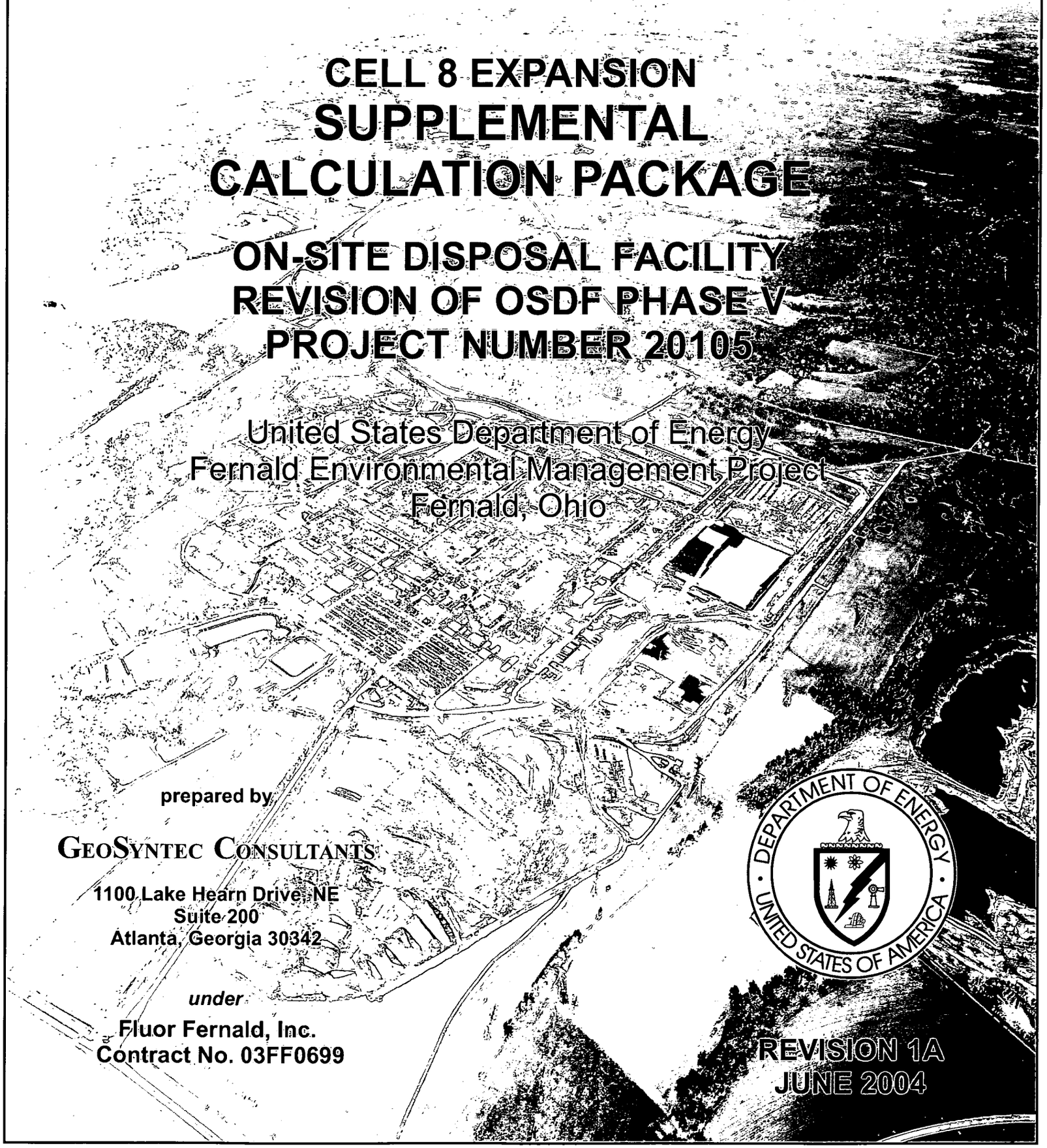
CELL 8 EXPANSION
SUPPLEMENTAL CALCULATION PACKAGE

ON-SITE DISPOSAL FACILITY
REVISION OF OSDF PHASE V
PROJECT NUMBER 20105

United States Department of Energy
Fernald Environmental Management Project
Fernald, Ohio



prepared by

GeoSyntec Consultants

1100 Lake Hearn Drive, NE
Suite 200
Atlanta, Georgia 30342

under

Fluor Fernald, Inc.
Contract No. 03FF0699

REVISION 1A
JUNE 2004

2.4 OSDF CAPACITY VERIFICATION – CELL 8 EXPANSION

COMPUTATION COVER SHEET

5529

SUBJECT OF COMPUTATIONS OSDF Capacity Calculation – Cell 8

Computations By:
(Cognizant Engineer)
Signature Leslie M. Griffin
Date 06-16-04
Printed Name Leslie M. Griffin
and Title Project Engineer

Assumptions and Procedures Checked By:
(Checker)
Signature Tamara E. Zettler
Date 16 June '04
Printed Name Tamara E. Zettler
and Title Engineer

Computations Checked by:
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Computations Backchecked by:
(Cognizant Engineer)
Signature Leslie M. Griffin
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Printed Name Leslie M. Griffin
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Approved by:
(PDP)
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Date 16 June '04
Printed Name Tamara E. Zettler
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Approved by:
(DTL and TETL)
Signature
Date
Printed Name Rudolph Bonaparte
and Title Principal

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval

000003

Written by: LMG Date: 6/16/2004 Reviewed by: TEZ Date: 06/16/04

Client: Flour Fernald Project: Cell 8 Expansion Project/Proposal No.: GQ3309 Task No.: 02

OSDF CAPACITY CALCULATION
CELL 8 EXPANSION

EXECUTIVE SUMMARY

PURPOSE OF ANALYSIS

The purpose of this calculation package is to present the OSDF capacity for Cell 8.

METHODS OF ANALYSIS

The capacity for Cell 8 was estimated using the computer program Autodesk® Civil Design 3 within Autodesk® Land Desktop 3.

CONCLUSIONS

The following table provides the estimated capacity for Cell 8.

	OSDF CAPACITY (CY)
CELL 8	397,219

OSDF CAPACITY CALCULATION
CELLS 7 AND 8

Table Of Contents

Written by: LMG Date: 6/16/2004 Reviewed by: TEZ Date: 06/16/04

Client: Flour Fernald Project: Cell 8 Expansion Project/Proposal No.: GQ3309 Task No.: 02

OSDF CAPACITY CALCULATION
CELL 8 EXPANSION

INTRODUCTION

PURPOSE OF ANALYSIS

The purpose of this calculation package is to present the OSDF capacity for Cell 8.

METHODS OF ANALYSIS

The capacity for Cell 8 was estimated using the computer program Autodesk® Civil Design 3 within Autodesk® Land Desktop 3.

Written by: LMG Date: 6/16/2004 Reviewed by: TEZ Date: 06/16/04

Client: Flour Fernald Project: Cell 8 Expansion Project/Proposal No.: GQ3309 Task No.: 02

OSDF CAPACITY CALCULATION
CELL 8
(Autodesk® PROCEDURES AND VOLUME RESULTS)

INTRODUCTION

The purpose of this section is to provide an overview of the Autodesk® procedures used to calculate the OSDF Cell 8 capacity and to present the capacity estimated using Autodesk®.

METHOD OF ANALYSIS

The Earthworks module of Autodesk® Civil Design 3 is used to compute volumes within Autodesk® Land Desktop 3 [Autodesk, 2001]. Earthworks calculates volumes based on a digital terrain model that represents each surface of interest. The surfaces used to compute the capacity of the OSDF Cell 8 are: (i) top of the leachate collection system (LCS) grading plan; and (ii) bottom of the contouring layer grading plan. Earthworks generates a triangular irregular network (TIN) to model each surface and uses the grid method to compute volume. The grid method calculates volumes using a grid system overlain on the two TIN surfaces. The volumes are calculated for each grid using the prismoidal volume between the surfaces, and then each grid volume is summed to give the total volume. For Cell 8, the volume is estimated using a parcel area defined by a vertical plane at the intercell berm between Cells 7 and 8. Figure1 provides an isopach representing the thickness of impacted material which can be placed in Cell 8 as well as the associated capacity of Cell 8.

Autodesk® RESULTS

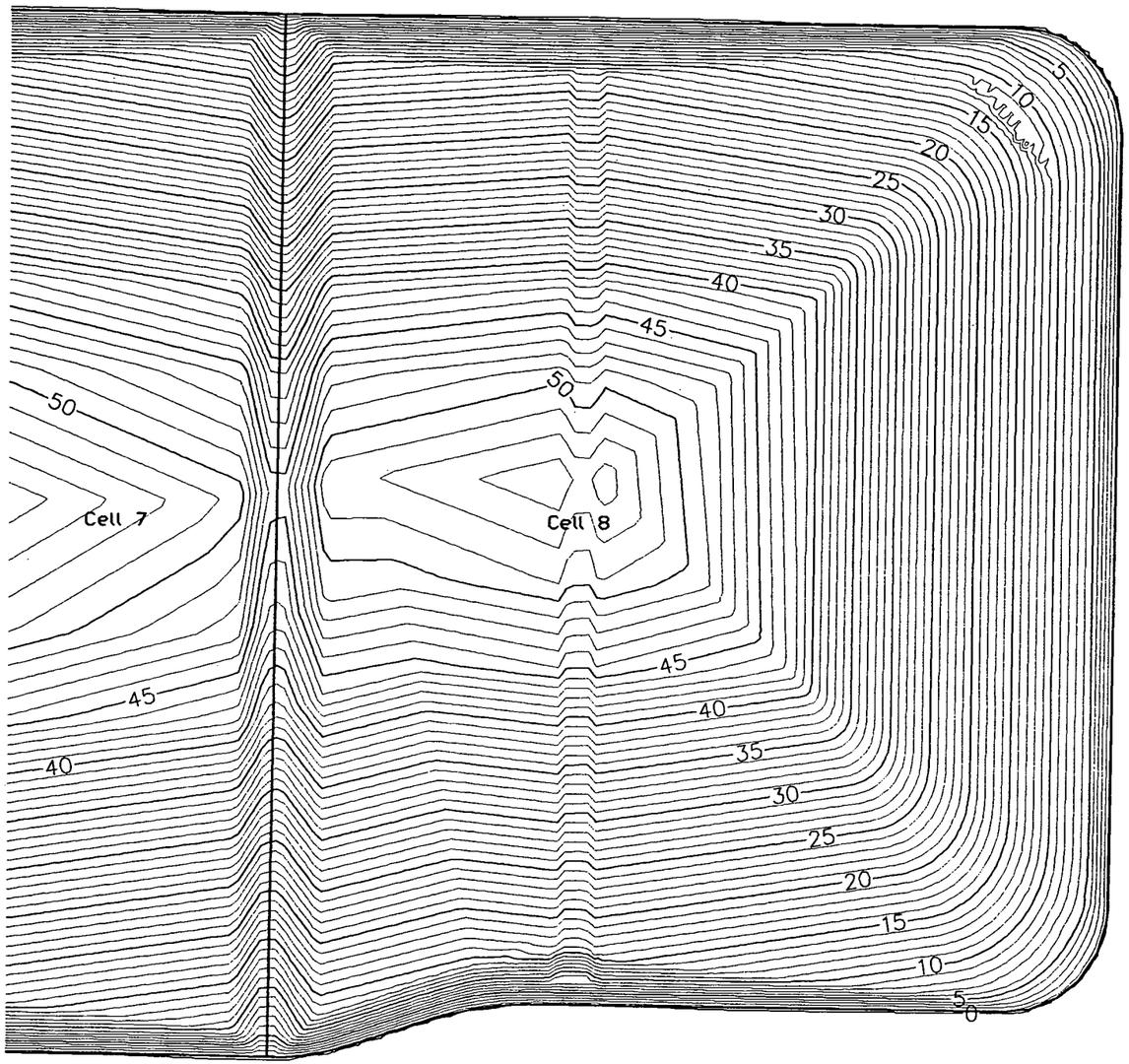
The following table provides the estimated capacity for Cell 8.

	OSDF CAPACITY (CY)
CELL 8	397,219

REFERENCES

Autodesk®, Inc., Autodesk® Civil Design Reference Manual, Henniker, NH, 2001.

5529



Parcel Volume Table: Unadjusted

Parcel	Stratum	Surf1	Surf2	Cut cu.yds	Fill cu.yds	Net cu.yds	Method
cell 8							
	top lcs layer	vs	bottom contouring layer	lcs 0	contouring 397219	397219 (F)	Grid

0 100
SCALE IN FEET

000008

GeoSyntec Consultants
ATLANTA, GA

PROJECT NO. GQ3309-02-02	FIGURE NO. 1
DOCUMENT NO. –	FILE NO. F04-F001.DWG

SECTION 7.3

7.3 CELL 8 IMPACTED RUNOFF CATCHMENT AREA REQUIREMENTS

5529

COMPUTATION COVER SHEET

SUBJECT OF COMPUTATIONS Cell 8 Impacted Runoff Catchment Area Requirements

Computations By:
(Cognizant Engineer)

Signature Tamara E. Zettler — Date 23 June 2004

Printed Name Tamara E. Zettler
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Assumptions and Procedures Checked By:
(Checker)

Signature Leslie M Griffin — Date 23 JUN 04

Printed Name Leslie M. Griffin
and Title Project Engineer

Computations Checked by:

Signature Leslie M Griffin — Date 23 JUN 04

Printed Name Leslie M. Griffin
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Computations Backchecked by:
(Cognizant Engineer)

Signature Tamara E. Zettler — Date 23 June 2004

Printed Name Tamara E. Zettler
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Approved by:
(PDP)

Signature Leslie M Griffin — Date 23 JUN 04

Printed Name Leslie M. Griffin
and Title Project Engineer

Approved by:
(DTL and TETL)

Signature _____ — Date _____

Printed Name Rudolph Bonaparte
and Title Principal

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
2A					

000010

GEOSYNTEC CONSULTANTS PAGE ___ OF ___

Written by: TEZ Date: 6/23/2004 Reviewed by: LMG Date: ___

Client: Fluor Fernald Project: Cell 8 Expansion Project No.: GQ3309 Task No.: 02

CELL 8 IMPACTED RUNOFF CATCHMENT AREA REQUIREMENTS (ADDENDUM TO SECTION 7.2)

The calculation package presented in Section 7.2 was prepared to establish minimum cell storage requirements for containment of impacted runoff during the filling of cells. The analyses shown in Section 7.2 are applicable for the northernmost and interior on-site disposal facility (OSDF) cells (i.e., Cells 1 to 7) where the maximum containment volume of the impacted runoff catchment area (IRCA) is limited by the minimum elevation of a rain flap installed along the intercell berm at the south edge of the IRCA. However, the southernmost OSDF cell (i.e., Cell 8) differs from the other cells in that: (i) Cell 8 is an end cell; and therefore, the maximum containment volume of the IRCA is limited by the minimum elevation of a rain flap installed along the Cell 8 perimeter; and (ii) Cell 8 has been expanded to the South to provide additional cell capacity.

This addendum to Section 7.2 was, therefore, prepared to verify the adequacy of the Cell 8 IRCA to contain impacted runoff from two cells (i.e., Cells 7 and 8) during the 25-year, 24-hour storm event with the required 0.5 ft of freeboard.

CELL 8 IMPACTED RUNOFF CATCHMENT AREA REQUIREMENTS
EXECUTIVE SUMMARY

PURPOSE OF ANALYSES

The purpose of this calculation package is to demonstrate the adequacy of the Cell 8 impacted runoff catchment area (IRCA) design in providing the necessary impacted runoff storage capacity from two cells (i.e., Cells 7 and 8) during the 25-year, 24-hour storm event with the required 0.5 ft of freeboard. The expected time for drawdown of impacted runoff within the IRCA is calculated to demonstrate that the design meets the required design criteria.

METHODS OF ANALYSES

The case modeled in this package represents conditions that exist when both Cells 7 and 8 are contributing impacted runoff to the Cell 8 IRCA. Analyses are separated into two groups:

i.) evaluation of IRCA storage capacity; and

ii.) evaluation of impacted runoff drawdown time.

IRCA Storage Capacity

The Cell 8 IRCA is designed to contain the runoff from two cells (i.e., Cells 7 and 8). As established in the calculation package presented in Section 7.2, the IRCA for Cells 1 through 7 was designed to have a North/South dimension of 250 ft measured from the centerline of the intercell berm and an East/West dimension of 185 ft measured from shoulder of the perimeter berm. This geometry provides a plan area of 46,250 ft^2.

Because Cell 8 is an end cell and has been expanded to a width greater than Cells 1 through 7, the IRCA dimensions have been modified to provide a more efficient design. Modifications include:

- The North/South dimension of the Cell 8 IRCA has been increased to approximately 415 ft. This will allow the IRCA to be located in the southwest corner of cell while still extending over the leachate collection corridor.
- The East/West dimension of the Cell 8 IRCA has been decreased to approximately 150 ft as measured from the crest of the protected clay layer.

As shown in Figure 1, the revised Cell 8 IRCA geometry provides a plan area of 60,948 ft^2, which is a larger IRCA plan area than that of Cells 1 through 7. This revised geometry is evaluated herein to verify the storage capacity of the IRCA based on the expanded size of Cell 8.

The IRCA is considered adequate if it complies with the design criteria used to evaluate the IRCAs for Cells 1 through 7 in Section 7.2, which requires the IRCA to provide storage capacity to handle the 25-year, 24-hour storm event with 0.5 ft of freeboard.

Drawdown Time

The amount of time expected for impacted runoff to drain from the IRCA after the completion of the 25-year, 24-hour storm event into the Cell 8 LCS is referred to; herein, as the drawdown time. The drawdown time is estimated for the revised Cell 8 IRCA geometry described earlier in this calculation package. The estimated drawdown time is controlled by the fact that the flowrate is limited by the capacity of the enhanced permanent leachate transmission system (EPLTS) permanent lift station pumps. A simplified calculation was performed where the volume of the IRCA is discharged at the maximum allowable flowrate of the EPLTS permanent lift station pumps (i.e., 200 gpm).

RESULTS

IRCA Storage Capacity

The results show that the required IRCA storage capacity is 212,215 ft^3, which is less than the provided IRCA storage capacity of 563,706 ft^3. Therefore, the revised Cell 8 IRCA geometry provides containment for runoff from two cells (i.e., Cells 7 and 8) during the 25-year, 24 hour storm event with the required 0.5 ft of freeboard.

Drawdown Time

The estimated drawdown time is limited by the capacity of the EPLTS. The EPLTS permanent lift station pumps provide a maximum allowable flowrate of 200 gpm, which results in an approximate drawdown time of 5.5 days.

CONCLUSIONS

The purpose of this calculation package was to demonstrate the adequacy of the revised Cell 8 IRCA geometry in providing the necessary impacted runoff storage capacity. The following conclusions are made based on the calculations performed in this package:

- The Cell 8 IRCA design provides adequate storage volume to contain the runoff for the 25-year, 24-hour storm event from two cells (i.e., Cells 7 and 8) with the required 0.5 ft of freeboard.
- Calculation results show that the design meets the applicable design criteria; therefore, the design is considered acceptable.

CELL 8 IMPACTED RUNOFF CATCHMENT AREA REQUIREMENTS
TABLE OF CONTENTS

CELL 8 IMPACTED RUNOFF CATCHMENT AREA REQUIREMENTS CALCULATION PROCEDURES

INTRODUCTION AND PURPOSE

The purpose of this calculation package is to demonstrate the adequacy of the Cell 8 impacted runoff catchment area (IRCA) design in providing the necessary impacted runoff storage capacity from two cells (i.e., Cells 7 and 8) during the 25-year, 24-hour storm event with the required 0.5 ft of freeboard. The expected time for drawdown of impacted runoff within the IRCA is calculated to demonstrate that the design meets the required design criteria.

DESIGN SCENARIOS

The case modeled in this package represents conditions that exist when both Cells 7 and 8 are contributing impacted runoff to the Cell 8 IRCA. Analyses are separated into two groups:

i.) evaluation of IRCA storage capacity; and

ii.) evaluation of impacted runoff drawdown time.

The Cell 8 IRCA is designed to contain the runoff from two cells (i.e., Cells 7 and 8). As established in the calculation package presented in Section 7.2, the IRCA for Cells 1 through 7 was designed to have a North/South dimension of 250 ft measured from the centerline of the intercell berm and an East/West dimension of 185 ft measured from the crest of the protective clay layer. This geometry provides a plan area of 46,250 ft^2.

Because Cell 8 is an end cell and has been expanded to a width greater than Cells 1 through 7, the IRCA dimensions have been modified to provide a more efficient design. Modifications include:

- The North/South dimension of the Cell 8 IRCA has been increased to approximately 415 ft. This will allow the IRCA to be located in the southwest corner of cell while still extending over the leachate collection corridor.

- The East/West dimension of the Cell 8 IRCA has been decreased to approximately 150 ft as measured from the crest of the protective clay layer.

As shown in Figure 1, the revised Cell 8 IRCA geometry provides a plan area of approximately 60,948 ft^2, which is a larger IRCA plan area than that of the IRCA for Cells 1 through 7. This revised geometry will be evaluated herein to verify the storage capacity of the IRCA based on the expanded Cell 8 footprint.

IRCA Storage Capacity

The required IRCA storage capacity (estimated volume of impacted runoff) will be shown to be adequate for containing the volume of impacted runoff from two cells by comparing the required capacity of the IRCA ($V_{required}$) to the actual provided capacity of the IRCA ($V_{provided}$). The revised Cell 8 IRCA geometry is shown in Figure 1.

Drawdown Time

The amount of time expected for impacted runoff to drain from the IRCA after the completion of the 25-year, 24-hour storm event into the Cell 8 LCS is referred to herein as the drawdown time. An estimate of the drawdown time is made for Cell 8 IRCA geometry represented in this calculation package. The estimate is controlled by the fact that the flowrate will be limited by the allowable capacity of the enhanced permanent leachate transmission system (EPLTS) permanent lift station pumps. A simplified calculation was performed where the volume of the IRCA is discharged at the maximum allowable flowrate of the EPLTS permanent lift station pumps (i.e., 200 gpm).

METHODS OF ANALYSIS

IRCA Storage Capacity

Required IRCA storage capacity calculations are performed using hydrologic and basin routing analyses as presented in TR-20 [USDA-SCS, 1982] and TR-55 [USDA-SCS, 1986]. Input parameters required for the analysis include: (i) rainfall from the design storm event (i.e., 25-year, 24-hour storm event); (ii) runoff curve numbers for the different areas contributing runoff; and (iii) the actual plan area for the areas contributing runoff.

Using the above described methods, the volume of runoff that is required to be stored in the Cell 8 IRCA can be calculated as:

$$V_{(required)} = R * A$$

where: $V_{(required)}$ = volume of runoff required to be stored in Cell 8 IRCA;

R = actual runoff; and

A = area contributing runoff.

The actual runoff (R) is calculated as:

$$R = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

where: P = rainfall from the design storm event;

S = potential maximum retention after runoff begins; and

$$S = \frac{1000}{CN} - 10$$

CN = runoff curve number.

For the calculation, the areas contributing runoff are separated to include: (i) Cell 7; (ii) Cell 8 outside of the IRCA; and (iii) the Cell 8 IRCA area.

The values for these parameters used herein are presented in the Data Verification Section of this calculation package. Further discussion of the significance of these input parameters can be found in Section 12.4 of the Revised Final Design Calculation Package On-Site Disposal Facility entitled "OSDF-Phase IV-Surface Water Management Design".

The volume of storage provided by the IRCA ($V_{provided}$) was calculated using the computer program Autodesk® Civil Design 3 within Autodesk® Land Desktop 3. Figure 2 shows the results of the volume calculation. The surfaces used to compute the IRCA capacity are: (i) top of the protective layer; and (ii) a flat surface projected across the 597.86 ft contour. This contour represents the maximum containment elevation of the IRCA minus 0.5 feet of freeboard.

The required depths for channels discharging to the IRCA will be calculated in subsequent revisions to this calculation package. However, it is anticipated that the channels provide adequate capacity with the required 0.5 ft of freeboard.

Drawdown Time

As mentioned earlier, the drawdown time is the amount of time expected for impacted runoff associated with a 25-year, 24-hour storm event to drain from the IRCA into the Cell 8 LCS. The drawdown time may be evaluated using Darcy's Law as shown below:

$$\Delta t = \frac{\Delta V}{kiA}$$

where: Δt = incremental drawdown time;

ΔV = incremental volume change;

k = permeability of the LCS drainage layer;

i = hydraulic gradient; and

A = area perpendicular to flow.

The drawdown time evaluated based on Darcy's Law, as noted above, is applicable to characterize liquid flow through the granular protective layer/LCS layer overlying the LCS corridor. This 'LCS corridor' drawdown time must be compared with the drawdown time associated with the allowable capacity of the EPLTS permanent lift station pumps, downstream of the LCS corridor. A simplified calculation may be performed where the volume of the IRCA is discharged at the maximum allowable flowrate of the EPLTS permanent lift station pumps (i.e., 200 gpm). The equation below shows the formula used to calculate the 'EPLTS limited' drawdown time:

$$t = \frac{V}{Q}$$

where: t = drawdown time;
V = required IRCA storage capacity for a given stage; and
Q = flow rate.

DESIGN CRITERIA

The calculations included in this package have been performed for the 25-year, 24-hour storm event as required by the Design Criteria Package (DCP), Revision [GeoSyntec, 2004]. For the Fernald Environmental Closure Project (FECP) property, this event has a rainfall intensity of 4.7 in. [Parsons, 1995].

IRCA Storage Capacity

The Cell 8 IRCA must be designed to contain impacted runoff from two cells during the 25-year, 24-hour storm event and shall provide at least 0.5 ft of freeboard from the minimum embankment crest elevation. As shown in Figure 2, the minimum elevation of the perimeter berm shoulder is 598.36 ft.

Drawdown Time

The drawdown time will be calculated and the results will be reported.

REFERENCES

GeoSyntec Consultants, *OSDF Final Design Criteria Package*, January 2004, Revision 1, United States Department of Energy, Fernald Environmental Closure Project, Fernald, Ohio, prepared by GeoSyntec Consultants, 2004.

Parsons, *2,000-Year Flood and Probable Maximum Flood Sitewide Flood Plain Determination*, CERCLA/RCRA Unit 2, Project Order 148, Fernald Environmental Management Project, Rev. A, Fairfield, OH, August 1995.

U.S. Department of Agriculture (USDA-SCS), *Urban Hydrology for Small Watersheds, Technical Release 55 (TR-55)*, 2nd ed. Washington, D.C., Soil Conservation Service, 1986.

U.S. Department of Agriculture (USDA-SCS), *Technical Release Number 20 (TR-20)*, Soil Conservation Service, 1982.

CELL 8 IMPACTED RUNOFF CATCHMENT AREA REQUIREMENTS DATA VERIFICATION

INTRODUCTION

This section presents the selection of parameters used to perform analyses in the Calculation Results section of this calculation package. The input parameters will be discussed in terms of the types of calculations being performed as part of this package.

INPUT PARAMETERS

IRCA Storage Capacity

As discussed in the Calculation Procedures section, the required IRCA storage capacity was computed using hydrologic and basin routing analyses as presented in TR-20 [USDA-SCS, 1982] and TR-55 [USDA-SCS, 1986]. Input parameters required for the analysis include: (i) rainfall during the design storm event (i.e., 25-year, 24-hour storm event); (ii) runoff curve numbers for the different areas contributing runoff; and (iii) the actual plan area for the areas contributing runoff.

The design storm event in this analysis is the 25-year, 24-hour storm event, which has a rainfall intensity of 4.7 in. [Parsons, 1995]. The runoff curve number for the entire OSDF was set as CN = 91 as established in Section 7.2 for a newly graded area of the soil type found at the OSDF. However, for the Cell 8 IRCA a CN of 100 is assumed because all rainfall that falls within the IRCA should be counted as runoff. The areas are established from the Construction Drawings and are shown in Figure 1.

Drawdown Time

As discussed in the Calculation Procedures section of this package, the 'LCS corridor' controlled drawdown time may be computed using Darcy's Law. The parameters needed for this analysis include: (i) the permeability of the LCS drainage layer, k (ft/s); (ii) the hydraulic gradient, i (ft/ft); and (iii) the area perpendicular to flow, A (ft). The input values used for the drawdown analysis are shown below:

where: k = 0.0033 ft/s (minimum permeability of the LCS drainage and granular protective layer as required by the specifications);
i = 1 (conservatively); and
A = 2,445 ft^2.

The simplified calculation performed to provide an estimate of the drawdown times controlled by the allowable capacity of the EPLTS permanent lift station pumps requires the

following input parameters: (i) volume of required IRCA storage capacity, V; and (ii) the flowrate of the leachate, Q. The volume of required IRCA storage capacity was computed as a part of the IRCA storage capacity calculations in this calculation package. The flowrate of the leachate is that of the EPLTS permanent lift station pumps, which has been established as 200 gpm.

REFERENCES

Parsons, *2,000-Year Flood and Probable Maximum Flood Sitewide Flood Plain Determination*, CERCLA/RCRA Unit 2, Project Order 148, Fernald Environmental Management Project, Rev. A, Fairfield, OH, August 1995.

U.S. Department of Agriculture (USDA-SCS), *Urban Hydrology for Small Watersheds, Technical Release 55 (TR-55)*, 2nd ed. Washington, D.C., Soil Conservation Service, 1986.

U.S. Department of Agriculture (USDA-SCS), *Technical Release Number 20 (TR-20)*, Soil Conservation Service, 1982.

CELL 8 IMPACTED RUNOFF CATCHMENT AREA REQUIREMENTS CALCULATIONS

INTRODUCTION

This section presents calculations and results based on procedures and data presented in the Calculation Procedures and Data Verification sections of this calculation package.

CALCULATIONS AND RESULTS

IRCA Storage Capacity

The Cell 8 IRCA is considered adequate if it complies with the design criteria used to evaluate the IRCAs for Cells 1 through 7 in Section 7.2, which requires the IRCA to provide storage capacity for runoff from two cells to handle the 25-year, 24-hour storm event with 0.5 ft of freeboard. As discussed in the Calculation Procedures section, the required IRCA storage capacity was computed using hydrologic and basin routing analyses as presented in TR-20 [USDA-SCS, 1982] and TR-55 [USDA-SCS, 1986]. The calculations can be found in Attachment A-1.

The results show that the required IRCA storage capacity is 212,215 ft^3, which is less than the provided IRCA storage capacity of 563,706 ft^3. Therefore, the revised Cell 8 IRCA geometry provides containment for runoff from two cells (i.e., Cells 7 and 8) during the 25-year, 24 hour storm event with the required 0.5 ft of freeboard.

Drawdown Time

The amount of time expected for impacted runoff to drain from the IRCA after the completion of the 25-year, 24-hour storm event into the Cell 8 LCS is referred to herein as the drawdown time. An estimation of the drawdown time is made in this calculation package. Analyses indicated that the estimated drawdown time is limited by the capacity of the EPLTS. The EPLTS permanent lift station pumps provide a maximum allowable flowrate of 200 gpm, which results in an approximate drawdown time of 5.5 days. The calculations can be found in Attachment A-2.

CONCLUSIONS

The following conclusions are made based on the calculations performed in this package:

- The IRCA for Cell 8 will provide adequate containment volume for impacted runoff from the 25-year, 24-hour storm event from two cells (i.e., Cells 7 and 8).

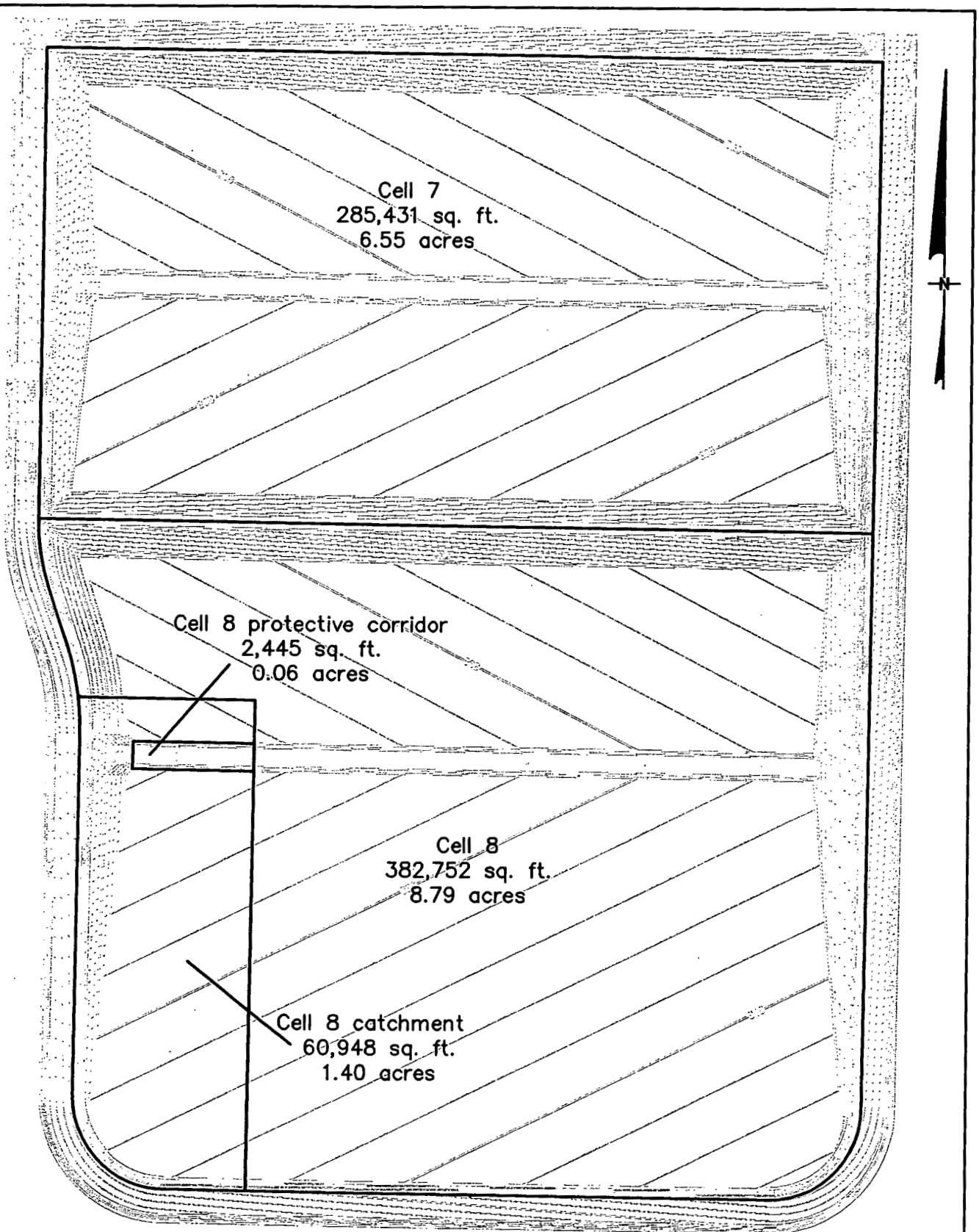
- Calculation results show that the design meets the applicable design criteria; therefore, the design is considered acceptable.

REFERENCES

U.S. Department of Agriculture (USDA-SCS), *Urban Hydrology for Small Watersheds, Technical Release 55 (TR-55)*, 2nd ed. Washington, D.C., Soil Conservation Service, 1986.

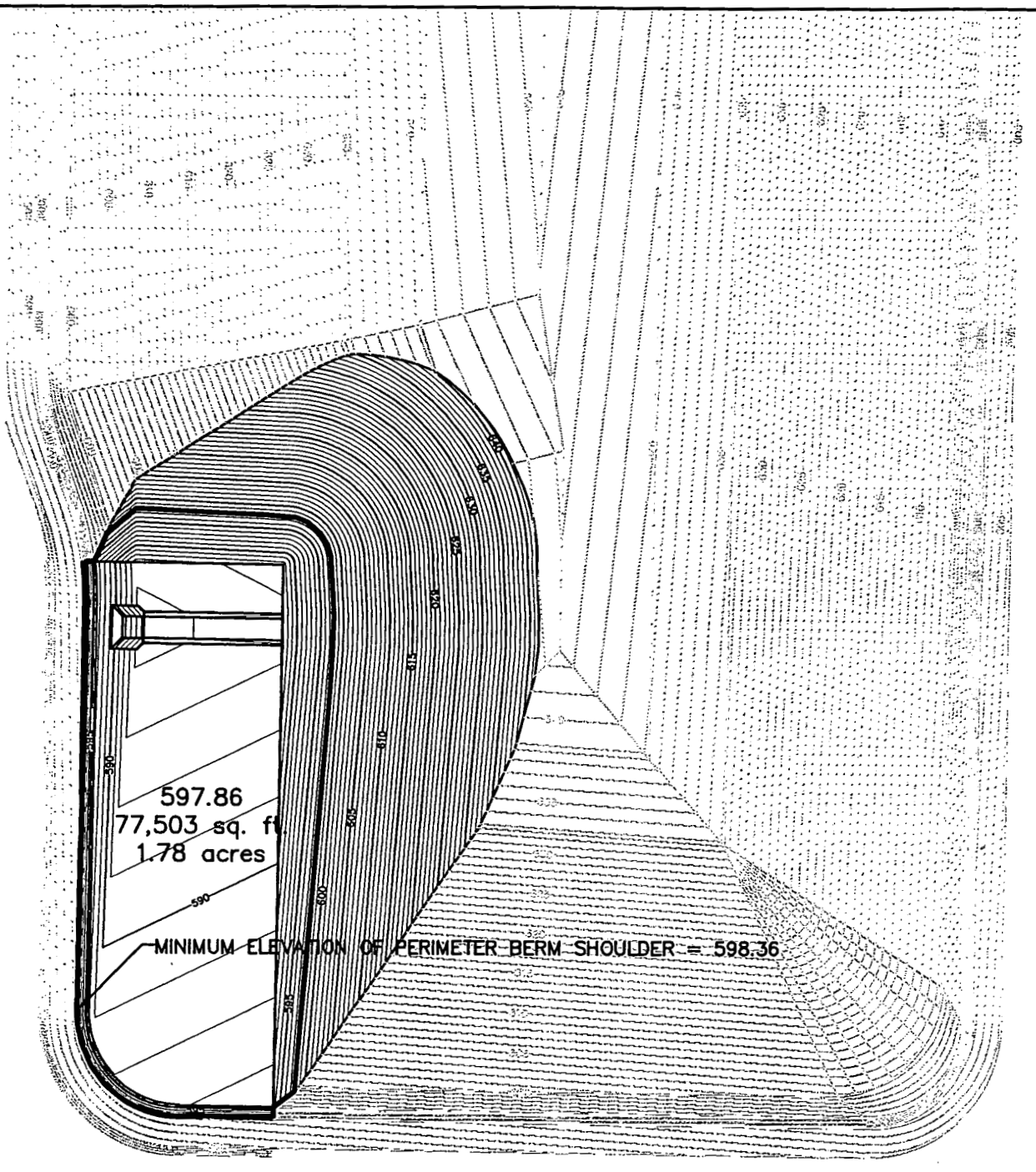
U.S. Department of Agriculture (USDA-SCS), *Technical Release Number 20 (TR-20)*, Soil Conservation Service, 1982.

FIGURES



GEOSYNTEC CONSULTANTS
ATLANTA, GEORGIA

FIGURE NO.	1
PROJECT NO.	GQ3309-02-02
DOCUMENT NO.	F04200010
FILE NO.	F04-F003.DWG



Parcel Volume Table: Unadjusted

Parcel	Stratum	Surf1	Surf2	Cut cu.yds	Fill cu.yds	Net cu.yds	Method
597.86							
	150 protective	vs	597.86	150 feet protective	597.86		
				0	20878	20878 (F)	Grid

NOTE:

CONTAINMENT ELEVATION OF IRCA = 598.36' − 0.5' = 597.86'

0 120

SCALE IN FEET

000028

GeoSyntec Consultants

ATLANTA, GEORGIA

FIGURE NO.	2
PROJECT NO.	GQ3309-02-02
DOCUMENT NO.	F0420010
FILE NO.	F04-F004.DWG

ATTACHMENT A-1

IRCA CAPACITY CALCULATIONS

GEOSYNTEC CONSULTANTS

Written by: TEZ Date: 04/06/23 (YY/MM/DD) Reviewed by: LMG Date: ___/___/___ (YY/MM/DD)

Client: EF Project: Cell 8 Expansion Project/Proposal No.: 6033609 Task No.: 02.03

REQUIRED IRCA CAPACITY (SCS Method)

$$V = (RA)_{CELL\,7} + (RA)_{cell\,8-IRCA} + (RA)_{IRCA}$$

where R = actual runoff
A = area contributing runoff

⇒ R

$$R = \frac{(P - 0.2S)^2}{P + 0.8S}$$

where P = rainfall from design storm event = 4.7"

$$S = \frac{1000}{CN} - 10$$

where CN = 91 for cell 7 area and cell 8 area outside of the IRCA
CN = 100 for inside IRCA

S = 0.989 for Cell 7 & Cell 8 outside of IRCA
S = 0 for Cell 8 IRCA area

$$R_{cell\,7\,\&\,cell\,8\,outside\,IRCA} = \frac{(4.7" - 0.2(0.989))^2}{4.7" + 0.8(0.989)} = 3.69" = 0.3076'$$

$$R_{cell\,8\,IRCA\,area} = 4.7" = 0.392'$$

⇒ A (see Figure 1)

$A_{cell\,7} = 285{,}431\ ft^2$

$A_{cell\,8-IRCA} = (387{,}752\ ft^2 - 60{,}948\ ft^2) = 326{,}804\ ft^2$

$A_{IRCA} = 60{,}948\ ft^2$

⇒ V_{REQ}

$$V_{REQ} = (0.3076')(285{,}431\ ft^2) + (0.3076)(326{,}804\ ft^2) + (0.392')(60{,}948\ ft^2)$$

$$V_{req} = 213{,}215\ ft^3$$

GEOSYNTEC CONSULTANTS

Written by: TEZ Date: 04/06/23 (YY/MM/DD) Reviewed by: LMG Date: ___/___/___ (YY/MM/DD)

Client: FF Project: CELL B EXPANSION Project/Proposal No.: 603309 Task No.: 02

PROVIDED IRCA CAPACITY

- calculation computed using the computer program Autodesk® Civil Design 3 within Autodesk® Land Desktop 3.

V_{prov} = (see Fig 2) = 20,878 cy = 563,706 cf

563,706 >> 212,215
V_{prov} >> V_{req} ✓

Written by: TEZ Date: 6/23/2004 Reviewed by: LMG Date: _____

Client: Fluor Fernald Project: Cell 8 Expansion Project No.: GQ3309 Task No.: 02

ATTACHMENT A-2

IRCA DRAWDOWN CALCULATION

GEOSYNTEC CONSULTANTS

Page ____ of ____

Written by: TEZ Date: 04/06/23 (YY/MM/DD) Reviewed by: LMG Date: ___/___/___ (YY/MM/DD)

Client: EP Project: CELL B EXPANSION Project/Proposal No.: GG3309 Task No.: 02.02

IMPACTED RUNOFF CATCHMENT AREA DRAWDOWN ESTIMATE

- Drawdown is estimated using Darcy's Law

$$Q = kiA$$

where $k = 0.1$ cm/s $= 0.0033$ ft/sec
for LCS + granular protective

$i = 1$ (conservatively)

$A = 2,445$ ft^2
(see Fig 1)

Estimated flow rate = $Q = kiA$

$Q = (0.0033 \text{ ft/sec})(1)(2,445 \text{ ft}^2)$

$= 8.069$ ft^3/s $=$

$= 3,629$ gpm

$Q \gg 200$ GPM ∴ = Max pump rate of EPLTS governs.

∴ Drawdown is limited by EPLTS Lift Station Pump

$$t_{drawdown} = \frac{V}{Q}$$

V = volume = 212,215 ft^3
(see Attachment 1)

Q = 200 gpm

$$t = \frac{212,215 (7.481 \text{ gal/ft}^3)}{200 \text{ gpm}} = 7,938 \text{ min}$$

$= \underline{5.5 \text{ days}}$.

SECTION 7.4

7.4 LEACHATE GENERATION RATES – CELL 8 SUPPLEMENT

5529

COMPUTATION COVER SHEET

SUBJECT OF COMPUTATIONS OSDF PHASE V, LEACHATE GENERATION RATES – CELL 8 SUPPLEMENT

Computations By: (Cognizant Engineer)
Signature: R. Kulasingam — Date: 1-23-04
Printed Name and Title: Ramachandran Kulasingam, Senior Staff Engineer

Assumptions and Procedures Checked By: (Checker)
Signature: GANESH GOPALAKRISHNAN — Date: 1-23-04
Printed Name and Title: for Leslie M. Griffin, Engineer

Computations Checked by:
Signature: Hollie N. Kinnecom — Date: 1-23-04
Printed Name and Title: Hollie N. Kinnecom, Staff Engineer

Computations Backchecked by: (Cognizant Engineer)
Signature: R. Kulasingam — Date: 1-23-04
Printed Name and Title: Ramachandran Kulasingam, Senior Staff Engineer

Approved by: (PDP)
Signature: — Date: 1-23-04
Printed Name and Title: for Leslie M. Griffin, Engineer

Approved by: (DTL/TETL)
Signature: Rudolph Bonaparte — Date: 23 Jan 04
Printed Name and Title: R. Bonaparte, Principal

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
1A	DCN CELL 8 EXPANSION	16 JUN 2004	RK/PR	LHG/RC	

000035

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

ADDENDUM TO SECTION 7.1
(ADDED TO REVISION 1 PACKAGE)

The Calculation Package "Leachate Generation Rates" presented in Section 7.1 estimated leachate generation rates for different stages of the life of the Fernald On-Site Disposal Facility (OSDF). These rates were used to evaluate the performance of the leachate collection system (LCS), leak detection system (LDS), and leachate transfer system (LTS) in other Calculation Packages. The rates were calculated based on a cell 400 feet wide and 6.5 acres in size. This size cell applies to the northernmost and interior OSDF cells (i.e., Cells 1 to 7). The southernmost OSDF cell (i.e., Cell 8) is sized differently from the other cells.

This addendum to Section 7.1 presents leachate generation rates for Cell 8. Similar methods and input data to that used in Section 7.1 were used herein. This addendum is presented as Section 7.4 of the OSDF Final Design Calculation Package, and is titled, "Leachate Generation Rates – Cell 8 Supplement". Section 7.4 is presented in Volume VII of the OSDF Final Design Calculation Package.

GEOSYNTEC CONSULTANTS

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

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Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEACHATE GENERATION RATES – CELL 8 SUPPLEMENT EXECUTIVE SUMMARY

PURPOSE OF ANALYSIS

The purpose of this analysis is to estimate leachate generation rates for different stages of the life of the Fernald On-Site Disposal Facility (OSDF) Cell 8. These rates will be used to evaluate the performance of the leachate collection system (LCS) and leak detection system (LDS).

METHOD OF ANALYSIS

The U.S. Environmental Protection Agency (USEPA) Hydrologic Evaluation of Landfill Performance (HELP) model, Version 3.07, was used to estimate leachate generation rates for Cell 8 of the OSDF.

CONCLUSIONS

Leachate Generation Rates for Cell 8

- Peak daily for active stage (i.e., 10 ft of waste) = 1754 gpad
- Peak daily for post-closure stage = ~~0.024~~ 0.054 gpad
- Average annual for active stage (i.e., 10 ft of waste) = 1261 gpad
- Average annual for post-closure stage = 0.002 gpad
- Baseline design flow rate during active operations = ~~11,050~~ 14,032 gpd
- Baseline design flow rate after closure = ~~0.15~~ 0.43 gpd

05/12/04

Note that the above design flow rates do not account for large peak flows associated with the storm design basis flow rate or incremental flows that may occur from the consolidation of impacted materials. The storm design basis flow rate is addressed in Calculation Package "LTS Gravity Line Flow Capacity" and Calculation Package "LTS Pipe Hydrograph". The potential effects of

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Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

impacted material consolidation on the leachate generation rates are addressed in Appendix B of the Calculation Package "Leachate Generation Rates".

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEACHATE GENERATION RATES – CELL 8 SUPPLEMENT CALCULATION PROCEDURES

INTRODUCTION

The purpose of this analysis is to estimate leachate generation rates for different stages of the life of the Fernald On-Site Disposal Facility (OSDF) Cell 8.

GENERAL DESCRIPTION OF CELL 8

The southernmost cell of the OSDF, Cell 8, is sized differently than the northernmost and interior cells (Cells 1 through 7). Cells 1 through 7 are approximately 700 feet long and 400 feet wide with a cell area of 6.5 acres. Cell 8 is designed approximately 650 feet long and ~~425~~ 540 feet wide with a cell area of 6.3 acres. 8.0

PR 05/12/04

LEACHATE GENERATION ANALYSIS

Generally, the analysis procedures presented in the Calculation Package "Leachate Generation Rates" are followed in these calculation packages. The U.S. Environmental Protection Agency (USEPA) Hydrologic Evaluation of Landfill Performance (HELP) model, Version 3.07 [Schroeder, et al., 1994a, b], is used to estimate leachate generation rates for Cell 8 of the OSDF.

Analyses were presented in the Calculation Package "Leachate Generation Rates" for three cases representing three different stages in the life of the OSDF. Based on these calculation results, it was determined that Case 1 is the critical case during active operation and Case 3 after closure of the OSDF. Therefore, leachate generation calculations for Cell 8 are performed for Cases 1 and 3 only in this calculation package.

The Calculation Package "Leachate Generation Rates" sub-classified Case 1 as 1A and 1B, and Case 3 as 3A, 3B, 3C, and 3D based on the different material types used to model certain layers in the

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OSDF. Based on the analysis results presented in that Calculation Package, it was determined that Case 1B, and Case 3D (or 3C) are the critical cases that need to be considered for further analyses. Therefore, in this Calculation Package analyses are performed for Cases 1B (active condition) and 3D (post-closure condition).

REFERENCES

Schroeder, P.R., Lloyd, C.M., and Zappi, P.A. (1994a). "*The Hydrologic Evaluation of Landfill Performance (HELP) Model: User's Guide for Version 3.*" U.S. Environmental Protection Agency, Office of the Research and Development, Washington D.C., Report No. EPA/600/R-94/168a, 83 p. (plus appendix).

Schroeder, P.R., Dozier, T.S., Zappi, P.A., McEnroe, B.M., Sjostrom, J.W., and Peyton, R.L. (1994b). "*The Hydrologic Evaluation of Landfill Performance (HELP) Model: Engineering Documentation for Version 3.*" U.S. Environmental Protection Agency, Office of the Research and Development, Washington D.C., Report No. EPA/600/R-94/168b, 116 p.

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEACHATE GENERATION RATES – CELL 8 SUPPLEMENT
HELP MODEL INPUT PARAMETERS

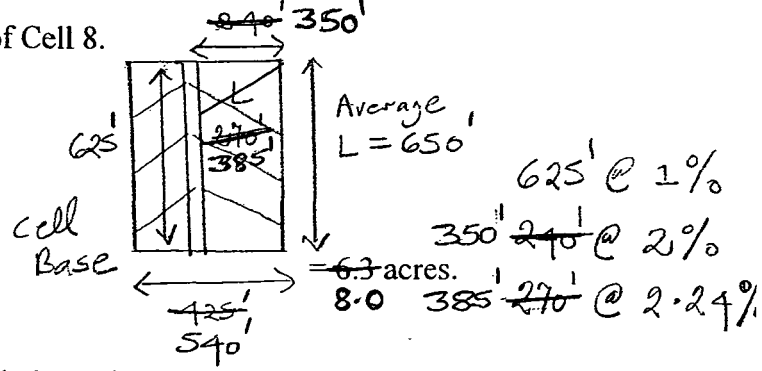
OBJECTIVE

To select values for the input parameters of HELP to model Cell 8 of the Fernald OSDF. Values are selected for Cases 1B and 3D for Cell 8. The following input parameters used for these cases are the same as the ones used in the Calculation Package "Leachate Generation Rates" presented in Section 7.1.

Weather Data Requirements

- Evaporation data
- Precipitation data
- Temperature data
- Solar radiation data

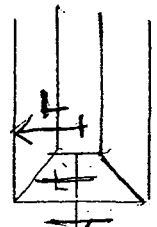
The following input parameters used for these cases are the same as the ones used in the Calculation Package "Leachate Generation Rates" presented in Section 7.1, except for the changes presented below to account for the new geometry of Cell 8.



Soil and Design data Requirements

- Landfill General Information
  - Cell area = ~~6.3~~ 8.0 acres.
- Layer Data
  - Drainage path length for the LCS drainage layer = ~~270~~ 385 ft; and
  - Drainage path length for the final cover = ~~480~~ 510 ft.
- Runoff Curve Number
  - calculated by the program based on the new input parameters

– Hydraulic conductivity of LCS and LDS drainage layers = 1 cm/s (based on test results from Fernald site)



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Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEACHATE GENERATION RATES – CELL 8 SUPPLEMENT

COMPUTATION RESULTS

The leachate generation rates were estimated for Case 1 (active condition) and Case 3 (post-closure condition). The HELP program output files are included at the end of this Calculation Package as appendix A. The results for the HELP analyses are summarized in Table 1.

Calculation of Baseline Design Flow Rates for Cell 8

- Peak daily for active stage (i.e., 10 ft of waste) = 1754 gpad
- Peak daily for post-closure stage = ~~0.024~~ 0.054 gpad
- Average annual for active stage (i.e., 10 ft of waste) = 1261 gpad
- Average annual for post-closure stage = 0.002 gpad
- Baseline design flow rate during active operations = ~~11,050 gpd~~ 14,032 gpd
- Baseline design flow rate after closure = ~~0.15~~ 0.43 gpd

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Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

Table 1. Summary of HELP Model Results

Case	Average Annual Totals (in)							Peak Daily Values (in)				
	P[1]	R[2]	E[3]	LD[4]	H_{avg}[5]	I[6]		P	R	LD	H_{avg} (H_{max}[7])	I
Case 1B	40.26	0	23.26	~~16.95~~ 16.96	~~0.99~~ 0.14	~~$6.0X10^{-5}$~~ $1.0X10^{-5}$		4.7	0	0.0646	~~1.375~~ 0.196 ~~(2.497)~~ 0.385	~~$2.4X10^{-7}$~~ $3.3X10^{-8}$
Case 3D	40.34	~~4.76~~ 4.75	27.50	$3.0X10^{-5}$	0	$2.5X10^{-6}$		13.0	8.29	~~$9.0X10^{-7}$~~ $2.0X10^{-6}$	0 ~~(0.005)~~ 0	$5.5X10^{-9}$

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Notes:

[1]P = Precipitation

[2]R = Runoff

[3]E = Evaporation

[4]LD = Lateral drainage in LCS drainage corridor

[5]H_{avg} = Average head above the primary geomembrane liner

[6]I = Infiltration through primary geomembrane liner

[7]H_{max} = Maximum head above the primary geomembrane liner

Appendix A

HELP Model Outputs

CASE1B8R

ph 05/13/04

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

PRECIPITATION DATA FILE: H:\Projects\Fernald\Cell8\Case1B.D4
TEMPERATURE DATA FILE: H:\Projects\Fernald\Cell8\Case1B.D7
SOLAR RADIATION DATA FILE: H:\Projects\Fernald\Cell8\Case1B.D13
EVAPOTRANSPIRATION DATA: H:\Projects\Fernald\Cell8\Case1B.D11
SOIL AND DESIGN DATA FILE: H:\Projects\Fernald\Cell8\Case1B8R.D10
OUTPUT DATA FILE: H:\Projects\Fernald\Cell8\Case1B8R.OUT

TIME: 15:32 DATE: 5/12/2004

****

TITLE: Fernald OSDF - Case 1B

****

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

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 31

THICKNESS	=	120.00	INCHES
POROSITY	=	0.5780	VOL/VOL
FIELD CAPACITY	=	0.0760	VOL/VOL
WILTING POINT	=	0.0250	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1790	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.410000002000E-02	CM/SEC

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER

CASE1B8R

MATERIAL TEXTURE NUMBER 26

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4450	VOL/VOL
FIELD CAPACITY	=	0.3930	VOL/VOL
WILTING POINT	=	0.2770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3930	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.190000003000E-05	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0320	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	1.00000000000	CM/SEC
SLOPE	=	2.24	PERCENT
DRAINAGE LENGTH	=	385.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER

MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	0.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	1.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 5

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.25	INCHES
POROSITY	=	0.7500	VOL/VOL
FIELD CAPACITY	=	0.7470	VOL/VOL
WILTING POINT	=	0.4000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.7500	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000003000E-08	CM/SEC

LAYER 6

CASE1B8R

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0320	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	1.00000000000	CM/SEC
SLOPE	=	2.24	PERCENT
DRAINAGE LENGTH	=	385.0	FEET

LAYER 7

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	0.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	1.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 8

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	36.25	INCHES
POROSITY	=	0.4290	VOL/VOL
FIELD CAPACITY	=	0.4200	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4290	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.819999997000E-07	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #31 WITH BARE GROUND CONDITIONS, A SURFACE SLOPE OF 5.% AND A SLOPE LENGTH OF 540. FEET.

SCS RUNOFF CURVE NUMBER	=	96.80	
FRACTION OF AREA ALLOWING RUNOFF	=	0.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	1.725	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	6.936	INCHES

CASE1B8R

LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.300	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	42.698	INCHES
TOTAL INITIAL WATER	=	42.698	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
CINCINNATI OHIO

STATION LATITUDE	=	39.29	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	104	
END OF GROWING SEASON (JULIAN DATE)	=	295	
EVAPORATIVE ZONE DEPTH	=	12.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	9.10	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	70.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	73.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	72.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR COVINGTON KENTUCKY

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.13	2.73	3.95	3.58	3.84	4.09
4.28	2.97	2.91	2.54	3.12	3.00

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR CINCINNATI OHIO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR CINCINNATI OHIO
AND STATION LATITUDE = 39.29 DEGREES

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CASE1B8R
AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.42	2.87	3.77	3.69	3.83	4.10
	4.42	2.86	2.79	2.35	3.22	2.94
STD. DEVIATIONS	1.59	1.34	1.48	1.54	1.84	2.18
	1.94	1.59	1.78	1.10	1.36	1.21
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.623	0.556	1.887	2.884	3.050	2.900
	3.205	2.290	1.874	1.653	1.373	0.965
STD. DEVIATIONS	0.271	0.310	0.589	0.753	0.960	1.012
	1.037	0.982	0.811	0.520	0.332	0.255
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	1.1201	1.2394	1.4275	1.8232	1.8697	1.7071
	1.5949	1.4525	1.3479	1.2918	1.0952	0.9858
STD. DEVIATIONS	0.6491	0.4902	0.4945	0.2690	0.3086	0.4044
	0.5309	0.6138	0.5907	0.6096	0.5642	0.5468
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 6						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 8						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

CASE1B8R
AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.1096	0.1332	0.1397	0.1843	0.1829	0.1726
	0.1561	0.1421	0.1363	0.1264	0.1107	0.0965
STD. DEVIATIONS	0.0635	0.0530	0.0484	0.0272	0.0302	0.0409
	0.0520	0.0601	0.0597	0.0596	0.0570	0.0535

DAILY AVERAGE HEAD ON TOP OF LAYER 7

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES	CU. FEET	PERCENT
PRECIPITATION	40.26 (5.552)	146142.4	100.00
RUNOFF	0.000 (0.0000)	0.00	0.000
EVAPOTRANSPIRATION	23.260 (2.6639)	84432.33	57.774
LATERAL DRAINAGE COLLECTED FROM LAYER 3	16.95500 (3.94392)	61546.664	42.11419
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00001 (0.00000)	0.032	0.00002
AVERAGE HEAD ON TOP OF LAYER 4	0.141 (0.033)		
LATERAL DRAINAGE COLLECTED FROM LAYER 6	0.00001 (0.00000)	0.023	0.00002
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.00000 (0.00000)	0.009	0.00001
AVERAGE HEAD ON TOP OF LAYER 7	0.000 (0.000)		
CHANGE IN WATER STORAGE	0.045 (3.0368)	163.32	0.112

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CASE1B8R

PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	4.70	17061.000
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 3	0.06463	234.60274
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00012
AVERAGE HEAD ON TOP OF LAYER 4	0.196	
MAXIMUM HEAD ON TOP OF LAYER 4	0.385	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	6.3 FEET	
DRAINAGE COLLECTED FROM LAYER 6	0.00000	0.00010
PERCOLATION/LEAKAGE THROUGH LAYER 8	0.000000	0.00002
AVERAGE HEAD ON TOP OF LAYER 7	0.000	
MAXIMUM HEAD ON TOP OF LAYER 7	0.027	
LOCATION OF MAXIMUM HEAD IN LAYER 6 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	7.68	27876.4355

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.5780
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0275

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

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

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FINAL WATER STORAGE AT END OF YEAR 100

LAYER	(INCHES)	(VOL/VOL)
1	25.8107	0.2151
2	4.8788	0.4066
3	0.3844	0.0320

4	0.0000	0.0000
5	0.1875	0.7500
6	0.3840	0.0320
7	0.0000	0.0000
8	15.5512	0.4290
SNOW WATER	0.000	

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CASE3D8R

05/13/04

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0
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********************************************************************************
**                                                                            **
**                                                                            **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE                 **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                  **
**                DEVELOPED BY ENVIRONMENTAL LABORATORY                       **
**                USAE WATERWAYS EXPERIMENT STATION                           **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY                **
**                                                                            **
**                                                                            **
********************************************************************************
********************************************************************************


PRECIPITATION DATA FILE:     H:\Projects\Fernald\Cell8\Case3D.D4
TEMPERATURE DATA FILE:       H:\Projects\Fernald\Cell8\Case3D.D7
SOLAR RADIATION DATA FILE:   H:\Projects\Fernald\Cell8\Case3D.D13
EVAPOTRANSPIRATION DATA:     H:\Projects\Fernald\Cell8\Case3D.D11
SOIL AND DESIGN DATA FILE:   H:\Projects\Fernald\Cell8\Case3D8R.D10
OUTPUT DATA FILE:            H:\Projects\Fernald\Cell8\Case3D8R.OUT


TIME:  16: 8     DATE:   5/12/2004


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

     TITLE:  Fernald OSDF - Case 3D

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


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


                                  LAYER  1
                                  --------

                  TYPE 1 - VERTICAL PERCOLATION LAYER
                      MATERIAL TEXTURE NUMBER  10
        THICKNESS                     =      6.00   INCHES
        POROSITY                      =      0.3980 VOL/VOL
        FIELD CAPACITY                =      0.2440 VOL/VOL
        WILTING POINT                 =      0.1360 VOL/VOL
        INITIAL SOIL WATER CONTENT    =      0.2324 VOL/VOL
        EFFECTIVE SAT. HYD. COND.     =  0.119999997000E-03 CM/SEC
      NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  4.63
               FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.


                                  LAYER  2
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CASE3D8R

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	21.00	INCHES
POROSITY	=	0.4000	VOL/VOL
FIELD CAPACITY	=	0.3000	VOL/VOL
WILTING POINT	=	0.2000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2929	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999975000E-04	CM/SEC

LAYER 3

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 2

THICKNESS	=	6.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.0620	VOL/VOL
WILTING POINT	=	0.0240	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1842	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.579999993000E-02	CM/SEC

LAYER 4

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	36.00	INCHES
POROSITY	=	0.3500	VOL/VOL
FIELD CAPACITY	=	0.0300	VOL/VOL
WILTING POINT	=	0.0100	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0300	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	100.000000000	CM/SEC

LAYER 5

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0528	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000001000	CM/SEC
SLOPE	=	13.40	PERCENT
DRAINAGE LENGTH	=	510.0	FEET

LAYER 6

CASE3D8R

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	0.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	1.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 7

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	24.25	INCHES
POROSITY	=	0.4300	VOL/VOL
FIELD CAPACITY	=	0.4210	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4300	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.750000027000E-07	CM/SEC

LAYER 8

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 26

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4450	VOL/VOL
FIELD CAPACITY	=	0.3930	VOL/VOL
WILTING POINT	=	0.2770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3930	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.190000003000E-05	CM/SEC

LAYER 9

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 26

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4450	VOL/VOL
FIELD CAPACITY	=	0.3930	VOL/VOL
WILTING POINT	=	0.2770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3930	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.190000003000E-05	CM/SEC

LAYER 10

CASE3D8R

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 31

THICKNESS	=	408.00	INCHES
POROSITY	=	0.5780	VOL/VOL
FIELD CAPACITY	=	0.0760	VOL/VOL
WILTING POINT	=	0.0250	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0760	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.410000002000E-02	CM/SEC

LAYER 11

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 26

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4450	VOL/VOL
FIELD CAPACITY	=	0.3930	VOL/VOL
WILTING POINT	=	0.2770	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3930	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.190000003000E-05	CM/SEC

LAYER 12

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0320	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	1.00000000000	CM/SEC
SLOPE	=	2.24	PERCENT
DRAINAGE LENGTH	=	385.0	FEET

LAYER 13

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	0.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	1.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

CASE3D8R

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.25	INCHES
POROSITY	=	0.7500	VOL/VOL
FIELD CAPACITY	=	0.7470	VOL/VOL
WILTING POINT	=	0.4000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.7500	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000003000E-08	CM/SEC

LAYER 15

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	12.00	INCHES
POROSITY	=	0.3970	VOL/VOL
FIELD CAPACITY	=	0.0320	VOL/VOL
WILTING POINT	=	0.0130	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0320	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	1.00000000000	CM/SEC
SLOPE	=	2.24	PERCENT
DRAINAGE LENGTH	=	385.0	FEET

LAYER 16

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	0.06	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	0.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	1.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

LAYER 17

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	36.25	INCHES
POROSITY	=	0.4290	VOL/VOL
FIELD CAPACITY	=	0.4200	VOL/VOL
WILTING POINT	=	0.3670	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4290	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.819999997000E-07	CM/SEC

CASE3D8R

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE #10 WITH A GOOD STAND OF GRASS, A SURFACE SLOPE OF 13.% AND A SLOPE LENGTH OF 510. FEET.

SCS RUNOFF CURVE NUMBER	=	80.70	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	30.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	8.162	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	12.099	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	5.088	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	82.454	INCHES
TOTAL INITIAL WATER	=	82.454	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM CINCINNATI OHIO

STATION LATITUDE	=	39.29	DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50	
START OF GROWING SEASON (JULIAN DATE)	=	104	
END OF GROWING SEASON (JULIAN DATE)	=	295	
EVAPORATIVE ZONE DEPTH	=	30.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	9.10	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	70.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	73.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	72.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR COVINGTON KENTUCKY

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.13	2.73	3.95	3.58	3.84	4.09
4.28	2.97	2.91	2.54	3.12	3.00

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR CINCINNATI OHIO

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC

28.90	32.10	41.80	53.50	63.00	71.40
75.40	74.10	67.50	55.30	43.40	33.80

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR CINCINNATI OHIO
AND STATION LATITUDE = 39.29 DEGREES

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 100

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.42	2.87	3.77	3.69	3.83	4.10
	4.51	2.86	2.79	2.35	3.22	2.94
STD. DEVIATIONS	1.59	1.34	1.48	1.54	1.84	2.18
	2.35	1.59	1.78	1.10	1.36	1.21
RUNOFF						
TOTALS	1.120	1.872	1.188	0.033	0.024	0.078
	0.149	0.024	0.034	0.017	0.042	0.166
STD. DEVIATIONS	1.338	1.405	1.738	0.086	0.067	0.162
	0.967	0.068	0.085	0.054	0.098	0.541
EVAPOTRANSPIRATION						
TOTALS	0.591	0.554	1.884	3.468	4.478	4.139
	4.251	3.158	2.016	1.242	0.969	0.748
STD. DEVIATIONS	0.208	0.278	0.564	0.622	1.154	1.494
	1.475	1.478	0.941	0.327	0.182	0.178
LATERAL DRAINAGE COLLECTED FROM LAYER 5						
TOTALS	0.9298	0.6222	2.1590	1.0906	0.4276	0.1304
	0.1822	0.0666	0.0869	0.1549	0.7798	1.4604
STD. DEVIATIONS	1.0578	0.8332	1.1118	1.0386	0.6576	0.3134
	0.6282	0.1837	0.3076	0.3843	1.1033	1.0827
PERCOLATION/LEAKAGE THROUGH LAYER 7						
TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LATERAL DRAINAGE COLLECTED FROM LAYER 12						

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 14

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LATERAL DRAINAGE COLLECTED FROM LAYER 15

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 17

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 6

AVERAGES	0.2050	0.1504	0.4760	0.2484	0.0943	0.0297
	0.0402	0.0147	0.0198	0.0341	0.1776	0.3220
STD. DEVIATIONS	0.2332	0.2014	0.2451	0.2366	0.1450	0.0714
	0.1385	0.0405	0.0701	0.0847	0.2513	0.2387

DAILY AVERAGE HEAD ON TOP OF LAYER 13

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

DAILY AVERAGE HEAD ON TOP OF LAYER 16

AVERAGES	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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CASE3D8R

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 100

	INCHES		CU. FEET	PERCENT
PRECIPITATION	40.34	(5.640)	146443.7	100.00
RUNOFF	4.747	(2.9201)	17233.12	11.768
EVAPOTRANSPIRATION	27.498	(3.4202)	99818.46	68.162
LATERAL DRAINAGE COLLECTED FROM LAYER 5	8.09031	(3.22816)	29367.822	20.05401
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.00003	(0.00001)	0.125	0.00009
AVERAGE HEAD ON TOP OF LAYER 6	0.151	(0.061)		
LATERAL DRAINAGE COLLECTED FROM LAYER 12	0.00003	(0.00001)	0.116	0.00008
PERCOLATION/LEAKAGE THROUGH LAYER 14	0.00000	(0.00000)	0.009	0.00001
AVERAGE HEAD ON TOP OF LAYER 13	0.000	(0.000)		
LATERAL DRAINAGE COLLECTED FROM LAYER 15	0.00000	(0.00000)	0.000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 17	0.00000	(0.00000)	0.009	0.00001
AVERAGE HEAD ON TOP OF LAYER 16	0.000	(0.000)		
CHANGE IN WATER STORAGE	0.007	(1.1735)	24.12	0.016

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 100

	(INCHES)	(CU. FT.)
PRECIPITATION	13.00	47190.000
RUNOFF	8.285	30074.0723
DRAINAGE COLLECTED FROM LAYER 5	0.71752	2604.58472
PERCOLATION/LEAKAGE THROUGH LAYER 7	0.000003	0.00916
AVERAGE HEAD ON TOP OF LAYER 6	4.903	

MAXIMUM HEAD ON TOP OF LAYER 6	9.401	
LOCATION OF MAXIMUM HEAD IN LAYER 5 (DISTANCE FROM DRAIN)	12.3 FEET	
DRAINAGE COLLECTED FROM LAYER 12	0.00000	0.00752
PERCOLATION/LEAKAGE THROUGH LAYER 14	0.000000	0.00002
AVERAGE HEAD ON TOP OF LAYER 13	0.000	
MAXIMUM HEAD ON TOP OF LAYER 13	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 12 (DISTANCE FROM DRAIN)	0.0 FEET	
DRAINAGE COLLECTED FROM LAYER 15	0.00000	0.00000
PERCOLATION/LEAKAGE THROUGH LAYER 17	0.000000	0.00002
AVERAGE HEAD ON TOP OF LAYER 16	0.000	
MAXIMUM HEAD ON TOP OF LAYER 16	0.005	
LOCATION OF MAXIMUM HEAD IN LAYER 15 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	7.68	27876.4355

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3527
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.1696

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

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

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FINAL WATER STORAGE AT END OF YEAR 100

LAYER	(INCHES)	(VOL/VOL)
1	2.3608	0.3935
2	6.4209	0.3058
3	0.7823	0.1304
4	1.0800	0.0300

5	0.3845	0.0320
6	0.0000	0.0000
7	10.4275	0.4300
8	4.7160	0.3930
9	4.7160	0.3930
10	31.0080	0.0760
11	4.7160	0.3930
12	0.3840	0.0320
13	0.0000	0.0000
14	0.1875	0.7500
15	0.3840	0.0320
16	0.0000	0.0000
17	15.5512	0.4290
SNOW WATER	0.000	

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SECTION 8.4

8.4 MAXIMUM HEAD IN LCS – CELL 8 SUPPLEMENT

COMPUTATION COVER SHEET

SUBJECT OF COMPUTATIONS OSDF PHASE V, MAXIMUM HEAD IN LCS – CELL 8 SUPPLEMENT

Computations By:
(Cognizant Engineer)

Signature R. Kulasingam — Date 1-23-04

Printed Name Ramachandran Kulasingam
and Title Senior Staff Engineer

Assumptions and Procedures Checked By:
(Checker)

Signature for GANESH GOPALAKRISHNAN — Date 1-23-04

Printed Name for Leslie M. Griffin
and Title Engineer

Computations Checked by:

Signature Hollie N. Kinnecom — Date 1-23-04

Printed Name Hollie N. Kinnecom
and Title Staff Engineer

Computations Backchecked by:
(Cognizant Engineer)

Signature R. Kulasingam — Date 1-23-04

Printed Name Ramachandran Kulasingam
and Title Senior Staff Engineer

Approved by:
(PDP)

Signature for — Date 1-23-04

Printed Name for Leslie M. Griffin
and Title Engineer

Approved by:
(DTL/TETL)

Signature Rudolph Bonaparte — Date 23 Jan 04

Printed Name R. Bonaparte
and Title Principal

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
1A	DCN CELL 8 EXPANSION	16 JUN 2004	RK/RK	LHG / RC	

000065

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

ADDENDUM TO SECTION 8.1
(ADDED TO REVISION 1 PACKAGE)

The Final Design Calculation Package "Leachate Collection System (LCS) Maximum Head in the LCS" presented in Section 8.1 evaluated the performance of the drainage layer and drainage corridor components of the LCS. Specifically the package estimated (i) average and maximum leachate head and liquid thickness for the drainage layer; and (ii) average and maximum leachate head and liquid thickness and flow capacity for the drainage corridor. The performance of the drainage layer and drainage corridor was evaluated using baseline design flow rates applicable to the northernmost and interior OSDF cells (i.e., Cells 1 to 7). Baseline design flow rates for the southernmost OSDF cell (i.e., Cell 8) are presented in Section 7.4 and will be utilized in this package.

This addendum to Section 8.1 evaluated the performance of the drainage layer and drainage corridor for Cell 8. Similar methods and input data to that used in Section 8.1 were used herein. This addendum is presented as Section 8.4 of the OSDF Final Design Calculation Package, and is titled, "Leachate Collection System (LCS) Maximum Head in the LCS – Cell 8 Supplement". Section 8.4 is presented in Volume VII of the OSDF Final Design Calculation Package.

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

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Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEACHATE COLLECTION SYSTEM (LCS) MAXIMUM HEAD IN LCS - CELL 8 SUPPLEMENT EXECUTIVE SUMMARY

PURPOSE OF ANALYSIS

The purpose of this analysis is to evaluate the performance of the drainage layer and the drainage corridor components of the leachate collection system (LCS) for Cell 8 of the Fernald On-site Disposal Facility (OSDF).

METHOD OF ANALYSIS

Drainage Layer: The maximum and average hydraulic head, and the maximum and average liquid thickness in the drainage layer were calculated using the USEPA HELP model and a closed-form analytical solution.

Drainage Corridor: The maximum and average hydraulic head, and maximum and average liquid thickness in the drainage corridor were calculated using a closed-form analytical solution. The flow capacity of the drainage corridor was calculated to verify its ability to convey leachate.

Calculations were performed for the active operation condition and for the post-closure (i.e., post-settlement) condition. Baseline design flow rates established in the "Leachate Generation Rates – Cell 8 Supplement" Calculation Package were utilized in the calculations. These flow rates do not account for large peak flows associated with the storm design basis flow rate.

CONCLUSIONS

ACTIVE OPERATION CONDITION:

Drainage Layer:

- maximum leachate head, h_{max} = ~~2.5~~ 0.38 in. < 12 in. (O.K.)
- average leachate head, h_{avg} = ~~1.3~~ 0.19 in.
- maximum liquid thickness, T_{max} = ~~2.5~~ 0.38 in.
- average liquid thickness, T_{avg} = ~~1.3~~ 0.19 in.

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PR 05/12/04

Written By: RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

Drainage Corridor:

- maximum leachate head, h_{max} = ~~3.3~~ 4.16 in. < 12 in. (O.K.)
- average leachate head, h_{avg} = ~~1.9~~ 2.33 in.
- maximum liquid thickness, T_{max} = ~~3.3~~ 4.16 in.
- average liquid thickness, T_{avg} = ~~1.9~~ 2.33 in.
- drainage corridor capacity, Q_{DC} = 23.6 gpm
- required flow capacity, Q_R = ~~7.7~~ 9.8 gpm
- flow capacity factor of safety, Q_{DC}/Q_R = ~~3.1 (equal to target rate of 3, O.K.)~~ 2.4

The DCP does not require a target factor of safety for the flow capacity of the drainage corridor material. However, the DCP does require a target factor of safety for the flow capacity of the leachate collection pipes equal to 3. This factor of safety is calculated in section 8.5.

POST-CLOSURE CONDITION:

Drainage Layer:

- maximum leachate head, h_{max} = 3.81x10^{-5} ~~in.~~ 1.21 X 10^{-5} in. < 12 in. (O.K.)
- average leachate head, h_{avg} = ~~1.91x10^{-5}~~ 6.05 X 10^{-6} in.
- maximum liquid thickness, T_{max} = ~~3.81x10^{-5}~~ 1.21 X 10^{-5} in.
- average liquid thickness, T_{avg} = ~~1.91x10^{-5}~~ 6.05 X 10^{-6} in.

Drainage Corridor:

- maximum leachate head, h_{max} = ~~1.32x10^{-4}~~ 3.72 X 10^{-4} in. < 12 in. (O.K.)
- average leachate head, h_{avg} = ~~6.59x10^{-5}~~ 1.86 X 10^{-4} in.
- maximum liquid thickness, T_{max} = ~~1.32x10^{-4}~~ 3.72 X 10^{-4} in.
- average liquid thickness, T_{avg} = ~~6.59x10^{-5}~~ 1.86 X 10^{-4} in.
- drainage corridor capacity, Q_{DC} = 9.42 gpm
- required flow capacity, Q_R = ~~1.08x10^{-4}~~ 3.04 X 10^{-4} gpm
- flow capacity factor of safety, Q_{DC}/Q_R = ~~87.5x10^{3} (much greater than target value of 10, O.K.)~~ 3.1X10^{4}

Ph 05/12/04

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The DCP does not require a target factor of safety for the flow capacity of the drainage corridor material. However, the DCP does require a target factor of safety for the flow capacity of the leachate collection pipe equal to 10. If during post closure the capacity of the pipes was to decrease, then the flow capacity of the corridor is more than adequate. Ph 05/12/04

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEACHATE COLLECTION SYSTEM (LCS)
MAXIMUM HEAD IN LCS - CELL 8 SUPPLEMENT
CALCULATION PROCEDURES

INTRODUCTION

The purpose of this package is to present the calculation procedures for the leachate collection system for Cell 8 of the OSDF. In particular, this package addresses the following analyses:

- drainage layer (average and maximum leachate head and liquid thickness); and
- drainage corridor (average and maximum leachate head and liquid thickness, and flow capacity).

METHODS OF ANALYSIS

This calculation package uses the same method of analysis as the one presented in Section 8.1, "Leachate Collection System (LCS) Maximum Head in LCS" in the Final Design Calculation Package.

Written By: RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

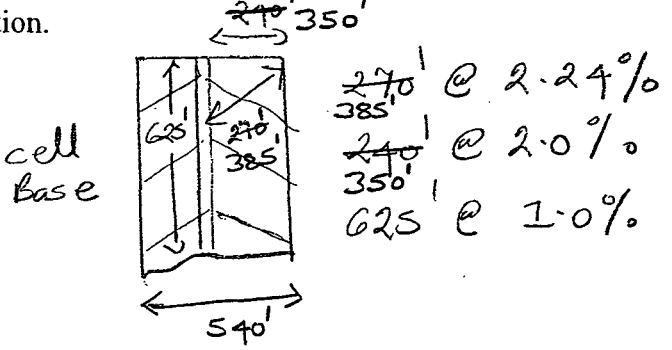
LEACHATE COLLECTION SYSTEM (LCS)
MAXIMUM HEAD IN LCS - CELL 8 SUPPLEMENT
DATA VERIFICATION

INTRODUCTION

The purpose of this package is to present the data parameters needed to perform the calculations for the leachate collection system for Cell 8 of the OSDF. In particular, this package addresses the following analyses:

- drainage layer (average and maximum leachate head and liquid thickness); and
- drainage corridor (average and maximum leachate head and liquid thickness, and flow capacity).

In order to perform the analyses the data presented in the Calculation Package "Leachate Collection System (LCS) Maximum Head in LCS" is used, except that the slope lengths, cell area, and flow rates are revised based on the Calculation Package "Leachate Generation Rates – Cell 8 Supplement" as described in the following section.



ACTIVE OPERATION CONDITION:

DRAINAGE LAYER

Leachate Head:

q_i = the maximum impingement rate of flow into the drainage layer = 0.0646 in. /day (peak daily value from HELP leachate generation analyses results; Case 1B) = 1.9×10^{-6} cm/sec

L = the length of the slope = ~~270~~ 385 ft (3240 in.)

k = Hydraulic Conductivity = 1 cm/s

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DRAINAGE CORRIDOR

Leachate Head: The impingement rate of flow into the drainage corridor is calculated by multiplying the impingement rate of flow into the drainage layer by (width of cell / width of drainage corridor). Therefore,

$q_{i\,dc}$ = (0.0646 in./day) x (~~425~~ 540 ft/ 16 ft) = ~~1.716~~ 2.180 in. /day (peak daily value) = ~~5.04×10^{-5}~~ 6.41×10^{-5} cm/sec

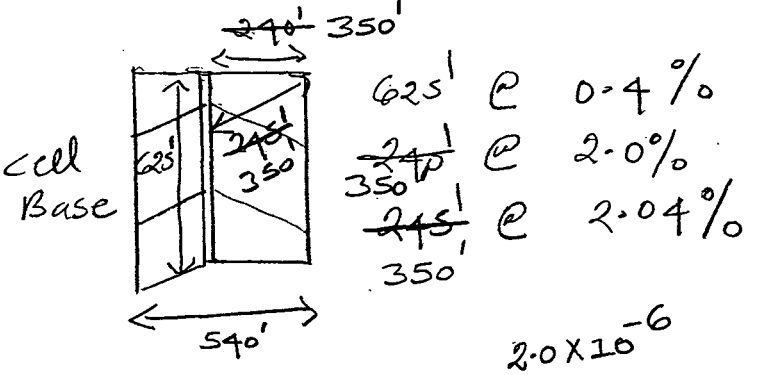
L = the length of the drainage corridor = 625 ft (7500 in.)

05-12-04

Written By: RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

POST-CLOSURE CONDITION:



DRAINAGE LAYER

Leachate Head:

q_i = the maximum impingement rate of flow into the drainage layer = ~~9.0×10^{-7}~~ 2.0×10^{-6} in. /day (peak daily value from HELP leachate generation analyses results; Case 3D) = ~~2.65×10^{-11}~~ 5.88×10^{-11} cm/sec

L = the length of the slope = ~~245~~ 350 ft (2940 in.)

K = Hydraulic Conductivity = 1 cm/s

DRAINAGE CORRIDOR

Leachate Head: The impingement rate of flow into the drainage corridor is calculated by multiplying the impingement rate of flow into the drainage layer by (width of cell / width of drainage corridor) as shown in Figure 2. Therefore, 6.8×10^{-5} 1.98×10^{-9}

$q_{i\ dc}$ = (~~9.0×10^{-7}~~ 2.0×10^{-6} in./day) x (~~425~~ 540 ft/ 16 ft) = ~~2.4×10^{-5}~~ in. /day (peak daily value) = ~~7.06×10^{-10}~~ cm/sec

L = the length of the drainage corridor = 625 ft (7500 in.)

05/12/04

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEACHATE COLLECTION SYSTEM (LCS)
MAXIMUM HEAD IN LCS - CELL 8 SUPPLEMENT
CALCULATION RESULTS

Hand calculations were performed for the active condition case. A spreadsheet was used to repeat the calculations for the active case and perform calculations for post-closure case. These calculation results are presented in the following pages.

Written by: RK Date: 03/12/03 Reviewed by: LMG Date: 03/12/09

Client: Ehsan Fonrald Project: OSDF - Revise Phase V Project/Proposal No.: GQ3211 Task No.: 06

DRAINAGE LAYER (ACTIVE OPERATION CONDITION)

LEACHATE HEAD

$$\lambda = \frac{q_i}{k \tan^2\beta} = \frac{1.9\times10^{-6}\ \text{cm/s}}{(\cancel{0.1\ \text{cm/s}}\ 1\ \text{cm/s})\tan^2(1.28^\circ)}$$

$$\lambda = \cancel{0.038}\ 0.0038$$

$$j = 1 - 0.12\ \exp\left[-\left[\log\left(\frac{8\lambda}{5}\right)^{\frac{5}{8}}\right]^2\right]$$

$$j = 1 - 0.12\ \exp\left[-\left[\log\left(\frac{8\times\overset{0.0038}{\cancel{0.038}}}{5}\right)^{\frac{5}{8}}\right]^2\right]$$

$$j = \cancel{0.933}\ 0.982$$

$$T_{max} = j\left[\frac{\sqrt{1+4\lambda}-1}{2}\cdot\frac{\tan\beta}{\cos\beta}\right]L$$

$$= \underset{0.982}{(\cancel{0.933})}\left[\frac{\sqrt{1+(4)(\overset{0.0038}{\cancel{0.033}})}-1}{2}\cdot\frac{\tan(1.28^\circ)}{\cos(1.28^\circ)}\right]\overset{385'}{\cancel{270'}}$$

$$= \cancel{2.48''}\ 0.38''$$

$$h_{max} = T_{max}\cos\beta$$

$$= \underset{0.38}{(\cancel{2.48})}\cos(1.28^\circ)$$

$$= \underset{0.38''}{\cancel{2.48''}} < 12''\ \text{ok}$$

For $\lambda = \cancel{0.038}\ 0.0038$

$$\frac{T_{ave}}{T_{max}} = \cancel{0.54}\ 0.50$$

$$T_{ave} = \underset{0.50}{(0.54)}\ \underset{0.38}{(\cancel{2.48})} = \underset{0.19''}{\cancel{1.34''}}$$

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plr 05/12/09

GEOSYNTEC CONSULTANTS

Written by: RK Date: 03/12/03 (YY/MM/DD) Reviewed by: LMG Date: 03/12/09 (YY/MM/DD)

Client: Fluor Fernald Project: OSDF – RPV Project/Proposal No.: GO 3211 Task No.: 06

$h_{ave} = T_{ave} \cos\beta$

$= (0.19) \cos(1.28^\circ)$

$= 0.19''$

$h_{max} = \frac{2.5''}{0.38''} < 12''$ ← allowable head ok

$T_{max} = \frac{2.5''}{0.38''} < 12''$ ← thickness of drainage layer ok

Phw
05/12/04

Written by: RK Date: 03/12/03 (YY/MM/DD) Reviewed by: LMG Date: 12/03/09 (YY/MM/DD)

Client: Ehmar Fernald Project: OSDF-RPV Project/Proposal No.: GR3211 Task No.: 06

DRAINAGE CORRIDOR (ACTIVE OPERATION CONDITION)

LEACHATE HEAD 6.41×10^{-5}

~~$q_i = 5.04 \times 10^{-5}$~~ cm/s 6.41×10^{-5}

$$\lambda = \frac{q_i}{k \tan^2\beta} = \frac{\text{~~}5.04\times10^{-5}\text{~~ cm/s}}{(10\text{cm/s})(\tan^2(0.573^\circ))}$$

$\lambda = $ ~~0.050~~ 0.064

$$j = 1 - 0.12 \exp\left[-\left[\log\left(\frac{8\lambda}{5}\right)^{\frac{5}{8}}\right]^2\right]$$

$j = $ ~~0.924~~ 0.918

$$T_{max} = j\left[\frac{\sqrt{1+4\lambda}-1}{2}\,\frac{\tan\beta}{\cos\beta}\right]L$$

$$= \underset{0.918}{(\text{~~0.924~~})}\left[\frac{\sqrt{1+(4)(\overset{0.064}{\text{~~0.050~~}})}-1}{2}\,\frac{\tan(0.573)}{\cos(0.573)}\right]\times 7500$$

$= $ ~~3.34~~ $4.16''$

$h_{max} = T_{max}\cos\beta$

$= \underset{4.16}{(\text{~~3.34~~})}\cos(0.573)$

$= $ ~~3.34~~ $4.16''$

ph 05/12/04

Written by: RK Date: 03/12/03 Reviewed by: LMA Date: 03/12/09

Client: Fluor Fernald Project: OSDF-RPV Project/Proposal No.: CQ3211 Task No.: 06

For $\lambda = \cancel{0.050}\ 0.064$

$\frac{T_{ave}}{T_{max}} = 0.56$ $\quad 4.16$

$T_{ave} = (0.56)(\cancel{3.34})$

$= \cancel{1.87''}\ 2.33''$

$h_{ave} = T_{ave}\cos\beta$

$= (\overset{2.33}{\cancel{1.87}})\cos(0.573)$

$= \cancel{1.87''}\ 2.33''$

$h_{max} = \frac{\cancel{3.34''}}{4.16''} < 12''$ ← allowable head ok

$T_{max} = \frac{\cancel{3.34''}}{4.16''} < 12''$ ← thickness at drainage corridor ok

05/22/04

Written by: RK Date: 03/12/03 (YY/MM/DD) Reviewed by: LMG Date: 03/12/09 (YY/MM/DD)

Client: Fluor Fernald Project: OSDF - RPV Project/Proposal No.: GQ3211 Task No.: 06

DRAINAGE CORRIDOR (ACTIVE OPERATION CONDITION)

FLOW CAPACITY

Flow capacity $Q_{DC} = kiA$

$= 1.49 \times 10^{-3} \ m^3/s$

(No change from section 8.1)

Required capacity $Q_R = q_2 A_d$

$Q_R = [1.9 \times 10^{-6} \times 10^{-2} \ m/s] [8.06 \text{ acre} \times 0.405 \frac{ha}{acre} \times 10{,}000 \frac{m^2}{ha}]$

$= [1.9 \times 10^{-8} \ m/s] [3.26 \times 10^4 \ m^2]$

$= 6.20 \times 10^{-4} \ m^3/s$

Ratio of drainage corridor capacity to required capacity

$\frac{Q_{DC}}{Q_R} = \frac{1.49 \times 10^{-3}}{6.20 \times 10^{-4}} = 2.40$

The DCP does not require a target factor of safety for the flow capacity of the drainage corridor material. However, the DCP does require a target factor of safety for the flow capacity of the leachate collection pipe equal to 3. This factor of safety is calculated in section 8-5.

05/12/04

LCS Drainage Layer

Parameter	Active	Post-Closure
Drainage Path Length (ft)	385	350
Drainage Path Slope (%)	2.24	2.04
Slope Angle (rad)	0.02	0.02
Slope Angle (deg)	1.28	1.17
Thickness (in.)	12	12
Total Cell Width (ft)	540	540
Total Cell Length (ft)	650	650
Total Cell Area (acre)	8.06	8.06
k (cm/s)	1	1
qi, (in/day) [from HELP]	0.0646	2.00E-06
qi, (cm/s)	1.90E-06	5.88E-11
λ [Giroud et al.]	0.004	0.000
j [Giroud et al.]	0.982	1.000
T_{max}/L	8.30E-05	2.88E-09
T_{max} (in.)	0.38	1.21E-05
h_{max} (in.)	0.38	1.21E-05
T_{ave}/T_{max}	0.5	0.5
T_{ave} (in.)	0.19	6.05E-06
h_{ave} (in.)	0.19	6.05E-06

05/12/04

LCS Drainage Corridor

Parameter	Active	Post-Closure
Drainage Path Length (ft)	625	625
Drainage Path Slope (%)	1.00	0.40
Slope Angle (rad)	0.01	0.00
Slope Angle (deg)	0.57	0.23
Thickness (in.)	12	12
Total Corridor Width (ft)	16	16
Total Corridor C/S Area (ft^2)	16	16
Total Corridor C/S Area (m^2)	1.49	1.49
Total Corridor Plan Area (acre)	0.23	0.23
k (cm/s)	10	10
qi, (in/day)	2.18	6.75E-05
qi, (cm/s)	6.41E-05	1.98E-09
λ [Giroud et al.]	0.064	0.000
j [Giroud et al.]	0.918	1.000
T_{max}/L	5.55E-04	4.96E-08
T_{max} (in.)	4.16	3.72E-04
h_{max} (in.)	4.16	3.72E-04
T_{ave}/T_{max}	0.56	0.5
T_{ave} (in.)	2.33	1.86E-04
h_{ave} (in.)	2.33	1.86E-04
Flow Capacity (m^3/s)	1.49E-03	5.95E-04
Required Capacity (m^3/s)	6.20E-04	1.92E-08
Factor of Safety (For Capacity)	2.40	3.10E+04

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05/12/04

8.5 LCS PIPE DESIGN – CELL 8 SUPPLEMENT

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COMPUTATION COVER SHEET

SUBJECT OF COMPUTATIONS OSDF PHASE V, LCS PIPE DESIGN – CELL 8 SUPPLEMENT

Computations By: (Cognizant Engineer)
Signature R. Kulasingam — Date 1-23-04
Printed Name and Title: Ramachandran Kulasingam, Senior Staff Engineer

Assumptions and Procedures Checked By: (Checker)
Signature GANESH GOPALAKRISHNAN — Date 1-23-04
Printed Name and Title: for Leslie M. Griffin, Engineer

Computations Checked by:
Signature Hollie N. Kinnecom — Date 1-23-04
Printed Name and Title: Hollie N. Kinnecom, Staff Engineer

Computations Backchecked by: (Cognizant Engineer)
Signature R. Kulasingam — Date 1-23-04
Printed Name and Title: Ramachandran Kulasingam, Senior Staff Engineer

Approved by: (PDP)
Signature — Date 1-23-04
Printed Name and Title: for Leslie M. Griffin, Engineer

Approved by: (DTL/TETL)
Signature Rudolph Bonaparte — Date 23 Jan 04
Printed Name and Title: R. Bonaparte, Principal

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
1A	DCN CELL 8 EXPANSION	16 JUN 2004	RK /	LMG / RC	

000082

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

ADDENDUM TO SECTION 8.3
(ADDED TO REVISION 1 PACKAGE)

The Final Design Calculation Package "Leachate Collection System (LCS) LCS Pipe Design" presented in Section 8.3 evaluated the performance of the LCS collector pipe. The LCS pipe flow capacity was compared to the required capacity as part of the evaluation in that Calculation Package using baseline design flow rates applicable to the northernmost and interior OSDF cells (i.e., Cells 1 to 7). Baseline design flow rates for the southernmost OSDF cell (i.e., Cell 8) are different from that of the other cells, and are presented in Section 7.4.

This addendum to Section 8.3 evaluated the performance of the LCS collector pipe for Cell 8 using the baseline flow rates for that cell. Similar methods and input data to that used in Section 8.3 were used herein. This addendum is presented as Section 8.5 of the OSDF Final Design Calculation Package, and is titled, "Leachate Collection System (LCS) LCS Pipe Design – Cell 8 Supplement". Section 8.5 is presented in Volume VII of the OSDF Final Design Calculation Package.

GEOSYNTEC CONSULTANTS

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

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Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEACHATE COLLECTION SYSTEM (LCS)
LCS PIPE DESIGN - CELL 8 SUPPLEMENT
EXECUTIVE SUMMARY

PURPOSE OF ANALYSIS

The purpose of this analysis is to evaluate the performance of the LCS collector pipe for Cell 8 of the OSDF. The evaluation will be performed for both active operation and post-closure conditions.

METHOD OF ANALYSIS

The flow capacity, perforation size, and structural stability (wall crushing, wall buckling, and excessive ring deflection) were calculated for the LCS collector pipe in the Section 8.3, "Leachate Collection System (LCS) LCS Pipe Design" of the Final Design Calculation Package. The parameters used to calculate the perforation size and structural stability of the LCS collector pipe have not changed. However, the flow capacity of the LCS pipe is compared to the required flow capacity for Cell 8 in this Calculation Package.

CONCLUSIONS

- Pipe flow capacity for active operation condition, Q_p = 196.4 gpm
- Required flow capacity for active operation condition, Q_{pr} = ~~7.7~~ 9.8 gpm
- Flow capacity factor of safety for active operation condition, Q_p/Q_{pr} = ~~25~~ 20 > 3 (OK)
- Pipe flow capacity for post-closure condition, Q_p = 124.2 gpm
- Required flow capacity for post-closure condition, Q_{pr} = ~~1.08×10^{-4}~~ 3.04×10^{-4} gpm
- Flow capacity factor of safety for post-closure condition, Q_p/Q_{pr} = ~~1.15×10^{6}~~ 4.09×10^{5} >> 10 (OK)

ph 05/12/04

000085

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEACHATE COLLECTION SYSTEM (LCS)
LCS PIPE DESIGN - CELL 8 SUPPLEMENT
CALCULATION PROCEDURES

INTRODUCTION

The purpose of this package is to evaluate the factor of safety for flow capacity by comparing the new required flow capacity for Cell 8 with the LCS pipe flow capacity.

METHOD OF ANALYSIS

The required flow capacity for Cell 8 was evaluated in Section 8.4, "Leachate Collection System (LCS) Maximum Head in LCS – Cell 8 Supplement". The LCS pipe flow capacity was evaluated in Section 8.3 "Leachate Collection System (LCS) LCS Pipe Design" of the Final Design Calculation Package.

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEACHATE COLLECTION SYSTEM (LCS)
LCS PIPE DESIGN - CELL 8 SUPPLEMENT
DATA VERIFICATION

Pipe flow capacity (Q_p) = 1.25×10^{-2} m^3/s (from Calculation Package "Leachate Collection System (LCS) LCS Pipe Design" – Section 8.3)

Required flow capacity (Q_{pr}) = ~~4.88×10^{-4}~~ 6.20×10^{-4} m^3/s (from Calculation Package "Leachate Collection System (LCS) Maximum Head in LCS – Cell 8 Supplement" – Section 8.4)

05/12/04

000087

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEACHATE COLLECTION SYSTEM (LCS)
LCS PIPE DESIGN - CELL 8 SUPPLEMENT
CALCULATION RESULTS

Hand calculations were performed for the active condition case. A spreadsheet was used to repeat the calculations for the active case and perform calculations for the post-closure case. These calculation results are presented in the following pages.

GEOSYNTEC CONSULTANTS

Written by: RK Date: 03/12/03 (YY/MM/DD) Reviewed by: LMG Date: 03/12/09 (YY/MM/DD)

Client: Ehrenfeld Project: DSDF - RIPV Project/Proposal No.: GQ 3211 Task No.: 06

LCS PIPE FLOW CAPACITY (ACTIVE OPERATION)

Lcs Pipe Flow capacity, $Q_p = 1.25 \times 10^{-2}$ m^3/s

(no change from the previous calculation Package) (section 8.3)

Required capacity $Q_{pr} = q_i A_d$

$Q_{pr} = [1.9 \times 10^{-6} \times 10^{-2}$ m/s$][6.34 \times 0.405 \times 10,000$ m$^2]$ 8.06

$= 4.88 \times 10^{-4}$ m^3/s
6.20×10^{-4}

$\frac{Q_p}{Q_{pr}} = \frac{1.25 \times 10^{-2}}{4.88 \times 10^{-4} \atop 6.20 \times 10^{-4}}$

$= 25.4 \atop 20.0 > 3$ O.K

RK
05/12/09

LCS Pipe

Parameter	Active	Post-Closure
Pipe Inner Diameter (in.)	5.421	5.421
Cross Section Area (in^2)	23.08	23.08
Cross Section Area (m^2)	1.49E-02	1.49E-02
Hydraulic Radius (in.)	1.36	1.36
Manning's Coefficient ($s/m^{0.33}$)	0.013	0.013
Drainage Path Slope (%)	1.00	0.40
Slope Angle (rad)	0.01	0.00
Slope Angle (deg)	0.57	0.23
Flow Capacity (m^3/s)	1.24E-02	7.84E-03
Required Capacity (m^3/s)	6.20E-04	1.92E-08
Factor of Safety (For Capacity)	20.00	4.09E+05

05/12/04

SECTION 9.6

9.6 MIGRATION THROUGH PRIMARY LINER – CELL 8 SUPPLEMENT

5529

COMPUTATION COVER SHEET

SUBJECT OF COMPUTATIONS OSDF PHASE V, MIGRATION THROUGH PRIMARY LINER – CELL 8 SUPPLEMENT

Computations By:
(Cognizant Engineer)

Signature R. Kulasingam — Date 1-23-04

Printed Name and Title: Ramachandran Kulasingam, Senior Staff Engineer

Assumptions and Procedures Checked By:
(Checker)

Signature GANESH GOPALAKRISHNAN — Date 1-23-04

Printed Name and Title: for Leslie M. Griffin, Engineer

Computations Checked by:

Signature Hollie N. Kinnecom — Date 1-23-04

Printed Name and Title: Hollie N. Kinnecom, Staff Engineer

Computations Backchecked by:
(Cognizant Engineer)

Signature R. Kulasingam — Date 1-23-04

Printed Name and Title: Ramachandran Kulasingam, Senior Staff Engineer

Approved by:
(PDP)

Signature — Date 1-23-04

Printed Name and Title: for Leslie M. Griffin, Engineer

Approved by:
(DTL/TETL)

Signature Rudolph Bonaparte — Date 23 Jan 04

Printed Name and Title: R. Bonaparte, Principal

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
1A	DCN CELL 8 EXPANSION	16 JUN 2004	RK /	LMG / RC	

000092

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

ADDENDUM TO SECTION 9.1
(ADDED TO REVISION 1 PACKAGE)

The Calculation Package "Leak Detection System (LDS) Migration through Primary Liner" presented in Section 9.1 summarized the analysis of leachate migration through the primary liner and into the LDS and discussed other potential sources of flow into the LDS for different stages of the life of the Fernald On-site Disposal Facility (OSDF). The leachate migration rates were calculated based on a cell 400 feet wide and 6.5 acres in size. This size cell applies to the northernmost and interior OSDF cells (i.e., Cells 1 to 7). The southernmost OSDF cell (i.e., Cell 8) is sized differently from the other cells.

This addendum to Section 9.1 summarizes the analysis of leachate migration through the primary liner for Cell 8. Similar methods and input data to that used in Section 9.1 were used herein. This addendum is presented as Section 9.6 of the OSDF Final Design Calculation Package, and is titled, "Leak Detection System (LDS) Migration through Primary Liner – Cell 8 Supplement". Section 9.6 is presented in Volume VII of the OSDF Final Design Calculation Package.

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

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Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEAK DETECTION SYSTEM (LDS)
MIGRATION THROUGH PRIMARY LINER - CELL 8
SUPPLEMENT
EXECUTIVE SUMMARY

PURPOSE OF ANALYSIS

The purpose of this package is to summarize the analysis of leachate migration through the primary liner and into the LDS for Cell 8 of the OSDF.

METHODS OF ANALYSIS

The infiltration rate of leachate through the primary liner into the LDS was estimated using the USEPA HELP model analysis performed in the "Leachate Generation Rates – Cell 8 Supplement" Calculation Package. The assumptions made to perform the leachate generation analysis were summarized in the "Leak Detection System (LDS) – Migration Through Primary Liner" Final Design Calculation Package. The updated results for Cell 8 of the OSDF are presented here.

CONCLUSIONS

Infiltration rates through the primary liner are as follows:

- Peak daily rate during active conditions = ~~6.5×10^{-3}~~ 8.9×10^{-4} gpad
- Average annual rate during active conditions = ~~4.5×10^{-3}~~ 7.5×10^{-4} gpad
- Average annual rate during post-closure conditions = 1.9×10^{-4} gpad

05/13/04

000095

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEAK DETECTION SYSTEM (LDS)
MIGRATION THROUGH PRIMARY LINER - CELL 8
SUPPLEMENT
CALCULATION PROCEDURES

INTRODUCTION

The purpose of this package is to present the calculation procedures for evaluating the migration of leachate through the primary liner.

METHOD OF ANALYSIS

Calculation procedures were the same as those presented in Section 9.1 "Leak Detection System (LDS) – Migration through Primary Liner" Final Design Calculation Package.

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEAK DETECTION SYSTEM (LDS)
MIGRATION THROUGH PRIMARY LINER - CELL 8
SUPPLEMENT
DATA VERIFICATION

Leachate migration through primary liner analysis was performed as part of Section 7.4 "Leachate Generation Rates – Cell 8 Supplement" Final Design Calculation Package. The data required to perform this analysis is included in that package. A discussion on the variables that have the greatest effect on results, namely frequency and size of holes in the geomembrane components of the primary liner and quality of contact between the geomembrane and GCL components of the primary liner, was presented in Section 9.1 "Leak Detection System (LDS) – Migration through Primary Liner – Data Verification" Final Design Calculation Package. The discussion presented in that calculation package is applicable to the results presented in this calculation package.

Written By: RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEAK DETECTION SYSTEM (LDS)
MIGRATION THROUGH PRIMARY LINER - CELL 8
SUPPLEMENT
CALCULATION RESULTS

Infiltration rates through the primary liner are as follows:

- Peak daily rate during active conditions = ~~6.5×10^{-3}~~ 8.9×10^{-4} gpad
- Average annual rate during active conditions = ~~4.5×10^{-3}~~ 7.5×10^{-4} gpad
- Average annual rate during post-closure conditions = 1.9×10^{-4} gpad

Note, that peak daily rate for the post-closure stage cannot be calculated with certainty due to rounding errors by the HELP program, but is expected to be greater than 1.9×10^{-4} gpad.

05/13/04

Written by: RIG Date: 03/12/03 Reviewed by: LMG Date: 03/12/09

Client: Fluor Fernald Project: OSDF-RPV Project/Proposal No.: GQ3211 Task No.: 06

Infiltration rates through primary liner

Peak daily rate during active conditions

$= 3.3 \times 10^{-8}$ in/day [from HELP]

$= 8.9 \times 10^{-4}$ gpad

Average annual rate during active conditions

$= 1.0 \times 10^{-5}$ in/yr

$= 7.5 \times 10^{-4}$ gpad

PLR 05/13/04

Average annual rate during post-closure conditions

$= 1.9 \times 10^{-4}$ gpad

Peak annual rate during post-closure conditions

$= 1.5 \times 10^{-4}$ gpad

(less than the average → considered to be due to the rounding errors in HELP)

9.7 MAXIMUM HEAD IN LDS – CELL 8 SUPPLEMENT

5529

COMPUTATION COVER SHEET

SUBJECT OF COMPUTATIONS OSDF PHASE V, MAXIMUM HEAD IN LDS - CELL 8 SUPPLEMENT

Computations By:
(Cognizant Engineer)

Signature: R. Kulasingam — Date: 1-23-04

Printed Name and Title: Ramachandran Kulasingam, Senior Staff Engineer

Assumptions and Procedures Checked By:
(Checker)

Signature: GANESH GOPALAKRISHNAN — Date: 1-23-04

Printed Name and Title: for Leslie M. Griffin, Engineer

Computations Checked by:

Signature: Hollie N. Kinnecom — Date: 1-23-04

Printed Name and Title: Hollie N. Kinnecom, Staff Engineer

Computations Backchecked by:
(Cognizant Engineer)

Signature: R. Kulasingam — Date: 1-23-04

Printed Name and Title: Ramachandran Kulasingam, Senior Staff Engineer

Approved by:
(PDP)

Signature: for — Date: 1-23-04

Printed Name and Title: Leslie M. Griffin, Engineer

Approved by:
(DTL/TETL)

Signature: Rudolph Bonaparte — Date: 23 Jan 04

Printed Name and Title: R. Bonaparte, Principal

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
1A	DCN CELL 8 EXPANSION	16 JUN 2004	RK/BE	LMG/RC	

000101

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

ADDENDUM TO SECTION 9.2
(ADDED TO REVISION 1 PACKAGE)

The Calculation Package "Leak Detection System (LDS) Maximum Head in LDS" presented in Section 9.2 evaluated the performance of the drainage layer and the drainage corridor components of the leak detection system (LDS) for different stages of the life of the Fernald On-site Disposal Facility (OSDF). The performance of the drainage layer and drainage corridor was evaluated using baseline design flow rates applicable to the northernmost and interior OSDF cells (i.e., Cells 1 to 7). Baseline design flow rates for the southernmost OSDF cell (i.e., Cell 8) are presented in Section 7.4 and will be utilized in this package.

This addendum to Section 9.2 evaluated the performance of the drainage layer and drainage corridor for Cell 8. Similar methods and input data to that used in Section 9.2 were used herein. This addendum is presented as Section 9.7 of the OSDF Final Design Calculation Package, and is titled, "Leak Detection System (LDS) Maximum Head in LDS – Cell 8 Supplement". Section 9.7 is presented in Volume VII of the OSDF Final Design Calculation Package.

GEOSYNTEC CONSULTANTS

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

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Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEAK DETECTION SYSTEM (LDS)
MAXIMUM HEAD IN LDS - CELL 8 SUPPLEMENT
EXECUTIVE SUMMARY

PURPOSE OF ANALYSIS

The purpose of this package is to evaluate the performance of the drainage layer and the drainage corridor components of the leak detection system (LDS) for Cell 8 of the OSDF.

METHODS OF ANALYSIS

Drainage Layer: The maximum and average thickness of liquid in the LDS drainage layer were calculated using a closed-form analytical solution.

Drainage Corridor: The maximum and average hydraulic head and thickness of liquid in the drainage corridor were calculated using a closed-form analytical solution. The flow capacity of the drainage corridor was calculated using Darcy's equation to verify its ability to convey liquid with an adequate factor of safety.

Calculations were performed for the active operation condition and for the post-closure (i.e., post-settlement) condition. Baseline design flow rates established in the "Leachate Generation Rates – Cell 8 Supplement" Calculation Package were utilized in the calculations. These flow rates do not account for large peak flows associated with the storm design basis flow rate.

CONCLUSIONS

ACTIVE OPERATION CONDITION:

LDS Drainage Layer:

- maximum thickness of liquid, T_{max} = ~~0.021~~ 0.002 in. < 12 in. (OK)
- average thickness of liquid, $T_{ave,w}$ = ~~1.9x10^{-4}~~ 6.4×10^{-6} in.

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05/13/04

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LDS Drainage Corridor:

- maximum leachate head, h_{max} = ~~1.41x10^{-5}~~ 2.46×10^{-6} in. < 12 in. (OK)
- average leachate head, h_{avg} = ~~7.0x10^{-6}~~ in. 1.23×10^{-6} in
- maximum liquid thickness, T_{max} = ~~1.41x10^{-5} in.~~ 2.46×10^{-6} in.
- average liquid thickness, T_{avg} = ~~7.0x10^{-6} in.~~ 1.23×10^{-6} in
- drainage corridor capacity, Q_{DC} = 23.6 gpm
- required flow capacity, Q_R = ~~2.9x10^{-5} gpm~~ 5.08×10^{-6}
- flow capacity factor of safety, Q_{DC}/Q_R = ~~8.2x10^{5} > 3 (OK)~~ 4.7×10^{6}

POST-CLOSURE CONDITION:

The DCP does not require a target factor of safety for the flow capacity of the drainage corridor material. However, the DCP does require a target factor of safety for the flow capacity of the leak detection pipes equal to 3. This factor of safety is calculated in Section 9.9.

LDS Drainage Layer:

- maximum thickness of liquid, T_{max} = ~~0.004 in.~~ 0.001 in. < 12 in. (OK)
- average thickness of liquid, $T_{ave,w}$ = ~~2.62x10^{-5} in.~~ 5.22×10^{-7} in.

LDS Drainage Corridor:

1.3×10^{-6} in.

- maximum leachate head, h_{max} = ~~2.4x10^{-5}~~ in. < 12 in. (OK)
- average leachate head, h_{avg} = ~~1.2x10^{-5} in.~~ 6.3×10^{-7} in.
- maximum liquid thickness, T_{max} = ~~2.4x10^{-5} in~~ 1.3×10^{-6} in.
- average liquid thickness, T_{avg} = ~~1.2x10^{-5} in.~~ 6.3×10^{-7} in.
- drainage corridor capacity, Q_{DC} = 9.42 gpm
- required flow capacity, Q_R = ~~8.13x10^{-7} gpm~~ 1.03×10^{-6} 9.11×10^{6}
- flow capacity factor of safety, Q_{DC}/Q_R = ~~1.2x10^{2} > 10 (OK)~~

PR 05/12/04

The DCP does not require a target factor of safety for the flow capacity of the drainage corridor material. However, the DCP does require a target factor of safety for the flow capacity of the leachate collection pipe equal to 10. If during post closure the capacity of the pipes was to decrease, then the flow capacity of the corridor is more than adequate. PR 05/12/04

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEAK DETECTION SYSTEM (LDS)
MAXIMUM HEAD IN LDS - CELL 8 SUPPLEMENT
CALCULATION PROCEDURES

INTRODUCTION

The purpose of this package is to present the calculation procedures for evaluating the maximum head in the LDS.

METHOD OF ANALYSIS

The calculation procedures are the same as those presented in Section 9.2 "Leak Detection System (LDS) Maximum Head in LDS" Final Design Calculation Package.

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEAK DETECTION SYSTEM (LDS)

MAXIMUM HEAD IN LDS - CELL 8 SUPPLEMENT

DATA VERIFICATION

INTRODUCTION

The purpose of this package is to present the data parameters needed to perform the calculations for the LDS for Cell 8 of the OSDF. In particular, this package addresses the following analyses:

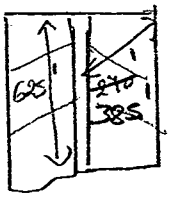
- drainage layer (average and maximum liquid thickness); and
- drainage corridor (average and maximum leachate head and liquid thickness, and flow capacity).

In order to perform the analyses the data presented in the Calculation Package "Leachate Detection System (LDS) Maximum Head in LDS" is used, except that the slope lengths, cell area, and flow rates are revised based on the Calculation Package "Leachate Generation Rates – Cell 8 Supplement" as described in the following section.

ACTIVE OPERATION CONDITIONS:

~~240~~ 350'

Cell Base



~~240~~ 350' @ 2%

~~270~~ 385' @ 2.24%

625' @ 1%

Drainage Layer:

Q = leakage rate through a hole in the primary liner (assumes 1 hole per acre)

= ~~4.5x10^{-3}~~ gpad (average annual daily infiltration calculated using the HELP model) X 1.0 acres 7.5×10^{-4}

= ~~4.5x10^{-3}~~ gpd 7.5×10^{-4} gpd

= ~~6.5x10^{-3}~~ gpad (peak daily infiltration calculated using the HELP model) X 1.0 acres

= ~~6.5x10^{-3}~~ gpd 8.9×10^{-4} 8.9×10^{-4} gpd 385'

L = the horizontal length of the slope = ~~270~~ ft (3240 in.)

K = Hydraulic conductivity = 1 cm/s 000107 plw 05/13/04

Drainage Corridor:

The impingement rate of flow into the drainage corridor is calculated by multiplying the peak daily value from HELP for the drainage layer by a factor (width of cell / width of drainage corridor). Impingement rate is taken equal to the infiltration through the top liner (from HELP calculations performed as part of "Leachate Generation Rates – Cell 8 Supplement" Calculation Package).

Written By: RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

q_i = the maximum impingement rate of flow into the drainage corridor
= (~~6.5×10^{-3}~~ 8.3×10^{-4} gpad or ~~2.4×10^{-7}~~ in/d) x (~~425~~ 540 ft / 16 ft)
= ~~6.4×10^{-6} in/d~~ 3.3×10^{-6} in/d 1.1×10^{-6} in/d
L = the length of the drainage corridor = 625 ft (7500 in.)

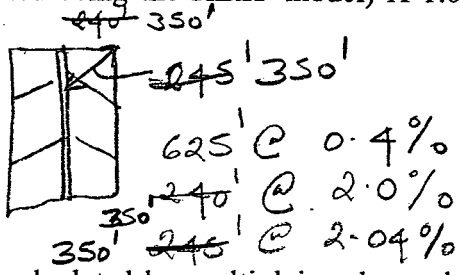
POST-CLOSURE CONDITION:

Drainage Layer:

Q = leakage rate through a hole in the primary liner (assumes 1 hole per acre)
= 1.9×10^{-4} gpad (average annual daily infiltration calculated using the HELP model) X 1.0 acres
= 1.9×10^{-4} gpd

L = the horizontal length of the slope = ~~245~~ 350 ft (2940 in.)

K = Hydraulic Conductivity = 1 cm/s



Drainage Corridor:

The impingement rate of flow into the drainage corridor is calculated by multiplying the peak daily value from HELP for the drainage layer by a factor (width of cell / width of drainage corridor). Impingement rate is taken as equal to the infiltration through the top liner (from HELP calculations performed as part of "Leachate Generation Rates – Cell 8 Supplement" Calculation Package).

q_i = the maximum impingement rate of flow into the drainage corridor
= (1.9×10^{-4} gpad or 2.5×10^{-6} in/yr) x (~~425 ft~~ 540 / 16 ft)
= ~~6.6×10^{-5} in/yr~~ 8.4×10^{-5} in/yr
L = the length of the drainage corridor = 625 ft (7500 in.)

05/13/04

GEOSYNTEC CONSULTANTS

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEAK DETECTION SYSTEM (LDS)

MAXIMUM HEAD IN LDS - CELL 8 SUPPLEMENT (SEE VOLUME VIII)

CALCULATION RESULTS

Hand calculations were performed for the active condition case. A spread sheet was used to repeat the calculations for the active case and perform calculations for post-closure case. These calculation results are presented in the following pages.

Written by: RK Date: 03/12/03 Reviewed by: LM Ch Date: 03/12/09

Client: Fluor Fonald Project: OSDF RPV Project/Proposal No.: GP3211 Task No.: 06

Drainage Layer

Active Condition :

$Q_{Peak, Daily} = \frac{8.9 \times 10^{-3}}{6.5 \times 10^{-4}}$ gpd (for 1 hole)

$Q_{Average, Annual} = \frac{7.5 \times 10^{-3}}{4.5 \times 10^{-4}}$ gpd (for 1 hole)

Peak Daily =>

$$T_{max} = \sqrt{\frac{Q}{K}}$$

$$= \sqrt{\frac{\left(\frac{8.9 \times 10^{-3}}{6.5 \times 10^{-4}} \text{ gpd}\right)\left(\frac{ft^3}{7.48 \text{ gal}}\right)\left[\frac{1}{24 \times 3600}\right]\frac{d}{s}}{\left(\frac{0.1}{1} \text{ cm/s}\right)\left(\frac{ft}{30.48 \text{ cm}}\right)}}$$

$$= \sqrt{\frac{3.07 \times 10^{-6}}{4.2 \times 10^{-8}}}$$

$$= \frac{1.75 \times 10^{-3}}{2.05 \times 10^{-4}} \text{ ft}$$

$$= \frac{0.021}{0.002}'' < 12'' \text{ o.k}$$

$$M = \frac{T_{max}}{L \sin\beta}$$

$$= \frac{\frac{2.05 \times 10^{-4}}{1.75 \times 10^{-3}} \text{ ft}}{\left(\frac{270 \text{ ft}}{385}\right) \sin(1.28^\circ)}$$

$$= \frac{2.90 \times 10^{-4}}{2.38 \times 10^{-5}}$$

RK 05/13/04

Written by: RK Date: 03/12/03 Reviewed by: LMG Date: 03/12/09

Client: Flour Fonds Project: OSDF-RPV Project/Proposal No.: GQ 3211 Task No.: 06

$$T_{ave,\omega} = \frac{3}{4} T_{max} = \frac{1 + \frac{3}{9}M}{\sqrt{1+\left(\frac{2}{M}\right)\left(1+\frac{M}{2}\right)}}$$

$= \cancel{1.90 \times 10^{-4}}$ 6.39×10^{-6} in //

Drainage corridor

$$q_i = \frac{\cancel{6.4 \times 10^{-6}}}{1.1 \times 10^{-6}} \text{ in/d}$$

$$\lambda = \frac{q_i}{k \tan^2\beta}$$

$$= \frac{\overset{1.1\times10^{-6}}{\cancel{6.4 \times 10^{-6}}} \frac{\text{in}}{\text{d}} \times \frac{2.54 \frac{\text{cm}}{\text{in}}}{24 \times 3600 \frac{\text{s}}{\text{d}}}}{(10 \text{ cm/s}) \tan^2(0.573^\circ)}$$

$= \cancel{1.88 \times 10^{-7}}$ 3.27×10^{-8}

$$j = 1 - 0.12 \exp\left[-\left[\log\left(\frac{8\lambda}{5}\right)^{\frac{5}{8}}\right]^2\right]$$

$$j = 1$$

$$T_{max} = j\left[\frac{\sqrt{1+4\lambda}-1}{2}\frac{\tan\beta}{\cos\beta}\right] L$$

$$= (1)\left[\frac{\sqrt{1+(4)\left(\overset{3.27\times10^{-8}}{\cancel{1.88 \times 10^{-7}}}\right)}-1}{2}\frac{\tan(0.573)}{\cos(0.573)}\right] 62$$

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05/13/09

Written by: RK Date: 03/12/03 (YY/MM/DD) Reviewed by: LMG Date: 03/12/09 (YY/MM/DD)

Client: Ebasco Fernald Project: OSDF RPV Project/Proposal No.: GQ3211 Task No.: 06

$$T_{max} = \frac{1.47 \times 10^{-5}}{2.46 \times 10^{-6}} \text{ in} < 12'' \quad \text{O.K}$$

$$f_{max} = T_{max} \cos\beta$$

$$= \left(\frac{1.47 \times 10^{-5}}{2.46 \times 10^{-6}}\right) \cos(0.573)$$

$$= \frac{1.47 \times 10^{-5}}{2.46 \times 10^{-6}} \text{ in}$$

For $\lambda = \frac{1.88 \times 10^{-7}}{3.27 \times 10^{-8}}$

$$\frac{T_{ave}}{T_{max}} = 0.5$$

$$T_{ave} = (0.5)\left(\frac{1.47 \times 10^{-5}}{2.46 \times 10^{-6}}\right)$$

$$= \frac{0.705 \times 10^{-5}}{1.23 \times 10^{-6}} \text{ in}$$

$$f_{ave} = T_{ave} \cos\beta$$

$$= \left(\frac{0.705 \times 10^{-5}}{1.23 \times 10^{-6}}\right) \cos(0.573^{\circ})$$

$$= \frac{0.705 \times 10^{-5}}{1.23 \times 10^{-6}} \text{ in} \quad //$$

RK 05/13/04

Written by: RK Date: 03/12/03 Reviewed by: LMG Date: 03/12/09

Client: Fluor Fonald Project: 000F - RPV Project/Proposal No.: GQ 3211 Task No.: 06

Drainage corridor Flow Capacity

$Q_{DC} = kiA$

$= 1.49 \times 10^{-3}\ m^3/s$

[23.6 gpm]

$i = 8.9 \times 10^{-4}$ gpad

$= 6.5 \times 10^{-3}$ gpad

$= 2.4 \times 10^{-7}$ in/d

$= 3.3 \times 10^{-8}$ in/d

Required capacity (Q_R)

$Q_R = i A_d$

$= \left[3.3 \times 10^{-8} \text{ in/d} \times \frac{2.54}{100} \times \frac{1}{24 \times 3600}\right]^m \times \left[(8.06 \text{ Acre}) \times 0.405 \frac{ha}{acre} \times 10{,}000 \frac{m^2}{ha}\right]$

$= 7.06 \times 10^{-14}\ m/s \times 25920\ m^2$

$= 1.83 \times 10^{-9}\ m^3/s$

$= 3.17 \times 10^{-10}\ m^3/s$

$\frac{Q_{DC}}{Q_R} = \frac{1.49 \times 10^{-3}}{1.83 \times 10^{-9}} = \frac{1.49 \times 10^{-3}}{3.17 \times 10^{-10}} = 4.7 \times 10^{6}$

>>3

OK

The DCP does not require a target factor of safety for the flow capacity of the drainage corridor material. However, the DCP does require a target factor of safety for the flow capacity of the leak detection pipe equal to 3. This factor of safety is calculated in section 9.9.

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05/13/04

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LDS Drainage Layer

Parameter	Active		Post-Closure	
	Daily Peak	Yearly Average	Daily Peak	Yearly Average
Drainage Path Length (ft)	385	385	350	350
Drainage Path Slope (%)	2.24	2.24	2.04	2.04
Slope Angle (rad)	0.02	0.02	0.02	0.02
Slope Angle (deg)	1.28	1.28	1.17	1.17
Thickness (in.)	12	12	12	12
Total Cell Width (ft)	540	540	540	540
Total Cell Length (ft)	650	650	650	650
Total Cell Area (acre)	8.06	8.06	8.06	8.06
k (cm/s)	1	1	1	1
qi, (in/day) [from HELP]	3.30E-08	2.70E-08	5.50E-09	6.80E-09
qi, (cm/s)	9.70E-13	7.94E-13	1.62E-13	2.00E-13
No of holes per acre	1	1	1	1
Q per hole, (ft3/s)	1.386E-09	1.134E-09	2.311E-10	2.857E-10
T_{max} (in.)	0.002	0.002	0.001	0.001
M	2.38E-05	2.16E-05	1.18E-05	1.31E-05
$T_{ave,w}$ (in.)	6.39E-06	8.37E-07	5.22E-07	5.80E-07

05/13/09

LDS Drainage Corridor

Parameter	Active	Post-Closure
Drainage Path Length (ft)	625	625
Drainage Path Slope (%)	1.00	0.40
Slope Angle (rad)	0.01	0.00
Slope Angle (deg)	0.57	0.23
Thickness (in.)	12	12
Total Corridor Width (ft)	16	16
Total Corridor C/S Area (ft^2)	16	16
Total Corridor C/S Area (m^2)	1.49	1.49
Total Corridor Plan Area (acre)	0.23	0.23
k (cm/s)	10	10
qi, (in/day)	1.11E-06	2.30E-07
qi, (cm/s)	3.27E-11	6.75E-12
λ [Giroud et al.]	3.274E-08	0.000
j [Giroud et al.]	1.000	1.000
T_{max}/L	3.27E-10	1.69E-10
T_{max} (in.)	2.46E-06	1.27E-06
h_{max} (in.)	2.46E-06	1.27E-06
T_{ave}/T_{max}	0.5	0.5
T_{ave} (in.)	1.23E-06	6.33E-07
h_{ave} (in.)	1.23E-06	6.33E-07
Flow Capacity (m^3/s)	1.49E-03	5.95E-04
Required Capacity (m^3/s)	3.17E-10	6.52E-11
Factor of Safety (For Capacity)	4.70E+06	9.11E+06

05/13/04

SECTION 9.8

9.8 TIME OF TRAVEL IN LDS – CELL 8 SUPPLEMENT

COMPUTATION COVER SHEET

5529

SUBJECT OF COMPUTATIONS OSDF PHASE V, TIME OF TRAVEL IN LDS – CELL 8 SUPPLEMENT

Computations By: (Cognizant Engineer)
Signature R. Kulasingam — Date 1-23-04
Printed Name and Title: Ramachandran Kulasingam, Senior Staff Engineer

Assumptions and Procedures Checked By: (Checker)
Signature Ganesh Gopalakrishnan — Date 1-23-04
Printed Name and Title: for Leslie M. Griffin, Engineer

Computations Checked by:
Signature Hollie N. Kinnecom — Date 1-23-04
Printed Name and Title: Hollie N. Kinnecom, Staff Engineer

Computations Backchecked by: (Cognizant Engineer)
Signature R. Kulasingam — Date 1-23-04
Printed Name and Title: Ramachandran Kulasingam, Senior Staff Engineer

Approved by: (PDP)
Signature — Date 1-23-04
Printed Name and Title: for Leslie M. Griffin, Engineer

Approved by: (DTL/TETL)
Signature Rudolph Bonaparte — Date 23 Jan 04
Printed Name and Title: R. Bonaparte, Principal

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
1A	DCN CELL 8 EXPANSION	16 JUN 2004	RK/[illegible]	LHG/RC	

000116

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

ADDENDUM TO SECTION 9.3
(ADDED TO REVISION 1 PACKAGE)

The Calculation Package "Leak Detection System (LDS) Time of Travel in LDS" presented in Section 9.3 estimated the maximum time of travel in the leak detection system (LDS) for different stages of the life of the Fernald On-site Disposal Facility (OSDF). The times of travel were calculated based on a cell 400 feet wide and 6.5 acres in size. This size cell applies to the northernmost and interior OSDF cells (i.e., Cells 1 to 7). The southernmost OSDF cell (i.e., Cell 8) is sized differently from the other cells.

This addendum to Section 9.3 estimated the maximum time of travel in the leak detection system (LDS) for Cell 8. Similar methods and input data to that used in Section 9.3 were used herein. This addendum is presented as Section 9.8 of the OSDF Final Design Calculation Package, and is titled, "Leak Detection System (LDS) Time of Travel in LDS". Section 9.8 is presented in Volume VII of the OSDF Final Design Calculation Package.

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

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Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEAK DETECTION SYSTEM (LDS)
TIME OF TRAVEL IN LDS - CELL 8 SUPPLEMENT
EXECUTIVE SUMMARY

PURPOSE OF ANALYSIS

The purpose of this package is to estimate the maximum time of travel in the leak detection system (LDS) for Cell 8 of the OSDF. In accordance with the Design Criteria Package (DCP), REV1E, the maximum time of travel in the LDS should not exceed 20 days.

METHOD OF ANALYSIS

The maximum time of travel of liquids in the LDS is estimated for the active operation condition and the post-closure condition. Design grades and slopes are utilized for the active operation condition and post-settlement grades and slopes are utilized for the post-closure condition.

CONCLUSIONS

- time of travel for active operation condition = ~~17.6 days~~ 3.1 days < 20 days (O.K.)
- time of travel for post-closure condition = ~~18.8 days~~ 4.6 days < 20 days (O.K.)

PR 05/13/04

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEAK DETECTION SYSTEM (LDS)
TIME OF TRAVEL IN LDS - CELL 8 SUPPLEMENT
CALCULATION PROCEDURES

INTRODUCTION

The purpose of this package is to present the calculation procedures for the time of travel in the leak detection system (LDS). The LDS drainage corridor is the primary collector and the LDS pipe acts as a backup.

METHOD OF ANALYSIS

The calculation procedures are the same as those presented in Section 9.3, "Leachate Detection System (LDS) Time of Travel in LDS" of the Final Design Calculation Package.

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEAK DETECTION SYSTEM (LDS)
TIME OF TRAVEL IN LDS - CELL 8 SUPPLEMENT
DATA VERIFICATION

INTRODUCTION

As described in the calculation procedures package, an analysis of the time of travel in the LDS will be performed.

In order to perform the analyses the data described in the Final Design Calculation Package "Leachate Detection System (LDS) Time of Travel in LDS" is used, except that the drainage path lengths are changed as described below to reflect the new geometry of Cell 8.

ACTIVE OPERATION CONDITION:

Time of Travel in the LDS Drainage Layer: 385
L_{DL} = length of flow in the LDS drainage layer = ~~270~~ ft

Time of Travel in the LDS Drainage Corridor: $= 625 - \sqrt{385^2 - 350^2}$
L_{DC} = length of flow in the drainage corridor = ~~501.3~~ ft = 465 ft

Time of Travel in the LDS Collector Pipe:
L_{CP} = length of LDS collector pipe = ~~501.3 ft~~ 465 ft

Time of Travel in the LDS Pipe (Extending from outside the cell to Valve House 8 (VH-8)):
L_p = length of LDS pipe extending from outside the cell to VH-8 = 180 ft

POST-CLOSURE CONDITION:

Time of Travel in the LDS Drainage Layer:
L_{DL} = length of flow in the LDS = ~~245 ft~~ 350 ft

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05/13/04

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

Time of Travel in the LDS Drainage Corridor:

L_{DC} = length of flow in the drainage corridor = ~~576 ft~~ 625 ft

Time of Travel in the LDS Collector Pipe:

L_{CP} = length of LDS collector pipe = ~~576 ft~~ 625 ft

Time of Travel in the LDS Pipe (Extending from outside the cell to Valve House 8 (VH-8)):

L_p = length of LDS pipe extending from outside the cell to VH-8 = 180 ft

Plw 05/13/04

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEAK DETECTION SYSTEM (LDS)
TIME OF TRAVEL IN LDS - CELL 8 SUPPLEMENT (SEE VOLUME VIII)
CALCULATION RESULTS

GEOSYNTEC CONSULTANTS

Written by: RK Date: 03/12/03 (YY/MM/DD) Reviewed by: LMG Date: 03/12/09 (YY/MM/DD)

Client: Elmar Fonald Project: OSDF – Revised Phase V Project/Proposal No.: GQ 3211 Task No.: 06

Time of Travel in LDS

ACTIVE CONDITION:

Time of travel in LDS drainage layer:

$$t_{DL} = \frac{L_{DL}\, n_{DL}}{K_{DL}\, i_{DL}}$$

$$= \frac{(\cancel{270}\ 385\ ft)(0.397)}{(\cancel{0.1}\ 1\ cm/s)\left(\frac{ft}{30.48\ cm}\right)(0.0224)} \times \frac{1}{3600}$$

$$= \cancel{405.15}\ 57.8\ hr$$

Time of travel in LDS drainage corridor:

$$t_{DC} = \frac{L_{DC}\, n_{DC}}{K_{DC}\, i_{DC}}$$

$$= \frac{(\cancel{501.3\ ft}\ 465)(0.397)}{(10\ cm/s)\left(\frac{ft}{30.48}\right)(0.01)} \times \frac{1}{3600\ \frac{s}{hr}}$$

$$= \cancel{16.85}\ 15.6\ hr$$

Time of travel in LDS collector pipe:

$$t_{cp} = \frac{L_{cp}\, n}{R_h^{0.66}\, i_{cp}^{0.5}}$$

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05/13/04

GEOSYNTEC CONSULTANTS

Written by: RK Date: 03/12/03 (YY/MM/DD) Reviewed by: LMG Date: 03/12/05

Client: Ehar Fernald Project: OSDF-Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

$$= \frac{\left[\frac{465}{\cancel{501}3}\text{ ft} \times \frac{12\ \frac{\text{in}}{\text{ft}} \times 2.54\ \frac{\text{cm}}{\text{in}}}{100\ \frac{\text{cm}}{\text{m}}}\right]\left(0.013\ \frac{\text{s}}{\text{m}^{0.33}}\right)}{(0.0345\text{ m})^{0.66}\,(0.010)^{0.5}}$$

$$= \frac{170.2}{\cancel{183.5}}\text{ secs}$$

$$= 0.05\text{ hr}$$

Time of travel in LDS pipe extending outside of cell to VH-4.

$$t_p = \frac{L_p n}{R_h^{0.66}\, i_p^{0.5}}$$

$$= \frac{\left(180\text{ ft} \times \frac{12 \times 2.54}{100}\ \frac{\text{m}}{\text{ft}}\right)\left(0.013\ \frac{\text{s}}{\text{m}^{0.33}}\right)}{(0.0345\text{ m})^{0.66}\,(0.040)^{0.5}}$$

$$= 32.9\text{ secs}$$

$$= 9.1 \times 10^{-3}\text{ hr}$$

$$= 0.009\text{ hr}$$

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Total time of travel, t

$$= \text{Max}\left[\begin{matrix}\cancel{405.15}^{57.8} + \cancel{16.85}^{15.6} + 0.009, \\ \cancel{405.15}^{57.8} + 0.05 + 0.009\end{matrix}\right]$$

RK 05/13/04

GEOSYNTEC CONSULTANTS

Written by: RK Date: 03/12/03 (YY/MM/DD) Reviewed by: LMG Date: 03/12/09 (YY/MM/DD)

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

$= \text{Max}\left[\overset{73.6}{\cancel{422}}\ \text{hr},\ \overset{57.9}{\cancel{405}}\ \text{hr}\right]$

$= \overset{73.6}{\cancel{422}}\ \text{hr}$

$= 3.1$ days

$= \cancel{176}$ days < 20 O.K

PR 05/13/04

GEOSYNTEC CONSULTANTS

Written by: RK Date: 03/12/03 (YY/MM/DD) Reviewed by: LMG Date: 03/12/04 (YY/MM/DD)

Client: Ehor Fenald Project: OSDF - Revised Phase Project/Proposal No.: GR3211 Task No.: 06

Time of Travel in LDS

POST-CLOSURE CONDITION:

Time of travel in LDS drainage layer:

$$t_{DL} = \frac{L_{DL} n_{DL}}{k_{DL} i_{DL}}$$

$$= \frac{(350 \text{ ft})(0.39)}{\left(\frac{1}{1} \text{ cm/s}\right)\left(\frac{\text{ft}}{30.48 \text{ cm}}\right)(0.0204)} \times \frac{1}{3600 \left(\frac{\text{s}}{\text{hr}}\right.}$$

$$= 57.7 \text{ hr}$$

Time of travel in LDS drainage corridor:

$$t_{DC} = \frac{L_{DC} n_{DC}}{k_{DC} i_{DC}}$$

$$= \frac{(625 \text{ ft})(0.39)}{(10 \text{ cm/s})\left(\frac{\text{ft}}{30.48 \text{ cm}}\right)(0.004)} \times \frac{1}{3600 \left(\frac{\text{s}}{\text{hr}}\right.}$$

$$= 52.5 \text{ hrs}$$

Time of travel in LDS collector pipe:

$$t_{cp} = \frac{L_{cp} n}{R_h^{0.66} i_{cp}^{0.5}}$$

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05/13/04

Written by: RK Date: 03/12/03 (YY/MM/DD) Reviewed by: LMG Date: 03/12/09 (YY/MM/DD)

Client: Ehrenfeld Project: GSDF - Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

$$= \frac{\left(\frac{625}{\cancel{576}}\ ft \times \frac{12 \times 2.54}{100}\ \frac{m}{ft}\right)\left(0.013\ \frac{s}{m^{0.33}}\right)}{(0.0345\ m)^{0.66}\,(0.004)^{0.5}}$$

$$= \frac{\overset{361}{\cancel{333}}}{}\ Secs$$

$$= \frac{\cancel{0.09}}{0.10}\ hr$$

Time of travel in LDS pipe extending outside of cell to VH-4

$$t_p = \frac{L_p n}{R_h^{0.66} \cdot i_p^{0.5}}$$

$$= \frac{\left(180\ ft \times \frac{12 \times 2.54}{100}\ \frac{m}{ft}\right)\left(0.013\ \frac{s}{m^{0.33}}\right)}{(0.0345\ m)^{0.66}\,(0.040)^{0.5}}$$

$$= 32.9\ secs$$

$$= 9.1 \times 10^{-3}\ hr$$

$$= 0.009\ hr$$

Total time of travel, t

$$= Max\left[\begin{matrix} \overset{57.7}{\cancel{403.7}} + \overset{52.5}{\cancel{48.4}} + 0.009, \\ \cancel{403.7} + \cancel{0.09} + 0.009 \\ 57.7 \qquad 0.1 \end{matrix}\right] = 0128$$

PR 05/13/04

GEOSYNTEC CONSULTANTS

Written by: RK Date: 03/12/03 (YY/MM/DD) Reviewed by: LMG Date: 03/12/03 (YY/MM/DD)

Client: Ehmor Fernald Project: OSDF - Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

$= M_{asc}\left[\frac{110.2}{\cancel{452.1}}\ hr,\ \frac{57.8}{\cancel{403.8}}\ hr\right]$

$= \frac{110.2}{\cancel{452.1}}\ hr$

$= \frac{4.6\ days}{\cancel{18.8}\ days} < 20$ O.K

RK
05/13/04

9.9 LDS PIPE DESIGN– CELL 8 SUPPLEMENT

5529

COMPUTATION COVER SHEET

SUBJECT OF COMPUTATIONS OSDF PHASE V, LDS PIPE DESIGN – CELL 8 SUPPLEMENT

Computations By: (Cognizant Engineer)
Signature: R. Kulasingam — Date: 1-23-04
Printed Name and Title: Ramachandran Kulasingam, Senior Staff Engineer

Assumptions and Procedures Checked By: (Checker)
Signature: GANESH GOPALAKRISHNAN — Date: 1-23-04
Printed Name and Title: for Leslie M. Griffin, Engineer

Computations Checked by:
Signature: Hollie N. Kinnecom — Date: 1-23-04
Printed Name and Title: Hollie N. Kinnecom, Staff Engineer

Computations Backchecked by: (Cognizant Engineer)
Signature: R. Kulasingam — Date: 1-23-04
Printed Name and Title: Ramachandran Kulasingam, Senior Staff Engineer

Approved by: (PDP)
Signature: — Date: 1-23-04
Printed Name and Title: for Leslie M. Griffin, Engineer

Approved by: (DTL/TETL)
Signature: Rudolph Bonaparte — Date: 21 Jan 04
Printed Name and Title: R. Bonaparte, Principal

Record of Revision (Number and initial all revisions)

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1A	DCN CELL 8 EXPANSION	16 JUN 2004	RK/[illegible]	LHG/RC	

000131

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

ADDENDUM TO SECTION 9.4
(ADDED TO REVISION 1 PACKAGE)

The Final Design Calculation Package "Leak Detection System (LDS) LDS Pipe Design" presented in Section 9.4 evaluated the performance of the LDS collector pipe for the OSDF. The LDS pipe flow capacity was compared to the required capacity as part of the evaluation in that Calculation Package using the leakage rates applicable to the northernmost and interior OSDF cells (i.e., Cells 1 to 7). Leakage rates for the southernmost OSDF cell (i.e., Cell 8) are different from that of the other cells, and are presented in Section 7.4.

This addendum to Section 9.4 evaluated the performance of the LDS collector pipe for Cell 8 using the leakage rates for that cell. Similar methods and input data to that used in Section 9.4 were used herein. This addendum is presented as Section 9.9 of the OSDF Final Design Calculation Package, and is titled, "Leak Detection System (LDS) LDS Pipe Design – Cell 8 Supplement". Section 9.9 is presented in Volume VII of the OSDF Final Design Calculation Package.

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

TABLE OF CONTENTS

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEAK DETECTION SYSTEM (LDS)
LDS PIPE DESIGN - CELL 8 SUPPLEMENT
EXECUTIVE SUMMARY

PURPOSE OF ANALYSIS

The purpose of this analysis is to evaluate the performance of the LDS collector pipe for Cell 8 of the OSDF. The evaluation will be performed for both active operation and post-closure conditions.

METHOD OF ANALYSIS

The flow capacity, perforation size, and structural stability (wall crushing, wall buckling, and excessive ring deflection) were calculated for the LDS collector pipe in the Section 9.4, "Leak Detection System (LDS) LDS Pipe Design" of the Final Design Calculation Package. The parameters used to calculate the perforation size and structural stability of the LDS collector pipe have not changed. However, the flow capacity of the LDS pipe is compared to the required flow capacity for Cell 8 in this Calculation Package.

CONCLUSIONS

- pipe flow capacity for active operation condition, Q_p = 198 gpm
- required flow capacity for active operation condition, Q_R = ~~2.9×10^{-5}~~ gpm 5.1×10^{-6} gpm
- flow capacity factor of safety for active operation condition, Q_p/Q_{pr} = ~~6.84×10^{6}~~ >>3 (OK) 3.92×10^{7}
- pipe flow capacity for post-closure condition, Q_p = 124 gpm
- required flow capacity for post-closure condition, Q_R = ~~8.1×10^{-7}~~ gpm 1.03×10^{-6} gpm
- flow capacity factor of safety for post-closure condition, Q_p/Q_{pr} = ~~1.5×10^{8}~~ >> 10 (OK) 1.2×10^{8}

05/13/04

001134

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEAK DETECTION SYSTEM (LDS)
LDS PIPE DESIGN - CELL 8 SUPPLEMENT
CALCULATION PROCEDURES

INTRODUCTION

The purpose of this package is to evaluate the factor of safety for flow capacity by comparing the new required flow capacity for Cell 8 with the LDS pipe flow capacity.

METHOD OF ANALYSIS

The required flow capacity for Cell 8 was evaluated in Section 9.7 "Leak Detection System (LDS) Maximum Head in LDS – Cell 8 Supplement" of the Final Design Calculation Package. The LDS pipe flow capacity was evaluated Section 9.4 "Leak Detection System (LDS) LDS Pipe Design" of the Final Design Calculation Package.

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEAK DETECTION SYSTEM (LDS)
LDS PIPE DESIGN - CELL 8 SUPPLEMENT
DATA VERIFICATION

Pipe flow capacity (Q_p) = 1.25×10^{-2} m^3/s (from Calculation Package "Leak Detection System (LDS) LDS Pipe Design" – Section 9.4)

Required flow capacity (Q_{pr}) = ~~1.83×10^{-9}~~ 3.17×10^{-10} m^3/s (from Calculation Package "Leak Detection System (LDS) Maximum Head in LDS" – Cell 8 Supplement" – Section 9.7)

05/13/04

Written By : RK Date: 12-03-03 Reviewed by: LMG Date: 12-09-03

Client: Fluor Fernald Project: OSDF – Revised Phase V Project/Proposal No.: GQ3211 Task No.: 06

LEAK DETECTION SYSTEM (LDS)
LDS PIPE DESIGN - CELL 8 SUPPLEMENT
CALCULATION RESULTS

Hand calculations were performed for the active condition case. A spread sheet was used to repeat the calculations for the active case and perform calculations for the post-closure case. These calculation results are presented in the following pages.

GEOSYNTEC CONSULTANTS

Written by: RK Date: 03/12/03 (YY/MM/DD) Reviewed by: LMG Date: 03/12/09

Client: Flour Fernald Project: OSDF – RPV Project/Proposal No.: GQ 3211 Task No.: 06

LDS Pipe Design – ACTIVE CONDITION

LDS pipe flow capacity

$$Q_p = \frac{R_h^{0.66}\, i_p^{0.5}\, A_p}{n}$$

$$= \frac{(0.0345)^{0.66}\,(0.01)^{0.5}\,(1.5\times10^{-2})}{0.013}$$

$$= 1.25\times10^{-2}\ m^3/s \quad (198\ gpm)$$

same as before

Required capacity

$$Q_{pr} = q_i A_d$$

$$= \left(\frac{3.3\times10^{-7}}{2.4\times10^{-4}} \times \frac{2.54}{100} \times \frac{1}{24\times3600}\right)\left(6.4\times0.405\times\frac{8.06}{10{,}000}\right)$$

$$= 3.17\times10^{-10}\ m^3/s$$

$$\frac{Q_p}{Q_{pr}} = \frac{1.25\times10^{-2}}{3.17\times10^{-10}} = 3.92\times10^{7} >> 3 \quad \text{OK}$$

RK 05/13/04

LDS Pipe

Parameter	Active	Post-Closure
Pipe Inner Diameter (in.)	5.421	5.421
Cross Section Area (in^2)	23.08	23.08
Cross Section Area (m^2)	1.49E-02	1.49E-02
Hydraulic Radius (in.)	1.36	1.36
Manning's Coefficient ($s/m^{0.33}$)	0.013	0.013
Drainage Path Slope (%)	1.00	0.40
Slope Angle (rad)	0.01	0.00
Slope Angle (deg)	0.57	0.23
Flow Capacity (m^3/s)	1.24E-02	7.84E-03
Required Capacity (m^3/s)	3.17E-10	6.52E-11
Factor of Safety (For Capacity)	3.92E+07	1.20E+08

05/13/04

12.5 OSDF PHASE V, SURFACE-WATER MANAGEMENT SYSTEM DESIGN AND POST-CLOSURE HYDROLOGY

5529

COMPUTATION COVER SHEET

SUBJECT OF COMPUTATIONS OSDF PHASE V, SURFACE-WATER MANAGEMENT SYSTEM DESIGN AND POST-CLOSURE HYDROLOGY

Computations By: (Cognizant Engineer)
Signature: Victoria S. Cheplak — Date: 1-21-04
Printed Name and Title: Victoria S. Cheplak, Senior Staff Engineer

Assumptions and Procedures Checked By: (Checker)
Signature: [signature] — Date: 1-21-04
Printed Name and Title: Ganesh Gopalakrishnan, Senior Engineer

Computations Checked by:
Signature: Hollie Kinnecom — Date: 1-21-04
Printed Name and Title: Hollie Kinnecom, Staff Engineer

Computations Backchecked by: (Cognizant Engineer)
Signature: Victoria S. Cheplak — Date: 1-21-04
Printed Name and Title: Victoria S. Cheplak, Senior Staff Engineer

Approved by: (PDP)
Signature: [signature] — Date: 1-21-04
Printed Name and Title: Ganesh Gopalakrishnan, Senior Engineer

Approved by: (DTL/TETL)
Signature: Rudolph Bonaparte — Date: 1/22/04
Printed Name and Title: R. Bonaparte, Engineer of Record

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
0	Submittal to FF/DOE/EPA	30 Jan 02	DBM	DGP	JFB
1	CFC Revision 1 Submittal to FF/DOE/EPA	23 Jan 04	VSC VSC	GG GG	RB
2A	DCN-Cell 8 Expansion	16 June 04	VSC VSC	GG GG	

000141

ADDENDUM TO SECTION 12.5

(REVISION 2A DUE TO CELL 8 EXPANSION DCN)

This addendum details the calculations that were revised within Section 12.5, OSDF Phase V, Surface-Water Management System Design and Post-Closure Hydrology, of the Final Design Calculation Package for the Fernald Environmental Management Project (FEMP), due to the re-design of Cell 8. This re-design, referred to as the Cell 8 Expansion DCN, encompasses the extension of Cell 8 by approximately 100-feet to the South. This addendum discusses the modifications made to this calculation package as Revision 2A and as associated with this DCN.

For Revision 2A to this calculation package, the critical case for the Surface-Water Management System Design was evaluated to confirm compliance with the Surface-Water Management and Erosion Control (SWMEC) Plan and the OSDF Design Criteria Package (DCP). This critical case is presented as the Construction Design Scenario, which considers the 25-Year, 24-Hour Storm. The surface water management system was modified to reflect the design changes resulting from the expansion of Cell 8 and analyzed to verify the adequacy of the designed surface water management features. For this submittal, only the East and West OSDF Construction Design Scenarios were modified; it should be noted that Design Cases A through C, detailed in this section, are not impacted, and therefore, are not presented.

In order to present the results of this DCN analysis in an efficient manner, only the attachments that summarize the modifications and updated results for the surface water management system with regard to the DCN are presented. These attachments are listed subsequently and explained in further detail.

- **Attachment A-2 – Layout of Design Scenario and Design Case SWM Systems.** These layouts demonstrate the revised configuration of the OSDF. Each surface water structure is labeled as identified in the hydrologic analysis.

- **Attachment A-8 – Nodal Network Diagrams.** These diagrams demonstrate the revised configuration of the surface water management system as a result of the DCN.

- **Attachment B-4 – Data for Time of Concentration Calculations.** These data demonstrate the revised flow paths used to calculate the time of concentration for the revised configuration of subcatchments used in the hydrologic analysis.

- **Attachment C-1A – HydroCAD Output Reports – 25-Year, 24-Hour Storm Event, East OSDF Construction-Phase Design Scenario.** This attachment

provides the results of the hydrologic modeling for the East OSDF Construction Design Scenario for the 25-Year, 24-Hour Storm, considered the critical case for these calculations.

- **Attachment C-1B – HydroCAD Output Reports – 25-Year, 24-Hour Storm Event, West OSDF Construction-Phase Design Scenario.** This attachment provides the results of the hydrologic modeling for the West OSDF Construction Design Scenario for the 25-Year, 24-Hour Storm, considered the critical case for these calculations.

- **Attachment C-2 – Weighted Curve Number Calculations.** These calculations present the revised areas and Curve Numbers for the revised configuration of subcatchments used in the hydrologic analysis.

- **Attachment C-3 – Tabulated Analysis Results for Channels.** These results present the revised channel characteristics (i.e., geometry), flow within each channel, and hydraulic characteristics including peak flow depth and available freeboard, for the revised configuration of channels used in the hydrologic and hydraulic analysis. The table has been modified to reflect these results for the East OSDF and West OSDF Construction Design Scenario only. The remainder of the table (i.e., features that have not been modified), has been shaded in gray.

- **Attachment C-4A – CulvertMaster Output Reports for Culverts.** These reports present the hydraulic analysis for the culverts. These reports are provided only for those culverts in the East and West OSDF Construction Design Scenario that were modified in design or were impacted by the DCN through altered flow rates.

- **Attachment C-4B – Tabulated Analysis Results for Culverts.** These results present the revised physical characteristics (i.e., geometry) and profile (i.e., inverts) of the revised configuration of culverts. The results also present the hydraulic capacity, structural capacity, and required outlet protection for these culverts as a result of flows analyzed based on the DCN. The table has been modified to reflect these results for the East OSDF and West OSDF Construction Design Scenario only. The remainder of the table (i.e., the features that have not been modified) has been shaded in gray.

Based on the analyses for the design change of the expansion of Cell 8, all channels and culverts are designed in accordance with the requirements of the SWMEC Plan and the DCP.

ATTACHMENT A-2

LAYOUT OF DESIGN SCENARIO AND DESIGN CASE SWM SYSTEMS

LEGEND

- SUBCATCHMENT LABEL AND BOUNDARY
- REACH ALIGNMENT AND LABEL
- CULVERT
- POND LABEL

5529

PHASE V

EAST OSDF DESIGN SCENARIO

SCALE 1" = 400'

0 400'

EXISTING EMERGENCY ACCESS ROAD (FORMERLY REROUTED NORTH ENTRANCE ROAD) (NOTE 12)

EXISTING OSDF MONITORING ACCESS (NOTE 13)

FUTURE OSDF IMPACTED MATERIAL HAUL ROAD AND CELL ACCESS RAMP

OSDF MONITORING ACCESS (NOTE 13)

EXISTING CHAIN-LINK FENCE (NOTE 16)

EXISTING RUN-OFF DIVERSION CHANNEL

EXISTING STP EXCAVATION

EXISTING CONSTRUCTION WATER WELL NO. 3 (NOTE 10)
N 479,293.95
E 1,351,619.22

EXISTING POWER POLE OP77

RELOCATED EMERGENCY ACCESS ROAD (NOTE 12)

EXISTING CONSTRUCTION WATER WELL NO. 2 (NOTE 10)
N 479,241.37
E 1,351,630.08

EXISTING CONSTRUCTION WATER WELL NO. 1 (NOTE 10)
N 479,183.03
E 1,351,665.56

EXISTING POWER POLE OP83

EXISTING EMERGENCY ACCESS ROAD (NOTE 12)

EXISTING 24' WIDE GATE (NOTE 16)

EXISTING CONSTRUCTION ADMINISTRATION AREA

EXISTING BORROW AREA ACCESS ROAD

BORROW AREA (NOTE 8)

MID-VALLEY PIPELINE EASEMENT (NOTE 9)

CONSTRUCTION LAYDOWN AREA

EXISTING BORROW AREA HAUL ROAD CORRIDOR

EXISTING GATE (NOTE 16)

CONSTRUCTION LAYDOWN AREA

EXISTING CONSTRUCTION FENCE TO BE REMOVED AS REQUIRED

SOUTH STOCKPILE AREA

SCREENED MATERIAL STOCKPILE AREA

BORROW AREA SUBAREA 5

BORROW AREA SUBAREA 6

BORROW AREA SUBAREA 7

BORROW AREA SUBAREA 8

EXISTING GATE (NOTE 16)

RELOCATED ACCESS CONTROL FACILITY (NOTE 15)
N 479510.49
E 1350663.46

EXISTING FENCE TO BE REMOVED AND REPLACED (NOTE 16)

EXISTING GATE TO BE REMOVED AND REPLACED (NOTE 16)

EXISTING RESTORED AREA

BORROW AREA SEDIMENTATION BASIN

EXISTING ROPE AND CONSTRUCTION BARRIER TO BE REMOVED AS REQUIRED

SOUTH ENTRANCE ROAD

BM-10

OSDF-2

W-2428

OSDF-3

N 482164.16
E 1350593.31
FENCE END POST

N 482218.23
E 1350557.88
FENCE END POST

N 482418.11
E 1350557.89
FENCE END POST

N 482656.64
E 1350549.60
FENCE END POST

N 482671.06
E 1350491.50
FENCE END POST

N 482164.48
E 1350557.88
FENCE END POST

EXISTING GATE (NOTE 16)

CHAIN-LINK FENCE (NOTE 16)

EXISTING FENCE TO BE REMOVED AND REPLACED (NOTE 16)

CHAIN-LINK FENCE (NOTE 16)

EXISTING ACCESS CORRIDOR

IMPACTED RUNOFF CATCHMENT AREA (TYP) (NOTE 5)

BUILDING 77

ABANDONED WHEEL WASH

EXISTING OSDF MATERIAL TRANSFER AREA (OMTA)

EXISTING FENCE TO BE REMOVED AND REPLACED (NOTE 16)

EXISTING OMTA BULK DEBRIS AREA

2nd STREET OSDF IMPACTED MATERIAL

OMTA EXPANSION AREA

OSDF IMPACTED MATERIAL HAUL ROAD AND CELL ACCESS RAMP AT CELL 8 (NOTE 11)

EXTENSION OF IMPACTED MATERIAL HAUL ROAD

EXISTING FENCE TO BE REMOVED AND REPLACED (NOTE 16)

2ND STREET

F STREET

N 480228.91
E 1350540.38

N 479975.40
E 1350533.43
EXISTING CVH

N 479513.29
E 1350520.80
EXISTING OSDF SEDIMENTATION BASIN NO. 2

EXISTING GUARD SHACK

LAYDOWN AREA

SITE SERVICE AREA

000145

LEGEND

- SUBCATCHMENT LABEL AND BOUNDARY
- REACH ALIGNMENT AND LABEL
- CULVERT
- POND LABEL

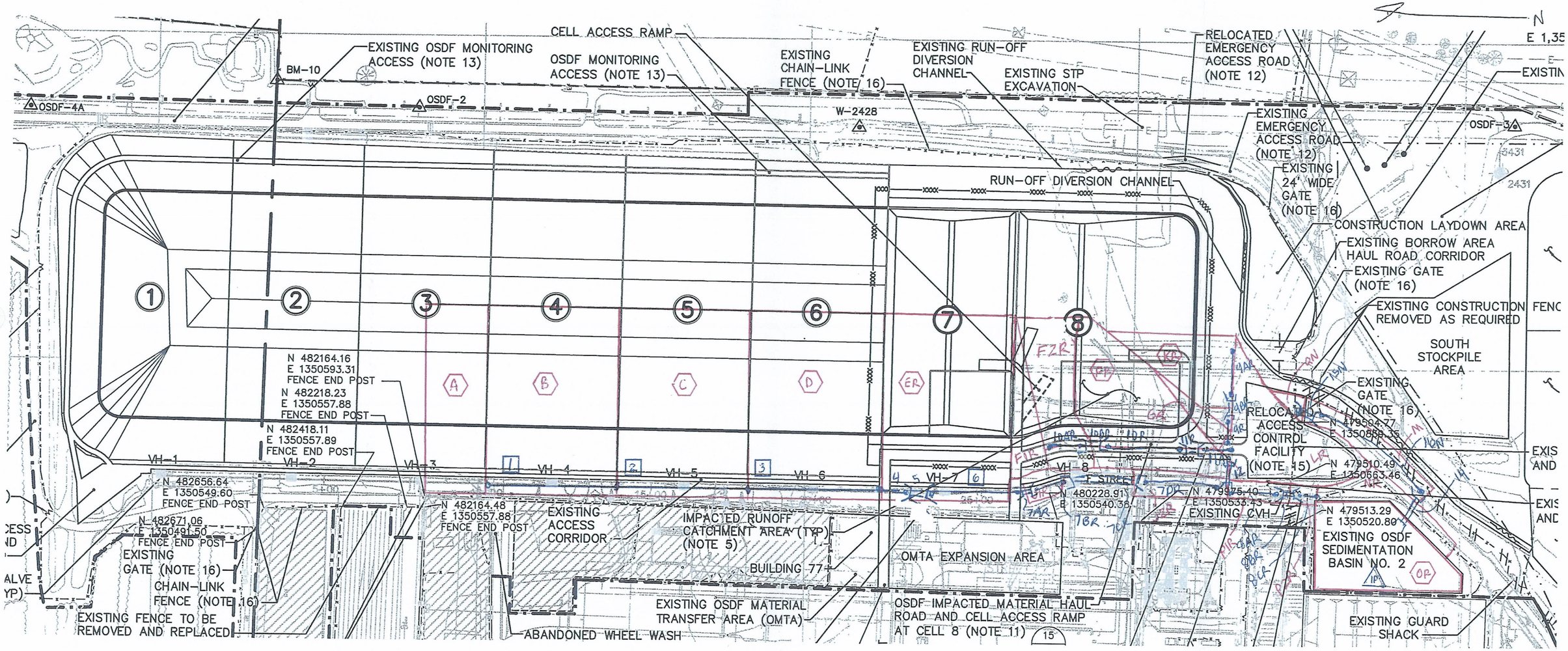
PHASE V 5529

WEST OSDF DESIGN SCENARIO

SCALE 1" = 300'

0 300

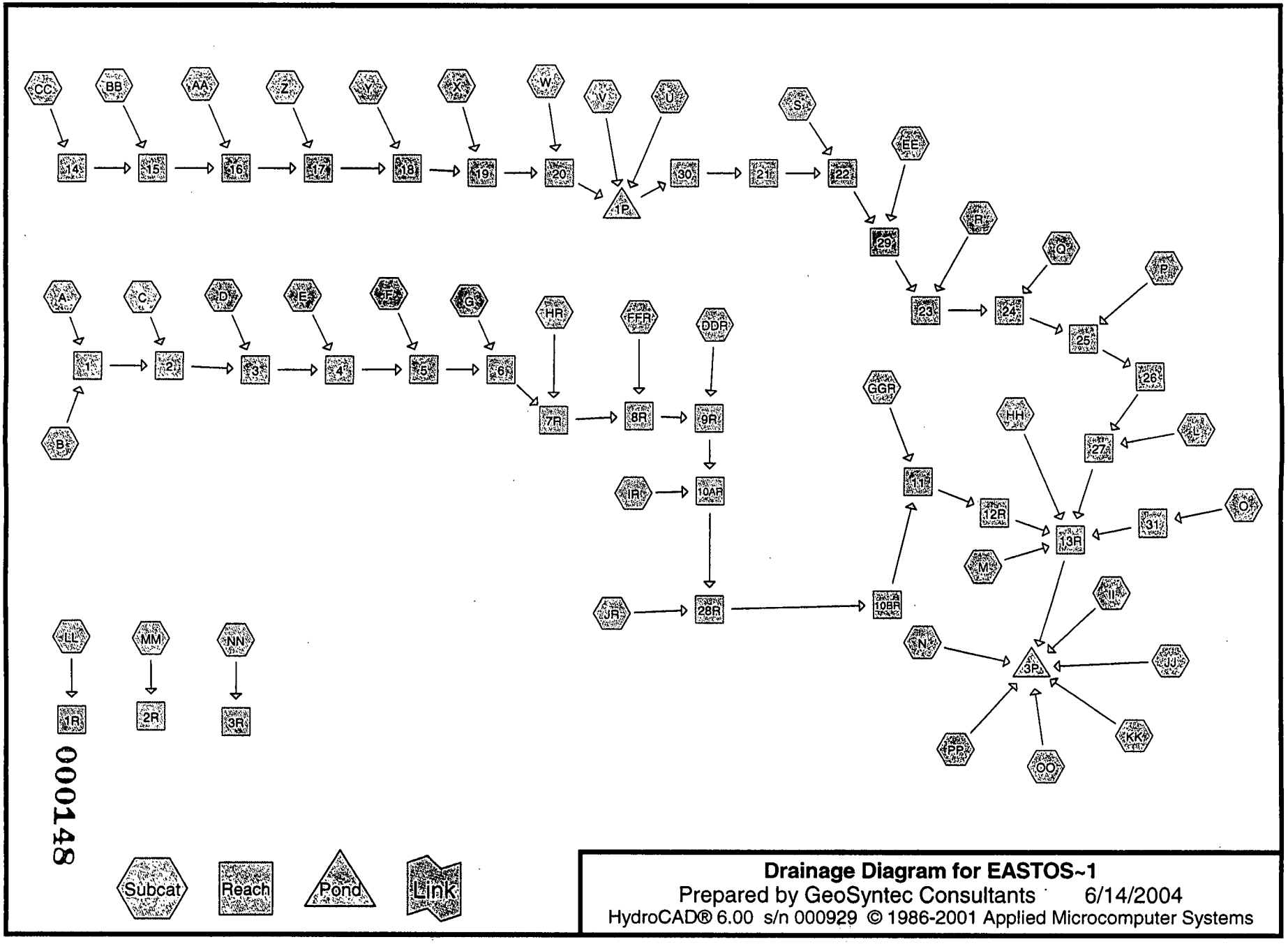
N



000146

ATTACHMENT A-8

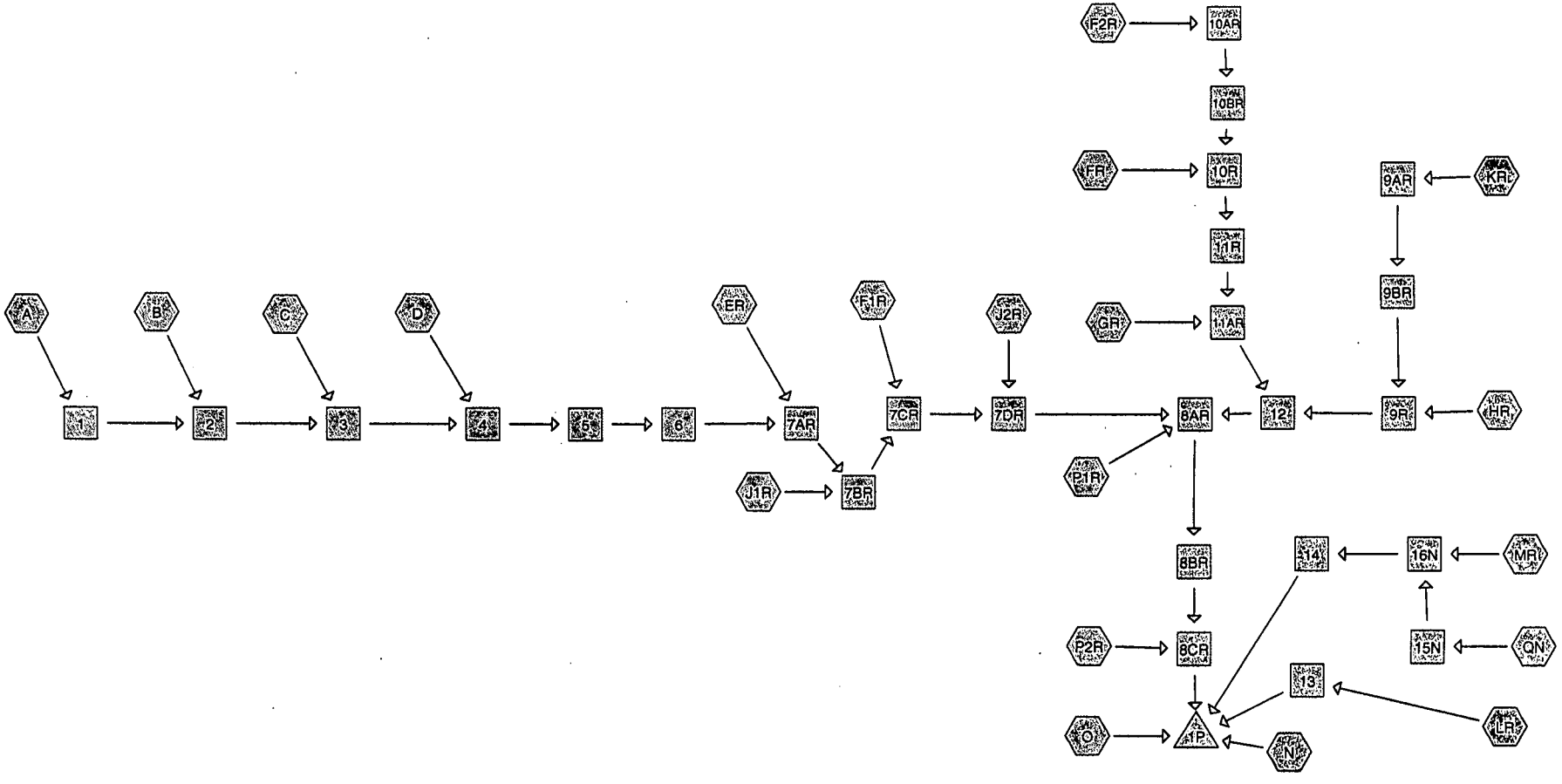
NODAL NETWORK DIAGRAMS



000148

Drainage Diagram for EASTOS~1

Prepared by GeoSyntec Consultants 6/14/2004



Subcat Reach Pond Link

Drainage Diagram for West OSDF

Prepared by GeoSyntec Consultants 6/14/2004

HydroCAD® 6.00 s/n 000929 © 1986-2001 Applied Microcomputer Systems

000149

5529

Written by: Victoria Cheplak (VSC) Date 6/13/04 Reviewed by: _____ Date: _____

Client: Fluor Fernald, Inc. Project: OSDF Phase V Revision Cell 8 DCN Project No.: GQ3309 Task No.: 2/2

ATTACHMENT B-4

DATA FOR CALCULATION OF TIME OF CONCENTRATION

HYDROCAD™ INPUT PARAMETERS FOR THE CALCULATION OF TIME OF CONCENTRATION
EAST OSDF CONSTRUCTION DESIGN SCENARIO

2-year, 24-hr Design Rainfall Depth, $P_{2,24}$ = 2.60 inches

SUBCATCHMENT LABEL AND DESCRIPTION		SHEET FLOW 1				SHEET FLOW 2				SHEET FLOW 3				SHALLOW CONCENTRATED FLOW			SHALLOW CONCENTRATED FLOW			SHALLOW CONCENTRATED FLOW			CHANNEL FLOW 1						CHANNEL FLOW 2					
No.	Description	Flow Length (ft)	Surface Description	Manning's n	Land Slope (ft/ft)	Flow Length (ft)	Surface Description	Manning's n	Land Slope (ft/ft)	Flow Length (ft)	Surface Description	Manning's n	Land Slope (ft/ft)	Flow Length (ft)	Surface Description	Land Slope (ft/ft)	Flow Length (ft)	Surface Description	Land Slope (ft/ft)	Flow Length (ft)	Surface Description	Land Slope (ft/ft)	Flow Length (ft)	Bottom Width (ft)	Flow Depth (ft)	Sideslopes (ft/ft)	Manning's n	Longitudinal Slope (ft/ft)	Flow Length (ft)	Bottom Width (ft)	Flow Depth (ft)	Sideslopes (ft/ft)	Manning's n	Longitudinal Slope (ft/ft)
A	VEGETATED FINAL COVER	90	GRASS: SHORT	0.150	0.0500	60	GRASS: SHORT	0.150	0.1000	150	GRASS: SHORT	0.150	0.1700	80	UNPAVED	0.1700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B	VEGETATED FINAL COVER	50	GRASS: SHORT	0.150	0.1800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	450	0	1.02	6.0, 3.0	0.030	0.0045	-	-	-	-	-	-
C	VEGETATED FINAL COVER	90	GRASS: SHORT	0.150	0.0500	60	GRASS: SHORT	0.150	0.1000	150	GRASS: SHORT	0.150	0.1700	170	UNPAVED	0.1700	-	-	-	-	-	-	400	0	1.02	6.0, 4.0	0.030	0.0045	-	-	-	-	-	-
D	VEGETATED FINAL COVER	90	GRASS: SHORT	0.150	0.0500	60	GRASS: SHORT	0.150	0.1000	150	GRASS: SHORT	0.150	0.1700	170	UNPAVED	0.1700	-	-	-	-	-	-	250	0	1.29	5.0, 3.0	0.030	0.0045	150	0	1.59	4.0, 3.0	0.030	0.0050
E	VEGETATED FINAL COVER	90	GRASS: SHORT	0.150	0.0500	60	GRASS: SHORT	0.150	0.1000	150	GRASS: SHORT	0.150	0.1700	170	UNPAVED	0.1700	-	-	-	-	-	-	380	0	1.60	4.0, 3.0	0.030	0.0050	-	-	-	-	-	-
F	VEGETATED FINAL COVER	90	GRASS: SHORT	0.150	0.0500	60	GRASS: SHORT	0.150	0.1000	150	GRASS: SHORT	0.150	0.1700	170	UNPAVED	0.1700	-	-	-	-	-	-	390	0	1.60	4.0, 3.0	0.030	0.0050	-	-	-	-	-	-
G	VEGETATED FINAL COVER	90	GRASS: SHORT	0.150	0.0500	60	GRASS: SHORT	0.150	0.1000	150	GRASS: SHORT	0.150	0.1700	170	UNPAVED	0.1700	-	-	-	-	-	-	410	0	1.60	4.0, 3.0	0.030	0.0050	-	-	-	-	-	-
HR	NON VEGETATED FINAL COVER	90	SMOOTH	0.011	0.0500	50	SMOOTH	0.011	0.1000	150	SMOOTH	0.011	0.1700	160	UNPAVED	0.1700	-	-	-	-	-	-	400	0	5.70	6.0, 3.0	0.030	0.0100	-	-	-	-	-	-
IR	NON VEGETATED FINAL COVER	140	SMOOTH	0.011	0.1700	12	SMOOTH	0.011	0.0500	-	-	-	-	-	-	-	-	-	-	-	-	-	144	3	3.80	3.0, 6.0	0.030	0.0050	-	-	-	-	-	-
JR	NON VEGETATED FINAL COVER	80	SMOOTH	0.011	0.0500	55	SMOOTH	0.011	0.1000	165	SMOOTH	0.011	0.1700	145	UNPAVED	0.1700	12.0000	PAVED	0.0500	-	-	-	356	9	3.85	6.0, 3.0	0.030	0.0050	-	-	-	-	-	-
L	RUNON NORTH OF BORROW AREA	140	GRASS: SHORT	0.150	0.0200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	290	0	2.00	3.0, 3.0	0.030	0.0075	-	-	-	-	-	-
M	RUNON NORTH OF BORROW AREA	170	GRASS: SHORT	0.150	0.0500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	200	20	2.50	3.0, 3.0	0.030	0.0045	-	-	-	-	-	-
N	DIRECT RUNON TO POND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
O	RUNON NORTH OF BORROW AREA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	230	0	1.00	5.0, 5.0	0.030	0.0086	-	-	-	-	-	-
P	RUNON NORTH OF BORROW AREA	300	GRASS: SHORT	0.150	0.0150	-	-	-	-	-	-	-	-	350	UNPAVED	0.0070	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Q	RUNON NORTH OF BORROW AREA	300	GRASS: SHORT	0.150	0.0260	-	-	-	-	-	-	-	-	1280	UNPAVED	0.0260	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R	RUNON NORTH OF BORROW AREA	300	GRASS: SHORT	0.150	0.0400	-	-	-	-	-	-	-	-	350	UNPAVED	0.0400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S	RUNON NORTH OF BORROW AREA	280	GRASS: SHORT	0.150	0.0150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	0	3.00	3.0, 3.0	0.030	0.0100	-	-	-	-	-	-
U	RUNON EAST OF OSDF	300	GRASS: SHORT	0.150	0.0140	-	-	-	-	-	-	-	-	240	UNPAVED	0.0140	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V	DIRECT RUNON TO POND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
W	RUNON EAST OF OSDF	300	GRASS: SHORT	0.150	0.1780	-	-	-	-	-	-	-	-	400	UNPAVED	0.1780	-	-	-	-	-	-	270	0	3.00	3.0, 30.0	0.030	0.0114	-	-	-	-	-	-
X	RUNON EAST OF OSDF	300	GRASS: SHORT	0.150	0.0190	-	-	-	-	-	-	-	-	730	UNPAVED	0.0190	-	-	-	-	-	-	330	0	2.00	3.0, 3.0	0.030	0.0100	-	-	-	-	-	-
Y	RUNON EAST OF OSDF	300	GRASS: SHORT	0.150	0.0130	-	-	-	-	-	-	-	-	510	UNPAVED	0.0130	-	-	-	-	-	-	340	0	2.00	5.0, 4.0	0.030	0.0110	-	-	-	-	-	-
Z	RUNON EAST OF OSDF	300	GRASS: SHORT	0.150	0.0310	-	-	-	-	-	-	-	-	250	UNPAVED	0.0310	-	-	-	-	-	-	50	0	2.00	5.0, 4.0	0.030	0.0070	-	-	-	-	-	-
AA	RUNON AREA EAST OF OSDF	300	GRASS: SHORT	0.150	0.0800	-	-	-	-	-	-	-	-	170	UNPAVED	0.0800	-	-	-	-	-	-	300	0	2.00	3.0, 3.0	0.030	0.0070	-	-	-	-	-	-
BB	RUNON AREA EAST OF OSDF	110	GRASS: SHORT	0.150	0.0800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	360	0	1.50	3.0, 5.0	0.030	0.0040	-	-	-	-	-	-
CC	RUNON AREA EAST OF OSDF	110	GRASS: SHORT	0.150	0.0800	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DDR	NON VEGETATED FINAL COVER	210	SMOOTH	0.011	0.1700	12	SMOOTH	0.011	0.0500	-	-	-	-	-	-	-	-	-	-	-	-	-	241	0	5.47	2.0, 6.0	0.030	0.0050	-	-	-	-	-	-
EE	RUNON NORTH OF BORROW AREA	300	GRASS: SHORT	0.150	0.0230	-	-	-	-	-	-	-	-	80	UNPAVED	0.0230	-	-	-	-	-	-	40	0	4.00	3.0, 3.0	0.030	0.0100	-	-	-	-	-	-
FFR	NON VEGETATED FINAL COVER	90	SMOOTH	0.011	0.0500	50	SMOOTH	0.011	0.1000	160	SMOOTH	0.011	0.1700	120	UNPAVED	0.1700	12	PAVED	0.0500	-	-	-	467	0	5.49	6.0, 3.0	0.030	0.0050	-	-	-	-	-	-
GGR	CONSTRUCTION LAYDOWN	280	GRASS: SHORT	0.150	0.0200	-	-	-	-	-	-	-	-	1	UNPAVED	0.0154	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HH	RUNON NORTH OF BORROW AREA	90	GRASS: SHORT	0.150	0.0100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	230	20	2.50	3.0, 3.0	0.030	0.0045	-	-	-	-	-	-
II	RUNON AREA TO BORROW AREA	210	GRASS: SHORT	0.150	0.0400	-	-	-	-	-	-	-	-	70	UNPAVED	0.1660	380	UNPAVED	0.0025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
JJ	RUNON AREA TO BORROW AREA	300	GRASS: SHORT	0.150	0.0250	-	-	-	-	-	-	-	-	40	UNPAVED	0.0250	110	UNPAVED	0.1660	840	UNPAVED	0.0025	-	-	-	-	-	-	-	-	-	-	-	-	-
KK	RUNON AREA TO BORROW AREA	300	GRASS: SHORT	0.150	0.0280	-	-	-	-	-	-	-	-	150	UNPAVED	0.0140	110	UNPAVED	0.1660	630	UNPAVED	0.0030	-	-	-	-	-	-	-	-	-	-	-	-	-
LL	RUNOFF	300	GRASS: SHORT	0.150	0.0240	-	-	-	-	-	-	-	-	200	UNPAVED	0.0240	-	-	-	-	-	-	900	0	3.00	3.0, 3.0	0.030	0.0090	-	-	-	-	-	-
MM	RUNOFF	100	GRASS: SHORT	0.150	0.0700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	980	0	3.00	5.0, 4.0	0.030	0.0060	-	-	-	-	-	-
NN	RUNOFF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	600	0	3.00	3.0, 3.0	0.030	0.0130	-	-	-	-	-	-
OO	RUNON AREA TO BORROW AREA	120	GRASS: SHORT	0.150	0.1660	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PP	VEGETATED BORROW AREA	150	GRASS: SHORT	0.150	0.1660	150	GRASS: SHORT	0.150	0.0025	-	-	-	-	1190	UNPAVED	0.0025	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

HYDROCAD™ INPUT PARAMETERS FOR THE CALCULATION OF TIME OF CONCENTRATION
WEST OSDF CONSTRUCTION DESIGN SCENARIO

2-year, 24-hr Design Rainfall Depth, P_{2-24} = 2.60 inches

SUBCATCHMENT LABEL AND DESCRIPTION		SHEET FLOW 1				SHEET FLOW 2				SHEET FLOW 3				SHALLOW CONCENTRATED FLOW 1			CHANNEL FLOW 1						PIPE FLOW				CHANNEL FLOW 2					
		Flow Length (ft)	Surface Description	Manning's n	Land Slope (ft/ft)	Flow Length (ft)	Surface Description	Manning's n	Land Slope (ft/ft)	Flow Length (ft)	Surface Description	Manning's n	Land Slope (ft/ft)	Flow Length (ft)	Surface Description	Land Slope (ft/ft)	Flow Length (ft)	Bottom Width (ft)	Flow Depth (ft)	Sideslopes (ft/ft)	Manning's n	Longitudinal Slope (ft/ft)	Flow Length (ft)	Diameter (inch)	Manning's n	Longitudinal Slope (ft/ft)	Flow Length (ft)	Bottom Width (ft)	Flow Depth (ft)	Sideslopes (ft/ft)	Manning's n	Longitudinal Slope (ft/ft)
No.	Description																															
A	VEGETATED FINAL COVER	90	GRASS: SHORT	0.150	0.0500	60	GRASS: SHORT	0.150	0.1000	150	GRASS: SHORT	0.150	0.1700	190	UNPAVED	0.1700	180	0	2.00	3.0, 6.0	0.030	0.0075	-	-	-	-	-	-	-	-	-	-
B	VEGETATED FINAL COVER	90	GRASS: SHORT	0.150	0.0500	60	GRASS: SHORT	0.150	0.1000	150	GRASS: SHORT	0.150	0.1700	200	UNPAVED	0.1700	190	0	2.00	3.0, 6.0	0.030	0.0075	60	72	0.013	0.0100	200	0	4.00	6.0, 2.0	0.030	0.0075
C	VEGETATED FINAL COVER	90	GRASS: SHORT	0.150	0.0500	60	GRASS: SHORT	0.150	0.1000	150	GRASS: SHORT	0.150	0.1700	200	UNPAVED	0.1700	190	0	2.00	3.0, 6.0	0.030	0.0075	60	72	0.013	0.0100	195	0	4.00	6.0, 2.0	0.030	0.0075
D	VEGETATED FINAL COVER	90	GRASS: SHORT	0.150	0.0500	60	GRASS: SHORT	0.150	0.1000	150	GRASS: SHORT	0.150	0.1700	205	UNPAVED	0.1700	190	0	2.00	3.0, 6.0	0.030	0.0075	60	72	0.013	0.0100	195	0	4.00	6.0, 2.0	0.030	0.0075
ER	NON VEGETATED FINAL COVER	110	SMOOTH	0.011	0.0625	45	SMOOTH	0.011	0.1110	150	SMOOTH	0.011	0.1700	200	UNPAVED	0.1700	510	0	3.50	3.0, 6.0	0.030	0.0075	85	72	0.013	0.0029	-	-	-	-	-	-
F1R	NON VEGETATED FINAL COVER	90	SMOOTH	0.011	0.0530	50	SMOOTH	0.011	0.1000	150	SMOOTH	0.011	0.1670	200	UNPAVED	0.1670	160	0	3.50	3.0, 6.0	0.030	0.0075	53	72	0.013	0.0580	-	-	-	-	-	-
F2R	NON VEGETATED FINAL COVER	90	SMOOTH	0.011	0.0500	55	SMOOTH	0.011	0.1000	150	SMOOTH	0.011	0.1667	200	UNPAVED	0.1667																
FR	NON VEGETATED FINAL COVER	70	SMOOTH	0.011	0.0500	60	SMOOTH	0.011	0.1000	150	SMOOTH	0.011	0.1670	175	UNPAVED	0.1700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GR	NON VEGETATED FINAL COVER/ RUNON NORTH OF BORROW AREA	150	SMOOTH	0.011	0.1400	-	-	-	-	-	-	-	-	350	UNPAVED	0.1400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HR	RUNON NORTH OF BORROW AREA	45	GRASS: SHORT	0.150	0.0700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
J1R	CONSTRUCTION LAYDOWN	54	GRASS: SHORT	0.150	0.1670	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
J2R	CONSTRUCTION LAYDOWN	100	GRASS: SHORT	0.150	0.0427	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KR	NON VEGETATED FINAL COVER/ RUNON NORTH OF BORROW AREA	65	SMOOTH	0.011	0.1000	150	SMOOTH	0.011	0.1700	-	-	-	-	180	UNPAVED	0.1700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LR	CONSTRUCTION LAYDOWN	300	GRASS: SHORT	0.150	0.0200	-	-	-	-	-	-	-	-	20	UNPAVED	0.0200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MR	RUNON NORTH OF BORROW AREA	40	GRASS: SHORT	0.150	0.0985	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N	CONSTRUCTION LAYDOWN	170	GRASS: SHORT	0.150	0.0250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
O	DIRECT RUNON TO POND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P1R	CONSTRUCTION LAYDOWN	100	GRASS: SHORT	0.150	0.0385	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P2R	CONSTRUCTION LAYDOWN	110	GRASS: SHORT	0.150	0.0473	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
QN	RUNON NORTH OF BORROW AREA	100	GRASS: SHORT	0.150	0.0167	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ATTACHMENT C

HydroCAD™ OUTPUT REPORTS

ATTACHMENT C-1A

HydroCAD™ OUTPUT REPORTS

EAST OSDF CONSTRUCTION-PHASE DESIGN SCENARIO

EAST OSDF CONSTRUCTION-PHASE DESIGN SCENARIO
25-YEAR, 24-HOUR STORM EVENT

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Type II 24-hr Rainfall=4.70"
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment A: vegetated final cover system Tc=17.3 min CN=83 Area=1.964 ac Runoff= 6.81 cfs 0.473 af

Subcatchment AA: runon area east of OSDF Tc=16.8 min CN=74 Area=2.708 ac Runoff= 6.97 cfs 0.478 af

Subcatchment B: vegetated final cover system Tc=6.2 min CN=83 Area=1.179 ac Runoff= 5.75 cfs 0.285 af

Subcatchment BB: runon east of OSDF Tc=9.1 min CN=79 Area=0.761 ac Runoff= 3.03 cfs 0.161 af

Subcatchment C: vegetated final cover Tc=20.7 min CN=83 Area=5.209 ac Runoff= 16.37 cfs 1.255 af

Subcatchment CC: runon east of OSDF Tc=6.7 min CN=79 Area=0.121 ac Runoff= 0.52 cfs 0.026 af

Subcatchment D: vegetated final cover Tc=20.1 min CN=83 Area=5.131 ac Runoff= 16.39 cfs 1.236 af

Subcatchment DDR: unvegetated final cover system Tc=1.8 min CN=89 Area=0.865 ac Runoff= 5.44 cfs 0.251 af

Subcatchment E: vegetated final cover Tc=19.7 min CN=83 Area=5.092 ac Runoff= 16.48 cfs 1.227 af

Subcatchment EE: runon north of borrow area Tc=25.4 min CN=77 Area=0.925 ac Runoff= 2.10 cfs 0.182 af

Subcatchment F: vegetated final cover Tc=19.7 min CN=83 Area=5.053 ac Runoff= 16.35 cfs 1.217 af

Subcatchment FFR: unvegetated final cover system Tc=3.6 min CN=89 Area=4.760 ac Runoff= 29.64 cfs 1.382 af

Subcatchment G: vegetated final cover Tc=19.8 min CN=83 Area=5.309 ac Runoff= 17.13 cfs 1.279 af

Subcatchment GGR: construction laydown area Tc=24.8 min CN=78 Area=2.620 ac Runoff= 6.27 cfs 0.533 af

Subcatchment HH: runon north of borrow area Tc=13.9 min CN=79 Area=0.548 ac Runoff= 1.86 cfs 0.116 af

Subcatchment HR: un-vegetated final cover Tc=3.2 min CN=89 Area=4.590 ac Runoff= 28.80 cfs 1.333 af

Subcatchment II: runon area to borrow area Tc=23.0 min CN=68 Area=1.669 ac Runoff= 2.73 cfs 0.230 af

Subcatchment IR: un vegetated final cover Tc=1.3 min CN=89 Area=0.520 ac Runoff= 3.35 cfs 0.151 af

Subcatchment JJ: runon area to borrow area Tc=41.9 min CN=62 Area=0.914 ac Runoff= 0.69 cfs 0.094 af

Subcatchment JR: un-vegetated final cover Tc=3.5 min CN=89 Area=2.590 ac Runoff= 16.17 cfs 0.752 af

Subcatchment KK: runon area to borrow area Tc=36.4 min CN=64 Area=5.893 ac Runoff= 5.63 cfs 0.674 af

Subcatchment L: runon north of borrow area Tc=15.4 min CN=76 Area=1.683 ac Runoff= 4.88 cfs 0.320 af

Subcatchment LL: runoff area Tc=28.1 min CN=61 Area=7.049 ac Runoff= 6.61 cfs 0.693 af

Subcatchment M: runon north of borrow area Tc=12.1 min CN=79 Area=1.000 ac Runoff= 3.60 cfs 0.212 af

Subcatchment MM: runoff area Tc=9.9 min CN=61 Area=1.943 ac Runoff= 3.30 cfs 0.192 af

Subcatchment N: direct runon to pond Tc=1.0 min CN=98 Area=7.818 ac Runoff= 57.89 cfs 2.908 af

Subcatchment NN: runoff area Tc=1.4 min CN=66 Area=1.274 ac Runoff= 3.78 cfs 0.162 af

Subcatchment O: runon north of borrow area Tc=1.3 min CN=79 Area=1.317 ac Runoff= 6.54 cfs 0.279 af

Subcatchment OO: runon area to borrow area Tc=5.4 min CN=66 Area=0.399 ac Runoff= 1.06 cfs 0.051 af

Subcatchment P: runon north of borrow area Tc=33.7 min CN=75 Area=5.238 ac Runoff= 9.16 cfs 0.955 af

Subcatchment PP: vegetated borrow area Tc=65.5 min CN=64 Area=40.964 ac Runoff= 25.40 cfs 4.631 af

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Subcatchment Q: runon north of borrow area Tc=31.8 min CN=72 Area=7.700 ac Runoff= 12.29 cfs 1.252 af

Subcatchment R: runon north of borrow area Tc=21.6 min CN=74 Area=2.612 ac Runoff= 5.83 cfs 0.460 af

Subcatchment S: runon north of borrow area Tc=27.9 min CN=78 Area=0.402 ac Runoff= 0.89 cfs 0.082 af

Subcatchment U: runon east of OSDF Tc=32.3 min CN=72 Area=4.149 ac Runoff= 6.57 cfs 0.674 af

Subcatchment V: direct runon to pond Tc=1.0 min CN=98 Area=0.274 ac Runoff= 2.03 cfs 0.102 af

Subcatchment W: runon east of OSDF Tc=12.6 min CN=72 Area=10.593 ac Runoff= 28.88 cfs 1.733 af

Subcatchment X: runon east of OSDF Tc=33.4 min CN=71 Area=11.853 ac Runoff= 17.50 cfs 1.851 af

Subcatchment Y: runon area east of OSDF Tc=36.8 min CN=73 Area=6.522 ac Runoff= 9.84 cfs 1.101 af

Subcatchment Z: runon area east of OSDF Tc=23.7 min CN=72 Area=1.606 ac Runoff= 3.11 cfs 0.262 af

Reach 1: east drainage channel Inflow= 10.81 cfs 0.758 af
Length= 420.0' Max Vel= 2.1 fps Capacity= 754.76 cfs Outflow= 10.06 cfs 0.756 af

Reach 1R: (new node) Inflow= 6.61 cfs 0.693 af
Length= 100.0' Max Vel= 5.4 fps Capacity= 1,101.12 cfs Outflow= 6.59 cfs 0.693 af

Reach 2: east drainage channel Inflow= 26.37 cfs 2.010 af
Length= 420.0' Max Vel= 2.7 fps Capacity= 1,205.98 cfs Outflow= 25.59 cfs 2.005 af

Reach 2R: (new node) Inflow= 3.30 cfs 0.192 af
Length= 100.0' Max Vel= 4.3 fps Capacity= 1,101.12 cfs Outflow= 3.25 cfs 0.192 af

Reach 3: east drainage channel Inflow= 40.77 cfs 3.241 af
Length= 420.0' Max Vel= 3.3 fps Capacity= 1,563.67 cfs Outflow= 39.76 cfs 3.234 af

Reach 3R: (new node) Inflow= 3.78 cfs 0.162 af
Length= 100.0' Max Vel= 4.5 fps Capacity= 1,101.12 cfs Outflow= 3.72 cfs 0.162 af

Reach 4: east drainage channel Inflow= 53.10 cfs 4.461 af
Length= 420.0' Max Vel= 3.5 fps Capacity= 1,106.53 cfs Outflow= 52.07 cfs 4.451 af

Reach 5: east drainage channel Inflow= 63.69 cfs 5.669 af
Length= 440.0' Max Vel= 3.5 fps Capacity= 182.58 cfs Outflow= 62.69 cfs 5.656 af

Reach 6: east drainage channel Inflow= 73.28 cfs 6.935 af
Length= 480.0' Max Vel= 4.6 fps Capacity= 258.21 cfs Outflow= 72.46 cfs 6.923 af

Reach 7R: runoff diversion channel Inflow= 75.24 cfs 8.256 af
Length= 467.0' Max Vel= 3.6 fps Capacity= 1,152.93 cfs Outflow= 74.27 cfs 8.238 af

Reach 8R: runoff diversion channel Inflow= 76.90 cfs 9.620 af
Length= 241.0' Max Vel= 3.1 fps Capacity= 1,600.80 cfs Outflow= 76.31 cfs 9.609 af

Reach 9R: runoff diversion channel Inflow= 76.73 cfs 9.860 af
Length= 144.0' Max Vel= 3.6 fps Capacity= 425.10 cfs Outflow= 76.34 cfs 9.854 af

Reach 10AR: (new node) Inflow= 76.58 cfs 10.005 af
Length= 356.0' Max Vel= 7.9 fps Capacity= 1,940.52 cfs Outflow= 76.23 cfs 9.995 af

Reach 10BR: runoff diversion channel Inflow= 77.31 cfs 10.744 af
Length= 142.0' Max Vel= 4.7 fps Capacity= 331.10 cfs Outflow= 77.00 cfs 10.738 af

Reach 11: new CMP arch Inflow= 79.86 cfs 11.272 af
Length= 40.0' Max Vel= 6.7 fps Capacity= 522.31 cfs Outflow= 79.78 cfs 11.270 af

Reach 12R: runoff diversion channel Inflow= 79.78 cfs 11.270 af
Length= 240.0' Max Vel= 3.7 fps Capacity= 317.79 cfs Outflow= 79.33 cfs 11.256 af

Reach 13R: runoff diversion channel Inflow= 145.41 cfs 21.223 af
Length= 450.0' Max Vel= 4.3 fps Capacity= 346.63 cfs Outflow= 144.59 cfs 21.172 af

Reach 14: east runon channel Inflow= 0.52 cfs 0.026 af
Length= 420.0' Max Vel= 0.9 fps Capacity= 22.78 cfs Outflow= 0.38 cfs 0.025 af

Reach 15: east runon channel Inflow= 3.20 cfs 0.186 af
Length= 420.0' Max Vel= 1.8 fps Capacity= 61.62 cfs Outflow= 2.82 cfs 0.186 af

Reach 16: east runon channel Inflow= 9.76 cfs 0.664 af
Length= 420.0' Max Vel= 2.6 fps Capacity= 256.58 cfs Outflow= 9.33 cfs 0.661 af

Reach 17: east runon channel Inflow= 12.43 cfs 0.923 af
Length= 420.0' Max Vel= 3.2 fps Capacity= 436.18 cfs Outflow= 12.07 cfs 0.921 af

Reach 18: east runon channel Inflow= 21.43 cfs 2.022 af
Length= 440.0' Max Vel= 3.7 fps Capacity= 169.20 cfs Outflow= 20.99 cfs 2.017 af

Reach 19: east runon channel Inflow= 38.43 cfs 3.868 af
Length= 470.0' Max Vel= 2.8 fps Capacity= 911.12 cfs Outflow= 37.75 cfs 3.855 af

Reach 20: east runon channel Inflow= 43.35 cfs 5.587 af
Length= 75.0' Max Vel= 4.2 fps Capacity= 153.84 cfs Outflow= 43.26 cfs 5.586 af

Reach 21: east runon channel Inflow= 45.89 cfs 6.151 af
Length= 65.0' Max Vel= 4.5 fps Capacity= 169.20 cfs Outflow= 45.84 cfs 6.149 af

Reach 22: east runon channel Inflow= 46.33 cfs 6.231 af
Length= 190.0' Max Vel= 4.5 fps Capacity= 364.40 cfs Outflow= 46.18 cfs 6.226 af

Reach 23: new CMP culverts Inflow= 48.76 cfs 6.862 af
Length= 92.0' Max Vel= 5.4 fps Capacity= 468.67 cfs Outflow= 48.70 cfs 6.859 af

Reach 24: runon channel Inflow= 57.15 cfs 8.111 af
Length= 160.0' Max Vel= 4.0 fps Capacity= 153.54 cfs Outflow= 56.99 cfs 8.104 af

Reach 25: new CMP arch Inflow= 64.24 cfs 9.059 af
Length= 53.0' Max Vel= 5.9 fps Capacity= 475.34 cfs Outflow= 64.21 cfs 9.057 af

Reach 26: runon channel Inflow= 64.21 cfs 9.057 af
Length= 300.0' Max Vel= 4.4 fps Capacity= 90.11 cfs Outflow= 64.05 cfs 9.045 af

Reach 27: new CMP arch Inflow= 65.00 cfs 9.365 af
Length= 106.0' Max Vel= 5.2 fps Capacity= 398.58 cfs Outflow= 64.88 cfs 9.361 af

Reach 28R: new CMP culverts Inflow= 77.45 cfs 10.747 af
Length= 86.0' Max Vel= 5.5 fps Capacity= 400.15 cfs Outflow= 77.31 cfs 10.744 af

Reach 29: east runon channel Inflow= 47.10 cfs 6.408 af
Length= 230.0' Max Vel= 4.6 fps Capacity= 255.23 cfs Outflow= 46.91 cfs 6.402 af

Reach 30: east runon channel Inflow= 45.98 cfs 6.152 af
Length= 30.0' Max Vel= 4.5 fps Capacity= 104.05 cfs Outflow= 45.89 cfs 6.151 af

Reach 31: culvert Inflow= 6.54 cfs 0.279 af
Length= 80.0' Max Vel= 5.1 fps Capacity= 1,025.91 cfs Outflow= 6.34 cfs 0.279 af

Pond 1P: (new node) Peak Storage= 1.584 af Inflow= 49.32 cfs 6.362 af
Primary= 45.98 cfs 6.152 af Outflow= 45.98 cfs 6.152 af

Pond 3P: Borrow Area Basin Peak Storage= 29.745 af Inflow= 176.44 cfs 29.759 af
Primary= 0.00 cfs 0.000 af Outflow= 0.00 cfs 0.000 af

Runoff Area = 172.817 ac Volume = 31.255 af Average Depth = 2.17"

Subcatchment A: vegetated final cover system

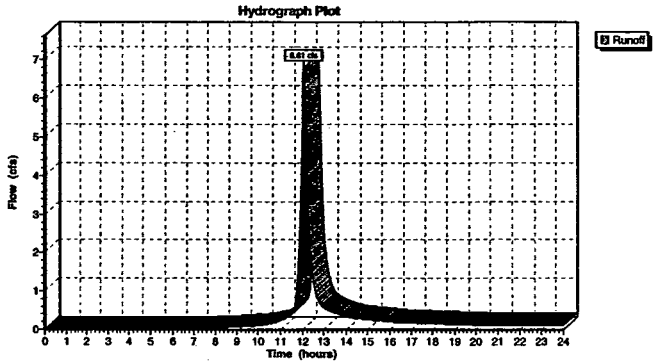
Runoff = 6.81 cfs @ 12.10 hrs, Volume= 0.473 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
1.964	83	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	90	0.0500	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
3.8	60	0.1000	0.3		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
6.4	150	0.1700	0.4		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
0.2	80	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
17.3	380	Total			

Subcatchment A: vegetated final cover system



Subcatchment AA: runon area east of OSDF

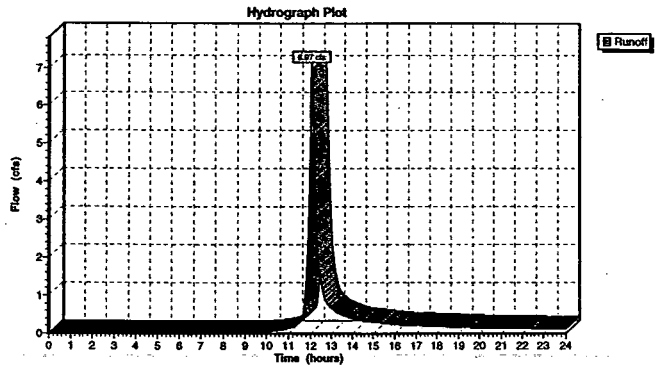
Runoff = 6.97 cfs @ 12.10 hrs, Volume= 0.478 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
2.708	74	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Descrtption
15.0	300	0.0800	0.3		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
0.6	170	0.0800	4.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
1.2	300	0.0070	4.0	48.01	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=2.00' Z= 3.0 '/' n= 0.030
16.8	770	Total			

Subcatchment AA: runon area east of OSDF



Subcatchment B: vegetated final cover system

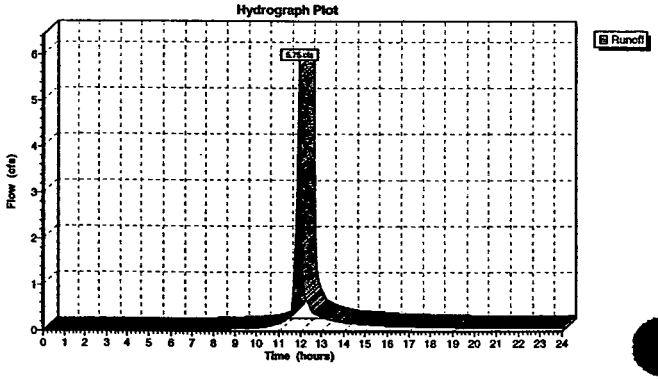
Runoff = 5.75 cfs @ 11.97 hrs, Volume= 0.285 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
1.179	83	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	50	0.1800	0.3		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
3.6	450	0.0045	2.1	9.75	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=1.02' Z= 6.0 & 3.0 '/' n= 0.030
6.2	500	Total			

Subcatchment B: vegetated final cover system



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Subcatchment BB: runon east of OSDF

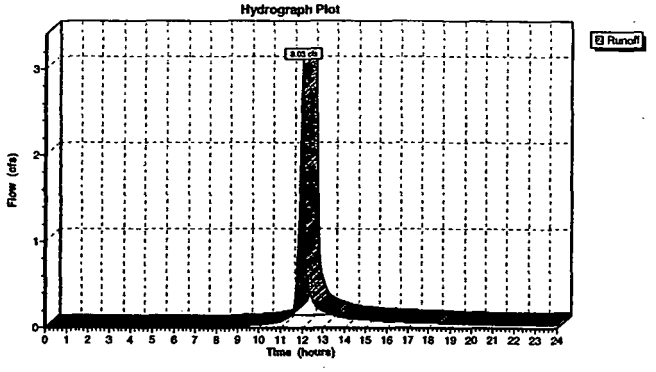
Runoff = 3.03 cfs @ 12.01 hrs, Volume= 0.161 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.761	79	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	110	0.0800	0.3		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
2.4	360	0.0040	2.5	22.78	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=1.50' Z= 3.0 & 5.0 '/' n= 0.030
9.1	470	Total			

Subcatchment BB: runon east of OSDF



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Subcatchment C: vegetated final cover

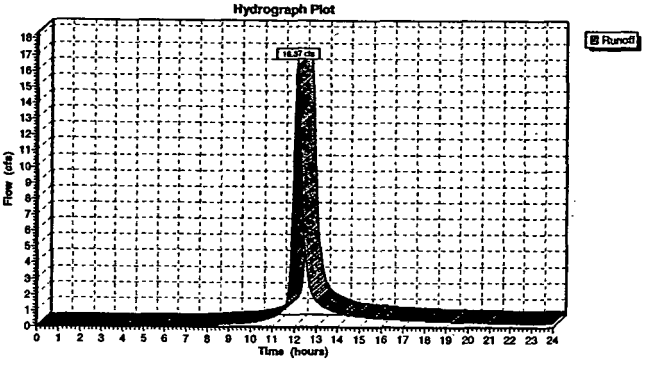
Runoff = 16.37 cfs @ 12.13 hrs, Volume= 1.255 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
5.209	83	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	90	0.0500	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
3.8	60	0.1000	0.3		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
6.4	150	0.1700	0.4		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
0.4	170	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
3.2	400	0.0045	2.1	10.88	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=1.02' Z= 6.0 & 4.0 '/' n= 0.030
20.7	870	Total			

Subcatchment C: vegetated final cover



Subcatchment CC: runon east of OSDF

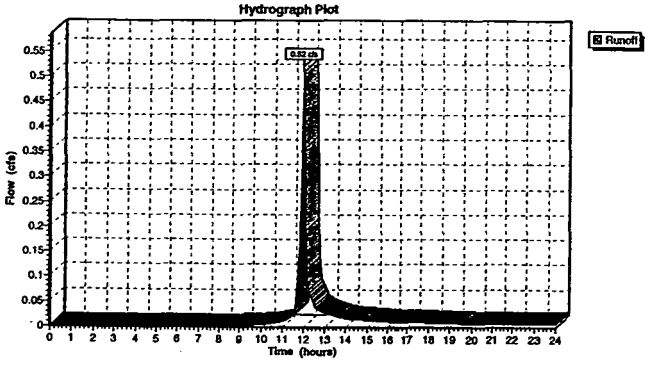
Runoff = 0.52 cfs @ 11.98 hrs, Volume= 0.026 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.121	79	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	110	0.0800	0.3		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"

Subcatchment CC: runon east of OSDF



Subcatchment D: vegetated final cover

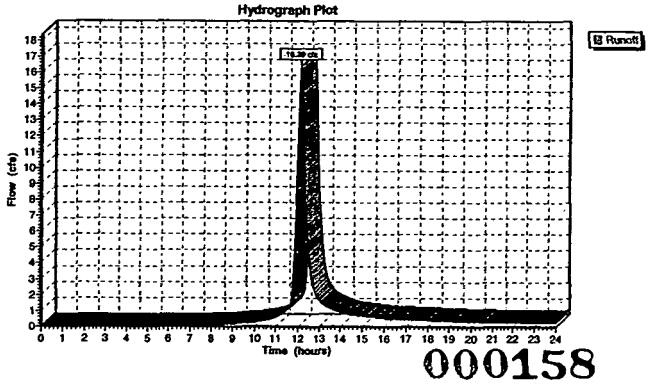
Runoff = 16.39 cfs @ 12.13 hrs, Volume= 1.236 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
5.131	83	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	90	0.0500	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
3.8	60	0.1000	0.3		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
6.4	150	0.1700	0.4		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
0.4	170	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
1.7	250	0.0045	2.4	16.16	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=1.29' Z= 5.0 & 3.0 '/' n= 0.030
0.9	150	0.0050	2.9	25.90	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=1.59' Z= 4.0 & 3.0 '/' n= 0.030
20.1	870	Total			

Subcatchment D: vegetated final cover



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Subcatchment DDR: unvegetated final cover system

[49] Hint: Tc<2dt may require smaller dt

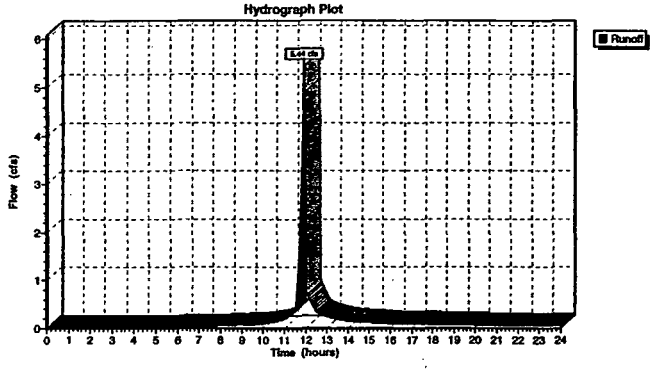
Runoff = 5.44 cfs @ 11.91 hrs, Volume= 0.251 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.865	89	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	210	0.1700	3.4		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.60"
0.2	12	0.0500	1.2		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.60"
0.6	241	0.0050	6.7	788.74	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=5.47' Z= 2.0 & 6.0 '/' n= 0.030
1.8	463	Total			

Subcatchment DDR: unvegetated final cover system



Subcatchment E: vegetated final cover

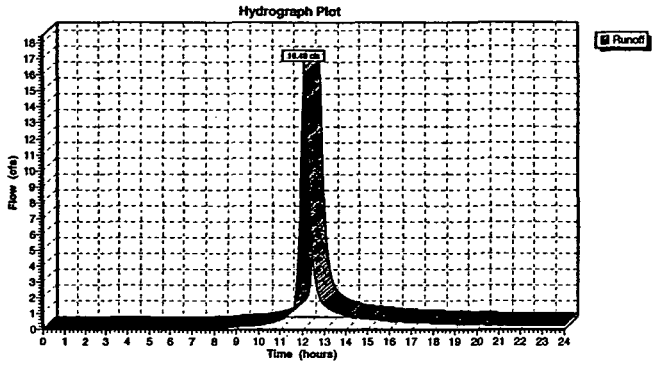
Runoff = 16.48 cfs @ 12.12 hrs, Volume= 1.227 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
5.092	83	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	90	0.0500	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
3.8	60	0.1000	0.3		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
6.4	150	0.1700	0.4		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
0.4	170	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
2.2	380	0.0050	2.9	26.33	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=1.60' Z= 4.0 & 3.0 '/' n= 0.030
19.7	850	Total			

Subcatchment E: vegetated final cover



Subcatchment EE: runon north of borrow area

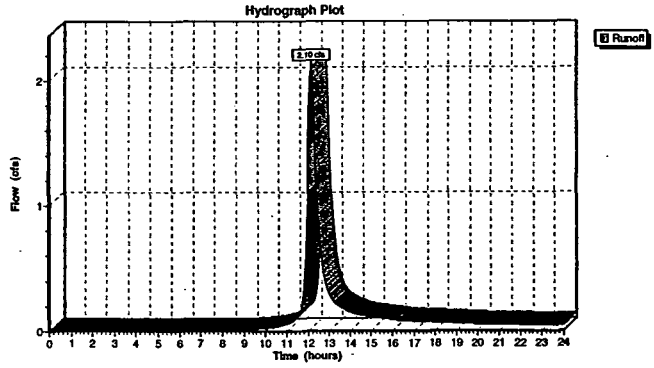
Runoff = 2.10 cfs @ 12.19 hrs, Volume= 0.182 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.925	77	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.8	300	0.0230	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
0.5	80	0.0230	2.4		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.1	40	0.0100	7.6	364.40	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=4.00' Z= 3.0 '/' n= 0.030
25.4	420	Total			

Subcatchment EE: runon north of borrow area



Subcatchment F: vegetated final cover

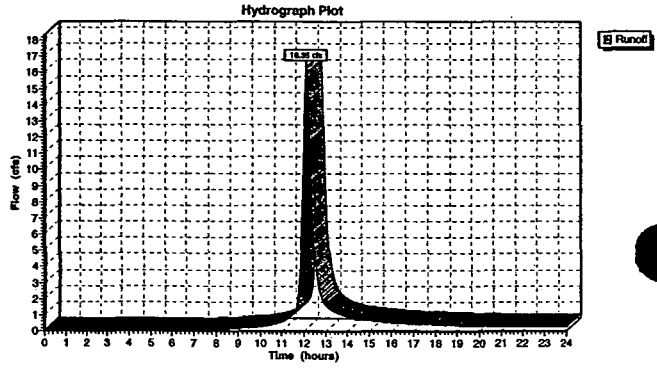
Runoff = 16.35 cfs @ 12.12 hrs, Volume= 1.217 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
5.053	83	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	90	0.0500	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
3.8	60	0.1000	0.3		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
6.4	150	0.1700	0.4		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
0.4	170	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
2.2	390	0.0050	2.9	26.33	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=1.60' Z= 4.0 & 3.0 '/' n= 0.030
19.7	860	Total			

Subcatchment F: vegetated final cover



Subcatchment FFR: unvegetated final cover system

[49] Hint: Tc<2dt may require smaller dt

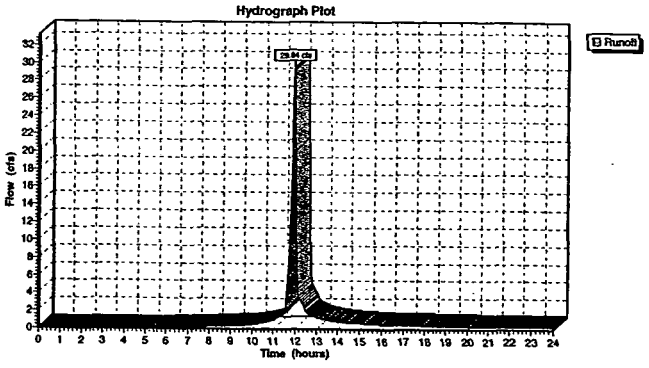
Runoff = 29.64 cfs @ 11.94 hrs, Volume= 1.382 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
4.760	89	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	90	0.0500	1.8		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.60"
0.4	50	0.1000	2.1		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.60"
0.8	160	0.1700	3.2		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.60"
0.3	120	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.0	12	0.0500	4.5		Shallow Concentrated Flow, Paved Kv= 20.3 fps
1.2	467	0.0050	6.7	914.80	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=5.49' Z= 6.0 & 3.0 '/' n= 0.030
3.6	899	Total			

Subcatchment FFR: unvegetated final cover system



Subcatchment G: vegetated final cover

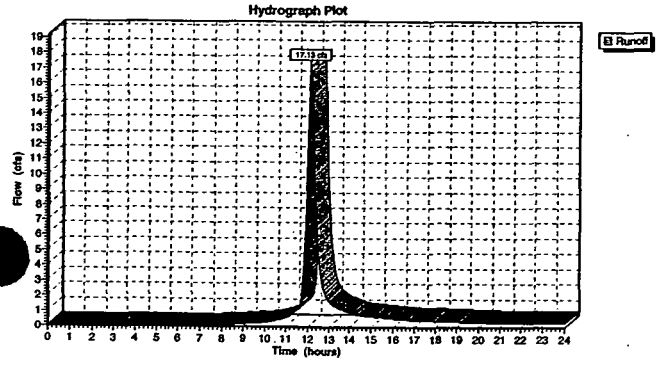
Runoff = 17.13 cfs @ 12.12 hrs, Volume= 1.279 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
5.309	83	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	90	0.0500	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
3.8	60	0.1000	0.3		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
6.4	150	0.1700	0.4		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
0.4	170	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
2.3	410	0.0050	2.9	26.33	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=1.60' Z= 4.0 & 3.0 '/' n= 0.030
19.8	880	Total			

Subcatchment G: vegetated final cover



Subcatchment GGR: construction laydown area

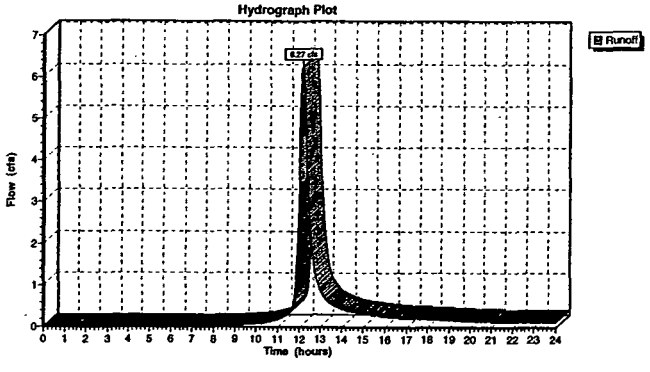
Runoff = 6.27 cfs @ 12.19 hrs, Volume= 0.533 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
2.620	78	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.8	280	0.0200	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
0.0	1	0.0154	2.0		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
24.8	281	Total			

Subcatchment GGR: construction laydown area



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Subcatchment HH: runon north of borrow area

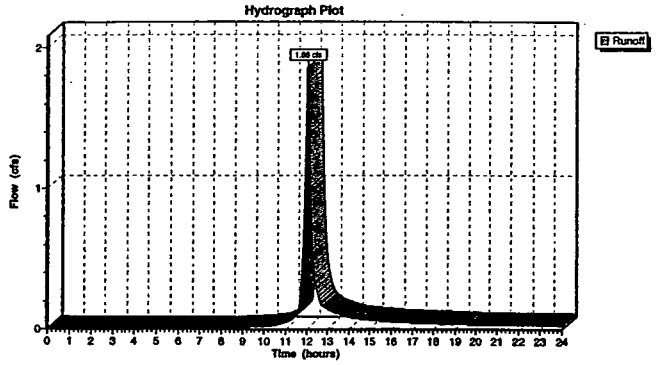
Runoff = 1.86 cfs @ 12.06 hrs, Volume= 0.116 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.548	79	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.2	90	0.0100	0.1		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
0.7	230	0.0045	5.1	352.87	Trap/Vee/Rect Channel Flow, Bot.W=20.00' D=2.50' Z= 3.0 '/' n= 0.030
13.9	320	Total			

Subcatchment HH: runon north of borrow area



Subcatchment HR: un-vegetated final cover

[49] Hint: Tc<2dt may require smaller dt

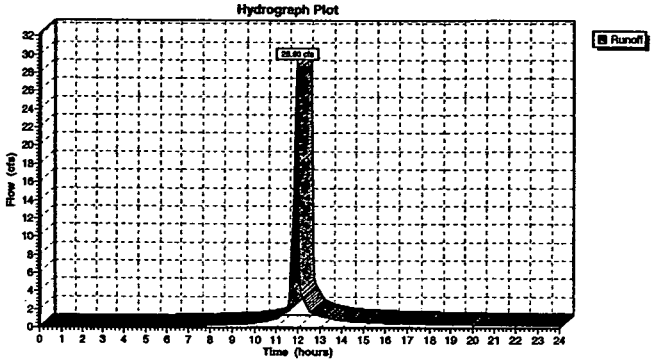
Runoff = 28.80 cfs @ 11.93 hrs, Volume= 1.333 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
4.590	89	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	90	0.0500	1.8		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.60"
0.4	50	0.1000	2.1		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.60"
0.8	150	0.1700	3.2		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.60"
0.4	160	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.7	400	0.0100	9.8	1,429.92	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=5.70' Z= 6.0 & 3.0 '/' n= 0.030
3.2	850	Total			

Subcatchment HR: un-vegetated final cover



Subcatchment II: runon area to borrow area

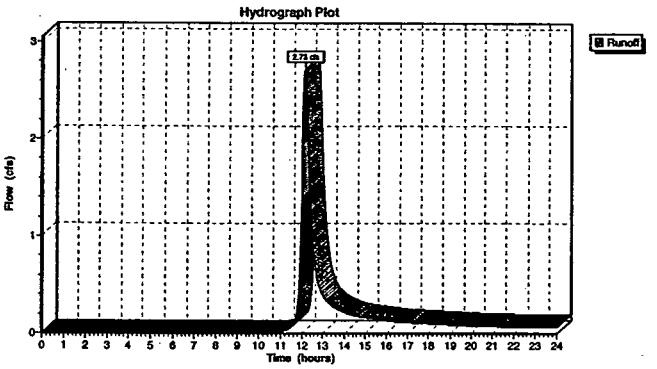
Runoff = 2.73 cfs @ 12.17 hrs, Volume= 0.230 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
1.669	68	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.9	210	0.0400	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
0.2	70	0.1660	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
7.9	380	0.0025	0.8		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
23.0	660	Total			

Subcatchment II: runon area to borrow area



Subcatchment IR: un vegetated final cover

[49] Hint: Tc<2dt may require smaller dt

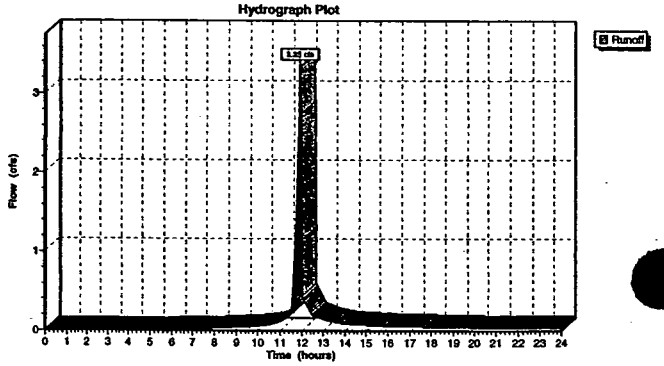
Runoff = 3.35 cfs @ 11.90 hrs, Volume= 0.151 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.520	89	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	140	0.1700	3.1		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.60"
0.2	12	0.0500	1.2		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.60"
0.4	144	0.0050	5.6	425.10	Trap/Vee/Rect Channel Flow, Bot.W=3.00' D=3.80' Z= 3.0 & 6.0 '/' n= 0.030
1.3	296	Total			

Subcatchment IR: un vegetated final cover



Subcatchment JJ: runon area to borrow area

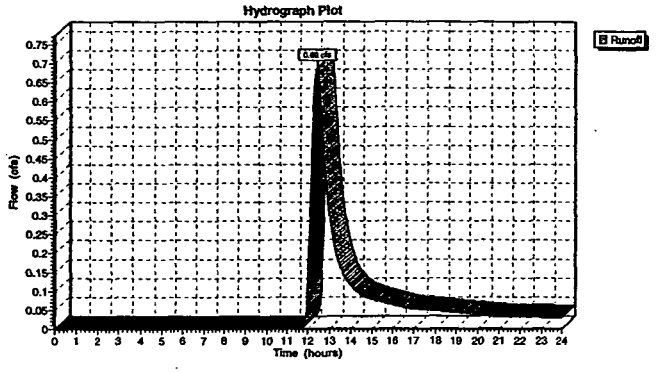
Runoff = 0.69 cfs @ 12.44 hrs, Volume= 0.094 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.914	62	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.9	300	0.0250	0.2		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
0.3	40	0.0250	2.5		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.3	110	0.1660	6.6		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
17.4	840	0.0025	0.8		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
41.9	1,290	Total			

Subcatchment JJ: runon area to borrow area



Subcatchment JR: un-vegetated final cover

[49] Hint: Tc<2dt may require smaller dt

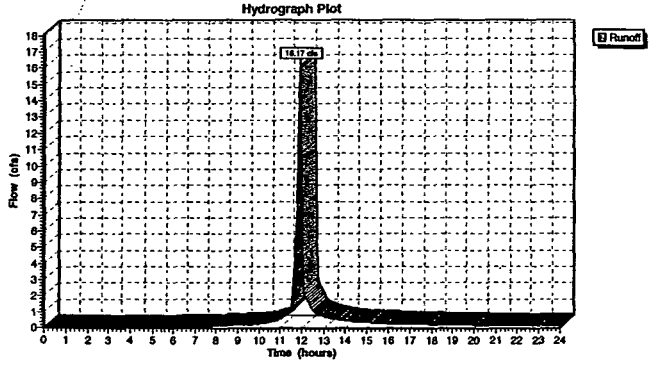
Runoff = 16.17 cfs @ 11.94 hrs, Volume= 0.752 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
2.590	89	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	80	0.0500	1.7		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.60"
0.4	55	0.1000	2.1		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.60"
0.9	165	0.1700	3.2		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.60"
0.4	145	0.1700	6.6		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.0	12	0.0500	4.5		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.0	356	0.0050	6.1	613.65	**Trap/Vee/Rect Channel Flow,** Bot.W=9.00' D=3.85' Z= 6.0 & 3.0 '/' n= 0.030
3.5	813	Total			

Subcatchment JR: un-vegetated final cover



Subcatchment KK: runon area to borrow area

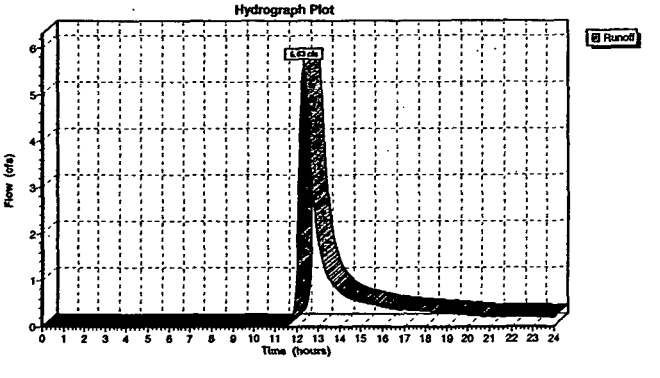
Runoff = 5.63 cfs @ 12.36 hrs, Volume= 0.674 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
5.893	64	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.9	300	0.0280	0.2		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
1.3	150	0.0140	1.9		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.3	110	0.1660	6.6		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
11.9	630	0.0030	0.9		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
36.4	1,190	Total			

Subcatchment KK: runon area to borrow area



Subcatchment L: runon north of borrow area

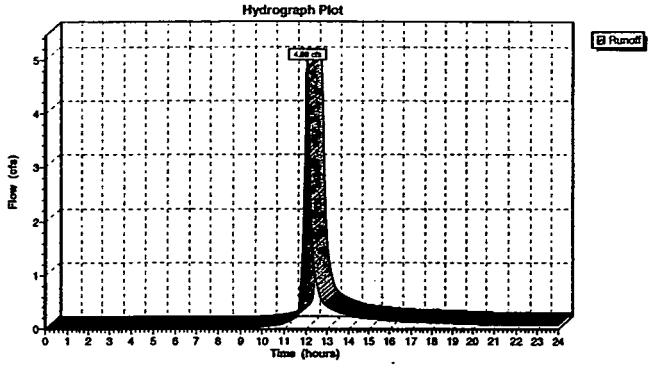
Runoff = 4.88 cfs @ 12.08 hrs, Volume= 0.320 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
1.683	76	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.2	140	0.0200	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
1.2	290	0.0075	4.1	49.70	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=2.00' Z= 3.0 '/' n= 0.030
15.4	430	Total			

Subcatchment L: runon north of borrow area



Subcatchment LL: runoff area

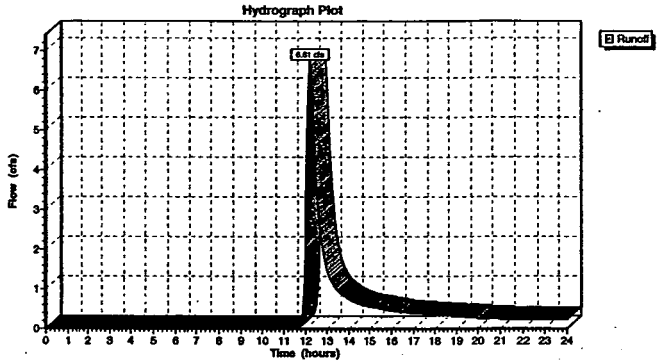
Runoff = 6.61 cfs @ 12.25 hrs, Volume= 0.693 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
7.049	61	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.3	300	0.0240	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
1.3	200	0.0240	2.5		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
2.5	900	0.0090	5.9	160.52	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=3.00' Z= 3.0 '/' n= 0.030
28.1	1,400	Total			

Subcatchment LL: runoff area



Subcatchment M: runon north of borrow area

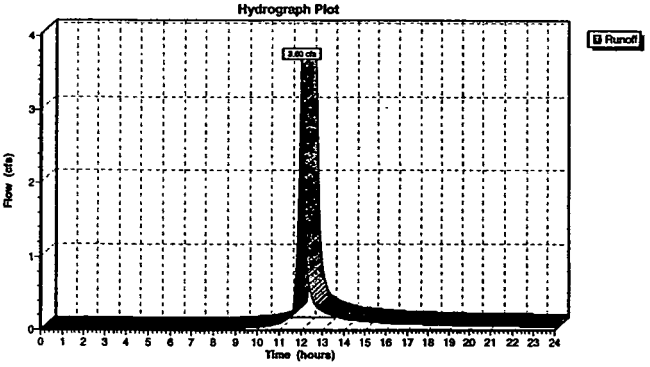
Runoff = 3.60 cfs @ 12.04 hrs, Volume= 0.212 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
1.000	79	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.5	170	0.0500	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
0.6	200	0.0045	5.1	352.87	Trap/Vee/Rect Channel Flow, Bot.W=20.00' D=2.50' Z= 3.0 '/' n= 0.030
12.1	370	Total			

Subcatchment M: runon north of borrow area



Subcatchment MM: runoff area

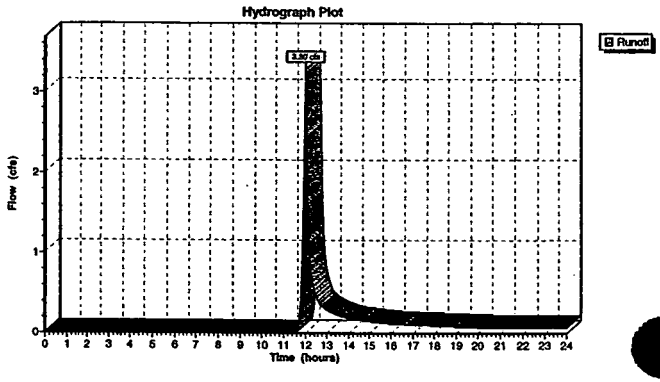
Runoff = 3.30 cfs @ 12.03 hrs, Volume= 0.192 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
1.943	61	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0700	0.3		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
3.3	980	0.0060	4.9	200.34	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=3.00' Z= 5.0 & 4.0 '/' n= 0.030
9.9	1,080	Total			

Subcatchment MM: runoff area



Subcatchment N: direct runon to pond

[49] Hint: Tc<2dt may require smaller dt

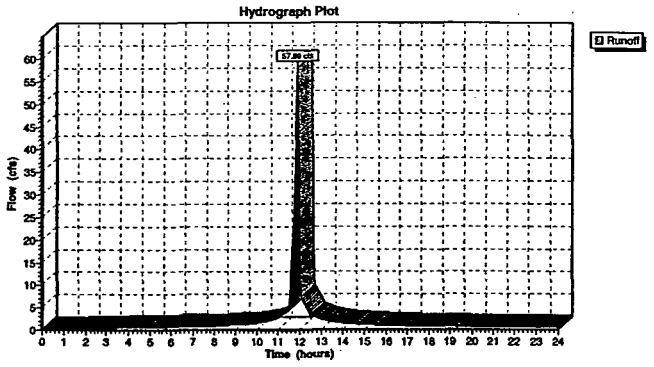
Runoff = 57.89 cfs @ 11.90 hrs, Volume= 2.908 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
7.818	98	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					Direct Entry,

Subcatchment N: direct runon to pond



Subcatchment NN: runoff area

[49] Hint: Tc<2dt may require smaller dt

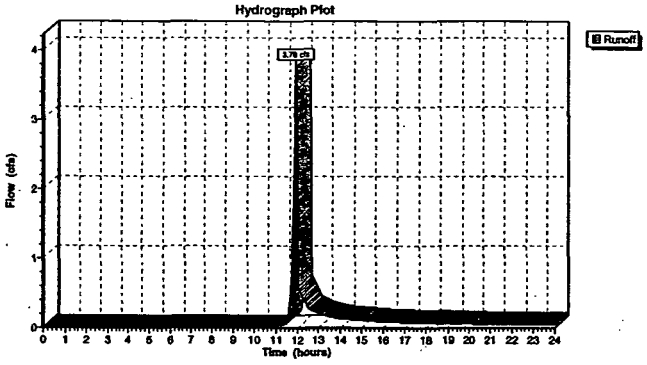
Runoff = 3.78 cfs @ 11.92 hrs, Volume= 0.162 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
1.274	66	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	600	0.0130	7.1	192.92	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=3.00' Z= 3.0 '/' n= 0.030

Subcatchment NN: runoff area



Subcatchment O: runon north of borrow area

[49] Hint: Tc<2dt may require smaller dt

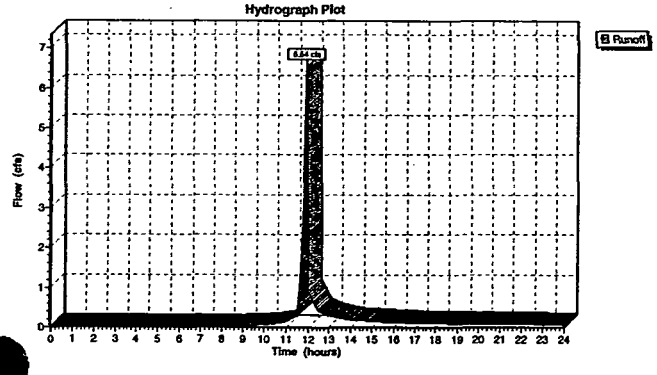
Runoff = 6.54 cfs @ 11.91 hrs, Volume= 0.279 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
1.317	79	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	230	0.0086	2.9	14.28	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=1.00' Z= 5.0 '/' n= 0.030

Subcatchment O: runon north of borrow area



Subcatchment OO: runon area to borrow area

[49] Hint: Tc<2dt may require smaller dt

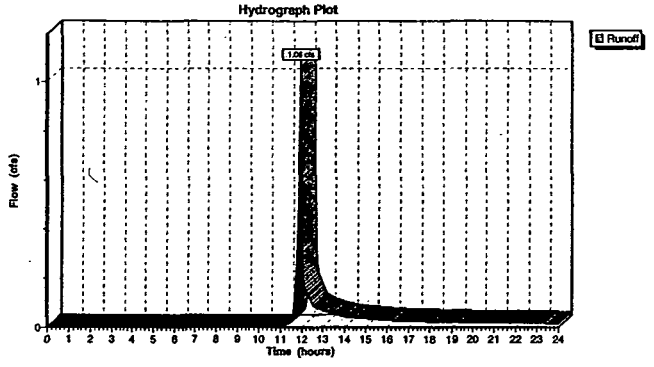
Runoff = 1.06 cfs @ 11.97 hrs, Volume= 0.051 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.399	66	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	120	0.1660	0.4		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"

Subcatchment OO: runon area to borrow area



Subcatchment P: runon north of borrow area

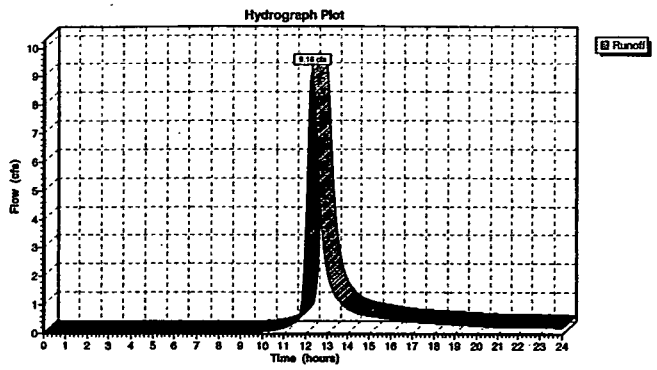
Runoff = 9.16 cfs @ 12.30 hrs, Volume= 0.955 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
5.238	75	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.4	300	0.0150	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
4.3	350	0.0070	1.3		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
33.7	650	Total			

Subcatchment P: runon north of borrow area



Subcatchment PP: vegetated borrow area

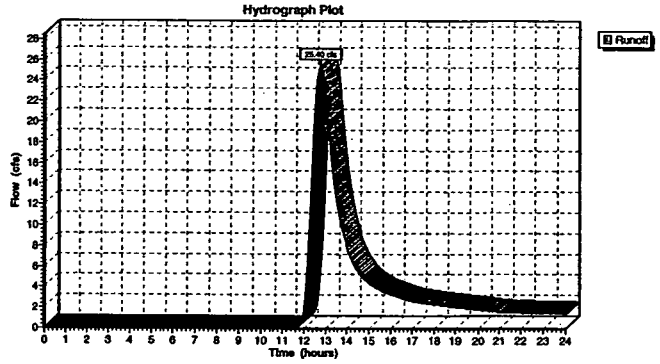
Runoff = 25.40 cfs @ 12.75 hrs, Volume= 4.631 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
40.964	64	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	150	0.1660	0.4		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
34.5	150	0.0025	0.1		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
24.6	1,190	0.0025	0.8		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
65.5	1,490	Total			

Subcatchment PP: vegetated borrow area



Subcatchment Q: runon north of borrow area

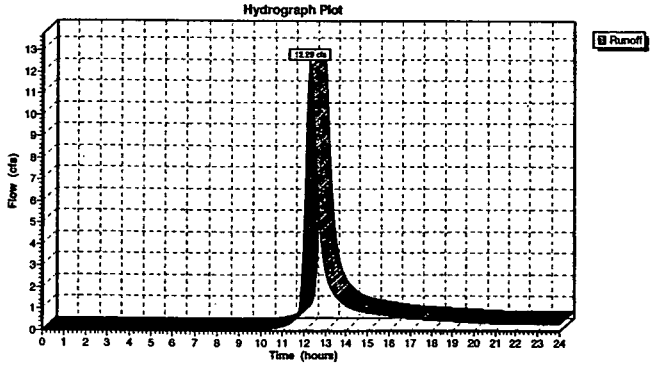
Runoff = 12.29 cfs @ 12.28 hrs, Volume= 1.252 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
7.700	72	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.6	300	0.0260	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
8.2	1,280	0.0260	2.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
31.8	1,580	Total			

Subcatchment Q: runon north of borrow area



Subcatchment R: runon north of borrow area

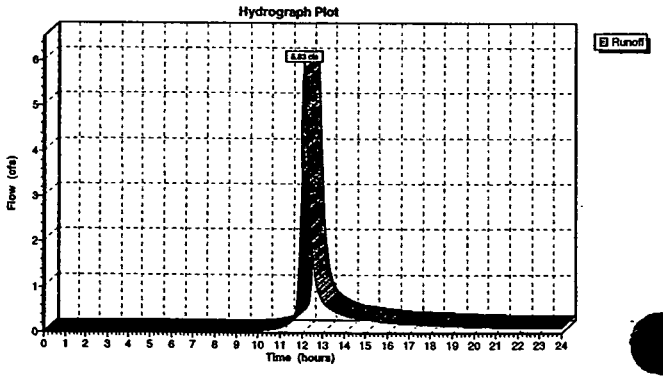
Runoff = 5.83 cfs @ 12.15 hrs, Volume= 0.460 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
2.612	74	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.8	300	0.0400	0.3		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
1.8	350	0.0400	3.2		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
21.6	650	Total			

Subcatchment R: runon north of borrow area



Subcatchment S: runon north of borrow area

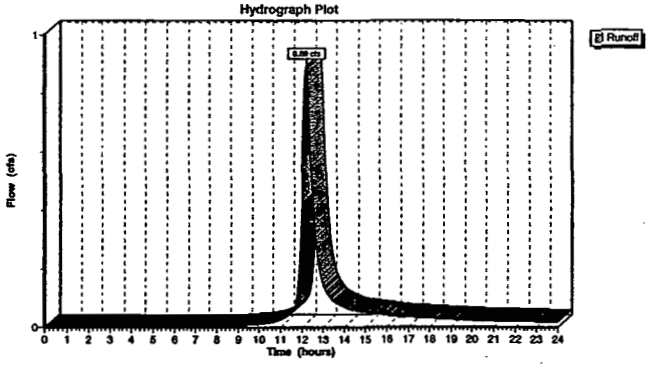
Runoff = 0.89 cfs @ 12.22 hrs, Volume= 0.082 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.402	78	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.8	280	0.0150	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
0.1	30	0.0100	6.3	169.20	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=3.00' Z= 3.0 '/' n= 0.030
27.9	310	Total			

Subcatchment S: runon north of borrow area



Subcatchment U: runon east of OSDF

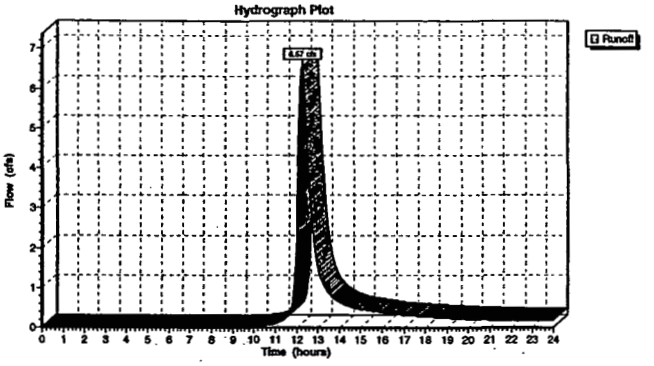
Runoff = 6.57 cfs @ 12.28 hrs, Volume= 0.674 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
4.149	72	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.2	300	0.0140	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
2.1	240	0.0140	1.9		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
32.3	540	Total			

Subcatchment U: runon east of OSDF



Subcatchment V: direct runon to pond

[49] Hint: Tc<2dt may require smaller dt

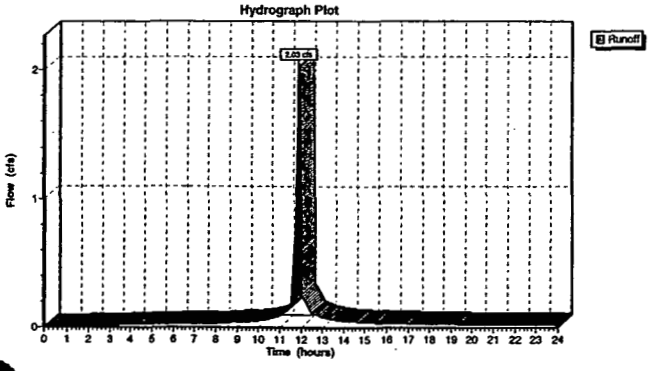
Runoff = 2.03 cfs @ 11.90 hrs, Volume= 0.102 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.274	98	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					Direct Entry,

Subcatchment V: direct runon to pond



Subcatchment W: runon east of OSDF

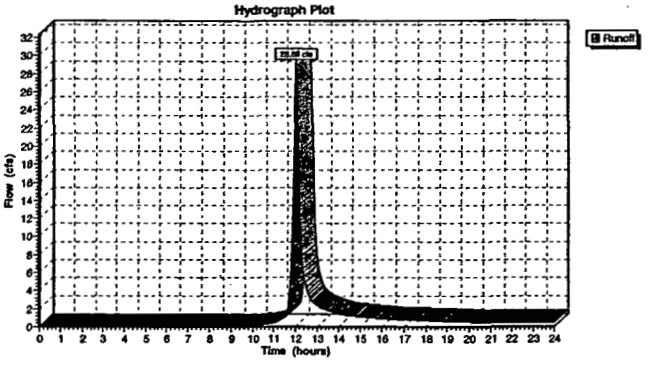
Runoff = 28.88 cfs @ 12.05 hrs, Volume= 1.733 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
10.593	72	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.9	300	0.1780	0.5		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
1.0	400	0.1780	6.8		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.7	270	0.0114	6.9	1,025.43	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=3.00' Z= 3.0 & 30.0 '/' n= 0.030
12.6	970	Total			

Subcatchment W: runon east of OSDF



Subcatchment X: runon east of OSDF

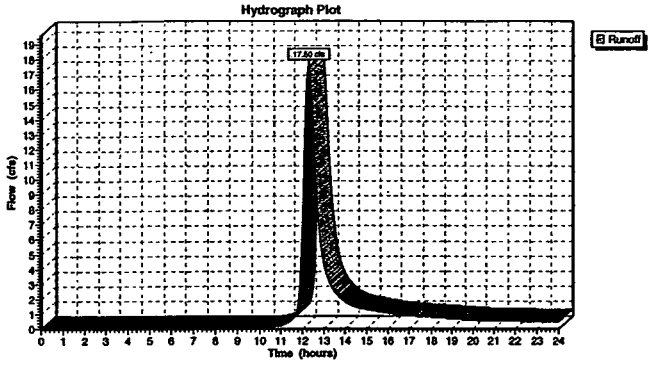
Runoff = 17.50 cfs @ 12.30 hrs, Volume= 1.851 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
11.853	71	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.7	300	0.0190	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
5.5	730	0.0190	2.2		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
1.2	330	0.0100	4.8	57.39	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=2.00' Z= 3.0 '/' n= 0.030
33.4	1,360	Total			

Subcatchment X: runon east of OSDF



Subcatchment Y: runon area east of OSDF

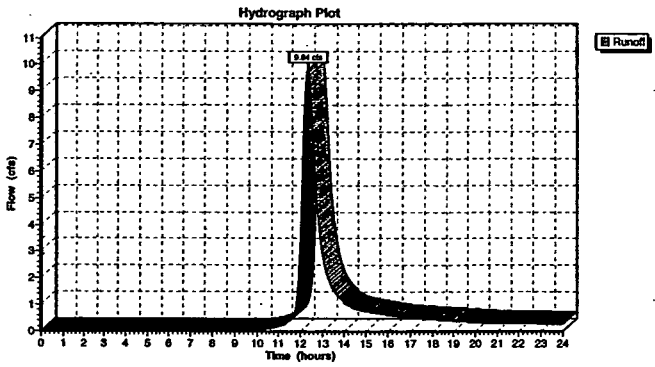
Runoff = 9.84 cfs @ 12.34 hrs, Volume= 1.101 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
6.522	73	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.1	300	0.0130	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
4.6	510	0.0130	1.8		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
1.1	340	0.0110	5.1	92.00	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=2.00' Z= 5.0 & 4.0 '/' n= 0.030
36.8	1,150	Total			

Subcatchment Y: runon area east of OSDF



Subcatchment Z: runon area east of OSDF

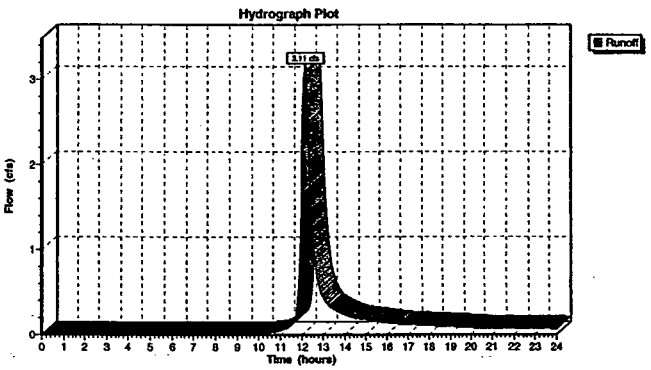
Runoff = 3.11 cfs @ 12.18 hrs, Volume= 0.262 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
1.608	72	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.0	300	0.0310	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
1.5	250	0.0310	2.8		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.2	50	0.0070	4.1	73.39	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=2.00' Z= 5.0 & 4.0 '/' n= 0.030
23.7	600	Total			

Subcatchment Z: runon area east of OSDF



Reach 1: east drainage channel

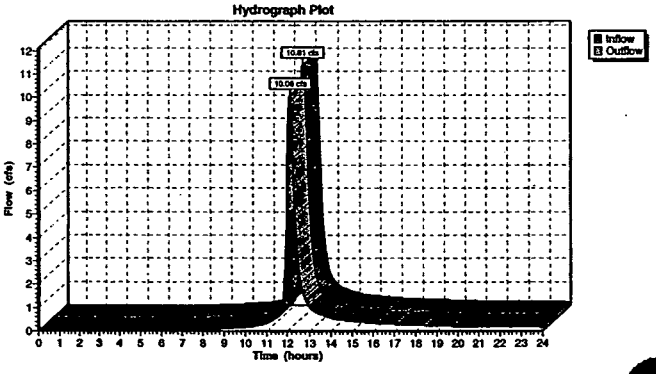
[65] Warning: Inlet elevation not specified

Inflow = 10.81 cfs @ 12.01 hrs, Volume= 0.758 af
Outflow = 10.06 cfs @ 12.11 hrs, Volume= 0.756 af, Atten= 7%, Lag= 6.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.1 fps, Min. Travel Time= 3.4 min
Avg. Velocity = 0.8 fps, Avg. Travel Time= 8.5 min

Peak Depth= 0.99'
Capacity at bank full= 754.76 cfs
0.00' x 5.00' deep channel, n= 0.030 Length= 420.0' Slope= 0.0045 '/'
Side Slope Z-value= 6.0 4.0 '/'

Reach 1: east drainage channel



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Reach 1R: (new node)

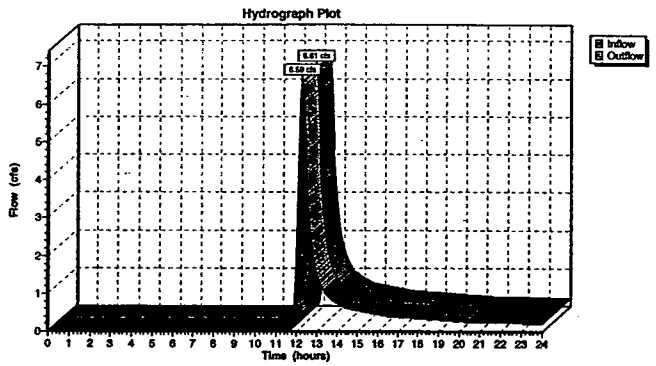
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 6.61 cfs @ 12.25 hrs, Volume= 0.693 af
Outflow = 6.59 cfs @ 12.26 hrs, Volume= 0.693 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.4 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.5 fps, Avg. Travel Time= 0.7 min

Peak Depth= 0.33'
Capacity at bank full= 1,101.12 cfs
A factor of 2.00 has been applied to the supplied storage and discharge data
72.0" Diameter Pipe n= 0.010 Length= 100.0' Slope= 0.0100 '/'

Reach 1R: (new node)



Reach 2: east drainage channel

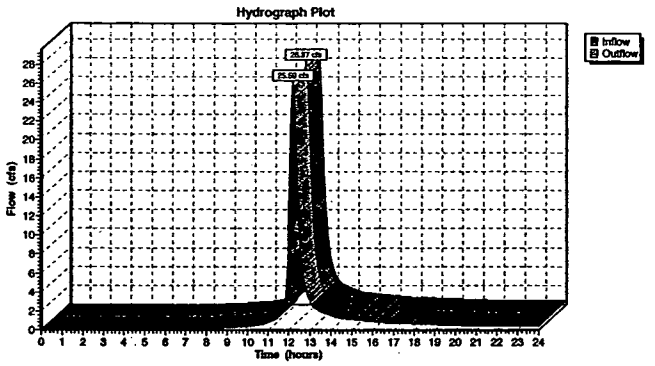
[65] Warning: Inlet elevation not specified

Inflow = 26.37 cfs @ 12.12 hrs, Volume= 2.010 af
Outflow = 25.59 cfs @ 12.20 hrs, Volume= 2.005 af, Atten= 3%, Lag= 4.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.7 fps, Min. Travel Time= 2.6 min
Avg. Velocity = 1.1 fps, Avg. Travel Time= 6.3 min

Peak Depth= 1.54'
Capacity at bank full= 1,205.98 cfs
0.00' x 6.50' deep channel, n= 0.030 Length= 420.0' Slope= 0.0045 '/'
Side Slope Z-value= 3.0 5.0 '/'

Reach 2: east drainage channel



Reach 2R: (new node)

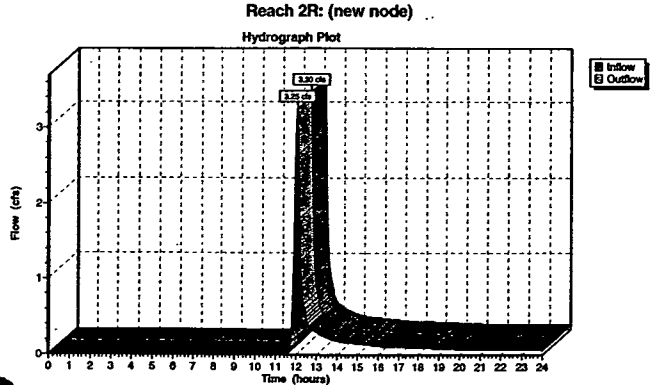
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 3.30 cfs @ 12.03 hrs, Volume= 0.192 af
Outflow = 3.25 cfs @ 12.04 hrs, Volume= 0.192 af, Atten= 1%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.3 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.9 fps, Avg. Travel Time= 0.9 min

Peak Depth= 0.24'
Capacity at bank full= 1,101.12 cfs
A factor of 2.00 has been applied to the supplied storage and discharge data
72.0" Diameter Pipe n= 0.010 Length= 100.0' Slope= 0.0100 '/'

Reach 2R: (new node)



Reach 3: east drainage channel

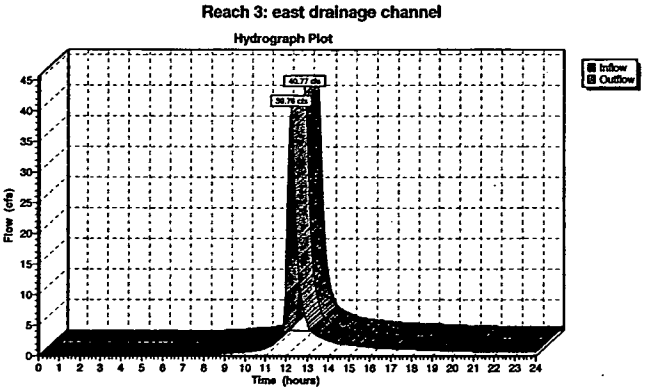
[65] Warning: Inlet elevation not specified

Inflow = 40.77 cfs @ 12.17 hrs, Volume= 3.241 af
Outflow = 39.76 cfs @ 12.24 hrs, Volume= 3.234 af, Atten= 2%, Lag= 4.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.3 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 5.3 min

Peak Depth= 1.87'
Capacity at bank full= 1,563.67 cfs
0.00' x 7.40' deep channel, n= 0.030 Length= 420.0' Slope= 0.0050 '/'
Side Slope Z-value= 3.0 4.0 '/'

Reach 3: east drainage channel



Reach 3R: (new node)

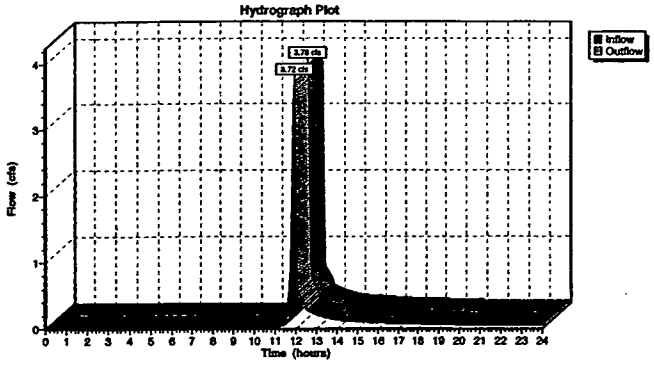
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 3.78 cfs @ 11.92 hrs, Volume= 0.162 af
Outflow = 3.72 cfs @ 11.93 hrs, Volume= 0.162 af, Atten= 2%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.5 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.8 fps, Avg. Travel Time= 0.9 min

Peak Depth= 0.25'
Capacity at bank full= 1,101.12 cfs
A factor of 2.00 has been applied to the supplied storage and discharge data
72.0" Diameter Pipe n= 0.010 Length= 100.0' Slope= 0.0100 '/'

Reach 3R: (new node)



Reach 4: east drainage channel

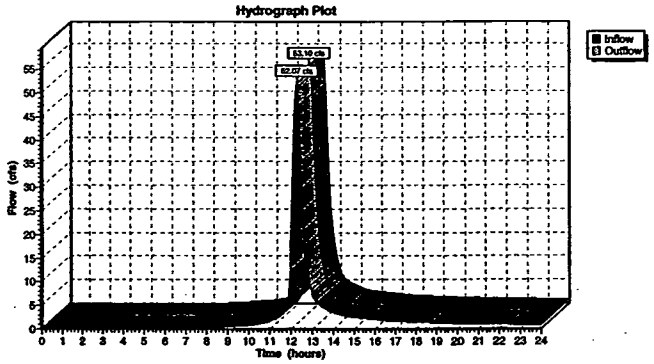
[65] Warning: Inlet elevation not specified

Inflow = 53.10 cfs @ 12.21 hrs, Volume= 4.461 af
Outflow = 52.07 cfs @ 12.27 hrs, Volume= 4.451 af, Atten= 2%, Lag= 3.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.5 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 1.4 fps, Avg. Travel Time= 4.9 min

Peak Depth= 2.07'
Capacity at bank full= 1,106.53 cfs
0.00' x 6.50' deep channel, n= 0.030 Length= 420.0' Slope= 0.0050 '/'
Side Slope Z-value= 3.0 4.0 '/'

Reach 4: east drainage channel



Reach 5: east drainage channel

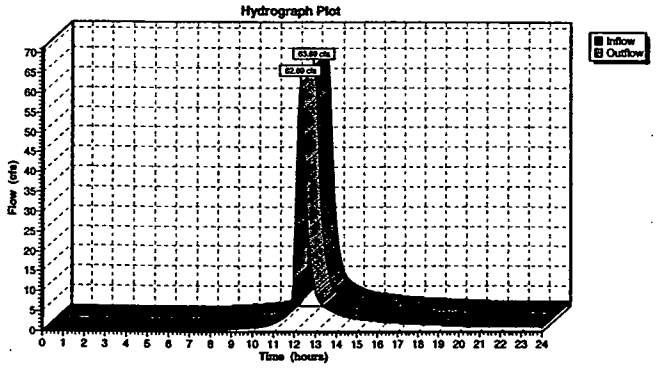
[65] Warning: Inlet elevation not specified

Inflow = 63.69 cfs @ 12.24 hrs, Volume= 5.669 af
Outflow = 62.69 cfs @ 12.30 hrs, Volume= 5.656 af, Atten= 2%, Lag= 3.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.5 fps, Min. Travel Time= 2.1 min
Avg. Velocity = 1.4 fps, Avg. Travel Time= 5.1 min

Peak Depth= 2.01'
Capacity at bank full= 182.58 cfs
0.00' x 3.00' deep channel, n= 0.030 Length= 440.0' Slope= 0.0050 '/'
Side Slope Z-value= 3.0 6.0 '/'

Reach 5: east drainage channel



Reach 6: east drainage channel

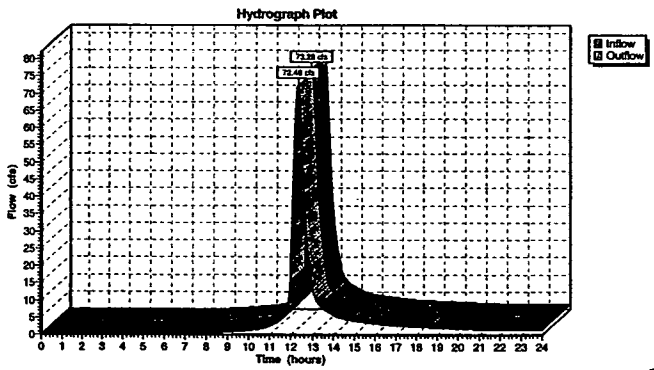
[65] Warning: Inlet elevation not specified

Inflow = 73.28 cfs @ 12.27 hrs, Volume= 6.935 af
Outflow = 72.46 cfs @ 12.32 hrs, Volume= 6.923 af, Atten= 1%, Lag= 3.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.6 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 2.0 fps, Avg. Travel Time= 4.1 min

Peak Depth= 1.87'
Capacity at bank full= 258.21 cfs
0.00' x 3.00' deep channel, n= 0.030 Length= 480.0' Slope= 0.0100 '/'
Side Slope Z-value= 3.0 6.0 '/'

Reach 6: east drainage channel



Reach 7R: runoff diversion channel

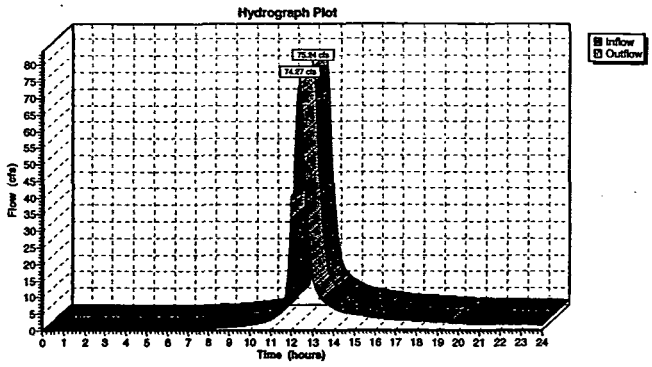
[65] Warning: Inlet elevation not specified

Inflow = 75.24 cfs @ 12.32 hrs, Volume= 8.256 af
Outflow = 74.27 cfs @ 12.38 hrs, Volume= 8.238 af, Atten= 1%, Lag= 3.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.6 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 1.5 fps, Avg. Travel Time= 5.2 min

Peak Depth= 2.15'
Capacity at bank full= 1,152.93 cfs
0.00' x 5.99' deep channel, n= 0.030 Length= 467.0' Slope= 0.0050 '/'
Side Slope Z-value= 3.0 6.0 '/'

Reach 7R: runoff diversion channel



Reach 8R: runoff diversion channel

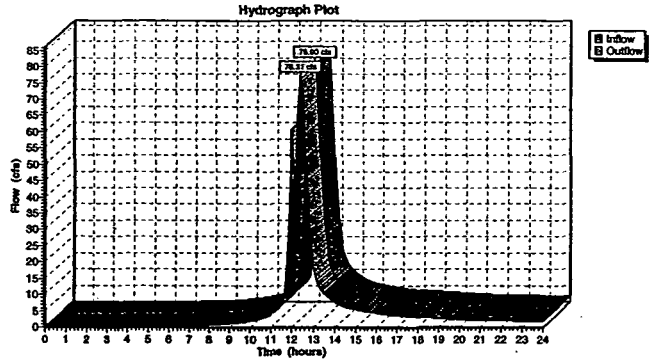
[65] Warning: Inlet elevation not specified

Inflow = 76.90 cfs @ 12.38 hrs, Volume= 9.620 af
Outflow = 76.31 cfs @ 12.42 hrs, Volume= 9.609 af, Atten= 1%, Lag= 2.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.1 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 3.0 min

Peak Depth= 1.75'
Capacity at bank full= 1,600.80 cfs
A factor of 2.00 has been applied to the supplied storage and discharge data
0.00' x 5.47' deep channel, n= 0.030 Length= 241.0' Slope= 0.0050 '/'
Side Slope Z-value= 6.0 2.0 '/'

Reach 8R: runoff diversion channel



Reach 9R: runoff diversion channel

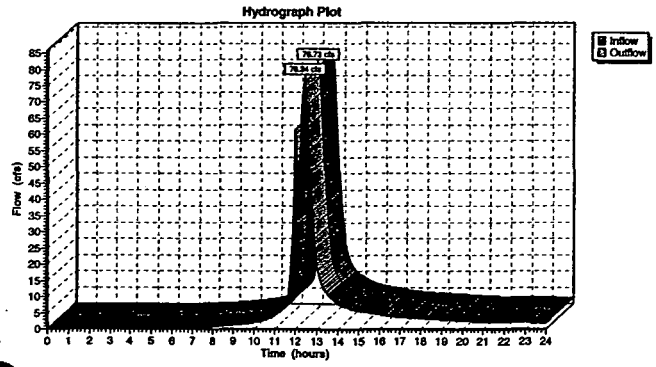
[65] Warning: Inlet elevation not specified

Inflow = 76.73 cfs @ 12.42 hrs, Volume= 9.860 af
Outflow = 76.34 cfs @ 12.44 hrs, Volume= 9.854 af, Atten= 1%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.6 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.5 fps, Avg. Travel Time= 1.6 min

Peak Depth= 1.86'
Capacity at bank full= 425.10 cfs
3.00' x 3.80' deep channel, n= 0.030 Length= 144.0' Slope= 0.0050 '/'
Side Slope Z-value= 6.0 3.0 '/'

Reach 9R: runoff diversion channel



Reach 10AR: (new node)

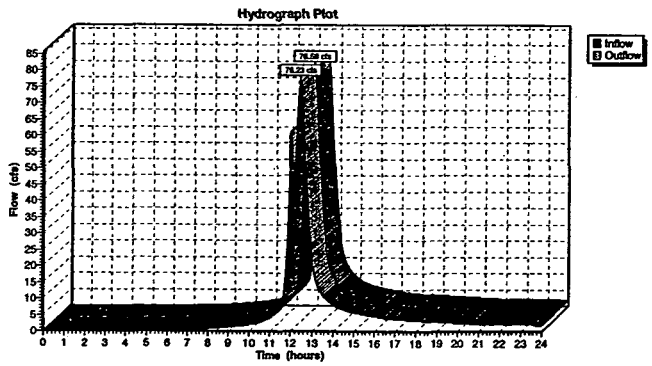
[65] Warning: Inlet elevation not specified

Inflow = 76.58 cfs @ 12.44 hrs, Volume= 10.005 af
Outflow = 76.23 cfs @ 12.46 hrs, Volume= 9.995 af, Atten= 0%, Lag= 1.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.9 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 2.7 fps, Avg. Travel Time= 2.2 min

Peak Depth= 0.78'
Capacity at bank full= 1,940.52 cfs
9.00' x 3.85' deep channel, n= 0.030 Length= 356.0' Slope= 0.0500 '/'
Side Slope Z-value= 6.0 3.0 '/'

Reach 10AR: (new node)



Reach 10BR: runoff diversion channel

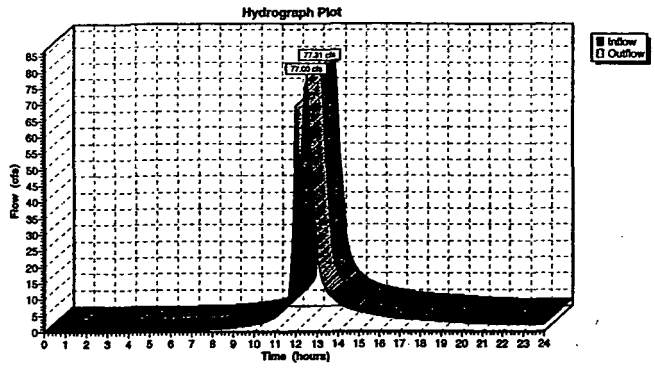
[65] Warning: Inlet elevation not specified

Inflow = 77.31 cfs @ 12.47 hrs, Volume= 10.744 af
Outflow = 77.00 cfs @ 12.48 hrs, Volume= 10.738 af, Atten= 0%, Lag= 0.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.7 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.6 fps, Avg. Travel Time= 1.5 min

Peak Depth= 1.22'
Capacity at bank full= 331.10 cfs
9.70' x 2.62' deep channel, n= 0.030 Length= 142.0' Slope= 0.0100 '/'
Side Slope Z-value= 3.0 '/'

Reach 10BR: runoff diversion channel



Reach 11: new CMP arch

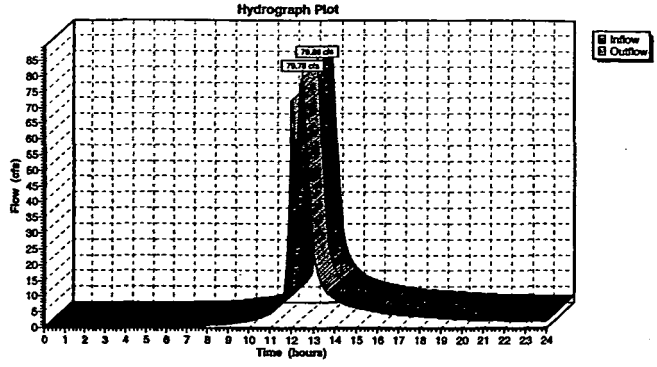
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 79.86 cfs @ 12.47 hrs, Volume= 11.272 af
Outflow = 79.78 cfs @ 12.48 hrs, Volume= 11.270 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.7 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.6 fps, Avg. Travel Time= 0.3 min

Peak Depth= 1.59'
Capacity at bank full= 522.31 cfs
A factor of 2.00 has been applied to the supplied storage and discharge data
72.0" Diameter Pipe n= 0.010 Length= 40.0' Slope= 0.0022 '/'

Reach 11: new CMP arch



Reach 12R: runoff diversion channel

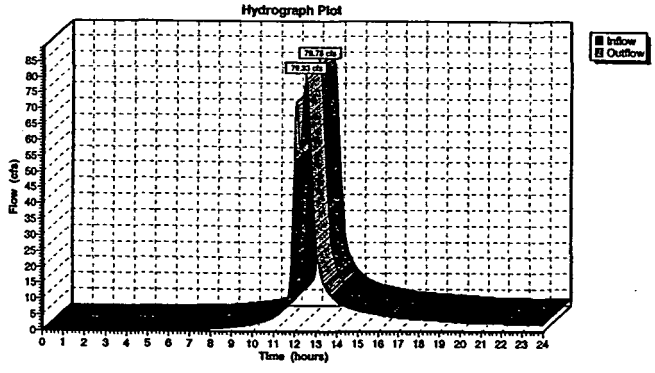
[65] Warning: Inlet elevation not specified

Inflow = 79.78 cfs @ 12.48 hrs, Volume= 11.270 af
Outflow = 79.33 cfs @ 12.51 hrs, Volume= 11.256 af, Atten= 1%, Lag= 1.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.7 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 3.2 min

Peak Depth= 1.17'
Capacity at bank full= 317.79 cfs
14.00' x 2.45' deep channel, n= 0.030 Length= 240.0' Slope= 0.0063 '/'
Side Slope Z-value= 3.0 4.3 '/'

Reach 12R: runoff diversion channel



Reach 13R: runoff diversion channel

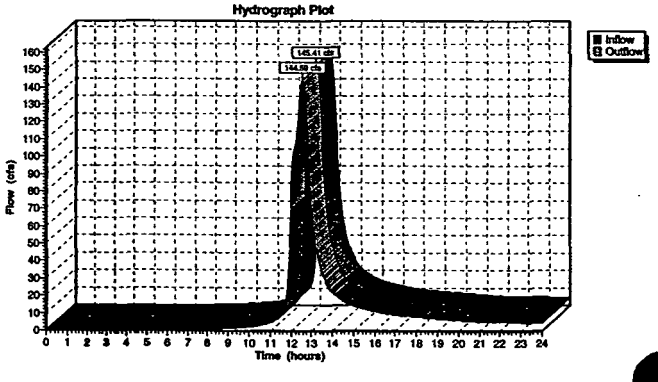
[65] Warning: Inlet elevation not specified

Inflow = 145.41 cfs @ 12.50 hrs, Volume= 21.223 af
Outflow = 144.59 cfs @ 12.55 hrs, Volume= 21.172 af, Atten= 1%, Lag= 3.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.3 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 5.9 min

Peak Depth= 1.25'
Capacity at bank full= 346.63 cfs
23.11' x 2.06' deep channel, n= 0.030 Length= 450.0' Slope= 0.0067 '/'
Side Slope Z-value= 2.3 4.0 '/'

Reach 13R: runoff diversion channel



Reach 14: east runon channel

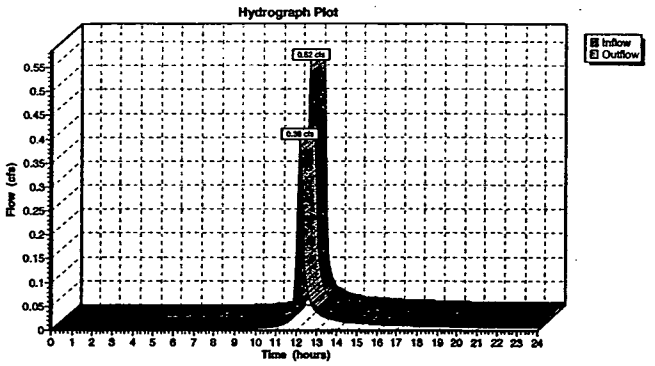
[65] Warning: Inlet elevation not specified

Inflow = 0.52 cfs @ 11.98 hrs, Volume= 0.026 af
Outflow = 0.38 cfs @ 12.17 hrs, Volume= 0.025 af, Atten= 27%, Lag= 11.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.9 fps, Min. Travel Time= 7.6 min
Avg. Velocity = 0.4 fps, Avg. Travel Time= 19.1 min

Peak Depth= 0.33'
Capacity at bank full= 22.78 cfs
0.00' x 1.50' deep channel, n= 0.030 Length= 420.0' Slope= 0.0040 '/'
Side Slope Z-value= 3.0 5.0 '/'

Reach 14: east runon channel



Reach 15: east runon channel

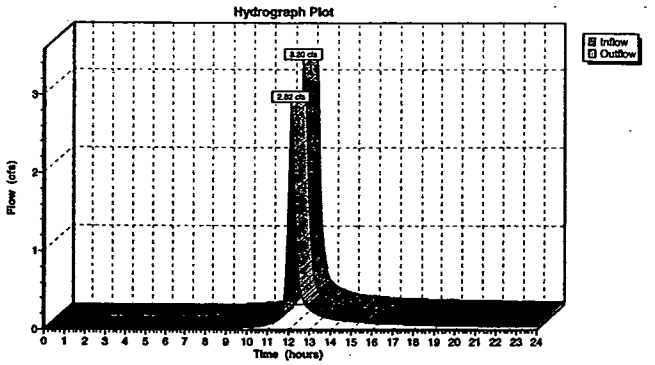
[65] Warning: Inlet elevation not specified

Inflow = 3.20 cfs @ 12.01 hrs, Volume= 0.186 af
Outflow = 2.82 cfs @ 12.12 hrs, Volume= 0.186 af, Atten= 12%, Lag= 6.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.8 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 9.9 min

Peak Depth= 0.64'
Capacity at bank full= 61.62 cfs
0.00' x 2.00' deep channel, n= 0.030 Length= 420.0' Slope= 0.0063 '/'
Side Slope Z-value= 3.0 5.0 '/'

Reach 15: east runon channel



Reach 16: east runon channel

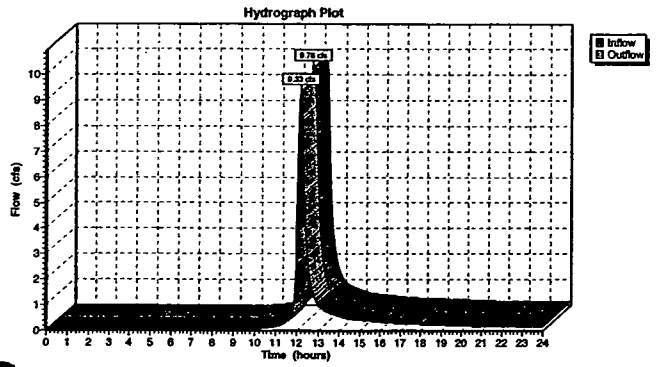
[65] Warning: Inlet elevation not specified

Inflow = 9.76 cfs @ 12.10 hrs, Volume= 0.664 af
Outflow = 9.33 cfs @ 12.19 hrs, Volume= 0.661 af, Atten= 4%, Lag= 4.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.6 fps, Min. Travel Time= 2.7 min
Avg. Velocity = 1.0 fps, Avg. Travel Time= 6.7 min

Peak Depth= 0.98'
Capacity at bank full= 256.58 cfs
0.00' x 3.40' deep channel, n= 0.030 Length= 420.0' Slope= 0.0074 '/'
Side Slope Z-value= 2.5 5.0 '/'

Reach 16: east runon channel



Reach 17: east runon channel

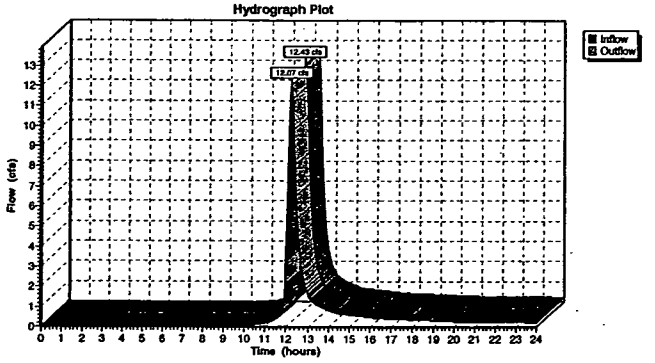
[65] Warning: Inlet elevation not specified

Inflow = 12.43 cfs @ 12.18 hrs, Volume= 0.923 af
Outflow = 12.07 cfs @ 12.25 hrs, Volume= 0.921 af, Atten= 3%, Lag= 4.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.2 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 5.3 min

Peak Depth= 0.92'
Capacity at bank full= 436.18 cfs
0.00' x 3.50' deep channel, n= 0.030 Length= 420.0' Slope= 0.0125 '/'
Side Slope Z-value= 4.0 5.0 '/'

Reach 17: east runon channel



Reach 18: east runon channel

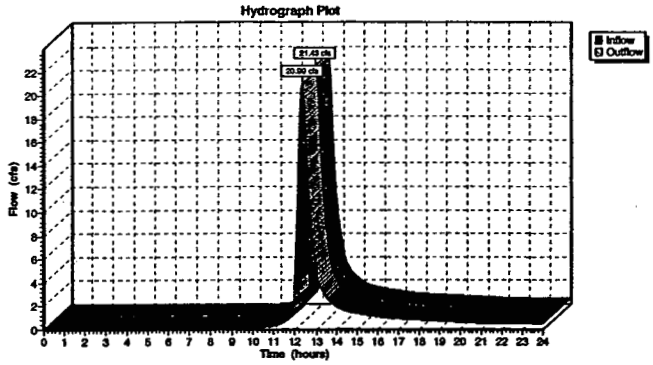
[65] Warning: Inlet elevation not specified

Inflow = 21.43 cfs @ 12.27 hrs, Volume= 2.022 af
Outflow = 20.99 cfs @ 12.33 hrs, Volume= 2.017 af, Atten= 2%, Lag= 3.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.7 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 1.6 fps, Avg. Travel Time= 4.5 min

Peak Depth= 1.38'
Capacity at bank full= 169.20 cfs
0.00' x 3.00' deep channel, n= 0.030 Length= 440.0' Slope= 0.0100 '/'
Side Slope Z-value= 3.0 '/'

Reach 18: east runon channel



Reach 19: east runon channel

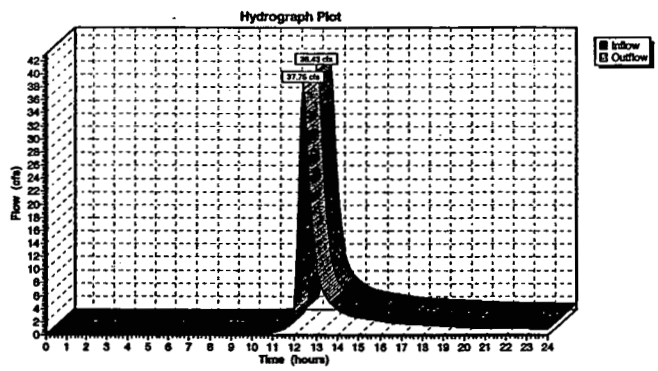
[65] Warning: Inlet elevation not specified

Inflow = 38.43 cfs @ 12.32 hrs, Volume= 3.868 af
Outflow = 37.75 cfs @ 12.41 hrs, Volume= 3.855 af, Atten= 2%, Lag= 5.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.8 fps, Min. Travel Time= 2.8 min
Avg. Velocity = 1.2 fps, Avg. Travel Time= 6.4 min

Peak Depth= 0.91'
Capacity at bank full= 911.12 cfs
0.00' x 3.00' deep channel, n= 0.030 Length= 470.0' Slope= 0.0090 '/'
Side Slope Z-value= 3.0 30.0 '/'

Reach 19: east runon channel



Reach 20: east runon channel

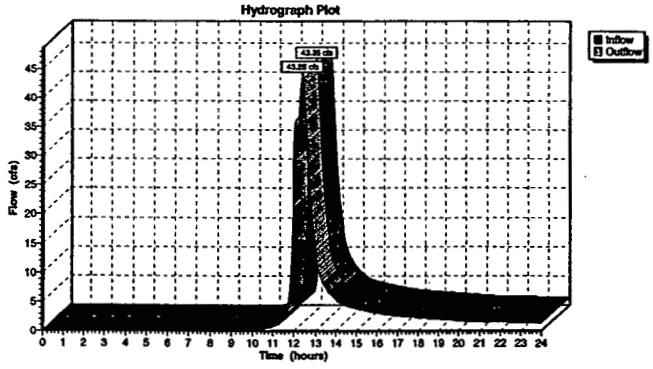
[65] Warning: Inlet elevation not specified

Inflow = 43.35 cfs @ 12.39 hrs, Volume= 5.587 af
Outflow = 43.26 cfs @ 12.40 hrs, Volume= 5.586 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.2 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.0 fps, Avg. Travel Time= 0.6 min

Peak Depth= 1.87'
Capacity at bank full= 153.84 cfs
0.00' x 3.00' deep channel, n= 0.030 Length= 75.0' Slope= 0.0083 '/'
Side Slope Z-value= 3.0 '/'

Reach 20: east runon channel



Reach 21: east runon channel

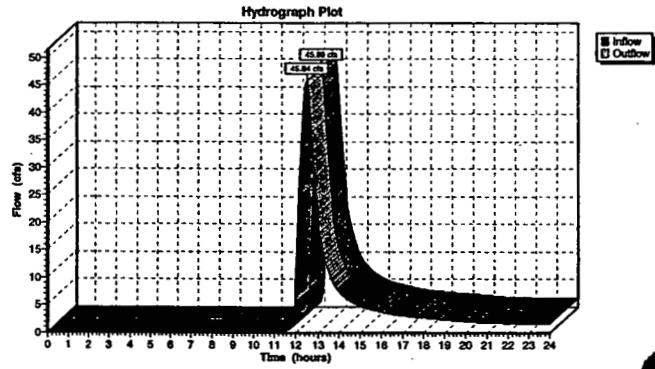
[65] Warning: Inlet elevation not specified

Inflow = 45.89 cfs @ 12.48 hrs, Volume= 6.151 af
Outflow = 45.84 cfs @ 12.49 hrs, Volume= 6.149 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.5 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.5 fps, Avg. Travel Time= 0.7 min

Peak Depth= 1.84'
Capacity at bank full= 169.20 cfs
0.00' x 3.00' deep channel, n= 0.030 Length= 65.0' Slope= 0.0100 '/'
Side Slope Z-value= 3.0 '/'

Reach 21: east runon channel



Reach 22: east runon channel

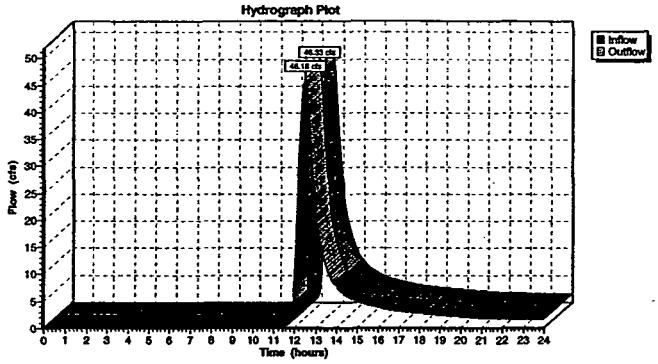
[65] Warning: Inlet elevation not specified

Inflow = 46.33 cfs @ 12.49 hrs, Volume= 6.231 af
Outflow = 46.18 cfs @ 12.51 hrs, Volume= 6.226 af, Atten= 0%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.5 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.6 fps, Avg. Travel Time= 2.0 min

Peak Depth= 1.85'
Capacity at bank full= 364.40 cfs
0.00' x 4.00' deep channel, n= 0.030 Length= 190.0' Slope= 0.0100 '/'
Side Slope Z-value= 3.0 '/'

Reach 22: east runon channel



Reach 23: new CMP culverts

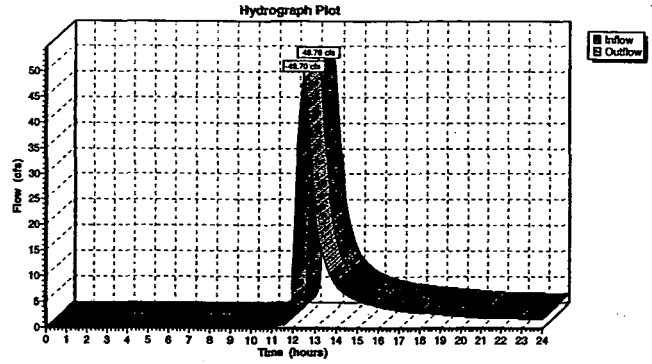
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 48.76 cfs @ 12.51 hrs, Volume= 6.862 af
Outflow = 48.70 cfs @ 12.52 hrs, Volume= 6.859 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.4 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.8 fps, Avg. Travel Time= 0.8 min

Peak Depth= 1.31'
Capacity at bank full= 468.67 cfs
A factor of 2.00 has been applied to the supplied storage and discharge data
72.0" Diameter Pipe n= 0.018 Length= 92.0' Slope= 0.0059 '/'

Reach 23: new CMP culverts



Reach 24: runon channel

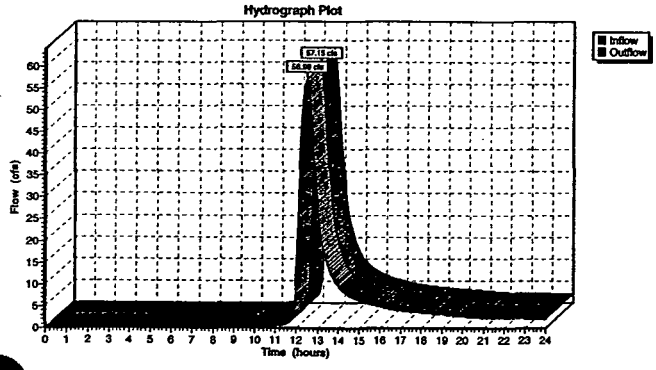
[65] Warning: Inlet elevation not specified

Inflow = 57.15 cfs @ 12.47 hrs, Volume= 8.111 af
Outflow = 56.99 cfs @ 12.49 hrs, Volume= 8.104 af, Atten= 0%, Lag= 1.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Max. Velocity= 4.0 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.2 fps, Avg. Travel Time= 2.3 min

Peak Depth= 1.19'
Capacity at bank full= 153.54 cfs
8.50' x 2.00' deep channel, n= 0.030 Length= 160.0' Slope= 0.0075 '/'
Side Slope Z-value= 3.0 '/'

Reach 24: runon channel



Reach 25: new CMP arch

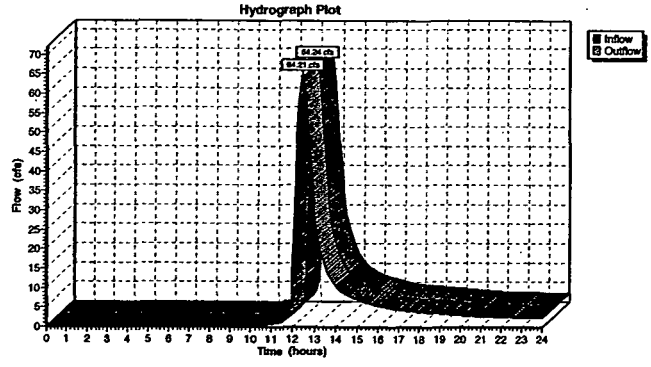
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 64.24 cfs @ 12.45 hrs, Volume= 9.059 af
Outflow = 64.21 cfs @ 12.46 hrs, Volume= 9.057 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.9 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.0 fps, Avg. Travel Time= 0.4 min

Peak Depth= 1.49'
Capacity at bank full= 475.34 cfs
A factor of 2.00 has been applied to the supplied storage and discharge data
72.0" Diameter Pipe n= 0.018 Length= 53.0' Slope= 0.0060 '/'

Reach 25: new CMP arch



Reach 26: runon channel

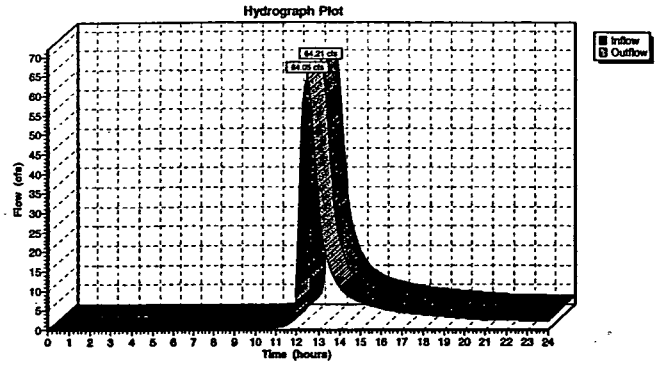
[65] Warning: Inlet elevation not specified

Inflow = 64.21 cfs @ 12.46 hrs, Volume= 9.057 af
Outflow = 64.05 cfs @ 12.49 hrs, Volume= 9.045 af, Atten= 0%, Lag= 2.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.4 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.6 fps, Avg. Travel Time= 3.2 min

Peak Depth= 2.20'
Capacity at bank full= 90.11 cfs
0.00' x 2.50' deep channel, n= 0.030 Length= 300.0' Slope= 0.0075 '/'
Side Slope Z-value= 3.0 '/'

Reach 26: runon channel



Reach 27: new CMP arch

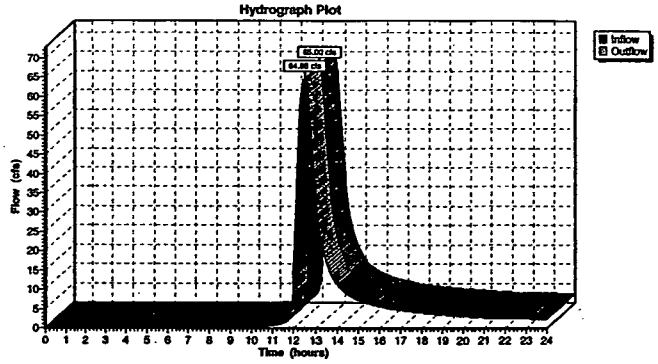
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 65.00 cfs @ 12.48 hrs, Volume= 9.365 af
Outflow = 64.88 cfs @ 12.49 hrs, Volume= 9.361 af, Atten= 0%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Max. Velocity= 5.2 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.8 fps, Avg. Travel Time= 1.0 min

Peak Depth= 1.64'
Capacity at bank full= 398.58 cfs
A factor of 2.00 has been applied to the supplied storage and discharge data
72.0" Diameter Pipe n= 0.018 Length= 106.0' Slope= 0.0042 '/'

Reach 27: new CMP arch



Reach 28R: new CMP culverts

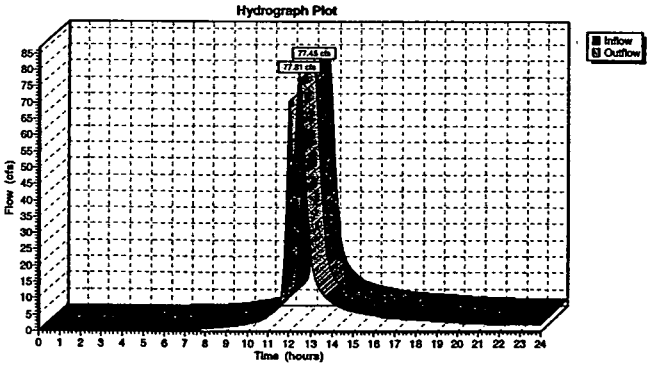
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 77.45 cfs @ 12.46 hrs, Volume= 10.747 af
Outflow = 77.31 cfs @ 12.47 hrs, Volume= 10.744 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.5 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.1 fps, Avg. Travel Time= 0.7 min

Peak Depth= 1.79'
Capacity at bank full= 400.15 cfs
A factor of 2.00 has been applied to the supplied storage and discharge data
72.0" Diameter Pipe n= 0.019 Length= 86.0' Slope= 0.0048 '/'

Reach 28R: new CMP culverts



Reach 29: east runon channel

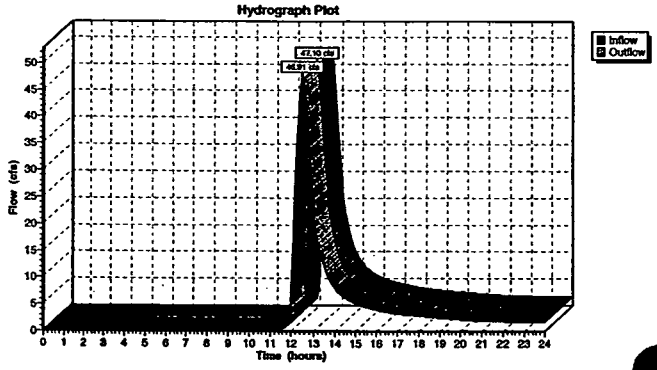
[65] Warning: Inlet elevation not specified

Inflow = 47.10 cfs @ 12.50 hrs, Volume= 6.408 af
Outflow = 46.91 cfs @ 12.53 hrs, Volume= 6.402 af, Atten= 0%, Lag= 1.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.6 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.6 fps, Avg. Travel Time= 2.4 min

Peak Depth= 1.86'
Capacity at bank full= 255.23 cfs
0.00' x 3.50' deep channel, n= 0.030 Length= 230.0' Slope= 0.0100 '/'
Side Slope Z-value= 3.0 '/'

Reach 29: east runon channel



Reach 30: east runon channel

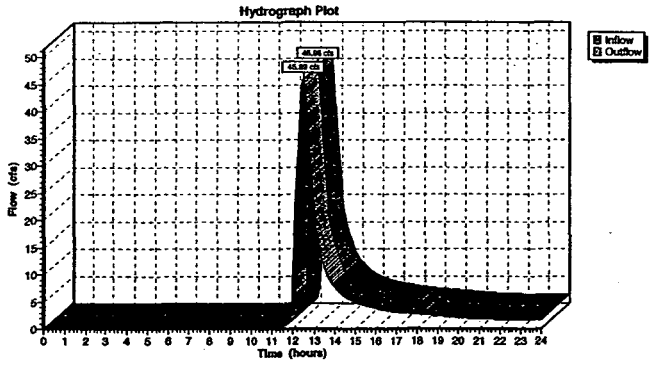
[65] Warning: Inlet elevation not specified

Inflow = 45.98 cfs @ 12.48 hrs, Volume= 6.152 af
Outflow = 45.89 cfs @ 12.48 hrs, Volume= 6.151 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Max. Velocity= 4.5 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.5 fps, Avg. Travel Time= 0.3 min

Peak Depth= 1.84'
Capacity at bank full= 104.05 cfs
0.00' x 2.50' deep channel, n= 0.030 Length= 30.0' Slope= 0.0100 '/'
Side Slope Z-value= 3.0 '/'

Reach 30: east runon channel



Reach 31: culvert

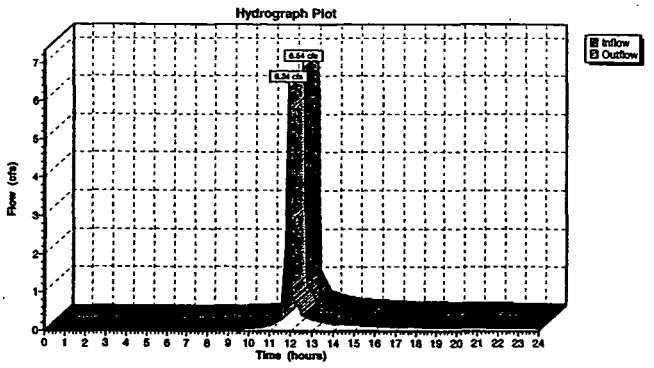
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 6.54 cfs @ 11.91 hrs, Volume= 0.279 af
Outflow = 6.34 cfs @ 11.91 hrs, Volume= 0.279 af, Atten= 3%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.1 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.8 fps, Avg. Travel Time= 0.8 min

Peak Depth= 0.34'
Capacity at bank full= 1,025.91 cfs
A factor of 2.00 has been applied to the supplied storage and discharge data
72.0" Diameter Pipe n= 0.012 Length= 80.0' Slope= 0.0125 '/'

Reach 31: culvert



Pond 1P: (new node)

Inflow = 49.32 cfs @ 12.39 hrs, Volume= 6.362 af
Outflow = 45.98 cfs @ 12.48 hrs, Volume= 6.152 af, Atten= 7%, Lag= 5.4 min
Primary = 45.98 cfs @ 12.48 hrs, Volume= 6.152 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

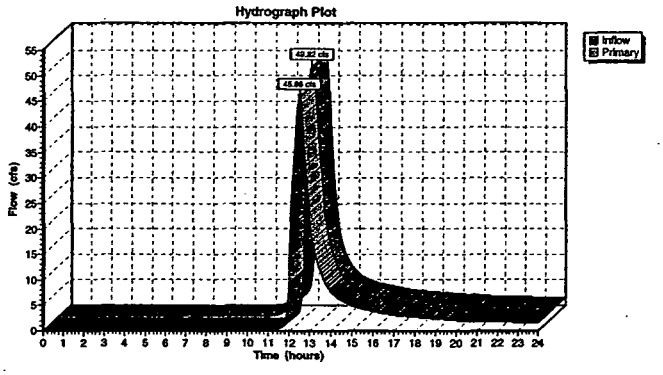
Starting Elev= 592.00' Storage= 0.691 af
Peak Elev= 593.91' Storage= 1.584 af (0.893 af above starting storage)
Plug-Flow detention time= 102.4 min calculated for 5.461 af (86% of Inflow)
Storage and wetted areas determined by Conic sections

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
589.30	0.186	0.000	0.000	0.186
590.00	0.210	0.139	0.139	0.211
591.00	0.278	0.243	0.382	0.279
592.00	0.342	0.309	0.691	0.344
593.00	0.463	0.401	1.092	0.465
594.00	0.624	0.542	1.634	0.627

Primary OutFlow (Free Discharge)
↳1=Special (user-defined)

#	Routing	Invert	Outlet Devices
1	Primary	592.00'	Special (user-defined)
			Head (feet) 0.00 0.01 0.18 0.51 1.01 1.34 1.67 2.00
			Disch. (cfs) 0.00 0.00 0.08 1.33 8.21 17.57 31.73 51.47

Pond 1P: (new node)



Pond 3P: Borrow Area Basin

Inflow = 176.44 cfs @ 12.56 hrs, Volume= 29.759 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

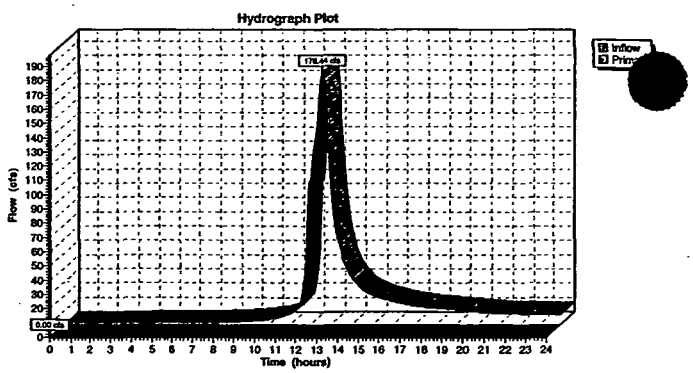
Peak Elev= 574.23' Storage= 29.745 af
Plug-Flow detention time= (not calculated)
Storage and wetted areas determined by Conic sections

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
570.00	6.391	0.000	0.000	6.391
571.00	6.687	6.538	6.538	6.690
572.00	7.017	6.851	13.390	7.023
573.00	7.290	7.153	20.543	7.300
574.00	7.613	7.451	27.994	7.626
575.00	7.921	7.766	35.760	7.938

Primary OutFlow (Free Discharge)
- 2=Culvert
  - 1=Orifice/Grate
- 3=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Device 2	575.30'	**48.0" Horiz. Orifice/Grate X 2.00 Limited to weir flow C= 0.600**
2	Primary	569.80'	**48.0" x 200.0' long Culvert X 2.00 Ke= 0.700** Outlet Invert= 569.00' S= 0.0040 '/' n= 0.024 Cc= 0.900
3	Primary	578.00'	**20.0' long Broad-Crested Rectangular Weir** Head (feet) 0.50 1.00 1.50 2.00 2.50 3.00 4.00 5.00 Coef. (English) 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00

Pond 3P: Borrow Area Basin



ATTACHMENT C-1B

HydroCAD™ OUTPUT REPORTS

WEST OSDF CONSTRUCTION-PHASE DESIGN SCENARIO

GEOSYNTEC CONSULTANTS

Written by: Victoria Cheplak (VSC) Date 6/13/04 Reviewed by: _____ Date: _____

Client: Fluor Fernald, Inc. Project: OSDF Phase V Revision Cell 8 DCN Project No.: GQ3309 Task No.: 2/2

WEST OSDF CONSTRUCTION-PHASE DESIGN SCENARIO 25-YEAR, 24-HOUR STORM EVENT

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Type II 24-hr Rainfall=4.70"
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment A: vegetated final cover
Tc=18.3 min CN=83 Area=2.730 ac Runoff= 9.20 cfs 0.658 af

Subcatchment B: vegetated final cover
Tc=19.0 min CN=83 Area=5.342 ac Runoff= 17.63 cfs 1.287 af

Subcatchment C: vegetated final cover
Tc=19.0 min CN=83 Area=5.399 ac Runoff= 17.82 cfs 1.301 af

Subcatchment D: vegetated final cover
Tc=19.0 min CN=83 Area=5.530 ac Runoff= 18.25 cfs 1.332 af

Subcatchment ER: non-vegetated final cover
Tc=4.2 min CN=89 Area=5.320 ac Runoff= 32.56 cfs 1.544 af

Subcatchment F1R: non-vegetated final cover
Tc=2.9 min CN=89 Area=0.918 ac Runoff= 5.78 cfs 0.267 af

Subcatchment F2R: (new node)
Tc=2.6 min CN=89 Area=1.550 ac Runoff= 9.78 cfs 0.450 af

Subcatchment FR: non-vegetated final cover/construction laydown
Tc=2.4 min CN=89 Area=3.020 ac Runoff= 18.59 cfs 0.877 af

Subcatchment GR: (new node)
Tc=1.9 min CN=89 Area=0.230 ac Runoff= 1.44 cfs 0.067 af

Subcatchment HR: non-vegetated final cover area
Tc=3.5 min CN=79 Area=0.120 ac Runoff= 0.58 cfs 0.025 af

Subcatchment J1R: construction laydown area
Tc=2.8 min CN=82 Area=0.312 ac Runoff= 1.66 cfs 0.073 af

Subcatchment J2R: construction laydown area
Tc=8.0 min CN=82 Area=0.970 ac Runoff= 4.41 cfs 0.227 af

Subcatchment KR: runon north of borrow area
Tc=1.8 min CN=89 Area=1.970 ac Runoff= 12.39 cfs 0.572 af

Subcatchment LR: construction laydown area
Tc=26.3 min CN=82 Area=1.860 ac Runoff= 4.93 cfs 0.433 af

Subcatchment MR: runon north of borrow area
Tc=2.8 min CN=79 Area=0.675 ac Runoff= 3.30 cfs 0.143 af

Subcatchment N: construction laydown area
Tc=15.2 min CN=82 Area=1.043 ac Runoff= 3.73 cfs 0.244 af

Subcatchment O: pond
Tc=1.0 min CN=98 Area=2.252 ac Runoff= 16.67 cfs 0.838 af

Subcatchment P1R: construction laydown area
Tc=8.4 min CN=82 Area=0.490 ac Runoff= 2.20 cfs 0.115 af

Subcatchment P2R: construction laydown area
Tc=8.3 min CN=82 Area=0.214 ac Runoff= 0.96 cfs 0.050 af

Subcatchment QN: runon north of borrow area
Tc=11.8 min CN=79 Area=0.127 ac Runoff= 0.46 cfs 0.027 af

Reach 1: west channel
Inflow= 9.20 cfs 0.658 af
Length= 400.0' Max Vel= 2.5 fps Capacity= 424.60 cfs Outflow= 8.87 cfs 0.656 af

Reach 2: west channel
Inflow= 25.75 cfs 1.943 af
Length= 400.0' Max Vel= 3.3 fps Capacity= 424.60 cfs Outflow= 25.10 cfs 1.939 af

Reach 3: west channel
Inflow= 41.23 cfs 3.240 af
Length= 400.0' Max Vel= 3.7 fps Capacity= 424.60 cfs Outflow= 40.35 cfs 3.234 af

Reach 4: west channel
Inflow= 55.70 cfs 4.566 af
Length= 90.0' Max Vel= 4.0 fps Capacity= 426.17 cfs Outflow= 55.45 cfs 4.565 af

Reach 5: culvert
Inflow= 55.45 cfs 4.565 af
Length= 95.0' Max Vel= 4.9 fps Capacity= 396.64 cfs Outflow= 55.23 cfs 4.563 af

Reach 6: west channel
Inflow= 55.23 cfs 4.563 af
Length= 380.0' Max Vel= 4.0 fps Capacity= 424.60 cfs Outflow= 54.31 cfs 4.555 af

Reach 7AR: Haul Road Culvert 1
Inflow= 57.96 cfs 6.100 af
Length= 81.5' Max Vel= 5.4 fps Capacity= 166.63 cfs Outflow= 57.80 cfs 6.098 af

Reach 7BR: Channel between GIS 14 & 15
Inflow= 57.98 cfs 6.171 af
Length= 100.0' Max Vel= 2.6 fps Capacity= 200.78 cfs Outflow= 57.49 cfs 6.167 af

Reach 7CR: Rimia Parking Lot Culvert
Inflow= 58.08 cfs 6.434 af
Length= 296.0' Max Vel= 8.1 fps Capacity= 296.41 cfs Outflow= 57.75 cfs 6.430 af

Reach 7DR: Runoff Drainage Channel south of Rimia
Inflow= 58.39 cfs 6.657 af
Length= 298.0' Max Vel= 3.3 fps Capacity= 372.29 cfs Outflow= 57.61 cfs 6.647 af

Reach 8AR: west channel
Inflow= 86.37 cfs 8.745 af
Length= 146.0' Max Vel= 3.5 fps Capacity= 388.16 cfs Outflow= 84.70 cfs 8.737 af

Reach 8BR: Culvert at Sed Basin 2 entrance
Inflow= 84.70 cfs 8.737 af
Length= 30.0' Max Vel= 6.9 fps Capacity= 535.70 cfs Outflow= 84.57 cfs 8.737 af

Reach 8CR: Channel into Sed Basin 2
Inflow= 85.42 cfs 8.787 af
Length= 62.7' Max Vel= 6.6 fps Capacity= 728.12 cfs Outflow= 85.12 cfs 8.785 af

Reach 9AR: Extended Drainge Channel South of Cell 8
Inflow= 12.39 cfs 0.572 af
Length= 197.0' Max Vel= 4.5 fps Capacity= 263.84 cfs Outflow= 11.99 cfs 0.572 af

Reach 9BR: (new node)
Inflow= 11.99 cfs 0.572 af
Length= 88.0' Max Vel= 5.8 fps Capacity= 357.73 cfs Outflow= 11.83 cfs 0.572 af

Reach 9R: Channel U/S of 30" Culvert
Inflow= 12.41 cfs 0.597 af
Length= 27.3' Max Vel= 4.5 fps Capacity= 1,027.28 cfs Outflow= 12.33 cfs 0.597 af

Reach 10AR: (new node)
Inflow= 9.78 cfs 0.450 af
Length= 71.4' Max Vel= 5.2 fps Capacity= 243.75 cfs Outflow= 9.65 cfs 0.450 af

Reach 10BR: (new node)
Inflow= 9.65 cfs 0.450 af
Length= 38.0' Max Vel= 5.3 fps Capacity= 343.51 cfs Outflow= 9.58 cfs 0.450 af

Reach 10R: access road diversion channel
Inflow= 28.58 cfs 1.327 af
Length= 407.0' Max Vel= 2.7 fps Capacity= 162.16 cfs Outflow= 26.00 cfs 1.322 af

Reach 11AR: (new node)
Inflow= 26.03 cfs 1.388 af
Length= 16.0' Max Vel= 2.7 fps Capacity= 571.70 cfs Outflow= 25.90 cfs 1.388 af

Reach 11R: culvert
Inflow= 26.00 cfs 1.322 af
Length= 50.0' Max Vel= 2.0 fps Capacity= 59.89 cfs Outflow= 25.39 cfs 1.321 af

Reach 12: Culvert from F Street Drainage Channel
Inflow= 36.01 cfs 1.985 af
Length= 119.2' Max Vel= 4.3 fps Capacity= 387.90 cfs Outflow= 35.49 cfs 1.984 af

Reach 13: (new node)
Inflow= 4.93 cfs 0.433 af
Length= 120.0' Max Vel= 4.7 fps Capacity= 386.61 cfs Outflow= 4.91 cfs 0.433 af

Reach 14: Culvert from North Entrance Road channel
Inflow= 3.20 cfs 0.169 af
Length= 112.0' Max Vel= 3.5 fps Capacity= 822.56 cfs Outflow= 3.11 cfs 0.169 af

Reach 15N: Culvert adjacent to North Entrance Road
Inflow= 0.46 cfs 0.027 af
Length= 55.0' Max Vel= 2.4 fps Capacity= 406.62 cfs Outflow= 0.46 cfs 0.027 af

Reach 16N: Channel east of North Entrance Road
Inflow= 3.58 cfs 0.170 af
Length= 382.0' Max Vel= 2.2 fps Capacity= 71.46 cfs Outflow= 3.20 cfs 0.169 af

Pond 1P: Sedimentation Basin 2
Peak Storage= 8.938 af Inflow= 97.27 cfs 10.469 af
Primary= 3.11 cfs 1.614 af Outflow= 3.11 cfs 1.614 af

Runoff Area = 40.072 ac Volume = 10.530 af Average Depth = 3.15"

Subcatchment A: vegetated final cover

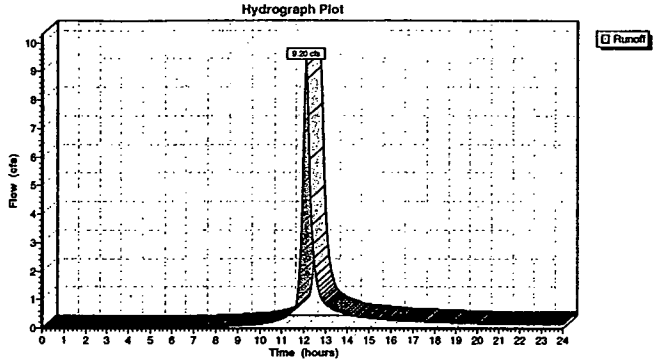
Runoff = 9.20 cfs @ 12.11 hrs, Volume= 0.658 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
2.730	83	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	90	0.0500	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
3.8	60	0.1000	0.3		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
6.4	150	0.1700	0.4		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
0.5	190	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.7	180	0.0075	4.2	75.84	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=2.00' Z= 3.0 & 6.0 '/' n= 0.030
18.3	670	Total			

Subcatchment A: vegetated final cover



Subcatchment B: vegetated final cover

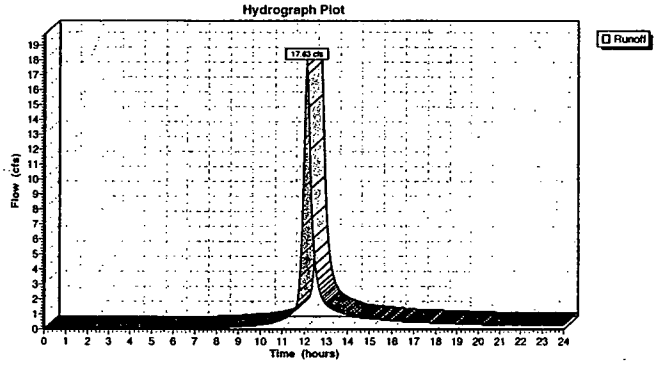
Runoff = 17.63 cfs @ 12.11 hrs, Volume= 1.287 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
5.342	83	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	90	0.0500	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
3.8	60	0.1000	0.3		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
6.4	150	0.1700	0.4		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
0.5	200	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.8	190	0.0075	4.2	75.84	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=2.00' Z= 3.0 & 6.0 '/' n= 0.030
0.1	60	0.0100	15.0	423.51	Circular Channel (pipe), Diam= 72.0" Area= 28.3 sf Perim= 18.8' r= 1.50' n= 0.013
0.5	200	0.0075	6.6	424.60	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=4.00' Z= 6.0 & 2.0 '/' n= 0.030
19.0	950	Total			

Subcatchment B: vegetated final cover



Subcatchment C: vegetated final cover

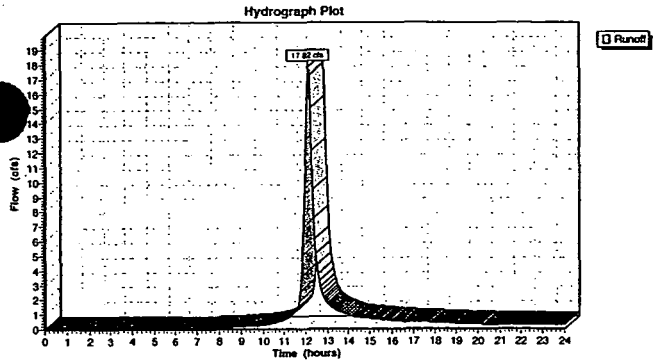
Runoff = 17.82 cfs @ 12.11 hrs, Volume= 1.301 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
5.399	83	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	90	0.0500	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
3.8	60	0.1000	0.3		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
6.4	150	0.1700	0.4		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"
0.5	200	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.8	190	0.0075	4.2	75.84	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=2.00' Z= 3.0 & 6.0 '/' n= 0.030
0.1	60	0.0100	15.0	423.51	Circular Channel (pipe), Diam= 72.0" Area= 28.3 sf Perim= 18.8' r= 1.50' n= 0.013
0.5	195	0.0075	6.6	424.60	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=4.00' Z= 6.0 & 2.0 '/' n= 0.030
19.0	945	Total			

Subcatchment C: vegetated final cover



Subcatchment D: vegetated final cover

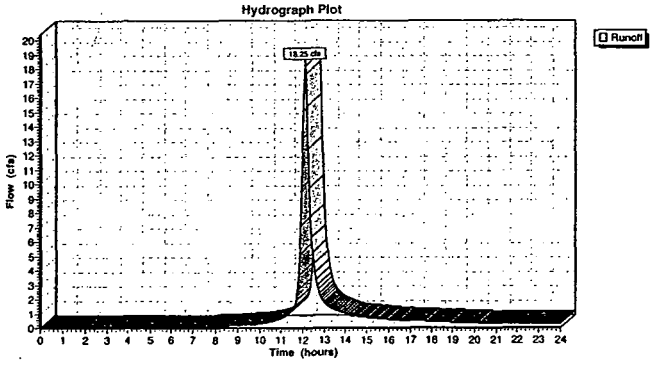
Runoff = 18.25 cfs @ 12.11 hrs, Volume= 1.332 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
5.530	83	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	90	0.0500	0.2		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
3.8	60	0.1000	0.3		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
6.4	150	0.1700	0.4		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
0.5	205	0.1700	6.6		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.8	190	0.0075	4.2	75.84	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.00' Z= 3.0 & 6.0 '/' n= 0.030
0.1	60	0.0100	15.0	423.51	**Circular Channel (pipe),** Diam= 72.0" Area= 28.3 sf Perim= 18.8' r= 1.50' n= 0.013
0.5	195	0.0075	6.6	424.60	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=4.00' Z= 6.0 & 2.0 '/' n= 0.030
19.0	950	Total			

Subcatchment D: vegetated final cover



Subcatchment ER: non-vegetated final cover

[49] Hint: Tc<2dt may require smaller dt

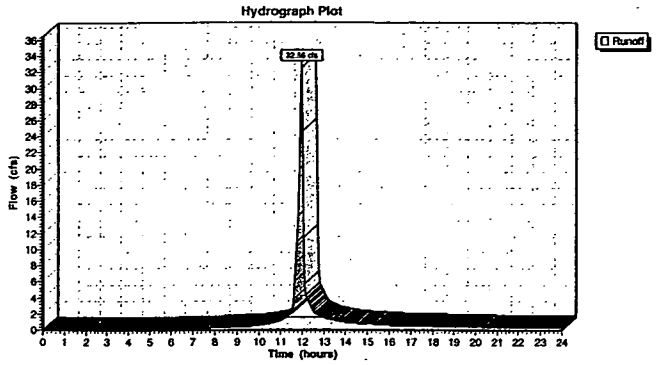
Runoff = 32.56 cfs @ 11.94 hrs, Volume= 1.544 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
5.320	89	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	110	0.0625	2.0		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.60"
0.4	45	0.1110	2.1		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.60"
0.8	150	0.1700	3.2		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.60"
0.5	200	0.1700	6.6		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.4	510	0.0075	6.1	337.31	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=3.50' Z= 3.0 & 6.0 '/' n= 0.030
0.2	85	0.0029	8.1	228.07	**Circular Channel (pipe),** Diam= 72.0" Area= 28.3 sf Perim= 18.8' r= 1.50' n= 0.013
4.2	1,100	Total			

Subcatchment ER: non-vegetated final cover



Subcatchment F1R: non-vegetated final cover

[49] Hint: Tc<2dt may require smaller dt

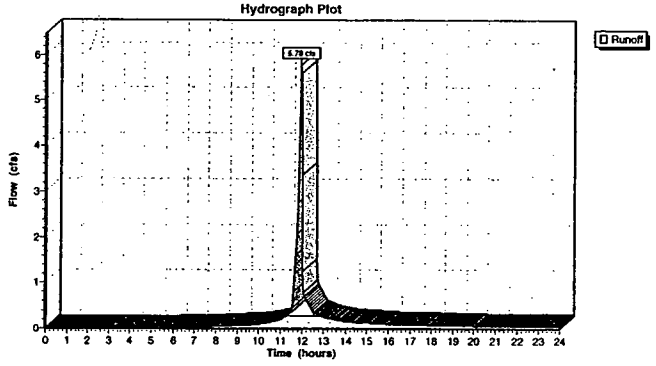
Runoff = 5.78 cfs @ 11.93 hrs, Volume= 0.267 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.918	89	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	90	0.0530	1.8		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.55"
0.4	50	0.1000	2.0		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.55"
0.8	150	0.1670	3.1		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.55"
0.5	200	0.1670	6.6		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.4	160	0.0075	6.1	337.31	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=3.50' Z= 6.0 & 3.0 '/' n= 0.030
0.0	53	0.0580	36.1	1,019.94	**Circular Channel (pipe),** Diam= 72.0" Area= 28.3 sf Perim= 18.8' r= 1.50' n= 0.013
2.9	703	Total			

Subcatchment F1R: non-vegetated final cover



Subcatchment F2R: (new node)

[49] Hint: Tc<2dt may require smaller dt

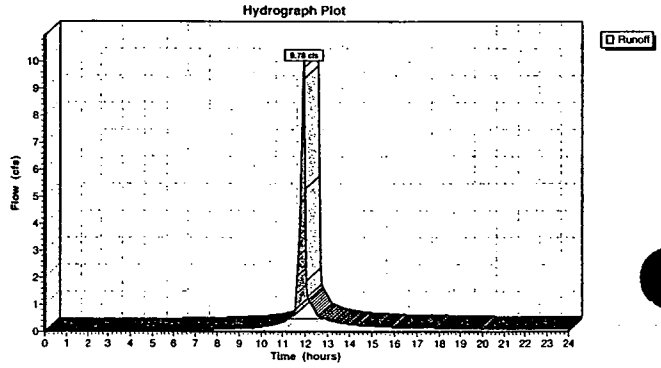
Runoff = 9.78 cfs @ 11.93 hrs, Volume= 0.450 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
1.550	89	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	90	0.0500	1.7		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.55"
0.4	55	0.1000	2.1		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.55"
0.8	150	0.1667	3.1		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.55"
0.5	200	0.1667	6.6		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
2.6	495	Total			

Subcatchment F2R: (new node)



Subcatchment FR: non-vegetated final cover/construction laydown

[49] Hint: Tc<2dt may require smaller dt

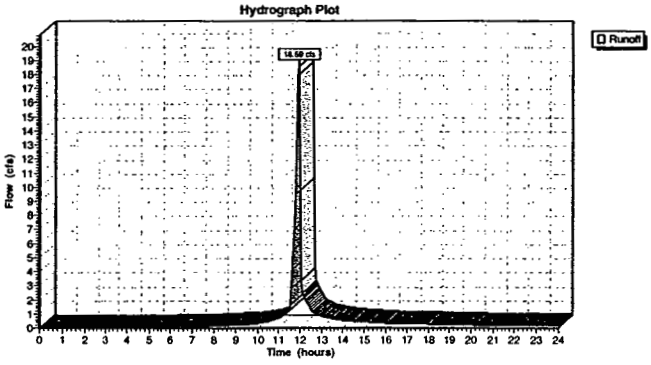
Runoff = 18.59 cfs @ 11.92 hrs, Volume= 0.877 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
3.020	89	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	70	0.0500	1.7		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.60"
0.5	60	0.1000	2.1		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.60"
0.8	150	0.1670	3.1		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.60"
0.4	175	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
2.4	455	Total			

Subcatchment FR: non-vegetated final cover/construction laydown



Subcatchment GR: (new node)

[49] Hint: Tc<2dt may require smaller dt

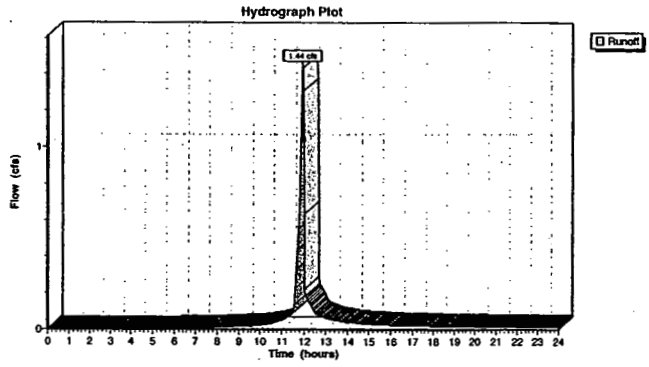
Runoff = 1.44 cfs @ 11.91 hrs, Volume= 0.067 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.230	89	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	150	0.1400	2.9		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.55"
1.0	350	0.1400	6.0		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
1.9	500	Total			

Subcatchment GR: (new node)



Subcatchment HR: non-vegetated final cover area

[49] Hint: Tc<2dt may require smaller dt

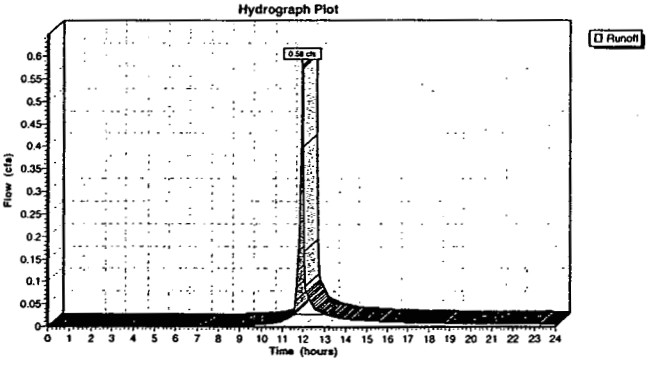
Runoff = 0.58 cfs @ 11.94 hrs, Volume= 0.025 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.120	79	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	45	0.0700	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"

Subcatchment HR: non-vegetated final cover area



Subcatchment J1R: construction laydown area

[49] Hint: Tc<2dt may require smaller dt

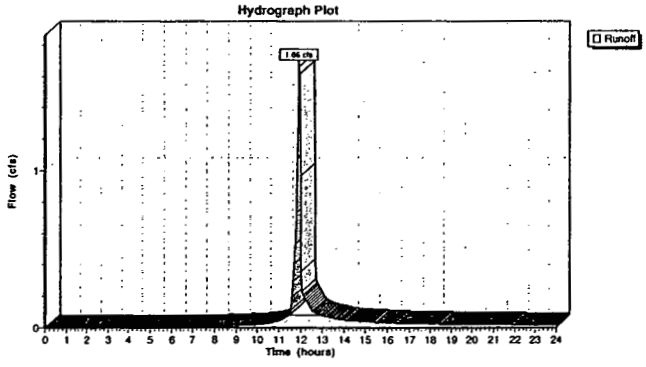
Runoff = 1.66 cfs @ 11.93 hrs, Volume= 0.073 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.312	82	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	54	0.1670	0.3		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"

Subcatchment J1R: construction laydown area



Subcatchment J2R: construction laydown area

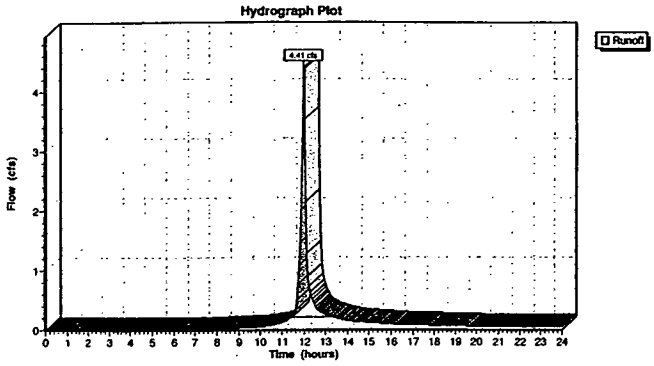
Runoff = 4.41 cfs @ 11.99 hrs, Volume= 0.227 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.970	82	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	100	0.0427	0.2		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"

Subcatchment J2R: construction laydown area



Subcatchment KR: runon north of borrow area

[49] Hint: Tc<2dt may require smaller dt

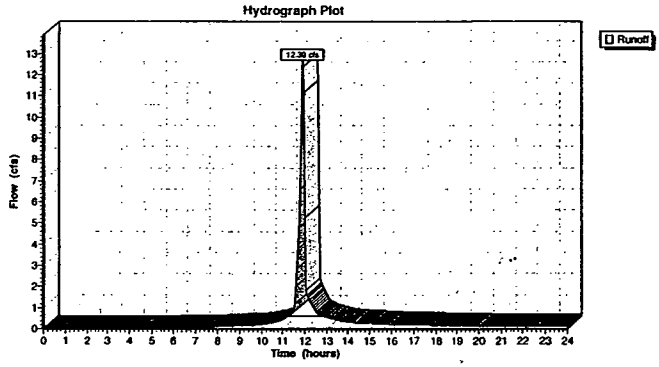
Runoff = 12.39 cfs @ 11.91 hrs, Volume= 0.572 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
1.970	89	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	65	0.1000	2.1		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.55"
0.8	150	0.1700	3.2		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.60"
0.5	180	0.1700	6.6		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.8	395	Total			

Subcatchment KR: runon north of borrow area



Subcatchment LR: construction laydown area

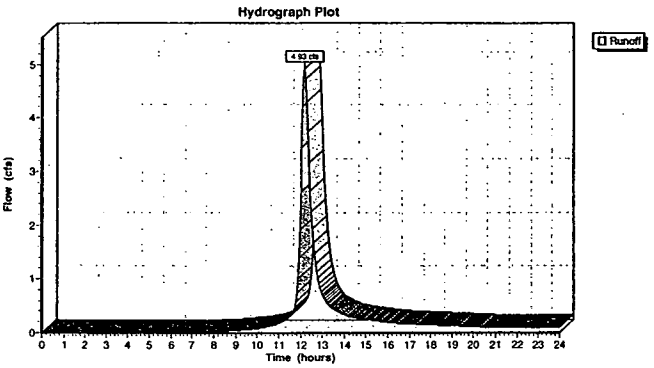
Runoff = 4.93 cfs @ 12.20 hrs, Volume= 0.433 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
1.860	82	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.2	300	0.0200	0.2		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
0.1	20	0.0200	2.3		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
26.3	320	Total			

Subcatchment LR: construction laydown area



Subcatchment MR: runon north of borrow area

[49] Hint: Tc<2dt may require smaller dt

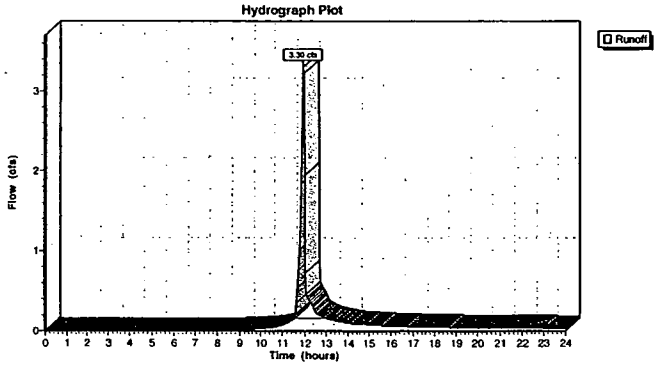
Runoff = 3.30 cfs @ 11.93 hrs, Volume= 0.143 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.675	79	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	40	0.0985	0.2		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"

Subcatchment MR: runon north of borrow area



Subcatchment N: construction laydown area

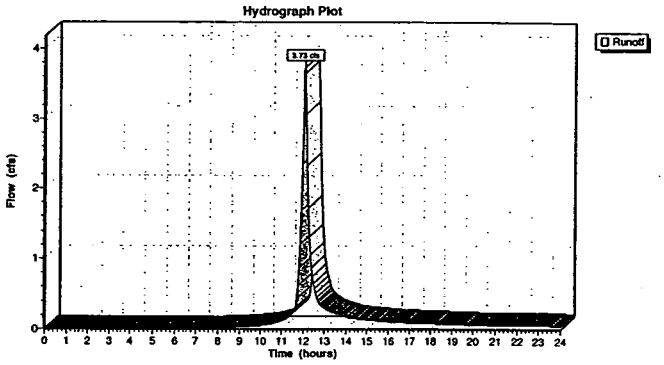
Runoff = 3.73 cfs @ 12.07 hrs, Volume= 0.244 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
1.043	82	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	170	0.0250	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"

Subcatchment N: construction laydown area



Subcatchment O: pond

[49] Hint: Tc<2dt may require smaller dt

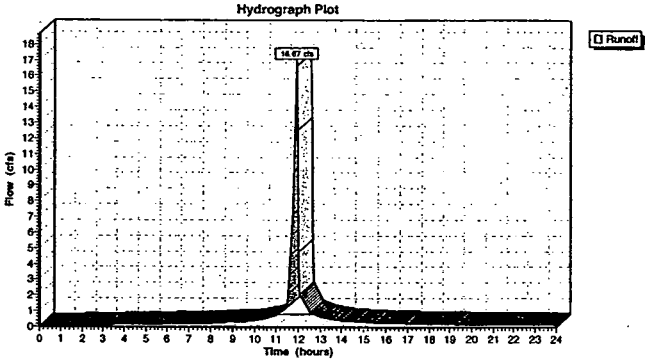
Runoff = 16.67 cfs @ 11.90 hrs, Volume= 0.838 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
2.252	98	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0					Direct Entry,

Subcatchment O: pond



Subcatchment P1R: construction laydown area

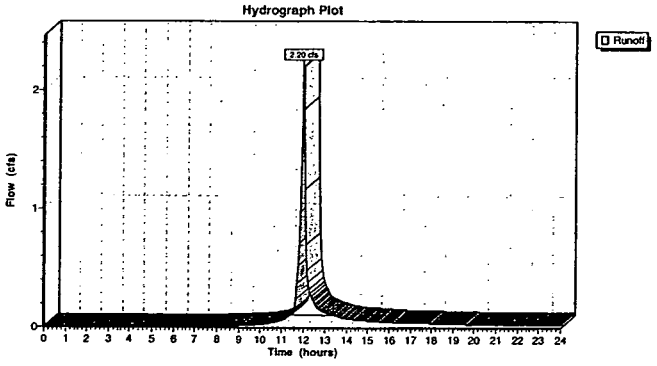
Runoff = 2.20 cfs @ 12.00 hrs, Volume= 0.115 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.490	82	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.4	100	0.0385	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"

Subcatchment P1R: construction laydown area



Subcatchment P2R: construction laydown area

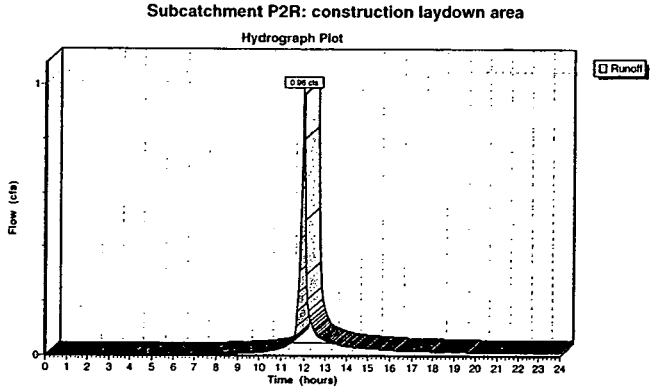
Runoff = 0.96 cfs @ 12.00 hrs, Volume= 0.050 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.214	82	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	110	0.0473	0.2		Sheet Flow, Grass: Short n= 0.150 P2= 2.60"

Subcatchment P2R: construction laydown area



Subcatchment QN: runon north of borrow area

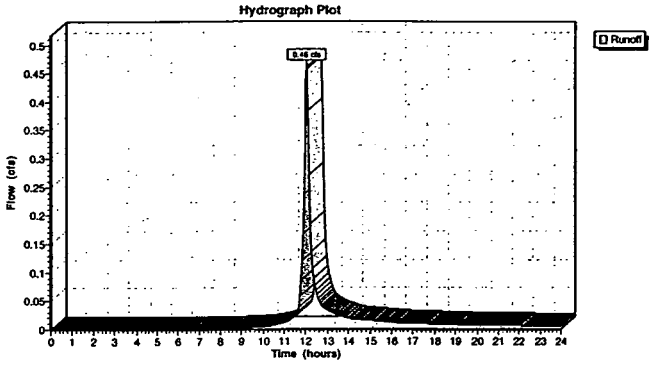
Runoff = 0.46 cfs @ 12.04 hrs, Volume= 0.027 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=4.70"

Area (ac)	CN	Description
0.127	79	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	100	0.0167	0.1		Sheet Flow, Grass: Short n= 0.150 P2= 2.55"

Subcatchment QN: runon north of borrow area



Reach 1: west channel

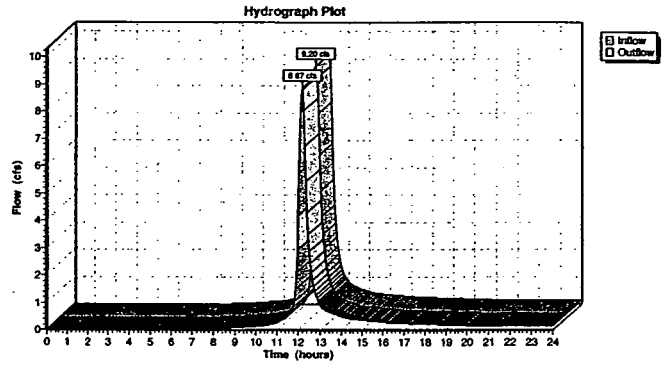
[65] Warning: Inlet elevation not specified

Inflow = 9.20 cfs @ 12.11 hrs, Volume= 0.658 af
Outflow = 8.87 cfs @ 12.19 hrs, Volume= 0.656 af, Atten= 4%, Lag= 4.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.5 fps, Min. Travel Time= 2.6 min
Avg. Velocity = 1.0 fps, Avg. Travel Time= 6.6 min

Peak Depth= 0.94'
Capacity at bank full= 424.60 cfs
0.00' x 4.00' deep channel, n= 0.030 Length= 400.0' Slope= 0.0075 '/'
Side Slope Z-value= 2.0 6.0 '/'

Reach 1: west channel



Reach 2: west channel

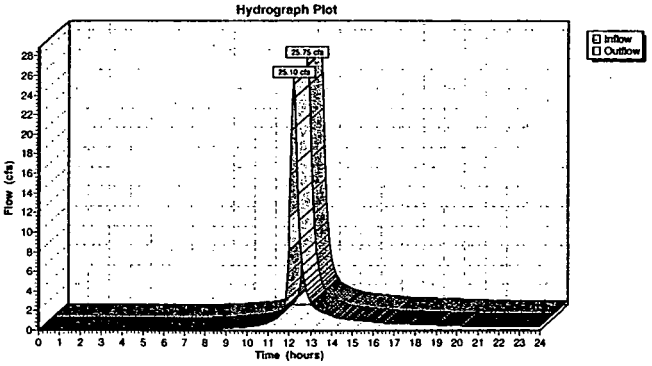
[65] Warning: Inlet elevation not specified

Inflow = 25.75 cfs @ 12.14 hrs, Volume= 1.943 af
Outflow = 25.10 cfs @ 12.20 hrs, Volume= 1.939 af, Atten= 3%, Lag= 3.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.3 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 5.1 min

Peak Depth= 1.39'
Capacity at bank full= 424.60 cfs
0.00' x 4.00' deep channel, n= 0.030 Length= 400.0' Slope= 0.0075 '/'
Side Slope Z-value= 2.0 6.0 '/'

Reach 2: west channel



Reach 3: west channel

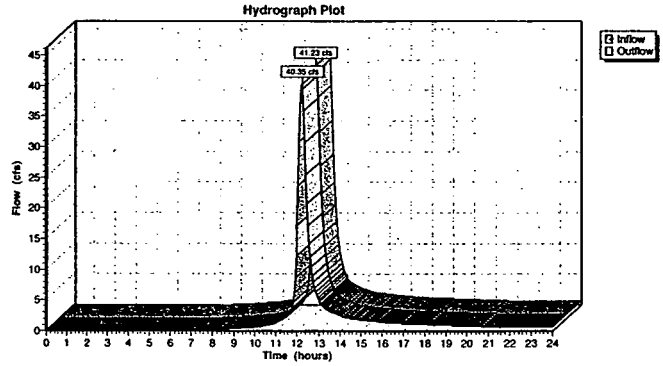
[65] Warning: Inlet elevation not specified

Inflow = 41.23 cfs @ 12.16 hrs, Volume= 3.240 af
Outflow = 40.35 cfs @ 12.22 hrs, Volume= 3.234 af, Atten= 2%, Lag= 3.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.7 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.5 fps, Avg. Travel Time= 4.5 min

Peak Depth= 1.66'
Capacity at bank full= 424.60 cfs
0.00' x 4.00' deep channel, n= 0.030 Length= 400.0' Slope= 0.0075 '/'
Side Slope Z-value= 2.0 6.0 '/'

Reach 3: west channel



Reach 4: west channel

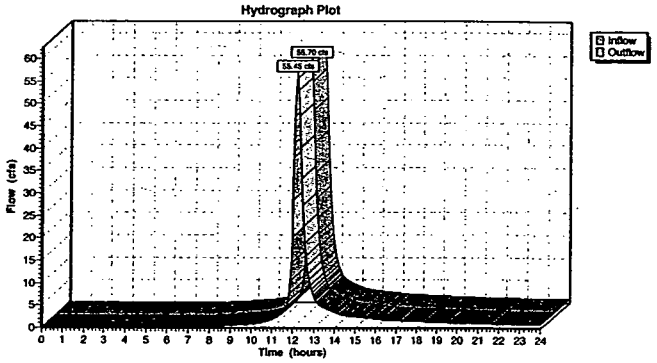
[65] Warning: Inlet elevation not specified

Inflow = 55.70 cfs @ 12.19 hrs, Volume= 4.566 af
Outflow = 55.45 cfs @ 12.20 hrs, Volume= 4.565 af, Atten= 0%, Lag= 0.7 min

ing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Velocity= 4.0 fps, Min. Travel Time= 0.4 min
g. Velocity = 1.6 fps, Avg. Travel Time= 0.9 min

Peak Depth= 1.86'
Capacity at bank full= 426.17 cfs
0.00' x 4.00' deep channel, n= 0.030 Length= 90.0' Slope= 0.0076 '/'
Side Slope Z-value= 2.0 6.0 '/'

Reach 4: west channel



Reach 5: culvert

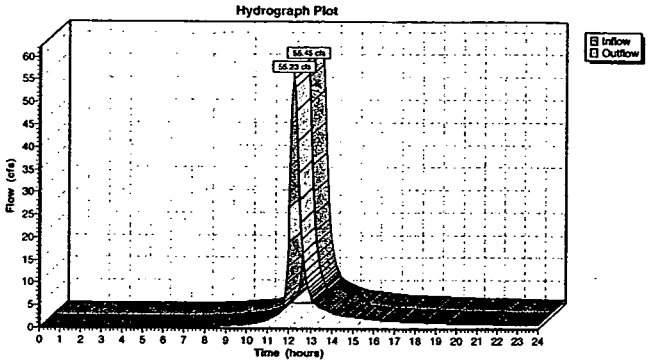
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 55.45 cfs @ 12.20 hrs, Volume= 4.565 af
Outflow = 55.23 cfs @ 12.21 hrs, Volume= 4.563 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.9 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.7 fps, Avg. Travel Time= 0.9 min

Peak Depth= 1.52'
Capacity at bank full= 396.64 cfs
A factor of 2.00 has been applied to the supplied storage and discharge data
72.0" Diameter Pipe n= 0.024 Length= 95.0' Slope= 0.0075 '/'

Reach 5: culvert



Reach 6: west channel

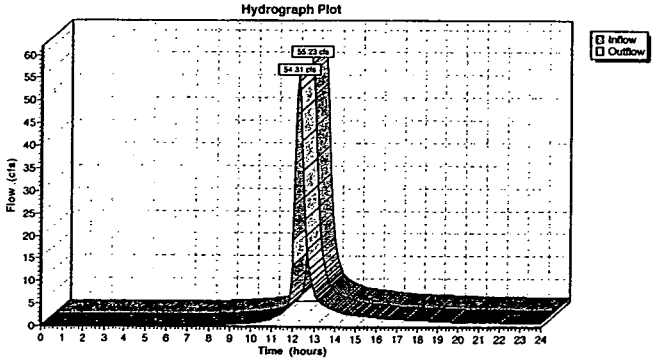
[65] Warning: Inlet elevation not specified

Inflow = 55.23 cfs @ 12.21 hrs, Volume= 4.563 af
Outflow = 54.31 cfs @ 12.25 hrs, Volume= 4.555 af, Atten= 2%, Lag= 2.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.0 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 1.6 fps, Avg. Travel Time= 3.9 min

Peak Depth= 1.86'
Capacity at bank full= 424.60 cfs
0.00' x 4.00' deep channel, n= 0.030 Length= 380.0' Slope= 0.0075 '/'
Side Slope Z-value= 6.0 2.0 '/'

Reach 6: west channel



Reach 7AR: Haul Road Culvert 1

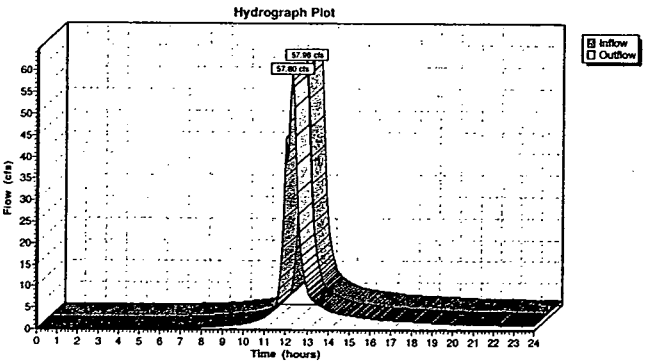
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 57.96 cfs @ 12.25 hrs, Volume= 6.100 af
Outflow = 57.80 cfs @ 12.26 hrs, Volume= 6.098 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.4 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.9 fps, Avg. Travel Time= 0.7 min

Peak Depth= 2.44'
Capacity at bank full= 166.63 cfs
72.0" Diameter Pipe n= 0.024 Length= 81.5' Slope= 0.0053 '/'

Reach 7AR: Haul Road Culvert 1



Reach 7BR: Channel between GIS 14 & 15

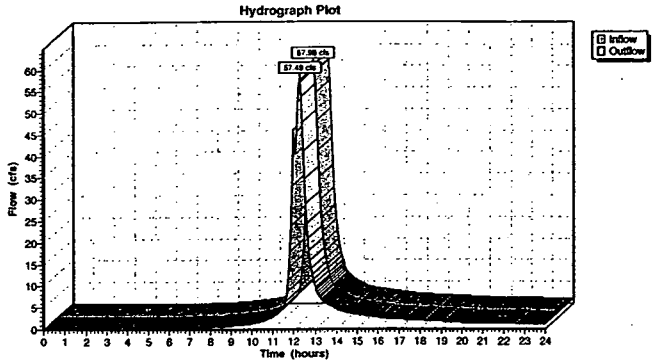
[65] Warning: Inlet elevation not specified

Inflow = 57.98 cfs @ 12.26 hrs, Volume= 6.171 af
Outflow = 57.49 cfs @ 12.28 hrs, Volume= 6.167 af, Atten= 1%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.6 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.1 fps, Avg. Travel Time= 1.6 min

Peak Depth= 2.37'
Capacity at bank full= 200.78 cfs
0.00' x 3.77' deep channel, n= 0.030 Length= 100.0' Slope= 0.0023 '/'
Side Slope Z-value= 6.0 2.0 '/'

Reach 7BR: Channel between GIS 14 & 15



Reach 7CR: Rimia Parking Lot Culvert

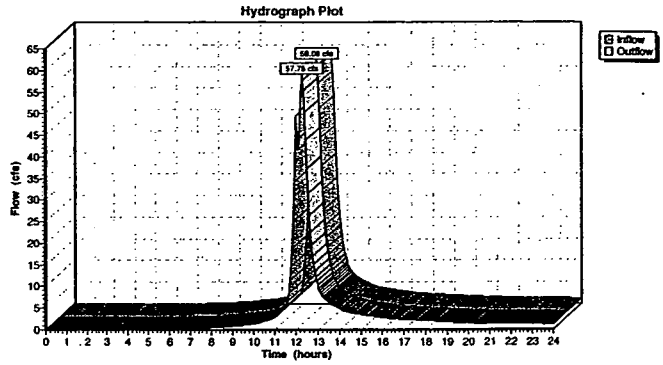
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 58.08 cfs @ 12.28 hrs, Volume= 6.434 af
Outflow = 57.75 cfs @ 12.30 hrs, Volume= 6.430 af, Atten= 1%, Lag= 1.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.1 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 2.9 fps, Avg. Travel Time= 1.7 min

Peak Depth= 1.80'
Capacity at bank full= 296.41 cfs
72.0" Diameter Pipe n= 0.013 Length= 296.0' Slope= 0.0049 '/'

Reach 7CR: Rimia Parking Lot Culvert



Reach 7DR: Runoff Drainage Channel south of Rimia

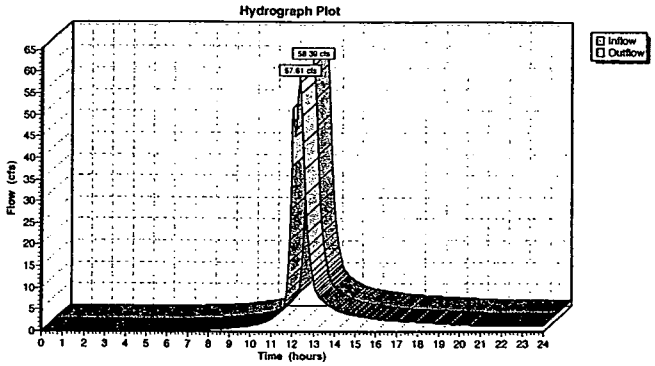
[65] Warning: Inlet elevation not specified

Inflow = 58.39 cfs @ 12.29 hrs, Volume= 6.657 af
Outflow = 57.61 cfs @ 12.34 hrs, Volume= 6.647 af, Atten= 1%, Lag= 2.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.3 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 3.7 min

Peak Depth= 1.41'
Capacity at bank full= 372.29 cfs
2.56' x 3.00' deep channel, n= 0.030 Length= 298.0' Slope= 0.0062 '/'
Side Slope Z-value= 4.0 10.0 '/'

Reach 7DR: Runoff Drainage Channel south of Rimia



Reach 8AR: west channel

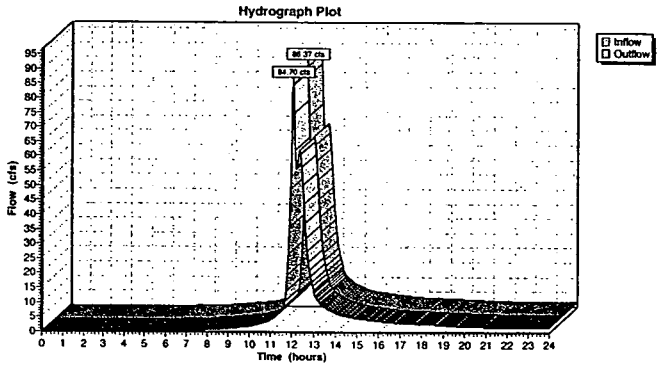
[65] Warning: Inlet elevation not specified

Inflow = 86.37 cfs @ 12.02 hrs, Volume= 8.745 af
Outflow = 84.70 cfs @ 12.04 hrs, Volume= 8.737 af, Atten= 2%, Lag= 1.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.5 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.1 fps, Avg. Travel Time= 2.3 min

Peak Depth= 1.35'
Capacity at bank full= 388.16 cfs
13.28' x 3.00' deep channel, n= 0.030 Length= 146.0' Slope= 0.0048 '/'
Side Slope Z-value= 4.2 2.6 '/'

Reach 8AR: west channel



Reach 8BR: Culvert at Sed Basin 2 entrance

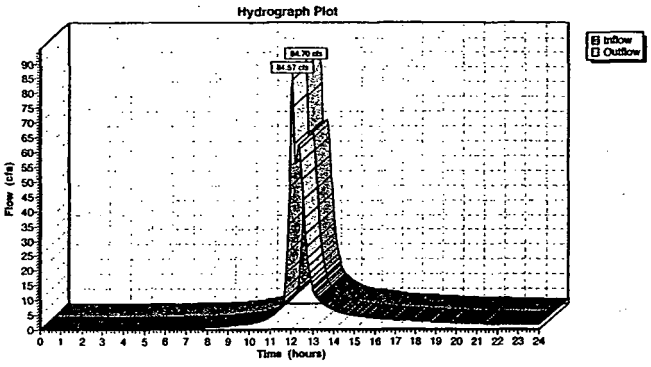
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 84.70 cfs @ 12.04 hrs, Volume= 8.737 af
Outflow = 84.57 cfs @ 12.04 hrs, Volume= 8.737 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.9 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.5 fps, Avg. Travel Time= 0.2 min

Peak Depth= 1.61'
Capacity at bank full= 535.70 cfs
A factor of 2.00 has been applied to the supplied storage and discharge data
72.0" Diameter Pipe n= 0.013 Length= 30.0' Slope= 0.0040 '/'

Reach 8BR: Culvert at Sed Basin 2 entrance



Reach 8CR: Channel into Sed Basin 2

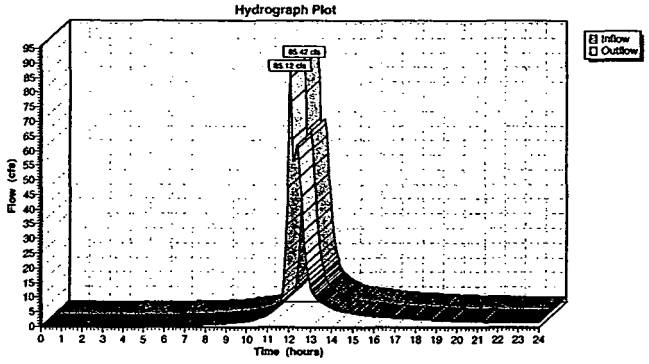
[65] Warning: Inlet elevation not specified

Inflow = 85.42 cfs @ 12.04 hrs, Volume= 8.787 af
Outflow = 85.12 cfs @ 12.04 hrs, Volume= 8.785 af, Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.6 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.7 fps, Avg. Travel Time= 0.4 min

Peak Depth= 2.11'
Capacity at bank full= 728.12 cfs
1.17' x 5.00' deep channel, n= 0.030 Length= 62.7' Slope= 0.0159 '/'
Side Slope Z-value= 2.4 2.3 '/'

Reach 8CR: Channel into Sed Basin 2



Reach 9AR: Extended Drainge Channel South of Cell 8

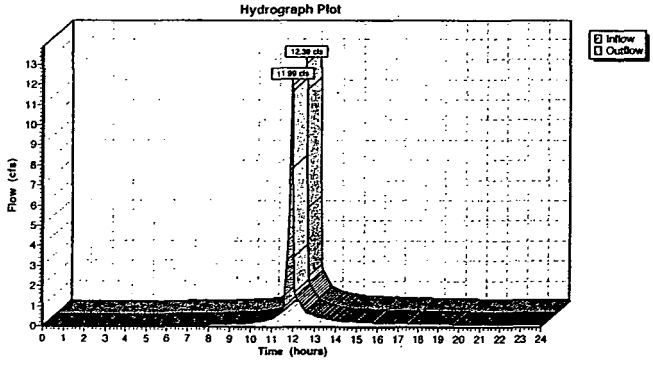
[65] Warning: Inlet elevation not specified

Inflow = 12.39 cfs @ 11.91 hrs, Volume= 0.572 af
Outflow = 11.99 cfs @ 11.93 hrs, Volume= 0.572 af, Atten= 3%, Lag= 1.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.5 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.6 fps, Avg. Travel Time= 2.1 min

Peak Depth= 0.95'
Capacity at bank full= 263.84 cfs
0.00' x 3.00' deep channel, n= 0.030 Length= 197.0' Slope= 0.0243 '/'
Side Slope Z-value= 3.0 '/'

Reach 9AR: Extended Drainge Channel South of Cell 8



Reach 9BR: (new node)

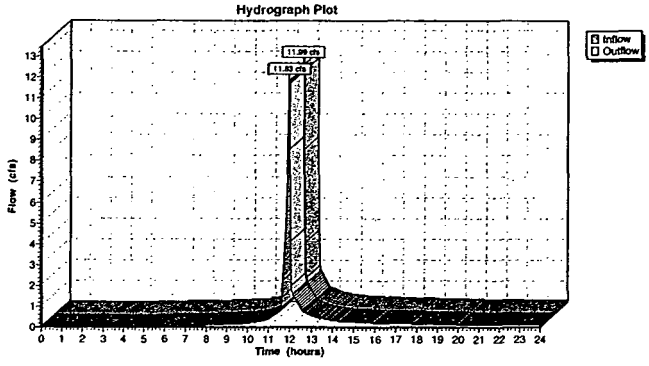
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 11.99 cfs @ 11.93 hrs, Volume= 0.572 af
Outflow = 11.83 cfs @ 11.94 hrs, Volume= 0.572 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.8 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.7 fps, Avg. Travel Time= 0.9 min

Peak Depth= 0.75'
Capacity at bank full= 357.73 cfs
72.0" Diameter Pipe n= 0.024 Length= 88.0' Slope= 0.0243 '/'

Reach 9BR: (new node)



Reach 9R: Channel U/S of 30" Culvert

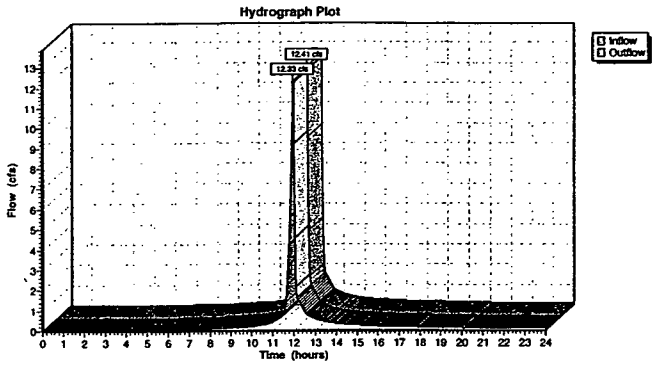
[65] Warning: Inlet elevation not specified

Inflow = 12.41 cfs @ 11.94 hrs, Volume= 0.597 af
Outflow = 12.33 cfs @ 11.94 hrs, Volume= 0.597 af, Atten= 1%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.5 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.6 fps, Avg. Travel Time= 0.3 min

Peak Depth= 0.95'
Capacity at bank full= 1,027.28 cfs
0.00' x 5.00' deep channel, n= 0.030 Length= 27.3' Slope= 0.0242 '/'
Side Slope Z-value= 3.0 '/'

Reach 9R: Channel U/S of 30" Culvert



Reach 10AR: (new node)

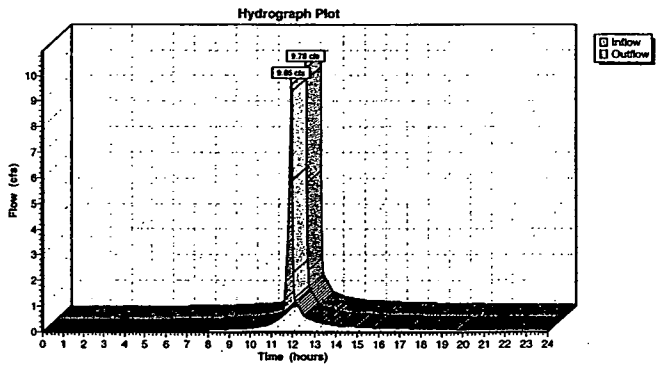
[65] Warning: Inlet elevation not specified

Inflow = 9.78 cfs @ 11.93 hrs, Volume= 0.450 af
Outflow = 9.65 cfs @ 11.93 hrs, Volume= 0.450 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.2 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.2 fps, Avg. Travel Time= 1.0 min

Peak Depth= 0.31'
Capacity at bank full= 243.75 cfs
5.00' x 1.75' deep channel, n= 0.030 Length= 71.4'. Slope= 0.0650 '/'
Side Slope Z-value= 3.0 '/'

Reach 10AR: (new node)



Reach 10BR: (new node)

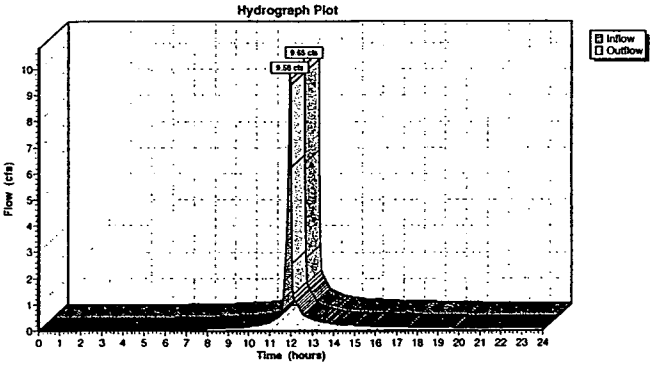
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 9.65 cfs @ 11.93 hrs, Volume= 0.450 af
Outflow = 9.58 cfs @ 11.93 hrs, Volume= 0.450 af, Atten= 1%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.3 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.6 fps, Avg. Travel Time= 0.4 min

Peak Depth= 0.69'
Capacity at bank full= 343.51 cfs
72.0" Diameter Pipe n= 0.013 Length= 38.0' Slope= 0.0066 '/'

Reach 10BR: (new node)



Reach 10R: access road diversion channel

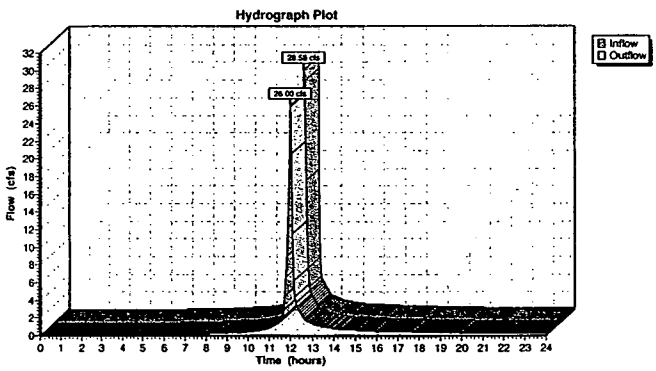
[65] Warning: Inlet elevation not specified

Inflow = 28.58 cfs @ 11.93 hrs, Volume= 1.327 af
Outflow = 26.00 cfs @ 11.99 hrs, Volume= 1.322 af, Atten= 9%, Lag= 3.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.7 fps, Min. Travel Time= 2.5 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 10.4 min

Peak Depth= 0.99'
Capacity at bank full= 162.16 cfs
7.00' x 2.50' deep channel, n= 0.030 Length= 407.0' Slope= 0.0044 '/'
Side Slope Z-value= 3.0 '/'

Reach 10R: access road diversion channel



Reach 11AR: (new node)

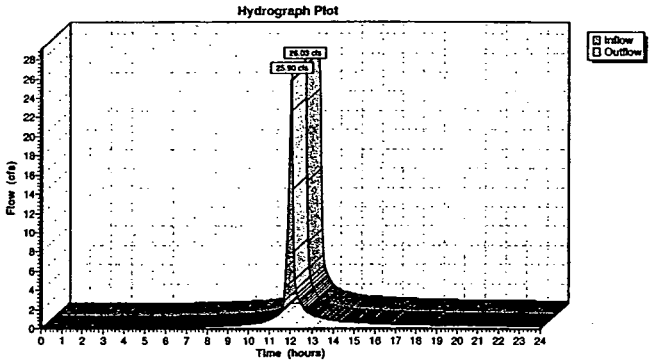
[65] Warning: Inlet elevation not specified

Inflow = 26.03 cfs @ 12.00 hrs, Volume= 1.388 af
Outflow = 25.90 cfs @ 12.00 hrs, Volume= 1.388 af, Atten= 0%, Lag= 0.1 min

ing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Velocity= 2.7 fps, Min. Travel Time= 0.1 min
g. Velocity = 0.7 fps, Avg. Travel Time= 0.4 min

Peak Depth= 0.98'
Capacity at bank full= 571.70 cfs
7.00' x 4.50' deep channel, n= 0.030 Length= 16.0' Slope= 0.0044 '/'
Side Slope Z-value= 3.0 '/'

Reach 11AR: (new node)



Reach 11R: culvert

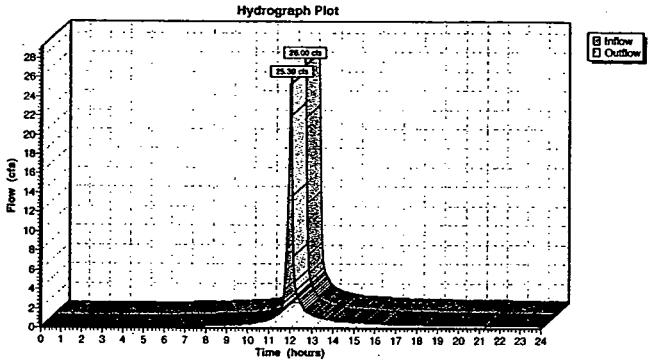
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 26.00 cfs @ 11.99 hrs, Volume= 1.322 af
Outflow = 25.39 cfs @ 12.00 hrs, Volume= 1.321 af, Atten= 2%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.0 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.6 fps, Avg. Travel Time= 1.4 min

Peak Depth= 2.76'
Capacity at bank full= 59.89 cfs
72.0" Diameter Pipe n= 0.013 Length= 50.0' Slope= 0.0002 '/'

Reach 11R: culvert



Reach 12: Culvert from F Street Drainage Channel

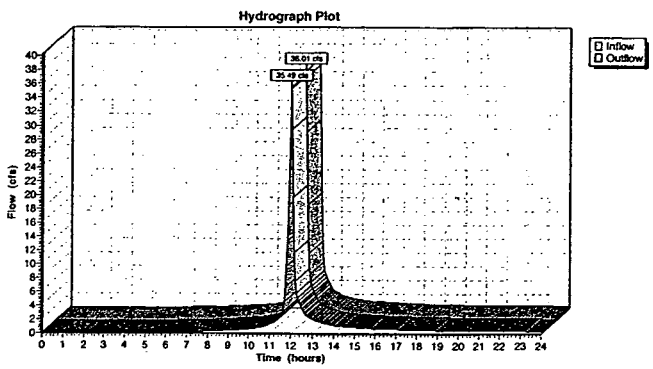
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 36.01 cfs @ 11.98 hrs, Volume= 1.985 af
Outflow = 35.49 cfs @ 11.99 hrs, Volume= 1.984 af, Atten= 1%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.3 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 1.6 min

Peak Depth= 1.24'
Capacity at bank full= 387.90 cfs
A factor of 2.00 has been applied to the supplied storage and discharge data
72.0" Diameter Pipe n= 0.013 Length= 119.2' Slope= 0.0021 '/'

Reach 12: Culvert from F Street Drainage Channel



Reach 13: (new node)

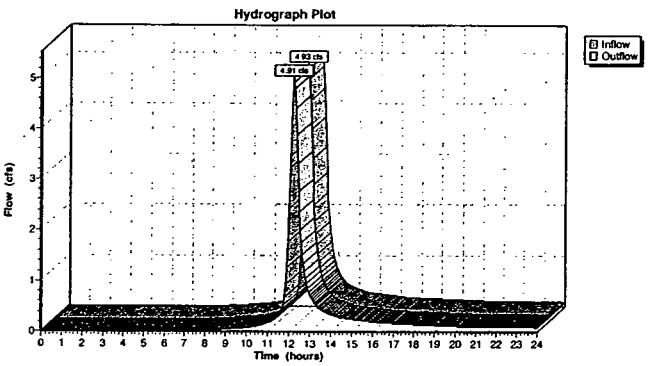
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 4.93 cfs @ 12.20 hrs, Volume= 0.433 af
Outflow = 4.91 cfs @ 12.21 hrs, Volume= 0.433 af, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.7 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.8 fps, Avg. Travel Time= 1.1 min

Peak Depth= 0.47'
Capacity at bank full= 386.61 cfs
72.0" Diameter Pipe n= 0.013 Length= 120.0' Slope= 0.0083 '/'

Reach 13: (new node)



Reach 14: Culvert from North Entrance Road channel

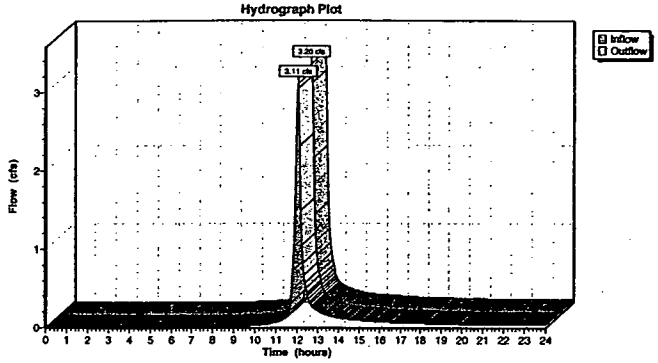
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 3.20 cfs @ 12.01 hrs, Volume= 0.169 af
Outflow = 3.11 cfs @ 12.03 hrs, Volume= 0.169 af, Atten= 3%, Lag= 1.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.5 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.4 fps, Avg. Travel Time= 1.3 min

Peak Depth= 0.27'
Capacity at bank full= 822.56 cfs
A factor of 2.00 has been applied to the supplied storage and discharge data
72.0" Diameter Pipe n= 0.024 Length= 112.0' Slope= 0.0321 '/'

Reach 14: Culvert from North Entrance Road channel



Reach 15N: Culvert adjacent to North Entrance Road

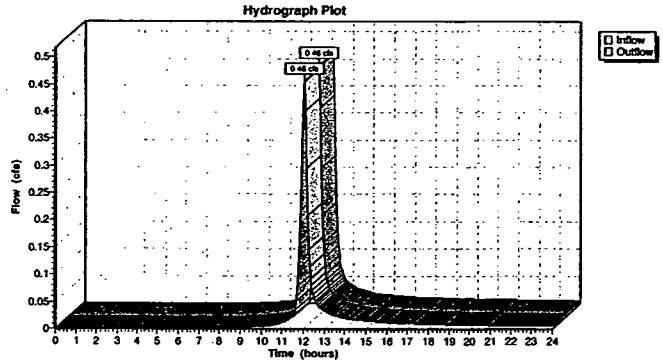
[52] Hint: Inlet conditions not evaluated
[65] Warning: Inlet elevation not specified

Inflow = 0.46 cfs @ 12.04 hrs, Volume= 0.027 af
Outflow = 0.46 cfs @ 12.05 hrs, Volume= 0.027 af, Atten= 1%, Lag= 0.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.4 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 0.7 min

Peak Depth= 0.15'
Capacity at bank full= 406.62 cfs
72.0" Diameter Pipe n= 0.010 Length= 55.0' Slope= 0.0055 '/'

Reach 15N: Culvert adjacent to North Entrance Road



Reach 16N: Channel east of North Entrance Road

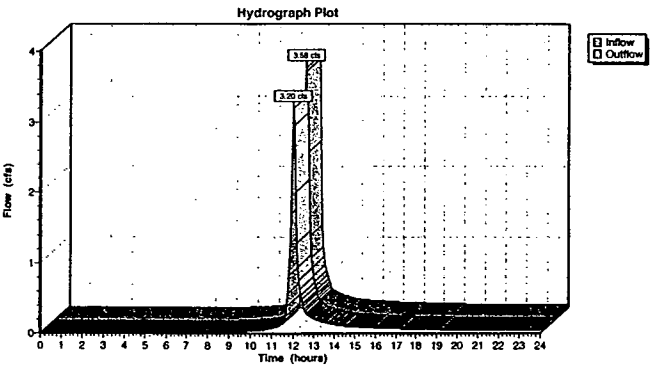
[65] Warning: Inlet elevation not specified

Inflow = 3.58 cfs @ 11.94 hrs, Volume= 0.170 af
Outflow = 3.20 cfs @ 12.01 hrs, Volume= 0.169 af, Atten= 11%, Lag= 4.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.2 fps, Min. Travel Time= 2.9 min
Avg. Velocity = 0.8 fps, Avg. Travel Time= 7.7 min

Peak Depth= 0.90'
Capacity at bank full= 71.46 cfs
0.00' x 2.88' deep channel, n= 0.030 Length= 382.0' Slope= 0.0069 '/'
Side Slope Z-value= 2.2 1.4 '/'

Reach 16N: Channel east of North Entrance Road



Pond 1P: Sedimentation Basin 2

Inflow = 97.27 cfs @ 12.04 hrs, Volume= 10.469 af
Outflow = 3.11 cfs @ 18.43 hrs, Volume= 1.614 af, Atten= 97%, Lag= 383.1 min
Primary = 3.11 cfs @ 18.43 hrs, Volume= 1.614 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 575.68' Storage= 8.938 af
Plug-Flow detention time= 563.4 min calculated for 1.611 af (15% of inflow)
Storage and wetted areas determined by Conic sections

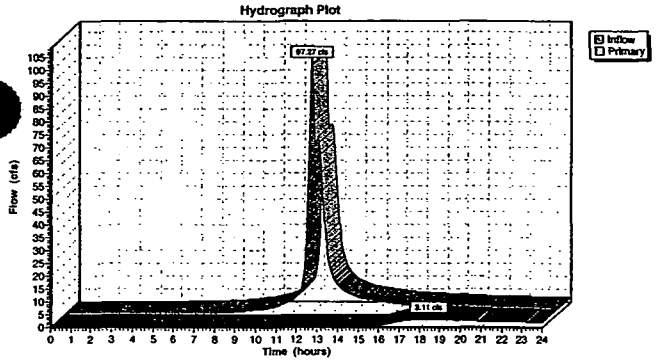
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
570.50	1.460	0.000	0.000	1.460
571.00	1.512	0.743	0.743	1.513
572.00	1.614	1.563	2.306	1.617
573.00	1.713	1.663	3.969	1.719
574.00	1.819	1.766	5.735	1.827
575.00	1.917	1.868	7.602	1.928
576.00	2.026	1.971	9.574	2.039
577.00	2.162	2.094	11.667	2.177

Primary OutFlow (Free Discharge)
2=Culvert
1=Orifice/Grate
3=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Device 2	575.50'	**48.0" Horiz. Orifice/Grate** Limited to weir flow C= 0.600
2	Primary	570.78'	**36.0" x 680.0' long Culvert** Ke= 0.700
			Outlet Invert= 563.30' S= 0.0110 '/' n= 0.024 Cc= 0.900
3	Primary	576.00'	**20.0' long Broad-Crested Rectangular Weir**
			Head (feet) 0.50 1.00 1.50 2.00 2.50 3.00 4.00 5.00
			Coef. (English) 3.00 3.00 3.00 3.00 3.00 3.00 3.00 3.00

5529

Pond 1P: Sedimentation Basin 2



000194

ATTACHMENT C-2

WEIGHTED CURVE NUMBER CALCULATIONS

SUBCATCHMENT AREA AND HYDROCAD™ INPUT PARAMETERS FOR THE CALCULATION OF WEIGHTED CN

East OSDF Construction Design Scenario

Subcatchment Label	Area (acres)	Percent of Total Area %	HSG	Land Use Description	CN	Weighted CN
A	1.96	100%	B/C	vegetated final cover	83	83
B	1.18	100%	B/C	vegetated final cover	83	83
C	5.21	100%	B/C	vegetated final cover	83	83
D	5.13	100%	B/C	vegetated final cover	83	83
E	5.09	100%	B/C	vegetated final cover	83	83
F	5.05	100%	B/C	vegetated final cover	83	83
G	5.31	100%	B/C	vegetated final cover	83	83
HR	4.59	100%	B/C	unvegetated final cover	89	89
IR	0.52	100%	B/C	unvegetated final cover	89	89
JR	2.59	100%	B/C	unvegetated final cover	89	89
L	1.68	30% 70%	B C	runon north of borrow area runon north of borrow area	69 79	76
M	1.00	100%	C	runon north of borrow area	79	79
N	7.82	100%	N/A	direct runon to pond	98	98
O	1.32	100%	C	runon north of borrow area	79	79
P	5.24	45% 55%	B C	runon north of borrow area runon north of borrow area	69 79	75
Q	7.70	70% 30%	B C	runon north of borrow area runon north of borrow area	69 79	72
R	2.61	55% 45%	B C	runon north of borrow area runon north of borrow area	69 79	74
S	0.40	10% 90%	B C	runon north of borrow area runon north of borrow area	69 79	78
U	4.15	70% 30%	B C	runon east of OSDF runon east of OSDF	69 79	72
V	0.27	100%	N/A	direct runon to pond	98	98
W	10.59	70% 30%	B C	runon east of OSDF runon east of OSDF	69 79	72
X	11.85	80% 20%	B C	runon east of OSDF runon east of OSDF	69 79	71
Y	6.52	60% 40%	B C	runon east of OSDF runon east of OSDF	69 79	73
Z	1.61	70% 30%	B C	runon east of OSDF runon east of OSDF	69 79	72
AA	2.71	55% 45%	B C	runon east of OSDF runon east of OSDF	69 79	74
BB	0.76	100%	C	runon east of OSDF	79	79
CC	0.12	100%	C	runon east of OSDF	79	79
DDR	0.87	100%	B/C	unvegetated final cover	89	89
EE	0.93	20% 80%	B C	runon north of borrow area runon north of borrow area	69 79	77
FFR	4.76	100%	B/C	unvegetated final cover	89	89
GGR	2.62	55% 45%	B C	construction laydown construction laydown	74 82	78
HH	0.55	100%	C	runon north of borrow area	79	79
II	1.67	50% 50%	B C	runon area to borrow area runon area to borrow area	61 74	68
JJ	0.91	93% 7%	B C	runon area to borrow area runon area to borrow area	61 74	62
KK	5.89	80% 20%	B C	runon area to borrow area runon area to borrow area	61 74	64
LL	7.05	100%	B	runoff	61	61
MM	1.94	100%	B	runoff	61	61
NN	1.27	60% 40%	B C	runoff runoff	61 74	66
OO	0.40	65% 35%	B C	runon area to borrow area runon area to borrow area	61 74	66
PP	40.96	80% 20%	B C	vegetated borrow area vegetated borrow area	61 74	64

N/A - Not Applicable

RESULTS FOR THE CALCULATION OF WEIGHTED CN
West OSDF Construction Design Scenario

Subcatchment Label	Area (acres)	Percent of Total Area %	HSG	Land Use Description	CN	Weighted CN
A	2.73	100%	B/C	vegetated final cover	83	83
B	5.34	100%	B/C	vegetated final cover	83	83
C	5.40	100%	B/C	vegetated final cover	83	83
D	5.53	100%	B/C	vegetated final cover	83	83
ER	5.32	100%	B/C	unvegetated final cover	89	89
F1R	0.92	100%	B/C	unvegetated final cover	89	89
F2R	1.55	100%	B/C	unvegetated final cover	89	89
FR	3.02	100%	B/C	unvegetated final cover	89	89
GR	0.23	100%	B/C	unvegetated final cover	89	89
HR	0.12	100%	B/C	runon north of borrow area	79	79
J1R	0.31	100%	C	construction laydown	82	82
J2R	0.97	100%	C	construction laydown	82	82
KR	1.97	100%	C	unvegetated final cover	89	89
LR	1.86	100%	C	construction laydown	82	82
MR	0.68	100%	C	runon north of borrow area	79	79
N	1.04	100%	C	construction laydown	82	82
O	2.25	100%	N/A	direct runon to pond	98	98
P1R	0.49	100%	C	construction laydown	82	82
P2R	0.21	100%	C	construction laydown	82	82
QN	0.13	100%	C	runon north of borrow area	79	79

Written by: Victoria Cheplak (VSC) Date 6/13/04 Reviewed by: _____ Date: _____

Client: Fluor Fernald, Inc. Project: OSDF Phase V Revision Cell 8 DCN Project No.: GQ3309 Task No.: 2/2

ATTACHMENT C-3

TABULATED ANALYSIS RESULTS FOR CHANNELS

OSDF CONSTRUCTION/FILLING PERIOD CONDITIONS
SUMMARY OF CHANNEL ANALYSIS RESULTS

Channel Identification			Channel Characteristics							Hydrologic Calculations		Hydraulic Calculations							
Channel Name[1]	Status	Design Scenario	Section Shape	Minimum Channel Depth (ft)	Longitudinal Slope[2] (%)	Manning n	Bottom Width B (ft)	Side Slope M_1:1	Side Slope M_2:1	HydroCAD Node	HydroCAD Q[4] (cfs)	Area of Flow A (sq ft)	Perimeter P (ft)	Hydraulic Radius, R (ft)	Peak Flow Depth[5] Y (ft)	Estimated Q[5] (cfs)	Channel Freeboard[7] (ft)	Peak Flow Velocity (fps)	Lining Type[6]
7R	new	E OSDF	vee	6.0	0.50%	0.030	0	6	3	8R	76.90	21.19	20.06	1.06	2.17	77.18	3.8	3.64	grass
8R	new	E OSDF	vee	5.5	0.50%	0.030	0	6	2	9R	76.73	20.61	18.88	1.09	2.27	76.74	3.2	3.72	grass
9R	new	E OSDF	trapezoidal	3.8	0.50%	0.030	3	6	3	10AR	76.58	21.15	20.20	1.05	1.86	76.59	1.9	3.62	grass
10AR	new	E OSDF	trapezoidal	3.9	0.50%	0.030	9	6	3	28R	77.45	22.29	22.31	1.00	1.44	78.24	2.4	3.51	grass
10BR	new/existing	E OSDF	trapezoidal	2.6	1.00%	0.030	9.7	3	3	11	79.86	16.81	17.61	0.95	1.25	80.97	1.4	4.82	grass
12R	existing	E OSDF	trapezoidal	2.5	0.63%	0.030	14	3	4.3	12R + HH	81.64	21.60	22.94	0.94	1.18	81.81	1.3	3.79	grass
13R	existing	E OSDF	trapezoidal	2.1	0.67%	0.030	23.11	2.3	4	13R	145.41	34.12	31.47	1.08	1.26	146.41	0.8	4.29	grass
18	new	E OSDF	vee	3.0	1.00%	0.030	0	3	3	19	38.43	8.77	10.81	0.81	1.71	37.89	1.3	4.32	grass
19	new	E OSDF	vee	3.0	0.90%	0.030	0	3	3	20	43.35	10.05	11.57	0.87	1.83	43.07	1.2	4.29	grass
20	new	E OSDF	vee	3.0	0.83%	0.030	0	3	3	1P - U - V	40.72	9.94	11.51	0.86	1.82	40.77	1.2	4.10	grass
30	new	E OSDF	vee	2.5	1.00%	0.030	0	3	3	30	45.98	10.05	11.57	0.87	1.83	45.40	0.7	4.52	grass
21	new	E OSDF	vee	3.0	1.00%	0.030	0	3	3	22	46.33	10.27	11.70	0.88	1.85	46.74	1.2	4.55	grass
22	new	E OSDF	vee	4.0	1.00%	0.030	0	3	3	29	47.10	10.27	11.70	0.88	1.85	46.74	2.2	4.55	grass
29	new	E OSDF	vee	3.5	1.00%	0.030	0	3	3	23	48.76	10.49	11.83	0.89	1.87	48.10	1.6	4.58	grass
24	new	E OSDF	trapezoidal	2.0	0.75%	0.030	8.5	3	3	24	57.15	14.21	15.96	0.89	1.18	56.54	0.8	3.98	grass
26	new	E OSDF	vee	2.5	0.75%	0.030	0	3	3	27	65.00	14.52	13.91	1.04	2.20	64.26	0.3	4.43	grass
7BR	new	W OSDF	vee	3.8	0.23%	0.030	0	6	2	7BR	57.98	22.47	19.72	1.14	2.37	58.39	1.4	2.60	grass
7DR	existing	W OSDF	trapezoidal	3.0	0.62%	0.030	2.56	4	10	7DR	58.39	17.53	22.52	0.78	1.41	57.95	1.6	3.31	grass
8AR	existing	W OSDF	trapezoidal	3.0	0.48%	0.030	13.28	4.2	2.6	8AR	86.37	24.12	22.87	1.05	1.35	86.02	1.7	3.57	grass
8CR	existing	W OSDF	trapezoidal	5.0	1.59%	0.030	1.17	2.4	2.3	8CR	85.42	12.93	11.95	1.08	2.11	85.37	2.9	6.60	rip rap
9AR	new	W OSDF	vee	3.0	2.43%	0.030	.0	3	3	9AR	12.39	2.71	6.01	0.45	0.95	12.32	2.1	4.55	grass
9R	new	W OSDF	vee	5.0	2.42%	0.030	0	3	3	9R	12.41	2.71	6.01	0.45	0.95	12.29	4.1	4.54	grass
10AR	new	W OSDF	trapezoidal	1.8	6.50%	0.030	5	3	3	10AR	9.78	1.84	6.96	0.26	0.31	9.58	1.4	5.21	rip rap
10R	new	W OSDF	trapezoidal	2.5	0.44%	0.030	7	3	3	10R	28.58	10.39	13.51	0.77	1.03	28.74	1.5	2.77	grass
11AR	new	W OSDF	trapezoidal	4.5	0.44%	0.030	7	3	3	11AR	26.03	9.61	13.13	0.73	0.97	25.72	3.5	2.68	grass
16N	existing	W OSDF	vee	2.9	0.69%	0.030	0	2.2	1.4	16N	3.58	1.56	3.85	0.41	0.93	3.51	2.0	2.26	grass
[illegible]	existing	DC A	vee	3.0	1.50%	0.030	0	2	3	1 + 0	8.82	2.81	7.65	0.37	0.75	8.37	2.3	3.12	grass
[illegible]	new	DC A	vee	2.5	0.34%	0.030	0	3	3	[illegible]	12.05	5.63	9.65	0.58	1.07	12.03	1.1	2.16	grass
6	new	DC A	vee	2.5	0.23%	0.030	0	3	3	6 + D	12.41	5.66	9.43	0.60	1.07	12.33	1.0	1.85	grass
[illegible]	existing	DC A	vee	2.0	2.00%	0.030	0	3	3	[illegible]	21.87	5.10	10.36	0.49	1.01	20.93	1.0	4.89	grass
[illegible]																			
1	existing	DC B	vee	6.5	0.45%	0.030	0	3	3	1	45.68	14.44	13.70	0.92	1.92	43.91	4.6	3.15	grass
2	new	DC B	vee	7.0	0.50%	0.030	0	6	4	2	66.65	17.89	16.45	1.09	2.28	68.82	5.1	3.73	grass
3	new	DC B	vee	6.5	0.50%	0.030	0	6	4	3	64.11	17.56	16.23	1.08	2.24	64.07	4.6	3.65	grass
4	new	DC B	vee	6.0	0.50%	0.030	0	6	4	4	62.72	18.00	15.49	0.97	2.00	62.57	4.0	3.43	grass
5	new	DC B	vee	5	0.50%	0.030	0	6	4	5	62.18	18.00	15.49	0.97	2.00	62.49	3.0	3.45	grass
6A	new	DC B	trapezoidal	2.71	0.50%	0.030	9.23	3.2	6	6A	64.11	18.85	19.88	0.95	1.86	64.32	1.5	3.40	grass
6B	new	DC B	trapezoidal	4	0.50%	0.030	10	3.2	6	6B	69.26	18.19	17.59	1.03	1.50	63.42	0.5	3.69	grass
7	new	DC B	trapezoidal	1.28	1.00%	0.030	2	3	3	8	12.70	4.33	8.77	0.49	0.93	12.42	0.5	2.93	grass
9	new	DC B	vee	4.5	1.00%	0.030	0	3	3	9	13.99	5.10	10.83	0.51	0.96	13.92	3.5	2.87	grass
[illegible]	existing	DC B	vee	7.5	0.45%	0.030	0	3	3	[illegible]	20.89	8.45	13.27	0.64	1.50	20.84	5.9	2.47	grass
[illegible]																			
1	new	DC C	vee	4	0.75%	0.030	0	6	3	2	25.75	7.73	11.56	0.67	1.39	25.43	2.5	3.29	grass
2	new	DC C	vee	4	0.75%	0.030	0	6	3	3	41.23	11.16	13.89	0.80	1.62	41.43	2.5	3.72	grass
3	new	DC C	vee	4	0.75%	0.030	0	6	3	4	45.28	12.25	14.29	0.86	1.75	45.66	2.5	3.93	grass
[illegible]	new	DC C	vee	4	0.76%	0.030	0	6	3	5	43.14	11.70	14.29	0.82	1.71	44.45	2.5	3.80	grass

E OSDF = East OSDF Construction-Phase Design Scenario
W OSDF = West OSDF Construction-Phase Design Scenario
DC A = Design Case "A"
DC B = Design Case "B"

Notes:
1. Channels are named after the corresponding subcatchment or reach.
2. Longitudinal slopes taken from the Drawings.
4. Peak inflow rates calculated by HydroCAD for each reach. See attachment C-1.
5. Calculated flow rates using an iterative procedure and compared with flow from HydroCAD.
6. Maximum permissible velocity for grass lined channels is 5 fps.
7. Calculated as the difference between minimum available flow depth and peak flow depth.

ATTACHMENT C-4A

CulvertMaster® OUTPUT REPORTS FOR CULVERTS

Written by: Victoria Cheplak (VSC) Date 6/13/04 Reviewed by: _____ Date: _____

Client: Fluor Fernald, Inc. Project: OSDF Phase V Revision Cell 8 DCN Project No.: GQ3309 Task No.: 2/2

CulvertMaster® OUTPUT REPORTS FOR CULVERTS

EAST OSDF DESIGN SCENARIO

Culvert Design Report
east node 11

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	N/A	ft	Storm Event	Design	
Computed Headwater Elevation	586.64	ft	Discharge	79.86	cfs
Headwater Depth/Height	1.32		Tailwater Elevation	584.74	ft
Inlet Control HW Elev.	586.64	ft	Control Type	Inlet Control	
Outlet Control HW Elev.	586.64	ft			

Grades					
Upstream Invert	583.67	ft	Downstream Invert	583.58	ft
Length	40.00	ft	Constructed Slope	0.002355	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	1.80	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.80	ft
Velocity Downstream	7.81	ft/s	Critical Slope	0.004576	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.010	
Section Material	Corrugated HDPE (Smooth Interior)		Span	2.25	ft
Section Size	27 inch		Rise	2.25	ft
Number Sections	3				

Outlet Control Properties					
Outlet Control HW Elev.	586.64	ft	Upstream Velocity Head	0.76	ft
Ke	0.20		Entrance Loss	0.15	ft

Inlet Control Properties					
Inlet Control HW Elev.	586.64	ft	Flow Control	Submerged	
Inlet Type	Groove end projecting		Area Full	11.9	ft²
K	0.00450		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	3	
C	0.03170		Equation Form	1	
Y	0.69000				

Culvert Design Report
east node 28R

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	N/A	ft	Storm Event	Design	
Computed Headwater Elevation	588.02	ft	Discharge	77.45	cfs
Headwater Depth/Height	1.03		Tailwater Elevation	586.01	ft
Inlet Control HW Elev.	587.87	ft	Control Type	Outlet Control	
Outlet Control HW Elev.	588.02	ft			

Grades					
Upstream Invert	585.20	ft	Downstream Invert	584.79	ft
Length	85.73	ft	Constructed Slope	0.004782	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	1.54	ft
Slope Type	Mild		Normal Depth	2.01	ft
Flow Regime	Subcritical		Critical Depth	1.54	ft
Velocity Downstream	6.90	ft/s	Critical Slope	0.009123	ft/ft

Section					
Section Shape	Arch		Mannings Coefficient	0.019	
Section Material	Steel and Aluminum Var CR		Span	4.08	ft
Section Size	49 x 33 inch		Rise	2.75	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	588.02	ft	Upstream Velocity Head	0.48	ft
Ke	0.90		Entrance Loss	0.44	ft

Inlet Control Properties					
Inlet Control HW Elev.	587.87	ft	Flow Control	N/A	
Inlet Type	Thin wall projecting		Area Full	17.8	ft²
K	0.03400		HDS 5 Chart	34	
M	1.50000		HDS 5 Scale	3	
C	0.04960		Equation Form	1	
Y	0.57000				

000203

Written by: Victoria Cheplak (VSC) Date 6/13/04 Reviewed by: _____ Date: _____

Client: Fluor Fernald, Inc. Project: OSDF Phase V Revision Cell 8 DCN Project No.: GQ3309 Task No.: 2/2

CulvertMaster® OUTPUT REPORTS FOR CULVERTS

WEST OSDF SCENARIO

Culvert Design Report
west node 8BR

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	577.00	ft	Storm Event	Design	
Computed Headwater Elevation	575.41	ft	Discharge	84.71	cfs
Headwater Depth/Height	1.10		Tailwater Elevation	573.32	ft
Inlet Control HW Elev.	575.28	ft	Control Type	Outlet Control	
Outlet Control HW Elev.	575.41	ft			

Grades					
Upstream Invert	572.12	ft	Downstream Invert	572.00	ft
Length	30.00	ft	Constructed Slope	0.004000	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	2.12	ft
Slope Type	Mild		Normal Depth	2.47	ft
Flow Regime	Subcritical		Critical Depth	2.12	ft
Velocity Downstream	7.93	ft/s	Critical Slope	0.005613	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	575.41	ft	Upstream Velocity Head	0.82	ft
Ke	0.20		Entrance Loss	0.16	ft

Inlet Control Properties					
Inlet Control HW Elev.	575.28	ft	Flow Control	Unsubmerged	
Inlet Type	Groove end w/headwall		Area Full	14.1	ft²
K	0.00180		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	2	
C	0.02920		Equation Form	1	
Y	0.74000				

Culvert Design Report
west node 9BR design

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	N/A	ft	Storm Event	Design	
Computed Headwater Elevation	581.42	ft	Discharge	11.99	cfs
Headwater Depth/Height	2.23		Tailwater Elevation	576.97	ft
Inlet Control HW Elev.	581.42	ft	Control Type	Inlet Control	
Outlet Control HW Elev.	580.97	ft			

Grades					
Upstream Invert	578.08	ft	Downstream Invert	576.00	ft
Length	88.00	ft	Constructed Slope	0.023636	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	1.27	ft
Slope Type	Steep		Normal Depth	1.27	ft
Flow Regime	Supercritical		Critical Depth	1.31	ft
Velocity Downstream	7.51	ft/s	Critical Slope	0.022602	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.018	
Section Material	CMP		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	580.97	ft	Upstream Velocity Head	0.83	ft
Ke	0.90		Entrance Loss	0.75	ft

Inlet Control Properties					
Inlet Control HW Elev.	581.42	ft	Flow Control	N/A	
Inlet Type	Projecting		Area Full	1.8	ft²
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Design Report
west node 11R design

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	N/A	ft	Storm Event	Design	
Computed Headwater Elevation	581.88	ft	Discharge	26.00	cfs
Headwater Depth/Height	2.19		Tailwater Elevation	579.94	ft
Inlet Control HW Elev.	581.05	ft	Control Type	Outlet Control	
Outlet Control HW Elev.	581.88	ft			

Grades					
Upstream Invert	577.50	ft	Downstream Invert	577.50	ft
Length	50.00	ft	Constructed Slope	0.000000	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	2.44	ft
Slope Type	N/A		Normal Depth	N/A	ft
Flow Regime	N/A		Critical Depth	1.79	ft
Velocity Downstream	8.28	ft/s	Critical Slope	0.011708	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	581.88	ft	Upstream Velocity Head	1.06	ft
Ke	0.20		Entrance Loss	0.21	ft

Inlet Control Properties					
Inlet Control HW Elev.	581.05	ft	Flow Control	Submerged	
Inlet Type	Groove end projecting		Area Full	3.1	ft²
K	0.00450		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	3	
C	0.03170		Equation Form	1	
Y	0.69000				

Culvert Design Report
west node 12 design

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	581.90	ft	Storm Event	Design	
Computed Headwater Elevation	579.94	ft	Discharge	36.01	cfs
Headwater Depth/Height	1.58		Tailwater Elevation	577.18	ft
Inlet Control HW Elev.	579.43	ft	Control Type	Outlet Control	
Outlet Control HW Elev.	579.94	ft			

Grades					
Upstream Invert	576.00	ft	Downstream Invert	575.75	ft
Length	119.24	ft	Constructed Slope	0.002097	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	2.04	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	2.04	ft
Velocity Downstream	8.41	ft/s	Critical Slope	0.007802	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.50	ft
Section Size	30 inch		Rise	2.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	579.94	ft	Upstream Velocity Head	0.84	ft
Ke	0.20		Entrance Loss	0.17	ft

Inlet Control Properties					
Inlet Control HW Elev.	579.43	ft	Flow Control	Submerged	
Inlet Type	Groove end projecting		Area Full	4.9	ft²
K	0.00450		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	3	
C	0.03170		Equation Form	1	
Y	0.69000				

Culvert Design Report
west node 13

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	581.50	ft	Storm Event	Design	
Computed Headwater Elevation	580.27	ft	Discharge	4.93	cfs
Headwater Depth/Height	0.85		Tailwater Elevation	N/A	ft
Inlet Control HW Elev.	580.23	ft	Control Type	Entrance Control	
Outlet Control HW Elev.	580.27	ft			

Grades					
Upstream Invert	579.00	ft	Downstream Invert	578.00	ft
Length	120.00	ft	Constructed Slope	0.008300	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.76	ft
Slope Type	Steep		Normal Depth	0.76	ft
Flow Regime	Supercritical		Critical Depth	0.85	ft
Velocity Downstream	5.46	ft/s	Critical Slope	0.005749	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	580.27	ft	Upstream Velocity Head	0.35	ft
Ke	0.20		Entrance Loss	0.07	ft

Inlet Control Properties					
Inlet Control HW Elev.	580.23	ft	Flow Control	N/A	
Inlet Type	Groove end projecting		Area Full	1.8	ft²
K	0.00450		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	3	
C	0.03170		Equation Form	1	
Y	0.69000				

Written by: Victoria Cheplak (VSC) Date 6/13/04 Reviewed by: _____ Date: _____

Client: Fluor Fernald, Inc. Project: OSDF Phase V Revision Cell 8 DCN Project No.: GQ3309 Task No.: 2/2

ATTACHMENT C-4B

TABULATED ANALYSIS RESULTS FOR CULVERTS

OSDF CONSTRUCTION/FILLING PERIOD CONDITIONS
SUMMARY OF CULVERT ANALYSES RESULTS

CULVERT IDENTIFICATION			PHYSICAL CHARACTERISTICS OF CULVERT						CULVERT PROFILE				CULVERTMASTER® MODELING CHARACTERISTICS			HYDRAULIC CAPACITY					STRUCTURAL CAPACITY [6]				OUTLET PROTECTION [6]				
Culvert Name	Status [1]	Design Scenario	Material - Type	Entrance Loss Coefficient (Ke)	Manning's n	Entrance Configuration [2]	Number of Culverts - Diameter	Approximate Length (ft)	Inlet Invert Elevation (ft MSL)	Outlet Invert Elevation (ft MSL)	Slope ft/ft	Overtopping Elevation (ft MSL)	Entrance Configuration [3]	Entrance Loss Coefficient (Ke)	Number of Culverts - Diameter [3]	HydroCad Node / Peak Flow Rate (cfs)	Tailwater Elevation (ft MSL)	Calculated Headwater Depth - Inlet Control [4] (ft MSL)	Calculated Headwater Depth Outlet Control [4] (ft MSL)	Calculated Freeboard (ft)	Available Cover (ft)	Design Traffic Type	Minimum Required Cover (ft)	Structurally Stable	Outlet Velocity (ft/s)	Riprap Length at Inlet (ft)	Riprap Length at Outlet (ft)	d_{50} (in)	Thickness (in)
11a	existing	E OSDF	HDPE	0.2	0.010	Projecting	2 - 27 inch	40	583.67	583.58	0.0023	587.20	Groove - Projecting	0.2	3 - 27 inch	11R / 79.86	584.74	586.64	586.64	0.6	-	-	-	-	7.8	-	-	-	-
11b	existing	E OSDF	RCP	0.2	0.013	Projecting	1 - 30 inch	40																					
23	new	E OSDF	Helical CMP	0.9	0.018	Projecting	2 - 36 inch	92	586.32	585.78	0.0059	590.00	Projecting	0.9	2 - 36 inch	23 / 48.76	587.01	588.83	589.02	1.0	2.04	On-Highway	2	yes	6.4	6	12	6	12
25	new	E OSDF	Helical CMP - Arch	0.9	0.018	Projecting	2 - 42 x 29 inch	53	584.85	584.53	0.0060	588.50	Thin Wall Projecting	0.9	2 - 42 x 29 inch	25 / 64.24	586.73	578.53	587.71	0.8	3.23	On-Highway	2	yes	4.9	0	0	0	0
27	new	E OSDF	Helical CMP - Arch	0.9	0.018	Projecting	2 - 42 x 29 inch	106	582.80	582.36	0.0042	587.00	Thin Wall Projecting	0.9	2 - 42 x 29 inch	27 / 65.00	583.88	585.50	585.63	1.4	3.78	Off-Highway	3	yes	6.8	7	14	6	12
28R	new - temporary	E OSDF	Helical CMP - Arch	0.9	0.019	Projecting	2 - 49 x 33 inch	140	585.75	585.00	0.0054	592.39	Thin Wall Projecting	0.9	2 - 49 x 33 inch	28R / 77.45	586.01	587.87	588.02	4.4	3.89	Off-Highway	3	yes	6.9	8	16	6	12
31	existing	E OSDF	HDPE	0.9	0.012	Projecting	1 - 27 inch	80	584.00	583.00	0.0125	588.50	Groove - Projecting	0.9	1 - 27 inch	31 / 6.54	584.51	585.20	585.49	3.0	-	-	-	-	2.3	-	-	-	-
5	new - temporary	W OSDF	Helical CMP	0.9	0.024	Projecting	1 - 42 inch	95	560.68	579.98	0.0737	585.34	Projecting	0.9	1 - 42 inch	5 / 55.45	582.50	584.67	584.89	0.5	27.64	Off-Highway	3	yes	7.48	7	14	6	12
7AR	new	W OSDF	CMP	0.9	0.024	Projecting	1 - 42 inch	82	577.67	577.23	0.0053	582.57	Projecting	0.9	1 - 42 inch	7AR / 57.96	579.58	581.8	582.10	0.5	4.83	Off-Highway	3	yes	8.30	6	12	6	12
7CR	existing	W OSDF	RCP - Horizontal Ellipse	0.2	0.013	Concrete Headwall	1 - 34 x 53 inch	296	574.96	573.50	0.00493	580.00	Groove - Headwall	0.2	1 - 34 x 53 inch	7CR / 58.08	575.39	577.92	578.01	2.0	-	-	-	-	8.40	-	-	-	-
8BR	existing	W OSDF	RCP	0.2	0.013	Concrete Headwall	2 - 36 inch	30	572.12	572.00	0.00400	577.00	Groove - Headwall	0.2	2 - 36 inch	8BR / 84.71	573.32	575.28	575.41	1.6	-	-	-	-	7.93	-	-	-	-
9BR	new	W OSDF	Helical CMP	0.9	0.018	Projecting	1 - 18 inch	88	578.08	576.00	0.02361	585.00	Projecting	0.9	1 - 18 inch	9BR / 11.99	576.97	581.42	580.97	3.6	5.42	Off-Highway	3	yes	7.51	3	6	6	12
10BR	new	W OSDF	RCP	0.2	0.013	Projecting	2 - 15 inch	44	579.67	579.52	0.00341	581.92	Groove - Projecting	0.2	2 - 15 inch	10BR / 9.65	580.06	581.04	581.12	0.8	1.00	N/A	N/A	N/A	5.16	2.5	5	6	12
11R	new	W OSDF	RCP	0.2	0.013	Projecting	1 - 24 inch	50	577.5	577.50	0	583.66	Groove -Projecting	0.2	1 - 24 inch	11R / 26.00	579.94	581.05	581.88	1.8	5.16	On-Highway	2	yes	8.28	4	8	6	12
12	new	W OSDF	RCP	0.2	0.013	Projecting	1 - 30 inch	119	576.00	575.75	0.0021	582.40	Groove -Projecting	0.2	1 - 30 inch	12 / 36.01	577.18	579.43	579.94	2.5	3.90	On-Highway	2	yes	8.41	5	10	6	12
13	new	W OSDF	RCP	0.2	0.013	Projecting	1 - 18 inch	120	579.00	578.00	0.0083	582.33	Groove - Projecting	0.2	1 - 18 inch	13 / 4.93	N/A	580.23	580.27	2.1	2.33	On-Highway	2	yes	5.46	3	6	6	12
14	existing	W OSDF	CMP	0.9	0.024	Projecting	1 - 50 x 31 inch	112	578.60	575.00	0.0321	581.90	Projecting	0.9	1 - 50 x 31 inch	14 / 3.20	N/A	579.1	579.26	2.6	-	-	-	-	4.04	-	-	-	-
15N	existing	W OSDF	HDPE	0.2	0.010	Projecting	1 - 18 inch	55	583.90	583.60	0.0055	585.05	Groove - Projecting	0.2	1 - 18 inch	15N / 0.46	582.99	584.23	584.26	0.8	-	-	-	-	2.89	-	-	-	-
1	existing - temporary	DC A	CMPA - Arch	0.9	0.018	Mitered End Section	1 - 81 x 57 inch	80	587.51	587.37	0.0125	592.00	Headwall	0.5	1 - 81 x 57 inch	1/ 2.02	588.80	587.07	588.93	0	3.51	On-Highway	2	yes	5.81	5	10	6	12
2	existing - temporary	DC A	RCP	0.2	0.010	Concrete Headwall	2 - 18 inch	53	581.60	581.50	0.0057	585.50	Groove Headwall	0.2	2 - 18 inch	2/ 8.41	584.22	582.70	582.76	1.7	2.16	On-Highway	2	yes	5.11	3	6	6	12
3	existing - temporary	DC A	RCP	0.2	0.010	Concrete Headwall	2 - 18 inch	60	582.50	581.50	0.0167	587.00	Groove Headwall	0.2	2 - 18 inch	3/ 8.20	584.03	583.42	583.45	3.5	5.11	On-Highway	2	yes	7.11	5	10	6	12
4	existing - temporary	DC A	Helical CMP	0.9	0.017	Projecting	2 - 36 inch	49	592.33	592.33	0.0100	596.50	Projecting	0.9	2 - 30 inch	3/24.73	593.80	591.13	591.45	1.1	2.62	On-Highway	2	yes	6.0	5	10	6	12
6	new - temporary	DC A	Helical CMP - Arch	0.9	0.019	Projecting	2 - 42 x 29 inch	92	588.95	588.9	0.0043	592.5	Thin Wall Projecting	0.9	2 - 42 x 29 inch	20/43.41	589.9	589.27	589.54	1.0	3.0	Off-Highway	3	yes	6.1	6	12	6	12
8	existing - temporary	DC A	RCP	0.2	0.013	Projecting	1 - 24 inch	45	580.30	579.80	0.0111	584.82	Projecting	0.2	1 - 24 inch	8/ 3.74	581.91	583.11	583.46	1.5	7.64	Off-Highway	3	yes	7.51	4	8	6	12

- E OSDF = East OSDF Construction-Phase Design Scenario
- W OSDF = West OSDF Construction-Phase Design Scenario
- DC A = Design Case "A"
- N/A = Not Applicable
- d_{50} = Average particle diameter

Notes
(1) New indicates a new culvert to be installed.
(2) Entrance configuration assumed.
(3) Dimensions and entrance configurations used in the Culvertmaster software package were selected to match existing culvert characteristics as closely as possible.
(4) Headwater depths calculated using Culvertmaster software package. Summary output presented for each culvert in Attachment C-4A.
(5) Grading is provided in the Construction Drawings
(6) Neither structural capacity nor outlet protection are evaluated for existing culverts.

13.3 OSDF PHASE V, EAST 2000-YEAR DRAINAGE CHANNEL EVALUATION

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COMPUTATION COVER SHEET

SUBJECT OF COMPUTATIONS OSDF PHASE V, EAST 2000-YEAR DRAINAGE CHANNEL EVALUATION

Computations By: (Cognizant Engineer)
Signature: Victoria Cheplak — Date: 1-21-04
Printed Name and Title: Victoria Cheplak, Senior Staff Engineer

Assumptions and Procedures Checked By: (Checker)
Signature: [signature] — Date: 1-21-04
Printed Name and Title: Ganesh Gopalakrishnan, Senior Engineer

Computations Checked by:
Signature: Hollie Kinnecom — Date: 1-21-04
Printed Name and Title: Holly Kinnecom, Staff Engineer

Computations Backchecked by: (Cognizant Engineer)
Signature: Victoria Cheplak — Date: 1-21-04
Printed Name and Title: Victoria Cheplak, Senior Staff Engineer

Approved by: (PDP)
Signature: [signature] — Date: 1-21-04
Printed Name and Title: Ganesh Gopalakrishnan, Senior Engineer

Approved by: (DTL/TETL)
Signature: Rudolph Bonaparte — Date: 1/22/04
Printed Name and Title: R. Bonaparte, Engineer of Record

Record of Revision (Number and initial all revisions)

Rev. No.	Reason	Date	By	Checked	Approval
0	Submittal to FF/DOE/EPA	30 Jan 02	DGP for DBM	DGP	JFB
1	CFC Revision 1 Submittal to FF/DOE/EPA	23 Jan 04	VSC VJC	GG	RB
2A	DCN-Cell 8 Expansion	16 June 04	VSC VAC	GG GG	

000213

ADDENDUM TO SECTION 13.3

(REVISION 2A DUE TO CELL 8 EXPANSION DCN)

This addendum details the calculations that were revised within Section 13.3, OSDF Phase V, East 2000-Year Drainage Channel Evaluation, of the Final Design Calculation Package for the Fernald Environmental Management Project (FEMP), due to the re-design of Cell 8. This re-design, referred to as the Cell 8 Expansion DCN, encompasses the extension of Cell 8 by approximately 100-feet to the South. This addendum discusses the modifications made to this calculation package as Revision 2A and as associated with this DCN.

For Revision 2A to this calculation package, the critical case for the drainage channel aligned along the east perimeter of the OSDF during the 2000-Year, 24-Hour Storm (i.e. the 2000-Year Drainage Channel) was evaluated to confirm the adequacy of the channel using the revised channel and OSDF geometry. This critical case is presented as the Heavy Vegetation Scenario, which considers Manning's n values of 0.24 for sheet flow and 0.07 for channel flow. The surface water management system was modified to reflect the design changes resulting from the expansion of Cell 8 and analyzed to verify the adequacy of the channel. For this submittal, only the Heavy Vegetation Scenario was modified; it should be noted that the Light and Moderate Vegetation Scenarios, detailed in this section, were not modified as they are less conservative than the critical Heavy Vegetation Scenario and are therefore not presented.

In order to present the results of this DCN analysis in an efficient manner, only the attachments that summarize the modifications and updated results for the 2000-Year Drainage Channel Evaluation with regard to the DCN are presented. These attachments are listed subsequently and explained in further detail.

- **Attachment A-1 – Layout of 2000-Year Storm Design Scenarios.** This layout demonstrates the revised configuration of the OSDF. Each surface water structure is labeled as identified in the hydrologic analysis.

- **Attachment A-2 – Nodal Network Diagram.** This diagram demonstrates the revised configuration of the surface water management system as a result of the DCN.

- **Attachment B-2 – Data for Calculation of Time of Concentration.** These data demonstrate the revised flow paths used to calculate the time of concentration for the revised configuration of subcatchments used in the hydrologic analysis.

- **Attachment C-1C – HydroCAD Output Reports – 2000-Year, 24-Hour Storm Event, 2000-Year Design Scenario – Heavy Vegetation.** This attachment provides the results of the hydrologic modeling for the 2000-Year Drainage Channel under the Heavy Vegetation Design Scenario for the 2000-Year, 24-Hour Storm, which is considered the critical case for these calculations.

- **Attachment C-2 – Weighted Curve Number Calculations.** These calculations present the revised areas and Curve Numbers for the revised configuration of subcatchments used in the hydrologic analysis.

- **Attachment C-3 – Tabulated Channel Analysis Results.** These results present the revised channel characteristics (i.e., geometry), flow within each channel, and hydraulic characteristics including peak flow depth and available freeboard, for the revised configuration of the 2000-Year Drainage Channel used in the hydrologic and hydraulic analysis.

Based on the analyses for the design change of the expansion of Cell 8, the 2000-Year Drainage Channel is adequate to convey the 2000-Year, 24-Hour Storm Event and provide the required freeboard.

ATTACHMENT A-1

LAYOUT OF 2000-YEAR STORM DESIGN SCENARIOS

5529

LEGEND

- SUBCATCHMENT LABEL AND BOUNDARY
- REACH ALIGNMENT AND LABEL
- CULVERT

PHASE V
2000 YEAR STORM DESIGN SCEN

N

SCALE 1"=300'

0 300'

EXISTING EMERGENCY ACCESS ROAD (FORMERLY REROUTED NORTH ENTRANCE ROAD) (NOTE 12)

EXISTING OSDF MONITORING ACCESS (NOTE 13)

FUTURE OSDF IMPACTED MATERIAL HAUL ROAD AND CELL ACCESS RAMP

OSDF MONITORING ACCESS (NOTE 13)

EXISTING CHAIN-LINK FENCE (NOTE 16)

EXISTING RUN-OFF DIVERSION CHANNEL

EXISTING STP EXCAVATION

EXISTING CONSTRUCTION WATER WELL NO. 3 (NOTE 10)
N 479,293.95
E 1,351,619.22

EXISTING POWER POLE OP77

RELOCATED EMERGENCY ACCESS ROAD (NOTE 12)

EXISTING EMERGENCY ACCESS ROAD (NOTE 12)

EXISTING 24' WIDE GATE (NOTE 16)

RUN-OFF DIVERSION CHANNEL

CONSTRUCTION LAYDOWN AREA

EXISTING BORROW AREA HAUL ROAD CORRIDOR

EXISTING GATE (NOTE 16)

EXISTING CONSTRUCTION REMOVED AS REQUIRED

SOUTH STOCKPILE AREA

EXISTING GATE (NOTE 16)

RELOCATED ACCESS CONTROL FACILITY (NOTE 15)
N 479504.77
E 1350889.35
N 479510.49
E 1350663.46

F STREET
N 480228.91
E 1350540.38

N 479975.40
E 1350533.43

N 479513.29

OSDF-4A

OSDF-2

OSDF-3

BM-10

W-2428

N 482164.16
E 1350593.31
FENCE END POST

N 482218.23
E 1350557.88
FENCE END POST

N 482418.11
E 1350557.89
FENCE END POST

N 482656.64
E 1350549.60
FENCE END POST

VH-1 VH-2 VH-3 VH-4 VH-5 VH-6 VH-7 VH-8

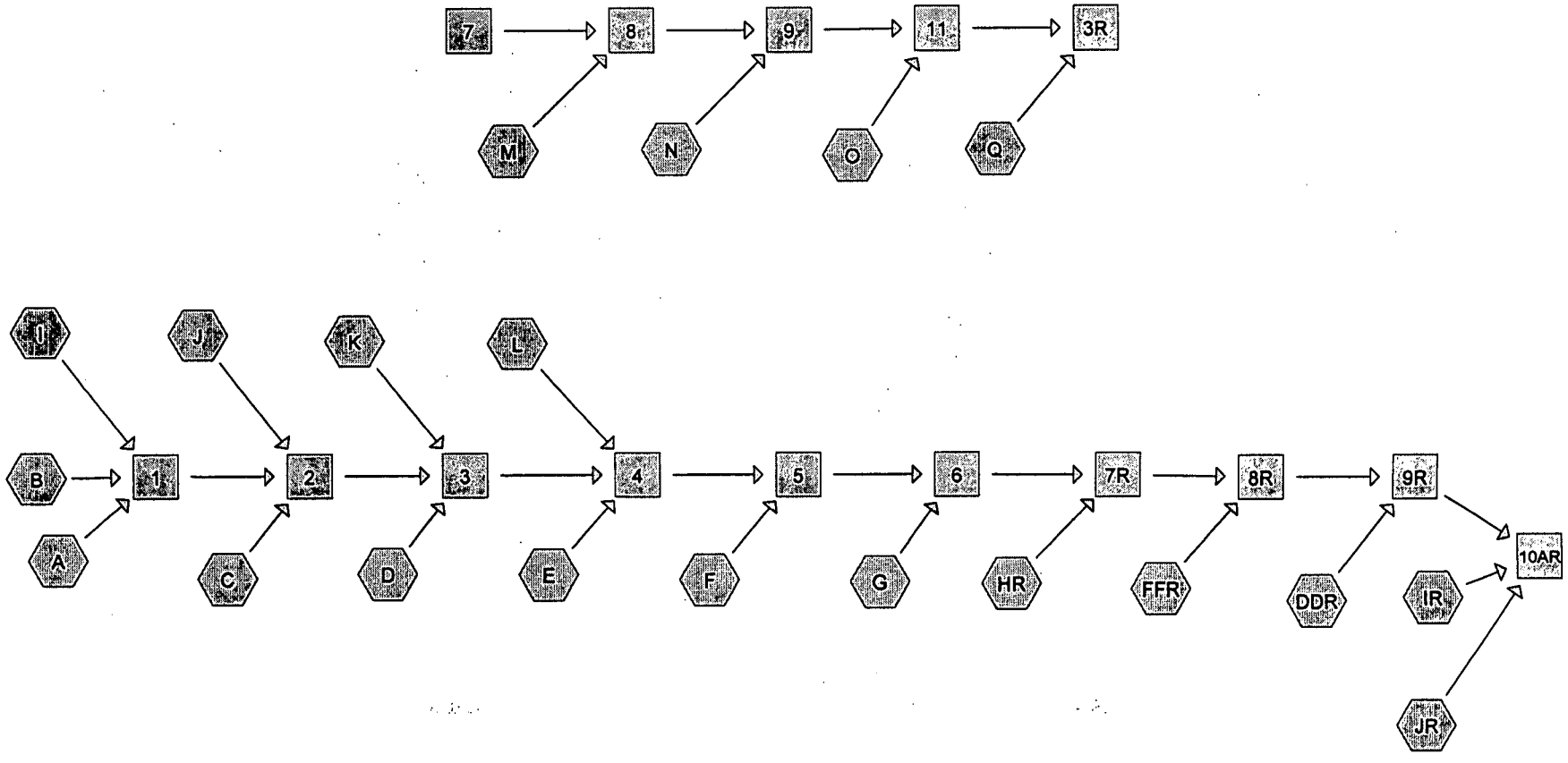
000217

Written by: Victoria Cheplak (VSC) Date: 6/16/2004 Reviewed by: ____ Date: ____

Client: Fluor Fernald, Inc. Project: OSDF Phase V Revision Cell 8 DCN Project No.: GQ3309 Task No.: 2

ATTACHMENT A-2

NODAL NETWORK DIAGRAM



Subcat Reach Pond Link

Drainage Diagram for 2000 year storm-heavy
Prepared by GeoSyntec Consultants 6/15/2004
HydroCAD® 6.00 s/n 000929 © 1986-2001 Applied Microcomputer Systems

000219

5529

GEOSYNTEC CONSULTANTS PAGE _____ OF _____

Written by: Victoria Cheplak (VSC) Date: 6/16/2004 Reviewed by: _____ Date: _____

Client: Fluor Fernald, Inc. Project: OSDF Phase V Revision Cell 8 DCN Project No.: GQ3309 Task No.: 2

ATTACHMENT B-2

DATA FOR CALCULATION OF TIME OF CONCENTRATION

HYDROCAD™ INPUT PARAMETERS FOR THE CALCULATION OF TIME OF CONCENTRATION
2000 YEAR STORM DESIGN SCENARIO - HEAVY VEGETATION

2-year, 24-hr Design Rainfall Depth, $P_{2,24}$ = 2.60 inches

SUBCATCHMENT LABEL AND DESCRIPTION		SHEET FLOW 1				SHEET FLOW 2				SHEET FLOW 3				SHALLOW CONCENTRATED FLOW			SHALLOW CONCENTRATED FLOW			CHANNEL FLOW 1						CHANNEL FLOW 2					
No.	Description	Flow Length (ft)	Surface Description	Manning's n	Land Slope (ft/ft)	Flow Length (ft)	Surface Description	Manning's n	Land Slope (ft/ft)	Flow Length (ft)	Surface Description	Manning's n	Land Slope (ft/ft)	Flow Length (ft)	Surface Description	Land Slope (ft/ft)	Flow Length (ft)	Surface Description	Land Slope (ft/ft)	Flow Length (ft)	Bottom Width (ft)	Flow Depth (ft)	Sideslopes (ft/ft)	Manning's n	Longitudinal Slope (ft/ft)	Flow Length (ft)	Bottom Width (ft)	Flow Depth (ft)	Sideslopes (ft/ft)	Manning's n	Longitudinal Slope (ft/ft)
A	vegetated final cover	90	grass: dense	0.240	0.0500	60	grass: dense	0.240	0.1000	150	grass: dense	0.240	0.1700	190	unpaved	0.1700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B	vegetated final cover	90	grass: dense	0.240	0.0750	-	-	-	-	-	-	-	-	-	-	-	-	-	-	130	0	2.03	6.0, 6.0	0.070	0.0250	320	0	2.03	4.0, 6.0	0.070	0.0075
C	vegetated final cover	90	grass: dense	0.240	0.0500	60	grass: dense	0.240	0.1000	150	grass: dense	0.240	0.1700	190	unpaved	0.1700	-	-	-	370	0	2.33	6.0, 4.0	0.070	0.0035	-	-	-	-	-	-
D	vegetated final cover	90	grass: dense	0.240	0.0500	60	grass: dense	0.240	0.1000	150	grass: dense	0.240	0.1700	180	unpaved	0.1700	-	-	-	200	0	2.86	6.0, 5.0	0.070	0.0083	150	0	2.86	6.0, 4.0	0.070	0.0045
DDR	vegetated final cover	210	grass: dense	0.240	0.1700	12	smooth	0.011	0.0500	-	-	-	-	-	-	-	-	-	-	241	0	5.50	6.0. 2.0	0.070	0.0050	-	-	-	-	-	-
E	vegetated final cover	90	grass: dense	0.240	0.0500	60	grass: dense	0.240	0.1000	150	grass: dense	0.240	0.1700	170	unpaved	0.1700	-	-	-	50	0	3.32	6.0, 4.0	0.070	0.0045	320	0	3.32	6.0, 3.0	0.070	0.0105
F	vegetated final cover	90	grass: dense	0.240	0.0500	60	grass: dense	0.240	0.1000	150	grass: dense	0.240	0.1700	175	unpaved	0.1700	-	-	-	360	0	3.68	4.0, 6.0	0.070	0.0050	-	-	-	-	-	-
FFR	vegetated final cover	90	grass: dense	0.240	0.0500	50	grass: dense	0.240	0.1000	160	grass: dense	0.240	0.1700	120	unpaved	0.1700	12	paved	0.0500	467	0	5.49	6.0, 3.0	0.070	0.0050	-	-	-	-	-	-
G	vegetated final cover	90	grass: dense	0.240	0.0500	60	grass: dense	0.240	0.1000	150	grass: dense	0.240	0.1700	175	unpaved	0.1700	-	-	-	370	0	3.86	3.0, 6.0	0.070	0.0050	-	-	-	-	-	-
HR	vegetated final cover	90	grass: dense	0.240	0.0500	50	grass: dense	0.240	0.1000	150	grass: dense	0.240	0.1700	160	unpaved	0.1700	-	-	-	400	0	5.70	3.0, 6.0	0.070	0.0100	-	-	-	-	-	-
I	runon east of OSDF	210	grass: dense	0.240	0.0050	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55	0	2.03	4.0, 6.0	0.070	0.0075	-	-	-	-	-	-
IR	vegetated final cover	170	grass: dense	0.240	0.1700	12	smooth	0.011	0.0500	-	-	-	-	-	-	-	-	-	-	144	3	3.80	6.0, 3.0	0.070	0.0050	-	-	-	-	-	-
J	runon east of OSDF	300	grass: dense	0.240	0.0158	-	-	-	-	-	-	-	-	100	unpaved	0.0158	-	-	-	150	0	2.33	6.0, 4.0	0.070	0.0035	-	-	-	-	-	-
JR	vegetated final cover	80	grass: dense	0.240	0.0500	22	grass: dense	0.240	0.1000	165	grass: dense	0.240	0.1700	145	unpaved	0.1700	12	paved	0.0500	-	-	-	-	-	-	-	-	-	-	-	-
K	runon east of OSDF	300	grass: dense	0.240	0.0070	-	-	-	-	-	-	-	-	290	unpaved	0.0200	-	-	-	250	0	2.86	6.0, 4.0	0.070	0.0045	-	-	-	-	-	-
L	runon east of OSDF	300	grass: dense	0.240	0.0250	-	-	-	-	-	-	-	-	140	unpaved	0.0250	170	unpaved	0.0375	90	0	3.32	6.0, 3.0	0.070	0.0105	-	-	-	-	-	-
M	runon east of OSDF	300	grass: dense	0.240	0.0100	-	-	-	-	-	-	-	-	350	unpaved	0.0139	180	unpaved	0.0167	360	0	0.82	4.0, 3.0	0.070	0.0125	-	-	-	-	-	-
N	runon east of OSDF	300	grass: dense	0.240	0.0198	-	-	-	-	-	-	-	-	770	unpaved	0.0198	-	-	-	395	0	1.17	58.0, 3.0	0.070	0.0100	-	-	-	-	-	-
O	runon east of OSDF	300	grass: dense	0.240	0.0200	-	-	-	-	-	-	-	-	420	unpaved	0.0200	-	-	-	250	0	1.17	60.0, 3.0	0.070	0.0100	-	-	-	-	-	-
Q	runon east of OSDF	300	grass: dense	0.240	0.0200	-	-	-	-	-	-	-	-	250	unpaved	0.0200	-	-	-	170	0	4.08	5.7, 13.5	0.070	0.0100	-	-	-	-	-	-

ATTACHMENT C-1C

2000-YEAR STORM DESIGN SCENARIO – HEAVY VEGETATION
2000-YEAR, 24-HOUR STORM EVENT

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Type II 24-hr Rainfall=13.00"
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment A: vegetated final cover
Tc=25.4 min CN=99 Area=2.601 ac Runoff= 27.84 cfs 2.780 af

Subcatchment B: vegetated final cover
Tc=12.1 min CN=99 Area=1.637 ac Runoff= 24.87 cfs 1.754 af

Subcatchment C: vegetated final cover
Tc=29.9 min CN=99 Area=4.960 ac Runoff= 48.10 cfs 5.297 af

Subcatchment D: vegetated final cover
Tc=28.2 min CN=99 Area=4.746 ac Runoff= 47.77 cfs 5.070 af

Subcatchment DDR: (new node)
Tc=13.8 min CN=99 Area=0.865 ac Runoff= 12.52 cfs 0.926 af

Subcatchment E: vegetated final cover
Tc=27.5 min CN=99 Area=4.946 ac Runoff= 50.54 cfs 5.285 af

Subcatchment F: vegetated final cover
Tc=28.0 min CN=99 Area=4.814 ac Runoff= 48.59 cfs 5.143 af

Subcatchment FFR: vegetated final cover
Tc=27.7 min CN=99 Area=4.760 ac Runoff= 48.40 cfs 5.086 af

Subcatchment G: vegetated final cover
Tc=28.0 min CN=99 Area=4.946 ac Runoff= 49.93 cfs 5.284 af

Subcatchment HR: vegetated final cover
Tc=26.2 min CN=99 Area=4.590 ac Runoff= 48.22 cfs 4.905 af

Subcatchment I: runon east of OSDF
Tc=20.4 min CN=90 Area=0.530 ac Runoff= 6.24 cfs 0.517 af

Subcatchment IR: (new node)
Tc=11.5 min CN=99 Area=0.520 ac Runoff= 8.01 cfs 0.557 af

Subcatchment J: runon east of OSDF
Tc=44.5 min CN=90 Area=1.242 ac Runoff= 9.07 cfs 1.207 af

Subcatchment JR: (new node)
Tc=22.1 min CN=99 Area=2.590 ac Runoff= 29.95 cfs 2.770 af

Subcatchment K: runon east of OSDF
Tc=62.4 min CN=86 Area=2.623 ac Runoff= 14.65 cfs 2.425 af

Subcatchment L: runon east of OSDF
Tc=37.2 min CN=86 Area=1.779 ac Runoff= 14.28 cfs 1.653 af

Subcatchment M: runon east of OSDF
Tc=59.5 min CN=86 Area=7.234 ac Runoff= 41.83 cfs 6.693 af

Subcatchment N: runon east of OSDF
Tc=48.4 min CN=85 Area=11.664 ac Runoff= 77.52 cfs 10.687 af

Subcatchment O: runon east of OSDF
Tc=44.0 min CN=86 Area=10.935 ac Runoff= 78.19 cfs 10.149 af

Subcatchment Q: runon east of OSDF
Tc=40.7 min CN=87 Area=1.520 ac Runoff= 11.56 cfs 1.428 af

Reach 1: runoff channel
Inflow= 52.44 cfs 5.051 af
Length= 405.0' Max Vel= 1.5 fps Capacity= 1,099.51 cfs Outflow= 49.07 cfs 5.034 af

Reach 2: runoff channel
Inflow= 104.36 cfs 11.538 af
Length= 385.0' Max Vel= 2.2 fps Capacity= 880.57 cfs Outflow= 102.73 cfs 11.513 af

Reach 3: runoff channel
Inflow= 155.41 cfs 19.009 af
Length= 405.0' Max Vel= 2.7 fps Capacity= 681.67 cfs Outflow= 153.39 cfs 18.973 af

Reach 3R: (new node)
Inflow= 180.08 cfs 28.844 af
Outflow= 180.08 cfs 28.844 af

Reach 4: runoff channel
Inflow= 206.22 cfs 25.911 af
Length= 395.0' Max Vel= 2.4 fps Capacity= 590.36 cfs Outflow= 203.76 cfs 25.859 af

Reach 5: runoff channel
Inflow= 236.60 cfs 31.002 af
Length= 405.0' Max Vel= 2.5 fps Capacity= 360.07 cfs Outflow= 234.19 cfs 30.942 af

Reach 6: runoff channel
Inflow= 262.61 cfs 36.226 af
Length= 490.0' Max Vel= 2.6 fps Capacity= 433.33 cfs Outflow= 259.87 cfs 36.144 af

Reach 7: east runon ditch
Length= 395.0' Max Vel= 0.0 fps Capacity= 104.13 cfs Outflow= 0.00 cfs 0.000 af

Reach 7R: (new node)
Inflow= 279.05 cfs 41.049 af
Length= 467.0' Max Vel= 2.6 fps Capacity= 376.60 cfs Outflow= 277.04 cfs 40.962 af

Reach 8: east runon ditch
Inflow= 41.83 cfs 6.693 af
Length= 405.0' Max Vel= 1.3 fps Capacity= 768.96 cfs Outflow= 41.21 cfs 6.667 af

Reach 8R: (new node)
Inflow= 294.51 cfs 46.048 af
Length= 241.0' Max Vel= 2.8 fps Capacity= 433.14 cfs Outflow= 293.29 cfs 46.000 af

Reach 9: east runon ditch
Inflow= 110.42 cfs 17.353 af
Length= 475.0' Max Vel= 1.7 fps Capacity= 5,717.07 cfs Outflow= 108.78 cfs 17.290 af

Reach 9R: (new node)
Inflow= 294.58 cfs 46.927 af
Length= 144.0' Max Vel= 2.7 fps Capacity= 1,284.57 cfs Outflow= 293.80 cfs 46.897 af

Reach 10AR: (new node)
Inflow= 300.41 cfs 50.224 af
Length= 356.0' Max Vel= 2.7 fps Capacity= 424.75 cfs Outflow= 298.95 cfs 50.139 af

Reach 11: (new node)
Inflow= 171.73 cfs 27.440 af
Length= 170.0' Max Vel= 2.5 fps Capacity= 543.34 cfs Outflow= 171.26 cfs 27.416 af

Runoff Area = 79.502 ac Volume = 79.619 af Average Depth = 12.02"

Subcatchment A: vegetated final cover

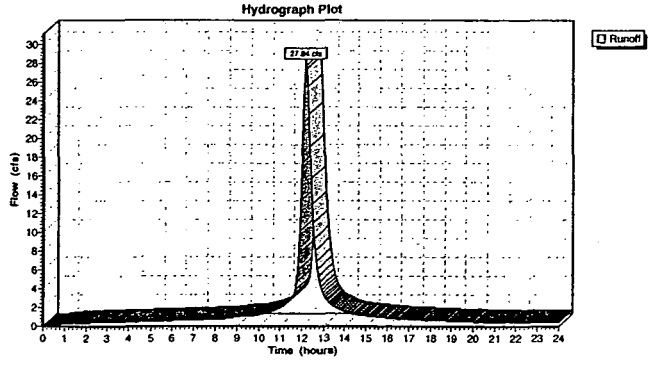
Runoff = 27.84 cfs @ 12.17 hrs, Volume= 2.780 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
2.601	99	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	90	0.0500	0.1		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
5.5	60	0.1000	0.2		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
9.3	150	0.1700	0.3		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
0.5	190	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
25.4	490	Total			

Subcatchment A: vegetated final cover



Subcatchment B: vegetated final cover

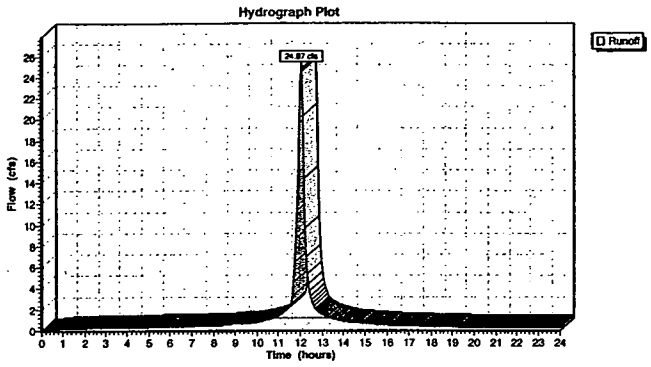
Runoff = 24.87 cfs @ 12.03 hrs, Volume= 1.754 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
1.637	99	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	90	0.0750	0.2		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.60"
0.6	130	0.0250	3.4	83.06	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.03' Z= 6.0 '/' n= 0.070
2.9	320	0.0075	1.8	37.74	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.03' Z= 4.0 & 6.0 '/' n= 0.070
12.1	540	Total			

Subcatchment B: vegetated final cover



Subcatchment C: vegetated final cover

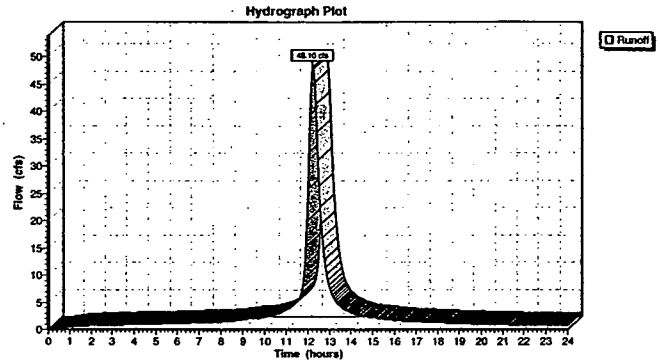
Runoff = 48.10 cfs @ 12.23 hrs, Volume= 5.297 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
4.960	99	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	90	0.0500	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.60"
5.5	60	0.1000	0.2		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.60"
9.3	150	0.1700	0.3		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.60"
0.5	190	0.1700	6.6		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
4.5	370	0.0035	1.4	37.24	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.33' Z= 6.0 & 4.0 '/' n= 0.070
29.9	860	Total			

Subcatchment C: vegetated final cover



Subcatchment D: vegetated final cover

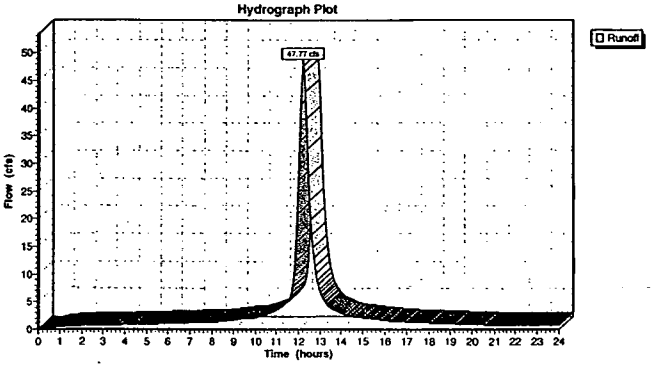
Runoff = 47.77 cfs @ 12.21 hrs, Volume= 5.070 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
4.746	99	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	90	0.0500	0.1		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.60"
5.5	60	0.1000	0.2		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.60"
9.3	150	0.1700	0.3		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.60"
0.5	180	0.1700	6.6		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.4	200	0.0083	2.4	109.24	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.86' Z= 6.0 & 5.0 '/' n= 0.070
1.4	150	0.0045	1.8	72.93	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=2.86' Z= 6.0 & 4.0 '/' n= 0.070
28.2	830	Total			

Subcatchment D: vegetated final cover



Subcatchment DDR: (new node)

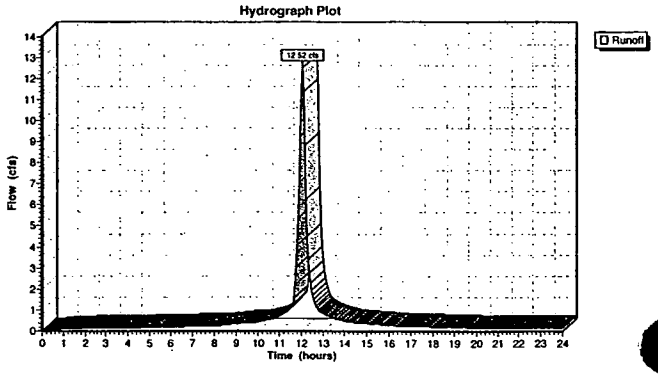
Runoff = 12.52 cfs @ 12.05 hrs, Volume= 0.926 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
0.865	99	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	210	0.1700	0.3		**Sheet Flow,** Grass: Dense n= 0.240 P2= 2.60"
0.2	12	0.0500	1.2		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.60"
1.4	241	0.0050	2.9	347.35	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=5.50' Z= 6.0 & 2.0 '/' n= 0.070
13.8	463	Total			

Subcatchment DDR: (new node)



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Subcatchment E: vegetated final cover

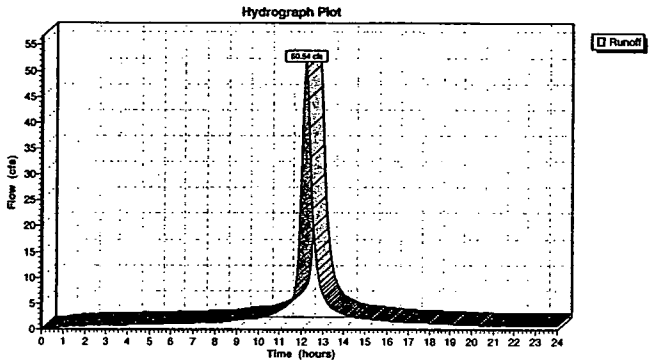
Runoff = 50.54 cfs @ 12.20 hrs, Volume= 5.285 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
4.946	99	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	90	0.0500	0.1		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
5.5	60	0.1000	0.2		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
9.3	150	0.1700	0.3		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
0.4	170	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.4	50	0.0045	2.0	108.55	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=3.32' Z= 6.0 & 4.0 '/' n= 0.070
1.8	320	0.0105	3.0	148.58	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=3.32' Z= 6.0 & 3.0 '/' n= 0.070
27.5	840	Total			

Subcatchment E: vegetated final cover



Subcatchment F: vegetated final cover

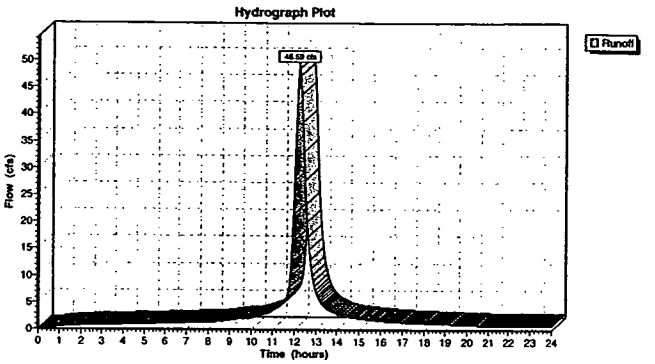
Runoff = 48.59 cfs @ 12.20 hrs, Volume= 5.143 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
4.814	99	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	90	0.0500	0.1		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
5.5	60	0.1000	0.2		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
9.3	150	0.1700	0.3		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
0.4	175	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
2.7	360	0.0050	2.2	150.56	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=3.68' Z= 4.0 & 6.0 '/' n= 0.070
28.0	835	Total			

Subcatchment F: vegetated final cover



Subcatchment FFR: vegetated final cover

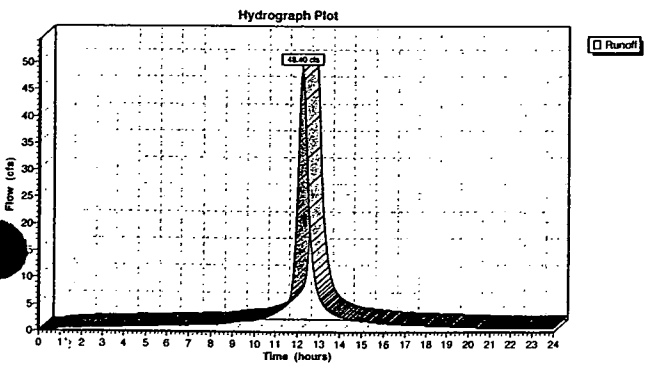
Runoff = 48.40 cfs @ 12.20 hrs, Volume= 5.086 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
4.760	99	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	90	0.0500	0.1		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
4.8	50	0.1000	0.2		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
9.8	160	0.1700	0.3		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
0.3	120	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.0	12	0.0500	4.5		Shallow Concentrated Flow, Paved Kv= 20.3 fps
2.7	467	0.0050	2.9	392.06	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=5.49' Z= 6.0 & 3.0 '/' n= 0.070
27.7	899	Total			

Subcatchment FFR: vegetated final cover



Subcatchment G: vegetated final cover

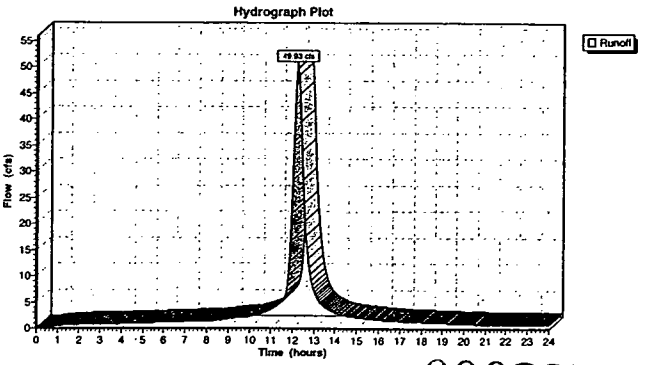
Runoff = 49.93 cfs @ 12.20 hrs, Volume= 5.284 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
4.946	99	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	90	0.0500	0.1		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
5.5	60	0.1000	0.2		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
9.3	150	0.1700	0.3		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
0.4	175	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
2.7	370	0.0050	2.3	153.25	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=3.86' Z= 3.0 & 6.0 '/' n= 0.070
28.0	845	Total			

Subcatchment G: vegetated final cover



Subcatchment HR: vegetated final cover

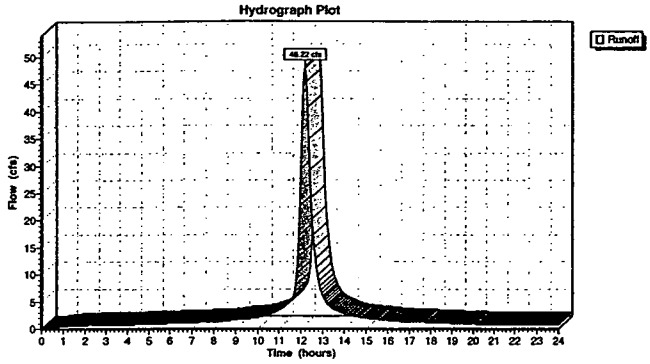
Runoff = 48.22 cfs @ 12.18 hrs, Volume= 4.905 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
4.590	99	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	90	0.0500	0.1		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
4.8	50	0.1000	0.2		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
9.3	150	0.1700	0.3		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
0.4	160	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
1.6	400	0.0100	4.2	612.82	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=5.70' Z= 3.0 & 6.0 '/' n= 0.070
26.2	850	Total			

Subcatchment HR: vegetated final cover



Subcatchment I: runon east of OSDF

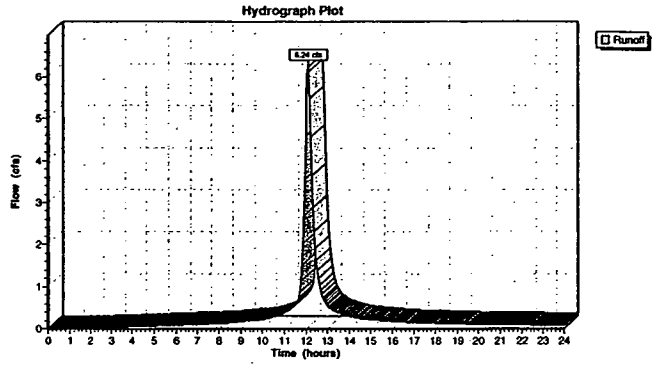
Runoff = 6.24 cfs @ 12.12 hrs, Volume= 0.517 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
0.530	90	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.9	210	0.0500	0.2		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
0.5	55	0.0075	1.8	37.74	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=2.03' Z= 4.0 & 6.0 '/' n= 0.070
20.4	265	Total			

Subcatchment I: runon east of OSDF



Subcatchment IR: (new node)

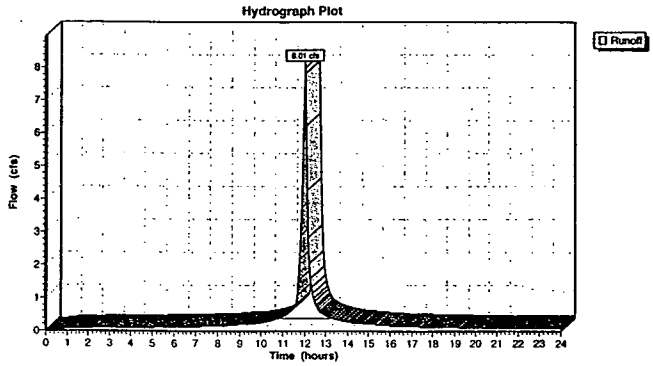
Runoff = 8.01 cfs @ 12.02 hrs, Volume= 0.557 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
0.520	99	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.3	170	0.1700	0.3		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
0.2	12	0.0500	1.2		Sheet Flow, Smooth surfaces n= 0.011 P2= 2.60"
1.0	144	0.0050	2.4	182.19	Trap/Vee/Rect Channel Flow, Bot.W=3.00' D=3.80' Z= 6.0 & 3.0 '/' n= 0.070
11.5	326	Total			

Subcatchment IR: (new node)



Subcatchment J: runon east of OSDF

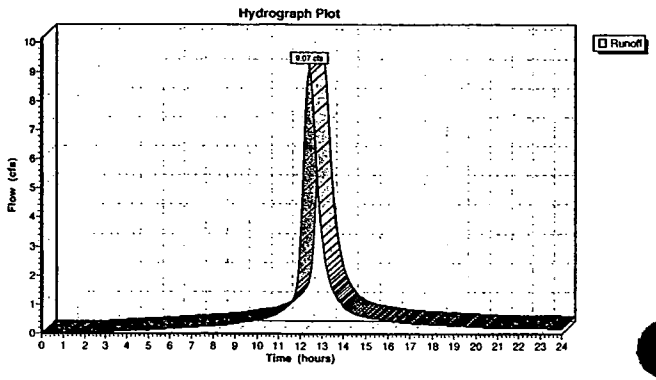
Runoff = 9.07 cfs @ 12.40 hrs, Volume= 1.207 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
1.242	90	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
41.9	300	0.0158	0.1		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
0.8	100	0.0158	2.0		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
1.8	150	0.0035	1.4	37.24	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=2.33' Z= 6.0 & 4.0 '/' n= 0.070
44.5	550	Total			

Subcatchment J: runon east of OSDF



Subcatchment JR: (new node)

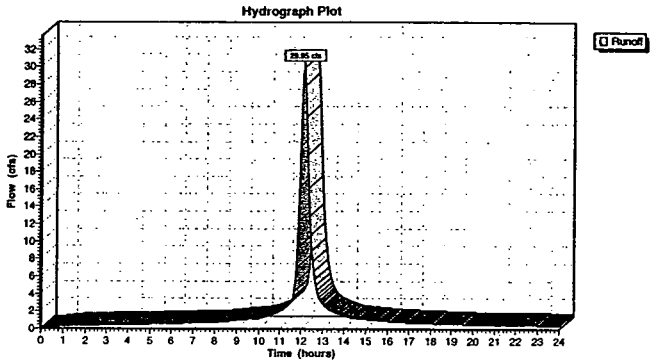
Runoff = 29.95 cfs @ 12.14 hrs, Volume= 2.770 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

rea (ac)	CN	Description
2.590	99	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	80	0.0500	0.1		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
2.5	22	0.1000	0.1		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
10.0	165	0.1700	0.3		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
0.4	145	0.1700	6.6		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.0	12	0.0500	4.5		Shallow Concentrated Flow, Paved Kv= 20.3 fps
22.1	424	Total			

Subcatchment JR: (new node)



Subcatchment K: runon east of OSDF

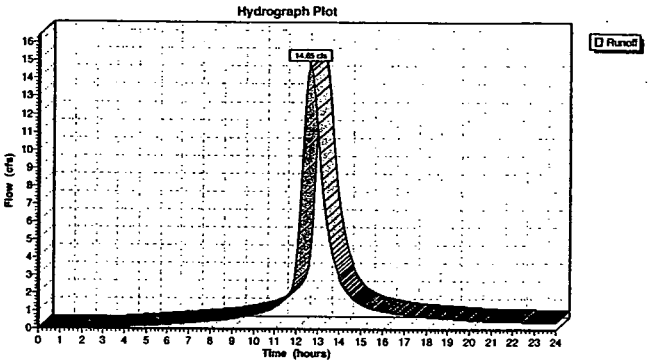
Runoff = 14.65 cfs @ 12.63 hrs, Volume= 2.425 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
2.623	86	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
58.0	300	0.0070	0.1		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
2.1	290	0.0200	2.3		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
2.3	250	0.0045	1.8	72.93	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=2.86' Z= 6.0 & 4.0 '/' n= 0.070
62.4	840	Total			

Subcatchment K: runon east of OSDF



Subcatchment L: runon east of OSDF

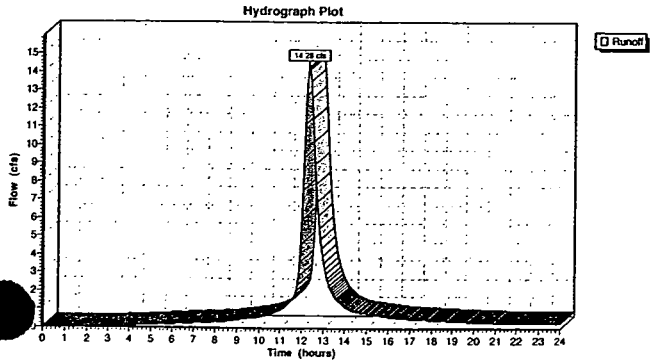
Runoff = 14.28 cfs @ 12.31 hrs, Volume= 1.653 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
1.779	86	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.9	300	0.0250	0.1		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
0.9	140	0.0250	2.5		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.9	170	0.0375	3.1		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.5	90	0.0105	3.0	148.58	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=3.32' Z= 6.0 & 3.0 '/' n= 0.070
37.2	700	Total			

Subcatchment L: runon east of OSDF



Subcatchment M: runon east of OSDF

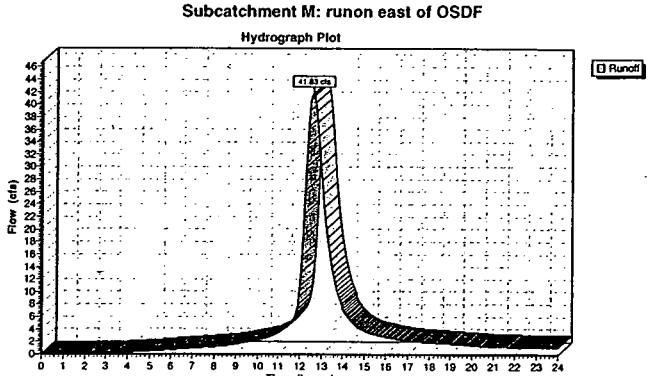
Runoff = 41.83 cfs @ 12.59 hrs, Volume= 6.693 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
7.234	86	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
50.3	300	0.0100	0.1		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
3.1	350	0.0139	1.9		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
1.4	180	0.0167	2.1		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
4.7	360	0.0125	1.3	3.00	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=0.82' Z= 4.0 & 3.0 '/' n= 0.070
59.5	1,190	Total			

Subcatchment M: runon east of OSDF



Subcatchment N: runon east of OSDF

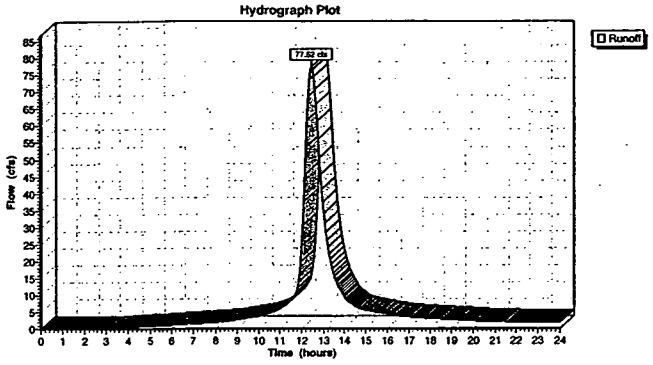
Runoff = 77.52 cfs @ 12.45 hrs, Volume= 10.687 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
11.664	85	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
38.3	300	0.0198	0.1		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
5.7	770	0.0198	2.3		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
4.4	395	0.0100	1.5	61.88	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=1.17' Z= 58.0 & 3.0 '/' n= 0.070
48.4	1,465	Total			

Subcatchment N: runon east of OSDF



Subcatchment O: runon east of OSDF

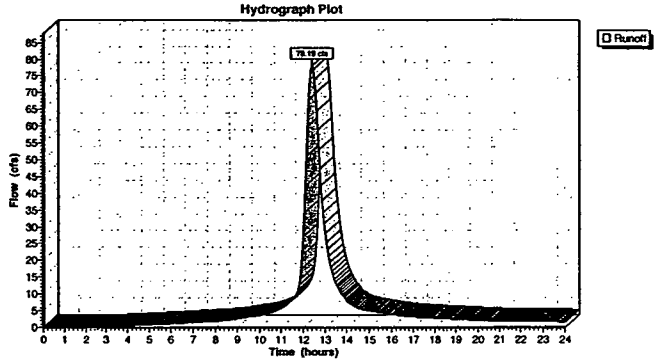
Runoff = 78.19 cfs @ 12.40 hrs, Volume= 10.149 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
10.935	86	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
38.1	300	0.0200	0.1		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
3.1	420	0.0200	2.3		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
2.8	250	0.0100	1.5	63.91	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=1.17' Z= 60.0 & 3.0 '/' n= 0.070
44.0	970	Total			

Subcatchment O: runon east of OSDF



Subcatchment Q: runon east of OSDF

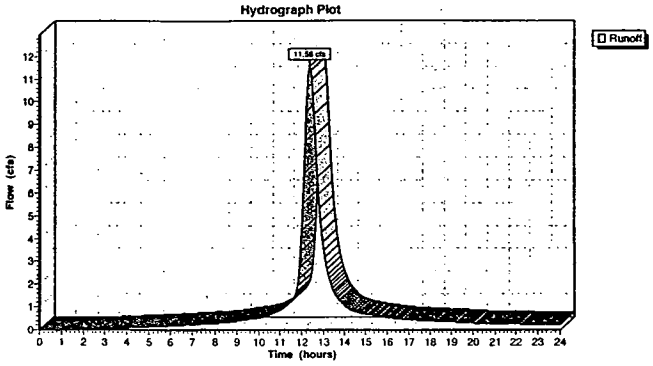
Runoff = 11.56 cfs @ 12.36 hrs, Volume= 1.428 af

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=13.00"

Area (ac)	CN	Description
1.520	87	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
38.1	300	0.0200	0.1		Sheet Flow, Grass: Dense n= 0.240 P2= 2.60"
1.8	250	0.0200	2.3		Shallow Concentrated Flow, Unpaved Kv= 16.1 fps
0.8	170	0.0100	3.4	543.34	Trap/Vee/Rect Channel Flow, Bot.W=0.00' D=4.08' Z= 5.7 & 13.5 '/' n= 0.070
40.7	720	Total			

Subcatchment Q: runon east of OSDF



Reach 1: runoff channel

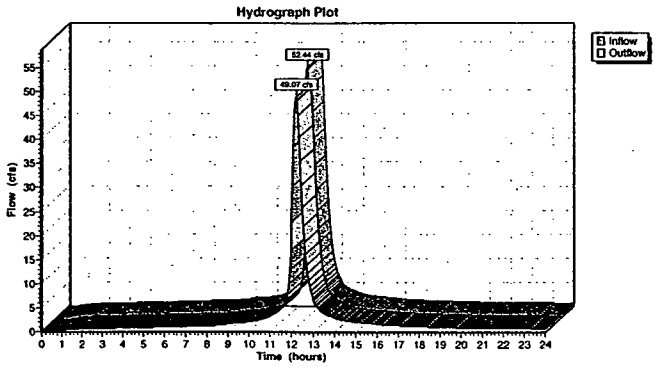
[65] Warning: Inlet elevation not specified

Inflow = 52.44 cfs @ 12.08 hrs, Volume= 5.051 af
Outflow = 49.07 cfs @ 12.22 hrs, Volume= 5.034 af, Atten= 6%, Lag= 8.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.5 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 0.6 fps, Avg. Travel Time= 11.1 min

Peak Depth= 2.59'
Capacity at bank full= 1,099.51 cfs
0.00' x 8.29' deep channel, n= 0.070 Length= 405.0' Slope= 0.0035 '/'
Side Slope Z-value= 6.0 4.0 '/'

Reach 1: runoff channel



Reach 2: runoff channel

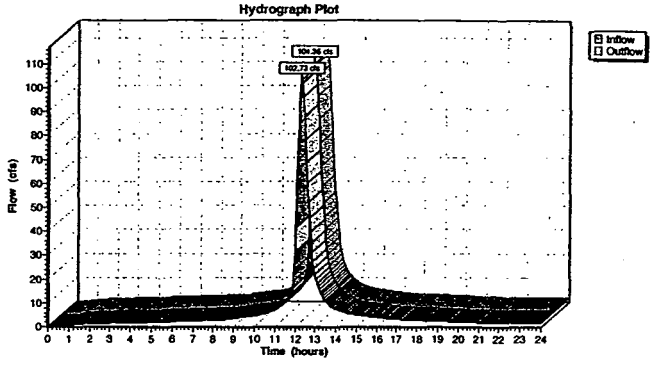
[65] Warning: Inlet elevation not specified

Inflow = 104.36 cfs @ 12.23 hrs, Volume= 11.538 af
Outflow = 102.73 cfs @ 12.32 hrs, Volume= 11.513 af, Atten= 2%, Lag= 5.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.2 fps, Min. Travel Time= 3.0 min
Avg. Velocity = 0.9 fps, Avg. Travel Time= 7.0 min

Peak Depth= 2.94'
Capacity at bank full= 880.57 cfs
0.00' x 6.57' deep channel, n= 0.070 Length= 385.0' Slope= 0.0064 '/'
Side Slope Z-value= 6.0 5.0 '/'

Reach 2: runoff channel



Reach 3: runoff channel

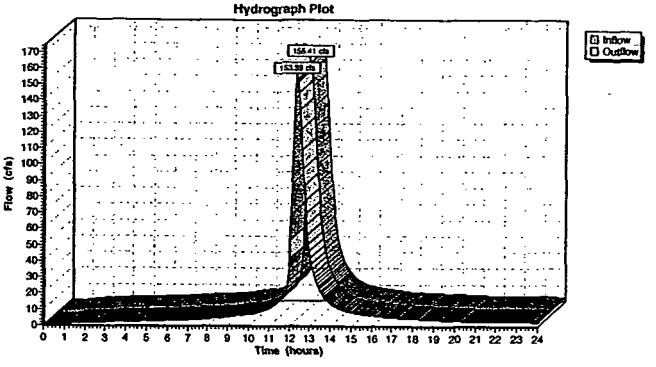
[65] Warning: Inlet elevation not specified

Inflow = 155.41 cfs @ 12.30 hrs, Volume= 19.009 af
Outflow = 153.39 cfs @ 12.37 hrs, Volume= 18.973 af, Atten= 1%, Lag= 4.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.7 fps, Min. Travel Time= 2.5 min
Avg. Velocity = 1.1 fps, Avg. Travel Time= 5.9 min

Peak Depth= 3.58'
Capacity at bank full= 681.67 cfs
0.00' x 6.26' deep channel, n= 0.070 Length= 405.0' Slope= 0.0075 '/'
Side Slope Z-value= 3.0 6.0 '/'

Reach 3: runoff channel



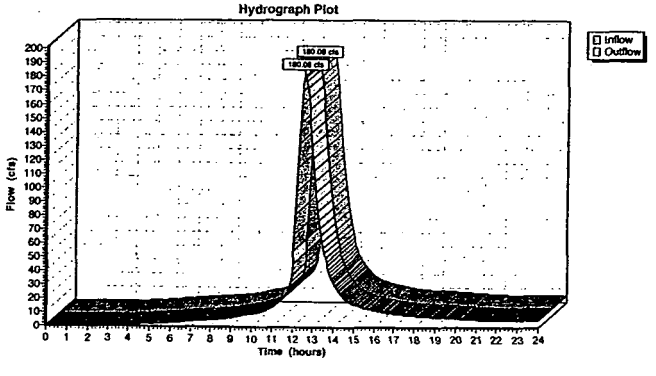
Reach 3R: (new node)

[40] Hint: Not Described (Outflow=Inflow)

Inflow = 180.08 cfs @ 12.58 hrs, Volume= 28.844 af
Outflow = 180.08 cfs @ 12.58 hrs, Volume= 28.844 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 3R: (new node)



Reach 4: runoff channel

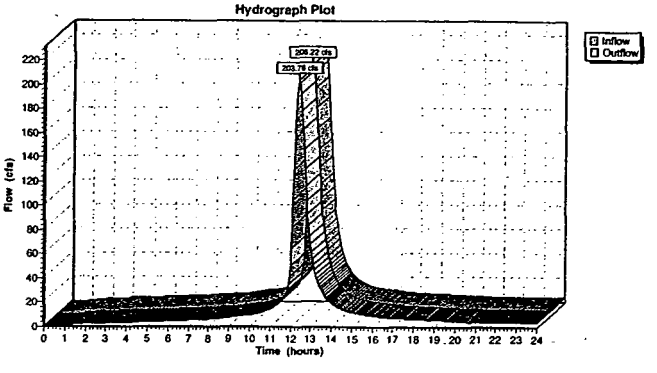
[65] Warning: Inlet elevation not specified

Inflow = 206.22 cfs @ 12.34 hrs, Volume= 25.911 af
Outflow = 203.76 cfs @ 12.42 hrs, Volume= 25.859 af, Atten= 1%, Lag= 4.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.4 fps, Min. Travel Time= 2.7 min
Avg. Velocity = 1.0 fps, Avg. Travel Time= 6.3 min

Peak Depth= 4.12'
Capacity at bank full= 590.36 cfs
0.00' x 6.14' deep channel, n= 0.070 Length= 395.0' Slope= 0.0050 '/'
Side Slope Z-value= 4.0 6.0 '/'

Reach 4: runoff channel



Reach 5: runoff channel

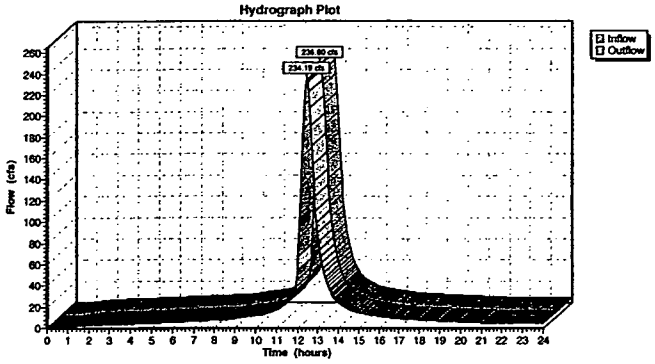
[65] Warning: Inlet elevation not specified

Inflow = 236.60 cfs @ 12.39 hrs, Volume= 31.002 af
Outflow = 234.19 cfs @ 12.47 hrs, Volume= 30.942 af, Atten= 1%, Lag= 4.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.5 fps, Min. Travel Time= 2.7 min
Avg. Velocity = 1.1 fps, Avg. Travel Time= 6.1 min

Peak Depth= 4.53'
Capacity at bank full= 360.07 cfs
0.00' x 5.32' deep channel, n= 0.070 Length= 405.0' Slope= 0.0050 '/'
Side Slope Z-value= 6.0 3.0 '/'

Reach 5: runoff channel



Reach 6: runoff channel

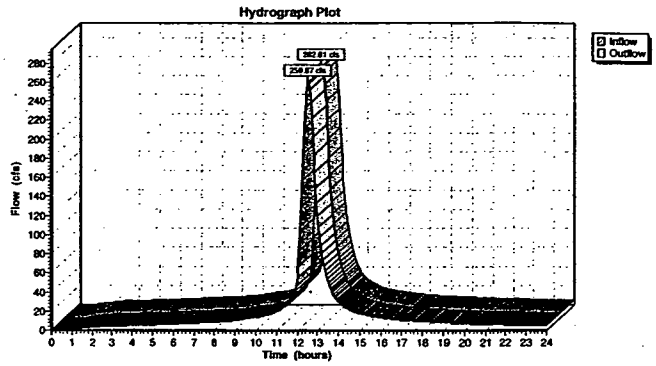
[65] Warning: Inlet elevation not specified

Inflow = 262.61 cfs @ 12.44 hrs, Volume= 36.226 af
Outflow = 259.87 cfs @ 12.53 hrs, Volume= 36.144 af, Atten= 1%, Lag= 5.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.6 fps, Min. Travel Time= 3.1 min
Avg. Velocity = 1.2 fps, Avg. Travel Time= 7.1 min

Peak Depth= 4.71'
Capacity at bank full= 433.33 cfs
0.00' x 5.70' deep channel, n= 0.070 Length= 490.0' Slope= 0.0050 '/'
Side Slope Z-value= 6.0 3.0 '/'

Reach 6: runoff channel



Reach 7: east runon ditch

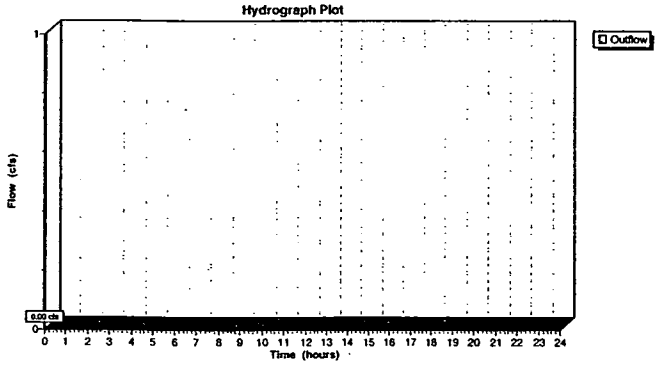
[43] Hint: Has no Inflow (Outflow=Zero)

Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.0 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.0 fps, Avg. Travel Time= 0.0 min

Peak Depth= 0.00'
Capacity at bank full= 104.13 cfs
0.00' x 3.10' deep channel, n= 0.070 Length= 395.0' Slope= 0.0125 '/'
Side Slope Z-value= 4.0 3.0 '/'

Reach 7: east runon ditch



Reach 7R: (new node)

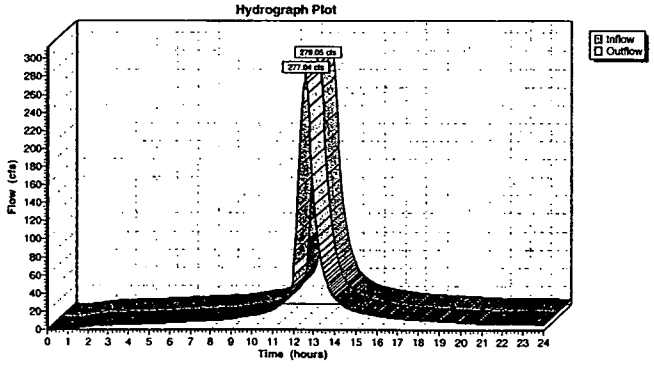
[65] Warning: Inlet elevation not specified

Inflow = 279.05 cfs @ 12.51 hrs, Volume= 41.049 af
Outflow = 277.04 cfs @ 12.59 hrs, Volume= 40.962 af, Atten= 1%, Lag= 5.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.6 fps, Min. Travel Time= 2.9 min
Avg. Velocity = 1.2 fps, Avg. Travel Time= 6.5 min

Peak Depth= 4.82'
Capacity at bank full= 376.60 cfs
0.00' x 5.41' deep channel, n= 0.070 Length= 467.0' Slope= 0.0050 '/'
Side Slope Z-value= 6.0 3.0 '/'

Reach 7R: (new node)



Reach 8: east runon ditch

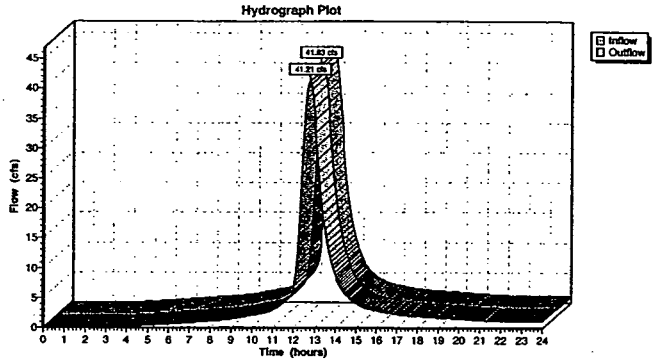
[65] Warning: Inlet elevation not specified

Inflow = 41.83 cfs @ 12.59 hrs, Volume= 6.693 af
Outflow = 41.21 cfs @ 12.74 hrs, Volume= 6.667 af, Atten= 1%, Lag= 8.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.3 fps, Min. Travel Time= 5.0 min
Avg. Velocity = 0.6 fps, Avg. Travel Time= 10.9 min

Peak Depth= 1.01'
Capacity at bank full= 768.96 cfs
0.00' x 3.01' deep channel, n= 0.070 Length= 405.0' Slope= 0.0100 '/'
Side Slope Z-value= 58.0 3.0 '/'

Reach 8: east runon ditch



Reach 8R: (new node)

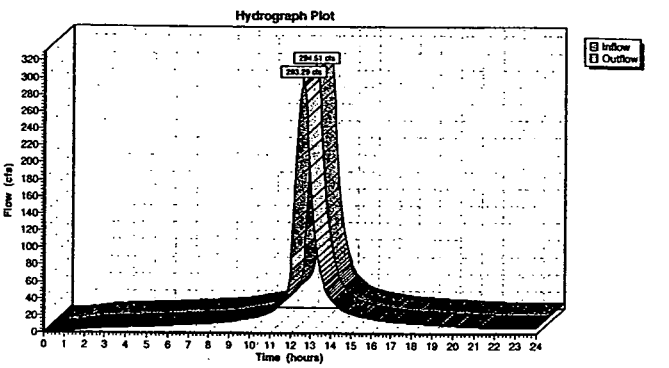
[65] Warning: Inlet elevation not specified

Inflow = 294.51 cfs @ 12.57 hrs, Volume= 46.048 af
Outflow = 293.29 cfs @ 12.62 hrs, Volume= 46.000 af, Atten= 0%, Lag= 2.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.8 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 3.2 min

Peak Depth= 5.16'
Capacity at bank full= 433.14 cfs
0.00' x 5.97' deep channel, n= 0.070 Length= 241.0' Slope= 0.0050 '/'
Side Slope Z-value= 6.0 2.0 '/'

Reach 8R: (new node)



Reach 9: east runon ditch

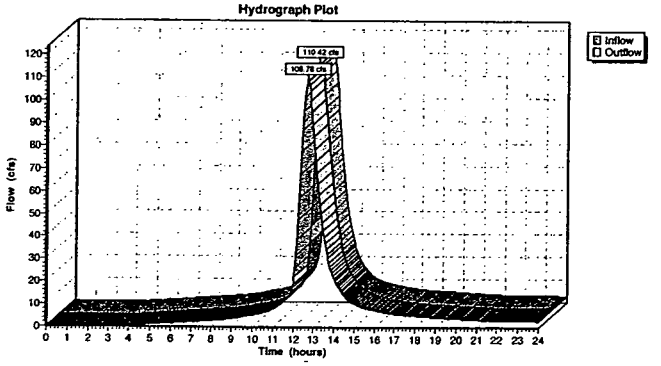
[65] Warning: Inlet elevation not specified

Inflow = 110.42 cfs @ 12.54 hrs, Volume= 17.353 af
Outflow = 108.78 cfs @ 12.68 hrs, Volume= 17.290 af, Atten= 1%, Lag= 8.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.7 fps, Min. Travel Time= 4.7 min
Avg. Velocity = 0.8 fps, Avg. Travel Time= 10.2 min

Peak Depth= 1.43'
Capacity at bank full= 5,717.07 cfs
0.00' x 6.31' deep channel, n= 0.070 Length= 475.0' Slope= 0.0100 '/'
Side Slope Z-value= 60.0 3.0 '/'

Reach 9: east runon ditch



Reach 9R: (new node)

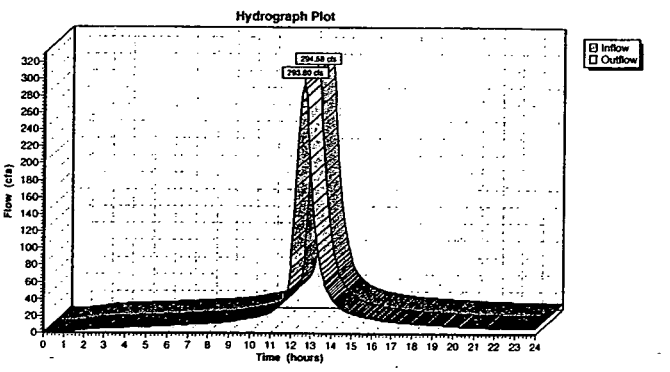
[65] Warning: Inlet elevation not specified

Inflow = 294.58 cfs @ 12.61 hrs, Volume= 46.927 af
Outflow = 293.80 cfs @ 12.64 hrs, Volume= 46.897 af, Atten= 0%, Lag= 1.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.7 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 1.2 fps, Avg. Travel Time= 2.0 min

Peak Depth= 4.61'
Capacity at bank full= 1,284.57 cfs
3.00' x 8.24' deep channel, n= 0.070 Length= 144.0' Slope= 0.0050 '/'
Side Slope Z-value= 6.0 3.0 '/'

Reach 9R: (new node)



ATTACHMENT C-2

WEIGHTED CURVE NUMBER CALCULATIONS

SUBCATCHMENT AREA AND HYDROCAD™ INPUT PARAMETERS FOR THE CALCULATION OF WEIGHTED CN
2000 YEAR STORM DESIGN SCENARIOS

Subcatchment Label	Area (acres)	Percent of Total Area %	HSG	Land Use Description	CN AMC = 2	Weighted CN AMC = 2	Weighted CN (2) AMC = 3
A	2.60	100%	B/C	vegetated final cover	74	(1) 98	99
B	1.64	100%	B/C	vegetated final cover	74	(1) 98	99
C	4.96	100%	B/C	vegetated final cover	74	(1) 98	99
D	4.75	100%	B/C	vegetated final cover	74	(1) 98	99
DDR	0.87	100%	B/C	vegetated final cover	74	(1) 98	99
E	4.95	100%	B/C	vegetated final cover	74	(1) 98	99
F	4.81	100%	B/C	vegetated final cover	74	(1) 98	99
FFR	4.76	100%	B/C	vegetated final cover	74	(1) 98	99
G	4.95	100%	B/C	vegetated final cover	74	(1) 98	99
HR	4.59	100%	B/C	vegetated final cover	74	(1) 98	99
I	0.53	100%	C	runon east of OSDF	79	79	90
IR	0.52	100%	B/C	vegetated final cover	74	(1) 98	99
J	1.24	100%	C	runon east of OSDF	79	79	90
JR	2.59	100%	B/C	vegetated final cover	74	(1) 98	99
K	2.62	65% 35%	B C	runon east of OSDF runon east of OSDF	69 79	73	86
L	1.78	70% 30%	B C	runon east of OSDF runon east of OSDF	69 79	72	86
M	7.23	60% 40%	B C	runon east of OSDF runon east of OSDF	69 79	73	86
N	11.66	75% 25%	B C	runon east of OSDF runon east of OSDF	69 79	72	85
O	10.94	65% 35%	B C	runon east of OSDF runon east of OSDF	69 79	73	86
Q	1.52	50% 50%	B C	runon east of OSDF runon east of OSDF	69 79	74	87

Note (1): The weighted curve number of the final cover system is assumed to be 98, as consistent with the *OSDF Final Design Package*, prepared by GeoSyntec Consultants for the United States Department of Engergy, Fernald Environmental Management Project, in May 1997.
Note (2): The Antecedent Moisture Condition (III) was calculated using the equation CN(III) = 23CN(II) / 10 + 0.13CN(II).

N/A - Not Applicable

Written by: Victoria Cheplak (VSC) Date: 6/16/2004 Reviewed by: _____ Date: _____

Client: Fluor Fernald, Inc. Project: OSDF Phase V Revision Cell 8 DCN Project No.: GO3309 Task No.: 2

ATTACHMENT C-3

TABULATED CHANNEL ANALYSIS RESULTS

2000 YEAR STORM DESIGN SCENARIO - HEAVY VEGETATION
SUMMARY OF CHANNEL ANALYSIS RESULTS

Channel Identification			Channel Characteristics							Hydrologic Calculations		Hydraulic Calculations							
Channel Name[1]	Status	Design Scenario	Section Shape	Minimum Channel Depth (ft)	Longitudinal Slope[2] (%)	Manning n	Bottom Width B (ft)	Side Slope M_1:1	Side Slope M_2:1	HydroCAD Node	HydroCAD Q[3] (cfs)	Area of Flow A (sq ft)	Perimeter P (ft)	Hydraulic Radius, R (ft)	Peak Flow Depth[5] Y (ft)	Estimated Q[5] (cfs)	Channel Freeboard[4] (ft)	Peak Flow Velocity (fps)	Lining Type[6]
subcatchment B	existing	2000 DS	vee	11.90	0.35%	0.070	0	6	4	1	52.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
reach 1	existing	2000 DS	vee	8.29	0.35%	0.070	0	6	4	2	104.4	58.8	35.01	1.68	3.43	104.72	4.86	1.78	riprap
reach 2	existing	2000 DS	vee	6.57	0.64%	0.070	0	6	5	3	155.4	64.71	38.35	1.69	3.43	156.18	3.14	2.41	riprap
reach 3	new[4]	2000 DS	vee	6.26	0.75%	0.070	0	6	3	4	206.2	71.64	36.89	1.94	3.99	205.62	2.27	2.87	riprap
reach 4	new	2000 DS	vee	6.14	0.50%	0.070	0	6	4	5	236.6	94.61	44.40	2.13	4.35	235.89	1.79	2.49	riprap
reach 5	new	2000 DS	vee	5.32	0.50%	0.070	0	6	3	6	262.6	99.83	43.54	2.29	4.71	261.31	0.61	2.62	riprap
reach 6	new	2000 DS	vee	5.70	0.50%	0.070	0	6	3	7R	279.1	104.98	44.65	2.35	4.83	279.45	0.87	2.66	riprap
reach 7	new	2000 DS	vee	3.10	1.25%	0.070	0	4	3	8	41.8	16.94	16.03	1.06	2.20	41.83	0.90	2.47	grass
reach 7R	new	2000 DS	vee	5.98	0.50%	0.070	0	6	3	8R	294.5	109.31	45.58	2.40	4.93	295.15	1.05	2.70	riprap
reach 8	new	2000 DS	vee	3.01	1.00%	0.070	0	58	3	9	110.4	64.13	88.70	0.72	1.45	109.94	1.56	1.71	grass
reach 8R	new	2000 DS	vee	5.97	0.50%	0.070	0	6	2	9R	294.6	106.92	43.01	2.49	5.17	295.40	0.80	5.17	riprap
reach 9	new	2000 DS	vee	6.31	1.00%	0.070	0	60	3	11	171.7	89.97	106.76	0.84	1.69	170.84	4.62	1.90	grass
reach 9R	new	2000 DS	trapezoidal	8.24	0.50%	0.070	3	6	3	9R+IR	302.6	111.70	46.08	2.42	4.66	303.46	3.58	2.72	riprap
reach 10AR	new	2000 DS	trapezoidal	4.76	0.50%	0.070	9	6	3	10AR	300.4	111.63	46.72	2.39	4.08	300.37	0.68	2.69	riprap
reach 11	new	2000 DS	vee	4.08	1.00%	0.070	0	5.7	13.5	3R	180.1	70.31	53.21	1.32	2.23	180.21	1.85	2.56	grass

2000 DS = 2000 Year Storm Design Scenario

Notes:
1. Channels are named after the corresponding subcatchment or reach.
2. Longitudinal slopes taken from existing topographic information and Construction Drawings.
3. Peak flow rates calculated by HydroCAD for each reach. See attachment C-1.
4. Calculated as the difference between minimum channel depth and peak flow depth.
5. Calculated flow rates using Manning's equation.
6. Maximum permissible velocity for grass lined channels is 5 fps.
   Maximum permissible velocity for riprap lined channels is 12 fps.

9:20 02.16

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REQUEST FOR CLARIFICATION/DESIGN CHANGE NOTICE

CHANGE OR CLARIFICATION REQUEST SECTION

PROJECT NUMBER:	SUBCONTRACT NO:	DATE:	PAGE 1 OF 1
20105	FSC-653	6/24/04	

SUBCONTRACT OR PROJECT TITLE:
On-Site Disposal Facility (OSDF) Phase V Construction

RCI NO:

RCI/DCN TITLE:
Cell 8 expansion construction drawings and calculations

DCN No:
20105-005

DESCRIPTION OF REQUESTED CLARIFICATION or PROPOSED CHANGE or CHANGE TO BE ADDRESSED:
With the need of additional airspace to accommodate projected impacted material quantities, Cell 8 is proposed to be expanded by 100 feet to the south . This expansion will increase airspace capacity by approximately 50,000 to 60,000 cubic yards. The following Construction Drawings and calculations have been revised to incorporate this expansion.

DOCUMENTS AFFECTED	DOCUMENT NUMBER	REVISION
Phase V Construction Drawings		
Sheet G-2A Site Development Plan III – Cell 8	90X-6000-G-00413	1A
Sheet G-6A Subgrade Grading Plan V – Cell 8 Liner System	90X-6000-G-00414	1A
Sheet G-7A Compacted Clay Liner Grading Plan II – Cell 8 Liner System	90X-6000-G-00415	1A
Sheet G-15A Final Cover System Grading Plan III – Cell 8	90X-6000-G-00417	1A
Sheet G-20A OSDF North- South Sections III	90X-6000-G-00419	1A
Final Design Calculation Package OSDF Revision of OSDF PhaseV, Volume VII		1A

FLUOR FERNALD REQUESTOR: (PRINT/SIGN)
Charles C. Van Arsdale Charles C. Van Arsdale

DATE: 6/24/04

DESIGN REVIEW SECTION

_ RCI _x_ DCN	REQUESTOR PROPOSED CHANGE? _x_YES _ _NO	SBDR NO: USQD NO:	PERFORMANCE GRADE: 4 QUALITY LEVEL: 4	SRC/ENGINEERING REVIEW REVIEW MADE FOR PG 1, 2 or 3: _Y _XN/A

DESIGN ORGANIZATION EVALUATION, SOLUTION OR COMMENTS; _X_REQUESTOR PROPOSED CHANGE ACCEPTED; ___ REQUESTOR PROPOSED CHANGE ACCEPTED WITH MODIFICATIONS BELOW; ___ DESIGN ORGANIZATION CHANGE PROVIDED BELOW, ___ CHANGE REJECTED WITH JUSTIFICATION BELOW; _ _ RCI CLARIFICATION ADDRESSED BELOW

See attached drawings and calculations. Drawings wil be issued and incorporated into the existing Phase V Construction Drawing set upon concurrence.

ADDITIONAL DOCUMENTS AFFECTED OR ADDED

DOCUMENT TITLE	DOCUMENT NUMBER	REVISION

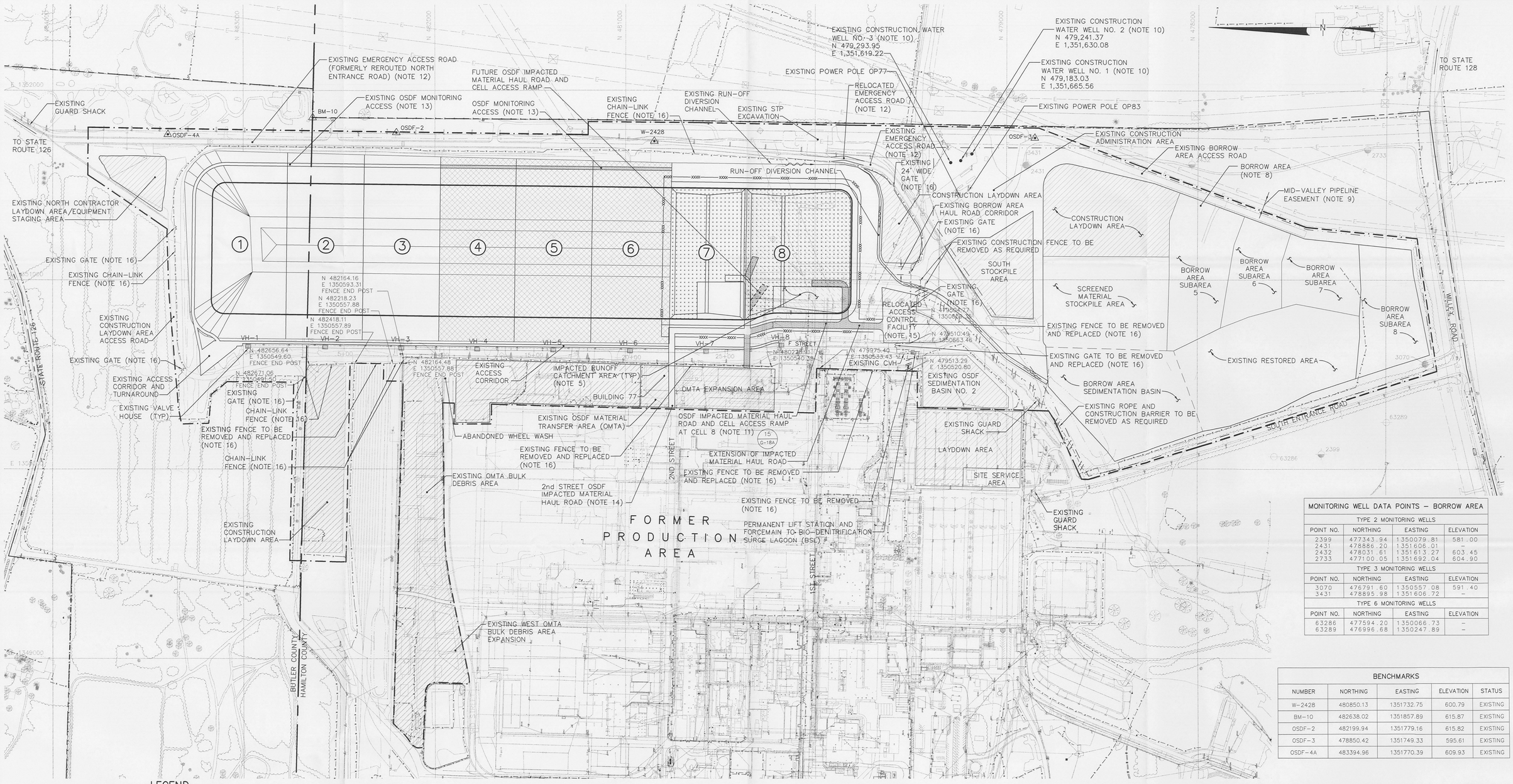
APPROVAL SECTION

DESIGN ORGANIZATION APPROVAL OF CLARIFICATION OR CHANGE AND VERIFICATION THAT ED-12-5002 REQUIREMENTS MET
NAME (PRINTED/SIGNED) DATE
James Fleck James Fleck 6/24/04

PE CONCURRENCE (Not Required if none assigned or for Requestor Proposed Change)
NAME (PRINTED/SIGNED) DATE
Uday Kumthekar Uday Kumthekar 6/24/04

REQUESTOR CONCURRENCE
NAME (PRINTED/SIGNED) DATE
Charles C. Van Arsdale Charles C. Van Arsdale 6/24/04

CHANGE COMPLETED
NAME (PRINTED/SIGNED) DATE



MONITORING WELL DATA POINTS – BORROW AREA			
TYPE 2 MONITORING WELLS			
POINT NO.	NORTHING	EASTING	ELEVATION
2399	477343.94	1350079.81	581.00
2431	478886.20	1351606.01	–
2432	478031.61	1351613.27	603.45
2733	477100.05	1351692.04	604.90
TYPE 3 MONITORING WELLS			
POINT NO.	NORTHING	EASTING	ELEVATION
3070	476791.60	1350557.08	591.40
3431	478895.98	1351606.72	–
TYPE 6 MONITORING WELLS			
POINT NO.	NORTHING	EASTING	ELEVATION
63286	477594.20	1350066.73	–
63289	476996.68	1350247.89	–

BENCHMARKS				
NUMBER	NORTHING	EASTING	ELEVATION	STATUS
W-2428	480850.13	1351732.75	600.79	EXISTING
BM-10	482638.02	1351857.89	615.87	EXISTING
OSDF-2	482199.94	1351779.16	615.82	EXISTING
OSDF-3	478850.42	1351749.33	595.61	EXISTING
OSDF-4A	483394.96	1351770.39	609.93	EXISTING

LEGEND

- BUTLER COUNTY/HAMILTON COUNTY LINE
- FCP PROPERTY LINE
- BATTERY LIMIT
- IMPACTED MATERIAL DISPOSAL LIMIT
- BORROW AREA LIMIT
- RADIOLOGICAL CONTROL LIMIT/FENCE (NOTE 6)
- FENCE
- ILTS — EXISTING ILTS PIPE
- LTS — EXISTING LTS PIPE
- 15+00 — EXISTING EPLTS PIPE
- DRAINAGE FLOW DIRECTION
- OSDF-4A — BENCHMARK
- 3070 / 2399 / 63289 — EXISTING MONITORING WELLS
- ② — ON-SITE DISPOSAL FACILITY CELL DESIGNATION
- ACCESS CORRIDOR, ACCESS ROAD, ACCESS RAMP, OR HAUL ROAD
- CELLS 4, 5, AND 6 FINAL COVER SYSTEM
- IMPACTED MATERIAL PLACEMENT AREA CELLS 7 AND 8
- CELL 8 LINER SYSTEM

NOTES:

1. PURPOSE OF THIS DRAWING IS TO CONCEPTUALLY ILLUSTRATE SITE DEVELOPMENT FOR OSDF-PHASE V WITH SUPPORT FACILITIES INCLUDING BUT NOT LIMITED TO HAUL ROADS, GUARD SHACKS, EQUIPMENT WASH FACILITY, CONTRACTOR ADMINISTRATION AREA, PARKING AREAS, CONSTRUCTION LAYDOWN AREA, ACCESS CONTROL FACILITY, RADIOLOGICAL CONTROL LIMIT/FENCE, STOCKPILE AREAS, AND SEDIMENTATION BASINS. SIZE AND LOCATION OF SUPPORT FACILITIES MAY VARY FROM THOSE SHOWN.
2. CONTAIN AND CONTROL WATER GENERATED DURING CONSTRUCTION AND FILLING OF OSDF IN ACCORDANCE WITH SPECIFICATION SECTIONS 02270 AND 13010.
3. PREPARE EARTHWORK WORK PLAN IN ACCORDANCE WITH SPECIFICATION SECTION 02200.
4. EXISTING CONTOURS ARE NOT SHOWN FOR CLARITY. EXISTING CONTOURS ARE SHOWN ON GRADING PLANS. ADDITIONAL EXISTING CONDITIONS ARE SHOWN ON REFERENCE DRAWINGS. EXISTING CONDITIONS SHALL BE VERIFIED IN ACCORDANCE WITH SPECIFICATION SECTION 02100.
5. IMPACTED RUNOFF CATCHMENT AREA IN ACTIVE CELL SHALL REMAIN OPEN UNTIL COMPACTION OF SECOND LIFT OF COMPACTED CLAY CAP IS COMPLETED IN ADJACENT UPGRADIENT CELL AND IMPACTED RUNOFF CATCHMENT AREA IN DOWNGRADIENT CELL IS CONSTRUCTED AND OPERATIONAL.
6. RADIOLOGICAL CONTROL LIMIT/FENCE INDICATES LIMIT OF RADIOLOGICAL CONTROL FOR IMPACTED MATERIAL HAULING AND PLACEMENT. RAD FENCE SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02200.
7. GEOTECHNICAL DATA POINTS ARE SHOWN ON DRAWINGS G-4, G-6, AND G-6A.
8. BORROW AREA MANAGEMENT SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 13000.
9. LOCATE MID-VALLEY PIPELINE EASEMENT IN ACCORDANCE WITH SPECIFICATION SECTION 02100. DO NOT ENTER PIPELINE EASEMENT.
10. CONSTRUCTION WATER SHALL BE OBTAINED FROM EXISTING WELL HOUSES LOCATED WEST OF FORMER PRODUCTION AREA AT LOCATIONS N 480,784.4 AND E 1,348,403.7 AND N 481,454.8 AND E 1,350,487.4 AND CONSTRUCTION WATER WELLS SHOWN ON THIS DRAWING.
11. OSDF IMPACTED MATERIAL HAUL ROAD AND CELL ACCESS RAMP AT CELL 8 GRADING PLANS ARE SHOWN ON DRAWING G-18A.
12. EMERGENCY ACCESS ROAD TO BE USED FOR EMERGENCY RESPONSE VEHICLES AND PICKUP TRUCK VEHICLES. THIS ROAD SHALL ONLY BE USED FOR DELIVERY OF CONSTRUCTION MATERIALS AND EQUIPMENT AS APPROVED BY CONSTRUCTION MANAGER.
13. OSDF MONITORING ACCESS TO BE USED FOR MAINTENANCE, SEEDING, IRRIGATION, MONITORING, INSPECTION, FEMP OPERATIONS, AND EMERGENCY VEHICLES ONLY.
14. SECOND STREET IMPACTED MATERIAL HAUL ROAD MAY BE ROUTED AROUND BUILDING 77 BASED ON DEMOLITION SCHEDULE. CONSTRUCT SECOND STREET IMPACTED MATERIAL HAUL ROAD TO BE OPERATIONAL BEFORE CONSTRUCTION OF CELL 4 FINAL COVER SYSTEM.
15. CONSTRUCT RELOCATED ACCESS CONTROL FACILITY. FACILITY TO BE OPERATIONAL BEFORE CONSTRUCTION OF CELL 4 FINAL COVER SYSTEM. LOCATION AND DESIGN OF RELOCATED ACCESS CONTROL FACILITY TO BE PROVIDED BY CONSTRUCTION MANAGER.
16. DENOTES FINAL CONFIGURATION OF OSDF FENCE AND GATES. CHAIN-LINK FENCE AND GATES SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02831.

PRE-FINAL CERTIFIED-FOR-CONSTRUCTION

REV. NO.	DATE	DESCRIPTION	DES. BY	DR. BY	CHK. BY	RVW. BY	APP. BY
1B	04.06.23	PRE-FINAL REVISION 1 SUBMITTAL TO FF/DOE PER DCN	TEZ	JJA	LMG	DKP	RB
1A	04.06.16	PRELIMINARY REVISION 1 SUBMITTAL TO FF/DOE PER DCN	TEZ	JJA	LMG	DKP	RB
0	04.01.22	CFC SUBMITTAL TO FF/DOE/EPA	TEZ	JJA	LMG	DKP	RB
B	03.12.08	PRE-FINAL SUBMITTAL TO FF/DOE	TEZ	JJA	LMG	DKP	RB
A	03.10.28	PRELIMINARY SUBMITTAL TO FF/DOE	TEZ	JJA	LMG	DKP	RB

200 100 0 200 400
SCALE IN FEET

OWNER/FACILITY:
UNITED STATES DEPARTMENT OF ENERGY
FERNALD CLOSURE PROJECT

CLIENT:
FLUOR FERNALD, INC.

PROJECT:
ON-SITE DISPOSAL FACILITY – PHASE V

TITLE:
SITE DEVELOPMENT PLAN III – CELL 8

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

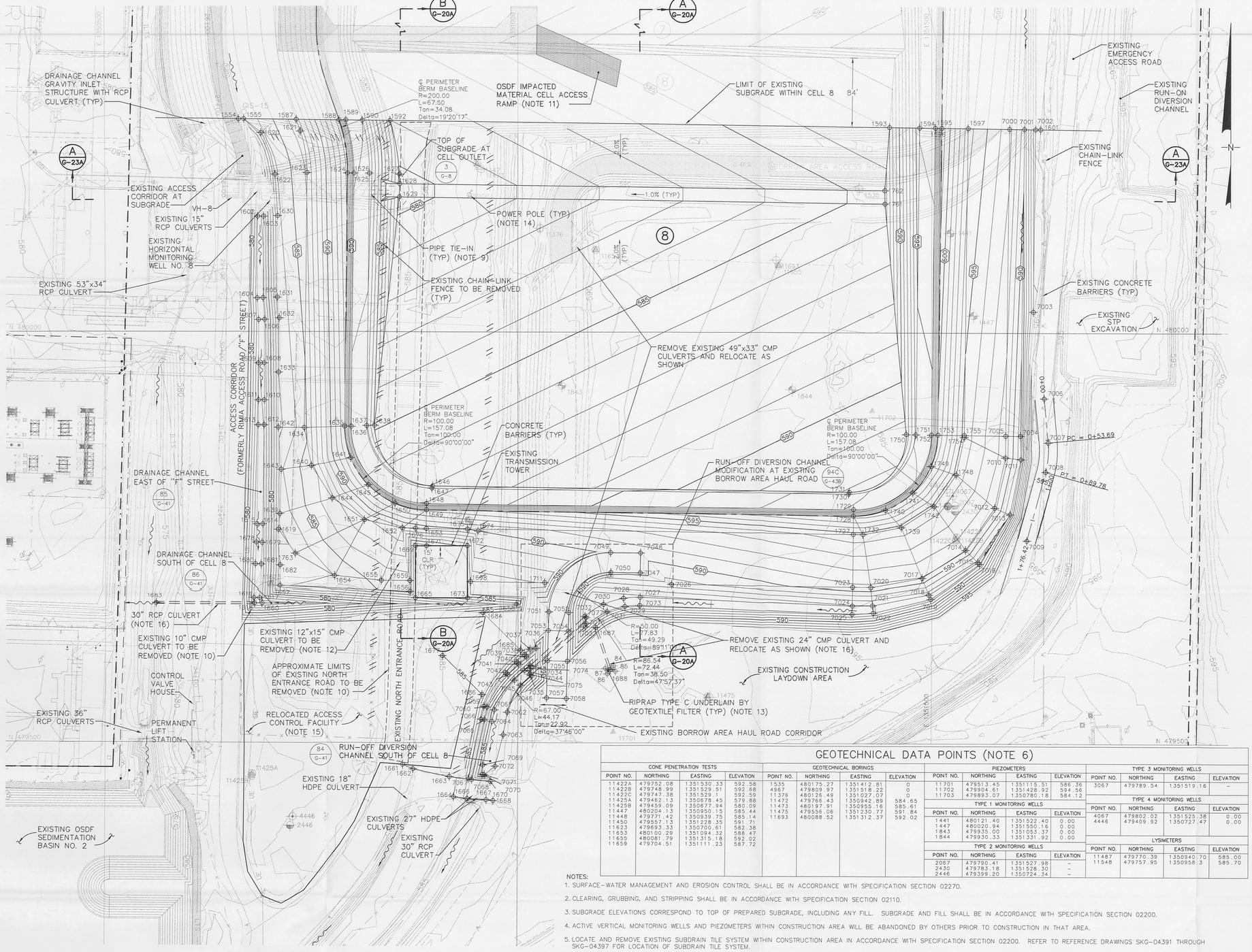
DATE

SEAL

GeoSyntec Consultants
1100 LAKE HEARN DRIVE
ATLANTA, GEORGIA 30342 USA

PROJECT NO.:	20105
CONTRACT NO.:	03FF0699
FEMP DRAWING NO.:	90X-6000-G-00413
GEOSYNTEC PROJECT NO.:	GG3309-02.02
GEOSYNTEC DOCUMENT NO.:	F04-1B007
SHEET NO.:	G-2A
REVISION NO.:	1B

5529



SUBGRADE CONSTRUCTION CONTROL POINTS

POINT NO.	NORTHING	EASTING	ELEVATION	POINT NO.	NORTHING	EASTING	ELEVATION
1554	480259.22	1350662.68	585.10	1711	479855.39	1351737.24	587.10
1555	480259.15	1350669.04	583.09	1727	479754.98	1351405.95	594.60
1587	480258.38	1350731.94	586.54	1728	479777.30	1351406.22	598.31
1588	480257.74	1350783.79	594.61	1729	479785.09	1351406.31	593.12
1589	480257.64	1350792.00	589.40	1730	479803.88	1351400.35	592.68
1590	480257.40	1350811.61	588.00	1731	479826.26	1351400.12	592.09
1592	480257.00	1350844.75	580.99	1732	479754.84	1351417.57	594.56
1593	480249.61	1351449.26	587.04	1739	479763.43	1351445.59	594.55
1594	480249.17	1351485.48	596.09	1740	479784.46	1351444.56	598.68
1595	480248.94	1351504.20	596.47	1741	479805.74	1351477.26	599.06
1596	480248.84	1351511.99	601.66	1742	479788.97	1351502.83	594.55
1597	480248.46	1351543.61	596.39	1748	479827.57	1351529.32	594.54
1601	480247.39	1351631.39	595.00	1749	479849.34	1351499.34	593.43
1602	480140.69	1350685.47	577.75	1750	479876.53	1351469.39	591.34
1603	480140.63	1350692.47	578.17	1751	479876.39	1351480.92	594.23
1604	480040.82	1350684.62	577.31	1752	479876.16	1351499.64	594.67
1605	480041.02	1350691.62	577.73	1753	479876.07	1351507.43	599.80
1606	480014.74	1350693.36	577.51	1754	479873.37	1351539.43	594.53
1607	480014.52	1350686.36	577.19	1755	479875.68	1351539.06	594.53
1608	479961.78	1350692.94	577.38	1761	480156.73	1351443.56	585.45
1609	479961.82	1350685.94	576.96	1762	480172.80	1351443.52	585.45
1610	479916.61	1350692.94	577.18	1763	479730.36	1350729.76	583.12
1611	479916.64	1350685.84	576.76	7000	480247.85	1351593.70	593.38
1612	479886.43	1350692.62	577.05	7001	480247.63	1351611.70	590.38
1613	479886.53	1350685.62	576.63	7002	480247.45	1351625.36	594.94
1614	479765.90	1350690.65	576.52	7003	480025.88	1351622.65	593.83
1615	479766.07	1350683.65	576.10	7004	479874.85	1351607.14	588.52
1616	479676.30	1350679.81	576.00	7005	479875.07	1351589.14	591.52
1617	479676.05	1350686.80	576.00	7006	479920.32	1351635.95	595.56
1618	479649.50	1350680.53	576.00	7007	479866.86	1351640.93	595.28
1619	479759.37	1350709.46	582.84	7008	479831.10	1351637.80	595.06
1620	480242.24	1350689.59	583.82	7009	479747.55	1351614.86	594.58
1621	480244.11	1350736.75	586.47	7010	479848.60	1351588.82	591.50
1622	480191.44	1350706.39	583.82	7011	479846.48	1351607.51	585.38
1623	480193.66	1350744.77	586.13	7012	479787.53	1351575.88	591.32
1624	480193.06	1350793.71	594.28	7013	479779.63	1351594.32	588.04
1625	480192.99	1350801.50	589.09	7014	479736.06	1351540.57	591.13
1626	480192.81	1350820.22	588.71	7015	479720.97	1351555.29	587.69
1627	480191.66	1350855.83	579.81	7016	479718.85	1351557.42	587.69
1628	480179.97	1350856.36	579.58	7017	479702.01	1351488.24	590.95
1629	480163.98	1350855.86	579.58	7018	479681.43	1351496.46	587.33
1630	480141.32	1350709.29	583.78	7019	479675.91	1351498.78	587.33
1631	480041.65	1350708.68	583.31	7020	479690.57	1351426.88	590.76
1632	480016.59	1350710.96	583.34	7021	479687.87	1351428.83	586.98
1633	479950.45	1350709.95	583.00	7022	479658.95	1351429.78	586.98
1634	479883.12	1350740.97	584.57	7023	479690.83	1351405.16	592.75
1635	479884.83	1350789.94	592.74	7024	479657.55	1351404.88	586.86
1636	479884.74	1350797.74	587.85	7025	479657.56	1351404.47	586.86
1637	479885.76	1350816.47	587.18	7026	479693.53	1351184.82	588.59
1638	479886.09	1350825.71	584.87	7027	479678.09	1351147.08	585.57
1639	479778.61	1350711.23	583.36	7028	479676.80	1351207.15	585.48
1640	479837.09	1350749.55	585.69	7029	479666.94	1351128.84	585.48
1641	479846.48	1350797.10	592.66	7030	479669.41	1351203.03	585.36
1642	479883.51	1350709.51	582.69	7031	479660.32	1351107.55	585.36
1643	479832.31	1350713.01	583.90	7032	479654.91	1351080.98	585.24
1644	479797.84	1350775.08	586.75	7033	479641.87	1351081.39	585.20
1645	479813.78	1350818.39	592.99	7034	479595.00	1351014.83	584.83
1646	479812.80	1350896.18	587.03	7035	479582.23	1351015.63	584.79
1647	479810.05	1350895.23	587.72	7036	479615.65	1351021.97	588.42
1648	479791.41	1350888.81	588.03	7037	479614.48	1351014.92	588.39
1649	479783.62	1350888.71	593.23	7038	479808.11	1351007.70	588.35
1650	479791.72	1350850.57	593.11	7039	479605.15	1351010.39	588.35
1651	479771.36	1350813.69	587.80	7040	479599.33	1350998.02	588.28
1652	479761.66	1350859.50	588.88	7041	479596.39	1351000.74	588.28
1653	479761.31	1350888.44	589.51	7042	479585.86	1350984.87	588.11
1654	479703.43	1350777.70	583.99	7043	479583.21	1350987.87	588.11
1655	479697.82	1350833.76	585.12	7044	479588.69	1351007.88	584.78
1656	479684.56	1350868.62	585.37	7045	479576.28	1350995.75	584.61
1657	479691.58	1350711.20	583.86	7046	479570.33	1351003.08	584.71
1658	479650.50	1350998.07	583.50	7047	479707.49	1351147.25	590.47
1659	479697.39	1350868.29	585.48	7048	479731.48	1351147.55	590.47
1660	479650.50	1350689.57	576.00	7049	479731.92	1351111.73	590.87
1661	479473.61	1350860.10	584.84	7050	479707.92	1351112.04	590.87
1662	479467.95	1350872.59	585.00	7051	479640.22	1351111.43	591.75
1663	479458.71	1350916.63	585.38	7052	479659.24	1351061.43	591.75
1664	479433.95	1350921.85	586.00	7053	479637.37	1351036.86	592.00
1665	479676.19	1350875.16	583.19	7054	479636.74	1351060.85	592.00
1666	479431.73	1350938.41	587.29	7055	479600.60	1351035.89	592.00
1667	479430.47	1350961.71	587.45	7056	479599.97	1351059.88	592.00
1668	479429.48	1350970.07	587.38	7057	479554.75	1351034.68	590.50
1669	479739.93	1350875.16	583.19	7058	479554.14	1351058.67	590.50
1670	479452.87	1350966.63	587.41	7059	479544.58	1350998.64	587.40
1671	479739.93	1350888.64	583.65	7060	479543.75	1350962.55	587.40
1672	479739.93	1350938.16	585.36	7061	479540.35	1350971.63	584.29
1673	479676.93	1350938.16	584.66	7062	479537.49	1350987.19	584.55
1674	479758.35	1350951.49	590.00	7063	479526.37	1350968.28	584.28
1675	479760.70	1350938.37	590.00	7064	479526.11	1350968.59	584.15
1676	479761.47	1350875.29	589.37	7065	479528.09	1350959.21	587.35
1677	479806.49	1350907.94	585.00	7066	479528.92	1350959.29	587.35
1678	479743.73	1350682.91	576.00	7067	479455.88	1350940.01	587.13
1679	479742.45	1350689.91	576.42	7068	479455.06	1350943.92	587.13
1680	479717.80	1350681.72	576.00	7069	479472.81	1350957.44	583.99
1681	479717.48	1350688.71	576.00	7070	479461.49	1350956.93	583.96
1682	479716.44	1350711.26	583.52	7071	479461.04	1350959.17	583.67
1683	479659.50	1350961.28	575.75	7072	479471.50	1350972.54	584.05
1684	479658.03	1350957.35	586.00	7073	479468.10	1351148.67	585.57
1685	479613.34	1351002.98	586.00	7074	479591.00	1351013.81	584.82
1686	479558.73	1350956.45	585.00	7075	479590.46	1351014.24	584.80
1687	479641.33	1351093.92	588.00	7076	479646.02	1351082.59	585.21
1688	479589.55	1351111.58	590.00	7077	479653.17	1351082.36	585.23
1698	479696.49	1350942.19	586.22				

RIPRAP LIMITS CONTROL POINTS

POINT NO.	NORTHING	EASTING
84	479594.48	1351115.18
85	479587.85	1351117.44
86	479584.63	1351107.98
87	479591.25	1351105.72

RELOCATED ACCESS ROAD HORIZONTAL ALIGNMENT STATION AND CURVE REPORT

Desc.	Station	Spiral/Curve Data		Northing	Easting
PI	0+00			479920.32	1351635.95
	Length:	71.93	Course:	S 05-19-25 E	
PI	0+71.93			479848.69	1351642.63
	Length:	104.88	Course:	S 15-21-10 W	
	Delta:	20-40-35			
	Tangent Data				
	0+00			479920.32	1351635.95
	0+53.69			479866.86	1351640.93
	Length:	53.69	Course:	S 05-19-25 E	
	Circular Curve Data				
PC	0+53.69			479866.86	1351640.93
RP				479857.58	1351541.37
PT	0+89.78			479831.10	1351637.80
	Delta:	20-41	Type:	RIGHT	
	Radius:	100.00	DOC:	57-18	
	Length:	36.09	Tangent:	18.24	
	Mid-Ord:	1.62	External:	1.65	
	Chord:	35.89	Course:	S 05-00-52 W	
	Es:	1.65			
PI	1+76.42			479747.55	1351614.86
	Tangent Data				
	0+89.78			479831.10	1351637.80
	1+76.42			479747.55	1351614.86
	Length:	86.64	Course:	S 15-21-10 W	

GEOTECHNICAL DATA POINTS (NOTE 6)

CONE PENETRATION TESTS

POINT NO.	NORTHING	EASTING	ELEVATION
11422A	479752.70	1351530.33	592.58
11422B	479748.99	1351529.51	592.68
11422C	479747.38	1351529.11	592.59
11425A	479462.13	1350678.45	579.88
11425B	479459.09	1350677.94	580.09
11447	480204.13	1350950.15	585.44
11448	479771.42	1350939.75	585.14
11450	479557.13	1351228.35	591.71
11623	479693.33	1350700.61	582.38
11653	480100.29	1351094.32	588.47
11655	480081.79	1351315.18	592.02
11659	479704.51	1351111.23	587.72

GEOTECHNICAL BORINGS

POINT NO.	NORTHING	EASTING	ELEVATION
1535	480175.27	1351412.81	0
4967	479809.97	1351518.22	0
11378	480126.49	1351027.07	0
11472	479766.43	1350942.89	584.65
11473	480197.91	1350955.16	585.61
11475	479556.06	1351230.77	591.84
11693	480088.52	1351312.37	592.02

PIEZOMETERS

POINT NO.	NORTHING	EASTING	ELEVATION
11701	479513.45	1351115.51	586.36
11702	479904.61	1351428.92	594.56
11703	479893.07	1350780.18	584.12

TYPE 1 MONITORING WELLS

POINT NO.	NORTHING	EASTING	ELEVATION
1441	480121.40	1351522.40	0.00
1447	480020.94	1351550.16	0.00
1843	479935.00	1351053.37	0.00
1844	479930.33	1351331.92	0.00

TYPE 2 MONITORING WELLS

POINT NO.	NORTHING	EASTING	ELEVATION
2067	479790.41	1351527.98	–
2430	479783.18	1351528.30	–
2446	479399.20	1350724.34	–

TYPE 3 MONITORING WELLS

POINT NO.	NORTHING	EASTING	ELEVATION
3067	479789.54	1351519.16	–

TYPE 4 MONITORING WELLS

POINT NO.	NORTHING	EASTING	ELEVATION
4067	479802.02	1351525.38	0.00
4446	479409.92	1350727.47	0.00

LYSIMETERS

POINT NO.	NORTHING	EASTING	ELEVATION
11487	479770.39	1350940.70	585.00
11548	479757.95	1350958.3	585.70

NOTES:

1. SURFACE-WATER MANAGEMENT AND EROSION CONTROL SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02270.
2. CLEARING, GRUBBING, AND STRIPPING SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02110.
3. SUBGRADE ELEVATIONS CORRESPOND TO TOP OF PREPARED SUBGRADE, INCLUDING ANY FILL. SUBGRADE AND FILL SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02200.
4. ACTIVE VERTICAL MONITORING WELLS AND PIEZOMETERS WITHIN CONSTRUCTION AREA WILL BE ABANDONED BY OTHERS PRIOR TO CONSTRUCTION IN THAT AREA.
5. LOCATE AND REMOVE EXISTING SUBDRAIN TILE SYSTEM WITHIN CONSTRUCTION AREA IN ACCORDANCE WITH SPECIFICATION SECTION 02200. REFER TO REFERENCE DRAWINGS SKG-04391 THROUGH SKG-04397 FOR LOCATION OF SUBDRAIN TILE SYSTEM.
6. REMOVE GROUT USED TO BACKFILL GEOTECHNICAL DATA POINTS AND MONITORING WELLS LOCATED WITHIN PERIMETER BERM BASELINE TO A MINIMUM DEPTH OF 3 FEET BELOW SUBGRADE ELEVATIONS.
7. DEWATER EXCAVATIONS AND MANAGE COLLECTED WATER IN ACCORDANCE WITH SPECIFICATION SECTION 02200. GROUNDWATER LEVELS IN BROWN AND GRAY TILL LAYERS VARY DURING YEAR AND MAY BE HIGHER THAN THOSE SHOWN ON REFERENCE DRAWINGS. LEVELS MAY APPROACH GROUND SURFACE DURING PERIODS OF HEAVY PRECIPITATION.
8. LOCATE EXISTING UNDERGROUND UTILITIES WITHIN CONSTRUCTION AREA AS SHOWN ON REFERENCE DRAWINGS SKG-04391 THROUGH SKG-04397. REMOVE UNDERGROUND UTILITIES IN CONSTRUCTION AREA IN ACCORDANCE WITH SPECIFICATION SECTION 02200 AND AS APPROVED BY CONSTRUCTION MANAGER.
9. LDS, LCS, AND RLCS PIPES SHALL TIE INTO EXISTING PIPES. CONSTRUCTION CONTROL POINTS FOR PIPE TIE-INS ARE SHOWN ON DRAWING G-9.
10. PAVEMENT COURSES AND ASSOCIATED IMPACTED MATERIAL FOR EXISTING NORTH ENTRANCE ROAD AND REROUTED NORTH ENTRANCE ROAD SHALL BE REMOVED WITHIN LIMITS SHOWN. REMOVAL SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02200. PLACE REMOVED MATERIAL IN ACTIVE CELL AS APPROVED BY CONSTRUCTION MANAGER.
11. OSDF IMPACTED MATERIAL HAUL ROAD RAMP AND CELL ACCESS RAMP GRADING PLAN IS SHOWN ON DRAWING G-18A.
12. REMOVE EXISTING CULVERTS AND STOCKPILE MATERIAL AT LOCATIONS DESIGNATED BY CONSTRUCTION MANAGER.
13. PLACE RIPRAP WITHIN AREA SHOWN. RIPRAP THICKNESS SHALL BE 1.5 FEET. RIPRAP SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02271. GEOTEXTILE FILTER SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02714.
14. REMOVE POWER POLES LOCATED WITHIN PROPOSED SUBGRADE AND BACKFILL HOLES IN ACCORDANCE WITH SPECIFICATION SECTION 02200.
15. RELOCATED ACCESS CONTROL FACILITY SHALL BE OPERATIONAL BEFORE CONSTRUCTION OF CELL 4 FINAL COVER SYSTEM. LOCATION AND DESIGN OF RELOCATED ACCESS CONTROL FACILITY TO BE PROVIDED BY FLUOR FERNALD.
16. ALUMINIZED CMP AND RCP CULVERTS AND JOINTS SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02721. CONTROL POINTS SHOWN AT ENDS OF CULVERT CORRESPONDS TO INVERT ELEVATIONS. TRENCHING AND BACKFILLING SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02215.
17. SIDESLOPES IN FILL OR EXCAVATION SHALL BE 3 HORIZONTAL TO 1 VERTICAL UNLESS OTHERWISE SHOWN ON DRAWINGS.

TOPOGRAPHY SHOWN ON THIS CONSTRUCTION DRAWING IS BASED ON JULY 2003 FLYOVER.

LEGEND

- EXISTING GROUND ELEVATION (FEET) — 590
- SUBGRADE ELEVATION (FEET) (NOTE 3) — 595
- FINISHED GRADE ELEVATION (FEET) — 585
- FCP PROPERTY LINE
- BATTERY LIMIT
- PERIMETER BERM BASELINE
- EXISTING ENHANCED PERMANENT LEACHATE TRANSMISSION SYSTEM (EPLTS) PIPE — 22+00
- EXISTING INTERIM LEACHATE TRANSMISSION SYSTEM (ILTS) PIPE — ILTS
- SLOPE TOE OR CREST
- EXISTING HORIZONTAL MONITORING WELL WITH COVER SLAB
- EXISTING GEOTECHNICAL DATA POINTS (NOTE 6) — 3067, 11447, 1441, 11472, 11703, 11487, 2430, 4446
- CELL DESIGNATION — 7
- CONSTRUCTION CONTROL POINT — 1763
- ACCESS CORRIDOR, ACCESS ROAD, ACCESS RAMP, MAINTENANCE ACCESS, OR HAUL ROAD
- BERM CREST
- RIPRAP LIMIT
- DRAINAGE FLOW DIRECTION

PRE-FINAL CERTIFIED-FOR-CONSTRUCTION

REV. NO.	DATE	DESCRIPTION	DES. BY	DR. BY	CHK. BY	RVW. BY	APP. BY
1B	04.05.21	PRE-FINAL REVISION 1 SUBMITTAL TO FF/DOE PER DCN	TEZ	JJA	LMG	DKP	RB
1A	04.05.14	PRELIMINARY REVISION 1 SUBMITTAL TO FF/DOE	TEZ	JJA	TEZ	DKP	RB
0	04.01.22	CFC SUBMITTAL TO FF/DOE/EPA	LMG	JJA	TEZ	DKP	RB
B	03.12.08	PRE-FINAL SUBMITTAL TO FF/DOE	LMG	JJA	TEZ	DKP	RB
A	03.10.28	PRELIMINARY SUBMITTAL TO FF/DOE	LMG	JJA	TEZ	DKP	RB

50 25 0 50 100
SCALE IN FEET

OWNER/FACILITY:

UNITED STATES DEPARTMENT OF ENERGY
FERNALD CLOSURE PROJECT

CLIENT:

FLUOR FERNALD, INC.

PROJECT:

ON-SITE DISPOSAL FACILITY - PHASE V

TITLE:

SUBGRADE GRADING PLAN V - CELL 8 LINER SYSTEM

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

239

SIGNATURE

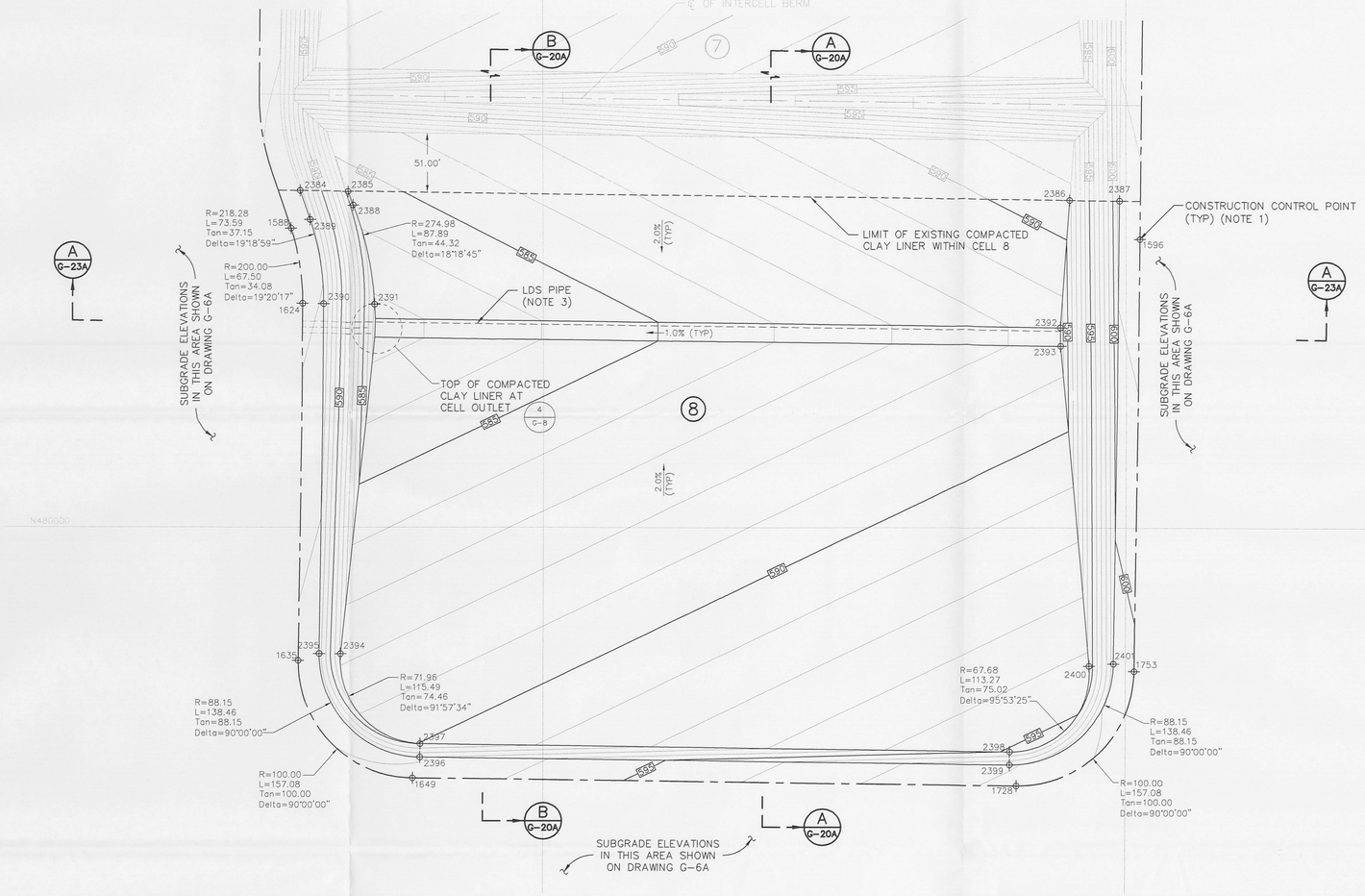
DATE

SEAL

GeoSyntec Consultants
1100 LAKE HEARN DRIVE
ATLANTA, GEORGIA 30342 USA

PROJECT NO.:	20105
CONTRACT NO.:	03FF0699
FEMP DRAWING NO.:	90X-6000-G-00414
GEOSYNTEC PROJECT NO.:	GQ3309-02.02
GEOSYNTEC DOCUMENT NO.:	F04-1B013
SHEET NO.:	G-6A
REVISION NO.:	1B

5529



2A / - PLAN
COMPACTED CLAY LINER – CELL 8
SCALE: 1" = 50'
XREF: F03X1A221.DWG

LEGEND

- 595 — EXISTING COMPACTED CLAY LINER ELEVATION (FEET) (NOTE 2)
- 590 — COMPACTED CLAY LINER ELEVATION (FEET) (NOTE 2)
- PERIMETER BERM BASELINE/LIMIT OF COMPACTED CLAY LINER
- 2308 — CONSTRUCTION CONTROL POINT
- (8) — CELL DESIGNATION

COMPACTED CLAY LINER CONSTRUCTION CONTROL POINTS

CELL 8

POINT NO.	NORTHING	EASTING	ELEVATION
2384	480290.25	1350791.88	594.39
2385	480289.74	1350833.42	584.53
2386	480282.19	1351451.32	590.71
2387	480281.66	1351494.35	601.46
2388	480277.89	1350837.94	584.34
2389	480265.19	1350800.33	594.26
2390	480192.84	1350811.75	593.92
2391	480192.30	1350856.16	582.82
2392	480172.77	1351443.14	588.45
2393	480156.83	1351443.27	588.45
2394	479890.58	1350826.55	587.79
2395	479890.81	1350808.06	592.41
2396	479801.59	1350895.11	592.93
2397	479813.22	1350895.29	590.02
2398	479806.67	1351400.41	595.08
2399	479795.41	1351400.23	597.89
2400	479880.46	1351468.65	594.26
2401	479882.48	1351489.47	599.47

SUBGRADE CONSTRUCTION CONTROL POINTS

CELL 8

POINT NO.	NORTHING	EASTING	ELEVATION
1588	480257.74	1350783.79	594.61
1596	480248.84	1351511.99	601.66
1624	480193.06	1350793.71	594.28
1635	479884.83	1350789.94	592.74
1649	479783.62	1350888.71	593.23
1728	479777.30	1351406.22	598.31
1753	479876.07	1351507.43	599.80

NOTES:

1. THIS DRAWING SHOWS GRADING AND CONSTRUCTION CONTROL POINTS FOR COMPACTED CLAY LINER FOR CELL 8.
2. COMPACTED CLAY LINER ELEVATIONS CORRESPOND TO TOP OF COMPACTED CLAY LINER.
3. LDS PIPE CONSTRUCTION CONTROL POINTS ARE SHOWN ON DRAWINGS G-8 AND G-9.

REV. NO.	DATE	DESCRIPTION	DES. BY	DR. BY	CHK. BY	RVW. BY	APP. BY
1A	04.05.28	PRELIMINARY REVISION 1 SUBMITTAL TO FF/DOE PER DCN	LMG	JJA	TEZ	DKP	RB
0	04.01.22	CFC SUBMITTAL TO FF/DOE/EPA	LMG	JJA	TEZ	DKP	RB
B	03.12.08	PRE-FINAL SUBMITTAL TO FF/DOE	LMG	JJA	TEZ	DKP	RB
A	03.10.28	PRELIMINARY SUBMITTAL TO FF/DOE	LMG	JJA	TEZ	DKP	RB

50 25 0 50 100
SCALE IN FEET

OWNER/FACILITY:
UNITED STATES DEPARTMENT OF ENERGY
FERNALD CLOSURE PROJECT

CLIENT:
FLUOR FERNALD, INC.

PROJECT: ON-SITE DISPOSAL FACILITY – PHASE V

TITLE: COMPACTED CLAY LINER GRADING PLAN II – CELL 8 LINER SYSTEM

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

SEAL

GeoSyntec Consultants
1100 LAKE HEARN DRIVE, ATLANTA, GEORGIA 30342 USA

PROJECT NO.:	20105
CONTRACT NO.:	03FF0699
FEMP DRAWING NO.:	90X-6000-G-00415
GEOSYNTEC PROJECT NO.:	GQ3309-02.02
GEOSYNTEC DOCUMENT NO.:	F04-1A016
SHEET NO.:	G-7A
REVISION NO.:	1A

PRELIMINARY CERTIFIED–FOR–CONSTRUCTION

240

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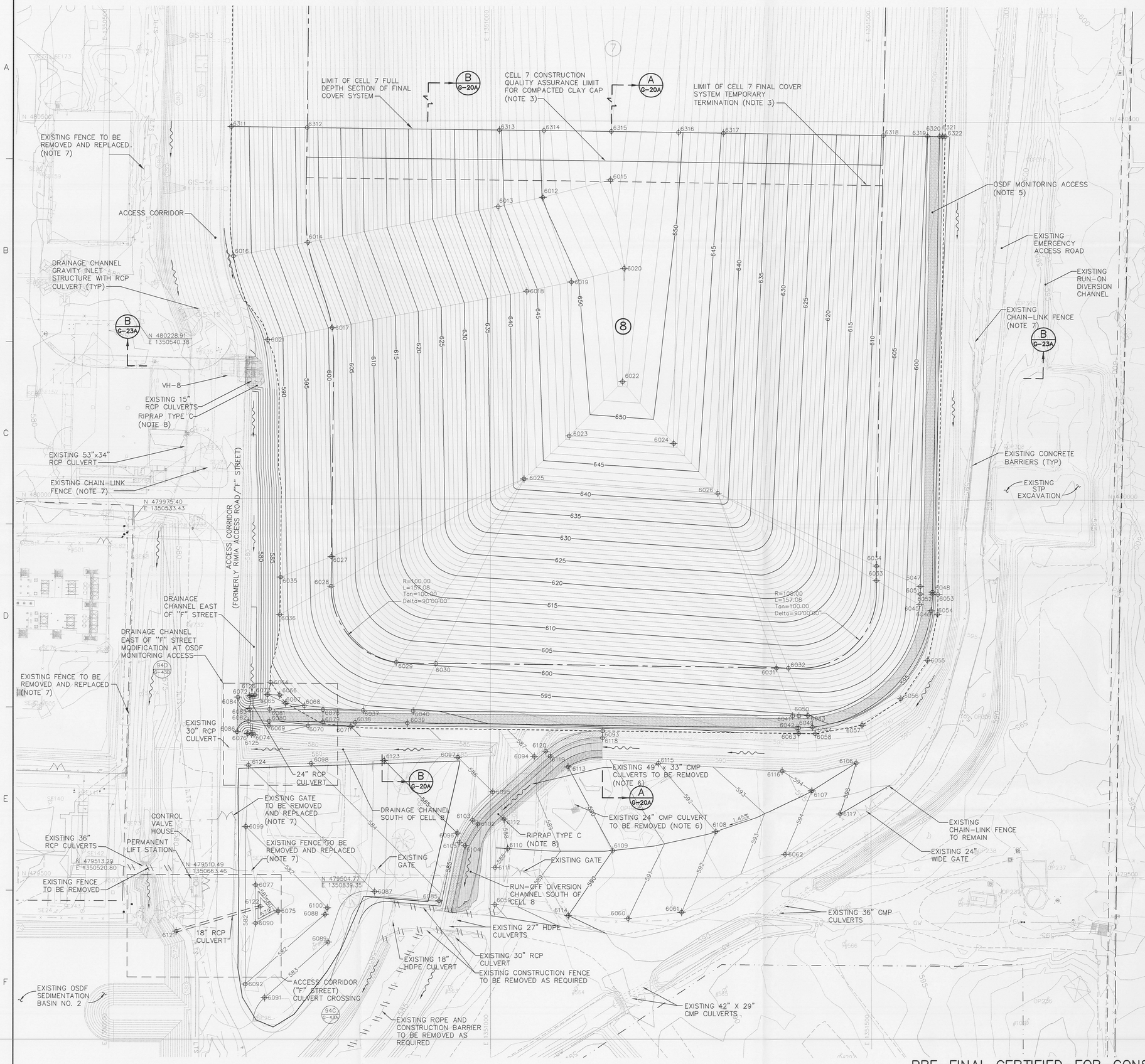
5529



LEGEND

- EXISTING FINISHED GRADE ELEVATION (FEET)
- FINISHED GRADE ELEVATION (FEET) (NOTE 2)
- PERIMETER BERM BASELINE
- APPROXIMATE LIMIT OF FINAL COVER SYSTEM CONSTRUCTION
- FCP PROPERTY LINE
- PERIMETER BERM BASELINE
- BORROW AREA LIMIT
- CONSTRUCTION CONTROL POINT
- CELL DESIGNATION
- OSDF MONITORING ACCESS (NOTE 5)
- RIPRAP LIMIT
- BERM CREST
- DRAINAGE FLOW DIRECTION
- FENCE

FINAL COVER SYSTEM CONSTRUCTION CONTROL POINTS

POINT NO.	NORTHING	EASTING	ELEVATION	POINT NO.	NORTHING	EASTING	ELEVATION
6012	480399.06	1351067.91	650.11	6075	479456.06	1350719.98	581.00
6013	480386.60	1351009.42	644.21	6076	479690.04	1350680.44	577.50
6014	480339.58	1350759.21	602.36	6077	479490.32	1350690.91	581.00
6015	480422.35	1351156.83	654.66	6078	479721.72	1350779.16	588.50
6016	480321.21	1350661.86	586.07	6079	479705.72	1350778.97	587.86
6017	480226.65	1350791.28	600.82	6080	479706.58	1350708.44	584.34
6018	480274.94	1351047.15	643.62	6081	479722.57	1350709.07	584.67
6019	480287.19	1351105.63	649.52	6082	479706.91	1350681.77	583.00
6020	480305.44	1351175.28	653.09	6083	479722.90	1350682.61	583.22
6021	480210.68	1350706.64	586.66	6084	479738.33	1350667.64	582.50
6022	480155.71	1351173.45	652.34	6085	479469.73	1350932.52	583.86
6023	480083.73	1351103.15	648.50	6086	479692.34	1350666.53	582.15
6024	480073.96	1351241.20	648.50	6087	479481.73	1350847.77	583.00
6025	480026.49	1351044.11	642.38	6088	479451.72	1350781.97	582.00
6026	480008.17	1351298.74	642.34	6089	479415.14	1350785.79	583.00
6027	479923.88	1350790.42	599.78	6090	479440.15	1350690.76	581.00
6028	479884.79	1350789.94	599.58	6091	479341.97	1350702.50	583.00
6029	479784.51	1350876.58	600.01	6092	479359.71	1350677.24	582.00
6030	479783.13	1350928.57	600.49	6093	479693.98	1351147.68	588.23
6031	479777.66	1351376.03	644.86	6094	479660.00	1351057.44	587.00
6032	479777.47	1351391.81	605.02	6095	479613.34	1351002.98	586.00
6033	479893.26	1351507.64	606.73	6096	479558.73	1350956.45	585.00
6034	479912.32	1351507.88	606.82	6097	479659.03	1350957.36	586.00
6035	479896.84	1350723.58	588.56	6098	479650.88	1350763.39	584.00
6036	479847.16	1350722.45	588.21	6099	479567.25	1350677.89	582.00
6037	479721.06	1350832.65	589.02	6100	479460.21	1350784.76	582.00
6038	479705.20	1350821.66	588.27	6102	479570.85	1350983.56	588.00
6039	479704.35	1350891.17	588.95	6103	479575.97	1350976.77	588.00
6040	479720.25	1350898.72	589.66	6104	479542.42	1350966.87	587.40
6041	479714.16	1351397.33	594.54	6105	479546.47	1350959.34	587.42
6042	479698.09	1351402.71	593.95	6106	479652.05	1351480.69	595.00
6043	479714.76	1351417.12	594.94	6107	479615.05	1351422.50	594.00
6044	479699.33	1351423.34	594.42	6108	479560.97	1351295.94	592.00
6045	479861.65	1351565.09	597.21	6109	479536.09	1351160.60	590.00
6046	479853.33	1351580.23	596.71	6110	479538.38	1351022.82	588.00
6047	479885.65	1351566.05	596.94	6111	479513.41	1351006.11	588.00
6048	479878.37	1351581.94	596.27	6112	479577.26	1351017.81	588.00
6049	479698.06	1351405.22	593.98	6113	479646.17	1351101.83	590.00
6050	479714.06	1351405.43	594.62	6114	479450.31	1351101.96	590.00
6051	479875.69	1351565.92	596.89	6115	479651.40	1351220.97	592.00
6052	479875.49	1351581.90	596.25	6116	479641.19	1351383.58	594.00
6053	479875.07	1351589.14	593.02	6117	479584.53	1351459.17	595.00
6054	479848.60	1351588.82	592.89	6118	479684.91	1351147.36	588.21
6055	479787.81	1351575.22	593.47	6119	479660.55	1351079.29	588.75
6056	479737.04	1351539.61	593.43	6120	479666.89	1351072.63	588.75
6057	479702.12	1351488.20	592.48	6121	479429.36	1350587.26	578.00
6058	479690.57	1351426.88	590.96	6122	479462.15	1350696.83	579.00
6059	479464.78	1351005.62	588.00	6123	479654.96	1350860.38	585.00
6060	479446.49	1351180.75	591.00	6124	479648.50	1350681.27	583.00
6061	479454.91	1351251.04	592.00	6125	479689.31	1350685.35	577.50
6062	479530.82	1351387.35	594.00	6126	479740.77	1350685.93	577.50
6063	479690.83	1351405.15	590.75	6311	480492.37	1350659.19	586.14
6064	479757.99	1350710.43	582.86	6312	480491.15	1350758.22	602.64
6065	479741.61	1350706.38	583.00	6313	480488.07	1351010.65	644.72
6066	479741.13	1350722.23	583.00	6314	480487.36	1351068.99	650.55
6067	479730.36	1350729.76	583.12	6315	480486.27	1351157.61	654.98
6068	479727.06	1350754.63	585.00	6316	480485.19	1351246.23	650.55
6069	479701.08	1350708.23	583.69	6317	480484.48	1351304.56	644.72
6070	479700.46	1350759.55	584.00	6318	480481.91	1351514.84	609.67
6071	479699.62	1350815.79	585.00	6319	480481.19	1351573.32	599.92
6072	479740.04	1350682.74	577.50	6320	480481.00	1351589.30	599.28
6073	479741.12	1350689.86	577.50	6321	480480.95	1351593.30	596.62
6074	479689.05	1350688.85	577.50	6322	480480.91	1351596.55	596.05

NOTES:

1. THIS DRAWING SHOWS CONSTRUCTION CONTROL POINTS FOR FINAL COVER SYSTEM FOR CELL 8, FINAL SURFACE-WATER FEATURES, AND FINAL FENCE CONFIGURATION.
2. FINISHED GRADE ELEVATIONS EXCLUDING OSDF MONITORING ACCESS CORRESPOND TO TOP OF FINAL COVER SYSTEM TOPSOIL LAYER.
3. CONSTRUCTION CONTROL POINTS FOR LIMIT OF FINAL COVER SYSTEM TEMPORARY TERMINATION AND CONSTRUCTION QUALITY ASSURANCE LIMIT FOR COMPACTED CLAY CAP FOR CELL 8 ARE PROVIDED ON DRAWING G-11.
4. FINAL COVER SYSTEM FOR CELLS 7 AND 8 MAY BE CONSTRUCTED CONCURRENTLY WITHOUT CONSTRUCTION OF THE FINAL COVER SYSTEM TEMPORARY TERMINATION. CELL 8 FINAL COVER SYSTEM STAGED CLOSURE SEQUENCE IS SHOWN ON DRAWING G-16.
5. OSDF MONITORING ACCESS DETAILS ARE SHOWN ON DRAWINGS G-37, G-38, AND G-43B. TRANSITION PROPOSED OSDF MONITORING ACCESS ELEVATIONS TO TIE-IN WITH EXISTING ACCESS CORRIDOR AT TIE-IN LOCATION SHOWN.
6. REMOVE EXISTING CULVERTS AND STOCKPILE MATERIAL AT LOCATIONS DESIGNATED BY CONSTRUCTION MANAGER.
7. DENOTES FINAL CONFIGURATION OF OSDF FENCE AND GATES. CHAIN-LINK FENCE AND GATES SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02831.
8. PLACE RIPRAP WITHIN AREA SHOWN. RIPRAP THICKNESSS SHALL BE 1.5 FEET. RIPRAP SHALL BE IN ACCORDANCE WITH SPECIFICATION.

REV. NO.	DATE	DESCRIPTION	DES. BY	DR. BY	CHK. BY	RVW. BY	APP. BY
1B	04.06.23	PRE-FINAL REVISION 1 SUBMITTAL TO FF/DOE PER DCN	TEZ	JJA	LMG	DKP	RB
1A	04.06.16	PRELIMINARY REVISION 1 SUBMITTAL TO FF/DOE PER DCN	TEZ	JJA	LMG	DKP	RB
0	04.01.22	CFC SUBMITTAL TO FF/DOE/EPA	LMG	JJA	TEZ	DKP	RB
B	03.12.08	PRE-FINAL SUBMITTAL TO FF/DOE	LMG	JJA	TEZ	DKP	RB
A	03.10.28	PRELIMINARY SUBMITTAL TO FF/DOE	TEZ	JJA	KRD	DKP	RB

50 25 0 50 100
SCALE IN FEET

OWNER/FACILITY:
UNITED STATES DEPARTMENT OF ENERGY
FERNALD CLOSURE PROJECT

CLIENT:
FLUOR FERNALD, INC.

PROJECT:
ON-SITE DISPOSAL FACILITY - PHASE V

TITLE:
FINAL COVER SYSTEM GRADING PLAN III - CELL 8

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

SEAL

GeoSyntec Consultants
1100 LAKE HEARN DRIVE
ATLANTA, GEORGIA 30342 USA

PROJECT NO.:	20105
CONTRACT NO.:	03FF0699
FEMP DRAWING NO.:	90X-6000-G-00417
GEOSYNTEC PROJECT NO.:	GQ3309-02.02
GEOSYNTEC DOCUMENT NO.:	FQ4-18058
SHEET NO.:	G-15A
REVISION NO.:	1B

PRE-FINAL CERTIFIED-FOR-CONSTRUCTION

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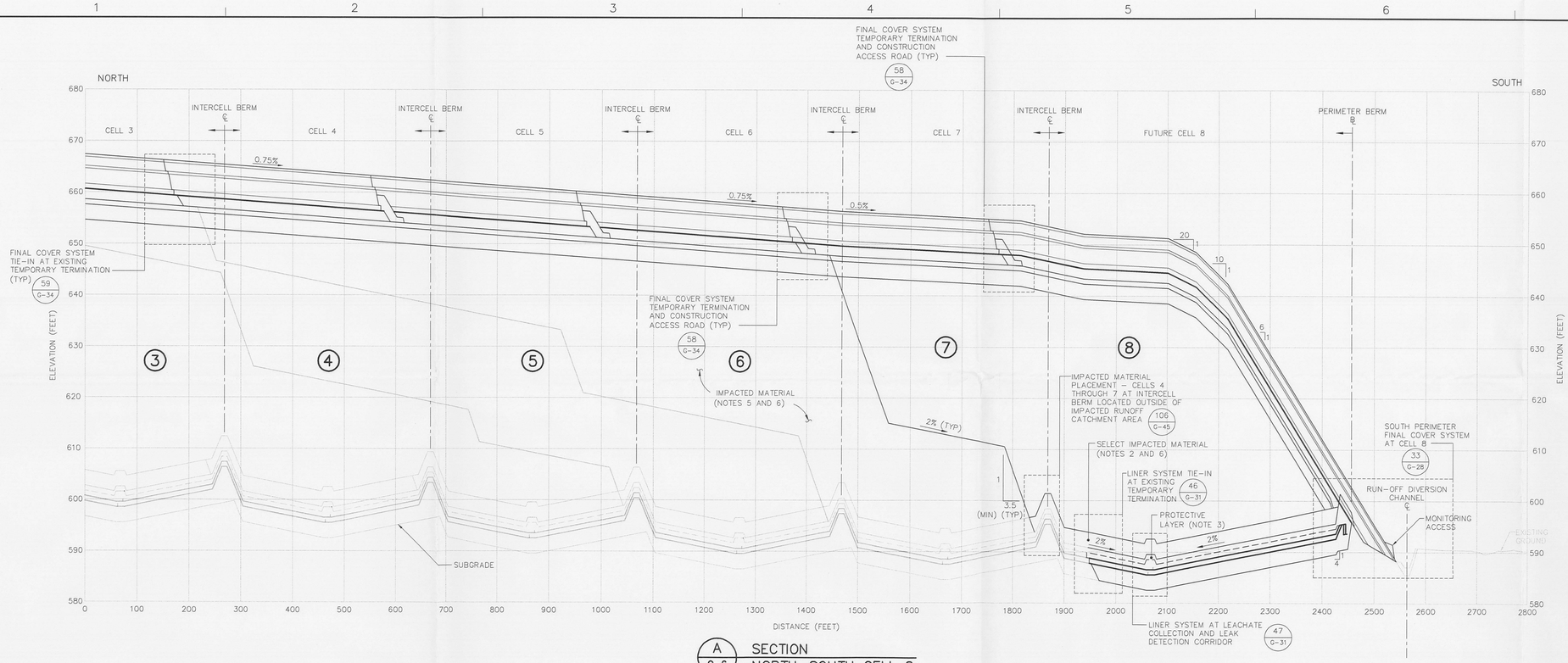
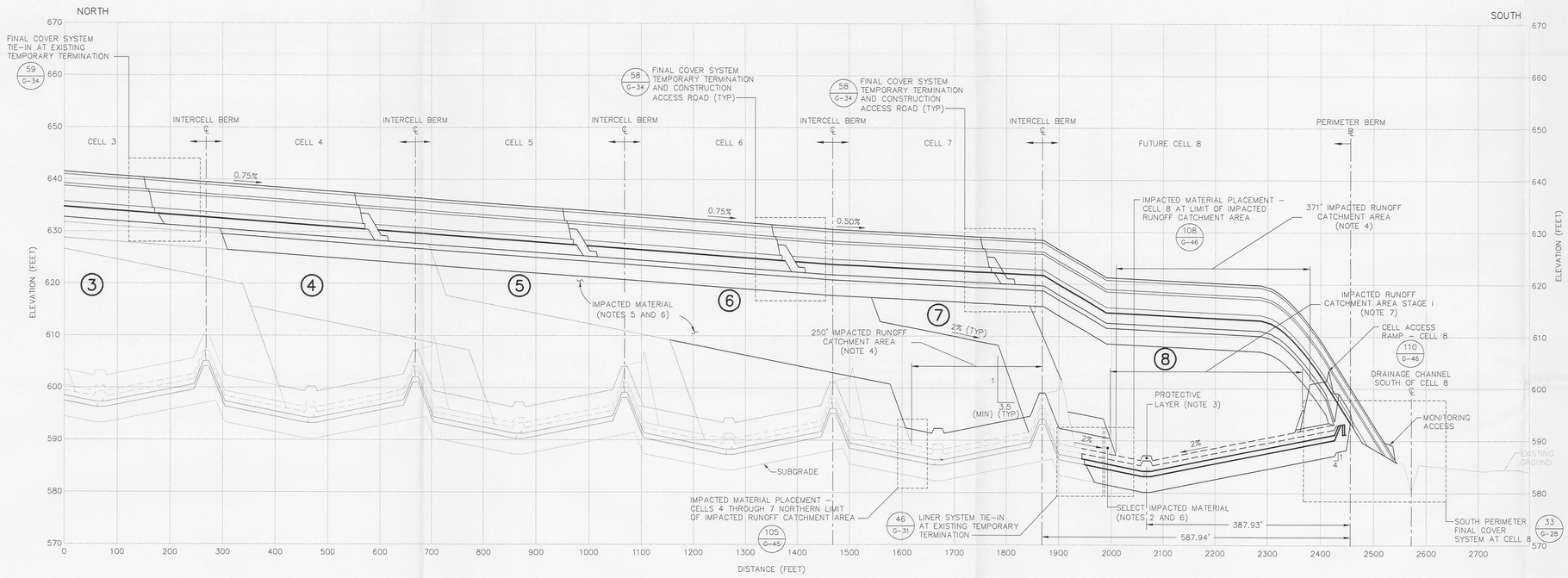


A G-6 SECTION
NORTH–SOUTH CELL 8

HORIZONTAL SCALE: 1" = 100'
VERTICAL SCALE: 1" = 10'
XREF: F04X1A252.DWG



B G-6 SECTION
NORTH–SOUTH CELL 8 AT IMPACTED RUNOFF CATCHMENT AREA

HORIZONTAL SCALE: 1" = 100'
VERTICAL SCALE: 1" = 10'
XREF: F04X1A251.DWG

NOTES:

1. SECTIONS ARE SHOWN TO SCALE AS NOTED EXCEPT FOR GEOSYNTHETICS WHICH ARE SHOWN AT AN EXAGGERATED SCALE FOR CLARITY. MATERIAL TOLERANCES SHALL BE WITHIN LIMITS GIVEN IN SPECIFICATIONS.
2. A MINIMUM THICKNESS OF 3 FEET OF SELECT IMPACTED MATERIAL SHALL BE PLACED ABOVE PROTECTIVE LAYER AND BELOW CONTOURING LAYER. THICKNESS OF SELECT IMPACTED MATERIAL OVERLYING PROTECTIVE LAYER MAY BE REDUCED TO 2 FEET IF FIRST LIFT OF IMPACTED MATERIAL TO BE PLACED OVER SELECT IMPACTED MATERIAL IS CATEGORY 1 IMPACTED MATERIAL.
3. PROTECTIVE LAYER SHALL CONSIST OF NON–IMPACTED GRANULAR MATERIAL IN IMPACTED RUNOFF CATCHMENT AREA AND IMPACTED MATERIAL IN REMAINING ACTIVE CELL AREAS EXCLUDING CELL AREA AT INTERCELL BERM TEMPORARY LINER SYSTEM TERMINATION. PROTECTIVE LAYER SHALL CONSIST OF NON–IMPACTED NON–GRANULAR MATERIAL IN ACTIVE AND FUTURE CELL AREAS OF TEMPORARY LINER SYSTEM TERMINATION. NON–IMPACTED PROTECTIVE LAYER SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02240. IMPACTED PROTECTIVE LAYER SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 13010.
4. IMPACTED RUNOFF CATCHMENT AREA IN ACTIVE CELL SHALL REMAIN OPEN UNTIL COMPACTION OF SECOND LIFT OF COMPACTED CLAY CAP IS COMPLETED IN ADJACENT UPGRADIENT CELL AND IMPACTED RUNOFF CATCHMENT AREA IN FUTURE CELL IS CONSTRUCTED AND OPERATIONAL.
5. IMPACTED MATERIAL INTERIM SLOPES SHALL BE NO STEEPER THAN 3.5H:1V. INTERIM SLOPE CONFIGURATION SHOWN IS FOR ILLUSTRATIVE PURPOSES ONLY AND MAY VARY BASED ON SEQUENCE AND SCHEDULE FOR REMOVAL OF IMPACTED MATERIAL FROM OPERABLE UNITS. EXISTING IMPACTED MATERIAL GRADES SHOWN ARE APPROXIMATE.
6. IMPACTED MATERIAL PLACEMENT SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 13010.
7. DEVELOP AND MAINTAIN CELL 8 IMPACTED RUNOFF CATCHMENT AREA AS SHOWN ON DRAWINGS G–16 AND G–46 AND IN ACCORDANCE WITH SPECIFICATION SECTIONS 13010 AND 02270.

REV. NO.	DATE	DESCRIPTION	DES. BY	DR. BY	CHK. BY	RVW. BY	APP. BY
1A	04.06.16	PRELIMINARY REVISION 1 SUBMITTAL TO FF/DOE PER DCN	TEZ	JJA	LMG	DKP	RB
0	04.01.22	CFC SUBMITTAL TO FF/DOE/EPA	KRD	JAS	KRD	DKP	RB
B	03.12.08	PRE–FINAL SUBMITTAL TO FF/DOE	KRD	JAS	KRD	DKP	RB
A	–	NOT ISSUED	–	–	–	–	–

HORIZONTAL SCALE IN FEET: 100 50 0 100 200
VERTICAL SCALE IN FEET: 10 5 0 10 20

OWNER/FACILITY:
UNITED STATES DEPARTMENT OF ENERGY
FERNALD CLOSURE PROJECT

CLIENT:
FLUOR FERNALD, INC.

PROJECT:
ON–SITE DISPOSAL FACILITY – PHASE V

TITLE:
OSDF NORTH–SOUTH SECTIONS III

THIS DRAWING MAY NOT BE ISSUED FOR PROJECT TENDER OR CONSTRUCTION, UNLESS SEALED.

SIGNATURE

DATE

SEAL

GeoSyntec Consultants
1100 LAKE HEARN DRIVE
ATLANTA, GEORGIA 30342 USA

PROJECT NO.:	20105
CONTRACT NO.:	03FF0699
FEMP DRAWING NO.:	90X–6000–G–00419
GEOSYNTEC PROJECT NO.:	GQ3309–02.02
GEOSYNTEC DOCUMENT NO.:	F04–1A042
SHEET NO.:	G–20A
REVISION NO.:	1A

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PRELIMIINARY CERTIFIED–FOR–CONSTRUCTION

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