

Commercial/Industrial Floodplain Development Permit

Doddridge County, WV Floodplain Management

This permit has been issued to **Blue Mountain, Inc.**, and is for the approved commercial and/or industrial development project associated with this permit that impacts the FEMA-designated floodplain and/or floodway of Doddridge County, WV, pursuant to the rules and regulations established by all applicable Federal, State and local laws and ordinances, including the Doddridge County Floodplain Ordinance. This permit must be posted at the site of work as to be clearly visible, and must remain posted during entirety of development.

**Permit: #14-255 ~ Blue Mountain, Inc. ~
South Fork Bridge #1 /Sheep Run Road**

Date Approved: 05/21/2015

Expires: 05/21/2016

Issued to: Blue Mountain, Inc.

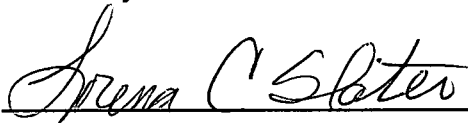
**POC: Edward Race, EIT, SIT
304-662-6486**

**Company Address: 10125 Mason Dixon Highway
Burton, WV 26562**

**Project Address: Southwest District
Lat/Long: 39.206402N/80.833848W**

Purpose of development: Permanent bridge replacement.

Issued by: Edwin L. "Bo" Wriston, Doddridge County FPM (or designee)



Date: 05/21/2015

For additional information regarding this permit, please contact
Doddridge County Floodplain Manager at 304.873.2631, or via email at
doddridgecountyfpm@gmail.com
118 East Court Street; West Union, WV 26456

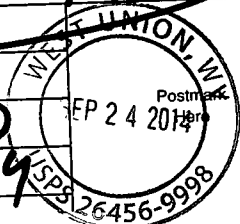
7013 2250 0001 6914 9312

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OFFICIAL USE
Dodd Co. LP

Postage	\$.49
Certified Fee	2.70
Return Receipt Fee (Endorsement Required)	3.30
Restricted Delivery Fee (Endorsement Required)	6.49



#14-255
 Juanita M. Leggett
 6131 Oxford Road
 West Union, WV 26456

See Reverse for Instructions

7013 2250 0001 6914 9312

U.S. Postal Service™
CERTIFIED MAIL™ RECEIPT
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OFFICIAL USE

Postage	\$.49
Certified Fee	2.70
Return Receipt Fee (Endorsement Required)	3.30
Restricted Delivery Fee (Endorsement Required)	6.49



#14-255
 William Bonnell
 RT 1 Box 83A
 West Union, WV 26456

See Reverse for Instructions

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

#14-255
 William Bonnell
 RT 1 Box 83A
 West Union, WV 26456

2. Article Number

(Transfer from service label)

7013 2250 0001 6914 9312

COMPLETE THIS SECTION ON DELIVERY

A. Signature


 Agent AddresseeB. Received by *(Printed Name)*

C. Date of Delivery

9-26-14

D. Is delivery address different from item 1? YesIf YES, enter delivery address below: No

3. Service Type

 Certified Mail® Priority Mail Express™ Registered Return Receipt for Merchandise Insured Mail Collect on Delivery4. Restricted Delivery? *(Extra Fee)* Yes

UNITED STATES POSTAL SERVICE



First-Class Mail
Postage & Fees Paid
USPS
Permit No. G-10

• Sender: Please print your name, address, and ZIP+4® in this box •

FILED
2014 SEP 26 AM 10 07

**WEST VIRGINIA
DOUGLASS COUNTY, WV**



Douglas County FPM
118 East Court St STE 102
West Union, WV 26456-1262

SENDER: COMPLETE THIS SECTION

- Complete items 1, 2, and 3. Also complete item 4 if Restricted Delivery is desired.
- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

#14-255
 Juanita M. Leggett
 6131 Oxford Road
 West Union, WV 26456

2. Article Number
 (Transfer from service label)

7013 2250 0001 6914 9329

COMPLETE THIS SECTION ON DELIVERY

A. Signature

X *Juanita Leggett* Agent
 Addressee

B. Received by (Printed Name)

J. Leggett

C. Date of Delivery

9-24-14

D. Is delivery address different from item 1? Yes
 If YES, enter delivery address below: No

3. Service Type

- Certified Mail® Priority Mail Express™
 Registered Return Receipt for Merchandise
 Insured Mail Collect on Delivery

4. Restricted Delivery? (Extra Fee) Yes

UNITED STATES POSTAL SERVICE

CHARLESTON

WV 250

25 SEP '14



First-Class Mail
Postage & Fees Paid
USPS
Permit No. G-10

• Sender: Please print your name, address, and ZIP+4® in this box •

FILED
2014 SEP 25
11:15 AM
DODDGE COUNTY, WV
#14 - COUNTY ELEX. DIV.
J. A. ROGERS

#14 -
Dodge County FPM
118 East Court St STE 102
West Union, WV 26456-1262

Legal Advertisement:
Doddridge County
Floodplain Permit Application

Please take notice that on the 5th day of August, 2014

Blue Mountain, Inc., CNX Gas Company, LLC

filed an application for a Floodplain Permit to develop land located at or about:

39.206402N / 80.833848W

Permit #14-255 South Fork Bridge #1

The Application is on file with the Clerk of the County Court and may be inspected or copied during regular business hours. Any interested persons who desire to comment shall present the same in writing by **September 8, 2014**, delivered to:

Clerk of the County Court

118 E. Court Street, West Union, WV 26456

Beth A Rogers, Doddridge County Clerk

Edwin L. "Bo" Wriston. Doddridge County Flood Plain Manager



April 22, 2015

Mr. Bo Wriston
Floodplain Coordinator
Doddridge County Courthouse
118 East Court Street
West Union, WV 26456

RE: Revised Submittals for Sheep Run Bridge Replacement

Dear Mr. Wriston:

On behalf of CNX Gas Company, we are re-submitting the Hydraulic Analysis Submittals for the Sheep Run Bridge Replacement. This particular project is located in Doddridge County on CR19/11 (South Fork Hughes River) at approximately Mile Post 2.45.

Should you have any questions or comments, please feel free to contact me at (304) 662-6486.

Sincerely,

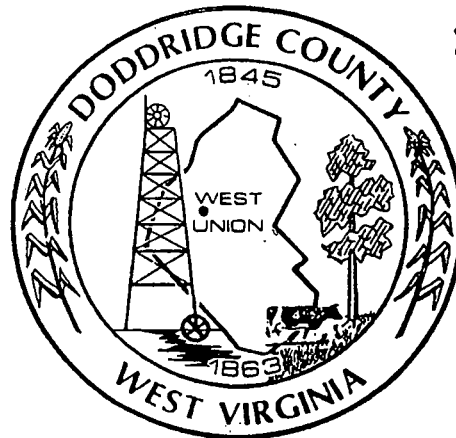
Ed Race, EIT
Project Manager
Blue Mountain Inc.

Enclosures

FILED

2014 AUG -5 AM 11:38

BETH A. ROGERS
COUNTY CLERK
DODDRIDGE COUNTY, WV



Commercial/Industrial Floodplain Development Permit Application Doddridge County, WV Floodplain Management

This document is to be used for commercial and/or industrial development projects that impact/potentially impact the FEMA-designated floodplain and/or floodway of Doddridge County, WV pursuant to the rules and regulations established by all applicable Federal, State and local laws and ordinances, including the Doddridge County Floodplain Ordinance.

Permit Application #: _____ (To be completed by Floodplain Manager or designee)

Date Submitted: _____

90 Day Window Date: _____

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Applicant Information:

Please provide all pertinent data.

Applicant Information		
Responsible Company Name: CNX Gas Company LLC		
Corporate Mailing Address: One Energy Drive, PO Box 1248		
City: Jane Lew	State: WV	Zip: 26378
Corporate Point of Contact (POC): Amanda Wright		
Corporate POC Title: Manager of Permitting		
Corporate POC Primary Phone: (304) 884-2009		
Corporate POC Primary Email: AmandaWright@consolenergy.com		
Corporate FEIN: 20-3170639	Corporate DUNS:	
Corporate Website: www.consolenergy.com		
Local Mailing Address: Same as above		
City:	State:	Zip:
Local Project Manager (PM):		
Local PM Primary Phone:		
Local PM Secondary Phone:		
Local PM Primary Email:		
Person Filing Application: Greg Currey, Blue Mountain Inc.		
Applicant Title: Permitting Specialist		
Applicant Primary Phone: (304) 662-6486		
Applicant Secondary Phone: (304) 266-1198		
Applicant Primary Email: G.Currey@bluemtninc.com		

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Proposed Development:

Please check all elements of the proposed project that apply.

Project Description: (Check all that apply)

- New Construction
- Commercial Structure
- Industrial Structure
- Pipeline
- Drill Pad
- Storage Yard/Facility
- Roadway Construction
- Bridge/Culvert (Please circle)
- Utility placement
- Utility displacement
- Grade/Excavation/Fill
- Watercourse Alteration
- Above ground chemical or HAZMAT storage tanks
- Above ground storage tanks (other)
- Below ground storage tanks (any)
- Well/Septic System
- Other

If other, please describe:

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Development Site/Property Information:

Please provide physical description of the site/property, along with pertinent ownership (surface and mineral rights) data as applicable. Attach appropriate maps from sources such as Google Earth, WV Flood Tool, etc. showing location of proposed development. Use additional copies of this page if development spans multiple property boundaries. Designate each property by number (i.e. Property 1 of 1, Property 2 of 7, etc.)

Property Designation: ____ of ____

Site/Property Information:		
Legal Description: NA No private property will be impacted. This is the replacement of a bridge on a county road.		
Physical Address/911 Address:		
Decimal Latitude/Longitude:		
DMS Latitude/Longitude:		
District:	Map:	Parcel:
Land Book Description:		
Deed Book Reference:		
Tax Map Reference:		
Existing Buildings/Use of Property:		

Floodplain Location Data: (to be completed by Floodplain Manager or designee)			
Community:	Number:	Panel:	Suffix:
Location (Lat/Long):		Approximate Elevation:	
		Estimated BFE:	
Is the development in the floodway? <input type="checkbox"/> Yes <input type="checkbox"/> No		Is the development in the floodplain? <input type="checkbox"/> Yes <input type="checkbox"/> No Zone: _____	
Notes:			

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Property Owner Data:

Please provide data on current site/property landowner(s), both surface and mineral rights (as applicable). Use additional copies of this page as needed. Designate each page in relation to each property listed above.

Property Designation: ____ of ____

Property Owner Data:		
Name of Primary Owner (PO): No private property will be impacted.		
PO Address:		
City:	State:	Zip:
PO Primary Phone:		
PO Secondary Phone:		
PO Primary Email:		

Surface Rights Owner Data:		
Name of Primary Owner (PO):		
PO Address:		
City:	State:	Zip:
PO Primary Phone:		
PO Secondary Phone:		
PO Primary Email:		

Mineral Rights Owner Data: (As Applicable)		
Name of Primary Owner (PO):		
PO Address:		
City:	State:	Zip:
PO Primary Phone:		
PO Secondary Phone:		
PO Primary Email:		

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Contractor Data:

Please provide all pertinent data for contractors and sub-contractors that may be participating in this project. Use additional copies of this page as needed. Designate each page in relation to each property listed above.

Property Designation: _____ of _____

Contractor/Sub-Contractor (C/SC) Information:		
C/SC Company Name:		
C/SC WV License Number:		
C/SC FEIN:	C/SC DUNS:	
Local C/SC Point of Contact (POC):		
Local C/SC POC Title:		
C/SC Mailing Address:		
City:	State:	Zip-Code:
Local C/SC Office Phone:		
Local C/SC POC Phone:		
Local C/SC POC E-Mail:		

Contractor/Sub-Contractor (C/SC) Information:		
C/SC Company Name:		
C/SC WV License Number:		
C/SC FEIN:	C/SC DUNS:	
Local C/SC Point of Contact (POC):		
Local C/SC POC Title:		
C/SC Mailing Address:		
City:	State:	Zip-Code:
Local C/SC Office Phone:		
Local C/SC POC Phone:		
Local C/SC POC E-Mail:		

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Engineering Firm Data:

Please provide all pertinent data for engineering firm(s) that may be participating in this project. Use additional copies of this page as needed. Designate each page in relation to each property listed above.

Property Designation: ____ of ____

Engineer Firm Information:		
Engineer Firm Name: Blue Mountain Inc.		
Engineer WV License Number: 4449		
Engineer Firm FEIN: 550704426	Engineer Firm DUNS: 805979713	
Engineer Firm Primary Point of Contact (POC): Greg Currey		
Engineer Firm Primary POC Title: Permitting Specialist		
Engineer Firm Mailing Address: 11023 Mason Dixon HWY		
City: Burton	State: WV	Zip-Code: 26562
Engineer Firm Office Phone: (304) 662-6486		
Engineer Firm Primary POC Phone: (304) 266-1198		
Engineer Firm Primary POC E-Mail: BMI@bluemtninc.com		

Engineer Firm Information:		
Engineer Firm Name:		
Engineer WV License Number:		
Engineer Firm FEIN:	Engineer Firm DUNS:	
Engineer Firm Primary Point of Contact (POC):		
Engineer Firm Primary POC Title:		
Engineer Firm Mailing Address:		
City:	State:	Zip-Code:
Engineer Firm Office Phone:		
Engineer Firm Primary POC Phone:		
Engineer Firm Primary POC E-Mail:		

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Adjacent and/or Affected Landowners Data

Please provide data for all adjacent and/or affected surface owners (both up and down stream) whose property may be impacted by proposed development as demonstrated by a floodplain study or survey. Use additional copies of this page as needed.

Adjacent Property Owner Data:		
Name of Primary Owner (PO): Juanita M. Leggett 7-5/5		
PO Address: 6131 Oxford RoAd		
City: West Union	State: WV	Zip: 26456
PO Primary Phone: (304) 349-2353		
PO Secondary Phone: (304) 349-4365		
PO Primary Email:		

Adjacent Property Owner Data:		
Name of Primary Owner (PO): William Bonnell 7-5/6		
PO Address: Rt 1 Box 83A		
City: West Union	State: WV	Zip: 26456
PO Primary Phone: (304) 349-4370		
PO Secondary Phone:		
PO Primary Email:		

Adjacent Property Owner Data:		
Name of Primary Owner (PO):		
PO Address:		
City:	State:	Zip:
PO Primary Phone:		
PO Secondary Phone:		
PO Primary Email:		

Adjacent Property Owner Data:		
Name of Primary Owner (PO):		
PO Address:		
City:	State:	Zip:
PO Primary Phone:		
PO Secondary Phone:		
PO Primary Email:		

Site Plan

A Site Plan is an accurate and detailed map of the proposed development for this project. It shows the size, shape, location and special features of the project property, and the size and location of any development planned to the property, especially as that development will impact the floodplain and/or floodway. Site plans show what currently exists on the project property, and any changes or improvements you are proposing to make. **Two complete sets of plans and specifications are required** when applying for a Floodplain Permit. The Floodplain Manager will retain one set, and one set will be dated and returned to the applicant when the permit is issued. **A certified and licensed engineering firm should complete site plans.**

A SITE PLAN MUST CONTAIN THE FOLLOWING INFORMATION: See Attachment 1

1. Legal description of the parcel, north arrow and scale
2. All property lines and their dimensions
3. Names of adjacent roads, location of driveways
4. Location of sloughs, tributaries, streams, rivers, wetlands, ponds, and lakes, with setbacks indicated, and including FEMA floodplain data based on most updated FIRM.
5. Location, size, shape of all buildings, existing and proposed, with elevation of lowest floor indicated.
6. Location and dimensions of existing or proposed on-site sewage systems.
7. Location of all propane tanks, fuel tanks or other liquid storage tanks whether above ground or below ground level.
8. Location and dimensions of any proposed pipeline placement(s) into floodplain/floodway.
9. Location and dimensions of any roadway development into floodplain/floodway. *(Includes initial development access roads)*
10. Location and dimensions of any bridge and/or culvert development into floodplain/floodway.
11. Location and dimensions of any storage yard or facility into the floodplain/floodway.
12. Location of any existing utilities and/or proposed utility placement and/or displacement.
13. Location, dimensions and depth of any existing or proposed fill on site.
14. A survey showing the **existing ground elevations** of at least location on the building site. **ELEVATION NOTE:** All vertical datum will reference either NGVD 29 or NAVD 88. Assumed datum will not be acceptable unless the property is located in an area where vertical datum has not been published. For those areas where vertical datum has not been established, a site plan with contours, elevations using assumed datum, high water marks and existing water levels of sloughs, rivers, lakes or streams and proposed lowest floor elevations is required.

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Applicable Permits:

- 1) US Army Corps of Engineers Nationwide Permit 3 or 14.
- 2) Office of Land and Streams Stream Activity Permit
- 3) Department of Highways Bridge Agreement

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Applicant

Please initial beside each bullet point, print name, sign and date.

gac

I certify that I am authorized to submit this application for the primary project developer.

gac

I certify that the information included in this application is to the best of my knowledge true and complete.

Pending

I certify that all required Federal, State, and local permits required by law and/or ordinance for the above described development of this project have been properly attained, are current and valid, and must be presented with this application before a Doddridge County Floodplain Permit may be issued.

gac

I understand that if in the course of the development project additional permits become required that were not needed during the initial proposal, the primary developer must notify the Doddridge County Floodplain Manager within 48 hours of such need, and that a "Stop Work" order may be issued for all project work directly impacting the floodplain or floodway, until such time the required additional permits are acquired.

gac

I understand that once the floodplain permit is submitted, the application will be entered into official public record at the next regularly scheduled Doddridge County Commission meeting after the date of submittal.

gac

I understand that from the date of submittal of the fully completed permit application, the Doddridge County Floodplain Manager has ninety (90) days to make a determination to either grant or deny said permit application. During this approval period, the Doddridge County Floodplain Manager may, at his or her discretion, conduct a review and/or additional study of provided documentation by means of an independent engineering firm. All costs associated with said review and/or study must be reimbursed to the County before issuance of approved permit.

gac

I understand that during the approval period, the Doddridge County Floodplain Manager of designee may at his or her discretion conduct site visits and document conditions of proposed development pursuant to the permit application.

gac

I understand that once the Floodplain Permit is granted, the permit will be entered into official public record at the next scheduled Doddridge County Commission meeting after the date of issuance. Appeals to the permit may be made no later than twenty (20) days after said issuance. If a valid appeal is submitted, as determined by the Doddridge County Floodplain Manager, a "Stop Work" order will be issued for all project development directly involving the floodplain or floodway. A public hearing by the Doddridge County Appeals Board will be scheduled no less than ten (10) days after the next regularly scheduled Doddridge County Commission meeting.

gac

I understand that all decisions of the Doddridge County Appeals Board shall be final.

gac

I understand issuance of a Floodplain Permit authorizes me to proceed with construction as proposed. A Certificate of Compliance is required upon substantial completion of the project.

In signing this application, the primary developer hereby grants the Doddridge County Floodplain Manager or designee the right to enter onto the above-described location to inspect the development work proposed, in progress, and/or completed.

gac

I understand that if I do not follow exactly the site-plan submitted and approved by this permit that a "Stop Work" order may be issued by the Wirt County Floodplain Manager and that I must stop all construction immediately until discrepancies of actual work vs. proposed work is resolved.

Applicant Signature: _____

Date: _____

Applicant Printed Name: _____

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Permit Issuance

- I certify that I am authorized to accept this granted Doddridge County Floodplain Permit for the primary project developer.
- I certify that all required Federal, State, and local permits required by law and/or ordinance for the approved development of this project have been properly attained, and are current and valid.
- I understand that if in the course of the development project additional permits become required that were not needed during the initial proposal, the primary developer must notify the Doddridge County Floodplain Manager within 48 hours of such need, and that a "Stop Work" order may be issued for all project work directly impacting the floodplain or floodway, until such time the required additional permits are acquired.
- I understand that once the Floodplain Permit is granted, the permit will be entered into official public record at the next scheduled Doddridge County Commission meeting after the date of issuance. Appeals to the permit may be made no later than twenty (20) days after said issuance. If a valid appeal is submitted, as determined by the Doddridge County Floodplain Manager, a "Stop Work" order will be issued for all project development directly involving the floodplain or floodway. A public hearing by the Doddridge County Appeals Board will be scheduled no less than ten (10) days after the next regularly scheduled Doddridge County Commission meeting.
- I understand that all decisions of the Doddridge County Appeals Board shall be final.
- **I understand issuance of a Floodplain Permit authorizes me to proceed with construction as proposed. A Certificate of Compliance is required upon substantial completion of the project.**
- I understand that the granted Doddridge County Floodplain Permit must be visibly displayed at the development site at or near floodplain or floodway activity. *(Doddridge County Floodplain Manager will provide one (1) laminated permit for display. Additional copies are available upon request.)*
- In signing this application, the primary developer grants the Doddridge County Floodplain Manager or designee the right to enter onto the above-described location to inspect the development work proposed, in progress, and/or completed.
- I understand that if I do not follow exactly the site-plan submitted and approved by this permit that a "Stop Work" order may be issued by the Wirt County Floodplain Manager and that I must stop all construction immediately until discrepancies of actual work vs. proposed work is resolved.

Primary Developer Permit Recipient

Signature: _____

Printed Name: _____

Title: _____

Floodplain Manager or Designee

Signature: _____

Date: _____

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Floodplain Manager Checklist:

Date submitted, Date required for completion, date of public notice of permit application at commission meeting, date of paper notification, date of paper publication, permit payment received, payment data, payment cleared bank, date submitted to engineer, date report received from engineer, date permit issued/rejected, date of site visit and documentation

Last date for appeal
Appeal received
Appeal valid/invalid
Stop work order issued
Commission meeting
Last date for FPM decision appeal
FPM decision appeal received
Commission meeting
Board of Appeals public hearing
Final BOA decision

Date of work completion
Date of closeout

FILED

2014 AUG -5 AM 11:36

Blue Mountain Inc.

BETH A. ROGERS
COUNTY CLERK
DODDRIDGE COUNTY, WV

August 1, 2014

Mr. Bo Wriston, Doddridge County Floodplain Manager
118 East Court St.
West Union, West Virginia 26456

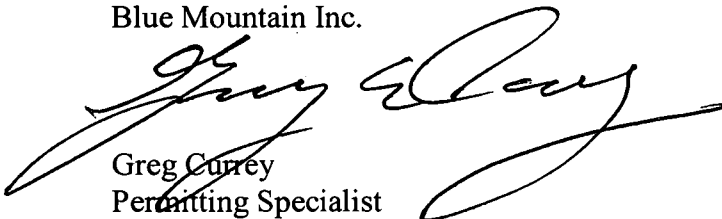
Subject: Commercial/Industrial Floodplain Development Permit Application
CNX Gas Company LLC
Proposed South Fork Bridge #1 Project
Doddridge County, West Virginia
Blue Mountain Inc. Project 0407-14

On behalf of CNX Gas Company LLC, Blue Mountain Inc. is submitting this Floodplain Development Permit Application for the proposed South Fork Bridge #1 Project, located in Doddridge County, West Virginia (39.206402 N, -80.833848 W).

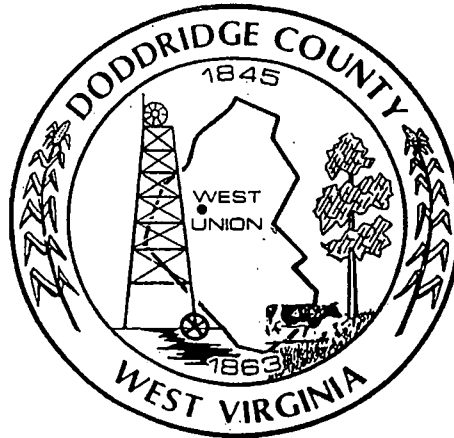
The project entails the replacement of an existing bridge across County Route 19/11 with a box culvert so that larger trucks and equipment associated with the gas industry can safely pass. This culvert will be located in Sheep Run (N 39.206402, W -80.833848) which is a perennial tributary of the South Fork of the Hughes River. Approximately 100 cubic yards of fill will be placed below the "Ordinary High Water Mark" of Sheep Run to place this culvert. The placement of fill for this culvert will impact approximately 440 square feet and 20 linear feet of Sheep Run. The proposed stream impact from the culvert installation is unavoidable.

Please contact Greg Currey at 304-662-6486 or at BMI@bluemtninc.com if you have any questions regarding this request. Thank you very much for your assistance.

Respectfully,
Blue Mountain Inc.


Greg Currey
Permitting Specialist

217
8/1/14 = 252/2017



Commercial/Industrial Floodplain Development Permit Application Doddridge County, WV Floodplain Management

This document is to be used for commercial and/or industrial development projects that impact/potentially impact the FEMA-designated floodplain and/or floodway of Doddridge County, WV pursuant to the rules and regulations established by all applicable Federal, State and local laws and ordinances, including the Doddridge County Floodplain Ordinance.

Permit Application #: _____ *(To be completed by Floodplain Manager or designee)*

Date Submitted: _____

90 Day Window Date: _____

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Applicant Information:

Please provide all pertinent data.

Applicant Information		
Responsible Company Name: CNX Gas Company LLC		
Corporate Mailing Address: One Energy Drive, PO Box 1248		
City: Jane Lew	State: WV	Zip: 26378
Corporate Point of Contact (POC): Amanda Wright		
Corporate POC Title: Manager of Permitting		
Corporate POC Primary Phone: (304) 884-2009		
Corporate POC Primary Email: AmandaWright@consolenergy.com		
Corporate FEIN: 20-3170639	Corporate DUNS:	
Corporate Website: www.consolenergy.com		
Local Mailing Address: Same as above		
City:	State:	Zip:
Local Project Manager (PM):		
Local PM Primary Phone:		
Local PM Secondary Phone:		
Local PM Primary Email:		
Person Filing Application: Greg Currey, Blue Mountain Inc.		
Applicant Title: Permitting Specialist		
Applicant Primary Phone: (304) 662-6486		
Applicant Secondary Phone: (304) 266-1198		
Applicant Primary Email: G.Currey@bluemtninc.com		

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Proposed Development:

Please check all elements of the proposed project that apply.

Project Description: (Check all that apply)	
<input type="checkbox"/>	New Construction
<input type="checkbox"/>	Commercial Structure
<input type="checkbox"/>	Industrial Structure
<input type="checkbox"/>	Pipeline
<input type="checkbox"/>	Drill Pad
<input type="checkbox"/>	Storage Yard/Facility
<input type="checkbox"/>	Roadway Construction
<input checked="" type="checkbox"/>	Bridge/Culvert (Please circle)
<input type="checkbox"/>	Utility placement
<input type="checkbox"/>	Utility displacement
<input type="checkbox"/>	Grade/Excavation/Fill
<input type="checkbox"/>	Watercourse Alteration
<input type="checkbox"/>	Above ground chemical or HAZMAT storage tanks
<input type="checkbox"/>	Above ground storage tanks (other)
<input type="checkbox"/>	Below ground storage tanks (any)
<input type="checkbox"/>	Well/Septic System
<input type="checkbox"/>	Other
If other, please describe:	

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Development Site/Property Information:

Please provide physical description of the site/property, along with pertinent ownership (surface and mineral rights) data as applicable. Attach appropriate maps from sources such as Google Earth, WV Flood Tool, etc. showing location of proposed development. Use additional copies of this page if development spans multiple property boundaries. Designate each property by number (i.e. Property 1 of 1, Property 2 of 7, etc.)

Property Designation: ____ of ____

Site/Property Information:		
Legal Description: NA No private property will be impacted. This is the replacement of a bridge on a county road.		
Physical Address/911 Address:		
Decimal Latitude/Longitude:		
DMS Latitude/Longitude:		
District:	Map:	Parcel:
Land Book Description:		
Deed Book Reference:		
Tax Map Reference:		
Existing Buildings/Use of Property:		

Floodplain Location Data: (to be completed by Floodplain Manager or designee)			
Community:	Number:	Panel:	Suffix:
Location (Lat/Long):		Approximate Elevation:	
		Estimated BFE:	
Is the development in the floodway? <input type="checkbox"/> Yes <input type="checkbox"/> No		Is the development in the floodplain? <input type="checkbox"/> Yes <input type="checkbox"/> No Zone: _____	
Notes:			

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Property Owner Data:

Please provide data on current site/property landowner(s), both surface and mineral rights (as applicable). Use additional copies of this page as needed. Designate each page in relation to each property listed above.

Property Designation: ____ of ____

Property Owner Data:		
Name of Primary Owner (PO): No private property will be impacted.		
PO Address:		
City:	State:	Zip:
PO Primary Phone:		
PO Secondary Phone:		
PO Primary Email:		

Surface Rights Owner Data:		
Name of Primary Owner (PO):		
PO Address:		
City:	State:	Zip:
PO Primary Phone:		
PO Secondary Phone:		
PO Primary Email:		

Mineral Rights Owner Data: (As Applicable)		
Name of Primary Owner (PO):		
PO Address:		
City:	State:	Zip:
PO Primary Phone:		
PO Secondary Phone:		
PO Primary Email:		

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Contractor Data:

Please provide all pertinent data for contractors and sub-contractors that may be participating in this project. Use additional copies of this page as needed. Designate each page in relation to each property listed above.

Property Designation: ___ of ___

Contractor/Sub-Contractor (C/SC) Information:		
C/SC Company Name:		
C/SC WV License Number:		
C/SC FEIN:	C/SC DUNS:	
Local C/SC Point of Contact (POC):		
Local C/SC POC Title:		
C/SC Mailing Address:		
City:	State:	Zip-Code:
Local C/SC Office Phone:		
Local C/SC POC Phone:		
Local C/SC POC E-Mail:		

Contractor/Sub-Contractor (C/SC) Information:		
C/SC Company Name:		
C/SC WV License Number:		
C/SC FEIN:	C/SC DUNS:	
Local C/SC Point of Contact (POC):		
Local C/SC POC Title:		
C/SC Mailing Address:		
City:	State:	Zip-Code:
Local C/SC Office Phone:		
Local C/SC POC Phone:		
Local C/SC POC E-Mail:		

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Engineering Firm Data:

Please provide all pertinent data for engineering firm(s) that may be participating in this project. Use additional copies of this page as needed. Designate each page in relation to each property listed above.

Property Designation: ____ of ____

Engineer Firm Information:		
Engineer Firm Name: Blue Mountain Inc.		
Engineer WV License Number: 4449		
Engineer Firm FEIN: 550704426	Engineer Firm DUNS: 805979713	
Engineer Firm Primary Point of Contact (POC): Greg Currey		
Engineer Firm Primary POC Title: Permitting Specialist		
Engineer Firm Mailing Address: 11023 Mason Dixon HWY		
City: Burton	State: WV	Zip-Code: 26562
Engineer Firm Office Phone: (304) 662-6486		
Engineer Firm Primary POC Phone: (304) 266-1198		
Engineer Firm Primary POC E-Mail: BMI@bluemtninc.com		

Engineer Firm Information:		
Engineer Firm Name:		
Engineer WV License Number:		
Engineer Firm FEIN:	Engineer Firm DUNS:	
Engineer Firm Primary Point of Contact (POC):		
Engineer Firm Primary POC Title:		
Engineer Firm Mailing Address:		
City:	State:	Zip-Code:
Engineer Firm Office Phone:		
Engineer Firm Primary POC Phone:		
Engineer Firm Primary POC E-Mail:		

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Adjacent and/or Affected Landowners Data

Please provide data for all adjacent and/or affected surface owners (both up and down stream) whose property may be impacted by proposed development as demonstrated by a floodplain study or survey. Use additional copies of this page as needed.

Adjacent Property Owner Data:		
Name of Primary Owner (PO): Juanita M. Leggett 7-5/5		
PO Address: 6131 Oxford RoAd		
City: West Union	State: WV	Zip: 26456
PO Primary Phone: (304) 349-2353		
PO Secondary Phone: (304) 349-4365		
PO Primary Email:		

Adjacent Property Owner Data:		
Name of Primary Owner (PO): William Bonnell 7-5/6		
PO Address: Rt 1 Box 83A		
City: West Union	State: WV	Zip: 26456
PO Primary Phone: (304) 349-4370		
PO Secondary Phone:		
PO Primary Email:		

Adjacent Property Owner Data:		
Name of Primary Owner (PO):		
PO Address:		
City:	State:	Zip:
PO Primary Phone:		
PO Secondary Phone:		
PO Primary Email:		

Adjacent Property Owner Data:		
Name of Primary Owner (PO):		
PO Address:		
City:	State:	Zip:
PO Primary Phone:		
PO Secondary Phone:		
PO Primary Email:		

Site Plan

A Site Plan is an accurate and detailed map of the proposed development for this project. It shows the size, shape, location and special features of the project property, and the size and location of any development planned to the property, especially as that development will impact the floodplain and/or floodway. Site plans show what currently exists on the project property, and any changes or improvements you are proposing to make. **Two complete sets of plans and specifications are required** when applying for a Floodplain Permit. The Floodplain Manager will retain one set, and one set will be dated and returned to the applicant when the permit is issued. **A certified and licensed engineering firm should complete site plans.**

A SITE PLAN MUST CONTAIN THE FOLLOWING INFORMATION: See Attachment 1

1. Legal description of the parcel, north arrow and scale
2. All property lines and their dimensions
3. Names of adjacent roads, location of driveways
4. Location of sloughs, tributaries, streams, rivers, wetlands, ponds, and lakes, with setbacks indicated, and including FEMA floodplain data based on most updated FIRM.
5. Location, size, shape of all buildings, existing and proposed, with elevation of lowest floor indicated.
6. Location and dimensions of existing or proposed on-site sewage systems.
7. Location of all propane tanks, fuel tanks or other liquid storage tanks whether above ground or below ground level.
8. Location and dimensions of any proposed pipeline placement(s) into floodplain/floodway.
9. Location and dimensions of any roadway development into floodplain/floodway. *(Includes initial development access roads)*
10. Location and dimensions of any bridge and/or culvert development into floodplain/floodway.
11. Location and dimensions of any storage yard or facility into the floodplain/floodway.
12. Location of any existing utilities and/or proposed utility placement and/or displacement.
13. Location, dimensions and depth of any existing or proposed fill on site.
14. A survey showing the **existing ground elevations** of at least location on the building site. **ELEVATION NOTE:** All vertical datum will reference either NGVD 29 or NAVD 88. Assumed datum will not be acceptable unless the property is located in an area where vertical datum has not been published. For those areas where vertical datum has not been established, a site plan with contours, elevations using assumed datum, high water marks and existing water levels of sloughs, rivers, lakes or streams and proposed lowest floor elevations is required.

**Doddridge County Commercial/Industrial
Floodplain Development Permit Application**

Permit # _____

Applicable Permits:

- 1) US Army Corps of Engineers Nationwide Permit 3 or 14.
- 2) Office of Land and Streams Stream Activity Permit
- 3) Department of Highways Bridge Agreement

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Applicant

Please initial beside each bullet point, print name, sign and date.

gal

I certify that I am authorized to submit this application for the primary project developer.

gal

I certify that the information included in this application is to the best of my knowledge true and complete.

Ponding

I certify that all required Federal, State, and local permits required by law and/or ordinance for the above described development of this project have been properly attained, are current and valid, and must be presented with this application before a Doddridge County Floodplain Permit may be issued.

gal

I understand that if in the course of the development project additional permits become required that were not needed during the initial proposal, the primary developer must notify the Doddridge County Floodplain Manager within 48 hours of such need, and that a "Stop Work" order may be issued for all project work directly impacting the floodplain or floodway, until such time the required additional permits are acquired.

gal

I understand that once the floodplain permit is submitted, the application will be entered into official public record at the next regularly scheduled Doddridge County Commission meeting after the date of submittal.

gal

I understand that from the date of submittal of the fully completed permit application, the Doddridge County Floodplain Manager has ninety (90) days to make a determination to either grant or deny said permit application. During this approval period, the Doddridge County Floodplain Manager may, at his or her discretion, conduct a review and/or additional study of provided documentation by means of an independent engineering firm. All costs associated with said review and/or study must be reimbursed to the County before issuance of approved permit.

gal

I understand that during the approval period, the Doddridge County Floodplain Manager or designee may at his or her discretion conduct site visits and document conditions of proposed development pursuant to the permit application.

gal

I understand that once the Floodplain Permit is granted, the permit will be entered into official public record at the next scheduled Doddridge County Commission meeting after the date of issuance. Appeals to the permit may be made no later than twenty (20) days after said issuance. If a valid appeal is submitted, as determined by the Doddridge County Floodplain Manager, a "Stop Work" order will be issued for all project development directly involving the floodplain or floodway. A public hearing by the Doddridge County Appeals Board will be scheduled no less than ten (10) days after the next regularly scheduled Doddridge County Commission meeting.

gal

I understand that all decisions of the Doddridge County Appeals Board shall be final.

gal

I understand issuance of a Floodplain Permit authorizes me to proceed with construction as proposed. A Certificate of Compliance is required upon substantial completion of the project.

gal

In signing this application, the primary developer hereby grants the Doddridge County Floodplain Manager or designee the right to enter onto the above-described location to inspect the development work proposed, in progress, and/or completed.

gal

I understand that if I do not follow exactly the site-plan submitted and approved by this permit that a "Stop Work" order may be issued by the Wirt County Floodplain Manager and that I must stop all construction immediately until discrepancies of actual work vs. proposed work is resolved.

Applicant Signature: _____

Date: _____

Applicant Printed Name: _____

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Permit Issuance

- I certify that I am authorized to accept this granted Doddridge County Floodplain Permit for the primary project developer.
- I certify that all required Federal, State, and local permits required by law and/or ordinance for the approved development of this project have been properly attained, and are current and valid.
- I understand that if in the course of the development project additional permits become required that were not needed during the initial proposal, the primary developer must notify the Doddridge County Floodplain Manager within 48 hours of such need, and that a "Stop Work" order may be issued for all project work directly impacting the floodplain or floodway, until such time the required additional permits are acquired.
- I understand that once the Floodplain Permit is granted, the permit will be entered into official public record at the next scheduled Doddridge County Commission meeting after the date of issuance. Appeals to the permit may be made no later than twenty (20) days after said issuance. If a valid appeal is submitted, as determined by the Doddridge County Floodplain Manager, a "Stop Work" order will be issued for all project development directly involving the floodplain or floodway. A public hearing by the Doddridge County Appeals Board will be scheduled no less than ten (10) days after the next regularly scheduled Doddridge County Commission meeting.
- I understand that all decisions of the Doddridge County Appeals Board shall be final.
- **I understand issuance of a Floodplain Permit authorizes me to proceed with construction as proposed. A Certificate of Compliance is required upon substantial completion of the project.**
- I understand that the granted Doddridge County Floodplain Permit must be visibly displayed at the development site at or near floodplain or floodway activity. *(Doddridge County Floodplain Manager will provide one (1) laminated permit for display. Additional copies are available upon request.)*
- In signing this application, the primary developer grants the Doddridge County Floodplain Manager or designee the right to enter onto the above-described location to inspect the development work proposed, in progress, and/or completed.
- I understand that if I do not follow exactly the site-plan submitted and approved by this permit that a "Stop Work" order may be issued by the Wirt County Floodplain Manager and that I must stop all construction immediately until discrepancies of actual work vs. proposed work is resolved.

Primary Developer Permit Recipient

Signature: _____

Printed Name: _____

Title: _____

Floodplain Manager or Designee

Signature: _____

Date: _____

Doddridge County Commercial/Industrial
Floodplain Development Permit Application

Permit # _____

Floodplain Manager Checklist:

Date submitted, Date required for completion, date of public notice of permit application at commission meeting, date of paper notification, date of paper publication, permit payment received, payment data, payment cleared bank, date submitted to engineer, date report received from engineer, date permit issued/rejected, date of site visit and documentation

Last date for appeal
Appeal received
Appeal valid/invalid
Stop work order issued
Commission meeting
Last date for FPM decision appeal
FPM decision appeal received
Commission meeting
Board of Appeals public hearing
Final BOA decision

Date of work completion
Date of closeout



Adjacent Home View 1



Adjacent Home View 2



Adjacent Home View 3



Adjacent Home & Garage View 4



Adjacent Home & Garage View 5



Sheep Run Temporary Bridge



Original Sheep Run Bridge View 1



Original Sheep Run Bridge View 2



Original Sheep Run Bridge View 3



May 21, 2015

Mr. Bo Wriston
County Floodplain Coordinator
Doddridge County Courthouse
118 East Court Street
West Union, WV 26456

RE: Settled Landowner Dispute for Sheep Run Bridge Replacement

Dear Mr. Wriston:

Please see the attached planset that has been signed by Mr. Bonnell for the Sheep Run Bridge Replacement. This particular project is located in Doddridge County on CR19/11 (South Fork Hughes River) at approximately Mile Post 0.06. CNX is working with Mr. Bonnell and his lawyer to complete a formal Surface Use Agreement, but he did sign this set of plans indicating his intent to allow this project to temporarily impact his property.

If you could please let me know if this will suffice for the issuance of the Floodplain Permit, you can contact Anthony Farrell or myself at (304) 662-6486.

Sincerely,

Ed Race, EIT
Project Manager
Blue Mountain Inc.

Enclosures

WILLIAM BONNELL

1. 304. 349. 4370 (H)

SEWERAGE CONTRACTS

HISTORY OF DITCH PLACEMENT

HOW BIG EXISTING OPENING?

HOW BIG BOX CULVERT?

DOH

↳ SOUTH FORK HUGHES RIVER

Bill Bonnell

871 Hughes River Rd

West Union, WV

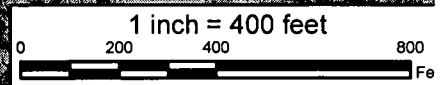
26456

304-349-4370

Needs copy of
Conrad Bridge



39.2064019151
-80.8338482090



Blue Mountain Inc.
bme@bme.co 304.662.6466
www.bluemountainengineering.com

FIGURE 1:
LOCATION MAP
BMI Aerial Photography
May 2013

CNX GAS
SOUTH FORK BRIDGE PROJECT
DODDRIDGE COUNTY

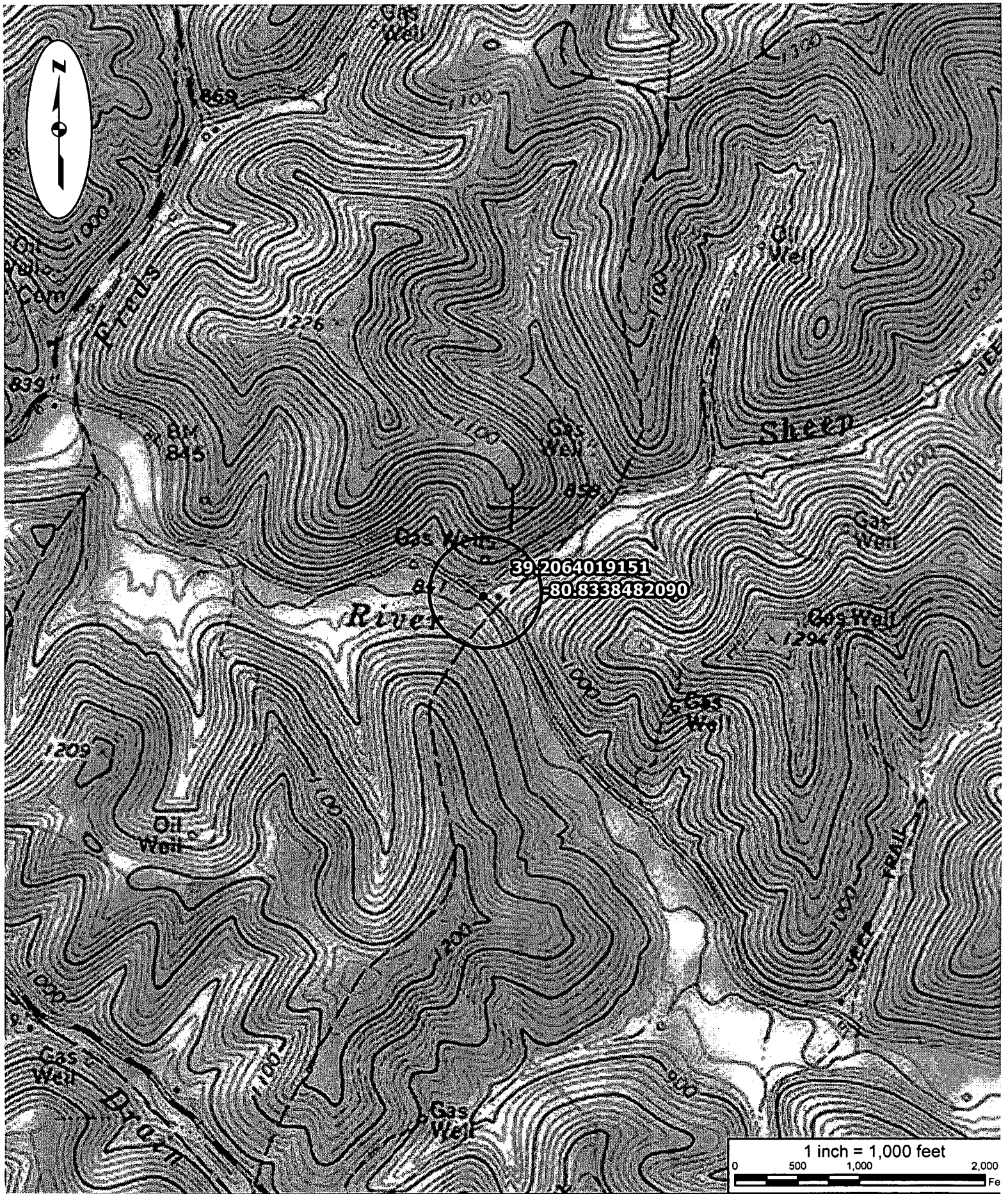


FIGURE 2:
 LOCATION MAP
 7.5 USGS TOPOGRAPHY
 OXFORD WV MAP



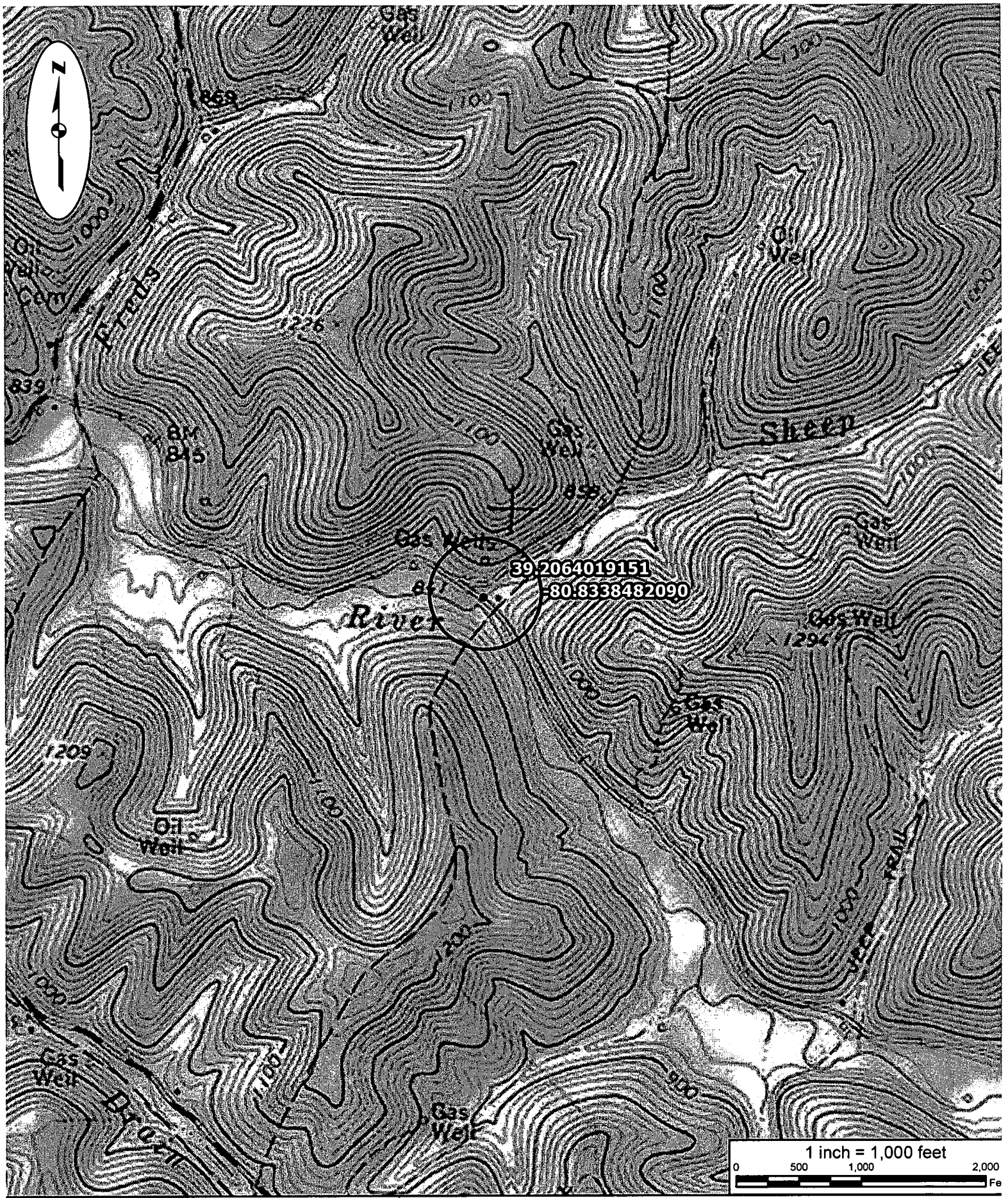


FIGURE 2:
 LOCATION MAP
 7.5 USGS TOPOGRAPHY
 OXFORD WV MAP





DIVISION OF NATURAL RESOURCES

324 Fourth Avenue, Room 200
South Charleston WV 25303-1228
TDD (304) 558-1439
TDD 1-800-354-6087
Fax (304) 558-6048
Telephone (304) 558-3225

Earl Ray Tomblin
Governor

Frank Jezioro
Director

July 14, 2014

Division of Natural Resources
RIGHT OF ENTRY

Re: LS-14-VI/09-1002

CNX Gas Company LLC
Amanda Wright
c/o Blue Mountain, Inc.
Attention: Greg Currey
11023 Mason Dixon Hwy.
Burton, WV 26562-

Dear Ms. Wright:

The Division of Natural Resources hereby grants to you for a period of ten (10) years from the date hereof, a Right of Entry for the purpose of installing and maintaining a sixty-six inch by twenty foot (66"x20') box culvert in the streambed along Sheep Run of the South Fork Hughes River near Oxford in Doddridge County, West Virginia.

This Right of Entry is subject to the following terms and conditions:

1. No in stream work during the fish-spawning season (April 1-June 30).
2. Work should be completed as quickly as possible during low flows in designated work areas only.
3. All shore areas disturbed by this operation must be reshaped, seeded and mulched immediately upon completion of work. The prompt establishment of vegetative cover will reduce future damage from high water levels.
4. Green concrete must not be put in the stream (highly toxic to aquatic life).
5. Guidance should be obtained from NRCS (formerly SCS) and a registered engineer for the design and construction. Must allow for passage of at least ten-year flood flow.
6. Best management practices should be followed; measures such as hay bales must be used to reduce downstream siltation.

7. Applicant is responsible for removing debris from in and around the installation periodically to prevent stream flow obstruction.
8. Durable head walls of logs, rock, or concrete shall be constructed at both the upstream and downstream ends of crossing to prevent erosion of fill material into the stream.
9. The State's issuance of this Right-of-Entry does not provide for the applicant to work outside the requested boundaries nor does the State assume any liability for the applicant's/landowner's construction activities. By accepting this Right-of-Entry, the applicant/landowner assumes liability for any/all damages caused by this activity to both upstream and downstream landowners.

Guidelines of Best Management Practices for Sediment and Erosion Control as outlined by the Section of Water Resources, Division of Environmental Protection must be followed. Copies of those guidelines are available from the Section of Water Resources, 601 57th Street S.E., Charleston, West Virginia 25304-2345, Telephone No. (304) 926-0440.

The issuance of this Right of Entry by the Division of Natural Resources does not preclude the necessity to obtain a permit from the Corps of Engineers or any other state or federal permits which may be required by law, nor does this Right of Entry negate the need to comply with the West Virginia Water Pollution Control Act and/or the State Environmental Quality Board's administrative regulations, applicant is also responsible for determining if the proposed activity is located within an identified flood plain and it is the applicant's responsibility for contacting the local governmental agency in charge of that program and obtaining a flood plain development permit for it. This Right of Entry does not grant any rights or privileges, or permission to enter upon or to cross the property of any other person, nor is permission granted to remove any material that lies upon the property of any other persons. Work should be completed in as brief a period as possible and within one year from the date of this letter. In the event you fail or refuse to comply with any of the terms or conditions herein, this Right of Entry will be canceled and considered null and void and the Division will reject further applications.

Your payment is now due and payable in the amount of \$100.00 to the Division of Natural Resources covering the first year's annual fee of this agreement. Your agreement will be effective upon receipt of your payment in full. You must notify this office in writing when this installation has been removed.

Sincerely,



Joe T. Scarberry, Supervisor
Office of Land and Streams

JTS:cb

pc: DNR Fish Biologist
Mr. Mike Zeto, Environmental Enforcement
DNR Conservation Officers



DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
602 EIGHTH STREET
HUNTINGTON, WEST VIRGINIA 25701-2070

REPLY TO
ATTENTION OF

August 7, 2014

Regulatory Division
Energy Resource Branch
LRH-2014-00584- LKR-Sheep Run
South Fork Bridge #1

Ms. Amanda Wright
CNX Gas Company LLC
One Energy Drive, P.O. Box 1248
Jane Lew, West Virginia 26378

Dear Ms. Wright:

I refer to the information submitted to this office regarding the South Fork Bridge #1 Project, a linear transportation project. The proposed project will include the replacement of an existing bridge located over Sheep Run. According to the information provided, implementation of the proposed project will result in the discharge of dredged and/or fill material into approximately 20 linear feet of stream, referred to as Sheep Run, for the installation of a 20-foot wide by 5.5-foot high precast concrete box culvert. The purpose of the project is to install a box culvert in order to provide access to accommodate heavy equipment utilized for gas production operations. Sheep Run is an indirect tributary of the Little Kanawha River, a traditional navigable water of the United States (U.S.). The proposed project is located approximately seven (7) aerial miles southwest of West Union, in Doddridge County, West Virginia (39.206402°N, 80.833848°W). The project has been assigned the following Department of the Army (DA) No. LRH-2014-00584. Please reference this number on all future correspondence related to this project.

The U.S. Army Corps of Engineers (Corps) authority to regulate waters of the U.S. is based, in part, on the definitions and limits of jurisdiction contained in 33 CFR 328 and 33 CFR 329. Section 404 of the Clean Water Act requires that a DA permit be obtained prior to the discharge of dredged and/or fill material into waters of the U.S. , including wetlands. Section 10 of the Rivers and Harbors Act of 1899 requires that a DA permit be obtained for any work in, on, over or under a navigable water.

To the extent the Corps has jurisdiction over the discharge of dredged and/or fill material associated with the proposed linear transportation activity, it has been determined the proposed project meets the criteria for Nationwide Permit Number (NWP) #14 (attached) under the February 21, 2012 Federal Register, Notice of Reissuance of Nationwide Permits (77 FR 10184) provided you comply with all terms and conditions of the enclosed material. A copy of this NWP can be found on our website at <http://www.lrh.usace.army.mil/Missions/Regulatory.aspx>.

Please be aware this nationwide permit authorization does not obviate the requirement to obtain other Federal, state, or local authorizations required by law. A copy of this NWP and verification letter must be supplied to your project engineer responsible for construction activities. A copy of the verification letter must be kept at the site during construction. Upon completion of the work, the attached certification must be signed and returned to this office.

If you have any questions concerning the above, please contact Ms. Audrey Richter at (304) 399-5257 or by email at Audrey.M.Richter@usace.army.mil.

Sincerely,



Samantha Dailey
Regulatory Project Manager
Energy Resource Branch

Enclosures



DIVISION OF NATURAL RESOURCES

324 Fourth Avenue, Room 200
South Charleston WV 25303-1228
TDD (304) 558-1439
TDD 1-800-354-6087
Fax (304) 558-6048
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Earl Ray Tomblin
Governor

Frank Jezioro
Director

July 14, 2014

Division of Natural Resources
RIGHT OF ENTRY

Re: LS-14-VI/09-1002

CNX Gas Company LLC
Amanda Wright
c/o Blue Mountain, Inc.
Attention: Greg Currey
11023 Mason Dixon Hwy.
Burton, WV 26562-

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This Right of Entry is subject to the following terms and conditions:

1. No in stream work during the fish-spawning season (April 1-June 30).
2. Work should be completed as quickly as possible during low flows in designated work areas only.
3. All shore areas disturbed by this operation must be reshaped, seeded and mulched immediately upon completion of work. The prompt establishment of vegetative cover will reduce future damage from high water levels.
4. Green concrete must not be put in the stream (highly toxic to aquatic life).
5. Guidance should be obtained from NRCS (formerly SCS) and a registered engineer for the design and construction. Must allow for passage of at least ten-year flood flow.
6. Best management practices should be followed; measures such as hay bales must be used to reduce downstream siltation.

7. Applicant is responsible for removing debris from in and around the installation periodically to prevent stream flow obstruction.
8. Durable head walls of logs, rock, or concrete shall be constructed at both the upstream and downstream ends of crossing to prevent erosion of fill material into the stream.
9. The State's issuance of this Right-of-Entry does not provide for the applicant to work outside the requested boundaries nor does the State assume any liability for the applicant's/landowner's construction activities. By accepting this Right-of-Entry, the applicant/landowner assumes liability for any/all damages caused by this activity to both upstream and downstream landowners.

Guidelines of Best Management Practices for Sediment and Erosion Control as outlined by the Section of Water Resources, Division of Environmental Protection must be followed. Copies of those guidelines are available from the Section of Water Resources, 601 57th Street S.E., Charleston, West Virginia 25304-2345, Telephone No. (304) 926-0440.

The issuance of this Right of Entry by the Division of Natural Resources does not preclude the necessity to obtain a permit from the Corps of Engineers or any other state or federal permits which may be required by law, nor does this Right of Entry negate the need to comply with the West Virginia Water Pollution Control Act and/or the State Environmental Quality Board's administrative regulations, applicant is also responsible for determining if the proposed activity is located within an identified flood plain and it is the applicant's responsibility for contacting the local governmental agency in charge of that program and obtaining a flood plain development permit for it. This Right of Entry does not grant any rights or privileges, or permission to enter upon or to cross the property of any other person, nor is permission granted to remove any material that lies upon the property of any other persons. Work should be completed in as brief a period as possible and within one year from the date of this letter. In the event you fail or refuse to comply with any of the terms or conditions herein, this Right of Entry will be canceled and considered null and void and the Division will reject further applications.

Your payment is now due and payable in the amount of \$100.00 to the Division of Natural Resources covering the first year's annual fee of this agreement. Your agreement will be effective upon receipt of your payment in full. You must notify this office in writing when this installation has been removed.

Sincerely,


Joe T. Scarberry, Supervisor
Office of Land and Streams

JTS:cb

pc: DNR Fish Biologist
Mr. Mike Zeto, Environmental Enforcement
DNR Conservation Officers

**WEST VIRGINIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
AGREEMENT
CNX GAS COMPANY LLC
STRUCTURE REPLACEMENT
DODDRIDGE COUNTY**

THIS AGREEMENT, executed in duplicate, made and entered into this 3rd day of June, 2014, by and between the West Virginia Department of Transportation, Division of Highways, hereinafter called "Department," and CNX Gas Company, LLC, P.O. Box 1248, Jane Lew, WV 26378, hereinafter called "Company,"

WHEREAS, to improve access to oil and gas operations in Doddridge County, Company desires perform temporary modifications to an existing drainage structure to allow for the passage of construction and drilling equipment and also to replace the existing bridge at no cost to the Department; and

WHEREAS, Department considers it to be in the public interest to cooperate with Company to facilitate Company's implementation of the highway improvement, as it pertains to the State Highway System;

NOW, THEREFORE, in consideration of the faithful performance of each party of the mutual covenants hereinafter set forth, Department and Company agree as follows:

- I. Company shall first obtain Department's approval regarding the proposed improvements Company desires to implement within or directly affecting the State Highway System and Company shall comply with the provisions described throughout this Agreement. Company acknowledges that execution of this Agreement does not constitute Department's approval of any part of Company's proposed work nor does execution of this Agreement represent Department's Notice to Proceed. Further, Company acknowledges that any work performed by Company, including work solely within Company's property that will directly affect Department's right-of-way, prior to receipt of Department's approval and notice to proceed with work pertaining to the State Highway System, is performed by Company with the understanding that subsequent review by Department of Company's plans and studies may result in necessary additional modifications to be performed at no cost to Department.
- II. Unless otherwise directed by Department, Company is to submit for Department's review and approval appropriate temporary bridge plans as well as replacement plans and related documents, all of which are collectively referred to as the "Plans," prepared in accordance with Department's Directives, criteria, guidelines and publications, for the performance of work that will occur within or that will directly affect Department's right-of-way of CR 19/11. Department's approvals shall be in writing.
- III. The scope of Company's work as it pertains to the State Highway System, is to include placing of a temporary bridge over an existing structure crossing Sheep Run. Temporary construction will be performed by a contractor approved by Department.

In the event the temporary bridge is long enough to be considered a bridge as defined by National Bridge Inspection Standards (NBIS) and temporary bridge is in place in excess of 12 months, Company agrees to have the bridge inspected according to NBIS.

While the temporary bridge is in use, Company's engineer will be engaged to design a new replacement structure (Box Culvert). Replacement plans shall be completed in accordance with the WVDOH Standard Specifications for Roads and Bridges and will be approved by Department. Temporary Right of Way easements may be required for the placement of cofferdams for dewatering purposes during placement of the box culvert.

Once the replacement box culvert is designed and all federal, state, and local permits are in hand, Company will remove the temporary bridge and construct the box culvert. Construction of the box culvert will occur during an appropriate lapse in Company operations or after the operations are complete with completion no later than December 31, 2014. The Design Loading of the completed structure shall be HL-93.

- IV. After receipt of Department's written approval of the Plans pertaining to the State Highway System and Department's authorization to proceed with construction and related work, Company then shall be authorized to construct Project as shown on the approved Plans, in accordance with Department's specifications, at no cost to Department.
 - V. Prior to construction of Project, Department and Company shall review and document, as appropriate, the existing condition of the State Highway System to be affected by Project, and Department shall be notified of Company's anticipated construction schedule and Department shall have the right at all times to inspect the work pertaining to Project. Department shall provide full time inspection during the construction of the permanent box culvert. If the results of Department's inspection indicate that the work is not being performed in accordance with the approved Plans and/or specifications, Department then will report such fact to Company for appropriate remedial action. Department shall perform an additional inspection of the work within thirty (30) days after receipt by Department of notice from Company that the work is complete. Upon completion of said inspection, Department shall, in writing, accept the completed work associated with Project or reject the work. If rejected, any deficiencies in the construction performed by Company, which are disclosed by Department's inspection, shall be promptly corrected by and at the expense of Company. Neither Department's review of Company's Plans nor its inspection of Company's construction relieves Company of the duty imposed by West Virginia Code Section 17-16-1 et seq. to refrain from casting water upon the public road.
 - VI. Company shall secure the approvals and/or permits, if any, required by other governmental agencies, and shall comply with all applicable Federal, State, and local environmental regulations including, but not limited to, the National Environmental Policy Act, Section 404 of the Clean Water Act, Section 106 of the National Historic Preservation Act, Rare, Threatened and Endangered Species Act, State 401 Water Quality Certification, and hazardous waste requirements. Upon request of Department, Company shall furnish Department with acceptable documentation of such approvals, permits, and compliance.
 - VII. In connection with Project, Company shall indemnify and hold Department harmless from and against any and all loss, damage, and liability, and from all claims for damages on account of or by reason of bodily injury, including death, which may be sustained, or claimed to be sustained, by any person or persons including employees of Department, and from and against any and all damages to property arising out of the Project, except if any such claim or liability results from
 - A. the sole negligence of Department; or
 - B. the willful misconduct or intentional unlawful acts of Department.
- Further, upon request Company shall furnish evidence of having at least the minimum amounts of insurance required of the Contractor in Section 103.6 through and including Section 103.6.5 of the "West Virginia Division of Highways, Standard Specifications, Roads and Bridges, Adopted 2010," and supplements hereto. Company also shall require its contractor(s) to have the aforesaid minimum insurance coverage and to provide evidence, as necessary, that contractor has a current license and is qualified to perform work in West Virginia.
- VIII. The review and approval of Plans by Department does not relieve the applicant from errors or omissions in the design. The review and approval by Department is solely to identify patent or obvious defects or apparent deviations from current applicable design standards in the manner that the proposed work connects to the highway network maintained by Department. This review and approval does not relieve the applicant, their engineer, their contractor, or any other personnel working on behalf of the applicant from liability for the design and/or construction of Project.
 - IX. As a result of implementation of Project, Company shall have no jurisdiction or control over Department's Right of Way.

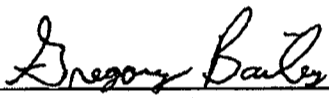
X. This Agreement shall be binding upon the successors and assigns of each party thereto.

IN WITNESS WHEREOF, the parties hereto have caused their respective names to be signed by their duly authorized officers.

ATTEST:

WEST VIRGINIA
DEPARTMENT OF TRANSPORTATION,
DIVISION OF HIGHWAYS

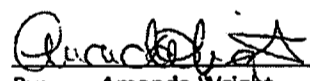

Title: **Executive Secretary**


By: **Gregory L. Bailey, P.E.**
Acting State Highway Engineer

ATTEST:

CNX GAS COMPANY, LLC

Title:


By: **Amanda Wright**
Manager-Permitting

APPROVED AS TO FORM THIS
2 DAY OF 6 2014


ATTORNEY LEGAL DIVISION
WEST VIRGINIA DIVISION
OF HIGHWAYS

(To be executed in duplicate)

Distribution: **Master File**
Company



Blue Mountain Inc.

Blue Mountain Inc.
11023 Mason Dixon Highway
Burton, WV 26562
Ph: (304) 662-6486
Fax: (304) 662-6501

July 8, 2014

Ms. Barbara Douglas, Ecological Services
U.S. Fish and Wildlife Service
694 Beverly Pike
Elkins, West Virginia 26241

RECEIVED

JUL 11 2014

WVFO

Dear Ms. Douglas:

Subject: Database Review Request
CNX Gas Company LLC
Proposed South Fork Bridge #1
Doddridge County, West Virginia
Blue Mountain Inc. Project 0407-14

On behalf of CNX Gas Company LLC, Blue Mountain Inc. presents this request for a database review to identify known and likely occurrences of federal and state protected species and their designated critical habitats, federal candidate species, and state special concern and rare species within the vicinity of the proposed South Fork Bridge #1 project, located in Doddridge County, West Virginia (N 39.206402 W 80.833848). Also we are requesting information on other significant biological features, geologic features, and unique natural areas located on or near the pad site.

The project boundary is shown on the attached portions of the Oxford, West Virginia USGS quadrangle map. The project proposal is to replace an existing bridge across County Route 19/11 with a box culvert so that larger trucks and equipment associated with the gas industry can safely pass. This culvert will be located in Sheep Run (N 39.206402, W -80.833848) which is a tributary of the South Fork of the Hughes River. Approximately 100 cubic yards of fill will be



United States Department of the Interior

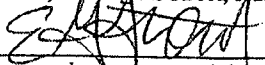
FISH AND WILDLIFE SERVICE


West Virginia Field Office
694 Beverly Pike
Elkins, West Virginia 26241



In response to your letter above, we have made a "no effect" determination that the project will not affect federally-listed endangered or threatened species. Therefore no biological assessment or further section 7 consultation under the Endangered Species Act is required with the Fish and Wildlife Service. Should project plans change, or if additional information on listed and proposed species becomes available, this determination may be reconsidered.

Definitive determinations of the presence of waters of the United States, including wetlands, in the project area and the need for permits, if any, are made by the U.S. Army Corps of Engineers. They may be contacted at: Huntington District, Regulatory Branch, 502 Eighth Street, Huntington, West Virginia 25701, telephone (304) 399-5710.


7/15/14
Reviewer's signature and date


7/15/14
Field Supervisor's signature and date



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
602 EIGHTH STREET
HUNTINGTON, WEST VIRGINIA 25701-2070

August 7, 2014

Regulatory Division
Energy Resource Branch
LRH-2014-00584- LKR-Sheep Run
South Fork Bridge #1

Ms. Amanda Wright
CNX Gas Company LLC
One Energy Drive, P.O. Box 1248
Jane Lew, West Virginia 26378

Dear Ms. Wright:

I refer to the information submitted to this office regarding the South Fork Bridge #1 Project, a linear transportation project. The proposed project will include the replacement of an existing bridge located over Sheep Run. According to the information provided, implementation of the proposed project will result in the discharge of dredged and/or fill material into approximately 20 linear feet of stream, referred to as Sheep Run, for the installation of a 20-foot wide by 5.5-foot high precast concrete box culvert. The purpose of the project is to install a box culvert in order to provide access to accommodate heavy equipment utilized for gas production operations. Sheep Run is an indirect tributary of the Little Kanawha River, a traditional navigable water of the United States (U.S.). The proposed project is located approximately seven (7) aerial miles southwest of West Union, in Doddridge County, West Virginia (39.206402°N, 80.833848°W). The project has been assigned the following Department of the Army (DA) No. LRH-2014-00584. Please reference this number on all future correspondence related to this project.

The U.S. Army Corps of Engineers (Corps) authority to regulate waters of the U.S. is based, in part, on the definitions and limits of jurisdiction contained in 33 CFR 328 and 33 CFR 329. Section 404 of the Clean Water Act requires that a DA permit be obtained prior to the discharge of dredged and/or fill material into waters of the U.S. , including wetlands. Section 10 of the Rivers and Harbors Act of 1899 requires that a DA permit be obtained for any work in, on, over or under a navigable water.

To the extent the Corps has jurisdiction over the discharge of dredged and/or fill material associated with the proposed linear transportation activity, it has been determined the proposed project meets the criteria for Nationwide Permit Number (NWP) #14 (attached) under the February 21, 2012 Federal Register, Notice of Reissuance of Nationwide Permits (77 FR 10184) provided you comply with all terms and conditions of the enclosed material. A copy of this NWP can be found on our website at <http://www.lrh.usace.army.mil/Missions/Regulatory.aspx>.

Please be aware this nationwide permit authorization does not obviate the requirement to obtain other Federal, state, or local authorizations required by law. A copy of this NWP and verification letter must be supplied to your project engineer responsible for construction activities. A copy of the verification letter must be kept at the site during construction. Upon completion of the work, the attached certification must be signed and returned to this office.

If you have any questions concerning the above, please contact Ms. Audrey Richter at (304) 399-5257 or by email at Audrey.M.Richter@usace.army.mil.

Sincerely,



Samantha Dailey
Regulatory Project Manager
Energy Resource Branch

Enclosures



The Culture Center
1900 Kanawha Blvd., E.
Charleston, WV 25305-0300

Randall Reid-Smith, Commissioner

Phone 304.558.0220 • www.wvculture.org
Fax 304.558.2779 • TDD 304.558.3562
EEO/AA Employer

August 27, 2014

Mr. Greg Currey
Blue Mountain, Inc.
11023 Mason Dixon Highway
Burton, WV 26562

RE: Proposed South Fork Bridge #1
FR# 14-992-DO

Dear Mr. Currey:

We have reviewed the above mentioned project to determine its effects to cultural resources. As required by Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations, 36 CFR 800: "Protection of Historic Properties," we submit our comments.

According to the information submitted, CNX Gas Company, LLC proposes to replace an existing bridge across Doddridge County Route 19/11 with a box culvert, which will be placed in Sheep Run in Doddridge County, WV. The proposed project will involve placing approximately 100 cubic yards of fill below the ordinary high water mark of Sheep Run along 20 linear feet of the stream.

Archaeological Resources:

A search of our records indicates that no archaeological resources are located within the proposed project area. In addition, available information indicates the proposed project will be confined to previously disturbed terrain, which makes it unlikely that significant archaeological resources will be encountered. In our opinion, no significant archaeological properties are located within the proposed project area. However, if intact cultural properties are discovered while replacing the bridge, we ask that you cease all activity in the area of discovery and contact this office immediately.

Architectural Resources:

We have reviewed the submitted information, and determined that there are no architectural properties which are eligible for or listed in the National Register of Historic Places that will be affected by the proposed project. No further consultation is necessary regarding architectural resources; however, we ask that you contact our office if your project should change.

We appreciate the opportunity to be of service. *If you have questions regarding our comments or the Section 106 process, please contact Lora A. Lamarre-DeMott, Senior Archaeologist, or Ernest E. Blevins, Structural Historian, at (304) 558-0240.*

Sincerely,

Susan M. Pierce
Deputy State Historic Preservation Officer

0000000000



Edwin Wriston <doddridgecountyfpm@gmail.com>

more Sheep Run Bridge

2 messages

Gregory Currey <G.Currey@bluemtninc.com>

Fri, Oct 10, 2014 at 2:14 PM

To: "doddridgecountyfpm@gmail.com" <doddridgecountyfpm@gmail.com>



Cc: Doug Six <D.Six@bluemtninc.com>

Greg Currey |Blue Mountain, Inc.
Ph: (304) 662-6486 | Fax: (304) 662-6501
11023 Mason Dixon Highway | Burton, WV 26562

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4 attachments

-  **Doddridge Floodplain Development Permit South Fork Bridge 1 Application (Draft).pdf**
779K
-  **SP-05-ProposedBox Culvert.pdf**
354K
-  **ST-01-Soil Types.pdf**
1716K
-  **T-01 - Title Sheet.pdf**
575K

Gregory Currey <G.Currey@bluemtninc.com>

Fri, Oct 10, 2014 at 2:42 PM

To: "doddridgecountyfpm@gmail.com" <doddridgecountyfpm@gmail.com>

Cc: Doug Six <D.Six@bluemtninc.com>


Bo, I know these files are probably not in the order they should be. I believe we sent you all the information as a hard copy and on a CD. Bruce Konsugar with Cobalt Professional Services did all of the engineering work, drawings, and H& H Analysis. If you still think something is missing you should probably contact him. His phone # is 724-942-6675 and e-mail is cobaltprof@verizon.net. If you still think I can help you with something please feel free to contact me. Thanks.

Greg

P.S. I have also attached the Corps and Office of Land and Streams approval letters with this e-mail.

[Quoted text hidden]

4 attachments

-  **XS-01-Bridge Section-Model.pdf**
207K
-  **T-01 - South Fork Bridge #1 Replacement - Title Sheet.pdf**
856K
-  **LRH 2014-00584 CNX Gas South Fork Bridge 1 TE Letter (NWP 14 Authorization Letter).pdf**
62K
-  **DNR (OLS) Right of Entry Approval.pdf**
647K



Edwin Wriston <doddridgecountyfpm@gmail.com>

FW: Sheep Run Culvert Project

1 message

Bo Wriston <bowriston@hotmail.com>

Fri, Aug 8, 2014 at 9:08 PM

To: "doddridgecountyfpm@gmail.com" <doddridgecountyfpm@gmail.com>

*Bo Wriston
304.629.3735 (c)
bowriston@hotmail.com*

"Remember, happiness doesn't depend on upon who you are, or what you have, it depends solely upon what you think." ~ Dale Carnegie

From: G.Currey@bluemtninc.com
To: bowriston@hotmail.com
CC: BMI@bluemtninc.com
Subject: Sheep Run Culvert Project
Date: Fri, 8 Aug 2014 14:51:13 +0000

Bo, attached are the approvals for the Army Corps of Engineers permit and the Office of Land and Streams (DNR) permit. The two approvals we still need are yours and the Department of Highway. If you need anything at all from me, just please let me know. Thanks.

Greg

Greg Currey |Blue Mountain, Inc.
Ph: (304) 662-6486 | Fax: (304) 662-6501
11023 Mason Dixon Highway | Burton, WV 26562

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This communication is the property of Blue Mountain Inc. and may contain confidential and privileged information. Unauthorized use is strictly prohibited and may be unlawful. If you have received this communication in error, please contact the sender by reply e-mail and destroy all copies of the original message and any attachments.

2 attachments

 **LRH 2014-00584 CNX Gas South Fork Bridge 1 TE Letter (NWP 14 Authorization Letter).pdf**
62K

 **DNR (OLS) Right of Entry Approval.pdf**
647K



DIVISION OF NATURAL RESOURCES
324 Fourth Avenue, Room 200
South Charleston WV 25303-1228
TDD (304) 558-1439
TDD 1-800-354-6087
Fax (304) 558-6048
Telephone (304) 558-3225

Earl Ray Tomblin
Governor

Frank Jezioro
Director

July 14, 2014

Division of Natural Resources
RIGHT OF ENTRY

Re: LS-14-VI/09-1002

CNX Gas Company LLC
Amanda Wright
c/o Blue Mountain, Inc.
Attention: Greg Currey
11023 Mason Dixon Hwy.
Burton, WV 26562-

Dear Ms. Wright:

The Division of Natural Resources hereby grants to you for a period of ten (10) years from the date hereof, a Right of Entry for the purpose of installing and maintaining a sixty-six inch by twenty foot (66"x20') box culvert in the streambed along Sheep Run of the South Fork Hughes River near Oxford in Doddridge County, West Virginia.

This Right of Entry is subject to the following terms and conditions:

1. No in stream work during the fish-spawning season (April 1-June 30).
2. Work should be completed as quickly as possible during low flows in designated work areas only.
3. All shore areas disturbed by this operation must be reshaped, seeded and mulched immediately upon completion of work. The prompt establishment of vegetative cover will reduce future damage from high water levels.
4. Green concrete must not be put in the stream (highly toxic to aquatic life).
5. Guidance should be obtained from NRCS (formerly SCS) and a registered engineer for the design and construction. Must allow for passage of at least ten-year flood flow.
6. Best management practices should be followed; measures such as hay bales must be used to reduce downstream siltation.

CNX Gas Company LLC
LS-14-VI/09-1002
Page 2
July 14, 2014

7. Applicant is responsible for removing debris from in and around the installation periodically to prevent stream flow obstruction.
8. Durable head walls of logs, rock, or concrete shall be constructed at both the upstream and downstream ends of crossing to prevent erosion of fill material into the stream.
9. The State's issuance of this Right-of-Entry does not provide for the applicant to work outside the requested boundaries nor does the State assume any liability for the applicant's/landowner's construction activities. By accepting this Right-of-Entry, the applicant/landowner assumes liability for any/all damages caused by this activity to both upstream and downstream landowners.

Guidelines of Best Management Practices for Sediment and Erosion Control as outlined by the Section of Water Resources, Division of Environmental Protection must be followed. Copies of those guidelines are available from the Section of Water Resources, 601 57th Street S.E., Charleston, West Virginia 25304-2345, Telephone No. (304) 926-0440.

The issuance of this Right of Entry by the Division of Natural Resources does not preclude the necessity to obtain a permit from the Corps of Engineers or any other state or federal permits which may be required by law, nor does this Right of Entry negate the need to comply with the West Virginia Water Pollution Control Act and/or the State Environmental Quality Board's administrative regulations, applicant is also responsible for determining if the proposed activity is located within an identified flood plain and it is the applicant's responsibility for contacting the local governmental agency in charge of that program and obtaining a flood plain development permit for it. This Right of Entry does not grant any rights or privileges, or permission to enter upon or to cross the property of any other person, nor is permission granted to remove any material that lies upon the property of any other persons. Work should be completed in as brief a period as possible and within one year from the date of this letter. In the event you fail or refuse to comply with any of the terms or conditions herein, this Right of Entry will be canceled and considered null and void and the Division will reject further applications.

Your payment is now due and payable in the amount of \$100.00 to the Division of Natural Resources covering the first year's annual fee of this agreement. Your agreement will be effective upon receipt of your payment in full. You must notify this office in writing when this installation has been removed.

Sincerely,


Joe T. Scarberry, Supervisor
Office of Land and Streams

JTS:cb

pc: DNR Fish Biologist
Mr. Mike Zeto, Environmental Enforcement
DNR Conservation Officers



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
602 EIGHTH STREET
HUNTINGTON, WEST VIRGINIA 25701-2070

August 7, 2014

Regulatory Division
Energy Resource Branch
LRH-2014-00584- LKR-Sheep Run
South Fork Bridge #1

Ms. Amanda Wright
CNX Gas Company LLC
One Energy Drive, P.O. Box 1248
Jane Lew, West Virginia 26378

Dear Ms. Wright:

I refer to the information submitted to this office regarding the South Fork Bridge #1 Project, a linear transportation project. The proposed project will include the replacement of an existing bridge located over Sheep Run. According to the information provided, implementation of the proposed project will result in the discharge of dredged and/or fill material into approximately 20 linear feet of stream, referred to as Sheep Run, for the installation of a 20-foot wide by 5.5-foot high precast concrete box culvert. The purpose of the project is to install a box culvert in order to provide access to accommodate heavy equipment utilized for gas production operations. Sheep Run is an indirect tributary of the Little Kanawha River, a traditional navigable water of the United States (U.S.). The proposed project is located approximately seven (7) aerial miles southwest of West Union, in Doddridge County, West Virginia (39.206402°N, 80.833848°W). The project has been assigned the following Department of the Army (DA) No. LRH-2014-00584. Please reference this number on all future correspondence related to this project.

The U.S. Army Corps of Engineers (Corps) authority to regulate waters of the U.S. is based, in part, on the definitions and limits of jurisdiction contained in 33 CFR 328 and 33 CFR 329. Section 404 of the Clean Water Act requires that a DA permit be obtained prior to the discharge of dredged and/or fill material into waters of the U.S. , including wetlands. Section 10 of the Rivers and Harbors Act of 1899 requires that a DA permit be obtained for any work in, on, over or under a navigable water.

To the extent the Corps has jurisdiction over the discharge of dredged and/or fill material associated with the proposed linear transportation activity, it has been determined the proposed project meets the criteria for Nationwide Permit Number (NWP) #14 (attached) under the February 21, 2012 Federal Register, Notice of Reissuance of Nationwide Permits (77 FR 10184) provided you comply with all terms and conditions of the enclosed material. A copy of this NWP can be found on our website at <http://www.lrh.usace.army.mil/Missions/Regulatory.aspx>.

Please be aware this nationwide permit authorization does not obviate the requirement to obtain other Federal, state, or local authorizations required by law. A copy of this NWP and verification letter must be supplied to your project engineer responsible for construction activities. A copy of the verification letter must be kept at the site during construction. Upon completion of the work, the attached certification must be signed and returned to this office.

If you have any questions concerning the above, please contact Ms. Audrey Richter at (304) 399-5257 or by email at Audrey.M.Richter@usace.army.mil.

Sincerely,



Samantha Dailey
Regulatory Project Manager
Energy Resource Branch

Enclosures



Engineers and Land Surveyors

*11023 Mason Dixon Hwy.
Burton, WV 26562-9656
(304) 662-6486*

**HYDROLOGIC & HYDRAULIC ANALYSIS
SHEEP RUN BRIDGE REPLACEMENT
WV CR 19/11 - MILE POST 2.45**

LOCATE

DODDRIDGE COUNTY, WV

REPORT PREPARED BY:

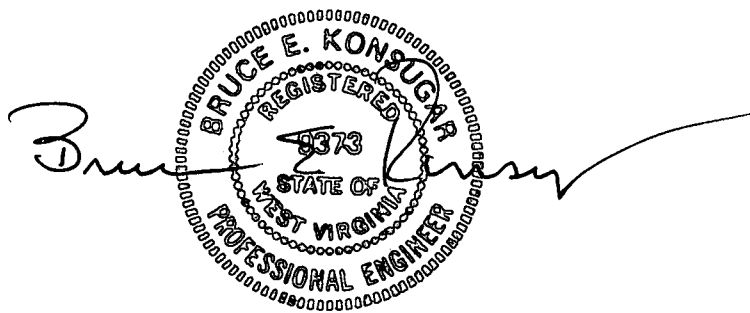
**COBALT PROFESSIONAL SERVICES, INC.
150 VALLEY ROAD
EIGHTY FOUR, PA 15330
724-942-6675**

JULY 22, 2014

**HYDROLOGIC & HYDRAULIC ANALYSIS
SHEEP RUN BRIDGE REPLACEMENT
WV CR 19/11 - MILE POST 2.45**

LOCATE

DODDRIDGE COUNTY, WV



REPORT PREPARED BY:

**COBALT PROFESSIONAL SERVICES, INC.
150 VALLEY ROAD
EIGHTY FOUR, PA 15330**

FOR

**BLUE MOUNTAIN INC.
11023 MASON DIXON HIGHWAY
BURTON, WV 26562-9656**

TABLE OF CONTENTS

I.	Purpose	Page 1
II.	Analysis	Page 1
III.	Watersheds	Page 1
IV.	Runoff Discharge Methods	Page 1
V.	Design Storms	Page 1
VI.	Hydrologic Soil Groups	Page 2
VII.	Weighted Curve Number	Page 2
VIII.	Time of Concentration	Page 2
IX.	Peak Discharge	Page 2
X.	Hydraulic Analysis	Page 3
XI.	Results	Page 5

APPENDIX

WVDOH Drainage Manual Worksheet 4-1 Runoff Curve Number Determination	APP-1
WVDOH Drainage Manual Worksheet 4-2 Time of Concentration Calculation	APP-2
WVDOH Drainage Manual Form 4-1 Peak Discharge Computation	APP-5
So. Fork Hughes River - 10 yr Storm	APP-6
Sheep Run - 10 yr Storm	APP-13
So. Fork Hughes River - 100 yr Storm	APP-20
Sheep run - 100 yr Storm	APP-27
So. Fork Hughes River - Sta. 0+00 10 yr Storm	APP-34
Sheep Run - Sta. 7+00 10 yr Storm	APP-36
So. Fork Hughes River - Sta. 0+00 100 yr Storm	APP-38
Sheep Run - Sta. 7+00 100 yr Storm	APP-40
Hec-Ras Summary Output	
So. Fork Hughes River - Existing Conditions 10 yr & 100 yr Storms	APP-42
Sheep Run - Existing Conditions 10 yr & 100 yr Storms	APP-43
Sheep Run - Proposed Conditions 10 yr & 100 yr Storms	APP-44

I. Purpose

CNX Gas LLC is proposing to upgrade an existing bridge structure on WV CR 19/11, Mile Post 2.45, to increase the available load carrying capacity of the crossing. The existing bridge, crossing Sheep Run near its confluence with the South Fork Hughes River, is to be replaced with a pre-cast concrete box culvert having a 95 ton combination load bearing capacity. This report analyzes the anticipated affect the installation of the box culvert will have on the water surface elevations in Sheep Run during the design storm events.

II. Analysis

As stated, the location of the proposed bridge replacement is close to the confluence of Sheep Run and the South Fork Hughes River, close enough that the water surfaces generated in the South Fork Hughes River basin during the design storm events will influence the water surface elevations in Sheep Run at the location of the proposed bridge replacement. Consequently, this report looks at the anticipated water surface elevations in the South Fork Hughes River basin in its entirety, which includes the Sheep Run basin, and then looks at the anticipated water surface elevations in the Sheep Run Basin for the existing and proposed conditions, taking into account the tailwater condition from the South Fork Hughes River that will occur downstream of the bridge location.

III. Watersheds

The contributing watershed for the South Fork Hughes River basin (includes the Sheep Run basin) and the contributing watershed for the Sheep Run basin were estimated from the New Milton, WV and the Oxford, WV USGS 7.5 min Quadrangle Maps.

South Fork Hughes River Watershed = 6,950 ac.

Sheep Run Watershed = 825 ac.

Please see Dwg. No. WS-01, 'Watershed Maps' for the watershed limits.

IV. Runoff Discharge Methods

The West Virginia Department of Transportation-Division of Highways-Engineering Division-Drainage Manual-3rd Edition-December 2007 (WVDOH Drainage Manual) suggests three hydrologic runoff estimation methods: the Rational Method, the TR-55 Method, and the USGS Method. With 6,950 ac. and 825 ac. watersheds for the South Fork Hughes River basin and the Sheep Run basin respectively, the Rational Method, with a 0 to 200 ac. watershed range, was deemed not applicable. For this analysis, the TR-55 Method and the USGS Method were used initially to estimate peak runoff for the design storms.

V. Design Storms

From the WVDOH Drainage Manual, design storms for different facilities are determined based on the estimated Average Daily Traffic Volume (ADT). For WV CR 19/11, no hard traffic data exists, but it is estimated that the ADT is less than 400 vehicles per day. As per

Table 4-2, Design Storm Criteria, for Channels, Culverts, and Bridges the recommended Design Storm is the 10 yr. Frequency (10%) storm.

This report also analyzes the effects of the 100 yr. Frequency (1%) Design Storm.

VI. Hydrologic Soil Groups

From the NRCS Soil Survey of Doddridge County, WV, it appears that the primary soil types in the South Fork Hughes River basin, which includes the Sheep Run Basin, are the Gilpin-Peabody Complex and the Gilpin-Upshur Complex, both belonging to the Hydrologic Soil Group (HSG) C/D. Other soil types occurring in the watershed are the Kanawha Loam Complex, HSG B; Monongahela Silt Loam, HSG C; Sensabaugh Silt Loam, HSG B; and Vandalia Silt Loam, HSG D. The Vandalia Silt Loam is a very small percentage of the total in the watershed and therefore a Hydrologic Soil Group Classification of C was used for the watershed.

VII. Weighted Curve Number, CN

It is estimated that 85% of the watershed is in tree cover and 15% is pasture/meadow. From the WVDOH Drainage Manual, Table 4-9, Runoff Curve Numbers for Rural Areas, for Woods Only in Good Condition & HSG C, the CN is 70; for Meadow with Continuous Grass Cover & HSG C, the CN is 71. The Weighted CN is 70.2. WVDOH Drainage Manual Worksheet 4-1, Runoff Curve Number Determination, is included in the Appendix.

VIII. Time of Concentration

The TR-55 Method was used to calculate the Time of Concentration for both the South Fork Hughes River basin and the Sheep Run Basin. The computer program, Hydraflow Hydrographs v6.0, which uses the TR-55 Method to determine Time of Concentration, was used to perform the calculations for both the South Fork Hughes River Basin and the Sheep Run Basin.

Tc, South Fork Hughes River: 76 min./1.27 hr.

Tc, Sheep Run: 29.3 min./0.49 hr.

The program summary sheet is attached to WVDOH Drainage Manual Worksheet 4-2, Time of Concentration Calculation, and is included in the Appendix.

IX. Peak Discharge

A. South Fork Hughes River

From the WVDOH Drainage Manual, Form 4-1, Peak Discharge Computation Form, the peak discharges for the 10 yr./24 hr. design storm from the TR-55 Method and the USGS Method are 2,825 cfs and 2,006 cfs, respectively. As an additional check, the computer program Hydraflow Hydrographs v6.0 was also used to estimate the peak flow for the SCS Type II 10 yr./24 hr. design storm. From Hydraflow, the estimated peak runoff for the 10 yr./24 hr. storm is 2,988 cfs.

With watershed sizes of 6,950 ac. (10.86 sq. mi.) for the South Fork Hughes River basin and 825 ac. (1.29 sq. mi.) for the Sheep Run basin, and the USGS Method being recommended for watersheds over 10 sq. mi., the USGS Method was disregarded. This leaves the TR-55 Method and the Hydraflow program.

As Hydraflow has the added feature of generating the outflow hydrograph in 1 minute time intervals, and having very similar results to the TR-55 method, it was decided to use the results from Hydraflow, peak flow of 2,988 cfs and to also use Hydraflow to analyze the Sheep Run basin.

WVDOH Drainage Manual Form 4-1 and the Hydraflow output are included in the Appendix.

B. Sheep Run

From Hydraflow, the estimated peak flow for the 10 yr./24 hr. design storm for the Sheep Run basin is 695.5 cfs and occurs at 12.20 hours. However, the peak flow in the South Fork Hughes River occurs at 12.68 hours. From the discharge hydrograph for the South Fork Hughes River, at 12.20 hours the flow is 1,324 cfs. Therefore 1,324 cfs was used to determine the estimated water surface elevations in the South Fork Hughes River at the time of peak flow in the Sheep Run basin.

X. Hydraulic Analysis

A. 10yr/24 hr. Design Storm

The computer program Hec-Ras v4.1.0 was used to estimate the water surface profile in the South Fork Hughes River reach and in the Sheep run reach for the 10 yr./24 hr. design storm, for both the existing and proposed conditions. Typical sections of the existing bridge and the proposed pre-cast concrete box culvert are shown on Dwg. No. XS-01, 'Typical Cross-Section Existing Bridge' and Dwg. No. XS-02, 'Typical Cross-Section Precast Concrete Box Culvert'.

The first step was to establish a starting water surface elevation in the South Fork Hughes River reach. With an approximate existing channel slope of 0.5% for the study reach of the South Fork Hughes River, the flow regime is subcritical and therefore the most downstream station, Sta. 0+00, was used as the control section. From the computer program FlowMaster v6.1, with a flow of 1,324 cfs, the water surface elevation is estimated to be El. 832.70 ft. The next step was to plug this information into Hec-Ras to estimate the water surface profile for the South Fork Hughes River for the 10 yr./24 hr. design storm. A subcritical steady flow analysis was performed and the results are shown on Dwg. No. SP-01, 'Site Map-10 yr. Storm-Existing Conditions', and Dwg. No. SP-02, 'Site Map-10 yr. Storm-Proposed Conditions'.

This information was used to establish the tailwater/downstream water surface elevation for the Sheep Run study reach. The estimated water surface elevation at Sta. 2+50 in the South Fork Hughes River is approximately El. 834.40 ft. and was used as the downstream water surface elevation in Sheep Run.

The channel slope for the Sheep Run study reach varies from mild at the downstream end to steep at the upstream end. Therefore a mixed flow regime was run for Sheep Run and a water surface elevation was estimated for Sta. 7+00 using FlowMaster. From FlowMaster, for a design flow of 695.5 cfs, the estimated water surface elevation at Sta. 7+00 is approximately El. 839.09 ft.

These two water surface elevations were used to run a mixed flow regime steady flow analysis with Hec-Ras for the existing and proposed conditions in Sheep Run.

Results of the Hec-Ras run have been plotted in plan view on Dwg. No. SP-01, 'Site Map-10 yr. Storm-Existing Conditions' and Dwg. No. SP-02, 'Site Map-10 yr. Storm-Proposed Conditions'. The water surface profile for existing and proposed conditions for the 10 yr./24 hr. storm has been plotted on Dwg. No. PR-01, 'Water Surface Profiles'.

Summary output information from the Hec-Ras run has been included in the Appendix.

B. 100yr/24 hr. Design Storm

The computer program Hec-Ras v4.1.0 was used to estimate the water surface profile in the South Fork Hughes River reach and in the Sheep run reach for the 100 yr./24 hr. design storm, for both the existing and proposed conditions. Typical sections of the existing bridge and the proposed pre-cast concrete box culvert are shown on Dwg. No. XS-01, 'Typical Cross-Section Existing Bridge' and Dwg. No. XS-02, 'Typical Cross-Section Precast Concrete Box Culvert'.

The same procedure used to analyze the 10 yr./24 hr. storm was used to analyze the 100 yr./24 hr. storm. Estimated flow in the South Fork Hughes River basin is 3,710 cfs and in the Sheep Run basin the estimated flow is 1,648 cfs. The estimated water surface elevation at Sta. 0+00 of the South Fork Hughes River is El. 835.21 ft. for a flow of 3,710 cfs. From the Hec-Ras run, the estimated water surface elevation at Sta. 2+50 in the South Fork Hughes River is approximately El. 836.70 ft. and was used as the downstream water surface elevation in Sheep Run. The estimated water surface elevation at Sta. 7+00 of Sheep Run for 1,648 cfs is El. 840.97 ft. Using the water surface elevations at Sta. 2+50 of the South Fork Hughes River as the known downstream elevation and the water surface elevation at Sta. 0+00 of Sheep run as the known upstream elevation, a mixed flow regime steady flow analysis was run for Sheep Run for existing and proposed conditions.

Results of the Hec-Ras run have been plotted in plan view on Dwg. No. SP-03, 'Site Map-100 yr. Storm-Existing Conditions' and Dwg. No. SP-04, 'Site Map-100 yr. Storm-Proposed Conditions'. The water surface profile for existing and proposed conditions for the 100 yr./24 hr. storm has been plotted on Dwg. No. PR-01, 'Water Surface Profiles'.

Summary output information from the Hec-Ras run has been included in the Appendix.

XI. Results

This analysis indicates that for both the 10 yr./24 hr. design storm and the 100 yr./24 hr. design storm, the installation of the pre-cast concrete box in Sheep Run on WV Co. Rd. 19/11 will **lower** the expected water surface elevation over existing conditions. The expected drop in the water surface elevation for the 10 yr./24 hr. storm is 0.40 ft. to 0.50 ft. For the 100 yr./24 hr. storm the expected drop is 0.25 ft. to 0.35 ft.

APPENDIX

Worksheet 4-1 Runoff Curve Number Determination

WORKSHEET 4-1 RUNOFF CURVE NUMBER DETERMINATION																			
CALCULATED BY: <u>BEK</u> DATE: <u>07-21-14</u>			PROJECT NAME: <u>Sheep Run Bridge Replacement</u>																
CHECKED BY: <u>BEK</u> DATE: <u>07-21-14</u>			STATE PROJECT NUMBER: _____																
Soil Name	Hydrologic Group	Cover Description percent impervious unconnected/connected impervious area ratio	CN Source			Area in mi ²	CN X Area												
			Table 4-9	Table 4-10	Chart 4-5														
Gilpin-Peabody	C/D	15% Meadow	71			1.63	115.7												
Gilpin-Upshur	C/D	85% Woods	70			9.23	546.1												
Kanawha Loam	B																		
Monongahela Silt Loam	C																		
Sensabaugh Silt Loam	B																		
Vanadalia Silt Loam	D																		
one CN source per line																			
Weighted CN = Total CN X Area / Total Area						Totals →													
						10.86	761.8												
Weighted Curve Number						70.2													
Potential Maximum Retention, S in inches						4.2													
<table border="1" style="margin: auto;"> <thead> <tr> <th></th> <th>Storm #1</th> <th>Storm #2</th> </tr> </thead> <tbody> <tr> <td>Return Period in years</td> <td>10</td> <td>100</td> </tr> <tr> <td>24 Hour Rainfall Depth, P in inches</td> <td>3.5</td> <td>5.25</td> </tr> <tr> <td>Runoff Depth, Q in inches</td> <td>1.0</td> <td>2.2</td> </tr> </tbody> </table>									Storm #1	Storm #2	Return Period in years	10	100	24 Hour Rainfall Depth, P in inches	3.5	5.25	Runoff Depth, Q in inches	1.0	2.2
	Storm #1	Storm #2																	
Return Period in years	10	100																	
24 Hour Rainfall Depth, P in inches	3.5	5.25																	
Runoff Depth, Q in inches	1.0	2.2																	
24 hour Rainfall Depth from Table 4-11, or Map 4-3 through Map 4-8 Runoff Depth from Table 4-12 or Chart 4-6																			

Source: Urban Hydrology for Small Watersheds, TR-55, June 1986

Worksheet 4-2 Time of Concentration Calculation

WORKSHEET 4-2 TIME OF CONCENTRATION COMPUTATION		
CALCULATED BY: <u>BEK</u> DATE: <u>07-21-14</u> CHECKED BY: <u>BEK</u> DATE: <u>07-21-14</u>	PROJECT NAME: <u>Sheep Run Bridge Replacement</u> STATE PROJECT NUMBER: _____	
Space for two sections per flow type can be used for each worksheet. Include a map, schematic or description of the flow segments		
OVERLAND FLOW SEGMENT. SHEET FLOW TYPE		
Surface description (Table 4-5) Roughness coeff. n (Table 4-5) Flow length L in ft (should be ≤ 100 ft) 2 Yr 24 Hr rainfall depth P in inches (Map 4-3) Land slope S in ft / ft Computed travel time T_t in <u>hours</u>	Section ID <input style="width: 100px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/>	* See Attached calculation sheets for T_c for South Fork Hughes River & Sheep Run Watersheds. = <input style="width: 80px;" type="text"/>
OVERLAND FLOW SEGMENT. SHALLOW CONCENTRATED FLOW TYPE		
Cover type Surface cover coefficient in equation Watercourse slope S in ft / ft Average velocity V in ft / s (Chart 4-7) Flow length in ft Computed travel time T_t in <u>hours</u>	Section ID <input style="width: 100px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/>	<input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> + <input style="width: 80px;" type="text"/> = <input style="width: 80px;" type="text"/>
note: overland flow (sheet flow + shallow concentrated flow should be < 200' urban areas, < 400' rural areas)		
CHANNEL FLOW SEGMENT		
Cross sectional flow area A in ft ² Wetted flow perimeter P in ft Hydraulic radius R = A / P in ft Channel slope S in ft / ft Mannings roughness coeff. n (Table 4-7) Velocity from Mannings equation, V in ft / s Flow length L in ft Computed travel time T_t in <u>hours</u>	Section ID <input style="width: 100px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/>	<input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> <input style="width: 100%; height: 20px;" type="text"/> + <input style="width: 80px;" type="text"/> = <input style="width: 80px;" type="text"/>
Watershed time of concentration T_c in <u>hours</u> <input style="width: 80px;" type="text"/>		

Source: Urban Hydrology for Small Watersheds, TR-55, June 1986

Hyd. No. 1

So Fork Hughes River
Storm frequency = 10 yrs

Sheet Flow

Manning's n-value = 0.400
Flow length = 100.0 ft
Two-year 24-hr precip. = 2.55 in
Land slope = 25.0 %

Travel Time = 8.8 min

Shallow Concentrated Flow

Flow length = 300 ft
Watercourse slope = 28.0 %
Surface description = Unpaved
Average velocity = 8.54 ft/s

Travel Time = 0.6 min

Channel Flow

Cross section flow area = 80.0 sqft
Wetted perimeter = 24.0 ft
Channel slope = 0.8 %
Manning's n-value = 0.035
Velocity = 8.53 ft/s
Flow length = 34140.0 ft

Travel Time = 66.7 min

Total Travel Time, Tc = 76.0 min

Hyd. No. 2

Sheep Run

Storm frequency = 10 yrs

Sheet Flow

Manning's n-value = 0.550
Flow length = 100.0 ft
Two-year 24-hr precip. = 2.55 in
Land slope = 18.0 %

Travel Time = 12.9 min

Shallow Concentrated Flow

Flow length = 300 ft
Watercourse slope = 13.0 %
Surface description = Unpaved
Average velocity = 5.82 ft/s

Travel Time = 0.9 min

Channel Flow

Cross section flow area = 18.4 sqft
Wetted perimeter = 9.5 ft
Channel slope = 3.6 %
Manning's n-value = 0.040
Velocity = 11.01 ft/s
Flow length = 10290.0 ft

Travel Time = 15.6 min

Total Travel Time, Tc = 29.3 min

Form 4-1
Peak Discharge Computation Form

PEAK DISCHARGE COMPUTATION FORM DR 4-1																	
CALCULATED BY: <u>BEK</u> CHECKED BY: <u>BEK</u>	DATE: <u>07-21-14</u> DATE: <u>07-21-14</u>	PROJECT NAME: <u>Sheep Run Bridge Replacement</u> STATE PROJECT NUMBER: _____															
AREA NUMBER: _____ LOCATION DESCRIPTION: <u>So. Fork Hughes River Basin</u> DRAINAGE AREA = <u>6,950</u> ACRES <u>10.86</u> MI ²	ATTACH WATERSHED MAP _____ STATION _____ TO _____ DESIGN RETURN PERIOD: <u>10</u> YEARS																
RATIONAL METHOD 1 acre - 200 acres N.A.	TR - 55 5 acres - 16,000 acres	USGS METHOD 10 square miles - 1,619 square miles															
TIME OF CONCENTRATION OVERLAND FLOW SHEET FLOW $T_{1oh} =$ _____ Min.	INFO FROM WORKSHEET 4-1 CN = <u>70.2</u> 24 hr P = <u>3.5</u> in. Runoff Depth Q = <u>1.0</u> in.	REGION: FROM MAP 4-9 EASTERN PANHANDLE <input type="checkbox"/> CENTRAL MOUNTAINS <input type="checkbox"/> WESTERN PLATEAUS <input checked="" type="checkbox"/>															
SHALLOW CONCENTRATED FLOW $T_{1sc} =$ _____ Min.	INFO FROM WORKSHEET 4-2 $T_c =$ <u>1.27</u> hr.																
CHANNEL FLOW $T_{1ch} =$ _____ Min.	INITIAL ABSTRACTION (Table 4-13) $I_a =$ <u>0.85</u> in. $I_a/P =$ <u>0.24</u>	EQUATION: FROM TABLE 4-7 ¹⁴															
$T_c = T_{1oh} + T_{1sc} + T_{1ch} =$ _____ Min. Method: Kirpich (rural areas) <input type="checkbox"/> Segments (urban areas) <input type="checkbox"/> IDF REGION _____ Rainfall Intensity $i =$ _____ in/hr <table style="width:100%; border-collapse: collapse;"> <tr> <td style="width: 33%; text-align: center;">C</td> <td style="width: 33%; text-align: center;">A</td> <td style="width: 33%; text-align: center;">CA</td> </tr> <tr> <td style="border-bottom: 1px solid black;"> </td> <td style="border-bottom: 1px solid black;"> </td> <td style="border-bottom: 1px solid black;"> </td> </tr> <tr> <td style="border-bottom: 1px solid black;"> </td> <td style="border-bottom: 1px solid black;"> </td> <td style="border-bottom: 1px solid black;"> </td> </tr> <tr> <td style="border-bottom: 1px solid black;"> </td> <td style="border-bottom: 1px solid black;"> </td> <td style="border-bottom: 1px solid black;"> </td> </tr> <tr> <td style="text-align: center;">Total</td> <td style="border-bottom: 1px solid black;"> </td> <td style="border-bottom: 1px solid black;"> </td> </tr> </table>	C	A	CA										Total			UNIT PEAK DISCHARGE q_u USE T_c AND I_a/P WITH CHART 4-8 $=$ <u>260</u> cfs / mi ² / in	Eqn: $292A^{0.699}$ $= 1,546.8$ cfs
C	A	CA															
Total																	
Weighted Coefficient "C" = _____ $C = \sum(CA) / \sum A$	POND AND SWAMP AREAS Percent of watershed = <u>0</u> % (Table 4-8) Factor $F_p =$ <u>1.0</u>	PRELIMINARY DESIGN DRAINAGE AREA 5 TO 10 MI ² ADD THE STANDARD PREDICTION ERROR $=$ <u>29.7</u> % $= 459.4$ cfs															
$Q =$ _____ cfs	$q_p =$ <u>2,825</u> cfs	$Q =$ <u>2,006</u> cfs															
SELECTED DESIGN DISCHARGE $Q =$ _____ cfs	REASON FOR SELECTION (BASED ON COMPARISON) SEE SECTION 4.3.4 <u>See Section IX.A, Peak Discharge South Fork Hughes River - H & H Report.</u>																

Source: Created by the WVDOH Hydraulic and Drainage Unit

Hydrograph Plot

English

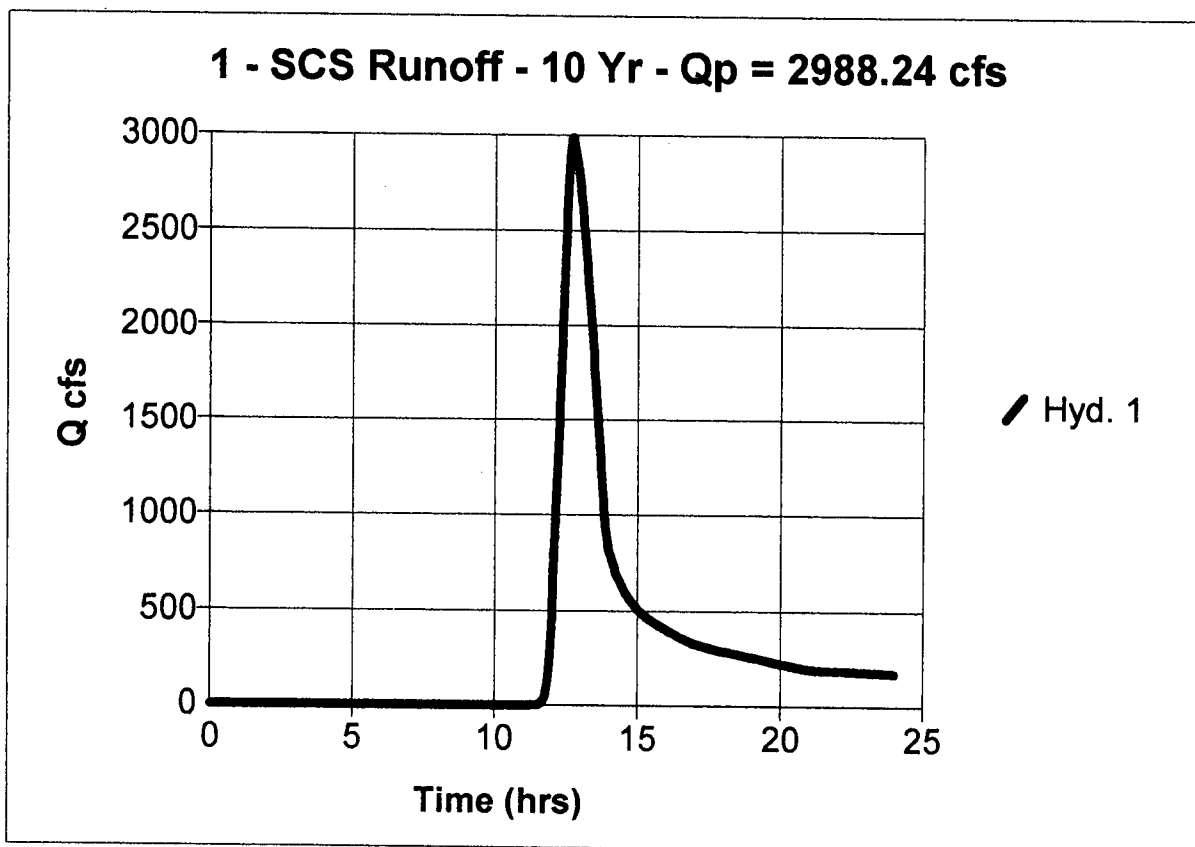
Hyd. No. 1

So Fork Hughes River

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Drainage area = 6950.00 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 3.50 in
Storm duration = 24 hrs

Peak discharge = 2988.24 cfs
Time interval = 1 min
Curve number = 70.2
Hydraulic length = 0 ft
Time of conc. (Tc) = 76 min
Distribution = Type II
Shape factor = 484

Total Volume = 25,145,960 cuft



Hyd. No. 1

So Fork Hughes River
Storm frequency = 10 yrs

Sheet Flow

Manning's n-value = 0.400
Flow length = 100.0 ft
Two-year 24-hr precip. = 2.55 in
Land slope = 25.0 %

Travel Time = 8.8 min

Shallow Concentrated Flow

Flow length = 300 ft
Watercourse slope = 28.0 %
Surface description = Unpaved
Average velocity = 8.54 ft/s

Travel Time = 0.6 min

Channel Flow

Cross section flow area = 80.0 sqft
Wetted perimeter = 24.0 ft
Channel slope = 0.8 %
Manning's n-value = 0.035
Velocity = 8.53 ft/s
Flow length = 34140.0 ft

Travel Time = 66.7 min

Total Travel Time, Tc = 76.0 min

Hydrograph Report

Hyd. No. 1

So Fork Hughes River

Hydrograph type	=	SCS Runoff	Peak discharge	=	2988.24 cfs
Storm frequency	=	10 yrs	Time interval	=	1 min
Drainage area	=	6950.00 ac	Curve number	=	70.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	76 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

Total Volume = 25,145,960 cuft

Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
11.70 33.21	12.23 1459.71	12.77 2947.23	13.30 2150.50
11.72 39.29	12.25 1528.49	12.78 2933.92	13.32 2116.90
11.73 46.44	12.27 1597.70	12.80 2919.69	13.33 2082.96
11.75 54.82	12.28 1667.34	12.82 2904.54	13.35 2048.70
11.77 64.64	12.30 1737.32	12.83 2888.49	13.37 2014.10
11.78 76.24	12.32 1807.58	12.85 2871.55	13.38 1979.19
11.80 90.01	12.33 1878.02	12.87 2853.75	13.40 1943.96
11.82 106.38	12.35 1948.54	12.88 2835.10	13.42 1908.42
11.83 125.81	12.37 2019.02	12.90 2815.61	13.43 1872.58
11.85 148.83	12.38 2089.34	12.92 2795.31	13.45 1836.44
11.87 176.03	12.40 2159.35	12.93 2774.21	13.47 1800.01
11.88 208.03	12.42 2228.89	12.95 2752.34	13.48 1763.29
11.90 245.51	12.43 2297.77	12.97 2729.71	13.50 1726.30
11.92 289.18	12.45 2365.80	12.98 2706.33	13.52 1689.05
11.93 337.14	12.47 2432.76	13.00 2682.23	13.53 1651.57
11.95 389.19	12.48 2498.43	13.02 2657.43	13.55 1613.86
11.97 444.46	12.50 2562.53	13.03 2631.96	13.57 1575.96
11.98 502.06	12.52 2624.71	13.05 2605.82	13.58 1537.91
12.00 560.94	12.53 2684.42	13.07 2579.05	13.60 1499.73
12.02 620.60	12.55 2741.05	13.08 2551.67	13.62 1461.48
12.03 681.03	12.57 2793.91	13.10 2523.69	13.63 1423.19
12.05 742.21	12.58 2842.23	13.12 2495.14	13.65 1384.92
12.07 804.12	12.60 2885.19	13.13 2466.06	13.67 1346.73
12.08 866.75	12.62 2921.84	13.15 2436.45	13.68 1308.69
12.10 930.08	12.63 2951.16	13.17 2406.34	13.70 1270.87
12.12 994.10	12.65 2972.07	13.18 2375.76	13.72 1233.34
12.13 1058.77	12.67 2983.41	13.20 2344.74	13.73 1196.20
12.15 1124.10	12.68 2988.24 <<	13.22 2313.30	13.75 1159.54
12.17 1190.05	12.70 2986.84	13.23 2281.46	13.77 1123.49
12.18 1256.60	12.72 2980.60	13.25 2249.25	13.78 1088.27
12.20 1323.74	12.73 2970.97	13.27 2216.68	13.80 1054.09
12.22 1391.45	12.75 2959.58	13.28 2183.77	13.82 1021.23

Continues on next page...

Hydrograph Discharge Table

Time -- (hrs)	Outflow (cfs)	Time -- (hrs)	Outflow (cfs)	Time -- (hrs)	Outflow (cfs)	Time -- (hrs)	Outflow (cfs)
13.83	989.96	14.65	571.79	15.47	449.64	16.28	377.70
13.85	960.60	14.67	568.01	15.48	447.99	16.30	376.30
13.87	933.50	14.68	564.30	15.50	446.35	16.32	374.91
13.88	909.04	14.70	560.66	15.52	444.73	16.33	373.52
13.90	887.64	14.72	557.10	15.53	443.12	16.35	372.14
13.92	869.72	14.73	553.61	15.55	441.53	16.37	370.76
13.93	854.14	14.75	550.19	15.57	439.96	16.38	369.40
13.95	840.79	14.77	546.84	15.58	438.39	16.40	368.03
13.97	829.15	14.78	543.56	15.60	436.84	16.42	366.68
13.98	818.69	14.80	540.36	15.62	435.31	16.43	365.33
14.00	808.78	14.82	537.21	15.63	433.78	16.45	364.00
14.02	799.14	14.83	534.14	15.65	432.26	16.47	362.67
14.03	789.75	14.85	531.12	15.67	430.76	16.48	361.35
14.05	780.61	14.87	528.17	15.68	429.26	16.50	360.04
14.07	771.72	14.88	525.27	15.70	427.78	16.52	358.74
14.08	763.07	14.90	522.43	15.72	426.30	16.53	357.45
14.10	754.66	14.92	519.65	15.73	424.83	16.55	356.18
14.12	746.49	14.93	516.91	15.75	423.37	16.57	354.91
14.13	738.54	14.95	514.23	15.77	421.91	16.58	353.66
14.15	730.81	14.97	511.60	15.78	420.46	16.60	352.41
14.17	723.30	14.98	509.01	15.80	419.02	16.62	351.19
14.18	716.00	15.00	506.47	15.82	417.58	16.63	349.97
14.20	708.91	15.02	503.97	15.83	416.15	16.65	348.77
14.22	702.02	15.03	501.52	15.85	414.71	16.67	347.58
14.23	695.33	15.05	499.11	15.87	413.29	16.68	346.40
14.25	688.83	15.07	496.73	15.88	411.86	16.70	345.24
14.27	682.50	15.08	494.40	15.90	410.44	16.72	344.10
14.28	676.36	15.10	492.11	15.92	409.02	16.73	342.97
14.30	670.38	15.12	489.85	15.93	407.60	16.75	341.85
14.32	664.57	15.13	487.63	15.95	406.17	16.77	340.76
14.33	658.91	15.15	485.45	15.97	404.75	16.78	339.67
14.35	653.40	15.17	483.30	15.98	403.33	16.80	338.61
14.37	648.03	15.18	481.19	16.00	401.90	16.82	337.56
14.38	642.79	15.20	479.11	16.02	400.48	16.83	336.52
14.40	637.67	15.22	477.06	16.03	399.05	16.85	335.50
14.42	632.68	15.23	475.05	16.05	397.62	16.87	334.49
14.43	627.79	15.25	473.06	16.07	396.19	16.88	333.50
14.45	623.00	15.27	471.11	16.08	394.76	16.90	332.53
14.47	618.31	15.28	469.18	16.10	393.33	16.92	331.56
14.48	613.71	15.30	467.29	16.12	391.90	16.93	330.61
14.50	609.18	15.32	465.41	16.13	390.47	16.95	329.68
14.52	604.73	15.33	463.57	16.15	389.04	16.97	328.76
14.53	600.36	15.35	461.75	16.17	387.61	16.98	327.85
14.55	596.05	15.37	459.96	16.18	386.19	17.00	326.95
14.57	591.82	15.38	458.18	16.20	384.76	17.02	326.07
14.58	587.67	15.40	456.43	16.22	383.34	17.03	325.20
14.60	583.59	15.42	454.71	16.23	381.93	17.05	324.34
14.62	579.58	15.43	453.00	16.25	380.52	17.07	323.50
14.63	575.65	15.45	451.31	16.27	379.11	17.08	322.66

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Hydrograph Discharge Table

Time -- (hrs)	Outflow (cfs)	Time -- (hrs)	Outflow (cfs)	Time -- (hrs)	Outflow (cfs)	Time -- (hrs)	Outflow (cfs)
17.10	321.84	17.92	291.35	18.73	265.49	19.55	238.56
17.12	321.03	17.93	290.83	18.75	264.95	19.57	238.00
17.13	320.23	17.95	290.31	18.77	264.41	19.58	237.44
17.15	319.44	17.97	289.79	18.78	263.87	19.60	236.88
17.17	318.66	17.98	289.28	18.80	263.33	19.62	236.32
17.18	317.90	18.00	288.76	18.82	262.78	19.63	235.76
17.20	317.14	18.02	288.24	18.83	262.24	19.65	235.20
17.22	316.40	18.03	287.72	18.85	261.70	19.67	234.64
17.23	315.66	18.05	287.20	18.87	261.16	19.68	234.08
17.25	314.93	18.07	286.68	18.88	260.62	19.70	233.52
17.27	314.22	18.08	286.16	18.90	260.07	19.72	232.95
17.28	313.51	18.10	285.64	18.92	259.53	19.73	232.39
17.30	312.81	18.12	285.12	18.93	258.98	19.75	231.83
17.32	312.12	18.13	284.60	18.95	258.44	19.77	231.26
17.33	311.44	18.15	284.07	18.97	257.89	19.78	230.70
17.35	310.77	18.17	283.55	18.98	257.35	19.80	230.13
17.37	310.11	18.18	283.03	19.00	256.80	19.82	229.57
17.38	309.45	18.20	282.50	19.02	256.26	19.83	229.00
17.40	308.80	18.22	281.98	19.03	255.71	19.85	228.44
17.42	308.16	18.23	281.45	19.05	255.16	19.87	227.87
17.43	307.53	18.25	280.93	19.07	254.62	19.88	227.30
17.45	306.90	18.27	280.40	19.08	254.07	19.90	226.74
17.47	306.28	18.28	279.88	19.10	253.52	19.92	226.17
17.48	305.67	18.30	279.35	19.12	252.97	19.93	225.60
17.50	305.06	18.32	278.82	19.13	252.42	19.95	225.04
17.52	304.46	18.33	278.29	19.15	251.87	19.97	224.47
17.53	303.87	18.35	277.76	19.17	251.32	19.98	223.90
17.55	303.28	18.37	277.24	19.18	250.77	20.00	223.33
17.57	302.70	18.38	276.71	19.20	250.22	20.02	222.76
17.58	302.12	18.40	276.18	19.22	249.67	20.03	222.19
17.60	301.55	18.42	275.65	19.23	249.12	20.05	221.62
17.62	300.98	18.43	275.12	19.25	248.57	20.07	221.05
17.63	300.42	18.45	274.58	19.27	248.01	20.08	220.49
17.65	299.86	18.47	274.05	19.28	247.46	20.10	219.92
17.67	299.31	18.48	273.52	19.30	246.91	20.12	219.35
17.68	298.76	18.50	272.99	19.32	246.35	20.13	218.79
17.70	298.21	18.52	272.46	19.33	245.80	20.15	218.22
17.72	297.67	18.53	271.92	19.35	245.25	20.17	217.66
17.73	297.13	18.55	271.39	19.37	244.69	20.18	217.10
17.75	296.59	18.57	270.85	19.38	244.14	20.20	216.54
17.77	296.06	18.58	270.32	19.40	243.58	20.22	215.98
17.78	295.53	18.60	269.78	19.42	243.02	20.23	215.42
17.80	295.00	18.62	269.25	19.43	242.47	20.25	214.87
17.82	294.47	18.63	268.71	19.45	241.91	20.27	214.32
17.83	293.95	18.65	268.18	19.47	241.35	20.28	213.77
17.85	293.43	18.67	267.64	19.48	240.80	20.30	213.23
17.87	292.90	18.68	267.10	19.50	240.24	20.32	212.68
17.88	292.38	18.70	266.56	19.52	239.68	20.33	212.14
17.90	291.87	18.72	266.02	19.53	239.12	20.35	211.61

Continues on next page...

Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
20.37 211.08	21.18 192.41	22.00 185.59	22.82 180.69
20.38 210.55	21.20 192.18	22.02 185.49	22.83 180.59
20.40 210.03	21.22 191.97	22.03 185.39	22.85 180.49
20.42 209.51	21.23 191.76	22.05 185.29	22.87 180.39
20.43 208.99	21.25 191.55	22.07 185.19	22.88 180.29
20.45 208.48	21.27 191.35	22.08 185.09	22.90 180.18
20.47 207.97	21.28 191.16	22.10 184.99	22.92 180.08
20.48 207.47	21.30 190.96	22.12 184.90	22.93 179.98
20.50 206.97	21.32 190.78	22.13 184.80	22.95 179.88
20.52 206.48	21.33 190.59	22.15 184.70	22.97 179.78
20.53 206.00	21.35 190.42	22.17 184.60	22.98 179.67
20.55 205.52	21.37 190.24	22.18 184.50	23.00 179.57
20.57 205.04	21.38 190.07	22.20 184.40	23.02 179.47
20.58 204.58	21.40 189.90	22.22 184.30	23.03 179.37
20.60 204.11	21.42 189.74	22.23 184.20	23.05 179.27
20.62 203.66	21.43 189.58	22.25 184.10	23.07 179.16
20.63 203.21	21.45 189.43	22.27 184.00	23.08 179.06
20.65 202.77	21.47 189.27	22.28 183.90	23.10 178.96
20.67 202.33	21.48 189.12	22.30 183.80	23.12 178.86
20.68 201.90	21.50 188.98	22.32 183.70	23.13 178.76
20.70 201.48	21.52 188.84	22.33 183.61	23.15 178.65
20.72 201.07	21.53 188.70	22.35 183.51	23.17 178.55
20.73 200.66	21.55 188.56	22.37 183.41	23.18 178.45
20.75 200.27	21.57 188.43	22.38 183.31	23.20 178.35
20.77 199.88	21.58 188.30	22.40 183.21	23.22 178.24
20.78 199.50	21.60 188.17	22.42 183.11	23.23 178.14
20.80 199.12	21.62 188.04	22.43 183.01	23.25 178.04
20.82 198.76	21.63 187.92	22.45 182.91	23.27 177.93
20.83 198.40	21.65 187.80	22.47 182.81	23.28 177.83
20.85 198.04	21.67 187.68	22.48 182.71	23.30 177.73
20.87 197.70	21.68 187.56	22.50 182.61	23.32 177.63
20.88 197.36	21.70 187.45	22.52 182.51	23.33 177.52
20.90 197.03	21.72 187.33	22.53 182.41	23.35 177.42
20.92 196.71	21.73 187.22	22.55 182.30	23.37 177.32
20.93 196.39	21.75 187.11	22.57 182.20	23.38 177.21
20.95 196.08	21.77 187.00	22.58 182.10	23.40 177.11
20.97 195.78	21.78 186.90	22.60 182.00	23.42 177.01
20.98 195.49	21.80 186.79	22.62 181.90	23.43 176.90
21.00 195.20	21.82 186.69	22.63 181.80	23.45 176.80
21.02 194.91	21.83 186.58	22.65 181.70	23.47 176.70
21.03 194.64	21.85 186.48	22.67 181.60	23.48 176.59
21.05 194.36	21.87 186.38	22.68 181.50	23.50 176.49
21.07 194.10	21.88 186.28	22.70 181.40	23.52 176.39
21.08 193.84	21.90 186.18	22.72 181.30	23.53 176.28
21.10 193.59	21.92 186.08	22.73 181.20	23.55 176.18
21.12 193.34	21.93 185.98	22.75 181.10	23.57 176.08
21.13 193.10	21.95 185.88	22.77 180.99	23.58 175.97
21.15 192.86	21.97 185.78	22.78 180.89	23.60 175.87
21.17 192.63	21.98 185.68	22.80 180.79	23.62 175.76

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Hydrograph Discharge Table**Time -- Outflow
(hrs cfs)**

23.63	175.66
23.65	175.56
23.67	175.45
23.68	175.35
23.70	175.24
23.72	175.14
23.73	175.03
23.75	174.93
23.77	174.83
23.78	174.72
23.80	174.62
23.82	174.51
23.83	174.41
23.85	174.30
23.87	174.20
23.88	174.09
23.90	173.99
23.92	173.88
23.93	173.78
23.95	173.67
23.97	173.57
23.98	173.46

...End

Hydrograph Plot

English

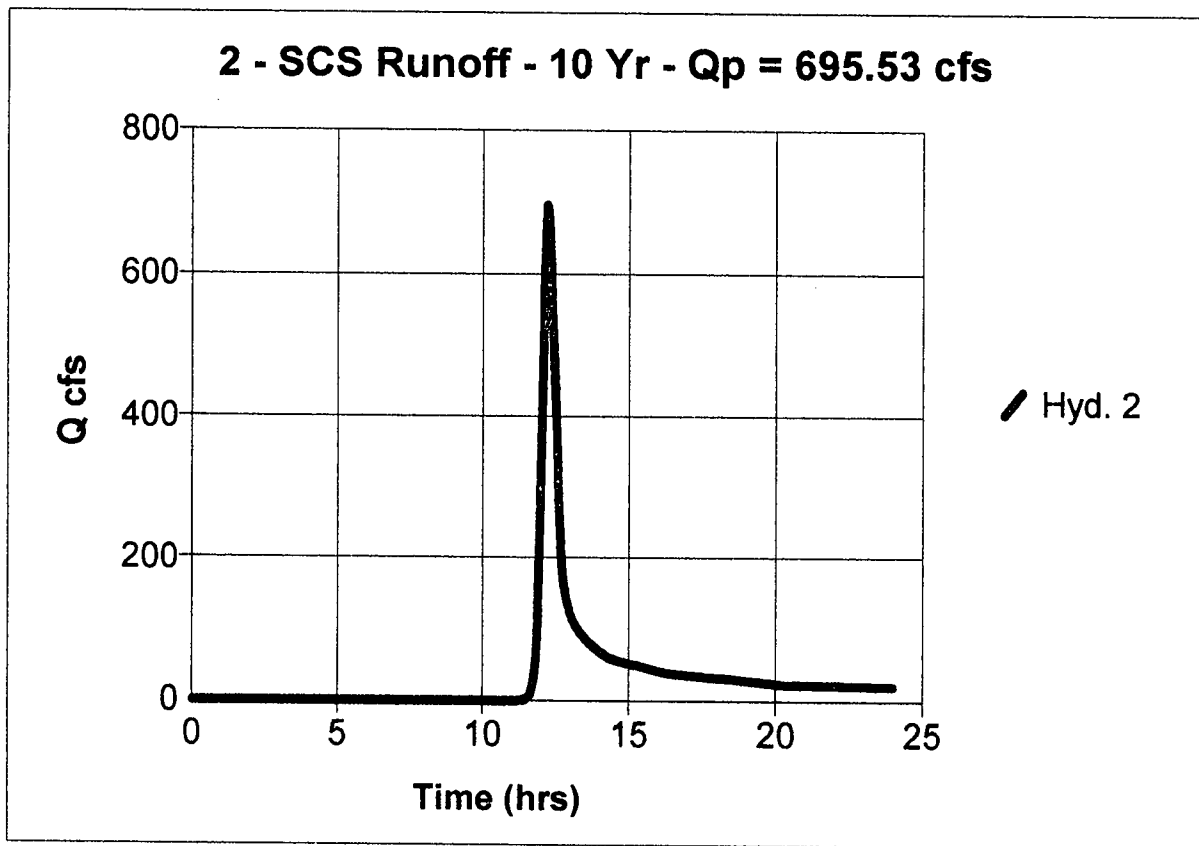
Hyd. No. 2

Sheep Run

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Drainage area = 825.00 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 3.50 in
Storm duration = 24 hrs

Peak discharge = 695.53 cfs
Time interval = 1 min
Curve number = 70.2
Hydraulic length = 0 ft
Time of conc. (Tc) = 29.3 min
Distribution = Type II
Shape factor = 484

Total Volume = 3,025,497 cuft



Hyd. No. 2

Sheep Run

Storm frequency = 10 yrs

Sheet Flow

- Manning's n-value = 0.550
- Flow length = 100.0 ft
- Two-year 24-hr precip. = 2.55 in
- Land slope = 18.0 %

Travel Time = 12.9 min

Shallow Concentrated Flow

- Flow length = 300 ft
- Watercourse slope = 13.0 %
- Surface description = Unpaved
- Average velocity = 5.82 ft/s

Travel Time = 0.9 min

Channel Flow

- Cross section flow area = 18.4 sqft
- Wetted perimeter = 9.5 ft
- Channel slope = 3.6 %
- Manning's n-value = 0.040
- Velocity = 11.01 ft/s
- Flow length = 10290.0 ft

Travel Time = 15.6 min

Total Travel Time, Tc = 29.3 min

Hydrograph Report

Hyd. No. 2

Sheep Run

Hydrograph type	= SCS Runoff	Peak discharge	= 695.53 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 825.00 ac	Curve number	= 70.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 29.3 min
Total precip.	= 3.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 3,025,497 cuft

Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
11.58 7.41	12.12 613.21	12.65 226.10	13.18 104.23
11.60 8.56	12.13 638.56	12.67 210.80	13.20 103.08
11.62 9.93	12.15 660.21	12.68 197.30	13.22 101.98
11.63 11.59	12.17 677.43	12.70 185.92	13.23 100.91
11.65 13.58	12.18 689.48	12.72 176.98	13.25 99.88
11.67 15.97	12.20 695.53 <<	12.73 169.66	13.27 98.88
11.68 18.82	12.22 694.72	12.75 163.90	13.28 97.91
11.70 22.23	12.23 689.33	12.77 159.32	13.30 96.96
11.72 26.28	12.25 679.54	12.78 155.53	13.32 96.03
11.73 31.07	12.27 666.38	12.80 152.11	13.33 95.12
11.75 36.70	12.28 650.93	12.82 148.82	13.35 94.24
11.77 43.33	12.30 634.38	12.83 145.68	13.37 93.36
11.78 51.22	12.32 617.34	12.85 142.67	13.38 92.51
11.80 60.63	12.33 599.82	12.87 139.79	13.40 91.67
11.82 71.83	12.35 581.82	12.88 137.04	13.42 90.85
11.83 85.17	12.37 563.37	12.90 134.41	13.43 90.05
11.85 101.00	12.38 544.50	12.92 131.90	13.45 89.26
11.87 119.70	12.40 525.23	12.93 129.50	13.47 88.48
11.88 141.70	12.42 505.59	12.95 127.21	13.48 87.72
11.90 167.42	12.43 485.62	12.97 125.03	13.50 86.97
11.92 197.32	12.45 465.36	12.98 122.94	13.52 86.24
11.93 229.91	12.47 444.86	13.00 120.95	13.53 85.51
11.95 264.96	12.48 424.15	13.02 119.06	13.55 84.79
11.97 301.70	12.50 403.31	13.03 117.24	13.57 84.09
11.98 339.36	12.52 382.38	13.05 115.51	13.58 83.40
12.00 377.03	12.53 361.46	13.07 113.87	13.60 82.72
12.02 414.20	12.55 340.61	13.08 112.29	13.62 82.05
12.03 450.69	12.57 319.96	13.10 110.79	13.63 81.39
12.05 486.33	12.58 299.67	13.12 109.36	13.65 80.73
12.07 520.83	12.60 279.92	13.13 107.99	13.67 80.09
12.08 553.80	12.62 260.92	13.15 106.68	13.68 79.46
12.10 584.76	12.63 242.90	13.17 105.43	13.70 78.84

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Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
13.72 78.22	14.53 56.97	15.35 48.79	16.17 40.32
13.73 77.61	14.55 56.76	15.37 48.62	16.18 40.15
13.75 77.02	14.57 56.56	15.38 48.45	16.20 39.99
13.77 76.42	14.58 56.37	15.40 48.28	16.22 39.84
13.78 75.84	14.60 56.18	15.42 48.11	16.23 39.69
13.80 75.26	14.62 56.00	15.43 47.94	16.25 39.54
13.82 74.69	14.63 55.82	15.45 47.78	16.27 39.40
13.83 74.13	14.65 55.64	15.47 47.61	16.28 39.26
13.85 73.57	14.67 55.47	15.48 47.44	16.30 39.12
13.87 73.02	14.68 55.31	15.50 47.27	16.32 38.99
13.88 72.48	14.70 55.14	15.52 47.09	16.33 38.87
13.90 71.94	14.72 54.98	15.53 46.92	16.35 38.75
13.92 71.40	14.73 54.82	15.55 46.75	16.37 38.63
13.93 70.87	14.75 54.66	15.57 46.58	16.38 38.52
13.95 70.35	14.77 54.50	15.58 46.41	16.40 38.42
13.97 69.83	14.78 54.34	15.60 46.24	16.42 38.31
13.98 69.31	14.80 54.18	15.62 46.07	16.43 38.22
14.00 68.80	14.82 54.02	15.63 45.89	16.45 38.12
14.02 68.29	14.83 53.86	15.65 45.72	16.47 38.03
14.03 67.79	14.85 53.70	15.67 45.55	16.48 37.94
14.05 67.29	14.87 53.55	15.68 45.38	16.50 37.85
14.07 66.79	14.88 53.39	15.70 45.20	16.52 37.77
14.08 66.31	14.90 53.22	15.72 45.03	16.53 37.69
14.10 65.83	14.92 53.06	15.73 44.86	16.55 37.61
14.12 65.35	14.93 52.90	15.75 44.68	16.57 37.54
14.13 64.89	14.95 52.74	15.77 44.51	16.58 37.47
14.15 64.43	14.97 52.58	15.78 44.33	16.60 37.39
14.17 63.99	14.98 52.42	15.80 44.16	16.62 37.33
14.18 63.55	15.00 52.26	15.82 43.98	16.63 37.26
14.20 63.12	15.02 52.09	15.83 43.81	16.65 37.19
14.22 62.70	15.03 51.93	15.85 43.63	16.67 37.13
14.23 62.29	15.05 51.77	15.87 43.46	16.68 37.07
14.25 61.90	15.07 51.61	15.88 43.28	16.70 37.00
14.27 61.52	15.08 51.44	15.90 43.11	16.72 36.94
14.28 61.15	15.10 51.28	15.92 42.93	16.73 36.88
14.30 60.79	15.12 51.11	15.93 42.75	16.75 36.82
14.32 60.44	15.13 50.95	15.95 42.58	16.77 36.76
14.33 60.11	15.15 50.79	15.97 42.40	16.78 36.71
14.35 59.79	15.17 50.62	15.98 42.22	16.80 36.65
14.37 59.49	15.18 50.46	16.00 42.04	16.82 36.59
14.38 59.19	15.20 50.29	16.02 41.87	16.83 36.53
14.40 58.91	15.22 50.12	16.03 41.69	16.85 36.47
14.42 58.63	15.23 49.96	16.05 41.51	16.87 36.41
14.43 58.37	15.25 49.79	16.07 41.34	16.88 36.35
14.45 58.11	15.27 49.63	16.08 41.16	16.90 36.29
14.47 57.87	15.28 49.46	16.10 40.99	16.92 36.23
14.48 57.63	15.30 49.29	16.12 40.82	16.93 36.17
14.50 57.40	15.32 49.12	16.13 40.65	16.95 36.11
14.52 57.18	15.33 48.96	16.15 40.48	16.97 36.05

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Hydrograph Discharge Table

Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)
16.98	35.99	17.80	32.99	18.62	29.85	19.43	26.59
17.00	35.93	17.82	32.92	18.63	29.78	19.45	26.52
17.02	35.87	17.83	32.86	18.65	29.72	19.47	26.45
17.03	35.81	17.85	32.80	18.67	29.65	19.48	26.39
17.05	35.75	17.87	32.74	18.68	29.58	19.50	26.32
17.07	35.69	17.88	32.67	18.70	29.52	19.52	26.25
17.08	35.63	17.90	32.61	18.72	29.45	19.53	26.18
17.10	35.57	17.92	32.55	18.73	29.39	19.55	26.11
17.12	35.51	17.93	32.48	18.75	29.32	19.57	26.05
17.13	35.45	17.95	32.42	18.77	29.26	19.58	25.98
17.15	35.39	17.97	32.36	18.78	29.19	19.60	25.91
17.17	35.33	17.98	32.29	18.80	29.12	19.62	25.84
17.18	35.27	18.00	32.23	18.82	29.06	19.63	25.78
17.20	35.21	18.02	32.17	18.83	28.99	19.65	25.71
17.22	35.15	18.03	32.10	18.85	28.93	19.67	25.64
17.23	35.09	18.05	32.04	18.87	28.86	19.68	25.57
17.25	35.03	18.07	31.97	18.88	28.79	19.70	25.50
17.27	34.97	18.08	31.91	18.90	28.73	19.72	25.43
17.28	34.91	18.10	31.85	18.92	28.66	19.73	25.37
17.30	34.84	18.12	31.78	18.93	28.60	19.75	25.30
17.32	34.78	18.13	31.72	18.95	28.53	19.77	25.23
17.33	34.72	18.15	31.66	18.97	28.46	19.78	25.16
17.35	34.66	18.17	31.59	18.98	28.40	19.80	25.09
17.37	34.60	18.18	31.53	19.00	28.33	19.82	25.02
17.38	34.54	18.20	31.46	19.02	28.26	19.83	24.96
17.40	34.48	18.22	31.40	19.03	28.20	19.85	24.89
17.42	34.42	18.23	31.34	19.05	28.13	19.87	24.82
17.43	34.35	18.25	31.27	19.07	28.06	19.88	24.75
17.45	34.29	18.27	31.21	19.08	28.00	19.90	24.68
17.47	34.23	18.28	31.14	19.10	27.93	19.92	24.61
17.48	34.17	18.30	31.08	19.12	27.86	19.93	24.54
17.50	34.11	18.32	31.01	19.13	27.80	19.95	24.48
17.52	34.05	18.33	30.95	19.15	27.73	19.97	24.41
17.53	33.98	18.35	30.89	19.17	27.66	19.98	24.34
17.55	33.92	18.37	30.82	19.18	27.60	20.00	24.27
17.57	33.86	18.38	30.76	19.20	27.53	20.02	24.20
17.58	33.80	18.40	30.69	19.22	27.46	20.03	24.13
17.60	33.74	18.42	30.63	19.23	27.40	20.05	24.06
17.62	33.67	18.43	30.56	19.25	27.33	20.07	24.00
17.63	33.61	18.45	30.50	19.27	27.26	20.08	23.93
17.65	33.55	18.47	30.43	19.28	27.19	20.10	23.86
17.67	33.49	18.48	30.37	19.30	27.13	20.12	23.80
17.68	33.42	18.50	30.30	19.32	27.06	20.13	23.73
17.70	33.36	18.52	30.24	19.33	26.99	20.15	23.67
17.72	33.30	18.53	30.17	19.35	26.93	20.17	23.61
17.73	33.24	18.55	30.11	19.37	26.86	20.18	23.54
17.75	33.17	18.57	30.04	19.38	26.79	20.20	23.48
17.77	33.11	18.58	29.98	19.40	26.72	20.22	23.43
17.78	33.05	18.60	29.91	19.42	26.66	20.23	23.37

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Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
20.25 23.32	21.07 22.30	21.88 21.73	22.70 21.14
20.27 23.26	21.08 22.29	21.90 21.71	22.72 21.12
20.28 23.21	21.10 22.28	21.92 21.70	22.73 21.11
20.30 23.17	21.12 22.26	21.93 21.69	22.75 21.10
20.32 23.12	21.13 22.25	21.95 21.68	22.77 21.09
20.33 23.08	21.15 22.24	21.97 21.67	22.78 21.07
20.35 23.04	21.17 22.23	21.98 21.65	22.80 21.06
20.37 23.00	21.18 22.22	22.00 21.64	22.82 21.05
20.38 22.96	21.20 22.21	22.02 21.63	22.83 21.04
20.40 22.93	21.22 22.19	22.03 21.62	22.85 21.03
20.42 22.90	21.23 22.18	22.05 21.61	22.87 21.01
20.43 22.87	21.25 22.17	22.07 21.59	22.88 21.00
20.45 22.84	21.27 22.16	22.08 21.58	22.90 20.99
20.47 22.81	21.28 22.15	22.10 21.57	22.92 20.98
20.48 22.78	21.30 22.14	22.12 21.56	22.93 20.96
20.50 22.76	21.32 22.13	22.13 21.55	22.95 20.95
20.52 22.74	21.33 22.11	22.15 21.53	22.97 20.94
20.53 22.71	21.35 22.10	22.17 21.52	22.98 20.93
20.55 22.69	21.37 22.09	22.18 21.51	23.00 20.92
20.57 22.67	21.38 22.08	22.20 21.50	23.02 20.90
20.58 22.66	21.40 22.07	22.22 21.49	23.03 20.89
20.60 22.64	21.42 22.06	22.23 21.47	23.05 20.88
20.62 22.62	21.43 22.04	22.25 21.46	23.07 20.87
20.63 22.61	21.45 22.03	22.27 21.45	23.08 20.85
20.65 22.59	21.47 22.02	22.28 21.44	23.10 20.84
20.67 22.58	21.48 22.01	22.30 21.43	23.12 20.83
20.68 22.57	21.50 22.00	22.32 21.41	23.13 20.82
20.70 22.55	21.52 21.99	22.33 21.40	23.15 20.80
20.72 22.54	21.53 21.97	22.35 21.39	23.17 20.79
20.73 22.53	21.55 21.96	22.37 21.38	23.18 20.78
20.75 22.52	21.57 21.95	22.38 21.37	23.20 20.77
20.77 22.51	21.58 21.94	22.40 21.35	23.22 20.75
20.78 22.49	21.60 21.93	22.42 21.34	23.23 20.74
20.80 22.48	21.62 21.91	22.43 21.33	23.25 20.73
20.82 22.47	21.63 21.90	22.45 21.32	23.27 20.72
20.83 22.46	21.65 21.89	22.47 21.31	23.28 20.70
20.85 22.45	21.67 21.88	22.48 21.29	23.30 20.69
20.87 22.44	21.68 21.87	22.50 21.28	23.32 20.68
20.88 22.43	21.70 21.86	22.52 21.27	23.33 20.67
20.90 22.41	21.72 21.84	22.53 21.26	23.35 20.65
20.92 22.40	21.73 21.83	22.55 21.25	23.37 20.64
20.93 22.39	21.75 21.82	22.57 21.23	23.38 20.63
20.95 22.38	21.77 21.81	22.58 21.22	23.40 20.62
20.97 22.37	21.78 21.80	22.60 21.21	23.42 20.61
20.98 22.36	21.80 21.78	22.62 21.20	23.43 20.59
21.00 22.34	21.82 21.77	22.63 21.18	23.45 20.58
21.02 22.33	21.83 21.76	22.65 21.17	23.47 20.57
21.03 22.32	21.85 21.75	22.67 21.16	23.48 20.56
21.05 22.31	21.87 21.74	22.68 21.15	23.50 20.54

Continues on next page...

Hydrograph Discharge Table**Time -- Outflow**
(hrs cfs)

23.52	20.53
23.53	20.52
23.55	20.51
23.57	20.49
23.58	20.48
23.60	20.47
23.62	20.46
23.63	20.44
23.65	20.43
23.67	20.42
23.68	20.40
23.70	20.39
23.72	20.38
23.73	20.37
23.75	20.35
23.77	20.34
23.78	20.33
23.80	20.32
23.82	20.30
23.83	20.29
23.85	20.28
23.87	20.27
23.88	20.25
23.90	20.24
23.92	20.23
23.93	20.22
23.95	20.20
23.97	20.19
23.98	20.18

...End

Hydrograph Plot

English

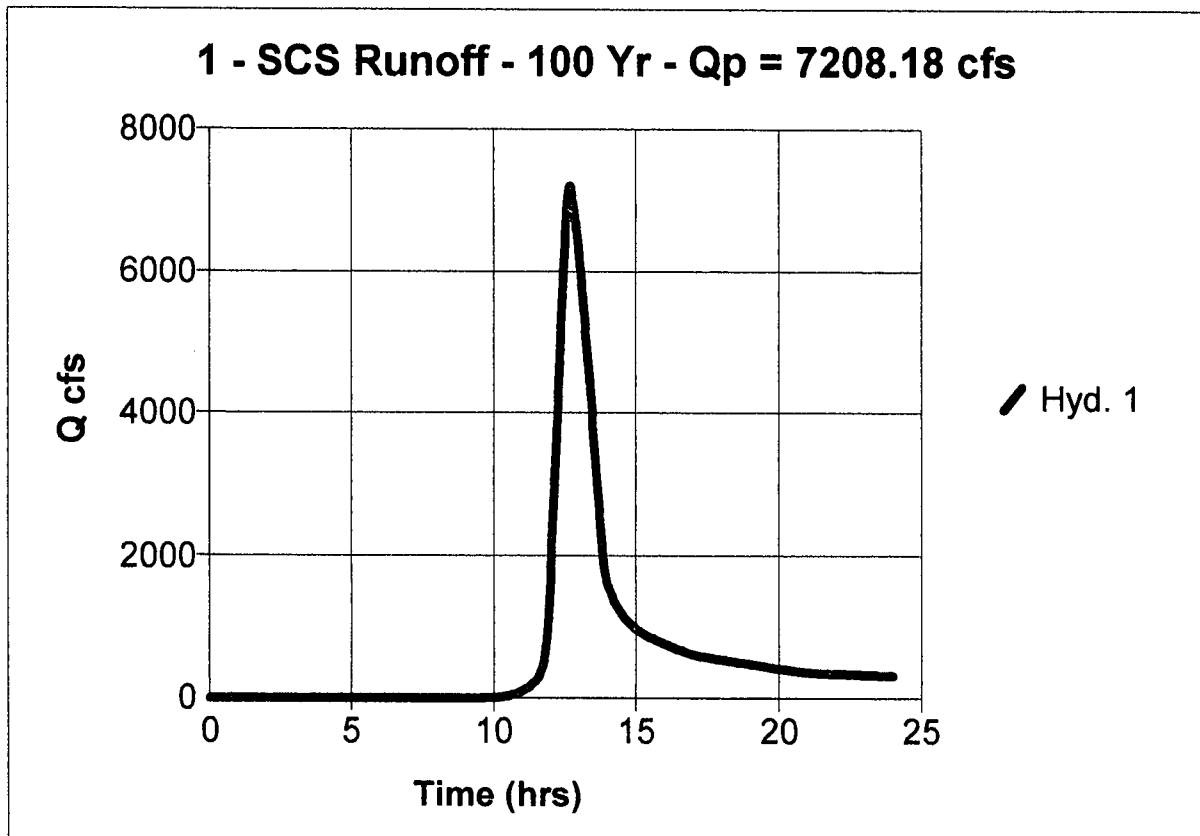
Hyd. No. 1

So Fork Hughes River

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Drainage area = 6950.00 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 5.25 in
Storm duration = 24 hrs

Peak discharge = 7208.18 cfs
Time interval = 1 min
Curve number = 70.2
Hydraulic length = 0 ft
Time of conc. (Tc) = 76 min
Distribution = Type II
Shape factor = 484

Total Volume = 55,480,370 cuft



Hyd. No. 1

So Fork Hughes River

Storm frequency = 100 yrs

Sheet Flow

Manning's n-value = 0.400
Flow length = 100.0 ft
Two-year 24-hr precip. = 2.55 in
Land slope = 25.0 %

Travel Time = 8.8 min

Shallow Concentrated Flow

Flow length = 300 ft
Watercourse slope = 28.0 %
Surface description = Unpaved
Average velocity = 8.54 ft/s

Travel Time = 0.6 min

Channel Flow

Cross section flow area = 80.0 sqft
Wetted perimeter = 24.0 ft
Channel slope = 0.8 %
Manning's n-value = 0.035
Velocity = 8.53 ft/s
Flow length = 34140.0 ft

Travel Time = 66.7 min

Total Travel Time, Tc = 76.0 min

Hydrograph Report

Hyd. No. 1

So Fork Hughes River

Hydrograph type	= SCS Runoff	Peak discharge	= 7208.18 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 6950.00 ac	Curve number	= 70.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 76 min
Total precip.	= 5.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 55,480,370 cuft

Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
10.82 72.23	11.35 205.24	11.88 995.06	12.42 5755.64
10.83 75.01	11.37 211.52	11.90 1095.83	12.43 5903.37
10.85 77.86	11.38 217.99	11.92 1209.80	12.45 6047.75
10.87 80.79	11.40 224.65	11.93 1332.64	12.47 6188.29
10.88 83.79	11.42 231.49	11.95 1463.84	12.48 6324.48
10.90 86.88	11.43 238.54	11.97 1601.46	12.50 6455.75
10.92 90.04	11.45 245.80	11.98 1743.58	12.52 6581.26
10.93 93.28	11.47 253.26	12.00 1888.03	12.53 6699.75
10.95 96.60	11.48 260.94	12.02 2033.75	12.55 6809.82
10.97 100.00	11.50 268.84	12.03 2180.72	12.57 6910.02
10.98 103.49	11.52 277.24	12.05 2328.89	12.58 6998.77
11.00 107.06	11.53 286.07	12.07 2478.22	12.60 7074.42
11.02 110.59	11.55 295.48	12.08 2628.67	12.62 7135.14
11.03 114.21	11.57 305.63	12.10 2780.19	12.63 7179.02
11.05 117.92	11.58 316.67	12.12 2932.75	12.65 7204.05
11.07 121.72	11.60 328.80	12.13 3086.30	12.67 7208.18 <<
11.08 125.63	11.62 342.18	12.15 3240.80	12.68 7198.35
11.10 129.64	11.63 357.05	12.17 3396.20	12.70 7175.34
11.12 133.76	11.65 373.60	12.18 3552.47	12.72 7142.20
11.13 137.99	11.67 392.08	12.20 3709.55	12.73 7102.02
11.15 142.33	11.68 412.73	12.22 3867.40	12.75 7058.23
11.17 146.80	11.70 435.83	12.23 4025.97	12.77 7012.48
11.18 151.39	11.72 461.67	12.25 4185.22	12.78 6964.81
11.20 156.11	11.73 490.54	12.27 4344.68	12.80 6915.27
11.22 160.97	11.75 522.77	12.28 4504.40	12.82 6863.88
11.23 165.97	11.77 559.06	12.30 4664.12	12.83 6810.68
11.25 171.11	11.78 600.00	12.32 4823.55	12.85 6755.73
11.27 176.40	11.80 646.44	12.33 4982.38	12.87 6699.05
11.28 181.84	11.82 699.29	12.35 5140.31	12.88 6640.69
11.30 187.44	11.83 759.50	12.37 5296.97	12.90 6580.69
11.32 193.20	11.85 828.11	12.38 5452.01	12.92 6519.09
11.33 199.14	11.87 906.23	12.40 5605.03	12.93 6455.94

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Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
12.95 6391.27	13.77 2274.02	14.58 1142.04	15.40 876.35
12.97 6325.12	13.78 2195.05	14.60 1133.76	15.42 872.86
12.98 6257.55	13.80 2119.04	14.62 1125.64	15.43 869.41
13.00 6188.60	13.82 2046.55	14.63 1117.67	15.45 866.00
13.02 6118.22	13.83 1978.16	14.65 1109.85	15.47 862.62
13.03 6046.56	13.85 1914.50	14.67 1102.18	15.48 859.29
13.05 5973.65	13.87 1856.25	14.68 1094.66	15.50 855.98
13.07 5899.55	13.88 1804.13	14.70 1087.29	15.52 852.71
13.08 5824.31	13.90 1758.89	14.72 1080.07	15.53 849.48
13.10 5747.99	13.92 1721.31	14.73 1073.00	15.55 846.27
13.12 5670.62	13.93 1688.78	14.75 1066.08	15.57 843.09
13.13 5592.27	13.95 1661.02	14.77 1059.30	15.58 839.94
13.15 5512.98	13.97 1636.88	14.78 1052.67	15.60 836.81
13.17 5432.80	13.98 1615.19	14.80 1046.17	15.62 833.71
13.18 5351.80	14.00 1594.69	14.82 1039.81	15.63 830.64
13.20 5270.02	14.02 1574.75	14.83 1033.58	15.65 827.59
13.22 5187.51	14.03 1555.36	14.85 1027.47	15.67 824.56
13.23 5104.32	14.05 1536.50	14.87 1021.49	15.68 821.55
13.25 5020.52	14.07 1518.17	14.88 1015.62	15.70 818.56
13.27 4936.14	14.08 1500.36	14.90 1009.88	15.72 815.59
13.28 4851.18	14.10 1483.06	14.92 1004.24	15.73 812.64
13.30 4765.66	14.12 1466.25	14.93 998.71	15.75 809.70
13.32 4679.58	14.13 1449.91	14.95 993.28	15.77 806.78
13.33 4592.98	14.15 1434.05	14.97 987.95	15.78 803.87
13.35 4505.84	14.17 1418.65	14.98 982.71	15.80 800.97
13.37 4418.20	14.18 1403.69	15.00 977.57	15.82 798.09
13.38 4330.05	14.20 1389.16	15.02 972.52	15.83 795.21
13.40 4241.42	14.22 1375.06	15.03 967.55	15.85 792.34
13.42 4152.32	14.23 1361.36	15.05 962.66	15.87 789.49
13.43 4062.76	14.25 1348.05	15.07 957.86	15.88 786.63
13.45 3972.74	14.27 1335.13	15.08 953.14	15.90 783.79
13.47 3882.30	14.28 1322.58	15.10 948.50	15.92 780.94
13.48 3791.44	14.30 1310.37	15.12 943.93	15.93 778.10
13.50 3700.17	14.32 1298.51	15.13 939.44	15.95 775.27
13.52 3608.67	14.33 1286.96	15.15 935.03	15.97 772.43
13.53 3516.91	14.35 1275.72	15.17 930.68	15.98 769.59
13.55 3424.99	14.37 1264.77	15.18 926.41	16.00 766.75
13.57 3333.02	14.38 1254.09	15.20 922.20	16.02 763.91
13.58 3241.11	14.40 1243.67	15.22 918.06	16.03 761.06
13.60 3149.37	14.42 1233.50	15.23 913.98	16.05 758.21
13.62 3057.94	14.43 1223.55	15.25 909.97	16.07 755.37
13.63 2966.93	14.45 1213.81	15.27 906.02	16.08 752.52
13.65 2876.51	14.47 1204.27	15.28 902.12	16.10 749.68
13.67 2786.82	14.48 1194.91	15.30 898.29	16.12 746.84
13.68 2698.03	14.50 1185.71	15.32 894.50	16.13 744.00
13.70 2610.30	14.52 1176.67	15.33 890.77	16.15 741.17
13.72 2523.83	14.53 1167.78	15.35 887.10	16.17 738.34
13.73 2438.80	14.55 1159.05	15.37 883.47	16.18 735.51
13.75 2355.43	14.57 1150.47	15.38 879.88	16.20 732.70

Continues on next page...

Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
16.22 729.88	17.03 615.12	17.85 552.05	18.67 501.23
16.23 727.08	17.05 613.43	17.87 551.01	18.68 500.18
16.25 724.28	17.07 611.75	17.88 549.98	18.70 499.13
16.27 721.50	17.08 610.10	17.90 548.94	18.72 498.08
16.28 718.72	17.10 608.48	17.92 547.92	18.73 497.03
16.30 715.95	17.12 606.87	17.93 546.89	18.75 495.98
16.32 713.20	17.13 605.29	17.95 545.86	18.77 494.93
16.33 710.45	17.15 603.73	17.97 544.83	18.78 493.87
16.35 707.72	17.17 602.19	17.98 543.81	18.80 492.82
16.37 705.01	17.18 600.67	18.00 542.78	18.82 491.76
16.38 702.30	17.20 599.17	18.02 541.75	18.83 490.71
16.40 699.62	17.22 597.69	18.03 540.73	18.85 489.65
16.42 696.94	17.23 596.23	18.05 539.70	18.87 488.60
16.43 694.29	17.25 594.79	18.07 538.67	18.88 487.54
16.45 691.65	17.27 593.37	18.08 537.64	18.90 486.49
16.47 689.03	17.28 591.97	18.10 536.61	18.92 485.43
16.48 686.43	17.30 590.58	18.12 535.58	18.93 484.37
16.50 683.85	17.32 589.22	18.13 534.55	18.95 483.31
16.52 681.29	17.33 587.86	18.15 533.51	18.97 482.25
16.53 678.75	17.35 586.53	18.17 532.48	18.98 481.19
16.55 676.23	17.37 585.21	18.18 531.45	19.00 480.13
16.57 673.74	17.38 583.91	18.20 530.41	19.02 479.07
16.58 671.27	17.40 582.62	18.22 529.38	19.03 478.01
16.60 668.82	17.42 581.35	18.23 528.34	19.05 476.95
16.62 666.40	17.43 580.09	18.25 527.31	19.07 475.89
16.63 664.00	17.45 578.85	18.27 526.27	19.08 474.83
16.65 661.63	17.47 577.61	18.28 525.23	19.10 473.76
16.67 659.29	17.48 576.40	18.30 524.20	19.12 472.70
16.68 656.97	17.50 575.19	18.32 523.16	19.13 471.64
16.70 654.68	17.52 574.00	18.33 522.12	19.15 470.57
16.72 652.43	17.53 572.82	18.35 521.08	19.17 469.51
16.73 650.20	17.55 571.65	18.37 520.04	19.18 468.44
16.75 648.01	17.57 570.49	18.38 519.00	19.20 467.38
16.77 645.84	17.58 569.34	18.40 517.96	19.22 466.31
16.78 643.71	17.60 568.20	18.42 516.92	19.23 465.24
16.80 641.60	17.62 567.07	18.43 515.88	19.25 464.18
16.82 639.53	17.63 565.96	18.45 514.84	19.27 463.11
16.83 637.49	17.65 564.85	18.47 513.79	19.28 462.04
16.85 635.47	17.67 563.74	18.48 512.75	19.30 460.97
16.87 633.49	17.68 562.65	18.50 511.70	19.32 459.90
16.88 631.53	17.70 561.56	18.52 510.66	19.33 458.83
16.90 629.60	17.72 560.48	18.53 509.62	19.35 457.76
16.92 627.70	17.73 559.41	18.55 508.57	19.37 456.69
16.93 625.83	17.75 558.34	18.57 507.52	19.38 455.62
16.95 623.98	17.77 557.28	18.58 506.48	19.40 454.55
16.97 622.16	17.78 556.22	18.60 505.43	19.42 453.48
16.98 620.36	17.80 555.17	18.62 504.38	19.43 452.41
17.00 618.59	17.82 554.13	18.63 503.33	19.45 451.33
17.02 616.84	17.83 553.08	18.65 502.28	19.47 450.26

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Hydrograph Discharge Table

Time -- (hrs)	Outflow (cfs)	Time -- (hrs)	Outflow (cfs)	Time -- (hrs)	Outflow (cfs)	Time -- (hrs)	Outflow (cfs)
19.48	449.19	20.30	396.41	21.12	358.37	21.93	343.81
19.50	448.11	20.32	395.37	21.13	357.90	21.95	343.61
19.52	447.04	20.33	394.35	21.15	357.44	21.97	343.41
19.53	445.96	20.35	393.33	21.17	357.00	21.98	343.21
19.55	444.89	20.37	392.31	21.18	356.56	22.00	343.01
19.57	443.81	20.38	391.31	21.20	356.13	22.02	342.81
19.58	442.73	20.40	390.31	21.22	355.71	22.03	342.61
19.60	441.66	20.42	389.32	21.23	355.30	22.05	342.41
19.62	440.58	20.43	388.33	21.25	354.90	22.07	342.21
19.63	439.50	20.45	387.36	21.27	354.51	22.08	342.01
19.65	438.43	20.47	386.39	21.28	354.12	22.10	341.81
19.67	437.35	20.48	385.44	21.30	353.75	22.12	341.61
19.68	436.27	20.50	384.49	21.32	353.38	22.13	341.41
19.70	435.19	20.52	383.56	21.33	353.02	22.15	341.21
19.72	434.11	20.53	382.63	21.35	352.67	22.17	341.01
19.73	433.03	20.55	381.72	21.37	352.33	22.18	340.81
19.75	431.95	20.57	380.81	21.38	351.99	22.20	340.61
19.77	430.87	20.58	379.92	21.40	351.67	22.22	340.40
19.78	429.78	20.60	379.04	21.42	351.34	22.23	340.20
19.80	428.70	20.62	378.17	21.43	351.03	22.25	340.00
19.82	427.62	20.63	377.31	21.45	350.72	22.27	339.80
19.83	426.54	20.65	376.47	21.47	350.42	22.28	339.60
19.85	425.45	20.67	375.64	21.48	350.13	22.30	339.40
19.87	424.37	20.68	374.82	21.50	349.84	22.32	339.20
19.88	423.29	20.70	374.02	21.52	349.56	22.33	339.00
19.90	422.20	20.72	373.23	21.53	349.28	22.35	338.80
19.92	421.12	20.73	372.45	21.55	349.01	22.37	338.59
19.93	420.03	20.75	371.69	21.57	348.74	22.38	338.39
19.95	418.95	20.77	370.95	21.58	348.48	22.40	338.19
19.97	417.86	20.78	370.21	21.60	348.22	22.42	337.99
19.98	416.77	20.80	369.50	21.62	347.97	22.43	337.79
20.00	415.69	20.82	368.80	21.63	347.72	22.45	337.59
20.02	414.60	20.83	368.11	21.65	347.48	22.47	337.39
20.03	413.51	20.85	367.43	21.67	347.24	22.48	337.18
20.05	412.42	20.87	366.77	21.68	347.01	22.50	336.98
20.07	411.34	20.88	366.13	21.70	346.78	22.52	336.78
20.08	410.25	20.90	365.49	21.72	346.55	22.53	336.58
20.10	409.17	20.92	364.87	21.73	346.32	22.55	336.38
20.12	408.09	20.93	364.26	21.75	346.10	22.57	336.17
20.13	407.01	20.95	363.67	21.77	345.88	22.58	335.97
20.15	405.93	20.97	363.09	21.78	345.67	22.60	335.77
20.17	404.86	20.98	362.52	21.80	345.45	22.62	335.57
20.18	403.79	21.00	361.96	21.82	345.24	22.63	335.36
20.20	402.72	21.02	361.41	21.83	345.03	22.65	335.16
20.22	401.66	21.03	360.88	21.85	344.83	22.67	334.96
20.23	400.60	21.05	360.35	21.87	344.62	22.68	334.76
20.25	399.54	21.07	359.84	21.88	344.42	22.70	334.55
20.27	398.49	21.08	359.34	21.90	344.21	22.72	334.35
20.28	397.45	21.10	358.85	21.92	344.01	22.73	334.15

Continues on next page...

Hydrograph Discharge Table

Time -- (hrs)	Outflow (cfs)	Time -- (hrs)	Outflow (cfs)
22.75	333.94	23.57	323.92
22.77	333.74	23.58	323.72
22.78	333.54	23.60	323.51
22.80	333.34	23.62	323.30
22.82	333.13	23.63	323.10
22.83	332.93	23.65	322.89
22.85	332.73	23.67	322.68
22.87	332.52	23.68	322.48
22.88	332.32	23.70	322.27
22.90	332.12	23.72	322.06
22.92	331.91	23.73	321.86
22.93	331.71	23.75	321.65
22.95	331.50	23.77	321.44
22.97	331.30	23.78	321.24
22.98	331.10	23.80	321.03
23.00	330.89	23.82	320.82
23.02	330.69	23.83	320.62
23.03	330.49	23.85	320.41
23.05	330.28	23.87	320.20
23.07	330.08	23.88	319.99
23.08	329.87	23.90	319.79
23.10	329.67	23.92	319.58
23.12	329.46	23.93	319.37
23.13	329.26	23.95	319.16
23.15	329.06	23.97	318.96
23.17	328.85	23.98	318.75
23.18	328.65		
23.20	328.44		
23.22	328.24	...End	
23.23	328.03		
23.25	327.83		
23.27	327.62		
23.28	327.42		
23.30	327.21		
23.32	327.01		
23.33	326.80		
23.35	326.60		
23.37	326.39		
23.38	326.19		
23.40	325.98		
23.42	325.77		
23.43	325.57		
23.45	325.36		
23.47	325.16		
23.48	324.95		
23.50	324.75		
23.52	324.54		
23.53	324.33		
23.55	324.13		

Hydrograph Plot

English

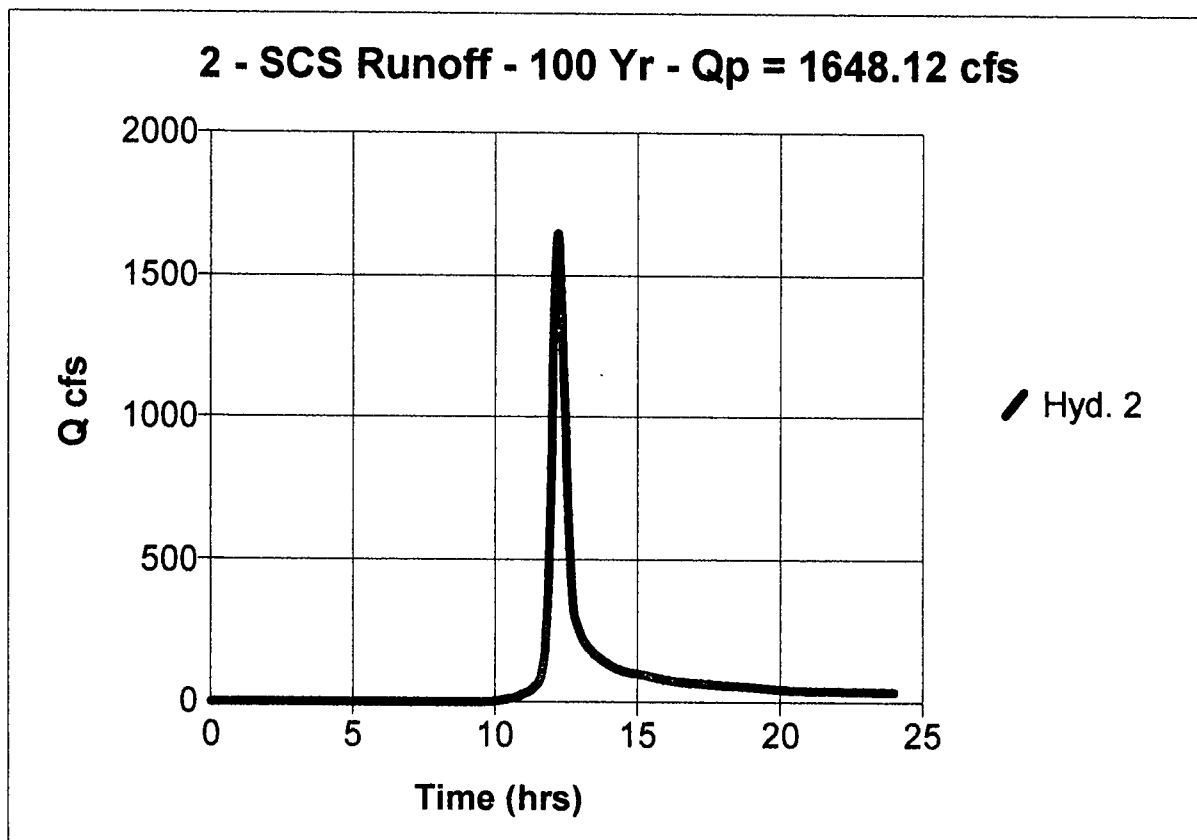
Hyd. No. 2

Sheep Run

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Drainage area = 825.00 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 5.25 in
Storm duration = 24 hrs

Peak discharge = 1648.12 cfs
Time interval = 1 min
Curve number = 70.2
Hydraulic length = 0 ft
Time of conc. (Tc) = 29.3 min
Distribution = Type II
Shape factor = 484

Total Volume = 6,660,276 cuft



Hyd. No. 2

Sheep Run

Storm frequency = 100 yrs

Sheet Flow

Manning's n-value = 0.550
Flow length = 100.0 ft
Two-year 24-hr precip. = 2.55 in
Land slope = 18.0 %

Travel Time = 12.9 min

Shallow Concentrated Flow

Flow length = 300 ft
Watercourse slope = 13.0 %
Surface description = Unpaved
Average velocity = 5.82 ft/s

Travel Time = 0.9 min

Channel Flow

Cross section flow area = 18.4 sqft
Wetted perimeter = 9.5 ft
Channel slope = 3.6 %
Manning's n-value = 0.040
Velocity = 11.01 ft/s
Flow length = 10290.0 ft

Travel Time = 15.6 min

Total Travel Time, Tc = 29.3 min

Hydrograph Report

Hyd. No. 2

Sheep Run

Hydrograph type	= SCS Runoff	Peak discharge	= 1648.12 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 825.00 ac	Curve number	= 70.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 29.3 min
Total precip.	= 5.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 6,660,276 cuft

Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
10.68 16.78	11.22 40.78	11.75 185.81	12.28 1502.34
10.70 17.31	11.23 41.89	11.77 206.51	12.30 1457.41
10.72 17.85	11.25 43.05	11.78 230.47	12.32 1411.62
10.73 18.40	11.27 44.25	11.80 258.30	12.33 1364.98
10.75 18.97	11.28 45.51	11.82 290.30	12.35 1317.55
10.77 19.55	11.30 46.81	11.83 327.33	12.37 1269.41
10.78 20.15	11.32 48.33	11.85 369.98	12.38 1220.66
10.80 20.76	11.33 49.90	11.87 418.89	12.40 1171.37
10.82 21.39	11.35 51.53	11.88 474.76	12.42 1121.65
10.83 22.04	11.37 53.22	11.90 538.31	12.43 1071.61
10.85 22.70	11.38 54.96	11.92 610.24	12.45 1021.34
10.87 23.37	11.40 56.77	11.93 687.11	12.47 970.97
10.88 24.06	11.42 58.63	11.95 768.27	12.48 920.63
10.90 24.77	11.43 60.55	11.97 852.03	12.50 870.44
10.92 25.50	11.45 62.54	11.98 936.66	12.52 820.56
10.93 26.24	11.47 64.58	12.00 1020.24	12.53 771.15
10.95 27.00	11.48 66.68	12.02 1101.65	12.55 722.39
10.97 27.77	11.50 68.85	12.03 1180.52	12.57 674.55
10.98 28.57	11.52 71.27	12.05 1256.44	12.58 627.99
11.00 29.37	11.53 73.89	12.07 1328.78	12.60 583.15
11.02 30.10	11.55 76.83	12.08 1396.60	12.62 540.45
11.03 30.85	11.57 80.20	12.10 1458.85	12.63 500.37
11.05 31.62	11.58 84.10	12.12 1514.42	12.65 463.39
11.07 32.41	11.60 88.66	12.13 1562.14	12.67 430.06
11.08 33.22	11.62 94.03	12.15 1600.78	12.68 400.94
11.10 34.06	11.63 100.35	12.17 1628.95	12.70 376.62
11.12 34.92	11.65 107.77	12.18 1645.23	12.72 357.70
11.13 35.81	11.67 116.46	12.20 1648.12 <<	12.73 342.28
11.15 36.74	11.68 126.61	12.22 1636.08	12.75 330.18
11.17 37.69	11.70 138.41	12.23 1614.24	12.77 320.58
11.18 38.68	11.72 152.06	12.25 1583.16	12.78 312.65
11.20 39.71	11.73 167.78	12.27 1545.11	12.80 305.47

Continues on next page...

Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
12.82	298.60	13.63	159.03
12.83	292.03	13.65	157.70
12.85	285.74	13.67	156.40
12.87	279.74	13.68	155.11
12.88	274.01	13.70	153.84
12.90	268.53	13.72	152.59
12.92	263.31	13.73	151.36
12.93	258.32	13.75	150.14
12.95	253.57	13.77	148.94
12.97	249.04	13.78	147.75
12.98	244.71	13.80	146.59
13.00	240.59	13.82	145.43
13.02	236.65	13.83	144.29
13.03	232.90	13.85	143.16
13.05	229.32	13.87	142.05
13.07	225.91	13.88	140.94
13.08	222.65	13.90	139.85
13.10	219.55	13.92	138.77
13.12	216.59	13.93	137.70
13.13	213.76	13.95	136.64
13.15	211.05	13.97	135.59
13.17	208.47	13.98	134.55
13.18	205.99	14.00	133.52
13.20	203.62	14.02	132.50
13.22	201.33	14.03	131.49
13.23	199.13	14.05	130.48
13.25	197.00	14.07	129.49
13.27	194.94	14.08	128.52
13.28	192.93	14.10	127.55
13.30	190.98	14.12	126.60
13.32	189.06	14.13	125.67
13.33	187.19	14.15	124.76
13.35	185.36	14.17	123.86
13.37	183.57	14.18	122.98
13.38	181.81	14.20	122.12
13.40	180.09	14.22	121.28
13.42	178.41	14.23	120.47
13.43	176.76	14.25	119.67
13.45	175.13	14.27	118.91
13.47	173.54	14.28	118.16
13.48	171.98	14.30	117.44
13.50	170.44	14.32	116.75
13.52	168.93	14.33	116.08
13.53	167.45	14.35	115.44
13.55	165.99	14.37	114.82
13.57	164.55	14.38	114.22
13.58	163.14	14.40	113.65
13.60	161.75	14.42	113.10
13.62	160.38	14.43	112.56
		14.45	112.05
		14.47	111.55
		14.48	111.07
		14.50	110.60
		14.52	110.15
		14.53	109.72
		14.55	109.30
		14.57	108.89
		14.58	108.50
		14.60	108.11
		14.62	107.74
		14.63	107.37
		14.65	107.01
		14.67	106.66
		14.68	106.32
		14.70	105.98
		14.72	105.65
		14.73	105.32
		14.75	104.99
		14.77	104.67
		14.78	104.34
		14.80	104.02
		14.82	103.69
		14.83	103.37
		14.85	103.04
		14.87	102.72
		14.88	102.39
		14.90	102.07
		14.92	101.74
		14.93	101.41
		14.95	101.08
		14.97	100.76
		14.98	100.43
		15.00	100.10
		15.02	99.77
		15.03	99.44
		15.05	99.11
		15.07	98.78
		15.08	98.45
		15.10	98.12
		15.12	97.79
		15.13	97.46
		15.15	97.13
		15.17	96.80
		15.18	96.46
		15.20	96.13
		15.22	95.80
		15.23	95.46
		15.25	95.13
		15.27	94.80
		15.28	94.46
		15.30	94.13
		15.32	93.79
		15.33	93.46
		15.35	93.12
		15.37	92.78
		15.38	92.45
		15.40	92.11
		15.42	91.77
		15.43	91.44
		15.45	91.10
		15.47	90.76
		15.48	90.42
		15.50	90.08
		15.52	89.74
		15.53	89.41
		15.55	89.07
		15.57	88.73
		15.58	88.39
		15.60	88.05
		15.62	87.70
		15.63	87.36
		15.65	87.02
		15.67	86.68
		15.68	86.34
		15.70	86.00
		15.72	85.65
		15.73	85.31
		15.75	84.97
		15.77	84.63
		15.78	84.28
		15.80	83.94
		15.82	83.59
		15.83	83.25
		15.85	82.90
		15.87	82.56
		15.88	82.21
		15.90	81.87
		15.92	81.52
		15.93	81.18
		15.95	80.83
		15.97	80.48
		15.98	80.14
		16.00	79.79
		16.02	79.44
		16.03	79.10
		16.05	78.75
		16.07	78.41

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Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
16.08 78.07	16.90 68.43	17.72 62.49	18.53 56.38
16.10 77.73	16.92 68.31	17.73 62.37	18.55 56.25
16.12 77.39	16.93 68.20	17.75 62.24	18.57 56.13
16.13 77.06	16.95 68.08	17.77 62.12	18.58 56.00
16.15 76.73	16.97 67.96	17.78 62.00	18.60 55.87
16.17 76.41	16.98 67.84	17.80 61.87	18.62 55.75
16.18 76.09	17.00 67.72	17.82 61.75	18.63 55.62
16.20 75.78	17.02 67.60	17.83 61.63	18.65 55.49
16.22 75.48	17.03 67.48	17.85 61.50	18.67 55.37
16.23 75.18	17.05 67.36	17.87 61.38	18.68 55.24
16.25 74.89	17.07 67.24	17.88 61.25	18.70 55.11
16.27 74.61	17.08 67.12	17.90 61.13	18.72 54.99
16.28 74.34	17.10 66.99	17.92 61.01	18.73 54.86
16.30 74.08	17.12 66.87	17.93 60.88	18.75 54.73
16.32 73.82	17.13 66.75	17.95 60.76	18.77 54.61
16.33 73.58	17.15 66.63	17.97 60.63	18.78 54.48
16.35 73.34	17.17 66.51	17.98 60.51	18.80 54.35
16.37 73.12	17.18 66.39	18.00 60.39	18.82 54.23
16.38 72.90	17.20 66.27	18.02 60.26	18.83 54.10
16.40 72.69	17.22 66.15	18.03 60.14	18.85 53.97
16.42 72.48	17.23 66.03	18.05 60.01	18.87 53.84
16.43 72.29	17.25 65.91	18.07 59.89	18.88 53.72
16.45 72.10	17.27 65.79	18.08 59.76	18.90 53.59
16.47 71.92	17.28 65.67	18.10 59.64	18.92 53.46
16.48 71.74	17.30 65.54	18.12 59.52	18.93 53.33
16.50 71.57	17.32 65.42	18.13 59.39	18.95 53.21
16.52 71.41	17.33 65.30	18.15 59.27	18.97 53.08
16.53 71.25	17.35 65.18	18.17 59.14	18.98 52.95
16.55 71.09	17.37 65.06	18.18 59.02	19.00 52.82
16.57 70.94	17.38 64.94	18.20 58.89	19.02 52.70
16.58 70.80	17.40 64.81	18.22 58.77	19.03 52.57
16.60 70.65	17.42 64.69	18.23 58.64	19.05 52.44
16.62 70.52	17.43 64.57	18.25 58.52	19.07 52.31
16.63 70.38	17.45 64.45	18.27 58.39	19.08 52.18
16.65 70.25	17.47 64.33	18.28 58.27	19.10 52.06
16.67 70.12	17.48 64.21	18.30 58.14	19.12 51.93
16.68 70.00	17.50 64.08	18.32 58.01	19.13 51.80
16.70 69.87	17.52 63.96	18.33 57.89	19.15 51.67
16.72 69.75	17.53 63.84	18.35 57.76	19.17 51.54
16.73 69.63	17.55 63.72	18.37 57.64	19.18 51.42
16.75 69.51	17.57 63.59	18.38 57.51	19.20 51.29
16.77 69.39	17.58 63.47	18.40 57.39	19.22 51.16
16.78 69.27	17.60 63.35	18.42 57.26	19.23 51.03
16.80 69.15	17.62 63.23	18.43 57.14	19.25 50.90
16.82 69.03	17.63 63.10	18.45 57.01	19.27 50.77
16.83 68.91	17.65 62.98	18.47 56.88	19.28 50.65
16.85 68.79	17.67 62.86	18.48 56.76	19.30 50.52
16.87 68.67	17.68 62.73	18.50 56.63	19.32 50.39
16.88 68.55	17.70 62.61	18.52 56.51	19.33 50.26

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Hydrograph Discharge Table

Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)
19.35	50.13	20.17	43.81	20.98	41.38	21.80	40.22
19.37	50.00	20.18	43.69	21.00	41.36	21.82	40.19
19.38	49.87	20.20	43.58	21.02	41.33	21.83	40.17
19.40	49.74	20.22	43.47	21.03	41.31	21.85	40.15
19.42	49.61	20.23	43.37	21.05	41.29	21.87	40.12
19.43	49.49	20.25	43.26	21.07	41.26	21.88	40.10
19.45	49.36	20.27	43.16	21.08	41.24	21.90	40.08
19.47	49.23	20.28	43.07	21.10	41.22	21.92	40.05
19.48	49.10	20.30	42.98	21.12	41.19	21.93	40.03
19.50	48.97	20.32	42.89	21.13	41.17	21.95	40.00
19.52	48.84	20.33	42.81	21.15	41.14	21.97	39.98
19.53	48.71	20.35	42.73	21.17	41.12	21.98	39.96
19.55	48.58	20.37	42.66	21.18	41.10	22.00	39.93
19.57	48.45	20.38	42.59	21.20	41.07	22.02	39.91
19.58	48.32	20.40	42.52	21.22	41.05	22.03	39.88
19.60	48.19	20.42	42.46	21.23	41.03	22.05	39.86
19.62	48.06	20.43	42.40	21.25	41.00	22.07	39.84
19.63	47.93	20.45	42.34	21.27	40.98	22.08	39.81
19.65	47.80	20.47	42.29	21.28	40.96	22.10	39.79
19.67	47.67	20.48	42.24	21.30	40.93	22.12	39.76
19.68	47.54	20.50	42.19	21.32	40.91	22.13	39.74
19.70	47.41	20.52	42.15	21.33	40.89	22.15	39.72
19.72	47.28	20.53	42.10	21.35	40.86	22.17	39.69
19.73	47.15	20.55	42.06	21.37	40.84	22.18	39.67
19.75	47.02	20.57	42.03	21.38	40.81	22.20	39.64
19.77	46.89	20.58	41.99	21.40	40.79	22.22	39.62
19.78	46.77	20.60	41.96	21.42	40.77	22.23	39.59
19.80	46.63	20.62	41.92	21.43	40.74	22.25	39.57
19.82	46.50	20.63	41.89	21.45	40.72	22.27	39.55
19.83	46.37	20.65	41.86	21.47	40.70	22.28	39.52
19.85	46.24	20.67	41.84	21.48	40.67	22.30	39.50
19.87	46.11	20.68	41.81	21.50	40.65	22.32	39.47
19.88	45.98	20.70	41.78	21.52	40.62	22.33	39.45
19.90	45.85	20.72	41.76	21.53	40.60	22.35	39.43
19.92	45.72	20.73	41.73	21.55	40.58	22.37	39.40
19.93	45.59	20.75	41.71	21.57	40.55	22.38	39.38
19.95	45.46	20.77	41.68	21.58	40.53	22.40	39.35
19.97	45.33	20.78	41.66	21.60	40.51	22.42	39.33
19.98	45.20	20.80	41.64	21.62	40.48	22.43	39.30
20.00	45.07	20.82	41.61	21.63	40.46	22.45	39.28
20.02	44.94	20.83	41.59	21.65	40.43	22.47	39.26
20.03	44.81	20.85	41.57	21.67	40.41	22.48	39.23
20.05	44.68	20.87	41.54	21.68	40.39	22.50	39.21
20.07	44.55	20.88	41.52	21.70	40.36	22.52	39.18
20.08	44.42	20.90	41.50	21.72	40.34	22.53	39.16
20.10	44.30	20.92	41.47	21.73	40.31	22.55	39.14
20.12	44.17	20.93	41.45	21.75	40.29	22.57	39.11
20.13	44.05	20.95	41.43	21.77	40.27	22.58	39.09
20.15	43.93	20.97	41.40	21.78	40.24	22.60	39.06

Continues on next page...

Hydrograph Discharge Table

Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)
22.62	39.04	23.43	37.84
22.63	39.01	23.45	37.81
22.65	38.99	23.47	37.79
22.67	38.97	23.48	37.76
22.68	38.94	23.50	37.74
22.70	38.92	23.52	37.72
22.72	38.89	23.53	37.69
22.73	38.87	23.55	37.67
22.75	38.84	23.57	37.64
22.77	38.82	23.58	37.62
22.78	38.79	23.60	37.59
22.80	38.77	23.62	37.57
22.82	38.75	23.63	37.54
22.83	38.72	23.65	37.52
22.85	38.70	23.67	37.49
22.87	38.67	23.68	37.47
22.88	38.65	23.70	37.44
22.90	38.62	23.72	37.42
22.92	38.60	23.73	37.39
22.93	38.58	23.75	37.37
22.95	38.55	23.77	37.34
22.97	38.53	23.78	37.32
22.98	38.50	23.80	37.29
23.00	38.48	23.82	37.27
23.02	38.45	23.83	37.25
23.03	38.43	23.85	37.22
23.05	38.40	23.87	37.20
23.07	38.38	23.88	37.17
23.08	38.36	23.90	37.15
23.10	38.33	23.92	37.12
23.12	38.31	23.93	37.10
23.13	38.28	23.95	37.07
23.15	38.26	23.97	37.05
23.17	38.23	23.98	37.02
23.18	38.21		
23.20	38.18		
23.22	38.16	...End	
23.23	38.13		
23.25	38.11		
23.27	38.09		
23.28	38.06		
23.30	38.04		
23.32	38.01		
23.33	37.99		
23.35	37.96		
23.37	37.94		
23.38	37.91		
23.40	37.89		
23.42	37.86		

South Fork Hughes River - Sta 0+00 - 10 Yr Storm Worksheet for Irregular Channel

Project Description	
Worksheet	So Fork Hughes Sta
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.005000 ft/ft
Discharge	333.00 cfs 1,324 cfs

Options	
Current Roughness Method	oved Lotter's Method
Open Channel Weighting	oved Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.043
Water Surface Elevation	832.70 ft
Elevation Range	8.00 to 839.00
Flow Area	282.9 ft ²
Wetted Perimeter	107.64 ft
Top Width	106.13 ft
Actual Depth	4.70 ft
Critical Elevation	831.17 ft
Critical Slope	0.020491 ft/ft
Velocity	4.68 ft/s
Velocity Head	0.34 ft
Specific Energy	833.04 ft
Froude Number	0.51
Flow Type	Subcritical

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+06	1+53	0.045
1+53	2+01	0.040
2+01	2+49	0.045

Natural Channel Points	
Station (ft)	Elevation (ft)
0+06	839.00
0+21	838.00
0+22	837.00
0+23	836.00
0+27	835.00
0+55	834.00
1+20	833.00
1+35	832.00
1+48	831.00
1+53	830.00
1+55	829.00
1+56	828.00

South Fork Hughes River - Sta 0+00 - 10 Yr Storm
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
1+97	828.00
1+98	829.00
2+01	830.00
2+05	831.00
2+25	832.00
2+33	833.00
2+37	834.00
2+39	835.00
2+42	836.00
2+45	837.00
2+47	838.00
2+49	839.00

Sheep Run Sta 7+00 - 10 Yr Storm Worksheet for Irregular Channel

Project Description	
Worksheet	Sheep Run - Sta
Flow Element	Irregular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data	
Slope	.029100 ft/ft
Discharge	1005.00 cfs 695.5 cfs

Options	
Current Roughness Method	oved Lotter's Method
Open Channel Weighting	oved Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.045
Water Surface Elev:	839.09 ft
Elevation Range	5.84 to 841.79
Flow Area	73.6 ft ²
Wetted Perimeter	33.86 ft
Top Width	32.85 ft
Actual Depth	3.25 ft
Critical Elevation	839.29 ft
Critical Slope	0.023129 ft/ft
Velocity	9.45 ft/s
Velocity Head	1.39 ft
Specific Energy	840.48 ft
Froude Number	1.11
Flow Type	Supercritical

Roughness Segments		
Start Station	End Station	Mannings Coefficient
-0+32	0+27	0.045

Natural Channel Points	
Station (ft)	Elevation (ft)
-0+32	841.03
-0+17	839.89
-0+13	838.16
-0+11	837.27
-0+08	836.72
-0+06	836.37
-0+04	836.03
-0+02	835.84
0+00	835.97
0+02	836.00
0+06	836.00
0+08	836.02
0+11	836.58
0+13	837.52

Sheep Run Sta 7+00 - 10 Yr Storm
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
0+15	838.22
0+17	838.81
0+21	839.97
0+25	841.14
0+27	841.79

South Fork Hughes River - Sta 0+00 - 100 Yr Storm Worksheet for Irregular Channel

Project Description	
Worksheet	So Fork Hughes Sta
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.005000 ft/ft
Discharge	XXXXXX 3,710 cfs

Options	
Current Roughness Method	oved Lotter's Method
Open Channel Weighting Method	oved Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.044
Water Surface Elevation	835.21 ft
Elevation Range	8.00 to 839.00
Flow Area	704.0 ft ²
Wetted Perimeter	215.55 ft
Top Width	213.62 ft
Actual Depth	7.21 ft
Critical Elevation	833.68 ft
Critical Slope	0.020787 ft/ft
Velocity	5.27 ft/s
Velocity Head	0.43 ft
Specific Energy	835.64 ft
Froude Number	0.51
Flow Type	Subcritical

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+06	1+53	0.045
1+53	2+01	0.040
2+01	2+49	0.045

Natural Channel Points	
Station (ft)	Elevation (ft)
0+06	839.00
0+21	838.00
0+22	837.00
0+23	836.00
0+27	835.00
0+55	834.00
1+20	833.00
1+35	832.00
1+48	831.00
1+53	830.00
1+55	829.00
1+56	828.00

South Fork Hughes River - Sta 0+00 - 100 Yr Storm
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
1+97	828.00
1+98	829.00
2+01	830.00
2+05	831.00
2+25	832.00
2+33	833.00
2+37	834.00
2+39	835.00
2+42	836.00
2+45	837.00
2+47	838.00
2+49	839.00

Sheep Run Sta 7+00 - 100 Yr Storm Worksheet for Irregular Channel

Project Description	
Worksheet	Sheep Run - Sta
Flow Element	Irregular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data	
Slope	.029100 ft/ft
Discharge	1,600 cfs 1,648 cfs

Options	
Current Roughness Method	oved Lotter's Method
Open Channel Weighting Method	oved Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.045
Water Surface Elevation	840.97 ft
Elevation Range	5.84 to 841.79
Flow Area	152.2 ft ²
Wetted Perimeter	57.08 ft
Top Width	55.61 ft
Actual Depth	5.13 ft
Critical Elevation	841.27 ft
Critical Slope	0.021419 ft/ft
Velocity	10.83 ft/s
Velocity Head	1.82 ft
Specific Energy	842.80 ft
Froude Number	1.15
Flow Type	Supercritical

Roughness Segments		
Start Station	End Station	Mannings Coefficient
-0+32	0+27	0.045

Natural Channel Points	
Station (ft)	Elevation (ft)
-0+32	841.03
-0+17	839.89
-0+13	838.16
-0+11	837.27
-0+08	836.72
-0+06	836.37
-0+04	836.03
-0+02	835.84
0+00	835.97
0+02	836.00
0+06	836.00
0+08	836.02
0+11	836.58
0+13	837.52

Sheep Run Sta 7+00 - 100 Yr Storm
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
0+15	838.22
0+17	838.81
0+21	839.97
0+25	841.14
0+27	841.79

Hec-Ras Summary Output
South Fork Hughes River
Existing Conditions
10 yr/24 hr Storm & 100 yr/24 hr Storm

HEC-RAS Plan: SFH River: SFHughes Reach: 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
1	650.000	10 Yr Storm	1324.00	830.00	835.47		835.94	0.002917	5.54	249.56	64.24	0.44
1	650.000	100 Yr Storm	3710.00	830.00	838.02		839.25	0.005202	9.29	475.82	132.74	0.62
1	600.000	10 Yr Storm	1324.00	830.00	835.41		835.78	0.002335	5.02	287.93	83.01	0.40
1	600.000	100 Yr Storm	3710.00	830.00	838.12		838.91	0.003410	7.70	585.88	133.26	0.51
1	550.000	10 Yr Storm	1324.00	830.00	835.19		835.64	0.002987	5.42	247.84	64.74	0.45
1	550.000	100 Yr Storm	3710.00	830.00	837.36		838.64	0.005762	9.43	456.95	121.60	0.65
1	500.000	10 Yr Storm	1324.00	830.00	834.99		835.48	0.003480	5.64	248.41	75.24	0.48
1	500.000	100 Yr Storm	3710.00	830.00	836.95	836.28	838.32	0.006809	9.84	447.41	129.03	0.71
1	450.000	10 Yr Storm	1324.00	829.96	834.85		835.30	0.003417	5.51	265.27	100.33	0.47
1	450.000	100 Yr Storm	3710.00	829.96	836.92		837.90	0.005239	8.64	528.20	143.37	0.62
1	400.000	10 Yr Storm	1324.00	829.74	834.57		835.10	0.004413	5.92	249.73	136.91	0.53
1	400.000	100 Yr Storm	3710.00	829.74	836.81		837.60	0.004589	7.88	582.72	167.13	0.58
1	350.000	10 Yr Storm	1324.00	829.46	834.43		834.87	0.003711	5.65	291.16	149.06	0.49
1	350.000	100 Yr Storm	3710.00	829.46	836.79		837.35	0.003089	7.00	715.10	193.08	0.49
1	300.000	10 Yr Storm	1324.00	829.19	834.30		834.68	0.003350	5.44	318.84	142.68	0.47
1	300.000	100 Yr Storm	3710.00	829.19	836.67		837.19	0.003013	6.95	719.02	189.41	0.46
1	250.000	10 Yr Storm	1324.00	829.00	834.41		834.53	0.000778	3.06	518.90	157.12	0.24
1	250.000	100 Yr Storm	3710.00	829.00	836.74		837.04	0.001208	4.89	982.33	198.95	0.31
1	200.000	10 Yr Storm	1324.00	828.79	834.24		834.47	0.001546	4.07	406.17	163.30	0.33
1	200.000	100 Yr Storm	3710.00	828.79	836.53		836.95	0.001978	5.99	833.04	205.91	0.40
1	150.000	10 Yr Storm	1324.00	828.33	833.29	832.69	834.25	0.007957	7.96	180.78	78.73	0.72
1	150.000	100 Yr Storm	3710.00	828.33	835.46	835.40	836.69	0.007289	10.28	514.26	182.45	0.74
1	100.000	10 Yr Storm	1324.00	828.00	832.63	832.31	833.79	0.009370	8.84	167.51	82.24	0.78
1	100.000	100 Yr Storm	3710.00	828.00	835.35		836.29	0.005268	9.37	587.78	184.90	0.64
1	50.000	10 Yr Storm	1324.00	828.00	832.84		833.29	0.004004	6.05	280.51	112.15	0.52
1	50.000	100 Yr Storm	3710.00	828.00	835.39		835.97	0.003347	7.59	712.02	199.32	0.51
1	0.000	10 Yr Storm	1324.00	828.00	832.70	831.14	833.10	0.003121	5.16	282.57	106.23	0.46
1	0.000	100 Yr Storm	3710.00	828.00	835.21	833.88	835.81	0.002983	6.99	710.54	213.29	0.48

Hec-Ras Summary Output

Sheep Run

Existing Conditions

10 yr/24 hr Storm & 100 yr/24 hr Storm

HEC-RAS Plan: Plan 01 River: SheepRun Reach: 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
1	700.000	10 Yr Storm	695.50	835.84	840.27	839.27	840.83	0.007825	6.00	118.43	42.41	0.61
1	700.000	100 yr Storm	1648.00	835.84	840.97	841.16	842.96	0.021415	11.41	150.66	55.30	1.04
1	650.000	10 Yr Storm	695.50	835.00	839.86	838.92	840.46	0.006668	6.53	126.11	105.99	0.58
1	650.000	100 yr Storm	1648.00	835.00	841.46	840.97	842.00	0.005137	7.18	335.60	141.71	0.53
1	600.000	10 Yr Storm	695.50	834.00	839.69		840.13	0.004875	5.50	154.65	110.85	0.49
1	600.000	100 yr Storm	1648.00	834.00	841.34		841.74	0.003707	6.05	384.27	152.88	0.45
1	550.000	10 Yr Storm	695.50	834.00	839.63		839.90	0.002774	4.59	199.08	104.38	0.38
1	550.000	100 yr Storm	1648.00	834.00	841.19		841.57	0.003093	5.91	393.39	139.19	0.42
1	500.000	10 Yr Storm	695.50	834.00	838.70	838.59	839.60	0.011017	8.32	110.10	66.79	0.73
1	500.000	100 yr Storm	1648.00	834.00	840.11	840.11	841.24	0.011538	10.40	232.11	102.20	0.79
1	450.000	10 Yr Storm	695.50	834.00	838.52		839.05	0.008520	5.88	124.41	67.52	0.62
1	450.000	100 yr Storm	1648.00	834.00	839.47	839.56	840.71	0.014676	9.40	206.81	102.94	0.86
1	400.000	10 Yr Storm	695.50	833.86	838.44	837.78	838.67	0.003658	4.51	209.41	128.26	0.43
1	400.000	100 yr Storm	1648.00	833.86	839.15	838.76	839.73	0.007523	7.33	308.59	149.45	0.63
1	350.000	10 Yr Storm	695.50	833.82	837.29	837.29	838.26	0.016515	8.26	98.88	124.40	0.87
1	350.000	100 yr Storm	1648.00	833.82	838.60	838.60	839.29	0.009932	8.29	307.83	192.90	0.72
1	300.000	10 Yr Storm	695.50	832.71	836.95	836.20	837.34	0.006067	5.34	153.20	139.96	0.54
1	300.000	100 yr Storm	1648.00	832.71	838.29	837.61	838.81	0.005893	6.70	346.75	222.91	0.56
1	250.000	10 Yr Storm	695.50	832.00	836.78		837.09	0.003444	4.78	175.67	128.67	0.42
1	250.000	100 yr Storm	1648.00	832.00	837.73	836.96	838.48	0.008999	7.87	315.01	201.03	0.63
1	200.000	10 Yr Storm	695.50	831.38	836.47		836.91	0.005497	6.63	165.50	158.14	0.54
1	200.000	100 yr Storm	1648.00	831.38	837.78		838.19	0.004981	7.45	391.64	187.23	0.54
1	150.000	10 Yr Storm	695.50	830.77	836.54		836.73	0.002097	3.98	258.69	176.26	0.33
1	150.000	100 yr Storm	1648.00	830.77	837.82		838.06	0.002279	4.91	493.12	188.18	0.36
1	130.000	10 Yr Storm	695.50	830.22	836.50		836.69	0.001859	3.96	284.01	183.14	0.32
1	130.000	100 yr Storm	1648.00	830.22	837.78		838.03	0.002089	4.92	510.96	198.24	0.35
1	110.000	10 Yr Storm	695.50	830.00	836.40	834.28	836.64	0.004280	4.10	214.54	214.21	0.42
1	110.000	100 yr Storm	1648.00	830.00	837.73	836.77	837.98	0.001980	3.57	512.10	235.55	0.30
1	109		Bridge									
1	93.000	10 Yr Storm	695.50	830.00	834.18	834.18	835.75	0.026674	10.04	69.26	22.16	1.00
1	93.000	100 yr Storm	1648.00	830.00	835.79	836.33	837.43	0.022054	11.73	225.96	227.02	0.95
1	73.000	10 Yr Storm	695.50	829.99	834.35	833.33	834.54	0.008038	3.52	204.35	177.87	0.54
1	73.000	100 yr Storm	1648.00	829.99	836.68	834.61	836.76	0.000944	2.39	840.95	378.41	0.22
1	50.000	10 Yr Storm	695.50	829.00	834.42		834.45	0.000647	1.51	517.48	344.78	0.17
1	50.000	100 yr Storm	1648.00	829.00	836.71		836.73	0.000219	1.37	1382.36	380.00	0.11
1	0.000	10 Yr Storm	695.50	829.00	834.40	831.54	834.43	0.000398	1.67	644.96	380.00	0.14
1	0.000	100 yr Storm	1648.00	829.00	836.70	832.94	836.72	0.000166	1.45	1518.96	380.00	0.10

Hec-Ras Summary Output

Sheep Run

Proposed Conditions

10 yr/24 hr Storm & 100 yr/24 hr Storm

HEC-RAS Plan: Plan 01 River: SheepRun Reach: 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
1	700.000	10 Yr Storm	695.50	835.84	840.25	839.27	840.82	0.007622	6.09	115.63	42.07	0.60
1	700.000	100 Yr Storm	1648.00	835.84	840.97	841.32	843.00	0.020835	11.54	150.66	55.30	1.03
1	650.000	10 Yr Storm	695.50	835.00	839.94	838.85	840.46	0.006417	5.84	135.23	116.57	0.56
1	650.000	100 Yr Storm	1648.00	835.00	841.51	840.90	842.00	0.004850	6.52	342.74	142.28	0.51
1	600.000	10 Yr Storm	695.50	834.00	839.74		840.17	0.004443	5.48	159.88	114.26	0.47
1	600.000	100 Yr Storm	1648.00	834.00	841.37		841.77	0.003560	6.10	388.96	153.12	0.45
1	550.000	10 Yr Storm	695.50	834.00	839.69		839.95	0.002568	4.56	205.48	106.39	0.37
1	550.000	100 Yr Storm	1648.00	834.00	841.23		841.60	0.002978	5.93	399.01	139.72	0.42
1	500.000	10 Yr Storm	695.50	834.00	838.63	838.63	839.65	0.011506	8.91	105.67	63.74	0.76
1	500.000	100 Yr Storm	1648.00	834.00	840.18	840.18	841.29	0.010647	10.56	239.39	104.07	0.77
1	450.000	10 Yr Storm	695.50	834.00	838.49	837.74	839.05	0.008284	6.08	122.89	66.49	0.62
1	450.000	100 Yr Storm	1648.00	834.00	839.42	839.60	840.76	0.015235	9.85	201.96	101.39	0.88
1	400.000	10 Yr Storm	695.50	833.86	838.43	837.80	838.68	0.003657	4.61	209.05	128.16	0.43
1	400.000	100 Yr Storm	1648.00	833.86	839.13	838.79	839.73	0.007749	7.55	306.25	149.07	0.64
1	350.000	10 Yr Storm	695.50	833.82	837.29	837.29	838.27	0.016592	8.27	98.83	124.67	0.88
1	350.000	100 Yr Storm	1648.00	833.82	838.61	838.61	839.29	0.008811	8.24	309.47	193.05	0.72
1	300.000	10 Yr Storm	695.50	832.71	838.86	836.20	837.29	0.006968	5.60	145.42	136.89	0.57
1	300.000	100 Yr Storm	1648.00	832.71	838.48	837.75	838.87	0.004408	5.96	397.27	224.41	0.49
1	250.000	10 Yr Storm	695.50	832.00	836.65		837.00	0.003952	4.93	165.76	123.63	0.45
1	250.000	100 Yr Storm	1648.00	832.00	837.50	836.94	838.50	0.009565	8.78	267.99	199.00	0.72
1	200.000	10 Yr Storm	695.50	831.38	835.96	835.80	836.71	0.010031	8.30	123.38	94.61	0.72
1	200.000	100 Yr Storm	1648.00	831.38	837.37	837.37	838.10	0.009052	9.58	315.76	183.96	0.72
1	150.000	10 Yr Storm	695.50	830.77	836.01	834.86	836.35	0.004023	5.06	175.23	131.75	0.45
1	150.000	100 Yr Storm	1648.00	830.77	837.47	836.71	837.78	0.003101	5.50	442.87	185.28	0.42
1	127.000	10 Yr Storm	695.50	830.00	835.96		836.28	0.002471	4.78	188.16	150.53	0.40
1	127.000	100 Yr Storm	1648.00	830.00	837.42		837.73	0.002262	5.53	453.49	196.89	0.40
1	113.000	10 Yr Storm	695.50	830.00	836.01	832.86	836.22	0.001585	3.91	248.14	198.45	0.28
1	113.000	100 Yr Storm	1648.00	830.00	837.48	836.32	837.67	0.001526	4.44	557.15	222.60	0.29
1	101		Culvert									
1	91.000	10 Yr Storm	695.50	830.00	833.96		834.68	0.007718	6.83	101.84	25.72	0.60
1	91.000	100 Yr Storm	1648.00	830.00	836.47		836.86	0.003509	6.14	429.94	264.99	0.43
1	73.000	10 Yr Storm	695.50	830.00	834.41		834.45	0.000618	1.72	440.75	180.96	0.17
1	73.000	100 Yr Storm	1648.00	830.00	836.69		836.74	0.000430	2.07	1071.52	378.69	0.18
1	50.000	10 Yr Storm	695.50	829.00	834.43		834.44	0.000063	0.76	1010.75	345.88	0.06
1	50.000	100 Yr Storm	1648.00	829.00	836.71		836.73	0.000070	1.04	1875.26	380.00	0.07
1	0.000	10 Yr Storm	695.50	829.00	834.40	831.54	834.43	0.000388	1.73	644.96	380.00	0.14
1	0.000	100 Yr Storm	1648.00	829.00	836.70	832.93	836.72	0.000165	1.49	1518.96	380.00	0.10

**HYDROLOGIC AND HYDRAULIC ANALYSIS
SHEEP RUN BRIDGE REPLACEMENT
WV CR19/11 – MILE POST 2.45**

FOR
CNX GAS COMPANY LLC

DODDRIDGE COUNTY, WEST VIRGINIA

JULY 31, 2014
REVISED April 17th, 2015

Prepared By:
Blue Mountain, Inc.
10125 Mason Dixon Hwy
Burton, WV 26562



TABLE OF CONTENTS

I.	Purpose	Page 1
II.	Analysis	Page 1
III.	Watersheds	Page 1
IV.	Runoff Discharge Methods	Page 1
V.	Design Storms	Page 2
VI.	Hydrologic Soil Groups	Page 2
VII.	Weighted Curve Number	Page 2
VIII.	Time of Concentration	Page 2
IX.	Peak Discharge	Page 3
X.	Hydraulic Analysis	Page 4
XI.	Results	Page 5 S

APPENDIX

WVDOH Drainage Manual Worksheet 4-1 Runoff Curve Number Determination	APP-1
WVDOH Drainage Manual Worksheet 4-2 Time of Concentration Calculation	APP-2
WVDOH Drainage Manual Form 4-1 Peak Discharge Computation	APP-5
So. Fork Hughes River - 10 yr Storm	APP-6
Sheep Run - 10 yr Storm	APP-13
So. Fork Hughes River - 100 yr Storm	APP-20
Sheep run - 100 yr Storm	APP-27
So. Fork Hughes River - Sta. 0+00 10 yr Storm	APP-34
Sheep Run - Sta. 7+00 10 yr Storm	APP-36
So. Fork Hughes River - Sta. 0+00 100 yr Storm	APP-38
Sheep Run - Sta. 7+00 100 yr Storm	APP-40
Hec-Ras Summary Output	
So. Fork Hughes River - Existing Conditions 10 yr & 100 yr Storms	APP-42
Sheep Run - Existing Conditions 10 yr & 100 yr Storms	APP-43
Sheep Run - Proposed Conditions 10 yr & 100 yr Storms	APP-44

I. Purpose

CNX Gas Company LLC is proposing to upgrade an existing bridge structure on WV CR 19/ 11, Mile Post 2.45, to increase the available load carrying capacity of the crossing. The existing bridge, crossing Sheep Run near it's confluence with the South Fork Hughes River, is to be replaced with an aluminum box culvert having a 95 ton combination load bearing capacity. This report analyzes the anticipated affect the installation of the box culvert will have on the water surface elevations in Sheep Run during the design storm events.

II. Analysis

As stated, the location of the proposed bridge replacement is close to the confluence of Sheep Run and the South Fork Hughes River, close enough that the water surfaces generated in the South Fork Hughes River basin during the design storm events will influence the water surface elevations in Sheep Run at the location of the proposed bridge replacement.

Consequently, this report looks at the anticipated water surface elevations in the South Fork Hughes River basin in its entirety, which includes the Sheep Run basin, and then looks at the anticipated water surface elevations in the Sheep Run Basin for the existing and proposed conditions, taking into account the tail water condition from the South Fork Hughes River that will occur downstream of the bridge location.

III. Watersheds

The contributing watershed for the South Fork Hughes River basin (includes the Sheep Run basin) and the contributing watershed for the Sheep Run basin were estimated from the New Milton, WV and the Oxford, WV USGS 7.5 min Quadrangle Maps.

South Fork Hughes River Watershed = 6,950 ac.

Sheep Run Watershed = 825 ac.

Please see Dwg. No. WS-01, 'Watershed Maps' for the watershed limits.

IV. Runoff Discharge Methods

The West Virginia Department of Transportation-Division of Highways-Engineering Division- Drainage Manual-3rd Edition-December 2007 (WVDOH Drainage Manual) suggests three hydrologic runoff estimation methods: the Rational Method, the TR-55 Method, and the USGS Method. With 6,950 ac. and 825 ac. watersheds for the South Fork Hughes River basin and the Sheep Run basin respectively, the Rational

Method, with a 0 to 200 ac. watershed range, was deemed not applicable. For this analysis, the TR-55 Method and the USGS Method were used initially to estimate peak runoff for the design storms.

V. Design Storms

From the WVDOH Drainage Manual, design storms for different facilities are determined based on the estimated Average Daily Traffic Volume (ADT). For WV CR 19/11, no hard traffic data exists, but it is estimated that the ADT is less than 400 vehicles per day. As per Table 4-2, Design Storm Criteria, for Channels, Culverts, and Bridges the recommended Design Storm is the 10 yr. Frequency (10%) storm.

This report also analyzes the effects of the 100 yr. Frequency (1%) Design Storm.

VI. Hydrologic Soil Groups

From the NRCS Soil Survey of Doddridge County, WV, it appears that the primary soil types in the South Fork Hughes River basin, which includes the Sheep Run Basin, are the Gilpin- Peabody Complex and the Gilpin-Upshur Complex, both belonging to the Hydrologic Soil Group (HSG) C/D. Other soil types occurring in the watershed are the Kanawha Loam Complex, HSG B; Monongahela Silt Loam, HSG C; Sensabaugh Silt Loam, HSG B; and Vandalia Silt Loam, HSG D. The Vandalia Silt Loam is a very small percentage of the total in the watershed and therefore a Hydrologic Soil Group Classification of C was used for the watershed.

VII. Weighted Curve Number, CN

It is estimated that 85% of the watershed is in tree cover and 15% is pasture/ meadow. From the WVDOH Drainage Manual, Table 4-9, Runoff Curve Numbers for Rural Areas, for Woods Only in Good Condition & HSG C, the CN is 70; for Meadow with Continuous Grass Cover & HSG C, the CN is 71. The Weighted CN is 70.2. WVDOH Drainage Manual Worksheet 4-1, Runoff Curve Number Determination, is included in the Appendix.

VIII. Time of Concentration

The TR-55 Method was used to calculate the Time of Concentration for both the South Fork Hughes River basin and the Sheep Run Basin. The computer program, Hydraflow Hydrographs v6.0, which uses the TR-55 Method to determine Time of Concentration, was used to perform the calculations for both the South Fork Hughes River Basin and the Sheep Run Basin.

Tc, South Fork Hughes River: 76 min. / 1.27 hr.

Tc, Sheep Run: 29.3 min. / 0.49 hr.

The program summary sheet is attached to WVD OH Drainage Manual Worksheet 4-2, Time of Concentration Calculation, and is included in the Appendix.

IX. Peak Discharge

A. South Fork Hughes River

From the WVD OH Drainage Manual, Form 4-1, Peak Discharge Computation Form, the peak discharges for the 10 yr. / 24 hr. design storm from the TR-55 Method and the USGS Method are 2,825 cfs and 2,006 cfs, respectively. As an additional check, the computer program Hydraflow Hydrographs v6.0 was also used to estimate the peak flow for the SC\$ Type II 10 yr. / 24 hr. design storm. From Hydraflow, the estimated peak runoff for the 10 yr. / 24 hr. storm is 2,988 cfs.

With watershed sizes of 6,950 ac. (10.86 sq. mi.) for the South Fork Hughes River basin and 825 ac. (1.29 sq. mi.) for the Sheep Run basin, and the USGS Method being recommended for watersheds over 10 sq. mi., the USGS Method was disregarded. This leaves the TR-SS Method and the Hydraflow program.

As Hydraflow has the added feature of generating the outflow hydrograph in 1 minute time intervals, and having very similar results to the TR-SS method, it was decided to use the results from Hydraflow, peak flow of 2,988 cfs and to also use Hydraflow to analyze the Sheep Run basin.

WVD OH Drainage Manual Form 4-1 and the Hydraflow output are included in the Appendix.

B. Sheep Run

From Hydraflow, the estimated peak flow for the 10 yr. / 24 hr. design storm for the Sheep Run basin is 695.5 cfs and occurs at 12.20 hours. However, the peak flow in the South Fork Hughes River occurs at 12.68 hours. From the discharge hydrograph for the South Fork Hughes River, at 12.20 hours the flow is 1,324 cfs. Therefore 1,324 cfs was used to determine the estimated water surface elevations in the South Fork Hughes River at the time of peak flow in the Sheep Run basin.

X. Hydraulic Analysis

A. 10yr/24 hr. Design Storm

The computer program Hec-Ras v4.1.0 was used to estimate the water surface profile in the South Fork Hughes River reach and in the Sheep run reach for the 10 yr. / 24 hr. design storm, for both the existing and proposed conditions. Typical sections of the existing bridge and the proposed pre-cast concrete box culvert are shown on Dwg. No. XS-01, 'Typical Cross- Section Existing Bridge' and Dwg. No. XS-02, 'Typical Cross-Section Precast Concrete Box Culvert'.

The first step was to establish a starting water surface elevation in the South Fork Hughes River reach. With an approximate existing channel slope of 0.5% for the study reach of the South Fork Hughes River, the flow regime is subcritical and therefore the most downstream station, Sta. 0+00, was used as the control section. From the computer program Flow Master V6.1, with a flow of 1,324 cfs, the water surface elevation is estimated to be EL 832.70 ft.

The next step was to input this information into Hec-Ras to estimate the water surface profile for the South Fork Hughes River for the 10 yr. / 24 hr. design storm. A subcritical steady flow analysis was performed and the results are shown on Dwg. No. SP-01, 'Site Map-10 yr. Storm-Existing Conditions', and Dwg. No. SP-02, 'Site Map-10 yr. Storm-Proposed Conditions'.

This information was used to establish the tail water /downstream water surface elevation for the Sheep Run study reach. The estimated water surface elevation at Sta. 2+50 in the South Fork Hughes River is approximately EL 834.40 ft. and was used as the downstream water surface elevation in Sheep Run. The channel slope for the Sheep Run study reach varies from mild at the downstream end to steep at the upstream end. Therefore a mixed flow regime was run for Sheep Run and a water surface elevation was estimated for Sta. 7+00 using Flow Master. From Flow Master, for a design flow of 695.5 cfs, the estimated water surface elevation at Sta. 7+00 is approximately El. 839.09 ft.

These two water surface elevations were used to run a mixed flow regime steady flow analysis with Hec-Ras for the existing and proposed conditions in Sheep Run.

Results of the Hec-Ras run have been plotted in plan view on Dwg. No. SP-01, 'Site Map-10 yr. Storm-Existing Conditions' and Dwg. No. SP-02, 'Site Map-10 yr. Storm-Proposed Conditions'. The water surface profile for existing and proposed conditions for the 10 yr. / 24 hr. storm has been plotted on Dwg. No. PR-01, 'Water Surface Profiles'.

Summary output information from the Hec-Ras run has been included in the Appendix.

B. 100yr/ 24 hr. Design Storm

The computer program Hec-Ras v4.1.0 was used to estimate the water surface profile in the South Fork Hughes River reach and in the Sheep run reach for the 100 yr. / 24 hr. design storm, for both the existing and proposed conditions. Typical sections of the existing bridge and the proposed pre-cast concrete box culvert are shown on Dwg. No. XS-01, 'Typical Cross- Section Existing Bridge' and Dwg. No. XS-02, 'Typical Cross- Section Precast Concrete Box Culvert'.

The same procedure used to analyze the 10 yr. / 24 hr. storm was used to analyze the 100yr. / 24 hr. storm. Estimated flow in the South Fork Hughes River basin is 3,710 cfs and in the Sheep Run basin the estimated flow is 1,648 cfs. The estimated water surface elevation at Sta. 0+00 of the South Fork Hughes River is El. 835.21 ft. for a flow of 3,710 cfs. From the Hec-Ras run, the estimated water surface elevation at Sta. 2+50 in the South Fork Hughes River is approximately El. 836.70 ft. and was used as the downstream water surface elevation in Sheep Run. The estimated water surface elevation at Sta. 7+00 of Sheep Run for 1,648 cfs is El. 840.97 ft. Using the water surface elevations at Sta. 2+50 of the South Fork Hughes River as the known downstream elevation and the water surface elevation at Sta. 0+00 of Sheep run as the known upstream elevation, a mixed flow regime steady flow analysis was run for Sheep Run for existing and proposed conditions.

Results of the Hec-Ras run have been plotted in plan view on Dwg. No. SP-03, 'Site Map- 100 yr. Storm-Existing Conditions' and Dwg. No. SP-04, 'Site Map-100 yr. Storm-Proposed Conditions'. The water surface profile for existing and proposed conditions for the 100 yr. / 24 hr. storm has been plotted on Dwg. No. PR-01, 'Water Surface Profiles'. Summary output information from the Hec-Ras run has been included in the Appendix.

XI. Results

This analysis indicates that for both the 10 yr. / 24 hr. design storm and the 100 yr. / 24 hr. design storm, the installation of the aluminum box in Sheep Run on WV Co. Rd. 19/ 11 will lower the expected water surface elevation over existing conditions. The expected drop in the water surface elevation for the 10 yr. / 24 hr. storm is 1.25 ft. to 1.35ft. For the 100 yr. / 24 hr. storm the expected drop is 0.40 ft. to 0.50 ft.

APPENDIX

Worksheet 4-1 Runoff Curve Number Determination

WORKSHEET 4-1 RUNOFF CURVE NUMBER DETERMINATION																					
CALCULATED BY: <u>BEK</u>		DATE: <u>07-21-14</u>		PROJECT NAME: <u>Sheep Run Bridge Replacement</u>																	
CHECKED BY: <u>BEK</u>		DATE: <u>07-21-14</u>		STATE PROJECT NUMBER: _____																	
Soil Name	Hydrologic Group	Cover Description percent impervious unconnected/connected impervious area ratio	CN Source			Area In mi ²	CN X Area														
			Table 4-9	Table 4-10	Chart 4-5																
Gilpin-Peabody	C/D	15% Meadow	71			1.63	115.7														
Gilpin-Upshur	C/D	85% Woods	70			9.23	646.1														
Kanawha Loam	B																				
Monongahela Silt Loam	C																				
Sensabaugh Silt Loam	B																				
Vanadalia Silt Loam	D																				
one CN source per line																					
Weighted CN = Total CN X Area / Total Area						Totals →															
Weighted Curve Number						10.86															
Potential Maximum Retention, S in inches						761.8															
			70.2																		
			4.2																		
			<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Storm #1</th> <th>Storm #2</th> </tr> </thead> <tbody> <tr> <td>Return Period in years</td> <td>10</td> </tr> <tr> <td>24 Hour Rainfall Depth, P in inches</td> <td>3.5</td> </tr> <tr> <td>Runoff Depth, Q in inches</td> <td>1.0</td> </tr> <tr> <td></td> <td>100</td> </tr> <tr> <td></td> <td>5.25</td> </tr> <tr> <td></td> <td>2.2</td> </tr> </tbody> </table>					Storm #1	Storm #2	Return Period in years	10	24 Hour Rainfall Depth, P in inches	3.5	Runoff Depth, Q in inches	1.0		100		5.25		2.2
Storm #1	Storm #2																				
Return Period in years	10																				
24 Hour Rainfall Depth, P in inches	3.5																				
Runoff Depth, Q in inches	1.0																				
	100																				
	5.25																				
	2.2																				
24 hour Rainfall Depth from Table 4-11, or Map 4-3 through Map 4-8 Runoff Depth from Table 4-12 or Chart 4-6																					

Source: Urban Hydrology for Small Watersheds, TR-55, June 1986

Worksheet 4-2 Time of Concentration Calculation

WORKSHEET 4-2 TIME OF CONCENTRATION COMPUTATION																										
CALCULATED BY: <u>BEK</u> DATE: <u>07-21-14</u> CHECKED BY: <u>BEK</u> DATE: <u>07-21-14</u>	PROJECT NAME: <u>Sheep Run Bridge Replacement</u> STATE PROJECT NUMBER: _____																									
Space for two sections per flow type can be used for each worksheet. Include a map, schematic or description of the flow segments																										
OVERLAND FLOW SEGMENT. SHEET FLOW TYPE																										
Surface description (Table 4-5) Roughness coeff. n (Table 4-5) Flow length L in ft (should be ≤ 100 ft) 2 Yr 24 Hr rainfall depth P in inches (Map 4-3) Land slope S in ft / ft Computed travel time T_t in <u>hours</u>	<table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;">Section ID</th> <td style="border: 1px solid black; width: 100px; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> </table>	Section ID																<p>* See Attached calculation sheets for T_c for South Fork Hughes River & Sheep Run Watersheds.</p> <p style="text-align: right; margin-top: 20px;">= </p>								
Section ID																										
OVERLAND FLOW SEGMENT. SHALLOW CONCENTRATED FLOW TYPE																										
Cover type Surface cover coefficient in equation Watercourse slope S in ft / ft Average velocity V in ft / s (Chart 4-7) Flow length in ft Computed travel time T_t in <u>hours</u>	<table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;">Section ID</th> <td style="border: 1px solid black; width: 100px; height: 20px;"></td> <td style="border: 1px solid black; width: 100px; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> </table>	Section ID																								<p style="text-align: right; margin-top: 20px;">+ = </p>
Section ID																										
note: overland flow (sheet flow + shallow concentrated flow should be < 200' urban areas, < 400' rural areas)																										
CHANNEL FLOW SEGMENT																										
Cross sectional flow area A in ft ² Wetted flow perimeter P in ft Hydraulic radius $R = A / P$ in ft Channel slope S in ft / ft Mannings roughness coeff. n (Table 4-7) Velocity from Mannings equation, V in ft / s Flow length L in ft Computed travel time T_t in <u>hours</u>	<table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;">Section ID</th> <td style="border: 1px solid black; width: 100px; height: 20px;"></td> <td style="border: 1px solid black; width: 100px; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> <tr> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> <td style="border: 1px solid black; height: 20px;"></td> </tr> </table>	Section ID																								<p style="text-align: right; margin-top: 20px;">+ = </p> <p style="text-align: right; margin-top: 10px;">Watershed time of concentration T_c in <u>hours</u> </p>
Section ID																										

Source: Urban Hydrology for Small Watersheds, TR-55, June 1986

Hyd. No. 1

So Fork Hughes River
Storm frequency = 10 yrs

Sheet Flow

Manning's n-value = 0.400
Flow length = 100.0 ft
Two-year 24-hr precip. = 2.55 in
Land slope = 25.0 %
Travel Time = 8.8 min

Shallow Concentrated Flow

Flow length = 300 ft
Watercourse slope = 28.0 %
Surface description = Unpaved
Average velocity = 8.54 ft/s
Travel Time = 0.6 min

Channel Flow

Cross section flow area = 80.0 sqft
Wetted perimeter = 24.0 ft
Channel slope = 0.8 %
Manning's n-value = 0.035
Velocity = 8.53 ft/s
Flow length = 34140.0 ft
Travel Time = 66.7 min

Total Travel Time, Tc = 76.0 min

Hyd. No. 2

Sheep Run

Storm frequency = 10 yrs

Sheet Flow

Manning's n-value = 0.550
Flow length = 100.0 ft
Two-year 24-hr precip. = 2.55 in
Land slope = 18.0 %

Travel Time = 12.9 min

Shallow Concentrated Flow

Flow length = 300 ft
Watercourse slope = 13.0 %
Surface description = Unpaved
Average velocity = 5.82 ft/s

Travel Time = 0.9 min

Channel Flow

Cross section flow area = 18.4 sqft
Wetted perimeter = 9.5 ft
Channel slope = 3.6 %
Manning's n-value = 0.040
Velocity = 11.01 ft/s
Flow length = 10290.0 ft

Travel Time = 15.6 min

Total Travel Time, Tc = 29.3 min

Form 4-1 Peak Discharge Computation Form

PEAK DISCHARGE COMPUTATION FORM DR 4-1														
CALCULATED BY: <u>BEK</u> CHECKED BY: <u>BEK</u>	DATE: <u>07-21-14</u> DATE: <u>07-21-14</u>	PROJECT NAME: <u>Sheep Run Bridge Replacement</u> STATE PROJECT NUMBER: _____												
AREA NUMBER: _____ LOCATION DESCRIPTION: <u>So. Fork Hughes River Basin</u> DRAINAGE AREA = <u>6,950</u> ACRES <u>10.86</u> MI ²	ATTACH WATERSHED MAP _____ STATION _____ TO _____ DESIGN RETURN PERIOD: <u>10</u> YEARS													
RATIONAL METHOD 1 acre - 200 acres	TR - 55 5 acres - 16,000 acres	USGS METHOD 10 square miles - 1,616 square miles												
TIME OF CONCENTRATION OVERLAND FLOW SHEET FLOW $T_{1sh} =$ _____ Min. SHALLOW CONCENTRATED FLOW $T_{1sc} =$ _____ Min. CHANNEL FLOW $T_{1ch} =$ _____ Min. $T_c = T_{1sh} + T_{1sc} + T_{1ch} =$ _____ Min. Method: Kirpich (rural areas) <input type="checkbox"/> Segments (urban areas) <input type="checkbox"/> IDF REGION _____ Rainfall Intensity $i =$ _____ in/hr <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; text-align: center;">C</td> <td style="width: 33%; text-align: center;">A</td> <td style="width: 33%; text-align: center;">CA</td> </tr> <tr> <td>_____</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>_____</td> <td>_____</td> <td>_____</td> </tr> <tr> <td style="text-align: center;">Total</td> <td>_____</td> <td>_____</td> </tr> </table> Weighted Coefficient "C" = _____ $C = \sum(CA) / \sum A$	C	A	CA	_____	_____	_____	_____	_____	_____	Total	_____	_____	INFO FROM WORKSHEET 4-1 $CN =$ <u>70.2</u> $24 \text{ hr } P =$ <u>3.5</u> in. $\text{Runoff Depth } Q =$ <u>1.0</u> in. INFO FROM WORKSHEET 4-2 $T_c =$ <u>1.27</u> hr. INITIAL ABSTRACTION (Table 4-13) $I_a =$ <u>0.85</u> in. $I_a / P =$ <u>0.24</u> UNIT PEAK DISCHARGE q_u USE T_c AND I_a / P WITH CHART 4-8 $=$ <u>260</u> cfs / mi ² / in. POND AND SWAMP AREAS Percent of watershed $=$ <u>0</u> % (Table 4-8) Factor $F_p =$ <u>1.0</u> PEAK DISCHARGE $q_p = q_u (A \text{ in } \text{mi}^2) Q F_p$ $q_p =$ <u>2,825</u> cfs	REGION: FROM MAP 4-9 EASTERN PANHANDLE <input type="checkbox"/> CENTRAL MOUNTAINS <input type="checkbox"/> WESTERN PLATEAUS <input checked="" type="checkbox"/> EQUATION: FROM TABLE 4-9 ¹⁴ $\text{Eqn: } 292A^{0.699}$ $= 1,546.8 \text{ cfs}$ PRELIMINARY DESIGN DRAINAGE AREA 5 TO 10 MI ² ADD THE STANDARD PREDICTION ERROR $=$ <u>29.7</u> % $= 459.4 \text{ cfs}$
C	A	CA												
_____	_____	_____												
_____	_____	_____												
Total	_____	_____												
$Q =$ _____ cfs	$q_p =$ <u>2,825</u> cfs	$Q =$ <u>2,006</u> cfs												
SELECTED DESIGN DISCHARGE $Q =$ _____ cfs	REASON FOR SELECTION (BASED ON COMPARISON) SEE SECTION 4.3.4 <u>See Section IX.A, Peak Discharge South Fork Hughes River - H & H Report.</u>													

Source: Created by the WVDOH Hydraulic and Drainage Unit

Hydrograph Plot

English

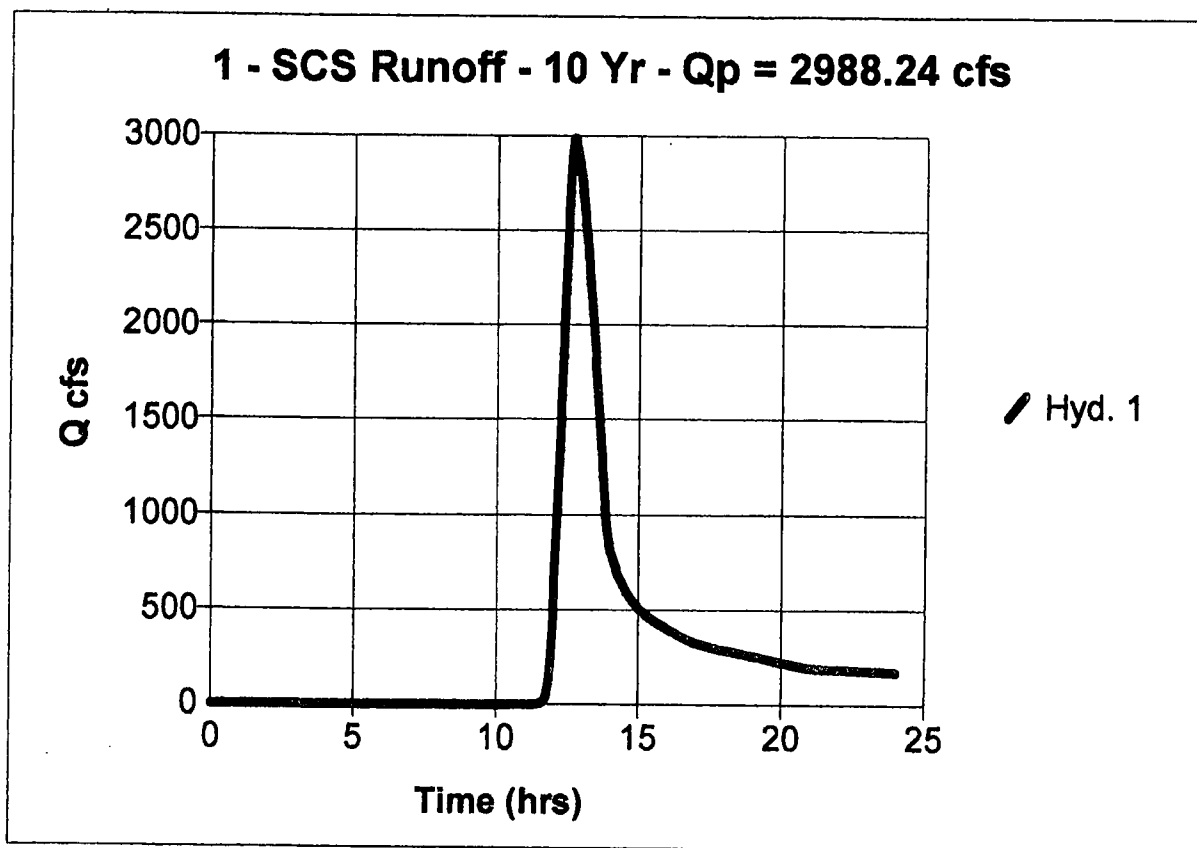
Hyd. No. 1

So Fork Hughes River

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Drainage area = 6950.00 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 3.50 in
Storm duration = 24 hrs

Peak discharge = 2988.24 cfs
Time interval = 1 min
Curve number = 70.2
Hydraulic length = 0 ft
Time of conc. (Tc) = 76 min
Distribution = Type II
Shape factor = 484

Total Volume = 25,145,960 cuft



Hyd. No. 1

So Fork Hughes River
Storm frequency = 10 yrs

Sheet Flow

Manning's n-value = 0.400
Flow length = 100.0 ft
Two-year 24-hr precip. = 2.55 in
Land slope = 25.0 %
Travel Time = 8.8 min

Shallow Concentrated Flow

Flow length = 300 ft
Watercourse slope = 28.0 %
Surface description = Unpaved
Average velocity = 8.54 ft/s
Travel Time = 0.6 min

Channel Flow

Cross section flow area = 80.0 sqft
Wetted perimeter = 24.0 ft
Channel slope = 0.8 %
Manning's n-value = 0.035
Velocity = 8.53 ft/s
Flow length = 34140.0 ft
Travel Time = 66.7 min

Total Travel Time, Tc = 76.0 min

Hydrograph Report

Hyd. No. 1

So Fork Hughes River

Hydrograph type	= SCS Runoff	Peak discharge	= 2988.24 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 6950.00 ac	Curve number	= 70.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 76 min
Total precip.	= 3.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 25,145,980 cuft

Hydrograph Discharge Table

Time -- Outflow	Time -- Outflow	Time -- Outflow	Time -- Outflow
(hrs cfs)	(hrs cfs)	(hrs cfs)	(hrs cfs)
11.70 33.21	12.23 1459.71	12.77 2947.23	13.30 2150.50
11.72 39.29	12.25 1528.49	12.78 2933.92	13.32 2116.90
11.73 46.44	12.27 1597.70	12.80 2919.69	13.33 2082.96
11.75 54.82	12.28 1667.34	12.82 2904.54	13.35 2048.70
11.77 64.64	12.30 1737.32	12.83 2888.49	13.37 2014.10
11.78 76.24	12.32 1807.58	12.85 2871.55	13.38 1979.19
11.80 90.01	12.33 1878.02	12.87 2853.75	13.40 1943.96
11.82 106.38	12.35 1948.54	12.88 2835.10	13.42 1908.42
11.83 125.81	12.37 2019.02	12.90 2815.61	13.43 1872.58
11.85 148.83	12.38 2089.34	12.92 2795.31	13.45 1836.44
11.87 176.03	12.40 2159.35	12.93 2774.21	13.47 1800.01
11.88 208.03	12.42 2228.89	12.95 2752.34	13.48 1763.29
11.90 245.51	12.43 2297.77	12.97 2729.71	13.50 1726.30
11.92 289.18	12.45 2365.80	12.98 2706.33	13.52 1689.05
11.93 337.14	12.47 2432.76	13.00 2682.23	13.53 1651.57
11.95 389.19	12.48 2498.43	13.02 2657.43	13.55 1613.86
11.97 444.46	12.50 2562.53	13.03 2631.96	13.57 1575.96
11.98 502.06	12.52 2624.71	13.05 2605.82	13.58 1537.91
12.00 560.94	12.53 2684.42	13.07 2579.05	13.60 1499.73
12.02 620.60	12.55 2741.05	13.08 2551.67	13.62 1461.48
12.03 681.03	12.57 2793.91	13.10 2523.69	13.63 1423.19
12.05 742.21	12.58 2842.23	13.12 2495.14	13.65 1384.92
12.07 804.12	12.60 2885.19	13.13 2466.06	13.67 1346.73
12.08 866.75	12.62 2921.84	13.15 2436.45	13.68 1308.69
12.10 930.08	12.63 2951.16	13.17 2406.34	13.70 1270.87
12.12 994.10	12.65 2972.07	13.18 2375.76	13.72 1233.34
12.13 1058.77	12.67 2983.41	13.20 2344.74	13.73 1196.20
12.15 1124.10	12.68 2988.24 <<	13.22 2313.30	13.75 1159.54
12.17 1190.05	12.70 2986.84	13.23 2281.46	13.77 1123.49
12.18 1256.60	12.72 2980.60	13.25 2249.25	13.78 1088.27
12.20 1323.74	12.73 2970.97	13.27 2216.68	13.80 1054.09
12.22 1391.45	12.75 2959.58	13.28 2183.77	13.82 1021.23

Continues on next page...

Hydrograph Discharge Table

Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)
13.83	989.96	14.65	571.79	15.47	449.64	16.28	377.70
13.85	960.60	14.67	568.01	15.48	447.99	16.30	376.30
13.87	933.50	14.68	564.30	15.50	446.35	16.32	374.91
13.88	909.04	14.70	560.66	15.52	444.73	16.33	373.52
13.90	887.64	14.72	557.10	15.53	443.12	16.35	372.14
13.92	869.72	14.73	553.61	15.55	441.53	16.37	370.76
13.93	854.14	14.75	550.19	15.57	439.96	16.38	369.40
13.95	840.79	14.77	546.84	15.58	438.39	16.40	368.03
13.97	829.15	14.78	543.56	15.60	436.84	16.42	366.68
13.98	818.69	14.80	540.36	15.62	435.31	16.43	365.33
14.00	808.78	14.82	537.21	15.63	433.78	16.45	364.00
14.02	799.14	14.83	534.14	15.65	432.26	16.47	362.67
14.03	789.75	14.85	531.12	15.67	430.76	16.48	361.35
14.05	780.61	14.87	528.17	15.68	429.26	16.50	360.04
14.07	771.72	14.88	525.27	15.70	427.78	16.52	358.74
14.08	763.07	14.90	522.43	15.72	426.30	16.53	357.45
14.10	754.66	14.92	519.65	15.73	424.83	16.55	356.18
14.12	746.49	14.93	516.91	15.75	423.37	16.57	354.91
14.13	738.54	14.95	514.23	15.77	421.91	16.58	353.66
14.15	730.81	14.97	511.60	15.78	420.46	16.60	352.41
14.17	723.30	14.98	509.01	15.80	419.02	16.62	351.19
14.18	716.00	15.00	506.47	15.82	417.58	16.63	349.97
14.20	708.91	15.02	503.97	15.83	416.15	16.65	348.77
14.22	702.02	15.03	501.52	15.85	414.71	16.67	347.58
14.23	695.33	15.05	499.11	15.87	413.29	16.68	346.40
14.25	688.83	15.07	496.73	15.88	411.86	16.70	345.24
14.27	682.50	15.08	494.40	15.90	410.44	16.72	344.10
14.28	676.36	15.10	492.11	15.92	409.02	16.73	342.97
14.30	670.38	15.12	489.85	15.93	407.60	16.75	341.85
14.32	664.57	15.13	487.63	15.95	406.17	16.77	340.76
14.33	658.91	15.15	485.45	15.97	404.75	16.78	339.67
14.35	653.40	15.17	483.30	15.98	403.33	16.80	338.61
14.37	648.03	15.18	481.19	16.00	401.90	16.82	337.56
14.38	642.79	15.20	479.11	16.02	400.48	16.83	336.52
14.40	637.67	15.22	477.06	16.03	399.05	16.85	335.50
14.42	632.68	15.23	475.05	16.05	397.62	16.87	334.49
14.43	627.79	15.25	473.06	16.07	396.19	16.88	333.50
14.45	623.00	15.27	471.11	16.08	394.76	16.90	332.53
14.47	618.31	15.28	469.18	16.10	393.33	16.92	331.56
14.48	613.71	15.30	467.29	16.12	391.90	16.93	330.61
14.50	609.18	15.32	465.41	16.13	390.47	16.95	329.68
14.52	604.73	15.33	463.57	16.15	389.04	16.97	328.76
14.53	600.36	15.35	461.75	16.17	387.61	16.98	327.85
14.55	596.05	15.37	459.96	16.18	386.19	17.00	326.95
14.57	591.82	15.38	458.18	16.20	384.76	17.02	326.07
14.58	587.67	15.40	456.43	16.22	383.34	17.03	325.20
14.60	583.59	15.42	454.71	16.23	381.93	17.05	324.34
14.62	579.58	15.43	453.00	16.25	380.52	17.07	323.50
14.63	575.65	15.45	451.31	16.27	379.11	17.08	322.66

Continues on next page...

Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
17.10 321.84	17.92 291.35	18.73 265.49	19.55 238.56
17.12 321.03	17.93 290.83	18.75 264.95	19.57 238.00
17.13 320.23	17.95 290.31	18.77 264.41	19.58 237.44
17.15 319.44	17.97 289.79	18.78 263.87	19.60 236.88
17.17 318.66	17.98 289.28	18.80 263.33	19.62 236.32
17.18 317.90	18.00 288.76	18.82 262.78	19.63 235.76
17.20 317.14	18.02 288.24	18.83 262.24	19.65 235.20
17.22 316.40	18.03 287.72	18.85 261.70	19.67 234.64
17.23 315.66	18.05 287.20	18.87 261.16	19.68 234.08
17.25 314.93	18.07 286.68	18.88 260.62	19.70 233.52
17.27 314.22	18.08 286.16	18.90 260.07	19.72 232.95
17.28 313.51	18.10 285.64	18.92 259.53	19.73 232.39
17.30 312.81	18.12 285.12	18.93 258.98	19.75 231.83
17.32 312.12	18.13 284.60	18.95 258.44	19.77 231.26
17.33 311.44	18.15 284.07	18.97 257.89	19.78 230.70
17.35 310.77	18.17 283.55	18.98 257.35	19.80 230.13
17.37 310.11	18.18 283.03	19.00 256.80	19.82 229.57
17.38 309.45	18.20 282.50	19.02 256.26	19.83 229.00
17.40 308.80	18.22 281.98	19.03 255.71	19.85 228.44
17.42 308.16	18.23 281.45	19.05 255.16	19.87 227.87
17.43 307.53	18.25 280.93	19.07 254.62	19.88 227.30
17.45 306.90	18.27 280.40	19.08 254.07	19.90 226.74
17.47 306.28	18.28 279.88	19.10 253.52	19.92 226.17
17.48 305.67	18.30 279.35	19.12 252.97	19.93 225.60
17.50 305.06	18.32 278.82	19.13 252.42	19.95 225.04
17.52 304.46	18.33 278.29	19.15 251.87	19.97 224.47
17.53 303.87	18.35 277.76	19.17 251.32	19.98 223.90
17.55 303.28	18.37 277.24	19.18 250.77	20.00 223.33
17.57 302.70	18.38 276.71	19.20 250.22	20.02 222.76
17.58 302.12	18.40 276.18	19.22 249.67	20.03 222.19
17.60 301.55	18.42 275.65	19.23 249.12	20.05 221.62
17.62 300.98	18.43 275.12	19.25 248.57	20.07 221.05
17.63 300.42	18.45 274.58	19.27 248.01	20.08 220.49
17.65 299.86	18.47 274.05	19.28 247.46	20.10 219.92
17.67 299.31	18.48 273.52	19.30 246.91	20.12 219.35
17.68 298.76	18.50 272.99	19.32 246.35	20.13 218.79
17.70 298.21	18.52 272.46	19.33 245.80	20.15 218.22
17.72 297.67	18.53 271.92	19.35 245.25	20.17 217.66
17.73 297.13	18.55 271.39	19.37 244.69	20.18 217.10
17.75 296.59	18.57 270.85	19.38 244.14	20.20 216.54
17.77 296.06	18.58 270.32	19.40 243.58	20.22 215.98
17.78 295.53	18.60 269.78	19.42 243.02	20.23 215.42
17.80 295.00	18.62 269.25	19.43 242.47	20.25 214.87
17.82 294.47	18.63 268.71	19.45 241.91	20.27 214.32
17.83 293.95	18.65 268.18	19.47 241.35	20.28 213.77
17.85 293.43	18.67 267.64	19.48 240.80	20.30 213.23
17.87 292.90	18.68 267.10	19.50 240.24	20.32 212.68
17.88 292.38	18.70 266.56	19.52 239.68	20.33 212.14
17.90 291.87	18.72 266.02	19.53 239.12	20.35 211.61

Continues on next page...

Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
20.37 211.08	21.18 192.41	22.00 185.59	22.82 180.69
20.38 210.55	21.20 192.18	22.02 185.49	22.83 180.59
20.40 210.03	21.22 191.97	22.03 185.39	22.85 180.49
20.42 209.51	21.23 191.76	22.05 185.29	22.87 180.39
20.43 208.99	21.25 191.55	22.07 185.19	22.88 180.29
20.45 208.48	21.27 191.35	22.08 185.09	22.90 180.18
20.47 207.97	21.28 191.16	22.10 184.99	22.92 180.08
20.48 207.47	21.30 190.96	22.12 184.90	22.93 179.98
20.50 206.97	21.32 190.78	22.13 184.80	22.95 179.88
20.52 206.48	21.33 190.59	22.15 184.70	22.97 179.78
20.53 206.00	21.35 190.42	22.17 184.60	22.98 179.67
20.55 205.52	21.37 190.24	22.18 184.50	23.00 179.57
20.57 205.04	21.38 190.07	22.20 184.40	23.02 179.47
20.58 204.58	21.40 189.90	22.22 184.30	23.03 179.37
20.60 204.11	21.42 189.74	22.23 184.20	23.05 179.27
20.62 203.66	21.43 189.58	22.25 184.10	23.07 179.16
20.63 203.21	21.45 189.43	22.27 184.00	23.08 179.06
20.65 202.77	21.47 189.27	22.28 183.90	23.10 178.96
20.67 202.33	21.48 189.12	22.30 183.80	23.12 178.86
20.68 201.90	21.50 188.98	22.32 183.70	23.13 178.76
20.70 201.48	21.52 188.84	22.33 183.61	23.15 178.65
20.72 201.07	21.53 188.70	22.35 183.51	23.17 178.55
20.73 200.66	21.55 188.56	22.37 183.41	23.18 178.45
20.75 200.27	21.57 188.43	22.38 183.31	23.20 178.35
20.77 199.88	21.58 188.30	22.40 183.21	23.22 178.24
20.78 199.50	21.60 188.17	22.42 183.11	23.23 178.14
20.80 199.12	21.62 188.04	22.43 183.01	23.25 178.04
20.82 198.76	21.63 187.92	22.45 182.91	23.27 177.93
20.83 198.40	21.65 187.80	22.47 182.81	23.28 177.83
20.85 198.04	21.67 187.68	22.48 182.71	23.30 177.73
20.87 197.70	21.68 187.56	22.50 182.61	23.32 177.63
20.88 197.36	21.70 187.45	22.52 182.51	23.33 177.52
20.90 197.03	21.72 187.33	22.53 182.41	23.35 177.42
20.92 196.71	21.73 187.22	22.55 182.30	23.37 177.32
20.93 196.39	21.75 187.11	22.57 182.20	23.38 177.21
20.95 196.08	21.77 187.00	22.58 182.10	23.40 177.11
20.97 195.78	21.78 186.90	22.60 182.00	23.42 177.01
20.98 195.49	21.80 186.79	22.62 181.90	23.43 176.90
21.00 195.20	21.82 186.69	22.63 181.80	23.45 176.80
21.02 194.91	21.83 186.58	22.65 181.70	23.47 176.70
21.03 194.64	21.85 186.48	22.67 181.60	23.48 176.59
21.05 194.36	21.87 186.38	22.68 181.50	23.50 176.49
21.07 194.10	21.88 186.28	22.70 181.40	23.52 176.39
21.08 193.84	21.90 186.18	22.72 181.30	23.53 176.28
21.10 193.59	21.92 186.08	22.73 181.20	23.55 176.18
21.12 193.34	21.93 185.98	22.75 181.10	23.57 176.08
21.13 193.10	21.95 185.88	22.77 180.99	23.58 175.97
21.15 192.86	21.97 185.78	22.78 180.89	23.60 175.87
21.17 192.63	21.98 185.68	22.80 180.79	23.62 175.76

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Hydrograph Discharge Table**Time -- Outflow
(hrs cfs)**

23.63	175.66
23.65	175.56
23.67	175.45
23.68	175.35
23.70	175.24
23.72	175.14
23.73	175.03
23.75	174.93
23.77	174.83
23.78	174.72
23.80	174.62
23.82	174.51
23.83	174.41
23.85	174.30
23.87	174.20
23.88	174.09
23.90	173.99
23.92	173.88
23.93	173.78
23.95	173.67
23.97	173.57
23.98	173.46

...End

Hydrograph Plot

English

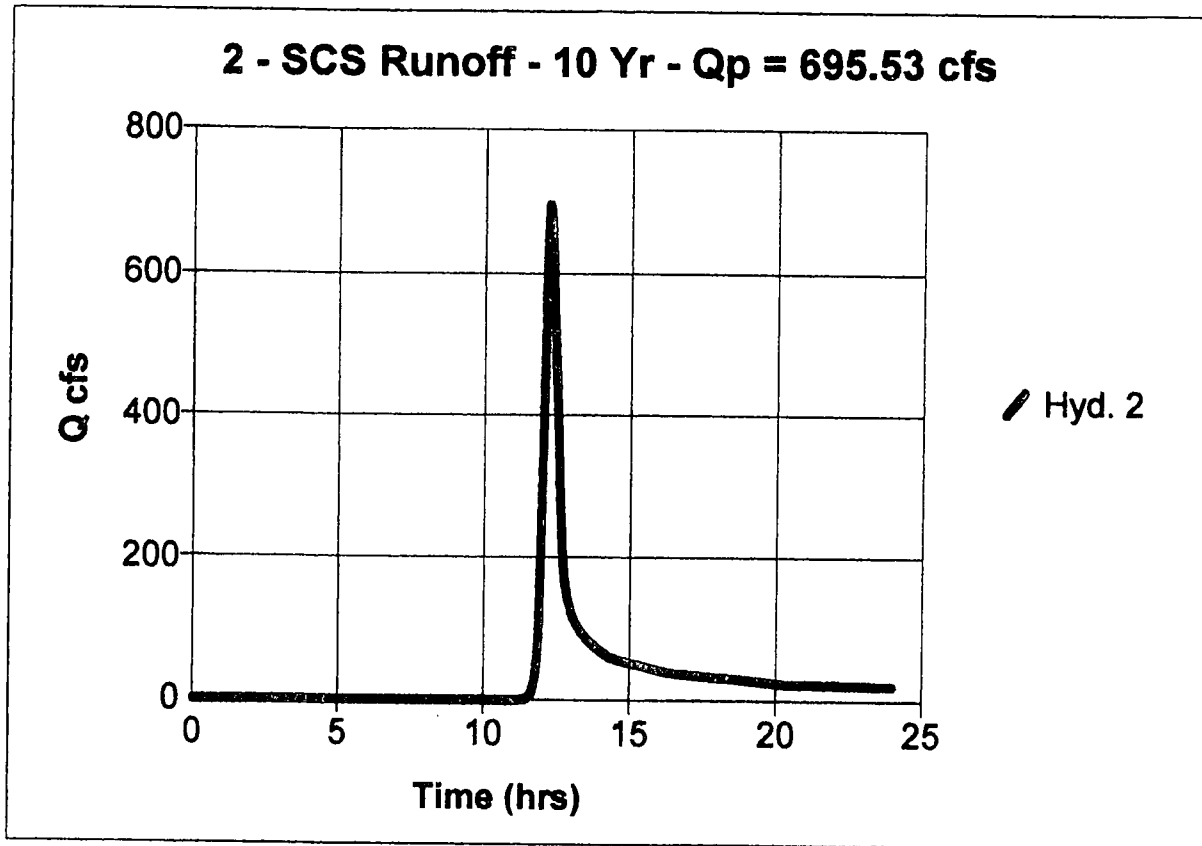
Hyd. No. 2

Sheep Run

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Drainage area = 825.00 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 3.50 in
Storm duration = 24 hrs

Peak discharge = 695.53 cfs
Time interval = 1 min
Curve number = 70.2
Hydraulic length = 0 ft
Time of conc. (Tc) = 29.3 min
Distribution = Type II
Shape factor = 484

Total Volume = 3,025,497 cuft



Hyd. No. 2

Sheep Run

Storm frequency = 10 yrs

Sheet Flow

Manning's n-value = 0.550
Flow length = 100.0 ft
Two-year 24-hr precip. = 2.55 in
Land slope = 18.0 %

Travel Time = 12.9 min

Shallow Concentrated Flow

Flow length = 300 ft
Watercourse slope = 13.0 %
Surface description = Unpaved
Average velocity = 5.82 ft/s

Travel Time = 0.9 min

Channel Flow

Cross section flow area = 18.4 sqft
Wetted perimeter = 9.5 ft
Channel slope = 3.6 %
Manning's n-value = 0.040
Velocity = 11.01 ft/s
Flow length = 10290.0 ft

Travel Time = 15.6 min

Total Travel Time, Tc = 29.3 min

Hydrograph Report

Hyd. No. 2

Sheep Run

Hydrograph type	= SCS Runoff	Peak discharge	= 695.53 cfs
Storm frequency	= 10 yrs	Time interval	= 1 min
Drainage area	= 825.00 ac	Curve number	= 70.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 29.3 min
Total precip.	= 3.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 3,025,497 cuft

Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
11.58 7.41	12.12 613.21	12.65 226.10	13.18 104.23
11.60 8.56	12.13 638.56	12.67 210.80	13.20 103.08
11.62 9.93	12.15 660.21	12.68 197.30	13.22 101.98
11.63 11.59	12.17 677.43	12.70 185.92	13.23 100.91
11.65 13.58	12.18 689.48	12.72 176.98	13.25 99.88
11.67 15.97	12.20 695.53 <<	12.73 169.66	13.27 98.88
11.68 18.82	12.22 694.72	12.75 163.90	13.28 97.91
11.70 22.23	12.23 689.33	12.77 159.32	13.30 96.96
11.72 26.28	12.25 679.54	12.78 155.53	13.32 96.03
11.73 31.07	12.27 666.38	12.80 152.11	13.33 95.12
11.75 36.70	12.28 650.93	12.82 148.82	13.35 94.24
11.77 43.33	12.30 634.38	12.83 145.68	13.37 93.36
11.78 51.22	12.32 617.34	12.85 142.67	13.38 92.51
11.80 60.63	12.33 599.82	12.87 139.79	13.40 91.67
11.82 71.83	12.35 581.82	12.88 137.04	13.42 90.85
11.83 85.17	12.37 563.37	12.90 134.41	13.43 90.05
11.85 101.00	12.38 544.50	12.92 131.90	13.45 89.26
11.87 119.70	12.40 525.23	12.93 129.50	13.47 88.48
11.88 141.70	12.42 505.59	12.95 127.21	13.48 87.72
11.90 167.42	12.43 485.62	12.97 125.03	13.50 86.97
11.92 197.32	12.45 465.36	12.98 122.94	13.52 86.24
11.93 229.91	12.47 444.86	13.00 120.95	13.53 85.51
11.95 264.96	12.48 424.15	13.02 119.06	13.55 84.79
11.97 301.70	12.50 403.31	13.03 117.24	13.57 84.09
11.98 339.36	12.52 382.38	13.05 115.51	13.58 83.40
12.00 377.03	12.53 361.46	13.07 113.87	13.60 82.72
12.02 414.20	12.55 340.61	13.08 112.29	13.62 82.05
12.03 450.69	12.57 319.96	13.10 110.79	13.63 81.39
12.05 486.33	12.58 299.67	13.12 109.36	13.65 80.73
12.07 520.83	12.60 279.92	13.13 107.99	13.67 80.09
12.08 553.80	12.62 260.92	13.15 106.68	13.68 79.46
12.10 584.76	12.63 242.90	13.17 105.43	13.70 78.84

Continues on next page...

Hydrograph Discharge Table

Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)
13.72	78.22	14.53	56.97	15.35	48.79	16.17	40.32
13.73	77.61	14.55	56.76	15.37	48.62	16.18	40.15
13.75	77.02	14.57	56.56	15.38	48.45	16.20	39.99
13.77	76.42	14.58	56.37	15.40	48.28	16.22	39.84
13.78	75.84	14.60	56.18	15.42	48.11	16.23	39.69
13.80	75.26	14.62	56.00	15.43	47.94	16.25	39.54
13.82	74.69	14.63	55.82	15.45	47.78	16.27	39.40
13.83	74.13	14.65	55.64	15.47	47.61	16.28	39.26
13.85	73.57	14.67	55.47	15.48	47.44	16.30	39.12
13.87	73.02	14.68	55.31	15.50	47.27	16.32	38.99
13.88	72.48	14.70	55.14	15.52	47.09	16.33	38.87
13.90	71.94	14.72	54.98	15.53	46.92	16.35	38.75
13.92	71.40	14.73	54.82	15.55	46.75	16.37	38.63
13.93	70.87	14.75	54.66	15.57	46.58	16.38	38.52
13.95	70.35	14.77	54.50	15.58	46.41	16.40	38.42
13.97	69.83	14.78	54.34	15.60	46.24	16.42	38.31
13.98	69.31	14.80	54.18	15.62	46.07	16.43	38.22
14.00	68.80	14.82	54.02	15.63	45.89	16.45	38.12
14.02	68.29	14.83	53.86	15.65	45.72	16.47	38.03
14.03	67.79	14.85	53.70	15.67	45.55	16.48	37.94
14.05	67.29	14.87	53.55	15.68	45.38	16.50	37.85
14.07	66.79	14.88	53.39	15.70	45.20	16.52	37.77
14.08	66.31	14.90	53.22	15.72	45.03	16.53	37.69
14.10	65.83	14.92	53.06	15.73	44.86	16.55	37.61
14.12	65.35	14.93	52.90	15.75	44.68	16.57	37.54
14.13	64.89	14.95	52.74	15.77	44.51	16.58	37.47
14.15	64.43	14.97	52.58	15.78	44.33	16.60	37.39
14.17	63.99	14.98	52.42	15.80	44.16	16.62	37.33
14.18	63.55	15.00	52.26	15.82	43.98	16.63	37.26
14.20	63.12	15.02	52.09	15.83	43.81	16.65	37.19
14.22	62.70	15.03	51.93	15.85	43.63	16.67	37.13
14.23	62.29	15.05	51.77	15.87	43.46	16.68	37.07
14.25	61.90	15.07	51.61	15.88	43.28	16.70	37.00
14.27	61.52	15.08	51.44	15.90	43.11	16.72	36.94
14.28	61.15	15.10	51.28	15.92	42.93	16.73	36.88
14.30	60.79	15.12	51.11	15.93	42.75	16.75	36.82
14.32	60.44	15.13	50.95	15.95	42.58	16.77	36.76
14.33	60.11	15.15	50.79	15.97	42.40	16.78	36.71
14.35	59.79	15.17	50.62	15.98	42.22	16.80	36.65
14.37	59.49	15.18	50.46	16.00	42.04	16.82	36.59
14.38	59.19	15.20	50.29	16.02	41.87	16.83	36.53
14.40	58.91	15.22	50.12	16.03	41.69	16.85	36.47
14.42	58.63	15.23	49.96	16.05	41.51	16.87	36.41
14.43	58.37	15.25	49.79	16.07	41.34	16.88	36.35
14.45	58.11	15.27	49.63	16.08	41.16	16.90	36.29
14.47	57.87	15.28	49.46	16.10	40.99	16.92	36.23
14.48	57.63	15.30	49.29	16.12	40.82	16.93	36.17
14.50	57.40	15.32	49.12	16.13	40.65	16.95	36.11
14.52	57.18	15.33	48.96	16.15	40.48	16.97	36.05

Continues on next page...

Hydrograph Discharge Table

Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)
16.98	35.99	17.80	32.99	18.62	29.85	19.43	26.59
17.00	35.93	17.82	32.92	18.63	29.78	19.45	26.52
17.02	35.87	17.83	32.86	18.65	29.72	19.47	26.45
17.03	35.81	17.85	32.80	18.67	29.65	19.48	26.39
17.05	35.75	17.87	32.74	18.68	29.58	19.50	26.32
17.07	35.69	17.88	32.67	18.70	29.52	19.52	26.25
17.08	35.63	17.90	32.61	18.72	29.45	19.53	26.18
17.10	35.57	17.92	32.55	18.73	29.39	19.55	26.11
17.12	35.51	17.93	32.48	18.75	29.32	19.57	26.05
17.13	35.45	17.95	32.42	18.77	29.26	19.58	25.98
17.15	35.39	17.97	32.36	18.78	29.19	19.60	25.91
17.17	35.33	17.98	32.29	18.80	29.12	19.62	25.84
17.18	35.27	18.00	32.23	18.82	29.06	19.63	25.78
17.20	35.21	18.02	32.17	18.83	28.99	19.65	25.71
17.22	35.15	18.03	32.10	18.85	28.93	19.67	25.64
17.23	35.09	18.05	32.04	18.87	28.86	19.68	25.57
17.25	35.03	18.07	31.97	18.88	28.79	19.70	25.50
17.27	34.97	18.08	31.91	18.90	28.73	19.72	25.43
17.28	34.91	18.10	31.85	18.92	28.66	19.73	25.37
17.30	34.84	18.12	31.78	18.93	28.60	19.75	25.30
17.32	34.78	18.13	31.72	18.95	28.53	19.77	25.23
17.33	34.72	18.15	31.66	18.97	28.46	19.78	25.16
17.35	34.66	18.17	31.59	18.98	28.40	19.80	25.09
17.37	34.60	18.18	31.53	19.00	28.33	19.82	25.02
17.38	34.54	18.20	31.46	19.02	28.26	19.83	24.96
17.40	34.48	18.22	31.40	19.03	28.20	19.85	24.89
17.42	34.42	18.23	31.34	19.05	28.13	19.87	24.82
17.43	34.35	18.25	31.27	19.07	28.06	19.88	24.75
17.45	34.29	18.27	31.21	19.08	28.00	19.90	24.68
17.47	34.23	18.28	31.14	19.10	27.93	19.92	24.61
17.48	34.17	18.30	31.08	19.12	27.86	19.93	24.54
17.50	34.11	18.32	31.01	19.13	27.80	19.95	24.48
17.52	34.05	18.33	30.95	19.15	27.73	19.97	24.41
17.53	33.98	18.35	30.89	19.17	27.66	19.98	24.34
17.55	33.92	18.37	30.82	19.18	27.60	20.00	24.27
17.57	33.86	18.38	30.76	19.20	27.53	20.02	24.20
17.58	33.80	18.40	30.69	19.22	27.46	20.03	24.13
17.60	33.74	18.42	30.63	19.23	27.40	20.05	24.06
17.62	33.67	18.43	30.56	19.25	27.33	20.07	24.00
17.63	33.61	18.45	30.50	19.27	27.26	20.08	23.93
17.65	33.55	18.47	30.43	19.28	27.19	20.10	23.86
17.67	33.49	18.48	30.37	19.30	27.13	20.12	23.80
17.68	33.42	18.50	30.30	19.32	27.06	20.13	23.73
17.70	33.36	18.52	30.24	19.33	26.99	20.15	23.67
17.72	33.30	18.53	30.17	19.35	26.93	20.17	23.61
17.73	33.24	18.55	30.11	19.37	26.86	20.18	23.54
17.75	33.17	18.57	30.04	19.38	26.79	20.20	23.48
17.77	33.11	18.58	29.98	19.40	26.72	20.22	23.43
17.78	33.05	18.60	29.91	19.42	26.66	20.23	23.37

Continues on next page...

Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
20.25 23.32	21.07 22.30	21.88 21.73	22.70 21.14
20.27 23.26	21.08 22.29	21.90 21.71	22.72 21.12
20.28 23.21	21.10 22.28	21.92 21.70	22.73 21.11
20.30 23.17	21.12 22.26	21.93 21.69	22.75 21.10
20.32 23.12	21.13 22.25	21.95 21.68	22.77 21.09
20.33 23.08	21.15 22.24	21.97 21.67	22.78 21.07
20.35 23.04	21.17 22.23	21.98 21.65	22.80 21.06
20.37 23.00	21.18 22.22	22.00 21.64	22.82 21.05
20.38 22.96	21.20 22.21	22.02 21.63	22.83 21.04
20.40 22.93	21.22 22.19	22.03 21.62	22.85 21.03
20.42 22.90	21.23 22.18	22.05 21.61	22.87 21.01
20.43 22.87	21.25 22.17	22.07 21.59	22.88 21.00
20.45 22.84	21.27 22.16	22.08 21.58	22.90 20.99
20.47 22.81	21.28 22.15	22.10 21.57	22.92 20.98
20.48 22.78	21.30 22.14	22.12 21.56	22.93 20.96
20.50 22.76	21.32 22.13	22.13 21.55	22.95 20.95
20.52 22.74	21.33 22.11	22.15 21.53	22.97 20.94
20.53 22.71	21.35 22.10	22.17 21.52	22.98 20.93
20.55 22.69	21.37 22.09	22.18 21.51	23.00 20.92
20.57 22.67	21.38 22.08	22.20 21.50	23.02 20.90
20.58 22.66	21.40 22.07	22.22 21.49	23.03 20.89
20.60 22.64	21.42 22.06	22.23 21.47	23.05 20.88
20.62 22.62	21.43 22.04	22.25 21.46	23.07 20.87
20.63 22.61	21.45 22.03	22.27 21.45	23.08 20.85
20.65 22.59	21.47 22.02	22.28 21.44	23.10 20.84
20.67 22.58	21.48 22.01	22.30 21.43	23.12 20.83
20.68 22.57	21.50 22.00	22.32 21.41	23.13 20.82
20.70 22.55	21.52 21.99	22.33 21.40	23.15 20.80
20.72 22.54	21.53 21.97	22.35 21.39	23.17 20.79
20.73 22.53	21.55 21.96	22.37 21.38	23.18 20.78
20.75 22.52	21.57 21.95	22.38 21.37	23.20 20.77
20.77 22.51	21.58 21.94	22.40 21.35	23.22 20.75
20.78 22.49	21.60 21.93	22.42 21.34	23.23 20.74
20.80 22.48	21.62 21.91	22.43 21.33	23.25 20.73
20.82 22.47	21.63 21.90	22.45 21.32	23.27 20.72
20.83 22.46	21.65 21.89	22.47 21.31	23.28 20.70
20.85 22.45	21.67 21.88	22.48 21.29	23.30 20.69
20.87 22.44	21.68 21.87	22.50 21.28	23.32 20.68
20.88 22.43	21.70 21.86	22.52 21.27	23.33 20.67
20.90 22.41	21.72 21.84	22.53 21.26	23.35 20.65
20.92 22.40	21.73 21.83	22.55 21.25	23.37 20.64
20.93 22.39	21.75 21.82	22.57 21.23	23.38 20.63
20.95 22.38	21.77 21.81	22.58 21.22	23.40 20.62
20.97 22.37	21.78 21.80	22.60 21.21	23.42 20.61
20.98 22.36	21.80 21.78	22.62 21.20	23.43 20.59
21.00 22.34	21.82 21.77	22.63 21.18	23.45 20.58
21.02 22.33	21.83 21.76	22.65 21.17	23.47 20.57
21.03 22.32	21.85 21.75	22.67 21.16	23.48 20.56
21.05 22.31	21.87 21.74	22.68 21.15	23.50 20.54

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Hydrograph Discharge Table**Time -- Outflow
(hrs cfs)**

23.52	20.53
23.53	20.52
23.55	20.51
23.57	20.49
23.58	20.48
23.60	20.47
23.62	20.46
23.63	20.44
23.65	20.43
23.67	20.42
23.68	20.40
23.70	20.39
23.72	20.38
23.73	20.37
23.75	20.35
23.77	20.34
23.78	20.33
23.80	20.32
23.82	20.30
23.83	20.29
23.85	20.28
23.87	20.27
23.88	20.25
23.90	20.24
23.92	20.23
23.93	20.22
23.95	20.20
23.97	20.19
23.98	20.18

...End

Hydrograph Plot

English

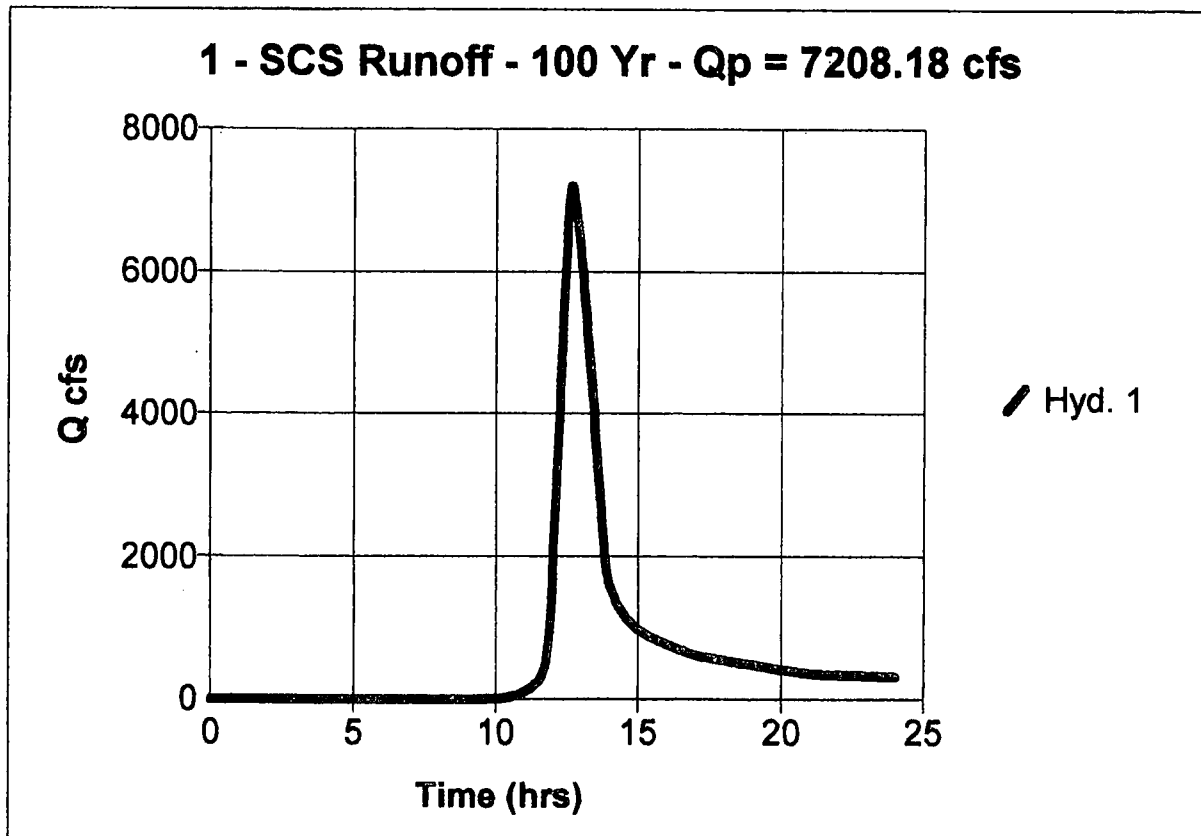
Hyd. No. 1

So Fork Hughes River

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Drainage area = 6950.00 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 5.25 in
Storm duration = 24 hrs

Peak discharge = 7208.18 cfs
Time interval = 1 min
Curve number = 70.2
Hydraulic length = 0 ft
Time of conc. (Tc) = 76 min
Distribution = Type II
Shape factor = 484

Total Volume = 55,480,370 cuft



Hyd. No. 1

So Fork Hughes River
Storm frequency = 100 yrs

Sheet Flow

Manning's n-value = 0.400
Flow length = 100.0 ft
Two-year 24-hr precip. = 2.55 in
Land slope = 25.0 %
Travel Time = 8.8 min

Shallow Concentrated Flow

Flow length = 300 ft
Watercourse slope = 28.0 %
Surface description = Unpaved
Average velocity = 8.54 ft/s
Travel Time = 0.6 min

Channel Flow

Cross section flow area = 80.0 sqft
Wetted perimeter = 24.0 ft
Channel slope = 0.8 %
Manning's n-value = 0.035
Velocity = 8.53 ft/s
Flow length = 34140.0 ft
Travel Time = 66.7 min

Total Travel Time, Tc = 76.0 min

Hydrograph Report

Hyd. No. 1

So Fork Hughes River

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Drainage area = 6950.00 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 5.25 in
Storm duration = 24 hrs

Peak discharge = 7208.18 cfs
Time interval = 1 min
Curve number = 70.2
Hydraulic length = 0 ft
Time of conc. (Tc) = 76 min
Distribution = Type II
Shape factor = 484

Total Volume = 55,480,370 cuft

Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
10.82 72.23	11.35 205.24	11.88 995.06	12.42 5755.64
10.83 75.01	11.37 211.52	11.90 1095.83	12.43 5903.37
10.85 77.86	11.38 217.99	11.92 1209.80	12.45 6047.75
10.87 80.79	11.40 224.65	11.93 1332.64	12.47 6188.29
10.88 83.79	11.42 231.49	11.95 1463.84	12.48 6324.48
10.90 86.88	11.43 238.54	11.97 1601.46	12.50 6455.75
10.92 90.04	11.45 245.80	11.98 1743.58	12.52 6581.26
10.93 93.28	11.47 253.26	12.00 1888.03	12.53 6699.75
10.95 96.60	11.48 260.94	12.02 2033.75	12.55 6809.82
10.97 100.00	11.50 268.84	12.03 2180.72	12.57 6910.02
10.98 103.49	11.52 277.24	12.05 2328.89	12.58 6998.77
11.00 107.06	11.53 286.07	12.07 2478.22	12.60 7074.42
11.02 110.59	11.55 295.48	12.08 2628.67	12.62 7135.14
11.03 114.21	11.57 305.63	12.10 2780.19	12.63 7179.02
11.05 117.92	11.58 316.67	12.12 2932.75	12.65 7204.05
11.07 121.72	11.60 328.80	12.13 3086.30	12.67 7208.18 <<
11.08 125.63	11.62 342.18	12.15 3240.80	12.68 7198.35
11.10 129.64	11.63 357.05	12.17 3396.20	12.70 7175.34
11.12 133.76	11.65 373.60	12.18 3552.47	12.72 7142.20
11.13 137.99	11.67 392.08	12.20 3709.55	12.73 7102.02
11.15 142.33	11.68 412.73	12.22 3867.40	12.75 7058.23
11.17 146.80	11.70 435.83	12.23 4025.97	12.77 7012.48
11.18 151.39	11.72 461.67	12.25 4185.22	12.78 6964.81
11.20 156.11	11.73 490.54	12.27 4344.68	12.80 6915.27
11.22 160.97	11.75 522.77	12.28 4504.40	12.82 6863.88
11.23 165.97	11.77 559.06	12.30 4664.12	12.83 6810.68
11.25 171.11	11.78 600.00	12.32 4823.55	12.85 6755.73
11.27 176.40	11.80 646.44	12.33 4982.38	12.87 6699.05
11.28 181.84	11.82 699.29	12.35 5140.31	12.88 6640.69
11.30 187.44	11.83 759.50	12.37 5296.97	12.90 6580.69
11.32 193.20	11.85 828.11	12.38 5452.01	12.92 6519.09
11.33 199.14	11.87 906.23	12.40 5605.03	12.93 6455.94

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Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
12.95 6391.27	13.77 2274.02	14.58 1142.04	15.40 876.35
12.97 6325.12	13.78 2195.05	14.60 1133.76	15.42 872.86
12.98 6257.55	13.80 2119.04	14.62 1125.64	15.43 869.41
13.00 6188.60	13.82 2046.55	14.63 1117.67	15.45 866.00
13.02 6118.22	13.83 1978.16	14.65 1109.85	15.47 862.62
13.03 6046.56	13.85 1914.50	14.67 1102.18	15.48 859.29
13.05 5973.65	13.87 1856.25	14.68 1094.66	15.50 855.98
13.07 5899.55	13.88 1804.13	14.70 1087.29	15.52 852.71
13.08 5824.31	13.90 1758.89	14.72 1080.07	15.53 849.48
13.10 5747.99	13.92 1721.31	14.73 1073.00	15.55 846.27
13.12 5670.62	13.93 1688.78	14.75 1066.08	15.57 843.09
13.13 5592.27	13.95 1661.02	14.77 1059.30	15.58 839.94
13.15 5512.98	13.97 1636.88	14.78 1052.67	15.60 836.81
13.17 5432.80	13.98 1615.19	14.80 1046.17	15.62 833.71
13.18 5351.80	14.00 1594.69	14.82 1039.81	15.63 830.64
13.20 5270.02	14.02 1574.75	14.83 1033.58	15.65 827.59
13.22 5187.51	14.03 1555.36	14.85 1027.47	15.67 824.56
13.23 5104.32	14.05 1536.50	14.87 1021.49	15.68 821.55
13.25 5020.52	14.07 1518.17	14.88 1015.62	15.70 818.56
13.27 4936.14	14.08 1500.36	14.90 1009.88	15.72 815.59
13.28 4851.18	14.10 1483.06	14.92 1004.24	15.73 812.64
13.30 4765.66	14.12 1466.25	14.93 998.71	15.75 809.70
13.32 4679.58	14.13 1449.91	14.95 993.28	15.77 806.78
13.33 4592.98	14.15 1434.05	14.97 987.95	15.78 803.87
13.35 4505.84	14.17 1418.65	14.98 982.71	15.80 800.97
13.37 4418.20	14.18 1403.69	15.00 977.57	15.82 798.09
13.38 4330.05	14.20 1389.16	15.02 972.52	15.83 795.21
13.40 4241.42	14.22 1375.06	15.03 967.55	15.85 792.34
13.42 4152.32	14.23 1361.36	15.05 962.66	15.87 789.49
13.43 4062.76	14.25 1348.05	15.07 957.86	15.88 786.63
13.45 3972.74	14.27 1335.13	15.08 953.14	15.90 783.79
13.47 3882.30	14.28 1322.58	15.10 948.50	15.92 780.94
13.48 3791.44	14.30 1310.37	15.12 943.93	15.93 778.10
13.50 3700.17	14.32 1298.51	15.13 939.44	15.95 775.27
13.52 3608.67	14.33 1286.96	15.15 935.03	15.97 772.43
13.53 3516.91	14.35 1275.72	15.17 930.68	15.98 769.59
13.55 3424.99	14.37 1264.77	15.18 926.41	16.00 766.75
13.57 3333.02	14.38 1254.09	15.20 922.20	16.02 763.91
13.58 3241.11	14.40 1243.67	15.22 918.06	16.03 761.06
13.60 3149.37	14.42 1233.50	15.23 913.98	16.05 758.21
13.62 3057.94	14.43 1223.55	15.25 909.97	16.07 755.37
13.63 2966.93	14.45 1213.81	15.27 906.02	16.08 752.52
13.65 2876.51	14.47 1204.27	15.28 902.12	16.10 749.68
13.67 2786.82	14.48 1194.91	15.30 898.29	16.12 746.84
13.68 2698.03	14.50 1185.71	15.32 894.50	16.13 744.00
13.70 2610.30	14.52 1176.67	15.33 890.77	16.15 741.17
13.72 2523.83	14.53 1167.78	15.35 887.10	16.17 738.34
13.73 2438.80	14.55 1159.05	15.37 883.47	16.18 735.51
13.75 2355.43	14.57 1150.47	15.38 879.88	16.20 732.70

Continues on next page...

Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
16.22 729.88	17.03 615.12	17.85 552.05	18.67 501.23
16.23 727.08	17.05 613.43	17.87 551.01	18.68 500.18
16.25 724.28	17.07 611.75	17.88 549.98	18.70 499.13
16.27 721.50	17.08 610.10	17.90 548.94	18.72 498.08
16.28 718.72	17.10 608.48	17.92 547.92	18.73 497.03
16.30 715.95	17.12 606.87	17.93 546.89	18.75 495.98
16.32 713.20	17.13 605.29	17.95 545.86	18.77 494.93
16.33 710.45	17.15 603.73	17.97 544.83	18.78 493.87
16.35 707.72	17.17 602.19	17.98 543.81	18.80 492.82
16.37 705.01	17.18 600.67	18.00 542.78	18.82 491.76
16.38 702.30	17.20 599.17	18.02 541.75	18.83 490.71
16.40 699.62	17.22 597.69	18.03 540.73	18.85 489.65
16.42 696.94	17.23 596.23	18.05 539.70	18.87 488.60
16.43 694.29	17.25 594.79	18.07 538.67	18.88 487.54
16.45 691.65	17.27 593.37	18.08 537.64	18.90 486.49
16.47 689.03	17.28 591.97	18.10 536.61	18.92 485.43
16.48 686.43	17.30 590.58	18.12 535.58	18.93 484.37
16.50 683.85	17.32 589.22	18.13 534.55	18.95 483.31
16.52 681.29	17.33 587.86	18.15 533.51	18.97 482.25
16.53 678.75	17.35 586.53	18.17 532.48	18.98 481.19
16.55 676.23	17.37 585.21	18.18 531.45	19.00 480.13
16.57 673.74	17.38 583.91	18.20 530.41	19.02 479.07
16.58 671.27	17.40 582.62	18.22 529.38	19.03 478.01
16.60 668.82	17.42 581.35	18.23 528.34	19.05 476.95
16.62 666.40	17.43 580.09	18.25 527.31	19.07 475.89
16.63 664.00	17.45 578.85	18.27 526.27	19.08 474.83
16.65 661.63	17.47 577.61	18.28 525.23	19.10 473.76
16.67 659.29	17.48 576.40	18.30 524.20	19.12 472.70
16.68 656.97	17.50 575.19	18.32 523.16	19.13 471.64
16.70 654.68	17.52 574.00	18.33 522.12	19.15 470.57
16.72 652.43	17.53 572.82	18.35 521.08	19.17 469.51
16.73 650.20	17.55 571.65	18.37 520.04	19.18 468.44
16.75 648.01	17.57 570.49	18.38 519.00	19.20 467.38
16.77 645.84	17.58 569.34	18.40 517.96	19.22 466.31
16.78 643.71	17.60 568.20	18.42 516.92	19.23 465.24
16.80 641.60	17.62 567.07	18.43 515.88	19.25 464.18
16.82 639.53	17.63 565.96	18.45 514.84	19.27 463.11
16.83 637.49	17.65 564.85	18.47 513.79	19.28 462.04
16.85 635.47	17.67 563.74	18.48 512.75	19.30 460.97
16.87 633.49	17.68 562.65	18.50 511.70	19.32 459.90
16.88 631.53	17.70 561.56	18.52 510.66	19.33 458.83
16.90 629.60	17.72 560.48	18.53 509.62	19.35 457.76
16.92 627.70	17.73 559.41	18.55 508.57	19.37 456.69
16.93 625.83	17.75 558.34	18.57 507.52	19.38 455.62
16.95 623.98	17.77 557.28	18.58 506.48	19.40 454.55
16.97 622.16	17.78 556.22	18.60 505.43	19.42 453.48
16.98 620.36	17.80 555.17	18.62 504.38	19.43 452.41
17.00 618.59	17.82 554.13	18.63 503.33	19.45 451.33
17.02 616.84	17.83 553.08	18.65 502.28	19.47 450.26

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Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
19.48 449.19	20.30 396.41	21.12 358.37	21.93 343.81
19.50 448.11	20.32 395.37	21.13 357.90	21.95 343.61
19.52 447.04	20.33 394.35	21.15 357.44	21.97 343.41
19.53 445.96	20.35 393.33	21.17 357.00	21.98 343.21
19.55 444.89	20.37 392.31	21.18 356.56	22.00 343.01
19.57 443.81	20.38 391.31	21.20 356.13	22.02 342.81
19.58 442.73	20.40 390.31	21.22 355.71	22.03 342.61
19.60 441.66	20.42 389.32	21.23 355.30	22.05 342.41
19.62 440.58	20.43 388.33	21.25 354.90	22.07 342.21
19.63 439.50	20.45 387.36	21.27 354.51	22.08 342.01
19.65 438.43	20.47 386.39	21.28 354.12	22.10 341.81
19.67 437.35	20.48 385.44	21.30 353.75	22.12 341.61
19.68 436.27	20.50 384.49	21.32 353.38	22.13 341.41
19.70 435.19	20.52 383.56	21.33 353.02	22.15 341.21
19.72 434.11	20.53 382.63	21.35 352.67	22.17 341.01
19.73 433.03	20.55 381.72	21.37 352.33	22.18 340.81
19.75 431.95	20.57 380.81	21.38 351.99	22.20 340.61
19.77 430.87	20.58 379.92	21.40 351.67	22.22 340.40
19.78 429.78	20.60 379.04	21.42 351.34	22.23 340.20
19.80 428.70	20.62 378.17	21.43 351.03	22.25 340.00
19.82 427.62	20.63 377.31	21.45 350.72	22.27 339.80
19.83 426.54	20.65 376.47	21.47 350.42	22.28 339.60
19.85 425.45	20.67 375.64	21.48 350.13	22.30 339.40
19.87 424.37	20.68 374.82	21.50 349.84	22.32 339.20
19.88 423.29	20.70 374.02	21.52 349.56	22.33 339.00
19.90 422.20	20.72 373.23	21.53 349.28	22.35 338.80
19.92 421.12	20.73 372.45	21.55 349.01	22.37 338.59
19.93 420.03	20.75 371.69	21.57 348.74	22.38 338.39
19.95 418.95	20.77 370.95	21.58 348.48	22.40 338.19
19.97 417.86	20.78 370.21	21.60 348.22	22.42 337.99
19.98 416.77	20.80 369.50	21.62 347.97	22.43 337.79
20.00 415.69	20.82 368.80	21.63 347.72	22.45 337.59
20.02 414.60	20.83 368.11	21.65 347.48	22.47 337.39
20.03 413.51	20.85 367.43	21.67 347.24	22.48 337.18
20.05 412.42	20.87 366.77	21.68 347.01	22.50 336.98
20.07 411.34	20.88 366.13	21.70 346.78	22.52 336.78
20.08 410.25	20.90 365.49	21.72 346.55	22.53 336.58
20.10 409.17	20.92 364.87	21.73 346.32	22.55 336.38
20.12 408.09	20.93 364.26	21.75 346.10	22.57 336.17
20.13 407.01	20.95 363.67	21.77 345.88	22.58 335.97
20.15 405.93	20.97 363.09	21.78 345.67	22.60 335.77
20.17 404.86	20.98 362.52	21.80 345.45	22.62 335.57
20.18 403.79	21.00 361.96	21.82 345.24	22.63 335.36
20.20 402.72	21.02 361.41	21.83 345.03	22.65 335.16
20.22 401.66	21.03 360.88	21.85 344.83	22.67 334.96
20.23 400.60	21.05 360.35	21.87 344.62	22.68 334.76
20.25 399.54	21.07 359.84	21.88 344.42	22.70 334.55
20.27 398.49	21.08 359.34	21.90 344.21	22.72 334.35
20.28 397.45	21.10 358.85	21.92 344.01	22.73 334.15

Continues on next page...

Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
22.75	333.94
22.77	333.74
22.78	333.54
22.80	333.34
22.82	333.13
22.83	332.93
22.85	332.73
22.87	332.52
22.88	332.32
22.90	332.12
22.92	331.91
22.93	331.71
22.95	331.50
22.97	331.30
22.98	331.10
23.00	330.89
23.02	330.69
23.03	330.49
23.05	330.28
23.07	330.08
23.08	329.87
23.10	329.67
23.12	329.46
23.13	329.26
23.15	329.06
23.17	328.85
23.18	328.65
23.20	328.44
23.22	328.24
23.23	328.03
23.25	327.83
23.27	327.62
23.28	327.42
23.30	327.21
23.32	327.01
23.33	326.80
23.35	326.60
23.37	326.39
23.38	326.19
23.40	325.98
23.42	325.77
23.43	325.57
23.45	325.36
23.47	325.16
23.48	324.95
23.50	324.75
23.52	324.54
23.53	324.33
23.55	324.13

...End

Hydrograph Plot

English

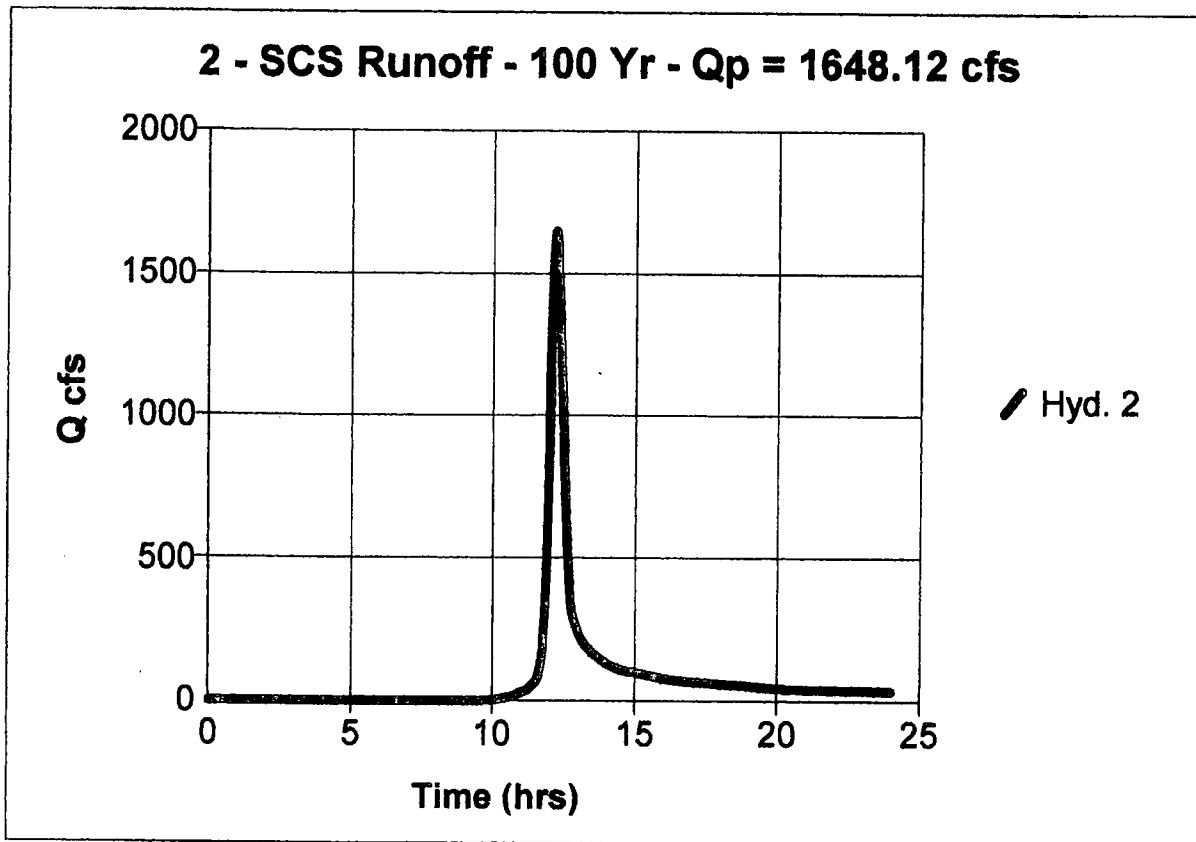
Hyd. No. 2

Sheep Run

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Drainage area = 825.00 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 5.25 in
Storm duration = 24 hrs

Peak discharge = 1648.12 cfs
Time interval = 1 min
Curve number = 70.2
Hydraulic length = 0 ft
Time of conc. (Tc) = 29.3 min
Distribution = Type II
Shape factor = 484

Total Volume = 6,660,276 cuft



Hyd. No. 2

Sheep Run

Storm frequency = 100 yrs

Sheet Flow

Manning's n-value = 0.550
Flow length = 100.0 ft
Two-year 24-hr precip. = 2.55 in
Land slope = 18.0 %

Travel Time = 12.9 min

Shallow Concentrated Flow

Flow length = 300 ft
Watercourse slope = 13.0 %
Surface description = Unpaved
Average velocity = 5.82 ft/s

Travel Time = 0.9 min

Channel Flow

Cross section flow area = 18.4 sqft
Wetted perimeter = 9.5 ft
Channel slope = 3.6 %
Manning's n-value = 0.040
Velocity = 11.01 ft/s
Flow length = 10290.0 ft

Travel Time = 15.6 min

Total Travel Time, Tc = 29.3 min

Hydrograph Report

Hyd. No. 2

Sheep Run

Hydrograph type	= SCS Runoff	Peak discharge	= 1648.12 cfs
Storm frequency	= 100 yrs	Time interval	= 1 min
Drainage area	= 825.00 ac	Curve number	= 70.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 29.3 min
Total precip.	= 5.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 6,660,276 cuft

Hydrograph Discharge Table

Time -- Outflow	Time -- Outflow	Time -- Outflow	Time -- Outflow
(hrs cfs)	(hrs cfs)	(hrs cfs)	(hrs cfs)
10.68 16.78	11.22 40.78	11.75 185.81	12.28 1502.34
10.70 17.31	11.23 41.89	11.77 206.51	12.30 1457.41
10.72 17.85	11.25 43.05	11.78 230.47	12.32 1411.62
10.73 18.40	11.27 44.25	11.80 258.30	12.33 1364.98
10.75 18.97	11.28 45.51	11.82 290.30	12.35 1317.55
10.77 19.55	11.30 46.81	11.83 327.33	12.37 1269.41
10.78 20.15	11.32 48.33	11.85 369.98	12.38 1220.66
10.80 20.76	11.33 49.90	11.87 418.89	12.40 1171.37
10.82 21.39	11.35 51.53	11.88 474.76	12.42 1121.65
10.83 22.04	11.37 53.22	11.90 538.31	12.43 1071.61
10.85 22.70	11.38 54.96	11.92 610.24	12.45 1021.34
10.87 23.37	11.40 56.77	11.93 687.11	12.47 970.97
10.88 24.06	11.42 58.63	11.95 768.27	12.48 920.63
10.90 24.77	11.43 60.55	11.97 852.03	12.50 870.44
10.92 25.50	11.45 62.54	11.98 936.66	12.52 820.56
10.93 26.24	11.47 64.58	12.00 1020.24	12.53 771.15
10.95 27.00	11.48 66.68	12.02 1101.65	12.55 722.39
10.97 27.77	11.50 68.85	12.03 1180.52	12.57 674.55
10.98 28.57	11.52 71.27	12.05 1256.44	12.58 627.99
11.00 29.37	11.53 73.89	12.07 1328.78	12.60 583.15
11.02 30.10	11.55 76.83	12.08 1396.60	12.62 540.45
11.03 30.85	11.57 80.20	12.10 1458.85	12.63 500.37
11.05 31.62	11.58 84.10	12.12 1514.42	12.65 463.39
11.07 32.41	11.60 88.66	12.13 1562.14	12.67 430.06
11.08 33.22	11.62 94.03	12.15 1600.78	12.68 400.94
11.10 34.06	11.63 100.35	12.17 1628.95	12.70 376.62
11.12 34.92	11.65 107.77	12.18 1645.23	12.72 357.70
11.13 35.81	11.67 116.46	12.20 1648.12 <<	12.73 342.28
11.15 36.74	11.68 126.61	12.22 1636.08	12.75 330.18
11.17 37.69	11.70 138.41	12.23 1614.24	12.77 320.58
11.18 38.68	11.72 152.06	12.25 1583.16	12.78 312.65
11.20 39.71	11.73 167.78	12.27 1545.11	12.80 305.47

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Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
12.82 298.60	13.63 159.03	14.45 112.05	15.27 94.80
12.83 292.03	13.65 157.70	14.47 111.55	15.28 94.46
12.85 285.74	13.67 156.40	14.48 111.07	15.30 94.13
12.87 279.74	13.68 155.11	14.50 110.60	15.32 93.79
12.88 274.01	13.70 153.84	14.52 110.15	15.33 93.46
12.90 268.53	13.72 152.59	14.53 109.72	15.35 93.12
12.92 263.31	13.73 151.36	14.55 109.30	15.37 92.78
12.93 258.32	13.75 150.14	14.57 108.89	15.38 92.45
12.95 253.57	13.77 148.94	14.58 108.50	15.40 92.11
12.97 249.04	13.78 147.75	14.60 108.11	15.42 91.77
12.98 244.71	13.80 146.59	14.62 107.74	15.43 91.44
13.00 240.59	13.82 145.43	14.63 107.37	15.45 91.10
13.02 236.65	13.83 144.29	14.65 107.01	15.47 90.76
13.03 232.90	13.85 143.16	14.67 106.66	15.48 90.42
13.05 229.32	13.87 142.05	14.68 106.32	15.50 90.08
13.07 225.91	13.88 140.94	14.70 105.98	15.52 89.74
13.08 222.65	13.90 139.85	14.72 105.65	15.53 89.41
13.10 219.55	13.92 138.77	14.73 105.32	15.55 89.07
13.12 216.59	13.93 137.70	14.75 104.99	15.57 88.73
13.13 213.76	13.95 136.64	14.77 104.67	15.58 88.39
13.15 211.05	13.97 135.59	14.78 104.34	15.60 88.05
13.17 208.47	13.98 134.55	14.80 104.02	15.62 87.70
13.18 205.99	14.00 133.52	14.82 103.69	15.63 87.36
13.20 203.62	14.02 132.50	14.83 103.37	15.65 87.02
13.22 201.33	14.03 131.49	14.85 103.04	15.67 86.68
13.23 199.13	14.05 130.48	14.87 102.72	15.68 86.34
13.25 197.00	14.07 129.49	14.88 102.39	15.70 86.00
13.27 194.94	14.08 128.52	14.90 102.07	15.72 85.65
13.28 192.93	14.10 127.55	14.92 101.74	15.73 85.31
13.30 190.98	14.12 126.60	14.93 101.41	15.75 84.97
13.32 189.06	14.13 125.67	14.95 101.08	15.77 84.63
13.33 187.19	14.15 124.76	14.97 100.76	15.78 84.28
13.35 185.36	14.17 123.86	14.98 100.43	15.80 83.94
13.37 183.57	14.18 122.98	15.00 100.10	15.82 83.59
13.38 181.81	14.20 122.12	15.02 99.77	15.83 83.25
13.40 180.09	14.22 121.28	15.03 99.44	15.85 82.90
13.42 178.41	14.23 120.47	15.05 99.11	15.87 82.56
13.43 176.76	14.25 119.67	15.07 98.78	15.88 82.21
13.45 175.13	14.27 118.91	15.08 98.45	15.90 81.87
13.47 173.54	14.28 118.16	15.10 98.12	15.92 81.52
13.48 171.98	14.30 117.44	15.12 97.79	15.93 81.18
13.50 170.44	14.32 116.75	15.13 97.46	15.95 80.83
13.52 168.93	14.33 116.08	15.15 97.13	15.97 80.48
13.53 167.45	14.35 115.44	15.17 96.80	15.98 80.14
13.55 165.99	14.37 114.82	15.18 96.46	16.00 79.79
13.57 164.55	14.38 114.22	15.20 96.13	16.02 79.44
13.58 163.14	14.40 113.65	15.22 95.80	16.03 79.10
13.60 161.75	14.42 113.10	15.23 95.46	16.05 78.75
13.62 160.38	14.43 112.56	15.25 95.13	16.07 78.41

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Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
16.08 78.07	16.90 68.43	17.72 62.49	18.53 56.38
16.10 77.73	16.92 68.31	17.73 62.37	18.55 56.25
16.12 77.39	16.93 68.20	17.75 62.24	18.57 56.13
16.13 77.06	16.95 68.08	17.77 62.12	18.58 56.00
16.15 76.73	16.97 67.96	17.78 62.00	18.60 55.87
16.17 76.41	16.98 67.84	17.80 61.87	18.62 55.75
16.18 76.09	17.00 67.72	17.82 61.75	18.63 55.62
16.20 75.78	17.02 67.60	17.83 61.63	18.65 55.49
16.22 75.48	17.03 67.48	17.85 61.50	18.67 55.37
16.23 75.18	17.05 67.36	17.87 61.38	18.68 55.24
16.25 74.89	17.07 67.24	17.88 61.25	18.70 55.11
16.27 74.61	17.08 67.12	17.90 61.13	18.72 54.99
16.28 74.34	17.10 66.99	17.92 61.01	18.73 54.86
16.30 74.08	17.12 66.87	17.93 60.88	18.75 54.73
16.32 73.82	17.13 66.75	17.95 60.76	18.77 54.61
16.33 73.58	17.15 66.63	17.97 60.63	18.78 54.48
16.35 73.34	17.17 66.51	17.98 60.51	18.80 54.35
16.37 73.12	17.18 66.39	18.00 60.39	18.82 54.23
16.38 72.90	17.20 66.27	18.02 60.26	18.83 54.10
16.40 72.69	17.22 66.15	18.03 60.14	18.85 53.97
16.42 72.48	17.23 66.03	18.05 60.01	18.87 53.84
16.43 72.29	17.25 65.91	18.07 59.89	18.88 53.72
16.45 72.10	17.27 65.79	18.08 59.76	18.90 53.59
16.47 71.92	17.28 65.67	18.10 59.64	18.92 53.46
16.48 71.74	17.30 65.54	18.12 59.52	18.93 53.33
16.50 71.57	17.32 65.42	18.13 59.39	18.95 53.21
16.52 71.41	17.33 65.30	18.15 59.27	18.97 53.08
16.53 71.25	17.35 65.18	18.17 59.14	18.98 52.95
16.55 71.09	17.37 65.06	18.18 59.02	19.00 52.82
16.57 70.94	17.38 64.94	18.20 58.89	19.02 52.70
16.58 70.80	17.40 64.81	18.22 58.77	19.03 52.57
16.60 70.65	17.42 64.69	18.23 58.64	19.05 52.44
16.62 70.52	17.43 64.57	18.25 58.52	19.07 52.31
16.63 70.38	17.45 64.45	18.27 58.39	19.08 52.18
16.65 70.25	17.47 64.33	18.28 58.27	19.10 52.06
16.67 70.12	17.48 64.21	18.30 58.14	19.12 51.93
16.68 70.00	17.50 64.08	18.32 58.01	19.13 51.80
16.70 69.87	17.52 63.96	18.33 57.89	19.15 51.67
16.72 69.75	17.53 63.84	18.35 57.76	19.17 51.54
16.73 69.63	17.55 63.72	18.37 57.64	19.18 51.42
16.75 69.51	17.57 63.59	18.38 57.51	19.20 51.29
16.77 69.39	17.58 63.47	18.40 57.39	19.22 51.16
16.78 69.27	17.60 63.35	18.42 57.26	19.23 51.03
16.80 69.15	17.62 63.23	18.43 57.14	19.25 50.90
16.82 69.03	17.63 63.10	18.45 57.01	19.27 50.77
16.83 68.91	17.65 62.98	18.47 56.88	19.28 50.65
16.85 68.79	17.67 62.86	18.48 56.76	19.30 50.52
16.87 68.67	17.68 62.73	18.50 56.63	19.32 50.39
16.88 68.55	17.70 62.61	18.52 56.51	19.33 50.26

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Hydrograph Discharge Table

Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)
19.35	50.13	20.17	43.81	20.98	41.38	21.80	40.22
19.37	50.00	20.18	43.69	21.00	41.36	21.82	40.19
19.38	49.87	20.20	43.58	21.02	41.33	21.83	40.17
19.40	49.74	20.22	43.47	21.03	41.31	21.85	40.15
19.42	49.61	20.23	43.37	21.05	41.29	21.87	40.12
19.43	49.49	20.25	43.26	21.07	41.26	21.88	40.10
19.45	49.36	20.27	43.16	21.08	41.24	21.90	40.08
19.47	49.23	20.28	43.07	21.10	41.22	21.92	40.05
19.48	49.10	20.30	42.98	21.12	41.19	21.93	40.03
19.50	48.97	20.32	42.89	21.13	41.17	21.95	40.00
19.52	48.84	20.33	42.81	21.15	41.14	21.97	39.98
19.53	48.71	20.35	42.73	21.17	41.12	21.98	39.96
19.55	48.58	20.37	42.66	21.18	41.10	22.00	39.93
19.57	48.45	20.38	42.59	21.20	41.07	22.02	39.91
19.58	48.32	20.40	42.52	21.22	41.05	22.03	39.88
19.60	48.19	20.42	42.46	21.23	41.03	22.05	39.86
19.62	48.06	20.43	42.40	21.25	41.00	22.07	39.84
19.63	47.93	20.45	42.34	21.27	40.98	22.08	39.81
19.65	47.80	20.47	42.29	21.28	40.96	22.10	39.79
19.67	47.67	20.48	42.24	21.30	40.93	22.12	39.76
19.68	47.54	20.50	42.19	21.32	40.91	22.13	39.74
19.70	47.41	20.52	42.15	21.33	40.89	22.15	39.72
19.72	47.28	20.53	42.10	21.35	40.86	22.17	39.69
19.73	47.15	20.55	42.06	21.37	40.84	22.18	39.67
19.75	47.02	20.57	42.03	21.38	40.81	22.20	39.64
19.77	46.89	20.58	41.99	21.40	40.79	22.22	39.62
19.78	46.77	20.60	41.96	21.42	40.77	22.23	39.59
19.80	46.63	20.62	41.92	21.43	40.74	22.25	39.57
19.82	46.50	20.63	41.89	21.45	40.72	22.27	39.55
19.83	46.37	20.65	41.86	21.47	40.70	22.28	39.52
19.85	46.24	20.67	41.84	21.48	40.67	22.30	39.50
19.87	46.11	20.68	41.81	21.50	40.65	22.32	39.47
19.88	45.98	20.70	41.78	21.52	40.62	22.33	39.45
19.90	45.85	20.72	41.76	21.53	40.60	22.35	39.43
19.92	45.72	20.73	41.73	21.55	40.58	22.37	39.40
19.93	45.59	20.75	41.71	21.57	40.55	22.38	39.38
19.95	45.46	20.77	41.68	21.58	40.53	22.40	39.35
19.97	45.33	20.78	41.66	21.60	40.51	22.42	39.33
19.98	45.20	20.80	41.64	21.62	40.48	22.43	39.30
20.00	45.07	20.82	41.61	21.63	40.46	22.45	39.28
20.02	44.94	20.83	41.59	21.65	40.43	22.47	39.26
20.03	44.81	20.85	41.57	21.67	40.41	22.48	39.23
20.05	44.68	20.87	41.54	21.68	40.39	22.50	39.21
20.07	44.55	20.88	41.52	21.70	40.36	22.52	39.18
20.08	44.42	20.90	41.50	21.72	40.34	22.53	39.16
20.10	44.30	20.92	41.47	21.73	40.31	22.55	39.14
20.12	44.17	20.93	41.45	21.75	40.29	22.57	39.11
20.13	44.05	20.95	41.43	21.77	40.27	22.58	39.09
20.15	43.93	20.97	41.40	21.78	40.24	22.60	39.06

Continues on next page...

Hydrograph Discharge Table

Time -- Outflow (hrs cfs)	Time -- Outflow (hrs cfs)
22.62 39.04	23.43 37.84
22.63 39.01	23.45 37.81
22.65 38.99	23.47 37.79
22.67 38.97	23.48 37.76
22.68 38.94	23.50 37.74
22.70 38.92	23.52 37.72
22.72 38.89	23.53 37.69
22.73 38.87	23.55 37.67
22.75 38.84	23.57 37.64
22.77 38.82	23.58 37.62
22.78 38.79	23.60 37.59
22.80 38.77	23.62 37.57
22.82 38.75	23.63 37.54
22.83 38.72	23.65 37.52
22.85 38.70	23.67 37.49
22.87 38.67	23.68 37.47
22.88 38.65	23.70 37.44
22.90 38.62	23.72 37.42
22.92 38.60	23.73 37.39
22.93 38.58	23.75 37.37
22.95 38.55	23.77 37.34
22.97 38.53	23.78 37.32
22.98 38.50	23.80 37.29
23.00 38.48	23.82 37.27
23.02 38.45	23.83 37.25
23.03 38.43	23.85 37.22
23.05 38.40	23.87 37.20
23.07 38.38	23.88 37.17
23.08 38.36	23.90 37.15
23.10 38.33	23.92 37.12
23.12 38.31	23.93 37.10
23.13 38.28	23.95 37.07
23.15 38.26	23.97 37.05
23.17 38.23	23.98 37.02
23.18 38.21	
23.20 38.18	
23.22 38.16	...End
23.23 38.13	
23.25 38.11	
23.27 38.09	
23.28 38.06	
23.30 38.04	
23.32 38.01	
23.33 37.99	
23.35 37.96	
23.37 37.94	
23.38 37.91	
23.40 37.89	
23.42 37.86	

South Fork Hughes River - Sta 0+00 - 10 Yr Storm Worksheet for Irregular Channel

Project Description	
Worksheet	So Fork Hughes Sta
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.005000 ft/ft
Discharge	1,324 cfs 1,324 cfs

Options	
Current Roughness Method	oved Lotter's Method
Open Channel Weighting	oved Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.043
Water Surface Elevt	832.70 ft
Elevation Range	8.00 to 839.00
Flow Area	282.9 ft ²
Wetted Perimeter	107.84 ft
Top Width	106.13 ft
Actual Depth	4.70 ft
Critical Elevation	831.17 ft
Critical Slope	0.020491 ft/ft
Velocity	4.88 ft/s
Velocity Head	0.34 ft
Specific Energy	833.04 ft
Froude Number	0.51
Flow Type	Subcritical

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+06	1+53	0.045
1+53	2+01	0.040
2+01	2+49	0.045

Natural Channel Points	
Station (ft)	Elevation (ft)
0+06	839.00
0+21	838.00
0+22	837.00
0+23	836.00
0+27	835.00
0+55	834.00
1+20	833.00
1+35	832.00
1+48	831.00
1+53	830.00
1+55	829.00
1+56	828.00

South Fork Hughes River - Sta 0+00 - 10 Yr Storm
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
1+97	828.00
1+98	829.00
2+01	830.00
2+05	831.00
2+25	832.00
2+33	833.00
2+37	834.00
2+39	835.00
2+42	836.00
2+45	837.00
2+47	838.00
2+49	839.00

Sheep Run Sta 7+00 - 10 Yr Storm Worksheet for Irregular Channel

Project Description	
Worksheet	Sheep Run - Sta
Flow Element	Irregular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data	
Slope	.029100 ft/ft
Discharge	695.5 cfs

Options	
Current Roughness Method	oved Lotter's Method
Open Channel Weighting	oved Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.045
Water Surface Elev	839.09 ft
Elevation Range	5.84 to 841.79
Flow Area	73.8 ft ²
Wetted Perimeter	33.86 ft
Top Width	32.85 ft
Actual Depth	3.25 ft
Critical Elevation	839.29 ft
Critical Slope	0.023129 ft/ft
Velocity	9.45 ft/s
Velocity Head	1.39 ft
Specific Energy	840.48 ft
Froude Number	1.11
Flow Type	Supercritical

Roughness Segments		
Start Station	End Station	Mannings Coefficient
-0+32	0+27	0.045

Natural Channel Points	
Station (ft)	Elevation (ft)
-0+32	841.03
-0+17	839.89
-0+13	838.16
-0+11	837.27
-0+08	836.72
-0+06	836.37
-0+04	836.03
-0+02	835.84
0+00	835.97
0+02	836.00
0+06	836.00
0+08	836.02
0+11	836.58
0+13	837.52

**Sheep Run Sta 7+00 - 10 Yr Storm
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
0+15	838.22
0+17	838.81
0+21	839.97
0+25	841.14
0+27	841.78

South Fork Hughes River - Sta 0+00 - 100 Yr Storm Worksheet for Irregular Channel

Project Description	
Worksheet	So Fork Hughes Sta
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Slope	.005000 ft/ft
Discharge	XXXXXX 3,710 cfs

Options	
Current Roughness Method	Improved Lotter's Method
Open Channel Weighting	Improved Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.044
Water Surface Elev:	835.21 ft
Elevation Range	8.00 to 839.00
Flow Area	704.0 ft ²
Wetted Perimeter	215.55 ft
Top Width	213.62 ft
Actual Depth	7.21 ft
Critical Elevation	833.68 ft
Critical Slope	0.020787 ft/ft
Velocity	5.27 ft/s
Velocity Head	0.43 ft
Specific Energy	835.64 ft
Froude Number	0.51
Flow Type	Subcritical

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+06	1+53	0.045
1+53	2+01	0.040
2+01	2+49	0.045

Natural Channel Points	
Station (ft)	Elevation (ft)
0+06	839.00
0+21	838.00
0+22	837.00
0+23	836.00
0+27	835.00
0+55	834.00
1+20	833.00
1+35	832.00
1+48	831.00
1+53	830.00
1+55	829.00
1+56	828.00

**South Fork Hughes River - Sta 0+00 - 100 Yr Storm
Worksheet for Irregular Channel**

Natural Channel Points	
Station (ft)	Elevation (ft)
1+97	828.00
1+98	829.00
2+01	830.00
2+05	831.00
2+25	832.00
2+33	833.00
2+37	834.00
2+39	835.00
2+42	836.00
2+45	837.00
2+47	838.00
2+49	839.00

Sheep Run Sta 7+00 - 100 Yr Storm Worksheet for Irregular Channel

Project Description	
Worksheet	Sheep Run - Sta
Flow Element	Irregular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data	
Slope	.029100 ft/ft
Discharge	21,000 cfs 1,648 cfs

Options	
Current Roughness Method	oved Lotter's Method
Open Channel Weighting	oved Lotter's Method
Closed Channel Weighting	Horton's Method

Results	
Mannings Coefficient	0.045
Water Surface Elev:	840.97 ft
Elevation Range	5.84 to 841.79
Flow Area	152.2 ft ²
Wetted Perimeter	57.08 ft
Top Width	55.61 ft
Actual Depth	5.13 ft
Critical Elevation	841.27 ft
Critical Slope	0.021419 ft/ft
Velocity	10.83 ft/s
Velocity Head	1.82 ft
Specific Energy	842.80 ft
Froude Number	1.15
Flow Type	Supercritical

Roughness Segments		
Start Station	End Station	Mannings Coefficient
-0+32	0+27	0.045

Natural Channel Points	
Station (ft)	Elevation (ft)
-0+32	841.03
-0+17	839.89
-0+13	838.16
-0+11	837.27
-0+08	836.72
-0+06	836.37
-0+04	836.03
-0+02	835.84
0+00	835.97
0+02	836.00
0+06	836.00
0+08	836.02
0+11	836.58
0+13	837.52

Sheep Run Sta 7+00 - 100 Yr Storm
Worksheet for Irregular Channel

Natural Channel Points	
Station (ft)	Elevation (ft)
0+15	838.22
0+17	838.81
0+21	839.97
0+25	841.14
0+27	841.79

Hec-Ras Summary Output
South Fork Hughes River
Existing Conditions
10 yr/24 hr Storm & 100 yr/24 hr Storm

HEC-RAS Plan: SFH River: SFHughes Reach: 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
1	650.000	10 Yr Storm	1324.00	830.00	835.47		835.04	0.002917	5.54	248.58	84.24	0.44
1	650.000	100 Yr Storm	3710.00	830.00	838.02		839.25	0.005202	9.29	475.82	132.74	0.62
1	600.000	10 Yr Storm	1324.00	830.00	835.41		835.78	0.002335	5.02	287.63	83.01	0.40
1	600.000	100 Yr Storm	3710.00	830.00	838.12		838.91	0.003410	7.70	585.88	133.28	0.51
1	550.000	10 Yr Storm	1324.00	830.00	835.19		835.64	0.002987	5.42	247.84	84.74	0.45
1	550.000	100 Yr Storm	3710.00	830.00	837.38		838.64	0.005762	8.43	456.95	121.60	0.65
1	500.000	10 Yr Storm	1324.00	830.00	834.89		835.48	0.003480	5.64	248.41	75.24	0.48
1	500.000	100 Yr Storm	3710.00	830.00	838.95	836.28	838.32	0.006809	8.84	447.41	128.03	0.71
1	450.000	10 Yr Storm	1324.00	828.98	834.85		835.30	0.003417	5.51	285.27	100.33	0.47
1	450.000	100 Yr Storm	3710.00	828.98	836.82		837.80	0.005239	8.64	528.20	143.37	0.62
1	400.000	10 Yr Storm	1324.00	828.74	834.57		835.10	0.004413	5.82	249.73	138.91	0.53
1	400.000	100 Yr Storm	3710.00	828.74	836.81		837.60	0.004589	7.88	682.72	187.13	0.58
1	350.000	10 Yr Storm	1324.00	828.48	834.43		834.87	0.003711	5.65	291.18	149.08	0.49
1	350.000	100 Yr Storm	3710.00	828.48	836.79		837.35	0.003089	7.00	715.10	193.08	0.49
1	300.000	10 Yr Storm	1324.00	828.19	834.30		834.68	0.003350	5.44	318.84	142.68	0.47
1	300.000	100 Yr Storm	3710.00	828.19	836.67		837.19	0.003013	6.95	719.02	189.41	0.48
1	250.000	10 Yr Storm	1324.00	828.00	834.41		834.53	0.000778	3.08	518.80	157.12	0.24
1	250.000	100 Yr Storm	3710.00	828.00	836.74		837.04	0.001208	4.89	982.33	188.95	0.31
1	200.000	10 Yr Storm	1324.00	828.79	834.24		834.47	0.001548	4.07	408.17	183.30	0.33
1	200.000	100 Yr Storm	3710.00	828.79	836.63		838.95	0.001978	5.99	833.04	205.91	0.40
1	150.000	10 Yr Storm	1324.00	828.33	833.29	832.69	834.25	0.007957	7.98	180.78	78.73	0.72
1	150.000	100 Yr Storm	3710.00	828.33	835.48	835.40	838.69	0.007288	10.28	514.28	182.45	0.74
1	100.000	10 Yr Storm	1324.00	828.00	832.63	832.31	833.79	0.008370	8.84	187.51	82.24	0.78
1	100.000	100 Yr Storm	3710.00	828.00	835.35		838.29	0.005288	9.37	587.78	184.80	0.64
1	50.000	10 Yr Storm	1324.00	828.00	832.84		833.29	0.004004	6.05	280.51	112.15	0.52
1	50.000	100 Yr Storm	3710.00	828.00	835.39		835.97	0.003347	7.59	712.02	189.32	0.51
1	0.000	10 Yr Storm	1324.00	828.00	832.70	831.14	833.10	0.003121	5.16	282.57	108.23	0.48
1	0.000	100 Yr Storm	3710.00	828.00	835.21	833.88	835.61	0.002883	6.99	710.54	213.29	0.48

Hec-Ras Summary Output
Sheep Run
Existing Conditions
10 yr/24 hr Storm & 100 yr/24 hr Storm

HEC-RAS Plan: Plan 01 River: SheepRun Reach: 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.B. (ft)	E.G. Elev (ft)	E.G. Slope (ft/m)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chi
1	700.000	10 Yr Storm	695.50	835.84	840.27	839.27	840.83	0.007825	6.00	118.43	42.41	0.81
1	700.000	100 yr Storm	1648.00	835.84	840.97	841.18	842.98	0.021415	11.41	150.68	55.30	1.04
1	650.000	10 Yr Storm	695.50	835.00	839.88	838.92	840.48	0.008888	6.53	126.11	105.89	0.58
1	650.000	100 yr Storm	1648.00	835.00	841.46	840.97	842.00	0.005137	7.18	335.60	141.71	0.53
1	600.000	10 Yr Storm	695.50	834.00	839.89		840.13	0.004875	5.50	154.65	110.85	0.49
1	600.000	100 yr Storm	1648.00	834.00	841.34		841.74	0.003707	6.05	384.27	152.88	0.45
1	550.000	10 Yr Storm	695.50	834.00	839.83		839.80	0.002774	4.58	189.08	104.38	0.38
1	550.000	100 yr Storm	1648.00	834.00	841.19		841.57	0.003093	5.91	393.39	139.18	0.42
1	500.000	10 Yr Storm	695.50	834.00	838.70	838.59	839.80	0.011017	8.32	110.10	88.79	0.73
1	500.000	100 yr Storm	1648.00	834.00	840.11	840.11	841.24	0.011538	10.40	232.11	102.20	0.79
1	450.000	10 Yr Storm	695.50	834.00	838.52		839.05	0.008520	5.88	124.41	87.52	0.62
1	450.000	100 yr Storm	1648.00	834.00	839.47	839.56	840.71	0.014678	9.40	206.81	102.84	0.88
1	400.000	10 Yr Storm	695.50	833.88	838.44	837.78	838.87	0.009858	4.51	209.41	128.26	0.43
1	400.000	100 yr Storm	1648.00	833.88	839.15	838.78	839.73	0.007523	7.33	309.59	149.45	0.63
1	350.000	10 Yr Storm	695.50	833.82	837.29	837.29	838.28	0.016515	8.28	98.88	124.40	0.87
1	350.000	100 yr Storm	1648.00	833.82	838.60	838.60	839.29	0.009832	8.29	307.83	182.90	0.72
1	300.000	10 Yr Storm	695.50	832.71	838.98	836.20	837.34	0.008087	5.34	153.20	139.86	0.54
1	300.000	100 yr Storm	1648.00	832.71	838.29	837.81	838.81	0.005893	6.70	348.75	222.91	0.56
1	250.000	10 Yr Storm	695.50	832.00	838.78		837.09	0.003444	4.78	175.87	128.87	0.42
1	250.000	100 yr Storm	1648.00	832.00	837.73	836.96	838.48	0.006999	7.87	315.01	201.03	0.63
1	200.000	10 Yr Storm	695.50	831.38	838.47		838.91	0.005497	6.83	165.50	156.14	0.54
1	200.000	100 yr Storm	1648.00	831.38	837.78		838.19	0.004981	7.45	361.84	187.23	0.54
1	150.000	10 Yr Storm	695.50	830.77	838.54		838.73	0.002097	3.98	258.89	176.28	0.33
1	150.000	100 yr Storm	1648.00	830.77	837.82		838.06	0.002278	4.91	493.12	188.18	0.36
1	130.000	10 Yr Storm	695.50	830.22	838.60		838.89	0.001859	3.96	284.01	183.14	0.32
1	130.000	100 yr Storm	1648.00	830.22	837.79		838.03	0.002089	4.82	510.88	188.24	0.35
1	110.000	10 Yr Storm	695.50	830.00	838.40	834.28	838.84	0.004280	4.10	214.84	214.21	0.42
1	110.000	100 yr Storm	1648.00	830.00	837.73	836.77	837.88	0.001980	3.57	512.10	235.55	0.30
1	109	Bridge										
1	83.000	10 Yr Storm	695.50	830.00	834.18	834.18	835.75	0.028874	10.04	69.28	22.18	1.00
1	83.000	100 yr Storm	1648.00	830.00	835.78	836.33	837.43	0.022054	11.73	225.86	227.02	0.95
1	73.000	10 Yr Storm	695.50	829.89	834.35	833.33	834.54	0.008038	3.52	204.35	177.87	0.54
1	73.000	100 yr Storm	1648.00	829.89	836.68	834.81	836.78	0.000944	2.39	840.95	378.41	0.22
1	50.000	10 Yr Storm	695.50	829.00	834.42		834.45	0.000847	1.51	517.48	344.78	0.17
1	50.000	100 yr Storm	1648.00	829.00	836.71		836.73	0.000218	1.37	1382.38	380.00	0.11
1	0.000	10 Yr Storm	695.50	829.00	834.40	831.54	834.43	0.000398	1.87	844.88	380.00	0.14
1	0.000	100 yr Storm	1648.00	829.00	836.70	832.84	836.72	0.000186	1.45	1518.88	380.00	0.10

HEC-RAS SUMMARY OUTPUT
SHEEP RUN
PROPOSED CONDITIONS
10 yr/24 hr STORM & 100 yr/24 hr STORM

HEC-RAS Plan: Plan 01 River: Sheep Run Reach: 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
1	700	10 Yr Storm	695.5	835.84	840.25	839.27	840.82	0.007622	6.09	115.63	42.07	0.6
1	700	100 Yr Storm	1648	835.84	840.97	841.32	843	0.020835	11.54	150.66	55.3	1.03
1	650	10 Yr Storm	695.5	835	839.94	838.85	840.46	0.006417	5.84	135.23	116.57	0.56
1	650	100 Yr Storm	1648	835	841.51	840.9	842	0.00485	6.52	342.74	142.28	0.51
1	600	10 Yr Storm	695.5	834	839.74		840.17	0.004443	5.48	159.88	114.26	0.47
1	600	100 Yr Storm	1648	834	841.37		841.77	0.00356	6.1	388.96	153.12	0.45
1	550	10 Yr Storm	695.5	834	839.69		839.95	0.002568	4.56	205.48	106.39	0.37
1	550	100 Yr Storm	1648	834	841.23		841.6	0.002978	5.93	399.01	139.72	0.42
1	500	10 Yr Storm	695.5	834	838.63	838.63	839.65	0.011506	8.91	105.67	63.74	0.76
1	500	100 Yr Storm	1648	834	840.18	840.18	841.29	0.010647	10.56	239.39	104.07	0.77
1	450	10 Yr Storm	695.5	834	838.49	837.74	839.05	0.008284	6.06	122.9	66.49	0.62
1	450	100 Yr Storm	1648	834	839.42	839.6	840.76	0.015235	9.85	201.56	101.39	0.88
1	400	10 Yr Storm	695.5	833.86	838.44	837.8	838.68	0.003657	4.61	209.06	128.16	0.43
1	400	100 Yr Storm	1648	833.86	839.13	838.79	839.73	0.007749	7.55	306.25	149.07	0.64
1	350	10 Yr Storm	695.5	833.82	837.29	837.29	838.27	0.016592	8.27	98.83	124.67	0.88
1	350	100 Yr Storm	1648	833.82	838.61	838.61	839.29	0.009811	8.24	309.47	193.05	0.72
1	300	10 Yr Storm	695.5	832.71	836.88	836.2	837.3	0.006746	5.54	147.2	137.51	0.56
1	300	100 Yr Storm	1648	832.71	838.48	837.75	838.87	0.004408	5.96	397.27	224.41	0.49
1	250	10 Yr Storm	695.5	832	836.68		837.02	0.003821	4.87	168.1	124.85	0.44
1	250	100 Yr Storm	1648	832	837.5	836.94	838.5	0.009565	8.78	267.99	199	0.72
1	200	10 Yr Storm	695.5	831.38	835.8	835.8	836.7	0.012324	8.96	112.29	86.66	0.79
1	200	100 Yr Storm	1648	831.38	837.37	837.37	838.1	0.009052	9.58	315.76	183.96	0.72
1	150	10 Yr Storm	695.5	830.77	834.62	834.86	835.94	0.024417	9.28	78.1	44.29	1.03
1	150	100 Yr Storm	1648	830.77	837.22	836.71	837.62	0.004206	6.2	396.01	183.14	0.48
1	127	10 Yr Storm	695.5	830	834.15	834.17	835.48	0.01856	9.27	75.23	31.46	1.01
1	127	100 Yr Storm	1648	830	837.1		837.54	0.003289	6.43	391.57	193.01	0.48
1	113	10 Yr Storm	695.5	830	834.46	832.86	835.06	0.005639	6.18	112.56	25.22	0.52
1	113	100 Yr Storm	1648	830	837.19	836.32	837.45	0.002068	5.04	495	217.95	0.33
1	101		Culvert									
1	91	10 Yr Storm	695.5	830	833.96		834.68	0.007718	6.83	101.84	25.72	0.6
1	91	100 Yr Storm	1648	830	836.47		836.86	0.003509	6.14	429.94	264.99	0.43
1	73	10 Yr Storm	695.5	830	834.41		834.45	0.000618	1.72	440.75	180.96	0.17
1	73	100 Yr Storm	1648	830	836.69		836.74	0.00043	2.07	1071.52	378.69	0.16
1	50	10 Yr Storm	695.5	829	834.43		834.44	0.000063	0.76	1010.75	345.88	0.06
1	50	100 Yr Storm	1648	829	836.71		836.73	0.00007	1.04	1875.26	380	0.07
1	0	10 Yr Storm	695.5	829	834.4	831.54	834.43	0.000388	1.73	644.96	380	0.14
1	0	100 Yr Storm	1648	829	836.7	832.93	836.72	0.000165	1.49	1518.96	380	0.1

STATE OF WEST VIRGINIA,
COUNTY OF DODDRIDGE, TO WIT

I, Virginia Nicholson, Editor of THE
HERALD RECORD, a weekly newspaper
published regularly, in Doddridge County,
West Virginia, Do Hereby Certify
That the Accompanying Legal Notice
Entitled:

..... Floodplain Permit
Application
..... Permit # 14-255

was published in said paper for ... 2

successive weeks beginning with the issue
of ... August 19th ... 2014 and
ending with the issue of

..... August 26th 2014 and

that said notice contains ... 189

WORD SPACE at ... 115 cents a word

amounts to the sum of \$... 217.4

FOR FIRST PUBLICATION, SECOND
PUBLICATION IS 75% OF THE FIRST
PUBLICATION

\$... 16.31
and each publication thereafter

\$... 38.05 TOTAL

EDITOR

..... Virginia Nicholson

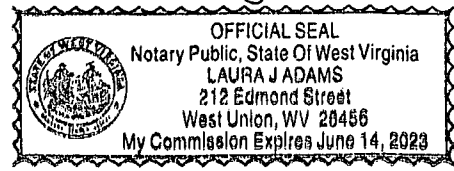
SWORN TO AND SUBSCRIBED

BEFORE ME THIS THE ... 28th DAY
OF ... August 2014

NOTARY PUBLIC

..... Laura Adams

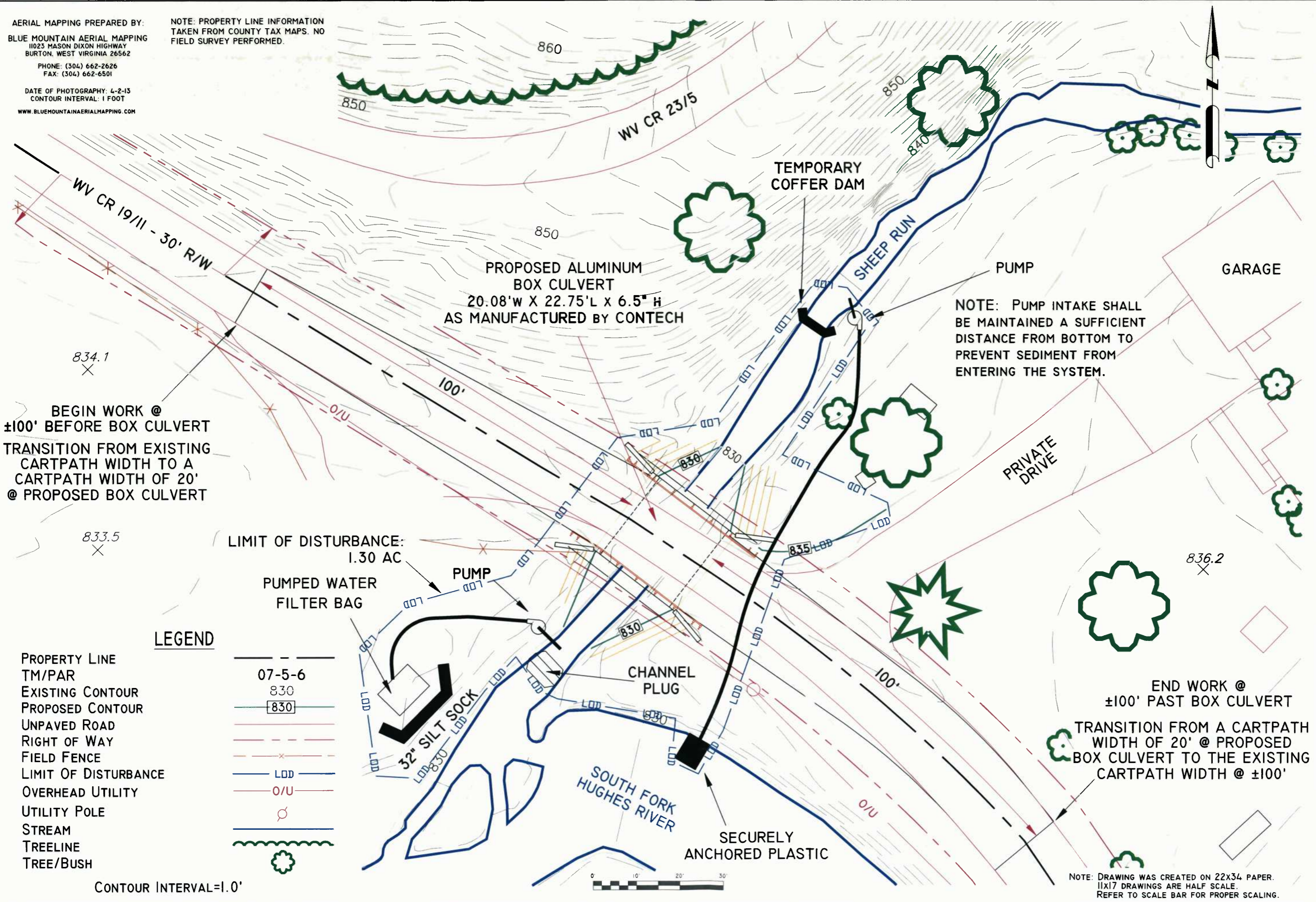
LEGAL ADVERTISEMENT
Doddridge County
Floodplain Permit Application
Please take notice that on the 5th day of August, 2014
Blue Mountain Inc. CNX Gas Company, LLC filed an
application for a Floodplain Permit to develop land
located at or about: 19 206402N/80:833548W/Permit #14-
255 South Fork Bridge, W.V. The Application is on file
with the Clerk of the County Court and may be inspected
or copied during regular business hours. As this project is
outside the FEMA identified flood plain of Doddridge
County, Doddridge County Floodplain Management has
no regulatory authority. Any interested persons who
desire to comment shall present the same in writing by
September 8, 2014.
Delivered to the
Clerk of the County Court
111 E. Court Street, West Union, WV 26456
Beth A. Rogers, Doddridge County Clerk
Edwin L. "Bo" Wriston, Doddridge County Flood Plain
Manager
8-19-2xb



AERIAL MAPPING PREPARED BY:
BLUE MOUNTAIN AERIAL MAPPING
 11023 MASON DIXON HIGHWAY
 BURTON, WEST VIRGINIA 26562
 PHONE: (304) 662-2626
 FAX: (304) 662-6501
 DATE OF PHOTOGRAPHY: 4-2-13
 CONTOUR INTERVAL: 1 FOOT
 WWW.BLUEMOUNTAINAERIALMAPPING.COM

NOTE: PROPERTY LINE INFORMATION
 TAKEN FROM COUNTY TAX MAPS. NO
 FIELD SURVEY PERFORMED.

Blue Mountain Inc.
 Engineers and Land Surveyors
 11023 Mason Dixon Hwy.
 Burton, WV 26562-9656
 (304) 662-6486



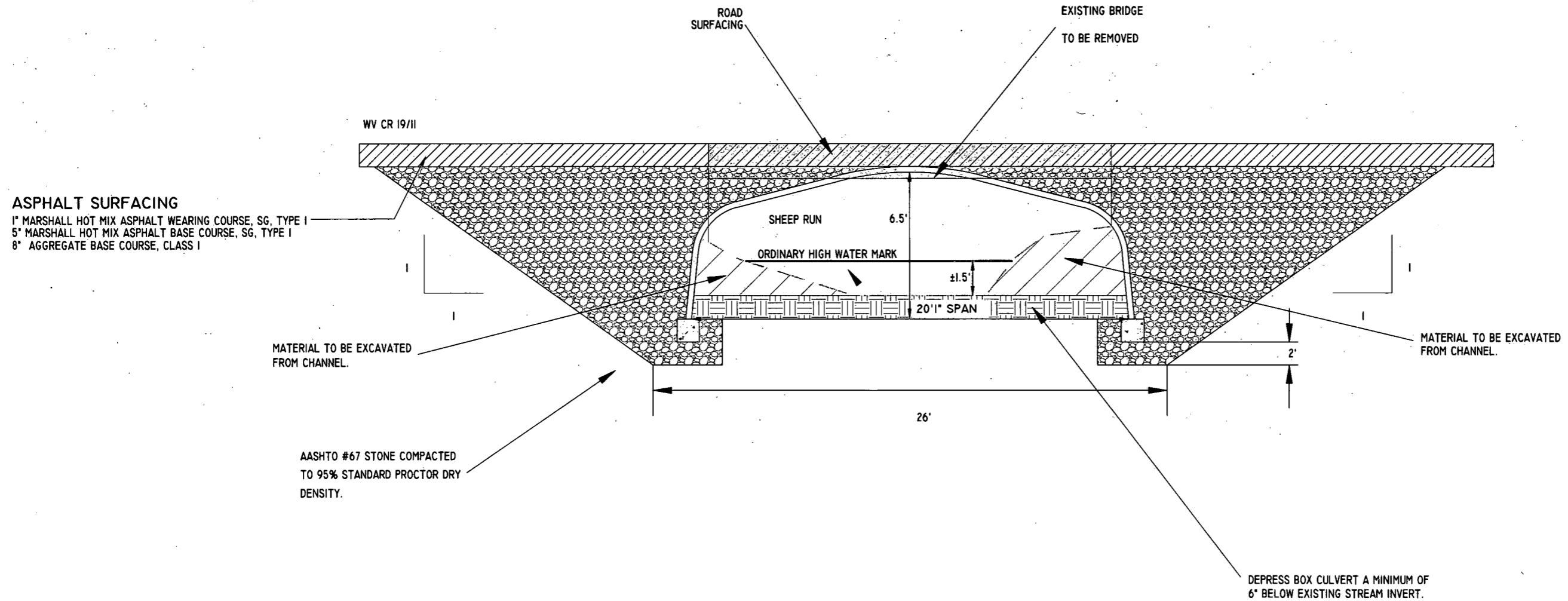
CNX GAS COMPANY, LLC
 ONE ENERGY DRIVE
 JANE LEW, WV 26378

CNX GAS

PROPOSED BRIDGE REPLACEMENT ON SHEEP RUN
 WV CR 19/11
 DODDRIDGE COUNTY, WV

NOTE: ASPHALT SURFACING TO EXTEND 100' FROM EDGE OF BOX CULVERT IN BOTH DIRECTIONS, MAKING A SMOOTH TRANSITION FROM THE EXISTING CARTPATH WIDTH TO A MINIMUM 20' CARTPATH WIDTH AT BOX CULVERT.

SECTION ALONG CENTERLINE OF WV CR 19/II
N.T.S.



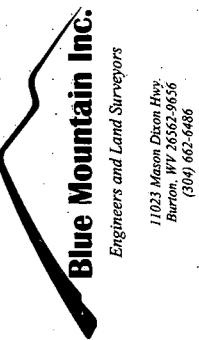
ASPHALT SURFACING
1" MARSHALL HOT MIX ASPHALT WEARING COURSE, SG, TYPE I
5" MARSHALL HOT MIX ASPHALT BASE COURSE, SG, TYPE I
8" AGGREGATE BASE COURSE, CLASS I

MATERIAL TO BE EXCAVATED FROM CHANNEL.

AASHTO #67 STONE COMPACTED TO 95% STANDARD PROCTOR DRY DENSITY.

MATERIAL TO BE EXCAVATED FROM CHANNEL.

DEPRESS BOX CULVERT A MINIMUM OF 6" BELOW EXISTING STREAM INVERT.



CNX GAS COMPANY, LLC
ONE ENERGY DRIVE
JANE LEW, WV 26378

CNX GAS

PROPOSED BRIDGE REPLACEMENT ON SHEEP RUN
WV CR 19/II
DODDRIDGE COUNTY, WV

REVISIONS

DATE	TYPE
4/17/15	NEW CULVERT DESIGN

DRAWN BY: EER
CHECKED BY: WPF
DATE: 08-15-14
SCALE: 1" = 5'
JOB NO.
DRAWING NAME: SECTIONS
DRAWING NO.: SECT-01
DATE TYPE

NOTE: DRAWING WAS CREATED ON 22X34 PAPER. 1/17 DRAWINGS ARE HALF SCALE. REFER TO SCALE BAR FOR PROPER SCALING.

