	0.00	0.000	0.167	0.3335	0.0000	.3346E-03	.2735E-06	0.0000	.2727E-06	.7658E-09
242	0.00	0.000	0.126	0.3100	0.0003	.1444E-01	.9455E-05	0.0000	.5573E-05	.7690E-09
243	1.25	0.012	0.092	0.3976	0.0020	.8917E-01	.4810E-04	0.0000	.0000E+00	.0000E+00
244	0.84	0.045	0.124	0.3868	0.0092	.2784	.8423E-04	0.0000	.0000E+00	.0000E+00
245	0.16	0.000	0.146	0.3476	0.0138	.5896	.2013E-03	0.0000	.0000E+00	.0000E+00
246	0.00	0.000	0.162	0.3207	0.0082	.3642	.1436E-03	0.0000	.0000E+00	.0000E+00
247	0.08	0.000	0.129	0.3102	0.0049	.2203	.9832E-04	0.0000	.0000E+00	.0000E+00
248	0.08	0.000	0.099	0.3042	0.0031	.1386	.6903E-04	0.0000	.0000E+00	.0000E+00
249	0.00	0.000	0.069	0.2941	0.0022	.9988E-01	.5390E-04	0.0000	.0000E+00	.0000E+00
250	0.00	0.000	0.109	0.2816	0.0020	.8773E-01	.4889E-04	0.0000	.0000E+00	.0000E+00
251	0.00	0.000	0.116	0.2686	0.0016	.7173E-01	.4196E-04	0.0000	.0000E+00	.0000E+00
252	0.10	0.000	0.102	0.2657	0.0015	.6495E-01	.3891E-04	0.0000	.0000E+00	.0000E+00
253	0.00	0.000	0.091	0.2568	0.0015	.6827E-01	.4042E-04	0.0000	.0000E+00	.0000E+00
254	0.00	0.000	0.045	0.2521	0.0013	.5647E-01	.3499E-04	0.0000	.0000E+00	.0000E+00
255	0.12	0.000	0.112	0.2515	0.0010	.4497E-01	.2939E-04	0.0000	.0000E+00	.0000E+00
256	0.00	0.000	0.091	0.2436	0.0011	.4826E-01	.3098E-04	0.0000	.0000E+00	.0000E+00
257	0.00	0.000	0.085	0.2366	0.0010	.4321E-01	.2852E-04	0.0000	.0000E+00	.0000E+00
258	0.00	0.000	0.092	0.2289	0.0008	.3676E-01	.2523E-04	0.0000	.0000E+00	.0000E+00
259	0.00	0.000	0.097	0.2208	0.0007	.3195E-01	.2268E-04	0.0000	.0000E+00	.0000E+00
260	0.00	0.000	0.084	0.2138	0.0006	.2822E-01	.2064E-04	0.0000	.0000E+00	.0000E+00
261	0.03	0.000	0.106	0.2075	0.0006	.2525E-01	.1897E-04	0.0000	.0000E+00	.0000E+00
262	0.07	0.000	0.100	0.2050	0.0005	.2283E-01	.1758E-04	0.0000	.0000E+00	.0000E+00
263	0.00	0.000	0.077	0.1986	0.0005	.2082E-01	.1639E-04	0.0000	.0000E+00	.0000E+00
264	0.00	0.000	0.042	0.1951	0.0004	.1913E-01	.1537E-04	0.0000	.0000E+00	.0000E+00
265	0.41	0.000	0.091	0.2217	0.0004	.1769E-01	.1448E-04	0.0000	.8652E-06	.7677E-09
266	0.05	0.000	0.098	0.2177	0.0004	.1644E-01	.1370E-04	0.0000	.1651E-05	.7680E-09
267	0.60	0.000	0.093	0.2600	0.0003	.1535E-01	.1300E-04	0.0000	.2348E-05	.7683E-09
268	0.20	0.000	0.119	0.2667	0.0003	.1439E-01	.1238E-04	0.0000	.2972E-05	.7684E-09
269	0.21	0.000	0.085	0.2771	0.0003	.1354E-01	.1182E-04	0.0000	.3532E-05	.7686E-09
270	0.00	0.000	0.083	0.2702	0.0003	.1279E-01	.1132E-04	0.0000	.4039E-05	.7687E-09
271	0.00	0.000	0.057	0.2654	0.0003	.1211E-01	.1086E-04	0.0000	.4500E-05	.7688E-09
272	0.20	0.000	0.077	0.2757	0.0003	.1150E-01	.1044E-04	0.0000	.4921E-05	.7689E-09
273	0.00	0.000	0.054	0.2711	0.0002	.1094E-01	.1006E-04	0.0000	.5308E-05	.7690E-09
274	0.03	0.000	0.110	0.2645	0.0002	.9624E-02	.8960E-05	0.0000	.6404E-05	.7692E-09
275	0.00	0.000	0.064	0.2591	0.0000	.6008E-03	.7009E-06	0.0000	.3673E-06	.7677E-09
276	0.00	0.000	0.072	0.2530	0.0000	.1554E-02	.1834E-05	0.0000	.1508E-05	.7681E-09
277	0.00	0.000	0.056	0.2483	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
278	0.02	0.000	0.082	0.2431	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00

279		0.00	0.000	0.040	0.2398	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
280		0.00	0.000	0.025	0.2377	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
281		1.54	0.022	0.060	0.3592	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
282		0.17	0.000	0.063	0.3548	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
283		0.00	0.000	0.064	0.3350	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
284		0.15	0.000	0.090	0.3299	0.0000	.0000E+00	.0000E+00	0.0000	.0000E+00	.0000E+00
285		0.15	0.000	0.101	0.3269	0.0001	.4430E-02	.4321E-05	0.0000	.3755E-05	.8781E-09
286		0.00	0.000	0.073	0.3154	0.0007	.3330E-01	.2310E-04	0.0000	.1507E-04	.7710E-09
287		0.00	0.000	0.068	0.3049	0.0011	.4897E-01	.3134E-04	0.0000	.1506E-04	.7710E-09
288		0.00	0.000	0.078	0.2947	0.0014	.6068E-01	.3691E-04	0.0000	.1506E-04	.7710E-09
289		0.00	0.000	0.076	0.2873	0.0018	.7818E-01	.4478E-04	0.0000	.1506E-04	.7710E-09
290		0.00	0.000	0.048	0.2825	0.0014	.6088E-01	.3690E-04	0.0000	.1505E-04	.7709E-09
291		0.00	0.000	0.057	0.2757	0.0009	.3827E-01	.2598E-04	0.0000	.1505E-04	.7709E-09
292		0.00	0.000	0.070	0.2674	0.0007	.3140E-01	.2238E-04	0.0000	.1504E-04	.7709E-09
293		0.00	0.000	0.038	0.2620	0.0007	.3237E-01	.2289E-04	0.0000	.1504E-04	.7709E-09
294	*	0.00	0.000	0.028	0.2581	0.0009	.3968E-01	.2674E-04	0.0000	.1504E-04	.7709E-09
295		0.00	0.000	0.032	0.2548	0.0010	.4263E-01	.2821E-04	0.0000	.1503E-04	.7709E-09
296		0.00	0.000	0.044	0.2511	0.0010	.4375E-01	.2879E-04	0.0000	.5775E-05	.3851E-09
297		0.00	0.000	0.055	0.2465	0.0008	.3716E-01	.2543E-04	0.0000	.0000E+00	.0000E+00
298		0.00	0.000	0.047	0.2426	0.0007	.3225E-01	.2284E-04	0.0000	.0000E+00	.0000E+00
299	*	0.00	0.000	0.026	0.2404	0.0006	.2846E-01	.2077E-04	0.0000	.0000E+00	.0000E+00
300	*	0.00	0.000	0.025	0.2384	0.0006	.2544E-01	.1908E-04	0.0000	.0000E+00	.0000E+00
301		0.00	0.000	0.030	0.2359	0.0005	.2299E-01	.1767E-04	0.0000	.0000E+00	.0000E+00
302	*	0.00	0.000	0.024	0.2339	0.0005	.2096E-01	.1647E-04	0.0000	.0000E+00	.0000E+00
303		0.00	0.000	0.032	0.2312	0.0004	.1924E-01	.1544E-04	0.0000	.1349E-07	.7464E-09
304	*	0.59	0.000	0.024	0.2329	0.0004	.1778E-01	.1454E-04	0.0000	.9156E-06	.7677E-09
305	*	0.31	0.000	0.019	0.2345	0.0004	.1652E-01	.1375E-04	0.0000	.1709E-05	.7681E-09
306	*	0.00	0.000	0.020	0.2362	0.0003	.1542E-01	.1305E-04	0.0000	.2412E-05	.7683E-09
307		0.00	0.000	0.027	0.2378	0.0003	.1446E-01	.1242E-04	0.0000	.3040E-05	.7685E-09
308		0.00	0.000	0.000	0.2988	0.0003	.1360E-01	.1186E-04	0.0000	.3604E-05	.7686E-09
309		0.00	0.000	0.032	0.2961	0.0003	.1267E-01	.1120E-04	0.0000	.4264E-05	.7687E-09
310		0.00	0.000	0.054	0.2916	0.0003	.1216E-01	.1090E-04	0.0000	.4572E-05	.7688E-09
311		0.02	0.000	0.052	0.2889	0.0002	.1104E-01	.1008E-04	0.0000	.5390E-05	.7690E-09
312		0.02	0.000	0.051	0.2863	0.0002	.1101E-01	.1010E-04	0.0000	.5368E-05	.7690E-09
313		0.20	0.000	0.069	0.2972	0.0002	.1034E-01	.9557E-05	0.0000	.5917E-05	.7691E-09
314		2.02	0.229	0.076	0.4170	0.0000	.1630E-02	.1521E-05	0.0000	.1077E-05	.7680E-09
315		0.04	0.000	0.057	0.3445	0.0017	.7711E-01	.3398E-04	0.0000	.1287E-04	.6604E-09
316		0.00	0.000	0.047	0.3257	0.0068	.3050	.1259E-03	0.0000	.0000E+00	.0000E+00
317		0.00	0.000	0.055	0.3129	0.0048	.2137	.9609E-04	0.0000	.0000E+00	.0000E+00
318		0.00	0.000	0.048	0.3041	0.0035	.1559	.7561E-04	0.0000	.0000E+00	.0000E+00
319		0.00	0.000	0.030	0.2976	0.0025	.1104	.5817E-04	0.0000	.0000E+00	.0000E+00
320		0.02	0.000	0.034	0.2928	0.0019	.8659E-01	.4839E-04	0.0000	.0000E+00	.0000E+00
321	*	0.00	0.000	0.000	0.2895	0.0017	.7443E-01	.4316E-04	0.0000	.0000E+00	.0000E+00
322	*	0.02	0.000	0.019	0.2870	0.0015	.6767E-01	.4015E-04	0.0000	.0000E+00	.0000E+00
323	*	0.00	0.000	0.021	0.2830	0.0014	.6091E-01	.3708E-04	0.0000	.0000E+00	.0000E+00
324	*	0.25	0.000	0.019	0.2831	0.0013	.5679E-01	.3522E-04	0.0000	.0000E+00	.0000E+00
325	*	0.60	0.000	0.022	0.2833	0.0011	.4873E-01	.3113E-04	0.0000	.0000E+00	.0000E+00
326		0.00	0.000	0.000	0.3373	0.0009	.4132E-01	.2751E-04	0.0000	.0000E+00	.0000E+00
327		0.06	0.000	0.012	0.3492	0.0010	.4471E-01	.2917E-04	0.0000	.0000E+00	.0000E+00
328		0.13	0.000	0.034	0.3498	0.0003	.1508E-01	.9788E-05	0.0000	.5876E-05	.7691E-09
329	*	0.09	0.000	0.019	0.3398	0.0000	.5792E-03	.6092E-06	0.0000	.0000E+00	.0000E+00
330		0.00	0.000	0.027	0.3320	0.0004	.1865E-01	.1446E-04	0.0000	.1383E-04	.7707E-09
331		0.10	0.000	0.038	0.3289	0.0017	.7384E-01	.4265E-04	0.0000	.2430E-05	.1285E-09
332		0.15	0.000	0.031	0.3336	0.0023	.1021	.5476E-04	0.0000	.0000E+00	.0000E+00
333	*	0.00	0.000	0.000	0.3277	0.0018	.7979E-01	.4513E-04	0.0000	.0000E+00	.0000E+00
334	*	0.00	0.000	0.000	0.3257	0.0024	.1080	.5712E-04	0.0000	.0000E+00	.0000E+00
335	*	0.02	0.000	0.030	0.3193	0.0010	.4497E-01	.2908E-04	0.0000	.0000E+00	.0000E+00
336	*	0.03	0.000	0.018	0.3145	0.0012	.5444E-01	.3389E-04	0.0000	.0000E+00	.0000E+00
337	*	0.00	0.000	0.000	0.3099	0.0015	.6736E-01	.4000E-04	0.0000	.0000E+00	.0000E+00
338	*	0.00	0.000	0.000	0.3062	0.0016	.6957E-01	.4099E-04	0.0000	.0000E+00	.0000E+00
339	*	0.22	0.000	0.011	0.3044	0.0014	.6380E-01	.3839E-04	0.0000	.0000E+00	.0000E+00
340	*	0.00	0.000	0.019	0.3035	0.0014	.6446E-01	.3869E-04	0.0000	.0000E+00	.0000E+00
341	*	0.00	0.000	0.015	0.3028	0.0012	.5475E-01	.3411E-04	0.0000	.0000E+00	.0000E+00
342	*	0.10	0.000	0.016	0.3024	0.0011	.5078E-01	.3223E-04	0.0000	.0000E+00	.0000E+00
343	* *	0.00	0.000	0.012	0.3024	0.0014	.6293E-01	.3798E-04	0.0000	.0000E+00	.0000E+00
344	* *	0.00	0.000	0.010	0.3024	0.0011	.5067E-01	.3207E-04	0.0000	.0000E+00	.0000E+00
345	* *	0.00	0.000	0.009	0.3024	0.0009	.4209E-01	.2796E-04	0.0000	.0000E+00	.0000E+00
346	* *	0.00	0.000	0.012	0.3024	0.0008	.3594E-01	.2480E-04	0.0000	.0000E+00	.0000E+00
347	* *	0.00	0.000	0.018	0.3024	0.0007	.3132E-01	.2234E-04	0.0000	.0000E+00	.0000E+00
348	* *	0.00	0.000	0.014	0.3024	0.0006	.2773E-01	.2037E-04	0.0000	.0000E+00	.0000E+00
349	* *	0.00	0.000	0.019	0.3024	0.0006	.2485E-01	.1874E-04	0.0000	.0000E+00	.0000E+00

350	*	*	0.00	0.000	0.013	0.3024	0.0005	.2250E-01	.1738E-04	0.0000	.0000E+00	.0000E+00
351	*	*	0.03	0.000	0.010	0.3024	0.0005	.2055E-01	.1622E-04	0.0000	.0000E+00	.0000E+00
352	*	*	0.60	0.000	0.010	0.3024	0.0004	.1890E-01	.1523E-04	0.0000	.6434E-06	.7675E-09
353	*	*	0.03	0.000	0.010	0.3024	0.0004	.1748E-01	.1435E-04	0.0000	.1519E-05	.7680E-09
354	*	*	0.01	0.000	0.008	0.3024	0.0004	.1626E-01	.1359E-04	0.0000	.2291E-05	.7683E-09
355	*	*	0.00	0.000	0.009	0.3024	0.0003	.1520E-01	.1290E-04	0.0000	.2976E-05	.7684E-09
356	*	*	0.00	0.000	0.000	0.3024	0.0003	.1426E-01	.1229E-04	0.0000	.3588E-05	.7686E-09
357		*	0.00	0.000	0.026	0.3024	0.0003	.1342E-01	.1174E-04	0.0000	.4140E-05	.7687E-09
358		*	0.10	0.124	0.000	0.3216	0.0003	.1268E-01	.1125E-04	0.0000	.4640E-05	.7688E-09
359		*	0.07	0.065	0.000	0.3349	0.0003	.1201E-01	.1080E-04	0.0000	.5093E-05	.7689E-09
360		*	0.00	0.001	0.021	0.3380	0.0003	.1141E-01	.1038E-04	0.0000	.5510E-05	.7690E-09
361	*	*	0.00	0.000	0.020	0.3380	0.0002	.1086E-01	.9999E-05	0.0000	.5891E-05	.7691E-09
362	*	*	0.00	0.000	0.025	0.3380	0.0002	.8005E-02	.7446E-05	0.0000	.6582E-05	.7693E-09
363	*	*	0.00	0.000	0.018	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2769E-06	.7656E-09
364	*	*	0.00	0.000	0.018	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2760E-06	.7656E-09
365	*	*	0.02	0.000	0.014	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2750E-06	.7656E-09

****

****

MONTHLY TOTALS (IN INCHES) FOR YEAR 1977

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.58	0.98	3.03	3.17	3.48	3.50
	4.34	5.26	3.15	2.65	4.03	1.23
RUNOFF	0.051	0.000	2.338	2.260	0.000	0.000
	0.000	0.192	0.045	0.022	0.229	0.191
EVAPOTRANSPIRATION	0.351	0.163	0.454	0.829	3.293	4.560
	3.868	2.285	2.835	1.701	0.911	0.405
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0002	0.2432	0.0017
	0.0001	0.1051	2.4863	0.7306	1.8602	0.9392
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000
	0.0000	0.0001	0.0012	0.0005	0.0010	0.0006
LATERAL DRAINAGE COLLECTED FROM LAYER 8	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001
	0.0000	0.0000	0.0000	0.0002	0.0001	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 4	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.002	0.001	0.001	0.001
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000

HEAD ON TOP OF LAYER 4	0.000	0.000	0.003	0.000	0.002	0.000
AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 9	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 9	0.000	0.000	0.000	0.000	0.000	0.000

****

****

ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	35.40	4369068.000	100.00
RUNOFF	5.329	657667.812	15.05
EVAPOTRANSPIRATION	21.656	2672815.750	61.18
DRAINAGE COLLECTED FROM LAYER 3	6.3666	785771.625	17.98
PERC./LEAKAGE THROUGH LAYER 4	0.003596	443.767	0.01
AVG. HEAD ON TOP OF LAYER 4	0.0004		
DRAINAGE COLLECTED FROM LAYER 8	0.0005	65.134	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.009	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	2.048	252747.406	5.78
SOIL WATER AT START OF YEAR	109.257	13484477.000	
SOIL WATER AT END OF YEAR	111.236	13728695.000	
SNOW WATER AT START OF YEAR	0.056	6914.730	0.16
SNOW WATER AT END OF YEAR	0.125	15443.600	0.35
ANNUAL WATER BUDGET BALANCE	0.0000	0.446	0.00

****

WARNING: TEMPERATURE FOR YEAR 5 USED WITH PRECIPITATION FOR YEAR 1978

WARNING: SOLAR RADIATION FOR YEAR 5 USED WITH PRECIPITATION FOR YEAR 1978

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 9
DRAIN #2: LATERAL DRAINAGE FROM LAYER 8 (RECIRCULATION AND COLLECTION)
LEAK #2: PERCOLATION OR LEAKAGE THROUGH LAYER 10

****

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	*	*	0.19	0.000	0.017	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2741E-06	.7656E-09
2	*	*	0.00	0.000	0.021	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2732E-06	.7656E-09
3	*	*	0.00	0.000	0.017	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2723E-06	.7656E-09
4	*	*	0.00	0.000	0.010	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2714E-06	.7656E-09
5	*	*	0.00	0.000	0.008	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2705E-06	.7655E-09
6	*	*	0.00	0.000	0.014	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2696E-06	.7655E-09
7	*	*	0.04	0.000	0.000	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2687E-06	.7655E-09
8	*	*	0.00	0.000	0.021	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2679E-06	.7655E-09
9	*	*	0.00	0.000	0.024	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2670E-06	.7655E-09
10	*	*	0.00	0.000	0.012	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2661E-06	.7655E-09
11	*	*	0.00	0.000	0.017	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2653E-06	.7655E-09
12	*	*	0.00	0.000	0.011	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2645E-06	.7655E-09
13	*	*	0.00	0.000	0.010	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2636E-06	.7655E-09
14	*	*	0.01	0.000	0.014	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2628E-06	.7655E-09
15	*	*	0.01	0.000	0.012	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2620E-06	.7655E-09
16	*	*	0.02	0.000	0.007	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2612E-06	.7655E-09
17	*	*	0.00	0.000	0.010	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2604E-06	.7655E-09
18	*	*	0.00	0.000	0.011	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2596E-06	.7655E-09
19	*	*	0.04	0.000	0.007	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2588E-06	.7655E-09
20	*	*	0.00	0.000	0.007	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2580E-06	.7655E-09
21	*	*	0.00	0.000	0.008	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2573E-06	.7655E-09
22	*	*	0.00	0.000	0.011	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2565E-06	.7654E-09
23	*	*	0.00	0.000	0.020	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2557E-06	.7654E-09
24	*	*	0.00	0.000	0.019	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2550E-06	.7654E-09
25	*	*	0.01	0.000	0.020	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2543E-06	.7654E-09
26	*	*	0.04	0.000	0.026	0.3380	0.0000	.0000E+00	.0000E+00	0.0000	.2535E-06	.7654E-09
27		*	0.01	0.000	0.000	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2528E-06	.7654E-09
28	*	*	0.00	0.000	0.032	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2521E-06	.7654E-09
29	*	*	0.00	0.000	0.027	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2514E-06	.7654E-09
30	*	*	0.00	0.000	0.031	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2507E-06	.7654E-09
31	*	*	0.01	0.000	0.032	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2500E-06	.7654E-09
32		*	0.00	0.000	0.001	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2493E-06	.7654E-09
33		*	0.00	0.000	0.000	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2486E-06	.7654E-09
34	*	*	0.00	0.000	0.000	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2479E-06	.7654E-09
35	*	*	0.00	0.000	0.000	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2473E-06	.7654E-09
36	*	*	0.01	0.000	0.010	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2466E-06	.7654E-09
37	*	*	0.00	0.000	0.000	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2460E-06	.7654E-09
38	*	*	0.00	0.000	0.000	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2453E-06	.7654E-09
39	*	*	0.00	0.000	0.000	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2447E-06	.7654E-09
40	*	*	0.00	0.000	0.000	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2441E-06	.7654E-09
41	*	*	0.00	0.000	0.000	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2435E-06	.7653E-09
42	*	*	0.00	0.000	0.000	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2429E-06	.7653E-09
43	*	*	0.03	0.000	0.018	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2423E-06	.7653E-09
44	*	*	0.00	0.000	0.012	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2417E-06	.7653E-09
45	*	*	0.00	0.000	0.000	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2411E-06	.7653E-09

46	*	*	0.00	0.000	0.000	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2405E-06	.7653E-09
47	*	*	0.00	0.000	0.000	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2399E-06	.7653E-09
48	*	*	0.00	0.000	0.000	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2394E-06	.7653E-09
49	*	*	0.00	0.000	0.000	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2388E-06	.7653E-09
50	*	*	0.00	0.000	0.000	0.3404	0.0000	.0000E+00	.0000E+00	0.0000	.2383E-06	.7653E-09
51		*	0.03	0.000	0.006	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2377E-06	.7653E-09
52	*	*	0.01	0.000	0.010	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2372E-06	.7653E-09
53	*	*	0.00	0.000	0.000	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2366E-06	.7653E-09
54	*	*	0.07	0.000	0.051	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2361E-06	.7653E-09
55		*	0.00	0.000	0.019	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2356E-06	.7653E-09
56	*	*	0.00	0.000	0.000	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2351E-06	.7653E-09
57	*	*	0.00	0.000	0.000	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2346E-06	.7653E-09
58	*	*	0.00	0.000	0.000	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2341E-06	.7653E-09
59	*	*	0.02	0.000	0.020	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2336E-06	.7653E-09
60	*	*	0.00	0.000	0.000	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2332E-06	.7653E-09
61	*	*	0.00	0.000	0.000	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2327E-06	.7653E-09
62	*	*	0.10	0.000	0.042	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2322E-06	.7653E-09
63	*	*	0.00	0.000	0.031	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2318E-06	.7653E-09
64	*	*	0.00	0.000	0.028	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2313E-06	.7653E-09
65	*	*	0.00	0.000	0.000	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2309E-06	.7653E-09
66	*	*	0.00	0.000	0.000	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2305E-06	.7653E-09
67	*	*	0.00	0.000	0.000	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2301E-06	.7652E-09
68		*	0.00	0.000	0.000	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2296E-06	.7652E-09
69		*	0.00	0.000	0.000	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2292E-06	.7652E-09
70		*	0.00	0.000	0.000	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2288E-06	.7652E-09
71		*	0.00	0.000	0.000	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2284E-06	.7652E-09
72		*	0.00	0.000	0.000	0.3424	0.0000	.0000E+00	.0000E+00	0.0000	.2280E-06	.7652E-09
73		*	0.65	0.464	0.005	0.3574	0.0000	.0000E+00	.0000E+00	0.0000	.2277E-06	.7652E-09
74		*	0.00	0.000	0.000	0.3574	0.0000	.0000E+00	.0000E+00	0.0000	.2273E-06	.7652E-09
75		*	0.00	0.000	0.000	0.3574	0.0000	.0000E+00	.0000E+00	0.0000	.2269E-06	.7652E-09
76		*	0.00	0.000	0.000	0.3574	0.0000	.0000E+00	.0000E+00	0.0000	.2266E-06	.7652E-09
77		*	0.00	0.000	0.000	0.3574	0.0000	.0000E+00	.0000E+00	0.0000	.2262E-06	.7652E-09
78		*	0.00	0.000	0.000	0.3574	0.0000	.0000E+00	.0000E+00	0.0000	.2259E-06	.7652E-09
79		*	0.00	0.000	0.000	0.3574	0.0000	.0000E+00	.0000E+00	0.0000	.2256E-06	.7652E-09
80		*	0.06	0.005	0.005	0.3616	0.0000	.0000E+00	.0000E+00	0.0000	.2252E-06	.7652E-09
81	*	*	0.00	0.000	0.000	0.3616	0.0000	.0000E+00	.0000E+00	0.0000	.2249E-06	.7652E-09
82	*	*	0.00	0.000	0.000	0.3616	0.0000	.0000E+00	.0000E+00	0.0000	.2246E-06	.7652E-09
83	*	*	0.00	0.000	0.000	0.3616	0.0000	.0000E+00	.0000E+00	0.0000	.2243E-06	.7652E-09
84	*	*	0.00	0.000	0.000	0.3616	0.0000	.0000E+00	.0000E+00	0.0000	.2240E-06	.7652E-09
85	*	*	0.00	0.000	0.000	0.3616	0.0000	.0000E+00	.0000E+00	0.0000	.2237E-06	.7652E-09
86	*	*	0.00	0.000	0.000	0.3616	0.0000	.0000E+00	.0000E+00	0.0000	.2234E-06	.7652E-09
87		*	0.00	0.000	0.000	0.3616	0.0000	.0000E+00	.0000E+00	0.0000	.2231E-06	.7652E-09
88	*	*	0.00	0.000	0.000	0.3616	0.0000	.0000E+00	.0000E+00	0.0000	.2229E-06	.7652E-09
89	*	*	0.00	0.000	0.000	0.3616	0.0000	.0000E+00	.0000E+00	0.0000	.2226E-06	.7652E-09
90	*	*	0.00	0.000	0.000	0.3616	0.0000	.0000E+00	.0000E+00	0.0000	.2224E-06	.7652E-09
91	*	*	0.00	0.000	0.000	0.3616	0.0000	.0000E+00	.0000E+00	0.0000	.2221E-06	.7652E-09
92	*	*	0.00	0.000	0.000	0.3616	0.0000	.0000E+00	.0000E+00	0.0000	.2219E-06	.7652E-09
93	*	*	0.33	0.000	0.021	0.3616	0.0000	.0000E+00	.0000E+00	0.0000	.2216E-06	.7652E-09
94		*	0.21	0.379	0.023	0.3713	0.0000	.0000E+00	.0000E+00	0.0000	.2214E-06	.7652E-09
95	*	*	0.00	0.000	0.000	0.3713	0.0000	.0000E+00	.0000E+00	0.0000	.2212E-06	.7652E-09
96	*	*	0.07	0.000	0.044	0.3713	0.0000	.0000E+00	.0000E+00	0.0000	.2210E-06	.7652E-09
97	*	*	0.66	0.000	0.034	0.3713	0.0000	.0000E+00	.0000E+00	0.0000	.2208E-06	.7652E-09
98	*	*	0.28	0.000	0.000	0.3713	0.0000	.0000E+00	.0000E+00	0.0000	.2206E-06	.7652E-09
99	*	*	0.00	0.000	0.030	0.3713	0.0000	.0000E+00	.0000E+00	0.0000	.2204E-06	.7652E-09
100	*	*	0.41	0.000	0.000	0.3713	0.0000	.0000E+00	.0000E+00	0.0000	.2202E-06	.7652E-09
101	*	*	0.00	0.000	0.027	0.3713	0.0000	.0000E+00	.0000E+00	0.0000	.2200E-06	.7652E-09
102	*	*	0.10	0.000	0.024	0.3713	0.0000	.0000E+00	.0000E+00	0.0000	.2199E-06	.7652E-09
103		*	0.18	0.601	0.000	0.3817	0.0000	.0000E+00	.0000E+00	0.0000	.2197E-06	.7652E-09
104	*	*	0.00	0.000	0.039	0.3817	0.0000	.0000E+00	.0000E+00	0.0000	.2195E-06	.7652E-09
105	*	*	0.00	0.000	0.040	0.3817	0.0000	.0000E+00	.0000E+00	0.0000	.2194E-06	.7652E-09
106	*	*	0.00	0.000	0.042	0.3817	0.0000	.0000E+00	.0000E+00	0.0000	.2193E-06	.7652E-09
107	*	*	0.00	0.000	0.044	0.3817	0.0000	.0000E+00	.0000E+00	0.0000	.2191E-06	.7652E-09
108		*	0.01	0.001	0.000	0.3841	0.0000	.0000E+00	.0000E+00	0.0000	.2190E-06	.7652E-09
109		*	0.52	0.729	0.000	0.3929	0.0000	.0000E+00	.0000E+00	0.0000	.2189E-06	.7652E-09
110		*	0.00	0.233	0.084	0.3929	0.0000	.0000E+00	.0000E+00	0.0000	.2188E-06	.7652E-09
111		*	0.09	0.035	0.004	0.3971	0.0000	.0000E+00	.0000E+00	0.0000	.2187E-06	.7652E-09
112		*	0.00	0.000	0.000	0.3971	0.0000	.0000E+00	.0000E+00	0.0000	.2186E-06	.7652E-09
113		*	0.14	0.078	0.004	0.4019	0.0000	.0000E+00	.0000E+00	0.0000	.2185E-06	.7652E-09
114		*	0.39	0.319	0.004	0.4075	0.0000	.0000E+00	.0000E+00	0.0000	.2184E-06	.7652E-09
115		*	0.07	0.029	0.004	0.4105	0.0000	.0000E+00	.0000E+00	0.0000	.2183E-06	.7652E-09
116		*	0.00	0.000	0.000	0.4105	0.0000	.0000E+00	.0000E+00	0.0000	.2183E-06	.7652E-09

117	*	0.00	0.000	0.000	0.4105	0.0000	.0000E+00	.0000E+00	0.0000	.2182E-06	.7652E-09
118	*	0.00	0.000	0.000	0.4105	0.0000	.0000E+00	.0000E+00	0.0000	.2181E-06	.7652E-09
119	*	0.01	0.000	0.004	0.4110	0.0000	.0000E+00	.0000E+00	0.0000	.2181E-06	.7652E-09
120	*	0.02	0.001	0.004	0.4122	0.0000	.0000E+00	.0000E+00	0.0000	.2181E-06	.7652E-09
121	*	0.00	0.000	0.000	0.4122	0.0000	.0000E+00	.0000E+00	0.0000	.2182E-06	.7659E-09
122	*	0.00	0.000	0.000	0.4122	0.0000	.0000E+00	.0000E+00	0.0000	.2241E-06	.7677E-09
123	* *	0.00	0.000	0.000	0.4122	0.0000	.0000E+00	.0000E+00	0.0000	.2327E-06	.7677E-09
124	*	0.00	0.000	0.000	0.4122	0.0000	.0000E+00	.0000E+00	0.0000	.2413E-06	.7677E-09
125		0.00	0.000	0.077	0.3455	0.0000	.1456E-02	.1325E-05	0.0000	.1573E-05	.7681E-09
126		0.00	0.000	0.108	0.3181	0.0019	.8399E-01	.4210E-04	0.0000	.1555E-04	.7710E-09
127		0.00	0.000	0.171	0.2957	0.0039	.1722	.8156E-04	0.0000	.1555E-04	.7710E-09
128		0.48	0.000	0.208	0.3129	0.0031	.1371	.6856E-04	0.0000	.1386E-04	.6876E-09
129		0.32	0.000	0.240	0.3151	0.0024	.1084	.5736E-04	0.0000	.1553E-04	.7710E-09
130		0.00	0.000	0.186	0.2960	0.0020	.9126E-01	.5034E-04	0.0000	.3657E-05	.1816E-09
131		0.00	0.000	0.134	0.2828	0.0019	.8521E-01	.4782E-04	0.0000	.0000E+00	.0000E+00
132		0.00	0.000	0.155	0.2691	0.0017	.7570E-01	.4368E-04	0.0000	.3218E-05	.1263E-08
133		0.25	0.000	0.197	0.2734	0.0015	.6651E-01	.3962E-04	0.0000	.1494E-04	.8108E-09
134		0.00	0.000	0.229	0.2543	0.0012	.5224E-01	.3301E-04	0.0000	.1555E-04	.7710E-09
135		0.00	0.000	0.170	0.2401	0.0010	.4362E-01	.2872E-04	0.0000	.1555E-04	.7710E-09
136		0.00	0.000	0.163	0.2265	0.0008	.3706E-01	.2538E-04	0.0000	.1554E-04	.7710E-09
137		0.00	0.000	0.155	0.2136	0.0007	.3217E-01	.2280E-04	0.0000	.1554E-04	.7710E-09
138		0.00	0.000	0.121	0.2036	0.0006	.2840E-01	.2074E-04	0.0000	.1553E-04	.7710E-09
139		0.00	0.000	0.095	0.1957	0.0006	.2539E-01	.1905E-04	0.0000	.1553E-04	.7710E-09
140		0.08	0.000	0.085	0.1952	0.0005	.2295E-01	.1764E-04	0.0000	.1552E-04	.7710E-09
141		0.01	0.000	0.067	0.1904	0.0005	.2092E-01	.1645E-04	0.0000	.1552E-04	.7710E-09
142		0.00	0.000	0.053	0.1860	0.0004	.1922E-01	.1542E-04	0.0000	.1545E-04	.7704E-09
143		0.00	0.000	0.046	0.1821	0.0004	.1776E-01	.1452E-04	0.0000	.1468E-04	.7634E-09
144		0.00	0.000	0.044	0.1785	0.0004	.1650E-01	.1374E-04	0.0000	.1387E-04	.7638E-09
145		0.00	0.000	0.042	0.1749	0.0003	.1540E-01	.1304E-04	0.0000	.1315E-04	.7641E-09
146		0.00	0.000	0.037	0.1716	0.0003	.1287E-01	.1102E-04	0.0000	.1134E-04	.7504E-09
147		0.04	0.000	0.041	0.1715	0.0003	.1392E-01	.1207E-04	0.0000	.1188E-04	.7826E-09
148		0.88	0.000	0.041	0.2409	0.0002	.9273E-02	.8032E-05	0.0000	.8687E-05	.7268E-09
149		0.73	0.000	0.226	0.2829	0.0003	.1294E-01	.1142E-04	0.0000	.1083E-04	.8242E-09
150		0.35	0.000	0.185	0.2967	0.0003	.1224E-01	.1095E-04	0.0000	.1101E-04	.7649E-09
151		0.00	0.000	0.201	0.2799	0.0003	.1162E-01	.1052E-04	0.0000	.1057E-04	.7651E-09
152		0.06	0.000	0.103	0.2763	0.0002	.1105E-01	.1013E-04	0.0000	.1017E-04	.7652E-09
153		0.00	0.000	0.235	0.2567	0.0002	.1054E-01	.9771E-05	0.0000	.9798E-05	.7653E-09
154		0.00	0.000	0.196	0.2404	0.0000	.1301E-02	.1221E-05	0.0000	.2614E-05	.6560E-09
155		0.00	0.000	0.237	0.2207	0.0000	.0000E+00	.0000E+00	0.0000	.5096E-06	.6789E-09
156		0.00	0.000	0.202	0.2038	0.0000	.0000E+00	.0000E+00	0.0000	.3724E-06	.7663E-09
157		0.00	0.000	0.199	0.1872	0.0000	.0000E+00	.0000E+00	0.0000	.3721E-06	.7663E-09
158		0.00	0.000	0.090	0.1797	0.0000	.0000E+00	.0000E+00	0.0000	.3718E-06	.7663E-09
159		0.35	0.000	0.080	0.2022	0.0000	.0000E+00	.0000E+00	0.0000	.3715E-06	.7663E-09
160		0.00	0.000	0.068	0.1965	0.0000	.0000E+00	.0000E+00	0.0000	.3711E-06	.7663E-09
161		0.00	0.000	0.058	0.1917	0.0000	.0000E+00	.0000E+00	0.0000	.3708E-06	.7663E-09
162		0.00	0.000	0.051	0.1874	0.0000	.0000E+00	.0000E+00	0.0000	.3705E-06	.7663E-09
163		0.27	0.000	0.065	0.2045	0.0000	.0000E+00	.0000E+00	0.0000	.3703E-06	.7663E-09
164		0.00	0.000	0.239	0.1846	0.0000	.0000E+00	.0000E+00	0.0000	.3700E-06	.7663E-09
165		0.00	0.000	0.040	0.1813	0.0000	.0000E+00	.0000E+00	0.0000	.3697E-06	.7663E-09
166		0.02	0.000	0.054	0.1784	0.0000	.0000E+00	.0000E+00	0.0000	.3694E-06	.7663E-09
167		0.21	0.000	0.054	0.1915	0.0000	.0000E+00	.0000E+00	0.0000	.3692E-06	.7663E-09
168		1.14	0.000	0.054	0.2820	0.0000	.7157E-09	.7614E-09	0.0000	.3683E-06	.7661E-09
169		0.00	0.000	0.186	0.2665	0.0000	.0000E+00	.0000E+00	0.0000	.3686E-06	.7666E-09
170		0.00	0.000	0.267	0.2443	0.0000	.0000E+00	.0000E+00	0.0000	.3684E-06	.7663E-09
171		0.08	0.000	0.224	0.2323	0.0000	.0000E+00	.0000E+00	0.0000	.3682E-06	.7663E-09
172		0.00	0.000	0.219	0.2140	0.0000	.0000E+00	.0000E+00	0.0000	.3680E-06	.7663E-09
173		0.00	0.000	0.239	0.1941	0.0000	.0000E+00	.0000E+00	0.0000	.3678E-06	.7663E-09
174		0.34	0.000	0.248	0.2018	0.0000	.0000E+00	.0000E+00	0.0000	.3676E-06	.7663E-09
175		0.00	0.000	0.221	0.1833	0.0000	.0000E+00	.0000E+00	0.0000	.3674E-06	.7663E-09
176		0.00	0.000	0.109	0.1743	0.0000	.0000E+00	.0000E+00	0.0000	.3672E-06	.7663E-09
177		2.19	0.113	0.115	0.3378	0.0000	.0000E+00	.0000E+00	0.0000	.3670E-06	.7663E-09
178		0.02	0.000	0.274	0.3166	0.0000	.0000E+00	.0000E+00	0.0000	.3668E-06	.7663E-09
179		0.00	0.000	0.289	0.2908	0.0000	.0000E+00	.0000E+00	0.0000	.3666E-06	.7663E-09
180		0.17	0.000	0.265	0.2784	0.0000	.0000E+00	.0000E+00	0.0000	.3665E-06	.7663E-09
181		0.00	0.000	0.256	0.2525	0.0000	.0000E+00	.0000E+00	0.0000	.3663E-06	.7663E-09
182		1.25	0.001	0.272	0.3302	0.0000	.0000E+00	.0000E+00	0.0000	.3661E-06	.7663E-09
183		0.90	0.014	0.191	0.3845	0.0002	.7096E-02	.5038E-05	0.0000	.4726E-05	.2319E-08
184		0.00	0.000	0.198	0.3307	0.0000	.1466E-02	.9918E-06	0.0000	.1744E-05	.6752E-09
185		0.00	0.000	0.179	0.3035	0.0011	.4852E-01	.2795E-04	0.0000	.8066E-05	.2543E-08
186		0.00	0.000	0.248	0.2756	0.0026	.1150	.5997E-04	0.0000	.1538E-04	.7840E-09
187		0.03	0.000	0.272	0.2503	0.0025	.1100	.5802E-04	0.0000	.1561E-04	.7711E-09

188	0.65	0.000	0.227	0.2816	0.0022	.9662E-01	.5258E-04	0.0000	.1561E-04	.7711E-09
189	0.56	0.000	0.238	0.3060	0.0020	.8955E-01	.4966E-04	0.0000	.1560E-04	.7711E-09
190	0.03	0.000	0.218	0.2895	0.0019	.8386E-01	.4724E-04	0.0000	.1560E-04	.7711E-09
191	0.00	0.000	0.282	0.2660	0.0015	.6914E-01	.4079E-04	0.0000	.1559E-04	.7711E-09
192	0.00	0.000	0.266	0.2438	0.0012	.5382E-01	.3334E-04	0.0000	.1559E-04	.7711E-09
193	0.00	0.000	0.232	0.2245	0.0010	.4496E-01	.2938E-04	0.0000	.1558E-04	.7711E-09
194	1.30	0.001	0.277	0.3097	0.0008	.3790E-01	.2582E-04	0.0000	.1558E-04	.7710E-09
195	0.00	0.000	0.243	0.2894	0.0007	.3281E-01	.2314E-04	0.0000	.1557E-04	.7710E-09
196	0.00	0.000	0.281	0.2660	0.0006	.2844E-01	.2073E-04	0.0000	.1557E-04	.7710E-09
197	0.00	0.000	0.294	0.2414	0.0006	.2590E-01	.1934E-04	0.0000	.1557E-04	.7710E-09
198	0.00	0.000	0.290	0.2173	0.0005	.2337E-01	.1789E-04	0.0000	.1556E-04	.7710E-09
199	0.00	0.000	0.293	0.1929	0.0005	.2127E-01	.1666E-04	0.0000	.1556E-04	.7710E-09
200	0.00	0.000	0.303	0.1676	0.0004	.1951E-01	.1560E-04	0.0000	.1555E-04	.7710E-09
201	0.00	0.000	0.056	0.1630	0.0004	.1801E-01	.1468E-04	0.0000	.1483E-04	.7638E-09
202	0.00	0.000	0.000	0.1630	0.0004	.1672E-01	.1387E-04	0.0000	.1400E-04	.7637E-09
203	0.27	0.000	0.110	0.1763	0.0003	.1560E-01	.1316E-04	0.0000	.1327E-04	.7640E-09
204	0.63	0.000	0.111	0.2196	0.0003	.1461E-01	.1252E-04	0.0000	.1261E-04	.7643E-09
205	0.00	0.000	0.157	0.2065	0.0003	.1374E-01	.1195E-04	0.0000	.1202E-04	.7645E-09
206	0.00	0.000	0.192	0.1905	0.0003	.1296E-01	.1143E-04	0.0000	.1149E-04	.7647E-09
207	0.02	0.000	0.203	0.1753	0.0003	.1226E-01	.1097E-04	0.0000	.1101E-04	.7649E-09
208	0.00	0.000	0.125	0.1649	0.0003	.1163E-01	.1053E-04	0.0000	.1057E-04	.7650E-09
209	0.00	0.000	0.017	0.1634	0.0002	.1107E-01	.1014E-04	0.0000	.1017E-04	.7652E-09
210	0.04	0.000	0.039	0.1636	0.0002	.1055E-01	.9782E-05	0.0000	.9801E-05	.7653E-09
211	0.00	0.000	0.004	0.1632	0.0000	.1634E-02	.1525E-05	0.0000	.2861E-05	.6600E-09
212	0.00	0.000	0.002	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	.6256E-06	.6780E-09
213	0.00	0.000	0.001	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.4524E-06	.7666E-09
214	0.72	0.000	0.099	0.2148	0.0000	.2228E-08	.2602E-09	0.0000	.4518E-06	.7665E-09
215	0.00	0.000	0.137	0.2034	0.0000	.0000E+00	.0000E+00	0.0000	.4516E-06	.7667E-09
216	0.00	0.000	0.167	0.1895	0.0000	.0000E+00	.0000E+00	0.0000	.4512E-06	.7666E-09
217	0.00	0.000	0.106	0.1807	0.0000	.5007E-06	.2201E-08	0.0000	.4490E-06	.7660E-09
218	0.00	0.000	0.146	0.1685	0.0000	.0000E+00	.0000E+00	0.0000	.4501E-06	.7672E-09
219	0.00	0.000	0.053	0.1641	0.0000	.0000E+00	.0000E+00	0.0000	.4501E-06	.7666E-09
220	0.00	0.000	0.008	0.1634	0.0000	.0000E+00	.0000E+00	0.0000	.4497E-06	.7666E-09
221	0.00	0.000	0.004	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.4494E-06	.7666E-09
222	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.4490E-06	.7666E-09
223	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.4487E-06	.7666E-09
224	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.4484E-06	.7666E-09
225	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.4480E-06	.7666E-09
226	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.4477E-06	.7666E-09
227	0.32	0.000	0.096	0.1817	0.0000	.0000E+00	.0000E+00	0.0000	.4474E-06	.7666E-09
228	0.39	0.000	0.107	0.2053	0.0000	.0000E+00	.0000E+00	0.0000	.4471E-06	.7666E-09
229	0.07	0.000	0.134	0.1999	0.0000	.0000E+00	.0000E+00	0.0000	.4468E-06	.7666E-09
230	0.31	0.000	0.144	0.2137	0.0000	.0000E+00	.0000E+00	0.0000	.4465E-06	.7666E-09
231	0.01	0.000	0.149	0.2021	0.0000	.5473E-08	.3046E-09	0.0000	.4460E-06	.7665E-09
232	0.00	0.000	0.162	0.1886	0.0000	.0000E+00	.0000E+00	0.0000	.4459E-06	.7667E-09
233	0.00	0.000	0.126	0.1781	0.0000	.0000E+00	.0000E+00	0.0000	.4457E-06	.7666E-09
234	0.00	0.000	0.143	0.1661	0.0000	.0000E+00	.0000E+00	0.0000	.4454E-06	.7666E-09
235	0.00	0.000	0.025	0.1640	0.0000	.0000E+00	.0000E+00	0.0000	.4451E-06	.7666E-09
236	0.42	0.000	0.096	0.1910	0.0000	.0000E+00	.0000E+00	0.0000	.4449E-06	.7666E-09
237	0.00	0.000	0.050	0.1869	0.0000	.0000E+00	.0000E+00	0.0000	.4447E-06	.7666E-09
238	0.00	0.000	0.071	0.1809	0.0000	.1789E-08	.2506E-09	0.0000	.4442E-06	.7665E-09
239	0.09	0.000	0.096	0.1804	0.0000	.0000E+00	.0000E+00	0.0000	.4442E-06	.7667E-09
240	0.47	0.000	0.097	0.2115	0.0000	.1891E-07	.7892E-09	0.0000	.4433E-06	.7664E-09
241	0.01	0.000	0.136	0.2010	0.0000	.2257E-08	.2607E-09	0.0000	.4434E-06	.7668E-09
242	0.00	0.000	0.116	0.1913	0.0000	.0000E+00	.0000E+00	0.0000	.4435E-06	.7667E-09
243	0.00	0.000	0.094	0.1835	0.0000	.0000E+00	.0000E+00	0.0000	.4434E-06	.7666E-09
244	0.07	0.000	0.156	0.1763	0.0000	.5860E-08	.3086E-09	0.0000	.4429E-06	.7665E-09
245	0.00	0.000	0.095	0.1684	0.0000	.0000E+00	.0000E+00	0.0000	.4429E-06	.7667E-09
246	0.00	0.000	0.041	0.1649	0.0000	.0000E+00	.0000E+00	0.0000	.4428E-06	.7666E-09
247	0.00	0.000	0.015	0.1636	0.0000	.5992E-03	.8456E-06	0.0000	.1003E-05	.9608E-09
248	0.00	0.000	0.005	0.1632	0.0000	.0000E+00	.0000E+00	0.0000	.5579E-05	.4429E-09
249	0.00	0.000	0.002	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.1526E-05	.6470E-09
250	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.4393E-06	.7659E-09
251	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.4391E-06	.7660E-09
252	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.4390E-06	.7660E-09
253	0.00	0.000	0.000	0.1630	0.0000	.1138E-08	.2310E-09	0.0000	.4387E-06	.7659E-09
254	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.4387E-06	.7660E-09
255	1.23	0.000	0.062	0.2603	0.0000	.0000E+00	.0000E+00	0.0000	.4387E-06	.7660E-09
256	0.98	0.013	0.114	0.3314	0.0000	.4334E-21	.3331E-15	0.0000	.4385E-06	.7660E-09
257	0.97	0.045	0.111	0.3926	0.0000	.9222E-03	.7690E-06	0.0000	.1007E-05	.9649E-09
258	0.00	0.000	0.072	0.3401	0.0000	.0000E+00	.0000E+00	0.0000	.5517E-06	.2959E-08

259		0.00	0.000	0.076	0.3196	0.0008	.3725E-01	.2164E-04	0.0000	.1017E-04	.1670E-08
260		0.70	0.000	0.129	0.3595	0.0027	.1176	.5692E-04	0.0000	.8996E-05	.1885E-08
261		0.00	0.000	0.079	0.3394	0.0017	.7614E-01	.3664E-04	0.0000	.1572E-04	.7711E-09
262		0.62	0.000	0.095	0.3691	0.0031	.1367	.6193E-04	0.0000	.1572E-04	.7711E-09
263		0.00	0.000	0.072	0.3389	0.0031	.1365	.6120E-04	0.0000	.1571E-04	.7711E-09
264		0.00	0.000	0.040	0.3216	0.0062	.2764	.1169E-03	0.0000	.1571E-04	.7711E-09
265		0.00	0.000	0.077	0.3073	0.0045	.2012	.9178E-04	0.0000	.1570E-04	.7711E-09
266		0.00	0.000	0.049	0.2978	0.0033	.1465	.7209E-04	0.0000	.1570E-04	.7711E-09
267		0.00	0.000	0.058	0.2888	0.0025	.1117	.5871E-04	0.0000	.1569E-04	.7711E-09
268		0.00	0.000	0.077	0.2789	0.0021	.9236E-01	.5083E-04	0.0000	.1569E-04	.7711E-09
269		0.00	0.000	0.069	0.2701	0.0017	.7544E-01	.4360E-04	0.0000	.1568E-04	.7711E-09
270		0.09	0.000	0.089	0.2676	0.0015	.6681E-01	.3971E-04	0.0000	.1568E-04	.7711E-09
271		0.00	0.000	0.067	0.2605	0.0015	.6620E-01	.3949E-04	0.0000	.1568E-04	.7711E-09
272		0.00	0.000	0.058	0.2547	0.0013	.5761E-01	.3608E-04	0.0000	.1567E-04	.7711E-09
273		0.00	0.000	0.063	0.2483	0.0010	.4473E-01	.2927E-04	0.0000	.1567E-04	.7711E-09
274		0.00	0.000	0.084	0.2411	0.0011	.4963E-01	.3155E-04	0.0000	.1566E-04	.7711E-09
275		0.00	0.000	0.134	0.2300	0.0010	.4276E-01	.2829E-04	0.0000	.1566E-04	.7711E-09
276		0.02	0.000	0.100	0.2233	0.0008	.3643E-01	.2506E-04	0.0000	.1565E-04	.7711E-09
277		0.00	0.000	0.096	0.2153	0.0007	.3169E-01	.2254E-04	0.0000	.1565E-04	.7711E-09
278		0.04	0.000	0.084	0.2117	0.0006	.2802E-01	.2053E-04	0.0000	.1564E-04	.7711E-09
279		0.00	0.000	0.111	0.2024	0.0006	.2509E-01	.1888E-04	0.0000	.1564E-04	.7711E-09
280		0.00	0.000	0.071	0.1964	0.0005	.2270E-01	.1750E-04	0.0000	.1564E-04	.7711E-09
281		0.00	0.000	0.049	0.1923	0.0005	.2071E-01	.1632E-04	0.0000	.1563E-04	.7711E-09
282		0.00	0.000	0.079	0.1851	0.0003	.1268E-01	.1086E-04	0.0000	.1084E-04	.7701E-09
283		0.00	0.000	0.060	0.1801	0.0004	.1861E-01	.1505E-04	0.0000	.1503E-04	.7709E-09
284		0.00	0.000	0.052	0.1756	0.0004	.1688E-01	.1384E-04	0.0000	.1381E-04	.7707E-09
285		0.00	0.000	0.045	0.1717	0.0004	.1582E-01	.1318E-04	0.0000	.1314E-04	.7706E-09
286		0.00	0.000	0.041	0.1683	0.0003	.1522E-01	.1292E-04	0.0000	.1288E-04	.7705E-09
287		0.00	0.000	0.038	0.1652	0.0003	.1428E-01	.1231E-04	0.0000	.1226E-04	.7704E-09
288		0.02	0.000	0.040	0.1635	0.0003	.1344E-01	.1176E-04	0.0000	.1171E-04	.7703E-09
289		0.01	0.000	0.010	0.1634	0.0003	.1270E-01	.1126E-04	0.0000	.1120E-04	.7702E-09
290		0.00	0.000	0.003	0.1632	0.0003	.1203E-01	.1081E-04	0.0000	.1075E-04	.7701E-09
291		0.00	0.000	0.001	0.1631	0.0003	.1142E-01	.1039E-04	0.0000	.1033E-04	.7700E-09
292	*	0.00	0.000	0.000	0.1631	0.0002	.1087E-01	.1001E-04	0.0000	.9943E-05	.7699E-09
293	*	0.00	0.000	0.001	0.1630	0.0002	.8281E-02	.7705E-05	0.0000	.7638E-05	.7695E-09
294		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.6294E-06	.7670E-09
295	*	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.6288E-06	.7670E-09
296	*	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.6282E-06	.7670E-09
297	*	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.6276E-06	.7670E-09
298	*	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.6271E-06	.7670E-09
299		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.6265E-06	.7670E-09
300	*	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.6260E-06	.7670E-09
301		0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.6254E-06	.7670E-09
302		0.05	0.000	0.017	0.1657	0.0000	.0000E+00	.0000E+00	0.0000	.6249E-06	.7670E-09
303		0.00	0.000	0.002	0.1656	0.0000	.0000E+00	.0000E+00	0.0000	.6243E-06	.7670E-09
304		0.00	0.000	0.006	0.1651	0.0000	.0000E+00	.0000E+00	0.0000	.6238E-06	.7670E-09
305		0.00	0.000	0.004	0.1648	0.0000	.2100E-06	.1104E-07	0.0000	.6122E-06	.7670E-09
306		0.00	0.000	0.004	0.1644	0.0000	.5776E-08	.3078E-09	0.0000	.6225E-06	.7670E-09
307		0.00	0.000	0.004	0.1641	0.0000	.0000E+00	.0000E+00	0.0000	.6223E-06	.7670E-09
308		0.00	0.000	0.004	0.1638	0.0000	.0000E+00	.0000E+00	0.0000	.6218E-06	.7670E-09
309		0.00	0.000	0.003	0.1635	0.0000	.5916E-05	.2191E-07	0.0000	.5994E-06	.7670E-09
310	*	0.00	0.000	0.003	0.1633	0.0000	.0000E+00	.0000E+00	0.0000	.6208E-06	.7670E-09
311	*	0.00	0.000	0.003	0.1631	0.0000	.1519E-05	.1167E-07	0.0000	.6087E-06	.7670E-09
312	*	0.00	0.000	0.000	0.1631	0.0000	.0000E+00	.0000E+00	0.0000	.6199E-06	.7670E-09
313	*	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.6195E-06	.7670E-09
314	*	0.00	0.000	0.000	0.1630	0.0000	.0000E+00	.0000E+00	0.0000	.6190E-06	.7670E-09
315	*	0.15	0.000	0.025	0.1646	0.0000	.0000E+00	.0000E+00	0.0000	.6186E-06	.7670E-09
316	*	0.00	0.000	0.028	0.1663	0.0000	.0000E+00	.0000E+00	0.0000	.6181E-06	.7670E-09
317		0.20	0.000	0.000	0.1878	0.0000	.0000E+00	.0000E+00	0.0000	.6177E-06	.7670E-09
318		0.32	0.000	0.024	0.2125	0.0000	.0000E+00	.0000E+00	0.0000	.6173E-06	.7670E-09
319		0.00	0.000	0.012	0.2115	0.0000	.0000E+00	.0000E+00	0.0000	.6168E-06	.7670E-09
320		0.00	0.000	0.014	0.2103	0.0000	.9069E-08	.3383E-09	0.0000	.6161E-06	.7670E-09
321		0.00	0.000	0.014	0.2092	0.0000	.0000E+00	.0000E+00	0.0000	.6160E-06	.7670E-09
322		0.07	0.000	0.030	0.2125	0.0000	.0000E+00	.0000E+00	0.0000	.6156E-06	.7670E-09
323		0.00	0.000	0.013	0.2114	0.0000	.0000E+00	.0000E+00	0.0000	.6152E-06	.7670E-09
324		0.00	0.000	0.015	0.2102	0.0000	.0000E+00	.0000E+00	0.0000	.6149E-06	.7670E-09
325		0.01	0.000	0.021	0.2092	0.0000	.0000E+00	.0000E+00	0.0000	.6145E-06	.7670E-09
326		0.00	0.000	0.013	0.2081	0.0000	.0000E+00	.0000E+00	0.0000	.6141E-06	.7670E-09
327		0.03	0.000	0.026	0.2084	0.0000	.0000E+00	.0000E+00	0.0000	.6138E-06	.7670E-09
328		0.03	0.000	0.026	0.2087	0.0000	.0000E+00	.0000E+00	0.0000	.6134E-06	.7670E-09
329		0.00	0.000	0.012	0.2077	0.0000	.0000E+00	.0000E+00	0.0000	.6131E-06	.7670E-09

330		0.00	0.000	0.014	0.2066	0.0000	.0000E+00	.0000E+00	0.0000	.6127E-06	.7670E-09
331		0.00	0.000	0.013	0.2054	0.0000	.0000E+00	.0000E+00	0.0000	.6124E-06	.7670E-09
332		0.13	0.000	0.029	0.2138	0.0000	.0000E+00	.0000E+00	0.0000	.6121E-06	.7670E-09
333		0.01	0.000	0.021	0.2129	0.0000	.0000E+00	.0000E+00	0.0000	.6118E-06	.7670E-09
334		0.00	0.000	0.013	0.2118	0.0000	.0000E+00	.0000E+00	0.0000	.6115E-06	.7670E-09
335	*	0.00	0.000	0.013	0.2107	0.0000	.0000E+00	.0000E+00	0.0000	.6112E-06	.7670E-09
336	*	0.00	0.000	0.000	0.2107	0.0000	.0000E+00	.0000E+00	0.0000	.6109E-06	.7670E-09
337	*	0.00	0.000	0.000	0.2107	0.0000	.0000E+00	.0000E+00	0.0000	.6106E-06	.7670E-09
338	*	0.32	0.000	0.013	0.2124	0.0000	.0000E+00	.0000E+00	0.0000	.6103E-06	.7670E-09
339	*	0.02	0.000	0.000	0.2140	0.0000	.0000E+00	.0000E+00	0.0000	.6100E-06	.7670E-09
340	*	0.00	0.000	0.021	0.2156	0.0000	.0000E+00	.0000E+00	0.0000	.6098E-06	.7670E-09
341		0.00	0.000	0.003	0.2330	0.0000	.0000E+00	.0000E+00	0.0000	.6095E-06	.7670E-09
342	*	0.00	0.000	0.021	0.2343	0.0000	.0000E+00	.0000E+00	0.0000	.6093E-06	.7670E-09
343	*	0.00	0.000	0.014	0.2332	0.0000	.0000E+00	.0000E+00	0.0000	.6090E-06	.7670E-09
344	*	0.00	0.000	0.013	0.2321	0.0000	.0000E+00	.0000E+00	0.0000	.6088E-06	.7670E-09
345		0.00	0.000	0.012	0.2310	0.0000	.6991E-08	.3198E-09	0.0000	.6082E-06	.7670E-09
346	*	0.00	0.000	0.000	0.2310	0.0000	.0000E+00	.0000E+00	0.0000	.6083E-06	.7670E-09
347		0.00	0.000	0.012	0.2300	0.0000	.0000E+00	.0000E+00	0.0000	.6081E-06	.7670E-09
348		0.00	0.000	0.012	0.2290	0.0000	.0000E+00	.0000E+00	0.0000	.6079E-06	.7670E-09
349		0.00	0.000	0.012	0.2280	0.0000	.0000E+00	.0000E+00	0.0000	.6077E-06	.7670E-09
350	*	0.00	0.000	0.000	0.2280	0.0000	.0000E+00	.0000E+00	0.0000	.6075E-06	.7670E-09
351	*	0.00	0.000	0.000	0.2280	0.0000	.2463E-09	.1603E-09	0.0000	.6072E-06	.7670E-09
352		0.00	0.000	0.012	0.2270	0.0000	.0000E+00	.0000E+00	0.0000	.6072E-06	.7670E-09
353	*	0.00	0.000	0.000	0.2270	0.0000	.0000E+00	.0000E+00	0.0000	.6070E-06	.7670E-09
354	*	0.23	0.000	0.015	0.2286	0.0000	.0000E+00	.0000E+00	0.0000	.6068E-06	.7670E-09
355	*	0.14	0.000	0.015	0.2303	0.0000	.0000E+00	.0000E+00	0.0000	.6067E-06	.7670E-09
356	*	0.00	0.000	0.009	0.2319	0.0000	.0000E+00	.0000E+00	0.0000	.6065E-06	.7670E-09
357	*	0.00	0.000	0.012	0.2335	0.0000	.0000E+00	.0000E+00	0.0000	.6064E-06	.7670E-09
358	* *	0.02	0.000	0.014	0.2335	0.0000	.0000E+00	.0000E+00	0.0000	.6063E-06	.7670E-09
359	* *	0.00	0.000	0.013	0.2335	0.0000	.0000E+00	.0000E+00	0.0000	.6061E-06	.7670E-09
360	* *	0.02	0.000	0.000	0.2335	0.0000	.0000E+00	.0000E+00	0.0000	.6060E-06	.7670E-09
361	* *	0.01	0.000	0.013	0.2335	0.0000	.0000E+00	.0000E+00	0.0000	.6059E-06	.7670E-09
362	* *	0.06	0.000	0.000	0.2335	0.0000	.0000E+00	.0000E+00	0.0000	.6058E-06	.7670E-09
363	* *	0.11	0.000	0.000	0.2335	0.0000	.0000E+00	.0000E+00	0.0000	.6057E-06	.7670E-09
364	* *	0.09	0.000	0.000	0.2335	0.0000	.0000E+00	.0000E+00	0.0000	.6056E-06	.7670E-09
365	* *	0.00	0.000	0.022	0.2335	0.0000	.0000E+00	.0000E+00	0.0000	.6055E-06	.7670E-09

****

****

MONTHLY TOTALS (IN INCHES) FOR YEAR 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	0.38	0.17	0.81	3.49	3.14	4.85
	5.68	2.81	4.66	0.14	0.95	1.02
RUNOFF	0.000	0.000	0.469	2.404	0.000	0.113
	0.016	0.000	0.057	0.000	0.000	0.000
EVAPOTRANSPIRATION	0.476	0.147	0.111	0.478	3.478	4.936
	5.819	2.565	1.772	1.126	0.389	0.271
LATERAL DRAINAGE COLLECTED FROM LAYER 3	0.0000	0.0000	0.0000	0.0000	1.2264	0.0229
	1.0481	0.0000	1.6447	0.4193	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.0000	0.0000	0.0000	0.0000	0.0007	0.0000
	0.0007	0.0000	0.0008	0.0003	0.0000	0.0000

LATERAL DRAINAGE COLLECTED	0.0000	0.0000	0.0000	0.0000	0.0003	0.0000
FROM LAYER 8	0.0004	0.0000	0.0002	0.0003	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAYER 10	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.001	0.000
TOP OF LAYER 4	0.001	0.000	0.001	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.001	0.000
HEAD ON TOP OF LAYER 4	0.001	0.000	0.002	0.000	0.000	0.000
AVERAGE DAILY HEAD ON	0.000	0.000	0.000	0.000	0.000	0.000
TOP OF LAYER 9	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATION OF DAILY	0.000	0.000	0.000	0.000	0.000	0.000
HEAD ON TOP OF LAYER 9	0.000	0.000	0.000	0.000	0.000	0.000

****

****

ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	28.10	3468102.500	100.00
RUNOFF	3.059	377523.250	10.89
EVAPOTRANSPIRATION	21.568	2661975.750	76.76
DRAINAGE COLLECTED FROM LAYER 3	4.3613	538274.000	15.52
PERC./LEAKAGE THROUGH LAYER 4	0.002562	316.192	0.01
AVG. HEAD ON TOP OF LAYER 4	0.0003		
DRAINAGE COLLECTED FROM LAYER 8	0.0013	163.333	0.00
PERC./LEAKAGE THROUGH LAYER 10	0.000000	0.035	0.00
AVG. HEAD ON TOP OF LAYER 9	0.0000		
CHANGE IN WATER STORAGE	-0.890	-109835.414	-3.17
SOIL WATER AT START OF YEAR	111.236	13728695.000	
SOIL WATER AT END OF YEAR	109.983	13574065.000	

SNOW WATER AT START OF YEAR	0.125	15443.600	0.45
SNOW WATER AT END OF YEAR	0.488	60238.176	1.74
ANNUAL WATER BUDGET BALANCE	0.0000	1.463	0.00

****

****

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.86	0.64	1.65	2.49	2.77	4.67
	2.88	3.34	2.68	1.18	1.93	0.68
STD. DEVIATIONS	0.90	0.34	0.90	1.34	1.04	0.83
	2.15	1.85	1.28	0.99	1.64	0.43
RUNOFF						
TOTALS	0.010	0.039	1.279	1.107	0.000	0.027
	0.003	0.079	0.023	0.004	0.063	0.053
STD. DEVIATIONS	0.023	0.054	0.985	1.130	0.000	0.049
	0.007	0.096	0.027	0.010	0.099	0.083
EVAPOTRANSPIRATION						
TOTALS	0.318	0.327	0.285	1.603	2.852	4.469
	3.355	2.165	2.190	0.877	0.664	0.311
STD. DEVIATIONS	0.167	0.166	0.195	0.987	1.537	0.433
	1.604	0.992	0.764	0.537	0.455	0.102
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.0000	0.0000	0.0000	0.2288	0.5868	0.1608
	0.3416	0.1892	0.9328	0.2302	0.6544	0.2961
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.3000	0.4387	0.2601
	0.4343	0.3173	1.0977	0.3334	0.7819	0.4270
PERCOLATION/LEAKAGE THROUGH LAYER 4						
TOTALS	0.0000	0.0000	0.0000	0.0001	0.0004	0.0001
	0.0002	0.0001	0.0005	0.0002	0.0004	0.0002

STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0002	0.0002	0.0002
	0.0003	0.0002	0.0005	0.0002	0.0004	0.0003

LATERAL DRAINAGE COLLECTED FROM LAYER 8

TOTALS	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001
	0.0002	0.0002	0.0002	0.0001	0.0001	0.0001
STD. DEVIATIONS	0.0001	0.0001	0.0002	0.0002	0.0001	0.0001
	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001

PERCOLATION/LEAKAGE THROUGH LAYER 10

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0000	0.0000	0.0000	0.0002	0.0004	0.0001
	0.0002	0.0001	0.0007	0.0002	0.0005	0.0002
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0002	0.0003	0.0002
	0.0003	0.0002	0.0009	0.0002	0.0006	0.0003

DAILY AVERAGE HEAD ON TOP OF LAYER 9

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

****

****

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

	INCHES		CU. FEET	PERCENT
PRECIPITATION	25.76	(7.822)	3178805.7	100.00
RUNOFF	2.687	(1.7041)	331582.09	10.431
EVAPOTRANSPIRATION	19.416	(3.5558)	2396290.00	75.383

LATERAL DRAINAGE COLLECTED FROM LAYER 3	3.62063 (2.14097)	446858.344	14.05743
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.00224 (0.00111)	275.986	0.00868
AVERAGE HEAD ON TOP OF LAYER 4	0.000 (0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 8	0.00141 (0.00066)	173.954	0.00547
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.00000 (0.00000)	0.022	0.00000
AVERAGE HEAD ON TOP OF LAYER 9	0.000 (0.000)		
CHANGE IN WATER STORAGE	0.032 (1.2659)	3900.93	0.123

****

****

PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	2.36	291271.187
RUNOFF	1.659	204705.5160
DRAINAGE COLLECTED FROM LAYER 3	0.58956	72763.50780
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.000201	24.84745
AVERAGE HEAD ON TOP OF LAYER 4	0.014	
MAXIMUM HEAD ON TOP OF LAYER 4	0.026	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	1.0 FEET	
DRAINAGE COLLECTED FROM LAYER 8	0.00002	1.94020
PERCOLATION/LEAKAGE THROUGH LAYER 10	0.000000	0.00074
AVERAGE HEAD ON TOP OF LAYER 9	0.000	
MAXIMUM HEAD ON TOP OF LAYER 9	0.001	
LOCATION OF MAXIMUM HEAD IN LAYER 8 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	2.69	331528.1250

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.4170
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1630

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

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

****

****

FINAL WATER STORAGE AT END OF YEAR 1978

LAYER	(INCHES)	(VOL/VOL)
1	1.3721	0.2287
2	5.5343	0.3075
3	0.0020	0.0100
4	0.0000	0.0000
5	0.5412	0.0451
6	91.2000	0.0760
7	0.5431	0.0453
8	0.0020	0.0100
9	0.0000	0.0000
10	10.2480	0.4270
SNOW WATER	0.488	

****
****

Appendix G

Surface Water Analysis

Surface Water Analysis

The surface water management system has been designed to manage the 25-year, 24-hour storm event of 5.7 inches. Stormwater generated by the landfill will be controlled on-site. Runoff will be controlled and routed by drainage swales, downslope structures, ditches and sedimentation basins as shown in the drawings. Drainage routing features have all been sized adequately to minimize erosion from the site based on the referenced storm event.

Surface water from the landfill cover system will be directed to the sedimentation pond located on the south and west sides of the site. The current sedimentation basin is sufficiently sized to control the increased storm water, with some additional routing features included. The outlets from the pond allow controlled discharge through rip rap which will be the final discharge point from the site.

HydroCAD-Stormwater Modeling, using the SCS Curve Number method, was used to calculate run-off hydrographs for the final landfill configuration. To determine surface water run-off for this analysis, the landfill was divided into subwatersheds according to the contributing drainage areas. Subwatershed areas are shown on Figure 1. A run-off curve number of 78 was assigned to the landfill area; representative of HSG C soils with fair grass cover (50% to 70%). A run-off curve number of 99 was assigned to the sedimentation pond area. Time of concentration in the final cover area was calculated using the HydroCAD model by inputting hydraulic distance and slope for each sub-watershed for applicable sheet flow and shallow concentrated flow conditions. To be conservative, any time of concentration that was calculated in the model to be greater than 6.0 min was edited and directly entered into the model as 6.0 min.

Runoff calculations were used in sizing the various components of the surface water management system discussed below.

Drainage Swale Design

The landfill site utilizes drainage swales to transport stormwater off the final cover. They are placed every 160 feet, at a minimum, on the 25% final cover grades in order to intercept and direct flow, as well as minimize erosion. The drainage swales are designed with the following characteristics:

Height:	2 ft
Slope:	2%
Uphill side slope:	4H:1V
Downhill side slope:	3H:1V
Mannings "n" value	0.03

The peak flow rate is 14.13 cfs which results in a flow depth of 0.92 feet and a flow velocity of 4.37 fps. As an additional safety factor, the swales will be lined with an erosion control blanket capable of withstanding velocities of 6 to 8 fps.

Downslope Structure, Perimeter Ditch, and Drainage Channel Design

The drainage swales discharge to one of three downslope structures that eventually outlet to a perimeter ditch that drains to the sedimentation pond or directly to the sedimentation pond.

Peak flows were calculated for each contributing portion of the subwatershed to individual ditches and channels. Based on the peak flows and assumed channel sections, peak velocities, and flow depths, the reinforcement of each downslope structure was determined. Although details of the channel reinforcement required is presented on the plans, alternative methods may be substituted during construction if the shear stress and maximum velocity criteria are met.

Downslope Structure A (West)

Approximately 8.2 acres of the site drain via swales to some portion of the downslope structure located in the west central portion of the site (Reach 6). Below is a summary table of the segments of the downslope structure. This structure discharges directly to Sedimentation Pond 2.

Structure Section	Slope (ft/ft)	Bottom Width (ft)	Inflow Area (acre)	Peak Flow (cfs)	Flow Depth (ft)	Max Flow Velocity (ft/s)	Shear Stress (psf)
6a	0.231	6	1.1	5.79	0.19	4.48	2.74
6b	0.225	6	3.6	18.56	0.39	6.67	5.49
6c	0.186	6	8.2	42.06	0.65	8.18	7.56

Downslope Structure B (North)

The drainage area contributing to the north side structure is approximately 2.6 acres, producing a peak flow of 13.47 cfs. Below is a summary table of the segments of the downslope structure. The structure discharges to a drainage ditch which outlets into Sedimentation Pond 1 near the SE corner of the site.

Structure Section	Slope (ft/ft)	Bottom Width (ft)	Inflow Area (acre)	Peak Flow (cfs)	Flow Depth (ft)	Max Flow Velocity (ft/s)	Shear Stress (psf)
13a	0.247	6	0.7	3.67	0.15	3.87	2.31
13b	0.242	6	2.6	13.47	0.31	6.14	4.69

Downslope Structure C (East)

The drainage area contributing to the east side structure is approximately 8 acres, producing a peak flow of 41.33 cfs. This downslope structure outlets to Sedimentation Pond 1. Below is a summary table of the segments of the downslope structure.

Structure Section	Slope (ft/ft)	Bottom Width (ft)	Inflow Area (acre)	Peak Flow (cfs)	Flow Depth (ft)	Max Flow Velocity (ft/s)	Shear Stress (psf)
20a	0.187	6	1.1	5.79	0.21	4.18	3.28
20b	0.252	6	3.8	19.8	0.39	7.09	6.01
20c	0.232	6	8.0	41.33	0.60	8.78	9.18

Sedimentation Ponds

The proposed design consists of two sedimentation ponds. Sedimentation Pond 1 is located on the southeast corner of the site and has a capacity of 2.5 acre-ft and drains into Sedimentation Pond 2. Pond 2 is located on the south and west ends of the site and will have a capacity of 4.5 acre-ft. The ponds are intended to control runoff from the property and to reduce scour and erosion. The pond will outlet via a proposed 30-inch CMP pipe at outlet invert of 1218' connected to a orifice and

standpipe which has an invert of 1222'. This device will serve as the sites ultimate discharge point. An emergency overflow area constructed from a 100 foot wide, 0.5 foot deep overflow weir at elevation 1223.5' will be graded in the berm at the discharge point to aid in controlling severe rain events.

The design parameters for the sedimentation basins are listed below:

Pond	Bottom Elevation (ft)	Top Elevation (ft)	Inlet Elevation (ft)	Outlet Elevation (ft)	Total Storage Capacity (ac-ft)
1	1219	1225	1219	1218.7	2.5
2	1218	1224	1218	1217.8	4.5

Routing the 25-year, 24-hour storm event through the sedimentation basins provides the following information. The sedimentation basin design incorporates permanent dead storage, which is the volume below the normal outlet. The values shown on the table below reflect the conservative assumption that the pond dead storage is full.

Pond	Peak Inflow (cfs)	Peak Outflow (cfs)	Peak Elevation (ft)	Top Elevation (ft)	Permanent Dead Storage (ac-ft)	Peak Storage From Storm (ac-ft)
1	74.52	34.64	1222.65	1225	0	1.523
2	102.35	28.19	1223.38	1224	0.203	3.938

The calculations above demonstrate that the sedimentation basins manage the runoff from a 25 year 24 hour event without utilizing the emergency weir. Therefore, the design of the sedimentation basin is acceptable.

Annual Soil Loss

The Revised Universal Soil Loss Equation was used to estimate the sediment loss from the closed facility. The results of the RUSLE indicate that the annual sediment generation off the site will be approximately 1.84 tons/ac/year or approximately 1.36 cy/acre/year. Regular maintenance, which requires cleaning of the sediment out of the ponds, will be required as part of the site operation and maintenance.

NORTH LINE NW1/4 SW1/4
SECTION 21-T103N-R18W

NW CORNER NW1/4 SW1/4
SECTION 21-T103N-R18W

SCALE IN FEET
0 150 300

SOUTH LINE NW1/4 SW1/4
SECTION 21-T103N-R18W

SE CORNER NW1/4 SW1/4
SECTION 21-T103N-R18W

LINE OF THE NORTH 10
OF THE SW1/4 SW1/4
ON 21-T103N-R18W

THE NORTH 10
SW1/4 SW1/4
03N-R18W

ABANDONED
MOBILE HOME

WATER
SPIGOT

WELL

SCALE

1300

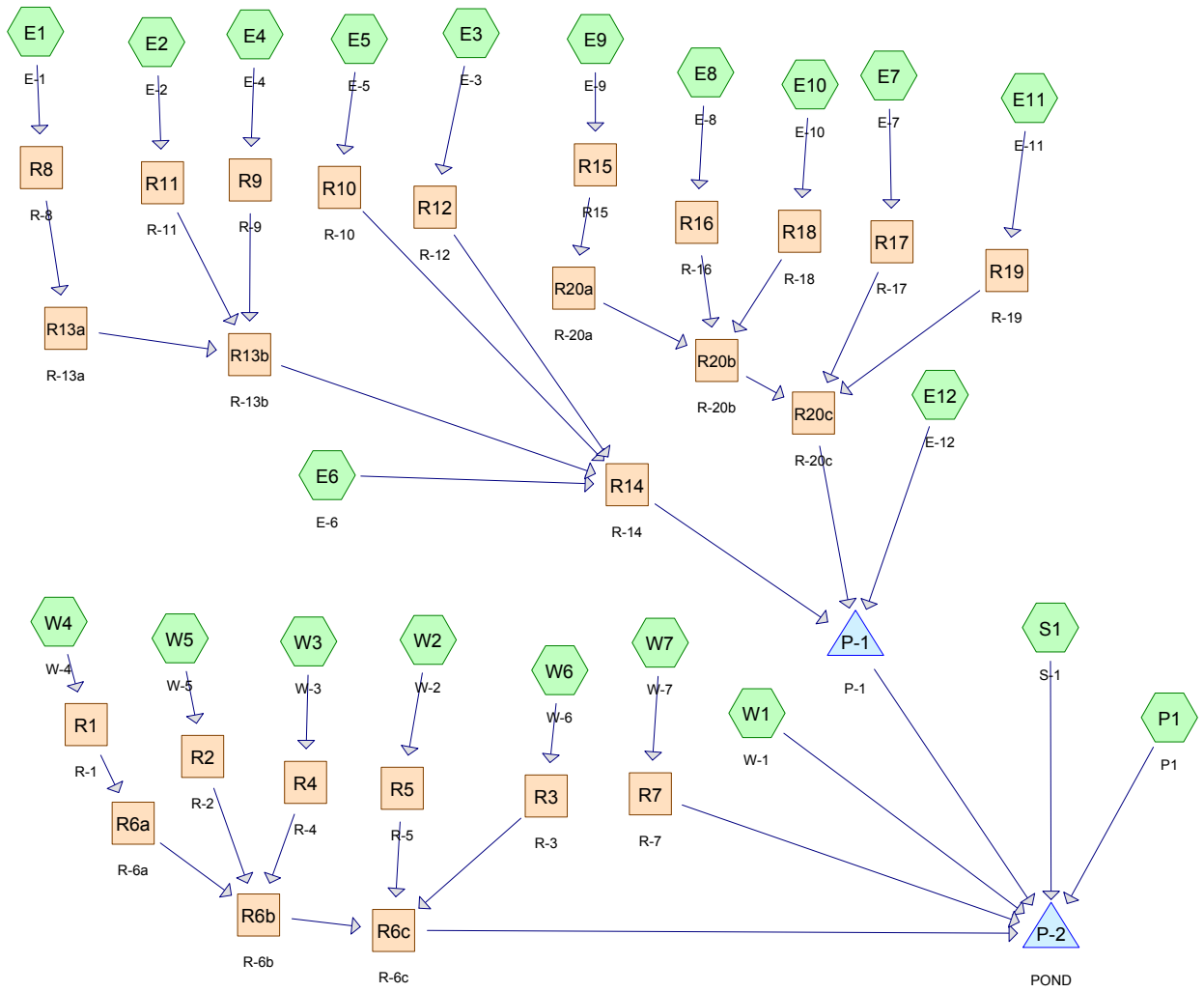
E-1
E-2
E-3
E-4
E-5
E-6
E-7
E-8
E-9
E-10
E-11
E-12

W-1
W-2
W-3
W-4
W-5
W-6
W-7

P-1
P-2

S-1

R-1
R-2
R-3
R-4
R-5
R-6a
R-6b
R-6c
R-7
R-8
R-9
R-10
R-11
R-12
R-13A
R-13B
R-14
R-15
R-16
R-17
R-18
R-19
R-20a
R-20b
R-20c



Subcat Reach Pond Link

Routing Diagram for Lansing SW Model

Prepared by {enter your company name here}, Printed 6/2/2016

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
33.280	78	(E1, E10, E11, E12, E2, E3, E4, E5, E6, E7, E8, E9, S1, W1, W2, W3, W4, W5, W6, W7)
1.500	99	(P1)
34.780	**79**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
34.780	Other	E1, E10, E11, E12, E2, E3, E4, E5, E6, E7, E8, E9, P1, S1, W1, W2, W3, W4, W5, W6, W7
34.780		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	34.780	34.780		E1, E10, E11, E12, E2, E3, E4, E5, E6, E7, E8, E9, P1, S1, W1, W2, W3, W4, W5, W6, W7
0.000	**0.000**	**0.000**	**0.000**	**34.780**	**34.780**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	P-1	1,219.00	1,218.70	60.0	0.0050	0.025	36.0	0.0	0.0
2	P-2	1,218.00	1,217.80	40.0	0.0050	0.025	30.0	0.0	0.0

Time span=0.00-20.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentE1: E-1 Runoff Area=0.700 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=3.96 cfs 0.179 af

SubcatchmentE10: E-10 Runoff Area=1.200 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=6.78 cfs 0.307 af

SubcatchmentE11: E-11 Runoff Area=2.100 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=11.87 cfs 0.538 af

SubcatchmentE12: E-12 Runoff Area=1.180 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=6.67 cfs 0.302 af

SubcatchmentE2: E-2 Runoff Area=0.500 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=2.83 cfs 0.128 af

SubcatchmentE3: E-3 Runoff Area=0.900 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=5.09 cfs 0.230 af

SubcatchmentE4: E-4 Runoff Area=1.400 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=7.91 cfs 0.359 af

SubcatchmentE5: E-5 Runoff Area=1.600 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=9.04 cfs 0.410 af

SubcatchmentE6: E-6 Runoff Area=3.200 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=18.09 cfs 0.819 af

SubcatchmentE7: E-7 Runoff Area=2.100 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=11.87 cfs 0.538 af

SubcatchmentE8: E-8 Runoff Area=1.500 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=8.48 cfs 0.384 af

SubcatchmentE9: E-9 Runoff Area=1.100 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=6.22 cfs 0.282 af

SubcatchmentP1: P1 Runoff Area=1.500 ac 100.00% Impervious Runoff Depth>5.30"
Tc=6.0 min CN=99 Runoff=11.89 cfs 0.663 af

SubcatchmentS1: S-1 Runoff Area=3.900 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=22.04 cfs 0.999 af

SubcatchmentW1: W-1 Runoff Area=1.500 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=8.48 cfs 0.384 af

SubcatchmentW2: W-2 Runoff Area=2.500 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=14.13 cfs 0.640 af

SubcatchmentW3: W-3 Runoff Area=1.100 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=6.22 cfs 0.282 af

SubcatchmentW4: W-4 Runoff Area=1.100 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=6.22 cfs 0.282 af

SubcatchmentW5: W-5 Runoff Area=1.400 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=7.91 cfs 0.359 af

SubcatchmentW6: W-6 Runoff Area=2.100 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=11.87 cfs 0.538 af

SubcatchmentW7: W-7 Runoff Area=2.200 ac 0.00% Impervious Runoff Depth>3.07"
Tc=6.0 min CN=78 Runoff=12.43 cfs 0.563 af

Reach R1: R-1 Avg. Flow Depth=0.71' Max Vel=3.48 fps Inflow=6.22 cfs 0.282 af
n=0.030 L=335.0' S=0.0209 '/' Capacity=97.61 cfs Outflow=5.79 cfs 0.281 af

Reach R10: R-10 Avg. Flow Depth=0.81' Max Vel=3.69 fps Inflow=9.04 cfs 0.410 af
n=0.030 L=615.0' S=0.0195 '/' Capacity=94.32 cfs Outflow=8.39 cfs 0.408 af

Reach R11: R-11 Avg. Flow Depth=0.53' Max Vel=2.89 fps Inflow=2.83 cfs 0.128 af
n=0.030 L=233.0' S=0.0215 '/' Capacity=98.92 cfs Outflow=2.67 cfs 0.128 af

Reach R12: R-12 Avg. Flow Depth=0.66' Max Vel=3.25 fps Inflow=5.09 cfs 0.230 af
n=0.030 L=400.0' S=0.0200 '/' Capacity=95.49 cfs Outflow=4.71 cfs 0.230 af

Reach R13a: R-13a Avg. Flow Depth=0.15' Max Vel=3.87 fps Inflow=3.67 cfs 0.179 af
n=0.050 L=162.0' S=0.2469 '/' Capacity=984.06 cfs Outflow=3.59 cfs 0.179 af

Reach R13b: R-13b Avg. Flow Depth=0.31' Max Vel=6.14 fps Inflow=13.47 cfs 0.664 af
n=0.050 L=132.0' S=0.2424 '/' Capacity=975.07 cfs Outflow=13.31 cfs 0.663 af

Reach R14: R-14 Avg. Flow Depth=1.28' Max Vel=4.92 fps Inflow=41.48 cfs 2.121 af
n=0.040 L=1,375.0' S=0.0262 '/' Capacity=268.35 cfs Outflow=35.75 cfs 2.105 af

Reach R15: R15 Avg. Flow Depth=0.71' Max Vel=3.48 fps Inflow=6.22 cfs 0.282 af
n=0.030 L=335.0' S=0.0209 '/' Capacity=97.61 cfs Outflow=5.79 cfs 0.281 af

Reach R16: R-16 Avg. Flow Depth=0.79' Max Vel=3.69 fps Inflow=8.48 cfs 0.384 af
n=0.030 L=498.0' S=0.0201 '/' Capacity=95.68 cfs Outflow=7.85 cfs 0.383 af

Reach R17: R-17 Avg. Flow Depth=0.90' Max Vel=3.95 fps Inflow=11.87 cfs 0.538 af
n=0.030 L=665.0' S=0.0195 '/' Capacity=94.41 cfs Outflow=11.01 cfs 0.536 af

Reach R18: R-18 Avg. Flow Depth=0.72' Max Vel=3.62 fps Inflow=6.78 cfs 0.307 af
n=0.030 L=495.0' S=0.0222 '/' Capacity=100.66 cfs Outflow=6.28 cfs 0.306 af

Reach R19: R-19 Avg. Flow Depth=0.88' Max Vel=4.03 fps Inflow=11.87 cfs 0.538 af
n=0.030 L=767.0' S=0.0209 '/' Capacity=97.53 cfs Outflow=10.85 cfs 0.535 af

Reach R2: R-2 Avg. Flow Depth=0.74' Max Vel=4.13 fps Inflow=7.91 cfs 0.359 af
n=0.030 L=321.0' S=0.0280 '/' Capacity=113.06 cfs Outflow=7.48 cfs 0.358 af

Reach R20a: R-20a Avg. Flow Depth=0.21' Max Vel=4.18 fps Inflow=5.79 cfs 0.281 af
n=0.050 L=160.0' S=0.1875 '/' Capacity=857.53 cfs Outflow=5.66 cfs 0.281 af

Reach R20b: R-20b Avg. Flow Depth=0.39' Max Vel=7.09 fps Inflow=19.80 cfs 0.970 af
n=0.050 L=159.0' S=0.2516 '/' Capacity=993.30 cfs Outflow=19.52 cfs 0.969 af

Reach R20c: R-20c Avg. Flow Depth=0.60' Max Vel=8.78 fps Inflow=41.33 cfs 2.040 af
n=0.050 L=56.0' S=0.2321 '/' Capacity=954.17 cfs Outflow=41.13 cfs 2.040 af

Reach R3: R-3 Avg. Flow Depth=0.86' Max Vel=4.37 fps Inflow=11.87 cfs 0.538 af
n=0.030 L=558.0' S=0.0251 '/' Capacity=106.96 cfs Outflow=10.99 cfs 0.536 af

Reach R4: R-4 Avg. Flow Depth=0.71' Max Vel=3.33 fps Inflow=6.22 cfs 0.282 af
n=0.030 L=477.0' S=0.0189 '/' Capacity=92.75 cfs Outflow=5.76 cfs 0.281 af

Reach R5: R-5 Avg. Flow Depth=0.92' Max Vel=4.37 fps Inflow=14.13 cfs 0.640 af
n=0.030 L=824.0' S=0.0231 '/' Capacity=102.53 cfs Outflow=12.96 cfs 0.637 af

Reach R6a: R-6a Avg. Flow Depth=0.19' Max Vel=4.48 fps Inflow=5.79 cfs 0.281 af
n=0.050 L=160.0' S=0.2313 '/' Capacity=952.33 cfs Outflow=5.67 cfs 0.281 af

Reach R6b: R-6b Avg. Flow Depth=0.39' Max Vel=6.67 fps Inflow=18.56 cfs 0.919 af
n=0.050 L=204.0' S=0.2255 '/' Capacity=940.40 cfs Outflow=18.31 cfs 0.918 af

Reach R6c: R-6c Avg. Flow Depth=0.65' Max Vel=8.18 fps Inflow=42.06 cfs 2.092 af
n=0.050 L=118.0' S=0.1864 '/' Capacity=855.10 cfs Outflow=41.66 cfs 2.091 af

Reach R7: R-7 Avg. Flow Depth=0.66' Max Vel=4.38 fps Inflow=12.43 cfs 0.563 af
n=0.040 L=829.0' S=0.0434 '/' Capacity=345.60 cfs Outflow=11.42 cfs 0.560 af

Reach R8: R-8 Avg. Flow Depth=0.61' Max Vel=3.00 fps Inflow=3.96 cfs 0.179 af
n=0.030 L=315.0' S=0.0190 '/' Capacity=93.19 cfs Outflow=3.67 cfs 0.179 af

Reach R9: R-9 Avg. Flow Depth=0.76' Max Vel=3.81 fps Inflow=7.91 cfs 0.359 af
n=0.030 L=481.0' S=0.0229 '/' Capacity=102.11 cfs Outflow=7.33 cfs 0.357 af

Pond P-1: P-1 Peak Elev=1,222.65' Storage=1.523 af Inflow=74.52 cfs 4.447 af
36.0" Round Culvert n=0.025 L=60.0' S=0.0050 '/' Outflow=34.64 cfs 4.186 af

Pond P-2: POND Peak Elev=1,223.25' Storage=3.938 af Inflow=102.35 cfs 8.882 af
Outflow=29.24 cfs 5.825 af

Total Runoff Area = 34.780 ac Runoff Volume = 9.185 af Average Runoff Depth = 3.17"
95.69% Pervious = 33.280 ac 4.31% Impervious = 1.500 ac

Summary for Subcatchment E1: E-1

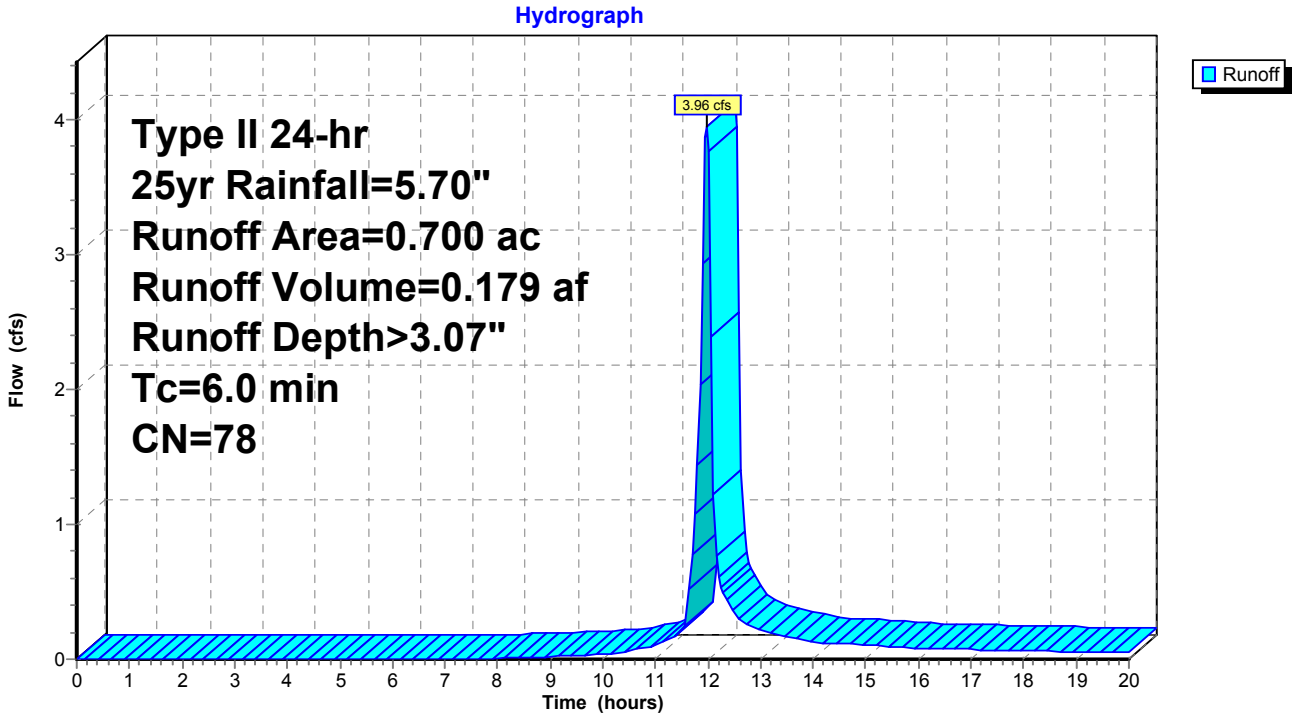
Runoff = 3.96 cfs @ 11.97 hrs, Volume= 0.179 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	0.700	78	
	0.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment E1: E-1



Summary for Subcatchment E10: E-10

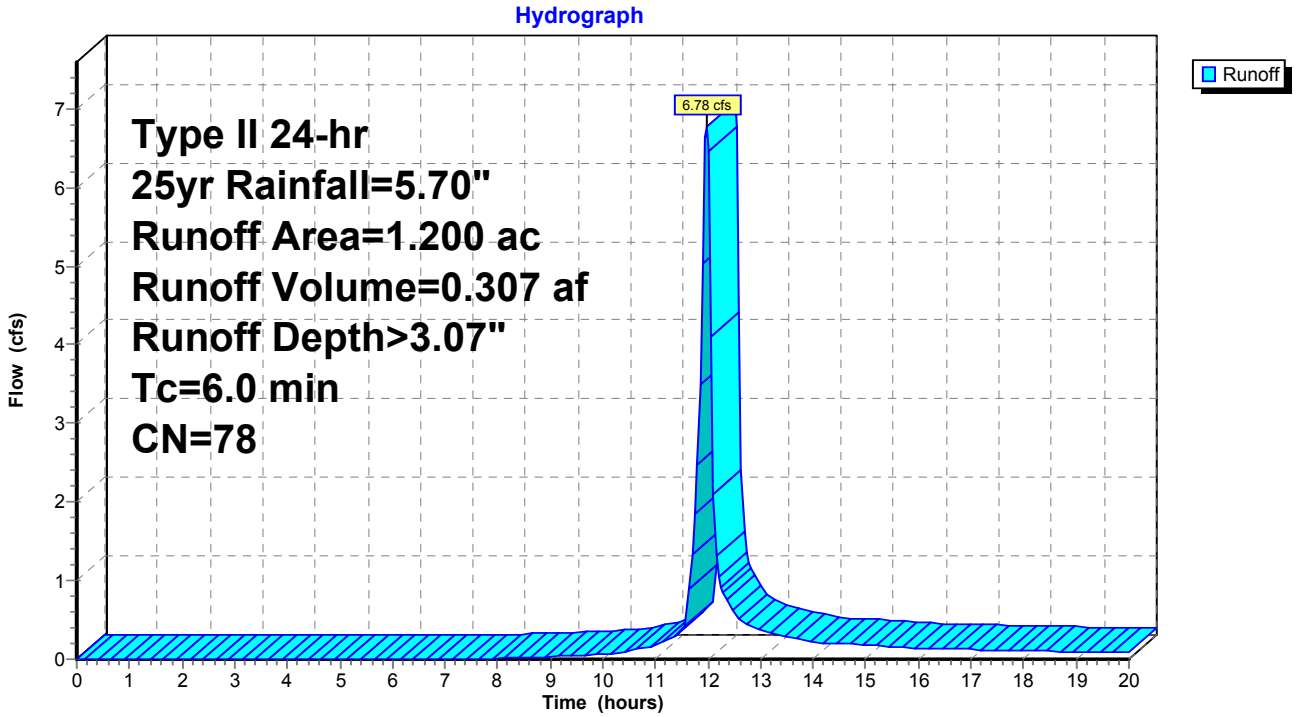
Runoff = 6.78 cfs @ 11.97 hrs, Volume= 0.307 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	1.200	78	
	1.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment E10: E-10



Summary for Subcatchment E11: E-11

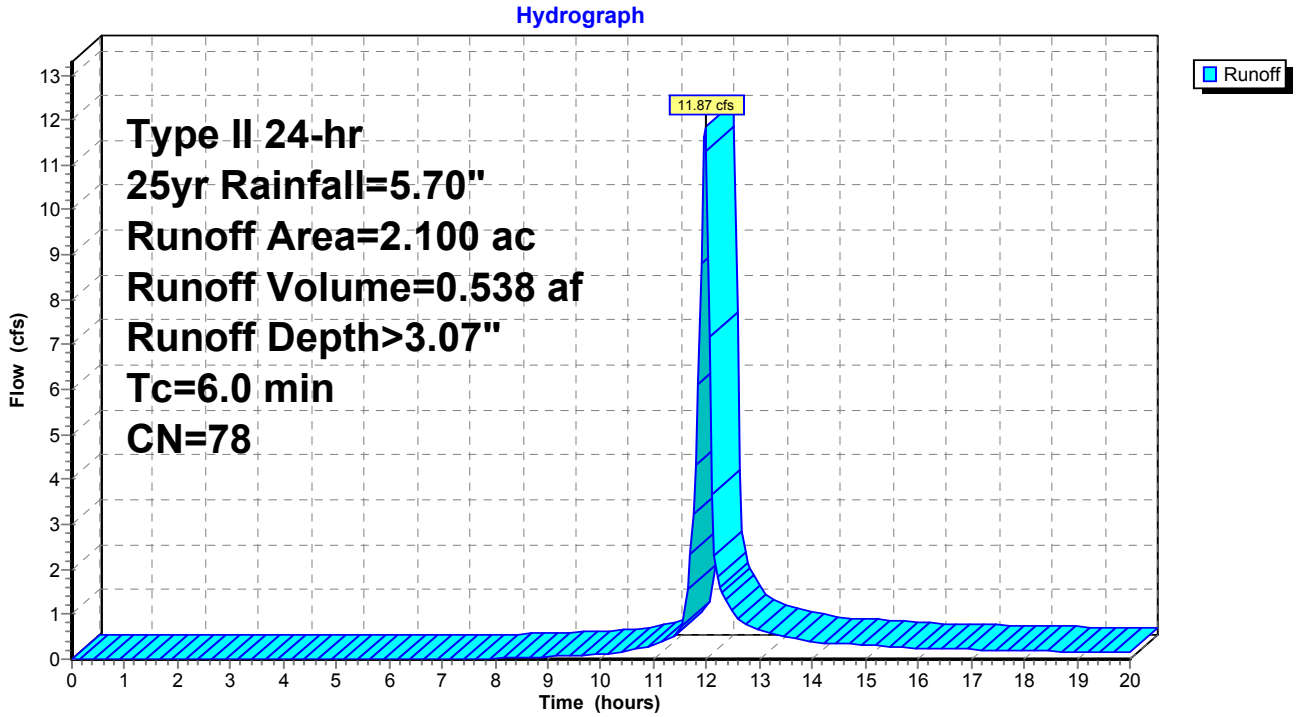
Runoff = 11.87 cfs @ 11.97 hrs, Volume= 0.538 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	2.100	78	
	2.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment E11: E-11



Summary for Subcatchment E12: E-12

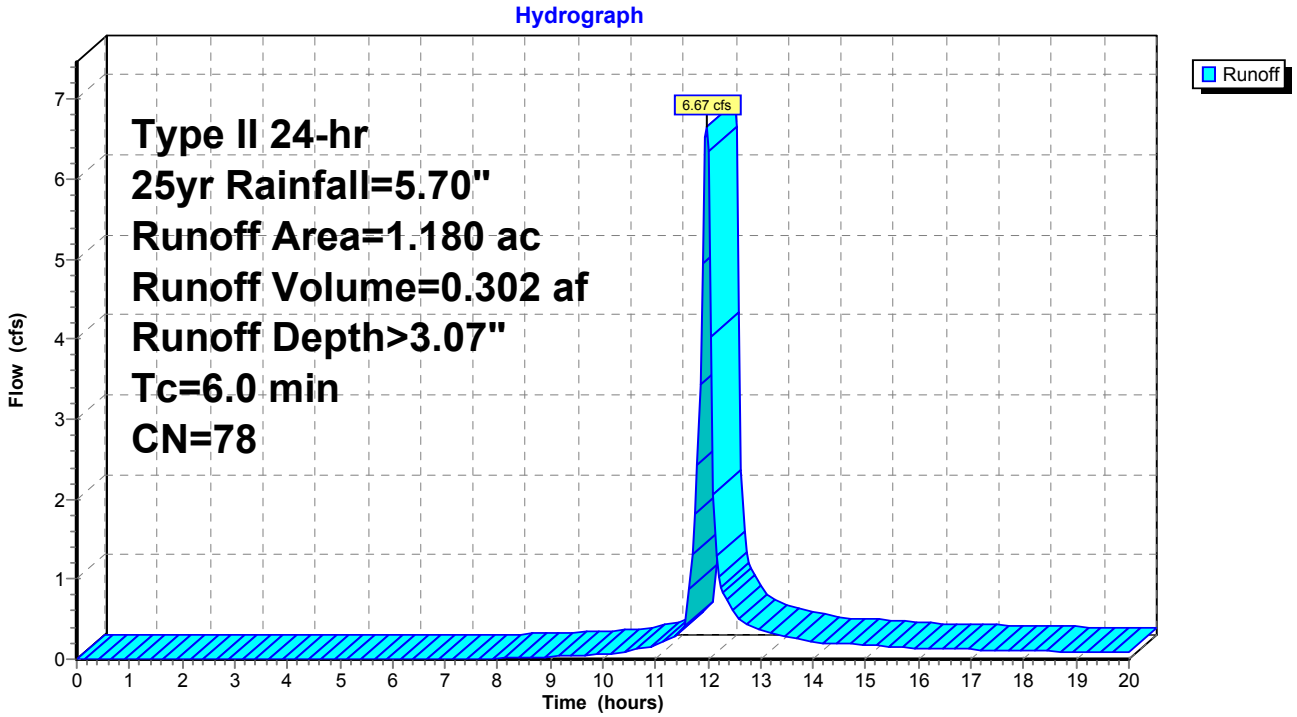
Runoff = 6.67 cfs @ 11.97 hrs, Volume= 0.302 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	1.180	78	
	1.180		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment E12: E-12



Summary for Subcatchment E2: E-2

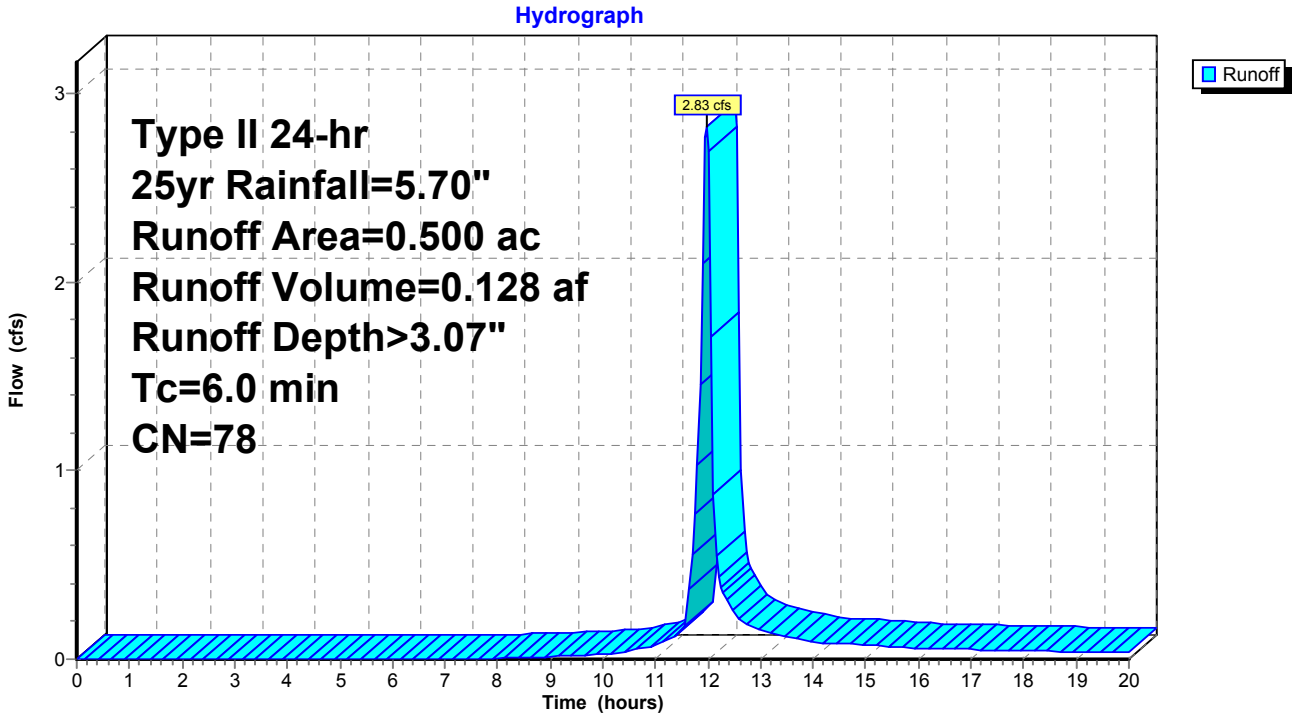
Runoff = 2.83 cfs @ 11.97 hrs, Volume= 0.128 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	0.500	78	
	0.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment E2: E-2



Summary for Subcatchment E3: E-3

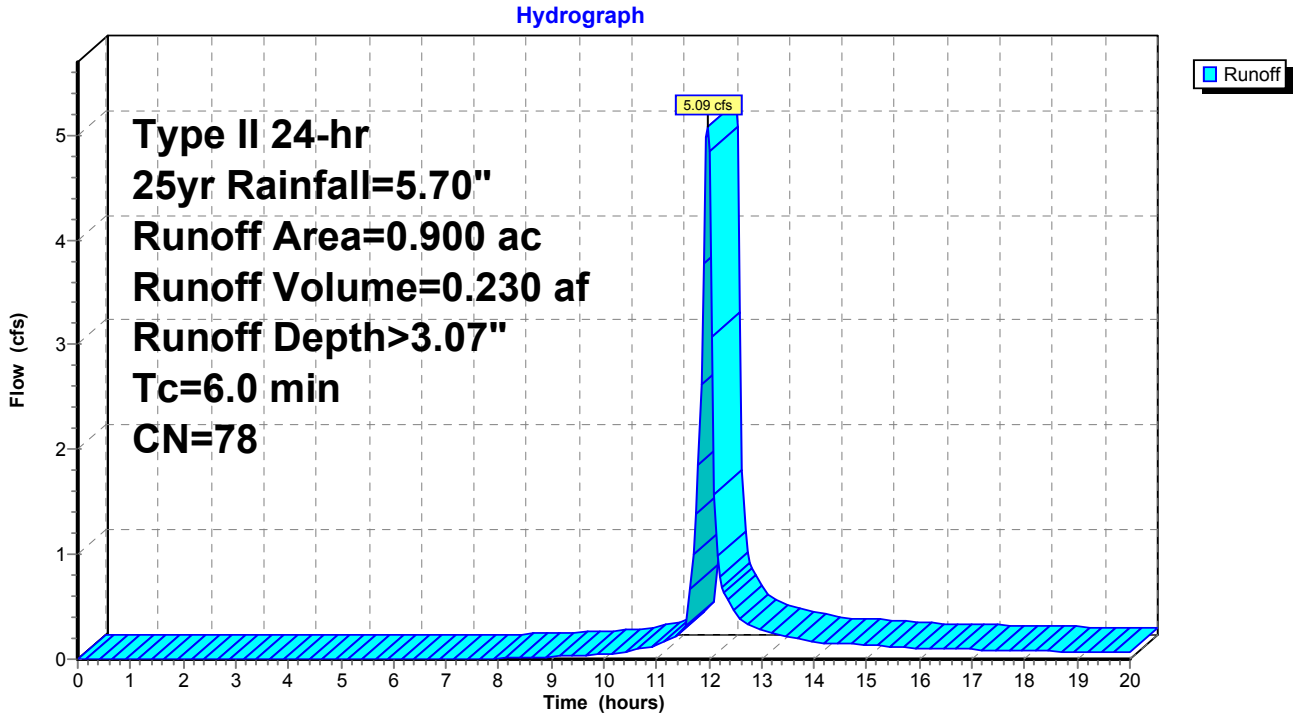
Runoff = 5.09 cfs @ 11.97 hrs, Volume= 0.230 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	0.900	78	
	0.900		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment E3: E-3



Summary for Subcatchment E4: E-4

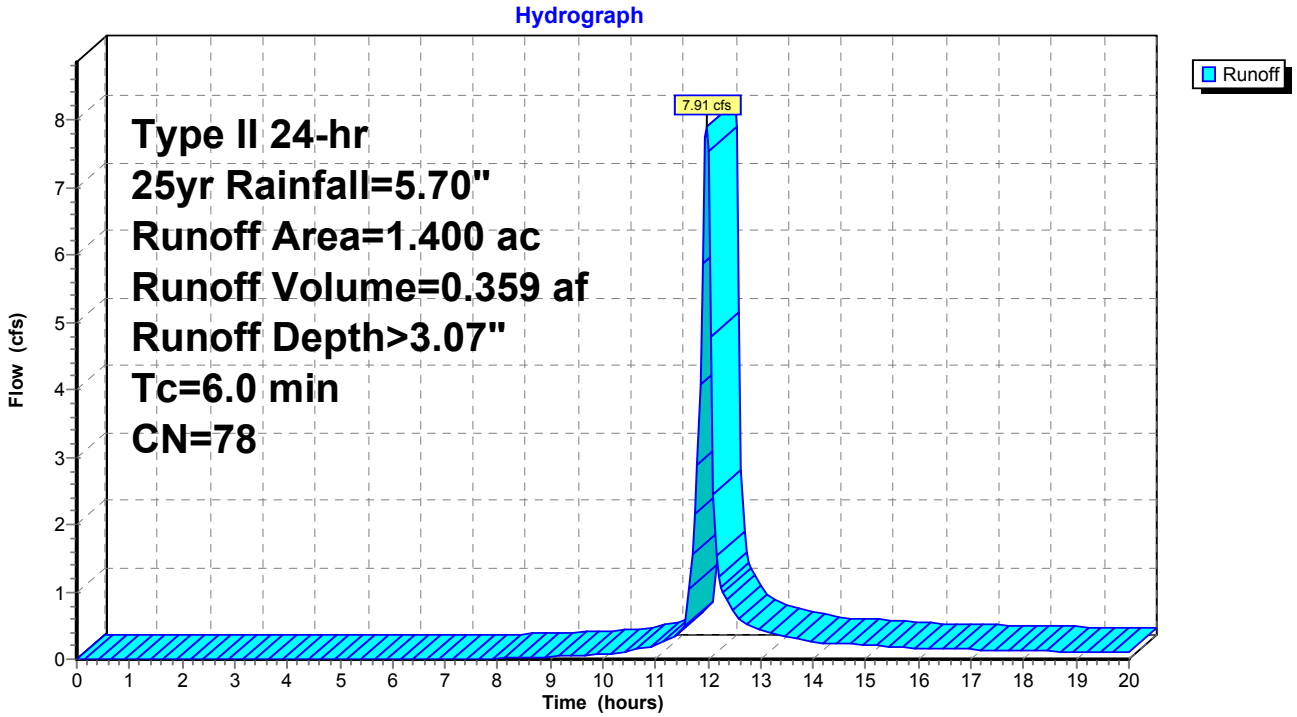
Runoff = 7.91 cfs @ 11.97 hrs, Volume= 0.359 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	1.400	78	
	1.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment E4: E-4



Summary for Subcatchment E5: E-5

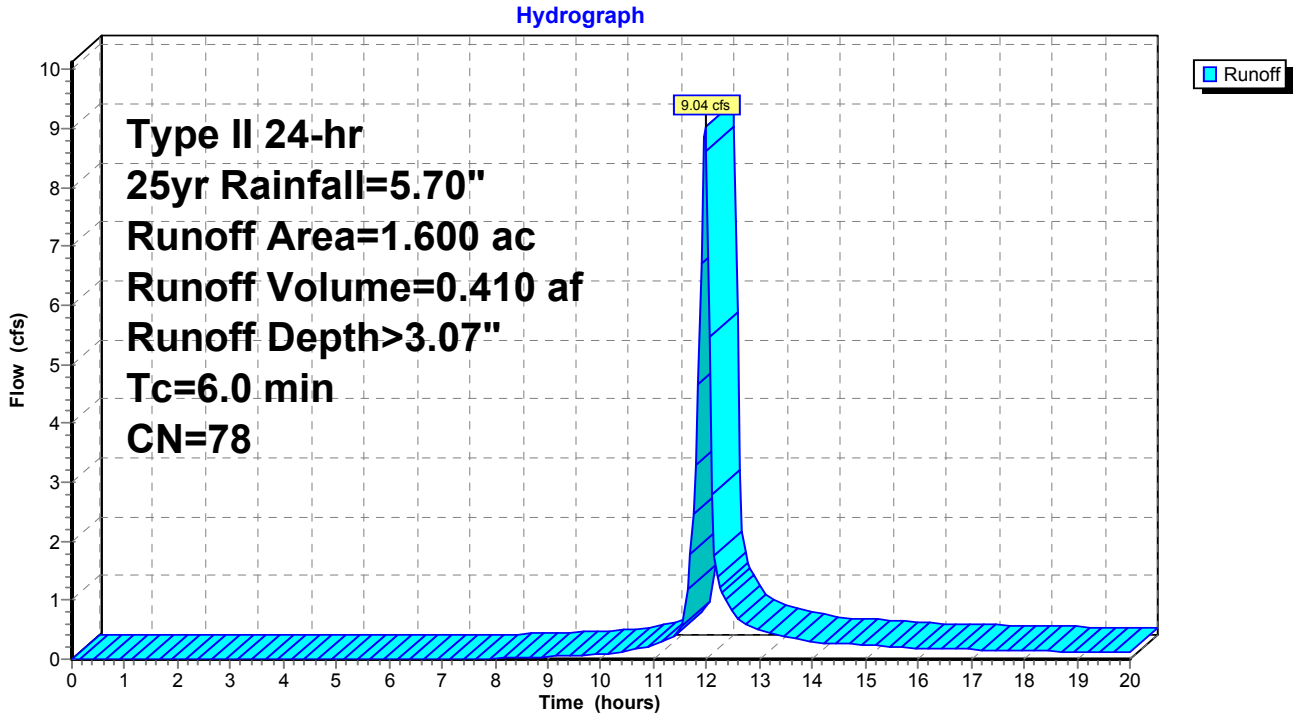
Runoff = 9.04 cfs @ 11.97 hrs, Volume= 0.410 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	1.600	78	
	1.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment E5: E-5



Summary for Subcatchment E6: E-6

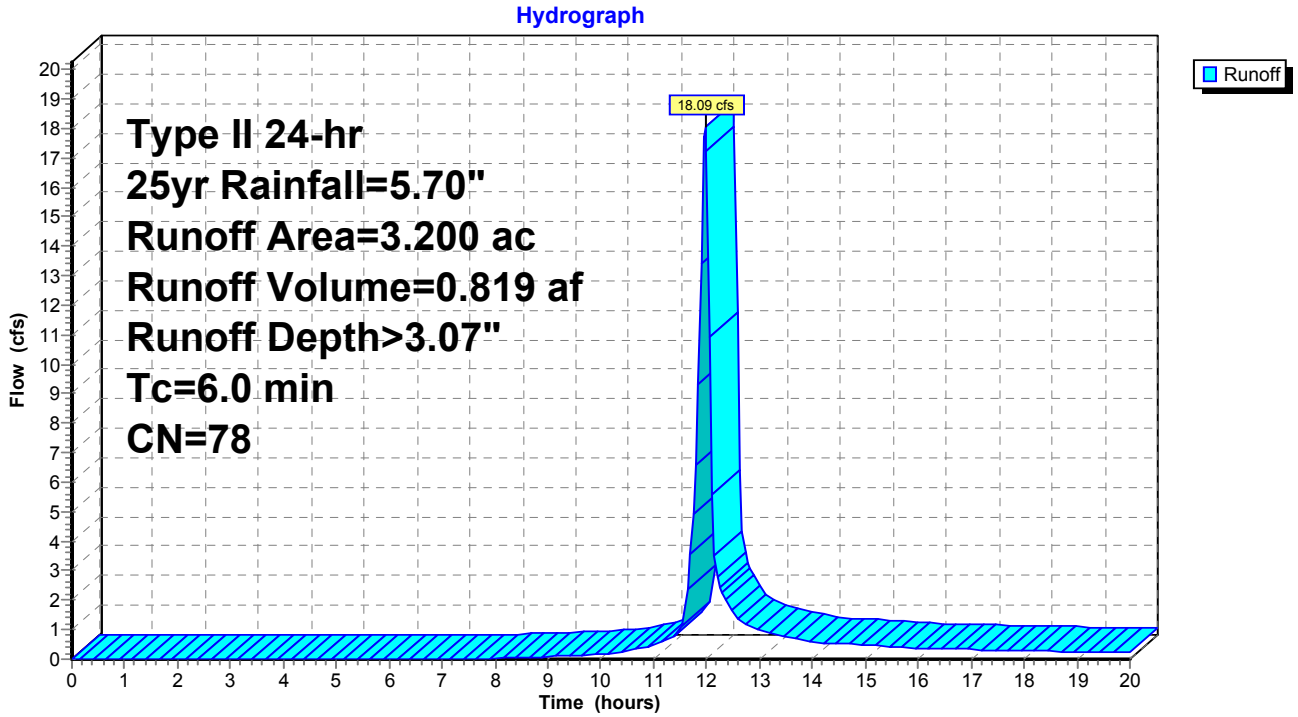
Runoff = 18.09 cfs @ 11.97 hrs, Volume= 0.819 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	3.200	78	
	3.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment E6: E-6



Summary for Subcatchment E7: E-7

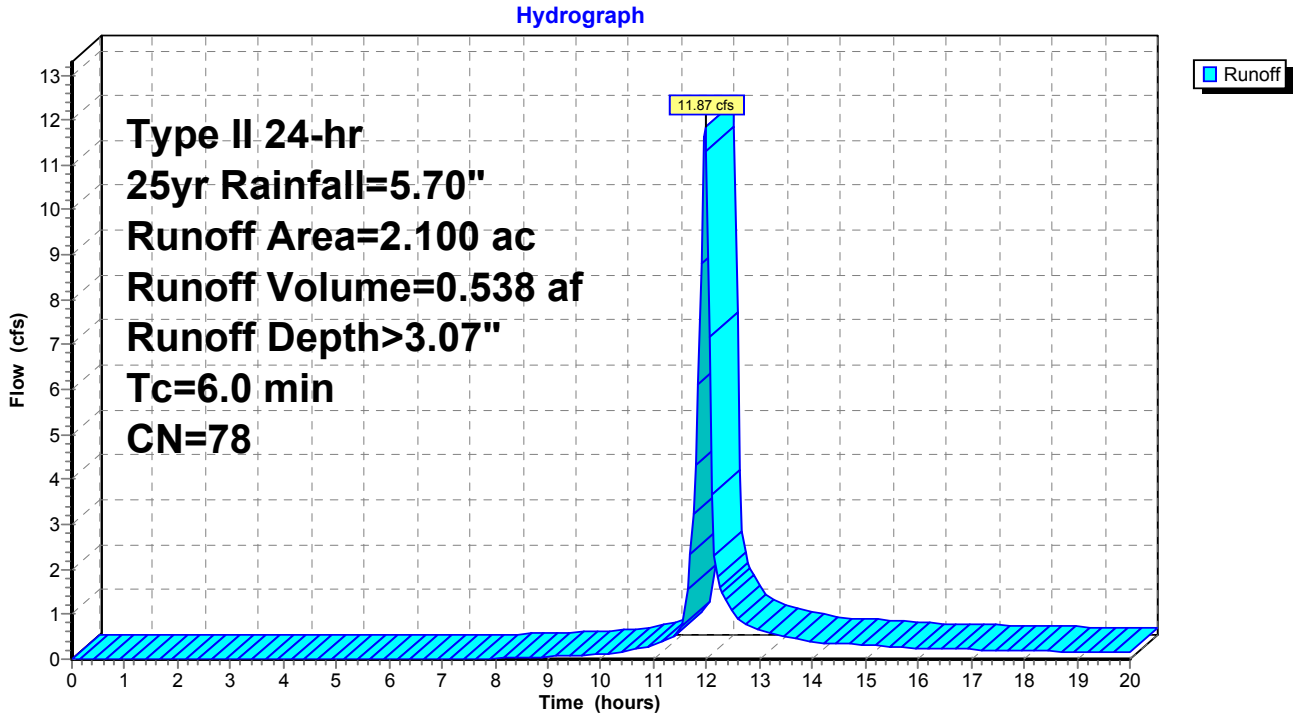
Runoff = 11.87 cfs @ 11.97 hrs, Volume= 0.538 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	2.100	78	
	2.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment E7: E-7



Summary for Subcatchment E8: E-8

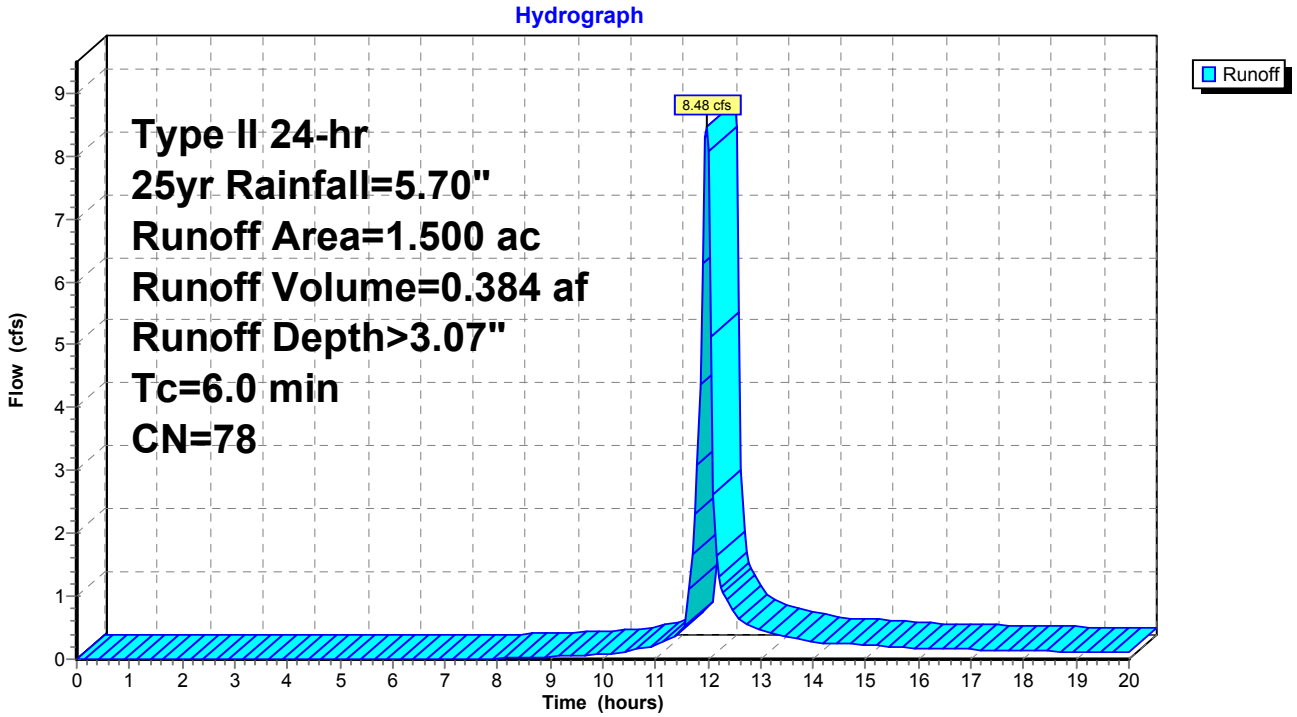
Runoff = 8.48 cfs @ 11.97 hrs, Volume= 0.384 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	1.500	78	
	1.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment E8: E-8



Summary for Subcatchment E9: E-9

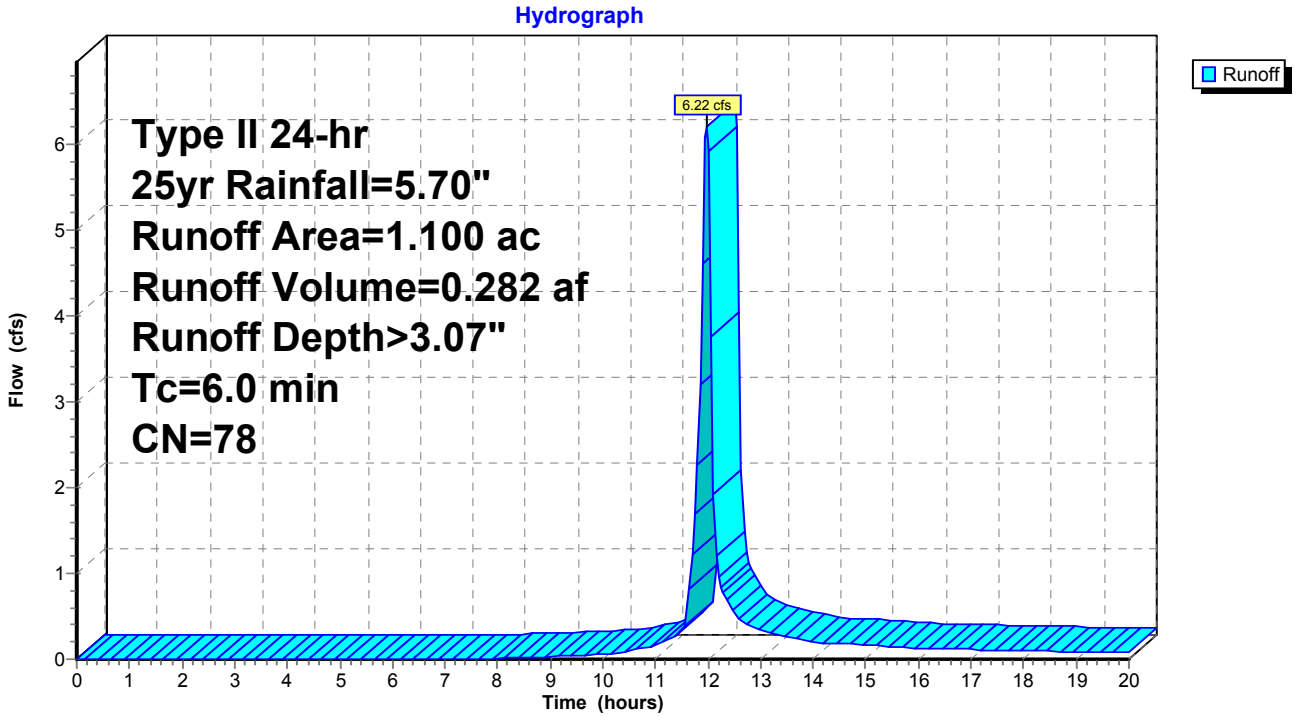
Runoff = 6.22 cfs @ 11.97 hrs, Volume= 0.282 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	1.100	78	
	1.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment E9: E-9



Summary for Subcatchment P1: P1

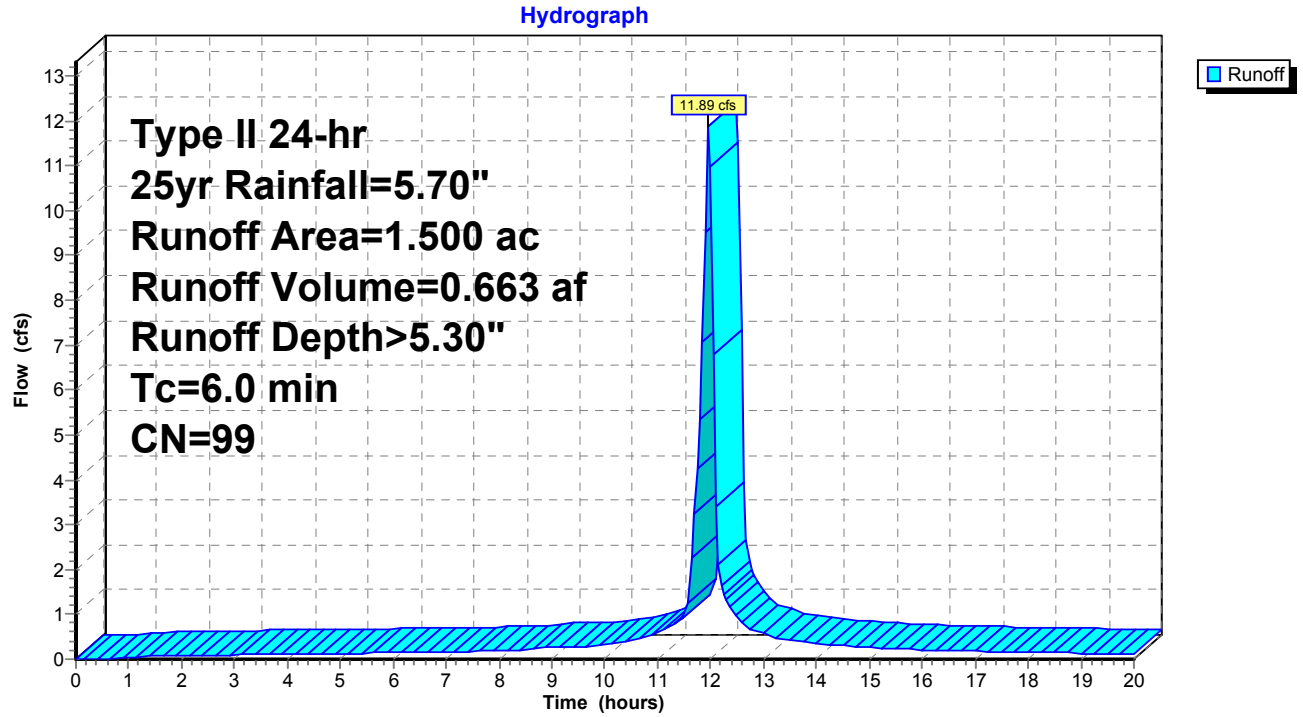
Runoff = 11.89 cfs @ 11.96 hrs, Volume= 0.663 af, Depth> 5.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	1.500	99	
	1.500		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment P1: P1



Summary for Subcatchment S1: S-1

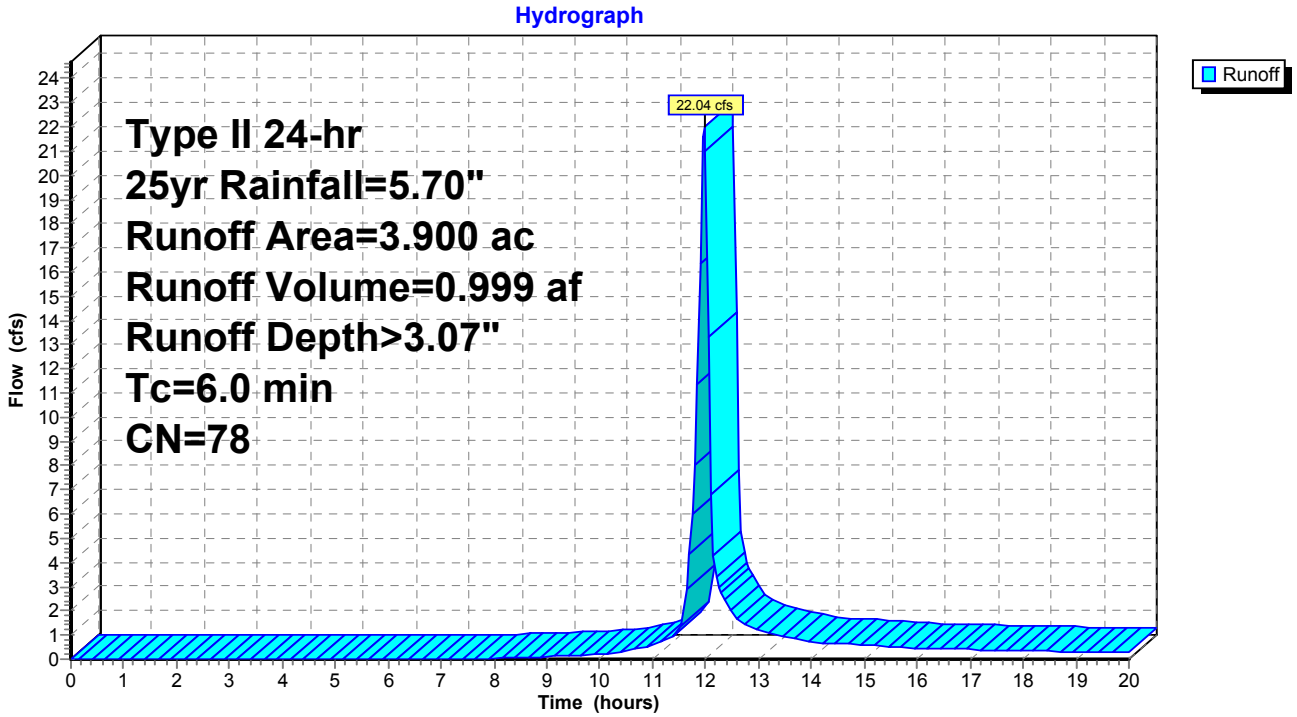
Runoff = 22.04 cfs @ 11.97 hrs, Volume= 0.999 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	3.900	78	
	3.900		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment S1: S-1



Summary for Subcatchment W1: W-1

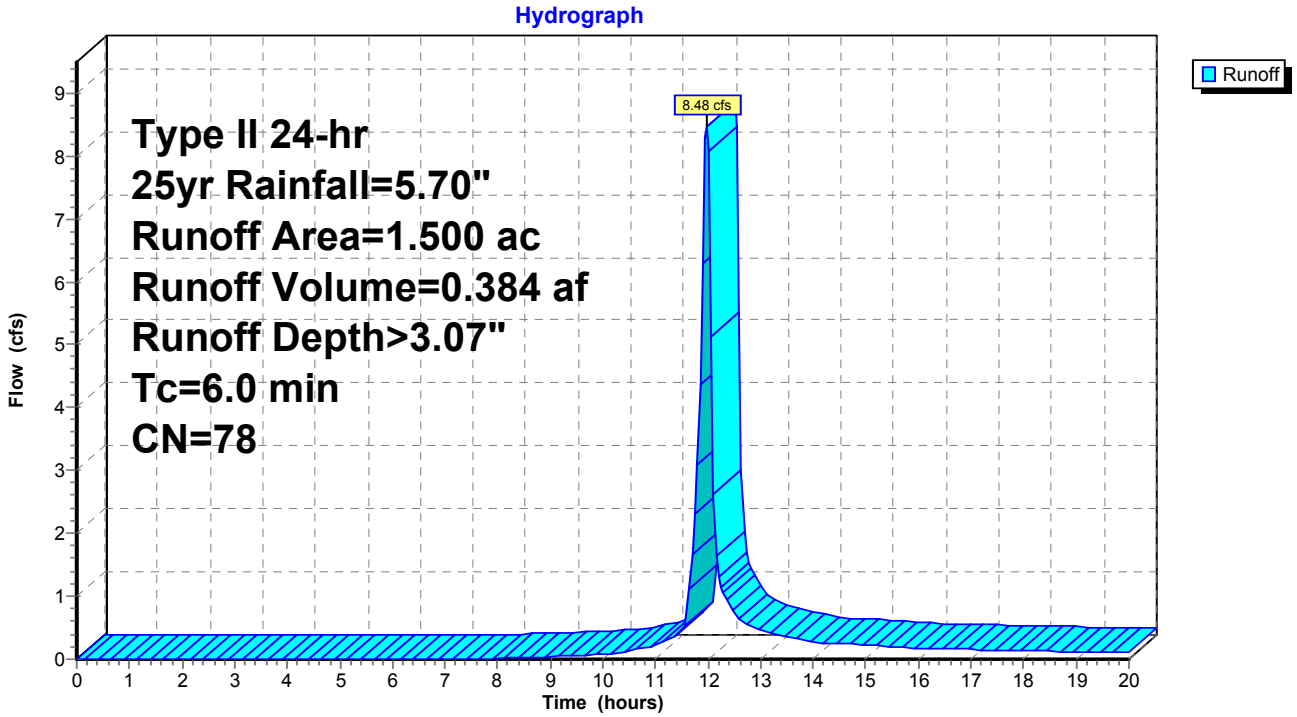
Runoff = 8.48 cfs @ 11.97 hrs, Volume= 0.384 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	1.500	78	
	1.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment W1: W-1



Summary for Subcatchment W2: W-2

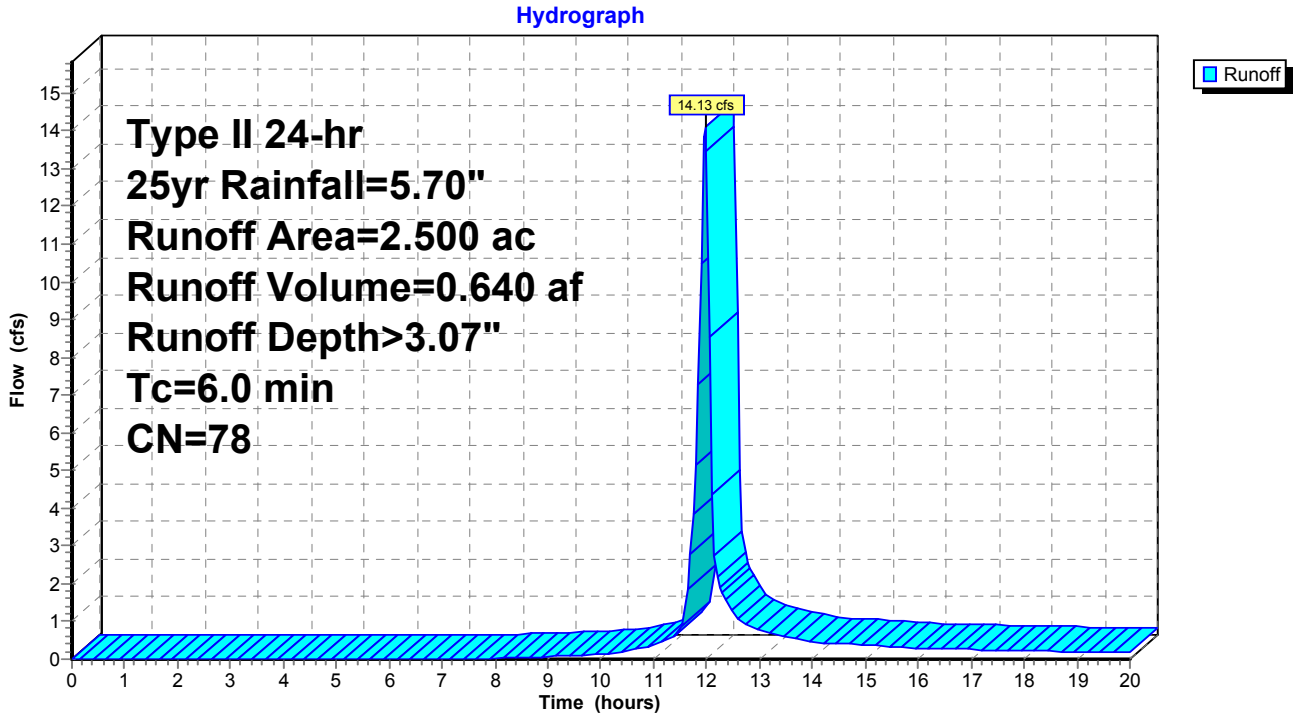
Runoff = 14.13 cfs @ 11.97 hrs, Volume= 0.640 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	2.500	78	
	2.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment W2: W-2



Summary for Subcatchment W3: W-3

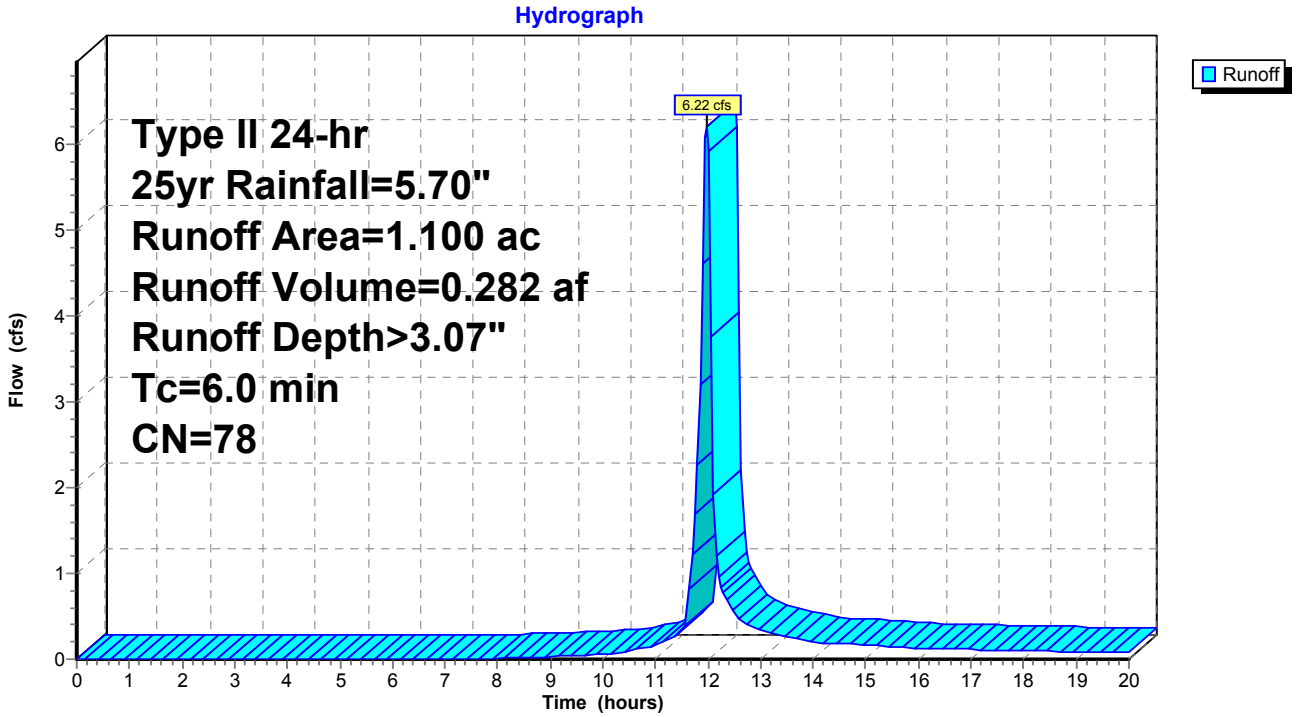
Runoff = 6.22 cfs @ 11.97 hrs, Volume= 0.282 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	1.100	78	
	1.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment W3: W-3



Summary for Subcatchment W4: W-4

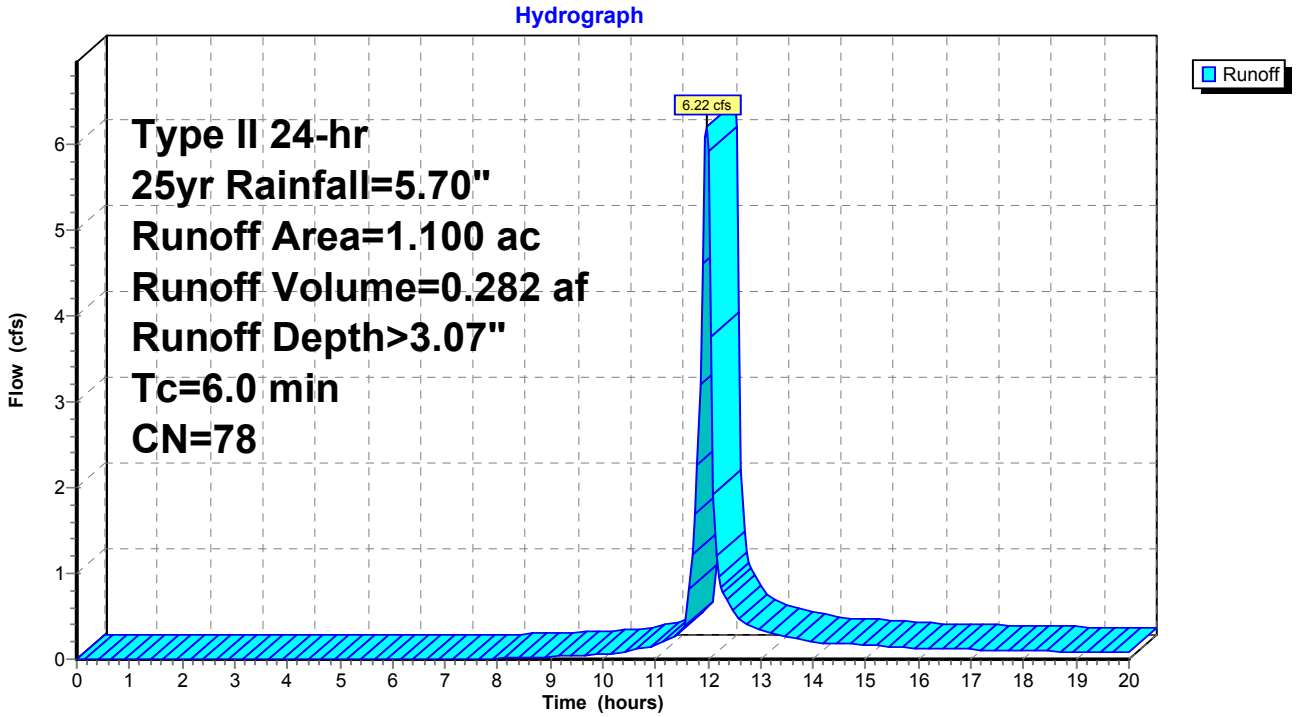
Runoff = 6.22 cfs @ 11.97 hrs, Volume= 0.282 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	1.100	78	
	1.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment W4: W-4



Summary for Subcatchment W5: W-5

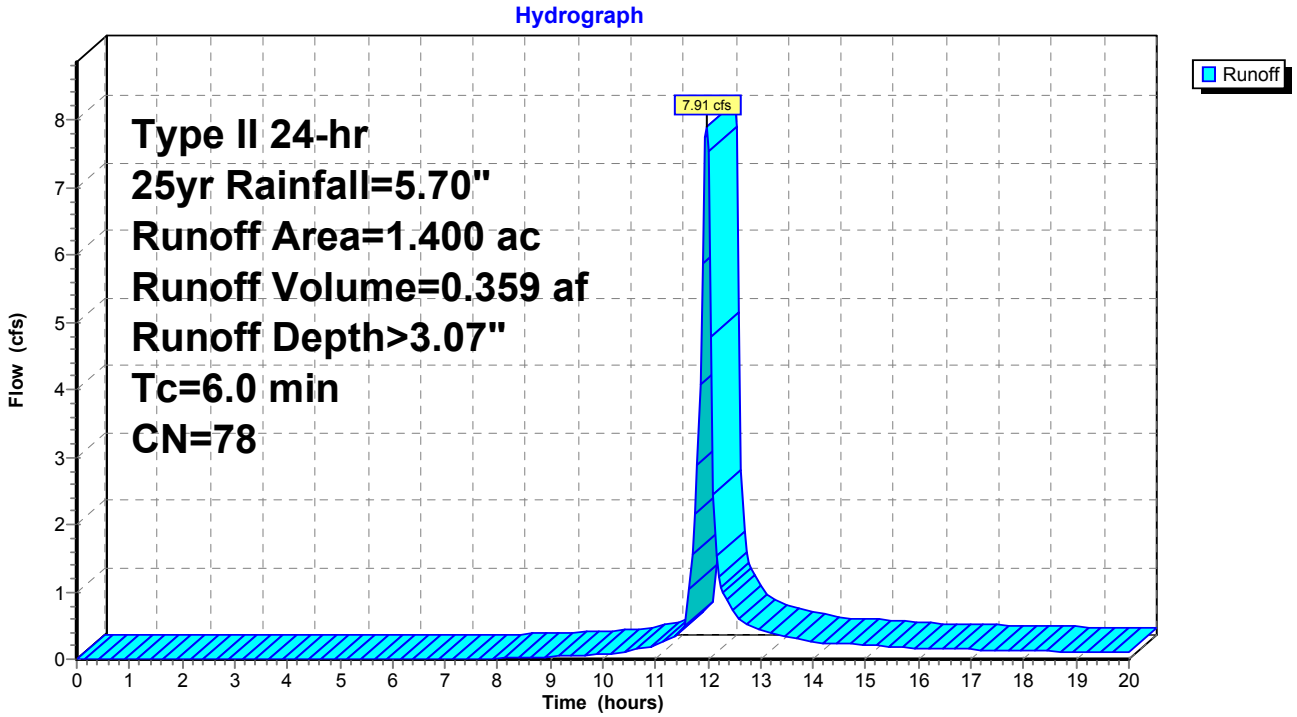
Runoff = 7.91 cfs @ 11.97 hrs, Volume= 0.359 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	1.400	78	
	1.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment W5: W-5



Summary for Subcatchment W6: W-6

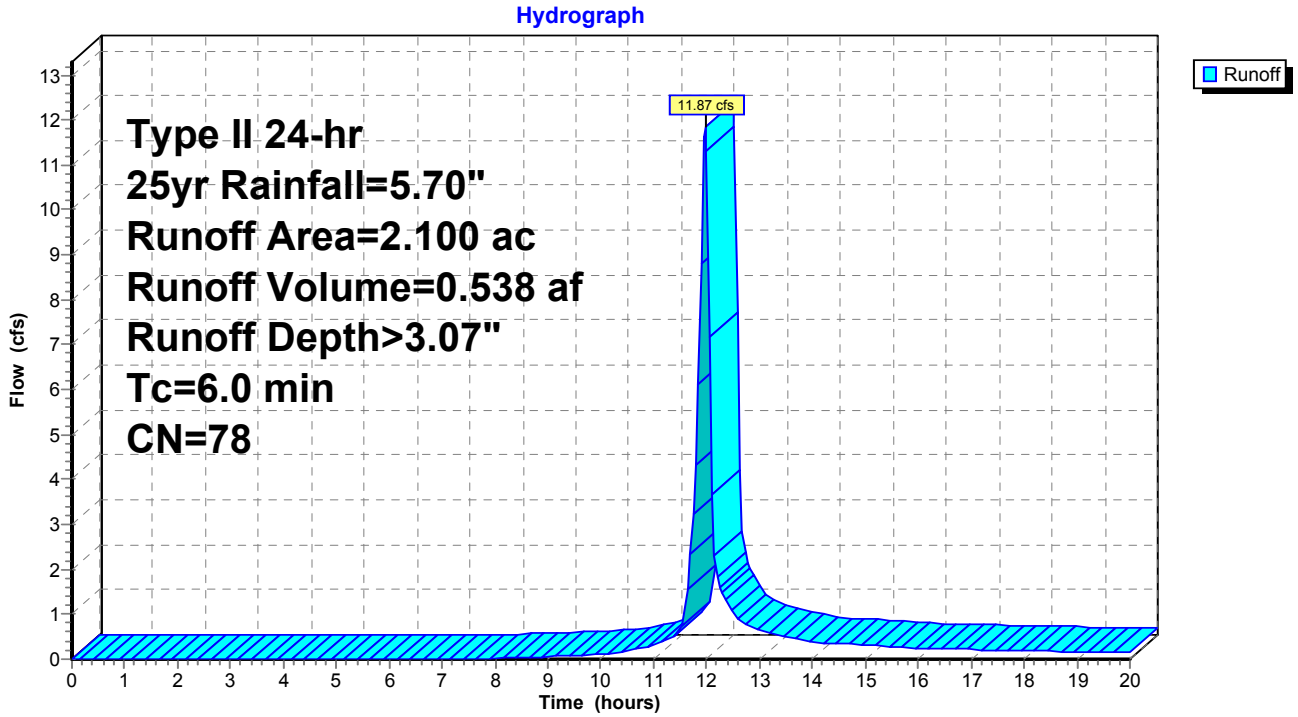
Runoff = 11.87 cfs @ 11.97 hrs, Volume= 0.538 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	2.100	78	
	2.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment W6: W-6



Summary for Subcatchment W7: W-7

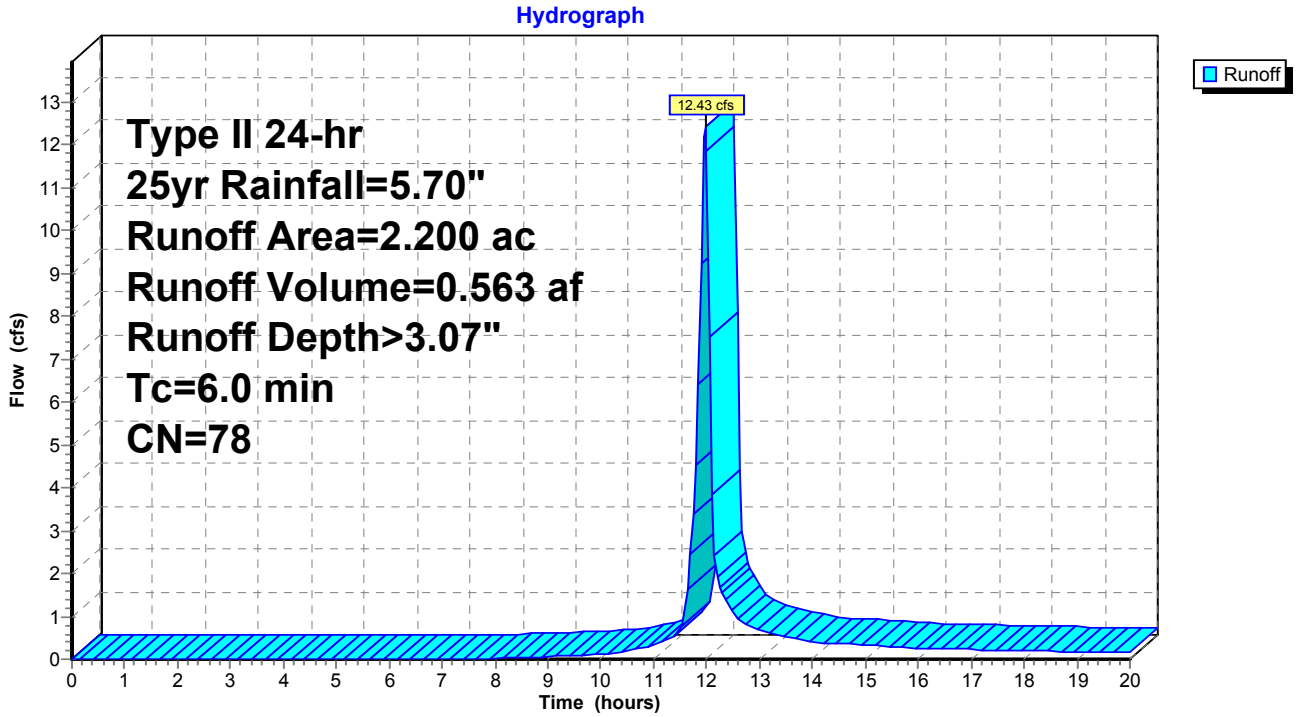
Runoff = 12.43 cfs @ 11.97 hrs, Volume= 0.563 af, Depth> 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25yr Rainfall=5.70"

	Area (ac)	CN	Description
*	2.200	78	
	2.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment W7: W-7



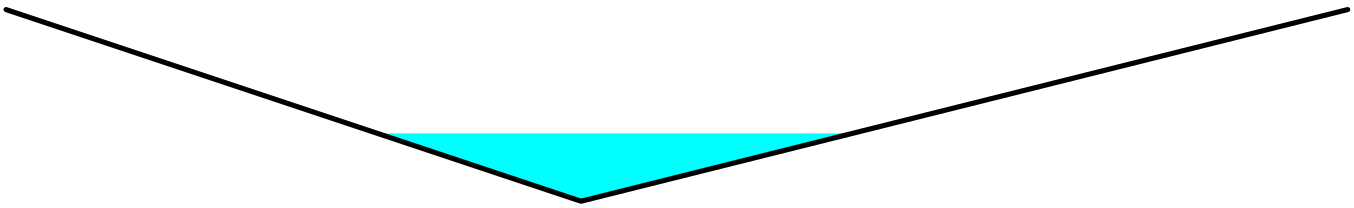
Summary for Reach R1: R-1

Inflow Area = 1.100 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 6.22 cfs @ 11.97 hrs, Volume= 0.282 af
Outflow = 5.79 cfs @ 12.01 hrs, Volume= 0.281 af, Atten= 7%, Lag= 2.7 min

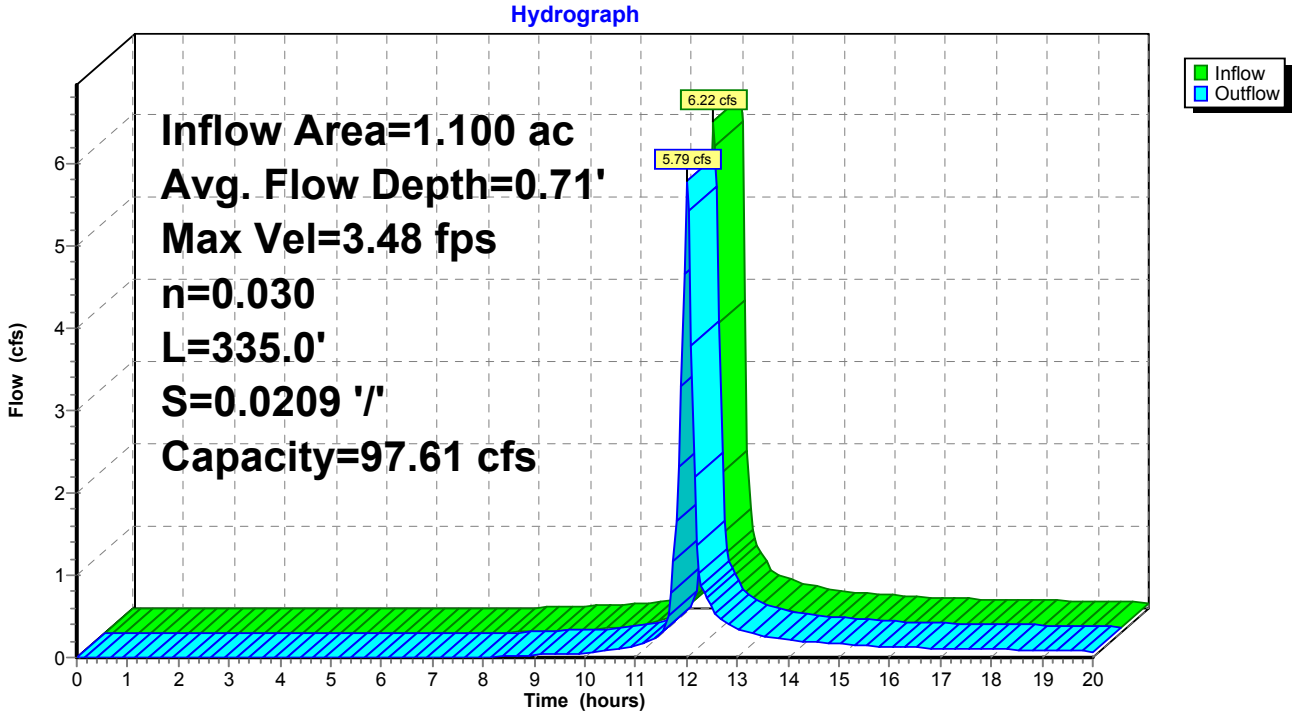
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.48 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 1.32 fps, Avg. Travel Time= 4.2 min

Peak Storage= 586 cf @ 11.99 hrs
Average Depth at Peak Storage= 0.71'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 97.61 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 4.0 '/' Top Width= 14.00'
Length= 335.0' Slope= 0.0209 '/'
Inlet Invert= 1,340.00', Outlet Invert= 1,333.00'



Reach R1: R-1



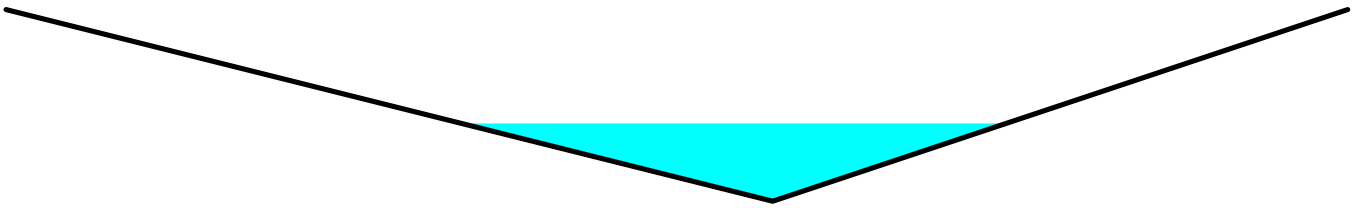
Summary for Reach R10: R-10

Inflow Area = 1.600 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 9.04 cfs @ 11.97 hrs, Volume= 0.410 af
Outflow = 8.39 cfs @ 12.05 hrs, Volume= 0.408 af, Atten= 7%, Lag= 4.7 min

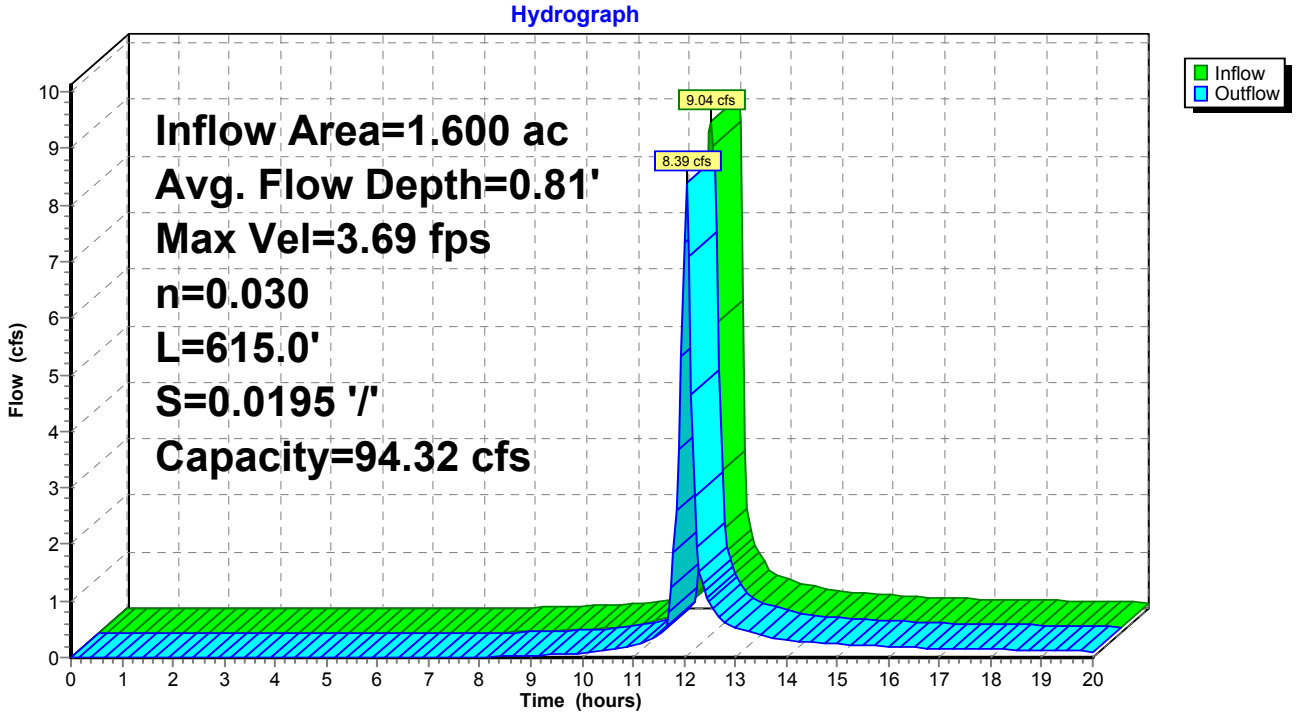
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.69 fps, Min. Travel Time= 2.8 min
Avg. Velocity = 1.41 fps, Avg. Travel Time= 7.3 min

Peak Storage= 1,413 cf @ 12.00 hrs
Average Depth at Peak Storage= 0.81'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 94.32 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 4.0 3.0 '/' Top Width= 14.00'
Length= 615.0' Slope= 0.0195 '/'
Inlet Invert= 1,272.00', Outlet Invert= 1,260.00'



Reach R10: R-10



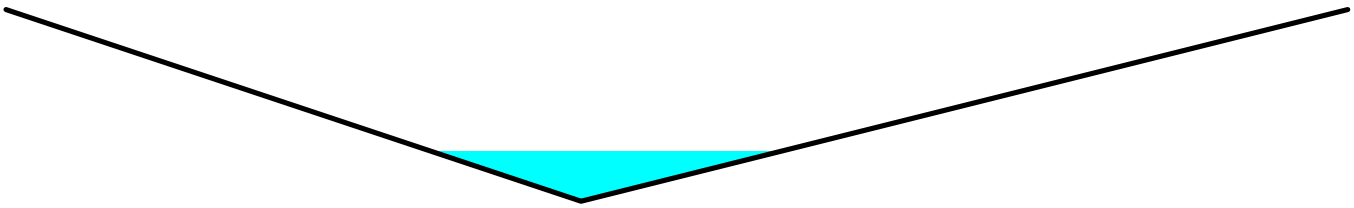
Summary for Reach R11: R-11

Inflow Area = 0.500 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 2.83 cfs @ 11.97 hrs, Volume= 0.128 af
Outflow = 2.67 cfs @ 12.01 hrs, Volume= 0.128 af, Atten= 6%, Lag= 2.2 min

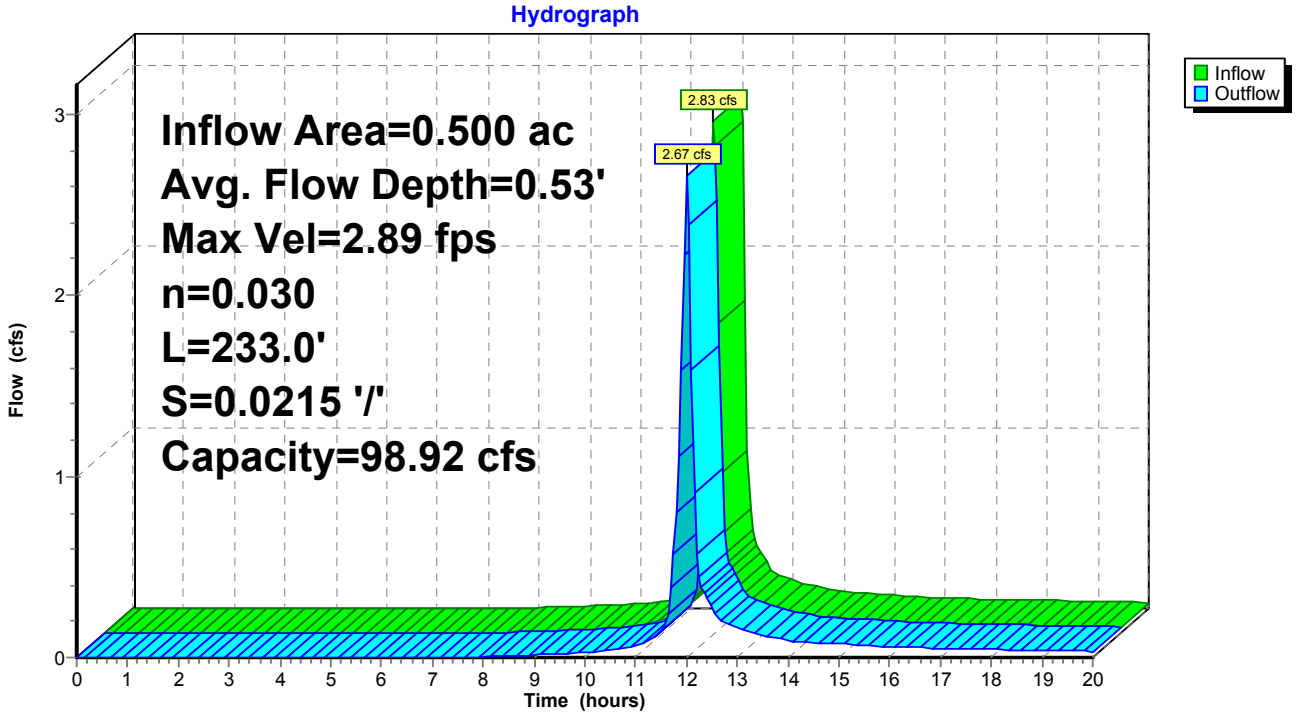
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.89 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 1.10 fps, Avg. Travel Time= 3.5 min

Peak Storage= 225 cf @ 11.99 hrs
Average Depth at Peak Storage= 0.53'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 98.92 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 4.0 '/' Top Width= 14.00'
Length= 233.0' Slope= 0.0215 '/'
Inlet Invert= 1,297.00', Outlet Invert= 1,292.00'



Reach R11: R-11



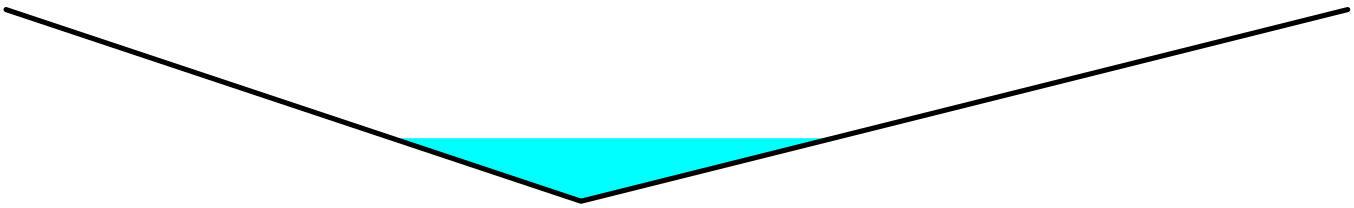
Summary for Reach R12: R-12

Inflow Area = 0.900 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 5.09 cfs @ 11.97 hrs, Volume= 0.230 af
Outflow = 4.71 cfs @ 12.03 hrs, Volume= 0.230 af, Atten= 7%, Lag= 3.6 min

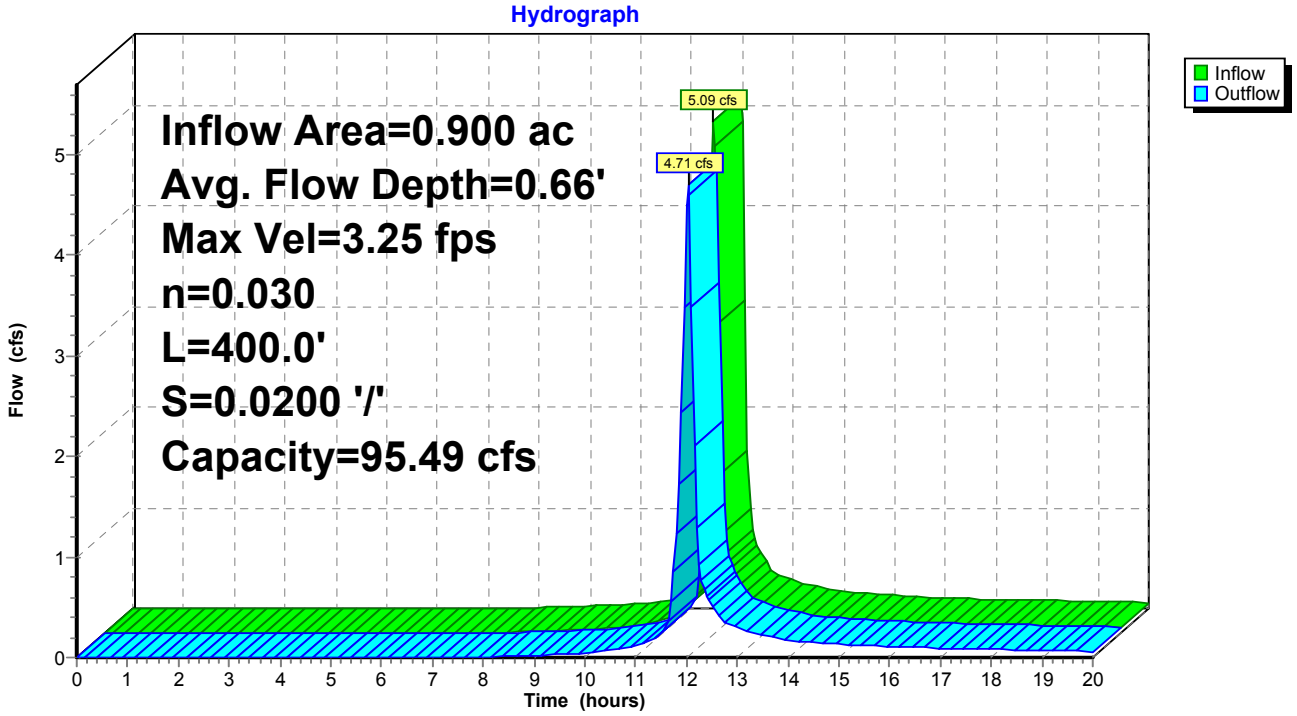
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.25 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 1.23 fps, Avg. Travel Time= 5.4 min

Peak Storage= 604 cf @ 11.99 hrs
Average Depth at Peak Storage= 0.66'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 95.49 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 4.0 '/' Top Width= 14.00'
Length= 400.0' Slope= 0.0200 '/'
Inlet Invert= 1,268.00', Outlet Invert= 1,260.00'



Reach R12: R-12



Summary for Reach R13a: R-13a

[61] Hint: Exceeded Reach R8 outlet invert by 0.14' @ 12.05 hrs

Inflow Area = 0.700 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 3.67 cfs @ 12.02 hrs, Volume= 0.179 af
Outflow = 3.59 cfs @ 12.04 hrs, Volume= 0.179 af, Atten= 2%, Lag= 1.1 min

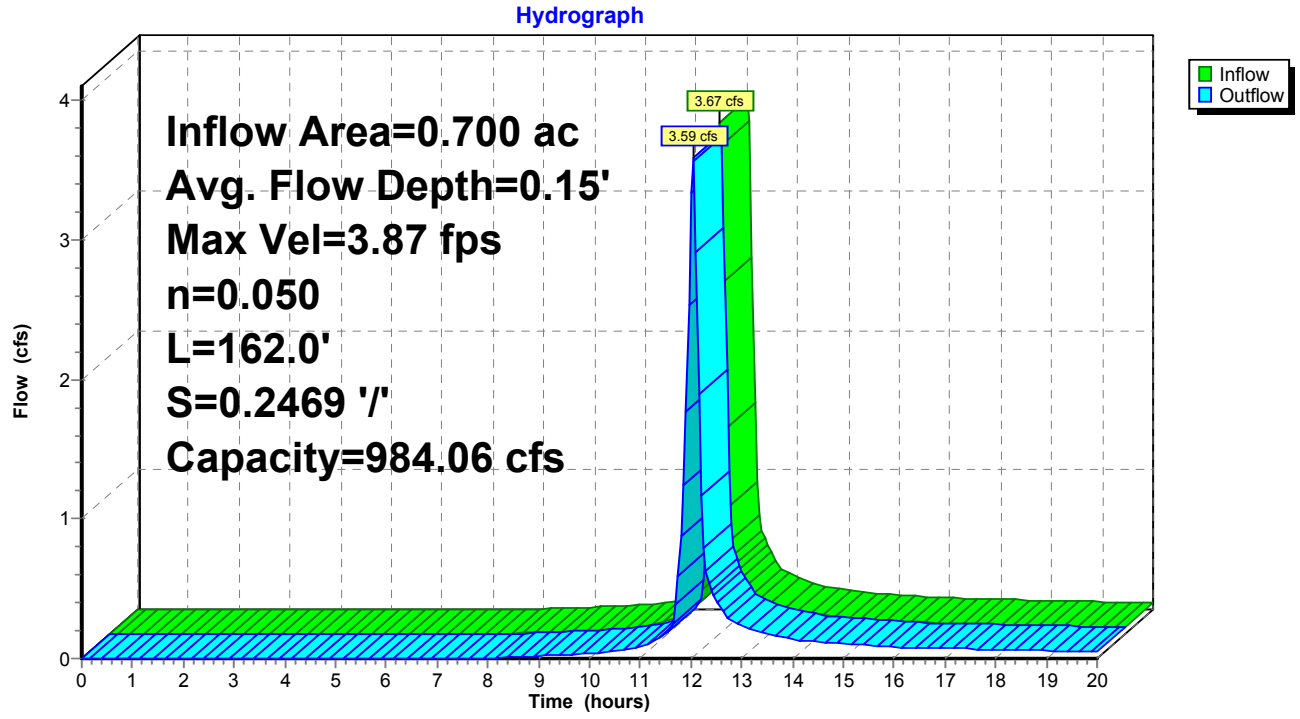
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.87 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.49 fps, Avg. Travel Time= 1.8 min

Peak Storage= 152 cf @ 12.03 hrs
Average Depth at Peak Storage= 0.15'
Bank-Full Depth= 3.00' Flow Area= 45.0 sf, Capacity= 984.06 cfs

6.00' x 3.00' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 24.00'
Length= 162.0' Slope= 0.2469 '/'
Inlet Invert= 1,332.00', Outlet Invert= 1,292.00'

‡

Reach R13a: R-13a



Summary for Reach R13b: R-13b

[61] Hint: Exceeded Reach R11 outlet invert by 0.31' @ 12.05 hrs
[62] Hint: Exceeded Reach R13a OUTLET depth by 0.17' @ 12.05 hrs
[61] Hint: Exceeded Reach R9 outlet invert by 0.31' @ 12.05 hrs

Inflow Area = 2.600 ac, 0.00% Impervious, Inflow Depth > 3.06" for 25yr event
Inflow = 13.47 cfs @ 12.03 hrs, Volume= 0.664 af
Outflow = 13.31 cfs @ 12.04 hrs, Volume= 0.663 af, Atten= 1%, Lag= 0.5 min

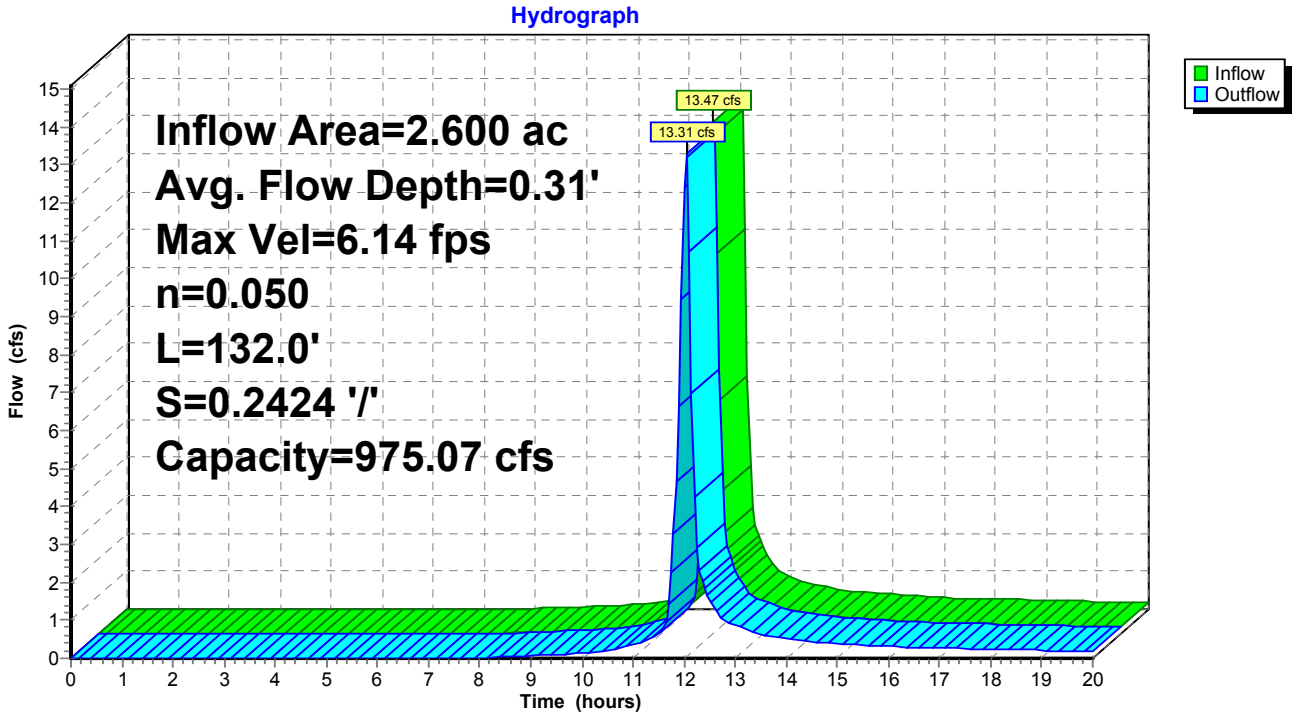
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.14 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.75 fps, Avg. Travel Time= 1.3 min

Peak Storage= 288 cf @ 12.03 hrs
Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 3.00' Flow Area= 45.0 sf, Capacity= 975.07 cfs

6.00' x 3.00' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 24.00'
Length= 132.0' Slope= 0.2424 '/'
Inlet Invert= 1,292.00', Outlet Invert= 1,260.00'

‡

Reach R13b: R-13b



Summary for Reach R14: R-14

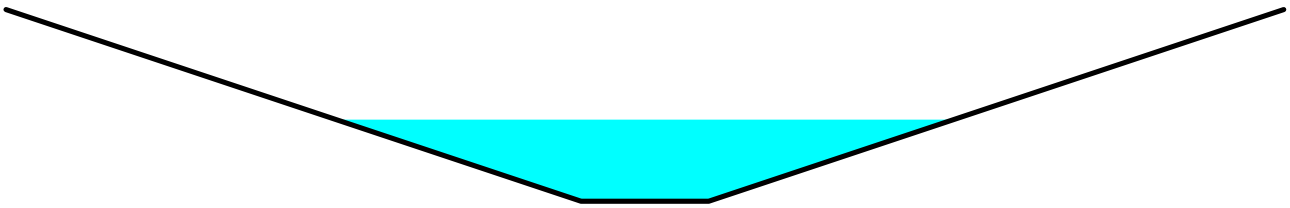
[62] Hint: Exceeded Reach R10 OUTLET depth by 0.58' @ 12.10 hrs
[62] Hint: Exceeded Reach R12 OUTLET depth by 0.73' @ 12.10 hrs
[62] Hint: Exceeded Reach R13b OUTLET depth by 0.97' @ 12.05 hrs

Inflow Area = 8.300 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 41.48 cfs @ 12.00 hrs, Volume= 2.121 af
Outflow = 35.75 cfs @ 12.13 hrs, Volume= 2.105 af, Atten= 14%, Lag= 7.8 min

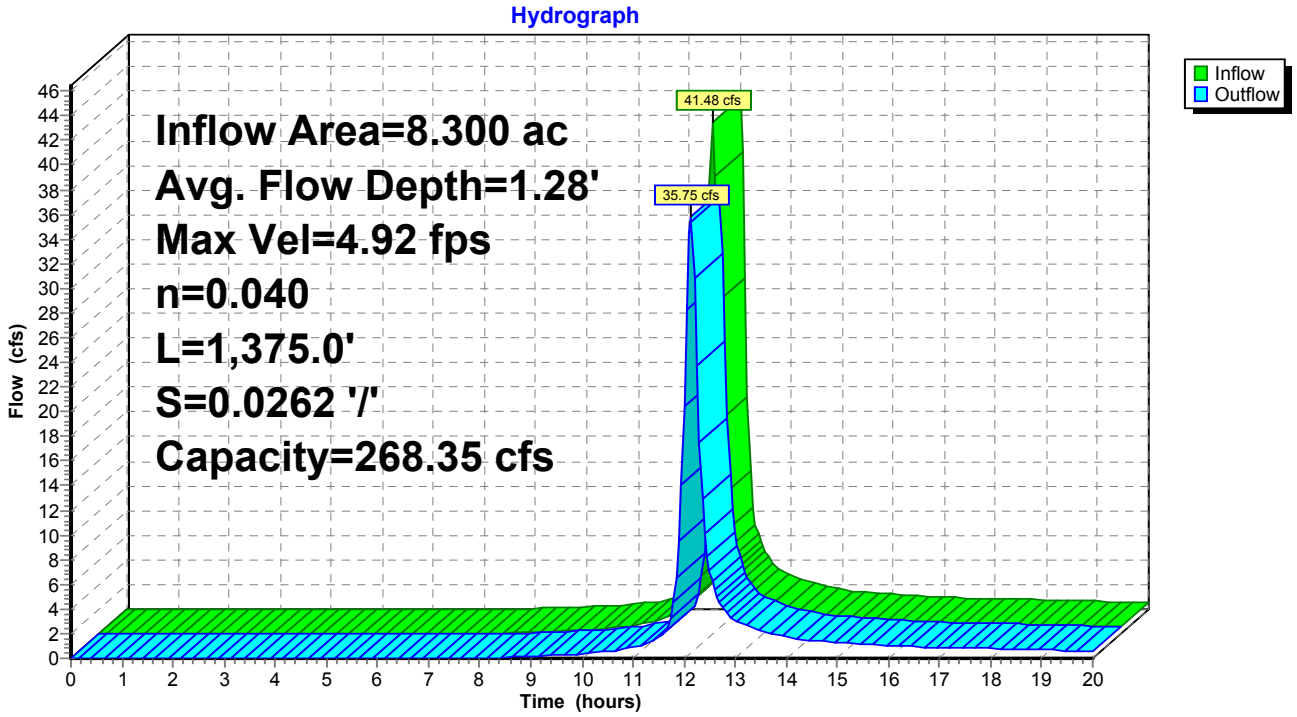
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.92 fps, Min. Travel Time= 4.7 min
Avg. Velocity = 1.77 fps, Avg. Travel Time= 13.0 min

Peak Storage= 10,264 cf @ 12.05 hrs
Average Depth at Peak Storage= 1.28'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 268.35 cfs

2.00' x 3.00' deep channel, n= 0.040
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 1,375.0' Slope= 0.0262 '/'
Inlet Invert= 1,260.00', Outlet Invert= 1,224.00'



Reach R14: R-14



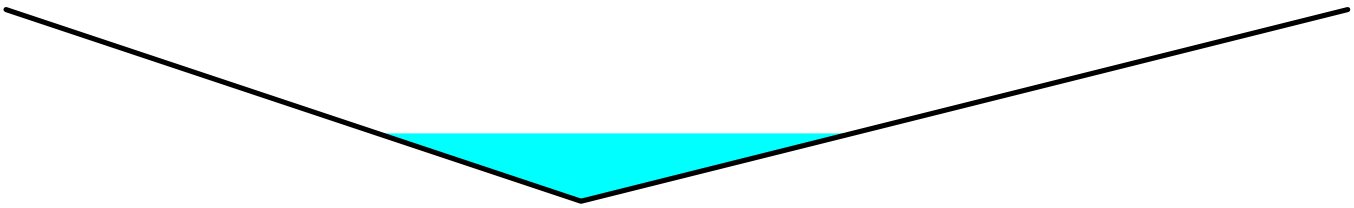
Summary for Reach R15: R15

Inflow Area = 1.100 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 6.22 cfs @ 11.97 hrs, Volume= 0.282 af
Outflow = 5.79 cfs @ 12.01 hrs, Volume= 0.281 af, Atten= 7%, Lag= 2.7 min

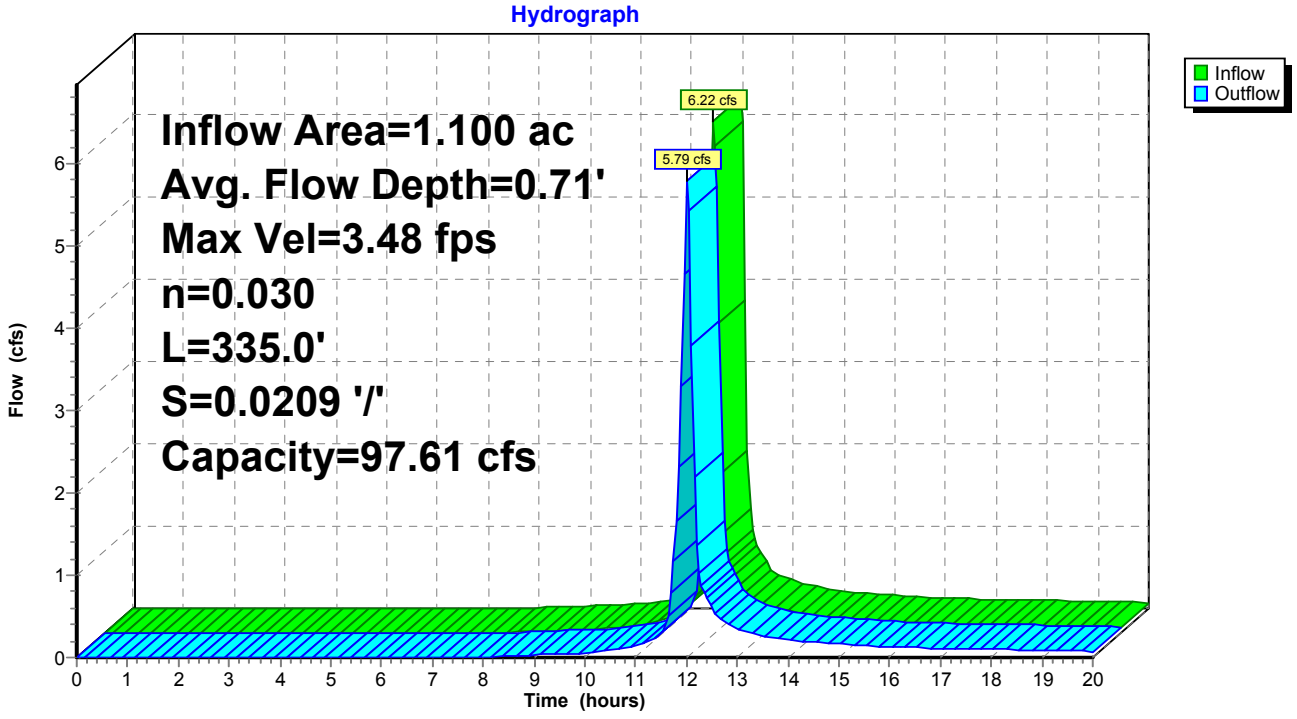
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.48 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 1.32 fps, Avg. Travel Time= 4.2 min

Peak Storage= 586 cf @ 11.99 hrs
Average Depth at Peak Storage= 0.71'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 97.61 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 4.0 '/' Top Width= 14.00'
Length= 335.0' Slope= 0.0209 '/'
Inlet Invert= 1,340.00', Outlet Invert= 1,333.00'



Reach R15: R15



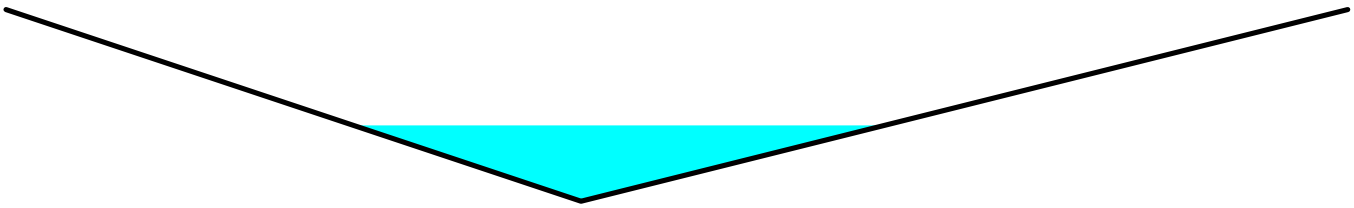
Summary for Reach R16: R-16

Inflow Area = 1.500 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 8.48 cfs @ 11.97 hrs, Volume= 0.384 af
Outflow = 7.85 cfs @ 12.03 hrs, Volume= 0.383 af, Atten= 7%, Lag= 3.9 min

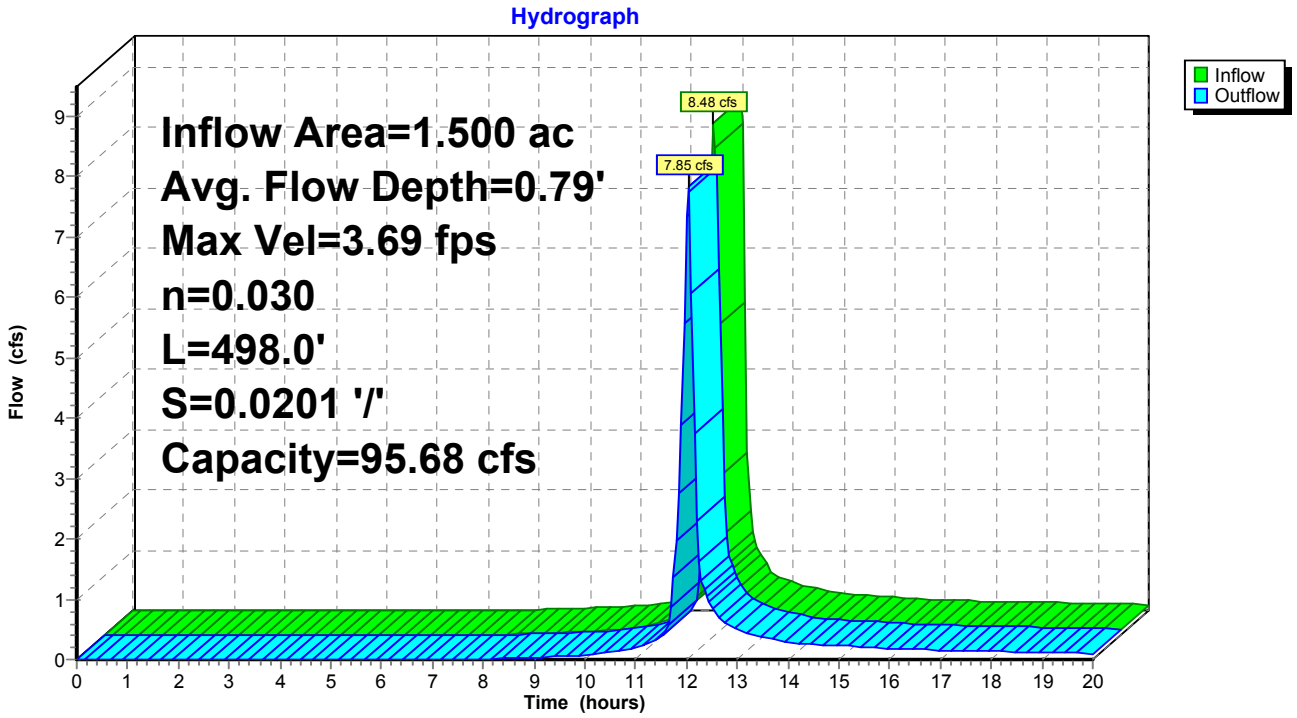
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.69 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 1.40 fps, Avg. Travel Time= 5.9 min

Peak Storage= 1,096 cf @ 12.00 hrs
Average Depth at Peak Storage= 0.79'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 95.68 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 4.0 '/' Top Width= 14.00'
Length= 498.0' Slope= 0.0201 '/'
Inlet Invert= 1,303.00', Outlet Invert= 1,293.00'



Reach R16: R-16



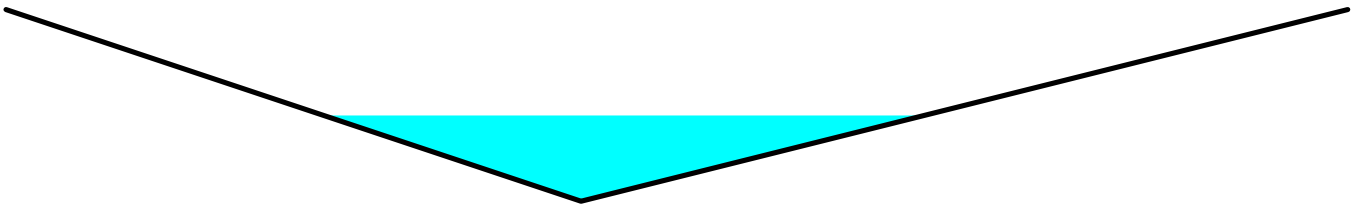
Summary for Reach R17: R-17

Inflow Area = 2.100 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 11.87 cfs @ 11.97 hrs, Volume= 0.538 af
Outflow = 11.01 cfs @ 12.05 hrs, Volume= 0.536 af, Atten= 7%, Lag= 4.7 min

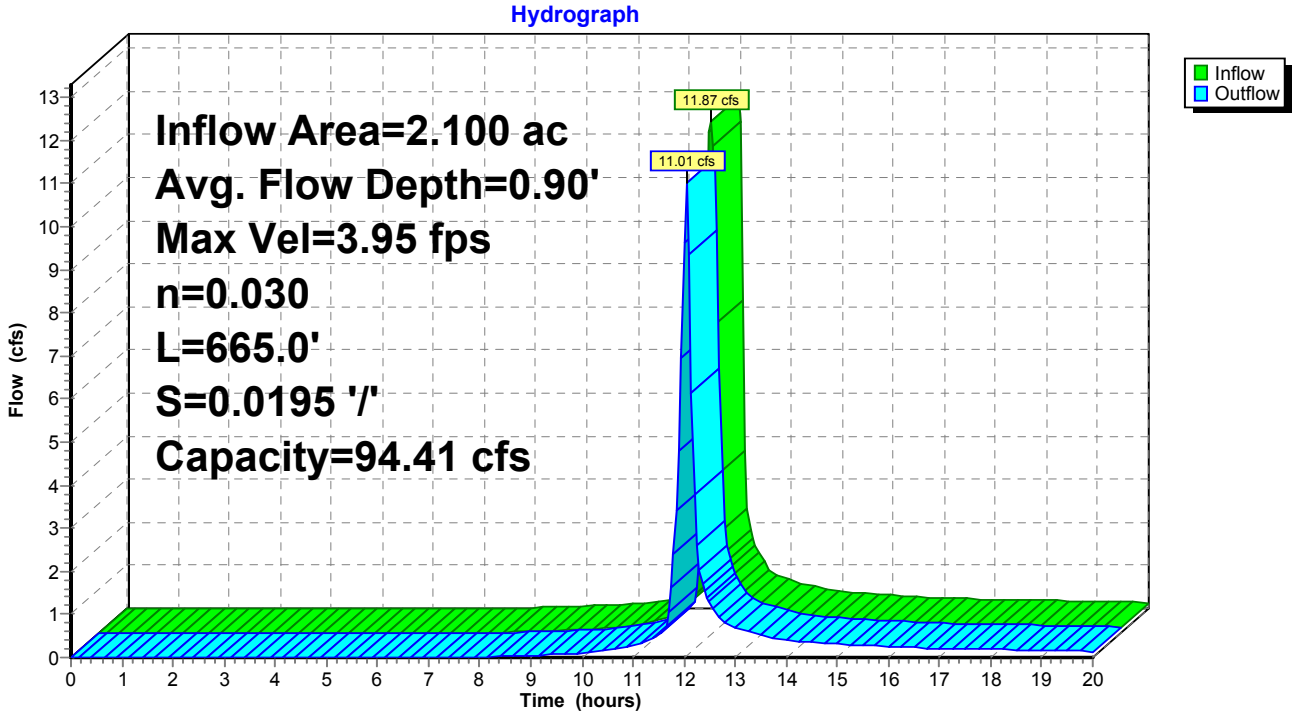
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.95 fps, Min. Travel Time= 2.8 min
Avg. Velocity = 1.51 fps, Avg. Travel Time= 7.4 min

Peak Storage= 1,871 cf @ 12.00 hrs
Average Depth at Peak Storage= 0.90'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 94.41 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 4.0 '/' Top Width= 14.00'
Length= 665.0' Slope= 0.0195 '/'
Inlet Invert= 1,266.00', Outlet Invert= 1,253.00'



Reach R17: R-17



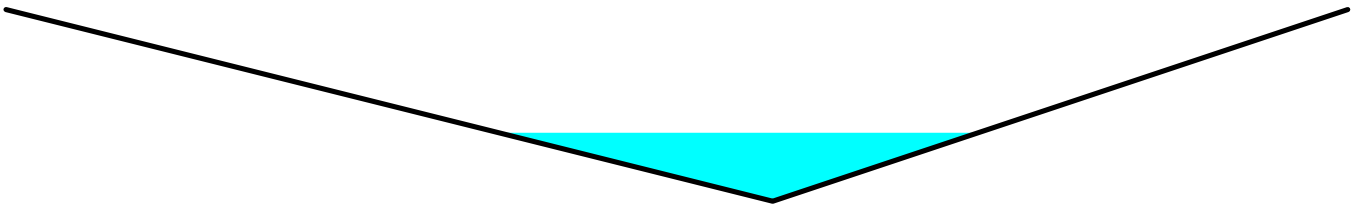
Summary for Reach R18: R-18

Inflow Area = 1.200 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 6.78 cfs @ 11.97 hrs, Volume= 0.307 af
Outflow = 6.28 cfs @ 12.04 hrs, Volume= 0.306 af, Atten= 7%, Lag= 4.0 min

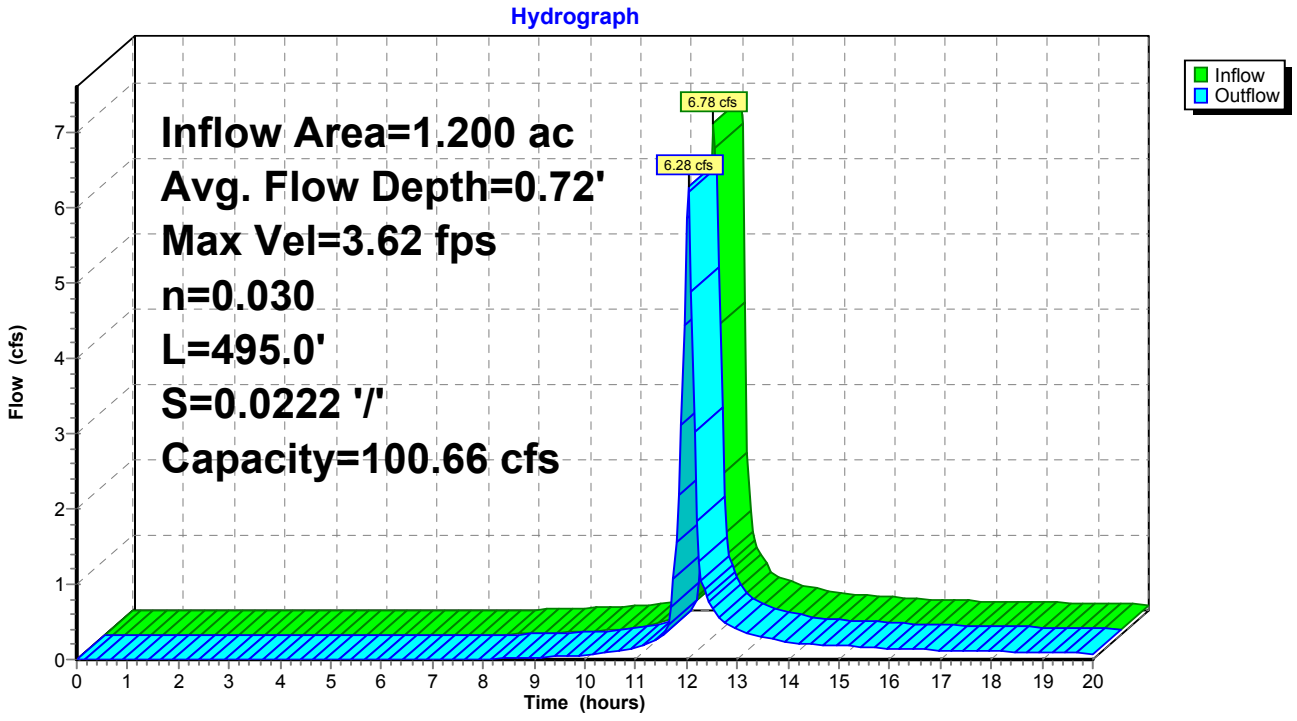
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.62 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 1.38 fps, Avg. Travel Time= 6.0 min

Peak Storage= 886 cf @ 12.00 hrs
Average Depth at Peak Storage= 0.72'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 100.66 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 4.0 3.0 '/' Top Width= 14.00'
Length= 495.0' Slope= 0.0222 '/'
Inlet Invert= 1,304.00', Outlet Invert= 1,293.00'



Reach R18: R-18



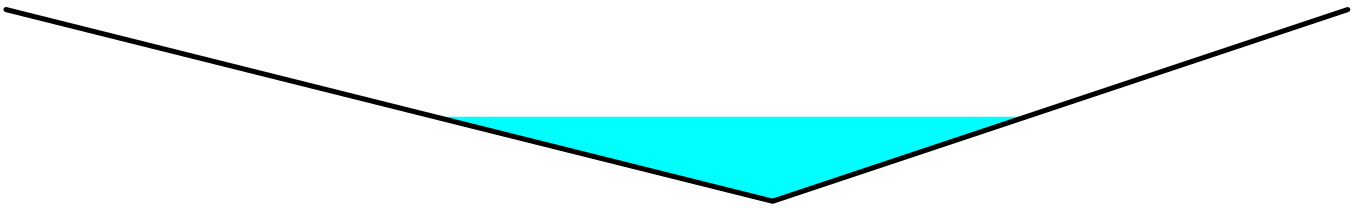
Summary for Reach R19: R-19

Inflow Area = 2.100 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 11.87 cfs @ 11.97 hrs, Volume= 0.538 af
Outflow = 10.85 cfs @ 12.06 hrs, Volume= 0.535 af, Atten= 9%, Lag= 5.1 min

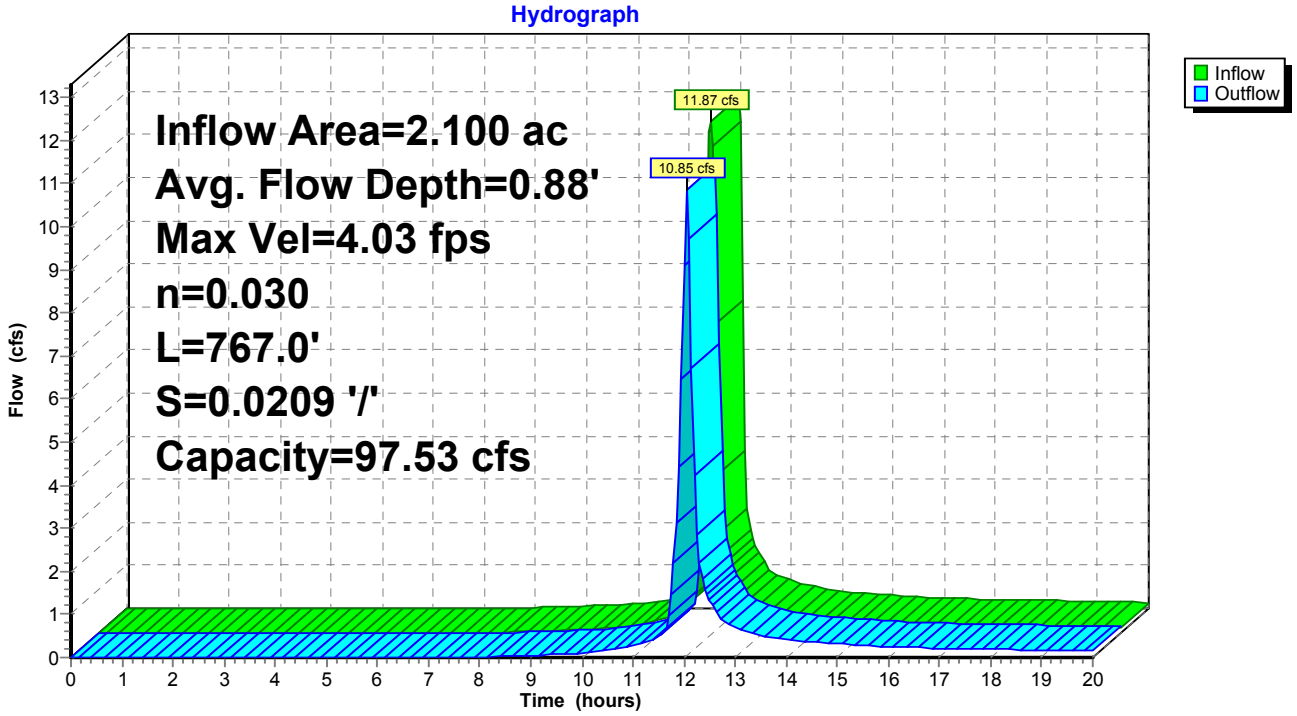
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.03 fps, Min. Travel Time= 3.2 min
Avg. Velocity = 1.54 fps, Avg. Travel Time= 8.3 min

Peak Storage= 2,082 cf @ 12.00 hrs
Average Depth at Peak Storage= 0.88'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 97.53 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 4.0 3.0 '/' Top Width= 14.00'
Length= 767.0' Slope= 0.0209 '/'
Inlet Invert= 1,269.00', Outlet Invert= 1,253.00'



Reach R19: R-19



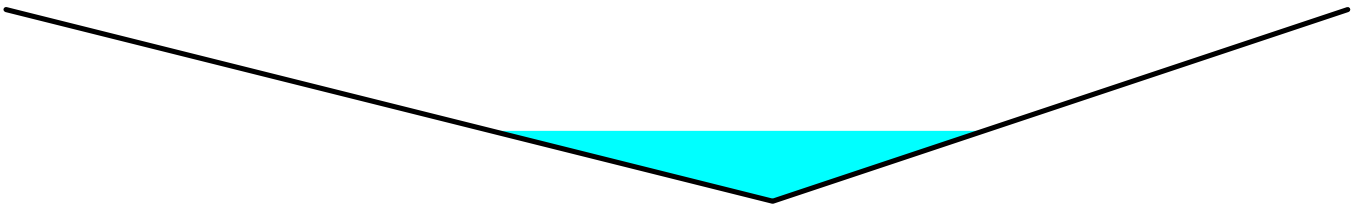
Summary for Reach R2: R-2

Inflow Area = 1.400 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 7.91 cfs @ 11.97 hrs, Volume= 0.359 af
Outflow = 7.48 cfs @ 12.00 hrs, Volume= 0.358 af, Atten= 5%, Lag= 2.1 min

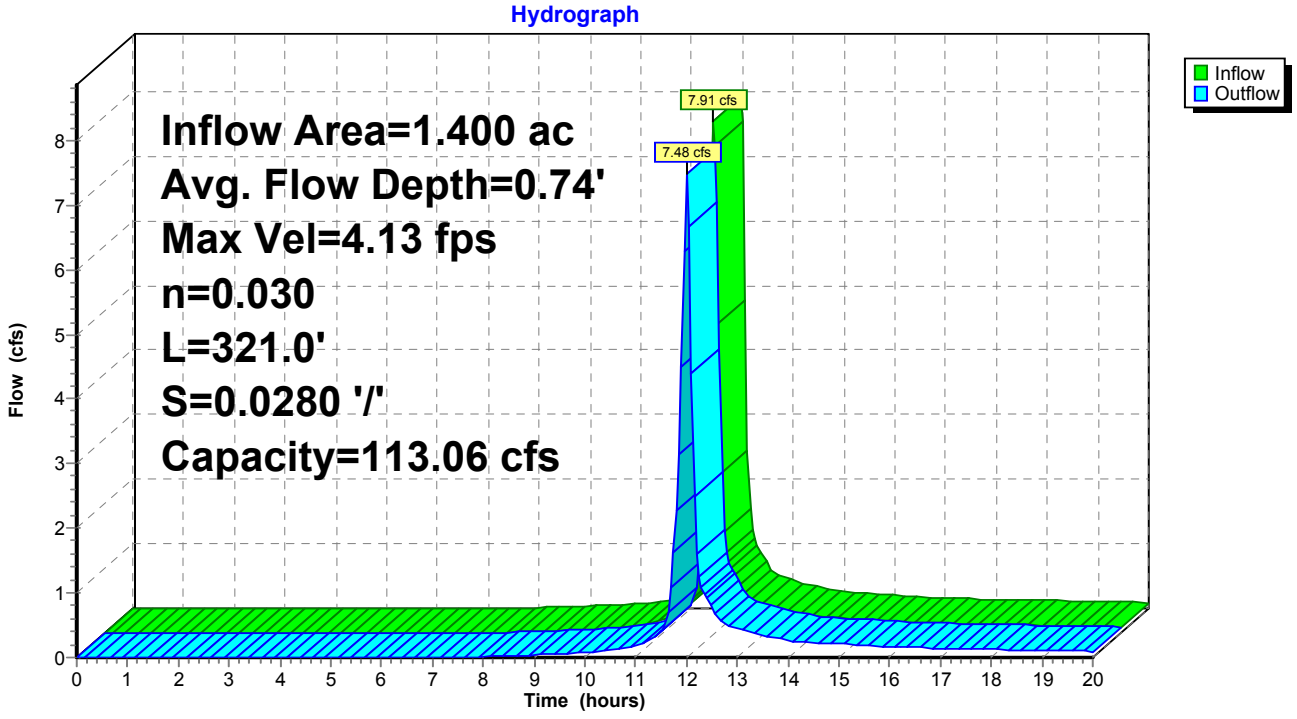
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.13 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 1.57 fps, Avg. Travel Time= 3.4 min

Peak Storage= 607 cf @ 11.99 hrs
Average Depth at Peak Storage= 0.74'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 113.06 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 4.0 3.0 '/' Top Width= 14.00'
Length= 321.0' Slope= 0.0280 '/'
Inlet Invert= 1,305.00', Outlet Invert= 1,296.00'



Reach R2: R-2



Summary for Reach R20a: R-20a

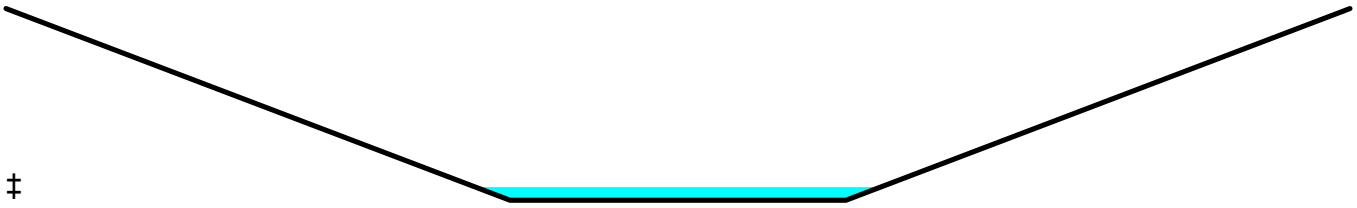
[61] Hint: Exceeded Reach R15 outlet invert by 0.20' @ 12.00 hrs

Inflow Area = 1.100 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 5.79 cfs @ 12.01 hrs, Volume= 0.281 af
Outflow = 5.66 cfs @ 12.03 hrs, Volume= 0.281 af, Atten= 2%, Lag= 1.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.18 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.36 fps, Avg. Travel Time= 2.0 min

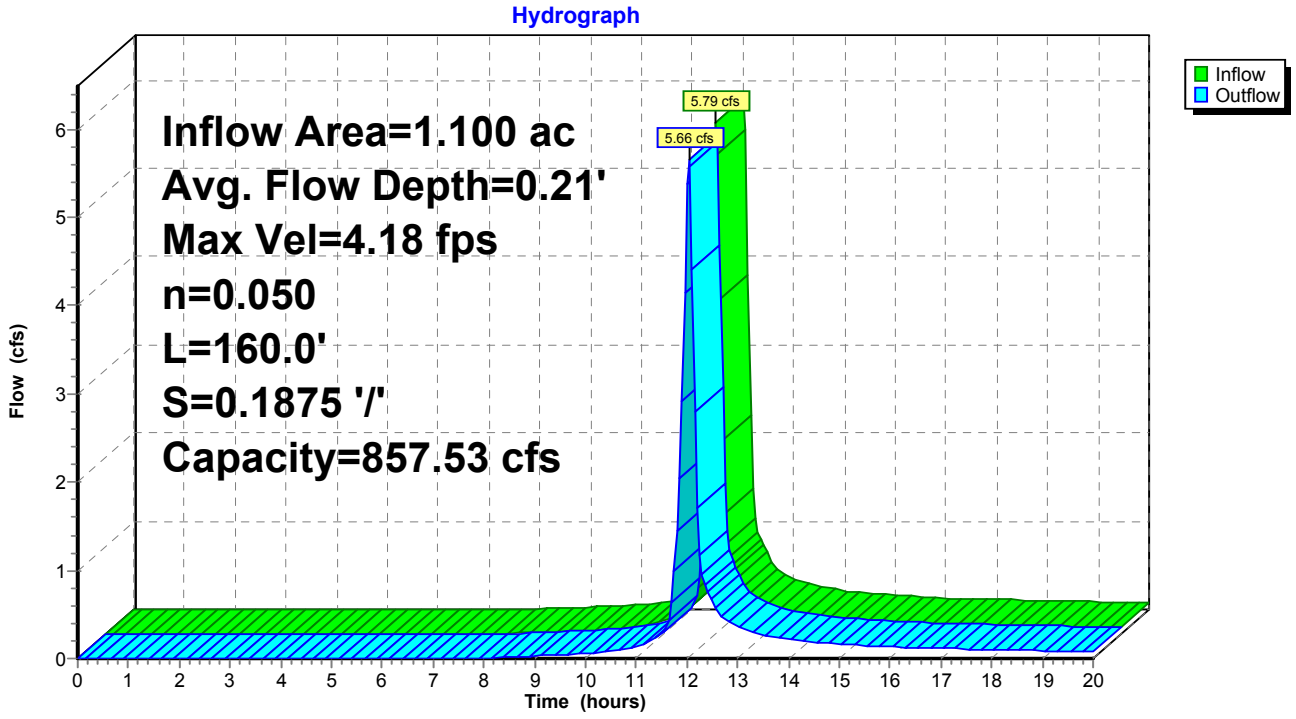
Peak Storage= 219 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.21'
Bank-Full Depth= 3.00' Flow Area= 45.0 sf, Capacity= 857.53 cfs

6.00' x 3.00' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 24.00'
Length= 160.0' Slope= 0.1875 '/'
Inlet Invert= 1,333.00', Outlet Invert= 1,303.00'



‡

Reach R20a: R-20a



Summary for Reach R20b: R-20b

[61] Hint: Exceeded Reach R16 outlet invert by 0.39' @ 12.05 hrs
[61] Hint: Exceeded Reach R18 outlet invert by 0.39' @ 12.05 hrs

Inflow Area = 3.800 ac, 0.00% Impervious, Inflow Depth > 3.06" for 25yr event
Inflow = 19.80 cfs @ 12.03 hrs, Volume= 0.970 af
Outflow = 19.52 cfs @ 12.04 hrs, Volume= 0.969 af, Atten= 1%, Lag= 0.5 min

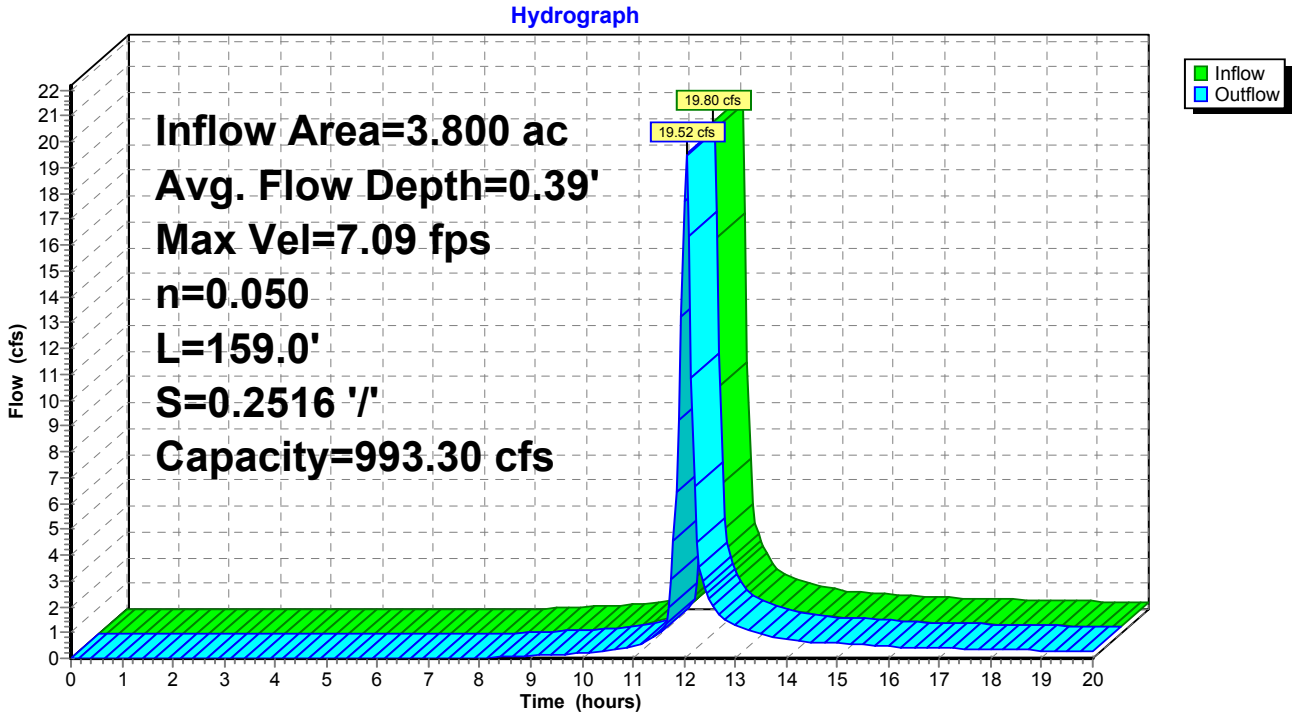
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.09 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.98 fps, Avg. Travel Time= 1.3 min

Peak Storage= 443 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.39'
Bank-Full Depth= 3.00' Flow Area= 45.0 sf, Capacity= 993.30 cfs

6.00' x 3.00' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 24.00'
Length= 159.0' Slope= 0.2516 '/'
Inlet Invert= 1,293.00', Outlet Invert= 1,253.00'

‡

Reach R20b: R-20b



Summary for Reach R20c: R-20c

[61] Hint: Exceeded Reach R17 outlet invert by 0.60' @ 12.05 hrs
[61] Hint: Exceeded Reach R19 outlet invert by 0.60' @ 12.05 hrs
[62] Hint: Exceeded Reach R20b OUTLET depth by 0.22' @ 12.05 hrs

Inflow Area = 8.000 ac, 0.00% Impervious, Inflow Depth > 3.06" for 25yr event
Inflow = 41.33 cfs @ 12.05 hrs, Volume= 2.040 af
Outflow = 41.13 cfs @ 12.05 hrs, Volume= 2.040 af, Atten= 0%, Lag= 0.2 min

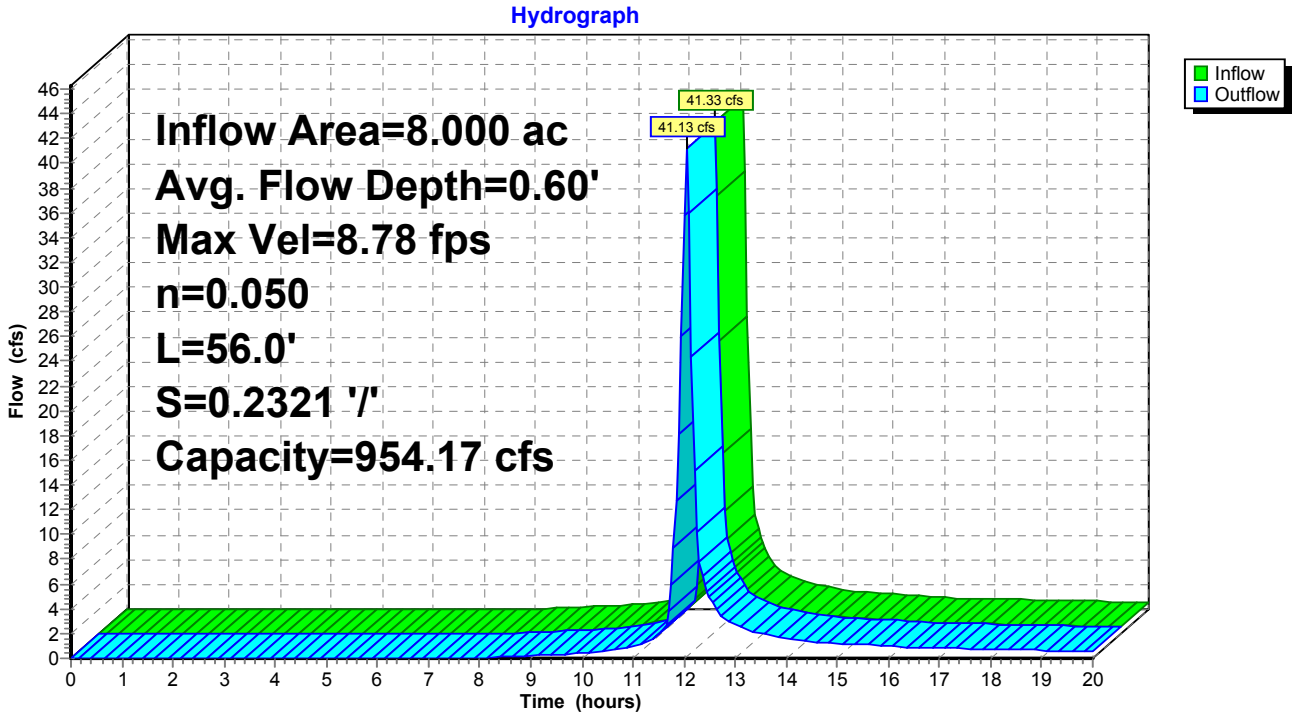
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.78 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.44 fps, Avg. Travel Time= 0.4 min

Peak Storage= 264 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.60'
Bank-Full Depth= 3.00' Flow Area= 45.0 sf, Capacity= 954.17 cfs

6.00' x 3.00' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 24.00'
Length= 56.0' Slope= 0.2321 '/'
Inlet Invert= 1,253.00', Outlet Invert= 1,240.00'

‡

Reach R20c: R-20c



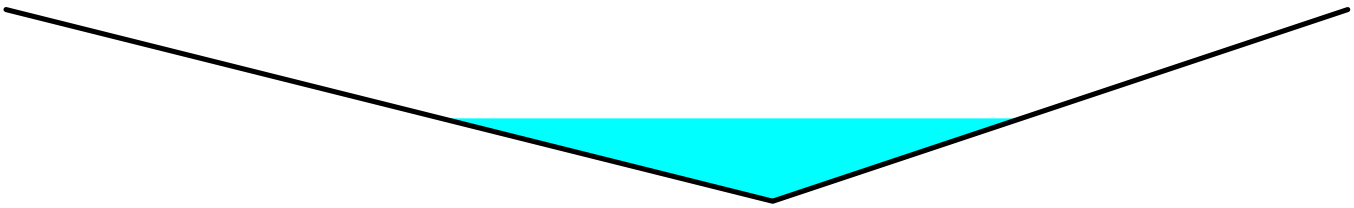
Summary for Reach R3: R-3

Inflow Area = 2.100 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 11.87 cfs @ 11.97 hrs, Volume= 0.538 af
Outflow = 10.99 cfs @ 12.03 hrs, Volume= 0.536 af, Atten= 7%, Lag= 3.7 min

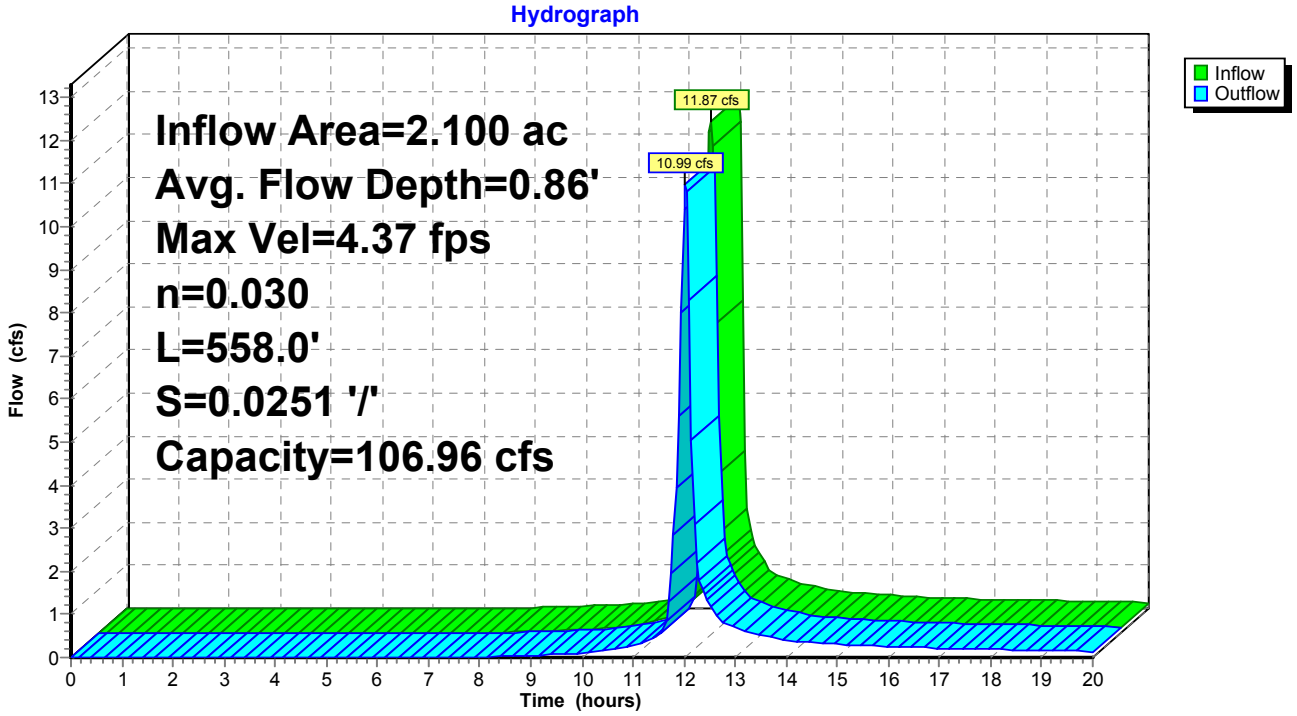
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.37 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 1.66 fps, Avg. Travel Time= 5.6 min

Peak Storage= 1,459 cf @ 11.99 hrs
Average Depth at Peak Storage= 0.86'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 106.96 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 4.0 3.0 '/' Top Width= 14.00'
Length= 558.0' Slope= 0.0251 '/'
Inlet Invert= 1,264.00', Outlet Invert= 1,250.00'



Reach R3: R-3



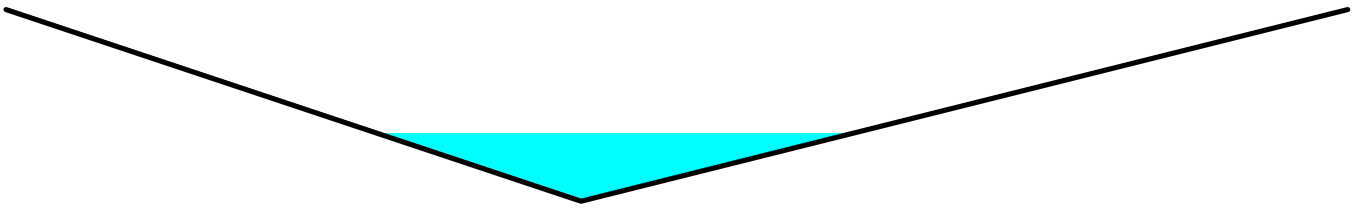
Summary for Reach R4: R-4

Inflow Area = 1.100 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 6.22 cfs @ 11.97 hrs, Volume= 0.282 af
Outflow = 5.76 cfs @ 12.04 hrs, Volume= 0.281 af, Atten= 7%, Lag= 4.1 min

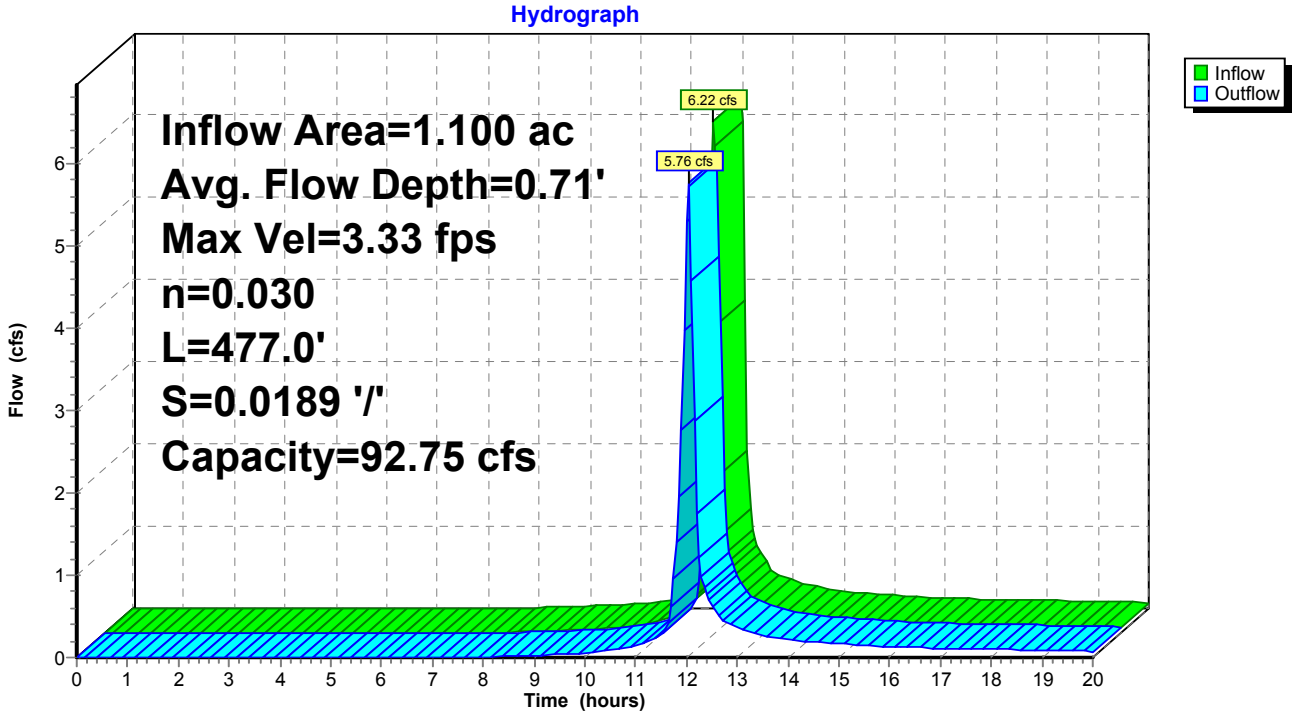
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.33 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 1.27 fps, Avg. Travel Time= 6.3 min

Peak Storage= 848 cf @ 12.00 hrs
Average Depth at Peak Storage= 0.71'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 92.75 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 4.0 '/' Top Width= 14.00'
Length= 477.0' Slope= 0.0189 '/'
Inlet Invert= 1,304.00', Outlet Invert= 1,295.00'



Reach R4: R-4



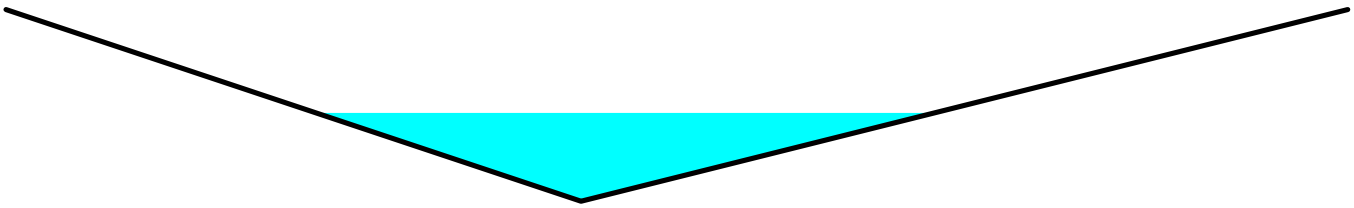
Summary for Reach R5: R-5

Inflow Area = 2.500 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 14.13 cfs @ 11.97 hrs, Volume= 0.640 af
Outflow = 12.96 cfs @ 12.05 hrs, Volume= 0.637 af, Atten= 8%, Lag= 5.1 min

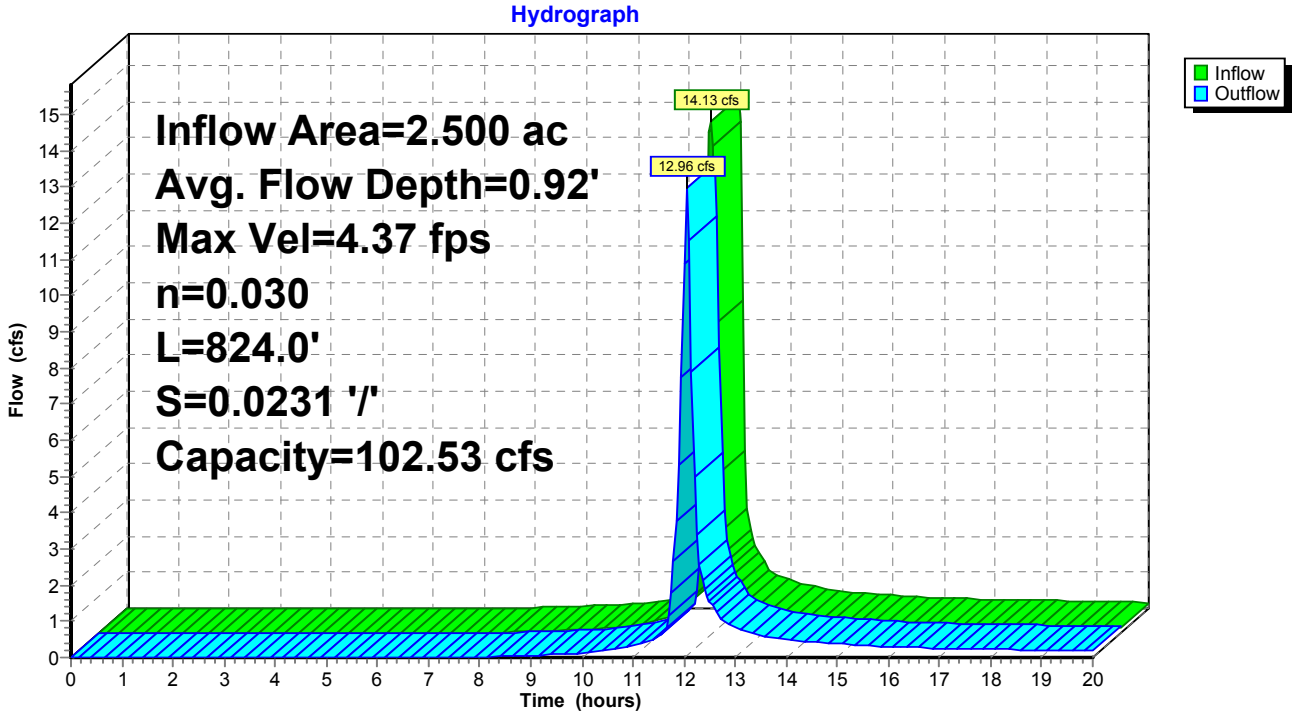
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.37 fps, Min. Travel Time= 3.1 min
Avg. Velocity = 1.67 fps, Avg. Travel Time= 8.2 min

Peak Storage= 2,457 cf @ 12.00 hrs
Average Depth at Peak Storage= 0.92'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 102.53 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 3.0 4.0 '/' Top Width= 14.00'
Length= 824.0' Slope= 0.0231 '/'
Inlet Invert= 1,269.00', Outlet Invert= 1,250.00'



Reach R5: R-5



Summary for Reach R6a: R-6a

[61] Hint: Exceeded Reach R1 outlet invert by 0.19' @ 12.00 hrs

Inflow Area = 1.100 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 5.79 cfs @ 12.01 hrs, Volume= 0.281 af
Outflow = 5.67 cfs @ 12.03 hrs, Volume= 0.281 af, Atten= 2%, Lag= 1.0 min

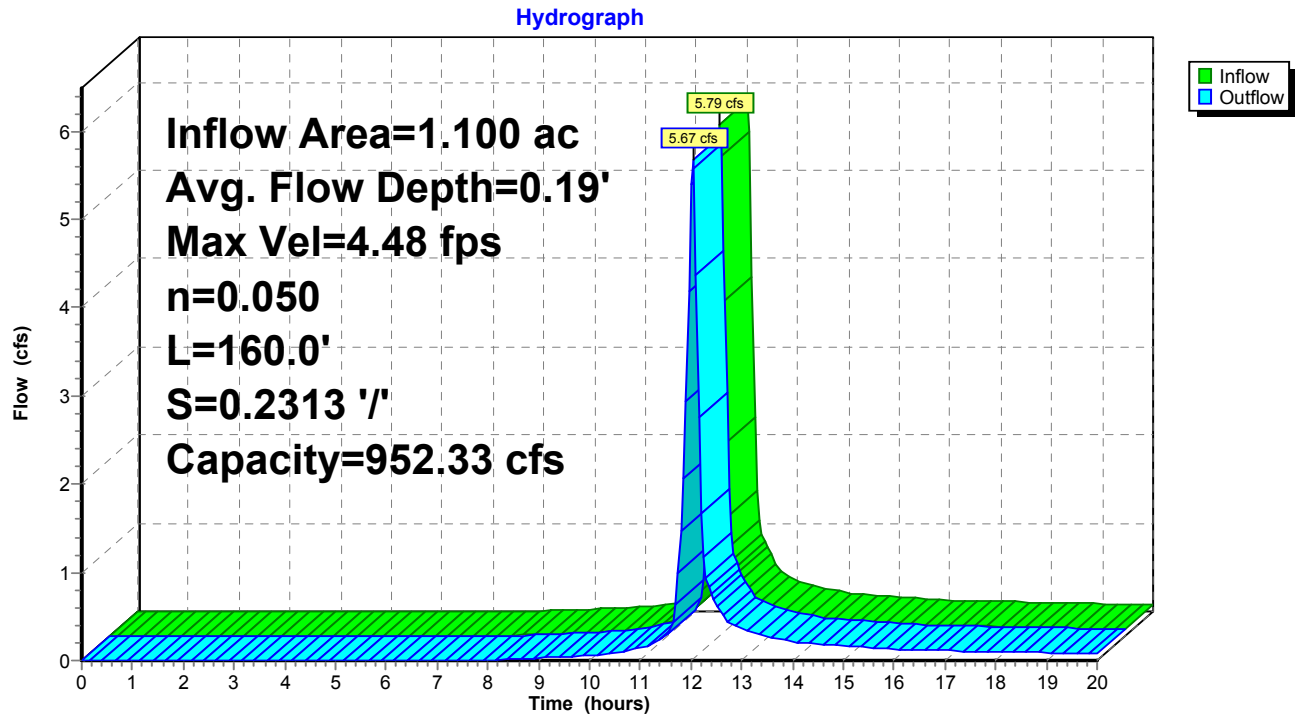
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.48 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.50 fps, Avg. Travel Time= 1.8 min

Peak Storage= 204 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.19'
Bank-Full Depth= 3.00' Flow Area= 45.0 sf, Capacity= 952.33 cfs

6.00' x 3.00' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 24.00'
Length= 160.0' Slope= 0.2313 '/'
Inlet Invert= 1,333.00', Outlet Invert= 1,296.00'

‡

Reach R6a: R-6a



Summary for Reach R6b: R-6b

[61] Hint: Exceeded Reach R2 outlet invert by 0.38' @ 12.05 hrs
[62] Hint: Exceeded Reach R4 OUTLET depth by 1.00' @ 0.00 hrs
[62] Hint: Exceeded Reach R6a OUTLET depth by 0.19' @ 12.05 hrs

Inflow Area = 3.600 ac, 0.00% Impervious, Inflow Depth > 3.06" for 25yr event
Inflow = 18.56 cfs @ 12.02 hrs, Volume= 0.919 af
Outflow = 18.31 cfs @ 12.04 hrs, Volume= 0.918 af, Atten= 1%, Lag= 0.8 min

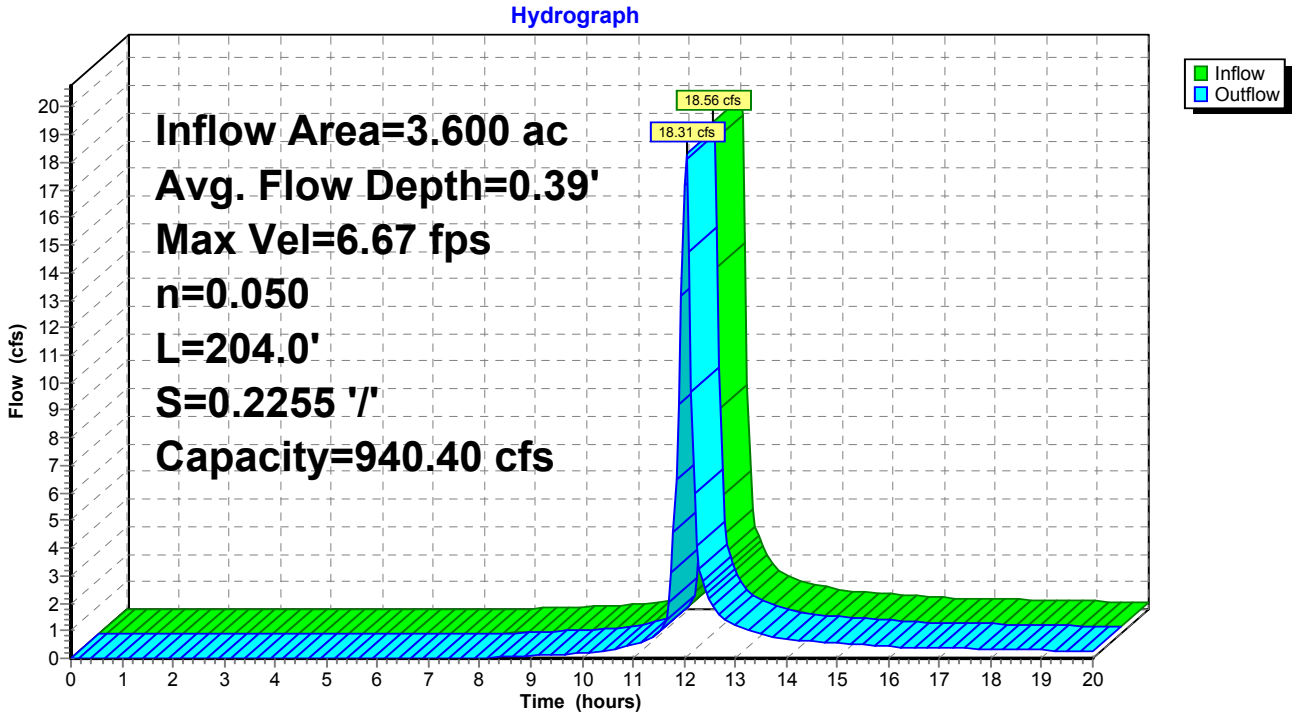
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.67 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.88 fps, Avg. Travel Time= 1.8 min

Peak Storage= 566 cf @ 12.03 hrs
Average Depth at Peak Storage= 0.39'
Bank-Full Depth= 3.00' Flow Area= 45.0 sf, Capacity= 940.40 cfs

6.00' x 3.00' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 24.00'
Length= 204.0' Slope= 0.2255 '/'
Inlet Invert= 1,296.00', Outlet Invert= 1,250.00'

‡

Reach R6b: R-6b



Summary for Reach R6c: R-6c

[61] Hint: Exceeded Reach R3 outlet invert by 0.65' @ 12.05 hrs
[61] Hint: Exceeded Reach R5 outlet invert by 0.65' @ 12.05 hrs
[62] Hint: Exceeded Reach R6b OUTLET depth by 0.26' @ 12.05 hrs

Inflow Area = 8.200 ac, 0.00% Impervious, Inflow Depth > 3.06" for 25yr event
Inflow = 42.06 cfs @ 12.04 hrs, Volume= 2.092 af
Outflow = 41.66 cfs @ 12.05 hrs, Volume= 2.091 af, Atten= 1%, Lag= 0.3 min

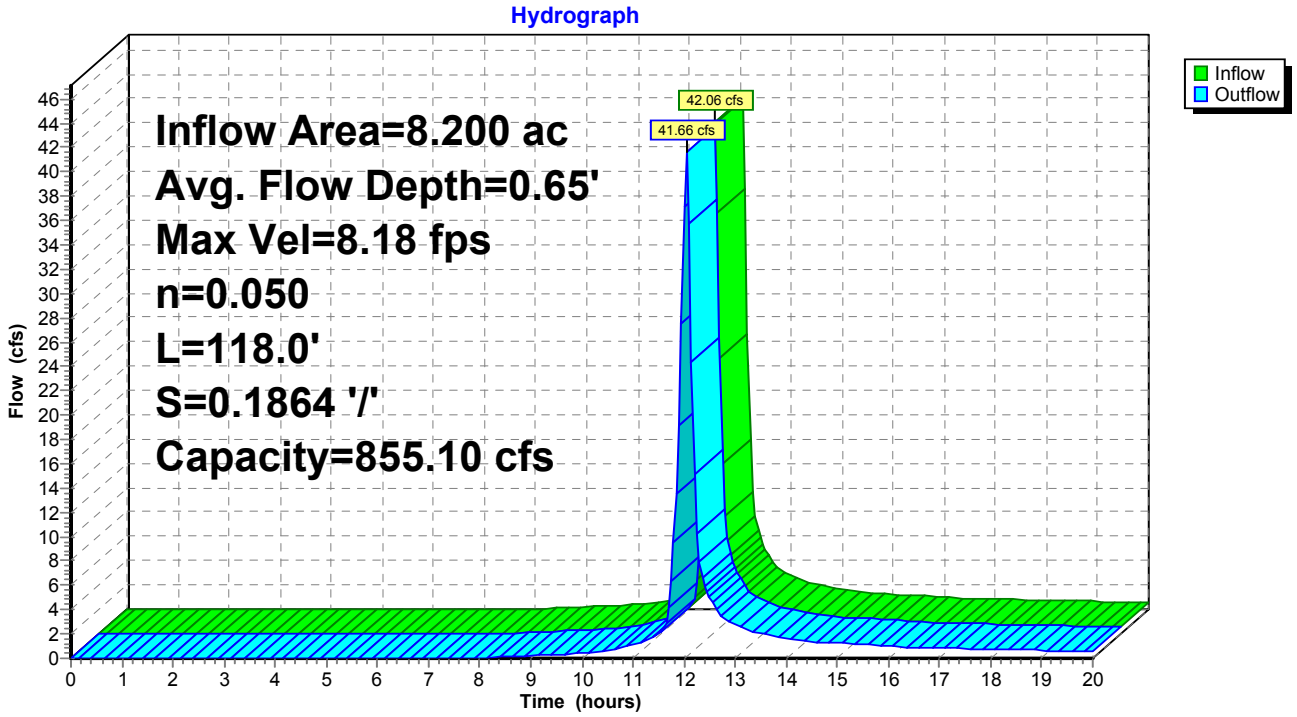
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.18 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.29 fps, Avg. Travel Time= 0.9 min

Peak Storage= 606 cf @ 12.04 hrs
Average Depth at Peak Storage= 0.65'
Bank-Full Depth= 3.00' Flow Area= 45.0 sf, Capacity= 855.10 cfs

6.00' x 3.00' deep channel, n= 0.050
Side Slope Z-value= 3.0 '/' Top Width= 24.00'
Length= 118.0' Slope= 0.1864 '/'
Inlet Invert= 1,250.00', Outlet Invert= 1,228.00'

‡

Reach R6c: R-6c



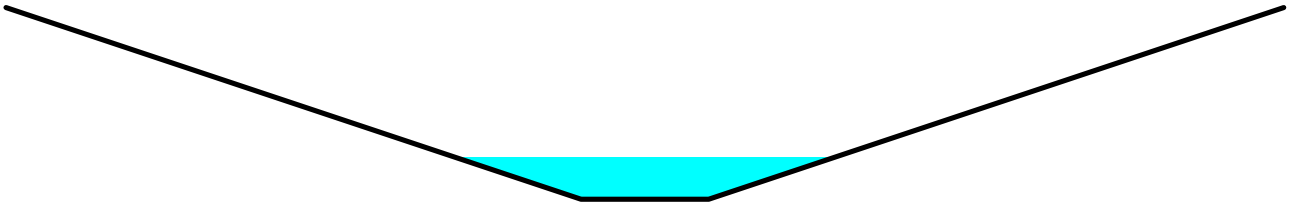
Summary for Reach R7: R-7

Inflow Area = 2.200 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 12.43 cfs @ 11.97 hrs, Volume= 0.563 af
Outflow = 11.42 cfs @ 12.05 hrs, Volume= 0.560 af, Atten= 8%, Lag= 5.1 min

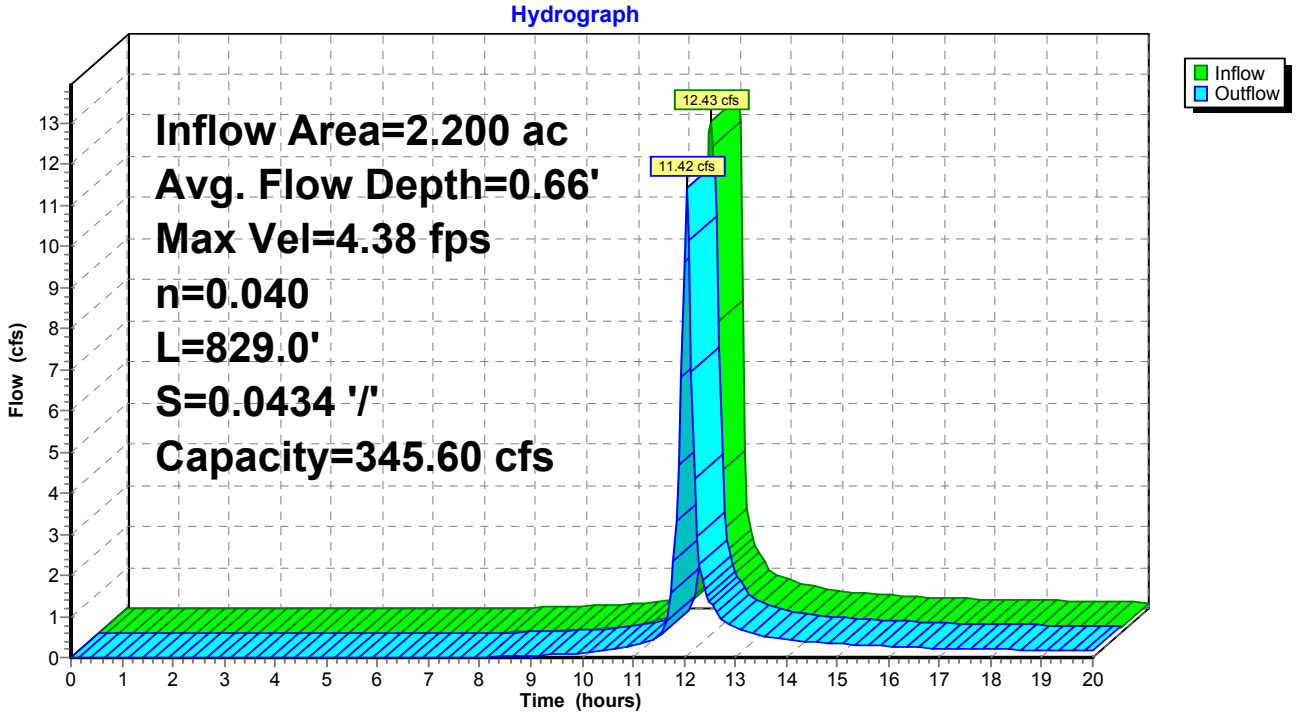
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.38 fps, Min. Travel Time= 3.2 min
Avg. Velocity = 1.41 fps, Avg. Travel Time= 9.8 min

Peak Storage= 2,178 cf @ 12.00 hrs
Average Depth at Peak Storage= 0.66'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 345.60 cfs

2.00' x 3.00' deep channel, n= 0.040
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 829.0' Slope= 0.0434 '/'
Inlet Invert= 1,260.00', Outlet Invert= 1,224.00'



Reach R7: R-7



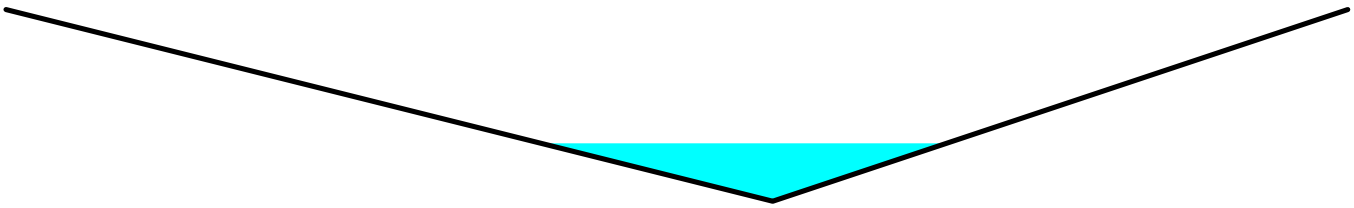
Summary for Reach R8: R-8

Inflow Area = 0.700 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 3.96 cfs @ 11.97 hrs, Volume= 0.179 af
Outflow = 3.67 cfs @ 12.02 hrs, Volume= 0.179 af, Atten= 7%, Lag= 3.0 min

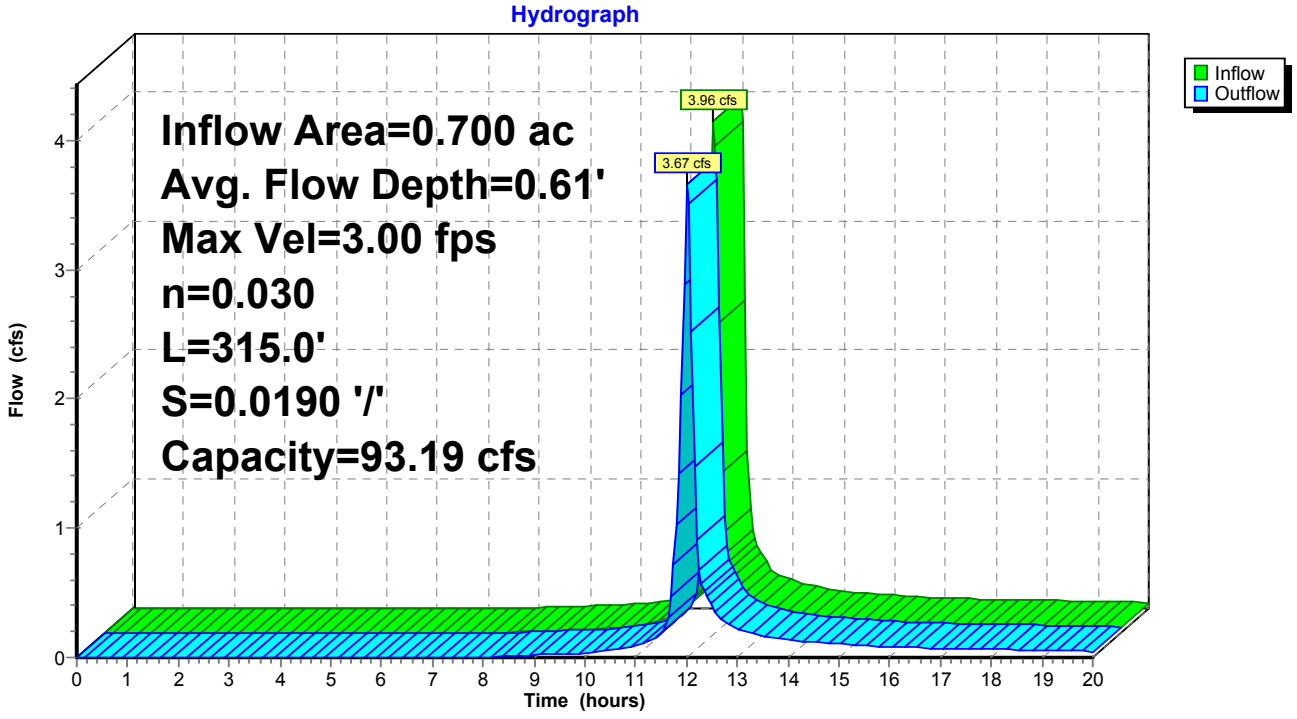
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.00 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.14 fps, Avg. Travel Time= 4.6 min

Peak Storage= 405 cf @ 11.99 hrs
Average Depth at Peak Storage= 0.61'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 93.19 cfs

0.00' x 2.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 4.0 3.0 '/' Top Width= 14.00'
Length= 315.0' Slope= 0.0190 '/'
Inlet Invert= 1,338.00', Outlet Invert= 1,332.00'



Reach R8: R-8



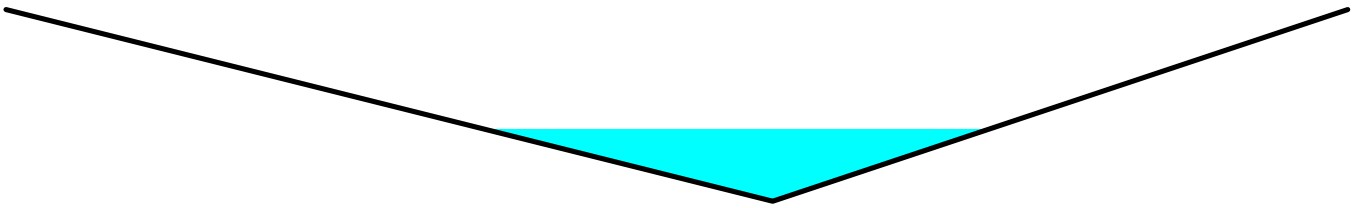
Summary for Reach R9: R-9

Inflow Area = 1.400 ac, 0.00% Impervious, Inflow Depth > 3.07" for 25yr event
Inflow = 7.91 cfs @ 11.97 hrs, Volume= 0.359 af
Outflow = 7.33 cfs @ 12.03 hrs, Volume= 0.357 af, Atten= 7%, Lag= 3.7 min

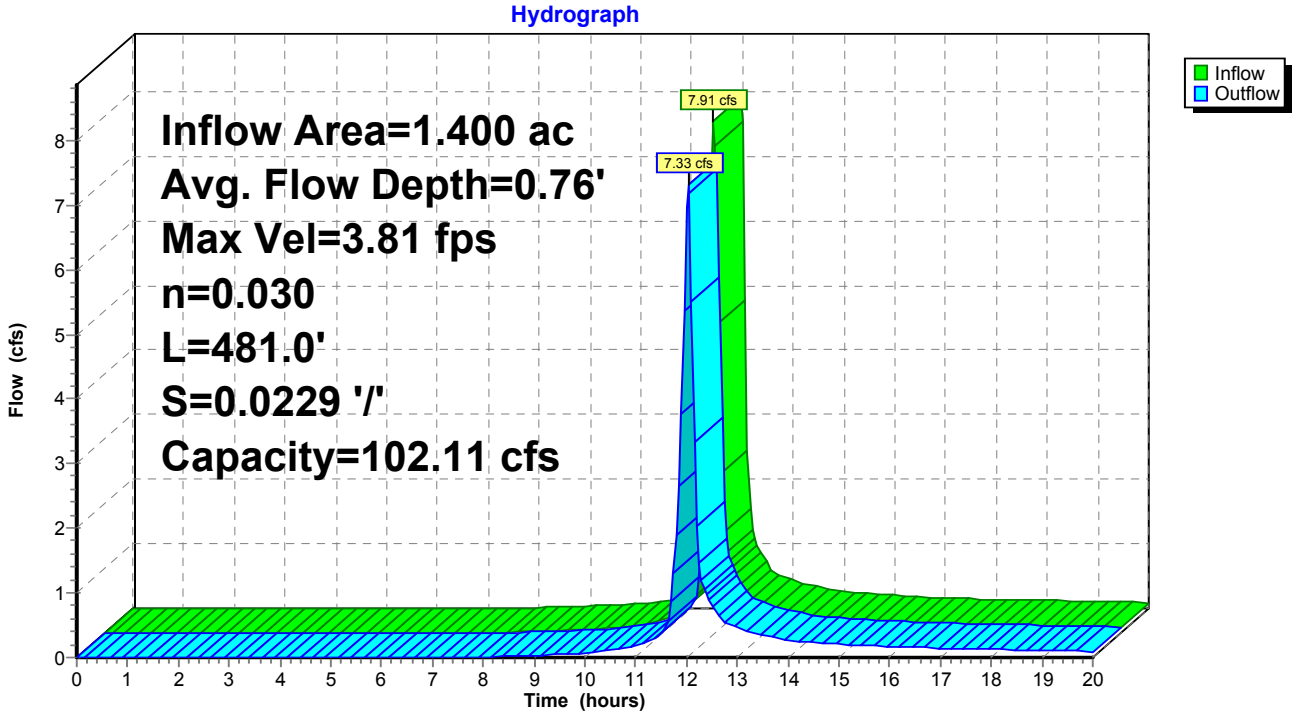
Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.81 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 1.45 fps, Avg. Travel Time= 5.5 min

Peak Storage= 961 cf @ 11.99 hrs
Average Depth at Peak Storage= 0.76'
Bank-Full Depth= 2.00' Flow Area= 14.0 sf, Capacity= 102.11 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 4.0 3.0 '/' Top Width= 14.00'
Length= 481.0' Slope= 0.0229 '/'
Inlet Invert= 1,303.00', Outlet Invert= 1,292.00'



Reach R9: R-9



Summary for Pond P-1: P-1

Inflow Area = 17.480 ac, 0.00% Impervious, Inflow Depth > 3.05" for 25yr event
Inflow = 74.52 cfs @ 12.07 hrs, Volume= 4.447 af
Outflow = 34.64 cfs @ 12.26 hrs, Volume= 4.186 af, Atten= 54%, Lag= 11.1 min
Primary = 34.64 cfs @ 12.26 hrs, Volume= 4.186 af

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,222.65' @ 12.26 hrs Surf.Area= 0.000 ac Storage= 1.523 af

Plug-Flow detention time= 57.0 min calculated for 4.186 af (94% of inflow)
Center-of-Mass det. time= 35.7 min (823.6 - 787.9)

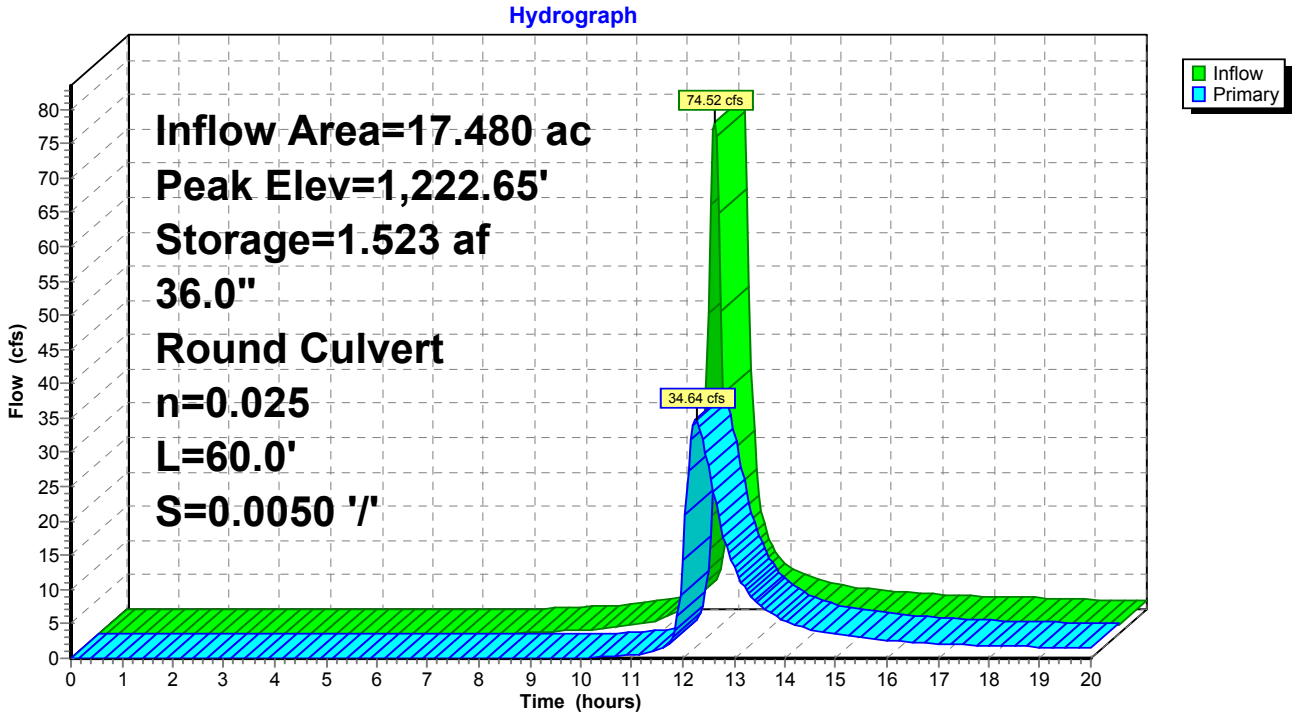
Volume	Invert	Avail.Storage	Storage Description
#1	1,219.00'	2.500 af	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (acre-feet)
1,219.00	0.000
1,225.00	2.500

Device	Routing	Invert	Outlet Devices
#1	Primary	1,219.00'	**36.0" Round Culvert** L= 60.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 1,219.00' / 1,218.70' S= 0.0050 '/' Cc= 0.900 n= 0.025, Flow Area= 7.07 sf

Primary OutFlow Max=34.59 cfs @ 12.26 hrs HW=1,222.65' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 34.59 cfs @ 5.11 fps)

Pond P-1: P-1


Hydrograph
Inflow Area=17.480 ac
Peak Elev=1,222.65'
Storage=1.523 af
36.0"
Round Culvert
n=0.025
L=60.0'
S=0.0050 '/'
74.52 cfs
34.64 cfs
Inflow
Primary
Flow (cfs)
Time (hours)
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Summary for Pond P-2: POND

[81] Warning: Exceeded Pond P-1 by 2.45' @ 19.95 hrs

Inflow Area = 34.780 ac, 4.31% Impervious, Inflow Depth > 3.06" for 25yr event
Inflow = 102.35 cfs @ 12.02 hrs, Volume= 8.882 af
Outflow = 29.24 cfs @ 12.67 hrs, Volume= 5.825 af, Atten= 71%, Lag= 39.0 min
Primary = 29.24 cfs @ 12.67 hrs, Volume= 5.825 af

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,223.25' @ 12.67 hrs Surf.Area= 0.000 ac Storage= 3.938 af

Plug-Flow detention time= 143.6 min calculated for 5.825 af (66% of inflow)
Center-of-Mass det. time= 69.6 min (865.7 - 796.0)

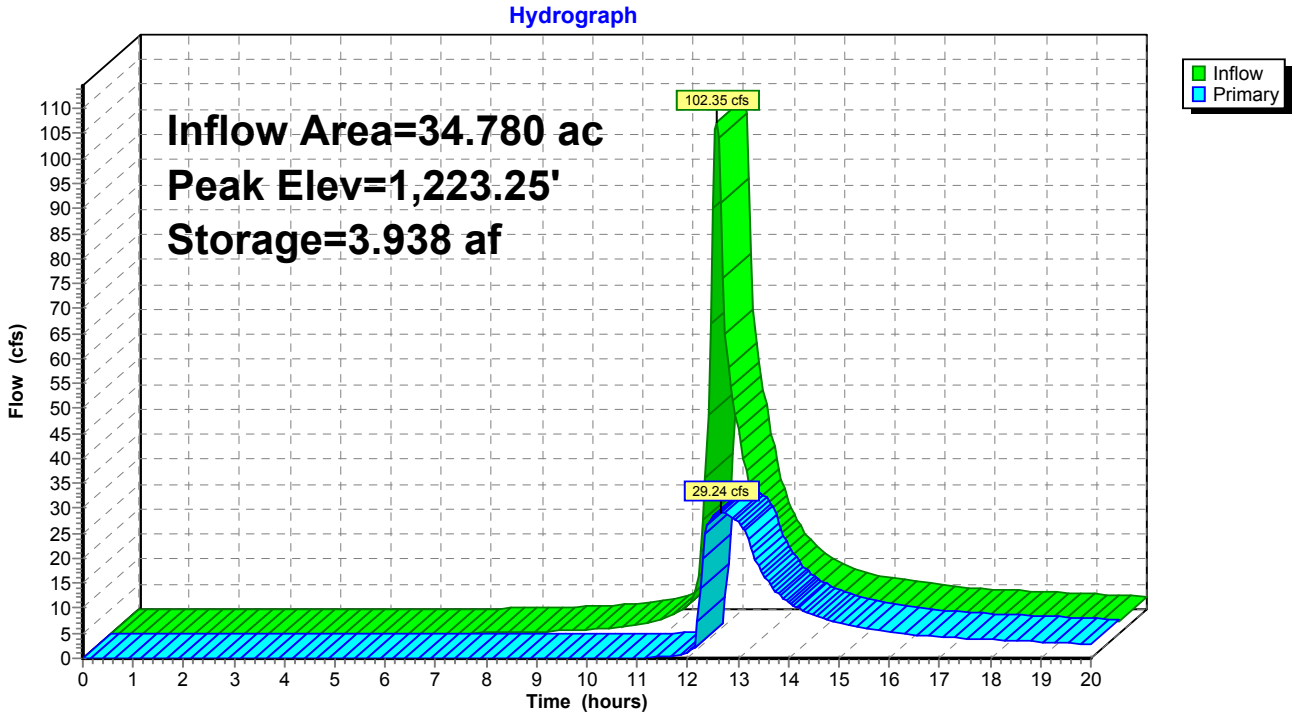
Volume	Invert	Avail.Storage	Storage Description
#1	1,218.00'	4.500 af	**Custom Stage Data**Listed below

Elevation (feet)	Cum.Store (acre-feet)
1,218.00	0.000
1,224.00	4.500

Device	Routing	Invert	Outlet Devices
#1	Primary	1,218.00'	**30.0" Round Culvert** L= 40.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 1,218.00' / 1,217.80' S= 0.0050 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 4.91 sf
#2	Device 1	1,218.00'	**1.0" Vert. Orifice/Grate X 9.00 columns** X 6 rows with 6.0" cc spacing C= 0.600
#3	Device 1	1,222.00'	**30.0" Horiz. Orifice/Grate** C= 0.600 in 30.0" Grate (100% open area) Limited to weir flow at low heads
#4	Primary	1,223.50'	**100.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=29.22 cfs @ 12.67 hrs HW=1,223.25' (Free Discharge)
- **1=Culvert** (Passes 29.22 cfs of 38.61 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 2.80 cfs @ 9.52 fps)
  - **3=Orifice/Grate** (Orifice Controls 26.42 cfs @ 5.38 fps)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond P-2: POND


Hydrograph
Inflow Area=34.780 ac
Peak Elev=1,223.25'
Storage=3.938 af
102.35 cfs
29.24 cfs
Inflow
Primary
Flow (cfs)
Time (hours)
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Appendix H

Industrial Solid Waste Management Plan

Industrial Solid Waste Management Plan

For Class III Area
(Phase 2 through Phase 5)

Austin, MN
Permit #SW-514

Prepared by:

SKB ENVIRONMENTAL
LANSINGLANDFILL
52563 243 STREET
AUSTIN, MN 55912

August 2013

Table of Contents

Table of Contents (cont.)

1.0 Introduction

1.1 PURPOSE

SKB (Austin) Environmental, LLC (SKB Lansing) has been approved to accept demolition debris, construction debris, and industrial solid waste (ISW) at an existing demolition debris landfill (Facility) operated under Minnesota Pollution Control Agency (MPCA) solid waste permit SW-514. This plan is being prepared and updated to reflect the composite liner that has been installed as part of re-permitting the facility as a type III demolition facility. As a type III demolition facility, up to forty nine percent of the waste accepted may be ISW in accordance with the MPCA's 2005 Demolition Landfill Guidance. This Industrial Solid Waste Management Plan (ISWMP) addresses the management of the ISW delivered to the Facility and has been prepared in accordance with MPCA Rules, Part 7035.2535, subpart 5 and Part 7035.2575, subpart 2, items B and C. The information outlined in this ISWMP is essential for the correct classification of the material and for proper waste management in accordance with applicable federal, state and local law. This Plan is intended to cover the lined portion of the facility. The existing ISWMP (May 2007) for the unlined site shall still be used for the unlined area until that area is completed and closed.

1.2 GENERAL INFORMATION

The Facility is currently owned and operated by SKB (Austin) Environmental, LLC under the terms and conditions of MPCA permit number SW-514. The SKB Lansing Facility is located on approximately 40 acres in Section 21, Township 103 North, Range 18 West in Mower County, Minnesota. The current lined area will be approximately five acres in size.

SKB Lansing has been re-permitted and lined for continued operation as a Type III Demolition Landfill.

1.3 PLAN AMENDMENT

This ISWMP will be reviewed as conditions warrant to determine its adequacy in dealing with industrial wastes received at the site. Future changes to the ISWMP will be submitted to the MPCA prior to implementation.

1.4 PLAN DEFINITIONS

For the purposes of this ISWMP, the MPCA definition of "industrial solid waste" as written in Part 7035.0300 applies and is as follows *"solid wastes generated from an industrial or manufacturing process and solid waste generated from non-manufacturing activities such as service and commercial establishments. Industrial solid waste does not include office materials, restaurant and food preparation waste, discarded machinery, demolition debris, municipal solid waste combustor ash, or household refuse."*

In addition, demolition debris is defined by the MPCA as *"solid waste resulting from the demolition of buildings, roads, and other structures including concrete, brick, bituminous concrete, untreated wood, masonry, glass, trees, rock, and plastic building parts. Demolition debris does not include asbestos wastes.*

Construction debris is defined by MPCA as *"waste building materials resulting from construction, remodeling, and repair of buildings and roads including asphalt; bricks; concrete (including re-rod); concrete block; copper tubing; felt or tar paper; electrical wiring (copper or aluminum); galvanized pipe; insulation; untreated lumber; particle board; plaster masonry; plywood; PVC conduit; PVC pipe; duct work; ceramic fixtures; fencing materials (galvanized steel, untreated wood); shingles; siding (aluminum, steel, vinyl plastic wood); steel pipe; sheetrock; and window pane glass."*

2.0 Acceptable and Unacceptable Wastes

2.1 ACCEPTABLE WASTES

The SKB Lansing Facility will be a composite lined Type III Demolition Landfill with leachate collection and groundwater monitoring and can accept all construction and demolition debris as defined by the MPCA. In addition, the Facility can accept all non-hazardous industrial wastes in accordance with this ISWMP. Some of these wastes include, but are not limited to, the following in Table 2-1:

Table 2-1

Description	No Further Evaluation Needed	Evaluate per Table 2-2
Wood Wastes:		
• Tree stumps, grubbing, and root balls	X	
• Pallets	X	
• Cabinetry, doors, prefabricated walls, countertops, etc.	X	
• Wood and sawdust	X	X (only if contains varnish or glue)
• Sawdust from an industrial/manufacturing source	X	X (only if contains varnish or glue
• Untreated Lumber	X	
• Particle Board	X	
• Plywood	X	
• Fencing Materials	X	
• Treated wood including but not limited to: brown-treated using pentachlorophenol, cresol-treated using creosote, green-treated using copper chromium arsenic (CCA)) scraps and end cuts from constructing a new deck, landscaping material, etc., copper-containing treatment, such as ammoniacal copper quat (ACQ), copper azole or ammoniacal copper citrate.	X	
• Railroad ties	X	
Metal Wastes (Recycled to the extent possible as markets allow):		
• Metal Scrap	X	
• Wiring	X	

Description	No Further Evaluation Needed	Evaluate per Table 2-2
• Copper Tubing	X	
• Copper or Aluminum Electrical Wiring - on or off the structure	X	
• Galvanized Pipe	X	
• Duct Work	X	
• Steel Piping	X	
• Lead Flashing	X	
• Lead Pipe	X	
• Fencing Materials (galvanized pipe)	X	
Asbestos • CAT 1&2, non-friable	X	
Concrete/Masonry Type Wastes:		
• Asphalt and bituminous concrete	X	
• Concrete (including rerod), and concrete block	X	
• Masonry and brick	X	
• Rock	X	
Other Building Material Wastes:		
• Carpet and padding	X	
• Ceramic, fiberglass and composite fixtures	X	
• Conduit	X	
• Glass, including window pane glass(non-leaded, non automotive)	X	X
• Automotive glass and mirrors		X
• Insulation (fiberglass, cellulose, etc.)	X	
• Plastic building parts, sheeting	X	
• Roofing and shingles (as markets develop, SKB Lansing will attempt to recycle)	X	
• Sheetrock	X	
• Siding (aluminum, steel, vinyl, plastic, wood, etc.)	X	
• Tile (ceramic, floor, vinyl, etc.)	X	
• Felt or Tar Paper	X	
• Plaster	X	
• Fiberboard	X	

Description	No Further Evaluation Needed	Evaluate per Table 2-2
• Counter tops, sinks, tubs, toilets	X	
• Fixtures (plumbing and lighting)	X	
• PVC Conduit	X	
• PVC Pipe	X	
• Garage Doors	X	
• Building parts (wood, glass, vinyl, plastic, metal , ceramic, fabric/leather, rubber, foam rubber)	X	
• Floor coverings (ceramic tile, linoleum, laminate, stone)		X (Only if suspected to contain Asbestos)
• Contaminated Soils		X
• Foundry Sands		X
• Sand Blasting Sand		X
• Grinding Sludges		X
• Car Wash Sand and Sediment	X	
• Non-PCB Ballasts	X	
• Shredder Fluff		X
• Incidental non-recyclable packaging (paper, plastic cardboard)	X	
• "Demo-like" industrial waste composed of wood, concrete, porcelain fixtures, shingles or window glass	X	
• Street Sweepings	X	
• Empty pesticide and chemical containers (containers must be certified as triple rinsed)		X
• Empty container from C&D activities	X	
• Residuals from recycling programs such as residual rubber and metal scrap from tire recycling	X	
• Autoclave Waste (i.e. medical waste that has been sterilized through autoclave process)	X	
Miscellaneous Demolition and Construction Wastes:		
• Packaging from construction materials and activities	X	
• Category I & II, non-friable asbestos containing materials, including: non-friable roofing materials, non-friable floor tile, and non-friable concrete	X	
• Dried or empty caulking (including applicators, containers, and tubes)	X	
• Dried joint compound (including empty containers and applicators)	X	
• Dried or cured urethanes, sealants, glue, adhesives and resins (epoxy or fiberglass) including applicators, containers and tubes Tire processing residue and tire waste		X
• Ashes from burnt structures		X
• Demolition debris with lead paint attached to woodwork, walls, doors or other elements	X	

Description	No Further Evaluation Needed	Evaluate per Table 2-2
• Dried paints, thinners, solvents, and varnishes (including dried applicators, brushes, cans, containers, filters, and dust collectors) from construction and demolition projects.	X	
• Friable Asbestos		X
Construction- and demolition-like wastes from an industrial process. These wastes may include, but are not limited to the following:: o Garage Doors o Mining waste consisting of conveyor belts, wood spools, pipe, hoses, fiberglass, plastic, etc. from mining companies o Wood and sawdust o Siding (aluminum, steel, vinyl, plastic, wood) o Bulk Sheetrock o Windows o Shingles	X	
• Additional materials from facilities manufacturing construction- or demolition-like products not already listed as an exempt waste from an industrial process (may include, but is not limited to aluminum, steel, glass, wood or hardened cured plastic wastes from manufacturers of products used in the construction industry).	X	
• Dewatered sewage sludge that has been treated by a process to significantly reduce pathogens pursuant to Mn Rules Part 7040.0100 to 7040.4700		X

Table 2-2

Parameter	CAS No.	RCRA No.	Acceptance Limits for Disposal		Acceptance Limits for ADC (Industrial SRV's)
			TCLP (mg/l)	Total (mg/kg) **(1)**	Total (mg/kg) **(3)**
TCLP Metals					
Arsenic	7740-38-2	D004	5	100	20
Barium	7440-39-3	D005	100	2000	18000
Cadmium	7440-43-9	D006	1	20	200
Chromium	7440-47-3	D007	5	100	100000
Lead	7439-92-1	D008	5	100	700
Mercury	7439-97-6	D009	0.2	4	1.5
Selenium	7782-49-2	D010	1	20	1300
Silver	7440-22-4	D011	5	100	1300
TCLP VOCs					
Benzene	71-43-2	D018	0.5	10	10
Carbon tetrachloride	56-23-5	D019	0.5	10	0.9
Chlorobenzene	108-90-7	D021	100	2000	32
Chloroform	67-66-3	D022	6	120	4
1,4-Dichlorobenzene	106-46-7	D027	7.5	150	50
1,2-Dichloroethane	107-06-2	D028	0.5	10	6
1,1-Dichloroethylene	75-35-4	D029	0.7	14	60
Methyl ethyl ketone	78-93-3	D035	200	4000	19000
Tetrachloroethylene	127-18-4	D039	0.7	14	131
Trichloroethylene	79-01-6	D040	0.5	10	46
Vinyl chloride	75-01-4	D043	0.2	4	2.2
TCLP SVOCs					
o-Cresol (2-methylphenol)	95-48-7	D023	200	4000	352
m-Cresol (3-methylphenol)	108-39-4	D024	200	4000	352
p-Cresol (4-methylphenol)	106-44-5	D025	200	4000	59
Cresol (**2**)		D026	200	4000	352
2,4 Dinitrotolune	121-14-2	D030	0.13	2.6	355
Hexachlorobenzene	118-74-1	D032	0.13	2.6	9
Hexachlorobutadiene	87-68-3	D033	0.5	10	37
Hexachloroethane	67-72-1	D034	3	60	n/a
Nitrobenzene	98-95-3	D036	2	40	n/a
Pentachlorophenol	87-86-5	D037	100	2000	120
Pyridine	110-86-1	D038	5	100	n/a
2,4,5-Trichlorophenol	95-95-4	D041	400	8000	10600
2,4,6-Trichlorophenol	88-06-2	D042	2	40	1060
TCLP Pesticides/Herbicides					
Chlordane	57-74-9	D020	0.03	0.6	74
2,4-D	94-75-7	D016	10	200	2200
Endrin	72-20-8	D012	0.02	0.4	56
Heptachlor (and its epoxide)	76-44-8	D031	0.008	0.16	3.5
Lindae	58-89-9	D013	0.4	8	15
Methoxychlor	72-43-5	D014	10	200	50
Toxaphene	8001-35-2	D015	0.5	10	28
2,4,5-TP (Silvex)	93-72-1	D017	1	20	2150
Other Parameters					
PCBs			50 ppm		8 ppm
pH			NA for Solids		NA for Solids
Reactive cyanide			250 ppm		125 ppm
Reactive sulfide			500 ppm		250 ppm
TPH (GRO)			None		5,000 mg/kg
TPH (DRO)			None		5,000 mg/kg
Flashpoint			<140°F		<140°F

Notes: 1. Total concentration (mg/kg) is 20 times the mg/l value and is a guidance value. If the guidance is exceeded, run the TCLP test. The TCLP result takes precedent.

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

3. ADC acceptance is based on the Industrial Soil Reference (SRVs) as provided by MPCA, which should be used for any parameter not listed in this table.

2.2 UNACCEPTABLE WASTES

The following materials will not be accepted for disposal in the facility:

- Animal carcasses, parts, or rendering and slaughterhouse wastes
- Appliances (including white goods and brown goods) (accepted for recycling)
- Ashes or hot wastes that could spontaneously combust or ignite other wastes due to high temperatures
- Lead Batteries
- Chemical containers containing free liquids (RCRA empty and triple rinsed are accepted)
- Fluorescent tubes and ballasts containing PCB's
- Food waste
- Mattresses (may be accepted at the Facility for recycling at an off-site location)
- Hazardous waste
- High-intensity discharge lamps
- Household refuse or garbage
- Infectious waste (unless treated to render non-infectious)
- Liquids (any type)
- Medical waste (unless autoclaved or other approved sterilization method)
- Mercury containing wastes (thermostats, switches)
- Paints, thinners, solvents, or varnishes - undried (including undried applicators, brushes, cans, containers, filters, or dust collectors)
- PCB contaminated wastes (greater than the regulatory limit of 50 ppm)
- Pesticide containers containing free liquids (empty and triple rinsed are accepted)
- Radioactive waste (unless natural materials at normal background levels)
- Household hazardous waste
- Explosives
- Raw animal manure
- MSW incinerator ash
- Septic tank pumpings
- Sewage Sludge (Unless significant pathogen reduction treatment in accordance to Minn. R. 7041.1400 subp 2)
- Tires (accepted for recycling)
- Vehicles
- Machinery
- Used Oil
- Yard waste

2.3 MANDATORY WASTE TYPES

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

Table 2-3

Waste Type	Accepted/Not Accepted Lined Area	Disposal Method
Empty containers	Accepted	Co-disposal
Asbestos	Accepted (all forms)	See Table 2-1 Section 2.3.2
Waste containing (PCBs) at a concentration less than 50 ppm	Accepted	See Table 2-1 Section 2.3.3
Spilled non-hazardous materials	Accepted	See Table 2-1 Section 2.3.4
Rendering and slaughterhouse wastes	Not Accepted	Section 2.3.5
Wastes that could spontaneously combust or that could ignite other wastes because of high temperatures	Not Accepted if risk of spontaneous combustion presents an unacceptable risk	Placed with non-combustible waste if accepted Section 2.3.6
Foundry wastes	Accepted	See Table 2-1 Secrtion 2.3.7
Ash from incinerators, resource recovery facilities and power plants	Accepted	See Table 2-1 (coal ash only accepted in cells with a MSW-equivalent liner) Section 2.3.8
Paint residues, paint filters and paint dust	Accepted	See Table 2-1 Section 2.3.9
Sludges, including ink sludges, lime sludge, wood sludge and paper sludge	Accepted	See Table 2-1 Section 2.3.10
Fiberglass, urethane, polyurethane and epoxy resin waste (dried)	Accepted	See Table 2-1 Section 2.3.11
Spent activated carbon filters	Accepted	See Table 2-1 Section 2.3.12

2.3.1 Empty containers

Empty hazardous waste containers sent to SKB Lansing for disposal must meet all of the requirements of Minnesota Rules, Part 7045.0127 and meet all applicable criteria listed below. The customer will be notified of this requirement in the approval letter.

Empty containers shipped to SKB Lansing for disposal must have had all contents removed using commonly employed practices such as pouring, pumping, etc, and also one of the following three conditions must be met (unless the container held non-hazardous material that SKB Lansing is permitted to accept):

- No more than 2.5 centimeters of residue remains on the bottom of the container.

- No more than 3.0 percent by weight of residue remains inside a container or inner liner having a total capacity of 110 gallons or less.

- No more than 0.3 percent by weight of the total capacity of the container remains in a container having a capacity of greater than 110 gallons.

Empty containers that were used to hold an acutely hazardous waste (listed in Minnesota Hazardous Waste Rules 7045.0135 subpart 2, 3 or 4, item E) or empty pesticide containers that are regulated by the Minnesota Department of Agriculture, must meet one of the three following conditions:

- The container or inner liner has been triple-rinsed using a solvent capable of removing the commercial chemical product or manufacturing chemical intermediate. To triple rinse is to flush the container three times. Each time using a volume of the normal diluents equal to approximately ten percent of the container's capacity. Any rinsate generated from the flushing of these containers must be used as product. If the rinsate is to be discarded, i.e., becomes a waste; it must be managed according to the Minnesota Hazardous Waste Rules.

- The container or inner liner has been cleaned by another equally effective and approved method.

- The inner liner that was in contact with the acutely hazardous material has been removed from the container.

All containers that are accepted for the purpose of disposal will contain only solid residues of the material originally held in the container.

Compressed gas containers will be accepted only if the empty container pressure is equal to atmospheric pressure.

Containers will be crushed by landfill equipment in the containment cell. Compressed gas containers will be crushed as much as possible using landfill equipment.

2.3.2 Asbestos

Customers and haulers of asbestos waste will be notified of the requirements they must follow to use SKB Lansing for asbestos disposal. These requirements include:

- Standards in 40 CFR, Part 61 and Asbestos NESHAPS Revision Final Rule of November 20, 1990
- Wetting of asbestos waste
- Packaging in leak tight containers
- Warning labels
- Marked transport vehicles
- Waste shipment record (manifest or bill of lading)
- Taking measures to ensure that any chemicals (solvents) used in removal of asbestos are not included in load

Rejected Asbestos waste will be returned to the generator and the MPCA will be notified.

SKB Lansing will accept non-regulated asbestos material (packings, gaskets, floor coverings, roofing products, etc.) in bulk loads. Non-regulated asbestos will not be made regulated and will be managed with all other asbestos material.

SKB Lansing will accept regulated asbestos material if it is wetted and packed in plastic bags at least 6-mils thick. The bags must be sealed shut and marked with warnings. Loads must be covered.

Asbestos materials will be covered with at least 6 inches of soil or appropriate waste material at the end of the day in a way that creates no visible emissions. Bulk loads of asbestos will be kept separate from bagged loads of regulated asbestos material. Other precautions will be taken to reduce the potential of puncturing of packaged asbestos material by other wastes. Compaction equipment will not be used in areas containing packaged asbestos material until at least 2 feet of material are covering the asbestos material.

SKB Lansing will maintain, until closure, shipping records, records of location, depth, area and quantity in cubic meters (cubic yards) of asbestos-containing material within the disposal site on a map of the disposal area.

Any excavation in asbestos containing areas will be done in compliance with NESHAP. Any repackaging or handling of asbestos containing materials will be done by trained personnel.

2.3.3 Waste containing PCB's less than 50 ppm

Customers and haulers will be informed of the MPCA's policy regarding non-hazardous PCB disposal in the waste approval letter. Specifically, they are encouraged to voluntarily manage the waste as a hazardous waste or to seek an alternative to land disposal for the waste, such as incineration.

Wastes that contain PCBs must be properly sampled and then tested using appropriate methods, such as EPA method 8080.

2.3.4 Non-hazardous waste spills

SKB Lansing may accept contaminated soil if the MPCA approves the use of a lined cell for disposal over other management options, such as land farming.

Contaminated soil proposed to be handled at the Facility is evaluated for metals, or organic compounds depending on the material spilled. Appropriate leach testing will also be utilized.

Customers will be notified in the waste approval letter that proper county and MPCA spill reporting procedures must be followed.

Contaminated soil that is approved for disposal at SKB Lansing may be used as cover material at the discretion of the Facility Manager and with the approval of Dakota County.

2.3.5 Rendering and Slaughterhouse Waste

No rendering and slaughterhouse waste will be accepted at the Facility.

2.3.6 Materials that Could Spontaneously Combust or that Could Ignite Other Wastes Because of High Temperature

Materials that would spontaneously combust will not be accepted.

Potential high temperature materials will be accepted. The generator will be instructed in the approval letter to allow the waste to cool prior to shipment. Care will be taken during inspection to ensure that the wastes are cool prior to placement in the cell. When accepted waste will be placed with non-combustible waste when possible.

2.3.7 Foundry Waste

All foundry wastes will be evaluated for metal content. This evaluation will be based upon knowledge of the waste and may include use of the TCLP.

Any foundry wastes, such as bag house dust, that are subject to wind dispersal, will typically be dampened by the customer prior to shipping. All foundry waste loads shipped to SKB Lansing must be covered during transit.

Wastes subject to wind dispersal will be further dampened during disposal in the cell. Other foundry wastes will be considered for use as cover material.

2.3.8 Coal Ash

SKB Lansing will accept ash and slag from burning of coal as a fuel source.
All ash or slag is tested for metals using the TCLP unless the customer can demonstrate this is unnecessary through metals analysis or by some other method.

During placement, operators will check for hot loads and wet as needed. Slags and bottom ashes may be considered for use as cover material if they do not contain fractions that are susceptible to wind dispersal. Wastes that are subject to wind dispersal will be covered with an appropriate material.

2.3.9 Paint Residue, Paint Filters, and Paint Dust

Paint related waste is common to a large number of industries and is often hazardous. SKB Lansing will not accept any hazardous wastes, including hazardous paint wastes. Potential SKB Lansing customers with paint wastes will be notified of SKB Lansing's waste approval policy regarding paint wastes and supplied with an MPCA fact sheet on Evaluating Paint-Related Waste (Appendix B).

Paint waste may contain both metals and organic compounds. During the pre-approval process, paint waste will be evaluated for metals and volatile organics using either pre-existing or newly developed data. Organic vapors in headspace will also be evaluated in paint waste. Depending on

the nature of the waste, ignitability may be evaluated as well. The requirement for evaluation may be changed if the customer can demonstrate that this is unnecessary by certification of the manufacturer, for example.

Some paint waste may be beneficially managed through incineration. SKB Lansing's staff will encourage these customers to seek this option if appropriate.

As with all wastes, paint wastes will not be disposed of in a liquid state. All containers of paint waste will be inspected for liquids. If liquids are present, the liquids will be solidified or the container will be rejected. Only wastes that have been approved for disposal (non-hazardous wastes) will be solidified.

Paint waste, such as paint dust, that is subject to wind dispersal will be moistened and covered during transport and at the working face of the containment cell.

2.3.10 Sludges, Including Ink Sludge, Lime Sludge, Wood Sludge, Paper Sludge, Air Pollution Control Sludge, or Industrial Waste Water Treatment Sludge

Sludges have the potential to contain free liquids. Care will be taken to ensure that sludges are properly solidified prior to being placed in the cell to prevent the release of liquids.

Ink sludge will be evaluated for selected metals and, if appropriate, volatiles and semi-volatiles using either pre-existing or newly developed testing information or product data.

Lime sludge will be evaluated for metals, for pH, and screened for radioactivity.

During placement sludges will be checked for free liquids. Some sludges may be appropriate for use as cover materials.

2.3.11 Fiberglass, Urethane, Polyurethane and Epoxy Resin Waste

These wastes can be found in a liquid, semi-solid or solid form. They will only be accepted at SKB Lansing in a cured, solid state.

Waste will be inspected on arrival at the Facility and rejected if it exhibits evidence of incomplete curing (e.g., strong styrene odor, release of heat or excessive stickiness).

Waste received in containers will be individually inspected.

2.3.12 Spent Activated Carbon Filters

Activated carbon filters are used to remove organics and metals from liquids. Evaluation of this waste will be dependent on what it was used for. For example, filters that were used to remove metals will be evaluated for metals.

Care will be taken to ensure that carbon filters arriving at the Facility do not contain free liquids.

During placement, operators will check to determine whether dust control measures such as covering or dampening are necessary.

2.4 EXEMPTED WASTE TYPES

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

Table 2-4

Waste Type	Accepted/Not Accepted Lined Area	Notes
Paper and cardboard wastes from manufacturing processes or packaging	Accepted	Will be recycled when possible. No further evaluation needed.
Food and beverage packaging and handling materials	Accepted	Includes packaging, wrapping and food handling (i.e. tissue wrap, etc.) materials not containing organic food waste. No further evaluation needed.
Food not containing free liquids	Not accepted	
Spilled non-hazardous materials	Accepted	See Table 2-1
Aluminum, iron, steel, glass, wood, and hardened, cured plastic waste	Accepted	Will be recycled when possible. No further evaluation needed.
Dewatered sewage sludge that has been treated by a process to significantly reduce pathogens pursuant to Minnesota Rules, parts 7040.0100 to 7040.4700	Accepted	See Table 2-1
Rejects and residuals from compost including sewage sludge compost produced in accordance with Minnesota Rules, part 7035.2836	Accepted	See Table 2-1
Grit and bar screenings from a wastewater treatment plant	Accepted	No further evaluation needed.
Ash from boilers and incinerators using only wood as a fuel source	Accepted	See Table 2-1

In addition, "demolition-like" industrial waste composed of wood, concrete, porcelain fixtures, shingles or window glass can be accepted without analysis following approval.

2.5 HAZARDOUS WASTES

The Facility will not accept hazardous wastes. A waste is a MN hazardous waste if:

- The waste exhibits any of the characteristics of hazardous waste in part 7045.0131 (ignitability, oxidizer, corrosivity, reactivity lethality, toxicity);
- The waste is nonspecific source (F), specific source (K), commercial chemical product (P,U), listed in part 7045.0135; or
- The waste is a polychlorinated biphenyl waste (PCB waste) at a concentration of 50 ppm or greater as described in part 7035.0135 subp. 5.

The characteristics of a MN hazardous waste are:

Ignitability: Any liquid having a flash point of 140 degrees Fahrenheit or less. Any non-liquid capable under standard temperature and pressure of causing fire through friction, absorption of moisture, or spontaneous chemical changes. Flash point is the temperature at which a liquid gives off vapors that will ignite when an open flame is applied.

Oxidizers: Any waste defined in 49 CFR as an oxidizer or any waste that readily supplies oxygen to a reaction in the absence of air.

Corrosivity: A waste exhibits the characteristic of corrosivity if a representative sample of the waste is aqueous and has a pH less than or equal to 2.0 or greater than or equal to 12.5. The pH is a measurement that determines the acidity or base of a sample. No liquid waste will be accepted at the facility. Therefore, solids that when mixed with water that have a pH less than 2.0 and greater than 12.5 may be accepted if the waste is not aqueous.

Reactivity: A waste is reactive if it is normally unstable; reacts violently with water; forms an explosive mixture with water; contains quantities of cyanide or sulfur that could be released into the air; or can easily be detonated or exploded.

Lethality: A waste exhibits the characteristics lethality if a representative sample of the waste has lethal dose rates less than described by regulation.

Toxicity: The Toxicity Characteristic leaching Procedure is a laboratory test where an acid solution is passed through the waste under investigation, the acid solution containing the material it has extracted is tested for a number of constituents that fall into three general categories: heavy metals, pesticides, organic solvents. If the regulatory levels for any constituents are exceeded, the waste is hazardous.

Regulated hazardous waste must be disposed of at a permitted hazardous waste disposal facility. Any material contaminated by a hazardous waste is also deemed to be a hazardous waste. The USEPA has given exemption from storage, transport, and disposal requirements to certain generators based on source and quantities. Household hazardous waste and hazardous waste generated by a conditionally exempt generator are exempted from the screening requirements. The Facility does not accept hazardous wastes, including household hazardous wastes and hazardous wastes from conditionally exempt generators. Anyone bringing in hazardous wastes for disposal will be redirected to either the Carlton County facility (Carlton County Transfer Station, 1950 Highway 210) for household hazardous wastes or another appropriate hazardous waste disposal facility.

3.0 Waste Evaluation Procedures

3.1 NOTIFICATION

A key component of this ISWMP is the notification of customers, which include generators and haulers, that certain wastes are unacceptable for disposal at the Facility. The Facility will notify the generators and haulers of the requirements and restrictions for disposal of industrial waste at the Facility by sending or posting a letter to all interested generators and haulers.

3.2 WASTE EVALUATION PROCESS FOR LOADS OF EXEMPT WASTE

The process of determining whether waste from a given generator will be accepted at the Facility is initiated by a verbal description of the waste by the generator upon arrival at the Facility scale. If the load is exempt from needing further evaluation and approval (as listed under Section 2.1 and 2.4) it is allowed in the Facility for disposal. Further evaluation of the waste is done by the field operators as the load is dumped. If there is unacceptable waste in the load it is removed from the Facility and rejected.

3.3 WASTE EVALUATION PROCESS FOR NEW INDUSTRIAL WASTES

New wastes will be considered for disposal in the Facility on a case-by-case basis, based on the process described in this Plan. Procedures for evaluating certain specific waste types are included in Table 2-1 and the appendices.

For these wastes, an initial evaluation process will begin by the Facility staff gathering pertinent information about the waste such as:

- Name of waste or waste stream;
- Brief description of the waste;
- Volume of waste;
- Generating company;
- Generator address;
- Hauler; and
- Hauler address

The SKB Lansing Landfill will utilize SKB Environmental Inc's technical staff to review and approve waste under this plan. SKB Environmental owns and operates the premier industrial waste management facility in Minnesota (MPCA permit SW-383). SKB's technical staff may require the generator to submit additional information that will help to characterize the waste. Such information may include process knowledge, MSDS(s), and/or laboratory data. This information would be included on the application sheet completed by the generator, referred to as a waste profile.

The information submitted on the waste profile, other required information from the generator, and Table 2-1 will be reviewed by the SKB staff to determine if the material is acceptable for disposal in the Facility. Upon SKB staff review, the waste stream may be approved for disposal in the Facility. (Currently, Mike Fullerton or an appropriate designee will be employed by SKB to conduct this review. Mr. Fullerton has nearly 20 years experience reviewing waste for approval and he conducts MPCA training to certify landfill operators.)

Based on the SKB technical review, a waste stream may require analytical testing. Factors that indicate a material requires testing include information from the generator, the process generating the waste, and source location (e.g. was the demolition site located near a contaminant source). The testing will be based on the source of chemicals the waste has been contaminated by and/or the MSDS of the waste or contaminants.

Analytical requirements for additional waste streams that may be considered for disposal in the Facility that are not included in this section will be handled on a case-by-case basis. The technical staff also reserves the right to request additional analytical testing than that listed in this section if deemed necessary to evaluate a waste. The final determination on acceptability of the waste will be based on comparisons with the acceptance limits in Table 2-2.

3.4 ANALYTICAL DATA QUALITY

Confidence in the information gathered during the waste evaluation process depends on the reliability of the laboratory conducting the tests. The Facility relies on the test results from laboratories employed by the waste generator. Thus, the Facility must have assurance that the laboratory results are accurate. A certification by the laboratory personnel that standard MDH, USEPA or ASTM or NELAC Institute methods have been utilized in the waste analysis may be required, if requested, by the Facility during the waste evaluation process. Ultimately, it is the responsibility of the generator to supply the Facility with valid analytic data in the waste evaluation process.

In addition to considering the validity of the laboratory test results, the test samples are required to be representative of the entire waste stream. The profile includes a certification from the generator that the information on the form is accurate and analyses have been performed on representative samples. If the waste stream is sufficiently variable, the technical staff or the Facility may request the generator to characterize the variability of the waste by additional samples.

Laboratory analytical results provided by the Generator shall:

- Be recorded and presented on the laboratory's official letterhead or stationary;
- State the name of the Generator, Generator ID Number, and Waste Approval Number;
- Provide a clear sample description (i.e., sewage sludge, soil, foundry sand);

- Include all parameters necessary to evaluate the waste type proposed for disposal;
- State the section or method number (reference) for each analytical test performed;
- If the test methods were modified, or varied, from the approved procedure, the laboratory shall provide an explanation detailing the modification and why it was necessary; and
- Be signed and dated by an official representative of the laboratory.

3.5 REVIEW OF SUBMITTALS

After all necessary documentation has been received; the Facility and SKB staff will verify that:

- The Generator has identified the waste type;
- The appropriate waste type has been selected for the waste described by the Generator;
- The laboratory analysis provided by the Generator meets the criteria specified above;
- The concentrations of applicable parameters of the waste proposed for disposal do not exceed the acceptance limits as specified.
- The analytical test references and methodologies used conform to those for the specified parameter.

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

As an initial comparison of total concentrations versus TCLP concentrations, divide the total concentration by 20. This “Rule of 20” is based on the fact that the weight of the fluid used for the leaching process in the TCLP test is 20 times the weight of the sample. Therefore, the

theoretical maximum concentration in the fluid at the completion of the leaching process is 1/20 of the total concentration in the sample, assuming 100 percent of the parameters being tested leaches during the test. If the result of dividing the total concentrations by 20 is less than the acceptance limits, the waste is acceptable and no TCLP test is required.

In practice, the ratio of the total concentration to the TCLP concentration is more than 20, since less than 100 percent leaches from the sample. If the result of dividing the total concentration by 20 is greater than the acceptance limit, the waste may still be acceptable. A TCLP test for the parameter in question will be used to determine if the waste is acceptable.

3.6 EVALUATION OF WASTES AS ALTERNATIVE DAILY COVER

Some waste types, including contaminated soil, some foundry sands, C&D fines used in accordance with state statute, or other soil like materials, will be suitable for use as Alternative Daily Cover (ADC). ADC replaces native soil as daily/intermittent/intermediate cover. The waste must first be determined to be acceptable at the landfill. Then, the waste can be evaluated for use as ADC if it can fulfill the function of native soil as a cover material, in that it must have the following characteristics:

- Be "soil-like" in nature
- Able to control vectors, odors, and fire
- Is not subject to undue erosion or dust creation
- Does not pose a physical hazard to vehicles or workers.
- Must not be odorous

ADC will be placed in a 6-inch layer over active working areas, and cannot be used on external side slopes. See Table 2-1 and Appendix C for information on evaluation and management of materials as ADC. The action limits for ADC are different than the action limits for disposal. See Table 2-2 for the ADC action limits. Waste meeting the conditions outlined above and the limits set in Table 2-1 will be used as daily cover. This plan outlines the process for approving material as cover and will supplant the need for waste specific Minnesota Pollution Control Agency approval of the soil as ADC.

4.0 Waste Delivery, Review, and Rejection Procedures

4.1 INSPECTION PROGRAM

The purpose of the load inspection program is to detect prohibited wastes and discourage attempts to dispose of them at the Facility. Additionally, the inspection process verifies whether the waste delivered to the facility is reasonably consistent with the waste pre-approved for receipt. Inspection of wastes represents a major consideration in managing the industrial wastes received at the facility. Several levels of inspection may be necessary for effective implementation of the ISWMP.

Following the Documentation Review process, a visual inspection of the waste for color, odor, physical state and free liquids may take place either at the scale house or the working face. The landfill operator and or the gatehouse attendant will then compare the information obtained during this inspection to the information provided and certified by the Generator. If the waste is reasonably consistent with the information previously provided by the generator, the load will be incorporated and commingled at the working face for disposal. If the information obtained during this examination indicates that the waste is inconsistent with waste profile approved by the landfill, the load will be held for until verification has been obtained that the waste indeed consistent with the information provided by the generator. If this discrepancy can't be rectified the waste will be rejected from the facility. The Generator will be notified as well as any other regulatory agency as required. If un-approved or prohibited waste types are discovered during this review of the waste, the load will be rejected.

The facility reserves the right to reject any waste, at any time regardless of any of the requirements of this ISWMP. The Facility reserves the right to conduct or require any testing deemed necessary on in-coming loads. Examples include, but are not limited to, USEPA paint-

filter-liquids tests and ignitability tests performed by the Facility staff at the gate. It should be noted that results of an USEPA paint-filter-liquids test conducted by the generator and/or hauler do not guarantee acceptance by the Facility.

4.1.1 Procedures at the Scalehouse

For all manifested wastes, the scale staff checks that the customer has a Non-Hazardous Waste Manifest and will verify that the generator and waste description are correct for the waste being delivered. The scale house will notify the operator at the working face that a manifested load is being delivered to the working face and will give the description of the waste as recorded on the manifest. The scale house will also notify the operator of any special conditions associated with the delivery of the waste as made by Facility technical staff. Should the staff encounter suspicious-looking loads, they will summon appropriate Facility personnel for further evaluation of the load. If prohibited wastes are identified at the scalehouse, the prohibited portion will not be allowed into the disposal area. If hazardous or PCB waste are detected, the entire load will be rejected.

4.1.2 Procedures at the Working Face

Prior to unloading, the operator will confirm that the waste is being delivered per the requirements of the approval by the technical staff. The operator at the working face will observe the unloading of the waste materials to ensure that the waste is acceptable and matches the waste described by the scale house.

The hauler is responsible for handling and unloading all material from the delivery vehicle. Furthermore, it is the haulers responsibility to assure that their vehicle personnel are appropriately trained in all health and safety requirements.

The operator will follow all safety and or PPE recommendations cited on the approval by the technical staff. The operator will also cover the waste in accordance with the technical staff's recommendations (such as direct burial).

4.2 REJECTION OF WASTES

Industrial solid wastes delivered to the facility which have not been approved through the process established in this ISWMP will not be accepted at the Facility. The generator will be notified of the rejection and will be responsible for: a) disposing of the waste elsewhere; or b) storing the waste temporarily and initiating the disposal application process established in this ISWMP. If the generator cannot be identified, the hauler will be responsible for removal of the waste from the Facility and for ultimate disposal.

Whenever a waste load is rejected at the facility, the Facility personnel will record it. (See example
Load Rejection Form in Appendix D).

4.2.1 Managing Prohibited Wastes

Non-acceptable/prohibited wastes, which are brought to the facility for disposal, are pulled out of loads upon identification. These wastes are either returned to the hauler/generator, redirected to the MSW/recycling storage bins, or arrangements are made for proper disposal.

The facility is approved for storage of the following: Scrap Metal Steel (two 90 cy boxes); Tires (500 units); Appliances (200 units); Electronic Waste (covered 30 cy box); Cardboard (40 cy box); untreated wood (10,000 ton stockpile); concrete/asphalt/brick (50,000 ton stockpile); shingles (10,000 ton stockpile); empty roll-off containers, and municipal solid waste (two covered 30 cy boxes). These storage boxes will be transferred off-site for disposal or recycling as necessary. All stockpiles will be used within three years.

4.3 TRAINING

Site managers, equipment operators, and gatehouse staff will be trained upon hire and annually in the contents of this plan. The training will typically be conducted in conjunction with special waste training.

The Facility operators will be certified through the State of Minnesota's operator certification program as identified in the MPCA rules. This certification will be renewed on a regular basis. Topics included in the operator certification program are waste identification, working from engineering plans, and handling requirements for specific waste types. The operators will be fully familiar with the contents of this ISWMP, and will work closely with the Facility management to ensure that proper screening, identification, and management procedures are adhered to. The operator will receive direction and assistance on an as-needed basis from the technical staff. It will be emphasized that the operators must contact the Facility management in any instance where previous training and experience is not sufficient for them to readily respond to a field situation.

Facility personnel involved either directly or indirectly with industrial and special wastes will receive training from designated personnel. Such training will be done on regularly scheduled sessions and will be documented as to the content and personnel. Such training will address the general requirements of the program, responsibilities of individual personnel, and any specific instructions concerning individual waste streams. Training records will document all ISWMP training, and will be filed in the Facility's operating record.

Training will address the following topics:

- Customer notification
- Load inspection procedures.
- Identification of hazardous wastes, PCB wastes and other prohibited wastes.
- Waste handling procedures (acceptable and prohibited wastes).
- Health and safety.
- Record keeping.

4.4 RE-ANALYSIS FREQUENCY

The re-analysis frequency proposed under this ISWMP is designed to be consistent with:

- A detailed analysis that fully characterizes the physical properties and chemical composition of each type of waste, or
- A Certification that the physical and chemical properties of the waste, and the process by which the waste was generated, have not changed from those set forth for the previous year.

The analysis or certification is required to be submitted every two years or as deemed necessary by the technical staff. The intent is to allow generators to use the analysis or certification provided to meet the re-analysis requirements of this ISWMP where applicable. Generators will be required to submit the information necessary to re-evaluate the parameters on a frequency consistent with the waste type as determined by the technical staff. Actual re-analysis may be required if any of the following occurs:

- A significant change in the manufacturing process is known to have occurred.
- A significant change in the waste composition is known to have occurred.
- The waste stream is variable due to changes in the waste stream feeds (such as industrial wastewater treatment plant residue).
- The waste stream is variable due to process variations (such as the waste stream generated by an industry that manufactures several products generating different waste streams).
- The Facility reserve the right to request any additional analyses, at any time, that are deemed to be pertinent to the proper characterization of a waste stream.

5.0 Recordkeeping and Inspection

5.1 RECORDS

An efficient record keeping system will be maintained at the Facility field office and long-term record storage will occur at the owner's main office location for industrial wastes and special wastes received at the facility. A file will be set up for each generator that brings industrial waste and/or special waste to the facility. Generator files will contain a separate record of each individual waste. The contents of the files will include the information listed below:

- Profile and associated documentation (lab results, MSDS's, customer approved number etc);
- Approval; and,
- Non-Hazardous Waste Manifest Form(s).

Depending on the type of waste being delivered to the Facility, haulers picking up waste from industrial generators may be required to complete a Non-Hazardous Waste Manifest (Manifest Form), which documents waste information for each truck. Manifest Forms will typically be used on new and/or unique industrial waste streams or by client request. For manifested waste streams that have multiple loads a day, only one manifest per day will be required for that waste stream. C&D wastes, exempted wastes, and regular occurring industrial waste stream deliveries will not be required to be manifested. However, all incoming waste will be recorded and documented in the Facility records to be used in the annual report. If the waste is manifested, the Manifest Form will be checked against the issued Approval when the hauler arrives at the facility. The Manifest will also reference the Approval number stated on the Approval.

The following records will also be maintained at the Facility:

- Load rejection forms;
- Diverted Waste Log;
- Records of hazardous, radioactive, or PCB waste notifications;
- Training records.

State notification is required whenever a hazardous, radioactive, or PCB waste is detected. Records of these notifications will be kept and will include the date and time of notification, agency, and individual contacted, phone number, and the information that was reported.

5.2 DOCUMENTATION REVIEW

Prior to receiving the initial load of a waste approved for receipt, the facility's gate attendant(s) will familiarize themselves with the contents of the waste application, paying specific attention to the characteristics of the waste stream (i.e. color, odor, physical state, specific gravity, etc.).

Documentation Review entails a review of all documentation presented by the waste hauler upon entering the facility. The manifest or bill of lading should be reviewed to ensure that the material is approved for disposal at the respective facility. The generator's information (name, address, phone number, approval number, etc.) should be contained within the documents presented. These documents should be compared against the information previously provided by the Generator during the pre-receipt process. If the information obtained during this initial examination appears to be reasonably consistent with the information previously provided, the waste load may be received for disposal. If the information does not appear to be reasonably consistent with information previously provided for the waste during the pre-approval process, the waste load may be rejected and/or the generator notified.

APPENDIX A

Evaluating Paint-Related Wastes

Minnesota Pollution Control Agency

Managing Paint-Related Waste from Coating Operations

Hazardous Waste Division Fact Sheet #4.39 August 1997

This fact sheet is intended for collision repair and other coating operations.

In This Fact Sheet:

Choosing Paint and Supplies

There are three main environmental concerns about industrial paints:

1. **The amount of toxic metals such as barium, cadmium and chromium in the paint.** Paint that has metal levels above those listed in Table 1 becomes hazardous waste when it is a waste. Related wastes, such as thinner wastes and used paint filters, are often hazardous as well.

2. **The amount of volatile organic compounds (VOCs) in the paint.** Paint that contains high VOC levels may affect air-permit requirements for a business. VOCs react with sunlight to form smog. High VOC paints and thinners may also contain toxic chemicals that pose health concerns for employees.

Table 1: Maximum Allowable Concentrations (MAC) of Metal Contaminants

Metal	MAC (parts per million)
Arsenic	5.0
Barium	100.0
Cadmium	1.0
Chromium	5.0
Lead	5.0
Mercury	0.2
Selenium	1.0
Silver	5.0

3. **The flashpoint of the paint.** A flashpoint below 140° F means that the paint waste is hazardous because it is ignitable.

When choosing paints and primers, check the Material Safety Data Sheets (MSDS) for those lowest in metals and VOCs that will do a good job in your type of operation. For waterborne coatings, flashpoint is usually not a concern and VOCs are often at such low concentrations that a permit may not be required; toxic metals are a concern. Contact the chemical company's technical-support division (their phone number is on the MSDS) or the supplier if information about VOCs or toxic metals is missing or unclear. Other things to consider are:

- the kind of surface preparation that is necessary for the paint to stick*;
- the compatibility of paints and primers;
- how many coats you need to get the finish you want;
- drying time and temperature;
- the kind of materials needed for cleanup; and
- clean-up time.

** If you use solvents to prepare surfaces or clean-up equipment, look for the lowest VOC level and least toxic solvent that will do the job.*

Minnesota Pollution Control Agency, 520 Lafayette Road North, St. Paul, Minnesota 55155-4194
(612) 296-6300, TDD (612) 282-5332, toll-free (800) 657-3864

To prevent paint from becoming unusable (waste) when sitting on the shelf, use good housekeeping practices. Here are some examples:

- Keep good records of what you have on hand.
- Buy only what you need. Use it all.
- Store it at the proper temperature.
- Use the oldest material first — rotate inventory!
- Consider investing in computerized mixing equipment that will allow you to match colors exactly and mix only what you need for a job.

If your shop is small and paint-filter disposal is a problem, ask your supplier about styrene paint filters. Spent styrene filters dissolve if mixed with waste thinner so you end up with one container of waste. However, they may not hold as much paint as paper or fiber filters. Styrene filters must have a "fire resistant" rating.

Remember: When paint and supplies become unusable, you pay twice — first for the product, then for the waste. Reducing or preventing waste will save you money!

Choosing Equipment

Use the most efficient painting practices and equipment you can. Make sure your time and supplies are used creating a finished product — not excess waste that must be cleaned up and disposed of. Here are some ideas:

- Train employees on new equipment and refine skills regularly — talk to your vendor about their training programs.
- Keep equipment in proper working order and review coating methods regularly.
- Eliminate or reduce all sources of impurities.
- Investigate using High-Volume Low-Pressure (HVLP) gravity-fed spray guns to reduce cleanup and increase efficiency.
- Consider avoiding the cost of extra equipment and worker exposure by sending paint stripping work to a specialized company.

Leftover Supplies

If you have leftover paint supplies, don't let them sit around until they are no longer usable! Instead —

- Make arrangements with your vendors to return unopened supplies regularly, if possible.
- Use similar and like-colored leftover paint as a primer and use it up!
- Donate usable supplies to interested local technical colleges or high schools.
- Explore materials exchange programs offered by organizations such as the Minnesota Technical Assistance Program (MnTAP) as an option. These may require significant quantities of common colors and materials. (MnTAP's phone number is on page 4.)

Reducing Solvent Use

Get the most out of your solvents! Using more than you need costs you money. Here are some ideas:

- If you clean spray-painting equipment manually, use two solvent baths to extend the solvent life. When the solvent in the first bath gets dirty, manage it as hazardous waste. Refill the first bath with the rinse solvent from the second bath, and refill the second bath with clean solvent.
- If you clean spray-painting equipment mechanically, consider purchasing or leasing closed gun-washing devices that use a minimal amount of solvent.
- If you use large amounts of just one or two solvents, consider purchasing on-site distillation equipment to recover spent solvent. Note: Distillation recovers most of the solvent for reuse, but also produces a hazardous-waste sludge. The fire department, building inspector, and insurance carrier must approve the device.

Classifying Wastes

You must determine whether or not each waste is hazardous in order to determine how to classify it — either as hazardous or industrial solid waste. How a

waste is classified dictates how it must be managed. Keep in mind:

- If, according to the MSDS the metal in the waste is above the maximum allowable concentration (MAC) listed in Table 1 or its flash point is below 140° F, it is hazardous and the hazardous waste requirements apply.
- If metal levels are below the MAC, the waste is an industrial solid waste and the industrial solid waste requirements apply.

If you cannot determine metal levels from the MSDS, contact the chemical company's technical-support division (the phone number is on the MSDS) or the supplier of this information. If you are still unable to determine the metal levels, you must have the waste tested by an environmental laboratory using the Toxicity Characteristic Leaching Procedure (TCLP). Related wastes, such as paint filters, that contain several kinds of paint will need to be tested to determine if they are hazardous. For a list of testing laboratories, request Hazardous Waste fact sheet #6.05, *Hazardous Waste Consultants and Testing Laboratories.*

Hazardous Waste Requirements

Hazardous waste must be stored on an impermeable surface and in a closed container marked with the words "Hazardous Waste," the date you begin filling the container, and a clear description of the waste (example: Paint Thinner Waste). You must also inspect the container every week to make sure it is not leaking and document the inspection. For complete storage requirements, see Hazardous Waste fact sheet # 1.04, *Label and Store Hazardous Waste Correctly.*

If you generate 220 pounds (about 22 gallons of liquid) or less of hazardous waste per month, the Minnesota Pollution Control Agency (MPCA) considers you to be a very small quantity generator (VSQG). VSQGs may either transport hazardous waste themselves to a collection site licensed by the MPCA, or hire a licensed hazardous-waste transporter to take it to a licensed disposal facility. If transporting yourself, contact the collection program to arrange an appointment. The program operator will help you package and transport your waste safely. Complete requirements for using a collection program are given on Hazardous Waste fact sheet # 2.51, *VSQG Collection Program Requirements for Generators.* If you intend to hire a transporter, refer to Hazardous Waste fact sheet # 1.06, *Transport and Dispose of Hazardous Waste Correctly.*

Industrial Solid Waste Requirements

If you have industrial solid wastes such as floor sweepings, tape, masks, strainers and filters, you need to arrange for transport of the wastes to a mixed-municipal or industrial landfill, or to a permitted municipal solid-waste incinerator.

In order to be certain that the facilities will accept your industrial solid wastes, it is important to:

- contact the site operator where the hauler plans to bring the waste for information on what is and is not acceptable material at their site;
- store wastes separately in marked containers for the hauler; and
- keep records of TCLP tests and other determinations, where available.

Air Permits

If you use painting supplies containing VOCs, you may need a permit. Use your Material Safety Data Sheets (MSDS) to determine which painting supplies contain VOCs. If you need assistance, contact the company's technical support division (their phone number is on the MSDS) or the supplier. Calculate how many gallons of VOC-containing materials you used within the last 12 months.

Less than 200 gallons of VOC-containing materials

If you used less than 200 gallons of VOC-containing materials within the last 12 months, record the total monthly purchase (in gallons) of these items. Show that you use less than 200 gallons/year by keeping a running total for the last 12 months.

If all other sources of air emissions are insignificant you do not need a permit.

200 gallons or more of VOC-containing materials

If you use close to or more than 200 gallons a year of VOC-containing material(s), take the following steps to determine exactly how many gallons of actual VOCs you use in a 12-month period:

1. From the MSDS, determine the percent VOCs by volume within each material.
2. Calculate the 12 month *rolling sum** by entering the amounts of VOCs contained within each material into the following equation:

   % VOC by volume x gallons of materials purchased or used/year = gallons of VOC used/year.

If you use at least 200 gallons of VOCs, but less than 2000** gallons of VOC-containing material and all other sources of air emissions are insignificant, consider registration permit Option B.

Air pollutants that affect human health at very low concentrations are called hazardous air pollutants (HAPs). The MPCA does not require holders of registration permits to calculate emissions of HAPs if the business has actual VOC emissions of less than five tons per year and the only HAP emissions are VOCs.

** A rolling sum is a running total of the gallons of all VOCs a business used over the last 12 months. Tables 2, 3 and 4 give an example of a business' 12-month rolling sum showing a VOC calculation.*

*** Businesses that purchase or use more than 2000 gallons of VOC-containing material could qualify for another form of permit. Contact the Small Business Assistance Program (SBAP) at the MPCA for assistance.*

Table 2: Rolling Sum Example Part 1
VOC Calculation for Previous 11 Months (March 1996 through January 1997)

Month	Gallons of VOCs
Mar 1996	17.8
Apr 1996	18.3
May 1996	12.8
June 1996	15.3
July 1996	14.5
Aug 1996	16.1
Sept 1996	15
Oct 1996	11.5
Nov 1996	15.61
Dec 1996	19.6
Jan 1997	20.6
Total	**177.11**

Table 3: Rolling Sum Example Part 2
VOC Calculation for Current Month (February 1997)

Materials	VOC content (Feb 1997)	Gallons of Material (Feb 1997)	Gallons of VOCs (February 1997)
Primer	58%	10	58/100 x 10 gallons = 5.8 gal
Catalyst	75%	5	75/100 x 5 gallons = 3.75 gal
Thinner	100%	5	100/100 x 5 gallons = 5 gal
Body Filler	47%	0.5	47/100 x 0.5 gallons = 0.24 gal
Total VOCs for Current Month (Feb 1997)			= **14.79 gal**
Total VOCs from *Previous* 11 Months (Mar 1996 through Jan 1997)			= **177.11 gal**

Table 4: Rolling Sum Example Part 3
VOC Calculation for Mar '96 through Feb '97

Previous 11 Months' VOC Total	+	Current Month's VOC Total	=	12-Month Rolling Sum
177.11 gal	+	14.79 gal	=	**189.9 gal***

*This qualifies as an **insignificant** activity because 189.9 gal is less than the 200-gallon limit. No permit is needed.

For More Information

- **Materials Exchange or MnTAP Fact Sheets**
  MnTAP..... (612) 627-4646 or (800) 247-0015
- **Air Quality Issues** (Businesses with 100 or more employees)
  Permit Information Coordinator.....(612) 282-5844
  (800) 646-6247
- **Air Quality Issues** (Businesses with less than 100 employees)
  Small Business Assistance Program.....(612) 282-6143
  (800) 657-3938
- **Hazardous Waste Issues**
  HW Business Assistance Unit..(612) 297-8363 or (800) 657-3724

APPENDIX B

Alternative Daily Cover

SKB ENVIRONMENTAL INC.

COMPANY (GENERATOR) NAME_____
CONTACT PERSON_____
ADDRESS_____
CITY, STATE, ZIP_____
PHONE NUMBER_____FAX_____

WASTE NAME _____
AMOUNT _____ (Yds/Tons/etc.) PER _____(Day/Week/etc.)

SKB WASTE NUMBER _____(Assigned by SKB)
LANDFILL _____
LANDFILL CONTACT _____

Does this waste have current SKB Environmental inc. disposal approval? _____ (If no, please explain)___
_____

Does this waste have an odor?_____ (If yes, please describe)_____

Does this waste contain debris, sharps or other hazards? (If yes, please describe) _____

_____

Does this waste have the potential to create dust? (If yes, please describe) _____

_____

Does this waste pose a tracking problem? (If yes, please describe) _____

_____

Is the waste soil or soil like? (If no, please explain) _____

I am requesting approval to stockpile this waste? (If yes, indicate where waste will be stockpiled and duration)

_____

Landfill Certification

I certify that the information contained in this application is complete, and to the best of my knowledge, true and accurate. I certify that I am familiar with the requirement of SKB ENVIRONMENTAL INC., and I certify that the proposed use as cover of this waste meets SKB Environmental Inc. requirements. I agree to comply with said requirements and any conditions imposed by SKB ENVIRONMENTAL INC. regarding the use of this waste as cover. I understand that this waste may not be stockpiled without SKB ENVIRONMENTAL INC. approval.

_____ _____ _____
Signature Title Date

APPENDIX C

Load Rejection Form

SKB ENVIRONMENTAL INC.
52563 243 Street, Austin, MN 55912
(507) 433-8133 phone. (507) 433-8131 fax

REJECTED WASTE REPORT

Date: _____Time: _____

Vehicle Type: _____ Volume: _____.____

_____

Generator:_____ Hauler: _____

Contact: _____ Phone: _____

Waste Returned & Action Taken:

Date:____ _____ Time: _____

Employee Signature: _____

Responsive partner.
Exceptional outcomes.

Toll Free: 800-472-2232 Email: wenckmp@wenck.com Web: wenck.com

MINNESOTA
Maple Plain
763-479-4200
Golden Valley
763-252-6800
Windom
507-831-2703
New Hope
800-368-8831
Woodbury
651-294-4580

COLORADO
Denver
800-472-2232
Fort Collins
970-223-4705

GEORGIA
Roswell
678-987-5840

NORTH DAKOTA
Fargo
701-297-9600
Mandan
701-751-3370
Dickinson
800-472-2232

SOUTH DAKOTA
Pierre
605-222-1826

WYOMING
Cheyenne
307-634-7848
Sheridan
307-675-1148

Appendix B

Criteria for Classification of Solid Waste Disposal Facilities and Practices

Part 257 Revision Introduction

PART 257—CRITERIA FOR CLASSIFICATION OF SOLID WASTE DISPOSAL FACILITIES AND PRACTICES

▲ 1. The authority citation for part 257 continues to read as follows:

Authority: 42 U.S.C. 6907(a)(3), 6912(a)(1), 6944(a); 33 U.S.C. 1345(d) and (e).

▲ 2. Section 257.1 is amended by:

a. Adding a sentence at the end of paragraph (a) introductory text;
b. Revising paragraphs (a)(1) and (2); and
c. Adding paragraph (c)(12).

The revisions and additions read as follows:

§ 257.1 Scope and purpose.

(a) Unless otherwise provided, the criteria in §§ 257.50 through 257.107 are adopted for determining which CCR landfills and CCR surface impoundments pose a reasonable probability of adverse effects on health or the environment under sections 1008(a)(3) and 4004(a) of the Act.

(b)

(1) Facilities failing to satisfy any of the criteria in §§ 257.1 through 257.4 or §§ 257.5 through 257.30 or §§ 257.50 through 257.107 are considered open

(2) Practices failing to satisfy any of the criteria in §§ 257.1 through 257.4 or §§ 257.5 through 257.30 or §§ 257.50 through 257.107 constitute open dumping, which is prohibited under section 4005 of the Act.

(c)

(12) Except as otherwise specifically provided in subpart D of this part, the criteria in subpart A of this part do not apply to CCR landfills, CCR surface impoundments, and lateral expansions of CCR units, as those terms are defined in subpart D of this part. Such units are instead subject to subpart D of this part.

▲ 3. Section 257.2 is amended by adding in alphabetical order definitions for ''CCR landfill'' and ''CCR surface impoundment'' to read as follows:

§ 257.2 Definitions.

CCR landfill means an area of land or an excavation that receives CCR and which is not a surface impoundment, an underground injection well, a salt dome CCR landfill also includes sand and gravel pits and quarries that receive CCR, CCR piles, and any practice that does not meet the definition of a beneficial use of CCR.

CCR surface impoundment means a natural topographic depression, man- made excavation, or diked area, which is designed to hold an accumulation of CCR and liquids, and the unit treats, stores, or disposes of CCR.

▲ 4. Part 257 is amended by:

a. Adding and reserving subpart C; and
b. Adding subpart D.

The additions read as follows:

Subpart C—[Reserved]

Part 257 Revision Introduction

Subpart D—Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments

General Provisions

257.50 Scope and purpose.
257.51 Effective date of this subpart.
257.52 Applicability of other regulations.
257.53 Definitions.

Location Restrictions

257.60 Placement above the uppermost aquifer.
257.61 Wetlands
257.62 Fault Areas
257.63 Seismic impact zones.
257.64 Unstable areas.

Design Criteria

257.70 Design criteria for new CCR landfills and any lateral expansion of a CCR landfill.
257.71 Liner design criteria for existing CCR surface impoundments.
257.72 Design criteria for new CCR surface impoundments and any lateral expansion of a CCR surface impoundment.
257.73 Structural integrity criteria for existing CCR surface impoundments.
257.74 Structural integrity criteria for new CCR surface impoundments and any lateral expansion of a CCR surface impoundment.

Operating Criteria

257.80 Air criteria.
257.81 Run-on and run-off controls for CCR landfills.
257.82 Hydrologic and hydraulic capacity requirements for CCR surface impoundments.
257.83 Inspection requirements for CCR surface impoundments.
257.84 Inspection requirements for CCR landfills.

Groundwater Monitoring and Corrective Action Requirements

257.94 Detection monitoring program.
257.95 Assessment monitoring program.
257.96 Assessment of corrective measures.
257.97 Selection of remedy.
257.98 Implementation of the corrective action program.

Closure and Post-Closure Care

257.100 Inactive CCR surface impoundments.
257.101 Closure or retrofit of CCR units.
257.102 Criteria for conducting the closure or retrofit of CCR units.
257.103 Alternative closure requirements.
257.104 Post-closure care requirements.

Recordkeeping, Notification, and Posting of Information to the Internet

257.105 Recordkeeping requirements.
257.106 Notification requirements.
257.107 Publicly accessible internet site requirements.

▲ 5. Amend part 257 by adding ‘‘Appendix III to Part 257’’ and ‘‘Appendix IV to Part 257’’ to read as follows:

Appendix III to Part 257—Constituents for Detection Monitoring

Common Name[1]
Boron
Calcium
Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids (TDS)

1 Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

Appendix IV to Part 257—Constituents for Assessment Monitoring

Common Name[1]
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228 combined

1 Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

Subpart D Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments
§ 257.50-52

§ 257.50 Scope and purpose.

(a) This subpart establishes minimum national criteria for purposes of determining which solid waste disposal facilities and solid waste management practices do not pose a reasonable probability of adverse effects on health or the environment under sections 1008(a)(3) and 4004(a) of the Resource Conservation and Recovery Act.

(b) This subpart applies to owners and operators of new and existing landfills and surface impoundments, including any lateral expansions of such units that dispose or otherwise engage in solid waste management of CCR generated from the combustion of coal at electric utilities and independent power producers. Unless otherwise provided in this subpart, these requirements also apply to disposal units located off-site of the electric utility or independent power producer. This subpart also applies to any practice that does not meet the definition of a beneficial use of CCR.

(c) This subpart also applies to inactive CCR surface impoundments at active electric utilities or independent power producers, regardless of the fuel currently used at the facility to produce electricity.

(d) This subpart does not apply to CCR landfills that have ceased receiving CCR prior to October 19, 2015.

(e) This subpart does not apply to electric utilities or independent power producers that have ceased producing electricity prior to October 19, 2015.

(f) This subpart does not apply to wastes, including fly ash, bottom ash, boiler slag, and flue gas desulfurization materials generated at facilities that are not part of an electric utility or independent power producer, such as manufacturing facilities, universities, and hospitals. This subpart also does not apply to fly ash, bottom ash, boiler slag, and flue gas desulfurization materials, generated primarily from the combustion of fuels (including other fossil fuels) other than coal, for the purpose of generating electricity unless the fuel burned consists of more than fifty percent (50%) coal on a total heat input or mass input basis, whichever results in the greater mass feed rate of coal.

(g) This subpart does not apply to practices that meet the definition of a beneficial use of CCR.

(h) This subpart does not apply to CCR placement at active or abandoned underground or surface coal mines.

(i) This subpart does not apply to municipal solid waste landfills that receive CCR.

§ 257.51 Effective date of this subpart.

The requirements of this subpart take effect on October 19, 2015.

§ 257.52 Applicability of other regulations.

(a) Compliance with the requirements of this subpart does not affect the need for the owner or operator of a CCR landfill, CCR surface impoundment, or lateral expansion of a CCR unit to comply with all other applicable federal, state, tribal, or local laws or other requirements.

(b) Any CCR landfill, CCR surface impoundment, or lateral expansion of a CCR unit continues to be subject to the requirements in §§ 257.3–1, 257.3–2, and 257.3–3.

Subpart D
§ 257.53 Definitions

The following definitions apply to this subpart. Terms not defined in this section have the meaning given by RCRA.

Acre foot means the volume of one acre of surface area to a depth of one foot.

Active facility or active electric utilities or independent power producers means any facility subject to the requirements of this subpart that is in operation on October 14, 2015. An electric utility or independent power producer is in operation if it is generating electricity that is provided to electric power transmission systems or to electric power distribution systems on or after October 14, 2015. An off-site disposal facility is in operation if it is accepting or managing CCR on or after October 14, 2015.

Active life or in operation means the period of operation beginning with the initial placement of CCR in the CCR unit and ending at completion of closure activities in accordance with § 257.102.

Active portion means that part of the CCR unit that has received or is receiving CCR or non-CCR waste and that has not completed closure in accordance with § 257.102.

Aquifer means a geologic formation, group of formations, or portion of a formation capable of yielding usable quantities of groundwater to wells or springs.

Area-capacity curves means graphic curves which readily show the reservoir water surface area, in acres, at different elevations from the bottom of the reservoir to the maximum water surface, and the capacity or volume, in acre-feet, of the water contained in the reservoir at various elevations.

Areas susceptible to mass movement means those areas of influence (i.e., areas characterized as having an active or substantial possibility of mass movement) where, because of natural or human-induced events, the movement of earthen material at, beneath, or adjacent to the CCR unit results in the downslope transport of soil and rock material by means of gravitational influence. Areas of mass movement include, but are not limited to, landslides, avalanches, debris slides and flows, soil fluctuation, block sliding, and rock fall.

Beneficial use of CCR means the CCR meet **all** of the following conditions:

(1) The CCR must provide a functional benefit;

(2) The CCR must substitute for the use of a virgin material, conserving natural resources that would otherwise need to be obtained through practices, such as extraction;

(3) The use of the CCR must meet relevant product specifications, regulatory standards or design standards when available, and when such standards are not available, the CCR is not used in excess quantities; and

(4) When unencapsulated use of CCR involving placement on the land of 12,400 tons or more in non-roadway applications, the user must demonstrate and keep records, and provide such documentation upon request, that environmental releases to groundwater, surface water, soil and air are comparable to or lower than those from analogous products made without CCR, or that environmental releases to groundwater, surface water, soil and air will be at or below relevant regulatory and health-based benchmarks for human and ecological receptors during use.

Subpart D
§ 257.53 Definitions

Closed means placement of CCR in a CCR unit has ceased, and the owner or operator has completed closure of the CCR unit in accordance with § 257.102 and has initiated post-closure care in accordance with § 257.104.

Coal combustion residuals (CCR) means fly ash, bottom ash, boiler slag, and flue gas desulfurization materials generated from burning coal for the purpose of generating electricity by electric utilities and independent power producers.

CCR fugitive dust means solid airborne particulate matter that contains or is derived from CCR, emitted from any source other than a stack or chimney.

CCR landfill or landfill means an area of land or an excavation that receives CCR and which is not a surface impoundment, an underground injection well, a salt dome formation, a salt bed formation, an underground or surface coal mine, or a cave. For purposes of this subpart, a CCR landfill also includes sand and gravel pits and quarries that receive CCR, CCR piles, and any practice that does not meet the definition of a beneficial use of CCR.

CCR pile or pile means any non- containerized accumulation of solid,non-flowing CCR that is placed on the land. CCR that is beneficially used off- site is not a CCR pile.

CCR surface impoundment or impoundment means a natural topographic depression, man-made excavation, or diked area, which is designed to hold an accumulation of CCR and liquids, and the unit treats, stores, or disposes of CCR.

CCR unit means any CCR landfill, CCR surface impoundment, or lateral expansion of a CCR unit, or a combination of more than one of these units, based on the context of the paragraph(s) in which it is used. This term includes both new and existing units, unless otherwise specified.

Dike means an embankment, berm, or ridge of either natural or man-made materials used to prevent the movement of liquids, sludges, solids, or other materials.

Displacement means the relative movement of any two sides of a fault measured in any direction.

Disposal means the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste as defined in section 1004(27) of the Resource Conservation and Recovery Act into or on any land or water so that such solid waste, or constituent thereof, may enter the environment or be emitted into the air or discharged into any waters, including groundwaters. For purposes of this subpart, disposal does not include the storage or the beneficial use of CCR.

Downstream toe means the junction of the downstream slope or face of the CCR surface impoundment with the ground surface.

Encapsulated beneficial use means a beneficial use of CCR that binds the CCR into a solid matrix that minimizes its mobilization into the surrounding environment.

Subpart D
§ 257.53 Definitions

Existing CCR landfill means a CCR landfill that receives CCR both before and after October 14, 2015, or for which construction commenced prior to October 14, 2015 and receives CCR on or after October 14, 2015. A CCR landfill has commenced construction if the owner or operator has obtained the federal, state, and local approvals or permits necessary to begin physical construction and a continuous on-site, physical construction program had begun prior to October 14, 2015.

Existing CCR surface impoundment means a CCR surface impoundment that receives CCR both before and after October 14, 2015, or for which construction commenced prior to October 14, 2015 and receives CCR on or after October 14, 2015. A CCR surface impoundment has commenced construction if the owner or operator has obtained the federal, state, and local approvals or permits necessary to begin physical construction and a continuous on-site, physical construction program had begun prior to October 14, 2015.

Facility means all contiguous land, and structures, other appurtenances, and improvements on the land, used for treating, storing, disposing, or otherwise conducting solid waste management of CCR. A facility may consist of several treatment, storage, or disposal operational units (e.g., one or more landfills, surface impoundments, or combinations of them).

Factor of safety (Safety factor) means the ratio of the forces tending to resist the failure of a structure to the forces tending to cause such failure as determined by accepted engineering practice.

Fault means a fracture or a zone of fractures in any material along which strata on one side have been displaced with respect to that on the other side.

Flood hydrograph means a graph showing, for a given point on a stream, the discharge, height, or other characteristic of a flood as a function of time.

Freeboard means the vertical distance between the lowest point on the crest of the impoundment dike and the surface of the waste contained therein.

Free liquids means liquids that readily separate from the solid portion of a waste under ambient temperature and pressure.

Groundwater means water below the land surface in a zone of saturation.

Hazard potential classification means the possible adverse incremental consequences that result from the release of water or stored contents due to failure of the diked CCR surface impoundment or mis-operation of the diked CCR surface impoundment or its appurtenances. The hazardous potential classifications include high hazard potential CCR surface impoundment, significant hazard potential CCR surface impoundment, and low hazard potential CCR surface impoundment, which terms mean:

(1) High hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation will probably cause loss of human life.

(2) Low hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis- operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the surface impoundment owner's property.

(3) Significant hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation results in no probable loss of human life, but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns.

Height means the vertical measurement from the downstream toe of the CCR surface impoundment at its lowest point to the lowest elevation of the crest of the CCR surface impoundment.

Holocene means the most recent epoch of the Quaternary period, extending from the end of the Pleistocene Epoch, at 11,700 years before present, to present.

Hydraulic conductivity means the rate at which water can move through a permeable medium (i.e., the coefficient of permeability).

Inactive CCR surface impoundment means a CCR surface impoundment that no longer receives CCR on or after October 14, 2015 and still contains both CCR and liquids on or after October 14, 2015.

Incised CCR surface impoundment means a CCR surface impoundment which is constructed by excavating entirely below the natural ground surface, holds an accumulation of CCR entirely below the adjacent natural ground surface, and does not consist of any constructed diked portion.

Indian country or Indian lands means:

(1) All land within the limits of any Indian reservation under the jurisdiction of the United States Government, notwithstanding the issuance of any patent, and including rights-of-way running throughout the reservation;

(2) All dependent Indian communities within the borders of the United States whether within the original or subsequently acquired territory thereof, and whether within or without the limits of the State; and

(3) All Indian allotments, the Indian titles to which have not been extinguished, including rights of way running through the s ame.

Indian Tribe or Tribe means any Indian tribe, band, nation, or community recognized by the Secretary of the Interior and exercising substantial governmental duties and powers on Indian lands.

Inflow design flood means the flood hydrograph that is used in the design or modification of the CCR surface impoundments and its appurtenant works.

In operation means the same as active life.

Karst terrain means an area where karst topography, with its characteristic erosional surface and subterranean features, is developed as the result of dissolution of limestone, dolomite, or other soluble rock. Characteristic physiographic features present in karst terranes include, but are not limited to, dolines, collapse shafts (sinkholes), sinking streams, caves, seeps, large springs, and blind valleys.

Lateral expansion means a horizontal expansion of the waste boundaries of an existing CCR landfill or existing CCR surface impoundment made after October 14, 2015.

Subpart D
§ 257.53 Definitions

Liquefaction factor of safety means the factor of safety (safety factor) determined using analysis under liquefaction conditions.

Lithified earth material means all rock, including all naturally occurring and naturally formed aggregates or masses of minerals or small particles of older rock that formed by crystallization of magma or by induration of loose sediments. This term does not include man-made materials, such as fill, concrete, and asphalt, or unconsolidated earth materials, soil, or regolith lying at or near the earth surface.

Maximum horizontal acceleration in lithified earth material means the maximum expected horizontal acceleration at the ground surface as depicted on a seismic hazard map, with a 98% or greater probability that the acceleration will not be exceeded in 50 years, or the maximum expected horizontal acceleration based on a site- specific seismic risk assessment.

New CCR landfill means a CCR landfill or lateral expansion of a CCR landfill that first receives CCR or commences construction after October 14, 2015. A new CCR landfill has commenced construction if the owner or operator has obtained the federal, state, and local approvals or permits necessary to begin physical construction and a continuous on-site, physical construction program had begun after October 14, 2015. Overfills are also considered new CCR landfills.

New CCR surface impoundment means a CCR surface impoundment or lateral expansion of an existing or new CCR surface impoundment that first receives CCR or commences construction after October 14, 2015. A new CCR surface impoundment has commenced construction if the owner or operator has obtained the federal, state, and local approvals or permits necessary to begin physical construction and a continuous on-site, physical construction program had begun after October 14, 2015.

Operator means the person(s) responsible for the overall operation of a CCR unit.

Overfill means a new CCR landfill constructed over a closed CCR surface impoundment.

Owner means the person(s) who owns a CCR unit or part of a CCR unit.

Poor foundation conditions mean those areas where features exist which indicate that a natural or human- induced event may result in inadequate foundation support for the structural components of an existing or new CCR unit. For example, failure to maintain static and seismic factors of safety as required in §§ 257.73(e) and 257.74(e) would cause a poor foundation condition.

Probable maximum flood means the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the drainage basin.

Qualified person means a person or persons trained to recognize specific appearances of structural weakness and other conditions which are disrupting or have the potential to disrupt the operation or safety of the CCR unit by visual observation and, if applicable, to monitor instrumentation.

Subpart D
§ 257.53 Definitions

Qualified professional engineer means an individual who is licensed by a state as a Professional Engineer to practice one or more disciplines of engineering and who is qualified by education, technical knowledge and experience to make the specific technical certifications required under this subpart. Professional engineers making these certifications must be currently licensed in the state where the CCR unit(s) is located.

Recognized and generally accepted good engineering practices means engineering maintenance or operation activities based on established codes, widely accepted standards, published technical reports, or a practice widely recommended throughout the industry. Such practices generally detail approved ways to perform specific engineering, inspection, or mechanical integrity activities.

Retrofit means to remove all CCR and contaminated soils and sediments from the CCR surface impoundment, and to ensure the unit complies with the requirements in § 257.72

Representative sample means a sample of a universe or whole (e.g., waste pile, lagoon, and groundwater) which can be expected to exhibit the average properties of the universe or whole. See EPA publication SW–846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Chapter 9 (available at http:// www.epa.gov/epawaste/hazard/ testmethods/sw846/online/index.htm) for a discussion and examples of representative samples.

Run-off means any rainwater, leachate, or other liquid that drains over land from any part of a CCR landfill or lateral expansion of a CCR landfill.

Run-on means any rainwater, leachate, or other liquid that drains over land onto any part of a CCR landfill or lateral expansion of a CCR landfill.

Sand and gravel pit or quarry means an excavation for the extraction of aggregate, minerals or metals. The term sand and gravel pit and/or quarry does not include subsurface or surface coal mines.

Seismic factor of safety means the factor of safety (safety factor) determined using analysis under earthquake conditions using the peak ground acceleration for a seismic event with a 2% probability of exceedance in 50 years, equivalent to a return period of approximately 2,500 years, based on the U.S. Geological Survey (USGS) seismic hazard maps for seismic events with this return period for the region where the CCR surface impoundment is located.

Seismic impact zone means an area having a 2% or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10 g in 50 years.

Slope protection means engineered or non-engineered measures installed on the upstream or downstream slope of the CCR surface impoundment to protect the slope against wave action or erosion, including but not limited to rock riprap, wooden pile, or concrete revetments, vegetated wave berms, concrete facing, gabions, geotextiles, or fascines.

Solid waste management or management means the systematic administration of the activities which provide for the collection, source separation, storage, transportation, processing, treatment, or disposal of solid waste.

Subpart D
§ 257.53 Definitions

State means any of the fifty States in addition to the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands.

State Director means the chief administrative officer of the lead state agency responsible for implementing the state program regulating disposal in CCR landfills, CCR surface impoundments, and all lateral expansions of a CCR unit.

Static factor of safety means the factor of safety (safety factor) determined using analysis under the long-term, maximum storage pool loading condition, the maximum surcharge pool loading condition, and under the end-of- construction loading condition.

Structural components mean liners, leachate collection and removal systems, final covers, run-on and run-off systems, inflow design flood control systems, and any other component used in the construction and operation of the CCR unit that is necessary to ensure the integrity of the unit and that the contents of the unit are not released into the environment.

Unstable area means a location that is susceptible to natural or human- induced events or forces capable of impairing the integrity, including structural components of some or all of the CCR unit that are responsible for preventing releases from such unit. Unstable areas can include poor foundation conditions, areas susceptible to mass movements, and karst terrains.

Uppermost aquifer means the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural ground surface to which the aquifer rises during the wet season.

Waste boundary means a vertical surface located at the hydraulically downgradient limit of the CCR unit. The vertical surface extends down into the uppermost aquifer.

Subpart D Location Restrictions

257.60 Placement above the uppermost aquifer

(a) New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must be constructed with a base that is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high water table). The owner or operator must demonstrate by the dates specified in paragraph (c) of this section that the CCR unit meets the minimum requirements for placement above the uppermost aquifer.

(b) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the demonstration meets the requirements of paragraph (a) of this section.

(c) The owner or operator of the CCR unit must complete the demonstration required by paragraph (a) of this section by the date specified in either paragraph (c)(1) or (2) of this section.

(1) For an existing CCR surface impoundment, the owner or operator must complete the demonstration no later than October 17, 2018.

(2) For a new CCR landfill, new CCR surface impoundment, or any lateral expansion of a CCR unit, the owner or operator must complete the demonstration no later than the date of initial receipt of CCR in the CCR unit.

(3) The owner or operator has completed the demonstration required by paragraph (a) of this section when the demonstration is placed in the facility's operating record as required by § 257.105(e).

(4) An owner or operator of an existing CCR surface impoundment who fails to demonstrate compliance with the requirements of paragraph (a) of this section by the date specified in paragraph (c)(1) of this section is subject to the requirements of § 257.101(b)(1).

(5) An owner or operator of a new CCR landfill, new CCR surface impoundment, or any lateral expansion of a CCR unit who fails to make the demonstration showing compliance with the requirements of paragraph (a) of this section is prohibited from placing CCR in the CCR unit.

(d) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in§ 257.105(e), the notification requirements specified in § 257.106(e), and the internet requirements specified in § 257.107(e).

Subpart D Location Restrictions

§ 257.61 Wetlands

(a) New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located in wetlands, as defined in § 232.2 of this chapter, unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that the CCR unit meets the requirements of paragraphs (a)(1) through (5) of this section.

(1) Where applicable under section 404 of the Clean Water Act or applicable state wetlands laws, a clear and objective rebuttal of the presumption that an alternative to the CCR unit is reasonably available that does not involve wetlands.

(2) The construction and operation of the CCR unit will not cause or contribute to any of the following:
- (i) A violation of any applicable state or federal water quality standard;
- (ii) A violation of any applicable toxic effluent standard or prohibition under section 307 of the Clean Water Act;
- (iii) Jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of a critical habitat, protected under the Endangered Species Act of 1973; and
- (iv) A violation of any requirement under the Marine Protection, Research, and Sanctuaries Act of 1972 for the protection of a marine sanctuary.

(3) The CCR unit will not cause or contribute to significant degradation of wetlands by addressing all of the following factors:
- (i) Erosion, stability, and migration potential of native wetland soils, muds and deposits used to support the CCR unit;
- (ii) Erosion, stability, and migration potential of dredged and fill materials used to support the CCR unit;
- (iii) The volume and chemical nature of the CCR;
- (iv) Impacts on fish, wildlife, and other aquatic resources and their habitat from release of CCR;
- (v) The potential effects of catastrophic release of CCR to the wetland and the resulting impacts on the environment; and
- (vi) Any additional factors, as necessary, to demonstrate that ecological resources in the wetland are sufficiently protected.

(4) To the extent required under section 404 of the Clean Water Act or applicable state wetlands laws, steps have been taken to attempt to achieve no net loss of wetlands (as defined by acreage and function) by first avoiding impacts to wetlands to the maximum extent reasonable as required by paragraphs (a)(1) through (3) of this section, then minimizing unavoidable impacts to the maximum extent reasonable, and finally offsetting remaining unavoidable wetland impacts through all appropriate and reasonable compensatory mitigation actions (e.g., restoration of existing degraded wetlands or creation of man-made wetlands); and

(5) Sufficient information is available to make a reasoned determination with respect to the demonstrations in paragraphs (a)(1) through (4) of this section.

Subpart D Location Restrictions

§ 257.61 Wetlands

(b) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the demonstration meets the requirements of paragraph (a) of this section.

(c) The owner or operator of the CCR unit must complete the demonstrations required by paragraph (a) of this section by the date specified in either paragraph (c)(1) or (2) of this section.

(1) For an existing CCR surface impoundment, the owner or operator must complete the demonstration no later than October 17, 2018.

(2) For a new CCR landfill, new CCR surface impoundment, or any lateral expansion of a CCR unit, the owner or operator must complete the demonstration no later than the date of initial receipt of CCR in the CCR unit.

(3) The owner or operator has completed the demonstration required by paragraph (a) of this section when the demonstration is placed in the facility's operating record as required by § 257.105(e).

(4) An owner or operator of an existing CCR surface impoundment who fails to demonstrate compliance with the requirements of paragraph (a) of this section by the date specified in paragraph (c)(1) of this section is subject to the requirements of § 257.101(b)(1).

(5) An owner or operator of a new CCR landfill, new CCR surface impoundment, or any lateral expansion of a CCR unit who fails to make the demonstrations showing compliance with the requirements of paragraph (a) of this section is prohibited from placing CCR in the CCR unit.

(d) The owner or operator must comply with the recordkeeping requirements specified in § 257.105(e), the notification requirements specified in § 257.106(e), and the Internet requirements specified in § 257.107(e).

Subpart D Location Restrictions

§ 257.62 Fault areas

(a) New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located within 60 meters (200 feet) of the outermost damage zone of a fault that has had displacement in Holocene time unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that an alternative setback distance of less than 60 meters (200 feet) will prevent damage to the structural integrity of the CCR unit.

(b) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the demonstration meets the requirements of paragraph (a) of this section.

(c) The owner or operator of the CCR unit must complete the demonstration required by paragraph (a) of this section by the date specified in either paragraph (c)(1) or (2) of this section.

(1) For an existing CCR surface impoundment, the owner or operator must complete the demonstration no later than October 17, 2018.

(2) For a new CCR landfill, new CCR surface impoundment, or any lateral expansion of a CCR unit, the owner or operator must complete the demonstration no later than the date of initial receipt of CCR in the CCR unit.

(3) The owner or operator has completed the demonstration required by paragraph (a) of this section when the demonstration is placed in the facility's operating record as required by § 257.105(e).

(4) An owner or operator of an existing CCR surface impoundment who fails to demonstrate compliance with the requirements of paragraph (a) of this section by the date specified in paragraph (c)(1) of this section is subject to the requirements of § 257.101(b)(1).

(5) An owner or operator of a new CCR landfill, new CCR surface impoundment, or any lateral expansion of a CCR unit who fails to make the demonstration showing compliance with the requirements of paragraph (a) of this section is prohibited from placing CCR in the CCR unit.

(d) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(e), the notification requirements specified in § 257.106(e), and the Internet requirements specified in § 257.107(e).

Subpart D Location Restrictions

§ 257.63 Seismic impact zones

(a) New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located in seismic impact zones unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site.

(b) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the demonstration meets the requirements of paragraph (a) of this section.

(c) The owner or operator of the CCR unit must complete the demonstration required by paragraph (a) of this section by the date specified in either paragraph (c)(1) or (2) of this section.

(1) For an existing CCR surface impoundment, the owner or operator must complete the demonstration no later than October 17, 2018.

(2) For a new CCR landfill, new CCR surface impoundment, or any lateral expansion of a CCR unit, the owner or operator must complete the demonstration no later than the date of initial receipt of CCR in the CCR unit.

(3) The owner or operator has completed the demonstration required by paragraph (a) of this section when the demonstration is placed in the facility's operating record as required by § 257.105(e).

(4) An owner or operator of an existing CCR surface impoundment who fails to demonstrate compliance with the requirements of paragraph (a) of this section by the date specified in paragraph (c)(1) of this section is subject to the requirements of § 257.101(b)(1).

(5) An owner or operator of a new CCR landfill, new CCR surface impoundment, or any lateral expansion of a CCR unit who fails to make the demonstration showing compliance with the requirements of paragraph (a) of this section is prohibited from placing CCR in the CCR unit.

(d) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(e), the notification requirements specified in § 257.106(e), and the Internet requirements specified in § 257.107(e).

Subpart D Location Restrictions

§ 257.64 Unstable areas

(a) An existing or new CCR landfill, existing or new CCR surface impoundment, or any lateral expansion of a CCR unit must not be located in an unstable area unless the owner or operator demonstrates by the dates specified in paragraph (d) of this section that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted.

(b) The owner or operator must consider all of the following factors, at a minimum, when determining whether an area is unstable:

(1) On-site or local soil conditions that may result in significant differential settling;

(2) On-site or local geologic or geomorphologic features; and

(3) On-site or local human-made features or events (both surface and subsurface).

(c) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the demonstration meets the requirements of paragraph (a) of this section.

(d) The owner or operator of the CCR unit must complete the demonstration required by paragraph (a) of this section by the date specified in either paragraph (d)(1) or (2) of this section.

(1) For an existing CCR landfill or existing CCR surface impoundment, the owner or operator must complete the demonstration no later than October 17, 2018.

(2) For a new CCR landfill, new CCR surface impoundment, or any lateral expansion of a CCR unit, the owner or operator must complete the demonstration no later than the date of initial receipt of CCR in the CCR unit.

(3) The owner or operator has completed the demonstration required by paragraph (a) of this section when the demonstration is placed in the facility's operating record as required by § 257.105(e).

(4) An owner or operator of an existing CCR surface impoundment or existing CCR landfill who fails to demonstrate compliance with the requirements of paragraph (a) of this section by the date specified in paragraph (d)(1) of this section is subject to the requirements of § 257.101(b)(1) or (d)(1), respectively.

(5) An owner or operator of a new CCR landfill, new CCR surface impoundment, or any lateral expansion of a CCR unit who fails to make the demonstration showing compliance with the requirements of paragraph (a) of this section is prohibited from placing CCR in the CCR unit.

(e) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(e), the notification requirements specified in § 257.106(e), and the Internet requirements specified in § 257.107(e).

Subpart D Design Criteria

§ 257.70 Design criteria for new CCR landfills and any lateral expansion of a CCR landfill

(a)

(1) New CCR landfills and any lateral expansion of a CCR landfill must be designed, constructed, operated, and maintained with either a composite liner that meets the requirements of paragraph (b) of this section or an alternative composite liner that meets the requirements in paragraph (c) of this section, and a leachate collection and removal system that meets the requirements of paragraph (d) of this section.

(2) Prior to construction of an overfill the underlying surface impoundment must meet the requirements of § 257.102(d).

(b) A composite liner must consist of two components; the upper component consisting of, at a minimum, a 30-mil geomembrane liner (GM), and the lower component consisting of at least a two- foot layer of compacted soil with a hydraulic conductivity of no more than $1x10^{-7}$ centimeters per second (cm/ sec). GM components consisting of high density polyethylene (HDPE) must be at least 60-mil thick. The GM or upper liner component must be installed in direct and uniform contact with the compacted soil or lower liner component. The composite liner must be:

(1) Constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure due to pressure gradients (including static head and external hydrogeologic forces), physical contact with the CCR or leachate to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation;

(2) Constructed of materials that provide appropriate shear resistance of the upper and lower component interface to prevent sliding of the upper component including on slopes;

(3) Placed upon a foundation or base capable of providing support to the liner and resistance to pressure gradients above and below the liner to prevent failure of the liner due to settlement, compression, or uplift; and

(4) Installed to cover all surrounding earth likely to be in contact with the CCR or leachate.

(c) If the owner or operator elects to install an alternative composite liner, all of the following requirements must be met:

(1) An alternative composite liner must consist of two components; the upper component consisting of, at a minimum, a 30-mil GM, and a lower component, that is not a geomembrane, with a liquid flow rate no greater than the liquid flow rate of two feet of compacted soil with a hydraulic conductivity of no more than 1x10-7 cm/sec. GM components consisting of high density polyethylene (HDPE) must be at least 60-mil thick. If the lower component of the alternative liner is compacted soil, the GM must be installed in direct and uniform contact with the compacted soil.

(2) The owner or operator must obtain certification from a qualified professional engineer that the liquid flow rate through the lower component of the alternative composite liner

is no greater than the liquid flow rate through two feet of compacted soil with a hydraulic conductivity of 1x10-7 cm/ sec. The hydraulic conductivity for the two feet of compacted soil used in the comparison shall be no greater than 1x10-7 cm/sec. The hydraulic conductivity of any alternative to the two feet of compacted soil must be determined using recognized and generally accepted methods. The liquid flow rate comparison must be made using Equation 1 of this section, which is derived from Darcy's Law for gravity flow through porous media.

(Eq. 1) $$\frac{Q}{A} = q = k\left(\frac{h}{t} + 1\right)$$

Where,
Q = flow rate (cubic centimeters/second);
A = surface area of the liner (squared centimeters);
q = flow rate per unit area (cubic centimeters/ second/squared centimeter);
k = hydraulic conductivity of the liner (centimeters/second);
h = hydraulic head above the liner (centimeters); and
t = thickness of the liner (centimeters).

(3) The alternative composite liner must meet the requirements specified in paragraphs (b)(1) through (4) of this section.

(d) The leachate collection and removal system must be designed, constructed, operated, and maintained to collect and remove leachate from the landfill during the active life and post-closure care period. The leachate collection and removal system must be:

(1) Designed and operated to maintain less than a 30-centimeter depth of leachate over the composite liner or alternative composite liner;

(2) Constructed of materials that are chemically resistant to the CCR and any non-CCR waste managed in the CCR unit and the leachate expected to be generated, and of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying waste, waste cover materials, and equipment used at the CCR unit; and

(3) Designed and operated to minimize clogging during the active life and post-closure care period.

(e) Prior to construction of the CCR landfill or any lateral expansion of a CCR landfill, the owner or operator must obtain a certification from a qualified professional engineer that the design of the composite liner (or, if applicable, alternative composite liner) and the leachate collection and removal system meets the requirements of this section.

Subpart D Design Criteria

§ 257.70 Design criteria for new CCR landfills and any lateral expansion of a CCR landfill

(f) Upon completion of construction of the CCR landfill or any lateral expansion of a CCR landfill, the owner or operator must obtain a certification from a qualified professional engineer that the composite liner (or, if applicable, alternative composite liner) and the leachate collection and removal system has been constructed in accordance with the requirements of this section.

(g) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(f), the notification requirements specified in § 257.106(f), and the Internet requirements specified in § 257.107(f).

Subpart D Design Criteria

§ 257.71 Liner design criteria for existing CCR surface impoundments

(a)

(1) No later than October 17, 2016, the owner or operator of an existing CCR surface impoundment must document whether or not such unit was constructed with any one of the following:

(i) A liner consisting of a minimum of two feet of compacted soil with a hydraulic conductivity of no more than 1x10-7 cm/sec;
(ii) A composite liner that meets the requirements of § 257.70(b); or
(iii) An alternative composite liner that meets the requirements of § 257.70(c).

(2) The hydraulic conductivity of the compacted soil must be determined using recognized and generally accepted methods.

(3) An existing CCR surface impoundment is considered to be an existing unlined CCR surface impoundment if either:

(i) The owner or operator of the CCR unit determines that the CCR unit is not constructed with a liner that meets the requirements of paragraphs (a)(1)(i), (ii), or (iii) of this section; or
(ii) The owner or operator of the CCR unit fails to document whether the CCR unit was constructed with a liner that meets the requirements of paragraphs (a)(1)(i), (ii), or (iii) of this section.

(4) All existing unlined CCR surface impoundments are subject to the requirements of §257.101(a).

(b) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer attesting that the documentation as to whether a CCR unit meets the requirements of paragraph (a) of this section is accurate.

(c) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(f), the notification requirements specified in § 257.106(f), and the Internet requirements specified in § 257.107(f).

Subpart D Design Criteria

§ 257.72 Liner design criteria for new CCR surface impoundments and any lateral expansion of a CCR surface impoundment

(a) New CCR surface impoundments and lateral expansions of existing and new CCR surface impoundments must be designed, constructed, operated, and maintained with either a composite liner or an alternative composite liner that meets the requirements of § 257.70(b) or (c).

(b) Any liner specified in this section must be installed to cover all surrounding earth likely to be in contact with CCR. Dikes shall not be constructed on top of the composite liner.

(c) Prior to construction of the CCR surface impoundment or any lateral expansion of a CCR surface impoundment, the owner or operator must obtain certification from a qualified professional engineer that the design of the composite liner or, if applicable, the design of an alternative composite liner complies with the requirements of this section.

(d) Upon completion, the owner or operator must obtain certification from a qualified professional engineer that the composite liner or if applicable, the alternative composite liner has been constructed in accordance with the requirements of this section.

(e) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(f), the notification requirements specified in § 257.106(f), and the Internet requirements specified in § 257.107(f).

Subpart D Design Criteria

§ 257.73 Structural integrity criteria for existing CCR surface impoundments

(a) The requirements of paragraphs (a)(1) through (4) of this section apply to all existing CCR surface impoundments, except for those existing CCR surface impoundments that are incised CCR units. If an incised CCR surface impoundment is subsequently modified (e.g., a dike is constructed) such that the CCR unit no longer meets the definition of an incised CCR unit, the CCR unit is subject to the requirements of paragraphs (a)(1) through (4) of this section.

(1) No later than, December 17, 2015, the owner or operator of the CCR unit must place on or immediately adjacent to the CCR unit a permanent identification marker, at least six feet high showing the identification number of the CCR unit, if one has been assigned by the state, the name associated with the CCR unit and the name of the owner or operator of the CCR unit.

(2) Periodic hazard potential classification assessments.

(i) The owner or operator of the CCR unit must conduct initial and periodic hazard potential classification assessments of the CCR unit according to the timeframes specified in paragraph (f) of this section. The owner or operator must document the hazard potential classification of each CCR unit as either a high hazard potential CCR surface impoundment, a significant hazard potential CCR surface impoundment, or a low hazard potential CCR surface impoundment. The owner or operator must also document the basis for each hazard potential classification.

(ii) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the initial hazard potential classification and each subsequent periodic classification specified in paragraph (a)(2)(i) of this section was conducted in accordance with the requirements of this section.

(3) Emergency Action Plan (EAP)

(i) Development of the plan. No later than April 17, 2017, the owner or operator of a CCR unit determined to be either a high hazard potential CCR surface impoundment or a significant hazard potential CCR surface impoundment under paragraph (a)(2) of this section must prepare and maintain a written EAP. At a minimum, the EAP must:

(A) Define the events or circumstances involving the CCR unit that represent a safety emergency, along with a description of the procedures that will be followed to detect a safety emergency in a timely manner;

(B) Define responsible persons, their respective responsibilities, and notification procedures in the event of a safety emergency involving the CCR unit;

(C) Provide contact information of emergency responders;

(D) Include a map which delineates the downstream area which would be affected in the event of a CCR unit failure and a physical description of the CCR unit; and

(E) Include provisions for an annual face-to-face meeting or exercise between representatives of the owner or operator of the CCR unit and the local emergency responders.

(ii) Amendment of the plan.

(A) The owner or operator of a CCR unit subject to the requirements of paragraph (a)(3)(i) of this section may amend the written EAP at any time provided the revised plan is placed in the facility's operating record as required by § 257.105(f)(6). The owner or operator must amend the written EAP whenever there is a change in conditions that would substantially affect the EAP in effect.

(B) The written EAP must be evaluated, at a minimum, every five years to ensure the information required in paragraph (a)(3)(i) of this section is accurate. As necessary, the EAP must be updated and a revised EAP placed in the facility's operating record as required by § 257.105(f)(6).

(iii) Changes in hazard potential classification.

(A) If the owner or operator of a CCR unit determines during a periodic hazard potential assessment that the CCR unit is no longer classified as either a high hazard potential CCR surface impoundment or a significant hazard potential CCR surface impoundment, then the owner or operator of the CCR unit is no longer subject to the requirement to prepare and maintain a written EAP beginning on the date the periodic hazard potential assessment documentation is placed in the facility's operating record as required by § 257.105(f)(5).

(B) If the owner or operator of a CCR unit classified as a low hazard potential CCR surface impoundment subsequently determines that the CCR unit is properly re-classified as either a high hazard potential CCR surface impoundment or a significant hazard potential CCR surface impoundment, then the owner or operator of the CCR unit must prepare a written EAP for the CCR unit as required by paragraph (a)(3)(i) of this section within six months of completing such periodic hazard potential assessment.

(iv) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the written EAP, and any subsequent amendment of the EAP, meets the requirements of paragraph (a)(3) of this section.

(v) Activation of the EAP. The EAP must be implemented once events or circumstances involving the CCR unit that represent a safety emergency are detected, including conditions identified during periodic structural stability assessments, annual inspections, and inspections by a qualified person.

(4) The CCR unit and surrounding areas must be designed, constructed, operated, and maintained with vegetated slopes of dikes not to exceed a height of 6 inches above the slope of the dike, except for slopes which are protected with an alternate form(s) of slope protection.

(b) The requirements of paragraphs (c) through (e) of this section apply to an owner or operator of an existing CCR surface impoundment that either:

(1) Has a height of five feet or more and a storage volume of 20 acre-feet or more; or

(2) Has a height of 20 feet or more.

(c)

(1) No later than October 17, 2016, the owner or operator of the CCR unit must compile a history of construction, which shall contain, to the extent feasible, the information specified in paragraphs (c)(1)(i) through (xi) of this section.

(i) The name and address of the person(s) owning or operating the CCR unit; the name associated with the CCR unit; and the identification number of the CCR unit if one has been assigned by the state.
(ii) The location of the CCR unit identified on the most recent U.S. Geological Survey (USGS) 7½ minute or 15 minute topographic quadrangle map, or a topographic map of equivalent scale if a USGS map is not available.
(iii) A statement of the purpose for which the CCR unit is being used.
(iv) The name and size in acres of the watershed within which the CCR unit is located.
(v) A description of the physical and engineering properties of the foundation and abutment materials on which the CCR unit is constructed.
(vi) A statement of the type, size, range, and physical and engineering properties of the materials used in constructing each zone or stage of the CCR unit; the method of site preparation and construction of each zone of the CCR unit; and the approximate dates of construction of each successive stage of construction of the CCR unit.

(vii) At a scale that details engineering structures and appurtenances relevant to the design, construction, operation, and maintenance of the CCR unit, detailed dimensional drawings of the CCR unit, including a plan view and cross sections of the length and width of the CCR unit, showing all zones, foundation improvements, drainage provisions, spillways, diversion ditches, outlets, instrument locations, and slope protection, in addition to the normal operating pool surface elevation and the maximum pool surface elevation following peak discharge from the inflow design flood, the expected maximum depth of CCR within the CCR surface impoundment, and any identifiable natural or manmade features that could adversely affect operation of the CCR unit due to malfunction or mis-operation.

(viii) A description of the type, purpose, and location of existing instrumentation.

(ix) Area-capacity curves for the CCR unit.

(x) A description of each spillway and diversion design features and capacities and calculations used in their determination.

(xi) The construction specifications and provisions for surveillance, maintenance, and repair of the CCR unit.

(xii) Any record or knowledge of structural instability of the CCR unit.

(2) Changes to the history of construction. If there is a significant change to any information compiled under paragraph (c)(1) of this section, the owner or operator of the CCR unit must update the relevant information and place it in the facility's operating record as required by § 257.105(f)(9).

(d) Periodic structural stability assessments.

(1) The owner or operator of the CCR unit must conduct initial and periodic structural stability assessments and document whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein. The assessment must, at a minimum, document whether the CCR unit has been designed, constructed, operated, and maintained with:

(i) Stable foundations and abutments;

(ii) Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown;

(iii) Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit;

(iv) Vegetated slopes of dikes and surrounding areas not to exceed a height of six inches above the slope of the dike, except for slopes which have an alternate form or forms of slope protection;

(v) A single spillway or a combination of spillways configured as specified in paragraph (d)(1)(v)(A) of this section. The combined capacity of all spillways must be designed, constructed, operated, and maintained to adequately manage flow during and following the peak discharge from the event specified in paragraph (d)(1)(v)(B) of this section.

(A) All spillways must be either:

(1) Of non-erodible construction and designed to carry sustained flows; or

(2) Earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected.

(B) The combined capacity of all spillways must adequately manage flow during and following the peak discharge from a:

(1) Probable maximum flood (PMF) for a high hazard potential CCR surface impoundment; or

(2) 1000-year flood for a significant hazard potential CCR surface impoundment; or

(3) 100-year flood for a low hazard potential CCR surface impoundment.

(vi) Hydraulic structures underlying the base of the CCR unit or passing through the dike of the CCR unit that maintain structural integrity and are free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation of the hydraulic structure; and

(vii) For CCR units with downstream slopes which can be inundated by the pool of an adjacent water body, such as a river, stream or lake, downstream slopes that maintain structural stability during low pool of the adjacent water body or sudden drawdown of the adjacent water body.

(2) The periodic assessment described in paragraph (d)(1) of this section must identify any structural stability deficiencies associated with the CCR unit in addition to recommending corrective measures. If a deficiency or a release is identified during the periodic assessment, the owner or operator unit must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.

(3) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the initial assessment and each subsequent periodic assessment was conducted in accordance with the requirements of this section.

(e) Periodic safety factor assessments.

(1) The owner or operator must conduct an initial and periodic safety factor assessments for each CCR unit and document whether the calculated factors of safety for each CCR unit achieve the minimum safety factors specified in paragraphs (e)(1)(i) through (iv)of this section for the critical cross section of the embankment. The critical cross section is the cross section anticipated to be the most susceptible of all cross sections to structural failure based on appropriate engineering considerations, including loading conditions.

The safety factor assessments must be supported by appropriate engineering calculations.

(i) The calculated static factor of safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50.
(ii) The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.
(iii) The calculated seismic factor of safety must equal or exceed 1.00.

(iv) For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.

(2) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the initial assessment and each subsequent periodic assessment specified in paragraph (e)(1) of this section meets the requirements of this section.

(f) Timeframes for periodic assessments

(1) Initial assessments. Except as provided by paragraph (f)(2) of this section, the owner or operator of the CCR unit must complete the initial assessments required by paragraphs (a)(2), (d), and (e) of this section no later than October 17, 2016. The owner or operator has completed an initial assessment when the owner or operator has placed the assessment required by paragraphs (a)(2), (d), and (e) of this section in the facility's operating record as required by § 257.105(f)(5), (10), and (12).

(2) Use of a previously completed assessment(s) in lieu of the initial assessment(s). The owner or operator of the CCR unit may elect to use a previously completed assessment to serve as the initial assessment required by paragraphs (a)(2), (d), and (e) of this section provided that the previously completed assessment(s):

(i) Was completed no earlier than 42 months prior to October 17, 2016; and
(ii) Meets the applicable requirements of paragraphs (a)(2), (d), and (e) of this section.

(3) Frequency for conducting periodic assessments. The owner or operator of the CCR unit must conduct and complete the assessments required by paragraphs (a)(2), (d), and (e) of this section every five years. The date of completing the initial assessment is the basis for establishing the deadline to complete the first subsequent assessment. If the owner or operator elects to use a previously completed assessment(s) in lieu of the initial assessment as provided by paragraph (f)(2) of this section, the date of the report for the previously completed assessment is the basis for establishing the deadline to complete the first subsequent assessment. The owner or operator may complete any required assessment prior to the required deadline provided the owner or operator places the completed assessment(s) into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing subsequent assessments is based on the date of completing the previous assessment. For purposes of this paragraph (f)(3), the owner or operator has completed an assessment when the relevant assessment(s) required by paragraphs (a)(2), (d), and (e) of this section has been placed in the facility's operating record as required by § 257.105(f)(5), (10), and (12).

(4) Closure of the CCR unit. An owner or operator of a CCR unit who either fails to complete a timely safety factor assessment or fails to demonstrate minimum safety factors as required by paragraph (e) of this section is subject to the requirements of §257.101(b)(2).

(g) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(f), the notification requirements specified in § 257.106(f), and the internet requirements specified in § 257.107(f).

Subpart D Design Criteria

§ 257.74 Structural integrity criteria for new CCR surface impoundments and any lateral expansion of a CCR surface impoundment

(a) The requirements of paragraphs (a)(1) through (4) of this section apply to all new CCR surface impoundments and any lateral expansion of a CCR surface impoundment, except for those new CCR surface impoundments that are incised CCR units. If an incised CCR surface impoundment is subsequently modified (e.g., a dike is constructed) such that the CCR unit no longer meets the definition of an incised CCR unit, the CCR unit is subject to the requirements of paragraphs (a)(1) through (4) of this section.

(1) No later than the initial receipt of CCR, the owner or operator of the CCR unit must place on or immediately adjacent to the CCR unit a permanent identification marker, at least six feet high showing the identification number of the CCR unit, if one has been assigned by the state, the name associated with the CCR unit and the name of the owner or operator of the CCR unit.

(2) Periodic hazard potential classification assessments.

(i) The owner or operator of the CCR unit must conduct initial and periodic hazard potential classification assessments of the CCR unit according to the timeframes specified in paragraph (f) of this section. The owner or operator must document the hazard potential classification of each CCR unit as either a high hazard potential CCR surface impoundment, a significant hazard potential CCR surface impoundment, or a low hazard potential CCR surface impoundment. The owner or operator must also document the basis for each hazard potential classification.

(ii) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the initial hazard potential classification and each subsequent periodic classification specified in paragraph (a)(2)(i) of this section was conducted in accordance with the requirements of this section.

(3) Emergency Action Plan (EAP)—(i) Development of the plan. Prior to the initial receipt of CCR in the CCR unit, the owner or operator of a CCR unit determined to be either a high hazard potential CCR surface impoundment or a significant hazard potential CCR surface impoundment under paragraph (a)(2) of this section must prepare and maintain a written EAP. At a minimum, the EAP must:

(A) Define the events or circumstances involving the CCR unit that represent a safety emergency, along with a description of the procedures that will be followed to detect a safety emergency in a timely manner;

(B) Define responsible persons, their respective responsibilities, and notification procedures in the event of a safety emergency involving the CCR unit;

(C) Provide contact information of emergency responders;

(D) Include a map which delineates the downstream area which would be affected in the event of a CCR unit failure and a physical description of the CCR unit; and

(E) Include provisions for an annual face-to-face meeting or exercise between representatives of the owner or operator of the CCR unit and the local emergency responders.

(ii) Amendment of the plan.

(A) The owner or operator of a CCR unit subject to the requirements of paragraph (a)(3)(i) of this section may amend the written EAP at any time provided the revised plan is placed in the facility's operating record as required by § 257.105(f)(6). The owner or operator must amend the written EAP whenever there is a change in conditions that would substantially affect the EAP in effect.

(B) The written EAP must be evaluated, at a minimum, every five years to ensure the information required in paragraph (a)(3)(i) of this section is accurate. As necessary, the EAP must be updated and a revised EAP placed in the facility's operating record as required by § 257.105(f)(6).

(iii) Changes in hazard potential classification.

(A) If the owner or operator of a CCR unit determines during a periodic hazard potential assessment that the CCR unit is no longer classified as either a high hazard potential CCR surface impoundment or a significant hazard potential CCR surface impoundment, then the owner or operator of the CCR unit is no longer subject to the requirement to prepare and maintain a written EAP beginning on the date the periodic hazard potential assessment documentation is placed in the facility's operating record as required by § 257.105(f)(5).

(B) If the owner or operator of a CCR unit classified as a low hazard potential CCR surface impoundment subsequently determines that the CCR unit is properly re-classified as either a high hazard potential CCR surface impoundment or a significant hazard potential CCR surface impoundment, then the owner or operator of the CCR unit must prepare a written EAP for the CCR unit as required by paragraph (a)(3)(i) of this section within six months of completing such periodic hazard potential assessment.

(iv) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the written EAP, and any subsequent amendment of the EAP, meets the requirements of paragraph (a)(3) of this section.

(v) Activation of the EAP. The EAP must be implemented once events or circumstances involving the CCR unit that represent a safety emergency are detected, including conditions identified during periodic structural stability assessments, annual inspections, and inspections by a qualified person.

(4) The CCR unit and surrounding areas must be designed, constructed, operated, and maintained with vegetated slopes of dikes not to exceed a height of six inches above the slope of the dike, except for slopes which are protected with an alternate form(s) of slope protection.

(b) The requirements of paragraphs (c) through (e) of this section apply to an owner or operator of a new CCR surface impoundment and any lateral expansion of a CCR surface impoundment that either:

(1) Has a height of five feet or more and a storage volume of 20 acre-feet or more; or
(2) Has a height of 20 feet or more.

(c)

(1) No later than the initial receipt of CCR in the CCR unit, the owner or operator unit must compile the design and construction plans for the CCR unit, which must include, to the extent feasible, the information specified in paragraphs (c)(1)(i) through (xi) of this section.

(i) The name and address of the person(s) owning or operating the CCR unit; the name associated with the CCR unit; and the identification number of the CCR unit if one has been assigned by the state.
(ii) The location of the CCR unit identified on the most recent U.S. Geological Survey (USGS) 7½ minute or 15 minute topographic quadrangle map, or a topographic map of equivalent scale if a USGS map is not available.
(iii) A statement of the purpose for which the CCR unit is being used.
(iv) The name and size in acres of the watershed within which the CCR unit is located.
(v) A description of the physical and engineering properties of the foundation and abutment materials on which the CCR unit is constructed.
(vi) A statement of the type, size, range, and physical and engineering properties of the materials used in constructing each zone or stage of the CCR unit; the method of site preparation and construction of each zone of the CCR unit; and the dates of construction of each successive stage of construction of the CCR unit.

(vii) At a scale that details engineering structures and appurtenances relevant to the design, construction, operation, and maintenance of the CCR unit, detailed dimensional drawings of the CCR unit, including a plan view and cross sections of the length and width of the CCR unit, showing all zones, foundation improvements, drainage provisions, spillways, diversion ditches, outlets, instrument locations, and slope protection, in addition to the normal operating pool surface elevation and the maximum pool surface elevation following peak discharge from the inflow design flood, the expected maximum depth of CCR within the CCR surface impoundment, and any identifiable natural or manmade features that could adversely affect operation of the CCR unit due to malfunction or mis-operation.

(viii) A description of the type, purpose, and location of existing instrumentation.

(ix) Area-capacity curves for the CCR unit.

(x) A description of each spillway and diversion design features and capacities and calculations used in their determination.

(xi) The construction specifications and provisions for surveillance, maintenance, and repair of the CCR unit.

(xii) Any record or knowledge of structural instability of the CCR unit.

(2) Changes in the design and construction. If there is a significant change to any information compiled under paragraph (c)(1) of this section, the owner or operator of the CCR unit must update the relevant information and place it in the facility's operating record as required by § 257.105(f)(13).

(d) Periodic structural stability assessments.

(1) The owner or operator of the CCR unit must conduct initial and periodic structural stability assessments and document whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein. The assessment must, at a minimum, document whether the CCR unit has been designed, constructed, operated, and maintained with:

(i) Stable foundations and abutments;

(ii) Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown;

(iii) Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit;

(iv) Vegetated slopes of dikes and surrounding areas not to exceed a height of six inches above the slope of the dike, except for slopes which have an alternate form or forms of slope protection;

(v) A single spillway or a combination of spillways configured as specified in paragraph (d)(1)(v)(A) of this section. The combined capacity of all spillways must be designed, constructed, operated, and maintained to adequately manage flow during and following the peak discharge from the event specified in paragraph (d)(1)(v)(B) of this section.

(A) All spillways must be either:
(1) Of non-erodible construction and designed to carry sustained flows; or
(2) Earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected.

(B) The combined capacity of all spillways must adequately manage flow during and following the peak discharge from a:

(1) Probable maximum flood (PMF) for a high hazard potential CCR surface impoundment; or
(2) 1000-year flood for a significant hazard potential CCR surface impoundment; or
(3) 100-year flood for a low hazard potential CCR surface impoundment.

(vi) Hydraulic structures underlying the base of the CCR unit or passing through the dike of the CCR unit that maintain structural integrity and are free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation of the hydraulic structure; and

(vii) For CCR units with downstream slopes which can be inundated by the pool of an adjacent water body, such as a river, stream or lake, downstream slopes that maintain structural stability during low pool of the adjacent water body or sudden drawdown of the adjacent water body.

(2) The periodic assessment described in paragraph (d)(1) of this section must identify any structural stability deficiencies associated with the CCR unit in addition to recommending corrective measures. If a deficiency or a release is identified during the periodic assessment, the owner or operator unit must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.

(3) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the initial assessment and each subsequent periodic assessment was conducted in accordance with the requirements of this section.

Subpart D Design Criteria

§ 257.74 Structural integrity criteria for new CCR surface impoundments and any lateral expansion of a CCR surface impoundment

(e) Periodic safety factor assessments.

(1) The owner or operator must conduct an initial and periodic safety factor assessments for each CCR unit and document whether the calculated factors of safety for each CCR unit achieve the minimum safety factors specified in paragraphs (e)(1)(i) through (v)of this section for the critical cross section of the embankment. The critical cross section is the cross section anticipated to be the most susceptible of all cross sections to structural failure based on appropriate engineering considerations, including loading conditions. The safety factor assessments must be supported by appropriate engineering calculations.

(i) The calculated static factor of safety under the end-of-construction loading condition must equal or exceed 1.30. The assessment of this loading condition is only required for the initial safety factor assessment and is not required for subsequent assessments.

(ii) The calculated static factor of safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50.

(iii) The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.

(iv) The calculated seismic factor of safety must equal or exceed 1.00.

(v) For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.

(2) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the initial assessment and each subsequent periodic assessment specified in paragraph (e)(1) of this section meets the requirements of this section.

(f) Timeframes for periodic assessments

(1) Initial assessments. Except as provided by paragraph (f)(2) of this section, the owner or operator of the CCR unit must complete the initial assessments required by paragraphs (a)(2), (d), and (e) of this section prior to the initial receipt of CCR in the unit. The owner or operator has completed an initial assessment when the owner or operator has placed the assessment required by paragraphs (a)(2), (d), and (e) of this section in the facility's operating record as required by § 257.105(f)(5), (10), and (12).

(2) Frequency for conducting periodic assessments. The owner or operator of the CCR unit must conduct and complete the assessments required by paragraphs (a)(2), (d), and (e) of this section every five years. The date of completing the initial assessment is the basis for establishing the deadline to complete the first subsequent assessment. The owner or operator may complete any required assessment prior to the required deadline provided the owner or operator places the completed assessment(s) into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing subsequent assessments is based on the date of completing the previous assessment. For purposes of this paragraph (f)(2), the owner or operator has completed an assessment when the relevant assessment(s) required by paragraphs (a)(2), (d), and (e) of this section has been placed in the facility's operating record as required by § 257.105(f)(5), (10), and (12).

(3) Failure to document minimum safety factors during the initial assessment. Until the date an owner or operator of a CCR unit documents that the calculated factors of safety achieve the minimum safety factors specified in paragraphs (e)(1)(i) through (v) of this section, the owner or operator is prohibited from placing CCR in such unit.

(4) Closure of the CCR unit. An owner or operator of a CCR unit who either fails to complete a timely periodic safety factor assessment or fails to demonstrate minimum safety factors as required by paragraph (e) of this section is subject to the requirements of § 257.101(c).

(g) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(f), the notification requirements specified in § 257.106(f), and the internet requirements specified in § 257.107(f).

Subpart D Operating Criteria
§ 257.80 Air criteria

(a) The owner or operator of a CCR landfill, CCR surface impoundment, or any lateral expansion of a CCR unit must adopt measures that will effectively minimize CCR from becoming airborne at the facility, including CCR fugitive dust originating from CCR units, roads, and other CCR management and material handling activities.

(b) CCR fugitive dust control plan. The owner or operator of the CCR unit must prepare and operate in accordance with a CCR fugitive dust control plan as specified in paragraphs (b)(1) through (7) of this section. This requirement applies in addition to, not in place of, any applicable standards under the Occupational Safety and Health Act.

(1) The CCR fugitive dust control plan must identify and describe the CCR fugitive dust control measures the owner or operator will use to minimize CCR from becoming airborne at the facility. The owner or operator must select, and include in the CCR fugitive dust control plan, the CCR fugitive dust control measures that are most appropriate for site conditions, along with an explanation of how the measures selected are applicable and appropriate for site conditions. Examples of control measures that may be appropriate include: Locating CCR inside an enclosure or partial enclosure; operating a water spray or fogging system; reducing fall distances at material drop points; using wind barriers, compaction, or vegetative covers; establishing and enforcing reduced vehicle speed limits; paving and sweeping roads; covering trucks transporting CCR; reducing or halting operations during high wind events; or applying a daily cover.

(2) If the owner or operator operates a CCR landfill or any lateral expansion of a CCR landfill, the CCR fugitive dust control plan must include procedures to emplace CCR as conditioned CCR. Conditioned CCR means wetting CCR with water to a moisture content that will prevent wind dispersal, but will not result in free liquids. In lieu of water, CCR conditioning may be accomplished with an appropriate chemical dust suppression agent.

(3) The CCR fugitive dust control plan must include procedures to log citizen complaints received by the owner or operator involving CCR fugitive dust events at the facility.

(4) The CCR fugitive dust control plan must include a description of the procedures the owner or operator will follow to periodically assess the effectiveness of the control plan.

(5) The owner or operator of a CCR unit must prepare an initial CCR fugitive dust control plan for the facility no later than October 19, 2015, or by initial receipt of CCR in any CCR unit at the facility if the owner or operator becomes subject to this subpart after October 19, 2015. The owner or operator has completed the initial CCR fugitive dust control plan when the plan has been placed in the facility's operating record as required by § 257.105(g)(1).

(6) Amendment of the plan. The owner or operator of a CCR unit subject to the requirements of this section may amend the written CCR fugitive dust control plan at any time provided the revised plan is placed in the facility's operating record as required by § 257.105(g)(1). The owner or operator must amend the written plan whenever there is a change in conditions that would substantially affect the written plan in effect, such as the construction and operation of a new CCR unit.

(7) The owner or operator must obtain a certification from a qualified professional engineer that the initial CCR fugitive dust control plan, or any subsequent amendment of it, meets the requirements of this section.

(c) Annual CCR fugitive dust control report. The owner or operator of a CCR unit must prepare an annual CCR fugitive dust control report that includes a description of the actions taken by the owner or operator to control CCR fugitive dust, a record of all citizen complaints, and a summary of any corrective measures taken. The initial annual report must be completed no later than 14 months after placing the initial CCR fugitive dust control plan in the facility's operating record. The deadline for completing a subsequent report is one year after the date of completing the previous report. For purposes of this paragraph (c), the owner or operator has completed the annual CCR fugitive dust control report when the plan has been placed in the facility's operating record as required by § 257.105(g)(2).

(d) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

Operating Criteria

§ 257.81 Run-on and run-off controls for CCR landfills

(a) The owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill must design, construct, operate, and maintain:

(1) A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm; and

(2) A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

(b) Run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under § 257.3–3.

(c) Run-on and run-off control system plan

(1) Content of the plan. The owner or operator must prepare initial and periodic run-on and run-off control system plans for the CCR unit according to the timeframes specified in paragraphs (c)(3) and (4) of this section. These plans must document how the run-on and run-off control systems have been designed and constructed to meet the applicable requirements of this section. Each plan must be supported by appropriate engineering calculations. The owner or operator has completed the initial run-on and run-off control system plan when the plan has been placed in the facility's operating record as required by § 257.105(g)(3).

(2) Amendment of the plan. The owner or operator may amend the written run-on and run-off control system plan at any time provided the revised plan is placed in the facility's operating record as required by § 257.105(g)(3). The owner or operator must amend the written run-on and run- off control system plan whenever there is a change in conditions that would substantially affect the written plan in effect.

(3) Timeframes for preparing the initial plan

(i) Existing CCR landfills. The owner or operator of the CCR unit must prepare the initial run-on and run- off control system plan no later than October 17, 2016.

(ii) New CCR landfills and any lateral expansion of a CCR landfill. The owner or operator must prepare the initial run-on and run-off control system plan no later than the date of initial receipt of CCR in the CCR unit.

(4) Frequency for revising the plan. The owner or operator of the CCR unit must prepare periodic run-on and run- off control system plans required by paragraph (c)(1) of this section every five years. The date of completing the initial plan is the basis for establishing the deadline to complete the first subsequent plan. The owner or operator may complete any required plan prior to the required deadline provided the owner or operator places the completed plan into the facility's operating recordwithin a reasonable amount of time. In all cases, the deadline for completing a subsequent plan is based on the date of completing the previous plan. For purposes of this paragraph (c)(4), the owner or operator has completed a periodic run-on and run-off control

system plan when the plan has been placed in the facility's operating record as required by § 257.105(g)(3).

(5) The owner or operator must obtain a certification from a qualified professional engineer stating that the initial and periodic run-on and run-off control system plans meet the requirements of this section.

(d) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

Operating Criteria

§ 257.82 Hydrologic and hydraulic capacity requirements for CCR surface impoundments

(a) The owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment must design, construct, operate, and maintain an inflow design flood control system as specified in paragraphs (a)(1) and (2) of this section.

(1) The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood specified in paragraph (a)(3) of this section.

(2) The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood specified in paragraph (a)(3) of this section.

(3) The inflow design flood is:

(i) For a high hazard potential CCR surface impoundment, as determined under § 257.73(a)(2) or § 257.74(a)(2), the probable maximum flood;
(ii) For a significant hazard potential CCR surface impoundment, as determined under § 257.73(a)(2) or
§ 257.74(a)(2), the 1,000-year flood;
(iii) For a low hazard potential CCR surface impoundment, as determined under § 257.73(a)(2) or § 257.74(a)(2), the 100-year flood; or
(iv) For an incised CCR surface impoundment, the 25-year flood.

(b) Discharge from the CCR unit must be handled in accordance with the surface water requirements under § 257.3–3.

(c) Inflow design flood control system plan

(1) Content of the plan. The owner or operator must prepare initial and periodic inflow design flood control system plans for the CCR unit according to the timeframes specified in paragraphs (c)(3) and (4) of this section. These plans must document how the inflow design flood control system has been designed and constructed to meet the requirements of this section. Each plan must be supported by appropriate engineering calculations. The owner or operator of the CCR unit has completed the inflow design flood control system plan when the plan has been placed in the facility's operating record as required by § 257.105(g)(4).

(2) Amendment of the plan. The owner or operator of the CCR unit may amend the written inflow design flood control system plan at any time provided the revised plan is placed in the facility's operating record as required by § 257.105(g)(4). The owner or operator must amend the written inflow design flood control system plan whenever there is a change in conditions that would substantially affect the written plan in effect.

(3) Timeframes for preparing the initial plan

(i) Existing CCR surface impoundments. The owner or operator of the CCR unit must prepare the initial inflow design flood control system plan no later than October 17, 2016.

(ii) New CCR surface impoundments and any lateral expansion of a CCR surface impoundment. The owner or operator must prepare the initial inflow design flood control system plan no later than the date of initial receipt of CCR in the CCR unit.

(4) Frequency for revising the plan. The owner or operator must prepare periodic inflow design flood control system plans required by paragraph (c)(1) of this section every five years. The date of completing the initial plan is the basis for establishing the deadline to complete the first periodic plan. The owner or operator may complete any required plan prior to the required deadline provided the owner or operator places the completed plan into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing a subsequent plan is based on the date of completing the previous plan. For purposes of this paragraph (c)(4), the owner or operator has completed an inflow design flood control system plan when the plan has been placed in the facility's operating record as required by § 257.105(g)(4).

(5) The owner or operator must obtain a certification from a qualified professional engineer stating that the initial and periodic inflow design flood control system plans meet the requirements of this section.

(d) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

Operating Criteria

§ 257.83 Inspection requirements for CCR surface impoundments

(a) Inspections by a qualified person.

(1) All CCR surface impoundments and any lateral expansion of a CCR surface impoundment must be examined by a qualified person as follows:

(i) At intervals not exceeding seven days, inspect for any appearances of actual or potential structural weakness and other conditions which are disrupting or have the potential to disrupt the operation or safety of the CCR unit;

(ii) At intervals not exceeding seven days, inspect the discharge of all outlets of hydraulic structures which pass underneath the base of the surface impoundment or through the dike of the CCR unit for abnormal discoloration, flow or discharge of debris or sediment; and

(iii) At intervals not exceeding 30 days, monitor all CCR unit instrumentation.

(iv) The results of the inspection by a qualified person must be recorded in the facility's operating record as required by § 257.105(g)(5).

(2) Timeframes for inspections by a qualified person

(i) Existing CCR surface impoundments. The owner or operator of the CCR unit must initiate the inspections required under paragraph (a) of this section no later than October 19, 2015.

(ii) New CCR surface impoundments and any lateral expansion of a CCR surface impoundment. The owner or operator of the CCR unit must initiate the inspections required under paragraph (a) of this section upon initial receipt of CCR by the CCR unit.

(b) Annual inspections by a qualified professional engineer.

(1) If the existing or new CCR surface impoundment or any lateral expansion of the CCR surface impoundment is subject to the periodic structural stability assessment requirements under § 257.73(d) or § 257.74(d), the CCR unit must additionally be inspected on a periodic basis by a qualified professional engineer to ensure that the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering standards. The inspection must, at a minimum, include:

(i) A review of available information regarding the status and condition of the CCR unit, including, but not limited to, files available in the operating record (e.g., CCR unit design and construction information required by §§ 257.73(c)(1) and 257.74(c)(1), previous periodic structural stability assessments required under §§ 257.73(d) and 257.74(d), the results of inspections by a qualified person, and results of previous annual inspections);

(ii) A visual inspection of the CCR unit to identify signs of distress or malfunction of the CCR unit and appurtenant structures; and

(iii) A visual inspection of any hydraulic structures underlying the base of the CCR unit or passing through the dike of the CCR unit for structural integrity and continued safe and reliable operation.

(2) Inspection report. The qualified professional engineer must prepare a report following each inspection that addresses the following:

(i) Any changes in geometry of the impounding structure since the previous annual inspection;
(ii) The location and type of existing instrumentation and the maximum recorded readings of each instrument since the previous annual inspection;
(iii) The approximate minimum, maximum, and present depth and elevation of the impounded water and CCR since the previous annual inspection;
(iv) The storage capacity of the impounding structure at the time of the inspection;
(v) The approximate volume of the impounded water and CCR at the time of the inspection;
(vi) Any appearances of an actual or potential structural weakness of the CCR unit, in addition to any existing conditions that are disrupting or have the potential to disrupt the operation and safety of the CCR unit and appurtenant structures; and
(vii) Any other change(s) which may have affected the stability or operation of the impounding structure since the previous annual inspection.

(3) Timeframes for conducting the initial inspection

(i) Existing CCR surface impoundments. The owner or operator of the CCR unit must complete the initial inspection required by paragraphs (b)(1) and (2) of this section no later than January 18, 2016.

(ii) New CCR surface impoundments and any lateral expansion of a CCR surface impoundment. The owner or operator of the CCR unit must complete the initial annual inspection required by paragraphs (b)(1) and (2) of this section is completed no later than 14 months following the date of initial receipt of CCR in the CCR unit.

(4) Frequency of inspections.

(i) Except as provided for in paragraph (b)(4)(ii) of this section, the owner or operator of the CCR unit must conduct the inspection required by paragraphs (b)(1) and (2) of this section on an annual basis. The date of completing the initial inspection report is the basis for establishing the deadline to complete the first subsequent inspection. Any required inspection may be conducted prior to the required deadline provided the owner or operator places the completed inspection report into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing subsequent inspection reports is based on the date of completing the previous inspection report. For purposes of this section, the owner or operator has completed an inspection when the inspection report has been placed in the facility's operating record as required by § 257.105(g)(6).

(ii) In any calendar year in which both the periodic inspection by a qualified professional engineer and the quinquennial (occurring every five years) structural stability assessment by a qualified professional engineer required by §§ 257.73(d) and 257.74(d) are required to be completed, the annual inspection is not required, provided the structural stability assessment is completed during the calendar year. If the annual inspection is not conducted in a year as provided by this paragraph (b)(4)(ii), the deadline for completing the next annual inspection is one year from the date of completing the quinquennial structural stability assessment.

(5) If a deficiency or release is identified during an inspection, the owner or operator must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.

(c) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

Operating Criteria
§ 257.84 Inspection requirements for CCR landfills

(a) Inspections by a qualified person.

(1) All CCR landfills and any lateral expansion of a CCR landfill must be examined by a qualified person as follows:

(i) At intervals not exceeding seven days, inspect for any appearances of actual or potential structural weakness and other conditions which are disrupting or have the potential to disrupt the operation or safety of the CCR unit; and

(ii) The results of the inspection by a qualified person must be recorded in the facility's operating record as required by § 257.105(g)(8).

(2) Timeframes for inspections by a qualified person

(i) Existing CCR landfills. The owner or operator of the CCR unit must initiate the inspections required under paragraph (a) of this section no later than October 19, 2015.

(ii) New CCR landfills and any lateral expansion of a CCR landfill. The owner or operator of the CCR unit must initiate the inspections required under paragraph (a) of this section upon initial receipt of CCR by the CCR unit.

(b) Annual inspections by a qualified professional engineer.

(1) Existing and new CCR landfills and any lateral expansion of a CCR landfill must be inspected on a periodic basis by a qualified professional engineer to ensure that the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering standards. The inspection must, at a minimum, include:

(i) A review of available information regarding the status and condition of the CCR unit, including, but not limited to, files available in the operating record (e.g., the results of inspections by a qualified person, and results of previous annual inspections); and

(ii) A visual inspection of the CCR unit to identify signs of distress or malfunction of the CCR unit.

(2) Inspection report. The qualified professional engineer must prepare a report following each inspection that addresses the following:

(i) Any changes in geometry of the structure since the previous annual inspection;

(ii) The approximate volume of CCR contained in the unit at the time of the inspection;

(iii) Any appearances of an actual or potential structural weakness of the CCR unit, in addition to any existing conditions that are disrupting or have the potential to disrupt the operation and safety of the CCR unit; and

(iv) Any other change(s) which may have affected the stability or operation of the CCR unit since the previous annual inspection.

(3) Timeframes for conducting the initial inspection

(i) Existing CCR landfills. The owner or operator of the CCR unit must complete the initial inspection required by paragraphs (b)(1) and (2) of this section no later than January 18, 2016.

(ii) New CCR landfills and any lateral expansion of a CCR landfill. The owner or operator of the CCR unit must complete the initial annual inspection required by paragraphs (b)(1) and (2) of this section no later than 14 months following the date of initial receipt of CCR in the CCR unit.

(4) Frequency of inspections. The owner or operator of the CCR unit must conduct the inspection required by paragraphs (b)(1) and (2) of this section on an annual basis. The date of completing the initial inspection report is the basis for establishing the deadline to complete the first subsequent inspection. Any required inspection may be conducted prior to the required deadline provided the owner or operator places the completed inspection report into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing subsequent inspection reports is based on the date of completing the previous inspection report. For purposes of this section, the owner or operator has completed an inspection when the inspection report has been placed in the facility's operating record as required by § 257.105(g)(9).

(5) If a deficiency or release is identified during an inspection, the owner or operator must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.

(c) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

Groundwater Monitoring and Corrective Action
§ 257.90 Applicability

(a) Except as provided for in § 257.100 for inactive CCR surface impoundments, all CCR landfills, CCR surface impoundments, and lateral expansions of CCR units are subject to the groundwater monitoring and corrective action requirements under §§ 257.90 through 257.98.

(b) Initial timeframes

(1) Existing CCR landfills and existing CCR surface impoundments. No later than October 17, 2017, the owner or operator of the CCR unit must be in compliance with the following groundwater monitoring requirements:

(i) Install the groundwater monitoring system as required by § 257.91;
(ii) Develop the groundwater sampling and analysis program to include selection of the statistical procedures to be used for evaluating groundwater monitoring data as required by § 257.93;
(iii) Initiate the detection monitoring program to include obtaining a minimum of eight independent samples for each background and downgradient well as required by § 257.94(b); and
(iv) Begin evaluating the groundwater monitoring data for statistically significant increases over background levels for the constituents listed in appendix III of this part as required by § 257.94.

(2) New CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units. Prior to initial receipt of CCR by the CCR unit, the owner or operator must be in compliance with the groundwater monitoring requirements specified in paragraph (b)(1)(i) and (ii) of this section. In addition, the owner or operator of the CCR unit must initiate the detection monitoring program to include obtaining a minimum of eight independent samples for each background well as required by § 257.94(b).

(c) Once a groundwater monitoring system and groundwater monitoring program has been established at the CCR unit as required by this subpart, the owner or operator must conduct groundwater monitoring and, if necessary, corrective action throughout the active life and post-closure care period of the CCR unit.

(d) In the event of a release from a CCR unit, the owner or operator must immediately take all necessary measures to control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of contaminants into the environment. The owner or operator of the CCR unit must comply with all applicable requirements in §§ 257.96, 257.97, and 257.98.

(e) Annual groundwater monitoring and corrective action report. For existing CCR landfills and existing CCR surface impoundments, no later than January 31, 2018, and annually thereafter, the owner or operator must prepare an annual groundwater monitoring and corrective action report. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, the owner or operator must prepare the initial annual groundwater monitoring and corrective action report no later than January 31 of the year following the calendar year a groundwater monitoring system has been established for such CCR unit as required by this subpart, and annually thereafter. For the preceding calendar year, the annual report must document the status of the groundwater monitoring and corrective action program for the CCR unit, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year. For purposes of this section, the owner or operator has prepared the annual report when the report is placed in the facility's operating record as required by § 257.105(h)(1). At a minimum, the annual groundwater monitoring and corrective action report must contain the following information, to the extent available:

(1) A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;

(2) Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;

(3) In addition to all the monitoring data obtained under §§ 257.90 through 257.98, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;

(4) A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels); and

(5) Other information required to be included in the annual report as specified in §§ 257.90 through 257.98.

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the internet requirements specified in § 257.107(h).

Groundwater Monitoring and Corrective Action
§ 257.91 Groundwater monitoring systems

(a) Performance standard. The owner or operator of a CCR unit must install a groundwater monitoring system that consists of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that:

(1) Accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit. A determination of background quality may include sampling of wells that are not hydraulically upgradient of the CCR management area where:

(i) Hydrogeologic conditions do not allow the owner or operator of the CCR unit to determine what wells are hydraulically upgradient; or

(ii) Sampling at other wells will provide an indication of background groundwater quality that is as representative or more representative than that provided by the upgradient wells; and

(2) Accurately represent the quality of groundwater passing the waste boundary of the CCR unit. The downgradient monitoring system must be installed at the waste boundary that ensures detection of groundwater contamination in the uppermost aquifer. All potential contaminant pathways must be monitored.

(b) The number, spacing, and depths of monitoring systems shall be determined based upon site-specific technical information that must include thorough characterization of:

(1) Aquifer thickness, groundwater flow rate, groundwater flow direction including seasonal and temporal fluctuations in groundwater flow; and

(2) Saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer, and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including, but not limited to, thicknesses, stratigraphy, lithology, hydraulic conductivities, porosities and effective porosities.

(c) The groundwater monitoring system must include the minimum number of monitoring wells necessary to meet the performance standards specified in paragraph (a) of this section, based on the site-specific information specified in paragraph (b) of this section. The groundwater monitoring system must contain:

(1) A minimum of one upgradient and three downgradient monitoring wells; and

(2) Additional monitoring wells as necessary to accurately represent the quality of background groundwater that has not been affected by leakage from the CCR unit and the quality of groundwater passing the waste boundary of the CCR unit.

(d) The owner or operator of multiple CCR units may install a multiunit groundwater monitoring system instead of separate groundwater monitoring systems for each CCR unit.

(1) The multiunit groundwater monitoring system must be equally as capable of detecting monitored constituents at the waste boundary of the CCR unit as the individual groundwater monitoring system specified in paragraphs (a) through (c) of this section for each CCR unit based on the following factors:

(i) Number, spacing, and orientation of each CCR unit;
(ii) Hydrogeologic setting;
(iii) Site history; and
(iv) Engineering design of the CCR unit.

(2) If the owner or operator elects to install a multiunit groundwater monitoring system, and if the multiunit system includes at least one existing unlined CCR surface impoundment as determined by § 257.71(a), and if at any time after October 19, 2015 the owner or operator determines in any sampling event that the concentrations of one or more constituents listed in appendix IV to this part are detected at statistically significant levels above the groundwater protection standard established under § 257.95(h) for the multiunit system, then all unlined CCR surface impoundments comprising the multiunit groundwater monitoring system are subject to the closure requirements under § 257.101(a) to retrofit or close.

(e) Monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole. This casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of groundwater samples. The annular space (i.e., the space between the borehole and well casing) above the sampling depth must be sealed to prevent contamination of samples and the groundwater.

(1) The owner or operator of the CCR unit must document and include in the operating record the design, installation, development, and decommissioning of any monitoring wells, piezometers and other measurement, sampling, and analytical devices. The qualified professional engineer must be given access to this documentation when completing the groundwater monitoring system certification required under paragraph (f) of this section.

(2) The monitoring wells, piezometers, and other measurement, sampling, and analytical devices must be operated and maintained so that they perform to the design specifications throughout the life of the monitoring program.

(f) The owner or operator must obtain a certification from a qualified professional engineer stating that the groundwater monitoring system has been designed and constructed to meet the requirements of this section. If the groundwater monitoring system includes the minimum number of monitoring wells specified in paragraph (c)(1) of this section, the certification must document the basis supporting this determination.

(g) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the internet requirements specified in § 257.107(h).

Groundwater Monitoring and Corrective Action
§ 257.92 [Reserved]

Groundwater Monitoring and Corrective Action
§ 257.93 Groundwater sampling and analysis requirements

(a) The groundwater monitoring program must include consistent sampling and analysis procedures that are designed to ensure monitoring results that provide an accurate representation of groundwater quality at the background and downgradient wells required by § 257.91. The owner or operator of the CCR unit must develop a sampling and analysis program that includes procedures and techniques for:

(1) Sample collection;
(2) Sample preservation and shipment;
(3) Analytical procedures;
(4) Chain of custody control; and
(5) Quality assurance and quality control.

(b) The groundwater monitoring program must include sampling and analytical methods that are appropriate for groundwater sampling and that accurately measure hazardous constituents and other monitoring parameters in groundwater samples. For purposes of §§ 257.90 through 257.98, the term constituent refers to both hazardous constituents and other monitoring parameters listed in either appendix III or IV of this part.

(c) Groundwater elevations must be measured in each well immediately prior to purging, each time groundwater is sampled. The owner or operator of the CCR unit must determine the rate and direction of groundwater flow each time groundwater is sampled. Groundwater elevations in wells which monitor the same CCR management area must be measured within a period of time short enough to avoid temporal variations in groundwater flow which could preclude accurate determination of groundwater flow rate and direction.

(d) The owner or operator of the CCR unit must establish background groundwater quality in a hydraulically upgradient or background well(s) for each of the constituents required in the particular groundwater monitoring program that applies to the CCR unit as determined under § 257.94(a) or § 257.95(a). Background groundwater quality may be established at wells that are not located hydraulically upgradient from the CCR unit if it meets the requirements of § 257.91(a)(1).

(e) The number of samples collected when conducting detection monitoring and assessment monitoring (for both downgradient and background wells) must be consistent with the statistical procedures chosen under paragraph (f) of this section and the performance standards under paragraph (g) of this section. The sampling procedures shall be those specified under § 257.94(b) through (d) for detection monitoring, § 257.95(b) through (d) for assessment monitoring, and § 257.96(b) for corrective action.

(f) The owner or operator of the CCR unit must select one of the statistical methods specified in paragraphs (f)(1) through (5) of this section to be used in evaluating groundwater monitoring data for each specified constituent. The statistical test chosen shall be conducted separately for each constituent in each monitoring well.

(1) A parametric analysis of variance followed by multiple comparison procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's mean and the background mean levels for each constituent.

(2) An analysis of variance based on ranks followed by multiple comparison procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's median and the background median levels for each constituent.

(3) A tolerance or prediction interval procedure, in which an interval for each constituent is established from the distribution of the background data and the level of each constituent in each compliance well is compared to the upper tolerance or prediction limit.

(4) A control chart approach that gives control limits for each constituent.

(5) Another statistical test method that meets the performance standards of paragraph (g) of this section.

(6) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the selected statistical method is appropriate for evaluating the groundwater monitoring data for the CCR management area. The certification must include a narrative description of the statistical method selected to evaluate the groundwater monitoring data.

(g) Any statistical method chosen under paragraph (f) of this section shall comply with the following performance standards, as appropriate, based on the statistical test method used:

(1) The statistical method used to evaluate groundwater monitoring data shall be appropriate for the distribution of constituents. Normal distributions of data values shall use parametric methods. Non-normal distributions shall use non-parametric methods. If the distribution of the constituents is shown by the owner or operator of the CCR unit to be inappropriate for a normal theory test, then the data must be transformed or a distribution-free (non-parametric) theory test must be used. If the distributions for the constituents differ, more than one statistical method may be needed.

(2) If an individual well comparison procedure is used to compare an individual compliance well constituent concentration with background constituent concentrations or a groundwater protection standard, the test shall be done at a Type I error level no less than 0.01 for each testing period. If a multiple comparison procedure is used, the Type I experiment wise error rate for each testing period shall be no less than 0.05; however, the Type I error of no less than 0.01 for individual well comparisons must be maintained. This performance standard does not apply to tolerance intervals, prediction intervals, or control charts.

(3) If a control chart approach is used to evaluate groundwater monitoring data, the specific type of control chart and its associated parameter values shall be such that this approach is at least as effective as any other approach in this section for evaluating groundwater data. The parameter values shall be determined after considering the number of samples in the background data base, the data distribution, and the range of the concentration values for each constituent of concern.

(4) If a tolerance interval or a predictional interval is used to evaluate groundwater monitoring data, the levels of confidence and, for tolerance intervals, the percentage of the population that the interval must contain, shall be such that this approach is at least as effective as any other approach in this section for evaluating groundwater data. These parameters shall be determined after considering the number of samples in the background data base, the data distribution, and the range of the concentration values for each constituent of concern.

(5) The statistical method must account for data below the limit of detection with one or more statistical procedures that shall at least as effective as any other approach in this section for evaluating groundwater data. Any practical quantitation limit that is used in the statistical method shall be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility.

(6) If necessary, the statistical method must include procedures to control or correct for seasonal and spatial variability as well as temporal correlation in the data.

(h) The owner or operator of the CCR unit must determine whether or not there is a statistically significant increase over background values for each constituent required in the particular groundwater monitoring program that applies to the CCR unit, as determined under § 257.94(a) or § 257.95(a).

(1) In determining whether a statistically significant increase has occurred, the owner or operator must compare the groundwater quality of each constituent at each monitoring well designated pursuant to § 257.91(a)(2) or (d)(1) to the background value of that constituent, according to the statistical procedures and performance standards specified under paragraphs (f) and (g) of this section.

(2) Within 90 days after completing sampling and analysis, the owner or operator must determine whether there has been a statistically significant increase over background for any constituent at each monitoring well.

(i) The owner or operator must measure ‘‘total recoverable metals’’ concentrations in measuring groundwater quality. Measurement of total recoverable metals captures both the particulate fraction and dissolved fraction of metals in natural waters. Groundwater samples shall not be field- filtered prior to analysis.

(j) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

Groundwater Monitoring and Corrective Action
§ 257.94 Detection monitoring program

(a) The owner or operator of a CCR unit must conduct detection monitoring at all groundwater monitoring wells consistent with this section. At a minimum, a detection monitoring program must include groundwater monitoring for all constituents listed in appendix III to this part.

(b) Except as provided in paragraph (d) of this section, the monitoring frequency for the constituents listed in appendix III to this part shall be at least semiannual during the active life of the CCR unit and the post-closure period. For existing CCR landfills and existing CCR surface impoundments, a minimum of eight independent samples from each background and downgradient well must be collected and analyzed for the constituents listed in appendix III and IV to this part no later than October 17, 2017. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, a minimum of eight independent samples for each background well must be collected and analyzed for the constituents listed in appendices III and IV to this part during the first six months of sampling.

(c) The number of samples collected and analyzed for each background well and downgradient well during subsequent semiannual sampling events must be consistent with § 257.93(e), and must account for any unique characteristics of the site, but must be at least one sample from each background and downgradient well.

(d) The owner or operator of a CCR unit may demonstrate the need for an alternative monitoring frequency for repeated sampling and analysis for constituents listed in appendix III to this part during the active life and the post-closure care period based on the availability of groundwater. If there is not adequate groundwater flow to sample wells semiannually, the alternative frequency shall be no less than annual. The need to vary monitoring frequency must be evaluated on a site-specific basis. The demonstration must be supported by, at a minimum, the information specified in paragraphs (d)(1) and (2) of this section.

(1) Information documenting that the need for less frequent sampling. The alternative frequency must be based on consideration of the following factors:

(i) Lithology of the aquifer and unsaturated zone;
(ii) Hydraulic conductivity of the aquifer and unsaturated zone; and
(iii) Groundwater flow rates.

(2) Information documenting that the alternative frequency will be no less effective in ensuring that any leakage from the CCR unit will be discovered within a timeframe that will not materially delay establishment of an assessment monitoring program.

(3) The owner or operator must obtain a certification from a qualified professional engineer stating that the demonstration for an alternative groundwater sampling and analysis frequency meets the requirements of this section. The owner or operator must include the demonstration providing the basis for the alternative monitoring frequency and the certification by a qualified professional engineer in the annual groundwater monitoring and corrective action report required by § 257.90(e).

Groundwater Monitoring and Corrective Action
§ 257.94 Detection monitoring program

(e) If the owner or operator of the CCR unit determines, pursuant to § 257.93(h) that there is a statistically significant increase over background levels for one or more of the constituents listed in appendix III to this part at any monitoring well at the waste boundary specified under § 257.91(a)(2), the owner or operator must:

(1) Except as provided for in paragraph (e)(2) of this section, within 90 days of detecting a statistically significant increase over background levels for any constituent, establish an assessment monitoring program meeting the requirements of § 257.95.

(2) The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The owner or operator must complete the written demonstration within 90 days of detecting a statistically significant increase over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report. If a successful demonstration is completed within the 90-day period, the owner or operator of the CCR unit may continue with a detection monitoring program under this section. If a successful demonstration is not completed within the 90-day period, the owner or operator of the CCR unit must initiate an assessment monitoring program as required under § 257.95. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

(3) The owner or operator of a CCR unit must prepare a notification stating that an assessment monitoring program has been established. The owner or operator has completed the notification when the notification is placed in the facility's operating record as required by § 257.105(h)(5).

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

Groundwater Monitoring and Corrective Action
§ 257.95 Assessment monitoring program

(a) Assessment monitoring is required whenever a statistically significant increase over background levels has been detected for one or more of the constituents listed in appendix III to this part.

(b) Within 90 days of triggering an assessment monitoring program, and annually thereafter, the owner or operator of the CCR unit must sample and analyze the groundwater for all constituents listed in appendix IV to this part. The number of samples collected and analyzed for each well during each sampling event must be consistent with § 257.93(e), and must account for any unique characteristics of the site, but must be at least one sample from each well.

(c) The owner or operator of a CCR unit may demonstrate the need for an alternative monitoring frequency for repeated sampling and analysis for constituents listed in appendix IV to this part during the active life and the post-closure care period based on the availability of groundwater. If there is not adequate groundwater flow to sample wells semiannually, the alternative frequency shall be no less than annual. The need to vary monitoring frequency must be evaluated on a site-specific basis. The demonstration must be supported by, at a minimum, the information specified in paragraphs (c)(1) and (2) of this section.

(1) Information documenting that the need for less frequent sampling. The alternative frequency must be based on consideration of the following factors:
  (i) Lithology of the aquifer and unsaturated zone;
  (ii) Hydraulic conductivity of the aquifer and unsaturated zone; and
  (iii) Groundwater flow rates.

(2) Information documenting that the alternative frequency will be no less effective in ensuring that any leakage from the CCR unit will be discovered within a timeframe that will not materially delay the initiation of any necessary remediation measures.

(3) The owner or operator must obtain a certification from a qualified professional engineer stating that the demonstration for an alternative groundwater sampling and analysis frequency meets the requirements of this section. The owner or operator must include the demonstration providing the basis for the alternative monitoring frequency and the certification by a qualified professional engineer in the annual groundwater monitoring and corrective action report required by § 257.90(e).

(d) After obtaining the results from the initial and subsequent sampling events required in paragraph (b) of this section, the owner or operator must:

(1) Within 90 days of obtaining the results, and on at least a semiannual basis thereafter, resample all wells that were installed pursuant to the requirements of § 257.91, conduct analyses for all parameters in appendix III to this part and for those constituents in appendix IV to this part that are detected in response to paragraph (b) of this section, and record their concentrations in the facility operating record. The number of samples collected and analyzed for each background well and downgradient well during subsequent semiannual sampling events must be consistent with § 257.93(e), and must account for any unique characteristics of the site, but must be at least one sample from each background and downgradient well;

(2) Establish groundwater protection standards for all constituents detected pursuant to paragraph (b) or (d) of this section. The groundwater protection standards must be established in accordance with paragraph (h) of this section; and

(3) Include the recorded concentrations required by paragraph (d)(1) of this section, identify the background concentrations established under § 257.94(b), and identify the groundwater protection standards established under paragraph (d)(2) of this section in the annual groundwater monitoring and corrective action report required by § 257.90(e).

(e) If the concentrations of all constituents listed in appendices III and IV to this part are shown to be at or below background values, using the statistical procedures in § 257.93(g), for two consecutive sampling events, the owner or operator may return to detection monitoring of the CCR unit. The owner or operator must prepare a notification stating that detection monitoring is resuming for the CCR unit. The owner or operator has completed the notification when the notification is placed in the facility's operating record as required by § 257.105(h)(7).

(f) If the concentrations of any constituent in Appendices III and IV to this part are above background values, but all concentrations are below the groundwater protection standard established under paragraph (h) of this section, using the statistical procedures in § 257.93(g), the owner or operator must continue assessment monitoring in accordance with this section.

(g) If one or more constituents in Appendix IV to this part are detected at statistically significant levels above the groundwater protection standard established under paragraph (h) of this section in any sampling event, the owner or operator must prepare a notification identifying the constituents in appendix IV to this part that have exceeded the groundwater protection standard. The owner or operator has completed the notification when the notification is placed in the facility's operating record as required by § 257.105(h)(8). The owner or operator of the CCR unit also must:

(1) Characterize the nature and extent of the release and any relevant site conditions that may affect the remedy ultimately selected. The characterization must be sufficient to support a complete and accurate assessment of the corrective measures necessary to effectively clean up all releases from the CCR unit pursuant to § 257.96. Characterization of the release includes the following minimum measures:

(i) Install additional monitoring wells necessary to define the contaminant plume(s);
(ii) Collect data on the nature and estimated quantity of material released including specific information on the constituents listed in appendix IV of this part and the levels at which they are present in the material released;
(iii) Install at least one additional monitoring well at the facility boundary in the direction of contaminant migration and sample this well in accordance with paragraph (d)(1) of this section; and
(iv) Sample all wells in accordance with paragraph (d)(1) of this section to characterize the nature and extent of the release.

(2) Notify all persons who own the land or reside on the land that directly overlies any part of the plume of contamination if contaminants have migrated off-site if indicated by sampling of wells in accordance with paragraph (g)(1) of this section. The owner or operator has completed the notifications when they are placed in the facility's operating record as required by § 257.105(h)(8).

(3) Within 90 days of finding that any of the constituents listed in appendix IV to this part have been detected at a statistically significant level exceeding the groundwater protection standards the owner or operator must either:

(i) Initiate an assessment of corrective measures as required by § 257.96; or

(ii) Demonstrate that a source other than the CCR unit caused the contamination, or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Any such demonstration must be supported by a report that includes the factual or evidentiary basis for any conclusions and must be certified to be accurate by a qualified professional engineer. If a successful demonstration is made, the owner or operator must continue monitoring in accordance with the assessment monitoring program pursuant to this section, and may return to detection monitoring if the constituents in appendices III and IV to this part are at or below background as specified in paragraph (e) of this section. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

(4) If a successful demonstration has not been made at the end of the 90 day period provided by paragraph (g)(3)(ii) of this section, the owner or operator of the CCR unit must initiate the assessment of corrective measures requirements under § 257.96.

(5) If an assessment of corrective measures is required under § 257.96 by either paragraph (g)(3)(i) or (g)(4) of this section, and if the CCR unit is an existing unlined CCR surface impoundment as determined by § 257.71(a), then the CCR unit is subject to the closure requirements under § 257.101(a) to retrofit or close. In addition, the owner or operator must prepare a notification stating that an assessment of corrective measures has been initiated.

(h) The owner or operator of the CCR unit must establish a groundwater protection standard for each constituent in appendix IV to this part detected in the groundwater. The groundwater protection standard shall be:

(1) For constituents for which a maximum contaminant level (MCL) has been established under §§ 141.62 and 141.66 of this title, the MCL for that constituent;

(2) For constituents for which an MCL has not been established, the background concentration for the constituent established from wells in accordance with § 257.91; or

(3) For constituents for which the background level is higher than the MCL identified under paragraph (h)(1) of this section, the background concentration.

(i) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

Groundwater Monitoring and Corrective Action
§ 257.96 Assessment of corrective measures

(a) Within 90 days of finding that any constituent listed in appendix IV to this part has been detected at a statistically significant level exceeding the groundwater protection standard defined under § 257.95(h), or immediately upon detection of a release from a CCR unit, the owner or operator must initiate an assessment of corrective measures to prevent further releases, to remediate any releases and to restore affected area to original conditions. The assessment of corrective measures must be completed within 90 days, unless the owner or operator demonstrates the need for additional time to complete the assessment of corrective measures due to site-specific conditions or circumstances. The owner or operator must obtain a certification from a qualified professional engineer attesting that the demonstration is accurate. The 90-day deadline to complete the assessment of corrective measures may be extended for no longer than 60 days. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

(b) The owner or operator of the CCR unit must continue to monitor groundwater in accordance with the assessment monitoring program as specified in § 257.95.

(c) The assessment under paragraph (a) of this section must include an analysis of the effectiveness of potential corrective measures in meeting all of the requirements and objectives of the remedy as described under § 257.97 addressing at least the following:

(1) The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to any residual contamination;

(2) The time required to begin and complete the remedy;

(3) The institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy(s).

(d) The owner or operator must place the completed assessment of corrective measures in the facility's operating record. The assessment has been completed when it is placed in the facility's operating record as required by § 257.105(h)(10).

(e) The owner or operator must discuss the results of the corrective measures assessment at least 30 days prior to the selection of remedy, in a public meeting with interested and affected parties.

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

Groundwater Monitoring and Corrective Action
§ 257.97 Selection of remedy

(a) Based on the results of the corrective measures assessment conducted under § 257.96, the owner or operator must, as soon as feasible, select a remedy that, at a minimum, meets the standards listed in paragraph (b) of this section. This requirement applies to, not in place of, any applicable standards under the Occupational Safety and Health Act. The owner or operator must prepare a semiannual report describing the progress in selecting and designing the remedy. Upon selection of a remedy, the owner or operator must prepare a final report describing the selected remedy and how it meets the standards specified in paragraph (b) of this section. The owner or operator must obtain a certification from a qualified professional engineer that the remedy selected meets the requirements of this section. The report has been completed when it is placed in the operating record as required by § 257.105(h)(12).

(b) Remedies must:

(1) Be protective of human health and the environment;

(2) Attain the groundwater protection standard as specified pursuant to § 257.95(h);

(3) Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in appendix IV to this part into the environment;

(4) Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems;

(5) Comply with standards for management of wastes as specified in § 257.98(d).

(c) In selecting a remedy that meets the standards of paragraph (b) of this section, the owner or operator of the CCR unit shall consider the following evaluation factors:

(1) The long- and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful based on consideration of the following:

(i) Magnitude of reduction of existing risks;
(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy;
(iii) The type and degree of long-term management required, including monitoring, operation, and maintenance;
(iv) Short-term risks that might be posed to the community or the environment during implementation of such a remedy, including potential threats to human health and the environment associated with excavation, transportation, and re-disposal of contaminant;
(v) Time until full protection is achieved;

(vi) Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment;
(vii) Long-term reliability of the engineering and institutional controls; and
(viii) Potential need for replacement of the remedy.

(2) The effectiveness of the remedy in controlling the source to reduce further releases based on consideration of the following factors:
(i) The extent to which containment practices will reduce further releases; and
(ii) The extent to which treatment technologies may be used.

(3) The ease or difficulty of implementing a potential remedy(s) based on consideration of the following types of factors:

(i) Degree of difficulty associated with constructing the technology;
(ii) Expected operational reliability of the technologies;
(iii) Need to coordinate with and obtain necessary approvals and permits from other agencies;
(iv) Availability of necessary equipment and specialists; and
(v) Available capacity and location of needed treatment, storage, and disposal services.

(4) The degree to which community concerns are addressed by a potential remedy(s).

(d) The owner or operator must specify as part of the selected remedy a schedule(s) for implementing and completing remedial activities. Such a schedule must require the completion of remedial activities within a reasonable period of time taking into consideration the factors set forth in paragraphs (d)(1) through (6) of this section. The owner or operator of the CCR unit must consider the following factors in determining the schedule of remedial activities:

(1) Extent and nature of contamination, as determined by the characterization required under § 257.95(g);

(2) Reasonable probabilities of remedial technologies in achieving compliance with the groundwater protection standards established under § 257.95(h) and other objectives of the remedy;

(3) Availability of treatment or disposal capacity for CCR managed during implementation of the remedy;

(4) Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy;

(5) Resource value of the aquifer including:
(i) Current and future uses;
(ii) Proximity and withdrawal rate of users;
(iii) Groundwater quantity and quality;

(iv) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to CCR constituents;
(v) The hydrogeologic characteristic of the facility and surrounding land; and
(vi) The availability of alternative water supplies; and

(6) Other relevant factors.

(e) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

Groundwater Monitoring and Corrective Action
§ 257.98 Implementation of the corrective action program

(a) Within 90 days of selecting a remedy under § 257.97, the owner or operator must initiate remedial activities. Based on the schedule established under § 257.97(d) for implementation and completion of remedial activities the owner or operator must:

(1) Establish and implement a corrective action groundwater monitoring program that:

(i) At a minimum, meets the requirements of an assessment monitoring program under § 257.95;
(ii) Documents the effectiveness of the corrective action remedy; and
(iii) Demonstrates compliance with the groundwater protection standard pursuant to paragraph (c) of this section.

(2) Implement the corrective action remedy selected under § 257.97; and

(3) Take any interim measures necessary to reduce the contaminants leaching from the CCR unit, and/or potential exposures to human or ecological receptors. Interim measures must, to the greatest extent feasible, be consistent with the objectives of and contribute to the performance of any remedy that may be required pursuant to § 257.97. The following factors must be considered by an owner or operator in determining whether interim measures are necessary:

(i) Time required to develop and implement a final remedy;
(ii) Actual or potential exposure of nearby populations or environmental receptors to any of the constituents listed in appendix IV of this part;
(iii) Actual or potential contamination of drinking water supplies or sensitive ecosystems;
(iv) Further degradation of the groundwater that may occur if remedial action is not initiated expeditiously;
(v) Weather conditions that may cause any of the constituents listed in appendix IV to this part to migrate or be released;
(vi) Potential for exposure to any of the constituents listed in appendix IV to this part as a result of an accident or failure of a container or handling system; and
(vii) Other situations that may pose threats to human health and the environment.

(b) If an owner or operator of the CCR unit, determines, at any time, that compliance with the requirements of § 257.97(b) is not being achieved through the remedy selected, the owner or operator must implement other methods or techniques that could feasibly achieve compliance with the requirements.

(c) Remedies selected pursuant to § 257.97 shall be considered complete when:

(1) The owner or operator of the CCR unit demonstrates compliance with the groundwater protection standards established under § 257.95(h) has been achieved at all points within the plume of contamination that lie beyond the groundwater monitoring well system established under § 257.91.

(2) Compliance with the groundwater protection standards established under § 257.95(h) has been achieved by demonstrating that concentrations of constituents listed in appendix IV to this part have not exceeded the groundwater protection standard(s) for a period of three consecutive years using the statistical procedures and performance standards in § 257.93(f) and (g).

(3) All actions required to complete the remedy have been satisfied.

(d) All CCR that are managed pursuant to a remedy required under § 257.97, or an interim measure required under paragraph (a)(3) of this section, shall be managed in a manner that complies with all applicable RCRA requirements.

(e) Upon completion of the remedy, the owner or operator must prepare a notification stating that the remedy has been completed. The owner or operator must obtain a certification from a qualified professional engineer attesting that the remedy has been completed in compliance with the requirements of paragraph (c) of this section. The report has been completed when it is placed in the operating record as required by § 257.105(h)(13).

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the internet requirements specified in § 257.107(h).

Closure and Post Closure Care
§ 257.100 Inactive CCR surface impoundments

(a) Except as provided by paragraph (b) of this section, inactive CCR surface impoundments are subject to all of the requirements of this subpart applicable to existing CCR surface impoundments.

(b) An owner or operator of an inactive CCR surface impoundment that completes closure of such CCR unit, and meets all of the requirements of either paragraphs (b)(1) through (4) of this section or paragraph (b)(5) of this section no later than April 17, 2018, is exempt from all other requirements of this subpart.

(1) Closure by leaving CCR in place. If the owner or operator of the inactive CCR surface impoundment elects to close the CCR surface impoundment by leaving CCR in place, the owner or operator must ensure that, at a minimum, the CCR unit is closed in a manner that will:

(i) Control, minimize or eliminate, to the maximum extent feasible, post- closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere;
(ii) Preclude the probability of future impoundment of water, sediment, or slurry;
(iii) Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system; and
(iv) Minimize the need for further maintenance of the CCR unit.

(2) The owner or operator of the inactive CCR surface impoundment must meet the requirements of paragraphs (b)(2)(i) and (ii) of this section prior to installing the final cover system required under paragraph (b)(3) of this section.

(i) Free liquids must be eliminated by removing liquid wastes or solidifying the remaining wastes and waste residues.
(ii) Remaining wastes must be stabilized sufficient to support the final cover system.

(3) The owner or operator must install a final cover system that is designed to minimize infiltration and erosion, and at a minimum, meets the requirements of paragraph (b)(3)(i) of this section, or the requirements of an alternative final cover system specified in paragraph (b)(3)(ii) of this section.

(i) The final cover system must be designed and constructed to meet the criteria specified in paragraphs (b)(3)(i)(A) through (D) of this section.

(A) The permeability of the final cover system must be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than $1x10^{-5}$ centimeters/second, whichever is less.
(B) The infiltration of liquids through the CCR unit must be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.

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

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

(ii) The owner or operator may select an alternative final cover system design, provided the alternative final cover system is designed and constructed to meet the criteria in paragraphs (b)(3)(ii)(A) through (C) of this section.

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

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

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

(4) The owner or operator of the CCR surface impoundment must obtain a written certification from a qualified professional engineer stating that the design of the final cover system meets either the requirements of paragraphs (b)(3)(i) or (ii) of this section.

(5) Closure through removal of CCR. The owner or operator may alternatively elect to close an inactive CCR surface impoundment by removing and decontaminating all areas affected by releases from the CCR surface impoundment. CCR removal and decontamination of the CCR surface impoundment are complete when all CCR in the inactive CCR surface impoundment is removed, including the bottom liner of the CCR unit.

(6) The owner or operator of the CCR surface impoundment must obtain a written certification from a qualified professional engineer that closure of the CCR surface impoundment under either paragraphs (b)(1) through (4) or (b)(5) of this section is technically feasible within the timeframe in paragraph (b) of this section.

(7) If the owner or operator of the CCR surface impoundment fails to complete closure of the inactive CCR surface impoundment within the timeframe in paragraph (b) of this section, the CCR unit must comply with all of the requirements applicable to existing CCR surface impoundments under this subpart.

(c) Required notices and progress reports. An owner or operator of an inactive CCR surface impoundment that closes in accordance with paragraph (b) of this section must complete the notices and progress reports specified in paragraphs (c)(1) through (3) of this section.

(1) No later than December 17, 2015, the owner or operator must prepare and place in the facility's operating record a notification of intent to initiate closure of the CCR surface impoundment. The notification must state that the CCR surface impoundment is an inactive CCR surface impoundment closing under the requirements of paragraph (b) of this section. The notification must also include a narrative description of how the CCR surface impoundment will be closed, a schedule for completing closure activities, and the required certifications under paragraphs (b)(4) and (6) of this section, if applicable.

(2) The owner or operator must prepare periodic progress reports summarizing the progress of closure implementation, including a description of the actions completed to date, any problems encountered and a description of the actions taken to resolve the problems, and projected closure activities for the upcoming year. The annual progress reports must be completed according to the following schedule:

(i) The first annual progress report must be prepared no later than 13 months after completing the notification of intent to initiate closure required by paragraph (c)(1) of this section.
(ii) The second annual progress report must be prepared no later than 12 months after completing the first progress report required by paragraph (c)(2)(i) of this section.
(iii) The owner or operator has completed the progress reports specified in paragraph (c)(2) of this section when the reports are placed in the facility's operating record as required by § 257.105(i)(2).

(3) The owner or operator must prepare and place in the facility's operating record a notification of completion of closure of the CCR surface impoundment. The notification must be submitted within 60 days of completing closure of the CCR surface impoundment and must include a written certification from a qualified professional engineer stating that the CCR surface impoundment was closed in accordance with the requirements of either paragraph (b)(1) through (4) or (b)(5) of this section.

(d) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(i), the notification requirements specified in § 257.106(i), and the internet requirements specified in § 257.107(i).

Closure and Post Closure Care
§ 257.101 Closure or retrofit of CCR units

(a) The owner or operator of an existing unlined CCR surface impoundment, as determined under § 257.71(a), is subject to the requirements of paragraph (a)(1) of this section.

(1) Except as provided by paragraph (a)(3) of this section, if at any time after October 19, 2015 an owner or operator of an existing unlined CCR surface impoundment determines in any sampling event that the concentrations of one or more constituents listed in appendix IV to this part are detected at statistically significant levels above the groundwater protection standard established under § 257.95(h) for such CCR unit, within six months of making such determination, the owner or operator of the existing unlined CCR surface impoundment must cease placing CCR and non-CCR waste streams into such CCR surface impoundment and either retrofit or close the CCR unit in accordance with the requirements of § 257.102.

(2) An owner or operator of an existing unlined CCR surface impoundment that closes in accordance with paragraph (a)(1) of this section must include a statement in the notification required under § 257.102(g) or (k)(5) that the CCR surface impoundment is closing or retrofitting under the requirements of paragraph (a)(1) of this section.

(3) The timeframe specified in paragraph (a)(1) of this section does not apply if the owner or operator complies with the alternative closure procedures specified in § 257.103.

(4) At any time after the initiation of closure under paragraph (a)(1) of this section, the owner or operator may cease closure activities and initiate a retrofit of the CCR unit in accordance with the requirements of § 257.102(k).

(b) The owner or operator of an existing CCR surface impoundment is subject to the requirements of paragraph (b)(1) of this section.

(1) Except as provided by paragraph (b)(4) of this section, within six months of determining that an existing CCR surface impoundment has not demonstrated compliance with any location standard specified in §§ 257.60(a), 257.61(a), 257.62(a), 257.63(a), and 257.64(a), the owner or operator of the CCR surface impoundment must cease placing CCR and non-CCR waste streams into such CCR unit and close the CCR unit in accordance with the requirements of § 257.102.

(2) Within six months of either failing to complete the initial or any subsequent periodic safety factor assessment required by § 257.73(e) by the deadlines specified in § 257.73(f)(1) through (3) or failing to document that the calculated factors of safety for the existing CCR surface impoundment achieve the minimum safety factors specified in § 257.73(e)(1)(i) through (iv), the owner or operator of the CCR surface impoundment must cease placing CCR and non-CCR waste streams into such CCR unit and close the CCR unit in accordance with the requirements of § 257.102.

(3) An owner or operator of an existing CCR surface impoundment that closes in accordance with paragraphs (b)(1) or (2) of this section must include a statement in the notification required under § 257.102(g) that the CCR surface impoundment is closing under the requirements of paragraphs (b)(1) or (2) of this section.

(4) The timeframe specified in paragraph (b)(1) of this section does not apply if the owner or operator complies with the alternative closure procedures specified in § 257.103.

(c) The owner or operator of a new CCR surface impoundment is subject to the requirements of paragraph (c)(1) of this section.

(1) Within six months of either failing to complete the initial or any subsequent periodic safety factor assessment required by § 257.74(e) by the deadlines specified in § 257.74(f)(1) through (3) or failing to document that the calculated factors of safety for the new CCR surface impoundment achieve the minimum safety factors specified in § 257.74(e)(1)(i) through (v), the owner or operator of the CCR surface impoundment must cease placing CCR and non-CCR wastestreams into such CCR unit and close the CCR unit in accordance with the requirements of § 257.102.

(2) An owner or operator of an new CCR surface impoundment that closes in accordance with paragraph (c)(1) of this section must include a statement in the notification required under § 257.102(g) that the CCR surface impoundment is closing under the requirements of paragraph (c)(1) of this section.

(d) The owner or operator of an existing CCR landfill is subject to the requirements of paragraph (d)(1) of this section.

(1) Except as provided by paragraph (d)(3) of this section, within six months of determining that an existing CCR landfill has not demonstrated compliance with the location restriction for unstable areas specified in § 257.64(a), the owner or operator of the CCR unit must cease placing CCR and non-CCR waste streams into such CCR landfill and close the CCR unit in accordance with the requirements of § 257.102.

(2) An owner or operator of an existing CCR landfill that closes in accordance with paragraph (d)(1) of this section must include a statement in the notification required under § 257.102(g) that the CCR landfill is closing under the requirements of paragraph (d)(1) of this section.

(3) The timeframe specified in paragraph (d)(1) of this section does not apply if the owner or operator complies with the alternative closure procedures specified in § 257.103.

Closure and Post Closure Care
§ 257.102 Criteria for conducting the closure or retrofit of CCR units

(a) Closure of a CCR landfill, CCR surface impoundment, or any lateral expansion of a CCR unit must be completed either by leaving the CCR in place and installing a final cover system or through removal of the CCR and decontamination of the CCR unit, as described in paragraphs (b) through (j) of this section. Retrofit of a CCR surface impoundment must be completed in accordance with the requirements in paragraph (k) of this section.

(b) Written closure plan

(1) Content of the plan. The owner or operator of a CCR unit must prepare a written closure plan that describes the steps necessary to close the CCR unit at any point during the active life of the CCR unit consistent with recognized and generally accepted good engineering practices. The written closure plan must include, at a minimum, the information specified in paragraphs (b)(1)(i) through (vi) of this section.

(i) A narrative description of how the CCR unit will be closed in accordance with this section.

(ii) If closure of the CCR unit will be accomplished through removal of CCR from the CCR unit, a description of the procedures to remove the CCR and decontaminate the CCR unit in accordance with paragraph (c) of this section.

(iii) If closure of the CCR unit will be accomplished by leaving CCR in place, a description of the final cover system, designed in accordance with paragraph (d)of this section, and the methods and procedures to be used to install the final cover. The closure plan must also discuss how the final cover system will achieve the performance standards specified in paragraph (d) of this section.

(iv) An estimate of the maximum inventory of CCR ever on-site over the active life of the CCR unit.

(v) An estimate of the largest area of the CCR unit ever requiring a final cover as required by paragraph (d) of this section at any time during the CCR unit's active life.

(vi) A schedule for completing all activities necessary to satisfy the closure criteria in this section, including an estimate of the year in which all closure activities for the CCR unit will be completed. The schedule should provide sufficient information to describe the sequential steps that will be taken to close the CCR unit, including identification of major milestones such as coordinating with and obtaining necessary approvals and permits from other agencies, the dewatering and stabilization phases of CCR surface impoundment closure, or installation of the final cover system, and the estimated timeframes to complete each step or phase of CCR unit closure. When preparing the written closure plan, if the owner or operator of a CCR unit estimates that the time required to complete closure will exceed the timeframes specified in paragraph (f)(1) of this section, the written closure plan must include the site-specific information, factors and considerations that would support any time extension sought under paragraph (f)(2) of this section.

(2) Timeframes for preparing the initial written closure plan

(i) Existing CCR landfills and existing CCR surface impoundments. No later than October 17, 2016, the owner or operator of the CCR unit must prepare an initial written closure plan consistent with the requirements specified in paragraph (b)(1) of this section.

(ii) New CCR landfills and new CCR surface impoundments, and any lateral expansion of a CCR unit. No later than the date of the initial receipt of CCR in the CCR unit, the owner or operator must prepare an initial written closure plan consistent with the requirements specified in paragraph (b)(1) of this section.

(iii) The owner or operator has completed the written closure plan when the plan, including the certification required by paragraph (b)(4) of this section, has been placed in the facility's operating record as required by § 257.105(i)(4).

(3) Amendment of a written closure plan.

(i) The owner or operator may amend the initial or any subsequent written closure plan developed pursuant to paragraph (b)(1) of this section at any time.

(ii) The owner or operator must amend the written closure plan whenever:

(A) There is a change in the operation of the CCR unit that would substantially affect the written closure plan in effect; or

(B) Before or after closure activities have commenced, unanticipated events necessitate a revision of the written closure plan.

(iii) The owner or operator must amend the closure plan at least 60 days prior to a planned change in the operation of the facility or CCR unit, or no later than 60 days after an unanticipated event requires the need to revise an existing written closure plan. If a written closure plan is revised after closure activities have commenced for a CCR unit, the owner or operator must amend the current closure plan no later than 30 days following the triggering event.

(4) The owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the initial and any amendment of the written closure plan meets the requirements of this section.

(c) Closure by removal of CCR. An owner or operator may elect to close a CCR unit by removing and decontaminating all areas affected by releases from the CCR unit. CCR removal and decontamination of the CCR unit are complete when constituent concentrations throughout the CCR unit and any areas affected by releases from the CCR unit have been removed and groundwater monitoring concentrations do not exceed the groundwater protection standard established pursuant to § 257.95(h) for constituents listed in appendix IV to this part.

(d) Closure performance standard when leaving CCR in place

(1) The owner or operator of a CCR unit must ensure that, at a minimum, the CCR unit is closed in a manner that will:

(i) Control, minimize or eliminate, to the maximum extent feasible, post- closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere;

(ii) Preclude the probability of future impoundment of water, sediment, or slurry;

(iii) Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period;

(iv) Minimize the need for further maintenance of the CCR unit; and

(v) Be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices.

(2) Drainage and stabilization of CCR surface impoundments. The owner or operator of a CCR surface impoundment or any lateral expansion of a CCR surface impoundment must meet the requirements of paragraphs (d)(2)(i) and (ii) of this section prior to installing the final cover system required under paragraph (d)(3) of this section.

(i) Free liquids must be eliminated by removing liquid wastes or solidifying the remaining wastes and waste residues.

(ii) Remaining wastes must be stabilized sufficient to support the final cover system.

(3) Final cover system. If a CCR unit is closed by leaving CCR in place, the owner or operator must install a final cover system that is designed to minimize infiltration and erosion, and at a minimum, meets the requirements of paragraph (d)(3)(i) of this section, or the requirements of the alternative final cover system specified in paragraph (d)(3)(ii) of this section.

(i) The final cover system must be designed and constructed to meet the criteria in paragraphs (d)(3)(i)(A) through (D) of this section. The design of the final cover system must be included in the written closure plan required by paragraph (b) of this section.

(A) The permeability of the final cover system must be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than $1x10^{-5}$ cm/sec, whichever is less.

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

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

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

(ii) The owner or operator may select an alternative final cover system design, provided the alternative final cover system is designed and constructed to meet the criteria in paragraphs (f)(3)(ii)(A) through (D) of this section. The design of the final cover system must be included in the written closure plan required by paragraph (b) of this section.

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

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

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

(iii) The owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the design of the final cover system meets the requirements of this section.

(e) Initiation of closure activities. Except as provided for in paragraph (e)(4) of this section and § 257.103, the owner or operator of a CCR unit must commence closure of the CCR unit no later than the applicable timeframes specified in either paragraph (e)(1) or (2) of this section.

(1) The owner or operator must commence closure of the CCR unit no later than 30 days after the date on which the CCR unit either:

(i) Receives the known final receipt of waste, either CCR or any non-CCR waste stream; or

(ii) Removes the known final volume of CCR from the CCR unit for the purpose of beneficial use of CCR.

(2)

(i) Except as provided by paragraph (e)(2)(ii) of this section, the owner or operator must commence closure of a CCR unit that has not received CCR or any non-CCR waste stream or is no longer removing CCR for the purpose of beneficial use within two years of the last receipt of waste or within two years of the last removal of CCR material for the purpose of beneficial use.

(ii) Notwithstanding paragraph (e)(2)(i) of this section, the owner or operator of the CCR unit may secure an additional two years to initiate closure of the idle unit provided the owner or operator provides written documentation that the CCR unit will continue to accept wastes or will start removing CCR for the purpose of beneficial use. The documentation must be supported by, at a minimum, the information specified in paragraphs (e)(2)(ii)(A) and (B) of this section. The owner or operator may obtain two-year extensions provided the owner or operator continues to be able to demonstrate that there is reasonable likelihood that the CCR unit will accept wastes in the foreseeable future or will remove CCR from the unit for the purpose of beneficial use. The owner or operator must place each completed demonstration, if more than one time extension is sought, in the facility's operating record as required by § 257.105(i)(5) prior to the end of any two-year period.

(A) Information documenting that the CCR unit has remaining storage or disposal capacity or that the CCR unit can have CCR removed for the purpose of beneficial use; and

(B) Information demonstrating that there is a reasonable likelihood that the CCR unit will resume receiving CCR or non-CCR waste streams in the foreseeable future or that CCR can be removed for the purpose of beneficial use. The narrative must include a best estimate as to when the CCR unit will resume receiving CCR or non-CCR waste streams. The situations listed in paragraphs (e)(2)(ii)(B)(1) through (4) of this section are examples of situations that would support a determination that the CCR unit will resume receiving CCR or non-CCR waste streams in the foreseeable future.

(1) Normal plant operations include periods during which the CCR unit does not receive CCR or non-CCR waste streams, such as the alternating use of two or more CCR units whereby at any point in time one CCR unit is receiving CCR while CCR is being removed from a second CCR unit after its dewatering.

(2) The CCR unit is dedicated to a coal-fired boiler unit that is temporarily idled (e.g., CCR is not being generated) and there is a reasonable likelihood that the coal-fired boiler will resume operations in the future.

(3)The CCR unit is dedicated to an operating coal-fired boiler (i.e., CCR is being generated); however, no CCR are being placed in the CCR unit because the CCR are being entirely diverted to beneficial uses, but there is a reasonable likelihood that the CCR unit will again be used in the foreseeable future.

(4) The CCR unit currently receives only non-CCR waste streams and those non-CCR waste streams are not generated for an extended period of time, but there is a reasonable likelihood that the CCR unit will again receive non-CCR waste streams in the future.

(iii) In order to obtain additional time extension(s) to initiate closure of a CCR unit beyond the two years provided by paragraph (e)(2)(i) of this section, the owner or operator of the CCR unit must include with the demonstration required by paragraph (e)(2)(ii) of this section the following statement signed by the owner or operator or an authorized representative:

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this demonstration and all attached documents, and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

(3) For purposes of this subpart, closure of the CCR unit has commenced if the owner or operator has ceased placing waste and completes any of the following actions or activities:

(i) Taken any steps necessary to implement the written closure plan required by paragraph (b) of this section;

(ii) Submitted a completed application for any required state or agency permit or permit modification; or

(iii) Taken any steps necessary to comply with any state or other agency standards that are a prerequisite, or are otherwise applicable, to initiating or completing the closure of a CCR unit.

(4) The timeframes specified in paragraphs (e)(1) and (2) of this section do not apply to any of the following owners or operators:

(i) An owner or operator of an inactive CCR surface impoundment closing the CCR unit as required by § 257.100(b);

(ii) An owner or operator of an existing unlined CCR surface impoundment closing the CCR unit as required by § 257.101(a);

(iii) An owner or operator of an existing CCR surface impoundment closing the CCR unit as required by § 257.101(b);

(iv) An owner or operator of a new CCR surface impoundment closing the CCR unit as required by § 257.101(c); or

(v) An owner or operator of an existing CCR landfill closing the CCR unit as required by § 257.101(d).

(f) Completion of closure activities.

(1) Except as provided for in paragraph (f)(2) of this section, the owner or operator must complete closure of the CCR unit:

(i) For existing and new CCR landfills and any lateral expansion of a CCR landfill, within six months of commencing closure activities.

(ii) For existing and new CCR surface impoundments and any lateral expansion of a CCR surface impoundment, within five years of commencing closure activities.

(2)

(i) Extensions of closure timeframes. The timeframes for completing closure of a CCR unit specified under paragraphs (f)(1) of this section may be extended if the owner or operator can demonstrate that it was not feasible to complete closure of the CCR unit within the required timeframes due to factors beyond the facility's control. If the owner or operator is seeking a time extension beyond the time specified in the written closure plan as required by paragraph (b)(1) of this section, the demonstration must include a narrative discussion providing the basis for additional time beyond that specified in the closure plan. The owner or operator must place each completed demonstration, if more than one time extension is sought, in the facility's operating record as required by § 257.105(i)(6) prior to the end of any two-year period. Factors that may support such a demonstration include:

(A) Complications stemming from the climate and weather, such as unusual amounts of precipitation or a significantly shortened construction season;

(B) Time required to dewater a surface impoundment due to the volume of CCR contained in the CCR unit or the characteristics of the CCR in the unit;

(C) The geology and terrain surrounding the CCR unit will affect the amount of material needed to close the CCR unit; or

(D) Time required or delays caused by the need to coordinate with and obtain necessary approvals and permits from a state or other agency.

(ii) Maximum time extensions.

(A) CCR surface impoundments of 40 acres or smaller may extend the time to complete closure by no longer than two years.

(B) CCR surface impoundments larger than 40 acres may extend the timeframe to complete closure of the CCR unit multiple times, in two-year increments. For each two-year extension sought, the owner or operator must substantiate the factual circumstances demonstrating the need for the extension. No more than a total of five two-year extensions may be obtained for any CCR surface impoundment.

(C) CCR landfills may extend the timeframe to complete closure of the CCR unit multiple times, in one-year increments. For each one-year extension sought, the owner or operator must substantiate the factual circumstances demonstrating the need for the extension. No more than a total of two one-year extensions may be obtained for any CCR landfill.

(iii) In order to obtain additional time extension(s) to complete closure of a CCR unit beyond the times provided by paragraph (f)(1) of this section, the owner or operator of the CCR unit must include with the demonstration required by paragraph (f)(2)(i) of this section the following statement signed by the owner or operator or an authorized representative:

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this demonstration and all attached documents, and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

(3) Upon completion, the owner or operator of the CCR unit must obtain a certification from a qualified professional engineer verifying that closure has been completed in accordance with the closure plan specified in paragraph (b) of this section and the requirements of this section.

(g) No later than the date the owner or operator initiates closure of a CCR unit, the owner or operator must prepare a notification of intent to close a CCR unit. The notification must include the certification by a qualified professional engineer for the design of the final cover system as required by § 257.102(d)(3)(iii), if applicable. The owner or operator has completed the notification when it has been placed in the facility's operating record as required by § 257.105(i)(7).

(h) Within 30 days of completion of closure of the CCR unit, the owner or operator must prepare a notification of closure of a CCR unit. The notification must include the certification by a qualified professional engineer as required by § 257.102(f)(3). The owner or operator has completed the notification when it has been placed in the facility's operating record as required by § 257.105(i)(8).

(i) Deed notations.

(1) Except as provided by paragraph (i)(4) of this section, following closure of a CCR unit, the owner or operator must record a notation on the deed to the property, or some other instrument that is normally examined during title search.

(2) The notation on the deed must in perpetuity notify any potential purchaser of the property that:

(i) The land has been used as a CCR unit; and

(ii) Its use is restricted under the post- closure care requirements as provided by § 257.104(d)(1)(iii).

(3) Within 30 days of recording a notation on the deed to the property, the owner or operator must prepare a notification stating that the notation has been recorded. The owner or operator has completed the notification when it has been placed in the facility's operating record as required by § 257.105(i)(9).

(4) An owner or operator that closes a CCR unit in accordance with paragraph (c) of this section is not subject to the requirements of paragraphs (i)(1) through (3) of this section.

(j) The owner or operator of the CCR unit must comply with the closure recordkeeping requirements specified in § 257.105(i), the closure notification requirements specified in § 257.106(i), and the closure Internet requirements specified in § 257.107(i).

(k) Criteria to retrofit an existing CCR surface impoundment.

(1) To retrofit an existing CCR surface impoundment, the owner or operator must:

(i) First remove all CCR, including any contaminated soils and sediments from the CCR unit; and

(ii) Comply with the requirements in § 257.72.

(iii) A CCR surface impoundment undergoing a retrofit remains subject to all other requirements of this subpart, including the requirement to conduct any necessary corrective action.

(2) Written retrofit plan

(i) Content of the plan. The owner or operator must prepare a written retrofit plan that describes the steps necessary to retrofit the CCR unit consistent with recognized and generally accepted good engineering practices. The written retrofit plan must include, at a minimum, all of the following information:

(A) A narrative description of the specific measures that will be taken to retrofit the CCR unit in accordance with this section.

(B) A description of the procedures to remove all CCR and contaminated soils and sediments from the CCR unit.

(C) An estimate of the maximum amount of CCR that will be removed as part of the retrofit operation.

(D) An estimate of the largest area of the CCR unit that will be affected by the retrofit operation.

(E) A schedule for completing all activities necessary to satisfy the retrofit criteria in this section, including an estimate of the year in which retrofit activities of the CCR unit will be completed.

(ii) Timeframes for preparing the initial written retrofit plan.

(A) No later than 60 days prior to date of initiating retrofit activities, the owner or operator must prepare an initial written retrofit plan consistent with the requirements specified in paragraph (k)(2) of this section. For purposes of this subpart, initiation of retrofit activities has commenced if the owner or operator has ceased placing waste in the unit and completes any of the following actions or activities:

(1) Taken any steps necessary to implement the written retrofit plan;

(2) Submitted a completed application for any required state or agency permit or permit modification; or

(3) Taken any steps necessary to comply with any state or other agency standards that are a prerequisite, or are otherwise applicable, to initiating or completing the retrofit of a CCR unit.

(B) The owner or operator has completed the written retrofit plan when the plan, including the certification required by paragraph (k)(2)(iv) of this section, has been placed in the facility's operating record as required by § 257.105(j)(1).

(iii) Amendment of a written retrofit plan.

(A) The owner or operator may amend the initial or any subsequent written retrofit plan at any time.

(B) The owner or operator must amend the written retrofit plan whenever:

(1) There is a change in the operation of the CCR unit that would substantially affect the written retrofit plan in effect; or

(2) Before or after retrofit activities have commenced, unanticipated events necessitate a revision of the written retrofit plan.

(C) The owner or operator must amend the retrofit plan at least 60 days prior to a planned change in the operation of the facility or CCR unit, or no later than 60 days after an unanticipated event requires the revision of an existing written retrofit plan. If a written retrofit plan is revised after retrofit activities have commenced for a CCR unit, the owner or operator must amend the current retrofit plan no later than 30 days following the triggering event.

(iv) The owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the activities outlined in the written retrofit plan, including any amendment of the plan, meet the requirements of this section.

(3) Deadline for completion of activities related to the retrofit of a CCR unit. Any CCR surface impoundment that is being retrofitted must complete all retrofit activities within the same time frames and procedures specified for the closure of a CCR surface impoundment in § 257.102(f) or, where applicable, § 257.103.

(4) Upon completion, the owner or operator must obtain a certification from a qualified professional engineer verifying that the retrofit activities have been completed in accordance with the retrofit plan specified in paragraph (k)(2) of this section and the requirements of this section.

(5) No later than the date the owner or operator initiates the retrofit of a CCR unit, the owner or operator must prepare a notification of intent to retrofit a CCR unit. The owner or operator has completed the notification when it has been placed in the facility's operating record as required by § 257.105(j)(5).

(6) Within 30 days of completing the retrofit activities specified in paragraph (k)(1) of this section, the owner or operator must prepare a notification of completion of retrofit activities. The notification must include the certification by a qualified professional engineer as required by paragraph (k)(4) of this section. The owner or operator has completed the notification when it has been placed in the facility's operating record as required by § 257.105(j)(6).

(7) At any time after the initiation of a CCR unit retrofit, the owner or operator may cease the retrofit and initiate closure of the CCR unit in accordance with the requirements of § 257.102.

(8) The owner or operator of the CCR unit must comply with the retrofit recordkeeping requirements specified in § 257.105(j), the retrofit notification requirements specified in § 257.106(j), and the retrofit Internet requirements specified in § 257.107(j).

Closure and Post Closure Care
§ 257.103 Alternative closure requirements

The owner or operator of a CCR landfill, CCR surface impoundment, or any lateral expansion of a CCR unit that is subject to closure pursuant to § 257.101(a), (b)(1), or (d) may continue to receive CCR in the unit provided the owner or operator meets the requirements of either paragraph (a) or (b) of this section.

(a)

(1) No alternative CCR disposal capacity. Notwithstanding the provisions of § 257.101(a), (b)(1), or (d), a CCR unit may continue to receive CCR if the owner or operator of the CCR unit certifies that the CCR must continue to be managed in that CCR unit due to the absence of alternative disposal capacity both on-site and off-site of the facility. To qualify under this paragraph (a)(1), the owner or operator of the CCR unit must document that all of the following conditions have been met:

(i) No alternative disposal capacity is available on-site or off-site. An increase in costs or the inconvenience of existing capacity is not sufficient to support qualification under this section;

(ii) The owner or operator has made, and continues to make, efforts to obtain additional capacity. Qualification under this subsection lasts only as long as no alternative capacity is available. Once alternative capacity is identified, the owner or operator must arrange to use such capacity as soon as feasible;

(iii) The owner or operator must remain in compliance with all other requirements of this subpart, including the requirement to conduct any necessary corrective action; and

(iv) The owner or operator must prepare an annual progress report documenting the continued lack of alternative capacity and the progress towards the development of alternative CCR disposal capacity.

(2) Once alternative capacity is available, the CCR unit must cease receiving CCR and initiate closure following the timeframes in § 257.102(e) and (f).

(3) If no alternative capacity is identified within five years after the initial certification, the CCR unit must cease receiving CCR and close in accordance with the timeframes in § 257.102(e) and (f).

(b)

(1) Permanent cessation of a coal- fired boiler(s) by a date certain. Notwithstanding the provisions of § 257.101(a), (b)(1), and (d), a CCR unit may continue to receive CCR if the owner or operator certifies that the facility will cease operation of the coal- fired boilers within the timeframes specified in paragraphs (b)(2) through (4) of this section, but in the interim period (prior to closure of the coal-fired boiler), the facility must continue to use the CCR unit due to the absence of alternative disposal capacity both on- site and off-site of the facility. To qualify under this paragraph (b)(1), the owner or operator of the CCR unit must document that all of the following conditions have been met:

(i) No alternative disposal capacity is available on-site or off-site. An increase in costs or the inconvenience of existing capacity is not sufficient to support qualification under this section.

(ii) The owner or operator must remain in compliance with all other requirements of this subpart, including the requirement to conduct any necessary corrective action; and

(iii) The owner or operator must prepare an annual progress report documenting the continued lack of alternative capacity and the progress towards the closure of the coal-fired boiler.

(2) For a CCR surface impoundment that is 40 acres or smaller, the coal-fired boiler must cease operation and the CCR surface impoundment must have completed closure no later than October 17, 2023.

(3) For a CCR surface impoundment that is larger than 40 acres, the coal- fired boiler must cease operation, and the CCR surface impoundment must complete closure no later than October 17, 2028.

(4) For a CCR landfill, the coal-fired boiler must cease operation, and the CCR landfill must complete closure no later than April 19, 2021.

(c) Required notices and progress reports. An owner or operator of a CCR unit that closes in accordance with paragraphs (a) or (b) of this section must complete the notices and progress reports specified in paragraphs (c)(1) through (3) of this section.

(1) Within six months of becoming subject to closure pursuant to § 257.101(a), (b)(1), or (d), the owner or operator must prepare and place in the facility's operating record a notification of intent to comply with the alternative closure requirements of this section. The notification must describe why the CCR unit qualifies for the alternative closure provisions under either paragraph (a) or (b) of this section, in addition to providing the documentation and certifications required by paragraph (a) or (b) of this section.

(2) The owner or operator must prepare the periodic progress reports required by paragraphs (a)(1)(iv) or (b)(1)(iii), in addition to describing any problems encountered and a description of the actions taken to resolve the problems. The annual progress reports must be completed according to the following schedule:

(i) The first annual progress report must be prepared no later than 13 months after completing the notification of intent to comply with the alternative closure requirements required by paragraph (c)(1) of this section.

(ii) The second annual progress report must be prepared no later than 12 months after completing the first annual progress report. Additional annual progress reports must be prepared within 12 months of completing the previous annual progress report.

(iii) The owner or operator has completed the progress reports specified in paragraph (c)(2) of this section when the reports are placed in the facility's operating record as required by § 257.105(i)(10).

(3) An owner or operator of a CCR unit must also prepare the notification of intent to close a CCR unit as required by § 257.102(g).

(d) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(i), the notification requirements specified in § 257.106(i), and the Internet requirements specified in § 257.107(i).

Closure and Post Closure Care

§ 257.104 Post-closure care requirements.

(a) Applicability.

(1) Except as provided by either paragraph (a)(2) or (3) of this section, § 257.104 applies to the owners or operators of CCR landfills, CCR surface impoundments, and all lateral expansions of CCR units that are subject to the closure criteria under § 257.102.

(2) An owner or operator of a CCR unit that elects to close a CCR unit by removing CCR as provided by § 257.102(c) is not subject to the post- closure care criteria under this section.

(3) An owner or operator of an inactive CCR surface impoundment that elects to close a CCR unit pursuant to the requirements under § 257.100(b) is not subject to the post-closure care criteria under this section.

(b) Post-closure care maintenance requirements. Following closure of the CCR unit, the owner or operator must conduct post-closure care for the CCR unit, which must consist of at least the following:

(1) Maintaining the integrity and effectiveness of the final cover system, including making repairs to the final cover as necessary to correct the effects of settlement, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the final cover;

(2) If the CCR unit is subject to the design criteria under § 257.70, maintaining the integrity and effectiveness of the leachate collection and removal system and operating the leachate collection and removal system in accordance with the requirements of § 257.70; and

(3) Maintaining the groundwater monitoring system and monitoring the groundwater in accordance with the requirements of §§ 257.90 through 257.98.

(c) Post-closure care period.

(1) Except as provided by paragraph (c)(2) of this section, the owner or operator of the CCR unit must conduct post-closure care for 30 years.

(2) If at the end of the post-closure care period the owner or operator of the CCR unit is operating under assessment monitoring in accordance with § 257.95, the owner or operator must continue to conduct post-closure care until the owner or operator returns to detection monitoring in accordance with § 257.95.

Closure and Post Closure Care
§ 257.104 Post-closure care requirements.

(d) Written post-closure plan

(1) Content of the plan. The owner or operator of a CCR unit must prepare a written post-closure plan that includes, at a minimum, the information specified in paragraphs (d)(1)(i) through (iii) of this section.

(i) A description of the monitoring and maintenance activities required in paragraph (b) of this section for the CCR unit, and the frequency at which these activities will be performed;
(ii) The name, address, telephone number, and email address of the person or office to contact about the facility during the post-closure care period; and
(iii) A description of the planned uses of the property during the post-closure period. Post-closure use of the property shall not disturb the integrity of the final cover, liner(s), or any other component of the containment system, or the function of the monitoring systems unless necessary to comply with the requirements in this subpart. Any other disturbance is allowed if the owner or operator of the CCR unit demonstrates that disturbance of the final cover, liner, or other component of the containment system, including any removal of CCR, will not increase the potential threat to human health or the environment. The demonstration must be certified by a qualified professional engineer, and notification shall be provided to the State Director that the demonstration has been placed in the operating record and on the owners or operator's publicly accessible Internet site.

(2) Deadline to prepare the initial written post-closure plan
(i) Existing CCR landfills and existing CCR surface impoundments. No later than October 17, 2016, the owner or operator of the CCR unit must prepare an initial written post-closure plan consistent with the requirements specified in paragraph (d)(1) of this section.
(ii) New CCR landfills, new CCR surface impoundments, and any lateral expansion of a CCR unit. No later than the date of the initial receipt of CCR in the CCR unit, the owner or operator must prepare an initial written post- closure plan consistent with the requirements specified in paragraph (d)(1) of this section.
(iii) The owner or operator has completed the written post-closure plan when the plan, including the certification required by paragraph (d)(4) of this section, has been placed in the facility's operating record as required by § 257.105(i)(4).

(3) Amendment of a written post- closure plan.
(i) The owner or operator may amend the initial or any subsequent written post-closure plan developed pursuant to paragraph (d)(1) of this section at any time.
(ii) The owner or operator must amend the written closure plan whenever:
(A) There is a change in the operation of the CCR unit that would substantially affect the written post-closure plan in effect; or
(B) After post-closure activities have commenced, unanticipated events necessitate a revision of the written post-closure plan.

(iii) The owner or operator must amend the written post-closure plan at least 60 days prior to a planned change in the operation of the facility or CCR unit, or no later than 60 days after an unanticipated event requires the need to revise an existing written post-closure plan. If a written post-closure plan is revised after post-closure activities have commenced for a CCR unit, the owner or operator must amend the written post-closure plan no later than 30 days following the triggering event.

(4) The owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the initial and any amendment of the written post-closure plan meets the requirements of this section.

(e) Notification of completion of post- closure care period. No later than 60 days following the completion of the post-closure care period, the owner or operator of the CCR unit must prepare a notification verifying that post-closure care has been completed. The notification must include the certification by a qualified professional engineer verifying that post-closure care has been completed in accordance with the closure plan specified in paragraph (d) of this section and the requirements of this section. The owner or operator has completed the notification when it has been placed in the facility's operating record as required by § 257.105(i)(13).

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(i), the notification requirements specified in § 257.106(i), and the Internet requirements specified in § 257.107(i).

Recordkeeping, Notification, and Posting of Information to the Internet
§ 257.105 Recordkeeping requirements

(a) Each owner or operator of a CCR unit subject to the requirements of this subpart must maintain files of all information required by this section in a written operating record at their facility.

(b) Unless specified otherwise, each file must be retained for at least five years following the date of each occurrence, measurement, maintenance, corrective action, report, record, or study.

(c) An owner or operator of more than one CCR unit subject to the provisions of this subpart may comply with the requirements of this section in one recordkeeping system provided the system identifies each file by the name of each CCR unit. The files may be maintained on microfilm, on a computer, on computer disks, on a storage system accessible by a computer, on magnetic tape disks, or on microfiche.

(d) The owner or operator of a CCR unit must submit to the State Director and/or appropriate Tribal authority any demonstration or documentation required by this subpart, if requested, when such information is not otherwise available on the owner or operator's publicly accessible Internet site.

(e) Location restrictions. The owner or operator of a CCR unit subject to this subpart must place the demonstrations documenting whether or not the CCR unit is in compliance with the requirements under §§ 257.60(a), 257.61(a), 257.62(a), 257.63(a), and 257.64(a), as it becomes available, in the facility's operating record.

(f) Design criteria. The owner or operator of a CCR unit subject to this subpart must place the following information, as it becomes available, in the facility's operating record:

(1) The design and construction certifications as required by § 257.70(e) and (f).

(2) The documentation of liner type as required by § 257.71(a).

(3) The design and construction certifications as required by § 257.72(c) and (d).

(4) Documentation prepared by the owner or operator stating that the permanent identification marker was installed as required by §§ 257.73(a)(1) and 257.74(a)(1).

(5) The initial and periodic hazard potential classification assessments as required by §§ 257.73(a)(2) and 257.74(a)(2).

(6) The emergency action plan (EAP), and any amendment of the EAP, as required by §§ 257.73(a)(3) and 257.74(a)(3), except that only the most recent EAP must be maintained in the facility's operating record irrespective of the time requirement specified in paragraph (b) of this section.

(7) Documentation prepared by the owner or operator recording the annual face-to-face meeting or exercise between representatives of the owner or operator of the CCR unit and the local emergency responders as required by § 257.73(a)(3)(i)(E) and 257.74(a)(3)(i)(E).

(8) Documentation prepared by the owner or operator recording all activations of the emergency action plan as required by §§ 257.73(a)(3)(v) and 257.74(a)(3)(v).

(9) The history of construction, and any revisions of it, as required by § 257.73(c), except that these files must be maintained until the CCR unit completes closure of the unit in accordance with § 257.102.

(10) The initial and periodic structural stability assessments as required by §§ 257.73(d) and 257.74(d).

(11) Documentation detailing the corrective measures taken to remedy the deficiency or release as required by §§ 257.73(d)(2) and 257.74(d)(2).

(12) The initial and periodic safety factor assessments as required by §§ 257.73(e) and 257.74(e).

(13) The design and construction plans, and any revisions of it, as required by § 257.74(c), except that these files must be maintained until the CCR unit completes closure of the unit in accordance with § 257.102.

(g) Operating criteria. The owner or operator of a CCR unit subject to this subpart must place the following information, as it becomes available, in the facility's operating record:

(1) The CCR fugitive dust control plan, and any subsequent amendment of the plan, required by § 257.80(b), except that only the most recent control plan must be maintained in the facility's operating record irrespective of the time requirement specified in paragraph (b) of this section.

(2) The annual CCR fugitive dust control report required by § 257.80(c).

(3) The initial and periodic run-on and run-off control system plans as required by § 257.81(c).

(4) The initial and periodic inflow design flood control system plan as required by § 257.82(c).

(5) Documentation recording the results of each inspection and instrumentation monitoring by a qualified person as required by § 257.83(a).

(6) The periodic inspection report as required by § 257.83(b)(2).

(7) Documentation detailing the corrective measures taken to remedy the deficiency or release as required by §§ 257.83(b)(5) and 257.84(b)(5).

(8) Documentation recording the results of the weekly inspection by a qualified person as required by § 257.84(a).

(9) The periodic inspection report as required by § 257.84(b)(2).

(h) Groundwater monitoring and corrective action. The owner or operator of a CCR unit subject to this subpart must place the following information, as it becomes available, in the facility's operating record:

(1) The annual groundwater monitoring and corrective action report as required by § 257.90(e).

(2) Documentation of the design, installation, development, and decommissioning of any monitoring wells, piezometers and other measurement, sampling, and analytical devices as required by § 257.91(e)(1).

(3) The groundwater monitoring system certification as required by § 257.91(f).

(4) The selection of a statistical method certification as required by § 257.93(f)(6).

(5) Within 30 days of establishing an assessment monitoring program, the notification as required by § 257.94(e)(3).

(6) The results of appendices III and IV to this part constituent concentrations as required by § 257.95(d)(1).

(7) Within 30 days of returning to a detection monitoring program, the notification as required by § 257.95(e).

(8) Within 30 days of detecting one or more constituents in appendix IV to this part at statistically significant levels above the groundwater protection standard, the notifications as required by § 257.95(g).

(9) Within 30 days of initiating the assessment of corrective measures requirements, the notification as required by § 257.95(g)(5).

(10) The completed assessment of corrective measures as required by § 257.96(d).

(11) Documentation prepared by the owner or operator recording the public meeting for the corrective measures assessment as required by § 257.96(e).

(12) The semiannual report describing the progress in selecting and designing the remedy and the selection of remedy report as required by § 257.97(a), except that the selection of remedy report must be maintained until the remedy has been completed.

(13) Within 30 days of completing the remedy, the notification as required by § 257.98(e).

Recordkeeping, Notification, and Posting of Information to the Internet
§ 257.105 Recordkeeping requirements

(i) Closure and post-closure care. The owner or operator of a CCR unit subject to this subpart must place the following information, as it becomes available, in the facility's operating record:

(1) The notification of intent to initiate closure of the CCR unit as required by § 257.100(c)(1).

(2) The annual progress reports of closure implementation as required by § 257.100(c)(2)(i) and (ii).

(3) The notification of closure completion as required by § 257.100(c)(3).

(4) The written closure plan, and any amendment of the plan, as required by § 257.102(b), except that only the most recent closure plan must be maintained in the facility's operating record irrespective of the time requirement specified in paragraph (b) of this section.

(5) The written demonstration(s), including the certification required by § 257.102(e)(2)(iii), for a time extension for initiating closure as required by § 257.102(e)(2)(ii).

(6) The written demonstration(s), including the certification required by § 257.102(f)(2)(iii), for a time extension for completing closure as required by § 257.102(f)(2)(i).

(7) The notification of intent to close a CCR unit as required by § 257.102(g).

(8) The notification of completion of closure of a CCR unit as required by § 257.102(h).

(9) The notification recording a notation on the deed as required by § 257.102(i).

(10) The notification of intent to comply with the alternative closure requirements as required by § 257.103(c)(1).

(11) The annual progress reports under the alternative closure requirements as required by § 257.103(c)(2).

(12) The written post-closure plan, and any amendment of the plan, as required by § 257.104(d), except that only the most recent closure plan must be maintained in the facility's operating record irrespective of the time requirement specified in paragraph (b) of this section.

(13) The notification of completion of post-closure care period as required by § 257.104(e).

Recordkeeping, Notification, and Posting of Information to the Internet
§ 257.105 Recordkeeping requirements

(j) Retrofit criteria. The owner or operator of a CCR unit subject to this subpart must place the following information, as it becomes available, in the facility's operating record:

(1) The written retrofit plan, and any amendment of the plan, as required by § 257.102(k)(2), except that only the most recent retrofit plan must be maintained in the facility's operating record irrespective of the time requirement specified in paragraph (b) of this section.

(2) The notification of intent that the retrofit activities will proceed in accordance with the alternative procedures in § 257.103.

(3) The annual progress reports required under the alternative requirements as required by § 257.103.

(4) The written demonstration(s), including the certification in § 257.102(f)(2)(iii), for a time extension for completing retrofit activities as required by § 257.102(k)(3).

(5) The notification of intent to initiate retrofit of a CCR unit as required by § 257.102(k)(5).

(6) The notification of completion of retrofit activities as required by § 257.102(k)(6).

Recordkeeping, Notification, and Posting of Information to the Internet
§ 257.106 Notification requirements

(a) The notifications required under paragraphs (e) through (i) of this section must be sent to the relevant State Director and/or appropriate Tribal authority before the close of business on the day the notification is required to be completed. For purposes of this section, before the close of business means the notification must be postmarked or sent by electronic mail (email). If a notification deadline falls on a weekend or federal holiday, the notification deadline is automatically extended to the next business day.

(b) If any CCR unit is located in its entirety within Indian Country, the notifications of this section must be sent to the appropriate Tribal authority. If any CCR unit is located in part within Indian Country, the notifications of this section must be sent both to the appropriate State Director and Tribal authority.

(c) Notifications may be combined as long as the deadline requirement for each notification is met.

(d) Unless otherwise required in this section, the notifications specified in this section must be sent to the State Director and/or appropriate Tribal authority within 30 days of placing in the operating record the information required by § 257.105.

(e) Location restrictions. The owner or operator of a CCR unit subject to the requirements of this subpart must notify the State Director and/or appropriate Tribal authority that each demonstration specified under § 257.105(e) has been placed in the operating record and on the owner or operator's publicly accessible internet site.

(f) Design criteria. The owner or operator of a CCR unit subject to this subpart must notify the State Director and/or appropriate Tribal authority when information has been placed in the operating record and on the owner or operator's publicly accessible internet site. The owner or operator must:

(1) Within 60 days of commencing construction of a new CCR unit, provide notification of the availability of the design certification specified under § 257.105(f)(1) or (3). If the owner or operator of the CCR unit elects to install an alternative composite liner, the owner or operator must also submit to the State Director and/or appropriate Tribal authority a copy of the alternative composite liner design.

(2) No later than the date of initial receipt of CCR by a new CCR unit, provide notification of the availability of the construction certification specified under § 257.105(f)(1) or (3).

(3) Provide notification of the availability of the documentation of liner type specified under § 257.105(f)(2).

(4) Provide notification of the availability of the initial and periodic hazard potential classification assessments specified under § 257.105(f)(5).

(5) Provide notification of the availability of emergency action plan (EAP), and any revisions of the EAP, specified under § 257.105(f)(6).

(6) Provide notification of the availability of documentation prepared by the owner or operator recording the annual face-to-face meeting or exercise between representatives of the owner or operator of the CCR unit and the local emergency responders specified under § 257.105(f)(7).

(7) Provide notification of documentation prepared by the owner or operator recording all activations of the emergency action plan specified under § 257.105(f)(8).

(8) Provide notification of the availability of the history of construction, and any revision of it, specified under § 257.105(f)(9).

(9) Provide notification of the availability of the initial and periodic structural stability assessments specified under § 257.105(f)(10).

(10) Provide notification of the availability of the documentation detailing the corrective measures taken to remedy the deficiency or release specified under § 257.105(f)(11).

(11) Provide notification of the availability of the initial and periodic safety factor assessments specified under § 257.105(f)(12).

(12) Provide notification of the availability of the design and construction plans, and any revision of them, specified under § 257.105(f)(13).

(g) Operating criteria. The owner or operator of a CCR unit subject to this subpart must notify the State Director and/or appropriate Tribal authority when information has been placed in the operating record and on the owner or operator's publicly accessible internet site. The owner or operator must:

(1) Provide notification of the availability of the CCR fugitive dust control plan, or any subsequent amendment of the plan, specified under § 257.105(g)(1).

(2) Provide notification of the availability of the annual CCR fugitive dust control report specified under § 257.105(g)(2).

(3) Provide notification of the availability of the initial and periodic run-on and run-off control system plans specified under § 257.105(g)(3).

(4) Provide notification of the availability of the initial and periodic inflow design flood control system plans specified under § 257.105(g)(4).

(5) Provide notification of the availability of the periodic inspection reports specified under § 257.105(g)(6).

(6) Provide notification of the availability of the documentation detailing the corrective measures taken to remedy the deficiency or release specified under § 257.105(g)(7).

(7) Provide notification of the availability of the periodic inspection reports specified under § 257.105(g)(9).

(h) Groundwater monitoring and corrective action. The owner or operator of a CCR unit subject to this subpart must notify the State Director and/or appropriate Tribal authority when information has been placed in the operating record and on the owner or operator's publicly accessible internet site. The owner or operator must:

(1) Provide notification of the availability of the annual groundwater monitoring and corrective action report specified under § 257.105(h)(1).

(2) Provide notification of the availability of the groundwater monitoring system certification specified under § 257.105(h)(3).

(3) Provide notification of the availability of the selection of a statistical method certification specified under § 257.105(h)(4).

(4) Provide notification that an assessment monitoring programs has been established specified under § 257.105(h)(5).

(5) Provide notification that the CCR unit is returning to a detection monitoring program specified under § 257.105(h)(7).

(6) Provide notification that one or more constituents in appendix IV to this part have been detected at statistically significant levels above the groundwater protection standard and the notifications to land owners specified under § 257.105(h)(8).

(7) Provide notification that an assessment of corrective measures has been initiated specified under § 257.105(h)(9).

(8) Provide notification of the availability of assessment of corrective measures specified under § 257.105(h)(10).

(9) Provide notification of the availability of the semiannual report describing the progress in selecting and designing the remedy and the selection of remedy report specified under § 257.105(h)(12).

(10) Provide notification of the completion of the remedy specified under § 257.105(h)(13).

(i) Closure and post-closure care. The owner or operator of a CCR unit subject to this subpart must notify the State Director and/or appropriate Tribal authority when information has been placed in the operating record and on the owner or operator's publicly accessible Internet site. The owner or operator must:

(1) Provide notification of the intent to initiate closure of the CCR unit specified under § 257.105(i)(1).

(2) Provide notification of the availability of the annual progress reports of closure implementation specified under § 257.105(i)(2).

(3) Provide notification of closure completion specified under § 257.105(i)(3).

(4) Provide notification of the availability of the written closure plan, and any amendment of the plan, specified under § 257.105(i)(4).

(5) Provide notification of the availability of the demonstration(s) for a time extension for initiating closure specified under § 257.105(i)(5).

(6) Provide notification of the availability of the demonstration(s) for a time extension for completing closure specified under § 257.105(i)(6).

(7) Provide notification of intent to close a CCR unit specified under § 257.105(i)(7).

(8) Provide notification of completion of closure of a CCR unit specified under § 257.105(i)(8).

(9) Provide notification of the deed notation as required by § 257.105(i)(9).

(10) Provide notification of intent to comply with the alternative closure requirements specified under § 257.105(i)(10).

(11) The annual progress reports under the alternative closure requirements as required by § 257.105(i)(11).

(12) Provide notification of the availability of the written post-closure plan, and any amendment of the plan, specified under § 257.105(i)(12).

(13) Provide notification of completion of post-closure care specified under § 257.105(i)(13).

(j) Retrofit criteria. The owner or operator of a CCR unit subject to this subpart must notify the State Director and/or appropriate Tribal authority when information has been placed in the operating record and on the owner or operator's publicly accessible Internet site. The owner or operator must:

(1) Provide notification of the availability of the written retrofit plan, and any amendment of the plan, specified under § 257.105(j)(1).

(2) Provide notification of intent to comply with the alternative retrofit requirements specified under § 257.105(j)(2).

(3) The annual progress reports under the alternative retrofit requirements as required by § 257.105(j)(3).

(4) Provide notification of the availability of the demonstration(s) for a time extension for completing retrofit activities specified under § 257.105(j)(4).

(5) Provide notification of intent to initiate retrofit of a CCR unit specified under § 257.105(j)(5).

(6) Provide notification of completion of retrofit activities specified under § 257.105(j)(6).

Recordkeeping, Notification, and Posting of Information to the Internet
§ 257.107 Publicly Accessible Internet Site Requirements

(a) Each owner or operator of a CCR unit subject to the requirements of this subpart must maintain a publicly accessible Internet site (CCR Web site) containing the information specified in this section. The owner or operator's Web site must be titled ''CCR Rule Compliance Data and Information.''

(b) An owner or operator of more than one CCR unit subject to the provisions of this subpart may comply with the requirements of this section by using the same Internet site for multiple CCR units provided the CCR Web site clearly delineates information by the name or identification number of each unit.

(c) Unless otherwise required in this section, the information required to be posted to the CCR Web site must be made available to the public for at least five years following the date on which the information was first posted to the CCR Web site.

(d) Unless otherwise required in this section, the information must be posted to the CCR Web site within 30 days of placing the pertinent information required by § 257.105 in the operating record.

(e) Location restrictions. The owner or operator of a CCR unit subject to this subpart must place each demonstration specified under § 257.105(e) on the owner or operator's CCR Web site.

(f) Design criteria. The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) Within 60 days of commencing construction of a new unit, the design certification specified under § 257.105(f)(1) or (3).

(2) No later than the date of initial receipt of CCR by a new CCR unit, the construction certification specified under § 257.105(f)(1) or (3).

(3) The documentation of liner type specified under § 257.105(f)(2).

(4) The initial and periodic hazard potential classification assessments specified under § 257.105(f)(5).

(5) The emergency action plan (EAP) specified under § 257.105(f)(6), except that only the most recent EAP must be maintained on the CCR Web site irrespective of the time requirement specified in paragraph (c) of this section.

(6) Documentation prepared by the owner or operator recording the annual face-to-face meeting or exercise between representatives of the owner or operator of the CCR unit and the local emergency responders specified under § 257.105(f)(7).

(7) Documentation prepared by the owner or operator recording any activation of the emergency action plan specified under § 257.105(f)(8).

(8) The history of construction, and any revisions of it, specified under § 257.105(f)(9).

(9) The initial and periodic structural stability assessments specified under § 257.105(f)(10).

(10) The documentation detailing the corrective measures taken to remedy the deficiency or release specified under § 257.105(f)(11).

(11) The initial and periodic safety factor assessments specified under § 257.105(f)(12).

(12) The design and construction plans, and any revisions of them, specified under § 257.105(f)(13).

(g) Operating criteria. The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The CCR fugitive dust control plan, or any subsequent amendment of the plan, specified under § 257.105(g)(1) except that only the most recent plan must be maintained on the CCR Web site irrespective of the time requirement specified in paragraph (c) of this section.

(2) The annual CCR fugitive dust control report specified under § 257.105(g)(2).

(3) The initial and periodic run-on and run-off control system plans specified under § 257.105(g)(3).

(4) The initial and periodic inflow design flood control system plans specified under § 257.105(g)(4).

(5) The periodic inspection reports

(6) The documentation detailing the corrective measures taken to remedy the deficiency or release specified under § 257.105(g)(7).

(7) The periodic inspection reports specified under § 257.105(g)(9).

(h) Groundwater monitoring and corrective action. The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The annual groundwater monitoring and corrective action report specified under § 257.105(h)(1).

(2) The groundwater monitoring system certification specified under § 257.105(h)(3).

(3) The selection of a statistical method certification specified under § 257.105(h)(4).

(4) The notification that an assessment monitoring programs has been established specified under § 257.105(h)(5).

(5) The notification that the CCR unit is returning to a detection monitoring program specified under § 257.105(h)(7).

(6) The notification that one or more constituents in Appendix IV to this part have been detected at statistically significant levels above the groundwater protection standard and the notifications to land owners specified under § 257.105(h)(8).

(7) The notification that an assessment of corrective measures has been initiated specified under § 257.105(h)(9).The assessment of corrective measures specified under § 257.105(h)(10).

(8) The assessment of corrective measures specified under § 257.105(h)(10).

(9) The semiannual reports describing the progress in selecting and designing remedy and the selection of remedy report specified under § 257.105(h)(12), except that the selection of the remedy report must be maintained until the remedy has been completed.

(10) The notification that the remedy has been completed specified under § 257.105(h)(13).

(i) Closure and post-closure care. The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The notification of intent to initiate closure of the CCR unit specified under §257.105(i)(1).

(2) The annual progress reports of closure implementation specified under § 257.105(i)(2).

(3) The notification of closure completion specified under § 257.105(i)(3).

(4) The written closure plan, and any amendment of the plan, specified under § 257.105(i)(4).

(5) Demonstration(s) for a time extension for initiating closure specified under § 257.105(i)(5).

(6) The demonstration(s) for a time extension for completing closure specified under § 257.105(i)(6).

(7) The notification of intent to close a CCR unit specified under § 257.105(i)(7).

(8) The notification of completion of closure of a CCR unit specified under § 257.105(i)(8).

(9) The notification recording a notation on the deed as required by § 257.105(i)(9).

(10) The notification of intent to comply with the alternative closure requirements as required by § 257.105(i)(10).

(11) The annual progress reports under the alternative closure requirements as required by § 257.105(i)(11).

(12) The written post-closure plan, and any amendment of the plan, specified under § 257.105(i)(12).

(13) The notification of completion of post-closure care specified under § 257.105(i)(13).

(j) Retrofit criteria. The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The written retrofit plan, and any amendment of the plan, specified under § 257.105(j)(1).

(2) The notification of intent to comply with the alternative retrofit requirements as required by § 257.105(j)(2).

(3) The annual progress reports under the alternative retrofit requirements as required by § 257.105(j)(3).

(4) The demonstration(s) for a time extension for completing retrofit activities specified under § 257.105(j)(4).

(5) The notification of intent to retrofit a CCR unit specified under § 257.105(j)(5).

(6) The notification of completion of retrofit activities specified under § 257.105(j)(6).

Responsive partner.
Exceptional outcomes.

Toll Free: 800-472-2232 **Email: wenckmp@wenck.com** **Web: wenck.com**

MINNESOTA
Maple Plain 763-479-4200
Golden Valley 763-252-6800
New Hope 800-368-8831
Windom 507-831-2703
Woodbury 651-294-4580

COLORADO
Denver 800-472-2232
Fort Collins 970-223-4705

GEORGIA
Roswell 678-987-5840

NORTH DAKOTA
Fargo 701-297-9600
Mandan 701-751-3370

SOUTH DAKOTA
Pierre 605-222-1826

WYOMING
Cheyenne 307-634-7848
Sheridan 307-675-1148