C/007/005 Incoming
#3549

Canyon Fuel Company, LLC.
Skyline Mine
A Subsidiary of Arch Western Bituminous Group, LLC.

COPY

Gregg Galecki, Environ. Engineer
HCR 35, Box 380
Helper, UT 84526
(435) 448-2636 - Office
(435) 448-2632 - Fax

June 3, 2010

Mr. Daron R. Haddock
Division of Oil, Gas, and Mining
1594 West North Temple
Salt Lake City, Utah 84114-5801

RE: Supplemental Information for Task ID #3504, Winter Quarters Ventilation Facility (WQVF), Canyon Fuel Company, LLC, Skyline Mine, C/007/005,

Dear Daron:

Attached to this letter is pertinent information in response to the Technical Analysis for Winter Quarters Ventilation Facility, Task #3504 dated May 17, 2010. For technical review convenience, a Deficiency Response document is attached. This document cites the regulation listed in the 'Summary of Permit Deficiencies' from Task #3504, summarizes how the deficiency has been addressed, and specifies the location (M&RP section and page) of the modification. Please note that in addition to responses to the listed deficiencies, a copy of the Affidavit of Publication of the WQVF Public Notice is attached.

Of the six (6) items identified in the May 17, 2010 letter, items 2. and 3. are still pending the execution of the land agreement with the Allred Family trust which has still not been finalized. This information will be submitted as soon as it is available.

Attached to this cover letter are completed C1 and C2 forms, three (3) copies of redline/strikeout text of the M&RP modified information, numerous plates and engineering report, and one (1) Compact Disc (CD) containing the complete submittal package. One copy of the submittal was delivered directly to the Price Field Office.

If you have any questions regarding this information, please give me a call at (435) 448-2636.

Sincerely,

Gregg A. Galecki

Gregg A. Galecki
Canyon Fuel Company, LLC.
Environmental Engineer – Skyline Mines

Enclosures

File in:
☐ Confidential
☒ Shelf
☐ Expandable
Date Folder 060810 C/0070005
See: Incoming

RECEIVED
JUN 08 2010
DIV. OF OIL, GAS & MINING

APPLICATION FOR COAL PERMIT PROCESSING

COPY

Permit Change ☒ New Permit ☐ Renewal ☐ Exploration ☐ Bond Release ☐ Transfer ☐

Permittee: Canyon Fuel Company, LLC
Mine: Skyline Mine **Permit Number:** C/007/005
Title: Winter Quarters Ventilation Facility
Description, Include reason for application and timing required to implement:
Supplemental Information for Task #3504.

Instructions: If you answer yes to any of the first eight (gray) questions, this application may require Public Notice publication.

☒ Yes ☐ No 1. Change in the size of the Permit Area? Acres: 7.93 Disturbed Area: ____ ☐ increase ☐ decrease.
☐ Yes ☒ No 2. Is the application submitted as a result of a Division Order? DO# ____
☐ Yes ☒ No 3. Does the application include operations outside a previously identified Cumulative Hydrologic Impact Area?
☐ Yes ☒ No 4. Does the application include operations in hydrologic basins other than as currently approved?
☐ Yes ☒ No 5. Does the application result from cancellation, reduction or increase of insurance or reclamation bond?
☐ Yes ☒ No 6. Does the application require or include public notice publication?
☒ Yes ☐ No 7. Does the application require or include ownership, control, right-of-entry, or compliance information?
☐ Yes ☒ No 8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
☐ Yes ☒ No 9. Is the application submitted as a result of a Violation? NOV # ____
☐ Yes ☒ No 10. Is the application submitted as a result of other laws or regulations or policies?
Explain: ____
☒ Yes ☐ No 11. Does the application affect the surface landowner or change the post mining land use?
☐ Yes ☒ No 12. Does the application require or include underground design or mine sequence and timing? (Modification of R2P2)
☒ Yes ☐ No 13. Does the application require or include collection and reporting of any baseline information?
☒ Yes ☐ No 14. Could the application have any effect on wildlife or vegetation outside the current disturbed area?
☒ Yes ☐ No 15. Does the application require or include soil removal, storage or placement?
☒ Yes ☐ No 16. Does the application require or include vegetation monitoring, removal or revegetation activities?
☒ Yes ☐ No 17. Does the application require or include construction, modification, or removal of surface facilities?
☒ Yes ☐ No 18. Does the application require or include water monitoring, sediment or drainage control measures?
☒ Yes ☐ No 19. Does the application require or include certified designs, maps or calculation?
☐ Yes ☒ No 20. Does the application require or include subsidence control or monitoring?
☒ Yes ☐ No 21. Have reclamation costs for bonding been provided?
☒ Yes ☐ No 22. Does the application involve a perennial stream, a stream buffer zone or discharges to a stream?
☐ Yes ☒ No 23. Does the application affect permits issued by other agencies or permits issued to other entities?

Please attach three (3) review copies of the application. (This number includes a copy for the Price Field Office.)

I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments, undertakings, and obligations, herein.

Wesley K Sorensen
Print Name

Wesley K Sorensen
Sign Name, Position, Date
General Manager 6/3/10

Subscribed and sworn to before me this 3 day of June, 20 10

Susan Rosenlof
Notary Public

My commission Expires: 6-26, 20 12
Attest: State of Utah } ss:
County of Sanpete

SUSAN ROSENLOF
NOTARY PUBLIC-STATE OF UTAH
COMMISSION# 574871
COMM. EXP. 6-26-2012

For Office Use Only:	Assigned Tracking Number:	Received by Oil, Gas & Mining
		RECEIVED JUN 08 2010 DIV. OF OIL, GAS & MINING

Form DOGM- C1 (Revised 3/22/2010)

APPLICATION FOR COAL PERMIT PROCESSING

Detailed Schedule Of Changes to the Mining And Reclamation Plan

COPY

Permittee: Canyon Fuel Company, LLC

Mine: Skyline Mine **Permit Number:** C/007/005

Title: Supplemental information for Task ID #3504. Winter Quarters Ventilation Facility

Provide a detailed listing of all changes to the Mining and Reclamation Plan, which is required as a result of this proposed permit application. Individually list all maps and drawings that are added, replaced, or removed from the plan. Include changes to the table of contents, section of the plan, or other information as needed to specifically locate, identify and revise the existing Mining and Reclamation Plan. Include page, section and drawing number as part of the description.

Add	Replace	Remove	DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐	☒	☐	Section 1; pages 1-20
☒	☐	☐	Section 1, Appendix 118; Affidavit of Publiction - Public Notice for Winter Quarters Ventilation Facility
☒	☐	☐	Section 4.9, Figures 4.9-B and 4.9-C
☒	☐	☐	Engineering Calculations Vol. 5, Vol. 2 - Section 24; Winter Quarters Ventilation Shaft Pad Runoff and Sediment Control Design Report - EarthFax Engineering, Inc. (TEXT OF REPORT ONLY - pages 1-23, Figures and appendicies in #3504)
☒	☐	☐	Attachement A for EarthFax Engineering, Inc. report
☒	☐	☐	Plates 3.2.4-3A, 3.2.4-3B, 3.2.4-3D, 3.2.4-3E, 4.4.2-3A
☐	☐	☐	
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Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.	Received by Oil, Gas & Mining
Three (3) redline-strikout copies of the submittal. Two (2) hard copies and one (1) CD to the Salt Lake Office, and one (1) hard copy to the Price Field Office.	RECEIVED JUN 08 2010 DIV. OF OIL, GAS & MINING

CANYON FUEL COMPANY, LLC.
SKYLINE MINE

WINTER QUARTERS VENTILATION FACILITY
Supplemental Information to Task #3504

June 2010

SUPPLEMENTAL INFORMATION
TASK #3504

The following is intended to serve as a guide for the technical reviewer to help identify how deficiencies identified in Task #3504 were addressed. The regulation and deficiency identified in Task #3504 is follow with an italicized response.

1. **(R645-112.600)** Drawing 1.6-2 shows that the property owned by George E. and Helene Liodakis & Liodakis Ranch, LLC is adjacent to the permit area with the construction of the Winter Quarters Ventilation Facility; however, their name and address does not appear on the list of owners on page 1-20.

   Page 1-20 has been modified to include George Liodakis' name and address.

2. **(R645-301-114.100)** Prior to final approval, please provide the date of execution of the deed from the Allred Family Trust to Ark Land Company.

   Ark Land Company and the Allred Family Trust are still working out the details of the agreement. Information will be submitted as soon as it is available.

3. **(R645-301-115.100)** Prior to final approval, please submit a copy of the approval recommendation from the Carbon County Planning Commission granting a Conditional Use Permit to construct and operate a ventilation facility in Winter Quarter's Canyon.

   A copy of the Conditional Use Permit will be included in the future once the road access and right-of-way is verified with the Allred Family Trust agreement.

4. **(R645-301-512)** Within the submittal, the applicant included a schematic cross section of the ventilation shaft as well as a schematic cross section of the mine slope. The schematic depicts the designs for shaft backfill. Neither of the cross sections (Figures 4.9B, 4.9C) appears to have been certified by a qualified registered professional engineer, and there does not appear to be any drawings or cross sections of the escape shaft. There is not enough information provided in terms of drawings, plans, cross sections, etc. of the shafts and slopes to be considered adequate. For purposes of completeness, the applicant should provide a certified map (rather than just a schematic figure within the text) that includes all relevant details pertaining to both shafts and the slope. The map should be complete enough to be certified by a professional engineer. Depictions of the shaft should be split or otherwise presented as to allow for the drawings to be scaled. The applicant stated, "Appropriate maps will be certified when the

application is approved and clean copies are provided". The maps depicting the shafts and slope are not yet complete enough to warrant approval.

Figure 4.9B has been modified to include both a vent and escape shaft (separately). Figure 4.9C was modified to include a height on the entry.

All drawings requiring PE certification will be certified when clean copies are submitted (at Conditional Approval).

5. **R645-3012-731.600, -742.111, -112, and 113,** It is unlikely that simply allowing the water to follow the roughly 150-foot long "natural" path from the riprap pad at the outfall of the ASCA 39 culvert, across the road and along the topsoil pile berm to the stream will prevent additional contributions of sediment to Winter Quarters Creek or minimize erosion.

   The Division finds that operation of the WQVF as shown on the submitted plans is likely to cause or contribute to the violation of applicable water quality standards and may adversely affect the water quantity and quality or other environmental resources of Winter Quarters Creek. Before the Division can authorize coal mining and reclamation operations at the WQVF, the Permittee must finish the runoff control design and provide a plan to control the flow over the approximately 150-foot path between the riprap pad at the outfall from the ASCA 39 culvert and Winter Quarters Creek.
   The Permittee must also either demonstrate that similar treatment is not needed for the flows leaving the riprap pads at the sedimentation pond spillways, the topsoil pile sediment trap, and the Upper Road culvert or provide the designs for such treatment.

   150-foot path (ASCA 39)
   The HydroCAD modeling in Attachment A has been modified to better demonstrate the engineering designs adequately prevent additional contributions of sediment to Winter Quarters Creek and minimize erosion.

   Page 70 of 85 (10yr, 24 hr ASCA) indicates the velocity of water in the Riprap below the ASCA culvert has a maximum velocity of 1.34 fps and an average velocity of 0.31 fps.

   Page 68 of 85 (10yr, 24 hr ASCA) indicates the velocity of water on the road leaving the riprap (assuming the road is improved to have a gravel surface) has a maximum velocity of 2.37 fps and an average velocity of 0.56 fps.

   Page 72 of 85 (10yr, 24hr ASCA) indicates the velocity of the water coming from the road and running down the Topsoil Berm ditch has a maximum velocity of 2.41 fps and an average velocity of 0.92 fps.

The three (3) HydroCAD models listed above adequately demonstrate both erosion and additional contributions of sediment to Winter Quarters Creek has been minimized.

Riprap Pads (Sediment Pond Outfall, Upper Road Culvert, Topsoil Pile Sediment Trap)

The Sediment Pond Outfall riprap is modeled using The HydroCAD program located in Attachment A page 39 of 85. The modeling indicates both a maximum and average velocity of 3.58 fps. Page 40 of 85 provides the FlowMaster modeling imbedding 12 to 24-inch boulders in the riprap, which reduces the velocity to 1.63 fps. Plate 3.2.4-3D and page12 of the EarthFax engineering report has been modified to reflect the addition of placing 12 to 24-inch boulders on top of the riprap to additionally reduce velocities and spread out the flow.

The Upper Road HydroCAD report begins on page 74 of 85 of Attachment A. Page 76 indicates the riprap has an average velocity of 2.31 fps and a maximum velocity of 2.43 fps. Page 77 provides the FlowMaster modling of imbedding 12 to 24-inch boulders in the riprap, which reduces the velocity to 1.25 fps. Plates3.2.4-3A, 3B, 3E, 4.4.2-3A, and page 15 of the EarthFax engineering report has been modified to reflect both a lengthening from 10 feet to 25 feet, and widening form 5 feet to 10 feet of the riprap channel. In addition to the lengthening and widening, 12 to 24-inch boulders have been placed on top of the 6-inch, D_{50} riprap.

The Topsoil Pile Sediment trap HydroCAD report begins on page 50 of 85 of Attachment A. Page 55 indicates the sediment trap will not discharge with a designed 10 year, 24-hour storm event. The riprap has been added as a precautionary measure in excess of the designed event.

6. **R645-301-742.120,** ASCAs 37, 38, and 39 are shown on Drawings 3.2.4-3A and 3.2.4-3B, but they are not correct on 3.2.4-3B: the Permittee must correct the ASCA outlines on Drawing 3.2.4-3B.

Plate 3.2..4-3B has been modified to appropriately illustrate the boundaries of ASCAs 37, 38, and 39. Plates 3.2.4-3A and 3.2.4-3B the ASCAs similarly.

Utah Power & Light Company
1407 West North Temple
Salt Lake City, Utah 84110

Helen Marakis
160 East 1st South
Price, Utah 84501

United States of America
Department of Agriculture
U.S. Forest Service
599 West Price River Drive
Price, Utah 84501

Virginia W. Mower
56 West 200 South
Fairview, Utah 84629

Kanawha & Hocking Coal & Coke Co.
P.O. Box 507
Clear Creek, Utah 84501

Euray Allred
P.O. Box 35
Fountain Green, Utah 84632

Nick and Koula Marakis
150 East 1st South
Price, Utah 84501

Bessie Oman (Milton)
61 South Main
Salt Lake City, Utah 84115

Greek Orthodox Church (Helinic)
P.O. Box 688
Price, Utah 84501

Union Pacific Railroad
1416 Dodge Street
Omaha, Nebraska 68179-0001

David G. and Rene L. Cunningham
995 East Hillside Drive
Provo, Utah 84604

George E. Liodakis
2655 E. Chalet Circle
Sandy, Utah 84093

The following list contains the names and addresses of the owners of mineral acreage contiguous to the mine permit boundary and are illustrated on Drawing 1.6-2 (excluding the waste rock disposal area and rail loadout):

Carbon County, Utah
Court House
Price, Utah 84501

Peper Estate
975 West 600 South
Orem, Utah 84058

C&B Coal
975 West 600 South
Orem, Utah 84058

Utah Power and Light Company
1407 West North Temple
Salt Lake City, Utah 84110

James and Linda Tracy
3148 North Timpview Drive
Provo, Utah 84604

United States of America
Department of the Interior
Bureau of Land Management
2370 South 2300 West
Salt Lake City, Utah 84119

Ark Land
City Place One Suite 300
St. Louis, Missouri 63141

Energy Fuels
Three Park Central, Suite 900
1515 Arapahoe
Denver, Colorado 80202

David G. and Rene L. Cunningham
995 East Hillside Drive
Provo, Utah 84604

AFFIDAVIT OF PUBLICATION

STATE OF UTAH)

ss.

County of Carbon,)

I, Richard Shaw, on oath, say that I am the Publisher of the Sun Advocate, a twice-weekly newspaper of general circulation, published at Price, State a true copy of which is hereto attached, was published in the full issue of such newspaper for 4 (Four) consecutive issues, and the first publication was on the 6th day of April, 2010, and that the last publication of such notice was in the issue of such newspaper dated the 27th day of April 2010.

Richard Shaw – Publisher

Subscribed and sworn to before me this 27th day of April, 2010.

Notary Public My commission expires January 10, 2011 Residing at Price, Utah

Publication fee, $ 499.20

LINDA THAYN
NOTARY PUBLIC-STATE OF UTAH
546 EAST MAIN
PRICE, UTAH 84501
COMM. EXP. 01-10-2011

PUBLIC NOTICE

Canyon Fuel Company, LLC, of Grand Junction, Colorado, has filed a complete application with the Division of Oil, Gas and Mining (DOGM) for a revision of the existing Mining and Reclamation Plan, C/007/005 for the Skyline Mine. The mine is located approximately 6 miles southwest of the town of Scofield, Utah in Eccles Canyon.

The revision includes the addition of a ventilation facility and 7.93 permitted acres located approximately 2 miles up the Winter Quarters Canyon west of the town of Scofield, Utah. Upon approval, DOGM will revise the permit to include the ventilation facility in the permit area.

According to the Scofield, Utah, USGS 7.5 minute topographic map, the Winter Quarters Ventilation Facility location is defined as follows:

PROPOSED PERMIT AREA MODIFICATION

Section 1, Township 13 South, Range 6 East, Salt Lake Base Meridian

Beginning at a point located at the centerline of Winter Quarters Creek which is 2,299 feet south and 1,482 feet west from the northeast corner of Section 1, Township 13 South, Range 6 East, Salt Lake Base Meridian; thence North 190 feet; thence West 1,466 feet; thence South 317 feet to the centerline of Winter Quarters Creek; thence easterly approximately 1,479 feet along the centerline of Winter Quarters Creek to the point of beginning.

A copy of the application will be available for inspection at the following locations:

Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
Salt Lake City, Utah 84114

Carbon County Courthouse
120 East Main Street
Price, Utah 84501

The address of the applicant is:

Canyon Fuel Company, LLC.
225 North 5th Street, Suite 900
Grand Junction, Colorado 81501
Phone: (970) 263-5130

Written comments or request for a hearing regarding this application must be submitted within 30 days of the last publication date of this notice, to the Utah Division of Oil, Gas and Mining, Attention Coal Regulatory Program, 1594 West North Temple, Suite 1210, Salt Lake City, Utah 84114-5801.

Published in the Sun Advocate April 6, 13, 20 and 27, 2010.

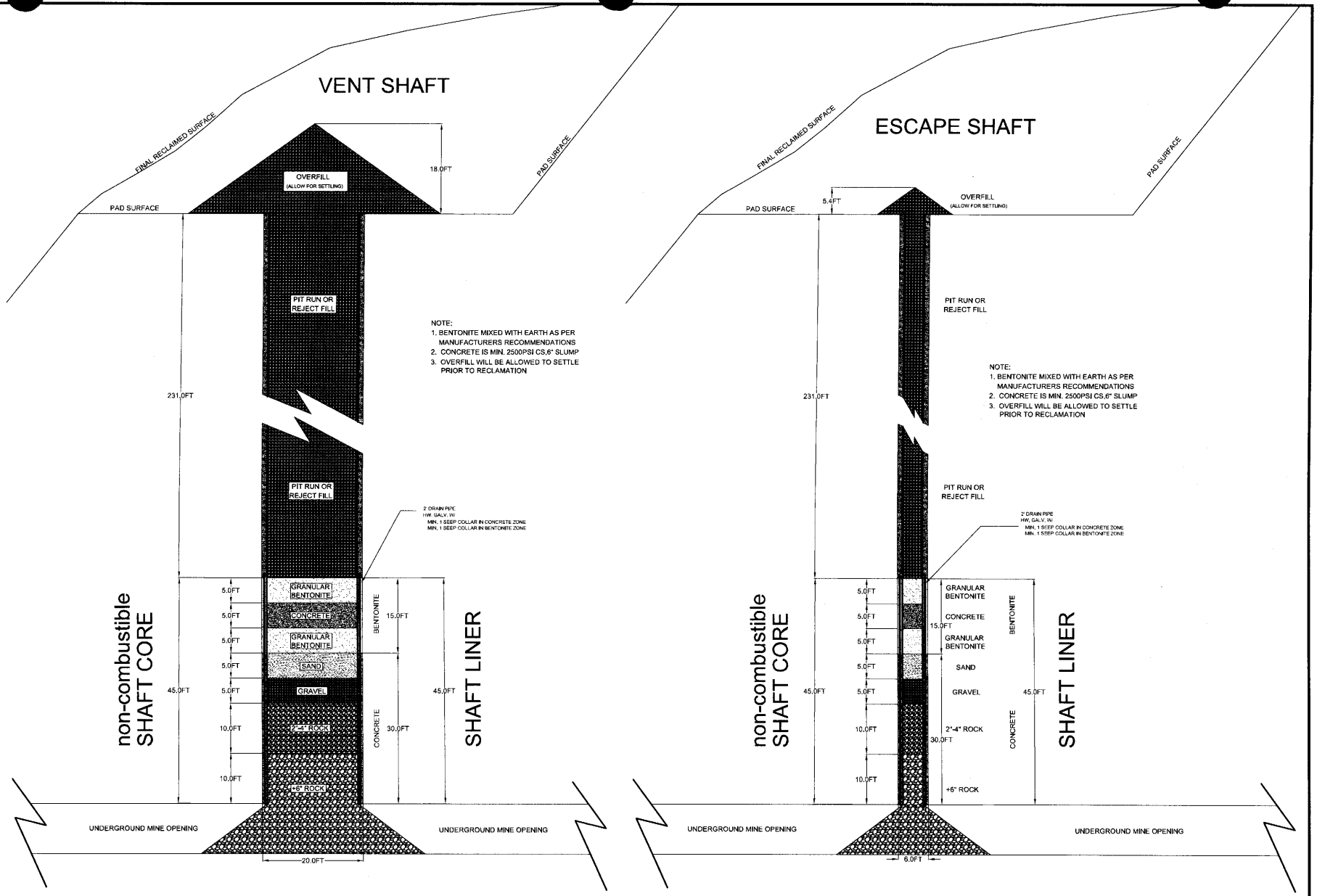

Figure: 4.9-B
Winter Quarters Ventilation Facility
Vent/Escape Shaft

Canyon Fuel Company, LLC
HC35 BOX 380, HELPER, UTAH 84526
435-448-8463
Skyline Mines

SCALE:	DATE: 3-22-10	CK.BY:GAG	REVISION: 0
DWG. NO.: 4.9-B		DR.BY:JF	3/22/2010
CAD FILE:			

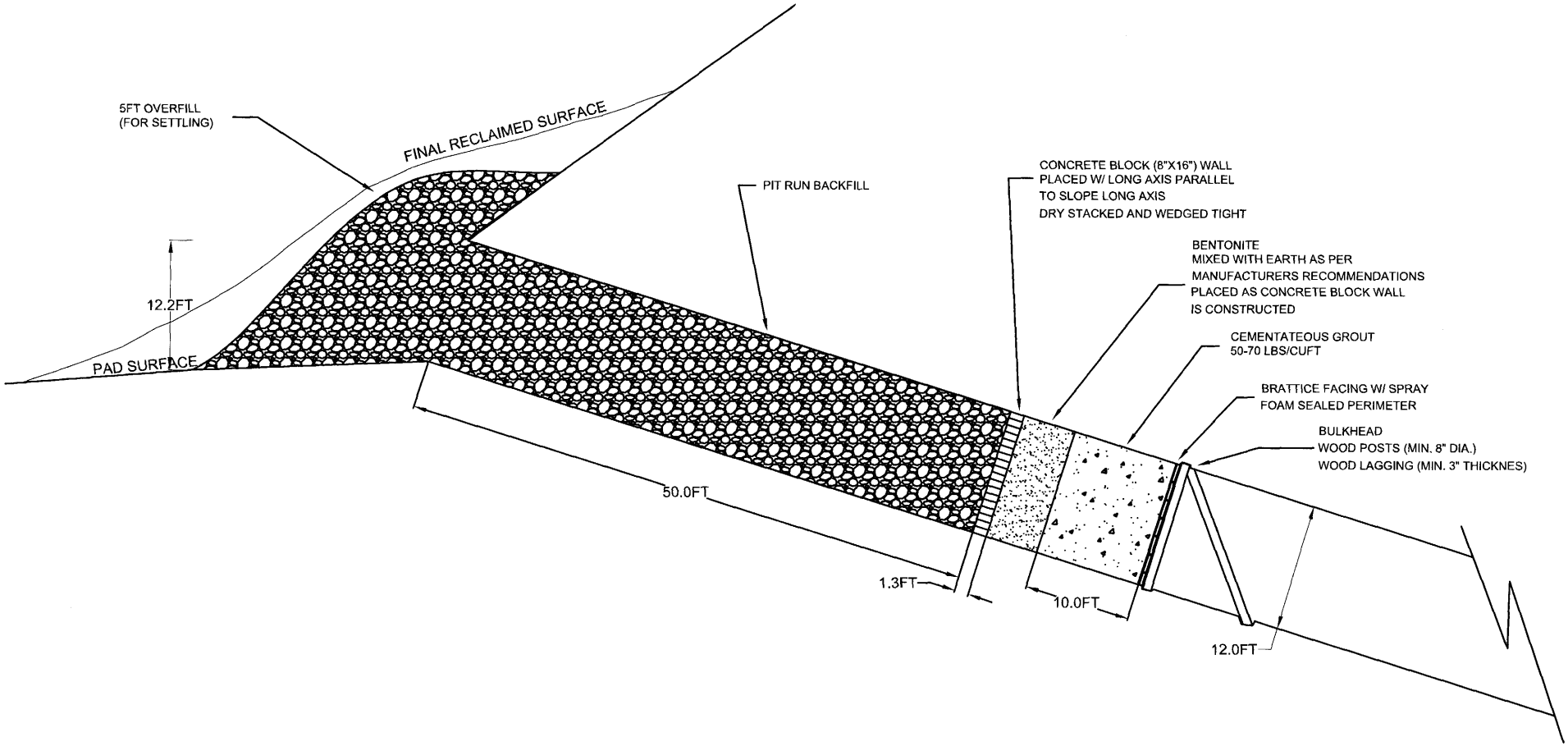

Figure: 4.9-C
Winter Quarters Ventilation Facility
Slope

Canyon Fuel Company, LLC
HC35 BOX 380, HELPER, UTAH 84526
435-448-6483
Skyline Mines

SCALE:	DATE: 5-24-10	CK.BY:GAG	REVISION:
DWG. NO.: 4.9-C		DR.BY:JF	0
CAD FILE:			3/22/2010

Winter Quarters
Ventilation Shaft Pad
Runoff and Sediment Control Design Report

Canyon Fuel Company
Skyline Mine
Scofield, Utah

June 2010

EarthFax EarthFax Engineering, Inc.

Engineers / Scientists
www.earthfax.com

TABLE OF CONTENTS

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LIST OF ATTACHMENTS

WINTER QUARTERS VENTILATION AND MINE SLOPE PAD RUNOFF AND SEDIMENT CONTROL DESIGN REPORT, SKYLINE MINE

CHAPTER 1
INTRODUCTION

Canyon Fuel Company is planning the construction of a vertical ventilation shaft, a sloped mine portal, and an emergency escape shaft in Winter Quarters Canyon to service the Skyline Mine. The surface pad for these additional shafts will be constructed about 2 miles southwest of the town of Scofield in Carbon County, Utah (Figure 1). To prevent adverse hydrologic impacts to Winter Quarters Creek and the surrounding area, the mine will construct a runoff sediment control system including a sedimentation pond.

The purpose of this document is to present design information for the runoff and sediment controls. A sedimentation pond is being designed as a temporary impoundment intended to contain sediment and runoff discharges from the disturbed areas. The runoff and sediment controls have been designed to conform to the applicable criteria outlined in the Utah Administrative Code Titles R645-300 and 301. This document has been prepared for Canyon Fuel Company by EarthFax Engineering, Inc., and contains the following information:

- Location and background information;
- Hydrologic analyses to determine runoff and sediment discharge for design storm events;
- Sediment control and sedimentation pond sizing and design criteria;
- Slope stability analyses for sedimentation pond embankments and cut highwalls; and
- Runoff conveyance system, sedimentation pond and topsoil sediment trap construction specifications.

Engineering calculations are included as attachments to this document.

CHAPTER 2
LOCATION AND BACKGROUND INFORMATION

The general layout of the proposed Winter Quarters facility is shown on Plate 3.2.4-3A. The watershed area contributing to the sedimentation pond is approximately 3.69 acres, which includes the pad areas for the ventilation shaft, sloped mine portal, emergency escape shaft, the power substation, sedimentation pond, and part of the access road. The watershed also includes nearby undisturbed drainage areas that can not be reasonably diverted. The watershed contributing to the topsoil sediment trap is approximately 0.61 acres, and includes only the topsoil stockpile area contained within the topsoil berm. The watershed area contributing to the alternative sediment control area (ASCA) along the access road is approximately 1.01 acres, and includes the remaining section of the access road not included in the sedimentation pond area and the undisturbed area below the upper road and above the access road. Construction is planned for 2010.

The sedimentation pond has been designed to contain storm runoff and sediment discharge as specified in the Utah Administrative Code Titles R645-301-742 and 743. Thus, the pond has been designed to comply with the following criteria:

- The pond will contain the runoff from a 10-year, 24-hour storm event in addition to sediment yielded from its catchment area.
- The pond will safely convey the peak flow resulting from a 25-year, 6-hour storm event immediately following a 10-year, 24-hour storm event via an 18-inch diameter riser primary spillway. An emergency spillway will also be constructed along the eastern edge of the pond and will pass the same storm event if the primary outlet fails. Additionally, a dewatering valve will be installed above the sediment storage elevation to drain the impoundment after a storm event once water-quality criteria are met.
- All embankments surrounding the pond have been evaluated for slope stability. They have been designed with a minimum factor of safety of 1.3 against rotational shear failure when the pond is filled to capacity.

- The pond will be constructed from native or imported materials. The embankment will not be constructed from coal mine waste rock.

The topsoil sediment trap has been designed to contain storm runoff and sediment discharge as specified in the Utah Administrative Code Titles R645-301-742 and 743. Thus, the sediment trap has been designed to comply with the following criteria:

- The sediment trap will contain the runoff from a 10-year, 24-hour storm event in addition to sediment yielded from its catchment area.
- The sediment trap will be constructed from native or imported materials. The embankment will not be constructed from coal mine waste rock.

The runoff conveyance systems associated with this facility have been designed to safely convey site runoff as specified in the Utah Administrative Code Titles R645-301-742 and 743. Thus, the conveyance systems have been designed to comply with the following criteria:

- The conveyance system will safely convey the runoff from a 10-year, 24-hour storm event.
- All of the side slopes of the swale and ditches have been designed to prevent channel degradation and erosion.
- The swale, ditches, and berms will be constructed from native or imported materials and not from coal mine waste rock.
- The culvert outfall will be riprap armored to prevent erosion.

The upper road runoff conveyance system has been designed to safely convey upstream runoff as specified in the Utah Administrative Code Titles R645-301-742 and 743. Thus, the conveyance systems have been designed to comply with the following criteria:

- The ditch, catch basin, and culvert have been designed to safely convey runoff from a 100-year, 6-hour storm event.
- The ditch will be constructed from native or imported materials and not from coal mine waste rock.
- The culvert outfall will be riprap armored to prevent erosion.

The ASCA would increase the sedimentation pond by approximately 20%. To prevent cutting north further into the existing slope below the access road and possibly increase slope instability, the sedimentation pond was not designed to contain runoff and sediment from the ASCA. The ASCA system has been designed to safely convey site runoff as specified in the Utah Administrative Code Titles R645-301-742 and 743. Thus, the conveyance systems have been designed to comply with the following criteria:

- The conveyance system will safely convey the runoff from a 10-year, 24-hour storm event.
- All of the side slopes of the ditches have been designed to prevent channel degradation and erosion.
- The ditches and berm will be constructed from native or imported materials and not from coal mine waste rock.
- The culvert outfall will be riprap armored to dissipate runoff.
- Wattles (erosion control log) placed around the inlet of the ASCA catch basin will be installed according to manufacturers specifications.

CHAPTER 3
OPERATIONAL HYDROLOGY

3.1 Hydrology Introduction

Storm water discharge for the area was calculated using HydroCAD version 9.1. The curve number (CN) value used was assigned for the Winter Quarters Canyon based on sub-basin soil types and vegetation cover type. According to Natural Resources Conservation Service native soil types are categorized as Hydrologic Soil Group B. Much of the native vegetation at the site is sagebrush and grass in fair to good condition.

Design storm magnitudes were taken from the National Oceanic and Atmospheric Administration (NOAA) ATLAS 14, Point Precipitation Frequency Estimates web page (http://hdsc.nws.noaa.gov/hdsc/pfds/sa/ut_pfds.html). Upstream and site watershed areas and average slopes were calculated from 2-foot contour interval topographic map by Psomas Engineering (Psomas 10/15/08) using AutoCad 2008 software. All storm runoff calculations are included in Attachment A.

3.2 Drainage Area Characteristics

The drainage areas contributing to the sedimentation pond, topsoil sediment trap, upstream, and ASCA watersheds are delineated in Plate 3.2.4-3G. The area draining to the sedimentation pond includes both disturbed and undisturbed areas: disturbed watersheds DW-1 through DW-4, undisturbed watersheds UDW-2 and UDW-3, and the sedimentation pond watershed (SPW). The area draining to the topsoil sediment trap includes only the topsoil stockpile watershed (TSW). The upstream watershed includes the undisturbed watershed UDW-1. The area drainage to the ASCA includes both undisturbed and disturbed areas: disturbed watershed DW-5, undisturbed watershed UDW-4 and UDW-5.

Watershed DW-1 consists of the highwall west, north and east of the ventilation shaft and extends east to the sloped mine portal. The highwall consists of 0.5 horizontal to 1 vertical cut face with 10 foot wide benches for every 20 feet in height, the tallest part of this wall is 60 feet high. A berm above the highwall will direct runoff from the undisturbed area above the highwall into the pad swale. Watershed DW-2 consists of the west half of the ventilation shaft pad, immediately south of DW-1. This pad area is sloped toward the pad swale along the north highwall at 2%. The vertical ventilation shaft, sloped mine portal and emergency access shaft are located within this watershed. Watershed DW-3 consists of the area along the highwall east of the sloped mine portal and north of the east half of the ventilation shaft pad and access road. This highwall is sloped at 0.5 horizontal to 1 vertical with a maximum height of 25 feet. Runoff from this watershed flows south into the access road ditch. Watershed DW-4 consists of the west half of the ventilation shaft pad, immediately south of DW-3. This area of the pad is sloped toward the access road ditch at 2%. From the access road ditch runoff enters the access road catch basin, runoff is then conveyed through a culvert under the access road and into the sedimentation pond (see Plates 3.2.4-3E and 3.2.4-3F). The power substation and field office are located within this watershed.

Watershed DW-5 consists of the east half of the access road and the portion of the existing road to be improved for site access. The access road is sloped toward the ASCA ditch at 2% to 5%, the access road is sloped toward a vertical curve in the middle of this watershed at 0 to 8.4%. The highwall above the access road is sloped at 0.5 horizontal to 1 vertical with a maximum height of 25 feet.

Watershed UDW-1 consists of the 46.83 acre area north of the upper road uphill from the site to the top of the ridge above the site. The average slope within this watershed is 40%, with vegetation consisting of sagebrush and grass. Runoff from this watershed will flow south to the upper road ditch. The upper road ditch will convey runoff to a culvert inlet on the north side of

the intersection of the site access road and the upper road. This culvert will convey runoff under the road and into the upper road catch basin. From the upper road catch basin, runoff will flow to a riprap pad 30 feet north of the Winter Quarters Creek. From the riprap pad runoff will flow into Winter Quarters Creek.

Watershed UDW-2 consists of the area north of DW-1 and south of the upper road. Watershed UDW-3 consists of the area north of DW-3 and south of the upper road. Runoff from this watershed will flow into DW-3 and then into the access road ditch. The average slope within both of these watersheds is 40%, with vegetation consisting of sagebrush and grass.

Watershed UDW-4 consists of the area north of DW-5 and south of the upper road. Runoff from this watershed will flow into DW-5 and then into the ASCA ditch. The average slope within the watershed is 50%, with vegetation consisting of sagebrush and grass. Watershed UDW-5 consists of the area south of DW-5 and north of the topsoil stockpile. This area includes a portion of the existing road from immediately below the upper road culvert inlet to the topsoil stockpile.

Runoff from the UDW-4 and DW-5 watershed will flow into the ASCA ditch. From the ASCA ditch runoff enters the ASCA catch basin. Runoff is then conveyed through a culvert under the access road and into riprap located north of the existing road, to dissipate and spread runoff. From this culvert outlet, runoff from UDW-5 and the culvert will flow across the existing road, as it currently does, and into the north side of the topsoil berm. The topsoil berm will direct runoff into Winter Quarters Creek (see Plates 3.2.4-3E and 3.2.4-3F).

3.3 Runoff Volume Calculations

Results of the runoff calculations are provided in Appendix A. HydroCAD was used in conjunction with precipitation data from The National Oceanic and Atmospheric Administration Atlas 14 to calculate runoff for the site. The runoff volumes are presented in the HydroCAD worksheets. Total runoff volume discharge to the sedimentation pond resulting from the 10-year, 24-hour storm event is 4,182 cubic feet. Total runoff volume discharge to the topsoil sediment trap from the 10-year, 24-hour storm event is 445 cubic feet.

3.4 Sediment Volume Calculations

The average annual anticipated sediment yield to the sedimentation pond and ASCA was calculated using an adaptation of the Universal Soil Loss Equation that was developed by the Utah Water Research Laboratory (Israelsen et al., 1984). This method estimates the average annual sediment yield per acre based on the following equation:

$$A = R \cdot K \cdot LS \cdot VM$$

Where A = Average annual sediment yield in tons per acre
R = Precipitation factor based on site location
K = Soil erodibility factor
LS = Slope length and steepness factor
VM = Erosion control factor

A copy of the instructions for obtaining input variables for this equation is included in Table 1 and 2 and Attachment B.

This method assumes that all the soil mobilized by erosion in the entire watershed travels

down slope to the sedimentation pond and ASCA (i.e., a sediment delivery ratio of 1.0). Thus, the sediment volume predicted by this equation is conservatively high.

The average annual sediment yield in tons per acre for each watershed was multiplied by that watershed's area to find the annual weight of sediment participated from the area. This value was then divided by the saturated density of the affected soil types to find a volume (the saturated density was used since erosion would occur during precipitation events and would thus involve saturated soil). Finally, the volumes for each watershed were summed to determine the total annual yield of the area draining into the sedimentation pond and the ASCA. The maximum calculated annual sediment yield for the area draining to the sedimentation pond is 1,108 cubic feet and ASCA is 183 cubic feet.

Derivations of each factor in the sediment yield equation for each of the watershed are summarized below:

- The value for R was obtained from an isoerodent precipitation map of Utah (Israelsen et al., 1984).
- Values for K were obtained for the native soils from the online NRCS soils database.
- Values for LS were calculated using the algorithms provided by Israelsen et al. (1984). Slope angles were read from the topographic map of the site (2 foot contour interval). Linear interpolation was used for slope values to more accurately model watersheds DW-2 and DW-4 and UDW-3. Linear interpolation was also used for length value to more accurately model watershed DW-2. These calculations are presented in Table 2 and 3 and Appendix B.
- Values for VM were taken from a table provided by Israelsen et al. (1984).

CHAPTER 4
SEDIMENT CONTROL DESIGN

4.1 Sedimentation Pond, Topsoil Sediment Trap and ASCA Capacities

The sedimentation pond has been sized to contain the runoff from a 10-year, 24-hour storm event (4,182 cubic feet, see Attachment A) and one year of predicted sediment yield (1,108 cubic feet, see Table 1), for a total capacity of at least 5,290 cubic feet. The design accommodates drainage from the facilities pad and west end of the access road. It will also accommodate runoff from nearby undisturbed areas that cannot be reasonably diverted.

The stage-capacity curve for the sedimentation pond is shown in Figure 2. As noted, the sedimentation pond will have the capacity to store sediment to an elevation of 8072.1 feet, and a total storage (sediment plus runoff) to an elevation of 8075.05 feet. Sediment will be cleaned out of the pond when it reaches an elevation of 8071.65 feet (the elevation corresponding to a volume of 60% of the calculated sediment storage volume).

An 18-inch diameter riser will be installed in the sedimentation pond to act as the primary spillway, with a top elevation of 8075.05 feet. A 6-inch diameter decant pipe will be placed at an inlet elevation of 8072.1 feet, which is the elevation of the top of the sediment storage capacity. Discharge from the primary spillway will be through an 18-inch diameter, 42-foot long pipe attached to the riser at an elevation of 8071.0 feet, with an outflow elevation of 8070.0 feet.

A secondary spillway will also be constructed on the south embankment of the sedimentation pond. This spillway, which will function only in the event of a storm larger than the design storm or in the event that the primary spillway is plugged, will consist of a 5-foot wide channel with 5 horizontal to 1 vertical sides, a 5% slope across the top of the embankment, and a 50% slope down the face of the embankment. The elevation of the secondary spillway

crest will be 8075.55 feet. This is 0.5 feet above the primary spillway, and approximately 1 foot below the compacted maximum elevation of the embankment. For design details see Plates 3.2.4-3D and 3.2.4-3E.

The topsoil sediment trap has been sized to contain the runoff from a 10-year, 24-hour storm event (445 cubic feet), as indicated in Table 3 and Attachment A. The design accommodates drainage from the topsoil stockpile area. As indicated in Plate 3.2.4D, a 3-foot high silt fence will be installed within the embankment. A 4 foot wide section of the fence will be cut and sown back to allow for a spillway 6 inches below the berm height (8,056.0 feet). This design will allow containment of the 10-year, 24-hour storm event with 0.5 feet of freeboard below the spillway.

A 12-inch diameter wattle will be placed around the ASCA catch basin, causing runoff to pool and flow through the wattle and removing sediment. As flows increase during a high flow event, runoff will flow over the wattles into the ASCA catch basin. However, due to the relatively flat and long section of the ASCA ditch on either side of the ASCA catch basin, much of the sediment will still be removed. It is estimated that the average annual sediment from the ASCA will be 183 cubic feet (see Table 2). Sediment trapped by the wattle will be removed as necessary to maintain functionality. The wattle will also be replacement as necessary.

4.2 Inflow and Outflow Erosion Protection

Peak flows for the both the sedimentation pond and the topsoil sediment trap were calculated using HydroCAD version 9.1 and FlowMaster version 6.0. The results of these calculations are presented in Attachment A and summarized in Table 4. For design details, see Plates 3.2.4-3D through 3.2.4-3F.

The sedimentation pond inlet was designed to safely convey the peak flow resulting from

the 10-year, 24-hour storm event. The primary spillway on the pond was designed to discharge the 25-year, 6-hour storm event assuming that the pond was full to the top of the primary spillway at the beginning of the storm.

The sedimentation pond inlet consists of an 18-inch diameter corrugated metal pipe with a design outflow peak discharge of 1.74 cfs (cubic feet per second) at a maximum velocity of 11.04 fps (feet per second). This culvert will outlet approximately 3 feet above the bottom level of the pond. To protect the soil and prevent erosion at the pond inlet a 5-foot by 5-foot riprap pad with D_{50} = 9 inches to dissipate the runoff energy. The riprap pad will be imbedded 1 foot into the pond floor and rise 2 feet above the pond floor. This will allow the runoff to free fall only a foot before the riprap pad dissipates the flow.

The topsoil sediment trap was designed to retain the runoff volume resulting from the 10-year, 24-hour storm event. The topsoil sediment trap will consist of a 6-inch high berm along the bottom of the topsoil stockpile. The peak discharge along the edge of the berm was calculated to be 0.17 cfs with a maximum velocity of 3.10 fps. Hence, no riprap is needed to protect this berm. A 6-foot wide and 3-foot long D_{50} = 4-inch riprap pad will be placed on the down slope side of the topsoil sediment trap overflow to prevent erosion if the trap is over topped.

The sedimentation pond primary and secondary outlets were model using the 25-year, 6-hour storm event. The maximum outflow form the primary spillway during a 25-year, 6-hour storm event has been determined to be 1.09 cfs with a velocity of 3.29 fps. A 5-foot wide and 5-foot long riprap pad with a D_{50} = 2 inches will placed at the outfall. Additionally, to protect the soil and slow flow velocity at the primary spillway outfall 12-inch to 24-inch stones will be imbedded within the riprap pad to reduce the velocity to 1.63 fps. The secondary spillway consists of a 5-foot wide channel with 5 horizontal to 1 vertical sides. Assuming the pond is full to the top of the primary spillway at the beginning of the event, and the primary spillway is plugged, the maximum outflow for the secondary spillway during a 25-year, 6-hour storm event

was calculated to be 2.06 cfs with a maximum velocity of 4.69 fps. Although this velocity is low enough to preclude the need fro riprap, to protect the face of the embankment the secondary spillway channel will be armored with D_{50} = 2 inch riprap.

4.3 Sedimentation Pond and Topsoil Sediment Trap Details

The sedimentation pond embankment will have a crest elevation of 8076.5 feet, and a minimum crest width of 10 feet. The first 1.6 feet of topsoil in this area will be removed and stored within the topsoil stockpile area. The bottom of the sedimentation pond elevation (8071.0) is approximately 2 feet below the existing ground level. Given the site constraints, the sedimentation pond has been designed to fit within a flat area between a zone approximately 30 feet from the stream and the steep sides of the hillside. Where fill is used to construct the embankment, the side slopes will be 2 horizontal to 1 vertical. The embankment will be constructed from native clay/silt soils, and will be compacted in 1-foot lifts using standard compaction techniques. The embankment material will be free of large rocks, sod, large roots, frozen soil, and acid or toxic forming coal processing waste. The sedimentation pond embankment has been designed with a factor of safety of 2.75, as indicated in Attachment C. The north slopes where the hillside is cut into bedrock will be 1 horizontal to 1 vertical. This cut will be in bedrock and will be stable. Slope analysis for the area above the pad (0.5 horizontal to 1 vertical) yielded a factor of safety of 2.0. The sedimentation pond will be cut into similar material, see Attachment C. For design details see Plate 3.2.4-3D.

The topsoil sediment trap will have a crest elevation of 8056.0 feet at its lowest point, and no crest width. The side of the embankment will slope at 2 horizontal to 1 vertical and will be no higher than about 3 feet. A silt fence will be located within the center of the embankment where the embankment is over 2 feet high. The center of the embankment will have a 4-foot wide section were the fence is cut down 6 inches and sown back on itself to provide an outlet. D_{50} = 4 inch riprap will be placed below this outlet to prevent erosion of the outfall area. For design

details see Plate 3.2.4-3F.

4.4 Erosion Protection for Runoff Conveyance System

The peak flow for the runoff conveyance systems were calculated using HydroCAD version 9.1 and FlowMaster version 6.0, as indicated in Attachment A and summarized in Table 4 and 5.

The runoff conveyance system for the sedimentation pond, topsoil stockpile , and ASCA will be temporary. Therefore, they were modeled using the 10-year, 24-hour storm event. As summarized in Table 4, velocities for the pad swale, access road ditch, topsoil berm, and ASCA ditches are lower then 5 fps. Therefore, no riprap lining will be required. The sedimentation pond inlet has a velocity of 11.04 fps. Therefore, a D_{50} = 9 inch riprap will armor the outfall of this culvert. The ASCA culvert will have an outfall velocity of 2.80 fps. However, as added protection at the ASCA outfall a 5-foot by 5-foot riprap pad will be installed. The access road catch basin will have a maximum of 0.6 feet of water depth. This is 3.4 feet below the top of this catch basin. The ASCA catch basin will have a maximum depth of 0.44 feet. This is 2.06 feet below the top of this catch basin.

The upper road ditch, upper road culvert inlet, and upper road culvert outlet will be permanent. Therefore, they were modeled using the 100-year, 6-hour precipitation event. The upper road ditch collects runoff from watershed UDW-1. The upper road ditch will have a maximum velocity of 4.24 fps. Therefore, no riprap lining is required. The upper road culvert inlet will consist of an 18 inch culvert with a maximum flow depth of 0.12 feet. The upper road catch basin will have a maximum of 0.4 feet of water depth. This is 3.6 feet below the top of this catch basin. The upper road culvert outlet will have a maximum flow depth of 0.10 feet with a velocity of 6.56 cfs. To prevent degradation of the outfall, a 10-foot wide by 25-foot long D_{50} = 6 riprap pad will be constructed at the outfall of the upper road culvert outlet. Additionally, a

10-foot by 10-foot area of 12-inch to 24-inch boulders will be imbedded within the riprap pad at the outfall to slow runoff to 1.25 fps.

4.5 Runoff Conveyance System Details

The pad swale will have a depth of 6 inches with 10 horizontal to 1 vertical sides and a slope ranging from 1.5% to 3%. The pad swale begins northwest of the ventilation shaft along the highwall and will convey runoff east to the access road ditch immediately east of the mine portal. The access road ditch will have a depth of 1 foot with 2 horizontal to 1 vertical sides and a slope ranging from 2% to 8.33%. The access road ditch will convey runoff into the access road catch basin. The access road catch basin will convey runoff into the sedimentation pond inlet culvert. The sedimentation pond inlet culvert is discussed in Section 4.2.

A ditch will be placed along the north side of the facility access road to capture runoff from the ASCA. This ditch will vary in width from 2 to 4 feet, as indicated on Plate 3.2.4-3A. The ditch will be constructed with side slopes of 2 horizontal to 1 vertical. Due to changes in slope, the depth of the ditch will vary from 6 to 12 inches in areas where the width is 2 feet and 4 feet, respectively.

The 4-foot wide ASCA ditch will convey runoff into the ASCA catch basin. The ASCA catch basin will be located at the center of the 4-foot wide ASCA ditch and will have a 12-inch diameter wattle placed around it to prevent sediment from entering the catch basin. The wattle will be installed according to recommendations from the manufacturer. The wattle will be maintained regularly to prevent sediment from building up. Accumulated sediment will be removed and the wattle will be replaced as needed. The ASCA catch basin will convey runoff into an 18-inch culvert under the access road and into a riprap pad along the north side of the existing road south of the access road. The riprap pad will dissipate flow and allow the runoff to flow along its natural path across the existing road. From the south side of the existing road

runoff will flow west along the north side of the topsoil berm toward Winter Quarters Creek.

The upper road ditch will have a depth of 6 inches with 2 horizontal to 1 vertical sides and a slope range from 7% to 20%. The upper road ditch begins northwest of the ventilation shaft on the north side of the upper road and conveys runoff approximately 1,400 feet east into the upper road culvert inlet. The upper road culvert inlet will consist of an 18 inch diameter culvert located on the north side of the intersection of the upper road and the site access road. From the upper road culvert inlet runoff will be conveyed under the intersection of the upper road and the site access road to the upper road catch basin. From the upper road catch basin runoff is conveyed into the 18 inch diameter upper road culvert outlet and then into Winter Quarters Creek.

For general layout of site see Plate 3.2.4-3A. For details of above described conveyances see Plates 3.2.4-3E and 3.2.4-3F.

CHAPTER 5
RECLAMATION HYDROLOGY

Natural drainage patterns will be restored during reclamation. To assure that natural drainage is restored contours will be regraded to closely resemble predevelopment conditions. Fill from behind the wall will be used to fill be cut areas below the highwalls, and topsoil from the topsoil stockpile area will be placed back on the site. Some gouging and scarring with a dozer will occur after topsoil placement to provide areas for moisture to gather adding to slope stability and vegetation growth.

The sedimentation pond, topsoil sediment trap and ASCA will be removed along will all ditches, swales, culverts and catch basins related to these sediment treatment devises will be removed during reclamation. The upper road ditch, culvert and catch basin will remain after reclamation to prevent excess runoff from entering the site and causing erosion to take place before vegetation is established. The upper road runoff conveyance system will also be left in place to add long term stability to the upper road.

The reclamation layout and cross sections can be seen on Plates 4.4.2-3A and 4.4.2-3B, respectively.

CHAPTER 6
REFERENCES

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TABLE 1

Erosion Calculations for the Sedimentation Pond

Erosion Calculation for the Sedimentation Pond								
R (Before Correction)[a]					17			
R (After Correction)[b]					26			
K					0.1			
Contributing Watersheds	Length (ft)				Slope (%)		LS[c]	
DW-1	50				80		23.60	
DW-2	125				2.5		0.26	
DW-3	10				55		6.48	
DW-4	80				2.5		0.23	
UDW-2	200				45		21.50	
UDW-3	150				42.5		17.06	
SPW	0				0		0.00	
Contributing Watersheds	R	K	LS	VM[d]	A	Area (ac)	Soil Density (pcf)	Sediment Load (CF)
DW-1	26	0.1	23.60	1.30	80.03	0.181	110	263
DW-2	26	0.1	0.26	1.48	1.00	0.392	110	7
DW-3	26	0.1	6.48	1.30	21.98	0.085	110	34
DW-4	26	0.1	0.23	1.48	0.89	0.408	110	7
UDW-2	26	0.1	21.50	0.35	19.63	1.143	110	408
UDW-3	26	0.1	17.06	0.35	15.58	1.372	110	389
SPW	26	0.0	0.00	0.00	0.00	0.113	0	0
Total								1,108

(a) From Isrealsen et. Al. Mean Annual Iso-Erodent Value, see Attachment B.
(b) From Isrealsen et. Al. Figure 9 "10 Year Recurrence Interval and Figure 1 Zone III", see Attachment B.
(c) From Isrealsen et. Al. Table 2, see Attachment B.
(d) From Isrealsen et. Al. Table 3, see Attachment B.

TABLE 2

Erosion Calculations for the Alternative Sediment Control Area

Erosion Calculation for the Alternative Sediment Control Area								
R (Before Correction)[a]					17			
R (After Correction)[b]					26			
K					0.1			
Contributing Watersheds	Length (ft)				Slope (%)		LS[c]	
UDW-4	100				50		17.82	
DW-5	70				3		0.26	
Contributing Watersheds	R	K	LS	VM[d]	A	Area (ac)	Soil Density (pcf)	Sediment Load (CF)
UDW-4	26	0.1	17.82	0.35	16.27	0.592	110	175
DW-5	26	0.1	0.26	1.48	1.00	0.422	110	8
Total								183

(a) From Isrealsen et. Al. Mean Annual Iso-Erodent Value, see Attachment B.
(b) From Isrealsen et. Al. Figure 9 "10 Year Recurrence Interval and Figure 1 Zone III", see Attachment B.
(c) From Isrealsen et. Al. Table 2, see Attachment B.
(d) From Isrealsen et. Al. Table 3, see Attachment B.

TABLE 3

Topsoil Stockpile Calculations

Topsoil Volume Calculation			
Disturbed Area (ft^2)	Average Topsoil Depth (ft)	Topsoil Volume (CY)[a]	Topsoil Volume Available (CY)[b]
73,667	1.6	4,365	4421
Topsoil Stockpile Berm Runoff Storage Capacity			
Elevation	Surface Area (ft)	Incremental Volume (CF)[c]	Cumulative Volume (CF)
8053	0	0	0
8054	220	110	110
8055	450	335	445
8056	765	608	1053
Total			1053

(a) Topsoil Volume = Disturbed Area X Average Topsoil Depth.
(b) Based on AutoCAD Cut and Fill.
(c) Surface area at given elevations based on AutoCAD topography of site.

TABLE 4

Runoff Conveyance Riprap Size

Runoff Conveyance Riprap Size		
Runoff Conveyance	Velocity (fps)[a]	D_{50} (in)[b]
2' Wide ASCA Ditch	3.74	N/A
4' Wide ASCA Ditch	3.51	N/A
Access Road Ditch	4.53	N/A
ASCA Culvert Outfall	2.80	2[c]
ASCA Topsoil Berm (North Side of Berm, South of Exiting Road)	3.49	N/A
Pad Swale	1.86	N/A
Sedimentation Pond Inlet	11.04	9
Sedimentation Pond Primary Outfall	3.29	2[c,d]
Sedimentation Pond Secondary Outfall (Upper Section)	2.23	2[c]
Sedimentation Pond Secondary Outfall (Lower Section)	4.69	2[c]
Topsoil Berm	3.10	N/A
Upper Road Ditch	4.24	N/A
Upper Road Ditch Culvert Outfall	6.56	6[e]

(a) From FlowMaster version 6.0 Worksheets, see Attachment A.
(b) From U.S. Dept. of Transportation "Use of Riprap for Bank Protection". Assuming K/d>1, therefore $V_s/V = 1$, as indicated in Attachment A.
(c) Riprap not required, but used to dissipate flow and energy.
(d) Additionally a 5-foot by 5-foot area of 12-inch to 24-inch boulders will be imbedded with riprap pad immediately downstream of the outfall.
(e) Additionally a 10-foot by 10-foot area of 12-inch to 24-inch boulders will be imbedded with riprap pad immediately downstream of the outfall.

TABLE 5

Runoff Conveyance Maximum Flow Depth

Runoff Conveyance Maximum Flow Depth		
Runoff Conveyance	Depth (ft)[a]	Freeboard (ft)[a]
2′ Wide ASCA Ditch	0.32	0.18
4′ Wide ASCA Ditch	0.35	0.65
Access Road Ditch	0.63	0.37
Access Road Catch Basin	0.60	3.40
ASCA Catch Basin	0.44	2.06
ASCA Culvert	0.28	1.22
ASCA Topsoil Berm (North Side of Berm, South of Exiting Road)	0.36	0.14
Pad Swale	0.22	0.28
Sedimentation Pond Inlet	0.21	1.29
Sedimentation Pond Primary Outfall	0.36	1.14
Sedimentation Pond Secondary Outfall (Upper Section)	0.16	0.79
Sedimentation Pond Secondary Outfall (Lower Section)	0.08	0.87
Topsoil Berm	0.26	0.24
Upper Road Ditch	0.27	0.23
Upper Road Culvert Inlet	0.12	1.38
Upper Road Catch Basin	0.40	3.60
Upper Road Culvert Outfall	0.10	0.50

(a) From FlowMaster version 6.0 Worksheets, see Attachment A.

ATTACHMENT A

Operational Hydrology Calculations

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Utah 39.72048 N 111.20086 W 8543 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Thu Dec 3 2009

Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Docs | Return to State Map

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.14	0.22	0.27	0.36	0.45	0.56	0.62	0.81	1.04	1.21	1.46	1.85	2.23	2.57	3.45	4.25	5.30	6.27
2	0.18	0.28	0.35	0.47	0.58	0.70	0.78	1.00	1.28	1.50	1.81	2.29	2.76	3.18	4.30	5.28	6.59	7.80
5	0.25	0.39	0.48	0.65	0.80	0.93	1.00	1.24	1.55	1.82	2.20	2.79	3.38	3.89	5.28	6.42	8.03	9.51
10	0.31	0.48	0.59	0.80	0.99	1.14	1.20	1.44	1.79	2.08	2.51	3.20	3.88	4.45	6.05	7.31	9.13	10.81
25	0.41	0.62	0.77	1.03	1.28	1.46	1.52	1.72	2.11	2.43	2.94	3.75	4.55	5.19	7.07	8.47	10.56	12.49
50	0.49	0.74	0.92	1.24	1.54	1.74	1.79	1.99	2.37	2.69	3.26	4.18	5.07	5.75	7.84	9.33	11.63	13.73
100	0.58	0.89	1.10	1.48	1.83	2.07	2.12	2.31	2.64	2.96	3.59	4.61	5.60	6.31	8.63	10.18	12.69	14.96
200	0.69	1.05	1.30	1.76	2.17	2.45	2.49	2.66	2.98	3.23	3.92	5.05	6.13	6.88	9.41	11.02	13.73	16.15
500	0.86	1.32	1.63	2.20	2.72	3.05	3.09	3.25	3.57	3.58	4.36	5.64	6.84	7.62	10.43	12.10	15.08	17.68
1000	1.02	1.55	1.92	2.59	3.20	3.60	3.64	3.79	4.11	4.15	4.70	6.10	7.39	8.19	11.21	12.90	16.09	18.81

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting forces estimates near zero to appear as zero.

* Upper bound of the 90% confidence interval Precipitation Frequency Estimates (inches)

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.17	0.26	0.32	0.44	0.54	0.66	0.73	0.92	1.16	1.37	1.66	2.13	2.59	2.98	4.06	4.96	6.24	7.27
2	0.22	0.34	0.42	0.56	0.69	0.83	0.91	1.15	1.43	1.70	2.05	2.65	3.21	3.69	5.05	6.17	7.76	9.07
5	0.30	0.46	0.57	0.77	0.95	1.11	1.18	1.41	1.74	2.06	2.50	3.23	3.93	4.52	6.23	7.54	9.47	11.06
10	0.38	0.57	0.71	0.96	1.19	1.35	1.41	1.64	2.00	2.35	2.86	3.70	4.50	5.17	7.16	8.57	10.78	12.56
25	0.49	0.75	0.93	1.25	1.54	1.75	1.79	1.98	2.37	2.75	3.34	4.33	5.30	6.04	8.39	9.94	12.49	14.54
50	0.59	0.90	1.11	1.50	1.86	2.09	2.12	2.30	2.67	3.05	3.71	4.83	5.91	6.70	9.33	10.95	13.77	16.04
100	0.71	1.07	1.33	1.79	2.22	2.51	2.53	2.69	3.00	3.35	4.10	5.34	6.54	7.39	10.27	11.97	15.05	17.49
200	0.84	1.29	1.59	2.15	2.66	2.99	3.00	3.12	3.43	3.67	4.50	5.85	7.18	8.07	11.23	13.00	16.34	18.94
500	1.07	1.63	2.02	2.73	3.38	3.78	3.80	3.88	4.15	4.19	5.04	6.57	8.09	8.99	12.54	14.35	18.02	20.84
1000	1.29	1.96	2.43	3.27	4.05	4.55	4.55	4.60	4.84	4.89	5.45	7.14	8.79	9.70	13.54	15.38	19.34	22.29

* The upper bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are greater than.
** These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.

Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

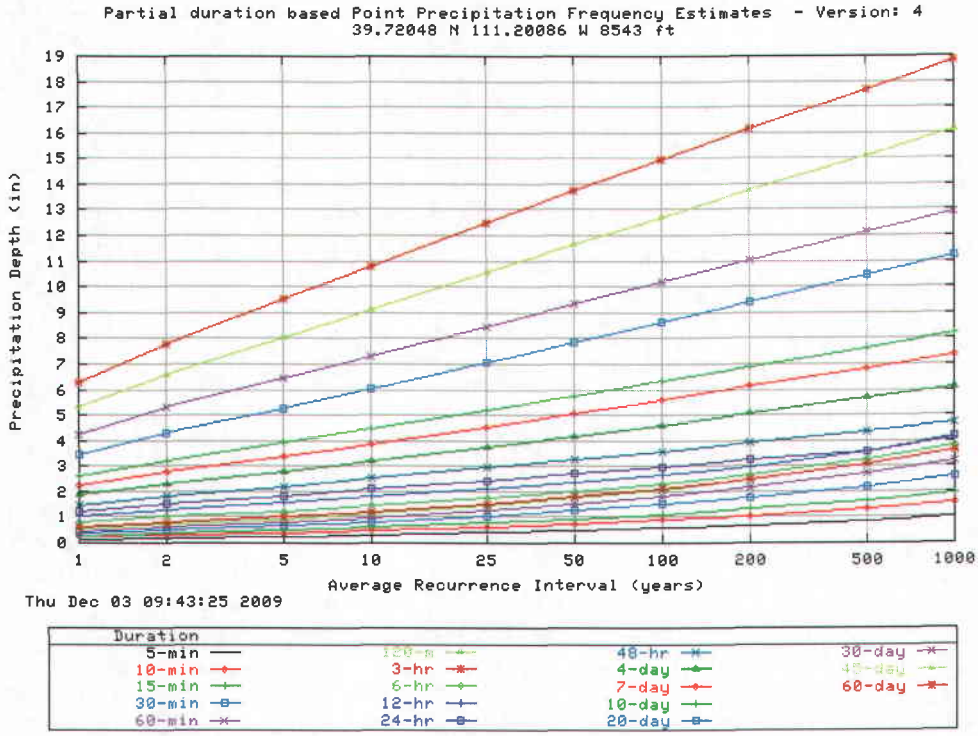
* Lower bound of the 90% confidence interval Precipitation Frequency Estimates (inches)

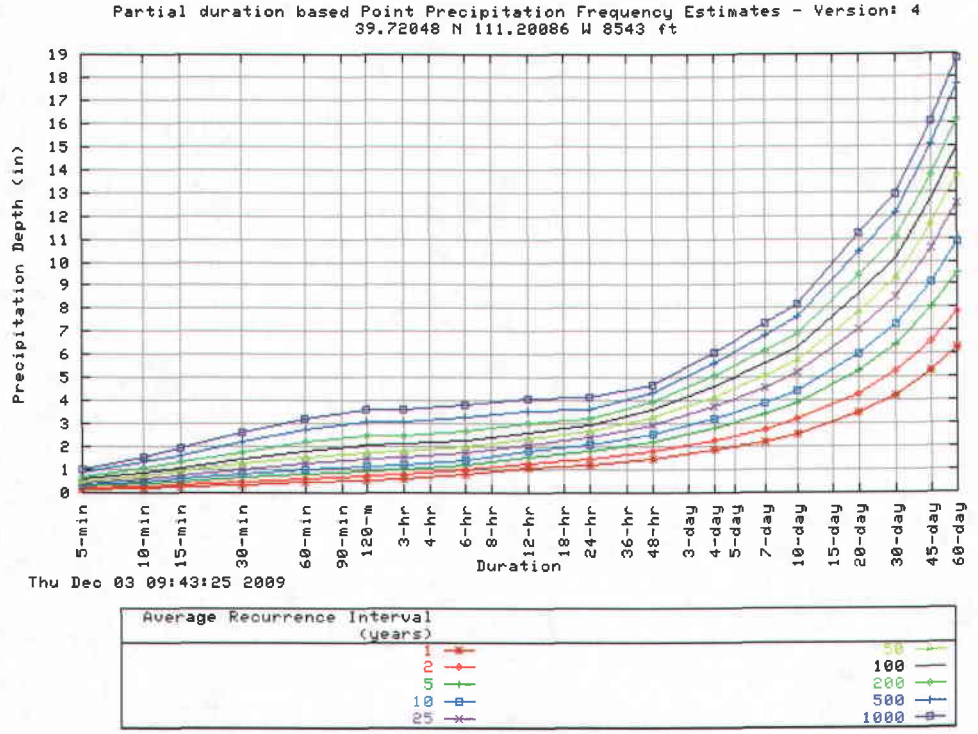
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.12	0.19	0.23	0.31	0.39	0.48	0.54	0.72	0.94	1.08	1.29	1.62	1.96	2.23	3.00	3.68	4.60	5.46
2	0.16	0.24	0.30	0.40	0.50	0.60	0.68	0.90	1.16	1.34	1.60	2.01	2.43	2.78	3.74	4.58	5.72	6.81
5	0.21	0.33	0.41	0.55	0.68	0.80	0.87	1.10	1.40	1.63	1.94	2.44	2.96	3.38	4.57	5.55	6.94	8.27
10	0.26	0.40	0.50	0.67	0.83	0.96	1.04	1.27	1.60	1.85	2.21	2.79	3.38	3.85	5.21	6.30	7.87	9.39
25	0.33	0.51	0.63	0.85	1.05	1.21	1.29	1.50	1.87	2.15	2.57	3.25	3.94	4.46	6.06	7.25	9.05	10.77
50	0.39	0.60	0.74	1.00	1.24	1.41	1.49	1.71	2.07	2.37	2.83	3.59	4.36	4.92	6.67	7.95	9.91	11.77
100	0.46	0.70	0.87	1.17	1.44	1.64	1.73	1.95	2.29	2.58	3.10	3.93	4.78	5.37	7.28	8.61	10.77	12.74
200	0.53	0.81	1.00	1.34	1.66	1.89	1.99	2.22	2.55	2.79	3.36	4.26	5.19	5.81	7.88	9.25	11.57	13.65
500	0.63	0.96	1.19	1.61	1.99	2.25	2.37	2.64	2.99	3.06	3.70	4.70	5.73	6.36	8.61	10.03	12.56	14.78
1000	0.72	1.09	1.36	1.83	2.26	2.56	2.70	3.01	3.39	3.42	3.94	5.01	6.12	6.77	9.16	10.61	13.29	15.60

* The lower bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are less than.

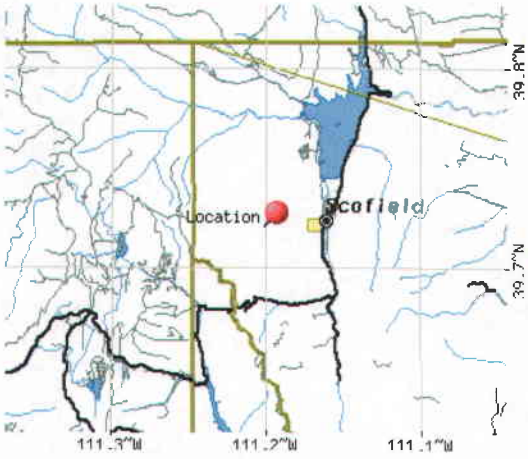
** These precipitation frequency estimates are based on a partial duration maxima series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

Text version of tables





Maps -



These maps were produced using a direct map request from the U.S. Census Bureau Mapping and Cartographic Resources Tiger Map Server.

Please read disclaimer for more information.

LEGEND

State
County
Indian Resv
Lake/Pond/Ocean
Street
Expressway
Highway
Connector
Stream
Military Area
National Park
Other Park
City
County

Scale 1:228583
*average--true scale depends on monitor resolution

0 2 4 6 8 mi
0 2 4 6 8 10 km

Other Maps/Photographs -

View USGS digital orthophoto quadrangle (DOQ) covering this location from TerraServer; **USGS Aerial Photograph** may also be available from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Visit the USGS for more information.

Watershed/Stream Flow Information -

Find the Watershed for this location using the U.S. Environmental Protection Agency's site.

Climate Data Sources -

Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study, please refer to NOAA Atlas 14 Document.

Using the National Climatic Data Center's (NCDC) station search engine, locate other climate stations within:

+/-30 minutes ...OR... +/-1 degree of this location (39.72048/-111.20086). Digital ASCII data can be obtained directly from NCDC.

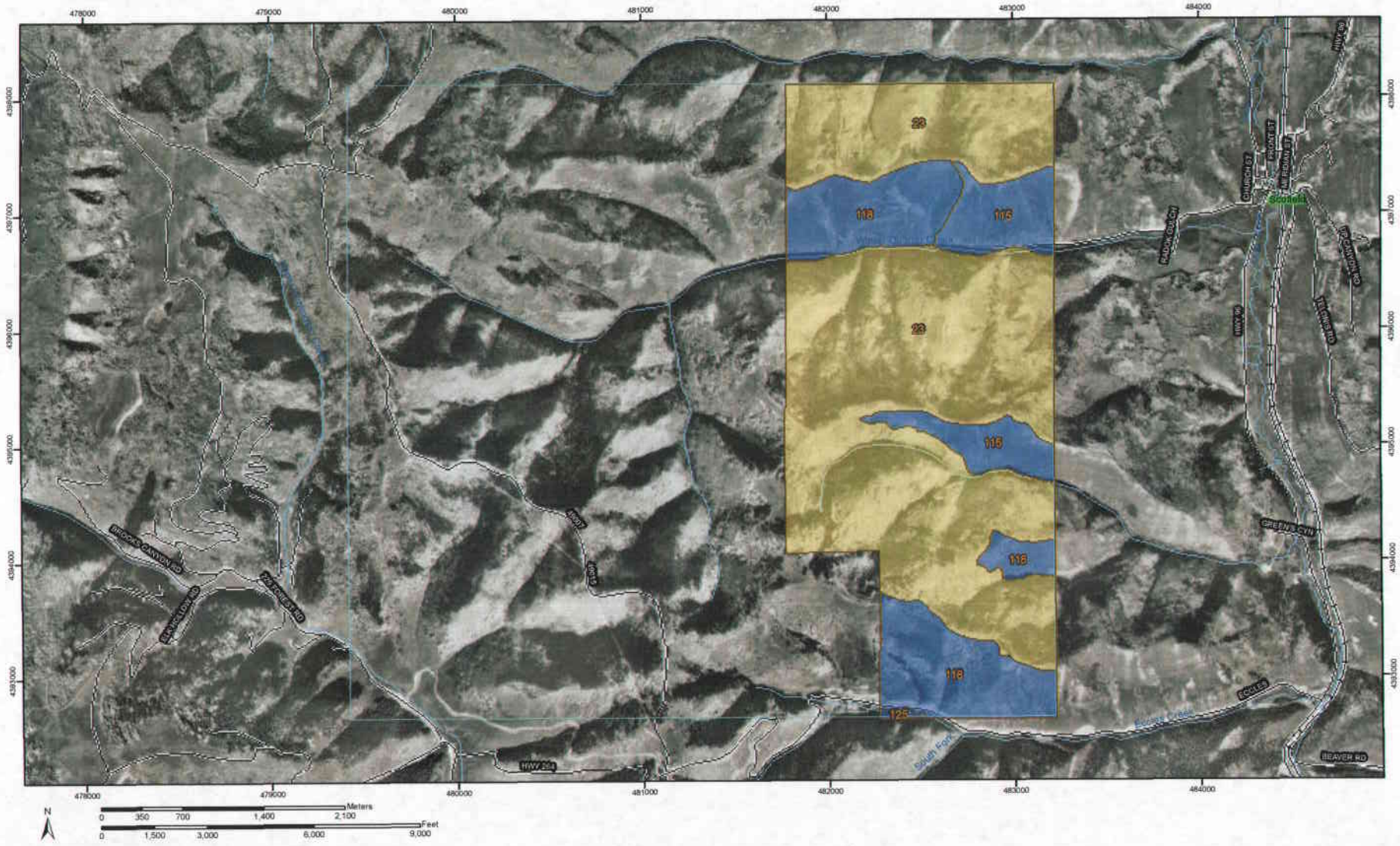
Find Natural Resources Conservation Service (NRCS) SNOTEL (SNOwpack TELemetry) stations by visiting the Western Regional Climate Center's state-specific SNOTEL station maps.

Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910

(301) 713-1669
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Hydrologic Soil Group–Carbon Area, Utah, Parts of Carbon and Emery Counties; and Manti-Lasal National Forest, Manti Division - Parts of Sanpete and Emery Counties
(Winter Quarters Canyon)



Natural Resources
Conservation Service

Web Soil Survey 2.0
National Cooperative Soil Survey

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Carbon Area, Utah, Parts of Carbon and Emery Counties
Survey Area Data: Version 4, Jul 2, 2008

Soil Survey Area: Manti-Lasal National Forest, Manti Division - Parts of Sanpete and Emery Counties
Survey Area Data: Not available

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 9/30/1997; 10/5/1997

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Carbon Area, Utah, Parts of Carbon and Emery Counties				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
23	Curecanti family-Pathead complex	C	2,030.6	24.7%
115	Trag stony loam, 30 to 60 percent slopes	B	259.7	3.2%
118	Trag-Croydon complex	B	550.2	6.7%
125	Uinta-Toze families complex	B	5.7	0.1%
Totals for Area of Interest (AOI)			8,217.0	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower

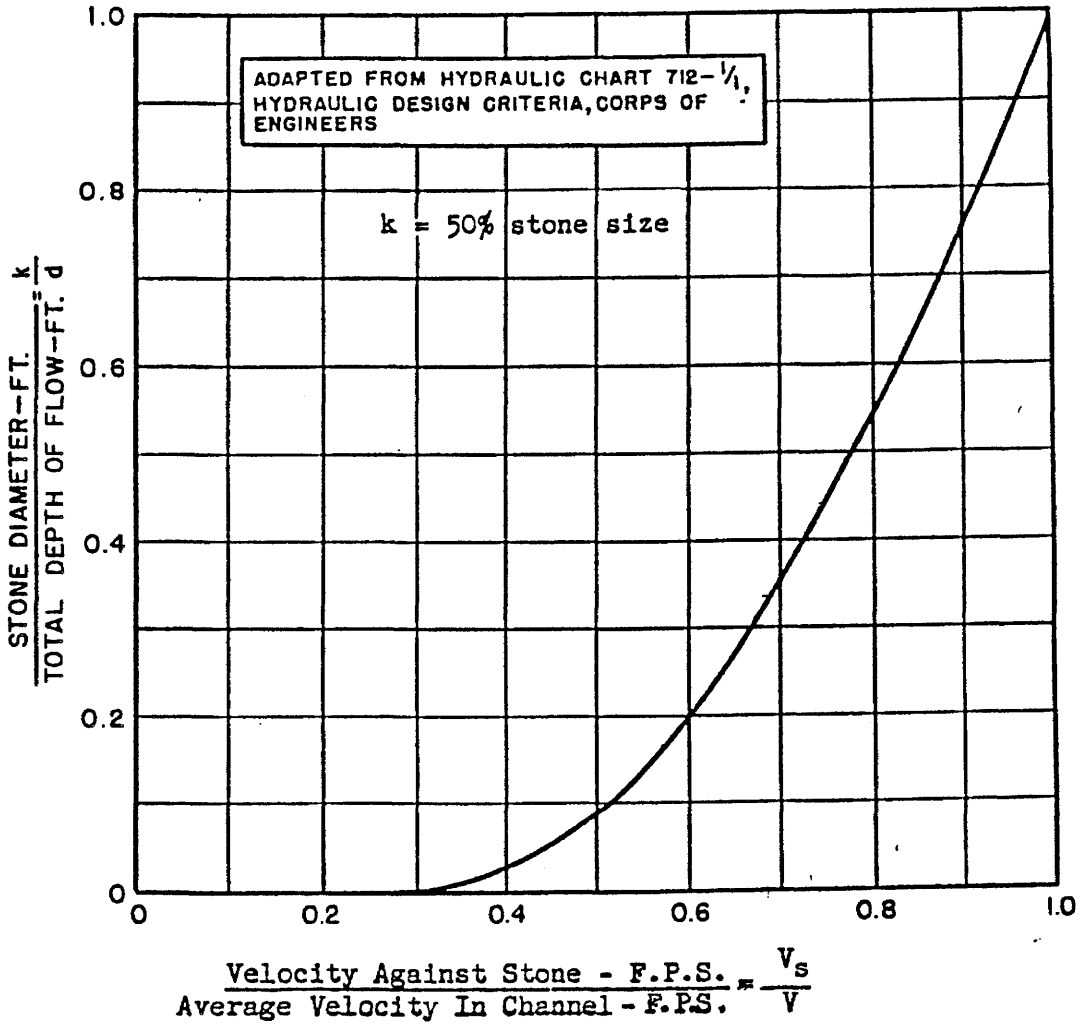


FIGURE 5-1 Velocity Against Stone on Channel Bottom (U.S. Department of Transportation, 1978).

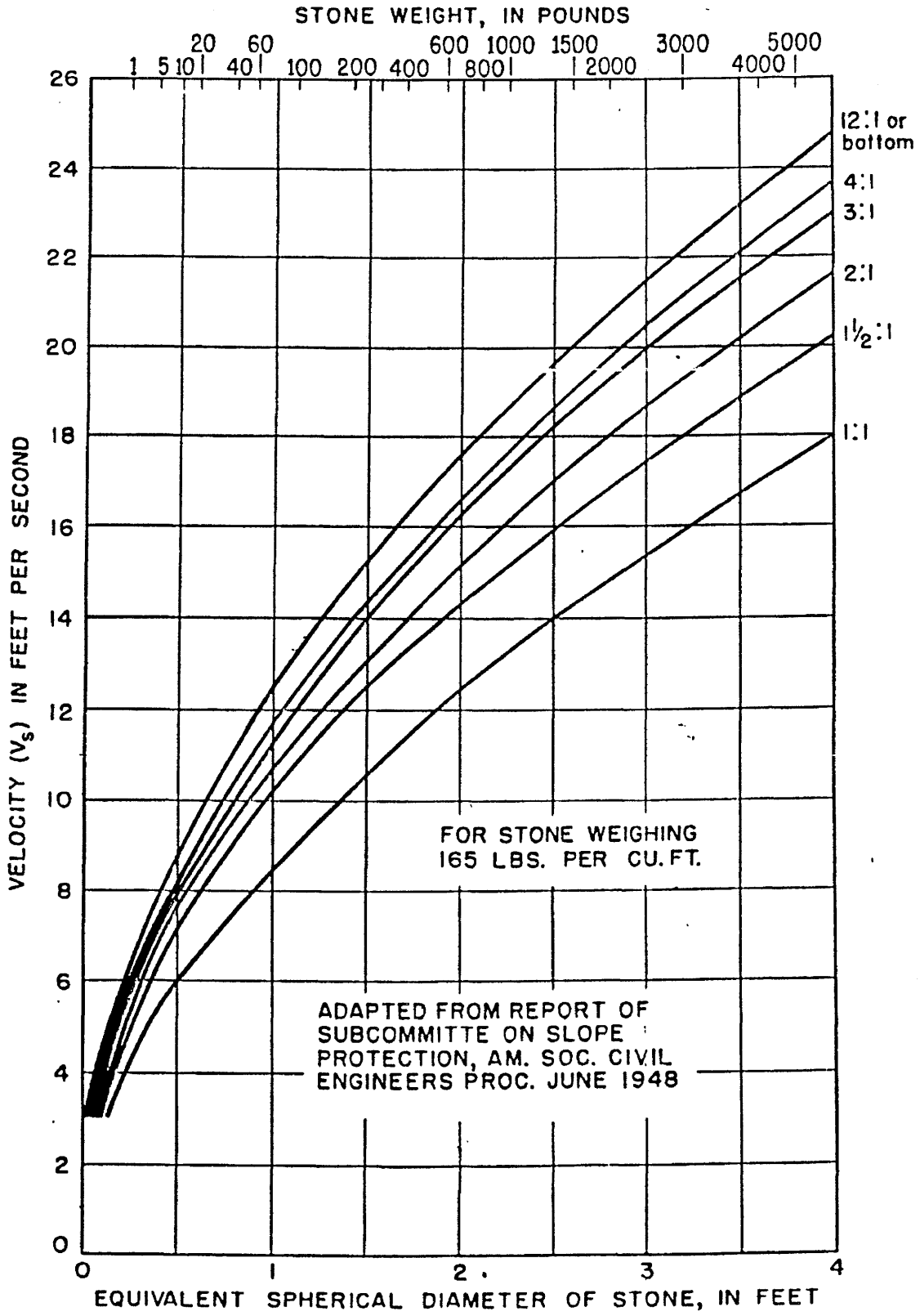
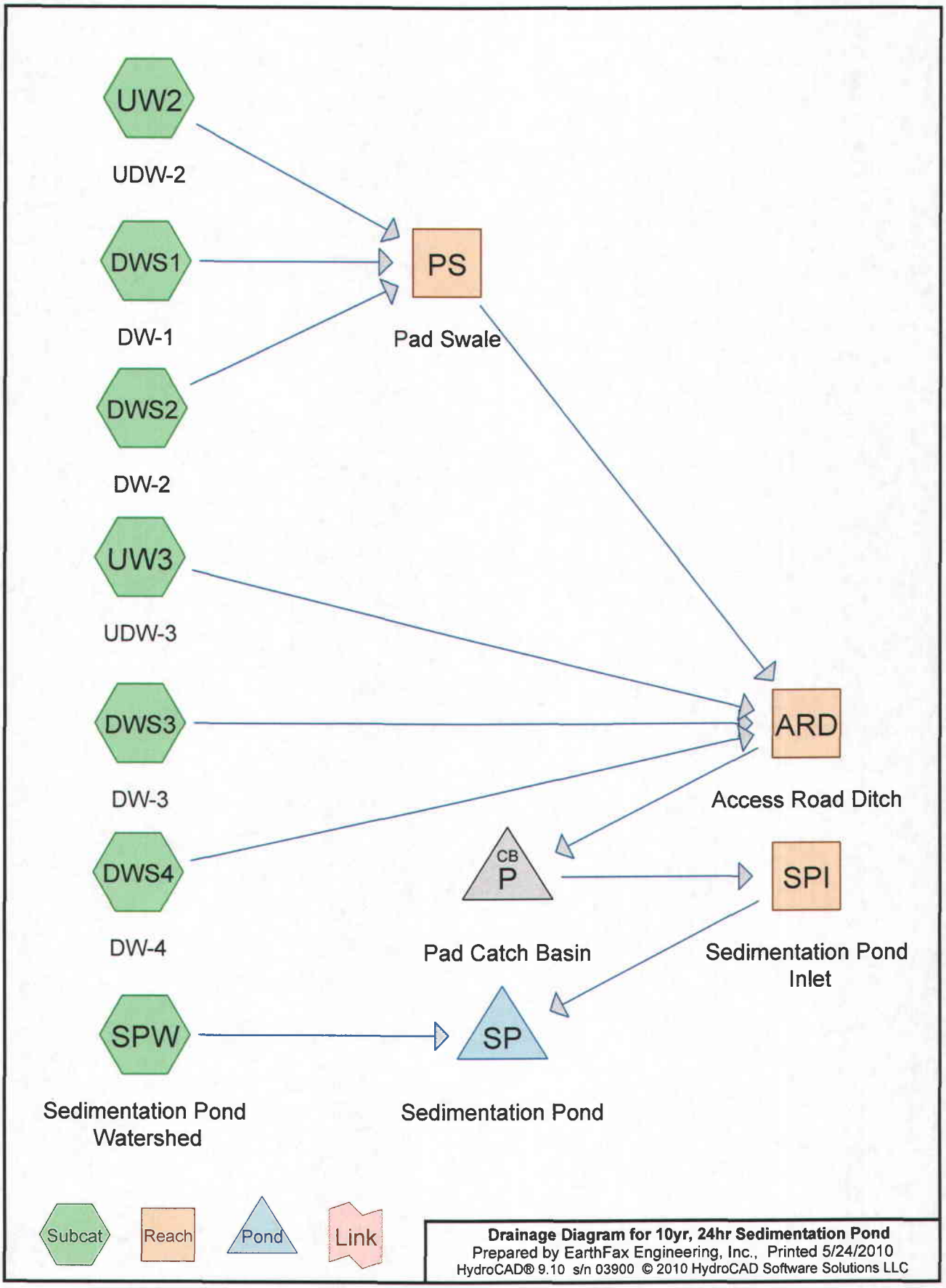


FIGURE 5-2 Size of Stone that will Resist Displacement for Various Velocities and Side Slopes (U.S. Department of Transportation, 1978).


UW2
UDW-2
DWS1
DW-1
DWS2
DW-2
UW3
UDW-3
DWS3
DW-3
DWS4
DW-4
SPW
Sedimentation Pond Watershed
PS
Pad Swale
ARD
Access Road Ditch
CB
P
Pad Catch Basin
SPI
Sedimentation Pond Inlet
SP
Sedimentation Pond
Subcat
Reach
Pond
Link
Drainage Diagram for 10yr, 24hr Sedimentation Pond
Prepared by EarthFax Engineering, Inc., Printed 5/24/2010
HydroCAD® 9.10 s/n 03900 © 2010 HydroCAD Software Solutions LLC

Summary for Subcatchment DWS1: DW-1

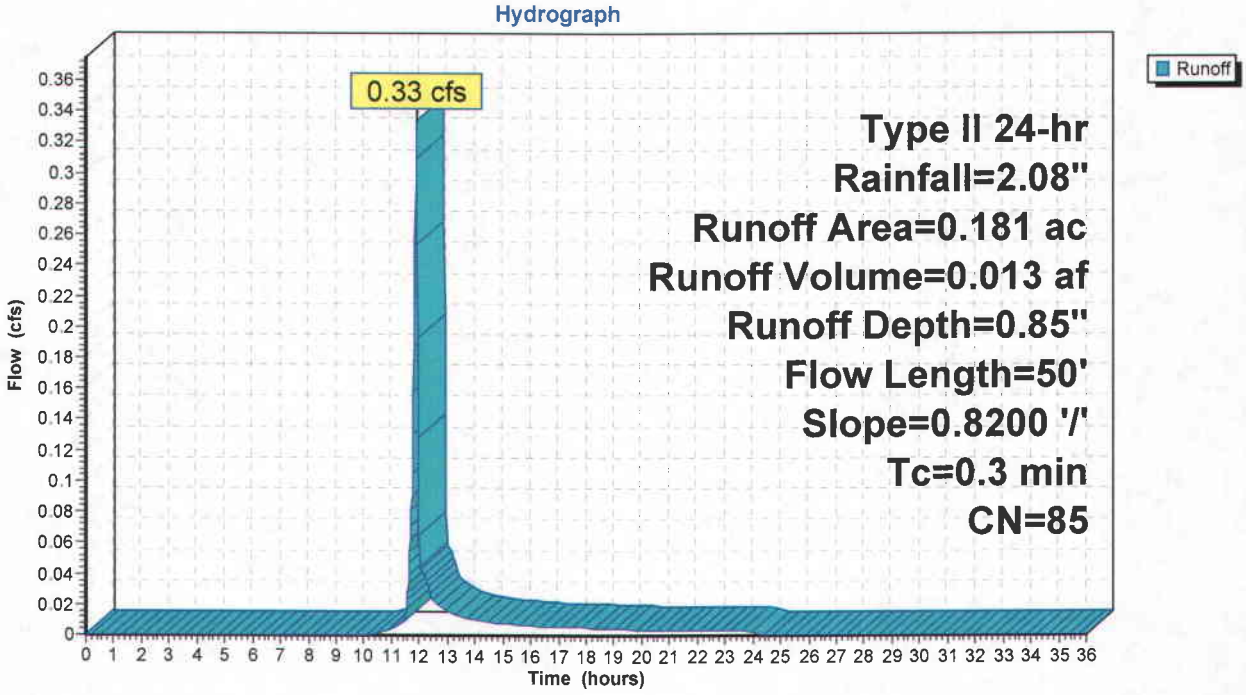
Runoff = 0.33 cfs @ 11.90 hrs, Volume= 0.013 af, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type II 24-hr Rainfall=2.08"

	Area (ac)	CN	Description
*	0.181	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
	0.181		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	50	0.8200	3.08		**Lag/CN Method, Slope from 8,182 to 8,121**

Subcatchment DWS1: DW-1



Summary for Subcatchment DWS2: DW-2

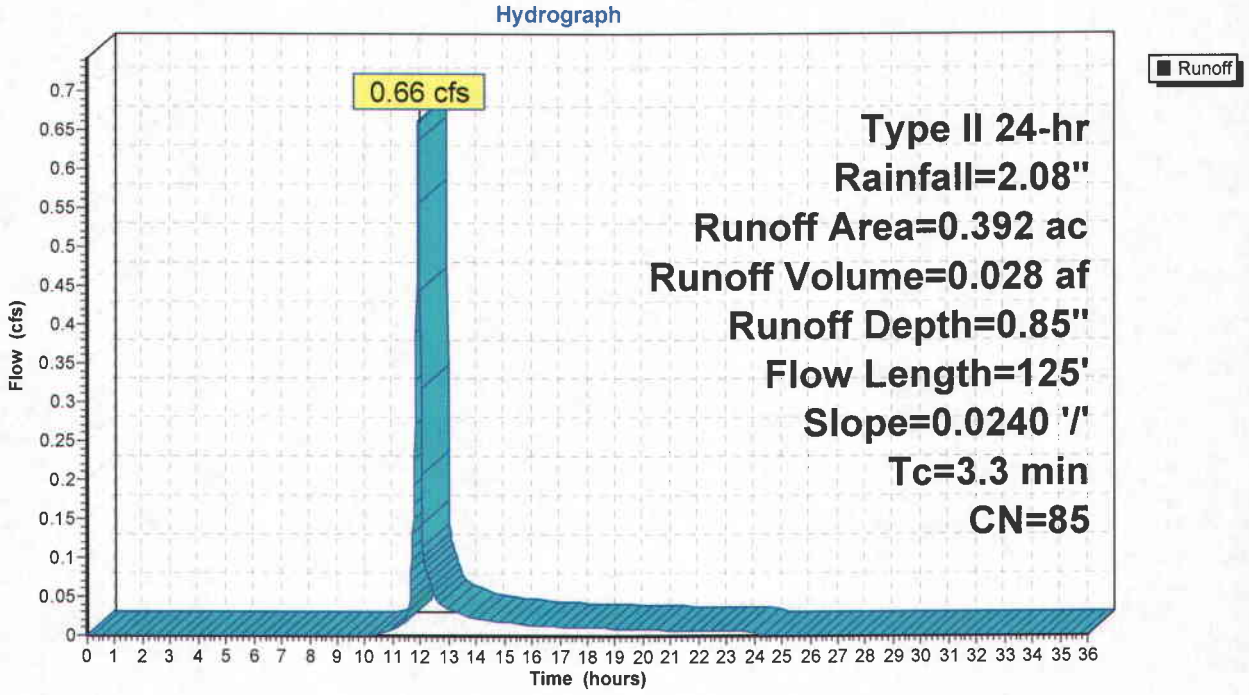
Runoff = 0.66 cfs @ 11.94 hrs, Volume= 0.028 af, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type II 24-hr Rainfall=2.08"

	Area (ac)	CN	Description
*	0.392	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
	0.392		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	125	0.0240	0.63		**Lag/CN Method, Slope from 8,122 to 8,119**

Subcatchment DWS2: DW-2



Summary for Subcatchment DWS3: DW-3

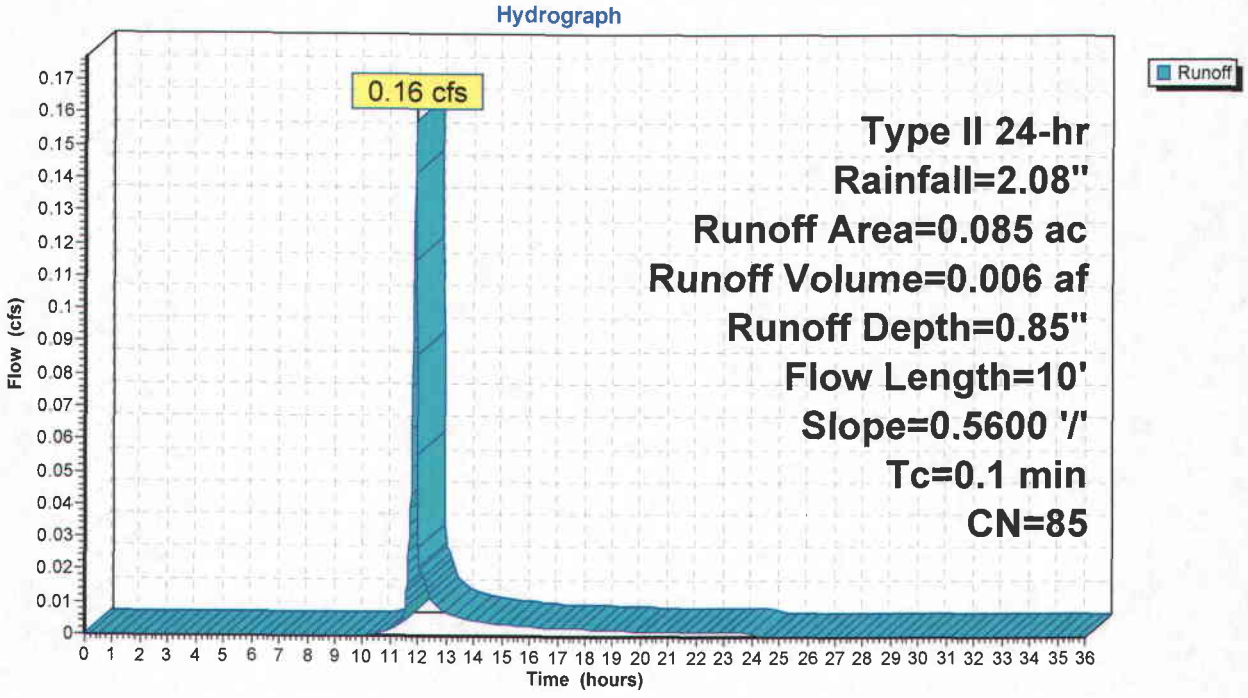
Runoff = 0.16 cfs @ 11.90 hrs, Volume= 0.006 af, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type II 24-hr Rainfall=2.08"

	Area (ac)	CN	Description
*	0.085	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
	0.085		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	10	0.5600	1.84		**Lag/CN Method, Slope from 8,133 to 8,115**

Subcatchment DWS3: DW-3



Summary for Subcatchment DWS4: DW-4

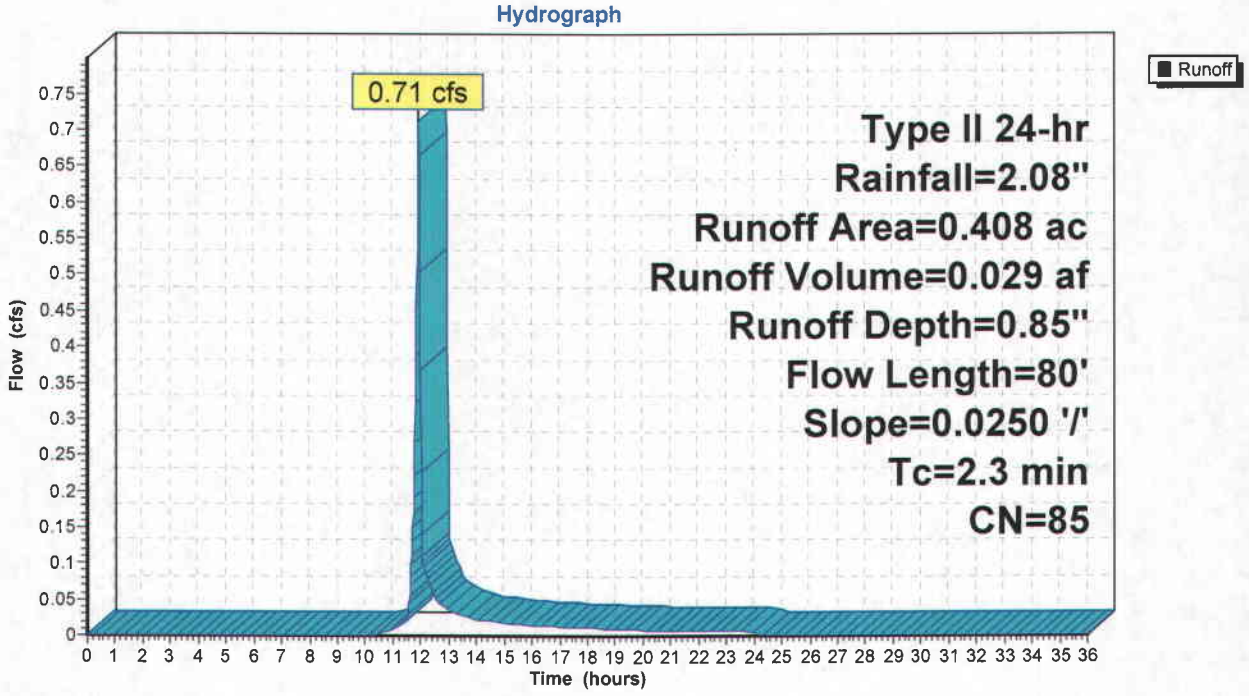
Runoff = 0.71 cfs @ 11.93 hrs, Volume= 0.029 af, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type II 24-hr Rainfall=2.08"

	Area (ac)	CN	Description
*	0.408	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
	0.408		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	80	0.0250	0.59		**Lag/CN Method, Slope from 8,118 to 8,116**

Subcatchment DWS4: DW-4



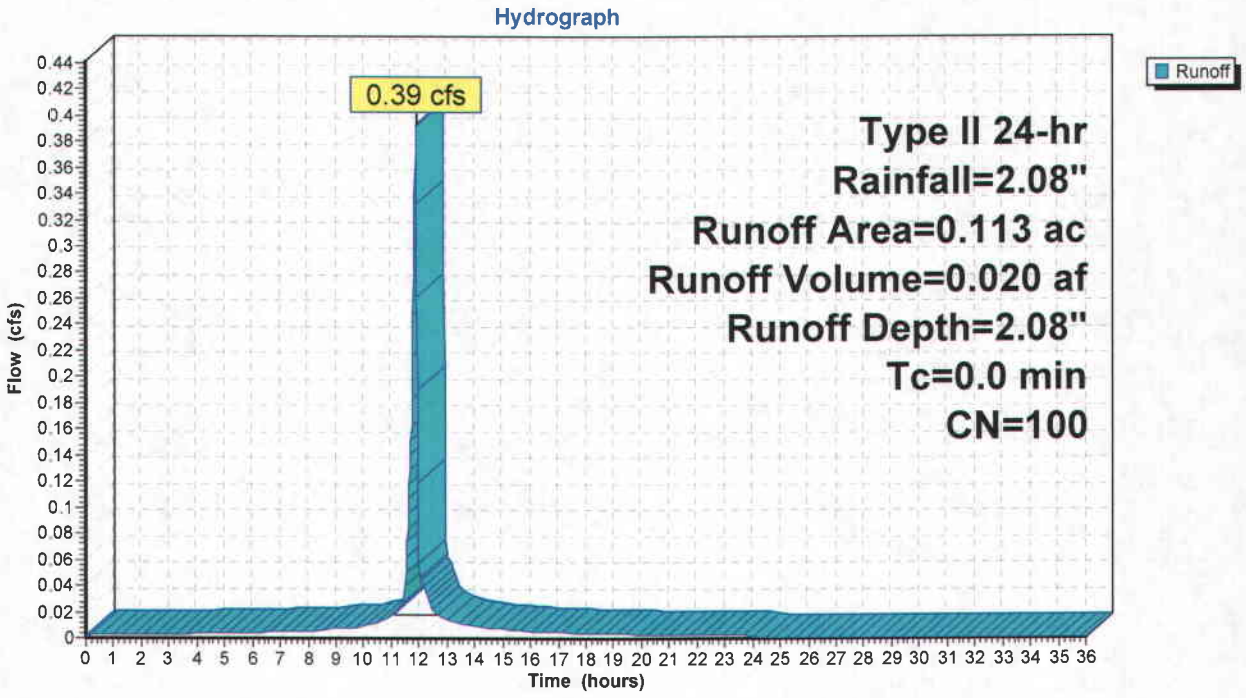
Summary for Subcatchment SPW: Sedimentation Pond Watershed

Runoff = 0.39 cfs @ 11.89 hrs, Volume= 0.020 af, Depth= 2.08"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type II 24-hr Rainfall=2.08"

	Area (ac)	CN	Description
*	0.113	100	
	0.113		100.00% Impervious Area

Subcatchment SPW: Sedimentation Pond Watershed



Summary for Subcatchment UW2: UDW-2

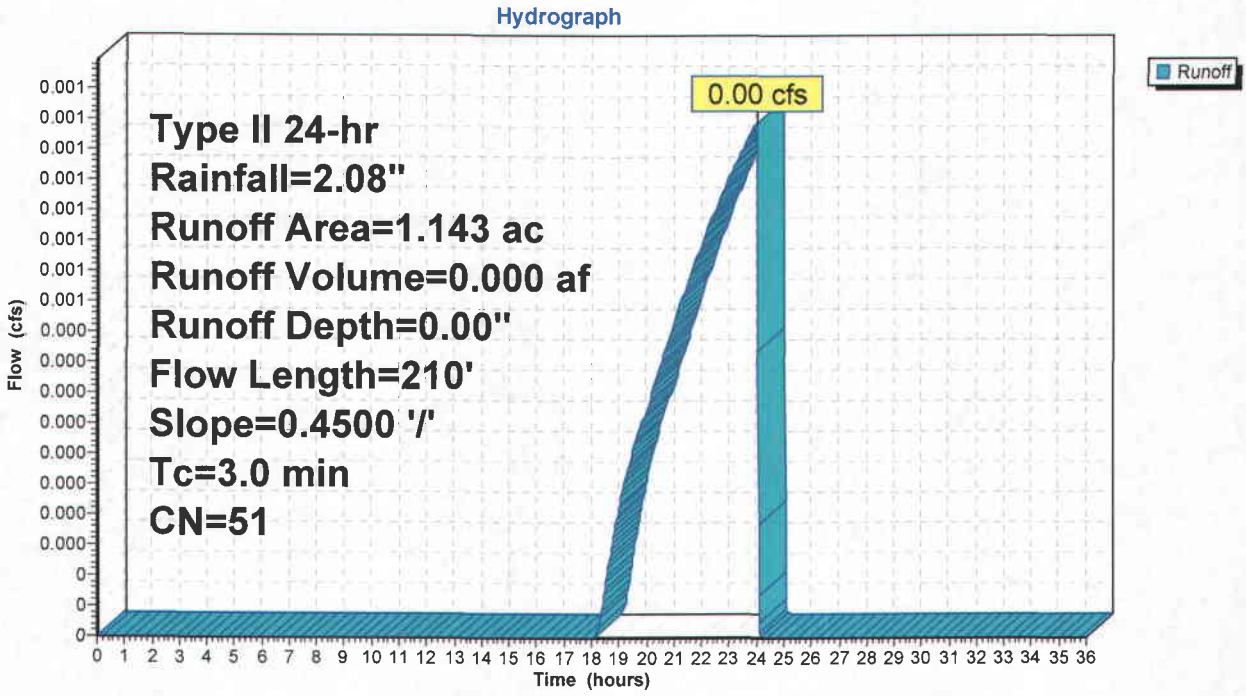
Runoff = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type II 24-hr Rainfall=2.08"

Area (ac)	CN	Description
1.143	51	Sagebrush range, Fair, HSG B
1.143		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	210	0.4500	1.18		**Lag/CN Method, Slope from 8,231 to 8,136**

Subcatchment UW2: UDW-2



Summary for Subcatchment UW3: UDW-3

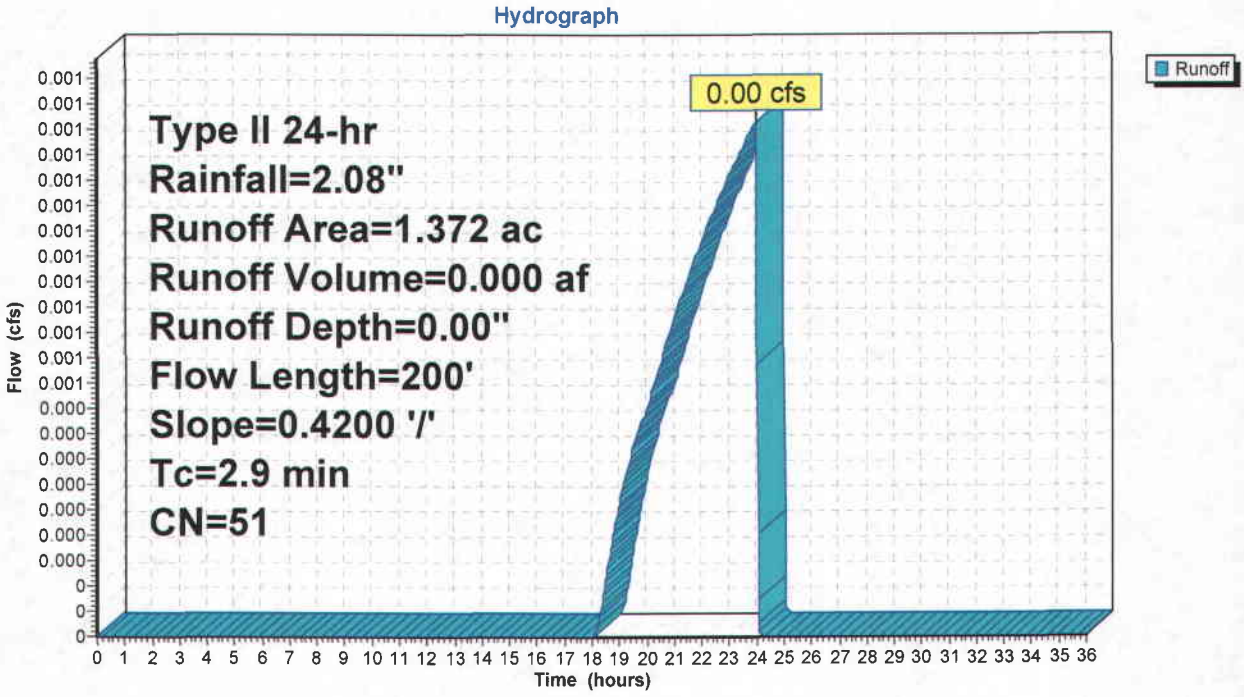
Runoff = 0.00 cfs @ 24.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type II 24-hr Rainfall=2.08"

Area (ac)	CN	Description
1.372	51	Sagebrush range, Fair, HSG B
1.372		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	200	0.4200	1.13		**Lag/CN Method, Slope from 8,214 to 8,130**

Subcatchment UW3: UDW-3



Summary for Reach ARD: Access Road Ditch

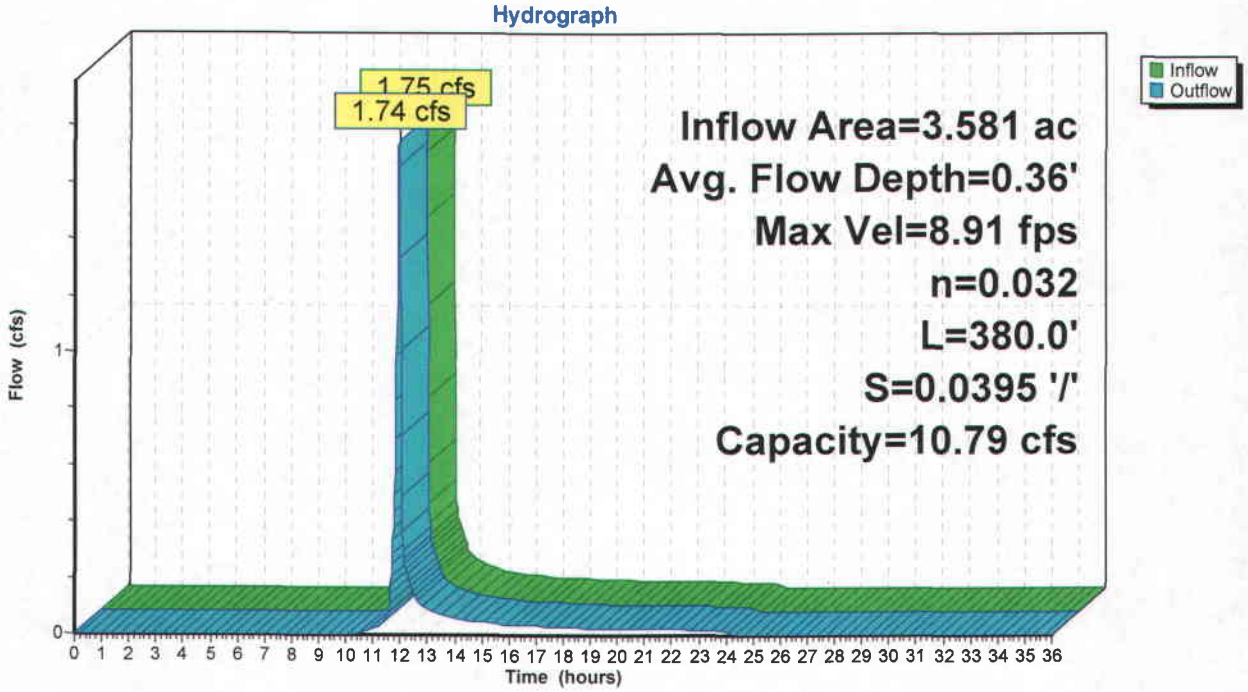
Inflow Area = 3.581 ac, 0.00% Impervious, Inflow Depth = 0.26"
Inflow = 1.75 cfs @ 11.93 hrs, Volume= 0.076 af
Outflow = 1.74 cfs @ 11.95 hrs, Volume= 0.076 af, Atten= 0%, Lag= 0.9 min

Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Reference Flow= 8.09 cfs Estimated Depth= 0.90' Velocity= 5.02 fps
m= 1.333, c= 6.69 fps, dt= 1.2 min, dx= 380.0' / 1 = 380.0', K= 0.9 min, X= 0.478
Max. Velocity= 8.91 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 6.69 fps, Avg. Travel Time= 0.9 min

Peak Storage= 98 cf @ 11.94 hrs
Average Depth at Peak Storage= 0.36'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 10.79 cfs

0.00' x 1.00' deep channel, n= 0.032
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 380.0' Slope= 0.0395 '/'
Inlet Invert= 8,116.00', Outlet Invert= 8,101.00'

Reach ARD: Access Road Ditch



Access Road Ditch Maximum Depth
Worksheet for Triangular Channel

Project Description	
Worksheet	ARD MD
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	020000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Discharge	1.75	cfs

Results		
Depth	0.57	ft
Flow Area	0.7	ft²
Wetted Perim	2.57	ft
Top Width	2.30	ft
Critical Depth	0.54	ft
Critical Slope	0.026726	ft/ft
Velocity	2.65	ft/s
Velocity Head	0.11	ft
Specific Energ	0.68	ft
Froude Numb	0.87	
Flow Type	Subcritical	

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Access Road Ditch Maximum Slope
Worksheet for Triangular Channel

Project Description	
Worksheet	ARD MV
Flow Element	Triangular Char
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	083300	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Discharge	1.75	cfs

Results		
Depth	0.44	ft
Flow Area	0.4	ft²
Wetted Perim	1.97	ft
Top Width	1.76	ft
Critical Depth	0.54	ft
Critical Slope	0.026726	ft/ft
Velocity	4.53	ft/s
Velocity Head	0.32	ft
Specific Energ	0.76	ft
Froude Numb	1.70	
Flow Type	Supercritical	

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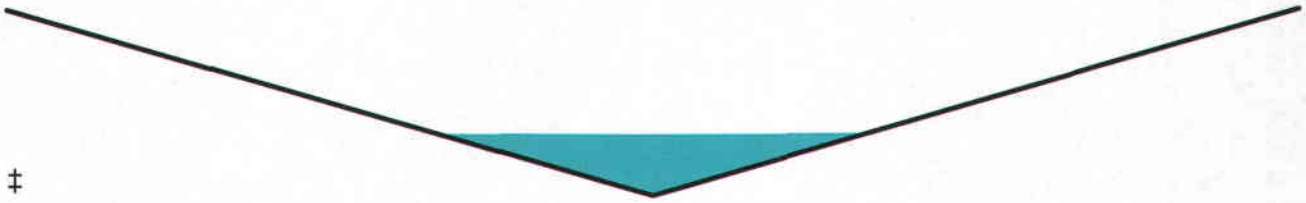
Summary for Reach PS: Pad Swale

Inflow Area = 1.716 ac, 0.00% Impervious, Inflow Depth = 0.29"
Inflow = 0.93 cfs @ 11.93 hrs, Volume= 0.041 af
Outflow = 0.92 cfs @ 11.95 hrs, Volume= 0.041 af, Atten= 0%, Lag= 1.2 min

Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Reference Flow= 4.97 cfs Estimated Depth= 0.45' Velocity= 2.47 fps
m= 1.333, c= 3.29 fps, dt= 1.2 min, dx= 240.0' / 1 = 240.0', K= 1.2 min, X= 0.466
Max. Velocity= 4.61 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 3.29 fps, Avg. Travel Time= 1.2 min

Peak Storage= 67 cf @ 11.94 hrs
Average Depth at Peak Storage= 0.17'
Bank-Full Depth= 0.50', Capacity at Bank-Full= 6.63 cfs

0.00' x 0.50' deep channel, n= 0.032
Side Slope Z-value= 10.0 '/' Top Width= 10.00'
Length= 240.0' Slope= 0.0208 '/'
Inlet Invert= 8,121.00', Outlet Invert= 8,116.00'



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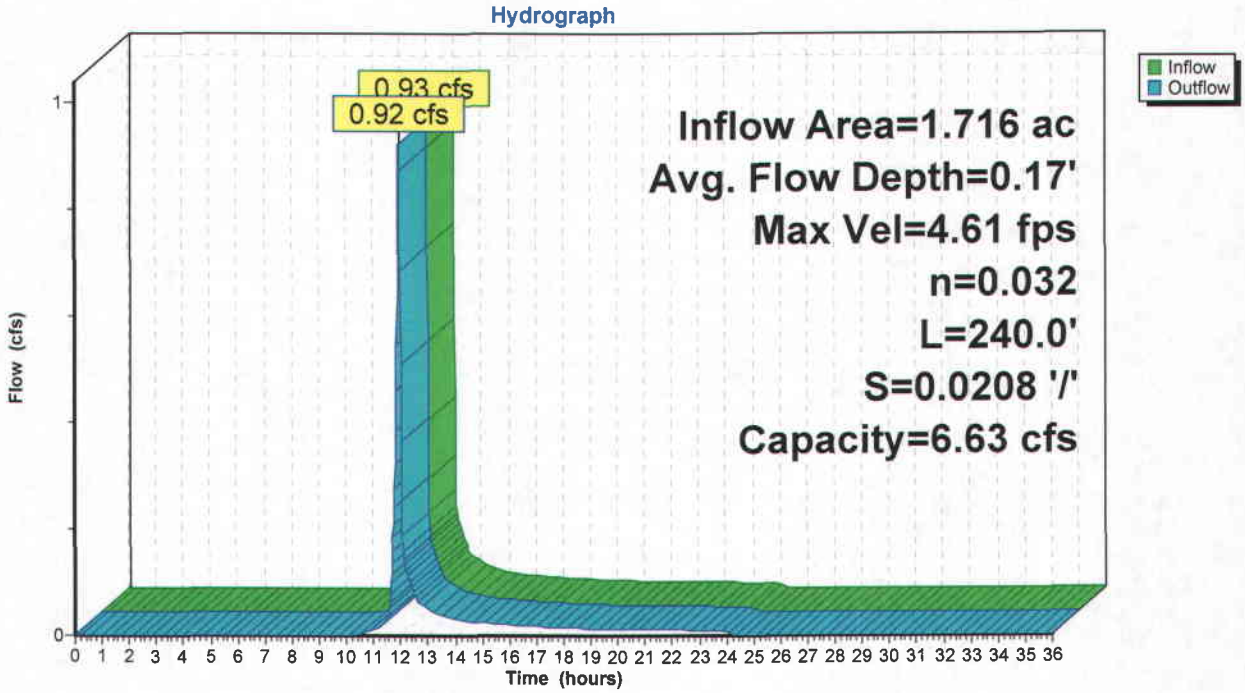
Reach PS: Pad Swale



Pad Swale Maximum Depth
Worksheet for Triangular Channel

Project Description	
Worksheet	PS MD
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	015000	ft/ft
Left Side Slope	0.10	V : H
Right Side Slope	0.10	V : H
Discharge	0.93	cfs

Results		
Depth	0.25	ft
Flow Area	0.6	ft²
Wetted Perim	5.12	ft
Top Width	5.09	ft
Critical Depth	0.22	ft
Critical Slope	0.031261	ft/ft
Velocity	1.43	ft/s
Velocity Head	0.03	ft
Specific Energ	0.29	ft
Froude Numb	0.71	
Flow Type	Subcritical	

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Pad Swale Maximum Slope
Worksheet for Triangular Channel

Project Description	
Worksheet	PS MV
Flow Element	Triangular Char
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	030000	ft/ft
Left Side Slope	0.10	V : H
Right Side Slope	0.10	V : H
Discharge	0.93	cfs

Results		
Depth	0.22	ft
Flow Area	0.5	ft²
Wetted Perim	4.49	ft
Top Width	4.47	ft
Critical Depth	0.22	ft
Critical Slope	0.031262	ft/ft
Velocity	1.86	ft/s
Velocity Head	0.05	ft
Specific Energ	0.28	ft
Froude Numb	0.98	
Flow Type	Subcritical	

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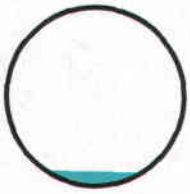
Summary for Reach SPI: Sedimentation Pond Inlet

Inflow Area = 3.581 ac, 0.00% Impervious, Inflow Depth = 0.26"
Inflow = 1.74 cfs @ 11.95 hrs, Volume= 0.076 af
Outflow = 1.74 cfs @ 11.95 hrs, Volume= 0.076 af, Atten= 0%, Lag= 0.0 min

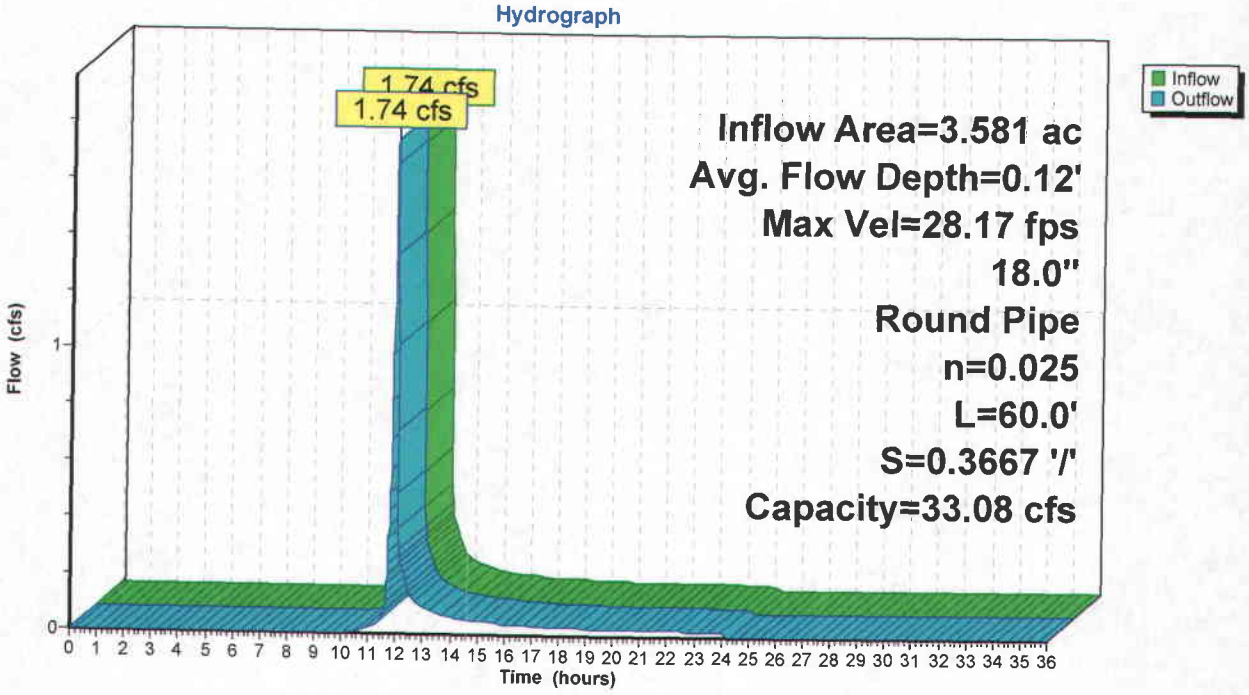
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Reference Flow= 24.81 cfs Estimated Depth= 0.97' Velocity= 20.54 fps
m= 1.355, c= 27.83 fps, dt= 1.2 min, dx= 60.0' / 1 = 60.0', K= 0.0 min, X= 0.484
Max. Velocity= 28.17 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 27.83 fps, Avg. Travel Time= 0.0 min

Peak Storage= 4 cf @ 11.95 hrs
Average Depth at Peak Storage= 0.12'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 33.08 cfs

18.0" Round Pipe
n= 0.025 Corrugated metal
Length= 60.0' Slope= 0.3667 '/'
Inlet Invert= 8,096.00', Outlet Invert= 8,074.00'



Reach SPI: Sedimentation Pond Inlet



Sedimentation Pond Inlet
Worksheet for Circular Channel

Project Description	
Worksheet	SPI
Flow Element	Circular Chann
Method	Manning's For
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.025	
Slope	500000	ft/ft
Diameter	18	in
Discharge	1.74	cfs

Results		
Depth	0.22	ft
Flow Area	0.2	ft²
Wetted Perime	1.17	ft
Top Width	1.06	ft
Critical Depth	0.50	ft
Percent Full	14.5	%
Critical Slope	0.018182	ft/ft
Velocity	11.04	ft/s
Velocity Head	1.89	ft
Specific Energ	2.11	ft
Froude Numbe	5.04	
Maximum Disc	41.55	cfs
Discharge Full	38.62	cfs
Slope Full	0.001015	ft/ft
Flow Type	Supercritical	

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Summary for Pond P: Pad Catch Basin

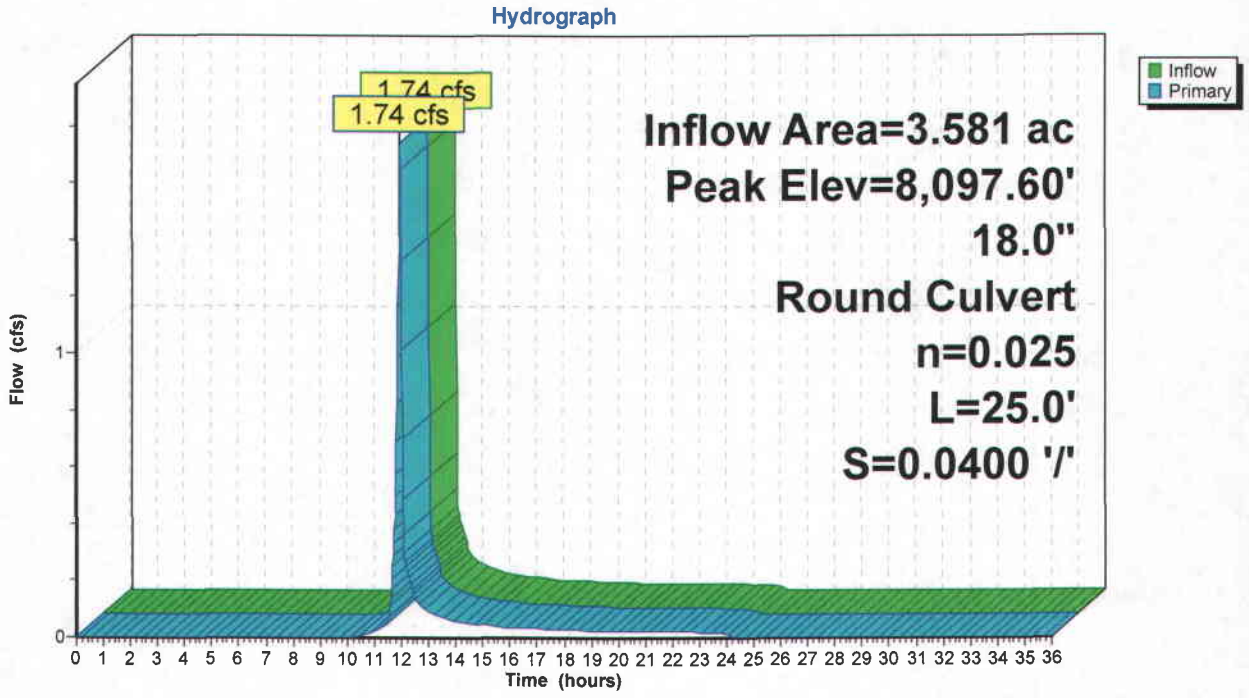
Inflow Area = 3.581 ac, 0.00% Impervious, Inflow Depth = 0.26"
Inflow = 1.74 cfs @ 11.95 hrs, Volume= 0.076 af
Outflow = 1.74 cfs @ 11.95 hrs, Volume= 0.076 af, Atten= 0%, Lag= 0.0 min
Primary = 1.74 cfs @ 11.95 hrs, Volume= 0.076 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Peak Elev= 8,097.60' @ 11.95 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	8,097.00'	**18.0" Round Culvert** L= 25.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 8,097.00' / 8,096.00' S= 0.0400 '/' Cc= 0.900 n= 0.025 Corrugated metal

Primary OutFlow Max=1.72 cfs @ 11.95 hrs HW=8,097.60' TW=8,096.11' (Dynamic Tailwater)
↑**1=Culvert** (Inlet Controls 1.72 cfs @ 2.63 fps)

Pond P: Pad Catch Basin



Summary for Pond SP: Sedimentation Pond

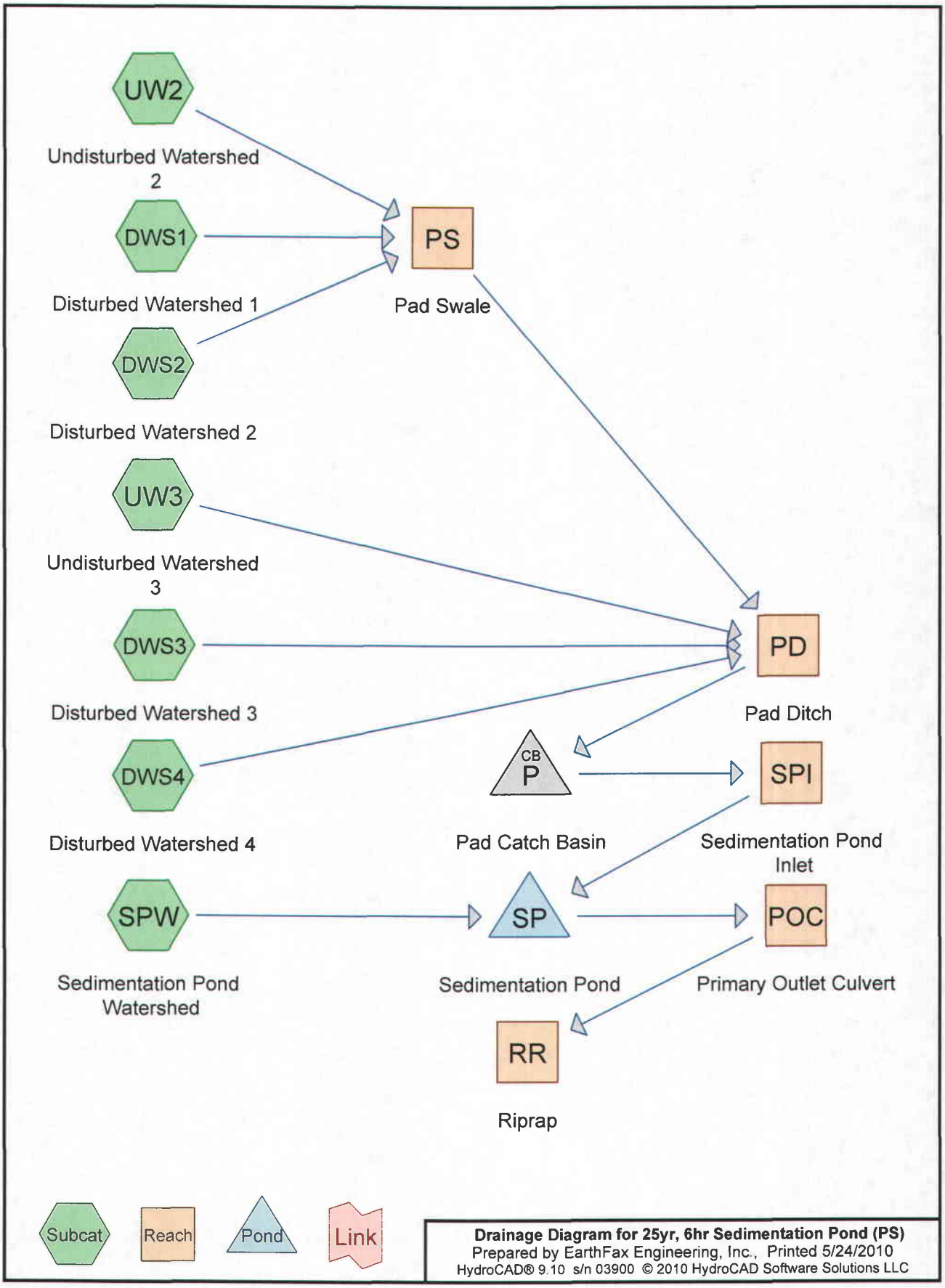
Inflow Area = 3.694 ac, 3.06% Impervious, Inflow Depth = 0.31"
Inflow = 1.98 cfs @ 11.94 hrs, Volume= 0.096 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Peak Elev= 8,074.40' @ 24.36 hrs Surf.Area= 1,696 sf Storage= 4,182 cf

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	8,070.50'	8,508 cf	**Custom Stage Data (Irregular)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
8,070.50	0	0.0	0	0	0
8,071.00	744	123.4	124	124	1,212
8,071.50	862	132.7	401	525	1,412
8,071.65	900	135.5	132	657	1,475
8,072.00	987	142.0	330	987	1,627
8,072.10	1,014	143.9	100	1,087	1,672
8,072.50	1,120	151.3	427	1,514	1,856
8,073.00	1,260	160.6	595	2,109	2,100
8,073.50	1,408	169.9	667	2,775	2,358
8,074.00	1,564	179.2	743	3,518	2,630
8,074.50	1,728	188.5	823	4,341	2,918
8,075.00	1,899	197.8	906	5,247	3,219
8,075.05	1,917	198.7	95	5,343	3,250
8,075.50	2,079	207.1	899	6,241	3,536
8,075.55	2,098	208.0	104	6,346	3,567
8,076.00	2,265	216.4	981	7,327	3,867
8,076.50	2,460	225.7	1,181	8,508	4,212


UW2
Undisturbed Watershed 2
DWS1
Disturbed Watershed 1
DWS2
Disturbed Watershed 2
PS
Pad Swale
UW3
Undisturbed Watershed 3
DWS3
Disturbed Watershed 3
DWS4
Disturbed Watershed 4
PD
Pad Ditch
CB
P
Pad Catch Basin
SPI
Sedimentation Pond Inlet
SPW
Sedimentation Pond Watershed
SP
Sedimentation Pond
POC
Primary Outlet Culvert
RR
Riprap
Subcat
Reach
Pond
Link
Drainage Diagram for 25yr, 6hr Sedimentation Pond (PS)
Prepared by EarthFax Engineering, Inc., Printed 5/24/2010
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Summary for Subcatchment DWS1: Disturbed Watershed 1

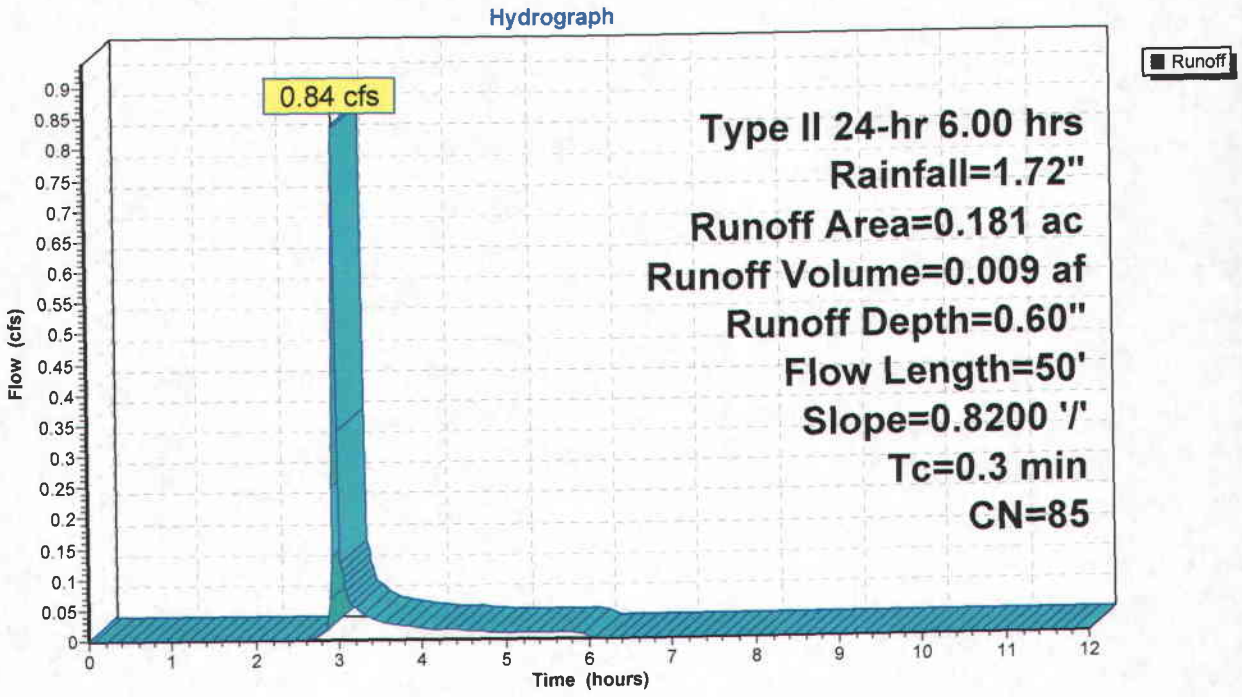
Runoff = 0.84 cfs @ 2.98 hrs, Volume= 0.009 af, Depth= 0.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-12.00 hrs, dt= 0.02 hrs
Type II 24-hr 6.00 hrs Rainfall=1.72"

	Area (ac)	CN	Description
*	0.181	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
	0.181		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	50	0.8200	3.08		**Lag/CN Method, Slope from 8,182 to 8,121**

Subcatchment DWS1: Disturbed Watershed 1



Summary for Subcatchment DWS2: Disturbed Watershed 2

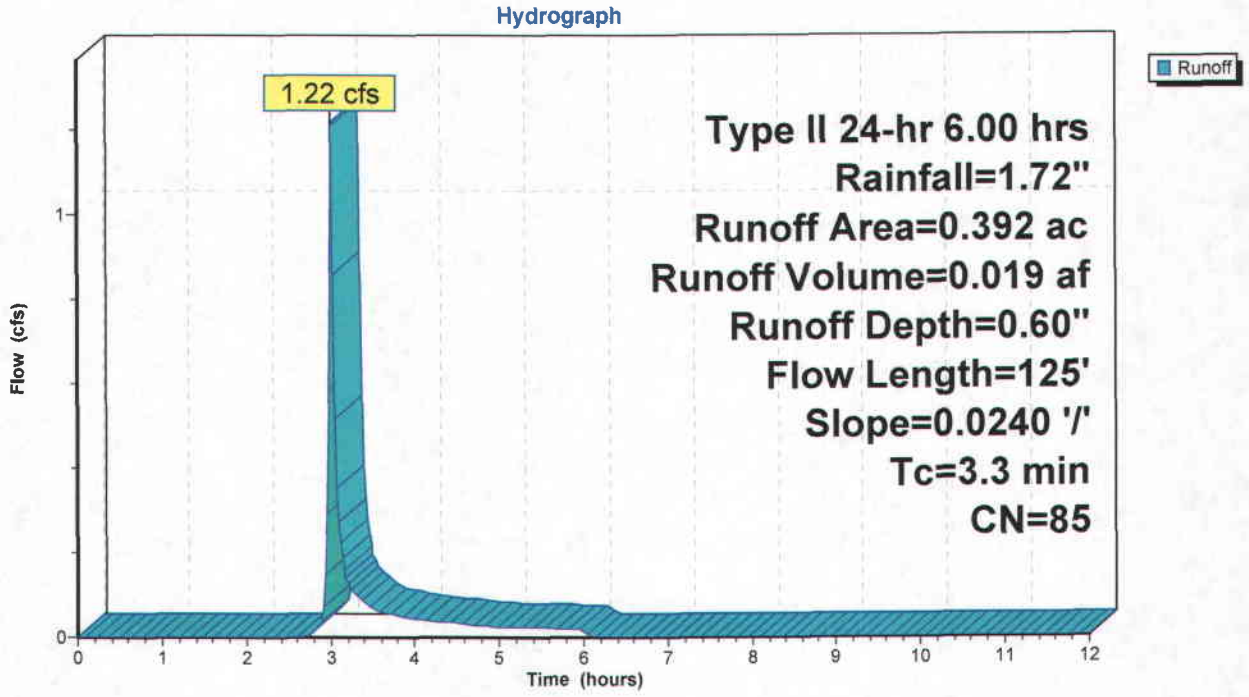
Runoff = 1.22 cfs @ 3.02 hrs, Volume= 0.019 af, Depth= 0.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-12.00 hrs, dt= 0.02 hrs
Type II 24-hr 6.00 hrs Rainfall=1.72"

	Area (ac)	CN	Description
*	0.392	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
	0.392		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	125	0.0240	0.63		**Lag/CN Method, Slope from 8,122 to 8,119**

Subcatchment DWS2: Disturbed Watershed 2



Summary for Subcatchment DWS3: Disturbed Watershed 3

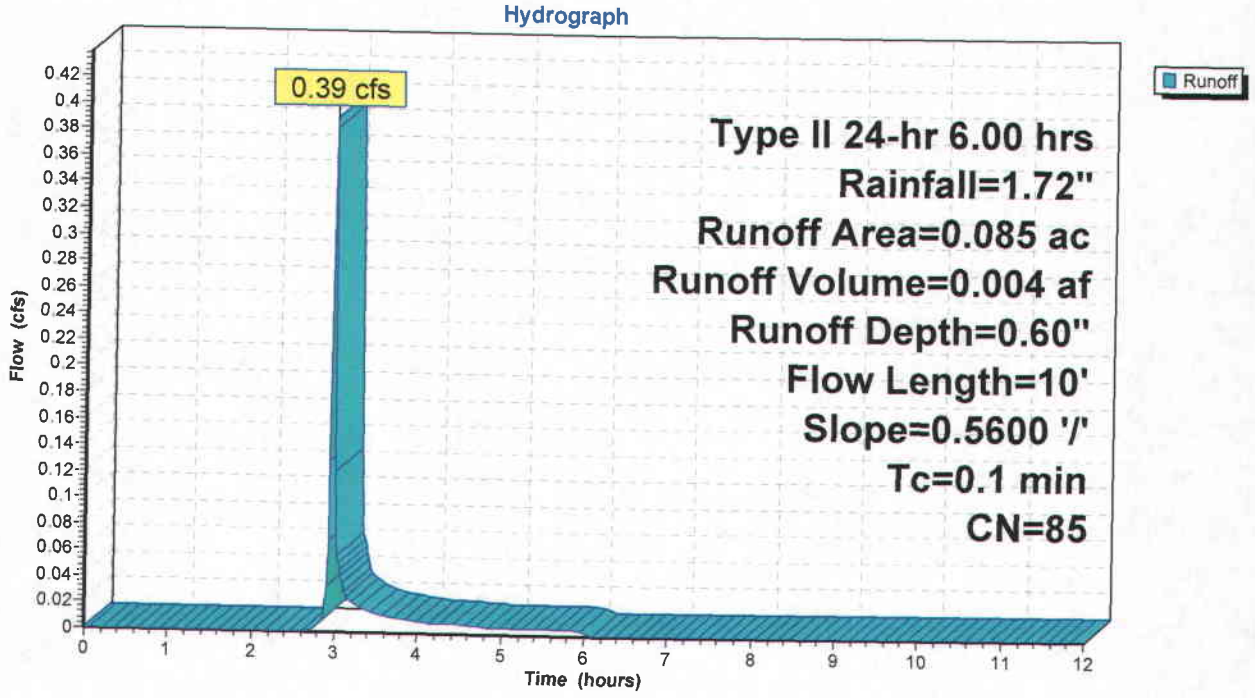
Runoff = 0.39 cfs @ 2.98 hrs, Volume= 0.004 af, Depth= 0.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-12.00 hrs, dt= 0.02 hrs
Type II 24-hr 6.00 hrs Rainfall=1.72"

	Area (ac)	CN	Description
*	0.085	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
	0.085		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	10	0.5600	1.84		**Lag/CN Method, Slope from 8,133 to 8,115**

Subcatchment DWS3: Disturbed Watershed 3



Summary for Subcatchment DWS4: Disturbed Watershed 4

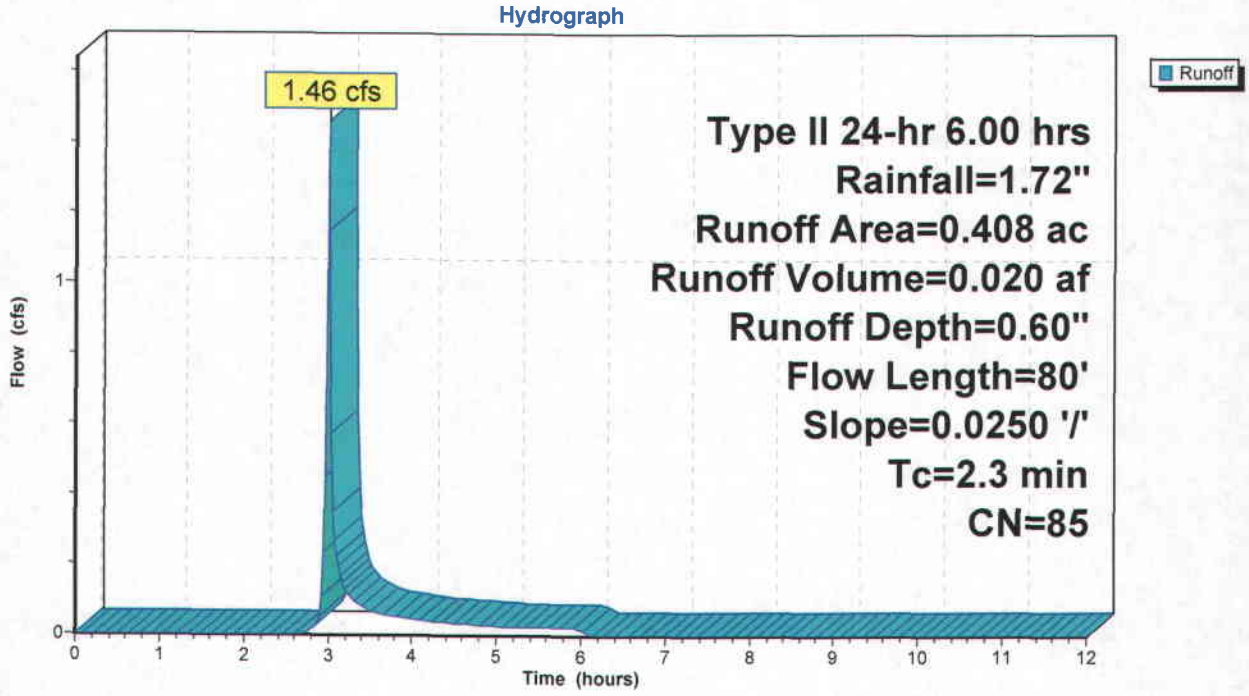
Runoff = 1.46 cfs @ 3.00 hrs, Volume= 0.020 af, Depth= 0.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-12.00 hrs, dt= 0.02 hrs
Type II 24-hr 6.00 hrs Rainfall=1.72"

	Area (ac)	CN	Description
*	0.408	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
	0.408		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	80	0.0250	0.59		**Lag/CN Method, Slope from 8,118 to 8,116**

Subcatchment DWS4: Disturbed Watershed 4



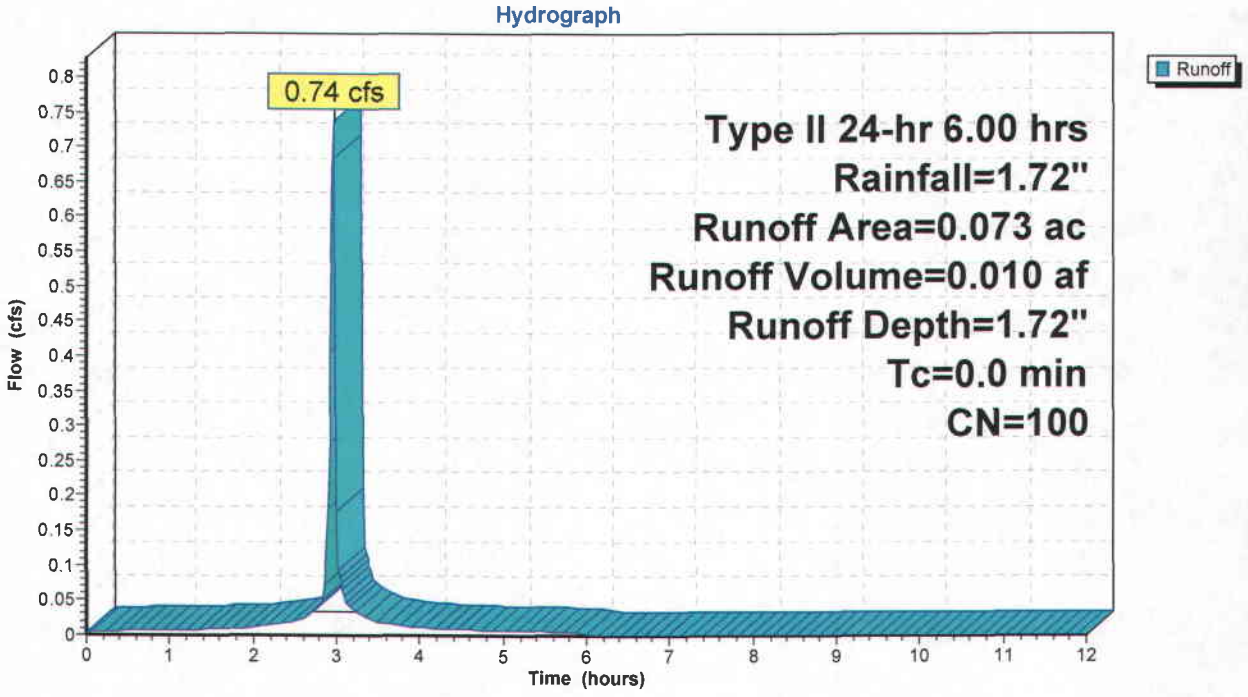
Summary for Subcatchment SPW: Sedimentation Pond Watershed

Runoff = 0.74 cfs @ 2.97 hrs, Volume= 0.010 af, Depth= 1.72"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-12.00 hrs, dt= 0.02 hrs
Type II 24-hr 6.00 hrs Rainfall=1.72"

	Area (ac)	CN	Description
*	0.073	100	
	0.073		100.00% Impervious Area

Subcatchment SPW: Sedimentation Pond Watershed



Summary for Subcatchment UW2: Undisturbed Watershed 2

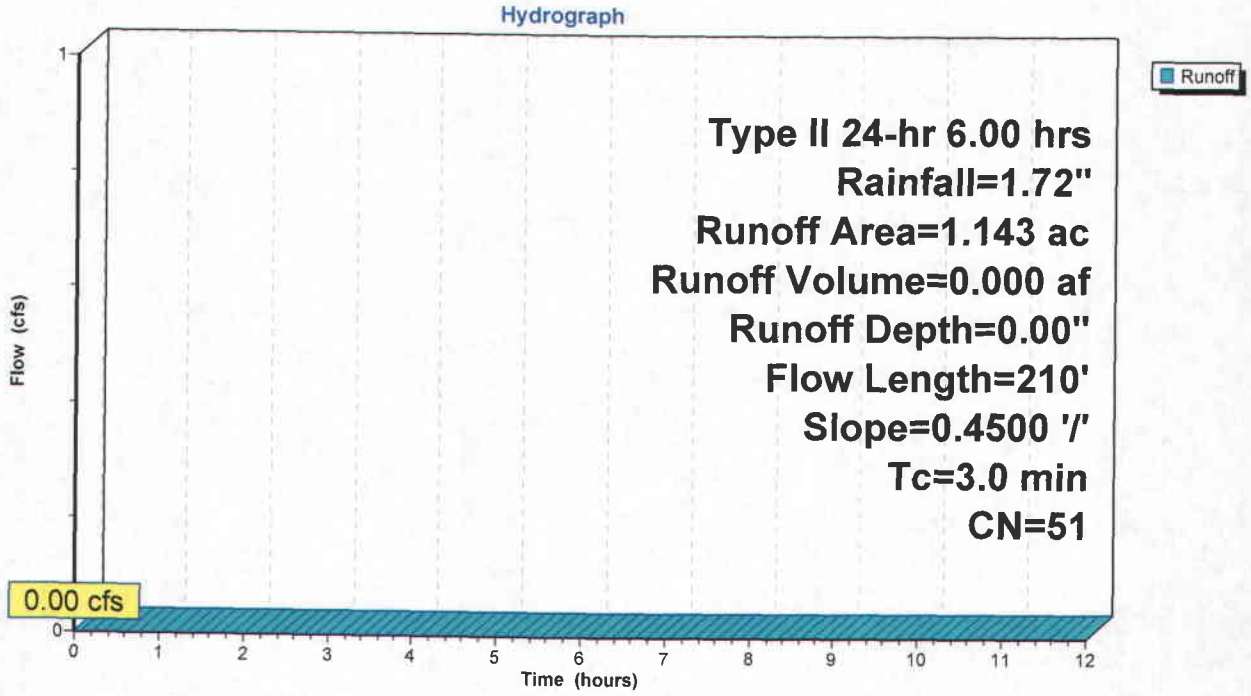
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-12.00 hrs, dt= 0.02 hrs
Type II 24-hr 6.00 hrs Rainfall=1.72"

Area (ac)	CN	Description
1.143	51	Sagebrush range, Fair, HSG B
1.143		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	210	0.4500	1.18		**Lag/CN Method, Slope from 8,231 to 8,136**

Subcatchment UW2: Undisturbed Watershed 2



Summary for Subcatchment UW3: Undisturbed Watershed 3

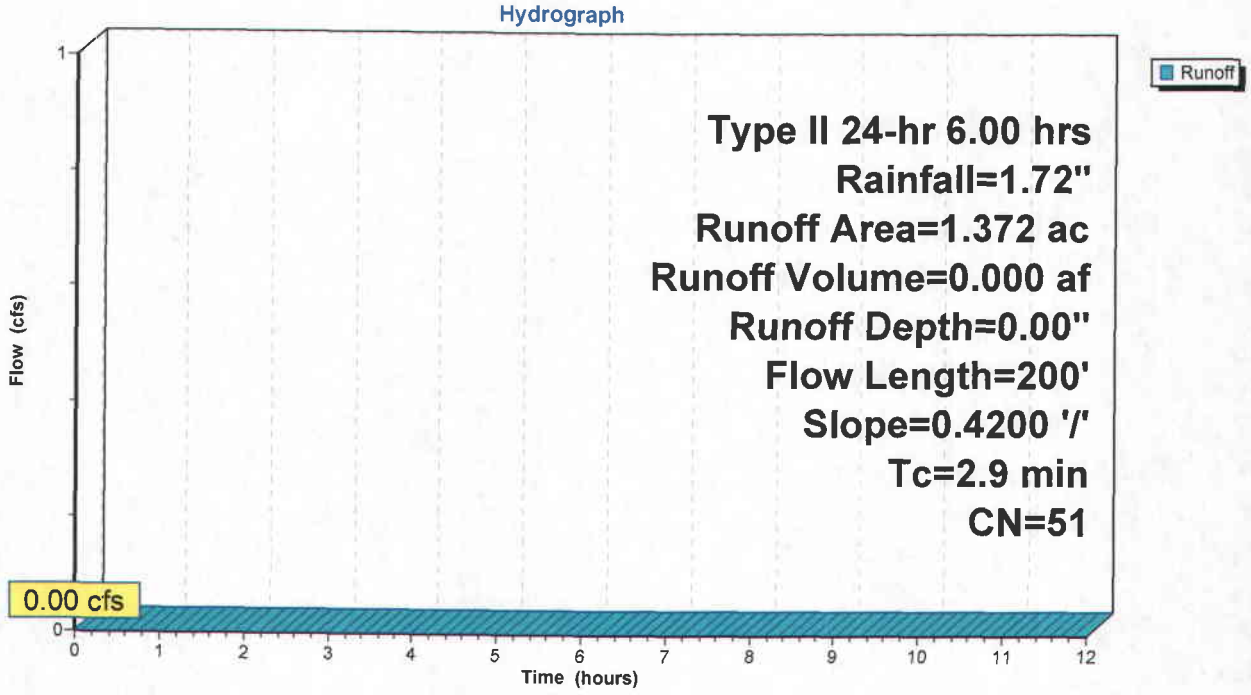
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-12.00 hrs, dt= 0.02 hrs
Type II 24-hr 6.00 hrs Rainfall=1.72"

Area (ac)	CN	Description
1.372	51	Sagebrush range, Fair, HSG B
1.372		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	200	0.4200	1.13		**Lag/CN Method, Slope from 8,214 to 8,130**

Subcatchment UW3: Undisturbed Watershed 3



Summary for Reach PD: Pad Ditch

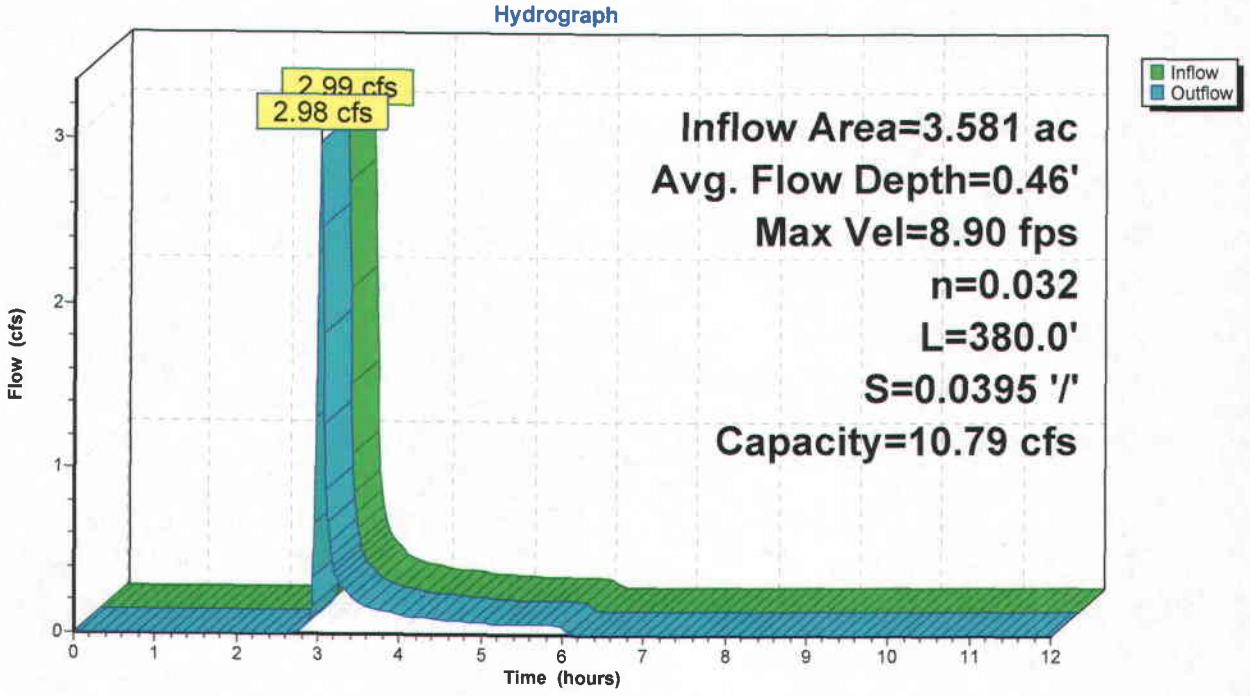
Inflow Area = 3.581 ac, 0.00% Impervious, Inflow Depth = 0.18"
Inflow = 2.99 cfs @ 3.00 hrs, Volume= 0.053 af
Outflow = 2.98 cfs @ 3.02 hrs, Volume= 0.053 af, Atten= 0%, Lag= 1.0 min

Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-12.00 hrs, dt= 0.02 hrs
Reference Flow= 8.09 cfs Estimated Depth= 0.90' Velocity= 5.02 fps
m= 1.333, c= 6.69 fps, dt= 1.2 min, dx= 380.0' / 1 = 380.0', K= 0.9 min, X= 0.478
Max. Velocity= 8.90 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 6.70 fps, Avg. Travel Time= 0.9 min

Peak Storage= 160 cf @ 3.01 hrs
Average Depth at Peak Storage= 0.46'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 10.79 cfs

0.00' x 1.00' deep channel, n= 0.032
Side Slope Z-value= 2.0 '/' Top Width= 4.00'
Length= 380.0' Slope= 0.0395 '/'
Inlet Invert= 8,116.00', Outlet Invert= 8,101.00'

Reach PD: Pad Ditch



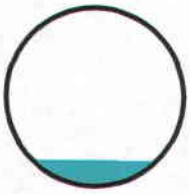
Summary for Reach POC: Primary Outlet Culvert

Inflow Area = 3.654 ac, 2.00% Impervious, Inflow Depth > 0.20"
Inflow = 1.09 cfs @ 3.09 hrs, Volume= 0.061 af
Outflow = 1.09 cfs @ 3.10 hrs, Volume= 0.061 af, Atten= 0%, Lag= 0.1 min

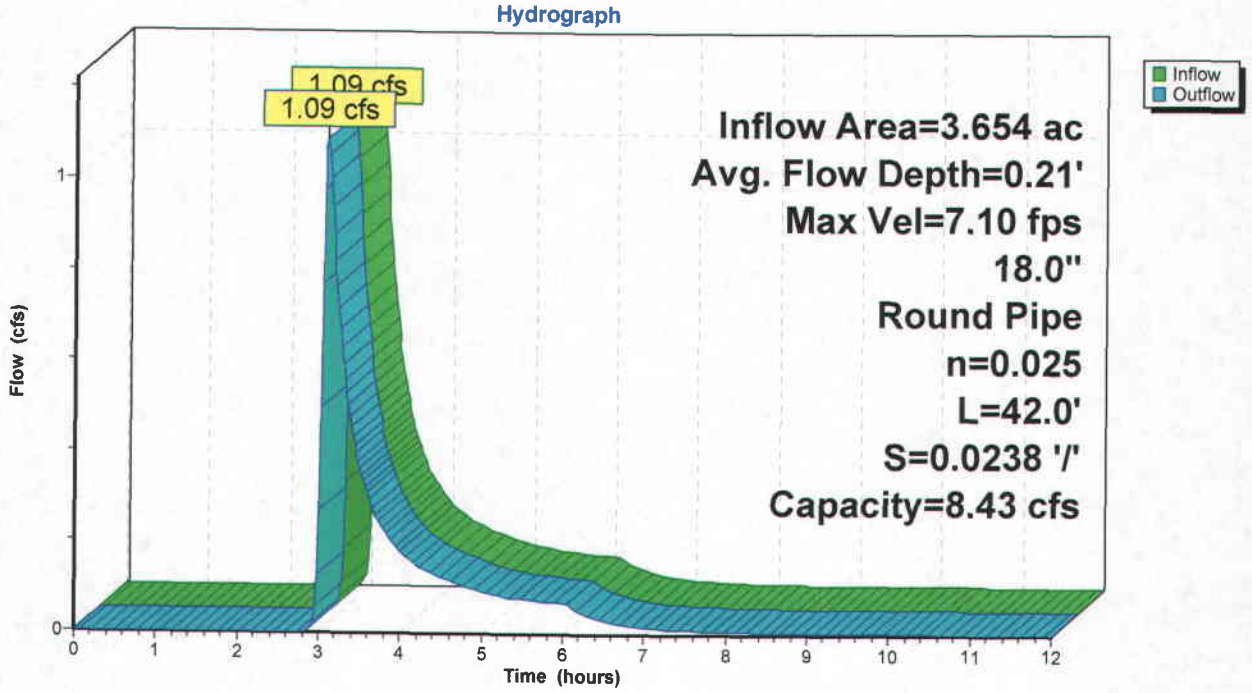
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-12.00 hrs, dt= 0.02 hrs
Reference Flow= 6.32 cfs Estimated Depth= 0.97' Velocity= 5.23 fps
m= 1.355, c= 7.09 fps, dt= 1.2 min, dx= 42.0' / 1 = 42.0', K= 0.1 min, X= 0.142
Max. Velocity= 7.10 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 7.09 fps, Avg. Travel Time= 0.1 min

Peak Storage= 6 cf @ 3.10 hrs
Average Depth at Peak Storage= 0.21'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 8.43 cfs

18.0" Round Pipe
n= 0.025 Corrugated metal
Length= 42.0' Slope= 0.0238 '/'
Inlet Invert= 8,071.00', Outlet Invert= 8,070.00'



Reach POC: Primary Outlet Culvert



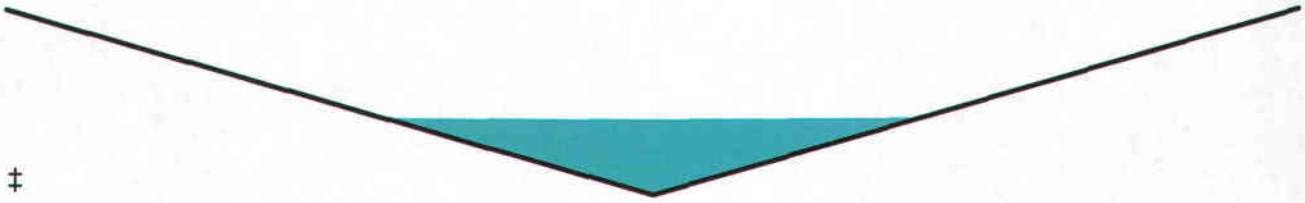
Summary for Reach PS: Pad Swale

Inflow Area = 1.716 ac, 0.00% Impervious, Inflow Depth = 0.20"
Inflow = 1.48 cfs @ 2.99 hrs, Volume= 0.028 af
Outflow = 1.46 cfs @ 3.01 hrs, Volume= 0.028 af, Atten= 1%, Lag= 1.2 min

Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-12.00 hrs, dt= 0.02 hrs
Reference Flow= 4.97 cfs Estimated Depth= 0.45' Velocity= 2.47 fps
m= 1.333, c= 3.29 fps, dt= 1.2 min, dx= 240.0' / 1 = 240.0', K= 1.2 min, X= 0.466
Max. Velocity= 4.63 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 3.28 fps, Avg. Travel Time= 1.2 min

Peak Storage= 103 cf @ 3.01 hrs
Average Depth at Peak Storage= 0.21'
Bank-Full Depth= 0.50', Capacity at Bank-Full= 6.63 cfs

0.00' x 0.50' deep channel, n= 0.032
Side Slope Z-value= 10.0 '/' Top Width= 10.00'
Length= 240.0' Slope= 0.0208 '/'
Inlet Invert= 8,121.00', Outlet Invert= 8,116.00'



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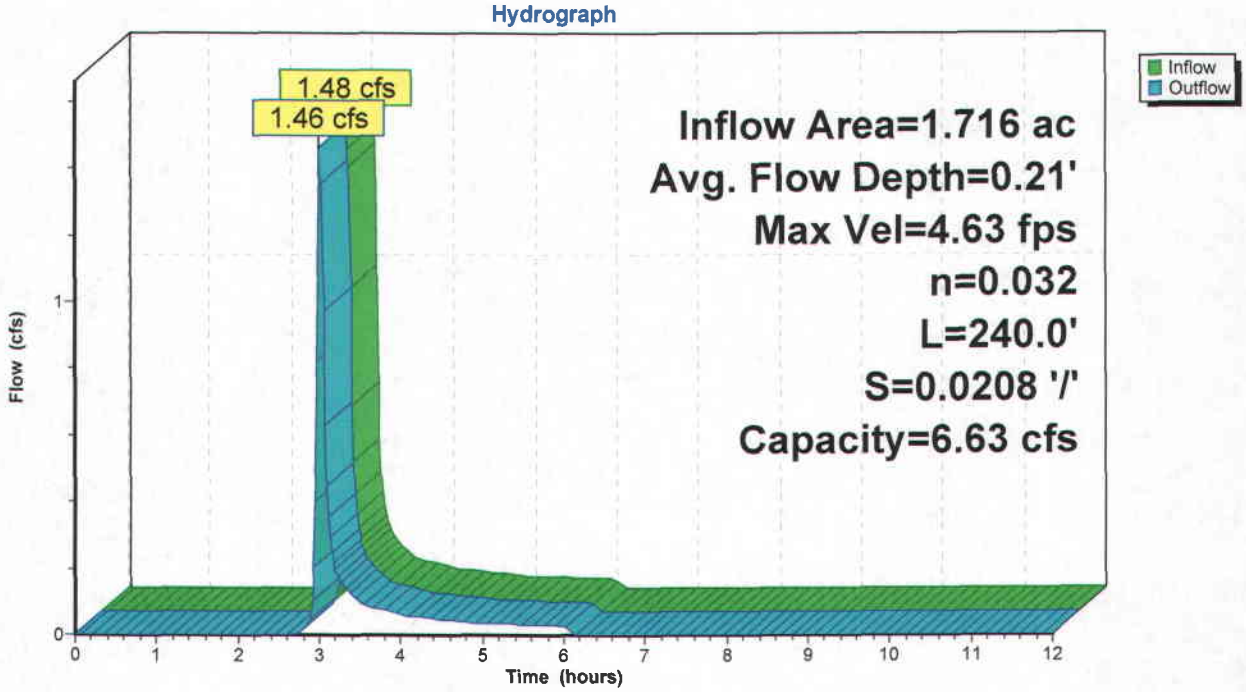
Reach PS: Pad Swale



Summary for Reach RR: Riprap

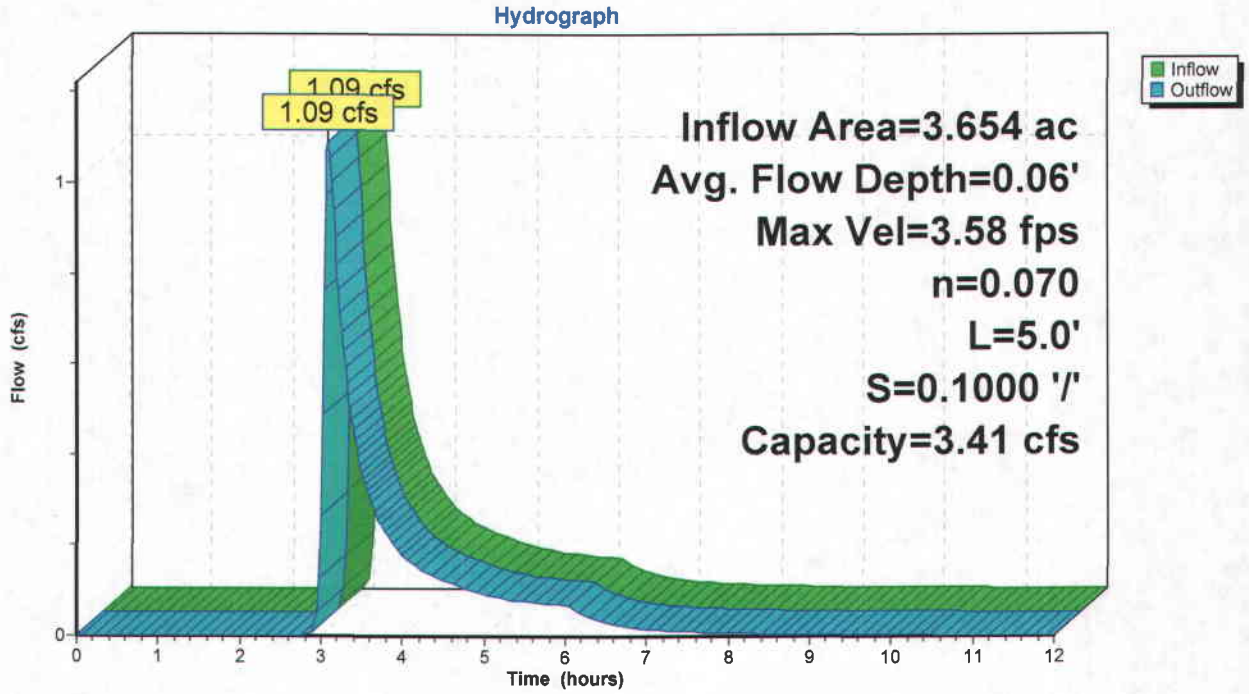
Inflow Area = 3.654 ac, 2.00% Impervious, Inflow Depth > 0.20"
Inflow = 1.09 cfs @ 3.10 hrs, Volume= 0.061 af
Outflow = 1.09 cfs @ 3.10 hrs, Volume= 0.061 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-12.00 hrs, dt= 0.02 hrs
Reference Flow= 2.56 cfs Estimated Depth= 0.21' Velocity= 2.24 fps
m= 1.601, c= 3.58 fps, dt= 1.2 min, dx= 5.0' / 1 = 5.0', K= 0.0 min, X= 0.368
Max. Velocity= 3.58 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 3.58 fps, Avg. Travel Time= 0.0 min

Peak Storage= 2 cf @ 3.10 hrs
Average Depth at Peak Storage= 0.06'
Bank-Full Depth= 0.25', Capacity at Bank-Full= 3.41 cfs

5.00' x 0.25' deep channel, n= 0.070 Mountain streams w/large boulders
Side Slope Z-value= 2.0 '/' Top Width= 6.00'
Length= 5.0' Slope= 0.1000 '/'
Inlet Invert= 8,069.50', Outlet Invert= 8,069.00'

Reach RR: Riprap



Sedimentation Pond Primary Spillway Riprap Pad
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Sed. Pond Ripra
Flow Element	Trapezoidal Cha
Method	Manning's Formı
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.070	
Slope	100000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Bottom Width	5.00	ft
Discharge	1.09	cfs

Results		
Depth	0.13	ft
Flow Area	0.7	ft²
Wetted Perim	5.57	ft
Top Width	5.51	ft
Critical Depth	0.11	ft
Critical Slope	0.152098	ft/ft
Velocity	1.63	ft/s
Velocity Head	0.04	ft
Specific Energ	0.17	ft
Froude Numb	0.83	
Flow Type	Subcritical	

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Summary for Reach SPI: Sedimentation Pond Inlet

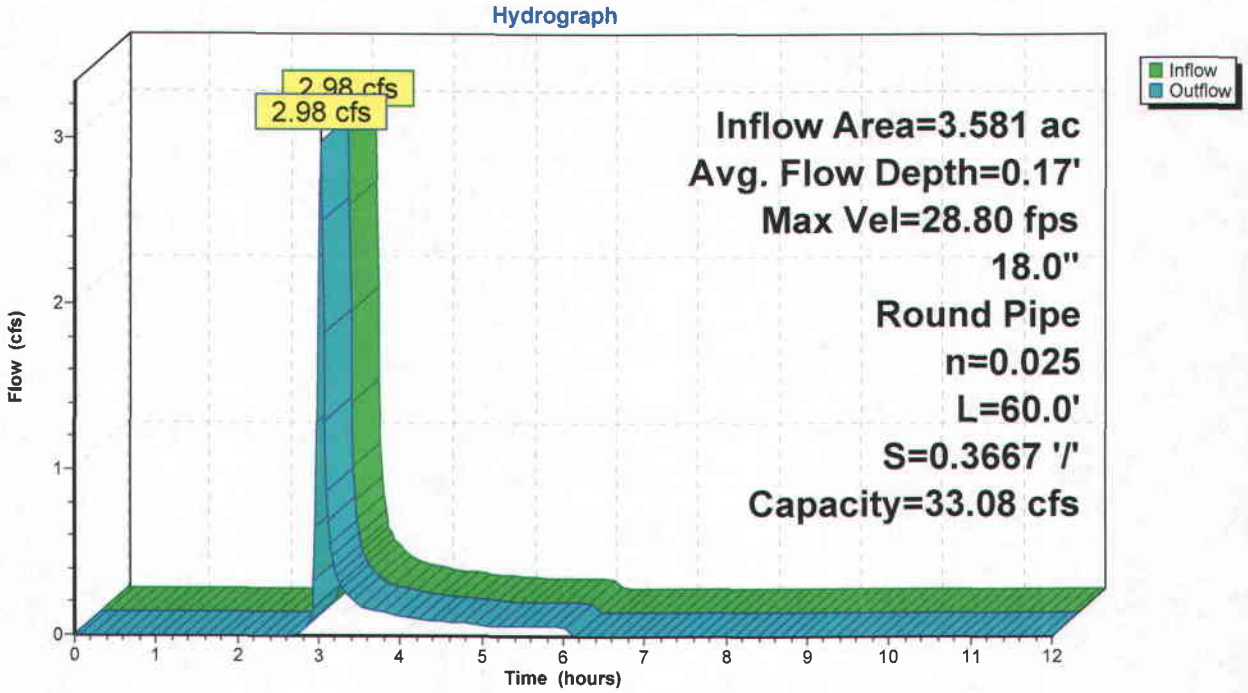
Inflow Area = 3.581 ac, 0.00% Impervious, Inflow Depth = 0.18"
Inflow = 2.98 cfs @ 3.02 hrs, Volume= 0.053 af
Outflow = 2.98 cfs @ 3.02 hrs, Volume= 0.053 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-12.00 hrs, dt= 0.02 hrs
Reference Flow= 24.81 cfs Estimated Depth= 0.97' Velocity= 20.54 fps
m= 1.355, c= 27.83 fps, dt= 1.2 min, dx= 60.0' / 1 = 60.0', K= 0.0 min, X= 0.484
Max. Velocity= 28.80 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 27.84 fps, Avg. Travel Time= 0.0 min

Peak Storage= 6 cf @ 3.02 hrs
Average Depth at Peak Storage= 0.17'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 33.08 cfs

18.0" Round Pipe
n= 0.025 Corrugated metal
Length= 60.0' Slope= 0.3667 '/'
Inlet Invert= 8,096.00', Outlet Invert= 8,074.00'

Reach SPI: Sedimentation Pond Inlet



Summary for Pond P: Pad Catch Basin

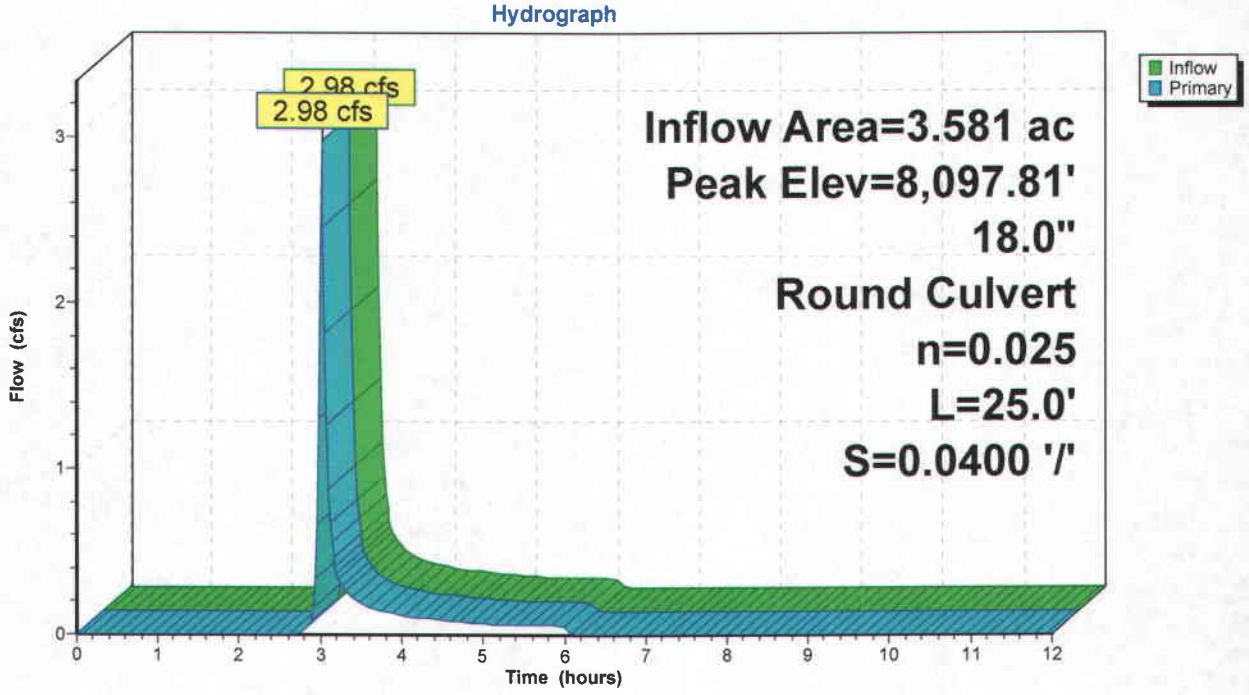
Inflow Area = 3.581 ac, 0.00% Impervious, Inflow Depth = 0.18"
Inflow = 2.98 cfs @ 3.02 hrs, Volume= 0.053 af
Outflow = 2.98 cfs @ 3.02 hrs, Volume= 0.053 af, Atten= 0%, Lag= 0.0 min
Primary = 2.98 cfs @ 3.02 hrs, Volume= 0.053 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.02 hrs
Peak Elev= 8,097.81' @ 3.02 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	8,097.00'	**18.0" Round Culvert** L= 25.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 8,097.00' / 8,096.00' S= 0.0400 '/' Cc= 0.900 n= 0.025 Corrugated metal

Primary OutFlow Max=2.95 cfs @ 3.02 hrs HW=8,097.80' TW=8,096.17' (Dynamic Tailwater)
↳**1=Culvert** (Inlet Controls 2.95 cfs @ 3.05 fps)

Pond P: Pad Catch Basin



Summary for Pond SP: Sedimentation Pond

Inflow Area =	3.654 ac,	2.00% Impervious,	Inflow Depth =	0.21"
Inflow =	3.07 cfs @	3.02 hrs, Volume=	0.063 af	
Outflow =	1.09 cfs @	3.09 hrs, Volume=	0.061 af,	Atten= 64%, Lag= 4.4 min
Primary =	1.09 cfs @	3.09 hrs, Volume=	0.061 af	
Secondary =	0.00 cfs @	0.00 hrs, Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.02 hrs
Peak Elev= 8,075.52' @ 3.09 hrs Surf.Area= 2,085 sf Storage= 1,029 cf

Plug-Flow detention time= 40.3 min calculated for 0.061 af (95% of inflow)
Center-of-Mass det. time= 33.8 min (243.6 - 209.8)

Volume	Invert	Avail.Storage	Storage Description
#1	8,070.50'	3,261 cf	**Custom Stage Data (Irregular)**Listed below

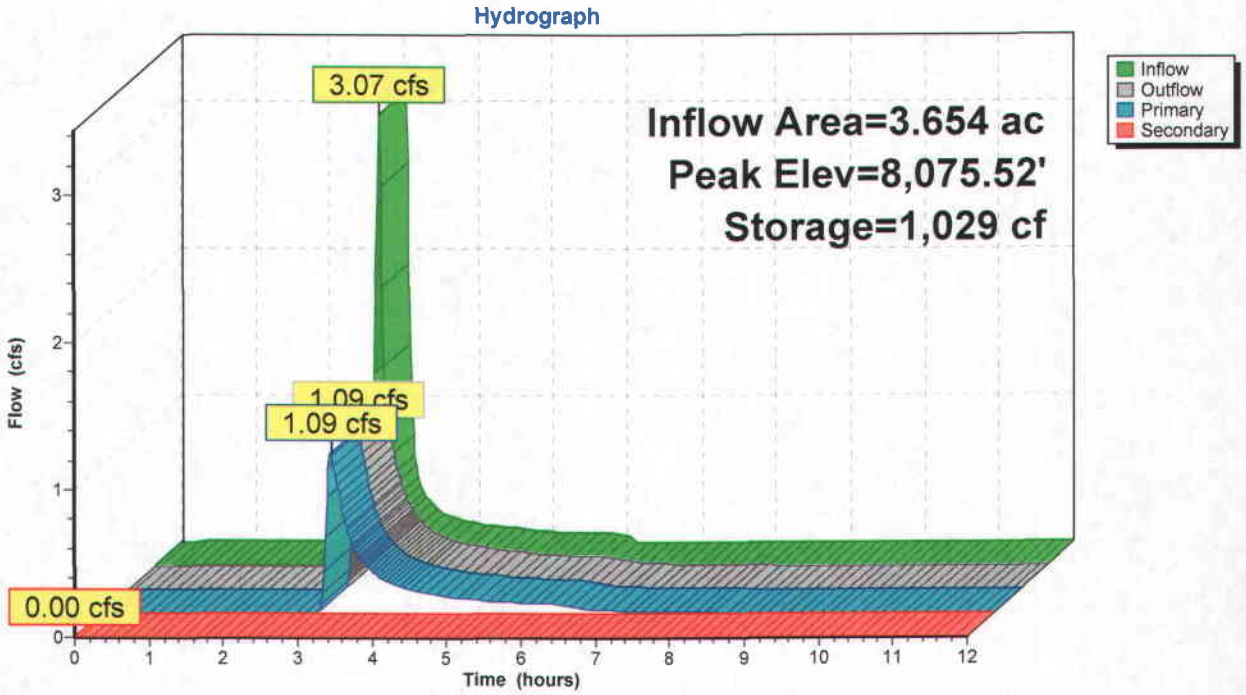
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
8,070.50	0	0.0	0.0	0	0	0
8,071.00	744	123.4	0.0	0	0	1,212
8,071.50	862	132.7	0.0	0	0	1,412
8,071.65	900	135.5	0.0	0	0	1,475
8,072.00	987	142.0	0.0	0	0	1,627
8,072.10	1,014	143.9	0.0	0	0	1,672
8,072.50	1,120	151.3	0.0	0	0	1,856
8,073.00	1,260	160.6	0.0	0	0	2,100
8,073.50	1,408	169.9	0.0	0	0	2,358
8,074.00	1,564	179.2	0.0	0	0	2,630
8,074.50	1,728	188.5	0.0	0	0	2,918
8,075.00	1,899	197.8	0.0	0	0	3,219
8,075.05	1,917	198.7	100.0	95	95	3,250
8,075.50	2,079	207.1	100.0	899	994	3,536
8,075.55	2,098	208.0	100.0	104	1,099	3,567
8,076.00	2,265	216.4	100.0	981	2,080	3,867
8,076.50	2,460	225.7	100.0	1,181	3,261	4,212

Device	Routing	Invert	Outlet Devices
#1	Primary	8,075.05'	**18.0" Vert. Orifice/Grate** C= 0.600
#2	Secondary	8,075.55'	**Special & User-Defined**
			Head (feet) 0.00 0.09
			Disch. (cfs) 0.000 0.840

Primary OutFlow Max=1.08 cfs @ 3.09 hrs HW=8,075.52' TW=8,071.21' (Dynamic Tailwater)
↑—**1=Orifice/Grate** (Orifice Controls 1.08 cfs @ 2.32 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=8,075.00' (Free Discharge)
↑—**2=Special & User-Defined** (Controls 0.00 cfs)

Pond SP: Sedimentation Pond



Sedimentation Pond Primary Outlet
Worksheet for Circular Channel

Project Description	
Worksheet	SPPO
Flow Element	Circular Chann
Method	Manning's For
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.025	
Slope	023800	ft/ft
Diameter	18	in
Discharge	1.09	cfs

Results		
Depth	0.36	ft
Flow Area	0.3	ft²
Wetted Perime	1.55	ft
Top Width	1.29	ft
Critical Depth	0.39	ft
Percent Full	24.3	%
Critical Slope	0.018197	ft/ft
Velocity	3.29	ft/s
Velocity Head	0.17	ft
Specific Energy	0.53	ft
Froude Numbe	1.14	
Maximum Disc	9.06	cfs
Discharge Full	8.43	cfs
Slope Full	0.000398	ft/ft
Flow Type	Supercritical	

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Summary for Pond FP: Sedimentation Pond

Inflow Area = 3.654 ac, 2.00% Impervious, Inflow Depth = 0.21"
Inflow = 3.07 cfs @ 3.02 hrs, Volume= 0.063 af
Outflow = 2.06 cfs @ 3.04 hrs, Volume= 0.061 af, Atten= 33%, Lag= 1.1 min
Secondary = 2.06 cfs @ 3.04 hrs, Volume= 0.061 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.02 hrs
Peak Elev= 8,075.73' @ 3.06 hrs Surf.Area= 2,165 sf Storage= 498 cf

Plug-Flow detention time= 12.4 min calculated for 0.061 af (96% of inflow)
Center-of-Mass det. time= 7.0 min (216.8 - 209.8)

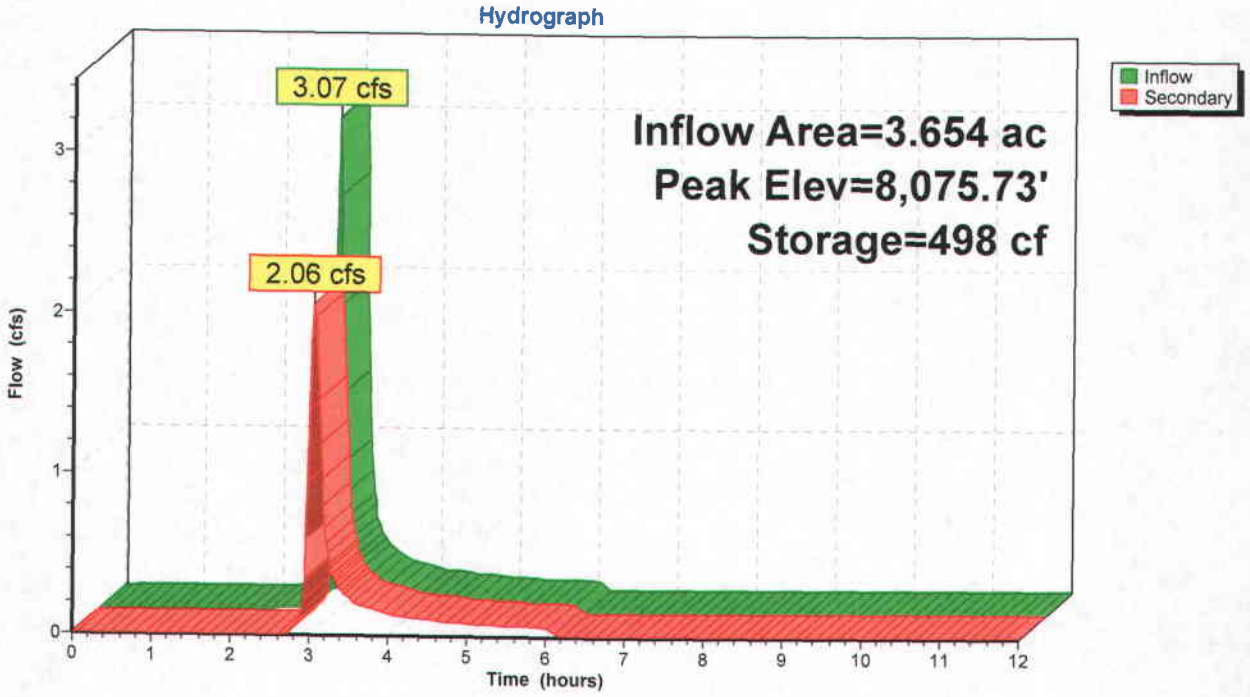
Volume	Invert	Avail.Storage	Storage Description
#1	8,070.50'	2,267 cf	**Custom Stage Data (Irregular)**Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
8,070.50	0	0.0	0.0	0	0	0
8,071.00	744	123.4	0.0	0	0	1,212
8,071.50	862	132.7	0.0	0	0	1,412
8,071.65	900	135.5	0.0	0	0	1,475
8,072.00	987	142.0	0.0	0	0	1,627
8,072.10	1,014	143.9	0.0	0	0	1,672
8,072.50	1,120	151.3	0.0	0	0	1,856
8,073.00	1,260	160.6	0.0	0	0	2,100
8,073.50	1,408	169.9	0.0	0	0	2,358
8,074.00	1,564	179.2	0.0	0	0	2,630
8,074.50	1,728	188.5	0.0	0	0	2,918
8,075.00	1,899	197.8	0.0	0	0	3,219
8,075.05	1,917	198.7	0.0	0	0	3,250
8,075.50	2,079	207.1	0.0	0	0	3,536
8,075.55	2,098	208.0	100.0	104	104	3,567
8,076.00	2,265	216.4	100.0	981	1,086	3,867
8,076.50	2,460	225.7	100.0	1,181	2,267	4,212

Device	Routing	Invert	Outlet Devices
#1	Secondary	8,075.55'	**Special & User-Defined** Head (feet) 0.00 0.16 Disch. (cfs) 0.000 2.060

Secondary OutFlow Max=2.06 cfs @ 3.04 hrs HW=8,075.72' (Free Discharge)
1=Special & User-Defined (Custom Controls 2.06 cfs)

Pond FP: Sedimentation Pond



Sedimentation Pond Secondary Spillway (Upper)
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	SPSS (Upper)
Flow Element	Trapezoidal Cha
Method	Manning's Formı
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	050000	ft/ft
Left Side Slope	0.20	V : H
Right Side Slope	0.20	V : H
Bottom Width	5.00	ft
Discharge	2.06	cfs

Results		
Depth	0.16	ft
Flow Area	0.9	ft²
Wetted Perimı	6.62	ft
Top Width	6.59	ft
Critical Depth	0.16	ft
Critical Slope	0.044769	ft/ft
Velocity	2.23	ft/s
Velocity Head	0.08	ft
Specific Energ	0.24	ft
Froude Numb	1.05	
Flow Type	Supercritical	

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Sedimentation Pond Secondary Spillway (Lower)
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	SPSS (Lower)
Flow Element	Trapezoidal Cha
Method	Manning's Formı
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	500000	ft/ft
Left Side Slope	0.20	V : H
Right Side Slope	0.20	V : H
Bottom Width	5.00	ft
Discharge	2.06	cfs

Results		
Depth	0.08	ft
Flow Area	0.4	ft²
Wetted Perim	5.83	ft
Top Width	5.81	ft
Critical Depth	0.16	ft
Critical Slope	0.044769	ft/ft
Velocity	4.69	ft/s
Velocity Head	0.34	ft
Specific Energ	0.42	ft
Froude Numb	3.01	
Flow Type	Supercritical	

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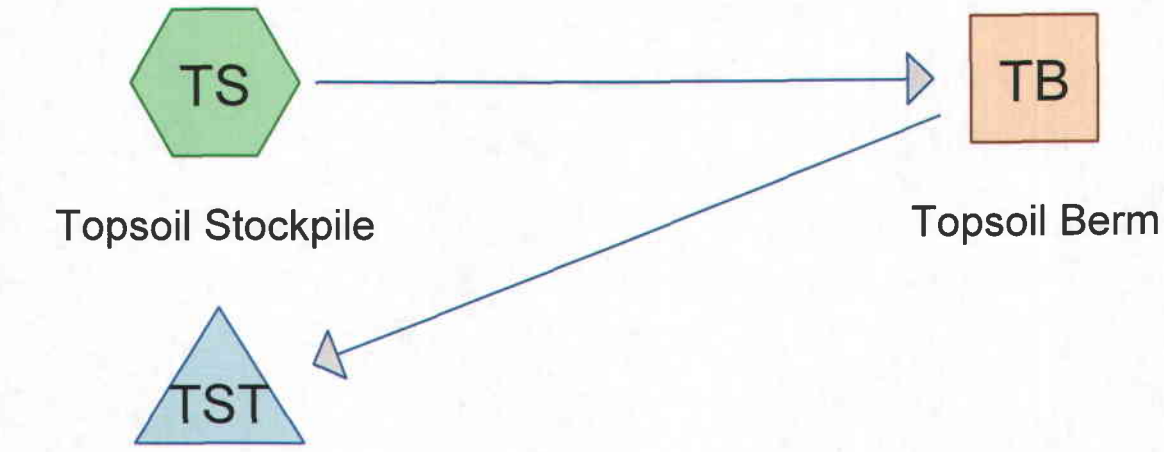


Subcat Reach Pond Link

Drainage Diagram for 10yr, 24hr Topsoil Sediment Trap
Prepared by EarthFax Engineering, Inc., Printed 5/24/2010

Summary for Subcatchment TS: Topsoil Stockpile

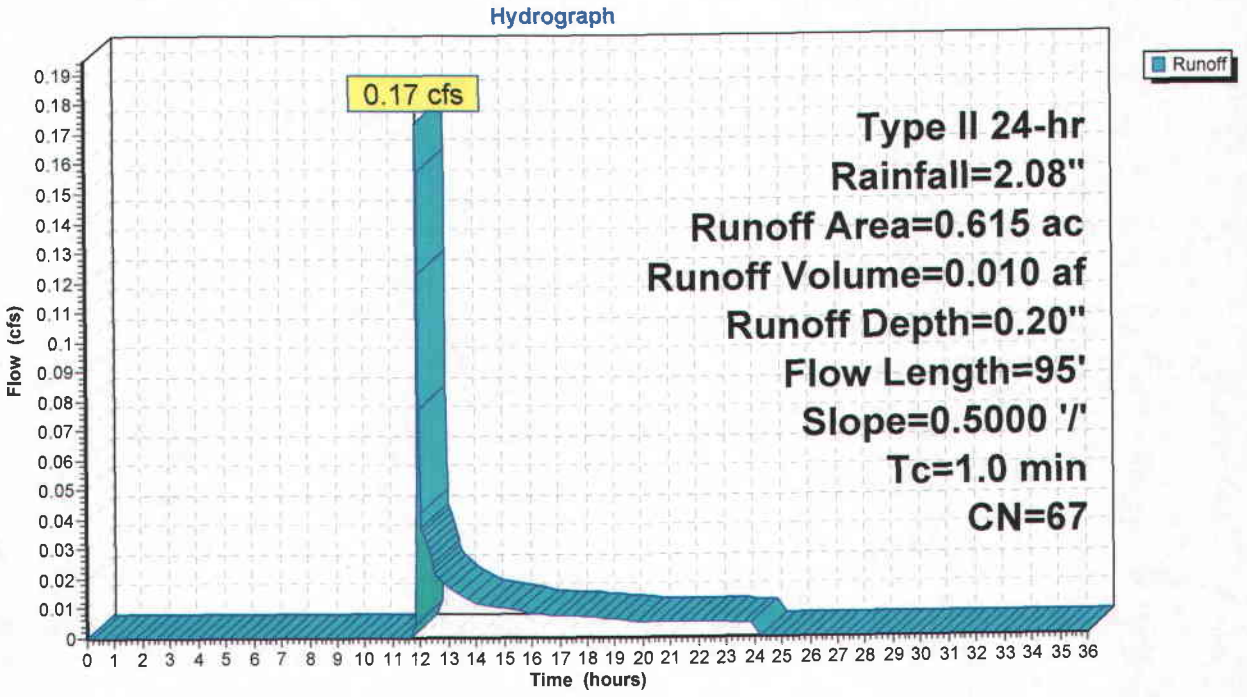
Runoff = 0.17 cfs @ 11.94 hrs, Volume= 0.010 af, Depth= 0.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Type II 24-hr Rainfall=2.08"

Area (ac)	CN	Description
0.615	67	Sagebrush range, Poor, HSG B
0.615		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	95	0.5000	1.60		**Lag/CN Method, Slope From 8,100 to 8,053**

Subcatchment TS: Topsoil Stockpile



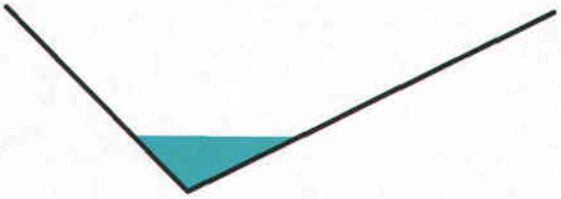
Summary for Reach TB: Topsoil Berm

Inflow Area = 0.615 ac, 0.00% Impervious, Inflow Depth = 0.20"
Inflow = 0.17 cfs @ 11.94 hrs, Volume= 0.010 af
Outflow = 0.17 cfs @ 11.98 hrs, Volume= 0.010 af, Atten= 0%, Lag= 2.6 min

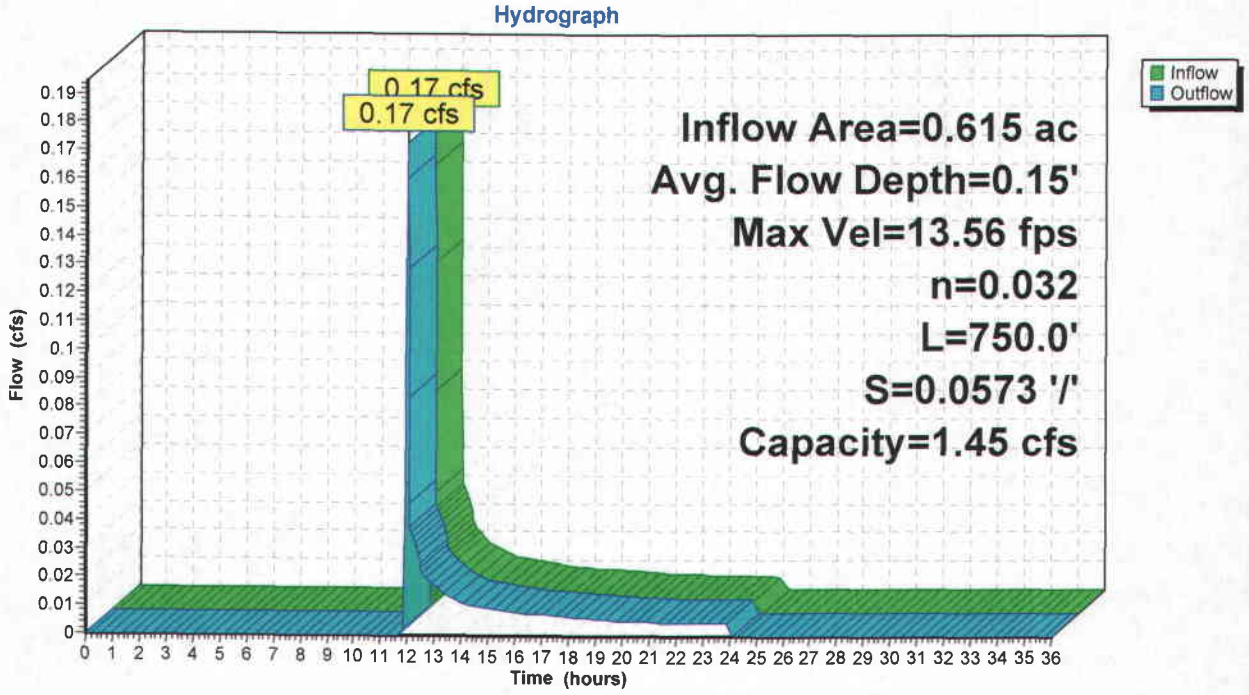
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Reference Flow= 1.09 cfs Estimated Depth= 0.45' Velocity= 3.60 fps
m= 1.333, c= 4.80 fps, dt= 1.2 min, dx= 750.0' / 2 = 375.0', K= 1.3 min, X= 0.492
Max. Velocity= 13.56 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 5.04 fps, Avg. Travel Time= 2.5 min

Peak Storage= 26 cf @ 11.96 hrs
Average Depth at Peak Storage= 0.15'
Bank-Full Depth= 0.50', Capacity at Bank-Full= 1.45 cfs

0.00' x 0.50' deep channel, n= 0.032
Side Slope Z-value= 1.0 2.0 '/' Top Width= 1.50'
Length= 750.0' Slope= 0.0573 '/'
Inlet Invert= 8,096.00', Outlet Invert= 8,053.00'



Reach TB: Topsoil Berm



Topsoil Berm Maximum Depth
Worksheet for Triangular Channel

Project Description	
Worksheet	TB MD
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	013330	ft/ft
Left Side Slope	1.00	V : H
Right Side Slope	0.50	V : H
Discharge	0.17	cfs

Results		
Depth	0.29	ft
Flow Area	0.1	ft²
Wetted Perim	1.07	ft
Top Width	0.88	ft
Critical Depth	0.24	ft
Critical Slope	0.039290	ft/ft
Velocity	1.31	ft/s
Velocity Head	0.03	ft
Specific Energ	0.32	ft
Froude Numb	0.60	
Flow Type	Subcritical	

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Topsoil Berm Maximum Slope
Worksheet for Triangular Channel

Project Description	
Worksheet	TB MV
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	133000	ft/ft
Left Side Slope	1.00	V : H
Right Side Slope	0.50	V : H
Discharge	0.17	cfs

Results		
Depth	0.19	ft
Flow Area	0.1	ft²
Wetted Perim	0.70	ft
Top Width	0.57	ft
Critical Depth	0.24	ft
Critical Slope	0.039291	ft/ft
Velocity	3.10	ft/s
Velocity Head	0.15	ft
Specific Energ	0.34	ft
Froude Numb	1.77	
Flow Type	Supercritical	

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Summary for Pond TST: Topsoil Sediment Trap

Inflow Area = 0.615 ac, 0.00% Impervious, Inflow Depth = 0.20"
Inflow = 0.17 cfs @ 11.98 hrs, Volume= 0.010 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

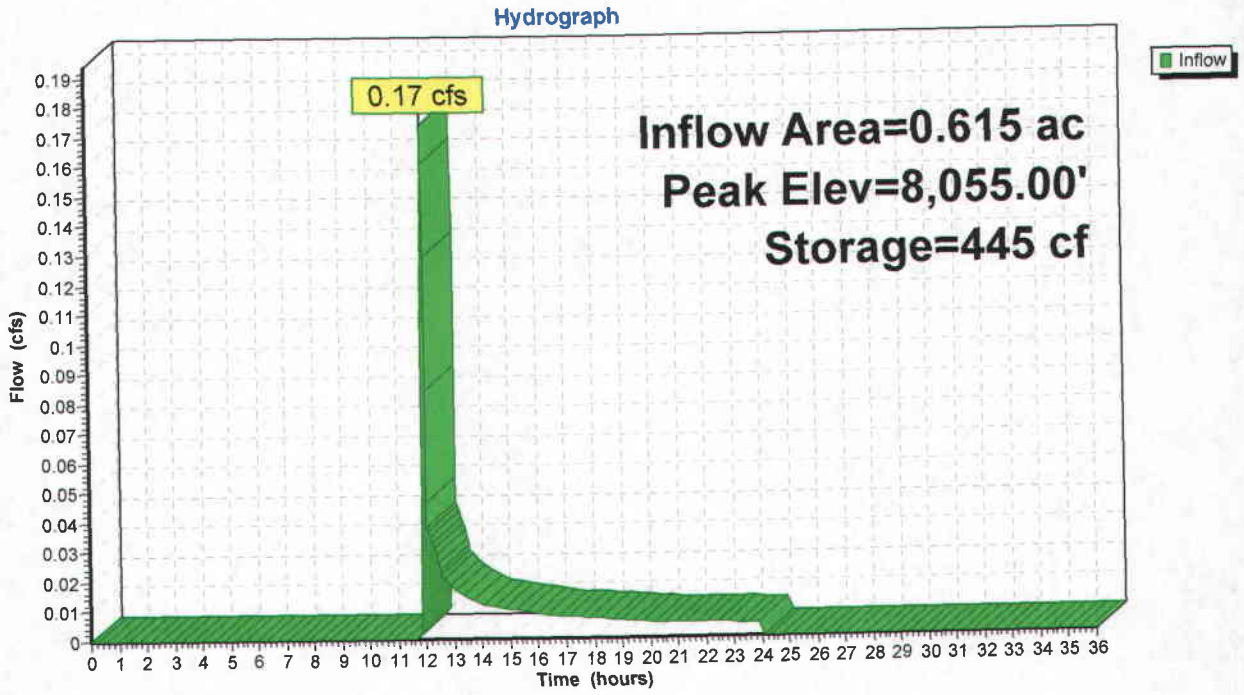
Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.02 hrs
Peak Elev= 8,055.00' @ 24.22 hrs Surf.Area= 450 sf Storage= 445 cf

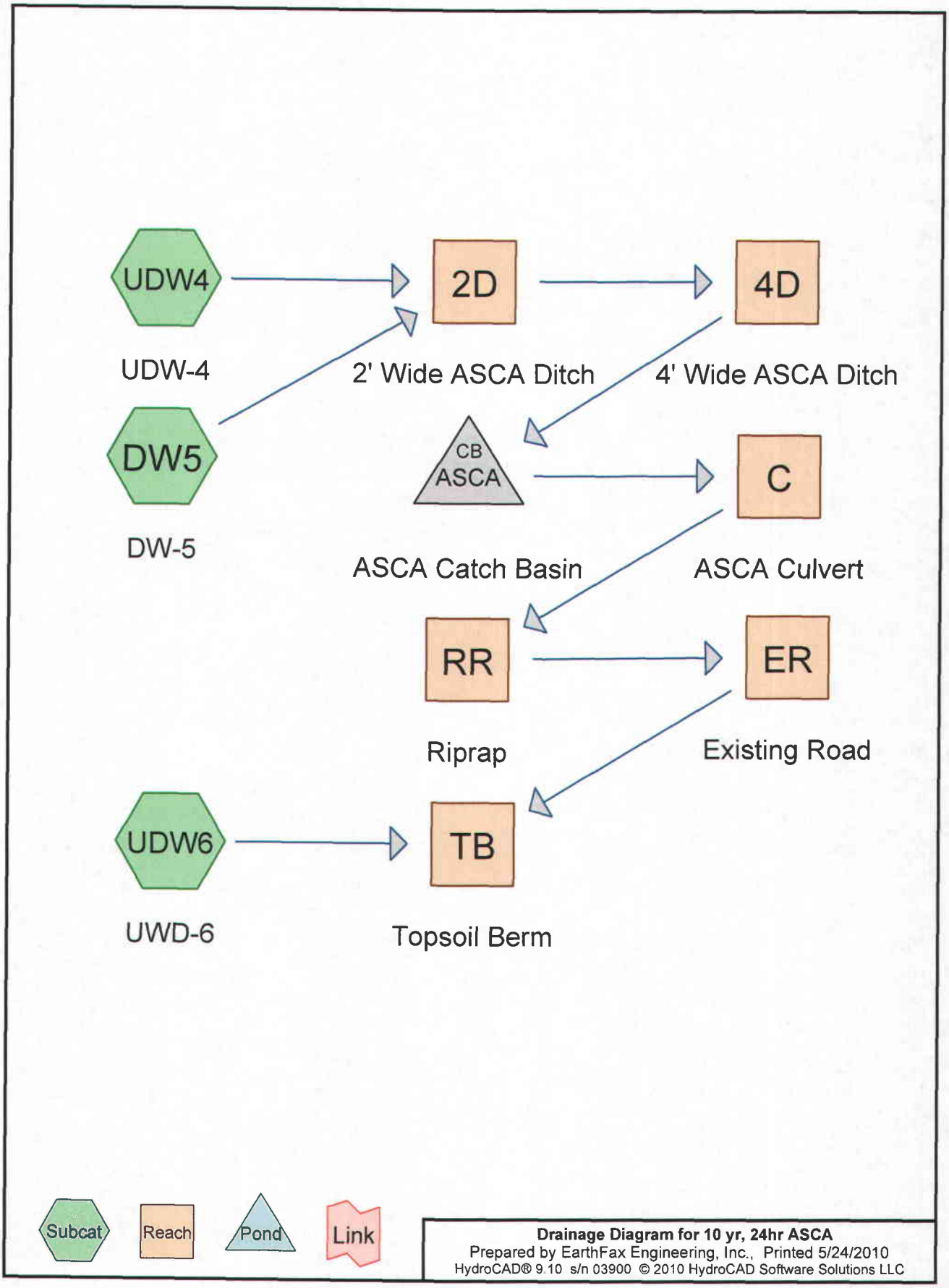
Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	8,053.00'	1,053 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
8,053.00	0	0	0
8,054.00	220	110	110
8,055.00	450	335	445
8,056.00	765	608	1,053

Pond TST: Topsoil Sediment Trap





Drainage Diagram for 10 yr, 24hr ASCA
Prepared by EarthFax Engineering, Inc., Printed 5/24/2010

Summary for Subcatchment DW5: DW-5

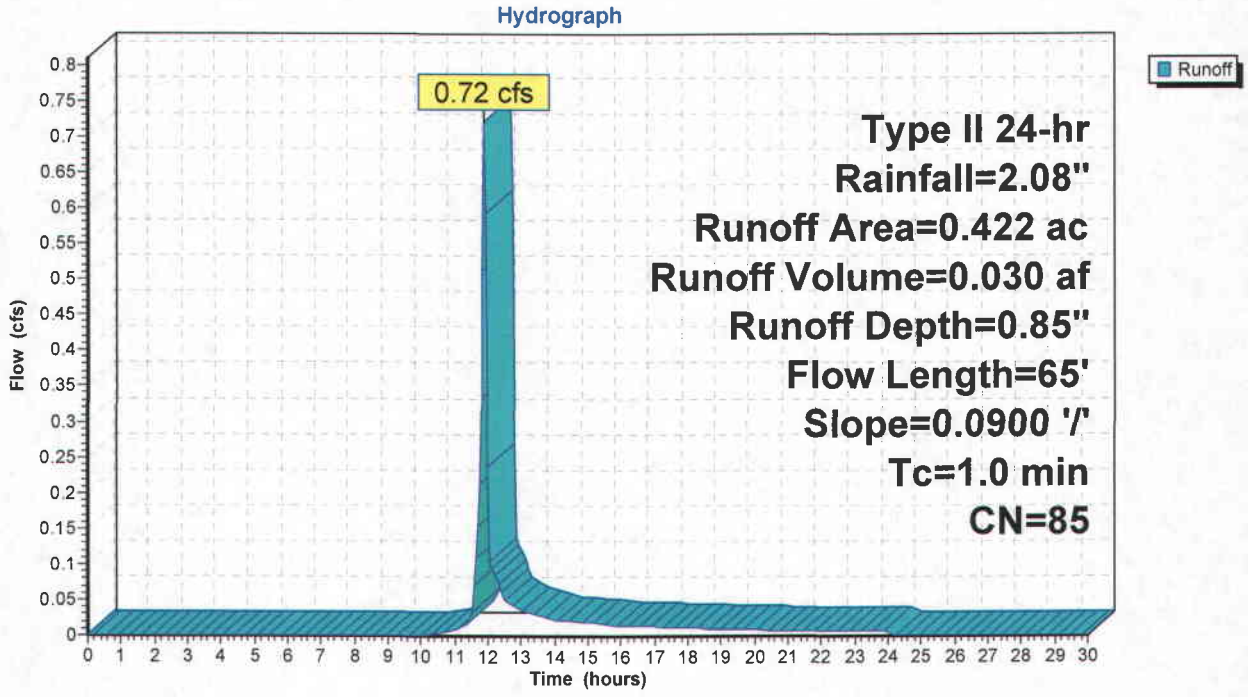
Runoff = 0.72 cfs @ 11.91 hrs, Volume= 0.030 af, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.08"

	Area (ac)	CN	Description
*	0.422	85	Soil Type "Trag-Croydon Complex", with Gravel roads, HSG B
	0.422		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	65	0.0900	1.07		**Lag/CN Method,**

Subcatchment DW5: DW-5



Summary for Subcatchment UDW4: UDW-4

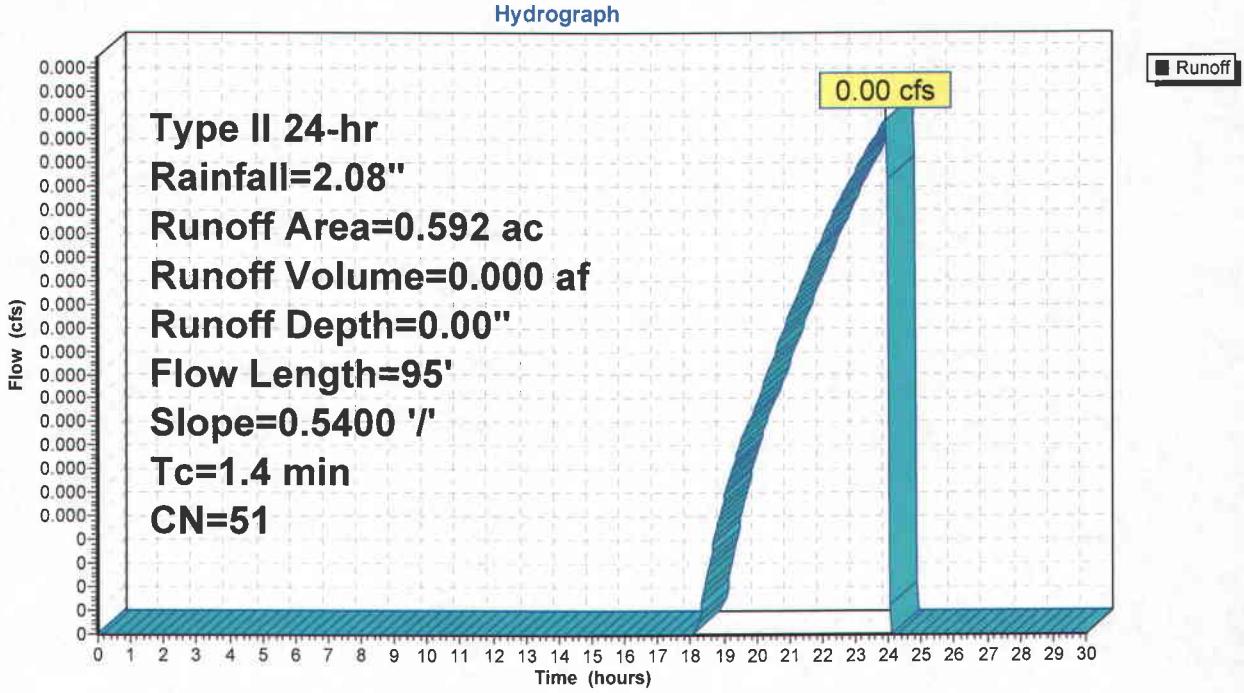
Runoff = 0.00 cfs @ 23.95 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.08"

Area (ac)	CN	Description
0.592	51	Sagebrush range, Fair, HSG B
0.592		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	95	0.5400	1.11		**Lag/CN Method,**

Subcatchment UDW4: UDW-4



Summary for Subcatchment UDW6: UWD-6

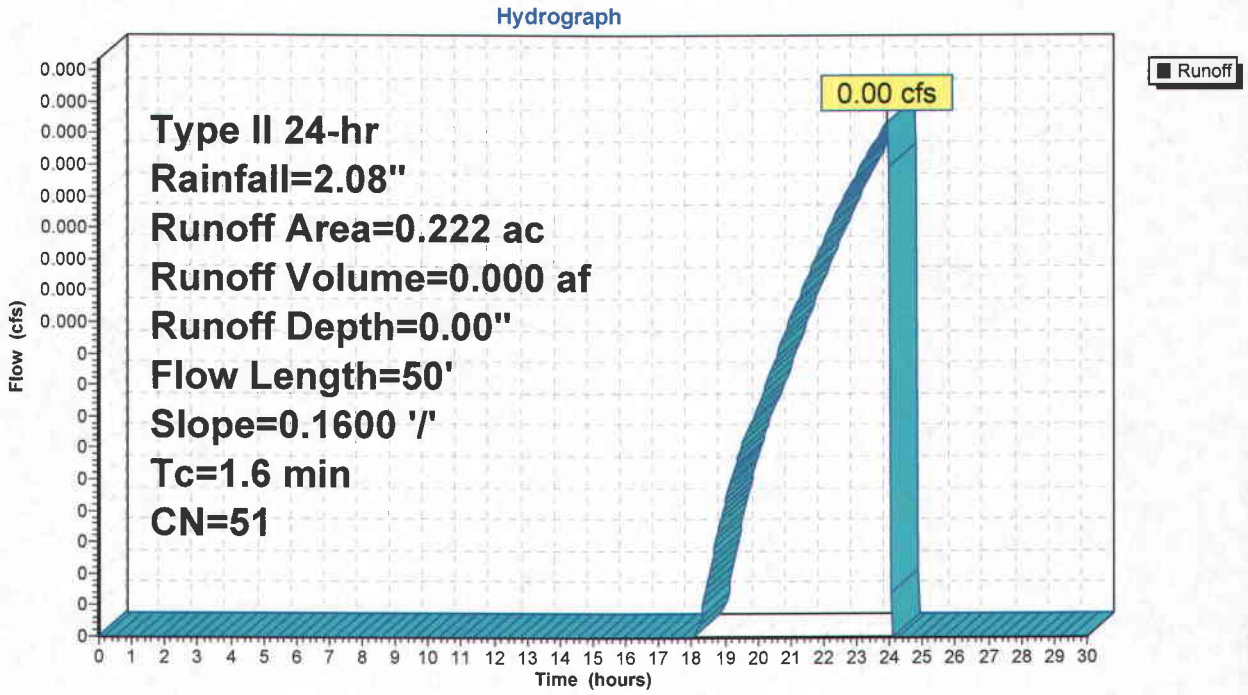
Runoff = 0.00 cfs @ 23.95 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.08"

Area (ac)	CN	Description
0.222	51	Sagebrush range, Fair, HSG B
0.222		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	50	0.1600	0.53		**Lag/CN Method,**

Subcatchment UDW6: UWD-6



Summary for Reach 2D: 2' Wide ASCA Ditch

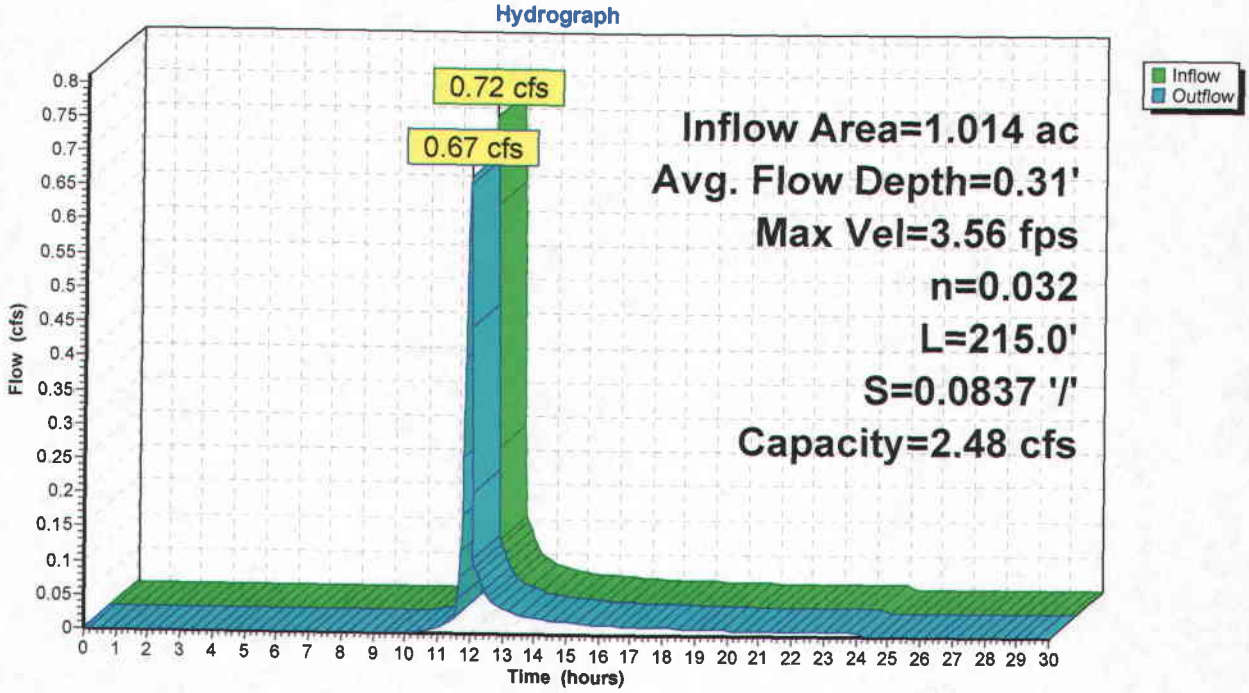
Inflow Area = 1.014 ac, 0.00% Impervious, Inflow Depth = 0.36"
Inflow = 0.72 cfs @ 11.91 hrs, Volume= 0.030 af
Outflow = 0.67 cfs @ 11.94 hrs, Volume= 0.030 af, Atten= 8%, Lag= 1.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.56 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.34 fps, Avg. Travel Time= 2.7 min

Peak Storage= 41 cf @ 11.92 hrs
Average Depth at Peak Storage= 0.31'
Bank-Full Depth= 0.50', Capacity at Bank-Full= 2.48 cfs

0.00' x 0.50' deep channel, n= 0.032
Side Slope Z-value= 2.0 '/' Top Width= 2.00'
Length= 215.0' Slope= 0.0837 '/'
Inlet Invert= 8,100.00', Outlet Invert= 8,082.00'

Reach 2D: 2' Wide ASCA Ditch



2' Wide ASCA Ditch Maximum Depth
Worksheet for Triangular Channel

Project Description	
Worksheet	2' ASCA Ditch M
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	080000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Discharge	0.72	cfs

Results		
Depth	0.32	ft
Flow Area	0.2	ft²
Wetted Perim	1.42	ft
Top Width	1.27	ft
Critical Depth	0.38	ft
Critical Slope	0.030086	ft/ft
Velocity	3.57	ft/s
Velocity Head	0.20	ft
Specific Energ	0.52	ft
Froude Numb	1.58	
Flow Type	Supercritical	

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2' Wide ASCA Ditch Maximum Slope
Worksheet for Triangular Channel

Project Description	
Worksheet	2' ASCA Ditch M
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	090000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Discharge	0.72	cfs

Results		
Depth	0.31	ft
Flow Area	0.2	ft²
Wetted Perim	1.39	ft
Top Width	1.24	ft
Critical Depth	0.38	ft
Critical Slope	0.030085	ft/ft
Velocity	3.74	ft/s
Velocity Head	0.22	ft
Specific Energ	0.53	ft
Froude Numb	1.67	
Flow Type	Supercritical	

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Summary for Reach 4D: 4' Wide ASCA Ditch

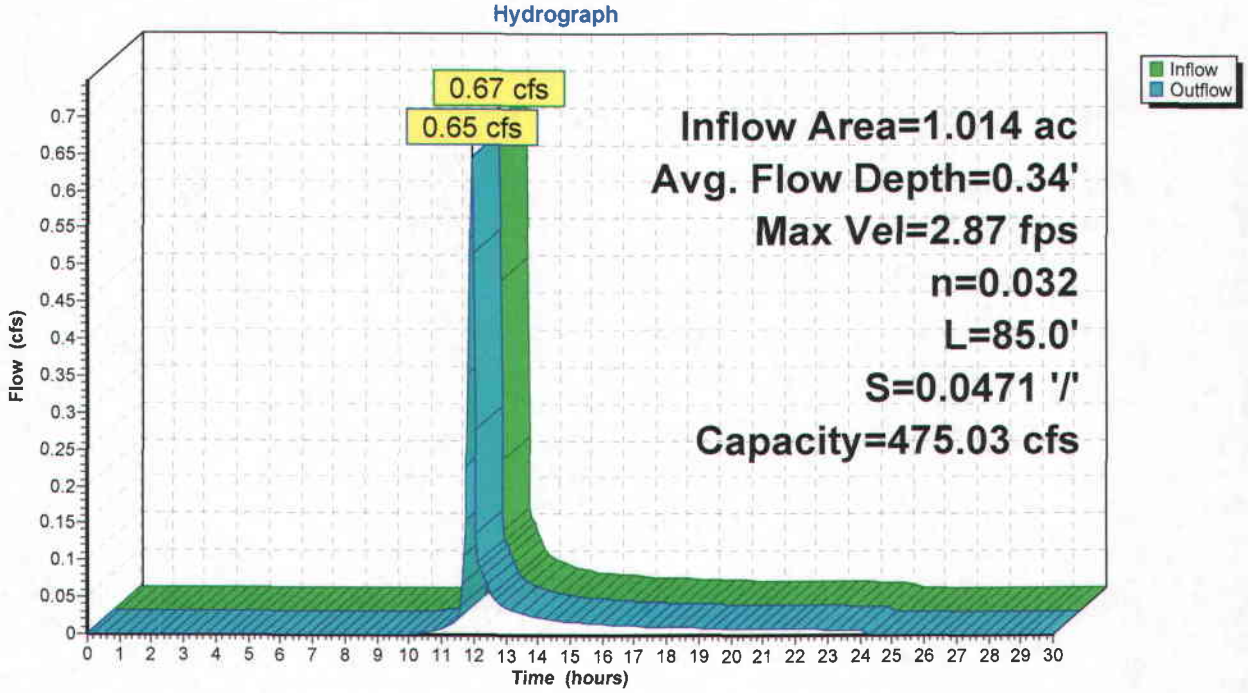
Inflow Area = 1.014 ac, 0.00% Impervious, Inflow Depth = 0.36"
Inflow = 0.67 cfs @ 11.94 hrs, Volume= 0.030 af
Outflow = 0.65 cfs @ 11.95 hrs, Volume= 0.030 af, Atten= 3%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.87 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.13 fps, Avg. Travel Time= 1.2 min

Peak Storage= 20 cf @ 11.94 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 4.00', Capacity at Bank-Full= 475.03 cfs

0.00' x 4.00' deep channel, n= 0.032
Side Slope Z-value= 2.0 '/' Top Width= 16.00'
Length= 85.0' Slope= 0.0471 '/'
Inlet Invert= 8,082.00', Outlet Invert= 8,078.00'

Reach 4D: 4' Wide ASCA Ditch



4' Wide ASCA Ditch Maximum Depth
Worksheet for Triangular Channel

Project Description	
Worksheet	4' ASCA Ditch M
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	040000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Discharge	0.67	cfs

Results		
Depth	0.35	ft
Flow Area	0.2	ft²
Wetted Perim	1.57	ft
Top Width	1.41	ft
Critical Depth	0.37	ft
Critical Slope	0.030375	ft/ft
Velocity	2.71	ft/s
Velocity Head	0.11	ft
Specific Energ	0.47	ft
Froude Numb	1.14	
Flow Type	Supercritical	

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4' Wide ASCA Ditch Maximum Slope
Worksheet for Triangular Channel

Project Description	
Worksheet	4' ASCA Ditch M
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	080000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Discharge	0.67	cfs

Results		
Depth	0.31	ft
Flow Area	0.2	ft²
Wetted Perim	1.38	ft
Top Width	1.24	ft
Critical Depth	0.37	ft
Critical Slope	0.030376	ft/ft
Velocity	3.51	ft/s
Velocity Head	0.19	ft
Specific Energ	0.50	ft
Froude Numb	1.57	
Flow Type	Supercritical	

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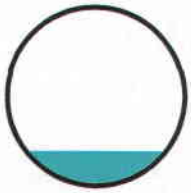
Summary for Reach C: ASCA Culvert

Inflow Area = 1.014 ac, 0.00% Impervious, Inflow Depth = 0.36"
Inflow = 0.65 cfs @ 11.95 hrs, Volume= 0.030 af
Outflow = 0.63 cfs @ 11.96 hrs, Volume= 0.030 af, Atten= 3%, Lag= 0.6 min

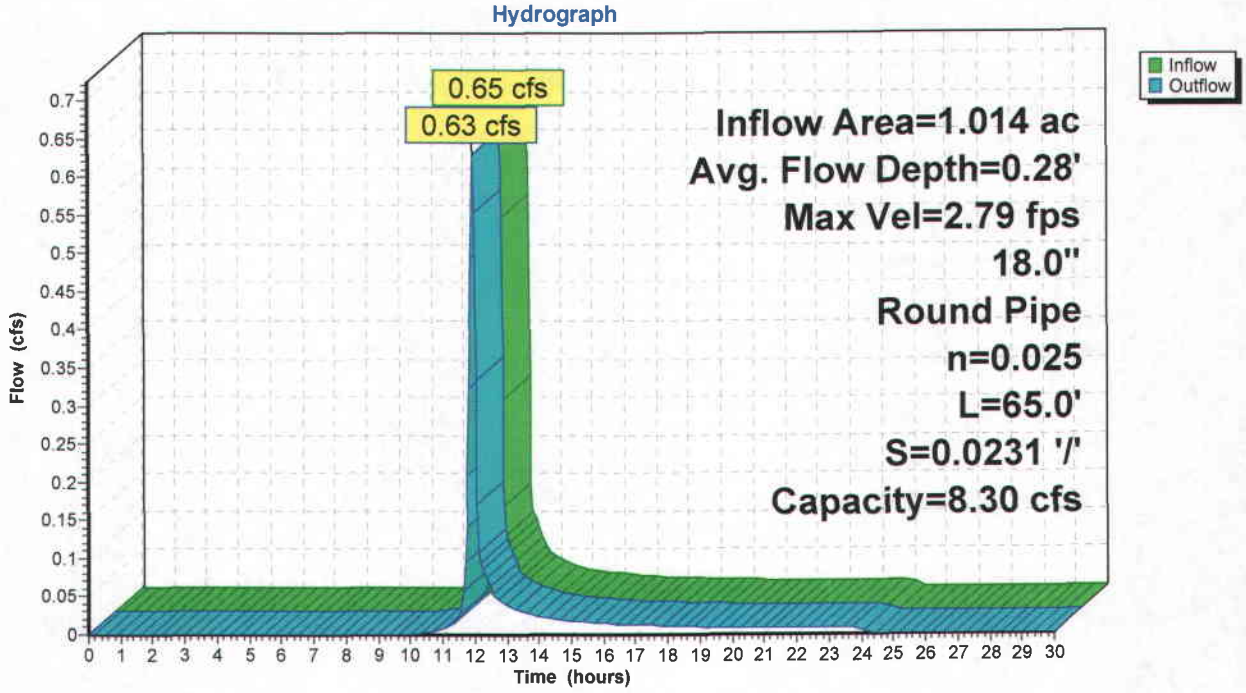
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.79 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 0.89 fps, Avg. Travel Time= 1.2 min

Peak Storage= 15 cf @ 11.95 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 8.30 cfs

18.0" Round Pipe
n= 0.025 Corrugated metal
Length= 65.0' Slope= 0.0231 '/'
Inlet Invert= 8,075.50', Outlet Invert= 8,074.00'



Reach C: ASCA Culvert



ASCA Culvert
Worksheet for Circular Channel

Project Description	
Worksheet	ASCA Culvert
Flow Element	Circular Chann
Method	Manning's For
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.025	
Slope	023100	ft/ft
Diameter	18	in
Discharge	0.65	cfs

Results		
Depth	0.28	ft
Flow Area	0.2	ft²
Wetted Perime	1.35	ft
Top Width	1.18	ft
Critical Depth	0.30	ft
Percent Full	18.9	%
Critical Slope	0.018705	ft/ft
Velocity	2.80	ft/s
Velocity Head	0.12	ft
Specific Energ	0.41	ft
Froude Numbe	1.11	
Maximum Disc	8.93	cfs
Discharge Full	8.30	cfs
Slope Full	0.000142	ft/ft
Flow Type	Supercritical	

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Summary for Reach ER: Existing Road

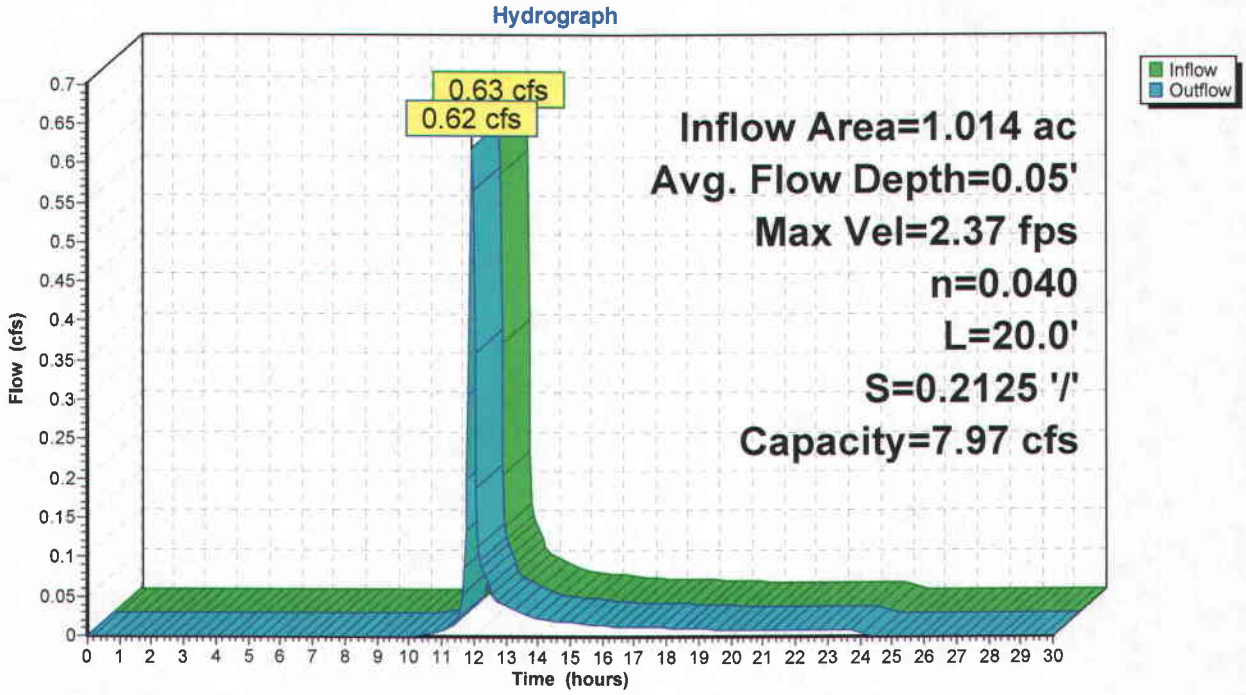
Inflow Area = 1.014 ac, 0.00% Impervious, Inflow Depth = 0.36"
Inflow = 0.63 cfs @ 11.96 hrs, Volume= 0.030 af
Outflow = 0.62 cfs @ 11.96 hrs, Volume= 0.030 af, Atten= 1%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.37 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 0.56 fps, Avg. Travel Time= 0.6 min

Peak Storage= 5 cf @ 11.96 hrs
Average Depth at Peak Storage= 0.05'
Bank-Full Depth= 0.25', Capacity at Bank-Full= 7.97 cfs

5.00' x 0.25' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Length= 20.0' Slope= 0.2125 '/'
Inlet Invert= 8,073.75', Outlet Invert= 8,069.50'

Reach ER: Existing Road



Existing Road
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	ER
Flow Element	Trapezoidal Cha
Method	Manning's Formı
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.040	
Slope	212500	ft/ft
Left Side Slope	10.00	V : H
Right Side Slope	10.00	V : H
Bottom Width	5.00	ft
Discharge	0.63	cfs

Results		
Depth	0.05	ft
Flow Area	0.3	ft²
Wetted Perim	5.11	ft
Top Width	5.01	ft
Critical Depth	0.08	ft
Critical Slope	0.056445	ft/ft
Velocity	2.38	ft/s
Velocity Head	0.09	ft
Specific Energ	0.14	ft
Froude Numb	1.83	
Flow Type	Supercritical	

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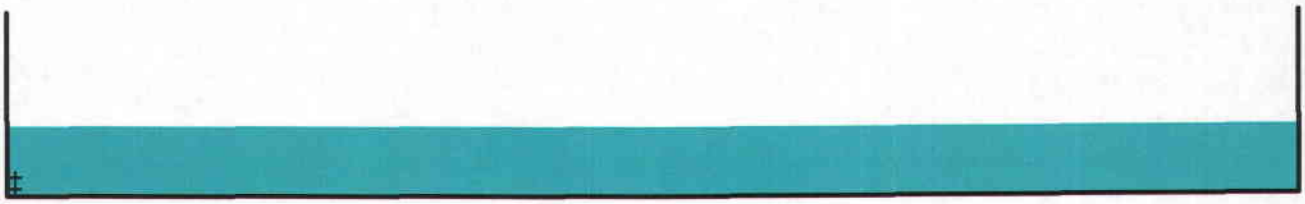
Summary for Reach RR: Riprap

Inflow Area = 1.014 ac, 0.00% Impervious, Inflow Depth = 0.36"
Inflow = 0.63 cfs @ 11.96 hrs, Volume= 0.030 af
Outflow = 0.63 cfs @ 11.96 hrs, Volume= 0.030 af, Atten= 0%, Lag= 0.1 min

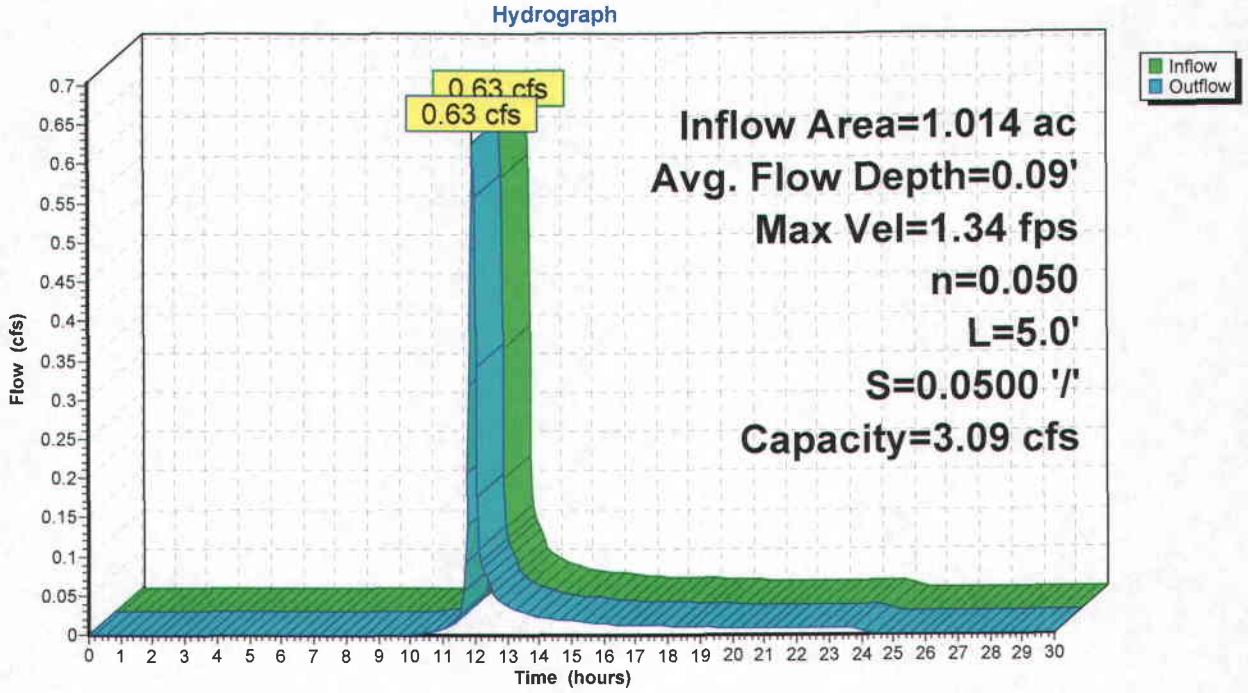
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.34 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 0.31 fps, Avg. Travel Time= 0.3 min

Peak Storage= 2 cf @ 11.96 hrs
Average Depth at Peak Storage= 0.09'
Bank-Full Depth= 0.25', Capacity at Bank-Full= 3.09 cfs

5.00' x 0.25' deep channel, n= 0.050 Earth, cobble bottom, clean sides
Length= 5.0' Slope= 0.0500 '/'
Inlet Invert= 8,074.00', Outlet Invert= 8,073.75'



Reach RR: Riprap



ASCA Riprap Pad
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	ASCA RR
Flow Element	Trapezoidal Cha
Method	Manning's Formı
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.050	
Slope	050000	ft/ft
Left Side Slope	10.00	V : H
Right Side Slope	10.00	V : H
Bottom Width	5.00	ft
Discharge	0.63	cfs

Results		
Depth	0.09	ft
Flow Area	0.5	ft²
Wetted Perim	5.19	ft
Top Width	5.02	ft
Critical Depth	0.08	ft
Critical Slope	0.088197	ft/ft
Velocity	1.34	ft/s
Velocity Head	0.03	ft
Specific Energ	0.12	ft
Froude Numb	0.77	
Flow Type	Subcritical	

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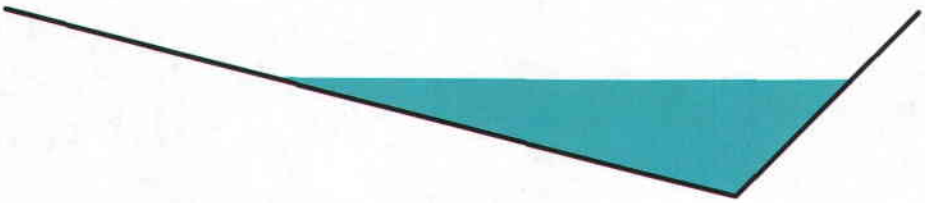
Summary for Reach TB: Topsoil Berm

Inflow Area = 1.236 ac, 0.00% Impervious, Inflow Depth = 0.29"
Inflow = 0.62 cfs @ 11.96 hrs, Volume= 0.030 af
Outflow = 0.60 cfs @ 11.99 hrs, Volume= 0.030 af, Atten= 4%, Lag= 1.4 min

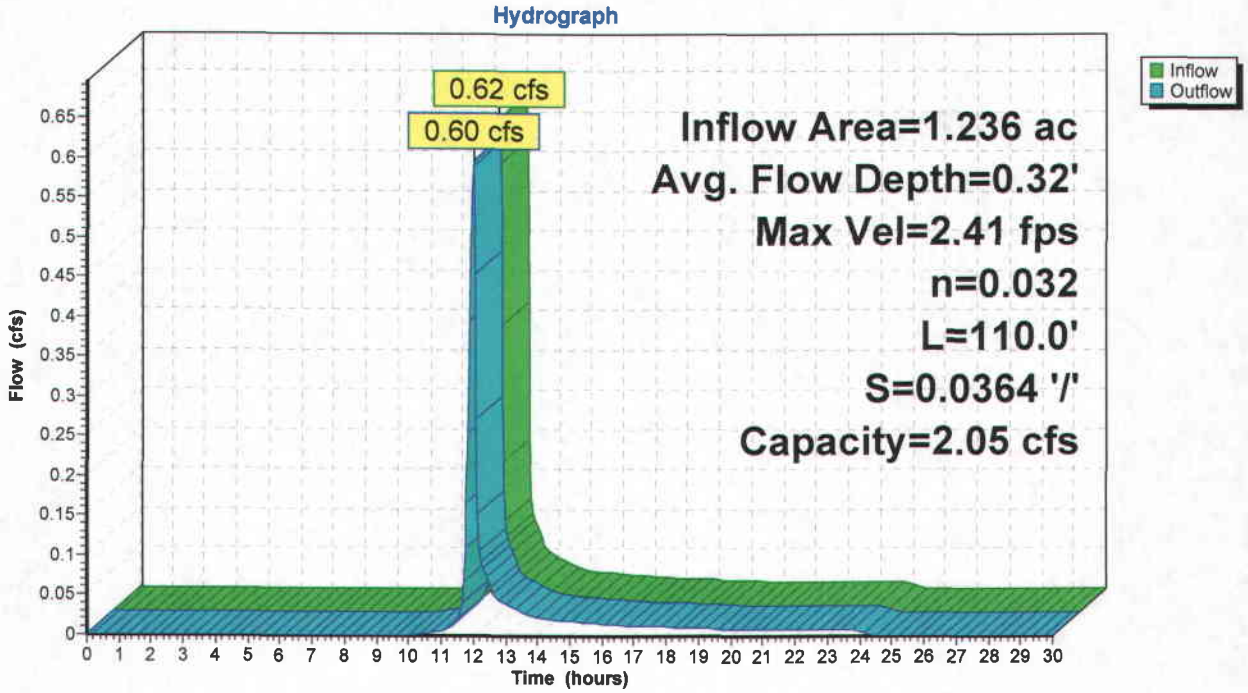
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.41 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 0.92 fps, Avg. Travel Time= 2.0 min

Peak Storage= 28 cf @ 11.97 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 0.50', Capacity at Bank-Full= 2.05 cfs

0.00' x 0.50' deep channel, n= 0.032
Side Slope Z-value= 4.0 1.0 '/' Top Width= 2.50'
Length= 110.0' Slope= 0.0364 '/'
Inlet Invert= 8,069.00', Outlet Invert= 8,065.00'



Reach TB: Topsoil Berm



Summary for Pond ASCA: ASCA Catch Basin

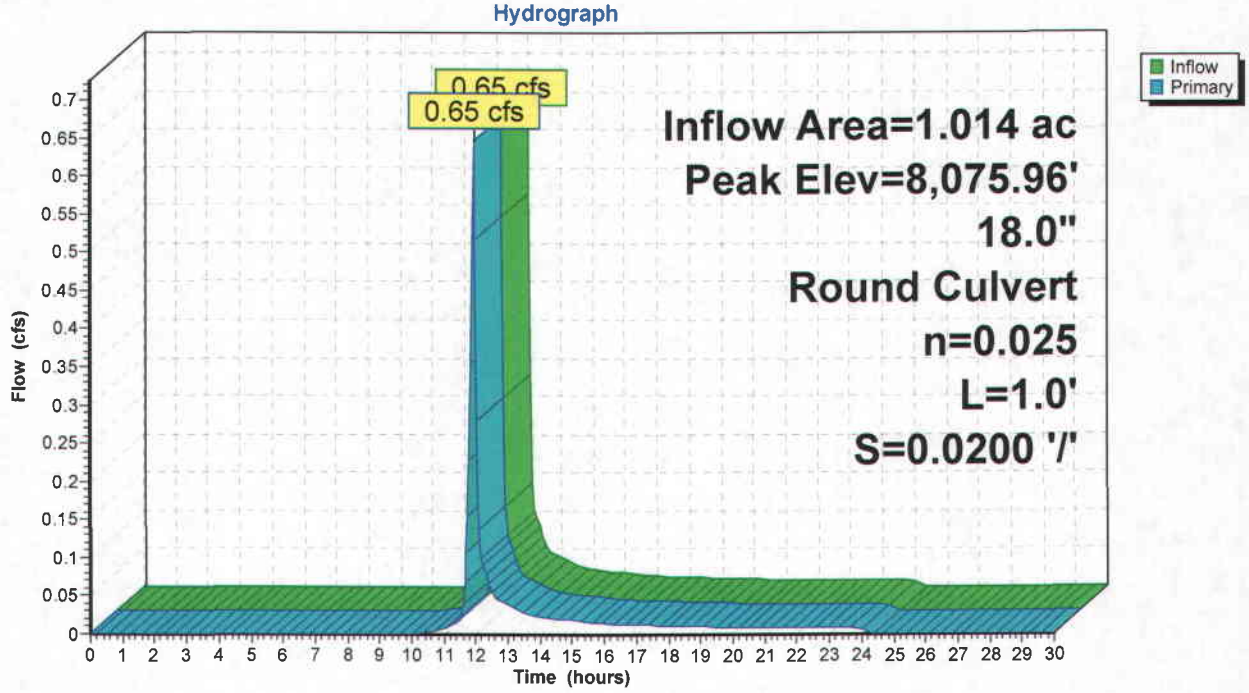
Inflow Area = 1.014 ac, 0.00% Impervious, Inflow Depth = 0.36"
Inflow = 0.65 cfs @ 11.95 hrs, Volume= 0.030 af
Outflow = 0.65 cfs @ 11.95 hrs, Volume= 0.030 af, Atten= 0%, Lag= 0.0 min
Primary = 0.65 cfs @ 11.95 hrs, Volume= 0.030 af

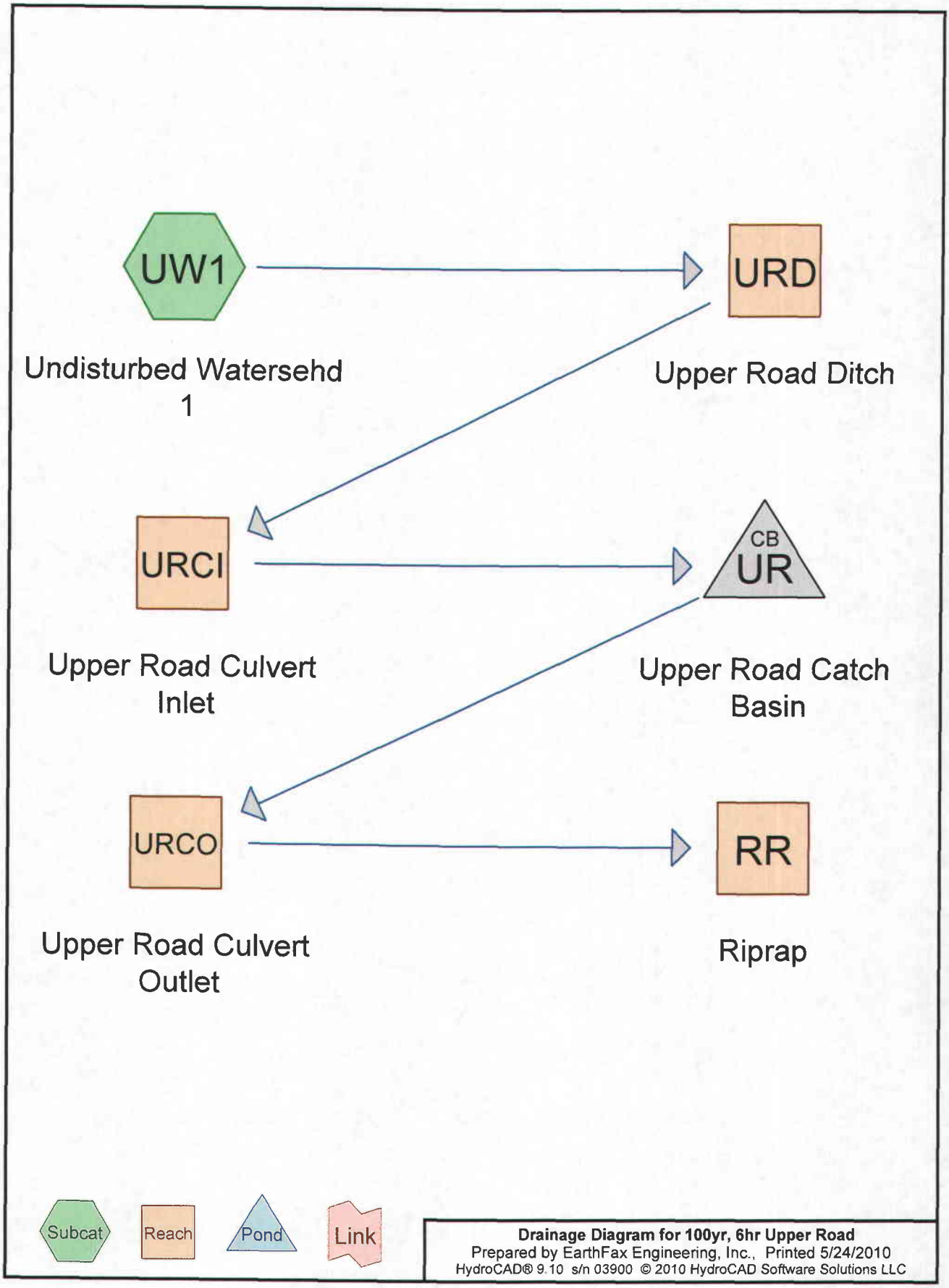
Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 8,075.96' @ 11.95 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	8,075.52'	**18.0" Round Culvert** L= 1.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 8,075.52' / 8,075.50' S= 0.0200 '/' Cc= 0.900 n= 0.025 Corrugated metal

Primary OutFlow Max=0.64 cfs @ 11.95 hrs HW=8,075.96' TW=8,075.50' (Fixed TW Elev= 8,075.50')
↳**1=Culvert** (Barrel Controls 0.64 cfs @ 2.24 fps)

Pond ASCA: ASCA Catch Basin





Drainage Diagram for 100yr, 6hr Upper Road
Prepared by EarthFax Engineering, Inc., Printed 5/24/2010

Summary for Subcatchment UW1: Undisturbed Watersehd 1

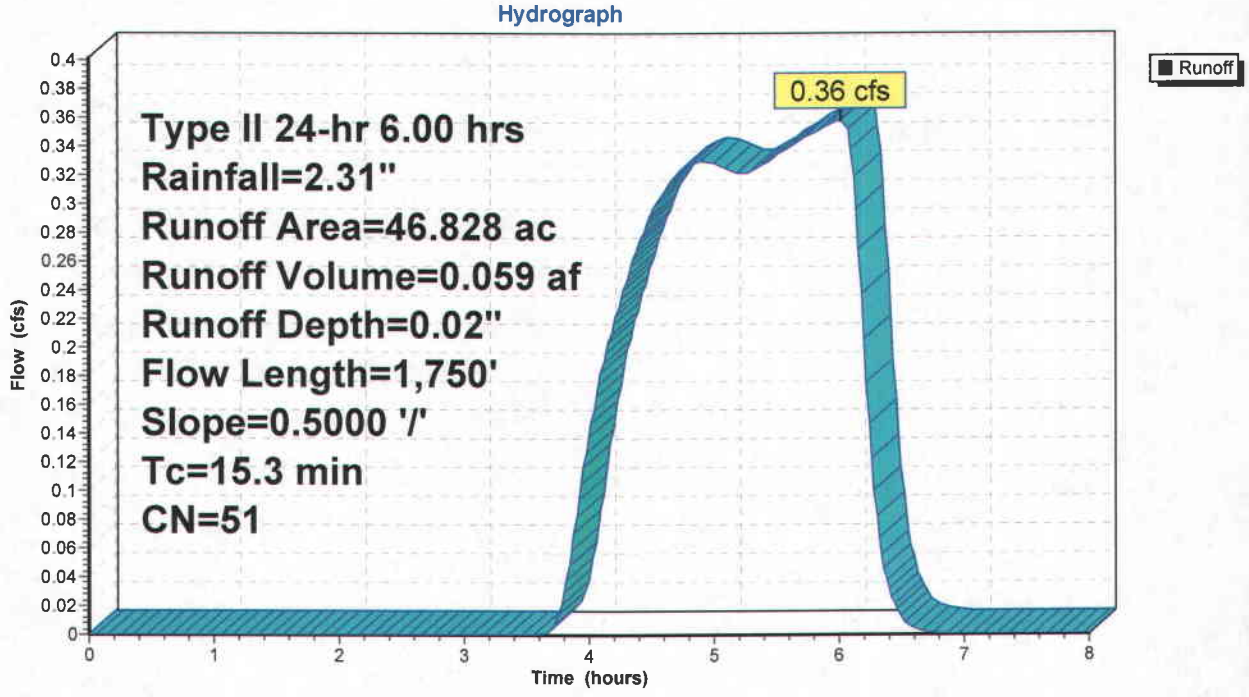
Runoff = 0.36 cfs @ 6.02 hrs, Volume= 0.059 af, Depth= 0.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-8.00 hrs, dt= 0.02 hrs
Type II 24-hr 6.00 hrs Rainfall=2.31"

Area (ac)	CN	Description
46.828	51	Sagebrush range, Fair, HSG B
46.828		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.3	1,750	0.5000	1.91		**Lag/CN Method, Slope from 9,050 to 8,178**

Subcatchment UW1: Undisturbed Watersehd 1



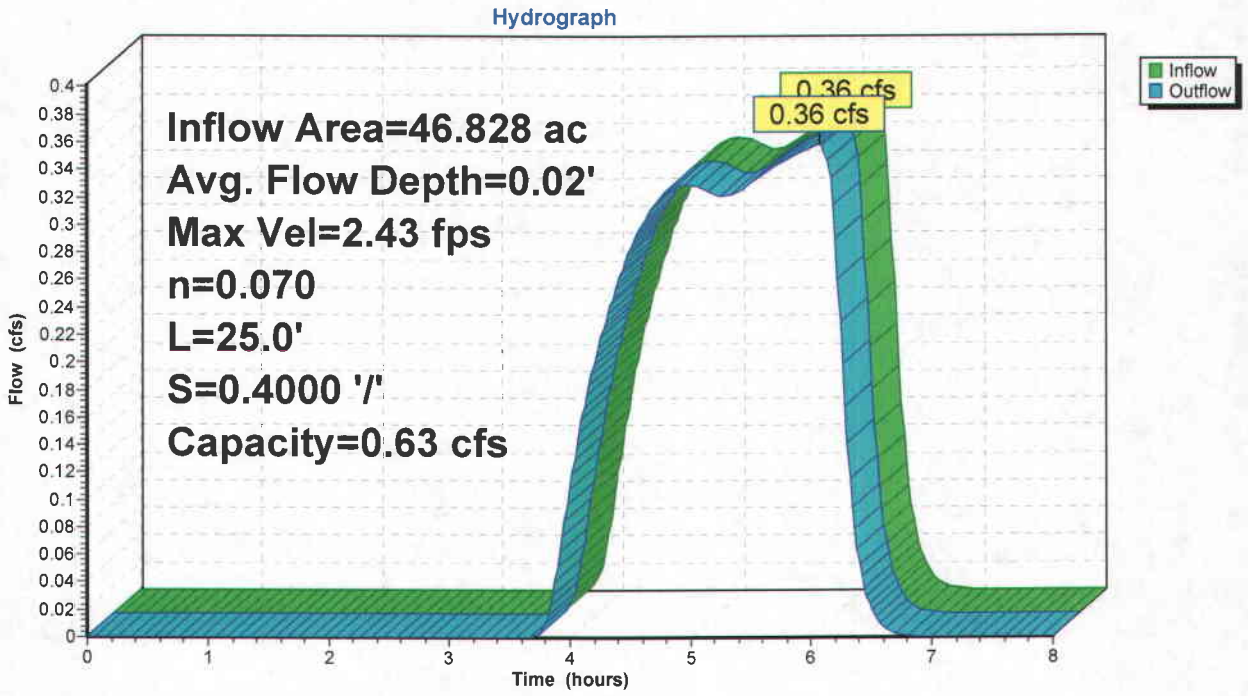
Summary for Reach RR: Riprap

Inflow Area = 46.828 ac, 0.00% Impervious, Inflow Depth = 0.02"
Inflow = 0.36 cfs @ 6.07 hrs, Volume= 0.059 af
Outflow = 0.36 cfs @ 6.07 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.3 min

Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-8.00 hrs, dt= 0.02 hrs
Reference Flow= 0.47 cfs Estimated Depth= 0.03' Velocity= 1.39 fps
m= 1.660, c= 2.31 fps, dt= 1.2 min, dx= 25.0' / 1 = 25.0', K= 0.2 min, X= 0.499
Max. Velocity= 2.43 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.31 fps, Avg. Travel Time= 0.2 min

Peak Storage= 4 cf @ 6.07 hrs
Average Depth at Peak Storage= 0.02'
Bank-Full Depth= 0.04', Capacity at Bank-Full= 0.63 cfs

10.00' x 0.04' deep channel, n= 0.070 Mountain streams w/large boulders
Side Slope Z-value= 2.0 '/' Top Width= 10.16'
Length= 25.0' Slope= 0.4000 '/'
Inlet Invert= 8,058.00', Outlet Invert= 8,048.00'



Upper Road Riprap Pad
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	URRR
Flow Element	Trapezoidal Cha
Method	Manning's Formu
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.070	
Slope	400000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Bottom Width	10.00	ft
Discharge	0.36	cfs

Results		
Depth	0.03	ft
Flow Area	0.3	ft²
Wetted Perim	10.13	ft
Top Width	10.11	ft
Critical Depth	0.03	ft
Critical Slope	0.220935	ft/ft
Velocity	1.25	ft/s
Velocity Head	0.02	ft
Specific Energ	0.05	ft
Froude Numb	1.31	
Flow Type	Supercritical	

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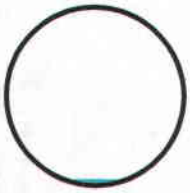
Summary for Reach URCI: Upper Road Culvert Inlet

Inflow Area = 46.828 ac, 0.00% Impervious, Inflow Depth = 0.02"
Inflow = 0.36 cfs @ 6.07 hrs, Volume= 0.059 af
Outflow = 0.36 cfs @ 6.07 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.0 min

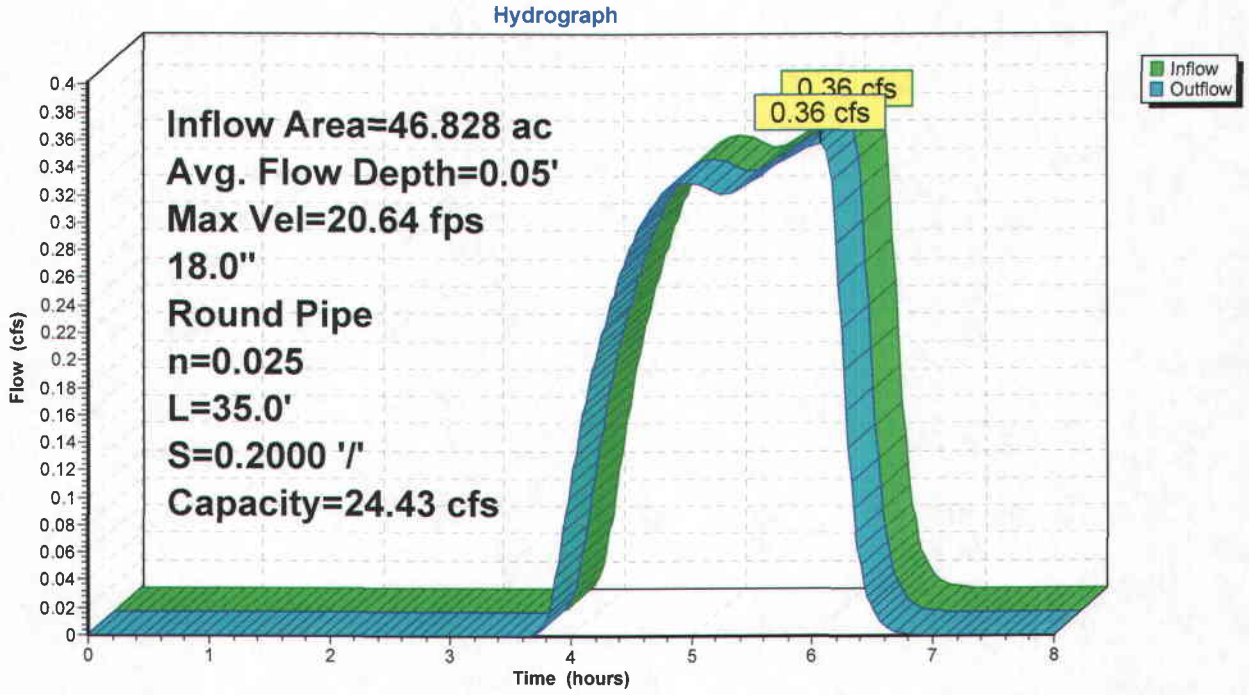
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-8.00 hrs, dt= 0.02 hrs
Reference Flow= 18.32 cfs Estimated Depth= 0.97' Velocity= 15.17 fps
m= 1.355, c= 20.56 fps, dt= 1.2 min, dx= 35.0' / 1 = 35.0', K= 0.0 min, X= 0.449
Max. Velocity= 20.64 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 20.56 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 6.07 hrs
Average Depth at Peak Storage= 0.05'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 24.43 cfs

18.0" Round Pipe
n= 0.025 Corrugated metal
Length= 35.0' Slope= 0.2000 '/'
Inlet Invert= 8,094.00', Outlet Invert= 8,087.00'



Reach URCI: Upper Road Culvert Inlet



Upper Road Culvert Inlet
Worksheet for Circular Channel

Project Description	
Worksheet	URCI
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.025	
Slope	200000	ft/ft
Diameter	18	in
Discharge	0.36	cfs

Results		
Depth	0.13	ft
Flow Area	0.1	ft²
Wetted Perime	0.89	ft
Top Width	0.84	ft
Critical Depth	0.22	ft
Percent Full	8.5	%
Critical Slope	0.019640	ft/ft
Velocity	4.99	ft/s
Velocity Head	0.39	ft
Specific Energ	0.51	ft
Froude Numbe	3.00	
Maximum Disc	26.28	cfs
Discharge Full	24.43	cfs
Slope Full	0.000043	ft/ft
Flow Type	Supercritical	

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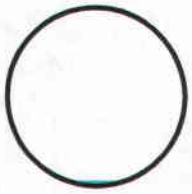
Summary for Reach URCO: Upper Road Culvert Outlet

Inflow Area = 46.828 ac, 0.00% Impervious, Inflow Depth = 0.02"
Inflow = 0.36 cfs @ 6.07 hrs, Volume= 0.059 af
Outflow = 0.36 cfs @ 6.07 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.0 min

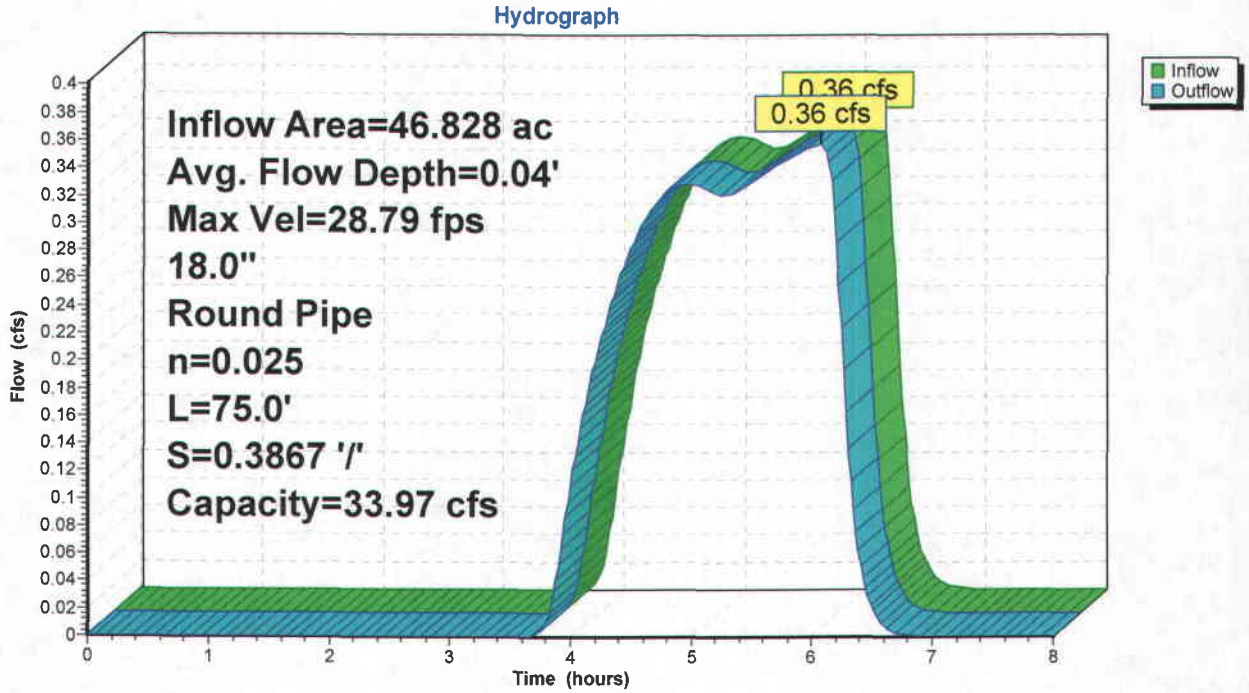
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-8.00 hrs, dt= 0.02 hrs
Reference Flow= 25.47 cfs Estimated Depth= 0.97' Velocity= 21.09 fps
m= 1.355, c= 28.58 fps, dt= 1.2 min, dx= 75.0' / 1 = 75.0', K= 0.0 min, X= 0.488
Max. Velocity= 28.79 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 28.58 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 6.07 hrs
Average Depth at Peak Storage= 0.04'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 33.97 cfs

18.0" Round Pipe
n= 0.025 Corrugated metal
Length= 75.0' Slope= 0.3867 '/'
Inlet Invert= 8,087.00', Outlet Invert= 8,058.00'



Reach URCO: Upper Road Culvert Outlet



Upper Road Culvert Outlet
Worksheet for Circular Channel

Project Description	
Worksheet	URCO
Flow Element	Circular Chann
Method	Manning's For
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.025	
Slope	437500	ft/ft
Diameter	18	in
Discharge	0.36	cfs

Results		
Depth	0.11	ft
Flow Area	0.1	ft²
Wetted Perime	0.81	ft
Top Width	0.77	ft
Critical Depth	0.22	ft
Percent Full	7.0	%
Critical Slope	0.019640	ft/ft
Velocity	6.56	ft/s
Velocity Head	0.67	ft
Specific Energ	0.77	ft
Froude Numbe	4.32	
Maximum Disc	38.86	cfs
Discharge Full	36.13	cfs
Slope Full	0.000043	ft/ft
Flow Type	Supercritical	

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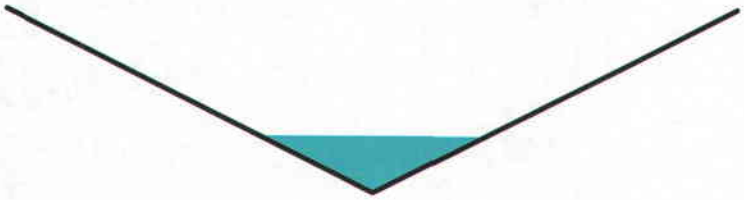
Summary for Reach URD: Upper Road Ditch

Inflow Area = 46.828 ac, 0.00% Impervious, Inflow Depth = 0.02"
Inflow = 0.36 cfs @ 6.02 hrs, Volume= 0.059 af
Outflow = 0.36 cfs @ 6.07 hrs, Volume= 0.059 af, Atten= 0%, Lag= 3.0 min

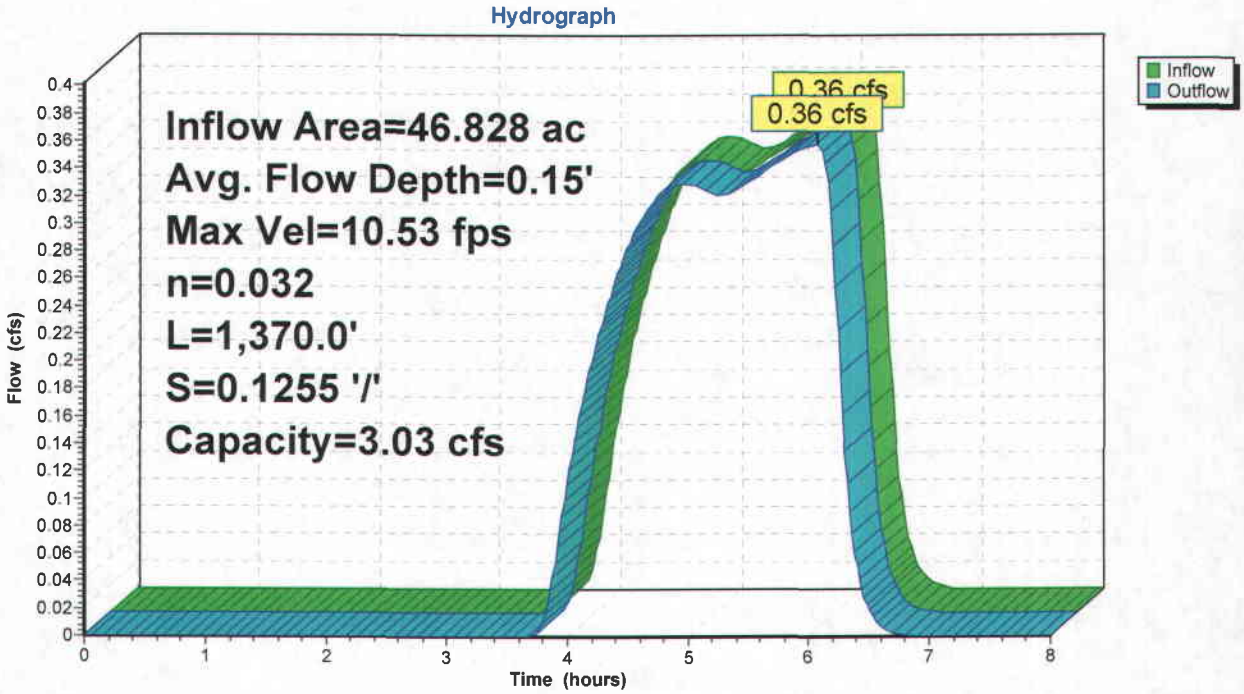
Routing by Dyn-Muskingum-Cunge method, Time Span= 0.00-8.00 hrs, dt= 0.02 hrs
Reference Flow= 2.27 cfs Estimated Depth= 0.45' Velocity= 5.64 fps
m= 1.333, c= 7.52 fps, dt= 1.2 min, dx= 1,370.0' / 3 = 456.7', K= 1.0 min, X= 0.497
Max. Velocity= 10.53 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 7.59 fps, Avg. Travel Time= 3.0 min

Peak Storage= 65 cf @ 6.04 hrs
Average Depth at Peak Storage= 0.15'
Bank-Full Depth= 0.50', Capacity at Bank-Full= 3.03 cfs

0.00' x 0.50' deep channel, n= 0.032
Side Slope Z-value= 2.0 '/' Top Width= 2.00'
Length= 1,370.0' Slope= 0.1255 '/'
Inlet Invert= 8,266.00', Outlet Invert= 8,094.00'



Reach URD: Upper Road Ditch



Upper Road Ditch Maximum Depth
Worksheet for Triangular Channel

Project Description	
Worksheet	URD MD
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	070000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Discharge	0.36	cfs

Results		
Depth	0.25	ft
Flow Area	0.1	ft²
Wetted Perim	1.12	ft
Top Width	1.00	ft
Critical Depth	0.29	ft
Critical Slope	0.032997	ft/ft
Velocity	2.86	ft/s
Velocity Head	0.13	ft
Specific Energ	0.38	ft
Froude Numb	1.42	
Flow Type	Supercritical	

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Upper Road Ditch Maximum Slope
Worksheet for Triangular Channel

Project Description	
Worksheet	URD MV
Flow Element	Triangular Char
Method	Manning's Form
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.032	
Slope	200000	ft/ft
Left Side Slope	0.50	V : H
Right Side Slope	0.50	V : H
Discharge	0.36	cfs

Results		
Depth	0.21	ft
Flow Area	0.1	ft²
Wetted Perim	0.92	ft
Top Width	0.82	ft
Critical Depth	0.29	ft
Critical Slope	0.032998	ft/ft
Velocity	4.24	ft/s
Velocity Head	0.28	ft
Specific Energ	0.49	ft
Froude Numb	2.33	
Flow Type	Supercritical	

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Summary for Pond UR: Upper Road Catch Basin

Inflow Area = 46.828 ac, 0.00% Impervious, Inflow Depth = 0.02"
Inflow = 0.36 cfs @ 6.07 hrs, Volume= 0.059 af
Outflow = 0.36 cfs @ 6.07 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.0 min
Primary = 0.36 cfs @ 6.07 hrs, Volume= 0.059 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-8.00 hrs, dt= 0.02 hrs
Peak Elev= 8,087.40' @ 6.07 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	8,087.00'	**18.0" Round Culvert** L= 10.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 8,087.00' / 8,087.00' S= 0.0000 '/' Cc= 0.900 n= 0.025 Corrugated metal

Primary OutFlow Max=0.36 cfs @ 6.07 hrs HW=8,087.40' TW=8,087.04' (Dynamic Tailwater)
└**1=Culvert** (Barrel Controls 0.36 cfs @ 1.41 fps)

Pond UR: Upper Road Catch Basin