



# Run-On and Run-Off Control System Plan

**Alma Offsite Disposal Facility  
Phase IV Landfill  
Alma, Wisconsin**

October 2016  
Revised October 2021  
Revised January 2024  
Revised July 2024

## Prepared For:

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A handwritten signature in blue ink that reads "BreAnne Kahnk".

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BreAnne Kahnk, P.E.  
Senior Project Engineer

A handwritten signature in blue ink that reads "Todd W. Martin".

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Todd Martin  
Principal Project Manager

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## APPENDICES

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Appendix B: Surface Water Run-Off Control System Calculations  
Appendix C: Relevant October 2000 POO Plan Sheets  
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## REVISION HISTORY

Revision Number	Revision Date	Section Revised	Summary of Revisions
1	10/6/2021	1.2, 2.2, 2.3, 3.0, App. B	5-year periodic revision, revised text and Appendix B
2	10/11/2023	Inserted Section 3	Requirements to meet WDNR standards

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## 1.0 Introduction

### 1.1 Purpose and Scope

This Run-On and Run-Off Control System Plan (Plan) was prepared by TRC Environmental Corporation (TRC) on behalf of Dairyland Power Cooperative (DPC) for the Alma Offsite Disposal Facility, Phase IV Landfill (Landfill) where coal combustion residuals (CCR) are disposed. The approximately 32.1 acre Landfill is located in Sections 18 and 19, T21N, R12W, Town of Belvidere, Buffalo County, Wisconsin.

This Plan meets the run-on and run-off control system requirements of the United States Environmental Protection Agency's (USEPA) CCR Rule (Title 40 Code of Federal Regulations (CFR) parts 257 Subpart D – "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments"). This text and its accompanying appendices and plan sheets present the plans and specifications of the run-off and run-on control systems of the Landfill. The plan sheets and the text, with its appendices, complement each other and should be reviewed and used as one document.

## **2.0 Engineering Design Concepts for Controlling Run-On and Run-Off**

### **2.1 General**

The Landfill design has been developed to provide environmentally sound CCR disposal. The storm water run-on and run-off control systems for the Landfill have been designed and meet the requirements of 40 CFR 257.81.

The supporting calculations for the run-on and run-off design are referenced throughout the text and are included in the appendices. Details and drawings illustrating design layout and specifications are referenced as applicable and presented on the plan sheets and figures. The majority of the calculations provided in the appendices were prepared during the initial permitting of the Phase IV Disposal Area and included in the October 2000 Plan of Operation (POO) in accordance with Wisconsin Administrative Code, Chapters 500 through 520, and conversations with the Wisconsin Department of Natural Resources (WDNR). Plan sheets included in Appendix C are the relevant plan sheets from the October 2000 POO drawing plan set. For the purposes of this Plan, the terms surface water and storm water have been used interchangeably and reflect precipitation routed over land or temporarily stored to manage run-on and run-off. No streams, wetlands, or bodies of water are located in areas that would impact run-on and run-off at the Landfill.

### **2.2 Run-On Control System**

#### **2.2.1 General**

The run-on control system for the Landfill consists of perimeter berms, diversion berms, downslope flumes, ditching, sedimentation basins, and culverts, designed and constructed to control surface water during both the operational and post-closure periods of the Landfill. The design of the surface water controls have been performed for the operational periods when the combination of surface conditions and contributing acreage would result in the greatest run-off volume, and for the post-closure period. Given the location of the site, the surface water management system was designed utilizing the 100-year, 24-hour storm event at the time of the design, which exceeds the current 25-year, 24-hour storm event required by 40 CFR 257.81(a)(1). Calculations for the surface water run-on control designs are included in Appendix A.

The surface water control system design has been performed to meet the following requirements:

- Run-off curve numbers (RCNs) used in the analysis provide a conservative analysis of the potential land uses of the upland areas. Upland areas within the watershed primarily include wooded areas and agricultural lands. The wooded areas are located on the steeper-sloped areas of the valley and are unlikely to be affected by future land uses. High RCNs for the agricultural lands were selected to represent a conservative fallow condition with exposed bare soil. The RCNs selected for these areas were 86.
- Surface water run-on controls have been designed to divert off-site surface water away from the active fill areas. On-site surface water is routed to sedimentation basins, except surface water in contact with active fill areas, which is treated as leachate.

### **2.2.2 Control of Surrounding Run-On**

Surface water from areas west, north, and east of the Landfill currently drain to existing drainage channels that have formed in the valleys near the Landfill. These drainage channels converge at the location of the Landfill, are conveyed around the Landfill by perimeter diversion ditches, and continue to the south in a single drainage ditch. The main drainage ditch then routes the water to the south for approximately 1.5 miles before discharging into the Mississippi River (see Plan Sheet 5 in Appendix C).

Diversion ditches are designed to route off-site surface water around the Landfill in a controlled manner. These ditches are constructed in phases as the Landfill is developed.

During previous construction events, the perimeter drainage ditch along the eastern, western, and northern sides of the Landfill were constructed to route storm water from the east, west, and north around the Landfill. Cells 1, 2, and 3 of the Landfill have been constructed (see Plan Sheet 9 in Appendix C). A temporary drainage ditch/diversion berm was constructed on the northwestern side of the Landfill to route surface water from areas northwest of the Landfill around the Landfill. During Cell 4, Module B development, the remaining surface water controls will be completed (see Plan Sheets 11 and 12 in Appendix C).

Temporary and permanent ditching and diversion berms were designed and constructed to manage the peak flows associated with the 100-year, 24-hour storm event.

### **2.2.3 Diversion Berms**

Diversion berms are designed along the final cover system to collect and transfer surface water to the receiving downslope flume or sedimentation basin (see Detail 2 on Plan Sheet 19 in Appendix C). These diversion berms concentrate and control flow, and discharge the non-contact surface water (water that has not come into contact with the CCR) from the Landfill away from the final cover. The swales created by the diversion berms are designed at 2 percent typical slopes along the flow lines. The locations of the surface water diversion berms are shown on Plan Sheet 12 in Appendix C.

Drainage areas for the Landfill are defined by the proposed surface water diversion berms at the site. Run-off computations were performed for the site with the proposed diversion berms in-place and are contained in Appendix A. Figure K-2 in Appendix A shows the post-closure drainage areas for the Landfill.

### **2.2.4 Downslope Flumes**

Downslope flumes are included in the design to collect and transfer surface water from the diversion berms on the final cover to the sedimentation basins. Plan Sheet 12 shows the location of the downslope flumes. The downslope flumes have been designed as enclosed pipe flumes to limit erosion and to control the flow as it crosses roads. Downslope flume calculations are included in the culvert design subsection of Appendix A.

### **2.2.5 Ditching**

Surface water ditching has been designed to minimize velocities and depths of flow. Velocities for the grass-lined ditching have been limited to 4 feet per second (fps). In areas where velocities exceed 4 fps, permanent erosion matting, or grouted riprap are used to limit erosion and reduce velocities. Ditch sizing calculations are contained in Appendix A. Designed ditch locations are shown on Figure K-3 in Appendix A. The ditching to route surface water around the Landfill and away from the active areas of the Landfill are designed at a minimum 2-foot depth as shown on Detail 8 on Plan Sheet 23 in Appendix A. Ditch sizing calculations for operational and post-closure conditions show that a minimum freeboard of 0.4 feet occurs as the worst case condition in the ditches for the 100-year 24-hour storm event. Therefore, the calculations indicate that run-on to the active areas of the Landfill should not occur for the 25-year 24-hour storm event as required by 40 CFR 257.81(a)(1).

### **2.2.6 Sedimentation Basins**

Two permanent sedimentation basins are designed to capture and treat non-contact run-off from the Landfill final cover system. The locations of the permanent sedimentation basins are shown on Plan Sheet 5 in Appendix C. The basins have been designed with a minimum surface area that exceeds the surface area required to settle 0.015 mm particles. The sedimentation basins are designed to accommodate the surface water run-off from a 100-year, 24-hour storm event. The emergency spillways are designed to control the run-off from a storm greater than the 100-year, 24-hour storm event.

### **2.2.7 Culverts**

Several culverts are designed to transport non-contact run-off from the Landfill final cover and surrounding areas. The locations of the permanent culverts are shown on Plan Sheet 12 in Appendix C. The culverts have been designed to allow the peak run-off associated with a 100-year, 24-hour storm to pass through it without creating surface water breaching (i.e., berm overflow and run-on into active areas of the Landfill) or excessive backwater levels. Culvert sizing was performed using design charts developed by the U.S. Department of Transportation Federal Highway Administration. Culvert sizing calculations are provided in Appendix A.

### **2.2.8 Temporary Surface Water Controls**

In addition to the permanent surface water management features discussed above, temporary surface water controls are also implemented during operation of the Landfill to control surface water from entering the active disposal area and to limit erosion of the final cover. These temporary control features include diversion berms, downslope discharge structure, and culverts. Temporary diversion berms will be constructed as needed along the transition from an active area to an area that has reached final grade, or that has intermediate cover, in order to control surface water from entering the active area. Temporary downslope discharge structures will be used to route non-contact run-off from diversion berms (either temporary or permanent) to the perimeter ditches.

## **2.3 Run-Off Control System**

### **2.3.1 General**

The leachate collection and handling system in conjunction with cell delineation berms (see detail 5 on Plan Sheet 17 in Appendix C) and perimeter berms comprise the control system for preventing contact surface water run-off from the active portions of the Landfill. Contact surface water is managed as leachate. The leachate collection system for the Landfill has been designed to provide effective drainage, collection, and removal of leachate from the Landfill.

### **2.3.2 Leachate Collection System**

The primary components of the leachate collection system consist of a drainage layer, leachate collection and transfer piping, cleanouts, manholes, a storage tank, and a load-out facility. The leachate collection system layout is shown on Plan Sheet 5 in Appendix C. The drainage layer is placed over the geomembrane on the base and sidewalls. The drainage layer promotes the efficient transmission of leachate to the leachate collection trenches and pipes. The drainage layer is a minimum of 12 inches thick and has a minimum hydraulic conductivity of  $1.0 \times 10^{-2}$  centimeters per second (cm/s).

The leachate collection piping is placed in vee-shaped trenches and consists of 6-inch-diameter perforated high density polyethylene (HDPE) pipe. Pipe bedding material is placed around the perforated pipe and mounded as shown on Plan Sheet 17 in Appendix C.

Leachate collection pipes in each cell are placed parallel to each other in valleys over the herringbone design across the base. These lines drain at a 4 to 6 percent slope to the leachate removal and transfer system.

Temporary cell delineation berms are used along the cell boundaries to control surface water run-off from exiting the active areas of the Landfill. Refer to Detail 5 on Plan Sheet 17 for further details on the temporary cell delineation berm design.

### **2.3.3 Leachate Removal and Transfer System**

The perforated leachate collection piping will transition to 6-inch-diameter nonperforated leachate transfer piping within the Landfill just prior to where the transfer piping penetrates the liner system at the southern toe-of-slope of each cell. The horizontal pipe penetration has been designed to prevent leachate from leaving the Landfill liner system through the liner penetration.

Outside of the limits of CCR, concrete manholes provide a location for transfer piping to manifold into a single perimeter transfer pipe around the southern end of the Landfill, and to provide a location for cleanout access piping.

The combined transfer piping then extends to the leachate storage tank located near the ash processing facility. Leachate collected in the tank is pumped into tanker trucks and transported to a nearby wastewater treatment plant for treatment which complies with 40 CFR 257.81(b). Plan Sheet 5 illustrates the location of the transfer piping, manholes, and the storage tank.

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#### **2.3.4 Leachate Storage Capacity From a 25-Year 24-Hour Storm Event**

The proposed phasing plans and existing conditions were reviewed to determine the worst-case scenario for leachate generation. This worst-case scenario was used to show that run-off from the active area of the Landfill would not occur from a 25-year 24-hour storm event. Calculations contained in Appendix B show that there is approximately 14,700 cubic feet of leachate storage capacity remaining in the leachate collection system after a 25-year 24-hour storm event. Therefore, sufficient infrastructure is provided to prevent run-off from the active area of the Landfill as required by 40 CFR 257.81(a)(2).

#### **2.3.5 Conclusions**

This Plan has demonstrated that the Landfill has a run-on control system and a run-off control system sufficient to prevent flow onto or off of the active portion during a 24-hour 25-year storm event. The Landfill is in compliance with the requirements of 40 CFR 257.81.

## **3.0 Construction of Run-on and Run-off Control System**

### **3.1 Run-on Control Systems**

As noted in Section 2.2, the run-on control system consists of perimeter berms, diversion berms, downslope flumes, ditching, sedimentation basins, and culverts. Run-on controls have been designed to divert off-site surface water away from the active fill areas. On-site water is routed to sedimentation basins, except surface water in contact with active fill areas which is treated as leachate.

As summarized in Section 2.2.2, the run-on features are constructed incrementally during both the liner construction and final cover construction events. The previously constructed features were constructed per the site specifications with construction oversight directed by a professional engineer licensed in the State of Wisconsin. Documentation reports for construction events at the Landfill were prepared, submitted to the WDNR, and approved by the WDNR.

Temporary systems are used at the limits of the construction event to assist in the run-on control system until the remainder of the components are completed. The remainder of the run-on control system components will be completed during development of Cell 4B and following its closure. Specific schedules of exactly when features will be developed is not practicable, as the development and closure of the Landfill is dependent on filling activities, which are highly variable. Future construction will meet the previously approved design and specifications as noted in the October 2000 Plan of Operation, and construction oversight will be directed by a professional engineer licensed in the State of Wisconsin.

An estimated schedule for these systems, based on an assumed CCR filling rate is included as Appendix D.

### **3.2 Run-off Control Systems**

As noted in Section 2.3, the run-off control system consists of the leachate collection system in conjunction with cell delineation berms and perimeter berms. The previously constructed features for the active area were constructed during the liner installation of the associated module/cell. The remaining portions of the run-off control system will be constructed during the construction events for Cells 4A and 4B. The general placement of the leachate collection system is summarized in Section 2.3.2 and is detailed in the approved October 2000 Plan of Operation.

Previous and future construction have been/will be completed in accordance with the site specifications and design, as shown in Appendix C. Construction oversight has/will be directed by a professional engineer licensed in the State of Wisconsin. Documentation reports for previous construction events have been prepared, submitted to the WDNR, and previously approved by the WDNR. Following construction of future landfill cells/modules, reports documenting construction will be prepared and submitted to the WDNR as required by ch. NR 516.

An estimated schedule for these systems, based on an assumed CCR filling rate is included as Appendix D.



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## 4.0 Amendment of the Plan and Notification

This Plan was completed in compliance with the requirements set forth in 40 CFR 257.81. This document has been placed in the operating record, posted to the publicly accessible website, and government notifications have been provided.

A Run-On and Run-Off Control System Plan must be prepared every 5 years from the completion date of this Plan.

The Plan must be amended whenever the periodic review period is reached or if changes in site conditions, either intentionally or unintentionally, occur that will sustainably impact the current written plan in effect.

## 5.0 Engineer's Certification

Pursuant to 40 CFR 257.81 and by means of this certification I attest that:

- (i) I am familiar with the requirements of the federal CCR rule (40 CFR 257);
- (ii) this Run-On and Run-Off Control System Plan has been prepared in accordance with good engineering practice; and
- (iii) this Run-On and Run-Off Control System Plan meets the requirements of 40 CFR 257.81(c).

For the purpose of this document, "certify" and "certification" shall be interpreted and construed to be a "statement of professional opinion." The certification is understood and intended to be an expression of my professional opinion as a Wisconsin licensed professional engineer, based upon knowledge, information, and belief. The statement(s) of professional opinion are not and shall not be interpreted or construed to be a guarantee or a warranty of the analysis herein.



Signature of Registered Professional Engineer

Registration No. E-46825

State: Wisconsin



## **Appendix A: Surface Water Run-On Control System Calculations**

Note: For clarification purposes, these run-on calculations estimate "run-off" quantities from areas in and surrounding the Landfill that develop non-contact surface water that is managed to prevent run-on to the active Landfill areas.

- Surface Water Run-off Calculations
  - Purpose/Methodology/Assumptions/Results/References
  - Post-closure Run-off Calculations
  - Operational Run-off Calculations
  - Reference Information
- Diversion Berm, Perimeter Ditch, and Spillway Design Calculations
  - Purpose/Methodology/Assumptions/Results/References
  - Calculations – Post-closure Landfill Conditions
  - Calculations – Operational Landfill Conditions
  - Reference Information
- Culvert/Downslope Flume Design Calculations
  - Purpose/Methodology/Assumptions/Results/References
  - Calculations – Post-closure Landfill Conditions
  - Calculations – Temporary Culverts, Operational Conditions
- Vegetation Information

## **Surface Water Run-off Calculations**

## **Purpose/Methodology/Assumptions/Results/References**



## COMPUTATION SHEET

SHEET 1 OF 3

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
Dairyland Power Cooperative	By: BJK	Date: 5/97	By: BLP	Date: 6/97	3081.40

### SURFACE WATER RUNOFF CALCULATIONS

#### Purpose

The purpose of the surface water runoff calculations was to estimate the amount of surface water runoff and the peak discharge for the 25-year, 24-hour and 100-year, 24-hour storms at the proposed Dairyland Power Landfill. Calculations were performed for the pre- and post-development conditions. Calculations were also performed for operational conditions for the 25-year, 24-hour storm. Once determined, the surface water runoff quantities were compared to determine the effect of the proposed landfill on the existing drainage patterns. The runoff calculations were also used to size diversion ditches, sedimentation basins, culverts, and downslope flumes.

#### Methodologies

Surface water runoff calculations consist of delineating drainage areas (watersheds), as shown on the attached figures, estimating runoff characteristics, and calculating the peak and total runoff rate and volume for each drainage area. The methods for computing surface water runoff were based on the methodologies presented in the Technical Release No. 55 - "Urban Hydrology for Small Watersheds" by the United States Soil Conservation Service.

The calculations were performed using the QUICK TR-55 computer program developed by Haestad Methods (Haestad 1989). The program incorporates rainfall quantities, storm distributions, surface runoff characteristics, drainage areas, times of concentration, and travel times to generate a hydrograph from which the volume of surface water runoff and the peak discharge are obtained.

It is noted that the storm water control structures have been designed using a 100-year, 24-hour storm event and a TR-55 Type II storm distribution to determine peak flow rates. Rainfall distributions for the Type II storm event include "nested" higher intensity storm events within those needed for longer durations at the same probability. The resulting peak flows using this design method meet or exceed the peak flows obtained using a 25-year, time of concentration storm event (required by NR 504.09).





## COMPUTATION SHEET

SHEET 2 OF 3

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

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Dairyland Power Cooperative	By: BJK	Date: 5/97	By: BLP	Date: 6/97	3081.40

### Assumptions

The following assumptions were made in developing the hydrographs (Note: The figures and values referenced in these assumptions have been included in the references portion of this appendix):

- A 2-year, 24-hour storm event in the vicinity of the landfill is 2.8 inches based on rainfall maps prepared by the U.S. Weather Bureau.
- A 25-year, 24-hour storm event in the vicinity of the landfill equates to 4.9 inches based on rainfall maps prepared by the U.S. Weather Bureau.
- A 100-year, 24-hour storm event in the vicinity of the landfill equates to 6.1 inches based on rainfall maps prepared by the U.S. Weather Bureau.
- A Type II rainfall distribution was used, based on SCS storm distribution maps provided in the TR-55 manual.
- Cover types for the pre-development conditions, from which runoff curve numbers were determined, were based on USGS topographic maps and an aerial photograph.
- For the post-development landfill conditions, a runoff curve number of 74 was assumed, based on values provided in the TR-55 manual.
- Based on the USDA-SCS General Soil Map for Buffalo County, Wisconsin, the primary soil formations present include the Dubuque silt loam and the Fayette silt loam. These soils are a Type B soil, based on tables provided in the TR-55 manual.
- Runoff curve numbers for the non-landfill areas ranged from 55 to 86, based on values provided in the TR-55 manual. Refer to the attached calculations for the breakdown and description of each of the curve numbers used for the various drainage areas.

### Results

The table below summarizes the results of the surface water runoff analyses and provides a comparison of the pre- and post-development conditions:

STORM	TOTAL RUNOFF (acre-ft)			PEAK DISCHARGE (cfs)		
	PRE-	POST-	Δ	PRE-	POST-	Δ
25-year	153	148	(5)	1,170	1,028	(142)
100-year	232	225	(7)	1,895	1,622	(273)

Based on the results of the surface water runoff calculations, the proposed landfill is not anticipated to have an adverse impact on the existing surface water at the site. Total runoff volumes to the existing drainageways are not anticipated to change in the pre- and post-development conditions. Peak runoff volumes to the existing drainageways for post-



## COMPUTATION SHEET

SHEET 3 OF 3

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
	By:	Date:	By:	Date:	
Dairyland Power Cooperative	BJK	5/97	BLP	6/97	3081.40

development conditions are slightly lower than the pre-development conditions. This is primarily due to the use of sedimentation basins to dissipate peak flows from the landfill to the surrounding areas. The reduced peak flows will result in reduced sediment transport from the site.

The results of these surface water runoff calculations have also been used in the attached diversion berm, perimeter ditch, spillway, and sedimentation basin calculations. These structures have been designed to handle the peak runoff from the 100-year, 24-hour storm event.

### References

US Department of Agriculture, Soil Conservation Service. Urban Hydrology for Small Watersheds. Technical Release No. 55. 2nd Edition. June 1986.

US Department of Agriculture, Soil Conservation Service. 1986. Engineering Field Manual for Conservation Practices. November 1986.

Haestad Methods. Pond Pack, QUICK TR-55. Hydrology for Small Watersheds. December 1989.



## **Post-closure Run-off Calculations**



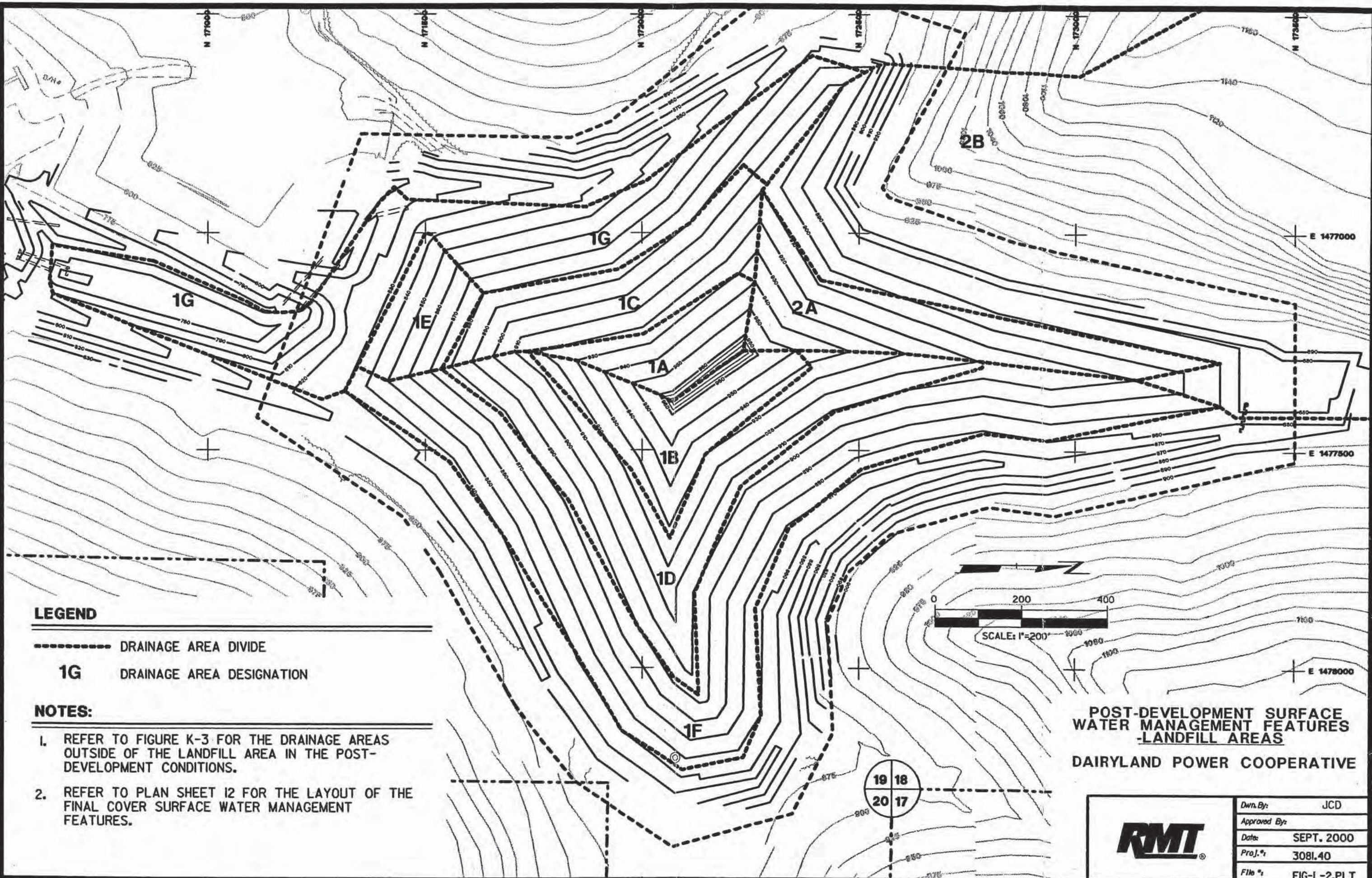
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(2) 1-16  
(3) 33,45-50  
(4) 2,3,14-16

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(2) 2  
(3) 3  
(4) 4

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Ref. File 3 = proposed.dgn  
Ref. File 4 = surface.dgn

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DEF05.plt  
Plot File =  
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Levels On = 1-63





Dairyland Power Coop.  
Feasibility Report  
Landfill Runoff  
BJK 3/97

RUNOFF CURVE NUMBER SUMMARY

.....

Subarea Description	Area (acres)	CN (weighted)
-----	-----	-----
1A	1.40	74
1B	2.20	74
1C	2.90	74
1D	5.30	74
1E	1.20	74
1F	9.50	74
1G	7.40	84

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6/13/97

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Feasibility Report  
Landfill Runoff  
BJK 3/97

RUNOFF CURVE NUMBER DATA

.....

Composite Area: 1A

SURFACE DESCRIPTION	AREA (acres)	CN
-----	-----	-----
Landfill Cover	1.40	74 ✓
COMPOSITE AREA --->	1.40	74.0 ( 74 )
.....	.....	.....

Composite Area: 1B

SURFACE DESCRIPTION	AREA (acres)	CN
-----	-----	-----
Landfill Cover	2.20	74 ✓
COMPOSITE AREA --->	2.20	74.0 ( 74 )
.....	.....	.....

Composite Area: 1C

SURFACE DESCRIPTION	AREA (acres)	CN
-----	-----	-----
Landfill Cover	2.90	74 ✓
COMPOSITE AREA --->	2.90	74.0 ( 74 )
.....	.....	.....

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Composite Area: 1D

SURFACE DESCRIPTION	AREA (acres)	CN
-----	-----	-----
Landfill Cover	5.30	74 ✓
COMPOSITE AREA --->	5.30	74.0 ( 74 )
.....	.....	.....

Composite Area: 1E

SURFACE DESCRIPTION	AREA (acres)	CN
-----	-----	-----
Landfill Cover	1.20	74 ✓
COMPOSITE AREA --->	1.20	74.0 ( 74 )
.....	.....	.....

Composite Area: 1F

SURFACE DESCRIPTION	AREA (acres)	CN
-----	-----	-----
Landfill Cover	9.50	74 ✓
COMPOSITE AREA --->	9.50	74.0 ( 74 )
.....	.....	.....

Composite Area: 1G

SURFACE DESCRIPTION	AREA (acres)	CN
-----	-----	-----
Landfill Cover	4.40	74 ✓
Sedimentation Basin	3.00	98 ✓
COMPOSITE AREA --->	7.40	83.7 ( 84 )
.....	.....	.....

Dairyland Power Coop.  
Feasibility Report  
Landfill Runoff  
BJK 3/97

RUNOFF CURVE NUMBER SUMMARY

.....

Subarea Description	Area (acres)	CN (weighted)
-----	-----	-----
2A	2.70	74
2B	21.50	69

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Dairyland Power Coop.  
Feasibility Report  
Landfill Runoff  
BJK 3/97

RUNOFF CURVE NUMBER DATA

Composite Area: 2A

SURFACE DESCRIPTION	AREA (acres)	CN
Landfill Cover	2.70	74 ✓
COMPOSITE AREA --->	2.70	74.0 ( 74 )

Composite Area: 2B

SURFACE DESCRIPTION	AREA (acres)	CN
Landfill Cover	2.70	74 ✓
Graded/Grassed Area	2.00	61 ✓
Woods/Brush	15.80	67 ✓
Sedimentation Basin	1.00	98 ✓
COMPOSITE AREA --->	21.50	68.8 ( 69 )

Quick TR-55 Ver.5.46 S/N:  
Executed: 08:55:25 06-18-1997 a:COVER1.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS  
(Solved for Time using TR-55 Methods)

Dairyland Power Coop.  
Feasibility Report  
Landfill Final Cover  
BJK 3/97

Subarea descr.	Tc or Tt	Time (hrs)
1A	Tc	0.18
1B	Tc	0.23
1C	Tc	0.23
1D	Tc	0.35
1E	Tc	0.18
1F	Tc	0.45
1G	Tc	0.22



Dairyland Power Coop.  
 Feasibility Report  
 Landfill Final Cover  
 BJK 3/97

✓ BGL  
 6/13/97

Tc COMPUTATIONS FOR: 1A

SHEET FLOW (Applicable to Tc only)

Segment ID	1		
Surface description	Dense Grass		
Manning's roughness coeff., n	0.2400	✓	
Flow length, L (total < or = 300)	ft 150.0	✓	
Two-yr 24-hr rainfall, P2	in 2.800		
Land slope, s	ft/ft 0.2500	✓	
	0.8		
	.007 * (n*L)		
T =	-----	hrs 0.13	= 0.13
	0.5 0.4		
	P2 * s		

SHALLOW CONCENTRATED FLOW

Segment ID	2		
Surface (paved or unpaved)?	Unpaved		
Flow length, L	ft 420.0	✓	
Watercourse slope, s	ft/ft 0.0200	✓	
	0.5		
Avg.V = Csf * (s)	ft/s 2.2818		
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs 0.05		= 0.05

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft 0.00		
Wetted perimeter, Pw	ft 0.00		
Hydraulic radius, r = a/Pw	ft 0.000		
Channel slope, s	ft/ft 0.0000		
Manning's roughness coeff., n	0.0000		
	2/3 1/2		
	1.49 * r * s		
V =	-----	ft/s 0.0000	
	n		
Flow length, L	ft 0		
T = L / (3600*V)	hrs 0.00		= 0.00

.....  
 TOTAL TIME (hrs) 0.18

Quick TR-55 Ver.5.46 S/N:  
 Executed: 09:48:41 04-09-1997 a:COVER1.TCT

✓ BJB  
 6/13/97

Dairyland Power Coop.  
 Feasibility Report  
 Landfill Final Cover  
 BJK 3/97

Tc COMPUTATIONS FOR: 1B

SHEET FLOW (Applicable to Tc only)

Segment ID	1		
Surface description	Dense Grass		
Manning's roughness coeff., n	0.2400		
Flow length, L (total < or = 300)	ft 125.0	✓	
Two-yr 24-hr rainfall, P2	in 2.800		
Land slope, s	ft/ft 0.2500	✓	
	0.8		
	.007 * (n*L)		
T =	-----	hrs 0.11	= 0.11
	0.5 0.4		
	P2 * s		

SHALLOW CONCENTRATED FLOW

Segment ID	2		
Surface (paved or unpaved)?	Unpaved		
Flow length, L	ft 960.0	✓	
Watercourse slope, s	ft/ft 0.0200	✓	
	0.5		
Avg.V = Csf * (s)	ft/s 2.2818		
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs 0.12		= 0.12

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft 0.00		
Wetted perimeter, Pw	ft 0.00		
Hydraulic radius, r = a/Pw	ft 0.000		
Channel slope, s	ft/ft 0.0000		
Manning's roughness coeff., n	0.0000		
	2/3 1/2		
	1.49 * r * s		
V =	-----	ft/s 0.0000	
	n		
Flow length, L	ft 0		
T = L / (3600*V)	hrs 0.00		= 0.00

.....  
 TOTAL TIME (hrs) 0.23

Quick TR-55 Ver.5.46 S/N:  
 Executed: 09:48:41 04-09-1997 a:COVER1.TCT

✓  
6/13/97

Dairyland Power Coop.  
 Feasibility Report  
 Landfill Final Cover  
 BJK 3/97

Tc COMPUTATIONS FOR: 1C

SHEET FLOW (Applicable to Tc only)

Segment ID	1
Surface description	Dense Grass
Manning's roughness coeff., n	0.2400
Flow length, L (total < or = 300)	ft 165.0 ✓
Two-yr 24-hr rainfall, P2	in 2.800
Land slope, s	ft/ft 0.2500 ✓
	0.8
	.007 * (n*L)
T =	hrs 0.14 = 0.14
	0.5 0.4
	P2 * s

SHALLOW CONCENTRATED FLOW

Segment ID	2
Surface (paved or unpaved)?	Unpaved
Flow length, L	ft 720.0 ✓
Watercourse slope, s	ft/ft 0.0200 ✓
	0.5
Avg.V = Csf * (s)	ft/s 2.2818
where: Unpaved Csf = 16.1345	
Paved Csf = 20.3282	
T = L / (3600*V)	hrs 0.09 = 0.09

CHANNEL FLOW

Segment ID	
Cross Sectional Flow Area, a	sq.ft 0.00
Wetted perimeter, Pw	ft 0.00
Hydraulic radius, r = a/Pw	ft 0.000
Channel slope, s	ft/ft 0.0000
Manning's roughness coeff., n	0.0000

	2/3 1/2
	1.49 * r * s
V =	ft/s 0.0000
	n

Flow length, L	ft 0
----------------	------

T = L / (3600*V)	hrs 0.00 = 0.00
------------------	-----------------

.....  
 TOTAL TIME (hrs) 0.23

Quick TR-55 Ver.5.46 S/N:  
 Executed: 08:55:25 06-18-1997 a:COVER1.TCT

Dairyland Power Coop.  
 Feasibility Report  
 Landfill Final Cover  
 BJK 3/97

✓ BJK  
 6/13/97

Tc COMPUTATIONS FOR: 1D

SHEET FLOW (Applicable to Tc only)

Segment ID	1	
Surface description	Dense Grass	
Manning's roughness coeff., n	0.2400	
Flow length, L (total < or = 300)	ft 160.0	✓
Two-yr 24-hr rainfall, P2	in 2.800	
Land slope, s	ft/ft 0.2500	✓
	0.8	
	.007 * (n*L)	
T =	-----	
	0.5 0.4	
	P2 * s	
	hrs 0.13	= 0.13

SHALLOW CONCENTRATED FLOW

Segment ID	2	
Surface (paved or unpaved)?	Unpaved	
Flow length, L	ft 1770.0	✓
Watercourse slope, s	ft/ft 0.0200	✓
	0.5	
Avg.V = Csf * (s)	ft/s 2.2818	
where: Unpaved Csf = 16.1345		
Paved Csf = 20.3282		
T = L / (3600*V)	hrs 0.22	= 0.22

CHANNEL FLOW

Segment ID	
Cross Sectional Flow Area, a	sq.ft 0.00
Wetted perimeter, Pw	ft 0.00
Hydraulic radius, r = a/Pw	ft 0.000
Channel slope, s	ft/ft 0.0000
Manning's roughness coeff., n	0.0000

	2/3 1/2
1.49 * r * s	
V =	-----
	n
	ft/s 0.0000

Flow length, L	ft 0
----------------	------

T = L / (3600*V)	hrs 0.00	= 0.00
------------------	----------	--------

.....  
 TOTAL TIME (hrs) 0.35



Quick TR-55 Ver.5.46 S/N:  
 Executed: 08:55:25 06-18-1997 a:COVER1.TCT

✓  
 6/13/97

Dairyland Power Coop.  
 Feasibility Report  
 Landfill Final Cover  
 BJK 3/97

Tc COMPUTATIONS FOR: 1E

SHEET FLOW (Applicable to Tc only)

Segment ID	1		
Surface description	Dense Grass		
Manning's roughness coeff., n	0.2400		
Flow length, L (total < or = 300)	ft	175.0	✓
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.2500	✓
	0.8		
	.007 * (n*L)		
T =	-----	hrs	0.14 = 0.14
	0.5 0.4		
	P2 * s		

SHALLOW CONCENTRATED FLOW

Segment ID	2		
Surface (paved or unpaved)?	Unpaved		
Flow length, L	ft	250.0	✓
Watercourse slope, s	ft/ft	0.0200	✓
	0.5		
Avg.V = Csf * (s)	ft/s	2.2818	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.03	= 0.03

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
	2/3 1/2		
	1.49 * r * s		
V =	-----	ft/s	0.0000
	n		
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

.....  
 TOTAL TIME (hrs) 0.18

Quick TR-55 Ver.5.46 S/W:  
 Executed: 09:48:41 04-09-1997 a:COVER1.TCT

Dairyland Power Coop.  
 Feasibility Report  
 Landfill Final Cover  
 BJK 3/97

*12/5*  
*6/13/97*

Tc COMPUTATIONS FOR: 1F

SHEET FLOW (Applicable to Tc only)

Segment ID	1	
Surface description	Dense Grass	
Manning's roughness coeff., n	0.2400	
Flow length, L (total < or = 300)	ft 150.0	✓
Two-yr 24-hr rainfall, P2	in 2.800	
Land slope, s	ft/ft 0.2500	✓
	0.8	
	.007 * (n*L)	
T =	hrs 0.13	= 0.13
	0.5 0.4	
	P2 * s	

SHALLOW CONCENTRATED FLOW

Segment ID	2	
Surface (paved or unpaved)?	Unpaved	
Flow length, L	ft 2650.0	✓
Watercourse slope, s	ft/ft 0.0200	✓
	0.5	
Avg.V = Csf * (s)	ft/s 2.2818	
where: Unpaved Csf = 16.1345		
Paved Csf = 20.3282		
T = L / (3600*V)	hrs 0.32	= 0.32

CHANNEL FLOW

Segment ID		
Cross Sectional Flow Area, a	sq.ft	0.00
Wetted perimeter, Pw	ft	0.00
Hydraulic radius, r = a/Pw	ft	0.000
Channel slope, s	ft/ft	0.0000
Manning's roughness coeff., n		0.0000

	2/3	1/2
	1.49 * r	* s
V =	ft/s 0.0000	
	n	

Flow length, L	ft	0
----------------	----	---

T = L / (3600*V)	hrs	0.00	= 0.00
------------------	-----	------	--------

.....  
 TOTAL TIME (hrs) 0.45

Quick TR-55 Ver.5.46 S/N:  
 Executed: 09:48:41 04-09-1997 a:COVER1.TCT

Dairyland Power Coop.  
 Feasibility Report  
 Landfill Final Cover  
 BJK 3/97

✓B2B  
 6/13/97

Tc COMPUTATIONS FOR: 1G

SHEET FLOW (Applicable to Tc only)

Segment ID	1	
Surface description	Dense Grass	
Manning's roughness coeff., n	0.2400	
Flow length, L (total < or = 300)	ft 170.0 ✓	
Two-yr 24-hr rainfall, P2	in 2.800	
Land slope, s	ft/ft 0.2500	
	0.8	
	.007 * (n*L)	
T =	hrs 0.14	= 0.14
	0.5 0.4	
	P2 * s	

SHALLOW CONCENTRATED FLOW

Segment ID	2	3
Surface (paved or unpaved)?	Unpaved	Unpaved
Flow length, L	ft 780.0 ✓	370.0 ✓
Watercourse slope, s	ft/ft 0.0600	0.0800
	0.5	
Avg.V = Csf * (s)	ft/s 3.9521	4.5635
where: Unpaved Csf = 16.1345		
Paved Csf = 20.3282		
T = L / (3600*V)	hrs 0.05 + 0.02	= 0.08

CHANNEL FLOW

Segment ID	
Cross Sectional Flow Area, a	sq.ft 0.00
Wetted perimeter, Pw	ft 0.00
Hydraulic radius, r = a/Pw	ft 0.000
Channel slope, s	ft/ft 0.0000
Manning's roughness coeff., n	0.0000
	2/3 1/2
	1.49 * r * s
V =	ft/s 0.0000
	n
Flow length, L	ft 0
T = L / (3600*V)	hrs 0.00
	= 0.00

.....  
 TOTAL TIME (hrs) 0.22

Quick TR-55 Ver.5.46 S/N:  
Executed: 08:57:44 06-18-1997 a:COVER2.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS  
(Solved for Time using TR-55 Methods)

Dairyland Power Coop.  
Feasibility Report  
Landfill Final Cover  
BJK 3/97

Subarea descr.	Tc or Tt	Time (hrs)
2A	Tc	0.28
2B	Tc	0.18



Dairyland Power Coop.  
 Feasibility Report  
 Landfill Final Cover  
 BJK 3/97

✓  
 6/13/97

Tc COMPUTATIONS FOR: 2A

SHEET FLOW (Applicable to Tc only)

Segment ID	1	
Surface description	Dense Grass	
Manning's roughness coeff., n	0.2400	
Flow length, L (total < or = 300)	ft 200.0	✓
Two-yr 24-hr rainfall, P2	in 2.800	
Land slope, s	ft/ft 0.2500	✓
	0.8	
	.007 * (n*L)	
T =	hrs 0.16	= 0.16
	0.5 0.4	
	P2 * s	

SHALLOW CONCENTRATED FLOW

Segment ID	2	
Surface (paved or unpaved)?	Unpaved	
Flow length, L	ft 940.0	✓
Watercourse slope, s	ft/ft 0.0200	✓
	0.5	
Avg.V = Csf * (s)	ft/s 2.2818	
where: Unpaved Csf = 16.1345		
Paved Csf = 20.3282		
T = L / (3600*V)	hrs 0.11	= 0.11

CHANNEL FLOW

Segment ID		
Cross Sectional Flow Area, a	sq.ft 0.00	
Wetted perimeter, Pw	ft 0.00	
Hydraulic radius, r = a/Pw	ft 0.000	
Channel slope, s	ft/ft 0.0000	
Manning's roughness coeff., n	0.0000	
	2/3 1/2	
	1.49 * r * s	
V =	ft/s 0.0000	
	n	
Flow length, L	ft 0	
T = L / (3600*V)	hrs 0.00	= 0.00

.....  
 TOTAL TIME (hrs) 0.28

Quick TR-55 Ver.5.46 S/N:  
 Executed: 08:57:44 06-18-1997 a:COVER2.TCT

Dairyland Power Coop.  
 Feasibility Report  
 Landfill Final Cover  
 BJK 3/97

Tc COMPUTATIONS FOR: 2B

SHEET FLOW (Applicable to Tc only)

Segment ID	1		
Surface description	Brush		
Manning's roughness coeff., n	0.1300		
Flow length, L (total < or = 300)	ft	300.0	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.2000	
	0.8		
	.007 * (n*L)		
T =	-----	hrs	0.15 = 0.15
	0.5 0.4		
	P2 * s		

SHALLOW CONCENTRATED FLOW

Segment ID	2	3
Surface (paved or unpaved)?	Unpaved	Unpaved
Flow length, L	ft	560.0 300.0
Watercourse slope, s	ft/ft	0.4400 0.0800
	0.5	
Avg.V = Csf * (s)	ft/s	X10.7024 4.5635
where: Unpaved Csf = 16.1345		
Paved Csf = 20.3282		
T = L / (3600*V)	hrs	0.01 + 0.02 = 0.03

CHANNEL FLOW

Segment ID	
Cross Sectional Flow Area, a	sq.ft 0.00
Wetted perimeter, Pw	ft 0.00
Hydraulic radius, r = a/Pw	ft 0.000
Channel slope, s	ft/ft 0.0000
Manning's roughness coeff., n	0.0000
	2/3 1/2
	1.49 * r * s
V =	-----
	n
	ft/s 0.0000
Flow length, L	ft 0
T = L / (3600*V)	hrs 0.00 = 0.00

.....  
 TOTAL TIME (hrs) 0.18

Return Frequency: 25 years

## TR-55 TABULAR HYDROGRAPH METHOD

Type II. Distribution

(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:33

Watershed file: --&gt; P:\DATA\PROJECTS\3081\40\SW\COVER1 .MOP

Hydrograph file: --&gt; P:\DATA\PROJECTS\3081\40\SW\COVER125.HYD

Dairyland Power Coop.

Fesibility Study

Landfill Cover

BJK 3/97

## &gt;&gt;&gt;&gt; Input Parameters Used to Compute Hydrograph &lt;&lt;&lt;&lt;

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
1A	1.40	74.0	0.20	0.00	4.90	2.28	1.14 .14
1B	2.20	74.0	0.20	0.00	4.90	2.28	1.14 .14
1C	2.90	74.0	0.20	0.00	4.90	2.28	1.14 .14
1D	5.30	74.0	0.40	0.00	4.90	2.28	1.14 .14
1E	1.20	74.0	0.20	0.00	4.90	2.28	1.14 .14
1F	9.50	74.0	0.50	0.00	4.90	2.28	1.14 .14
1G	7.40	84.0	0.20	0.00	4.90	3.18	1.08 .10

\* Travel time from subarea outfall to composite watershed outfall point.

I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 29.90 acres or 0.04672 sq.mi

Peak discharge = 67 cfs

WARNING: Drainage areas of two or more subareas  
differ by a factor of 5 or greater.

$$\begin{aligned} \text{Total Runoff} &= \\ \frac{22.5 \text{ ac}(2.28") + 7.4 \text{ ac}(3.18")}{12} \\ &= 6.2 \text{ ac} - \text{FT} \end{aligned}$$

## &gt;&gt;&gt;&gt; Computer Modifications of Input Parameters &lt;&lt;&lt;&lt;

Subarea Description	Input Values		Rounded Values		Ia/p	
	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)	Interpolated (Yes/No)	Ia/p Messages
1A	0.18	0.00	0.20	0.00	Yes	--
1B	0.23	0.00	0.20	0.00	Yes	--
1C	0.23	0.00	0.20	0.00	Yes	--
1D	0.35	0.00	0.40	0.00	Yes	--
1E	0.18	0.00	0.20	0.00	Yes	--
1F	0.45	0.00	0.50	0.00	Yes	--
1G	0.22	0.00	0.20	0.00	No	Computed Ia/p < .1

\* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD  
Type II. Distribution  
(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:33

Watershed file: --&gt; P:\DATA\PROJECTS\3081\40\SW\COVER1 .MOP

Hydrograph file: --&gt; P:\DATA\PROJECTS\3081\40\SW\COVER125.HYD

Dairyland Power Coop.  
Fesibility Study  
Landfill Cover  
BJK 3/97

## &gt;&gt;&gt;&gt; Summary of Subarea Times to Peak &lt;&lt;&lt;&lt;

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
1A	4	12.2
1B	6	12.2
1C	8	12.2
1D	11	12.3
1E	3	12.1
1F	17	12.4
1G	29	12.2
Composite Watershed	67	12.2



## TR-55 TABULAR HYDROGRAPH METHOD

Type II. Distribution

(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:33

Watershed file: --&gt; P:\DATA\PROJECTS\3081\40\SW\COVER1 .MOP

Hydrograph file: --&gt; P:\DATA\PROJECTS\3081\40\SW\COVER125.HYD

Dairyland Power Coop.

Fesibility Study

Landfill Cover

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## Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
1A	0	0	0	1	2	3	4	2	1
1B	0	0	0	1	3	5	6	4	2
1C	0	0	0	2	4	7	8	5	3
1D	0	0	1	1	2	5	8	11	11
1E	0	0	0	1	2	3	3	2	1
1F	0	1	1	2	3	5	9	15	17
1G	1	1	2	8	15	27	29	18	9
Total (cfs)	1	2	4	16	31	55	67	57	44

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
1A	1	1	1	0	0	0	0	0	0
1B	1	1	1	1	1	1	0	0	0
1C	2	1	1	1	1	1	1	1	0
1D	8	6	4	3	2	2	1	1	1
1E	1	1	0	0	0	0	0	0	0
1F	17	13	10	8	5	3	3	2	2
1G	6	5	4	3	3	2	2	2	2
Total (cfs)	36	28	21	16	12	9	7	6	5

## TR-55 TABULAR HYDROGRAPH METHOD

Type II. Distribution

(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:33

Watershed file: --&gt; P:\DATA\PROJECTS\3081\40\SW\COVER1 .MOP

Hydrograph file: --&gt; P:\DATA\PROJECTS\3081\40\SW\COVER125.HYD

Dairyland Power Coop.

Fesibility Study

Landfill Cover

BJK 3/97

## Composite Hydrograph Summary (cfs)

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
1A	0	0	0	0	0	0	0	0	0
1B	0	0	0	0	0	0	0	0	0
1C	0	0	0	0	0	0	0	0	0
1D	1	1	1	1	1	1	0	0	0
1E	0	0	0	0	0	0	0	0	0
1F	2	1	1	1	1	1	1	1	1
1G	1	1	1	1	1	1	1	1	1
Total (cfs)	4	3	3	3	3	3	2	2	2

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
1A	0	0	0	0	0
1B	0	0	0	0	0
1C	0	0	0	0	0
1D	0	0	0	0	0
1E	0	0	0	0	0
1F	1	1	1	0	0
1G	1	1	0	0	0
Total (cfs)	2	2	1	0	0

## TR-55 TABULAR HYDROGRAPH METHOD

Type II. Distribution

(24 hr. Duration Storm)

Executed: 07-30-1998 11:54:55

Watershed file: --&gt; A:COVER1 .MOP

Hydrograph file: --&gt; A:COVER100.HYD

Dairyland Power Coop.

Fesibility Study

Landfill Cover

BJK 3/97

1320  
5/20/98

## &gt;&gt;&gt;&gt; Input Parameters Used to Compute Hydrograph &lt;&lt;&lt;&lt;

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
1A	1.40	74.0	0.20	0.00	6.10	3.27	1.12 .12
1B	2.20	74.0	0.20	0.00	6.10	3.27	1.12 .12
1C	2.90	74.0	0.20	0.00	6.10	3.27	1.12 .12
1D	5.30	74.0	0.40	0.00	6.10	3.27	1.12 .12
1E	1.20	74.0	0.20	0.00	6.10	3.27	1.12 .12
1F	9.50	74.0	0.50	0.00	6.10	3.27	1.12 .12
1G	7.40	84.0	0.20	0.00	6.10	4.29	1.06 .10

\* Travel time from subarea outfall to composite watershed outfall point.

I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 29.90 acres or 0.04672 sq.mi

Peak discharge = 98 cfs

WARNING: Drainage areas of two or more subareas  
differ by a factor of 5 or greater.

$$\begin{aligned} \text{Total Runoff} &= \\ &= \frac{22.5 \text{ ac } (3.27'') + 7.4 \text{ ac } (4.29'')}{12} \\ &= 3.8 \text{ ac-ft} \end{aligned}$$

## &gt;&gt;&gt;&gt; Computer Modifications of Input Parameters &lt;&lt;&lt;&lt;

Subarea Description	Input Values		Rounded Values		Ia/p	
	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)	Interpolated (Yes/No)	Ia/p Messages
1A	0.18	0.00	0.20	0.00	Yes	--
1B	0.23	0.00	0.20	0.00	Yes	--
1C	0.23	0.00	0.20	0.00	Yes	--
1D	0.35	0.00	0.40	0.00	Yes	--
1E	0.18	0.00	0.20	0.00	Yes	--
1F	0.45	0.00	0.50	0.00	Yes	--
1G	0.22	0.00	0.20	0.00	No	Computed Ia/p < .1

\* Travel time from subarea outfall to composite watershed outfall point.

## TR-55 TABULAR HYDROGRAPH METHOD

Type II. Distribution

(24 hr. Duration Storm)

Executed: 07-30-1998 11:54:55

Watershed file: --&gt; A:COVER1 .MOP

Hydrograph file: --&gt; A:COVER100.HYD

Dairyland Power Coop.

Fesibility Study

Landfill Cover

BJK 3/97

## &gt;&gt;&gt;&gt; Summary of Subarea Times to Peak &lt;&lt;&lt;&lt;

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
1A	6	12.2
1B	9	12.2
1C	12	12.2
1D	16	12.3
1E	5	12.2
1F	25	12.4
1G	40	12.2
-----	-----	-----
Composite Watershed	98	12.2



## TR-55 TABULAR HYDROGRAPH METHOD

Type II. Distribution

(24 hr. Duration Storm)

Executed: 07-30-1998 11:54:55

Watershed file: --&gt; A:COVER1 .MOP

Hydrograph file: --&gt; A:COVER100.HYD

Dairyland Power Coop.

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## Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
1A	0	0	0	1	3	5	6	3	2
1B	0	0	0	2	4	8	9	5	3
1C	0	0	1	3	6	11	12	7	4
1D	0	1	1	2	4	7	12	16	15
1E	0	0	0	1	2	4	5	3	2
1F	1	1	1	2	4	8	14	22	25
1G	1	2	2	10	20	37	40	24	12
Total (cfs)	2	4	5	21	43	80	98	80	63

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
1A	1	1	1	1	1	0	0	0	0
1B	2	1	1	1	1	1	1	1	1
1C	3	2	2	1	1	1	1	1	1
1D	12	8	6	4	3	2	2	2	1
1E	1	1	1	1	0	0	0	0	0
1F	24	19	14	11	7	5	4	3	3
1G	8	6	5	4	3	3	3	2	2
Total (cfs)	51	38	30	23	16	12	11	9	8

## TR-55 TABULAR HYDROGRAPH METHOD

Type II. Distribution

(24 hr. Duration Storm)

Executed: 07-30-1998 11:54:55

Watershed file: --&gt; A:COVER1 .MOP

Hydrograph file: --&gt; A:COVER100.HYD

Dairyland Power Coop.

Fesibility Study

Landfill Cover

BJK 3/97

## Composite Hydrograph Summary (cfs)

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
1A	0	0	0	0	0	0	0	0	0
1B	0	0	0	0	0	0	0	0	0
1C	1	1	1	0	0	0	0	0	0
1D	1	1	1	1	1	1	1	1	1
1E	0	0	0	0	0	0	0	0	0
1F	2	2	2	2	1	1	1	1	1
1G	2	2	2	1	1	1	1	1	1
Total (cfs)	6	6	6	4	3	3	3	3	3

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
1A	0	0	0	0	0
1B	0	0	0	0	0
1C	0	0	0	0	0
1D	1	0	0	0	0
1E	0	0	0	0	0
1F	1	1	1	1	0
1G	1	1	1	1	0
Total (cfs)	3	2	2	2	0

Return Frequency: 25 years

## TR-55 TABULAR HYDROGRAPH METHOD

Type II. Distribution

(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:16

Watershed file: --&gt; P:\DATA\PROJECTS\3081\40\SW\COVER2 .MOP

Hydrograph file: --&gt; P:\DATA\PROJECTS\3081\40\SW\COVER225.HYD

Dairyland Power Coop.

Fesibility Study

Landfill Cover

BJK 3/97

## &gt;&gt;&gt;&gt; Input Parameters Used to Compute Hydrograph &lt;&lt;&lt;&lt;

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
2A	2.70	74.0	0.30	0.00	4.90	2.28	1.14 .14
2B	21.50	69.0	0.20	0.00	4.90	1.89	1.18 .18

\* Travel time from subarea outfall to composite watershed outfall point.

I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 24.20 acres or 0.03781 sq.mi

Peak discharge = 54 cfs

WARNING: Drainage areas of two or more subareas  
differ by a factor of 5 or greater.

## &gt;&gt;&gt;&gt; Computer Modifications of Input Parameters &lt;&lt;&lt;&lt;

Subarea Description	Input Values		Rounded Values		Ia/p	
	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)	Interpolated (Yes/No)	Ia/p Messages
2A	0.28	0.00	0.30	0.00	Yes	--
2B	0.18	0.00	0.20	0.00	Yes	--

\* Travel time from subarea outfall to composite watershed outfall point.

Return Frequency: 25 years

## TR-55 TABULAR HYDROGRAPH METHOD

Type II. Distribution

(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:16

Watershed file: --&gt; P:\DATA\PROJECTS\3081\40\SW\COVER2 .MOP

Hydrograph file: --&gt; P:\DATA\PROJECTS\3081\40\SW\COVER225.HYD

Dairyland Power Coop.

Fesibility Study

Landfill Cover

BJK 3/97

## &gt;&gt;&gt;&gt; Summary of Subarea Times to Peak &lt;&lt;&lt;&lt;

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
2A	6	12.2
2B	48	12.2
Composite Watershed	54	12.2



## TR-55 TABULAR HYDROGRAPH METHOD

Type II. Distribution

(24 hr. Duration Storm)

Executed: 09-18-2000 12:51:16

Watershed file: --&gt; P:\DATA\PROJECTS\3081\40\SW\COVER2 .MOP

Hydrograph file: --&gt; P:\DATA\PROJECTS\3081\40\SW\COVER225.HYD

Dairyland Power Coop.

Fesibility Study

Landfill Cover

BJK 3/97

## Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
2A	0	0	0	1	2	4	6	6	4
2B	1	1	2	9	20	42	48	31	17
Total (cfs)	1	1	2	10	22	46	54	37	21

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
2A	3	2	1	1	1	1	1	1	0
2B	11	9	7	6	5	4	4	4	3
Total (cfs)	14	11	8	7	6	5	5	5	3

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
2A	0	0	0	0	0	0	0	0	0
2B	3	3	2	2	2	2	2	2	1
Total (cfs)	3	3	2	2	2	2	2	2	1

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
2A	0	0	0	0	0
2B	1	1	1	1	0

Return Frequency: 100 years

## TR-55 TABULAR HYDROGRAPH METHOD

Type II. Distribution

(24 hr. Duration Storm)

Executed: 10-01-1998 15:19:47

Watershed file: --&gt; A:\COVER2 .MOP

Hydrograph file: --&gt; A:\COVER200.HYD

Dairyland Power Coop.

Fesibility Study

Landfill Cover

BJK 3/97

## &gt;&gt;&gt;&gt; Input Parameters Used to Compute Hydrograph &lt;&lt;&lt;&lt;

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
2A	2.70	74.0	0.30	0.00	6.10	3.27	1.12 .12
2B	21.50	69.0	0.20	0.00	6.10	2.79	1.15 .15

\* Travel time from subarea outfall to composite watershed outfall point.

I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 24.20 acres or 0.03781 sq.mi

Peak discharge = 82 cfs

WARNING: Drainage areas of two or more subareas  
differ by a factor of 5 or greater.

## &gt;&gt;&gt;&gt; Computer Modifications of Input Parameters &lt;&lt;&lt;&lt;

Subarea Description	Input Values		Rounded Values		Ia/p	
	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)	Interpolated (Yes/No)	Ia/p Messages
2A	0.28	0.00	0.30	0.00	Yes	--
2B	0.18	0.00	0.20	0.00	Yes	--

\* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD  
Type II. Distribution  
(24 hr. Duration Storm)

Executed: 10-01-1998 15:19:47  
Watershed file: --> A:\COVER2 .MOP  
Hydrograph file: --> A:\COVER200.HYD

Dairyland Power Coop.  
Fesibility Study  
Landfill Cover  
BJK 3/97

## &gt;&gt;&gt;&gt; Summary of Subarea Times to Peak &lt;&lt;&lt;&lt;

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
2A	9	12.2
2B	73	12.2
Composite Watershed	82	12.2

## TR-55 TABULAR HYDROGRAPH METHOD

Type II. Distribution

(24 hr. Duration Storm)

Executed: 10-01-1998 15:19:47

Watershed file: --&gt; A:\COVER2 .MOP

Hydrograph file: --&gt; A:\COVER200.HYD

Dairyland Power Coop.

Fesibility Study

Landfill Cover

BJK 3/97

## Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
2A	0	0	1	1	3	6	9	9	6
2B	2	2	3	16	33	65	73	45	24
Total (cfs)	2	2	4	17	36	71	82	54	30

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
2A	4	3	2	2	1	1	1	1	1
2B	16	13	10	9	7	6	6	5	5
Total (cfs)	20	16	12	11	8	7	7	6	6

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
2A	1	1	0	0	0	0	0	0	0
2B	4	4	3	3	3	3	2	2	2
Total (cfs)	5	5	3	3	3	3	2	2	2

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
2A	0	0	0	0	0
2B	2	2	1	1	0



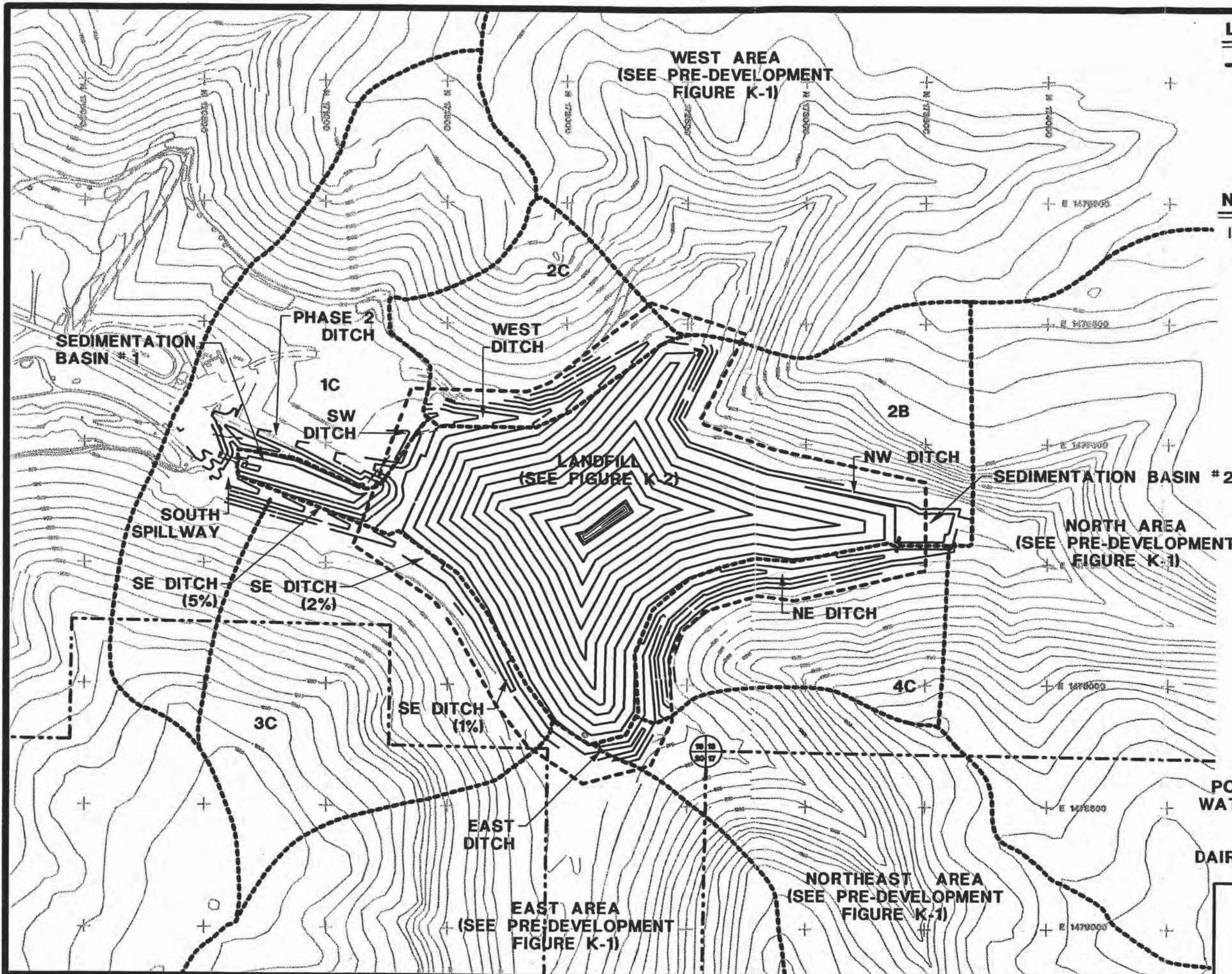
# LEGEND

----- DRAINAGE AREA DIVIDE

**3C** WEST AREA DRAINAGE AREA DESIGNATION

## NOTES:

1. REFER TO FIGURE K-2 FOR DRAINAGE AREAS ALONG THE LANDFILL FINAL COVER.



**POST-DEVELOPMENT SURFACE  
WATER MANAGEMENT FEATURES  
-EXTERIOR AREAS**

**DAIRYLAND POWER COOPERATIVE**

**RMT**

Drawn By:	JCD
Approved By:	
Date:	SEPT. 2000
Proj. #:	3081.40
File #:	FIG-L-3.PLT

**FIGURE K-3**

(1) 4-6, 9, 10, 12, 21, 23, 24, 26-28, 32, 34, 40, 43, 45, 54, 55, 57, 61  
(2) 1-4, 10-16  
(3) 33, 45-50  
(4) 2, 3, 14-16

(1) bms  
(2) bms  
(3) bms  
(4) bms

Ref. File 1 = bndlent.dgn  
Ref. File 2 = bmrmt.dgn  
Ref. File 3 = proposed.dgn  
Ref. File 4 = surface.dgn

Design File = J:\0308\40\FIG-L-3.PLT  
DEFLOT.Dwg = Tue Sep 19 11:21:17 2000  
Plot File = J:\0308\40\FIG-L-3.plt  
Pen Table = J:\NET\TBL\default.tbl  
Levels On = 13



Quick TR-55 Ver.5.46 S/N:  
Executed: 11:43:33 07-30-1998

Dairyland Power Coop.  
Feasibility Report  
PostDevelopment Conditions  
BJK 5/97 rev 7/98

RUNOFF CURVE NUMBER SUMMARY

.....

Subarea Description	Area (acres)	CN (weighted)
-----	-----	-----
1C	42.00	67
2C	15.00	56
3C	33.00	58
4C	16.00	57
East	520.00	67
Northeast	80.00	63
North	236.00	63
West	100.00	71

Quick TR-55 Ver.5.46 S/N:  
Executed: 11:43:33 07-30-1998

Dairyland Power Coop.  
Feasibility Report  
PostDevelopment Conditions  
BJK 5/97 rev 7/98

✓ BJB  
8/20/98

RUNOFF CURVE NUMBER DATA

.....

Composite Area: 1C

SURFACE DESCRIPTION	AREA (acres)	CN
Woods (35%)	15.00	55
Existing Landfill (50%)	21.00	74
Graded Areas (10%)	4.00	61
Fallow - Bare Soil (5%)	2.00	86
COMPOSITE AREA --->	42.00	66.5 ( 67 )

.....

Composite Area: 2C

SURFACE DESCRIPTION	AREA (acres)	CN
Woods (85%)	12.80	55
Graded Areas (15%)	2.20	61
COMPOSITE AREA --->	15.00	55.9 ( 56 )

.....

Composite Area: 3C

SURFACE DESCRIPTION	AREA (acres)	CN
Woods (80%)	27.00	55
Graded Areas (10%)	3.00	61
Fallow - Bare Soil (10%)	3.00	86
COMPOSITE AREA --->	33.00	58.4 ( 58 )

.....

Quick TR-55 Ver.5.46 S/N:  
Executed: 11:43:33 07-30-1998

✓B2B  
8/20/98

Composite Area: 4C

SURFACE DESCRIPTION	AREA (acres)	CN
Woods (75%)	12.00	55
Graded Areas (25%)	4.00	61
COMPOSITE AREA --->	16.00	56.5 ( 57 )

Composite Area: East

SURFACE DESCRIPTION	AREA (acres)	CN
Woods (60%)	312.00	55
Fallow - Bare Soil (40%)	208.00	86
COMPOSITE AREA --->	520.00	67.4 ( 67 )

Composite Area: Northeast

SURFACE DESCRIPTION	AREA (acres)	CN
Woods (75%)	60.00	55
Fallow - Bare Soil (25%)	20.00	86
COMPOSITE AREA --->	80.00	62.8 ( 63 )

Composite Area: North

SURFACE DESCRIPTION	AREA (acres)	CN
Woods (75%)	177.00	55
Fallow - Bare Soil (25%)	59.00	86
COMPOSITE AREA --->	236.00	62.8 ( 63 )



Quick TR-55 Ver.5.46 S/N:  
Executed: 11:43:33 07-30-1998

✓BAG  
8/20/98

Composite Area: West

SURFACE DESCRIPTION	AREA (acres)	CN
Woods (50%)	50.00	55
Fallow - Bare Soil (50%)	50.00	86
COMPOSITE AREA --->	100.00	70.5 ( 71 )

.....

Quick TR-55 Ver.5.46 S/N:  
Executed: 09:21:09 05-09-1997 a:POSTDVTC.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS  
(Solved for Time using TR-55 Methods)

Dairyland Power Coop.  
Feasibility Report  
PostDevelopment Conditions  
BJK 5/97

Subarea descr.	Tc or Tt	Time (hrs)
1C	Tc	0.35
2C	Tc	0.32
3C	Tc	0.41
4C	Tc	0.38
East	Tc	0.68
Northeast	Tc	0.37
North	Tc	0.53
West	Tc	0.52

Quick TR-55 Ver.5.46 S/N:  
 Executed: 09:21:09 05-09-1997 a:POSTDVTC.TCT

Dairyland Power Coop.  
 Feasibility Report  
 PostDevelopment Conditions  
 BJK 5/97

*SBG*  
 6/17/97

Tc COMPUTATIONS FOR: 1C

SHEET FLOW (Applicable to Tc only)

Segment ID	1
Surface description	Woods
Manning's roughness coeff., n	0.4000
Flow length, L (total < or = 300)	ft 300.0 ✓
Two-yr 24-hr rainfall, P2	in 2.800
Land slope, s	ft/ft 0.2700 ✓
0.8	
.007 * (n*L)	
T =	hrs 0.33 = 0.33
0.5 0.4	
P2 * s	

SHALLOW CONCENTRATED FLOW

Segment ID	2
Surface (paved or unpaved)?	Unpaved
Flow length, L	ft 650.0 ✓
Watercourse slope, s	ft/ft 0.5000 ✓
0.5	
Avg.V = Csf * (s)	ft/s %11.4088
where: Unpaved Csf = 16.1345	
Paved Csf = 20.3282	
T = L / (3600*V)	hrs 0.02 = 0.02

CHANNEL FLOW

Segment ID	3
Cross Sectional Flow Area, a	sq.ft 42.00
Wetted perimeter, Pw	ft 28.00
Hydraulic radius, r = a/Pw	ft 1.500
Channel slope, s	ft/ft 0.1500 ✓
Manning's roughness coeff., n	0.0450
2/3 1/2	
1.49 * r * s	
V =	ft/s %16.8040
n	
Flow length, L	ft 500 ✓
T = L / (3600*V)	hrs 0.01 = 0.01

.....  
 TOTAL TIME (hrs) 0.35

Quick TR-55 Ver.5.46 S/N:  
 Executed: 09:21:09 05-09-1997 a:POSTDVTC.TCT

Dairyland Power Coop.  
 Feasibility Report  
 PostDevelopment Conditions  
 BJK 5/97

✓ BJK  
 6/17/97

Tc COMPUTATIONS FOR: 2C

SHEET FLOW (Applicable to Tc only)

Segment ID	1		
Surface description	Woods		
Manning's roughness coeff., n	0.4000		
Flow length, L (total < or = 300)	ft 300.0 ✓		
Two-yr 24-hr rainfall, P2	in 2.800		
Land slope, s	ft/ft 0.4200 ✓		
0.8			
.007 * (n*L)			
T =	hrs 0.27	=	0.27
0.5 0.4			
P2 * s			

SHALLOW CONCENTRATED FLOW

Segment ID	2		
Surface (paved or unpaved)?	Unpaved		
Flow length, L	ft 370.0 ✓		
Watercourse slope, s	ft/ft 0.4200 ✓		
0.5			
Avg.V = Csf * (s)	ft/s 10.4564		
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs 0.01	=	0.01

CHANNEL FLOW

Segment ID	3		
Cross Sectional Flow Area, a	sq.ft 17.00		
Wetted perimeter, Pw	ft 17.00		
Hydraulic radius, r = a/Pw	ft 1.000		
Channel slope, s	ft/ft 0.0600 ✓		
Manning's roughness coeff., n	0.0450		
2/3 1/2			
1.49 * r * s			
V =	ft/s 8.1105		
n			
Flow length, L	ft 1050 ✓		
T = L / (3600*V)	hrs 0.04	=	0.04

=====

TOTAL TIME (hrs)	0.32
------------------	------



Quick TR-55 Ver.5.46 S/N:  
 Executed: 09:21:09 05-09-1997 a:POSTDVTC.TCT

✓  
 BJK  
 6/17/97

Dairyland Power Coop.  
 Feasibility Report  
 PostDevelopment Conditions  
 BJK 5/97

Tc COMPUTATIONS FOR: 3C

SHEET FLOW (Applicable to Tc only)

Segment ID	1	
Surface description	Row Crops	
Manning's roughness coeff., n	0.1700	✓
Flow length, L (total < or = 300)	ft 300.0	✓
Two-yr 24-hr rainfall, P2	in 2.800	
Land slope, s	ft/ft 0.0500	✓
0.8		
.007 * (n*L)		
T =	hrs 0.32	= 0.32
0.5 0.4		
P2 * s		

SHALLOW CONCENTRATED FLOW

Segment ID	2	
Surface (paved or unpaved)?	Unpaved	
Flow length, L	ft 1020.0	✓
Watercourse slope, s	ft/ft 0.3600	✓
0.5		
Avg.V = Csf * (s)	ft/s 9.6807	
where: Unpaved Csf = 16.1345		
Paved Csf = 20.3282		
T = L / (3600*V)	hrs 0.03	= 0.03

CHANNEL FLOW

Segment ID	3	
Cross Sectional Flow Area, a	sq.ft 150.00	✓
Wetted perimeter, Pw	ft 45.00	✓
Hydraulic radius, r = a/Pw	ft 3.333	
Channel slope, s	ft/ft 0.0150	✓
Manning's roughness coeff., n	0.0600	✓
2/3 1/2		
1.49 * r * s		
V =	ft/s 6.7868	
n		
Flow length, L	ft 1450	✓
T = L / (3600*V)	hrs 0.06	= 0.06

.....  
 TOTAL TIME (hrs) 0.41

Quick TR-55 Ver.5.46 S/N:  
 Executed: 09:21:09 05-09-1997 a:POSTDVTC.TCT

Dairyland Power Coop.  
 Feasibility Report  
 PostDevelopment Conditions  
 BJK 5/97

✓ BJK  
 6/17/97

Tc COMPUTATIONS FOR: 4C

SHEET FLOW (Applicable to Tc only)

Segment ID	1	
Surface description	Woods	
Manning's roughness coeff., n	0.4000	
Flow length, L (total < or = 300)	ft 300.0 ✓	
Two-yr 24-hr rainfall, P2	in 2.800	
Land slope, s	ft/ft 0.3700 ✓	
	0.8	
	.007 * (n*L)	
T =	hrs 0.29	= 0.29
	0.5 0.4	
	P2 * s	

SHALLOW CONCENTRATED FLOW

Segment ID	2	
Surface (paved or unpaved)?	Unpaved	
Flow length, L	ft 390.0 ✓	
Watercourse slope, s	ft/ft 0.5000 ✓	
	0.5	
Avg.V = Csf * (s)	ft/s 11.4088	
where: Unpaved Csf = 16.1345		
Paved Csf = 20.3282		
T = L / (3600*V)	hrs 0.01	= 0.01

CHANNEL FLOW

Segment ID	3	
Cross Sectional Flow Area, a	sq.ft 28.00 ✓	
Wetted perimeter, Pw	ft 20.00 ✓	
Hydraulic radius, r = a/Pw	ft 1.400	
Channel slope, s	ft/ft 0.0200 ✓	
Manning's roughness coeff., n	0.0500	
	2/3 1/2	
	1.49 * r * s	
V =	ft/s 5.2741	
	n	
Flow length, L	ft 1670 ✓	
T = L / (3600*V)	hrs 0.09	= 0.09

.....  
 TOTAL TIME (hrs) 0.38

Quick TR-55 Ver.5.46 S/N:  
 Executed: 09:21:09 05-09-1997 a:POSTDVTC.TCT

Dairyland Power Coop.  
 Feasibility Report  
 PostDevelopment Conditions  
 BJK 5/97

✓ BJB  
 6/17/97

Tc COMPUTATIONS FOR: East

SHEET FLOW (Applicable to Tc only)

Segment ID	1	
Surface description	Row Crops	
Manning's roughness coeff., n	0.1700	
Flow length, L (total < or = 300)	ft 300.0 ✓	
Two-yr 24-hr rainfall, P2	in 2.800	
Land slope, s	ft/ft 0.0500 ✓	
	0.8	
	.007 * (n*L)	
T =	hrs 0.32	= 0.32
	0.5 0.4	
	P2 * s	

SHALLOW CONCENTRATED FLOW

Segment ID	2	
Surface (paved or unpaved)?	Unpaved	
Flow length, L	ft 2000.0 ✓	
Watercourse slope, s	ft/ft 0.0700 ✓	
	0.5	
Avg.V = Csf * (s)	ft/s 4.2688	
where: Unpaved Csf = 16.1345		
Paved Csf = 20.3282		
T = L / (3600*V)	hrs 0.13	= 0.13

CHANNEL FLOW

Segment ID	3	4
Cross Sectional Flow Area, a	sq.ft 27.00	27.00
Wetted perimeter, Pw	ft 16.40	16.40
Hydraulic radius, r = a/Pw	ft 1.646	1.646
Channel slope, s	ft/ft 0.0700 ✓	0.0400 ✓
Manning's roughness coeff., n	0.0700	0.0700

	2/3	1/2
	1.49 * r	* s
V =	ft/s 7.8521	5.9356
	n	

Flow length, L	ft 2500 ✓	3000 ✓
----------------	-----------	--------

T = L / (3600*V)	hrs 0.09 + 0.14	= 0.23
------------------	-----------------	--------

.....  
 TOTAL TIME (hrs) 0.68

Quick TR-55 Ver.5.46 S/N:  
 Executed: 09:21:09 05-09-1997 a:POSTDVTC.TCT

Dairyland Power Coop.  
 Feasibility Report  
 PostDevelopment Conditions  
 BJK 5/97

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 6/17/97

Tc COMPUTATIONS FOR: Northeast

SHEET FLOW (Applicable to Tc only)

Segment ID	1	
Surface description	Row Crops	
Manning's roughness coeff., n	0.1700	
Flow length, L (total < or = 300)	ft 300.0 ✓	
Two-yr 24-hr rainfall, P2	in 2.800	
Land slope, s	ft/ft 0.0800 ✓	
0.8		
.007 * (n*L)		
T =	hrs 0.27	= 0.27
0.5 0.4		
P2 * s		

SHALLOW CONCENTRATED FLOW

Segment ID	2	
Surface (paved or unpaved)?	Unpaved	
Flow length, L	ft 600.0 ✓	
Watercourse slope, s	ft/ft 0.0700 ✓	
0.5		
Avg.V = Csf * (s)	ft/s 4.2688	
where: Unpaved Csf = 16.1345		
Paved Csf = 20.3282		
T = L / (3600*V)	hrs 0.04	= 0.04

CHANNEL FLOW

Segment ID	3	
Cross Sectional Flow Area, a	sq.ft 27.00	
Wetted perimeter, Pw	ft 16.40	
Hydraulic radius, r = a/Pw	ft 1.646	
Channel slope, s	ft/ft 0.1400 ✓	
Manning's roughness coeff., n	0.0700	
2/3 1/2		
1.49 * r * s		
V =	ft/s 11.1045	
n		
Flow length, L	ft 2400 ✓	
T = L / (3600*V)	hrs 0.06	= 0.06

.....  
 TOTAL TIME (hrs) 0.37



Quick TR-55 Ver.5.46 S/N:  
 Executed: 09:21:09 05-09-1997 a:POSTDVTC.TCT

Dairyland Power Coop.  
 Feasibility Report  
 PostDevelopment Conditions  
 BJK 5/97

✓  
 6/17/97

Tc COMPUTATIONS FOR: North

SHEET FLOW (Applicable to Tc only)

Segment ID	1	
Surface description	Row Crops	
Manning's roughness coeff., n	0.1700	
Flow length, L (total < or = 300)	ft 300.0 ✓	
Two-yr 24-hr rainfall, P2	in 2.800	
Land slope, s	ft/ft 0.0500 ✓	
	0.8	
	.007 * (n*L)	
T =	-----	hrs 0.32 = 0.32
	0.5 0.4	
	P2 * s	

SHALLOW CONCENTRATED FLOW

Segment ID	2	
Surface (paved or unpaved)?	Unpaved	
Flow length, L	ft 1000.0 ✓	
Watercourse slope, s	ft/ft 0.0600 ✓	
	0.5	
Avg.V = Csf * (s)	ft/s 3.9521	
where: Unpaved Csf = 16.1345		
Paved Csf = 20.3282		
T = L / (3600*V)	hrs 0.07	= 0.07

CHANNEL FLOW

Segment ID	3	
Cross Sectional Flow Area, a	sq.ft 27.00	
Wetted perimeter, Pw	ft 16.40	
Hydraulic radius, r = a/Pw	ft 1.646	
Channel slope, s	ft/ft 0.0830 ✓	
Manning's roughness coeff., n	0.0700	
	2/3 1/2	
	1.49 * r * s	
V =	-----	ft/s 8.5502
	n	
Flow length, L	ft 4200 ✓	
T = L / (3600*V)	hrs 0.14	= 0.14

.....  
 TOTAL TIME (hrs) 0.53



Quick TR-55 Ver.5.46 S/N:  
Executed: 11:30:57 06-18-1997 a:POSTDVT.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS  
(Solved for Time using TR-55 Methods)

Dairyland Power Coop.  
Feasibility Report  
PostDevelopment Conditions  
BJK 5/97

Subarea descr.	Tc or Tt	Time (hrs)
1C	Tt	0.00
2C	Tt	0.05
3C	Tt	0.01
4C	Tt	0.09
East	Tt	0.07
Northeast	Tt	0.09
North	Tt	0.18
West	Tt	0.08

Quick TR-55 Ver.5.46 S/N:  
 Executed: 09:24:17 05-09-1997 a:POSTDVTT.TCT

Dairyland Power Coop.  
 Feasibility Report  
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1028  
 6/17/97

Tt COMPUTATIONS FOR: 2C

SHEET FLOW (Applicable to Tc only)

Segment ID  
 Surface description  
 Manning's roughness coeff., n 0.0000  
 Flow length, L (total < or = 300) ft 0.0  
 Two-yr 24-hr rainfall, P2 in 0.000  
 Land slope, s ft/ft 0.0000  
 0.8  
 $.007 * (n * L)$   
 $T = \frac{0.5}{P2 * s} \frac{0.4}{0.0000} \text{ hrs} = 0.00$

SHALLOW CONCENTRATED FLOW

Segment ID  
 Surface (paved or unpaved)?  
 Flow length, L ft 0.0  
 Watercourse slope, s ft/ft 0.0000  
 0.5  
 $\text{Avg. } V = Csf * (s) \text{ ft/s} = 0.0000$   
 where: Unpaved Csf = 16.1345  
 Paved Csf = 20.3282  
 $T = L / (3600 * V) \text{ hrs} = 0.00$

CHANNEL FLOW

Segment ID 1  
 Cross Sectional Flow Area, a sq.ft 17.00  
 Wetted perimeter, Pw ft 17.00  
 Hydraulic radius, r = a/Pw ft 1.000  
 Channel slope, s ft/ft 0.0500 ✓  
 Manning's roughness coeff., n 0.0450

$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n} \text{ ft/s} = 7.4039$

Flow length, L ft 1200 ✓

$T = L / (3600 * V) \text{ hrs} = 0.05$

.....  
 TOTAL TIME (hrs) 0.05



Quick TR-55 Ver.5.46 S/N:  
 Executed: 09:24:17 05-09-1997 a:POSTDVT.TCT

Dairyland Power Coop.  
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 6/17/97

Tt COMPUTATIONS FOR: 3C

SHEET FLOW (Applicable to Tc only)

Segment ID  
 Surface description  
 Manning's roughness coeff., n 0.0000  
 Flow length, L (total < or = 300) ft 0.0  
 Two-yr 24-hr rainfall, P2 in 0.000  
 Land slope, s ft/ft 0.0000  
 0.8  
 $.007 * (n^2 L)$   
 $T = \frac{0.5}{P2 * s} \quad \text{hrs} \quad 0.00 \quad = \quad 0.00$

SHALLOW CONCENTRATED FLOW

Segment ID  
 Surface (paved or unpaved)?  
 Flow length, L ft 0.0  
 Watercourse slope, s ft/ft 0.0000  
 0.5  
 Avg.V = Csf \* (s) ft/s 0.0000  
 where: Unpaved Csf = 16.1345  
 Paved Csf = 20.3282  
 $T = L / (3600 * V) \quad \text{hrs} \quad 0.00 \quad = \quad 0.00$

CHANNEL FLOW

Segment ID 1  
 Cross Sectional Flow Area, a sq.ft 42.00 ✓  
 Wetted perimeter, PW ft 28.00 ✓  
 Hydraulic radius, r = a/PW ft 1.500  
 Channel slope, s ft/ft 0.1500 ✓  
 Manning's roughness coeff., n 0.0450

$1.49 * r^{2/3} * s^{1/2}$   
 $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n} \quad \text{ft/s} \quad 16.8040$

Flow length, L ft 550 ✓

$T = L / (3600 * V) \quad \text{hrs} \quad 0.01 \quad = \quad 0.01$

.....  
 TOTAL TIME (hrs) 0.01

Quick TR-55 Ver.5.46 S/N:  
 Executed: 09:24:17 05-09-1997 a:POSTDVTT.TCT

Dairyland Power Coop.  
 Feasibility Report  
 PostDevelopment Conditions  
 BJK 5/97

*1000*  
*6/17/97*

Tt COMPUTATIONS FOR: 4C

SHEET FLOW (Applicable to Tc only)

Segment ID  
 Surface description  
 Manning's roughness coeff., n 0.0000  
 Flow length, L (total < or = 300) ft 0.0  
 Two-yr 24-hr rainfall, P2 in 0.000  
 Land slope, s ft/ft 0.0000  
 0.8  
 $.007 * (n * L)$   
 $T = \frac{0.5}{P2 * s} \quad \text{hrs} \quad 0.00 \quad = \quad 0.00$

SHALLOW CONCENTRATED FLOW

Segment ID  
 Surface (paved or unpaved)?  
 Flow length, L ft 0.0  
 Watercourse slope, s ft/ft 0.0000  
 0.5  
 Avg.V = Csf \* (s) ft/s 0.0000  
 where: Unpaved Csf = 16.1345  
 Paved Csf = 20.3282  
 $T = L / (3600 * V) \quad \text{hrs} \quad 0.00 \quad = \quad 0.00$

CHANNEL FLOW

Segment ID	1	2
Cross Sectional Flow Area, a	sq.ft 150.00	42.00
Wetted perimeter, Pw	ft 45.00	28.00
Hydraulic radius, r = a/Pw	ft 3.333	1.500
Channel slope, s	ft/ft 0.0150	0.1500
Manning's roughness coeff., n	0.0600	0.0450

$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n} \quad \text{ft/s} \quad 6.7868 \quad 16.8040$

Flow length, L ft 1950 / 550 /

$T = L / (3600 * V) \quad \text{hrs} \quad 0.08 + 0.01 = 0.09$

.....  
 TOTAL TIME (hrs) 0.09

Quick TR-55 Ver.5.46 S/M:  
 Executed: 09:24:17 05-09-1997 a:POSTDVTT.TCT

Deiryland Power Coop.  
 Feasibility Report  
 PostDevelopment Conditions  
 BJK 5/97

Tt COMPUTATIONS FOR: East

*10218*  
*6/17/97*

SHEET FLOW (Applicable to Tc only)

Segment ID  
 Surface description  
 Manning's roughness coeff., n 0.0000  
 Flow length, L (total < or = 300) ft 0.0  
 Two-yr 24-hr rainfall, P2 in 0.000  
 Land slope, s ft/ft 0.0000  
 0.8  
 $.007 * (n * L)$   
 $T = \frac{0.5}{P2 * s}$  hrs 0.00 = 0.00

SHALLOW CONCENTRATED FLOW

Segment ID  
 Surface (paved or unpaved)?  
 Flow length, L ft 0.0  
 Watercourse slope, s ft/ft 0.0000  
 0.5  
 Avg.V = Csf \* (s) ft/s 0.0000  
 where: Unpaved Csf = 16.1345  
 Paved Csf = 20.3282  
 $T = L / (3600 * V)$  hrs 0.00 = 0.00

CHANNEL FLOW

Segment ID		1	2
Cross Sectional Flow Area, a	sq.ft	150.00	42.00
Wetted perimeter, Pw	ft	45.00	28.00
Hydraulic radius, r = a/Pw	ft	3.333	1.500
Channel slope, s	ft/ft	0.0150	0.1500
Manning's roughness coeff., n		0.0600	0.0450

$1.49 * r^{2/3} * s^{1/2}$   
 $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$  ft/s 6.7868 16.8040

Flow length, L ft 1600 550

$T = L / (3600 * V)$  hrs 0.07 + 0.01 = 0.07

.....  
 TOTAL TIME (hrs) 0.07

Quick TR-55 Ver.5.46 S/N:  
 Executed: 11:30:57 06-18-1997 a:POSTDVTT.TCT

Dairyland Power Coop.  
 Feasibility Report  
 PostDevelopment Conditions  
 BJK 5/97

102B  
 6/17/91

Tt COMPUTATIONS FOR: Northeast

SHEET FLOW (Applicable to Tc only)

Segment ID  
 Surface description  
 Manning's roughness coeff., n 0.0000  
 Flow length, L (total < or = 300) ft 0.0  
 Two-yr 24-hr rainfall, P2 in 0.000  
 Land slope, s ft/ft 0.0000  
 0.8  
 $.007 * (n * L)$   
 $T = \frac{0.5}{P2 * s} = 0.00 \text{ hrs} = 0.00$

SHALLOW CONCENTRATED FLOW

Segment ID  
 Surface (paved or unpaved)?  
 Flow length, L ft 0.0  
 Watercourse slope, s ft/ft 0.0000  
 0.5  
 Avg.V = Csf \* (s) ft/s 0.0000  
 where: Unpaved Csf = 16.1345  
 Paved Csf = 20.3282  
 $T = L / (3600 * V) = 0.00 \text{ hrs} = 0.00$

CHANNEL FLOW

Segment ID	1	2
Cross Sectional Flow Area, a	sq.ft 150.00	42.00
Wetted perimeter, Pw	ft 45.00	28.00
Hydraulic radius, r = a/Pw	ft 3.333	1.500
Channel slope, s	ft/ft 0.0150 ✓	0.1500 ✓
Manning's roughness coeff., n	0.0600	0.0450

2/3 1/2  
 $1.49 * r^{2/3} * s^{1/2}$   
 $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$   
 ft/s 6.7868 16.8040  
 Flow length, L ft 1870 ✓ 550 ✓  
 $T = L / (3600 * V) = 0.08 + 0.01 = 0.09$

.....  
 TOTAL TIME (hrs) 0.09



Quick TR-55 Ver.5.46 S/N:  
 Executed: 11:30:57 06-18-1997 a:POSTDVTT.TCT

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✓ BJB  
 6/17/97

Tt COMPUTATIONS FOR: North

SHEET FLOW (Applicable to Tc only)

Segment ID  
 Surface description  
 Manning's roughness coeff., n 0.0000  
 Flow length, L (total < or = 300) ft 0.0  
 Two-yr 24-hr rainfall, P2 in 0.000  
 Land slope, s ft/ft 0.0000  
 0.8  
 $.007 * (n * L)$   
 $T = \frac{0.5}{P2 * s} \frac{0.4}{0.0000} \text{ hrs} = 0.00$

SHALLOW CONCENTRATED FLOW

Segment ID  
 Surface (paved or unpaved)?  
 Flow length, L ft 0.0  
 Watercourse slope, s ft/ft 0.0000  
 0.5  
 Avg.V = Csf \* (s) ft/s 0.0000  
 where: Unpaved Csf = 16.1345  
 Paved Csf = 20.3282  
 $T = L / (3600 * V) \text{ hrs} = 0.00$

CHANNEL FLOW

Segment ID	1	2
Cross Sectional Flow Area, a	sq.ft 28.00	150.00
Wetted perimeter, Pw	ft 20.00	45.00
Hydraulic radius, r = a/Pw	ft 1.400	3.333
Channel slope, s	ft/ft 0.0200 ✓	0.0150 ✓
Manning's roughness coeff., n	0.0500	0.0600

$1.49 * r^{2/3} * s^{1/2}$   
 $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n} \text{ ft/s}$   
 5.2741 6.7868

Flow length, L ft 1670 ✓ 2250 ✓

$T = L / (3600 * V) \text{ hrs} = 0.09 + 0.09 = 0.18$

.....  
 TOTAL TIME (hrs) 0.18

Quick TR-55 Ver.5.46 S/N:  
 Executed: 09:24:17 05-09-1997 a:POSTDVT.TCT

Dairyland Power Coop.  
 Feasibility Report  
 PostDevelopment Conditions  
 BJK 5/97

1328  
 6/17/97

Tt COMPUTATIONS FOR: West

SHEET FLOW (Applicable to Tc only)

Segment ID  
 Surface description  
 Manning's roughness coeff., n 0.0000  
 Flow length, L (total < or = 300) ft 0.0  
 Two-yr 24-hr rainfall, P2 in 0.000  
 Land slope, s ft/ft 0.0000  
 0.8  
 $.007 * (n * L)$   
 $T = \frac{0.5}{P2 * s} \frac{0.4}{s}$  hrs 0.00 = 0.00

SHALLOW CONCENTRATED FLOW

Segment ID  
 Surface (paved or unpaved)?  
 Flow length, L ft 0.0  
 Watercourse slope, s ft/ft 0.0000  
 0.5  
 Avg.V = Csf \* (s) ft/s 0.0000  
 where: Unpaved Csf = 16.1345  
 Paved Csf = 20.3282  
 $T = L / (3600 * V)$  hrs 0.00 = 0.00

CHANNEL FLOW

Segment ID	1	2
Cross Sectional Flow Area, a	sq.ft 17.00	17.00
Wetted perimeter, Pw	ft 17.00	17.00
Hydraulic radius, r = a/Pw	ft 1.000	1.000
Channel slope, s	ft/ft 0.0600	0.0500
Manning's roughness coeff., n	0.0450	0.0450

$1.49 * r^{2/3} * s^{1/2}$   
 $V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$  ft/s 8.1105 7.4039  
 Flow length, L ft 1050 1200  
 $T = L / (3600 * V)$  hrs 0.04 + 0.05 = 0.08

.....  
 TOTAL TIME (hrs) 0.08

Return Frequency: 25 years

TR-55 TABULAR HYDROGRAPH METHOD  
Type II. Distribution  
(24 hr. Duration Storm)

Executed: 09-18-2000 12:58:17

Watershed file: --&gt; P:\DATA\PROJECTS\3081\40\SW\POSTDV2 .MOP

Hydrograph file: --&gt; P:\DATA\PROJECTS\3081\40\SW\POSTDV25.HYD

Dairyland Power Coop.  
Feasibility Report  
PostDevelopment Conditions  
BJK 5/97 REV 9/98

## &gt;&gt;&gt;&gt; Input Parameters Used to Compute Hydrograph &lt;&lt;&lt;&lt;

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
1C	42.00	67.0	0.40	0.00	4.90	1.73	1.2 .20
2C	15.00	56.0	0.30	0.10	4.90	0.99	1.32 .32
3C	33.00	58.0	0.40	0.00	4.90	1.11	1.3 .30
4C	16.00	57.0	0.40	0.10	4.90	1.05	1.31 .31
East	520.00	67.0	0.75	0.00	4.90	1.73	1.2 .20
Northeast	80.00	63.0	0.40	0.10	4.90	1.45	1.24 .24
North	236.00	63.0	0.50	0.20	4.90	1.45	1.24 .24
West	100.00	71.0	0.50	0.10	4.90	2.04	1.17 .17

\* Travel time from subarea outfall to composite watershed outfall point.  
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 1042.00 acres or 1.6281 sq.mi  
Peak discharge = 1027 cfs

WARNING: Drainage areas of two or more subareas  
differ by a factor of 5 or greater.

Total Runoff  
= 141.9 ac-ft

## &gt;&gt;&gt;&gt; Computer Modifications of Input Parameters &lt;&lt;&lt;&lt;

Subarea Description	Input Values		Rounded Values		Ia/p	
	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)	Interpolated (Yes/No)	Ia/p Messages
1C	0.35	0.00	0.40	0.00	Yes	--
2C	0.32	0.05	0.30	0.10	Yes	--
3C	0.41	0.01	0.40	0.00	Yes	--
4C	0.38	0.09	0.40	0.10	Yes	--
East	0.68	0.07	0.75	0.00	Yes	--
Northeast	0.37	0.09	0.40	0.10	Yes	--
North	0.53	0.18	0.50	0.20	Yes	--
West	0.52	0.08	0.50	0.10	Yes	--

\* Travel time from subarea outfall to composite watershed outfall point.

## TR-55 TABULAR HYDROGRAPH METHOD

Type II. Distribution

(24 hr. Duration Storm)

Executed: 09-18-2000 12:58:17

Watershed file: --&gt; P:\DATA\PROJECTS\3081\40\SW\POSTDV2 .MOP

Hydrograph file: --&gt; P:\DATA\PROJECTS\3081\40\SW\POSTDV25.HYD

Dairyland Power Coop.

Feasibility Report

PostDevelopment Conditions

BJK 5/97 REV 9/98

## &gt;&gt;&gt;&gt; Summary of Subarea Times to Peak &lt;&lt;&lt;&lt;

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
1C	61	12.3
2C	11	12.4
3C	28	12.4
4C	12	12.5
East	533	12.7
Northeast	84	12.5
North	219	12.6
West	145	12.5
-----	-----	-----
Composite Watershed	1027	12.6



TR-55 TABULAR HYDROGRAPH METHOD  
 Type II. Distribution  
 (24 hr. Duration Storm)

Executed: 09-18-2000 12:58:17

Watershed file: --> P:\DATA\PROJECTS\3081\40\SW\POSTDV2 .MOP

Hydrograph file: --> P:\DATA\PROJECTS\3081\40\SW\POSTDV25.HYD

Dairyland Power Coop.  
 Feasibility Report  
 PostDevelopment Conditions  
 BJK 5/97 REV 9/98

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
1C	1	1	2	5	9	22	43	61	61
2C	0	0	0	0	0	1	4	9	11
3C	0	0	0	0	1	6	17	27	28
4C	0	0	0	0	0	0	2	6	10
East	9	13	17	25	33	52	102	197	329
Northeast	1	1	2	4	7	14	31	57	80
North	2	3	4	6	8	13	28	66	126
West	3	5	6	11	17	30	56	95	128
Total (cfs)	16	23	31	51	75	138	283	518	773

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
1C	48	34	26	20	13	10	8	7	7
2C	10	8	6	5	3	2	2	2	2
3C	24	18	13	11	7	6	5	4	4
4C	12	11	9	7	4	3	3	2	2
East	454	527	533	490	350	248	183	143	117
Northeast	84	74	58	45	28	20	16	14	12
North	187	219	217	191	130	86	62	49	41
West	145	136	115	92	58	39	29	24	20
Total (cfs)	964	1027	977	861	593	414	308	245	205

## TR-55 TABULAR HYDROGRAPH METHOD

Type II. Distribution

(24 hr. Duration Storm)

Executed: 09-18-2000 12:58:17

Watershed file: --&gt; P:\DATA\PROJECTS\3081\40\SW\POSTDV2 .MOP

Hydrograph file: --&gt; P:\DATA\PROJECTS\3081\40\SW\POSTDV25.HYD

Dairyland Power Coop.

Feasibility Report

PostDevelopment Conditions

BJK 5/97 REV 9/98

## Composite Hydrograph Summary (cfs)

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
1C	6	5	5	4	4	4	3	3	3
2C	1	1	1	1	1	1	1	1	1
3C	3	3	3	3	2	2	2	2	2
4C	2	2	1	1	1	1	1	1	1
East	98	81	69	59	53	47	42	38	36
Northeast	11	9	8	8	7	6	6	5	5
North	35	30	26	23	21	19	17	16	14
West	18	15	13	12	11	10	9	8	7
Total (cfs)	174	146	126	111	100	90	81	74	69

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
1C	3	2	2	2	0
2C	1	1	1	0	0
3C	2	1	1	1	0
4C	1	1	1	1	0
East	34	30	27	22	0
Northeast	5	4	4	3	0
North	14	12	10	9	0
West	7	6	5	5	0
Total (cfs)	67	57	51	43	0

Return Frequency: 100 years

TR-55 TABULAR HYDROGRAPH METHOD  
Type II. Distribution  
(24 hr. Duration Storm)

Executed: 10-01-1998 11:25:28

Watershed file: --&gt; A:\POSTDV2.MOP

Hydrograph file: --&gt; A:\POSTDV00.HYD

Dairyland Power Coop.  
Feasibility Report  
PostDevelopment Conditions  
BJK 5/97 REV 9/98

## &gt;&gt;&gt;&gt; Input Parameters Used to Compute Hydrograph &lt;&lt;&lt;&lt;

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
1C	42.00	67.0	0.40	0.00	6.10	2.61	1.16 .16
2C	15.00	56.0	0.30	0.10	6.10	1.66	1.26 .26
3C	33.00	58.0	0.40	0.00	6.10	1.82	1.24 .24
4C	16.00	57.0	0.40	0.10	6.10	1.74	1.25 .25
East	520.00	67.0	0.75	0.00	6.10	2.61	1.16 .16
Northeast	80.00	63.0	0.40	0.10	6.10	2.25	1.19 .19
North	236.00	63.0	0.50	0.20	6.10	2.25	1.19 .19
West	100.00	71.0	0.50	0.10	6.10	2.98	1.13 .13

\* Travel time from subarea outfall to composite watershed outfall point.

I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 1042.00 acres or 1.6281 sq.mi

Peak discharge = 1618 cfs

WARNING: Drainage areas of two or more subareas  
differ by a factor of 5 or greater.

## &gt;&gt;&gt;&gt; Computer Modifications of Input Parameters &lt;&lt;&lt;&lt;

Subarea Description	Input Values		Rounded Values		Ia/p Interpolated (Yes/No)	Ia/p Messages
	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)		
1C	0.35	0.00	0.40	0.00	Yes	--
2C	0.32	0.05	0.30	0.10	Yes	--
3C	0.41	0.01	0.40	0.00	Yes	--
4C	0.38	0.09	0.40	0.10	Yes	--
East	0.68	0.07	0.75	0.00	Yes	--
Northeast	0.37	0.09	0.40	0.10	Yes	--
North	0.53	0.18	0.50	0.20	Yes	--
West	0.52	0.08	0.50	0.10	Yes	--

\* Travel time from subarea outfall to composite watershed outfall point.

Total Runoff

= 215.7 ac-ft

TR-55 TABULAR HYDROGRAPH METHOD  
 Type II. Distribution  
 (24 hr. Duration Storm)

Executed: 10-01-1998 11:25:28

Watershed file: --> A:\POSTDV2 .MOP

Hydrograph file: --> A:\POSTDV00.HYD

Dairyland Power Coop.  
 Feasibility Report  
 PostDevelopment Conditions  
 BJK 5/97 REV 9/98

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
1C	96	12.3
2C	20	12.4
3C	49	12.4
4C	20	12.5
East	837	12.6
Northeast	136	12.4
North	360	12.6
West	223	12.5
Composite Watershed	1618	12.6



## TR-55 TABULAR HYDROGRAPH METHOD

Type II. Distribution

(24 hr. Duration Storm)

Executed: 10-01-1998 11:25:28

Watershed file: --&gt; A:\POSTDV2.MOP

Hydrograph file: --&gt; A:\POSTDV00.HYD

Dairyland Power Coop.  
Feasibility Report  
PostDevelopment Conditions  
BJK 5/97 REV 9/98

## Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
1C	2	3	4	9	18	38	71	96	94
2C	0	0	0	1	2	4	10	18	20
3C	1	1	1	2	6	15	33	48	49
4C	0	0	0	1	1	3	7	13	19
East	19	27	36	53	69	105	190	343	547
Northeast	3	4	5	10	18	36	70	109	136
North	6	9	11	17	22	33	63	127	224
West	6	9	12	20	32	56	102	165	209
Total (cfs)	37	53	69	113	168	290	546	919	1298

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
1C	73	51	38	29	19	14	12	10	9
2C	18	13	10	7	5	4	3	3	3
3C	39	28	21	17	11	9	7	6	6
4C	20	18	14	11	7	5	4	3	3
East	733	837	830	756	531	370	270	208	168
Northeast	132	110	85	65	40	28	23	19	17
North	315	360	350	303	200	130	92	71	59
West	223	201	163	128	79	53	40	32	27
Total (cfs)	1553	1618	1511	1316	892	613	451	352	292

## TR-55 TABULAR HYDROGRAPH METHOD

Type II. Distribution

(24 hr. Duration Storm)

Executed: 10-01-1998 11:25:28

Watershed file: --&gt; A:\POSTDV2 .MOP

Hydrograph file: --&gt; A:\POSTDV00.HYD

Dairyland Power Coop.

Feasibility Report

PostDevelopment Conditions

BJK 5/97 REV 9/98

## Composite Hydrograph Summary (cfs)

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
1C	8	7	7	6	5	5	4	4	4
2C	2	2	2	2	1	1	1	1	1
3C	5	5	4	4	3	3	3	3	2
4C	3	2	2	2	2	2	1	1	1
East	141	115	97	83	74	66	59	53	49
Northeast	15	13	12	11	10	9	8	7	7
North	51	44	38	33	30	27	24	22	20
West	24	21	18	16	14	13	12	11	10
Total (cfs)	249	209	180	157	139	126	112	102	94

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
1C	4	3	3	2	0
2C	1	1	1	1	0
3C	2	2	2	2	0
4C	1	1	1	1	0
East	47	42	37	30	0
Northeast	6	6	5	4	0
North	19	17	15	13	0
West	10	8	7	6	0
Total (cfs)	90	80	71	59	0

Executed 09-18-2000 13:11:11

Data directory: p:\data\projects\3081\40\sw\\*.HYD

## File Summary for Composite Hydrograph

Time (hrs)	POSTDV25 (cfs)	BSN1OUT1 (cfs)	BSN2OUT1 (cfs)	TPTPST25 (Total)
11.00	16.0	0.0	0.0	16.0
11.10	18.0	0.2	0.2	18.4
11.20	21.0	0.2	0.2	21.4
11.30	23.0	0.3	0.2	23.5
11.40	26.0	0.3	0.2	26.5
11.50	28.0	0.3	0.2	28.5
11.60	31.0	0.4	0.2	31.6
11.70	38.0	0.4	0.3	38.7
11.80	44.0	0.4	0.3	44.7
11.90	51.0	0.5	0.3	51.8
12.00	75.0	0.5	0.4	75.9
12.10	138.0	0.6	0.4	139.0
12.20	283.0	0.6	0.5	284.1
12.30	518.0	0.7	0.5	519.2
12.40	773.0	0.7	0.5	774.2
12.50	964.0	0.7	0.6	965.3
12.60	1027.0	0.7	0.6	1028.3
12.70	977.0	0.7	0.6	978.3
12.80	861.0	0.7	0.6	862.3
12.90	727.0	0.7	0.6	728.3
13.00	593.0	0.8	0.6	594.3
13.10	503.0	0.8	0.6	504.4
13.20	414.0	0.8	0.6	415.4
13.30	361.0	0.8	0.6	362.4
13.40	308.0	0.8	0.6	309.4
13.50	277.0	0.8	0.6	278.4
13.60	245.0	0.8	0.6	246.4
13.70	225.0	0.8	0.6	226.4
13.80	205.0	0.8	0.6	206.4
13.90	190.0	0.8	0.6	191.4
14.00	174.0	0.8	0.6	175.4
14.10	165.0	0.8	0.6	166.4
14.20	155.0	0.8	0.6	156.4
14.30	146.0	0.9	0.6	147.5
14.40	139.0	1.2	0.6	140.8
14.50	133.0	1.5	0.6	135.1
14.60	126.0	1.8	0.6	128.4
14.70	122.0	2.0	0.6	124.6
14.80	118.0	2.2	0.6	120.8
14.90	115.0	2.3	0.6	117.9

Combined Post-Development  
Hydrograph 25 yr storm

Basin 1 +  
Basin 2 +  
Surrounding watershed.

← Peak

Executed 09-18-2000 13:11:11

Data directory: p:\data\projects\3081\40\sw\\*.HYD

## File Summary for Composite Hydrograph

Time (hrs)	POSTDV25 (cfs)	BSN1OUT1 (cfs)	BSN2OUT1 (cfs)	TPTPST25 (Total)
15.00	111.0	2.4	0.6	114.0
15.10	109.0	2.5	0.6	112.1
15.20	107.0	2.6	0.6	110.2
15.30	104.0	2.7	0.6	107.3
15.40	102.0	2.7	0.6	105.3
15.50	100.0	2.8	0.6	103.4
15.60	98.0	2.8	0.6	101.4
15.70	96.0	2.8	0.6	99.4
15.80	94.0	2.9	0.6	97.5
15.90	92.0	2.9	0.6	95.5
16.00	90.0	2.9	0.6	93.5
16.10	88.0	2.9	0.6	91.5
16.20	86.0	2.9	0.6	89.5
16.30	85.0	2.9	0.6	88.5
16.40	83.0	2.7	0.6	86.3
16.50	81.0	2.6	0.6	84.2
16.60	80.0	2.5	0.6	83.1
16.70	78.0	2.4	0.6	81.0
16.80	77.0	2.3	0.6	79.9
16.90	75.0	2.3	0.6	77.9
17.00	74.0	2.2	0.6	76.8
17.10	73.0	2.2	0.6	75.8
17.20	72.0	2.2	0.6	74.8
17.30	71.0	2.1	0.6	73.7
17.40	70.0	2.1	0.6	72.7
17.50	69.0	2.1	0.6	71.7
17.60	69.0	2.1	0.6	71.7
17.70	68.0	2.1	0.6	70.7
17.80	68.0	2.0	0.6	70.7
17.90	67.0	2.0	0.6	69.6
18.00	67.0	2.0	0.6	69.6
18.10	66.0	2.0	0.6	68.6
18.20	65.0	2.0	0.6	67.6
18.30	64.0	2.0	0.6	66.6
18.40	63.0	2.0	0.6	65.6
18.50	62.0	2.0	0.6	64.6
18.60	61.0	2.0	0.6	63.6
18.70	60.0	2.0	0.6	62.6
18.80	59.0	2.0	0.7	61.7
18.90	58.0	2.0	0.7	60.8
19.00	57.0	2.0	0.8	59.8



Executed 09-18-2000 13:11:11

Data directory: p:\data\projects\3081\40\sw\\*.HYD

## File Summary for Composite Hydrograph

Time (hrs)	POSTDV25 (cfs)	BSN1OUT1 (cfs)	BSN2OUT1 (cfs)	TPTPST25 (Total)
19.10	56.0	2.0	0.8	58.8
19.20	56.0	2.0	0.9	58.9
19.30	55.0	2.0	0.9	57.9
19.40	55.0	2.0	0.9	57.9
19.50	54.0	2.0	0.9	56.9
19.60	53.0	1.9	0.9	55.9
19.70	53.0	1.8	0.9	55.7
19.80	52.0	1.6	1.0	54.6
19.90	52.0	1.5	1.0	54.5
20.00	51.0	1.4	1.0	53.4
20.10	51.0	1.4	1.0	53.3
20.20	50.0	1.3	1.0	52.3
20.30	50.0	1.2	1.0	52.2
20.40	49.0	1.2	1.0	51.2
20.50	49.0	1.2	1.0	51.2
20.60	49.0	1.1	1.0	51.1
20.70	48.0	1.1	1.0	50.1
20.80	48.0	1.1	1.0	50.1
20.90	47.0	1.1	1.0	49.1
21.00	47.0	1.0	1.0	49.0
21.10	47.0	0.8	1.0	48.8
21.20	46.0	0.8	1.0	47.8
21.30	46.0	0.8	1.0	47.8
21.40	45.0	0.8	1.0	46.8
21.50	45.0	0.8	1.0	46.8
21.60	45.0	0.8	1.0	46.8
21.70	44.0	0.8	1.0	45.8
21.80	44.0	0.8	1.0	45.8
21.90	43.0	0.8	1.0	44.8
22.00	43.0	0.8	1.0	44.8
22.10	42.0	0.8	1.0	43.8
22.20	41.0	0.8	1.0	42.8
22.30	40.0	0.8	1.0	41.8
22.40	39.0	0.8	1.0	40.8
22.50	38.0	0.8	1.0	39.8
22.60	37.0	0.8	1.0	38.8
22.70	35.0	0.8	1.0	36.8
22.80	34.0	0.8	1.0	35.8
22.90	33.0	0.8	1.0	34.8
23.00	32.0	0.8	1.0	33.8
23.10	31.0	0.8	1.0	32.8

Executed 09-18-2000 13:11:11

Data directory: p:\data\projects\3081\40\sw\\*.HYD

## File Summary for Composite Hydrograph

Time (hrs)	POSTDV25 (cfs)	BSN1OUT1 (cfs)	BSN2OUT1 (cfs)	TPTPST25 (Total)
23.20	30.0	0.8	1.0	31.8
23.30	29.0	0.8	1.0	30.8
23.40	28.0	0.8	1.0	29.8
23.50	27.0	0.8	1.0	28.8
23.60	26.0	0.8	1.0	27.8
23.70	25.0	0.8	1.0	26.8
23.80	24.0	0.8	1.0	25.8
23.90	23.0	0.8	1.0	24.8
24.00	22.0	0.8	0.9	23.7
24.10	20.0	0.8	0.7	21.5
24.20	19.0	0.8	0.6	20.4
24.30	18.0	0.8	0.6	19.4
24.40	17.0	0.8	0.6	18.4
24.50	16.0	0.8	0.6	17.4
24.60	15.0	0.8	0.6	16.4
24.70	14.0	0.8	0.6	15.4
24.80	13.0	0.8	0.6	14.4
24.90	12.0	0.8	0.6	13.4
25.00	11.0	0.8	0.6	12.4
25.10	10.0	0.8	0.6	11.4
25.20	9.0	0.8	0.6	10.4
25.30	8.0	0.8	0.6	9.4
25.40	6.0	0.8	0.6	7.4
25.50	5.0	0.8	0.6	6.4

Executed 09-18-2000 13:14:54

Data directory: p:\data\projects\3081\40\sw\\*.HYD

## File Summary for Composite Hydrograph

Time (hrs)	POSTDV00 (cfs)	BSN1OUT2 (cfs)	BSN2OUT2 (cfs)	TOTPST00 (Total)
11.00	37.0	0.0	0.0	37.0
11.10	42.0	0.2	0.2	42.4
11.20	48.0	0.3	0.2	48.5
11.30	53.0	0.3	0.2	53.5
11.40	58.0	0.4	0.3	58.6
11.50	64.0	0.4	0.3	64.7
11.60	69.0	0.4	0.3	69.7
11.70	84.0	0.4	0.3	84.7
11.80	98.0	0.5	0.3	98.8
11.90	113.0	0.5	0.4	113.9
12.00	168.0	0.6	0.4	169.0
12.10	290.0	0.6	0.5	291.1
12.20	546.0	0.7	0.5	547.2
12.30	919.0	0.7	0.6	920.3
12.40	1298.0	0.7	0.6	1299.3
12.50	1553.0	0.8	0.6	1554.4
12.60	1618.0	2.8	1.2	1622.0
12.70	1511.0	8.2	3.7	1522.9
12.80	1316.0	12.2	5.2	1333.4
12.90	1104.0	14.8	6.1	1124.9
13.00	892.0	15.7	6.6	914.3
13.10	752.0	15.5	6.9	774.4
13.20	613.0	14.8	7.0	634.8
13.30	532.0	14.0	7.0	553.0
13.40	451.0	13.3	7.0	471.3
13.50	402.0	12.5	7.0	421.5
13.60	352.0	11.7	6.9	370.6
13.70	322.0	10.8	6.7	339.5
13.80	292.0	10.0	6.6	308.6
13.90	270.0	9.6	6.5	286.0
14.00	249.0	9.1	6.3	264.3
14.10	236.0	8.5	6.0	250.6
14.20	222.0	8.1	5.8	235.9
14.30	209.0	7.7	5.7	222.4
14.40	199.0	7.4	5.4	211.9
14.50	190.0	7.2	5.2	202.3
14.60	180.0	7.0	4.8	191.8
14.70	174.0	6.8	4.5	185.3
14.80	168.0	6.6	4.2	178.8
14.90	163.0	6.2	4.0	173.2

Combined Post-Development  
Hydrograph - 100 yr Storm

Basin 1 +  
Basin 2 +  
Surrounding Watershed.

← Peak

Executed 09-18-2000 13:14:54

Data directory: p:\data\projects\3081\40\sw\\*.HYD

## File Summary for Composite Hydrograph

Time (hrs)	POSTDV00 (cfs)	BSN1OUT2 (cfs)	BSN2OUT2 (cfs)	TOTPST00 (Total)
15.00	157.0	5.8	3.8	166.6
15.10	153.0	5.5	3.6	162.1
15.20	150.0	5.3	3.5	158.8
15.30	146.0	5.0	3.4	154.4
15.40	143.0	4.6	3.3	150.9
15.50	139.0	4.3	3.3	146.6
15.60	136.0	4.1	3.2	143.3
15.70	134.0	3.9	3.2	141.1
15.80	131.0	3.8	3.1	137.9
15.90	129.0	3.6	3.1	135.7
16.00	126.0	3.5	3.1	132.6
16.10	123.0	3.4	3.1	129.5
16.20	120.0	3.4	3.1	126.4
16.30	118.0	3.3	3.0	124.2
16.40	115.0	3.2	2.8	121.0
16.50	112.0	3.2	2.6	117.8
16.60	110.0	3.2	2.5	115.7
16.70	108.0	3.1	2.4	113.5
16.80	106.0	3.1	2.3	111.4
16.90	104.0	3.1	2.3	109.3
17.00	102.0	3.1	2.2	107.3
17.10	100.0	3.1	2.2	105.2
17.20	99.0	3.0	2.1	104.2
17.30	97.0	3.0	2.1	102.2
17.40	96.0	3.0	2.1	101.1
17.50	94.0	3.0	2.1	99.1
17.60	93.0	3.0	2.1	98.1
17.70	92.0	3.0	2.0	97.1
17.80	92.0	3.0	2.0	97.1
17.90	91.0	3.0	2.0	96.0
18.00	90.0	3.0	2.0	95.0
18.10	89.0	3.0	2.0	94.0
18.20	88.0	3.0	2.0	93.0
18.30	87.0	3.0	2.0	92.0
18.40	86.0	3.0	2.0	91.0
18.50	85.0	2.9	2.0	89.9
18.60	84.0	2.8	2.0	88.8
18.70	83.0	2.6	2.0	87.6
18.80	82.0	2.5	2.0	86.5
18.90	81.0	2.4	2.0	85.4
19.00	80.0	2.4	2.0	84.4



Executed 09-18-2000 13:14:54

Data directory: p:\data\projects\3081\40\sw\\*.HYD

## File Summary for Composite Hydrograph

Time (hrs)	POSTDV00 (cfs)	BSN1OUT2 (cfs)	BSN2OUT2 (cfs)	TOTPST00 (Total)
19.10	79.0	2.3	2.0	83.3
19.20	78.0	2.2	2.0	82.2
19.30	77.0	2.2	2.0	81.2
19.40	76.0	2.2	2.0	80.2
19.50	76.0	2.1	2.0	80.1
19.60	75.0	2.1	1.9	79.0
19.70	74.0	2.1	1.7	77.8
19.80	73.0	2.1	1.6	76.7
19.90	72.0	2.1	1.5	75.5
20.00	71.0	2.0	1.4	74.4
20.10	70.0	2.0	1.3	73.3
20.20	70.0	2.0	1.3	73.3
20.30	69.0	2.0	1.2	72.2
20.40	69.0	2.0	1.2	72.2
20.50	68.0	2.0	1.1	71.1
20.60	67.0	2.0	1.1	70.1
20.70	67.0	2.0	1.1	70.1
20.80	66.0	2.0	1.1	69.1
20.90	66.0	2.0	1.0	69.1
21.00	65.0	2.0	1.0	68.1
21.10	64.0	2.0	1.0	67.0
21.20	64.0	2.0	1.0	67.0
21.30	63.0	2.0	1.0	66.0
21.40	63.0	2.0	1.0	66.0
21.50	62.0	2.0	1.0	65.0
21.60	61.0	2.0	1.0	64.0
21.70	61.0	2.0	1.0	64.0
21.80	60.0	2.0	1.0	63.0
21.90	60.0	2.0	1.0	63.0
22.00	59.0	2.0	1.0	62.0
22.10	58.0	2.0	1.0	61.0
22.20	56.0	2.0	1.0	59.0
22.30	55.0	2.0	1.0	58.0
22.40	53.0	2.0	1.0	56.0
22.50	52.0	2.0	1.0	55.0
22.60	50.0	2.0	1.0	53.0
22.70	49.0	2.0	1.0	52.0
22.80	47.0	2.0	1.0	50.0
22.90	46.0	2.0	1.0	49.0
23.00	44.0	2.0	1.0	47.0
23.10	43.0	1.9	1.0	45.9

Executed 09-18-2000 13:14:54

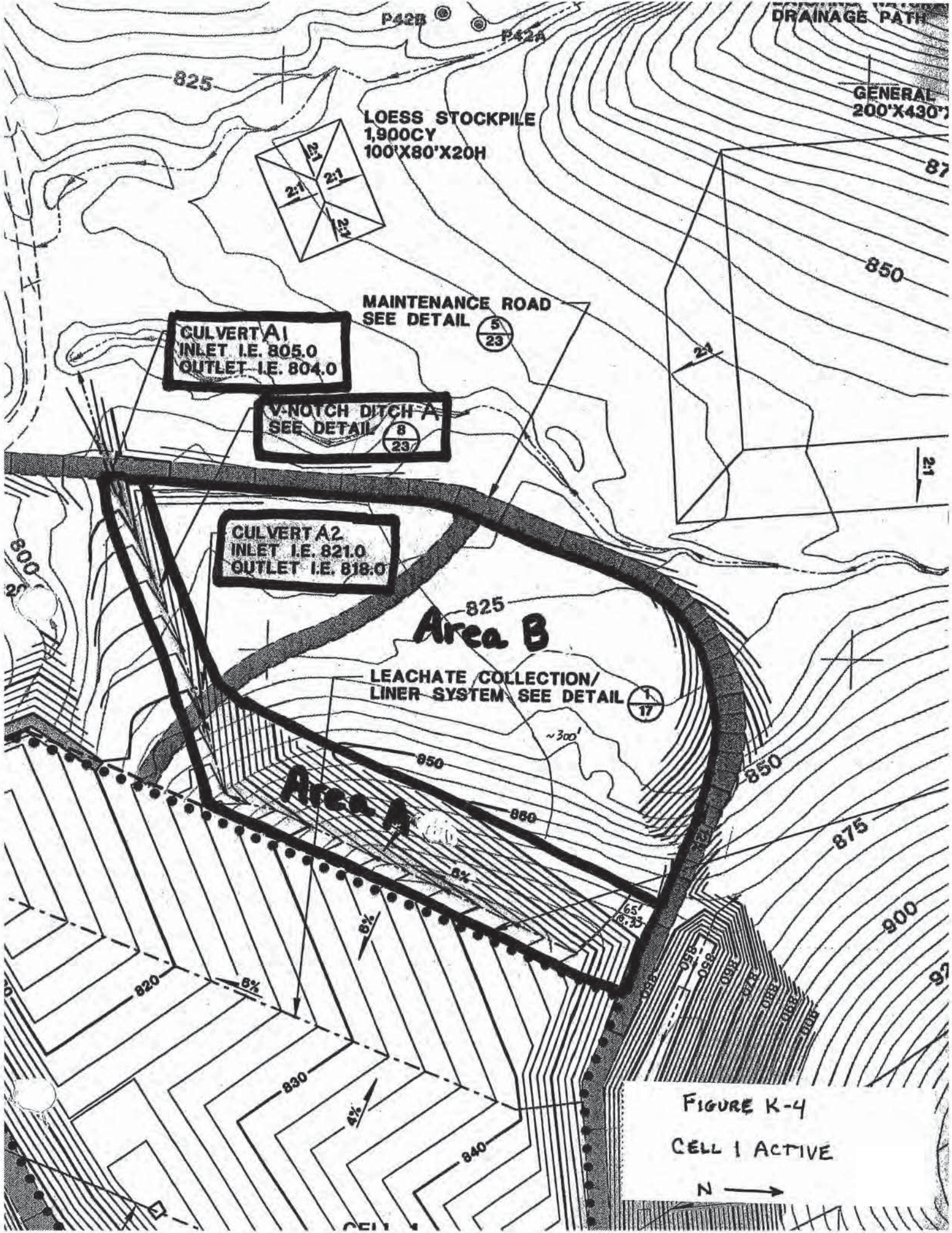
Data directory: p:\data\projects\3081\40\sw\\*.HYD

## File Summary for Composite Hydrograph

Time (hrs)	POSTDV00 (cfs)	BSN1OUT2 (cfs)	BSN2OUT2 (cfs)	TOTPST00 (Total)
23.20	41.0	1.8	1.0	43.8
23.30	40.0	1.6	1.0	42.6
23.40	38.0	1.5	1.0	40.5
23.50	37.0	1.4	1.0	39.4
23.60	35.0	1.4	1.0	37.3
23.70	34.0	1.3	1.0	36.3
23.80	32.0	1.2	1.0	34.2
23.90	31.0	1.2	1.0	33.2
24.00	30.0	1.2	0.9	32.1
24.10	28.0	1.1	0.7	29.9
24.20	27.0	1.1	0.6	28.7
24.30	25.0	1.1	0.6	26.7
24.40	24.0	1.1	0.6	25.7
24.50	22.0	1.1	0.6	23.7
24.60	21.0	1.0	0.6	22.6
24.70	19.0	1.0	0.6	20.6
24.80	18.0	1.0	0.6	19.6
24.90	16.0	1.0	0.6	17.6
25.00	15.0	0.9	0.6	16.5
25.10	13.0	0.8	0.6	14.4
25.20	12.0	0.8	0.6	13.4
25.30	10.0	0.8	0.6	11.4
25.40	9.0	0.8	0.6	10.4
25.50	7.0	0.8	0.6	8.4

## **Operational Run-off Calculations**







APPROXIMATE LIM  
EXISTING ASH BO

AREA C - PREDEVELOPMENT  
AREAS WEST + NORTH

DITCH # B

CULVERT  
INLET I.E. 762.0  
OUTLET I.E. 755.5

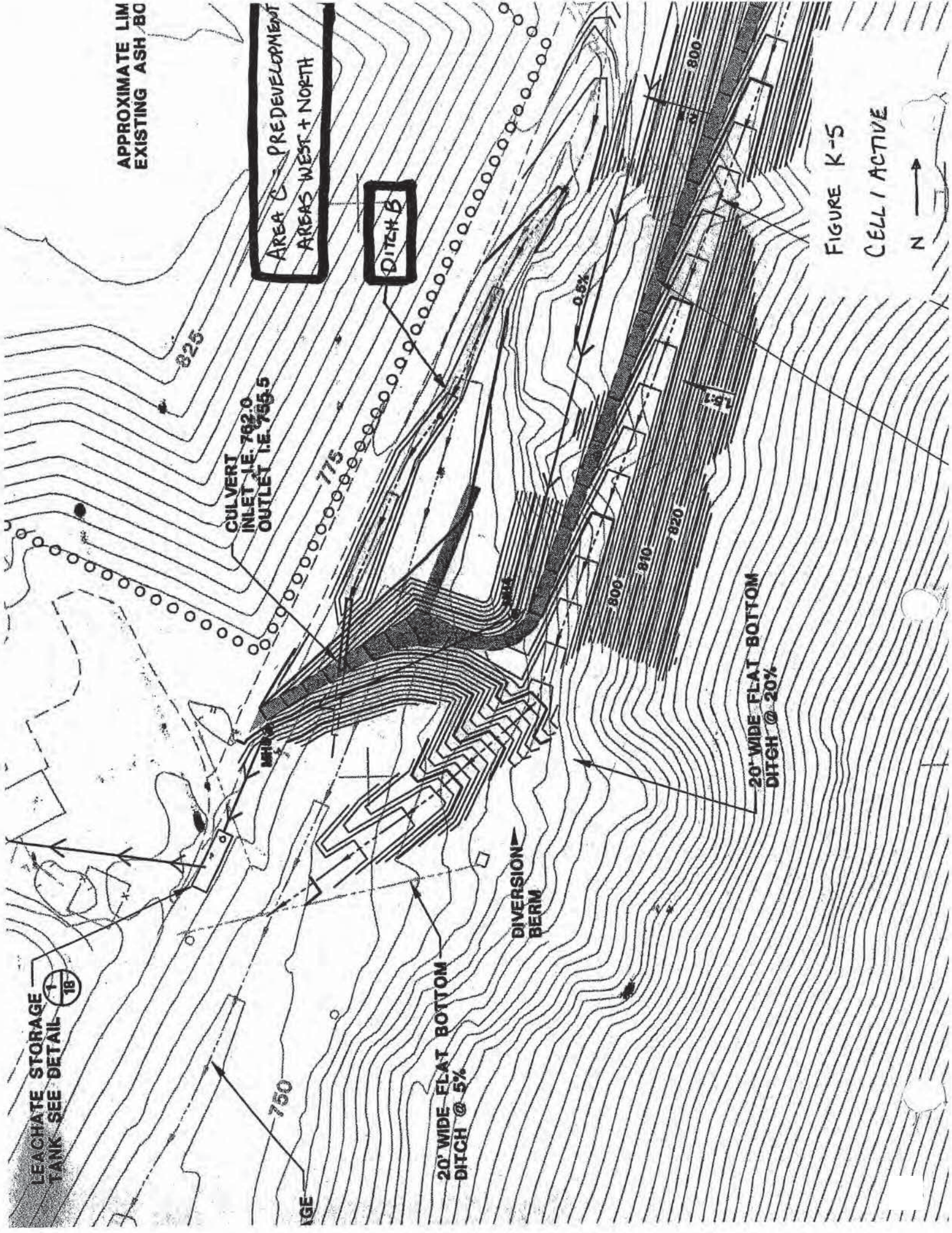
LEACHATE STORAGE  
TANK SEE DETAIL 18

20' WIDE FLAT BOTTOM  
DITCH @ 5%

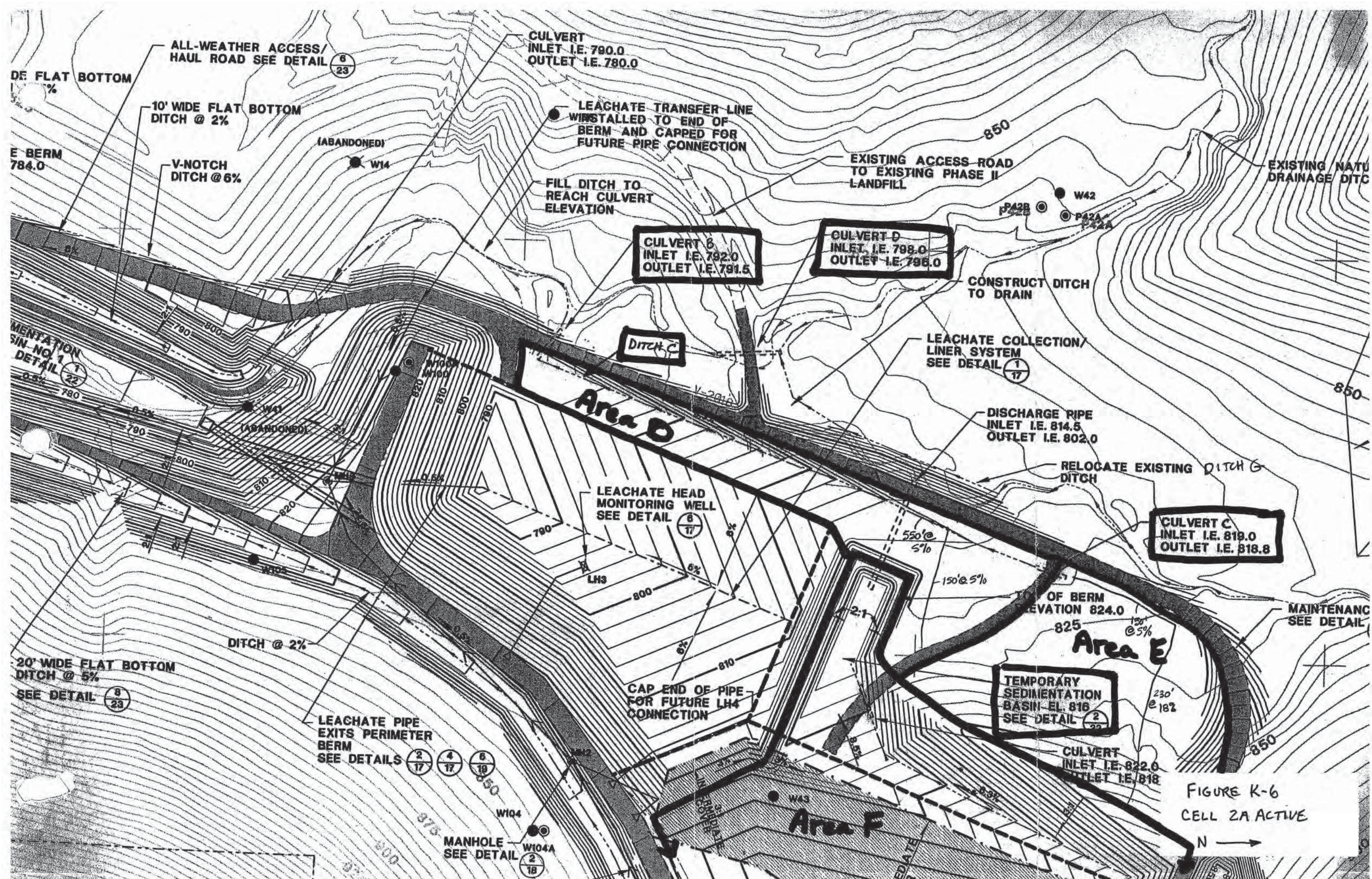
DIVERSION  
BERM

20' WIDE FLAT BOTTOM  
DITCH @ 20%

FIGURE K-5  
CELL 1 ACTIVE









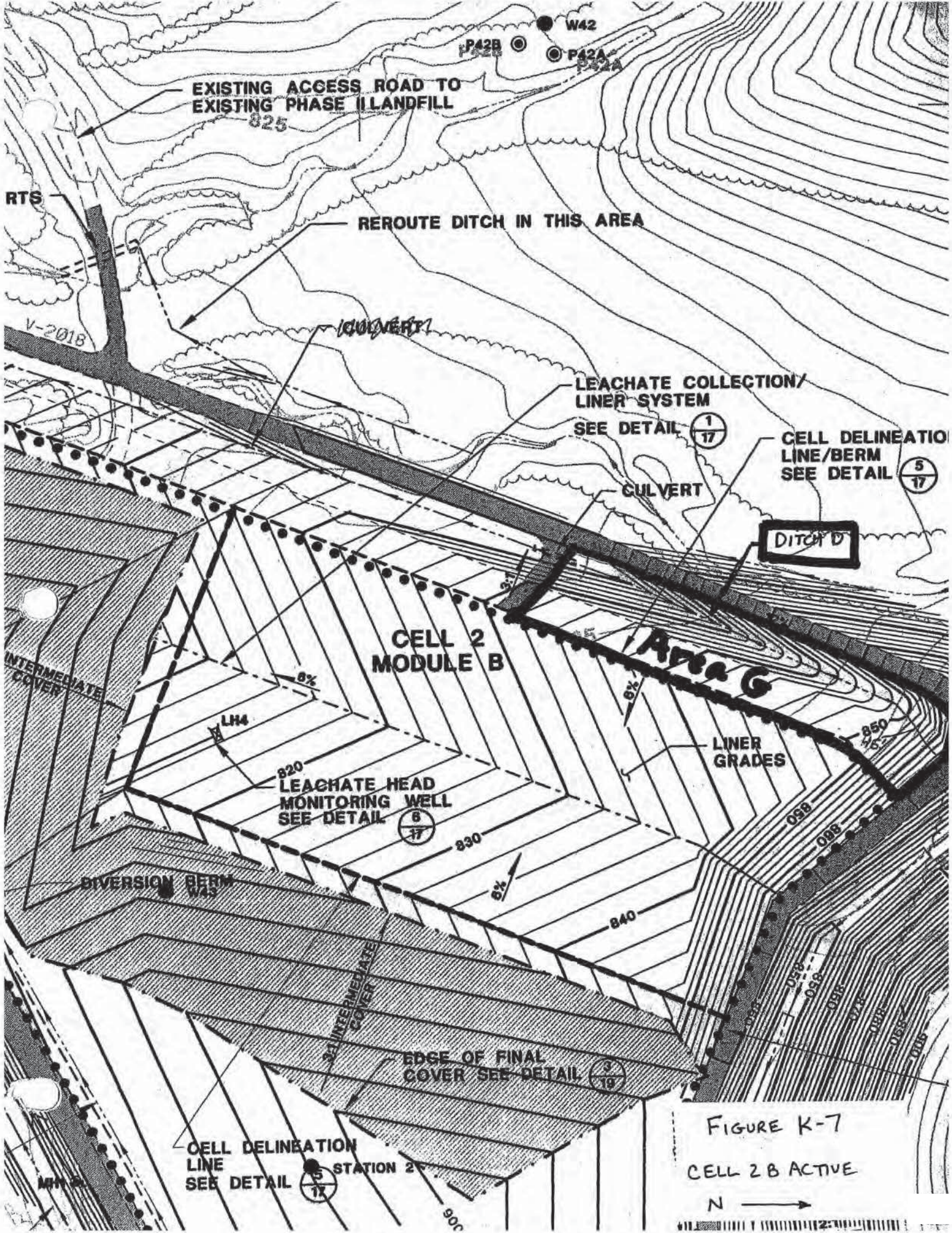
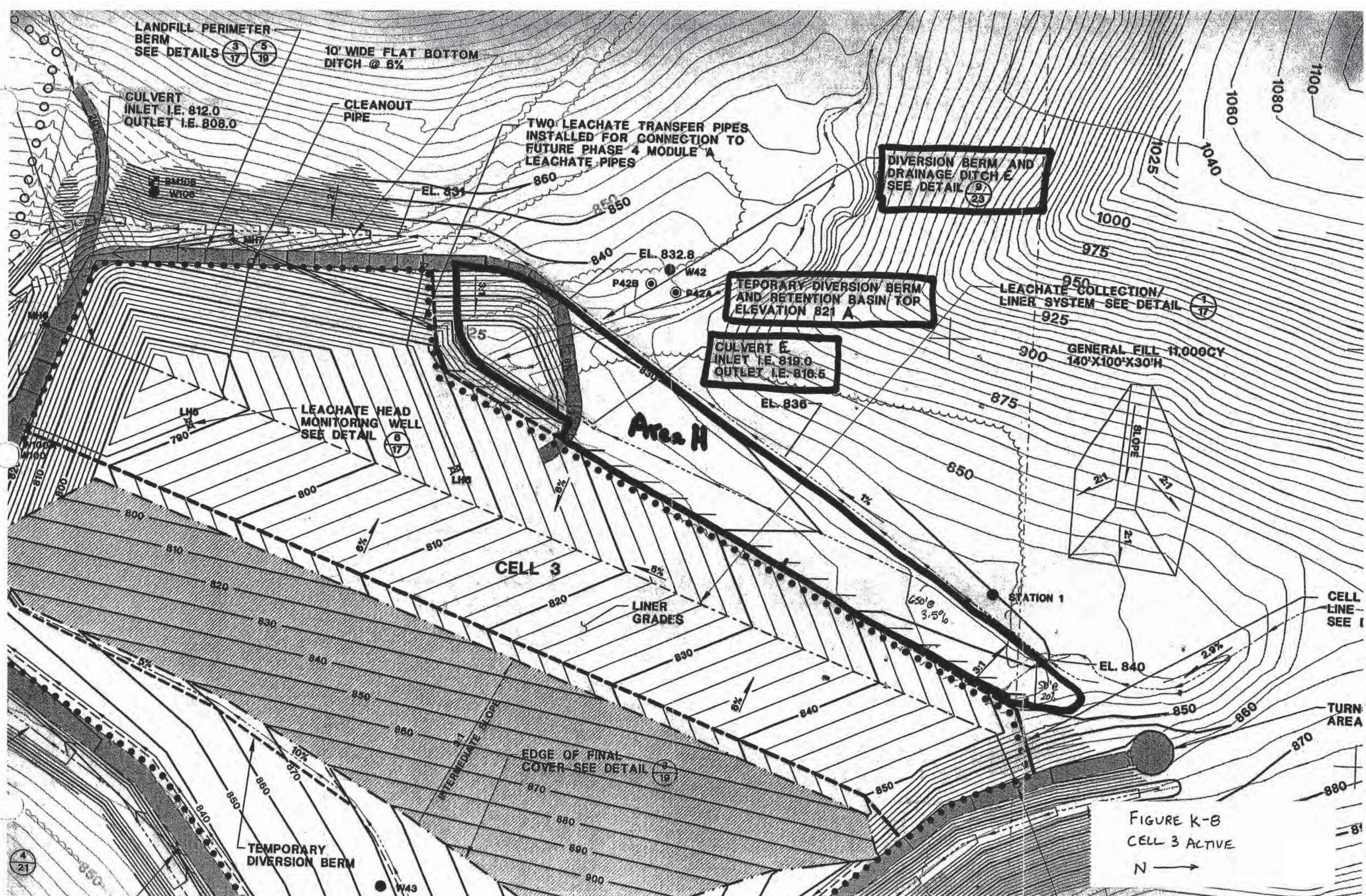


FIGURE K-7  
CELL 2 B ACTIVE  
N →







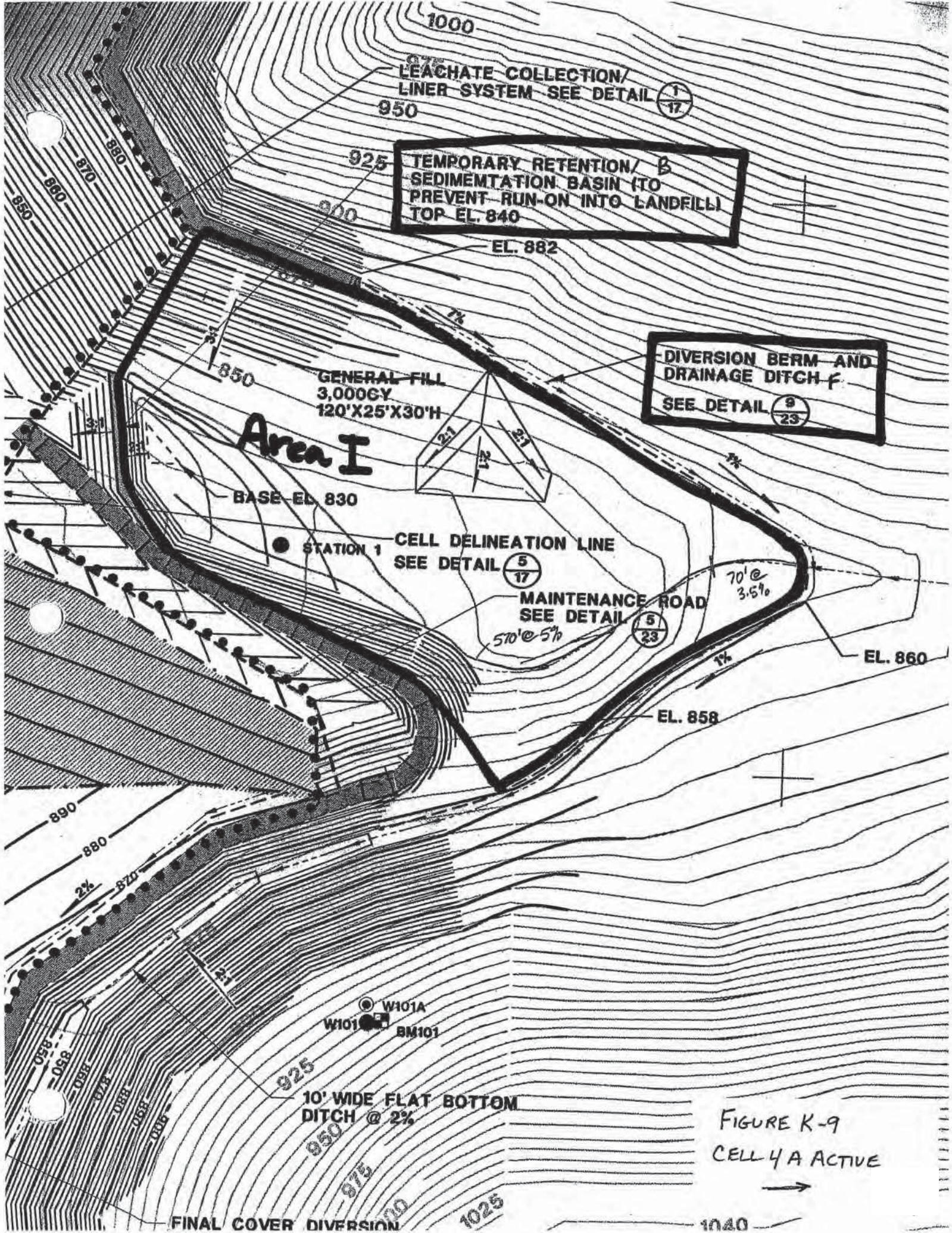


FIGURE K-9  
CELL 4A ACTIVE  
→



Quick TR-55 Ver.5.46 S/N:

Executed: 19:42:40 10-12-2000 p:\data\projects\3081\40\sw\op\OPERAT.TCT

SUMMARY SHEET FOR Tc or Tt COMPUTATIONS  
(Solved for Time using TR-55 Methods)

Dairyland Power Coop.  
Plan of Operation  
Operational Conditions

Subarea descr.	Tc or Tt	Time (hrs)
Area A	Tc	0.08
Area B	Tc	0.21
Area D	Tc	0.06 - Round to 0.10
Area E	Tc	0.15
Area F	Tc	0.24
Area G	Tc	0.05 - Round to 0.10
Area H	Tc	0.10
Area I	Tc	0.15





Quick TR-55 Ver.5.46 S/N:

Executed: 19:42:40 10-12-2000 p:\data\projects\3081\40\sw\op\OPERAT.TCT

Dairyland Power Coop.  
Plan of Operation  
Operational Conditions

Tc COMPUTATIONS FOR: Area B

SHEET FLOW (Applicable to Tc only)

Segment ID	1
Surface description	grass
Manning's roughness coeff., n	0.1500
Flow length, L (total < or = 300)	ft 300.0
Two-yr 24-hr rainfall, P2	in 2.800
Land slope, s	ft/ft 0.1700
0.8	
.007 * (n*L)	
T = -----	hrs 0.18 = 0.18
0.5 0.4	
P2 * s	

SHALLOW CONCENTRATED FLOW

Segment ID	2
Surface (paved or unpaved)?	Unpaved
Flow length, L	ft 220.0
Watercourse slope, s	ft/ft 0.0200
0.5	
Avg.V = Csf * (s)	ft/s 2.2818
where: Unpaved Csf = 16.1345	
Paved Csf = 20.3282	
T = L / (3600*V)	hrs 0.03 = 0.03

CHANNEL FLOW

Segment ID	
Cross Sectional Flow Area, a	sq.ft 0.00
Wetted perimeter, PW	ft 0.00
Hydraulic radius, r = a/PW	ft 0.000
Channel slope, s	ft/ft 0.0000
Manning's roughness coeff., n	0.0000
2/3 1/2	
1.49 * r * s	
V = -----	ft/s 0.0000
n	
Flow length, L	ft 0
T = L / (3600*V)	hrs 0.00 = 0.00

.....  
TOTAL TIME (hrs) 0.21

Quick TR-55 Ver.5.46 S/N:  
 Executed: 19:42:40 10-12-2000 p:\data\projects\3081\40\sw\op\OPERAT.TCT

Dairyland Power Coop.  
 Plan of Operation  
 Operational Conditions

Tc COMPUTATIONS FOR: Area D

SHEET FLOW (Applicable to Tc only)

Segment ID	1		
Surface description	soil		
Manning's roughness coeff., n	0.0110		
Flow length, L (total < or = 300)	ft	150.0	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.0500	
	0.8		
	.007 * (n*L)		
T =	-----	hrs	0.02 = 0.02
	0.5 0.4		
	P2 * s		

SHALLOW CONCENTRATED FLOW

Segment ID	2		
Surface (paved or unpaved)?	Unpaved		
Flow length, L	ft	550.0	
Watercourse slope, s	ft/ft	0.0500	
	0.5		
Avg.V = Csf * (s)	ft/s	3.6078	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.04	= 0.04

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
	2/3 1/2		
	1.49 * r * s		
V =	-----	ft/s	0.0000
	n		
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

.....  
 TOTAL TIME (hrs) 0.06

Executed: 19:42:40 10-12-2000 p:\data\projects\3081\40\sw\op\OPERAT.TCT

Tc COMPUTATIONS FOR: Area E

Segment ID	1
Surface description	grass
Manning's roughness coeff., n	0.1500
Flow length, L (total < or = 300)	ft 230.0
Two-yr 24-hr rainfall, P2	in 2.800
Land slope, s	ft/ft 0.1800

.....

TOTAL TIME (hrs) 0.15



Dairyland Power Coop.  
 Plan of Operation  
 Operational Conditions

Tc COMPUTATIONS FOR: Area F

SHEET FLOW (Applicable to Tc only)

Segment ID	1		
Surface description	grass		
Manning's roughness coeff., n	0.1500		
Flow length, L (total < or = 300)	ft	185.0	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.2500	
	0.8		
	.007 * (n*L)		
T =	-----	hrs	0.10 = 0.10
	0.5 0.4		
	P2 * s		

SHALLOW CONCENTRATED FLOW

Segment ID	2		
Surface (paved or unpaved)?	Unpaved		
Flow length, L	ft	1370.0	
Watercourse slope, s	ft/ft	0.0300	
	0.5		
Avg.V = Csf * (s)	ft/s	2.7946	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.14	= 0.14

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
	2/3 1/2		
	1.49 * r * s		
V =	-----	ft/s	0.0000
	n		
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

.....  
 TOTAL TIME (hrs) 0.24

Dairyland Power Coop.  
Plan of Operation  
Operational Conditions

## Tc COMPUTATIONS FOR: Area G

## SHEET FLOW (Applicable to Tc only)

Segment ID	1		
Surface description	grass		
Manning's roughness coeff., n	0.1500		
Flow length, L (total < or = 300)	ft	45.0	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.3300	
	0.8		
	.007 * (n*L)		
T =	-----	hrs	0.03 = 0.03
	0.5 0.4		
	P2 * s		

## SHALLOW CONCENTRATED FLOW

Segment ID	2		
Surface (paved or unpaved)?	Unpaved		
Flow length, L	ft	320.0	
Watercourse slope, s	ft/ft	0.1200	
	0.5		
Avg.V = Csf * (s)	ft/s	5.5892	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.02	= 0.02

## CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
	2/3 1/2		
	1.49 * r * s		
V =	-----	ft/s	0.0000
	n		
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

::

TOTAL TIME (hrs) 0.05

Dairyland Power Coop.  
Plan of Operation  
Operational Conditions

## Tc COMPUTATIONS FOR: Area H

## SHEET FLOW (Applicable to Tc only)

Segment ID	1		
Surface description	grass		
Manning's roughness coeff., n	0.1500		
Flow length, L (total < or = 300)	ft	50.0	
Two-yr 24-hr rainfall, P2	in	2.800	
Land slope, s	ft/ft	0.2000	
	0.8		
	.007 * (n*L)		
T =	-----	hrs	0.04 = 0.04
	0.5    0.4		
	P2    *    s		

## SHALLOW CONCENTRATED FLOW

Segment ID	2		
Surface (paved or unpaved)?	Unpaved		
Flow length, L	ft	650.0	
Watercourse slope, s	ft/ft	0.0350	
	0.5		
Avg.V = Csf * (s)	ft/s	3.0185	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.06	= 0.06

## CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
	2/3    1/2		
	1.49 * r * s		
V =	-----	ft/s	0.0000
	n		
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

.....  
TOTAL TIME (hrs)    0.10



```

.....
TOTAL TIME (hrs)      0.15

```

## TR-55 TABULAR HYDROGRAPH METHOD

Type II Distribution  
(24 hr. Duration Storm)

Executed: 10-12-2000 20:11:42

Watershed file: --&gt; p:\data\projects\3081\40\sw\op\CELL1 .WSD

Hydrograph file: --&gt; p:\data\projects\3081\40\sw\op\CELL1 .HYD

Dairyland Power Coop.

Plan of Operation

Operational Conditions

Cell 1

## &gt;&gt;&gt;&gt; Input Parameters Used to Compute Hydrograph &lt;&lt;&lt;&lt;

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Area A	1.10	69.0	0.10	0.00	6.10	2.79	.15 .10
Area B	2.70	69.0	0.20	0.00	6.10	2.79	.15 .10

\* Travel time from subarea outfall to composite watershed outfall point.

Total area = 3.80 acres or 0.00594 sq.mi

Peak discharge = 14 cfs

## &gt;&gt;&gt;&gt; Computer Modifications of Input Parameters &lt;&lt;&lt;&lt;

Subarea Description	Input Values		Rounded Values		Ia/p	
	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)	Interpolated (Yes/No)	Ia/p Messages
Area A	0.10	0.00	**	**	No	--
Area B	0.21	0.00	0.20	0.00	No	--

\* Travel time from subarea outfall to composite watershed outfall point.

\*\* Tc &amp; Tt are available in the hydrograph tables.

TR-55 TABULAR HYDROGRAPH METHOD  
Type II Distribution  
(24 hr. Duration Storm)

Executed: 10-12-2000 20:11:42

Watershed file: --> p:\data\projects\3081\40\sw\op\CELL1 .WSD

Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL1 .HYD

Dairyland Power Coop.  
Plan of Operation  
Operational Conditions  
Cell 1

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
-----	-----	-----
Area A	5	12.1
Area B	9	12.1
-----	-----	-----
Composite Watershed	14	12.1



## TR-55 TABULAR HYDROGRAPH METHOD

Type II Distribution

(24 hr. Duration Storm)

Executed: 10-12-2000 20:11:49

Watershed file: --&gt; p:\data\projects\3081\40\sw\op\CELL2A .WSD

Hydrograph file: --&gt; p:\data\projects\3081\40\sw\op\CELL2A .HYD

Dairyland Power Coop.

Plan of Operation

Operational Conditions

Cell 2A

## &gt;&gt;&gt;&gt; Input Parameters Used to Compute Hydrograph &lt;&lt;&lt;&lt;

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Area D	1.30	69.0	0.10	0.00	6.10	2.79	.15 .10
Area E	1.60	69.0	0.20	0.00	6.10	2.79	.15 .10

\* Travel time from subarea outfall to composite watershed outfall point.

Total area = 2.90 acres or 0.00453 sq.mi

Peak discharge = 11 cfs

## &gt;&gt;&gt;&gt; Computer Modifications of Input Parameters &lt;&lt;&lt;&lt;

Subarea Description	Input Values		Rounded Values		Ia/p Interpolated	Ia/p Messages
	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)	(Yes/No)	
Area D	0.10	0.00	**	**	No	--
Area E	0.15	0.00	0.20	0.00	No	--

\* Travel time from subarea outfall to composite watershed outfall point.

\*\* Tc &amp; Tt are available in the hydrograph tables.

## TR-55 TABULAR HYDROGRAPH METHOD

Type II Distribution

(24 hr. Duration Storm)

Executed: 10-12-2000 20:11:49

Watershed file: --&gt; p:\data\projects\3081\40\sw\op\CELL2A .WSD

Hydrograph file: --&gt; p:\data\projects\3081\40\sw\op\CELL2A .HYD

Dairyland Power Coop.

Plan of Operation

Operational Conditions

Cell 2A

## &gt;&gt;&gt;&gt; Summary of Subarea Times to Peak &lt;&lt;&lt;&lt;

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Area D	6	12.1
Area E	6	12.2
Composite Watershed	11	12.1

## TR-55 TABULAR HYDROGRAPH METHOD

Type II Distribution

(24 hr. Duration Storm)

Executed: 10-12-2000 20:11:57

Watershed file: --&gt; p:\data\projects\3081\40\sw\op\TEMPBAS .WSD

Hydrograph file: --&gt; p:\data\projects\3081\40\sw\op\TEMPBAS .HYD

Dairyland Power Coop.

Plan of Operation

Operational Conditions

Cell 2A Temporary Basin

## &gt;&gt;&gt;&gt; Input Parameters Used to Compute Hydrograph &lt;&lt;&lt;&lt;

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Area F	7.60	69.0	0.20	0.00	6.10	2.79	.15 .10

\* Travel time from subarea outfall to composite watershed outfall point.

Total area = 7.60 acres or 0.01187 sq.mi

Peak discharge = 27 cfs

## &gt;&gt;&gt;&gt; Computer Modifications of Input Parameters &lt;&lt;&lt;&lt;

Subarea Description	Input Values		Rounded Values		Ia/p	
	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)	Interpolated (Yes/No)	Ia/p Messages
Area F	0.24	0.00	0.20	0.00	No	--

\* Travel time from subarea outfall to composite watershed outfall point.



## TR-55 TABULAR HYDROGRAPH METHOD

Type II Distribution  
(24 hr. Duration Storm)

Executed: 10-12-2000 20:11:57

Watershed file: --&gt; p:\data\projects\3081\40\sw\op\TEMPBAS .WSD

Hydrograph file: --&gt; p:\data\projects\3081\40\sw\op\TEMPBAS .HYD

Dairyland Power Coop.  
Plan of Operation  
Operational Conditions  
Cell 2A Temporary Basin

## &gt;&gt;&gt;&gt; Summary of Subarea Times to Peak &lt;&lt;&lt;&lt;

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
----- Area F -----	27	12.2
----- Composite Watershed -----	27	12.2

## TR-55 TABULAR HYDROGRAPH METHOD

Type II Distribution

(24 hr. Duration Storm)

Executed: 10-12-2000 20:12:03

Watershed file: --&gt; p:\data\projects\3081\40\sw\op\CELL2B .WSD

Hydrograph file: --&gt; p:\data\projects\3081\40\sw\op\CELL2B .HYD

Dairyland Power Coop.

Plan of Operation

Operational Conditions

Cell 2B

## &gt;&gt;&gt;&gt; Input Parameters Used to Compute Hydrograph &lt;&lt;&lt;&lt;

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Area G	0.60	69.0	0.10	0.00	6.10	2.79	.15 .10

\* Travel time from subarea outfall to composite watershed outfall point.

Total area = 0.60 acres or 0.00094 sq.mi

Peak discharge = 3 cfs

## &gt;&gt;&gt;&gt; Computer Modifications of Input Parameters &lt;&lt;&lt;&lt;

Subarea Description	Input Values		Rounded Values		Ia/p	
	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)	Interpolated (Yes/No)	Ia/p Messages
Area G	0.10	0.00	**	**	No	--

\* Travel time from subarea outfall to composite watershed outfall point.

\*\* Tc &amp; Tt are available in the hydrograph tables.

TR-55 TABULAR HYDROGRAPH METHOD  
 Type II Distribution  
 (24 hr. Duration Storm)

Executed: 10-12-2000 20:12:03

Watershed file: --> p:\data\projects\3081\40\sw\op\CELL2B .WSD

Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL2B .HYD

Dairyland Power Coop.  
 Plan of Operation  
 Operational Conditions  
 Cell 2B

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
-----	-----	-----
Area G	3	12.1
-----	-----	-----
Composite Watershed	3	12.1



## TR-55 TABULAR HYDROGRAPH METHOD

Type II Distribution

(24 hr. Duration Storm)

Executed: 10-12-2000 20:12:08

Watershed file: --&gt; p:\data\projects\3081\40\sw\op\CELL3 .WSD

Hydrograph file: --&gt; p:\data\projects\3081\40\sw\op\CELL3 .HYD

Dairyland Power Coop.

Plan of Operation

Operational Conditions

Cell 3

## &gt;&gt;&gt;&gt; Input Parameters Used to Compute Hydrograph &lt;&lt;&lt;&lt;

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Area H	1.70	69.0	0.10	0.00	6.10	2.79	.15 .10

\* Travel time from subarea outfall to composite watershed outfall point.

Total area = 1.70 acres or 0.00266 sq.mi

Peak discharge = 7 cfs

## &gt;&gt;&gt;&gt; Computer Modifications of Input Parameters &lt;&lt;&lt;&lt;

Subarea Description	Input Values		Rounded Values		Ia/p	
	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)	Interpolated (Yes/No)	Ia/p Messages
Area H	0.10	0.00	**	**	No	--

\* Travel time from subarea outfall to composite watershed outfall point.

\*\* Tc &amp; Tt are available in the hydrograph tables.

## TR-55 TABULAR HYDROGRAPH METHOD

Type II Distribution

(24 hr. Duration Storm)

Executed: 10-12-2000 20:12:08

Watershed file: --&gt; p:\data\projects\3081\40\sw\op\CELL3 .WSD

Hydrograph file: --&gt; p:\data\projects\3081\40\sw\op\CELL3 .HYD

Dairyland Power Coop.

Plan of Operation

Operational Conditions

Cell 3

## &gt;&gt;&gt;&gt; Summary of Subarea Times to Peak &lt;&lt;&lt;&lt;

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
-----	-----	-----
Area H	7	12.1
-----	-----	-----
Composite Watershed	7	12.1

## TR-55 TABULAR HYDROGRAPH METHOD

Type II Distribution

(24 hr. Duration Storm)

Executed: 10-12-2000 20:21:09

Watershed file: --&gt; p:\data\projects\3081\40\sw\op\CELL4A .WSD

Hydrograph file: --&gt; p:\data\projects\3081\40\sw\op\CELL4A .HYD

Dairyland Power Coop.

Plan of Operation

Operational Conditions

Cell 4A

## &gt;&gt;&gt;&gt; Input Parameters Used to Compute Hydrograph &lt;&lt;&lt;&lt;

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Area I	3.60	69.0	0.20	0.00	6.10	2.79	.15 .10

\* Travel time from subarea outfall to composite watershed outfall point.

Total area = 3.60 acres or 0.00562 sq.mi

Peak discharge = 13 cfs

## &gt;&gt;&gt;&gt; Computer Modifications of Input Parameters &lt;&lt;&lt;&lt;

Subarea Description	Input Values		Rounded Values		Ia/p	
	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)	Interpolated (Yes/No)	Ia/p Messages
Area I	0.15	0.00	0.20	0.00	No	--

\* Travel time from subarea outfall to composite watershed outfall point.



TR-55 TABULAR HYDROGRAPH METHOD  
Type II Distribution  
(24 hr. Duration Storm)

Executed: 10-12-2000 20:21:09

Watershed file: --> p:\data\projects\3081\40\sw\op\CELL4A .WSD

Hydrograph file: --> p:\data\projects\3081\40\sw\op\CELL4A .HYD

Dairyland Power Coop.  
Plan of Operation  
Operational Conditions  
Cell 4A

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
----- Area 1 -----	13	12.2
----- Composite Watershed -----	13	12.2

## Reference Information

Table 2-2a.—Runoff curve numbers for urban areas<sup>1</sup>

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area <sup>2</sup>	A	B	C	D
<i>Fully developed urban areas (vegetation established)</i>					
Open space (lawns, parks, golf courses, cemeteries, etc.) <sup>3</sup> :					
Poor condition (grass cover < 50%) .....		68	79	86	89
Fair condition (grass cover 50% to 75%) .....		49	69	79	84
Good condition (grass cover > 75%) .....		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way) .....		98	98	98	98
Streets and roads:					
Paved: curbs and storm sewers (excluding right-of-way) .....		98	98	98	98
Paved: open ditches (including right-of-way) .....		83	89	92	93
Gravel (including right-of-way) .....		76	85	89	91
Dirt (including right-of-way) .....		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) <sup>4</sup> ...		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders) .....		96	96	96	96
Urban districts:					
Commercial and business .....	85	89	92	94	95
Industrial .....	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses) .....	65	77	85	90	92
1/4 acre .....	38	61	75	83	87
1/3 acre .....	30	57	72	81	86
1/2 acre .....	25	54	70	80	85
1 acre .....	20	51	68	79	84
2 acres .....	12	46	65	77	82
<i>Developing urban areas</i>					
Newly graded areas (pervious areas only, no vegetation) <sup>5</sup> .....		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

<sup>1</sup>Average runoff condition, and  $I_a = 0.25$ .<sup>2</sup>The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.<sup>3</sup>CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.<sup>4</sup>Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.<sup>5</sup>Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4, based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.



Table 2-2b.—Runoff curve numbers for cultivated agricultural lands<sup>1</sup>

Cover description			Curve numbers for hydrologic soil group—			
Cover type	Treatment <sup>2</sup>	Hydrologic condition <sup>3</sup>	A	(B)	C	D
Fallow	Bare soil	—	77	(86)	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	(78)	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	→ Contoured (C)	Poor	70	(79)	84	88
		Good	65	(75) <i>Ans = 77</i>	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T + CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

<sup>1</sup>Average runoff condition, and  $I_a = 0.2S$ .<sup>2</sup>Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.<sup>3</sup>Hydrologic condition is based on combination of factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes in rotations, (d) percent of residue cover on the land surface (good  $\geq 20\%$ ), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

Table 2-2c.—Runoff curve numbers for other agricultural lands<sup>1</sup>

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition	A	(B)	C	D
Pasture (grassland) or range—continuous forage for grazing. <sup>2</sup>	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	(61)	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
→ Brush—brush-weed-grass mixture with brush the major element. <sup>3</sup>	Poor	48	(67)	77	83
	Fair	35	56	70	77
	Good	30	48	65	73
Woods—grass combination (orchard or tree farm). <sup>5</sup>	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
→ Woods. <sup>6</sup>	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30	(55)	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

<sup>1</sup>Average runoff condition, and  $I_a = 0.2S$ .

<sup>2</sup>Poor: <50% ground cover or heavily grazed with no mulch.  
 Fair: 50 to 75% ground cover and not heavily grazed.  
 Good: >75% ground cover and lightly or only occasionally grazed.

<sup>3</sup>Poor: <50% ground cover.  
 Fair: 50 to 75% ground cover.  
 Good: >75% ground cover.

<sup>4</sup>Actual curve number is less than 30; use CN = 30 for runoff computations.

<sup>5</sup>CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

<sup>6</sup>Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.  
 Fair: Woods are grazed but not burned, and some forest litter covers the soil.  
 Good: Woods are protected from grazing, and litter and brush adequately cover the soil.



## Sheet flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's  $n$ ) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. These  $n$  values are for very shallow flow depths of about 0.1 foot or so. Table 3-1 gives Manning's  $n$  values for sheet flow for various surface conditions.

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overton and Meadows 1976) to compute  $T_t$ :

$$T_t = \frac{0.007 (nL)^{0.8}}{(P_2)^{0.5} s^{0.4}} \quad [\text{Eq. 3-3}]$$

Table 3-1.—Roughness coefficients (Manning's  $n$ ) for sheet flow

Surface description	$n^1$
Smooth surfaces (concrete, asphalt, gravel, or bare soil) .....	0.011
Fallow (no residue) .....	0.05 ←
Cultivated soils:	
Residue cover ≤ 20% .....	0.06
Residue cover > 20% .....	0.17 ←
Grass:	
Short grass prairie .....	0.15 ←
Dense grasses <sup>2</sup> .....	0.24 ←
Bermudagrass .....	0.41
Range (natural) .....	0.13 ←
Woods: <sup>3</sup>	
Light underbrush .....	0.40 ←
Dense underbrush .....	0.80

<sup>1</sup>The  $n$  values are a composite of information compiled by Engman (1986).

<sup>2</sup>Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.

<sup>3</sup>When selecting  $n$ , consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

where

$T_t$  = travel time (hr),

$n$  = Manning's roughness coefficient (table 3-1),

$L$  = flow length (ft),

$P_2$  = 2-year, 24-hour rainfall (in), and

$s$  = slope of hydraulic grade line (land slope, ft/ft).

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time. Rainfall depth can be obtained from appendix B.

## Shallow concentrated flow

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from figure 3-1, in which average velocity is a function of watercourse slope and type of channel. For slopes less than 0.005 ft/ft, use equations given in appendix F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

After determining average velocity in figure 3-1, use equation 3-1 to estimate travel time for the shallow concentrated flow segment.

## Open channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bank-full elevation.



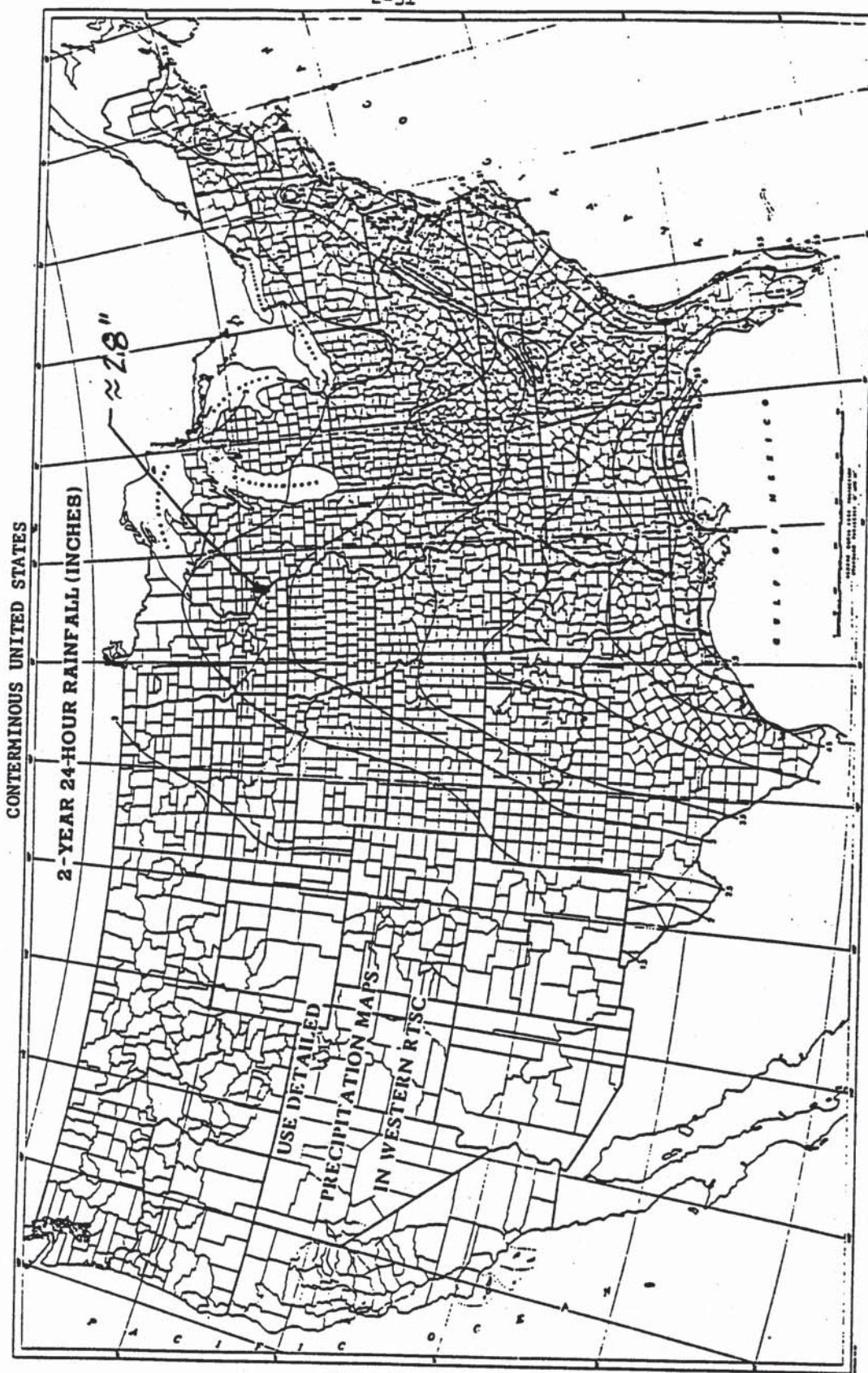
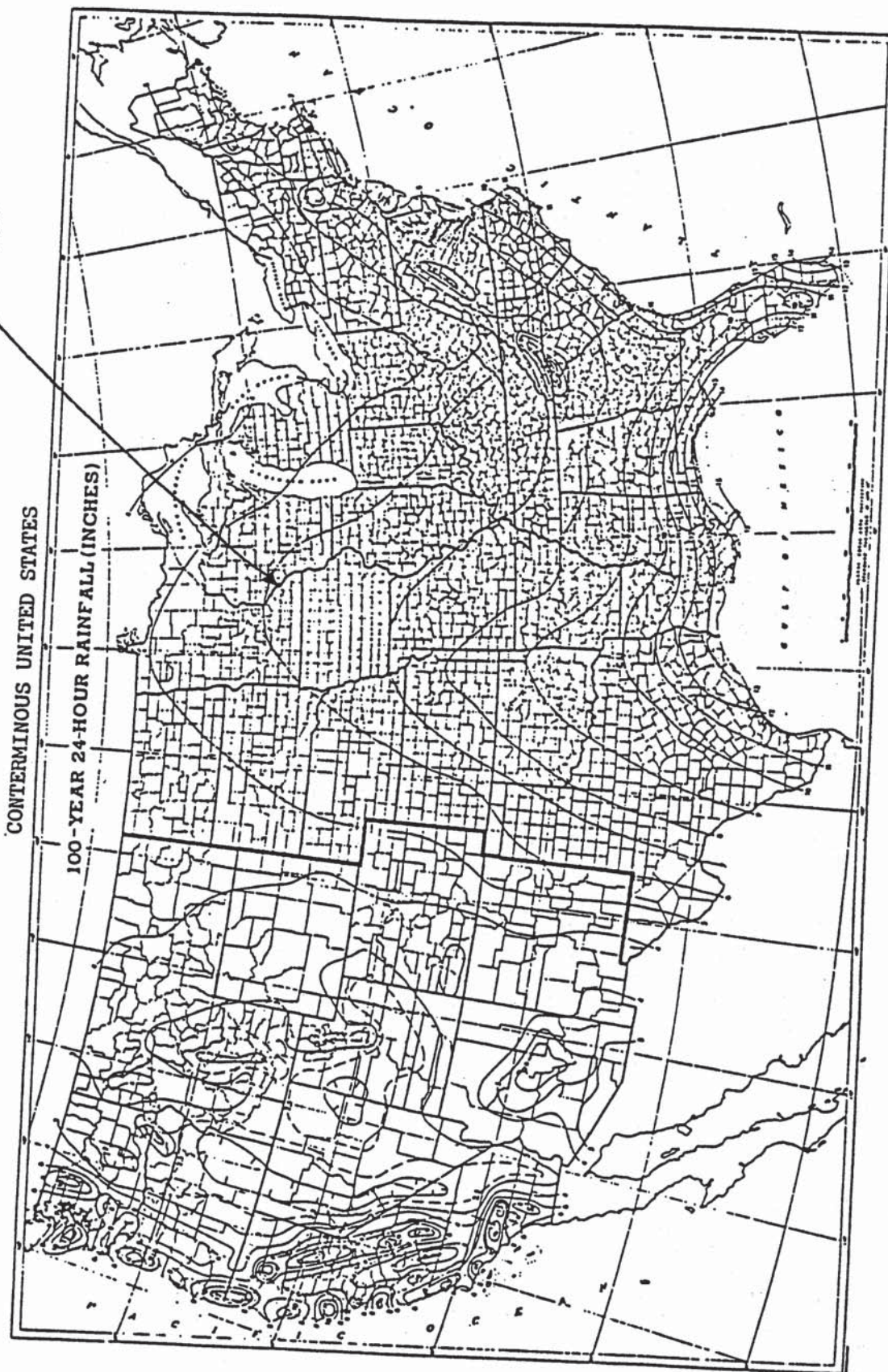


Exhibit 2-3  
Sheet 1 of 5

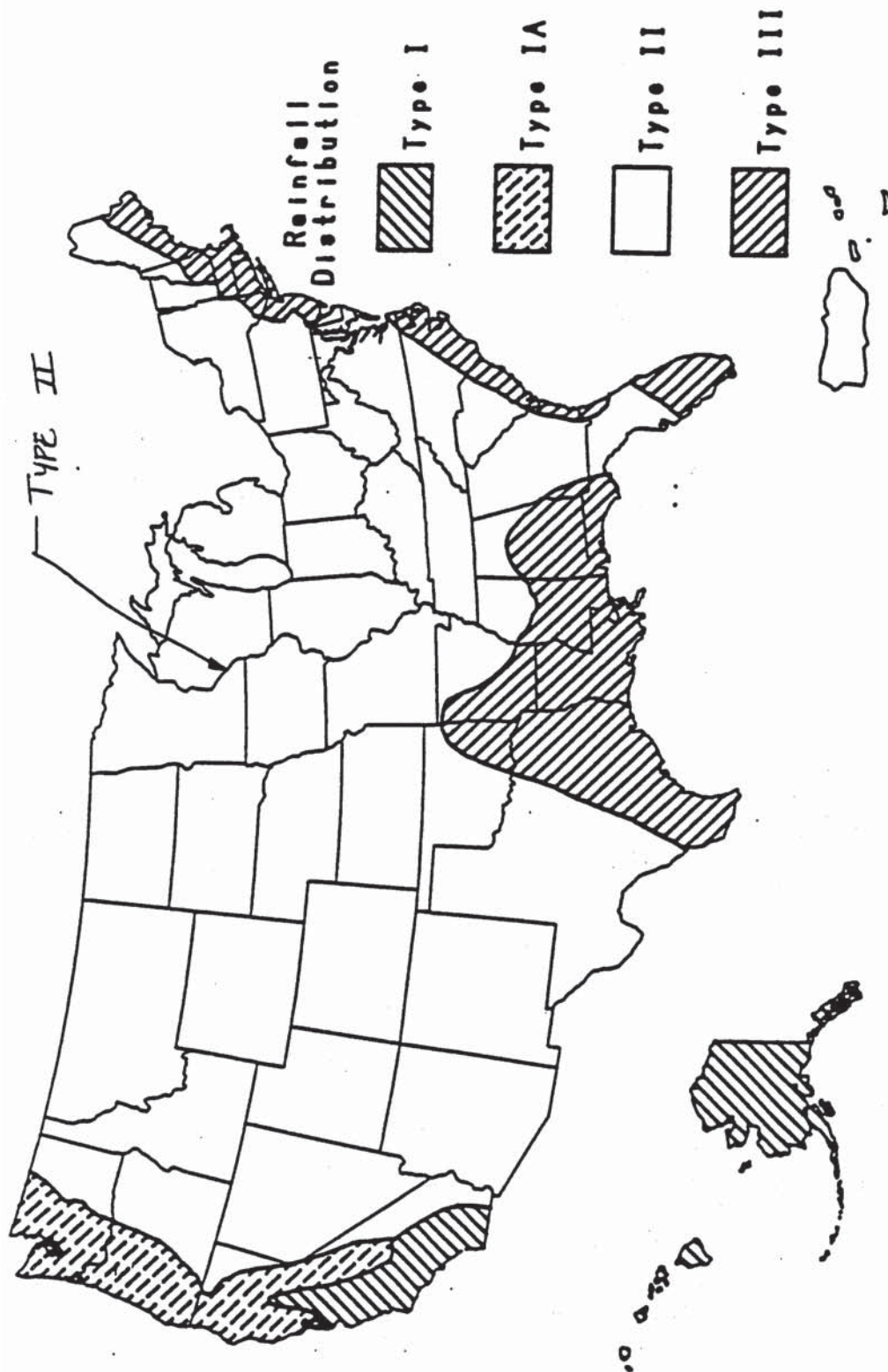
Prepared by U. S. Weather Bureau





Prepared by U. S. Weather Bureau

FROM: Urban Hydrology for Small Watersheds. [ n.p. ]: U.S. Department of Agriculture.  
Soil Conservation Service Engineering Division, ( Technical Release No. 55 ).  
1975, as revised 1981.



—Approximate geographic boundaries for SCS rainfall distributions.



## **Diversion Berm, Perimeter Ditch, and Spillway Design Calculations**

## **Purpose/Methodology/Assumptions/Results/References**



## COMPUTATION SHEET

SHEET 1 OF 3

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
Dairyland Power Cooperative	By: BJK	Date: 9/00	By:	Date:	3081.40

### DIVERSION BERM, PERIMETER DITCH, AND SPILLWAY DESIGN CALCULATIONS

#### Purpose

To size the diversion berms, perimeter ditches and spillway at the proposed Dairyland Power Cooperative Landfill to adequately handle the surface water runoff from a 100-year, 24-hour storm.

#### Methodologies

Ditches, diversion berms and spillways were designed to channel the surface water runoff from the landfill drainage areas to the sedimentation basins, receiving ditches, or spillways. The direction of surface water runoff from the drainage areas surrounding the proposed landfill is towards the proposed landfill. Perimeter drainage ditches were therefore incorporated into the design to route the surface water runoff from outside the proposed landfill limits along the perimeter of the landfill area to the existing main channel at the south end of the landfill. These ditches are labeled as the NW, NE, West, SE, and SW ditches. The perimeter ditches sized in this subsection of the appendix, then, include ditches to collect runoff from the landfill drainage areas as well as ditches to collect surface water run-on from the drainage areas surrounding the landfill.

The adequacy of the diversion berms and ditches in handling the surface water runoff and run-on and in limiting the amount of erosion is based on the depth of flow and velocity, respectively, in the ditch. An in-house RMT spreadsheet incorporating Manning's equation was used to assist in the design of the diversion berms and ditches. This program allows the user to input the ditch geometry, the peak flow (as determined by the surface water runoff calculation), and the vegetative retardance factor (Chow, 1959). The program then begins an iterative process which adjusts the flow depth and Manning's coefficient until the trial velocity and the resultant velocity are within 0.002 feet per second (fps) of each other. The end result is the peak flow depth and peak velocity for the geometry and peak flow entered. Design software provided by Synthetic Industries was also used to select erosion control matting for ditches and grouted riprap for spillways.

Permanent ditches, diversion berms, and spillways will be constructed as early in the site development as practicable. Where temporary ditching is required, these temporary ditches have been designed to the same standards as the permanent ditches. Calculations for the sizing of the temporary ditches are also attached.





## COMPUTATION SHEET

SHEET 2 OF 3

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
Dairyland Power Cooperative	By: BJK	Date: 9/00	By:	Date:	3081.40

It is noted that the storm water control structures have been designed using a 100-year, 24-hour storm event and a TR-55 Type II storm distribution. As noted in the surface water runoff calculations, the peak flows calculated using this method meet or exceed the peak flows calculated using a 25-year, time of concentration storm event (required by NR 504.09).

### Assumptions

The following assumptions were used to design the diversion berms and perimeter ditches:

- Diversion berms, perimeter ditches and the spillway were designed to handle the runoff from the 100-year, 24-hour storm event.
- Diversion berm ditches were designed as V-notch ditches with a minimum 0.5 foot of freeboard for the 25-year, 24-hour storm. Diversion berm ditches were designed to convey the 100-year, 24-hour storm without overtopping.
- Perimeter ditches were designed as both V-notch and flat bottom (10-foot and 20-foot-wide) ditches with a minimum 0.5 foot of freeboard for the 25-year, 24-hour storm. Perimeter ditches were designed to convey the 100-year, 24-hour storm without overtopping.
- Grass-lined diversion berm and perimeter ditches were designed for a maximum velocity of 4 fps. Ditches with velocities exceeding 4 fps were designed to be lined with erosion mat or riprap, as appropriate.
- The spillway was designed as 20-foot-wide, flat-bottom spillway with a minimum 0.5 foot of freeboard.
- The peak flows in the diversion berms, perimeter ditches and the spillway were obtained from the hydrographs generated in the "Surface Water Runoff Calculations" subsection of this appendix.
- Manning's numbers were selected for both "low" retardance (Type "D") and "moderate" retardance (Type "C") as given by the U.S. Soil and Conservation Service. Type "D" is typical of spring conditions while Type "C" is typical of summer conditions. For ditches lined with erosion matting, default Manning numbers from the Synthetic Industries design software were utilized.

### Results

The diversion berms and perimeter ditches were adequately sized to handle the surface water runoff from a 100-year, 24-hour storm event. The diversion berms at a 2 percent slope will be grass-lined. To limit erosion, permanent erosion matting will be placed in the diversion berms at a 6 percent slope, as well as in most of the perimeter ditching. Grouted riprap will be constructed in the spillways. The attached figure highlights the ditch sizing results.



## COMPUTATION SHEET

SHEET 3 OF 3

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
	By:	Date:	By:	Date:	
Dairyland Power Cooperative	BJK	9/00			3081.40

### References

Chow, V.T. 1959. Open Channel Hydraulics, McGraw Hill, New York.

Wisconsin Department of Transportation. 1994. Facilities Development Manual. February 1994.

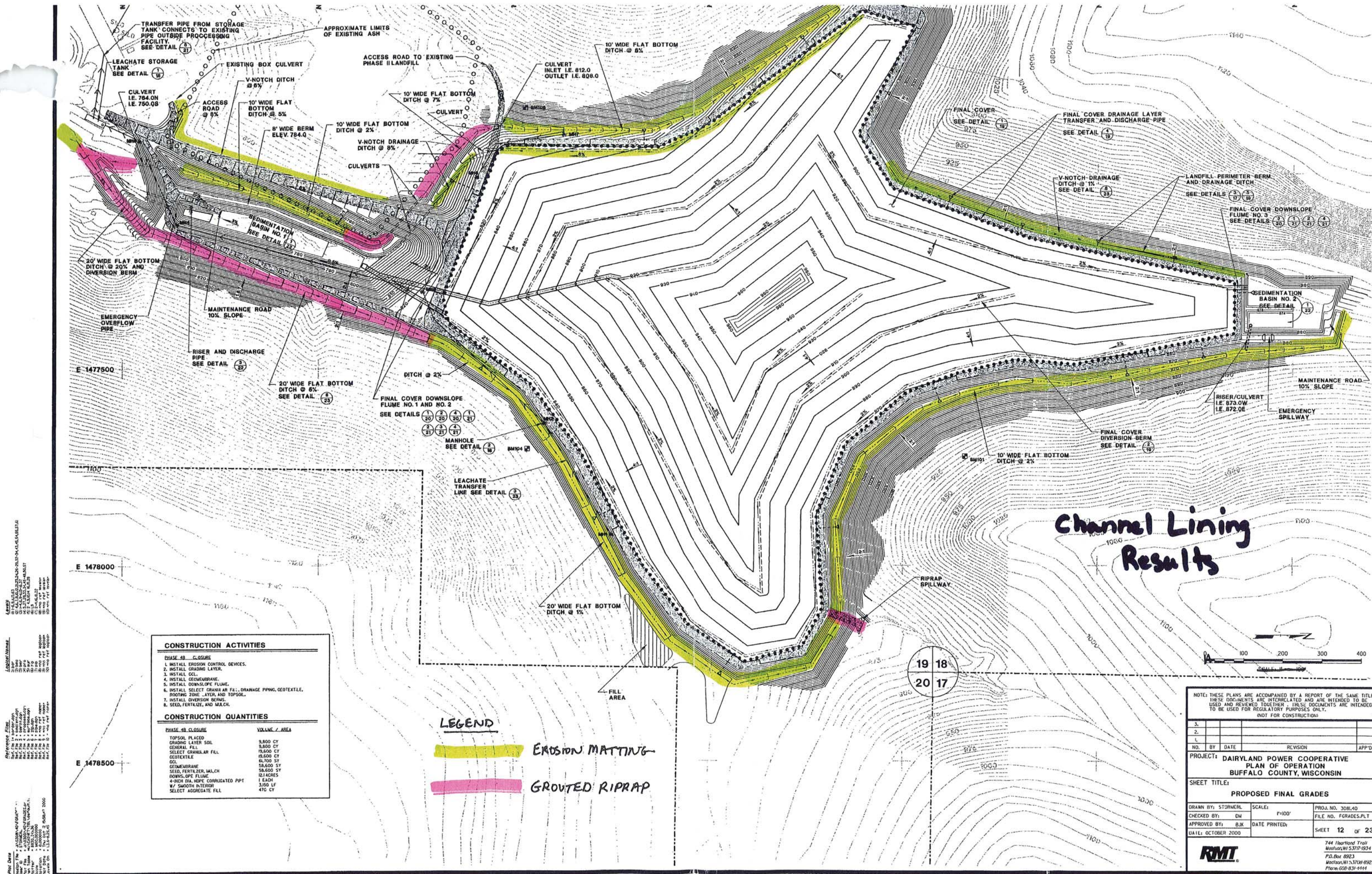
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NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY. (NOT FOR CONSTRUCTION)

NO.	BY	DATE	REVISION	APP'D.
1.				
2.				
3.				

PROJECT: DAIRYLAND POWER COOPERATIVE  
PLAN OF OPERATION  
BUFFALO COUNTY, WISCONSIN

SHEET TITLE: PROPOSED FINAL GRADES

DRAWN BY: STORMER	SCALE: 1"=100'	PROJ. NO. 3081.40
CHECKED BY: DM	FILE NO. FGRADES.PLT	
APPROVED BY: BJK	DATE PRINTED:	
DATE: OCTOBER 2000	SHEET 12 OF 23	

**RMT**

744 Hartford Trail  
Madison, WI 53717-1934  
P.O. Box 8923  
Madison, WI 53708-8923  
Phone: 608-831-4444

FIGURE R-10



## **Calculations – Post-closure Landfill Conditions**

RMT, Inc.  
Grass Channel Sizing Calculations

Site:	Dairyland Power Cooperative	Date:	10/1/98
Project #:	3081.33	User:	BLP
Channel:	Diversion Berm (2%) - worst case flow Area 1F		

*✓ 10/1/98*

I. Input Parameters.

A. Side slope, Z1 (hor/vert) =	4.000 ft/ft ✓
B. Side slope, Z2 (hor/vert) =	2.000 ft/ft ✓
C. Bottom width, B =	0.000 ft ✓
D. Design channel slope, S =	0.020 ft/ft ✓
E. Channel Peak Flow, Q =	25.000 cfs ✓
F. Enter     - 1 - for Type "C" Veg. Retardence - 2 - for Type "D" Veg. Retardence	1 ← <i>Summer Conditions</i>

II. Peak Flow Calculations.

A. Trial flow depth, D = (Bisection method until $V_a = V_b$ )	1.570 ft <i>0.4' freeboard</i>
B. Channel flow area, $A_c =$ $(.5 * Z1 * D^2) + (B * D) + (.5 * Z2 * D^2)$	7.390 sq ft
C. Wetted Perimeter, $P_w =$ $(D * (Z1^2 + 1)^{.5}) + B + (D * (Z2^2 + 1)^{.5})$	9.981 ft
D. Hydraulic radius, $R_h =$ $(A_c / P_w)$	0.740 ft
E. Velocity and hydraulic radius, $V_R =$ $(V_a * R_h)$	2.505 sfps
F. Channel flow Manning's coeff, $n_c =$ 0	0.051
G. Trial velocity, $V_a =$ $(Q / A_c)$	3.383 fps
H. Resultant velocity, $V_b =$ $(1.49 / n_c) * (R_h^{.667}) * (S^{.5})$	3.383 fps <i>&lt; 4 fps</i>

Invoke Solution Macro by typing - 'ctrl' D

RMT, Inc.  
Grass Channel Sizing Calculations

Site:	Dairyland Power Cooperative	Date:	10/1/98
Project #:	3081.33	User:	BLP
Channel:	Diversion Berm (2%) - worst case flow Area 1F		✓ 10/98

=====

I. Input Parameters.

A. Side slope, Z1 (hor/vert) =	4.000 ft/ft ✓
B. Side slope, Z2 (hor/vert) =	2.000 ft/ft ✓
C. Bottom width, B =	0.000 ft ✓
D. Design channel slope, S =	0.020 ft/ft ✓
E. Channel Peak Flow, Q =	25.000 cfs ✓
F. Enter     - 1 - for Type "C" Veg. Retardence - 2 - for Type "D" Veg. Retardence	2 ← Spring Conditions ✓

II. Peak Flow Calculations.

A. Trial flow depth, D = (Bisection method until $V_a = V_b$ )	1.456 ft 0.5' freeboard
B. Channel flow area, $A_c$ = $(.5 * Z1 * D^2) + (B * D) + (.5 * Z2 * D^2)$	6.357 sq ft
C. Wetted Perimeter, $P_w$ = $(D * (Z1^2 + 1)^{.5}) + B + (D * (Z2^2 + 1)^{.5})$	9.257 ft
D. Hydraulic radius, $R_h$ = $(A_c / P_w)$	0.687 ft
E. Velocity and hydraulic radius, $V_R$ = $(V_a * R_h)$	2.701 sfps
F. Channel flow Manning's coeff, $n_c$ = 0	0.042
G. Trial velocity, $V_a$ = $(Q / A_c)$	3.933 fps
H. Resultant velocity, $V_b$ = $(1.49 / n_c) * (R_h^{.667}) * (S^{.5})$	3.933 fps < 4 fps ✓

Invoke Solution Macro by typing - 'ctrl' D



RMT, Inc.  
Grass Channel Sizing Calculations

Site:	Dairyland Power Corp.	Date:	31-July-98
Project #:	3081.33	User:	SRC
Channel:	Ditch (8%)		
	Area 1G - Flow From Landfill Portion - 15 cfs		

*✓ 10/1/98*

I. Input Parameters.

A. Side slope, Z1 (hor/vert) =	3.000 ft/ft
B. Side slope, Z2 (hor/vert) =	2.000 ft/ft
C. Bottom width, B =	0.000 ft
D. Design channel slope, S =	0.080 ft/ft
E. Channel Peak Flow, Q =	15.000 cfs
F. Enter    - 1 - for Type "C" Veg. Retardence - 2 - for Type "D" Veg. Retardence	1 ← <i>Summer conditions</i>

II. Peak Flow Calculations.

A. Trial flow depth, D = (Bisection method until $V_a = V_b$ )	1.071 ft <i>0.9' freeboard</i>
B. Channel flow area, $A_c =$ $(.5 * Z1 * D^2) + (B * D) + (.5 * Z2 * D^2)$	2.870 sq ft
C. Wetted Perimeter, $P_w =$ $(D * (Z1^2 + 1)^{.5}) + B + (D * (Z2^2 + 1)^{.5})$	5.784 ft
D. Hydraulic radius, $R_h =$ $(A_c / P_w)$	0.496 ft
E. Velocity and hydraulic radius, $V_R =$ $(V_a * R_h)$	2.593 sfps
F. Channel flow Manning's coeff, $n_c =$ 0	0.051
G. Trial velocity, $V_a =$ $(Q / A_c)$	5.226 fps
H. Resultant velocity, $V_b =$ $(1.49 / n_c) * (R_h^{.667}) * (S^{.5})$	5.226 fps > 4fps

*use permanent erosion*

RMT, Inc.  
Grass Channel Sizing Calculations

Site: Dairyland Power Corp. Date: 31-July-98  
Project #: 3081.33 User: SRC  
Channel: Ditch (8%)  
Area 1G - Flow From Landfill Portion - 15 cfs

*✓ 10/1/98*

I. Input Parameters.

A. Side slope, Z1 (hor/vert) = 3.000 ft/ft  
B. Side slope, Z2 (hor/vert) = 2.000 ft/ft  
C. Bottom width, B = 0.000 ft  
D. Design channel slope, S = 0.080 ft/ft  
E. Channel Peak Flow, Q = 15.000 cfs  
F. Enter - 1 - for Type "C" Veg. Retardence  
- 2 - for Type "D" Veg. Retardence *2 ← Spring conditions*

II. Peak Flow Calculations.

A. Trial flow depth, D = 0.992 ft *1' freeboard*  
(Bisection method until  $V_a = V_b$ )  
B. Channel flow area,  $A_c =$  2.459 sq ft  
 $(.5 * Z1 * D^2) + (B * D) + (.5 * Z2 * D^2)$   
C. Wetted Perimeter,  $P_w =$  5.353 ft  
 $(D * (Z1^2 + 1)^{.5}) + B + (D * (Z2^2 + 1)^{.5})$   
D. Hydraulic radius,  $R_h =$  0.459 ft  
 $(A_c / P_w)$   
E. Velocity and hydraulic radius,  $V_R =$  2.802 sfps  
 $(V_a * R_h)$   
F. Channel flow Manning's coeff,  $n_c =$  0.041  
0  
G. Trial velocity,  $V_a =$  6.101 fps  
 $(Q / A_c)$   
H. Resultant velocity,  $V_b =$  6.101 fps *> 4 fps*  
 $(1.49 / n_c) * (R_h^{.667}) * (S^{.5})$   
*use permanent erosion matting*

✓ BSG  
10/6/98

\*\*\*\*\*  
NORTH AMERICAN GREEN - ECMD5 VER.IV - CHANNEL PROTECTION - ENGLISH  
USER SPECIFIED CHANNEL LINING ANALYSIS  
\*\*\*\*\*

PROJECT NAME: Dairyland Power                      PROJECT NO.: 3081.33  
COMPUTED BY: BJK                                      DATE: 10-06-1998  
FROM STATION/REACH: Area 1G - Fl                  TO STATION/REACH:  
DRAINAGE AREA:                                      DESIGN FREQUENCY: 100

-----  
Channel Bottom    Side Slope Lt.    Side Slope Rt.    Channel Slope  
Width (ft)        (Horz. to 1)       (Horz. to 1)       (ft/ft)  
-----  
0.00               3.0               2.0               0.080               ✓

-----  
Discharge    Peak Flow    Velocity    Area    Hydraulic    Normal  
(cfs)        Period (hrs)   (ft/sec)   (ft^2)   Radius (ft)   Depth (ft)  
-----  
15.0           2.0           5.34       2.81       0.49       1.06               OK

-----  
Lining Growth Veg. Manning    Permissible    Calculated    Safety    Remark  
Type    Habit    Den    Coefficient    Shear (lb/sf)    Shear (lb/sf)    Factor  
-----  
P300                   0.049           8.00           5.29           1.51    STABLE    ✓  
Staple E  
Phase 3 (Mature Vegetation)



RMT, Inc.  
Grass Channel Sizing Calculations

Site:	Dairyland Power Corp.	Date:	31-July-98
Project #:	3081.33	User:	SRC
Channel:	Ditch (1%)		
	Area 2B		

*✓ 10/1/98*

I. Input Parameters.

A. Side slope, Z1 (hor/vert) =	3.000 ft/ft
B. Side slope, Z2 (hor/vert) =	2.000 ft/ft
C. Bottom width, B =	0.000 ft
D. Design channel slope, S =	0.010 ft/ft
E. Channel Peak Flow, Q =	73.000 cfs
F. Enter    - 1 - for Type "C" Veg. Retardence - 2 - for Type "D" Veg. Retardence	1 ← <i>Summer conditions</i>

II. Peak Flow Calculations.

A. Trial flow depth, D = (Bisection method until $V_a = V_b$ )	2.593 ft <i>0.4' freeboard</i>
B. Channel flow area, $A_c =$ $(.5 * Z1 * D^2) + (B * D) + (.5 * Z2 * D^2)$	16.814 sq ft
C. Wetted Perimeter, $P_w =$ $(D * (Z1^2 + 1)^{.5}) + B + (D * (Z2^2 + 1)^{.5})$	14.000 ft
D. Hydraulic radius, $R_h =$ $(A_c / P_w)$	1.201 ft
E. Velocity and hydraulic radius, $V_R =$ $(V_a * R_h)$	5.214 sfps
F. Channel flow Manning's coeff, $n_c =$ 0	0.039
G. Trial velocity, $V_a =$ $(Q / A_c)$	4.342 fps
H. Resultant velocity, $V_b =$ $(1.49 / n_c) * (R_h^{.667}) * (S^{.5})$	4.341 fps > 4 fps

*use permanent erosion matting*

RMT, Inc.  
Grass Channel Sizing Calculations

Site:	Dairyland Power Corp.	Date:	31-July-98
Project #:	3081.33	User:	SRC
Channel:	Ditch (1%) Area 2B		

*✓ 10/14/98*

I. Input Parameters.

A. Side slope, Z1 (hor/vert) =	3.000 ft/ft -
B. Side slope, Z2 (hor/vert) =	2.000 ft/ft -
C. Bottom width, B =	0.000 ft -
D. Design channel slope, S =	0.010 ft/ft -
E. Channel Peak Flow, Q =	73.000 cfs -
F. Enter    - 1 - for Type "C" Veg. Retardence - 2 - for Type "D" Veg. Retardence	2 ← Spring conditions

II. Peak Flow Calculations.

A. Trial flow depth, D = (Bisection method until $V_a = V_b$ )	2.512 ft    0.5' freeboard
B. Channel flow area, $A_c =$ $(.5 * Z1 * D^2) + (B * D) + (.5 * Z2 * D^2)$	15.774 sq ft
C. Wetted Perimeter, $P_w =$ $(D * (Z1^2 + 1)^{.5}) + B + (D * (Z2^2 + 1)^{.5})$	13.560 ft
D. Hydraulic radius, $R_h =$ $(A_c / P_w)$	1.163 ft
E. Velocity and hydraulic radius, $V_R =$ $(V_a * R_h)$	5.383 sfps
F. Channel flow Manning's coeff, $n_c =$ 0	0.036
G. Trial velocity, $V_a =$ $(Q / A_c)$	4.628 fps
H. Resultant velocity, $V_b =$ $(1.49 / n_c) * (R_h^{.667}) * (S^{.5})$	4.627 fps > 4 fps use permanent erosion matting

✓ BJB  
10/6/98

\*\*\*\*\*  
NORTH AMERICAN GREEN - ECMDS VER.IV - CHANNEL PROTECTION - ENGLISH  
USER SPECIFIED CHANNEL LINING ANALYSIS  
\*\*\*\*\*

PROJECT NAME: Dairyland Power Coop.      PROJECT NO.: 3081.33  
COMPUTED BY: BJK      DATE: 10-06-1998  
FROM STATION/REACH: Area 2B      TO STATION/REACH:  
DRAINAGE AREA:      DESIGN FREQUENCY: 100

-----  
Channel Bottom    Side Slope Lt.    Side Slope Rt.    Channel Slope  
Width (ft)      (Horz. to 1)      (Horz. to 1)      (ft/ft)  
-----  
0.00              3.0              2.0              0.010 ✓

-----  
Discharge    Peak Flow    Velocity    Area    Hydraulic    Normal  
(cfs)    Period (hrs)    (ft/sec)    (ft^2)    Radius (ft)    Depth (ft)  
-----  
73.0          2.0          3.64      20.08      1.31          2.83    OK

-----  
Lining Growth Veg. Manning    Permissible    Calculated    Safety    Remark  
Type    Habit    Den    Coefficient    Shear (lb/sf)    Shear (lb/sf)    Factor  
-----  
P300              0.049          8.00          1.77          4.52    STABLE ✓  
Staple E  
Phase 3 (Mature Vegetation)





# COMPUTATION SHEET

744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

SHEET 1 OF 3

PROJECT / PROPOSAL NAME

DAIRYLAND POWER COOP.

PREPARED

By: BJK Date: 5/19/97

CHECKED

By: BJK Date: 6/17/97

PROJECT / PROPOSAL NO.

3081.24

Rev BJK 10/96  
Rev BJK 9/00

## DITCH DESIGN CALCULATIONS - DESIGN INFORMATION (25 YR. 24 HR. STORM)

### SOUTH SPILLWAY

WIDTH = 20'  
SLOPE = 20%  
MIN DEPTH = 4'

#### PEAK FLOW - CONTRIBUTING DRAINAGE AREAS

3C + 4C + EAST + NORTHEAST + NORTH + BASIN 2 OUTFLOW ✓

18 + 11 + 445 + 68 + 194 + 10 = 746 CFS (25-YEAR)

↳ Round to 750 for Calc's

28 + 18 + 857 + 110 + 360 + 21 = 1,374 CFS (100-year) ✓

Note: All flows @ 12.6 HRS (25 year)

and @ 12.5 HRS (100-YR Follow)

### SE DITCH (29%) & (5%)

WIDTH = 20'  
SLOPE = 2%  
MIN DEPTH = 5'

#### PEAK FLOW - CONTRIBUTING DRAINAGE AREAS

3C + 4C + EAST + NORTHEAST + NORTH + BASIN 2 OUTFLOW ✓

SEE ABOVE

= 750 CFS (25-YEAR)

= 1,374 (100-yr Follow)

### SE DITCH (12%)

SAME FLOWS AS ABOVE

WIDTH = 20'  
SLOPE = 1%  
MIN DEPTH = 6'

### NE DITCH

WIDTH = 10'  
SLOPE = 2%  
MIN DEPTH = 10'

#### PEAK FLOW - CONTRIBUTING DRAINAGE AREAS

4C + NORTH + BASIN 2 OUT ✓

11 + 194 + 10 = 215 CFS (25-YEAR) ✓

18 + 360 + 21 = 399 CFS (100-YEAR FOLLOW)

- ALL FLOWS AT 12.6 HRS (25 yr) and AT  
12.5 HRS (100-YR FOLLOW)

### E Ditch

Width = 20'  
Slope = 2%  
Min Depth = 10'

#### Peak Flow - Contributing Drainage Areas

4C + Northeast + North + Basin 2 out

= 18 + 110 + 360 + 21 = 509 CFS (100 yr)





# COMPUTATION SHEET

SHEET

2 OF 3

744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

PROJECT / PROPOSAL NAME	PREPARED By: <u>BJK</u> Date:	CHECKED By: <u>BJK</u> Date: <u>6/17/97</u>	PROJECT / PROPOSAL NO. <u>3081.24</u>
-------------------------	----------------------------------	--	--

## NW DITCH

WIDTH - 0' (V-NOTCH)

SLOPE - 1%  
MIN DEPTH - 4 FT

PEAK FLOW - CONTRIBUTING DRAINAGE AREAS

2B - 48 CFS (25 YR) ✓

73 CFS (100 YR FALLOW)

## WEST DITCH

WIDTH = 10'

SLOPE = 6%

MIN DEPTH = 6'

PEAK FLOW - CONTRIBUTING DRAINAGE AREAS

2C + WEST AREA ✓

10 + 111 = 121 CFS (25-YEAR) ✓

10 + 223 = 241 CFS (100-YEAR FALLOW) ✓

- FLOWS @ 12.5 HRS (25-YEAR) AND AT  
12.5 HRS (100-YEAR FALLOW)

## SW DITCH

WIDTH = 10'

SLOPE = 2%, 5%, 7%

MIN DEPTH = 4'

PEAK FLOW - CONTRIBUTING DRAINAGE AREAS

1C + 2C + WEST AREA ✓

46 + 10 + 111 = 167 CFS (25-YEAR) ✓

94 + 20 + 209 = 323 CFS (100-YEAR FALLOW) ✓

FLOWS @ 12.5 HRS (25-YEAR) AND  
@ 12.5 HRS (100-YEAR FALLOW)

## MAIN CHANNEL

WIDTH ~ 20' MIN

SLOPE ~ 3%

MIN DEPTH ~ 6'

PEAK FLOW - CONTRIBUTING DRAINAGE AREAS

1C + 2C + 3C + 4C + EAST + NE + NORTH + WEST + BARN 1 + BARN 2 ✓

887 CFS + 8 + 10 = 905 CFS (25 YR)

1618 CFS + 21 + 21 = 1660 CFS (100-YR FALLOW) ✓

FLOWS @ 12.6 HRS (25-YEAR) AND @ 12.6 HRS  
(100-YEAR FALLOW)





PROJECT / PROPOSAL NAME / LOCATION:		PROJECT / PROPOSAL NO.
SUBJECT: <u>Dairyland Power Coop</u>		<u>3081.40</u>
PREPARED BY: <u>gjk</u>	DATE: <u>9/00</u>	FINAL <input checked="" type="checkbox"/>
CHECKED BY:	DATE:	REVISION <input type="checkbox"/>

AREA 1G DITCH

Width - V-NOTCH  
SLOPE - 8%  
MIN DEPTH = 4'

PEAK FLOW - CONTRIBUTING DRAINAGE AREA  
= 15 CFS FLOW FROM LF.


PHASE 2 DITCH

Width: V-NOTCH  
SLOPE: 6%  
MIN DEPTH: 2'

PEAK FLOW - CONTRIBUTING DRAINAGE AREA  
~ 1.5 ACRES OF PHASE 2 COVER  
DRAINAGE AREA - 1C = 42 ACRES  
 $\frac{1.5}{42} (96 \text{ CFS}) = 3.4 \text{ CFS}$   
USE 4 CFS



## Analysis By:

User Information:	Generated by EC-Design:
<b>Bernie Krantz</b> <b>RMT, Inc.</b> <b>744 Heartland Trail</b>  <b>Madison, WI 53717</b>	 <b>SYNTHETIC INDUSTRIES</b> <i>Geosynthetic Products Division</i> 4019 Industry Drive • Chattanooga, TN 37416 • USA (423) 899-0444 • (800) FIX-SOIL <a href="http://www.fixsoil.com">www.fixsoil.com</a>

## General Information:

Project Details:	Project Notes:
Project Name: <b>DPC Plan of Operation</b> Description: <b>Channel Lining</b> State/Country: <b>WI</b> City: <b>La Crosse</b> Units: <b>English</b>  Created: <b>01/19/99 @ 10:43</b>	

## Disclaimer:

*The information presented herein is for general information only. While every effort has been made to ensure its accuracy, this information should not be used for a specific application without independent professional examination and verification of its suitability, applicability and accuracy.*

# EC-Design 2000 Channel Analysis Report

Page 2 of 4

## Channel Analysis Information:

<b>Name:</b>
Channel Analysis Name: South Spillway

## Channel Geometry & Hydraulics:

<b>Design By:</b>	<b>Flow Velocity:</b>	<b>Channel Geometry:</b>
Designed By: FLOW	Discharge (cfs): 1374.00	Bed Slope (ft/ft): 0.20000
	Flow Duration (hrs): 1.00	Req. Freeboard (ft): 0.00
<b>Channel Side Slopes:</b>	Average Velocity (ft/s): 0.00	Channel Length (ft): 270.00
Left Slope (xH:1V): 2.00		Bottom Width (ft): 20.00
Right Slope (xH:1V): 2.00		Channel Depth (ft): 4.00
<b>Channel Bend:</b>	<b>Vegetation:</b>	<b>Soil Filled:</b>
Channel Bend: No	Vegetated: Yes	Soil Filled: No
Bend Radius (ft): 1.00	Vegetation Class: C	
Outside Bend:		
<b>Factor of Safety:</b> 1.10	<b>Functional Longevity:</b> 999	

## Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s)			Shear Stress (lbs/sqft)			Flow Depth (ft)	Discharge (cfs)	OK?
				Actual	Max. Allowed	Safety Factor	Actual	Max. Allowed	Safety Factor			
Analysis #1	Left:	PYRAMAT	0.0280	24.0	23.3	1.0	20.2	9.4	0.5	2.0857	1374.0	No
	Bottom:	PYRAMAT	0.0280	27.3	23.3	0.9	26.0	9.4	0.4			
	Right:	PYRAMAT	0.0280	24.0	23.3	1.0	20.2	9.4	0.5			
Analysis #2	Left:	GABIONS	0.0270	28.6	17.0	0.6	17.3	35.0	2.0	1.7968	1374.0	No
	Bottom:	GABIONS	0.0270	32.6	17.0	0.5	22.4	35.0	1.6			
	Right:	GABIONS	0.0270	28.6	17.0	0.6	17.3	35.0	2.0			
Analysis #3	Left:	ROCK RIPRAP	0.0300	26.6	50.0	1.9	18.3	45.0	2.5	1.9093	1374.0	Yes
	Bottom:	ROCK RIPRAP	0.0300	30.4	50.0	1.6	23.8	45.0	1.9			
	Right:	ROCK RIPRAP	0.0300	26.6	50.0	1.9	18.3	45.0	2.5			

## Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Velocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	50.4146	1.7190	0.0351	4.6638	4.6638	29.3276	27.2540	1374.0	3.06
Analysis #2	42.3935	1.5121	0.0270	4.0178	4.0178	28.0356	32.4106	1374.0	3.94
Analysis #3	45.4772	1.5935	0.0300	4.2694	4.2694	28.5387	30.2130	1374.0	3.55



# EC-Design 2000 Channel Analysis Report

Page 2 of 4

## Channel Analysis Information:

Name:
Channel Analysis Name: SE Ditch (2%)

## Channel Geometry & Hydraulics:

Design By:	Flow Velocity:	Channel Geometry:
Designed By: FLOW	Discharge (cfs): 1374.00	Bed Slope (ft/ft): 0.02000
	Flow Duration (hrs): 1.00	Req. Freeboard (ft): 0.00
Channel Side Slopes:	Average Velocity (ft/s): 0.00	Channel Length (ft): 200.00
Left Slope (xH:1V): 2.00		Bottom Width (ft): 20.00
Right Slope (xH:1V): 2.00		Channel Depth (ft): 5.00
Channel Bend:	Vegetation:	Soil Filled:
Channel Bend: No	Vegetated: Yes	Soil Filled: No
Bend Radius (ft): 0.00	Vegetation Class: C	
Outside Bend:		
Factor of Safety: 1.10	Functional Longevity: 999	

## Analysis Results:

Side	Lining Type	Manning's "n"	Velocity (ft/s)			Shear Stress (lbs/sqft)			Flow Depth (ft)	Discharge (cfs)	OK?
			Actual	Max. Allowed	Safety Factor	Actual	Max. Allowed	Safety Factor			
Analysis #1	Left: LANDLOK TRM	0.0250	10.0	16.5	1.6	4.2	4.7	1.1	4.2678	1374.0	No
	Bottom: LANDLOK TRM	0.0250	11.3	16.5	1.5	5.3	4.7	0.9			
	Right: LANDLOK TRM	0.0250	10.0	16.5	1.6	4.2	4.7	1.1			
Analysis #2	Left: LANDLOK TRM	0.0250	10.0	16.8	1.7	4.2	6.5	1.6	4.2678	1374.0	Yes
	Bottom: LANDLOK TRM	0.0250	11.3	16.8	1.5	5.3	6.5	1.2			
	Right: LANDLOK TRM	0.0250	10.0	16.8	1.7	4.2	6.5	1.6			
Analysis #3	Left:	0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:	0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:	0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

## Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter (ft)	Right Wetted Perimeter (ft)	Total Wetted Perimeter (ft)	Average Velocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	121.7841	3.1158	0.0397	9.5431	9.5431	39.0862	11.2823	1374.0	.890
Analysis #2	121.7841	3.1158	0.0397	9.5431	9.5431	39.0862	11.2823	1374.0	.890
Analysis #3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000



# EC-Design 2000 Channel Analysis Report

Page 2 of 4

## Channel Analysis Information:

<b>Name:</b>
Channel Analysis Name: <b>SE Ditch (5%)</b>

## Channel Geometry & Hydraulics:

<b>Design By:</b>	<b>Flow Velocity:</b>	<b>Channel Geometry:</b>
Designed By: <b>FLOW</b>	Discharge (cfs): <b>1374.00</b>	Bed Slope (ft/ft): <b>0.05000</b>
	Flow Duration (hrs): <b>1.00</b>	Req. Freeboard (ft): <b>0.00</b>
<b>Channel Side Slopes:</b>	Average Velocity (ft/s): <b>0.00</b>	Channel Length (ft): <b>750.00</b>
Left Slope (xH:1V): <b>2.00</b>		Bottom Width (ft): <b>20.00</b>
Right Slope (xH:1V): <b>2.00</b>		Channel Depth (ft): <b>5.00</b>
<b>Channel Bend:</b>	<b>Vegetation:</b>	<b>Soil Filled:</b>
Channel Bend: <b>No</b>	Vegetated: <b>Yes</b>	Soil Filled: <b>No</b>
Bend Radius (ft): <b>0.00</b>	Vegetation Class: <b>C</b>	
Outside Bend:		
<b>Factor of Safety: 1.10</b>	<b>Functional Longevity: 999</b>	

## Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s)		Safety Factor	Shear Stress (lbs/sqft)			Flow Depth (ft)	Discharge (cfs)	OK?
				Actual	Max. Allowed		Actual	Max. Allowed	Safety Factor			
<b>Analysis #1</b>	Left:	LANDLOK TRM	0.0260	14.3	19.1	1.3	7.8	7.5	1.0	3.2178	1374.0	No
	Bottom:	LANDLOK TRM	0.0260	16.2	19.1	1.2	10.0	7.5	0.8			
	Right:	LANDLOK TRM	0.0260	14.3	19.1	1.3	7.8	7.5	1.0			
<b>Analysis #2</b>	Left:	PYRAMAT	0.0280	14.3	23.3	1.6	7.8	9.4	1.2	3.2184	1374.0	No
	Bottom:	PYRAMAT	0.0280	16.2	23.3	1.4	10.0	9.4	0.9			
	Right:	PYRAMAT	0.0280	14.3	23.3	1.6	7.8	9.4	1.2			
<b>Analysis #3</b>	Left:	ROCK RIPRAP	0.0300	17.6	50.0	2.8	6.6	45.0	6.8	2.7285	1374.0	Yes
	Bottom:	ROCK RIPRAP	0.0300	19.9	50.0	2.5	8.5	45.0	5.3			
	Right:	ROCK RIPRAP	0.0300	17.6	50.0	2.8	6.6	45.0	6.8			

## Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Velocity (ft/s)	Average Discharge (cfs)	Froude
<b>Analysis #1</b>	85.0635	2.4735	0.0378	7.1952	7.1952	34.3903	16.1526	1374.0	1.47
<b>Analysis #2</b>	85.0856	2.4739	0.0378	7.1967	7.1967	34.3933	16.1484	1374.0	1.47
<b>Analysis #3</b>	69.4578	2.1569	0.0280	6.1010	6.1010	32.2020	19.7818	1374.0	1.96



# EC-Design 2000 Channel Analysis Report

Page 2 of 4

## Channel Analysis Information:

<b>Name:</b>
Channel Analysis Name: <b>SE Ditch (1%)</b>

## Channel Geometry & Hydraulics:

<b>Design By:</b>	<b>Flow/Velocity:</b>	<b>Channel Geometry:</b>
Designed By: <b>FLOW</b>	Discharge (cfs): <b>1374.00</b>	Bed Slope (ft/ft): <b>0.01000</b>
	Flow Duration (hrs): <b>1.00</b>	Req. Freeboard (ft): <b>0.00</b>
<b>Channel Side Slopes:</b>	Average Velocity (ft/s): <b>0.00</b>	Channel Length (ft): <b>1000.0</b>
Left Slope (xH:1V): <b>2.00</b>		Bottom Width (ft): <b>20.00</b>
Right Slope (xH:1V): <b>2.00</b>		Channel Depth (ft): <b>6.00</b>
<b>Channel Bend:</b>	<b>Vegetation:</b>	<b>Soil Filled:</b>
Channel Bend: <b>No</b>	Vegetated: <b>Yes</b>	Soil Filled: <b>No</b>
Bend Radius (ft): <b>0.00</b>	Vegetation Class: <b>C</b>	
Outside Bend:		
<b>Factor of Safety: 1.10</b>	<b>Functional Longevity: 999</b>	

## Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s)			Shear Stress (lbs/sqft)			Flow Depth (ft)	Discharge (cfs)	OK?
				Actual	Max. Allowed	Safety Factor	Actual	Max. Allowed	Safety Factor			
<b>Analysis #1</b>	Left:	LANDLOK TRM	0.0250	7.7	16.5	2.2	2.6	4.7	1.8	5.2542	1374.0	Yes
	Bottom:	LANDLOK TRM	0.0250	8.6	16.5	1.9	3.3	4.7	1.4			
	Right:	LANDLOK TRM 435	0.0250	7.7	16.5	2.2	2.6	4.7	1.8			
<b>Analysis #2</b>	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
<b>Analysis #3</b>	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

## Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Velocity (ft/s)	Average Discharge (cfs)	Froude
<b>Analysis #1</b>	160.2976	3.6852	0.0413	11.7488	11.7488	43.4975	8.5716	1374.0	.615
<b>Analysis #2</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000
<b>Analysis #3</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000



# EC-Design 2000 Channel Analysis Report

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## Channel Analysis Information:

<b>Name:</b>
Channel Analysis Name: NE Ditch

## Channel Geometry & Hydraulics:

<b>Design By:</b>	<b>Flow Velocity:</b>	<b>Channel Geometry:</b>
Designed By: FLOW	Discharge (cfs): 399.00	Bed Slope (ft/ft): 0.02000
	Flow Duration (hrs): 1.00	Req. Freeboard (ft): 0.00
<b>Channel Side Slopes:</b>	Average Velocity (ft/s): 0.00	Channel Length (ft): 1800.0
Left Slope (xH:1V): 2.00		Bottom Width (ft): 10.00
Right Slope (xH:1V): 2.00		Channel Depth (ft): 5.00
<b>Channel Bend:</b>	<b>Vegetation:</b>	<b>Soil Filled:</b>
Channel Bend: No	Vegetated: Yes	Soil Filled: No
Bend Radius (ft): 0.00	Vegetation Class: C	
Outside Bend:		
<b>Factor of Safety:</b> 1.10	<b>Functional Longevity:</b> 999	

## Analysis Results:

Side	Lining Type	Manning's "n"	Velocity (ft/s)			Shear Stress (lbs/sqft)			Flow Depth (ft)	Discharge (cfs)	OK?
			Actual	Max. Allowed	Safety Factor	Actual	Max. Allowed	Safety Factor			
Analysis #1	Left:	LANDLOK TRM	7.1	16.5	2.3	3.1	4.7	1.5	3.1235	399.0	Yes
	Bottom:	LANDLOK TRM	7.9	16.5	2.1	3.9	4.7	1.2			
	Right:	LANDLOK TRM	7.1	16.5	2.3	3.1	4.7	1.5			
Analysis #2	Left:	435	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0	0.0	0.0	0.0	0.0	0.0			
Analysis #3	Left:		0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0	0.0	0.0	0.0	0.0	0.0			

## Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter (ft)	Right Wetted Perimeter (ft)	Total Wetted Perimeter (ft)	Average Velocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	50.7483	2.1173	0.0440	6.9844	6.9844	23.9689	7.8623	399.0	.735
Analysis #2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000
Analysis #3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000



# EC-Design 2000 Channel Analysis Report

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## Channel Analysis Information:

<b>Name:</b>
Channel Analysis Name: East Ditch

## Channel Geometry & Hydraulics:

<b>Design By:</b>	<b>Flow/Velocity:</b>	<b>Channel Geometry:</b>
Designed By: <b>FLOW</b>	Discharge (cfs): <b>509.00</b>	Bed Slope (ft/ft): <b>0.02000</b>
<b>Channel Side Slopes:</b>	Flow Duration (hrs): <b>1.00</b>	Req. Freeboard (ft): <b>0.00</b>
Left Slope (xH:1V): <b>2.00</b>	Average Velocity (ft/s): <b>0.00</b>	Channel Length (ft): <b>350.00</b>
Right Slope (xH:1V): <b>2.00</b>		Bottom Width (ft): <b>10.00</b>
		Channel Depth (ft): <b>5.00</b>
<b>Channel Bend:</b>	<b>Vegetation:</b>	<b>Soil Filled:</b>
Channel Bend: <b>Yes</b>	Vegetated: <b>Yes</b>	Soil Filled: <b>No</b>
Bend Radius (ft): <b>200.00</b>	Vegetation Class: <b>C</b>	
Outside Bend: <b>L</b>		
<b>Factor of Safety: 1.10</b>	<b>Functional Longevity: 999</b>	

## Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s)		Safety Factor	Shear Stress (lbs/sqft)		Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
				Actual	Max. Allowed		Actual	Max. Allowed				
<b>Analysis #1</b>	Left:	LANDLOK TRM	0.0250	7.8	16.5	2.1	3.6	4.7	1.3	3.4942	509.0	No
	Bottom:	LANDLOK TRM	0.0250	8.6	16.5	1.9	4.4	4.7	1.1			
	Right:	LANDLOK TRM	0.0250	7.8	16.5	2.1	3.6	4.7	1.3			
<b>Analysis #2</b>	Left:	LANDLOK TRM	0.0250	7.8	16.8	2.2	3.6	6.5	1.8	3.4942	509.0	Yes
	Bottom:	LANDLOK TRM	0.0250	8.6	16.8	1.9	4.4	6.5	1.5			
	Right:	LANDLOK TRM 45o	0.0250	7.8	16.8	2.2	3.6	6.5	1.8			
<b>Analysis #3</b>	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

## Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Velocity (ft/s)	Average Discharge (cfs)	Froude
<b>Analysis #1</b>	59.3615	2.3164	0.0429	7.8133	7.8133	25.6267	8.5746	509.0	.760
<b>Analysis #2</b>	59.3615	2.3164	0.0429	7.8133	7.8133	25.6267	8.5746	509.0	.760
<b>Analysis #3</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000



# EC-Design 2000 Channel Analysis Report

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## Channel Analysis Information:

<b>Name:</b>
Channel Analysis Name: <b>NW Ditch</b>

## Channel Geometry & Hydraulics:

<b>Design By:</b>	<b>Flow Velocity:</b>	<b>Channel Geometry:</b>
Designed By: <b>FLOW</b>	Discharge (cfs): <b>73.00</b>	Bed Slope (ft/ft): <b>0.01000</b>
	Flow Duration (hrs): <b>1.00</b>	Req. Freeboard (ft): <b>0.00</b>
<b>Channel Side Slopes:</b>	Average Velocity (ft/s): <b>0.00</b>	Channel Length (ft): <b>1000.0</b>
Left Slope (xH:1V): <b>2.00</b>		Bottom Width (ft): <b>0.01</b>
Right Slope (xH:1V): <b>2.00</b>		Channel Depth (ft): <b>4.00</b>
<b>Channel Bend:</b>	<b>Vegetation:</b>	<b>Soil Filled:</b>
Channel Bend: <b>No</b>	Vegetated: <b>Yes</b>	Soil Filled: <b>No</b>
Bend Radius (ft): <b>0.00</b>	Vegetation Class: <b>C</b>	
Outside Bend:		
<b>Factor of Safety: 1.10</b>	<b>Functional Longevity: 999</b>	

## Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s)			Shear Stress (lbs/sqft)			Flow Depth (ft)	Discharge (cfs)	OK?
				Actual	Max. Allowed	Safety Factor	Actual	Max. Allowed	Safety Factor			
<b>Analysis #1</b>	Left:	LANDLOK TRM	0.0250	3.4	16.5	4.8	2.1	4.7	2.3	3.2826	73.0	Yes
	Bottom:	LANDLOK TRM	0.0250	3.4	16.5	4.8	2.0	4.7	2.3			
	Right:	LANDLOK TRM	0.0250	3.4	16.5	4.8	2.1	4.7	2.3			
<b>Analysis #2</b>	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
<b>Analysis #3</b>	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

## Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Velocity (ft/s)	Average Discharge (cfs)	Froude
<b>Analysis #1</b>	21.5836	1.4693	0.0564	7.3401	7.3401	14.6902	3.3822	73.0	.331
<b>Analysis #2</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000
<b>Analysis #3</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000



# EC-Design 2000 Channel Analysis Report

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## Channel Analysis Information:

<b>Name:</b>
Channel Analysis Name: <b>West Ditch</b>

## Channel Geometry & Hydraulics:

<b>Design By:</b>	<b>Flow/Velocity:</b>	<b>Channel Geometry:</b>
Designed By: <b>FLOW</b>	Discharge (cfs): <b>241.00</b>	Bed Slope (ft/ft): <b>0.06000</b>
	Flow Duration (hrs): <b>1.00</b>	Req. Freeboard (ft): <b>0.00</b>
<b>Channel Side Slopes:</b>	Average Velocity (ft/s): <b>0.00</b>	Channel Length (ft): <b>1020.0</b>
Left Slope (xH:1V): <b>2.00</b>		Bottom Width (ft): <b>10.00</b>
Right Slope (xH:1V): <b>2.00</b>		Channel Depth (ft): <b>6.00</b>
<b>Channel Bend:</b>	<b>Vegetation:</b>	<b>Soil Filled:</b>
Channel Bend: <b>No</b>	Vegetated: <b>Yes</b>	Soil Filled: <b>No</b>
Bend Radius (ft): <b>0.00</b>	Vegetation Class: <b>C</b>	
Outside Bend:		
<b>Factor of Safety: 1.10</b>	<b>Functional Longevity: 999</b>	

## Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s)			Shear Stress (lbs/sqft)			Flow Depth (ft)	Discharge (cfs)	OK?
				Actual	Max. Allowed	Safety Factor	Actual	Max. Allowed	Safety Factor			
<b>Analysis #1</b>	Left:	PYRAMAT	0.0280	8.9	23.3	2.6	5.1	9.4	1.8	1.7595	241.0	Yes
	Bottom:	PYRAMAT	0.0280	10.1	23.3	2.3	6.6	9.4	1.4			
	Right:	PYRAMAT	0.0280	8.9	23.3	2.6	5.1	9.4	1.8			
<b>Analysis #2</b>	Left:	LANDLOK TRM	0.0260	8.9	19.1	2.1	5.1	7.5	1.5	1.7684	241.0	No
	Bottom:	LANDLOK TRM	0.0260	10.1	19.1	1.9	6.6	7.5	1.1			
	Right:	LANDLOK TRM	0.0260	8.9	19.1	2.1	5.1	7.5	1.5			
<b>Analysis #3</b>	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

## Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Velocity (ft/s)	Average Discharge (cfs)	Froude
<b>Analysis #1</b>	23.7860	1.3312	0.0439	3.9343	3.9343	17.8685	10.1320	241.0	1.24
<b>Analysis #2</b>	23.9376	1.3367	0.0438	3.9541	3.9541	17.9083	10.0679	241.0	1.23
<b>Analysis #3</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000



# EC-Design 2000 Channel Analysis Report

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## Channel Analysis Information:

<b>Name:</b>
Channel Analysis Name: SW Ditch (7%)

## Channel Geometry & Hydraulics:

<b>Design By:</b>	<b>Flow Velocity:</b>	<b>Channel Geometry:</b>
Designed By: FLOW	Discharge (cfs): 323.00	Bed Slope (ft/ft): 0.07000
	Flow Duration (hrs): 1.00	Req. Freeboard (ft): 0.00
<b>Channel Side Slopes:</b>	Average Velocity (ft/s): 0.00	Channel Length (ft): 225.00
Left Slope (xH:1V): 2.00		Bottom Width (ft): 10.00
Right Slope (xH:1V): 2.00		Channel Depth (ft): 4.00
<b>Channel Bend:</b>	<b>Vegetation:</b>	<b>Soil Filled:</b>
Channel Bend: No	Vegetated: Yes	Soil Filled: No
Bend Radius (ft): 0.00	Vegetation Class: C	
Outside Bend:		
<b>Factor of Safety: 1.10</b>	<b>Functional Longevity: 999</b>	

## Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s)			Shear Stress (lbs/sqft)			Flow Depth (ft)	Discharge (cfs)	OK?
				Actual	Max. Allowed	Safety Factor	Actual	Max. Allowed	Safety Factor			
Analysis #1	Left:	PYRAMAT	0.0280	10.6	23.3	2.2	6.6	9.4	1.4	1.9335	323.0	No
	Bottom:	PYRAMAT	0.0280	12.0	23.3	1.9	8.4	9.4	1.1			
	Right:	PYRAMAT	0.0280	10.6	23.3	2.2	6.6	9.4	1.4			
Analysis #2	Left:	ROCK RIPRAP	0.0300	13.4	50.0	3.7	5.5	45.0	8.2	1.6178	323.0	Yes
	Bottom:	ROCK RIPRAP	0.0300	15.2	50.0	3.3	7.1	45.0	6.4			
	Right:	ROCK RIPRAP	0.0300	13.4	50.0	3.7	5.5	45.0	8.2			
Analysis #3	Left:		0.0280	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

## Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter (ft)	Right Wetted Perimeter (ft)	Total Wetted Perimeter (ft)	Average Velocity (ft/s)	Average Discharge (cfs)	Froude
Analysis #1	26.8125	1.4379	0.0419	4.3235	4.3235	18.6470	12.0466	323.0	1.40
Analysis #2	21.4118	1.2424	0.0300	3.6174	3.6174	17.2348	15.0851	323.0	1.94
Analysis #3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000



# EC-Design 2000 Channel Analysis Report

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## Channel Analysis Information:

<b>Name:</b>
Channel Analysis Name: <b>SW Ditch (2%)</b>

## Channel Geometry & Hydraulics:

<b>Design By:</b>	<b>Flow Velocity:</b>	<b>Channel Geometry:</b>
Designed By: <b>FLOW</b>	Discharge (cfs): <b>323.00</b>	Bed Slope (ft/ft): <b>0.02000</b>
	Flow Duration (hrs): <b>1.00</b>	Req. Freeboard (ft): <b>0.00</b>
<b>Channel Side Slopes:</b>	Average Velocity (ft/s): <b>0.00</b>	Channel Length (ft): <b>300.00</b>
Left Slope (xH:1V): <b>2.00</b>		Bottom Width (ft): <b>10.00</b>
Right Slope (xH:1V): <b>2.00</b>		Channel Depth (ft): <b>4.00</b>
<b>Channel Bend:</b>	<b>Vegetation:</b>	<b>Soil Filled:</b>
Channel Bend: <b>No</b>	Vegetated: <b>Yes</b>	Soil Filled: <b>No</b>
Bend Radius (ft): <b>0.00</b>	Vegetation Class: <b>C</b>	
Outside Bend:		
<b>Factor of Safety: 1.10</b>	<b>Functional Longevity: 999</b>	

## Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s)		Safety Factor	Shear Stress (lbs/sqft)		Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
				Actual	Max. Allowed		Actual	Max. Allowed				
<b>Analysis #1</b>	Left:	PYRAMAT	0.0280	6.5	23.3	3.6	2.8	9.4	3.3	2.8325	323.0	Yes
	Bottom:	PYRAMAT	0.0280	7.3	23.3	3.2	3.5	9.4	2.7			
	Right:	PYRAMAT	0.0280	6.5	23.3	3.6	2.8	9.4	3.3			
<b>Analysis #2</b>	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
<b>Analysis #3</b>	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

## Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Velocity (ft/s)	Average Discharge (cfs)	Froude
<b>Analysis #1</b>	44.3719	1.9575	0.0451	6.3337	6.3337	22.6675	7.2794	323.0	.709
<b>Analysis #2</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000
<b>Analysis #3</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000



# EC-Design 2000 Channel Analysis Report

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## Channel Analysis Information:

<b>Name:</b>
Channel Analysis Name: <b>SW Ditch (5%)</b>

## Channel Geometry & Hydraulics:

<b>Design By:</b>	<b>Flow Velocity:</b>	<b>Channel Geometry:</b>
Designed By: <b>FLOW</b>	Discharge (cfs): <b>323.00</b>	Bed Slope (ft/ft): <b>0.05000</b>
	Flow Duration (hrs): <b>1.00</b>	Req. Freeboard (ft): <b>0.00</b>
<b>Channel Side Slopes:</b>	Average Velocity (ft/s): <b>0.00</b>	Channel Length (ft): <b>240.00</b>
Left Slope (xH:1V): <b>2.00</b>		Bottom Width (ft): <b>10.00</b>
Right Slope (xH:1V): <b>2.00</b>		Channel Depth (ft): <b>4.00</b>
<b>Channel Bend:</b>	<b>Vegetation:</b>	<b>Soil Filled:</b>
Channel Bend: <b>No</b>	Vegetated: <b>Yes</b>	Soil Filled: <b>No</b>
Bend Radius (ft): <b>0.00</b>	Vegetation Class: <b>C</b>	
Outside Bend:		
<b>Factor of Safety: 1.10</b>	<b>Functional Longevity: 999</b>	

## Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s)		Safety Factor	Shear Stress (lbs/sqft)		Safety Factor	Flow Depth (ft)	Discharge (cfs)	OK?
				Actual	Max. Allowed		Actual	Max. Allowed				
<b>Analysis #1</b>	Left:	<b>PYRAMAT</b>	0.0280	9.3	23.3	2.5	5.2	9.4	1.8	2.1429	323.0	Yes
	Bottom:	<b>PYRAMAT</b>	0.0280	10.5	23.3	2.2	6.7	9.4	1.4			
	Right:	<b>PYRAMAT</b>	0.0280	9.3	23.3	2.5	5.2	9.4	1.8			
<b>Analysis #2</b>	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
<b>Analysis #3</b>	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

## Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter (ft)	Right Wetted Perimeter (ft)	Total Wetted Perimeter (ft)	Average Velocity (ft/s)	Average Discharge (cfs)	Froude
<b>Analysis #1</b>	30.6135	1.5632	0.0427	4.7917	4.7917	19.5835	10.5509	323.0	1.17
<b>Analysis #2</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000
<b>Analysis #3</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000



# EC-Design 2000 Channel Analysis Report

Page 2 of 4

## Channel Analysis Information:

<b>Name:</b>
Channel Analysis Name: Main Channel

## Channel Geometry & Hydraulics:

<b>Design By:</b>	<b>Flow Velocity:</b>	<b>Channel Geometry:</b>
Designed By: <b>FLOW</b>	Discharge (cfs): <b>1660.00</b>	Bed Slope (ft/ft): <b>0.01300</b>
	Flow Duration (hrs): <b>1.00</b>	Req. Freeboard (ft): <b>0.00</b>
<b>Channel Side Slopes:</b>	Average Velocity (ft/s): <b>0.00</b>	Channel Length (ft): <b>3500.0</b>
Left Slope (xH:1V): <b>2.00</b>		Bottom Width (ft): <b>20.00</b>
Right Slope (xH:1V): <b>2.00</b>		Channel Depth (ft): <b>6.00</b>
<b>Channel Bend:</b>	<b>Vegetation:</b>	<b>Soil Filled:</b>
Channel Bend: <b>No</b>	Vegetated: <b>Yes</b>	Soil Filled: <b>No</b>
Bend Radius (ft): <b>0.00</b>	Vegetation Class: <b>C</b>	
Outside Bend:		
<b>Factor of Safety: 1.10</b>	<b>Functional Longevity: 999</b>	

## Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s)			Shear Stress (lbs/sqft)			Flow Depth (ft)	Discharge (cfs)	OK?
				Actual	Max. Allowed	Safety Factor	Actual	Max. Allowed	Safety Factor			
<b>Analysis #1</b>	Left:	LANDLOK TRM	0.0250	9.1	16.5	1.8	3.4	4.7	1.4	5.3260	1660.0	No
	Bottom:	LANDLOK TRM	0.0250	10.2	16.5	1.6	4.3	4.7	1.1			
	Right:	LANDLOK TRM	0.0250	9.1	16.5	1.8	3.4	4.7	1.4			
<b>Analysis #2</b>	Left:	LANDLOK TRM	0.0250	9.1	16.8	1.8	3.4	6.5	1.9	5.3260	1660.0	Yes
	Bottom:	LANDLOK TRM	0.0250	10.2	16.8	1.6	4.3	6.5	1.5			
	Right:	LANDLOK TRM	0.0250	9.1	16.8	1.8	3.4	6.5	1.9			
<b>Analysis #3</b>	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

## Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter (ft)	Right Wetted Perimeter (ft)	Total Wetted Perimeter (ft)	Average Velocity (ft/s)	Average Discharge (cfs)	Froude
<b>Analysis #1</b>	163.2521	3.7256	0.0400	11.9093	11.9093	43.8185	10.1683	1660.0	.723
<b>Analysis #2</b>	163.2521	3.7256	0.0400	11.9093	11.9093	43.8185	10.1683	1660.0	.723
<b>Analysis #3</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000



# EC-Design 2000 Channel Analysis Report

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## Channel Analysis Information:

<b>Name:</b>
Channel Analysis Name: Area 1G Ditch

## Channel Geometry & Hydraulics:

<b>Design By:</b>	<b>Flow Velocity:</b>	<b>Channel Geometry:</b>
Designed By: FLOW	Discharge (cfs): 15.00	Bed Slope (ft/ft): 0.08000
	Flow Duration (hrs): 1.00	Req. Freeboard (ft): 0.00
<b>Channel Side Slopes:</b>	Average Velocity (ft/s): 0.00	Channel Length (ft): 140.00
Left Slope (xH:1V): 2.00		Bottom Width (ft): 0.10
Right Slope (xH:1V): 2.00		Channel Depth (ft): 4.00
<b>Channel Bend:</b>	<b>Vegetation:</b>	<b>Soil Filled:</b>
Channel Bend: No	Vegetated: Yes	Soil Filled: No
Bend Radius (ft): 0.00	Vegetation Class: C	
Outside Bend:		
<b>Factor of Safety:</b> 1.10	<b>Functional Longevity:</b> 999	

## Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s)			Shear Stress (lbs/sqft)			Flow Depth (ft)	Discharge (cfs)	OK?
				Actual	Max. Allowed	Safety Factor	Actual	Max. Allowed	Safety Factor			
<b>Analysis #1</b>	Left:	LANDLOK TRM	0.0250	4.7	16.5	3.5	6.3	4.7	0.8	1.2450	15.0	No
	Bottom:	LANDLOK TRM	0.0250	4.6	16.5	3.5	6.2	4.7	0.8			
	Right:	LANDLOK TRM	0.0250	4.7	16.5	3.5	6.3	4.7	0.8			
<b>Analysis #2</b>	Left:	LANDLOK TRM	0.0250	4.7	16.8	3.6	6.3	6.5	1.0	1.2450	15.0	No
	Bottom:	LANDLOK TRM	0.0250	4.6	16.8	3.6	6.2	6.5	1.1			
	Right:	LANDLOK TRM	0.0250	4.7	16.8	3.6	6.3	6.5	1.0			
<b>Analysis #3</b>	Left:	PYRAMAT	0.0280	4.7	23.3	5.0	6.3	9.4	1.5	1.2502	15.0	Yes
	Bottom:	PYRAMAT	0.0280	4.7	23.3	5.0	6.2	9.4	1.5			
	Right:	PYRAMAT	0.0280	4.7	23.3	5.0	6.3	9.4	1.5			

## Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter (ft)	Right Wetted Perimeter (ft)	Total Wetted Perimeter (ft)	Average Velocity (ft/s)	Average Discharge (cfs)	Froude
<b>Analysis #1</b>	3.2247	0.5689	0.0624	2.7840	2.7840	5.6680	4.6516	15.0	.737
<b>Analysis #2</b>	3.2247	0.5689	0.0624	2.7840	2.7840	5.6680	4.6516	15.0	.737
<b>Analysis #3</b>	3.2511	0.5713	0.0622	2.7956	2.7956	5.6912	4.6138	15.0	.741



# EC-Design 2000 Channel Analysis Report

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## Channel Analysis Information:

<b>Name:</b>
Channel Analysis Name: Phase 2 Ditch

## Channel Geometry & Hydraulics:

<b>Design By:</b>	<b>Flow/Velocity:</b>	<b>Channel Geometry:</b>
Designed By: <b>FLOW</b>	Discharge (cfs): <b>4.00</b> Flow Duration (hrs): <b>1.00</b> Average Velocity (ft/s): <b>0.00</b>	Bed Slope (ft/ft): <b>0.06000</b> Req. Freeboard (ft): <b>0.00</b> Channel Length (ft): <b>560.00</b> Bottom Width (ft): <b>0.01</b> Channel Depth (ft): <b>2.00</b>
<b>Channel Side Slopes:</b>		
Left Slope (xH:1V): <b>4.00</b> Right Slope (xH:1V): <b>2.00</b>		
<b>Channel Bend:</b>	<b>Vegetation:</b>	<b>Soil Filled:</b>
Channel Bend: <b>No</b> Bend Radius (ft): <b>0.00</b> Outside Bend:	Vegetated: <b>Yes</b> Vegetation Class: <b>C</b>	Soil Filled: <b>No</b>
<b>Factor of Safety:</b> <b>1.10</b>	<b>Functional Longevity:</b> <b>999</b>	

## Analysis Results:

Side	Lining Type	Manning's "n"	Velocity (ft/s)			Shear Stress (lbs/sqft)			Flow Depth (ft)	Discharge (cfs)	OK?	
			Actual	Max. Allowed	Safety Factor	Actual	Max. Allowed	Safety Factor				
Analysis #1	Left:	LANDLOK TRM	0.0250	2.3	16.5	7.1	4.0	4.7	1.2	0.8207	4.0	Yes
	Bottom:	LANDLOK TRM	0.0250	2.0	16.5	8.1	3.1	4.7	1.5			
	Right:	LANDLOK TRM	0.0250	2.1	16.5	8.0	3.1	4.7	1.5			
Analysis #2	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
Analysis #3	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

## Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Velocity (ft/s)	Average Discharge (cfs)	Froude
<b>Analysis #1</b>	2.0287	0.3880	0.0955	3.3837	1.8351	5.2288	1.9717	4.0	.415
<b>Analysis #2</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000
<b>Analysis #3</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000



## Suggested Vegetation for: La Crosse,WI

All Season Grasses					
Species	Scientific Name	Retardance Class	Seed Rate (lbs/ac)	Height at Maturity (in)	Recommended Planting Dates
Alsike Clover	Trifolium hybridum	A - E	15		4/1 - 5/31 or 8/16 - 10/15
Reed Canarygrass	Phalaris arundinacea	A - E	20		4/1 - 5/31 or 8/16 - 10/15
Colonial Bentgrass	Agrostis tenuis	A - E	50		4/1 - 5/31 or 8/16 - 10/15
Creeping Bentgrass	Agrostis palustris	A - E	50		4/1 - 5/31 or 8/16 - 10/15
Poa Trivialis	Poa trivialis	A - E	50		4/1 - 5/31 or 8/16 - 10/15
Creeping Foxtrail	Alopecurus arundinaceus	A - E	50		4/1 - 5/31 or 8/16 - 10/15
Meadow Foxtail	Alopecurus pratensis	A - E	50		4/1 - 5/31 or 8/16 - 10/15
Perennial Ryegrass	Lolium perenne	A - E	240		4/1 - 5/31 or 8/16 - 10/15
RedTop	Agrostis alba	A - E	80		4/1 - 5/31 or 8/16 - 10/15
Meadow Fescue	Festuca elatior	A - E	160		4/1 - 5/31 or 8/16 - 10/15
Cold Season Grasses					
Species	Scientific Name	Retardance Class	Seed Rate (lbs/ac)	Height at Maturity (in)	Recommended Planting Dates
Crested Wheatgrass	Agropyron desertorum	A		2 - 3	
Green Needlegrass	Stipa viridula	A		3 - 4	
Russian WildRye	Psathyrostachys gunceus	A		3 - 4	
Smooth Bromegrass	Bromus inermis	A		3 - 4	
Tall Fescue	Festuca arundinacea	A		3 - 4	
Tall Wheatgrass	Elytriga pontica	A		4 - 5	
Western Wheatgrass	Agropyron smithii	A		2 - 3	
Warm Season Grasses					
Species	Scientific Name	Retardance Class	Seed Rate (lbs/ac)	Height at Maturity (in)	Recommended Planting Dates
Bermuda Grass	Cynodon dactylon	C		3/4 - 2	
Big Bluestem	Andropogon gerardii	B		4 - 6	
Blue grama	Boutelova gracillis	B		1 - 2	
Buffalo grass	Buchloe dactyloides	D		1/3 - 1	
Green Sprangletop	Leptochloa dubia	A		3 - 4	
Indian grass	Sorghastrum nutans	A		5 - 6	
Kleingrass	Panicum coloratum	A		3 - 4	
Little bluestem	Schizachyrium scoparium	A		3 - 4	
Plains bristlegrass	Setaria macrostachya	B		1 - 2	
Sand bluestem	Andropogon hallii	A		5 - 6	
Sideoats grama	Bouteloua curtipendula	A		2 - 3	
Switch grass	Panicum Virgatum	A		4 - 5	
Vine mesquitegrass	Panicum Obtusum	B		1 - 2	
Weeping lovegrass	Eragrostis Curvula	A		3 - 4	



## **Calculations – Operational Landfill Conditions**





PROJECT / PROPOSAL NAME / LOCATION: <u>DPC-P00</u>		PROJECT / PROPOSAL NO. <u>3078.40</u>
SUBJECT: <u>OPERATIONAL DITCH SIZING</u>		
PREPARED BY: <u>BSK</u>	DATE: <u>10/00</u>	FINAL <input checked="" type="checkbox"/>
CHECKED BY:	DATE:	REVISION <input type="checkbox"/>

OPERATIONAL DITCHES

(SEE FIGURES K-4 to K-9, OPERATIONAL RUNOFF CALCULATIONS)

<u>DITCH</u>	<u>LOCATION</u>	<u>100-YR FLOW</u>	<u>SLOPE</u>	<u>SHAPE</u>
V-NOTCH DITCH A	CELL 1 ACTIVE	5 CFS	6%	V-NOTCH
DITCH B	CELL 1 ACTIVE	<sup>561</sup> 583 CFS'	2%	10' FLAT
DITCH C	CELL 2A ACTIVE	6 CFS	6.3%	V-NOTCH
DITCH D	CELL 2B ACTIVE	3 CFS	12%	V-NOTCH
DITCH E	CELL 3 ACTIVE	<sup>561</sup> 583 CFS' ✓	1%	10' FLAT
DITCH F	CELL 4A ACTIVE	<sup>373</sup> 433 CFS <sup>2</sup>	1%	10' FLAT
DITCH G	CELL 2A ACTIVE	360 CFS <sup>4</sup>		

- NOTES
1. FLOWS FROM PREDEVELOPMENT AREAS NORTH + WEST (See p. 95) @ 12.6 hrs
  2. FLOWS FROM PREDEVELOPMENT AREAS NORTH + 2B @ 12.6 hrs (See p. 66/95)
  3. PERMANANT DITCHES SIZED UNDER POST-DEVELOPMENT CALCULATIONS.
  4. Flow from PREDEVELOPMENT ~~AREA~~ AREA NORTH (See p. 95)

SW DITCH	CELL 2A ACTIVE	561 CFS'	5%	10' FLAT
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RMT, Inc.  
Grass Channel Sizing Calculations

Site:	Dairyland Power Cooperative	Date:	10/00
Project #:	3081.40	User:	BJK
Channel:	Ditch A		

=====

I. Input Parameters.

A. Side slope, Z1 (hor/vert) =	3.000 ft/ft
B. Side slope, Z2 (hor/vert) =	16.000 ft/ft
C. Bottom width, B =	0.000 ft
D. Design channel slope, S =	0.060 ft/ft
E. Channel Peak Flow, Q =	5.000 cfs
F. Enter     - 1 - for Type "C" Veg. Retardance - 2 - for Type "D" Veg. Retardance	2

II. Peak Flow Calculations.

A. Trial flow depth, D = (Bisection method until Va=Vb)	0.533 ft
B. Channel flow area, Ac = (.5*Z1*D^2) + (B*D) + (.5*Z2*D^2)	2.703 sq ft
C. Wetted Perimeter, Pw = (D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5)	10.239 ft
D. Hydraulic radius, Rh = (Ac/Pw)	0.264 ft
E. Velocity and hydraulic radius, VR = (Va * Rh)	0.488 sfps
F. Channel flow Manning's coeff, nc = 0	0.081
G. Trial velocity, Va = (Q/Ac)	1.850 fps
H. Resultant velocity, Vb = (1.49/nc) * (Rh^.667) * (S^.5)	1.850 fps <i>✓OK</i>

Invoke Solution Macro by typing - 'ctrl' D



# EC-Design 2000 Channel Analysis Report

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## Channel Analysis Information:

<b>Name:</b>
Channel Analysis Name: Ditch B

## Channel Geometry & Hydraulics:

<b>Design By:</b>	<b>Flow Velocity:</b>	<b>Channel Geometry:</b>
Designed By: <b>FLOW</b>	Discharge (cfs): <b>583.00</b>	Bed Slope (ft/ft): <b>0.02000</b>
	Flow Duration (hrs): <b>1.00</b>	Req. Freeboard (ft): <b>0.00</b>
<b>Channel Side Slopes:</b>	Average Velocity (ft/s): <b>0.00</b>	Channel Length (ft): <b>530.00</b>
Left Slope (xH:1V): <b>3.00</b>		Bottom Width (ft): <b>10.00</b>
Right Slope (xH:1V): <b>3.00</b>		Channel Depth (ft): <b>4.00</b>
<b>Channel Bend:</b>	<b>Vegetation:</b>	<b>Soil Filled:</b>
Channel Bend: <b>No</b>	Vegetated: <b>No</b>	Soil Filled: <b>Yes</b>
Bend Radius (ft): <b>0.00</b>	Vegetation Class:	
Outside Bend:		
<b>Factor of Safety: 1.00</b>	<b>Functional Longevity: 48</b>	

## Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s)			Shear Stress (lbs/sqft)			Flow Depth (ft)	Discharge (cfs)	OK?
				Actual	Max. Allowed	Safety Factor	Actual	Max. Allowed	Safety Factor			
<b>Analysis #1</b>	Left:	LANDLOK TRM	0.0250	13.4	16.5	1.2	2.5	6.2	2.5	2.3594	583.0	Yes
	Bottom:	LANDLOK TRM	0.0250	14.5	16.5	1.1	2.9	6.2	2.1			
	Right:	LANDLOK TRM 45°	0.0250	13.4	16.5	1.2	2.5	6.2	2.5			
<b>Analysis #2</b>	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
<b>Analysis #3</b>	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

## Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter (ft)	Right Wetted Perimeter (ft)	Total Wetted Perimeter (ft)	Average Velocity (ft/s)	Average Discharge (cfs)	Froude
<b>Analysis #1</b>	40.2945	1.6168	0.0200	7.4611	7.4611	24.9222	14.4685	583.0	1.58
<b>Analysis #2</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000
<b>Analysis #3</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000

RMT, Inc.  
Grass Channel Sizing Calculations

Site:	Dairyland Power Cooperative	Date:	10/00
Project #:	3081.40	User:	BJK
Channel:	Ditch C		

I. Input Parameters.

A. Side slope, Z1 (hor/vert) =	3.000 ft/ft
B. Side slope, Z2 (hor/vert) =	16.000 ft/ft
C. Bottom width, B =	0.000 ft
D. Design channel slope, S =	0.063 ft/ft
E. Channel Peak Flow, Q =	6.000 cfs
F. Enter     - 1 - for Type "C" Veg. Retardence - 2 - for Type "D" Veg. Retardence	2

II. Peak Flow Calculations.

A. Trial flow depth, D = (Bisection method until Va=Vb)	0.550 ft
B. Channel flow area, Ac = (.5*Z1*D^2) + (B*D) + (.5*Z2*D^2)	2.870 sq ft
C. Wetted Perimeter, Pw = (D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5)	10.549 ft
D. Hydraulic radius, Rh = (Ac/Pw)	0.272 ft
E. Velocity and hydraulic radius, VR = (Va * Rh)	0.569 sfps
F. Channel flow Manning's coeff, nc = 0	0.075
G. Trial velocity, Va = (Q/Ac)	2.091 fps
H. Resultant velocity, Vb = (1.49/nc) * (Rh^.667) * (S^.5)	2.091 fps ✓OK

Invoke Solution Macro by typing - 'ctrl' D



RMT, Inc.  
Grass Channel Sizing Calculations

Site:	Dairyland Power Cooperative	Date:	10/00
Project #:	3081.40	User:	BJK
Channel:	Ditch D		

I. Input Parameters.

A. Side slope, Z1 (hor/vert) =	3.000 ft/ft
B. Side slope, Z2 (hor/vert) =	3.000 ft/ft
C. Bottom width, B =	0.000 ft
D. Design channel slope, S =	0.120 ft/ft
E. Channel Peak Flow, Q =	3.000 cfs
F. Enter     - 1 - for Type "C" Veg. Retardance	2
- 2 - for Type "D" Veg. Retardance	

II. Peak Flow Calculations.

A. Trial flow depth, D =	0.547 ft
(Bisection method until Va=Vb)	
B. Channel flow area, Ac =	0.897 sq ft
(.5*Z1*D^2) + (B*D) + (.5*Z2*D^2)	
C. Wetted Perimeter, Pw =	3.459 ft
(D*(Z1^2+1)^.5) + B + (D*(Z2^2+1)^.5)	
D. Hydraulic radius, Rh =	0.259 ft
(Ac/Pw)	
E. Velocity and hydraulic radius, VR =	0.867 sfps
(Va * Rh)	
F. Channel flow Manning's coeff, nc =	0.063
0	
G. Trial velocity, Va =	3.344 fps
(Q/Ac)	
H. Resultant velocity, Vb =	3.344 fps ✓ ok
(1.49/nc) * (Rh^.667) * (S^.5)	

Invoke Solution Macro by typing - 'ctrl' D

# EC-Design 2000 Channel Analysis Report

Page 2 of 4

## Channel Analysis Information:

<b>Name:</b>
Channel Analysis Name: Ditch E

## Channel Geometry & Hydraulics:

<b>Design By:</b>	<b>Flow Velocity:</b>	<b>Channel Geometry:</b>
Designed By: <b>FLOW</b>	Discharge (cfs): <b>583.00</b>	Bed Slope (ft/ft): <b>0.01000</b>
<b>Channel Side Slopes:</b>	Flow Duration (hrs): <b>1.00</b>	Req. Freeboard (ft): <b>0.00</b>
Left Slope (xH:1V): <b>3.00</b>	Average Velocity (ft/s): <b>0.00</b>	Channel Length (ft): <b>1000.0</b>
Right Slope (xH:1V): <b>10.00</b>		Bottom Width (ft): <b>10.00</b>
		Channel Depth (ft): <b>3.00</b>
<b>Channel Bend:</b>	<b>Vegetation:</b>	<b>Soil Filled:</b>
Channel Bend: <b>No</b>	Vegetated: <b>No</b>	Soil Filled: <b>Yes</b>
Bend Radius (ft): <b>0.00</b>	Vegetation Class:	
Outside Bend:		
<b>Factor of Safety: 1.00</b>	<b>Functional Longevity: 60</b>	

## Analysis Results:

Side	Lining Type	Manning's "n"	Velocity (ft/s)			Shear Stress (lbs/sqft)			Flow Depth (ft)	Discharge (cfs)	OK?	
			Actual	Max. Allowed	Safety Factor	Actual	Max. Allowed	Safety Factor				
Analysis #1	Left:	LANDLOK TRM	0.0250	8.9	16.5	1.9	1.3	6.2	4.9	2.3865	583.0	Yes
	Bottom:	LANDLOK TRM	0.0250	9.6	16.5	1.7	1.5	6.2	4.2			
	Right:	LANDLOK TRM	0.0250	9.3	16.5	1.8	1.4	6.2	4.5			
Analysis #2	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
Analysis #3	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

## Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Velocity (ft/s)	Average Discharge (cfs)	Froude
<b>Analysis #1</b>	60.8850	1.4660	0.0200	7.5468	23.9840	41.5308	9.5754	583.0	1.06
<b>Analysis #2</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000
<b>Analysis #3</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000



# EC-Design 2000 Channel Analysis Report

Page 2 of 4

## Channel Analysis Information:

<b>Name:</b>
Channel Analysis Name: Ditch F

## Channel Geometry & Hydraulics:

<b>Design By:</b>	<b>Flow/Velocity:</b>	<b>Channel Geometry:</b>
Designed By: <b>FLOW</b>	Discharge (cfs): <b>433.00</b>	Bed Slope (ft/ft): <b>0.01000</b>
	Flow Duration (hrs): <b>1.00</b>	Req. Freeboard (ft): <b>0.00</b>
<b>Channel Side Slopes:</b>	Average Velocity (ft/s): <b>0.00</b>	Channel Length (ft): <b>750.00</b>
Left Slope (xH:1V): <b>3.00</b>		Bottom Width (ft): <b>10.00</b>
Right Slope (xH:1V): <b>5.00</b>		Channel Depth (ft): <b>3.00</b>
<b>Channel Bend:</b>	<b>Vegetation:</b>	<b>Soil Filled:</b>
Channel Bend: <b>No</b>	Vegetated: <b>No</b>	Soil Filled: <b>Yes</b>
Bend Radius (ft): <b>0.00</b>	Vegetation Class:	
Outside Bend:		
<b>Factor of Safety:</b> <b>1.00</b>	<b>Functional Longevity:</b> <b>0</b>	

## Analysis Results:

	Side	Lining Type	Manning's "n"	Velocity (ft/s)			Shear Stress (lbs/sqft)			Flow Depth (ft)	Discharge (cfs)	OK?
				Actual	Max. Allowed	Safety Factor	Actual	Max. Allowed	Safety Factor			
<b>Analysis #1</b>	Left:	LANDLOK TRM	0.0250	9.1	16.5	1.8	1.2	6.2	5.1	2.2978	433.0	Yes
	Bottom:	LANDLOK TRM	0.0250	9.9	16.5	1.7	1.4	6.2	4.4			
	Right:	LANDLOK TRM	0.0250	9.5	16.5	1.7	1.3	6.2	4.7			
<b>Analysis #2</b>	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
<b>Analysis #3</b>	Left:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0	0.0000	0.0	No
	Bottom:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			
	Right:		0.0000	0.0	0.0	0.0	0.0	0.0	0.0			

## Channel Calculation Results:

	Flow Area (sq ft)	Hydraulic Radius (ft)	Composite 'n'	Left Wetted Perimeter(ft)	Right Wetted Perimeter(ft)	Total Wetted Perimeter(ft)	Average Velocity (ft/s)	Average Discharge (cfs)	Froude
<b>Analysis #1</b>	44.0967	1.5215	0.0200	7.2662	11.7164	28.9826	9.8193	433.0	1.10
<b>Analysis #2</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000
<b>Analysis #3</b>	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0	.000

# EC-DESIGN(R) 2000 Channel Analysis Report

## Project Information

**Project Name:** DPC **Last Update:** 8/25/2003 10:58:10 A  
**Description:** Cell 2A operational Calcs **Units:** English  
**Nearest City:**

**Notes:** Calculated for 170 slope section  
 Backwater from culvert 1 will  
 protect 520 slope section

## Channel Design

**Channel Name:** SW Ditch - Operational 100 yr **Units:** English **Design life:** 1,200 months

Design Criteria	Vegetation and Soil	Channel Geometry	Flow/Velocity
Flow Rate (Q)	Vegetated Yes Vegetation Class B Soil Filled No	Bed Slope (ft/ft) 0.010 Req. Freeboard (ft) 0.000 Channel Length (ft) 475.000 Bottom Width (ft) 10.000 Channel Depth (ft) 6.000	Discharge (cf/s) 561.000 Flow Duration (hrs) 1.000 Avg. Velocity (ft/s) 5.490
Channel Side Slopes	Channel Bend		
Left (H:1 V) 2.000 Right (H:1 V) 2.000	No Bend Radius (ft) 0.000 Outside Bend		Required Factor of Safety 1.00

## Results

Lining Materials		Velocity (ft/s)			Shear Stress (lbs/sqft)			Avg. Flow Depth (ft)
		Computed	Max Allowed	Safety Factor	Computed	Max Allowed	Safety Factor	
Left	PYRAMAT	5.100	23.340	4.580	2.720	9.400	3.460	5.070
Bottom	PYRAMAT	5.510	23.340	4.240	3.170	9.400	2.970	
Right	PYRAMAT	5.100	23.340	4.580	2.720	9.400	3.460	

## Calculation Results:

Flow Depth (ft)	5.070	Left Wetted Perimeter (ft)	11.350
Flow Area (ft)	102.230	Bottom Wetted Perimeter (ft)	9.990
		Right Wetted Perimeter (ft)	11.350
		Total Wetted Perimeter (ft)	32.690
Hydraulic Radius (ft)	3.130	Avg. Velocity (ft/s)	5.490
Composite 'n'	0.0580	Avg. Discharge (cf/s)	561.000



# EC-DESIGN(R) 2000 Channel Analysis Report

## Project Information

**Project Name:** DPC **Last Update:** 8/25/2003 10:53:12 A  
**Description:** Cell 2A operational Calcs **Units:** English  
**Nearest City:**

**Notes:** FOR 5% SLOPE  
 SECTION 25-YR STORM

## Channel Design

**Channel Name:** SW Ditch - Operational 25 yr **Units:** English **Design life:** 48 months

Design Criteria	Vegetation and Soil	Channel Geometry	Flow/Velocity
Flow Rate (Q)	Vegetated Yes Vegetation Class B Soil Filled No	Bed Slope (ft/ft) 0.050 Req. Freeboard (ft) 0.000 Channel Length (ft) 450.000 Bottom Width (ft) 10.000 Channel Depth (ft) 4.000	Discharge (cf/s) 355.000 Flow Duration (hrs) 1.000 Avg. Velocity (ft/s) 8.940
Channel Side Slopes	Channel Bend		
Left (H:1 V) 2.000 Right (H:1 V) 2.000	No Bend Radius (ft) 0.000 Outside Bend		Required Factor of Safety 1.00

## Results

Lining Materials		Velocity (ft/s)			Shear Stress (lbs/sqft)			Avg. Flow Depth (ft) 2.610
		Computed	Max Allowed	Safety Factor	Computed	Max Allowed	Safety Factor	
Left	PYRAMAT	8.030	23.340	2.910	6.450	9.400	1.460	
Bottom	PYRAMAT	9.020	23.340	2.590	8.140	9.400	1.150	
Right	PYRAMAT	8.030	23.340	2.910	6.450	9.400	1.460	

## Calculation Results:

Flow Depth (ft)	2.610	Left Wetted Perimeter (ft)	5.830
Flow Area (ft)	39.690	Bottom Wetted Perimeter (ft)	10.000
		Right Wetted Perimeter (ft)	5.830
		Total Wetted Perimeter (ft)	21.660
Hydraulic Radius (ft)	1.830	Avg. Velocity (ft/s)	8.940
Composite 'n'	0.0554	Avg. Discharge (cf/s)	355.000

# EC-DESIGN(R) 2000 Channel Analysis Report

## Project Information

**Project Name:** DPC  
**Description:** Cell 2A operational Calcs  
**Notes:**  
**Last Update:** 8/25/2003 11:00:48 A  
**Units:** English  
**Nearest City:**

## Channel Design

**Channel Name:** Phase III South Slope Ditch  
**Units:** English  
**Design life:** 24 months

Design Criteria	Vegetation and Soil	Channel Geometry	Flow/Velocity
Flow Rate (Q)	Vegetated No Vegetation Class Soil Filled Yes	Bed Slope (ft/ft) 0.060 Req. Freeboard (ft) 0.000 Channel Length (ft) 500.000 Bottom Width (ft) 1.000 Channel Depth (ft) 1.500	Discharge (cf/s) 4.000 Flow Duration (hrs) 1.000 Avg. Velocity (ft/s) 6.280 Required Factor of Safety 1.00
Channel Side Slopes	Channel Bend		
Left (H:1 V) 2.000 Right (H:1 V) 3.000	No Bend Radius (ft) 0.000 Outside Bend		

## Results

Lining Materials		Velocity (ft/s)			Shear Stress (lbs/sqft)			Avg. Flow Depth (ft)
		Computed	Max Allowed	Safety Factor	Computed	Max Allowed	Safety Factor	
Left	LANDLOK TRM 450	6.080	16.490	2.710	1.050	6.250	5.950	0.340
Bottom	LANDLOK TRM 450	6.730	16.490	2.450	1.280	6.250	4.880	
Right	LANDLOK TRM 450	6.350	16.490	2.600	1.140	6.250	5.480	

## Calculation Results:

Flow Depth (ft)	0.340	Left Wetted Perimeter (ft)	0.770
Flow Area (ft)	0.640	Bottom Wetted Perimeter (ft)	1.000
		Right Wetted Perimeter (ft)	1.080
		Total Wetted Perimeter (ft)	2.850
Hydraulic Radius (ft)	0.220	Avg. Velocity (ft/s)	6.280
Composite 'n'	0.0200	Avg. Discharge (cf/s)	4.000



# EC-DESIGN(R) 2000 Channel Analysis Report

## Project Information

<b>Project Name:</b> DPC <b>Description:</b> Cell 2A operational Calcs  <b>Notes:</b>	<b>Last Update:</b> 8/25/2003 11:00:48 A <b>Units:</b> English <b>Nearest City:</b>
--	---

## Channel Design

**Channel Name:** Ditch G      **Units:** English      **Design life:** 48 months

Design Criteria	Vegetation and Soil	Channel Geometry	Flow/Velocity
Flow Rate (Q)	Vegetated No Vegetation Class Soil Filled No	Bed Slope (ft/ft) 0.015 Req. Freeboard (ft) 0.000 Channel Length (ft) 1.000 Bottom Width (ft) 10.000 Channel Depth (ft) 4.000	Discharge (cf/s) 360.000 Flow Duration (hrs) 1.000 Avg. Velocity (ft/s) 10.930  Required Factor of Safety 1.00
<b>Channel Side Slopes</b>	<b>Channel Bend</b> No		
Left (H:1 V) 3.000 Right (H:1 V) 3.000	Bend Radius (ft) 0.000 Outside Bend		

## Results

		Velocity (ft/s)			Shear Stress (lbs/sqft)			Avg. Flow Depth (ft) 2.040
		Computed	Max Allowed	Safety Factor	Computed	Max Allowed	Safety Factor	
<b>Lining Materials</b>								
Left	LANDLOK TRM 450	10.170	16.490	1.620	1.610	6.250	3.880	
Bottom	LANDLOK TRM 450	11.090	16.490	1.490	1.910	6.250	3.270	
Right	LANDLOK TRM 450	10.170	16.490	1.620	1.610	6.250	3.880	

## Calculation Results:

Flow Depth (ft) 2.040	Left Wetted Perimeter (ft) 6.460
Flow Area (ft) 32.920	Bottom Wetted Perimeter (ft) 9.990
	Right Wetted Perimeter (ft) 6.460
	Total Wetted Perimeter (ft) 22.910
Hydraulic Radius (ft) 1.440	Avg. Velocity (ft/s) 10.930
Composite 'n' 0.0210	Avg. Discharge (cf/s) 360.000

## Reference Information



roughness) varies with VR. The term VR is the product of velocity and the hydraulic radius. This relationship will be referred to as the "n-VR relationship", which is the recommended basis for vegetated channel design.

The five general retardance curves, designated as A, B, C, D, and E in Exhibit 7-1, have been developed for various cover conditions. The vegetal conditions under which the various retardance values apply are shown in Exhibit 7-2. These cover classifications are based on tests in experimental channels when the covers were green and generally uniform.

Most of the vegetation used in waterways does not exceed 18 inches in height and may be much shorter at times during the year. Therefore, it is recommended that when designing the channel for safe velocity, a retardance not greater than "D" be used. After designing the channel for safe velocity, it must be checked for capacity to accommodate the peak flow under conditions where vegetation gives the highest retardance. The retardance used in this instance is the curve corresponding to the expected vegetal cover and, in most cases, it will be retardance "C", though curve "B" may be used where considered appropriate.

All pertinent design data and computations should be recorded.

#### DESIGN DATA

The following information is required for designing a waterway:

1. Watershed area in acres, together with the soil characteristics, cover and topography. This information is used to estimate runoff by the procedures set forth in Chapter 2 of this manual.
2. Grade of the proposed waterway in percent slope (this is the fall in feet per 100 feet of length).
3. Vegetal cover adapted to site conditions.
4. Erodibility of the soil in the waterway.
5. Expected height at which vegetative cover will be maintained.
6. The permissible velocity for the conditions encountered.
7. Allowance for space that will be occupied by the vegetative lining.
8. Allowance for freeboard, if required by State Standards and Specifications.

#### NON-EROSIVE VELOCITY OF FLOW

In designing grassed waterways, care must be taken to insure that the design velocity is well within the limits of permissible velocities given in Exhibit 7-3. These values apply to average, uniform stands of each type of cover.

Cover	Slope range <u>2/</u> (percent)	Permissible velocity <u>1/</u>	
		Erosion re- sistant soils (ft.per sec.)	Easily eroded soils (ft.per sec.)
Bermudagrass	0-5 5-10 over 10	8 7 6	6 5 4
Bahia Buffalograss Kentucky bluegrass Smooth brome Blue grama Tall fescue	0-5 5-10 over 10	7 6 5	5 4 3
Grass mixtures Reed canarygrass	<u>2/</u> 0-5 5-10	<u>5</u> 4	<u>4</u> 3
Lespedeza sericea Weeping lovegrass Yellow bluestem Redtop Alfalfa Red fescue	<u>3/</u> 0-5	3.5	2.5
Common lespedeza <u>4/</u> Sudangrass <u>4/</u>	<u>5/</u> 0-5	3.5	2.5

use  
4 f/s  
max

- 1/ Use velocities exceeding 5 feet per second only where good covers and proper maintenance can be obtained.
- 2/ Do not use on slopes steeper than 10 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.
- 3/ Do not use on slopes steeper than 5 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.
- 4/ Annuals--use on mild slopes or as temporary protection until permanent covers are established.
- 5/ Use on slopes steeper than 5 percent is not recommended.

Exhibit 7-3. Permissible velocities for channels lined with vegetation



## **Culvert/Downslope Flume Design Calculations**

## **Purpose/Methodology/Assumptions/Results/References**





## COMPUTATION SHEET

SHEET 1 OF 2

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
Dairyland Power Cooperative	By: BJK	Date: 9/00	By: RAA	Date: 10/00	3081.40

### CULVERT DESIGN CALCULATIONS

#### Purpose

To determine the appropriate culvert and downslope flume sizes for the anticipated peak flows resulting from the 100-year, 24-hour storm at the proposed Dairyland Power Cooperative Landfill.

#### Methodologies

Culvert design involves the process of selecting an appropriate culvert size capable of allowing the estimated peak storm water runoff to pass through it without creating surface water breaching (i.e., berm overflow) or excessive backwater levels. Culvert sizing was performed using design charts developed by the U.S. Department of Transportation Federal Highway Administration.

Downslope flumes will convey flow from the final cover diversion berms to the sedimentation basin. Downslope flumes were also sized using design charts developed by the U.S. Department of Transportation Federal Highway Administration. The energy dissipater for the downslope flume was sized using design guidance from the US Department of the Interior, Bureau of Reclamation.

#### Assumptions

The following assumptions were used in the culvert and downslope flume sizing analysis:

1. Culvert and downslope flume layout and allowable headwater levels are shown on the accompanying plan set.
2. Tailwater depths were assumed based on anticipated flows within the ditching. For culverts discharging into sedimentation basins, the tailwater elevation in the basin from the routing calculations.
3. Culverts are assumed to be corrugated metal culvert pipes or concrete box culverts.
4. Culverts were designed to maintain a minimum 1 to 2 feet of freeboard, depending on the location.



## COMPUTATION SHEET

SHEET 2 OF 2

744 Heartland Trail (53717-8923) P. O. Box 8923 (53708-8923) Madison, WI (608) 831-4444 FAX: (608) 831-3334 VOICE: (608) 831-1989

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
	By:	Date:	By:	Date:	
Dairyland Power Cooperative	BJK	9/00	RAA	10/00	3081.40

### Results

The table below summarizes the results of the culvert pipe sizing analyses:

CULVERT	SLOPE (%)	LENGTH (ft)	100-YR. FLOW (cfs)	SIZE
Culvert #1	7.0	96	323	4' x 7' Box
Culvert #2	7.7	126	323	4' x 7' Box
Culvert #3	11.2	125	15	30" CMP
Culvert #4	9.3	75	15	30" CMP
Culvert #5	5	85	323	4' x 7' Box

Note:

Culvert lengths to be adjusted based on available culvert section lengths.

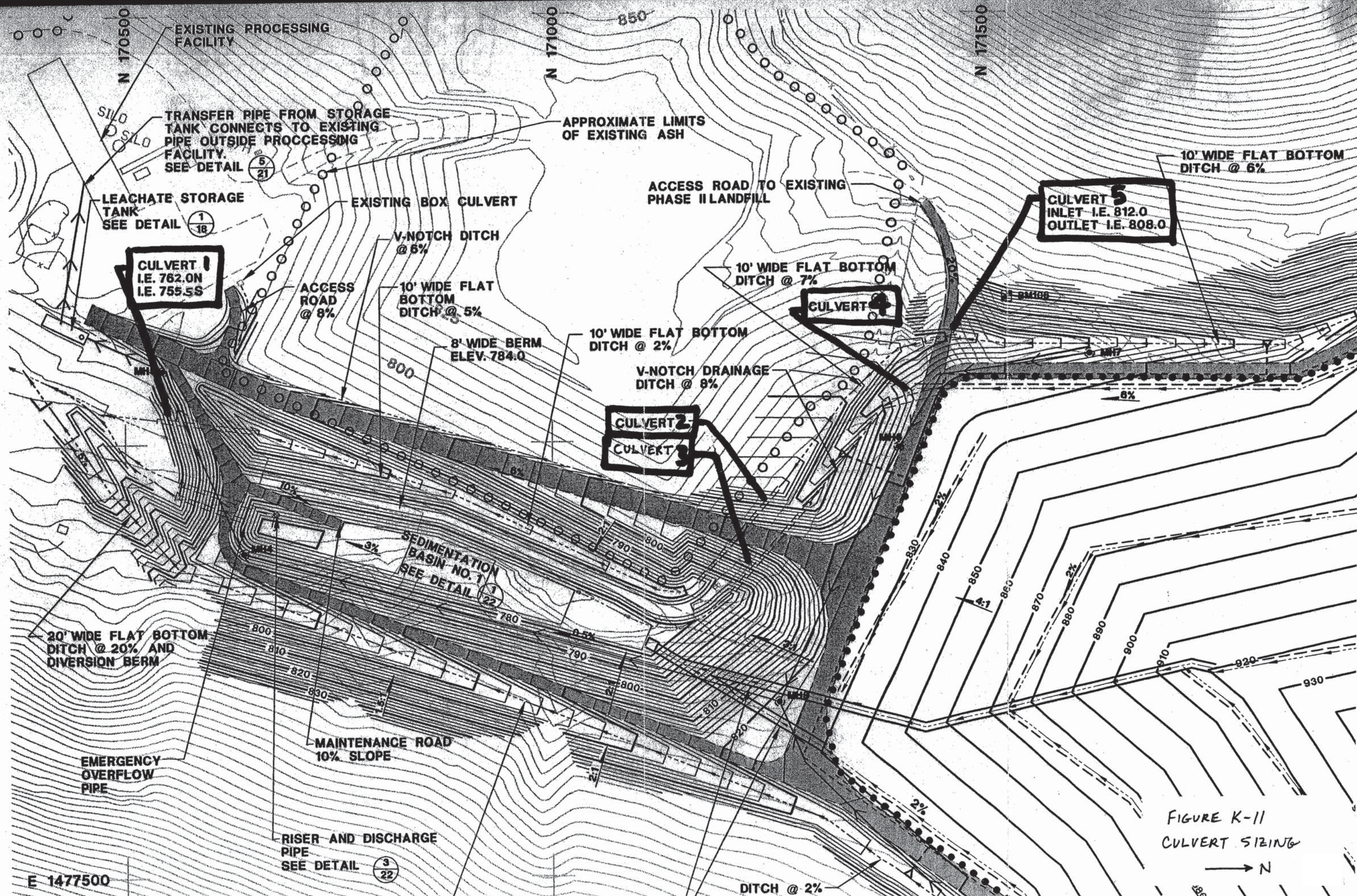
Downslope pipe and energy dissipater sizing are shown on the engineering details included in the Plan Set.

### References

U.S. Department of Transportation. Hydraulics charts for the selection of highway culverts. Hydraulic engineering circular no. 5. December 1965.

U.S. Department of the Interior, Bureau of Reclamation. Hydraulic Design of Stilling Basins and Energy Dissipaters. Engineering Nomograph No. 25. May 1984.







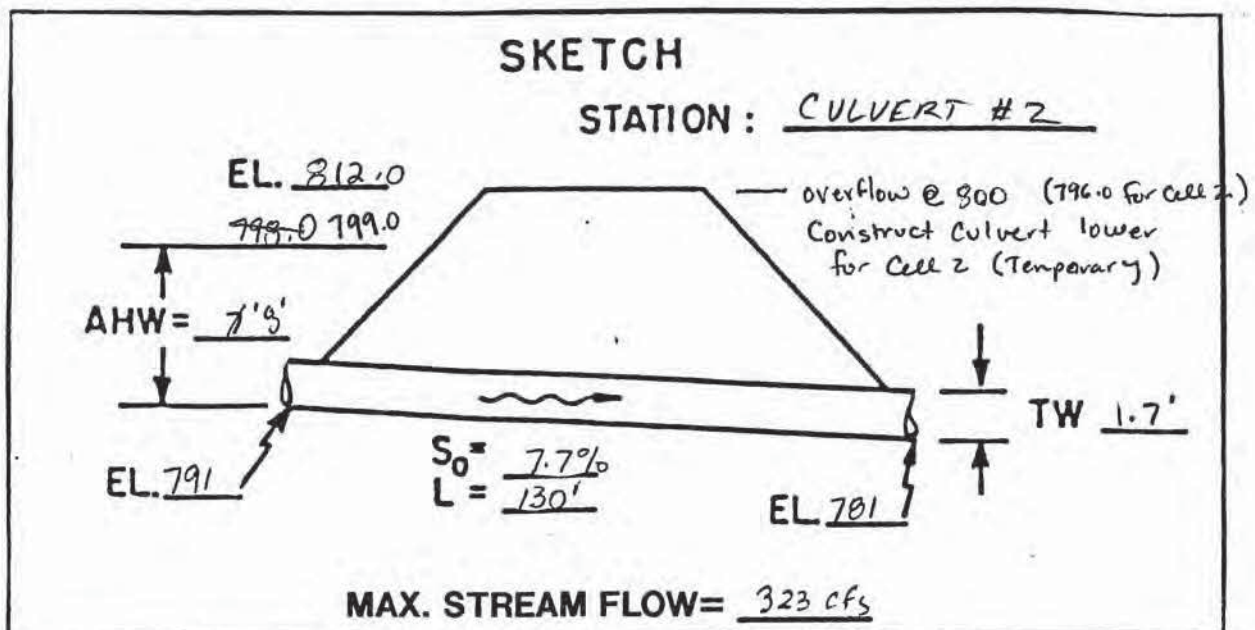
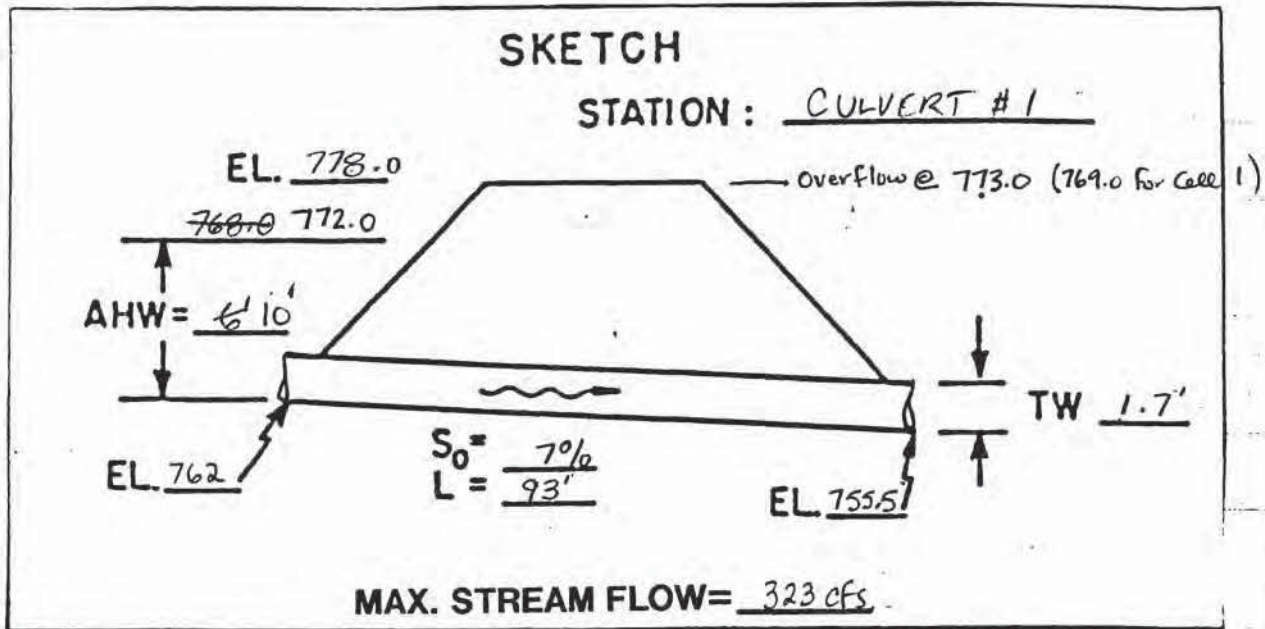
## **Calculations – Post-closure Landfill Conditions**



744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334 SHEET \_\_\_\_\_ OF \_\_\_\_\_

PROJECT/PROPOSAL NAME	PREPARED	CHECKED	PROJECT/PROPOSAL NO.
DPC - PLAN OF OPERATION	By: <u>BJV</u> Date: <u>9/10</u>	By: _____ Date: _____	<u>3081.40</u>

Rev. 7/03  
BJV

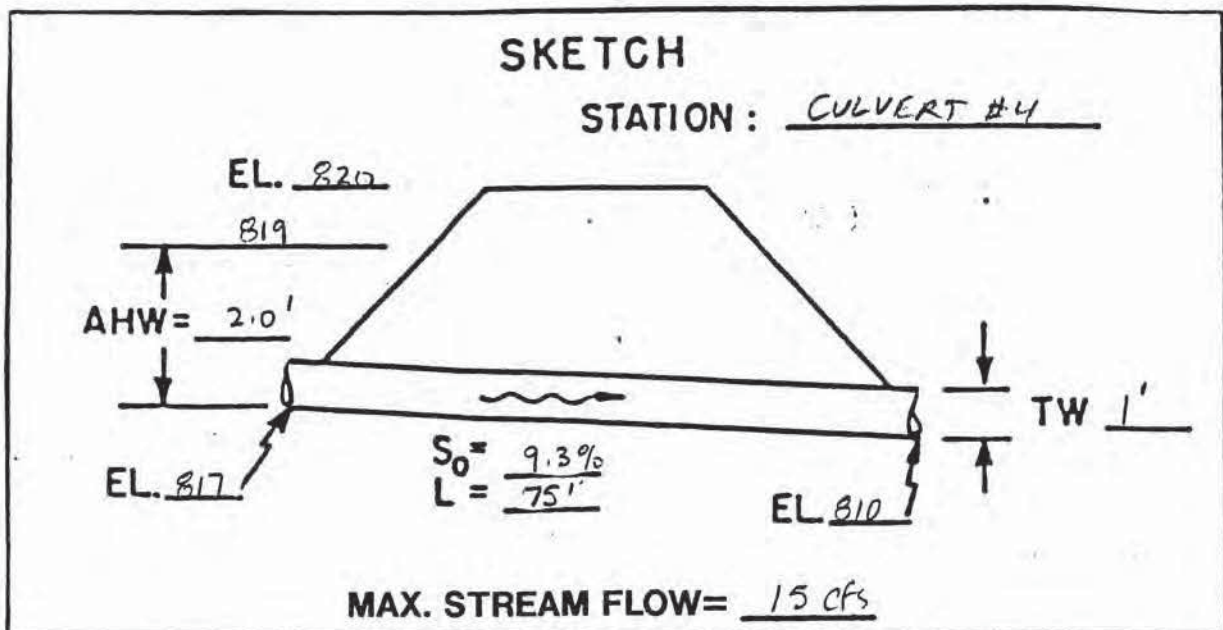
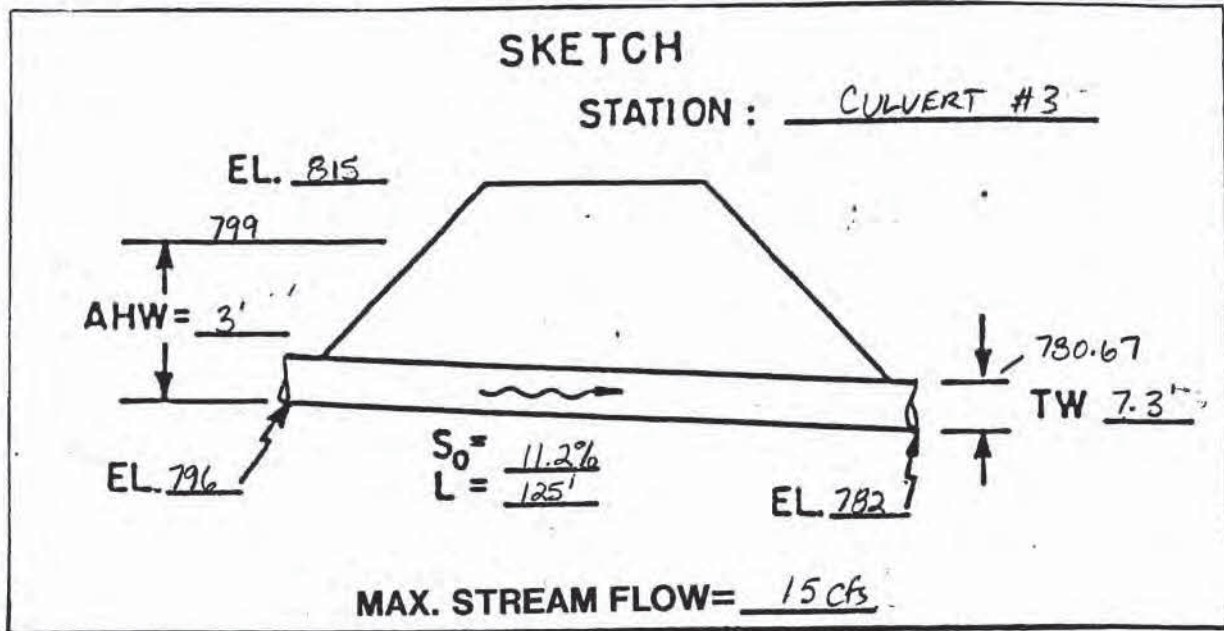




# COMPUTATION SHEET

744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334 SHEET \_\_\_\_\_ OF \_\_\_\_\_

PROJECT/PROPOSAL NAME	PREPARED		CHECKED		PROJECT/PROPOSAL NO.
	By:	Date:	By:	Date:	
DPC - PLAN OF OPERATION	BJA	9/00			3081.40







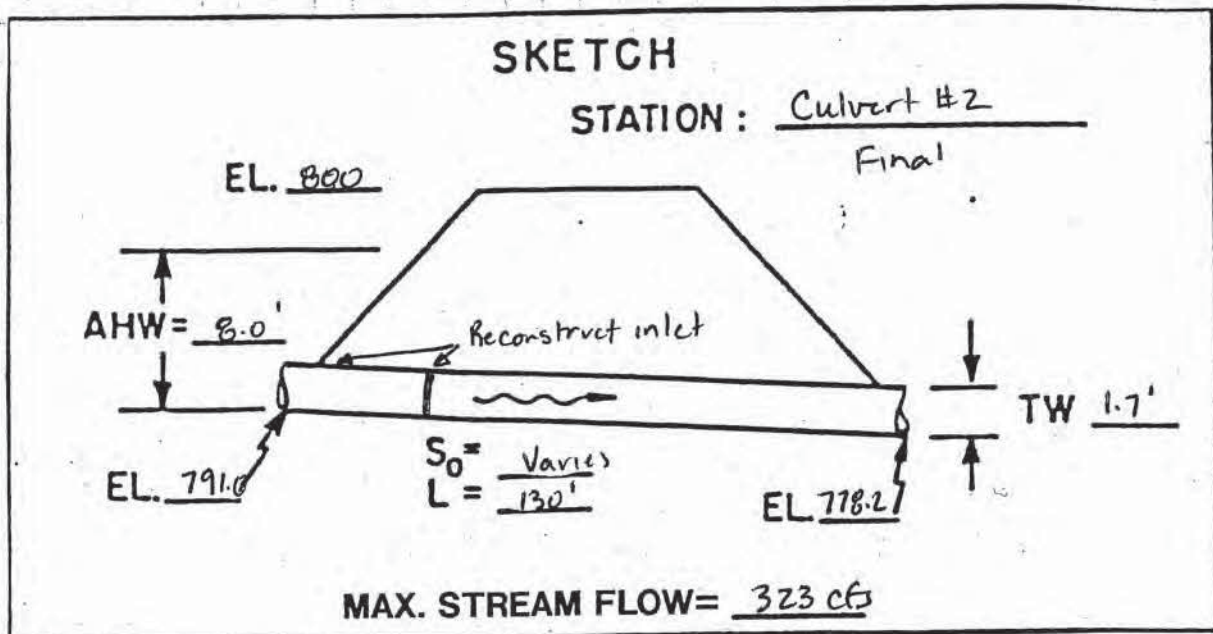
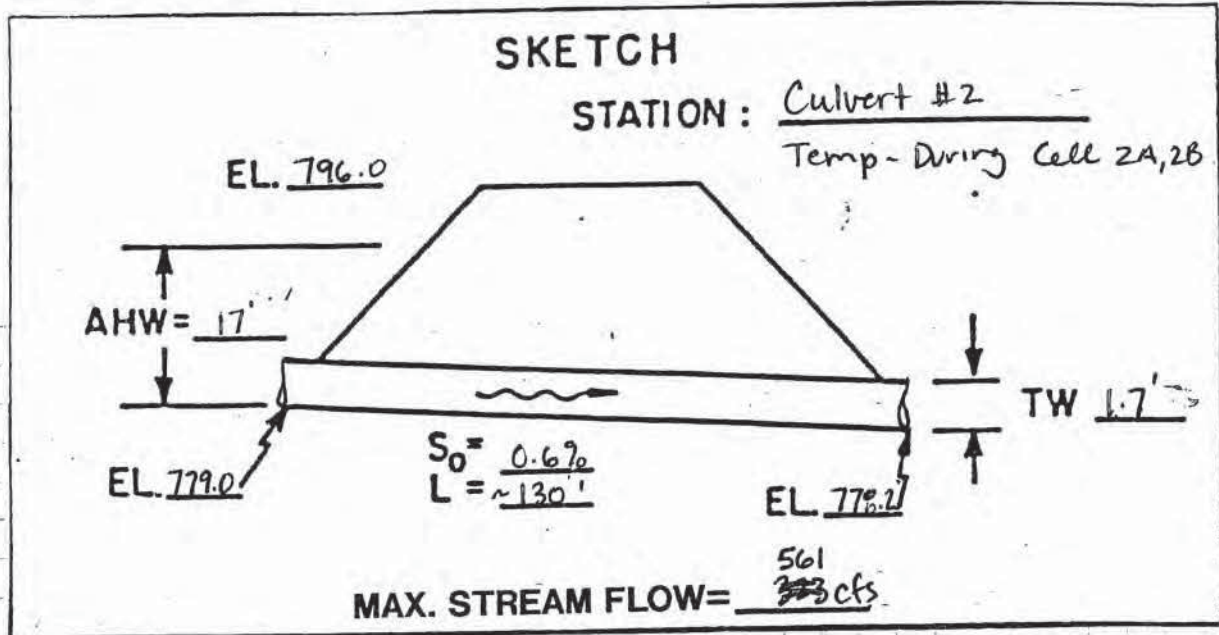
# COMPUTATION SHEET

744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

SHEET

OF

PROJECT / PROPOSAL NAME	PREPARED	CHECKED	PROJECT / PROPOSAL NO.
Dairyland Power - Phase IV	By: <u>BTH</u> Date: <u>7/03</u>	By: Date:	<u>3061.56</u>



# Culvert Calculator Report

## Culvert 2 - Operational

Solve For: Headwater Elevation

<b>Culvert Summary</b>			
Allowable HW Elevation	796.00 ft	Headwater Depth/ Height	3.86
Computed Headwater Elevation	794.45 ft	Discharge	561.00 cfs
Inlet Control HW Elev	792.30 ft	Tailwater Elevation	779.90 ft
Outlet Control HW Elev	794.45 ft	Control Type	Outlet Control
<b>Grades</b>			
Upstream Invert	779.00 ft	Downstream Invert	778.20 ft
Length	130.00 ft	Constructed Slope	0.006154 ft/ft
<b>Hydraulic Profile</b>			
Profile	Pressure	Depth, Downstream	4.00 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	4.00 ft
Velocity Downstream	20.04 ft/s	Critical Slope	0.022277 ft/ft
<b>Section</b>			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	7.00 ft
Section Size	7 x 4 ft	Rise	4.00 ft
Number Sections	1		
<b>Outlet Control Properties</b>			
Outlet Control HW Elev	794.45 ft	Upstream Velocity Head	6.24 ft
Ke	0.50	Entrance Loss	3.12 ft
<b>Inlet Control Properties</b>			
Inlet Control HW Elev	792.30 ft	Flow Control	Submerged
Inlet Type	18 to 33.7 ° wingwall flare, d=0.0830	Area Full	28.0 ft <sup>2</sup>
K	0.48600	HDS 5 Chart	9
M	0.66700	HDS 5 Scale	2
C	0.02490	Equation Form	2
Y	0.83000		



## Culvert Calculator Report

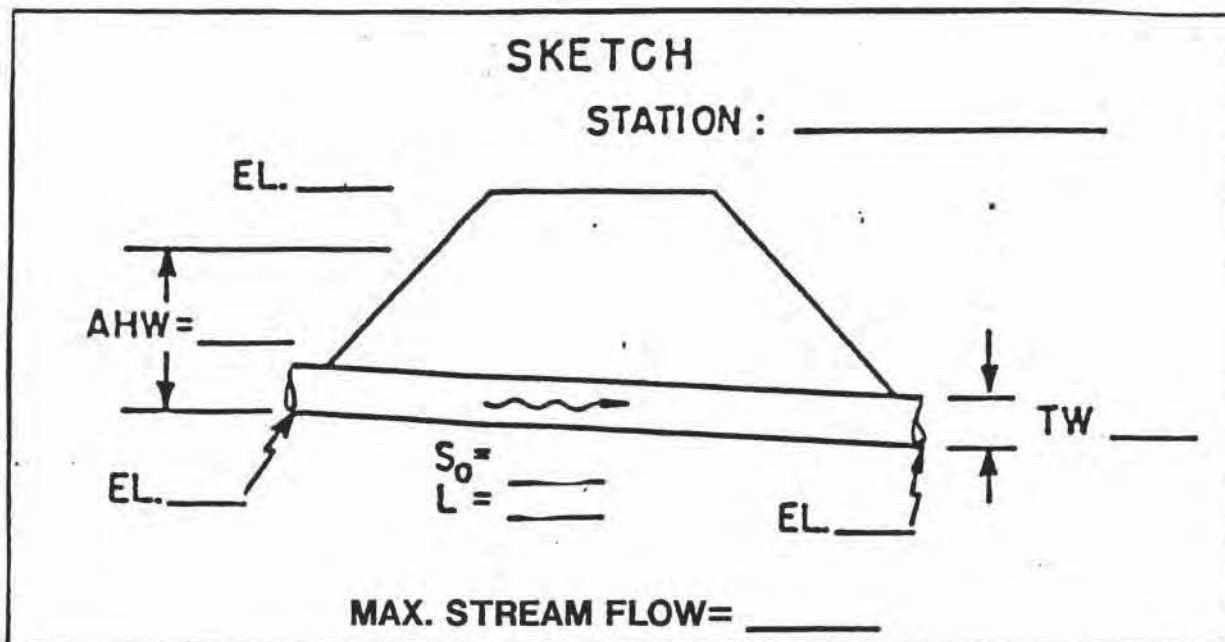
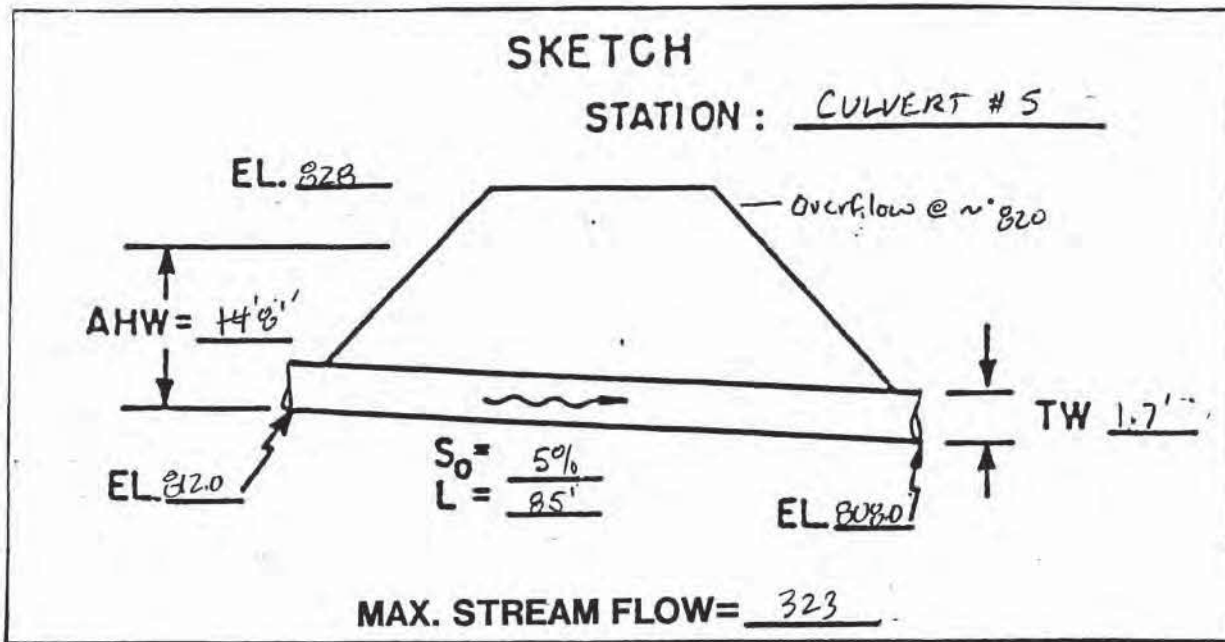
### Culvert 2 - Final

Solve For: Headwater Elevation

<b>Culvert Summary</b>			
Allowable HW Elevation	799.00 ft	Headwater Depth/ Height	1.78
Computed Headwater Elevation	798.10 ft	Discharge	323.00 cfs
Inlet Control HW Elev	797.44 ft	Tailwater Elevation	779.90 ft
Outlet Control HW Elev	798.10 ft	Control Type	Entrance Control
<b>Grades</b>			
Upstream Invert	791.00 ft	Downstream Invert	778.20 ft
Length	130.00 ft	Constructed Slope	0.098462 ft/ft
<b>Hydraulic Profile</b>			
Profile	S2	Depth, Downstream	1.60 ft
Slope Type	Steep	Normal Depth	1.32 ft
Flow Regime	Supercritical	Critical Depth	4.00 ft
Velocity Downstream	28.87 ft/s	Critical Slope	0.007385 ft/ft
<b>Section</b>			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	7.00 ft
Section Size	7 x 4 ft	Rise	4.00 ft
Number Sections	1		
<b>Outlet Control Properties</b>			
Outlet Control HW Elev	798.10 ft	Upstream Velocity Head	2.07 ft
Ke	0.50	Entrance Loss	1.03 ft
<b>Inlet Control Properties</b>			
Inlet Control HW Elev	797.44 ft	Flow Control	Submerged
Inlet Type	18 to 33.7 ° wingwall flare, d=0.0830	Area Full	28.0 ft <sup>2</sup>
K	0.48600	HDS 5 Chart	9
M	0.66700	HDS 5 Scale	2
C	0.02490	Equation Form	2
Y	0.83000		

744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

PROJECT/PROPOSAL NAME <u>OPC POO</u>	PREPARED	CHECKED	PROJECT/PROPOSAL NO.
	By: <u>BSP</u> Date: <u>9/01</u>	By: _____ Date: _____	<u>3091.40</u>





PROJECT: DPC P00 DESIGNER: BTK  
DATE: 9/2000

HYDROLOGIC AND CHANNEL INFORMATION

STATION: SEE SKETCHES

SKETCH

$Q_1 = \text{SEE SKETCHES}$   $TW_1 =$   
 $Q_2 =$   $TW_2 =$   
(  $Q_1$  = DESIGN DISCHARGE, SAY  $Q_{25}$   
 $Q_2$  = CHECK DISCHARGE, SAY  $Q_{50}$  OR  $Q_{100}$  )

CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	HEADWATER COMPUTATION										CONTROLLING % K	OUTLET VELOCITY ft/s	COST	COMMENTS	
			INLET CONT.		OUTLET CONTROL						HW = H + h <sub>0</sub> - LS <sub>0</sub>						
			H/W D	HW	K <sub>e</sub>	H	d <sub>c</sub>	d <sub>c</sub> +D 2	TW	h <sub>0</sub>	LS <sub>0</sub>	HW					
CULVERT #1 CMP	162 FA	2'- 60"	1.2	6'													
CULVERT #1 BOX CULVERT	323 46/ft	7'- 4'	1.45 1.95	5.8' 7.8'	0.4	3.8'	4.0'	4.0'	1.7'	4.0	6.5'	1.3		5.8' 7.8'		Not Rec.	
CULVERT #2 BOX CULVERT	323 46/ft	7'- 4'	1.45 1.95	5.8' 7.8'	0.4	3.8'	4.0'	4.0'	1.7	4.0	10'	-		5.8' 7.8'		Recommended	
CULVERT #3 CMP	15	24"	1.15	2.3'	0.5	2.8'	1.4	1.7	7.3'	7.3'	6'	4.1				Not Rec.	
CULVERT #3 CMP	15	30"	0.77	1.9	0.5	0.8	1.3	1.9	7.3'	7.3'	6'	2.1				Recommended	

SUMMARY & RECOMMENDATIONS:

ACTUAL LENGTHS OF CULVERTS #1 & 2 = 96' and 126' RESPECTIVELY  
BASED ON 6' CULVERT SECTION LENGTHS

Figure 7





TABLE 1 - ENTRANCE LOSS COEFFICIENTS

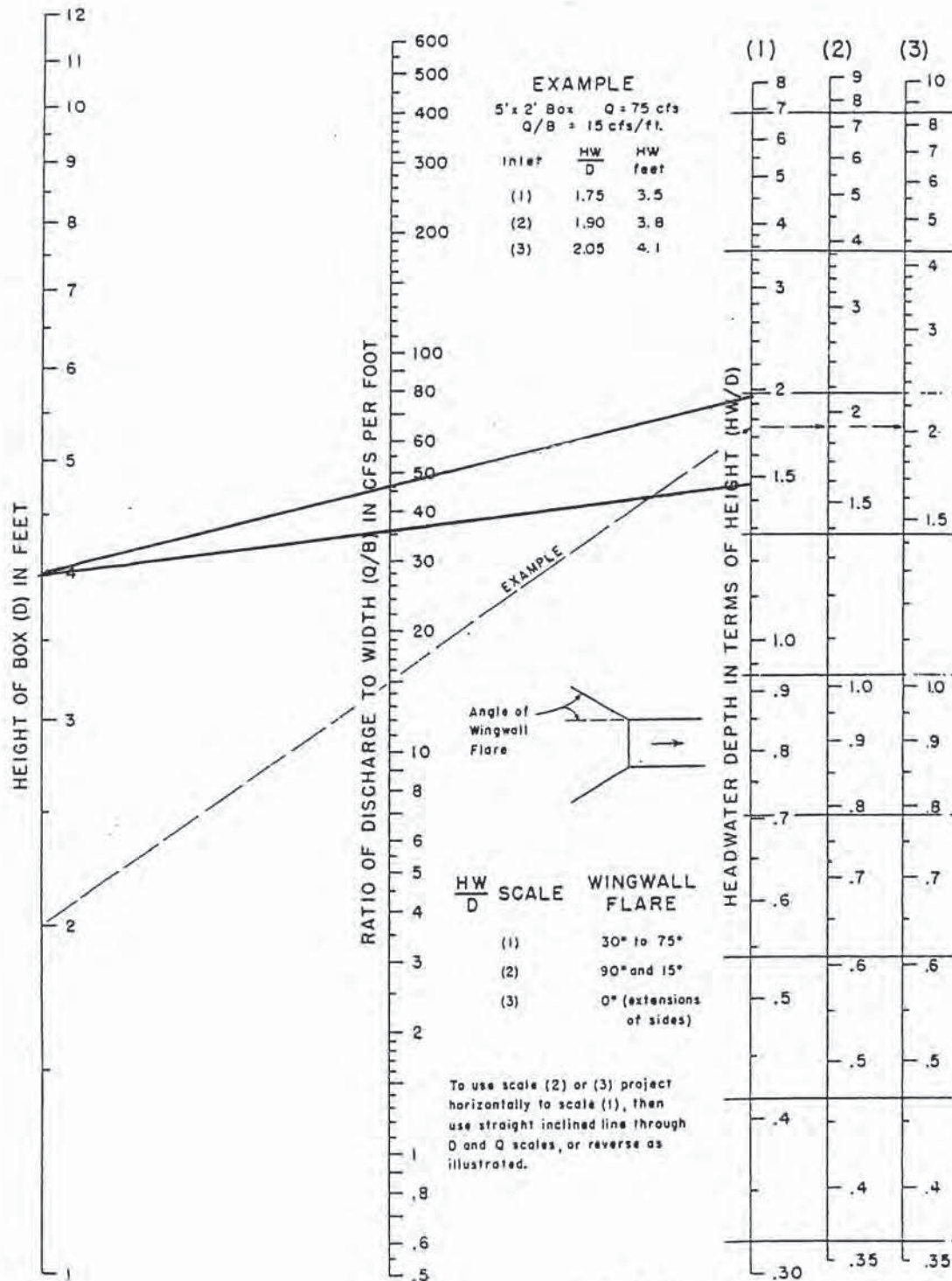
Outlet Control, Full or Partly Full

$$\text{Entrance head loss } H_e = k_e \frac{v^2}{2g}$$

<u>Type of Structure and Design of Entrance</u>	<u>Coefficient <math>k_e</math></u>
<u>Pipe, Concrete</u>	
Projecting from fill, socket end (groove-end) . . . .	0.2
Projecting from fill, sq. cut end . . . . .	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end) . . . . .	0.2
Square-edge . . . . .	0.5
Rounded (radius = $1/12D$ ) . . . . .	0.2
Mitered to conform to fill slope . . . . .	0.7
*End-Section conforming to fill slope . . . . .	0.5
Beveled edges, $33.7^\circ$ or $45^\circ$ bevels . . . . .	0.2
Side-or slope-tapered inlet . . . . .	0.2
<u>Pipe, or Pipe-Arch, Corrugated Metal</u>	
Projecting from fill (no headwall) . . . . .	0.9
Headwall or headwall and wingwalls square-edge . .	0.5
Mitered to conform to fill slope, paved or unpaved	
slope . . . . .	0.7
*End-Section conforming to fill slope . . . . .	0.5 ← CULVERTS 3,4
Beveled edges, $33.7^\circ$ or $45^\circ$ bevels . . . . .	0.2
Side-or slope-tapered inlet . . . . .	0.2
<u>Box, Reinforced Concrete</u>	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges . . . . .	0.5
Rounded on 3 edges to radius of $1/12$ barrel	
dimension, or beveled edges on 3 sides . . .	0.2
Wingwalls at $30^\circ$ to $75^\circ$ to barrel	
Square-edged at crown . . . . .	0.4 ← CULVERTS 1,2
Crown edge rounded to radius of $1/12$ barrel	
dimension, or beveled top edge . . . . .	0.2
Wingwall at $10^\circ$ to $25^\circ$ to barrel	
Square-edged at crown . . . . .	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown . . . . .	0.7
Side-or slope-tapered inlet . . . . .	0.2

\*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be designed using the information given for the beveled inlet, p. 5-13.

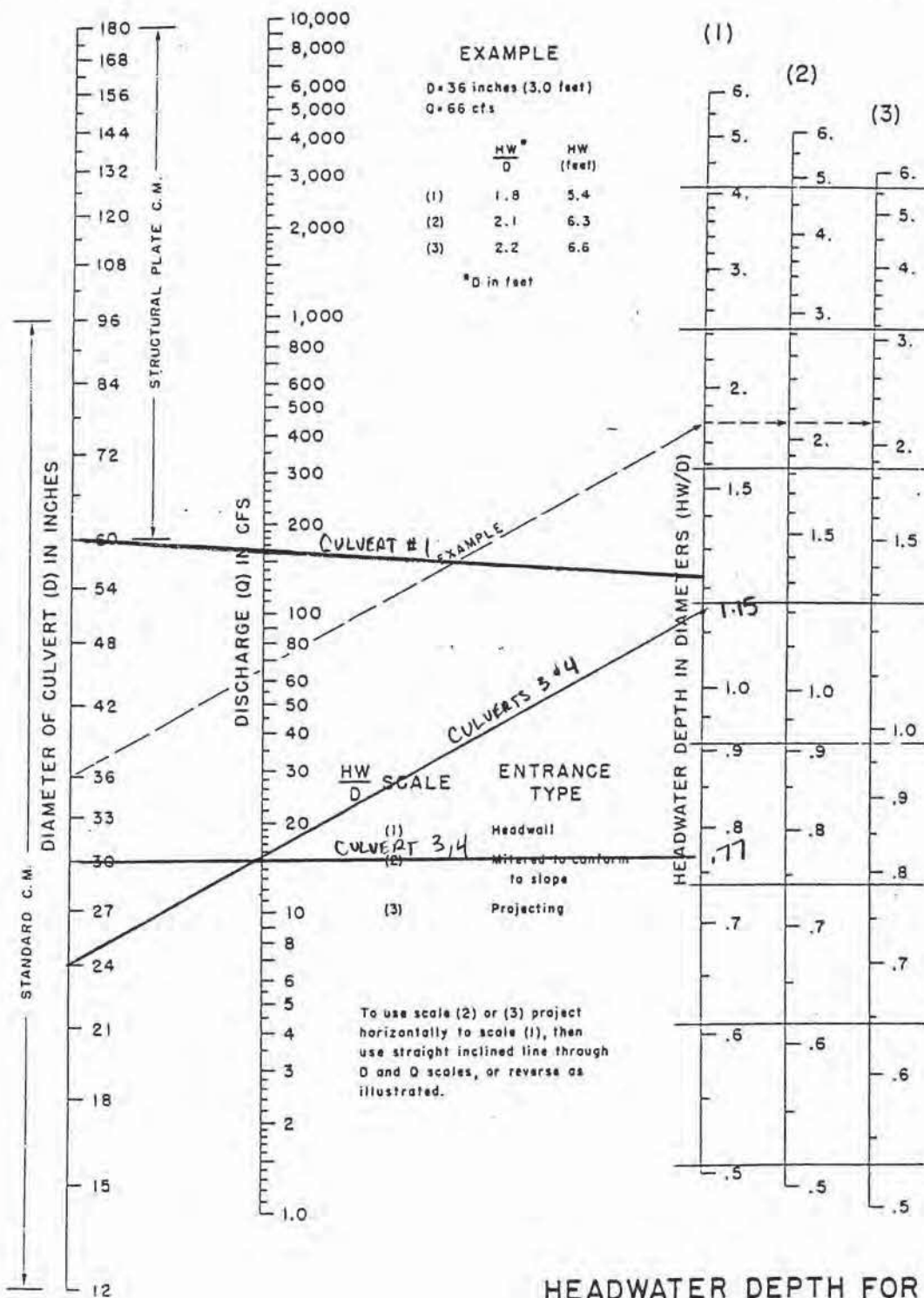
# CHART I



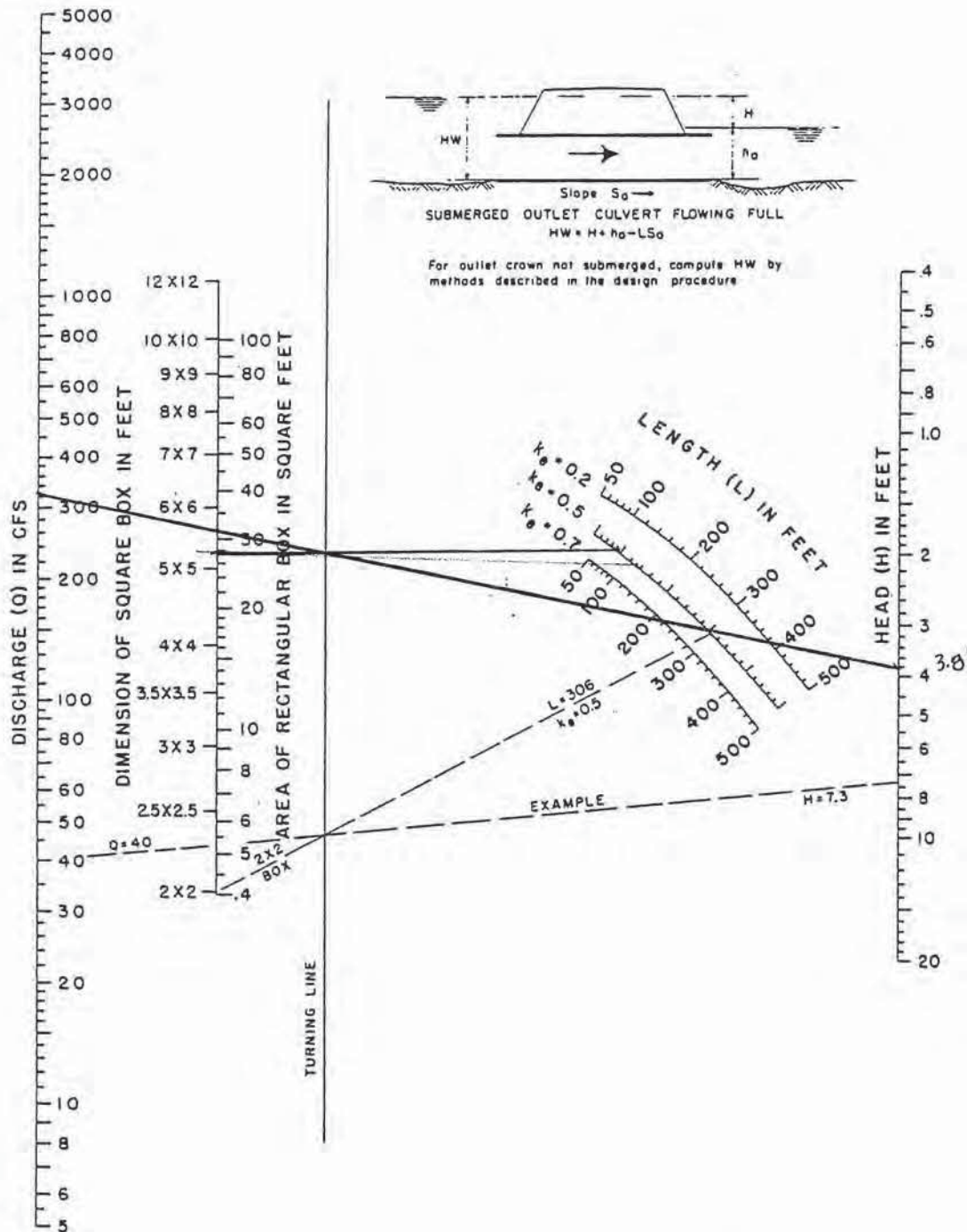
HEADWATER DEPTH  
 FOR BOX CULVERTS  
 WITH INLET CONTROL



# CHART 5



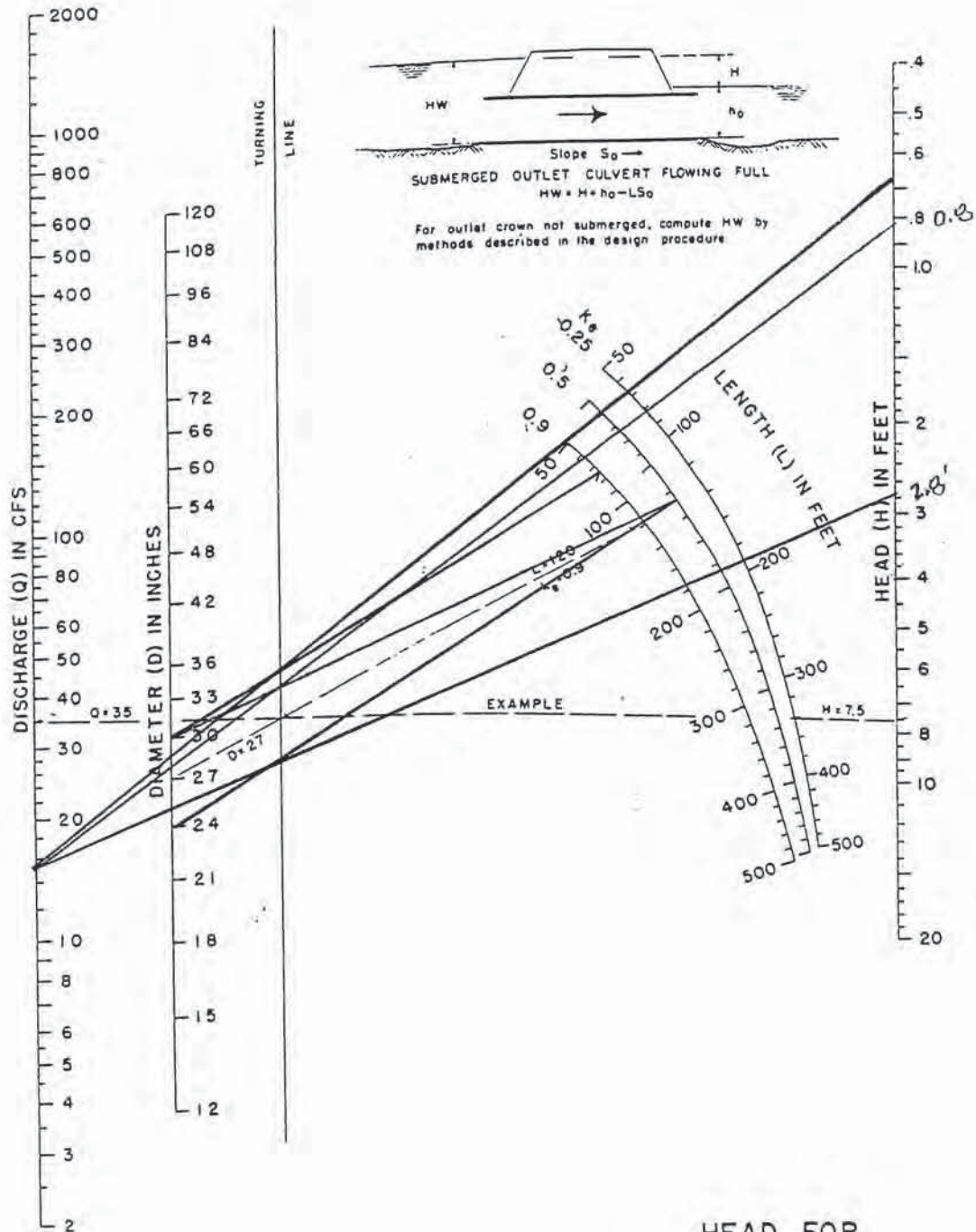
# CHART 8



HEAD FOR  
CONCRETE BOX CULVERTS  
FLOWING FULL  
 $n = 0.012$

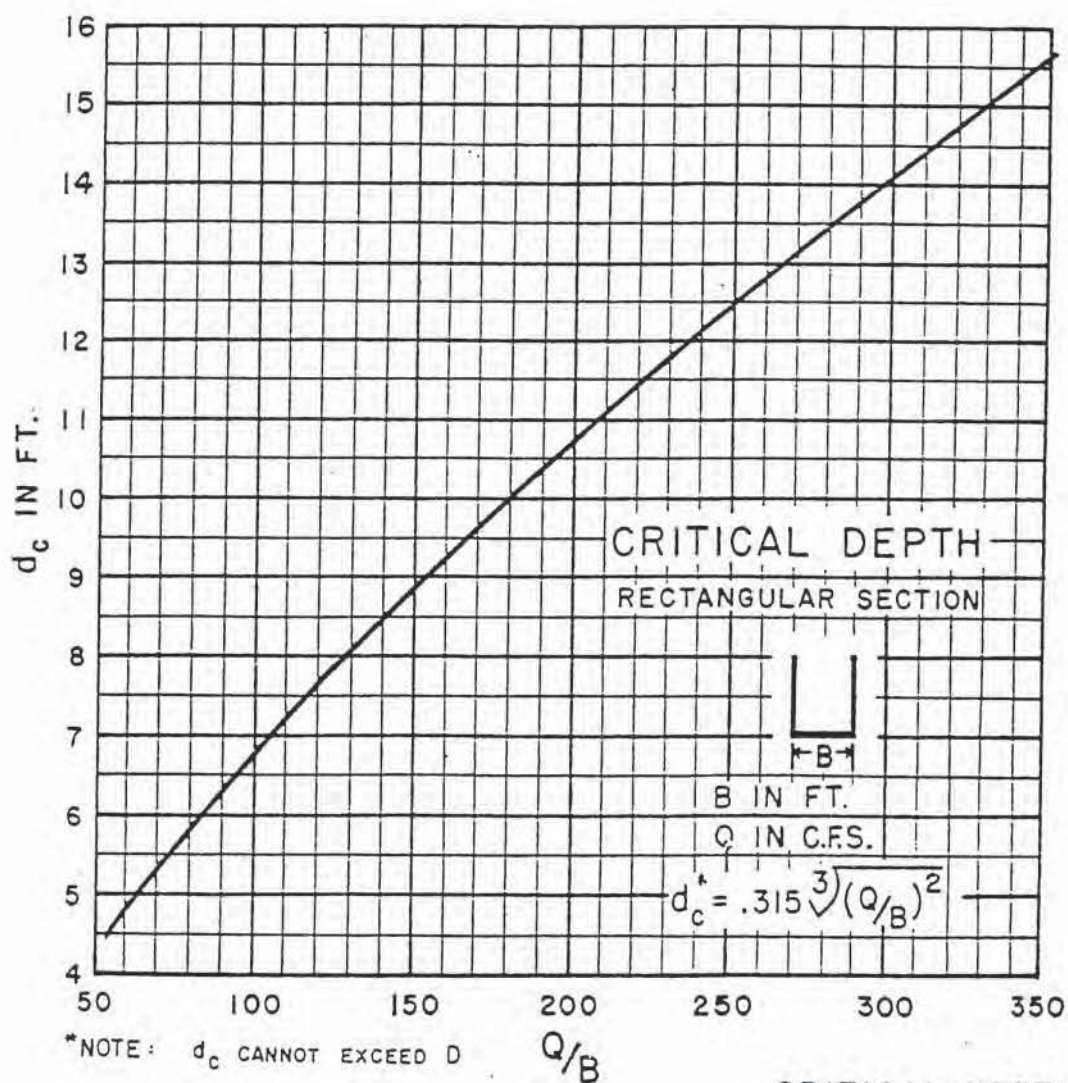
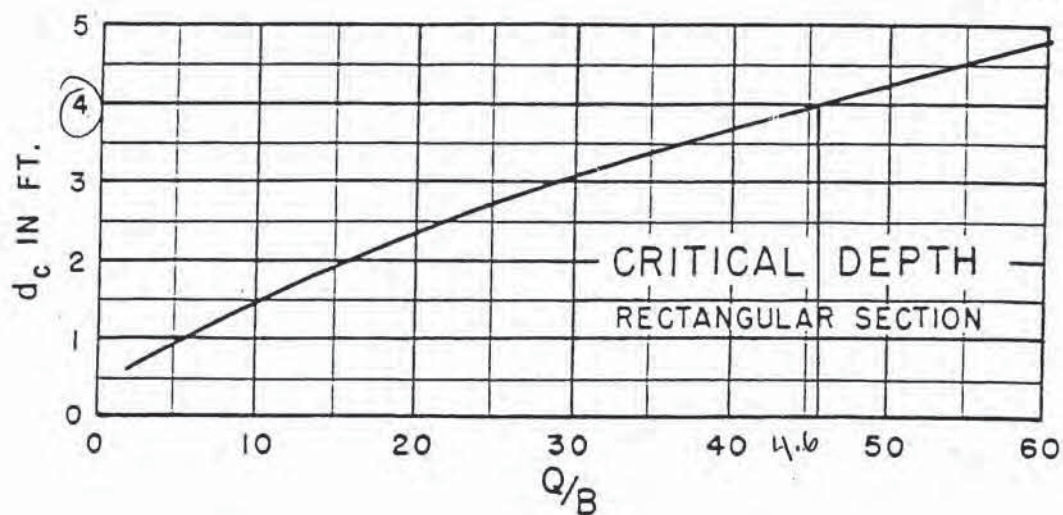


# CHART 11



HEAD FOR  
STANDARD  
C. M. PIPE CULVERTS  
FLOWING FULL  
 $n = 0.024$

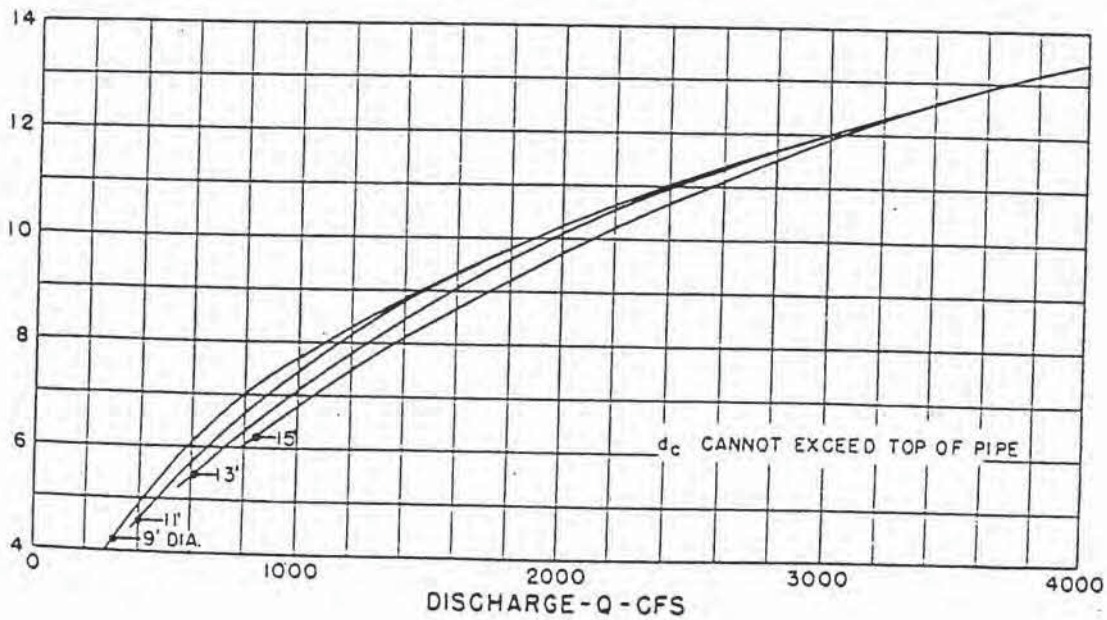
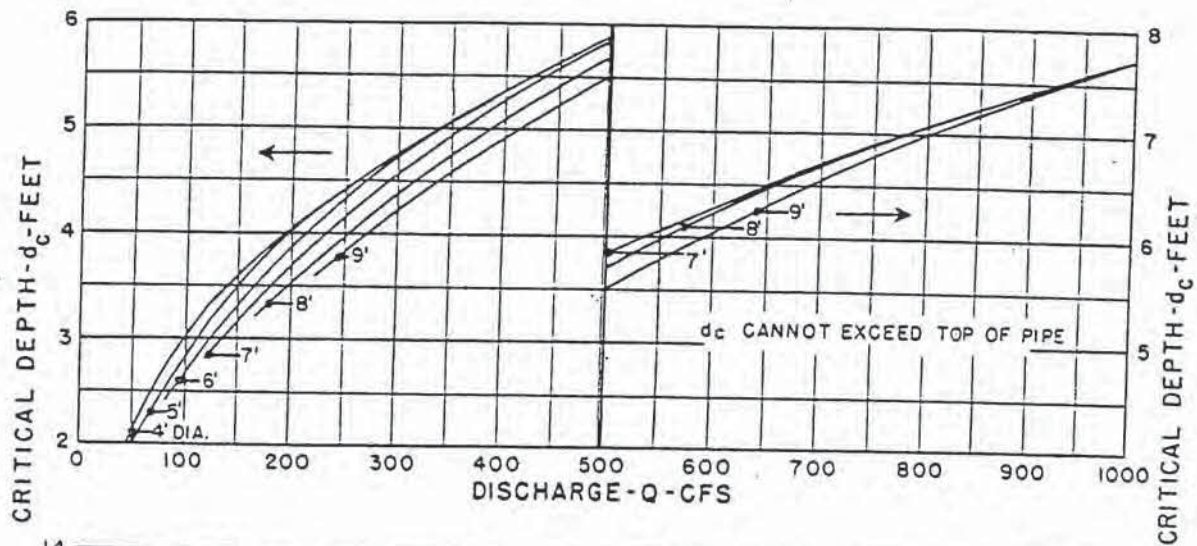
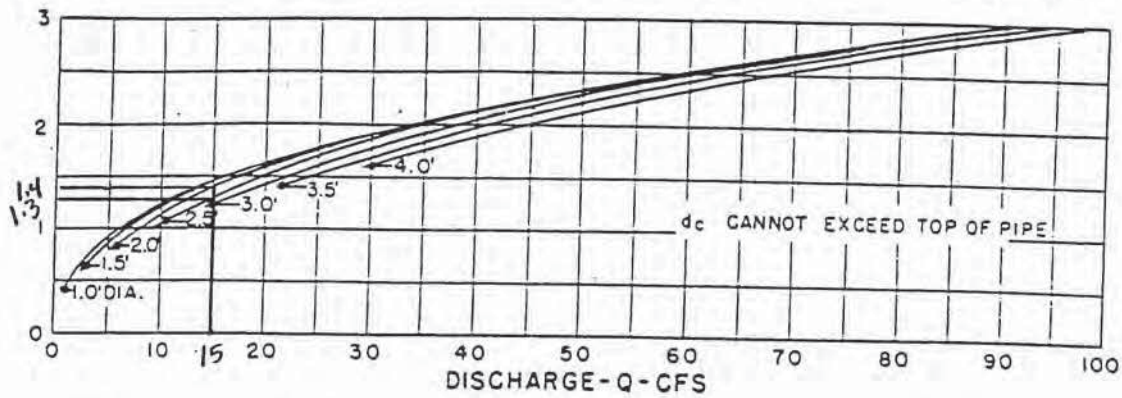
Chart 15



CRITICAL DEPTH  
RECTANGULAR SECTION



# CHART 1'6



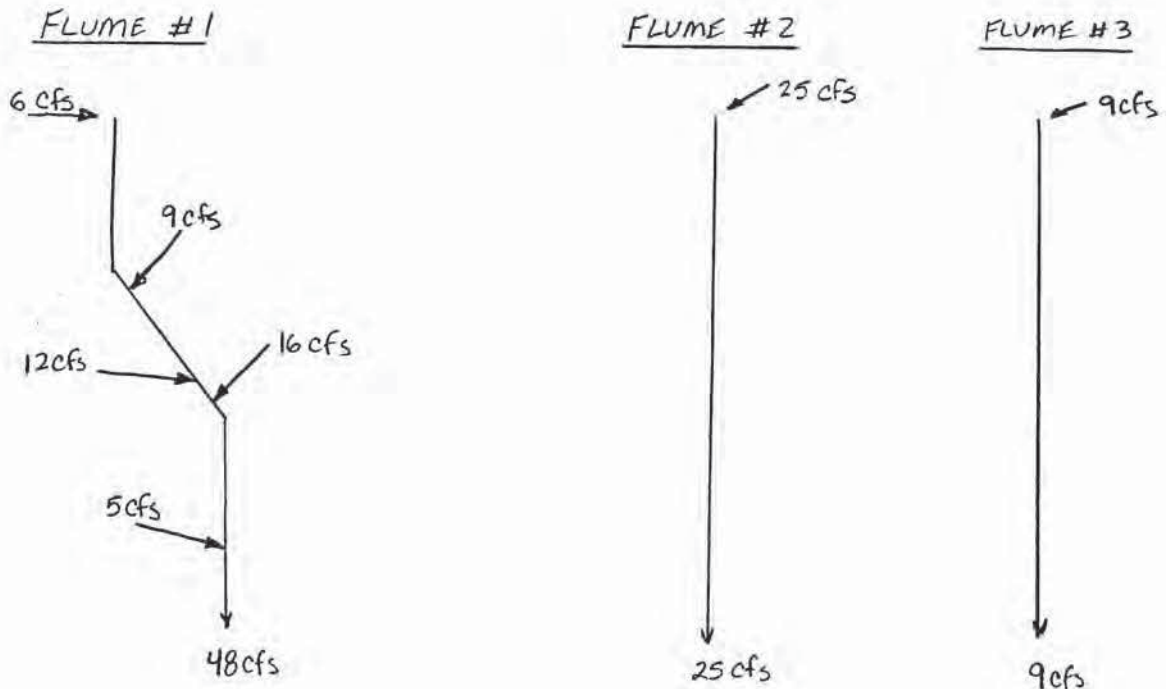
CRITICAL DEPTH  
CIRCULAR PIPE



PROJECT / PROPOSAL NAME / LOCATION: <u>DAIRYLAND POWER - P00</u>		PROJECT / PROPOSAL NO.
SUBJECT: <u>FLUME SIZING</u>		<u>3081.40</u>
PREPARED BY: <u>B.J.K</u>	DATE: <u>9/00</u>	FINAL <input type="checkbox"/>
CHECKED BY:	DATE:	REVISION <input type="checkbox"/>

## DOWNSLOPE FLUME SIZING

### 1. SIZE INLET PIPES



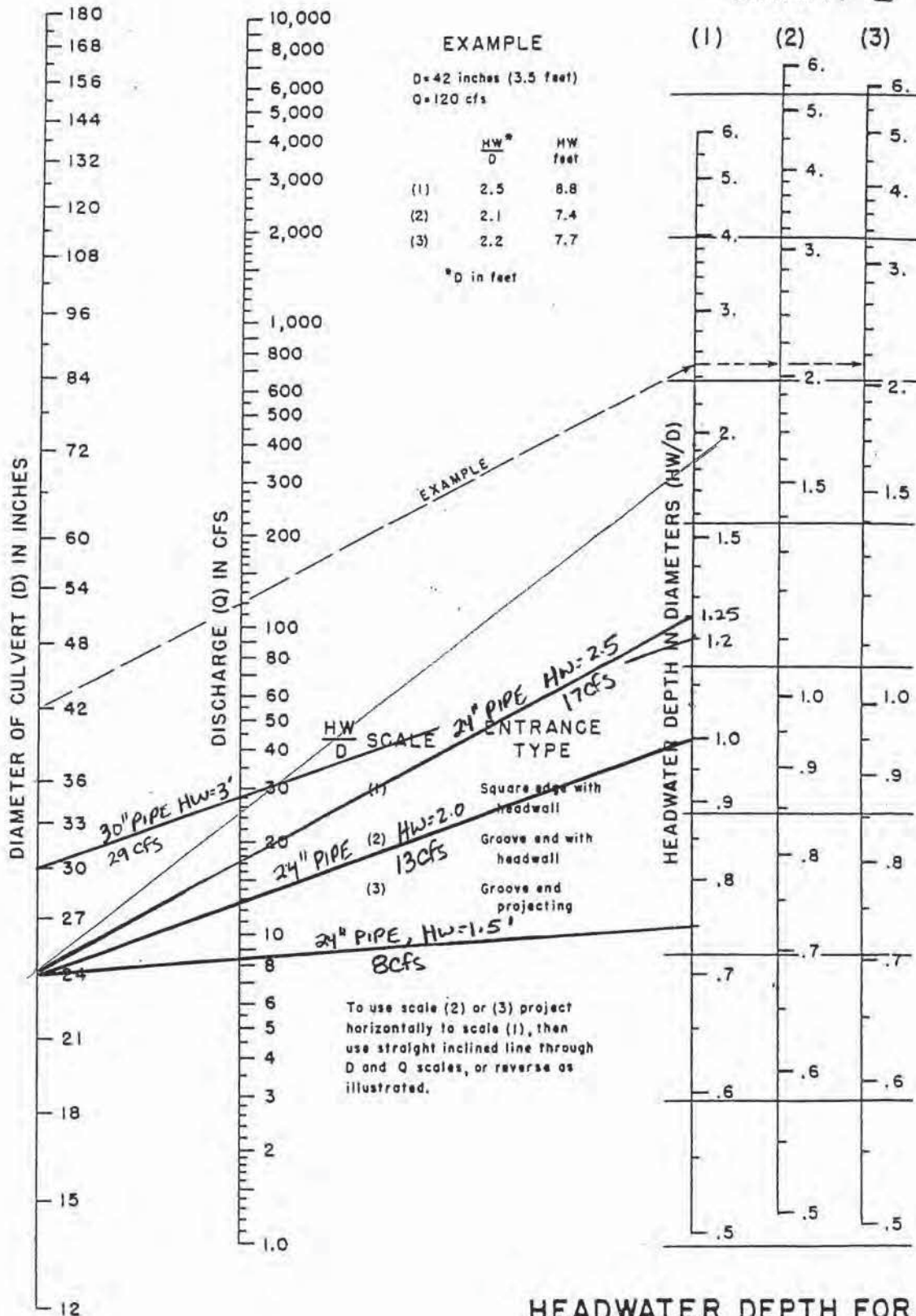
NOTE: PEAK FLOWS OBTAINED FROM RUNOFF CALCULATIONS  
PEAK FLOWS ADDED TO OBTAIN TOTALS (CONSERVATIVE)

ESTABLISH INLET PIPE SIZES AND BERM HEIGHTS USING INLET  
CONTROL NOMOGRAPHS!

<u>FLOW RANGE</u>	<u>INLET PIPE SIZE</u>	<u>HW</u>	<u>REQ'D BERM HEIGHT</u>
0-8 cfs	24"	1.5'	2.5'
9-13 cfs	24"	2.0'	2.5'
14-17 cfs	24"	2.5'	3.0'
18-29 cfs	30"	3.0'	3.5'



# CHART 2'



HEADWATER DEPTH FOR  
CONCRETE PIPE CULVERTS  
WITH INLET CONTROL



PROJECT / PROPOSAL NAME / LOCATION: <u>DAIRYLAND POWER - P00</u>		PROJECT / PROPOSAL NO. <u>308140</u>
SUBJECT: <u>FLUME SIZING</u>		
PREPARED BY: <u>BJK</u>	DATE: <u>9/00</u>	FINAL <input type="checkbox"/>
CHECKED BY:	DATE:	REVISION <input type="checkbox"/>

### CHECK STRAIGHT PIPE FLUME SIZING

WORST-CASE FLOW - FLUME #1

SLOPE = 20% (AT RIDGE)

PIPE DIA = 1.5'

MAX FLOW = 48 cfs

FULL PIPE FLOW:

$$Q = \frac{1.49}{n} R^{2/3} S^{1/2} A$$

$n = 0.010$  for HDPE PIPE

$R = D/4 = 1.5/4 = 0.375$

$S = 0.20$  ft/ft

$A = \pi D^2/4 = \pi (1.5)^2/4 = 1.77 \text{ ft}^2$

$$Q_{\text{FULL}} = \frac{1.49}{0.01} (0.375)^{2/3} (0.20)^{1/2} (1.77)$$

$$= 61 \text{ cfs} > 48 \text{ cfs} \quad \text{OK} \checkmark$$



# Hydraulic Design of Stilling Basins and Energy Dissipators

By A. J. PETERKA

Denver, Colorado



United States Department of the Interior



BUREAU OF RECLAMATION

**RMT**  
**LIBRARY**

NOV 22 1999

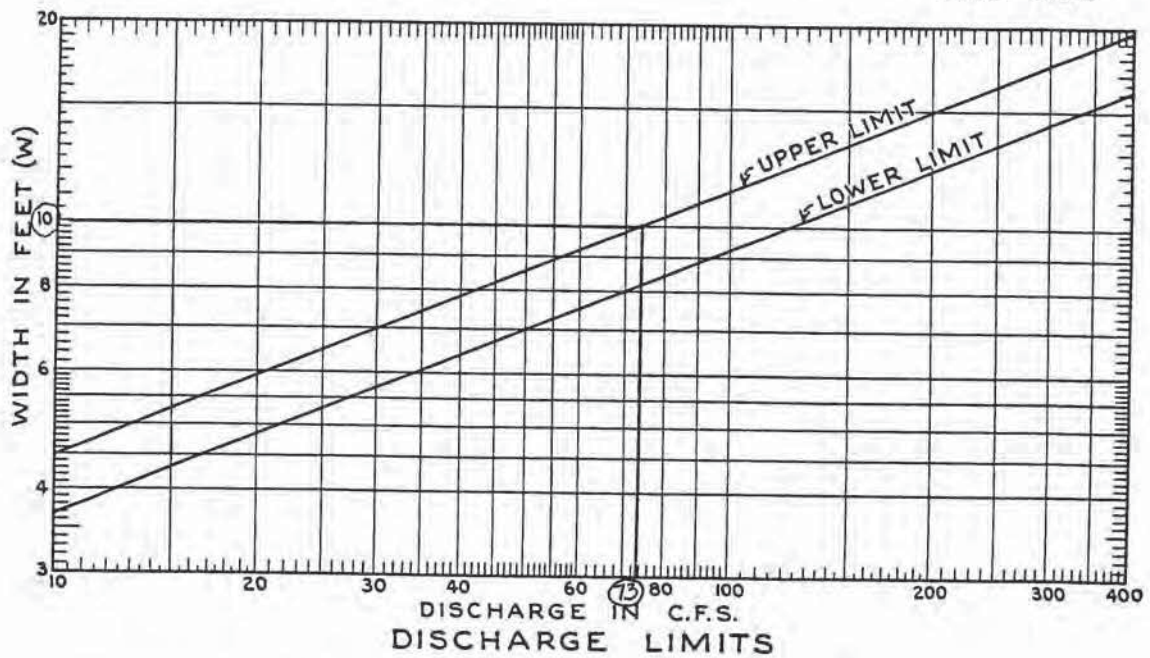
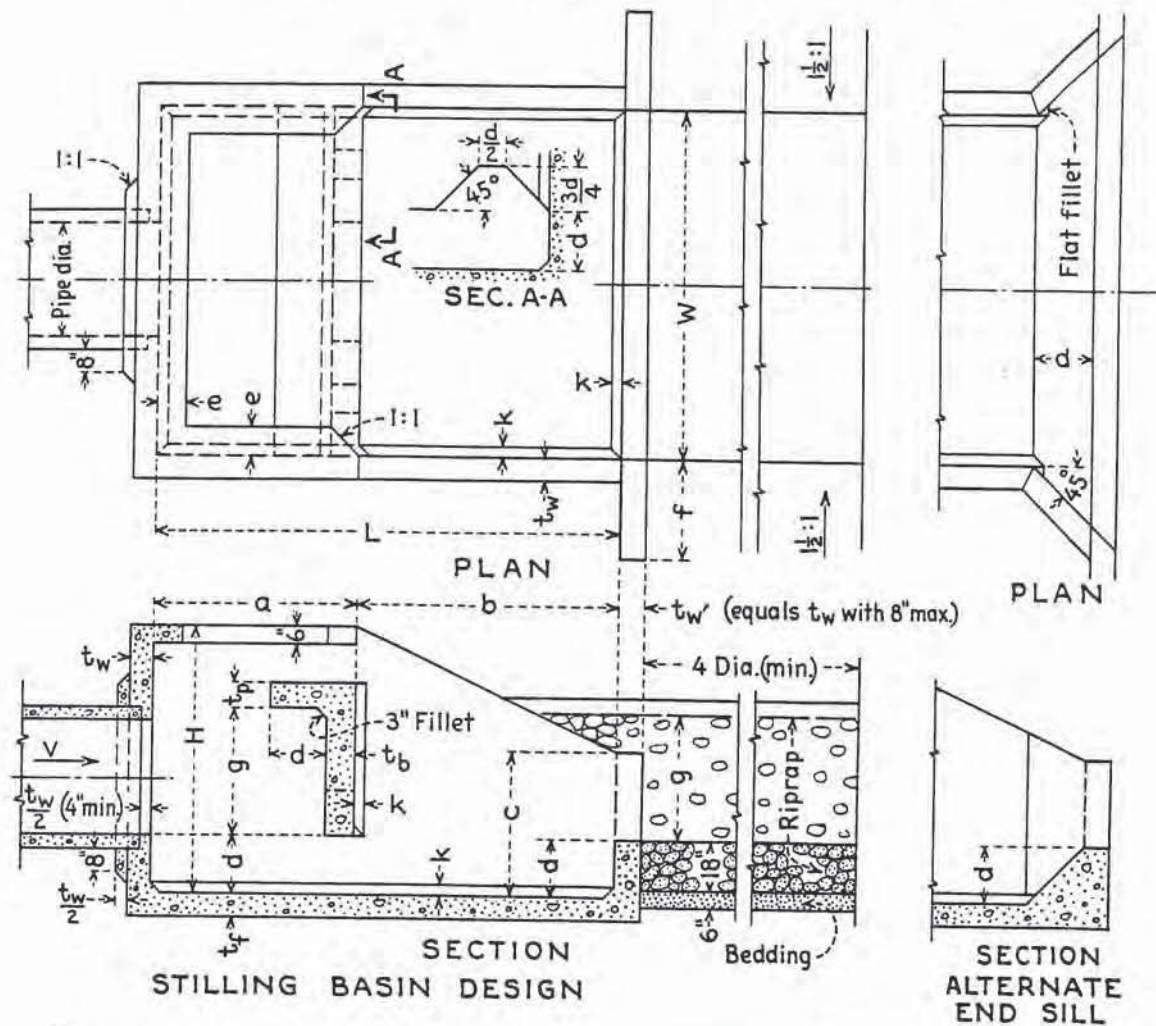


FIGURE 42.—Impact-type energy dissipator (Basin VI).



TABLE 11.—Stilling basin dimensions (Basin VI). Impact-type energy dissipator.

Suggested pipe size <sup>1</sup>			Max dis- charge Q (3)	Feet and inches									Inches					
Dia in. (1)	Area (sq ft) (2)	W (4)		II (5)	L (6)	a (7)	b (8)	c (9)	d (10)	e (11)	f (12)	g (13)	t <sub>w</sub> (14)	t <sub>r</sub> (15)	t <sub>b</sub> (16)	t <sub>p</sub> (17)	K (18)	Suggested riprap size (19) <sup>2</sup>
18	1.77	21	5-6	4-3	7-4	3-3	4-1	2-4	0-11	0-6	1-6	2-1	6	6½	6	6	3	4.0
24	3.14	38	6-9	5-3	9-0	3-11	5-1	2-10	1-2	0-6	2-0	2-6	6	6½	6	6	3	7.0
30	4.91	59	8-0	6-3	10-8	4-7	6-1	3-4	1-4	0-8	2-6	3-0	6	6½	7	7	3	8.5
36	7.07	85	9-3	7-3	12-4	5-3	7-1	3-10	1-7	0-8	3-0	3-6	7	7½	8	8	3	9.0
42	9.62	115	10-6	8-0	14-0	6-0	8-0	4-5	1-9	0-10	3-0	3-11	8	8½	9	8	4	9.5
48	12.57	151	11-9	9-0	15-8	6-9	8-11	4-11	2-0	0-10	3-0	4-5	9	9½	10	8	4	10.5
54	15.90	191	13-0	9-9	17-4	7-4	10-0	5-5	2-2	1-0	3-0	4-11	10	10½	10	8	4	12.0
60	19.63	236	14-3	10-9	19-0	8-0	11-0	5-11	2-5	1-0	3-0	5-4	11	11½	11	8	6	13.0
72	28.27	339	16-6	12-3	22-0	9-3	12-9	6-11	2-9	1-3	3-0	6-2	12	12½	12	8	6	14.0

<sup>1</sup> Suggested pipe will run full when velocity is 12 feet per second or half full when velocity is 24 feet per second. Size may be modified for other velocities by  $Q = AV$ , but relation between  $Q$  and basin dimensions shown must be maintained.

<sup>2</sup> For discharges less than 21 second-feet, obtain basin width from curve of Fig. 42. Other dimensions proportional to  $W$ ;  $H = \frac{3W}{4}$ ,  $L = \frac{4W}{3}$ ,  $d = \frac{W}{6}$ , etc.

<sup>3</sup> Determination of riprap size explained in Sec. 10.

73cfs →

## **Calculations – Temporary Culverts, Operational Conditions**



# COMPUTATION SHEET

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- SHEET

OF

PROJECT / PROPOSAL NAME	
-------------------------	--

## DPC - PLAN OF OPERATION

PREPARED

By: BJ

Date: 9/00

**CHECKED**

By: \_\_\_\_\_

Date:

PROJECT/PROPOSAL NO.
----------------------

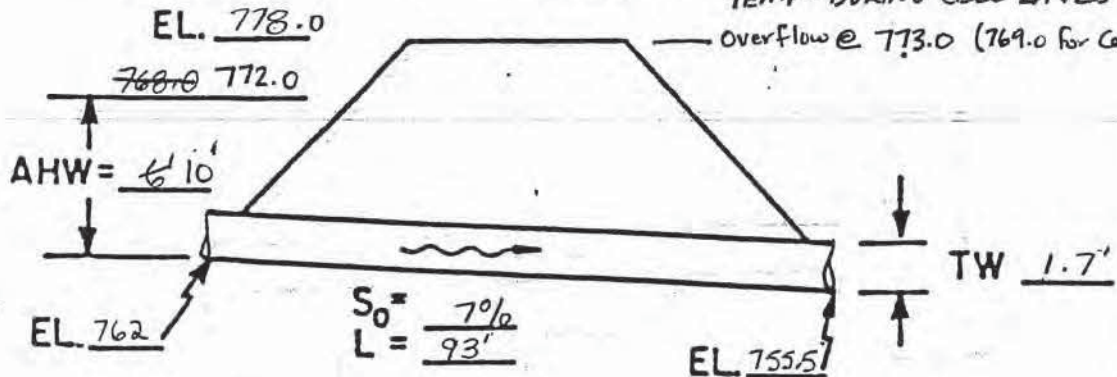
3081.40

REV  
b7c 7/03

## SKETCH

STATION: CULVERT #1  
TEMP - DURING CELL 2A & 2B

- Overflow @ 773.0 (769.0 for Cell 1)



**MAX. STREAM FLOW=** 323 cfs      355 cfs (25 yr)  
                                      561 cfs (100 yr)

Flows for Areas North + West - See Pages 92 + 96  
From PCO App K

# Culvert Calculator Report

## Culvert 1 - Operational (25-Year)

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	773.00 ft	Headwater Depth/ Height	1.94
Computed Headwater Elevation	769.75 ft	Discharge	355.00 cfs
Inlet Control HW Elev	769.18 ft	Tailwater Elevation	757.20 ft
Outlet Control HW Elev	769.75 ft	Control Type	Entrance Control
Grades			
Upstream Invert	762.00 ft	Downstream Invert	755.50 ft
Length	93.00 ft	Constructed Slope	0.069892 ft/ft
Hydraulic Profile			
Profile	S2	Depth, Downstream	2.10 ft
Slope Type	Steep	Normal Depth	1.58 ft
Flow Regime	Supercritical	Critical Depth	4.00 ft
Velocity Downstream	24.17 ft/s	Critical Slope	0.008921 ft/ft
Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	7.00 ft
Section Size	7 x 4 ft	Rise	4.00 ft
Number Sections	1		
Outlet Control Properties			
Outlet Control HW Elev	769.75 ft	Upstream Velocity Head	2.50 ft
Ke	0.50	Entrance Loss	1.25 ft
Inlet Control Properties			
Inlet Control HW Elev	769.18 ft	Flow Control	Submerged
Inlet Type	18 to 33.7 ° wingwall flare, d=0.0830	Area Full	28.0 ft²
K	0.48600	HDS 5 Chart	9
M	0.66700	HDS 5 Scale	2
C	0.02490	Equation Form	2
Y	0.83000		



# Culvert Calculator Report

## Culvert 1 - Operational (100-Year)

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	773.00 ft	Headwater Depth/ Height	3.34
Computed Headwater Elevation	775.36 ft	Discharge	561.00 cfs
Inlet Control HW Elev	775.18 ft	Tailwater Elevation	757.20 ft
Outlet Control HW Elev	775.36 ft	Control Type	Entrance Control
Grades			
Upstream Invert	762.00 ft	Downstream Invert	755.50 ft
Length	93.00 ft	Constructed Slope	0.069892 ft/ft
Hydraulic Profile			
Profile	S2	Depth, Downstream	2.93 ft
Slope Type	Steep	Normal Depth	2.18 ft
Flow Regime	Supercritical	Critical Depth	4.00 ft
Velocity Downstream	27.37 ft/s	Critical Slope	0.022277 ft/ft
Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	7.00 ft
Section Size	7 x 4 ft	Rise	4.00 ft
Number Sections	1		
Outlet Control Properties			
Outlet Control HW Elev	775.36 ft	Upstream Velocity Head	6.24 ft
Ke	0.50	Entrance Loss	3.12 ft
Inlet Control Properties			
Inlet Control HW Elev	775.18 ft	Flow Control	Submerged
Inlet Type	18 to 33.7 ° wingwall flare, d=0.0830	Area Full	28.0 ft²
K	0.48600	HDS 5 Chart	9
M	0.66700	HDS 5 Scale	2
C	0.02490	Equation Form	2
Y	0.83000		

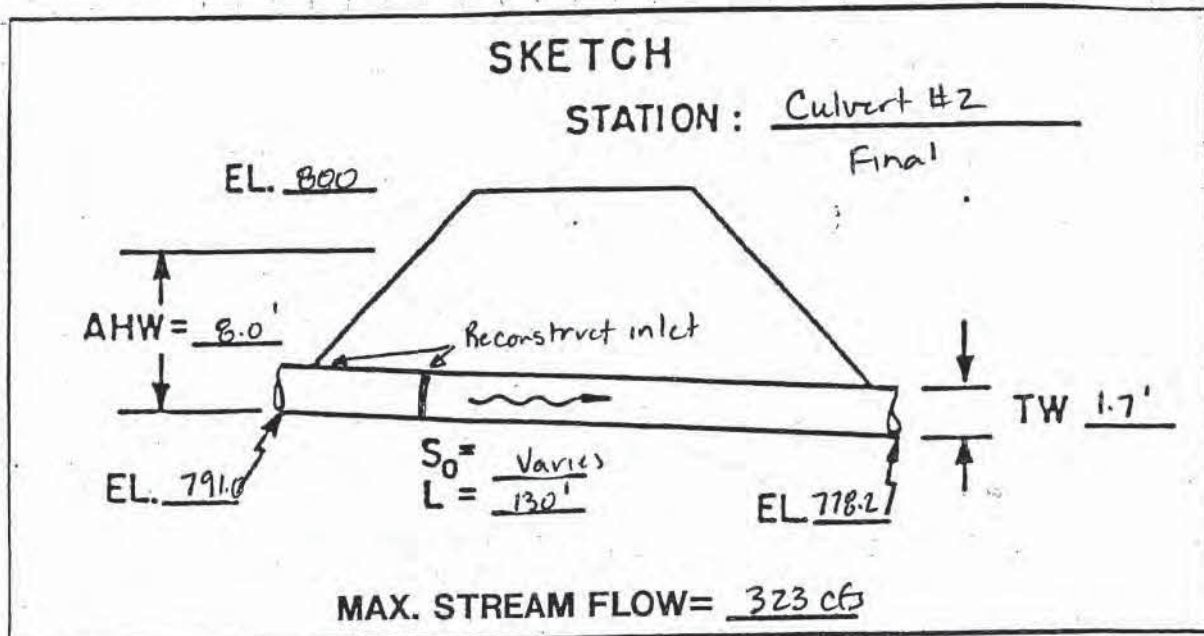
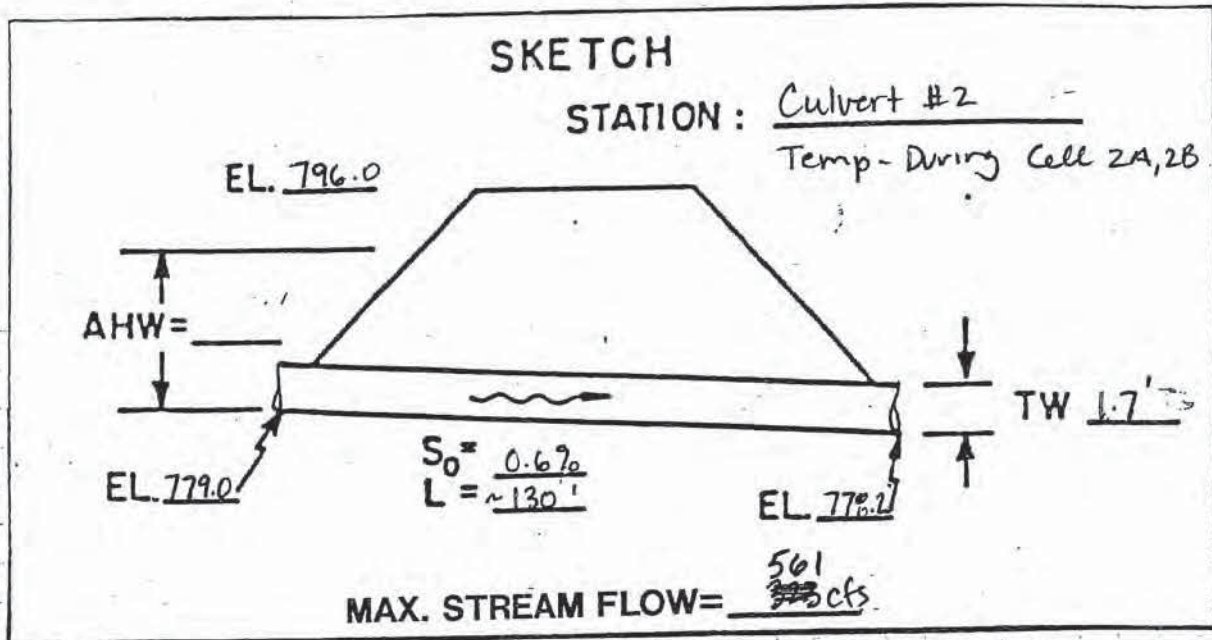


# COMPUTATION SHEET

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SHEET \_\_\_\_\_ OF \_\_\_\_\_

PROJECT / PROPOSAL NAME	PREPARED By: <u>BST</u> Date: <u>7/03</u>	CHECKED By: _____ Date: _____	PROJECT / PROPOSAL NO. <u>3081.56</u>
<u>Dairyland Power - Phase IV</u>			





# Culvert Calculator Report

## Culvert 2 - Operational

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	796.00 ft	Headwater Depth/ Height	3.86
Computed Headwater Elevation	794.45 ft	Discharge	561.00 cfs
Inlet Control HW Elev	792.30 ft	Tailwater Elevation	779.90 ft
Outlet Control HW Elev	794.45 ft	Control Type	Outlet Control
Grades			
Upstream Invert	779.00 ft	Downstream Invert	778.20 ft
Length	130.00 ft	Constructed Slope	0.006154 ft/ft
Hydraulic Profile			
Profile	Pressure	Depth, Downstream	4.00 ft
Slope Type	N/A	Normal Depth	N/A ft
Flow Regime	N/A	Critical Depth	4.00 ft
Velocity Downstream	20.04 ft/s	Critical Slope	0.022277 ft/ft
Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	7.00 ft
Section Size	7 x 4 ft	Rise	4.00 ft
Number Sections	1		
Outlet Control Properties			
Outlet Control HW Elev	794.45 ft	Upstream Velocity Head	6.24 ft
Ke	0.50	Entrance Loss	3.12 ft
Inlet Control Properties			
Inlet Control HW Elev	792.30 ft	Flow Control	Submerged
Inlet Type 18 to 33.7 ° wingwall flare, d=0.0830		Area Full	28.0 ft²
K	0.48600	HDS 5 Chart	9
M	0.66700	HDS 5 Scale	2
C	0.02490	Equation Form	2
Y	0.83000		

# Culvert Calculator Report

## Culvert 2 - Final

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	799.00 ft	Headwater Depth/ Height	1.78
Computed Headwater Elevation	798.10 ft	Discharge	323.00 cfs
Inlet Control HW Elev	797.44 ft	Tailwater Elevation	779.90 ft
Outlet Control HW Elev	798.10 ft	Control Type	Entrance Control
Grades			
Upstream Invert	791.00 ft	Downstream Invert	778.20 ft
Length	130.00 ft	Constructed Slope	0.098462 ft/ft
Hydraulic Profile			
Profile	S2	Depth, Downstream	1.60 ft
Slope Type	Steep	Normal Depth	1.32 ft
Flow Regime	Supercritical	Critical Depth	4.00 ft
Velocity Downstream	28.87 ft/s	Critical Slope	0.007385 ft/ft
Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	7.00 ft
Section Size	7 x 4 ft	Rise	4.00 ft
Number Sections	1		
Outlet Control Properties			
Outlet Control HW Elev	798.10 ft	Upstream Velocity Head	2.07 ft
Ke	0.50	Entrance Loss	1.03 ft
Inlet Control Properties			
Inlet Control HW Elev	797.44 ft	Flow Control	Submerged
Inlet Type	18 to 33.7 ° wingwall flare, d=0.0830	Area Full	28.0 ft <sup>2</sup>
K	0.48600	HDS 5 Chart	9
M	0.66700	HDS 5 Scale	2
C	0.02490	Equation Form	2
Y	0.83000		





# COMPUTATION SHEET

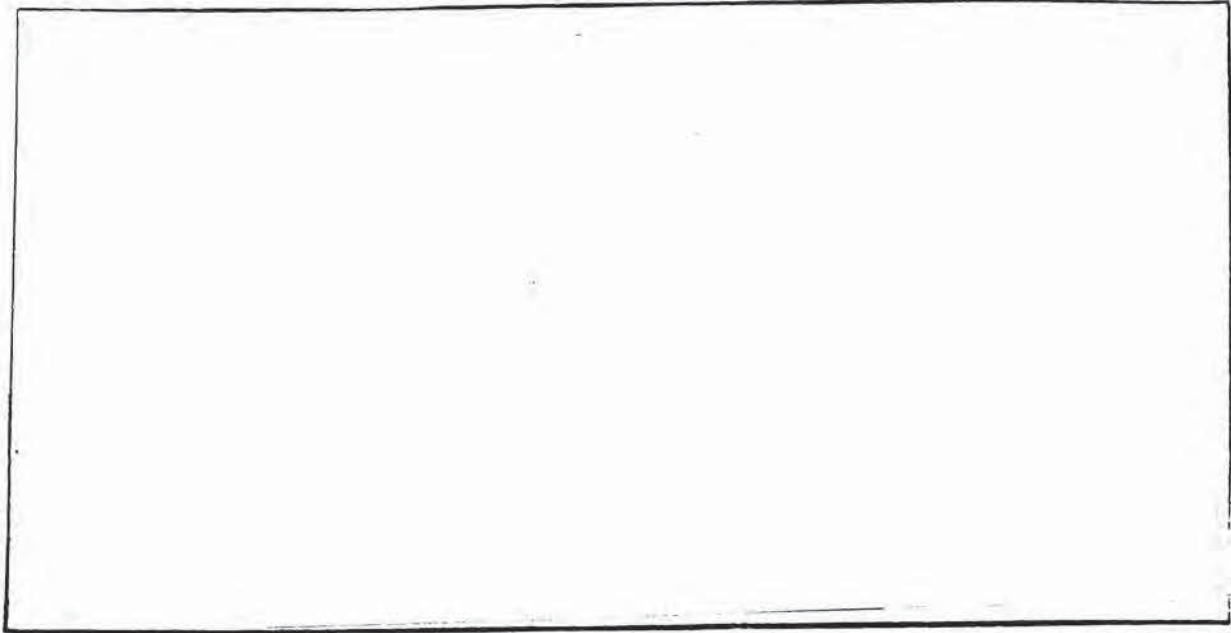
744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

SHEET

OF

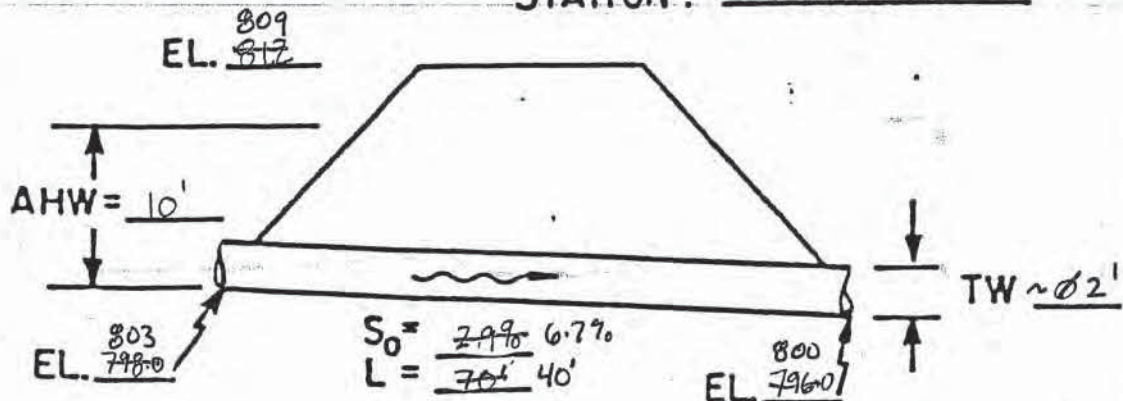
PROJECT / PROPOSAL NAME	PREPARED	CHECKED	PROJECT / PROPOSAL NO.
DPC-PLAN OF OPERATION	By: JAA Date: 9/29/00	By: Date:	30E/14C

REV BSK 8/03



## SKETCH

STATION: CULVERT D



MAX. STREAM FLOW = 583 cfs 228 cfs (25-YR) 360 cfs (100-YR)

# Culvert Calculator Report

## Culvert D - 25 Year

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	809.00 ft	Headwater Depth/ Height	1.40
Computed Headwater Elevation	808.61 ft	Discharge	228.00 cfs
Inlet Control HW Elev	807.84 ft	Tailwater Elevation	802.00 ft
Outlet Control HW Elev	808.61 ft	Control Type	Entrance Control

Grades			
Upstream Invert	803.00 ft	Downstream Invert	800.00 ft
Length	45.00 ft	Constructed Slope	0.066667 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	1.74 ft
Slope Type	Steep	Normal Depth	1.19 ft
Flow Regime	Supercritical	Critical Depth	3.21 ft
Velocity Downstream	18.70 ft/s	Critical Slope	0.003975 ft/ft

Section			
Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	7.00 ft
Section Size	7 x 4 ft	Rise	4.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev	808.61 ft	Upstream Velocity Head	1.60 ft
Ke	0.50	Entrance Loss	0.80 ft

Inlet Control Properties			
Inlet Control HW Elev	807.84 ft	Flow Control	Submerged
Inlet Type	18 to 33.7 ° wingwall flare, d=0.0830	Area Full	28.0 ft²
K	0.48600	HDS 5 Chart	9
M	0.66700	HDS 5 Scale	2
C	0.02490	Equation Form	2
Y	0.83000		



# Culvert Calculator Report

## Culvert D - 100 Year

Solve For: Headwater Elevation

### Culvert Summary

Allowable HW Elevation	809.00 ft	Headwater Depth/ Height	1.96
Computed Headwater Elevation	810.85 ft	Discharge	360.00 cfs
Inlet Control HW Elev	810.30 ft	Tailwater Elevation	802.00 ft
Outlet Control HW Elev	810.85 ft	Control Type	Entrance Control

### Grades

Upstream Invert	803.00 ft	Downstream Invert	800.00 ft
Length	45.00 ft	Constructed Slope	0.066667 ft/ft

### Hydraulic Profile

Profile	S2	Depth, Downstream	2.52 ft
Slope Type	Steep	Normal Depth	1.63 ft
Flow Regime	Supercritical	Critical Depth	4.00 ft
Velocity Downstream	20.38 ft/s	Critical Slope	0.009174 ft/ft

### Section

Section Shape	Box	Mannings Coefficient	0.013
Section Material	Concrete	Span	7.00 ft
Section Size	7 x 4 ft	Rise	4.00 ft
Number Sections	1		

### Outlet Control Properties

Outlet Control HW Elev	810.85 ft	Upstream Velocity Head	2.57 ft
Ke	0.50	Entrance Loss	1.28 ft

### Inlet Control Properties

Inlet Control HW Elev	810.30 ft	Flow Control	Submerged
Inlet Type	18 to 33.7 ° wingwall flare, d=0.0830	Area Full	28.0 ft²
K	0.48600	HDS 5 Chart	9
M	0.66700	HDS 5 Scale	2
C	0.02490	Equation Form	2
Y	0.83000		

# Culvert Calculator Report Flume MH

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	8.00 ft	Headwater Depth/ Height	1.98
Computed Headwater Elevation	825.18 ft	Discharge	73.00 cfs
Inlet Control HW Elev	825.18 ft	Tailwater Elevation	780.67 ft
Outlet Control HW Elev	824.72 ft	Control Type	Inlet Control
Grades			
Upstream Invert	819.25 ft	Downstream Invert	779.00 ft
Length	185.00 ft	Constructed Slope	0.217568 ft/ft
Hydraulic Profile			
Profile	S2	Depth, Downstream	0.91 ft
Slope Type	Steep	Normal Depth	0.86 ft
Flow Regime	Supercritical	Critical Depth	2.70 ft
Velocity Downstream	40.57 ft/s	Critical Slope	0.006248 ft/ft
Section			
Section Shape	Circular	Mannings Coefficient	0.010
Section Material	PVC	Span	3.00 ft
Section Size	36 inch	Rise	3.00 ft
Number Sections	1		
Outlet Control Properties			
Outlet Control HW Elev	824.72 ft	Upstream Velocity Head	1.85 ft
Ke	0.50	Entrance Loss	0.92 ft
Inlet Control Properties			
Inlet Control HW Elev	825.18 ft	Flow Control	Submerged
Inlet Type	Square edge w/headwall	Area Full	7.1 ft²
K	0.00980	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	1
C	0.03980	Equation Form	1
Y	0.67000		

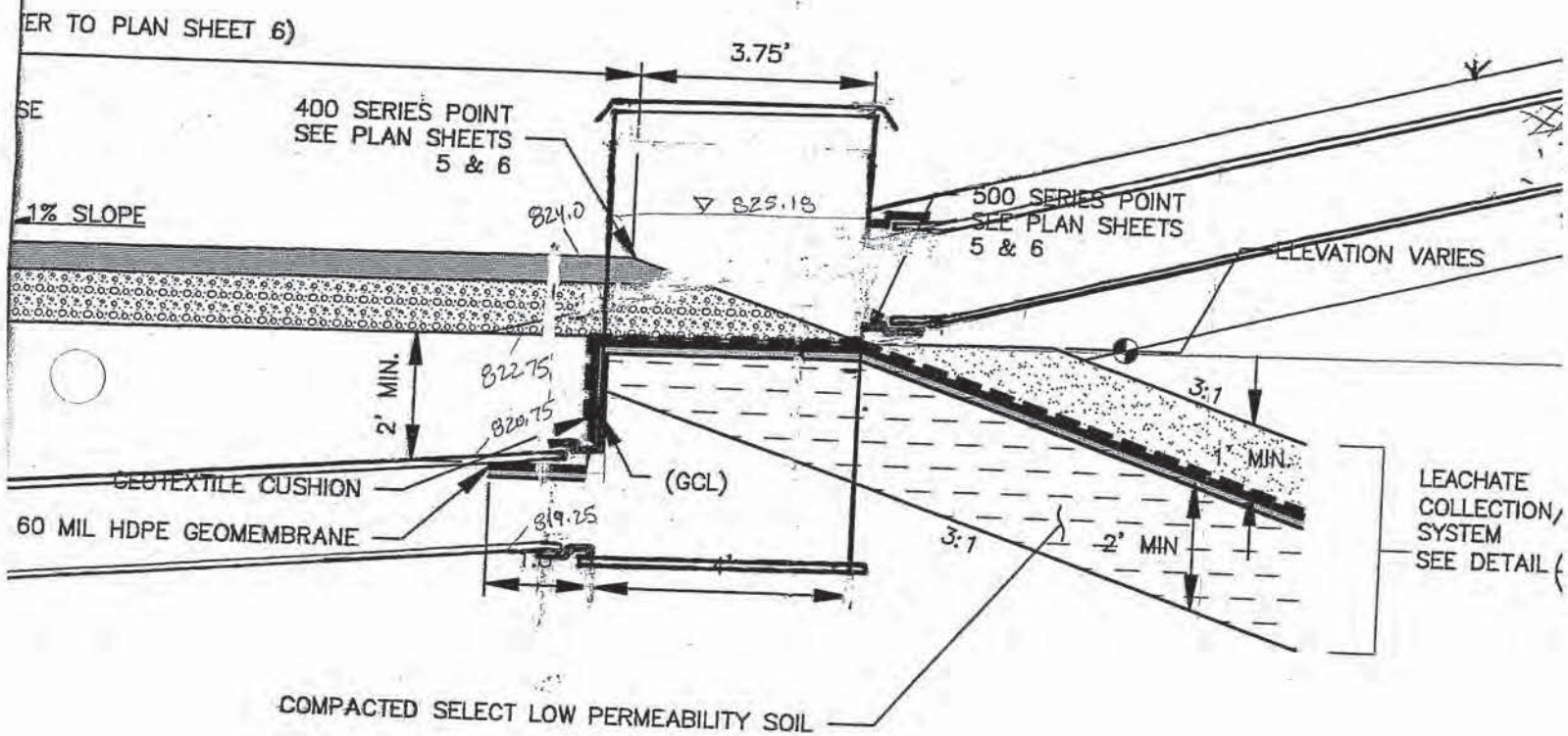


add flange  
lid add \$500

1 WEEK SUPPLY  
LARRY WOOD  
262-255-3030  
5/27/03

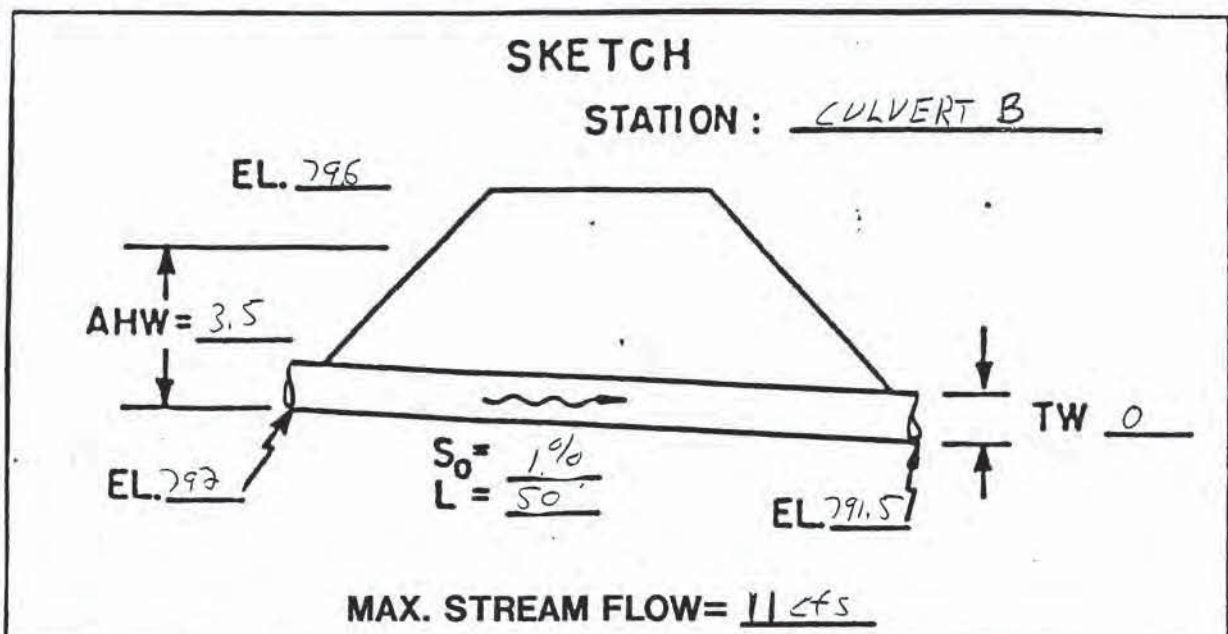
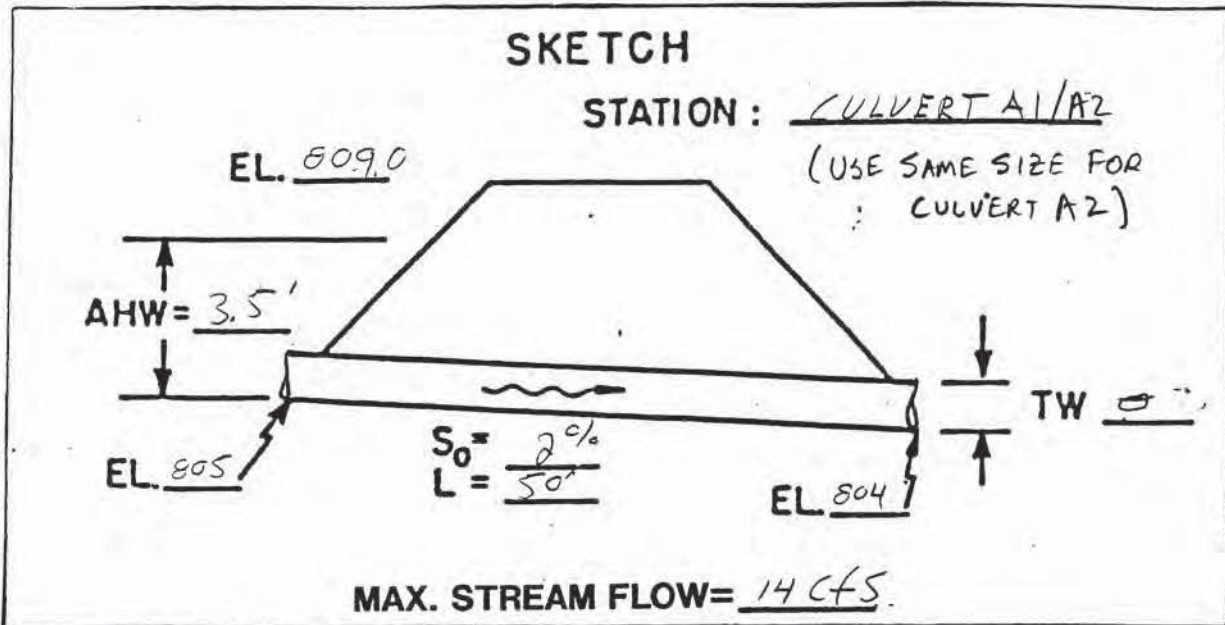
\$65 1/2 x 7 VF BARREL  
PLATE 1"

2200 - 2500 (incl. \$500 for lid)



744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334 SHEET \_\_\_\_\_ OF \_\_\_\_\_

PROJECT/PROPOSAL NAME	PREPARED	CHECKED	PROJECT/PROPOSAL NO.
DPC-PLAN OF OPERATION	By: SAA Date: 7/31/00	By: BJK Date: 7/31/00	3CE1.40



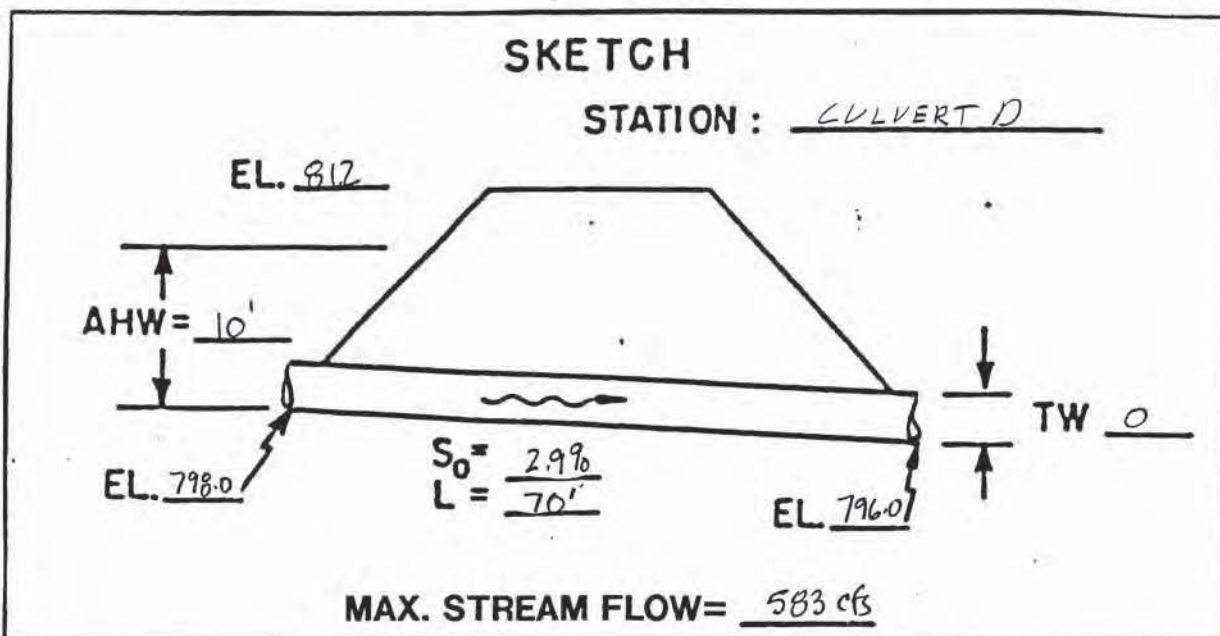
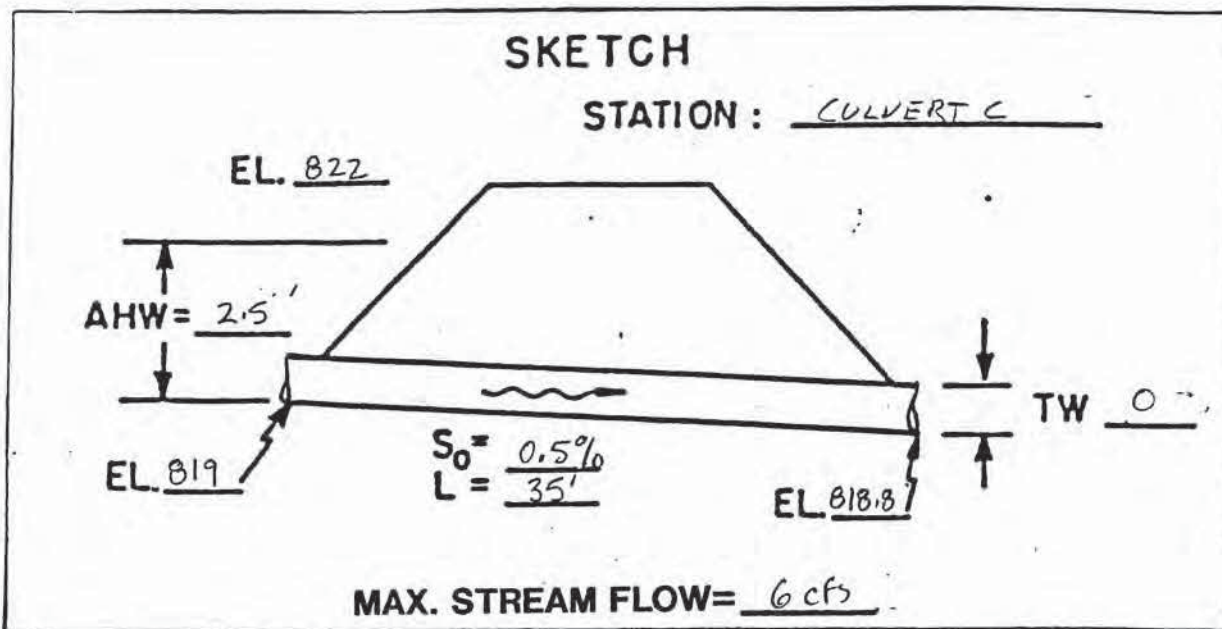


744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334

SHEET

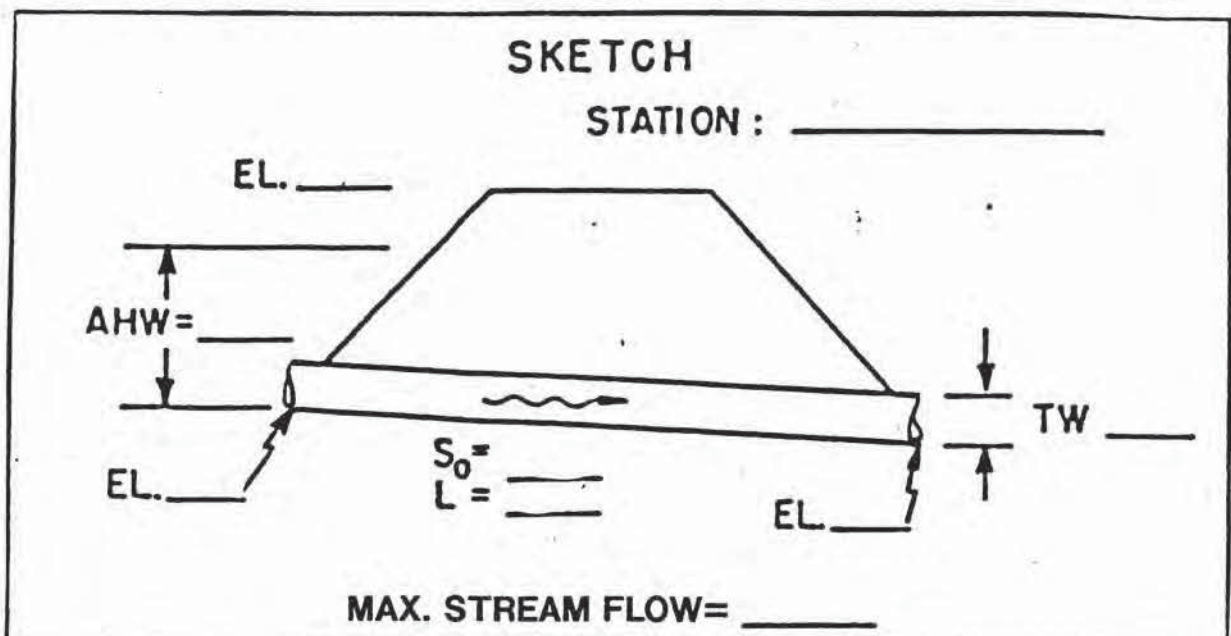
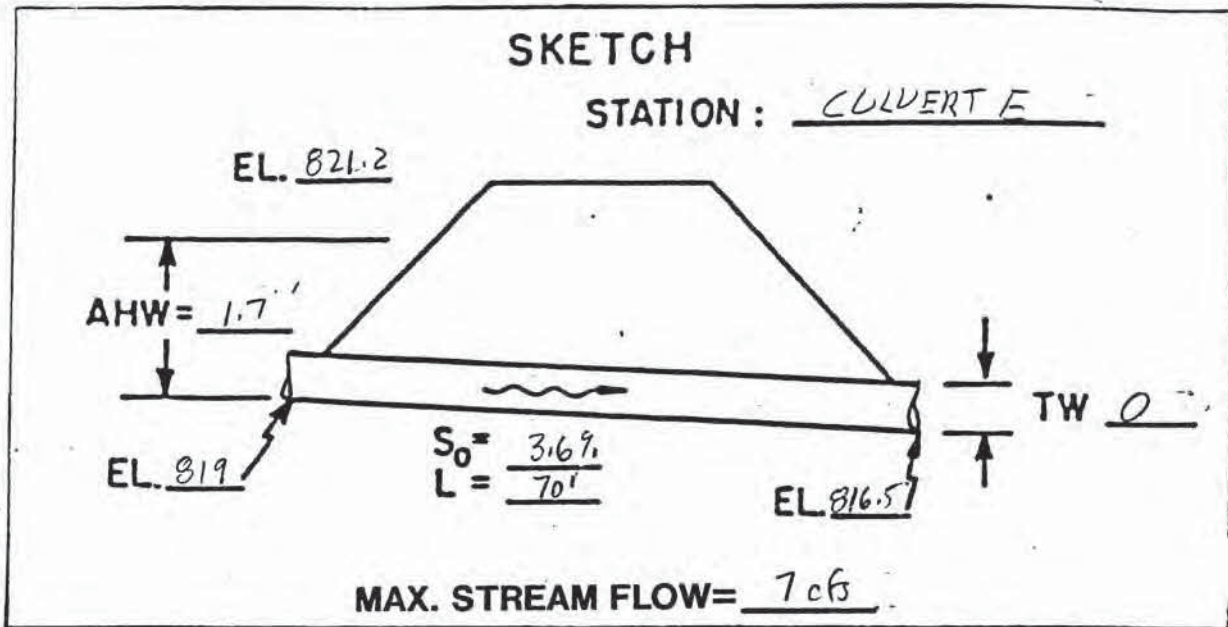
OF

PROJECT/PROPOSAL NAME	PREPARED	CHECKED	PROJECT/PROPOSAL NO.
DPC-PLAN OF OPERATION	By: JAA Date: 9/29/00	By: Date:	30E14C



744 Heartland Trail P.O. Box 8923 Madison, WI 53708-8923 (608) 831-4444 FAX: (608) 831-3334 SHEET \_\_\_\_\_ OF \_\_\_\_\_

PROJECT/PROPOSAL NAME <u>DPL-PLAN OF OPERATION</u>	PREPARED		CHECKED		PROJECT/PROPOSAL NO. <u>308140</u>
	By: <u>RAA</u>	Date: <u>7/29/00</u>	By: _____	Date: _____	





PROJECT: <u>DPL P00</u>		DESIGNER: <u>BAA</u>														
		DATE: <u>7/29/00</u>														
HYDROLOGIC AND CHANNEL INFORMATION		STATION: <u>SEE SKETCHES</u>														
$Q_1 = \underline{SEE SKETCHES}$ $TW_1 = \underline{\hspace{2cm}}$ $Q_2 = \underline{\hspace{2cm}}$ $TW_2 = \underline{\hspace{2cm}}$ ( $Q_1$ = DESIGN DISCHARGE, SAY $Q_{25}$ $Q_2$ = CHECK DISCHARGE, SAY $Q_{50}$ OR $Q_{100}$ )		SKETCH 														
HEADWATER COMPUTATION																
CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	INLET CONT.		OUTLET CONTROL					HW	CONTROLLING	OUTLET VELOCITY	COST	COMMENTS		
			HW/D	HW	K <sub>e</sub>	H	d <sub>c</sub>	$\frac{d_c + D}{2}$	TW						h <sub>0</sub>	LS <sub>0</sub>
CULVERT A CMP-PROTECTIVE	14	24"	1.15	2.3	0.9	1.3	1.4	1.7								
CULVERT A CONCRETE	14	18"	2	3	0.2	2.1	1.4	1.45								OK
CULVERT B CMP	11	24"	1.0	2.0	0.9	0.8	1.2	1.6	0							RECOMMENDED
CULVERT C	6	24"	.65	1.3	0.9	0.4	0.8	1.4	0							OK
SUMMARY & RECOMMENDATIONS:																

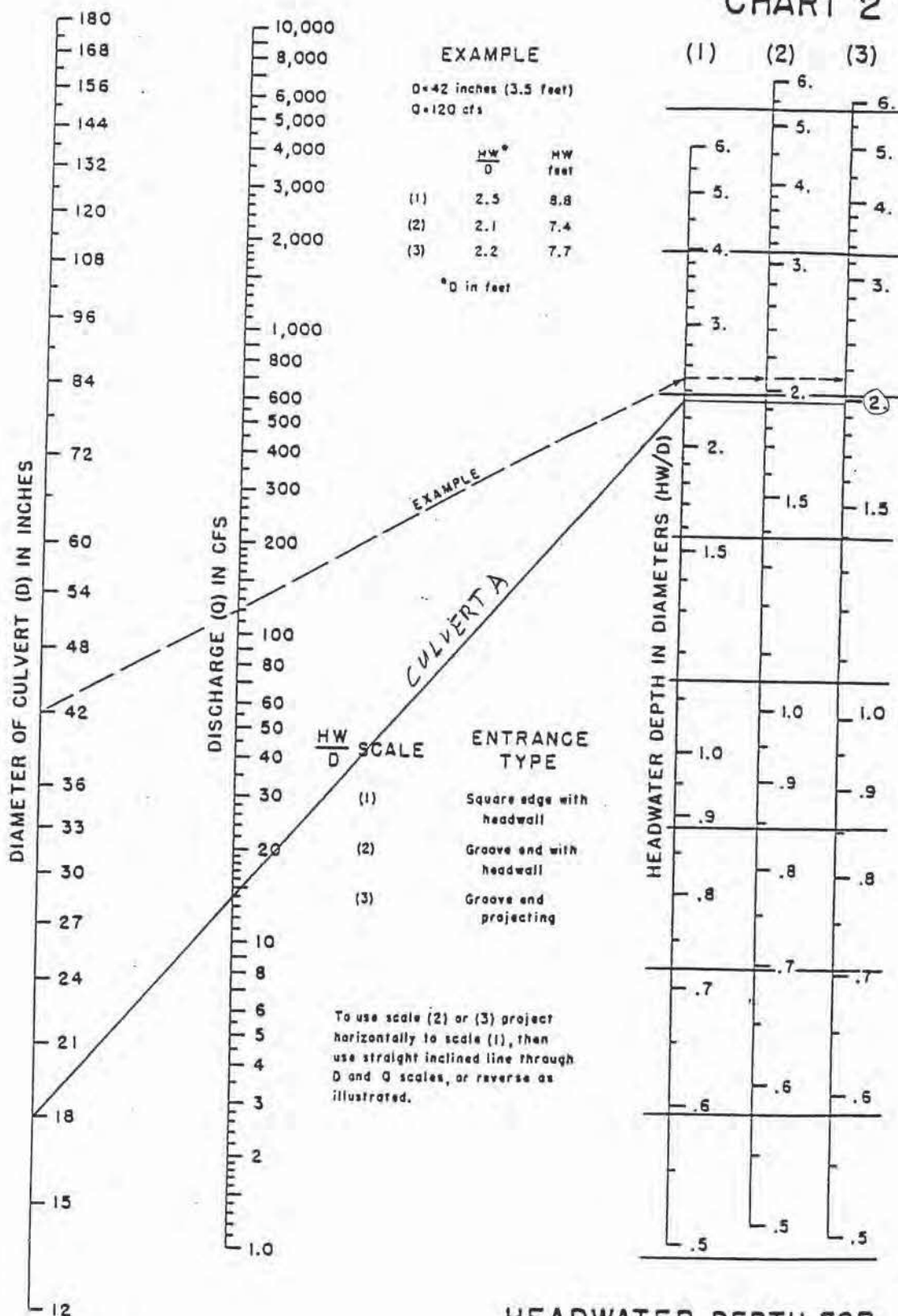
Figure 7

PROJECT: <u>DPL P00</u>		DESIGNER: <u>BAA</u> DATE: <u>9/29/00</u>		SKETCH STATION: <u>SEE SKETCHES</u>														
HYDROLOGIC AND CHANNEL INFORMATION  $Q_1 = \text{SEE SKETCHES}$ $Q_2 = \text{SEE SKETCHES}$ $TW_1 = \text{SEE SKETCHES}$ $TW_2 = \text{SEE SKETCHES}$ $(Q_1 = \text{DESIGN DISCHARGE, SAY } Q_{25}$ $Q_2 = \text{CHECK DISCHARGE, SAY } Q_{50} \text{ OR } Q_{100})$																		
		HEADWATER COMPUTATION																
CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	INLET CONT.		OUTLET CONTROL					TW	h <sub>0</sub>	LS <sub>0</sub>	HW	CONTROLLING HW	OUTLET VELOCITY	COST	COMMENTS	
			$\frac{HW}{D}$	HW	K <sub>e</sub>	H	d <sub>c</sub>	$\frac{d_c + D}{2}$	HW = H + h <sub>0</sub> - LS <sub>0</sub>									
CULVERT D 7'x4' BOX	583	24"	0.7	1.4	0.9	0.4	0.8	1.4	0	1.4	2.5	-	1.4					
SUMMARY & RECOMMENDATIONS:																		

Figure 7

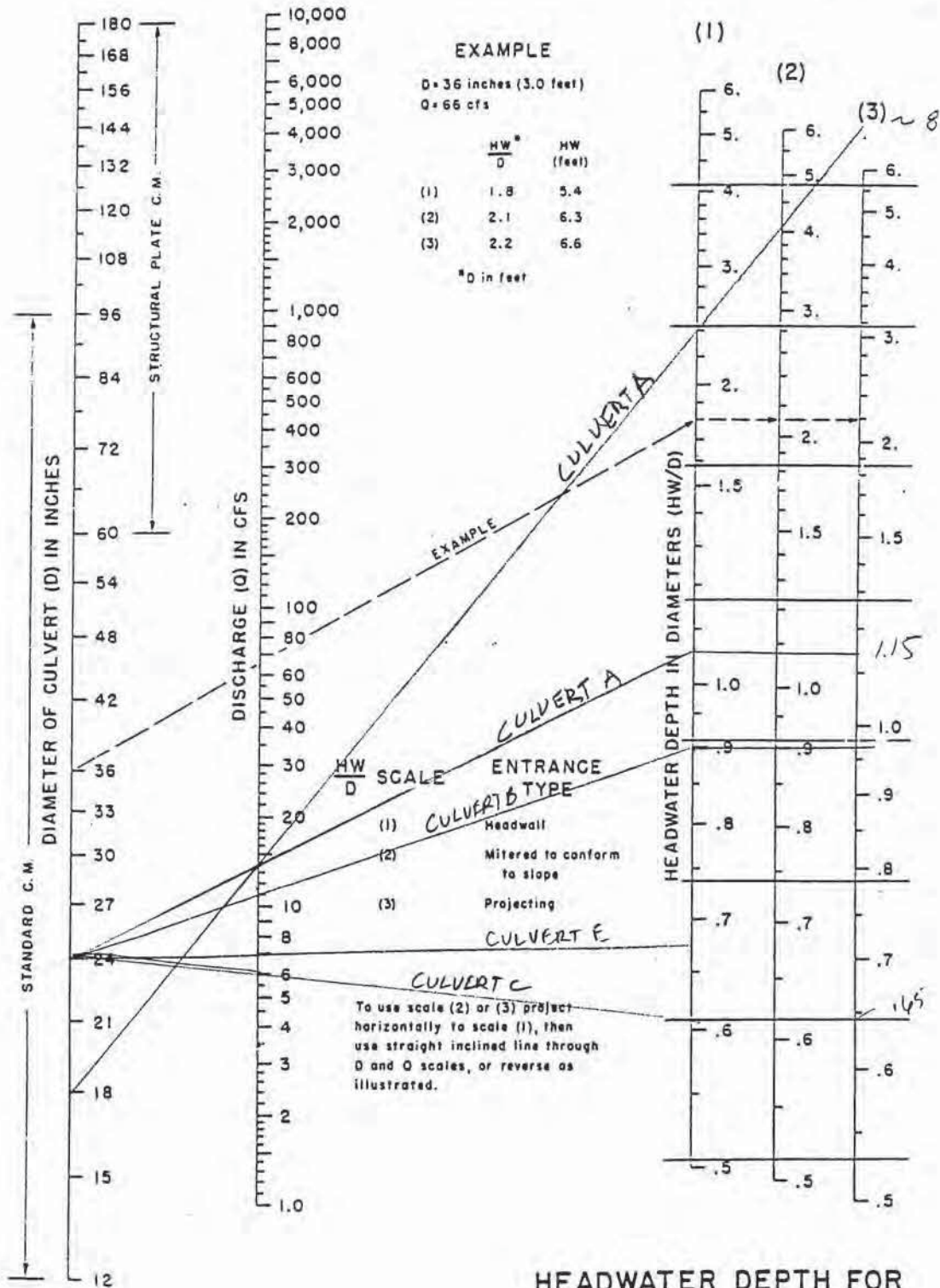


# CHART 2'



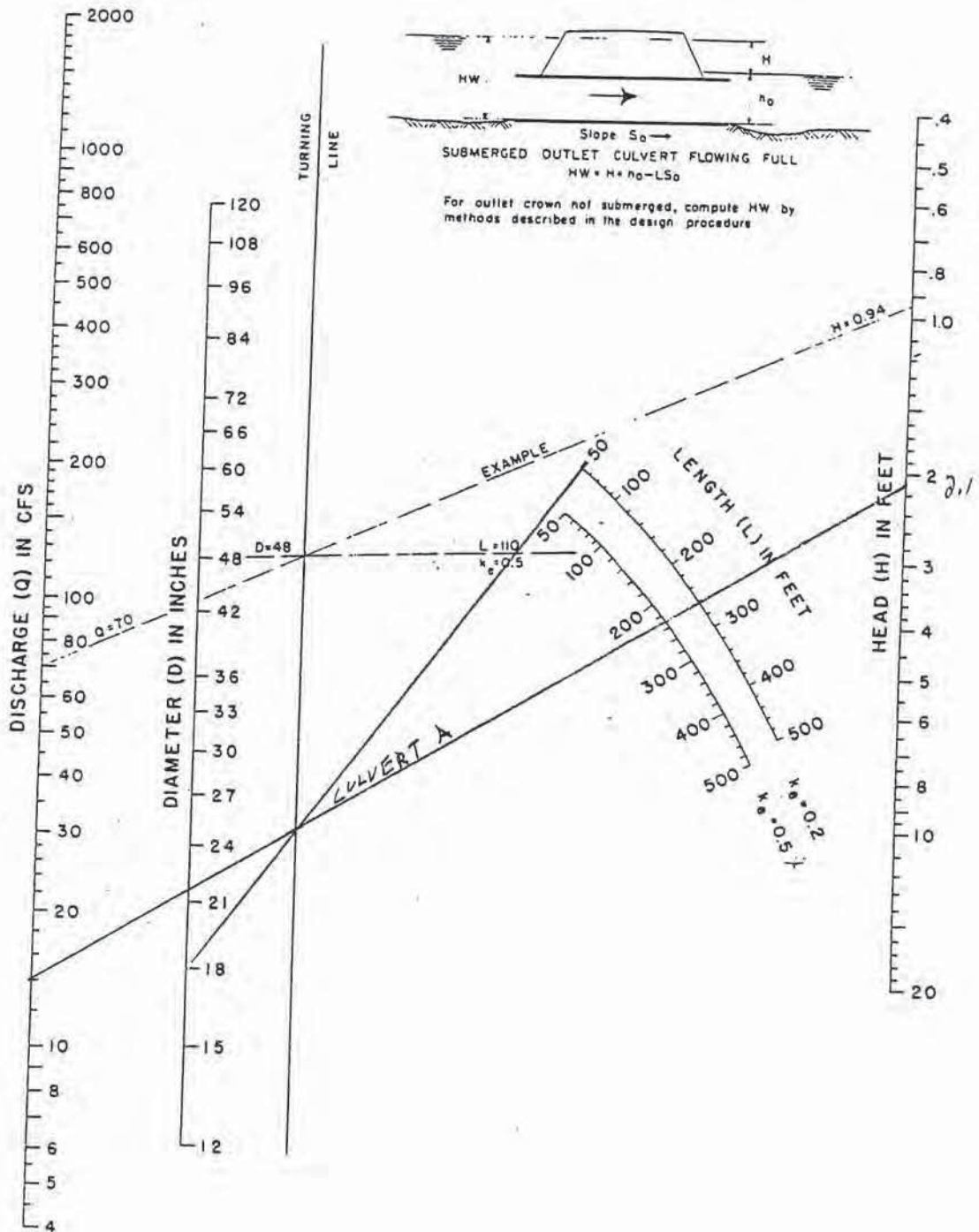
HEADWATER DEPTH FOR  
CONCRETE PIPE CULVERTS  
WITH INLET CONTROL

# CHART 5



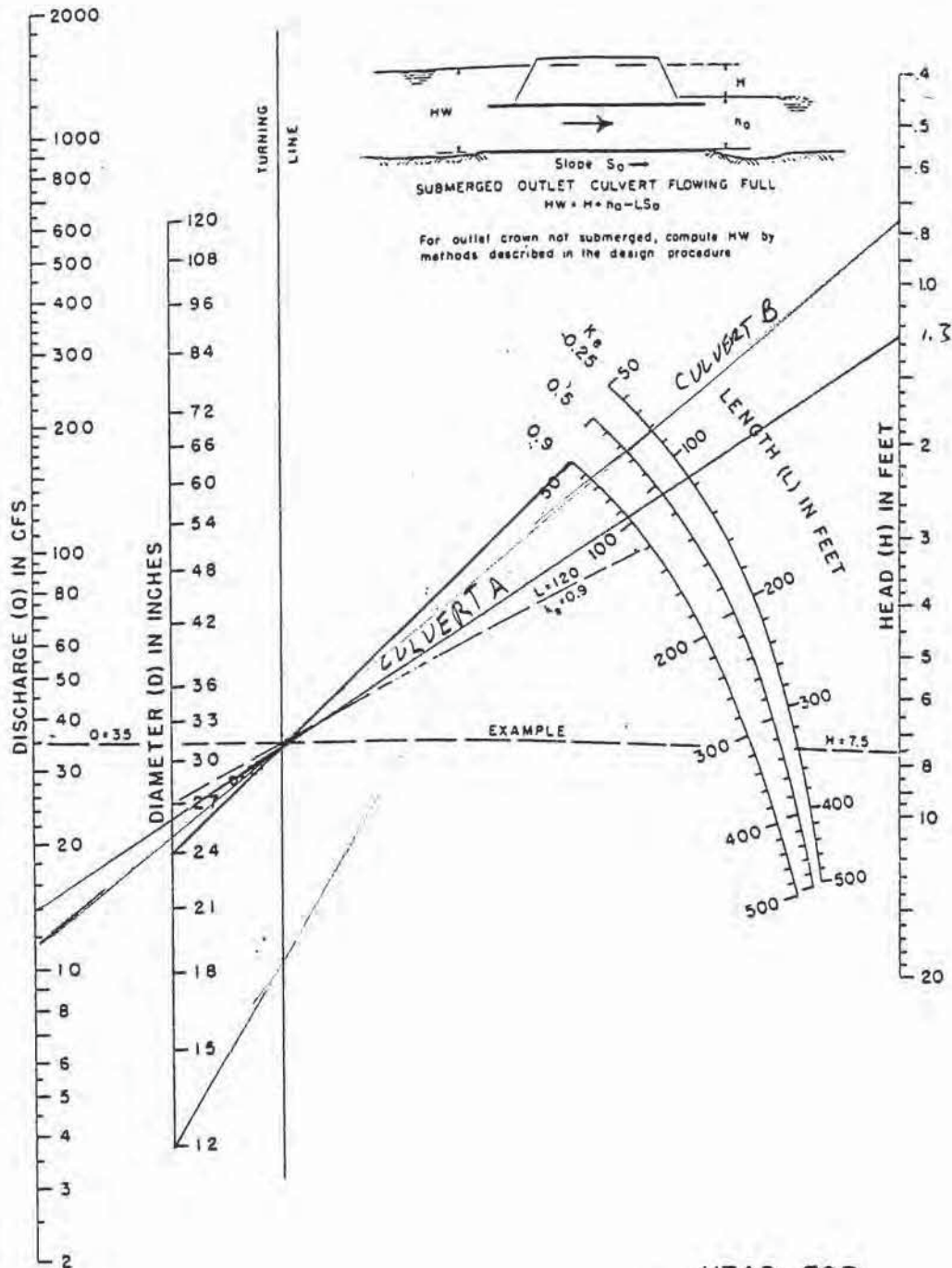


# CHART 9



HEAD FOR  
 CONCRETE PIPE CULVERTS  
 FLOWING FULL  
 $n = 0.012$

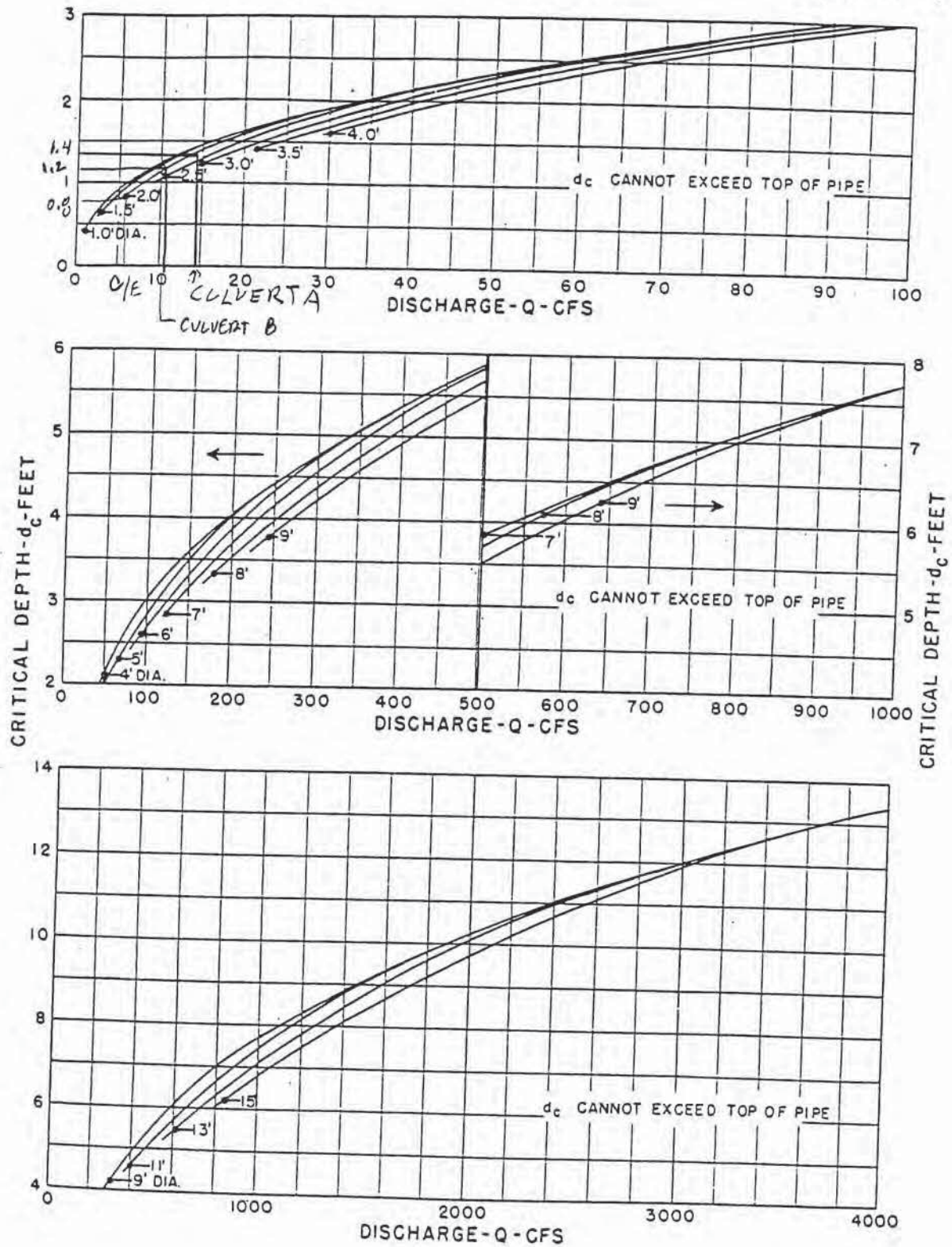
# CHART 11



HEAD FOR  
STANDARD  
C. M. PIPE CULVERTS  
FLOWING FULL  
 $n = 0.024$



# CHART 1'6



## CRITICAL DEPTH CIRCULAR PIPE

TABLE 1 - ENTRANCE LOSS COEFFICIENTS

Outlet Control, Full or Partly Full

$$\text{Entrance head loss } H_e = k_e \frac{v^2}{2g}$$

<u>Type of Structure and Design of Entrance</u>	<u>Coefficient <math>k_e</math></u>
<u>Pipe, Concrete</u>	
Projecting from fill, socket end (groove-end) . . . . .	0.2
Projecting from fill, sq. cut end . . . . .	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove-end) . . . . .	0.2
Square-edge . . . . .	0.5
Rounded (radius = $1/12D$ ) . . . . .	0.2
Mitered to conform to fill slope . . . . .	0.7
*End-Section conforming to fill slope . . . . .	0.5
Beveled edges, $33.7^\circ$ or $45^\circ$ bevels . . . . .	0.2
Side-or slope-tapered inlet . . . . .	0.2
<u>Pipe, or Pipe-Arch, Corrugated Metal</u>	
Projecting from fill (no headwall) . . . . .	0.9
Headwall or headwall and wingwalls square-edge . . . . .	0.5
Mitered to conform to fill slope, paved or unpaved . . . . .	0.7
*End-Section conforming to fill slope . . . . .	0.5
Beveled edges, $33.7^\circ$ or $45^\circ$ bevels . . . . .	0.2
Side-or slope-tapered inlet . . . . .	0.2
<u>Box, Reinforced Concrete</u>	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges . . . . .	0.5
Rounded on 3 edges to radius of $1/12$ barrel dimension, or beveled edges on 3 sides . . . . .	0.2
Wingwalls at $30^\circ$ to $75^\circ$ to barrel	
Square-edged at crown . . . . .	0.4
Crown edge rounded to radius of $1/12$ barrel dimension, or beveled top edge . . . . .	0.2
Wingwall at $10^\circ$ to $25^\circ$ to barrel	
Square-edged at crown . . . . .	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown . . . . .	0.7
Side-or slope-tapered inlet . . . . .	0.2

\*Note: "End Section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both inlet and outlet control. Some end sections, incorporating a closed taper in their design have a superior hydraulic performance. These latter sections can be designed using the information given for the beveled inlet, p. 5-13.



## **Vegetation Information**

✓ BJB  
10/6/98

\*\*\*\*\*  
NORTH AMERICAN GREEN - ECMS VER.IV - SLOPE PROTECTION - ENGLISH  
USER SPECIFIED - PERMANENT PROTECTION RESULTS  
\*\*\*\*\*

PROJECT NAME: Dairyland Power Coop. PROJECT NO.: 3081.33  
COMPUTED BY: BJK DATE: 10-06-1998  
SLOPE DESCRIPTION: 2:1 Slopes

Slope Gradient: 2.00:1 ✓ Slope Length: 50 feet ✓  
Soil Type: Clay Loam (K= 0.21) ✓ Annual R Factor: 125.0 ✓

Slope Reach feet	Material	Type	Density	LS	C					
0 - 30	Est. Veg.	Mix	75-95%	4.10	.020					
30 - 50	P300	Mix	75-95%	7.35	.002					
Slope Reach feet	Material	Type	Density	ASLbare	ASLmat	SLT	Sf	Recommend		
				inch	inch	inch				
0 - 30	Est. Veg.	Mix	75-95%	0.641	0.013	0.03	2.3	STABLE		
30 - 50	P300	Mix	75-95%	1.149	0.002	0.03	13.1	STABLE		
=====										
0 - 50	Composite			0.844	0.009					

Vegetation Density=Percentage of soil coverage provided by vegetation  
C=Cover material performance factor (Fraction of soil loss of unprotected)  
ASLbare=Average Soil Loss potential of unprotected soil (uniform inches)  
ASLmat=Average Soil Loss potential w/material (uniform inches)  
SLT=Soil Loss Tolerance for slope segment (uniform inches)  
Sf=Safety Factor  
Composite=Average soil loss from total slope length (uniform inches)

← For Slope's 0'-30' use Mix No. 20 Vegetation  
← For slopes >30', use permanent erosion matting on bottom Portion of Slope (below 30') And No. 20 Vegetation on upper portion  
  
- See Attached For Vegetation Types



Species Common Name	Species Botanical Name	Acceptable Varieties
Kentucky Bluegrass .....	Poa pratensis	
Red Fescue .....	Festuca rubra .....	Creeping
Hard Fescue .....	Festuca ovina .....	Improved
	var. duriuscula	
Tall Fescue .....	Festuca arundinacea .....	Improved turf type
Salt Grass .....	Puccinella distans .....	Fult's
Redtop .....	Agrostis alba	
Timothy .....	Phleum pratense	
Little Bluestem* .....	Andropogon scoparius	
Sideoats Grama* .....	Bouteloua curtipendula	
Canada Wild Rye* .....	Elymus canadensis	
Perennial Ryegrass .....	Lolium perenne	
Perennial Ryegrass .....	Lolium perenne .....	Improved Fine
Annual Ryegrass .....	Lolium multiflorum	
Alsike Clover .....	Trifolium hybridum	
Red Clover .....	Trifolium pratense	
White Clover .....	Trifolium repens	
Birdsfoot Trefoil .....	Lotus corniculatus .....	Empire
Japanese Millet .....	Echinochola crusgalli	
	var. frumentacea	
Annual Oats .....	Avena sativa	
Alfalfa .....	Medicago sativa	
Bromegrass .....	Bromus inermis	
Orchardgrass .....	Dactylis glomerata	
Ladino Clover .....	Trifolium repens .....	Ladino
	var. latum	
Agricultural Rye .....	Secale cereale	
Winter Wheat .....	Triticum aestivum	

\*Pure Live Seed

Species	Purity Min. %	Germination min. %	Mixture Proportions, Percent						
			No. 10	No. 20	No. 30	No. 40	No. 50	No. 60	No. 70
Kentucky Bluegrass	85	80	40	6	10	35			
Red Fescue	97	85	25		30	20			
Hard Fescue	97	85		24	25	20			10
Tall Fescue	98	85		40					25
Salt Grass	98	85			10				
Redtop	92	85	5						
Timothy	98	90						12	
Little Bluestem		PLS*							15
Sideoats Grama		PLS*							15
Canada Wild Rye		PLS*						12	5
Perennial Ryegrass	97	90	20	30					30
Improved Fine Perennial Ryegrass	96	85			15	25			
Annual Ryegrass	97	90						35	
Alsike Clover	97	90						4	
Red Clover	98	90						4	
White Clover	95	90	10						
Birdsfoot Trefoil	95	80			10		100		
Japanese Millet	97	85						8	
Annual Oats*	98	90						25	

\* Substitute winter wheat for annual oats in fall plantings started after September 1.

**630.2.1.5.1.1.2 Mixture to be Used.** The selection of the seed mixture or mixtures for use on the project shall meet with the approval of the engineer, and unless otherwise provided in the contract, shall be in accordance with the following:

➤ Seed Mixture No. 10 is intended for use on projects where average loam, heavy clay or moist soils predominate.

➤ Seed Mixture No. 20 is intended for use on projects where light, dry, well-drained, sandy or gravelly soils predominate and shall be used for all high cut and fill slopes (generally exceeding 1.8 to 2.4 m), except where No. 70 is used.

STATE OF WISCONSIN  
DEPARTMENT OF TRANSPORTATION

# STANDARD SPECIFICATIONS

FOR

HIGHWAY  
AND  
STRUCTURE  
CONSTRUCTION



1996 EDITION

**RMT**  
LIBRARY

86-00019-22  
SEP 02 1997



\*\*\*\*\*  
 \*\*\*\*\* VEGETATION SELECTION \*\*\*\*\*  
 \*\*\*\*\* North American Green \*\*\*\*\*  
 \*\*\*\*\*

Region Number: 1

Predominant Soil Type: Clay - Clay Loam

Moisture Regime Conditions: Normal Moisture

Planned Maintenance: Medium - High Maintenance

Growth      Seed Rate  
 Longevity   Habit   lb/ac   kg/ha

Grasses

Tall Fescue (Festuca arundinacea)	P	B	200	224	(No. 20)
Chewings Fescue (Festuca rubra, commutata)	P	B	120	134	(No. 20)
Kentucky Bluegrass (Poa pratensis)	P	S	80	90	(No. 10, No. 20)
Perennial Ryegrass (Lolium perenne)	P	B	160	179	(No. 10, No. 20)
Annual Ryegrass (Lolium multiflorum)	A	B	160	179	
Orchardgrass (Dactylis glomerata)	P	B	40	45	
Timothy (Phleum pratense)	P	B	80	90	
Creeping Red Fescue (Festuca rubra)	P	S	120	134	

Legumes

Alsike Clover (Trifolium hybridum)	P		15	17	
White Dutch Clover (Trifolium repens)	P		5	6	
White Sweet Clover (Melilotus alba)	P		15	17	

## **Appendix B: Surface Water Run-Off Control System Calculations**

- Leachate Storage Capacity for the 25-Year 24-Hour Storm Event
- References



## **Leachate Storage Capacity for the 25-Year 24-Hour Storm Event**



PROJECT / LOCATION: DPC: Alma Offsite Disposal Facility, Phase IV Landfill		PROJECT / PROPOSAL NO.
SUBJECT: Active Area Leachate Disposal Capacity		421717.0000
PREPARED BY: B. Kahnk	DATE: 4/27/2021	FINAL X
CHECKED BY: J. Hotstream	DATE: 4/29/2021	REVISION X

Purpose: Determine the leachate storage capacity from a 25 year, 24-hour storm event during the critical leachate generation scenario.

Assumptions:

1. Critical leachate generation scenario occurs during the current condition with approximately 12.7 acres are operational (Portions of Cell 2 and the entirety of Cell 3) and approximately 7.6 acres have final cover. (See Figure 1 for this scenario).
2. The 25 year, 24-hour storm event is 5.40 inches (refer to attached sheet).
3. No portion of the leachate drainage layer within the open area is saturated.
4. The leachate drainage sand has a porosity of 30 percent. The bottom ash has a porosity of 25 percent.
5. The minimum thickness of the drainage layer is 1.0 foot.
6. A minimum of 1 foot of bottom ash was installed above the drainage layer in Cell 2A over an area of approximately 2.3 acres.
7. A minimum of 4 feet of bottom ash was installed above the drainage layer during the Cell 3A construction. Using a maximum elevation of 820 feet, this bottom ash covers an area of approximately 2.75 acres.

Method:

1. Determine the volume of rain collected in the open areas during the critical condition from a 25 year, 24-hour storm event.
2. Calculate the available storage volume for leachate in the drainage layer. Due to the slope of the landfill perimeter berm, the capacity of the drainage layer is based on the area of the drainage layer at or below an elevation of 820 feet. Elevation 820 represents the lowest top of berm base grade elevation documented during construction of Cell 3A (refer to attached base grades sheet).
3. The available storage volume within the pipe trenches, transfer piping, and leachate collection tank is ignored.
4. Calculate the available storage volume for leachate in the 4 feet of bottom ash placed above the drainage layer during Cell 3A construction and 1 foot of bottom ash placed above the drainage layer during Cell 2A construction.
5. Calculate the volume of storage required for the 25 year, 24-hour storm event.





PROJECT / LOCATION: DPC: Alma Offsite Disposal Facility, Phase IV Landfill		PROJECT / PROPOSAL NO.
SUBJECT: Active Area Leachate Disposal Capacity		421717.0000
PREPARED BY: B. Kahnk	DATE: 4/27/2021	FINAL X
CHECKED BY: J. Hotstream	DATE: 4/29/2021	REVISION □

Step 1. Determine volume of run-off collected during the 25 year, 24-hour storm event

Area: 12.7 acres - Area open (portions of Cell 2 and the entirety of Cell 3)

Rain Event: 5.43 inches

$$\text{Runoff Volume}(ft^3): \text{Rain Event (inches)} \times \frac{1ft}{12 \text{ inches}} \times \text{Area (acres)} \times \frac{43,560 ft^2}{1 \text{ acre}}$$

Runoff Volume: 250,328 cubic feet

Step 2. Calculate the available storage volume for leachate in the drainage layer.

Area: 9.2 acres - see attached base grades plan

Thickness: 1 foot

Porosity: 0.3

$$\text{Storage Capacity}(ft^3): \text{Area (acres)} \times \frac{43,560 ft^2}{1 \text{ acre}} \times \text{Thickness (foot)} \times \text{Porosity}$$

Storage Capacity: 120,226 cubic feet

Step 3. Ignore storage in pipe trenches, transfer piping and leachate collection tank

Step 4. Calculate the available storage volume in the bottom ash placed above the drainage layer

Cell 2A:

Area: 2.3 acre(s)

Thickness: 1 foot

Porosity: 0.25

Cell 3A:

Area: 2.75 acre(s)

Thickness: 4 feet

Porosity: 0.25

$$\text{Storage Capacity}(ft^3): \text{Area (acres)} \times \frac{43,560 ft^2}{1 \text{ acre}} \times \text{Thickness (foot)} \times \text{Porosity}$$

Cell 2A:

Storage Capacity: 25,047 cubic feet

Cell 3A:

Storage Capacity: 119,790 cubic feet

Total Storage Capacity (Cell 2A + Cell 3A): 144,837 cubic feet



PROJECT / LOCATION: DPC: Alma Offsite Disposal Facility, Phase IV Landfill		PROJECT / PROPOSAL NO.
SUBJECT: Active Area Leachate Disposal Capacity		421717.0000
PREPARED BY: B. Kahnk	DATE: 4/27/2021	FINAL <input checked="" type="checkbox"/>
CHECKED BY: J. Hotstream	DATE: 4/29/2021	REVISION <input type="checkbox"/>

Step 5. Calculate the storage required for the 25 year, 24-hour storm event.

Required Storage:

$$\text{Required Storage} = \text{Run Off Volume} - \text{Drainage Layer Capacity} - \text{Bottom Ash Capacity}$$

Run-Off Volume:	250,328	cubic feet from Step 1
Drainage Layer:	120,226	cubic feet, from Step 2
Bottom Ash:	144,837	cubic feet from Step 4

Required Storage: -14,734 cubic feet

The negative required storage calculated above indicates that there is sufficient storage capacity in the leachate collection drainage layer and the bottom ash that was placed in the cells above the drainage layer to contain the runoff from a 25 year, 24-hour storm event.



## References



NOAA Atlas 14, Volume 8, Version 2  
 Location name: Alma, Wisconsin, US\*  
 Latitude: 44.3657°, Longitude: -91.9171°  
 Elevation: 1074 ft\*  
 \* source: Google Maps



### POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk,  
 Dale Unruh, Michael Yekta, Geoffrey Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

PF tabular

#### PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)<sup>1</sup>

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.366 (0.300-0.455)	0.436 (0.357-0.543)	0.555 (0.453-0.692)	0.657 (0.532-0.822)	0.801 (0.626-1.03)	0.915 (0.697-1.20)	1.03 (0.757-1.38)	1.16 (0.809-1.58)	1.32 (0.887-1.85)	1.45 (0.946-2.06)
10-min	0.536 (0.439-0.666)	0.639 (0.523-0.795)	0.813 (0.663-1.01)	0.962 (0.779-1.20)	1.17 (0.917-1.52)	1.34 (1.02-1.75)	1.51 (1.11-2.02)	1.69 (1.19-2.31)	1.94 (1.30-2.71)	2.13 (1.39-3.02)
15-min	0.653 (0.535-0.812)	0.779 (0.638-0.969)	0.991 (0.809-1.24)	1.17 (0.950-1.47)	1.43 (1.12-1.85)	1.64 (1.25-2.14)	1.84 (1.35-2.46)	2.06 (1.45-2.82)	2.36 (1.58-3.31)	2.59 (1.69-3.68)
30-min	0.908 (0.744-1.13)	1.09 (0.894-1.36)	1.40 (1.14-1.74)	1.66 (1.34-2.08)	2.03 (1.58-2.62)	2.32 (1.76-3.03)	2.62 (1.92-3.49)	2.92 (2.05-4.00)	3.34 (2.24-4.68)	3.66 (2.39-5.19)
60-min	1.19 (0.978-1.48)	1.42 (1.16-1.77)	1.82 (1.48-2.27)	2.17 (1.76-2.72)	2.69 (2.12-3.51)	3.13 (2.39-4.11)	3.58 (2.63-4.81)	4.07 (2.86-5.60)	4.76 (3.20-6.70)	5.31 (3.46-7.53)
2-hr	1.48 (1.22-1.82)	1.75 (1.44-2.15)	2.23 (1.84-2.76)	2.68 (2.19-3.33)	3.36 (2.67-4.37)	3.94 (3.04-5.15)	4.55 (3.38-6.09)	5.22 (3.70-7.15)	6.18 (4.20-8.66)	6.96 (4.57-9.80)
3-hr	1.67 (1.38-2.04)	1.95 (1.62-2.39)	2.48 (2.05-3.05)	2.99 (2.46-3.69)	3.79 (3.04-4.93)	4.48 (3.48-5.86)	5.24 (3.92-7.00)	6.07 (4.33-8.31)	7.28 (4.97-10.2)	8.28 (5.46-11.6)
6-hr	1.96 (1.64-2.38)	2.28 (1.91-2.77)	2.90 (2.41-3.53)	3.50 (2.90-4.28)	4.47 (3.63-5.79)	5.32 (4.18-6.93)	6.27 (4.73-8.33)	7.32 (5.27-9.96)	8.86 (6.11-12.3)	10.1 (6.74-14.1)
12-hr	2.23 (1.88-2.68)	2.59 (2.18-3.12)	3.29 (2.76-3.96)	3.96 (3.30-4.79)	5.02 (4.10-6.43)	5.96 (4.71-7.68)	6.99 (5.31-9.21)	8.13 (5.90-11.0)	9.80 (6.81-13.5)	11.2 (7.49-15.5)
24-hr	2.53 (2.15-3.01)	2.91 (2.47-3.46)	3.63 (3.07-4.33)	4.33 (3.64-5.19)	5.43 (4.47-6.89)	6.40 (5.10-8.17)	7.46 (5.72-9.75)	8.65 (6.33-11.6)	10.4 (7.26-14.2)	11.8 (7.97-16.2)
2-day	2.94 (2.52-3.46)	3.29 (2.81-3.87)	3.97 (3.39-4.69)	4.65 (3.94-5.53)	5.76 (4.79-7.25)	6.75 (5.44-8.56)	7.86 (6.08-10.2)	9.10 (6.72-12.1)	10.9 (7.72-14.9)	12.5 (8.48-17.0)
3-day	3.23 (2.79-3.79)	3.58 (3.08-4.19)	4.26 (3.65-5.01)	4.95 (4.21-5.84)	6.07 (5.07-7.59)	7.07 (5.72-8.91)	8.19 (6.37-10.6)	9.45 (7.01-12.5)	11.3 (8.02-15.3)	12.8 (8.79-17.5)
4-day	3.48 (3.00-4.05)	3.85 (3.32-4.49)	4.57 (3.93-5.35)	5.28 (4.51-6.21)	6.42 (5.37-7.98)	7.43 (6.03-9.31)	8.55 (6.67-11.0)	9.81 (7.30-12.9)	11.6 (8.29-15.7)	13.2 (9.04-17.9)
7-day	4.09 (3.56-4.73)	4.59 (3.99-5.31)	5.48 (4.75-6.37)	6.30 (5.42-7.35)	7.54 (6.31-9.20)	8.58 (6.97-10.6)	9.70 (7.58-12.3)	10.9 (8.15-14.2)	12.6 (9.03-16.9)	14.0 (9.70-19.0)
10-day	4.64 (4.05-5.34)	5.24 (4.57-6.03)	6.27 (5.45-7.24)	7.17 (6.20-8.32)	8.50 (7.11-10.3)	9.58 (7.80-11.7)	10.7 (8.39-13.4)	11.9 (8.91-15.4)	13.6 (9.73-18.1)	14.9 (10.4-20.1)
20-day	6.27 (5.53-7.14)	7.04 (6.19-8.02)	8.32 (7.29-9.51)	9.40 (8.19-10.8)	10.9 (9.19-13.0)	12.1 (9.95-14.7)	13.4 (10.6-16.6)	14.7 (11.0-18.7)	16.4 (11.8-21.6)	17.7 (12.4-23.7)
30-day	7.70 (6.82-8.72)	8.60 (7.61-9.75)	10.1 (8.89-11.5)	11.3 (9.91-12.9)	13.0 (11.0-15.3)	14.3 (11.8-17.2)	15.7 (12.4-19.3)	17.0 (12.9-21.6)	18.8 (13.6-24.6)	20.2 (14.2-26.9)
45-day	9.58 (8.53-10.8)	10.7 (9.51-12.1)	12.5 (11.1-14.1)	13.9 (12.3-15.8)	15.9 (13.4-18.5)	17.3 (14.3-20.6)	18.8 (14.9-22.9)	20.2 (15.3-25.3)	21.9 (15.9-28.5)	23.3 (16.4-30.8)
60-day	11.2 (10.0-12.6)	12.6 (11.2-14.1)	14.7 (13.0-16.5)	16.3 (14.4-18.5)	18.5 (15.7-21.4)	20.1 (16.6-23.7)	21.5 (17.1-26.1)	22.9 (17.4-28.7)	24.7 (18.0-31.8)	25.9 (18.4-34.2)

<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

[Back to Top](#)



PROJECT / LOCATION: DPC: Alma Offsite Disposal Facility, Phase IV Landfill		PROJECT / PROPOSAL NO.
SUBJECT: Active Area Leachate Disposal Capacity		243332.0002
PREPARED BY: J. Hotstream	DATE: 8/31/2016	FINAL <input type="checkbox"/>
CHECKED BY:	DATE:	REVISION <input type="checkbox"/>

## Volume Relationships of Sand

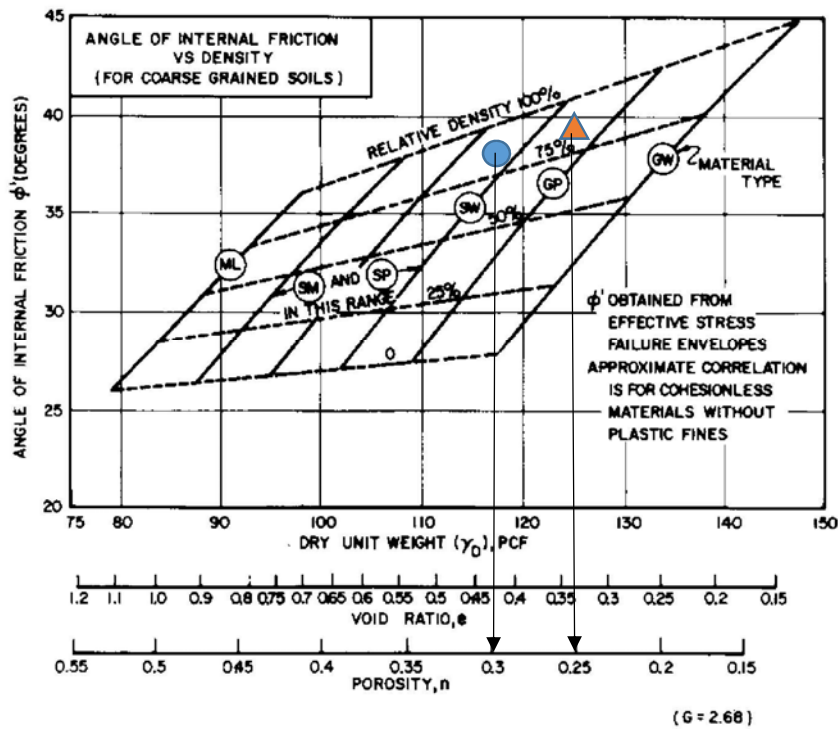
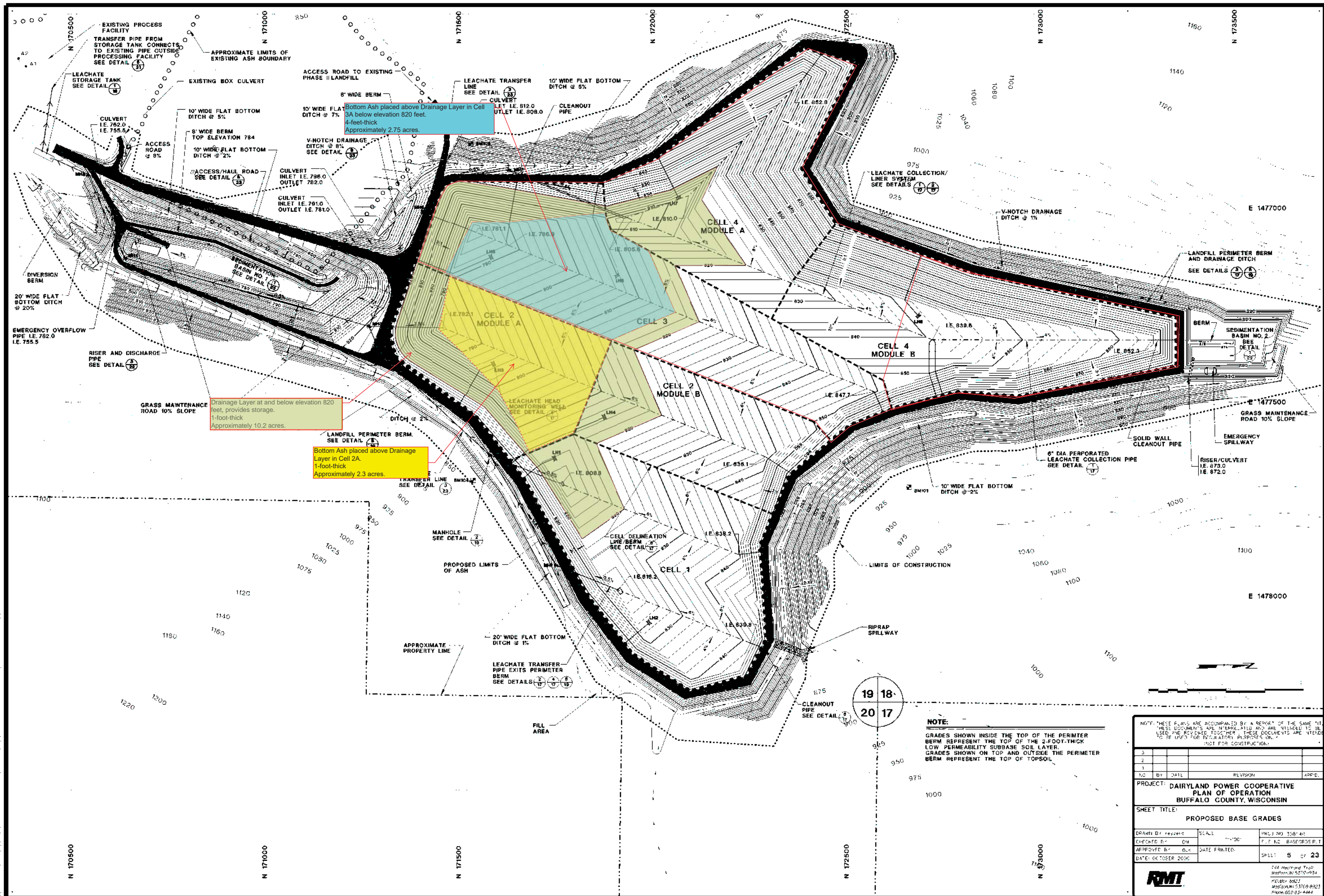


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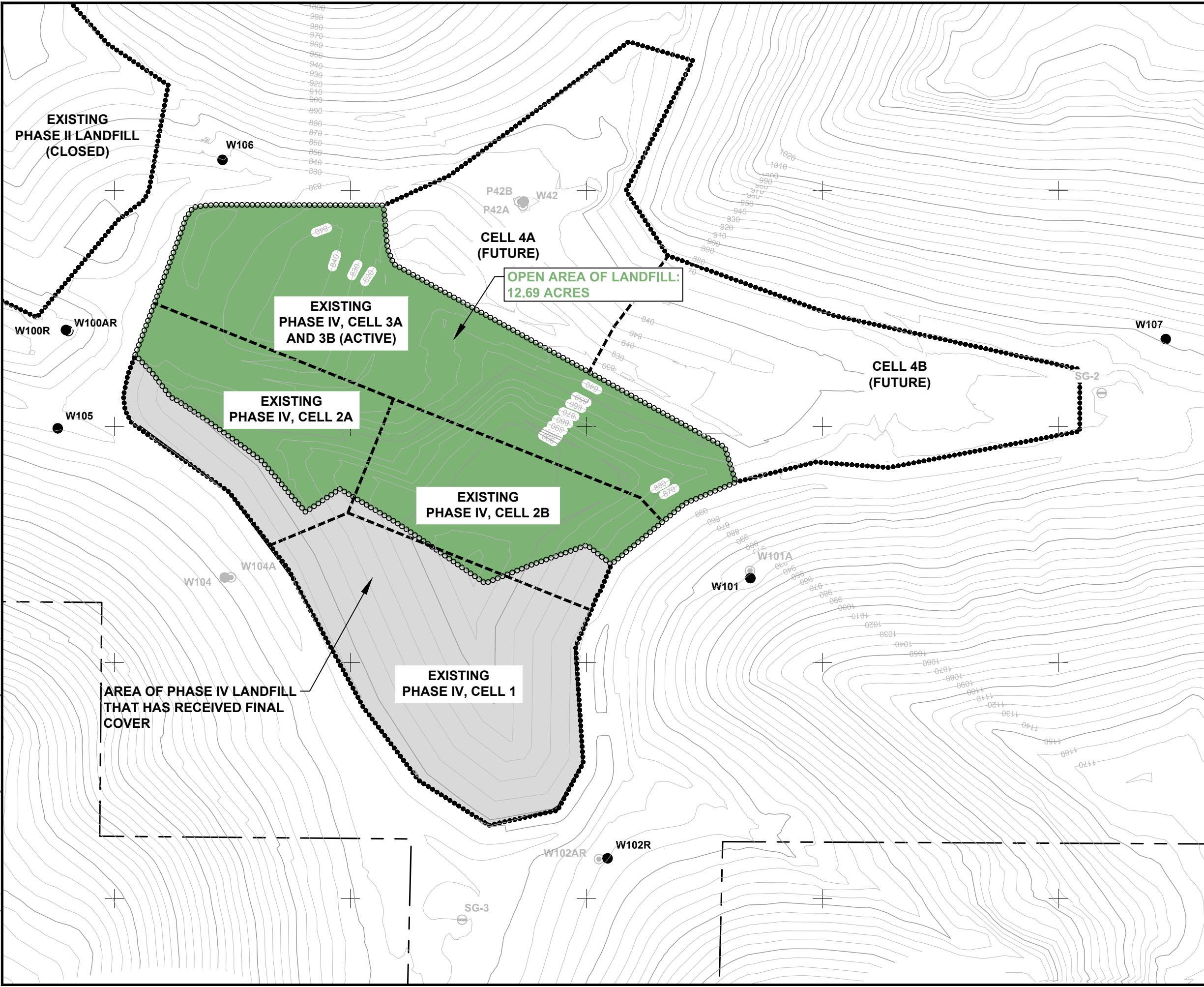
● Drainage Layer Sand - Poorly Graded Sand (SP)

▲ Bottom Ash - Poorly Graded Sand (SP) to Poorly Graded Gravel (GP)





11x17 -- ATTACHED REFS: WELLS 200, GRD 200, PROPOSED: EG 2020-11-12 -- ATTACHED IMAGES:  
DRAWING NAME: J:\dairyland power\Alma\421717 - 2020 annual groundwater\0000\_421717.01.dwg -- PLOT DATE: April 28, 2021 - 3:59PM -- LAYOUT: FIGURE 2 GROUNDWATER ELEVATION MAP



**LEGEND**

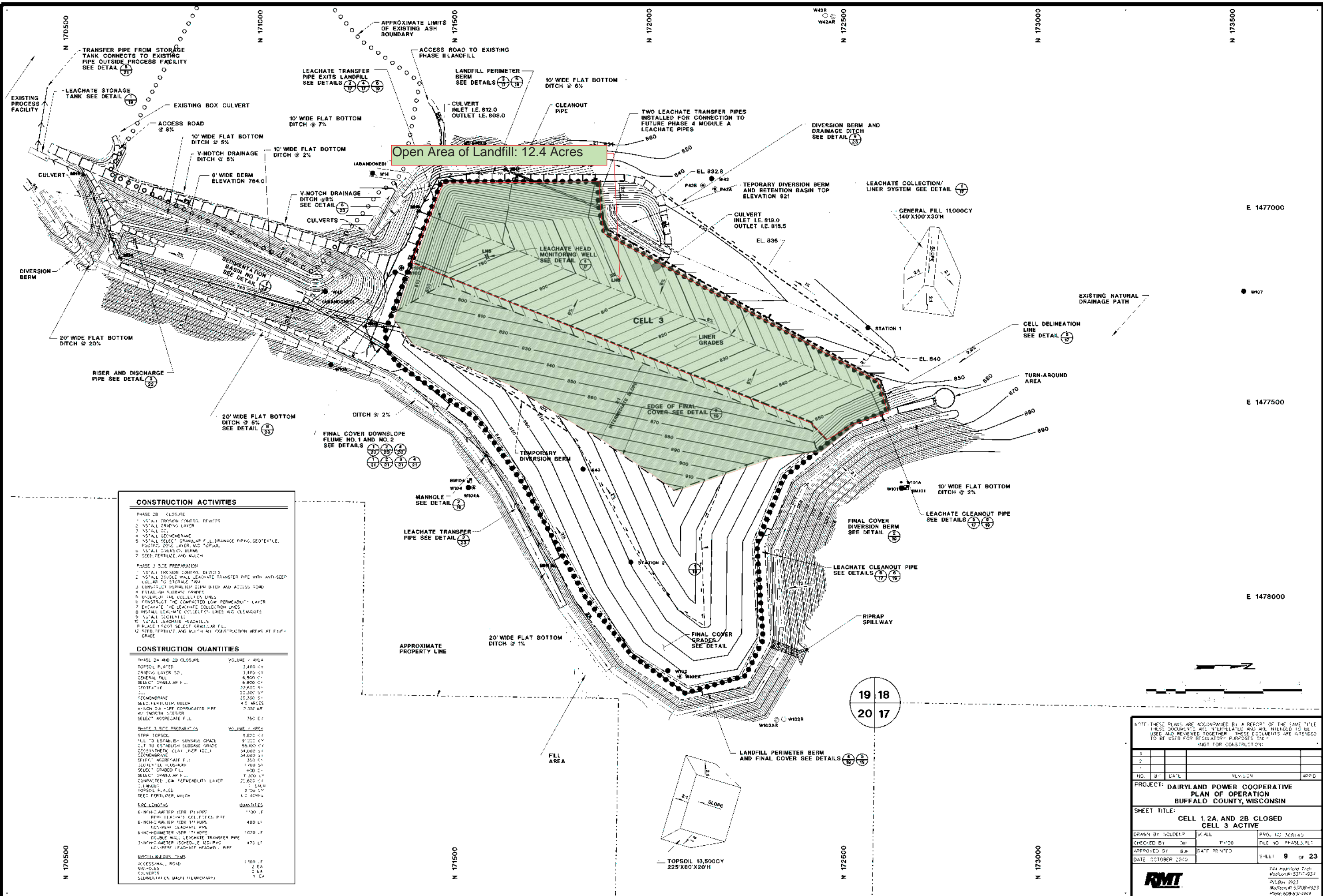
	APPROXIMATE PROPERTY BOUNDARY
	GRID LOCATION
	EXISTING 10' CONTOUR
	EXISTING SPOT ELEVATION
	LIMITS OF PERMITTED LANDFILL
	LIMITS OF CCR DISPOSAL (ACTIVE LANDFILL)
	PHASE LINE
	W42 MONITORING WELL (NOT INCLUDED IN FEDERAL GWMP)
	W42B PIEZOMETER (NOT INCLUDED IN FEDERAL GWMP)
	W101 MONITORING WELL LOCATION
	W101A PIEZOMETER LOCATION

- NOTES**
1. THE BASE MAP WAS COMPILED FROM THE CELL 3B LINER CONSTRUCTION DOCUMENTATION REPORT (OCTOBER, 2016) AND THE NOVEMBER 12, 2020 ANNUAL AIR SPACE SURVEY BY EXETER DESIGN, INC.
  2. THE HORIZONTAL DATUM IS REFERENCED TO THE WISCONSIN STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NORTH AMERICAN DATUM 1983, US SURVEY FEET.
  3. VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM 1988. CONTOUR INTERVAL IS 10 FEET.

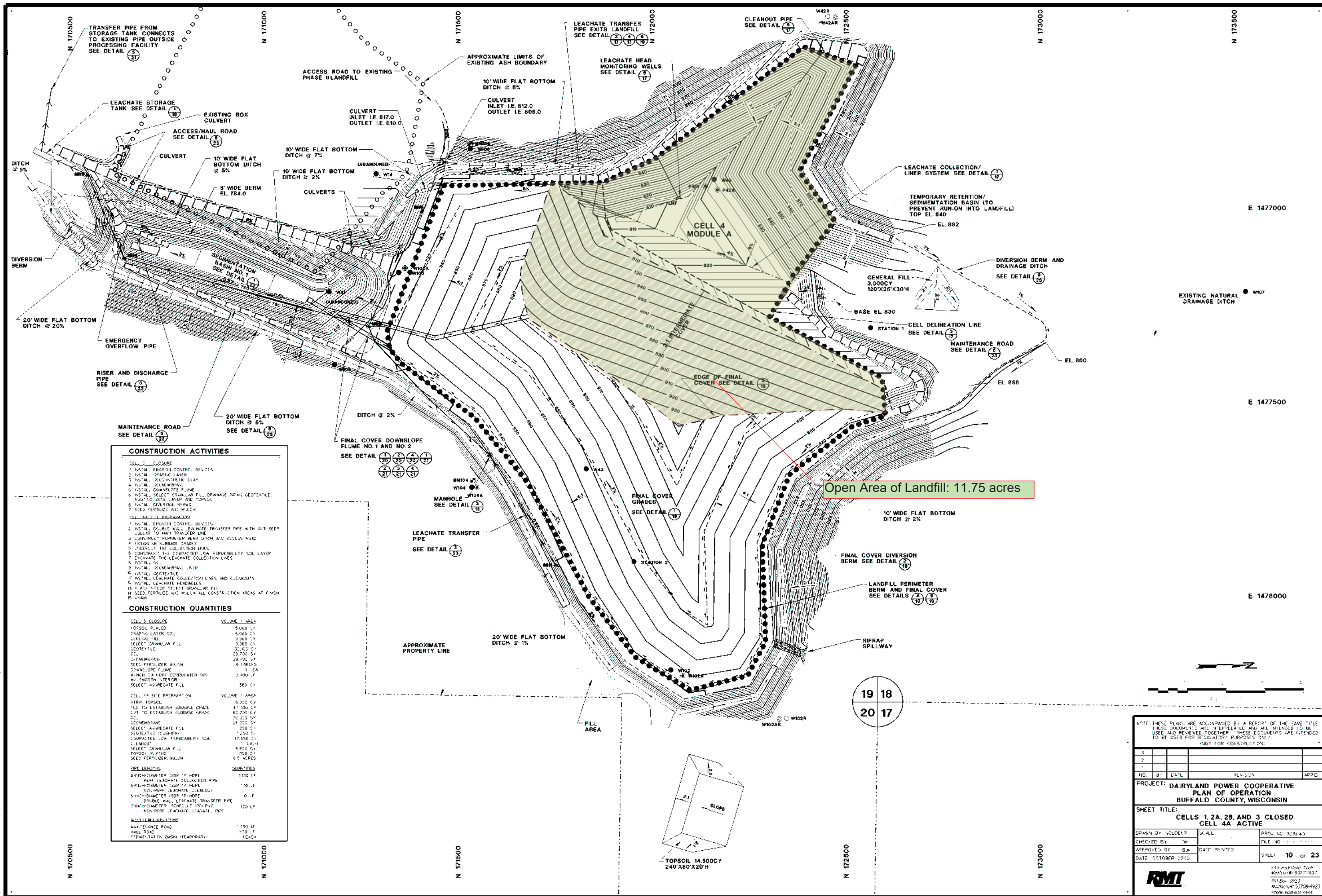


PROJECT: <b>DAIRYLAND POWER COOPERATIVE RUN-ON AND RUN-OFF CONTROL SYSTEMS PLAN ALMA OFF-SITE PHASE IV LANDFILL BUFFALO COUNTY, WISCONSIN</b>	
TITLE: <b>EXISTING CONDITIONS</b>	
DRAWN BY: S. HAMWAY	PROJ NO.: 421717
CHECKED BY: B. KAHNK	<b>FIGURE 1</b>
APPROVED BY:	
DATE: OCTOBER 2021	
708 Heartland Trail Suite 3000 Madison, WI 53717 Phone: 608.826.3600	
FILE NO.:	421717.01.dwg









CONSTRUCTION ACTIVITIES	
CELL 3 CLOSURE	
1. INSTALL EROSION CONTROL DEVICES	
2. INSTALL GRADING LAYER	
3. INSTALL SEEDING/SPREADING CLAY	
4. INSTALL SCUMMING	
5. INSTALL DRAINAGE PINE	
6. INSTALL SELECT GRANULAR FILL, DRAINAGE SPRING, GEOTEXTILE, GEOTEXTILE LAYER AND TOPSOIL	
7. SEED FERTILIZER AND MULCH	
8. INSTALL EROSION CONTROL DEVICES	
9. INSTALL DOUBLE WALL LEACHATE TRANSFER PIPE WITH ANTI SEEP - GULCH TO HAD TRANSFER LINE	
10. CONSTRUCT PERIMETER BERM DITCH AND ACCESS ROAD	
11. STAGE IN SUBBASE GRADES	
12. INSTALL THE COLLECTION LINES	
13. CONSTRUCT THE COMPACTED LGA PERMEABILITY SOL LAYER	
14. DRAINAGE THE LEACHATE COLLECTION LINES	
15. INSTALL SCUMMING	
16. INSTALL SEEDING/SPREADING CLAY	
17. INSTALL LEACHATE COLLECTION LINES AND CLEANOUTS	
18. INSTALL LEACHATE HEADWELLS	
19. PLACE 12" X 12" REINFORCED GRASS/AR FILL	
20. SEED FERTILIZER AND MULCH ALL CONSTRUCTION AREAS AT FINISH	
21. UNPAVE	
CONSTRUCTION QUANTITIES	
CELL 3 CLOSURE	VOLUME / AREA
TOPSOIL PLACED	5,000 CY
GRADING LAYER SOL	5,000 CY
SEEDING/SPREADING CLAY	9,900 CY
SELECT GRANULAR FILL	9,900 CY
GEOTEXTILES	32,000 SF
SCUMMING	29,700 SF
SEED FERTILIZER MULCH	61 ARCS
DRAINAGE PINE	1 EA
4" HEN 2.5 HEN CORRUGATED PIPE	2,400 LF
W/ SMOOTH INTERIOR	
SELECT AGGREGATE FILL	360 CY
CELL 4A SITE PREPARATION	VOLUME / AREA
STRIP TOPSOIL	5,300 CY
FILL TO ESTABLISH SUBBASE GRADE	47,000 CY
CUT TO ESTABLISH SUBBASE GRADE	62,700 CY
SCUMMING	29,700 SF
SELECT AGGREGATE FILL	24,300 CY
GEOTEXTILES (SCUMMING)	240 CY
COMPACTED LGA PERMEABILITY SOL	17,550 CY
CLEANOUT	1 EA
SELECT GRANULAR FILL	9,900 CY
TOPSOIL PLACED	800 CY
SEED FERTILIZER MULCH	6.5 ARCS
SUMMARY	
GRASS/CLAMBER CORR 12" HEN	1102 LF
NEW LEACHATE COLLECTION PIPE	170 LF
GRASS/CLAMBER CORR 12" HEN	170 LF
NEW LEACHATE CLEANOUT	0 LF
DOUBLE WALL LEACHATE TRANSFER PIPE	120 LF
GRASS/CLAMBER CORR 12" HEN	120 LF
NEW LEACHATE TRANSFER PIPE	120 LF
GRASS/CLAMBER CORR 12" HEN	120 LF
MATERIALS SUMMARY	
TOPSOIL	1790 LF
MAINTENANCE ROAD	070 LF
TEMPORARY BASIN (TEMPORARY)	1 LEACH

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY. NOT FOR CONSTRUCTION.

3				
2				
1				
NO.	BY	DATE	REVISION	APP'D

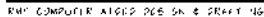
PROJECT: DAIRYLAND POWER COOPERATIVE  
PLAN OF OPERATION  
BUFFALO COUNTY, WISCONSIN

SHEET TITLE:  
CELLS 1, 2A, 2B, AND 3 CLOSED  
CELL 4A ACTIVE

DRAWN BY: HOLDEAR	SCALE	PROJ. NO. ACR145
CHECKED BY: DM		FILE NO. 11-1-1-1
APPROVED BY: BJA	DATE PRINTED	
DATE: OCTOBER 2003	SHEET 10 OF 23	

744 Highland Tech  
Madison WI 53704-9341  
P.O. Box 3663  
Madison WI 53708-9923  
Phone: 608/551-4444





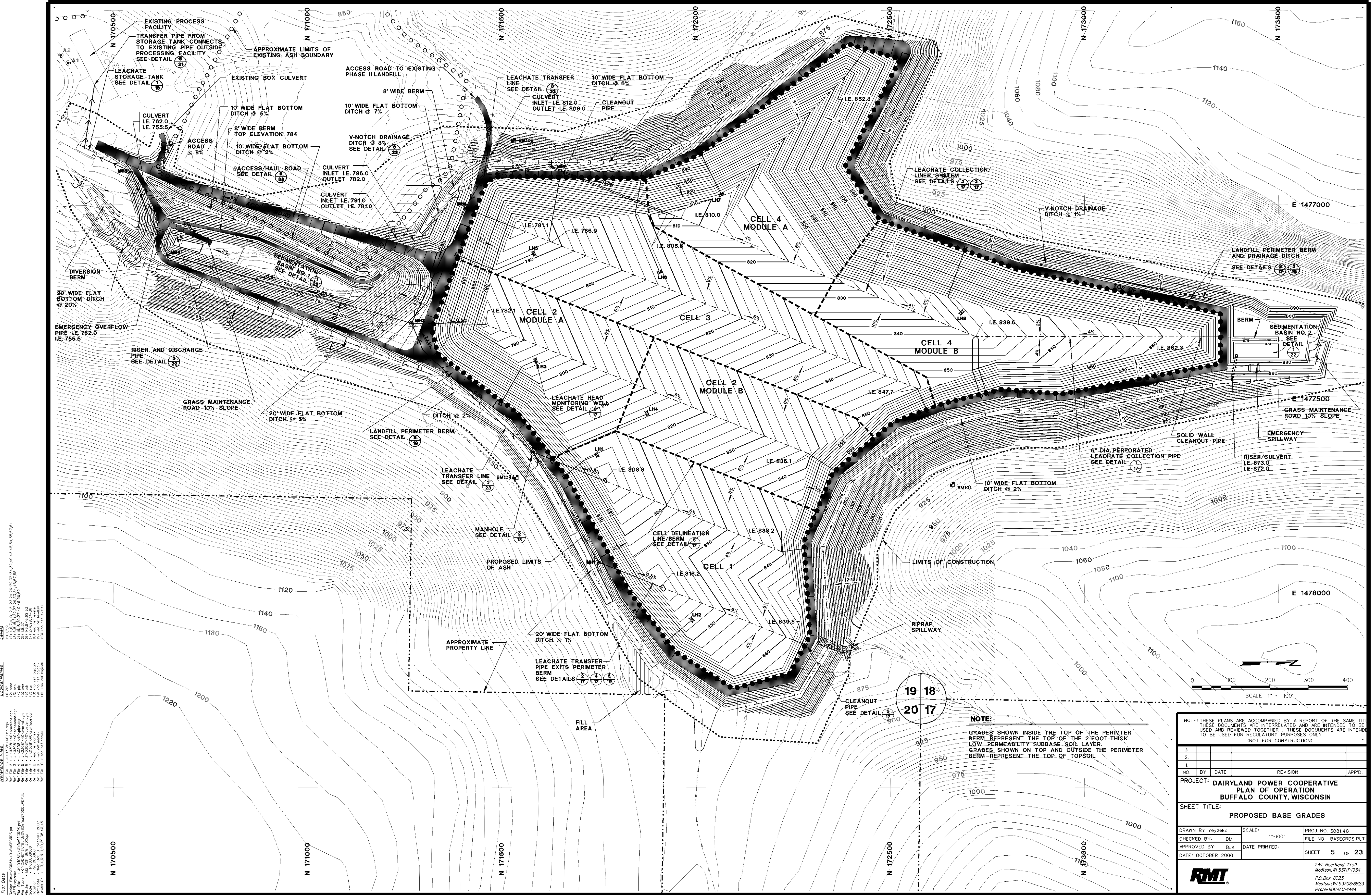


## **Appendix C: Relevant October 2000 POO Plan Sheets**

- Sheet 3 Existing Conditions Map – Phase IV, Cell 3B Liner & Area C (Over Cells 1 & 2)  
Final Cover Construction
- Sheet 5 Proposed Base Grades
- Sheet 9 Phasing Plan – Cell 1, 2A, and 2B Closed; Cell 3 Active
- Sheet 11 Phasing Plan – Cell 1, 2A, 2B, 3, and 4A Closed; Cell 4B Active
- Sheet 12 Proposed Final Grades
- Sheet 17 Details – Liner and Collection Pipes
- Sheet 19 Details – Final Cover
- Sheet 22 Details – Sedimentation Basins
- Sheet 23 Details – Miscellaneous







**Legend**

(1) 1/2" = 1' (2) 1/4" = 1' (3) 1/8" = 1' (4) 1/16" = 1' (5) 1/32" = 1' (6) 1/64" = 1' (7) 1/128" = 1' (8) 1/256" = 1' (9) 1/512" = 1' (10) 1/1024" = 1' (11) 1/2048" = 1' (12) 1/4096" = 1' (13) 1/8192" = 1' (14) 1/16384" = 1' (15) 1/32768" = 1' (16) 1/65536" = 1' (17) 1/131072" = 1' (18) 1/262144" = 1' (19) 1/524288" = 1' (20) 1/1048576" = 1'

**Reference Elevation**

1000 1025 1050 1075 1100 1120 1140 1160 1180 1200 1220

**Grid**

N 170500 N 171000 N 171500 N 172000 N 172500 N 173000

E 1477000 E 1477500 E 1478000

**NOTE:**  
GRADES SHOWN INSIDE THE TOP OF THE PERIMTER BERM REPRESENT THE TOP OF THE 2-FOOT-THICK LOW PERMEABILITY SUBBASE SOIL LAYER. GRADES SHOWN ON TOP AND OUTSIDE THE PERIMTER BERM REPRESENT THE TOP OF TOPSOIL

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY. (NOT FOR CONSTRUCTION)

NO.	BY	DATE	REVISION	APP'D.
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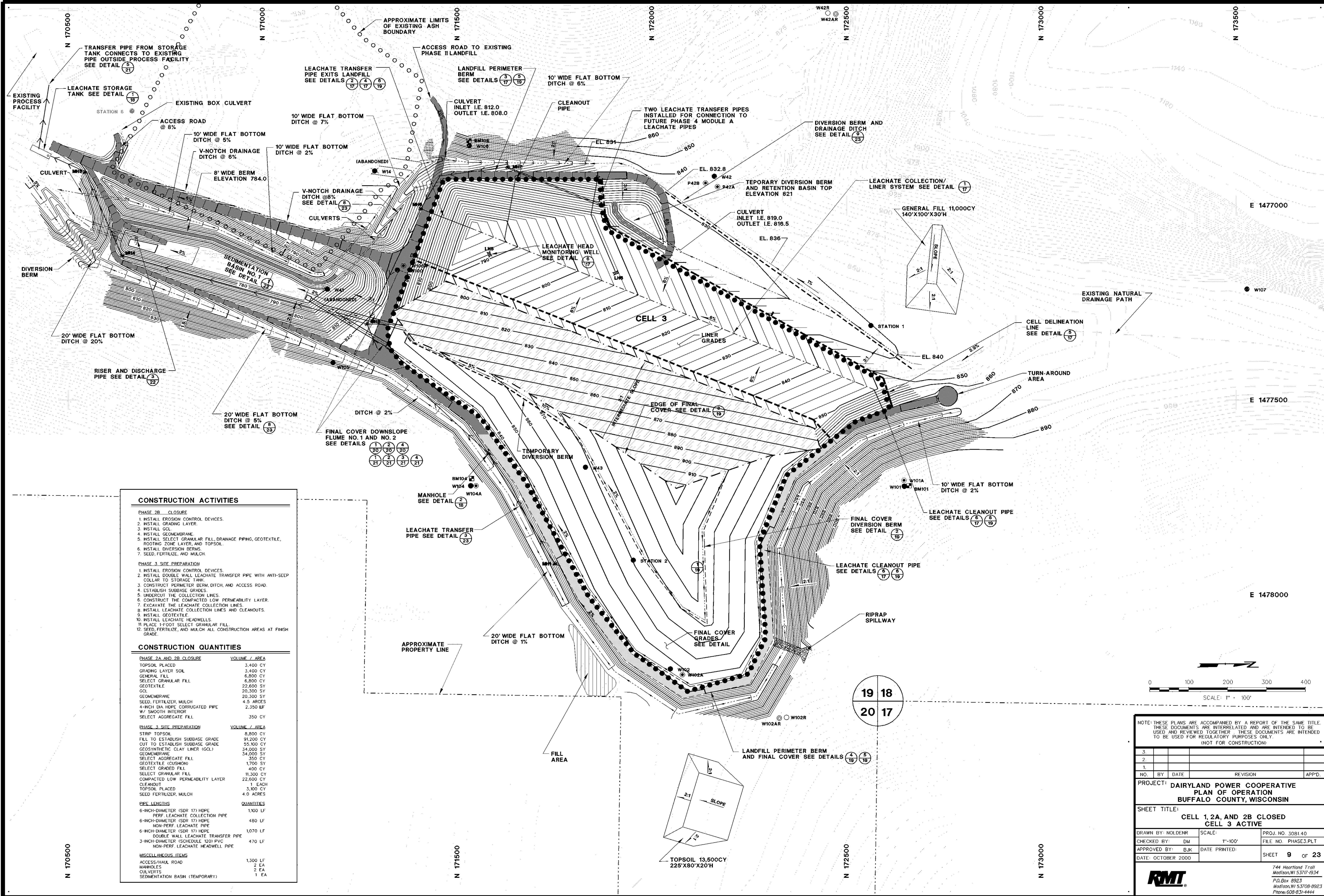
PROJECT: DAIRYLAND POWER COOPERATIVE  
PLAN OF OPERATION  
BUFFALO COUNTY, WISCONSIN

SHEET TITLE:  
PROPOSED BASE GRADES

DRAWN BY:	CHECKED BY:	APPROVED BY:	DATE:	SCALE:	DATE PRINTED:	PROJ. NO.	FILE NO.	SHEET	OF
reyzkd	DM	BJK	OCTOBER 2000	1"=100'		308140	BASEGRS.PLT	5	23

744 Heartland Trail  
Madison, WI 53717-9334  
P.O. Box 8923  
Madison, WI 53708-8923  
Phone: 608/831-4444





## CONSTRUCTION ACTIVITIES

- PHASE 2B CLOSURE
1. INSTALL EROSION CONTROL DEVICES.
  2. INSTALL GRADING LAYER.
  3. INSTALL GCL.
  4. INSTALL GEOMEMBRANE.
  5. INSTALL SELECT GRANULAR FILL, DRAINAGE PIPING, GEOTEXTILE,  
ROOTING ZONE LAYER, AND TOPSOIL.
  6. INSTALL DIVERSION BERMS.
  7. SEED, FERTILIZE, AND MULCH.

- PHASE 3 SITE PREPARATION**
1. INSTALL EROSION CONTROL DEVICES.
  2. INSTALL DOUBLE WALL LEACHATE TRANSFER PIPE WITH ANTI-SEEP COLLAR TO STORAGE TANK.
  3. CONSTRUCT PERIMETER BERM, DITCH, AND ACCESS ROAD.
  4. ESTABLISH SURFACE GRASSES.
  5. UNDERCUT THE COLLECTION LINES.
  6. CONSTRUCT THE COMPACTED LOW PERMEABILITY LAYER.
  7. EXCAVATE THE LEACHATE COLLECTION LINES.
  8. INSTALL LEACHATE COLLECTION LINES AND CLEANOUTS.
  9. INSTALL GEOTEXTILE.
  10. INSTALL LEACHATE HEADS.
  11. PLACE 1-FOOT SELECT GRANULAR FILL.
  12. SEED, FERTILIZE, AND MULCH ALL CONSTRUCTION AREAS AT FINISH GRADE.

## CONSTRUCTION QUANTITIES

<u>PHASE 2A AND 2B CLOSURE</u>	<u>VOLUME / AREA</u>
TOPSOIL PLACED	3,400 CY
GRADING LAYER SOIL	3,400 CY
GENERAL FILL	6,800 CY
SELECT GRANULAR FILL	6,800 CY
GEOTEXTILE	22,600 SY
COI	20,300 SY
GEOMEMBRANE	20,300 SY
SEED, FERTILIZER, MULCH	4.5 ACRES
4-INCH DIA. HDPE CORRUGATED PIPE	2,350 LBF
W/ SMOOTH INTERIOR	
SELECT AGGREGATE FILL	350 CY

PHASE 3 SITE PREPARATION	VOLUME / AREA
STRIP TOPSOIL	8,800 CY
FILL TO ESTABLISH SUBBASE GRADE	91,200 CY
CUT TO ESTABLISH SUBBASE GRADE	55,100 CY
GEOSYNTHETIC CLAY LINER (GCL)	34,000 SY
GEOMEMBRANE	34,000 SY
SELECT AGGREGATE FILL	350 CY
GEOTEXTILE (CUSHION)	1,700 SY
SELECT GRADED FILL	400 CY
SELECT GRANULAR FILL	11,300 CY
COMPACTED LOW PERMEABILITY LAYER	22,600 SY
CLAYBANK	1 EACH
TOPSOIL PLACED	3,100 CY
SEED FERTILIZER, MULCH	4.0 ACRES

PIPE LENGTHS	QUANTITIES
6-INCH-DIAMETER (SDR 17) HDPE PERF. LEACHATE COLLECTION PIPE	1,100 LF
6-INCH-DIAMETER (SDR 17) HDPE NON-PERF. LEACHATE PIPE	480 LF
6-INCH-DIAMETER (SDR 17) HDPE DOUBLE WALL LEACHATE TRANSFER PIPE	1,070 LF
3-INCH-DIAMETER (SCHEDULE 120) PVC NON-PERF. LEACHATE HEADWALL PIPE	470 LF

<u>MISCELLANEOUS ITEMS</u>	
ACCESS/HAUL ROAD	1,300 LF
MANHOLES	2 EA
CULVERTS	2 EA
SEDIMENTATION BASIN (TEMPORARY)	1 EA

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE.  
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USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED  
TO BE USED FOR REGULATORY PURPOSES ONLY.  
(NOT FOR CONSTRUCTION)

3.				
2.				
1.				

NO.	BY	DATE	REVISION	APP'D.
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PROJECT: DAIRYLAND POWER COOPERATIVE  
PLAN OF OPERATION  
BUFFALO COUNTY, WISCONSIN

SHEET TITLE:  
CELL 1, 2A, AND 2B CLOSED  
CELL 3 ACTIVE

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CHECKED BY: DM	1"=100'	FILE NO. PHASE3.PLT

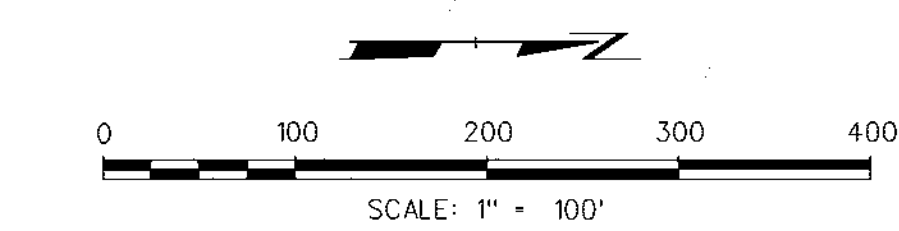
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DATE: OCTOBER 2000		

**RMT**®

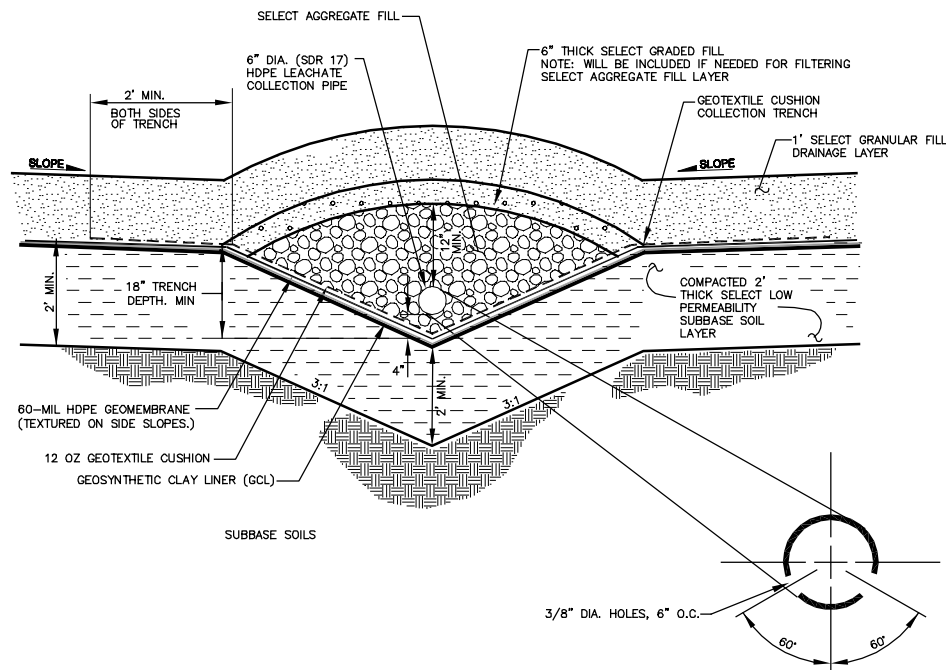




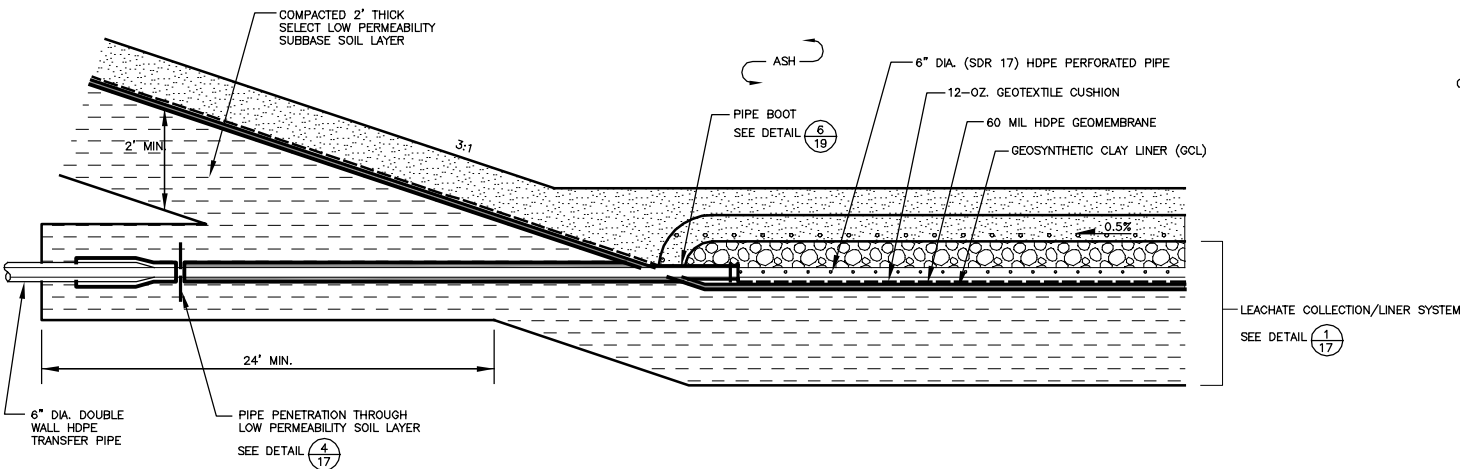


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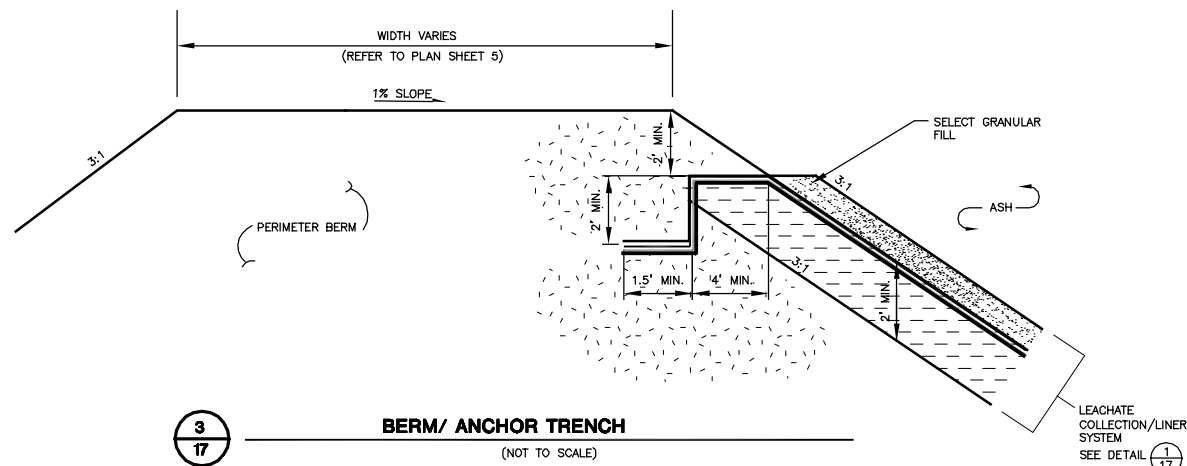




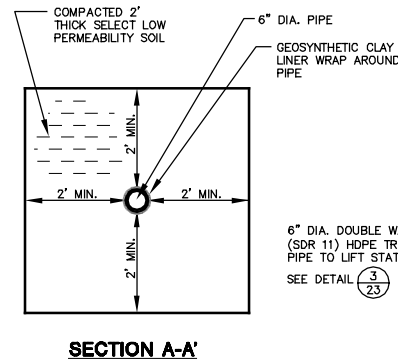
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17  
LEACHATE COLLECTION/LINER SYSTEM  
(NOT TO SCALE)



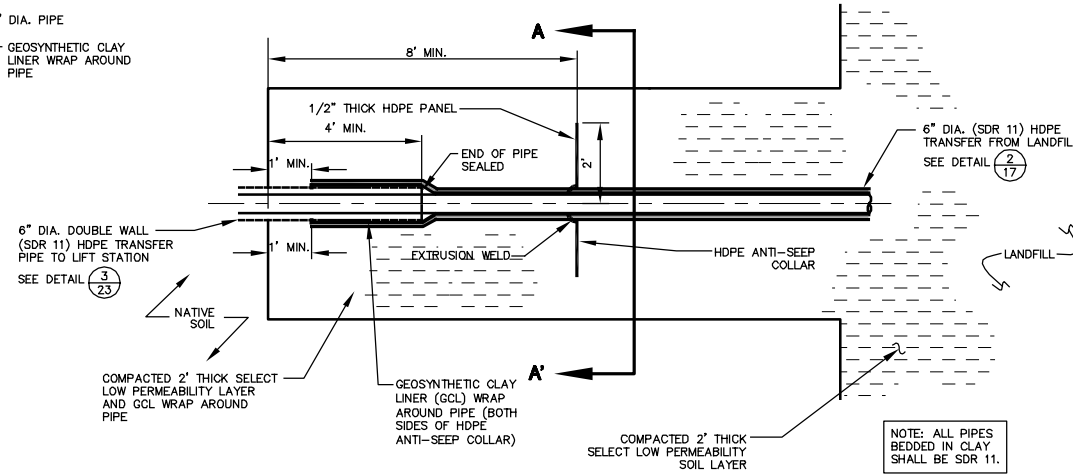
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17  
PIPE PENETRATION THROUGH  
LANDFILL PERIMETER BERM (TYPICAL)  
(NOT TO SCALE)  
LOOKING EAST



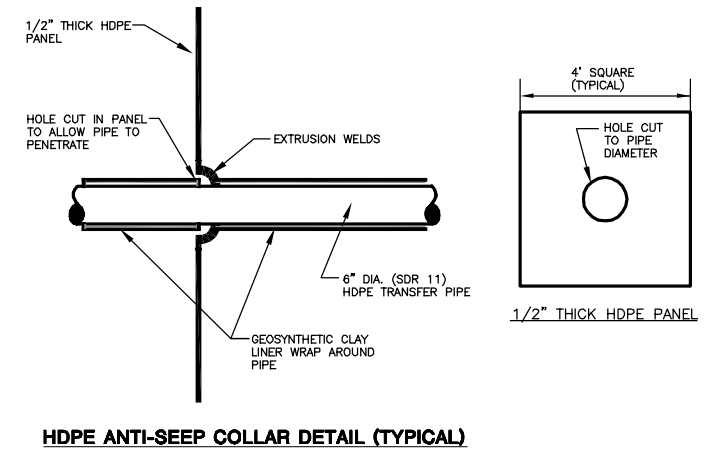
3  
17  
BERM/ ANCHOR TRENCH  
(NOT TO SCALE)



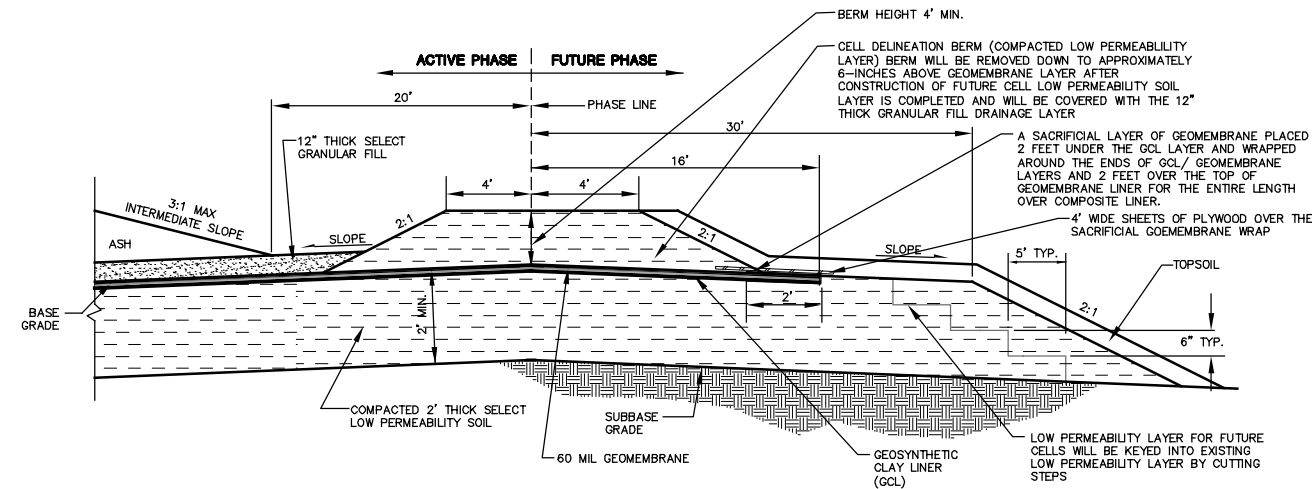
SECTION A-A'



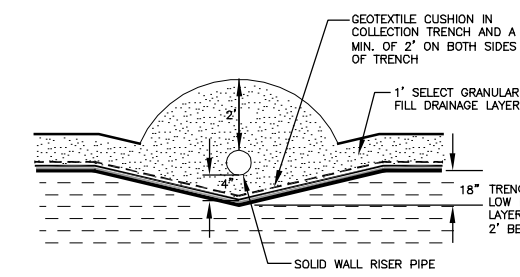
4  
17  
LEACHATE TRANSFER PIPE CLAY TRENCH CUT-OFF  
THROUGH PERIMETER BERM (TYPICAL)  
(NOT TO SCALE)



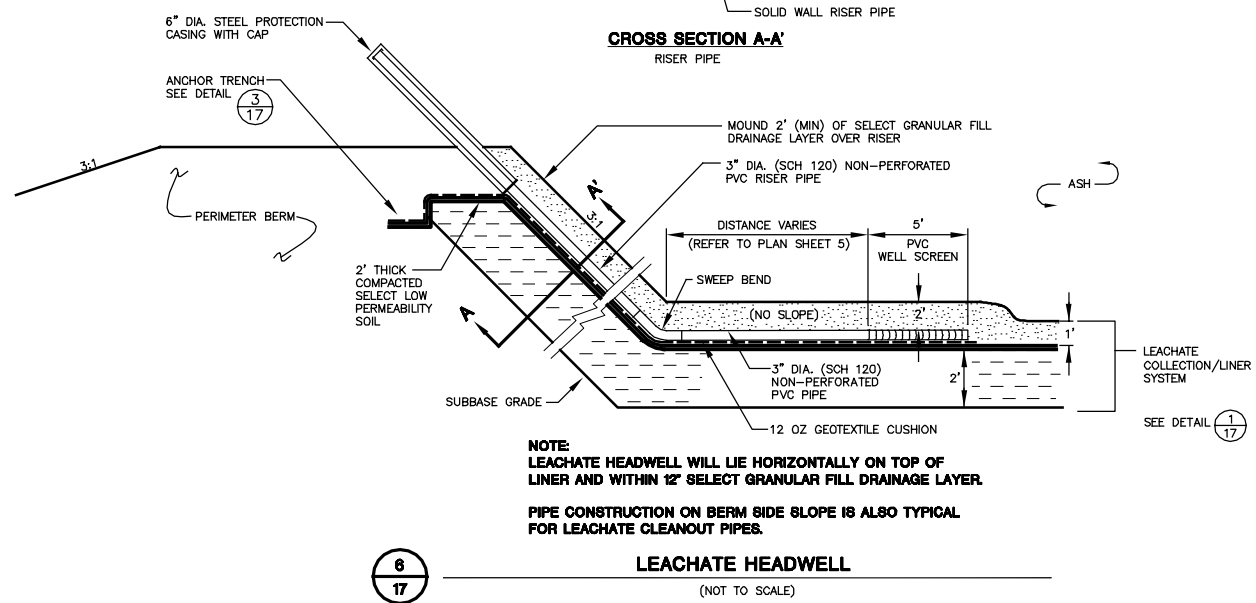
HDPE ANTI-SEEP COLLAR DETAIL (TYPICAL)



5  
17  
CELL DELINEATION BERM  
(NOT TO SCALE)



CROSS SECTION A-A'  
RISER PIPE



6  
17  
LEACHATE HEADWELL  
(NOT TO SCALE)

**LINE AND SHADING LEGEND**

--- GEOTEXTILE	--- GEOMEMBRANE
--- GEOCOMPOSITE	--- GEOSYNTHETIC CLAY LINER (GCL)
--- TOPSOIL	--- NATIVE SOIL
--- SELECT GRANULAR FILL DRAINAGE LAYER	--- CONCRETE
--- PIPE BEDDING MATERIAL	--- RIPRAP
--- SELECT AGGREGATE FILL	--- GRAVEL
--- COMPACTED SELECT LOW PERMEABILITY SOIL	--- GENERAL FILL

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY.

NOT FOR CONSTRUCTION

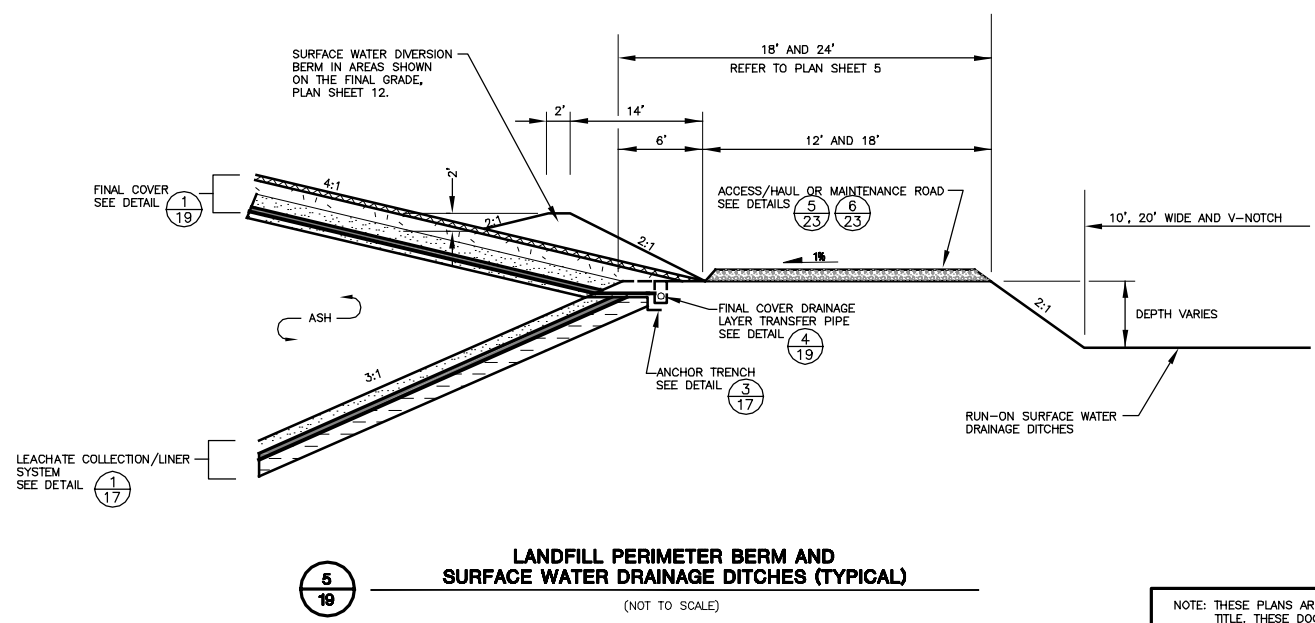
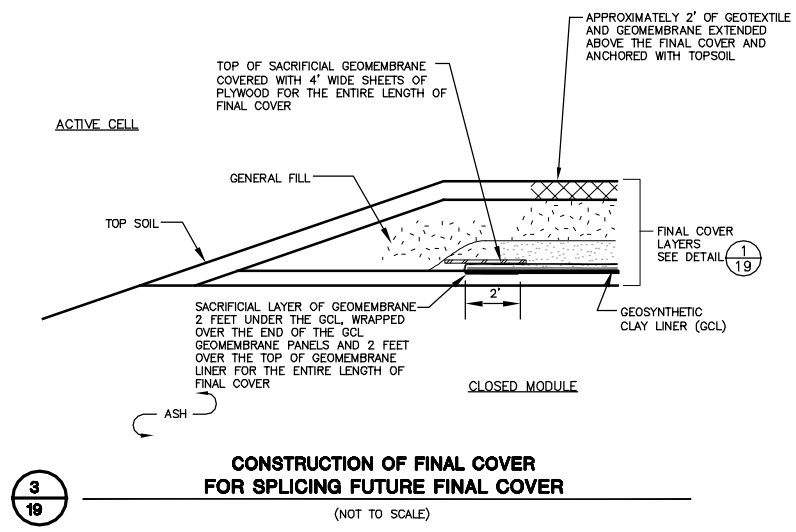
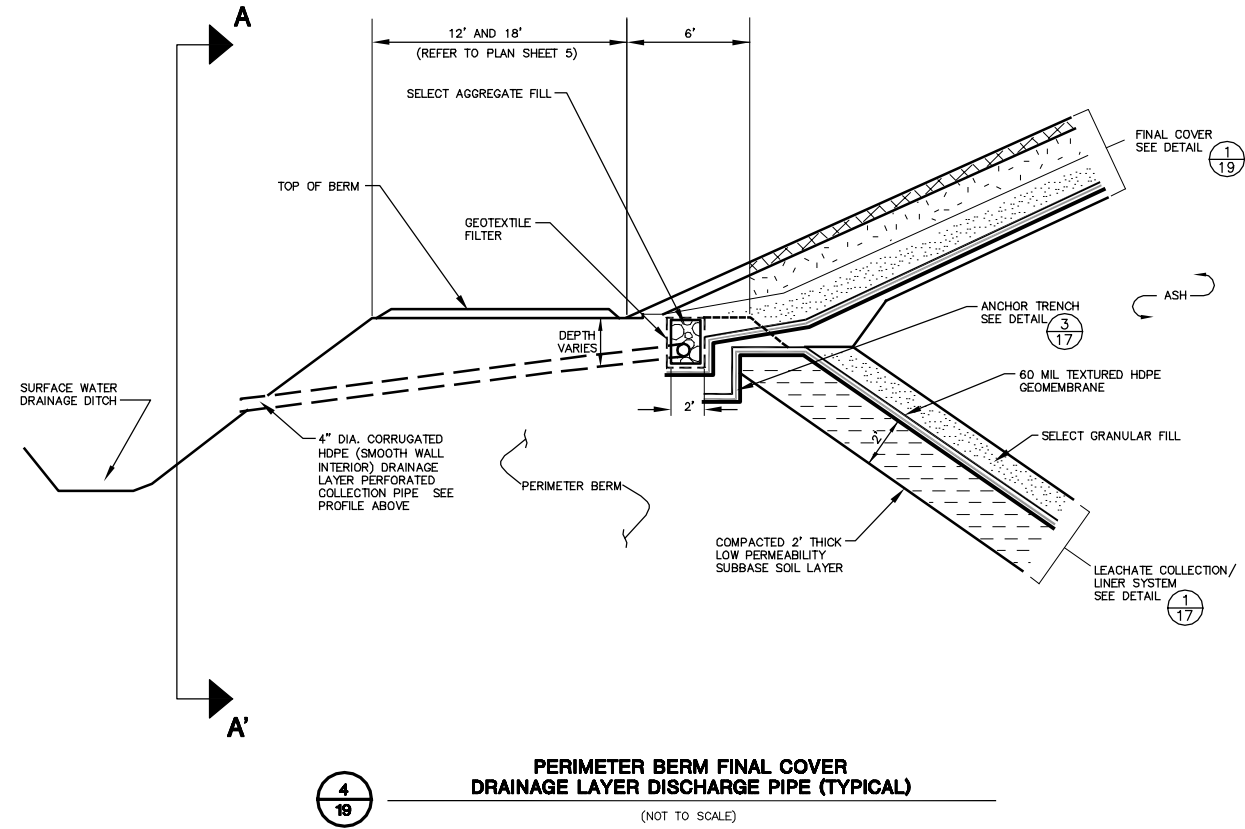
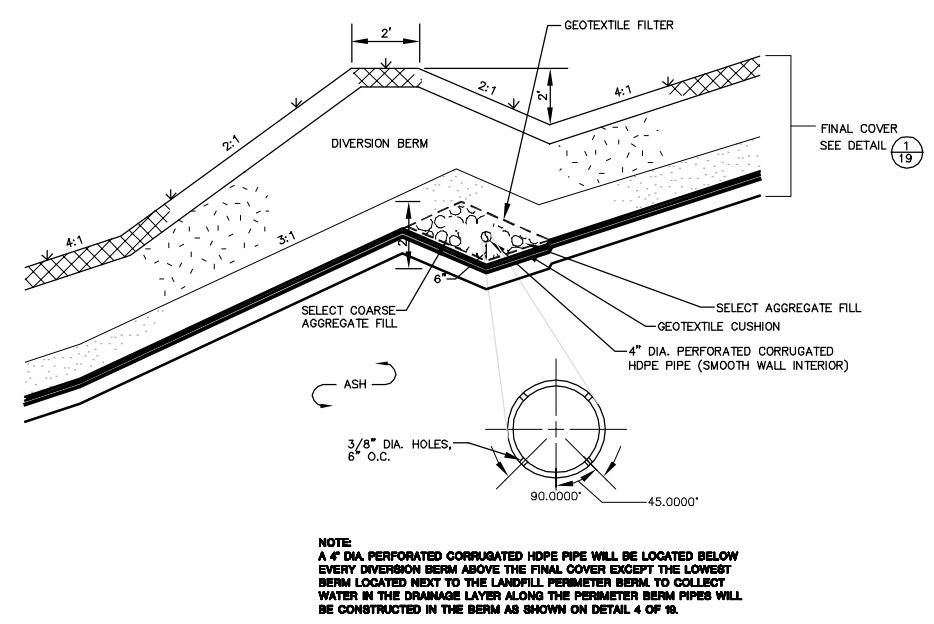
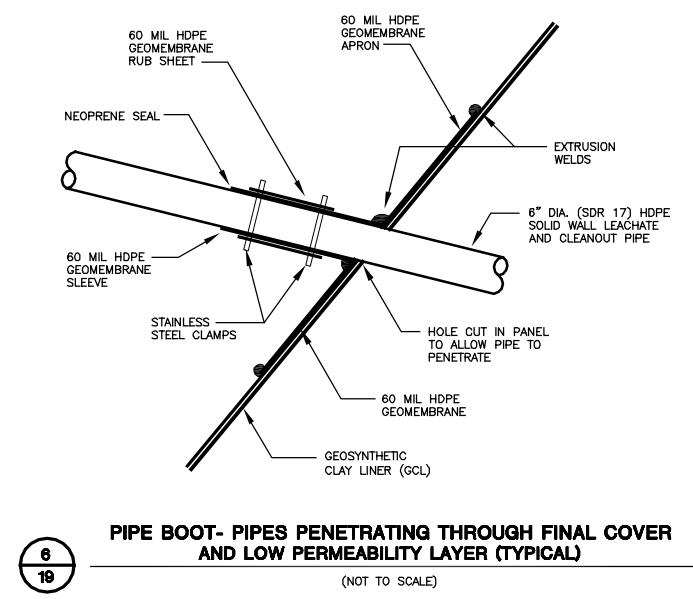
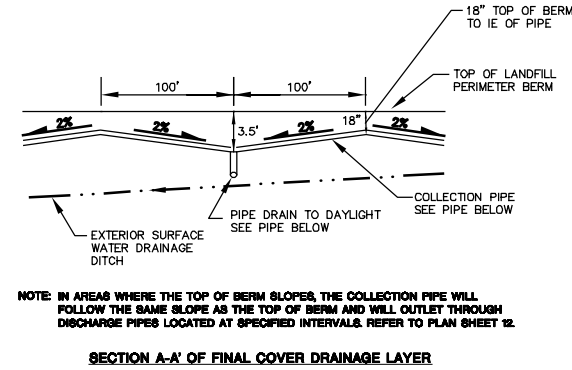
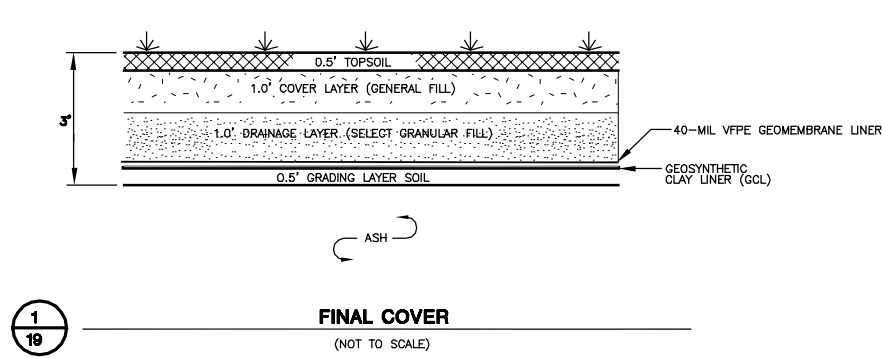
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PROJECT: DAIRYLAND POWER COOPERATIVE  
PLAN OF OPERATION  
BUFFALO COUNTY, WISCONSIN

SHEET TITLE: DETAILS- LINER AND COLLECTION PIPES

DRAWN BY: DEFOEJ	SCALE: NOT TO SCALE	PROJ. NO. 3081.40
CHECKED BY: DM	DATE PRINTED: DATE: OCTOBER 2000	FILE NO. 30814005.DWG
APPROVED BY: BJK		SHEET 17 OF 23

744 Heartland Trail  
Madison, WI 53717-1934  
P.O. Box 8923  
Madison, WI 53708-8923  
Phone: 608/831-4444



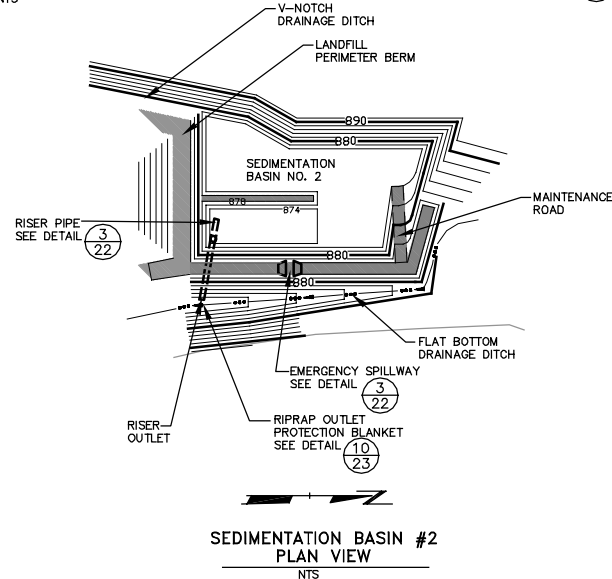
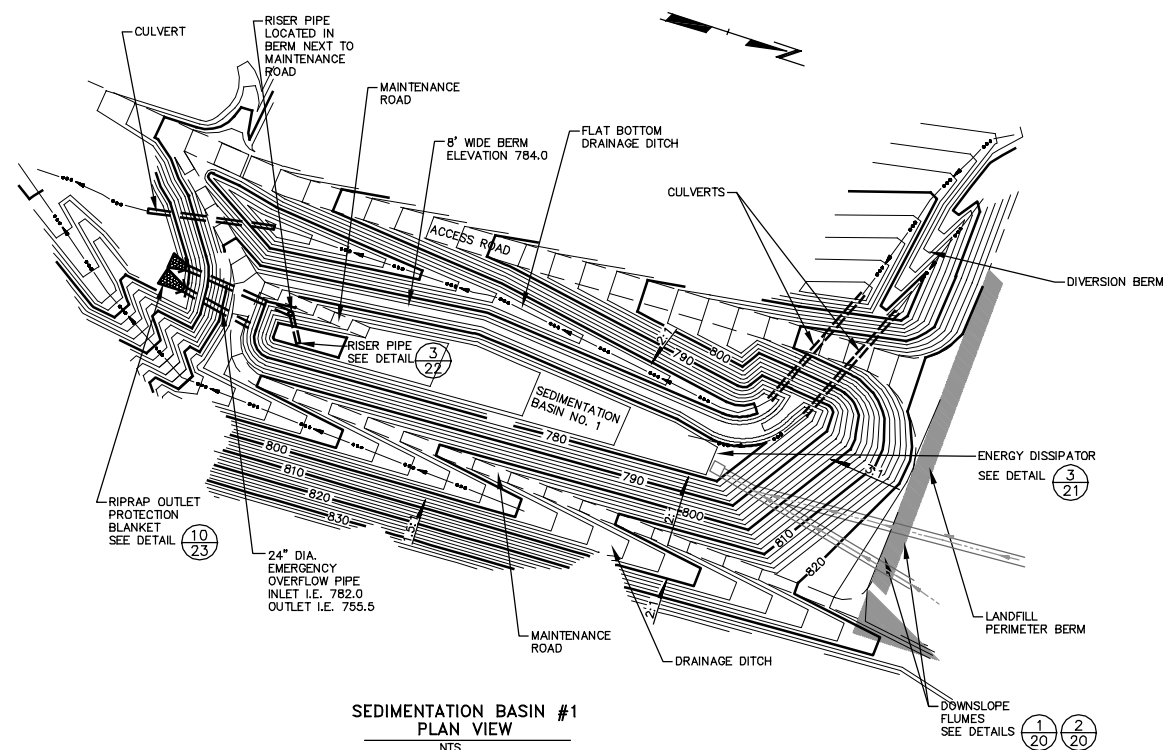
LINE AND SHADING LEGEND					
---	GEOTEXTILE	---	GEOMEMBRANE		
---	GEOCOMPOSITE	---	GEOSYNTHETIC CLAY LINER (GCL)		
---	TOPSOIL	---	NATIVE SOIL		
---	SELECT GRANULAR FILL DRAINAGE LAYER	---	CONCRETE		
---	PIPE BEDDING MATERIAL	---	RIPRAP		
---	SELECT AGGREGATE FILL	---	GRAVEL		
---	COMPACTED SELECT LOW PERMEABILITY SOIL	---	GENERAL FILL		
NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED AND REVIEWED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY. NOT FOR CONSTRUCTION					
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NO.	BY	DATE	REVISION	APP'D.	
PROJECT: DAIRYLAND POWER COOPERATIVE PLAN OF OPERATION BUFFALO COUNTY, WISCONSIN					
SHEET TITLE: DETAILS- FINAL COVER					
DRAWN BY: DEFOEJ	SCALE:	PROJ. NO. 3081.40			
CHECKED BY: DM	NOT TO SCALE	FILE NO. 30814004.dwg			
APPROVED BY: BJL	DATE PRINTED:	SHEET 19 OF 23			
DATE: OCTOBER 2000					

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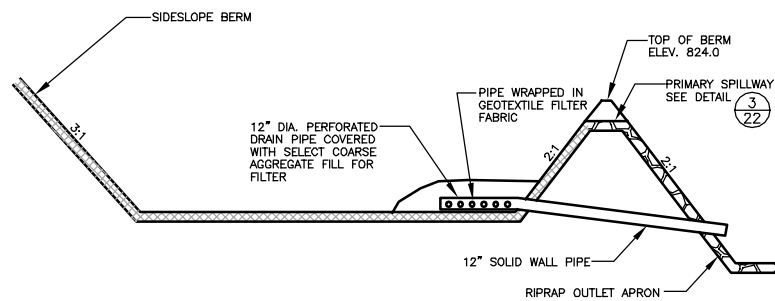
**RMT**  
744 Heartland Trail  
Madison, WI 53717-1934  
P.O. Box 8923  
Madison, WI 53708-8923  
Phone: 608/631-4444

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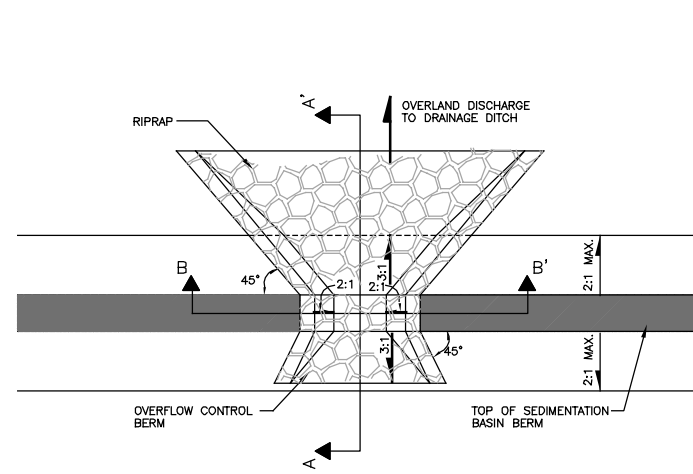




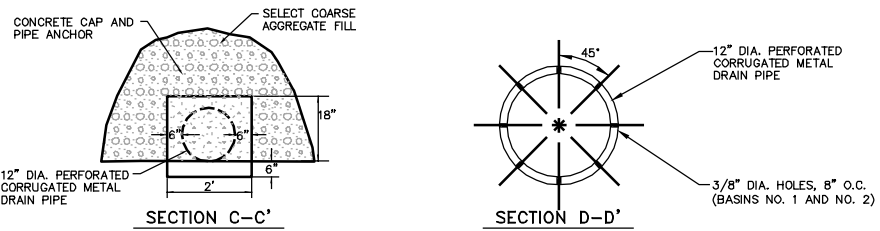
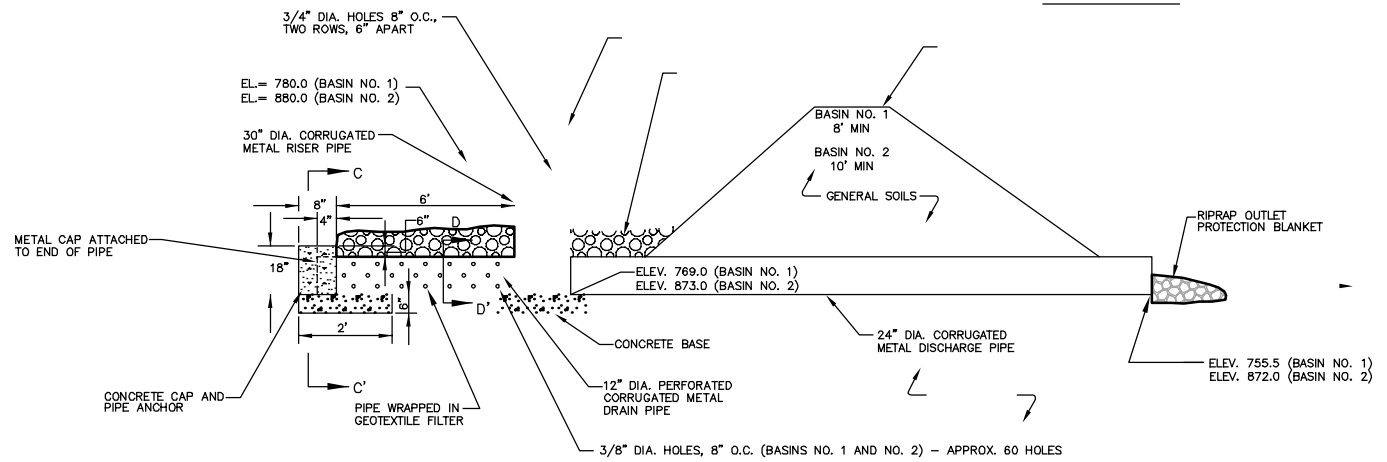
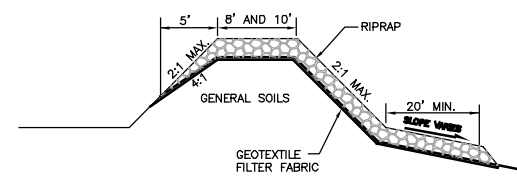
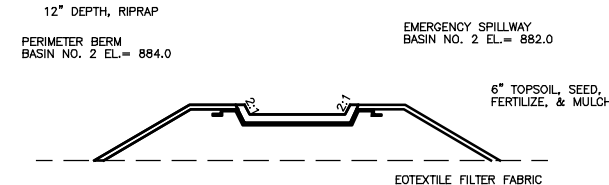
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**22** **SEDIMENTATION BASINS NO. 1 AND NO. 2**  
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**2**  
**22** **TEMPORARY SEDIMENTATION BASIN (TYPICAL)**  
(NOT TO SCALE)



**NOTE:**  
**SEDIMENTATION BASIN NO. 1 WILL HAVE A CULVERT**  
**PIPE INSTALLED FOR THE EMERGENCY OVERFLOW.**  
**SEE DETAIL 1 OF 22.**



**3**  
**22** **RISER/DISCHARGE PIPE/EMERGENCY SPILLWAY**  
(NOT TO SCALE)

LINE AND SHADING LEGEND	
---	GEOTEXTILE
----	GEOMEMBRANE
=====	GEOSYNTHETIC CLAY LINER (GCL)
	GEOCOMPOSITE
XXXXXX	TOPSOIL
XXXXXX	SELECT GRANULAR FILL DRAINAGE LAYER
XXXXXX	PIPE BEDDING MATERIAL
XXXXXX	SELECT AGGREGATE FILL
XXXXXX	COMPACTED SELECT LOW PERMEABILITY SOIL
XXXXXX	NATIVE SOIL
XXXXXX	CONCRETE
XXXXXX	RIPRAP
XXXXXX	GRAVEL
XXXXXX	GENERAL FILL

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NO.	BY	DATE	REVISION	APP'D.
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PROJECT: **DAIRYLAND POWER COOPERATIVE  
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BUFFALO COUNTY, WISCONSIN**

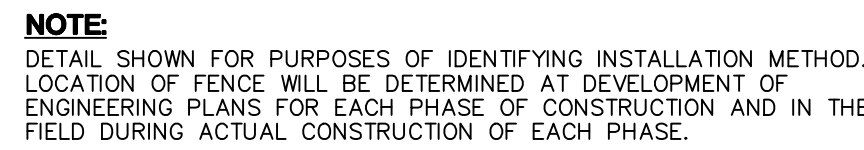
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CHECKED BY: DM	DATE PRINTED:	FILE NO. 30814007.dwg
APPROVED BY: BJK		SHEET 22 OF 23
DATE: OCTOBER 2000		

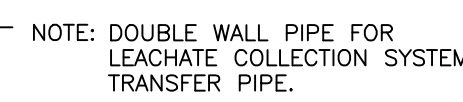
**RMT**

744 Heartland Trail  
Madison, WI 53717-1934  
P.O. Box 8923  
Madison, WI 53708-8923  
Phone: 608/631-4444

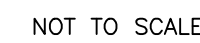
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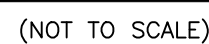
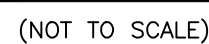
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**SECTION A-A'**



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PLAN OF OPERATION  
BUFFALO COUNTY, WISCONSIN**

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## **Appendix D: Estimated Control System Construction Schedule**

**Estimated Run-on and Run-off Structures Construction Schedule**  
**Run-on and Run-off Control System Plan**  
**Dairyland Power Cooperative, Alma Off-Site Disposal Facility**  
**Plan Modification- June 2024**

<b>Control System</b>	<b>System Components</b>	<b>Construction Event</b>	<b>Anticipated Year of Construction</b>
Run-on Control System	<ul style="list-style-type: none"> <li>- Sedimentation Basin 1</li> <li>- Perimeter Drainage Ditches around Cells 1-3</li> <li>- Temporary diversion berm on the northern boundary of Cell 3</li> <li>- Temporary retention basin on northern boundary of Cell 3</li> <li>- Downslope Flume and diversion berms in final cover</li> <li>- Stormwater culverts</li> </ul>	Currently Constructed	N/A
Run-off Control System	<ul style="list-style-type: none"> <li>- Leachate collection and transfer system for Cells 1 through 3</li> </ul>		
Run-on Control System	<ul style="list-style-type: none"> <li>- Perimeter Drainage Ditches around the northern perimeter of Cell 4A</li> <li>- Stormwater culverts beneath access road</li> <li>- Temporary diversion berm and drainage ditch within Cell 4B footprint</li> <li>- Temporary sedimentation basin east of Cell 4A</li> </ul>	Cell 4A Liner	2026
Run-off Control System	<ul style="list-style-type: none"> <li>- Leachate collection system for Cell 4A</li> </ul>		
Run-on Control System	<ul style="list-style-type: none"> <li>- Final Cover Diversion Berms and drainage outlets</li> </ul>	Cell 3 Final Cover	2029
Run-on Control System	<ul style="list-style-type: none"> <li>- Sedimentation Basin 2 construction</li> <li>- Perimeter drainage ditch around remainder of Cell 4</li> </ul>	Cell 4B Liner	2036
Run-off Control System	<ul style="list-style-type: none"> <li>- Leachate collection system for Cell 4B</li> </ul>		
Run-on Control System	<ul style="list-style-type: none"> <li>- Final Cover Diversion Berms and drainage outlets</li> </ul>	Cell 4A Final Cover	2038
Run-on Control System	<ul style="list-style-type: none"> <li>- Final Cover Diversion Berms and drainage outlets</li> </ul>	Cell 4B Final Cover	2057