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George Eidel
Doddridge County FloodPlain MGT
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West Union, WV 26456

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Charles P. Heaster, Et Al # 15-404
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1. Article Addressed to:

Charles P. Heaster, Et Al #15-404
Rt 1, Box 57
West Union, WV 26456

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A. Signature

X ☐ Agent ☐ Addressee

B. Received by *(Printed Name)* | C. Date of Delivery

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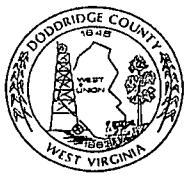

Doddridge County FPM
108 Court Street, Ste. 1
West Union, WV 26456

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Respectfully yours,

Doddridge County Floodplain Manager
304-873-2631 or 304-873-1343
doddridgecountyfpm@gmail.com

caused by any of these crossings. Temporary bridges are currently in place until the low water ford crossings can be installed.

Included in the attachments are the following: cover letter and signed and sealed floodplain analysis of Bluestone Creek, signed application, Stream Crossing Reports for streams A-J, FEMA map with the site location, an overview map with stream crossing locations (Streams A-D in Flood Zone), vicinity map, "Stream Crossings in Flood Zone" write-up, revised site plans dated 6/03/2014, original site plans dated 11/04/2013, a copy of the original permit issued for this site (Permit No. 13-113), ford crossing plans, and the drilling permit authorization issued by the WV DEP.

If you have any questions, please call.

Adam Wilson
Smith Land Surveying, Inc.
P.O. Box 150
Glenville, WV 26351
(304) 462-5634 awilson@slssurveys.com

#15-404

PROFESSIONAL ENERGY CONSULTANTS

A DIVISION OF SMITH LAND SURVEYING, INC.

November 3, 2015

Mr. George Eidel
Floodplain Manager
Doddridge County Commission
118 East Court Street
West Union, WV 26456

2015 NOV 20 PM 4:11

Re: EQT Production Company- OXF 157 Proposed Well Pad, Associated Pit, and Access Road Modification

Mr. Eidel,

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P.O. Box 150, 12 Vanhorn Drive, Glenville, WV 26351
T: (304)-462-5634 F: (304)-462-5656

56065 Dilles Bottom Road, Shadyside, OH 43947
T: (740)-671-9911

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1. Article Addressed to:

Arden and Anne Ashcraft #15-404
102 Maxwell Ridge Rd
West Union, WV 26456

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A. Signature
X Arden Ann Ashcraft ☐ Agent ☒ Addressee

B. Received by (Printed Name) Anne Ashcraft
C. Date of Delivery 12-9-15

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

Ann Ashcraft

3. Service Type
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4. Restricted Delivery? (Extra Fee) ☐ Yes

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1. Article Addressed to:

IL Morris #15-404
P.O. Box 397
Glenville, WV 26351

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Mike Triplett ☒ Agent ☐ Addressee

B. Received by (Printed Name) Mike Triplett
C. Date of Delivery

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

DEC 30 ... ETH A. ... COUNTY CL... RIDGE COU...

3. Service Type
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☐ Registered ☐ Return Receipt for Merchandise
☐ Insured Mail ☐ Collect on Delivery

4. Restricted Delivery? (Extra Fee) ☐ Yes

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#15-404

Sent To: Mary Holland est
Street, Apt. No.; or PO Box No.: 225 Watchung Frk
City, State, ZIP+4: Westfield, NJ 07090

PS Form 3800, August 2006 See Reverse for Instructions

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Total Postage & Fees	$ 6.74

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#15-404

Sent To: IL Morris
Street, Apt. No.; or PO Box No.: P.O. Box 397
City, State, ZIP+4: Glenville, WV 26351

PS Form 3800, August 2006 See Reverse for Instructions

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Return Receipt Fee (Endorsement Required)	2.80
Restricted Delivery Fee (Endorsement Required)	
Total Postage & Fees	$ 6.74

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Sent To: Sue Ann Spiker
Street, Apt. No.; or PO Box No.: 166 Linden Lane
City, State, ZIP+4: Jane Lew, WV 26378

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Total Postage & Fees	$ 6.74

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Sent To: Charles R. Heater, Et Al
Street, Apt. No.; or PO Box No.: Rt 1 Box 57
City, State, ZIP+4: West Union, WV 26456

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Total Postage & Fees	$ 6.74

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#15-404

7013 2250 0001 6914 9596

Sent To: Arden & Anne Ashcraft
Street, Apt. No.; or PO Box No.: 102 Maxwell Ridge Rd
City, State, ZIP+4: West Union, WV 26456

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Total Postage & Fees	$ 6.74

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7013 2250 0001 6914 9534

Sent To: James Donley
Street, Apt. No.; or PO Box No.: Rt 1 Box 33
City, State, ZIP+4: West Union, WV 26456

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Return Receipt Fee (Endorsement Required)	2.80
Restricted Delivery Fee (Endorsement Required)	
Total Postage & Fees	$ 6.74

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#15-404

7013 2250 0001 6914 9572

Sent To: Mary Farr Secrist
Street, Apt. No.; or PO Box No.: Rt 1, Box 56 A
City, State, ZIP+4: West Union, WV 26456

PS Form 3800, August 2006 See Reverse for Instructions

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1. Article Addressed to:

Sue Ann Spiker # 15-404
166 Linden Lane
Jane Lew, WV 26378

COMPLETE THIS SECTION ON DELIVERY

A. Signature
X Sue Ann Spiker ☐ Agent ☐ Addressee

B. Received by *(Printed Name)* SUE ANN SPIKER C. Date of Delivery 12/21/15

D. Is delivery address different from item 1? ☐ Yes
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George Eidel
Doddridge County FloodPlain MGT
108 Court St., Ste 1
West Union, WV 26456

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1. Article Addressed to:

Mary Holland Est. # 15-404
225 Watchung Frk
Westfield, NJ 07090

COMPLETE THIS SECTION ON DELIVERY

A. Signature

X

☐ Agent
☑ Addressee

B. Received by *(Printed Name)* D Hardin

C. Date of Delivery 12/9/15

D. Is delivery address different from item 1? ☐ Yes
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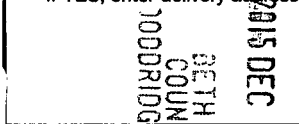

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14 DEC '15

PM 6 L

First-Class Mail
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USPS
Permit No. G-10

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George Eidel
Doddridge County FloodPlain MGT
108 Court St., Ste 1
West Union, WV 26456

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George Eidel
Doddridge County FloodPlain MGT
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A DIVISION OF SMITH LAND SURVEYING, INC.

November 3, 2015

Mr. George Eidel
Floodplain Manager
Doddridge County Commission
118 East Court Street
West Union, WV 26456

2015 NOV 20 PM 4:11

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T: (304)-462-5634 F: (304)-462-5656

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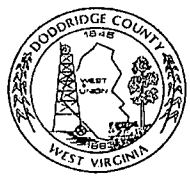
Smith Land Surveying, Inc.
P.O. Box 150
Glenville, WV 26351
(304) 462-5634 awilson@slssurveys.com



Doddridge County FPM
108 Court Street, Ste. 1
West Union, WV 26456

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Doddridge County Floodplain Manager
304-873-2631 or 304-873-1343
doddridgecountyfpm@gmail.com

CERTIFIED MAIL™

George Eidel
Doddridge County FloodPlain MGT
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26456209501 RC01

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Mary Farr Secrist #15-404
Rt 1, Box 56 A
West Union, WV 26456

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A. Signature

X ☐ Agent ☐ Addressee

B. Received by *(Printed Name)* | C. Date of Delivery

D. Is delivery address different from item 1? ☐ Yes
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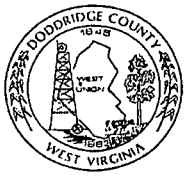

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A DIVISION OF SMITH LAND SURVEYING, INC.

November 3, 2015

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Floodplain Manager
Doddridge County Commission
118 East Court Street
West Union, WV 26456

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If you have any questions, please call.

Adam Wilson
Smith Land Surveying, Inc.
P.O. Box 150
Glenville, WV 26351
(304) 462-5634 awilson@slssurveys.com

Floodplain Development Permit

Doddridge County, WV Floodplain Management

This permit gives approval for the development/ project listed 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: # 15-404

Date Approved: 02/17/2016 **Expires: 02/17/2017**

Issued to: EQT Production Company **POC: Lacoa Corder 304-848-0076**
OXF 157 Well Pad, Pit and Access Road Modification

Company Address: 115 Professional Place/P.O. Box 280
Bridgeport, WV 26330

Project Address: West of Maxwell Ridge along Bluestone Creek off Co. Rt. 13.

Firm: 225C **Lat/Long:**

Purpose of development: Well Pad, Associated Pit and Access Road Modification

Issued by: George C Eidel, Doddridge County FPM (*or designee*)

George C Eidel

Date: 02/17/2016

For additional information regarding this permit, please contact
Doddridge County Floodplain Manager at 304.873.2631, or via email at
doddridgecountyfpm@gmail.com
108 Court Street Ste 1; West Union, WV 26456

SLS SMITH LAND SURVEYING, INC.
P.O. BOX 150, GLENVILLE, WV 26351
(304) 462-5634 • FAX (304) 462-5656

LETTER OF TRANSMITTAL

DATE	JOB NO.
11/19/15	7889
ATTENTION: George Eidel	
RE: EQT OXF 157 Re-Permit	

TO: Doddridge County Floodplain Coordinator
118 East Court St.
West Union, WV 26456

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via _____ the following items:

☐ Shop drawings ☐ Prints ☒ Plans ☐ Samples ☐ Specifications
☐ Copy of letter ☐ Change order ☐ _____

COPIES	DATE	NO.	DESCRIPTION
1			Floodplain Packet for EQT OXF 157 Wells (Application, Site Plans, Flood Analysis, Etc.)
1			$500.00 SLS Check # 45286

THESE ARE TRANSMITTED as checked below:

☒ For approval ☐ Approved as submitted ☐ Resubmit_____copies for approval
☒ For your use ☐ Approved as noted ☐ Submit_____copies for distribution
☐ As requested ☐ Returned for corrections ☐ Return_____corrected prints
☐ For review and comment ☐ _____
☐ FOR BIDS DUE _____ 20_____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS _____

If you have any questions or concerns on this re-application please feel free to call Adam Wilson or Wes Wayne at 304-462-5634. Thank you.

COPY TO SLS Files

7889 OXF 157 Floodplain

SIGNED: Adam Wilson

If enclosures are not as noted, kindly notify us at once.

#15-404

PROFESSIONAL ENERGY CONSULTANTS

A DIVISION OF SMITH LAND SURVEYING, INC.

November 3, 2015

Mr. George Eidel
Floodplain Manager
Doddridge County Commission
118 East Court Street
West Union, WV 26456

Re: EQT Production Company- OXF 157 Proposed Well Pad, Associated Pit, and Access Road Modification

Mr. Eidel,

On behalf of EQT, Smith Land Surveying, Inc. is applying for a new Doddridge County Floodplain Permit due to the expiration of the existing permit (No. 13-113). EQT has constructed a well pad, associated pit, and an access road to aid in the development of multiple Marcellus Shale gas wells. The site is located in Doddridge County west of Maxwell Ridge along Bluestone Creek off County Route 13. The entrance to the site is approximately 3/4 mile southwest of County Route 13 and County Route 13/3 Intersection. The total disturbance area of the site is approximately 36.97 acres.

Portions of the site are located within Flood Zone A as indicated on FEMA Panel 54017C0225C. Please see the attached maps showing the limits of disturbance overlaid onto a FEMA Firmette. The four stream crossings that are in the Flood Zone originally were permitted to be constructed with culverts as permanent stream crossings. A modification to the permit was requested using revised plans to show the three stream crossings (Crossings B, C, and D) utilizing a permanent concrete low water ford crossing (please see attached "OXF 157 Stream Crossings in Flood Zone" for a detailed description of each of the three streams). The fourth crossing (Crossing A) used to access the pit will be removed after the reclamation. These Low Water Ford Crossings will not include any culverts and they will be solid concrete with rebar reinforcement level with the existing stream bed. There will be no change in the base flood elevation

P.O. Box 150, 12 Vanhorn Drive, Glenville, WV 26351
T: (304)-462-5634 F: (304)-462-5656

56065 Dilles Bottom Road, Shadyside, OH 43947
T: (740)-671-9911

caused by any of these crossings. Temporary bridges are currently in place until the low water ford crossings can be installed.

Included in the attachments are the following: cover letter and signed and sealed floodplain analysis of Bluestone Creek, signed application, Stream Crossing Reports for streams A-J, FEMA map with the site location, an overview map with stream crossing locations (Streams A-D in Flood Zone), vicinity map, "Stream Crossings in Flood Zone" write-up, revised site plans dated 6/03/2014, original site plans dated 11/04/2013, a copy of the original permit issued for this site (Permit No. 13-113), ford crossing plans, and the drilling permit authorization issued by the WV DEP.

If you have any questions, please call.

Adam Wilson
Smith Land Surveying, Inc.
P.O. Box 150
Glenville, WV 26351
(304) 462-5634 awilson@slssurveys.com

#15-404

DODDRIDGE COUNTY
FLOODPLAIN DEVELOPMENT PERMIT APPLICATION

SECTION 1: GENERAL PROVISIONS (APPLICANT TO READ AND SIGN)

1. No work may start until a permit is issued.
2. The permit may be revoked if any false statements are made herein.
3. If revoked, all work must cease until permit is re-issued.
4. Development shall not be used or occupied until a Certificate of Compliance is issued.
5. The permit will expire if no work is commenced within six months of issuance.
6. Applicant is hereby informed that other permits may be required to fulfill local, state, and federal requirements.
7. Applicant hereby gives consent to the Floodplain Administrator/Manager or his/her representative to make inspections to verify compliance.
8. **I, THE APPLICANT CERTIFY THAT ALL STATEMENTS HEREIN AND IN ATTACHMENTS TO THIS APPLICATION ARE, TO THE BEST OF MY KNOWLEDGE, TRUE AND ACCURATE.**

APPLICANT'S SIGNATURE Jacob Corder

DATE 11/18/15

SECTION 2: PROPOSE DEVELOPMENT (TO BE COMPLETED BY APPLICANT).

IF THE APPLICANT IS NOT A NATURAL PERSON, THE NAME, ADDRESS, AND TELEPHONE NUMBER OF A NATURAL PERSON WHO SHALL BE APPOINTED BY THE APPLICANT TO RECEIVE NOTICE PURSUANT TO ANY PROVISION OF THE CURRENT DODDRIDGE COUNTY FLOODPLAIN ORDINANCE.

APPLICANT'S NAME: EQT Production Company

ADDRESS: 115 Professional Place P.O. Box 280 Bridgeport WV 26330

TELEPHONE NUMBER: 304-848-0076

BUILDER'S NAME: EQT Production Company

ADDRESS: 115 Professional Place P.O. Box 280 Bridgeport, WV 26330

TELEPHONE NUMBER: 304-848-0076

ENGINEER'S NAME: Cyrus S. Kump/ Navitus Engineering Inc.

ADDRESS: 151 Windy Hill Lane Winchester VA 22602

TELEHONE NUMBER: 888-662-4185

PROJECT LOCATION:

The OXF 157 Site (Modification) is located west of Maxwell Ridge along Bluestone Creek off of County Route 13. The Entrance to the site is approximately ¾ mile southwest of the County Route 13 and County Route 13/3 intersection. The coordinates of the site are:

OXF 157:

Site entrance: Latitude 39.227701 Longitude -80.758964 (NAD 83)

Well Pad entrance: Latitude 39.234468 Longitude -80.764983 (NAD 83)

Well Pad: Latitude 39.236047 Longitude -80.766261 (NAD 83)

Associated Pit: Latitude 39.238452 Longitude -80.764291 (NAD 83)

NAME OF SURFACE OWNER/OWNERS (IF NOT THE APPLICANT) Justin L. Henderson

ADDRESS OF SURFACE OWNER/OWNERS (IF NOT THE APPLICANT)

P.O. Box 100 Meadowbrook, WV 26404

DISTRICT: West Union District (Property is taxed in Southwest District, but the wells/site are in West Union)

DATE/FROM WHOM PROPERTY PURCHASED:

LAND BOOK DESCRIPTION: Bluestone 1602.90 AC

DEED BOOK REFERENCE: Book- WB29 page- 224

TAX MAP REFERENCE: Map 6-1 (Taxed in Southwest)

EXISTING BUILDINGS/USES OF PROPERTY:

NAME OF AT LEAST ONE ADULT RESIDING IN EACH RESIDENCE LOCATED UPON THE SUBJECT PROPERTY N/A

ADDRESS OF AT LEAST ONE ADULT RESIDING IN EACH RESIDENCE LOCATED UPON THE SUBJECT PROPERTY

To avoid delay in processing the application, please provide enough information to easily identify the project location.

DESCRIPTION OF WORK (CHECK ALL APPLICABLE BOXES)

A. STRUCTURAL DEVELOPMENT

	ACTIVITY		STRUCTURAL TYPE
[]	New Structure	[]	Residential (1 – 4 Family)
[]	Addition	[]	Residential (more than 4 Family)
[]	Alteration	[]	Non-residential (floodproofing)
[]	Relocation	[]	Combined Use (res. & com.)
[]	Demolition	[]	Replacement
[]	Manufactured/Mobil Home		

B. OTHER DEVEOPLMENT ACTIVITIES:

[X] Fill [] Mining [X] Drilling [] Pipelining

[X] Grading

[] Excavation (except for STRUCTURAL DEVELOPMENT checked above)

[] Watercourse Altercation (including dredging and channel modification)

[X] Drainage Improvements (including culvert work)

[X] Road, Street, or Bridge Construction

[] Subdivision (including new expansion)

[] Individual Water or Sewer System

[] Other (please specify)

C. STANDARD SITE PLAN OR SKETCH

1. **SUBMIT ALL STANDARD SITE PLANS, IF ANY HAVE BEEN PREPARED.**
2. **IF STANDARD SITE PLANS HAVE NOT BEEN PREPARED:**
   SKETCH ON A SEPARATE 8 ½ X 11 INCH SHEET OF PAPER THE SHAPE AND LOCATION OF THE LOT. SHOW THE LOCATION OF THE INTENDED CONSTRUCTION OR LAND USE

INDICATING BUILDING SETBACKS, SIZE & HEIGHT. IDENTIFY EXISTING BUILDINGS, STRUCTURES OR LAND USES ON THE PROPERTY.

3. **SIGN AND DATE THE SKETCH.**

ACTUAL TOTAL CONSTRUCTION COSTS OF THE COMPLETE DEVELOPMENT IRRESPECTIVE OF WHETHER ALL OR ANY PART OF THE SUBJECT PROPOSED CONSTRUCTION PROJECT IS WITHIN THE FLOODPLAIN $ $1,674,600

D. ADJACENT AND/OR AFFECTED LANDOWNERS:

1. **NAME AND ADDRESS OF ALL OWNERS OF SURFACE TRACTS ADJACENT TO THE AREA OF THE SURFACE TRACT (UP & DOWN STREAM) UPON WHICH THE PROPOSED ACTIVITY WILL OCCUR AND ALL OTHER SURFACE OWNERS UP & DOWN STREAM) WHO OWN PROPERTY THAT MAY BE AFFECTED BY FLOODING AS IS DEMONSTRATED BY A FLOODPLAIN STUDY OR SURVEY (IF ONE HAS BEEN COMPLETED).**

NAME: James Donley
ADDRESS: Rt 1 Box 33
West Union, WV 26456

NAME: Sue Ann Spiker
ADDRESS: 166 Linden Lane
Jane Lew, WV 26378

NAME: IL Morris
ADDRESS: P.O. Box 397
Glenville, WV 26351

NAME: Mary Holland Estates
ADDRESS: 225 Watchung Frk
Westfield, NJ 7090

NAME: Mary Farr Secrist
ADDRESS: Rt 1 Box 56 A
West Union, WV 26456

NAME: Charles P. Heaster, Et AL.
ADDRESS: Rt 1 Box 57
West Union, WV 26456

NAME: Arden and Anne Ashcraft
ADDRESS: 102 Maxwell Ridge Road
West Union, WV 26456

1. **NAME AND ADDRESS OF AT LEAST ONE ADULT RESIDING IN EACH RESIDENCE LOCATED UPON ANY ADJACENT PROPERTY AT THE TIME THE FLOODPLAIN PERMIT APPLICATION IS FILED AND THE NAME AND ADDRESS OF AT LEAST ONE ADULT RESIDING IN ANY HOME ON ANY PROPERTY THAT MAY BE AFFECTED BY FLOODING AS IS DEMONSTRATED BY A FLOODPLAIN STUDY OR SURVEY.**

NAME: Mary Farr Secrist
ADDRESS: Rt 1 Box 56 A
West Union, WV 26456

NAME: Charles P. Heaster, Et AL.
ADDRESS: Rt 1 Box 57
West Union, WV 26456

NAME: Arden and Anne Ashcraft
ADDRESS: 102 Maxwell Ridge Road
West Union, WV 26456

NAME: James Donley
ADDRESS: Rt 1 Box 33
West Union, WV 26456

E. CONFIRMATION FORM

THE APPLICANT ACKNOWLEDGES, AGREES, AND CONFIRMS THAT HE/IT WILL PAY WITHIN 30 DAYS OF RECEIPT OF INVOICE BY THE COUNTY FOR ALL EXPENSES RELATIVE TO THE PERMIT APPLICATION PROCESS GREATER THAN THE REQUIRED DEPOSIT FOR EXPENSES INCLUDING:

(A) PERSONAL SERVICE OF PROCESS BY THE DODDRIDGE COUNTY SHERIFF AT THE RATES PERMITTED BY LAW FOR SUCH SERVICE.

(B) SERVICE BY CERTIFIED MAIL RETURN RECEIPT REQUESTED.

(C) PUBLICATION.

(D) COURT REPORTING SERVICES AT ANY HEARINGS REQUESTED BY THE APPLICANT.

(E) CONSULTANTS AND/OR HEARING EXPERTS UTILIZED BY DODDRIDGE COUNTY FLOODPLAIN ADMINISTRATOR/MANAGER OR FLOODPLAIN APPEALS BOARD FOR REVIEW OF MATERIALS AND/OR TESTIMONY REGARDING THE EFFICACY OF GRANTING OR DENYING THE APPLICANT'S FLOODPLAIN PERMIT.

NAME (PRINT): Lacoa Corder

SIGNATURE: Lacoa Corder **DATE:** 11/18/15

After completing SECTION 2, APPLICANT should submit form to Floodplain Administrator/Manager or his/her representative for review.

SECTION 3: FLOODPLAIN DETERMINATION (to be completed by Floodplain Administrator/Manager or his/her representative)

THE PROPOSED DEVELOPMENT:

THE PROPOSED DEVELOPMENT IS LOCATED ON:

FIRM Panel:_____
Dated:_____

[] Is **NOT** located in a Specific Flood Hazard Area (Notify applicant that the application review is complete and **NO FLOOPLAIN DEVELOPMENT PERMIT IS REQUIRED**).

[] Is located in Special Flood Hazard Area.
FIRM zone designation_____
100-Year flood elevation is:_____NGVD (MSL)

[] Unavailable

[] The proposed development is located in a floodway.
FBFM Panel No._____ Dated_____

[] See section 4 for additional instructions.

SIGNED_____ **DATE**_____

SECTION 4: ADDITIONAL INFORMATION REQUIRED (To be completed by Floodplain Administrator/Manager or his/her representative)

The applicant must submit the documents checked below before the application can be processed.

[] A plan showing the location of all existing structures, water bodies, adjacent roads, lot dimensions and proposed development.

[] Development plans, drawn to scale, and specifications, including where applicable: details for anchoring structures, storage tanks, proposed elevation of lowest floor, (including basement or crawl space), types of water resistant materials used below the first floor, details of flood proffing of utilities located below the first floor and details of enclosures below the first floor. Also_____
_____

[] Subdivision or other development plans (If the subdivision or development exceeds 50 lots or 5 acres, whichever is the lesser, the applicant must provide 100-year flood elevations if they are not otherwise available).

[] Plans showing the extent of watercourse relocation and/or landform alterations.

[] Top of new fill elevation_____Ft. NGVD (MSL).
For floodproofing structures applicant must attach certification from registered engineer or architect.

[] Certification from a registered engineer that the proposed activity in a regulatory floodway will not result in any increase in the height of the 100-year flood. A copy of all data and calculations supporting this finding must also be submitted.

[] Manufactured homes located in a floodplain area must have a West Virginia Contractor's License and a Manufactured Home Installation License as required by the Federal Emergency Management Agency (FEMA).

[] Other:

_____

_____

_____

SECTION 5: PERMIT DETERMINATION (To be completed by Floodplain Administrator/Manager or his/her representative)

I have determined that the proposed activity **(type is or is not)** in conformance with provisions of the Floodplain Ordinance adopted by the County Commission of Doddridge County on May 21, 2013. The permit is issued subject to the conditions attached to and made part of this permit.

SIGNED_____DATE_____

If the Floodplain Administrator/Manager found that the above was not in conformance with the provisions of the Doddridge County Floodplain Ordinance and/or denied that application, the applicant may complete an appealing process below.

APPEALS: Appealed to the County Commission of Doddridge County? [] Yes {} No
Hearing Date:_____
County Commission Decision - Approved [] Yes [] No

CONDITIONS:_____
_____
_____
_____

SECTION 6: AS-BUILT ELEVATIONS (To be submitted by APPLICANT before Certificate of Compliance is issued).

The following information must be provided for project structures. This section must be completed by a registered professional engineer or a licensed land surveyor (or attach a certification to this application).

COMPLETE 1 OR 2 BELOW:

1 Actual (As-Built) Elevation of the top of the lowest floor (including basement or crawl space is_____FT. NGVD (MSL)

2 Actual (As Built) elevation of floodproofing is_____FT. NGVD (MSL)

Note: Any work performed prior to submittal of the above information is at risk of the applicant.

SECTION 7: COMPLIANCE ACTION (To be completed by the Floodplain Administrator/Manager or his/her representative).

The Floodplain Administrator/Manager or his/her representative will complete this section as applicable based on inspection of the project to ensure compliance with the Doddridge County Floodplain Ordinance.

INSPECTIONS:

DATE:_____ **BY:**_____

DEFICIENCIES ? **Y/N**

COMMENTS_____

_____

_____

_____

_____

_____

SECTION 8: CERTIFICATE OF COMPLIANCE (To be completed by Floodplain Administrator/Manager or his/her representative).

Certificate of Compliance issued: DATE:_____ BY:_____

CERTIFICATE OF COMPLIANCE
FOR DEVELOPMENT IN SPECIAL FLOOD HAZARD AREA
(OWNER MUST RETAIN)

PERMIT NUMBER:_____
PERMIT DATE:_____

PURPOSE –

CONSTRUCTION LOCATION:_____

OWNER'S ADDRESS:_____

_____

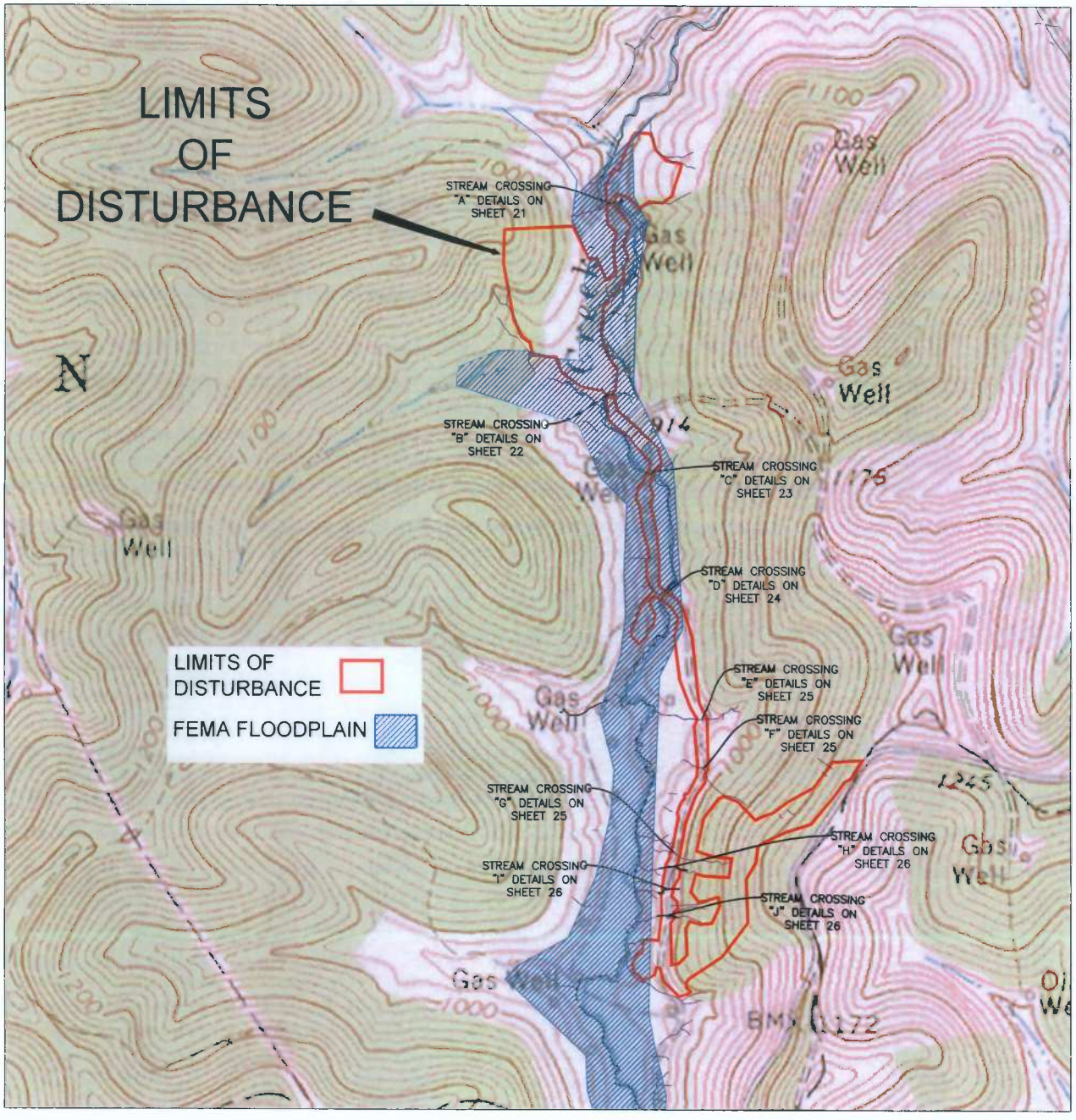
_____

THE FOLLOWING MUST BE COMPLETED BY THE FLOODPLAIN ADMINISTRATOR/MANAGER OR HIS/HER AGENT.

COMPLIANCE IS HEREBY CERTIFIED WITH THE REQUIREMENT OF THE FLOODPLAIN ORDINANCE ADOPTED BY THE COUNTY COMMISSION OF DODDRIDGE COUNTY ON MAY 21, 2013.

SIGNED_____**DATE**_____

OXFORD 157 STREAM CROSSINGS AND FEMA MAP



N

NOTES

DODDRIDGE COUNTY, WV: OXFORD AND NEW MILTON TOPO QUADS

SCALE
1 INCH= 1000-FEET

0′ 1000′ 2000′ 3000′

SCALE: 1"= 1000′ | DATE: 06-24-14 | DRAWN BY: CMH | JOB #: 7889

OXFORD 157

THIS DOCUMENT WAS PREPARED BY:
SMITH LAND SURVEYING, INC.
FOR: EQT

Professional Energy Consultants
A DIVISION OF SMITH LAND SURVEYING, INC.
SLS
SURVEYORS
ENGINEERS
ENVIRONMENTAL
PROJECT MGMT.
(304) 462-5634
WWW.SLSSURVEYS.COM

EQT
Where energy meets innovation.

CAD FILE: R:\Data\CADD\WORK 7800-7899\7889\PERMITTING\OXF 157 MODIFIED SITE 6.24.14\OXFD 157 STREAM CROSSING MAP.dwg LAYOUT: ST CROSS AND FEMA US

PERMIT NO. 13-113

DODDRIDGE COUNTY

FLOODPLAIN DEVELOPMENT

PERMIT

EQT OXFORD 157

EQT OXFORD 159

PURPOSE FOR PERMIT: CREEK CROSSING

ISSUED TO: EQT Henderson Freshwater Impoundment

ADDRESS: 115 Professional Place PO Box 280 Bridgeport, WV 26330

PROJECT ADDRESS: BLUESTONE

ISSUED BY: Dan Wetherington

DATE: 02/03/2014

CONSTRUCTION MUST START WITHIN 180 DAYS FROM ISSUED DATE. PERMIT EXPIRES IN 12 MONTHS FROM ISSUED DATE. IF EXTENTION IS NEEDED A REQUEST MUST BE MADE IN WRITING STATING A REASON FOR THE EXTENTION.

THIS PERMIT MUST BE POSTED ON THE PREMISES IN A CONSPICUOUS PLACE SO AS TO BE CLEARLY VISIBLE FROM THE STREET.

#13-113
EQT-OXF 157 & 159
Proposed Well Pad & Associated Pi
Henderson Centralized Freshwa
Impoundment

DODDRIDGE COUNTY

FLOODPLAIN DEVELOPMENT PERMIT APPLICATION

FILED
2014 JAN -8 PM 12:22
BETH A. ROGERS
COUNTY CLERK
DODDRIDGE COUNTY, WV

SECTION 1: GENERAL PROVISIONS (APPLICANT TO READ AND SIGN)

1. No work may start until a permit is issued.
2. The permit may be revoked if any false statements are made herein.
3. If revoked, all work must cease until permit is re-issued.
4. Development shall not be used or occupied until a Certificate of Compliance is issued.
5. The permit will expire if no work is commenced within six months of issuance.
6. Applicant is hereby informed that other permits may be required to fulfill local, state, and federal requirements.
7. Applicant hereby gives consent to the Floodplain Administrator/Manager or his/her representative to make inspections to verify compliance.
8. **I, THE APPLICANT CERTIFY THAT ALL STATEMENTS HEREIN AND IN ATTACHMENTS TO THIS APPLICATION ARE, TO THE BEST OF MY KNOWLEDGE, TRUE AND ACCURATE.**

APPLICANT'S SIGNATURE Megan E Jarfe

DATE 1-3-14

SECTION 2: PROPOSE DEVELOPMENT (TO BE COMPLETED BY APPLICANT).

IF THE APPLICANT IS NOT A NATURAL PERSON, THE NAME, ADDRESS, AND TELEPHONE NUMBER OF A NATURAL PERSON WHO SHALL BE APPOINTED BY THE APPLICANT TO RECEIVE NOTICE PURSUANT TO ANY PROVISION OF THE CURRENT DODDRIDGE COUNTY FLOODPLAIN ORDINANCE.

APPLICANT'S NAME: EQT Production Company
ADDRESS: 115 Professional Place P.O. Box 280 Bridgeport WV 26330
TELEPHONE NUMBER: 304-848-0076

BUILDER'S NAME: EQT Production Company

PERMIT NO. 13-113

DODDRIDGE COUNTY

FLOODPLAIN DEVELOPMENT

PERMIT

EQT OXFORD 157

EQT OXFORD 159

PURPOSE FOR PERMIT: CREEK CROSSING Henderson Freshwater Impoundment

ISSUED TO: EQT

ADDRESS: 115 Professional Place PO Box 280 Bridgeport, WV 26330

PROJECT ADDRESS: BLUESTONE

ISSUED BY: Dan Wetherby

DATE: 02/03/2014

CONSTRUCTION MUST START WITHIN 180 DAYS FROM ISSUED DATE. PERMIT EXPIRES IN 12 MONTHS FROM ISSUED DATE. IF EXTENTION IS NEEDED A REQUEST MUST BE MADE IN WRITING STATING A REASON FOR THE EXTENTION.

THIS PERMIT MUST BE POSTED ON THE PREMISES IN A CONSPICUOUS PLACE SO AS TO BE CLEARLY VISIBLE FROM THE STREET.

SECTION 3: FLOODPLAIN DETERMINATION (to be completed by Floodplain Administrator/Manager or his/her representative)

THE PROPOSED DEVELOPMENT:

THE PROPOSED DEVELOPMENT IS LOCATED ON:

FIRM Panel: 230

Dated: 10/09/2011

[] Is **NOT** located in a Specific Flood Hazard Area (Notify applicant that the application review is complete and **NO FLOOPLAIN DEVELOPMENT PERMIT IS REQUIRED).**

[X] Is located in Special Flood Hazard Area.

FIRM zone designation A

100-Year flood elevation is: AE/A NGVD (MSL)

[] Unavailable

[] The proposed development is located in a floodway.

FBFM Panel No._____ Dated_____

[] See section 4 for additional instructions.

SIGNED Dan Waltman **DATE** 02/09/2014

SECTION 4: ADDITIONAL INFORMATION REQUIRED (To be completed by Floodplain Administrator/Manager or his/her representative)

The applicant must submit the documents checked below before the application can be processed.

[] A plan showing the location of all existing structures, water bodies, adjacent roads, lot dimensions and proposed development.

west virginia department of environmental protection

Office of Oil and Gas
601 57th Street SE
Charleston, WV 25304
(304) 926-0450
(304) 926-0452 fax

Earl Ray Tomblin, Governor
Randy C. Huffman, Cabinet Secretary
www.dep.wv.gov

April 18, 2014

WELL WORK PERMIT

Horizontal 6A Well

This permit, API Well Number: 47-1706458, issued to EQT PRODUCTION COMPANY, is evidence of permission granted to perform the specified well work at the location described on the attached pages and located on the attached plat, subject to the provisions of Chapter 22 of the West Virginia Code of 1931, as amended, and all rules and regulations promulgated thereunder, and to all conditions and provisions outlined in the pages attached hereto. Notification shall be given by the operator to the Oil and Gas Inspector at least 24 hours prior to the construction of roads, locations, and/or pits for any permitted work. In addition, the well operator shall notify the same inspector 24 hours before any actual well work is commenced and prior to running and cementing casing. Spills or emergency discharges must be promptly reported by the operator to 1-800-642-3074 and to the Oil and Gas inspector.

Please be advised that form WR-35, Well Operators Report of Well Work is to be submitted to this office within 90 days completion of permitted well work, as should form WR-34 Discharge Monitoring Report within 30 days of discharge of pits, if applicable. Failure to abide by all statutory and regulatory provisions governing all duties and operations hereunder may result in suspension or revocation of this permit and, in addition, may result in civil and/or criminal penalties being imposed upon the operators.

In addition to the applicable requirements of this permit, and the statutes and rules governing oil and gas activity in WV, this permit may contain specific conditions which must be followed. Permit conditions are attached to this cover letter.

Per 35CSR-4-5.2.g this permit will expire in two (2) years from the issue date unless permitted well work is commenced. If there are any questions, please feel free to contact me at (304) 926-0499 ext. 1654.

James Martin
Chief

Operator's Well No: 513144
Farm Name: HENDERSON, JUSTIN L. ET AL
API Well Number: 47-1706458
Permit Type: Horizontal 6A Well
Date Issued: 04/18/2014

Promoting a healthy environment.

API Number 47 017 06458

PERMIT CONDITIONS

West Virginia Code § 22-6A-8(d) allows the Office of Oil and Gas to place specific conditions upon this permit. Permit conditions have the same effect as law. Failure to adhere to the specified permit conditions may result in enforcement action.

CONDITIONS

1. This proposed activity may require permit coverage from the United States Army Corps of Engineers (USACE). Through this permit, you are hereby being advised to consult with USACE regarding this proposed activity.

2. If the operator encounters an unanticipated void, or an anticipated void at an unanticipated depth, the operator shall notify the inspector within 24 hours. Modifications to the casing program may be necessary to comply with W. Va. Code § 22-6A-5a (12), which requires drilling to a minimum depth of thirty feet below the bottom of the void, and installing a minimum of twenty (20) feet of casing. Under no circumstance should the operator drill more than fifty (50) feet below the bottom of the void or install less than twenty (20) feet of casing below the bottom of the void.

3. When compacting fills, each lift before compaction shall not be more than 12 inches in height, and the moisture content of the fill material shall be within limits as determined by the Standard Proctor Density test of the actual soils used in specific engineered fill, ASTM D698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort, to achieve 95 % compaction of the optimum density. Each lift shall be tested for compaction, with a minimum of two tests per lift per acre of fill. All test results shall be maintained on site and available for review.

4. Operator shall install signage per § 22-6A-8g (6) (B) at all source water locations included in their approved water management plan within 24 hours of water management plan activation.

5. Oil and gas water supply wells will be registered with the Office of Oil and Gas and all such wells will be constructed and plugged in accordance with the standards of the Bureau for Public Health set forth in its Legislative rule entitled *Water Well Regulations*, 64 C.S.R. 19. Operator is to contact the Bureau of Public Health regarding permit requirements. In lieu of plugging, the operator may transfer the well to the surface owner upon agreement of the parties. All drinking water wells within fifteen hundred feet of the water supply well shall be flow tested by the operator upon request of the drinking well owner prior to operating the water supply well.

6. Pursuant to the requirements pertaining to the sampling of domestic water supply wells/springs the operator shall, no later than thirty (30) days after receipt of analytical data provide a written copy to the Chief and any of the users who may have requested such analyses.

7. If any explosion or other accident causing loss of life or serious personal injury occurs in or about a well or well work on a well, the well operator or its contractor shall give notice, stating the particulars of the explosion or accident, to the oil and gas inspector and the Chief, within 24 hours of said accident.

8. During the casing and cementing process, in the event cement does not return to the surface, the oil and gas inspector shall be notified within 24 hours.

OXF 157 STREAM CROSSINGS IN FLOOD ZONE

Stream Crossing A (Sheet 21 of Site Plans Revised 6/03/2014)

- **Temporary Crossing:**
  - The original design (Sheet 20 of Original Site Plans dated 11/04/2013) for "Stream Crossing A" Temporary Crossing showed clean rock fill 6" of 2"-4" coarse aggregate with large angular rock and a 40' temporary steel bridge.
  - The revised site plans show a 40' temporary steel bridge with 12"-18" rip-rap side slopes.
- **Permanent Crossing:**
  - The original design had a proposed permanent crossing with (4) 18" CMP culverts.
  - The revised design does not show a permanent crossing because this portion of the access road leads to the pit area. After construction is completed this area is going to be reclaimed in the required amount of time. Because of this, this road will no longer be used and a permanent stream crossing is not necessary.

Stream Crossing B (Sheet 22 of Site Plans Revised 6/03/2014)

- **Temporary Crossing:**
  - The original design (Sheet 21 of Original Site Plans dated 11/04/2013) for "Stream Crossing B" Temporary Crossing showed clean rock fill 6" of 2"-4" coarse angular rock and a 40' temporary steel bridge.
  - The revised site plans show a 40' temporary steel bridge with 12"-18" rip-rap side slopes.
- **Permanent Crossing:**
  - The original design had a proposed permanent crossing with (4) 18" CMP culverts.
  - The revised design shows the permanent crossing where the temporary bridge will be removed and a concrete low water ford crossing will be constructed. This low water ford will be comprised of 12" thick 4,000 PSI concrete reinforced with #4 rebar 12" each way and will have 12"-18" of rip rap. During construction, a sandbag cofferdam will be

placed on the inlet and outlet sides of the stream crossing. The water will then be pumped around while the low water crossing is being constructed.

Stream Crossing C (Sheet 23 of Site Plans Revised 6/03/2014)

- **Temporary Crossing:**
  - The original design (Sheet 23 of Original Site Plans dated 11/04/2013) for "Stream Crossing C" Temporary Crossing showed clean rock fill 6" of 2"-4" coarse aggregate with large angular rock and a 40' temporary steel bridge.
  - The revised site plans show a 40' temporary steel bridge with 12"-18" rip-rap side slopes.
- **Permanent Crossing:**
  - The original design had a proposed permanent crossing with (3) 18" CMP culverts.
  - The revised design shows the permanent crossing where the temporary bridge will be removed and a concrete low water ford crossing will be constructed. This low water ford will be comprised of 12" thick 4,000 PSI concrete reinforced with #4 rebar 12" each way and will have 12"-18" of rip rap. During construction, a sandbag cofferdam will be placed on the inlet and outlet sides of the stream crossing. The water will then be pumped around while the low water crossing is being constructed.

Stream Crossing D (Sheet 24 of Site Plans Revised 6/03/2014)

- **Permanent Crossing:**
  - The original design (Sheet 24 of Original Site Plans dated 11/04/2013) had a proposed permanent crossing with (3) 18" CMP culverts.
  - The revised design shows the permanent crossing where the temporary bridge will be removed and a concrete low water ford crossing will be constructed. This low water ford will be comprised of 12" thick 4,000 PSI concrete reinforced with #4 rebar 12" each way and will have 12"-18" of rip rap. During construction, a sandbag cofferdam will be placed on the inlet and outlet sides of the stream crossing. The water will then be pumped around while the low water crossing is being constructed.

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

REPLY TO
ATTENTION OF

FEB 03 2015

Regulatory Division
Energy Resource Branch
LRH-2014-00214-OHR-Bluestone Creek

Ms. Megan Landfried
EQT Production Company
115 Professional Place
Bridgeport, West Virginia 26330

Dear Ms. Landfried:

I refer to the Pre-Construction Notification (PCN) requesting a Department of the Army (DA) authorization to discharge dredged and/or fill material into waters of the United States (U.S.) in association with the construction of the Well Site OXF 157 Access Road Project. The proposed Well Site OXF 157 Access Road Project will include upgrading approximately 1.16 miles (6,122.7 linear feet [lf]) of an existing dirt access road and constructing approximately 0.47 mile (2.503.3 lf) of new access road. The proposed access road will facilitate heavy equipment and large truck traffic required as part to normal drilling operations. On-site waters flow into Bluestone Creek, a tributary Middle Island Creek, a traditional navigable water (TNW) of the U.S. The proposed project would be located approximately 4.7 aerial miles south of West Union, in Doddridge County, West Virginia. The center of the proposed project is located at 39.234468°North, 80.764983°West. The PCN has been assigned the following file number: LRH-2014-00214-OHR-Bluestone Creek. 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 on the definitions and limits of jurisdiction contained in 33 CFR 328 and 33 CFR 329. Section 404 of the Clean Water Act (Section 404) requires a DA permit be obtained prior to discharging dredged or fill material into waters of the U.S., including wetlands. Section 10 of the Rivers and Harbors Act of 1899 (Section 10) requires a DA permit be obtained for any work in, on, over or under a navigable water.

Based on a review of the aquatic resources in the PCN, fifteen (15) streams (Bluestone Creek and Unnamed tributaries 1, 2, 5, 12, 14, 15, 17, 18, 19, 20, 21, 22, 23, and 24), totaling 1061.87 lf are included in the preliminary jurisdictional determination (PJD), as described in the enclosed PJD form. The on-site aquatic resource may be waters of the U.S. in accordance with the Regulatory Guidance Letter for Jurisdictional Determinations (JDs) issued by the Corps on June 26, 2008 (Regulatory Guidance Letter No. 08-02). As indicated in the guidance, this PJD is non-binding and cannot be appealed (33 CFR 331.2) and only provides a written indication that waters of the U.S. may be present on-site.

You have declined to exercise the option to obtain an approved JD in this instance and at this time. However, for the purposes of the determination of impacts, compensatory mitigation, and other resource protection measures for activities that require authorization from this office, the streams referenced above will be evaluated as if is they are waters of the U.S.

Enclosed please find two (2) copies of the PJD form. If you agree with the findings of this PJD and understand your options regarding the same, please sign and date one copy of the PJD form and return it to this office within 30 days of receipt of this letter. You should submit the signed copy via email to Audrey.M.Richter@usace.army.mil or to the following address:

U.S. Army Corps of Engineers
Huntington District, Regulatory Division
Energy Resource Branch
Attn: Audrey Richter (LRH-2014-00214)
502 Eighth Street
Huntington, West Virginia 25701.

The proposed project, as described in the submitted information, has been reviewed in accordance with Section 404 and Section 10. Based on your description of the proposed work, and other information available to us, it has been determined that this project will not involve activities subject to the requirements of Section 10. However, this project will include the discharge of dredged or fill material into waters of the U.S. subject to the requirements of Section 404.

In the PCN received in this office, you have requested a DA authorization to discharge dredged and/or fill material into 1061.87 lf of stream, involving twelve (12) single and complete projects, associated with the construction of the proposed Well Site OXF 157 Access Road Project, as described in Table 1 enclosed with this letter. To avoid and minimize impacts the Bluestone Creek (perennial stream), project construction will include the use of temporary bridges, at four (4) separate and distant stream crossings. The proposed temporary bridges will be constructed above the ordinary high waters mark (OHW) of Bluestone Creek and will not include a discharge of dredged and/or fill material into waters of the U.S. Upon completion of the well/drilling operations, the temporary bridges will be removed and permanent forded stream crossings will be installed at three (3) separate and distant locations in Bluestone Creek. Bluestone Creek Stream Crossing A will not require a permanent ford crossing. The proposed discharge of dredged and/or fill material into waters of the U.S. is described in Table 1 enclosed with this letter.

Based on your description of the proposed work, it has been determined the proposed discharge of dredged and/or fill material into waters of the U.S., as described on Table 1 enclosed with this letter, for the construction of the Well Site OXF 157 Access Road Project, meets the criteria for authorization under Nationwide Permit (NWP) #14 (enclosed) under the February 21, 2012 Federal Register, Notice of Reissuance of NWPs (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 note that you

must comply with all applicable terms and conditions of the enclosed material and the attached special conditions for the authorizations to be valid.

In view of the above, your linear transportation project is authorized subject to the terms and conditions of the enclosed material, including the enclosed special conditions. It is your responsibility to ensure that your work conforms to all of the environmental management conditions listed within the enclosed material. Please be aware this NWP verification does not obviate the requirement to obtain any state or local assent required by law for the activities.

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 enclosed 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,

Teresa D. Spagna

Teresa Spagna
Acting Chief, North Branch

Enclosures

CF: (w/out encls)

Ms. Beth Burdette
Potesta & Associates, Inc.
7012 MacCorkle Ave SE
Charleston, West Virginia 25304
sbburdette@potesta.com

Nationwide Permit 14 Verification Special Conditions
EQT Production Company
Well Site OXF 157 Access Road Project
LRH-2014-00214-OHR- Bluestone Creek

1. Should new information regarding the scope and/or impacts of the project become available that was not submitted to this office during our review of the proposal, the permittee will submit written information concerning proposed modification(s) to this office for review and evaluation, as soon as practicable.

2. Section 7 obligations under Endangered Species Act must be reconsidered if new information reveals impacts of the project that may affect federally listed species or critical habitat in a manner not previously considered, the proposed project is subsequently modified to include activities which were not considered during Section 7 consultation with the United States Fish and Wildlife Service, or new species are listed or critical habitat designated that might be affected by the subject project.

Table 1- Authorized discharge of dredged and/or fill material into waters of the U.S. associated with the construction of the Well Site OXF 157 Access Road Project, LRH-2014-00214-OHR- Bluestone Creek

Water ID	Latitude °N	& Longitude °W	Flow Regime or Cowardin Class	Length (lf) or area (acre) of Fill	Area (ac) of Fill	Other Pertinent Information
Bluestone Creek Crossing B	39.234301	80.764888	Perennial	50	0.0077	Temporary Bridge Outside of OHW/Permanent Ford
Bluestone Creek Crossing C	39.232888	80.763930	Perennial	46	0.0071	Temporary Bridge Outside of OHW/Permanent Ford
Bluestone Creek Crossing D	39.230725	80.763568	Perennial	42	0.0065	Temporary Bridge Outside of OHW/Permanent Ford
UNT 1	39.227652	80.762575	Ephemeral	72.03	0.0020	Existing Culvert- Maintenance/Upgrade/ Riprap Installation
UNT 2	39.228532	80.762594	Intermittent	71.17	0.0059	Existing Culvert- Maintenance/Upgrade/ Riprap Installation
UNT 5	39.230725	80.763568	Ephemeral	110.95	0.0025	Existing Culvert- Maintenance/Upgrade/ Riprap Installation
UNT 12	39.224992	80.763361	Ephemeral	55.00	0.0020	Existing Culvert- Maintenance/Upgrade/ Riprap Installation
UNT 22	39.225063	80.763202	Ephemeral	38.00	0.0022	Access Road- Culvert/riprap installation
UNT 14	39.225468	80.763392	Ephemeral	236.52	0.0065	Existing Culvert- Maintenance/Upgrade/ Riprap Installation
UNT 15	39.225907	80.763333	Ephemeral	32.32	0.0012	Access Road- Culvert/riprap installation
UNT 17	39.227583	80.75968	Ephemeral	25	0.0003	Access Road- Fill placement and riprap installation
UNT 18	39.227725	80.759565	Ephemeral	25	0.0011	Access Road- Fill placement and riprap installation
UNT 19	39.226892	80.760484	Ephemeral	71.38	0.0008	Access Road- Fill- Slope

Table 1- Authorized discharge of dredged and/or fill material into waters of the U.S. associated with the construction of the Well Site OXF 157 Access Road Project, LRH-2014-00214-OHR- Bluestone Creek

UNT 20	39.226798	80.760672	Ephemeral	50.00	0.0034	Access Road- Fill- Slope
UNT 21	39.226383	80.761519	Ephemeral	17.21	0.008	Access Road- Fill- Slope
UNT 23	39.226129	80.763203	Ephemeral	73.67	0.0020	Existing Culvert- Maintenance/Upgrade/ Riprap Installation
UNT 24	39.225183	80.763296	Ephemeral	45.62	0.0010	Access Road- Fill- Slope

Permit Number: LRH-2014-00214-OHR- Bluestone Creek
Well Site OXF 157 Access Road

Name of Permittee: EQT Production Company

Date of Issuance: February 3, 2015

Upon completion of the activity authorized by this permit and any mitigation required by the permit, sign this certification and return it to the following address:

Huntington District
U. S. Army Corps of Engineers
502 8th Street
Huntington, West Virginia 25701-2070
Attn: CELRH-RD-E

Please note that your permitted activity is subject to a compliance inspection by an U. S. Army Corps of Engineers representative. If you fail to comply with this permit you are subject to permit suspension, modification, or revocation.

I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and conditions of the said permit, and required mitigation was completed in accordance with the permit conditions.

Signature of Permittee Date

PM: A. Richter

PRELIMINARY JURISDICTIONAL DETERMINATION FORM

BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR PRELIMINARY JURISDICTIONAL DETERMINATION (JD): February 3, 2015

B. NAME AND ADDRESS OF PERSON REQUESTING PRELIMINARY JD:
Ms. Megan Landfried
EQT Production Company
115 Professional Place
Bridgeport, West Virginia 26330

C. DISTRICT OFFICE, FILE NAME, AND NUMBER:
LRH-2014-00214-OHR-Bluestone Creek, EQT Production Company- Well Site OXF 157 Access Road Project

D. PROJECT LOCATION(S) AND BACKGROUND INFORMATION:
State: West Virginia
County: Doddridge County
City: West Union
Coordinates of site: 39.234468°North, 80.764983°West

Name of nearest waterbody: Bluestone Creek

Identify (estimate) amount of waters in the review area:
Non-wetland waters: 1061.87 linear feet
Cowardin Class: Riverine
Stream Flow: Ephemeral, Intermittent, and Perennial
Wetlands: Not applicable
Cowardin Class: Not applicable

Name of any water bodies on the site that have been identified as Section 10 waters:
None.

E. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):
☒ Office (Desk) Determination. Date: February 2, 2015
☐ Field Determination. Date(s):

1. The Corps of Engineers believes that there may be jurisdictional waters of the United States on the subject site, and the permit applicant or other affected party who requested this preliminary JD is hereby advised of his or her option to request and obtain an approved jurisdictional determination (JD) for that site. Nevertheless, the permit applicant or other person who requested this preliminary JD has declined to exercise the option to obtain an approved JD in this instance and at this time.

2. In any circumstance where a permit applicant obtains an individual permit, or a Nationwide General Permit (NWP) or other general permit verification requiring "pre-construction notification" (PCN), or requests verification for a non-reporting NWP or other general permit, and the permit applicant has not requested an approved JD for the activity, the permit applicant is hereby made aware of the following: (1) the permit applicant has elected to seek a permit authorization based on a preliminary JD, which does not make an official determination of jurisdictional waters; (2) that the applicant has the option to request an approved JD before accepting the terms and conditions of the permit authorization, and that basing a permit authorization on an approved JD could possibly result in less compensatory mitigation being required or different special conditions; (3) that the applicant has the right to request an individual permit rather than accepting the terms and conditions of the NWP or other general permit authorization; (4) that the applicant can accept a permit authorization and thereby agree to comply with all the terms and conditions of that permit, including whatever mitigation requirements the Corps has determined to be necessary; (5) that undertaking any activity in reliance upon the subject permit authorization without requesting an approved JD constitutes the applicant's acceptance of the use of the preliminary JD, but that either form of JD will be processed as soon as is practicable; (6) accepting a permit authorization (e.g., signing a proffered individual permit) or undertaking any activity in reliance on any form of Corps permit authorization based on a preliminary JD constitutes agreement that all wetlands and other water bodies on the site affected in any way by that activity are jurisdictional waters of the United States, and precludes any challenge to such jurisdiction in any administrative or judicial compliance or enforcement action, or in any administrative appeal or in any Federal court; and (7) whether the applicant elects to use either an approved JD or a preliminary JD, that JD will be processed as soon as is practicable. Further, an approved JD, a proffered individual permit (and all terms and conditions contained therein), or individual permit denial can be administratively appealed pursuant to 33 C.F.R. Part 331, and that in any administrative appeal, jurisdictional issues can be raised (see 33 C.F.R. 331.5(a)(2)). If, during that administrative appeal, it becomes necessary to make an official determination whether CWA jurisdiction exists over a site, or to provide an official delineation of jurisdictional waters on the site, the Corps will provide an approved JD to accomplish that result, as soon as is practicable.
This preliminary JD finds that there *"may be"* waters of the United States on the subject project site, and identifies all aquatic features on the site that could be affected by the proposed activity, based on the following information:

SUPPORTING DATA. Data reviewed for preliminary JD (check all that apply - checked items should be included in case file and, where checked and requested, appropriately reference sources below):

☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant: In report entitled: "*Nationwide Permit 14 for Linear Transportation Projects, EQT Production Company, Well Site OXF 157, Doddridge County, West Virginia*"

☒ Data sheets prepared/submitted by or on behalf of the applicant/consultant.

- ☒ Office concurs with data sheets/delineation report.
- ☐ Office does not concur with data sheets/delineation report.

☐ Data sheets prepared by the Corps:

☐ Corps navigable waters' study:

☒ U.S. Geological Survey Hydrologic Atlas:
  ☒ USGS NHD data. USACE ORM USGS NHD dataset
  ☐ USGS 8 and 12 digit HUC maps.
☒ U.S. Geological Survey map(s). USGS WV-Oxford 24K Quad.
☒ USDA Natural Resources Conservation Service Soil Survey. Web Soil Survey.
☒ National wetlands inventory map(s). USACE ORM NWI dataset
☐ State/Local wetland inventory map(s):
☐ FEMA/FIRM maps:
☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
☒ Photographs: ☒ Aerial (Name & Date): Google and bing map..
  or ☒ Other (Name & Date): in the report referenced above.
☐ Previous determination(s). File no. and date of response letter:
☐ Other information (please specify):

IMPORTANT NOTE: The information recorded on this form has not necessarily been verified by the Corps and should not be relied upon for later jurisdictional determinations.

3Feb2015
Signature and date of
Regulatory Project Manager
(REQUIRED)

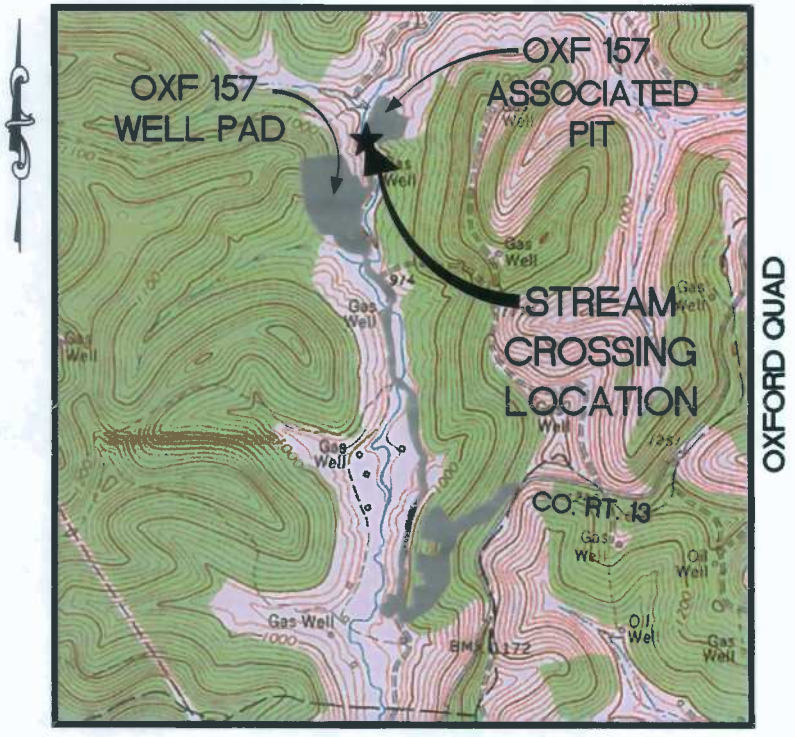
Lacoa Corder 2/6/15
Signature and date of
person requesting preliminary JD
(REQUIRED, unless obtaining the
signature is impracticable)

Table 1 – On-site Aquatic Resources associated with the construction of EQT Production Company- Well Site OXF 157 Access Road Project, LRH-2014-00214-OHR-Bluestone Creek

Waters ID	Latitude (°N)	Longitude (°W)	Flow Regime	Length (lf) of Stream within the AOI	Class of aquatic resource
Bluestone Creek	39.230725	-80.763568	Perennial	150.00	non-section 10 – non-wetland
UNT 1	39.227652	-80.762575	Ephemeral	72.03	non-section 10 – non-wetland
UNT 2	39.228532	80.762594	Ephemeral	71.17	non-section 10 – non-wetland
UNT 5	39.230725	80.763568	Ephemeral	110.95	non-section 10 – non-wetland
UNT 12	39.224992	80.763361	Ephemeral	55.00	non-section 10 – wetland
UNT 22	39.225063	80.763202	Ephemeral	38.00	non-section 10 – non-wetland
UNT 14	39.225468	80.763392	Ephemeral	236.52	non-section 10 – non-wetland
UNT 15	39.225907	80.763333	Ephemeral	32.32	non-section 10 – non-wetland
UNT 17	39.227583	80.75968	Ephemeral	25.00	non-section 10 – non-wetland
UNT 18	39.227725	80.759565	Ephemeral	25.00	non-section 10 – non-wetland
UNT 19	39.226892	80.760484	Ephemeral	71.38	non-section 10 – non-wetland

UNT 20	39.226798	80.760672	Ephemeral	50.00	non-section 10 – non-wetland
UNT 21	39.226383	80.761519	Ephemeral	17.21	non-section 10 – non-wetland
UNT 23	39.226129	80.763203	Ephemeral	73.67	non-section 10 – non-wetland
UNT 24	39.225183	80.763296	Ephemeral	45.62	non-section 10 – non-wetland

STREAM CROSSING "A"
STORMWATER COMPUTATIONS
OXF 157 WELL PAD



VICINITY MAP
1" = 2,000'

NAVITUS
ENERGY ENGINEERING
Telephone: (888) 662-4185 | www.NavitusEng.com

Prepared For:
EQT Production Company
115 Professional Place
P.O. Box 280
Bridgeport, WV 26330

Contact:
Victoria J. Roark
Permitting Supervisor
(304) 848-0076

Designed By:
Navitus Engineering Inc.

Project Manager:
Chandler Pearson
cpearson@navituseng.com

Date: June 3, 2014

Surface Owner (s)
Justin L. Henderson

Tax Parcel:
Map 6 Parcel 1

Location:
West Union District, Doddridge County
West Virginia

FN# 7889

OXF 157 WELL PAD

STREAM CROSSING "A"

STORMWATER COMPUTATIONS

Sections

SECTION 1

Overview

The intent of this project is to construct a gravel access road to a gas well pad site and associated facilities. This project will include a temporary stream crossing. Bluestone Creek, which has been classified as a perennial stream per the wetlands report conducted by Potesta Engineers and Environmental Consultants dated May 29, 2013, will be crossed at station 12+67.356 of the proposed access road.

Drainage Narrative

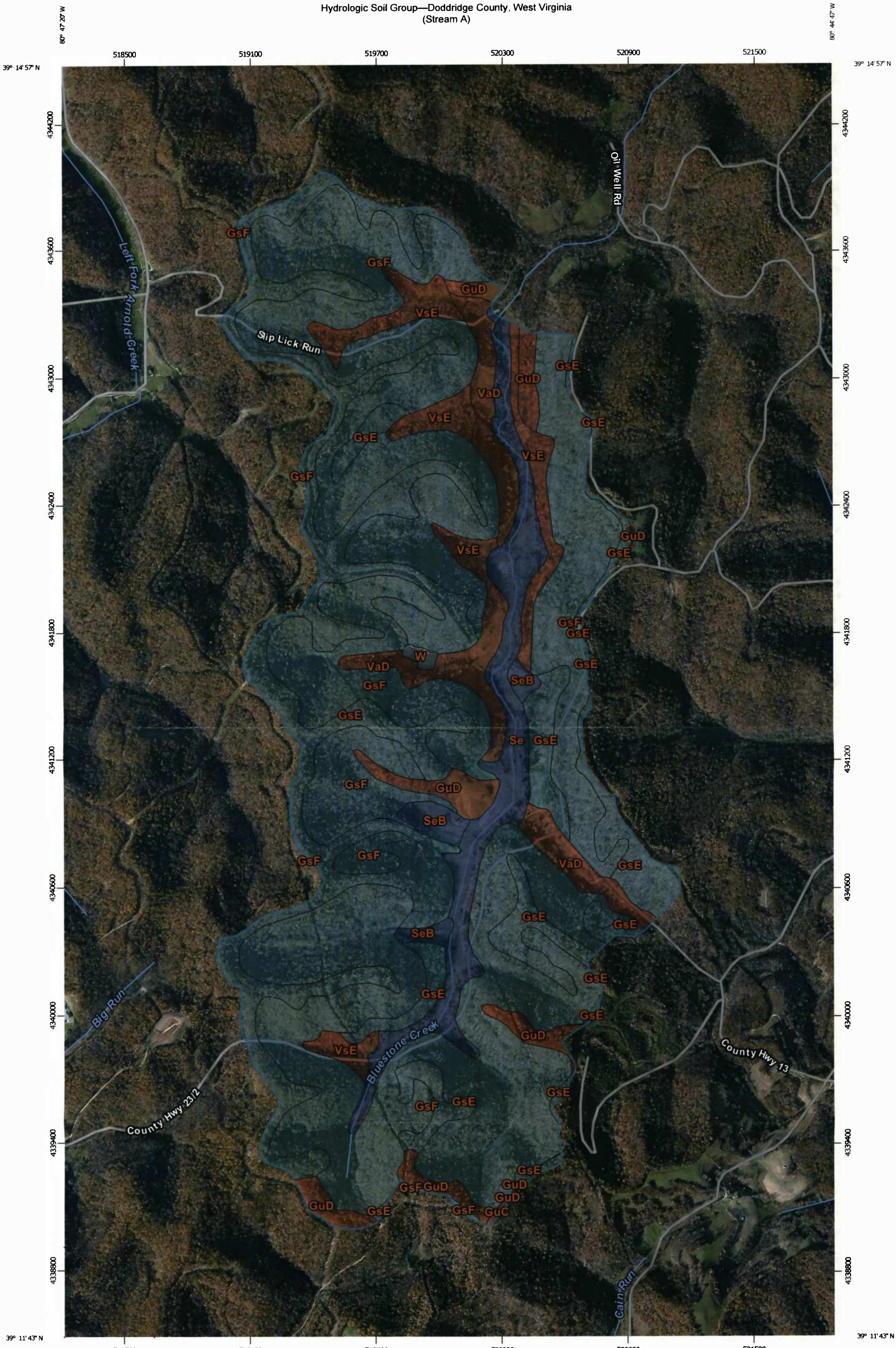
Using the SCS Method, with HEC-HMS, we determined the 1, 10, and 100-year rainfall events at the stream crossing study point. We then used HEC-RAS to design the crossings and to determine the base flow water surface elevation for each rainfall event. Stream Crossing "A" has a drainage area of 1,692.5 Acres. Design flows are shown as the downstream junction, provided in the drainage calculations in Section 3.

A 40 ft long steel bridge with timber abutments will be used to cross the stream channel. Disturbance to the stream channel will be limited to minor excavation at or near the stream bank, there will be no disturbance to the stream bed or flow. The bridge and abutments will be removed within 6 months when the associated facilities it serves are reclaimed. The crossing area will be restored to existing conditions upon removal.

SECTION 2

NRCS Soils Report

Hydrologic Soil Group—Doddridge County, West Virginia
(Stream A)



Map Scale: 1:16,800 if printed on B portrait (11" x 17") sheet.

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

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

Soils

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

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

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

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: Doddridge County, West Virginia
Survey Area Data: Version 8, Apr 2, 2009

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 8, 2011—Oct 25, 2011

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Doddridge County, West Virginia (WV017)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
GsE	Gilpin-Peabody complex, 15 to 35 percent slopes, very stony	C	399.4	23.6%
GsF	Gilpin-Peabody complex, 35 to 70 percent slopes, very stony	C	930.6	55.0%
GuC	Gilpin-Upshur complex, 8 to 15 percent slopes	D	1.0	0.1%
GuD	Gilpin-Upshur complex, 15 to 25 percent slopes	D	60.3	3.6%
Se	Sensabaugh silt loam	B	113.3	6.7%
SeB	Sensabaugh silt loam, 3 to 8 percent slopes, rarely flooded	B	20.2	1.2%
VaD	Vandalia silt loam, 15 to 25 percent slopes	D	84.6	5.0%
VsE	Vandalia silt loam, 15 to 35 percent slopes, very stony	D	79.8	4.7%
W	Water		3.1	0.2%
Totals for Area of Interest			**1,692.5**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

SECTION 3

HEC-HMS
Drainage Computations

Project: OXF 157 Simulation Run: Existing

Start of Run:	04Sep2013, 00:00	Basin Model:	Existing
End of Run:	05Sep2013, 00:05	Meteorologic Model:	100 YR
Compute Time:	04Sep2013, 15:18	Control Specifications:	Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Upper Bluestone	0.882	443.8	04Sep2013, 12:55	95.5
Upper1 Bluestone	0.17	221.9	04Sep2013, 12:10	20.3
Junction-1	1.052	482.7	04Sep2013, 12:50	115.8
Reach-1	1.052	482.7	04Sep2013, 13:00	115.4
Middle1 Bluestone	0.252	189.6	04Sep2013, 12:30	28.7
Junction-2	1.304	601.9	04Sep2013, 12:50	144.1
Reach-2	1.304	601	04Sep2013, 13:10	143.1
Middle Bluestone	0.363	303	04Sep2013, 12:25	41.4
Junction-3	1.667	763.6	04Sep2013, 12:40	184.5
Reach-3	1.667	762	04Sep2013, 13:00	183.2
Lower Bluestone	0.286	238.7	04Sep2013, 12:20	31.4
Junction-4	1.953	855.6	04Sep2013, 13:00	214.6
Reach-4	1.953	853.6	04Sep2013, 13:05	214.2
Lower1 Bluestone	0.078	130	04Sep2013, 12:00	9
Junction-5	2.031	865	04Sep2013, 13:05	223.1
Reach-5	2.031	865	04Sep2013, 13:10	222.7
Lower2 Bluestone	0.188	175.7	04Sep2013, 12:20	22.3
Junction-6	2.219	914.4	04Sep2013, 13:10	245
Reach-6	2.219	910.4	04Sep2013, 13:25	243.8
Lower3 Bluestone	0.425	337.3	04Sep2013, 12:30	50.2
Downstream	2.644	1021.2	04Sep2013, 13:20	294

Project: OXF 157 Simulation Run: Existing

Start of Run:	04Sep2013, 00:00	Basin Model:	Existing
End of Run:	05Sep2013, 00:05	Meteorologic Model:	10 YR
Compute Time:	04Sep2013, 15:18	Control Specifications:	Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Upper Bluestone	0.882	189.7	04Sep2013, 13:00	44.7
Upper1 Bluestone	0.17	101.9	04Sep2013, 12:10	9.8
Junction-1	1.052	208.9	04Sep2013, 12:55	54.5
Reach-1	1.052	208.9	04Sep2013, 13:05	54.3
Middle1 Bluestone	0.252	83.2	04Sep2013, 12:30	13.7
Junction-2	1.304	259.4	04Sep2013, 12:55	67.9
Reach-2	1.304	259.3	04Sep2013, 13:10	67.4
Middle Bluestone	0.363	133.4	04Sep2013, 12:25	19.7
Junction-3	1.667	326.8	04Sep2013, 12:40	87.1
Reach-3	1.667	326.6	04Sep2013, 13:00	86.4
Lower Bluestone	0.286	102.3	04Sep2013, 12:25	14.7
Junction-4	1.953	371.5	04Sep2013, 13:00	101.1
Reach-4	1.953	369.7	04Sep2013, 13:05	100.8
Lower1 Bluestone	0.078	57.7	04Sep2013, 12:00	4.3
Junction-5	2.031	375.8	04Sep2013, 13:05	105.1
Reach-5	2.031	375.8	04Sep2013, 13:10	104.9
Lower2 Bluestone	0.188	79	04Sep2013, 12:20	10.8
Junction-6	2.219	400.9	04Sep2013, 13:10	115.7
Reach-6	2.219	399.6	04Sep2013, 13:25	115
Lower3 Bluestone	0.425	152.3	04Sep2013, 12:30	24.3
Downstream	2.644	453	04Sep2013, 13:25	139.3

Project: OXF 157 Simulation Run: Existing

Start of Run:	04Sep2013, 00:00	Basin Model:	Existing
End of Run:	05Sep2013, 00:05	Meteorologic Model:	1 YR
Compute Time:	04Sep2013, 15:18	Control Specifications:	Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Upper Bluestone	0.882	38.4	04Sep2013, 13:10	12.3
Upper1 Bluestone	0.17	22.4	04Sep2013, 12:10	2.9
Junction-1	1.052	43.9	04Sep2013, 13:05	15.3
Reach-1	1.052	43.9	04Sep2013, 13:15	15.2
Middle1 Bluestone	0.252	17.3	04Sep2013, 12:35	3.9
Junction-2	1.304	55	04Sep2013, 13:05	19.1
Reach-2	1.304	55	04Sep2013, 13:25	18.9
Middle Bluestone	0.363	27.6	04Sep2013, 12:30	5.7
Junction-3	1.667	68.2	04Sep2013, 13:05	24.6
Reach-3	1.667	68.2	04Sep2013, 13:25	24.3
Lower Bluestone	0.286	19.5	04Sep2013, 12:30	4.1
Junction-4	1.953	78.9	04Sep2013, 13:05	28.4
Reach-4	1.953	78.8	04Sep2013, 13:10	28.3
Lower1 Bluestone	0.078	12.9	04Sep2013, 12:05	1.2
Junction-5	2.031	80.8	04Sep2013, 13:10	29.5
Reach-5	2.031	80.8	04Sep2013, 13:15	29.4
Lower2 Bluestone	0.188	17.6	04Sep2013, 12:25	3.2
Junction-6	2.219	88	04Sep2013, 13:15	32.7
Reach-6	2.219	87.6	04Sep2013, 13:30	32.4
Lower3 Bluestone	0.425	34.2	04Sep2013, 12:35	7.3
Downstream	2.644	104.1	04Sep2013, 13:25	39.7

SECTION 4

HEC-RAS Culvert Analysis Report and Sections

HEC-RAS Version 4.1.0 Jan 2010
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

****

PROJECT DATA
Project Title: OXF 157-159 Bridges
Project File : OXF157-159Bridges.prj
Run Date and Time: 5/29/2014 12:53:55 PM

Project in English units

BRIDGE

RIVER: Bluestone Creek
REACH: Lower RS: 2862.727

BRIDGE OUTPUT Profile #PF 1

E.G. US. (ft)	890.63	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	890.07	E.G. Elev (ft)	890.62	890.62
Q Total (cfs)	1021.20	W.S. Elev (ft)	890.07	890.07
Q Bridge (cfs)	282.18	Crit W.S. (ft)	890.09	890.08
Q Weir (cfs)	739.02	Max Chl Dpth (ft)	5.43	5.63
Weir Sta Lft (ft)	64.92	Vel Total (ft/s)	4.05	4.16
Weir Sta Rgt (ft)	179.02	Flow Area (sq ft)	252.08	245.28
Weir Submerg	0.54	Froude # Chl	0.54	0.50
Weir Max Depth (ft)	2.81	Specif Force (cu ft)	501.37	503.33
Min El Weir Flow (ft)	888.30	Hydr Depth (ft)	2.30	2.14
Min El Prs (ft)	887.21	W.P. Total (ft)	161.07	181.74
Delta EG (ft)	0.37	Conv. Total (cfs)		
Delta WS (ft)	0.32	Top Width (ft)	109.69	114.59
BR Open Area (sq ft)	46.87	Frctn Loss (ft)		
BR Open Vel (ft/s)	6.02	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)		

```
* Br Sel Method          * Press/Weir  * Power Total (lb/ft s)  *       0.00  *       0.00  *
*********************************************************************************************
```

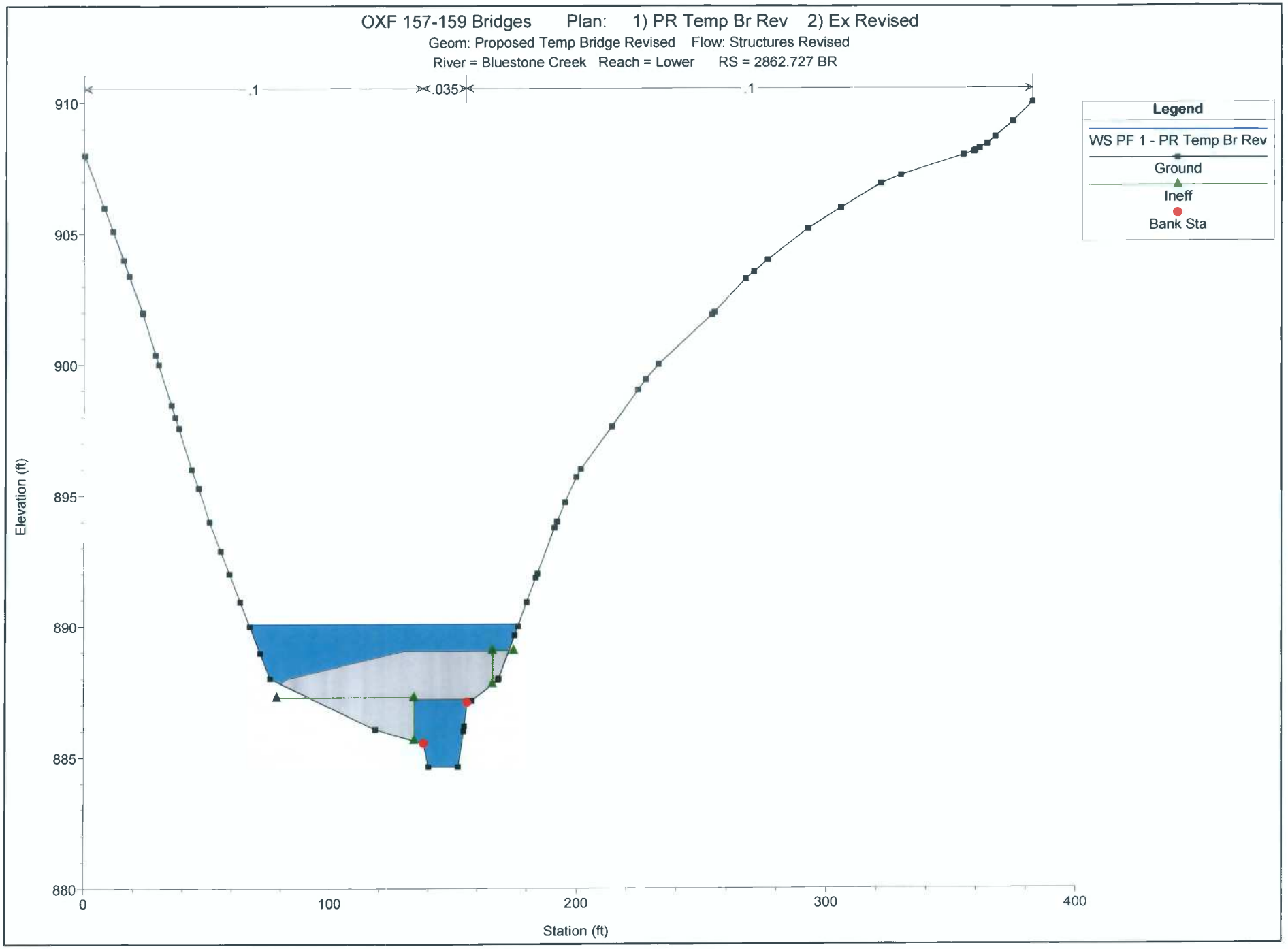
Note: The downstream water surface is above the minimum elevation required for orifice flow. The orifice flow equation was used for pressure flow.

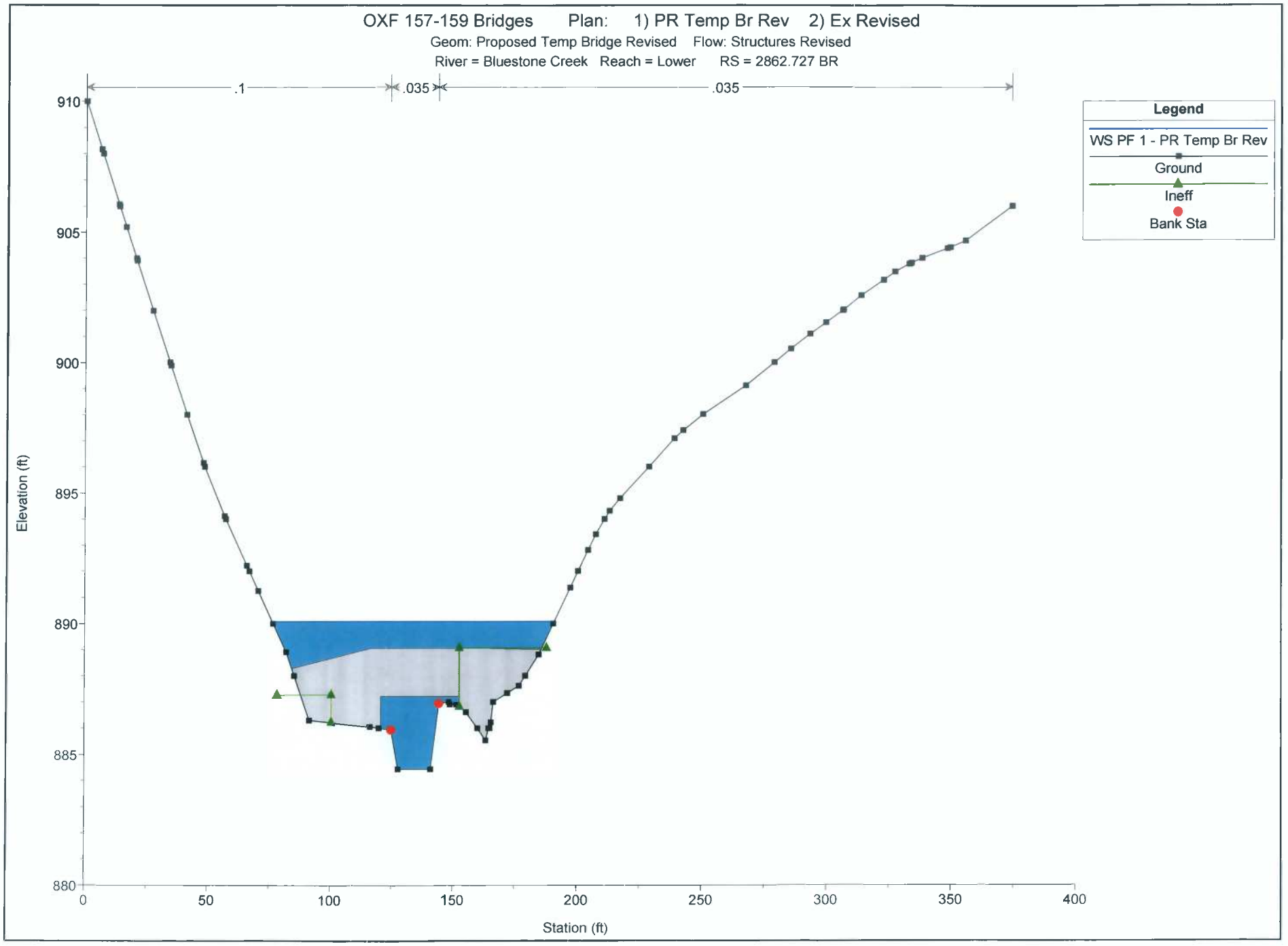
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

Note: For the cross section inside the bridge at the upstream end, the water surface and energy have been projected from the upstream cross section. The selected bridge modeling method does not compute answers inside the bridge.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

Note: For the cross section inside the bridge at the downstream end, the water surface and energy have been projected from the downstream cross section. The selected bridge modeling method does not compute answers inside the bridge.


OXF 157-159 Bridges Plan: 1) PR Temp Br Rev 2) Ex Revised
Geom: Proposed Temp Bridge Revised Flow: Structures Revised
River = Bluestone Creek Reach = Lower RS = 2862.727 BR
.1
.035
.1
Legend
WS PF 1 - PR Temp Br Rev
Ground
Ineff
Bank Sta
Elevation (ft)
910
905
900
895
890
885
880
0
100
200
300
400
Station (ft)

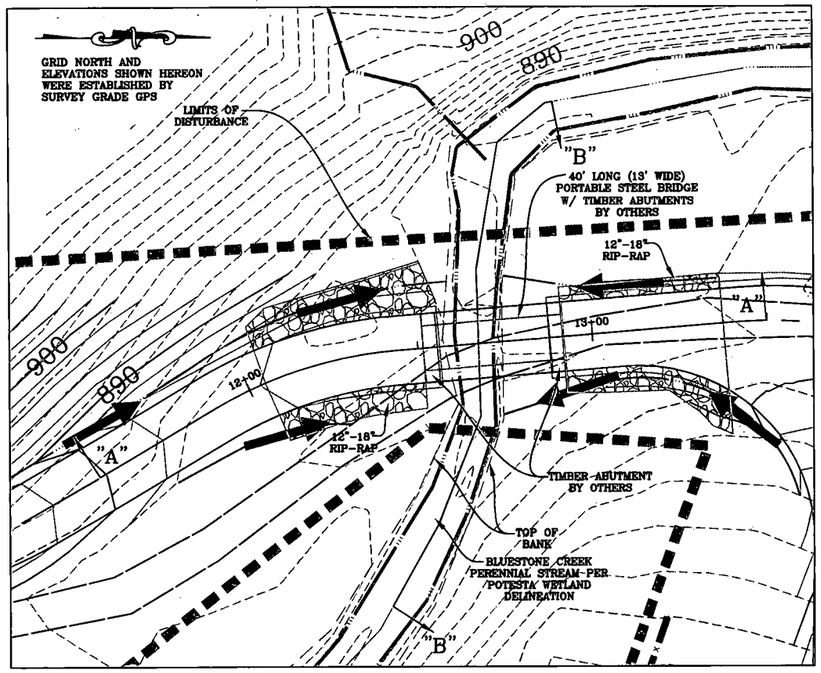

OXF 157-159 Bridges Plan: 1) PR Temp Br Rev 2) Ex Revised
Geom: Proposed Temp Bridge Revised Flow: Structures Revised
River = Bluestone Creek Reach = Lower RS = 2862.727 BR
.1
.035
.035
Legend
WS PF 1 - PR Temp Br Rev
Ground
Ineff
Bank Sta
Elevation (ft)
910
905
900
895
890
885
880
0
50
100
150
200
250
300
350
400
Station (ft)

SECTION 5

Stream Crossing "A" Details

TEMPORARY STREAM CROSSING DETAILS

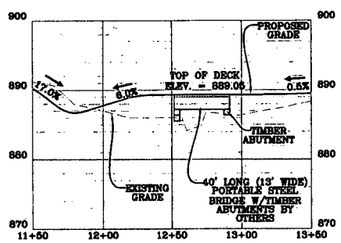
STREAM CROSSING "A" DETAILS



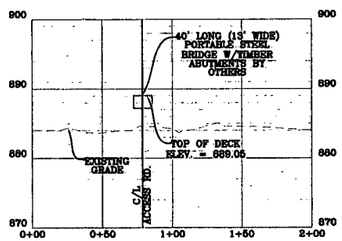
SCALE: 1" = 20'

NOTE:
1) SEE STREAM CROSSING REPORT BY NAVITUS ENGINEERING FOR CULVERT AND DRAINAGE COMPUTATIONS.
2) EQT SHALL OBTAIN A STREAM ACTIVITY PERMIT THROUGH THE PUBLIC LAND CORPORATION OFFICE OF LAND AND STREAMS FOR STREAM CROSSING "A".

STREAM CROSSING "A" SECTIONS



CROSS SECTION "A-A"
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

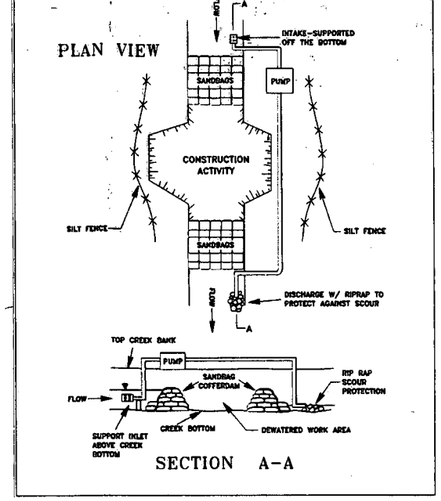


CROSS SECTION "B-B"
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

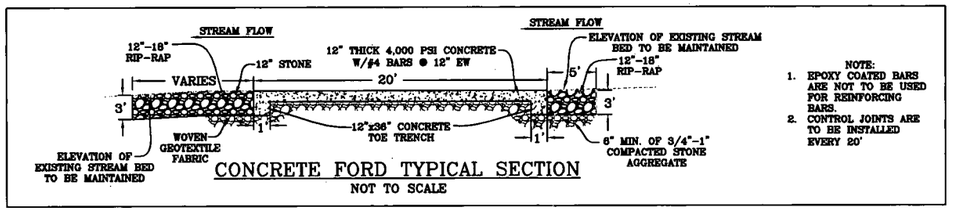
GENERAL TEMPORARY STREAM CROSSING NOTES:
1) DO NOT USE ERODIBLE MATERIAL FOR CONSTRUCTION OF THE CROSSING.
2) CLEARING AND EXCAVATION OF THE STREAM BANKS SHALL BE KEPT TO A MINIMUM.
3) APPROPRIATE PERIMETER CONTROLS SUCH AS COMPOST FILTER SOCK, SUPER SILT FENCE AND/OR SEDIMENT TRAPS SHALL BE EMPLOYED ALONG THE BANKS AND PARALLEL TO THE STREAMBED.
4) TIMBER ABUTMENTS FOR THE BRIDGE INSTALLATION SHALL BE INSTALLED TO REDUCE STRUCTURAL DAMAGE DURING HIGH VELOCITY WATER OVERFLOW PERIODS.
5) STREAMBED MATERIAL IS NOT TO BE USED AS FILL.
6) DURING ROUTINE MAINTENANCE DO NOT GRADE MUD AND DEBRIS OVER THE SIDES OF THE CROSSING INTO THE STREAM.
7) THE TEMPORARY BRIDGE SHALL BE ANCHORED AS REQUIRED PER THE DODDRIDGE COUNTY FLOODPLAIN ORDINANCE.

FIGURE

PUMP AROUND

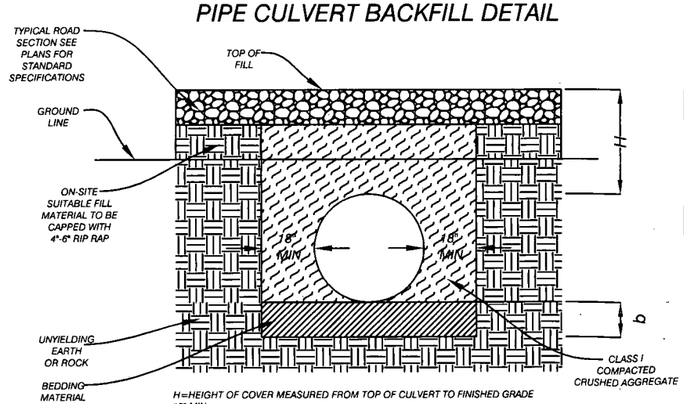


PUMP AROUND NOTES:
1) CONSTRUCTION SHOULD BE PERFORMED DURING LOW FLOW PERIODS.
2) PUMP(S) SHOULD BE SUFFICIENTLY LARGE TO PUMP THE ENTIRE STREAM FLOW AROUND THE SITE.
3) THE COFFERDAM CONSTRUCTED MUST BE IMPERVIOUS TO WATER.
4) THE INLET OF THE PUMP(S) IS TO BE SUSPENDED ABOVE THE STREAMBED IN ORDER TO PREVENT SUCKING MUD AND SEDIMENT.
5) THE DISCHARGE POINT MUST BE STABILIZED WITH ROCK TO DISPERSE THE ENERGY AND PREVENT EROSION.



CONCRETE FORD TYPICAL SECTION
NOT TO SCALE

PIPE CULVERT BACKFILL DETAIL



H=HEIGHT OF COVER MEASURED FROM TOP OF CULVERT TO FINISHED GRADE
12" MIN.
b=1/4" PER 12" OF H; 12" MIN, 24" MAX

CLASS I BACKFILL MATERIAL
(3/4"-1" MAX AGGREGATE SIZE)
IN ACCORDANCE WITH SECTION 604 AND 704.6 OF THE WVDOH ROAD & BRIDGE STANDARD SPECIFICATIONS. BACKFILL SHALL BE COMPACTED IN HORIZONTAL LAYERS NOT MORE THAN 6 INCHES IN THICKNESS. BACKFILL SHALL BE PLACED IN HORIZONTAL LAYERS AND IN A MANNER TO DETER IMPOUNDMENT OF WATER AND FACILITATE EXISTING DRAINAGE.

BEDDING MATERIAL
(0"-1/2" MAX AGGREGATE SIZE)
IN ACCORDANCE WITH SECTION 716.1.1.2 OF THE WVDOH ROAD & BRIDGE STANDARD SPECIFICATIONS

NOTES:
1. THE FOUNDATION SHALL BE EXPLORED BELOW THE BOTTOM OF THE STRUCTURE TO DETERMINE THE TYPE AND CONDITION OF THE MATERIAL. EXPLORATION SHALL EXTEND TO A DEPTH EQUAL TO 1/2 INCH PER FOOT OF FILL OR 8 INCHES, WHICHEVER IS GREATER.
2. IN THE EVENT UNSUITABLE OR YIELDING MATERIALS ARE ENCOUNTERED, THE FOUNDATION WILL BE EXCAVATED DOWN TO ROCK OR UNYIELDING EARTH. THE UNSUITABLE MATERIAL WILL BE REPLACED WITH CLASS I BACKFILL AND COMPACTED AS DETAILED ABOVE.
3. ALL OPENINGS TO BACKFILLED SHALL BE DEWATERED PRIOR TO FILLING.

NAVITUS ENERGY ENGINEERING
Telephone: (888) 662-4185 | www.NavitusEng.com

Professional Energy Consultants
A DIVISION OF SMITH LAND SURVEYING, INC.
SURVEYORS
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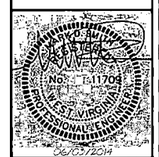
ENVIRONMENTAL
PROJECT MGMT.
(304) 462-5634
www.SLSsurveys.com



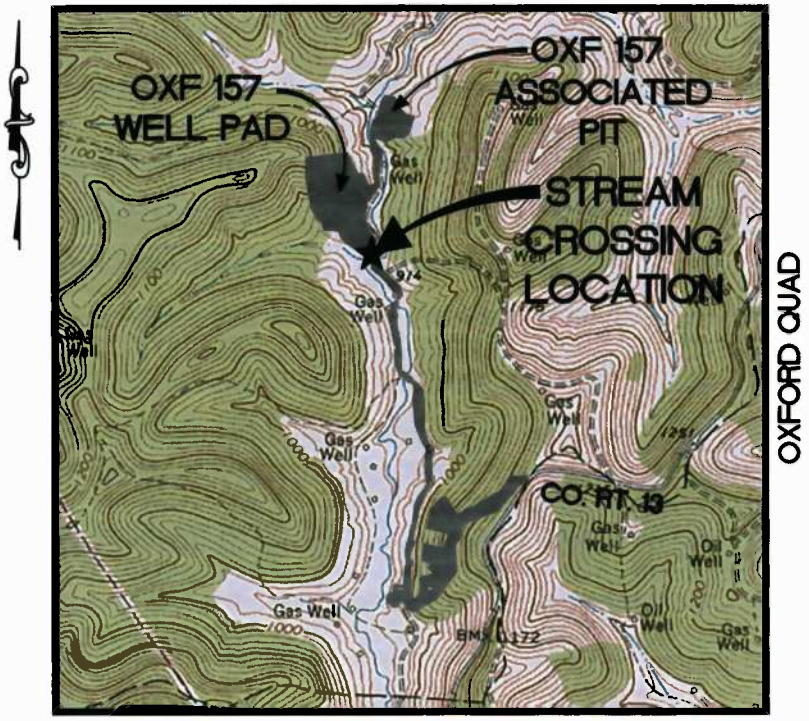
THIS DOCUMENT WAS PREPARED BY:
NAVITUS ENGINEERING INC.
FOR: EQT PRODUCTION COMPANY

MAJOR STREAM CROSSING DETAILS
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013
SCALE: N/A
DESIGNED BY: CSK
FILE NO. 7889
SHEET 21 OF 32
REV: 06/03/2014

STREAM CROSSING "B"
STORMWATER COMPUTATIONS

OXF 157 WELL PAD



VICINITY MAP
1" = 2,000'

NAVITUS
ENERGY ENGINEERING
Telephone: (888) 662-4185 | www.NavitusEng.com

Prepared For:
EQT Production Company
115 Professional Place
P.O. Box 280
Bridgeport, WV 26330

Contact:
Victoria J. Roark
Permitting Supervisor
(304) 848-0076

Designed By:
Navitus Engineering Inc.

Project Manager:
Chandler Pearson
cpearson@navituseng.com

Date: June 3, 2014

Surface Owner (s)
Justin L. Henderson

Tax Parcel:
Map 6 Parcel 1

Location:
West Union District, Doddridge County
West Virginia

FN# 7889

OXF 157 WELL PAD

STREAM CROSSING "B"

STORMWATER COMPUTATIONS

Sections

SECTION 1

Overview

The intent of this project is to construct a gravel access road to a gas well pad site and associated facilities. This project will include a permanent stream crossing. Bluestone Creek, which has been classified as a perennial stream per the wetlands report conducted by Potesta Engineers and Environmental Consultants dated May 29, 2013, will be crossed at station 41+44.952 of the proposed access road.

Drainage Narrative

Using the SCS Method, with HEC-HMS, we determined the 1, 10, and 100-year rainfall events at the stream crossing study point. We then used HEC-RAS to design the crossings and to determine the base flow water surface elevation for each rainfall event. Stream Crossing "B" has a drainage area of 1,420.2 Acres. Design flows are shown as Junction-6 in the drainage calculations in Section 3.

Stream Crossing "B" is to be a "low water ford crossing" which is designed to handle the base flow. The stream crossing was designed as a permanent structure in accordance with the U.S. Army Corps of Engineering Nationwide 14 Permit. The concrete ford will be installed at the existing elevation of the stream bed, the ford will be 20 ft. wide by 8 in. thick and reinforced with welded wire fabric. At the upstream and downstream end of the ford there will be a 5' wide by 18" thick rip-rap apron. At no point during construction will the normal flow of the stream be exposed to "green" concrete. Stream diversions, temporary cofferdams, and pump-arounds will be utilized during construction to shield the stream flow from concrete placement and sediment disturbance. The 1-yr, 10-yr and 100-yr flood elevations are passed over the ford without creating an adverse raise to the 100-yr base flood elevations. Stream Crossing "B" will have a permanent disturbance of 42.0 ft.

Prior to the construction of the "low water crossing" a 40 ft long steel bridge with timber abutments will be used to cross the stream channel. Disturbance to the stream channel will be limited to minor excavation at or near the stream bank, there will be no disturbance to the stream bed or flow.

SECTION 2

NRCS Soils Report

Hydrologic Soil Group—Doddridge County, West Virginia
(Stream B)

Map Scale: 1:13,900 if printed on B portrait (11" x 17") sheet.

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

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

Soils

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

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

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

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: Doddridge County, West Virginia
Survey Area Data: Version 8, Apr 2, 2009

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 8, 2011—Oct 25, 2011

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Doddridge County, West Virginia (WV017)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
GsE	Gilpin-Peabody complex, 15 to 35 percent slopes, very stony	C	345.8	24.3%
GsF	Gilpin-Peabody complex, 35 to 70 percent slopes, very stony	C	778.6	54.8%
GuC	Gilpin-Upshur complex, 8 to 15 percent slopes	D	1.0	0.1%
GuD	Gilpin-Upshur complex, 15 to 25 percent slopes	D	46.6	3.3%
Se	Sensabaugh silt loam	B	102.8	7.2%
SeB	Sensabaugh silt loam, 3 to 8 percent slopes, rarely flooded	B	20.2	1.4%
VaD	Vandalia silt loam, 15 to 25 percent slopes	D	70.0	4.9%
VsE	Vandalia silt loam, 15 to 35 percent slopes, very stony	D	52.0	3.7%
W	Water		3.1	0.2%
Totals for Area of Interest			**1,420.2**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

SECTION 3

HEC-HMS
Drainage Computations

Project: OXF 157 Simulation Run: Existing

Start of Run:	04Sep2013, 00:00	Basin Model:	Existing
End of Run:	05Sep2013, 00:05	Meteorologic Model:	100 YR
Compute Time:	04Sep2013, 15:18	Control Specifications:	Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Upper Bluestone	0.882	443.8	04Sep2013, 12:55	95.5
Upper1 Bluestone	0.17	221.9	04Sep2013, 12:10	20.3
Junction-1	1.052	482.7	04Sep2013, 12:50	115.8
Reach-1	1.052	482.7	04Sep2013, 13:00	115.4
Middle1 Bluestone	0.252	189.6	04Sep2013, 12:30	28.7
Junction-2	1.304	601.9	04Sep2013, 12:50	144.1
Reach-2	1.304	601	04Sep2013, 13:10	143.1
Middle Bluestone	0.363	303	04Sep2013, 12:25	41.4
Junction-3	1.667	763.6	04Sep2013, 12:40	184.5
Reach-3	1.667	762	04Sep2013, 13:00	183.2
Lower Bluestone	0.286	238.7	04Sep2013, 12:20	31.4
Junction-4	1.953	855.6	04Sep2013, 13:00	214.6
Reach-4	1.953	853.6	04Sep2013, 13:05	214.2
Lower1 Bluestone	0.078	130	04Sep2013, 12:00	9
Junction-5	2.031	865	04Sep2013, 13:05	223.1
Reach-5	2.031	865	04Sep2013, 13:10	222.7
Lower2 Bluestone	0.188	175.7	04Sep2013, 12:20	22.3
Junction-6	2.219	914.4	04Sep2013, 13:10	245
Reach-6	2.219	910.4	04Sep2013, 13:25	243.8
Lower3 Bluestone	0.425	337.3	04Sep2013, 12:30	50.2
Downstream	2.644	1021.2	04Sep2013, 13:20	294

Project: OXF 157 Simulation Run: Existing

Start of Run:	04Sep2013, 00:00	Basin Model:	Existing
End of Run:	05Sep2013, 00:05	Meteorologic Model:	10 YR
Compute Time:	04Sep2013, 15:18	Control Specifications:	Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Upper Bluestone	0.882	189.7	04Sep2013, 13:00	44.7
Upper1 Bluestone	0.17	101.9	04Sep2013, 12:10	9.8
Junction-1	1.052	208.9	04Sep2013, 12:55	54.5
Reach-1	1.052	208.9	04Sep2013, 13:05	54.3
Middle1 Bluestone	0.252	83.2	04Sep2013, 12:30	13.7
Junction-2	1.304	259.4	04Sep2013, 12:55	67.9
Reach-2	1.304	259.3	04Sep2013, 13:10	67.4
Middle Bluestone	0.363	133.4	04Sep2013, 12:25	19.7
Junction-3	1.667	326.8	04Sep2013, 12:40	87.1
Reach-3	1.667	326.6	04Sep2013, 13:00	86.4
Lower Bluestone	0.286	102.3	04Sep2013, 12:25	14.7
Junction-4	1.953	371.5	04Sep2013, 13:00	101.1
Reach-4	1.953	369.7	04Sep2013, 13:05	100.8
Lower1 Bluestone	0.078	57.7	04Sep2013, 12:00	4.3
Junction-5	2.031	375.8	04Sep2013, 13:05	105.1
Reach-5	2.031	375.8	04Sep2013, 13:10	104.9
Lower2 Bluestone	0.188	79	04Sep2013, 12:20	10.8
Junction-6	2.219	400.9	04Sep2013, 13:10	115.7
Reach-6	2.219	399.6	04Sep2013, 13:25	115
Lower3 Bluestone	0.425	152.3	04Sep2013, 12:30	24.3
Downstream	2.644	453	04Sep2013, 13:25	139.3

Project: OXF 157 Simulation Run: Existing

Start of Run:	04Sep2013, 00:00	Basin Model:	Existing
End of Run:	05Sep2013, 00:05	Meteorologic Model:	1 YR
Compute Time:	04Sep2013, 15:18	Control Specifications:	Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Upper Bluestone	0.882	38.4	04Sep2013, 13:10	12.3
Upper1 Bluestone	0.17	22.4	04Sep2013, 12:10	2.9
Junction-1	1.052	43.9	04Sep2013, 13:05	15.3
Reach-1	1.052	43.9	04Sep2013, 13:15	15.2
Middle1 Bluestone	0.252	17.3	04Sep2013, 12:35	3.9
Junction-2	1.304	55	04Sep2013, 13:05	19.1
Reach-2	1.304	55	04Sep2013, 13:25	18.9
Middle Bluestone	0.363	27.6	04Sep2013, 12:30	5.7
Junction-3	1.667	68.2	04Sep2013, 13:05	24.6
Reach-3	1.667	68.2	04Sep2013, 13:25	24.3
Lower Bluestone	0.286	19.5	04Sep2013, 12:30	4.1
Junction-4	1.953	78.9	04Sep2013, 13:05	28.4
Reach-4	1.953	78.8	04Sep2013, 13:10	28.3
Lower1 Bluestone	0.078	12.9	04Sep2013, 12:05	1.2
Junction-5	2.031	80.8	04Sep2013, 13:10	29.5
Reach-5	2.031	80.8	04Sep2013, 13:15	29.4
Lower2 Bluestone	0.188	17.6	04Sep2013, 12:25	3.2
Junction-6	2.219	88	04Sep2013, 13:15	32.7
Reach-6	2.219	87.6	04Sep2013, 13:30	32.4
Lower3 Bluestone	0.425	34.2	04Sep2013, 12:35	7.3
Downstream	2.644	104.1	04Sep2013, 13:25	39.7

SECTION 4

HEC-RAS In-Line Structure Analysis Report and Sections

HEC-RAS Version 4.1.0 Jan 2010
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

****

PROJECT DATA
Project Title: OXF 157-159 Bridges
Project File : OXF157-159Bridges.prj
Run Date and Time: 5/29/2014 2:49:29 PM

Project in English units

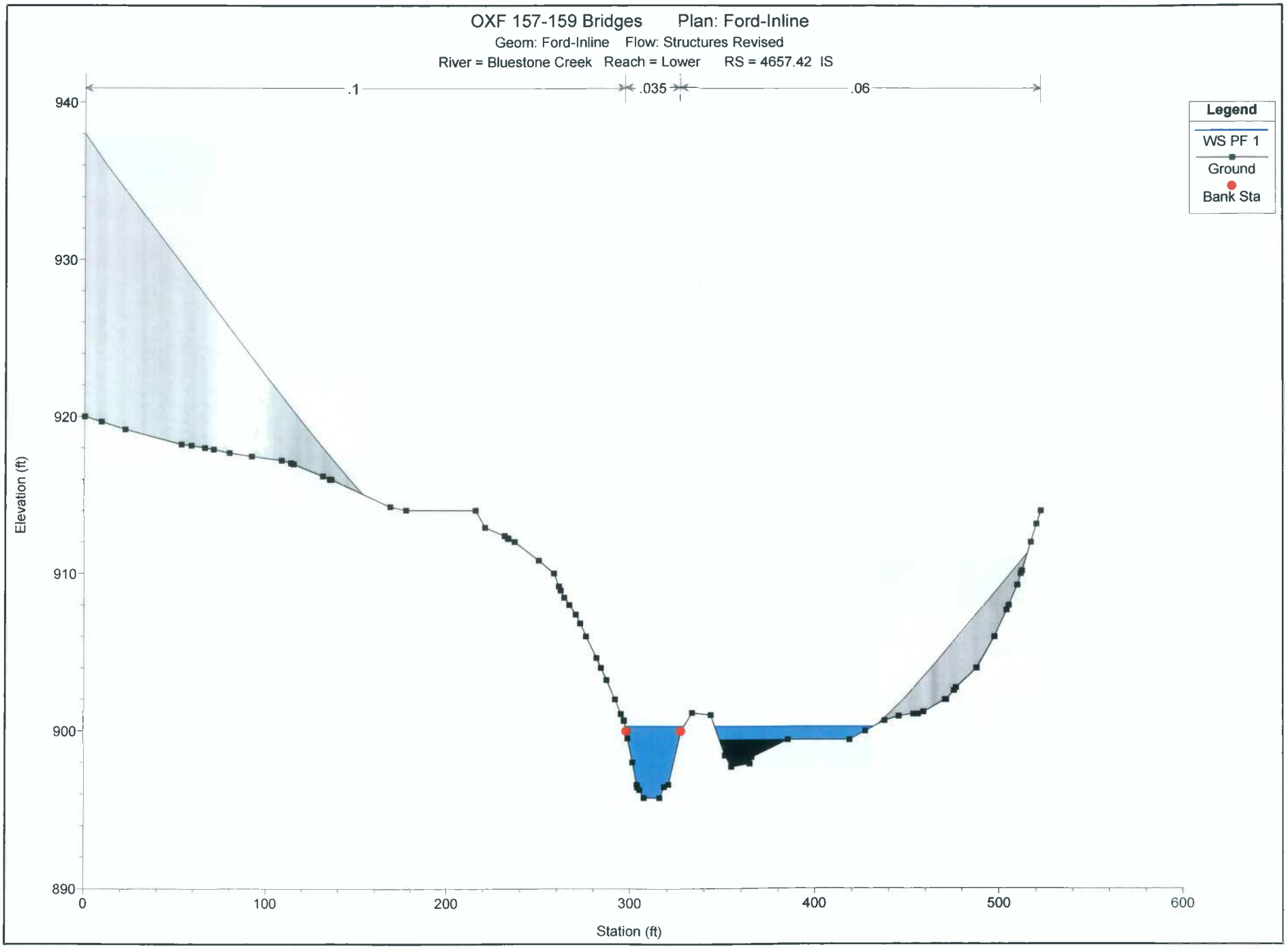
INLINE STRUCTURE

RIVER: Bluestone Creek
REACH: Lower RS: 4657.42

INLINE STRUCTURE OUTPUT Profile #PF 1 Inl Struct:

E.G. Elev (ft)	901.17	Q Gates (cfs)	
W.S. Elev (ft)	900.31	Q Gate Group (cfs)	0.00
Q Total (cfs)	914.40	Gate Open Ht (ft)	899.72
Q Weir (cfs)	914.40	Gate #Open	
Weir Flow Area (sq ft)	277.48	Gate Area (sq ft)	1.00
Weir Sta Lft (ft)	294.69	Gate Submerg	0.00
Weir Sta Rgt (ft)	440.64	Gate Invert (ft)	0.00
Weir Max Depth (ft)	5.42	Gate Weir Coef	0.000
Weir Avg Depth (ft)	1.90		
Weir Coef (ft^1/2)	2.600	Q Breach (cfs)	
Weir Submerg	0.45	Breach Avg Velocity (ft/s)	
Min El Weir Flow (ft)	895.76	Breach Flow Area (sq ft)	
Wr Top Wdth (ft)	145.95		

Warning: Critical depth in the cross section upstream of the inline structure produced too much flow past the inline structure. This
means there is not a valid subcritical answer. The upstream cross section defaulted to critical depth.

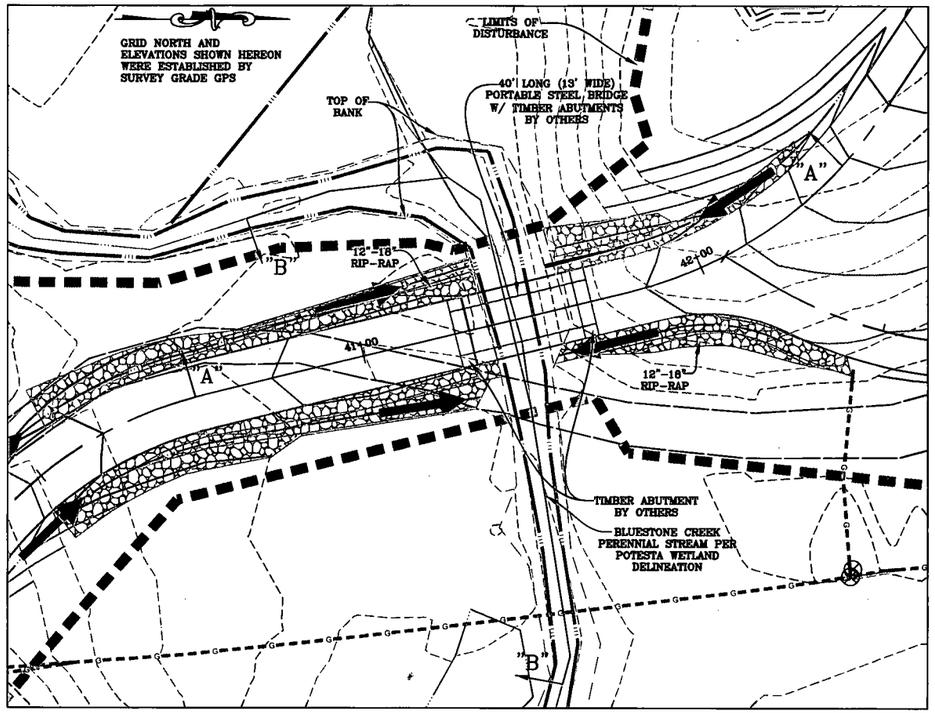

OXF 157-159 Bridges Plan: Ford-Inline
Geom: Ford-Inline Flow: Structures Revised
River = Bluestone Creek Reach = Lower RS = 4657.42 IS
.1
.035
.06
Legend
WS PF 1
Ground
Bank Sta
940
930
920
910
900
890
Elevation (ft)
0
100
200
300
400
500
600
Station (ft)

SECTION 5

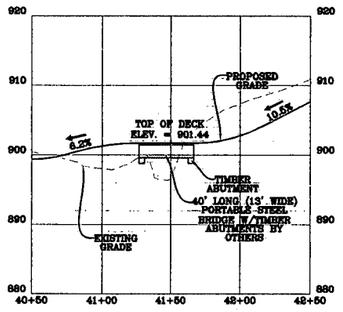
Stream Crossing "B" Details

TEMPORARY STREAM CROSSING DETAILS

STREAM CROSSING "B" DETAILS

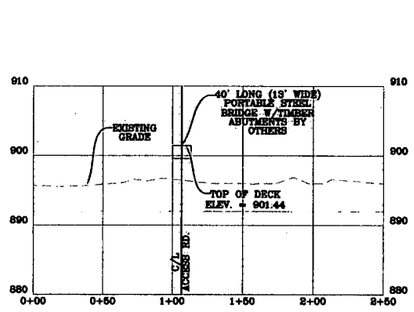


STREAM CROSSING "B" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

GENERAL TEMPORARY STREAM CROSSING NOTES:

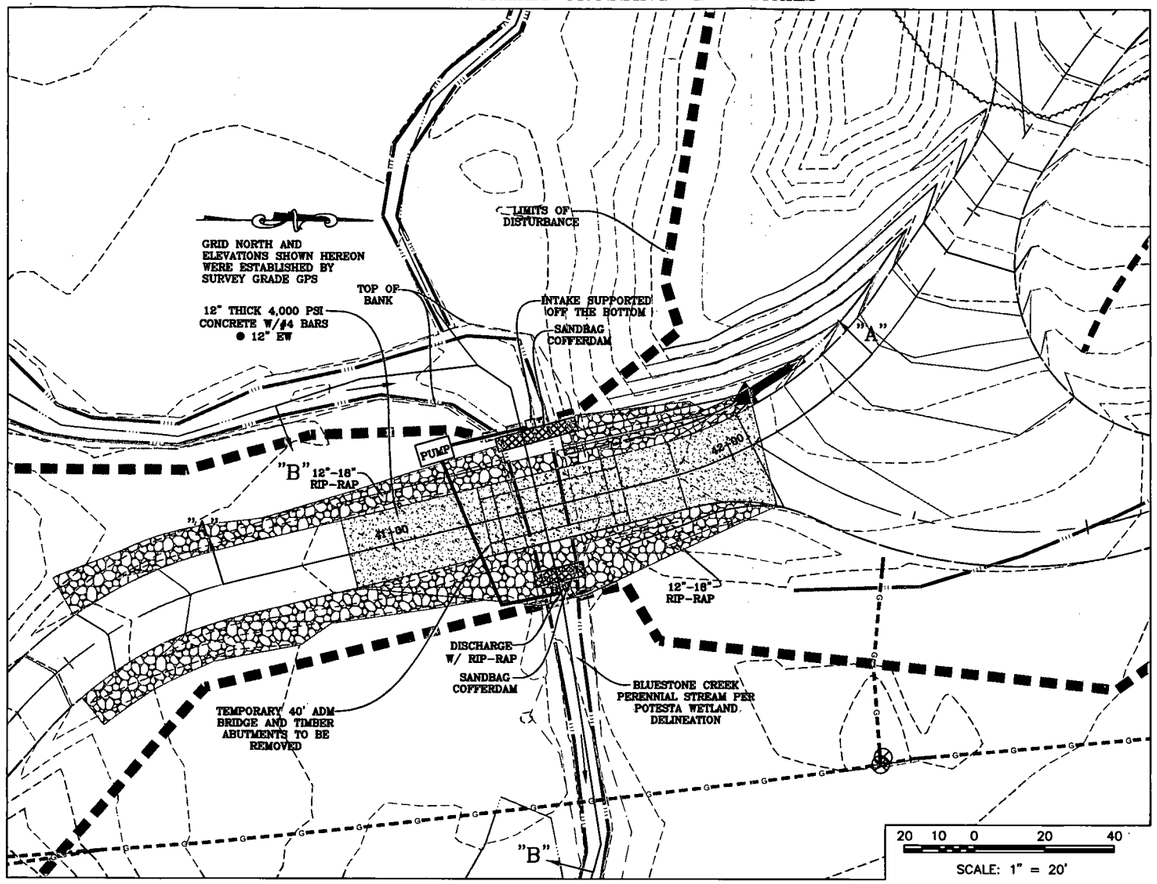
1) DO NOT USE ERODIBLE MATERIAL FOR CONSTRUCTION OF THE CROSSING.
2) CLEARING AND EXCAVATION OF THE STREAM BANKS SHALL BE KEPT TO A MINIMUM.
3) APPROPRIATE PERIMETER CONTROLS SUCH AS COMPOST FILTER SOCK, SUPER SILT FENCE AND/OR SEDIMENT TRAPS SHALL BE EMPLOYED ALONG THE BANKS AND PARALLEL TO THE STREAMBED.
4) TIMBER ABUTMENTS FOR THE BRIDGE INSTALLATION SHALL BE INSTALLED TO REDUCE STRUCTURAL DAMAGE DURING HIGH VELOCITY WATER OVERFLOW PERIODS.
5) STREAMBED MATERIAL IS NOT TO BE USED AS FILL.
6) DURING ROUTINE MAINTENANCE DO NOT GRADE MUD AND DEBRIS OVER THE SIDES OF THE CROSSING INTO THE STREAM.
7) THE TEMPORARY BRIDGE SHALL BE ANCHORED AS REQUIRED PER THE DODDRIDGE COUNTY FLOODPLAIN ORDINANCE.

NOTE:

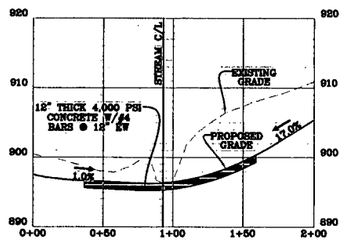
1) SEE SHEET 21 FOR PUMP AROUND NOTES AND DETAILS
2) SEE STREAM CROSSING REPORT BY NAVITUS ENGINEERING FOR CULVERT AND DRAINAGE COMPUTATATIONS.
3) EQT SHALL OBTAIN A STREAM ACTIVITY PERMIT THROUGH THE PUBLIC LAND CORPORATION OFFICE OF LAND AND STREAMS FOR STREAM CROSSING "B".

PERMANENT STREAM CROSSING DETAILS

STREAM CROSSING "B" DETAILS

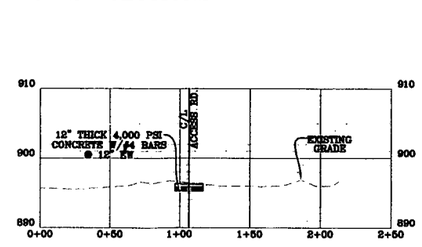


STREAM CROSSING "B" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

GENERAL STREAM CROSSING NOTES:

1) CLEARING AND EXCAVATION OF THE STREAMBED AND BANKS SHALL BE KEPT TO A MINIMUM.
2) STREAM BED WILL BE MONITORED DURING CONSTRUCTION, ALL GROUNDWATER SEEPAGE NEEDS TO REMOVED PRIOR TO STRUCTURAL BASE MATERIAL AND CONCRETE BEING EMPLACED.
3) SOIL BEARING CAPACITY TO BE FIELD VERIFIED PRIOR TO CONSTRUCTION, MINIMUM SOIL BEARING CAPACITY IS 4,000 PSF.
4) IF UNSUITABLE MATERIAL IS ENCOUNTERED DURING CONSTRUCTION, THE MATERIAL IS TO BE REMOVED, AND ADDITIONAL 3/4"-1" STONE IS TO BE EMPLACED.
5) FILTER CLOTH SHALL BE PLACED ON THE STREAMBED AND STREAM BANKS PRIOR TO PLACEMENT OF THE CONCRETE AND AGGREGATE. THE FILTER CLOTH SHALL COVER THE STREAMBED AND EXTEND A MINIMUM OF SIX INCHES AND A MAXIMUM OF ONE FOOT BEYOND THE END OF THE FORD AND BEDDING MATERIAL.
6) A PUMP AROUND SYSTEM SHALL BE CONSTRUCTED ACROSS THE ROADWAY ON EITHER SIDE OF THE STREAM CROSSING AS DIRECTED DURING CROSSING CONSTRUCTION.
10) AT NO POINT DURING CONSTRUCTION SHALL THE CONCRETE FORD BE EXPOSED TO THE NORMAL FLOW OF THE STREAM, ONLY UNTIL AFTER THE CONCRETE HAS HARDENED AND CURED SHALL THE PUMP AROUND SYSTEM BE REMOVED AND NORMAL FLOW RESTORED.
11) APPROPRIATE PERIMETER CONTROLS SUCH AS COMPOST FILTER SOCK, SUPER SILT FENCE AND/OR SEDIMENT TRAPS SHALL BE EMPLOYED ALONG THE BANKS AND PARALLEL TO THE STREAMBED.
12) STREAMBED MATERIAL IS NOT TO BE USED AS FILL.
13) DURING ROUTINE MAINTENANCE DO NOT GRADE MUD AND DEBRIS OVER THE SIDES OF THE CROSSING INTO THE STREAM.
14) THE CROSSING MUST BE INSPECTED AFTER EVERY RAIN EVENT OF 0.5 INCHES OR MORE AND ONCE A WEEK TO ENSURE THAT THE FORD, STREAMBED, AND STREAM BANKS ARE MAINTAINED AND NOT DAMAGED. NEVER ALLOW THE FORD TO BECOME CLOGGED WITH DEBRIS AND REMOVE ANY OBSTRUCTIONS IMMEDIATELY.
15) GEOTEXTILE FABRIC SHALL MEETS THE TENSILE STRENGTH REQUIREMENTS OF 180 LBS PER ASTM D 4632, MULLEN BURSTING REQUIREMENTS OF 320 PSI PER ASTM D 3786, AND PUNCTURE TEST REQUIREMENTS OF 80 LBS PER ASTM D 4833.
16) ACCESS ROAD DITCHES SHALL BE MAINTAINED AND EXCAVATED AS NECESSARY FOR THE EMPLACEMENT OF RIP-RAP ARMORING.
17) CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4,000 PSI AT 28 DAYS.
18) STORM RUNOFF MAY DEPOSIT DEBRIS AT THE CROSSING LOCATION WHICH WILL NEED TO BE REMOVED.

NAVITUS ENERGY ENGINEERING
Telephone: (888) 662-4185 | www.NavitusEng.com

Professional Energy Consultants
A DIVISION OF SMITHLAND SURVEYING, INC.
SURVEYORS
ENGINEERS
ENVIRONMENTAL
PROJECT MGMT.
www.SLSSURVEYS.com
(304) 462-5634

COMMONWEALTH OF VIRGINIA
No. 11709
PROFESSIONAL ENGINEER
06/02/2014

THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC.
FOR: EQT PRODUCTION COMPANY

MAJOR STREAM CROSSING DETAILS

OXF 157

WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013

SCALE: N/A

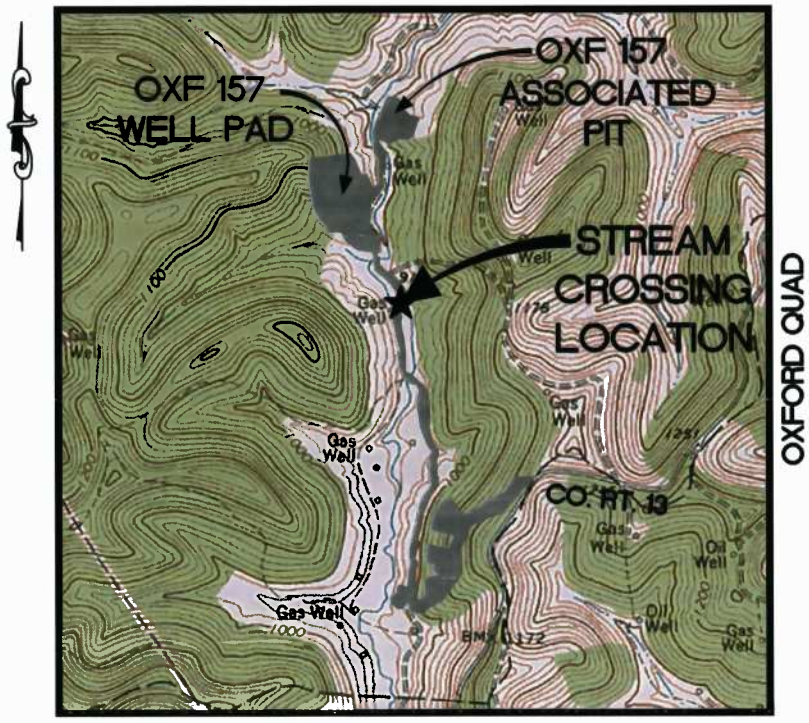
DESIGNED BY: CSK

FILE NO. 7889

SHEET 22 OF 32

REV: 08/03/2014

STREAM CROSSING "C"
STORMWATER COMPUTATIONS
OXF 157 WELL PAD



VICINITY MAP
1" = 2,000'

NAVITUS
ENERGY ENGINEERING
Telephone: (888) 662-4185 | www.NavitusEng.com

Prepared For:
EQT Production Company
115 Professional Place
P.O. Box 280
Bridgeport, WV 26330

Contact:
Victoria J. Roark
Permitting Supervisor
(304) 848-0076

Designed By:
Navitus Engineering Inc.

Project Manager:
Chandler Pearson
cpearson@navituseng.com

Date: June 3, 2014

Surface Owner (s)
Justin L. Henderson

Tax Parcel:
Map 6 Parcel 1

Location:
West Union District, Doddridge County
West Virginia

FN# 7889

OXF 157 WELL PAD

STREAM CROSSING "C"

STORMWATER COMPUTATIONS

Sections

SECTION 1

Overview

The intent of this project is to construct a gravel access road to a gas well pad site and associated facilities. This project will include a permanent stream crossing. Bluestone Creek, which has been classified as a perennial stream per the wetlands report conducted by Potesta Engineers and Environmental Consultants dated May 29, 2013, will be crossed at station 35+06.795 of the proposed access road.

Drainage Narrative

Using the SCS Method, with HEC-HMS, we determined the 1, 10, and 100-year rainfall events at the stream crossing study point. We then used HEC-RAS to design the crossings and to determine the base flow water surface elevation for each rainfall event. Stream Crossing "C" has a drainage area of 1,299.9 Acres. Design flows are shown as Junction-5 in the drainage calculations in Section 3.

Stream Crossing "C" is to be a "low water ford crossing" which is designed to handle the base flow. The stream crossing was designed as a permanent structure in accordance with the U.S. Army Corps of Engineering Nationwide 14 Permit. The concrete ford will be installed at the existing elevation of the stream bed, the ford will be 20 ft. wide by 8 in. thick and reinforced with welded wire fabric. At the upstream and downstream end of the ford there will be a 5' wide by 18" thick rip-rap apron. At no point during construction will the normal flow of the stream be exposed to "green" concrete. Stream diversions, temporary cofferdams, and pump-arounds will be utilized during construction to shield the stream flow from concrete placement and sediment disturbance. The 1-yr, 10-yr and 100-yr flood elevations are passed over the ford without creating an adverse raise to the 100-yr base flood elevations. Stream Crossing "C" will have a permanent disturbance of 40.0 ft.

Prior to the construction of the "low water crossing" a 40 ft long steel bridge with timber abutments will be used to cross the stream channel. Disturbance to the stream channel will be limited to minor excavation at or near the stream bank, there will be no disturbance to the stream bed or flow.

SECTION 2

NRCS Soils Report

Hydrologic Soil Group—Doddridge County, West Virginia
(CROSSING C)

Map Scale: 1:13,100 if printed on B portrait (11" x 17") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

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

Soils

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

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

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

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: Doddridge County, West Virginia
Survey Area Data: Version 8, Apr 2, 2009

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 8, 2011—Oct 25, 2011

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Doddridge County, West Virginia (WV017)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
GsE	Gilpin-Peabody complex, 15 to 35 percent slopes, very stony	C	316.0	24.3%
GsF	Gilpin-Peabody complex, 35 to 70 percent slopes, very stony	C	710.4	54.6%
GuC	Gilpin-Upshur complex, 8 to 15 percent slopes	D	1.0	0.1%
GuD	Gilpin-Upshur complex, 15 to 25 percent slopes	D	46.6	3.6%
Se	Sensabaugh silt loam	B	101.2	7.8%
SeB	Sensabaugh silt loam, 3 to 8 percent slopes, rarely flooded	B	20.2	1.6%
VaD	Vandalia silt loam, 15 to 25 percent slopes	D	62.9	4.8%
VsE	Vandalia silt loam, 15 to 35 percent slopes, very stony	D	38.4	3.0%
W	Water		3.1	0.2%
Totals for Area of Interest			**1,299.9**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

SECTION 3

HEC-HMS
Drainage Computations

Project: OXF 157 Simulation Run: Existing

Start of Run:	04Sep2013, 00:00	Basin Model:	Existing
End of Run:	05Sep2013, 00:05	Meteorologic Model:	100 YR
Compute Time:	04Sep2013, 15:18	Control Specifications:	Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Upper Bluestone	0.882	443.8	04Sep2013, 12:55	95.5
Upper1 Bluestone	0.17	221.9	04Sep2013, 12:10	20.3
Junction-1	1.052	482.7	04Sep2013, 12:50	115.8
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Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Upper Bluestone	0.882	189.7	04Sep2013, 13:00	44.7
Upper1 Bluestone	0.17	101.9	04Sep2013, 12:10	9.8
Junction-1	1.052	208.9	04Sep2013, 12:55	54.5
Reach-1	1.052	208.9	04Sep2013, 13:05	54.3
Middle1 Bluestone	0.252	83.2	04Sep2013, 12:30	13.7
Junction-2	1.304	259.4	04Sep2013, 12:55	67.9
Reach-2	1.304	259.3	04Sep2013, 13:10	67.4
Middle Bluestone	0.363	133.4	04Sep2013, 12:25	19.7
Junction-3	1.667	326.8	04Sep2013, 12:40	87.1
Reach-3	1.667	326.6	04Sep2013, 13:00	86.4
Lower Bluestone	0.286	102.3	04Sep2013, 12:25	14.7
Junction-4	1.953	371.5	04Sep2013, 13:00	101.1
Reach-4	1.953	369.7	04Sep2013, 13:05	100.8
Lower1 Bluestone	0.078	57.7	04Sep2013, 12:00	4.3
Junction-5	2.031	375.8	04Sep2013, 13:05	105.1
Reach-5	2.031	375.8	04Sep2013, 13:10	104.9
Lower2 Bluestone	0.188	79	04Sep2013, 12:20	10.8
Junction-6	2.219	400.9	04Sep2013, 13:10	115.7
Reach-6	2.219	399.6	04Sep2013, 13:25	115
Lower3 Bluestone	0.425	152.3	04Sep2013, 12:30	24.3
Downstream	2.644	453	04Sep2013, 13:25	139.3

Project: OXF 157 Simulation Run: Existing

Start of Run:	04Sep2013, 00:00	Basin Model:	Existing
End of Run:	05Sep2013, 00:05	Meteorologic Model:	1 YR
Compute Time:	04Sep2013, 15:18	Control Specifications:	Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Upper Bluestone	0.882	38.4	04Sep2013, 13:10	12.3
Upper1 Bluestone	0.17	22.4	04Sep2013, 12:10	2.9
Junction-1	1.052	43.9	04Sep2013, 13:05	15.3
Reach-1	1.052	43.9	04Sep2013, 13:15	15.2
Middle1 Bluestone	0.252	17.3	04Sep2013, 12:35	3.9
Junction-2	1.304	55	04Sep2013, 13:05	19.1
Reach-2	1.304	55	04Sep2013, 13:25	18.9
Middle Bluestone	0.363	27.6	04Sep2013, 12:30	5.7
Junction-3	1.667	68.2	04Sep2013, 13:05	24.6
Reach-3	1.667	68.2	04Sep2013, 13:25	24.3
Lower Bluestone	0.286	19.5	04Sep2013, 12:30	4.1
Junction-4	1.953	78.9	04Sep2013, 13:05	28.4
Reach-4	1.953	78.8	04Sep2013, 13:10	28.3
Lower1 Bluestone	0.078	12.9	04Sep2013, 12:05	1.2
Junction-5	2.031	80.8	04Sep2013, 13:10	29.5
Reach-5	2.031	80.8	04Sep2013, 13:15	29.4
Lower2 Bluestone	0.188	17.6	04Sep2013, 12:25	3.2
Junction-6	2.219	88	04Sep2013, 13:15	32.7
Reach-6	2.219	87.6	04Sep2013, 13:30	32.4
Lower3 Bluestone	0.425	34.2	04Sep2013, 12:35	7.3
Downstream	2.644	104.1	04Sep2013, 13:25	39.7

SECTION 4

HEC-RAS In-Line Structure Analysis Report and Sections

HEC-RAS Version 4.1.0 Jan 2010
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

****

PROJECT DATA
Project Title: OXF 157-159 Bridges
Project File : OXF157-159Bridges.prj
Run Date and Time: 5/29/2014 2:49:29 PM

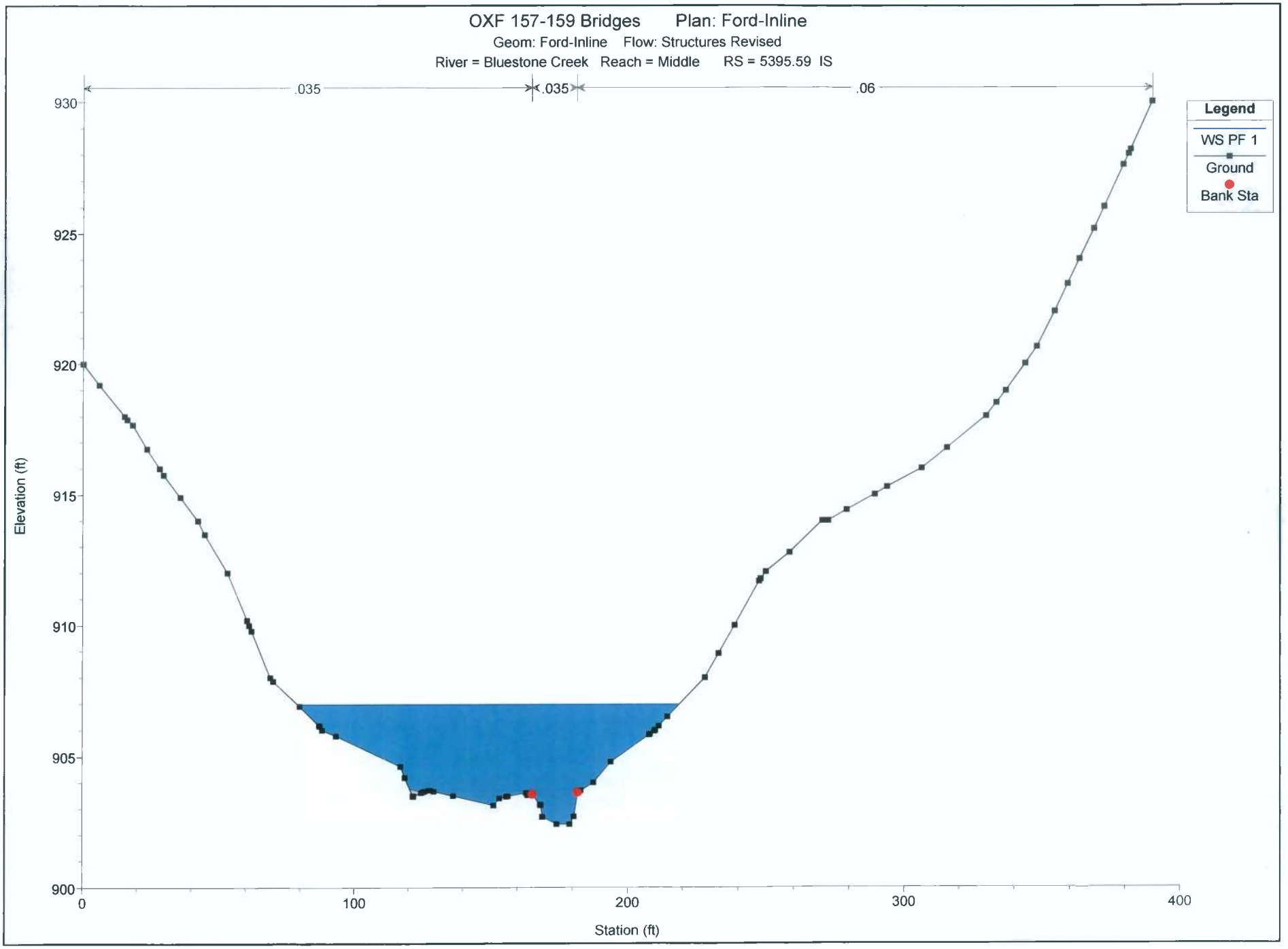
Project in English units

INLINE STRUCTURE

RIVER: Bluestone Creek
REACH: Middle RS: 5395.59

INLINE STRUCTURE OUTPUT Profile #PF 1 Inl Struct:

E.G. Elev (ft)	907.09	Q Gates (cfs)	
W.S. Elev (ft)	906.98	Q Gate Group (cfs)	0.00
Q Total (cfs)	865.00	Gate Open Ht (ft)	906.96
Q Weir (cfs)	865.00	Gate #Open	
Weir Flow Area (sq ft)	368.91	Gate Area (sq ft)	1.00
Weir Sta Lft (ft)	78.09	Gate Submerg	0.00
Weir Sta Rgt (ft)	219.89	Gate Invert (ft)	0.00
Weir Max Depth (ft)	4.67	Gate Weir Coef	0.000
Weir Avg Depth (ft)	2.60		
Weir Coef (ft^1/2)	2.600	Q Breach (cfs)	
Weir Submerg	0.98	Breach Avg Velocity (ft/s)	
Min El Weir Flow (ft)	902.43	Breach Flow Area (sq ft)	
Wr Top Wdth (ft)	141.80		

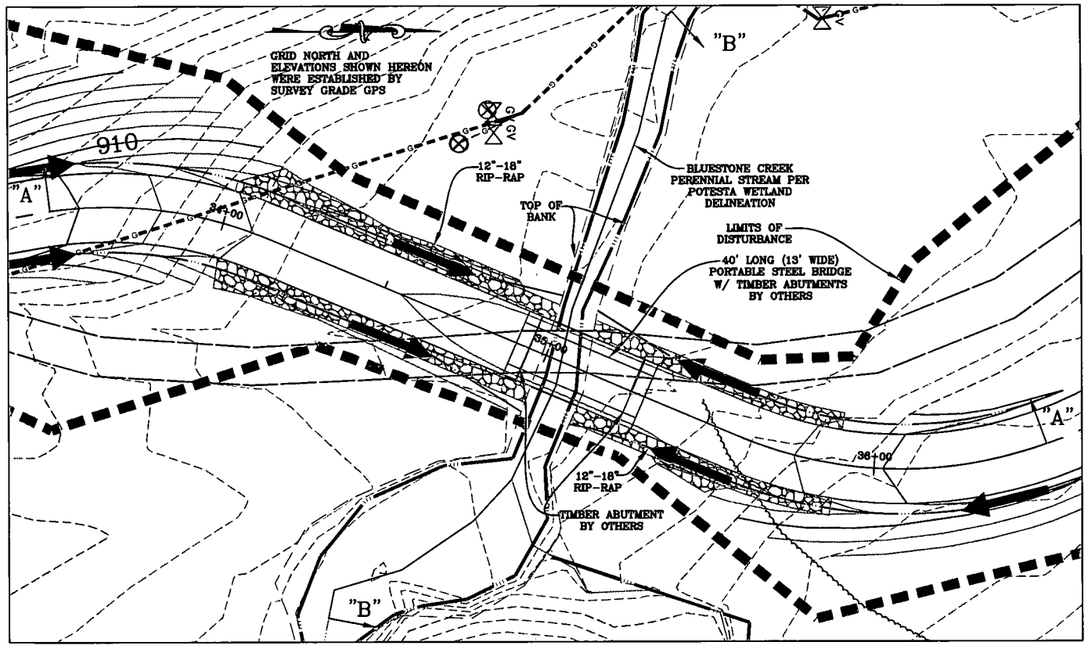

OXF 157-159 Bridges Plan: Ford-Inline
Geom: Ford-Inline Flow: Structures Revised
River = Bluestone Creek Reach = Middle RS = 5395.59 IS
.035
.035
.06
Legend
WS PF 1
Ground
Bank Sta
930
925
920
915
910
905
900
Elevation (ft)
0
100
200
300
400
Station (ft)

SECTION 5

Stream Crossing "C" Details

TEMPORARY STREAM CROSSING DETAILS

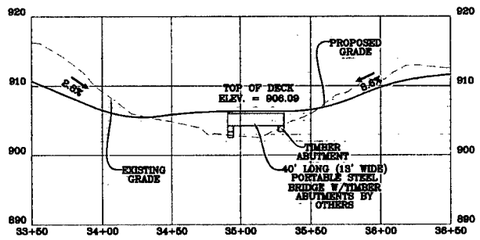
STREAM CROSSING "C" DETAILS



20 10 0 20 40

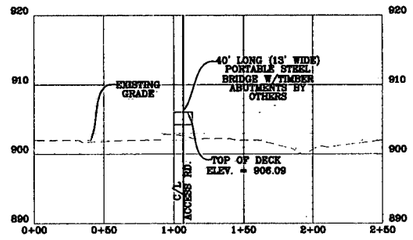
SCALE: 1" = 20'

STREAM CROSSING "C" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

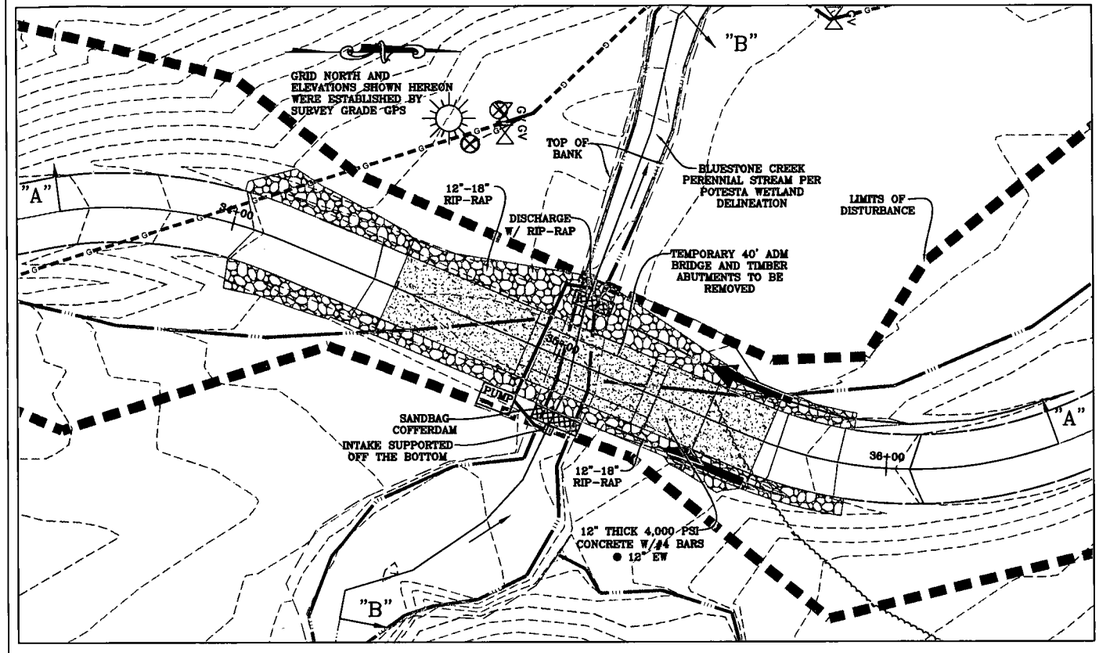
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

GENERAL TEMPORARY STREAM CROSSING NOTES:

1) DO NOT USE ERODIBLE MATERIAL FOR CONSTRUCTION OF THE CROSSING.
2) CLEARING AND EXCAVATION OF THE STREAM BANKS SHALL BE KEPT TO A MINIMUM.
3) APPROPRIATE PERIMETER CONTROLS SUCH AS COMPOST FILTER SOCK, SUPER SILT FENCE AND/OR SEDIMENT TRAPS SHALL BE EMPLOYED ALONG THE BANKS AND PARALLEL TO THE STREAMBED.
4) TIMBER ABUTMENTS FOR THE BRIDGE INSTALLATION SHALL BE INSTALLED TO REDUCE STRUCTURAL DAMAGE DURING HIGH VELOCITY WATER OVERFLOW PERIODS.
5) STREAMBED MATERIAL IS NOT TO BE USED AS FILL.
6) DURING ROUTINE MAINTENANCE DO NOT GRADE MUD AND DEBRIS OVER THE SIDES OF THE CROSSING INTO THE STREAM.
7) THE TEMPORARY BRIDGE SHALL BE ANCHORED AS REQUIRED PER THE DODDRIDGE COUNTY FLOODPLAIN ORDINANCE.

PERMANENT STREAM CROSSING DETAILS

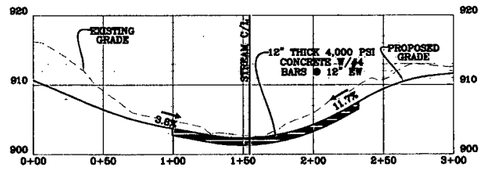
STREAM CROSSING "C" DETAILS



20 10 0 20 40

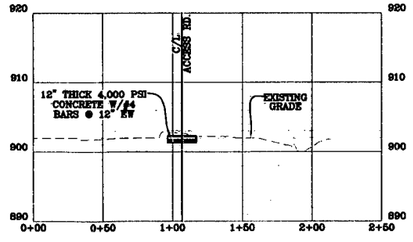
SCALE: 1" = 20'

STREAM CROSSING "C" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

GENERAL STREAM CROSSING NOTES:

1) CLEARING AND EXCAVATION OF THE STREAMBED AND BANKS SHALL BE KEPT TO A MINIMUM.
2) STREAM BED WILL BE MONITORED DURING CONSTRUCTION, ALL GROUNDWATER SEEPAGE NEEDS TO REMOVED PRIOR TO STRUCTURAL BASE MATERIAL AND CONCRETE BEING EMPLACED.
3) SOIL BEARING CAPACITY TO BE FIELD VERIFIED PRIOR TO CONSTRUCTION, MINIMUM SOIL BEARING CAPACITY IS 4,000 PSF.
4) IF UNSUITABLE MATERIAL IS ENCOUNTERED DURING CONSTRUCTION, THE MATERIAL IS TO BE REMOVED, AND ADDITIONAL 3/4"-1" STONE IS TO BE EMPLACED.
5) FILTER CLOTH SHALL BE PLACED ON THE STREAMBED AND STREAM BANKS PRIOR TO PLACEMENT OF THE CONCRETE AND AGGREGATE. THE FILTER CLOTH SHALL COVER THE STREAMBED AND EXTEND A MINIMUM OF SIX INCHES AND A MAXIMUM OF ONE FOOT BEYOND THE END OF THE FORD AND BEDDING MATERIAL.
6) A PUMP AROUND SYSTEM SHALL BE CONSTRUCTED ACROSS THE ROADWAY ON EITHER SIDE OF THE STREAM CROSSING AS DIRECTED DURING CROSSING CONSTRUCTION.
10) AT NO POINT DURING CONSTRUCTION SHALL THE CONCRETE FORD BE EXPOSED TO THE NORMAL FLOW OF THE STREAM, ONLY UNTIL AFTER THE CONCRETE HAS HARDENED AND CURED SHALL THE PUMP AROUND SYSTEM BE REMOVED AND NORMAL FLOW RESTORED.
11) APPROPRIATE PERIMETER CONTROLS SUCH AS COMPOST FILTER SOCK, SUPER SILT FENCE AND/OR SEDIMENT TRAPS SHALL BE EMPLOYED ALONG THE BANKS AND PARALLEL TO THE STREAMBED.
12) STREAMBED MATERIAL IS NOT TO BE USED AS FILL.
13) DURING ROUTINE MAINTENANCE DO NOT GRADE MUD AND DEBRIS OVER THE SIDES OF THE CROSSING INTO THE STREAM.
14) THE CROSSING MUST BE INSPECTED AFTER EVERY RAIN EVENT OF 0.5 INCHES OR MORE AND ONCE A WEEK TO ENSURE THAT THE FORD, STREAMBED, AND STREAM BANKS ARE MAINTAINED AND NOT DAMAGED. NEVER ALLOW THE FORD TO BECOME CLOGGED WITH DEBRIS AND REMOVE ANY OBSTRUCTIONS IMMEDIATELY.
15) GEOTEXTILE FABRIC SHALL MEETS THE TENSILE STRENGTH REQUIREMENTS OF 180 LBS PER ASTM D 4632, MULLEN BURSTING REQUIREMENTS OF 320 PSI PER ASTM D 3786, AND PUNCTURE TEST REQUIREMENTS OF 80 LBS PER ASTM D 4833.
16) ACCESS ROAD DITCHES SHALL BE MAINTAINED AND EXCAVATED AS NECESSARY FOR THE EMPLACEMENT OF RIP-RAP ARMORING.
17) CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4,000 PSI AT 28 DAYS.
18) STORM RUNOFF MAY DEPOSIT DEBRIS AT THE CROSSING LOCATION WHICH WILL NEED TO BE REMOVED.

NOTE:

1) SEE SHEET 21 FOR PUMP AROUND NOTES AND DETAILS
2) SEE STREAM CROSSING REPORT BY NAVITUS ENGINEERING FOR CULVERT AND DRAINAGE COMPUTATATIONS.
3) EQT SHALL OBTAIN A STREAM ACTIVITY PERMIT THROUGH THE PUBLIC LAND CORPORATION OFFICE OF LAND AND STREAMS FOR STREAM CROSSING "C".

NAVITUS ENGINEERING
Telephone: (888) 662-4185 | www.NavitusEng.com

Professional Energy Consultants
A DIVISION OF SMITH LAND SURVEYING, INC.
SURVEYORS · ENGINEERS · ENVIRONMENTAL · PROJECT MGMT.
www.SLSSURVEYS.com
(304) 462-5634

THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

MAJOR STREAM CROSSING DETAILS

OXF 157

WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013

SCALE: N/A

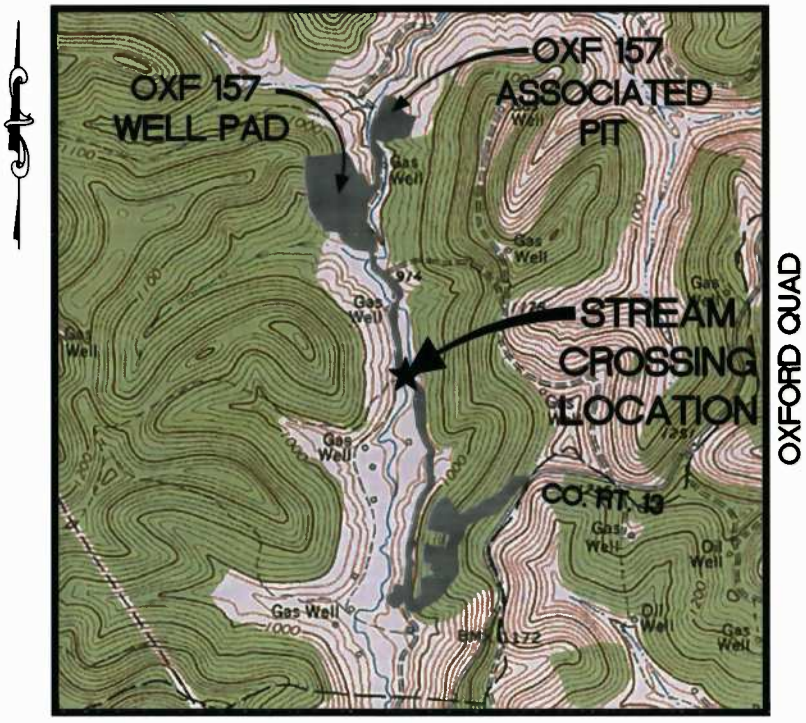
DESIGNED BY: CSK

FILE NO. 7889

SHEET 23 OF 32

REV: 06/03/2014

STREAM CROSSING "D"
STORMWATER COMPUTATIONS
OXF 157 WELL PAD



VICINITY MAP
1" = 2,000'

NAVITUS
ENERGY ENGINEERING
Telephone: (888) 662-4185 | www.NavitusEng.com

Prepared For:
EQT Production Company
115 Professional Place
P.O. Box 280
Bridgeport, WV 26330

Contact:
Victoria J. Roark
Permitting Supervisor
(304) 848-0076

Designed By:
Navitus Engineering Inc.

Project Manager:
Chandler Pearson
cpearson@navituseng.com

Date: June 3, 2014

Surface Owner (s)
Justin L. Henderson

Tax Parcel:
Map 6 Parcel 1

Location:
West Union District, Doddridge County
West Virginia

FN# 7889

OXF 157 WELL PAD

STREAM CROSSING "D"

STORMWATER COMPUTATIONS

Sections

SECTION 1

Overview

The intent of this project is to construct a gravel access road to a gas well pad site and associated facilities. This project will include a permanent stream crossing. Bluestone Creek, which has been classified as a perennial stream per the wetlands report conducted by Potesta Engineers and Environmental Consultants dated May 29, 2013, will be crossed at station 26+81.854 of the proposed access road.

Drainage Narrative

Using the SCS Method, with HEC-HMS, we determined the 1, 10, and 100-year rainfall events at the stream crossing study point. We then used HEC-RAS to design the crossings and to determine the base flow water surface elevation for each rainfall event. Stream Crossing "D" has a drainage area of 1,249.9 Acres. Design flows are shown as Junction-4 in the drainage calculations in Section 3.

Stream Crossing "D" is to be a "low water ford crossing" which is designed to handle the base flow. The stream crossing was designed as a permanent structure in accordance with the U.S. Army Corps of Engineering Nationwide 14 Permit. The concrete ford will be installed at the existing elevation of the stream bed, the ford will be 20 ft. wide by 8 in. thick and reinforced with welded wire fabric. At the upstream and downstream end of the ford there will be a 5' wide by 18" thick rip-rap apron. At no point during construction will the normal flow of the stream be exposed to "green" concrete. Stream diversions, temporary cofferdams, and pump-arounds will be utilized during construction to shield the stream flow from concrete placement and sediment disturbance. The 1-yr, 10-yr and 100-yr flood elevations are passed over the ford without creating an adverse raise to the 100-yr base flood elevations. Stream Crossing "D" will have a permanent disturbance of 43.0 ft.

Prior to the construction of the "low water crossing" a 40 ft long steel bridge with timber abutments will be used to cross the stream channel. Disturbance to the stream channel will be limited to minor excavation at or near the stream bank, there will be no disturbance to the stream bed or flow.

SECTION 2

NRCS Soils Report

Hydrologic Soil Group—Doddridge County, West Virginia
(Stream D)

Map Scale: 1:12,100 if printed on B portrait (11" x 17") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

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

Soils

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

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

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

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: Doddridge County, West Virginia
Survey Area Data: Version 8, Apr 2, 2009

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 8, 2011—Oct 25, 2011

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Doddridge County, West Virginia (WV017)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
GsE	Gilpin-Peabody complex, 15 to 35 percent slopes, very stony	C	314.8	25.2%
GsF	Gilpin-Peabody complex, 35 to 70 percent slopes, very stony	C	684.0	54.7%
GuC	Gilpin-Upshur complex, 8 to 15 percent slopes	D	1.0	0.1%
GuD	Gilpin-Upshur complex, 15 to 25 percent slopes	D	46.4	3.7%
Se	Sensabaugh silt loam	B	93.6	7.5%
SeB	Sensabaugh silt loam, 3 to 8 percent slopes, rarely flooded	B	20.2	1.6%
VaD	Vandalia silt loam, 15 to 25 percent slopes	D	58.9	4.7%
VsE	Vandalia silt loam, 15 to 35 percent slopes, very stony	D	27.9	2.2%
W	Water		3.1	0.2%
Totals for Area of Interest			**1,249.9**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

SECTION 3

HEC-HMS
Drainage Computations

Project: OXF 157 Simulation Run: Existing

Start of Run:	04Sep2013, 00:00	Basin Model:	Existing
End of Run:	05Sep2013, 00:05	Meteorologic Model:	100 YR
Compute Time:	04Sep2013, 15:18	Control Specifications:	Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Upper Bluestone	0.882	443.8	04Sep2013, 12:55	95.5
Upper1 Bluestone	0.17	221.9	04Sep2013, 12:10	20.3
Junction-1	1.052	482.7	04Sep2013, 12:50	115.8
Reach-1	1.052	482.7	04Sep2013, 13:00	115.4
Middle1 Bluestone	0.252	189.6	04Sep2013, 12:30	28.7
Junction-2	1.304	601.9	04Sep2013, 12:50	144.1
Reach-2	1.304	601	04Sep2013, 13:10	143.1
Middle Bluestone	0.363	303	04Sep2013, 12:25	41.4
Junction-3	1.667	763.6	04Sep2013, 12:40	184.5
Reach-3	1.667	762	04Sep2013, 13:00	183.2
Lower Bluestone	0.286	238.7	04Sep2013, 12:20	31.4
Junction-4	1.953	855.6	04Sep2013, 13:00	214.6
Reach-4	1.953	853.6	04Sep2013, 13:05	214.2
Lower1 Bluestone	0.078	130	04Sep2013, 12:00	9
Junction-5	2.031	865	04Sep2013, 13:05	223.1
Reach-5	2.031	865	04Sep2013, 13:10	222.7
Lower2 Bluestone	0.188	175.7	04Sep2013, 12:20	22.3
Junction-6	2.219	914.4	04Sep2013, 13:10	245
Reach-6	2.219	910.4	04Sep2013, 13:25	243.8
Lower3 Bluestone	0.425	337.3	04Sep2013, 12:30	50.2
Downstream	2.644	1021.2	04Sep2013, 13:20	294

Project: OXF 157 Simulation Run: Existing

Start of Run:	04Sep2013, 00:00	Basin Model:	Existing
End of Run:	05Sep2013, 00:05	Meteorologic Model:	10 YR
Compute Time:	04Sep2013, 15:18	Control Specifications:	Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Upper Bluestone	0.882	189.7	04Sep2013, 13:00	44.7
Upper1 Bluestone	0.17	101.9	04Sep2013, 12:10	9.8
Junction-1	1.052	208.9	04Sep2013, 12:55	54.5
Reach-1	1.052	208.9	04Sep2013, 13:05	54.3
Middle1 Bluestone	0.252	83.2	04Sep2013, 12:30	13.7
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Reach-2	1.304	259.3	04Sep2013, 13:10	67.4
Middle Bluestone	0.363	133.4	04Sep2013, 12:25	19.7
Junction-3	1.667	326.8	04Sep2013, 12:40	87.1
Reach-3	1.667	326.6	04Sep2013, 13:00	86.4
Lower Bluestone	0.286	102.3	04Sep2013, 12:25	14.7
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Reach-4	1.953	369.7	04Sep2013, 13:05	100.8
Lower1 Bluestone	0.078	57.7	04Sep2013, 12:00	4.3
Junction-5	2.031	375.8	04Sep2013, 13:05	105.1
Reach-5	2.031	375.8	04Sep2013, 13:10	104.9
Lower2 Bluestone	0.188	79	04Sep2013, 12:20	10.8
Junction-6	2.219	400.9	04Sep2013, 13:10	115.7
Reach-6	2.219	399.6	04Sep2013, 13:25	115
Lower3 Bluestone	0.425	152.3	04Sep2013, 12:30	24.3
Downstream	2.644	453	04Sep2013, 13:25	139.3

Project: OXF 157 Simulation Run: Existing

Start of Run:	04Sep2013, 00:00	Basin Model:	Existing
End of Run:	05Sep2013, 00:05	Meteorologic Model:	1 YR
Compute Time:	04Sep2013, 15:18	Control Specifications:	Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Upper Bluestone	0.882	38.4	04Sep2013, 13:10	12.3
Upper1 Bluestone	0.17	22.4	04Sep2013, 12:10	2.9
Junction-1	1.052	43.9	04Sep2013, 13:05	15.3
Reach-1	1.052	43.9	04Sep2013, 13:15	15.2
Middle1 Bluestone	0.252	17.3	04Sep2013, 12:35	3.9
Junction-2	1.304	55	04Sep2013, 13:05	19.1
Reach-2	1.304	55	04Sep2013, 13:25	18.9
Middle Bluestone	0.363	27.6	04Sep2013, 12:30	5.7
Junction-3	1.667	68.2	04Sep2013, 13:05	24.6
Reach-3	1.667	68.2	04Sep2013, 13:25	24.3
Lower Bluestone	0.286	19.5	04Sep2013, 12:30	4.1
Junction-4	1.953	78.9	04Sep2013, 13:05	28.4
Reach-4	1.953	78.8	04Sep2013, 13:10	28.3
Lower1 Bluestone	0.078	12.9	04Sep2013, 12:05	1.2
Junction-5	2.031	80.8	04Sep2013, 13:10	29.5
Reach-5	2.031	80.8	04Sep2013, 13:15	29.4
Lower2 Bluestone	0.188	17.6	04Sep2013, 12:25	3.2
Junction-6	2.219	88	04Sep2013, 13:15	32.7
Reach-6	2.219	87.6	04Sep2013, 13:30	32.4
Lower3 Bluestone	0.425	34.2	04Sep2013, 12:35	7.3
Downstream	2.644	104.1	04Sep2013, 13:25	39.7

SECTION 4

HEC-RAS In-Line Structure Analysis Report and Sections

HEC-RAS Version 4.1.0 Jan 2010
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

****

PROJECT DATA
Project Title: OXF 157-159 Bridges
Project File : OXF157-159Bridges.prj
Run Date and Time: 5/29/2014 2:49:29 PM

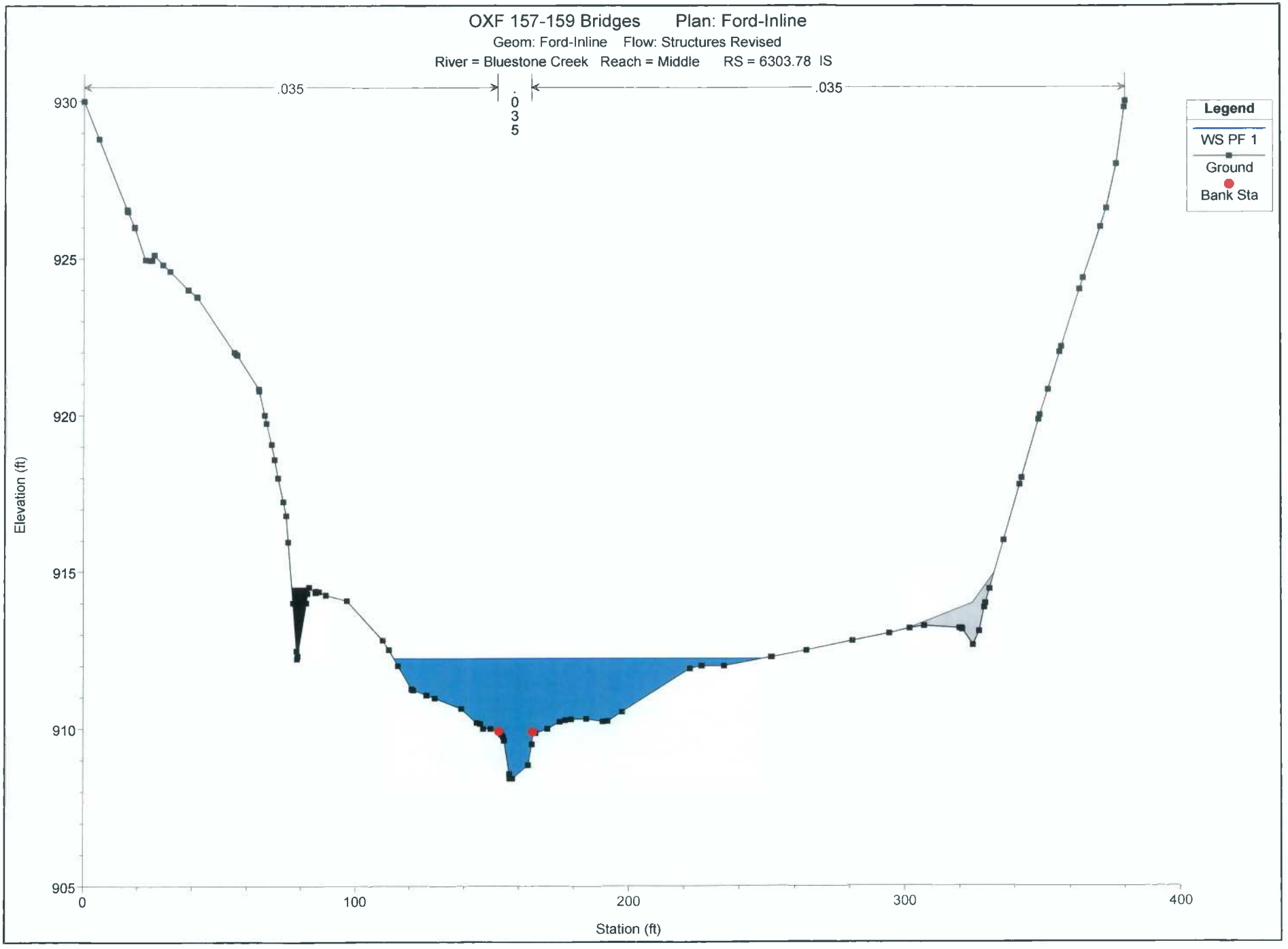
Project in English units

INLINE STRUCTURE

RIVER: Bluestone Creek
REACH: Middle RS: 6303.78

INLINE STRUCTURE OUTPUT Profile #PF 1 Inl Struct:

E.G. Elev (ft)	912.64	Q Gates (cfs)		
W.S. Elev (ft)	912.23	Q Gate Group (cfs)	0.00	
Q Total (cfs)	855.60	Gate Open Ht (ft)	912.12	
Q Weir (cfs)	855.60	Gate #Open		
Weir Flow Area (sq ft)	250.62	Gate Area (sq ft)	1.00	
Weir Sta Lft (ft)	111.67	Gate Submerg	0.00	
Weir Sta Rgt (ft)	272.65	Gate Invert (ft)	0.00	
Weir Max Depth (ft)	4.23	Gate Weir Coef	0.000	
Weir Avg Depth (ft)	1.56			
Weir Coef (ft^1/2)	2.600	Q Breach (cfs)		
Weir Submerg	0.82	Breach Avg Velocity (ft/s)		
Min El Weir Flow (ft)	908.42	Breach Flow Area (sq ft)		
Wr Top Wdth (ft)	160.97			

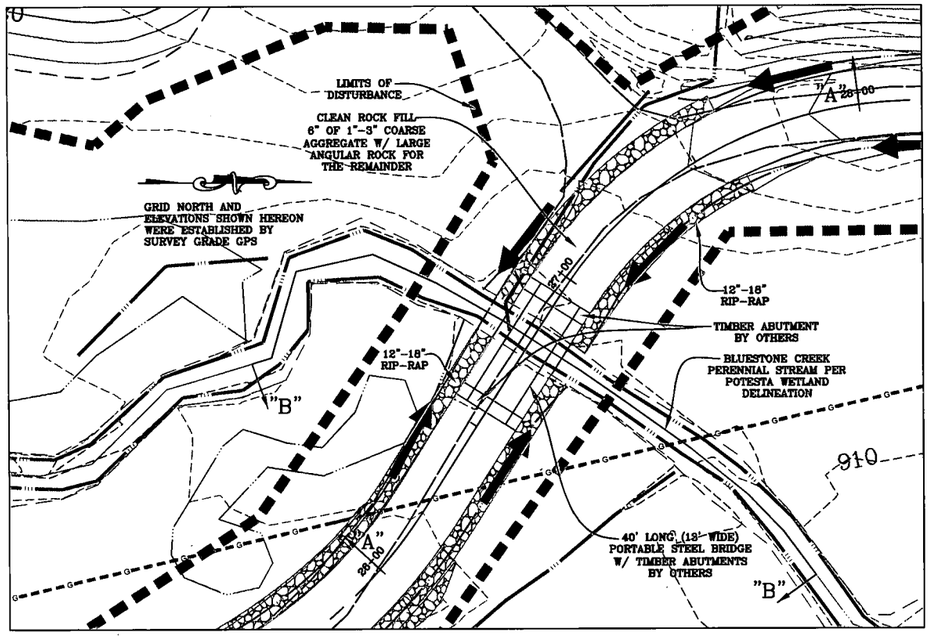

OXF 157-159 Bridges Plan: Ford-Inline
Geom: Ford-Inline Flow: Structures Revised
River = Bluestone Creek Reach = Middle RS = 6303.78 IS
.035
.035
.035
Legend
WS PF 1
Ground
Bank Sta
930
925
920
915
910
905
Elevation (ft)
0
100
200
300
400
Station (ft)

SECTION 5

Stream Crossing "D" Details

TEMPORARY STREAM CROSSING DETAILS

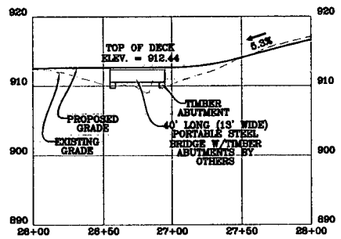
STREAM CROSSING "D" DETAILS



20 10 0 20 40

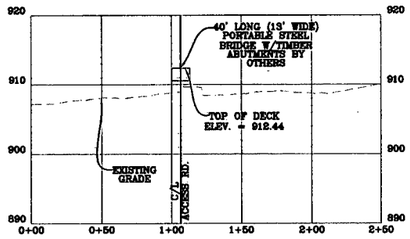
SCALE: 1" = 20'

STREAM CROSSING "D" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

GENERAL TEMPORARY STREAM CROSSING NOTES:

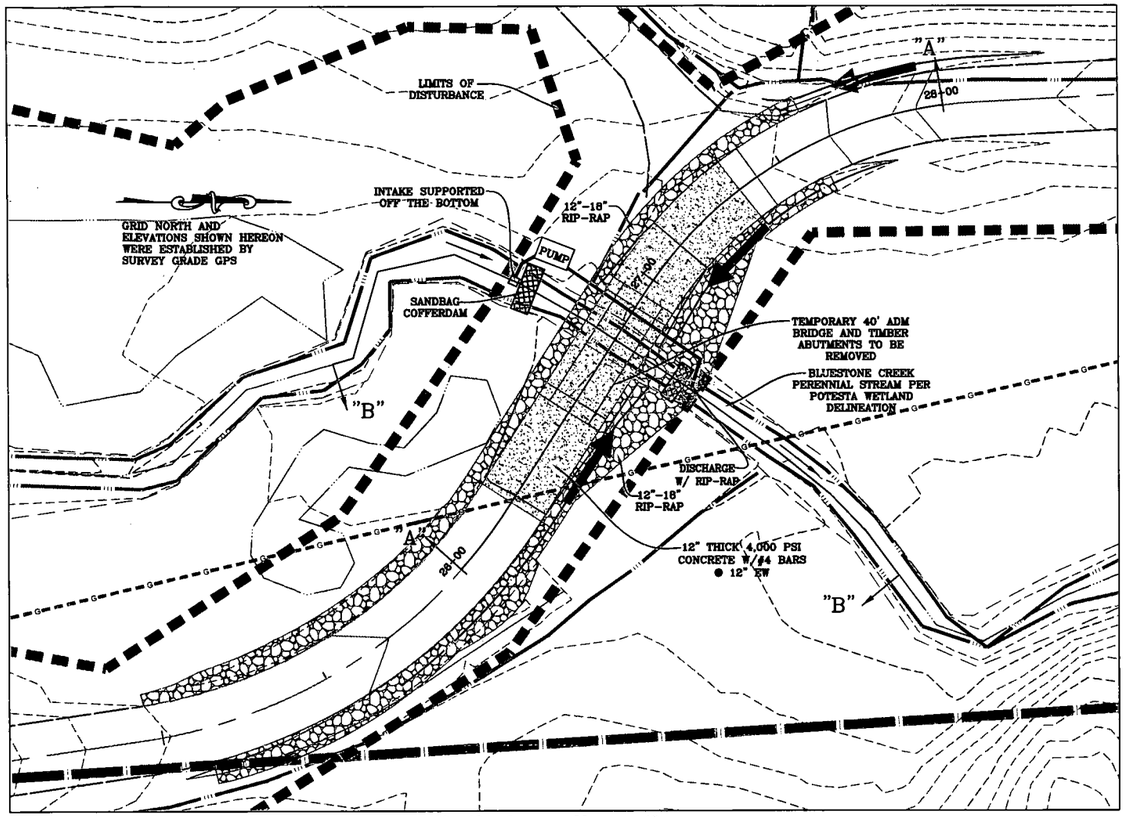
1) DO NOT USE ERODIBLE MATERIAL FOR CONSTRUCTION OF THE CROSSING.
2) CLEARING AND EXCAVATION OF THE STREAM BANKS SHALL BE KEPT TO A MINIMUM.
3) APPROPRIATE PERIMETER CONTROLS SUCH AS COMPOST FILTER SOCK, SUPER SILT FENCE AND/OR SEDIMENT TRAPS SHALL BE EMPLOYED ALONG THE BANKS AND PARALLEL TO THE STREAMBED.
4) TIMBER ABUTMENTS FOR THE BRIDGE INSTALLATION SHALL BE INSTALLED TO REDUCE STRUCTURAL DAMAGE DURING HIGH VELOCITY WATER OVERFLOW PERIODS.
5) STREAMBED MATERIAL IS NOT TO BE USED AS FILL.
6) DURING ROUTINE MAINTENANCE DO NOT GRADE MUD AND DEBRIS OVER THE SIDES OF THE CROSSING INTO THE STREAM.
7) THE TEMPORARY BRIDGE SHALL BE ANCHORED AS REQUIRED PER THE DODDRIDGE COUNTY FLOODPLAIN ORDINANCE.

NOTE:

1) SEE SHEET 21 FOR PUMP AROUND NOTES AND DETAILS
2) SEE STREAM CROSSING REPORT BY NAVITUS ENGINEERING FOR CULVERT AND DRAINAGE COMPUTATATIONS.
3) EQT SHALL OBTAIN A STREAM ACTIVITY PERMIT THROUGH THE PUBLIC LAND CORPORATION OFFICE OF LAND AND STREAMS FOR STREAM CROSSING "D".

PERMANENT STREAM CROSSING DETAILS

STREAM CROSSING "D" DETAILS



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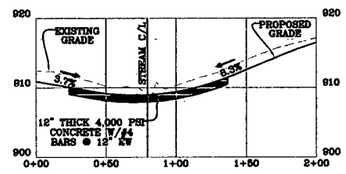
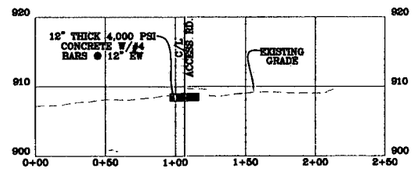
SCALE: 1" = 20'

STREAM CROSSING "D" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

GENERAL STREAM CROSSING NOTES:

1) CLEARING AND EXCAVATION OF THE STREAMBED AND BANKS SHALL BE KEPT TO A MINIMUM.
2) STREAM BED WILL BE MONITORED DURING CONSTRUCTION, ALL GROUNDWATER SEEPAGE NEEDS TO REMOVED PRIOR TO STRUCTURAL BASE MATERIAL AND CONCRETE BEING EMPLACED.
3) SOIL BEARING CAPACITY TO BE FIELD VERIFIED PRIOR TO CONSTRUCTION, MINIMUM SOIL BEARING CAPACITY IS 4,000 PSF.
4) IF UNSUITABLE MATERIAL IS ENCOUNTERED DURING CONSTRUCTION, THE MATERIAL IS TO BE REMOVED, AND ADDITIONAL 3/4"-1" STONE IS TO BE EMPLACED.
5) FILTER CLOTH SHALL BE PLACED ON THE STREAMBED AND STREAM BANKS PRIOR TO PLACEMENT OF THE CONCRETE AND AGGREGATE. THE FILTER CLOTH SHALL COVER THE STREAMBED AND EXTEND A MINIMUM OF SIX INCHES AND A MAXIMUM OF ONE FOOT BEYOND THE END OF THE FORD AND BEDDING MATERIAL.
6) A PUMP AROUND SYSTEM SHALL BE CONSTRUCTED ACROSS THE ROADWAY ON EITHER SIDE OF THE STREAM CROSSING AS DIRECTED DURING CROSSING CONSTRUCTION.
10) AT NO POINT DURING CONSTRUCTION SHALL THE CONCRETE FORD BE EXPOSED TO THE NORMAL FLOW OF THE STREAM, ONLY UNTIL AFTER THE CONCRETE HAS HARDENED AND CURED SHALL THE PUMP AROUND SYSTEM BE REMOVED AND NORMAL FLOW RESTORED.
11) APPROPRIATE PERIMETER CONTROLS SUCH AS COMPOST FILTER SOCK, SUPER SILT FENCE AND/OR SEDIMENT TRAPS SHALL BE EMPLOYED ALONG THE BANKS AND PARALLEL TO THE STREAMBED.
12) STREAMBED MATERIAL IS NOT TO BE USED AS FILL.
13) DURING ROUTINE MAINTENANCE DO NOT GRADE MUD AND DEBRIS OVER THE SIDES OF THE CROSSING INTO THE STREAM.
14) THE CROSSING MUST BE INSPECTED AFTER EVERY RAIN EVENT OF 0.5 INCHES OR MORE AND ONCE A WEEK TO ENSURE THAT THE FORD, STREAMBED, AND STREAM BANKS ARE MAINTAINED AND NOT DAMAGED. NEVER ALLOW THE FORD TO BECOME CLOGGED WITH DEBRIS AND REMOVE ANY OBSTRUCTIONS IMMEDIATELY.
15) GEOTEXTILE FABRIC SHALL MEETS THE TENSILE STRENGTH REQUIREMENTS OF 180 LBS PER ASTM D 4632, MULLEN BURSTING REQUIREMENTS OF 320 PSI PER ASTM D 3786, AND PUNCTURE TEST REQUIREMENTS OF 80 LBS PER ASTM D 4833.
16) ACCESS ROAD DITCHES SHALL BE MAINTAINED AND EXCAVATED AS NECESSARY FOR THE EMPLACEMENT OF RIP-RAP ARMORING.
17) CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4,000 PSI AT 28 DAYS.
18) STORM RUNOFF MAY DEPOSIT DEBRIS AT THE CROSSING LOCATION WHICH WILL NEED TO BE REMOVED.

NAVITUS ENERGY ENGINEERING
Telephone: (888) 662-4185 | www.NavitusEng.com

Professional Energy Consultants
A DIVISION OF SMITH LAND SURVEYING, INC.
SURVEYORS ENGINEERS ENVIRONMENTAL PROJECT MGMT.
SLS
(304) 462-5634
WWW.SLSSURVEYS.COM

COMMONWEALTH OF VIRGINIA
No. 11709
PROFESSIONAL ENGINEER

THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

MAJOR STREAM CROSSING DETAILS

OXF 157

WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013

SCALE: N/A

DESIGNED BY: CSK

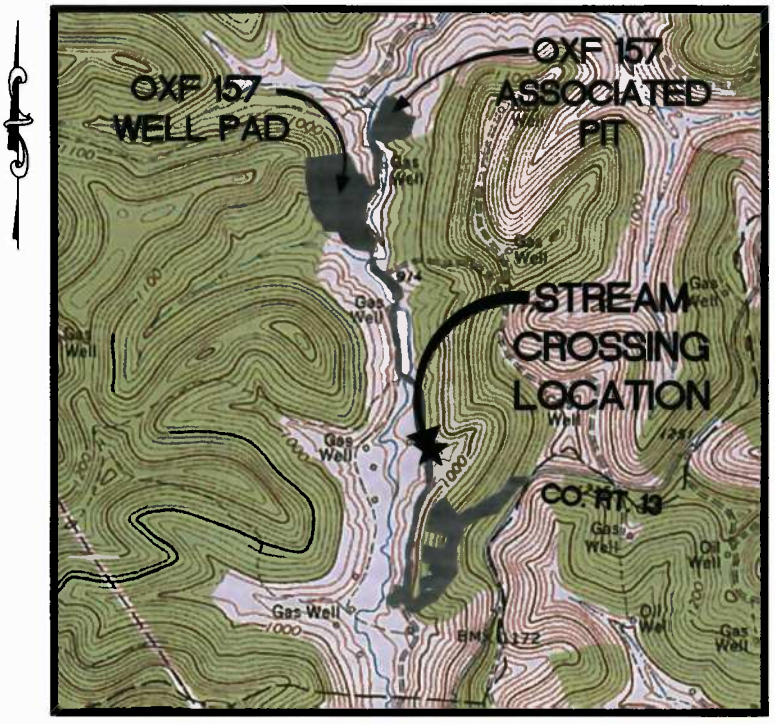
FILE NO. 7889

SHEET 24 OF 32

REV: 06/03/2014

STREAM CROSSING "E"
STORMWATER COMPUTATIONS

OXF 157 WELL PAD



VICINITY MAP
1" = 2,000'

NAVITUS
ENERGY ENGINEERING
Telephone: (888) 662-4185 | www.NavitusEng.com

Prepared For:
EQT Production Company
115 Professional Place
P.O. Box 280
Bridgeport, WV 26330

Contact:
Victoria J. Roark
Permitting Supervisor
(304) 848-0076

Designed By:
Navitus Engineering Inc.

Project Manager:
Chandler Pearson
cpearson@navituseng.com

MARK O. SMITH
REG. No. 11709
WEST VIRGINIA
PROFESSIONAL ENGINEER

Date: June 3, 2014

Surface Owner (s)
Justin L. Henderson

Tax Parcel:
Map 6 Parcel 1

Location:
West Union District, Doddridge County
West Virginia

FN# 7889

OXF 157 WELL PAD

STREAM CROSSING "E"

STORMWATER COMPUTATIONS

Sections

SECTION 1

Overview

The intent of this project is to construct a gravel access road to a gas well pad site and associated facilities. This project will include a permanent stream crossing. UNT 2, which has been classified as a intermittent stream per the wetlands report conducted by Potesta Engineers and Environmental Consultants dated May 29, 2013, will be crossed at station 17+99.255 of the proposed access road.

Drainage Narrative

Using the SCS Method, we determined the 1, 10, and 100-year rainfall events at the stream crossing study point. We then used HY-8 to design the culvert and to determine the base flow water surface elevation for each rainfall event. Stream Crossing "E" has a drainage area of 33.50 Acres. Design flows are provided in the drainage calculations in Section 3.

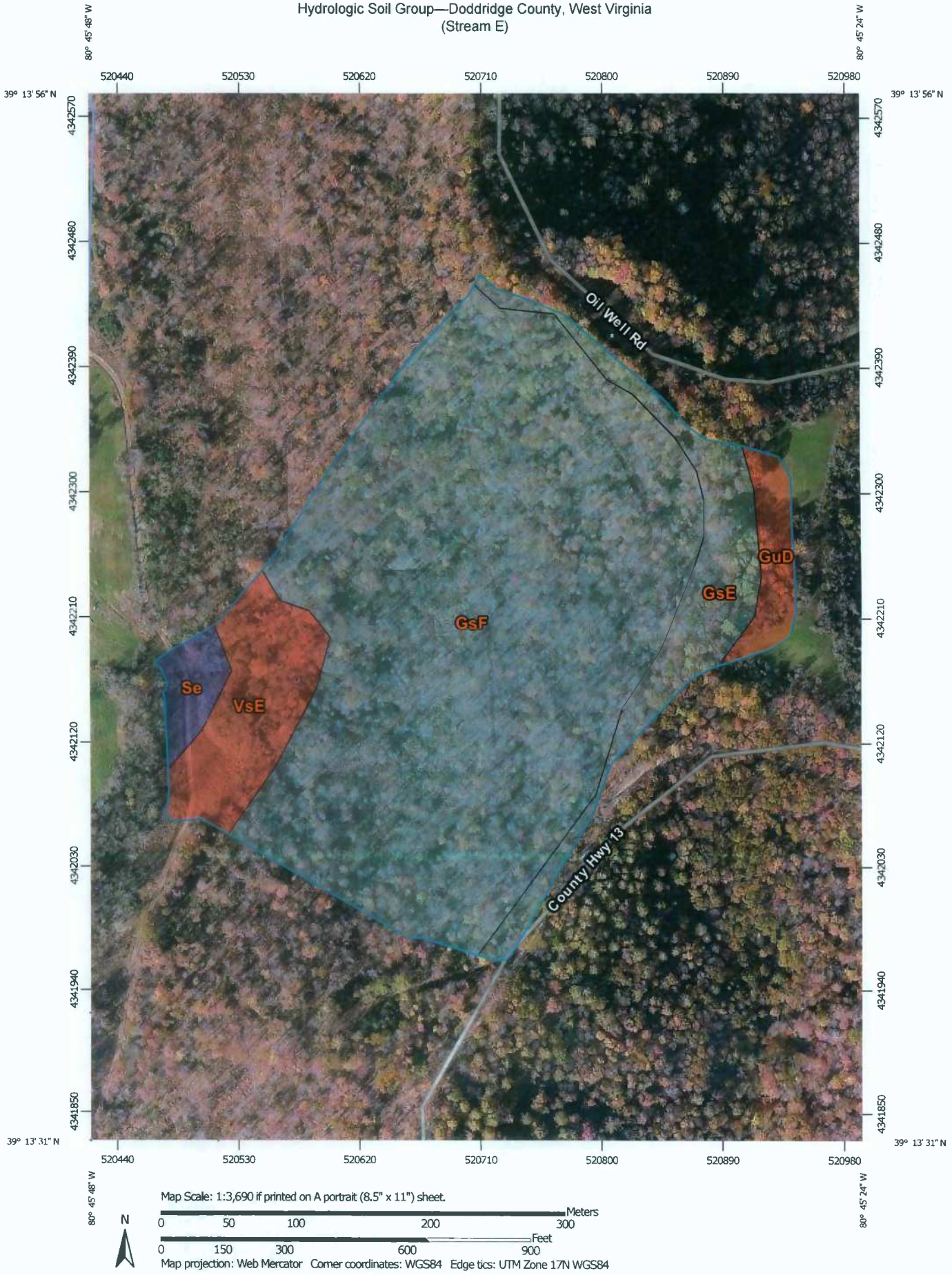
The permanent stream crossing was designed per the West Virginia Department of Environmental Protection Erosion and Sediment Control Best Management Practice Manual 2006 edition, Section 3.21-21. Per this manual, any structure that will remain in place 6 months or longer shall be large enough to convey the flow from a 10-year frequency, 24 hour duration storm. This culvert is sized to handle the computed 10-year storm event flow of 41.59 cfs.

The stream crossing was also designed as a permanent structure in accordance with the U.S. Army Corps of Engineering Nationwide 14 Permit. The structure is a 42 inch high-density polyethylene pipe culvert. The culvert is 54.00 LF with a slope of 6.15%. The stream crossing will contain clean rock fill made of 2-4" aggregate 50 feet on each side of the culvert for the first 6" of fill, the remainder of material shall be only large angular rock. No erodible material or green concrete shall be used in the crossing. The permanent stream crossing will impact 70.6' of the intermittent stream, UNT 2.

SECTION 2

NRCS Soils Report

Hydrologic Soil Group—Doddridge County, West Virginia
(Stream E)



MAP LEGEND

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

Soils

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

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

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

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: Doddridge County, West Virginia
Survey Area Data: Version 8, Apr 2, 2009

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 8, 2011—Oct 25, 2011

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Doddridge County, West Virginia (WV017)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
GsE	Gilpin-Peabody complex, 15 to 35 percent slopes, very stony	C	3.3	10.0%
GsF	Gilpin-Peabody complex, 35 to 70 percent slopes, very stony	C	25.5	76.2%
GuD	Gilpin-Upshur complex, 15 to 25 percent slopes	D	1.0	3.1%
Se	Sensabaugh silt loam	B	0.8	2.3%
VsE	Vandalia silt loam, 15 to 35 percent slopes, very stony	D	2.9	8.5%
Totals for Area of Interest			**33.5**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

SECTION 3

SCS TR-55
Drainage Computations

Runoff Curve Number (CN)

Cover Description	CN	Soil Group	Area (Acre)
Meadow (Good)	58	B	0.00
Meadow (Good)	78	D	0.00
Woods (Good)	55	B	0.80
Woods (Good)	70	C	28.80
Woods (Good)	77	D	3.90
CN (weighted):	70		
Total Area:	33.50	Acre(s)	

Time of Concentration (SCS)

Curve Number:	70	
Length of Flow:	1744.39	ft
Average Land Slope:	22.97	%
Time of Concentration:	0.224	hrs

Runoff Hydrograph: SCS Method

Input Data:		
Drainage Area	33.50	Acre(s)
Runoff Curve Number, CN	70	
Time of Concentration	0.224	hrs
Base Flow	0.00	cfs
Antecendent Moisture Condition	Type II	
Rainfall Distribution Type	Type II	24 hr
Rainfall Depth, 1-year	2.15	in
Rainfall Depth, 10-year	3.54	in
Rainfall Depth, 100-year	5.17	in
Peak Rate Factor	484	
Computed Results, 1 year:		
Time to Peak	12.20	hrs
Peak Discharge, 1-year	8.75	cfs
Runoff Volume, 1-year	0.85	acre-ft
Computed Results, 10 year:		
Time to Peak	12.20	hrs
Peak Discharge	41.59	cfs
Runoff Volume	2.92	acre-ft
Computed Results, 100 year:		
Time to Peak	12.20	hrs
Peak Discharge	90.82	cfs
Runoff Volume	6.11	acre-ft

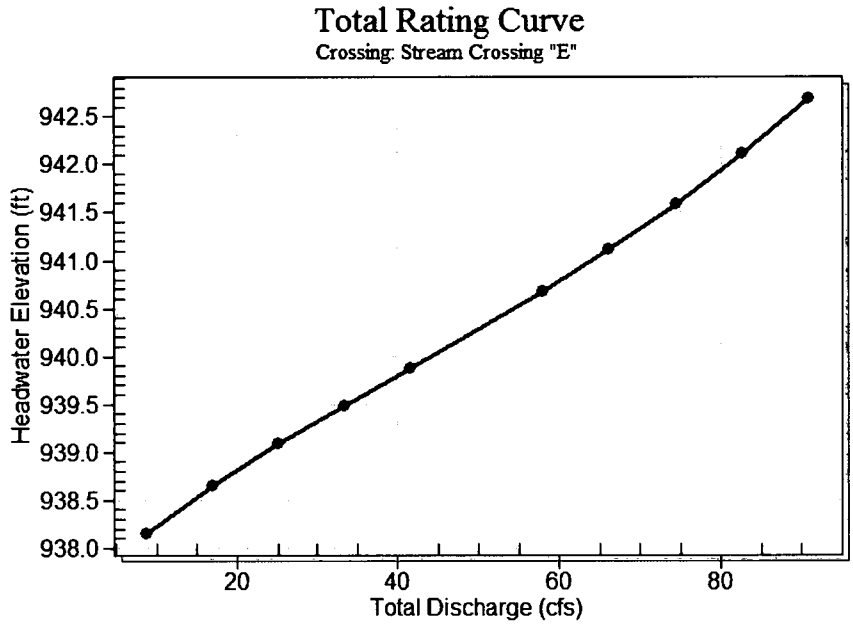
SECTION 4

HY-8 Culvert Analysis Report and Sections

HY-8 Culvert Analysis Report

Headwater Elevation (ft)	Total Discharge (cfs)	Stream Crossing E Discharge (cfs)	Roadway Discharge (cfs)	Iterations
938.16	8.75	8.75	0.00	1
938.65	16.96	16.96	0.00	1
939.08	25.16	25.16	0.00	1
939.49	33.37	33.37	0.00	1
939.87	41.58	41.58	0.00	1
939.87	41.59	41.59	0.00	1
940.67	57.99	57.99	0.00	1
941.11	66.20	66.20	0.00	1
941.59	74.41	74.41	0.00	1
942.11	82.61	82.61	0.00	1
942.69	90.82	90.82	0.00	1
943.92	105.98	105.98	0.00	Overtopping

Table 1 - Summary of Culvert Flows at Crossing: Stream Crossing "E"



Rating Curve Plot for Crossing: Stream Crossing "E"

Table 2 - Culvert Summary Table: Stream Crossing "E"

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
8.75	8.75	938.16	1.157	0.0*	1-S2n	0.580	0.877	0.587	0.573	8.031	5.548
16.96	16.96	938.65	1.648	0.0*	1-S2n	0.822	1.246	0.836	0.754	9.526	6.689
25.16	25.16	939.08	2.083	0.0*	1-S2n	1.018	1.535	1.025	0.891	10.701	7.452
33.37	33.37	939.49	2.486	0.0*	1-S2n	1.176	1.786	1.176	1.005	11.721	8.039
41.58	41.58	939.87	2.873	0.0*	1-S2n	1.326	2.001	1.333	1.103	12.336	8.522
41.59	41.59	939.87	2.874	0.0*	1-S2n	1.326	2.002	1.333	1.103	12.337	8.522
57.99	57.99	940.67	3.670	0.0*	5-S2n	1.596	2.380	1.605	1.270	13.469	9.300
66.20	66.20	941.11	4.108	0.0*	5-S2n	1.726	2.542	1.773	1.343	13.534	9.626
74.41	74.41	941.59	4.586	0.0*	5-S2n	1.851	2.691	1.907	1.411	13.887	9.923
82.61	82.61	942.11	5.113	0.0*	5-S2n	1.974	2.828	2.037	1.475	14.219	10.195
90.82	90.82	942.69	5.694	0.0*	5-S2n	2.098	2.933	2.168	1.535	14.522	10.447

* theoretical depth is impractical. Depth reported is corrected.

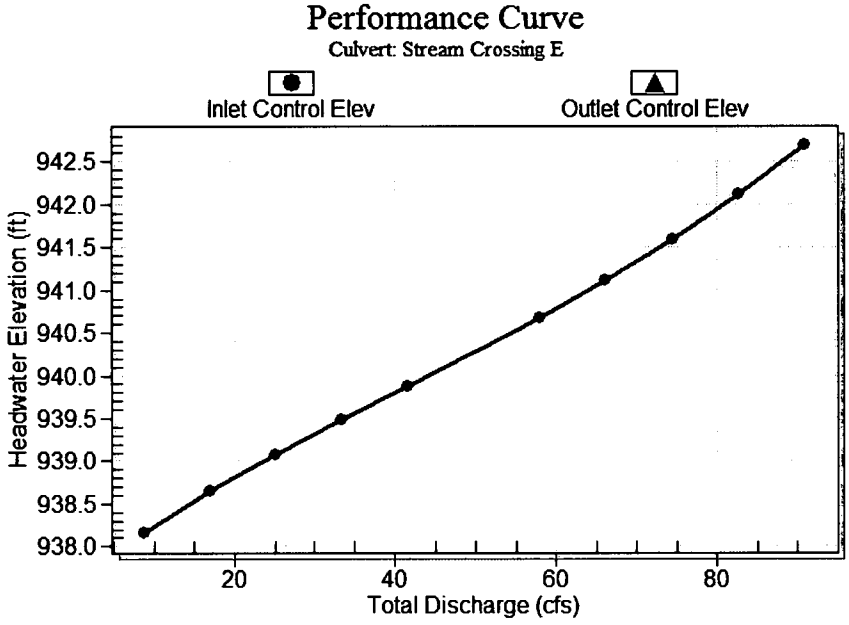
****

Inlet Elevation (invert): 937.00 ft, Outlet Elevation (invert): 933.68 ft

Culvert Length: 54.10 ft, Culvert Slope: 0.0615

****

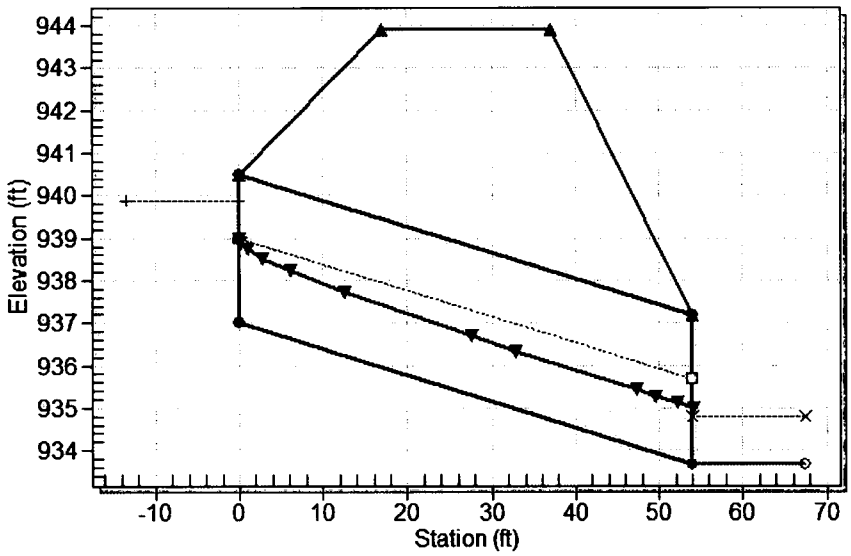
Culvert Performance Curve Plot: Stream Crossing "E"



Water Surface Profile Plot for Culvert: Stream Crossing "E"

Crossing - Stream Crossing "E" , Design Discharge - 41.6 cfs

Culvert - Stream Crossing E, Culvert Discharge - 41.6 cfs



Site Data - Stream Crossing "E"

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 937.00 ft

Outlet Station: 54.00 ft

Outlet Elevation: 933.68 ft

Number of Barrels: 1

Culvert Data Summary - Stream Crossing "E"

Barrel Shape: Circular

Barrel Diameter: 3.50 ft

Barrel Material: Corrugated PE

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Square Edge with Headwall

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: Stream Crossing "E")

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
8.75	934.25	0.57	5.55	2.79	1.70
16.96	934.43	0.75	6.69	3.67	1.78
25.16	934.57	0.89	7.45	4.34	1.82
33.37	934.68	1.00	8.04	4.89	1.86
41.58	934.78	1.10	8.52	5.37	1.88
41.59	934.78	1.10	8.52	5.37	1.88
57.99	934.95	1.27	9.30	6.18	1.92
66.20	935.02	1.34	9.63	6.54	1.94
74.41	935.09	1.41	9.92	6.87	1.95
82.61	935.15	1.47	10.19	7.18	1.96
90.82	935.21	1.53	10.45	7.47	1.98

Tailwater Channel Data - Stream Crossing "E"

Tailwater Channel Option: Irregular Channel

Channel Slope: 0.0780

User Defined Channel Cross-Section:

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	940.00	0.0350
2	5.60	938.00	0.0350
3	11.00	936.00	0.0350
4	16.70	934.00	0.0350
5	18.60	933.68	0.0350
6	20.10	934.00	0.0350
7	25.30	936.00	0.0350
8	30.40	938.00	0.0350
9	34.90	940.00	0.0000

Roadway Data for Crossing: Stream Crossing "E"

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

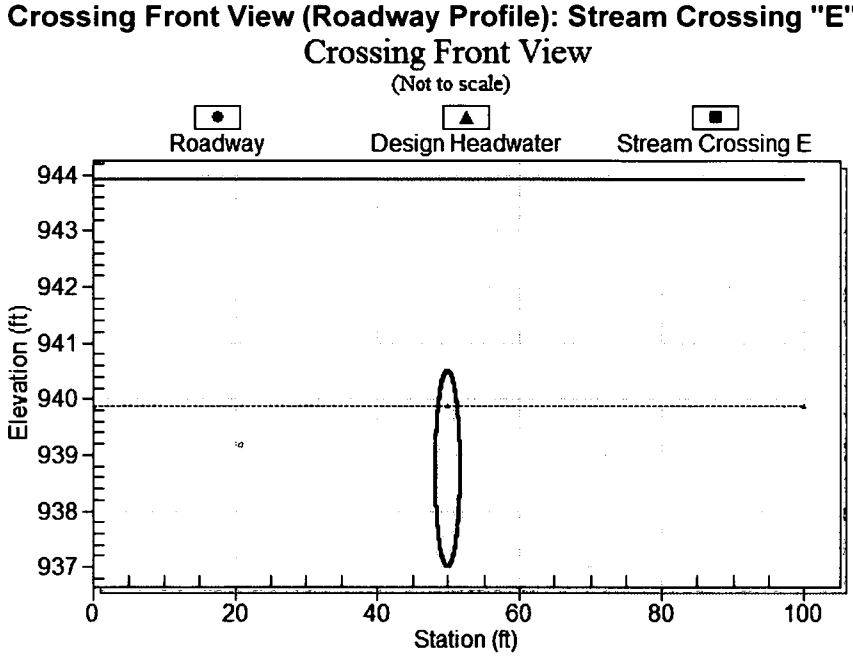
Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
0	0.00	943.92
1	50.00	943.92
2	100.00	943.92

Roadway Surface: Gravel

Roadway Top Width: 20.00 ft

Crossing Front View (Roadway Profile): Stream Crossing "E"

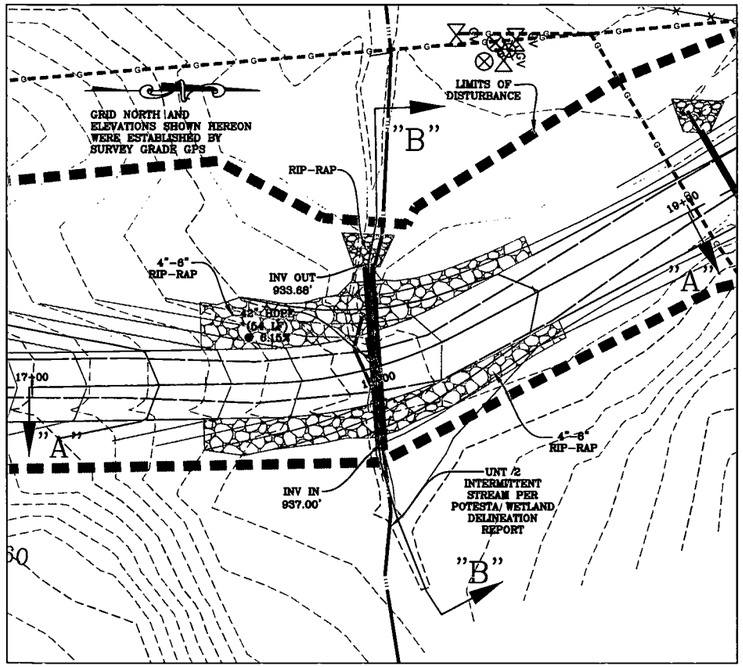


SECTION 5

Stream Crossing "E" Details

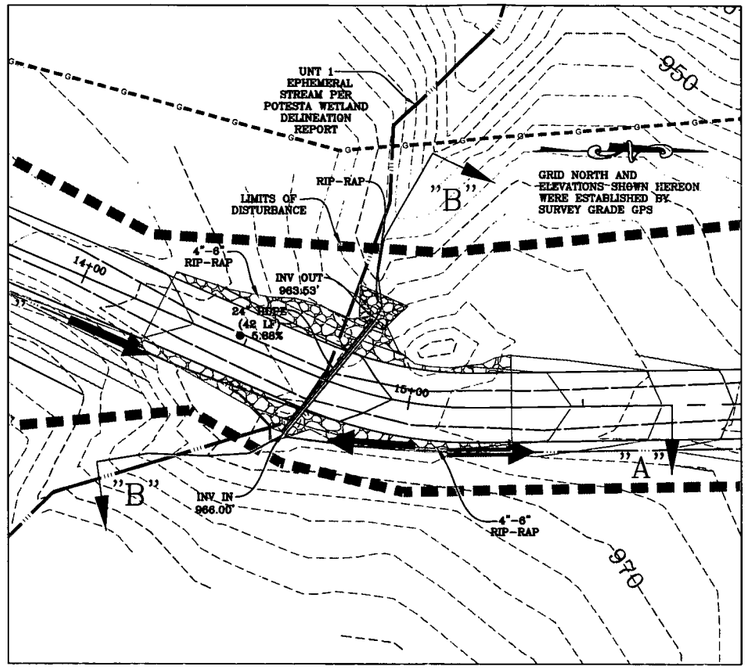
STREAM CROSSING DETAILS

STREAM CROSSING "E" DETAILS



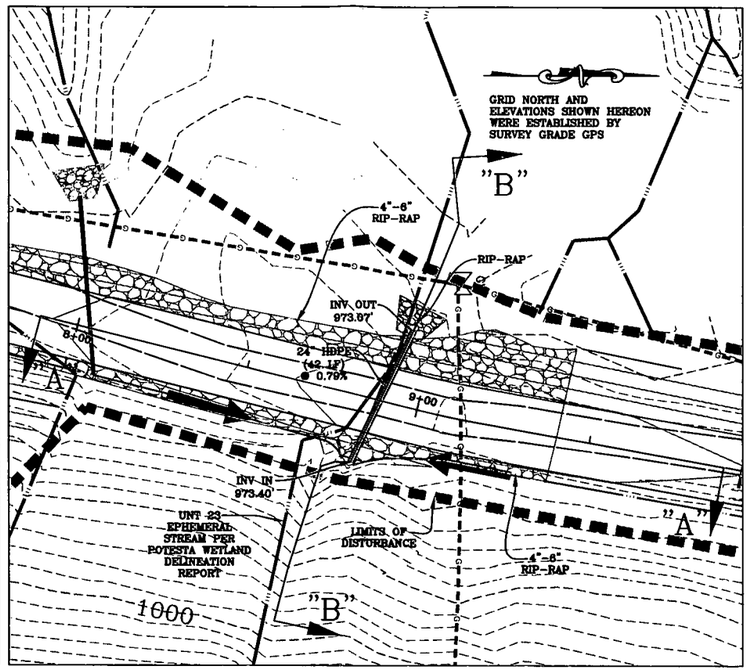
20 10 0 20 40
SCALE: 1" = 20'

STREAM CROSSING "F" DETAILS



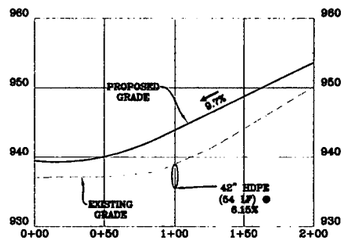
20 10 0 20 40
SCALE: 1" = 20'

STREAM CROSSING "G" DETAILS

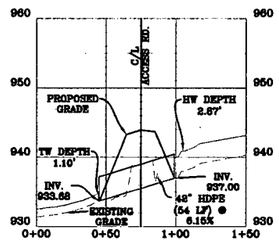


20 10 0 20 40
SCALE: 1" = 20'

STREAM CROSSING "E" SECTIONS

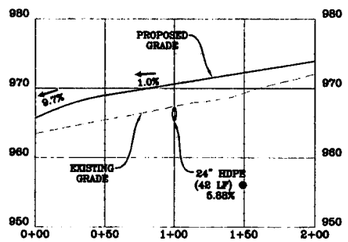


CROSS SECTION "A-A"
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

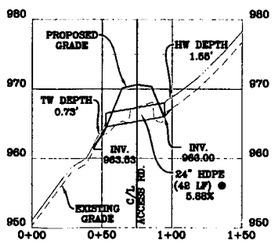


CROSS SECTION "B-B"
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

STREAM CROSSING "F" SECTIONS

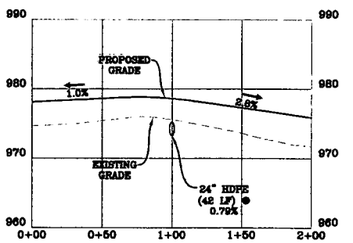


CROSS SECTION "A-A"
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

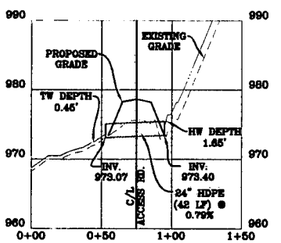


CROSS SECTION "B-B"
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

STREAM CROSSING "G" SECTIONS



CROSS SECTION "A-A"
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

GENERAL STREAM CROSSING NOTES:

1) IF MULTIPLE CULVERTS ARE USED, THEY SHALL BE SEPARATED BY AT LEAST 12 INCHES OF COMPACTED AGGREGATE FILL.
2) CLEARING AND EXCAVATION OF THE STREAMBED AND BANKS SHALL BE KEPT TO A MINIMUM.
3) FILTER CLOTH SHALL BE PLACED ON THE STREAMBED AND STREAMBANKS PRIOR TO PLACEMENT OF THE PIPE CULVERTS AND AGGREGATE. THE FILTER CLOTH SHALL COVER THE STREAMBED AND EXTEND A MINIMUM OF SIX INCHES AND A MAXIMUM OF ONE FOOT BEYOND THE END OF THE CULVERTS AND BEDDING MATERIAL.
4) A WATER DIVERTING SWALE SHALL BE CONSTRUCTED ACROSS THE ROADWAY ON EITHER SIDE OF THE STREAM CROSSING.
5) APPROPRIATE PERIMETER CONTROLS SUCH AS COMPOST FILTER SOCK, SUPER SILT FENCE AND/OR SEDIMENT TRAPS SHALL BE EMPLOYED ALONG THE BANKS AND PARALLEL TO THE STREAMBED.
6) CROSS CRIBBING OF THE DOWNSTREAM SIDE OF THE CULVERT INSTALLATIONS MAY BE NEEDED TO AID IN REDUCING STRUCTURAL DAMAGE DURING HIGH VELOCITY WATER OVERFLOW PERIODS.
7) STREAMBED MATERIAL IS NOT TO BE USED AS FILL.
8) GREEN CONCRETE SHALL NOT BE PLACED IN CONTACT WITH FLOWING WATER.
9) WHEN THE CROSSING HAS SERVED ITS PURPOSE, ALL STRUCTURES INCLUDING CULVERTS, BEDDING, AND FILTER CLOTH SHALL BE REMOVED. REMOVAL OF THE STRUCTURE AND CLEAN UP OF THE AREA SHOULD BE ACCOMPLISHED WITHOUT CONSTRUCTION EQUIPMENT WORKING IN THE WATERWAY CHANNEL. UPON REMOVAL OF THE STRUCTURE, THE STREAM BANK SHALL IMMEDIATELY BE STABILIZED.
10) DURING ROUTINE MAINTENANCE DO NOT GRADE MUD AND DEBRIS OVER THE SIDES OF THE CROSSING INTO THE STREAM.
11) THE CROSSING MUST BE INSPECTED AFTER EVERY RAIN EVENT OF 0.5 INCHES OR MORE AND ONCE A WEEK TO ENSURE THAT THE CULVERTS, STREAMBED, AND STREAM BANKS ARE MAINTAINED AND NOT DAMAGED. NEVER ALLOW THE CULVERTS TO BECOME CLOGGED WITH DEBRIS AND REMOVE ANY OBSTRUCTIONS IMMEDIATELY.
12) FLUSHING IS NOT AN APPROVED METHOD TO BE UTILIZED FOR CULVERT CLEANOUT.

NOTE:

1) SEE STREAM CROSSING REPORT BY NAVITUS ENGINEERING FOR CULVERT AND DRAINAGE COMPUTATATIONS.
2) EQT SHALL OBTAIN A STREAM ACTIVITY PERMIT THROUGH THE PUBLIC LAND CORPORATION OFFICE OF LAND AND STREAMS FOR STREAM CROSSING "E", "F" & "G".

NAVITUS ENERGY ENGINEERING
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Professional Energy Consultants
A DIVISION OF SMITHLAND SURVEYING, INC.
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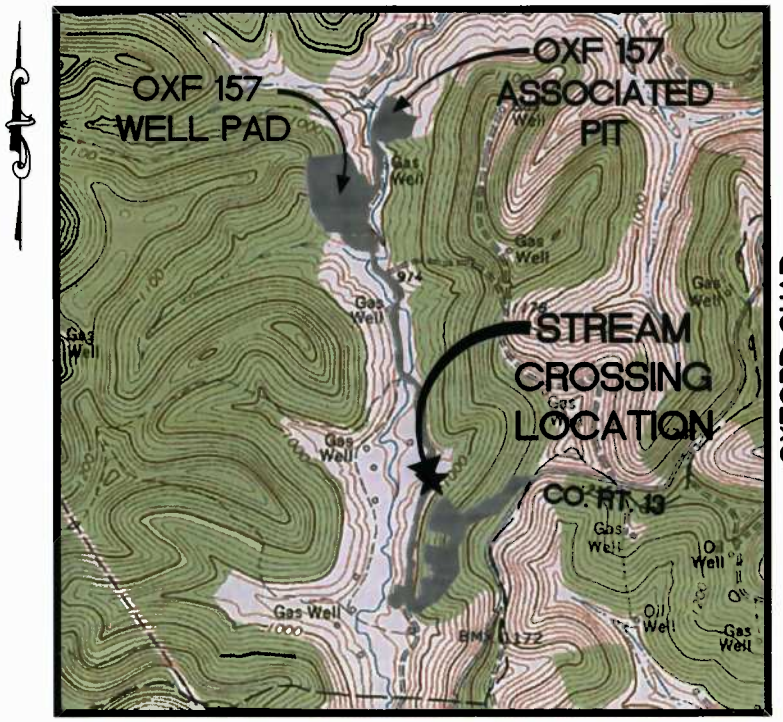
THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC.
FOR: EQT PRODUCTION COMPANY

MINOR STREAM CROSSING DETAILS
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013	
SCALE: N/A	
DESIGNED BY: CSK	
FILE NO. 7889	
SHEET 25 OF 32	
REV: 06/03/2014	

STREAM CROSSING "F"
STORMWATER COMPUTATIONS
OXF 157 WELL PAD



VICINITY MAP
1" = 2,000'

NAVITUS
ENERGY ENGINEERING
Telephone: (888) 662-4185 | www.NavitusEng.com

Prepared For:
EQT Production Company
115 Professional Place
P.O. Box 280
Bridgeport, WV 26330

Contact:
Victoria J. Roark
Permitting Supervisor
(304) 848-0076

Designed By:
Navitus Engineering Inc.

Project Manager:
Chandler Pearson
cpearson@navituseng.com

Date: June 3, 2014

Surface Owner (s)
Justin L. Henderson

Tax Parcel:
Map 6 Parcel 1

Location:
West Union District, Doddridge County
West Virginia

FN# 7889

OXF 157 WELL PAD

STREAM CROSSING "F"

STORMWATER COMPUTATIONS

Sections

SECTION 1

Overview

The intent of this project is to construct a gravel access road to a gas well pad site and associated facilities. This project will include a permanent stream crossing. UNT 1, which has been classified as a ephemeral stream per the wetlands report conducted by Potesta Engineers and Environmental Consultants dated May 29, 2013, will be crossed at station 14+75.465 of the proposed access road.

Drainage Narrative

Using the SCS Method, we determined the 1, 10, and 100-year rainfall events at the stream crossing study point. We then used HY-8 to design the culvert and to determine the base flow water surface elevation for each rainfall event. Stream Crossing "F" has a drainage area of 5.10 Acres. Design flows are provided in the drainage calculations in Section 3.

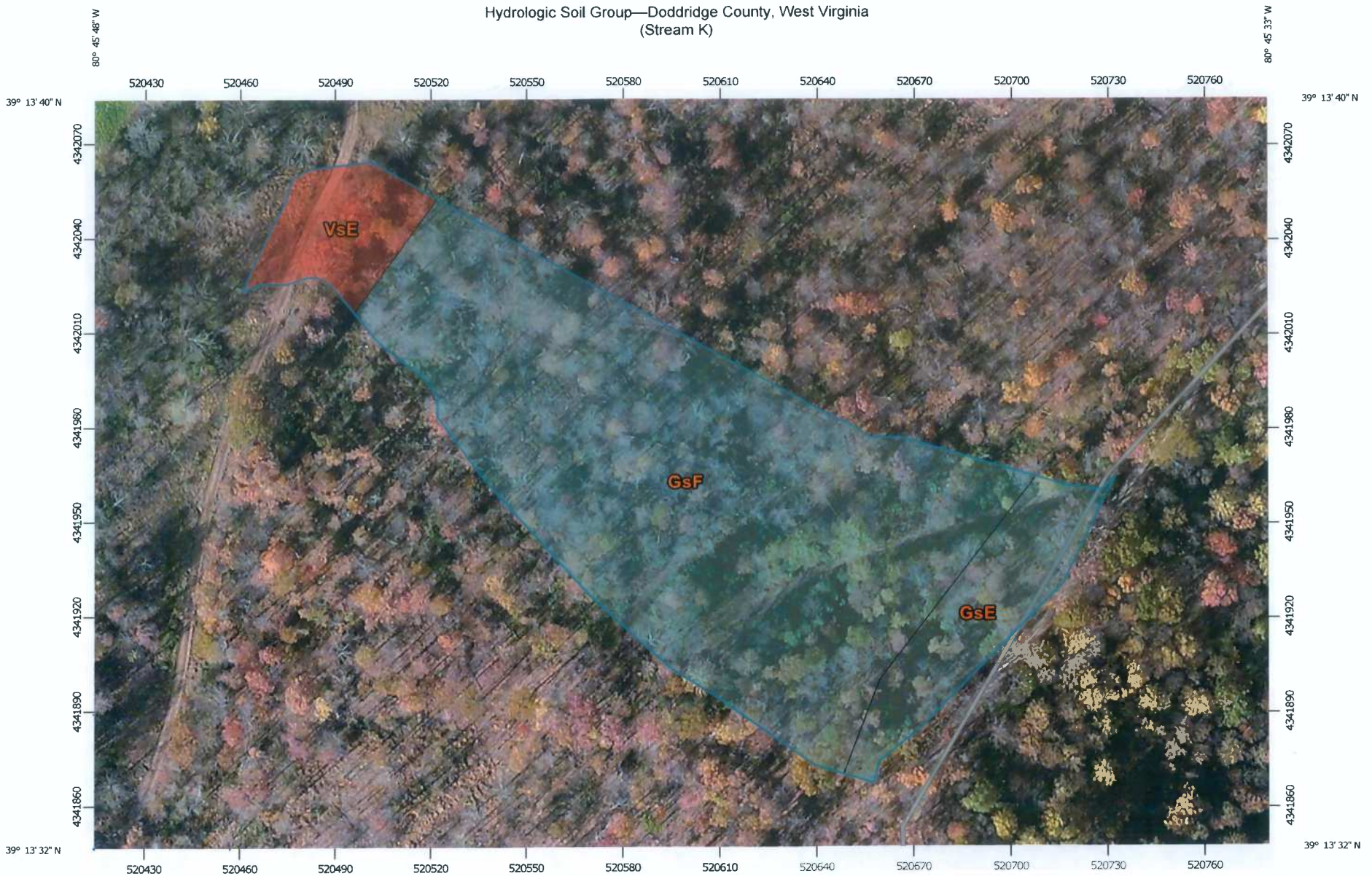
The permanent stream crossing was designed per the West Virginia Department of Environmental Protection Erosion and Sediment Control Best Management Practice Manual 2006 edition, Section 3.21-21. Per this manual, any structure that will remain in place 6 months or longer shall be large enough to convey the flow from a 10-year frequency, 24 hour duration storm. This culvert is sized to handle the computed 10-year storm event flow of 8.23 cfs.

The stream crossing was also designed as a permanent structure in accordance with the U.S. Army Corps of Engineering Nationwide 14 Permit. The structure is a 24 inch high-density polyethylene pipe culvert. The culvert is 42.00 LF with a slope of 5.88%. The stream crossing will contain clean rock fill made of 2-4" aggregate 50 feet on each side of the culvert for the first 6" of fill, the remainder of material shall be only large angular rock. No erodible material or green concrete shall be used in the crossing. The permanent stream crossing will impact 72.3' of the ephemeral stream, UNT 1.

SECTION 2

NRCS Soils Report

Hydrologic Soil Group—Doddridge County, West Virginia
(Stream K)



MAP LEGEND

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

Soils

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

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

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

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: Doddridge County, West Virginia
Survey Area Data: Version 8, Apr 2, 2009

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 8, 2011—Oct 25, 2011

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Doddridge County, West Virginia (WV017)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
GsE	Gilpin-Peabody complex, 15 to 35 percent slopes, very stony	C	0.6	11.9%
GsF	Gilpin-Peabody complex, 35 to 70 percent slopes, very stony	C	4.1	80.2%
VsE	Vandalia silt loam, 15 to 35 percent slopes, very stony	D	0.4	8.0%
Totals for Area of Interest			**5.1**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

SECTION 3

SCS TR-55
Drainage Computations

Runoff Curve Number (CN)

Cover Description	CN	Soil Group	Area (Acre)
Meadow (Good)	58	B	0.00
Meadow (Good)	78	D	0.00
Woods (Good)	55	B	0.00
Woods (Good)	70	C	4.70
Woods (Good)	77	D	0.40
CN (weighted):	71		
Total Area:	5.10	Acre(s)	

Time of Concentration (SCS)

Curve Number:	71	
Length of Flow:	1005.41	ft
Average Land Slope:	30.14	%
Time of Concentration:	0.126	hrs

Runoff Hydrograph: SCS Method

Input Data:		
Drainage Area	5.10	Acre(s)
Runoff Curve Number, CN	71	
Time of Concentration	0.126	hrs
Base Flow	0.00	cfs
Antecendent Moisture Condition	Type II	
Rainfall Distribution Type	Type II	24 hr
Rainfall Depth, 1-year	2.15	in
Rainfall Depth, 10-year	3.54	in
Rainfall Depth, 100-year	5.17	in
Peak Rate Factor	484	

Computed Results, 1 year:		
Time to Peak	12.20	hrs
Peak Discharge, 1-year	2.25	cfs
Runoff Volume, 1-year	0.14	acre-ft

Computed Results, 10 year:		
Time to Peak	12.20	hrs
Peak Discharge	8.23	cfs
Runoff Volume	0.46	acre-ft

Computed Results, 100 year:		
Time to Peak	12.20	hrs
Peak Discharge	16.75	cfs
Runoff Volume	0.95	acre-ft

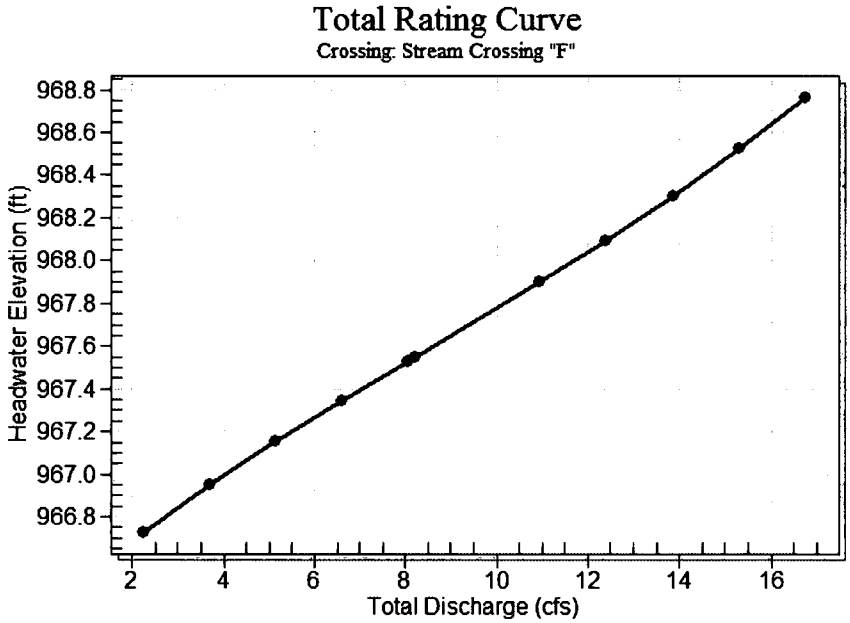
SECTION 4

HY-8 Culvert Analysis Report and Sections

HY-8 Culvert Analysis Report

Headwater Elevation (ft)	Total Discharge (cfs)	Stream Crossing F Discharge (cfs)	Roadway Discharge (cfs)	Iterations
966.73	2.25	2.25	0.00	1
966.95	3.70	3.70	0.00	1
967.15	5.15	5.15	0.00	1
967.34	6.60	6.60	0.00	1
967.53	8.05	8.05	0.00	1
967.55	8.23	8.23	0.00	1
967.90	10.95	10.95	0.00	1
968.09	12.40	12.40	0.00	1
968.30	13.85	13.85	0.00	1
968.52	15.30	15.30	0.00	1
968.77	16.75	16.75	0.00	1
970.64	25.08	25.08	0.00	Overtopping

Table 1 - Summary of Culvert Flows at Crossing: Stream Crossing "F"



Rating Curve Plot for Crossing: Stream Crossing "F"

Table 2 - Culvert Summary Table: Stream Crossing "F"

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
2.25	2.25	966.73	0.729	0.0*	1-S2n	0.364	0.512	0.371	0.447	5.533	6.872
3.70	3.70	966.95	0.952	0.0*	1-S2n	0.468	0.668	0.477	0.538	6.384	7.782
5.15	5.15	967.15	1.153	0.0*	1-S2n	0.558	0.800	0.559	0.610	7.139	8.453
6.60	6.60	967.34	1.344	0.0*	1-S2n	0.637	0.905	0.644	0.669	7.592	8.994
8.05	8.05	967.53	1.528	0.0*	1-S2n	0.706	1.009	0.708	0.721	8.061	9.452
8.23	8.23	967.55	1.551	0.0*	1-S2n	0.714	1.020	0.719	0.727	8.073	9.504
10.95	10.95	967.90	1.897	0.0*	1-S2n	0.838	1.185	0.839	0.809	8.772	10.207
12.40	12.40	968.09	2.092	0.0*	5-S2n	0.897	1.262	0.901	0.847	9.024	10.530
13.85	13.85	968.30	2.300	0.0*	5-S2n	0.957	1.336	0.959	0.883	9.294	10.825
15.30	15.30	968.52	2.524	0.0*	5-S2n	1.016	1.409	1.017	0.917	9.538	11.098
16.75	16.75	968.77	2.767	0.0*	5-S2n	1.073	1.470	1.079	0.949	9.695	11.352

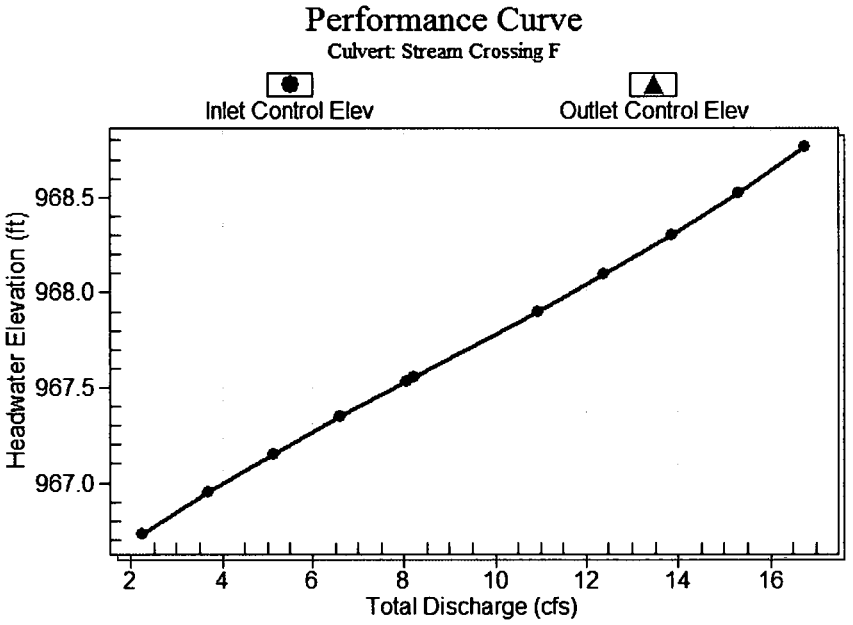
* theoretical depth is impractical. Depth reported is corrected.

****

Inlet Elevation (invert): 966.00 ft, Outlet Elevation (invert): 963.53 ft

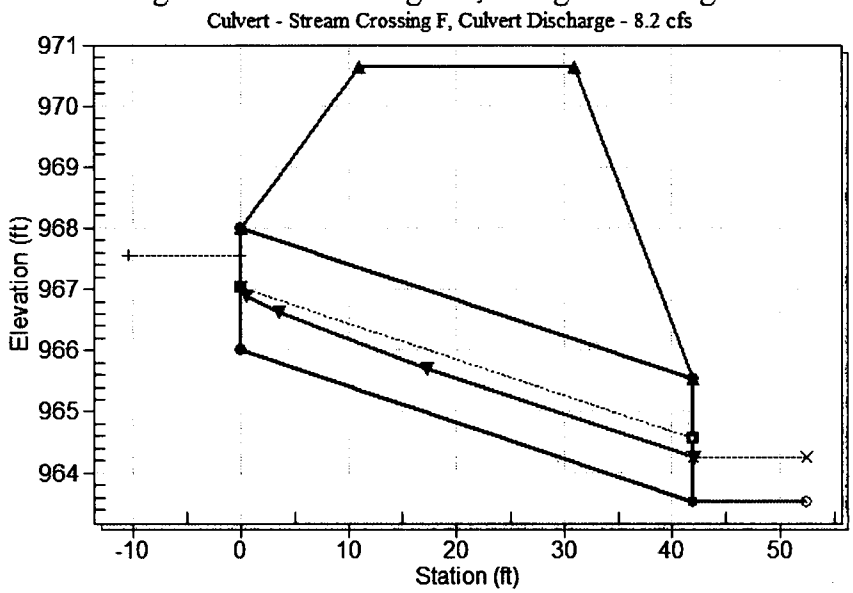
Culvert Length: 42.07 ft, Culvert Slope: 0.0588

****



Culvert Performance Curve Plot: Stream Crossing "F"

Water Surface Profile Plot for Culvert: Stream Crossing "F"



Site Data - Stream Crossing "F"

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 966.00 ft

Outlet Station: 42.00 ft

Outlet Elevation: 963.53 ft

Number of Barrels: 1

Culvert Data Summary - Stream Crossing "F"

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Corrugated PE

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Thin Edge Projecting

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: Stream Crossing "F")

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
2.25	963.98	0.45	6.87	6.66	2.56
3.70	964.07	0.54	7.78	8.03	2.64
5.15	964.14	0.61	8.45	9.09	2.70
6.60	964.20	0.67	8.99	9.98	2.74
8.05	964.25	0.72	9.45	10.75	2.77
8.23	964.26	0.73	9.50	10.84	2.78
10.95	964.34	0.81	10.21	12.06	2.83
12.40	964.38	0.85	10.53	12.64	2.85
13.85	964.41	0.88	10.82	13.17	2.87
15.30	964.45	0.92	11.10	13.68	2.89
16.75	964.48	0.95	11.35	14.15	2.90

Tailwater Channel Data - Stream Crossing "F"

Tailwater Channel Option: Irregular Channel

Channel Slope: 0.2390

User Defined Channel Cross-Section:

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	968.00	0.0350
2	5.50	966.00	0.0350
3	10.00	963.53	0.0350
4	13.60	966.00	0.0350
5	18.10	968.00	0.0350

Roadway Data for Crossing: Stream Crossing "F"

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

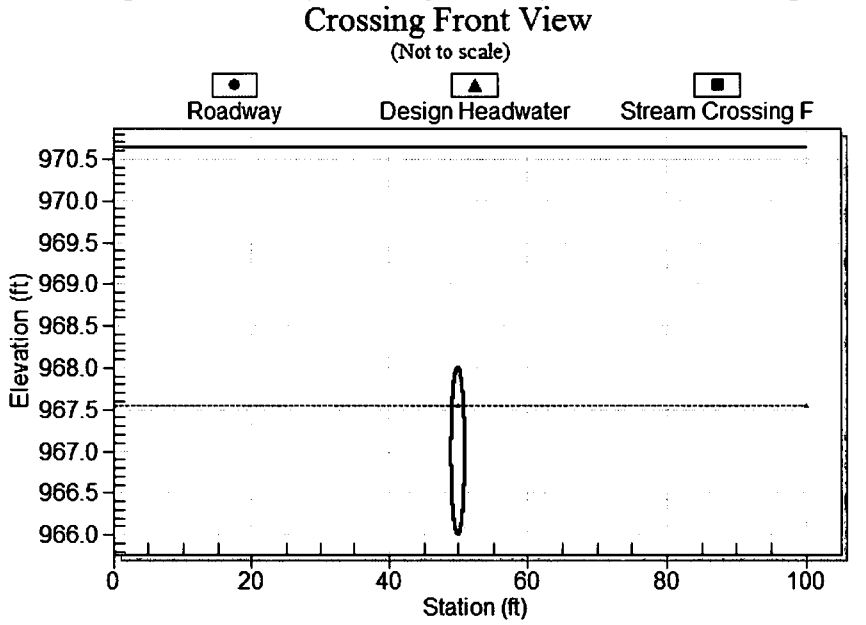
Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
0	0.00	970.64
1	50.00	970.64
2	100.00	970.64

Roadway Surface: Gravel

Roadway Top Width: 20.00 ft

Crossing Front View (Roadway Profile): Stream Crossing "F"

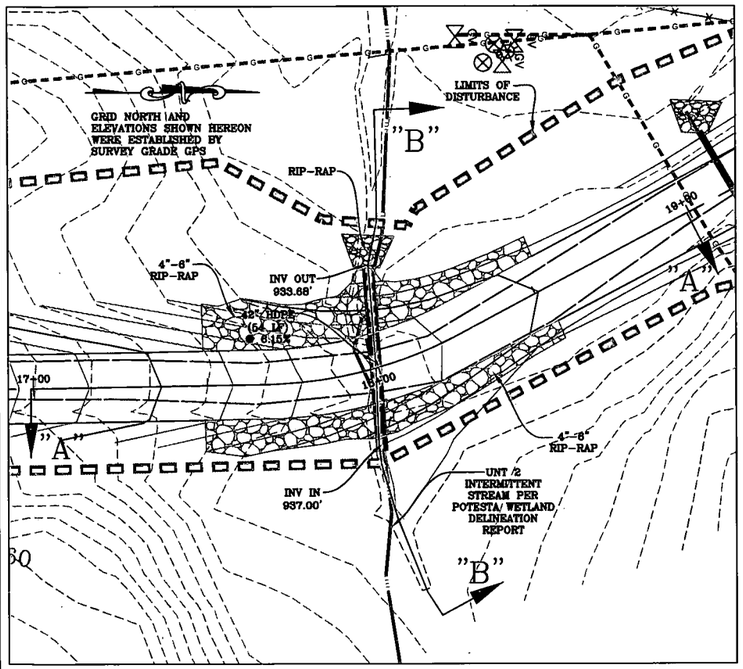


SECTION 5

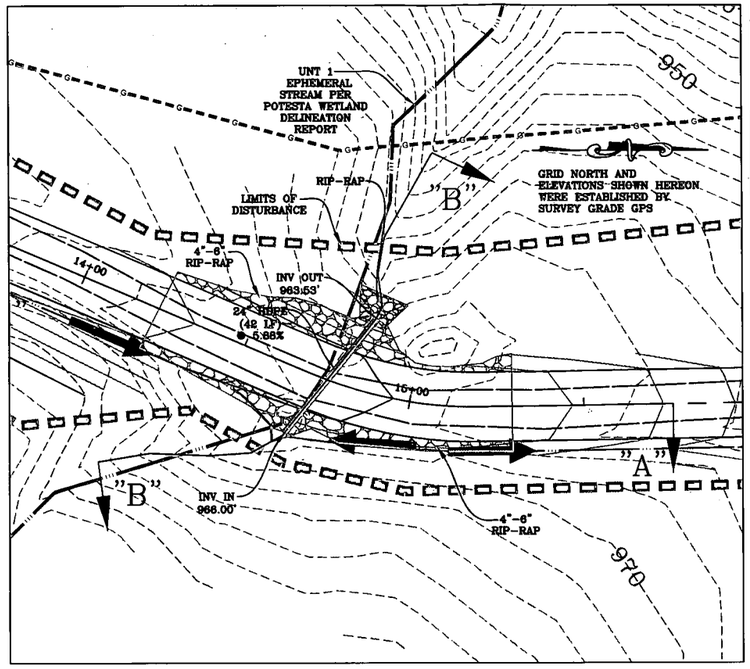
Stream Crossing "F" Details

STREAM CROSSING DETAILS

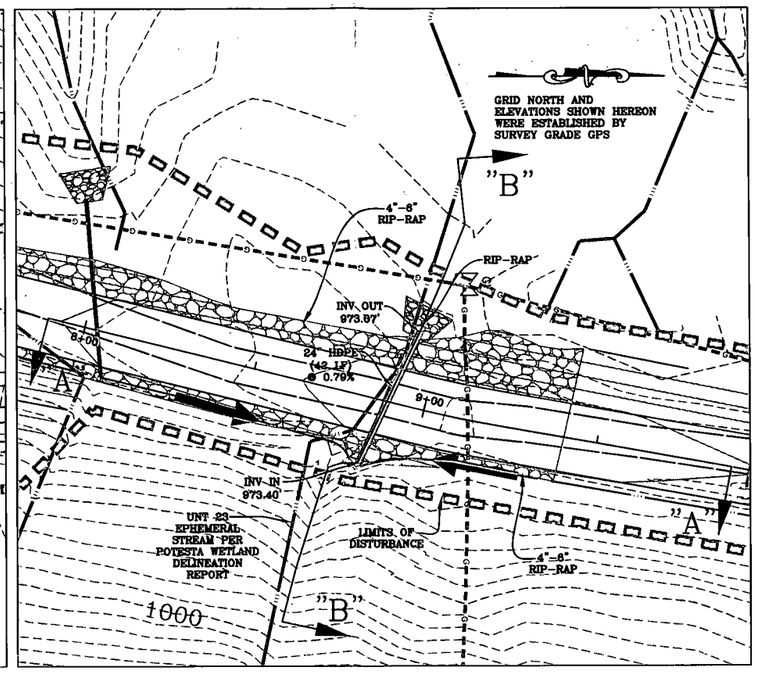
STREAM CROSSING "E" DETAILS



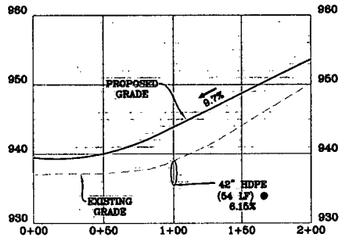
STREAM CROSSING "F" DETAILS



STREAM CROSSING "G" DETAILS

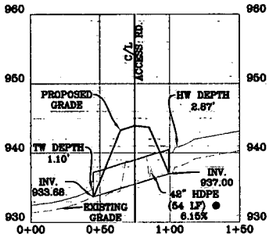


STREAM CROSSING "E" SECTIONS



CROSS SECTION "A-A"

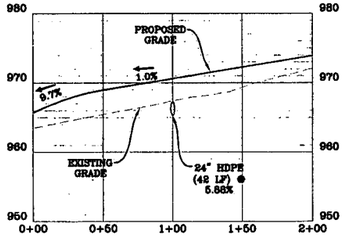
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

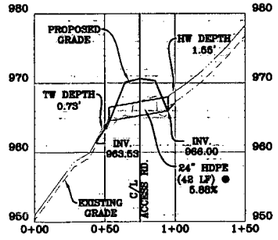
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

STREAM CROSSING "F" SECTIONS



CROSS SECTION "A-A"

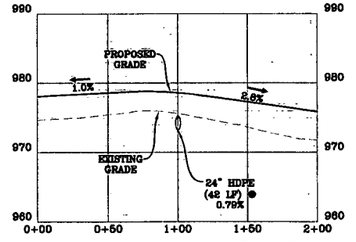
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

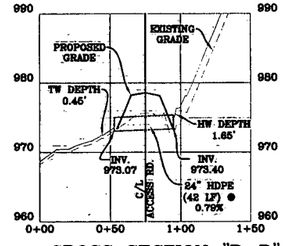
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

STREAM CROSSING "G" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

GENERAL STREAM CROSSING NOTES:

1) IF MULTIPLE CULVERTS ARE USED, THEY SHALL BE SEPARATED BY AT LEAST 12 INCHES OF COMPACTED AGGREGATE FILL.
2) CLEARING AND EXCAVATION OF THE STREAMBED AND BANKS SHALL BE KEPT TO A MINIMUM.
3) FILTER CLOTH SHALL BE PLACED ON THE STREAMBED AND STREAMBANKS PRIOR TO PLACEMENT OF THE PIPE CULVERTS AND AGGREGATE. THE FILTER CLOTH SHALL COVER THE STREAMBED AND EXTEND A MINIMUM OF SIX INCHES AND A MAXIMUM OF ONE FOOT BEYOND THE END OF THE CULVERTS AND BEDDING MATERIAL.
4) A WATER DIVERTING SWALE SHALL BE CONSTRUCTED ACROSS THE ROADWAY ON EITHER SIDE OF THE STREAM CROSSING.
5) APPROPRIATE PERIMETER CONTROLS SUCH AS COMPOST FILTER SOCK, SUPER SILT FENCE AND/OR SEDIMENT TRAPS SHALL BE EMPLOYED ALONG THE BANKS AND PARALLEL TO THE STREAMBED.
6) CROSS CRIBBING OF THE DOWNSTREAM SIDE OF THE CULVERT INSTALLATIONS MAY BE NEEDED TO AID IN REDUCING STRUCTURAL DAMAGE DURING HIGH VELOCITY WATER OVERFLOW PERIODS.
7) STREAMBED MATERIAL IS NOT TO BE USED AS FILL.
8) GREEN CONCRETE SHALL NOT BE PLACED IN CONTACT WITH FLOWING WATER.
9) WHEN THE CROSSING HAS SERVED ITS PURPOSE, ALL STRUCTURES INCLUDING CULVERTS, BEDDING, AND FILTER CLOTH SHALL BE REMOVED. REMOVAL OF THE STRUCTURE AND CLEAN UP OF THE AREA SHOULD BE ACCOMPLISHED WITHOUT CONSTRUCTION EQUIPMENT WORKING IN THE WATERWAY CHANNEL. UPON REMOVAL OF THE STRUCTURE, THE STREAM BANK SHALL IMMEDIATELY BE STABILIZED.
10) DURING ROUTINE MAINTENANCE DO NOT GRADE MUD AND DEBRIS OVER THE SIDES OF THE CROSSING INTO THE STREAM.
11) THE CROSSING MUST BE INSPECTED AFTER EVERY RAIN EVENT OF 0.5 INCHES OR MORE AND ONCE A WEEK TO ENSURE THAT THE CULVERTS, STREAMBED, AND STREAM BANKS ARE MAINTAINED AND NOT DAMAGED. NEVER ALLOW THE CULVERTS TO BECOME CLOGGED WITH DEBRIS AND REMOVE ANY OBSTRUCTIONS IMMEDIATELY.
12) FLUSHING IS NOT AN APPROVED METHOD TO BE UTILIZED FOR CULVERT CLEANOUT.

NOTE:

1) SEE STREAM CROSSING REPORT BY NAVITUS ENGINEERING FOR CULVERT AND DRAINAGE COMPUTATATIONS.
2) EQT SHALL OBTAIN A STREAM ACTIVITY PERMIT THROUGH THE PUBLIC LAND CORPORATION OFFICE OF LAND AND STREAMS FOR STREAM CROSSING "E", "F" & "G".

NAVITUS ENERGY ENGINEERING
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Professional Energy Consultants
A DIVISION OF SMITH LAND IMPROVEMENT CORP.
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ENVIRONMENTAL
PROJECT MGMT.
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(304) 472-3634

THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

MINOR STREAM CROSSING DETAILS

OXF 157

WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013

SCALE: N/A

DESIGNED BY: CSK

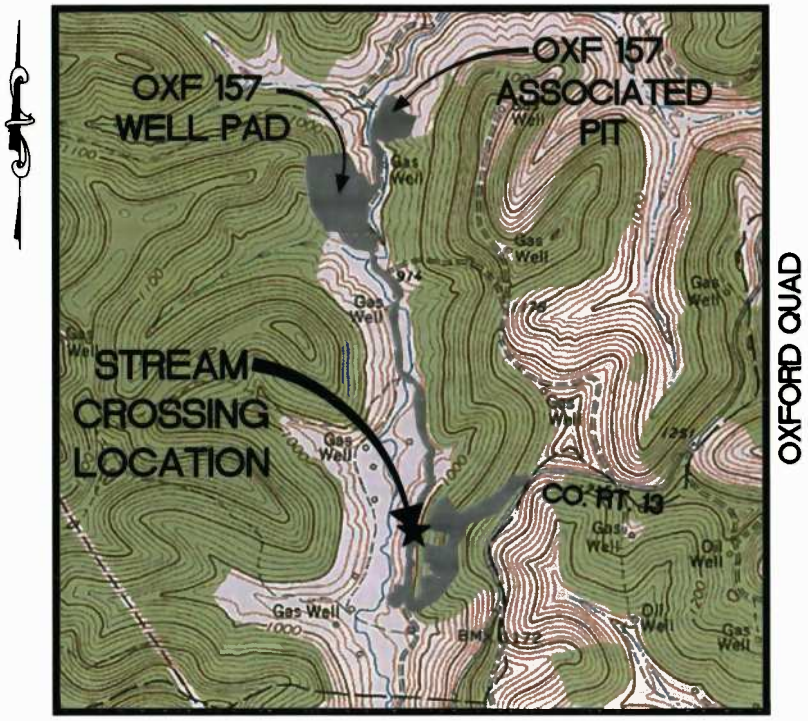
FILE NO. 7889

SHEET 25 OF 32

REV: 06/03/2014

STREAM CROSSING "G"
STORMWATER COMPUTATIONS

OXF 157 WELL PAD



VICINITY MAP
1" = 2,000'

NAVITUS
ENERGY ENGINEERING
Telephone: (888) 662-4185 | www.NavitusEng.com

Prepared For:
EQT Production Company
115 Professional Place
P.O. Box 280
Bridgeport, WV 26330

Contact:
Victoria J. Roark
Permitting Supervisor
(304) 848-0076

Designed By:
Navitus Engineering Inc.

Project Manager:
Chandler Pearson
cpearson@navituseng.com

Date: June 3, 2014

Surface Owner (s)
Justin L. Henderson

Tax Parcel:
Map 6 Parcel 1

Location:
West Union District, Doddridge County
West Virginia

FN# 7889

OXF 157 WELL PAD

STREAM CROSSING "G"

STORMWATER COMPUTATIONS

Sections

SECTION 1

Overview

The intent of this project is to construct a gravel access road to a gas well pad site and associated facilities. This project will include a permanent stream crossing. UNT 23, which has been classified as a ephemeral stream per the wetlands report conducted by Potesta Engineers and Environmental Consultants dated May 29, 2013, will be crossed at station 08+89.104 of the proposed access road.

Drainage Narrative

Using the SCS Method, we determined the 1, 10, and 100-year rainfall events at the stream crossing study point. We then used HY-8 to design the culvert and to determine the base flow water surface elevation for each rainfall event. Stream Crossing "G" has a drainage area of 5.20 Acres. Design flows are provided in the drainage calculations in Section 3.

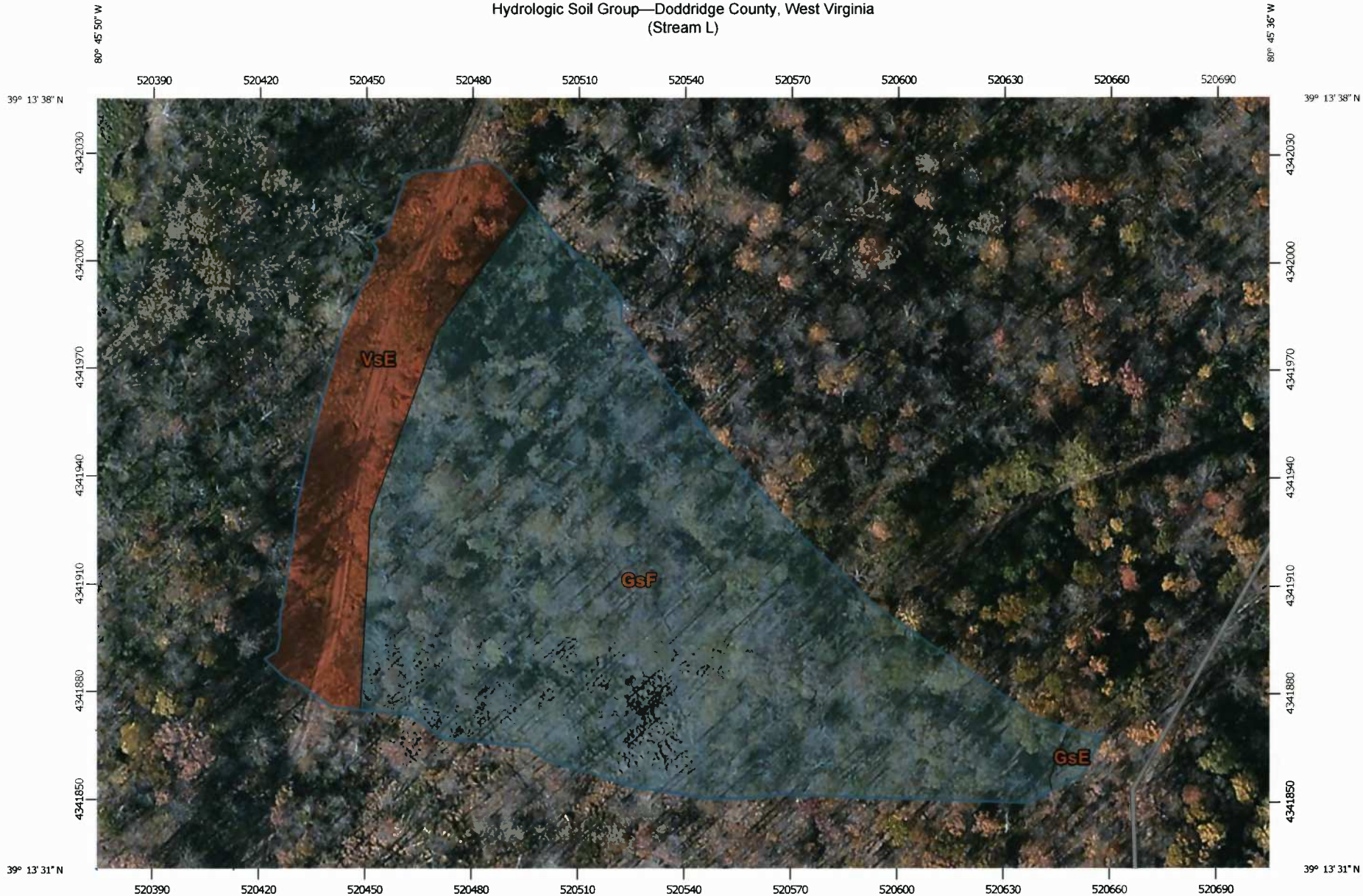
The permanent stream crossing was designed per the West Virginia Department of Environmental Protection Erosion and Sediment Control Best Management Practice Manual 2006 edition, Section 3.21-21. Per this manual, any structure that will remain in place 6 months or longer shall be large enough to convey the flow from a 10-year frequency, 24 hour duration storm. This culvert is sized to handle the computed 10-year storm event flow of 7.65 cfs.

The stream crossing was also designed as a permanent structure in accordance with the U.S. Army Corps of Engineering Nationwide 14 Permit. The structure is a 24 inch high-density polyethylene pipe culvert. The culvert is 42.00 LF with a slope of 0.79%. The stream crossing will contain clean rock fill made of 2-4" aggregate 50 feet on each side of the culvert for the first 6" of fill, the remainder of material shall be only large angular rock. No erodible material or green concrete shall be used in the crossing. The permanent stream crossing will impact 68.8' of the ephemeral stream, UNT 23.

SECTION 2

NRCS Soils Report

Hydrologic Soil Group—Doddridge County, West Virginia
(Stream L)



Map Scale: 1:1,510 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 20 40 80 120

Feet
0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

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

Soils

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

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

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

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: Doddridge County, West Virginia
Survey Area Data: Version 8, Apr 2, 2009

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 8, 2011—Oct 25, 2011

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Doddridge County, West Virginia (WV017)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
GsE	Gilpin-Peabody complex, 15 to 35 percent slopes, very stony	C	0.0	0.6%
GsF	Gilpin-Peabody complex, 35 to 70 percent slopes, very stony	C	4.2	80.9%
VsE	Vandalia silt loam, 15 to 35 percent slopes, very stony	D	1.0	18.5%
Totals for Area of Interest			**5.2**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

SECTION 3

SCS TR-55
Drainage Computations

Runoff Curve Number (CN)

Cover Description	CN	Soil Group	Area (Acre)
Meadow (Good)	58	B	0.00
Meadow (Good)	78	D	0.00
Woods (Good)	55	B	0.00
Woods (Good)	70	C	4.20
Woods (Good)	77	D	1.00
CN (weighted):	71		
Total Area:	5.20	Acre(s)	

Time of Concentration (SCS)

Curve Number:	71	
Length of Flow:	865.42	ft
Average Land Slope:	34.20	%
Time of Concentration:	0.105	hrs

Runoff Hydrograph: SCS Method

Input Data:		
Drainage Area	5.20	Acre(s)
Runoff Curve Number, CN	71	
Time of Concentration	0.105	hrs
Base Flow	0.00	cfs
Antecendent Moisture Condition	Type II	
Rainfall Distribution Type	Type II	24 hr
Rainfall Depth, 1-year	2.15	in
Rainfall Depth, 10-year	3.54	in
Rainfall Depth, 100-year	5.17	in
Peak Rate Factor	484	
Computed Results, 1 year:		
Time to Peak	12.20	hrs
Peak Discharge, 1-year	2.13	cfs
Runoff Volume, 1-year	0.13	acre-ft
Computed Results, 10 year:		
Time to Peak	12.20	hrs
Peak Discharge	7.65	cfs
Runoff Volume	0.42	acre-ft
Computed Results, 100 year:		
Time to Peak	12.20	hrs
Peak Discharge	15.48	cfs
Runoff Volume	0.86	acre-ft

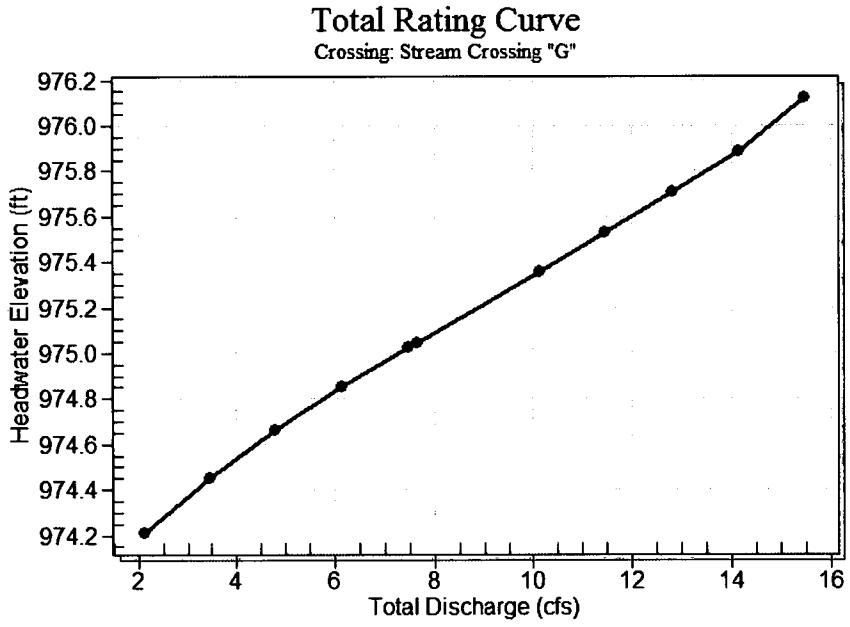
SECTION 4

HY-8 Culvert Analysis Report and Sections

HY-8 Culvert Analysis Report

Headwater Elevation (ft)	Total Discharge (cfs)	Stream Crossing G Discharge (cfs)	Roadway Discharge (cfs)	Iterations
974.21	2.13	2.13	0.00	1
974.45	3.46	3.46	0.00	1
974.66	4.80	4.80	0.00	1
974.85	6.14	6.14	0.00	1
975.02	7.47	7.47	0.00	1
975.05	7.65	7.65	0.00	1
975.36	10.14	10.14	0.00	1
975.53	11.48	11.48	0.00	1
975.70	12.81	12.81	0.00	1
975.88	14.15	14.15	0.00	1
976.12	15.48	15.48	0.00	1
978.61	25.08	25.08	0.00	Overtopping

Table 1 - Summary of Culvert Flows at Crossing: Stream Crossing "G"



Rating Curve Plot for Crossing: Stream Crossing "G"

Table 2 - Culvert Summary Table: Stream Crossing "G"

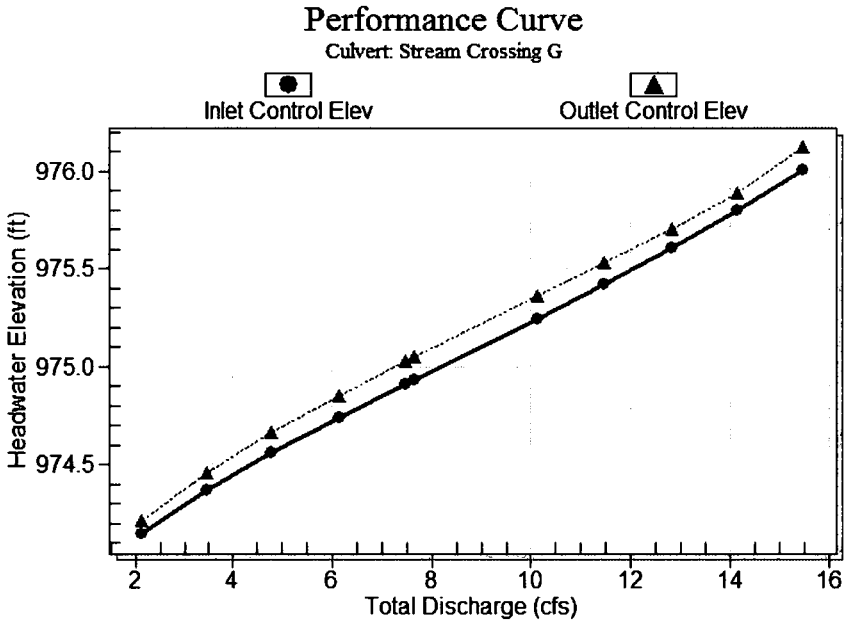
Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
2.13	2.13	974.21	0.744	0.813	2-M2c	0.600	0.498	0.506	0.280	3.407	5.248
3.46	3.46	974.45	0.970	1.054	2-M2c	0.774	0.646	0.651	0.337	3.905	5.927
4.80	4.80	974.66	1.156	1.261	2-M2c	0.928	0.768	0.771	0.380	4.298	6.430
6.14	6.14	974.85	1.335	1.450	2-M2c	1.074	0.872	0.876	0.417	4.635	6.837
7.47	7.47	975.02	1.506	1.625	2-M2c	1.218	0.969	0.971	0.449	4.937	7.182
7.65	7.65	975.05	1.529	1.647	2-M2c	1.238	0.982	0.983	0.453	4.975	7.225
10.14	10.14	975.36	1.843	1.958	2-M2c	1.535	1.136	1.140	0.503	5.484	7.752
11.48	11.48	975.53	2.018	2.128	2-M2c	1.774	1.215	1.216	0.527	5.741	7.996
12.81	12.81	975.70	2.201	2.304	2-M2c	2.000	1.283	1.287	0.550	5.994	8.219
14.15	14.15	975.88	2.395	2.482	2-M2c	2.000	1.352	1.355	0.570	6.246	8.425
15.48	15.48	976.12	2.604	2.724	7-M2c	2.000	1.416	1.418	0.590	6.498	8.617

****

Inlet Elevation (invert): 973.40 ft, Outlet Elevation (invert): 973.07 ft

Culvert Length: 42.00 ft, Culvert Slope: 0.0079

****

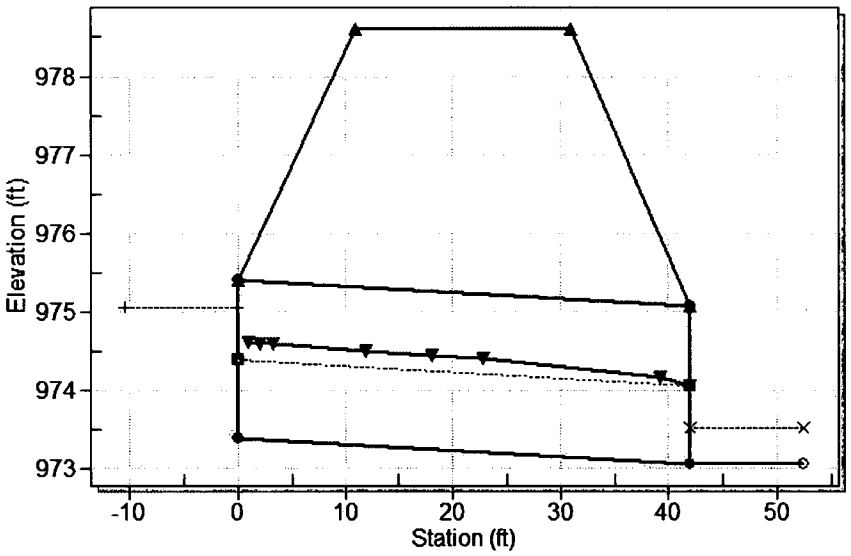


Culvert Performance Curve Plot: Stream Crossing "G"

Water Surface Profile Plot for Culvert: Stream Crossing "G"

Crossing - Stream Crossing "G", Design Discharge - 7.7 cfs

Culvert - Stream Crossing G, Culvert Discharge - 7.7 cfs



Site Data - Stream Crossing "G"

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 973.40 ft

Outlet Station: 42.00 ft

Outlet Elevation: 973.07 ft

Number of Barrels: 1

Culvert Data Summary - Stream Crossing "G"

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Corrugated PE

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Thin Edge Projecting

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: Stream Crossing "G")

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
2.13	973.35	0.28	5.25	3.76	2.47
3.46	973.41	0.34	5.93	4.52	2.55
4.80	973.45	0.38	6.43	5.10	2.60
6.14	973.49	0.42	6.84	5.59	2.64
7.47	973.52	0.45	7.18	6.02	2.67
7.65	973.52	0.45	7.22	6.08	2.68
10.14	973.57	0.50	7.75	6.75	2.72
11.48	973.60	0.53	8.00	7.07	2.74
12.81	973.62	0.55	8.22	7.37	2.76
14.15	973.64	0.57	8.42	7.65	2.78
15.48	973.66	0.59	8.62	7.91	2.80

Tailwater Channel Data - Stream Crossing "G"

Tailwater Channel Option: Irregular Channel

Channel Slope: 0.2150

User Defined Channel Cross-Section:

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	976.00	0.0350
2	6.30	974.00	0.0350
3	11.30	973.07	0.0350
4	15.90	974.00	0.0350
5	21.40	976.00	0.0350

Roadway Data for Crossing: Stream Crossing "G"

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

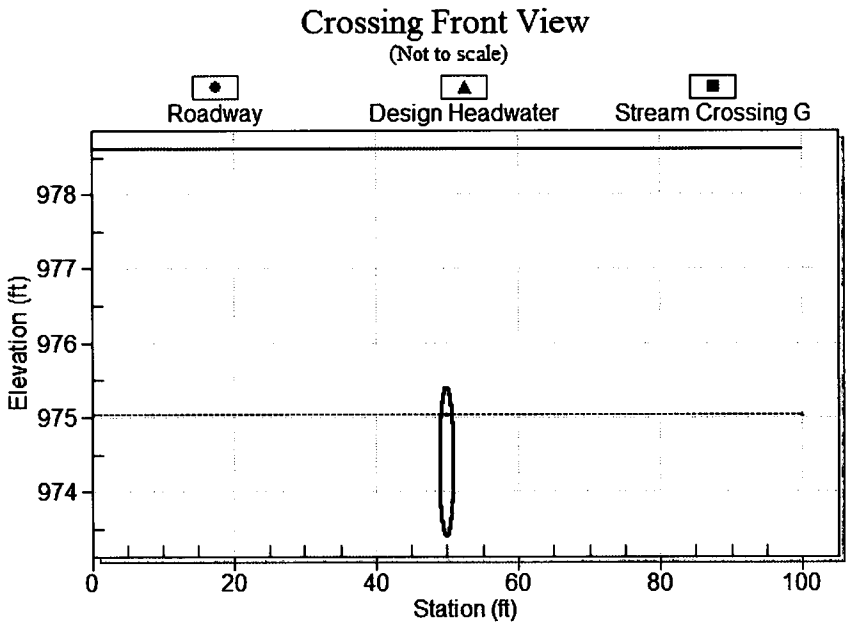
Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
0	0.00	978.61
1	50.00	978.61
2	100.00	978.61

Roadway Surface: Gravel

Roadway Top Width: 20.00 ft

Crossing Front View (Roadway Profile): Stream Crossing "G"

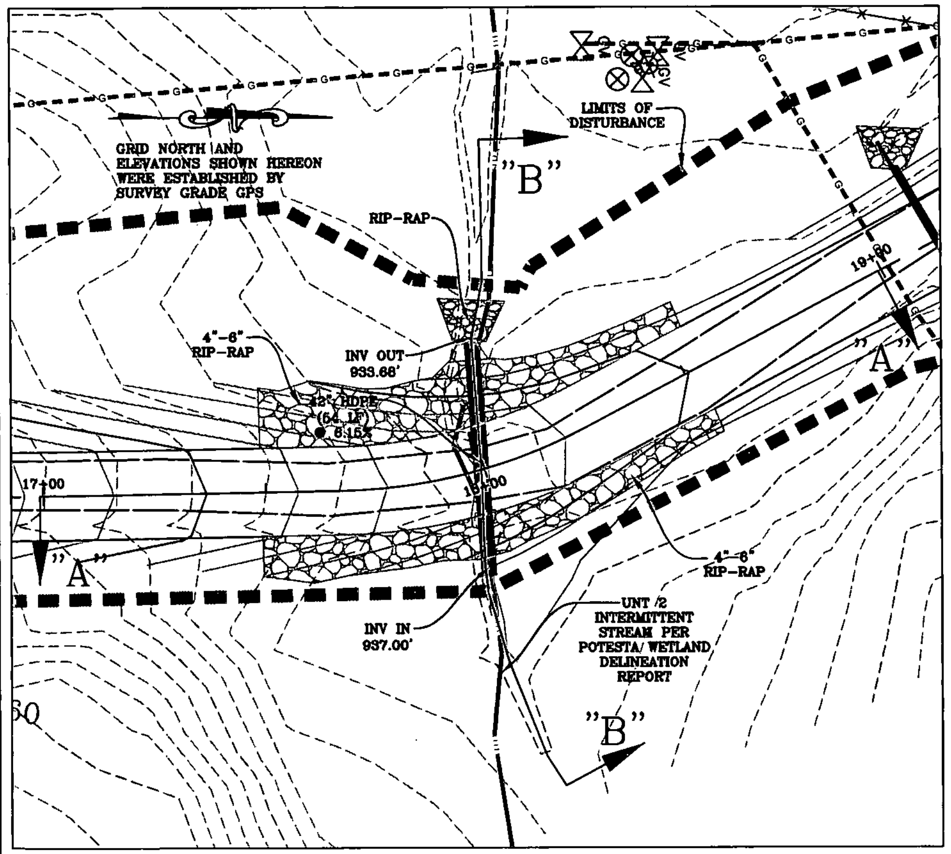


SECTION 5

Stream Crossing "G" Details

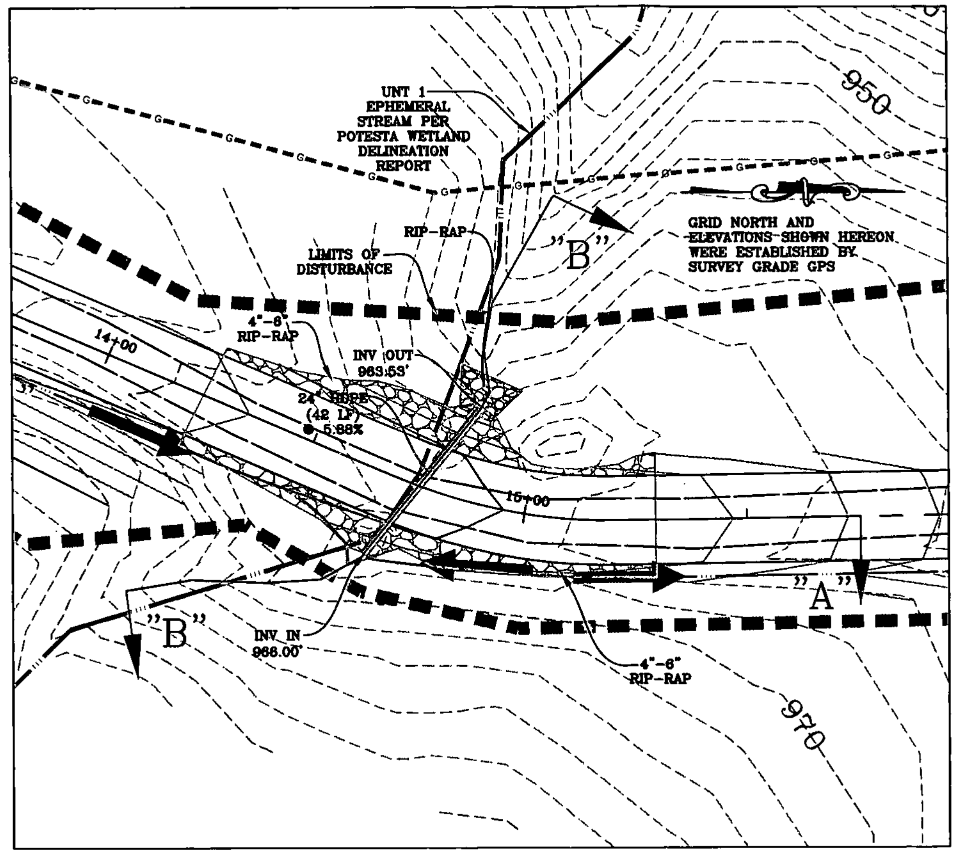
STREAM CROSSING DETAILS

STREAM CROSSING "E" DETAILS



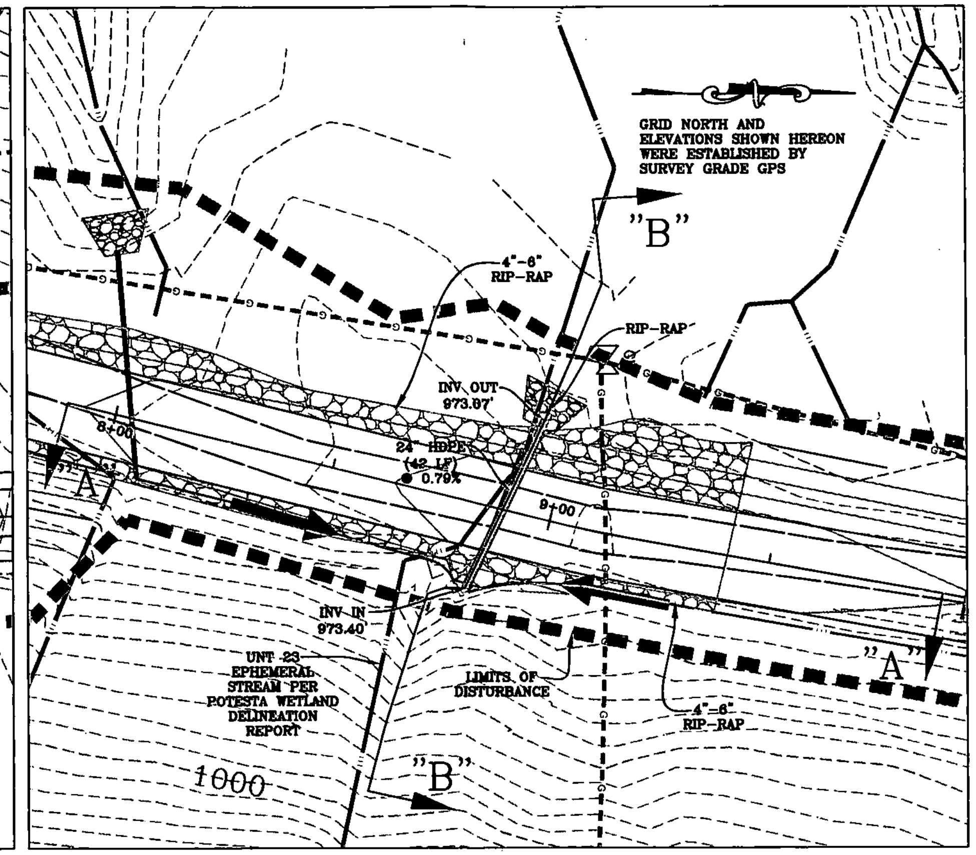
SCALE: 1" = 20'

STREAM CROSSING "F" DETAILS



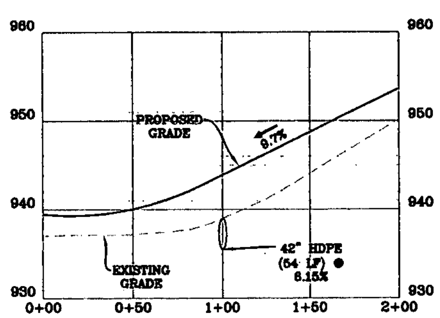
SCALE: 1" = 20'

STREAM CROSSING "G" DETAILS



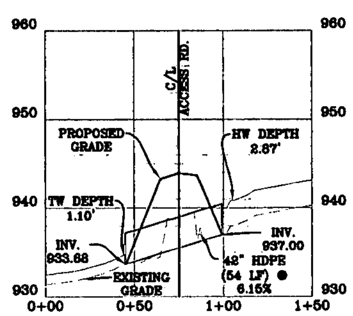
SCALE: 1" = 20'

STREAM CROSSING "E" SECTIONS



CROSS SECTION "A-A"

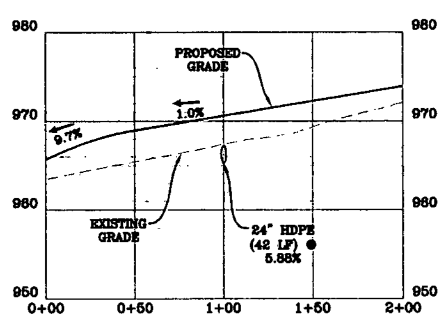
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

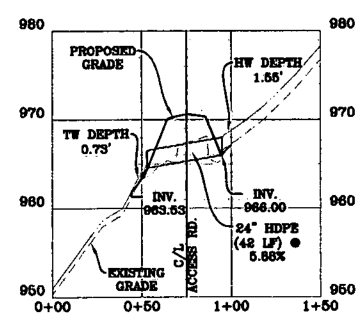
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

STREAM CROSSING "F" SECTIONS



CROSS SECTION "A-A"

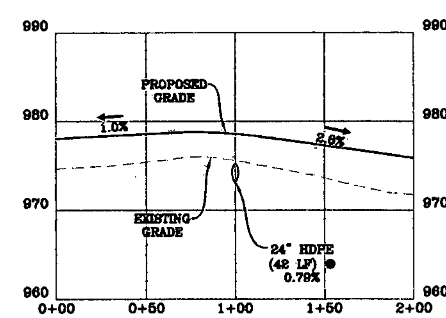
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

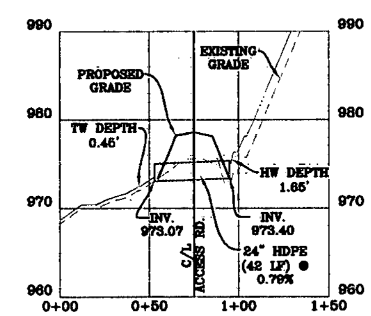
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

STREAM CROSSING "G" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

GENERAL STREAM CROSSING NOTES:

1) IF MULTIPLE CULVERTS ARE USED, THEY SHALL BE SEPARATED BY AT LEAST 12 INCHES OF COMPACTED AGGREGATE FILL.
2) CLEARING AND EXCAVATION OF THE STREAMBED AND BANKS SHALL BE KEPT TO A MINIMUM.
3) FILTER CLOTH SHALL BE PLACED ON THE STREAMBED AND STREAMBANKS PRIOR TO PLACEMENT OF THE PIPE CULVERTS AND AGGREGATE. THE FILTER CLOTH SHALL COVER THE STREAMBED AND EXTEND A MINIMUM OF SIX INCHES AND A MAXIMUM OF ONE FOOT BEYOND THE END OF THE CULVERTS AND BEDDING MATERIAL.
4) A WATER DIVERTING SWALE SHALL BE CONSTRUCTED ACROSS THE ROADWAY ON EITHER SIDE OF THE STREAM CROSSING.
5) APPROPRIATE PERIMETER CONTROLS SUCH AS COMPOST FILTER SOCK, SUPER SILT FENCE AND/OR SEDIMENT TRAPS SHALL BE EMPLOYED ALONG THE BANKS AND PARALLEL TO THE STREAMBED.
6) CROSS CRIBBING OF THE DOWNSTREAM SIDE OF THE CULVERT INSTALLATIONS MAY BE NEEDED TO AID IN REDUCING STRUCTURAL DAMAGE DURING HIGH VELOCITY WATER OVERFLOW PERIODS.
7) STREAMBED MATERIAL IS NOT TO BE USED AS FILL.
8) GREEN CONCRETE SHALL NOT BE PLACED IN CONTACT WITH FLOWING WATER.
9) WHEN THE CROSSING HAS SERVED ITS PURPOSE, ALL STRUCTURES INCLUDING CULVERTS, BEDDING, AND FILTER CLOTH SHALL BE REMOVED. REMOVAL OF THE STRUCTURE AND CLEAN UP OF THE AREA SHOULD BE ACCOMPLISHED WITHOUT CONSTRUCTION EQUIPMENT WORKING IN THE WATERWAY CHANNEL. UPON REMOVAL OF THE STRUCTURE, THE STREAM BANK SHALL IMMEDIATELY BE STABILIZED.
10) DURING ROUTINE MAINTENANCE DO NOT GRADE MUD AND DEBRIS OVER THE SIDES OF THE CROSSING INTO THE STREAM.
11) THE CROSSING MUST BE INSPECTED AFTER EVERY RAIN EVENT OF 0.5 INCHES OR MORE AND ONCE A WEEK TO ENSURE THAT THE CULVERTS, STREAMBED, AND STREAM BANKS ARE MAINTAINED AND NOT DAMAGED. NEVER ALLOW THE CULVERTS TO BECOME CLOGGED WITH DEBRIS AND REMOVE ANY OBSTRUCTIONS IMMEDIATELY.
12) FLUSHING IS NOT AN APPROVED METHOD TO BE UTILIZED FOR CULVERT CLEANOUT.

NOTE:

1) SEE STREAM CROSSING REPORT BY NAVITUS ENGINEERING FOR CULVERT AND DRAINAGE COMPUTATATIONS.
2) EQT SHALL OBTAIN A STREAM ACTIVITY PERMIT THROUGH THE PUBLIC LAND CORPORATION OFFICE OF LAND AND STREAMS FOR STREAM CROSSING "E", "F" & "G".

NAVITUS ENERGY ENGINEERING
Telephone: (888) 662-4185 | www.NavitusEng.com

Professional Energy Consultants
A DIVISION OF SMITH LAND SURVEYING, INC.
SLS
SURVEYORS ENGINEERS ENVIRONMENTAL PROJECT MGMT.
(304) 462-5634 WWW.SLSSURVEYS.COM

No. 11704 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER
06/03/2014

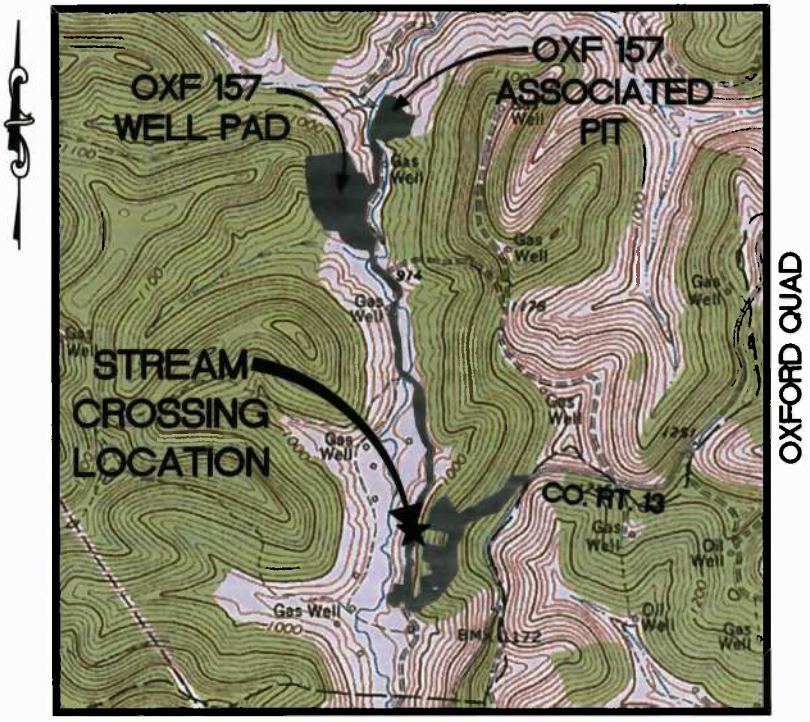
THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

MINOR STREAM CROSSING DETAILS
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE:	11/04/2013
SCALE:	N/A
DESIGNED BY:	CSK
FILE NO.	7869
SHEET	25 OF 32
REV:	06/03/2014

STREAM CROSSING "H"
STORMWATER COMPUTATIONS

OXF 157 WELL PAD



VICINITY MAP
1" = 2,000'

NAVITUS
ENERGY ENGINEERING
Telephone: (888) 662-4185 | www.NavitusEng.com

Prepared For:
EQT Production Company
115 Professional Place
P.O. Box 280
Bridgeport, WV 26330

Contact:
Victoria J. Roark
Permitting Supervisor
(304) 848-0076

Designed By:
Navitus Engineering Inc.

Project Manager:
Chandler Pearson
cpearson@navituseng.com

Date: June 3, 2014

Surface Owner (s)
Justin L. Henderson

Tax Parcel:
Map 6 Parcel 1

Location:
West Union District, Doddridge County
West Virginia

FN# 7889

OXF 157 WELL PAD

STREAM CROSSING "H"

STORMWATER COMPUTATIONS

Sections

SECTION 1

Overview

The intent of this project is to construct a gravel access road to a gas well pad site and associated facilities. This project will include a permanent stream crossing. UNT 15, which has been classified as a ephemeral stream per the wetlands report conducted by Potesta Engineers and Environmental Consultants dated May 29, 2013, will be crossed at station 08+03.679 of the proposed access road.

Drainage Narrative

Using the SCS Method, we determined the 1, 10, and 100-year rainfall events at the stream crossing study point. We then used HY-8 to design the culvert and to determine the base flow water surface elevation for each rainfall event. Stream Crossing "H" has a drainage area of 1.40 Acres. Design flows are provided in the drainage calculations in Section 3.

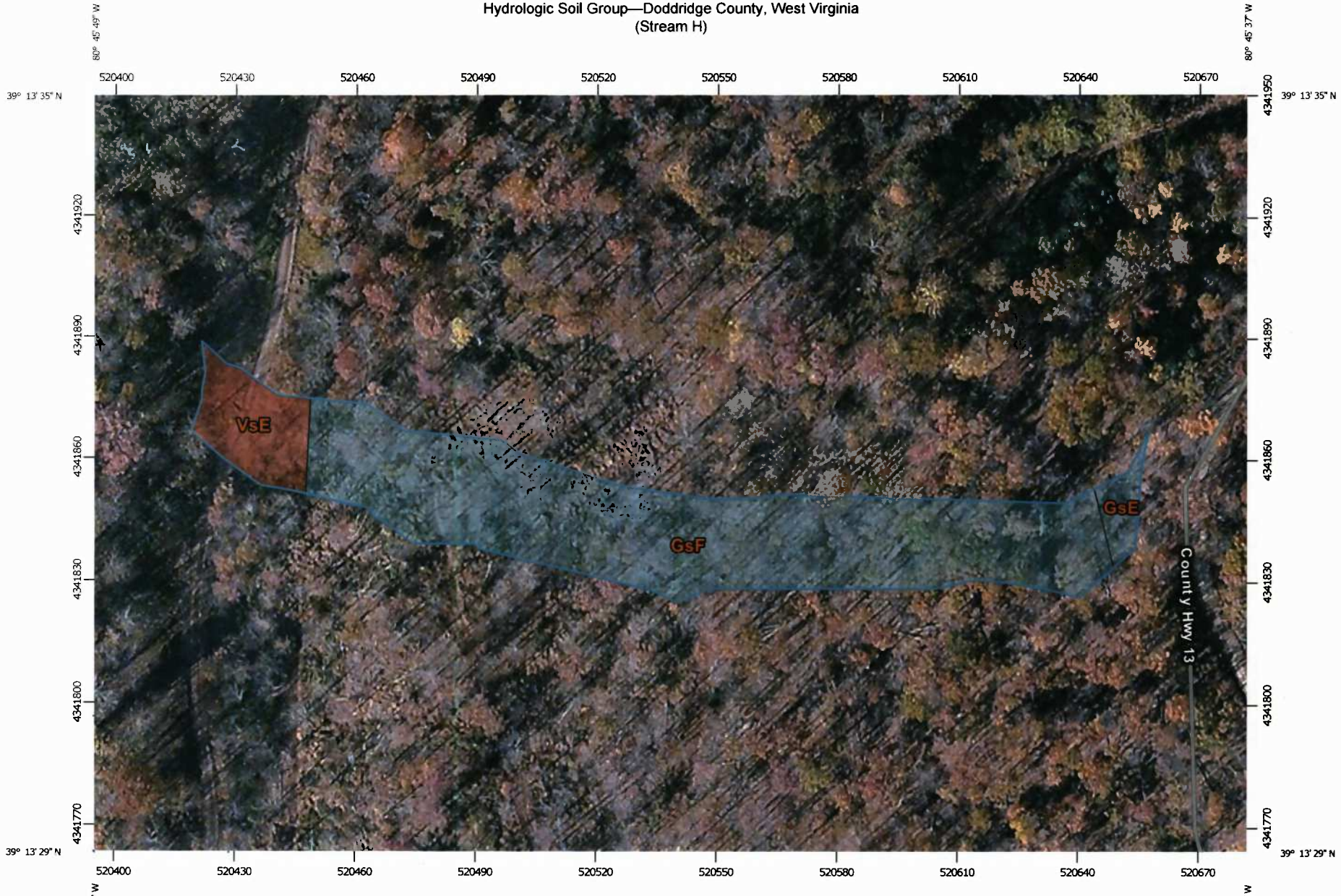
The permanent stream crossing was designed per the West Virginia Department of Environmental Protection Erosion and Sediment Control Best Management Practice Manual 2006 edition, Section 3.21-21. Per this manual, any structure that will remain in place 6 months or longer shall be large enough to convey the flow from a 10-year frequency, 24 hour duration storm. This culvert is sized to handle the computed 10-year storm event flow of 2.14 cfs.

The stream crossing was also designed as a permanent structure in accordance with the U.S. Army Corps of Engineering Nationwide 14 Permit. The structure is a 15 inch high-density polyethylene pipe culvert. The culvert is 52.00 LF with a slope of 10.90%. The stream crossing will contain clean rock fill made of 2-4" aggregate 50 feet on each side of the culvert for the first 6" of fill, the remainder of material shall be only large angular rock. No erodible material or green concrete shall be used in the crossing. The permanent stream crossing will impact 39.5' of the ephemeral stream, UNT 15.

SECTION 2

NRCS Soils Report

Hydrologic Soil Group—Doddridge County, West Virginia
(Stream H)



Map Scale: 1:1,310 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 15 30 60 90

Feet
0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

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

Soils

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

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

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

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: Doddridge County, West Virginia
Survey Area Data: Version 8, Apr 2, 2009

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 8, 2011—Oct 25, 2011

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Doddridge County, West Virginia (WV017)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
GsE	Gilpin-Peabody complex, 15 to 35 percent slopes, very stony	C	0.0	3.5%
GsF	Gilpin-Peabody complex, 35 to 70 percent slopes, very stony	C	1.2	84.8%
VsE	Vandalia silt loam, 15 to 35 percent slopes, very stony	D	0.2	11.7%
Totals for Area of Interest			**1.4**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

SECTION 3

SCS TR-55
Drainage Computations

Runoff Curve Number (CN)

Cover Description	CN	Soil Group	Area (Acre)
Meadow (Good)	58	B	0.00
Meadow (Good)	78	D	0.00
Woods (Good)	55	B	0.00
Woods (Good)	70	C	1.20
Woods (Good)	77	D	0.20
CN (weighted):	71		
Total Area:	1.40	Acre(s)	

Time of Concentration (SCS)

Curve Number:	71	
Length of Flow:	900.45	ft
Average Land Slope:	32.89	%
Time of Concentration:	0.110	hrs

Runoff Hydrograph: SCS Method

Input Data:		
Drainage Area	1.40	Acre(s)
Runoff Curve Number, CN	71	
Time of Concentration	0.110	hrs
Base Flow	0.00	cfs
Antecendent Moisture Condition	Type II	
Rainfall Distribution Type	Type II	24 hr
Rainfall Depth, 1-year	2.15	in
Rainfall Depth, 10-year	3.54	in
Rainfall Depth, 100-year	5.17	in
Peak Rate Factor	484	
Computed Results, 1 year:		
Time to Peak	12.20	hrs
Peak Discharge, 1-year	0.59	cfs
Runoff Volume, 1-year	0.04	acre-ft
Computed Results, 10 year:		
Time to Peak	12.20	hrs
Peak Discharge	2.14	cfs
Runoff Volume	0.12	acre-ft
Computed Results, 100 year:		
Time to Peak	12.20	hrs
Peak Discharge	4.34	cfs
Runoff Volume	0.24	acre-ft

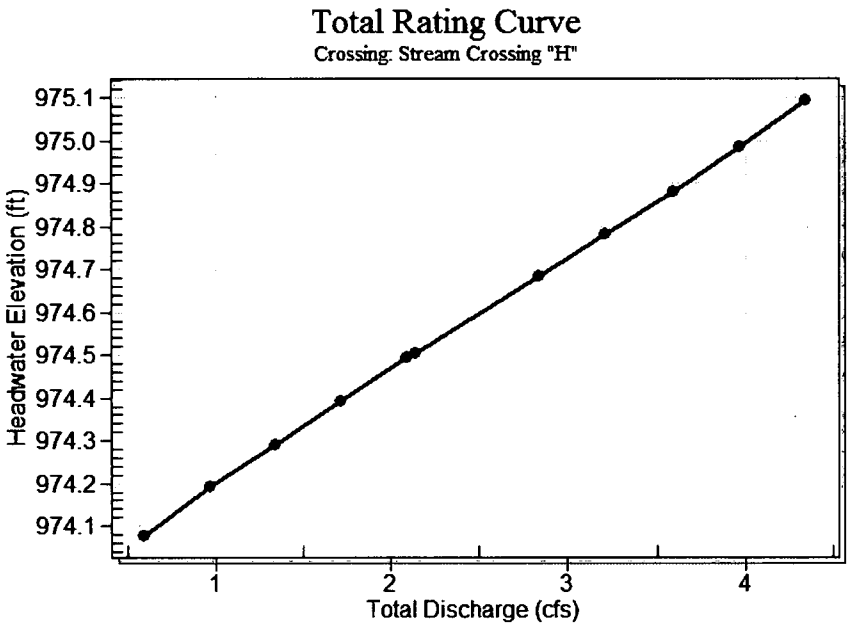
SECTION 4

HY-8 Culvert Analysis Report and Sections

HY-8 Culvert Analysis Report

Headwater Elevation (ft)	Total Discharge (cfs)	Stream Crossing H Discharge (cfs)	Roadway Discharge (cfs)	Iterations
974.08	0.59	0.59	0.00	1
974.19	0.96	0.96	0.00	1
974.29	1.34	1.34	0.00	1
974.39	1.71	1.71	0.00	1
974.49	2.09	2.09	0.00	1
974.51	2.14	2.14	0.00	1
974.68	2.84	2.84	0.00	1
974.78	3.21	3.21	0.00	1
974.88	3.59	3.59	0.00	1
974.98	3.96	3.96	0.00	1
975.10	4.34	4.34	0.00	1
976.30	7.31	7.31	0.00	Overtopping

Table 1 - Summary of Culvert Flows at Crossing: Stream Crossing "H"



Rating Curve Plot for Crossing: Stream Crossing "H"

Table 2 - Culvert Summary Table: Stream Crossing "H"

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.59	0.59	974.08	0.409	0.0*	1-S2n	0.181	0.294	0.184	0.211	5.079	5.160
0.96	0.96	974.19	0.521	0.0*	1-S2n	0.242	0.385	0.244	0.253	5.711	5.835
1.34	1.34	974.29	0.620	0.0*	1-S2n	0.283	0.454	0.284	0.287	6.550	6.334
1.71	1.71	974.39	0.723	0.0*	1-S2n	0.320	0.518	0.327	0.314	6.645	6.737
2.09	2.09	974.49	0.822	0.0*	1-S2n	0.357	0.573	0.358	0.339	7.162	7.078
2.14	2.14	974.51	0.835	0.0*	1-S2n	0.362	0.581	0.363	0.342	7.217	7.120
2.84	2.84	974.68	1.014	0.0*	1-S2n	0.419	0.674	0.423	0.380	7.852	7.642
3.21	3.21	974.78	1.111	0.0*	1-S2n	0.447	0.720	0.449	0.398	8.076	7.883
3.59	3.59	974.88	1.210	0.0*	1-S2n	0.476	0.764	0.478	0.415	8.300	8.104
3.96	3.96	974.98	1.315	0.0*	5-S2n	0.504	0.803	0.505	0.431	8.545	8.307
4.34	4.34	975.10	1.425	0.0*	5-S2n	0.529	0.842	0.532	0.445	8.746	8.497

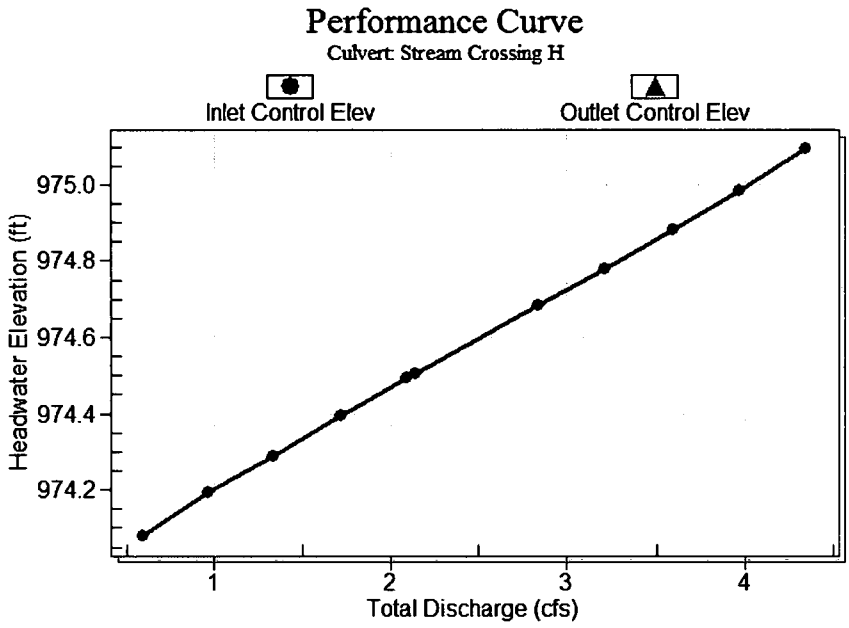
* theoretical depth is impractical. Depth reported is corrected.

****

Inlet Elevation (invert): 973.67 ft, Outlet Elevation (invert): 968.00 ft

Culvert Length: 52.31 ft, Culvert Slope: 0.1090

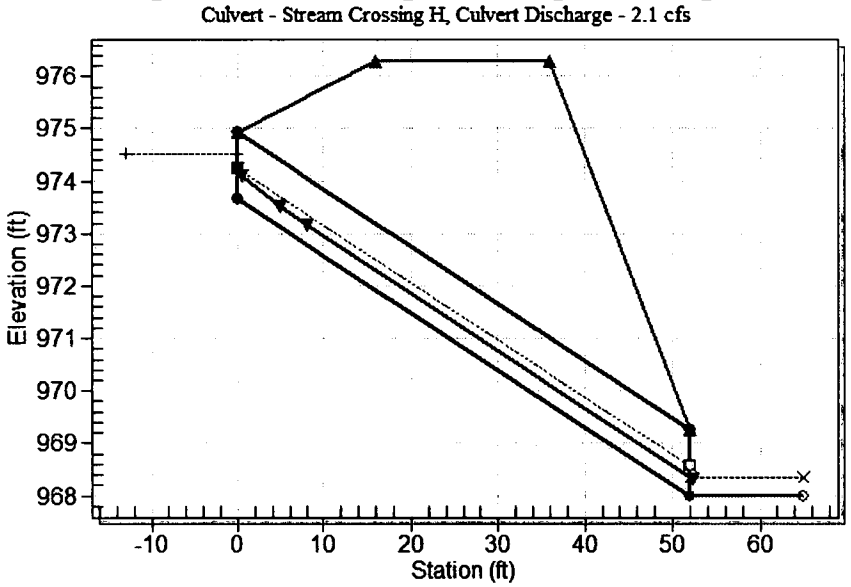
****



Culvert Performance Curve Plot: Stream Crossing "H"

Water Surface Profile Plot for Culvert: Stream Crossing "H"

Crossing - Stream Crossing "H", Design Discharge - 2.1 cfs



Site Data - Stream Crossing "H"

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 973.67 ft

Outlet Station: 52.00 ft

Outlet Elevation: 968.00 ft

Number of Barrels: 1

Culvert Data Summary - Stream Crossing "H"

Barrel Shape: Circular

Barrel Diameter: 1.25 ft

Barrel Material: Corrugated PE

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Thin Edge Projecting

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: Stream Crossing "H")

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.59	968.21	0.21	5.16	4.29	2.80
0.96	968.25	0.25	5.83	5.16	2.89
1.34	968.29	0.29	6.33	5.83	2.95
1.71	968.31	0.31	6.74	6.40	2.99
2.09	968.34	0.34	7.08	6.89	3.03
2.14	968.34	0.34	7.12	6.95	3.04
2.84	968.38	0.38	7.64	7.73	3.09
3.21	968.40	0.40	7.88	8.10	3.11
3.59	968.41	0.41	8.10	8.44	3.14
3.96	968.43	0.43	8.31	8.76	3.16
4.34	968.45	0.45	8.50	9.06	3.17

Tailwater Channel Data - Stream Crossing "H"

Tailwater Channel Option: Irregular Channel

Channel Slope: 0.3260

User Defined Channel Cross-Section:

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	972.00	0.0350
2	14.70	970.00	0.0350
3	20.20	968.00	0.0350
4	25.00	970.00	0.0350
5	43.20	972.00	0.0350

Roadway Data for Crossing: Stream Crossing "H"

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

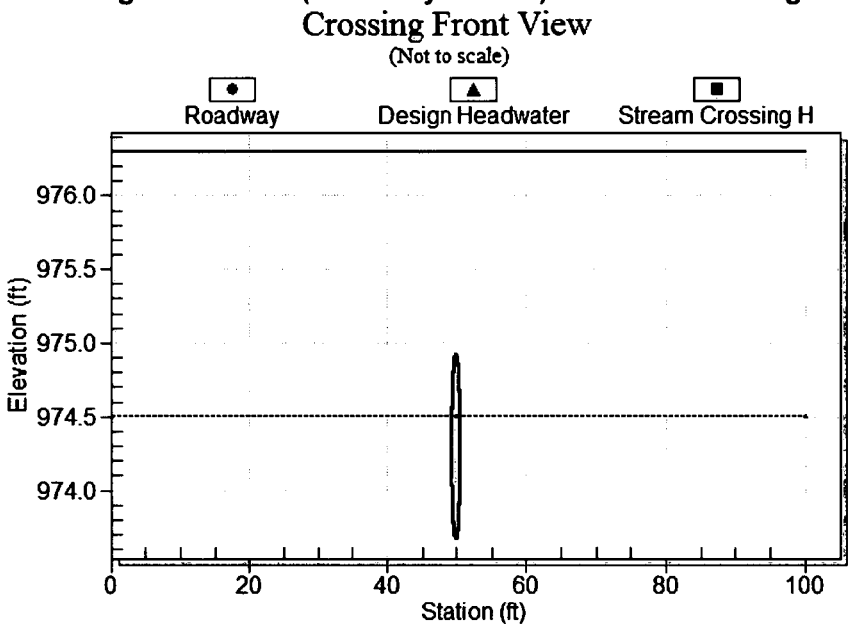
Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
0	0.00	976.30
1	50.00	976.30
2	100.00	976.30

Roadway Surface: Gravel

Roadway Top Width: 20.00 ft

Crossing Front View (Roadway Profile): Stream Crossing "H"

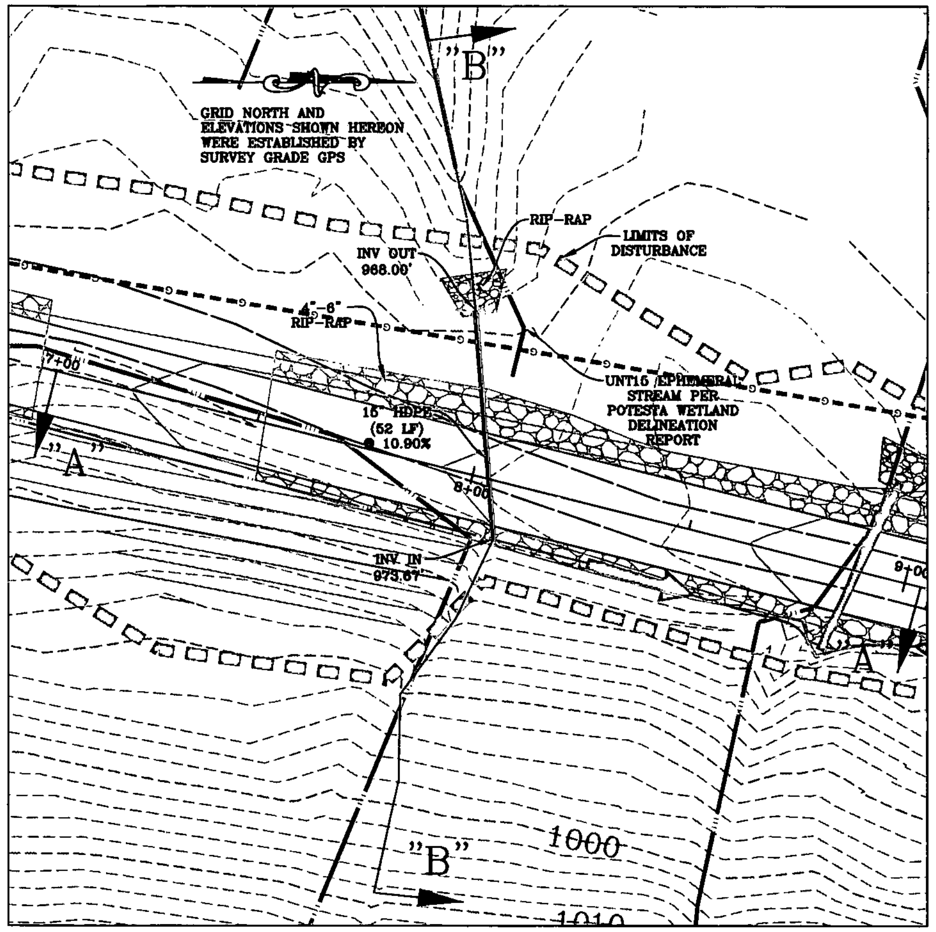


SECTION 5

Stream Crossing "H" Details

STREAM CROSSING DETAILS

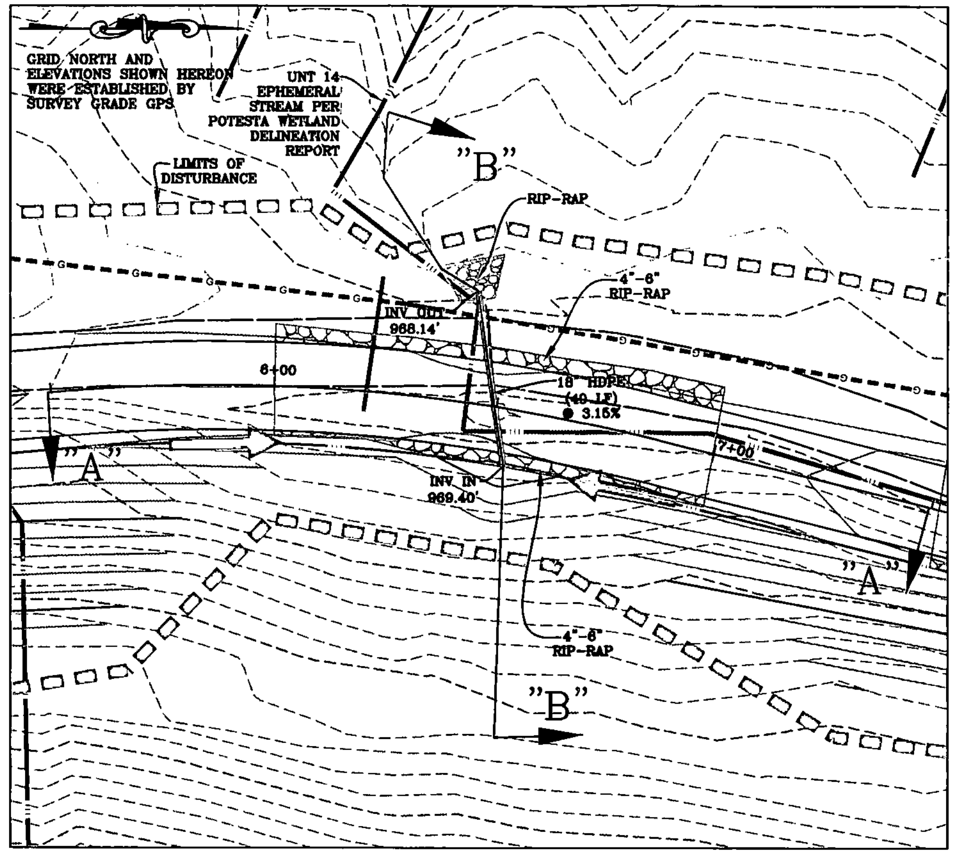
STREAM CROSSING "H" DETAILS



20 10 0 20 40

SCALE: 1" = 20'

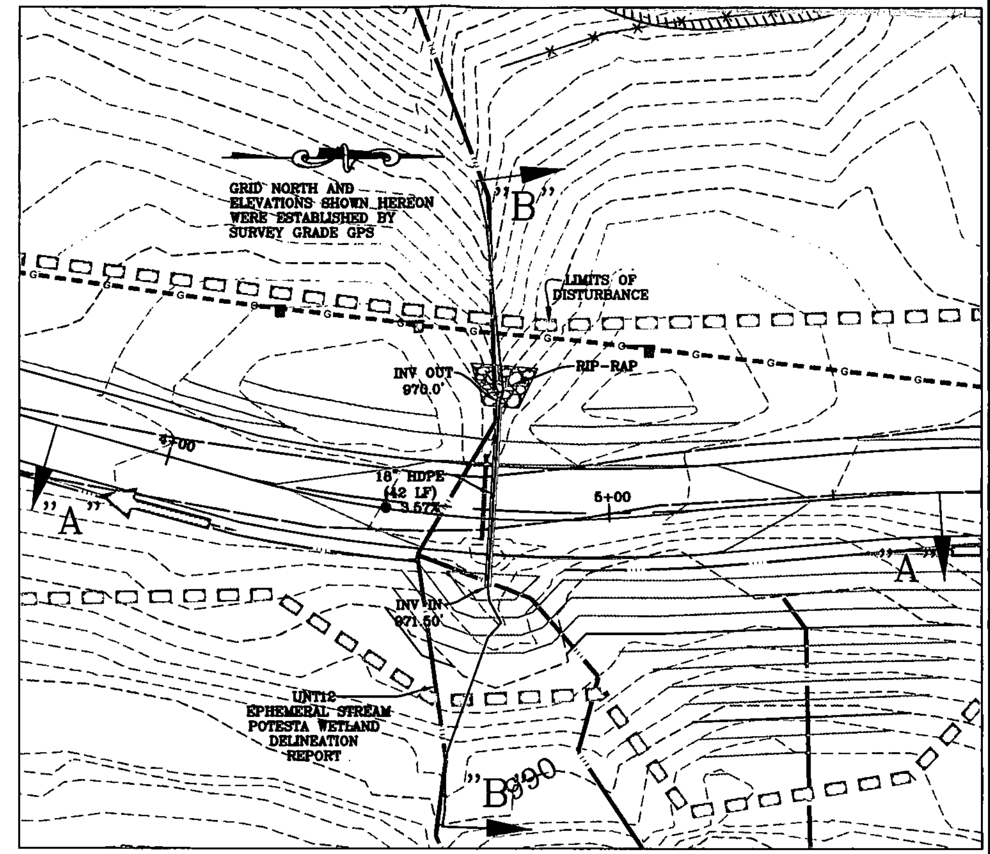
STREAM CROSSING "I" DETAILS



20 10 0 20 40

SCALE: 1" = 20'

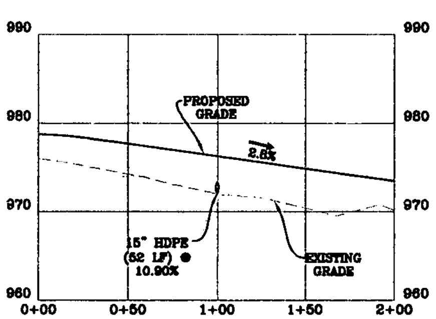
STREAM CROSSING "J" DETAILS



20 10 0 20 40

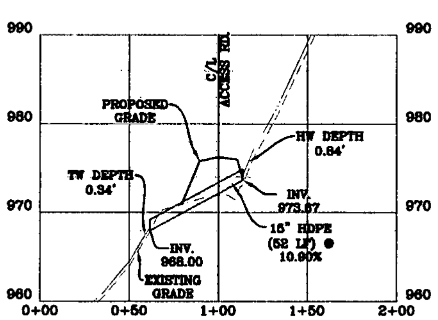
SCALE: 1" = 20'

STREAM CROSSING "H" SECTIONS



CROSS SECTION "A-A"

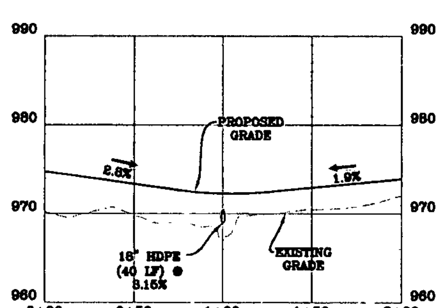
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

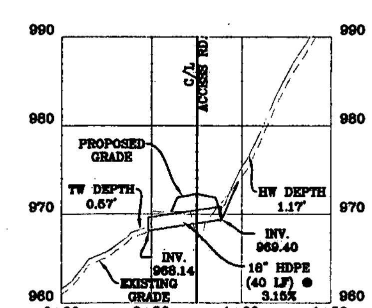
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

STREAM CROSSING "I" SECTIONS



CROSS SECTION "A-A"

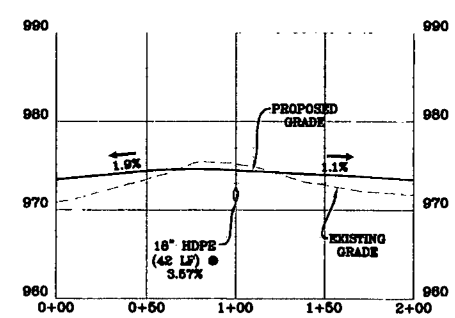
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

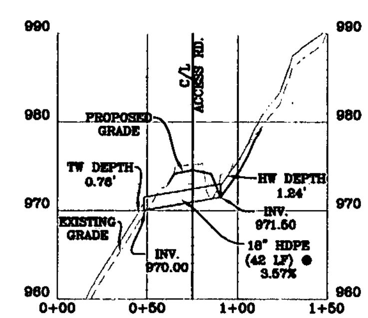
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

STREAM CROSSING "J" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

GENERAL STREAM CROSSING NOTES:

1) IF MULTIPLE CULVERTS ARE USED, THEY SHALL BE SEPARATED BY AT LEAST 12 INCHES OF COMPACTED AGGREGATE FILL.
2) CLEARING AND EXCAVATION OF THE STREAMBED AND BANKS SHALL BE KEPT TO A MINIMUM.
3) FILTER CLOTH SHALL BE PLACED ON THE STREAMBED AND STREAMBANKS PRIOR TO PLACEMENT OF THE PIPE CULVERTS AND AGGREGATE. THE FILTER CLOTH SHALL COVER THE STREAMBED AND EXTEND A MINIMUM OF SIX INCHES AND A MAXIMUM OF ONE FOOT BEYOND THE END OF THE CULVERTS AND BEDDING MATERIAL.
4) A WATER DIVERTING SWALE SHALL BE CONSTRUCTED ACROSS THE ROADWAY ON EITHER SIDE OF THE STREAM CROSSING.
5) APPROPRIATE PERIMETER CONTROLS SUCH AS COMPOST FILTER SOCK, SUPER SILT FENCE AND/OR SEDIMENT TRAPS SHALL BE EMPLOYED ALONG THE BANKS AND PARALLEL TO THE STREAMBED.
6) CROSS CRIBBING OF THE DOWNSTREAM SIDE OF THE CULVERT INSTALLATIONS MAY BE NEEDED TO AID IN REDUCING STRUCTURAL DAMAGE DURING HIGH VELOCITY WATER OVERFLOW PERIODS.
7) STREAMBED MATERIAL IS NOT TO BE USED AS FILL.
8) GREEN CONCRETE SHALL NOT BE PLACED IN CONTACT WITH FLOWING WATER.
9) WHEN THE CROSSING HAS SERVED ITS PURPOSE, ALL STRUCTURES INCLUDING CULVERTS, BEDDING, AND FILTER CLOTH SHALL BE REMOVED. REMOVAL OF THE STRUCTURE AND CLEAN UP OF THE AREA SHOULD BE ACCOMPLISHED WITHOUT CONSTRUCTION EQUIPMENT WORKING IN THE WATERWAY CHANNEL. UPON REMOVAL OF THE STRUCTURE, THE STREAM BANK SHALL IMMEDIATELY BE STABILIZED.
10) DURING ROUTINE MAINTENANCE DO NOT GRADE MUD AND DEBRIS OVER THE SIDES OF THE CROSSING INTO THE STREAM.
11) THE CROSSING MUST BE INSPECTED AFTER EVERY RAIN EVENT OF 0.5 INCHES OR MORE AND ONCE A WEEK TO ENSURE THAT THE CULVERTS, STREAMBED, AND STREAM BANKS ARE MAINTAINED AND NOT DAMAGED. NEVER ALLOW THE CULVERTS TO BECOME CLOGGED WITH DEBRIS AND REMOVE ANY OBSTRUCTIONS IMMEDIATELY.
12) FLUSHING IS NOT AN APPROVED METHOD TO BE UTILIZED FOR CULVERT CLEANOUT.

NOTE:

1) SEE STREAM CROSSING REPORT BY NAVITUS ENGINEERING FOR CULVERT AND DRAINAGE COMPUTATATIONS.
2) EQT SHALL OBTAIN A STREAM ACTIVITY PERMIT THROUGH THE PUBLIC LAND CORPORATION OFFICE OF LAND AND STREAMS FOR STREAM CROSSING "H", "I" & "J".

NAVITUS ENERGY ENGINEERING
Telephone: (888) 662-4185 | www.NavitusEng.com

Professional Energy Consultants
A DIVISION OF SMITH LAND SURVEYING, INC.
SLS
SURVEYORS
ENGINEERS
ENVIRONMENTAL
PROJECT MGMT.
(304) 462-5634
WWW.SLSSURVEYS.COM

GARY D. SMITH REGISTERED No. 11709 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER
06/03/2014

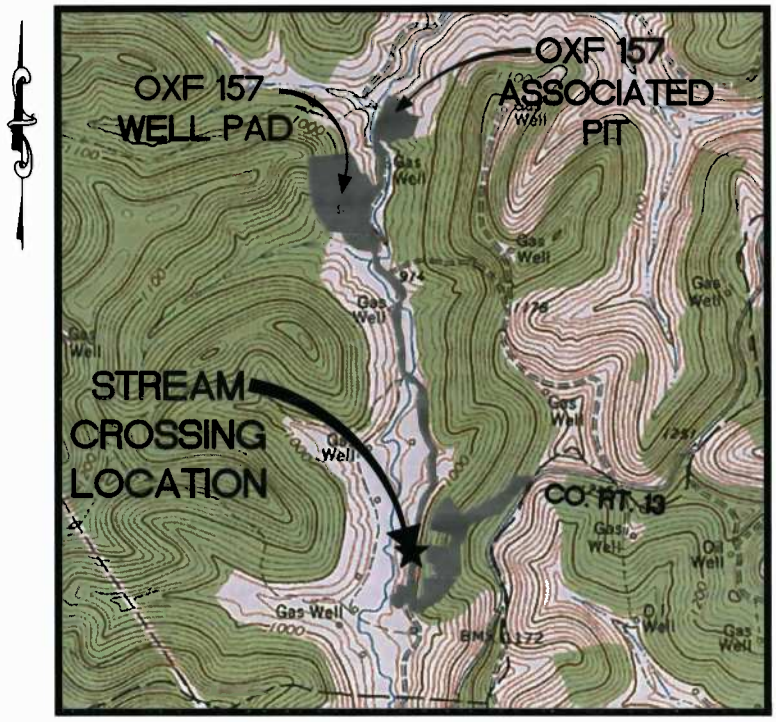
THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC.
FOR: EQT PRODUCTION COMPANY

MINOR STREAM CROSSING DETAILS
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013
SCALE: N/A
DESIGNED BY: CSK
FILE NO. 7889
SHEET 26 OF 32
REV: 06/03/2014

STREAM CROSSING "I"
STORMWATER COMPUTATIONS

OXF 157 WELL PAD



VICINITY MAP
1" = 2,000'

NAVITUS
ENERGY ENGINEERING
Telephone: (888) 662-4185 | www.NavitusEng.com

Prepared For:
EQT Production Company
115 Professional Place
P.O. Box 280
Bridgeport, WV 26330

Contact:
Victoria J. Roark
Permitting Supervisor
(304) 848-0076

Designed By:
Navitus Engineering Inc.

Project Manager:
Chandler Pearson
cpearson@navituseng.com

Date: June 3, 2014

Surface Owner (s)
Justin L. Henderson

Tax Parcel:
Map 6 Parcel 1

Location:
West Union District, Doddridge County
West Virginia

FN# 7889

OXF 157 WELL PAD

STREAM CROSSING "I"

STORMWATER COMPUTATIONS

Sections

SECTION 1

Overview

The intent of this project is to construct a gravel access road to a gas well pad site and associated facilities. This project will include a permanent stream crossing. UNT 14, which has been classified as a ephemeral stream per the wetlands report conducted by Potesta Engineers and Environmental Consultants dated May 29, 2013, will be crossed at station 06+49.563 of the proposed access road.

Drainage Narrative

Using the SCS Method, we determined the 1, 10, and 100-year rainfall events at the stream crossing study point. We then used HY-8 to design the culvert and to determine the base flow water surface elevation for each rainfall event. Stream Crossing "I" has a drainage area of 2.40 Acres. Design flows are provided in the drainage calculations in Section 3.

The permanent stream crossing was designed per the West Virginia Department of Environmental Protection Erosion and Sediment Control Best Management Practice Manual 2006 edition, Section 3.21-21. Per this manual, any structure that will remain in place 6 months or longer shall be large enough to convey the flow from a 10-year frequency, 24 hour duration storm. This culvert is sized to handle the computed 10-year storm event flow of 3.94 cfs.

The stream crossing was also designed as a permanent structure in accordance with the U.S. Army Corps of Engineering Nationwide 14 Permit. The structure is a 18 inch high-density polyethylene pipe culvert. The culvert is 40.00 LF with a slope of 3.15%. The stream crossing will contain clean rock fill made of 2-4" aggregate 50 feet on each side of the culvert for the first 6" of fill, the remainder of material shall be only large angular rock. No erodible material or green concrete shall be used in the crossing. The permanent stream crossing will impact 222.13' of the ephemeral stream, UNT 14.

SECTION 2

NRCS Soils Report

Hydrologic Soil Group—Doddridge County, West Virginia
(Stream I)

Map Scale: 1:1,310 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 15 30 60 90

Feet
0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

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

Soils

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

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

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

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: Doddridge County, West Virginia
Survey Area Data: Version 8, Apr 2, 2009

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 8, 2011—Oct 25, 2011

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Doddridge County, West Virginia (WV017)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
GsF	Gilpin-Peabody complex, 35 to 70 percent slopes, very stony	C	1.6	66.4%
VsE	Vandalia silt loam, 15 to 35 percent slopes, very stony	D	0.8	33.6%
Totals for Area of Interest			**2.4**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

SECTION 3

SCS TR-55
Drainage Computations

Runoff Curve Number (CN)

Cover Description	CN	Soil Group	Area (Acre)
Meadow (Good)	58	B	0.00
Meadow (Good)	78	D	0.00
Woods (Good)	55	B	0.00
Woods (Good)	70	C	1.60
Woods (Good)	77	D	0.80
CN (weighted):	72		
Total Area:	2.40	Acre(s)	

Time of Concentration (SCS)

Curve Number:	72	
Length of Flow:	929.95	ft
Average Land Slope:	30.85	%
Time of Concentration:	0.114	hrs

Runoff Hydrograph: SCS Method

Input Data:		
Drainage Area	2.40	Acre(s)
Runoff Curve Number, CN	72	
Time of Concentration	0.114	hrs
Base Flow	0.00	cfs
Antecendent Moisture Condition	Type II	
Rainfall Distribution Type	Type II	24 hr
Rainfall Depth, 1-year	2.15	in
Rainfall Depth, 10-year	3.54	in
Rainfall Depth, 100-year	5.17	in
Peak Rate Factor	484	

Computed Results, 1 year:		
Time to Peak	12.20	hrs
Peak Discharge, 1-year	1.16	cfs
Runoff Volume, 1-year	0.07	acre-ft

Computed Results, 10 year:		
Time to Peak	12.20	hrs
Peak Discharge	3.94	cfs
Runoff Volume	0.22	acre-ft

Computed Results, 100 year:		
Time to Peak	12.20	hrs
Peak Discharge	7.85	cfs
Runoff Volume	0.44	acre-ft

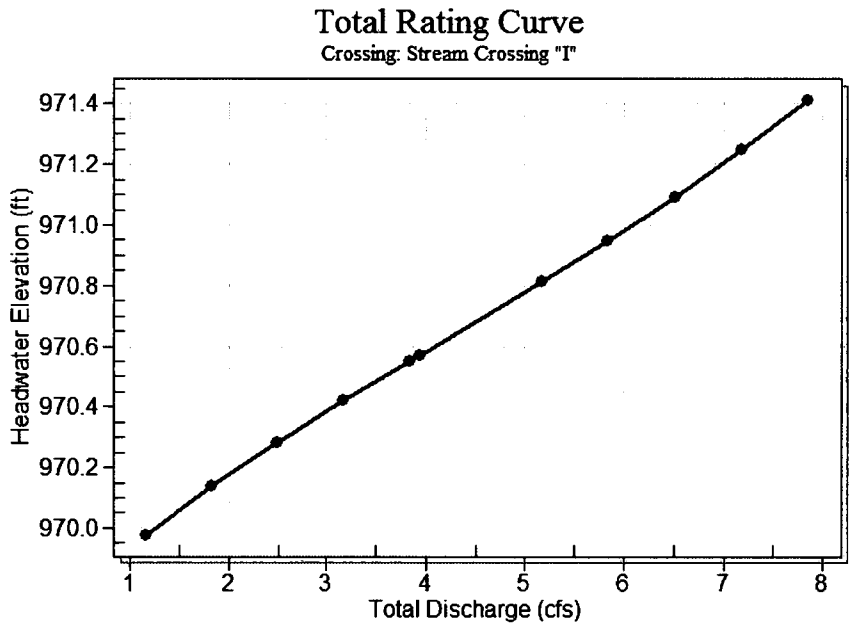
SECTION 4

HY-8 Culvert Analysis Report and Sections

HY-8 Culvert Analysis Report

Headwater Elevation (ft)	Total Discharge (cfs)	Stream Crossing I Discharge (cfs)	Roadway Discharge (cfs)	Iterations
969.98	1.16	1.16	0.00	1
970.14	1.83	1.83	0.00	1
970.28	2.50	2.50	0.00	1
970.42	3.17	3.17	0.00	1
970.55	3.84	3.84	0.00	1
970.57	3.94	3.94	0.00	1
970.81	5.17	5.17	0.00	1
970.95	5.84	5.84	0.00	1
971.09	6.51	6.51	0.00	1
971.25	7.18	7.18	0.00	1
971.41	7.85	7.85	0.00	1
972.29	10.68	10.68	0.00	Overtopping

Table 1 - Summary of Culvert Flows at Crossing: Stream Crossing "I"



Rating Curve Plot for Crossing: Stream Crossing "I"

Table 2 - Culvert Summary Table: Stream Crossing "I"

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.16	1.16	969.98	0.578	0.0*	1-S2n	0.338	0.396	0.345	0.358	3.867	4.426
1.83	1.83	970.14	0.738	0.0*	1-S2n	0.429	0.504	0.433	0.425	4.309	4.960
2.50	2.50	970.28	0.883	0.0*	1-S2n	0.504	0.598	0.507	0.478	4.734	5.362
3.17	3.17	970.42	1.019	0.0*	1-S2n	0.574	0.674	0.576	0.522	5.065	5.690
3.84	3.84	970.55	1.150	0.0*	1-S2n	0.639	0.749	0.640	0.561	5.352	5.969
3.94	3.94	970.57	1.170	0.0*	1-S2n	0.648	0.759	0.649	0.567	5.401	6.009
5.17	5.17	970.81	1.411	0.0*	1-S2n	0.760	0.874	0.760	0.627	5.756	6.432
5.84	5.84	970.95	1.548	0.0*	5-S2n	0.818	0.931	0.821	0.657	5.907	6.631
6.51	6.51	971.09	1.693	0.0*	5-S2n	0.875	0.984	0.876	0.684	6.081	6.813
7.18	7.18	971.25	1.847	0.0*	5-S2n	0.934	1.037	0.934	0.710	6.200	6.982
7.85	7.85	971.41	2.014	0.0*	5-S2n	0.994	1.082	0.995	0.734	6.314	7.139

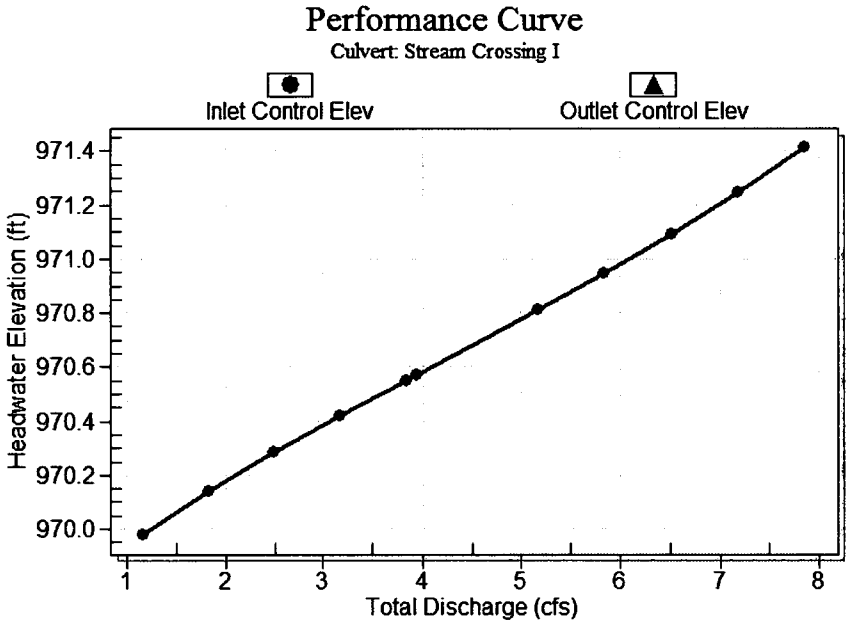
* theoretical depth is impractical. Depth reported is corrected.

****

Inlet Elevation (invert): 969.40 ft, Outlet Elevation (invert): 968.14 ft

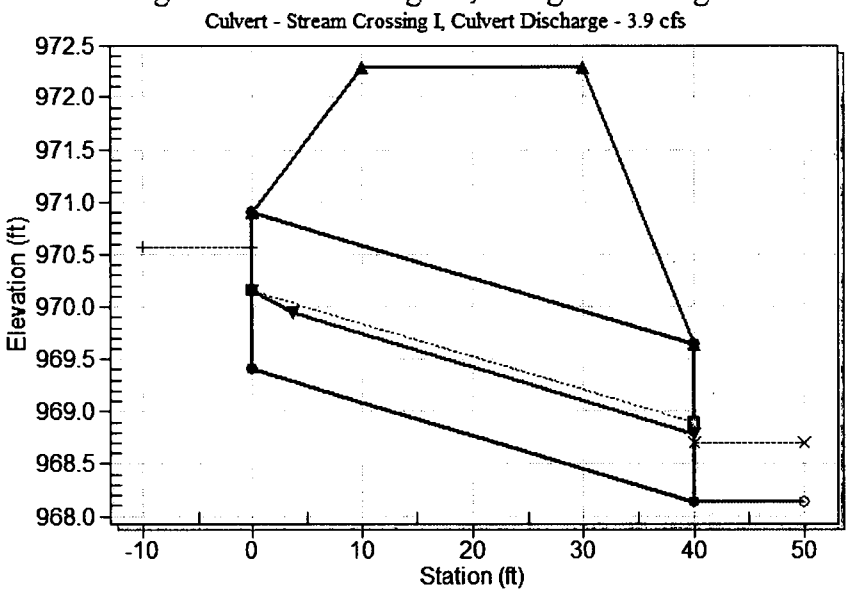
Culvert Length: 40.02 ft, Culvert Slope: 0.0315

****



Culvert Performance Curve Plot: Stream Crossing "I"

Water Surface Profile Plot for Culvert: Stream Crossing "I"



Site Data - Stream Crossing "I"

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 969.40 ft

Outlet Station: 40.00 ft

Outlet Elevation: 968.14 ft

Number of Barrels: 1

Culvert Data Summary - Stream Crossing "I"

Barrel Shape: Circular

Barrel Diameter: 1.50 ft

Barrel Material: Corrugated PE

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Thin Edge Projecting

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: Stream Crossing "I")

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
1.16	968.50	0.36	4.43	2.79	1.84
1.83	968.56	0.42	4.96	3.31	1.90
2.50	968.62	0.48	5.36	3.72	1.93
3.17	968.66	0.52	5.69	4.07	1.96
3.84	968.70	0.56	5.97	4.37	1.99
3.94	968.71	0.57	6.01	4.42	1.99
5.17	968.77	0.63	6.43	4.89	2.02
5.84	968.80	0.66	6.63	5.12	2.04
6.51	968.82	0.68	6.81	5.34	2.05
7.18	968.85	0.71	6.98	5.53	2.07
7.85	968.87	0.73	7.14	5.72	2.08

Tailwater Channel Data - Stream Crossing "I"

Tailwater Channel Option: Irregular Channel

Channel Slope: 0.1250

User Defined Channel Cross-Section:

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	972.00	0.0350
2	15.80	970.00	0.0350
3	18.70	968.14	0.0350
4	23.40	970.00	0.0350
5	40.20	972.00	0.0350

Roadway Data for Crossing: Stream Crossing "I"

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

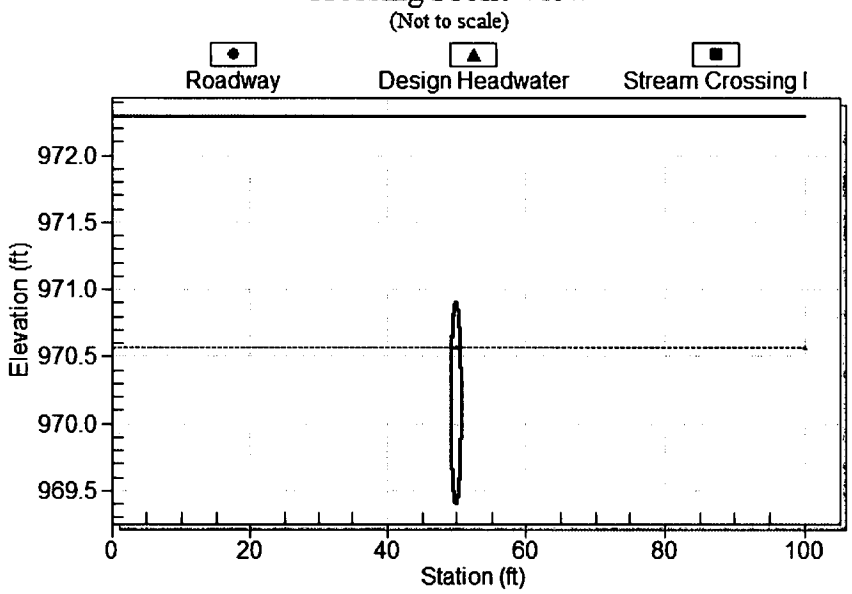
Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
0	0.00	972.29
1	50.00	972.29
2	100.00	972.29

Roadway Surface: Gravel

Roadway Top Width: 20.00 ft

Crossing Front View (Roadway Profile): Stream Crossing "I"

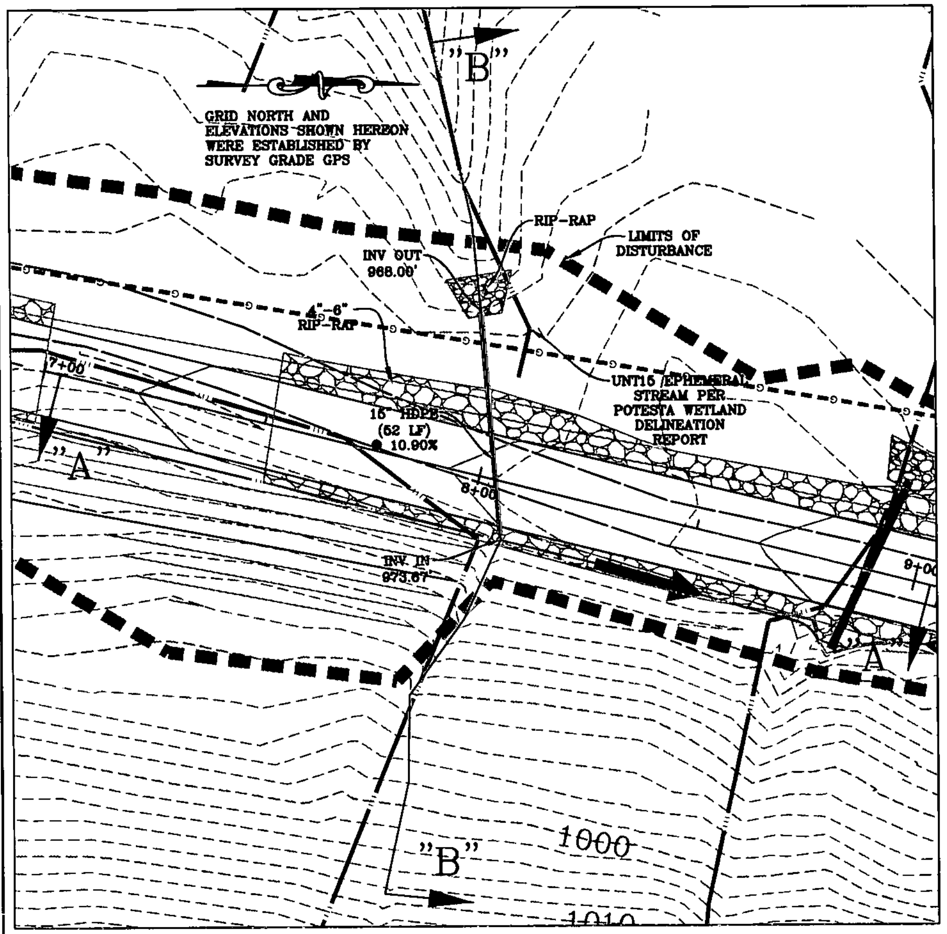


SECTION 5

Stream Crossing "I" Details

STREAM CROSSING DETAILS

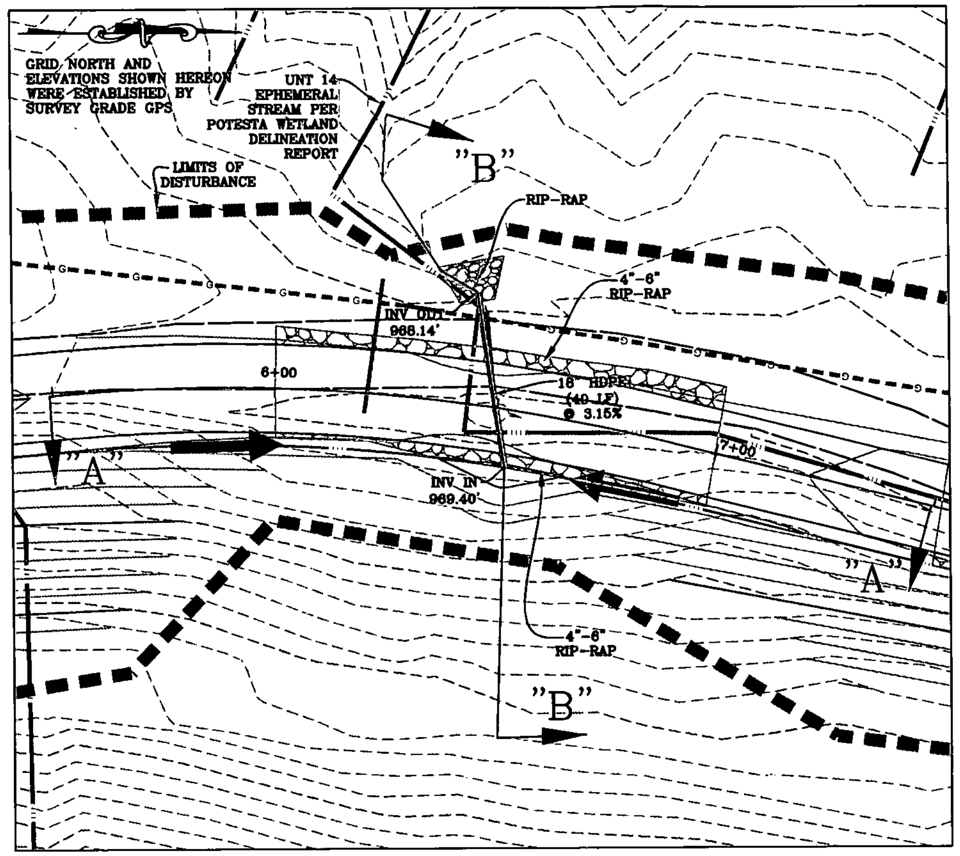
STREAM CROSSING "H" DETAILS



20 10 0 20 40

SCALE: 1" = 20'

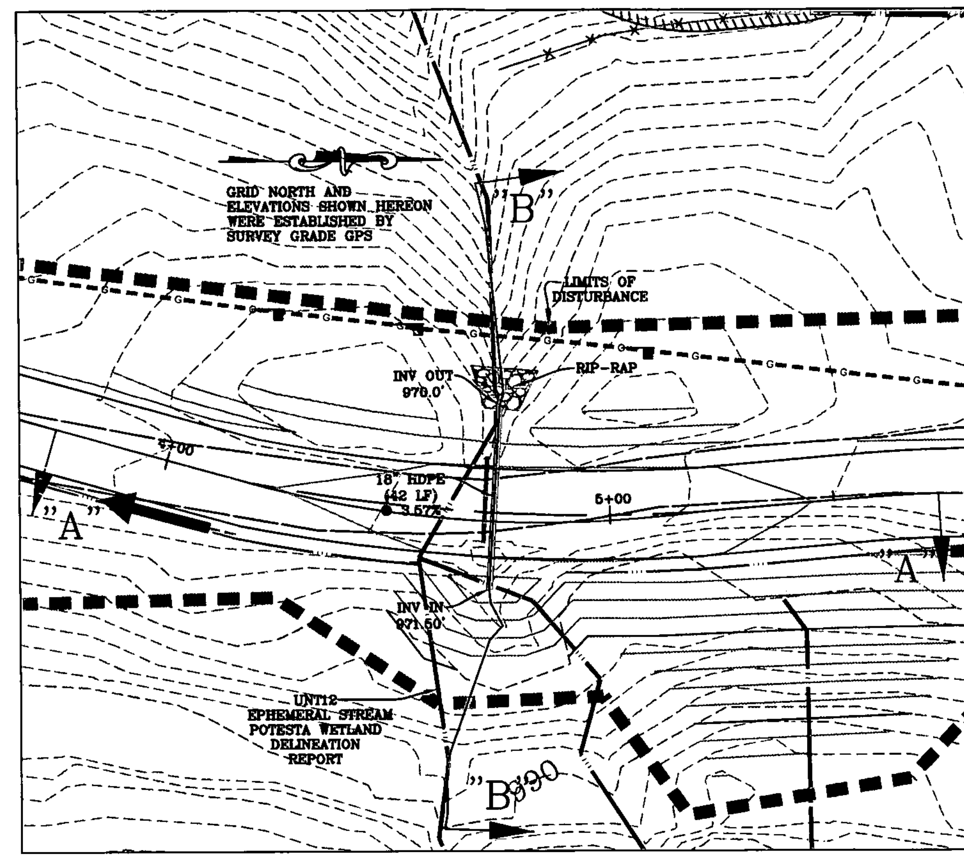
STREAM CROSSING "I" DETAILS



20 10 0 20 40

SCALE: 1" = 20'

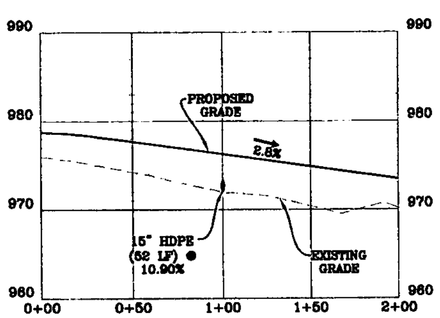
STREAM CROSSING "J" DETAILS



20 10 0 20 40

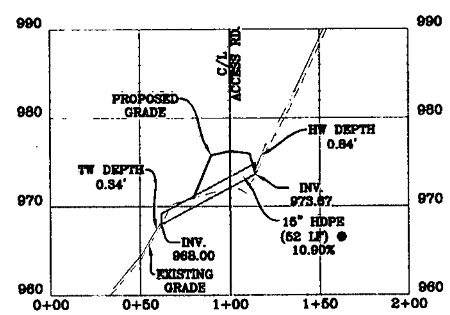
SCALE: 1" = 20'

STREAM CROSSING "H" SECTIONS



CROSS SECTION "A-A"

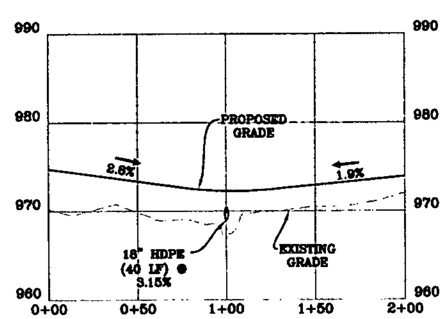
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

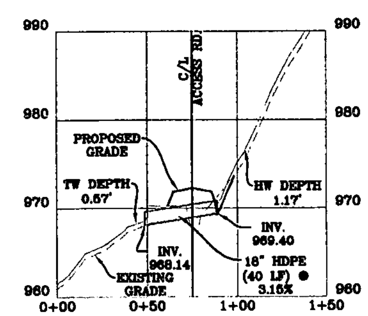
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

STREAM CROSSING "I" SECTIONS



CROSS SECTION "A-A"

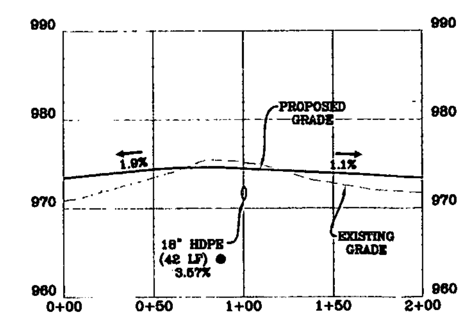
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

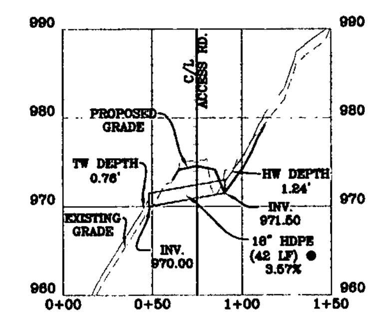
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

STREAM CROSSING "J" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

GENERAL STREAM CROSSING NOTES:

1) IF MULTIPLE CULVERTS ARE USED, THEY SHALL BE SEPARATED BY AT LEAST 12 INCHES OF COMPACTED AGGREGATE FILL.
2) CLEARING AND EXCAVATION OF THE STREAMBED AND BANKS SHALL BE KEPT TO A MINIMUM.
3) FILTER CLOTH SHALL BE PLACED ON THE STREAMBED AND STREAMBANKS PRIOR TO PLACEMENT OF THE PIPE CULVERTS AND AGGREGATE. THE FILTER CLOTH SHALL COVER THE STREAMBED AND EXTEND A MINIMUM OF SIX INCHES AND A MAXIMUM OF ONE FOOT BEYOND THE END OF THE CULVERTS AND BEDDING MATERIAL.
4) A WATER DIVERTING SWALE SHALL BE CONSTRUCTED ACROSS THE ROADWAY ON EITHER SIDE OF THE STREAM CROSSING.
5) APPROPRIATE PERIMETER CONTROLS SUCH AS COMPOST FILTER SOCK, SUPER SILT FENCE AND/OR SEDIMENT TRAPS SHALL BE EMPLOYED ALONG THE BANKS AND PARALLEL TO THE STREAMBED.
6) CROSS CRIBBING OF THE DOWNSTREAM SIDE OF THE CULVERT INSTALLATIONS MAY BE NEEDED TO AID IN REDUCING STRUCTURAL DAMAGE DURING HIGH VELOCITY WATER OVERFLOW PERIODS.
7) STREAMBED MATERIAL IS NOT TO BE USED AS FILL.
8) GREEN CONCRETE SHALL NOT BE PLACED IN CONTACT WITH FLOWING WATER.
9) WHEN THE CROSSING HAS SERVED ITS PURPOSE, ALL STRUCTURES INCLUDING CULVERTS, BEDDING, AND FILTER CLOTH SHALL BE REMOVED. REMOVAL OF THE STRUCTURE AND CLEAN UP OF THE AREA SHOULD BE ACCOMPLISHED WITHOUT CONSTRUCTION EQUIPMENT WORKING IN THE WATERWAY CHANNEL. UPON REMOVAL OF THE STRUCTURE, THE STREAM BANK SHALL IMMEDIATELY BE STABILIZED.
10) DURING ROUTINE MAINTENANCE DO NOT GRADE MUD AND DEBRIS OVER THE SIDES OF THE CROSSING INTO THE STREAM.
11) THE CROSSING MUST BE INSPECTED AFTER EVERY RAIN EVENT OF 0.5 INCHES OR MORE AND ONCE A WEEK TO ENSURE THAT THE CULVERTS, STREAMBED, AND STREAM BANKS ARE MAINTAINED AND NOT DAMAGED. NEVER ALLOW THE CULVERTS TO BECOME CLOGGED WITH DEBRIS AND REMOVE ANY OBSTRUCTIONS IMMEDIATELY.
12) FLUSHING IS NOT AN APPROVED METHOD TO BE UTILIZED FOR CULVERT CLEANOUT.

NOTE:

1) SEE STREAM CROSSING REPORT BY NAVITUS ENGINEERING FOR CULVERT AND DRAINAGE COMPUTATATIONS.
2) EQT SHALL OBTAIN A STREAM ACTIVITY PERMIT THROUGH THE PUBLIC LAND CORPORATION OFFICE OF LAND AND STREAMS FOR STREAM CROSSING "H", "I" & "J".

NAVITUS ENERGY ENGINEERING
Telephone: (888) 662-4185 | www.NavitusEng.com

Professional Energy Consultants
A DIVISION OF SMITH LAND SURVEYING, INC.
SLS
SURVEYORS ENGINEERS ENVIRONMENTAL PROJECT MGMT.
(304) 462-5634
WWW.SLSSURVEYS.COM

MARK O. SMITH No. 11709 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER

06/03/2014

THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

MINOR STREAM CROSSING DETAILS

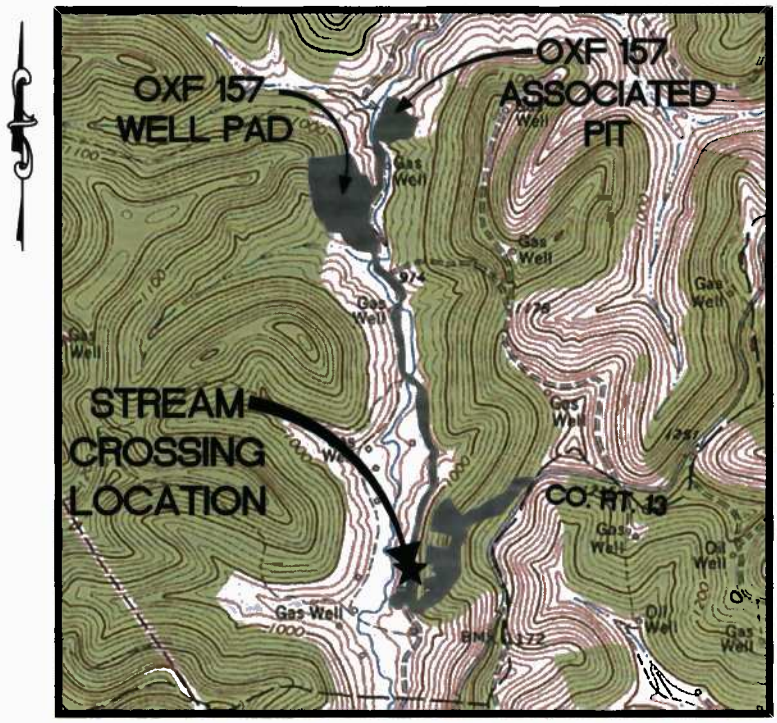
OXF 157

WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013	
SCALE: N/A	
DESIGNED BY:	CSK
FILE NO.	7869
SHEET 26 OF 32	
REV: 06/03/2014	

STREAM CROSSING "J"
STORMWATER COMPUTATIONS

OXF 157 WELL PAD



VICINITY MAP
1" = 2,000'

NAVITUS
ENERGY ENGINEERING
Telephone: (888) 662-4185 | www.NavitusEng.com

Prepared For:
EQT Production Company
115 Professional Place
P.O. Box 280
Bridgeport, WV 26330

Contact:
Victoria J. Roark
Permitting Supervisor
(304) 848-0076

Designed By:
Navitus Engineering Inc.

Project Manager:
Chandler Pearson
cpearson@navituseng.com

Date: June 3, 2014

Surface Owner (s)
Justin L. Henderson

Tax Parcel:
Map 6 Parcel 1

Location:
West Union District, Doddridge County
West Virginia

FN# 7889

OXF 157 WELL PAD

STREAM CROSSING "J"

STORMWATER COMPUTATIONS

Sections

SECTION 1

Overview

The intent of this project is to construct a gravel access road to a gas well pad site and associated facilities. This project will include a permanent stream crossing. UNT 12, which has been classified as a ephemeral stream per the wetlands report conducted by Potesta Engineers and Environmental Consultants dated May 29, 2013, will be crossed at station 04+73.962 of the proposed access road.

Drainage Narrative

Using the SCS Method, we determined the 1, 10, and 100-year rainfall events at the stream crossing study point. We then used HY-8 to design the culvert and to determine the base flow water surface elevation for each rainfall event. Stream Crossing "J" has a drainage area of 2.70 Acres. Design flows are provided in the drainage calculations in Section 3.

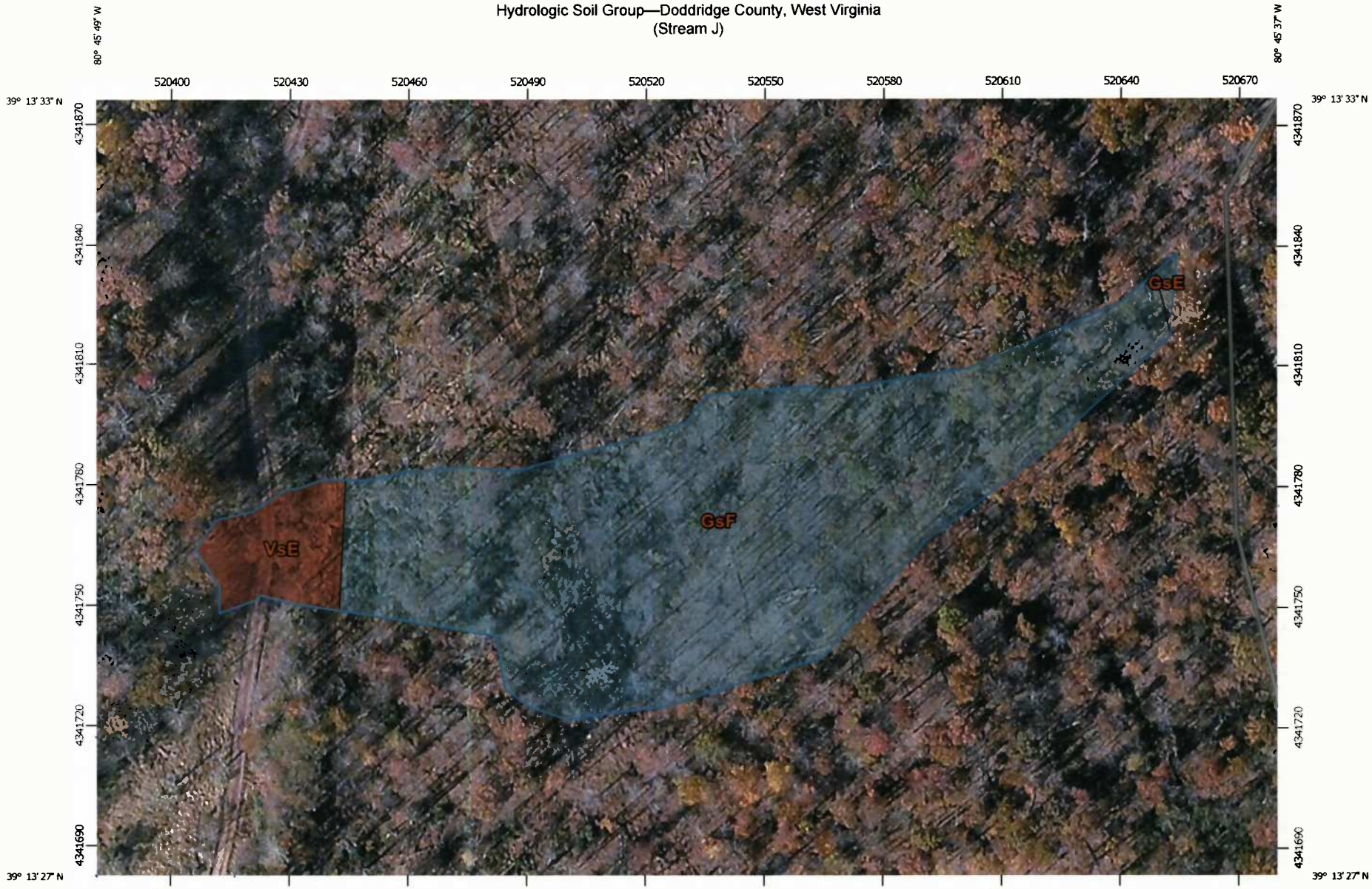
The permanent stream crossing was designed per the West Virginia Department of Environmental Protection Erosion and Sediment Control Best Management Practice Manual 2006 edition, Section 3.21-21. Per this manual, any structure that will remain in place 6 months or longer shall be large enough to convey the flow from a 10-year frequency, 24 hour duration storm. This culvert is sized to handle the computed 10-year storm event flow of 4.34 cfs.

The stream crossing was also designed as a permanent structure in accordance with the U.S. Army Corps of Engineering Nationwide 14 Permit. The structure is a 18 inch high-density polyethylene pipe culvert. The culvert is 42.00 LF with a slope of 3.57%. The stream crossing will contain clean rock fill made of 2-4" aggregate 50 feet on each side of the culvert for the first 6" of fill, the remainder of material shall be only large angular rock. No erodible material or green concrete shall be used in the crossing. The permanent stream crossing will impact 90.3' of the ephemeral stream, UNT 12.

SECTION 2

NRCS Soils Report

Hydrologic Soil Group—Doddridge County, West Virginia
(Stream J)



Map Scale: 1:1,360 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 20 40 80 120

Feet
0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

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

Soils

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

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

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

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: Doddridge County, West Virginia
Survey Area Data: Version 8, Apr 2, 2009

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 8, 2011—Oct 25, 2011

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Doddridge County, West Virginia (WV017)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
GsE	Gilpin-Peabody complex, 15 to 35 percent slopes, very stony	C	0.0	0.5%
GsF	Gilpin-Peabody complex, 35 to 70 percent slopes, very stony	C	2.5	91.5%
VsE	Vandalia silt loam, 15 to 35 percent slopes, very stony	D	0.2	8.0%
Totals for Area of Interest			**2.7**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

SECTION 3

SCS TR-55

Drainage Computations

Runoff Curve Number (CN)

Cover Description	CN	Soil Group	Area (Acre)
Meadow (Good)	58	B	0.00
Meadow (Good)	78	D	0.00
Woods (Good)	55	B	0.00
Woods (Good)	70	C	2.50
Woods (Good)	77	D	0.20
CN (weighted):	71		
Total Area:	2.70	Acre(s)	

Time of Concentration (SCS)

Curve Number:	71	
Length of Flow:	973.07	ft
Average Land Slope:	29.93	%
Time of Concentration:	0.123	hrs

Runoff Hydrograph: SCS Method

Input Data:		
Drainage Area	2.70	Acre(s)
Runoff Curve Number, CN	71	
Time of Concentration	0.123	hrs
Base Flow	0.00	cfs
Antecendent Moisture Condition	Type II	
Rainfall Distribution Type	Type II	24 hr
Rainfall Depth, 1-year	2.15	in
Rainfall Depth, 10-year	3.54	in
Rainfall Depth, 100-year	5.17	in
Peak Rate Factor	484	
Computed Results, 1 year:		
Time to Peak	12.20	hrs
Peak Discharge, 1-year	1.19	cfs
Runoff Volume, 1-year	0.07	acre-ft
Computed Results, 10 year:		
Time to Peak	12.20	hrs
Peak Discharge	4.34	cfs
Runoff Volume	0.24	acre-ft
Computed Results, 100 year:		
Time to Peak	12.20	hrs
Peak Discharge	8.81	cfs
Runoff Volume	0.50	acre-ft

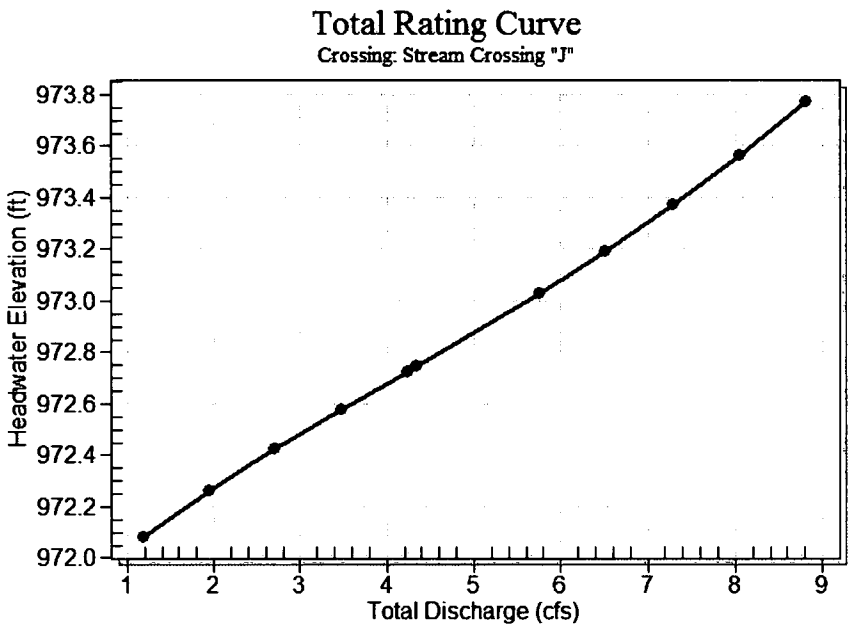
SECTION 4

HY-8 Culvert Analysis Report and Sections

HY-8 Culvert Analysis Report

Headwater Elevation (ft)	Total Discharge (cfs)	Stream Crossing J Discharge (cfs)	Roadway Discharge (cfs)	Iterations
972.08	1.19	1.19	0.00	1
972.26	1.95	1.95	0.00	1
972.42	2.71	2.71	0.00	1
972.58	3.48	3.48	0.00	1
972.72	4.24	4.24	0.00	1
972.74	4.34	4.34	0.00	1
973.03	5.76	5.76	0.00	1
973.19	6.52	6.52	0.00	1
973.37	7.29	7.29	0.00	1
973.56	8.05	8.05	0.00	1
973.77	8.81	8.81	0.00	1
976.00	14.23	14.23	0.00	Overtopping

Table 1 - Summary of Culvert Flows at Crossing: Stream Crossing "J"



Rating Curve Plot for Crossing: Stream Crossing "J"

Table 2 - Culvert Summary Table: Stream Crossing J

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
1.19	1.19	972.08	0.584	0.0*	1-S2n	0.332	0.402	0.332	0.467	4.163	5.169
1.95	1.95	972.26	0.762	0.0*	1-S2n	0.430	0.522	0.431	0.562	4.638	5.850
2.71	2.71	972.42	0.924	0.0*	1-S2n	0.510	0.623	0.513	0.636	5.067	6.352
3.48	3.48	972.58	1.077	0.0*	1-S2n	0.585	0.708	0.587	0.698	5.415	6.757
4.24	4.24	972.72	1.225	0.0*	1-S2n	0.652	0.786	0.655	0.752	5.706	7.101
4.34	4.34	972.74	1.244	0.0*	1-S2n	0.661	0.796	0.665	0.758	5.734	7.143
5.76	5.76	973.03	1.528	0.0*	5-S2n	0.780	0.924	0.780	0.843	6.204	7.668
6.52	6.52	973.19	1.692	0.0*	5-S2n	0.842	0.985	0.844	0.884	6.376	7.909
7.29	7.29	973.37	1.869	0.0*	5-S2n	0.904	1.045	0.905	0.921	6.539	8.131
8.05	8.05	973.56	2.062	0.0*	5-S2n	0.968	1.095	0.969	0.956	6.674	8.336
8.81	8.81	973.77	2.274	0.0*	5-S2n	1.032	1.145	1.035	0.989	6.781	8.526

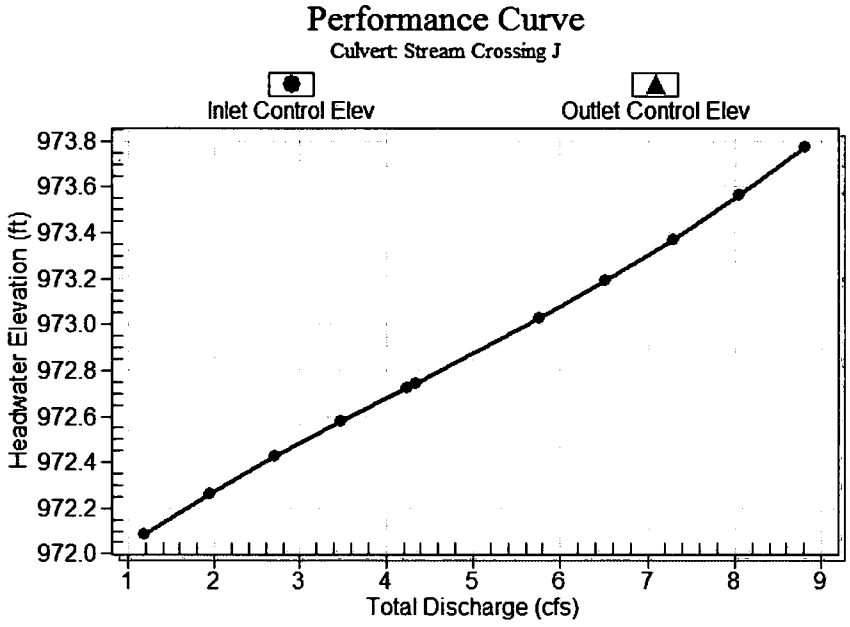
* theoretical depth is impractical. Depth reported is corrected.

****

Inlet Elevation (invert): 971.50 ft, Outlet Elevation (invert): 970.00 ft

Culvert Length: 42.03 ft, Culvert Slope: 0.0357

****

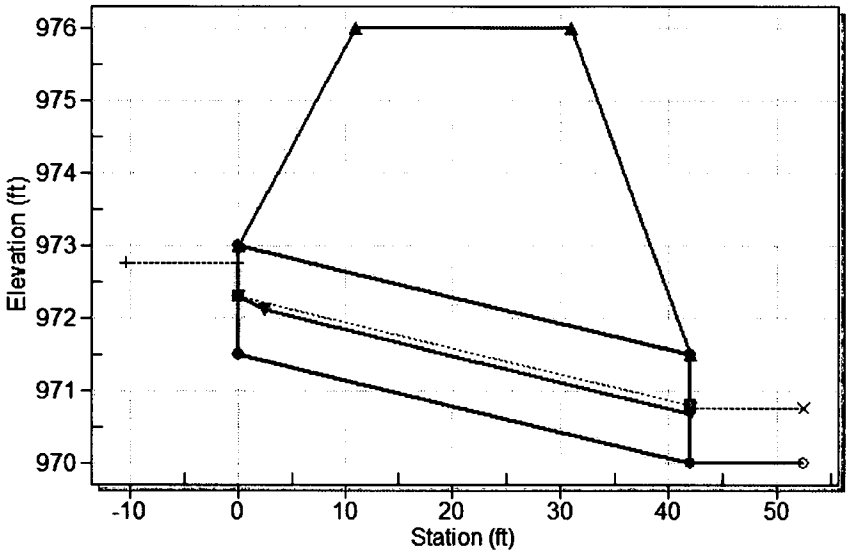


Culvert Performance Curve Plot: Stream Crossing J

Water Surface Profile Plot for Culvert: Stream Crossing J

Crossing - Stream Crossing "J", Design Discharge - 4.3 cfs

Culvert - Stream Crossing J, Culvert Discharge - 4.3 cfs



Site Data - Stream Crossing J

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 971.50 ft

Outlet Station: 42.00 ft

Outlet Elevation: 970.00 ft

Number of Barrels: 1

Culvert Data Summary - Stream Crossing J

Barrel Shape: Circular

Barrel Diameter: 1.50 ft

Barrel Material: Corrugated PE

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Inlet Type: Conventional

Inlet Edge Condition: Thin Edge Projecting

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: Stream Crossing "J")

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
1.19	970.47	0.47	5.17	4.60	1.89
1.95	970.56	0.56	5.85	5.54	1.94
2.71	970.64	0.64	6.35	6.27	1.99
3.48	970.70	0.70	6.76	6.88	2.02
4.24	970.75	0.75	7.10	7.41	2.04
4.34	970.76	0.76	7.14	7.48	2.04
5.76	970.84	0.84	7.67	8.32	2.08
6.52	970.88	0.88	7.91	8.71	2.10
7.29	970.92	0.92	8.13	9.08	2.11
8.05	970.96	0.96	8.34	9.43	2.12
8.81	970.99	0.99	8.53	9.75	2.14

Tailwater Channel Data - Stream Crossing "J"

Tailwater Channel Option: Irregular Channel

Channel Slope: 0.1580

User Defined Channel Cross-Section:

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	974.00	0.0350
2	4.15	970.00	0.0350
3	8.45	974.00	0.0350

Roadway Data for Crossing: Stream Crossing "J"

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

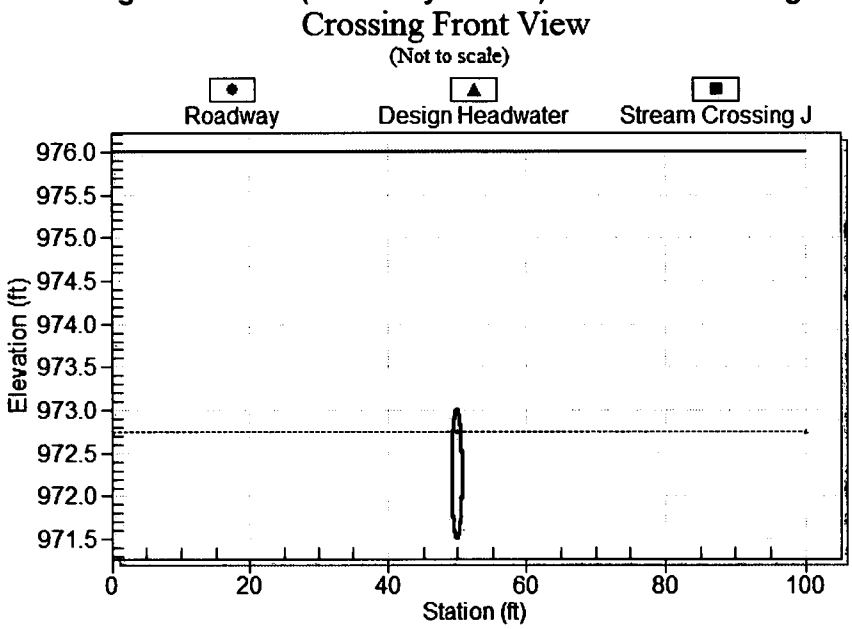
Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
0	0.00	976.00
1	50.00	976.00
2	100.00	976.00

Roadway Surface: Gravel

Roadway Top Width: 20.00 ft

Crossing Front View (Roadway Profile): Stream Crossing "J"

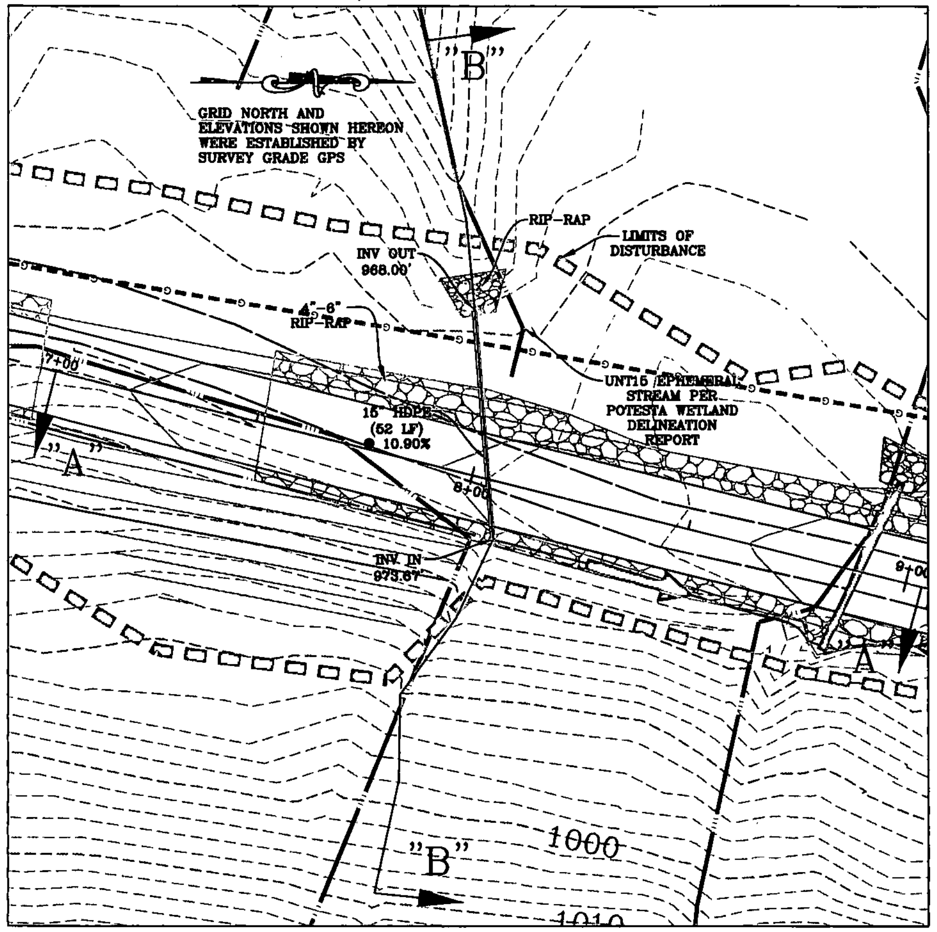


SECTION 5

Stream Crossing "J" Details

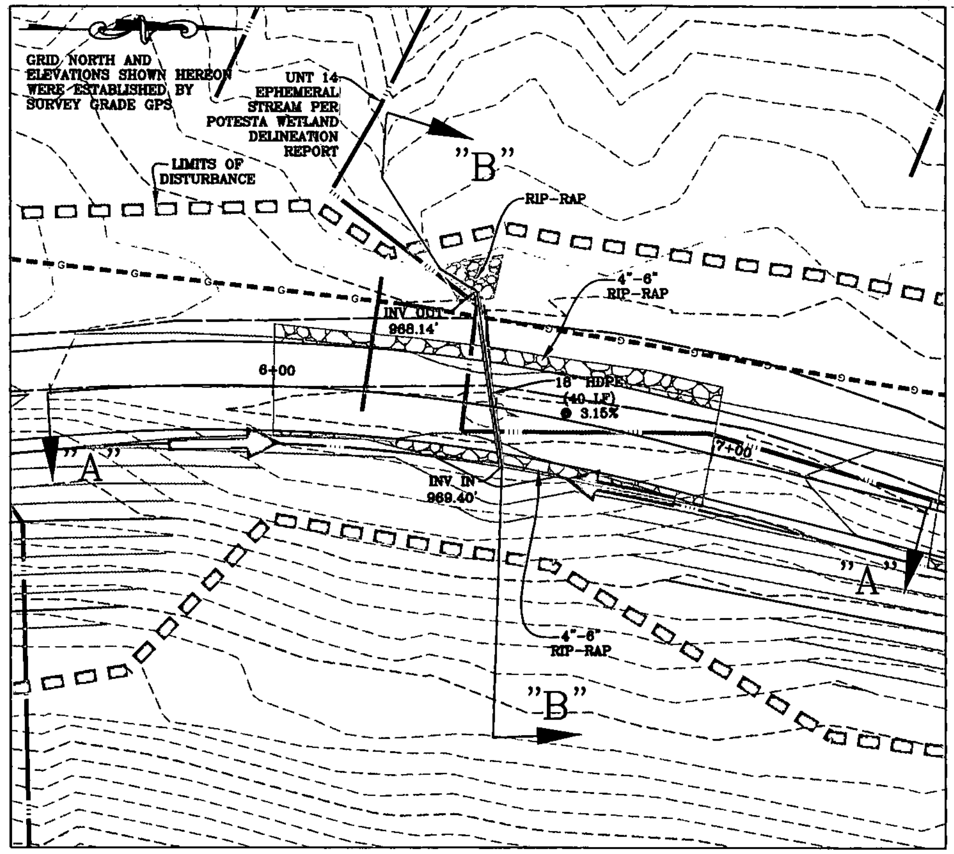
STREAM CROSSING DETAILS

STREAM CROSSING "H" DETAILS



20 10 0 20 40
SCALE: 1" = 20'

STREAM CROSSING "I" DETAILS



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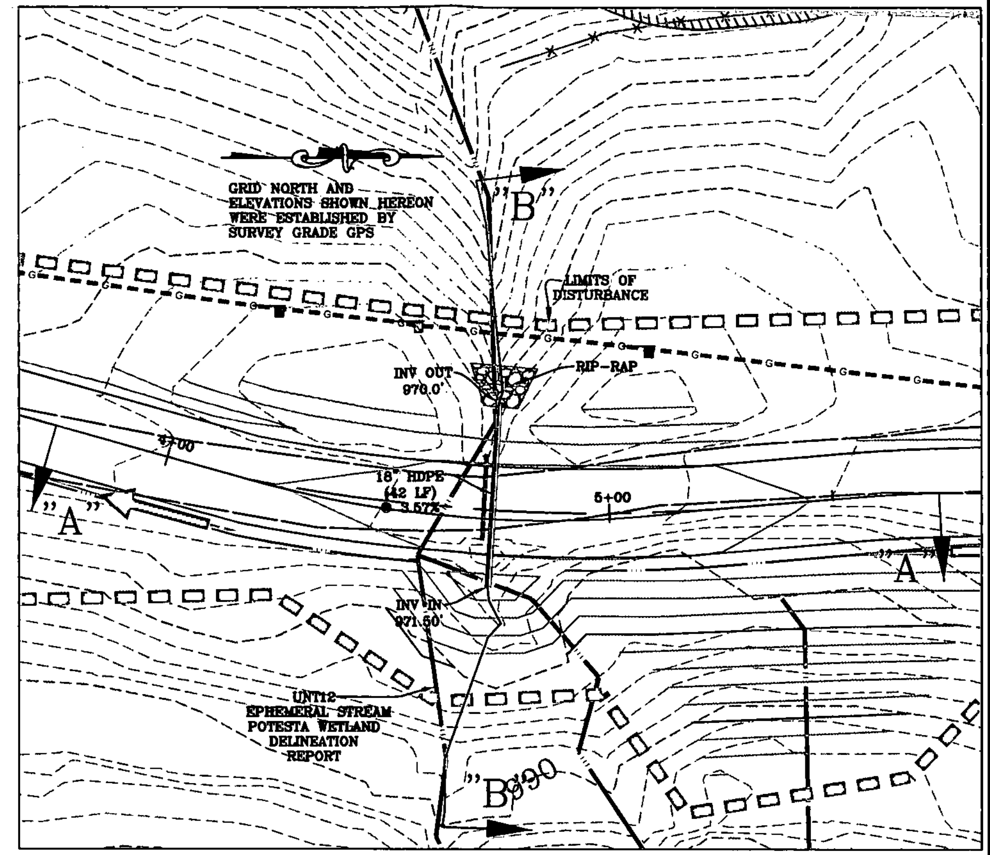
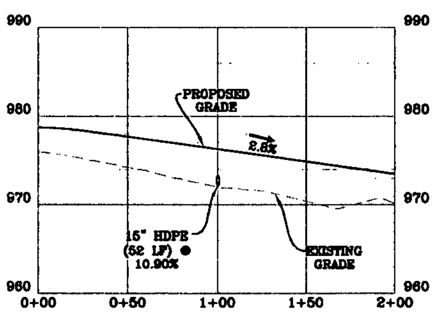
SCALE: 1" = 20'

STREAM CROSSING "J" DETAILS

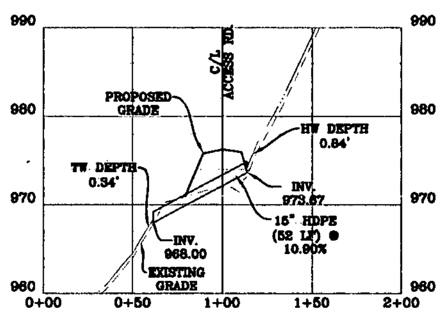


20 10 0 20 40
SCALE: 1" = 20'

STREAM CROSSING "H" SECTIONS

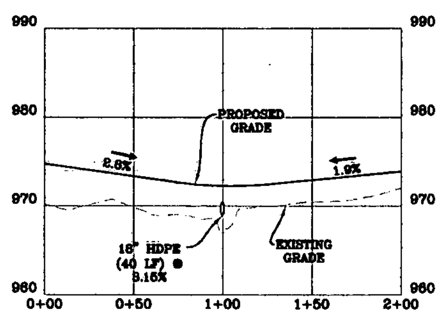


CROSS SECTION "A-A"
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

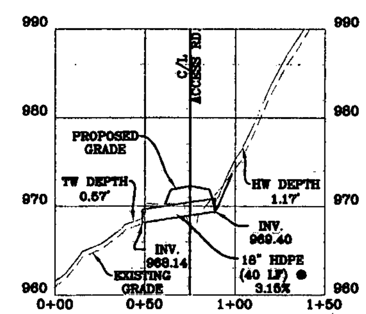


CROSS SECTION "B-B"
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

STREAM CROSSING "I" SECTIONS

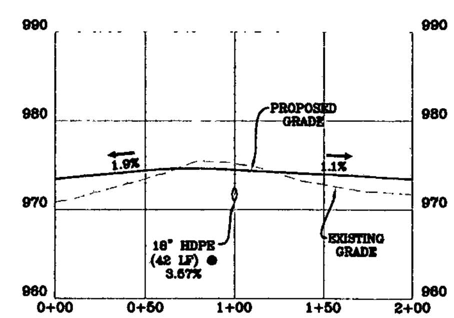


CROSS SECTION "A-A"
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

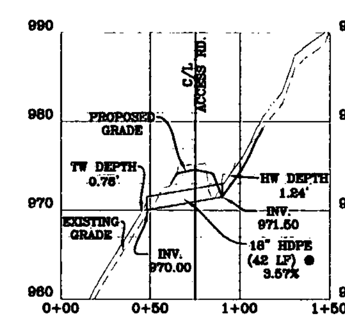


CROSS SECTION "B-B"
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

STREAM CROSSING "J" SECTIONS



CROSS SECTION "A-A"
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

GENERAL STREAM CROSSING NOTES:

1) IF MULTIPLE CULVERTS ARE USED, THEY SHALL BE SEPARATED BY AT LEAST 12 INCHES OF COMPACTED AGGREGATE FILL.
2) CLEARING AND EXCAVATION OF THE STREAMBED AND BANKS SHALL BE KEPT TO A MINIMUM.
3) FILTER CLOTH SHALL BE PLACED ON THE STREAMBED AND STREAMBANKS PRIOR TO PLACEMENT OF THE PIPE CULVERTS AND AGGREGATE. THE FILTER CLOTH SHALL COVER THE STREAMBED AND EXTEND A MINIMUM OF SIX INCHES AND A MAXIMUM OF ONE FOOT BEYOND THE END OF THE CULVERTS AND BEDDING MATERIAL.
4) A WATER DIVERTING SWALE SHALL BE CONSTRUCTED ACROSS THE ROADWAY ON EITHER SIDE OF THE STREAM CROSSING.
5) APPROPRIATE PERIMETER CONTROLS SUCH AS COMPOST FILTER SOCK, SUPER SILT FENCE AND/OR SEDIMENT TRAPS SHALL BE EMPLOYED ALONG THE BANKS AND PARALLEL TO THE STREAMBED.
6) CROSS CRIBBING OF THE DOWNSTREAM SIDE OF THE CULVERT INSTALLATIONS MAY BE NEEDED TO AID IN REDUCING STRUCTURAL DAMAGE DURING HIGH VELOCITY WATER OVERFLOW PERIODS.
7) STREAMBED MATERIAL IS NOT TO BE USED AS FILL.
8) GREEN CONCRETE SHALL NOT BE PLACED IN CONTACT WITH FLOWING WATER.
9) WHEN THE CROSSING HAS SERVED ITS PURPOSE, ALL STRUCTURES INCLUDING CULVERTS, BEDDING, AND FILTER CLOTH SHALL BE REMOVED. REMOVAL OF THE STRUCTURE AND CLEAN UP OF THE AREA SHOULD BE ACCOMPLISHED WITHOUT CONSTRUCTION EQUIPMENT WORKING IN THE WATERWAY CHANNEL. UPON REMOVAL OF THE STRUCTURE, THE STREAM BANK SHALL IMMEDIATELY BE STABILIZED.
10) DURING ROUTINE MAINTENANCE DO NOT GRADE MUD AND DEBRIS OVER THE SIDES OF THE CROSSING INTO THE STREAM.
11) THE CROSSING MUST BE INSPECTED AFTER EVERY RAIN EVENT OF 0.5 INCHES OR MORE AND ONCE A WEEK TO ENSURE THAT THE CULVERTS, STREAMBED, AND STREAM BANKS ARE MAINTAINED AND NOT DAMAGED. NEVER ALLOW THE CULVERTS TO BECOME CLOGGED WITH DEBRIS AND REMOVE ANY OBSTRUCTIONS IMMEDIATELY.
12) FLUSHING IS NOT AN APPROVED METHOD TO BE UTILIZED FOR CULVERT CLEANOUT.

NOTE:

1) SEE STREAM CROSSING REPORT BY NAVITUS ENGINEERING FOR CULVERT AND DRAINAGE COMPUTATIONS.
2) EQT SHALL OBTAIN A STREAM ACTIVITY PERMIT THROUGH THE PUBLIC LAND CORPORATION OFFICE OF LAND AND STREAMS FOR STREAM CROSSING "H", "I" & "J".

NAVITUS ENERGY ENGINEERING
Telephone: (888) 662-4185 | www.NavitusEng.com

Professional Energy Consultants
A DIVISION OF SMITH LAND SURVEYING, INC.
SLS
SURVEYORS
ENGINEERS
ENVIRONMENTAL
PROJECT MGMT.
(304) 462-5634
WWW.SLSSURVEYS.COM

No. 11703
STATE OF WEST VIRGINIA
PROFESSIONAL ENGINEER
06/03/2014

THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

MINOR STREAM CROSSING DETAILS
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE:	11/04/2013
SCALE:	N/A
DESIGNED BY:	CSK
FILE NO.	7889
SHEET	26 OF 32
REV:	06/03/2014

Re EQT Prod. Co.
OXF 157 Proposed Well
Pad

No map was inclosed

Please send map

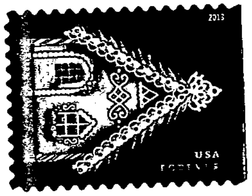
Thank You

Arden + Ann
Ashcraft
PO Box 189
West Union WV
new 911 add.
4790 Maxwell Ridge Rd

Arden Ashcraft
PO Box 189
West Union, WV 26456-0189

FILED
2015 DEC 17 AM 11:17
...ERS
CLERK
DODDRIDGE COUNTY, WV

George Eddy
Dodd. Co. Flood Plain MGT
108 Court St, St 1
West Union WV
26456



The Doddridge Independent

The Doddridge Independent
PUBLISHER'S CERTIFICATE

I, Michael D. Zorn, Publisher of The Doddridge Independent, A newspaper of general circulation published in the town of West Union, Doddridge County, West Virginia, do hereby certify that:

Permit Application # 15-404
Please take notice that on the 30th day of October, 2015
EQT Production Company
filed an application for a Floodplain Permit to develop land located at or about
OXF 157 Proposed Well Pad, Associated Pit and Access RD
Location: West of Maxwell Ridge along Bluestone Creek off County Rt. 13
Received: 11/20/2015
Announced: 12/01/2015
Publication Date: Week of 11/23/15
20-Day Comment Period Window (from Commission Meeting) 12/21/2015
90-Day Approval Window (from date of receipt) N/A
Project Description: Well Pad/Pit/Access Rd

was published in The Doddridge Independent
2 times commencing on Friday, November 27, 2015 and
Ending on Friday, December 4, 2015 at the request of:

George Eidel, Doddridge County Floodplain Manager& Doddridge County Commission

Given under my hand this Monday, December 7, 2015

The publisher's fee for said publication is:
$ 25.27 1st Run/$ 18.95 Subsequent Runs
This Legal Ad Total: $ 44.22

Michael D. Zorn
Publisher of The Doddridge Independent

Subscribed to and sworn to before me on
this date: 12/7/15

Notary Public in and for Doddridge County
My Commission expires on
The 17th day of May 2019

Public Notice • Legal Notice

Doddridge ~~County~~
Permit Application # 15-404
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20-Day Comment Period Window (from Commission Meeting) 12/21/2015
90-Day Approval Window (from date of receipt) N/A
Project Description: Well Pad/Pit/Access Rd
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 floodplain 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 November 30 , 2015, delivered to:
Clerk of the County Court
118 E. Court Street, West Union, WV 26456
Beth A Rogers, Doddridge County Clerk
George Eidel. Doddridge County Flood Plain Manager
11/27 - 12/04

OXF 157 SITE PLAN
EQT PRODUCTION COMPANY

(PROPOSED WELLS NO. WV 513144, WV 513145, WV 513146, WV 513147, WV 513148, WV 513149, WV 514089 & WV 514090)

SITUATE ON THE WATERS OF BLUESTONE CREEK IN WEST UNION DISTRICT, DODDRIDGE COUNTY, WEST VIRGINIA.

PROJECT INFORMATION

PROJECT NAME: OXF 157 H1-H8

TAX PARCEL:
WEST UNION DISTRICT
MAP 6-1

SURFACE OWNER:
JUSTIN L. HENDERSON
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV
TOTAL PROPERTY AREA: 1,602.9 ± ACRES

OIL AND GAS ROYALTY OWNER:
LEEMAN MAXWELL HRS
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV
TOTAL PROPERTY AREA: 2,164 ± ACRES

SITE LOCATION:
THE OXF 157 SITE IS WEST OF MAXWELL RIDGE ALONG BLUESTONE CREEK OFF COUNTY ROUTE 13. THE ENTRANCE TO THE SITE IS APPROXIMATELY 3/4 MILE SOUTHWEST OF THE CO. RT. 13 AND CO. RT. 13/3 INTERSECTION.

LOCATION COORDINATES

OXF 157 SITE ENTRANCE
LATITUDE: 39.227701 LONGITUDE: -80.758964 (NAD 83)

OXF 157 H1-H8 WELL PAD ENTRANCE
LATITUDE: 39.234468 LONGITUDE: -80.764983 (NAD 83)

OXF 157 H1-H8 WELL PAD
LATITUDE: 39.236047 LONGITUDE: -80.766261 (NAD 83)

OXF 157 ASSOCIATED PIT
LATITUDE: 39.238452 LONGITUDE: -80.764291 (NAD 83)

SITE DISTURBANCE COMPUTATIONS

ROAD A PHASE I= 11.7 ± ACRES (ROAD A PHASE I & STOCKPILES A-D)
WELL PAD AREA = 9.7 ± ACRES (PAD, PORTION OF ROAD B & STOCKPILES E-F)
ASSOCIATED PIT AREA = 3.2 ± ACRES (PIT, ROAD D & STOCKPILE G)
ACCESS ROAD = 12.7 ± ACRES (ROADS B, C & STOCKPILE H)
TOTAL SITE DISTURBANCE = 37.3 ± ACRES

ENTRANCE PERMIT

EQT PRODUCTION COMPANY WILL OBTAIN AN ENCROACHMENT PERMIT (FORM MM-109) FROM THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS, PRIOR TO COMMENCEMENT OF CONSTRUCTION ACTIVITIES.

MISS UTILITY STATEMENT

MISS UTILITY OF WEST VIRGINIA WAS NOTIFIED FOR THE LOCATING OF UTILITIES PRIOR TO THIS PROJECT DESIGN; TICKET #1328176253. IN ADDITION, MISS UTILITY WILL BE CONTACTED PRIOR TO START OF THE PROJECT.

FLOODPLAIN NOTE

THE PROPOSED LIMITS OF DISTURBANCE FOR THIS PROJECT IS LOCATED IN FEMA FLOOD ZONE X and A, PER THE FLOOD INSURANCE RATE MAP (FIRM) NUMBER 54017C0225C, DATED OCTOBER 4, 2011.

ENVIRONMENTAL NOTES

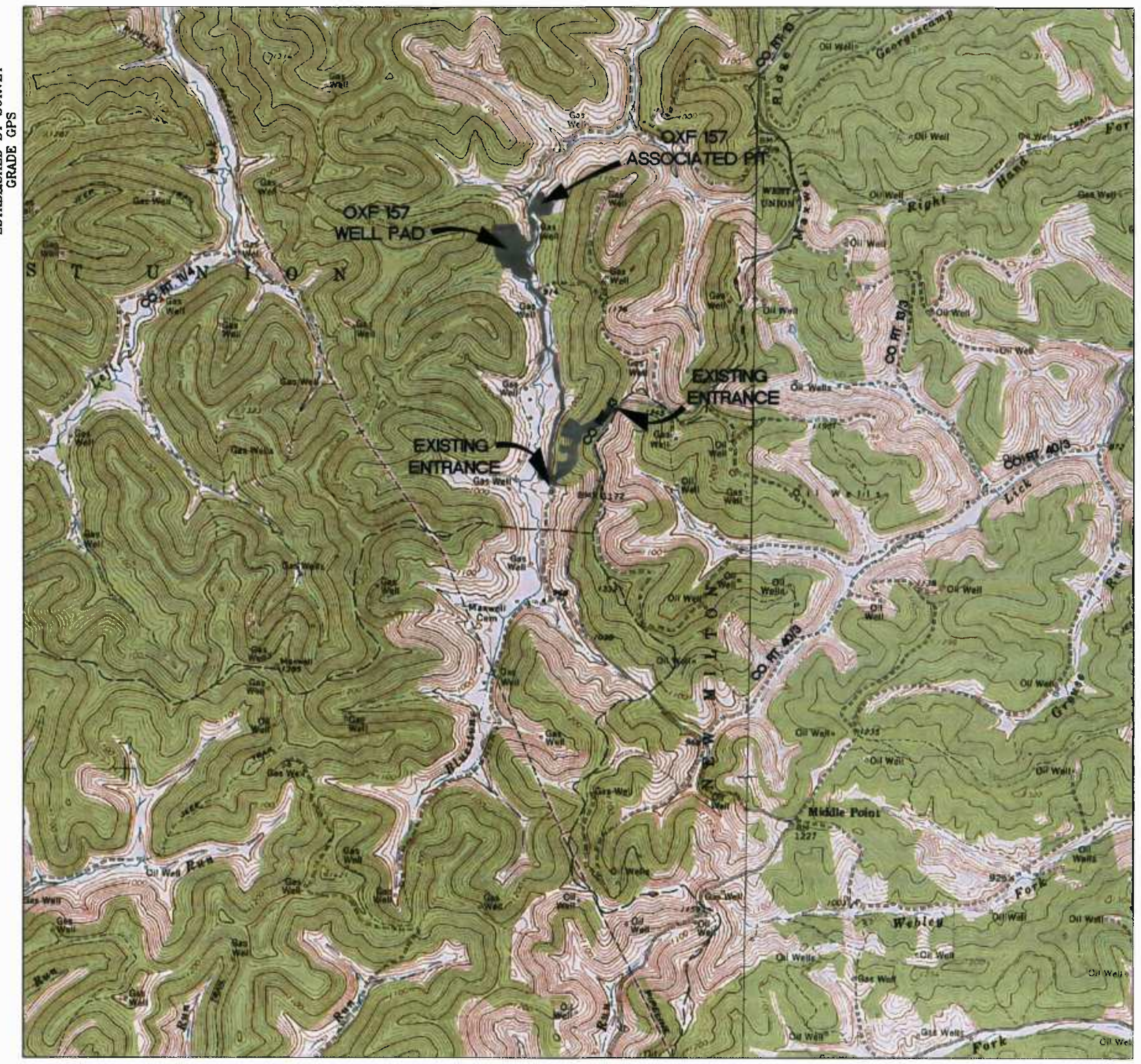
A WETLAND DELINEATION WAS PERFORMED ON APRIL 25-26, 2013 BY POTESTA AND ASSOCIATES, INC. TO REVIEW THE SITE FOR WATERS AND WETLANDS THAT ARE MOST LIKELY WITHIN THE REGULATORY PURVIEW OF THE U.S. ARMY CORPS OF ENGINEERS (USACE) AND/OR THE WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION (WVDEP). THE MAY 29, 2013 REPORT PROJECT # 0101-11-147-15701 WAS PREPARED BY POTESTA AND ASSOCIATES, INC. SUMMARIZES THE RESULTS OF THE FIELD DELINEATION. THE REPORT DOES NOT, IN ANY WAY, REPRESENT A JURISDICTIONAL DETERMINATION OF THE LANDWARD LIMITS OF WATERS AND WETLANDS WHICH MAY BE REGULATED BY THE USACE OR THE WVDEP. IT IS STRONGLY RECOMMENDED THAT THE AFOREMENTIONED AGENCIES BE CONSULTED IN AN EFFORT TO GAIN WRITTEN CONFIRMATION OF THE DELINEATION DESCRIBED BY THIS REPORT PRIOR TO ENGAGING CONSTRUCTION ON THE PROPERTY DESCRIBED HEREIN. THE DEVELOPER SHALL OBTAIN THE APPROPRIATE PERMITS FROM THE FEDERAL AND/OR STATE REGULATORY AGENCIES PRIOR TO ANY PROPOSED IMPACTS TO WATERS OF THE U.S., INCLUDING WETLAND FILLS AND STREAM CROSSINGS.

GENERAL DESCRIPTION

THE WELL PAD & ASSOCIATED PIT IS BEING CONSTRUCTED TO AID IN THE DEVELOPMENT OF INDIVIDUAL MARCELLUS SHALE GAS WELLS.

MISS Utility of West Virginia
1-800-245-4848
West Virginia State Law
(Section XIV: Chapter 24-C)
Requires that you call two business days before you dig in the state of West Virginia.
IT'S THE LAW!!

GRID NORTH AND ELEVATIONS SHOWN HEREON WERE ESTABLISHED BY SURVEY GRADE GPS



OXFORD QUAD   NEW MILTON QUAD

2000 0 2000
SCALE: 1" = 2000'

LIST OF DRAWINGS

1 - COVER SHEET
2 - NOTES
3 - OVERALL SHEET INDEX & VOLUMES
4 - WELL PAD, ACCESS ROAD & STOCKPILE DETAILS
5 - ASSOCIATED PIT, ACCESS ROAD & STOCKPILE DETAILS
6 - ACCESS ROAD DETAILS
7 - ACCESS ROAD AND STOCKPILE DETAILS
8 - ACCESS ROAD DETAILS
9 - WELL PAD & ASSOCIATED PIT SECTIONS
10 - ACCESS ROAD "A" PH-1 PROFILE
11-12 - ACCESS ROAD "B" PROFILE
13 - ACCESS ROADS "C" & "D" PROFILE
14-19 - ROAD SECTIONS
20-23 - MAJOR STREAM CROSSING DETAILS
24-25 - MINOR STREAM CROSSING DETAILS
26 - WELL PAD RECLAMATION PLAN
27 - ASSOCIATED PIT RECLAMATION PLAN
28-31 CONSTRUCTION DETAILS

LEGEND

EX. INDEX CONTOUR
EX. INTERMEDIATE CONTOUR
EX. BOUNDARY LINE
EX. ROAD EDGE OF GRAVEL/DIRT
EX. ROAD EDGE OF PAVEMENT
EX. ROAD CENTERLINE
EX. DITCHLINE
EX. CULVERT
EX. GUARDRAIL
EX. FENCELINE
EX. GATE
EX. OVERHEAD UTILITY
EX. OVERHEAD UTILITY R/W
EX. POWER POLE
EX. GUY WIRE
EX. TELEPHONE LINE
EX. GASLINE
EX. GASLINE R/W
EX. WATERLINE
EX. WATER WELL
EX. GAS WELL
EX. TREELINE
EX. REFERENCE TREE
EX. DELINEATED STREAM
EX. DELINEATED WETLAND
EX. BUILDING
EX. BRIDGE
100' WETLAND/STREAM BUFFER

PROP. INDEX CONTOUR
PROP. INTERMEDIATE CONTOUR
PROP. GRADING LIMITS
PROP. LIMITS OF DISTURBANCE
PROP. WELL PAD
PROP. WELL HEAD
PROP. 4" PVC DRAIN PIPE
PROP. SUMP DRAIN
PROP. CONTAINMENT BERM
PROP. PIT/IMPOUNDMENT CL
PROP. PERIMETER SAFETY FENCE
PROP. ACCESS GATE WITH EMERGENCY LIFELINE
PROP. ROCK CONSTRUCTION ENTRANCE
PROP. ROAD EDGE OF GRAVEL
PROP. ROAD CENTERLINE
PROP. V-DITCH W/ CHECK DAMS
PROP. DITCH RELIEF CULVERT (DRC)
PROP. RIP-RAP OUTLET PROTECTION
PROP. GUARDRAIL
PROP. ROCK LEVEL SPREADER
PROP. EARTHEN DIVERSION BERM
PROP. ORANGE SAFETY FENCE
PROP. SUPER SILT FENCE
PROP. COMPOST FILTER SOCK
PROP. COMPOST SOCK DIVERSION
PROP. GROUNDWATER DEWATERING TRENCH
PROP. GROUNDWATER DEWATERING PIPE
SECTION LINE
MATCHLINE
X-SECTION GRID INDEX
X-SECTION GRID INTERMEDIATE
X-SECTION PROPOSED GRADE
X-SECTION EXISTING GRADE
X-SECTION WATER SURFACE
SPOT ELEVATION
CENTER OF PAD

OPERATOR

EQT PRODUCTION COMPANY
OPERATOR ID: 306686
115 PROFESSIONAL PLACE
P.O. BOX 280
BRIDGEPORT, WV 26330
PHONE: (304) 348-3870

ENGINEER

NAVITUS ENGINEERING, INC.
151 WINDY HILL LANE
WINCHESTER, VA 22602
PHONE: (888) 662-4185

SURVEYOR

SMITH LAND SURVEYING, INC.
226 WEST MAIN STREET
P.O. BOX 150
GLENVILLE, WV 26351
PHONE: (304) 462-5634

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www.navituseng.com

Professional Energy Consultants
A DIVISION OF SMITH LAND SURVEYING
SLS
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CYRUS S. KUMP REGISTERED 19678 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER
11/04/2013

THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

COVER SHEET
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013
SCALE: 1" = 2000'
DESIGNED BY: CSK
FILE NO. 7889
SHEET 1 OF 31

CONSTRUCTION NOTES:

1. METHODS AND MATERIALS USED IN THE CONSTRUCTION OF THE IMPROVEMENTS HEREIN SHALL CONFORM TO THE CURRENT COUNTY CONSTRUCTION STANDARDS AND SPECIFICATIONS AND/OR CURRENT WVDEP EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICE MANUAL STANDARDS AND SPECIFICATIONS.

2. MEASURES TO CONTROL EROSION AND SILTATION, INCLUDING DETENTION PONDS SERVING AS SILT BASINS DURING CONSTRUCTION, MUST BE PROVIDED PRIOR TO ISSUANCE OF THE SITE DEVELOPMENT PERMIT. THE APPROVAL OF THESE PLANS IN NO WAY RELIEVES THE DEVELOPER OR HIS AGENT OF THE RESPONSIBILITIES CONTAINED IN THE WVDEP EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICE MANUAL.

3. AN APPROVED SET OF PLANS AND ALL APPLICABLE PERMITS MUST BE AVAILABLE AT THE CONSTRUCTION SITE. ALSO, A REPRESENTATIVE OF THE DEVELOPER MUST BE AVAILABLE AT ALL TIMES.

4. THE CONTRACTOR SHALL PROVIDE ADEQUATE MEANS OF CLEANING MUD FROM TRUCKS AND/OR OTHER EQUIPMENT PRIOR TO ENTERING PUBLIC STREETS, AND IT IS THE CONTRACTOR'S RESPONSIBILITY TO CLEAN STREETS, ALLAY DUST, AND TO TAKE WHATEVER MEASURES ARE NECESSARY TO INSURE THAT THE STREETS ARE MAINTAINED IN A CLEAN, MUD AND DUST FREE CONDITION AT ALL TIMES.

5. NOTIFICATION SHALL BE GIVEN TO THE APPROPRIATE UTILITY COMPANY PRIOR TO CONSTRUCTION OF WATER AND/OR GAS PIPE LINES. INFORMATION SHOULD ALSO BE OBTAINED FROM THE APPROPRIATE AUTHORITY CONCERNING PERMITS, CUT SHEETS, AND CONNECTIONS TO EXISTING LINES.

6. THE LOCATION OF EXISTING UTILITIES SHOWN IN THESE PLANS ARE FROM FIELD LOCATIONS. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO VERIFY THE EXACT HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UTILITIES AS NEEDED PRIOR TO CONSTRUCTION. THE CONTRACTOR SHALL INFORM THE ENGINEER OF ANY CONFLICTS ARISING FROM HIS EXISTING UTILITY VERIFICATION AND THE PROPOSED CONSTRUCTION.

7. THE DEVELOPER WILL BE RESPONSIBLE FOR ANY DAMAGE TO THE EXISTING STREETS AND UTILITIES WHICH OCCURS AS A RESULT OF HIS CONSTRUCTION PROJECT WITHIN OR CONTIGUOUS TO THE EXISTING RIGHT-OF-WAY.

8. WHEN GRADING IS PROPOSED WITHIN EASEMENTS OF UTILITIES, LETTERS OF PERMISSION FROM ALL INVOLVED COMPANIES MUST BE OBTAINED PRIOR TO GRADING AND/OR SITE DEVELOPMENT.

9. THE DEVELOPER WILL BE RESPONSIBLE FOR THE RELOCATION OF ANY UTILITIES WHICH IS REQUIRED AS A RESULT OF HIS PROJECT. THE RELOCATION SHOULD BE DONE PRIOR TO CONSTRUCTION.

10. THESE PLANS IDENTIFY THE LOCATION OF ALL KNOWN GRAVESITES. GRAVESITES SHOWN ON THIS PLAN WILL BE PROTECTED IN ACCORDANCE WITH STATE LAW. IN THE EVENT GRAVESITES ARE DISCOVERED DURING CONSTRUCTION, THE OWNER AND ENGINEER MUST BE NOTIFIED IMMEDIATELY.

11. THE CONTRACTOR IS TO VERIFY FIELD CONDITIONS PRIOR TO AND DURING CONSTRUCTION AND NOTIFY NAVITUS ENGINEERING AT (888) 662-4185 OR SMITH LAND SURVEYING AT (304) 462-5634 IMMEDIATELY OF ANY DISCREPANCIES BETWEEN ACTUAL FIELD CONDITIONS AND THE APPROVED PLAN.

12. CONTRACTORS SHALL NOTIFY OPERATORS WHO MAINTAIN UNDERGROUND UTILITY LINES IN THE AREA OF PROPOSED EXCAVATING OR BLASTING AT LEAST TWO (2) WORKING DAYS, BUT NOT MORE THAN TEN (10) WORKING DAYS, PRIOR TO COMMENCEMENT OF EXCAVATION OR DEMOLITION.

13. CONTRACTOR TO CONTACT OPERATOR AND ENGINEER IF GROUNDWATER IS ENCOUNTERED DURING CONSTRUCTION.

14. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE MAINTAINED BY THE CONTRACTOR DAILY AND CHECKED AFTER EVERY RAINFALL. ALL DRAIN INLETS SHALL BE FREE OF SILTATION AND DEBRIS. INEFFECTIVE MEASURES SHALL BE REPLACED, AS NECESSARY.

15. THE CONTRACTOR SHALL SCHEDULE A PRE-CONSTRUCTION MEETING WITH THE EROSION AND SEDIMENT CONTROL INSPECTOR, 2 DAYS PRIOR TO THE START OF CONSTRUCTION.

FLOODPLAIN NOTES

1. NO FILL SHALL BE PERMITTED IN THE FLOODWAY.

2. ALL FILL PLACED IN FLOODPLAIN AREAS SHALL MEET OR EXCEED THE FOLLOWING STANDARDS:

2.1. FILL SHALL BE USED ONLY TO THE EXTENT TO WHICH IT DOES NOT ADVERSELY AFFECT THE CAPACITY OF CHANNELS OR FLOODWAYS OF ANY TRIBUTARY TO THE MAIN STREAM, DRAINAGE DITCH, OR ANY OTHER DRAINAGE FACILITY OR SYSTEM.
2.2. FILLED SITE MUST BE CONTOURED TO DRAIN PROPERLY (AVOID PONDING).
2.3. FILL SHALL EXTEND BEYOND A STRUCTURE FOR A SUFFICIENT DISTANCE TO PROVIDE ACCEPTABLE ACCESS. FOR NONRESIDENTIAL STRUCTURES, FILL SHALL BE PLACE TO PROVIDE ACCESS ACCEPTABLE FOR INTENDED USE.
2.4. AT GRADE ACCESS, WITH FILL EXTENDING LATERALLY FIFTEEN (15) FEET BEYOND THE BUILDING LINE SHALL BE PROVIDED TO A MINIMUM OF TWENTY-FIVE (25) PERCENT OF THE PERIMETER OF A NONRESIDENTIAL STRUCTURE.
2.5. FILL SHALL CONSIST OF SOIL OR ROCK MATERIAL ONLY. NO TRASH OR WOODY DEBRIS SHALL BE BURIED ON SITE.
2.6. FILL MATERIAL SHALL BE COMPACTED TO PROVIDE THE NECESSARY STABILITY AND RESISTANCE TO EROSION, SCOURING, OR SETTLING. FILL COMPACTION STANDARDS MUST BE APPROPRIATE TO PROPOSED POST FILL USE, PARTICULAR ATTENTION IS NECESSARY WHEN FILL IS BEING USED TO ELEVATE A STRUCTURE.
2.7. FILL SLOPES SHALL BE NO STEEPER THAN (1) VERTICAL ON TWO (2) HORIZONTAL, UNLESS SUBSTANTIATING DATA JUSTIFYING STEEPER SLOPES ARE SUBMITTED TO AND APPROVED BY THE FLOODPLAIN ADMINISTRATOR.
2.8. FILL SITE AND FILL MUST BE PROTECTED FROM EROSION. EROSION CONTROL BLANKETS OR OTHER ARMORING MATERIALS SHALL BE USED ALONG ALL EMBANKMENTS LOCATED BELOW THE 100-YR FLOODPLAIN.

3. ALL STORAGE TANKS LOCATED AT OR BELOW THE BASE FLOOD ELEVATION SHALL BE FIRMLY ANCHORED TO RESIST FLOTATION.

4. NO MATERIALS THAT ARE BUOYANT, FLAMMABLE, EXPLOSIVE, OR IN TIMES OF FLOODING COULD BE INJURIOUS TO HUMAN, ANIMAL, OR PLANT LIFE, SHALL BE STORED BELOW BASE FLOOD ELEVATION.

5. ALL EXISTING CULVERTS WITHIN LIMITS OF DISTURBANCE SHALL BE REMOVED UNLESS OTHERWISE NOTED.

CONSTRUCTION SEQUENCE

THE BMP'S SHALL BE IMPLEMENTED, MAINTAINED, AND OPERATED IN THE FOLLOWING GENERAL SEQUENCE OF CONSTRUCTION TO MITIGATE THE HAZARD OF ACCELERATED EROSION AND SEDIMENTATION TO ACCEPTABLE LEVELS. MINOR DEVIATIONS FROM THIS SEQUENCE SHALL BE EXECUTED BY THE PROJECT'S FOREMAN AS NEEDED TO ELIMINATE ANY POTENTIAL EROSIVE CONDITION THAT MAY ARISE FOR THE DURATION OF THE PROJECT. THE WVDEP OFFICE OF OIL AND GAS SHALL BE NOTIFIED OF ANY AND ALL SUCH DEVIATIONS FROM THE APPROVED PLANS.

1) STAKE THE LIMITS OF CONSTRUCTION.

2) INSTALL THE ROCK CONSTRUCTION ENTRANCE AS SHOWN ON THE PLANS.

3) INSTALL ALL ORANGE SAFETY FENCE AS SHOWN AROUND ANY DELINEATED STREAMS AND WETLANDS TO CLEARLY IDENTIFY THOSE AREAS THAT ARE NOT TO BE DISTURBED.

4) INSTALL ALL BMP'S (SUPER SILT FENCE, REINFORCED SILT FENCE, SEDIMENT TRAPS, ETC) AS SHOWN ON THE PLANS AND DETAILS.

5) CLEAR AND GRUB THE ACCESS ROAD AND PAD AND PIT AREA. ALL WOODY MATERIAL, BRUSH, TREES, STUMPS, LARGE ROOTS, BOULDERS, AND DEBRIS SHALL BE CLEARED FROM THE SITE AREA AND KEPT TO THE MINIMUM NECESSARY FOR PROPER CONSTRUCTION, INCLUDING THE INSTALLATION OF NECESSARY SEDIMENT CONTROLS. TREES SIX INCHES IN DIAMETER AND LARGER SHALL BE CUT AND LOGS STACKED. SMALLER TREES, BRUSH, & STUMPS SHALL BE CUT AND OR GRUBBED AND WINDROWED IN APPROPRIATE AREAS FOR USE AS SEDIMENT BARRIERS AT WATER DRAINAGE OUTLETS, WINDROWED BELOW THE WELL SITE, USED FOR WILDLIFE HABITAT, BURNED (AS PER WV FOREST FIRE LAWS), REMOVED FROM SITE, OR DISPOSED OF BY OTHER METHODS APPROVED BY DEP.

6) INSTALL ANY WETLAND OR STREAM CROSSINGS AS SHOWN ON THE PLANS.

7) CONVEY UPSLOPE DRAINAGE AROUND THE ACCESS ROAD AND PAD AND PIT AREA BY CONSTRUCTING ALL DIVERSION BERM(S) AS SHOWN ON THE PLANS.

8) CONSTRUCT THE ACCESS ROAD. DITCH RELIEF CULVERTS SHALL BE INSTALLED AT A GRADE OF 1-8% TO MINIMIZE OUTLET VELOCITIES TO THE EXTENT POSSIBLE. INSTALL OUTLET PROTECTION AS SHOWN ON PLANS. STABILIZE THE ROAD WITH STONE AND SIDE SLOPES AS SPECIFIED WITH PERMANENT SEEDING. STOCKPILE AND STABILIZE TOPSOIL ALONG THE ACCESS ROAD, AS NEEDED.

9) STRIP THE TOPSOIL FROM THE PAD AND PIT AREA. TOPSOIL SHALL BE STOCKPILED AND IMMEDIATELY STABILIZED.

10) GRADE THE PAD AND PIT AREA AS SHOWN ON THE PLAN. IMMEDIATELY STABILIZE THE OUTER AREAS OF THE PIT, AS WELL AS THE WELL PAD AND ANY TURNAROUND AREAS WITH STONE AND THE SIDE SLOPES WITH EROSION CONTROL BLANKETING WHEN SLOPES ARE 3:1 OR GREATER. APPLY SEED AND MULCH ALL DISTURBED AREAS. THIS SHALL INCLUDE ALL AREAS THAT WILL NOT BE SUBJECT TO REGULAR TRAFFIC ACTIVITY (TO BE STABILIZED WITH STONE), OR ANY DISTURBED AREA THAT WILL NOT BE RE-DISTURBED BEFORE SITE RECLAMATION BEGINS.

11) INSTALL THE PIT LINER SYSTEM AND PERIMETER SAFETY FENCE W/GATE AND EMERGENCY LIFE LINE AS SHOWN ON THE PLANS.

12) PREVIOUSLY DISTURBED AREAS AND IMMEDIATE DOWN SLOPE AREAS SHALL BE INSPECTED AFTER EACH RAINFALL STORM EVENT AND MONITORED WEEKLY FOR SIGNS OF ACCELERATED EROSION. IMPLEMENT ADDITIONAL BMP'S AS DEEMED NECESSARY. THESE INSPECTIONS SHALL CONTINUE DURING THE DURATION OF THE PROJECT AND SUBSEQUENT SITE RECLAMATION.

13) ONCE THE PIT HAS BEEN COMPLETED, SUBMIT THE AS-BUILT CERTIFICATION FOR EACH PIT/IMPOUNDMENT FACILITY TO THE WVDEP OFFICE OF OIL AND GAS, PRIOR TO PLACING FLUIDS IN EITHER STRUCTURE.

14) COMMENCE THE DRILLING ACTIVITY.

15) ONCE DISTURBED AREAS HAVE BEEN RE-VEGETATED AND STABILIZED FOLLOWING RECLAMATION, THE TEMPORARY BMP'S IN THOSE AREAS MAY BE REMOVED. CONTINUE TO MONITOR THESE AREAS TO ENSURE A UNIFORM RATE OF 70% VEGETATIVE COVERAGE IS MAINTAINED. ANY AREAS FOUND TO BE DEFICIENT SHALL BE RE-SEEDED AND MULCHED.

SITE CLEANUP & RECYCLE PROGRAM

1. GARBAGE, FUELS OR ANY SUBSTANCE HARMFUL TO HUMAN, AQUATIC OR FISH LIFE, WILL BE PREVENTED FROM ENTERING SPRINGS, STREAMS, PONDS, LAKES, WETLANDS OR ANY WATER COURSE OR WATER BODY.

2. OILS, FUELS, LUBRICANTS AND COOLANTS WILL BE PLACED IN SUITABLE CONTAINERS AND DISPOSED PROPERLY.

3. ALL TRASH AND GARBAGE WILL BE COLLECTED AND DISPOSED PROPERLY.

4. ALL SEDIMENT REMOVED FROM SEDIMENT CAPTURING DEVICES SHALL BE PLACED ON THE TOPSOIL STOCKPILE, THEN SEEDED AND MULCHED, AS NECESSARY. ALTERNATIVELY, THE REMOVED SEDIMENT CAN BE TRANSPORTED TO A SITE WITH AN APPROVED PERMIT.

MAINTENANCE PROGRAM

1. BMP'S WILL BE INSPECTED ON A WEEKLY BASIS AND AFTER EACH MEASURABLE RAINFALL EVENT DURING THE ACTIVE CONSTRUCTION PHASE OF THE PROJECT.

2. ALL REVEGETATED ACCESS ROADS AND FACILITIES ARE TO BE MAINTAINED THROUGHOUT THE LIFE OF EACH STRUCTURE.

3. CULVERTS, ROAD DITCHES, BROAD-BASED DIPS, DIVERSION DITCHES, AND ROCK CHECK DAMS MUST BE MAINTAINED IN PROPER WORKING ORDER AND WILL BE CLEANED OUT, REPAIRED, OR REPLACED AS NECESSARY.

4. FILTER STRIPS AND/OR SILT FENCE WILL BE MAINTAINED.

5. ALL AREAS OF EARTH DISTURBANCE WILL BE REPAIRED WHERE SIGNS OF ACCELERATED EROSION ARE DETECTED.

6. SEEDING AND MULCHING WILL BE REPEATED IN THOSE AREAS THAT APPEAR TO BE FAILING OR HAVE FAILED.

ASSOCIATED PIT CONSTRUCTION STANDARD NOTES

THE DESIGN, CONSTRUCTION, AND REMOVAL OF EMBANKMENTS ASSOCIATED WITH ASSOCIATED PITS FOR OIL AND GAS WELLS MUST BE ACCOMPLISHED IN SUCH A MANNER AS TO PROTECT THE HEALTH AND SAFETY OF THE PEOPLE, THE NATURAL RESOURCES, AND ENVIRONMENT OF THE STATE. THE PIT EMBANKMENTS SHALL BE DESIGNED, CONSTRUCTED, AND MAINTAINED TO BE STRUCTURALLY SOUND AND REASONABLY PROTECTED FROM UNAUTHORIZED ACTS OF THIRD PARTIES.

1. THE FOUNDATION FOR A ASSOCIATED PIT EMBANKMENT MUST BE STRIPPED AND GRUBBED TO A MINIMUM DEPTH OF 2 FEET PRIOR TO PLACEMENT AND COMPACTION OF EARTHEN FILL MATERIAL. NO EMBANKMENT MUST FILL SHALL BE PLACED ON FROZEN MATERIAL.

2. ANY SPRINGS ENCOUNTERED WITHIN THE FOUNDATION AREA SHALL BE DRAINED TO THE OUTSIDE/DOWNSTREAM TOE OF EMBANKMENT. CONSTRUCTED DRAIN SECTION SHALL BE AN EXCAVATED 2' x 2' TRENCH AND BACK FILLED WITH TYPE A SAND, COMPACTED BY HAND TAMPER. NO GEOTEXTILES SHALL BE USED TO LINE TRENCH. THE LAST 3' OF DRAIN AT THE DOWNSTREAM END SHALL BE CONSTRUCTED WITH AASHTO #8 MATERIAL.

3. SOILS FOR EARTHEN EMBANKMENT CONSTRUCTION SHALL BE LIMITED TO TYPES GC, GM, SC, SM, CL, OR ML (ASTMD-2487 – UNIFIED SOILS CLASSIFICATION). SOILS MUST CONTAIN A MINIMUM OF 20% OF PLUS NO. 200 SIEVE AND BE "WELL GRADED" MATERIAL WITH NO COBBLES OR BOULDER SIZE MATERIAL MIXED WITH THE CLAY. A MINIMUM OF THREE SAMPLES SHALL BE CLASSIFIED.

4. THE EARTHEN EMBANKMENT SHALL BE COMPACTED BY A VIBRATING SHEEPSFOOT ROLLER. THE LIFTS MUST BE IN HORIZONTAL LAYERS WITH A MAXIMUM LOOSE LIFT THICKNESS 12" AND MAXIMUM PARTICLE SIZE LESS THAN 6".

5. THE PLACEMENT OF ALL FILL MATERIAL SHALL BE FREE OF WOOD, STUMPS AND ROOTS, LARGE ROCKS AND BOULDERS, AND ANY OTHER NONCOMPACTABLE SOIL MATERIAL. THE EMBANKMENT SHALL BE COMPACTED TO A MINIMUM OF VISIBLE NON-MOVEMENT, HOWEVER, THE COMPACTION EFFORT SHALL NOT EXCEED THE OPTIMUM MOISTURE LIMITS.

6. THE EMBANKMENT TOP SHALL BE A MINIMUM OF 12' IN WIDTH.

7. THE MINIMUM INSIDE AND OUTSIDE SIDESLOPES SHALL BE 2H:1V, UNLESS OTHERWISE SPECIFIED.

8. ALL EXPOSED EMBANKMENT SLOPES, NOT COVERED BY COMPACTED ROCKFILL OR RIPRAP SHALL BE LIMED, FERTILIZED, SEEDED AND MULCHED. PERMANENT VEGETATIVE GROUND COVER IN COMPLIANCE WITH THE WVDEP EROSION AND SEDIMENT CONTROL FIELD MANUAL MUST BE ESTABLISHED UPON THE COMPLETION OF THE IMPOUNDMENT/PIT CONSTRUCTION. EMBANKMENTS SHALL BE MAINTAINED WITH A GRASSY VEGETATIVE COVER AND FREE OF BRUSH AND/OR TREES.

9. A MINIMUM OF 2' OF FREEBOARD SHALL BE MAINTAINED AT ALL TIMES DURING THE OPERATION OF THE IMPOUNDMENT.

10. ALL EMBANKMENT CONSTRUCTION AND COMPACTION TESTING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.

ASSOCIATED PIT LINER SYSTEM NOTES:

THE DESIGNED PIT FACILITY SHALL BE FULLY LINED WITH A GEOSYNTHETIC LINER SYSTEM. LINERS SHALL BE INSTALLED IN ACCORDANCE TO MANUFACTURER'S SPECIFICATIONS.

1. THE SUB-BASE SHALL BEAR THE WEIGHT OF THE LINER SYSTEM, WATER, AND EQUIPMENT OPERATING ON THE PIT WITHOUT CAUSING OR ALLOWING A FAILURE OF THE LINER SYSTEM.

2. THE SUB-BASE SHALL BE COMPACTED TO ACCOMMODATE POTENTIAL SETTLEMENT WITHOUT DAMAGE TO THE LINER SYSTEM.

3. THE UPPER 6" OF THE SUB-BASE SHALL BE COMPACTED TO A STANDARD PROCTOR DENSITY OF AT LEAST 95%.

4. THE SUB-BASE SHALL BE HARD, UNIFORM, SMOOTH AND FREE OF DEBRIS, ROCK FRAGMENTS, PLANT MATERIAL AND OTHER FOREIGN MATERIAL.

5. THE SUB-BASE SHALL BE COVERED WITH NON-WOVEN GEOTEXTILE FABRIC TO CUSHION THE PRIMARY LINER AND ALLOW FOR ADEQUATE VENTING BETWEEN THE PRIMARY LINER AND THE SUB-BASE TO PREVENT THE ENTRAPMENT OF GASES BENEATH THE LINER SYSTEM.

6. THE PIT AREA SHALL BE DRAINED AND COMPLETELY DRY PRIOR TO THE PLACEMENT OF THE PRIMARY LINER. THE PRIMARY LINER SHALL MEET ALL WV DEP GUIDELINES FOR MINIMUM THICKNESS AND SHALL PREVENT THE MIGRATION OF WATER THROUGH THE LINER TO THE GREATEST DEGREE THAT IS TECHNOLOGICALLY POSSIBLE.

7. THE PRIMARY LINER SHALL FULLY COVER THE BOTTOM AND SIDEWALLS OF THE PIT.

8. AN ANCHOR TRENCH SHALL BE EXCAVATED COMPLETELY AROUND THE PERIMETER OF THE PIT AREA AT THE PLANNED ELEVATION OF THE TOP OF THE LINING. THE TRENCH SHALL BE A MINIMUM 36 INCHES DEEP AND 24 INCHES WIDE.

9. ALL ELEMENTS OF THE LINER SYSTEM SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS. ALL SEAMS AND SEALS AROUND ANY PROJECTIONS SHALL BE SEALED AND TESTED IN A METHOD APPROVED BY THE MANUFACTURER.

10. GAS RELIEF VENTS SHALL BE PROVIDED ALONG THE TOP OF THE LINER AND WITHIN ONE FOOT OF THE PERIMETER OF THE IMPOUNDMENT TO ALLOW GASES TO ESCAPE FROM UNDER THE GEOMEMBRANE. MAXIMUM SPACING FOR VENTS SHALL BE 30 FEET.

11. WATER LEVEL MARKINGS SHALL BE CLEARLY PAINTED (1' INCREMENTS) ON THE LINER SYSTEM TO IDENTIFY THE WATER SURFACE ELEVATION.

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CYRUS S. KUMP
REGISTERED
19578
STATE OF WEST VIRGINIA
PROFESSIONAL ENGINEER
11/04/2013

THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

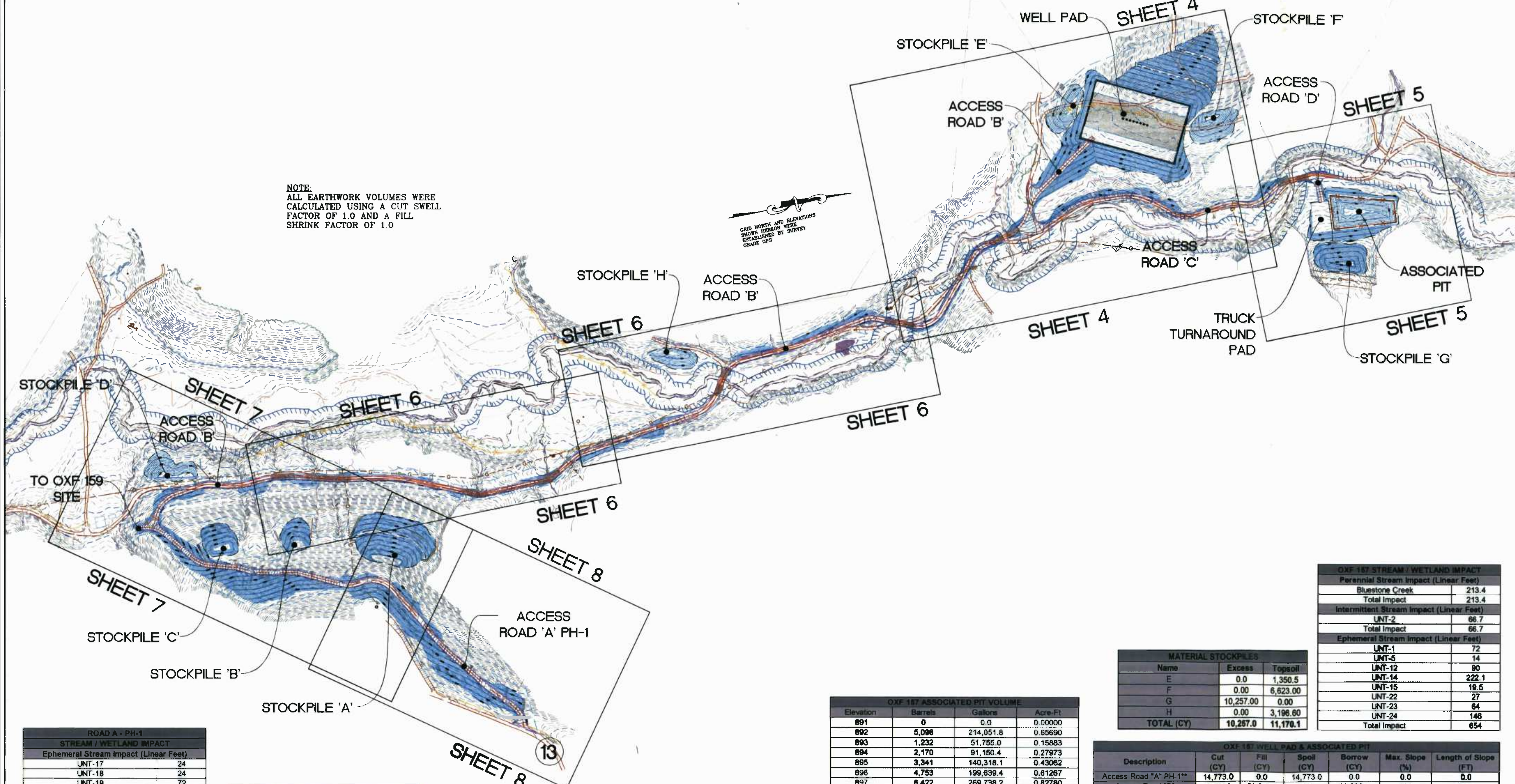
NOTES
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013	
SCALE: N/A	
DESIGNED BY:	CSK
FILE NO.	7889
SHEET 2	OF 31

OVERALL SHEET INDEX & VOLUMES

(PROPOSED WELLS NO. WV 513144, WV 513145, WV 513146, WV 513147, WV 513148, WV 513149, WV 514089 & WV 514090)

NOTE:
ALL EARTHWORK VOLUMES WERE CALCULATED USING A CUT SWELL FACTOR OF 1.0 AND A FILL SHRINK FACTOR OF 1.0



ROAD A - PH-1	
STREAM / WETLAND IMPACT	
Ephemeral Stream Impact (Linear Feet)	
UNT-17	24
UNT-18	24
UNT-19	72
UNT-20	50
UNT-21	18
Total Impact	188
Ephemeral Pool Impact (Square Feet)	
POOL - 1	95
POOL - 2	389
Total Area	484

ROAD A PH-1 MATERIAL STOCKPILES		
Name	Excess	Topsoil
A	21,038.60	0.00
B	4,030.10	0.00
C	4,152.00	0.00
D	0.00	3,673.10
TOTAL (CY)	29,220.7	3,673.1

OXF 159 ACCESS ROAD A - PHASE 1						
Description	Cut (CY)	Fill (CY)	Spoil (CY)	Borrow (CY)	Max. Slope (%)	Length of Slope (FT)
Access Road "A" Ph-1	31,492.1	3,205.3	28,286.8	0.0	0.0	0.0
Stripped Topsoil (6")	3,500.7	0.0	3,500.7	0.0	n/a	n/a
Material Stockpiles	0.0	32,893.8	0.0	32,893.8	n/a	n/a
Totals	34,992.8	36,099.1	31,787.5	32,893.8	n/a	n/a
	TOTAL SPOIL (CY) =		-1,106.3			

OXF 157 ASSOCIATED PIT VOLUME			
Elevation	Barrels	Gallons	Acre-Ft
891	0	0.0	0.00000
892	5,096	214,051.8	0.65690
893	1,232	51,755.0	0.15883
894	2,170	91,150.4	0.27973
895	3,341	140,318.1	0.43062
896	4,753	199,639.4	0.61267
897	6,422	269,738.2	0.82780
898	8,360	351,104.9	1.07750
899	10,582	444,425.5	1.36389
900	13,097	550,079.5	1.68813
901	15,922	668,741.6	2.05229
902	19,066	800,757.0	2.45743
903	22,546	946,927.4	2.90601
904 Storage	26,371	1,107,591.7	3.39907
905	30,559	1,283,466.8	3.93881
906	35,131	1,475,497.5	4.52813

Incised Elev. = 898.0

MATERIAL STOCKPILES		
Name	Excess	Topsoil
E	0.0	1,350.5
F	0.00	6,623.00
G	10,257.00	0.00
H	0.00	3,196.60
TOTAL (CY)	10,257.0	11,170.1

OXF 157 STREAM / WETLAND IMPACT	
Perennial Stream Impact (Linear Feet)	
Bluestone Creek	213.4
Total Impact	213.4
Intermittent Stream Impact (Linear Feet)	
UNT-2	66.7
Total Impact	66.7
Ephemeral Stream Impact (Linear Feet)	
UNT-1	72
UNT-5	14
UNT-12	90
UNT-14	222.1
UNT-15	19.5
UNT-22	27
UNT-23	64
UNT-24	146
Total Impact	654

OXF 157 WELL PAD & ASSOCIATED PIT						
Description	Cut (CY)	Fill (CY)	Spoil (CY)	Borrow (CY)	Max. Slope (%)	Length of Slope (FT)
Access Road "A" PH-1**	14,773.0	0.0	14,773.0	0.0	0.0	0.0
Access Road "B"	5,048.6	31,271.7	0.0	26,223.1	11.4	100.0
Access Road "C"	1,946.6	1,760.8	185.8	0.0	14.2	94.9
Access Road "D"	10.0	381.5	0.0	371.5	0.0	0.0
Well Pad	66,659.0	55,022.3	11,636.7	0.0	n/a	n/a
Well Pad Containment Berm	0.0	373.0	0.0	373.0	n/a	n/a
Associated Pit	13,513.5	2,615.1	10,898.4	0.0	n/a	n/a
Truck Turnaround Pad	2,853.4	72.2	2,781.2	0.0	n/a	n/a
Stripped Topsoil (6")	11,075.3	0.0	11,075.3	0.0	n/a	n/a
Material Stockpiles	0.0	21,427.1	0.0	21,427.1	n/a	n/a
Totals	115,879.4	112,923.7	51,350.4	48,394.7	n/a	n/a
	TOTAL SPOIL (CY) =		2,955.7			

**NOTE:
MATERIAL SHALL BE BORROWED FROM THE ACCESS ROAD "A" PH-1 IN ORDER TO CONSTRUCT THE ACCESS ROAD "B" TO THE OXF 157 WELL PAD.

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CYRUS S. KUMP
REGISTERED
19578
STATE OF WEST VIRGINIA
PROFESSIONAL ENGINEER

THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

OVERALL SHEET INDEX & VOLUMES
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013
SCALE: 1" = 100'
DESIGNED BY: CSK
FILE NO. 7889
SHEET 3 OF 31

WELL PAD, ACCESS ROAD & STOCKPILE DETAILS

(PROPOSED WELLS NO. WV 513144, WV 513145, WV 513146, WV 513147, WV 513148, WV 513149, WV 514089 & WV 514090)

NOTE:
1. ALL PROPOSED DRAINAGE CULVERTS AND DRAIN PIPES SHALL HAVE ADEQUATE OUTLET PROTECTION (RIP-RAP) AS SHOWN ON THESE PLANS.
2. ALL FILL AREAS SHALL BE "KEYED IN" AND COMPACTED IN 12" LIFTS (9" RECOMMENDED) WITH A VIBRATING SHEEPSFOOT ROLLER TO 95% COMPACTION PER STANDARD PROCTOR.
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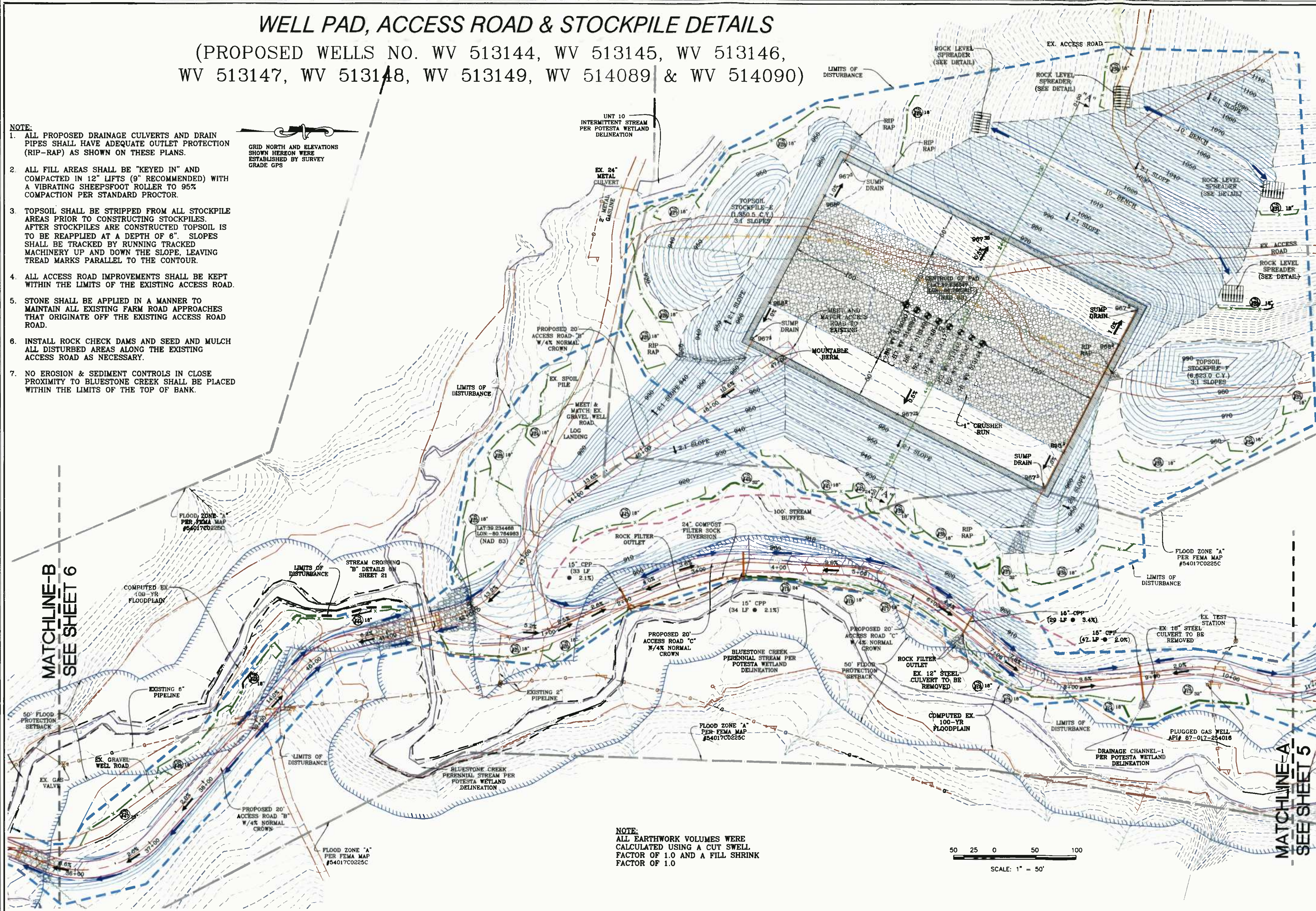

NOTE:
ALL EARTHWORK VOLUMES WERE CALCULATED USING A CUT SWELL FACTOR OF 1.0 AND A FILL SHRINK FACTOR OF 1.0

SCALE: 1" = 50'

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WELL PAD, ACCESS ROAD & STOCKPILE DETAILS

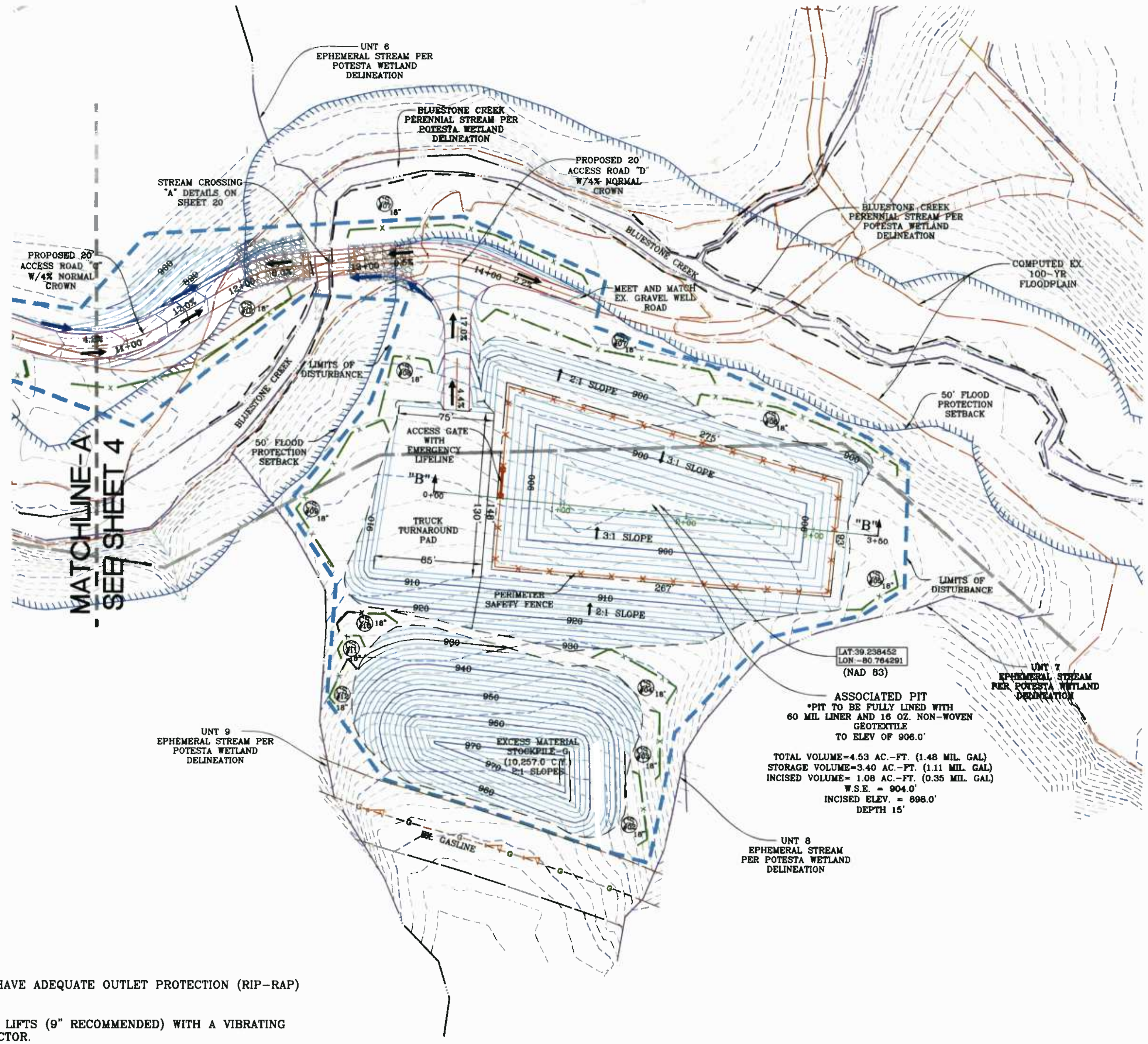
OXF 157

WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE:	11/04/2013
SCALE:	1" = 50'
DESIGNED BY:	CSK
FILE NO.	7889
SHEET	4 OF 31

ASSOCIATED PIT, ACCESS ROAD & STOCKPILE DETAILS

(PROPOSED WELLS NO. WV 513144, WV 513145, WV 513146, WV 513147, WV 513148, WV 513149, WV 514089 & WV 514090)



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50 25 0 50 100

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CYRUS S. KUMP REGISTERED 19578 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER 11/04/2013

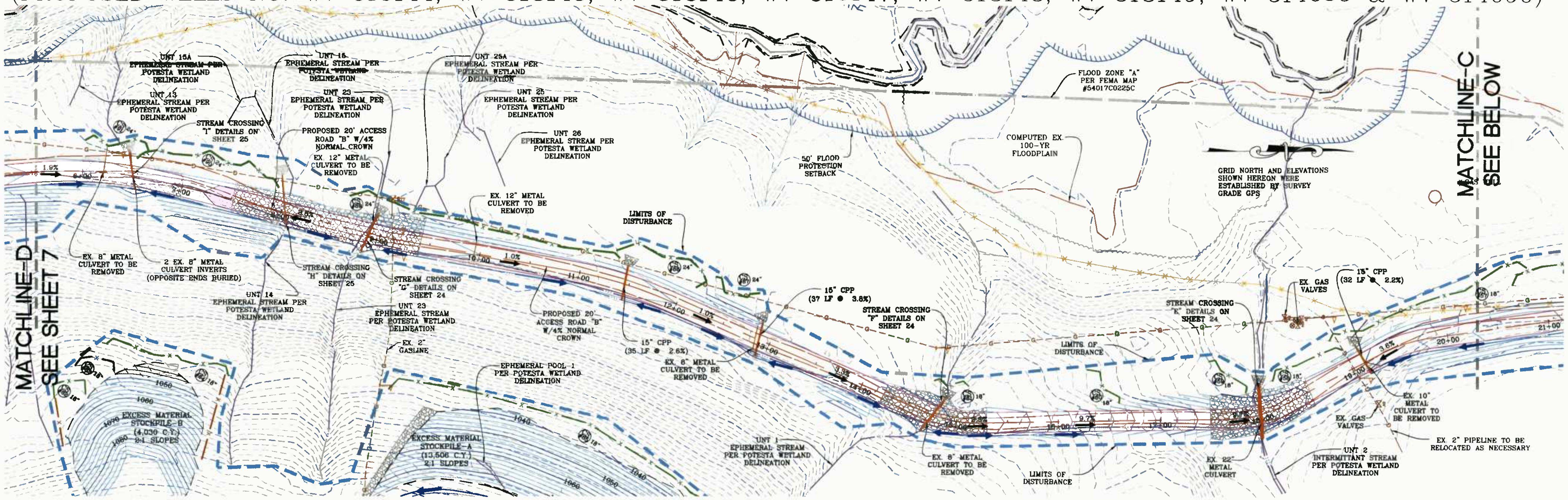
THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

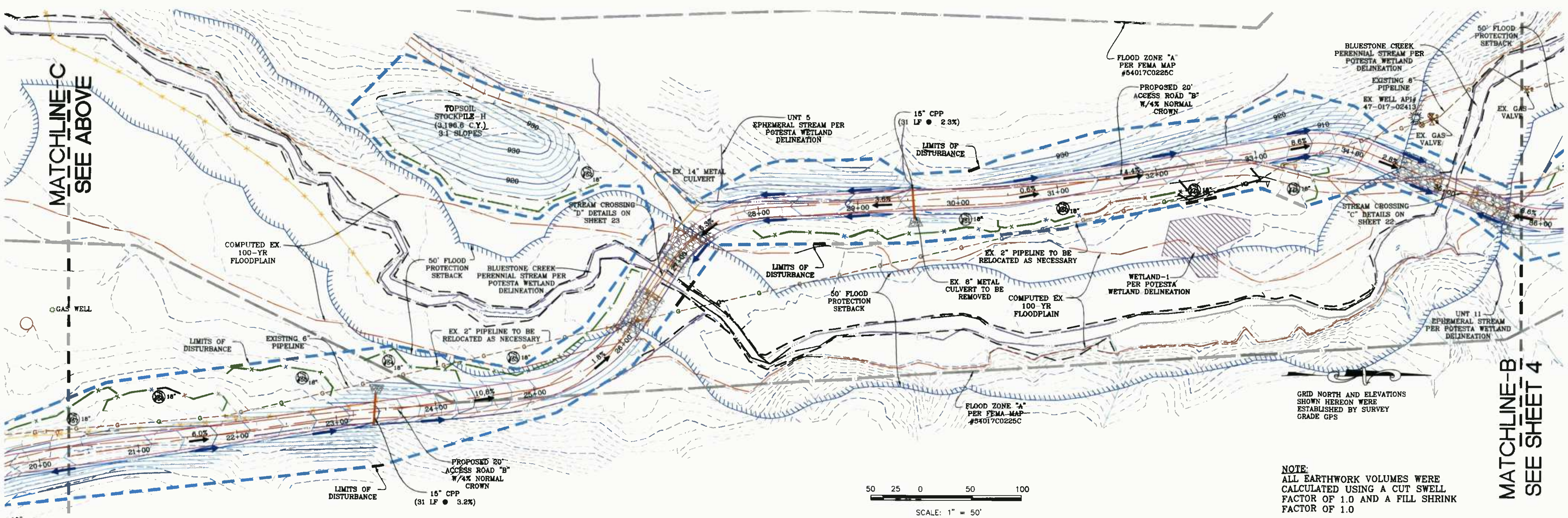
PIT, ACCESS ROAD & STOCKPILE DETAILS
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013	
SCALE: 1" = 50'	
DESIGNED BY:	CSK
FILE NO.	7889
SHEET 5	OF 31

ACCESS ROAD DETAILS

(PROPOSED WELLS NO. WV 513144, WV 513145, WV 513146, WV 513147, WV 513148, WV 513149, WV 514089 & WV 514090)





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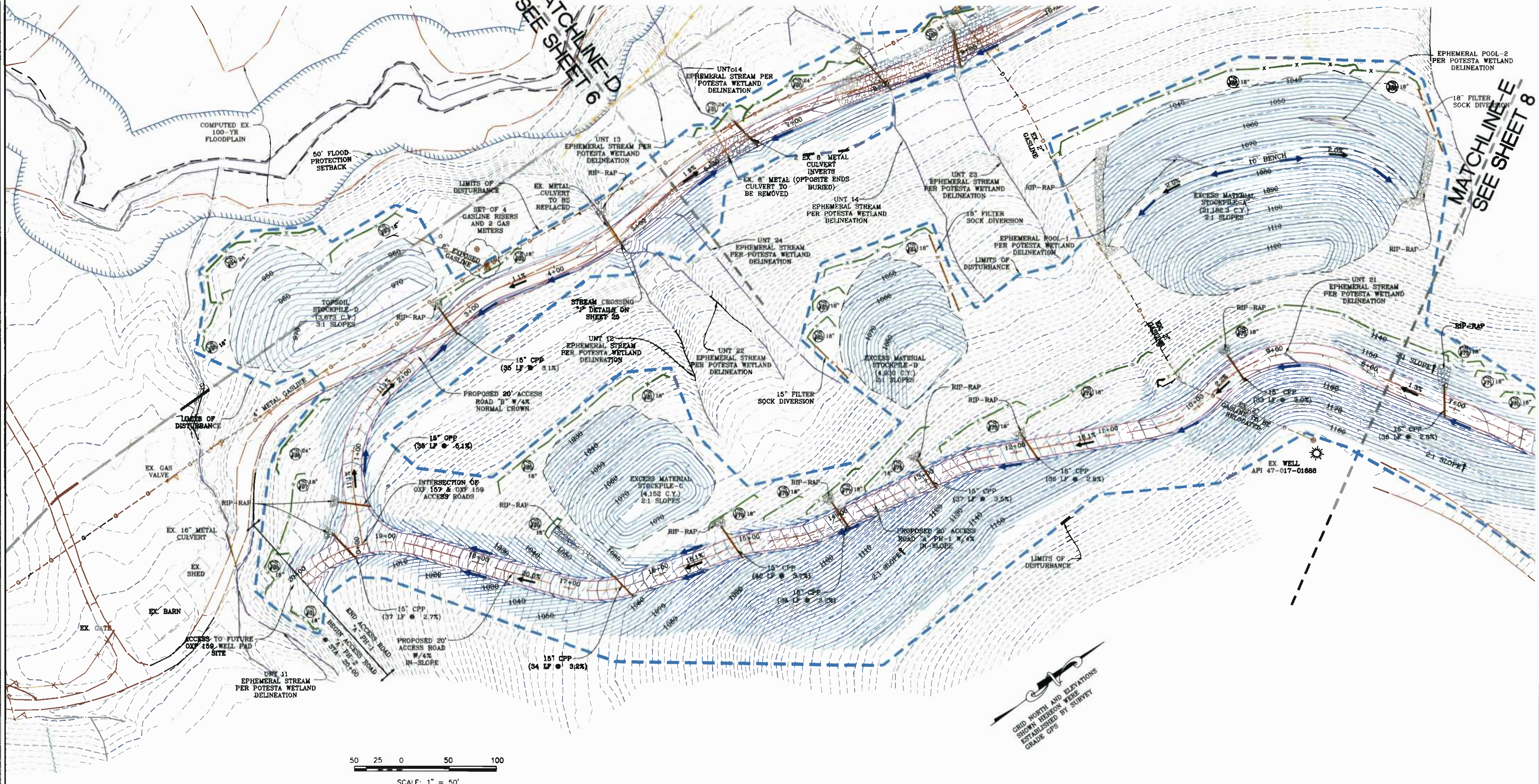
ACCESS ROAD DETAILS
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE:	11/04/2013
SCALE:	1" = 50'
DESIGNED BY:	CSK
FILE NO.	7889
SHEET	6 OF 31

ACCESS ROAD AND STOCKPILE DETAILS

(PROPOSED WELLS NO. WV 513144, WV 513145, WV 513146, WV 513147, WV 513148, WV 513149, WV 514089 & WV 514090)



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ACCESS ROAD & STOCKPILE DETAILS
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE:	11/04/2013
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FILE NO.	7889
SHEET 7	OF 31

ACCESS ROAD DETAILS

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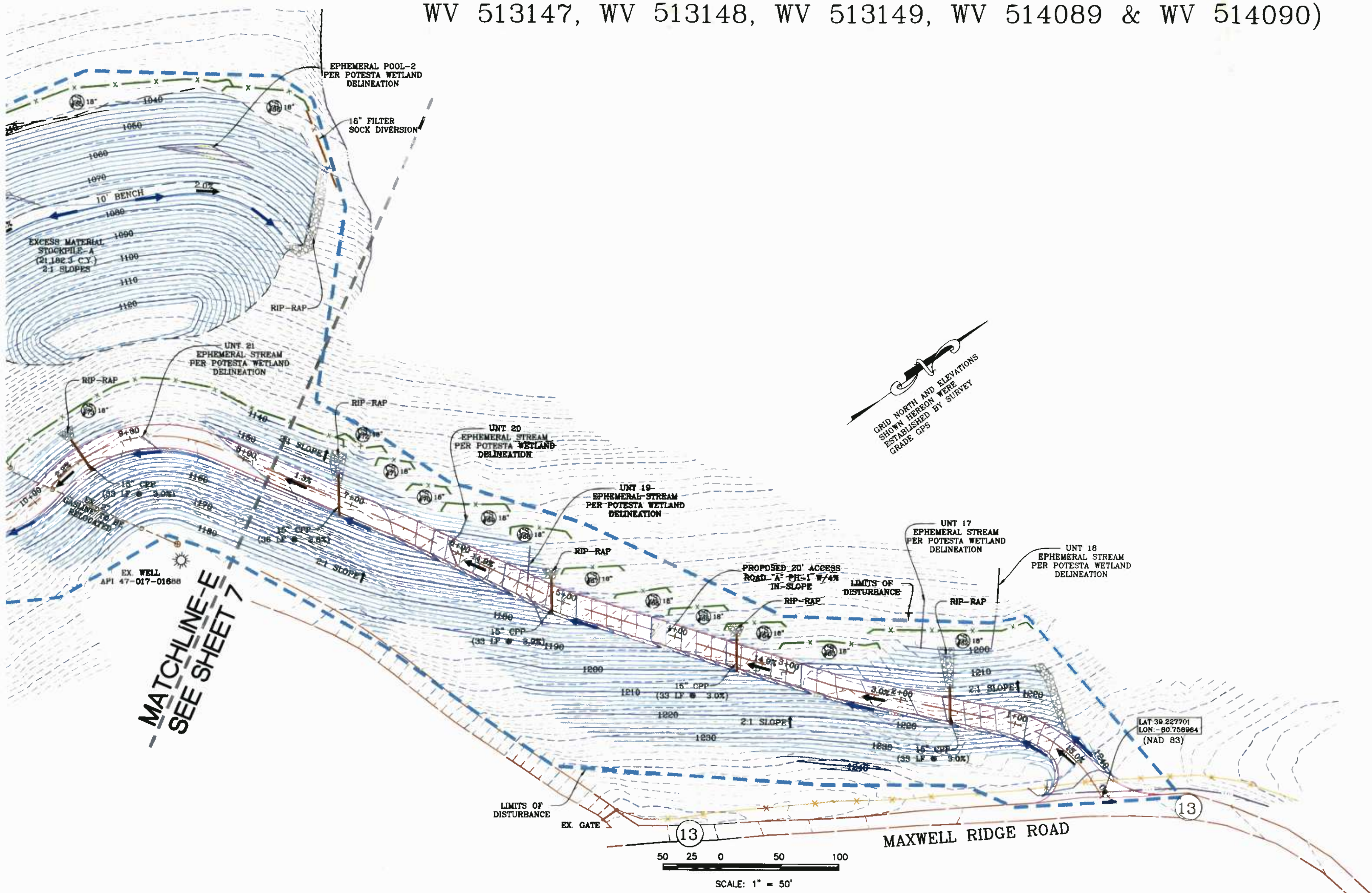

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CYRUS S. KUMP
REGISTERED
18078
STATE OF WEST VIRGINIA
PROFESSIONAL ENGINEER
11/04/2013

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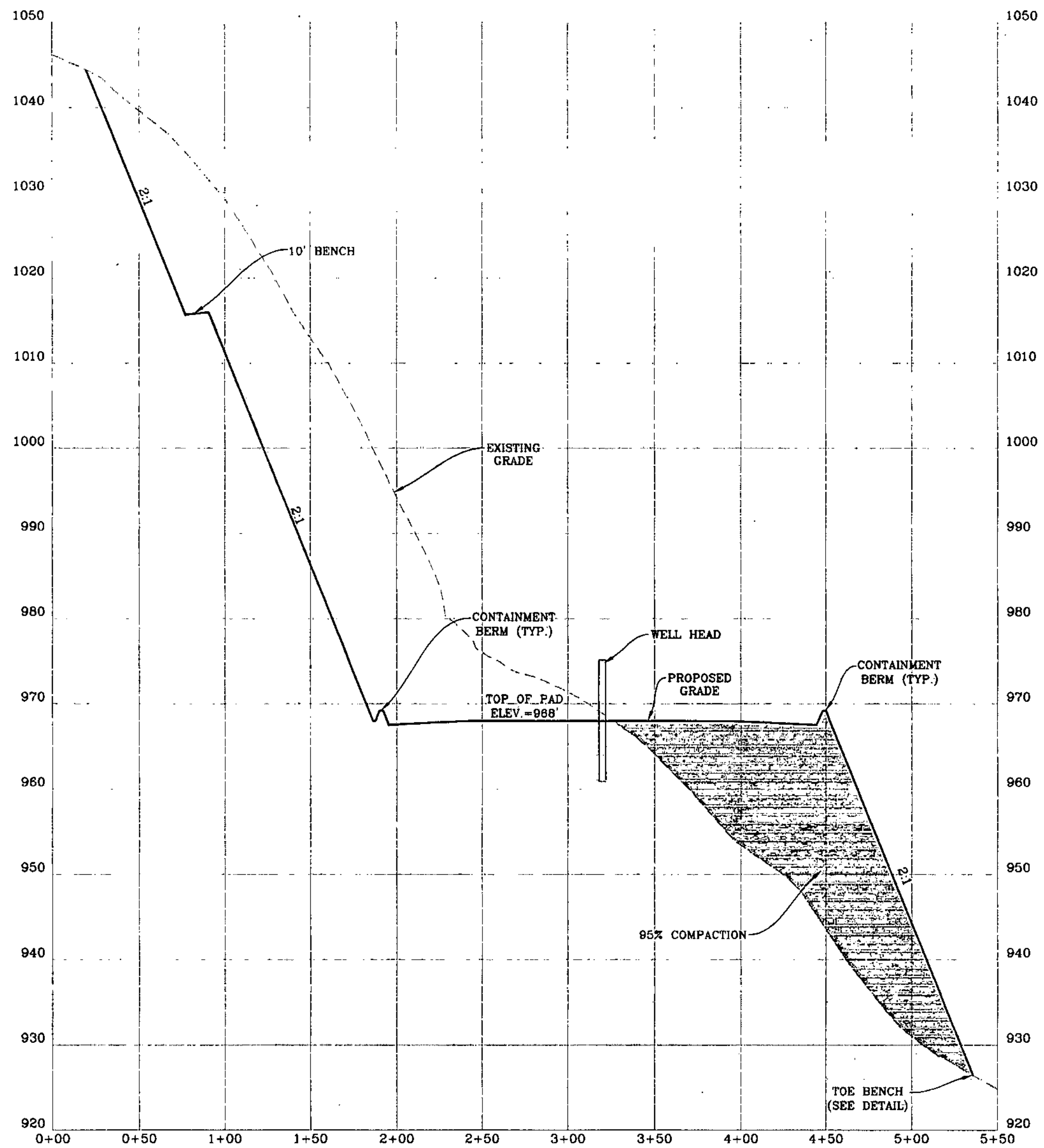
ACCESS ROAD DETAILS
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

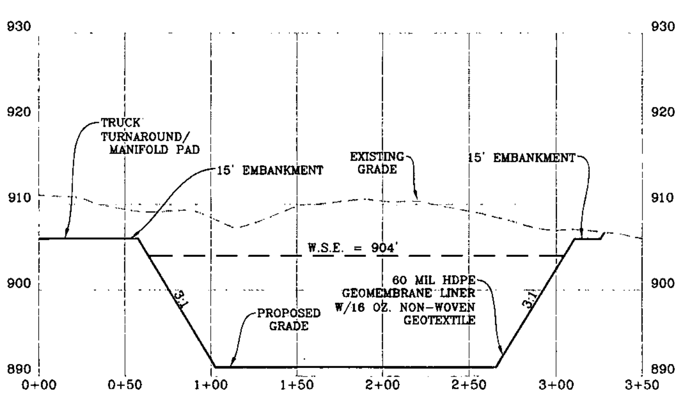
DATE: 11/04/2013
SCALE: 1" = 50'
DESIGNED BY: CSK
FILE NO. 7889
SHEET 8 OF 31

WELL PAD & ASSOCIATED PIT SECTIONS



WELL PAD CROSS-SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



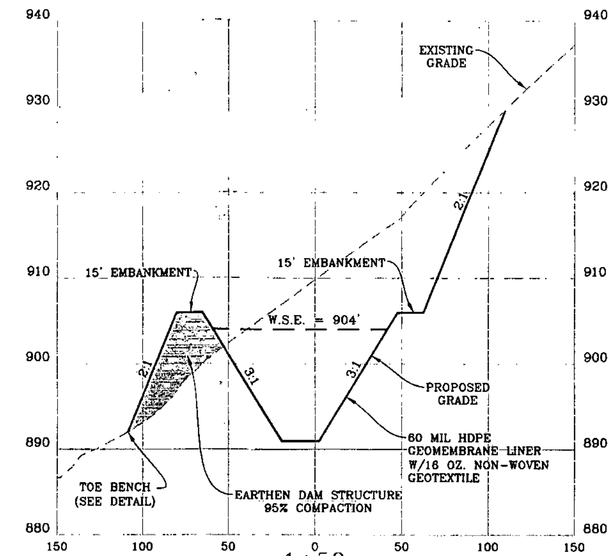
ASSOCIATED PIT CROSS-SECTION "B-B"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

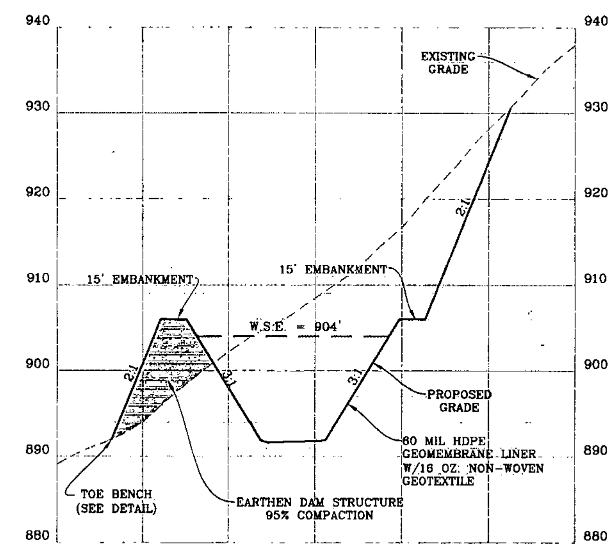
ASSOCIATED PIT CROSS-SECTIONS ALONG BASELINE "B-B"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

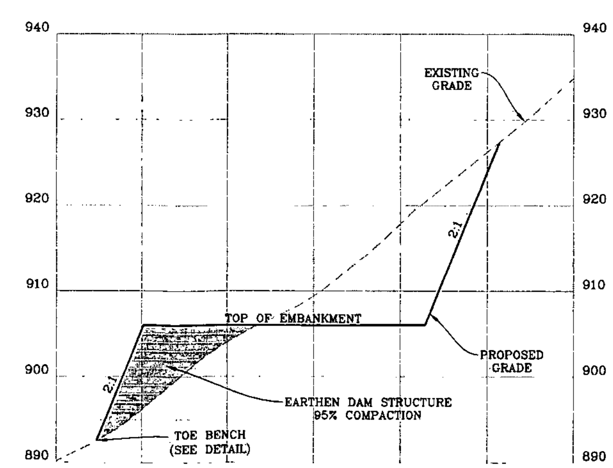
NOTE:
1. ALL FILL AREAS SHALL BE "KEYED IN" AND COMPACTED IN 12" LIFTS (9" RECOMMENDED) WITH A VIBRATING SHEEPSFOOT ROLLER TO 95% COMPACTION PER STANDARD PROCTOR.



1+50



1+00



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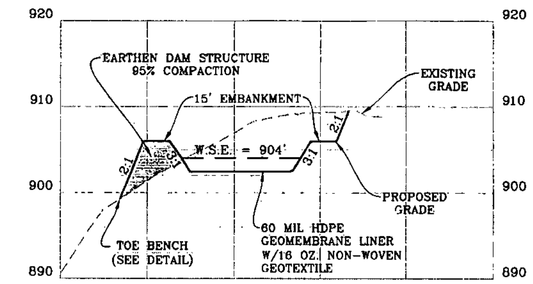

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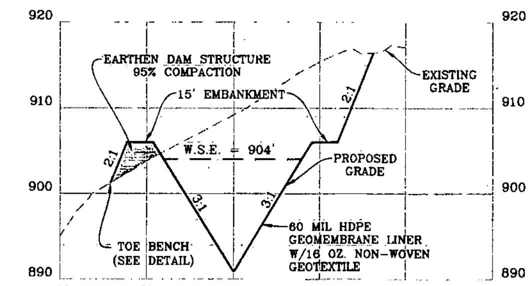
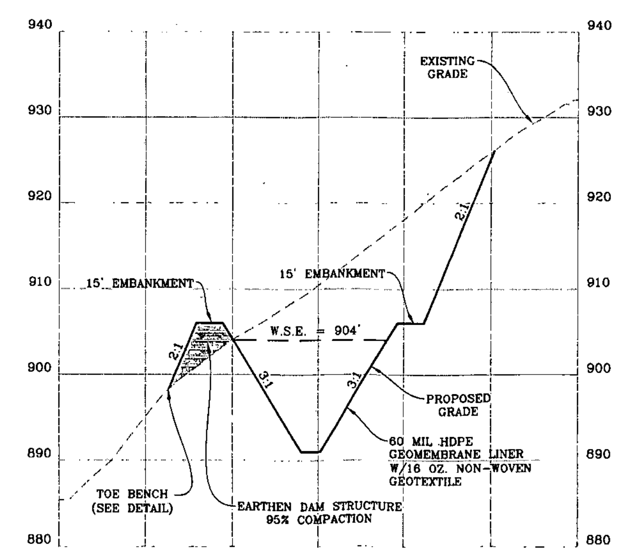


2+50



2+00

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CYRUS S. KUMP — REGISTERED — 19578 — STATE OF WEST VIRGINIA — PROFESSIONAL ENGINEER — 11/04/2013

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WELL PAD & ASSOCIATED PIT SECTIONS

OXF 157

WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013

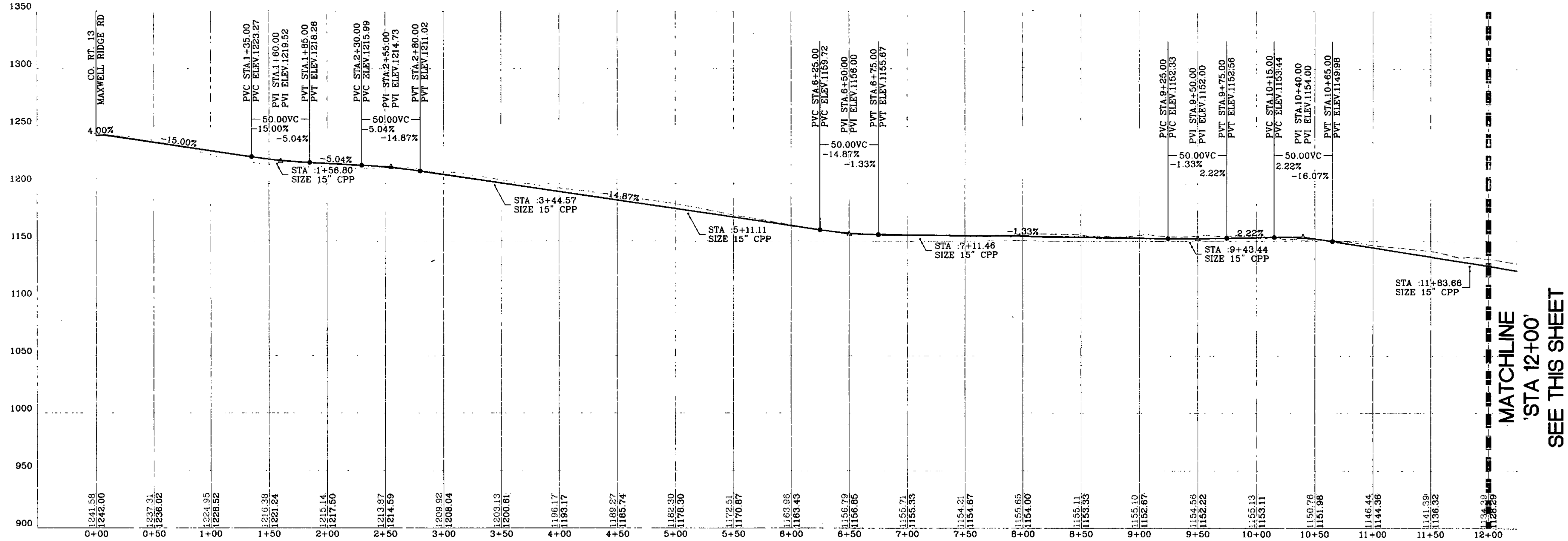
SCALE: 1" = 50'

DESIGNED BY: CSK

FILE NO. 7869

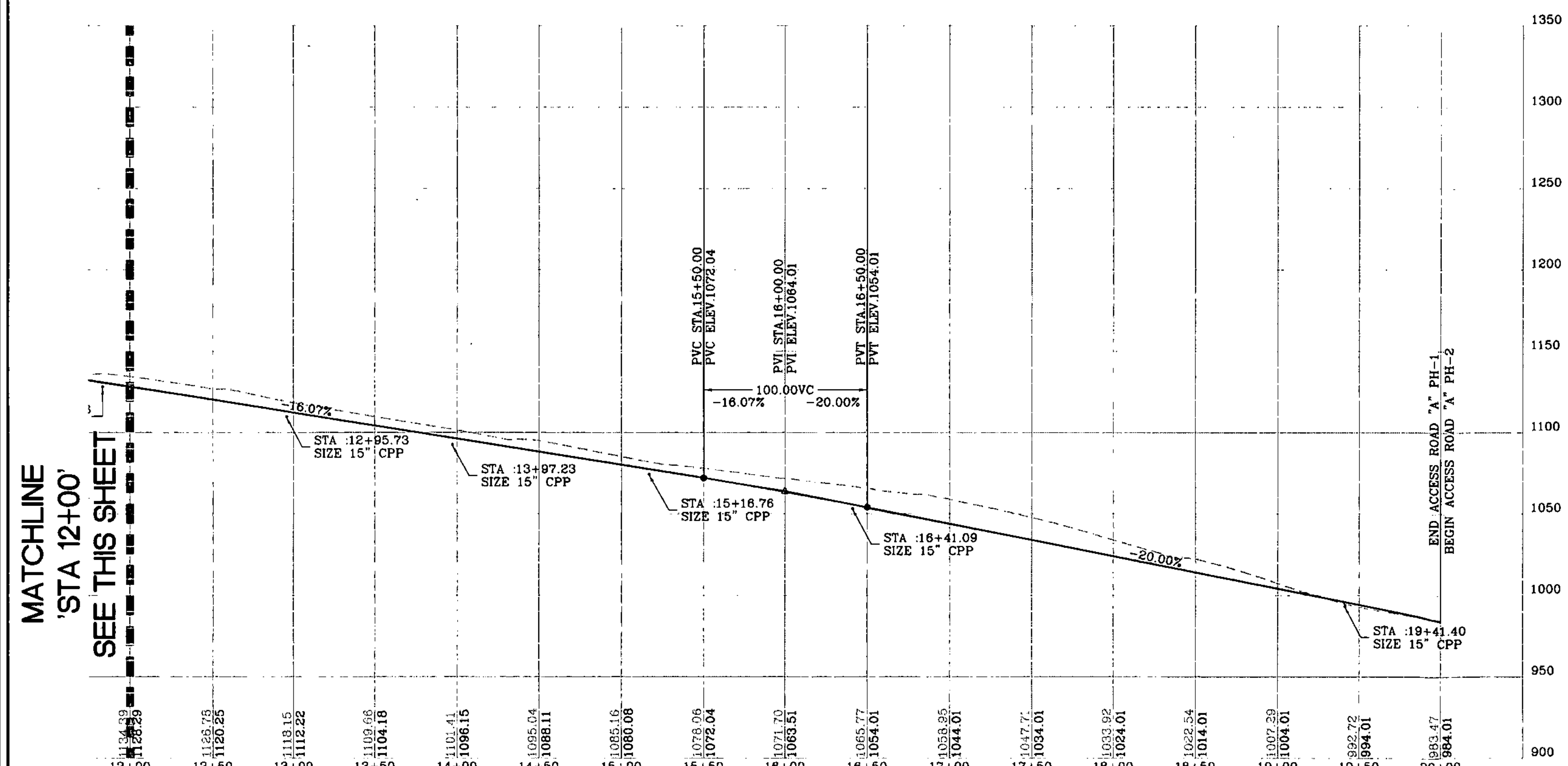
SHEET 9 OF 31

ACCESS ROAD "A" PH-1 PROFILE



ACCESS ROAD "A" PH-1 PROFILE

SCALE: HORIZ. 1" = 50' VERT. 1" = 50'



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CYRUS S. KUMP, REGISTERED PROFESSIONAL ENGINEER, STATE OF WEST VIRGINIA, 19678
11/04/2013

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ACCESS ROAD "A" PH-1 PROFILE

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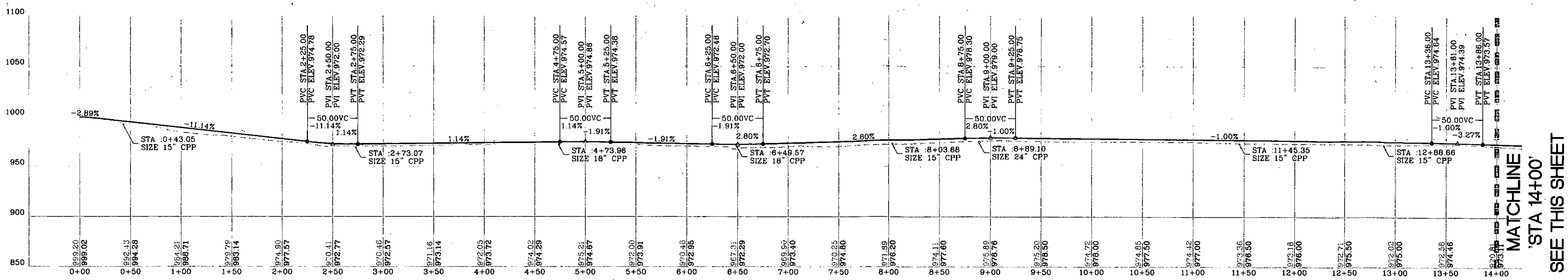
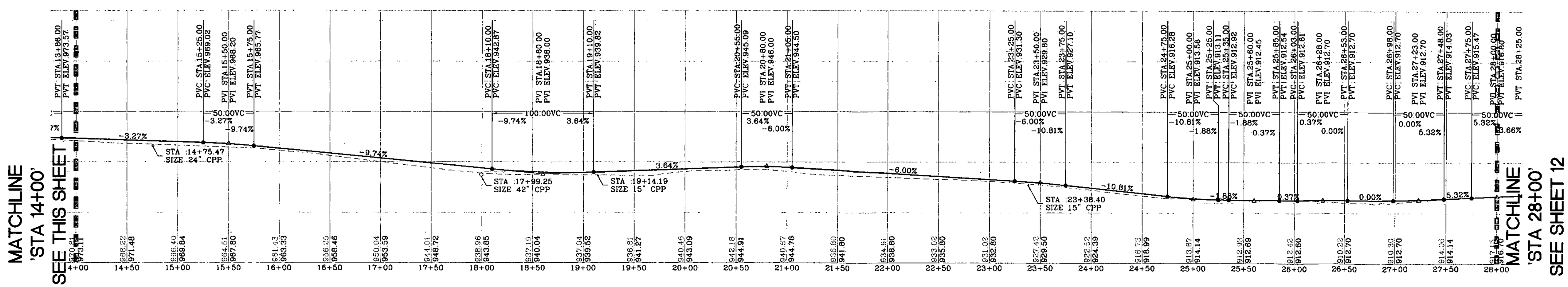
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013	
SCALE: 1" = 50'	
DESIGNED BY: CSK	
FILE NO. 7669	
SHEET 10 OF 31	

ACCESS ROAD "B" PROFILE





ACCESS ROAD "B" PROFILE

SCALE: HORIZ. 1" = 50' VERT. 1" = 50'

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11/04/2013

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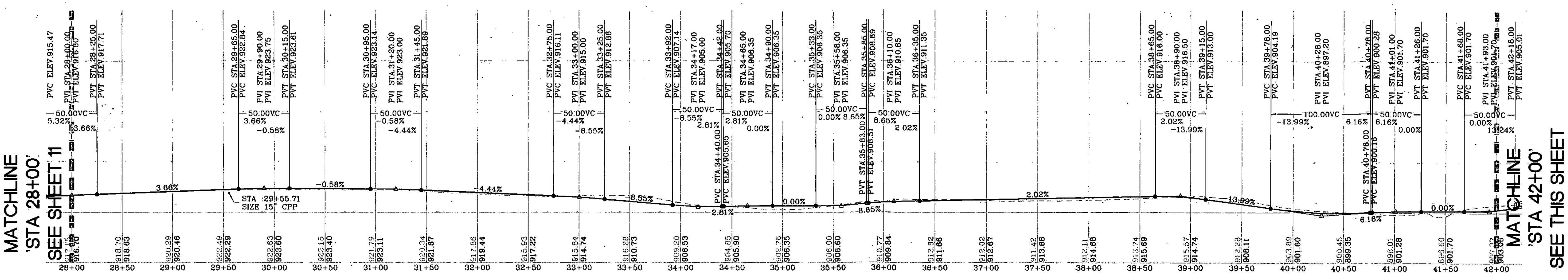
ACCESS ROAD "B" PROFILE

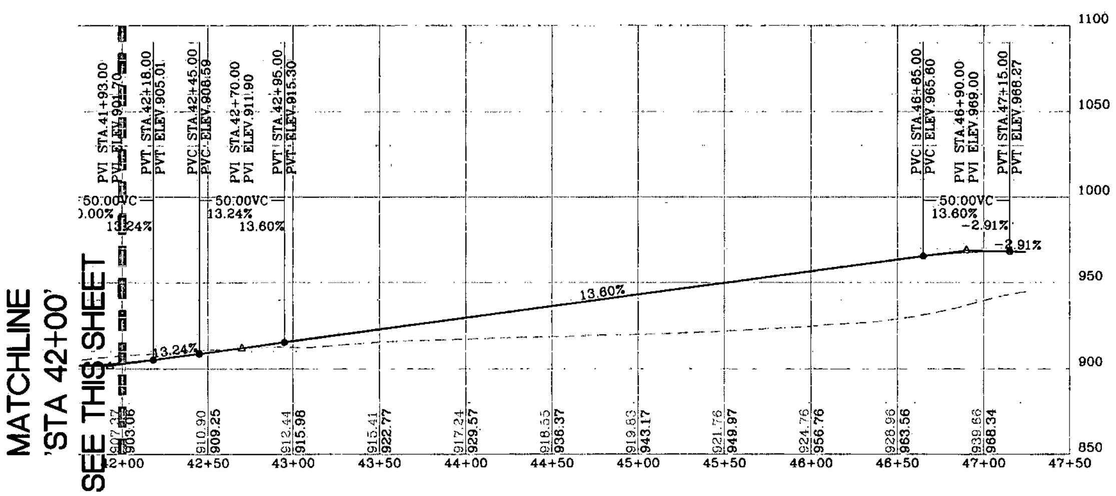
OXF 157

WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013	
SCALE: 1" = 50'	
DESIGNED BY:	CSK
FILE NO.	7889
SHEET 11 OF 31	

ACCESS ROAD "B" PROFILE





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ACCESS ROAD "B" PROFILE
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013
SCALE: 1" = 50'
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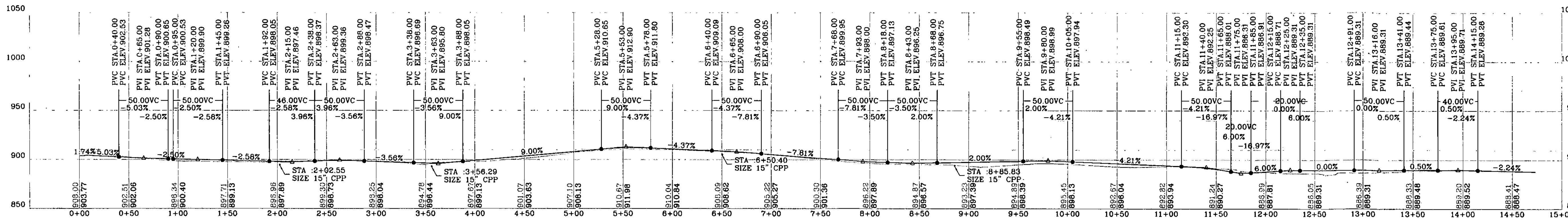
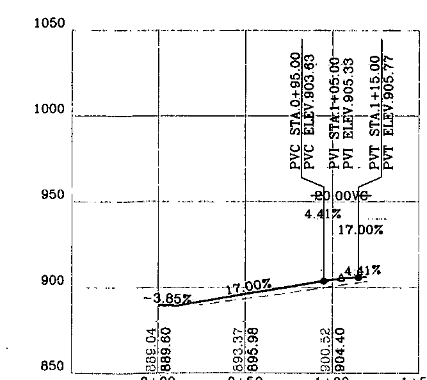
FILE NO. 7889
SHEET 12 OF 31

ACCESS ROADS "C" & "D" PROFILE



ACCESS ROAD "C" PROFILE

SCALE: HORIZ. 1" = 50' VERT. 1" = 50'



ACCESS ROAD "D" PROFILE

SCALE: HORIZ. 1" = 50' VERT. 1" = 50'

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ACCESS ROADS "C" & "D" PROFILE

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WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013

SCALE: 1" = 50'

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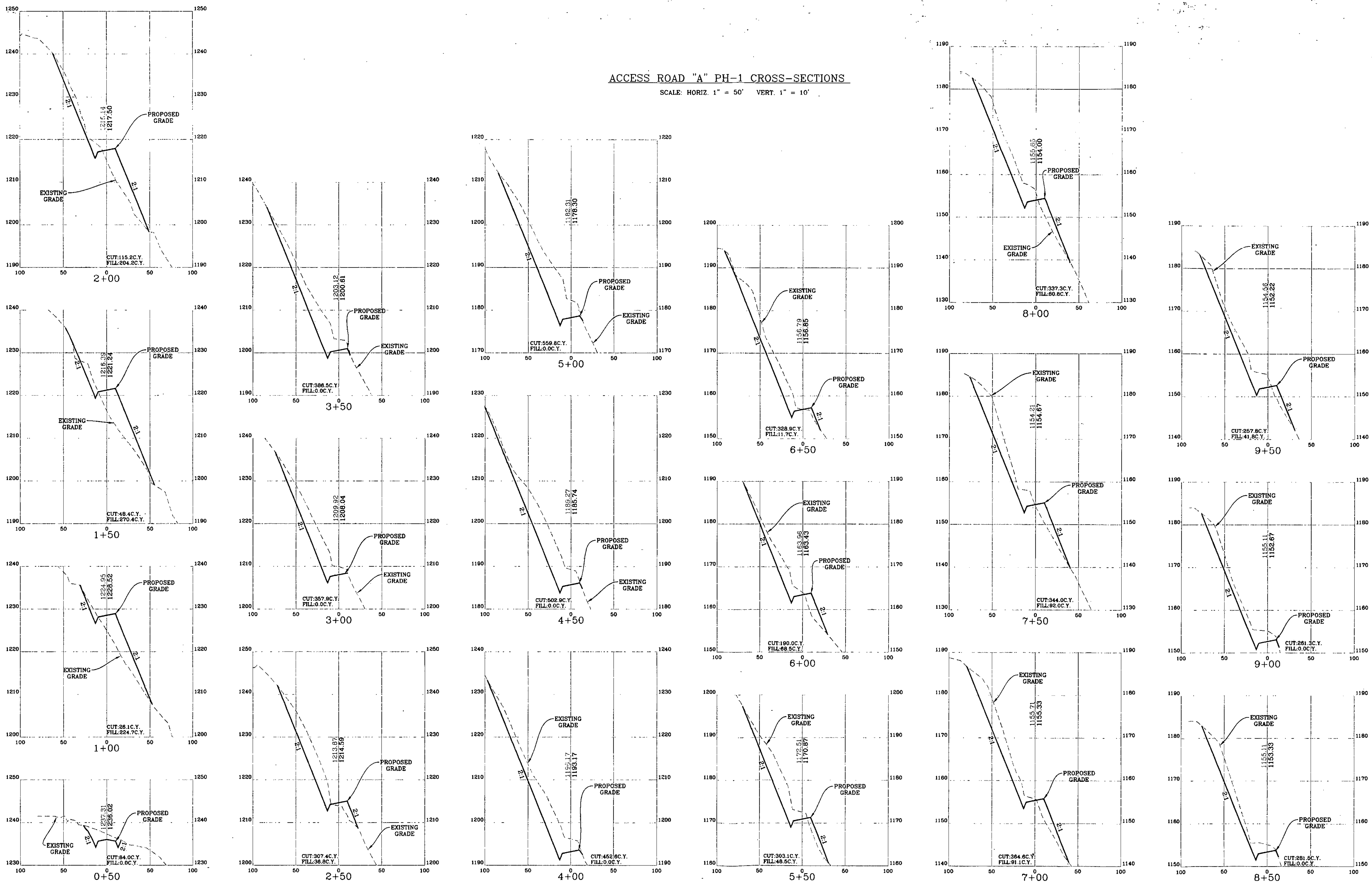
FILE NO. 7889

SHEET 13 OF 31

ROAD SECTIONS

ACCESS ROAD "A" PH-1 CROSS-SECTIONS

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



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ROAD SECTIONS

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WEST UNION DISTRICT

DODDRIDGE COUNTY, WV

DATE: 11/04/2013

SCALE: 1" = 50'

DESIGNED BY: CSK

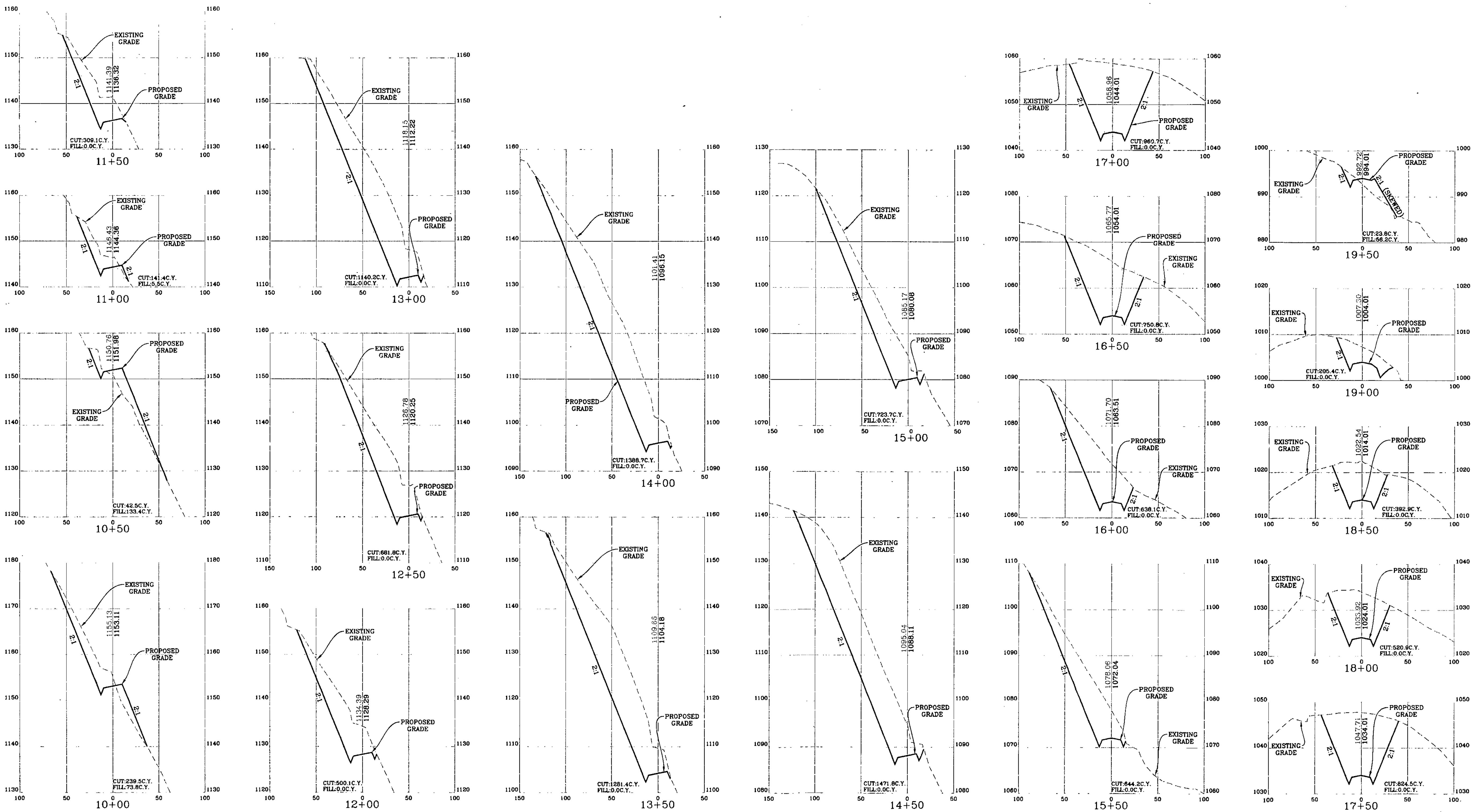
FILE NO. 7689

SHEET 14 OF 31

ROAD SECTIONS

ACCESS ROAD "A" PH-1 CROSS-SECTIONS

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



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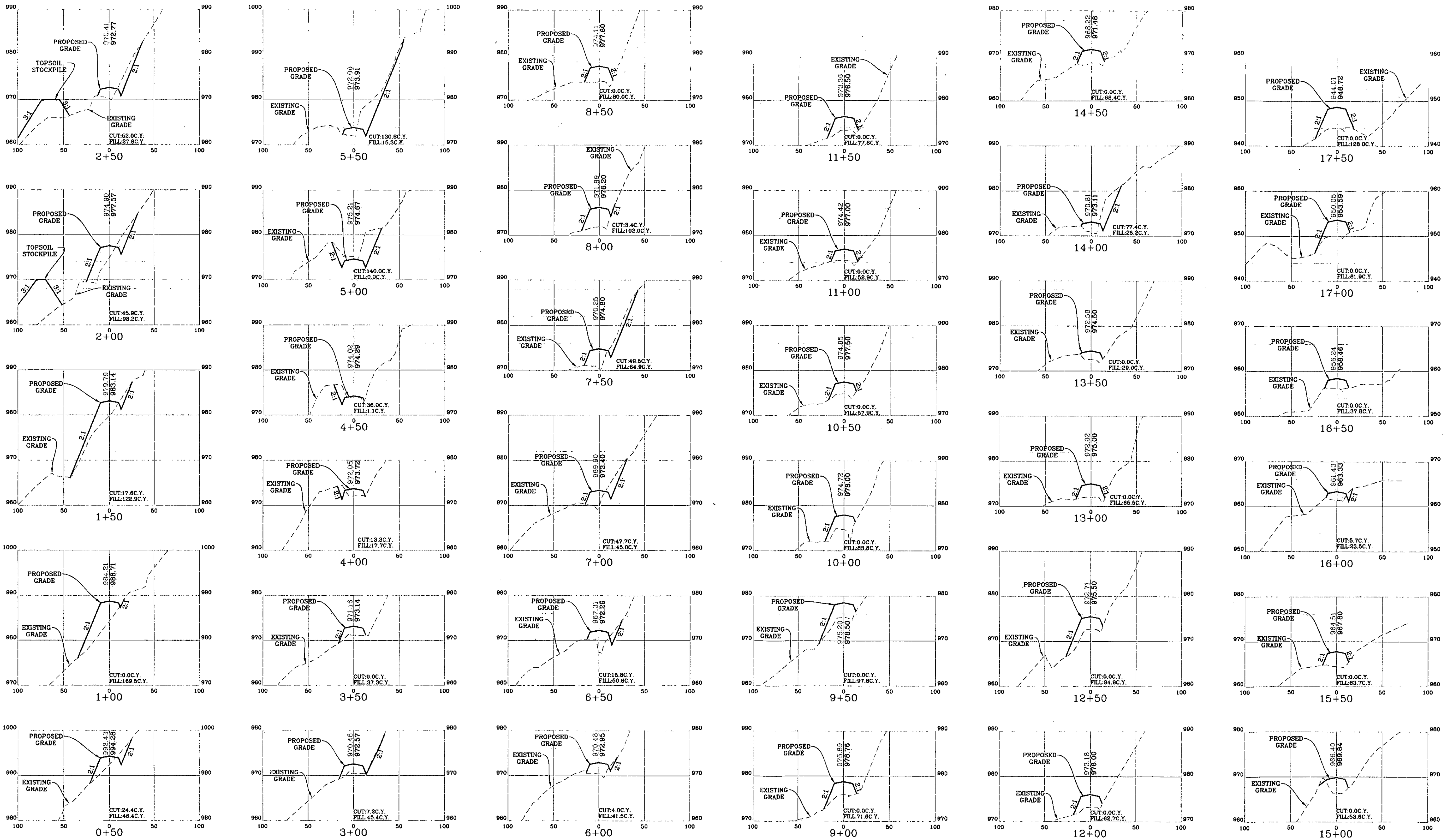
FILE NO. 7889
SHEET 15 OF 31

ROAD SECTIONS

ACCESS ROAD "B" CROSS-SECTIONS

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



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CYRUS S. KUMP REGISTERED No. 18578 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER
11/04/2013

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ROAD SECTIONS
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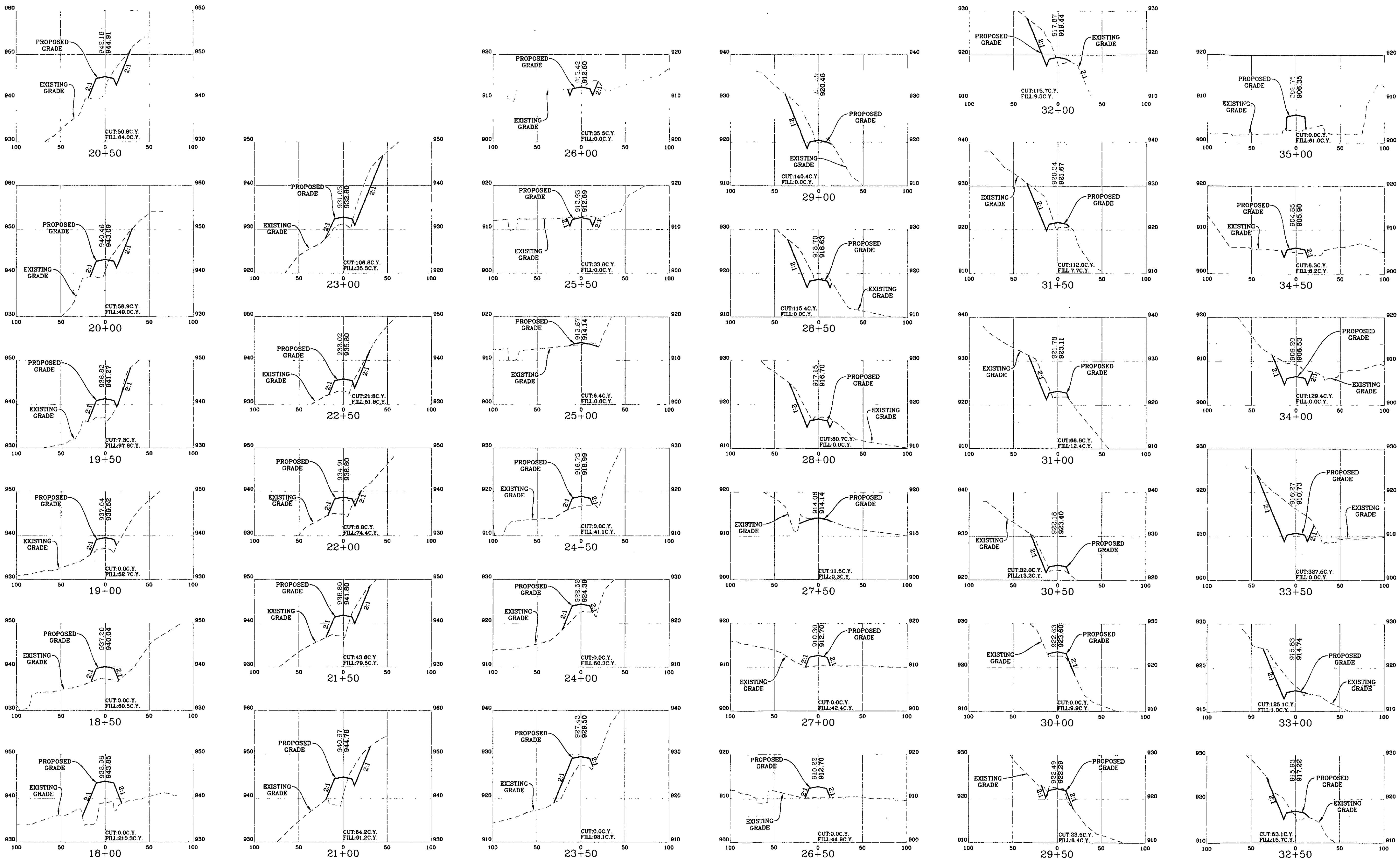
DODDRIDGE COUNTY, WV

DATE: 11/04/2013	
SCALE: 1" = 50'	
DESIGNED BY: CSK	
FILE NO. 7689	
SHEET 16 OF 31	

ROAD SECTIONS

ACCESS ROAD "B" CROSS-SECTIONS

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



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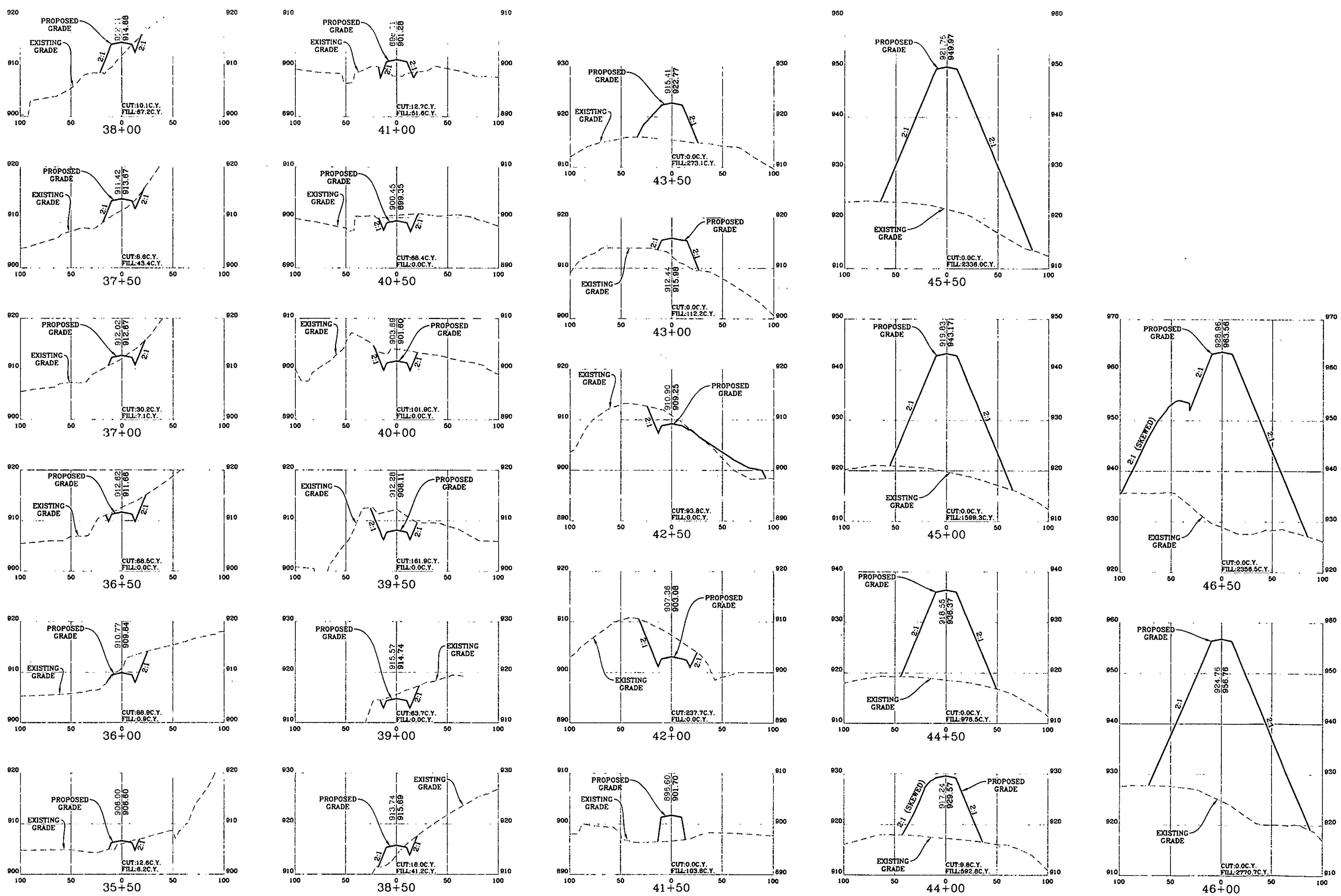
DODDRIDGE COUNTY, WV

DATE: 11/04/2013	
SCALE: 1" = 50'	
DESIGNED BY:	CSK
FILE NO.	7889
SHEET 17 OF 31	

ROAD SECTIONS

ACCESS ROAD "B" CROSS-SECTIONS

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



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ROAD SECTIONS
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013

SCALE: 1" = 50'

DESIGNED BY: CSK

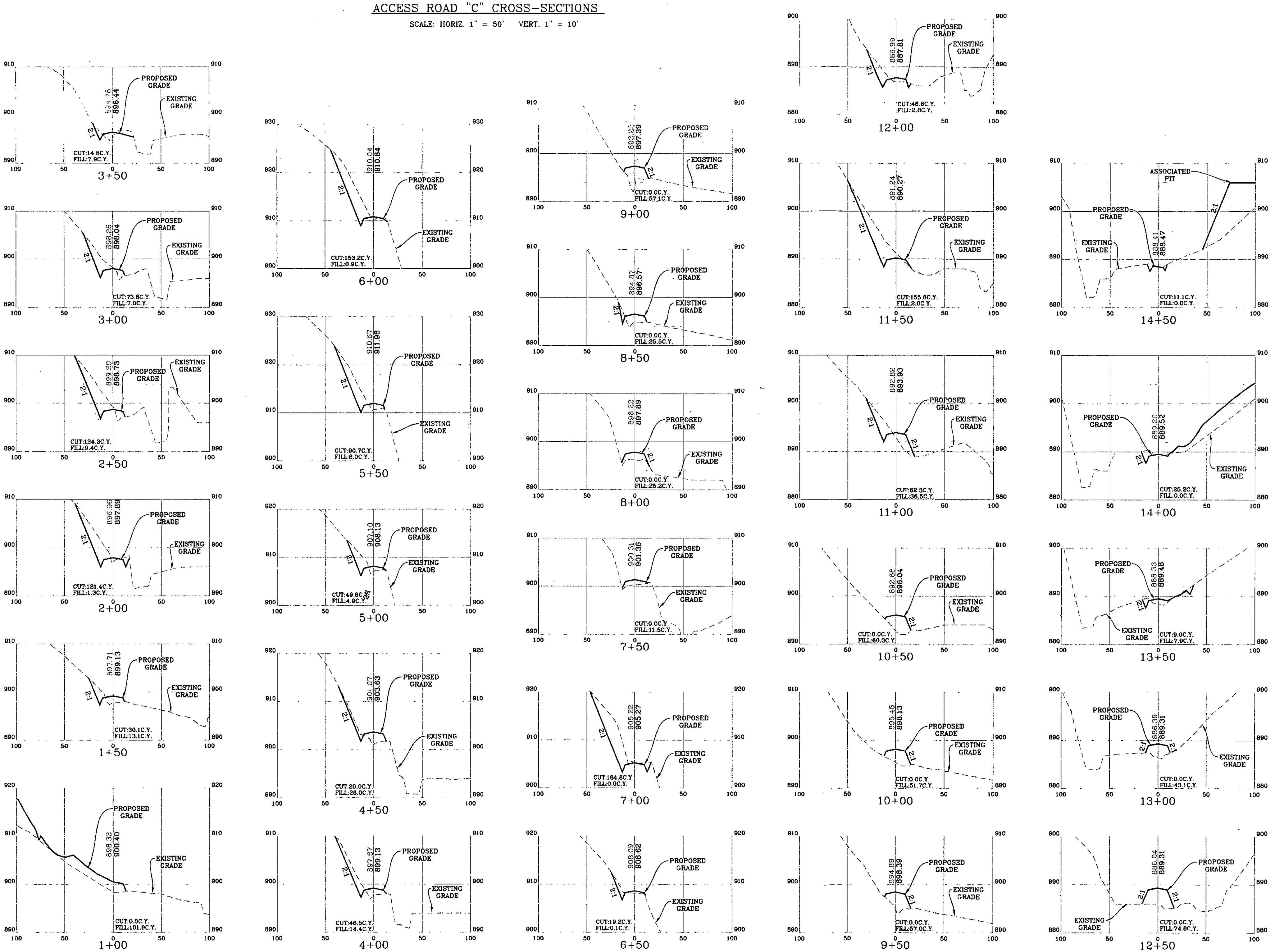
FILE NO. 7669

SHEET 18 OF 31

ROAD SECTIONS

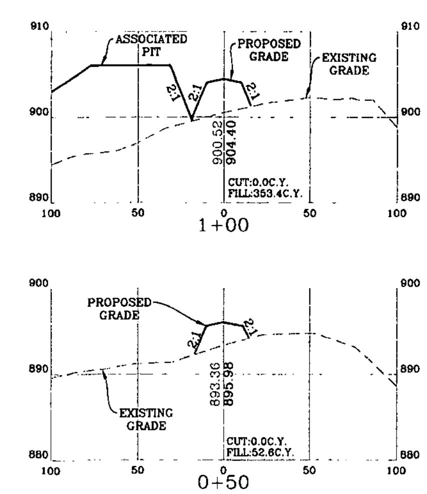
ACCESS ROAD "C" CROSS-SECTIONS

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



ACCESS ROAD "D" CROSS-SECTIONS

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



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REGISTERED
19578
STATE OF WEST VIRGINIA
PROFESSIONAL ENGINEER
11/04/2013

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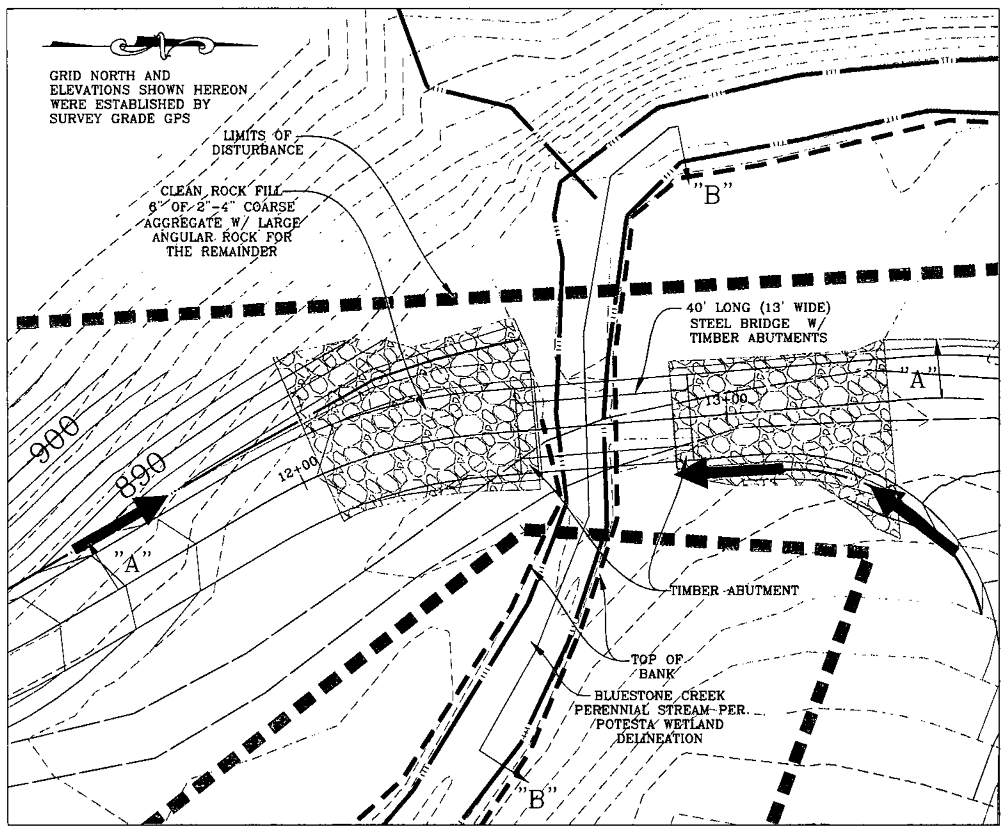
ROAD SECTIONS
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE:	11/04/2013
SCALE:	1" = 50'
DESIGNED BY:	CSK
FILE NO.	7889
SHEET	19 OF 31

TEMPORARY STREAM CROSSING DETAILS

STREAM CROSSING "A" DETAILS



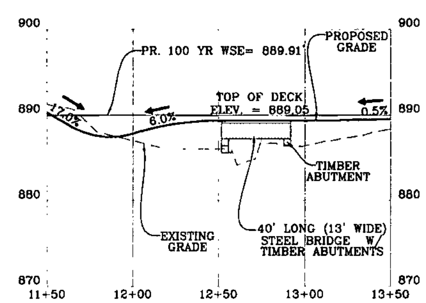
20 10 0 20 40

SCALE: 1" = 20'

NOTE:

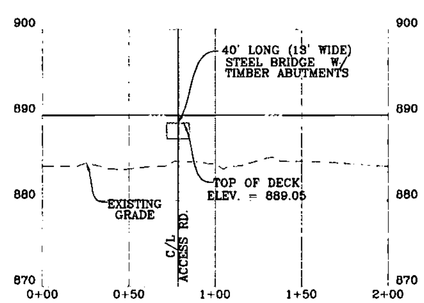
1) SEE STREAM CROSSING REPORT BY NAVITUS ENGINEERING FOR CULVERT AND DRAINAGE COMPUTATATIONS.
2) EQT SHALL OBTAIN A STREAM ACTIVITY PERMIT THROUGH THE PUBLIC LAND CORPORATION OFFICE OF LAND AND STREAMS FOR STREAM CROSSING "A".

STREAM CROSSING "A" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

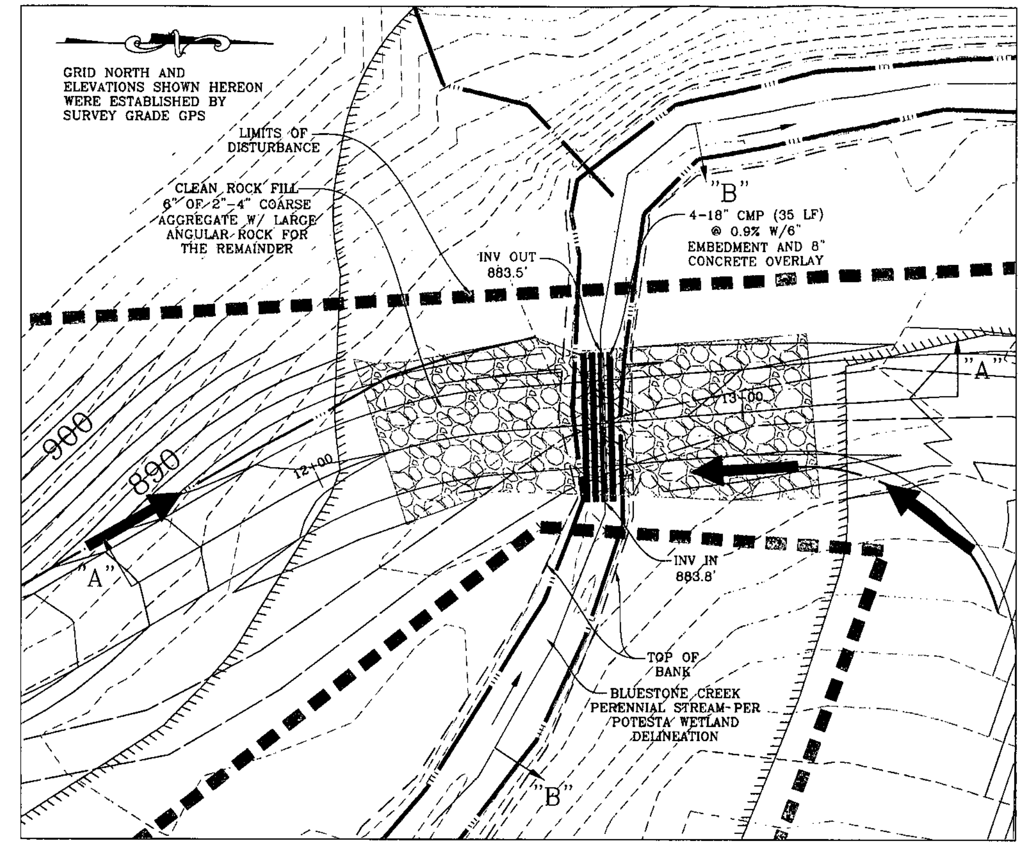
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

GENERAL STREAM CROSSING NOTES:

1) 2" TO 4" COARSE AGGREGATE OR LARGER SHALL BE USED TO FORM THE FIRST 6" OF FILL FOR THE CROSSING, THE REMAINDER OF MATERIAL SHALL BE ONLY LARGE ANGULAR DURABLE ROCK. "DO NOT USE ERODIBLE MATERIAL FOR CONSTRUCTION OF THE CROSSING."
2) DEPTH OF STONE COVER OVER THE CULVERTS SHALL BE EQUAL TO ONE-HALF THE CULVERT DIAMETER OR 12 INCHES, WHICHEVER IS GREATER.
3) IF MULTIPLE CULVERTS ARE USED, THEY SHALL BE SEPARATED BY AT LEAST 12 INCHES OF COMPACTED AGGREGATE FILL.
4) CLEARING AND EXCAVATION OF THE STREAMBED AND BANKS SHALL BE KEPT TO A MINIMUM.
5) FILTER CLOTH SHALL BE PLACED ON THE STREAM BED AND STREAM BANKS PRIOR TO PLACEMENT OF THE PIPE CULVERTS AND AGGREGATE. THE FILTER CLOTH SHALL COVER THE STREAMBED AND EXTEND A MINIMUM OF SIX INCHES AND A MAXIMUM OF ONE FOOT BEYOND THE END OF THE CULVERTS AND BEDDING MATERIAL.
6) A WATER DIVERTING SWALE OR PUMP AROUND SYSTEM SHALL BE CONSTRUCTED ACROSS THE ROADWAY ON EITHER SIDE OF THE STREAM CROSSING AS DIRECTED.
7) APPROPRIATE PERIMETER CONTROLS SUCH AS COMPOST FILTER SOCK, SUPER SILT FENCE AND/OR SEDIMENT TRAPS SHALL BE EMPLOYED ALONG THE BANKS AND PARALLEL TO THE STREAMBED.
8) TIMBER ABUTMENTS ON THE UPSTREAM AND DOWNSTREAM SIDE OF THE CULVERT INSTALLATION SHALL BE INSTALLED TO REDUCE STRUCTURAL DAMAGE DURING HIGH VELOCITY WATER OVERFLOW PERIODS.
9) STREAMBED MATERIAL IS NOT TO BE USED AS FILL.
10) GREEN CONCRETE SHALL NOT BE PLACED IN CONTACT WITH FLOWING WATER.
11) WHEN THE CROSSING HAS SERVED ITS PURPOSE, ALL STRUCTURES INCLUDING CULVERTS, BEDDING, AND FILTER CLOTH SHALL BE REMOVED. REMOVAL OF THE STRUCTURE AND CLEAN UP OF THE AREA SHOULD BE ACCOMPLISHED WITHOUT CONSTRUCTION EQUIPMENT WORKING IN THE WATERWAY CHANNEL. UPON REMOVAL OF THE STRUCTURE, THE STREAM BANK SHALL IMMEDIATELY BE STABILIZED.
12) DURING ROUTINE MAINTENANCE DO NOT GRADE MUD AND DEBRIS OVER THE SIDES OF THE CROSSING INTO THE STREAM.
13) THE CROSSING MUST BE INSPECTED AFTER EVERY RAIN EVENT OF 0.5 INCHES OR MORE AND ONCE A WEEK TO ENSURE THAT THE CULVERTS, STREAMBED, AND STREAM BANKS ARE MAINTAINED AND NOT DAMAGED. NEVER ALLOW THE CULVERTS TO BECOME CLOGGED WITH DEBRIS AND REMOVE ANY OBSTRUCTIONS IMMEDIATELY.
14) FLUSHING IS NOT AN APPROVED METHOD TO BE UTILIZED FOR CULVERT CLEANOUT.
15) ALL CROSSING STRUCTURES SHALL BE ANCHORED IN ACCORDANCE WITH THE DODDRIDGE COUNTY FLOODPLAIN ORDINANCE.

PERMANENT STREAM CROSSING DETAILS

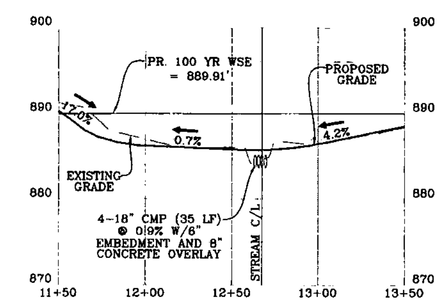
STREAM CROSSING "A" DETAILS



20 10 0 20 40

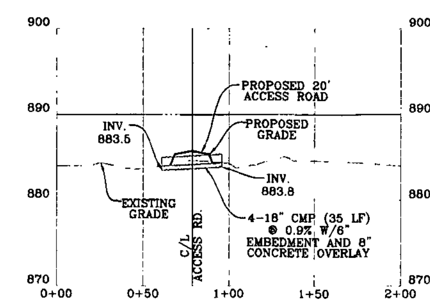
SCALE: 1" = 20'

STREAM CROSSING "A" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

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CIRUS S. KUMP REGISTERED 19078 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER
11/04/2013

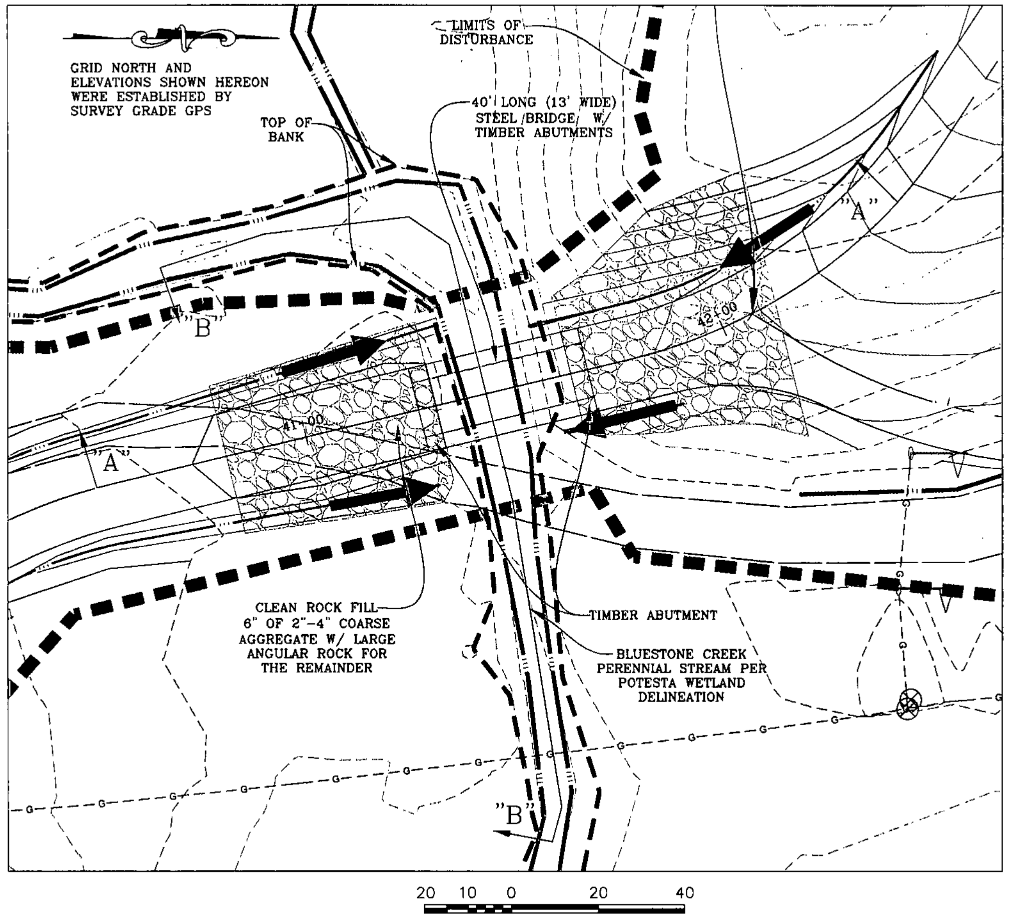
THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

STREAM CROSSING DETAILS
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013
SCALE: N/A
DESIGNED BY: CSK
FILE NO. 7889
SHEET 20 OF 31

TEMPORARY STREAM CROSSING DETAILS

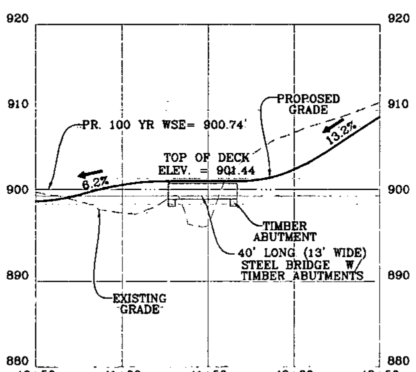
STREAM CROSSING "B" DETAILS



NOTE:

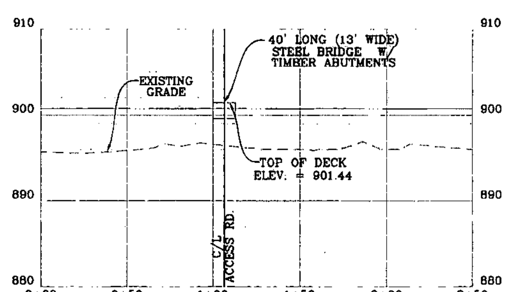
1) SEE STREAM CROSSING REPORT BY NAVITUS ENGINEERING FOR CULVERT AND DRAINAGE COMPUTATATIONS.
2) EQT SHALL OBTAIN A STREAM ACTIVITY PERMIT THROUGH THE PUBLIC LAND CORPORATION OFFICE OF LAND AND STREAMS FOR STREAM CROSSING "B".

STREAM CROSSING "B" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

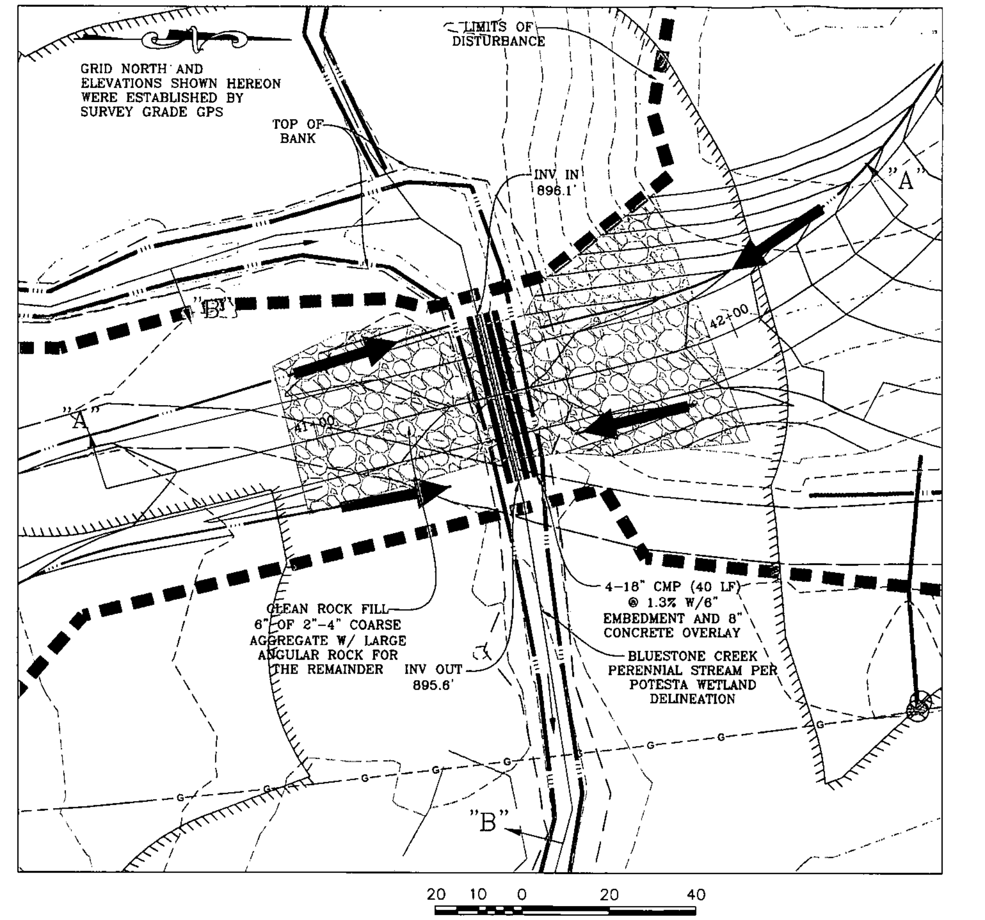
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

GENERAL STREAM CROSSING NOTES:

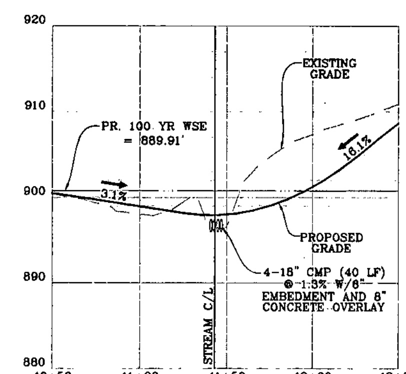
1) 2" TO 4" COARSE AGGREGATE OR LARGER SHALL BE USED TO FORM THE FIRST 6" OF FILL FOR THE CROSSING, THE REMAINDER OF MATERIAL SHALL BE ONLY LARGE ANGULAR DURABLE ROCK. "DO NOT USE ERODIBLE MATERIAL FOR CONSTRUCTION OF THE CROSSING."
2) DEPTH OF STONE COVER OVER THE CULVERTS SHALL BE EQUAL TO ONE-HALF THE CULVERT DIAMETER OR 12 INCHES, WHICHEVER IS GREATER.
3) IF MULTIPLE CULVERTS ARE USED, THEY SHALL BE SEPARATED BY AT LEAST 12 INCHES OF COMPACTED AGGREGATE FILL.
4) CLEARING AND EXCAVATION OF THE STREAMBED AND BANKS SHALL BE KEPT TO A MINIMUM.
5) FILTER CLOTH SHALL BE PLACED ON THE STREAM BED AND STREAM BANKS PRIOR TO PLACEMENT OF THE PIPE CULVERTS AND AGGREGATE. THE FILTER CLOTH SHALL COVER THE STREAMBED AND EXTEND A MINIMUM OF SIX INCHES AND A MAXIMUM OF ONE FOOT BEYOND THE END OF THE CULVERTS AND BEDDING MATERIAL.
6) A WATER DIVERTING SWALE OR PUMP AROUND SYSTEM SHALL BE CONSTRUCTED ACROSS THE ROADWAY ON EITHER SIDE OF THE STREAM CROSSING AS DIRECTED.
7) APPROPRIATE PERIMETER CONTROLS SUCH AS COMPOST FILTER SOCK, SUPER SILT FENCE AND/OR SEDIMENT TRAPS SHALL BE EMPLOYED ALONG THE BANKS AND PARALLEL TO THE STREAMBED.
8) TIMBER ABUTMENTS ON THE UPSTREAM AND DOWNSTREAM SIDE OF THE CULVERT INSTALLATION SHALL BE INSTALLED TO REDUCE STRUCTURAL DAMAGE DURING HIGH VELOCITY WATER OVERFLOW PERIODS.
9) STREAMBED MATERIAL IS NOT TO BE USED AS FILL.
10) GREEN CONCRETE SHALL NOT BE PLACED IN CONTACT WITH FLOWING WATER.
11) WHEN THE CROSSING HAS SERVED ITS PURPOSE, ALL STRUCTURES INCLUDING CULVERTS, BEDDING, AND FILTER CLOTH SHALL BE REMOVED. REMOVAL OF THE STRUCTURE AND CLEAN UP OF THE AREA SHOULD BE ACCOMPLISHED WITHOUT CONSTRUCTION EQUIPMENT WORKING IN THE WATERWAY CHANNEL. UPON REMOVAL OF THE STRUCTURE, THE STREAM BANK SHALL IMMEDIATELY BE STABILIZED.
12) DURING ROUTINE MAINTENANCE DO NOT GRADE MUD AND DEBRIS OVER THE SIDES OF THE CROSSING INTO THE STREAM.
13) THE CROSSING MUST BE INSPECTED AFTER EVERY RAIN EVENT OF 0.5 INCHES OR MORE AND ONCE A WEEK TO ENSURE THAT THE CULVERTS, STREAMBED, AND STREAM BANKS ARE MAINTAINED AND NOT DAMAGED. NEVER ALLOW THE CULVERTS TO BECOME CLOGGED WITH DEBRIS AND REMOVE ANY OBSTRUCTIONS IMMEDIATELY.
14) FLUSHING IS NOT AN APPROVED METHOD TO BE UTILIZED FOR CULVERT CLEANOUT.
15) ALL CROSSING STRUCTURES SHALL BE ANCHORED IN ACCORDANCE WITH THE DODDRIDGE COUNTY FLOODPLAIN ORDINANCE.

PERMANENT STREAM CROSSING DETAILS

STREAM CROSSING "B" DETAILS

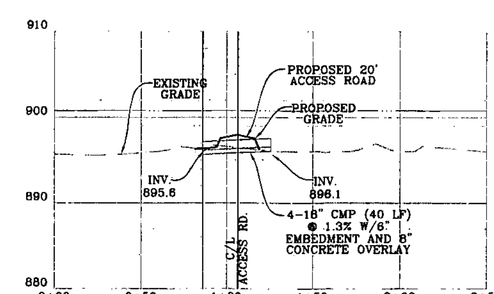


STREAM CROSSING "B" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

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HONESTY, INTEGRITY, QUALITY

CYRUS S. KUMP · REGISTERED · 19578 · STATE OF WEST VIRGINIA · PROFESSIONAL ENGINEER · 11/04/2013

THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

STREAM CROSSING DETAILS

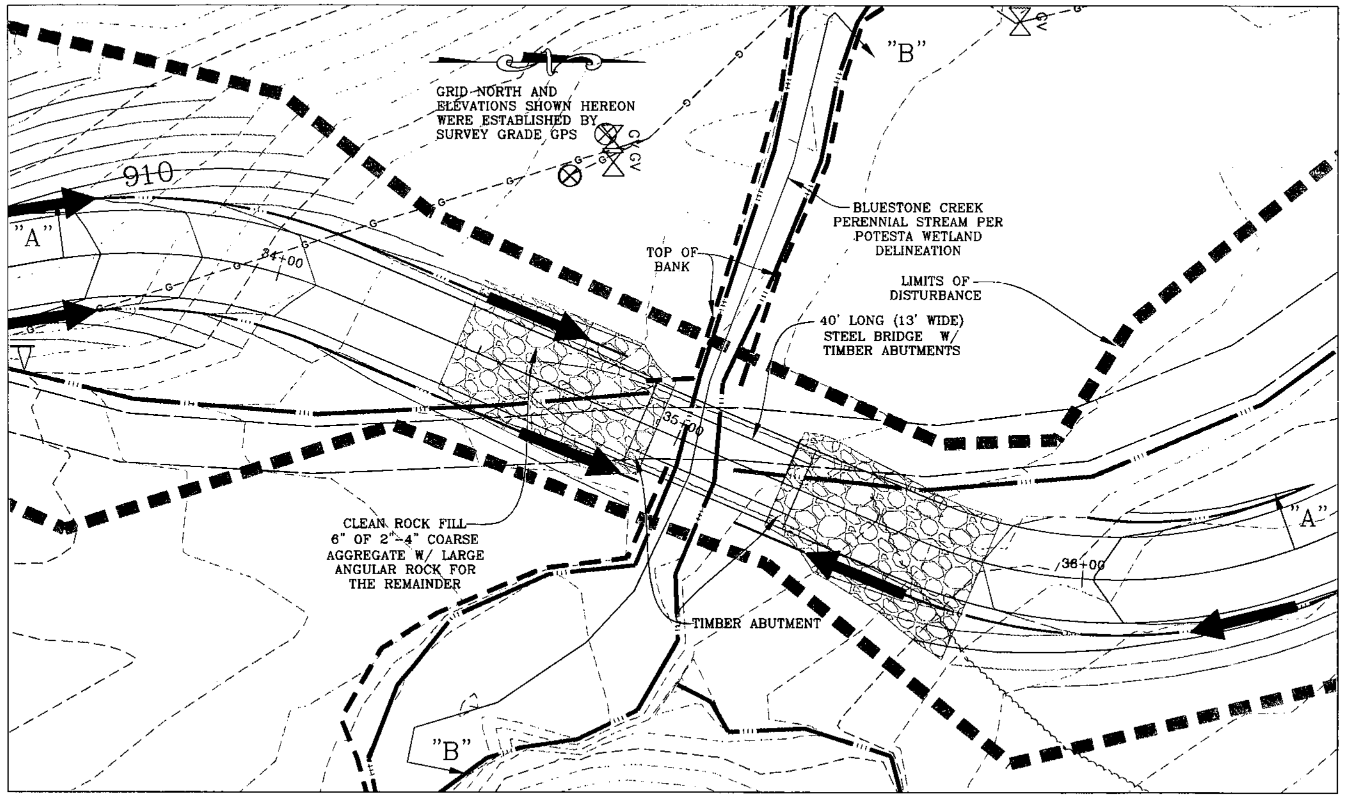
OXF 157

WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013	
SCALE: N/A	
DESIGNED BY:	CSK
FILE NO.	7889
SHEET 21 OF 31	

TEMPORARY STREAM CROSSING DETAILS

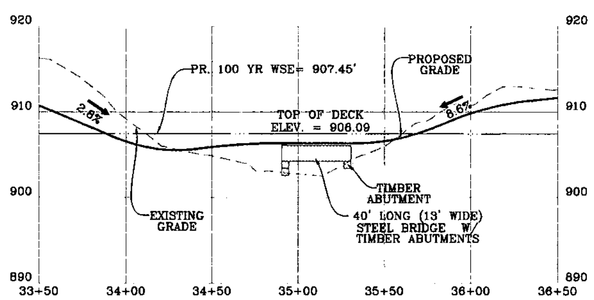
STREAM CROSSING "C" DETAILS



20 10 0 20 40

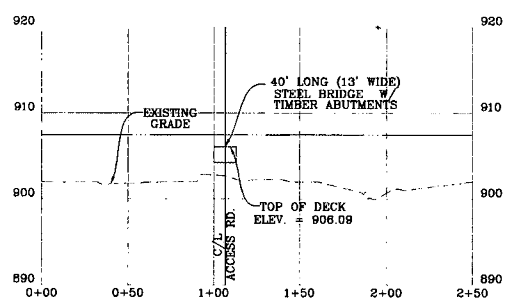
SCALE: 1" = 20'

STREAM CROSSING "C" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

GENERAL STREAM CROSSING NOTES:

1) 2" TO 4" COARSE AGGREGATE OR LARGER SHALL BE USED TO FORM THE FIRST 6" OF FILL FOR THE CROSSING, THE REMAINDER OF MATERIAL SHALL BE ONLY LARGE ANGULAR DURABLE ROCK. "DO NOT USE ERODIBLE MATERIAL FOR CONSTRUCTION OF THE CROSSING."
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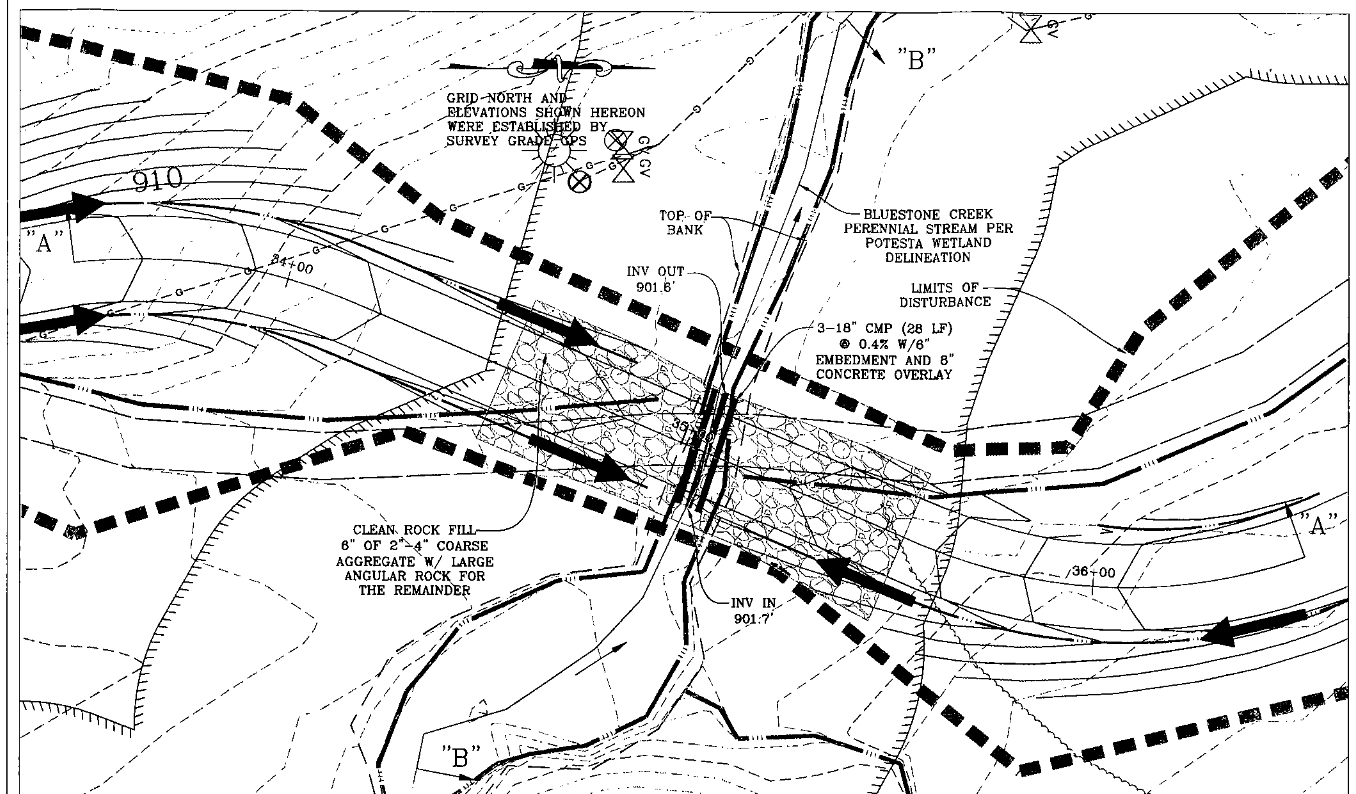
PERMANENT STREAM CROSSING DETAILS

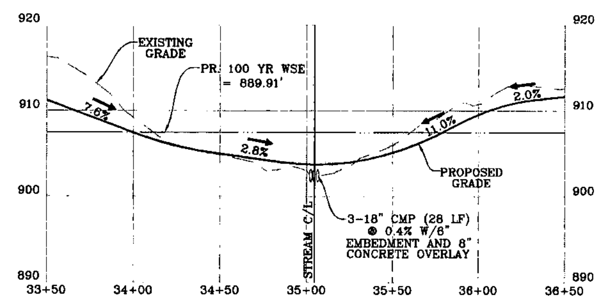
STREAM CROSSING "C" DETAILS



20 10 0 20 40

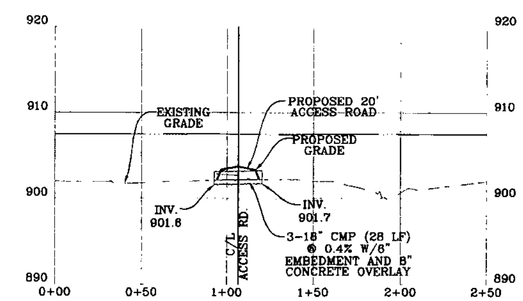
SCALE: 1" = 20'

STREAM CROSSING "C" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

NOTE:

1) SEE STREAM CROSSING REPORT BY NAVITUS ENGINEERING FOR CULVERT AND DRAINAGE COMPUTATATIONS.
2) EQT SHALL OBTAIN A STREAM ACTIVITY PERMIT THROUGH THE PUBLIC LAND CORPORATION OFFICE OF LAND AND STREAMS FOR STREAM CROSSING "C".

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(304) 462-5634
56065 Dilles Bottom Road
Shadyside, OH 43947
(740) 671-9911
HONESTY, INTEGRITY, QUALITY

CYRUS S. KUMP REGISTERED 19578 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER
11/04/2013

THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

STREAM CROSSING DETAILS

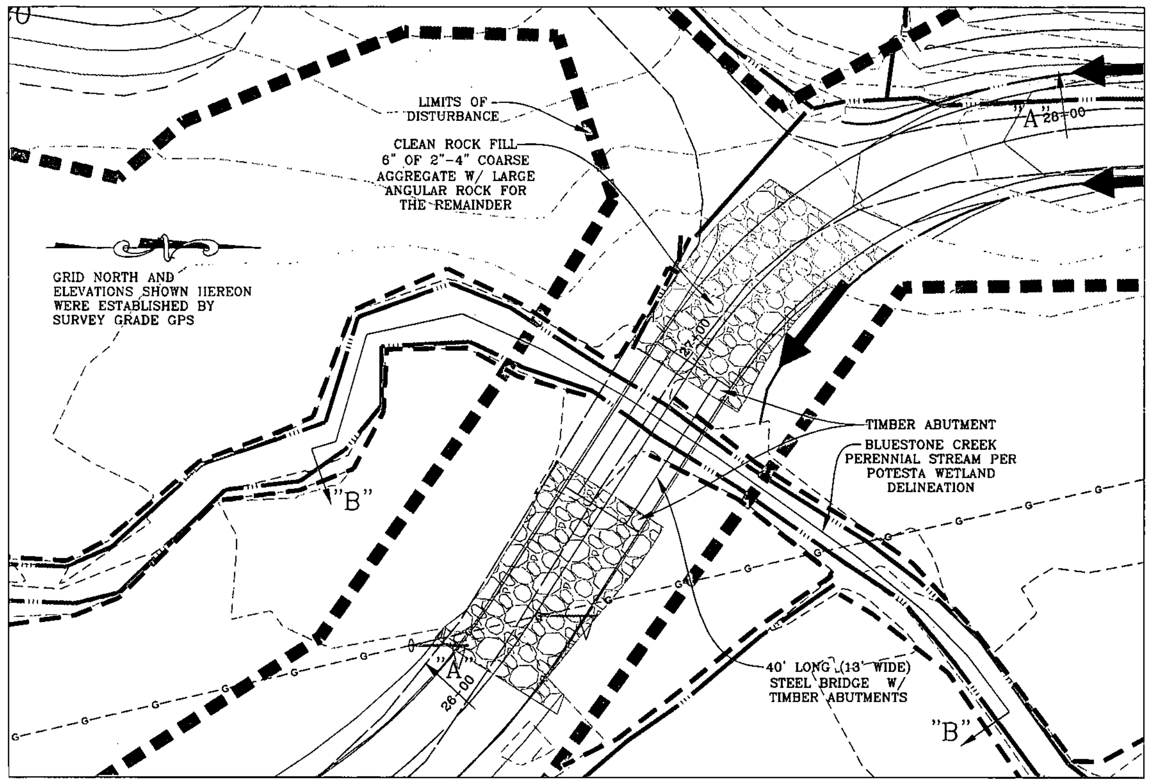
OXF 157

WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013	
SCALE: N/A	
DESIGNED BY: CSK	
FILE NO.	7889
SHEET 22 OF 31	

TEMPORARY STREAM CROSSING DETAILS

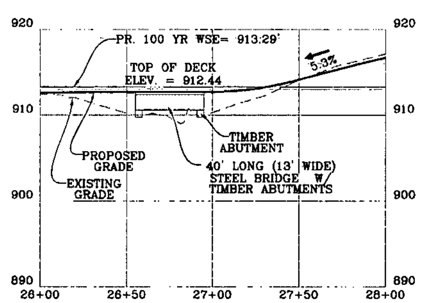
STREAM CROSSING "D" DETAILS



20 10 0 20 40

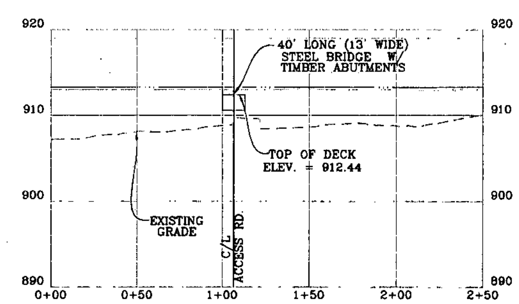
SCALE: 1" = 20'

STREAM CROSSING "D" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

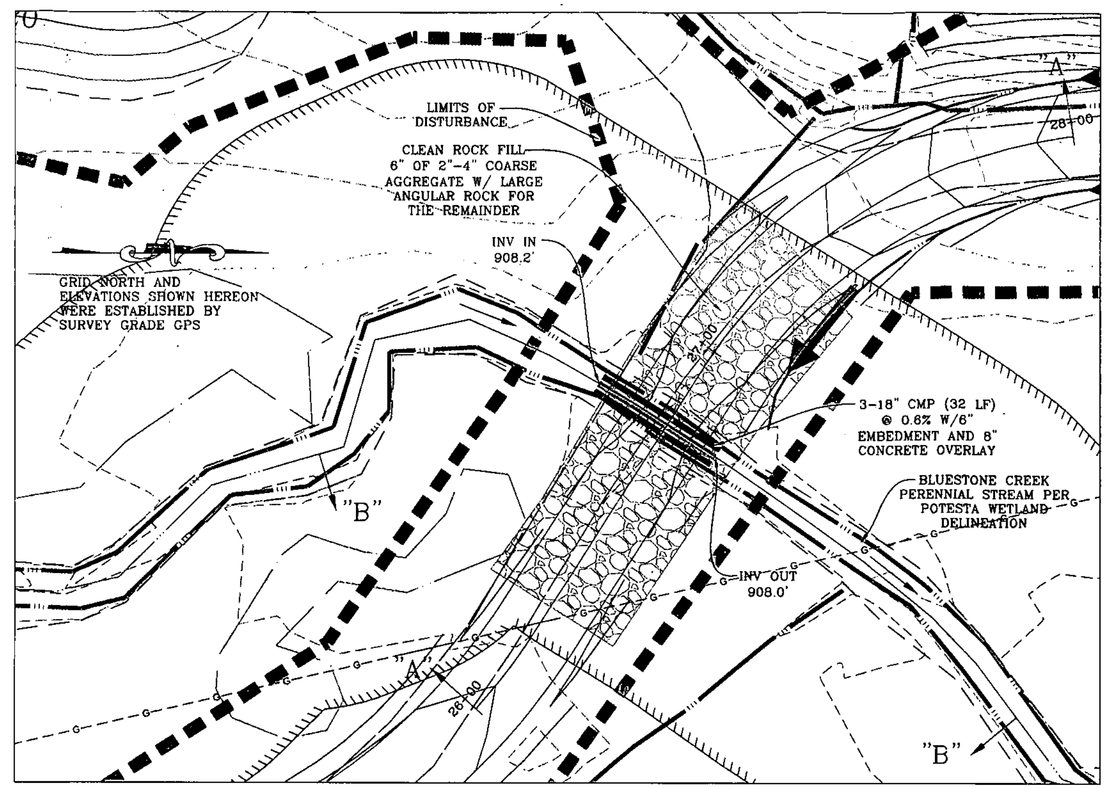


CROSS SECTION "B-B"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

PERMANENT STREAM CROSSING DETAILS

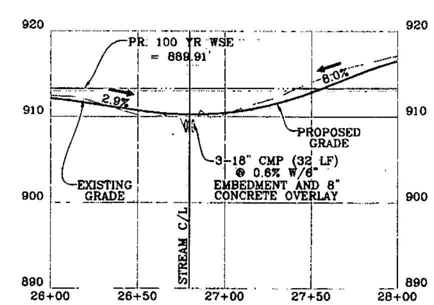
STREAM CROSSING "D" DETAILS



20 10 0 20 40

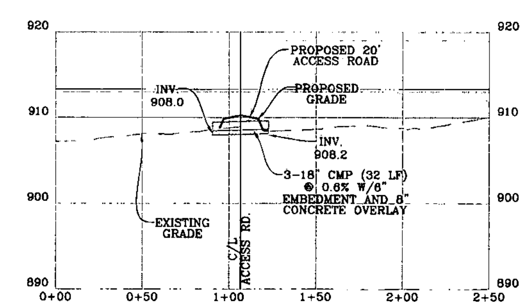
SCALE: 1" = 20'

STREAM CROSSING "D" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

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GENERAL STREAM CROSSING NOTES:

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NOTE:

1) SEE STREAM CROSSING REPORT BY NAVITUS ENGINEERING FOR CULVERT AND DRAINAGE COMPUTATATIONS.
2) EQT SHALL OBTAIN A STREAM ACTIVITY PERMIT THROUGH THE PUBLIC LAND CORPORATION OFFICE OF LAND AND STREAMS FOR STREAM CROSSING "D".

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11/04/2013

THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

STREAM CROSSING DETAILS

OXF 157

WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013

SCALE: N/A

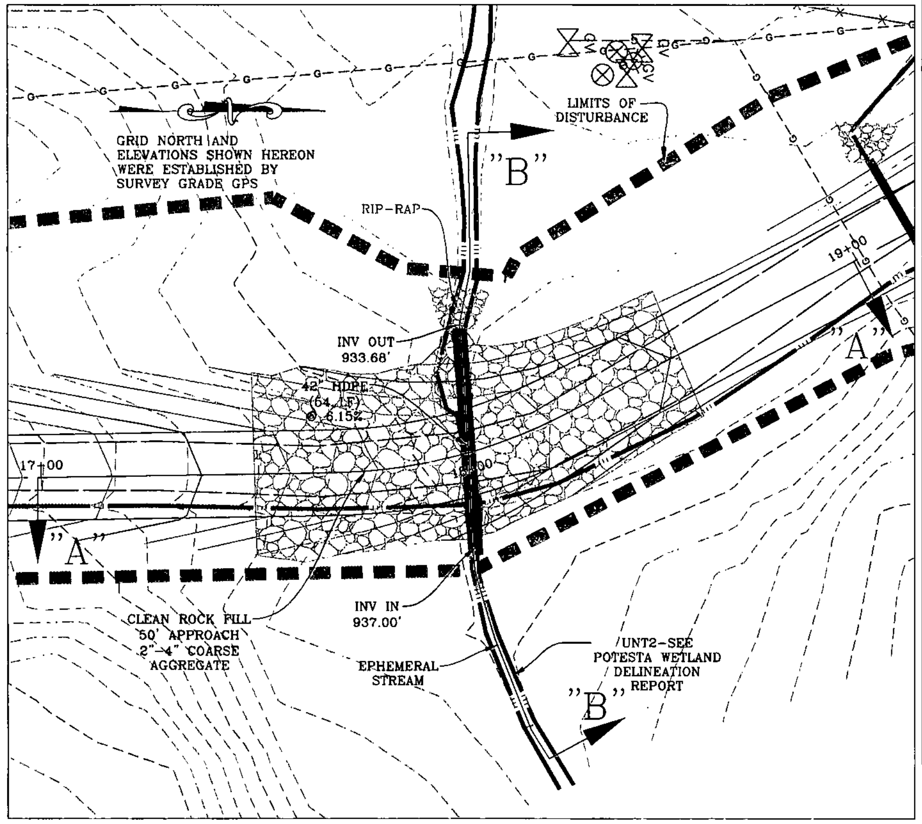
DESIGNED BY: CSK

FILE NO. 7889

SHEET 23 OF 31

STREAM CROSSING DETAILS

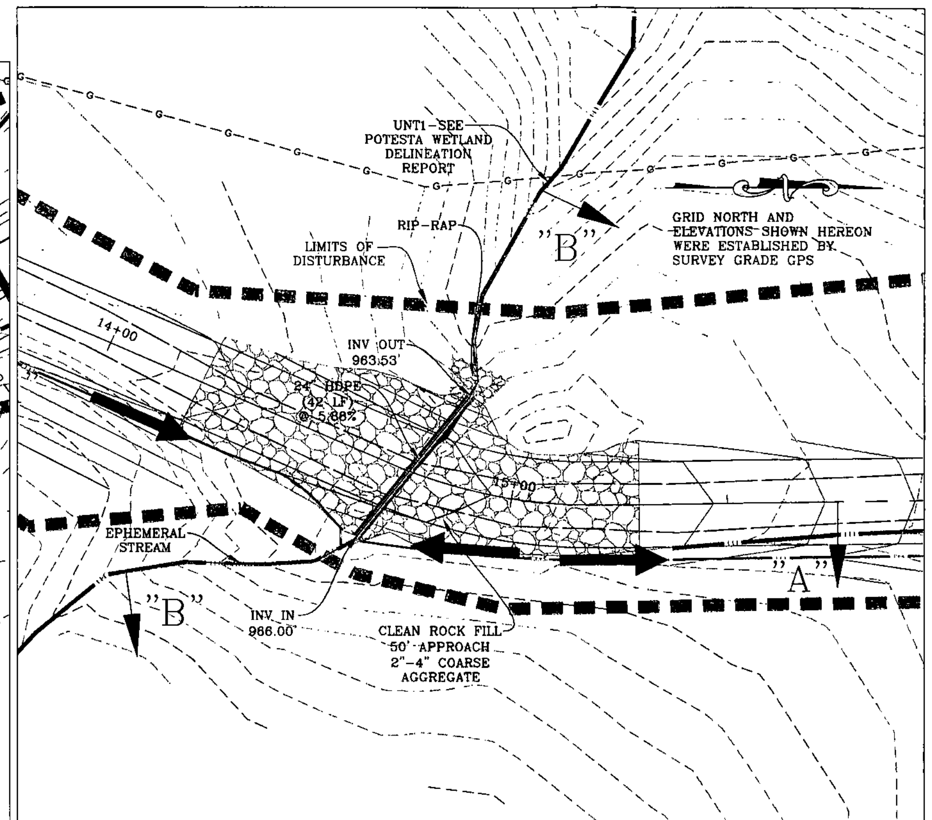
STREAM CROSSING "E" DETAILS



20 10 0 20 40

SCALE: 1" = 20'

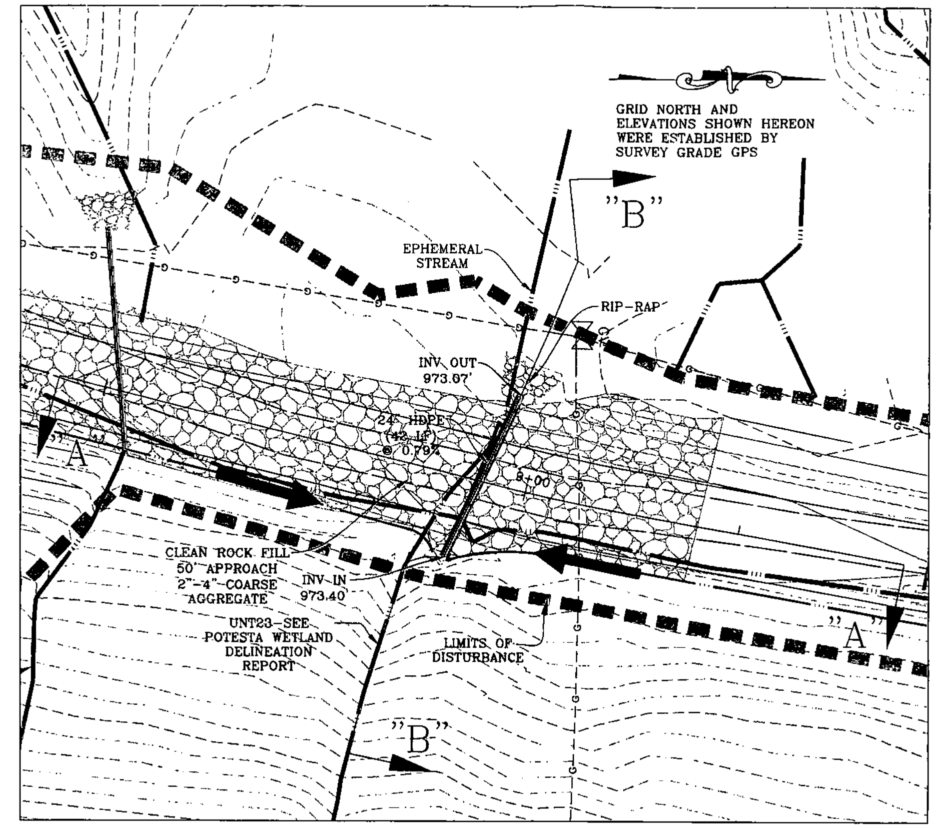
STREAM CROSSING "F" DETAILS



20 10 0 20 40

SCALE: 1" = 20'

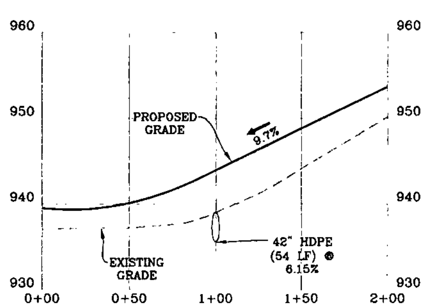
STREAM CROSSING "G" DETAILS



20 10 0 20 40

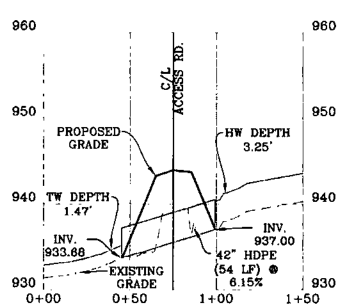
SCALE: 1" = 20'

STREAM CROSSING "E" SECTIONS



CROSS SECTION "A-A"

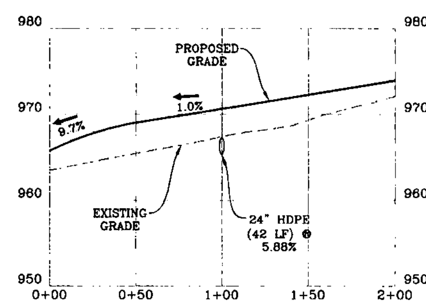
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

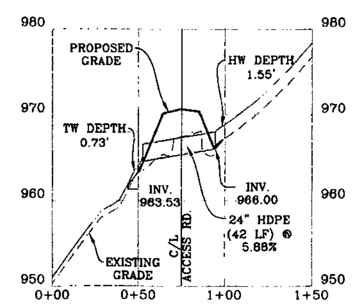
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

STREAM CROSSING "F" SECTIONS



CROSS SECTION "A-A"

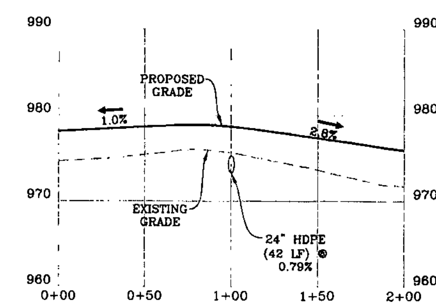
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

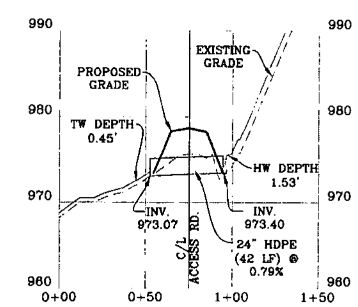
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

STREAM CROSSING "G" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



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GENERAL STREAM CROSSING NOTES:

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NOTE:

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Professional Energy Consultants
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CYRUS S. KUMP REGISTERED 19578 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER
11/04/2013

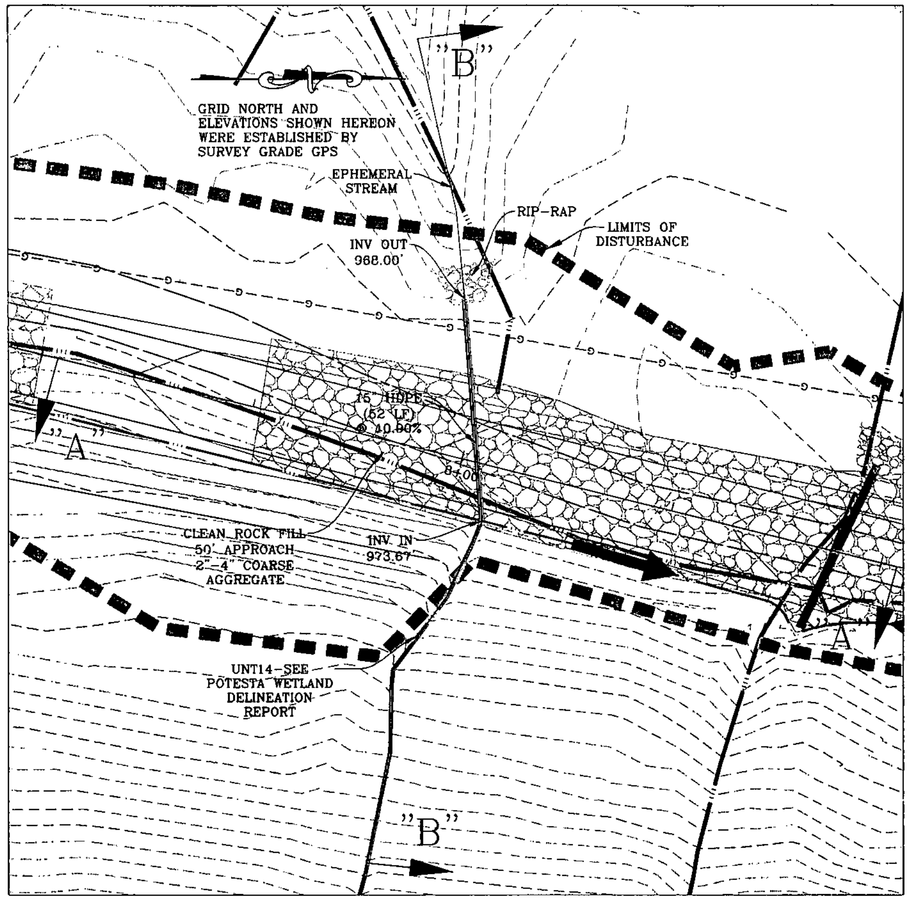
THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

STREAM CROSSING DETAILS
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013	
SCALE: N/A	
DESIGNED BY:	CSK
FILE NO.	7869
SHEET 24 OF 31	

STREAM CROSSING DETAILS

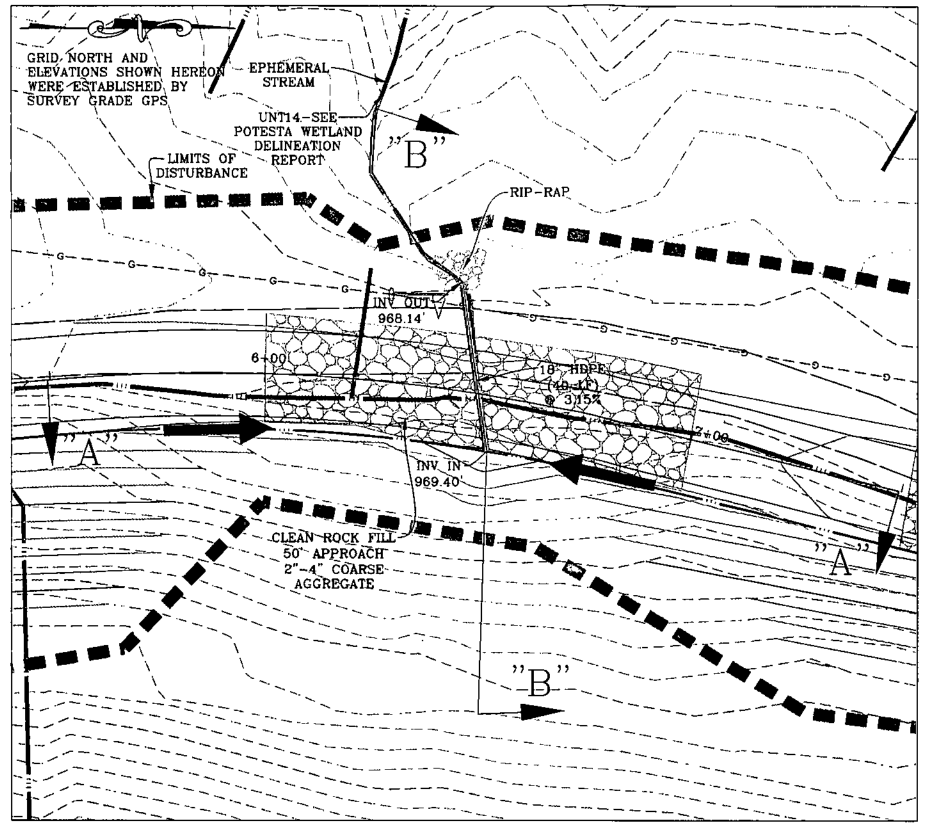
STREAM CROSSING "E" DETAILS



20 10 0 20 40

SCALE: 1" = 20'

STREAM CROSSING "F" DETAILS



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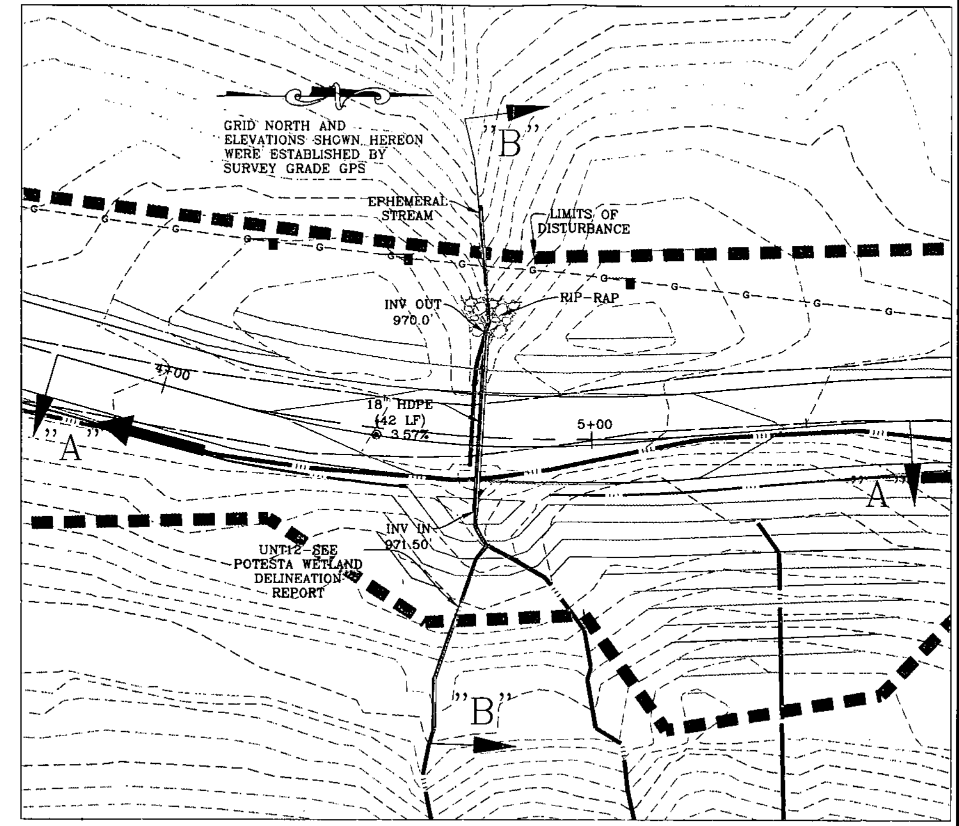
SCALE: 1" = 20'

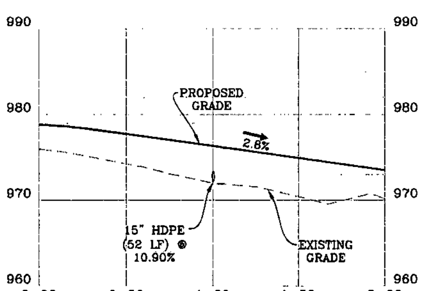
STREAM CROSSING "G" DETAILS



20 10 0 20 40

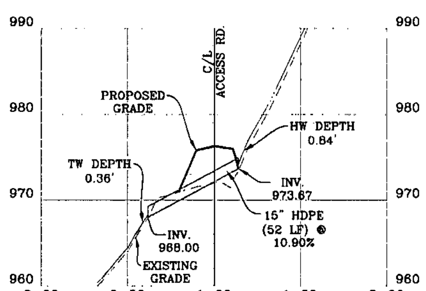
SCALE: 1" = 20'

STREAM CROSSING "H" SECTIONS



CROSS SECTION "A-A"

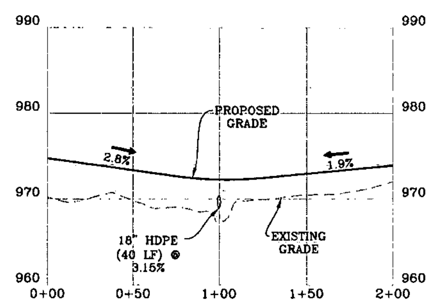
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

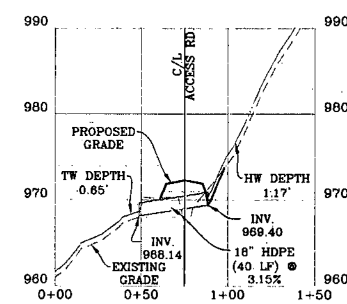
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

STREAM CROSSING "I" SECTIONS



CROSS SECTION "A-A"

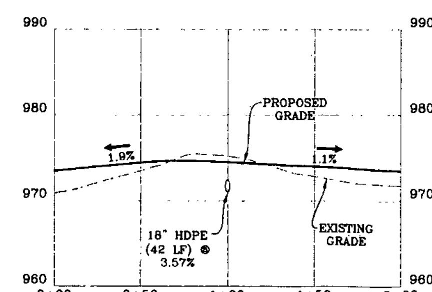
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

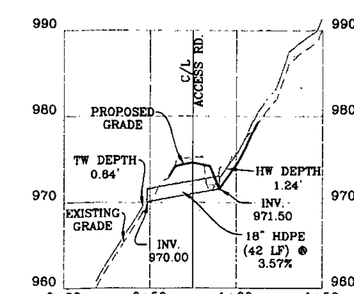
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

STREAM CROSSING "J" SECTIONS



CROSS SECTION "A-A"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



CROSS SECTION "B-B"

SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

GENERAL STREAM CROSSING NOTES:

1) 2" TO 4" COARSE AGGREGATE OR LARGER SHALL BE USED TO FORM THE FIRST 6" OF FILL FOR THE CROSSING, THE REMAINDER OF MATERIAL SHALL BE ONLY LARGE ANGULAR DURABLE ROCK. "DO NOT USE ERODIBLE MATERIAL FOR CONSTRUCTION OF THE CROSSING."
2) DEPTH OF STONE COVER OVER THE CULVERTS SHALL BE EQUAL TO ONE-HALF THE CULVERT DIAMETER OR 12 INCHES, WHICHEVER IS GREATER.
3) IF MULTIPLE CULVERTS ARE USED, THEY SHALL BE SEPARATED BY AT LEAST 12 INCHES OF COMPACTED AGGREGATE FILL.
4) CLEARING AND EXCAVATION OF THE STREAMBED AND BANKS SHALL BE KEPT TO A MINIMUM.
5) FILTER CLOTH SHALL BE PLACED ON THE STREAM BED AND STREAM BANKS PRIOR TO PLACEMENT OF THE PIPE CULVERTS AND AGGREGATE. THE FILTER CLOTH SHALL COVER THE STREAMBED AND EXTEND A MINIMUM OF SIX INCHES AND A MAXIMUM OF ONE FOOT BEYOND THE END OF THE CULVERTS AND BEDDING MATERIAL.
6) A WATER DIVERTING SWALE OR PUMP AROUND SYSTEM SHALL BE CONSTRUCTED ACROSS THE ROADWAY ON EITHER SIDE OF THE STREAM CROSSING AS DIRECTED.
7) APPROPRIATE PERIMETER CONTROLS SUCH AS COMPOST FILTER SOCK, SUPER SILT FENCE AND/OR SEDIMENT TRAPS SHALL BE EMPLOYED ALONG THE BANKS AND PARALLEL TO THE STREAMBED.
8) TIMBER ABUTMENTS ON THE UPSTREAM AND DOWNSTREAM SIDE OF THE CULVERT INSTALLATION SHALL BE INSTALLED TO REDUCE STRUCTURAL DAMAGE DURING HIGH VELOCITY WATER OVERFLOW PERIODS.
9) STREAMBED MATERIAL IS NOT TO BE USED AS FILL.
10) GREEN CONCRETE SHALL NOT BE PLACED IN CONTACT WITH FLOWING WATER.
11) WHEN THE CROSSING HAS SERVED ITS PURPOSE, ALL STRUCTURES INCLUDING CULVERTS, BEDDING, AND FILTER CLOTH SHALL BE REMOVED. REMOVAL OF THE STRUCTURE AND CLEAN UP OF THE AREA SHOULD BE ACCOMPLISHED WITHOUT CONSTRUCTION EQUIPMENT WORKING IN THE WATERWAY CHANNEL. UPON REMOVAL OF THE STRUCTURE, THE STREAM BANK SHALL IMMEDIATELY BE STABILIZED.
12) DURING ROUTINE MAINTENANCE DO NOT GRADE MUD AND DEBRIS OVER THE SIDES OF THE CROSSING INTO THE STREAM.
13) THE CROSSING MUST BE INSPECTED AFTER EVERY RAIN EVENT OF 0.5 INCHES OR MORE AND ONCE A WEEK TO ENSURE THAT THE CULVERTS, STREAMBED, AND STREAM BANKS ARE MAINTAINED AND NOT DAMAGED. NEVER ALLOW THE CULVERTS TO BECOME CLOGGED WITH DEBRIS AND REMOVE ANY OBSTRUCTIONS IMMEDIATELY.
14) FLUSHING IS NOT AN APPROVED METHOD TO BE UTILIZED FOR CULVERT CLEANOUT.
15) ALL CROSSING STRUCTURES SHALL BE ANCHORED IN ACCORDANCE WITH THE DODDRIDGE COUNTY FLOODPLAIN ORDINANCE.

NOTE:
1) SEE STREAM CROSSING REPORT BY NAVITUS ENGINEERING FOR CULVERT AND DRAINAGE COMPUTATATIONS.
2) EQT SHALL OBTAIN A STREAM ACTIVITY PERMIT THROUGH THE PUBLIC LAND CORPORATION OFFICE OF LAND AND STREAMS FOR STREAM CROSSING "H", "I" & "J".

Engineering • Survey • Environmental • GIS

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CYRUS S. KUMP REGISTERED 19578 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER
11/04/2013

THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

STREAM CROSSING DETAILS
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

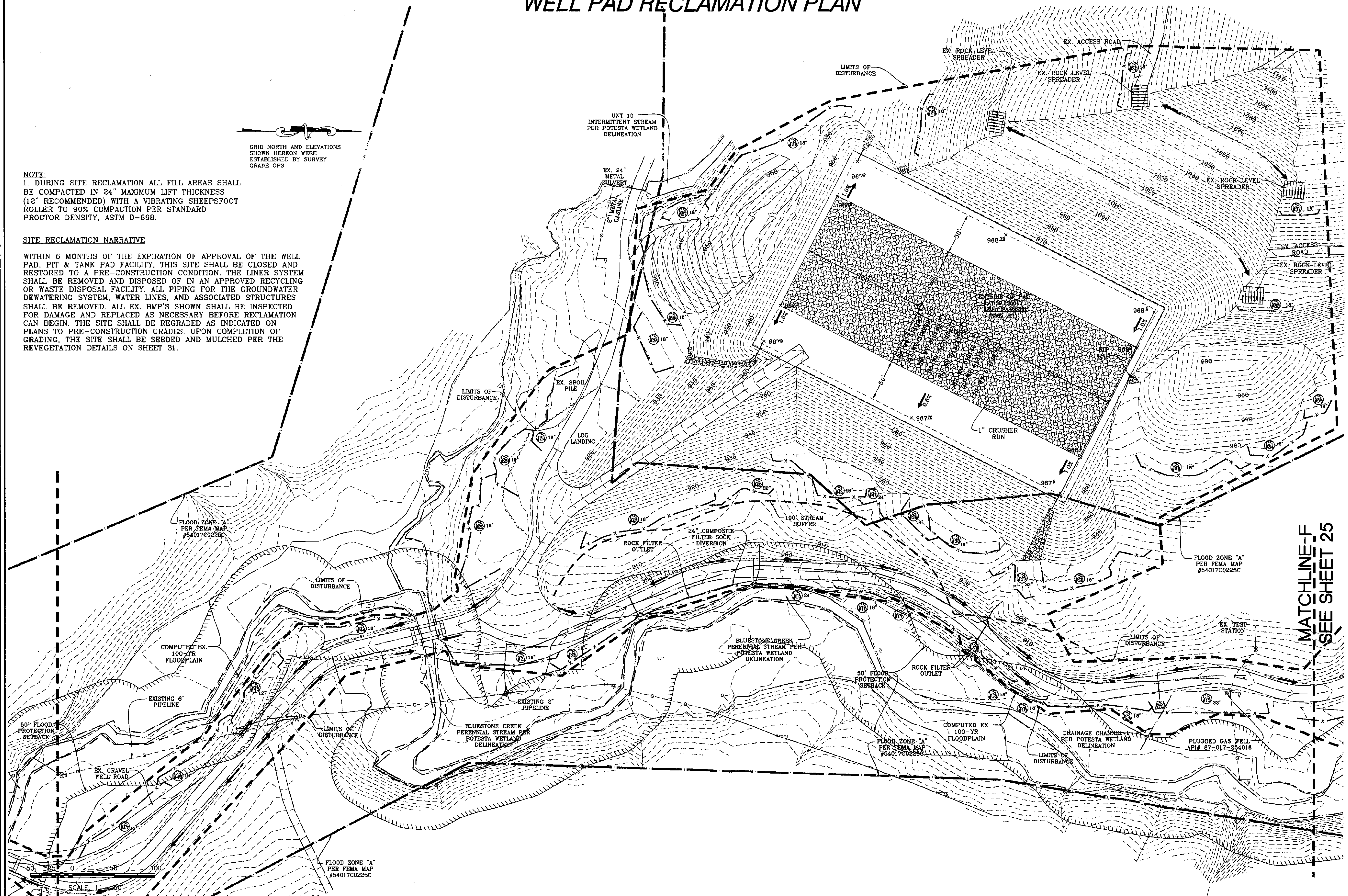
DATE: 11/04/2013	
SCALE: N/A	
DESIGNED BY:	CSK
FILE NO.	7889
SHEET 25 OF 31	

WELL PAD RECLAMATION PLAN

NOTE:
1. DURING SITE RECLAMATION ALL FILL AREAS SHALL BE COMPACTED IN 24" MAXIMUM LIFT THICKNESS (12" RECOMMENDED) WITH A VIBRATING SHEEPSFOOT ROLLER TO 90% COMPACTION PER STANDARD PROCTOR DENSITY, ASTM D-698.

SITE RECLAMATION NARRATIVE

WITHIN 6 MONTHS OF THE EXPIRATION OF APPROVAL OF THE WELL PAD, PIT & TANK PAD FACILITY, THIS SITE SHALL BE CLOSED AND RESTORED TO A PRE-CONSTRUCTION CONDITION. THE LINER SYSTEM SHALL BE REMOVED AND DISPOSED OF IN AN APPROVED RECYCLING OR WASTE DISPOSAL FACILITY. ALL PIPING FOR THE GROUNDWATER DEWATERING SYSTEM, WATER LINES, AND ASSOCIATED STRUCTURES SHALL BE REMOVED. ALL EX. BMP'S SHOWN SHALL BE INSPECTED FOR DAMAGE AND REPLACED AS NECESSARY BEFORE RECLAMATION CAN BEGIN. THE SITE SHALL BE REGRADED AS INDICATED ON PLANS TO PRE-CONSTRUCTION GRADES. UPON COMPLETION OF GRADING, THE SITE SHALL BE SEEDED AND MULCHED PER THE REVEGETATION DETAILS ON SHEET 31.



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CYRUS S. KUMP REGISTERED 19578 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER
11/04/2013

THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

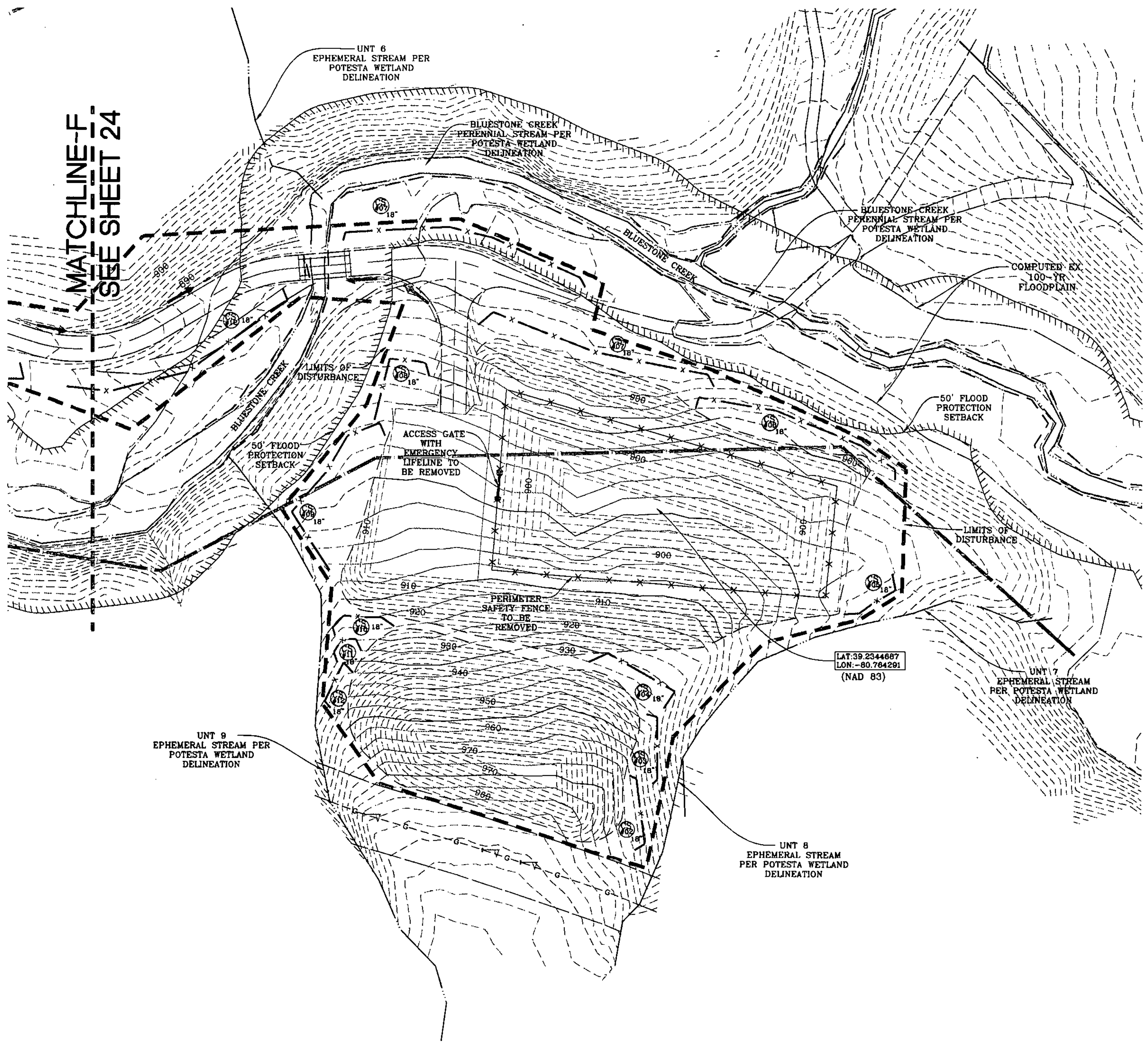
WELL PAD RECLAMATION PLAN

OXF 157

WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013
SCALE: 1" = 50'
DESIGNED BY: CSK
FILE NO. 7689
SHEET 26 OF 31

ASSOCIATED PIT RECLAMATION PLAN



NOTE:
1. DURING SITE RECLAMATION ALL FILL AREAS SHALL BE COMPACTED IN 24" MAXIMUM LIFT THICKNESS (12" RECOMMENDED) WITH A VIBRATING SHEEPSFOOT ROLLER TO 90% COMPACTION PER STANDARD PROCTOR DENSITY, ASTM D-698.

SITE RECLAMATION NARRATIVE

WITHIN 6 MONTHS OF THE EXPIRATION OF APPROVAL OF THE WELL PAD, PIT, & TANK PAD FACILITY, THIS SITE SHALL BE CLOSED AND RESTORED TO A PRE-CONSTRUCTION CONDITION. THE LINER SYSTEM SHALL BE REMOVED AND DISPOSED OF IN AN APPROVED RECYCLING OR WASTE DISPOSAL FACILITY. ALL PIPING FOR THE GROUNDWATER DEWATERING SYSTEM, WATER LINES, AND ASSOCIATED STRUCTURES SHALL BE REMOVED. ALL EX. BMP'S SHOWN SHALL BE INSPECTED FOR DAMAGE AND REPLACED AS NECESSARY BEFORE RECLAMATION CAN BEGIN. THE SITE SHALL BE REGRADED AS INDICATED ON PLANS TO PRE-CONSTRUCTION GRADES. UPON COMPLETION OF GRADING, THE SITE SHALL BE SEEDED AND MULCHED PER THE REVEGETATION DETAILS ON SHEET 31.

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CYRUS S. KUMP
REGISTERED
19528
STATE OF WEST VIRGINIA
PROFESSIONAL ENGINEER
11/04/2013

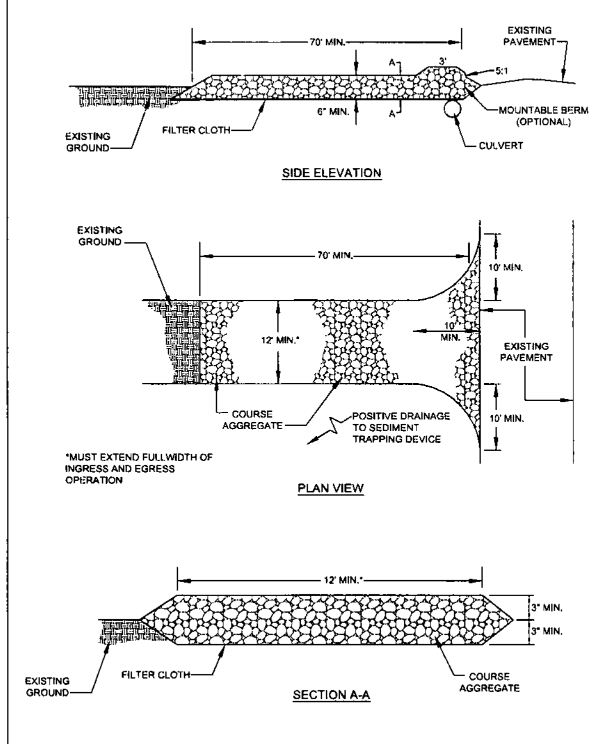
THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

ASSOCIATED PIT RECLAMATION PLAN
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE:	11/04/2013
SCALE:	N/A
DESIGNED BY:	CSK
FILE NO.	7889
SHEET	27 OF 31

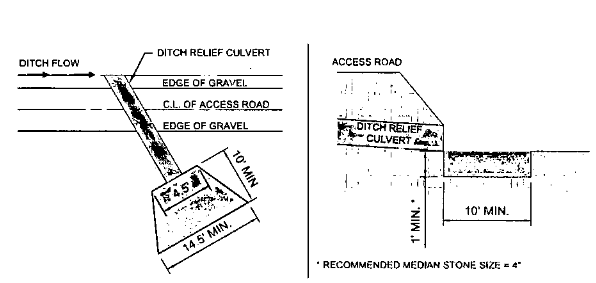
FIGURE 3.02.1

STONE CONSTRUCTION ENTRANCE



SOURCE: ADAPTED from the 1983 Maryland Standards for Soil Erosion and Sediment Control and Va. DSWC

TYPICAL DITCH RELIEF CULVERT OUTLET TREATMENT



* RECOMMENDED MEDIAN STONE SIZE = 4"

PLAN VIEW
NTS

SECTION VIEW
NTS

NOTE:
ALL DITCH LINE PROTECTION SHALL BE INSTALLED AS RECOMMENDED IN THE WEST VIRGINIA EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICE (BMP) MANUAL. DITCH LINE PROTECTION SHALL BE BASED ON THE FOLLOWING GRADES:

1. LESS THAN 3% – GRASSED
2. 3–8% – GRASS WITH ROLLED EROSION CONTROL PRODUCTS (RECP)
3. GREATER THAN 9% – RIPRAP OR EQUIVALENT GEOTEXTILE

IF HIGH EROSIVE SOILS ARE ENCOUNTERED DURING CONSTRUCTION, THE ENGINEER SHOULD BE CONTACTED FOR FURTHER EVALUATION.

Modified Figure 3.1 – Typical Roadside Ditch Section Sump at Ditch Relief Culvert

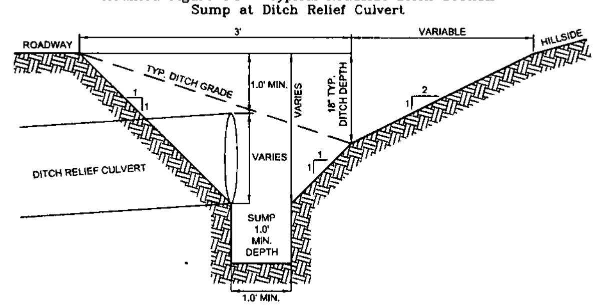
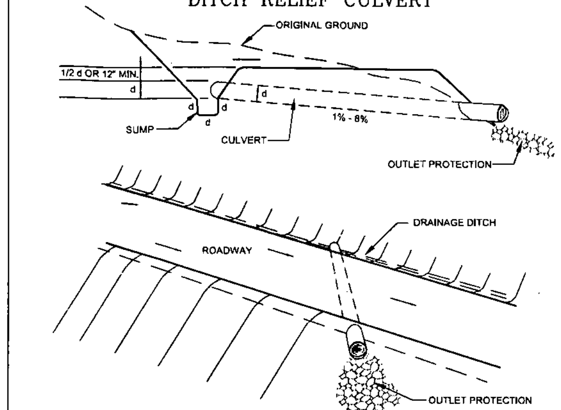


FIGURE II-4

DITCH RELIEF CULVERT



SOURCE: West Virginia Erosion and Sediment Control Field Manual, Office of Oil and Gas

Table II-5

Pipe Sizes for Culverts Across Roads		
Drainage Area (Ac)	Pipe Diameter (In)	Pipe Capacity (Cfs)
10	15	5
20	18	9
30	21	12
50	24	18
80	27	24
100	30	29
300	36	60
500	42	85

Table II-6

Spacing of Culverts	
Road Grade %	Distance (Ft)
2-5	500-300
6-10	300-200
11-15	200-100
16-20	100

FIGURE 3.05.1

ROCK CHECK DAM

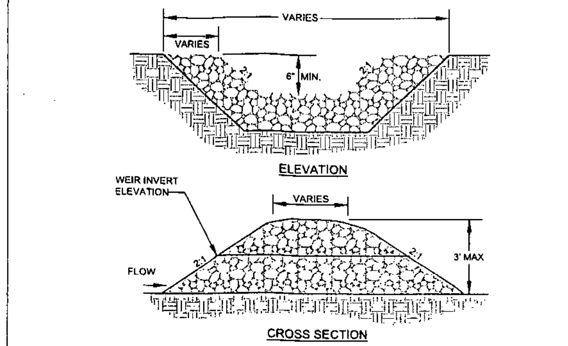
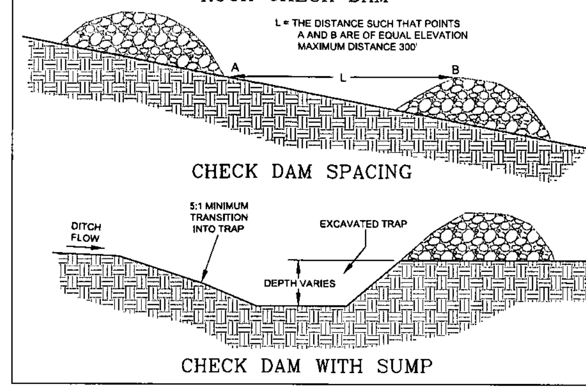
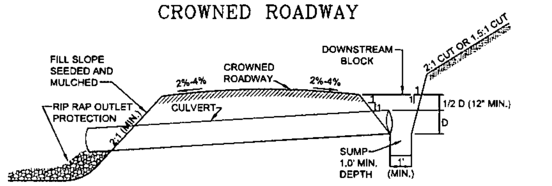


FIGURE 3.05.2

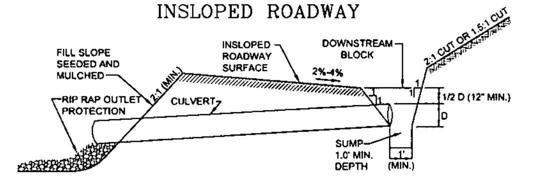
ROCK CHECK DAM



CROWNED ROADWAY



INSLOPED ROADWAY



Cut and fill slopes shall be stabilized immediately upon completion of roadway grading. These areas shall be blanketed wherever they are located within 50 feet of a surface water or within 100 feet of a surface water where a suitable vegetative filter strip does not exist.

A durable top dressing shall be provided for soils having low strength.

Roadside ditches shall be provided with adequate protective lining.

Adequately sized culverts or other suitable cross drains shall be provided at all seeps, springs, and drainageways.

Roadway shall be inspected weekly and after each runoff event. Damaged roadways, ditches, or cross drains shall be repaired immediately.

SOURCE: PA DEPARTMENT OF ENVIRONMENTAL PROTECTION, BUREAU OF OIL AND GAS MANAGEMENT 5500-PM-OG0111 APPENDIX A BMP CONSTRUCTION DETAILS (MODIFIED)

TURNOUT

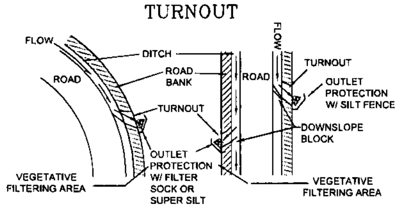
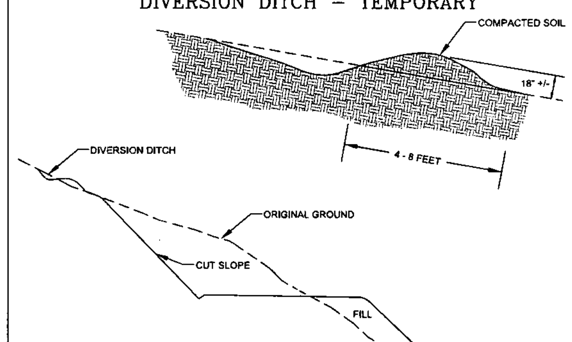


FIGURE II-3

DIVERSION DITCH – TEMPORARY



SOURCE: West Virginia Erosion and Sediment Control Field Manual, Office of Oil and Gas

TOE BENCH DETAIL

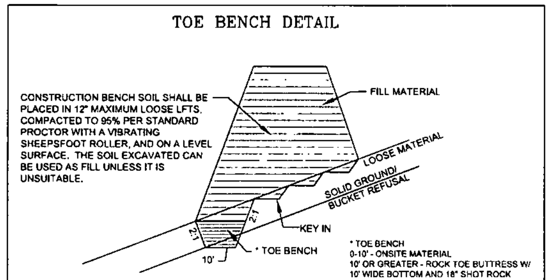
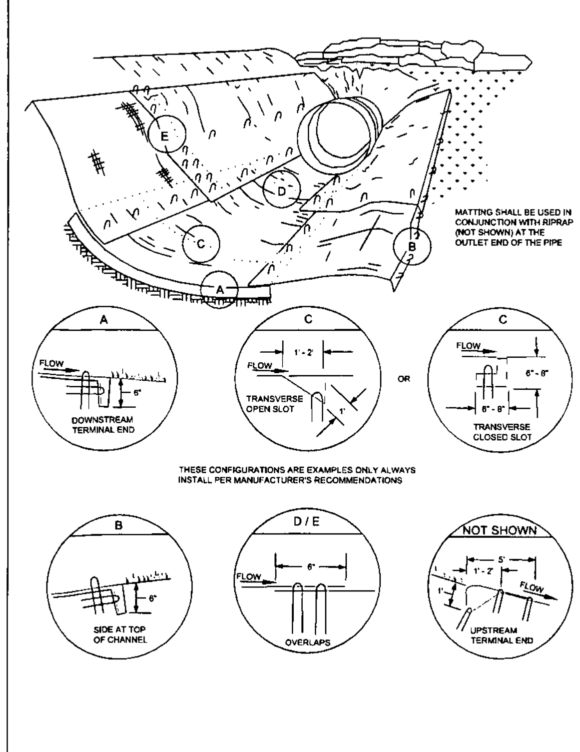


FIGURE 3.13.1

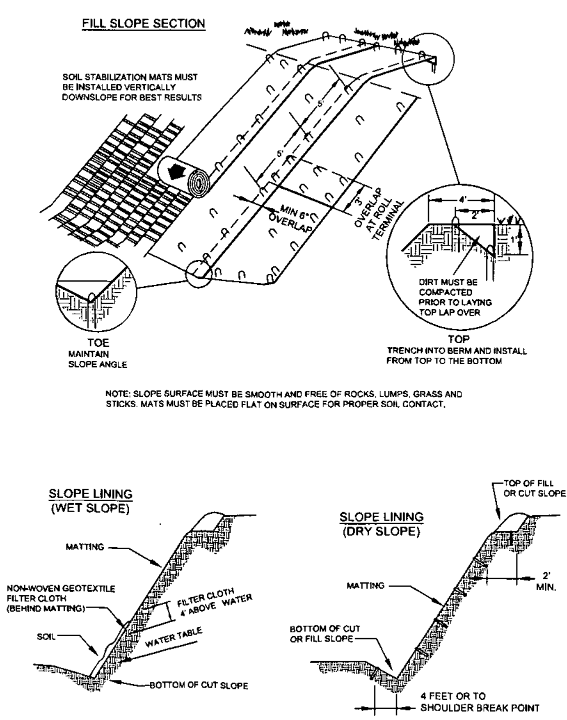
TYPICAL RECP CHANNEL INSTALLATION



SOURCE: VA DCR-DSWC AND NORTH AMERICAN GREEN

FIGURE 3.13.2

ROLLED EROSION CONTROL PRODUCTS



SOURCE: VDOT STANDARDS AND VA DCR-DSWC

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HONESTY, INTEGRITY, QUALITY

CYRUS S. KUMP
REGISTERED
19678
STATE OF WEST VIRGINIA
PROFESSIONAL ENGINEER
11/04/2013

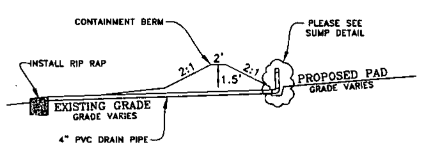
THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC.
FOR: EQT PRODUCTION COMPANY

CONSTRUCTION DETAILS
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

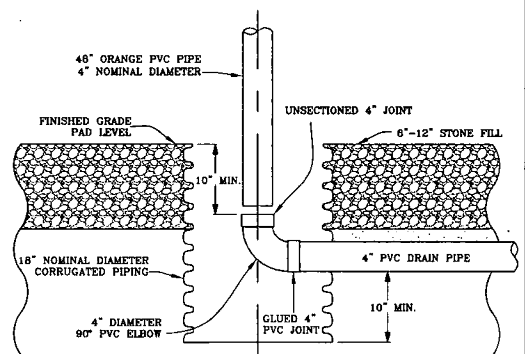
DATE: 11/04/2013
SCALE: N/A
DESIGNED BY: CSK
FILE NO. 7889
SHEET 28 OF 31

BERM TYPICAL

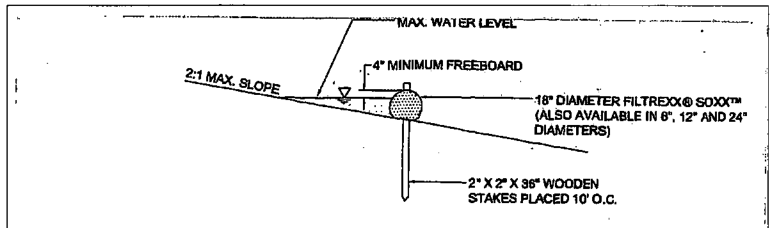
NOT TO SCALE



SUMP TYPICAL

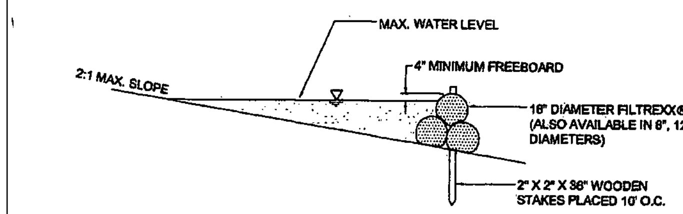


1. ALL CONTAINMENT SUMPS SHALL BE CLOSED DURING ALL WELL PAD ACTIVITIES.
2. SUMP AREAS SHALL BE LINED AS NECESSARY TO PREVENT FILTRATION THROUGH THE CONTAINMENT BERM.



SINGLE INSTALLATION SECTION

NTS



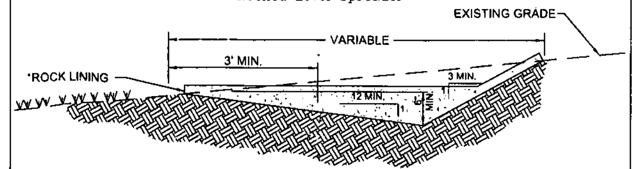
PYRAMID INSTALLATION SECTION

NTS

FILTREXX® RUNOFF DIVERSION SECTIONS

NTS

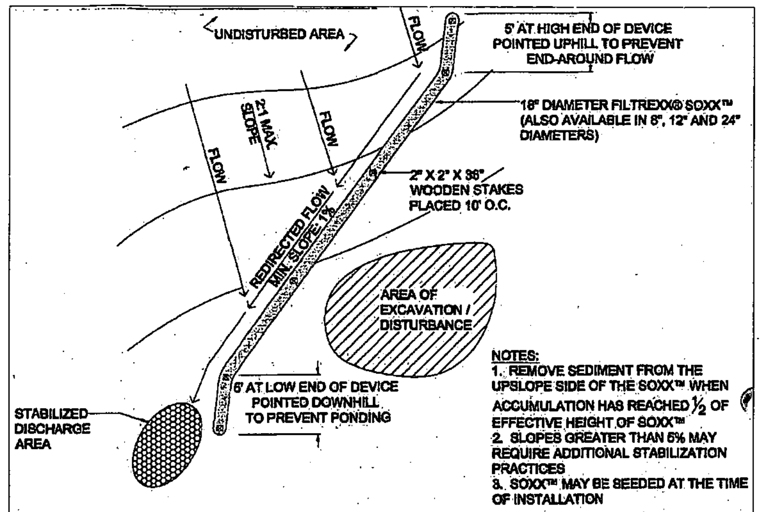
STANDARD CONSTRUCTION DETAIL
Rocked Level Spreader



SECTION VIEW

NTS

*All Level Spreader rock shall be a minimum of R4.

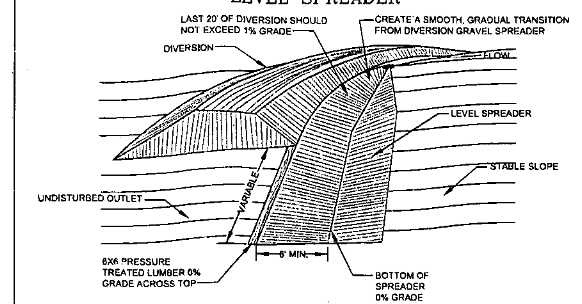


NOTES:
1. REMOVE SEDIMENT FROM THE UPSLOPE SIDE OF THE SOXX™ WHEN ACCUMULATION HAS REACHED ½ OF EFFECTIVE HEIGHT OF SOXX™
2. SLOPES GREATER THAN 6% MAY REQUIRE ADDITIONAL STABILIZATION PRACTICES
3. SOXX™ MAY BE SEEDED AT THE TIME OF INSTALLATION

FILTREXX® RUNOFF DIVERSION

FIGURE 3.02.1

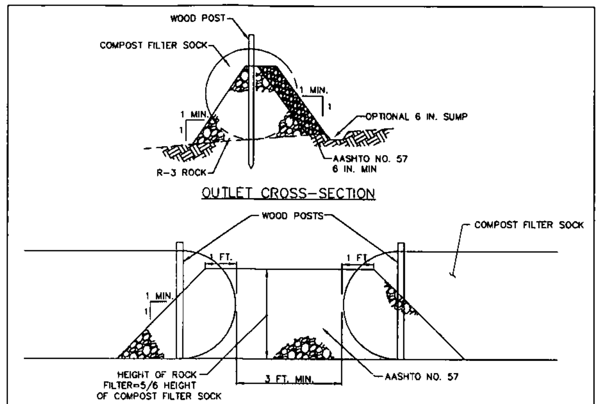
LEVEL SPREADER



PERSPECTIVE VIEW

NOTE: ALL TEMPORARY BERMS, SWALES AND LEVEL SPREADER DITCHES MUST RECEIVE TEMPORARY SEEDING AND MULCHING AFTER INSTALLATION

SOURCE: ADAPTED FROM N.C. E&S Control Planning and Design Manual and VA DCSQ



NOTES:

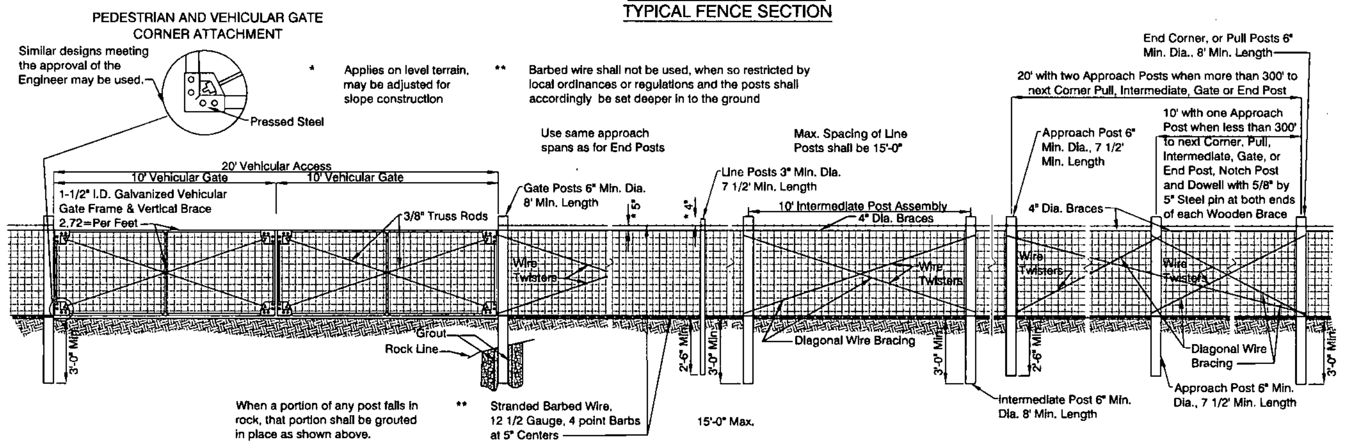
A ROCK FILTER OUTLET SHALL BE INSTALLED WHERE FAILURE OF A COMPOST FILTER SOCK HAS OCCURRED DUE TO CONCENTRATED FLOW.

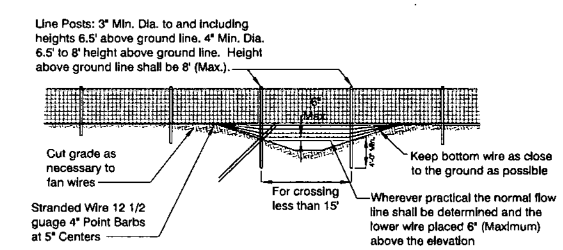
SEDIMENT SHALL BE REMOVED WHEN ACCUMULATIONS REACH 1/3 THE HEIGHT OF THE OUTLET.

ROCK FILTER OUTLET
(MODIFIED FROM PA DEP)

NOT TO SCALE

CONSTRUCTION DETAIL
TYPICAL FENCE SECTION





DETAIL SHOWING TYPICAL SECTION AT MINOR DEPRESSIONS AND WET WEATHER CROSSINGS

NOTES:

Posts and braces may be either round or square shaped. Dimensions shown on the plans are for round posts and braces only. When square posts are used, line posts shall be 3" square (min.);braces 4" square (min.); corner, end, pull, gate, approach, and intermediate posts 6" square (min.).
The positioning of the fence fabric and barbed wire on the posts, as shown on the "Typical Fence Section" detail, applies for level and gentle sloping terrain. For fence erected on slopes, the positioning may be adjusted to meet the slope conditions as long as the adjustment is continued from post to post in a uniform manner. Trenching on slopes may be warranted. On slopes, posts will continue to be erected vertically, unless otherwise directed, and the ends of the fencing fabric shall be cut on a skew as may be necessary for proper connection to the posts.

Dumped rock channel protection will be used at channel crossings when called for on the plans.

Install drainage structure terminal installation as called for on the plans and/or as shown on typical fence details.

Unless otherwise specified, or directed by the Engineer, the farm field fence may be installed with the fence fabric and barbed wire positioned on either side of the fence posts.

Hardware and miscellaneous fittings, not specifically designated herein as to type or dimensions, shall conform to the applicable requirements of Section 608 of the Specifications and shall be of good quality commerical design acceptable to the Engineer.

In lieu of the barbed wire detailed herein, the following additional types are acceptable, provided they retain the "4-point barb at 5-inch centers" requirement and provided they meet or exceed the strength and coating requirements for the standard, 12 1/2 gauge, barbed wire as called for in 712.10 of the Specifications.
(a) stranded, 15 1/2 gauge, high carbon steel barbed wire
(b) one strand, 12 gauge, steel barbed wire

Vehicular gate frames (and vertical braces) may be either galvanized steel pipe members as shown herein or may be triple-coated steel pipe members meeting the requirements specified on Standard Sheet F2. All other metal components of the gate shall be galvanized, with the exception of the die-cast aluminum corner fittings, or pressed steel corner fittings.

BRUSH PILE SEDIMENT BARRIER

FIGURE II-10

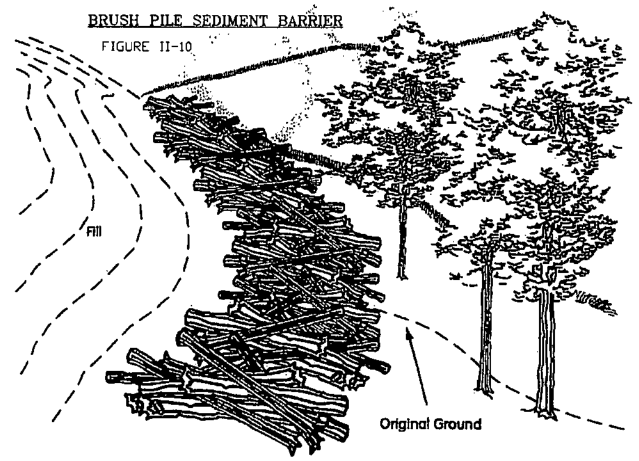
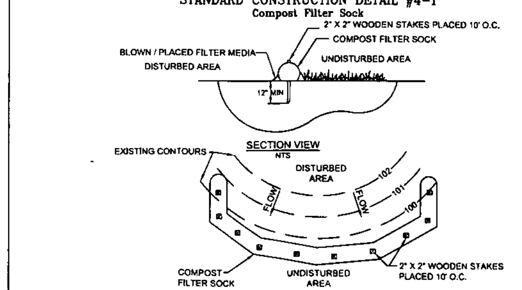


Table 4.1
Compost Sock Fabric Minimum Specifications

Material Type	3 mil HDPE	5 mil HDPE	5 mil HDPE	Multi-Filament Polypropylene (MFPP)	Heavy Duty Multi-Filament Polypropylene (HDMFPP)
Material Characteristics	Photo-degradable	Photo-degradable	Bio-degradable	Photo-degradable	Photo-degradable
Sock Diameters	12" 18"	12" 18" 24" 32"	12" 18" 24" 32"	12" 18" 24" 32"	12" 18" 24" 32"
Mesh Opening	3/8"	3/8"	3/8"	3/8"	1/8"
Textile Strength		26 psi	26 psi	44 psi	202 psi
Ultraviolet Stability % Original Strength (ASTM G-155)	23% at 1000 hr.	23% at 1000 hr.		100% at 1000 hr.	100% at 1000 hr.
Minimum Functional Longevity	6 months	9 months	6 months	1 year	2 years
Two-ply systems					
Inner Containment Netting	HDPE biaxial net Continuously wound Fusion-welded junctures 3/4" x 3/4" Max. aperture size				
Outer Filtration Mesh	Composite Polypropylene Fabric (Woven layer & non-woven fleece mechanically fused via needle punch) 3/16" Max. aperture size				
Sock fabrics composed of burlap may be used on projects lasting 6 months or less.					

STANDARD CONSTRUCTION DETAIL #4-1
Compost Filter Sock



PLAN VIEW

NTS

Adapted from Filtrexx

Sock fabric shall meet standards of Table 4.1. Compost shall meet the following standards:

Organic Matter Content	80% -100% (dry weight basis)
Organic Portion	Fibrous and elongated
pH	5.5-8.0
Moisture Content	35%-55%
Particle Size	98% pass through 1" screen
Soluble Salt Concentration	5.0 dS Maximum

Compost Filter Sock shall be placed at existing level grade. Both ends of the sock shall be extended at least 8 feet up the slope at 45 degrees to the main sock alignment. Maximum slope length above any sock shall not exceed manufacturer's maximum permissible slope length.

Traffic shall not be permitted to cross filter socks.

Accumulated Sediment shall be removed when it reaches 1/2 the above ground height of the sock and disposed in the manner described elsewhere in the plan.

Socks shall be inspected weekly and after each runoff event. Damaged socks shall be repaired according to manufacturer's specifications or replaced within 24 hours of inspection.

Biodegradable filter socks shall be replaced after 6 months; photodegradable socks after 1 year. Polypropylene socks shall be replaced according to manufacturer's recommendations.

Upon stabilization of the area tributary to the sock, stakes shall be removed. The sock may be left in place and vegetated or removed. In the latter case, the mesh shall be cut open and the mulch spread as a soil supplement.

In the event the ground is frozen, #5 rebar with safety caps shall be used instead of wooden stakes to anchor the filter sock. Once the ground thaws the rebar anchors shall be removed and replaced with 2" x 2" wooden stakes and installed as shown in the detail above.

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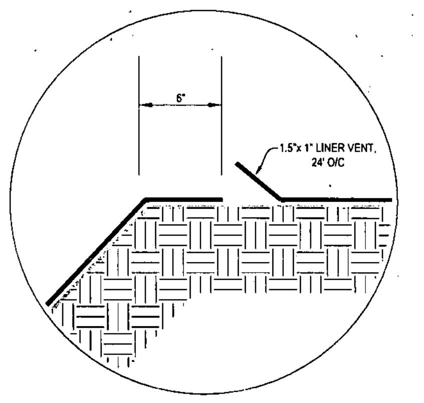
REGISTERED
19578
STATE OF WEST VIRGINIA
PROFESSIONAL ENGINEER
11/04/2013

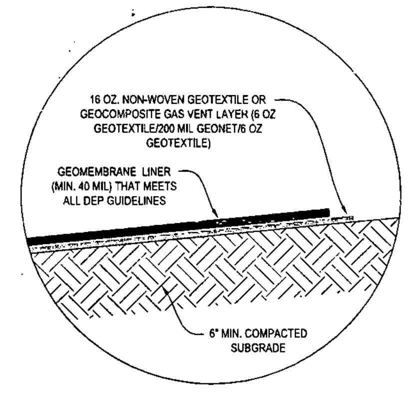
THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

CONSTRUCTION DETAILS
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

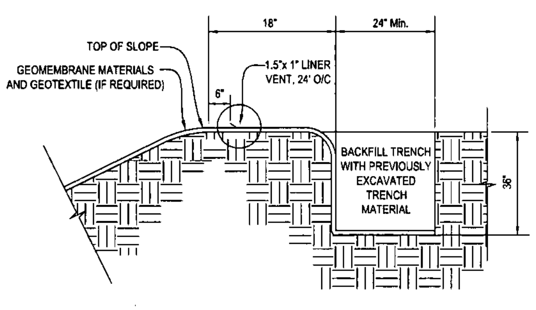
DATE: 11/04/2013
SCALE: N/A
DESIGNED BY: CSK
FILE NO. 7889
SHEET 29 OF 31



TYPICAL LINER VENT DETAIL
NTS

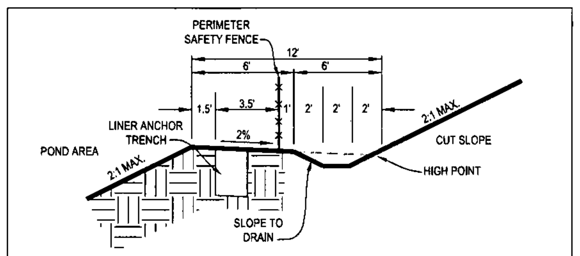


GEOMEMBRANE LINER SYSTEM
NTS

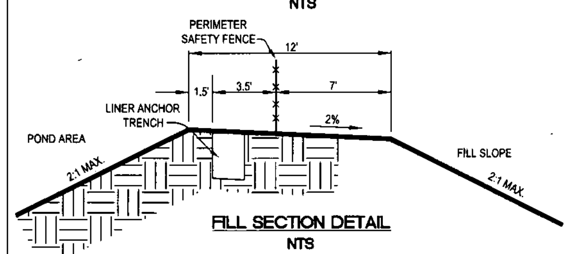


NOTE: USE SAND BAGS AS GEOMEMBRANE WEIGHTS IN TRENCH DURING GEOMEMBRANE INSTALLATION

TOP OF BERM ANCHOR TRENCH DETAIL
NTS



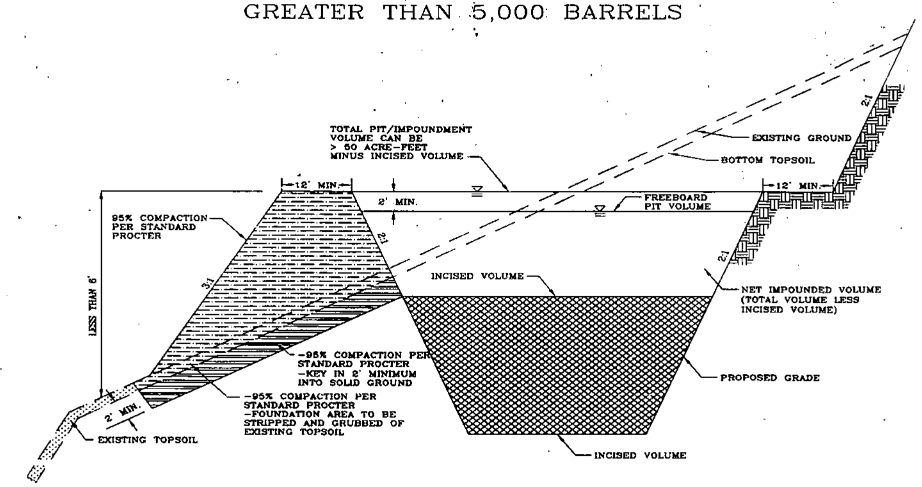
CUT SECTION DETAIL
NTS



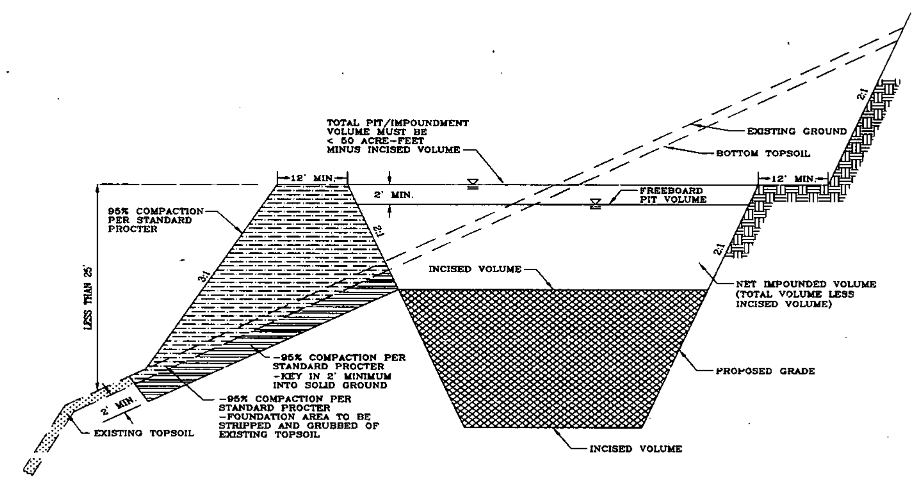
FILL SECTION DETAIL
NTS

IMPOUNDMENT/PIT BENCH DETAIL
NTS

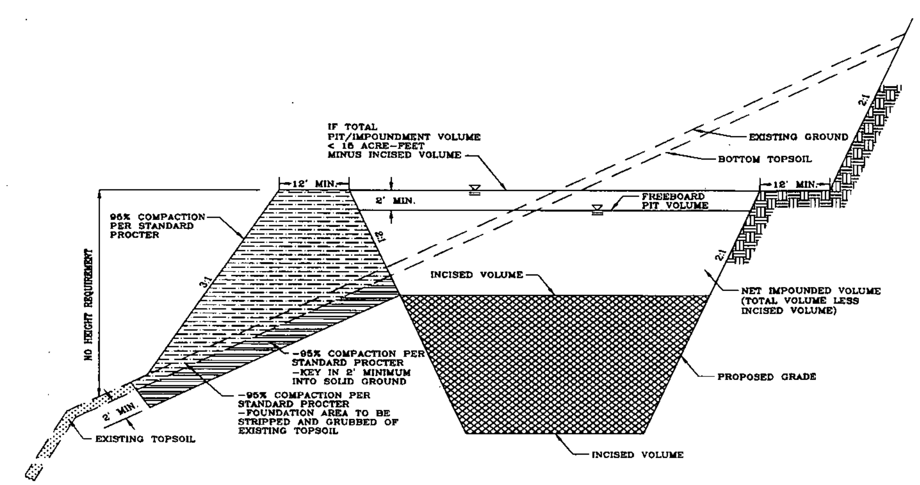
WEST VIRGINIA CODE 35 CSR 4
DESIGN AND CONSTRUCTION REQUIREMENTS
FOR ASSOCIATED PITS, ASSOCIATED IMPOUNDMENTS, &
CENTRALIZED IMPOUNDMENTS
GREATER THAN 5,000 BARRELS



SECTION VIEW



SECTION VIEW



SECTION VIEW

NOTES:
1. ALL FILL SHOULD BE KEYED IN TO ORIGINAL GROUND EVERY 2-5 VERTICAL FEET DEPENDING ON EXISTING GROUND SLOPE

2. MINIMUM OUTSIDE AND INSIDE EMBANKMENT (FILL) SLOPES SHALL BE 2H:1V. THE INSIDE AND OUTSIDE SLOPES MUST ADD UP TO 5H:1V.

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CYRUS S. KUMP
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STATE OF WEST VIRGINIA
PROFESSIONAL ENGINEER
11/04/2013

THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC. FOR: EQT PRODUCTION COMPANY

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OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013
SCALE: N/A
DESIGNED BY: CSK
FILE NO. 7869
SHEET 30 OF 31

REVEGETATION

Taken from the
West Virginia Erosion and Sediment Control Field Manual
West Virginia Division of Environmental Protection Office of Oil and Gas
Charleston, W.Va.
Section IV

Temporary Seeding

a. General Conditions Where Practice Applies
Where exposed soil surfaces are not to be fine-graded or worked for periods longer than 21 days. Temporary vegetative cover with sediment controls must be established where runoff will go directly into a stream. Immediately upon construction of the site (site includes road and location), vegetation must be established on road bank and location slopes. A permanent vegetative cover shall be applied to areas that will be left un-worked for a period of more than six months.

b. Seed Mixtures and Planting Dates
Refer to Tables 2 through 4 for recommended dates to establish vegetative cover and the approved lists of temporary and permanent plant species, and planting rates. Table 3 gives recommended types of temporary vegetation, rates of application, and optimum seeding dates. In situations where another cover is desired, contact the local soil conservation district for seeding recommendations.

c. Seed Application
Apply seed by broadcasting, drilling, or by hydroseed according to the rates indicates in Table IV-3. Perform all planting operations at right angles to the slope. Necessary site preparation and roughening of the soil surface should be done just prior to seeding. Seedbed preparation may not be required on newly disturbed areas.

Permanent Seeding

a. General
Permanent vegetative cover will be established where no further soil disturbance is anticipated or needed. Soil fertility and pH level should be tested and adjusted according to seed species planted. Planting of permanent vegetative covers must be performed on all disturbed areas after completion of the drilling process. Any site that contains significant amounts of topsoil shall have the topsoil removed and stockpiled when feasible. Topsoil should not be added to slopes steeper than 2:1 unless a good bonding to the sub-layer can be achieved. After proper grading and seedbed preparation, the vegetation will reestablish ground cover for the control of surface water runoff erosion.
All required seedbed preparation and loosening of soil by disking or dozer tracking should be performed just prior to seeding. If seedbed preparation is not feasible, 50% more seed shall be added to the recommended rates shown in Tables IV-3 and IV-4.
When hydroseeding, seedbed preparation may not be necessary if adequate site preparation was performed. Incorporate the appropriate amount of lime and/or fertilizer in the slurry mix when hydroseeding.
When hydroseeding, first mix the lime, fertilizer, and hydro-mulch in the recommended amount of water. Mix the seed and inoculants together within one hour prior to planting, and add to the slurry just before seeding. Apply the slurry uniformly over the prepared site. Assure that agitation is continuous throughout the seeding operation and the mix is applied within one hour of initial mixing.

b. Lime and Fertilizer
1. Lime shall be applied to all permanent seedings. The pH of the soil is to be determined and lime applied accordingly. Once the pH is known, select the amount of lime to be applied from Table IV-5.
2. Fertilizer shall be applied in all permanent seedings. Apply the equivalent for 500 lbs. minimum 10-20-20 fertilizer per acre or use the amount of fertilizer and lime recommended by a certified soil test.
3. Application: For best results and maximum benefits, the lime and fertilizer are to be applied at the time of seedbed preparation.

c. Permanent Seed Mixtures
Planners should take into consideration the species makeup of the existing pasture and the landowner's future pasture management plans when recommending seed mixtures. Selection: From Tables IV 4a and b, Permanent Seeding Mixtures Suitable for Establishment in West Virginia.
Notes:
1. All legumes must be planted with the proper inoculants prior to seeding.
2. 'Lathco' Flatpea is potentially poisonous to some livestock.
3. Only endophyte free varieties of Tall Fescue should be used. Tall Fescue and Crownvetch are also very invasive species, non-native to WV.
4. For unprepared seedbeds or seeding outside the optimum timeframes, add 50% more seed to the specified rate. Mixtures in Table 4b are more wildlife and farm friendly; those listed in bold are suitable for use in shaded woodland settings. Mixtures in italic are suitable for use in filter strips.

d. Seeding for Wildlife Habitat
Consider the use of the native plants or locally adapted plants when selecting cover types and species for wildlife habitat. Wildlife friendly species or mixes that have multiple values should be considered. See wildlife friendly species/mixtures in Table IV-4b. Consider selecting no or low maintenance long-lived plants adaptable to sites which may be difficult to maintain with equipment.

Mulching

a. General Organic Mulches
The application of straw, hay or other suitable materials to the soil surface to prevent erosion. Straw made from wheat or oats is the preferred mulch, the use of hay is permissible, but not encouraged due to the risk of spreading invasive species. Mulch must be applied to all temporary and permanent seeding on all disturbed areas. Depending on site conditions, in critical areas such as waterways or steep slopes, additional or substitute soil protective measures may be used if deemed necessary. Examples include jute mesh and soil stabilization blankets or erosion control matting.
Areas that have been temporarily or permanently seeded should be mulched immediately following seeding. Mulches conserve desirable soil properties, reduce soil moisture loss, prevent crusting and sealing of the soil surface and provide a suitable microclimate for seed germination.
Areas that cannot be seeded because of the season should be mulched to provide some protection to the soil surface. An organic mulch, straw or hay should be used and the area then seeded as soon as weather or seasonal conditions permit. Do not use fiber mulch (cellulose-hydroseed) alone for this practice; at normal application rates it will not give the soil protection of other types of mulch.
Wood cellulose fiber mulch is used in hydroseeding operations and applied as part of the slurry. It creates the best seed-soil contact when applied over the top of (as a separate operation) newly seeded areas. Fiber mulch does not alone provide sufficient protection on highly erodible soils, or during less than favorable growing conditions. Fiber mulch should not be used alone during the dry summer months or when used for late fall mulch cover. Use straw mulch during these periods and fiber mulch may be used to tack (anchor) the straw mulch. Fiber mulch is well suited for steep slopes, critical areas and areas susceptible to wind.

b. Chemical Mulches, Soil Binders and Tackifiers
A wide range of synthetic spray on materials are marketed to stabilize and protect the soil surface. These are mixed with water and sprayed over the mulch and to the soil. They may be used alone in some cases as temporary stabilizers, or in conjunction with fiber mulch, straw or hay.
When used alone most chemical mulches do not have the capability to insulate the soil or retain soil moisture that organic mulches have.

c. Specifications
From Table IV-6 select the type of mulch and rate of application that will best suit the conditions at the site.

d. Anchoring
Depending on the field situation, mulch may not stay in place because of wind action or rapid water runoff. In such cases, mulch is to be anchored mechanically or with mulch netting.
1. Mechanical Anchoring
Apply mulch and pull mulch anchoring tool over the mulch.
When a disk is used set the disk straight and pull across slope.
Mulch material should be tucked into the soil about three inches.
2. Mulch netting
Follow manufacturer's recommendation when positioning and stapling the mulch netting in the soil.

Table IV-1
Recommended Seeding Dates

Planting Dates	Suitability
March 1 - April 15 and August 1 - October 1	Best Seeding Periods
April 15 - August 1	HIGH RISK - moisture stress likely
October 1 - December 1	HIGH RISK - freeze damage to young seedlings
December 1 - March 1	Good seeding period. Dormant seeding

Table 2
Acceptable Fertilization Recommendation

Species	N (lbs/ac)	P2O5 (lbs/ac)	Example Rec.* (per acre)
Cool Season Grass	40	80	400 lbs. 10-20-20
CS Grass & Legume	30	60	300 lbs. 10-20-20
Temporary Cover	40	40	200 lbs. 19-19-19

Table 3
Temporary Cover

Species	Seeding Rate (lbs/acre)	Optimum Seeding Dates	Drainage	pH Range
Annual Ryegrass	40	3/1 - 6/15 or 8/15 - 9/15	Well - Poorly	5.5 - 7.5
Field Bromegrass	40	3/1 - 6/15 or 8/15 - 9/15	Well - Mod. Well	6.0 - 7.0
Spring Oats	96	3/1 - 6/15	Well - Poorly	5.5 - 7.0
Sundangrass	40	5/15 - 8/15	Well - Poorly	5.5 - 7.5
Winter Rye	168	8/15 - 10/15	Well - Poorly	5.5 - 7.5
Winter Wheat	180	8/15 - 11/15	Well - Mod. Well	5.5 - 7.0
Japanese Millet	30	6/15 - 8/15	Well	4.5 - 7.0
Redtop	5	3/1 - 6/15	Well	4.0 - 7.5
Annual Ryegrass	26	3/1 - 6/15	Well - Poorly	5.5 - 7.5
Spring Oats	64	3/1 - 6/15	Well - Poorly	5.5 - 7.5

NOTE: *These rates should be increased by 50% if planted April 15 - August 1 and October 1 - March 1.*

Table 4a
Permanent Seeding Mixture

Species/Mixture	Seeding Rate (lbs/acre)	Soil Drainage preference	pH Range
Crownvetch /	10 - 15	Well - Mod. Well	5.0 - 7.5
Tall Fescue	30		
Crownvetch /	10 - 15	Well - Mod. Well	5.0 - 7.5
Perennial Ryegrass	20		
Flatpea or Perennial Pea /	**20**	**Well - Mod. Well**	**4.0 - 8.0**
Tall Fescue	**15**		
Ladino Clover /	30		
Serecia Lespedeza /	25	Well - Mod. Well	4.5 - 7.5
Tall Fescue	2		
Tall Fescue /	*40*		
Ladino Clover /	*3*	*Well - Mod. Well*	*5.0 - 7.5*
Redtop	*3*		
Crownvetch /	10		
Tall Fescue /	20	Well - Mod. Well	5.0 - 7.5
Redtop	3		
Tall Fescue /	40		
Birdsfoot Trefoil /	10	Well - Mod. Well	5.0 - 7.5
Redtop	3		
Serecia Lespedeza /	25		
Tall Fescue /	30	Well - Mod. Well	4.5 - 7.5
Redtop	3		
Redtop /	30		
Tall Fescue /	3	Well - Mod. Well	5.0 - 7.5
Creeping Red	50		
Tall Fescue	*50*	*Well - Poorly*	*4.5 - 7.5*
Perennial Ryegrass /	**10**		
Tall Fescue /	**15**	**Well -Poorly**	**5.8 - 8.0**
Lathco Flatpea *	**20**		

** 'Lathco' Flatpea is potentially poisonous to some livestock. All legumes should be planted with proper inoculants prior to seeding. For unprepared seedbeds or seeding outside the optimum timeframe, add 50% more seed to the specified rate.*
Mixtures listed in bold are suitable for use in shaded woodland settings; those in italics are suitable for use in filter strips.

Table 4b
Wildlife and Farm Friendly Seed Mixtures

Species/Mixture	Seeding Rate (lbs/acre)	Soil Drainage preference	pH Range
KY Bluegrass /	20		
Redtop /	3	Well - Mod. Well	5.5 - 7.5
Ladino Clover or Birdsfoot Trefoil	2 / 10		
Timothy /	5	Well - Mod. Well	6.5 - 8.0
Alfalfa	12		
Timothy /	5	Well - Poorly	5.5 - 7.5
Birdsfoot Trefoil	8		
Orchardgrass /	*10*		
Ladino Clover /	*2*	*Well - Mod. Well*	*5.5 - 7.5*
Redtop	*3*		
Orchardgrass /	*10*	*Well - Mod. Well*	*5.5 - 7.5*
Ladino Clover	*2*		
Orchardgrass /	*20*	*Well - Mod. Well*	*5.5 - 7.5*
Perennial Ryegrass	*10*		
Creeping Red Fescue /	**30**	*Well - Mod. Well*	**5.5 - 7.5**
Perennial Ryegrass	**10**		
Orchardgrass or KY Bluegrass	20	Well - Mod. Well	6.0 - 7.5
Birdsfoot Trefoil /	10		
Redtop /	5	Well - Mod. Well	5.5 - 7.5
Orchardgrass	20		
Lathco Flatpea */	**30**	**Well - Mod. Well**	**5.5 - 7.5**
Perennial Ryegrass	**20**		
Lathco Flatpea */	30	Well - Mod. Well	5.5 - 7.5
Orchardgrass	20		

** 'Lathco' Flatpea is potentially poisonous to some livestock. All legumes should be planted with proper inoculants prior to seeding. For unprepared seedbeds or seeding outside the optimum timeframe, add 50% more seed to the specified rate.*

Mixtures listed in bold are suitable for use in shaded woodland settings; those in italics are suitable for use in filter strips.

Table IV-5
Lime and Fertilizer Application Table

pH of Soil	Lime in Tons per Acre	Fertilizer, Lbs. per Acre (10-20-20 or Equivalent)
Above 6.0	2	500
5.0 to 6.0	3	500
Below 5.0	4	500

The pH can be determined with a portable pH testing kit or by sending the soil samples to a soil testing laboratory. When 4 tons of lime per acre are applied it must be incorporated into the soil by disking, backblading or tracking up and down the slope.

Table IV-6
Mulch Materials Rates and Uses

Material	Minimum Rates per acre	Coverage	Remarks
Hay or Straw	2 to 3 Tons 100 to 150 bales	Cover 75% to 90% of Surface	Subject to wind blowing or washing unless tied down
Wood Fiber Pulp Fiber Wood - Cellulose Recirculated Paper	1000 to 1500 lbs	Cover all Disturbed Areas	For hydroseeding

Tables IV 1-4 taken from Natural Resources Conservation Service Manual 'Critical Area Planting'

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HONESTY, INTEGRITY, QUALITY

CYRUS S. KUMP
REGISTERED
STATE OF WEST VIRGINIA
PROFESSIONAL ENGINEER
11/04/2013

THIS DOCUMENT WAS PREPARED BY: NAVITUS ENGINEERING INC.
FOR: EQT PRODUCTION COMPANY

CONSTRUCTION DETAILS
OXF 157
WEST UNION DISTRICT
DODDRIDGE COUNTY, WV

DATE: 11/04/2013	
SCALE: N/A	
DESIGNED BY: CSK	
FILE NO. 7889	
SHEET 31 OF 31	

OXF-157 FORD CROSSING
EQT PRODUCTION COMPANY

SITUATED ON THE WATERS OF BLUESTONE CREEK IN WEST UNION DISTRICT, DODDRIDGE COUNTY, WV

PROJECT INFORMATION

LOCATION COORDINATES

EQT OXF 151 CONCRETE FORD CROSSING D
LATITUDE: 39.230656 LONGITUDE: -80.763755 (NAD 83)

EQT OXF 151 CONCRETE FORD CROSSING C
LATITUDE: 39.232818 LONGITUDE: -80.764114 (NAD 83)

EQT OXF 151 CONCRETE FORD CROSSING B
LATITUDE: 39.234223 LONGITUDE: -80.765021 (NAD 83)

MISS UTILITY STATEMENT

MISS UTILITY OF WEST VIRGINIA WAS NOTED FOR THE LOCATING OF UTILITIES PRIOR TO THIS PROJECT DESIGN; TICKET #1328176253.
IN ADDITION, MISS UTILITY WILL BE CONTACTED PRIOR TO START OF THE PROJECT

MISS Utility of West Virginia
1-800-245-4848
West Virginia State Law
(Section XIV, Chapter 24-C)
Requires that you call two business days before you dig in the state of West Virginia.
IT'S THE LAW!

ENVIRONMENTAL NOTES

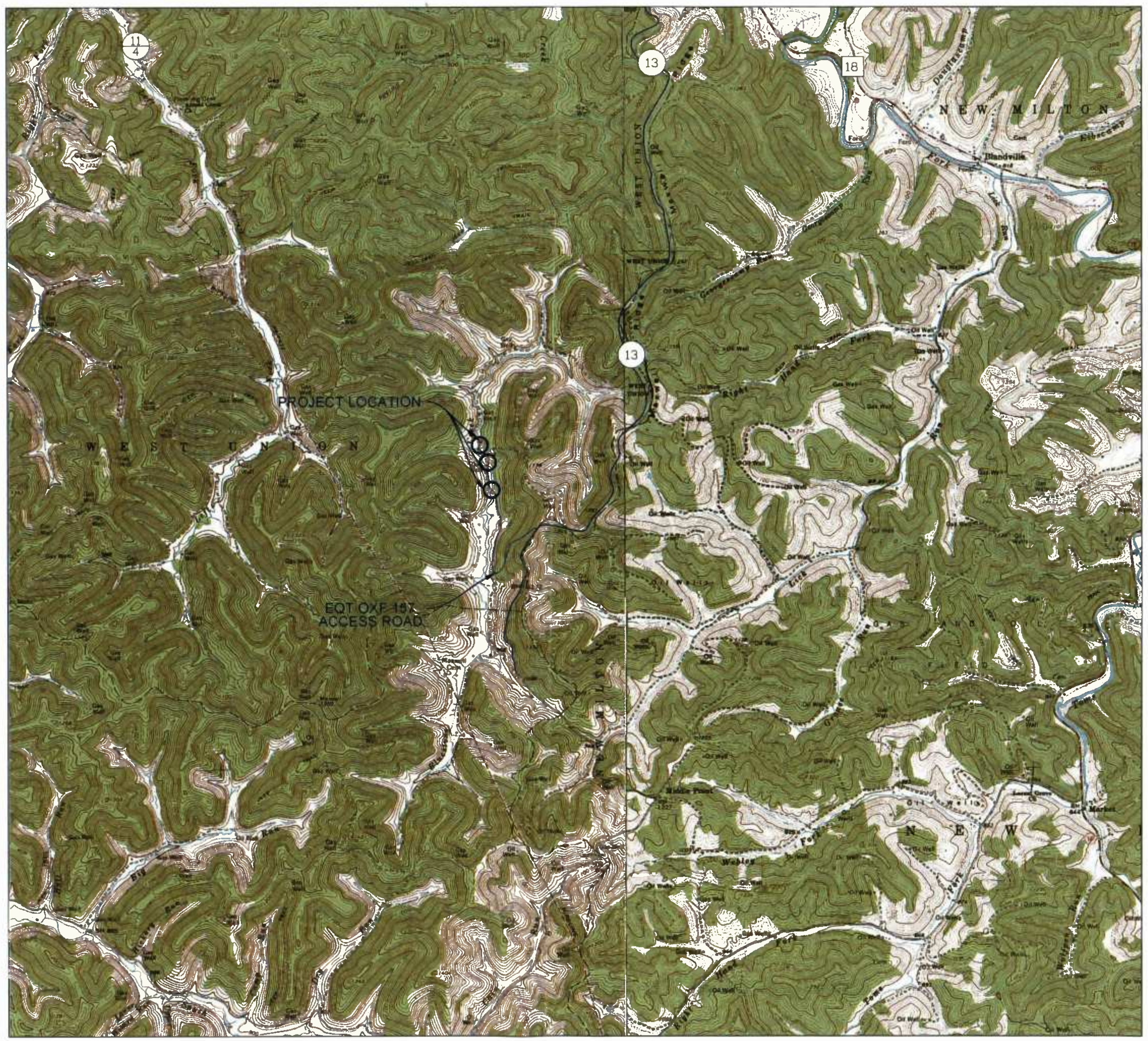
A WETLAND DELINEATION WAS PERFORMED BY POTESTA & ASSOCIATES TO REVIEW THE SITE FOR WATERS AND WETLANDS THAT ARE MOST LIKELY WITHIN THE REGULATORY PURVIEW OF THE U.S. ARMY CORPS OF ENGINEERS (USACE) AND/OR THE WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION (WVDEP). THE MAY 29, 2013 REPORT FOR EQT OXF 157 PREPARED BY POTESTA & ASSOCIATES, INC., SUMMARIZES THE RESULTS OF THE FIELD DELINEATION. THE REPORT DOES NOT, IN ANY WAY, REPRESENT A JURISDICTIONAL DETERMINATION OF THE LANDWARD LIMITS OF WATERS AND WETLANDS WHICH MAY BE REGULATED BY THE USACE OR THE WVDEP. IT IS STRONGLY RECOMMENDED THAT THE AFORMENTIONED AGENCIES BE CONSULTED IN AN EFFORT TO GAIN WRITTEN CONFIRMATION OF THE DELINEATION DESCRIBED BY THIS REPORT PRIOR TO ENGAGING CONSTRUCTION ON THE PROPERTY DESCRIBED HEREIN. THE DEVELOPER SHALL OBTAIN THE APPROPRIATE PERMITS FROM THE FEDERAL AND/OR STATE REGULATORY AGENCIES PRIOR TO ANY PROPOSED IMPACTS TO WATERS OF THE U.S., INCLUDING WETLAND FILLS AND STREAM CROSSI NGS.

GEOTECHNICAL NOTES

A SUBSURFACE GEOTECHNICAL INVESTIGATION HAS NOT BEEN PERFORMED AT THIS SITE

DESIGN NOTES

CONCRETE PAVEMENT DESIGN BASED ON A SOIL TYPE OF ML WITH A CALIFORNIA BEARING RATIO OF 2. PAVEMENT DESIGN WAS BASED OFF OF A ADT ≠ 100 VEHICLE PER DAY WITH 50% TRUCKS.



NEW MILTON, OXFORD, SMITHBURG AND WEST UNION QUADRANGLE
WEST VIRGINIA
7.5 MINUTE SERIES

0 2000' 4000'

SHEET INDEX

LEGEND

- LIMITS OF DISTURBANCE
- BRUSH PILE
- EXISTING STREAM
- EDGE OF GRAVEL
- EXISTING CULVERT (AS NOTED)
- CFS — COMPOST FILTER SOCK (AS NOTED)
- RIP RAP
- GRAVEL
- PROPOSED 2' CONTOURS
- AS BUILT 2' CONTOURS
- PROPOSED WELL LOCATIONS
- PERMITTED WELL LOCATIONS
- 0000.0 SPOT ELEVATIONS

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Professional Energy Consultants
SLS

10/7/2015

THIS DOCUMENT WAS PREPARED BY: SMITH LAND SURVEYING, INC. FOR: EQT

COVER SHEET
OXF-157 FORD CROSSINGS

DATE:	10/07/15
SCALE:	1"=300'
DESIGNED BY:	B.J.H
FILE NO.	8147
SHEET:	1 OF 15

EQT OXF 157 MATERIAL QUANTITIES				
FORD CROSSING				
ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	ITEM TOTAL
1.0 UNCLASSIFIED EXCAVATION	746	CY	$	$
2.0 AGGREGATE SURFACING				
2.a. 8" OF 3"-6" STONE BASE	28	TONS	$	$
2.b. 2" OF 3/4" CRUSHER RUN	7	TONS		
2.c. GEOTEXTILE SEPARATION FABRIC	66	SY	$	$
3.0 WATER PUMP AROUND	3	EA	$	$
4.0 CONCRETE FORD				
4.a. 4,000 PSI CONCRETE	159	CY	$	$
4.b. 12" OF 3" STONE SUBBASE	345	TONS	$	$
4.c. 6" OF AGGREAGTE BASE COURSE	173	SY	$	$
4.d. RIP RAP	69	TONS	$	$
5.0 REMOVE EXISTING BRIDGE	3	EA	$	$
6.0 #6 REBAR	22,177	LB	$	$
7.0 1 ½" DOWELS	2,632	LB	$	$

SLAB TYPE 1 9'x16' FLAT						CROSSING D (1)						
MARK	TYPE	LENGTH (EACH)		NUMBER REQ'D	SLAB TOTAL WEIGHT (LBS) 602001-001	TOTAL WEIGHT (LBS) 602001-001	DIMENSIONS A		B		C	
		FT	IN				FT	IN	FT	IN	FT	IN
S1-601	1	16	6	13	322.2	322.2	1	0	15	6		
S1-602	2	6	2	13	120.4	120.4	1	2	2	0	3	0
S1-604	STR	8	6	26	331.9	331.9						
1-1/4" DOWEL	STR	1	6	34	219.3	219.3						

SLAB TYPE 2 15'x16' TRANSITION						CROSSING D (2) CROSSING C (2)						
MARK	TYPE	LENGTH (EACH)		NUMBER REQ'D	SLAB TOTAL WEIGHT (LBS) 602001-001	TOTAL WEIGHT (LBS) 602001-001	DIMENSIONS A		B		C	
		FT	IN				FT	IN	FT	IN	FT	IN
S2-601	1	16	6	21	520.4	2081.8	1	0	15	6		
S2-602	2	6	2	21	194.5	778.0	1	2	2	0	3	0
S2-603	3	4	0	22	132.2	528.7	1	9	1	1	1	2
S2-605	STR	14	6	26	566.3	2265.0						
1-1/4" DOWEL	STR	1	6	17	109.7	438.6						

SLAB TYPE 3 15'x16'						CROSSING D (2) CROSSING C (2)						
MARK	TYPE	LENGTH (EACH)		NUMBER REQ'D	SLAB TOTAL WEIGHT (LBS) 602001-001	TOTAL WEIGHT (LBS) 602001-001	DIMENSIONS A		B		C	
		FT	IN				FT	IN	FT	IN	FT	IN
S3-601	1	16	6	21	520.4	2081.8	1	0	15	6		
S3-602	2	6	2	21	194.5	778.0	1	2	2	0	3	0
S3-605	STR	14	6	26	566.3	2265.0						
1-1/4" DOWEL	STR	1	6	17	109.7	438.6						

SLAB TYPE 4 6'-6"x16' END						CROSSING D (2)						
MARK	TYPE	LENGTH (EACH)		NUMBER REQ'D	SLAB TOTAL WEIGHT (LBS) 602001-001	TOTAL WEIGHT (LBS) 602001-001	DIMENSIONS A		B		C	
		FT	IN				FT	IN	FT	IN	FT	IN
S4-601	1	16	6	9	223.0	446.1	1	0	15	6		
S4-602	2	6	2	9	83.4	166.7	1	2	2	0	3	0
S4-606	STR	6	0	26	234.3	468.6						
1-1/4" DOWEL	STR	1	6	17	109.7	219.3						

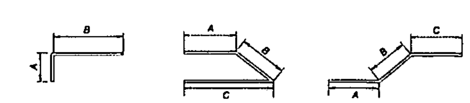
SLAB TYPE 5 15'x16' FLAT						CROSSING B (1)						
MARK	TYPE	LENGTH (EACH)		NUMBER REQ'D	SLAB TOTAL WEIGHT (LBS) 602001-001	TOTAL WEIGHT (LBS) 602001-001	DIMENSIONS A		B		C	
		FT	IN				FT	IN	FT	IN	FT	IN
S5-601	1	16	6	21	520.4	520.4	1	0	15	6		
S5-602	2	6	2	21	194.5	194.5	1	2	2	0	3	0
S5-605	STR	14	6	26	566.3	566.3						
1-1/4" DOWEL	STR	1	6	34	219.3	219.3						

SLAB TYPE 6 16'x16' TRANSITION						CROSSING B (2)						
MARK	TYPE	LENGTH (EACH)		NUMBER REQ'D	SLAB TOTAL WEIGHT (LBS) 602001-001	TOTAL WEIGHT (LBS) 602001-001	DIMENSIONS A		B		C	
		FT	IN				FT	IN	FT	IN	FT	IN
S6-601	1	16	6	22	545.2	1090.5	1	0	15	6		
S6-602	2	6	2	22	203.8	407.5	1	2	2	0	3	0
S6-603	3	4	0	22	132.2	264.4	1	9	1	1	1	2
S6-607	STR	15	6	26	605.3	1210.6						
1-1/4" DOWEL	STR	1	6	17	109.7	219.3						

SLAB TYPE 7 16'x16' END						CROSSING B (2)						
MARK	TYPE	LENGTH (EACH)		NUMBER REQ'D	SLAB TOTAL WEIGHT (LBS) 602001-001	TOTAL WEIGHT (LBS) 602001-001	DIMENSIONS A		B		C	
		FT	IN				FT	IN	FT	IN	FT	IN
S7-601	1	16	6	22	545.2	1090.5	1	0	15	6		
S7-602	2	6	2	22	203.8	407.5	1	2	2	0	3	0
S7-607	STR	15	6	26	605.3	1210.6						
1-1/4" DOWEL	STR	1	6	17	109.7	219.3						

SLAB TYPE 8 9'-1"x16' FLAT						CROSSING C (1)						
MARK	TYPE	LENGTH (EACH)		NUMBER REQ'D	SLAB TOTAL WEIGHT (LBS) 602001-001	TOTAL WEIGHT (LBS) 602001-001	DIMENSIONS A		B		C	
		FT	IN				FT	IN	FT	IN	FT	IN
S8-601	1	16	6	13	322.2	322.2	1	0	15	6		
S8-602	2	6	2	13	120.4	120.4	1	2	2	0	3	0
S8-604	STR	8	7	26	335.2	335.2						
1-1/4" DOWEL	STR	1	6	34	219.3	219.3						

SLAB TYPE 9 10'-6"x16' END						CROSSING C (2)						
MARK	TYPE	LENGTH (EACH)		NUMBER REQ'D	SLAB TOTAL WEIGHT (LBS) 602001-001	TOTAL WEIGHT (LBS) 602001-001	DIMENSIONS A		B		C	
		FT	IN				FT	IN	FT	IN	FT	IN
S9-601	1	16	6	15	371.7	743.5	1	0	15	6		
S9-602	2	6	2	15	138.9	277.9	1	2	2	0	3	0
S9-608	STR	10	0	26	390.5	781.0						
1-1/4" DOWEL	STR	1	6	34	219.3	438.6						



TYPE 1 TYPE 2 TYPE 3

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PROJECT MGMT. ENVIRONMENTAL
SLS
HONESTY, INTEGRITY, QUALITY

STEPHEN G. JOHNSON REGISTERED No. 18428 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER
10/7/2015

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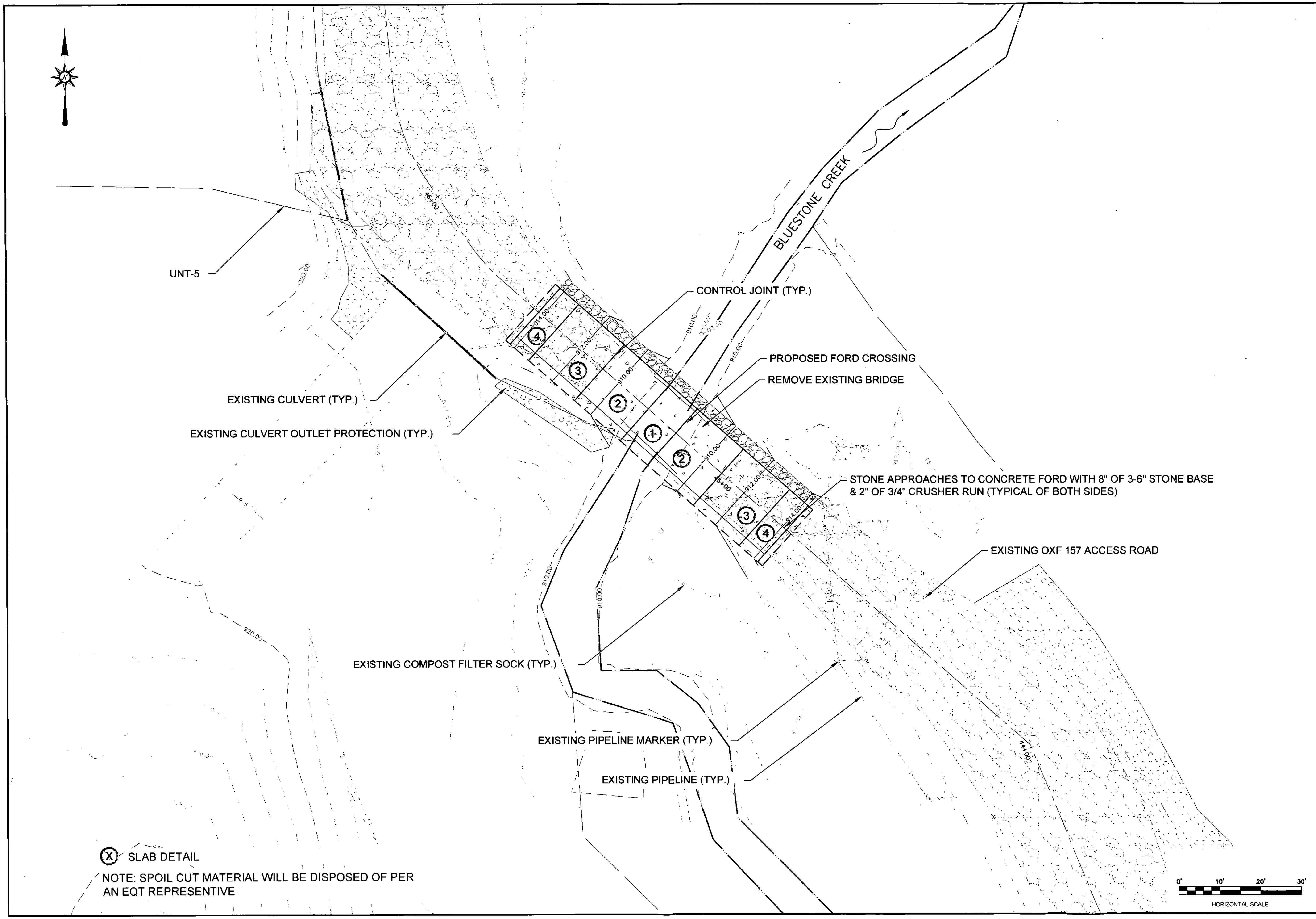
SITE QUANTITIES & REBAR SCHEDULE

OXF-157 FORD CROSSINGS

DATE: 10/07/15
SCALE: 1"=10'
DESIGNED BY: B.J.H
FILE NO. 8147
SHEET: 2 OF 15



(X) SLAB DETAIL

NOTE: SPOIL CUT MATERIAL WILL BE DISPOSED OF PER AN EQT REPRESENTIVE

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STEPHEN G. JOHNSON
No. 16426
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PROFESSIONAL ENGINEER
10/7/2016

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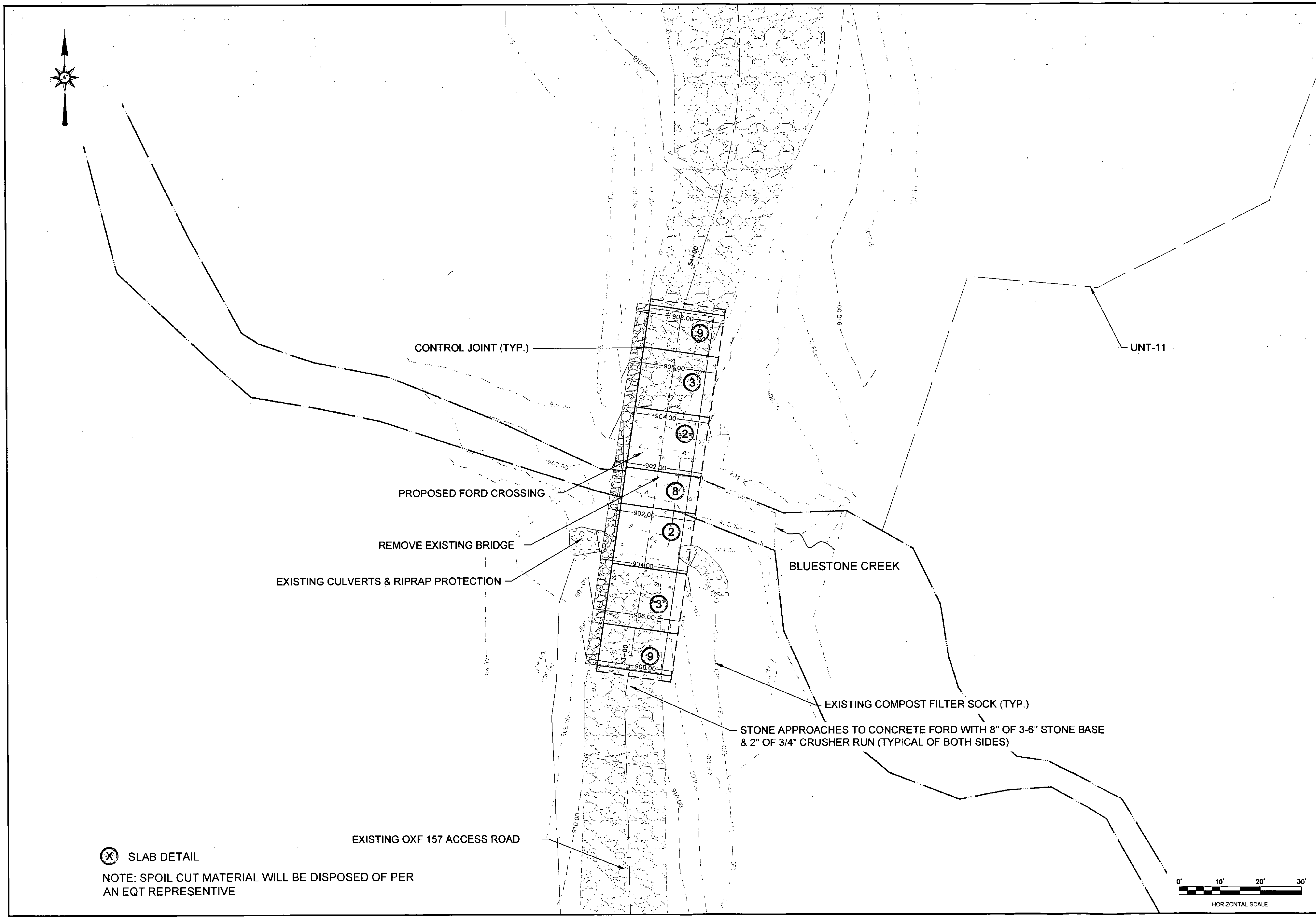
CROSSING D SITE PLAN

OXF-157 FORD CROSSINGS

DATE: 10/07/16
SCALE: 1"=10'
DESIGNED BY: B.J.H
FILE NO. 8147
SHEET: 3 OF 16



(X) SLAB DETAIL

NOTE: SPOIL CUT MATERIAL WILL BE DISPOSED OF PER AN EQT REPRESENTIVE

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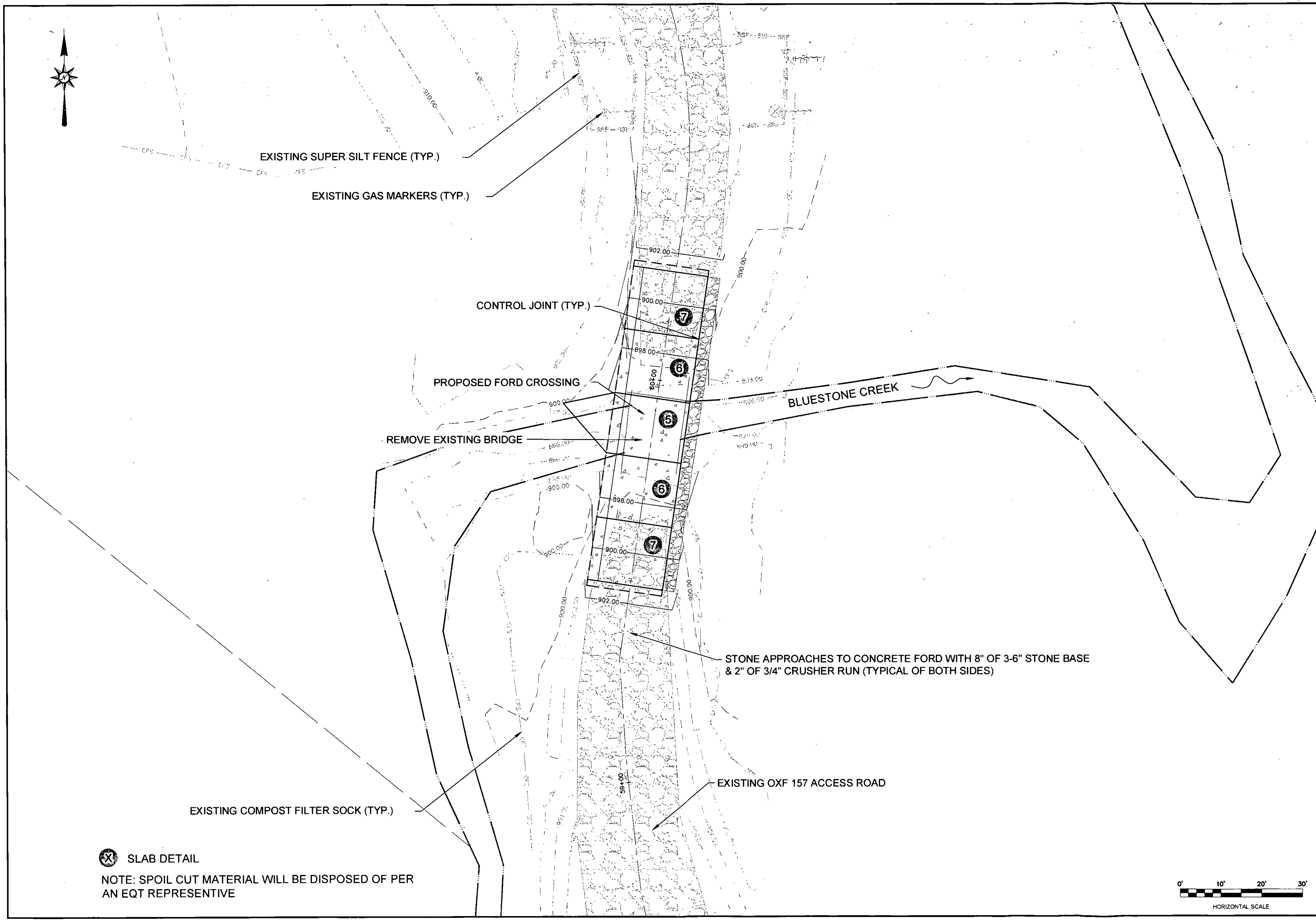
CROSSING C SITE PLAN

OXF-157 FORD CROSSINGS

DATE: 10/07/15
SCALE: 1"=10'
DESIGNED BY: B.J.H
FILE NO. 8147
SHEET: 4 OF 15



X SLAB DETAIL

NOTE: SPOIL CUT MATERIAL WILL BE DISPOSED OF PER AN EQT REPRESENTIVE

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10/7/2015

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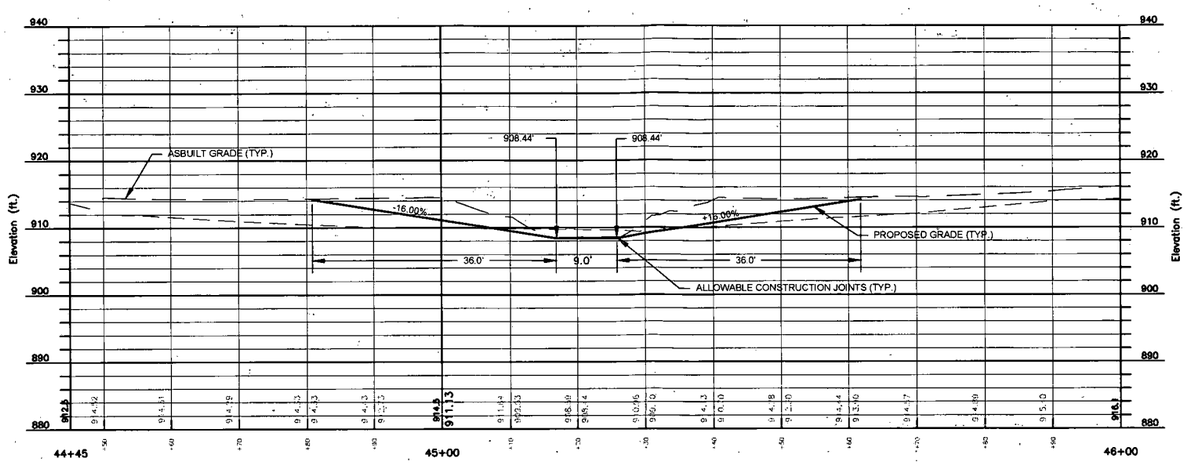
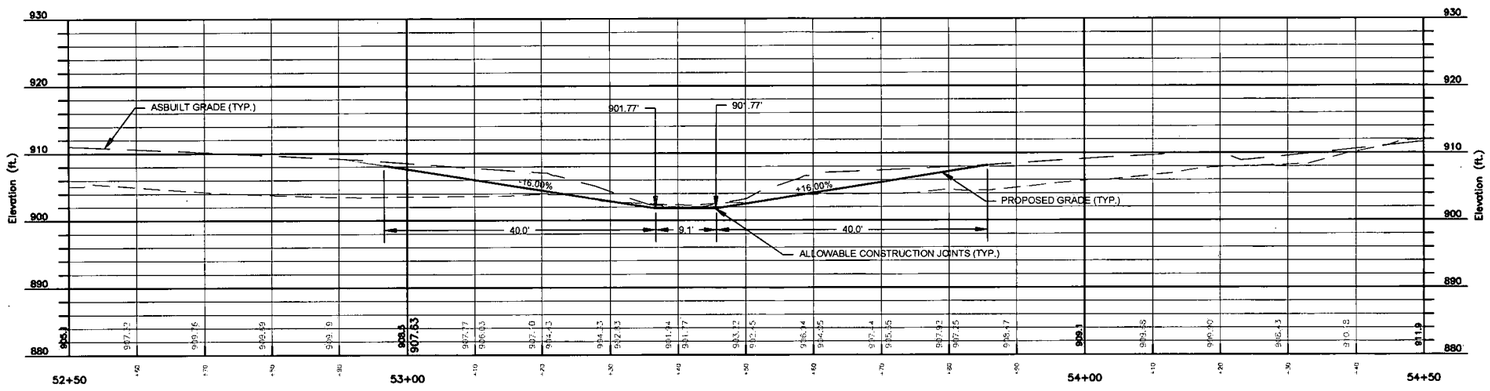
CROSSING B SITE PLAN

OXF-157 FORD CROSSINGS

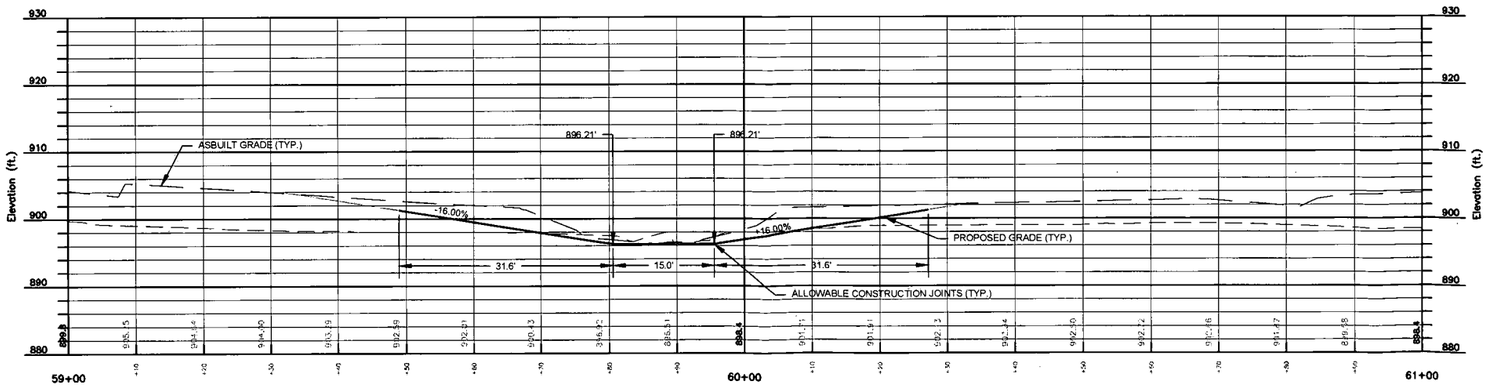
DATE: 10/07/15
SCALE: 1"=10'
DESIGNED BY: B.J.H
FILE NO. 8147
SHEET: 5 OF 15



CROSSING D PROFILE



CROSSING C PROFILE



CROSSING B PROFILE

0' 10' 20' 30'
HORIZONTAL SCALE

0' 10' 20' 30'
VERTICAL SCALE

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HONESTY, INTEGRITY, QUALITY

STEVEN G. JOHNSON
REGISTERED
No. 15428
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER
10/7/2015

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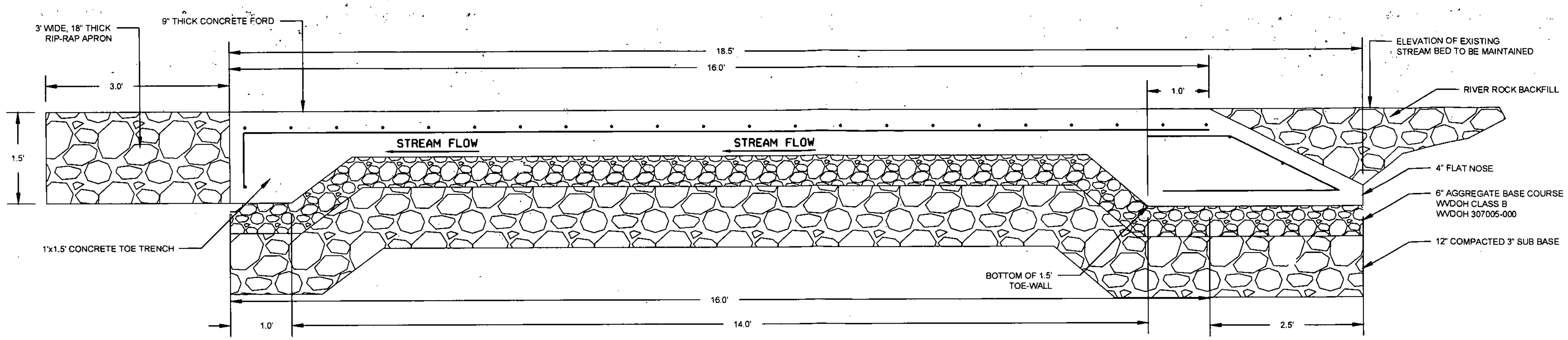
SMITH LAND SURVEYING, INC.
FOR: EQT

PROFILE SHEET

OXF-157 FORD CROSSINGS

DATE:	10/07/15
SCALE:	1"=10'
DESIGNED BY:	B.J.H
FILE NO.	8147
SHEET:	6 OF 15

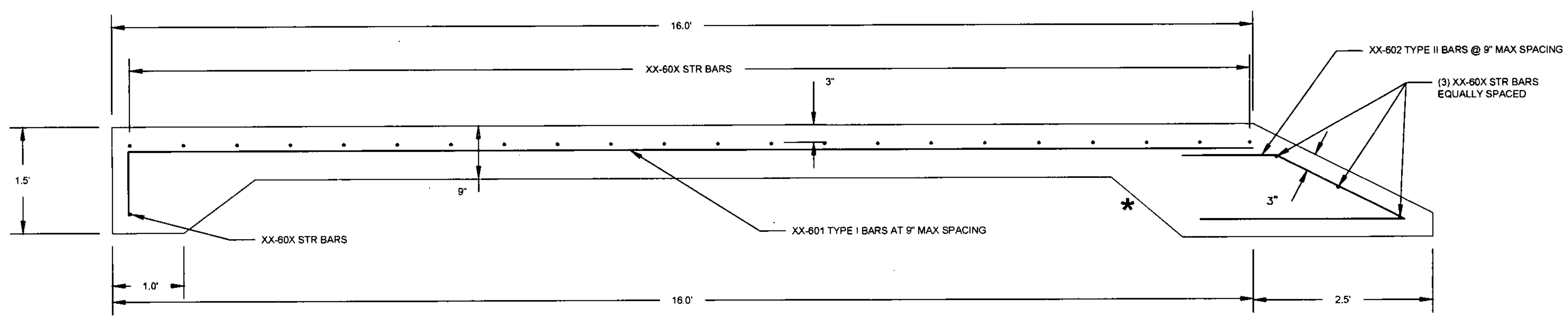


CONCRETE FORD TYPICAL SECTION

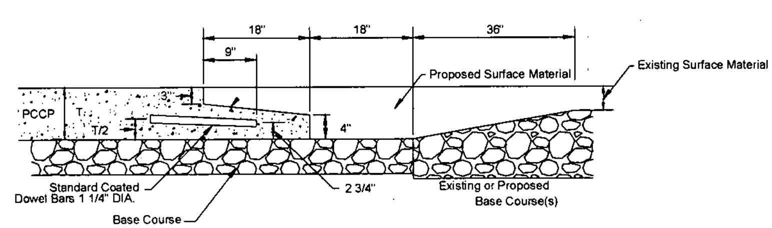
NOT TO SCALE

NOTES

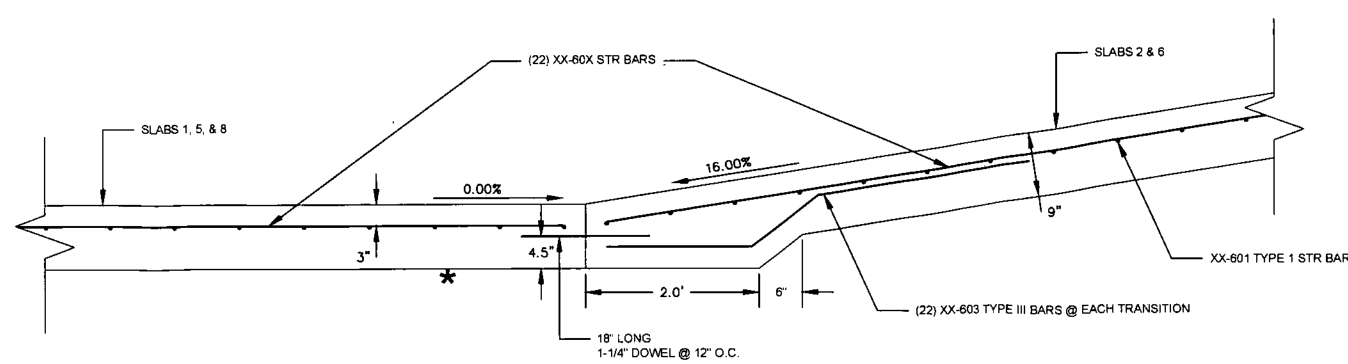
1. CONCRETE SHALL BE fc= 4000' PSI, 6% ± 1% AIR CONTENT, WITH A 4" SLUMP.
2. CONSTRUCTION JOINTS SHALL BE SEALED BY CAULKING.
3. CONTROL JOINTS SHALL BE SAW CUT PER DETAIL.
4. FRESH CONCRETE SHALL BE PROTECTED FROM RAINS, FLOWING WATER AND MECHANICAL DAMAGE FOR A PERIOD OF FOUR (4) DAYS.
5. THE FINISHED SURFACE OF THE CONCRETE FORD TRAVEL LANE SHALL BE ROUGHENED.
6. ALL REINFORCING BAR SHALL BE ASTM A-615, GRADE 60.



SECTION A-A'



END TRANSITION DETAIL



GRADE CHANGE DETAIL

* BASE COURSE & SUBBASE NOT SHOWN FOR CLARITY

0' 1' 2' 3'
HORIZONTAL SCALE

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SLS

STEPHEN G. JOHNSON
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No. 15628
STATE OF WEST VIRGINIA
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10/7/2015

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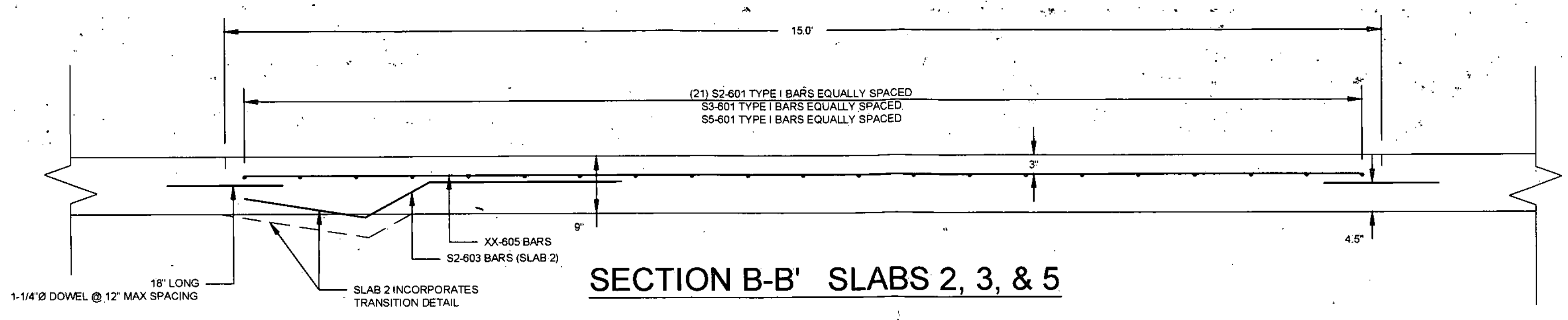
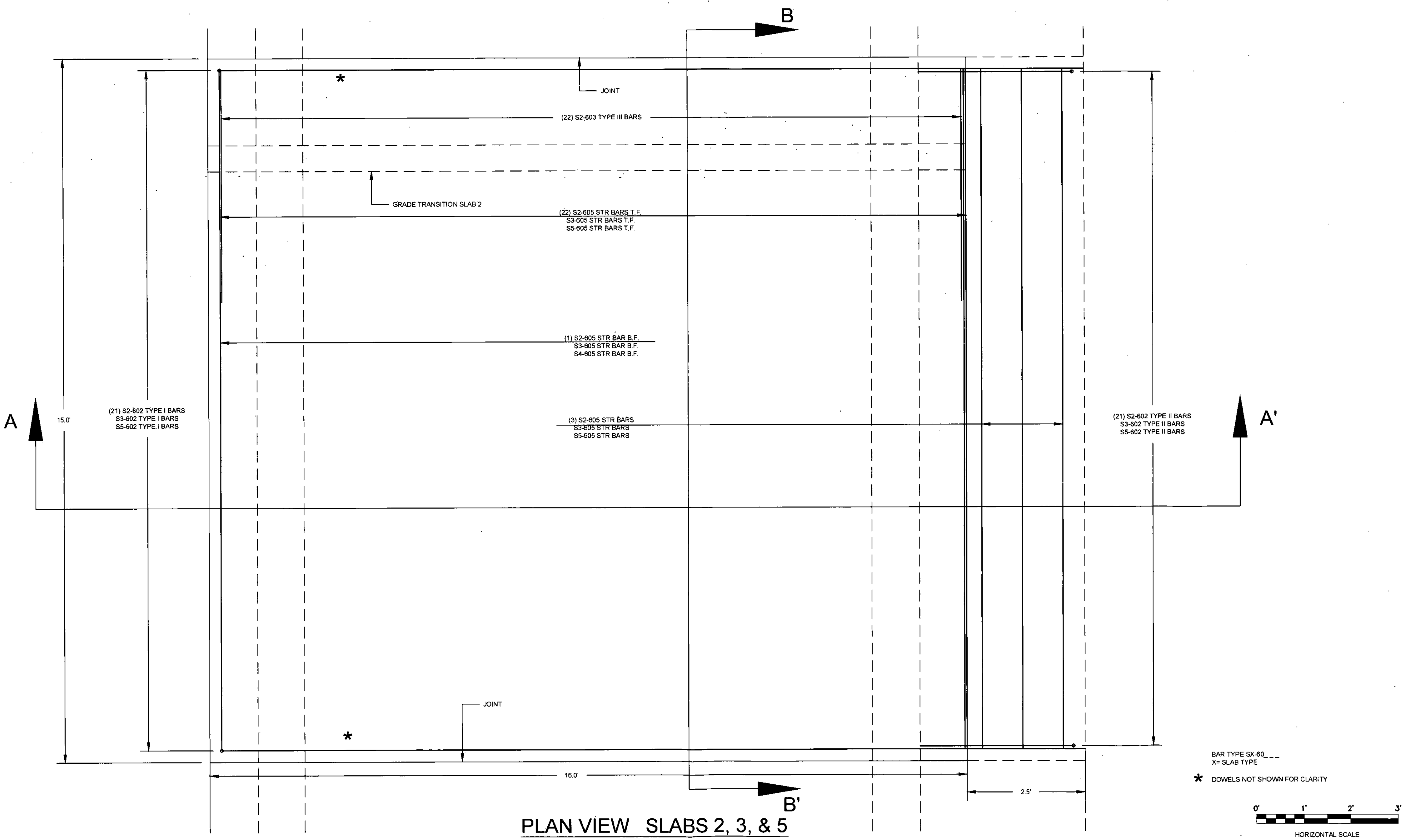
TYPICAL SECTIONS

OXF-157 FORD CROSSINGS

DATE:	10/07/15
SCALE:	1"=1'
DESIGNED BY:	B.J.H
FILE NO.	8147
SHEET:	7 OF 15



SECTION B-B' SLABS 2, 3, & 5



PLAN VIEW SLABS 2, 3, & 5

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PROJECT MGMT. ENVIRONMENTAL

HONESTY, INTEGRITY, QUALITY

STEPHEN G. JOHNSON
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STATE OF WEST VIRGINIA
PROFESSIONAL ENGINEER
10/7/2015

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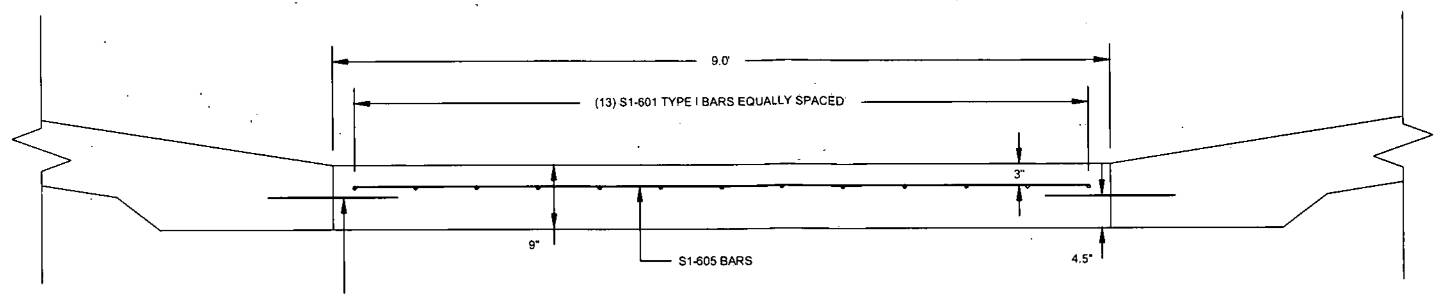
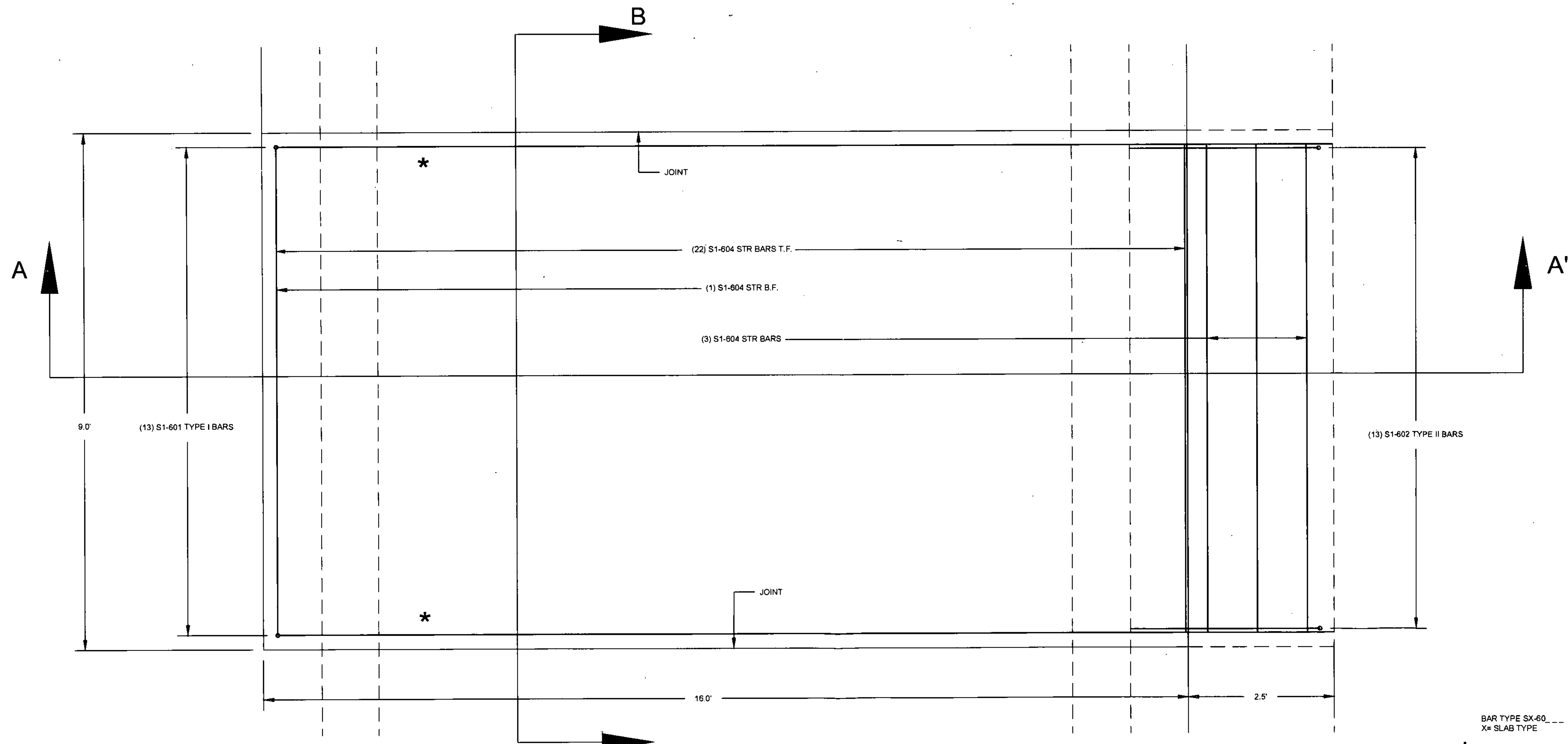
SLAB 2, 3, & 5 -15' LENGTH

OXF-157 FORD CROSSINGS

DATE: 10/07/15
SCALE: 1"=1'
DESIGNED BY: B.J.H
FILE NO. 8147
SHEET: 8 OF 15



SECTION B-B' SLAB 1



PLAN VIEW B-B' SLAB 1

BAR TYPE SX-60_ _ _
X= SLAB TYPE

* DOWELS NOT SHOWN FOR CLARITY

0' 1' 2' 3'
HORIZONTAL SCALE

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10/7/2015

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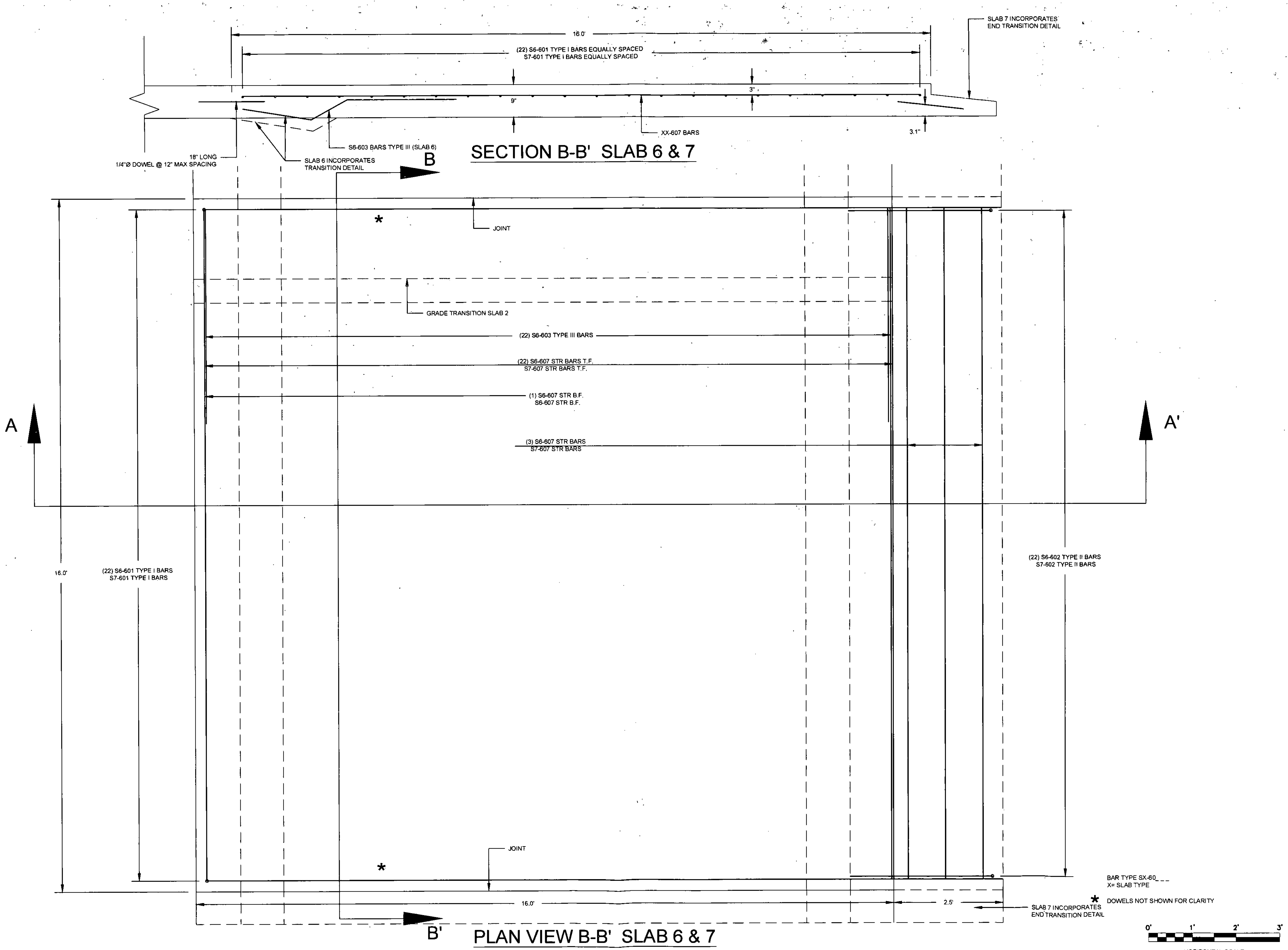
SLAB 1 - 9' LENGTH

OXF-157 FORD CROSSINGS

DATE: 10/07/15
SCALE: 1"=1'
DESIGNED BY: B.J.H
FILE NO. 8147
SHEET: 9 OF 15



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PROFESSIONAL ENGINEER
10/7/2015

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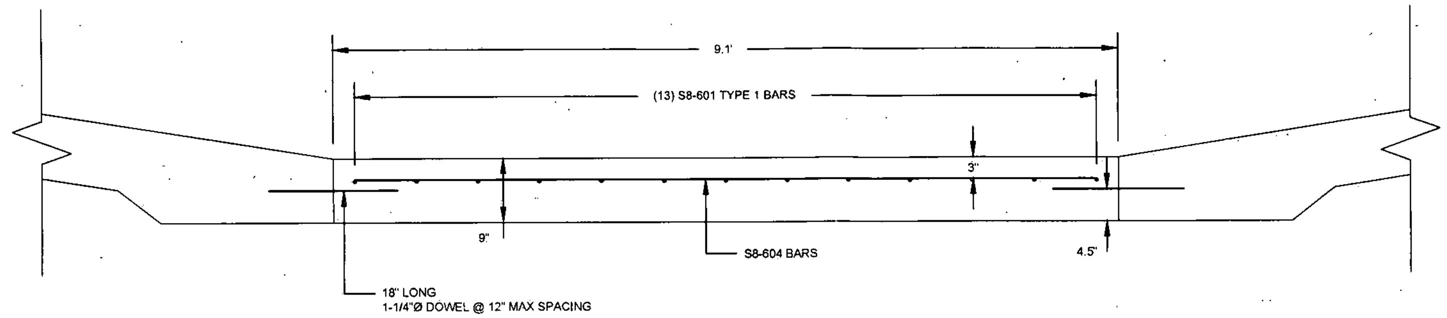
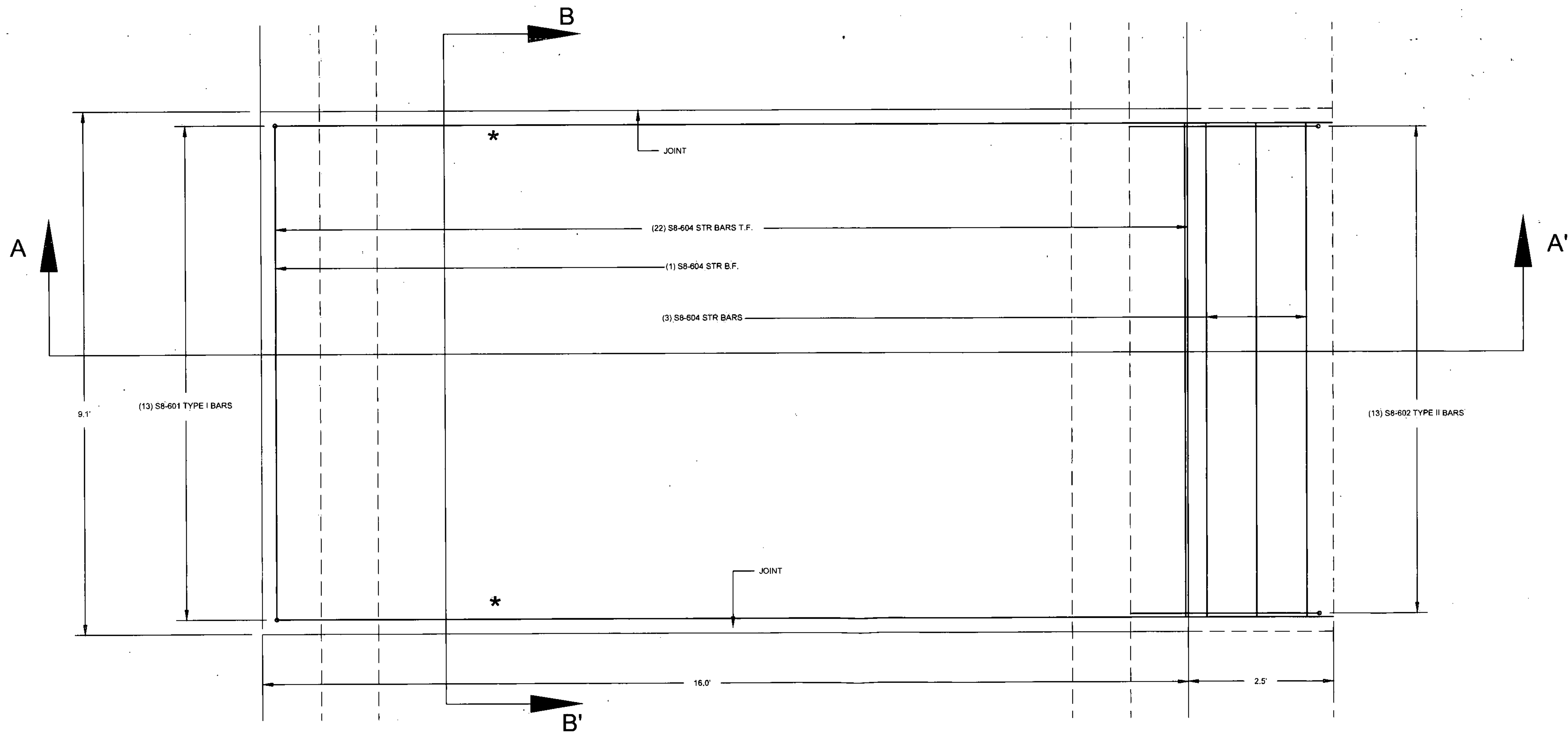
SLAB 6 & 7 - 16' LENGTH

OXF-157 FORD CROSSINGS

DATE: 10/07/15
SCALE: 1"=1'
DESIGNED BY: B.J.H
FILE NO. 8147
SHEET: 10 OF 15



SECTION B-B' SLAB 8



PLAN VIEW B-B' SLAB 8

BAR TYPE SX-60_ _ _
X= SLAB TYPE

* DOWELS NOT SHOWN FOR CLARITY

0' 1' 2' 3'
HORIZONTAL SCALE

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STEPHEN G. JOHNSON
REGISTERED
PROFESSIONAL ENGINEER
10/7/2015

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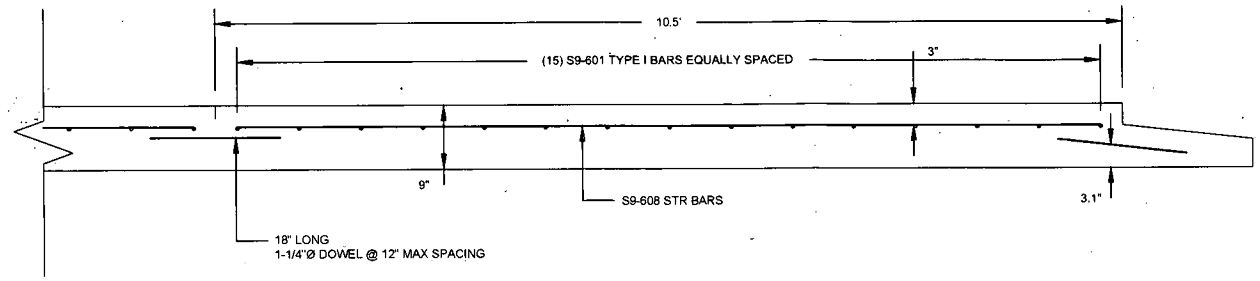
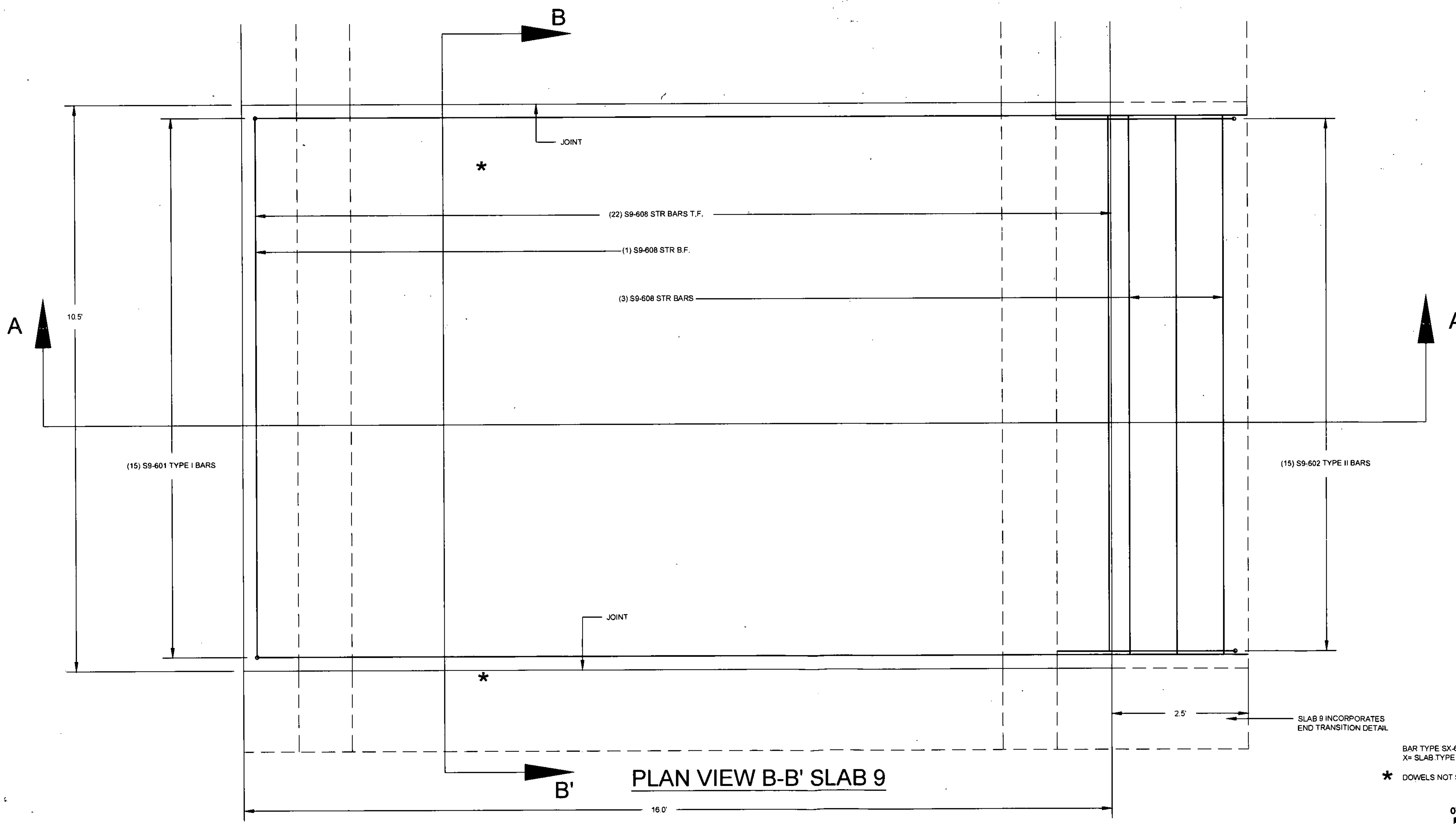
SLAB 8 - 9.1' LENGTH

OXF-157 FORD CROSSINGS

DATE:	10/07/15
SCALE:	1"=1'
DESIGNED BY:	B.J.H
FILE NO.	8147
SHEET:	11 OF 15



SECTION B-B' SLAB 9



PLAN VIEW B-B' SLAB 9

BAR TYPE SX-60__
X= SLAB TYPE

* DOWELS NOT SHOWN FOR CLARITY

0' 1' 2' 3'
HORIZONTAL SCALE

Stantec

Professional Energy Consultants
A DIVISION OF SMITH LAND SURVEYING
SLS

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No. 18420
STATE OF WEST VIRGINIA
PROFESSIONAL ENGINEER
10/7/2015

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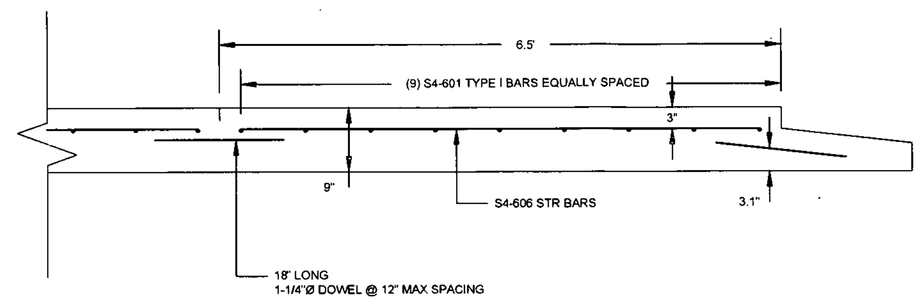
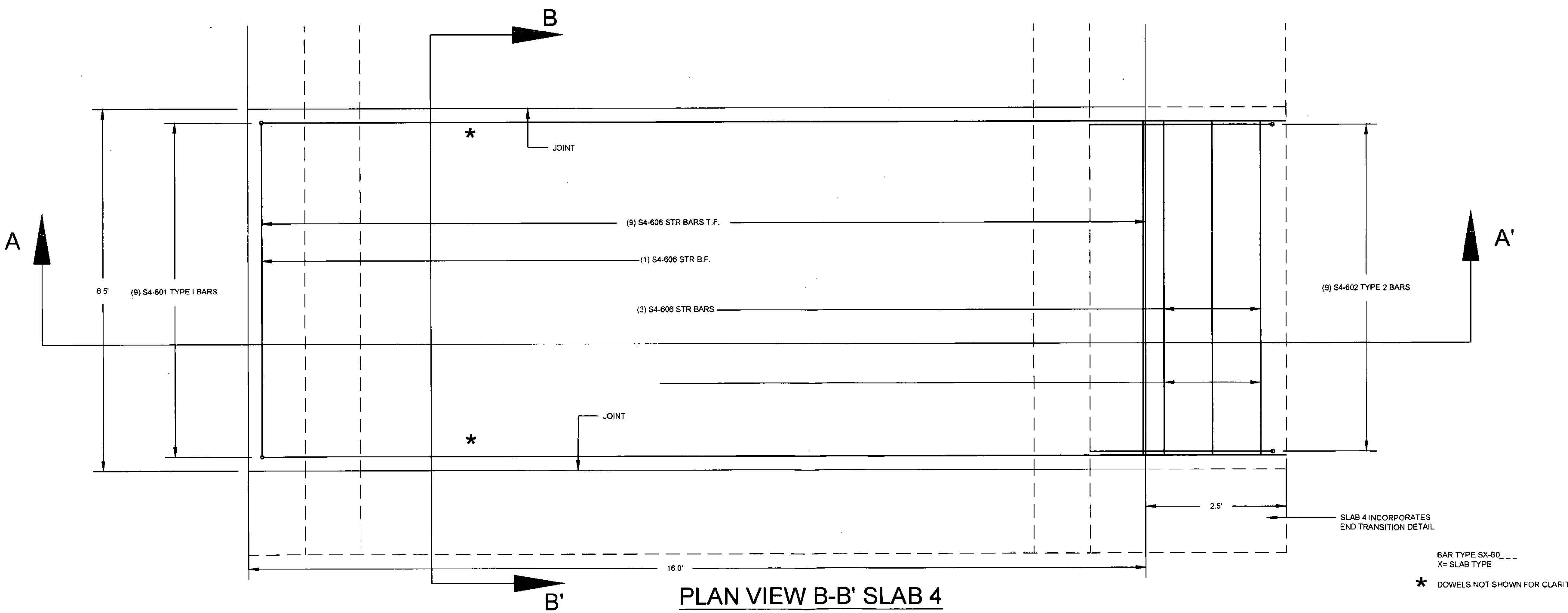
SLAB 9 - 10.5' LENGTH

OXF-157 FORD CROSSINGS

DATE:	10/07/16
SCALE:	1"=1'
DESIGNED BY:	B.J.H
FILE NO.	8147
SHEET:	12 OF 16



SECTION B-B' SLAB 4



PLAN VIEW B-B' SLAB 4

BAR TYPE SX-60_ _
X= SLAB TYPE

* DOWELS NOT SHOWN FOR CLARITY

0' 1' 2' 3'
HORIZONTAL SCALE

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THIS DOCUMENT WAS PREPARED BY: SMITH LAND SURVEYING, INC. FOR: EQT

SLAB 4 - 6.5' LENGTH

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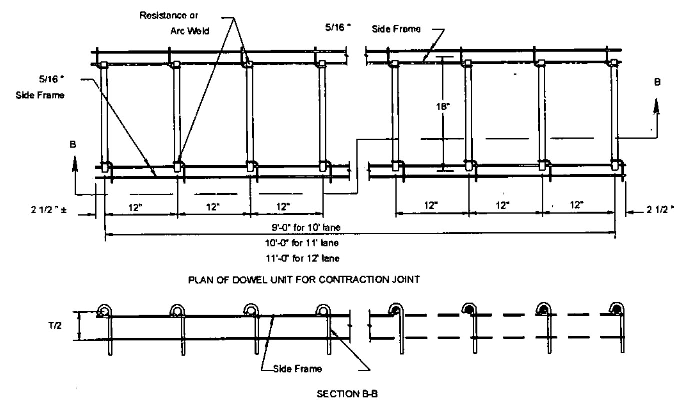
GENERAL STREAM CROSSING NOTES:

1. CLEARING AND EXCAVATION OF THE STREAMBED AND BANKS SHALL BE KEPT TO A MINIMUM.
2. FILTER CLOTH SHALL BE PLACED ON THE STREAMBED AND STREAM BANKS PRIOR TO PLACEMENT OF THE CONCRETE FORD AND AGGREGATE. THE FILTER CLOTH SHALL COVER THE STREAMBED AND EXTEND A MINIMUM OF SIX INCHES AND A MAXIMUM OF ONE FOOT BEYOND THE END OF THE FORD AND BEDDING MATERIAL.
3. A PUMP AROUND SYSTEM SHALL BE CONSTRUCTED ACROSS THE ROADWAY ON EITHER SIDE OF THE STREAM CROSSING AS DIRECTED.
4. APPROPRIATE PERIMETER CONTROLS SUCH AS COMPOST FILTER SOCK, SUPER SILT FENCE AND / OR SEDIMENT TRAPS SHALL BE EMPLOYED ALONG THE BANKS AND PARALLEL TO THE STREAMBED.
5. STREAMBED MATERIAL IS NOT TO BE USED AS FILL.
6. GREEN CONCRETE SHALL NOT BE PLACED IN CONTACT WITH FLOWING WATER.
7. DURING ROUTINE MAINTENANCE DO NOT GRADE MUD AND DEBRIS OVER THE SIDES OF THE CROSSING INTO THE STREAM.
8. THE CROSSING MUST BE INSPECTED AFTER EVERY RAIN EVENT OF 0.5 INCHES OR MORE AND ONCE A WEEK TO ENSURE THAT THE CONCRETE, RIP-RAP APRON, STREAMBED, AND STREAM BANKS ARE MAINTAINED AND NOT DAMAGED. NEVER ALLOW THE CROSSING TO BECOME OBSTRUCTED WITH DEBRIS AND REMOVE ANY OBSTRUCTIONS IMMEDIATELY.
9. GEOTEXTILE FABRIC SHALL MEETS THE TENSILE STRENGTH REQUIREMENTS OF 180 LBS PER ASTM D 4632, MULLEN BURSTING REQUIREMENTS OF 80 LBS PER ASTM D 4833.
10. CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4,000 PSI AT 28 DAYS.
11. STORM RUNOFF MAY DEPOSIT DEBRIS AT THE CROSSING LOCATION WHICH WILL NEED TO BE REMOVED.

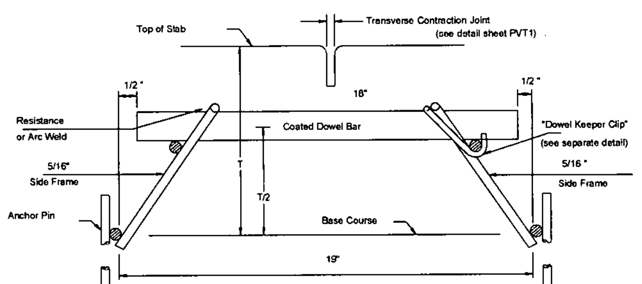
PUMP AROUND NOTES:

1. CONSTRUCTION SHOULD BE PERFORMED DURING LOW FLOW PERIODS.
2. PUMP(S) SHOULD BE SUFFICIENTLY LARGE TO PUMP THE ENTIRE STREAM FLOW AROUND THE SITE.
3. THE COFFERDAM CONSTRUCTED MUST BE IMPERVIOUS TO WATER.
4. THE INLET TO THE PUMP(S) IS TO BE SUSPENDED ABOVE THE STREAMBED IN ORDER TO PREVENT SUCKING MUD AND SEDIMENT.
5. THE DISCHARGE POINT MUST BE STABILIZED WITH ROCK TO DISPERSE THE ENERGY AND PREVENT EROSION.

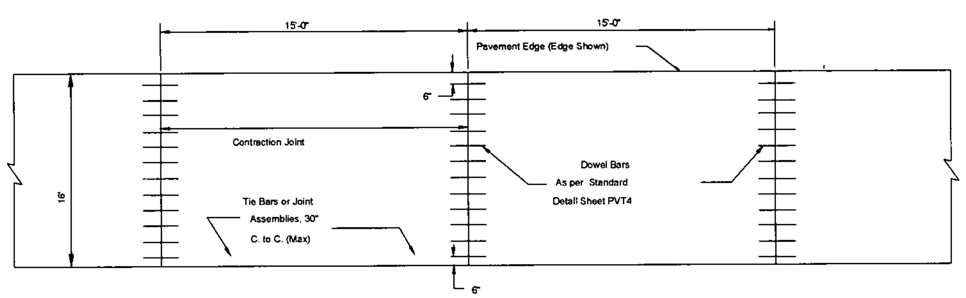


PLAN OF DOWEL UNIT FOR CONTRACTION JOINT

SECTION B-B

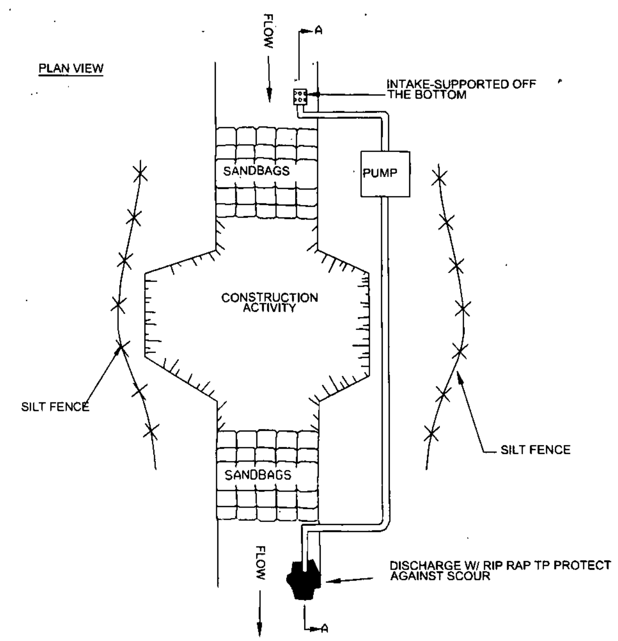


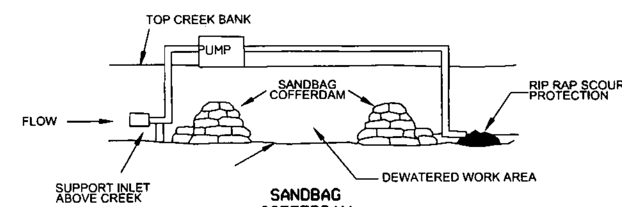
SECTION THROUGH CONTRACTION JOINT



TYPICAL JOINT LAYOUT FOR CONCRETE PAVEMENT

PUMP AROUND





SANDBAG COFFERDAM

SECTION A-A

PAVEMENT JOINT DETAILS ADAPTED FROM WEST VIRGINIA DOH STANDARD DRAWINGS AND STANDARD SPECIFICATIONS. SEE DOH DRAWINGS AND SPECIFICATIONS FOR FOR ADDITIONAL DETAILS.

All dowel bars shall have a Department approved coating and shall meet the requirements of Section 709.15 of the Specifications. Dowel bar uncoated diameter to be 1/8 of the pavement thickness with minimum diameter of 1 1/4" . Dowel bars to be 18" long and spaced on 1' c:c.

The units are to be shop assembled as to dowels, side frames, and center frames, and shipped nested.

The units are to be fabricated to fit the crown of the base course.

Wire used in the expansion and contraction joint load transfer units shall have a minimum ultimate tensile strength of 50,000 P.S.I..

The expansion joint load transfer unit detailed herein shall specially designated locations only.

Anchor pins are to be 1/2" round bars and 16" minimum length to hold the unit rigidly in place. A minimum of 8 pins per unit shall be used.

The units as detailed are shown as examples only. Initial approval of load transfer units shall be by submission of shop drawings. Approval will be valid until the standard drawing is revised or the supplier changes his design. All notes as shown above are to apply.

The Type H Joint is to be used for connecting portland cement concrete pavement to hot mix asphalt pavement. The standard coated dowel bars are to meet the applicable requirements of Standard Sheet PVT4.

Tie bolts shall meet the requirements of Section 709.7 of the Specifications.

Tie bolts shall be placed on 30" centers(max.)

Tie bolts shall be placed 15" from each end of form.

Metal channel shall run the full length of forms.

5/8" diameter tie bars; 30" long, placed longitudinally on 30" centers (max.), and centered across the joint or pavement edge; may be used in place of the Specifications.

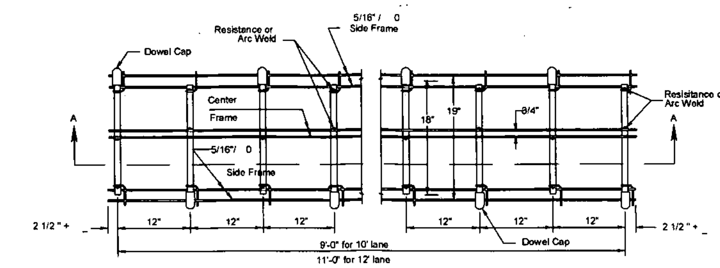
The longitudinal tie bolt assembly for slip-form paving shall consist of one sleeve nut, one 8" long hook bolt or J bolt, and 12" long alternate hook bolt. As an initial step in installing this assembly, the 12" long alternate hook bolt, with sleeve nut attached, shall be positioned in its proper location in the pavement by appropriate slip-form paving of the bolt assemblies.

Typical tie bolt assemblies are shown herein. Minor variations in details and dimensional tolerances are permitted; however, minimum values specified herein shall be complied with. All tie bars and J or Hook Bolt Assemblies shall be epoxy coated in accordance with section 709.1 of the Standard Specifications. equipment.

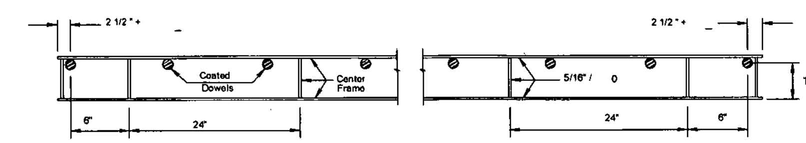
For additional details and requirements concerning dowel bars and dowel baskets for Type A & B Joints, see Standard Sheet PVT4.

Type D Longitudinal Joint may be used as an alternate to Type E Longitudinal Joint for lane-at-time construction . When so used, the construction joint between lanes shall be keyed as shown for Type E Joint. Type F joint is not intended, in lane-at-a-time construction, as an alternate to Type D or E Longitudinal Joints between main-line pavement slabs. For additional details and requirements concerning Types D and E Joints and the keyway for Type F Joint, see Standard Sheet PVT3, Longitudinal Tie Bolt Assembly.

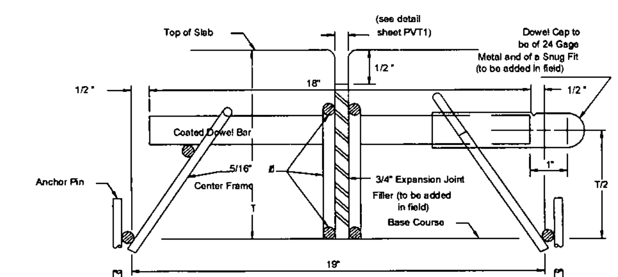
The shape shown for preformed elastomeric seals must conform to the requirements of 708.2 of the Specifications, in addition to the 1-1/4" (normal) width requirement, to be acceptable.



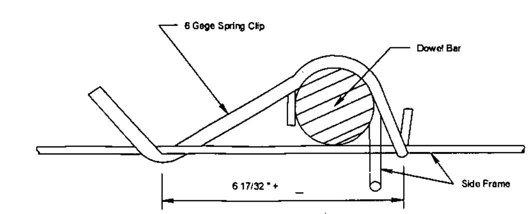
PLAN OF DOWEL UNIT FOR EXPANSION JOINT
(JOINT FILLER NOT SHOWN)



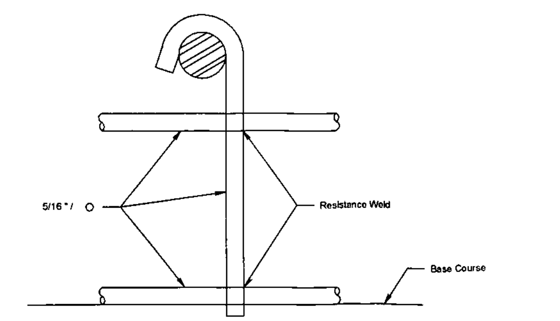
SECTION A-A



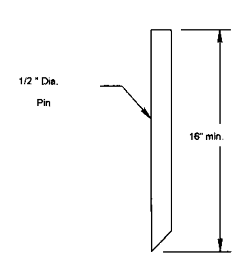
SECTION THROUGH EXPANSION JOINT



DOWEL KEEPER CLIP
(4 TO EACH CONTRACTION JOINT ASSEMBLY)



SIDE FRAME DETAIL



ANCHOR PIN

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ENGINEERS
ENVIRONMENTAL
HONESTY, INTEGRITY, QUALITY

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No. 15628
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PROFESSIONAL ENGINEER
10/7/2015

THIS DOCUMENT WAS PREPARED BY: SMITH LAND SURVEYING, INC. FOR: EQT

CONSTRUCTION DETAILS

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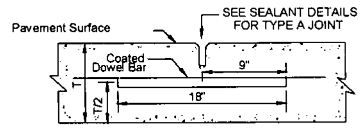
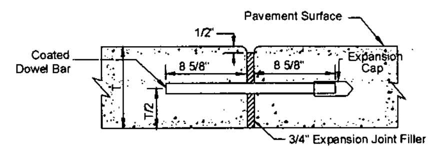
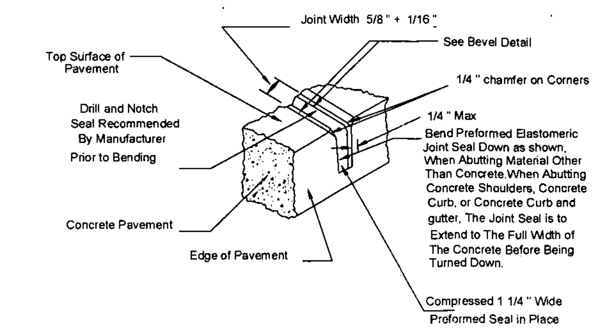


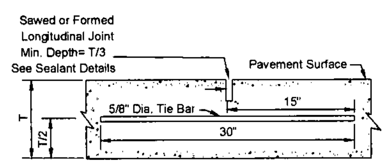
CONTRACTION OR CONSTRUCTION JOINT
TYPE A



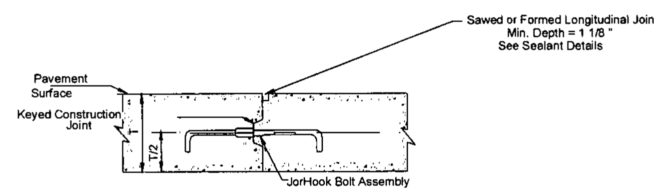
EXPANSION JOINT
TYPE B



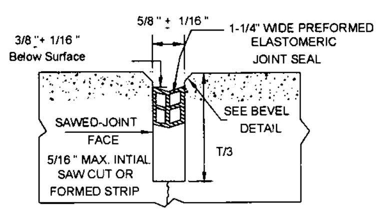
PAVEMENT EDGE TREATMENT FOR TRANSVERSE CONTRACTION
OR CONSTRUCTION JOINT (TYPE A) WHEN USING PREFORMED SEALS



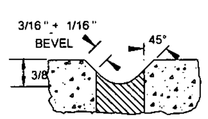
LONGITUDINAL JOINT
(Full-Width Construction)
TYPE D



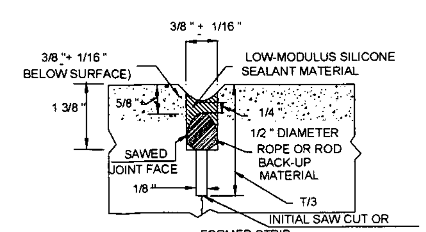
LONGITUDINAL JOINT
(Lane-At-A-Time Construction)
TYPE E



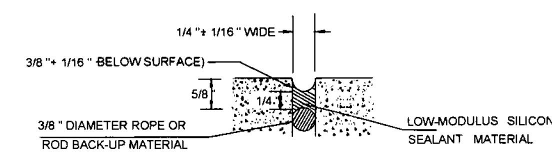
PREFORMED SEAL



BEVEL DETAIL



LOW-MODULUS SILICONE SEALANT



SEALANT DETAILS FOR LONGITUDINAL JOINT
TYPE D,E,F

SEALANT DETAILS FOR CONTRACTION OR CONSTRUCTION JOINT (TYPE A JOINT)

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