

**Doddridge County Sheriff  
Flood Plain Ordinance Fund**

**1066**  
69-217/515

DATE November 5, 2013

PAY TO THE ORDER OF THE HERALD RECORD \$ 108.70

One Hundred Eight dollars and 70/100-----DOLLARS



MEMO #: 2841-2842-2856-2857-2858

*Ralph Davidson*  
*Beth A. Rogers*  
*M. C. [Signature]* Sheriff

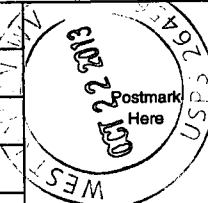
⑈00 1066⑈ ⑆05 150 21 75⑆ 11 9649 9⑈

BLUE TRADITIONAL

U.S. Postal Service™  
**CERTIFIED MAIL™ RECEIPT**  
(Domestic Mail Only, No Insurance Coverage Provided)

For delivery information visit our website at [www.usps.com](http://www.usps.com)  
**OFFICIAL USE**

Postage	\$ .46
Certified Fee	3.10
Return Receipt Fee (Endorsement Required)	2.55
Restricted Delivery Fee (Endorsement Required)	
<b>Total Postage &amp; Fees</b>	<b>\$ 6.11</b>



#13-079

Sent To Michael D. Travis  
Street, Apt. No.; or PO Box No. HC 68 Box 25  
City, State, ZIP+4 West Union, WV 26456  
PS Form 3800, August 2006 See Reverse for Instructions

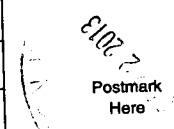
7011 0470 0000 8523 2662

# 13-078  
# 13-077  
# 13-083  
# 13-079  
# 13-082

U.S. Postal Service™  
**CERTIFIED MAIL™ RECEIPT**  
(Domestic Mail Only, No Insurance Coverage Provided)

For delivery information visit our website at [www.usps.com](http://www.usps.com)  
**OFFICIAL USE**

Postage	\$ .46
Certified Fee	3.10
Return Receipt Fee (Endorsement Required)	2.55
Restricted Delivery Fee (Endorsement Required)	
<b>Total Postage &amp; Fees</b>	<b>\$ 6.11</b>



#13-079

Sent To Dodd Co. Board of Ed.  
Street, Apt. No.; or PO Box No. 103 Sistersville Pike  
City, State, ZIP+4 West Union, WV 26456  
PS Form 3800, August 2006 See Reverse for Instructions

7011 0470 0000 8523 2666

**SENDER: COMPLETE THIS SECTION**

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

1. Article Addressed to:

13-079

Dodd Co Board of Ed.  
103 Sistersville Pike  
West Union, WV 26456

2. Article Number

(Transfer from service label)

7011 0470 0000 8523 2686

**COMPLETE THIS SECTION ON DELIVERY**

A. Signature

X Carol Taylor

 Agent Addressee

B. Received by (Printed Name)

Carol Taylor

C. Date of Delivery

10-22-73

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

3. Service Type

 Certified Mail Express Mail Registered Return Receipt for Merchandise Insured Mail C.O.D.

4. Restricted Delivery? (Extra Fee)

 Yes

UNITED STATES POSTAL SERVICE



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

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

**FILED**

**2013 OCT 23 AM 10:57**

**BETH A. ROGERS  
COUNTY CLERK  
DODDRIDGE COUNTY, WV**

BETH A. ROGER  
DODDRIDGE CO. CLERK  
118 EAST COURT ST.  
ROOM 102  
WEST UNION, WV 26456



**SENDER: COMPLETE THIS SECTION**

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

1. Article Addressed to:

13-079

Michael D. Travis  
 HC 68 Box 25  
 West Union, WV 26456

2. Article Number

(Transfer from service label)

7011 0470 0000 8523 2662

**COMPLETE THIS SECTION ON DELIVERY**

A. Signature

X


 Agent Addressee

B. Received by (Printed Name)



C. Date of Delivery

10-23-13

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

3. Service Type

 Certified Mail Express Mail Registered Return Receipt for Merchandise Insured Mail C.O.D.

4. Restricted Delivery? (Extra Fee)

 Yes



UNITED STATES POSTAL SERVICE



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

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

BETH A. ROGER  
DODDRIDGE CO. CLERK  
118 EAST COURT ST.  
ROOM 102  
WEST UNION, WV 26456

2013 OCT 24 PM 12:03  
BETH A. ROGERS  
COUNTY CLERK  
DODDRIDGE COUNTY, WV

FILED

6456129799





**ANTERO RESOURCES CORPORATION**  
 1625 17th STREET, SUITE 300  
 DENVER, COLORADO 80202

Vendor Name	Vendor No.	Date	Check Number	Check Total
DODDRIDGE COUNTY COMMISSION	43312	Oct-11-2013	40142	\$689.09

VOUCHER	VENDOR INV #	INV DATE	TOTAL AMOUNT	PRIOR PMTS & DISCOUNTS	NET AMOUNT
10-AP-7639	WILLARDPAD	10/11/13	689.09	0.00	689.09
Willard Pad Flood Plain Permit					
TOTAL INVOICES PAID					689.09

**FILED**  
 2013 OCT 15 PM 2:58  
 BETH A. ROGERS  
 COUNTY CLERK  
 DODDRIDGE COUNTY, WV

# 13-079

DETACH AND RETAIN FOR TAX PURPOSES

By: BH - MEH - AML  
 Asst. Chief Tax Deputy

W. C .Underwood Jr.  
 Sheriff of Doddridge County

The Person paying Money into the Treasury shall forthwith file one of these Receipts with the County Clerk

**Doddridge County, West Virginia**

No. 717

Date: October 21, 2013  
 \*\*\*Customer copy\*\*\*

Received: #13-079 ANTERO (WILLARD PAD) \$689.09

In Payment For: 318 Building Permits (LP)

For: 12-Flood Plain Ordinance #20 Fund

By: BH - MEH - AML  
 Asst. Chief Tax Deputy

W. C .Underwood Jr.  
 Sheriff of Doddridge County

REVISED

Doddridge County Flood Plain Application Fee Calculator (if in Flood Plain)	
Willard Pad	
Estimated Construction Costs	\$37,818.63
Amount over \$100,000	-\$62,181.37
Drilling Oil and Gas Well Fee	\$1,000.00
Deposit for additional charges	\$1,000.00
\$5 per \$1,000 over \$100,000	-\$310.91
Amount Due with application	\$689.09

FILED

2013 OCT 15 PM 2:58

BETH A. ROGERS  
COUNTY CLERK  
DODDRIDGE COUNTY, WY

**Doddridge County Flood Plain Application Fee Calculator (if in Flood Plain)**

**Willard Pad**

Estimated Construction Costs	\$37,818.63
Amount over \$100,000	-\$62,181.37
Drilling Oil and Gas Well Fee	\$1,000.00
Deposit for additional charges	\$1,000.00
\$5 per \$1,000 over \$100,000	-\$310.91
Amount Due with application	\$1,689.09

che fr  
\$ 500.00

---

Legal Advertisement:  
Doddridge County  
Floodplain Permit Application

Please take notice that on the 21<sup>st</sup> day of October, 2013

**ANTERO RESOURCES APPALACHIAN CORPORATION –**  
**WILLARD PAD -13-079**

filed an

application for a Floodplain Permit to develop land located at or  
about: **SURFACE OWNERS: MICHAEL D. TRAVIS AND DODDRIDGE**  
**CO. BOARD OF EDUCATION.**

**NEW MILTON DISTRICT, D/B: 196/715, & 275/077, T/M: 4-10,4-29**

The Application is on file with the Clerk of the County Court and  
may be inspected or copied during regular business hours.

Any interested persons who desire to comment shall present  
the same in writing by **November 9<sup>th</sup>, 2013.**

Delivered to the:  
Clerk of the County Court  
118 E. Court Street, West Union, WV 26456.

Beth A Rogers, Doddridge County Clerk  
Dan Wellings, Doddridge County Flood Plain Manager

TRANSACTION REPORT

P. 01

OCT-21-2013 MON 12:09 PM

FOR: DODDRIDGE CO. CLERK

304 873 1840

SEND

DATE	START	RECEIVER	TX TIME	PAGES	TYPE	NOTE	M#	DP
OCT-21	12:09 PM	93048731600	25"	1	FAX TX	OK	671	

TOTAL : 25S PAGES: 1

Legal Advertisement:

Doddridge County  
Floodplain Permit Application

Please take notice that on the 21<sup>st</sup> day of October, 2013

**ANTERO RESOURCES APPALACHIAN CORPORATION -  
WILLARD PAD**

filed an

application for a Floodplain Permit to develop land located at or  
about: **SURFACE OWNERS: MICHAEL D. TRAVIS AND DODDRIDGE  
CO. BOARD OF EDUCATION.**

**NEW MILTON DISTRICT, D/B: 196/715, & 275/077, T/M: 4-10,4-29**

The Application is on file with the Clerk of the County Court and  
may be inspected or copied during regular business hours.

Any interested persons who desire to comment shall present  
the same in writing by **November 9<sup>th</sup>, 2013.**

Delivered to the:

Clerk of the County Court  
118 E. Court Street, West Union, WV 26456.

Beth A Rogers, Doddridge County Clerk  
Dan Wellings, Doddridge County Flood Plain Manager

FILED

2013 OCT 15 PM 2: 58

BETH A. ROGERS  
COUNTY CLERK  
DODDRIDGE COUNTY, WV



Antero Resources  
1625 17th Street  
Denver, Colorado 80202  
Office 303.357.7310  
Fax 303.357.7315

October 11, 2013

Doddridge County Commission  
Attn: Dan Wellings, Doddridge County Floodplain Manager  
118 East Court Street, Room 102  
West Union, WV 26456

Mr. Wellings:

Please find enclosed two revised checks to correspond with the Doddridge County Floodplain permits submitted for the Willard Pad and the Canton Loop Waterline. Per your phone message on October 10, 2013, these checks are being re-submitted for the revised amounts to no longer include \$1,000 for additional charges. We have enclosed the revised application fee calculators for your reference.

The self-addressed and stamped envelope can be used to send us the previously submitted checks.

If you have any questions please feel free to contact me at (303) 357-6820.

Sincerely,



Shauna Redican  
Permit Representative  
Antero Resources Corporation

Enclosures

PERMIT NO. 13-079

**DODDRIDGE COUNTY**  
**FLOODPLAIN DEVELOPMENT**  
**PERMIT**

PURPOSE FOR PERMIT: Well Access Road  
Willard Pad

ISSUED TO ANTERO RESOURCES  
Denver Co.

ADDRESS: MEATHOUSE FORK  
NEAR SUGAR CAMP RUN

PROJECT ADDRESS: ↓

ISSUED BY: Dan Wellens

DATE: 4/13/2013

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.





Antero Resources  
1625 17th Street  
Denver, Colorado 80202  
Office 303.357.7310  
Fax 303.357.7315

October 2, 2013

Doddridge County Commission  
Attn: Dan Wellings, Doddridge County Floodplain Manager  
118 East Court Street, Room 102  
West Union, WV 26456

Mr. Wellings:

Antero Resources Corporation (Antero) would like to submit a Doddridge County Floodplain permit application for our Willard Drill Pad. Our project is located in Doddridge County, New Milton District. Per HEC-RAS study prepared by Navitus Engineering, on September 16th, 2013, and FEMA Map 54017C0230C and 54017C0140C, there will be minimal changes in the 100 year base flood elevation and no adverse impacts to upstream and downstream properties along Meathouse Fork.

Attached you will find the following:

- Doddridge County Floodplain Permit Application and Permit Fee
- HEC-RAS Floodplain Study
- A detailed set of plans signed by a WV licensed professional engineer
- Adjacent Surface Owner Data

If you have any questions please feel free to contact me at (303) 357-6820. Thank you in advance for your consideration.

Sincerely,

Shauna Redican  
Permit Representative  
Antero Resources Corporation

Enclosures

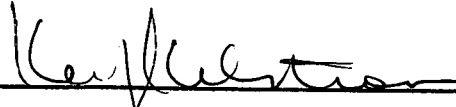
2013 OCT -3 PM 4:50

# 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 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.**

2013 OCT -3 PM 4:50

APPLICANT'S SIGNATURE 

DATE October 2, 2013

## 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: Antero Resources Corporation - Kevin Kilstrom-VP of Production

ADDRESS: 1625 17th Street, Denver, CO 80202

TELEPHONE NUMBER: Contact Shauna Redican: 303-357-6820

**BUILDER'S NAME:** Antero Resources Corporation  
**ADDRESS:** 1625 17th Street, Denver, CO 80202  
**TELEPHONE NUMBER:** (303) 357-7310

**ENGINEER'S NAME:** Navitus Engineering Inc - Cyrus Kump  
**ADDRESS:** 151 Windy Hill Lane, Winchester, Virginia 22602  
**TELEPHONE NUMBER:** 888-662-4185

**PROJECT LOCATION:**

**NAME OF SURFACE OWNER/OWNERS (IF NOT THE APPLICANT)** \_\_\_\_\_  
Please see attached Firm Map with Landowner Tabulation

**ADDRESS OF SURFACE OWNER/OWNERS (IF NOT THE APPLICANT)** \_\_\_\_\_  
Please see attached Firm Map with Landowner Tabulation

**DISTRICT:** New Milton

**DATE/FROM WHOM PROPERTY PURCHASED:** N/A

**LAND BOOK DESCRIPTION:** \_\_\_\_\_  
**DEED BOOK REFERENCE:** Please see attached Firm Map with Landowner Tabulation

**TAX MAP REFERENCE:** \_\_\_\_\_  
**EXISTING BUILDINGS/USES OF PROPERTY:** None

**NAME OF AT LEAST ONE ADULT RESIDING IN EACH RESIDENCE LOCATED UPON THE SUBJECT PROPERTY** \_\_\_\_\_

**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**

- |                                     |                         |                          |                                  |
|-------------------------------------|-------------------------|--------------------------|----------------------------------|
| <input checked="" type="checkbox"/> | New Structure           | <input type="checkbox"/> | Residential (1 – 4 Family)       |
| <input type="checkbox"/>            | Addition                | <input type="checkbox"/> | Residential (more than 4 Family) |
| <input type="checkbox"/>            | Alteration              | <input type="checkbox"/> | Non-residential (floodproofing)  |
| <input type="checkbox"/>            | Relocation              | <input type="checkbox"/> | Combined Use (res. & com.)       |
| <input type="checkbox"/>            | Demolition              | <input type="checkbox"/> | Replacement                      |
| <input type="checkbox"/>            | Manufactured/Mobil Home |                          |                                  |

**B. OTHER DEVELOPMENT ACTIVITIES:**

- Fill                       Mining                       Drilling                       Pipelining
- Grading
- Excavation (except for STRUCTURAL DEVELOPMENT checked above)
- Watercourse Altercation (including dredging and channel modification)
- Drainage Improvements (including culvert work)
- Road, Street, or Bridge Construction      \*Access Road Construction as shown on page 6-7
- Subdivision (including new expansion)      attached Willard Pad Design
- 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 \$ 37,818.63**

\*See attached Floodplain Calculation Fee

**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:** Please see attached Firm Map with  
**ADDRESS:** Landowner Tabulation

**NAME:** \_\_\_\_\_  
**ADDRESS:** \_\_\_\_\_

**NAME:** \_\_\_\_\_  
**ADDRESS:** \_\_\_\_\_

**NAME:** \_\_\_\_\_  
**ADDRESS:** \_\_\_\_\_

**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:** N/A  
**ADDRESS:** \_\_\_\_\_

**NAME:** \_\_\_\_\_  
**ADDRESS:** \_\_\_\_\_

**NAME:** \_\_\_\_\_  
**ADDRESS:** \_\_\_\_\_

**NAME:** \_\_\_\_\_  
**ADDRESS:** \_\_\_\_\_

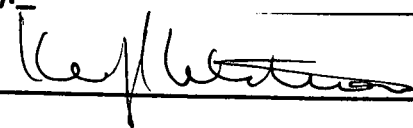
**E. CONFIRMATION FORM**

**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): Antero Resources Corporation - Kevin Kilstrom-VP of Production

SIGNATURE:  DATE: October 2, 2013

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: 140 + 230  
 Dated: 10/04/2011

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

Is located in Special Flood Hazard Area.  
 FIRM zone designation AE  
 100-Year flood elevation is: 825 NGVD ~~(MSE)~~

Unavailable

The proposed development is located in a floodway.  
 FBFM Panel No. \_\_\_\_\_ Dated \_\_\_\_\_

See section 4 for additional instructions.

SIGNED 1 Dan Willey

DATE 11/13/13

**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: 12/05/13 BY: Don Willard  
DEFICIENCIES? Y/N

COMMENTS Access road to Willard pad  
has not started.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**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** \_\_\_\_\_

ANTERO RESOURCES CORPORATION

SCHEDULE OF QUANTITIES

CLEARING & GRUBBING; EROSION & SEDIMENT CONTROLS	WILLARD WELL PAD & WATER CONTAINMENT PAD			
	QUANTITY	UNIT	UNIT PRICE	FINAL PRICE
MOBILIZATION	1.0	EA	\$17,510.00	\$17,510.00
CONSTRUCTION ENTRANCE	1.0	EA	\$2,517.00	\$2,517.00
CLEARING & GRUBBING (TREE REMOVAL 22.43 ACRES)	1.20	AC	\$3,821.00	\$4,585.20
JUTE MATTING - SLOPE MATTING	458.0	SY	\$2.10	\$961.80
12" COMPOST FILTER SOCK	0.0	LF	\$3.80	\$0.00
18" COMPOST FILTER SOCK	0.0	LF	\$7.90	\$0.00
24" COMPOST FILTER SOCK	0.0	LF	\$9.40	\$0.00
32" COMPOST FILTER SOCK	0.0	LF		\$0.00
SUPER SILT FENCE	399.0	LF	\$8.60	\$3,431.40
<b>TOTAL</b>				<b>\$29,005.40</b>
<b>SITE - UNCLASSIFIED EXCAVATION</b>				
	QUANTITY	UNIT	UNIT PRICE	FINAL PRICE
WELL PAD	0.0	CY	\$3.80	\$0.00
ACCESS ROADS	54.0	CY	\$4.00	\$216.00
WATER CONTAINMENT PAD	0.0	CY	\$4.10	\$0.00
STAGING AREA	3.1	CY	\$7.00	\$21.70
EXCESS MATERIAL STOCKPILES	0.0	CY	\$3.90	\$0.00
TOPSOIL STOCKPILES	0.0	CY	\$3.90	\$0.00
<b>TOTAL</b>				<b>\$237.70</b>
<b>SUMP(S) PER ANTERO RESOURCES STANDARD DETAIL</b>				
	QUANTITY	UNIT	UNIT PRICE	FINAL PRICE
INSTALL 102" x 78" x 44" PRE CAST SUMP	0.0	EA		\$0.00
4" PVC CONNECTIVE PIPE (ANTERO SUMP DRAIN DETAIL)	0.0	LF		\$0.00
<b>TOTAL</b>				<b>\$0.00</b>
<b>AGGREGATE SURFACING - SPREADING, COMPACTION, and/or INSTALLATION</b>				
	QUANTITY	UNIT	UNIT PRICE	FINAL PRICE
WELL PAD 6" OR 4" MINUS CRUSHER RUN AGGREGATE (6" THICK)	0.0	TON	\$2.62	\$0.00
WELL PAD 1 1/2" OR 3/4" CRUSHER RUN STONE (2" THICK)	0.0	TON	\$2.90	\$0.00
WELL PAD GEOTEXTILE FABRIC (US 200)	0.0	SY	\$0.80	\$0.00
ACCESS ROADS 6" OR 4" MINUS CRUSHER RUN AGGREGATE (8" THICK)	273.1	TON	\$2.80	\$764.68
ACCESS ROADS 1 1/2" OR 3/4" CRUSHER RUN STONE (2" THICK)	68.4	TON	\$2.90	\$198.36
ACCESS ROADS GEOTEXTILE FABRIC (US 200)	1,228.5	SY	\$0.70	\$859.95
*INSTALL TENSAR TX190 GEOGRID or EQUIVALENT		SY	\$1.90	\$0.00
WATER CONTAINMENT PAD 6" OR 4" MINUS CRUSHER RUN AGGREGATE (8" THICK)	0.0	TON	\$2.60	\$0.00
WATER CONTAINMENT PAD 1 1/2" OR 3/4" CRUSHER RUN AGGREGATE (2" THICK)	0.0	TON	\$2.60	\$0.00
WATER CONTAINMENT PAD GEOTEXTILE FABRIC (US 200)	0.0	SY	\$0.70	\$0.00
*INSTALL TENSAR TX190 GEOGRID or EQUIVALENT		SY	\$2.10	\$0.00
STAGING AREA 6" OR 4" MINUS CRUSHER RUN AGGREGATE (8" THICK)	391.3	TON	\$3.80	\$1,486.94
STAGING AREA 1/2" OR 3/4" CRUSHER RUN AGGREGATE (2" THICK)	98.0	TON	\$3.80	\$372.40
STAGING AREA GEOTEXTILE FABRIC (US 200)	1,760.2	SY	\$0.70	\$1,232.14
*INSTALL TENSAR TX190 GEOGRID or EQUIVALENT		SY	\$1.50	\$0.00
<b>TOTAL</b>				<b>\$4,914.47</b>

**ANTERO RESOURCES CORPORATION**

**SCHEDULE OF QUANTITIES**

<b>ROAD CULVERTS</b>				
	<b>QUANTITY</b>	<b>UNIT</b>	<b>UNIT PRICE</b>	<b>FINAL PRICE</b>
15" HDPE	43.0	LF	\$20.10	\$864.30
R4 RIP RAP (INLETS/OUTLETS)	9.0	TON	\$29.00	\$261.00
AASHTO #1 STONE (DITCH CHECKS)	1.0	TON	\$51.80	\$51.80
DITCH LINING - (ACCESS ROAD) SYNTHETIC MATTING (TRM)	115.0	SY	\$3.80	\$437.00
DITCH LINING - (ACCESS ROAD) ROCK-LINED DITCH (R4)	27.5	TON	\$16.80	\$462.00
<b>TOTAL</b>				<b>\$2,076.10</b>
<b>SEEDING</b>				
	<b>QUANTITY</b>	<b>UNIT</b>	<b>UNIT PRICE</b>	<b>FINAL PRICE</b>
SITE SEEDING (LIME, FERTILIZER, SEEDING, AND HYDRO-MULCH w/TACK (HYC-2 OR EQUAL))	0.5	AC	\$3,302.00	\$1,584.96
<b>TOTAL</b>				<b>\$1,584.96</b>
<b>LINER SYSTEM</b>				
	<b>QUANTITY</b>	<b>UNIT</b>	<b>QUANTITY</b>	<b>UNIT</b>
60 MIL TEXTURED PRIMARY LINER	0.0	SY		\$0.00
16 OZ. NON-WOVEN GEOTEXTILE FABRIC CUSHION	0.0	SY		\$0.00
<b>TOTAL</b>				<b>\$0.00</b>
<b>NOTE: THE SQUARE YARDAGE FOR THE LINER SYSTEM DOES NOT ACCOUNT FOR MATERIAL OVERLAP AND WASTE.</b>				
<b>UNFORESEEN SITE CONDITIONS</b>				
	<b>QUANTITY</b>	<b>UNIT</b>	<b>UNIT PRICE</b>	<b>FINAL PRICE</b>
*FRENCH DRAINS		FT		\$0.00
*PHASE 1 FENCING - STEEL CORRUGATED PANELS w/"T" POST (10 FT CENTERS) - WETLAND PROTECTION		LF		\$0.00
*PHASE 2 FENCING - SILT FENCE AND OR FILTER SOCK OUTSIDE OF PHASE 3 FENCING - WETLAND PROTECTION		LF		\$0.00
*PHASE 3 FENCING - ORANGE SAFETY FENCE w/"T" POST (10FT CENTERS) - WETLAND PROTECTION		LF		\$0.00
*SILT FENCE		LF		\$0.00
*TEMPORARY SEEDING		AC		\$0.00
*CONSTRUCTION STAKEOUT		HOUR		\$0.00
* 4 FT FARM FENCE ( WOOD CORNER AND PULL POST & "T" POST - 10 FT SPACING)		LF		\$0.00
* 5 STRAND BARB WIRE FENCE ( WOOD CORNER AND PULL POST & "T" POST - 10 FT SPACING)		LF		\$0.00
<b>TOTAL</b>				<b>\$0.00</b>

<b>GRAND TOTAL</b>	<b>\$37,818.63</b>
--------------------	--------------------

**ANTERO RESOURCES WILL PROVIDE THE FOLLOWING:**

- 102" x 78" x 44" PRE CAST SUMP
- VALVE FOR SUMP DISCHARGE
- TX 190 GEOGRID OR EQUIVALENT
- GEOTEXTILE FABRIC (US 200) OR EQUIVALENT
- ALL HDPE CULVERT PIPE
- ALL AGGREGATE

Antero

13 - 079



Proposed well access road  
to Willard pad.

12/05/2013

Rt. 18 south near old Middle Island Grade  
School.  
Meathouse Fork near mouth of Sugar Camp.



**NAVITUS**  
ENGINEERING INC.

151 Windy Hill Lane  
Winchester, Virginia 22602  
Telephone: (888) 662-4185

September 16, 2013

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

Attn: Dan Wellings, Doddridge County Floodplain Administrator

Re: Willard Well Pad - Floodplain Analysis

Dear Mr. Wellings:

Navitus Engineering has completed a floodplain analysis for the access road entrance to the Willard Well Pad along County Route 18, north of New Milton, in Doddridge County, West Virginia. The entrance to the proposed site is located within FEMA Flood Zone AE, as shown on the Flood Insurance Rate Maps (FIRM) from the National Flood Insurance Program (NFIP), Map Number 54017C0140C and 54017C0230C dated October 4, 2011. Being that the site entrance is located in a Flood Zone AE, base flood elevations for this area have been established, and detailed information for Meathouse Fork is found within the Flood Insurance Study for Doddridge County, dated October 4, 2011.

A hydrologic and hydraulic analysis was performed as outlined in the current Doddridge County Floodplain Ordinance, enacted May 21st, 2013. Using field shot data, 10-foot interval topography converted from 3 meter West Virginia GIS Technical Center DEM data, and information taken from USGS 7.5 Minute Series Topographic Maps, a drainage analysis was performed for the Meathouse Fork drainage shed. Calculated peak flows for the 100-year storm event were checked for accuracy with the Flood Insurance Study. A HEC-RAS river analysis was conducted for a section of Meathouse Fork adjacent to the Willard Well Pad site entrance area and Base Flood Elevations (BFE) were established. The established BFEs were compared to those found in the Flood Insurance Study as shown on the Summary of Computed Elevations found in the attached report. The established BFEs were generally less than the FIS elevations. With cross sections built from two foot interval aerial topography, the stream channel slope is generally flatter than the profile 54017-17 (17P Meathouse Fork) from the FIS. The elevations of the existing stream channel for the analysis are also generally lower than those shown in the FIS. The resulting BFEs were used to establish adjusted floodplain boundaries for the segment of Meathouse Fork being studied. These boundaries are shown on the attached Floodplain Exhibit of this development site.

A proposed conditions analysis was performed to determine the impacts of the proposed access road and staging area within the floodplain. The proposed grading was added into the cross sections and the manning's "n" values were adjusted. The results of this analysis indicate that the proposed development will cause a maximum increase of 0.1' in the BFEs along Meathouse Fork immediately upstream of the development area. The maximum increase in the BFE occurs at River Stations 27+17.603. The cross section at River Station 17+17.603 has an existing BFE of 824.4 and a proposed BFE of 824.5. The Willard Well Pad Site Plan (attached) contains a FEMA FIRM Map exhibit showing the proposed site overlaid on the FIRM Map. This map contains approximate property lines and owner information.

Engineering Dedicated to the Development and Transmission of Energy

**Serving PA-WV-OH-NY**


Engineering Surveying Environmental GIS  
www.navituseng.com

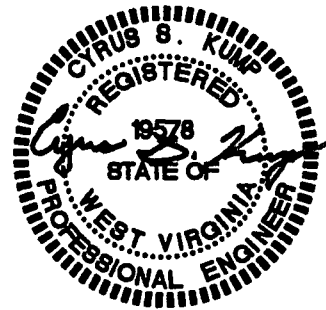
Attached are the following documents associated with this submission:

- A Floodplain Analysis of Meathouse Fork documenting the methods used for the analysis, drainage computations, cross sections, and a narrative to describe the analysis. Included with this analysis are exhibits that identify the existing and proposed 100-year floodplain.
- The Willard Well Pad Site Plan, prepared by Navitus Engineering, Inc. which includes additional site design and construction specifications.
- Floodplain Permit Application Fee
- Doddridge County Improvement Location Permit Application

Should any questions or comments arise during the review, please let us know and we will work to address them. Please let me know if you should need additional information. You can reach me by phone (540) 336-9486 or email: [dmurphy@navituseng.com](mailto:dmurphy@navituseng.com).

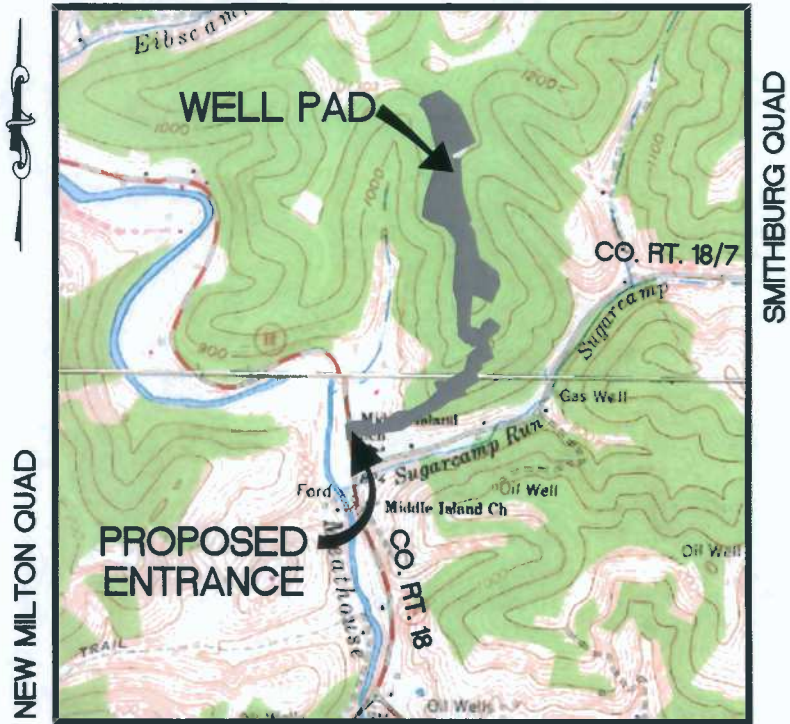
Sincerely,  
Navitus Engineering, Inc.

  
\_\_\_\_\_, CFM  
Daniel E. Murphy, CFM  
#US-13-07064  
Certified Floodplain Manager (CFM®)





FLOODPLAIN ANALYSIS OF  
MEATHOUSE FORK  
WILLARD  
WELL PAD



VICINITY MAP

1" = 2,000'



Prepared For:

Engineering    Survey    Environmental    GIS



981 East Washington Avenue  
Ellenboro, WV 26346  
(304) 869-3405

Contacts:  
Aaron Kunzler, Construction Supervisor  
(405) 227-8344  
Anthony Smith, Field Engineer  
(304) 673-6196  
Mark Hutson, Land Agent  
(304) 669-8315  
Chris Brown, Water Resources  
(304) 877-8233



Designed By:  
Navitus Engineering Inc.

Project Manager:  
Dan Murphy, CFM  
dmurphy@navituseng.com

Surface Owner (s)  
Michael D. Travis  
D.K. & Janet Kelley  
Roy K. & Creola M. Nicholson

Tax Parcel:  
Map 4 Parcel 10, 31 & 32

Location:  
New Milton District, Doddridge County  
West Virginia

Date: September 16, 2013

**FN# ANT044**



## 1. Objective

The objective of this floodplain analysis was to establish boundaries for the existing and proposed conditions of the 100 year base flood elevations (BFE). The proposed condition includes the installation of an access road for a well pad, where the entrance off of County Route 18 and the site staging area is within the FEMA floodplain.

## 2. Existing Conditions

### 2.1. Property Description

This site is located in Doddridge County, West Virginia along Meathouse Fork and County Route 18 north of New Milton. The proposed access road entrance is located on the east side of County Route 18.

### 2.2. Floodplain Delineation

The approximate limit of the 100-year floodplain (a flood event that has a 1% chance of being equaled or exceeded in any given year) is shown on FEMA Flood Insurance Rate Map (FIRM) for Doddridge County on panels 54017C0230C and 54017C0140C effective October 4, 2011. This floodplain is located in flood zone designation "AE" as shown on the FIRM, and there has been a detailed study analysis with whole foot base flood elevations established within the Doddridge County Flood Insurance Study (FIS) effective October 4, 2011.

### 2.3. Floodplain Ordinance

This site is administered under the Doddridge County Floodplain Ordinance. Per Section 4.3 of the ordinance, when a site is located in FEMA Flood Zone designation "AE" no new construction or development shall be allowed unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the elevation of the 100-year flood more than one (1) foot at any point.

Per Section 5.1 of this ordinance, permits are required for the construction of the entrance to the well pad site. The format of the permit will coincide with the requirements set forth in Section 5.2 of the ordinance.

Per Section 6.1.E of this ordinance, any fill outside of the main floodway associated with the project shall be only used in manner which does not adversely affect upstream and downstream properties. The access road entrance and staging area has been designed with this in mind. The proposed access road accesses County Route 18 with a minimal slope to reduce fill across the floodplain area on the east side of County Route 18. The staging area was placed primarily at grade with negligible fill. Impacts to the 100 year are demonstrated later in this report, however, the entrance road and staging area are located within mapped 100 year Base Flood Elevations and cause a max increase in Base Flood Elevations of 0.1' immediately upstream of the proposed development.

Per Section 6.1.E.6-9 of this ordinance, all fill within the floodplain shall consist of clean rock fill made of 2-4" aggregate and stabilized with raked concrete to minimize erosion during storm events. All designed slopes are no steeper than one (1) vertical on two (2) horizontal and all fill material shall be compacted to provide the necessary stability and resistance to erosion, scouring, or setting.

Per Section 6.1.I.1 of this ordinance, no materials that are buoyant, flammable, explosive, or in times of flooding shall be injurious to human, animal or plant life, shall be stored below Base Flood Elevation except for mineral storage properly and wholly within the ground in compliance with other State environmental agency(ies) requirements.

Per Section 6.1.I.2 of this ordinance, storage of other material or equipment may be allowed if not subject to substantial damage by floods and firmly anchored to prevent flotation or readily removable from the area within the time available after flood warning.

Per Section 6.1.K of this ordinance, culverts have been proposed in low lying areas at the entrance to allow adequate drainage through the drainage shed.

All other specific requirements covered in Section 6.1 of this ordinance are not applicable to this design. (Sections 6.1.A, 6.1.B, 6.1.C, 6.1.D, 6.1.G, 6.1.H, 6.1.J, and 6.1.L)

The developer shall conform with all administrative procedures as outline in Article 7 of this ordinance.

#### *2.4. Meathouse Fork Characteristics*

Meathouse Fork is located in several districts of Doddridge County and flows in a northwesterly direction. The drainage area flowing to Meathouse Fork at the access road entrance location is approximately 33,590 acres of forested and agricultural land with an average basin slope of 37.45%.

### **3. Analysis Information**

#### *3.1. HEC-RAS*

A HEC-RAS hydraulic analysis was performed for the portion of the Meathouse Fork that has an impact on the BFE's across the property. HEC-RAS is designed to perform one-dimensional hydraulic calculations for a full network of natural and constructed channels. The steady flow system is designed for applications in floodplain management and flood insurance studies.

#### *3.2. Analysis Limits*

The analysis information is based upon two foot interval aerial topography by Blue Mountain Aerial Mapping. The upstream analysis limit for Meathouse Fork is located approximately

1,378 feet upstream from the proposed entrance location and represents the 31+89.903 section. The downstream analysis limit for Meathouse Fork is located approximately 812 feet downstream of the proposed entrance location and represents the 10+00.000 section. These limits were selected so that the HEC-RAS model would accurately determine the base flood elevations on site and off site.

3.3. Flow Data

The hydrologic analysis utilized USDA soil surveys for computation of drainage shed curve numbers, aerial topography, and 3 meter West Virginia GIS Technical Center DEM to determine the drainage area(s) and time of concentration path(s). The peak 100-year discharge within the inundation area was determined through TR-55 SCS methodology. Time of concentration paths were calculated utilizing the SCS lag method. The hydrologic calculations for the drainage area were performed using HEC-HMS. See the table below for a summary of the flow conditions and see Supplement 1 for the complete Drainage Computations.

Stream	Drainage Area	Flow (cfs)	FIS Flow (cfs)	Note
Laurel / Big Issac	2,381 Ac.	2013.9	2,230	
Meathouse / Brushy	19,104 Ac.	6250.8	6,050	
Meathouse / Toms	32,551 Ac.	8252.1	8,200	
Sugarcamp Run	749 Ac.	782.5	N/A	
Meathouse Fork	33,722	8421.6	N/A	Area to Entrance

3.4. Cross Section Data

The cross sections were employed at significant changes in site features. This includes major bends in the stream channel, areas of major contraction and expansion of the floodplain area, upstream and downstream of existing culverts, and at building obstructions (cross sections were compiled using Aerial Mapping by Blue Mountain Aerial Mapping).

3.5. Manning's n-value

The channel and overbank areas were assigned manning's n-values based on photographs and close inspection of existing aerial photography. The chart below describes the manning's n values used in this study.

Manning's n value	Description	Portion Used
.035	Clean, straight, full, no rifts or deep pools, some stones and weeds	Main Channel
.013	Asphalt-smooth	Floodplains
.033	Gravel-dry rubble rip rap	Floodplains

.035	Pasture-high grass	Floodplains
.06	Light brush and trees-summer	Floodplains
.1	Heavy stand of timber, few down trees little undergrowth, flow below branches	Floodplains

#### 4. Results

##### 4.1. Existing Conditions

Since the site is in Zone "AE" floodplain area as shown on the FIRM, there has been a detailed study analysis with whole foot base flood elevations established within the Doddridge County Flood Insurance Study (FIS) effective October 4, 2011. An existing conditions model was prepared based upon aerial topography and existing drainage computations. This information was processed in HEC-RAS to determine the existing conditions of the Base Flood Elevations and then compared to the FIS study for accuracy. The FIS BFE of 824.0' was used as the downstream boundary condition for the analysis. The mapped elevations from the analysis are generally less than the FIS elevations. With cross sections built from two foot interval aerial topography, the stream channel slope is generally flatter than the profile 54017-17 (17P Meathouse Fork) from the FIS. The elevations of the existing stream channel for the analysis are also generally lower than those shown in the FIS.

##### 4.2. Proposed Conditions

The proposed conditions model was based on the proposed topography for the site access road and staging area. This information was added into the existing conditions cross sections, and then was processed in HEC-RAS to determine the proposed conditions of the Base Flood Elevations. A summary of elevation changes showing the existing and proposed BFEs at the various cross sections has been provided below. As shown in the table, the proposed development will not increase the existing BFEs more than 0.1' immediately upstream of the proposed staging area and entrance location.

13-079

**WILLARD WELL PAD ACCESS ROAD  
FLOODPLAIN STUDY  
SUMMARY OF COMPUTED ELEVATIONS**

CROSS SECTION STATION	RIVER NAME	100 YEAR BASE FLOOD ELEVATION			
		DODDRIDGE COUNTY FIS MODEL*	EXISTING CONDITIONS MODEL	PROPOSED CONDITIONS MODEL	PROPOSED DIFFERENCE
4692.485	MEATHOUSE FORK-UPPER	827.0		**	
3189.903	MEATHOUSE FORK-UPPER	826.1	824.8	824.8	0.0
2964.226	MEATHOUSE FORK-UPPER	826.0		**	
2919.274	MEATHOUSE FORK-UPPER	825.9	824.6	824.6	0.0
2762.352	MEATHOUSE FORK-UPPER	825.7	824.5	824.6	+ 0.1
2717.603	MEATHOUSE FORK-UPPER	825.6	824.4	824.4	0.0
2621.319	MEATHOUSE FORK-UPPER	825.5	824.4	824.5	+ 0.1
2580.999	MEATHOUSE FORK-UPPER	825.4	824.4	824.5	+ 0.1
2527.424	MEATHOUSE FORK-UPPER	825.3	824.5	824.5	0.0
1908.741	SUGARCAMP RUN	N/A	825.8	825.8	0.0
1702.205	SUGARCAMP RUN	N/A	824.6	824.7	+ 0.1
1374.631	SUGARCAMP RUN	N/A	824.7	824.7	0.0
1206.899	SUGARCAMP RUN	N/A	824.7	824.7	0.0
1158.997	SUGARCAMP RUN		CULVERT		
1115.181	SUGARCAMP RUN	N/A	824.7	824.7	0.0
2421.596	MEATHOUSE FORK-LOWER	825.2	824.6	824.6	0.0
2303.411	MEATHOUSE FORK-UPPER	825.0		**	
2236.871	MEATHOUSE FORK-LOWER	825.0	824.5	824.5	0.0
2005.226	MEATHOUSE FORK-LOWER	825.0	824.3	824.3	0.0
1852.485	MEATHOUSE FORK-LOWER	825.0	824.3	824.3	0.0
1812.068	MEATHOUSE FORK-LOWER	825.0	824.3	824.3	0.0
1786.606	MEATHOUSE FORK-LOWER	825.0	824.3	824.3	0.0
1752.54	MEATHOUSE FORK-LOWER	825.0		**	
1674.792	MEATHOUSE FORK-LOWER	824.9	824.3	824.3	0.0
1554.849	MEATHOUSE FORK-LOWER	824.8	824.3	824.3	0.0
1294.27	MEATHOUSE FORK-LOWER	824.5	824.2	824.2	0.0
1192.596	MEATHOUSE FORK-LOWER	824.4	824.2	824.2	0.0
1000	MEATHOUSE FORK-LOWER	824.1	824.1	824.1	0.0
879.3	MEATHOUSE FORK-LOWER	824.0		**	

\*\* STATIONS ARE INTERPOLATED FROM DODDRIDGE COUNTY FIS EFFECTIVE OCTOBER 4, 2011.

\* ELEVATIONS ARE INTERPOLATED FROM DODDRIDGE COUNTY FIS EFFECTIVE OCTOBER 4, 2011.

## **5. Conclusion**

The results of this floodplain analysis indicate that there will be minimal changes in the 100 year base flood elevation and no adverse impacts to upstream and downstream properties along Meathouse Fork. The largest increase in base flood elevation is 0.1' and is located immediately upstream of the site.

**APPENDIX**

Exhibit A	FIRM Panel 54017C0140C & 54017C0230C
Exhibit B	Overall Site Map
Exhibit C	Existing Conditions Plan
Exhibit D	Proposed Conditions Plan
Supplement 1	Drainage Computations
Supplement 2	HEC-RAS Analysis –Existing Conditions Summary w
Supplement 3	HEC-RAS Analysis –Proposed Conditions Summary w/ Cross Sections

**Exhibit A**

**FIRM Panel 54017C0140C & 54017C0230C**





JOINS PANEL 0230

1625000 FT

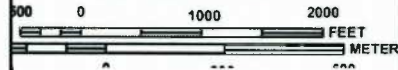
1630000 FT

39° 15' 00"  
80° 41' 15"

280000 FT



MAP SCALE 1" = 1000'



PANEL 0140C

**FIRM**

FLOOD INSURANCE RATE MAP  
DODDRIDGE COUNTY,  
WEST VIRGINIA  
AND INCORPORATED AREAS

PANEL 140 OF 325  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

COMMUNITY	NUMBER	PANEL	SUFFIX
DODDRIDGE COUNTY	140C	0140	C

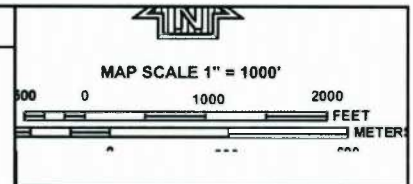
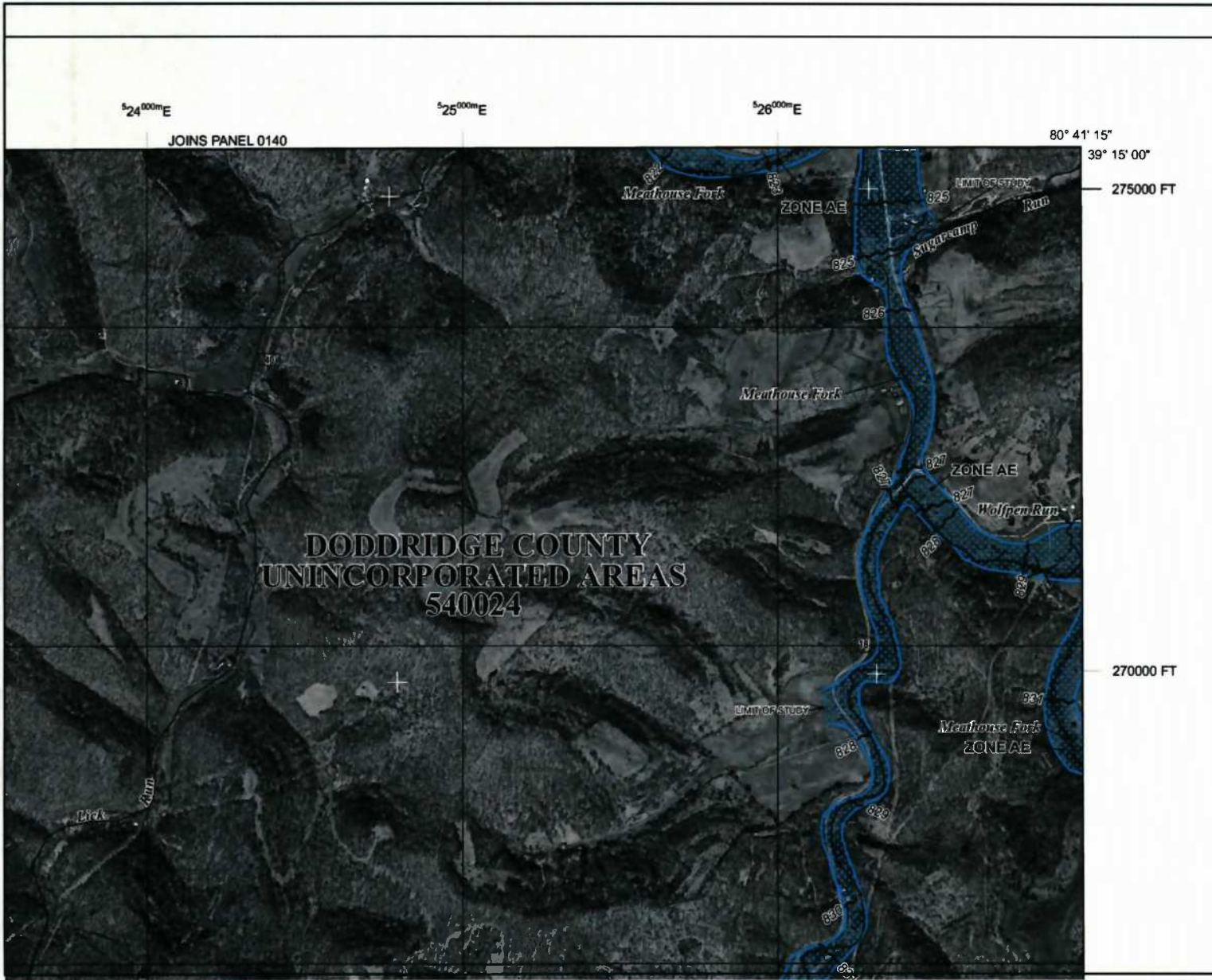
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.



MAP NUMBER  
54017C0140C  
MAP REVISED  
OCTOBER 4, 2011

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using FIRM On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)



**NFIIP**


PANEL 0230C

**FIRM**  
**FLOOD INSURANCE RATE MAP**  
**DODDRIDGE COUNTY,**  
**WEST VIRGINIA**  
**AND INCORPORATED AREAS**

PANEL 230 OF 325  
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

COUNTY	NUMBER	PANEL	SHEET
DODDRIDGE COUNTY	54004	2730	C

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.



**MAP NUMBER**  
54017C0230C

**MAP REVISED**  
OCTOBER 4, 2011


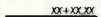


Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)

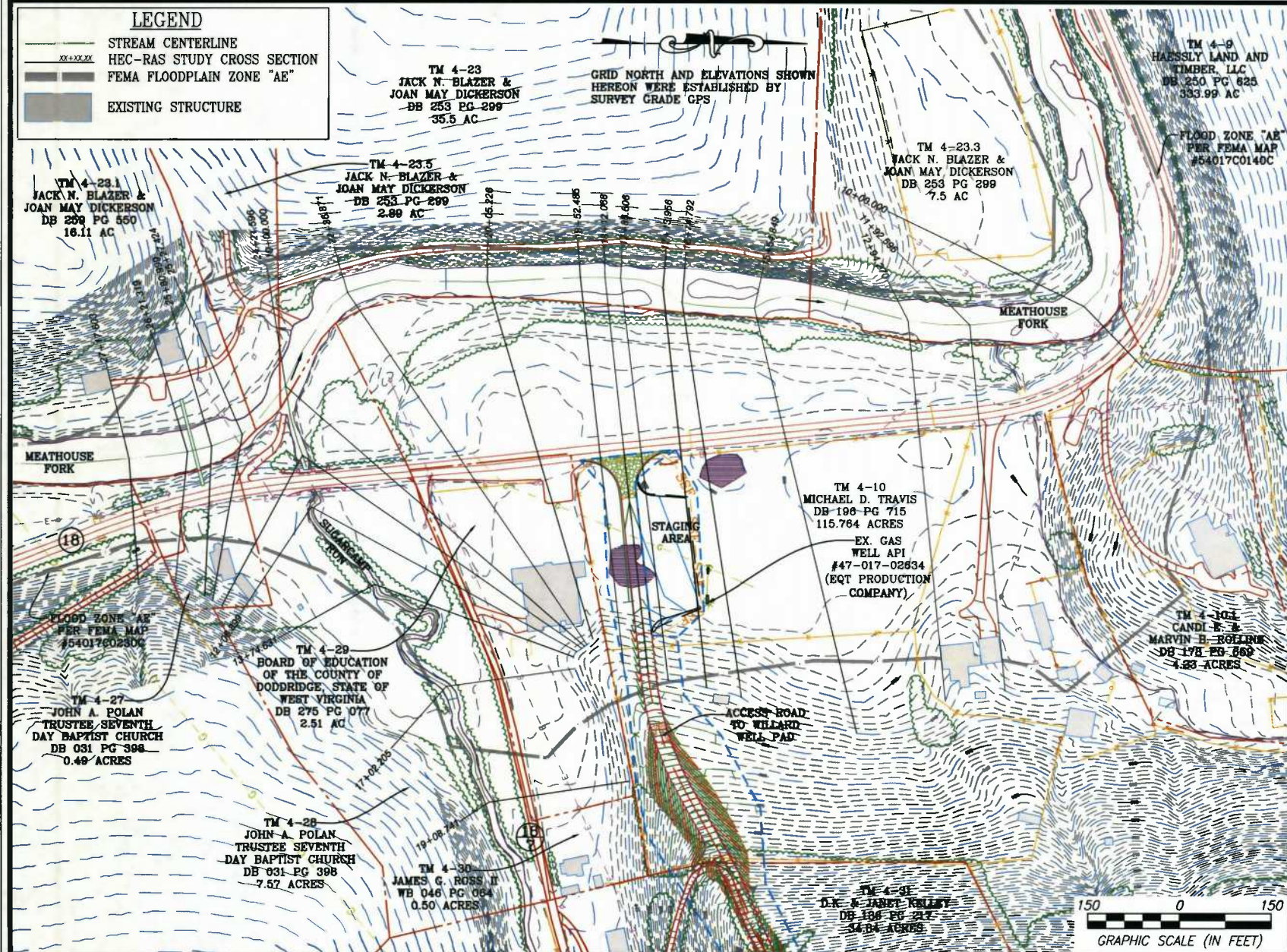
**Exhibit B**  
**Overall Site Map**



**LEGEND**

-  STREAM CENTERLINE
-  HEC-RAS STUDY CROSS SECTION
-  FEMA FLOODPLAIN ZONE "AE"
-  EXISTING STRUCTURE

GRID NORTH AND ELEVATIONS SHOWN  
HEREON WERE ESTABLISHED BY  
SURVEY GRADE GPS



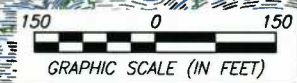
OVERALL CONDITIONS PLAN

**WILLARD FLOODPLAIN STUDY**

NEW MILTON DISTRICT  
DODDRIDGE COUNTY, WV

SCALE: 1" = 150'


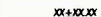



WILLARD  
JOB NO. ANT044  
DATE: 09/16/2013

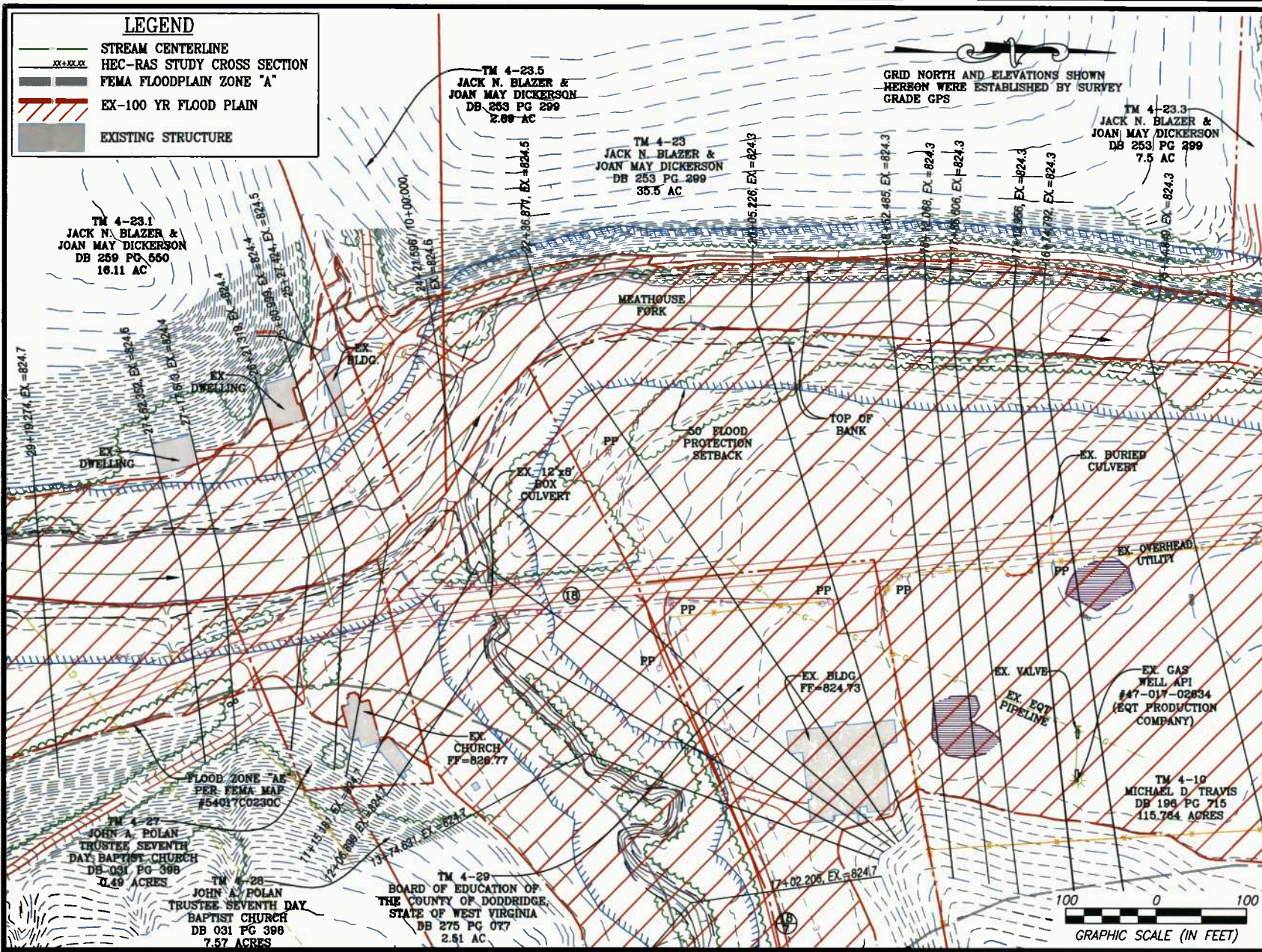


**Exhibit C**  
**Existing Conditions Plan**



**LEGEND**

-  STREAM CENTERLINE
-  HEC-RAS STUDY CROSS SECTION
-  FEMA FLOODPLAIN ZONE "A"
-  EX-100 YR FLOOD PLAIN
-  EXISTING STRUCTURE



**NAVITUS ENGINEERING INC.**

151 Windy Hill Lane  
Winchester, Virginia 22602  
Phone: 540-361-4165  
www.navituseng.com

Engineering Survey Environmental GIS

**CYRUS S. KUMP REGISTERED PROFESSIONAL ENGINEER**

1957 STATE OF WEST VIRGINIA

**ANTERO RESOURCES**

THIS DOCUMENT WAS PREPARED FOR: ANTERO RESOURCES CORPORATION

**EXISTING CONDITIONS PLAN**

**WILLARD FLOODPLAIN STUDY**

NEW MILTON DISTRICT  
DODDRIDGE COUNTY, WV

SCALE: 1" = 100'


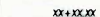



WILLARD  
JOB NO. ANT044  
DATE: 09/16/2013

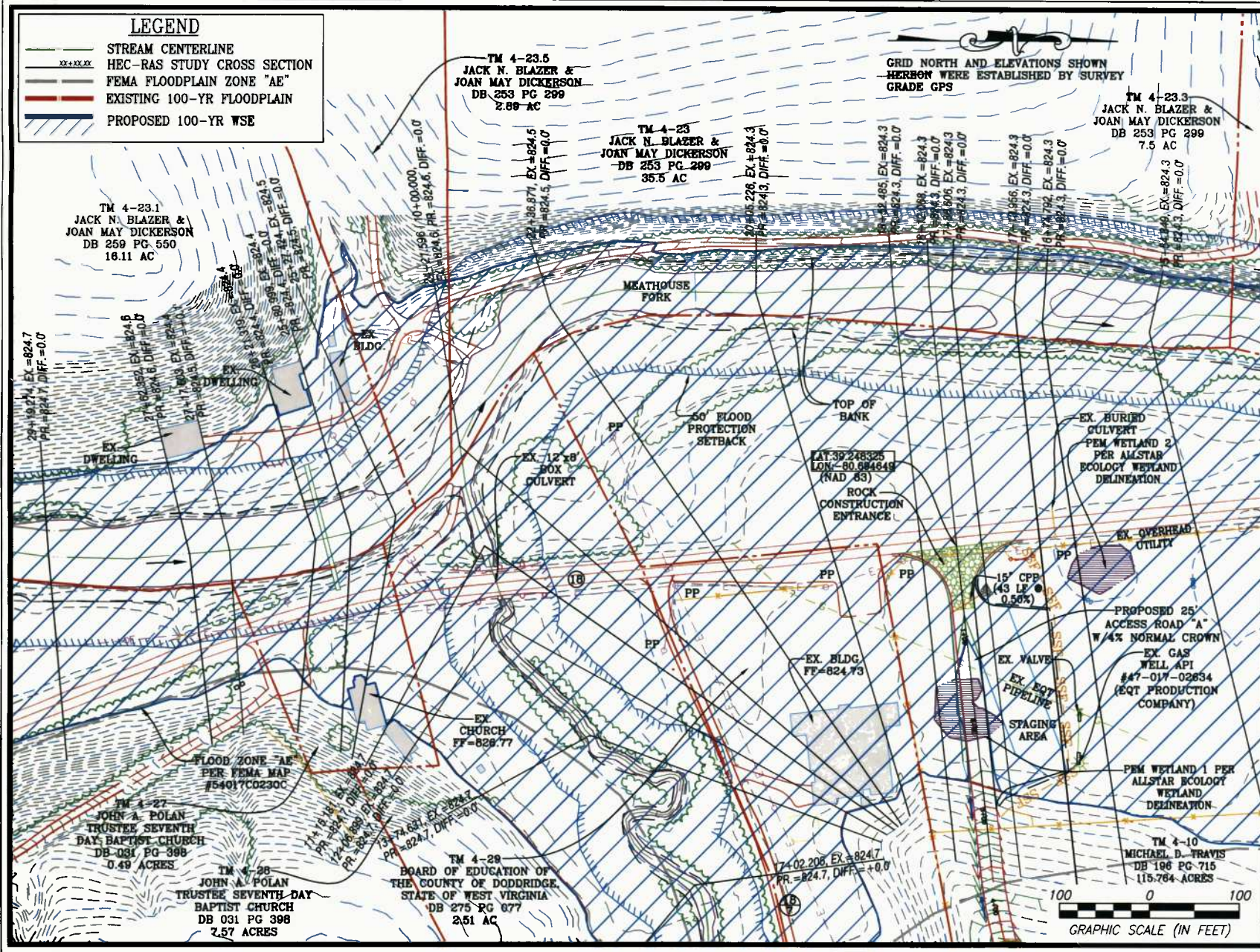


**Exhibit D**  
**Proposed Conditions Plan**



**LEGEND**

-  STREAM CENTERLINE
-  HEC-RAS STUDY CROSS SECTION
-  FEMA FLOODPLAIN ZONE "AE"
-  EXISTING 100-YR FLOODPLAIN
-  PROPOSED 100-YR WSE



GRID NORTH AND ELEVATIONS SHOWN HEREON WERE ESTABLISHED BY SURVEY GRADE GPS

**NAVITUS ENGINEERING INC.**  
 151 Windy Hill Lane  
 Winchester, Virginia 22602  
 Telephone: (888) 662-8185  
 www.navituseng.com

Engineering Survey Environmental GIS



**ANTERO RESOURCES**  
 THIS DOCUMENT WAS PREPARED FOR:  
**ANTERO RESOURCES CORPORATION**

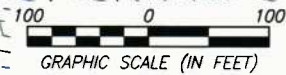
PROPOSED CONDITIONS PLAN

**WILLARD FLOODPLAIN STUDY**

NEW MILTON DISTRICT  
 DODDRIDGE COUNTY, WV

SCALE: 1" = 100'

WILLARD  
 JOB NO. ANT044  
 DATE: 09/16/2013



TM 4-23.1  
 JACK N. BLAZER &  
 JOAN MAY DICKERSON  
 DB 259 PG 550  
 18.11 AC

TM 4-23.5  
 JACK N. BLAZER &  
 JOAN MAY DICKERSON  
 DB 253 PG 299  
 2.86 AC

TM 4-23  
 JACK N. BLAZER &  
 JOAN MAY DICKERSON  
 DB 253 PG 299  
 35.5 AC

TM 4-23.3  
 JACK N. BLAZER &  
 JOAN MAY DICKERSON  
 DB 253 PG 299  
 7.5 AC

TM 4-27  
 JOHN A. POLAN  
 TRUSTEE SEVENTH  
 DAY BAPTIST CHURCH  
 DB 031 PG 398  
 0.49 ACRES

TM 4-28  
 JOHN A. POLAN  
 TRUSTEE SEVENTH DAY  
 BAPTIST CHURCH  
 DB 031 PG 398  
 2.57 ACRES

TM 4-29  
 BOARD OF EDUCATION OF  
 THE COUNTY OF DODDRIDGE,  
 STATE OF WEST VIRGINIA  
 DB 275 PG 077  
 2.51 AC

74-02.208, EX=824.7  
 PR=824.7, DIFF=+0.0

TM 4-10  
 MICHAEL D. TRAVIS  
 DB 196 PG 715  
 115.764 ACRES



**Supplement 1**  
**Drainage Computations**

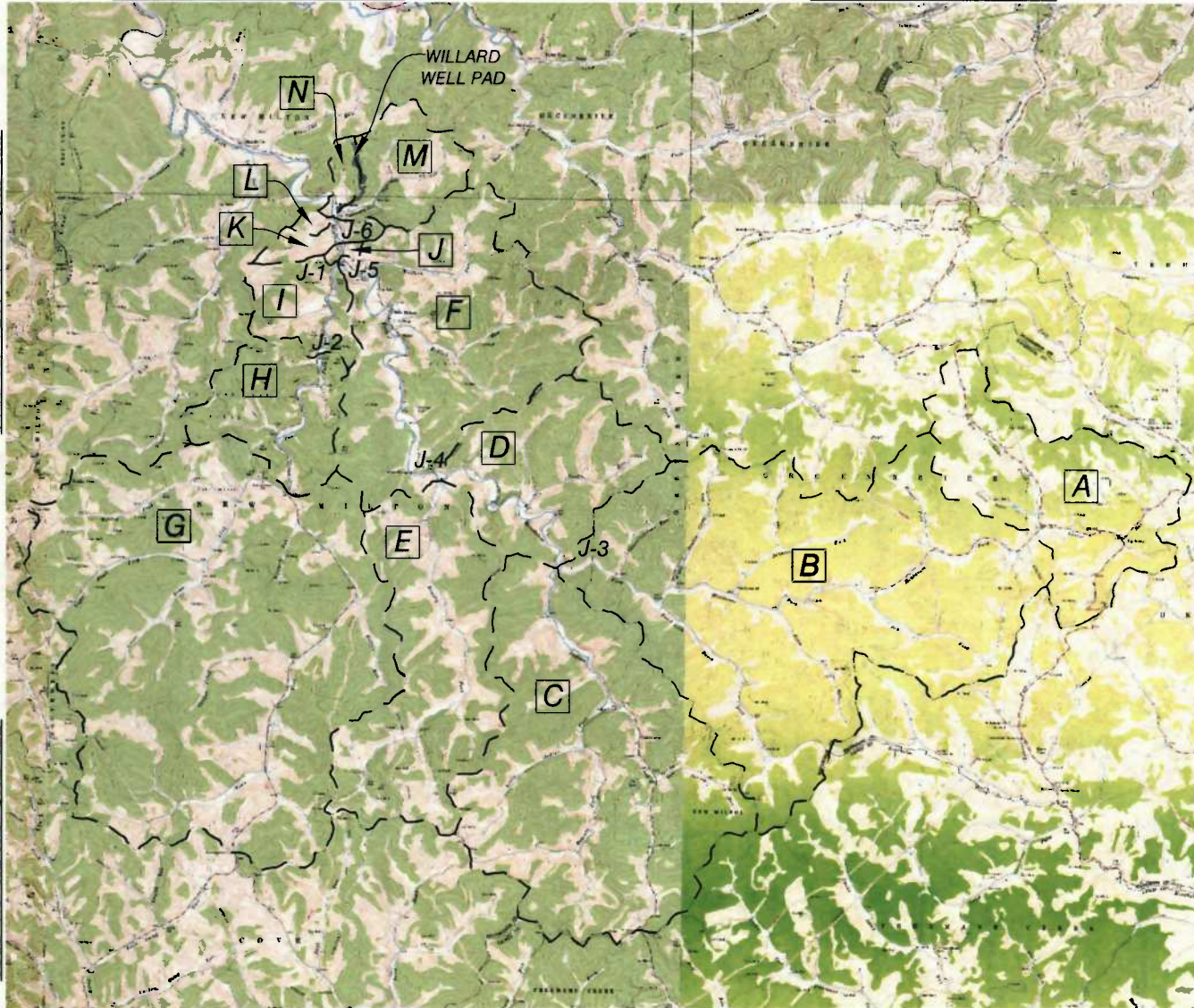
# DRAINAGE MAP

USGS 7.5 SMITHBURG QUAD MAP

USGS 7.5 SALEM QUAD MAP

USGS 7.5 WEST UNION QUAD MAP

USGS 7.5 OXFORD QUAD MAP



USGS 7.5 NEW MILTON QUAD MAP

USGS 7.5 BIG ISAAC QUAD MAP

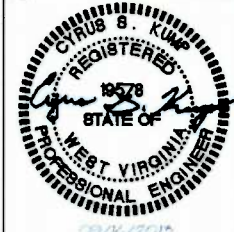


WEST VIRGINIA STATE PLANE  
COORDINATE SYSTEM  
NORTH ZONE, NAD83  
ELEVATION BASED ON NAVD88  
ESTABLISHED BY SURVEY GRADE GPS  
& OPUS POST-PROCESSING

**NAVITUS**  
ENGINEERING INC.

151 Windy Hill Lane  
Martinsburg, WV 26151  
Telephone: 800.462.4452  
www.navituseg.com

Engineering Survey Environmental GIS



KEY	HYDROLOGIC ELEMENT	DRAINAGE AREA (SQ. MI.)
A	BIG ISAAC / LAUREL RUN	3.72
B	UPPER MEATHOUSE	11.19
C	INDIAN RUN	7.86
D	MIDDLE MEATHOUSE	2.79
E	BUSHY CREEK	4.29
F	LOWER MEATHOUSE	5.46
G	UPPER TOMS FORK	12.83
H	MIDDLE TOMS FORK	1.77
I	LOWER TOMS FORK	0.94
J	MEATHOUSE/TOMS JUNCTION	0.06
K	LOWER1 MEATHOUSE	0.33
L	UNNAMED TRIBUTARY 1	0.07
M	SUGARCAMP RUN	1.17
N	UNNAMED TRIBUTARY 2	0.21
	<b>TOTAL</b>	<b>52.69</b>

J-1	JUNCTION 1
J-2	JUNCTION 2
J-3	JUNCTION 3
J-4	JUNCTION 4
J-5	JUNCTION 5
J-6	JUNCTION 6



**ANTERO RESOURCES**

THIS DOCUMENT WAS PREPARED FOR:  
**ANTERO RESOURCES CORPORATION**

DRAINAGE MAP  
**WILLARD FLOODPLAIN STUDY**  
NEW MILTON DISTRICT  
DODDRIDGE COUNTY, WV

SCALE: 1" = 6000'  
WILLARD  
JOB NO. ANT044  
DATE: 09/16/2013

Project: Willard

Simulation Run: Existing

Start of Run: 02Aug2013, 00:00

Basin Model: Existing

End of Run: 03Aug2013, 00:05

Meteorologic Model: 100 YR

Compute Time: 02Aug2013, 15:18

Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI <sup>2</sup> )	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Upper Meathouse	11.19	2489.9	02Aug2013, 15:15	1176
Indian Run	7.86	2389.7	02Aug2013, 14:05	858.3
Big Isaac/Laurel Run	3.72	2013.9	02Aug2013, 12:50	419.4
Reach-3	3.72	2013.9	02Aug2013, 15:50	391
Junction-3	22.77	5730.7	02Aug2013, 15:45	2425.4
Reach-4	22.77	5730.7	02Aug2013, 17:05	2332.5
Brushy Creek	4.29	1630.1	02Aug2013, 13:30	475.9
Middle Meathouse	2.79	1273.8	02Aug2013, 13:10	312.4
Junction-4	29.85	6250.8	02Aug2013, 17:00	3120.8
Reach-5	29.85	6250.8	02Aug2013, 18:20	2986.3
Upper Toms Fork	12.83	3765.8	02Aug2013, 14:10	1397
Reach-1	12.83	3764.2	02Aug2013, 14:40	1381.3
Middle Toms Fork	1.77	948.5	02Aug2013, 12:55	199.4
Junction-2	14.60	4018.5	02Aug2013, 14:35	1580.6
Reach-2	14.60	4017.5	02Aug2013, 14:55	1568.3
Lower Toms Fork	0.94	748.4	02Aug2013, 12:25	107.5
Junction-1	15.55	4097.4	02Aug2013, 14:55	1675.8
Lower Meathouse	5.46	2219	02Aug2013, 13:20	608
Junction-5	50.86	8252.1	02Aug2013, 14:50	5270.1
SugarCamp Run	1.17	782.5	02Aug2013, 12:35	132.2
Lower1 Meathouse	0.33	269	02Aug2013, 12:25	37.6
Unnamed Trib 1	0.07	138	02Aug2013, 12:00	8.4
Meathouse/Toms Junctio	0.06	113.4	02Aug2013, 12:00	6.9
Reach-6	0.06	113.4	02Aug2013, 12:05	6.9
Junction-6	52.48	8405.4	02Aug2013, 14:50	5455.2
Reach-7	52.48	8405.4	02Aug2013, 14:55	5441.1
Unnamed Trib 2	0.21	218.7	02Aug2013, 12:15	23.6
Downstream	52.69	8421.6	02Aug2013, 14:55	5464.7

**Supplement 2**

**HEC-RAS Analysis –Existing Conditions Summary**

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
XXXXXXXX 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: willard  
Project File : Willard.prj  
Run Date and Time: 8/19/2013 8:10:55 AM

Project in English units

\*\*\*\*\*

PLAN DATA

Plan Title: Existing  
Plan File : x:\Navitus Jobfiles\Antero Resources\ANT044-willard\Engineering\Drainage  
Comp\Floodplain\Computations\HEC-RAS\Revised2\Willard.p01

Geometry Title: Existing  
Geometry File : x:\Navitus Jobfiles\Antero Resources\ANT044-willard\Engineering\Drainage  
Comp\Floodplain\Computations\HEC-RAS\Revised2\Willard.g01

Flow Title : Existing  
Flow File : x:\Navitus Jobfiles\Antero Resources\ANT044-willard\Engineering\Drainage  
Comp\Floodplain\Computations\HEC-RAS\Revised2\Willard.f01

Plan Summary Information:

Number of:	Cross Sections =	23	Multiple Openings =	0
	Culverts =	1	Inline Structures =	0
	Bridges =	0	Lateral Structures =	0

Computational Information

water surface calculation tolerance =	0.1
critical depth calculation tolerance =	0.01
Maximum number of iterations =	20
Maximum difference tolerance =	0.3

Flow tolerance factor = 0.001

Computation Options

Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

\*\*\*\*\*

FLOW DATA

Flow Title: Existing
Flow File : x:\Navitus Jobfiles\Antero Resources\ANT044-willard\Engineering\Drainage
Comp\Floodplain\Computations\HEC-RAS\Revised2\willard.f01

Flow Data (cfs)

Table with 4 columns: River, Reach, RS, PF 1. Rows include Meathouse Fork (Upper/Lower) and Sugarcamp Run (Upper).

Boundary Conditions

Table with 5 columns: River, Reach, Profile, Upstream, Downstream. Rows include Meathouse Fork (Upper/Lower) with profile PF 1 and known water surface elevations.

\*\*\*\*\*

GEOMETRY DATA

Geometry Title: Existing
Geometry File : x:\Navitus Jobfiles\Antero Resources\ANT044-willard\Engineering\Drainage
Comp\Floodplain\Computations\HEC-RAS\Revised2\willard.g01

Reach Connection Table

Table with 5 columns: River, Reach, Upstream Boundary, Downstream Boundary. Rows include Meathouse Fork (Upper/Lower) and Sugarcamp Run (Upper) with boundary values of 1.

JUNCTION INFORMATION



Name: 1  
 Description:  
 Energy computation Method

Length across Junction		Tributary		Reach	Length	Angle
River	Reach	River	Reach			
Meathouse Fork	Upper	to Meathouse Fork	Lower		105.55	0
Sugarcamp Run	Upper	to Meathouse Fork	Lower		0	0

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Upper RS: 3189.903

INPUT  
 Description:

Station Elevation Data num= 84

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	4.44	838	7.6	836.54	8.74	836	13.67	834.13
13.99	834	14.79	833.7	19.29	832	21.1	831.31	24.47	830
26.67	829.17	30.09	828	33.75	827.2	39.43	826	41.42	825.53
43.48	824.99	47.22	824	49.95	822.8	51.66	822	53.77	821.05
55.14	820.44	56.08	820	56.57	819.63	58.57	818	59.26	817.36
60.68	816	62.04	814.8	62.94	814	64.92	812.65	65.96	812
67.18	811.11	68.63	810.19	112	810.21	125.35	810.21	126.67	811.47
127.15	812	128.83	813.76	129.02	814	129.23	814.3	130.51	816
130.6	816	138.18	816.51	152.01	816	160.17	817.57	162.51	818
172.56	818.53	190.59	819.55	195.19	819.81	198.42	820	206.44	821.17
210.95	820.24	231.51	820	254.69	820	282.1	819.47	318.2	820
325.76	821.88	326.26	822	327.93	822.35	330	822.8	331.34	823.1
331.87	823.22	333.18	823.52	350.01	823.5	352.3	823.5	352.69	823.52
352.78	823.52	352.81	823.52	355.41	823.61	366.46	824	366.89	824.41
368.63	826	369.15	826.51	370.78	828	371.39	828.59	372.93	830
373.62	830.67	375.06	832	375.83	832.75	377.19	834	378.03	834.81
379.31	836	380.81	837.25	381.7	838	384.11	840		

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	53.77	.035	130.6	.035	333.18	.013
						352.3	.1

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	53.77	130.6		267.8	267.64	210.16	.1 .3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 825.05	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.28	* wt. n-Val.	* 0.100	* 0.035	* 0.035
* W.S. Elev (ft)	* 824.77	* Reach Len. (ft)	* 267.80	* 267.64	* 210.16

* Crit W.S. (ft)	*	* Flow Area (sq ft)	*	15.73	*	1022.87	*	1132.05	*
* E.G. Slope (ft/ft)	*0.000477	* Area (sq ft)	*	15.73	*	1022.87	*	1132.05	*
* Q Total (cfs)	* 8252.10	* Flow (cfs)	*	6.83	*	5059.02	*	3186.25	*
* Top width (ft)	* 322.96	* Top width (ft)	*	9.45	*	76.83	*	236.68	*
* Vel Total (ft/s)	* 3.80	* Avg. Vel. (ft/s)	*	0.43	*	4.95	*	2.81	*
* Max Chl Dpth (ft)	* 14.58	* Hydr. Depth (ft)	*	1.67	*	13.31	*	4.78	*
* Conv. Total (cfs)	*377651.5	* Conv. (cfs)	*	312.5	*	231522.7	*	145816.4	*
* Length wtd. (ft)	* 251.82	* Wetted Per. (ft)	*	10.18	*	83.09	*	237.86	*
* Min Ch El (ft)	* 810.19	* Shear (lb/sq ft)	*	0.05	*	0.37	*	0.14	*
* Alpha	* 1.25	* Stream Power (lb/ft s)	*	384.11	*	0.00	*	0.00	*
* Frctn Loss (ft)	* 0.12	* Cum Volume (acre-ft)	*	4.39	*	19.34	*	9.80	*
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	*	0.55	*	1.21	*	1.66	*

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Upper RS: 2919.274

INPUT

Description:

Station Elevation Data		num= 77		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	5.35	838	10.14	836.12	10.93	835.82	15.61	834
17.43	833.34	21.22	832	23.59	831.23	27.27	830	30.88	828.73
32.84	828	34.04	827.57	38.26	826	45.27	824.25	46.28	824
47.03	823.89	47.65	823.82	49.69	823.58	62.66	822	63.65	821.81
66.37	821.27	67.53	821.04	73.35	820	74.73	819.47	78.07	818
79.13	817.33	81.22	816	82.27	815.17	83.79	814	85.05	813.01
87.02	811.39	87.56	810.92	87.78	810.73	88.06	810.49	92.04	810.47
99.15	810.44	160.4	810.2	161.6	811.14	162.85	811.91	162.99	812
165.22	812.75	169.24	814	175.99	815.51	178.06	816	179.09	816.26
185.3	818	186.61	818	219.11	818.86	227.98	819.09	254.46	819.77
256.14	819.82	263.42	820	265.94	820.82	269.7	822	272.66	822.4
274.95	822.7	276.06	822.84	277.07	822.97	280.17	823.4	285.34	823.42
300.38	823.49	313.16	823.88	316.67	824	320.12	825.39	321.61	826
326.07	827.8	326.57	828	328.02	828.59	331.69	830	333.23	830.61
336.61	832	339.39	833.28	340.96	834	342.36	834.64	345.32	836
349.67	838	354.02	840						

Manning's n Values		num= 5		Sta n Val		Sta n Val		Sta n Val	
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	79.13	.035	185.3	.035	280.17	.013	300.38	.1

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 79.13 185.3 131.84 156.71 162.29 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

\*\*\*\*\*



* E.G. Elev (ft)	* 824.93	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.32	* Wt. n-Val.	* 0.035	* 0.035	* 0.034
* W.S. Elev (ft)	* 824.61	* Reach Len. (ft)	* 131.84	* 156.71	* 162.29
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 99.65	* 1373.21	* 519.50
* E.G. Slope (ft/ft)	*0.000458	* Area (sq ft)	* 99.65	* 1373.21	* 519.50
* Q Total (cfs)	* 8252.10	* Flow (cfs)	* 177.57	* 6719.16	* 1355.37
* Top Width (ft)	* 274.34	* Top width (ft)	* 35.29	* 106.17	* 132.88
* Vel Total (ft/s)	* 4.14	* Avg. Vel. (ft/s)	* 1.78	* 4.89	* 2.61
* Max Chl Dpth (ft)	* 14.41	* Hydr. Depth (ft)	* 2.82	* 12.93	* 3.91
* Conv. Total (cfs)	*385588.6	* Conv. (cfs)	* 8297.4	*313960.3	* 63330.9
* Length wtd. (ft)	* 156.81	* Wetted Per. (ft)	* 36.28	* 109.88	* 133.43
* Min Ch El (ft)	* 810.20	* Shear (lb/sq ft)	* 0.08	* 0.36	* 0.11
* Alpha	* 1.21	* Stream Power (lb/ft s)	* 354.02	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.07	* Cum Volume (acre-ft)	* 4.04	* 11.98	* 5.81
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.42	* 0.64	* 0.77

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Upper

RS: 2762.352

INPUT

Description:

Station Elevation Data		num= 92									
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	1.27	839.34	3.81	838	5.84	836.77	7.03	836		
8.82	834.81	10.03	834	11.1	833.45	12.03	833.17	15.42	832		
23.45	830	33.33	828	42.89	826	51.39	824	60.13	822		
67.91	821.29	82.32	820	95.74	818.2	97.15	818	99.2	817.24		
102.46	816	103.43	815.58	107.43	814	109.95	812.28	112.14	810.81		
112.83	810.36	113.17	810.14	113.7	809.8	117.15	809.81	181.98	810.08		
187	810.1	187.15	810.1	188.38	811.16	189.39	812	190.37	812.87		
191.39	813.78	191.65	814	191.8	814.02	193.89	814.27	196.34	814.56		
210.55	816	216.57	816	224.58	817.07	231.11	818	232.63	818.64		
235.89	820	237.39	820.57	240.95	822	241.94	822.22	249.55	823.63		
270.2	823.18	282.86	822.07	283.45	822	284.05	822	284.81	822.05		
285.06	822.07	285.69	822.14	295.52	823.01	297.53	823.16	300.76	823.72		
301.24	823.78	302.86	824	303.13	824	305.67	824.32	307.45	824.58		
312.1	825.16	317.59	826	318.66	826.41	322.99	828	325.87	829.1		
328.3	830	333.1	831.96	333.21	832	333.31	832.06	336.95	834		
339.26	835.18	340.76	836	341.87	836.46	342.31	836.53	344.52	837.18		
345.5	837.23	347.59	837.46	348.9	837.46	349.21	837.48	352.12	837.59		
354.08	837.77	354.3	837.79	356.46	838	357.01	838.06	357.37	838.14		
361.2	838.8	366.1	840								

Manning's n Values		num= 5							
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val		
0	.035	97.15	.035	191.65	.035	249.55	.013	270.2	.1

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 97.15 191.65 44.24 44.75 36.49 .1 .3  
 Blocked Obstructions num= 1  
 Sta L Sta R Elev  
 \*\*\*\*\*  
 0 44.57 835

CROSS SECTION OUTPUT Profile #PF 1

\*\*\*\*\*  
 \* E.G. Elev (ft) \* 824.86 \* Element \* Left OB \* Channel \* Right OB \*  
 \* Vel Head (ft) \* 0.33 \* Wt. n-Val. \* 0.035 \* 0.035 \* 0.035 \*  
 \* W.S. Elev (ft) \* 824.52 \* Reach Len. (ft) \* 44.24 \* 44.75 \* 36.49 \*  
 \* Crit W.S. (ft) \* \* \* Flow Area (sq ft) \* 173.91 \* 1293.10 \* 481.17 \*  
 \* E.G. Slope (ft/ft) \* 0.000451 \* Area (sq ft) \* 173.91 \* 1293.10 \* 481.17 \*  
 \* Q Total (cfs) \* 8252.10 \* Flow (cfs) \* 367.52 \* 6513.06 \* 1371.52 \*  
 \* Top width (ft) \* 257.87 \* Top width (ft) \* 47.97 \* 94.50 \* 115.40 \*  
 \* Vel Total (ft/s) \* 4.24 \* Avg. Vel. (ft/s) \* 2.11 \* 5.04 \* 2.85 \*  
 \* Max Chl Dpth (ft) \* 14.72 \* Hydr. Depth (ft) \* 3.62 \* 13.68 \* 4.17 \*  
 \* Conv. Total (cfs) \* 388438.5 \* Conv. (cfs) \* 17299.9 \* 306579.3 \* 64559.4 \*  
 \* Length wtd. (ft) \* 43.61 \* wetted Per. (ft) \* 48.49 \* 97.99 \* 116.79 \*  
 \* Min Ch El (ft) \* 809.80 \* Shear (lb/sq ft) \* 0.10 \* 0.37 \* 0.12 \*  
 \* Alpha \* 1.20 \* Stream Power (lb/ft s) \* 366.10 \* 0.00 \* 0.00 \*  
 \* Frctn Loss (ft) \* 0.02 \* Cum Volume (acre-ft) \* 3.62 \* 7.18 \* 3.95 \*  
 \* C & E Loss (ft) \* 0.01 \* Cum SA (acres) \* 0.29 \* 0.28 \* 0.31 \*  
 \*\*\*\*\*

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Upper RS: 2717.603

INPUT

Description:

Station Elevation Data		num= 75									
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	.7	839.65	3.98	838	7.57	836.28	8.16	836		
12.37	834	16.4	832	20.38	830	24.35	828	28.35	826		
29.88	825.23	37.55	824.67	42.97	824	57.91	822.25	59.39	822.08		
59.68	822.05	60.09	822	63.21	821.79	79.95	820.64	90.24	820		
93.42	819.23	99.15	818	102.2	817.21	106.8	816	111.09	815.16		
117.61	814	118.85	812.86	119.55	812.21	119.77	812	120.9	810.96		
122.15	809.8	123.72	809.8	163.46	809.97	192.54	810.1	195.09	811.74		
195.48	812	196.5	812.4	200.29	813.89	200.57	814	200.78	814.05		
211.04	816	211.1	816.01	225.44	818	226.34	818.38	230.3	820		
233.97	821.51	235.17	822	235.93	822.14	239.43	822.78	244.7	823.55		
254.96	823.4	265.97	823.09	278.56	823.48	285.27	823.66	297.56	824		
301.23	824.38	305.1	824.77	316.67	826	320.13	826.93	324.09	828		
331.03	829.52	333.58	830	338.02	830.85	341.67	831.24	343.49	831.41		
344.25	831.45	346.75	832	348.72	832	351.51	833.35	352.64	834		

354 834.78 356.19 836 357.45 836.65 360.17 838 363.88 840

Manning's n Values num= 7  
 Sta n Val Sta n Val Sta n Val Sta n Val Sta n Val  
 \*\*\*\*\*  
 0 .035 29.88 .033 37.55 .035 117.61 .035 200.57 .06  
 244.7 .013 265.97 .035

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 123.72 196.5 1 1 1 .1 .3

Blocked Obstructions num= 1  
 Sta L Sta R Elev  
 \*\*\*\*\*  
 0 43.17 835

CROSS SECTION OUTPUT Profile #PF 1

\*\*\*\*\*  
 \* E.G. Elev (ft) \* 824.82 \* Element \* Left OB \* Channel \* Right OB \*  
 \* Vel Head (ft) \* 0.44 \* Wt. n-Val. \* 0.035 \* 0.035 \* 0.049 \*  
 \* W.S. Elev (ft) \* 824.39 \* Reach Len. (ft) \* 1.00 \* 1.00 \* 1.00 \*  
 \* Crit W.S. (ft) \* \* \* Flow Area (sq ft) \* 412.50 \* 1045.35 \* 356.62 \*  
 \* E.G. slope (ft/ft) \*0.000561 \* Area (sq ft) \* 412.50 \* 1045.35 \* 356.62 \*  
 \* Q Total (cfs) \* 8252.10 \* Flow (cfs) \* 1277.11 \* 6177.84 \* 797.15 \*  
 \* Top width (ft) \* 258.13 \* Top width (ft) \* 80.55 \* 72.78 \* 104.80 \*  
 \* Vel Total (ft/s) \* 4.55 \* Avg. Vel. (ft/s) \* 3.10 \* 5.91 \* 2.24 \*  
 \* Max chl Dpth (ft) \* 14.59 \* Hydr. Depth (ft) \* 5.12 \* 14.36 \* 3.40 \*  
 \* Conv. Total (cfs) \*348254.0 \* Conv. (cfs) \* 53896.4 \*260716.4 \* 33641.2 \*  
 \* Length wtd. (ft) \* 1.00 \* Wetted Per. (ft) \* 83.45 \* 73.42 \* 106.39 \*  
 \* Min Ch El (ft) \* 809.80 \* Shear (lb/sq ft) \* 0.17 \* 0.50 \* 0.12 \*  
 \* Alpha \* 1.36 \* Stream Power (lb/ft s) \* 363.88 \* 0.00 \* 0.00 \*  
 \* Frctn Loss (ft) \* 0.00 \* Cum Volume (acre-ft) \* 3.33 \* 5.98 \* 3.60 \*  
 \* C & E Loss (ft) \* 0.02 \* Cum SA (acres) \* 0.22 \* 0.20 \* 0.21 \*  
 \*\*\*\*\*

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Upper RS: 2621.319

INPUT

Description:

Station Elevation Data num= 113  
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev  
 \*\*\*\*\*  
 0 840 2.5 838.2 2.79 838 3.52 837.52 6.47 835.49  
 7.67 834.78 8.48 834.31 9.1 834 11.24 832.79 12.69 832  
 14.06 831.18 15.39 830.33 15.91 830 17.86 828.85 19.21 828  
 20.22 827.42 21 826.97 22.94 826 24.71 826 28.47 825.85  
 49.15 824 49.86 823.97 49.94 823.96 50 823.96 50.76 823.91  
 52 823.81 58.2 823.32 59.8 823.19 74.84 822 75.96 821.94  
 77.8 821.87 78.58 821.84 79.01 821.82 81.83 821.8 82.07 821.78

willard.rep

84.15	821.67	89.76	821.41	91.77	821.43	100.32	820.95	114.95	820.32
115.55	820.3	116.56	820.27	116.7	820.27	119.32	820.19	120.19	820.18
124.78	820.02	125.39	820	128.82	819.2	133.34	818.23	133.84	818.12
134.41	818	140.39	817.38	142.33	817.17	147.27	816.6	152.25	816
157.76	814.99	163.18	814	163.89	813.58	166.17	812.23	166.57	812
169.23	810.43	169.76	810.11	170.28	809.8	188.3	809.88	212.72	809.98
238.94	810.1	239.88	810.78	241.63	812	244.56	813.72	244.89	813.91
245.05	814	246.68	814.54	247.93	814.96	251.09	816	251.81	816.24
257.15	818	260.11	819.04	262.77	820	265.26	820.9	268.18	822
269.76	822.26	278.47	823.72	296.32	823.24	300.91	823.21	301.88	823.14
303.06	823.1	304.52	823.09	306.7	823.09	314.69	822.97	315.31	822.98
327.06	823.33	339.9	823.67	340.83	823.72	342.56	823.87	344.22	824
346.93	824	356.7	824.36	371.78	824.85	375.68	825.23	378.88	825.53
384	826	389.55	827.96	389.65	828	389.8	828.06	395.31	830
400.25	831.78	400.87	832	404.06	833.15	406.41	834	406.92	834.19
411.79	836	412.51	836.34	420.22	840				

Manning's n Values

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	79.01	.033	89.76	.035	163.89	.035	247.93	.035
278.47	.013	301.88	.035						

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

163.89	247.93	50.27	40.32	52.82	.1	.3
--------	--------	-------	-------	-------	----	----

Blocked Obstructions num= 1

Sta L	Sta R	Elev
0	62.4	835

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.81	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.38	* Wt. n-Val.	* 0.035	* 0.035	* 0.032
* W.S. Elev (ft)	* 824.43	* Reach Len. (ft)	* 50.27	* 40.32	* 52.82
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 489.55	* 1179.02	* 213.55
* E.G. slope (ft/ft)	* 0.000501	* Area (sq ft)	* 489.55	* 1179.02	* 213.55
* Q Total (cfs)	* 8252.10	* Flow (cfs)	* 1396.68	* 6398.56	* 456.86
* Top width (ft)	* 296.31	* Top width (ft)	* 101.49	* 84.04	* 110.78
* Vel Total (ft/s)	* 4.38	* Avg. Vel. (ft/s)	* 2.85	* 5.43	* 2.14
* Max Chl Dpth (ft)	* 14.63	* Hydr. Depth (ft)	* 4.82	* 14.03	* 1.93
* Conv. Total (cfs)	* 368707.2	* Conv. (cfs)	* 62404.2	* 285890.5	* 20412.5
* Length wtd. (ft)	* 42.96	* Wetted Per. (ft)	* 103.64	* 86.38	* 112.16
* Min Ch El (ft)	* 809.80	* Shear (lb/sq ft)	* 0.15	* 0.43	* 0.06
* Alpha	* 1.27	* Stream Power (lb/ft s)	* 420.22	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.02	* Cum Volume (acre-ft)	* 3.32	* 5.95	* 3.59
* C & E Loss (ft)	* 0.01	* Cum SA (acres)	* 0.22	* 0.19	* 0.21

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Upper

RS: 2580.999

INPUT

Description:

Station Elevation Data		num= 111		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	3.65	838.07	3.74	838.02	3.79	838	6.25	836.63
7.43	836	9.05	835.24	11.64	834	15.96	832.16	16.15	832.07
16.32	832	18.83	830.91	21.06	830	21.9	829.65	23.66	828.94
25.08	828.34	25.95	828	29.1	827.17	31.92	826.52	32.9	826.28
33.32	826.18	34.32	826	37.52	825.73	38.72	825.57	42.08	825.22
43.71	825.02	46.29	824.63	50.12	824	50.53	824	55.48	823.6
56.5	823.54	57.7	823.52	58.73	823.5	59.83	823.46	61.43	823.4
64.27	823.28	68.59	823.09	73.5	822.89	93.06	822	94.12	822
110.16	821.58	116.43	821.2	128.71	820.65	138.06	820	154.63	818
160.44	817.54	169.18	816.82	175.11	816.33	179.34	816	190.97	815.66
192.13	814.1	192.84	814	192.87	813.97	194.42	812.6	195.09	812.01
195.1	812	196.56	810.69	197.59	809.8	215.68	809.88	265.01	810.1
265.6	810.73	266.09	811.24	266.84	812	267.7	812.93	268.68	814
269.47	814.36	270.29	814.68	271.35	815.14	273.53	816	275.4	816.6
277.65	817.32	279.75	818	281.37	818.73	283.09	819.44	284.44	820
284.76	820.08	286.73	820.58	291.04	821.66	291.49	821.77	291.67	821.8
291.8	821.83	292.4	822	306.77	823.32	328.6	823.32	333.74	822
335.18	821.78	338.87	822	342.71	822.28	351.06	822	365.19	821.5
384	822	412.74	822.63	430.11	824	435.51	824.84	439.45	825.45
441.78	825.81	442.64	825.93	443.01	826	445.11	826.69	447.46	827.46
449.07	828	453.66	829.57	454.92	830	460.68	831.97	466.64	834
467.55	834.33	472.24	836	473.22	836.52	476.03	838	476.6	838.3
479.81	840								

Manning's n Values		num= 7		Sta n Val		Sta n Val		Sta n Val	
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	110.16	.033	116.43	.035	190.97	.035	273.53	.035
306.77	.013	328.6	.035						

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 190.97 273.53 48.53 53.58 14.67 .1 .3

Blocked Obstructions		num= 2		Sta L Sta R Elev		Sta L Sta R Elev	
0	89.34	835	430	479.81	835		

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.77	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.34	* wt. n-Val.	* 0.035	* 0.035	* 0.033
* W.S. Elev (ft)	* 824.43	* Reach Len. (ft)	* 48.53	* 53.58	* 14.67
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 527.65	* 1145.33	* 366.89
* E.G. Slope (ft/ft)	*0.000492	* Area (sq ft)	* 527.65	* 1145.33	* 366.89

* Q Total (cfs)	* 8252.10	* Flow (cfs)	* 1556.35	* 6012.30	* 683.46	*
* Top width (ft)	* 340.66	* Top width (ft)	* 101.63	* 82.56	* 156.47	*
* Vel Total (ft/s)	* 4.05	* Avg. Vel. (ft/s)	* 2.95	* 5.25	* 1.86	*
* Max Chl Dpth (ft)	* 14.63	* Hydr. Depth (ft)	* 5.19	* 13.87	* 2.34	*
* Conv. Total (cfs)	* 372024.4	* Conv. (cfs)	* 70164.0	* 271048.7	* 30811.8	*
* Length wtd. (ft)	* 49.79	* Wetted Per. (ft)	* 104.15	* 87.03	* 158.22	*
* Min Ch El (ft)	* 809.80	* Shear (lb/sq ft)	* 0.16	* 0.40	* 0.07	*
* Alpha	* 1.34	* Stream Power (lb/ft s)	* 479.81	* 0.00	* 0.00	*
* Frctn Loss (ft)	* 0.02	* Cum Volume (acre-ft)	* 2.73	* 4.88	* 3.24	*
* C & E Loss (ft)	* 0.03	* Cum SA (acres)	* 0.10	* 0.12	* 0.05	*

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Upper RS: 2527.424

INPUT

Description:

Station Elevation Data num= 105

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	5.66	838.97	10.86	838	11.23	837.93	11.39	837.9
11.48	837.88	14.98	837.14	15.17	837.1	15.32	837.07	15.74	836.96
19.15	836	19.43	835.91	19.68	835.84	23.67	834.67	29.01	833.1
32.65	832	35.39	831.16	38.88	830	40.7	829.39	44.64	828
45.84	827.65	47.18	827.26	48.91	826.73	51.35	826	51.48	825.98
51.54	825.97	55.08	825.39	56.48	825.22	59.66	824.71	62.05	824.46
64.5	824.21	66.33	824.02	66.4	824.01	66.58	824	69.87	823.72
71.16	823.51	76.19	822.98	78.2	822.58	79.76	822.39	80.97	822.17
82.06	822	82.24	822	83.04	821.95	86.52	821.79	89.9	821.62
103.11	820	104.51	819.92	119.44	819.22	126.71	818.99	132.07	818.81
138.62	817.88	142.32	817.81	143.36	817.81	147.79	817.79	148.81	817.78
159.57	817.91	159.93	817.91	160.86	817.92	166.57	817.93	181.03	817.28
183.74	817.12	185.96	817.1	189.41	816.85	192.81	816.61	194.42	816.53
198.7	816.19	201.12	816	224.53	814	228.53	812	231.17	811.13
250.36	810.59	253.75	809.8	307.36	810.09	311.08	812	314.99	814
320.415	816	327.33	818	332.99	820	346.37	822	350.32	822.31
352.77	822.52	354.6	822.67	361.3	823	384.2	823.39	389.28	822
399.36	822.1	420.71	821.49	448.57	822	511.85	824	514.31	824.83
517.68	826	518.07	826.14	523.06	828	526.54	829.27	528.55	830
533.41	831.77	534.05	832	538.57	833.64	539.55	834	542.74	835.21
543.59	835.53	544.84	836	548.45	837.8	548.86	838	552.86	840

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	143.36	.033	160.86	.035	224.53	.035	332.99	.035
361.3	.013	384.2	.035						

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

224.53 332.99 152.44 105.55 614.2 .1 .3  
 Blocked Obstructions num= 2  
 Sta L Sta R Elev Sta L Sta R Elev  
 \*\*\*\*\*  
 67.61 143.65 835 465.56 519.57 835

CROSS SECTION OUTPUT Profile #PF 1

\*\*\*\*\*  
 \* E.G. Elev (ft) \* 824.72 \* Element \* Left OB \* Channel \* Right OB \*  
 \* Vel Head (ft) \* 0.23 \* Wt. n-Val. \* 0.035 \* 0.035 \* 0.032 \*  
 \* W.S. Elev (ft) \* 824.49 \* Reach Len. (ft) \* 105.55 \* 105.55 \* 105.55 \*  
 \* Crit W.S. (ft) \* \* \* Flow Area (sq ft) \* 631.37 \* 1398.64 \* 310.06 \*  
 \* E.G. Slope (ft/ft) \* 0.000336 \* Area (sq ft) \* 631.37 \* 1398.64 \* 310.06 \*  
 \* Q Total (cfs) \* 8252.10 \* Flow (cfs) \* 1883.29 \* 5892.44 \* 476.36 \*  
 \* Top Width (ft) \* 327.71 \* Top width (ft) \* 86.68 \* 108.46 \* 132.57 \*  
 \* Vel Total (ft/s) \* 3.53 \* Avg. Vel. (ft/s) \* 2.98 \* 4.21 \* 1.54 \*  
 \* Max Chl Dpth (ft) \* 14.69 \* Hydr. Depth (ft) \* 7.28 \* 12.90 \* 2.34 \*  
 \* Conv. Total (cfs) \* 450023.6 \* Conv. (cfs) \* 102704.4 \* 321341.0 \* 25978.2 \*  
 \* Length Wtd. (ft) \* 105.55 \* Wetted Per. (ft) \* 94.11 \* 111.10 \* 134.91 \*  
 \* Min Ch El (ft) \* 809.80 \* Shear (lb/sq ft) \* 0.14 \* 0.26 \* 0.05 \*  
 \* Alpha \* 1.19 \* Stream Power (lb/ft s) \* 552.86 \* 0.00 \* 0.00 \*  
 \* Frctn Loss (ft) \* 0.02 \* Cum Volume (acre-ft) \* 2.08 \* 3.31 \* 3.12 \*  
 \* C & E Loss (ft) \* 0.05 \* Cum SA (acres) \* \* \* \*  
 \*\*\*\*\*

Warning: Divided flow computed for this cross-section.

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Lower RS: 2421.596

INPUT

Description:

Station Elevation Data num= 117  
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev  
 \*\*\*\*\*  
 0 840 2.4 838 3.98 836.71 4.83 836 6.42 834.71  
 7.29 834 7.57 833.78 9.78 832 10.72 831.25 12.29 830  
 13.8 828.98 15.26 828 17.57 826.57 18.49 826 20.59 824.69  
 21.71 824 23.06 823.23 25.21 822 28.1 820.35 28.74 820  
 34.09 819.22 36.52 818.88 40.59 818.28 40.6 818.28 41.19 818.22  
 42.87 818.04 43.16 818 45.11 817.8 47 817.58 49.1 816.98  
 49.33 816.96 49.85 816.91 51.06 816.77 53.61 816.48 58.5 816  
 61.54 815.75 61.99 815.72 65.18 815.28 67.15 815.07 70.09 814.52  
 73.19 814 73.87 813.91 75.09 813.82 76.89 813.71 83.62 813.28  
 84.78 813.23 85.25 813.2 86.34 813.01 89.24 812.83 95.26 812.49  
 98.03 812.35 102.97 812.03 105.29 812 106.07 812 106.41 811.9  
 106.53 812 108.25 812.48 109.66 812.93 110.83 813.3 113.22 814  
 118.69 814 138.26 814 139.46 813.78 140.2 813.65 143.53 813.05  
 148.05 812.23 148.53 812.15 148.72 812.11 149.33 812 151.61 811.43

155.86	810.37	158.05	809.8	160.2	809.8	161.03	809.81	182.9	809.9
193.52	809.93	200.73	809.95	228.75	810.1	230.24	811.95	230.28	812
230.36	812.1	232.17	814	233.25	815.08	242.99	815.55	264.24	816
286.38	816.24	304.43	815.6	361.73	816	379.92	818	385.94	819.5
387.93	820	392.66	820.99	397.15	822	403.4	822.95	431.28	823.15
438.18	822	441.14	821.34	443.33	820.86	445.4	820.43	447.52	820
464.78	820	468.66	820.23	473.73	820.39	479.97	820.65	483.21	820.77
494.84	821.03	523.25	819.76	536	820	544.38	821.08	620.38	821.38
690.56	823.34	802.04	824	828.96	826	833.31	826.8	836.02	827.31
839.52	828	847.77	830						

Manning's n Values num= 9

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.06	40.59	.033	47	.035	73.19	.033	83.62	.035
138.26	.035	233.25	.06	403.4	.033	431.28	.035		

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

138.26	233.25	114.88	182.56	4.38	.1	.3
--------	--------	--------	--------	------	----	----

Blocked Obstructions num= 1

Sta L	Sta R	Elev
691.58	794	835

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.65	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.08	* wt. n-Val.	* 0.035	* 0.035	* 0.050
* W.S. Elev (ft)	* 824.57	* Reach Len. (ft)	* 114.88	* 182.56	* 4.38
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 1087.66	* 1335.19	* 2269.09
* E.G. Slope (ft/ft)	*0.000126	* Area (sq ft)	* 1087.66	* 1335.19	* 2269.09
* Q Total (cfs)	* 8421.60	* Flow (cfs)	* 2353.36	* 3631.18	* 2437.06
* Top Width (ft)	* 686.53	* Top width (ft)	* 117.48	* 94.99	* 474.06
* Vel Total (ft/s)	* 1.79	* Avg. Vel. (ft/s)	* 2.16	* 2.72	* 1.07
* Max Chl Dpth (ft)	* 14.77	* Hydr. Depth (ft)	* 9.26	* 14.06	* 4.79
* Conv. Total (cfs)	*751669.6	* Conv. (cfs)	*210049.4	*324100.6	*217519.5
* Length wtd. (ft)	* 105.16	* Wetted Per. (ft)	* 119.56	* 97.66	* 477.05
* Min Ch El (ft)	* 809.80	* Shear (lb/sq ft)	* 0.07	* 0.11	* 0.04
* Alpha	* 1.50	* Stream Power (lb/ft s)	* 847.77	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.02	* Cum Volume (acre-ft)	* 4.42	* 44.93	* 41.12
* C & E Loss (ft)	* 0.01	* Cum SA (acres)	* 0.79	* 3.03	* 10.46

Warning: Divided flow computed for this cross-section.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.

This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Meathouse Fork



REACH: Lower

RS: 2236.871

INPUT

Description:

Station Elevation Data		num= 80		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	2.42	838	3.01	837.53	4.88	836	6.52	834.71
7.43	834	8.71	833.01	10.11	832	12.25	830.33	12.68	830
13.23	829.57	15.18	828	16.6	826.53	17.11	826	18.95	824.08
19.03	824	19.41	823.6	21.01	822	25.84	820.14	26.2	820
26.79	819.82	30.13	818.8	30.56	818.67	31.04	818.51	32.65	818.55
39.05	818.69	39.71	818.44	40.22	818.24	40.77	818	43.5	816.3
44.02	816	44.44	815.59	46.05	814	47.5	812.48	47.94	812
51.96	809.92	52.19	809.8	69.7	809.86	76.58	809.89	83.09	809.91
104.65	810	107.43	811.6	108.18	812	112.48	813.22	115.84	814
119.31	814.63	137.01	815.12	154.55	815.51	173.13	815.59	204.65	816
211.29	816.6	224.02	817.3	241.5	816	244.49	815.88	245.12	816
260.46	818	266.23	818.43	272.64	819	277.68	819.42	283.84	820
312.88	820.85	350.09	820	387.7	818.12	391.82	820	399.11	822
406.37	823.5	432.04	823.48	447.02	823.25	504.8	822	606.85	822.75
736.62	824	737.21	824.05	737.5	824.09	738.16	824.16	741.43	824.5
753.67	825.79	755.55	826	760.26	827.09	763.94	828	771.96	830

Manning's n Values		num= 8		Sta n Val		Sta n Val		Sta n Val	
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	31.04	.033	46.05	.035	119.31	.06	272.64	.035
406.37	.013	432.04	.033	447.02	.035				

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 46.05 119.31 251.91 229.47 12.96 .1 .3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
618.43	736.8	835

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.62	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.16	* Wt. n-Val.	* 0.039	* 0.035	* 0.049
* W.S. Elev (ft)	* 824.46	* Reach Len. (ft)	* 251.91	* 229.47	* 12.96
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 146.93	* 1013.12	* 2237.53
* E.G. Slope (ft/ft)	*0.000307	* Area (sq ft)	* 146.93	* 1013.12	* 2237.53
* Q Total (cfs)	* 8421.60	* Flow (cfs)	* 292.03	* 4255.01	* 3874.56
* Top width (ft)	* 604.05	* Top width (ft)	* 27.46	* 73.26	* 503.33
* Vel Total (ft/s)	* 2.48	* Avg. Vel. (ft/s)	* 1.99	* 4.20	* 1.73
* Max chl Dpth (ft)	* 14.66	* Hydr. Depth (ft)	* 5.35	* 13.83	* 4.45
* Conv. Total (cfs)	*480711.5	* Conv. (cfs)	* 16669.3	*242879.2	*221163.0
* Length Wtd. (ft)	* 148.60	* wetted Per. (ft)	* 30.61	* 75.50	* 506.65
* Min ch El (ft)	* 809.80	* Shear (lb/sq ft)	* 0.09	* 0.26	* 0.08
* Alpha	* 1.70	* Stream Power (lb/ft s)	* 771.96	* 0.00	* 0.00

\* Frctn Loss (ft) \* 0.05 \* Cum Volume (acre-ft) \* 2.79 \* 40.01 \* 40.90 \*  
 \* C & E Loss (ft) \* 0.01 \* Cum SA (acres) \* 0.60 \* 2.67 \* 10.41 \*  
 \*\*\*\*\*

Warning: Divided flow computed for this cross-section.

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Lower RS: 2005.226

INPUT

Description:

Station Elevation Data num= 67

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	830	3.33	828	3.51	827.92	8.38	826.1	9.86	826.02
10.17	826	11.54	825.94	13.67	825.85	16.69	825.76	19.16	825
20.02	824.76	21.44	824.39	22.82	824	25.01	822.89	26.69	822
28.27	820.31	28.56	820	29.27	819.23	30.41	818	30.58	817.82
32.27	816	32.87	815.53	34.82	814	35.95	813.18	37.72	812
43.21	810.11	43.52	810	43.55	809.99	44	809.86	44.21	809.8
57.46	809.77	93.44	809.7	94.1	809.92	94.39	810	106.84	811.29
113.26	812	116.34	812.53	123.69	814	125.41	814.23	134.6	814
140.71	813.65	157.35	814	162.73	816	166.62	818	219.96	820
224.67	820.23	261.72	822	291.85	822.65	338.25	822.45	354.69	823.04
378.14	823.06	442.52	822.3	536.09	822.5	600.57	823.78	624.56	824
637.01	824	641.97	824.64	644.55	824.9	647.65	825.09	653.2	825.74
653.66	825.78	653.86	825.8	655.46	826	659.43	826.9	664.23	828
667.25	828.7	673.02	830						

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	34.82	.035	125.41	.06	166.62	.035	354.69	.013
378.14	.033	442.52	.035						

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 34.82 125.41 147.51 152.72 70.79 .1 .3

Blocked Obstructions num= 1  
 Sta L Sta R Elev  
 \*\*\*\*\*  
 544.3 573.38 835

CROSS SECTION OUTPUT Profile #PF 1

\*\*\*\*\*  
 \* E.G. Elev (ft) \* 824.56 \* Element \* Left OB \* Channel \* Right OB \*  
 \* Vel Head (ft) \* 0.27 \* wt. n-Val. \* 0.100 \* 0.035 \* 0.044 \*  
 \* W.S. Elev (ft) \* 824.29 \* Reach Len. (ft) \* 147.51 \* 152.72 \* 70.79 \*  
 \* Crit W.S. (ft) \* \* Flow Area (sq ft) \* 58.29 \* 1236.08 \* 1353.36 \*  
 \* E.G. slope (ft/ft) \*0.000400 \* Area (sq ft) \* 58.29 \* 1236.08 \* 1353.36 \*  
 \*\*\*\*\*

* Q Total (cfs)	* 8421.60	* Flow (cfs)	* 39.59	* 5931.08	* 2450.94	*
* Top width (ft)	* 588.39	* Top width (ft)	* 13.03	* 90.59	* 484.77	*
* Vel Total (ft/s)	* 3.18	* Avg. Vel. (ft/s)	* 0.68	* 4.80	* 1.81	*
* Max Chl Dpth (ft)	* 14.59	* Hydr. Depth (ft)	* 4.47	* 13.64	* 2.79	*
* Conv. Total (cfs)	* 421318.8	* Conv. (cfs)	* 1980.6	* 296721.9	* 122616.3	*
* Length wtd. (ft)	* 126.56	* Wetted Per. (ft)	* 16.86	* 91.94	* 488.45	*
* Min Ch El (ft)	* 809.70	* Shear (lb/sq ft)	* 0.09	* 0.34	* 0.07	*
* Alpha	* 1.70	* Stream Power (lb/ft s)	* 673.02	* 0.00	* 0.00	*
* Frctn Loss (ft)	* 0.04	* Cum Volume (acre-ft)	* 2.20	* 34.09	* 40.36	*
* C & E Loss (ft)	* 0.03	* Cum SA (acres)	* 0.48	* 2.24	* 10.26	*

Warning: Divided flow computed for this cross-section.

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Lower

RS: 1852.485

INPUT

Description:

Station Elevation Data		num= 95		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	830	.6	829.62	4.98	828.05	7.01	828.02	8.23	828
10.1	828	11.89	827.37	14.51	826	16.23	824.67	17.07	824
18.17	823.07	19.41	822	21.43	820.29	21.77	820	22.49	819.39
24.14	818	26.33	816.32	26.75	816	27.39	815.58	29.81	814
30.44	813.6	32.98	812	36.29	810.7	38.13	810	38.83	809.82
39.53	809.64	40.1	809.5	48.8	809.46	55.57	809.4	79.44	809.16
85.39	809.1	89.56	809.1	112.11	809.51	112.56	809.7	112.68	809.67
113.11	809.83	113.67	810	114.97	810.64	117.02	811.7	117.41	811.9
117.59	812	119.2	812.51	120.99	813.07	124.04	814	128.79	815.28
137.84	814	151.41	813.38	157.36	814	161.88	816	163.5	816.1
164.21	816.12	173.31	816.52	192.16	817.38	205.83	818	218.06	818.82
236.65	820	278.18	821.85	303.1	822	320.84	822	326.76	822.47
333.94	822.97	356.11	823.2	357.02	822.9	360.22	822.08	360.6	822
403.27	821.6	447.81	821.8	509.02	821.08	525.99	821.08	590.82	822
594.92	822.46	601.33	823.22	604.46	823.59	607.95	824	611.59	824.87
616.26	826	618.02	826.41	624.91	828	633.93	830	638.5	830.72
646.44	832	648.48	832.31	650.42	832.58	655.38	833.3	660.74	834
661.04	834.04	661.36	834.08	668.65	835.01	675.33	835.81	676.85	836
684.13	837.15	688.09	837.79	689.4	838	694.16	838.81	701.17	840

Manning's n Values		num= 6		Sta n Val		Sta n Val		Sta n Val	
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	27.39	.035	128.79	.06	151.41	.035	333.94	.013
356.11	.035								

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

27.39 128.79 44.03 40.42 40.14 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

```

*****
* E.G. Elev (ft)      * 824.49 * Element          * Left OB * Channel * Right OB *
* Vel Head (ft)      * 0.16  * Wt. n-Val.      * 0.100  * 0.035  * 0.038  *
* W.S. Elev (ft)     * 824.32 * Reach Len. (ft) * 44.03  * 40.42  * 40.14  *
* Crit W.S. (ft)     *      * Flow Area (sq ft) * 48.20  * 1432.03 * 1784.21 *
* E.G. Slope (ft/ft) * 0.000245 * Area (sq ft)    * 48.20  * 1432.03 * 1784.21 *
* Q Total (cfs)      * 8421.60 * Flow (cfs)      * 25.77  * 5473.92 * 2921.91 *
* Top Width (ft)     * 592.65 * Top width (ft)  * 10.73  * 101.40  * 480.52  *
* Vel Total (ft/s)   * 2.58  * Avg. Vel. (ft/s) * 0.53  * 3.82  * 1.64  *
* Max Chl Dpth (ft) * 15.22  * Hydr. Depth (ft) * 4.49  * 14.12  * 3.71  *
* Conv. Total (cfs)  * 537552.4 * Conv. (cfs)     * 1645.1 * 349401.5 * 186505.8 *
* Length wtd. (ft)  * 40.33  * Wetted Per. (ft) * 13.85  * 103.94 * 481.59 *
* Min Ch El (ft)    * 809.10 * Shear (lb/sq ft) * 0.05  * 0.21  * 0.06  *
* Alpha              * 1.57  * Stream Power (lb/ft s) * 701.17 * 0.00  * 0.00  *
* Frctn Loss (ft)   * 0.01  * Cum Volume (acre-ft) * 2.02  * 29.41  * 37.81  *
* C & E Loss (ft)   * 0.00  * Cum SA (acres)   * 0.44  * 1.90  * 9.48  *
*****

```

CROSS SECTION

RIVER: Meathouse Fork

REACH: Lower

RS: 1812.068

INPUT

Description:

```

Station Elevation Data      num=      79
Sta      Elev      Sta      Elev      Sta      Elev      Sta      Elev      Sta      Elev
*****
0         830      1.73  828.96   3.32    828      4.29  827.3   6.14    826
6.98    825.33   8.31  824.27   8.65    824     10.1  822.84  11.11   822
11.47   821.69  13.49  820      15.59   818.2   15.83  818     17.67  816.47
18.27    816    20.33  814.27   20.66   814     20.85  813.85  23.11   812
26.5    810.21   26.9   810      28.45   809.39  28.95  809.2   29.09  809.2
50.32   809.16   60.5   809.14   80.04   809.1   97.7   809.1  107.43  809.1
108.42  809.55  109.41  810     110.75  810.56  114.2   812    117.5  813.04
120.76   814    123.82  814.89  132.65  814     145.63  813.45  152.09  814
156.36   816    157.53  816.05  158.47  816.09  174.51  816.79  182.9   817.14
203.16   818    232.77  820     237.96  820.14  266.87  821.47  308.3   822
320.97   823    341.83  823.21  345.85  822     491.35  821.08  559.28  821.08
581.74   822    592.21  822.81  594.91  822.92  599.36  823.32  600.78  823.4
607.08   824    610.09  824.66  615.96  826     617.48  826.35  621.11  827.15
623.61  827.71  624.97  828     628.83  828.68  636.94  830     645.91  831.35
650.04   832    659.59  833.51  662.72  834     672.22  835.45  675.86  836
685.98  837.51  688.11  837.83  689.24  838     697.84  839.31

```

Manning's n Values

```

num=      6
Sta      n Val      Sta      n Val      Sta      n Val      Sta      n Val
*****

```

0 .1 18.27 .035 123.82 .06 145.63 .035 320.97 .013  
 341.83 .035

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 18.27 123.82 29.48 25.45 34.43 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

```
*****
* E.G. Elev (ft) * 824.47 * Element * Left OB * Channel * Right OB *
* Vel Head (ft) * 0.15 * Wt. n-Val. * 0.100 * 0.035 * 0.038 *
* W.S. Elev (ft) * 824.33 * Reach Len. (ft) * 29.48 * 25.45 * 34.43 *
* Crit W.S. (ft) * * * Flow Area (sq ft) * 41.60 * 1520.51 * 1843.32 *
* E.G. Slope (ft/ft) *0.000217 * Area (sq ft) * 41.60 * 1520.51 * 1843.32 *
* Q Total (cfs) * 8421.60 * Flow (cfs) * 19.72 * 5517.31 * 2884.57 *
* Top Width (ft) * 600.32 * Top width (ft) * 10.03 * 105.55 * 484.74 *
* Vel Total (ft/s) * 2.47 * Avg. Vel. (ft/s) * 0.47 * 3.63 * 1.56 *
* Max Chl Dpth (ft) * 15.23 * Hydr. Depth (ft) * 4.15 * 14.41 * 3.80 *
* Conv. Total (cfs) *572189.8 * Conv. (cfs) * 1339.6 *374863.3 *195986.8 *
* Length wtd. (ft) * 28.57 * Wetted Per. (ft) * 13.04 * 108.66 * 485.77 *
* Min Ch El (ft) * 809.10 * Shear (lb/sq ft) * 0.04 * 0.19 * 0.05 *
* Alpha * 1.55 * Stream Power (lb/ft s) * 697.84 * 0.00 * 0.00 *
* Frctn Loss (ft) * 0.01 * Cum Volume (acre-ft) * 1.97 * 28.04 * 36.14 *
* C & E Loss (ft) * 0.00 * Cum SA (acres) * 0.43 * 1.81 * 9.03 *
*****
```

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Lower

RS: 1786.606

INPUT

Description:

Station		Elevation Data		num= 80		Sta		Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	830	3.34	828.32	4.01	828	6.64	826.12	6.8	826
7.1	825.76	7.79	825.22	9.37	824	9.64	823.8	11.96	822
12.82	821.35	14.57	820	17.05	818.14	17.24	818	17.7	817.77
21.2	816	23.74	814.73	26.52	813.31	29.13	812	31.41	810.79
33.1	810	33.31	809.89	34.48	809.2	52.54	809.16	60.3	809.14
78.3	809.1	82.43	809.79	96.51	809.68	99.45	809.1	109.1	809.1
109.16	809.13	111.49	810	117.05	812	122.81	814	125.69	815.03
138.08	814	148.85	813.49	156	814	159.9	816	200.84	817.9
202.78	818	203.35	818.05	208.74	818.53	217.07	819.18	220.25	819.46
227.17	820	266.69	821.29	305.42	822	319.52	823.01	339.86	823.25
344.61	822	345.76	821.95	424.65	820.92	428.02	820.94	429.74	820.94
537.34	821.55	540.11	821.57	589.07	822	591.55	822	598.97	822.6
613.42	823.64	616.28	823.86	618.32	824	622.78	825	627.56	826
629.97	826.48	637.78	828	639.93	828.34	643.64	828.96	649.72	830
657.22	831.23	661.71	832	672.92	833.76	674.42	834	683.53	835.45
687	836	687.69	836.11	699.53	838	701.26	838.31	710.33	840

Manning's n Values		num= 6		Sta n Val		Sta n Val		Sta n Val	
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	23.74	.035	125.69	.06	148.85	.035	319.52	.013
339.86	.035								

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	23.74	125.69		105.08	108.5	124.1	.1 .3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.47	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.15	* Wt. n-Val.	* 0.100	* 0.035	* 0.038
* W.S. Elev (ft)	* 824.31	* Reach Len. (ft)	* 105.08	* 108.50	* 124.10
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 77.94	* 1456.65	* 1844.25
* E.G. Slope (ft/ft)	* 0.000231	* Area (sq ft)	* 77.94	* 1456.65	* 1844.25
* Q Total (cfs)	* 8421.60	* Flow (cfs)	* 47.28	* 5440.94	* 2933.39
* Top Width (ft)	* 610.74	* Top width (ft)	* 14.77	* 101.95	* 494.02
* Vel Total (ft/s)	* 2.49	* Avg. Vel. (ft/s)	* 0.61	* 3.74	* 1.59
* Max Chl Dpth (ft)	* 15.21	* Hydr. Depth (ft)	* 5.28	* 14.29	* 3.73
* Conv. Total (cfs)	* 554630.6	* Conv. (cfs)	* 3113.5	* 358329.8	* 193187.3
* Length wtd. (ft)	* 114.24	* Wetted Per. (ft)	* 17.68	* 104.44	* 495.05
* Min Ch El (ft)	* 809.10	* Shear (lb/sq ft)	* 0.06	* 0.20	* 0.05
* Alpha	* 1.59	* Stream Power (lb/ft s)	* 710.33	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.02	* Cum Volume (acre-ft)	* 1.93	* 27.17	* 34.69
* C & E Loss (ft)	* 0.01	* Cum SA (acres)	* 0.42	* 1.75	* 8.65

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Lower RS: 1674.792

INPUT

Description:

Station Elevation Data		num= 94		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	830	2.66	828	3.75	827.05	5.04	826	7.31	824.18
7.51	824.02	9.91	822	10.39	821.59	12.28	820	14.68	818.09
14.79	818	15.27	817.53	16.79	816	17.04	815.74	18.76	814
19.24	813.51	20.73	812	22.3	811.14	24.52	810	25.95	809.57
26.7	809.33	27.56	809.1	30.19	808.98	35.6	808.84	47.52	808.46
52.62	808.42	55.03	808.36	62.86	808.31	63.26	808.31	68.57	808.35
72.32	808.41	76.95	808.5	85.28	808.57	89.67	808.66	97.02	808.82
98.03	808.84	100.76	808.91	102.08	809.69	102.69	810	106.29	811.72
106.73	811.92	106.89	812	111.27	813.8	111.75	814	115.12	815.35
134.2	814	144.18	813.5	152.04	814	162.7	816	187.88	818
195.27	820	253.59	820.67	288.96	822	298.97	822.92	320.03	822.93
323.27	822	332.71	820	391.45	820	406.66	820.13	408.13	820.15

420.6	820.26	426.17	820.31	436.53	820.41	441.82	820.46	446.44	820.5
450.97	820.54	610.8	822	612.23	822	616.44	822.65	621.44	823.4
626.16	824	630.15	824.67	634.39	825.36	637.82	826	646.33	827.73
647.62	828	655.98	829.48	658.91	830	669.45	831.57	670.6	831.73
672.46	832	676.94	832.64	681.77	833.34	683.96	833.64	686.46	834
690.53	834.57	694.69	835.13	701.14	836	703.06	836.27	705.23	836.58
710.83	837.36	715.5	838	721.27	838.71	731.36	840		

Manning's n Values num= 6

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	18.76	.035	115.12	.06	134.2	.035	298.97	.013
320.03	.035								

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

18.76	115.12	130.48	119.69	198.02	.1	.3
-------	--------	--------	--------	--------	----	----

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.44	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.13	* wt. n-Val.	* 0.100	* 0.035	* 0.037
* W.S. Elev (ft)	* 824.30	* Reach Len. (ft)	* 130.48	* 119.69	* 198.02
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 57.21	* 1440.33	* 2113.53
* E.G. Slope (ft/ft)	* 0.000197	* Area (sq ft)	* 57.21	* 1440.33	* 2113.53
* Q Total (cfs)	* 8421.60	* Flow (cfs)	* 28.47	* 5108.63	* 3284.51
* Top width (ft)	* 620.80	* Top width (ft)	* 11.60	* 96.36	* 512.84
* Vel Total (ft/s)	* 2.33	* Avg. Vel. (ft/s)	* 0.50	* 3.55	* 1.55
* Max Chl Dpth (ft)	* 15.99	* Hydr. Depth (ft)	* 4.93	* 14.95	* 4.12
* Conv. Total (cfs)	* 599803.6	* Conv. (cfs)	* 2027.4	* 363846.8	* 233929.4
* Length wtd. (ft)	* 150.78	* Wetted Per. (ft)	* 15.53	* 99.24	* 514.04
* Min Ch El (ft)	* 808.31	* Shear (lb/sq ft)	* 0.05	* 0.18	* 0.05
* Alpha	* 1.58	* Stream Power (lb/ft s)	* 731.36	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.03	* Cum Volume (acre-ft)	* 1.77	* 23.56	* 29.05
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.39	* 1.50	* 7.21

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Lower

RS: 1554.849

INPUT

Description:

Station Elevation Data num= 100

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	830	1.47	828.11	1.55	828	2.97	826.17	3.11	826
4.5	824.21	4.67	824	5.46	822.97	6.19	822	6.33	821.8
7.62	820	7.78	819.77	7.8	819.74	9.05	818	9.24	817.73
10.48	816	10.71	815.66	11.9	814	12.21	813.54	13.32	812
14.67	811.16	15.92	810.37	16.5	810	17.42	809.5	18.12	809.1

willard.rep

23.35	808.84	33.59	808.44	42.34	808.21	44.47	808.21	55.66	808.27
58.87	808.29	85.48	808.51	86.6	808.51	88.27	809.5	89.12	810
90.11	810.53	93.05	812	93.15	812.03	98.66	814	100.88	814.6
132.58	814	135.88	814	147.7	815	152.33	815.37	160.67	816
161.25	816.15	161.71	816.24	163.2	816.52	168.33	817.6	170.72	818
172.66	818.23	175.25	818.5	180.75	819.13	183.39	819.41	189.65	820
228.78	819.2	240.39	820	251.89	822	266.6	823.59	287.31	823.53
317.19	820	405.76	820	435	820.13	439.36	820.17	440.9	820.19
448.54	820.24	561.9	822	567.33	822	576.68	822.22	594.84	822.49
598.63	822.57	602.95	822.67	608.88	822.83	618.95	823.1	630.91	823.34
648.78	824	649.7	824	650.64	824.05	651.09	824.07	659.02	824.5
691.63	826	693.23	826	701.16	827.08	708.7	828	721.58	829.59
725.17	830	732.01	831.13	737.41	832	743.46	832.99	750.12	834
750.5	834.06	750.76	834.1	750.99	834.13	752.29	834.34	760.67	835.67
762.67	836	767.24	837.1	771.09	838	776.11	839.15	779.86	840

Manning's n	Values	num=	6	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	11.9	.035	100.88	.06	135.88	.035	266.6	.013
287.31	.035								

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	11.9	100.88	203.32	252.49	154.61	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.40	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.14	* Wt. n-Val.	* 0.100	* 0.035	* 0.039
* W.S. Elev (ft)	* 824.26	* Reach Len. (ft)	* 203.32	* 252.49	* 154.61
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 37.65	* 1340.68	* 2170.50
* E.G. Slope (ft/ft)	*0.000218	* Area (sq ft)	* 37.65	* 1340.68	* 2170.50
* Q Total (cfs)	* 8421.60	* Flow (cfs)	* 17.08	* 5010.82	* 3393.69
* Top Width (ft)	* 650.08	* Top width (ft)	* 7.44	* 88.98	* 553.67
* Vel Total (ft/s)	* 2.37	* Avg. Vel. (ft/s)	* 0.45	* 3.74	* 1.56
* Max chl Dpth (ft)	* 16.05	* Hydr. Depth (ft)	* 5.06	* 15.07	* 3.92
* Conv. Total (cfs)	*570091.3	* Conv. (cfs)	* 1156.5	*339202.4	*229732.4
* Length wtd. (ft)	* 214.71	* Wetted Per. (ft)	* 12.67	* 92.15	* 554.61
* Min Ch El (ft)	* 808.21	* Shear (lb/sq ft)	* 0.04	* 0.20	* 0.05
* Alpha	* 1.65	* Stream Power (lb/ft s)	* 779.86	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.05	* Cum Volume (acre-ft)	* 1.63	* 19.74	* 19.31
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.36	* 1.25	* 4.79

CROSS SECTION

RIVER: Meathouse Fork  
REACH: Lower

RS: 1294.270

INPUT  
Description:



willard.rep

Station Elevation Data		num= 149		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	830	6	828	6.33	827.8	6.96	827.44	7.62	827.06
9.48	826	10.29	825.41	12.14	824	13.13	823.22	14.73	822
15.08	821.7	17.29	820	18.3	819.12	19.64	818	21.33	816.56
22.05	816	23.89	814.45	24.47	814	28.43	812.02	28.47	812
32.66	810.04	32.75	810	34.08	809.54	38.59	808	38.66	807.98
39.11	807.81	39.38	807.69	80.46	807.69	94.68	807.71	96.63	807.96
97.03	808	100.04	808.54	103.21	809.08	105.59	809.48	106.57	809.64
108.54	810	112.7	811.37	114.7	812	119.49	812.23	127.37	812.6
131.07	812.79	136.21	813.03	138.2	813.13	146.07	813.53	149.2	813.68
149.59	813.7	150.21	813.74	155.17	814	167.03	815.89	167.66	816
175.38	816.57	194.98	818	197.08	818.33	206.92	820	209.48	820.48
217.46	822	218.57	822.14	220.28	822.39	224.4	823.02	238.6	823.17
245.6	823.38	247.24	822.88	247.64	822.77	248.02	822.67	248.35	822.58
249.01	822.41	250.6	822	252.94	820.83	254.57	820	262.15	818.35
263.85	818	312.88	818	323.04	818.49	330.58	818.84	341.68	819.38
356.42	820	359.5	820	405.73	821.73	408.93	821.84	412.56	822
412.81	822	414.07	822.05	427.78	822.46	437.55	822.74	447.91	823.02
456.19	823.21	463.38	823.32	472.25	823.61	480.5	823.89	481.41	823.9
483.61	824	489.93	824.41	496.41	824.82	511.04	825.75	512.62	825.84
514.88	826	523.87	827.06	531.32	828	534.1	828.36	536.59	828.69
546.57	830	549.15	830.31	553.89	830.87	560.57	831.74	561.21	831.83
562.54	832	568.55	832.74	571.5	833.08	576.65	833.76	577.46	833.86
578.47	834	587.44	834.93	591.45	835.37	593.78	835.61	594.67	835.69
595.23	835.74	595.66	835.77	596.71	835.85	596.97	835.87	598.89	835.97
599.41	836	610.82	836	620.55	836.25	632.85	836.82	635.33	836.84
637.03	836.86	638.33	836.89	641.29	836.94	646.59	837.03	647.94	837.12
650.22	837.28	652.4	837.41	655.33	837.47	656.6	837.57	658.28	837.71
661.72	837.97	661.81	837.97	662.13	838	666.52	838.36	666.6	838.37
666.73	838.38	670.46	838.63	671.37	838.68	674.7	838.85	677.61	839.02
680.53	839.16	686.01	839.47	687.7	839.55	695.58	840		

Manning's n Values		num= 6		Sta n Val		Sta n Val		Sta n Val	
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	28.43	.035	114.7	.06	146.07	.035	224.4	.013
245.6	.035								

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	28.43	114.7		48.1 101.54	99.66	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.35	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.16	* wt. n-Val.	* 0.100	* 0.035	* 0.040
* W.S. Elev (ft)	* 824.19	* Reach Len. (ft)	* 48.10	* 101.54	* 99.66
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 107.47	* 1365.25	* 1759.24
* E.G. Slope (ft/ft)	* 0.000214	* Area (sq ft)	* 107.47	* 1365.25	* 1759.24
* Q Total (cfs)	* 8421.60	* Flow (cfs)	* 70.20	* 5288.34	* 3063.06
* Top width (ft)	* 474.65	* Top width (ft)	* 16.54	* 86.27	* 371.84

* Vel Total (ft/s)	* 2.61	* Avg. Vel. (ft/s)	* 0.65	* 3.87	* 1.74
* Max Chl Dpth (ft)	* 16.50	* Hydr. Depth (ft)	* 6.50	* 15.83	* 4.73
* Conv. Total (cfs)	* 575829.4	* Conv. (cfs)	* 4800.2	* 361592.0	* 209437.3
* Length wtd. (ft)	* 99.26	* Wetted Per. (ft)	* 20.62	* 87.62	* 373.55
* Min Ch El (ft)	* 807.69	* Shear (lb/sq ft)	* 0.07	* 0.21	* 0.06
* Alpha	* 1.55	* Stream Power (lb/ft s)	* 695.58	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.02	* Cum Volume (acre-ft)	* 1.29	* 11.90	* 12.34
* C & E Loss (ft)	* 0.01	* Cum SA (acres)	* 0.31	* 0.74	* 3.14

CROSS SECTION

RIVER: Meathouse Fork

REACH: Lower

RS: 1192.596

INPUT

Description:

Station Elevation Data

num= 194

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	830	1.59	829.77	2.45	829.63	3.73	829.43	5.49	829.14
7.91	828.74	9.51	828.47	12.3	828	12.72	827.93	12.83	827.91
13.02	827.87	17	827.17	21.02	826.41	22.08	826.21	23.2	826
26.45	825.4	29.47	824.89	31.28	824.58	34.71	824	38.25	823.49
38.42	823.46	41.22	822.95	46.15	822	49.24	821.24	55.79	820
56.29	819.91	56.75	819.84	61.56	819.07	63.32	818.78	67.22	818.27
67.66	818.2	67.95	818.17	69.56	818	71.14	817.79	71.56	817.73
74.16	817.42	76.2	817.15	79.41	816.67	80.61	816.51	83.84	816
86.3	815.63	87.51	815.46	89.91	815.12	90.52	815.03	91.17	814.93
91.57	814.88	94.66	814.46	95.59	814.33	97.92	814	99.67	813.66
100.45	813.49	102.92	812.98	107.49	812.02	107.57	812	111.82	810.5
113.4	810	116.19	809.15	117.05	808.99	118.41	808.61	120.28	808
121.14	807.71	124.74	806.42	127.86	806.45	128.22	806.45	128.69	806.44
142.71	806.53	146.04	806.55	156.28	806.61	159.8	806.64	164.33	806.67
190.84	806.92	191.04	807.03	191.31	807.2	192.58	808	195.19	809.56
195.94	810	196.46	810.2	201.28	812	205.83	812.49	209.85	812.93
211.71	813.15	220.11	813.54	221.14	813.53	224.51	813.5	225.04	813.49
225.19	813.49	225.23	813.49	225.68	813.49	226.46	813.49	244.18	813.94
246.74	814	254.28	814	256.89	814.47	265.42	816	268.72	816.81
273.28	818	276.48	818.76	281.49	820	288.56	821.47	291.1	822
291.33	822.01	292.89	822.08	300.2	822.55	321.2	823.79	331.34	822
331.62	821.96	333.72	821.68	334.54	821.67	341.34	820.68	354.66	820
363.88	820	376.58	820.36	388.76	820.24	390.93	820.25	392.34	820.26
393.28	820.26	394.05	820.26	404.7	820.51	432.66	821.19	461.12	821.53
472.69	821.76	475.13	821.83	476.38	821.85	481.48	822	483.04	822.04
494.25	822.33	500.74	822.51	501.75	822.53	506.56	822.61	512.28	822.92
514.56	823.07	517.98	823.29	521.95	823.53	527.98	823.88	530.14	824
533.8	824.18	538.91	824.45	543.97	824.7	549.84	824.99	562.37	825.68
568.79	825.91	570.31	826	571.54	826	606.6	827.49	617.21	828
618.26	828.02	621.83	828.08	626.98	828.45	631.84	828.67	635.8	828.86
651.84	829.99	652	830	654.88	830.36	658.88	830.69	661.36	830.82

willard.rep

665.11	831.4	667.28	831.57	671.3	831.85	671.88	831.9	673.38	832
675.42	832.15	677.58	832.29	679.31	832.36	681.42	832.41	689.21	832.57
696.73	833.15	703.03	833.32	712.96	833.86	713.59	833.89	713.95	833.9
714.54	833.94	715.52	834	718.53	834.17	718.81	834.19	719.1	834.21
722.13	834.41	722.88	834.47	725.82	834.65	727.4	834.77	729.89	834.95
732.01	835.1	735.73	835.48	736.98	835.62	738.5	835.83	739.81	836
741.9	836.33	743.37	836.59	746.65	837.14	748.13	837.4	751.72	838
753.63	838.33	754.81	838.54	758.78	839.23	763.08	840		

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	55.79	.06	102.92	.035	220.11	.06	256.89	.035
300.2	.013	321.2	.035						

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
102.92	220.11	68.62	189.67	570.98	.1	.3	

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.33	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.14	* Wt. n-Val.	* 0.058	* 0.035	* 0.044
* W.S. Elev (ft)	* 824.18	* Reach Len. (ft)	* 68.62	* 189.67	* 570.98
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 401.46	* 1833.61	* 1208.59
* E.G. Slope (ft/ft)	*0.000172	* Area (sq ft)	* 401.46	* 1833.61	* 1208.59
* Q Total (cfs)	* 8421.60	* Flow (cfs)	* 483.59	* 6313.41	* 1624.60
* Top Width (ft)	* 500.26	* Top width (ft)	* 69.30	* 117.19	* 313.77
* Vel Total (ft/s)	* 2.45	* Avg. Vel. (ft/s)	* 1.20	* 3.44	* 1.34
* Max Chl Dpth (ft)	* 17.76	* Hydr. Depth (ft)	* 5.79	* 15.65	* 3.85
* Conv. Total (cfs)	*641253.4	* Conv. (cfs)	* 36822.8	*480727.7	*123703.0
* Length wtd. (ft)	* 220.86	* Wetted Per. (ft)	* 70.23	* 119.48	* 315.05
* Min Ch El (ft)	* 806.42	* Shear (lb/sq ft)	* 0.06	* 0.17	* 0.04
* Alpha	* 1.56	* Stream Power (lb/ft s)	* 763.08	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.04	* Cum Volume (acre-ft)	* 1.01	* 8.17	* 8.94
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.26	* 0.50	* 2.36

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Lower RS: 1000.000

INPUT

Description:

Station	Elevation	Data	num=	29	Sta	Elev	Sta	Elev	Sta	Elev
0	830	14.09	828	28.28	826	34.99	824	121.08	822	
146.41	822	254.08	820	257.7	818	260.84	816	276.97	814	
295.68	812	306.18	810.08	306.6	810	313.88	808	318.6	806.42	
400.77	806.12	403.71	808	404.94	808.92	406.39	810	408.78	812	

411.22 814 413.6 816 415.74 818 420.71 820 437.65 822.26  
 458.87 824.49 476.21 826 485.54 828 493.83 830

Manning's n Values num= 6  
 Sta n Val Sta n Val Sta n Val Sta n Val Sta n Val  
 \*\*\*\*\*  
 0 .035 254.08 .06 295.68 .035 408.78 .035 437.65 .013  
 458.87 .035

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 295.68 408.78 1 1 1 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

\*\*\*\*\*  
 \* E.G. Elev (ft) \* 824.29 \* Element \* Left OB \* Channel \* Right OB \*  
 \* Vel Head (ft) \* 0.19 \* wt. n-val. \* 0.049 \* 0.035 \* 0.033 \*  
 \* W.S. Elev (ft) \* 824.10 \* Reach Len. (ft) \* \* \* \*  
 \* Crit W.S. (ft) \* 812.71 \* Flow Area (sq ft) \* 876.90 \* 1919.65 \* 155.70 \*  
 \* E.G. Slope (ft/ft) \* 0.000181 \* Area (sq ft) \* 876.90 \* 1919.65 \* 155.70 \*  
 \* Q Total (cfs) \* 8421.60 \* Flow (cfs) \* 1044.31 \* 7139.18 \* 238.11 \*  
 \* Top Width (ft) \* 420.50 \* Top width (ft) \* 261.03 \* 113.10 \* 46.38 \*  
 \* Vel Total (ft/s) \* 2.85 \* Avg. Vel. (ft/s) \* 1.19 \* 3.72 \* 1.53 \*  
 \* Max Chl Dpth (ft) \* 17.98 \* Hydr. Depth (ft) \* 3.36 \* 16.97 \* 3.36 \*  
 \* Conv. Total (cfs) \* 625214.6 \* Conv. (cfs) \* 77529.1 \* 530008.2 \* 17677.3 \*  
 \* Length wtd. (ft) \* \* \* Wetted Per. (ft) \* 262.41 \* 115.75 \* 49.25 \*  
 \* Min Ch El (ft) \* 806.12 \* Shear (lb/sq ft) \* 0.04 \* 0.19 \* 0.04 \*  
 \* Alpha \* 1.47 \* Stream Power (lb/ft s) \* 493.83 \* 0.00 \* 0.00 \*  
 \* Frctn Loss (ft) \* \* \* Cum Volume (acre-ft) \* \* \* \*  
 \* C & E Loss (ft) \* \* \* Cum SA (acres) \* \* \* \*  
 \*\*\*\*\*

CROSS SECTION

RIVER: Sugarcamp Run  
 REACH: Upper RS: 1908.741

INPUT

Description:

Station Elevation Data num= 65  
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev  
 \*\*\*\*\*  
 0 840 2.85 838 4.65 836.74 5.7 836 9.54 834.13  
 9.59 834.11 9.79 834 13.88 832.24 14.39 832 15.17 831.68  
 19.44 830 23.66 828.84 26.86 828 29.01 827.73 37.13 826.73  
 42.61 826 43.85 825.53 45.76 824.77 47.71 824 49.37 823.29  
 50.5 822.81 50.98 822.62 52.45 822.6 64.28 822.72 65.04 823.15  
 66.57 823.92 66.71 824 67.78 824.38 90.72 825.58 111.26 825.14  
 113.49 824 114.23 823.78 126.95 823.32 131.24 824 134.22 824.94  
 137.66 826 155.28 826 170.11 826.41 182.16 826.39 183.86 826.43  
 190.71 826.37 191.94 826.4 197.22 826.38 198.66 826.41 201.37 826.51  
 204.96 826.54 209.31 826.73 211.91 826.81 217.21 827.08 224.29 827.51

225.52	827.57	232.07	828	250.42	829.7	253.25	830	254.32	830.27
260.93	832	266.35	833.39	268.69	834	273.14	835.06	274.77	835.45
276.86	836	278.58	836.5	283.41	838	289.84	839.93	290.08	840

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	42.61	.035	67.78	.035

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	42.61	67.78		163.72	203	205.48	.1 .3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 826.42	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.60	* Wt. n-Val.	* 0.035	* 0.035	* 0.035
* W.S. Elev (ft)	* 825.83	* Reach Len. (ft)	* 163.72	* 203.00	* 205.48
* Crit W.S. (ft)	* 825.83	* Flow Area (sq ft)	* 62.38	* 76.82	* 76.82
* E.G. Slope (ft/ft)	* 0.008996	* Area (sq ft)	* 62.38	* 76.82	* 76.82
* Q Total (cfs)	* 782.50	* Flow (cfs)	* 453.40	* 329.10	* 329.10
* Top Width (ft)	* 94.03	* Top width (ft)	* 24.71	* 69.32	* 69.32
* Vel Total (ft/s)	* 5.62	* Avg. Vel. (ft/s)	* 7.27	* 4.28	* 4.28
* Max Chl Dpth (ft)	* 3.23	* Hydr. Depth (ft)	* 2.52	* 1.11	* 1.11
* Conv. Total (cfs)	* 8250.3	* Conv. (cfs)	* 4780.5	* 3469.8	* 3469.8
* Length wtd. (ft)	* 201.33	* Wetted Per. (ft)	* 25.72	* 70.00	* 70.00
* Min Ch El (ft)	* 822.60	* Shear (lb/sq ft)	* 1.36	* 0.62	* 0.62
* Alpha	* 1.21	* Stream Power (lb/ft s)	* 290.08	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.19	* Cum Volume (acre-ft)	* 7.69	* 24.71	* 11.30
* C & E Loss (ft)	* 0.17	* Cum SA (acres)	* 1.15	* 0.47	* 0.83

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth

for the water surface and continued on with the calculations.

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.

This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the

need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water

surface came back below critical depth. This indicates that there is not a valid subcritical answer. The

program defaulted to critical depth.

CROSS SECTION

RIVER: Sugarcamp Run

REACH: Upper

RS: 1702.205

INPUT

Description:

Station Elevation Data num= 59

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	17.7	830	20.12	829.08	22.72	828	25.35	826.79
27.55	826	29.19	825.57	34.86	824.22	35.8	824	37.05	823.92
37.28	823.91	37.72	823.88	38.52	823.82	38.78	823.8	48.95	823.09
51.78	822.9	54.78	822.68	59.18	822.44	62.92	822.19	66.54	822.07
68.86	822	72.97	822	120.78	820.85	126.15	820	128.43	819.64
128.59	819.61	128.65	819.6	128.91	819.6	140.23	819.86	143.88	819.94
143.91	819.95	143.97	819.98	143.99	820	148.2	821.7	184.83	822
190.49	822	198.04	822.27	217.67	822.88	219.93	822.78	228.98	822.18
230.23	822.02	230.45	822	234.5	822	246.38	822.51	258.21	823.02
261.49	823.09	265.12	823.23	268.48	823.28	271.25	823.32	272.59	823.37
273.96	823.42	300.27	824	310.16	824	318.03	825	324.88	826
328.87	826.57	339.25	828	342.22	828.55	349.67	829.97		

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	120.78	.035	148.2	.035	217.67	.033	228.98	.035

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

120.78	148.2	259.55	203	19.61	.1	.3
--------	-------	--------	-----	-------	----	----

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.69	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.04	* Wt. n-Val.	* 0.100	* 0.035	* 0.035
* W.S. Elev (ft)	* 824.65	* Reach Len. (ft)	* 259.55	* 203.00	* 19.61
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 223.70	* 125.62	* 321.39
* E.G. Slope (ft/ft)	*0.000332	* Area (sq ft)	* 223.70	* 125.62	* 321.39
* Q Total (cfs)	* 782.50	* Flow (cfs)	* 112.97	* 265.30	* 404.23
* Top width (ft)	* 282.20	* Top width (ft)	* 87.72	* 27.42	* 167.06
* Vel Total (ft/s)	* 1.17	* Avg. Vel. (ft/s)	* 0.51	* 2.11	* 1.26
* Max chl Dpth (ft)	* 5.05	* Hydr. Depth (ft)	* 2.55	* 4.58	* 1.92
* Conv. Total (cfs)	* 42925.4	* Conv. (cfs)	* 6197.4	* 14553.4	* 22174.7
* Length wtd. (ft)	* 138.44	* Wetted Per. (ft)	* 87.87	* 27.87	* 167.19
* Min ch El (ft)	* 819.60	* Shear (lb/sq ft)	* 0.05	* 0.09	* 0.04
* Alpha	* 1.74	* Stream Power (lb/ft s)	* 349.67	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.01	* Cum Volume (acre-ft)	* 7.27	* 24.28	* 10.36
* C & E Loss (ft)	* 0.01	* Cum SA (acres)	* 0.99	* 0.35	* 0.27

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.

This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Sugarcamp Run  
 REACH: Upper

RS: 1374.631

INPUT

Description:

Station Elevation Data num= 57

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	4.05	838	6.37	836.85	8.1	836	8.95	835.58
12.14	834	12.7	833.74	16.5	832	32.71	826	34.3	825.83
38.97	825.31	49.3	824	58.87	823.14	70.93	822	85.27	820.91
112.35	820.08	156.29	820	170.77	819.68	173.54	818	175.5	816.8
176.3	816.28	181.49	816.3	187.41	816.25	189.61	816.67	190.84	816.79
192.94	817.34	201.34	818	274.02	820	287.12	820.13	289.99	820.13
291.35	820.18	291.9	820.21	294.72	820.22	295.96	820.22	296.19	820.23
297.15	820.27	298.55	820.29	301.16	820.34	303.13	820.42	307.39	820.56
313.51	820.8	318.82	821.04	342.82	822.01	350.5	822.28	364.6	822.04
376.04	822	448.14	824	469.97	824	494.23	825.59	500.61	825.89
501.32	825.92	503.16	826	510.04	826.95	511.29	827.12	514.54	827.55
517.59	828	527.33	830						

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	38.97	.035	156.29	.1	170.77	.035	201.34	.1
350.5	.033	364.6	.035						

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

170.77	201.34	73.24	163.13	9.98	.1	.3
--------	--------	-------	--------	------	----	----

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.66	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.01	* Wt. n-Val.	* 0.040	* 0.035	* 0.081
* W.S. Elev (ft)	* 824.66	* Reach Len. (ft)	* 73.24	* 163.13	* 9.98
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 468.40	* 232.27	* 900.65
* E.G. Slope (ft/ft)	* 0.000042	* Area (sq ft)	* 468.40	* 232.27	* 900.65
* Q Total (cfs)	* 782.50	* Flow (cfs)	* 274.70	* 241.54	* 266.26
* Top width (ft)	* 435.85	* Top width (ft)	* 126.64	* 30.57	* 278.64
* Vel Total (ft/s)	* 0.49	* Avg. Vel. (ft/s)	* 0.59	* 1.04	* 0.30
* Max Chl Dpth (ft)	* 8.41	* Hydr. Depth (ft)	* 3.70	* 7.60	* 3.23
* Conv. Total (cfs)	* 120576.8	* Conv. (cfs)	* 42329.6	* 37218.8	* 41028.4
* Length wtd. (ft)	* 65.02	* Wetted Per. (ft)	* 126.83	* 31.67	* 278.76
* Min Ch El (ft)	* 816.25	* Shear (lb/sq ft)	* 0.01	* 0.02	* 0.01
* Alpha	* 2.03	* Stream Power (lb/ft s)	* 527.33	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.00	* Cum Volume (acre-ft)	* 5.21	* 23.44	* 10.09
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.35	* 0.22	* 0.17

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than

1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Sugarcamp Run  
 REACH: Upper RS: 1206.899

INPUT

Description:

Station Elevation Data num= 88

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	5.15	838	6.16	837.61	10.31	836	14.61	834.22
15.16	834	16.08	833.6	19.39	832	22.47	830.36	23.14	830
23.74	829.63	26.33	828	29.15	827.52	33.34	826.81	34.97	826.52
41.02	825.68	52.83	824.68	54.17	824.57	57.07	824.32	60.94	824
65.64	823.68	91.36	822	135.98	820.53	160.72	820	160.91	820
161.41	819.98	161.6	819.96	172.02	819.55	172.79	819.49	173.18	819.46
173.51	819.43	180.74	819.12	181.06	819.09	181.53	819.05	183.05	818.94
186.24	818.8	189.82	818.52	191.18	818.45	195.74	818.07	196.59	818
198.07	816.56	198.65	816	199.6	815.03	200.29	814.32	200.52	814.1
200.97	813.68	203.52	813.83	206.6	813.86	207.71	813.9	210.16	814.1
213.14	814.37	217.06	814.79	224.47	815.56	226.47	815.73	228.49	816
229.53	816	248.83	816.91	255.11	817.1	262.27	817.22	270.69	817.46
271.02	817.46	271.99	817.48	274.37	817.52	281.21	817.71	282.16	817.74
282.55	817.75	282.78	817.75	289.39	818	355.4	818.8	422.11	820
480.91	821.95	498.51	822.13	512.2	822.96	635.19	824	636.67	824
641.37	824.19	642.29	824.24	653.53	824.74	662.6	825.15	678.14	825.75
678.82	825.74	681.79	826	685.14	826.55	689.63	827.27	693.96	828
696.95	828.68	698.59	829.05	703.02	830				

Manning's n values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	181.53	.06	195.74	.035	229.53	.06
480.91	.033	498.51	.035			248.83	.035

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 195.74 229.53 32.52 91.72 10.02 .1 .3

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
0	45	835	602.55	638.67	835

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.66	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.00	* Wt. n-Val.	* 0.039	* 0.035	* 0.037
* W.S. Elev (ft)	* 824.66	* Reach Len. (ft)	* 32.52	* 91.72	* 10.02
* Crit W.S. (ft)	* 817.56	* Flow Area (sq ft)	* 505.78	* 329.08	* 1630.50



* E.G. slope (ft/ft)	*0.000007	* Area (sq ft)	* 505.78	* 329.08	* 1630.50	*
* Q Total (cfs)	* 782.50	* Flow (cfs)	* 119.15	* 158.20	* 505.15	*
* Top width (ft)	* 562.51	* Top width (ft)	* 142.66	* 33.79	* 386.06	*
* Vel Total (ft/s)	* 0.32	* Avg. Vel. (ft/s)	* 0.24	* 0.48	* 0.31	*
* Max Chl Dpth (ft)	* 10.98	* Hydr. Depth (ft)	* 3.55	* 9.74	* 4.22	*
* Conv. Total (cfs)	*303919.6	* Conv. (cfs)	* 46276.0	* 61445.7	*196197.9	*
* Length wtd. (ft)	* 91.72	* Wetted Per. (ft)	* 142.84	* 35.68	* 387.70	*
* Min Ch El (ft)	* 813.68	* Shear (lb/sq ft)	* 0.00	* 0.00	* 0.00	*
* Alpha	* 1.16	* Stream Power (lb/ft s)	* 703.02	* 0.00	* 0.00	*
* Frctn Loss (ft)	*	* Cum Volume (acre-ft)	* 4.39	* 22.39	* 9.80	*
* C & E Loss (ft)	*	* Cum SA (acres)	* 0.12	* 0.10	* 0.09	*

CULVERT

RIVER: Sugarcamp Run  
 REACH: Upper RS: 1158.997

INPUT

Description:  
 Distance from Upstream XS = 37.71  
 Deck/Roadway width = 20  
 Weir Coefficient = 2.6  
 Upstream Deck/Roadway Coordinates

num=	4	
Sta Hi Cord Lo Cord	Sta Hi Cord Lo Cord	Sta Hi Cord Lo Cord
69.42 823.49 0	211.7 822.58 0	359.2 823.21 0
708.32 823.48 0		

Upstream Bridge Cross Section Data

Station	Elevation	num=	88						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev		
0	840	5.15	838	6.16	837.61	10.31	836	14.61	834.22
15.16	834	16.08	833.6	19.39	832	22.47	830.36	23.14	830
23.74	829.63	26.33	828	29.15	827.52	33.34	826.81	34.97	826.52
41.02	825.68	52.83	824.68	54.17	824.57	57.07	824.32	60.94	824
65.64	823.68	91.36	822	135.98	820.53	160.72	820	160.91	820
161.41	819.98	161.6	819.96	172.02	819.55	172.79	819.49	173.18	819.46
173.51	819.43	180.74	819.12	181.06	819.09	181.53	819.05	183.05	818.94
186.24	818.8	189.82	818.52	191.18	818.45	195.74	818.07	196.59	818
198.07	816.56	198.65	816	199.6	815.03	200.29	814.32	200.52	814.1
200.97	813.68	203.52	813.83	206.6	813.86	207.71	813.9	210.16	814.1
213.14	814.37	217.06	814.79	224.47	815.56	226.47	815.73	228.49	816
229.53	816	248.83	816.91	255.11	817.1	262.27	817.22	270.69	817.46
271.02	817.46	271.99	817.48	274.37	817.52	281.21	817.71	282.16	817.74
282.55	817.75	282.78	817.75	289.39	818	355.4	818.8	422.11	820
480.91	821.95	498.51	822.13	512.2	822.96	635.19	824	636.67	824
641.37	824.19	642.29	824.24	653.53	824.74	662.6	825.15	678.14	825.75
678.82	825.74	681.79	826	685.14	826.55	689.63	827.27	693.96	828

696.95 828.68 698.59 829.05 703.02 830

Manning's n Values num= 7  
 Sta n Val Sta n Val Sta n Val Sta n Val Sta n Val  
 \*\*\*\*\*  
 0 .035 181.53 .06 195.74 .035 229.53 .06 248.83 .035  
 480.91 .033 498.51 .035

Bank Sta: Left Right Coeff Contr. Expan.  
 195.74 229.53 .1 .3  
 Blocked Obstructions num= 2  
 Sta L Sta R Elev Sta L Sta R Elev  
 \*\*\*\*\*  
 0 45 835 602.55 638.67 835

Downstream Deck/Roadway Coordinates  
 num= 4  
 Sta Hi Cord Lo Cord Sta Hi Cord Lo Cord Sta Hi Cord Lo Cord  
 \*\*\*\*\*  
 69.42 823.49 0 211.7 822.58 0 359.2 823.21 0  
 708.32 823.48 0

Downstream Bridge Cross Section Data  
 Station Elevation Data num= 100  
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev  
 \*\*\*\*\*  
 0 840 4.29 838 8.56 836.05 8.69 836 9.54 835.67  
 13.87 834 14.64 833.7 19.1 832 21.4 831.1 24.27 830  
 28.11 828.51 29.48 828 34.6 826.89 36.65 826.45 39.25 826  
 42.17 825.69 45.92 825.3 47.53 825.12 49.29 824.95 52.44 824.65  
 57.93 824.09 57.95 824.09 58.76 824 69.42 823.49 91.56 822.43  
 100.93 822 161.31 821.02 203.98 822 210.39 822.48 211.7 822.58  
 213.66 822.81 238.41 822.54 242.96 822 253.18 820 254.41 819.48  
 255.86 818.8 256.98 818.3 257.63 818 259.38 817.16 261.32 816.07  
 261.44 816 261.7 815.78 263.74 814 264.53 813.26 265.93 812  
 267.16 810.93 267.44 810.69 267.47 810.7 267.51 810.7 267.55 810.7  
 277.7 810.98 279.81 811.23 280.38 811.29 281.75 811.98 284.85 811.84  
 285.24 811.85 287.17 812 288.88 812.96 289.84 813.5 290.54 814  
 291.43 814.82 292.96 816 294.34 817.02 295.01 817.13 296.17 817.33  
 298.52 817.79 298.81 817.9 299.48 818 300.93 818.27 301.16 818.32  
 302.65 818.62 303.45 818.81 304.42 819.02 306.89 819.59 307.53 819.74  
 311.58 820 324.17 822 328.53 822.41 359.2 823.21 359.47 822.85  
 361.32 822.62 365.95 822 369.24 821.24 372.87 820.38 377.37 820  
 437.48 818.67 499.15 819.3 510.95 820 552.12 821.19 576.07 821.31  
 587.37 822 647.28 822.16 708.32 823.48 776.84 824.08 812.26 826  
 816.98 827.32 819.69 827.78 820.92 828 823.99 828.66 829.84 830

Manning's n Values num= 9  
 Sta n Val Sta n Val Sta n Val Sta n Val Sta n Val  
 \*\*\*\*\*  
 0 .035 213.66 .013 242.96 .06 253.18 .035 311.58 .06  
 328.53 .013 359.2 .035 552.12 .033 576.07 .035

Bank Sta: Left Right Coeff Contr. Expan.  
 253.18 311.58 .1 .3  
 Blocked Obstructions num= 2  
 Sta L Sta R Elev Sta L Sta R Elev  
 \*\*\*\*\*  
 0 61.13 835 718.6 769.45 835

Upstream Embankment side slope = 0 horiz. to 1.0 vertical  
 Downstream Embankment side slope = 0 horiz. to 1.0 vertical  
 Maximum allowable submergence for weir flow = .98  
 Elevation at which weir flow begins =  
 Energy head used in spillway design =  
 Spillway height used in design =  
 Weir crest shape = Broad Crested

Number of Culverts = 1

Culvert Name Shape Rise Span  
 Culvert #1 Box 8 12  
 FHWA Chart # 8 - flared wingwalls  
 FHWA Scale # 3 - wingwall flared 0 deg. (sides extended straight)  
 Solution Criteria = Highest U.S. EG  
 Culvert Upstrm Dist Length Top n Bottom n Depth Blocked Entrance Loss Coef Exit Loss Coef  
 28.84 38.12 .012 .012 0 .7 1  
 Upstream Elevation = 813.87  
 Centerline Station = 209.42  
 Downstream Elevation = 812.56  
 Centerline Station = 277.56

CULVERT OUTPUT Profile #PF 1 Culv Group: Culvert #1  
 \*\*\*\*\*  
 \* Q Culv Group (cfs) \* 56.23 \* Culv Full Len (ft) \* 38.12 \*  
 \* # Barrels \* 1 \* Culv Vel US (ft/s) \* 0.59 \*  
 \* Q Barrel (cfs) \* 56.23 \* Culv Vel DS (ft/s) \* 0.59 \*  
 \* E.G. US. (ft) \* 824.66 \* Culv Inv El Up (ft) \* 813.87 \*  
 \* W.S. US. (ft) \* 824.66 \* Culv Inv El Dn (ft) \* 812.56 \*  
 \* E.G. DS (ft) \* 824.65 \* Culv Frctn Ls (ft) \* 0.00 \*  
 \* W.S. DS (ft) \* 824.65 \* Culv Exit Loss (ft) \* 0.00 \*  
 \* Delta EG (ft) \* 0.01 \* Culv Entr Loss (ft) \* 0.00 \*  
 \* Delta WS (ft) \* 0.01 \* Q weir (cfs) \* 726.27 \*  
 \* E.G. IC (ft) \* 822.45 \* Weir Sta Lft (ft) \* 53.08 \*  
 \* E.G. OC (ft) \* 824.66 \* Weir Sta Rgt (ft) \* 651.72 \*  
 \* Culvert Control \* Outlet \* Weir Submerg \* 1.00 \*  
 \* Culv WS Inlet (ft) \* 821.87 \* Weir Max Depth (ft) \* 2.08 \*  
 \* Culv WS Outlet (ft) \* 820.56 \* Weir Avg Depth (ft) \* 1.47 \*  
 \* Culv Nml Depth (ft) \* \* Weir Flow Area (sq ft) \* 828.78 \*  
 \* Culv crt Depth (ft) \* 0.88 \* Min El Weir Flow (ft) \* 822.59 \*  
 \*\*\*\*\*

Warning: The weir over culvert is submerged.  
 Warning: During the culvert inlet control computations, the program could not balance the culvert/weir flow. The  
 Page 31

reported inlet  
energy grade answer may not be valid.

CROSS SECTION

RIVER: Sugarcamp Run  
REACH: Upper RS: 1115.181

INPUT

Description:

Station		Elevation		Data		num= 100		Sta		Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	4.29	838	8.56	836.05	8.69	836	9.54	835.67		
13.87	834	14.64	833.7	19.1	832	21.4	831.1	24.27	830		
28.11	828.51	29.48	828	34.6	826.89	36.65	826.45	39.25	826		
42.17	825.69	45.92	825.3	47.53	825.12	49.29	824.95	52.44	824.65		
57.93	824.09	57.95	824.09	58.76	824	69.42	823.49	91.56	822.43		
100.93	822	161.31	821.02	203.98	822	210.39	822.48	211.7	822.58		
213.66	822.81	238.41	822.54	242.96	822	253.18	820	254.41	819.48		
255.86	818.8	256.98	818.3	257.63	818	259.38	817.16	261.32	816.07		
261.44	816	261.7	815.78	263.74	814	264.53	813.26	265.93	812		
267.16	810.93	267.44	810.69	267.47	810.7	267.51	810.7	267.55	810.7		
277.7	810.98	279.81	811.23	280.38	811.29	281.75	811.98	284.85	811.84		
285.24	811.85	287.17	812	288.88	812.96	289.84	813.5	290.54	814		
291.43	814.82	292.96	816	294.34	817.02	295.01	817.13	296.17	817.33		
298.52	817.79	298.81	817.9	299.48	818	300.93	818.27	301.16	818.32		
302.65	818.62	303.45	818.81	304.42	819.02	306.89	819.59	307.53	819.74		
311.58	820	324.17	822	328.53	822.41	359.2	823.21	359.47	822.85		
361.32	822.62	365.95	822	369.24	821.24	372.87	820.38	377.37	820		
437.48	818.67	499.15	819.3	510.95	820	552.12	821.19	576.07	821.31		
587.37	822	647.28	822.16	708.32	823.48	776.84	824.08	812.26	826		
816.98	827.32	819.69	827.78	820.92	828	823.99	828.66	829.84	830		

Manning's n Values		num= 9		Sta		n Val		Sta		n Val	
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	213.66	.013	242.96	.06	253.18	.035	311.58	.06		
328.53	.013	359.2	.035	552.12	.033	576.07	.035				

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
253.18 311.58 558.86 114.81 5.55 .1 .3

Blocked Obstructions		num= 2		Sta		Elev	
Sta L	Sta R	Elev	Sta L	Sta R	Elev	Sta L	Sta R
0	61.13	835	718.6	769.45	835		

CROSS SECTION OUTPUT Profile #PF 1

\* E.G. Elev (ft) \* 824.65 \* Element \* Left OB \* Channel \* Right OB \*  
\* Vel Head (ft) \* 0.00 \* wt. n-Val. \* 0.031 \* 0.035 \* 0.034 \*

* W.S. Elev (ft)	* 824.65	* Reach Len. (ft)	* 0.00	* 0.00	* 0.00	*
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 511.19	* 563.67	* 1467.33	*
* E.G. Slope (ft/ft)	* 0.000006	* Area (sq ft)	* 511.19	* 563.67	* 1467.33	*
* Q Total (cfs)	* 782.50	* Flow (cfs)	* 118.96	* 258.59	* 404.95	*
* Top width (ft)	* 675.41	* Top width (ft)	* 192.05	* 58.40	* 424.96	*
* Vel Total (ft/s)	* 0.31	* Avg. Vel. (ft/s)	* 0.23	* 0.46	* 0.28	*
* Max chl Dpth (ft)	* 13.96	* Hydr. Depth (ft)	* 2.66	* 9.65	* 3.45	*
* Conv. Total (cfs)	* 310645.9	* Conv. (cfs)	* 47227.6	* 102657.7	* 160760.7	*
* Length wtd. (ft)	* 0.00	* Wetted Per. (ft)	* 193.14	* 63.44	* 427.41	*
* Min ch El (ft)	* 810.69	* Shear (lb/sq ft)	* 0.00	* 0.00	* 0.00	*
* Alpha	* 1.24	* Stream Power (lb/ft s)	* 829.84	* 0.00	* 0.00	*
* Frctn Loss (ft)	* 0.00	* Cum Volume (acre-ft)	*	*	*	*
* C & E Loss (ft)	* 0.01	* Cum SA (acres)	*	*	*	*

Warning: Divided flow computed for this cross-section.

\*\*\*\*\*

SUMMARY OF MANNING'S N VALUES

River: Meathouse Fork

\*\*\*\*\*

* Reach	* River Sta.	* n1	* n2	* n3	* n4	* n5	* n6	* n7	* n8	* n9
* Upper	* 3189.903	* .1*	* .035*	* .035*	* .013*	* .1*	*	*	*	*
* Upper	* 2919.274	* .035*	* .035*	* .035*	* .013*	* .1*	*	*	*	*
* Upper	* 2762.352	* .035*	* .035*	* .035*	* .013*	* .1*	*	*	*	*
* Upper	* 2717.603	* .035*	* .033*	* .035*	* .035*	* .06*	* .013*	* .035*	*	*
* Upper	* 2621.319	* .035*	* .033*	* .035*	* .035*	* .035*	* .013*	* .035*	*	*
* Upper	* 2580.999	* .035*	* .033*	* .035*	* .035*	* .035*	* .013*	* .035*	*	*
* Upper	* 2527.424	* .035*	* .033*	* .035*	* .035*	* .035*	* .013*	* .035*	*	*
* Lower .035*	* 2421.596	* .06*	* .033*	* .035*	* .033*	* .035*	* .035*	* .06*	* .033*	*
* Lower	* 2236.871	* .1*	* .033*	* .035*	* .06*	* .035*	* .013*	* .033*	* .035*	*
* Lower	* 2005.226	* .1*	* .035*	* .06*	* .035*	* .013*	* .033*	* .035*	*	*
* Lower	* 1852.485	* .1*	* .035*	* .06*	* .035*	* .013*	* .035*	*	*	*
* Lower	* 1812.068	* .1*	* .035*	* .06*	* .035*	* .013*	* .035*	*	*	*

*Lower*	*	1786.606	*	.1*	.035*	.06*	.035*	.013*	.035*	*	*
*Lower*	*	1674.792	*	.1*	.035*	.06*	.035*	.013*	.035*	*	*
*Lower*	*	1554.849	*	.1*	.035*	.06*	.035*	.013*	.035*	*	*
*Lower*	*	1294.270	*	.1*	.035*	.06*	.035*	.013*	.035*	*	*
*Lower*	*	1192.596	*	.035*	.06*	.035*	.06*	.035*	.013*	.035*	*
*Lower*	*	1000.000	*	.035*	.06*	.035*	.035*	.013*	.035*	*	*

\*\*\*\*\*  
\*\*\*\*\*

River: Sugarcamp Run

\*\*\*\*\*  
\*\*\*\*\*

* Reach *	* River Sta. *	* n1 *	* n2 *	* n3 *	* n4 *	* n5 *	* n6 *	* n7 *	* n8 *	* n9 *
*Upper*	* 1908.741 *	* .1*	* .035*	* .035*	*	*	*	*	*	*
*Upper*	* 1702.205 *	* .1*	* .035*	* .035*	* .033*	* .035*	*	*	*	*
*Upper*	* 1374.631 *	* .1*	* .035*	* .1*	* .035*	* .1*	* .033*	* .035*	*	*
*Upper*	* 1206.899 *	* .035*	* .06*	* .035*	* .06*	* .035*	* .033*	* .035*	*	*
*Upper*	* 1158.997 *	* culvert *	*	*	*	*	*	*	*	*
*Upper*.035*	* 1115.181 *	* .035*	* .013*	* .06*	* .035*	* .06*	* .013*	* .035*	* .033*	*

\*\*\*\*\*  
\*\*\*\*\*

\*\*\*\*\*

SUMMARY OF REACH LENGTHS

River: Meathouse Fork

\*\*\*\*\*

* Reach *	* River Sta. *	* Left *	* Channel *	* Right *
*Upper*	* 3189.903 *	* 267.8*	* 267.64*	* 210.16*
*Upper*	* 2919.274 *	* 131.84*	* 156.71*	* 162.29*
*Upper*	* 2762.352 *	* 44.24*	* 44.75*	* 36.49*
*Upper*	* 2717.603 *	* 1*	* 1*	* 1*
*Upper*	* 2621.319 *	* 50.27*	* 40.32*	* 52.82*
*Upper*	* 2580.999 *	* 48.53*	* 53.58*	* 14.67*
*Upper*	* 2527.424 *	* 152.44*	* 105.55*	* 614.2*
*Lower*	* 2421.596 *	* 114.88*	* 182.56*	* 4.38*

*Lower	*	2236.871	*	251.91*	229.47*	12.96*
*Lower	*	2005.226	*	147.51*	152.72*	70.79*
*Lower	*	1852.485	*	44.03*	40.42*	40.14*
*Lower	*	1812.068	*	29.48*	25.45*	34.43*
*Lower	*	1786.606	*	105.08*	108.5*	124.1*
*Lower	*	1674.792	*	130.48*	119.69*	198.02*
*Lower	*	1554.849	*	203.32*	252.49*	154.61*
*Lower	*	1294.270	*	48.1*	101.54*	99.66*
*Lower	*	1192.596	*	68.62*	189.67*	570.98*
*Lower	*	1000.000	*	1*	1*	1*

River: Sugarcamp Run

* Reach	* River Sta.	* Left	* Channel	* Right
*Upper	* 1908.741	* 163.72*	203*	205.48*
*Upper	* 1702.205	* 259.55*	203*	19.61*
*Upper	* 1374.631	* 73.24*	163.13*	9.98*
*Upper	* 1206.899	* 32.52*	91.72*	10.02*
*Upper	* 1158.997	* Culvert	*	*
*Upper	* 1115.181	* 558.86*	114.81*	5.55*

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: Meathouse Fork

* Reach	* River Sta.	* Contr.	* Expan.
*Upper	* 3189.903*	.1*	.3*
*Upper	* 2919.274*	.1*	.3*
*Upper	* 2762.352*	.1*	.3*
*Upper	* 2717.603*	.1*	.3*
*Upper	* 2621.319*	.1*	.3*
*Upper	* 2580.999*	.1*	.3*
*Upper	* 2527.424*	.1*	.3*
*Lower	* 2421.596*	.1*	.3*
*Lower	* 2236.871*	.1*	.3*
*Lower	* 2005.226*	.1*	.3*
*Lower	* 1852.485*	.1*	.3*
*Lower	* 1812.068*	.1*	.3*
*Lower	* 1786.606*	.1*	.3*
*Lower	* 1674.792*	.1*	.3*
*Lower	* 1554.849*	.1*	.3*
*Lower	* 1294.270*	.1*	.3*
*Lower	* 1192.596*	.1*	.3*
*Lower	* 1000.000*	.1*	.3*

River: Sugarcamp Run

```
*****
* Reach * River Sta. * Contr. * Expan. *
*****
*Upper * 1908.741* .1* .3*
*Upper * 1702.205* .1* .3*
*Upper * 1374.631* .1* .3*
*Upper * 1206.899* .1* .3*
*Upper * 1158.997* Culvert * *
*Upper * 1115.181* .1* .3*
*****
```

\*\*\*\*\*

ERRORS WARNINGS AND NOTES

Errors Warnings and Notes for Plan : Existing

River: Meathouse Fork Reach: Upper RS: 2527.424 Profile: PF 1

Warning: Divided flow computed for this cross-section.

River: Meathouse Fork Reach: Lower RS: 2421.596 Profile: PF 1

Warning: Divided flow computed for this cross-section.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.

This may indicate the need for additional cross sections.

River: Meathouse Fork Reach: Lower RS: 2236.871 Profile: PF 1

Warning: Divided flow computed for this cross-section.

River: Meathouse Fork Reach: Lower RS: 2005.226 Profile: PF 1

Warning: Divided flow computed for this cross-section.

River: Sugarcamp Run Reach: Upper RS: 1908.741 Profile: PF 1

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth

for the water surface and continued on with the calculations.

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.

This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate

the need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated

water surface came back below critical depth. This indicates that there is not a valid subcritical answer.

The

program defaulted to critical depth.

River: Sugarcamp Run Reach: Upper RS: 1702.205 Profile: PF 1

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.

This may indicate the need for additional cross sections.

River: Sugarcamp Run Reach: Upper RS: 1374.631 Profile: PF 1

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.



Willard.rep

This may indicate the need for additional cross sections.

River: Sugarcamp Run Reach: Upper RS: 1158.997 Profile: PF 1

Warning:The weir over culvert is submerged.

River: Sugarcamp Run Reach: Upper RS: 1158.997 Profile: PF 1 Culv: Culvert #1

Warning:During the culvert inlet control computations, the program could not balance the culvert/weir flow. The reported

inlet energy grade answer may not be valid.

River: Sugarcamp Run Reach: Upper RS: 1115.181 Profile: PF 1

Warning:Divided flow computed for this cross-section.

**Supplement 3**

**HEC-RAS Analysis –Proposed Conditions Summary w/ Cross 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      X
XXXXXXXX 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      X  XXXXXX   XXXX       X      X      X  X     XXXXX

```

\*\*\*\*\*

PROJECT DATA

Project Title: willard  
Project File : willard.prj  
Run Date and Time: 8/20/2013 7:06:09 AM

Project in English units

\*\*\*\*\*

PLAN DATA

Plan Title: Proposed  
Plan File : x:\Navitus Jobfiles\Antero Resources\ANT044-willard\Engineering\Drainage  
Comp\Floodplain\Computations\HEC-RAS\Revised2\willard.p02

Geometry Title: Proposed  
Geometry File : x:\Navitus Jobfiles\Antero Resources\ANT044-willard\Engineering\Drainage  
Comp\Floodplain\Computations\HEC-RAS\Revised2\willard.g02

Flow Title : Existing  
Flow File : x:\Navitus Jobfiles\Antero Resources\ANT044-willard\Engineering\Drainage  
Comp\Floodplain\Computations\HEC-RAS\Revised2\willard.f01

Plan Summary Information:

Number of:	Cross Sections = 23	Multiple Openings = 0
	Culverts = 1	Inline Structures = 0
	Bridges = 0	Lateral Structures = 0

Computational Information

water surface calculation tolerance	= 0.1
Critical depth calculation tolerance	= 0.01
Maximum number of iterations	= 20
Maximum difference tolerance	= 0.3

Flow tolerance factor = 0.001

Computation Options

Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

\*\*\*\*\*

FLOW DATA

Flow Title: Existing
Flow File : x:\Navitus Jobfiles\Antero Resources\ANT044-willard\Engineering\Drainage
Comp\Floodplain\Computations\HEC-RAS\Revised2\willard.f01

Flow Data (cfs)

Table with 4 columns: River, Reach, RS, PF 1. Rows include Meathouse Fork (Upper/Lower) and Sugarcamp Run (Upper).

Boundary Conditions

Table with 5 columns: River, Reach, Profile, Upstream, Downstream. Rows include Meathouse Fork (Upper/Lower) with profile PF 1 and known water surface elevations.

\*\*\*\*\*

GEOMETRY DATA

Geometry Title: Proposed
Geometry File : x:\Navitus Jobfiles\Antero Resources\ANT044-willard\Engineering\Drainage
Comp\Floodplain\Computations\HEC-RAS\Revised2\willard.g02

Reach Connection Table

Table with 5 columns: River, Reach, Upstream Boundary, Downstream Boundary. Rows include Meathouse Fork (Upper/Lower) and Sugarcamp Run (Upper) with boundary values of 1.

JUNCTION INFORMATION

Name: 1  
 Description:  
 Energy computation Method

Length across Junction		Tributary		Reach	Length	Angle
River	Reach	River	Reach			
Meathouse Fork	Upper	to Meathouse Fork	Lower		105.55	0
Sugarcamp Run	Upper	to Meathouse Fork	Lower		0	0

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Upper RS: 3189.903

INPUT

Description:

Station Elevation Data num= 84

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	4.44	838	7.6	836.54	8.74	836	13.67	834.13
13.99	834	14.79	833.7	19.29	832	21.1	831.31	24.47	830
26.67	829.17	30.09	828	33.75	827.2	39.43	826	41.42	825.53
43.48	824.99	47.22	824	49.95	822.8	51.66	822	53.77	821.05
55.14	820.44	56.08	820	56.57	819.63	58.57	818	59.26	817.36
60.68	816	62.04	814.8	62.94	814	64.92	812.65	65.96	812
67.18	811.11	68.63	810.19	112	810.21	125.35	810.21	126.67	811.47
127.15	812	128.83	813.76	129.02	814	129.23	814.3	130.51	816
130.6	816	138.18	816.51	152.01	816	160.17	817.57	162.51	818
172.56	818.53	190.59	819.55	195.19	819.81	198.42	820	206.44	821.17
210.95	820.24	231.51	820	254.69	820	282.1	819.47	318.2	820
325.76	821.88	326.26	822	327.93	822.35	330	822.8	331.34	823.1
331.87	823.22	333.18	823.52	350.01	823.5	352.3	823.5	352.69	823.52
352.78	823.52	352.81	823.52	355.41	823.61	366.46	824	366.89	824.41
368.63	826	369.15	826.51	370.78	828	371.39	828.59	372.93	830
373.62	830.67	375.06	832	375.83	832.75	377.19	834	378.03	834.81
379.31	836	380.81	837.25	381.7	838	384.11	840		

Manning's n Values num= 5

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	53.77	.035	130.6	.035	333.18	.013
						352.3	.1

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	53.77	130.6		267.8	267.64	210.16	.1 .3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 825.07	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.28	* Wt. n-Val.	* 0.100	* 0.035	* 0.035
* W.S. Elev (ft)	* 824.80	* Reach Len. (ft)	* 267.80	* 267.64	* 210.16

* Crit W.S. (ft)	*	* Flow Area (sq ft)	*	16.02	*	1025.15	*	1139.07	*
* E.G. Slope (ft/ft)	*0.000472	* Area (sq ft)	*	16.02	*	1025.15	*	1139.07	*
* Q Total (cfs)	* 8252.10	* Flow (cfs)	*	6.94	*	5046.93	*	3198.23	*
* Top Width (ft)	* 323.10	* Top width (ft)	*	9.56	*	76.83	*	236.71	*
* Vel Total (ft/s)	* 3.78	* Avg. Vel. (ft/s)	*	0.43	*	4.92	*	2.81	*
* Max Chl Dpth (ft)	* 14.61	* Hydr. Depth (ft)	*	1.68	*	13.34	*	4.81	*
* Conv. Total (cfs)	*379963.1	* Conv. (cfs)	*	319.4	*	232383.1	*	147260.6	*
* Length wtd. (ft)	* 251.75	* Wetted Per. (ft)	*	10.30	*	83.09	*	237.91	*
* Min Ch El (ft)	* 810.19	* Shear (lb/sq ft)	*	0.05	*	0.36	*	0.14	*
* Alpha	* 1.25	* Stream Power (lb/ft s)	*	384.11	*	0.00	*	0.00	*
* Frctn Loss (ft)	* 0.12	* Cum Volume (acre-ft)	*	4.42	*	19.38	*	9.84	*
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	*	0.55	*	1.21	*	1.66	*

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Upper RS: 2919.274

INPUT

Description:

Station		Elevation Data		num= 77		Sta		Elev		Sta		Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	5.35	838	10.14	836.12	10.93	835.82	15.61	834				
17.43	833.34	21.22	832	23.59	831.23	27.27	830	30.88	828.73				
32.84	828	34.04	827.57	38.26	826	45.27	824.25	46.28	824				
47.03	823.89	47.65	823.82	49.69	823.58	62.66	822	63.65	821.81				
66.37	821.27	67.53	821.04	73.35	820	74.73	819.47	78.07	818				
79.13	817.33	81.22	816	82.27	815.17	83.79	814	85.05	813.01				
87.02	811.39	87.56	810.92	87.78	810.73	88.06	810.49	92.04	810.47				
99.15	810.44	160.4	810.2	161.6	811.14	162.85	811.91	162.99	812				
165.22	812.75	169.24	814	175.99	815.51	178.06	816	179.09	816.26				
185.3	818	186.61	818	219.11	818.86	227.98	819.09	254.46	819.77				
256.14	819.82	263.42	820	265.94	820.82	269.7	822	272.66	822.4				
274.95	822.7	276.06	822.84	277.07	822.97	280.17	823.4	285.34	823.42				
300.38	823.49	313.16	823.88	316.67	824	320.12	825.39	321.61	826				
326.07	827.8	326.57	828	328.02	828.59	331.69	830	333.23	830.61				
336.61	832	339.39	833.28	340.96	834	342.36	834.64	345.32	836				
349.67	838	354.02	840										

Manning's n Values		num= 5		Sta		n Val		Sta		n Val	
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	79.13	.035	185.3	.035	280.17	.013	300.38	.1		

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 79.13 185.3 131.84 156.71 162.29 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

\*\*\*\*\*

* E.G. Elev (ft)	* 824.96	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.32	* Wt. n-Val.	* 0.035	* 0.035	* 0.034
* W.S. Elev (ft)	* 824.64	* Reach Len. (ft)	* 131.84	* 156.71	* 162.29
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 100.74	* 1376.51	* 523.63
* E.G. Slope (ft/ft)	* 0.000453	* Area (sq ft)	* 100.74	* 1376.51	* 523.63
* Q Total (cfs)	* 8252.10	* Flow (cfs)	* 179.42	* 6708.65	* 1364.03
* Top width (ft)	* 274.54	* Top width (ft)	* 35.42	* 106.17	* 132.96
* Vel Total (ft/s)	* 4.12	* Avg. Vel. (ft/s)	* 1.78	* 4.87	* 2.60
* Max Chl Dpth (ft)	* 14.44	* Hydr. Depth (ft)	* 2.84	* 12.97	* 3.94
* Conv. Total (cfs)	* 387739.8	* Conv. (cfs)	* 8430.5	* 315218.2	* 64091.2
* Length wtd. (ft)	* 156.81	* Wetted Per. (ft)	* 36.40	* 109.88	* 133.52
* Min Ch El (ft)	* 810.20	* Shear (lb/sq ft)	* 0.08	* 0.35	* 0.11
* Alpha	* 1.21	* Stream Power (lb/ft s)	* 354.02	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.07	* Cum Volume (acre-ft)	* 4.06	* 12.00	* 5.83
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.42	* 0.64	* 0.77

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Upper

RS: 2762.352

INPUT

Description:

Station		Elevation Data		num= 92		Sta		Elev		Sta		Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	1.27	839.34	3.81	838	5.84	836.77	7.03	836				
8.82	834.81	10.03	834	11.1	833.45	12.03	833.17	15.42	832				
23.45	830	33.33	828	42.89	826	51.39	824	60.13	822				
67.91	821.29	82.32	820	95.74	818.2	97.15	818	99.2	817.24				
102.46	816	103.43	815.58	107.43	814	109.95	812.28	112.14	810.81				
112.83	810.36	113.17	810.14	113.7	809.8	117.15	809.81	181.98	810.08				
187	810.1	187.15	810.1	188.38	811.16	189.39	812	190.37	812.87				
191.39	813.78	191.65	814	191.8	814.02	193.89	814.27	196.34	814.56				
210.55	816	216.57	816	224.58	817.07	231.11	818	232.63	818.64				
235.89	820	237.39	820.57	240.95	822	241.94	822.22	249.55	823.63				
270.2	823.18	282.86	822.07	283.45	822	284.05	822	284.81	822.05				
285.06	822.07	285.69	822.14	295.52	823.01	297.53	823.16	300.76	823.72				
301.24	823.78	302.86	824	303.13	824	305.67	824.32	307.45	824.58				
312.1	825.16	317.59	826	318.66	826.41	322.99	828	325.87	829.1				
328.3	830	333.1	831.96	333.21	832	333.31	832.06	336.95	834				
339.26	835.18	340.76	836	341.87	836.46	342.31	836.53	344.52	837.18				
345.5	837.23	347.59	837.46	348.9	837.46	349.21	837.48	352.12	837.59				
354.08	837.77	354.3	837.79	356.46	838	357.01	838.06	357.37	838.14				
361.2	838.8	366.1	840										

Manning's n Values		num= 5		Sta		n Val		Sta		n Val	
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	97.15	.035	191.65	.035	249.55	.013	270.2	.1		

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 97.15 191.65 44.24 44.75 36.49 .1 .3  
 Blocked Obstructions num= 1  
 Sta L Sta R Elev  
 \*\*\*\*\*  
 0 44.57 835

CROSS SECTION OUTPUT Profile #PF 1

\*\*\*\*\*  
 \* E.G. Elev (ft) \* 824.89 \* Element \* Left OB \* Channel \* Right OB \*  
 \* Vel Head (ft) \* 0.33 \* Wt. n-Val. \* 0.035 \* 0.035 \* 0.035 \*  
 \* W.S. Elev (ft) \* 824.55 \* Reach Len. (ft) \* 44.24 \* 44.75 \* 36.49 \*  
 \* Crit W.S. (ft) \* \* \* Flow Area (sq ft) \* 175.43 \* 1296.11 \* 484.84 \*  
 \* E.G. Slope (ft/ft) \*0.000447 \* Area (sq ft) \* 175.43 \* 1296.11 \* 484.84 \*  
 \* Q Total (cfs) \* 8252.10 \* Flow (cfs) \* 370.26 \* 6504.04 \* 1377.80 \*  
 \* Top Width (ft) \* 258.22 \* Top width (ft) \* 48.11 \* 94.50 \* 115.61 \*  
 \* Vel Total (ft/s) \* 4.22 \* Avg. Vel. (ft/s) \* 2.11 \* 5.02 \* 2.84 \*  
 \* Max chl Dpth (ft) \* 14.75 \* Hydr. Depth (ft) \* 3.65 \* 13.72 \* 4.19 \*  
 \* Conv. Total (cfs) \*390484.6 \* Conv. (cfs) \* 17520.5 \* 307767.6 \* 65196.6 \*  
 \* Length Wtd. (ft) \* 43.61 \* wetted Per. (ft) \* 48.62 \* 97.99 \* 117.01 \*  
 \* Min Ch El (ft) \* 809.80 \* Shear (lb/sq ft) \* 0.10 \* 0.37 \* 0.12 \*  
 \* Alpha \* 1.20 \* Stream Power (lb/ft s) \* 366.10 \* 0.00 \* 0.00 \*  
 \* Frctn Loss (ft) \* 0.02 \* Cum Volume (acre-ft) \* 3.64 \* 7.20 \* 3.95 \*  
 \* C & E Loss (ft) \* 0.01 \* Cum SA (acres) \* 0.29 \* 0.28 \* 0.31 \*  
 \*\*\*\*\*

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Upper RS: 2717.603

INPUT

Description:

Station Elevation Data		num= 75							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	.7	839.65	3.98	838	7.57	836.28	8.16	836
12.37	834	16.4	832	20.38	830	24.35	828	28.35	826
29.88	825.23	37.55	824.67	42.97	824	57.91	822.25	59.39	822.08
59.68	822.05	60.09	822	63.21	821.79	79.95	820.64	90.24	820
93.42	819.23	99.15	818	102.2	817.21	106.8	816	111.09	815.16
117.61	814	118.85	812.86	119.55	812.21	119.77	812	120.9	810.96
122.15	809.8	123.72	809.8	163.46	809.97	192.54	810.1	195.09	811.74
195.48	812	196.5	812.4	200.29	813.89	200.57	814	200.78	814.05
211.04	816	211.1	816.01	225.44	818	226.34	818.38	230.3	820
233.97	821.51	235.17	822	235.93	822.14	239.43	822.78	244.7	823.55
254.96	823.4	265.97	823.09	278.56	823.48	285.27	823.66	297.56	824
301.23	824.38	305.1	824.77	316.67	826	320.13	826.93	324.09	828
331.03	829.52	333.58	830	338.02	830.85	341.67	831.24	343.49	831.41
344.25	831.45	346.75	832	348.72	832	351.51	833.35	352.64	834



354 834.78 356.19 836 357.45 836.65 360.17 838 363.88 840

Manning's n Values num= 5  
 Sta n Val Sta n Val Sta n Val Sta n Val Sta n Val  
 \*\*\*\*\*  
 0 .035 117.61 .035 200.57 .06 244.7 .013 265.97 .035

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 123.72 196.5 1 1 1 .1 .3

Blocked Obstructions num= 1  
 Sta L Sta R Elev  
 \*\*\*\*\*  
 0 43.17 835

CROSS SECTION OUTPUT Profile #PF 1

\*\*\*\*\*  
 \* E.G. Elev (ft) \* 824.85 \* Element \* Left OB \* Channel \* Right OB \*  
 \* Vel Head (ft) \* 0.43 \* Wt. n-Val. \* 0.035 \* 0.035 \* 0.049 \*  
 \* W.S. Elev (ft) \* 824.42 \* Reach Len. (ft) \* 1.00 \* 1.00 \* 1.00 \*  
 \* Crit W.S. (ft) \* \* \* Flow Area (sq ft) \* 415.20 \* 1047.79 \* 360.13 \*  
 \* E.G. Slope (ft/ft) \* 0.000555 \* Area (sq ft) \* 415.20 \* 1047.79 \* 360.13 \*  
 \* Q Total (cfs) \* 8252.10 \* Flow (cfs) \* 1282.37 \* 6166.56 \* 803.16 \*  
 \* Top Width (ft) \* 258.47 \* Top width (ft) \* 80.55 \* 72.78 \* 105.14 \*  
 \* Vel Total (ft/s) \* 4.53 \* Avg. Vel. (ft/s) \* 3.09 \* 5.89 \* 2.23 \*  
 \* Max Chl Dpth (ft) \* 14.62 \* Hydr. Depth (ft) \* 5.15 \* 14.40 \* 3.43 \*  
 \* Conv. Total (cfs) \* 350248.5 \* Conv. (cfs) \* 54428.5 \* 261730.9 \* 34089.1 \*  
 \* Length Wtd. (ft) \* 1.00 \* Wetted Per. (ft) \* 83.48 \* 73.42 \* 106.72 \*  
 \* Min Ch El (ft) \* 809.80 \* Shear (lb/sq ft) \* 0.17 \* 0.49 \* 0.12 \*  
 \* Alpha \* 1.36 \* Stream Power (lb/ft s) \* 363.88 \* 0.00 \* 0.00 \*  
 \* Frctn Loss (ft) \* 0.00 \* Cum Volume (acre-ft) \* 3.34 \* 5.99 \* 3.60 \*  
 \* C & E Loss (ft) \* 0.02 \* Cum SA (acres) \* 0.22 \* 0.20 \* 0.21 \*  
 \*\*\*\*\*

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Upper RS: 2621.319

INPUT

Description:

Station Elevation Data num= 113  
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev  
 \*\*\*\*\*  
 0 840 2.5 838.2 2.79 838 3.52 837.52 6.47 835.49  
 7.67 834.78 8.48 834.31 9.1 834 11.24 832.79 12.69 832  
 14.06 831.18 15.39 830.33 15.91 830 17.86 828.85 19.21 828  
 20.22 827.42 21 826.97 22.94 826 24.71 826 28.47 825.85  
 49.15 824 49.86 823.97 49.94 823.96 50 823.96 50.76 823.91  
 52 823.81 58.2 823.32 59.8 823.19 74.84 822 75.96 821.94  
 77.8 821.87 78.58 821.84 79.01 821.82 81.83 821.8 82.07 821.78  
 84.15 821.67 89.76 821.41 91.77 821.43 100.32 820.95 114.95 820.32

willard.rep

115.55	820.3	116.56	820.27	116.7	820.27	119.32	820.19	120.19	820.18
124.78	820.02	125.39	820	128.82	819.2	133.34	818.23	133.84	818.12
134.41	818	140.39	817.38	142.33	817.17	147.27	816.6	152.25	816
157.76	814.99	163.18	814	163.89	813.58	166.17	812.23	166.57	812
169.23	810.43	169.76	810.11	170.28	809.8	188.3	809.88	212.72	809.98
238.94	810.1	239.88	810.78	241.63	812	244.56	813.72	244.89	813.91
245.05	814	246.68	814.54	247.93	814.96	251.09	816	251.81	816.24
257.15	818	260.11	819.04	262.77	820	265.26	820.9	268.18	822
269.76	822.26	278.47	823.72	296.32	823.24	300.91	823.21	301.88	823.14
303.06	823.1	304.52	823.09	306.7	823.09	314.69	822.97	315.31	822.98
327.06	823.33	339.9	823.67	340.83	823.72	342.56	823.87	344.22	824
346.93	824	356.7	824.36	371.78	824.85	375.68	825.23	378.88	825.53
384	826	389.55	827.96	389.65	828	389.8	828.06	395.31	830
400.25	831.78	400.87	832	404.06	833.15	406.41	834	406.92	834.19
411.79	836	412.51	836.34	420.22	840				

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	79.01	.033	89.76	.035	163.89	.035	247.93	.035
278.47	.013	301.88	.035						

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 163.89 247.93 50.27 40.32 52.82 .1 .3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
0	62.4	835

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.83	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.38	* Wt. n-Val.	* 0.035	* 0.035	* 0.032
* W.S. Elev (ft)	* 824.46	* Reach Len. (ft)	* 50.27	* 40.32	* 52.82
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 492.94	* 1181.83	* 217.27
* E.G. slope (ft/ft)	*0.000495	* Area (sq ft)	* 492.94	* 1181.83	* 217.27
* Q Total (cfs)	* 8252.10	* Flow (cfs)	* 1403.11	* 6384.98	* 464.01
* Top width (ft)	* 297.34	* Top width (ft)	* 101.49	* 84.04	* 111.81
* Vel Total (ft/s)	* 4.36	* Avg. Vel. (ft/s)	* 2.85	* 5.40	* 2.14
* Max Chl Dpth (ft)	* 14.66	* Hydr. Depth (ft)	* 4.86	* 14.06	* 1.94
* Conv. Total (cfs)	*370958.5	* Conv. (cfs)	* 63074.3	*287025.3	* 20858.9
* Length wtd. (ft)	* 42.99	* Wetted Per. (ft)	* 103.68	* 86.38	* 113.19
* Min Ch El (ft)	* 809.80	* Shear (lb/sq ft)	* 0.15	* 0.42	* 0.06
* Alpha	* 1.27	* Stream Power (lb/ft s)	* 420.22	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.02	* Cum Volume (acre-ft)	* 3.33	* 5.97	* 3.59
* C & E Loss (ft)	* 0.01	* Cum SA (acres)	* 0.22	* 0.19	* 0.21

CROSS SECTION

RIVER: Meathouse Fork

REACH: Upper

RS: 2580.999

INPUT

Description:

Station Elevation Data		num= 111		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	3.65	838.07	3.74	838.02	3.79	838	6.25	836.63
7.43	836	9.05	835.24	11.64	834	15.96	832.16	16.15	832.07
16.32	832	18.83	830.91	21.06	830	21.9	829.65	23.66	828.94
25.08	828.34	25.95	828	29.1	827.17	31.92	826.52	32.9	826.28
33.32	826.18	34.32	826	37.52	825.73	38.72	825.57	42.08	825.22
43.71	825.02	46.29	824.63	50.12	824	50.53	824	55.48	823.6
56.5	823.54	57.7	823.52	58.73	823.5	59.83	823.46	61.43	823.4
64.27	823.28	68.59	823.09	73.5	822.89	93.06	822	94.12	822
110.16	821.58	116.43	821.2	128.71	820.65	138.06	820	154.63	818
160.44	817.54	169.18	816.82	175.11	816.33	179.34	816	190.97	815.66
192.13	814.1	192.84	814	192.87	813.97	194.42	812.6	195.09	812.01
195.1	812	196.56	810.69	197.59	809.8	215.68	809.88	265.01	810.1
265.6	810.73	266.09	811.24	266.84	812	267.7	812.93	268.68	814
269.47	814.36	270.29	814.68	271.35	815.14	273.53	816	275.4	816.6
277.65	817.32	279.75	818	281.37	818.73	283.09	819.44	284.44	820
284.76	820.08	286.73	820.58	291.04	821.66	291.49	821.77	291.67	821.8
291.8	821.83	292.4	822	306.77	823.32	328.6	823.32	333.74	822
335.18	821.78	338.87	822	342.71	822.28	351.06	822	365.19	821.5
384	822	412.74	822.63	430.11	824	435.51	824.84	439.45	825.45
441.78	825.81	442.64	825.93	443.01	826	445.11	826.69	447.46	827.46
449.07	828	453.66	829.57	454.92	830	460.68	831.97	466.64	834
467.55	834.33	472.24	836	473.22	836.52	476.03	838	476.6	838.3
479.81	840								

Manning's n Values		num= 7		Sta n Val		Sta n Val		Sta n Val	
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	110.16	.033	116.43	.035	190.97	.035	273.53	.035
306.77	.013	328.6	.035						

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 190.97 273.53 48.53 53.58 14.67 .1 .3

Blocked Obstructions		num= 2		Sta L Sta R Elev	
Sta L	Sta R	Elev	Sta L	Sta R	Elev
0	89.34	835	430	479.81	835

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.80	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.34	* Wt. n-Val.	* 0.035	* 0.035	* 0.033
* W.S. Elev (ft)	* 824.46	* Reach Len. (ft)	* 48.53	* 53.58	* 14.67
* Crit W.S. (ft)		* Flow Area (sq ft)	* 531.09	* 1148.12	* 372.18
* E.G. Slope (ft/ft)	* 0.000485	* Area (sq ft)	* 531.09	* 1148.12	* 372.18
* Q Total (cfs)	* 8252.10	* Flow (cfs)	* 1561.43	* 5995.54	* 695.13

* Top width (ft)	* 340.66	* Top width (ft)	* 101.63	* 82.56	* 156.47	*
* Vel Total (ft/s)	* 4.02	* Avg. Vel. (ft/s)	* 2.94	* 5.22	* 1.87	*
* Max Chl Dpth (ft)	* 14.66	* Hydr. Depth (ft)	* 5.23	* 13.91	* 2.38	*
* Conv. Total (cfs)	* 374580.9	* Conv. (cfs)	* 70876.6	* 272150.6	* 31553.6	*
* Length wtd. (ft)	* 49.74	* Wetted Per. (ft)	* 104.19	* 87.03	* 158.25	*
* Min Ch El (ft)	* 809.80	* Shear (lb/sq ft)	* 0.15	* 0.40	* 0.07	*
* Alpha	* 1.34	* Stream Power (lb/ft s)	* 479.81	* 0.00	* 0.00	*
* Frctn Loss (ft)	* 0.02	* Cum Volume (acre-ft)	* 2.74	* 4.89	* 3.23	*
* C & E Loss (ft)	* 0.03	* Cum SA (acres)	* 0.11	* 0.12	* 0.05	*

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Upper RS: 2527.424

INPUT

Description:

Station Elevation Data		num= 105									
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	5.66	838.97	10.86	838	11.23	837.93	11.39	837.9		
11.48	837.88	14.98	837.14	15.17	837.1	15.32	837.07	15.74	836.96		
19.15	836	19.43	835.91	19.68	835.84	23.67	834.67	29.01	833.1		
32.65	832	35.39	831.16	38.88	830	40.7	829.39	44.64	828		
45.84	827.65	47.18	827.26	48.91	826.73	51.35	826	51.48	825.98		
51.54	825.97	55.08	825.39	56.48	825.22	59.66	824.71	62.05	824.46		
64.5	824.21	66.33	824.02	66.4	824.01	66.58	824	69.87	823.72		
71.16	823.51	76.19	822.98	78.2	822.58	79.76	822.39	80.97	822.17		
82.06	822	82.24	822	83.04	821.95	86.52	821.79	89.9	821.62		
103.11	820	104.51	819.92	119.44	819.22	126.71	818.99	132.07	818.81		
138.62	817.88	142.32	817.81	143.36	817.81	147.79	817.79	148.81	817.78		
159.57	817.91	159.93	817.91	160.86	817.92	166.57	817.93	181.03	817.28		
183.74	817.12	185.96	817.1	189.41	816.85	192.81	816.61	194.42	816.53		
198.7	816.19	201.12	816	224.53	814	228.53	812	231.17	811.13		
250.36	810.59	253.75	809.8	307.36	810.09	311.08	812	314.99	814		
320.415	816	327.33	818	332.99	820	346.37	822	350.32	822.31		
352.77	822.52	354.6	822.67	361.3	823	384.2	823.39	389.28	822		
399.36	822.1	420.71	821.49	448.57	822	511.85	824	514.31	824.83		
517.68	826	518.07	826.14	523.06	828	526.54	829.27	528.55	830		
533.41	831.77	534.05	832	538.57	833.64	539.55	834	542.74	835.21		
543.59	835.53	544.84	836	548.45	837.8	548.86	838	552.86	840		

Manning's n Values		num= 7									
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	143.36	.033	160.86	.035	224.53	.035	332.99	.035		
361.3	.013	384.2	.035								

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 224.53 332.99 152.44 105.55 614.2 .1 .3

Blocked Obstructions num= 2  
 Sta L Sta R Elev Sta L Sta R Elev  
 67.61 143.65 835 465.56 519.57 835

CROSS SECTION OUTPUT Profile #PF 1

```

*****
* E.G. Elev (ft)          * 824.75 * Element          * Left OB * Channel * Right OB *
* Vel Head (ft)          * 0.23  * Wt. n-Val.      * 0.035  * 0.035  * 0.032  *
* W.S. Elev (ft)         * 824.52 * Reach Len. (ft) * 105.55 * 105.55 * 105.55 *
* Crit W.S. (ft)         *        * Flow Area (sq ft) * 634.22 * 1402.20 * 314.42 *
* E.G. Slope (ft/ft)     * 0.000332 * Area (sq ft)    * 634.22 * 1402.20 * 314.42 *
* Q Total (cfs)          * 8252.10 * Flow (cfs)      * 1884.92 * 5882.02 * 485.16 *
* Top width (ft)         * 328.03 * Top width (ft)  * 87.00  * 108.46 * 132.57 *
* Vel Total (ft/s)       * 3.51  * Avg. Vel. (ft/s) * 2.97  * 4.19  * 1.54  *
* Max Chl Dpth (ft)     * 14.72 * Hydr. Depth (ft) * 7.29  * 12.93 * 2.37  *
* Conv. Total (cfs)      * 452735.5 * Conv. (cfs)     * 103412.5 * 322705.9 * 26617.1 *
* Length wtd. (ft)      * 105.55 * Wetted Per. (ft) * 94.49  * 111.10 * 134.95 *
* Min Ch El (ft)        * 809.80 * Shear (lb/sq ft) * 0.14  * 0.26  * 0.05  *
* Alpha                  * 1.19  * Stream Power (lb/ft s) * 552.86 * 0.00  * 0.00  *
* Frctn Loss (ft)       * 0.02  * Cum Volume (acre-ft) * 2.09  * 3.32  * 3.12  *
* C & E Loss (ft)       * 0.05  * Cum SA (acres)   *        *        *        *
*****
  
```

Warning: Divided flow computed for this cross-section.

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Lower RS: 2421.596

INPUT

Description:

Station Elevation Data num= 117

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	2.4	838	3.98	836.71	4.83	836	6.42	834.71
7.29	834	7.57	833.78	9.78	832	10.72	831.25	12.29	830
13.8	828.98	15.26	828	17.57	826.57	18.49	826	20.59	824.69
21.71	824	23.06	823.23	25.21	822	28.1	820.35	28.74	820
34.09	819.22	36.52	818.88	40.59	818.28	40.6	818.28	41.19	818.22
42.87	818.04	43.16	818	45.11	817.8	47	817.58	49.1	816.98
49.33	816.96	49.85	816.91	51.06	816.77	53.61	816.48	58.5	816
61.54	815.75	61.99	815.72	65.18	815.28	67.15	815.07	70.09	814.52
73.19	814	73.87	813.91	75.09	813.82	76.89	813.71	83.62	813.28
84.78	813.23	85.25	813.2	86.34	813.01	89.24	812.83	95.26	812.49
98.03	812.35	102.97	812.03	105.29	812	106.07	812	106.41	811.9
106.53	812	108.25	812.48	109.66	812.93	110.83	813.3	113.22	814
118.69	814	138.26	814	139.46	813.78	140.2	813.65	143.53	813.05
148.05	812.23	148.53	812.15	148.72	812.11	149.33	812	151.61	811.43
155.86	810.37	158.05	809.8	160.2	809.8	161.03	809.81	182.9	809.9

193.52	809.93	200.73	809.95	228.75	810.1	230.24	811.95	230.28	812
230.36	812.1	232.17	814	233.25	815.08	242.99	815.55	264.24	816
286.38	816.24	304.43	815.6	361.73	816	379.92	818	385.94	819.5
387.93	820	392.66	820.99	397.15	822	403.4	822.95	431.28	823.15
438.18	822	441.14	821.34	443.33	820.86	445.4	820.43	447.52	820
464.78	820	468.66	820.23	473.73	820.39	479.97	820.65	483.21	820.77
494.84	821.03	523.25	819.76	536	820	544.38	821.08	620.38	821.38
690.56	823.34	802.04	824	828.96	826	833.31	826.8	836.02	827.31
839.52	828	847.77	830						

Manning's n Values num= 9

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.06	40.59	.033	47	.035	73.19	.033	83.62	.035
138.26	.035	233.25	.06	403.4	.033	431.28	.035		

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 138.26 233.25 114.88 182.56 4.38 .1 .3

Blocked Obstructions num= 1  
 Sta L Sta R Elev  
 674.66 794 835

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.68	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.07	* Wt. n-Val.	* 0.035	* 0.035	* 0.050
* W.S. Elev (ft)	* 824.60	* Reach Len. (ft)	* 114.88	* 182.56	* 4.38
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 1091.42	* 1338.23	* 2259.36
* E.G. Slope (ft/ft)	*0.000124	* Area (sq ft)	* 1091.42	* 1338.23	* 2259.36
* Q Total (cfs)	* 8421.60	* Flow (cfs)	* 2352.44	* 3624.48	* 2444.68
* Top width (ft)	* 670.09	* Top width (ft)	* 117.53	* 94.99	* 457.57
* Vel Total (ft/s)	* 1.80	* Avg. Vel. (ft/s)	* 2.16	* 2.71	* 1.08
* Max chl Dpth (ft)	* 14.80	* Hydr. Depth (ft)	* 9.29	* 14.09	* 4.94
* Conv. Total (cfs)	*755917.3	* Conv. (cfs)	*211153.9	*325330.5	*219432.9
* Length wtd. (ft)	* 106.88	* Wetted Per. (ft)	* 119.62	* 97.66	* 461.07
* Min Ch El (ft)	* 809.80	* Shear (lb/sq ft)	* 0.07	* 0.11	* 0.04
* Alpha	* 1.49	* Stream Power (lb/ft s)	* 847.77	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.02	* Cum Volume (acre-ft)	* 4.42	* 44.93	* 39.99
* C & E Loss (ft)	* 0.01	* Cum SA (acres)	* 0.79	* 3.03	* 10.16

Warning: Divided flow computed for this cross-section.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.

This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Lower

RS: 2236.871

INPUT

Description:

Station Elevation Data		num= 80		Sta Elev		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	2.42	838	3.01	837.53	4.88	836	6.52	834.71		
7.43	834	8.71	833.01	10.11	832	12.25	830.33	12.68	830		
13.23	829.57	15.18	828	16.6	826.53	17.11	826	18.95	824.08		
19.03	824	19.41	823.6	21.01	822	25.84	820.14	26.2	820		
26.79	819.82	30.13	818.8	30.56	818.67	31.04	818.51	32.65	818.55		
39.05	818.69	39.71	818.44	40.22	818.24	40.77	818	43.5	816.3		
44.02	816	44.44	815.59	46.05	814	47.5	812.48	47.94	812		
51.96	809.92	52.19	809.8	69.7	809.86	76.58	809.89	83.09	809.91		
104.65	810	107.43	811.6	108.18	812	112.48	813.22	115.84	814		
119.31	814.63	137.01	815.12	154.55	815.51	173.13	815.59	204.65	816		
211.29	816.6	224.02	817.3	241.5	816	244.49	815.88	245.12	816		
260.46	818	266.23	818.43	272.64	819	277.68	819.42	283.84	820		
312.88	820.85	350.09	820	387.7	818.12	391.82	820	399.11	822		
406.37	823.5	432.04	823.48	447.02	823.25	484.2	822	604.1	822.05		
736.62	824	737.21	824.05	737.5	824.09	738.16	824.16	741.43	824.5		
753.67	825.79	755.55	826	760.26	827.09	763.94	828	771.96	830		

Manning's n Values		num= 9		Sta n Val		Sta n Val		Sta n Val		Sta n Val	
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	31.04	.033	46.05	.035	119.31	.06	272.64	.035		
406.37	.013	432.04	.035	484.2	.033	604.1	.035				

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	46.05	119.31		251.91	229.47	12.96	.1 .3

Blocked Obstructions		num= 2		Sta L Sta R Elev		Sta L Sta R Elev	
				471.82	604.11	835	618.43 731.04 835

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.65	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.18	* Wt. n-Val.	* 0.039	* 0.035	* 0.051
* W.S. Elev (ft)	* 824.47	* Reach Len. (ft)	* 251.91	* 229.47	* 12.96
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 147.20	* 1013.84	* 1979.97
* E.G. Slope (ft/ft)	*0.000330	* Area (sq ft)	* 147.20	* 1013.84	* 1979.97
* Q Total (cfs)	* 8421.60	* Flow (cfs)	* 303.62	* 4417.83	* 3700.15
* Top width (ft)	* 477.62	* Top width (ft)	* 27.47	* 73.26	* 376.89
* Vel Total (ft/s)	* 2.68	* Avg. Vel. (ft/s)	* 2.06	* 4.36	* 1.87
* Max chl Dpth (ft)	* 14.67	* Hydr. Depth (ft)	* 5.36	* 13.84	* 5.25
* Conv. Total (cfs)	*463543.3	* Conv. (cfs)	* 16712.0	*243166.9	*203664.3
* Length wtd. (ft)	* 153.72	* Wetted Per. (ft)	* 30.62	* 75.50	* 385.39
* Min ch El (ft)	* 809.80	* Shear (lb/sq ft)	* 0.10	* 0.28	* 0.11
* Alpha	* 1.62	* Stream Power (lb/ft s)	* 771.96	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.06	* Cum Volume (acre-ft)	* 2.79	* 40.01	* 39.78

\* C & E Loss (ft) \* 0.01 \* Cum SA (acres) \* 0.60 \* 2.67 \* 10.12 \*  
 \*\*\*\*\*

Warning: Divided flow computed for this cross-section.

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Lower RS: 2005.226

INPUT

Description:

Station Elevation Data num= 67

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	830	3.33	828	3.51	827.92	8.38	826.1	9.86	826.02
10.17	826	11.54	825.94	13.67	825.85	16.69	825.76	19.16	825
20.02	824.76	21.44	824.39	22.82	824	25.01	822.89	26.69	822
28.27	820.31	28.56	820	29.27	819.23	30.41	818	30.58	817.82
32.27	816	32.87	815.53	34.82	814	35.95	813.18	37.72	812
43.21	810.11	43.52	810	43.55	809.99	44	809.86	44.21	809.8
57.46	809.77	93.44	809.7	94.1	809.92	94.39	810	106.84	811.29
113.26	812	116.34	812.53	123.69	814	125.41	814.23	134.6	814
140.71	813.65	157.35	814	162.73	816	166.62	818	219.96	820
224.67	820.23	261.72	822	291.85	822.65	338.25	822.45	354.69	823.04
378.14	823.06	408.78	822.5	530.63	822	600.57	823.78	624.56	824
637.01	824	641.97	824.64	644.55	824.9	647.65	825.09	653.2	825.74
653.66	825.78	653.86	825.8	655.46	826	659.43	826.9	664.23	828
667.25	828.7	673.02	830						

Manning's n Values num= 8

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	34.82	.035	125.41	.06	166.62	.035	354.69	.013
378.14	.035	408.78	.033	530.63	.035				

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 34.82 125.41 147.51 152.72 70.79 .1 .3

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
408.78	530.63	835	544	584.88	835

CROSS SECTION OUTPUT Profile #PF 1

\*\*\*\*\*

* E.G. Elev (ft)	* 824.58	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.30	* wt. n-Val.	* 0.100	* 0.035	* 0.045
* W.S. Elev (ft)	* 824.28	* Reach Len. (ft)	* 147.51	* 152.72	* 70.79
* Crit w.s. (ft)	*	* Flow Area (sq ft)	* 58.18	* 1235.27	* 1120.14
* E.G. Slope (ft/ft)	* 0.000431	* Area (sq ft)	* 58.18	* 1235.27	* 1120.14
* Q Total (cfs)	* 8421.60	* Flow (cfs)	* 41.02	* 6151.86	* 2228.72



* Top width (ft)	* 454.64	* Top width (ft)	* 13.00	* 90.59	* 351.05	*
* Vel Total (ft/s)	* 3.49	* Avg. Vel. (ft/s)	* 0.71	* 4.98	* 1.99	*
* Max Chl Dpth (ft)	* 14.58	* Hydr. Depth (ft)	* 4.48	* 13.64	* 3.19	*
* Conv. Total (cfs)	*405752.9	* Conv. (cfs)	* 1976.6	*296396.8	*107379.5	*
* Length wtd. (ft)	* 128.65	* Wetted Per. (ft)	* 16.83	* 91.94	* 358.96	*
* Min Ch El (ft)	* 809.70	* Shear (lb/sq ft)	* 0.09	* 0.36	* 0.08	*
* Alpha	* 1.57	* Stream Power (lb/ft s)	* 673.02	* 0.00	* 0.00	*
* Frctn Loss (ft)	* 0.04	* Cum Volume (acre-ft)	* 2.20	* 34.08	* 39.32	*
* C & E Loss (ft)	* 0.04	* Cum SA (acres)	* 0.48	* 2.24	* 10.01	*

Warning: Divided flow computed for this cross-section.

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Lower RS: 1852.485

INPUT

Description:

Station	Elevation	Data	num=	95						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	830	.6	829.62	4.98	828.05	7.01	828.02	8.23	828	
10.1	828	11.89	827.37	14.51	826	16.23	824.67	17.07	824	
18.17	823.07	19.41	822	21.43	820.29	21.77	820	22.49	819.39	
24.14	818	26.33	816.32	26.75	816	27.39	815.58	29.81	814	
30.44	813.6	32.98	812	36.29	810.7	38.13	810	38.83	809.82	
39.53	809.64	40.1	809.5	48.8	809.46	55.57	809.4	79.44	809.16	
85.39	809.1	89.56	809.1	112.11	809.51	112.56	809.7	112.68	809.67	
113.11	809.83	113.67	810	114.97	810.64	117.02	811.7	117.41	811.9	
117.59	812	119.2	812.51	120.99	813.07	124.04	814	128.79	815.28	
137.84	814	151.41	813.38	157.36	814	161.88	816	163.5	816.1	
164.21	816.12	173.31	816.52	192.16	817.38	205.83	818	218.06	818.82	
236.65	820	278.18	821.85	303.1	822	320.84	822	326.76	822.47	
333.94	822.97	356.11	823.2	366.05	823.19	368.99	822	475.88	822	
477.61	822.74	493.95	823.33	517.66	823.24	519.84	822	590.82	822	
594.92	822.46	601.33	823.22	604.46	823.59	607.95	824	611.59	824.87	
616.26	826	618.02	826.41	624.91	828	633.93	830	638.5	830.72	
646.44	832	648.48	832.31	650.42	832.58	655.38	833.3	660.74	834	
661.04	834.04	661.36	834.08	668.65	835.01	675.33	835.81	676.85	836	
684.13	837.15	688.09	837.79	689.4	838	694.16	838.81	701.17	840	

Manning's n Values	num=	8							
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	.1	27.39	.035	128.79	.06	151.41	.035	333.94	.013
356.11	.035	477.61	.033	517.66	.035				

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 27.39 128.79 44.03 40.42 40.14 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

```

*****
* E.G. Elev (ft)          * 824.50 * Element                * Left OB * Channel * Right OB *
* Vel Head (ft)          * 0.18  * Wt. n-Val.            * 0.100  * 0.035  * 0.039  *
* W.S. Elev (ft)         * 824.32 * Reach Len. (ft)       * 44.03  * 40.42  * 40.14  *
* Crit W.S. (ft)         *         * Flow Area (sq ft)     * 48.17  * 1431.75 * 1620.79 *
* E.G. Slope (ft/ft)     * 0.000264 * Area (sq ft)         * 48.17  * 1431.75 * 1620.79 *
* Q Total (cfs)          * 8421.60 * Flow (cfs)           * 26.73  * 5679.26 * 2715.61 *
* Top Width (ft)         * 592.63 * Top Width (ft)       * 10.72  * 101.40  * 480.51  *
* Vel Total (ft/s)       * 2.72  * Avg. Vel. (ft/s)     * 0.55  * 3.97  * 1.68  *
* Max Chl Dpth (ft)     * 15.22 * Hydr. Depth (ft)     * 4.49  * 14.12  * 3.37  *
* Conv. Total (cfs)      * 517945.2 * Conv. (cfs)          * 1643.8 * 349285.8 * 167015.7 *
* Length wtd. (ft)      * 40.35 * Wetted Per. (ft)     * 13.84  * 103.94  * 482.13  *
* Min Ch El (ft)        * 809.10 * Shear (lb/sq ft)     * 0.06  * 0.23  * 0.06  *
* Alpha                  * 1.56  * Stream Power (lb/ft s) * 701.17 * 0.00  * 0.00  *
* Frctn Loss (ft)       * 0.01  * Cum Volume (acre-ft) * 2.02  * 29.41  * 37.09  *
* C & E Loss (ft)       * 0.00  * Cum SA (acres)       * 0.44  * 1.90  * 9.34  *
*****
    
```

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Lower

RS: 1812.068

INPUT

Description:

Station Elevation Data num= 57

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	830	1.73	828.96	3.32	828	4.29	827.3	6.14	826
6.98	825.33	8.31	824.27	8.65	824	10.1	822.84	11.11	822
11.47	821.69	13.49	820	15.59	818.2	15.83	818	17.67	816.47
18.27	816	20.33	814.27	20.66	814	20.85	813.85	23.11	812
26.5	810.21	26.9	810	28.45	809.39	28.95	809.2	29.09	809.2
50.32	809.16	60.5	809.14	80.04	809.1	97.7	809.1	107.43	809.1
108.42	809.55	109.41	810	110.75	810.56	114.2	812	117.5	813.04
120.76	814	123.82	814.89	132.65	814	145.63	813.45	152.09	814
156.36	816	157.53	816.05	158.47	816.09	174.51	816.79	182.9	817.14
203.16	818	232.77	820	237.96	820.14	266.87	821.47	308.3	822
320.97	823	341.83	823.21	418.09	824	591.17	826	615.97	828
631.56	830	697.84	840						

Manning's n values num= 6

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	18.27	.035	123.82	.06	145.63	.035
341.83	.033					320.97	.013

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 18.27 123.82 29.48 25.45 34.43 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

```

*****
* E.G. Elev (ft)          * 824.49 * Element          * Left OB * Channel * Right OB *
* Vel Head (ft)          * 0.20  * Wt. n-Val.      * 0.100  * 0.035  * 0.039  *
* W.S. Elev (ft)         * 824.28 * Reach Len. (ft) * 29.48  * 25.45  * 34.43  *
* Crit W.S. (ft)         *        * Flow Area (sq ft) * 41.19  * 1516.23 * 1159.67 *
* E.G. Slope (ft/ft)     * 0.000273 * Area (sq ft)    * 41.19  * 1516.23 * 1159.67 *
* Q Total (cfs)          * 8421.60 * Flow (cfs)      * 21.85  * 6165.07 * 2234.68 *
* Top width (ft)         * 434.45 * Top width (ft)  * 9.98   * 105.55  * 318.92  *
* Vel Total (ft/s)       * 3.10   * Avg. Vel. (ft/s) * 0.53   * 4.07   * 1.93   *
* Max Chl Dpth (ft)     * 15.18  * Hydr. Depth (ft) * 4.13   * 14.37  * 3.64   *
* Conv. Total (cfs)     * 509671.8 * Conv. (cfs)     * 1322.3 * 373107.3 * 135242.2 *
* Length Wtd. (ft)      * 28.20  * Wetted Per. (ft) * 12.97  * 108.66 * 319.64 *
* Min Ch El (ft)        * 809.10 * Shear (lb/sq ft) * 0.05   * 0.24   * 0.06   *
* Alpha                  * 1.36   * Stream Power (lb/ft s) * 697.84 * 0.00   * 0.00   *
* Frctn Loss (ft)       * 0.01   * Cum Volume (acre-ft) * 1.97  * 28.04  * 35.81  *
* C & E Loss (ft)       * 0.01   * Cum SA (acres)   * 0.43   * 1.81   * 8.97   *
*****
    
```

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Lower

RS: 1786.606

INPUT

Description:

Station Elevation Data num= 80

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	830	3.34	828.32	4.01	828	6.64	826.12	6.8	826
7.1	825.76	7.79	825.22	9.37	824	9.64	823.8	11.96	822
12.82	821.35	14.57	820	17.05	818.14	17.24	818	17.7	817.77
21.2	816	23.74	814.73	26.52	813.31	29.13	812	31.41	810.79
33.1	810	33.31	809.89	34.48	809.2	52.54	809.16	60.3	809.14
78.3	809.1	82.43	809.79	96.51	809.68	99.45	809.1	109.1	809.1
109.16	809.13	111.49	810	117.05	812	122.81	814	125.69	815.03
138.08	814	148.85	813.49	156	814	159.9	816	200.84	817.9
202.78	818	203.35	818.05	208.74	818.53	217.07	819.18	220.25	819.46
227.17	820	266.69	821.29	305.42	822	319.52	823.01	339.86	823.25
360.11	823.14	363.69	822	424.65	820.92	428.02	820.94	429.74	820.94
537.34	821.55	540.11	821.57	589.07	822	591.55	822	598.97	822.6
613.42	823.64	616.28	823.86	618.32	824	622.78	825	627.56	826
629.97	826.48	637.78	828	639.93	828.34	643.64	828.96	649.72	830
657.22	831.23	661.71	832	672.92	833.76	674.42	834	683.53	835.45
687	836	687.69	836.11	699.53	838	701.26	838.31	710.33	840

Manning's n Values num= 6

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val		
0	.1	23.74	.035	125.69	.06	148.85	.035	319.52	.013

339.86 .035

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 23.74 125.69 105.08 108.5 124.1 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

```

*****
* E.G. Elev (ft)          * 824.47 * Element          * Left OB * Channel * Right OB *
* Vel Head (ft)          * 0.16  * Wt. n-Val.      * 0.100  * 0.035  * 0.038  *
* W.S. Elev (ft)         * 824.31 * Reach Len. (ft) * 105.08 * 108.50 * 124.10 *
* Crit w.s. (ft)         *        * Flow Area (sq ft) * 77.91  * 1456.41 * 1808.12 *
* E.G. slope (ft/ft)     * 0.000235 * Area (sq ft)    * 77.91  * 1456.41 * 1808.12 *
* Q Total (cfs)          * 8421.60 * Flow (cfs)      * 47.68  * 5489.08 * 2884.85 *
* Top width (ft)         * 610.73 * Top width (ft)  * 14.77  * 101.95  * 494.01  *
* Vel Total (ft/s)       * 2.52   * Avg. Vel. (ft/s) * 0.61   * 3.77   * 1.60   *
* Max Chl Dpth (ft)     * 15.21  * Hydr. Depth (ft) * 5.27   * 14.29  * 3.66   *
* Conv. Total (cfs)     * 549614.0 * Conv. (cfs)     * 3111.6 * 358230.3 * 188272.1 *
* Length wtd. (ft)     * 114.20 * Wetted Per. (ft) * 17.68  * 104.44 * 495.06 *
* Min Ch El (ft)        * 809.10 * Shear (lb/sq ft) * 0.06   * 0.20   * 0.05   *
* Alpha                  * 1.60   * Stream Power (lb/ft s) * 710.33 * 0.00   * 0.00   *
* Frctn Loss (ft)       * 0.02   * Cum Volume (acre-ft) * 1.93   * 27.17  * 34.63  *
* C & E Loss (ft)       * 0.01   * Cum SA (acres)   * 0.42   * 1.75   * 8.65   *
*****
    
```

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Lower RS: 1674.792

INPUT

Description:

Station	Elevation	Data	num=	94	Sta	Elev	Sta	Elev	Sta	Elev
0	830	2.66	828	3.75	827.05	5.04	826	7.31	824.18	
7.51	824.02	9.91	822	10.39	821.59	12.28	820	14.68	818.09	
14.79	818	15.27	817.53	16.79	816	17.04	815.74	18.76	814	
19.24	813.51	20.73	812	22.3	811.14	24.52	810	25.95	809.57	
26.7	809.33	27.56	809.1	30.19	808.98	35.6	808.84	47.52	808.46	
52.62	808.42	55.03	808.36	62.86	808.31	63.26	808.31	68.57	808.35	
72.32	808.41	76.95	808.5	85.28	808.57	89.67	808.66	97.02	808.82	
98.03	808.84	100.76	808.91	102.08	809.69	102.69	810	106.29	811.72	
106.73	811.92	106.89	812	111.27	813.8	111.75	814	115.12	815.35	
134.2	814	144.18	813.5	152.04	814	162.7	816	187.88	818	
195.27	820	253.59	820.67	288.96	822	298.97	822.92	320.03	822.93	
323.27	822	332.71	820	391.45	820	406.66	820.13	408.13	820.15	
420.6	820.26	426.17	820.31	436.53	820.41	441.82	820.46	446.44	820.5	
450.97	820.54	610.8	822	612.23	822	616.44	822.65	621.44	823.4	
626.16	824	630.15	824.67	634.39	825.36	637.82	826	646.33	827.73	
647.62	828	655.98	829.48	658.91	830	669.45	831.57	670.6	831.73	
672.46	832	676.94	832.64	681.77	833.34	683.96	833.64	686.46	834	

690.53 834.57 694.69 835.13 701.14 836 703.06 836.27 705.23 836.58  
 710.83 837.36 715.5 838 721.27 838.71 731.36 840

Manning's n Values num= 6  
 Sta n Val Sta n Val Sta n Val Sta n Val Sta n Val  
 \*\*\*\*\*  
 0 .1 18.76 .035 115.12 .06 134.2 .035 298.97 .013  
 320.03 .035

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 18.76 115.12 130.48 119.69 198.02 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

\*\*\*\*\*  
 \* E.G. Elev (ft) \* 824.44 \* Element \* Left OB \* Channel \* Right OB \*  
 \* Vel Head (ft) \* 0.13 \* wt. n-Val. \* 0.100 \* 0.035 \* 0.037 \*  
 \* W.S. Elev (ft) \* 824.30 \* Reach Len. (ft) \* 130.48 \* 119.69 \* 198.02 \*  
 \* Crit W.S. (ft) \* \* \* Flow Area (sq ft) \* 57.21 \* 1440.33 \* 2113.53 \*  
 \* E.G. Slope (ft/ft) \* 0.000197 \* Area (sq ft) \* 57.21 \* 1440.33 \* 2113.53 \*  
 \* Q Total (cfs) \* 8421.60 \* Flow (cfs) \* 28.47 \* 5108.63 \* 3284.51 \*  
 \* Top Width (ft) \* 620.80 \* Top width (ft) \* 11.60 \* 96.36 \* 512.84 \*  
 \* Vel Total (ft/s) \* 2.33 \* Avg. Vel. (ft/s) \* 0.50 \* 3.55 \* 1.55 \*  
 \* Max Chl Dpth (ft) \* 15.99 \* Hydr. Depth (ft) \* 4.93 \* 14.95 \* 4.12 \*  
 \* Conv. Total (cfs) \* 599803.6 \* Conv. (cfs) \* 2027.4 \* 363846.8 \* 233929.4 \*  
 \* Length wtd. (ft) \* 150.78 \* Wetted Per. (ft) \* 15.53 \* 99.24 \* 514.04 \*  
 \* Min ch El (ft) \* 808.31 \* Shear (lb/sq ft) \* 0.05 \* 0.18 \* 0.05 \*  
 \* Alpha \* 1.58 \* Stream Power (lb/ft s) \* 731.36 \* 0.00 \* 0.00 \*  
 \* Frctn Loss (ft) \* 0.03 \* Cum Volume (acre-ft) \* 1.77 \* 23.56 \* 29.05 \*  
 \* C & E Loss (ft) \* 0.00 \* Cum SA (acres) \* 0.39 \* 1.50 \* 7.21 \*  
 \*\*\*\*\*

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Lower RS: 1554.849

INPUT

Description:

Station Elevation Data num= 100  
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev  
 \*\*\*\*\*  
 0 830 1.47 828.11 1.55 828 2.97 826.17 3.11 826  
 4.5 824.21 4.67 824 5.46 822.97 6.19 822 6.33 821.8  
 7.62 820 7.78 819.77 7.8 819.74 9.05 818 9.24 817.73  
 10.48 816 10.71 815.66 11.9 814 12.21 813.54 13.32 812  
 14.67 811.16 15.92 810.37 16.5 810 17.42 809.5 18.12 809.1  
 23.35 808.84 33.59 808.44 42.34 808.21 44.47 808.21 55.66 808.27  
 58.87 808.29 85.48 808.51 86.6 808.51 88.27 809.5 89.12 810  
 90.11 810.53 93.05 812 93.15 812.03 98.66 814 100.88 814.6  
 132.58 814 135.88 814 147.7 815 152.33 815.37 160.67 816  
 161.25 816.15 161.71 816.24 163.2 816.52 168.33 817.6 170.72 818

willard.rep

172.66	818.23	175.25	818.5	180.75	819.13	183.39	819.41	189.65	820
228.78	819.2	240.39	820	251.89	822	266.6	823.59	287.31	823.53
317.19	820	405.76	820	435	820.13	439.36	820.17	440.9	820.19
448.54	820.24	561.9	822	567.33	822	576.68	822.22	594.84	822.49
598.63	822.57	602.95	822.67	608.88	822.83	618.95	823.1	630.91	823.34
648.78	824	649.7	824	650.64	824.05	651.09	824.07	659.02	824.5
691.63	826	693.23	826	701.16	827.08	708.7	828	721.58	829.59
725.17	830	732.01	831.13	737.41	832	743.46	832.99	750.12	834
750.5	834.06	750.76	834.1	750.99	834.13	752.29	834.34	760.67	835.67
762.67	836	767.24	837.1	771.09	838	776.11	839.15	779.86	840

Manning's n Values num= 6

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	11.9	.035	100.88	.06	135.88	.035	266.6	.013
287.31	.035								

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	11.9	100.88		203.32	252.49	154.61	.1 .3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.40	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.14	* Wt. n-Val.	* 0.100	* 0.035	* 0.039
* W.S. Elev (ft)	* 824.26	* Reach Len. (ft)	* 203.32	* 252.49	* 154.61
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 37.65	* 1340.68	* 2170.50
* E.G. slope (ft/ft)	*0.000218	* Area (sq ft)	* 37.65	* 1340.68	* 2170.50
* Q Total (cfs)	* 8421.60	* Flow (cfs)	* 17.08	* 5010.82	* 3393.69
* Top width (ft)	* 650.08	* Top width (ft)	* 7.44	* 88.98	* 553.67
* Vel Total (ft/s)	* 2.37	* Avg. Vel. (ft/s)	* 0.45	* 3.74	* 1.56
* Max chl Dpth (ft)	* 16.05	* Hydr. Depth (ft)	* 5.06	* 15.07	* 3.92
* Conv. Total (cfs)	*570091.3	* Conv. (cfs)	* 1156.5	*339202.4	*229732.4
* Length wtd. (ft)	* 214.71	* Wetted Per. (ft)	* 12.67	* 92.15	* 554.61
* Min Ch El (ft)	* 808.21	* Shear (lb/sq ft)	* 0.04	* 0.20	* 0.05
* Alpha	* 1.65	* Stream Power (lb/ft s)	* 779.86	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.05	* Cum Volume (acre-ft)	* 1.63	* 19.74	* 19.31
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.36	* 1.25	* 4.79

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Lower

RS: 1294.270

INPUT

Description:

Station	Elevation	Data	num=	149	Sta	Elev	Sta	Elev	Sta	Elev
0	830	6	828	6.33	827.8	6.96	827.44	7.62	827.06	
9.48	826	10.29	825.41	12.14	824	13.13	823.22	14.73	822	

15.08	821.7	17.29	820	18.3	819.12	19.64	818	21.33	816.56
22.05	816	23.89	814.45	24.47	814	28.43	812.02	28.47	812
32.66	810.04	32.75	810	34.08	809.54	38.59	808	38.66	807.98
39.11	807.81	39.38	807.69	80.46	807.69	94.68	807.71	96.63	807.96
97.03	808	100.04	808.54	103.21	809.08	105.59	809.48	106.57	809.64
108.54	810	112.7	811.37	114.7	812	119.49	812.23	127.37	812.6
131.07	812.79	136.21	813.03	138.2	813.13	146.07	813.53	149.2	813.68
149.59	813.7	150.21	813.74	155.17	814	167.03	815.89	167.66	816
175.38	816.57	194.98	818	197.08	818.33	206.92	820	209.48	820.48
217.46	822	218.57	822.14	220.28	822.39	224.4	823.02	238.6	823.17
245.6	823.38	247.24	822.88	247.64	822.77	248.02	822.67	248.35	822.58
249.01	822.41	250.6	822	252.94	820.83	254.57	820	262.15	818.35
263.85	818	312.88	818	323.04	818.49	330.58	818.84	341.68	819.38
356.42	820	359.5	820	405.73	821.73	408.93	821.84	412.56	822
412.81	822	414.07	822.05	427.78	822.46	437.55	822.74	447.91	823.02
456.19	823.21	463.38	823.32	472.25	823.61	480.5	823.89	481.41	823.9
483.61	824	489.93	824.41	496.41	824.82	511.04	825.75	512.62	825.84
514.88	826	523.87	827.06	531.32	828	534.1	828.36	536.59	828.69
546.57	830	549.15	830.31	553.89	830.87	560.57	831.74	561.21	831.83
562.54	832	568.55	832.74	571.5	833.08	576.65	833.76	577.46	833.86
578.47	834	587.44	834.93	591.45	835.37	593.78	835.61	594.67	835.69
595.23	835.74	595.66	835.77	596.71	835.85	596.97	835.87	598.89	835.97
599.41	836	610.82	836	620.55	836.25	632.85	836.82	635.33	836.84
637.03	836.86	638.33	836.89	641.29	836.94	646.59	837.03	647.94	837.12
650.22	837.28	652.4	837.41	655.33	837.47	656.6	837.57	658.28	837.71
661.72	837.97	661.81	837.97	662.13	838	666.52	838.36	666.6	838.37
666.73	838.38	670.46	838.63	671.37	838.68	674.7	838.85	677.61	839.02
680.53	839.16	686.01	839.47	687.7	839.55	695.58	840		

Manning's n Values

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	28.43	.035	114.7	.06	146.07	.035	224.4	.013
245.6	.035								

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	28.43	114.7		48.1 101.54	99.66	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.35	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.16	* wt. n-Val.	* 0.100	* 0.035	* 0.040
* W.S. Elev (ft)	* 824.19	* Reach Len. (ft)	* 48.10	* 101.54	* 99.66
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 107.47	* 1365.25	* 1759.24
* E.G. Slope (ft/ft)	* 0.000214	* Area (sq ft)	* 107.47	* 1365.25	* 1759.24
* Q Total (cfs)	* 8421.60	* Flow (cfs)	* 70.20	* 5288.34	* 3063.06
* Top width (ft)	* 474.65	* Top width (ft)	* 16.54	* 86.27	* 371.84
* Vel Total (ft/s)	* 2.61	* Avg. Vel. (ft/s)	* 0.65	* 3.87	* 1.74
* Max Chl Dpth (ft)	* 16.50	* Hydr. Depth (ft)	* 6.50	* 15.83	* 4.73
* Conv. Total (cfs)	* 575829.4	* Conv. (cfs)	* 4800.2	* 361592.0	* 209437.3
* Length wtd. (ft)	* 99.26	* Wetted Per. (ft)	* 20.62	* 87.62	* 373.55
* Min Ch El (ft)	* 807.69	* Shear (lb/sq ft)	* 0.07	* 0.21	* 0.06

\* Alpha \* 1.55 \* Stream Power (lb/ft s) \* 695.58 \* 0.00 \* 0.00 \*  
 \* Frctn Loss (ft) \* 0.02 \* Cum Volume (acre-ft) \* 1.29 \* 11.90 \* 12.34 \*  
 \* C & E Loss (ft) \* 0.01 \* Cum SA (acres) \* 0.31 \* 0.74 \* 3.14 \*  
 \*\*\*\*\*

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Lower

RS: 1192.596

INPUT

Description:

Station Elevation Data		num=		194							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	830	1.59	829.77	2.45	829.63	3.73	829.43	5.49	829.14		
7.91	828.74	9.51	828.47	12.3	828	12.72	827.93	12.83	827.91		
13.02	827.87	17	827.17	21.02	826.41	22.08	826.21	23.2	826		
26.45	825.4	29.47	824.89	31.28	824.58	34.71	824	38.25	823.49		
38.42	823.46	41.22	822.95	46.15	822	49.24	821.24	55.79	820		
56.29	819.91	56.75	819.84	61.56	819.07	63.32	818.78	67.22	818.27		
67.66	818.2	67.95	818.17	69.56	818	71.14	817.79	71.56	817.73		
74.16	817.42	76.2	817.15	79.41	816.67	80.61	816.51	83.84	816		
86.3	815.63	87.51	815.46	89.91	815.12	90.52	815.03	91.17	814.93		
91.57	814.88	94.66	814.46	95.59	814.33	97.92	814	99.67	813.66		
100.45	813.49	102.92	812.98	107.49	812.02	107.57	812	111.82	810.5		
113.4	810	116.19	809.15	117.05	808.99	118.41	808.61	120.28	808		
121.14	807.71	124.74	806.42	127.86	806.45	128.22	806.45	128.69	806.44		
142.71	806.53	146.04	806.55	156.28	806.61	159.8	806.64	164.33	806.67		
190.84	806.92	191.04	807.03	191.31	807.2	192.58	808	195.19	809.56		
195.94	810	196.46	810.2	201.28	812	205.83	812.49	209.85	812.93		
211.71	813.15	220.11	813.54	221.14	813.53	224.51	813.5	225.04	813.49		
225.19	813.49	225.23	813.49	225.68	813.49	226.46	813.49	244.18	813.94		
246.74	814	254.28	814	256.89	814.47	265.42	816	268.72	816.81		
273.28	818	276.48	818.76	281.49	820	288.56	821.47	291.1	822		
291.33	822.01	292.89	822.08	300.2	822.55	321.2	823.79	331.34	822		
331.62	821.96	333.72	821.68	334.54	821.67	341.34	820.68	354.66	820		
363.88	820	376.58	820.36	388.76	820.24	390.93	820.25	392.34	820.26		
393.28	820.26	394.05	820.26	404.7	820.51	432.66	821.19	461.12	821.53		
472.69	821.76	475.13	821.83	476.38	821.85	481.48	822	483.04	822.04		
494.25	822.33	500.74	822.51	501.75	822.53	506.56	822.61	512.28	822.92		
514.56	823.07	517.98	823.29	521.95	823.53	527.98	823.88	530.14	824		
533.8	824.18	538.91	824.45	543.97	824.7	549.84	824.99	562.37	825.68		
568.79	825.91	570.31	826	571.54	826	606.6	827.49	617.21	828		
618.26	828.02	621.83	828.08	626.98	828.45	631.84	828.67	635.8	828.86		
651.84	829.99	652	830	654.88	830.36	658.88	830.69	661.36	830.82		
665.11	831.4	667.28	831.57	671.3	831.85	671.88	831.9	673.38	832		
675.42	832.15	677.58	832.29	679.31	832.36	681.42	832.41	689.21	832.57		
696.73	833.15	703.03	833.32	712.96	833.86	713.59	833.89	713.95	833.9		
714.54	833.94	715.52	834	718.53	834.17	718.81	834.19	719.1	834.21		
722.13	834.41	722.88	834.47	725.82	834.65	727.4	834.77	729.89	834.95		



732.01	835.1	735.73	835.48	736.98	835.62	738.5	835.83	739.81	836
741.9	836.33	743.37	836.59	746.65	837.14	748.13	837.4	751.72	838
753.63	838.33	754.81	838.54	758.78	839.23	763.08	840		

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	55.79	.06	102.92	.035	220.11	.06	256.89	.035
300.2	.013	321.2	.035						

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

102.92	220.11	68.62	189.67	570.98	.1	.3
--------	--------	-------	--------	--------	----	----

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.33	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.14	* Wt. n-Val.	* 0.058	* 0.035	* 0.044
* W.S. Elev (ft)	* 824.18	* Reach Len. (ft)	* 68.62	* 189.67	* 570.98
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 401.46	* 1833.61	* 1208.59
* E.G. slope (ft/ft)	* 0.000172	* Area (sq ft)	* 401.46	* 1833.61	* 1208.59
* Q Total (cfs)	* 8421.60	* Flow (cfs)	* 483.59	* 6313.41	* 1624.60
* Top width (ft)	* 500.26	* Top width (ft)	* 69.30	* 117.19	* 313.77
* Vel Total (ft/s)	* 2.45	* Avg. Vel. (ft/s)	* 1.20	* 3.44	* 1.34
* Max Chl Dpth (ft)	* 17.76	* Hydr. Depth (ft)	* 5.79	* 15.65	* 3.85
* Conv. Total (cfs)	* 641253.4	* Conv. (cfs)	* 36822.8	* 480727.7	* 123703.0
* Length wtd. (ft)	* 220.86	* Wetted Per. (ft)	* 70.23	* 119.48	* 315.05
* Min Ch El (ft)	* 806.42	* Shear (lb/sq ft)	* 0.06	* 0.17	* 0.04
* Alpha	* 1.56	* Stream Power (lb/ft s)	* 763.08	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.04	* Cum Volume (acre-ft)	* 1.01	* 8.17	* 8.94
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.26	* 0.50	* 2.36

CROSS SECTION

RIVER: Meathouse Fork  
 REACH: Lower

RS: 1000.000

INPUT

Description:

Station Elevation Data num= 29

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	830	14.09	828	28.28	826	34.99	824	121.08	822
146.41	822	254.08	820	257.7	818	260.84	816	276.97	814
295.68	812	306.18	810.08	306.6	810	313.88	808	318.6	806.42
400.77	806.12	403.71	808	404.94	808.92	406.39	810	408.78	812
411.22	814	413.6	816	415.74	818	420.71	820	437.65	822.26
458.87	824.49	476.21	826	485.54	828	493.83	830		

Manning's n Values num= 6

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
-----	-------	-----	-------	-----	-------	-----	-------

\*\*\*\*\*  
 0 .035 254.08 .06 295.68 .035 408.78 .035 437.65 .013  
 458.87 .035

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 295.68 408.78 1 1 1 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

\*\*\*\*\*  
 \* E.G. Elev (ft) \* 824.29 \* Element \* Left OB \* Channel \* Right OB \*  
 \* Vel Head (ft) \* 0.19 \* Wt. n-Val. \* 0.049 \* 0.035 \* 0.033 \*  
 \* W.S. Elev (ft) \* 824.10 \* Reach Len. (ft) \* \* \* \*  
 \* Crit W.S. (ft) \* 812.71 \* Flow Area (sq ft) \* 876.90 \* 1919.65 \* 155.70 \*  
 \* E.G. Slope (ft/ft) \* 0.000181 \* Area (sq ft) \* 876.90 \* 1919.65 \* 155.70 \*  
 \* Q Total (cfs) \* 8421.60 \* Flow (cfs) \* 1044.31 \* 7139.18 \* 238.11 \*  
 \* Top Width (ft) \* 420.50 \* Top width (ft) \* 261.03 \* 113.10 \* 46.38 \*  
 \* Vel Total (ft/s) \* 2.85 \* Avg. Vel. (ft/s) \* 1.19 \* 3.72 \* 1.53 \*  
 \* Max Chl Dpth (ft) \* 17.98 \* Hydr. Depth (ft) \* 3.36 \* 16.97 \* 3.36 \*  
 \* Conv. Total (cfs) \* 625214.6 \* Conv. (cfs) \* 77529.1 \* 530008.2 \* 17677.3 \*  
 \* Length wtd. (ft) \* \* Wetted Per. (ft) \* 262.41 \* 115.75 \* 49.25 \*  
 \* Min Ch El (ft) \* 806.12 \* Shear (lb/sq ft) \* 0.04 \* 0.19 \* 0.04 \*  
 \* Alpha \* 1.47 \* Stream Power (lb/ft s) \* 493.83 \* 0.00 \* 0.00 \*  
 \* Frctn Loss (ft) \* \* Cum Volume (acre-ft) \* \* \* \*  
 \* C & E Loss (ft) \* \* Cum SA (acres) \* \* \* \*  
 \*\*\*\*\*

CROSS SECTION

RIVER: Sugarcamp Run  
 REACH: Upper RS: 1908.741

INPUT

Description:

Station Elevation Data num= 65

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	2.85	838	4.65	836.74	5.7	836	9.54	834.13
9.59	834.11	9.79	834	13.88	832.24	14.39	832	15.17	831.68
19.44	830	23.66	828.84	26.86	828	29.01	827.73	37.13	826.73
42.61	826	43.85	825.53	45.76	824.77	47.71	824	49.37	823.29
50.5	822.81	50.98	822.62	52.45	822.6	64.28	822.72	65.04	823.15
66.57	823.92	66.71	824	67.78	824.38	90.72	825.58	111.26	825.14
113.49	824	114.23	823.78	126.95	823.32	131.24	824	134.22	824.94
137.66	826	155.28	826	170.11	826.41	182.16	826.39	183.86	826.43
190.71	826.37	191.94	826.4	197.22	826.38	198.66	826.41	201.37	826.51
204.96	826.54	209.31	826.73	211.91	826.81	217.21	827.08	224.29	827.51
225.52	827.57	232.07	828	250.42	829.7	253.25	830	254.32	830.27
260.93	832	266.35	833.39	268.69	834	273.14	835.06	274.77	835.45
276.86	836	278.58	836.5	283.41	838	289.84	839.93	290.08	840

Manning's n Values num= 3

Sta n Val      Sta n Val      Sta n Val  
 \*\*\*\*\*  
 0      .1    42.61    .035    67.78    .035

Bank Sta: Left    Right      Lengths: Left Channel    Right      Coeff Contr.    Expan.  
           42.61    67.78            163.72    203    205.48            .1            .3

CROSS SECTION OUTPUT Profile #PF 1

\*\*\*\*\*  
 \* E.G. Elev (ft)            \* 826.42 \* Element                    \* Left OB \* Channel \* Right OB \*  
 \* Vel Head (ft)            \* 0.60 \* Wt. n-Val.                \*           \* 0.035 \* 0.035 \*  
 \* W.S. Elev (ft)            \* 825.83 \* Reach Len. (ft)           \* 163.72 \* 203.00 \* 205.48 \*  
 \* Crit W.S. (ft)            \* 825.83 \* Flow Area (sq ft)         \*           \* 62.38 \* 76.82 \*  
 \* E.G. Slope (ft/ft)        \* 0.008996 \* Area (sq ft)              \*           \* 62.38 \* 76.82 \*  
 \* Q Total (cfs)             \* 782.50 \* Flow (cfs)                 \*           \* 453.40 \* 329.10 \*  
 \* Top width (ft)            \* 94.03 \* Top width (ft)             \*           \* 24.71 \* 69.32 \*  
 \* Vel Total (ft/s)          \* 5.62 \* Avg. Vel. (ft/s)          \*           \* 7.27 \* 4.28 \*  
 \* Max chl Dpth (ft)         \* 3.23 \* Hydr. Depth (ft)          \*           \* 2.52 \* 1.11 \*  
 \* Conv. Total (cfs)         \* 8250.3 \* Conv. (cfs)                \*           \* 4780.5 \* 3469.8 \*  
 \* Length wtd. (ft)         \* 201.33 \* Wetted Per. (ft)          \*           \* 25.72 \* 70.00 \*  
 \* Min Ch El (ft)            \* 822.60 \* Shear (lb/sq ft)           \*           \* 1.36 \* 0.62 \*  
 \* Alpha                     \* 1.21 \* Stream Power (lb/ft s)    \* 290.08 \* 0.00 \* 0.00 \*  
 \* Frctn Loss (ft)           \* 0.18 \* Cum Volume (acre-ft)      \* 7.75 \* 24.66 \* 11.36 \*  
 \* C & E Loss (ft)          \* 0.17 \* Cum SA (acres)             \* 1.16 \* 0.47 \* 0.81 \*  
 \*\*\*\*\*

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth

for the water surface and continued on with the calculations.

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.

This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the

need for additional cross sections.

Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water

surface came back below critical depth. This indicates that there is not a valid subcritical answer. The

program

defaulted to critical depth.

CROSS SECTION

RIVER: Sugarcamp Run

REACH: Upper

RS: 1702.205

INPUT

Description:

Station Elevation Data

num= 59

willard.rep									
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	17.7	830	20.12	829.08	22.72	828	25.35	826.79
27.55	826	29.19	825.57	34.86	824.22	35.8	824	37.05	823.92
37.28	823.91	37.72	823.88	38.52	823.82	38.78	823.8	48.95	823.09
51.78	822.9	54.78	822.68	59.18	822.44	62.92	822.19	66.54	822.07
68.86	822	72.97	822	120.78	820.85	126.15	820	128.43	819.64
128.59	819.61	128.65	819.6	128.91	819.6	140.23	819.86	143.88	819.94
143.91	819.95	143.97	819.98	143.99	820	148.2	821.7	184.83	822
190.49	822	198.04	822.27	217.67	822.88	219.93	822.78	228.98	822.18
230.23	822.02	230.45	822	234.5	822	246.38	822.51	258.21	823.02
261.49	823.09	265.12	823.23	268.48	823.28	271.25	823.32	272.59	823.37
273.96	823.42	300.27	824	310.16	824	318.03	825	324.88	826
328.87	826.57	339.25	828	342.22	828.55	349.67	829.97		

Manning's n Values									
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	120.78	.035	148.2	.035	217.67	.033	228.98	.035

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	120.78	148.2		259.55	203	19.61	.1 .3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.71	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.04	* Wt. n-Val.	* 0.100	* 0.035	* 0.035
* W.S. Elev (ft)	* 824.68	* Reach Len. (ft)	* 259.55	* 203.00	* 19.61
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 226.38	* 126.46	* 326.49
* E.G. Slope (ft/ft)	* 0.000320	* Area (sq ft)	* 226.38	* 126.46	* 326.49
* Q Total (cfs)	* 782.50	* Flow (cfs)	* 112.95	* 263.19	* 406.36
* Top Width (ft)	* 282.57	* Top Width (ft)	* 87.85	* 27.42	* 167.30
* Vel Total (ft/s)	* 1.15	* Avg. Vel. (ft/s)	* 0.50	* 2.08	* 1.24
* Max chl Dpth (ft)	* 5.08	* Hydr. Depth (ft)	* 2.58	* 4.61	* 1.95
* Conv. Total (cfs)	* 43749.6	* Conv. (cfs)	* 6315.0	* 14715.0	* 22719.6
* Length wtd. (ft)	* 138.06	* Wetted Per. (ft)	* 88.00	* 27.87	* 167.43
* Min Ch El (ft)	* 819.60	* Shear (lb/sq ft)	* 0.05	* 0.09	* 0.04
* Alpha	* 1.73	* Stream Power (lb/ft s)	* 349.67	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.01	* Cum Volume (acre-ft)	* 7.33	* 24.22	* 10.40
* C & E Loss (ft)	* 0.01	* Cum SA (acres)	* 0.99	* 0.35	* 0.25

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.

This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Sugarcamp Run  
REACH: Upper

RS: 1374.631

INPUT

Description:

Station Elevation Data num= 57											
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	4.05	838	6.37	836.85	8.1	836	8.95	835.58		
12.14	834	12.7	833.74	16.5	832	32.71	826	34.3	825.83		
38.97	825.31	49.3	824	58.87	823.14	70.93	822	85.27	820.91		
112.35	820.08	156.29	820	170.77	819.68	173.54	818	175.5	816.8		
176.3	816.28	181.49	816.3	187.41	816.25	189.61	816.67	190.84	816.79		
192.94	817.34	201.34	818	274.02	820	287.12	820.13	289.99	820.13		
291.35	820.18	291.9	820.21	294.72	820.22	295.96	820.22	296.19	820.23		
297.15	820.27	298.55	820.29	301.16	820.34	303.13	820.42	307.39	820.56		
313.51	820.8	318.82	821.04	342.82	822.01	350.5	822.28	364.6	822.04		
376.04	822	448.14	824	469.97	824	494.23	825.59	500.61	825.89		
501.32	825.92	503.16	826	510.04	826.95	511.29	827.12	514.54	827.55		
517.59	828	527.33	830								

Manning's n Values num= 7											
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	38.97	.035	156.29	.1	170.77	.035	201.34	.1		
350.5	.033	364.6	.035								

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	170.77	201.34		73.24 163.13	9.98	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.69	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.01	* Wt. n-Val.	* 0.040	* 0.035	* 0.081
* W.S. Elev (ft)	* 824.69	* Reach Len. (ft)	* 73.24	* 163.13	* 9.98
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 472.23	* 233.19	* 909.08
* E.G. Slope (ft/ft)	*0.000041	* Area (sq ft)	* 472.23	* 233.19	* 909.08
* Q Total (cfs)	* 782.50	* Flow (cfs)	* 274.87	* 240.26	* 267.37
* Top width (ft)	* 436.55	* Top width (ft)	* 126.88	* 30.57	* 279.10
* Vel Total (ft/s)	* 0.48	* Avg. vel. (ft/s)	* 0.58	* 1.03	* 0.29
* Max Chl Dpth (ft)	* 8.44	* Hydr. Depth (ft)	* 3.72	* 7.63	* 3.26
* Conv. Total (cfs)	*122023.4	* Conv. (cfs)	* 42863.7	* 37465.8	* 41693.9
* Length wtd. (ft)	* 65.06	* Wetted Per. (ft)	* 127.08	* 31.67	* 279.22
* Min Ch El (ft)	* 816.25	* Shear (lb/sq ft)	* 0.01	* 0.02	* 0.01
* Alpha	* 2.02	* Stream Power (lb/ft s)	* 527.33	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.00	* Cum Volume (acre-ft)	* 5.24	* 23.38	* 10.13
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.35	* 0.22	* 0.15

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.

This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Sugarcamp Run  
 REACH: Upper

RS: 1206.899

INPUT

Description:

Station Elevation Data num= 88

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	5.15	838	6.16	837.61	10.31	836	14.61	834.22
15.16	834	16.08	833.6	19.39	832	22.47	830.36	23.14	830
23.74	829.63	26.33	828	29.15	827.52	33.34	826.81	34.97	826.52
41.02	825.68	52.83	824.68	54.17	824.57	57.07	824.32	60.94	824
65.64	823.68	91.36	822	135.98	820.53	160.72	820	160.91	820
161.41	819.98	161.6	819.96	172.02	819.55	172.79	819.49	173.18	819.46
173.51	819.43	180.74	819.12	181.06	819.09	181.53	819.05	183.05	818.94
186.24	818.8	189.82	818.52	191.18	818.45	195.74	818.07	196.59	818
198.07	816.56	198.65	816	199.6	815.03	200.29	814.32	200.52	814.1
200.97	813.68	203.52	813.83	206.6	813.86	207.71	813.9	210.16	814.1
213.14	814.37	217.06	814.79	224.47	815.56	226.47	815.73	228.49	816
229.53	816	248.83	816.91	255.11	817.1	262.27	817.22	270.69	817.46
271.02	817.46	271.99	817.48	274.37	817.52	281.21	817.71	282.16	817.74
282.55	817.75	282.78	817.75	289.39	818	355.4	818.8	422.11	820
480.91	821.95	498.51	822.13	512.2	822.96	635.19	824	636.67	824
641.37	824.19	642.29	824.24	653.53	824.74	662.6	825.15	678.14	825.75
678.82	825.74	681.79	826	685.14	826.55	689.63	827.27	693.96	828
696.95	828.68	698.59	829.05	703.02	830				

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	181.53	.06	195.74	.035	229.53	.06
480.91	.033	498.51	.035				

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 195.74 229.53 32.52 91.72 10.02 .1 .3

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
0	45	835	545.48	638.67	835

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.69	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.00	* Wt. n-Val.	* 0.039	* 0.035	* 0.037
* W.S. Elev (ft)	* 824.69	* Reach Len. (ft)	* 32.52	* 91.72	* 10.02
* Crit w.s. (ft)	* 817.56	* Flow Area (sq ft)	* 510.07	* 330.10	* 1573.27
* E.G. slope (ft/ft)	* 0.000007	* Area (sq ft)	* 510.07	* 330.10	* 1573.27
* Q Total (cfs)	* 782.50	* Flow (cfs)	* 120.78	* 159.18	* 502.54
* Top width (ft)	* 506.48	* Top width (ft)	* 143.02	* 33.79	* 329.67
* Vel Total (ft/s)	* 0.32	* Avg. Vel. (ft/s)	* 0.24	* 0.48	* 0.32
* Max chl Dpth (ft)	* 11.01	* Hydr. Depth (ft)	* 3.57	* 9.77	* 4.77

```

* Conv. Total (cfs)      *303620.6 * Conv. (cfs)          * 46864.0 * 61762.4 *194994.1 *
* Length Wtd. (ft)     * 91.72  * Wetted Per. (ft)    * 143.20 * 35.68  * 331.85 *
* Min Ch El (ft)       * 813.68 * Shear (lb/sq ft)    * 0.00   * 0.00   * 0.00 *
* Alpha                 * 1.16   * Stream Power (lb/ft s) * 703.02 * 0.00   * 0.00 *
* Frctn Loss (ft)      *         * Cum Volume (acre-ft) * 4.42   * 22.32  * 9.84 *
* C & E Loss (ft)      *         * Cum SA (acres)       * 0.13   * 0.10   * 0.08 *
*****

```

CULVERT

RIVER: Sugarcamp Run  
 REACH: Upper RS: 1158.997

INPUT

Description:  
 Distance from Upstream XS = 37.71  
 Deck/Roadway width = 20  
 Weir Coefficient = 2.6  
 Upstream Deck/Roadway Coordinates  
 num= 4

Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
69.42	823.49		0	211.7	822.58		0	359.2	823.21		0			
708.32	823.48		0											

Upstream Bridge Cross Section Data

Station Elevation Data		num= 88		Sta		Elev		Sta		Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	5.15	838	6.16	837.61	10.31	836	14.61	834.22		
15.16	834	16.08	833.6	19.39	832	22.47	830.36	23.14	830		
23.74	829.63	26.33	828	29.15	827.52	33.34	826.81	34.97	826.52		
41.02	825.68	52.83	824.68	54.17	824.57	57.07	824.32	60.94	824		
65.64	823.68	91.36	822	135.98	820.53	160.72	820	160.91	820		
161.41	819.98	161.6	819.96	172.02	819.55	172.79	819.49	173.18	819.46		
173.51	819.43	180.74	819.12	181.06	819.09	181.53	819.05	183.05	818.94		
186.24	818.8	189.82	818.52	191.18	818.45	195.74	818.07	196.59	818		
198.07	816.56	198.65	816	199.6	815.03	200.29	814.32	200.52	814.1		
200.97	813.68	203.52	813.83	206.6	813.86	207.71	813.9	210.16	814.1		
213.14	814.37	217.06	814.79	224.47	815.56	226.47	815.73	228.49	816		
229.53	816	248.83	816.91	255.11	817.1	262.27	817.22	270.69	817.46		
271.02	817.46	271.99	817.48	274.37	817.52	281.21	817.71	282.16	817.74		
282.55	817.75	282.78	817.75	289.39	818	355.4	818.8	422.11	820		
480.91	821.95	498.51	822.13	512.2	822.96	635.19	824	636.67	824		
641.37	824.19	642.29	824.24	653.53	824.74	662.6	825.15	678.14	825.75		
678.82	825.74	681.79	826	685.14	826.55	689.63	827.27	693.96	828		
696.95	828.68	698.59	829.05	703.02	830						

Manning's n Values

num= 7		Sta		n Val		Sta		n Val	
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****

0 .035 181.53 .06 195.74 .035 229.53 .06 248.83 .035  
 480.91 .033 498.51 .035

Bank Sta: Left Right Coeff Contr. Expan.  
 195.74 229.53 .1 .3  
 Blocked Obstructions num= 2  
 Sta L Sta R Elev Sta L Sta R Elev  
 \*\*\*\*\*  
 0 45 835 545.48 638.67 835

Downstream Deck/Roadway Coordinates  
 num= 4  
 Sta Hi Cord Lo Cord Sta Hi Cord Lo Cord Sta Hi Cord Lo Cord  
 \*\*\*\*\*  
 69.42 823.49 0 211.7 822.58 0 359.2 823.21 0  
 708.32 823.48 0

Downstream Bridge Cross Section Data  
 Station Elevation Data num= 100  
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev  
 \*\*\*\*\*  
 0 840 4.29 838 8.56 836.05 8.69 836 9.54 835.67  
 13.87 834 14.64 833.7 19.1 832 21.4 831.1 24.27 830  
 28.11 828.51 29.48 828 34.6 826.89 36.65 826.45 39.25 826  
 42.17 825.69 45.92 825.3 47.53 825.12 49.29 824.95 52.44 824.65  
 57.93 824.09 57.95 824.09 58.76 824 69.42 823.49 91.56 822.43  
 100.93 822 161.31 821.02 203.98 822 210.39 822.48 211.7 822.58  
 213.66 822.81 238.41 822.54 242.96 822 253.18 820 254.41 819.48  
 255.86 818.8 256.98 818.3 257.63 818 259.38 817.16 261.32 816.07  
 261.44 816 261.7 815.78 263.74 814 264.53 813.26 265.93 812  
 267.16 810.93 267.44 810.69 267.47 810.7 267.51 810.7 267.55 810.7  
 277.7 810.98 279.81 811.23 280.38 811.29 281.75 811.98 284.85 811.84  
 285.24 811.85 287.17 812 288.88 812.96 289.84 813.5 290.54 814  
 291.43 814.82 292.96 816 294.34 817.02 295.01 817.13 296.17 817.33  
 298.52 817.79 298.81 817.9 299.48 818 300.93 818.27 301.16 818.32  
 302.65 818.62 303.45 818.81 304.42 819.02 306.89 819.59 307.53 819.74  
 311.58 820 324.17 822 328.53 822.41 359.2 823.21 359.47 822.85  
 361.32 822.62 365.95 822 369.24 821.24 372.87 820.38 377.37 820  
 437.48 818.67 499.15 819.3 510.95 820 552.12 821.19 576.07 821.31  
 587.37 822 647.28 822.16 708.32 823.48 776.84 824.08 812.26 826  
 816.98 827.32 819.69 827.78 820.92 828 823.99 828.66 829.84 830

Manning's n Values num= 9  
 Sta n Val Sta n Val Sta n Val Sta n Val Sta n Val  
 \*\*\*\*\*  
 0 .035 213.66 .013 242.96 .06 253.18 .035 311.58 .06  
 328.53 .013 359.2 .035 552.12 .033 576.07 .035

Bank Sta: Left Right Coeff Contr. Expan.  
 253.18 311.58 .1 .3  
 Blocked Obstructions num= 2  
 Sta L Sta R Elev Sta L Sta R Elev



\*\*\*\*\*

0 61.13 835 664.35 769.45 835

Upstream Embankment side slope = 0 horiz. to 1.0 vertical  
 Downstream Embankment side slope = 0 horiz. to 1.0 vertical  
 Maximum allowable submergence for weir flow = .98  
 Elevation at which weir flow begins =  
 Energy head used in spillway design =  
 Spillway height used in design =  
 Weir crest shape = Broad Crested

Number of Culverts = 1

Culvert Name Shape Rise Span  
 Culvert #1 Box 8 12  
 FHWA Chart # 8 - flared wingwalls  
 FHWA Scale # 3 - wingwall flared 0 deg. (sides extended straight)  
 Solution Criteria = Highest U.S. EG  
 Culvert Upstrm Dist Length Top n Bottom n Depth Blocked Entrance Loss Coef Exit Loss Coef  
 28.84 38.12 .012 .012 0 .7 1  
 Upstream Elevation = 813.87  
 Centerline Station = 209.42  
 Downstream Elevation = 812.56  
 Centerline Station = 277.56

CULVERT OUTPUT Profile #PF 1 Culv Group: Culvert #1

\*\*\*\*\*  
 \* Q Culv Group (cfs) \* 52.37 \* Culv Full Len (ft) \* 38.12 \*  
 \* # Barrels \* 1 \* Culv Vel US (ft/s) \* 0.55 \*  
 \* Q Barrel (cfs) \* 52.37 \* Culv Vel DS (ft/s) \* 0.55 \*  
 \* E.G. US. (ft) \* 824.69 \* Culv Inv El Up (ft) \* 813.87 \*  
 \* W.S. US. (ft) \* 824.69 \* Culv Inv El Dn (ft) \* 812.56 \*  
 \* E.G. DS (ft) \* 824.68 \* Culv Frctn Ls (ft) \* 0.00 \*  
 \* W.S. DS (ft) \* 824.68 \* Culv Exit Loss (ft) \* 0.00 \*  
 \* Delta EG (ft) \* 0.01 \* Culv Entr Loss (ft) \* 0.00 \*  
 \* Delta WS (ft) \* 0.01 \* Q Weir (cfs) \* 730.13 \*  
 \* E.G. IC (ft) \* 822.45 \* Weir Sta Lft (ft) \* 52.69 \*  
 \* E.G. OC (ft) \* 824.69 \* Weir Sta Rgt (ft) \* 652.44 \*  
 \* Culvert Control \* Outlet \* Weir Submerg \* 1.00 \*  
 \* Culv WS Inlet (ft) \* 821.87 \* Weir Max Depth (ft) \* 2.11 \*  
 \* Culv WS Outlet (ft) \* 820.56 \* Weir Avg Depth (ft) \* 1.54 \*  
 \* Culv Nml Depth (ft) \* \* Weir Flow Area (sq ft) \* 778.59 \*  
 \* Culv Crt Depth (ft) \* 0.84 \* Min El Weir Flow (ft) \* 822.59 \*  
 \*\*\*\*\*

Warning: The weir over culvert is submerged.  
 Warning: During the culvert inlet control computations, the program could not balance the culvert/weir flow. The reported inlet energy grade answer may not be valid.

CROSS SECTION

RIVER: Sugarcamp Run  
 REACH: Upper

RS: 1115.181

INPUT

Description:

Station Elevation Data num= 100

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	840	4.29	838	8.56	836.05	8.69	836	9.54	835.67
13.87	834	14.64	833.7	19.1	832	21.4	831.1	24.27	830
28.11	828.51	29.48	828	34.6	826.89	36.65	826.45	39.25	826
42.17	825.69	45.92	825.3	47.53	825.12	49.29	824.95	52.44	824.65
57.93	824.09	57.95	824.09	58.76	824	69.42	823.49	91.56	822.43
100.93	822	161.31	821.02	203.98	822	210.39	822.48	211.7	822.58
213.66	822.81	238.41	822.54	242.96	822	253.18	820	254.41	819.48
255.86	818.8	256.98	818.3	257.63	818	259.38	817.16	261.32	816.07
261.44	816	261.7	815.78	263.74	814	264.53	813.26	265.93	812
267.16	810.93	267.44	810.69	267.47	810.7	267.51	810.7	267.55	810.7
277.7	810.98	279.81	811.23	280.38	811.29	281.75	811.98	284.85	811.84
285.24	811.85	287.17	812	288.88	812.96	289.84	813.5	290.54	814
291.43	814.82	292.96	816	294.34	817.02	295.01	817.13	296.17	817.33
298.52	817.79	298.81	817.9	299.48	818	300.93	818.27	301.16	818.32
302.65	818.62	303.45	818.81	304.42	819.02	306.89	819.59	307.53	819.74
311.58	820	324.17	822	328.53	822.41	359.2	823.21	359.47	822.85
361.32	822.62	365.95	822	369.24	821.24	372.87	820.38	377.37	820
437.48	818.67	499.15	819.3	510.95	820	552.12	821.19	576.07	821.31
587.37	822	647.28	822.16	708.32	823.48	776.84	824.08	812.26	826
816.98	827.32	819.69	827.78	820.92	828	823.99	828.66	829.84	830

Manning's n Values num= 9

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	213.66	.013	242.96	.06	253.18	.035	311.58	.06
328.53	.013	359.2	.035	552.12	.033	576.07	.035		

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 253.18 311.58 558.86 114.81 5.55 .1 .3

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
0	61.13	835	664.35	769.45	835

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 824.68	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.00	* wt. n-Val.	* 0.031	* 0.035	* 0.034
* W.S. Elev (ft)	* 824.68	* Reach Len. (ft)	* 0.00	* 0.00	* 0.00
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 517.20	* 565.49	* 1394.93
* E.G. Slope (ft/ft)	* 0.000006	* Area (sq ft)	* 517.20	* 565.49	* 1394.93
* Q Total (cfs)	* 782.50	* Flow (cfs)	* 121.67	* 260.58	* 400.25
* Top width (ft)	* 621.73	* Top width (ft)	* 192.05	* 58.40	* 371.28

* Vel Total (ft/s)	* 0.32	* Avg. Vel. (ft/s)	* 0.24	* 0.46	* 0.29
* Max Chl Dpth (ft)	* 13.99	* Hydr. Depth (ft)	* 2.69	* 9.68	* 3.76
* Conv. Total (cfs)	* 309945.7	* Conv. (cfs)	* 48193.8	* 103213.4	* 158538.5
* Length Wtd. (ft)	* 0.00	* Wetted Per. (ft)	* 193.17	* 63.44	* 374.83
* Min Ch El (ft)	* 810.69	* Shear (lb/sq ft)	* 0.00	* 0.00	* 0.00
* Alpha	* 1.22	* Stream Power (lb/ft s)	* 829.84	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.00	* Cum Volume (acre-ft)	*	*	*
* C & E Loss (ft)	* 0.01	* Cum SA (acres)	*	*	*

Warning: Divided flow computed for this cross-section.

\*\*\*\*\*

SUMMARY OF MANNING'S N VALUES

River: Meathouse Fork

\*\*\*\*\*

* Reach	* River Sta.	* n1	* n2	* n3	* n4	* n5	* n6	* n7	* n8	* n9
* Upper	* 3189.903	* .1*	* .035*	* .035*	* .013*	* .1*	*	*	*	*
* Upper	* 2919.274	* .035*	* .035*	* .035*	* .013*	* .1*	*	*	*	*
* Upper	* 2762.352	* .035*	* .035*	* .035*	* .013*	* .1*	*	*	*	*
* Upper	* 2717.603	* .035*	* .035*	* .06*	* .013*	* .035*	*	*	*	*
* Upper	* 2621.319	* .035*	* .033*	* .035*	* .035*	* .035*	* .013*	* .035*	*	*
* Upper	* 2580.999	* .035*	* .033*	* .035*	* .035*	* .035*	* .013*	* .035*	*	*
* Upper	* 2527.424	* .035*	* .033*	* .035*	* .035*	* .035*	* .013*	* .035*	*	*
* Lower .035*	* 2421.596	* .06*	* .033*	* .035*	* .033*	* .035*	* .035*	* .06*	* .033*	*
* Lower .035*	* 2236.871	* .1*	* .033*	* .035*	* .06*	* .035*	* .013*	* .035*	* .033*	*
* Lower	* 2005.226	* .1*	* .035*	* .06*	* .035*	* .013*	* .035*	* .033*	* .035*	*
* Lower	* 1852.485	* .1*	* .035*	* .06*	* .035*	* .013*	* .035*	* .033*	* .035*	*
* Lower	* 1812.068	* .1*	* .035*	* .06*	* .035*	* .013*	* .033*	*	*	*
* Lower	* 1786.606	* .1*	* .035*	* .06*	* .035*	* .013*	* .035*	*	*	*
* Lower	* 1674.792	* .1*	* .035*	* .06*	* .035*	* .013*	* .035*	*	*	*
* Lower	* 1554.849	* .1*	* .035*	* .06*	* .035*	* .013*	* .035*	*	*	*

willard.rep

* *Lower *	* 1294.270 *	* .1* *	* .035* *	* .06* *	* .035* *	* .013* *	* .035* *	* * *	* * *
* *Lower *	* 1192.596 *	* .035* *	* .06* *	* .035* *	* .06* *	* .035* *	* .013* *	* .035* *	* * *
* *Lower *	* 1000.000 *	* .035* *	* .06* *	* .035* *	* .035* *	* .013* *	* .035* *	* * *	* * *

\*\*\*\*\*  
\*\*\*\*\*

River: Sugarcamp Run

\*\*\*\*\*  
\*\*\*\*\*

* * *	Reach	* * *	River Sta.	* * *	n1	* * *	n2	* * *	n3	* * *	n4	* * *	n5	* * *	n6	* * *	n7	* * *	n8	* * *	n9
* *Upper *		* * *	1908.741	* * *	.1*	* * *	.035*	* * *	.035*	* * *	*	* * *	*	* * *	*	* * *	*	* * *	*	* * *	*
* *Upper *		* * *	1702.205	* * *	.1*	* * *	.035*	* * *	.035*	* * *	.033*	* * *	.035*	* * *	*	* * *	*	* * *	*	* * *	*
* *Upper *		* * *	1374.631	* * *	.1*	* * *	.035*	* * *	.1*	* * *	.035*	* * *	.1*	* * *	.033*	* * *	.035*	* * *	.035*	* * *	* * *
* *Upper *		* * *	1206.899	* * *	.035*	* * *	.06*	* * *	.035*	* * *	.06*	* * *	.035*	* * *	.033*	* * *	.035*	* * *	.035*	* * *	* * *
* *Upper * *Upper .035*		* * * *	1158.997 1115.181	* * * *	* * * *	* * * *	* * * *	* * * *	* * * *	* * * *	* * * *	* * * *	* * * *	* * * *	* * * *	* * * *	* * * *	* * * *	* * * *	* * * *	* * * *

\*\*\*\*\*  
\*\*\*\*\*

\*\*\*\*\*

SUMMARY OF REACH LENGTHS

River: Meathouse Fork

\*\*\*\*\*

* * *	Reach	* * *	River Sta.	* * *	Left	* * *	Channel	* * *	Right	* * *
* *Upper *		* * *	3189.903	* * *	267.8*	* * *	267.64*	* * *	210.16*	* * *
* *Upper *		* * *	2919.274	* * *	131.84*	* * *	156.71*	* * *	162.29*	* * *
* *Upper *		* * *	2762.352	* * *	44.24*	* * *	44.75*	* * *	36.49*	* * *
* *Upper *		* * *	2717.603	* * *	1*	* * *	1*	* * *	1*	* * *
* *Upper *		* * *	2621.319	* * *	50.27*	* * *	40.32*	* * *	52.82*	* * *
* *Upper *		* * *	2580.999	* * *	48.53*	* * *	53.58*	* * *	14.67*	* * *
* *Upper *		* * *	2527.424	* * *	152.44*	* * *	105.55*	* * *	614.2*	* * *
* *Lower *		* * *	2421.596	* * *	114.88*	* * *	182.56*	* * *	4.38*	* * *
* *Lower *		* * *	2236.871	* * *	251.91*	* * *	229.47*	* * *	12.96*	* * *
* *Lower *		* * *	2005.226	* * *	147.51*	* * *	152.72*	* * *	70.79*	* * *
* *Lower *		* * *	1852.485	* * *	44.03*	* * *	40.42*	* * *	40.14*	* * *
* *Lower *		* * *	1812.068	* * *	29.48*	* * *	25.45*	* * *	34.43*	* * *
* *Lower *		* * *	1786.606	* * *	105.08*	* * *	108.5*	* * *	124.1*	* * *

*Lower	*	1674.792	*	130.48*	119.69*	198.02*
*Lower	*	1554.849	*	203.32*	252.49*	154.61*
*Lower	*	1294.270	*	48.1*	101.54*	99.66*
*Lower	*	1192.596	*	68.62*	189.67*	570.98*
*Lower	*	1000.000	*	1*	1*	1*

River: Sugarcamp Run

* Reach	* River Sta.	* Left	* Channel	* Right
*Upper	* 1908.741	* 163.72*	203*	205.48*
*Upper	* 1702.205	* 259.55*	203*	19.61*
*Upper	* 1374.631	* 73.24*	163.13*	9.98*
*Upper	* 1206.899	* 32.52*	91.72*	10.02*
*Upper	* 1158.997	* Culvert	*	*
*Upper	* 1115.181	* 558.86*	114.81*	5.55*

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS  
River: Meathouse Fork

* Reach	* River Sta.	* Contr.	* Expan.
*Upper	* 3189.903*	.1*	.3*
*Upper	* 2919.274*	.1*	.3*
*Upper	* 2762.352*	.1*	.3*
*Upper	* 2717.603*	.1*	.3*
*Upper	* 2621.319*	.1*	.3*
*Upper	* 2580.999*	.1*	.3*
*Upper	* 2527.424*	.1*	.3*
*Lower	* 2421.596*	.1*	.3*
*Lower	* 2236.871*	.1*	.3*
*Lower	* 2005.226*	.1*	.3*
*Lower	* 1852.485*	.1*	.3*
*Lower	* 1812.068*	.1*	.3*
*Lower	* 1786.606*	.1*	.3*
*Lower	* 1674.792*	.1*	.3*
*Lower	* 1554.849*	.1*	.3*
*Lower	* 1294.270*	.1*	.3*
*Lower	* 1192.596*	.1*	.3*
*Lower	* 1000.000*	.1*	.3*

River: Sugarcamp Run

* Reach	* River Sta.	* Contr.	* Expan.
*Upper	* 1908.741*	.1*	.3*

```
*Upper      * 1702.205*   .1*   .3*
*Upper      * 1374.631*   .1*   .3*
*Upper      * 1206.899*   .1*   .3*
*Upper      * 1158.997*Culvert *   *
*Upper      * 1115.181*   .1*   .3*
*****
```

\*\*\*\*\*

ERRORS WARNINGS AND NOTES

Errors Warnings and Notes for Plan : Proposed

```
River: Meathouse Fork Reach: Upper RS: 2527.424 Profile: PF 1
Warning:Divided flow computed for this cross-section.
River: Meathouse Fork Reach: Lower RS: 2421.596 Profile: PF 1
Warning:Divided flow computed for this cross-section.
Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater
than 1.4.
This may indicate the need for additional cross sections.
River: Meathouse Fork Reach: Lower RS: 2236.871 Profile: PF 1
Warning:Divided flow computed for this cross-section.
River: Meathouse Fork Reach: Lower RS: 2005.226 Profile: PF 1
Warning:Divided flow computed for this cross-section.
River: Sugarcamp Run Reach: Upper RS: 1908.741 Profile: PF 1
Warning:The energy equation could not be balanced within the specified number of iterations. The program used
critical depth
for the water surface and continued on with the calculations.
Warning:The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional
cross sections.
Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater
than 1.4.
This may indicate the need for additional cross sections.
Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may
indicate
the need for additional cross sections.
Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the
calculated
water surface came back below critical depth. This indicates that there is not a valid subcritical answer.
The
program defaulted to critical depth.
River: Sugarcamp Run Reach: Upper RS: 1702.205 Profile: PF 1
Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater
than 1.4.
This may indicate the need for additional cross sections.
River: Sugarcamp Run Reach: Upper RS: 1374.631 Profile: PF 1
Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater
than 1.4.
This may indicate the need for additional cross sections.
River: Sugarcamp Run Reach: Upper RS: 1158.997 Profile: PF 1
Warning:The weir over culvert is submerged.
River: Sugarcamp Run Reach: Upper RS: 1158.997 Profile: PF 1 Culv: Culvert #1
Warning:During the culvert inlet control computations, the program could not balance the culvert/weir flow. The
```

willard.rep

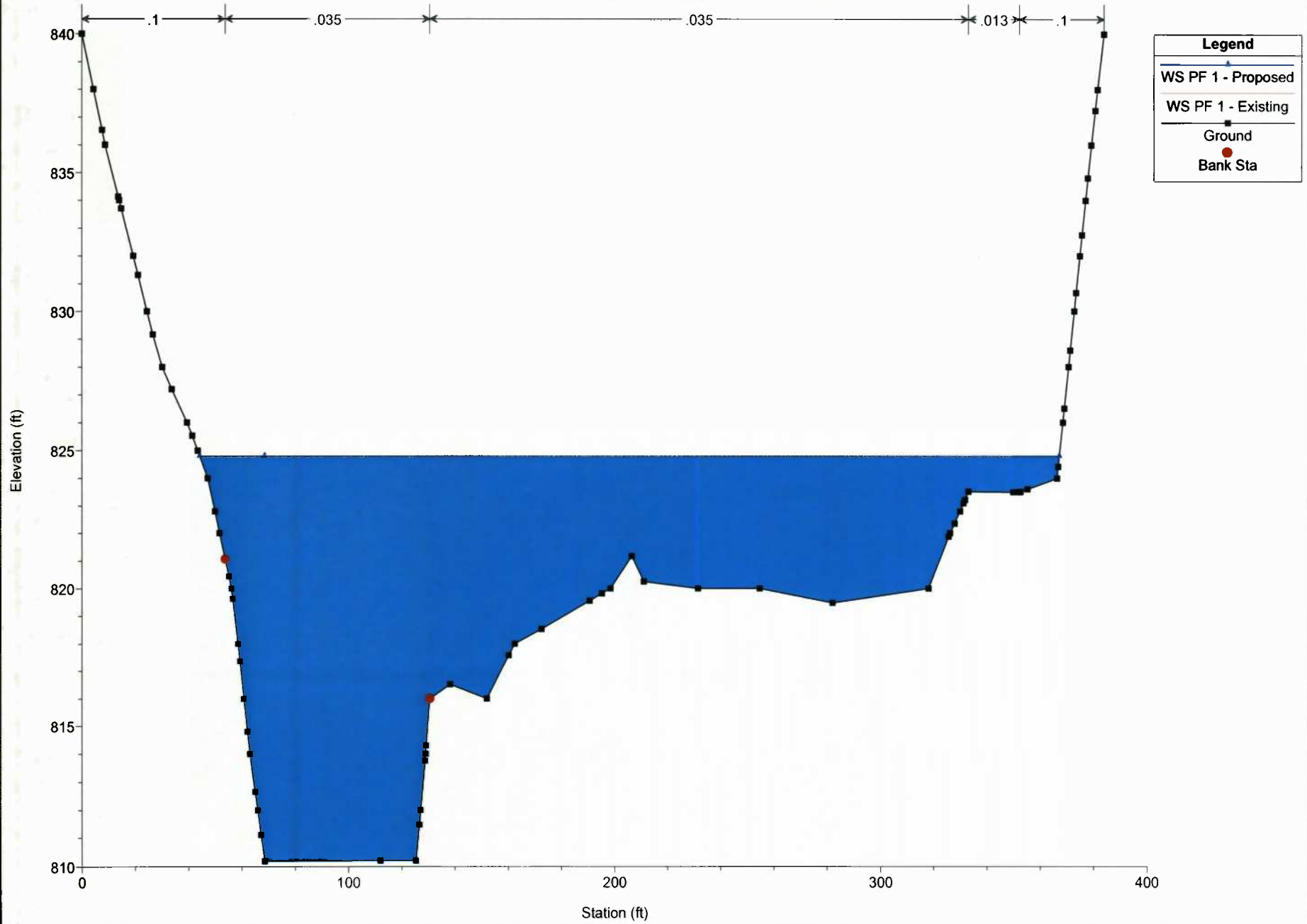
reported

inlet energy grade answer may not be valid.

River: Sugarcamp Run Reach: Upper RS: 1115.181 Profile: PF 1

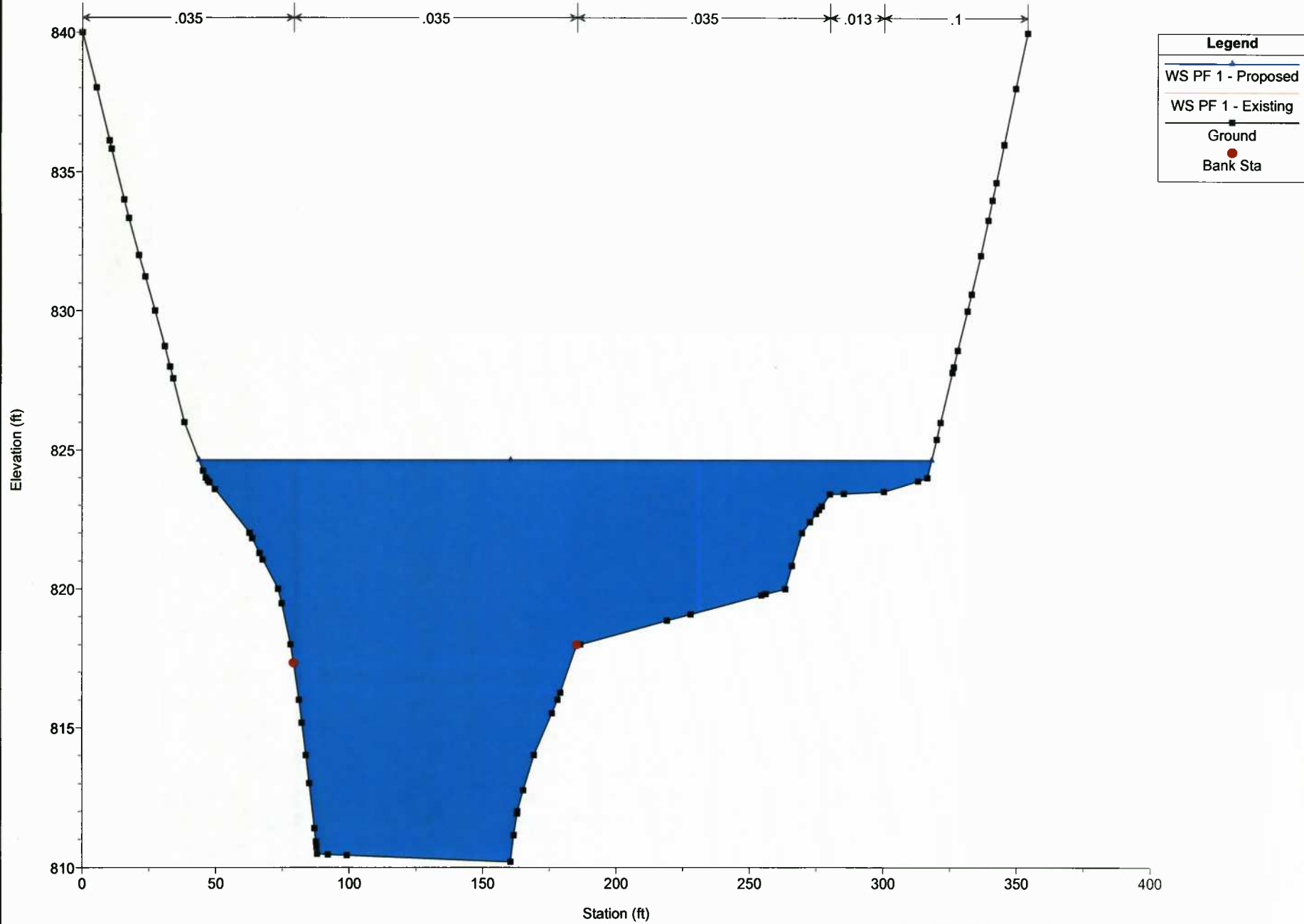
Warning:Divided flow computed for this cross-section.

Willard Plan: 1) Proposed 2) Existing  
Geom: Proposed Flow: Existing  
River = Meathouse Fork Reach = Upper RS = 3189.903

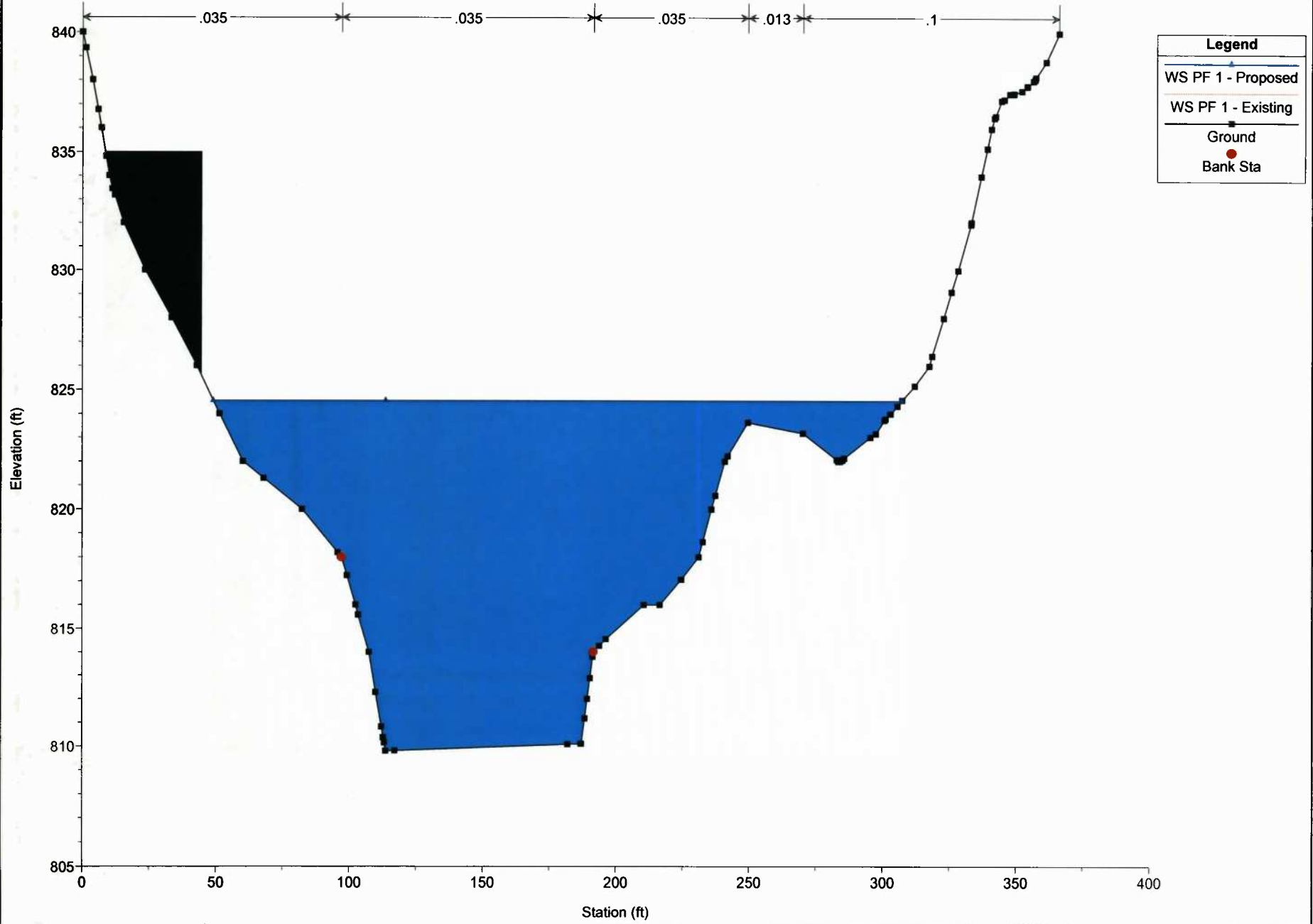




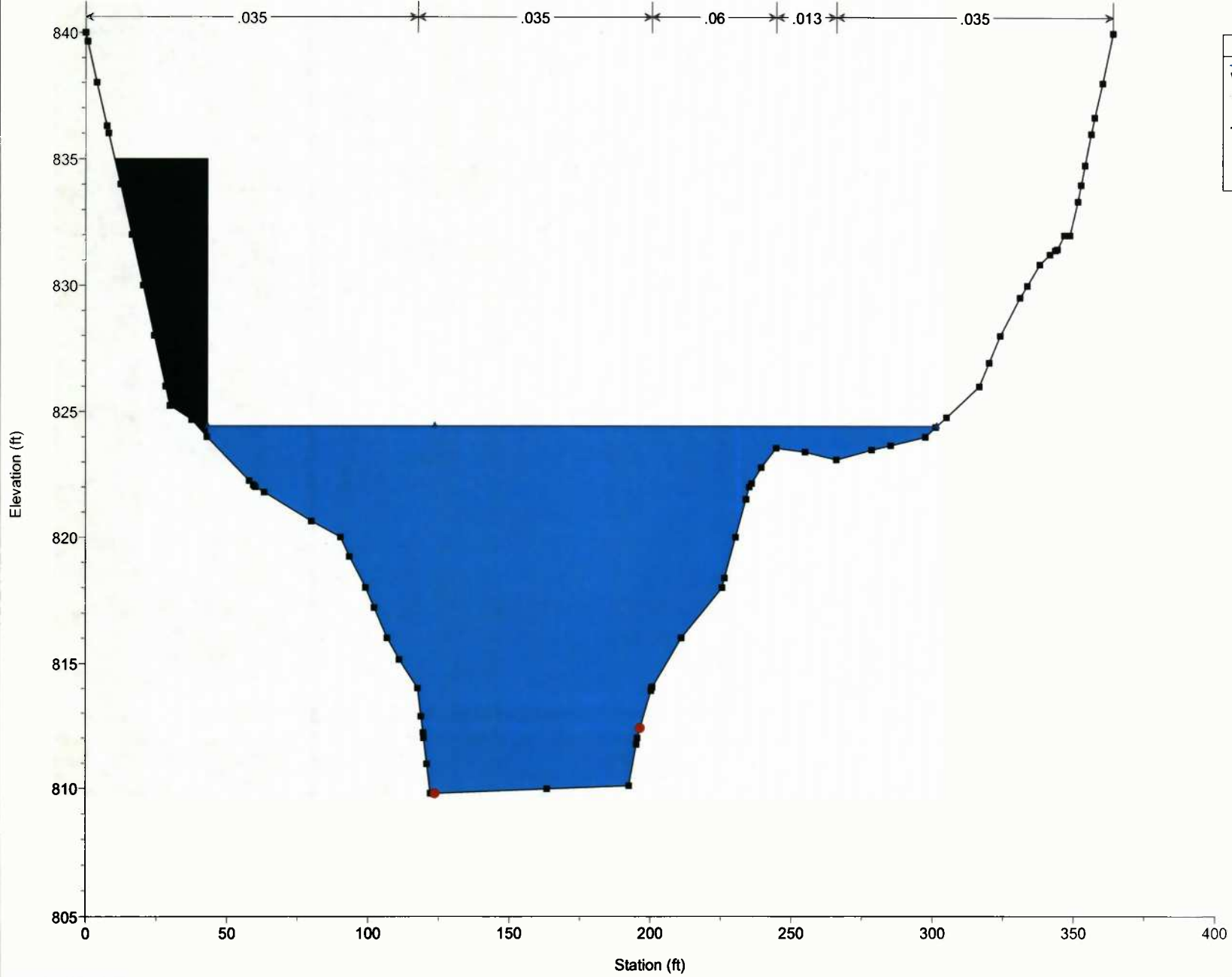
Willard Plan: 1) Proposed 2) Existing  
Geom: Proposed Flow: Existing  
River = Meathouse Fork Reach = Upper RS = 2919.274



Willard Plan: 1) Proposed 2) Existing  
Geom: Proposed Flow: Existing  
River = Meathouse Fork Reach = Upper RS = 2762.352



Willard Plan: 1) Proposed 2) Existing  
Geom: Proposed Flow: Existing  
River = Meathouse Fork Reach = Upper RS = 2717.603

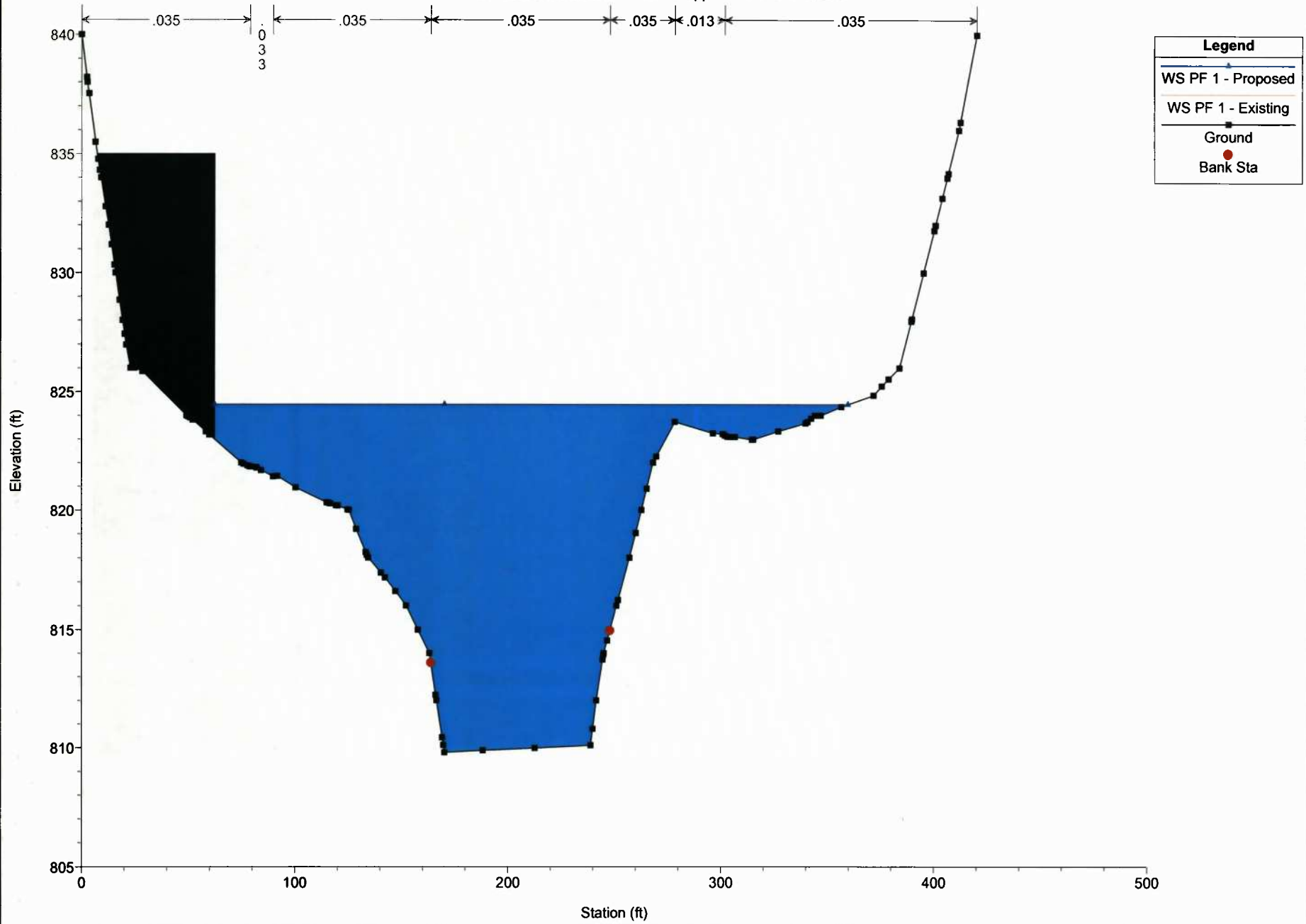


Legend	
WS PF 1 - Proposed	(Blue line)
WS PF 1 - Existing	(Black line)
Ground	(Black line with square markers)
Bank Sta	(Red dot)

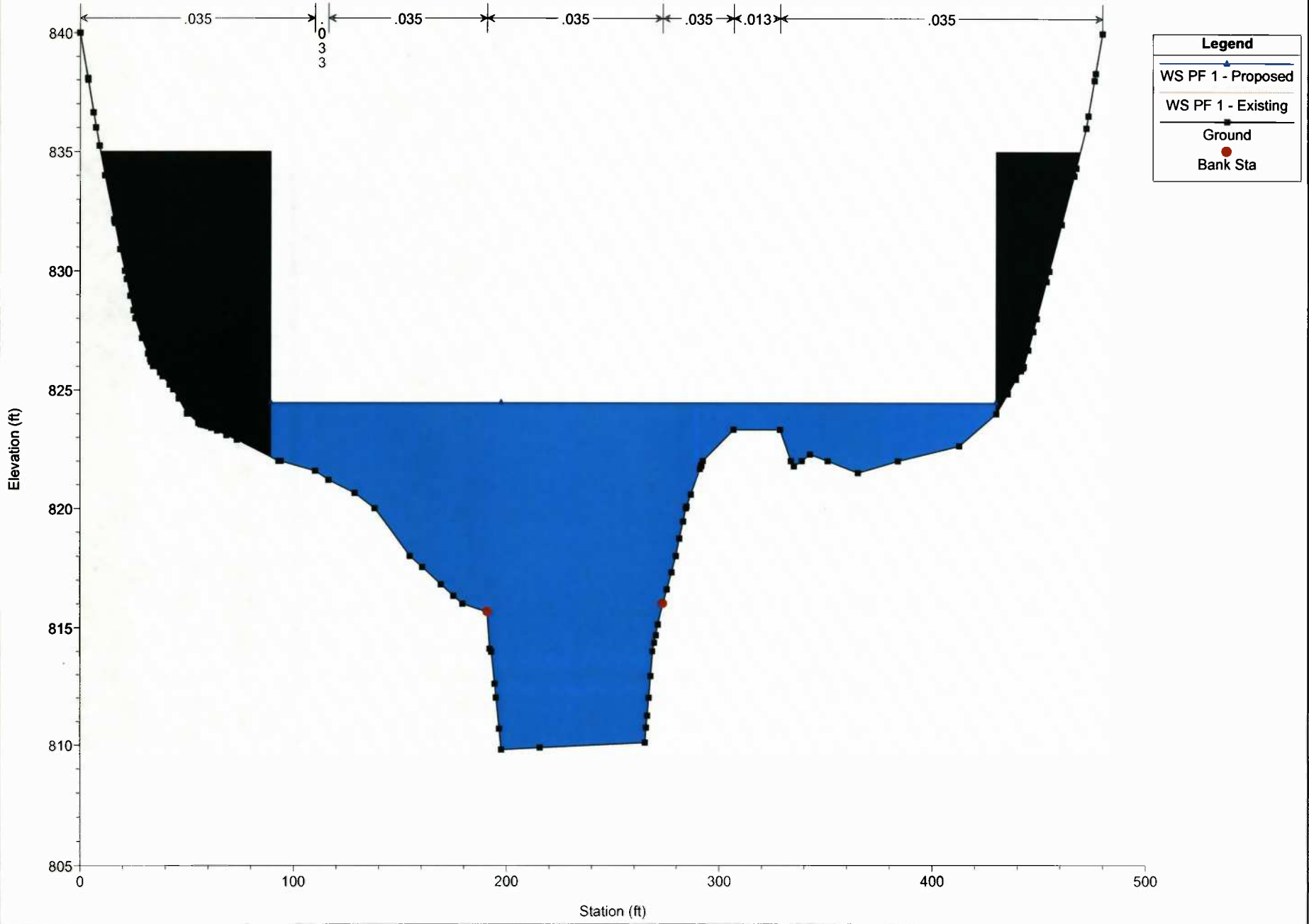
Willard Plan: 1) Proposed 2) Existing

Geom: Proposed Flow: Existing

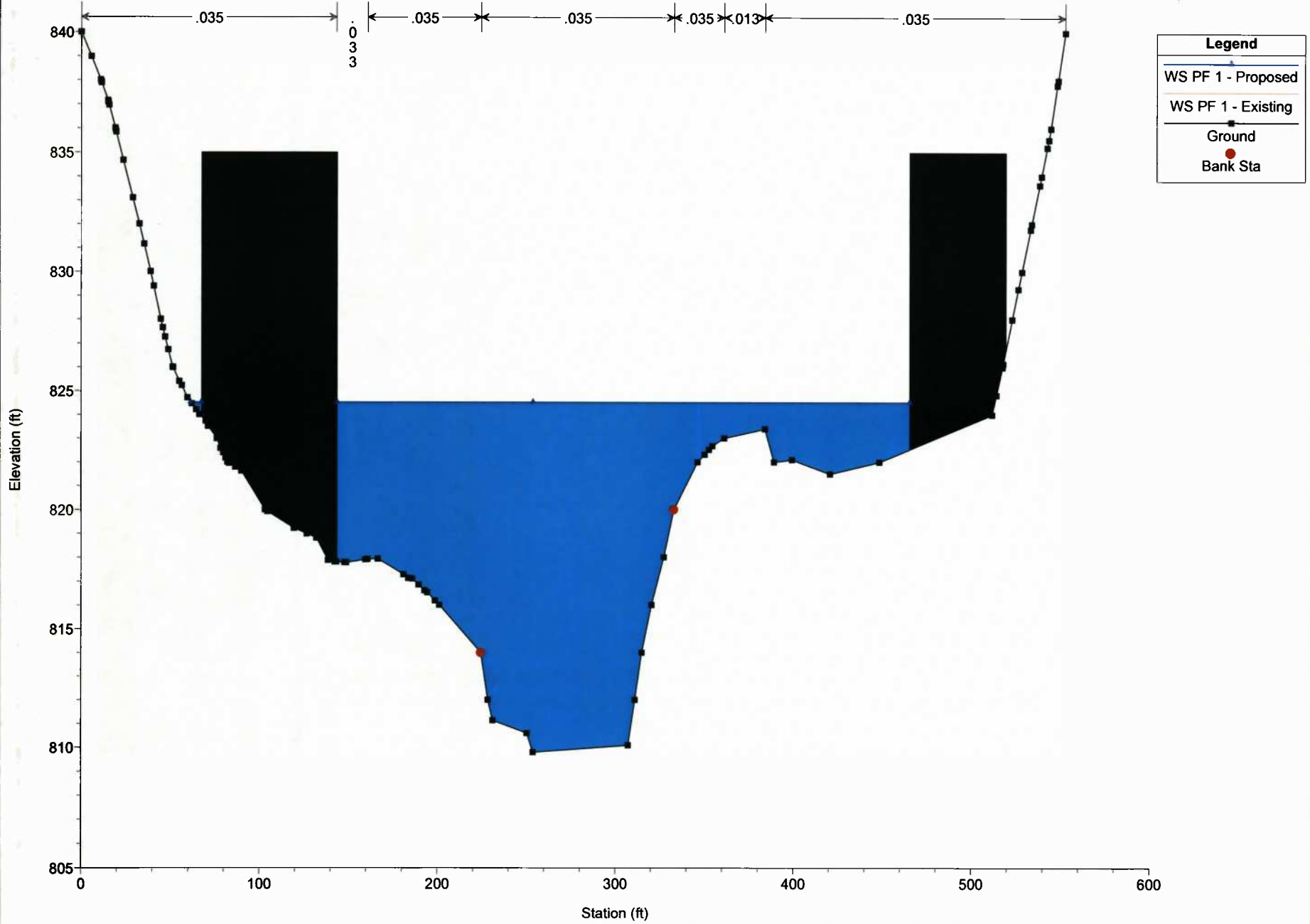
River = Meathouse Fork Reach = Upper RS = 2621.319



Willard Plan: 1) Proposed 2) Existing  
Geom: Proposed Flow: Existing  
River = Meathouse Fork Reach = Upper RS = 2580.999



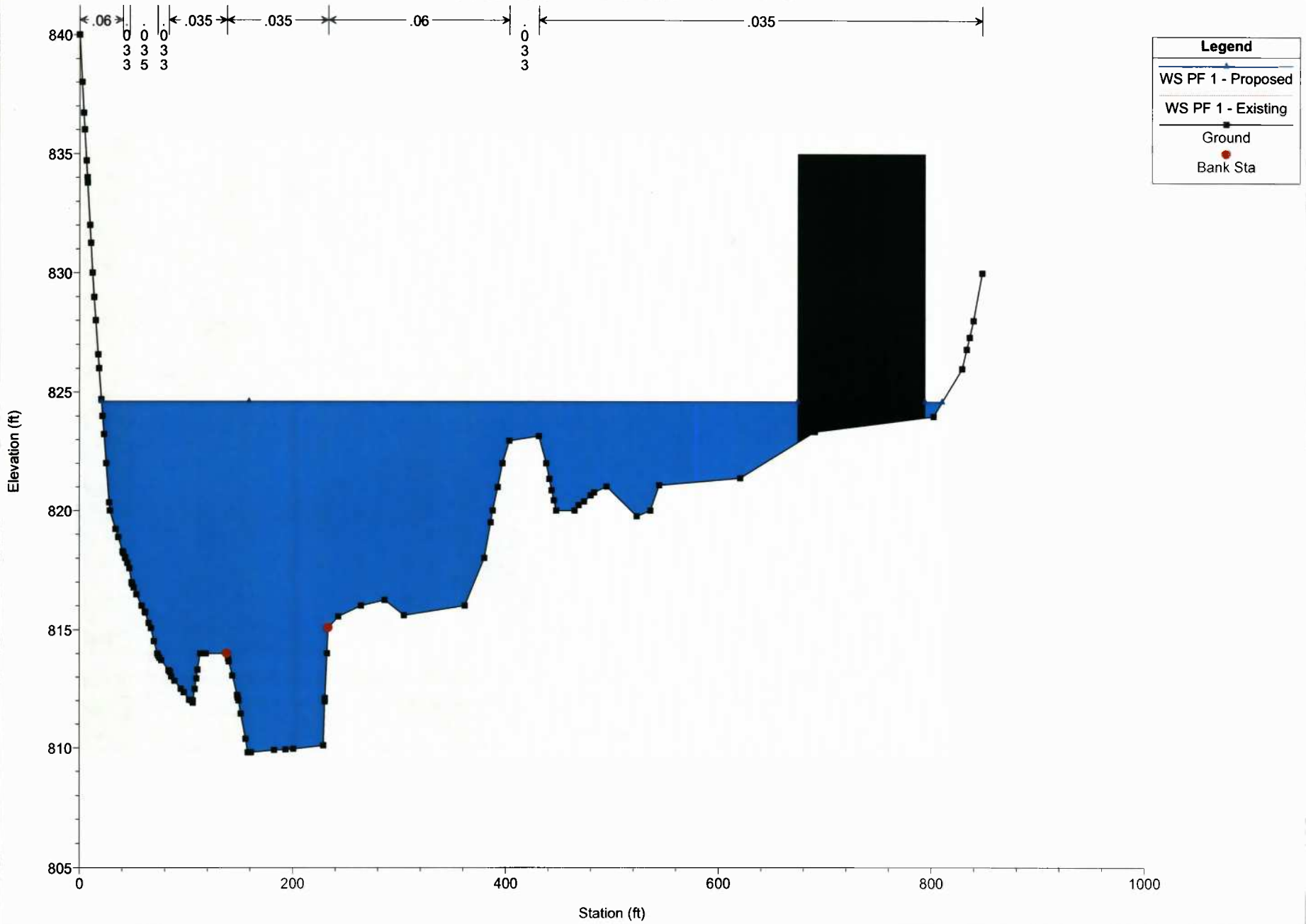
Willard Plan: 1) Proposed 2) Existing  
Geom: Proposed Flow: Existing  
River = Meathouse Fork Reach = Upper RS = 2527.424



Willard Plan: 1) Proposed 2) Existing

Geom: Proposed Flow: Existing

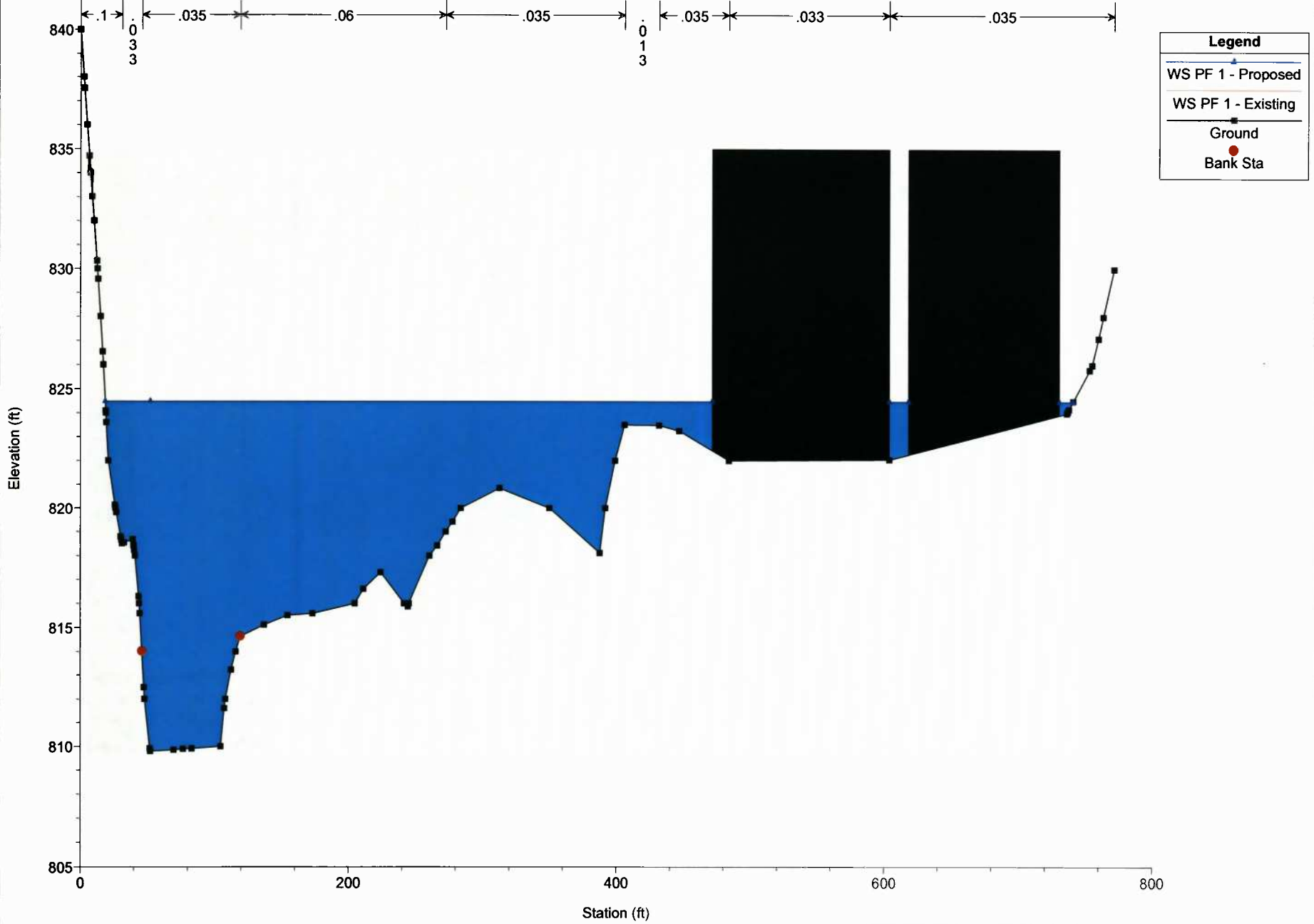
River = Meathouse Fork Reach = Lower RS = 2421.596



Willard Plan: 1) Proposed 2) Existing

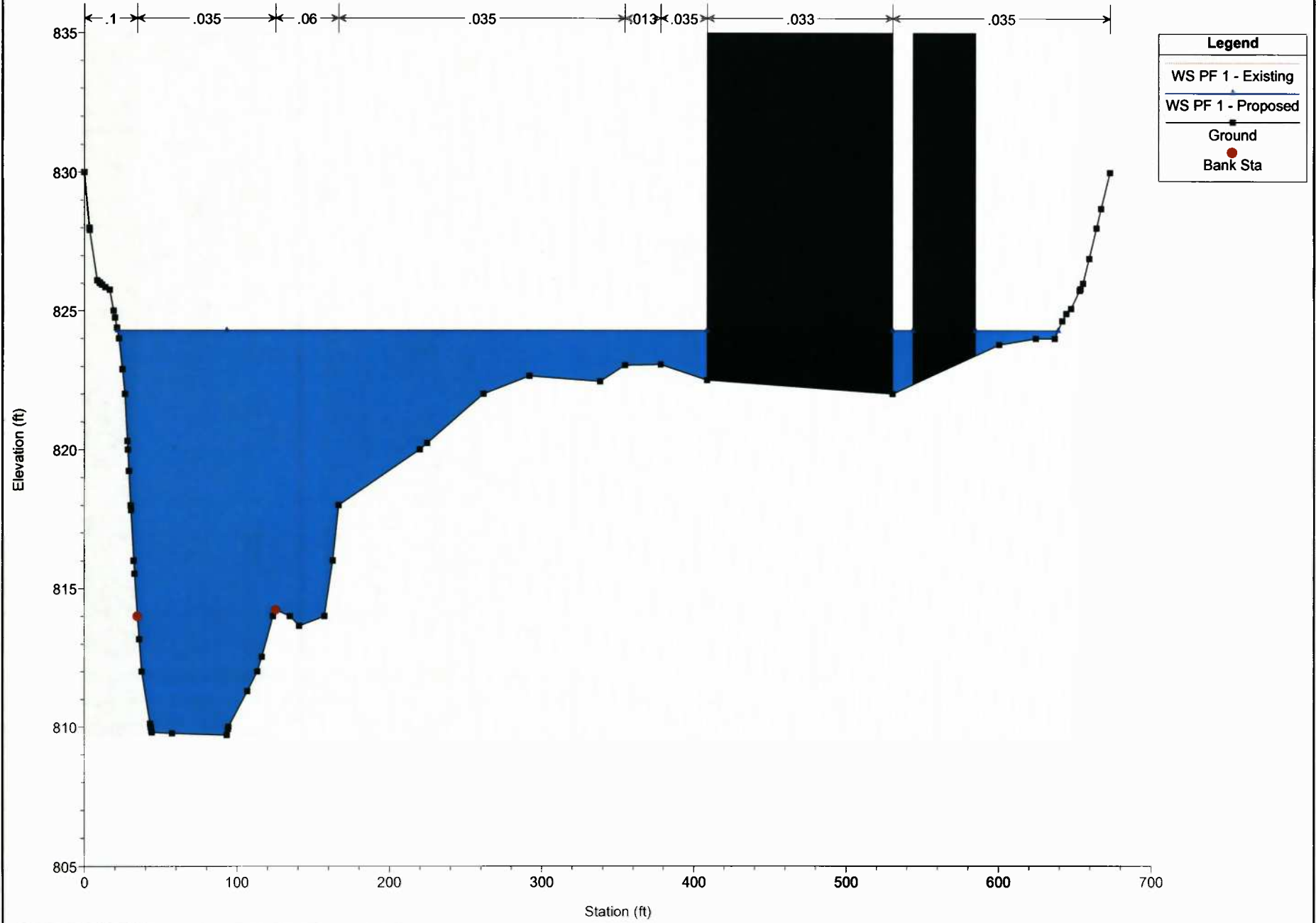
Geom: Proposed Flow: Existing

River = Meathouse Fork Reach = Lower RS = 2236.871





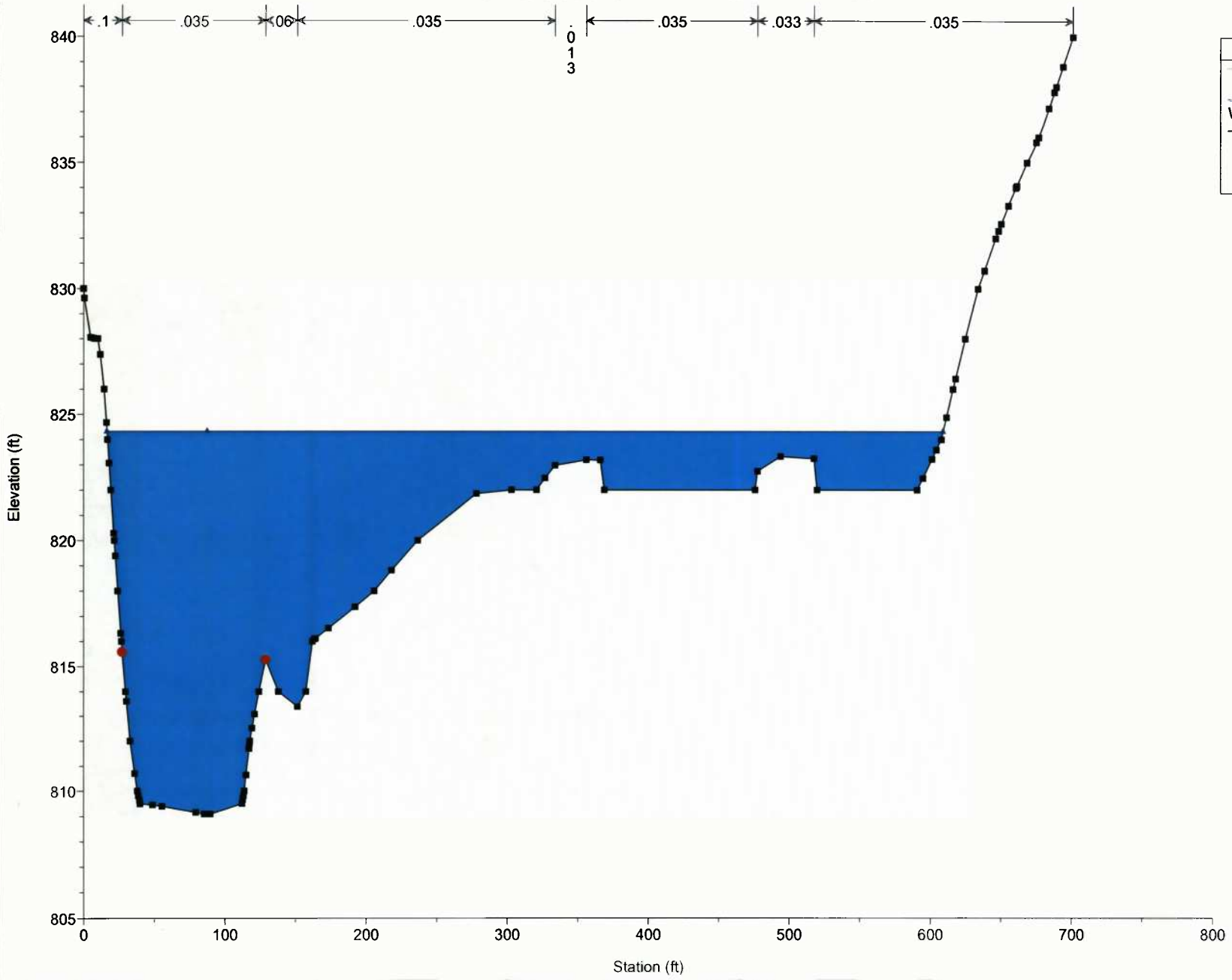
Willard Plan: 1) Proposed 2) Existing  
Geom: Proposed Flow: Existing  
River = Meathouse Fork Reach = Lower RS = 2005.226



Willard Plan: 1) Proposed 2) Existing

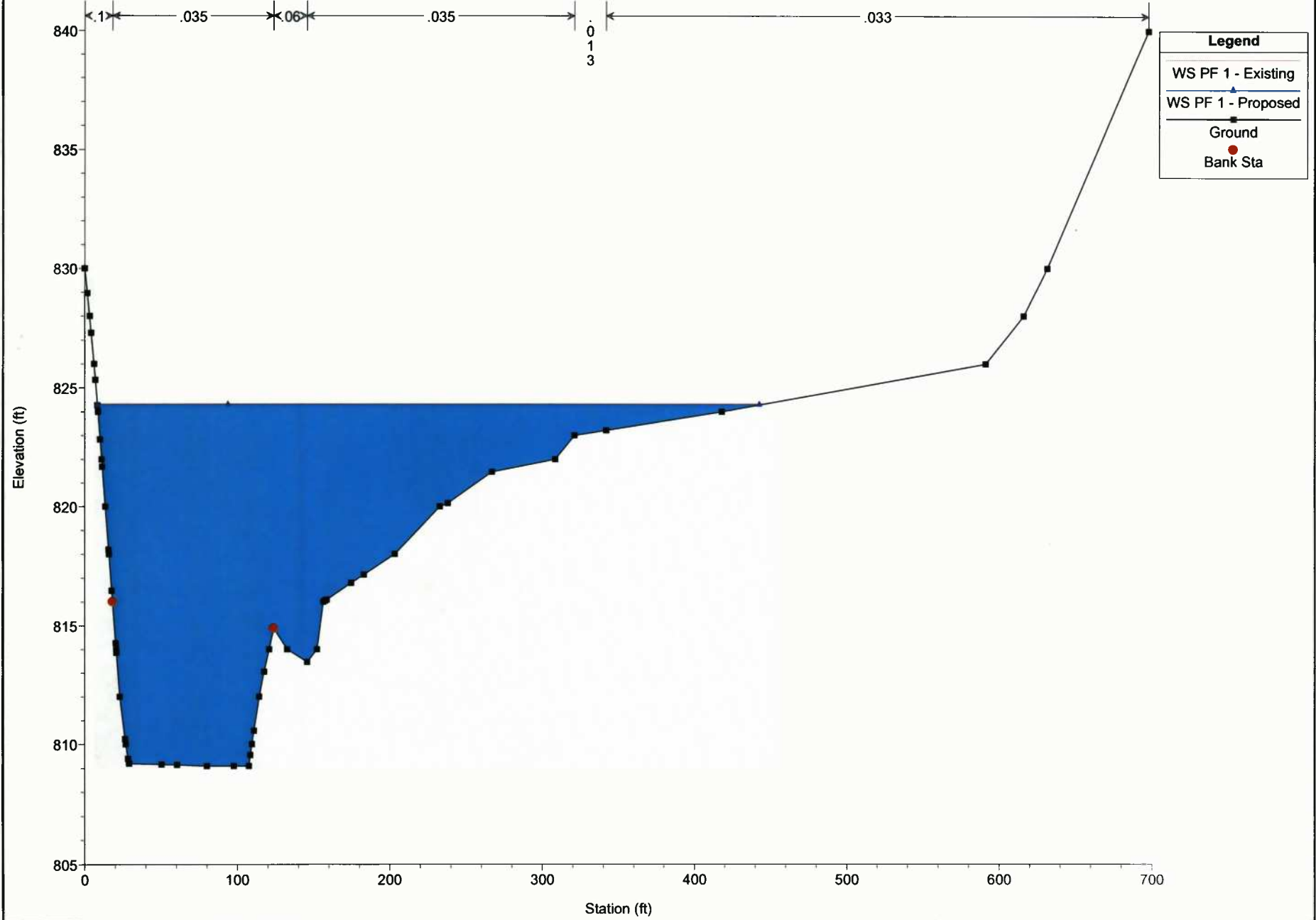
Geom: Proposed Flow: Existing

River = Meathouse Fork Reach = Lower RS = 1852.485

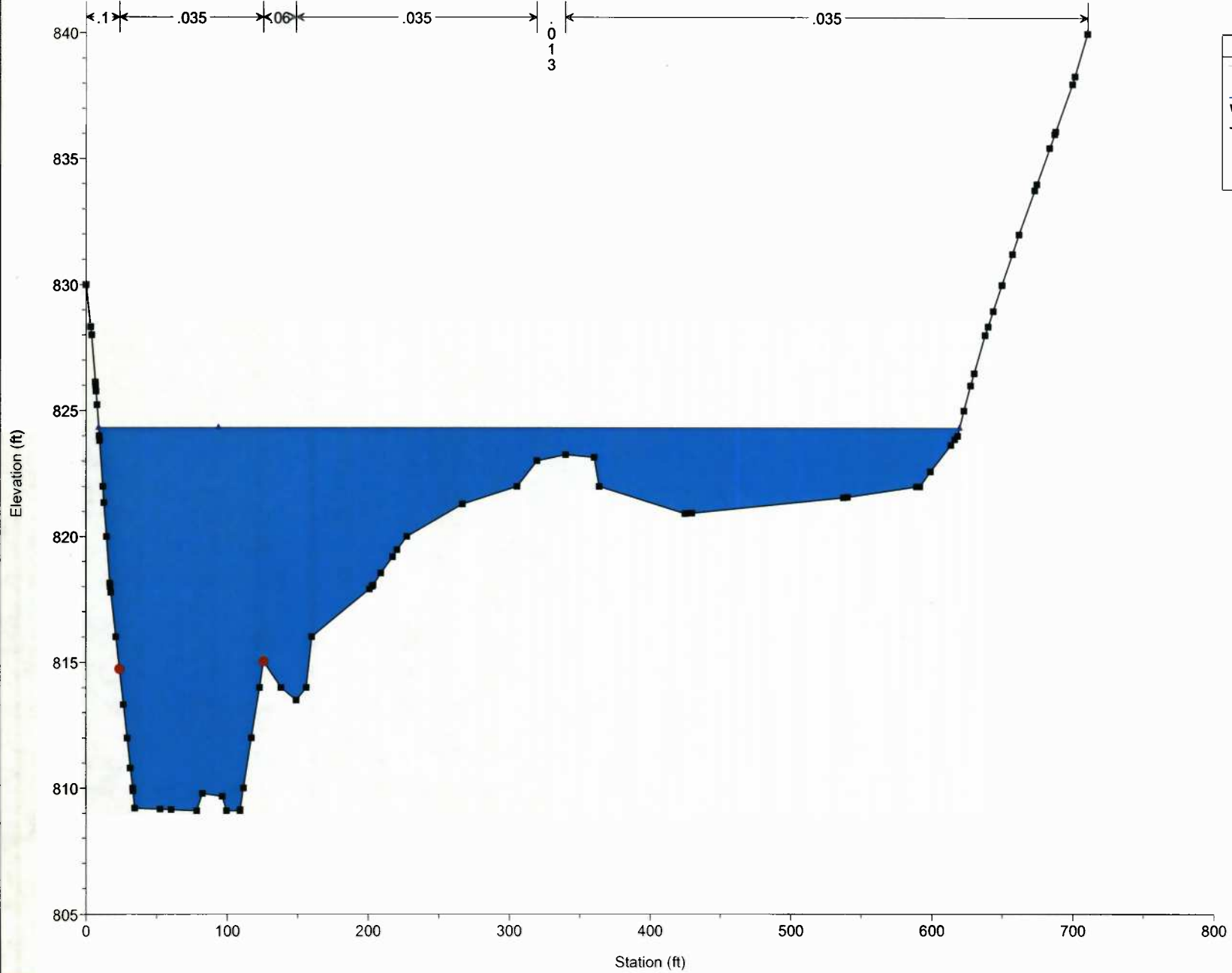


Legend	
WS PF 1 - Existing	▲
WS PF 1 - Proposed	■
Ground	■
Bank Sta	●

Willard Plan: 1) Proposed 2) Existing  
Geom: Proposed Flow: Existing  
River = Meathouse Fork Reach = Lower RS = 1812.068



Willard Plan: 1) Proposed 2) Existing  
Geom: Proposed Flow: Existing  
River = Meathouse Fork Reach = Lower RS = 1786.606

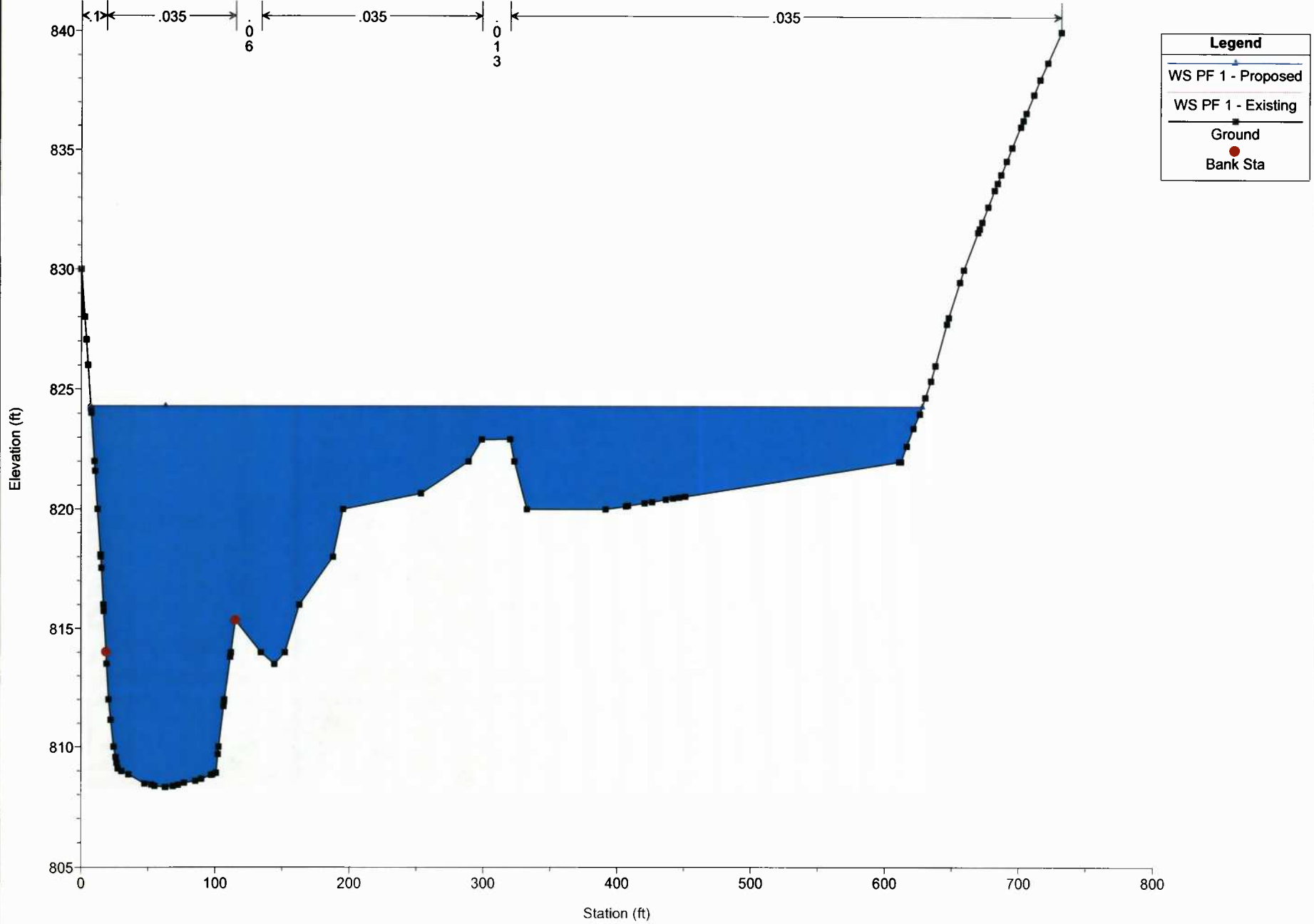


Legend	
WS PF 1 - Existing	—
WS PF 1 - Proposed	■
Ground	■
Bank Sta	●

Willard Plan: 1) Proposed 2) Existing

Geom: Proposed Flow: Existing

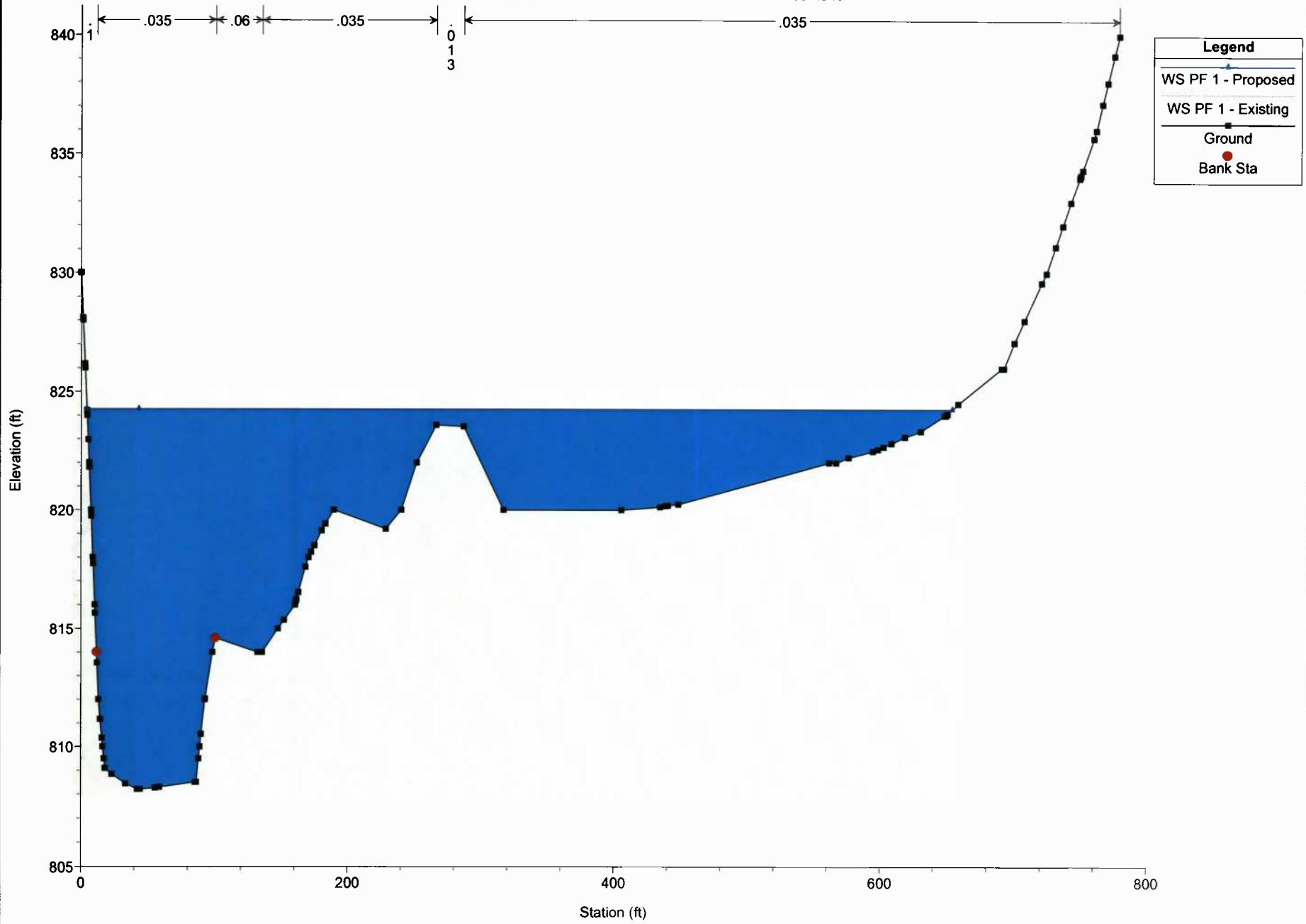
River = Meathouse Fork Reach = Lower RS = 1674.792



Willard Plan: 1) Proposed 2) Existing

Geom: Proposed Flow: Existing

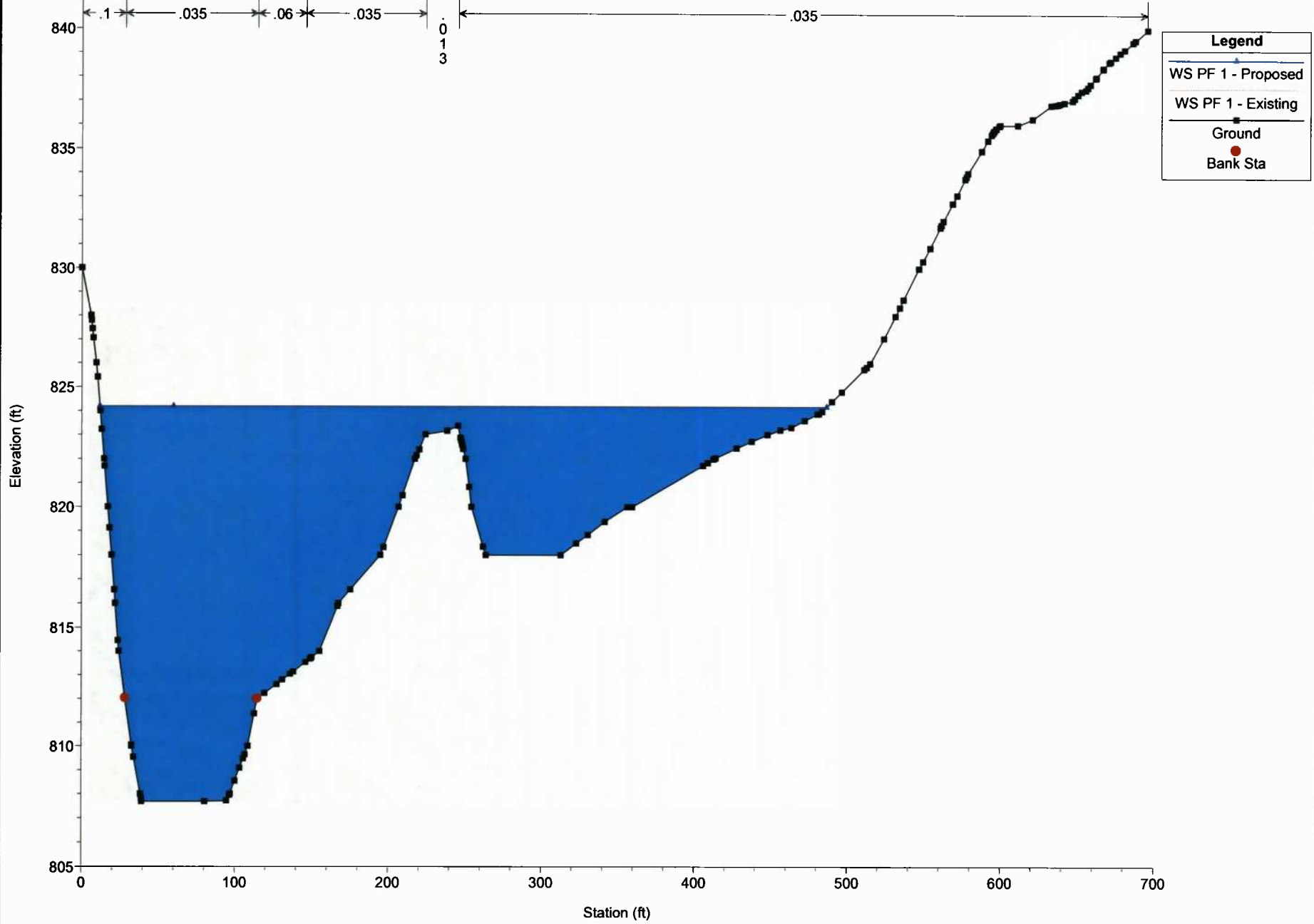
River = Meathouse Fork Reach = Lower RS = 1554.849



Willard Plan: 1) Proposed 2) Existing

Geom: Proposed Flow: Existing

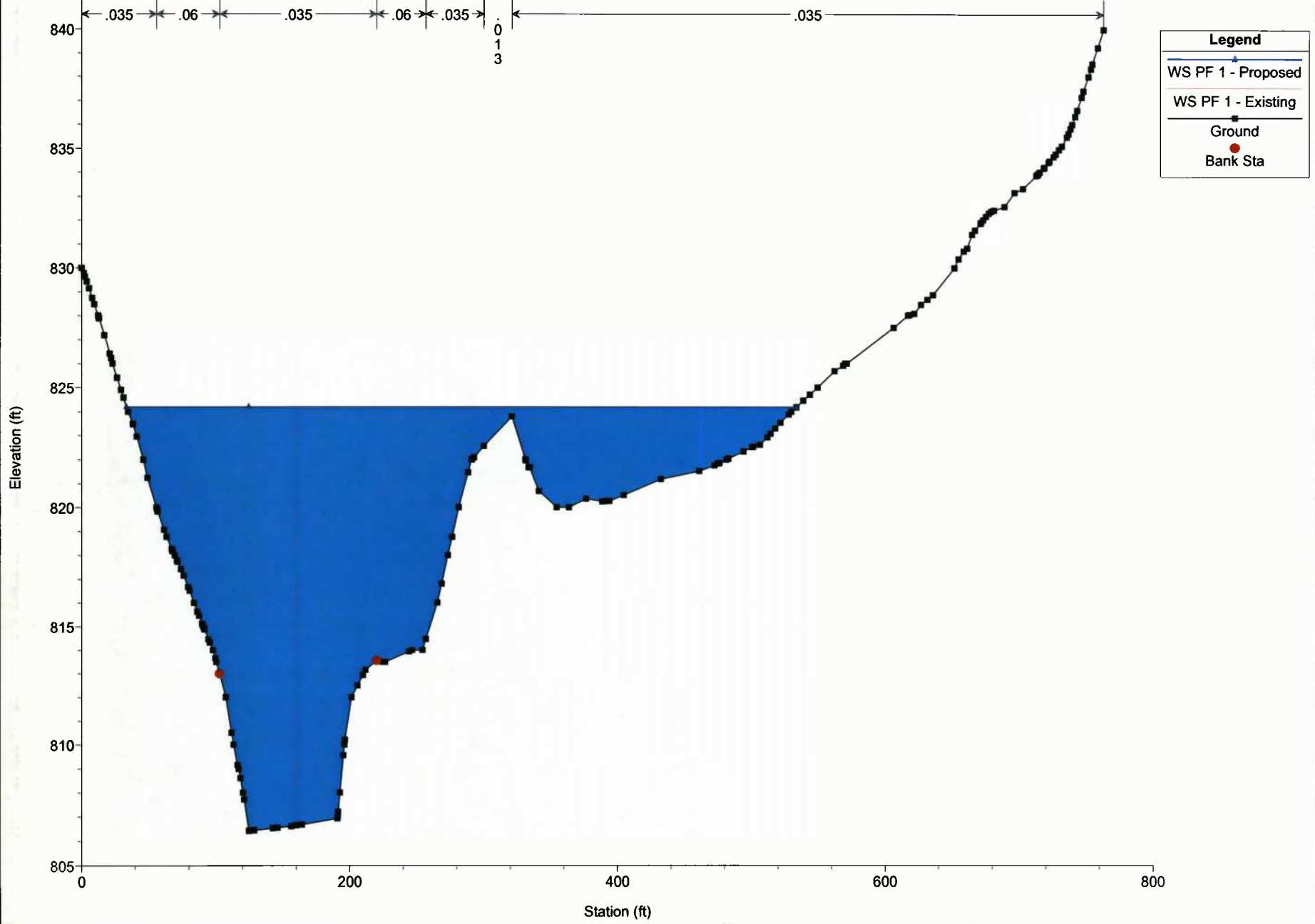
River = Meathouse Fork Reach = Lower RS = 1294.270



Willard Plan: 1) Proposed 2) Existing

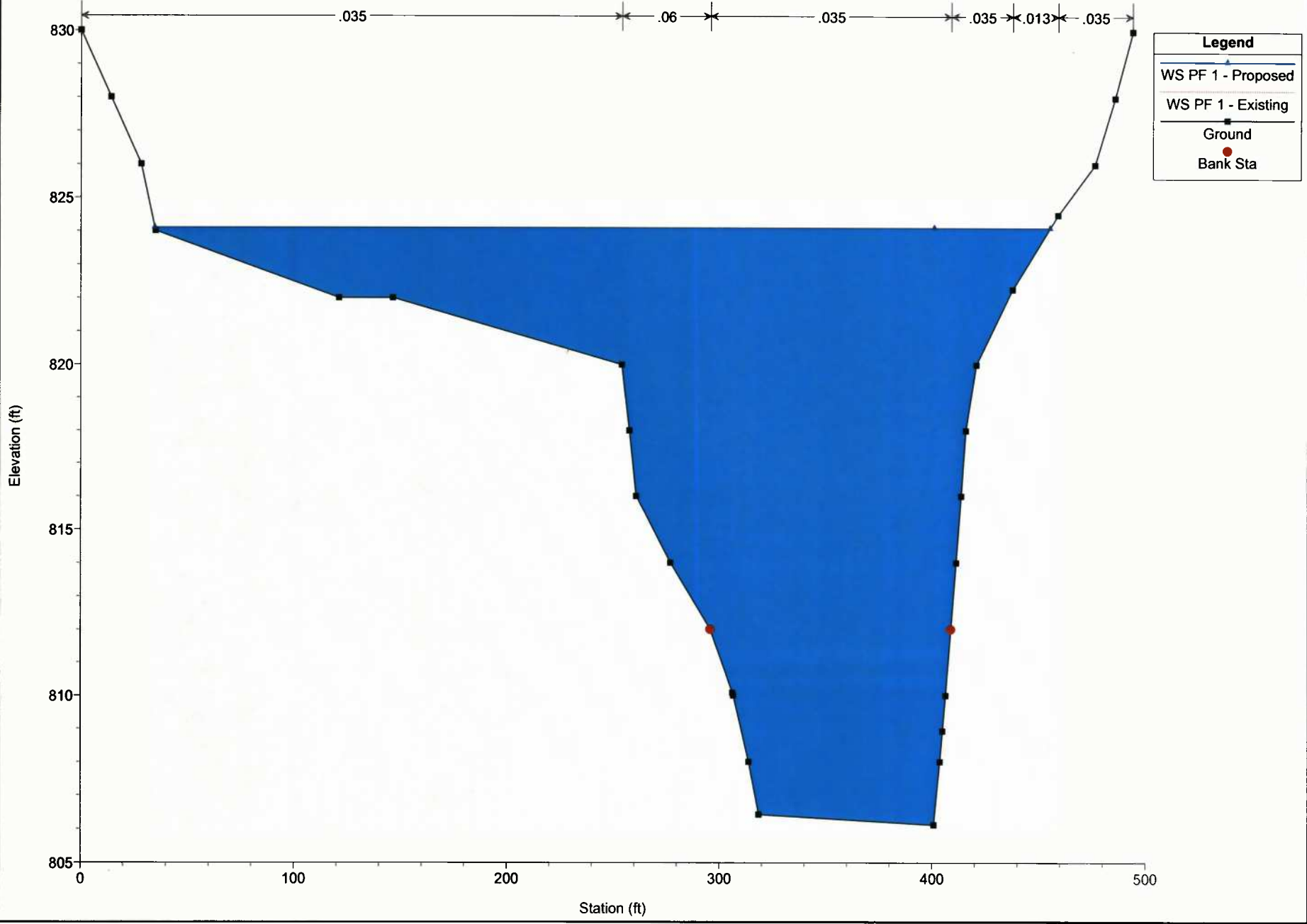
Geom: Proposed Flow: Existing

River = Meathouse Fork Reach = Lower RS = 1192.596

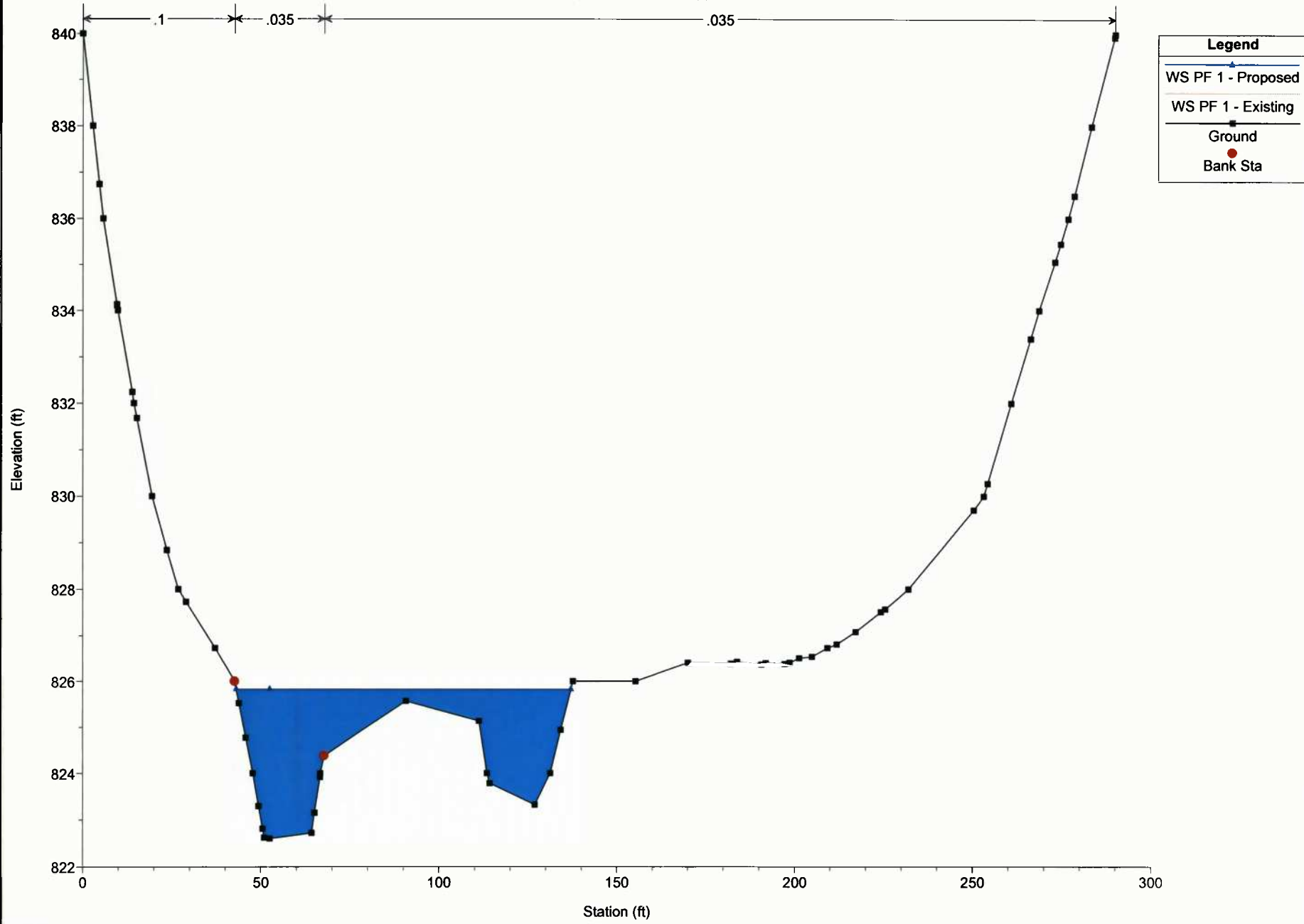




Willard Plan: 1) Proposed 2) Existing  
Geom: Proposed Flow: Existing  
River = Meathouse Fork Reach = Lower RS = 1000.000



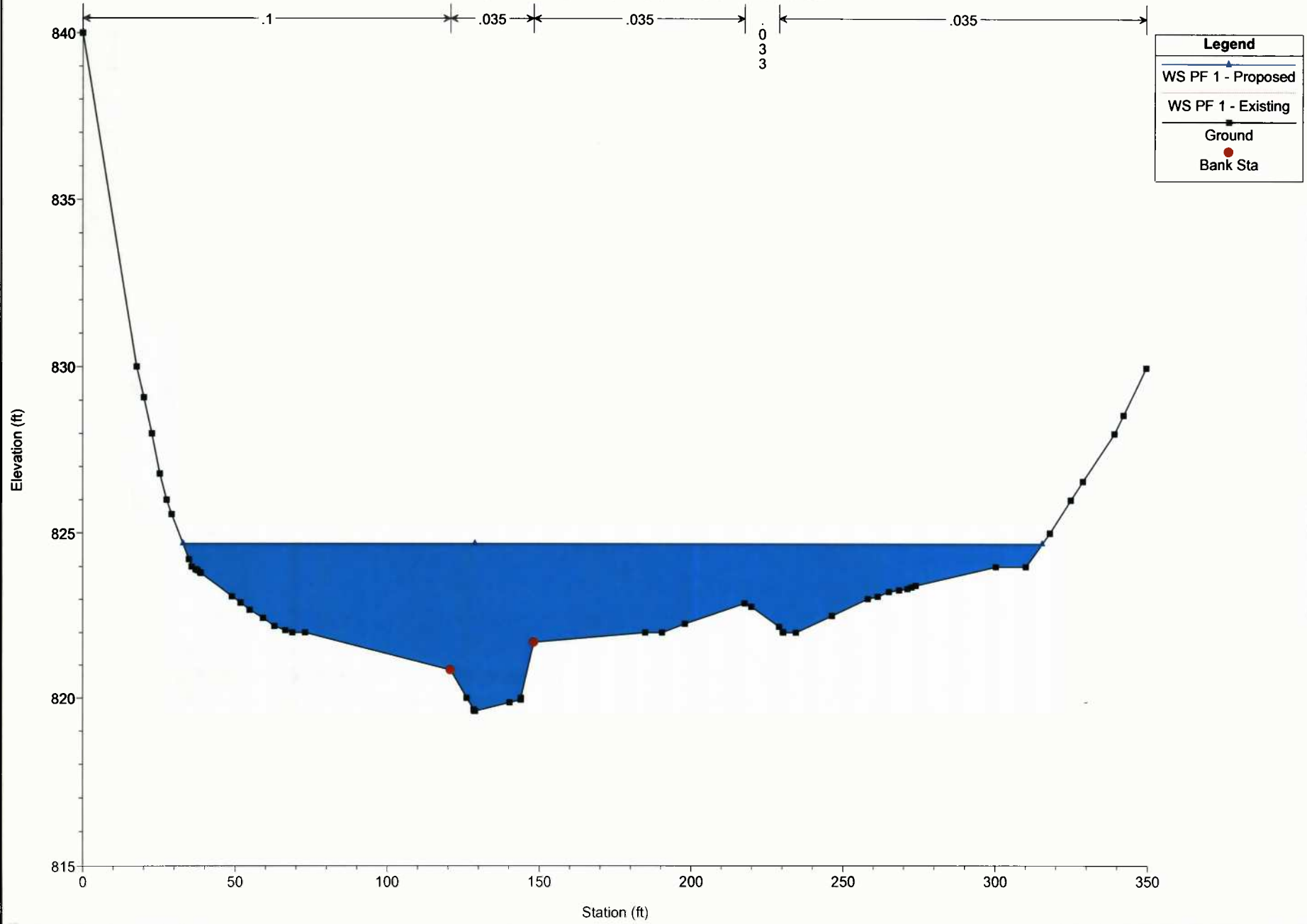
Willard Plan: 1) Proposed 2) Existing  
Geom: Proposed Flow: Existing  
River = Sugarcamp Run Reach = Upper RS = 1908.741



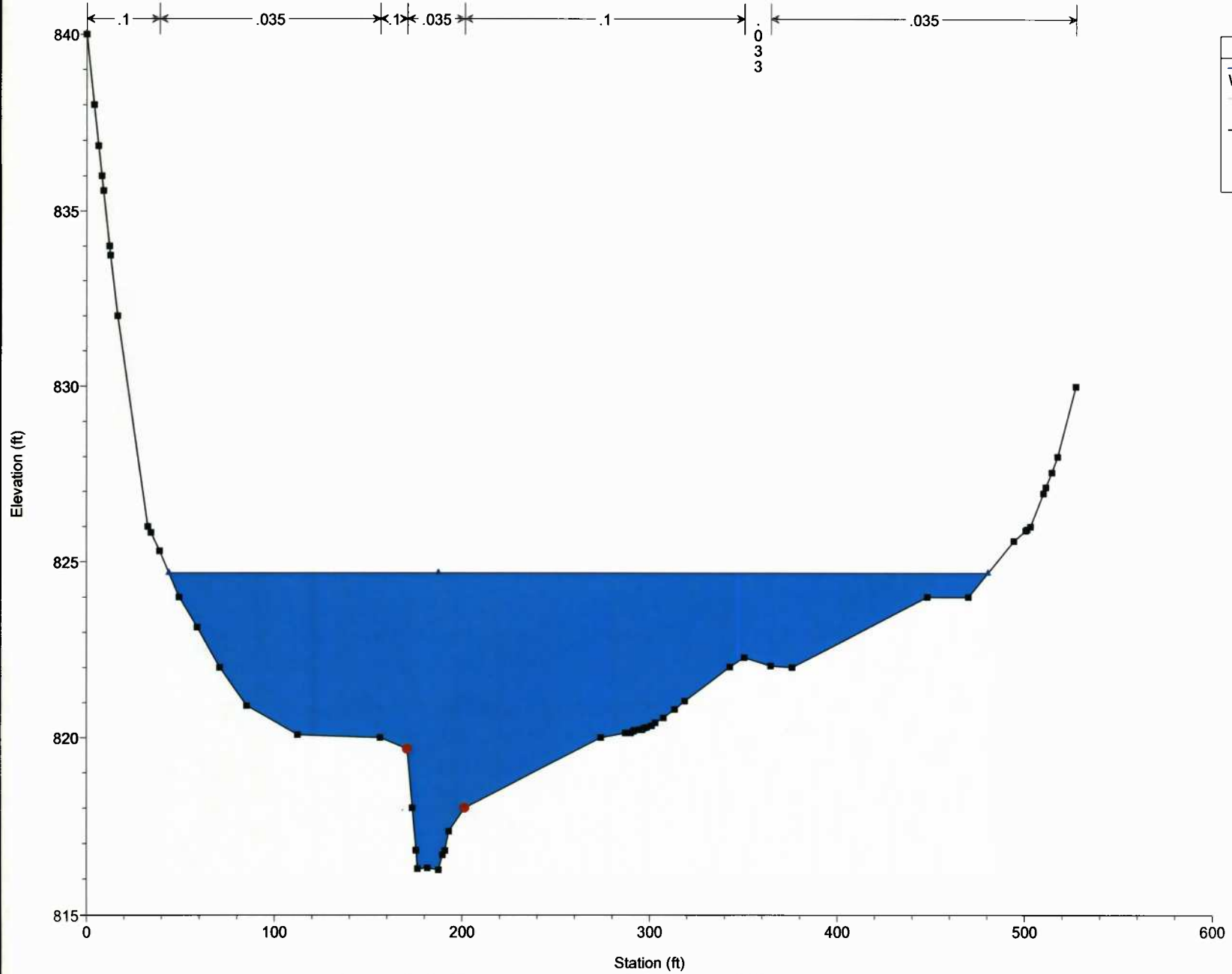
Willard Plan: 1) Proposed 2) Existing

Geom: Proposed Flow: Existing

River = Sugarcamp Run Reach = Upper RS = 1702.205

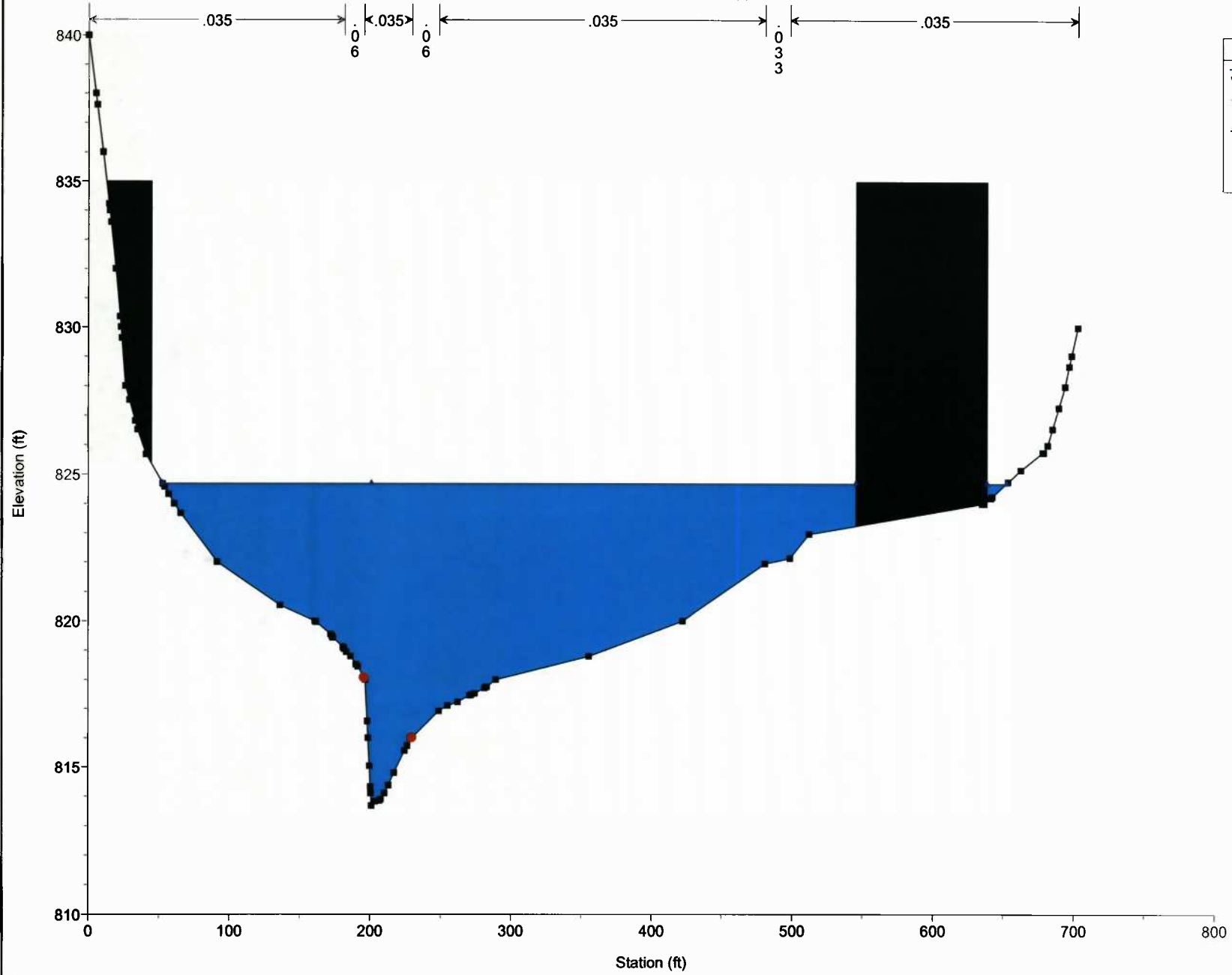


Willard Plan: 1) Proposed 2) Existing  
Geom: Proposed Flow: Existing  
River = Sugarcamp Run Reach = Upper RS = 1374.631



Legend	
—■—	WS PF 1 - Proposed
—■—	WS PF 1 - Existing
■	Ground
●	Bank Sta

Willard Plan: 1) Proposed 2) Existing  
Geom: Proposed Flow: Existing  
River = Sugarcamp Run Reach = Upper RS = 1206.899



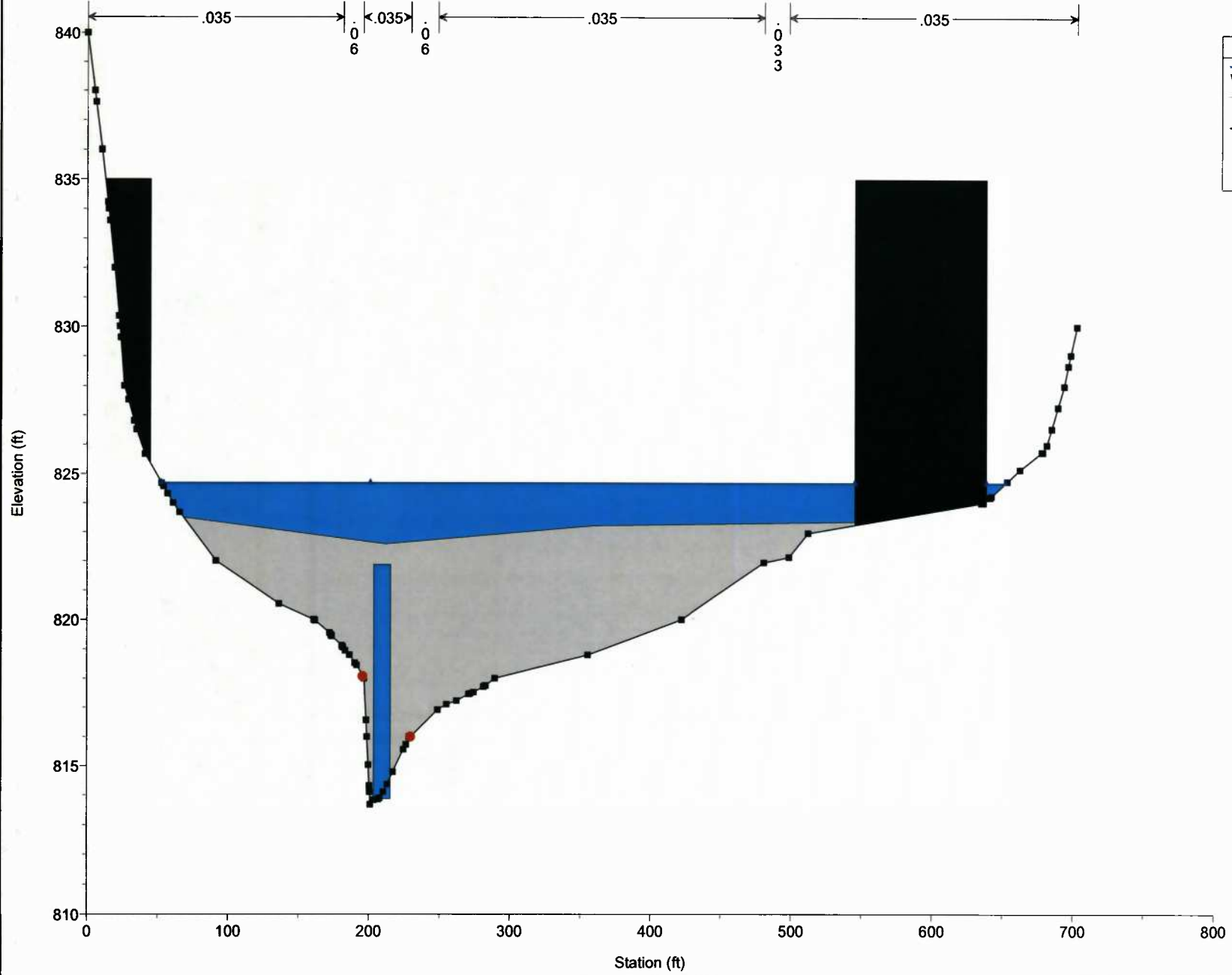
**Legend**

- WS PF 1 - Proposed
- WS PF 1 - Existing
- Ground
- Bank Sta

Willard Plan: 1) Proposed 2) Existing

Geom: Proposed Flow: Existing

River = Sugarcamp Run Reach = Upper RS = 1158.997 Culv

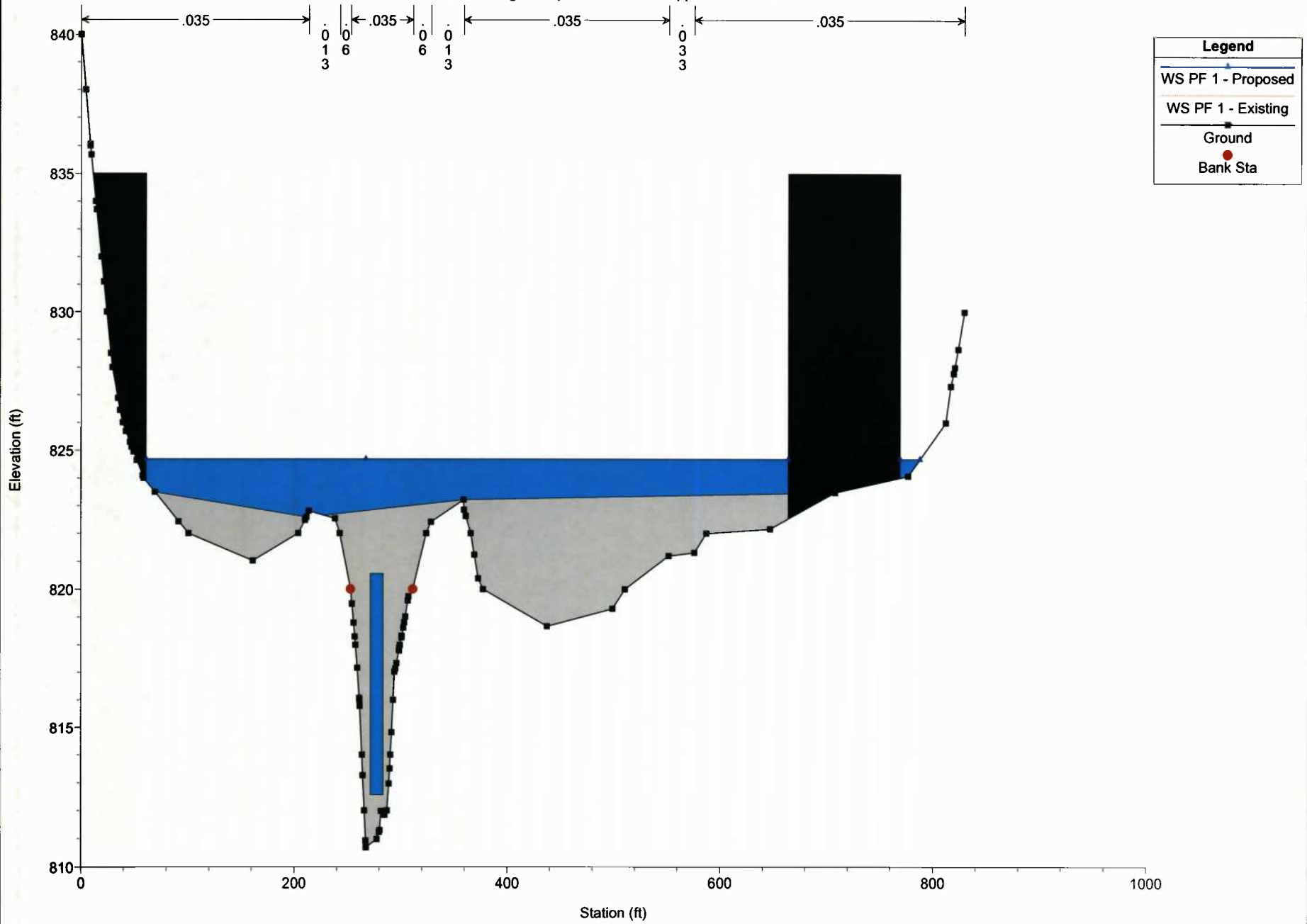


Legend	
—	WS PF 1 - Proposed
—	WS PF 1 - Existing
—■—	Ground
●	Bank Sta

Willard Plan: 1) Proposed 2) Existing

Geom: Proposed Flow: Existing

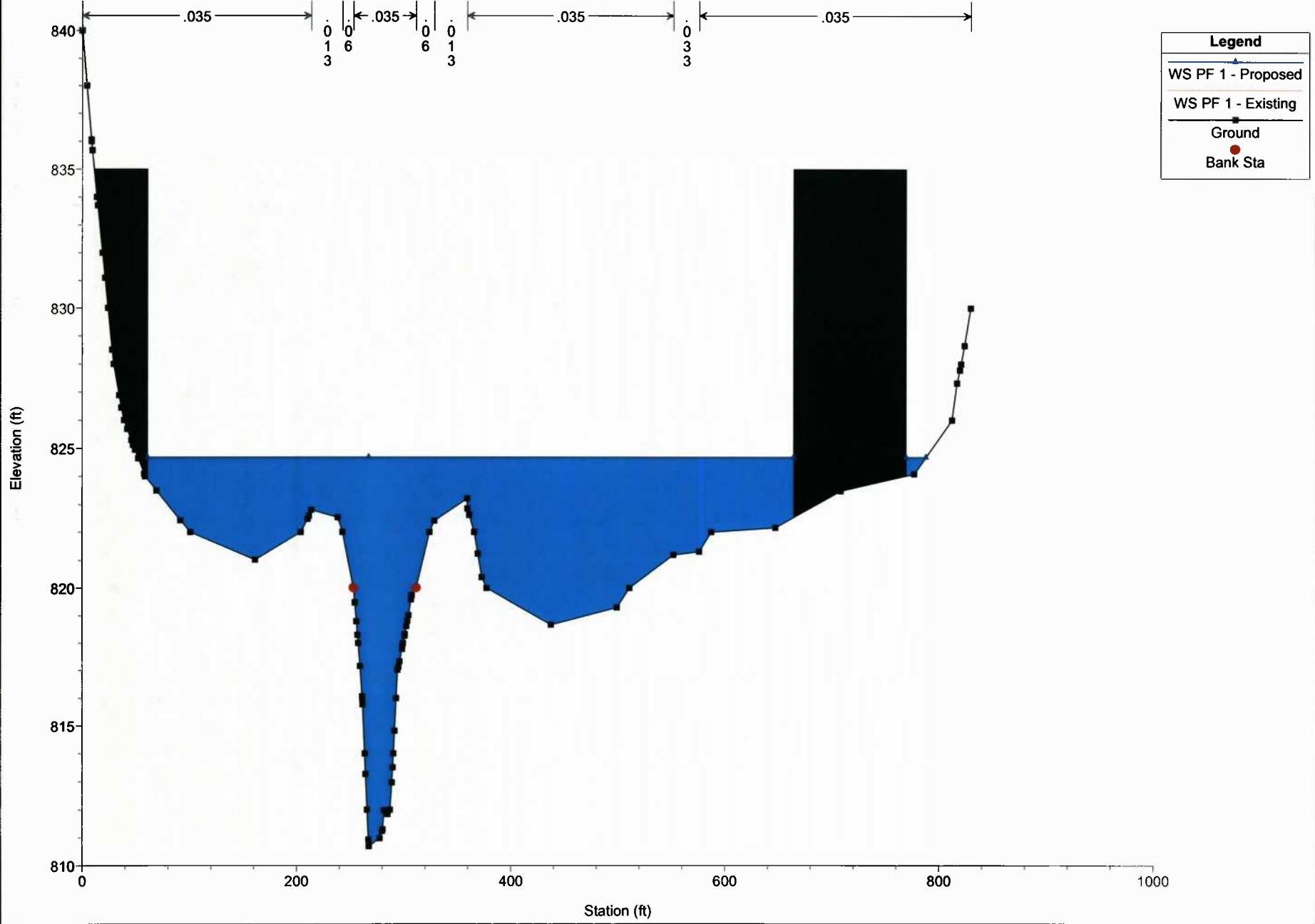
River = Sugarcamp Run Reach = Upper RS = 1158.997 Culv



Willard Plan: 1) Proposed 2) Existing

Geom: Proposed Flow: Existing

River = Sugarcamp Run Reach = Upper RS = 1115.181





STATE OF WEST VIRGINIA,  
COUNTY OF DODDRIDGE, TO WIT

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

*Floodplain Permit Application*  
# *13-079*

was published in said paper for .....

successive weeks beginning with the issue  
of *October 22* ..... 2013 and

ending with the issue of  
*October 22* ..... 2013 and

that said notice contains *189*

WORD SPACE at *e. 115* ..... cents a word

amounts to the sum of \$ *21.74*

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

\$ *0* .....  
and each publication thereafter

\$ *21.74* ..... TOTAL

EDITOR  
*Virginia Nicholson*

SWORN TO AND SUBSCRIBED  
BEFORE ME THIS THE *24* ..... DAY  
OF *October* ..... 2013

NOTARY PUBLIC  
*Laura J Adams*

Legal Advertisement  
Doddridge County  
Floodplain Permit Application  
Please take notice that on that on the 21<sup>st</sup> day of  
October, 2013 ANTERO RESOURCES APPALACHIAN  
CORPORATION - WILLARD PAD - #13-079 filed an  
application for a Floodplain Permit to develop land  
located at or about: SURFACE OWNERS: MICHAEL D.  
TRAVIS AND DODDRIDGE CO. BOARD OF  
EDUCATION, NEW MILTON DISTRICT, D/B: 196/715,  
& 275/077, T/M: 4-10,4-29.  
The Application is on file with the Clerk of the County  
Court and may be inspected or copied during regular  
business hours. Any interested persons who desire to  
comment shall present the same in writing by November  
9<sup>th</sup>, 2013.  
Delivered to the:  
Clerk of the County Court  
118 E. Court Street, West Union, WV 26456  
Beth A. Rogers, Doddridge County Clerk  
Dan Wellings, Doddridge County Flood Plain Manager  
10-22-1xb







# FIRM EXHIBIT

## LANDOWNER TABULATION

<b>A</b> TM 4-10 MICHAEL D. TRAVIS DB 196 PG 715 115.764 ACRES HC 68 BOX 25 WEST UNION, WV 26456	<b>F</b> TM 4-31 D.K. & JANET KELLEY DB 136 PG 217 34.84 ACRES RT 1 BOX 13 NEW MILTON, WV 26411	<b>K</b> TM 4-23 JACK N. BLAZER & JOAN MAY DICKERSON DB 253 PG 299 35.5 ACRES 5938 WV RT 18 SOUTH NEW MILTON, WV 26411
<b>B</b> TM 4-11 WILLARD N. & BILLIE E. KELLEY DB 202 PG 411 26.14 ACRES 125 ANNETTE DRIVE RICHMOND, KY 40475	<b>G</b> TM 4-31.1 D.K. & JANET KELLEY DB 136 PG 217 5.35 ACRES RT 1 BOX 13 NEW MILTON, WV 26411	<b>L</b> TM 4-23.3 JACK N. BLAZER & JOAN MAY DICKERSON DB 253 PG 299 7.5 ACRES 5938 WV RT 18 SOUTH NEW MILTON, WV 26411
<b>C</b> TM 4-11.1 WILLARD N. & BILLIE E. KELLEY DB 202 PG 411 11.2 ACRES 125 ANNETTE DRIVE RICHMOND, KY 40475	<b>H</b> TM 4-30 JAMES G. ROSS II WB 046 PG 064 0.5 ACRES 236 WHITETAIL HAVEN ROAD NEW MILTON, WV 26411	<b>M</b> TM 4-10.1 CANDI E. & MARVIN B. ROLLINS DB 178 PG 659 4.23 ACRES PO BOX 56 WEST UNION, WV 26456
<b>D</b> TM 4-33 DARWIN J. KELLEY DB 082 PG 275 17.05 ACRES 214 NORTH 6TH STREET CLARKSBURG, WV 26301	<b>I</b> TM 4-28 JOHN A. POLAN TRUSTEE SEVENTH DAY BAPTIST CHURCH DB 031 PG 398 7.57 ACRES HC 69 BOX 30 MIDDLEBOURNE, WV 26149	<b>N</b> TM 4-9 HAESSLY LAND AND TIMBER, LLC DB 250 PG 625 333.99 ACRES RT 1 BOX 185 MARIETTA, OH 45750
<b>E</b> TM 4-32 ROY K. & CREOLA M. NICHOLSON DB 220 PG 106 52 ACRES 422 SUGAR CAMP ROAD NEW MILTON, WV 26411	<b>J</b> TM 4-29 BOARD OF EDUCATION OF THE COUNTY OF DODDRIDGE, STATE OF WEST VIRGINIA DB 275 PG 077 2.51 ACRES 103 SISTERSVILLE PIKE WEST UNION, WV 26456	<b>O</b> TM 4-8 JAMES & BETTY E. FRANK DB 246 PG 482 40 ACRES 922 EIBS CAMP ROAD NEW MILTON, WV 26411

**NFIP**  
**PANEL 0140C**

**FIRM**  
FLOOD INSURANCE RATE MAP  
DODDRIDGE COUNTY,  
WEST VIRGINIA  
AND INCORPORATED AREAS

**PANEL 140 OF 325**  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

**CONTAINS:**

COMMUNITY	NUMBER	PANEL	SUFFIX
DODDRIDGE COUNTY	540224	0140	C

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

**MAP NUMBER**  
54017C0140C  
**MAP REVISED**  
OCTOBER 4, 2011

Federal Emergency Management Agency

**NFIP**  
**PANEL 0230C**

**FIRM**  
FLOOD INSURANCE RATE MAP  
DODDRIDGE COUNTY,  
WEST VIRGINIA  
AND INCORPORATED AREAS

**PANEL 230 OF 325**  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

**CONTAINS:**

COMMUNITY	NUMBER	PANEL	SUFFIX
DODDRIDGE COUNTY	540224	0230	C

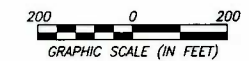
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

**MAP NUMBER**  
54017C0230C  
**MAP REVISED**  
OCTOBER 4, 2011

Federal Emergency Management Agency

**FLOODPLAIN NOTE**

THE PROPOSED SITE IS LOCATED IN FLOODZONE "X" PER FEMA FLOOD MAPS #54017C0230C AND #54017C0140C. THE PROPOSED SITE ENTRANCE IS LOCATED IN FLOODZONE "AE" PER FEMA FLOOD MAPS #54017C0230C AND #54017C0140C.



Engineering  
Survey  
Environmental  
GIS

**NAVITUS**  
ENGINEERING INC.



151 W. Indy Hill Lane  
Winchester, Virginia 22602  
Telephone: (888) 662-4185  
www.navituseng.com

REVISION

DATE



FIRM EXHIBIT

**WILLARD**  
WELL PAD & WATER CONTAINMENT PAD  
NEW MILTON DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 09/16/2013

SCALE: 1" = 200'

SHEET 26 OF 26



**LOCATION COORDINATES**

ACCESS ROAD ENTRANCE  
 LATITUDE: 39.248325 LONGITUDE: -80.894649 (NAD 83)  
 N 4344378.46 E 5268348.27 (UTM ZONE 17 METERS)

CENTER OF TANK  
 LATITUDE: 39.252784 LONGITUDE: -80.899485 (NAD 83)  
 N 4344874.86 E 526792.13 (UTM ZONE 17 METERS)

CENTROID OF PAD  
 LATITUDE: 39.255373 LONGITUDE: -80.890733 (NAD 83)  
 N 4345161.84 E 526683.45 (UTM ZONE 17 METERS)

**GENERAL DESCRIPTION**

THE ACCESS ROAD(S), WATER CONTAINMENT PAD, AND WELL PAD ARE BEING CONSTRUCTED TO AID IN THE DEVELOPMENT OF INDIVIDUAL MARCELLUS SHALE GAS WELLS.

**FLOODPLAIN NOTE**

THE PROPOSED SITE IS LOCATED IN FLOODZONE "X" PER FEMA FLOOD MAPS #54017C0230C AND #54017C0140C. THE PROPOSED SITE ENTRANCE IS LOCATED IN FLOODZONE "AE" PER FEMA FLOOD MAPS #54017C0230C AND #54017C0140C.

**MISS UTILITY STATEMENT**

ANTERO RESOURCES CORPORATION WILL NOTIFY MISS UTILITY OF WEST VIRGINIA FOR THE LOCATING OF UTILITIES PRIOR TO THIS PROJECT DESIGN; TICKET #1316341455. IN ADDITION, MISS UTILITY WILL BE CONTACTED PRIOR TO START OF THE PROJECT.

**ENTRANCE PERMIT**

ANTERO RESOURCES CORPORATION WILL OBTAIN AN ENCROACHMENT PERMIT (FORM MM-109) FROM THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS, PRIOR TO COMMENCEMENT OF CONSTRUCTION ACTIVITIES.

**ENVIRONMENTAL NOTES**

WETLAND DELINEATIONS WERE PERFORMED JUNE, JULY, & AUGUST, 2013 BY ALLSTAR ECOLOGY 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 AUGUST 23, 2013 STREAM AND WETLAND DELINEATION DESIGNER'S MAP WAS PREPARED BY ALLSTAR ECOLOGY AND SUMMARIZES THE RESULTS OF THE FIELD DELINEATION. THE MAP 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 SHOWN ON THIS EXHIBIT 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.

**WILLARD WETLAND IMPACT (SQUARE FEET)**

Wetland and Impact Cause	Fill (SF)	Const. Disturb to LOD (SF)	Total Impact (SF)
Wetland 1 (Access Road "A")	1810.35	1743.90	3554.25
		<b>Total</b>	<b>3554.25</b>
		<b>Total Acres</b>	<b>0.08</b>

**GEOTECHNICAL NOTE**

NO SOIL STUDIES OR SUBSURFACE INVESTIGATIONS WERE PERFORMED AND ANALYZED FOR THE DESIGN OF THIS SITE. THE PROPOSED ACCESS ROAD CUT SLOPE (1.5:1) SHALL BE FIELD VERIFIED BY A CERTIFIED GEOTECHNICAL ENGINEER TO ENSURE THE PROPOSED SLOPES ARE ADEQUATE PRIOR TO CONSTRUCTION. ACCESS ROAD CONSTRUCTION SHALL BE MONITORED BY A GEOTECHNICAL ENGINEER DURING CONSTRUCTION.

**PROJECT CONTACTS**

**OPERATOR:**  
 ANTERO RESOURCES CORPORATION  
 981 EAST WASHINGTON AVENUE  
 ELLENBORO, WV 26348  
 PHONE: (304) 869-3405  
 FAX: (304) 869-3408

**ELI WAGONER - ENVIRONMENTAL ENGINEER**  
 OFFICE: (304) 622-3842, EXT. 311 CELL: (304) 476-9770

**JOHN KAWCAK - OPERATIONS SUPERINTENDENT**  
 CELL: (817) 368-1553

**AARON KUNZLER - CONSTRUCTION SUPERVISOR**  
 CELL: (405) 227-8344

**ANTHONY SMITH - FIELD ENGINEER**  
 OFFICE: (304) 869-3405 CELL: (304) 673-6196

**ROGER DUNLAP - SURVEYING COORDINATOR**  
 OFFICE: (304) 869-3405 CELL: (304) 651-5588

**MARK HUTSON - LAND AGENT**  
 CELL: (304) 869-8315

**ENGINEER/SURVEYOR:**  
 NAVITUS ENGINEERING, INC.  
 CYRUS S. KUMP, PE - PROJECT MANAGER/ENGINEER  
 OFFICE: (888) 862-4185 CELL: (540) 886-6747

**ENVIRONMENTAL:**

ALLSTAR ECOLOGY, LLC  
 RYAN L. WARD - ENVIRONMENTAL SCIENTIST  
 OFFICE: (866) 213-2666 CELL: (304) 692-7477

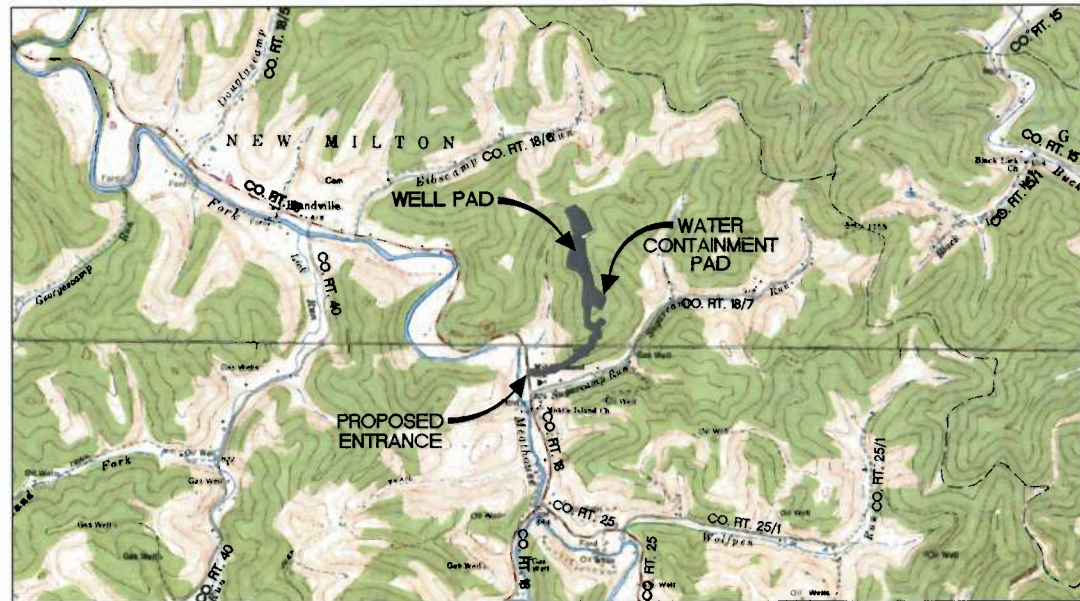
**RESTRICTIONS NOTES:**

- THERE ARE NO PERENNIAL STREAMS, LAKES, OR RESERVOIRS WITHIN 100 FEET OF THE WELL PAD AND LOD. THERE IS A WETLAND IMPACT THAT WILL NEED TO BE PERMITTED BY THE APPROPRIATE AGENCIES. THERE IS A POND WITHIN 100' OF THE ACCESS ROAD LOD. NO PERMIT REQUIRED.
- THERE ARE NO NATURALLY PRODUCING TROUT STREAMS WITHIN 300 FEET OF THE WELL PAD AND LOD.
- THERE ARE NO GROUNDWATER INTAKE OR PUBLIC WATER SUPPLY FACILITIES WITHIN 1000 FEET OF THE WELL PAD AND LOD.
- THERE ARE NO APPARENT EXISTING WATER WELLS OR DEVELOPED SPRINGS WITHIN 250 FEET OF THE WELL(S) BEING DRILLED.
- THERE ARE NO OCCUPIED DWELLING STRUCTURES WITHIN 625 FEET OF THE CENTER OF THE WELL PAD.
- THERE ARE NO AGRICULTURAL BUILDINGS LARGER THAN 2,500 SQUARE FEET WITHIN 625 FEET OF THE CENTER OF THE WELL PAD.

# WILLARD WELL PAD & WATER CONTAINMENT PAD SITE DESIGN & CONSTRUCTION PLAN, EROSION & SEDIMENT CONTROL PLANS

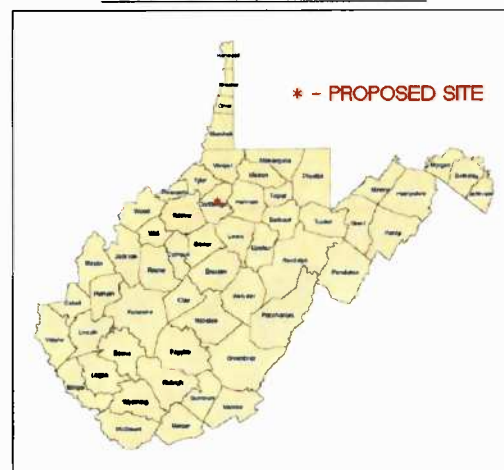
NEW MILTON DISTRICT, DODDRIDGE COUNTY, WEST VIRGINIA  
 MEATHOUSE FORK WATERSHED

USGS 7.5 NEW MILTON & SMITHBURG QUAD MAPS



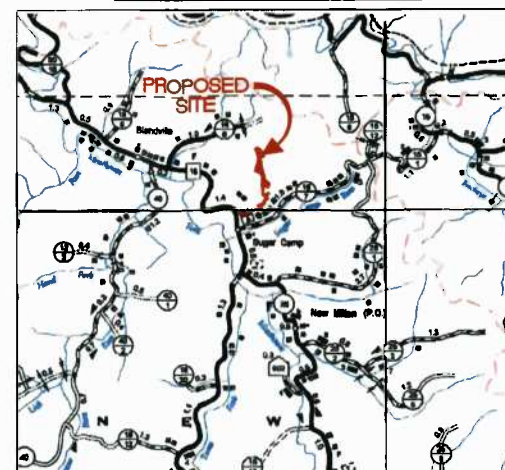
WEST VIRGINIA STATE PLANE COORDINATE SYSTEM  
 NORTH ZONE, ZONES 18 AND 19 NAVD83  
 ESTABLISHED BY SURVEY GRADE GPS & OPUS  
 POST-PROCESSING

WEST VIRGINIA COUNTY MAP



(NOT TO SCALE)

WVDOH COUNTY ROAD MAP



SCALE: 1" = 5000'

**DESIGN CERTIFICATION**

THE DRAWINGS, CONSTRUCTION NOTES, AND REFERENCE DIAGRAM ATTACHED HERETO HAVE BEEN PREPARED IN ACCORDANCE WITH THE WEST VIRGINIA CODE OF STATE RULES, DIVISION OF ENVIRONMENTAL PROTECTION, OFFICE OF OIL AND GAS CRS 35-8.

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!!**

**SHEET INDEX**

- 01 - COVER SHEET
- 02 - CONSTRUCTION AND E&S CONTROL NOTES
- 03 - MATERIAL QUANTITIES
- 04 - EXISTING CONDITIONS
- 05 - OVERALL PLAN SHEET INDEX & VOLUMES
- 06 - ACCESS ROAD PLAN
- 07 - ACCESS ROAD & WATER CONTAINMENT PAD PLAN
- 08 - WELL PAD PLAN
- 09 - STOCKPILE PLAN
- 10-11 - ACCESS ROAD PROFILES
- 12-13 - ACCESS ROAD SECTIONS
- 14 - WELL PAD & WATER CONTAINMENT PAD SECTIONS
- 15 - WELL PAD SECTIONS
- 16-21 - CONSTRUCTION DETAILS
- 22 - ACCESS ROAD RECLAMATION PLAN
- 23 - ACCESS ROAD & WATER CONTAINMENT PAD RECLAMATION PLAN
- 24 - WELL PAD RECLAMATION PLAN
- 25 - STOCKPILE RECLAMATION PLAN
- 26 - FIRM EXHIBIT

WILLARD LIMITS OF DISTURBANCE AREA (AC)	
Total Site	
Access Road "A" (3,717.95')	11.61
Access Road "B" (268.88')	0.68
Staging Area	0.58
Well Pad	6.59
Water Containment Pad	2.15
Excess/Topsoil Material Stockpiles	6.05
<b>Total Affected Area</b>	<b>27.65</b>
Total Wooded Acres Disturbed	22.43
Impacts to Michael D. Travis TM 4-10	
Access Road "A" (693.89')	2.41
Well Pad	4.97
Staging Area	0.58
Excess/Topsoil Material Stockpiles	5.44
<b>Total Affected Area</b>	<b>13.40</b>
Total Wooded Acres Disturbed	9.13
Impacts to D.K. & Janet Kelley TM 4-31	
Access Road "A" (1,005.19')	3.77
<b>Total Affected Area</b>	<b>3.77</b>
Total Wooded Acres Disturbed	3.11
Impacts to Roy K. & Creola M. Nicholson TM 4-32	
Access Road "A" (1,832.74')	5.43
Access Road "B" (268.88')	0.68
Well Pad	1.62
Water Containment Pad	2.15
Excess/Topsoil Material Stockpiles	0.82
<b>Total Affected Area</b>	<b>10.49</b>
Total Wooded Acres Disturbed	10.19

Proposed Well Name	NAD 83 NAD 83	UTM METERS	NAD 83 Lat & Long
June	N 277292.93	N 277328.88	N 4345151.54
Unit 1H	E 1662745.85	E 1631304.76	E 526676.47
June	N 277302.94	N 277338.88	N 4345154.59
Unit 2H	E 1662745.85	E 1631304.76	E 526676.42
Gravis	N 277312.94	N 277348.88	N 4345157.63
Unit 1H	E 1662745.85	E 1631304.76	E 526676.37
Sugarcamp	N 277322.93	N 277358.88	N 4345160.68
Unit 1H	E 1662745.85	E 1631304.76	E 526676.32
Lena	N 277332.93	N 277368.88	N 4345163.73
Unit 1H	E 1662745.85	E 1631304.76	E 526676.26
Rilla	N 277342.94	N 277378.88	N 4345166.77
Unit 1H	E 1662745.85	E 1631304.76	E 526676.21
Rilla	N 277352.93	N 277388.88	N 4345169.82
Unit 2H	E 1662745.85	E 1631304.76	E 526676.16
Dewitt	N 277362.93	N 277398.88	N 4345172.87
Unit 1H	E 1662745.85	E 1631304.76	E 526676.11
Dewitt	N 277372.94	N 277408.88	N 4345175.91
Unit 2H	E 1662745.85	E 1631304.76	E 526676.06
Well Pad Elevation	1189.00		

Engineering Survey Environmental GIS

**NAVITUS ENGINEERING INC.**

151 Windy Hill Lane  
 Fletcher, Virginia 24162  
 Telephone: 888-888-2185  
 www.navituseng.com

REVISION	DATE

ANTERO RESOURCES CORPORATION  
 THIS DOCUMENT WAS PREPARED FOR ANTERO RESOURCES CORPORATION

COVER SHEET

**WILLARD**

**WELL PAD & WATER CONTAINMENT PAD**

NEW MILTON DISTRICT  
 DODDRIDGE COUNTY, WEST VIRGINIA

PROFESSIONAL ENGINEER  
 STATE OF WEST VIRGINIA  
 04/16/2013

DATE: 09/16/2013  
 SCALE: AS SHOWN  
 SHEET 1 OF 26



# CONSTRUCTION AND E&S CONTROL NOTES

## CONSTRUCTION NOTES:

- THE CONTRACTOR IS TO VERIFY FIELD CONDITIONS PRIOR TO AND DURING CONSTRUCTION AND WILL NOTIFY NAVITUS ENGINEERING AT (888) 682-4185 IMMEDIATELY OF ANY DISCREPANCIES BETWEEN ACTUAL FIELD CONDITIONS AND THE APPROVED PLANS. ANY WORK PERFORMED BY THE CONTRACTOR AFTER THE FINDING OF SUCH DISCREPANCIES SHALL BE DONE AT THE CONTRACTOR'S RISK.
- METHODS AND MATERIALS USED IN THE CONSTRUCTION OF THE IMPROVEMENTS HEREIN SHALL CONFORM TO THE CURRENT COUNTY CONSTRUCTION STANDARDS AND SPECIFICATIONS AND/OR CURRENT WV DEP EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICE MANUAL STANDARDS AND SPECIFICATIONS. SHOULD A CONFLICT BETWEEN THE DESIGN, SPECIFICATIONS, AND PLANS OCCUR, THE MOST STRINGENT REQUIREMENT WILL APPLY. THE APPROVAL OF THESE PLANS IN NO WAY RELIEVES THE DEVELOPER OR HIS AGENT OF THE RESPONSIBILITIES CONTAINED IN THE WV DEP EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICE MANUAL.
- 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.
- 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.
- 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.
- THE CONTRACTOR SHALL PROVIDE NOTIFICATION 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.
- THE CONTRACTOR WILL BE RESPONSIBLE FOR THE REPAIR OF ANY DAMAGES TO THE EXISTING STREETS AND UTILITIES WHICH OCCURS AS A RESULT OF HIS CONSTRUCTION PROJECT WITHIN OR CONTIGUOUS TO THE EXISTING RIGHT-OF-WAY.
- 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.
- 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.
- 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.
- THE CONTRACTOR(S) 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.
- CONTRACTOR TO CONTACT OPERATOR AND ENGINEER IF GROUNDWATER IS ENCOUNTERED DURING CONSTRUCTION.
- THE CONTRACTOR SHALL SCHEDULE A PRE-CONSTRUCTION MEETING WITH THE EROSION AND SEDIMENT CONTROL INSPECTOR 2 DAYS PRIOR TO THE START OF CONSTRUCTION.
- THE CONTRACTOR IS RESPONSIBLE FOR ALL FILL MATERIAL TESTING REQUIRED DURING THE CONSTRUCTION OF THIS PROJECT. ALL MATERIAL TESTS SHALL BE CONDUCTED BY A CERTIFIED MATERIALS TESTING LABORATORY AND A CERTIFICATION OF THE MATERIALS TESTED SHALL BE PROVIDED BY A LICENSED PROFESSIONAL ENGINEER REPRESENTING THE LABORATORY. ALL TEST RESULTS SHALL BE SUBMITTED TO THE ENGINEER CERTIFYING THE CONSTRUCTED FACILITY. FAILURE TO CONDUCT THE DENSITY TEST SHALL BE CAUSE FOR NON-ACCEPTANCE OF THE CONSTRUCTED FACILITY.
- SATISFACTORY MATERIALS FOR USE AS FILL FOR PAD AREAS INCLUDE MATERIALS CLASSIFIED IN ASTM D-2487 AS GW, GP, GM, GC, SW, SP, SM, SC, ML, AND CL GROUPS. MOISTURE CONTENT WILL BE CONTROLLED IN ACCORDANCE WITH THE STANDARD PROCTOR TEST (ASTM-D698) RESULTS. GENERALLY, UNSATISFACTORY MATERIALS INCLUDE MATERIALS CLASSIFIED IN ASTM D-2487 AS PT, CH, MH, OL, OH, AND ANY SOIL TOO WET TO FACILITATE COMPACTION. CH AND MH SOILS MAY BE USED SUBJECT TO APPROVAL OF THE ENGINEER. SOILS SHALL HAVE A MINIMUM DRY DENSITY OF 92LB/CF PER ASTM D-698 AND SHALL HAVE A PLASTICITY INDEX LESS THAN 17.
- CONTRACTOR SHALL SUBMIT A GENERIC GROUNDWATER PROTECTION PLAN (GPP) TO THE WV DEP GROUNDWATER PROGRAM. THE GROUNDWATER PROTECTION PLAN SHALL BE ADHERED TO DURING CONSTRUCTION.
- THE CONTRACTOR IS RESPONSIBLE FOR CONSTRUCTING THE SITE IN ACCORDANCE WITH THE DESIGN PLANS AND CONSTRUCTION DOCUMENTS AND THE SCOPE OF WORK SHALL CONFORM WITH THE GRADES, BERMS, DEPTHS, DIMENSIONS, ETC. SHOWN HEREON.
- SUPER SILT FENCE CAN BE USED IN PLACE OF ANY COMPOST FILTER SOCK.

## SITE CLEANUP & RECYCLE PROGRAM

- 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.
- OILS, FUELS, LUBRICANTS AND COOLANTS WILL BE PLACED IN SUITABLE CONTAINERS AND DISPOSED PROPERLY.
- ALL TRASH AND GARBAGE WILL BE COLLECTED AND DISPOSED PROPERLY.
- 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.
- ALL POLLUTION AND EMERGENCY SPILLS SHALL BE IMMEDIATELY REPORTED TO THE WVDEP OFFICE OF OIL AND GAS. (EMERGENCY #1-800-642-3074)

## EROSION AND SEDIMENT CONTROL NARRATIVE

**PROJECT DESCRIPTION:** THE PURPOSE OF THIS PROJECT IS TO CONSTRUCT A GAS WELL DRILLING PAD AND WATER CONTAINMENT PAD TO AID IN THE DEVELOPMENT OF INDIVIDUAL GAS WELLS. THE ACCESS ROAD ENTRANCE TO THE PROPOSED SITE IS LOCATED ON THE EAST SIDE OF W.V. SR. 18, 0.08 MILES NORTH OF THE INTERSECTION OF CO. RT. 18/7 & W.V. SR. 18 IN NEW MILTON DISTRICT, DODDRIDGE COUNTY, WEST VIRGINIA. THE TOTAL APPROXIMATE LAND DISTURBANCE ASSOCIATED WITH THIS PROJECT IS 27.65 ACRES.

**EXISTING SITE CONDITIONS:** THE EXISTING SITE IS APPROXIMATELY 80.5% WOODED. THE TOPOGRAPHY RANGES FROM MODERATE TO STEEP TERRAIN (1% TO 50% SLOPES). PRESENT ON SITE ARE ACCESS ROADS, OVERHEAD UTILITIES, EXISTING WATER WELLS/DEVELOPED SPRINGS, EXISTING GASLINES, EXISTING GAS WELLS AND TANKS ASSOCIATED WITH THE EXISTING GAS WELLS, AND EXISTING STRUCTURES. ONE POND, THREE PEM WETLANDS, ONE PERENNIAL STREAM, ONE INTERMITTENT STREAM, AND SEVEN EPHEMERAL STREAMS ARE ALSO LOCATED ONSITE. THE SITE IS LOCATED ON A RIDGE AND DRAINS TO MEATHOUSE FORK. NO EROSION WAS NOTICED ON SITE.

**ADJACENT PROPERTY:** THE SITE IS BORDERED BY FORESTED LANDS TO THE NORTH, EAST AND WEST SIDES. W.V. STATE ROUTE 18 BORDERS THE SITE TO THE SOUTH.

**CRITICAL AREAS:** THE AREA(S) SHOWN ALONG THE FIELD DELINEATED STREAMS, WETLANDS, AND PONDS, AS SHOWN ON THE PLANS, ARE DESIGNATED AS CRITICAL AREA(S), IF PRESENT. ALL 3:1 SLOPES AND STEEPER, DITCHES, AND OTHER CONTROLS SHALL BE CONSIDERED CRITICAL EROSION AREAS. THESE AREAS SHALL BE MONITORED AND MAINTAINED DAILY DURING CONSTRUCTION AND AFTER EACH RAINFALL OF 0.5 INCHES OR GREATER. COMPOST FILTER SOCKS ARE TO BE USED TO PROTECT THESE FIELD DELINEATED AREA(S) FROM SEDIMENT LEAVING THE SITE. ADDITIONALLY, ORANGE SAFETY FENCE IS RECOMMENDED TO BE INSTALLED ABOVE/AROUND THESE AREA(S), TO SERVE AS A PHYSICAL BARRIER, ENSURING THE AREA(S) ARE NOT DISTURBED. THE LOCAL GOVERNING AUTHORITY WILL HAVE THE AUTHORITY TO RECOMMEND THE PLACEMENT OF ADDITIONAL EROSION CONTROL MEASURES IN THESE AREAS IF IT BECOMES EVIDENT DURING CONSTRUCTION THAT THE ONES IN PLACE ARE NOT FUNCTIONING SUFFICIENTLY.

**SOILS:** NO SOIL STUDIES OR SUBSURFACE INVESTIGATIONS WERE PERFORMED AND ANALYZED FOR THE DESIGN OF THIS SITE. THE PROPOSED ACCESS ROAD CUT SLOPE (1.5:1) SHALL BE FIELD VERIFIED BY A CERTIFIED GEOTECHNICAL ENGINEER TO ENSURE THE PROPOSED SLOPES ARE ADEQUATE PRIOR TO CONSTRUCTION. ACCESS ROAD CONSTRUCTION SHALL BE MONITORED BY A GEOTECHNICAL ENGINEER DURING CONSTRUCTION.

**OFF SITE AREAS:** THERE ARE NO BORROW AREA(S) OR EXPORT STOCKPILE AREA(S) OUTSIDE OF THE PROPOSED LIMITS OF DISTURBANCE FOR THIS PROJECT.

**EROSION AND SEDIMENT CONTROL MEASURES:** UNLESS OTHERWISE INDICATED, ALL VEGETATIVE AND STRUCTURAL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE CONSTRUCTED AND MAINTAINED ACCORDING TO MINIMUM STANDARDS AND SPECIFICATIONS OF THE CURRENT WEST VIRGINIA EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICE MANUAL.

### STRUCTURAL PRACTICES:

- INSTALL ORANGE SAFETY FENCE TO ENSURE NO DISTURBANCE TO THE DELINEATED AREA(S).
- INSTALL TEMPORARY CONSTRUCTION ENTRANCE.
- INSTALL COMPOST FILTER SOCKS AS SHOWN ON THE PLANS TO REMOVE SEDIMENT FROM RUNOFF. SELECTIVELY REMOVE TREES REQUIRED TO INSTALL COMPOST FILTER SOCK IN WOODED AREAS. CLEARING AND GRUBBING SHALL BE KEPT AT A MINIMUM TO INSTALL E&S CONTROLS.
- EROSION CONTROL BLANKETS (JUTE MATTING) SHALL BE PLACED ON ALL CRITICAL SLOPES (3:1 OR GREATER) AND AS NEEDED TO STABILIZE DISTURBED AREAS.
- FILL SLOPE SURFACE SHALL BE LEFT IN A ROUGHENED CONDITION TO REDUCE EROSION. CONTRACTOR SHALL REDIRECT RUNOFF AWAY FROM THE FILL SLOPE BY INSTALLING EARTHEN DIVERSION BERMS, AND DIVERTING THE RUNOFF TO SEDIMENT TRAPPING DEVICES.
- INSTALL V-DITCHES, DITCH RELIEF CULVERTS, AND OUTLET PROTECTION (RIP-RAP APRONS) AS SHOWN ON THE PLANS.

DEVICES LISTED ABOVE ARE CONSIDERED MINIMUM EROSION AND SEDIMENT CONTROLS. ADDITIONAL CONTROL MEASURES MAY BE NECESSARY DUE TO CONTRACTOR PHASING OR OTHER UNFORESEEN CONDITIONS. IMMEDIATELY UPON DISCOVERING UNFORESEEN CIRCUMSTANCES POSING THE POTENTIAL FOR ACCELERATED EROSION AND/OR SEDIMENT POLLUTION, THE CONTRACTOR SHALL IMPLEMENT APPROPRIATE BMP'S TO MINIMIZE THE POTENTIAL FOR EROSION AND SEDIMENT POLLUTION. ALL MEASURES SHALL BE CONSTRUCTED AND MAINTAINED ACCORDING TO MINIMUM STANDARDS AND SPECIFICATIONS OF THE CURRENT WEST VIRGINIA EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICE MANUAL.

**PERMANENT STABILIZATION:** ALL AREAS LEFT UNCOVERED BY EITHER BUILDINGS OR PAVEMENT SHALL BE STABILIZED WITH PERMANENT SEEDING IMMEDIATELY FOLLOWING FINISH GRADING AND WITHIN SEVEN (7) DAYS. AT NO TIME SHALL LAND LAY DORMANT LONGER THAN TWENTY-ONE (21) DAYS.

**MAINTENANCE PROGRAM:** DURING CONSTRUCTION ACTIVITIES, ALL CONTROL MEASURES SHALL BE INSPECTED DAILY BY THE SITE SUPERINTENDENT OR HIS REPRESENTATIVE AND WITHIN TWENTY-FOUR (24) HOURS AFTER ANY SIGNIFICANT RAIN EVENT, WHICH SHALL BE DEFINED AS RAINFALL OF TWO (2) INCHES OR MORE IN A SIX (6) HOUR PERIOD. ONCE CONSTRUCTION ACTIVITIES HAVE CONCLUDED, THE SITE SHALL BE INSPECTED EVERY TWO (2) WEEKS FOR THE LIFE OF THE FACILITY AND WITHIN TWENTY-FOUR (24) HOURS OF A SIGNIFICANT RAIN EVENT AS DEFINED ABOVE. ANY DAMAGED STRUCTURAL MEASURES ARE TO BE REPAIRED, BY THE END OF THE DAY, OR AT THE EARLIEST TIME IN WHICH IT IS SAFE TO DO SO. SEEDED AREAS SHALL BE CHECKED REGULARLY TO ENSURE THAT A GOOD STAND OF GRASS IS MAINTAINED. ALL AREAS SHALL BE FERTILIZED AND RESEDED AS NEEDED UNTIL GRASS IS ESTABLISHED.

TRAPPED SEDIMENT IS TO BE REMOVED AS REQUIRED TO MAINTAIN 50% TRAP AND/OR SOCK EFFICIENCY AND DISPOSED OF BY SPREADING ON THE STOCKPILE.

INLET OF DITCH RELIEF CULVERTS SHALL BE CHECKED REGULARLY FOR SEDIMENT BUILD-UP. IF THE GRAVEL OUTLET IS CLOGGED BY SEDIMENT, IT SHALL BE REMOVED AND CLEANED OR REPLACED IMMEDIATELY.

SEDIMENT TRACKED ONTO ANY PUBLIC ROADWAY OR SIDEWALK SHALL BE RETURNED TO THE CONSTRUCTION SITE BY THE END OF EACH WORK DAY AND DISPOSED IN THE MANNER DESCRIBED IN THIS PLAN. IN NO CASE SHALL THE SEDIMENT BE WASHED, SHOVELED OR SWEEP INTO ANY ROADSIDE DITCH, CULVERT OR SURFACE WATER.

ANY DISTURBED AREAS ALONG THE ACCESS ROAD SHALL BE STABILIZED PRIOR TO THE END OF EACH DAY WITH EITHER ROCK STABILIZATION OR SEEDING AND MULCHING METHODS.

NOTE: THE WV DEP RETAINS THE RIGHT TO ADD AND/OR MODIFY THESE EROSION AND SEDIMENT CONTROL MEASURES DURING THE CONSTRUCTION PROCESS, WITHIN REASON, TO ENSURE ADEQUATE PROTECTION TO THE PUBLIC AND THE ENVIRONMENT.

### SEEDING (SOIL STABILIZATION):

- CONTRACTOR SHALL APPLY SEED AND STABILIZATION IN ACCORDANCE WITH THE WV DEP EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICE (BMP) MANUAL, BASED UPON SITE SPECIFIC SOIL CHARACTERISTICS.
- WHEREVER SEEDING IS TO BE APPLIED TO STEEP SLOPES (> 3H:1V), SEED MIXTURES SHOULD BE SELECTED THAT ARE APPROPRIATE FOR STEEP SLOPES.

### DUST CONTROL:

- TEMPORARY SEEDING SHALL BE APPLIED TO ALL DISTURBED AREAS SUBJECT TO LITTLE OR NO CONSTRUCTION TRAFFIC.
- ALL HAUL ROADS AND OTHER HEAVY TRAFFIC ROUTES SHALL BE SPRINKLED WITH WATER UNTIL THE SURFACE IS WET AND REPEATED AS NEEDED TO CONTROL DUST.

## CONSTRUCTION SEQUENCE

THE DEVELOPMENT OF THIS SITE SHALL BE CONSISTENT WITH THE FOLLOWING GENERAL SEQUENCE OF CONSTRUCTION. THE CONTRACTOR SHALL IMPLEMENT, MAINTAIN AND OPERATE ALL PROPOSED EROSION AND SEDIMENT CONTROL MEASURES TO EFFECTIVELY MITIGATE THE HAZARD OF ACCELERATED EROSION AND SEDIMENTATION TO ACCEPTABLE LEVELS. MINOR DEVIATIONS FROM THIS SEQUENCE SHALL BE EXECUTED BY THE PROJECT'S SUPERINTENDENT AS NEEDED TO ELIMINATE ANY POTENTIAL EROSION CONDITION THAT MAY ARISE FOR THE DURATION OF THE PROJECT. THE WV DEP OFFICE OF OIL AND GAS SHALL BE NOTIFIED OF ANY AND ALL SUCH DEVIATIONS FROM THE APPROVED PLANS.

- A PRE-CONSTRUCTION CONFERENCE WITH THE CONTRACTOR AND THE APPROPRIATE EROSION AND SEDIMENT CONTROL INSPECTOR 48 HOURS PRIOR TO BEGINNING WORK TO REVIEW THE CONSTRUCTION DRAWINGS AND PROVIDE ANY REQUESTED GUIDANCE.
- STAKE THE LIMITS OF CONSTRUCTION AND MARK ALL IDENTIFIED WETLANDS, STREAMS, AND OTHER AREAS OF CONCERN FOR CONSTRUCTION ACTIVITIES. INSTALL SIGNS TO DESIGNATE THE AREAS AND ORANGE SAFETY FENCE TO IDENTIFY IMPORTANT PROJECT ATTRIBUTES SUCH AS APPROVED ACCESS ROADS, NO REFUELING ZONES, WETLANDS/STREAM BOUNDS, ETC.
- CONSTRUCT THE ROCK CONSTRUCTION ENTRANCE. ALL VEHICLES ENTERING AND EXITING THE SITE SHALL DO SO VIA THE ROCK CONSTRUCTION ENTRANCE.
- CONSTRUCT ALL BMP'S AS SOON AS CLEARING AND GRUBBING OPERATIONS ALLOW. DIVERSIONS AND SEDIMENT TRAP(S)/BASIN(S) SHALL BE SEEDED AND MULCHED IMMEDIATELY.
- IF APPLICABLE, CONVEY UPSLOPE DRAINAGE AROUND THE ACCESS ROAD, WELL PAD, AND WATER CONTAINMENT PAD AREAS BY CONSTRUCTING ALL DIVERSION BERM(S) AND/OR COMPOST FILTER SOCK DIVERSION(S) AS SHOWN ON THE PLANS.
- CLEAR AND GRUB THE SITE. 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, AND STUMPS SHALL BE CUT AND/OR GRUBBED AND WINDROWED IN APPROPRIATE AREAS FOR USE AS SEDIMENT BARRIERS AT WATER DRAINAGE OUTLETS (AS SHOWN ON THE PLANS). 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 WV DEP.
- IF APPLICABLE, INSTALL ALL WETLAND OR STREAM CROSSINGS AS SHOWN ON THE PLANS.
- STRIP THE TOPSOIL FROM THE ACCESS ROAD. PRIOR TO PLACING ANY FILL, THE EXPOSED SUBGRADE SHALL BE COMPACTED AND PROOF ROLLED TO PRODUCE A STABLE AND UNYIELDING SITE. ALL STRIPPED TOPSOIL SHALL BE STOCKPILED IN AREAS SHOWN IN THE PLANS AND IMMEDIATELY STABILIZED. ADDITIONAL BMP MEASURES SHALL BE CONSTRUCTED AROUND TOPSOIL STOCKPILES, IF NECESSARY.
- CONSTRUCT THE ACCESS ROAD. ALL FILL AREAS, INCLUDING EXCESS MATERIAL STOCKPILES, SHALL BE "KEYED IN" AND COMPACTED IN HORIZONTAL LIFTS WITH A MAXIMUM LOOSE LIFT THICKNESS OF 12" AND MAXIMUM PARTICLE SIZE OF LESS THAN 8". ALL FILL SHALL BE COMPACTED BY A VIBRATING SHEEPSFOOT ROLLER TO 95% PER THE STANDARD PROCTOR TEST (ASTM-D698). MOISTURE CONTENT WILL BE CONTROLLED IN ACCORDANCE WITH THE STANDARD PROCTOR TEST (ASTM-D698) RESULTS. IT IS ALSO RECOMMENDED THAT EACH LIFT BE PROOF ROLLED WITH A LOADED HAUL TRUCK WHERE APPLICABLE. DITCH RELIEF CULVERTS SHALL BE INSTALLED AT A GRADE OF 1-8% TO MINIMIZE OUTLET VELOCITIES TO THE EXTENT POSSIBLE. INSTALL OUTLET PROTECTION ONCE DITCH RELIEF CULVERTS ARE INSTALLED, AS SHOWN ON PLANS. STABILIZE THE ROAD WITH GEOTEXTILE FABRIC & STONE AND SIDE SLOPES AS SPECIFIED WITH PERMANENT SEEDING. EXCESS MATERIAL SHALL BE STOCKPILED (IF NECESSARY) IN AREAS SHOWN IN THE PLANS AND IMMEDIATELY STABILIZED. TOPSOIL SHALL BE STRIPPED FROM ALL STOCKPILE AREAS PRIOR TO CONSTRUCTION STOCKPILES. AFTER STOCKPILES ARE CONSTRUCTED, TOPSOIL IS TO BE REAPPLIED AT A DEPTH OF 6". SLOPES SHALL BE TRACKED BY RUNNING TRACKED MACHINERY UP AND DOWN THE SLOPE, LEAVING TREAD MARKS PARALLEL TO THE CONTOUR. ALL DITCH LINES SHALL BE CLEANED PRIOR TO INSTALLATION OF LINED PROTECTION.
- STRIP THE TOPSOIL FROM THE WELL PAD AND WATER CONTAINMENT PAD. PRIOR TO PLACING ANY FILL, THE EXPOSED SUBGRADE SHALL BE COMPACTED AND PROOF ROLLED TO PRODUCE A STABLE AND UNYIELDING SITE. ALL STRIPPED TOPSOIL SHALL BE STOCKPILED IN AREAS SHOWN IN THE PLANS AND IMMEDIATELY STABILIZED. ADDITIONAL BMP MEASURES SHALL BE CONSTRUCTED AROUND TOPSOIL STOCKPILES, IF NECESSARY.
- GRADE THE WELL PAD AND WATER CONTAINMENT PAD AREAS AS SHOWN ON THE PLANS. INSTALL PAD SUMPS (WITH 4" PVC DRAIN PIPE AND OUTLET PROTECTION) AND CONTAINMENT BERM LINER SYSTEM. IMMEDIATELY STABILIZE THE OUTER AREAS OF THE WELL PAD AND WATER CONTAINMENT PAD. THE WELL PAD AND WATER CONTAINMENT PAD AREAS SHALL BE STABILIZED WITH GEOTEXTILE FABRIC & STONE AND THE SIDE SLOPES WITH EROSION CONTROL BLANKETING WHEN SLOPES ARE 3:1 OR GREATER. APPLY SEED AND MULCH TO 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.
- COMMENCE WELL DRILLING ACTIVITY.
- ALL BMP'S MUST REMAIN IN PLACE AND FUNCTIONAL UNTIL ALL AREAS WITHIN THE LIMIT OF DISTURBANCE ARE COMPLETE AND PERMANENTLY STABILIZED. MAINTENANCE MUST INCLUDE INSPECTION OF ALL EROSION AND SEDIMENT CONTROLS AFTER EACH RUNOFF EVENT IN EXCESS OF 0.5" AND ON A BIWEEKLY BASIS.
- THE CONSTRUCTION SITE SHOULD BE STABILIZED AS SOON AS POSSIBLE AFTER COMPLETION. ESTABLISHMENT OF FINAL STABILIZATION MUST BE INITIATED NO LATER THAN 7 DAYS AFTER REACHING FINAL GRADE. FINAL STABILIZATION MEANS THAT ALL SOIL-DISTURBING ACTIVITIES ARE COMPLETED, AND THAT EITHER A PERMANENT VEGETATIVE COVER WITH A DENSITY OF 70% OR GREATER HAS BEEN ESTABLISHED OR THAT THE SURFACE HAS BEEN STABILIZED BY HARD COVER SUCH AS PAVEMENT OR BUILDINGS. IT SHOULD BE NOTED THAT THE 70% REQUIREMENT REFERS TO THE TOTAL AREA VEGETATED AND NOT JUST A PERCENT OF THE SITE.
- ALL PERMANENT SEDIMENT CONTROL MEASURES CAN BE REMOVED AFTER THE SITE IS PERMANENTLY STABILIZED AND APPROVAL IS RECEIVED FROM THE WVDEP.
- ANY AREAS DISTURBED BY REMOVAL OF CONTROLS SHALL BE REPAIRED, STABILIZED, AND PERMANENTLY SEEDED.

Engineering  
Survey  
Environmental  
GIS

**NAVITUS ENGINEERING INC.**  
151 Windy Hill Lane  
Wehaver, VA 24280  
Telephone: (888) 682-4185  
www.navituseng.com



REVISION	DATE

**ANTERO RESOURCES**  
THIS DOCUMENT WAS PREPARED FOR ANTERO RESOURCES CORPORATION

CONSTRUCTION AND E&S CONTROL NOTES

**WILLARD**  
WELL PAD & WATER CONTAINMENT PAD  
NEW MILTON DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA

DATE: 09/16/2013

SCALE: N/A

SHEET 2 OF 26



# MATERIAL QUANTITIES

MATERIAL QUANTITIES				
WELL PAD & WATER CONTAINMENT-PAD SITE: WILLARD				
Item Description	Quantity	Unit	Unit Cost	Item Total
1.0 Mobilization				
(Limited to 10% of Total Base Bid)	1.0	LS	\$	\$
2.0 Erosion & Sediment Control				
2.1 Clearing and Grubbing				
2.1.1 Wooded	22.43	AC	\$	\$
2.1.2 Open Field	5.22	AC	\$	\$
2.2 Super Sill Fence	1,381.3	LF	\$	\$
2.3 12" Compost Filter Sock	5,453.0	LF	\$	\$
2.4 18" Compost Filter Sock	1,105.7	LF	\$	\$
2.5 24" Compost Filter Sock	347.0	LF	\$	\$
2.6 12" Compost Sock Diversion	233.8	LF	\$	\$
2.7 Jute Matting - Slope Matting	507,782.6	SF	\$	\$
2.8 Ditch Lining - Synthetic Matting (TRM)	2,033.9	SF	\$	\$
3.0 Unclassified Earthwork				
3.1 Access Road "A"				
3.1.1 Topsoil Removal to Stockpile (Assume 6" Depth)	5,212.4	CY	\$	\$
3.1.2 Excavation (Cut to Compact Fill)	25,471.6	CY	\$	\$
3.1.3 Excavation (Export to Stockpile)	5,592.2	CY	\$	\$
3.2 Access Road "B"				
3.2.1 Topsoil Removal to Stockpile (Assume 6" Depth)	284.3	CY	\$	\$
3.2.2 Excavation (Cut to Compact Fill)	425.3	CY	\$	\$
3.2.3 Excavation (Import from Stockpile)	482.4	CY	\$	\$
3.3 Staging Area				
3.3.1 Topsoil Removal to Stockpile (Assume 6" Depth)	319.0	CY	\$	\$
3.3.2 Excavation (Cut to Compact Fill)	3.1	CY	\$	\$
3.3.3 Excavation (Import from Stockpile)	836.1	CY	\$	\$
3.4 Well Pad				
3.4.1 Topsoil Removal to Stockpile (Assume 6" Depth)	3,944.9	CY	\$	\$
3.4.2 Excavation (Cut to Compact Fill)	21,915.6	CY	\$	\$
3.4.3 Excavation (Export to Stockpile)	9,737.3	CY	\$	\$
3.5 Water Containment Pad				
3.5.1 Topsoil Removal to Stockpile (Assume 6" Depth)	970.7	CY	\$	\$
3.5.2 Excavation (Cut to Compact Fill)	6,664.7	CY	\$	\$
3.5.3 Excavation (Export to Stockpile)	1,766.3	CY	\$	\$
3.6 Excavation/Undiggable Material (Hammering)				
3.7 Excavation/Undiggable Material (Blasting)				

4.0 Stone and Aggregate Surfacing				
4.1 Construction Entrance				
4.1.1 6"-4" Crusher Run (10" Depth)	153.3	TONS	\$	\$
4.1.2 Geotextile Fabric (US 200 or Equal)	3,324.4	SF	\$	\$
4.2 Access Road "A"				
4.2.1 6"-4" Crusher Run (8" Depth)	3,344.6	TONS	\$	\$
4.2.2 3/4"-1 1/2" Crusher Run (2" Depth)	837.5	TONS	\$	\$
4.2.3 Geotextile Fabric (US 200 or Equal)	89,853.8	SF	\$	\$
4.3 Access Road "B"				
4.3.1 6"-4" Crusher Run (8" Depth)	325.8	TONS	\$	\$
4.3.2 3/4"-1 1/2" Crusher Run (2" Depth)	81.6	TONS	\$	\$
4.3.3 Geotextile Fabric (US 200 or Equal)	8,752.8	SF	\$	\$
4.4 Staging Area				
4.4.1 6"-4" Crusher Run (8" Depth)	587.0	TONS	\$	\$
4.4.2 3/4"-1 1/2" Crusher Run (2" Depth)	147.0	TONS	\$	\$
4.4.3 Geotextile Fabric (US 200 or Equal)	15,768.8	SF	\$	\$
4.5 Well Pad				
4.5.1 6"-4" Crusher Run (8" Depth)	3,498.0	TONS	\$	\$
4.5.2 3/4"-1 1/2" Crusher Run (2" Depth)	1,168.4	TONS	\$	\$
4.5.3 Geotextile Fabric (US 200 or Equal)	125,928.0	SF	\$	\$
4.6 Water Containment Pad				
4.6.1 6"-4" Crusher Run (8" Depth)	1,001.6	TONS	\$	\$
4.6.2 3/4"-1 1/2" Crusher Run (2" Depth)	250.8	TONS	\$	\$
4.6.3 Geotextile Fabric (US 200 or Equal)	26,907.3	SF	\$	\$
4.7 4" Rip Rap (Outlets/Level Spreaders) 18" Depth	811.5	TONS	\$	\$
4.8 4" Rip Rap (Rock-Lined Ditches) 6" Depth	406.8	TONS	\$	\$
4.9 Rock Fill Check Dams (#1 Stone)	10.7	TONS	\$	\$
5.0 Ditch Relief and Drainage Culverts				
5.1 15" HDPE (total)	755.5	LF	\$	\$
6.0 Well Pad Dewatering System				
6.1 102"x78"x54" Pre-Cast Low Profile Tank Catch Basins	5.0	EA	\$	\$
6.2 HDPE Pipe Riser (8" Minimum Dia., 60" Length) and 4" PVC Valve	5.0	EA	\$	\$
6.3 4" PVC Discharge Pipe	178.8	LF	\$	\$
6.4 Catch Basin Base (1-1/2" or 3/4" Crusher Run Stone) 12" Depth	33.1	TONS	\$	\$
6.5 4" Rip Rap (Discharge Pipe Outlets) 18" Depth	55.5	TONS	\$	\$
7.0 Liner System				
7.1 Well Pad Containment Berm				
7.1.1 Primary Liner (60 Mil Textured)	12,892.6	SF	\$	\$
7.1.2 Non-woven Geotextile Fabric Cushion (16 oz.)	12,892.6	SF	\$	\$
8.0 Miscellaneous				
8.1 Seeding and Mulching				
8.1.1 Temporary Seeding (Vegetation & Mulch)	0.0	AC	\$	\$
8.1.2 Permanent Seeding (Vegetation & Mulch / Fertilizer/ Lime)	21.5	AC	\$	\$
8.1.3 Lime, Fertilizer, Seeding, and Hydro-Mulch w/tack (HYC2 or Equal)		AC	\$	\$

**NOTE:**

1. THE SQUARE FOOTAGE FOR THE GEOTEXTILE FABRIC AND THE LINER SYSTEM DOES NOT ACCOUNT FOR MATERIAL OVERLAP AND WASTE.

Engineering  
Survey  
Environmental  
GIS

**NAVITUS ENGINEERING INC.**

151 Windy Hill Lane  
Winchester, Virginia 22602  
Phone: 540-361-1188  
www.navituseng.com

REVISION	DATE

**ANTERO RESOURCES**  
THIS DOCUMENT  
WAS PREPARED  
BY ANTERO RESOURCES  
CORPORATION

MATERIAL QUANTITIES

**WILLARD**

**WELL PAD & WATER CONTAINMENT PAD**

NEW MILTON DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA

DATE: 09/16/2013  
SCALE: N/A  
SHEET 3 OF 26



# EXISTING CONDITIONS

## GENERAL NOTES:

1. THE TOPOGRAPHIC INFORMATION SHOWN HEREON IS BASED ON MARCH 30, 2013 AERIAL PHOTOGRAPHY COMPILED MAY, 2013 BY BLUE MOUNTAIN AERIAL MAPPING, BURTON, WEST VIRGINIA.
2. THE PROPERTY LINES SHOWN HEREON DO NOT REPRESENT A BOUNDARY SURVEY ON ANY OF THE PARCELS SHOWN. PROPERTY CORNERS AND LINES PERTINENT TO WELL LOCATION ARE BASED ON A FIELD SURVEY. THE REMAINDER OF THE PROPERTY LINES ARE BASED ON COUNTY REAL ESTATE TAX MAPS, GIS INFORMATION AND DEEDS OF RECORD.
3. UTILITIES AND THEIR LOCATIONS AS SHOWN HEREON ARE BASED ON: A) OBSERVABLE EVIDENCE OF THOSE VISIBLE, ABOVE-GROUND FACILITIES, FEATURES, AND MARKERS WHICH WERE FOUND ON THE SUBJECT PROPERTY AT THE TIME OF SURVEY PERFORMED BY NAVITUS ENGINEERING AND B) FIELD MARKINGS PLACED BY UTILITY COMPANIES IN RESPONSE TO THE WV 811 TICKET SUBMITTED BY NAVITUS ENGINEERING. NAVITUS ENGINEERING CANNOT GUARANTEE THE ACCURACY OF THE UTILITY MARKINGS PERFORMED BY OTHERS OR THAT ALL UTILITIES EXISTING WITHIN THE LIMITS OF THIS PLAN ARE SHOWN. ANY UTILITIES ENCOUNTERED SUBSEQUENT TO PLAN APPROVAL OR DURING CONSTRUCTION THAT ARE NOT SHOWN ON THE PLAN SHOULD BE REPORTED TO NAVITUS ENGINEERING AND ANTERO RESOURCES CORPORATION.

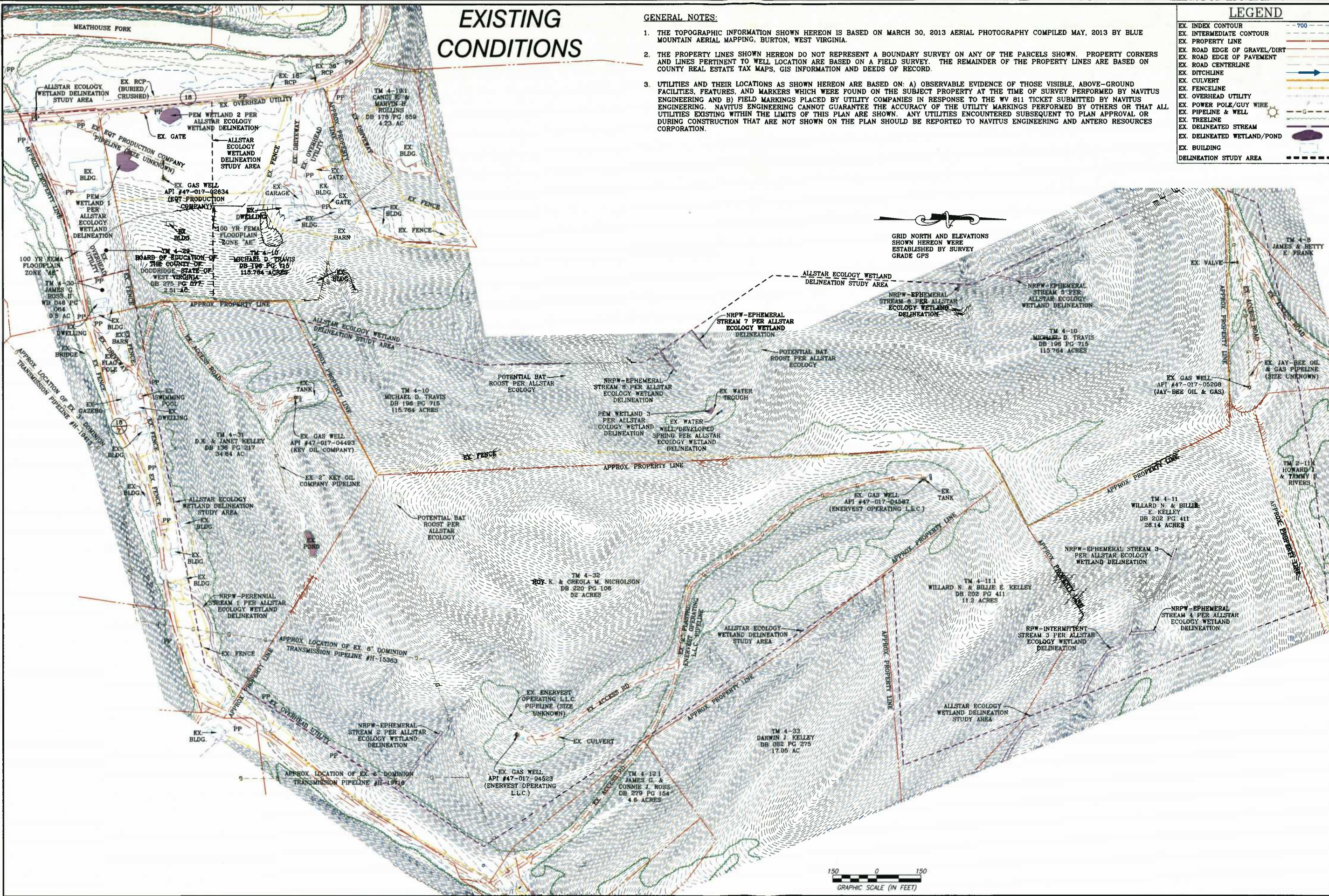
## LEGEND

EX INDEX CONTOUR	- 700 -
EX INTERMEDIATE CONTOUR	- - - - -
EX PROPERTY LINE	- - - - -
EX ROAD EDGE OF GRAVEL/DIRT	- - - - -
EX ROAD EDGE OF PAVEMENT	- - - - -
EX ROAD CENTERLINE	- - - - -
EX DITCHLINE	- - - - -
EX CULVERT	- - - - -
EX FENCELINE	- - - - -
EX OVERHEAD UTILITY	- - - - -
EX POWER POLE/GUY WIRE	- - - - -
EX PIPELINE & WELL	- - - - -
EX TRELLINE	- - - - -
EX DELINEATED STREAM	- - - - -
EX DELINEATED WETLAND/POND	- - - - -
EX BUILDING	- - - - -
DELINEATION STUDY AREA	- - - - -

Engineering  
Survey  
Environmental  
GIS

**NAVITUS ENGINEERING INC.**

151 Windy Hill Lane  
Winchester, Virginia 22602  
Telephone: (888) 662-4185  
www.navituseng.com



GRID NORTH AND ELEVATIONS SHOWN HEREON WERE ESTABLISHED BY SURVEY GRADE GPS

REVISION	DATE

**ANTERO RESOURCES**

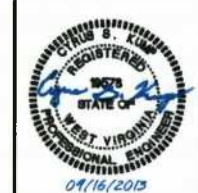
THIS DOCUMENT WAS PREPARED FOR ANTERO RESOURCES CORPORATION

EXISTING CONDITIONS

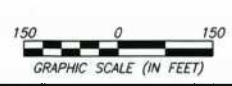
**WILLARD**

**WELL PAD & WATER CONTAINMENT PAD**

NEW MILTON DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 09/16/2013  
SCALE: 1" = 150'  
SHEET 4 OF 26





# OVERALL PLAN SHEET INDEX & VOLUMES

Name	Excess	Topsoil
A	0.0	2,100.0
B	21,500.0	0.0
C	0.0	9,240.0
<b>TOTAL</b>	<b>21,500.0</b>	<b>11,340.0</b>

Description	Cut (CY)	Fill (CY)	Spill (CY)	Borrow (CY)	Max. Slope (%)	Length of Slope (FT)
Access Road "A"	31,063.8	25,471.6	5,592.2	0.0	20.0	596.6
Access Road "B"	425.3	907.7	0.0	482.4	20.0	143.8
Staging Area	3.1	839.2	0.0	836.1	n/a	n/a
Well Pad	31,852.9	21,915.6	9,737.3	0.0	n/a	n/a
Water Containment Pad	8,431.0	6,664.7	1,766.3	0.0	n/a	n/a
Stripped Topsoil (6")	10,711.3	0.0	10,711.3	0.0	n/a	n/a
Material Stockpiles	0.0	32,840.0	0.0	32,840.0	n/a	n/a
<b>Totals</b>	<b>82,287.4</b>	<b>88,638.8</b>	<b>27,807.1</b>	<b>34,158.5</b>	<b>n/a</b>	<b>n/a</b>
<b>Total Spill (CY) =</b>			<b>-6,351.4</b>			

THE EARTHWORK QUANTITIES PROVIDED ARE AN ESTIMATE FOR CONSIDERATION. THE QUANTITIES SHOWN ARE CALCULATED USING A 1:1 CUT/SWELL & FILL SHRINK FACTOR. THE QUANTITIES SHOWN MAY BE GREATER OR LESSER THAN ACTUALLY EXCAVATED. THE ENGINEER IS NOT RESPONSIBLE FOR VARIANCES FROM THE ESTIMATED QUANTITIES AND DOES NOT CERTIFY TO THEIR ACCURACY.

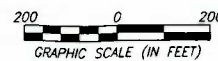
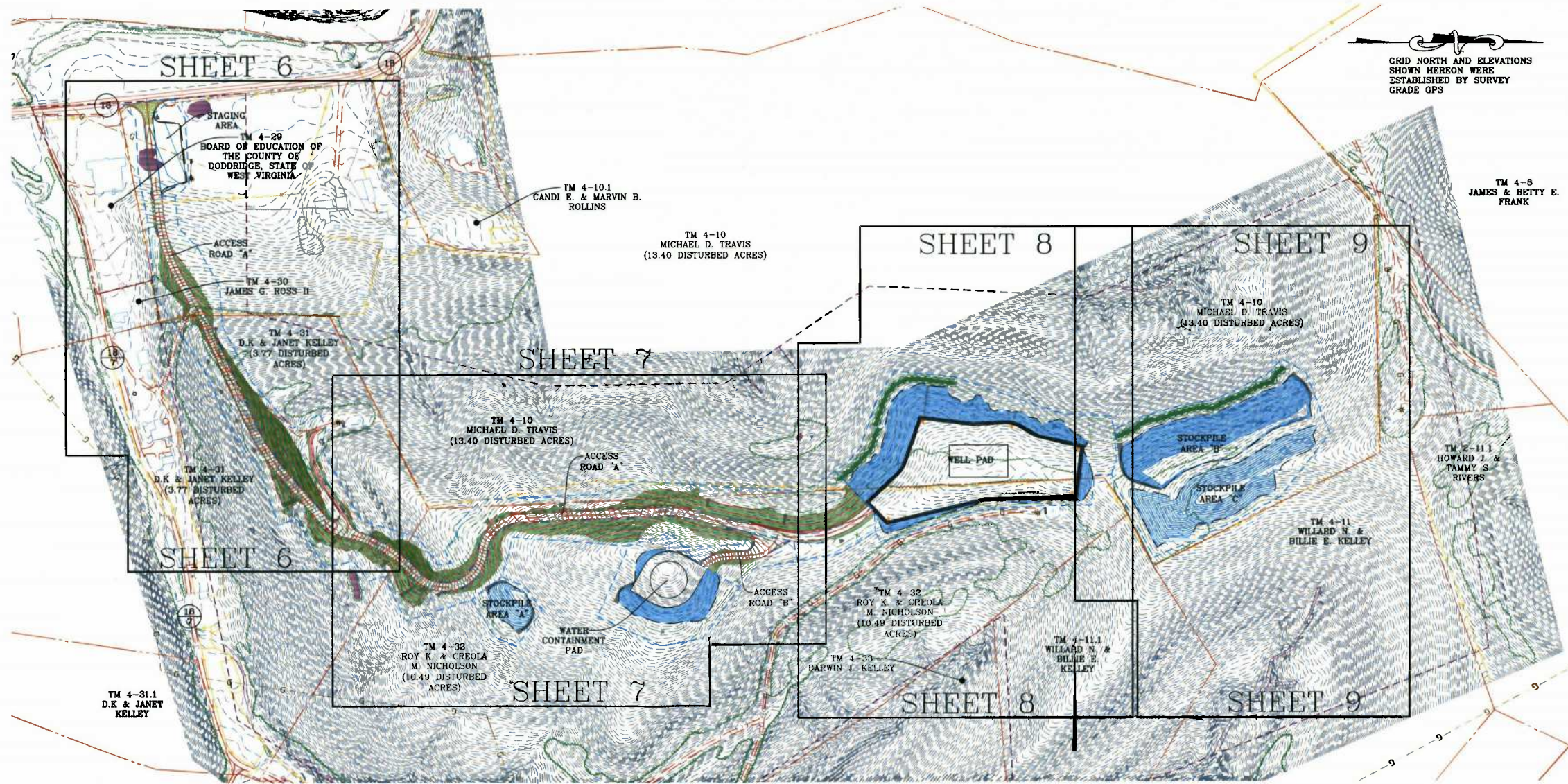
Access Road "A"	
Topsail Removal:	5,212.4 C.Y.
Total Cut:	31,063.8 C.Y. (Cut/Swell=1)
Total Fill:	25,471.6 C.Y. (Fill Shrink=1)
Cut slope percent grade:	66.67/50.00 %, slope ratio: 1.5:1, 2:1
Fill slope percent grade:	50.00 %, slope ratio: 2:1
Gravel (10" Depth):	2,788.0 C.Y.

Access Road "B"	
Topsail Removal:	264.3 C.Y.
Total Cut:	425.3 C.Y. (Cut/Swell=1)
Total Fill:	907.7 C.Y. (Fill Shrink=1)
Cut slope percent grade:	50.00 %, slope ratio: 2:1
Fill slope percent grade:	50.00 %, slope ratio: 2:1
Gravel (10" Depth):	271.6 C.Y.

Staging Area	
Topsail Removal:	319.0 C.Y.
Total Cut:	3.1 C.Y. (Cut/Swell=1)
Total Fill:	839.2 C.Y. (Fill Shrink=1)
Cut slope percent grade:	50.00 %, slope ratio: 2:1
Fill slope percent grade:	50.00 %, slope ratio: 2:1
Top of Pad Elevation:	822.0'
Gravel (10" Depth):	489.3 C.Y.

Well Pad	
Topsail Removal:	3,944.9 C.Y.
Total Cut:	31,852.9 C.Y. (Cut/Swell=1)
Total Fill:	21,915.6 C.Y. (Fill Shrink=1)
Cut slope percent grade:	50.00 %, slope ratio: 2:1
Fill slope percent grade:	50.00 %, slope ratio: 2:1
Top of Pad Elevation:	1,189.0'
Gravel (8" Depth):	3,110.9 C.Y.

Water Containment Pad	
Topsail Removal:	970.7 C.Y.
Total Cut:	8,431.0 C.Y. (Cut/Swell=1)
Total Fill:	6,664.7 C.Y. (Fill Shrink=1)
Cut slope percent grade:	50.00 %, slope ratio: 2:1
Fill slope percent grade:	50.00 %, slope ratio: 2:1
Top of Pad Elevation:	1,230.0'
Gravel (10" Depth):	834.9 C.Y.



Engineering  
Survey  
Environmental  
GIS

**NAVITUS ENGINEERING INC.**

151 Woody Hill Lane  
Fayetteville, AR 72703  
Phone: (479) 482-4185  
www.navituseng.com

REVISION	DATE

**ANTERO RESOURCES**

THIS DOCUMENT WAS PREPARED BY ANTERO RESOURCES CORPORATION

OVERALL PLAN SHEET INDEX & VOLUMES

**WILLARD**

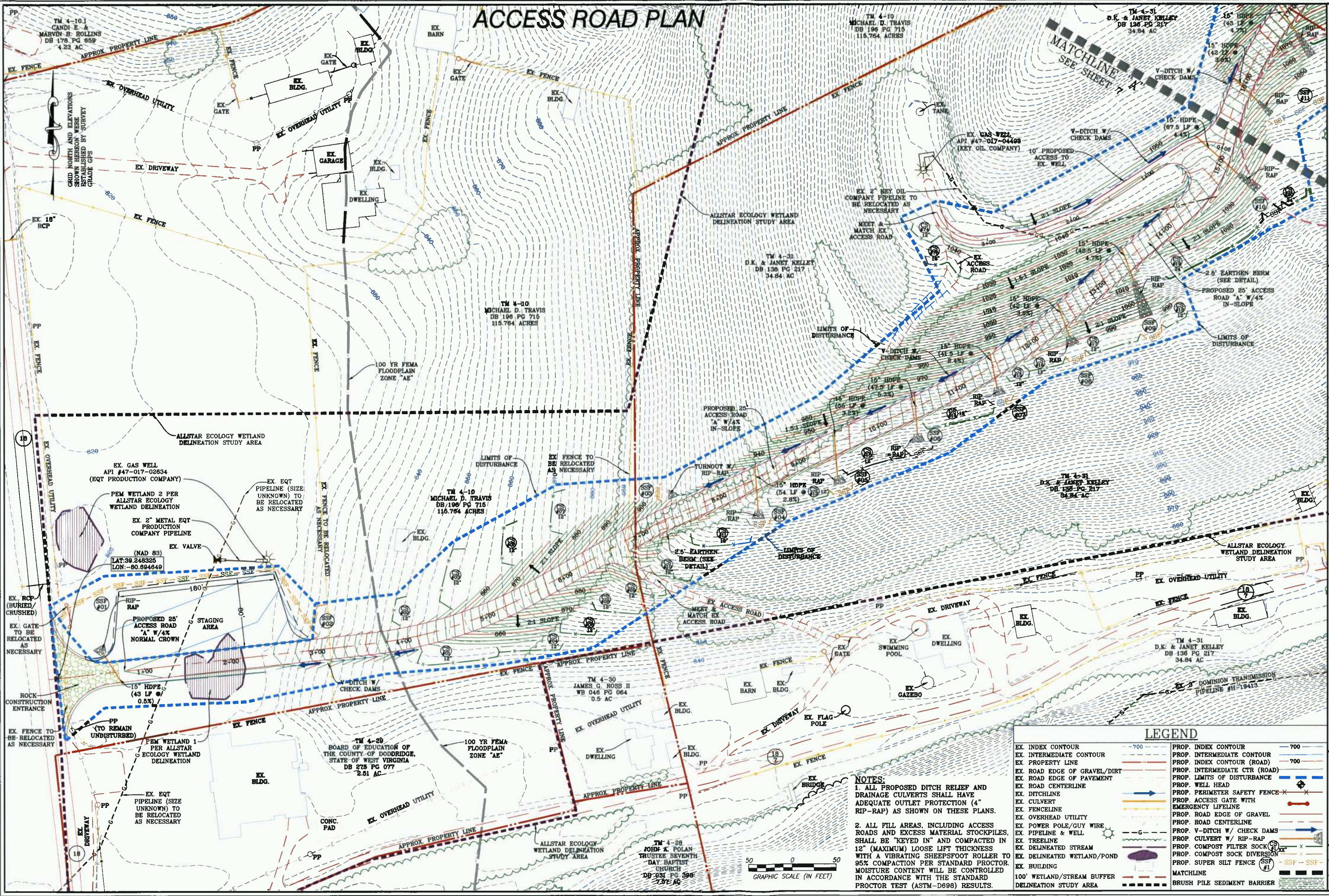
**WELL PAD & WATER CONTAINMENT PAD**

NEW MILTON DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA

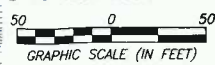
DATE: 09/16/2013  
SCALE: 1" = 200'  
SHEET 5 OF 26



# ACCESS ROAD PLAN



**NOTES:**  
 1. ALL PROPOSED DITCH RELIEF AND DRAINAGE CULVERTS SHALL HAVE ADEQUATE OUTLET PROTECTION (4" RIP-RAP) AS SHOWN ON THESE PLANS.  
 2. ALL FILL AREAS, INCLUDING ACCESS ROADS AND EXCESS MATERIAL STOCKPILES, SHALL BE "KEYED IN" AND COMPACTED IN 12" (MAXIMUM) LOOSE LIFT THICKNESS WITH A VIBRATING SHEEPSFOOT ROLLER TO 95% COMPACTION PER STANDARD PROCTOR. MOISTURE CONTENT WILL BE CONTROLLED IN ACCORDANCE WITH THE STANDARD PROCTOR TEST (ASTM-D696) RESULTS.



LEGEND	
EX. INDEX CONTOUR	700
EX. INTERMEDIATE CONTOUR	700
EX. PROPERTY LINE	700
EX. ROAD EDGE OF GRAVEL/DIRT	
EX. ROAD EDGE OF PAVEMENT	
EX. ROAD CENTERLINE	
EX. DITCHLINE	
EX. CULVERT	
EX. FENCELINE	
EX. OVERHEAD UTILITY	
EX. POWER POLE/GUY WIRE	
EX. PIPELINE & WELL	
EX. TRENCH	
EX. DELINEATED STREAM	
EX. DELINEATED WETLAND/POND	
EX. BUILDING	
100' WETLAND/STREAM BUFFER DELINEATION STUDY AREA	
PROP. INDEX CONTOUR	700
PROP. INTERMEDIATE CONTOUR	700
PROP. INDEX CONTOUR (ROAD)	
PROP. INTERMEDIATE CTR (ROAD)	
PROP. LIMITS OF DISTURBANCE	
PROP. WELL HEAD	
PROP. PERMETER SAFETY FENCE	
PROP. ACCESS GATE WITH EMERGENCY LIFELINE	
PROP. ROAD EDGE OF GRAVEL	
PROP. ROAD CENTERLINE	
PROP. V-DITCH W/ CHECK DAMS	
PROP. CULVERT W/ RIP-RAP	
PROP. COMPOST FILTER SOCK	
PROP. COMPOST SOCK DIVERSION	
PROP. SUPER SILT FENCE	
MATCHLINE	
BRUSH PILE SEDIMENT BARRIER	

Engineering  
Survey  
Environmental  
GIS

151 Windy Hill Lane  
Winchester, Virginia 22602  
Telephone: (888) 662-4185  
www.navituseng.com

DATE	REVISION

ANTERO RESOURCES CORPORATION  
 THIS DOCUMENT WAS PREPARED BY ANTERO RESOURCES CORPORATION

ACCESS ROAD PLAN

WILLARD

WELL PAD & WATER CONTAINMENT PAD

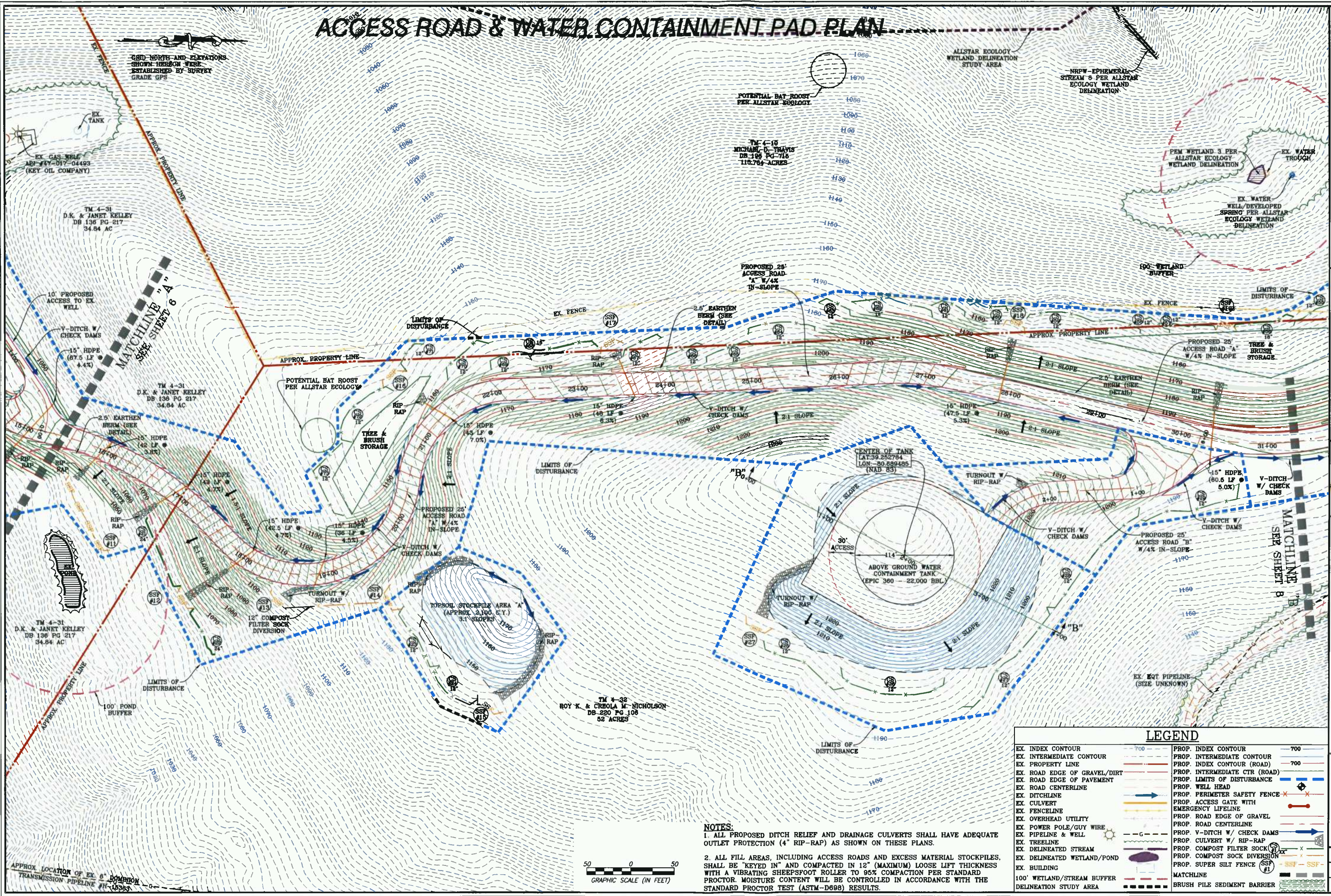
NEW MILTON DISTRICT

DODDRIDGE COUNTY, WEST VIRGINIA

DATE: 09/16/2013  
 SCALE: 1" = 50'  
 SHEET 6 OF 26



# ACCESS ROAD & WATER CONTAINMENT PAD PLAN



GRID NORTH AND ELEVATIONS SHOWN HEREON WERE ESTABLISHED BY SURVEY GRADE GPS

POTENTIAL BAT ROOST PER ALLSTAR ECOLOGY

TM 4-10 MICHAEL D. TRAVIS DB 108 PG 716 116.724 ACRES

TM 4-31 D.K. & JANET KELLEY DB 136 PG 217 34.84 AC

MATCHLINE "A" SEE SHEET 6

TM 4-31 D.K. & JANET KELLEY DB 136 PG 217 34.84 AC

TM 4-31 D.K. & JANET KELLEY DB 136 PG 217 34.84 AC

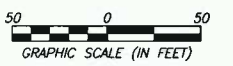
TM 4-32 ROY K. & CREOLA M. NICHOLSON DB 220 PG 108 52 ACRES

CENTER OF TANK  
LAT: 39.252784  
LON: -80.598495  
(NAD 83)

ABOVE GROUND WATER CONTAINMENT TANK  
EPIC 300 - 22,000 BBL

**NOTES:**

- ALL PROPOSED DITCH RELIEF AND DRAINAGE CULVERTS SHALL HAVE ADEQUATE OUTLET PROTECTION (4" RIP-RAP) AS SHOWN ON THESE PLANS.
- ALL FILL AREAS, INCLUDING ACCESS ROADS AND EXCESS MATERIAL STOCKPILES, SHALL BE "KEYED IN" AND COMPACTED IN 12" (MAXIMUM) LOOSE LIFT THICKNESS WITH A VIBRATING SHEEPSFOOT ROLLER TO 95% COMPACTION PER STANDARD PROCTOR MOISTURE CONTENT WILL BE CONTROLLED IN ACCORDANCE WITH THE STANDARD PROCTOR TEST (ASTM-D698) RESULTS.



**LEGEND**

EX. INDEX CONTOUR	700	PROP. INDEX CONTOUR	700
EX. INTERMEDIATE CONTOUR	700	PROP. INTERMEDIATE CONTOUR	700
EX. PROPERTY LINE		PROP. PROPERTY LINE (ROAD)	
EX. ROAD EDGE OF GRAVEL/DIRT		PROP. INTERMEDIATE CTR (ROAD)	
EX. ROAD EDGE OF PAVEMENT		PROP. LIMITS OF DISTURBANCE	
EX. ROAD CENTERLINE		PROP. WELL HEAD	
EX. DITCHLINE		PROP. PERIMETER SAFETY FENCE	
EX. CULVERT		PROP. ACCESS GATE WITH EMERGENCY LIFELINE	
EX. FENCELINE		PROP. ROAD EDGE OF GRAVEL	
EX. OVERHEAD UTILITY		PROP. ROAD CENTERLINE	
EX. POWER POLE/GUY WIRE		PROP. V-DITCH W/ CHECK DAMS	
EX. PIPELINE & WELL		PROP. CULVERT W/ RIP-RAP	
EX. TRELLINE		PROP. COMPOST FILTER SOCK	
EX. DELINEATED STREAM		PROP. COMPOST SOCK DIVERSION	
EX. DELINEATED WETLAND/POND		PROP. SUPER SILT FENCE	
EX. BUILDING		MATCHLINE	
100' WETLAND/STREAM BUFFER DELINEATION STUDY AREA		BRUSH PILE SEDIMENT BARRIER	

**NAVITUS ENGINEERING INC.**  
 Engineering Survey Environmental GIS  
 151 Windy Hill Lane  
 Winchester, Virginia 22602  
 Telephone: (888) 662-4185  
 www.navituseg.com

REVISION	DATE

**ANTERO RESOURCES**  
 THIS DOCUMENT WAS PREPARED BY ANTERO RESOURCES CORPORATION

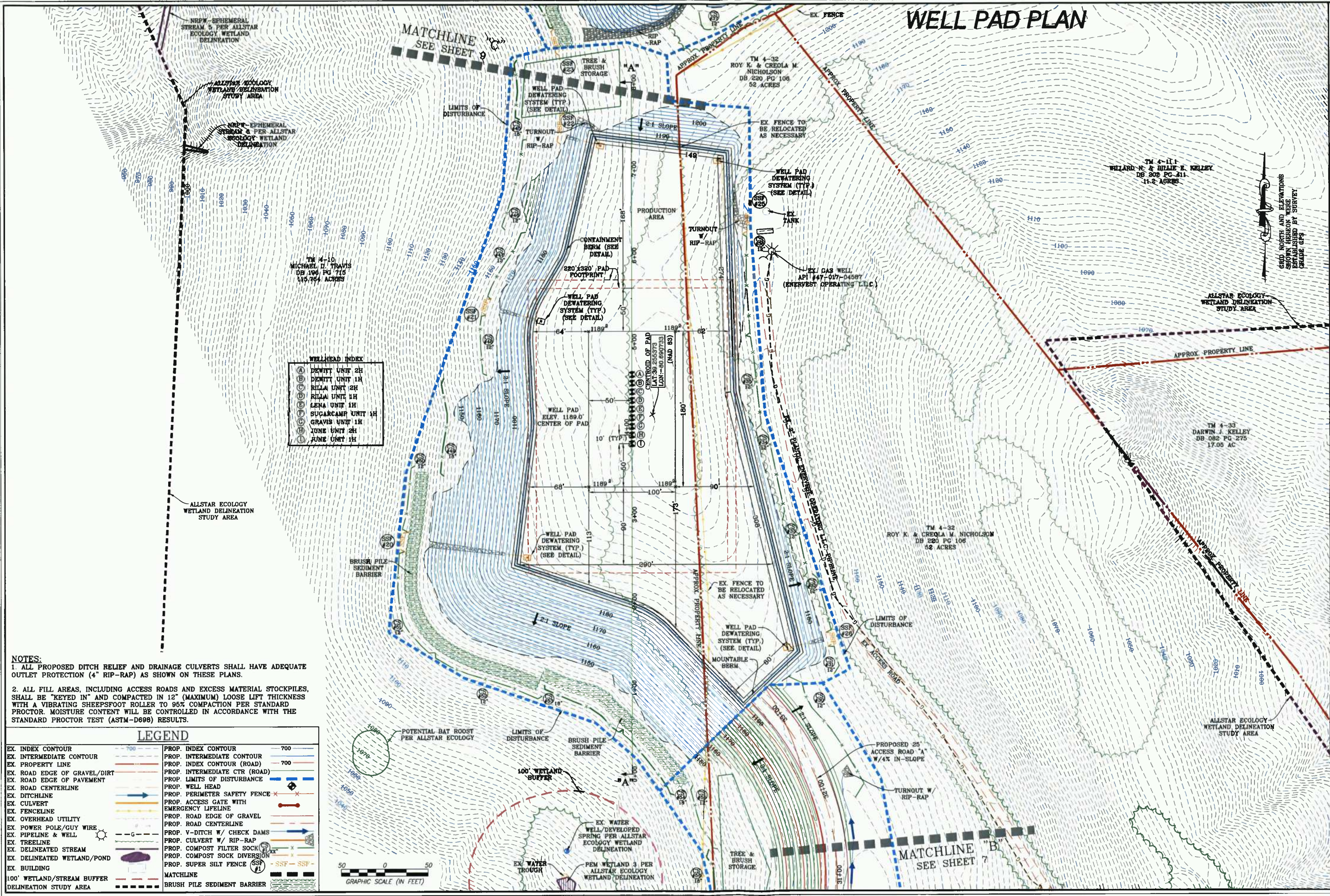
ACCESS ROAD & WATER CONTAINMENT PAD PLAN  
**WILLARD**  
 WELL PAD & WATER CONTAINMENT PAD  
 NEW MILTON DISTRICT  
 DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 09/16/2013  
 SCALE: 1" = 50'  
 SHEET 7 OF 28



# WELL PAD PLAN



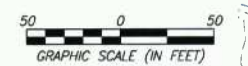
**WELLHEAD INDEX**

(A)	DEWITT UNIT 2H
(B)	DEWITT UNIT 1H
(C)	RILLA UNIT 2H
(D)	RILLA UNIT 1H
(E)	LENA UNIT 1H
(F)	SUGARCAMP UNIT 1H
(G)	GRAVIS UNIT 1H
(H)	JUNE UNIT 2H
(I)	JUNE UNIT 1H

**NOTES:**  
 1. ALL PROPOSED DITCH RELIEF AND DRAINAGE CULVERTS SHALL HAVE ADEQUATE OUTLET PROTECTION (4" RIP-RAP) AS SHOWN ON THESE PLANS.  
 2. ALL FILL AREAS, INCLUDING ACCESS ROADS AND EXCESS MATERIAL STOCKPILES, SHALL BE "KEYED IN" AND COMPACTED IN 12" (MAXIMUM) LOOSE LIFT THICKNESS WITH A VIBRATING SHEEPSFOOT ROLLER TO 95% COMPACTION PER STANDARD PROCTOR. MOISTURE CONTENT WILL BE CONTROLLED IN ACCORDANCE WITH THE STANDARD PROCTOR TEST (ASTM-D698) RESULTS.

**LEGEND**

EX. INDEX CONTOUR	---	700	PROP. INDEX CONTOUR	---	700
EX. INTERMEDIATE CONTOUR	---	700	PROP. INTERMEDIATE CONTOUR	---	700
EX. PROPERTY LINE	---	---	PROP. PROPERTY LINE	---	---
EX. ROAD EDGE OF GRAVEL/DIRT	---	---	PROP. ROAD EDGE OF GRAVEL	---	---
EX. ROAD EDGE OF PAVEMENT	---	---	PROP. ROAD CENTERLINE	---	---
EX. ROAD CENTERLINE	---	---	PROP. LIMITS OF DISTURBANCE	---	---
EX. DITCHLINE	---	---	PROP. WELL HEAD	---	---
EX. CULVERT	---	---	PROP. PERIMETER SAFETY FENCE	---	---
EX. FENCELINE	---	---	PROP. ACCESS GATE WITH EMERGENCY LIFELINE	---	---
EX. OVERHEAD UTILITY	---	---	PROP. ROAD EDGE OF GRAVEL	---	---
EX. POWER POLE/GUY WIRE	---	---	PROP. ROAD CENTERLINE	---	---
EX. PIPELINE & WELL	---	---	PROP. V-DITCH W/ CHECK DAMS	---	---
EX. TREELINE	---	---	PROP. CULVERT W/ RIP-RAP	---	---
EX. DELINEATED STREAM	---	---	PROP. COMPOST FILTER SOCK	---	---
EX. DELINEATED WETLAND/POND	---	---	PROP. COMPOST SOCK DIVERSION	---	---
EX. BUILDING	---	---	PROP. SUPER SILT FENCE	---	---
100' WETLAND/STREAM BUFFER DELINEATION STUDY AREA	---	---	MATCHLINE	---	---
			BRUSH PILE SEDIMENT BARRIER	---	---



**NAVITUS ENGINEERING INC.**  
 Engineering Survey Environmental GIS  
 151 Windy Hill Lane  
 Winchester, Virginia 22602  
 Telephone: (888) 662-4185  
 www.navituseng.com

REVISION	DATE

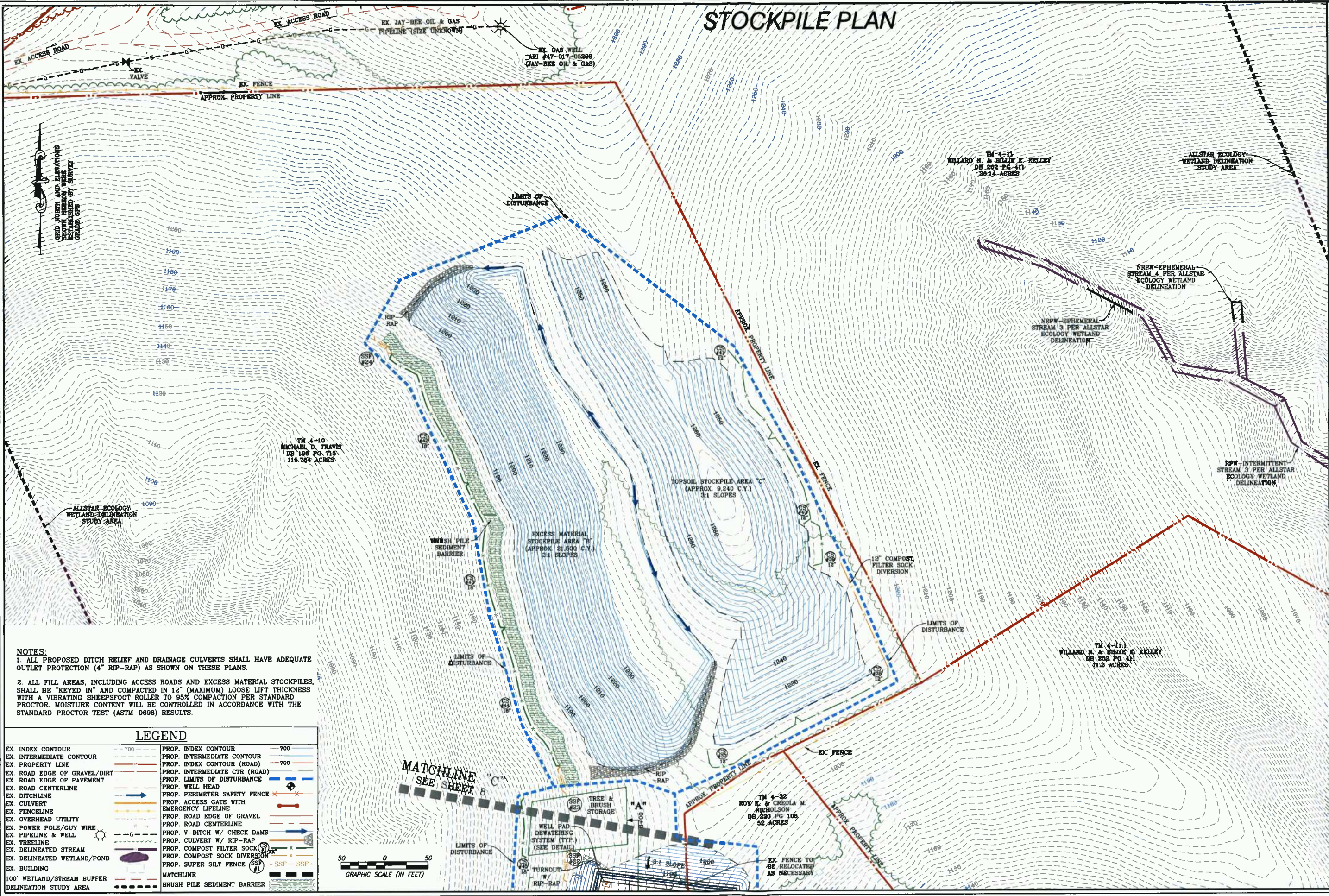
**ANTERO RESOURCES**  
 THIS DOCUMENT WAS PREPARED FOR:  
**ANTERO RESOURCES CORPORATION**

**WILLARD WETLAND DISTRICT**  
 NEW MILTON DISTRICT  
 DODDRIDGE COUNTY, WEST VIRGINIA

WELL PAD PLAN  
 DATE: 09/16/2013  
 SCALE: 1" = 50'  
 SHEET 8 OF 26



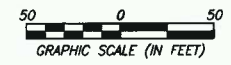
# STOCKPILE PLAN



**NOTES:**  
 1. ALL PROPOSED DITCH RELIEF AND DRAINAGE CULVERTS SHALL HAVE ADEQUATE OUTLET PROTECTION (4" RIP-RAP) AS SHOWN ON THESE PLANS.  
 2. ALL FILL AREAS, INCLUDING ACCESS ROADS AND EXCESS MATERIAL STOCKPILES, SHALL BE "KEYED IN" AND COMPACTED IN 12" (MAXIMUM) LOOSE LIFT THICKNESS WITH A VIBRATING SHEEPSFOOT ROLLER TO 95% COMPACTION PER STANDARD PROCTOR. MOISTURE CONTENT WILL BE CONTROLLED IN ACCORDANCE WITH THE STANDARD PROCTOR TEST (ASTM-D698) RESULTS.

### LEGEND

EX. INDEX CONTOUR	--- 700 ---	PROP. INDEX CONTOUR	--- 700 ---
EX. INTERMEDIATE CONTOUR	--- 700 ---	PROP. INTERMEDIATE CONTOUR	--- 700 ---
EX. PROPERTY LINE	---	PROP. PROPERTY LINE (ROAD)	---
EX. ROAD EDGE OF GRAVEL/DIRT	---	PROP. INTERMEDIATE CTR (ROAD)	---
EX. ROAD EDGE OF PAVEMENT	---	PROP. LIMITS OF DISTURBANCE	---
EX. ROAD CENTERLINE	---	PROP. WELL HEAD	---
EX. DITCHLINE	---	PROP. PERIMETER SAFETY FENCE	---
EX. CULVERT	---	PROP. ACCESS GATE WITH EMERGENCY LIFELINE	---
EX. FENCELINE	---	PROP. ROAD EDGE OF GRAVEL	---
EX. OVERHEAD UTILITY	---	PROP. ROAD CENTERLINE	---
EX. POWER POLE/GUY WIRE	---	PROP. V-DITCH W/ CHECK DAMS	---
EX. PIPELINE & WELL	---	PROP. CULVERT W/ RIP-RAP	---
EX. TREELINE	---	PROP. COMPOST FILTER SOCK	---
EX. DELINEATED STREAM	---	PROP. COMPOST SOCK DIVERSION	---
EX. DELINEATED WETLAND/POND	---	PROP. SUPER SILT FENCE (SSP)	---
EX. BUILDING	---	MATCHLINE	---
100' WETLAND/STREAM BUFFER DELINEATION STUDY AREA	---	BRUSH PILE SEDIMENT BARRIER	---



Engineering  
Survey  
Environmental  
GIS

**NAVITUS ENGINEERING INC.**

151 Windy Hill Lane  
Winchester, Virginia 22602  
Telephone: (888) 662-4185  
www.navituseng.com

REVISION  
DATE

**ANTERO RESOURCES**  
 THIS DOCUMENT WAS PREPARED FOR:  
 ANTERO RESOURCES CORPORATION

STOCKPILE PLAN

**WILLARD**

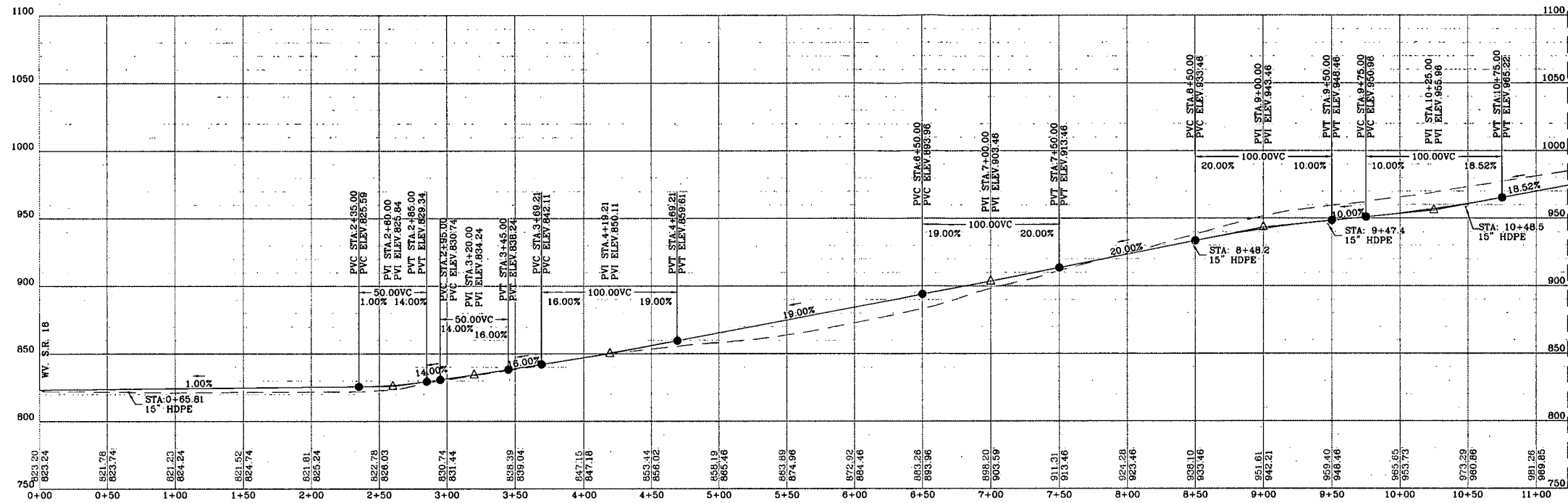
**WELL PAD & WATER CONTAINMENT PAD**  
 NEW MILTON DISTRICT  
 DODDERIDGE COUNTY, WEST VIRGINIA



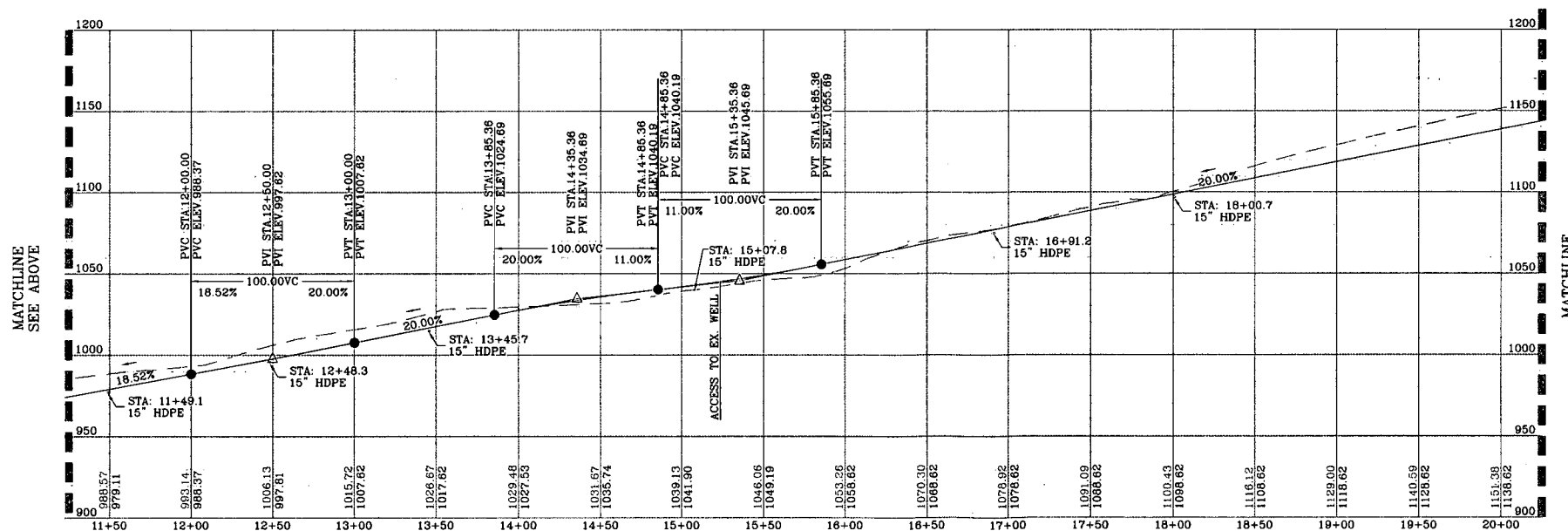
DATE: 09/16/2013  
 SCALE: 1" = 50'  
 SHEET 9 OF 26



# ACCESS ROAD PROFILES



ACCESS ROAD "A" PROFILE  
SCALE: HORIZ. 1" = 50' VERT. 1" = 50'



ACCESS ROAD "A" PROFILE  
SCALE: HORIZ. 1" = 50' VERT. 1" = 50'

MATCHLINE  
SEE BELOW

MATCHLINE  
SEE ABOVE

MATCHLINE  
SEE SHEET 11

**NAVITUS ENGINEERING INC.**  
 Engineering Survey Environmental GIS  
 151 Windy Hill Lane  
 Winchester, Virginia 22602  
 Telephone: (888) 662-4185  
 www.navituseng.com

DATE	REVISION

**ANTERO RESOURCES**  
 THIS DOCUMENT WAS PREPARED BY  
 ANTERO RESOURCES CORPORATION

ACCESS ROAD PROFILES  
**WILLARD**  
 WELL PAD & WATER CONTAINMENT PAD  
 NEW MILTON DISTRICT  
 DODDRIDGE COUNTY, WEST VIRGINIA

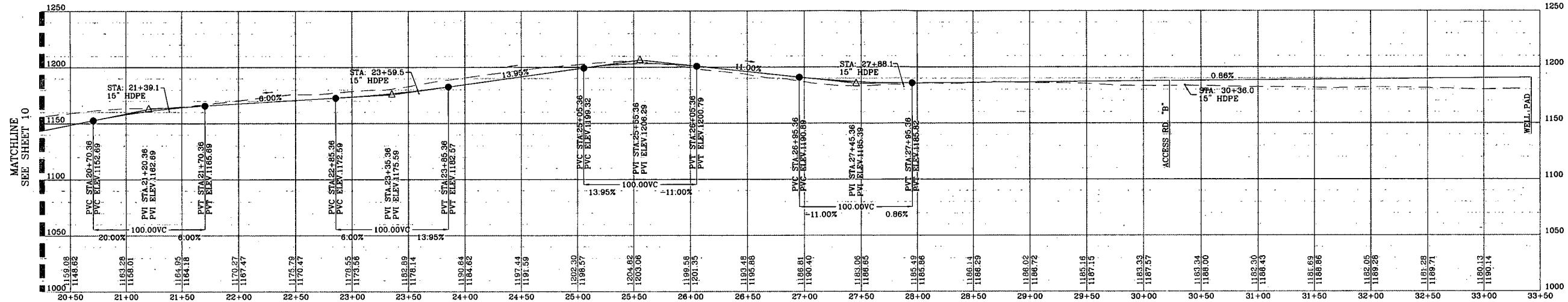


**LEGEND**

- X-SECTION GRID INDEX
- X-SECTION GRID INTERMEDIATE
- X-SECTION PROPOSED GRADE
- X-SECTION EXISTING GRADE
- X-SECTION WATER SURFACE
- MATCHLINE

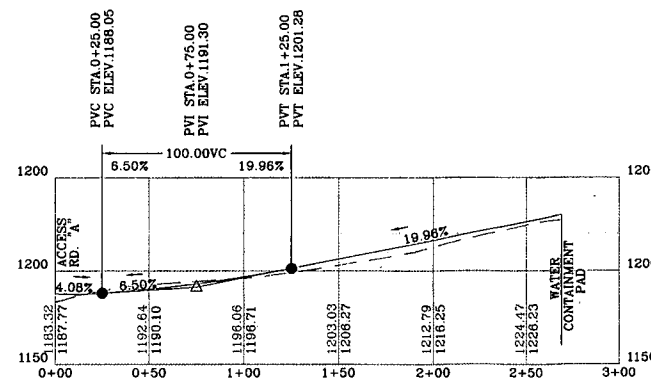
DATE: 09/16/2013  
 SCALE: AS SHOWN  
 SHEET 10 OF 26

# ACCESS ROAD PROFILES



**ACCESS ROAD "A" PROFILE**

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



**ACCESS ROAD "B" PROFILE**

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

MATCHLINE  
SEE SHEET 10

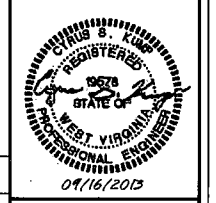
### LEGEND

- X-SECTION GRID INDEX
- X-SECTION GRID INTERMEDIATE
- X-SECTION PROPOSED GRADE
- X-SECTION EXISTING GRADE
- X-SECTION WATER SURFACE
- MATCHLINE

DATE	REVISION

**ANTERO RESOURCES**  
THIS DOCUMENT  
WAS PREPARED  
BY  
ANTERO RESOURCES  
CORPORATION

ACCESS ROAD PROFILES  
**WILLARD**  
**WELL PAD & WATER CONTAINMENT PAD**  
NEW MILTON DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 09/16/2013  
SCALE: AS SHOWN  
SHEET 11 OF 26

**NAVITUS ENGINEERING INC.**  
151 Windy Hill Lane  
Winchester, Virginia 26002  
www.navituseng.com

Engineering  
Survey  
Environmental  
GIS

**NOTE:**  
 1. ALL FILL AREAS, INCLUDING ACCESS ROADS AND EXCESS MATERIAL STOCKPILES, SHALL BE "KEYED IN" AND COMPACTED IN 12" (MAXIMUM) LOOSE LIFT THICKNESS WITH A VIBRATING SHEEPSFOOT ROLLER TO 95% COMPACTION PER STANDARD PROCTOR. MOISTURE CONTENT WILL BE CONTROLLED IN ACCORDANCE WITH THE STANDARD PROCTOR TEST (ASTM-D698) RESULTS.

2. ALL CUT & FILL SLOPES SHALL BE 2:1 UNLESS STATED OTHERWISE.

# ACCESS ROAD SECTIONS

**LEGEND**

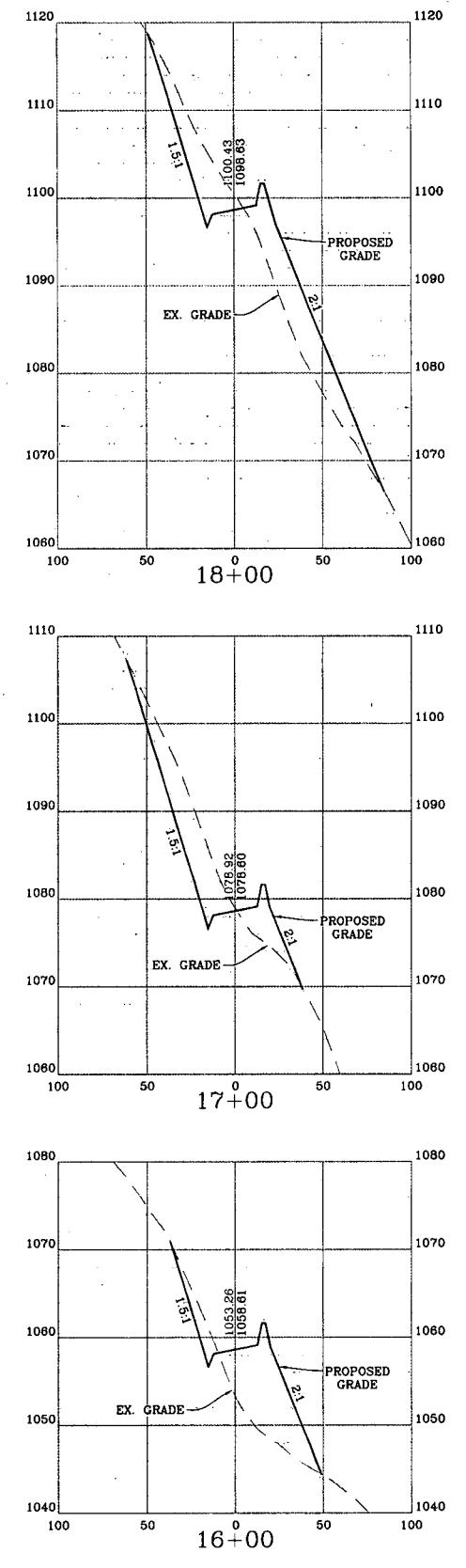
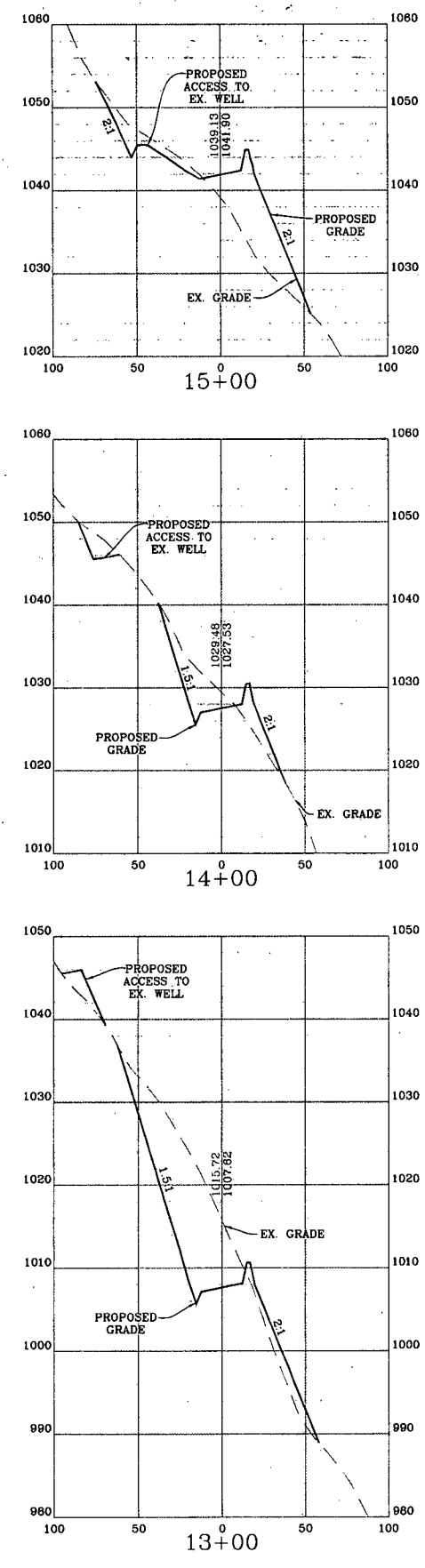
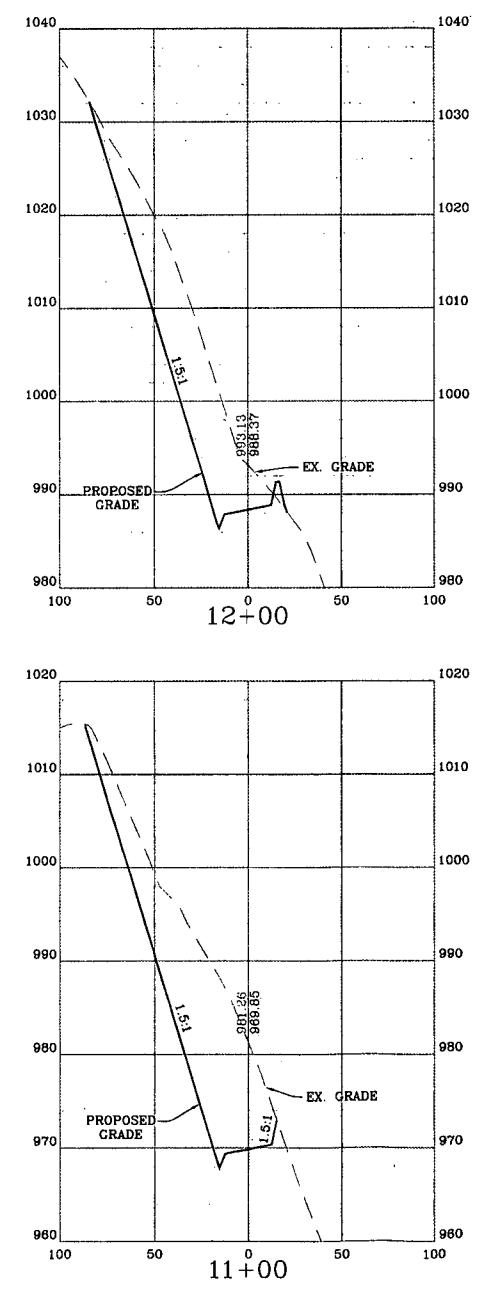
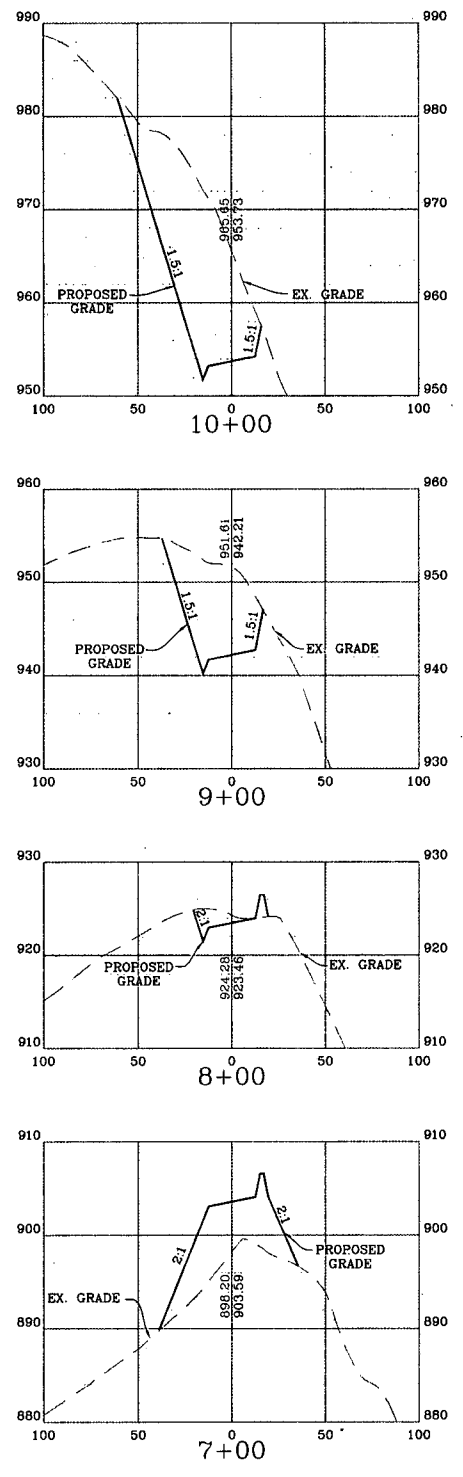
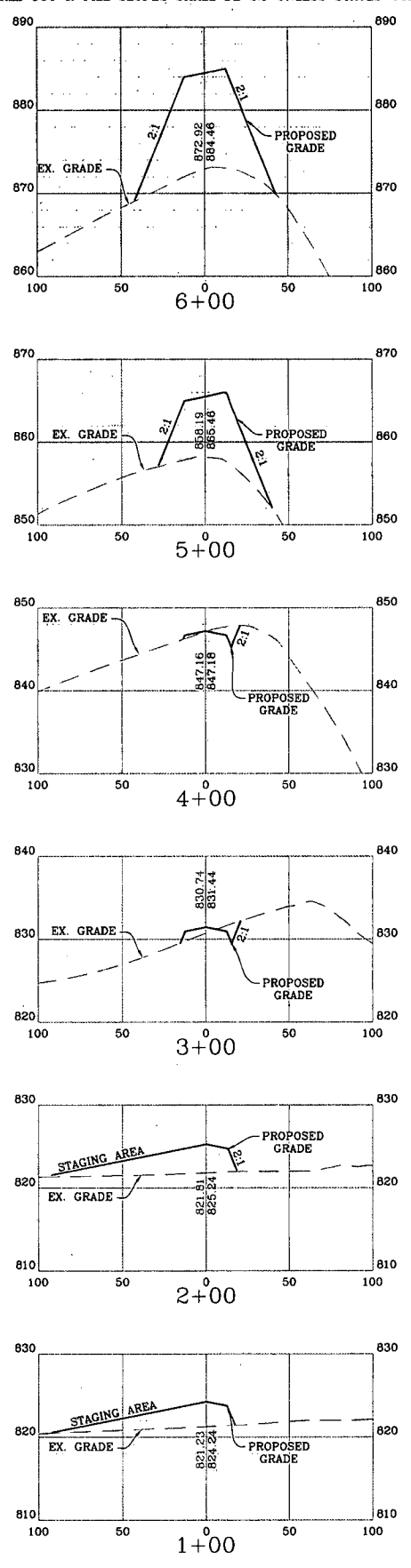
- X-SECTION GRID INDEX
- X-SECTION GRID INTERMEDIATE
- X-SECTION PROPOSED GRADE
- X-SECTION EXISTING GRADE
- X-SECTION WATER SURFACE
- MATCHLINE

Engineering  
 Survey  
 Environmental  
 GIS

**NAVITUS ENGINEERING INC.**  
 151 Wandy Hill Lane  
 Chesapeake, VA 23042  
 Telephone: (888) 662-4185  
 www.navituseng.com

## ACCESS ROAD "A" CROSS-SECTIONS

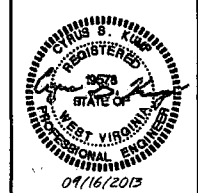
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'



REVISION	DATE

**ANTERO RESOURCES**  
 THIS DOCUMENT WAS PREPARED FOR  
 ANTERO RESOURCES CORPORATION

**WILLARD**  
 WELL PAD & WATER CONTAINMENT PAD  
 NEW MILTON DISTRICT  
 DODDRIDGE COUNTY, WEST VIRGINIA

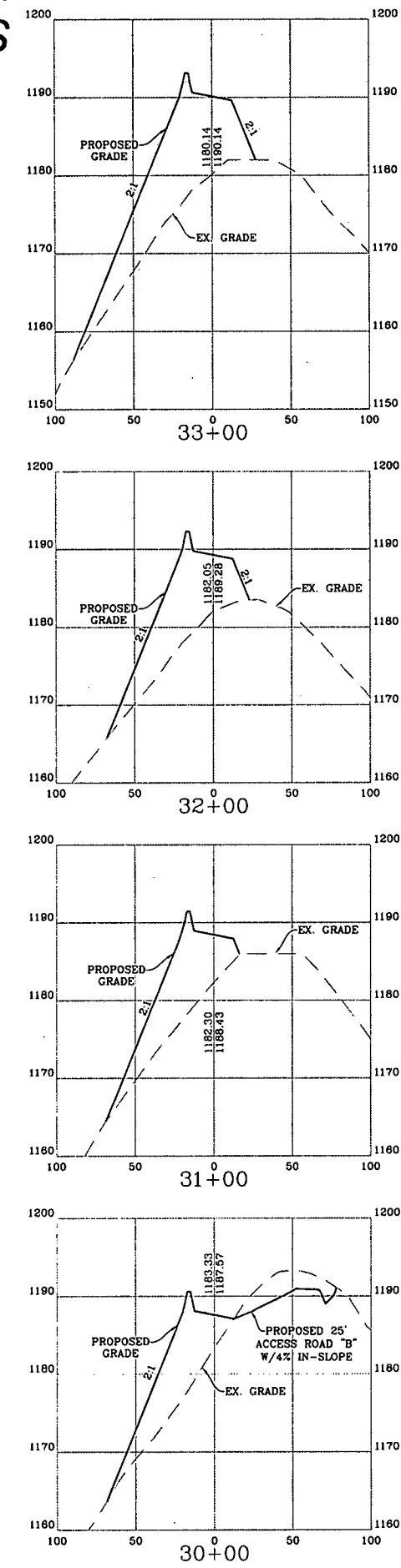
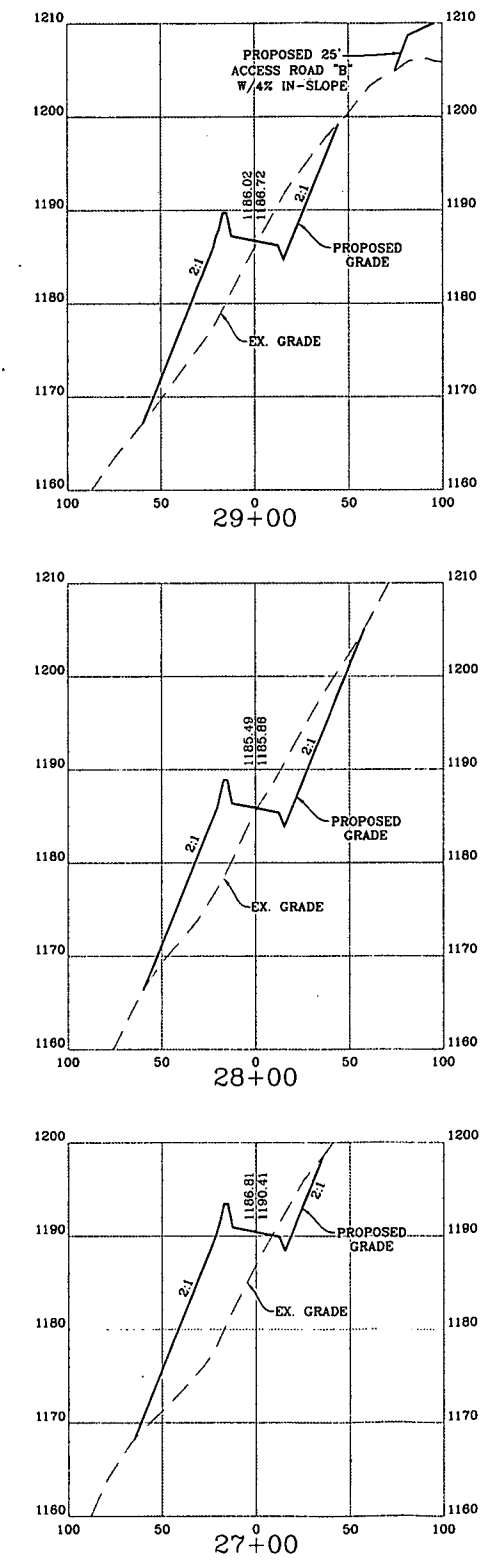
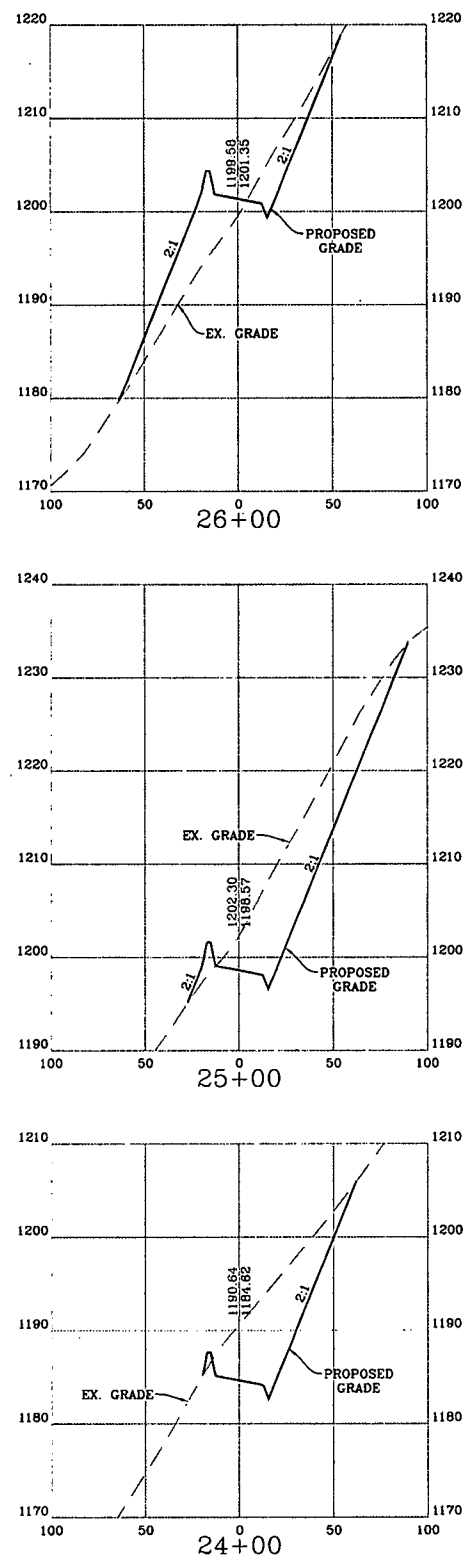
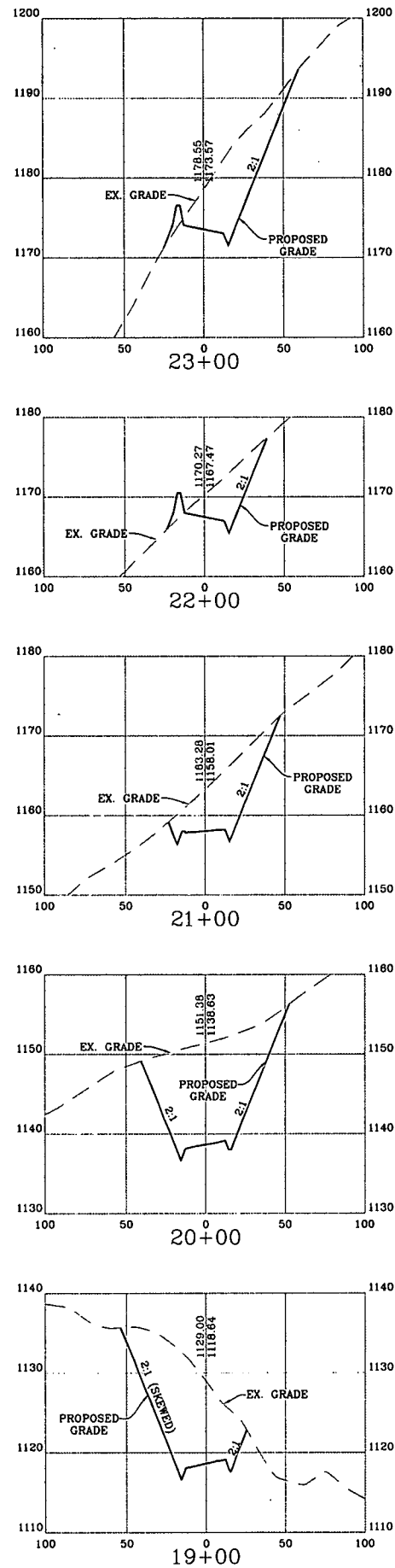


DATE: 09/16/2013  
 SCALE: AS SHOWN  
 SHEET 12 OF 26

# ACCESS ROAD SECTIONS

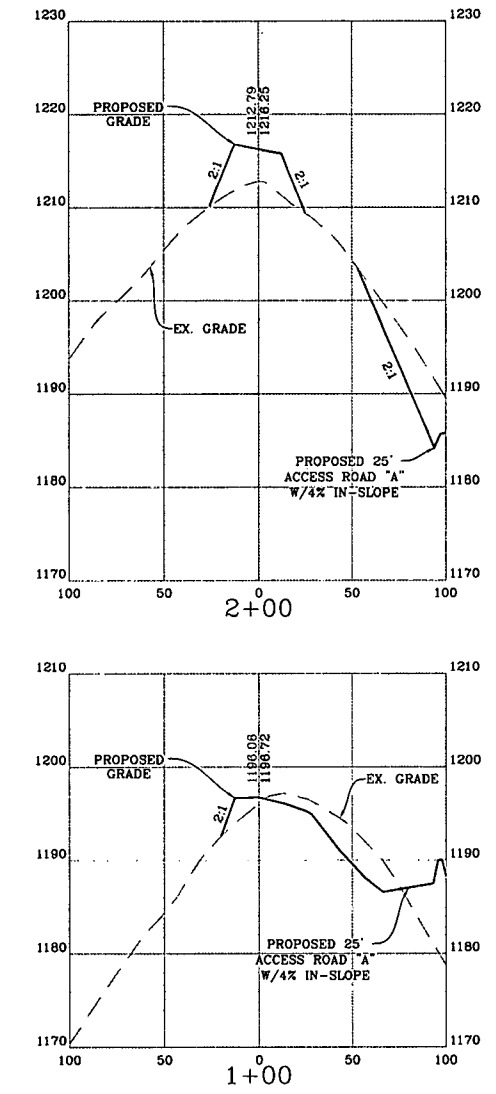
## ACCESS ROAD "A" CROSS-SECTIONS

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



## ACCESS ROAD "B" CROSS-SECTIONS

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



### LEGEND

- X-SECTION GRID INDEX
- X-SECTION GRID INTERMEDIATE
- X-SECTION PROPOSED GRADE
- X-SECTION EXISTING GRADE
- X-SECTION WATER SURFACE
- MATCHLINE

### NOTE:

1. ALL FILL AREAS, INCLUDING ACCESS ROADS AND EXCESS MATERIAL STOCKPILES, SHALL BE "KEYED IN" AND COMPACTED IN 12" (MAXIMUM) LOOSE LIFT THICKNESS WITH A VIBRATING SHEEPSFOOT ROLLER TO 95% COMPACTION PER STANDARD PROCTOR. MOISTURE CONTENT WILL BE CONTROLLED IN ACCORDANCE WITH THE STANDARD PROCTOR TEST (ASTM-D698) RESULTS.
2. ALL CUT & FILL SLOPES SHALL BE 2:1 UNLESS STATED OTHERWISE.

Engineering Survey Environmental GIS

**NAVITUS ENGINEERING INC.**

151 Windy Hill Lane  
Winchester, Virginia 24002  
Tel: 540-361-1185  
www.navituseng.com

REVISION	DATE

**ANTERO RESOURCES**  
THIS DOCUMENT WAS PREPARED BY  
**ANTERO RESOURCES CORPORATION**

ACCESS ROAD SECTIONS

**WILLARD**

**WELL PAD & WATER CONTAINMENT PAD**

NEW MILTON DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA

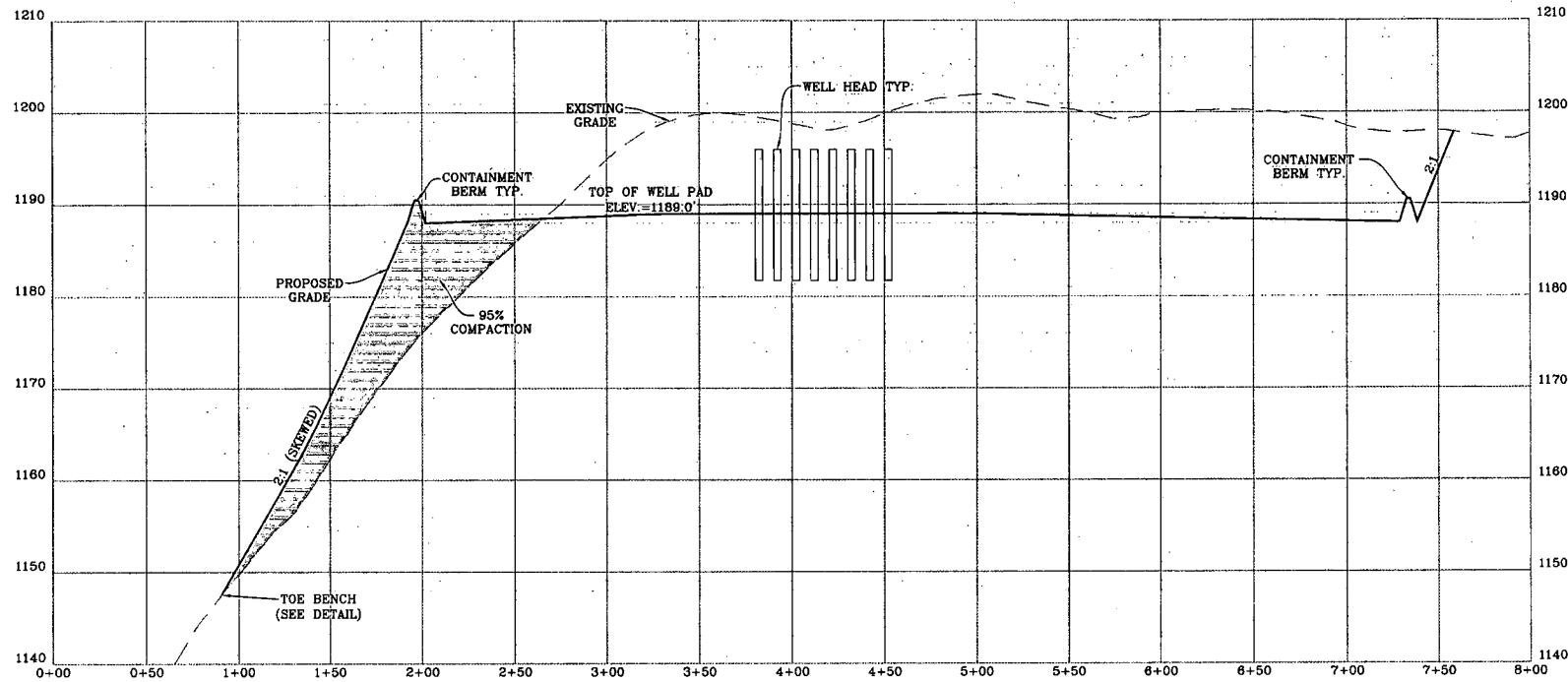
REGISTERED PROFESSIONAL ENGINEER  
STATE OF WEST VIRGINIA  
1967  
01/16/2013



# WELL PAD & WATER CONTAINMENT PAD SECTIONS

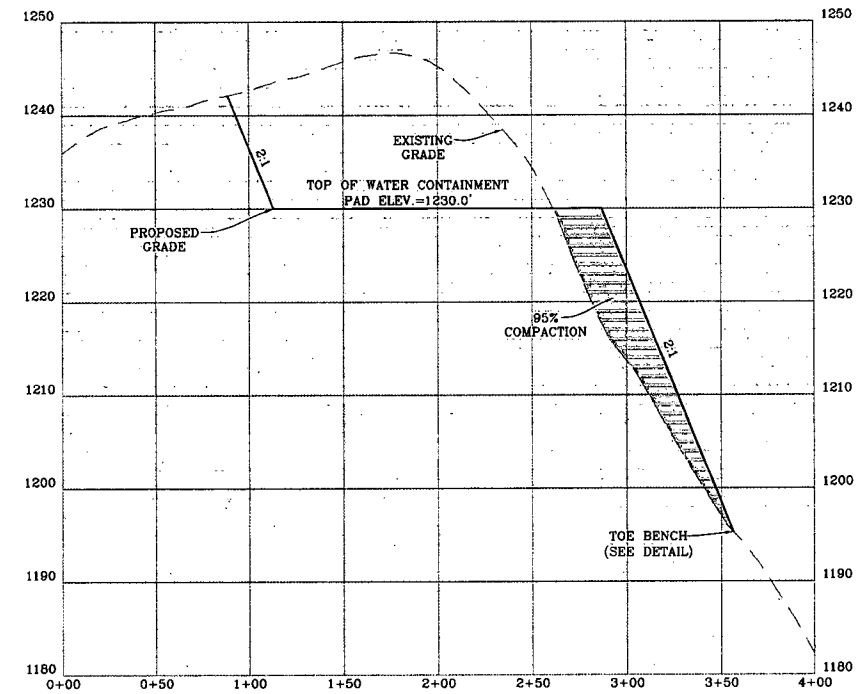
WELL PAD CROSS-SECTION "A-A"

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



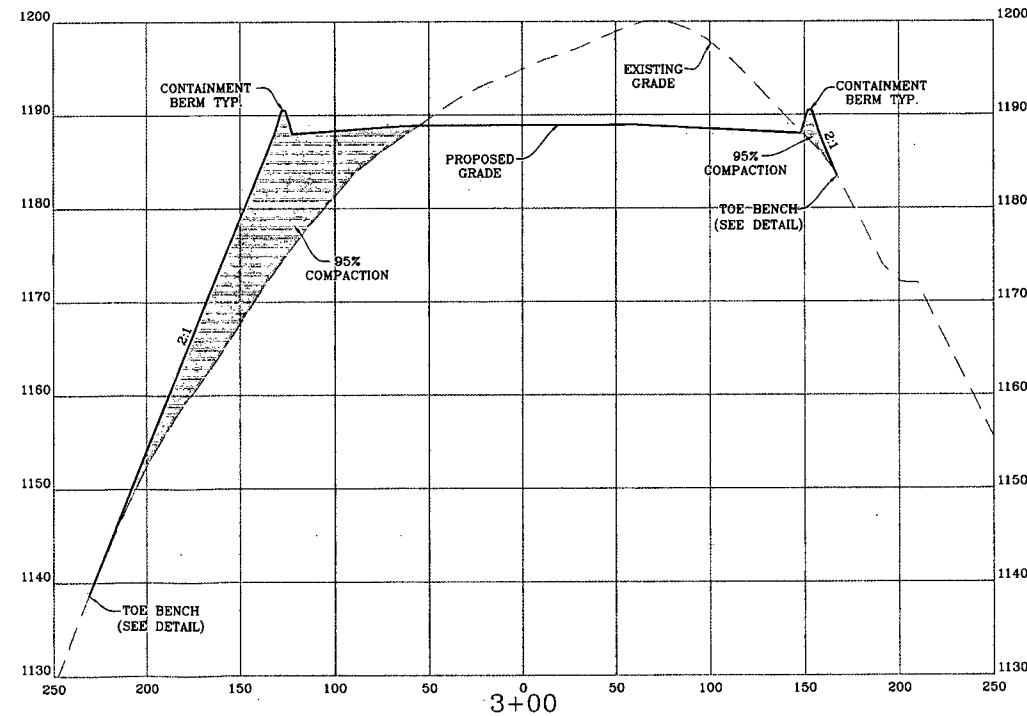
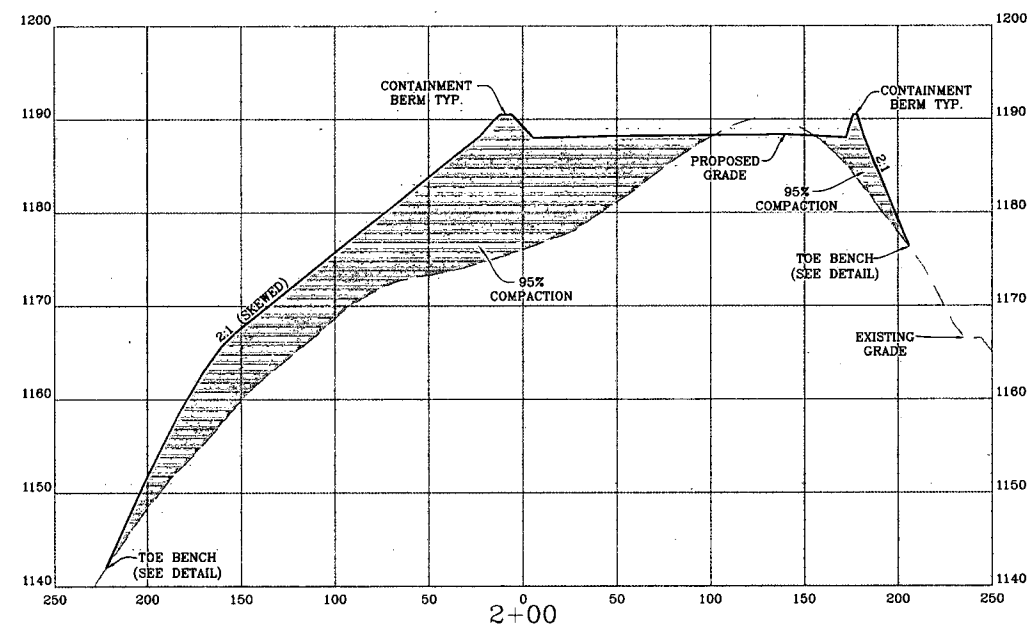
WATER CONTAINMENT PAD CROSS-SECTION "B-B"

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



WELL PAD CROSS-SECTIONS ALONG BASELINE "A-A"

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



- NOTE:**
1. ALL FILL AREAS, INCLUDING ACCESS ROADS AND EXCESS MATERIAL STOCKPILES, SHALL BE "KEYED IN" AND COMPACTED IN 12" (MAXIMUM) LOOSE LIFT THICKNESS WITH A VIBRATING SHEEPSFOOT ROLLER TO 95% COMPACTION PER STANDARD PROCTOR. MOISTURE CONTENT WILL BE CONTROLLED IN ACCORDANCE WITH THE STANDARD PROCTOR TEST (ASTM-D698) RESULTS.
  2. ALL CUT & FILL SLOPES SHALL BE 2:1 UNLESS STATED OTHERWISE.

**LEGEND**

X-SECTION GRID INDEX	---
X-SECTION GRID INTERMEDIATE	---
X-SECTION PROPOSED GRADE	---
X-SECTION EXISTING GRADE	---
X-SECTION WATER SURFACE	---
MATCHLINE	---



REVISION

DATE



WELL PAD & WATER CONTAINMENT PAD SECTIONS  
**WILLARD**  
WELL PAD & WATER CONTAINMENT PAD  
NEW MILTON DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 09/16/2013

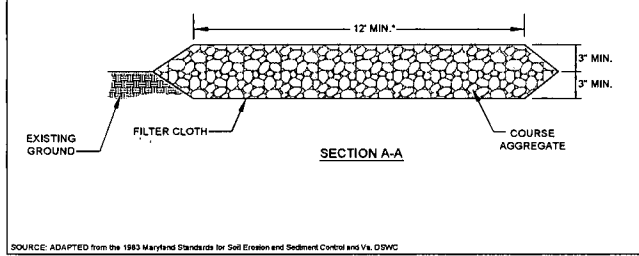
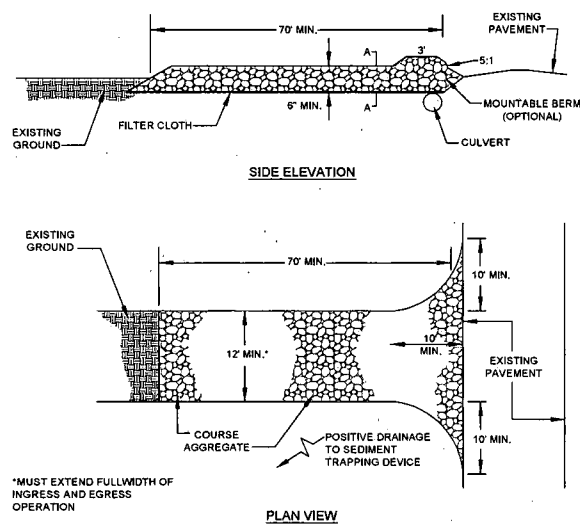
SCALE: AS SHOWN

SHEET 14 OF 26

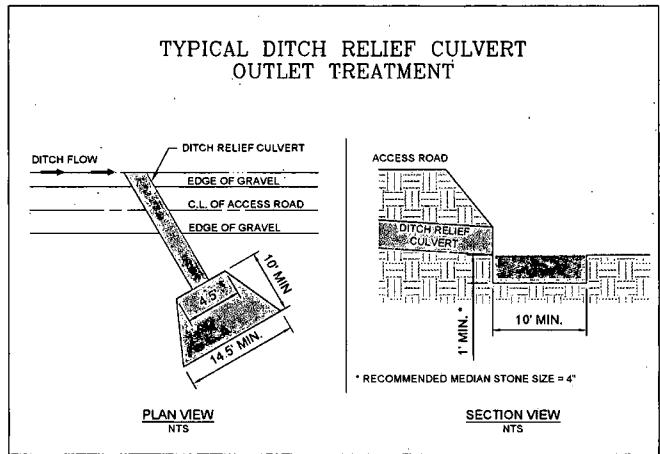


FIGURE 3.02.1

STONE CONSTRUCTION ENTRANCE



SOURCE: ADAPTED FROM THE 1983 MARYLAND STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL AND V.L. DSWC



**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 8% - RIPRAP OR EQUIVALENT GEOTEXTILE

IF HIGH EROSION SOILS ARE ENCOUNTERED DURING CONSTRUCTION, THE ENGINEER SHOULD BE CONTACTED FOR FURTHER EVALUATION.

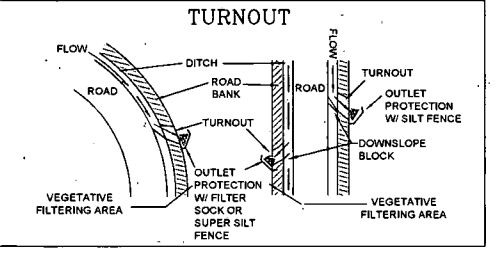
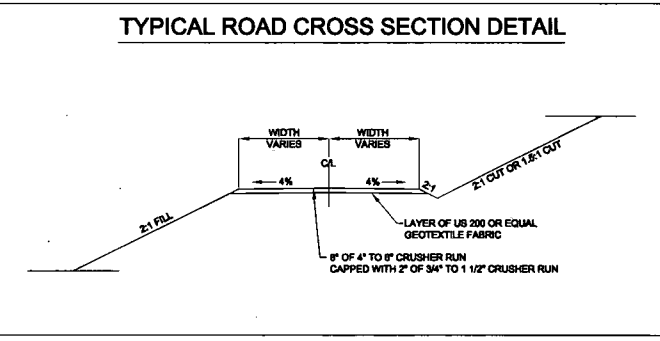
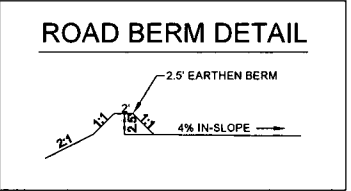
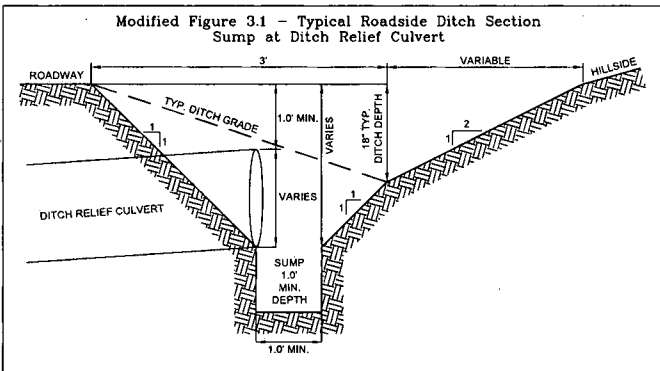


Table II-6  
Spacing of Culverts

Road Grade %	Distance (Ft)
2-5	500-300
6-10	300-200
11-15	200-100
16-20	100

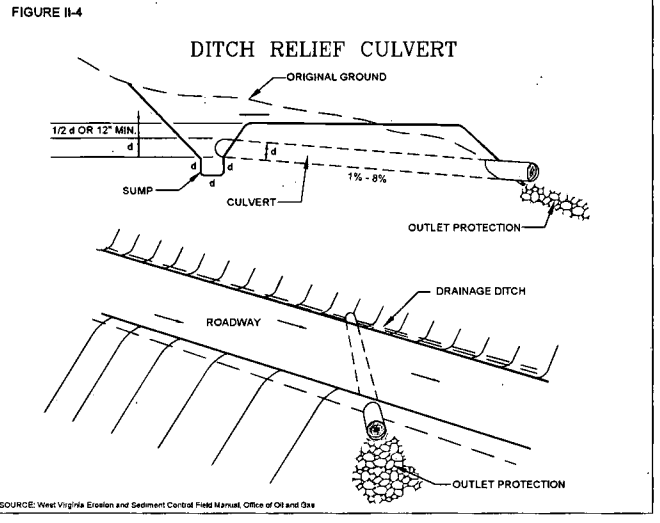
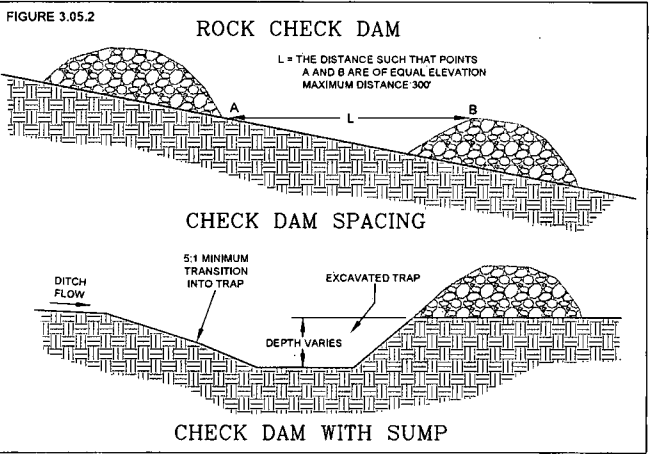
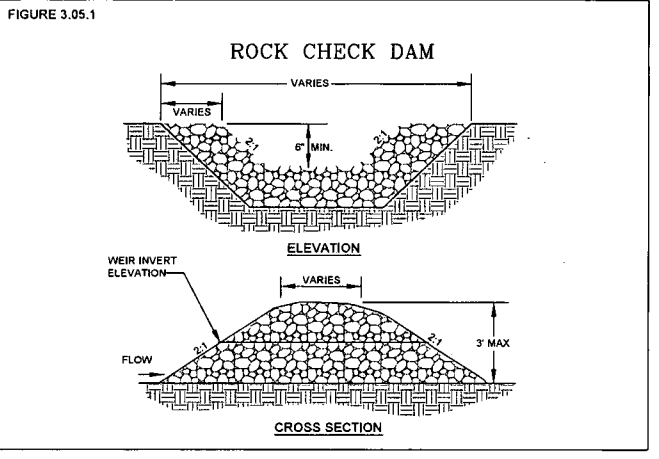
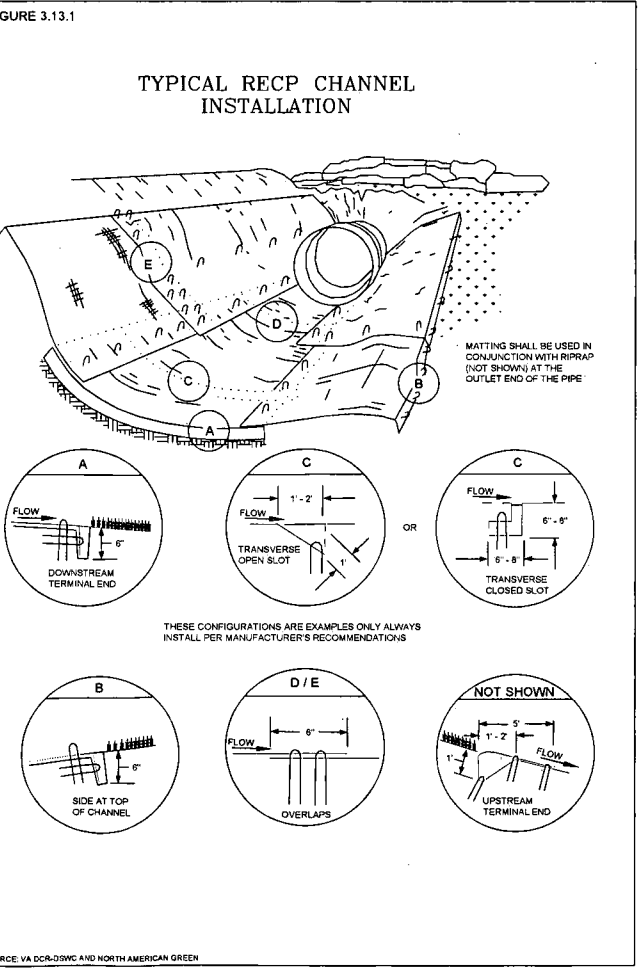
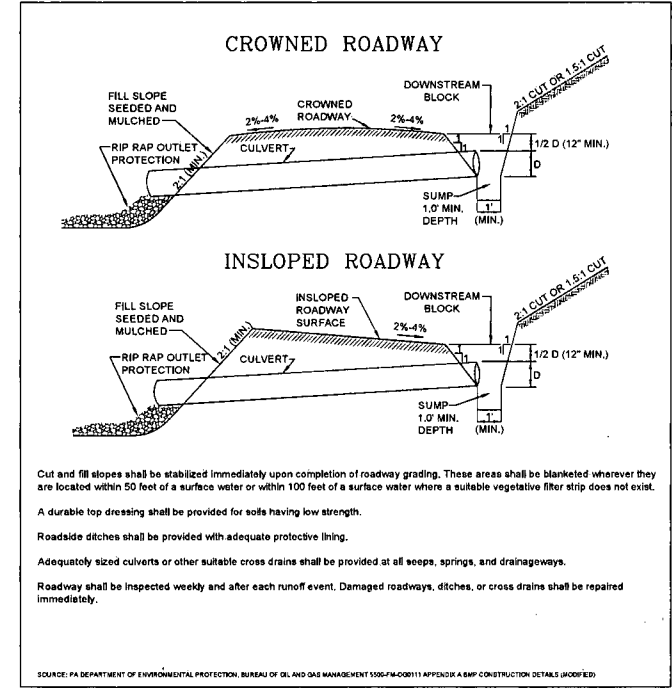


Table II-5  
Pipe Sizes for Culverts Across Roads

Drainage Area (Ac)	Pipe Diameter (In)	Pipe Capacity (Ch)
10	15	5
20	18	9
30	21	12
50	24	18
80	27	24
100	30	29
300	36	60
500	42	85



REVISION

NO.	DATE	DESCRIPTION

**ANTERO RESOURCES**  
 THIS DOCUMENT WAS PREPARED FOR OR BY ANTERO RESOURCES CORPORATION

CONSTRUCTION DETAILS  
**WILLARD**  
 WELL PAD & WATER CONTAINMENT PAD  
 NEW MILTON DISTRICT  
 DODDRIDGE COUNTY, WEST VIRGINIA

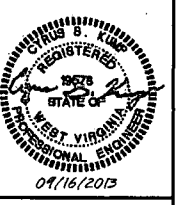
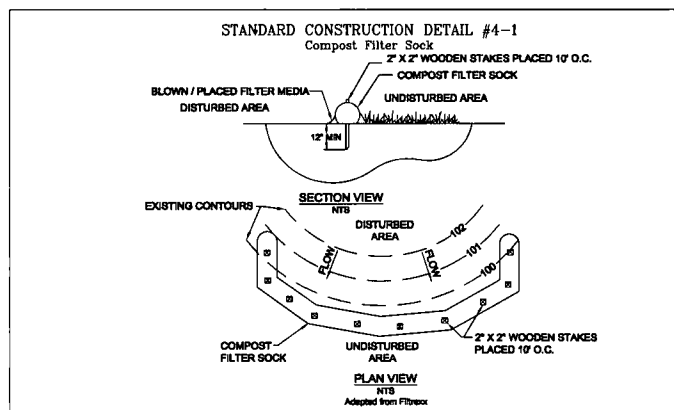
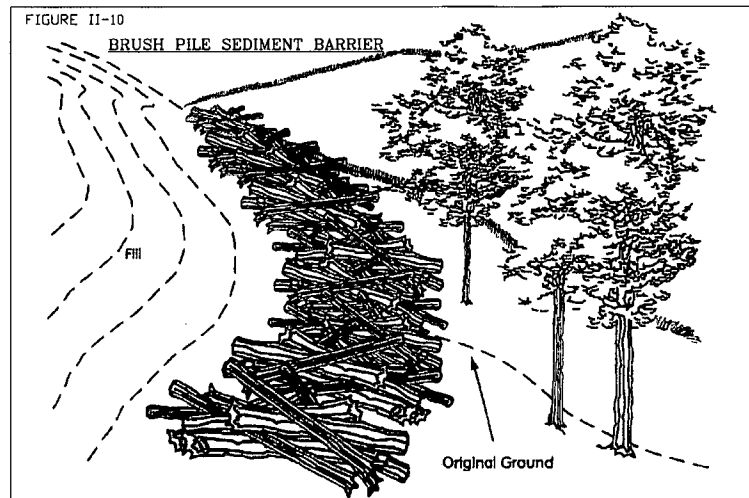
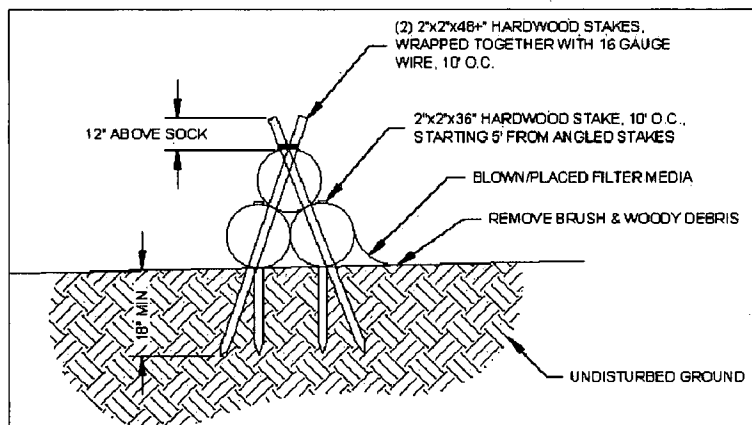
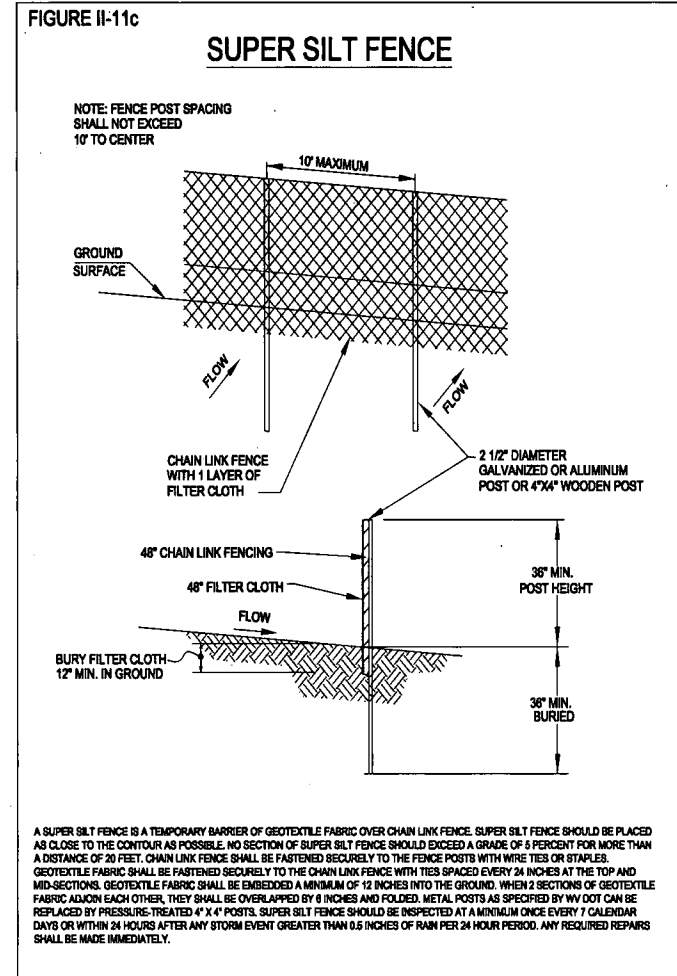
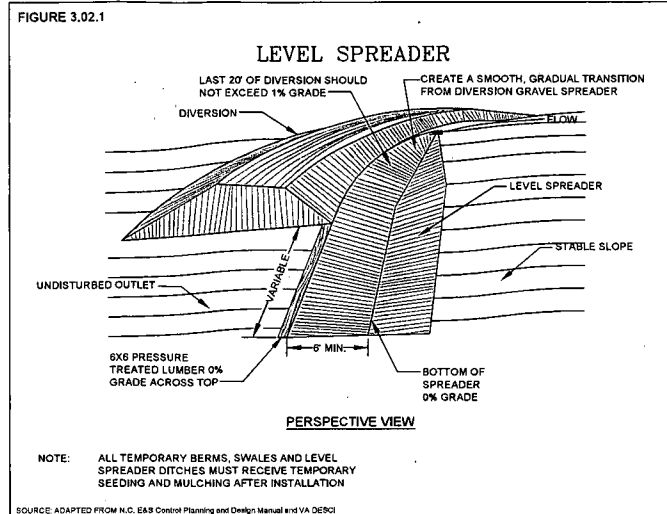
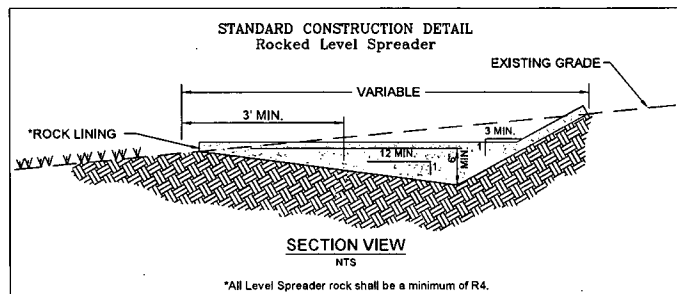


Table 4.1  
Compost Sock Fabric Minimum Specifications

Material Type	3 mil HDPE		5 mil HDPE		Heavy Duty Multi-Filament Polypropylene (HDMPFP)	
	Photo-degradable	Bio-degradable	Photo-degradable	Bio-degradable	Photo-degradable	Bio-degradable
Material Characteristics	Photo-degradable	Bio-degradable	Photo-degradable	Bio-degradable	Photo-degradable	Bio-degradable
Sock Diameters	12" 18"	12" 18" 24" 32"	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"	3/8"	3/8"
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.	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					
Outer Filtration Mesh	3/4" x 3/4" Max. aperture size					
	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.



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.

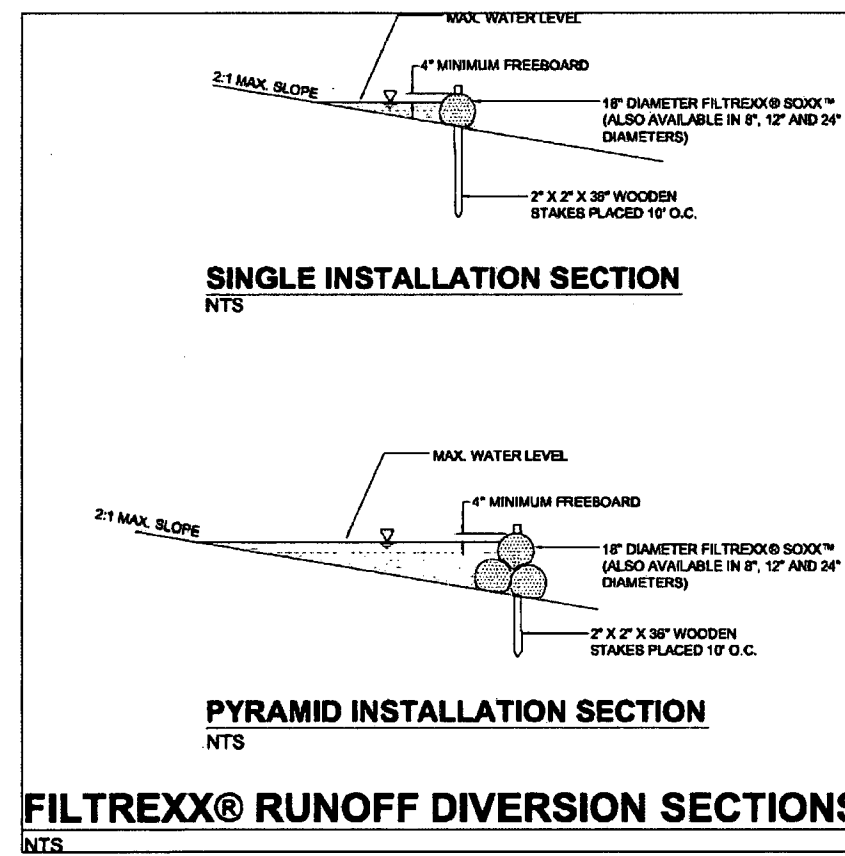
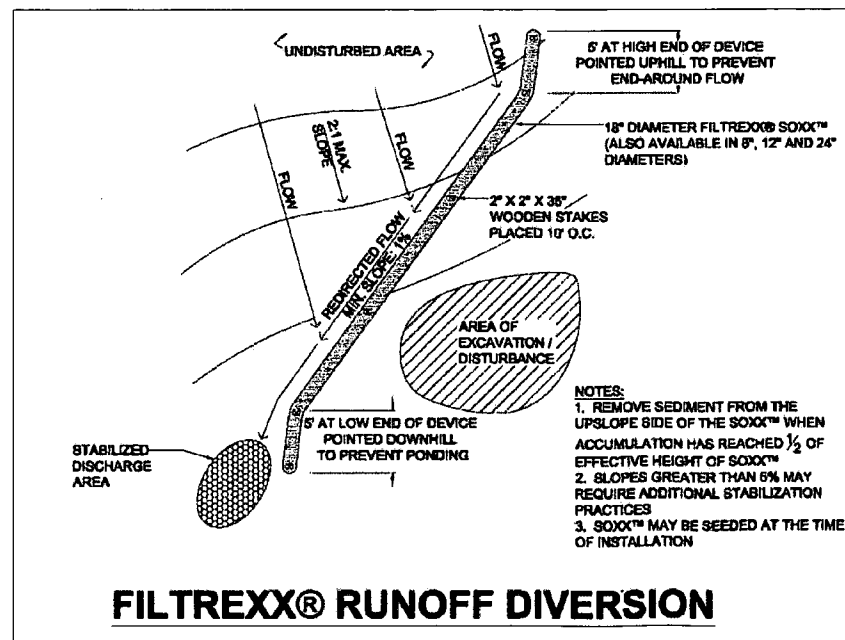
Accumulated Sediment shall be removed when it reaches 1/2 the above ground height of the sock and disposed in the manner described elsewhere in the plan.

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.



Engineering Survey Environmental GIS

**NAVITUS ENGINEERING INC.**

151 Windy Hill Lane  
Waukesha, Virginia 22602  
www.navituseng.com

REVISION	DATE

**ANTERO RESOURCES**  
THIS DOCUMENT WAS PREPARED FOR ANTERO RESOURCES CORPORATION

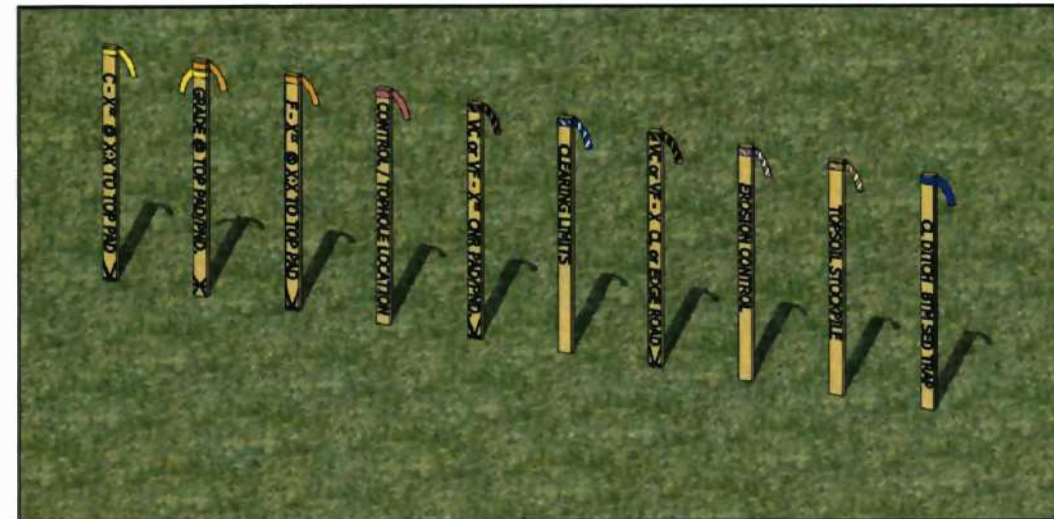
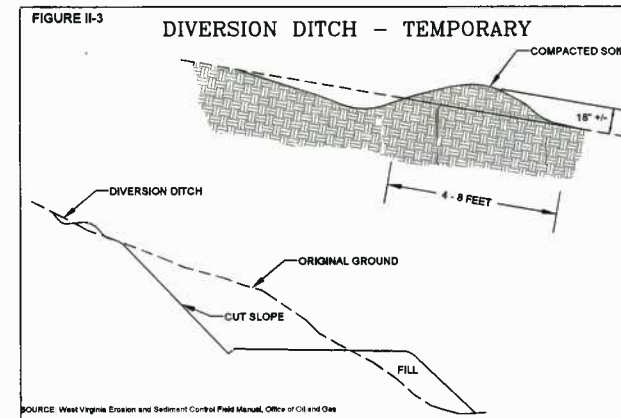
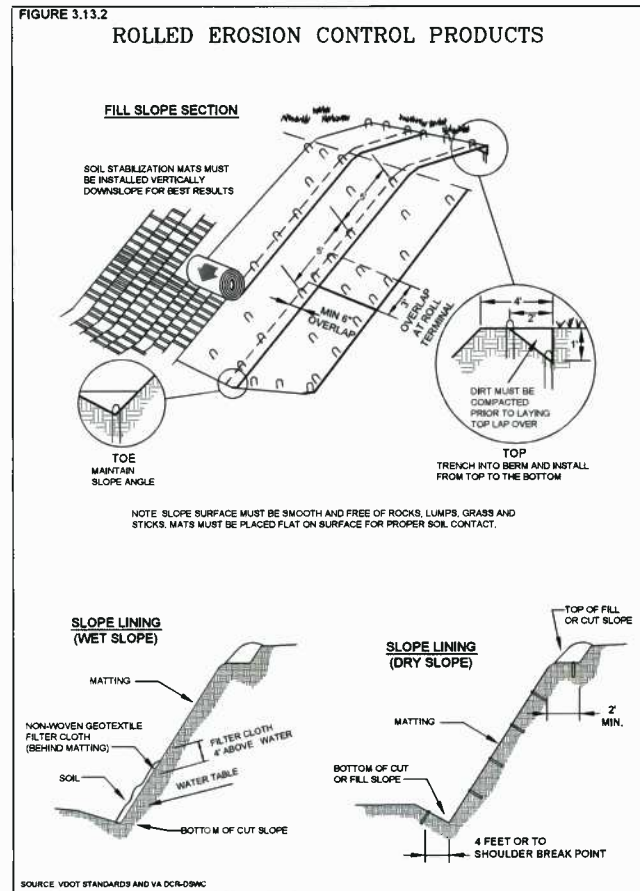
CONSTRUCTION DETAILS











**WILLARD**  
WELL PAD & WATER CONTAINMENT PAD  
NEW MILTON DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA

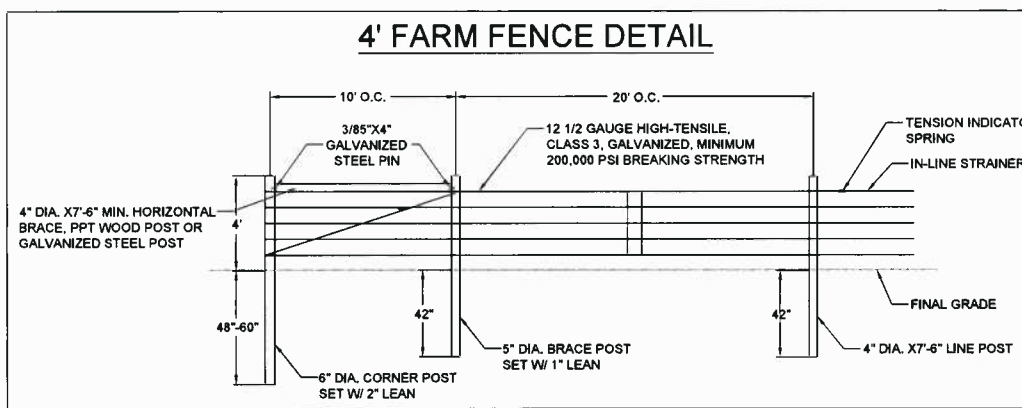
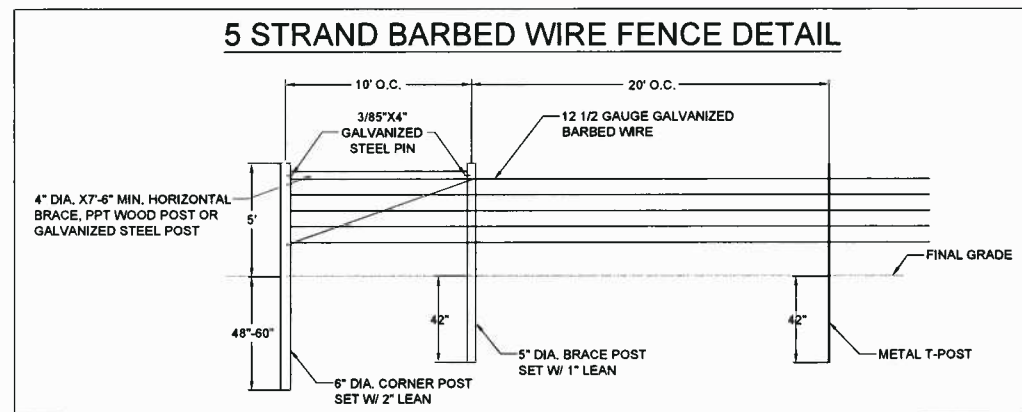
PROFESSIONAL ENGINEER  
STATE OF WEST VIRGINIA  
09/16/2013

DATE: 09/16/2013  
SCALE: N/A  
SHEET 17 OF 26





	<b>Yellow Ribbon:</b> Yellow Ribbon used to indicate top of Cuts (C) Cut to be determined at time of stakeout Slope determined by site design
	<b>Yellow &amp; Orange Ribbon:</b> Yellow and Orange Ribbon used to indicate Grade at Top of Pad/Pond/Pit
	<b>Orange Ribbon:</b> Orange Ribbon used to indicate toes of Fills (F) Fill to be determined at time of stakeout Slope determined by site design
	<b>Pink Ribbon:</b> Pink Ribbon used to indicate Top Hole Location Pink Ribbon used to indicate Survey Control Location
	<b>Pink &amp; Black Stripes Ribbon:</b> Pink & Black Stripes Ribbon used to indicate Vertical Cut (VC) at Pad/Pond/Pit corner or edge Pink & Black Stripes Ribbon used to indicate Vertical Fill (VF) at Pad/Pond/Pit corner or edge Vertical Cut/Vertical Fill to be determined at time of stakeout
	<b>Blue &amp; White Stripes Ribbon:</b> Blue & White Stripes Ribbon used to indicate clearing limits/construction limits
	<b>Orange &amp; Black Stripes Ribbon:</b> Orange & Black Stripes Ribbon used to indicate Vertical Cut (VC) at Centerline or edge of access road Orange & Black Stripes Ribbon used to indicate Vertical Fill (VF) at centerline or edge of access road
	<b>Pink &amp; White Stripes Ribbon:</b> Pink & White Stripes Ribbon used to indicate Erosion and Sediment Control Structures Silt Fence (SF) Reinforced Filter Fence (RFF) Super Silt Fence (SSF) Filter Sock (FS)
	<b>Orange &amp; White Stripes Ribbon:</b> Orange & White Stripes Ribbon used to indicate Topsoil Stockpile Locations
	<b>Blue Ribbon:</b> Blue Ribbon used to indicate Centerline (C) Ditch Blue Ribbon used to indicate Bottom (BTM) Sediment Traps

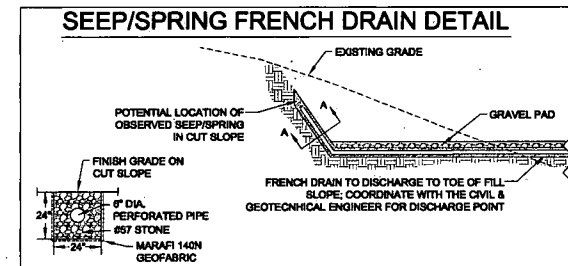
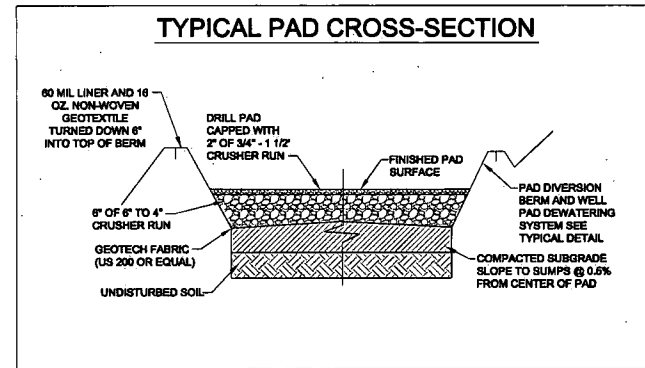
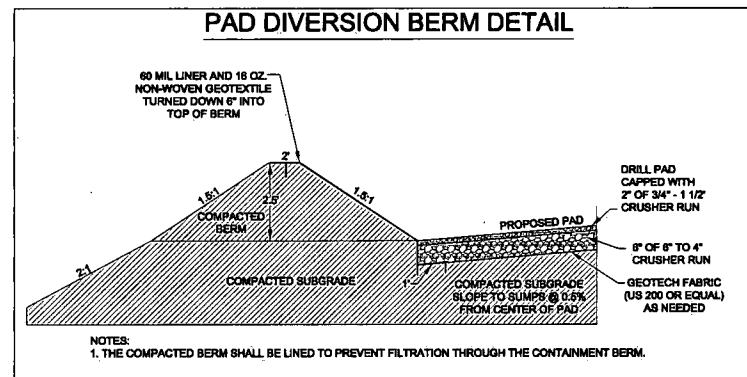
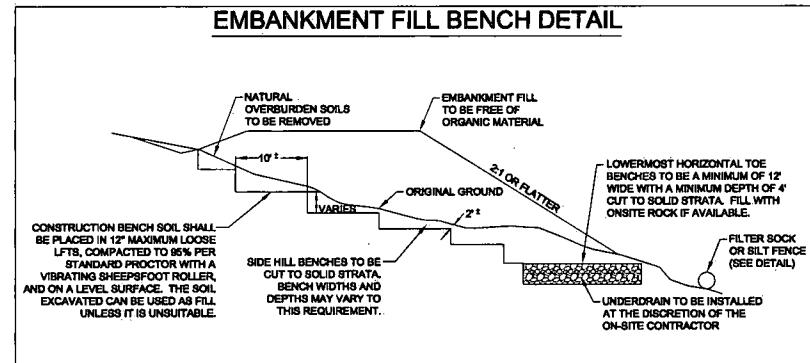
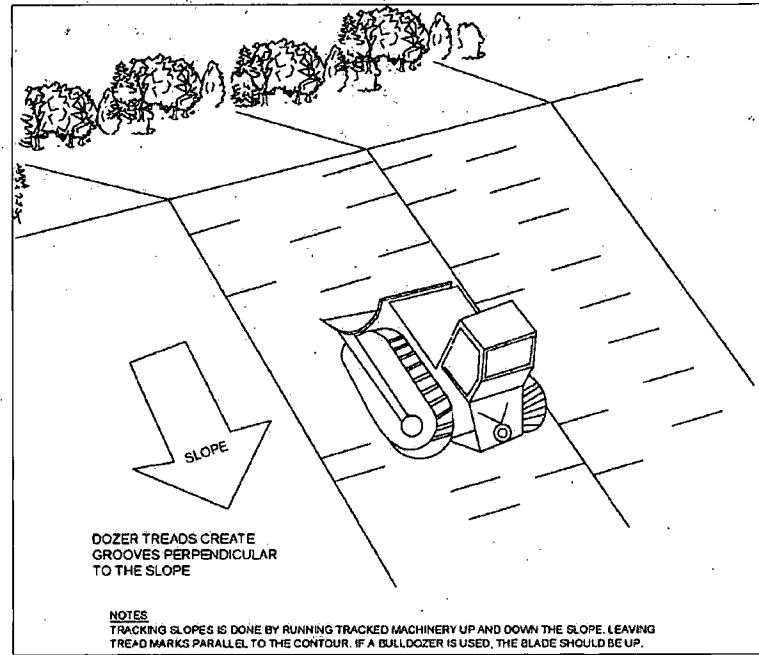


ANTERO RESOURCES CORPORATION STANDARD RIBBON COLOR SCHEME  
PROVIDED BY ANTERO RESOURCES APPALACHIAN CORPORATION

REVISION	DATE







REVISION	DATE

**ANTERO RESOURCES**  
THIS DOCUMENT WAS PREPARED FOR  
**ANTERO RESOURCES CORPORATION**

CONSTRUCTION DETAILS

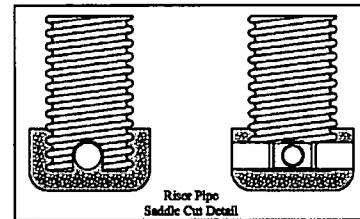
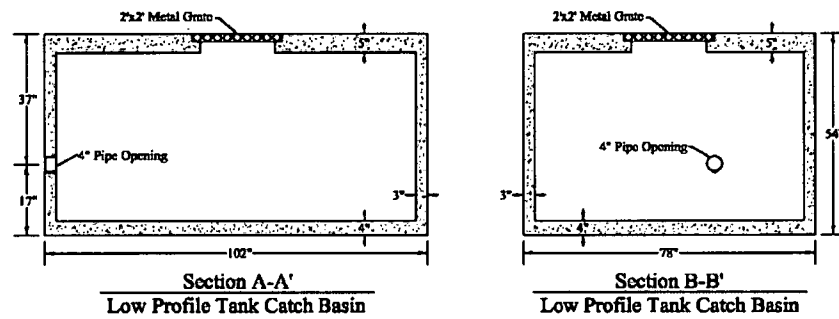
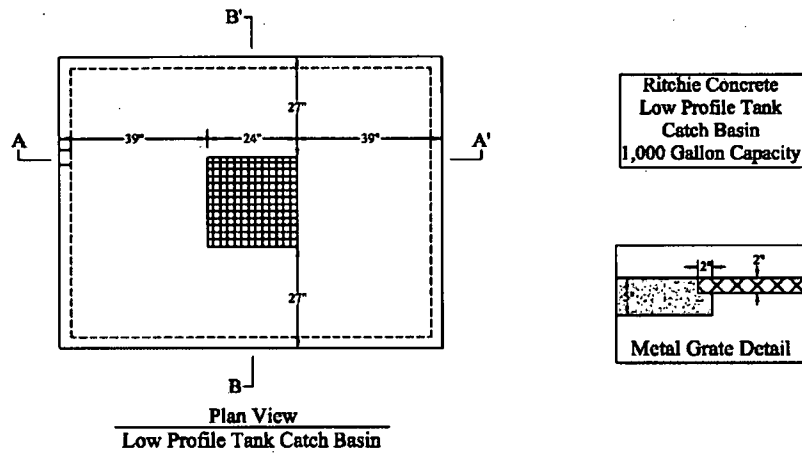
**WILLARD**

**WELL PAD & WATER CONTAINMENT PAD**

NEW MILTON DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



# WELL PAD DEWATERING SYSTEM SPECIFICATIONS



### Size of Tank

6½' Wide  
8½' Long  
4½' Tall

### Hole Size

7½' Wide  
9½' Long  
5'-2" Tall

### Mix Design

4000 psi

	lbs. yd.	Ab. vol.
	563	2.86
	270	4.33
	5%+1	1.35
	1222	7.42
	1770	11.04
		27.00cf

### Outlet Lines

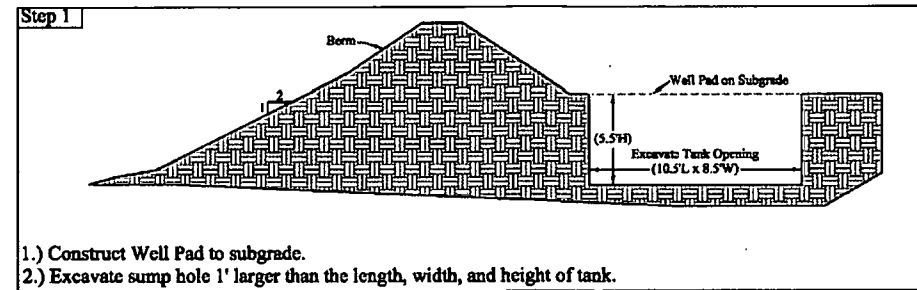
Outlet 17" from bottom of tank  
Polylock Seals adaptable for 2, 3, & 4"

All tanks are of durable construction and are state approved

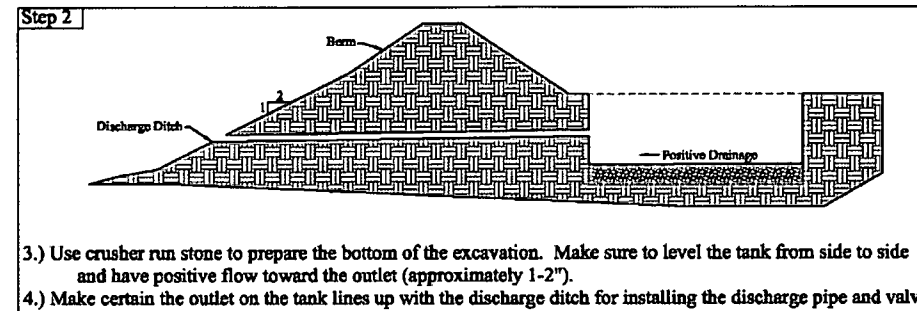
### Thickness

Walls 3"  
6x6x10 gauge wire mesh  
¾" Rebar on 18" Centers  
Bottom 4"

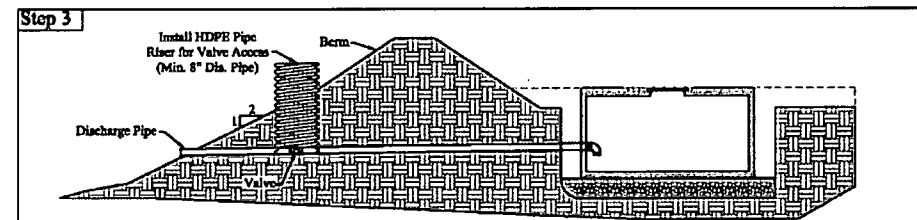
Tops with ½" Rebar on 14" Centers



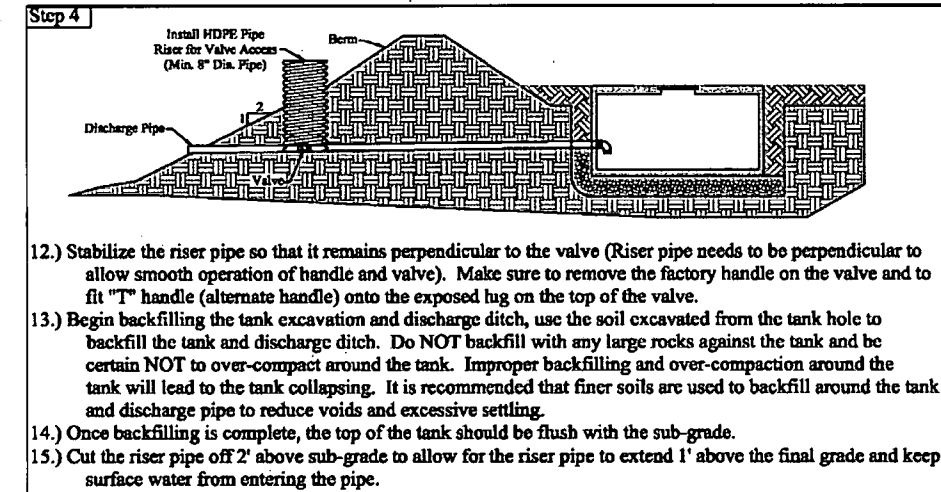
- 1.) Construct Well Pad to subgrade.
- 2.) Excavate sump hole 1' larger than the length, width, and height of tank.



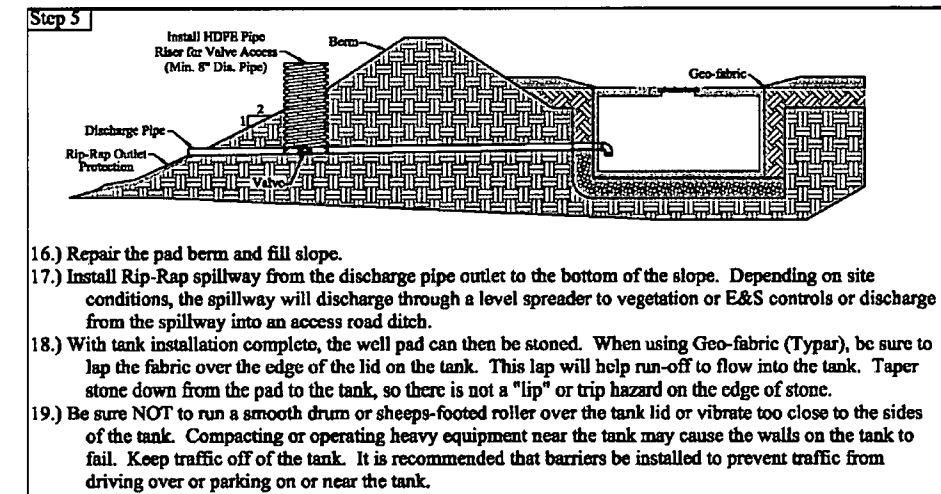
- 3.) Use crusher run stone to prepare the bottom of the excavation. Make sure to level the tank from side to side and have positive flow toward the outlet (approximately 1-2").
- 4.) Make certain the outlet on the tank lines up with the discharge ditch for installing the discharge pipe and valve



- 5.) Set the tank in the excavation and level.
- 6.) Install pipe section, (approximately 1-2' piece) into the outlet fitting on the tank. Use hydraulic cement around the connection to insure positive seal.
- 7.) Install 4" valve onto short section of the pipe with glue (make certain to clean and prime both valve and pipe before gluing connection).
- 8.) Install sections of pipe onto the outlet side of the valve until the pipe extends through the berm and slope approximately 1'. Leave the end of the pipe exposed (make certain to clean and prime the pipe and joints before gluing the connections).
- 9.) Make certain that the pipe is supported and maintains positive flow away from the valve. Use excavated soil from the discharge ditch to support the pipe.
- 10.) Install the riser for the valve. Use a section of HDPE pipe with a larger diameter than the valve (minimum 8" diameter HDPE pipe). Cut a "saddle" on the bottom of the riser pipe so that the riser pipe will rest on the discharge pipe, surrounding the valve and keeping dirt away from the operation of the valve.
- 11.) Fill around the valve with crusher run stone and 1' on the riser pipe to keep soil out.



- 12.) Stabilize the riser pipe so that it remains perpendicular to the valve (Riser pipe needs to be perpendicular to allow smooth operation of handle and valve). Make sure to remove the factory handle on the valve and to fit "T" handle (alternate handle) onto the exposed lug on the top of the valve.
- 13.) Begin backfilling the tank excavation and discharge ditch, use the soil excavated from the tank hole to backfill the tank and discharge ditch. Do NOT backfill with any large rocks against the tank and be certain NOT to over-compact around the tank. Improper backfilling and over-compaction around the tank will lead to the tank collapsing. It is recommended that finer soils are used to backfill around the tank and discharge pipe to reduce voids and excessive settling.
- 14.) Once backfilling is complete, the top of the tank should be flush with the sub-grade.
- 15.) Cut the riser pipe off 2' above sub-grade to allow for the riser pipe to extend 1' above the final grade and keep surface water from entering the pipe.



- 16.) Repair the pad berm and fill slope.
- 17.) Install Rip-Rap spillway from the discharge pipe outlet to the bottom of the slope. Depending on site conditions, the spillway will discharge through a level spreader to vegetation or E&S controls or discharge from the spillway into an access road ditch.
- 18.) With tank installation complete, the well pad can then be stoned. When using Geo-fabric (Tytar), be sure to lap the fabric over the edge of the lid on the tank. This lap will help run-off to flow into the tank. Taper stone down from the pad to the tank, so there is not a "lip" or trip hazard on the edge of stone.
- 19.) Be sure NOT to run a smooth drum or sheeps-footed roller over the tank lid or vibrate too close to the sides of the tank. Compacting or operating heavy equipment near the tank may cause the walls on the tank to fail. Keep traffic off of the tank. It is recommended that barriers be installed to prevent traffic from driving over or parking on or near the tank.

### Operational Note:

The dewatering valve will remain closed during drilling and completion operations. Any water captured during the drilling and completion operations will be tested prior to being discharged or pumped by a commercial vendor. After drilling and completion operations are complete, the valve will be opened by a designated responsible person only.

### NOTE:

1. THE WELL PAD DEWATERING SYSTEM DETAILS AND SPECIFICATIONS SHOWN ON THIS SHEET WERE PROVIDED BY ANTERO RESOURCES APPALACHIAN CORPORATION AND REFLECT THEIR CURRENT STANDARD, FOR ALL WELL PAD SITES, TO CONTROL POTENTIAL SPILLS DURING DRILLING AND COMPLETION OPERATIONS.

REVISION

DATE

CONSTRUCTION DETAILS

**WILLARD**

**WELL PAD & WATER CONTAINMENT PAD**  
NEW MILTON DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 09/16/2013

SCALE: N/A

SHEET 20 OF 26

**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**

- 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.
- 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.
- 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:**

- All legumes must be planted with the proper inoculants prior to seeding.
- Lathco* Flatpea is potentially poisonous to some livestock.
- Only endophyte free varieties of Tall Fescue should be used. Tall Fescue and Crownvetch are also very invasive species, non-native to WV.
- 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.

**NOTE:**

- NO FESCUE OR TIMOTHY GRASS SHALL BE USED.

**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**

Species/Mixture	Seeding Rate (lbs/acre)	Soil Drainage preference	pH Range
Crownvetch / Tall Fescue	10 - 15	Well - Mod. Well	5.0 - 7.5
Crownvetch / Perennial Ryegrass	20	Well - Mod. Well	5.0 - 7.5
Flatpea or Perennial Pea / Tall Fescue	20	Well - Mod. Well	4.0 - 8.0
Ladino Clover / Serecia Lespedeza / Tall Fescue	15		
Ladino Clover / Redtop	30	Well - Mod. Well	4.5 - 7.5
Tall Fescue / Ladino Clover / Redtop	25	Well - Mod. Well	4.5 - 7.5
Crownvetch / Tall Fescue / Redtop	40		
Ladino Clover / Redtop	3	Well - Mod. Well	5.0 - 7.5
Crownvetch / Tall Fescue / Redtop	10		
Tall Fescue / Redtop	20	Well - Mod. Well	5.0 - 7.5
Tall Fescue / Birdsfoot Trefoil / Redtop	3	Well - Mod. Well	5.0 - 7.5
Serecia Lespedeza / Tall Fescue / Redtop	3		
Redtop / Tall Fescue / Creeping Red	25	Well - Mod. Well	4.5 - 7.5
Redtop / Tall Fescue / Creeping Red	30		
Tall Fescue / Creeping Red	3	Well - Mod. Well	5.0 - 7.5
Tall Fescue / Perennial Ryegrass / Tall Fescue	50		
Perennial Ryegrass / Tall Fescue	50	Well - Poorly	4.5 - 7.5
Lathco Flatpea *	10		
Lathco Flatpea *	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**

Species/Mixture	Seeding Rate (lbs/acre)	Soil Drainage preference	pH Range
KY Bluegrass / Redtop	20		
Ladino Clover or Birdsfoot Trefoil	3	Well - Mod. Well	5.5 - 7.5
Timothy / Alfalfa	2 / 10		
Timothy / Birdsfoot Trefoil	5	Well - Mod. Well	6.5 - 8.0
Alfalfa / Timothy	12		
Birdsfoot Trefoil / Crchardgrass / Ladino Clover / Redtop	5	Well - Poorly	5.5 - 7.5
Crchardgrass / Ladino Clover / Redtop	8		
Crchardgrass / Ladino Clover / Crchardgrass	10	Well - Mod. Well	5.5 - 7.5
Perennial Ryegrass / Creeping Red Fescue / Perennial Ryegrass	2	Well - Mod. Well	5.5 - 7.5
Orchardgrass or KY Bluegrass	20	Well - Mod. Well	5.5 - 7.5
Birdsfoot Trefoil / Redtop / Crchardgrass	10	Well - Mod. Well	5.5 - 7.5
Crchardgrass / Lathco Flatpea * / Perennial Ryegrass	20	Well - Mod. Well	5.5 - 7.5
Perennial Ryegrass / Lathco Flatpea * / Crchardgrass	30		
Crchardgrass / Lathco Flatpea * / Perennial Ryegrass	10	Well - Mod. Well	5.5 - 7.5
Lathco Flatpea * / Perennial Ryegrass	20		
Perennial Ryegrass / Lathco Flatpea * / Crchardgrass	30	Well - Mod. Well	5.5 - 7.5
Crchardgrass	20	Well - Mod. Well	5.5 - 7.5

\* *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**

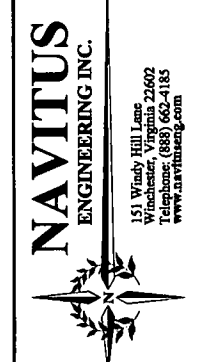
pH of Soil	Lime in Tons per Acre	Fertilizer, Lbs., per Acre (10-20-20 or Equivalent)
Above 6.0	2	500
5.0 to 6.0	3	500
Below 5.0	4	500

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**

Material	Minimum Rates per acre	Coverage	Remarks
Hay or Straw	2 to 3 Tons	Cover 75% to 90% of Surface	Subject to wind blowing or washing unless tied down
Wood Fiber	100 to 150 bales	Cover all Disturbed Areas	For hydroseeding
Pulp Fiber			
Wood - Cellulose			
Recirculated Paper			

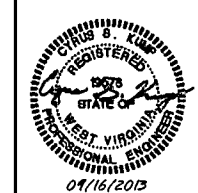
Engineering  
Survey  
Environmental  
GIS



REVISION	DATE



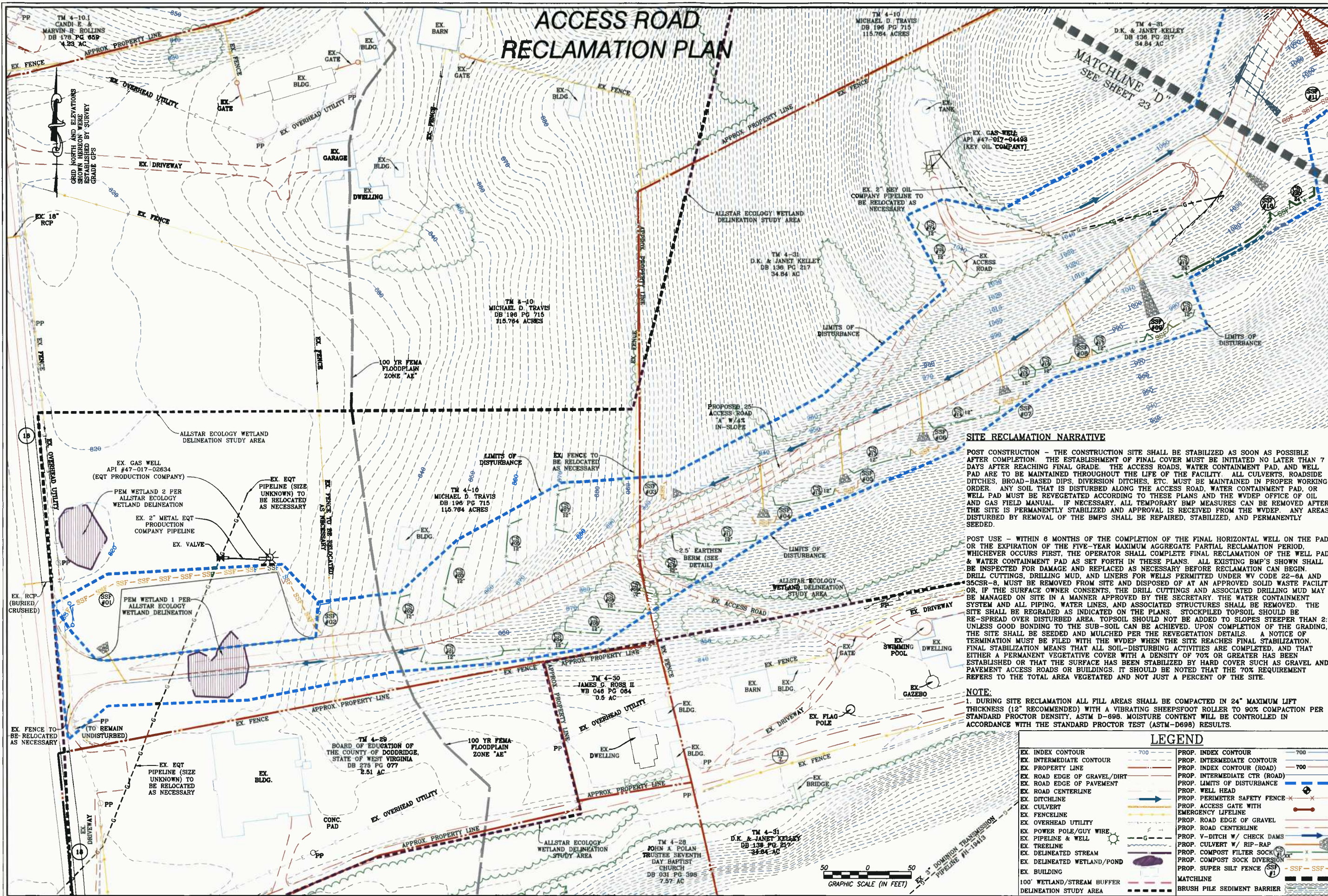
CONSTRUCTION DETAILS  
**WILLARD**  
WELL PAD & WATER CONTAINMENT PAD  
NEW MILTON DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 09/16/2013  
SCALE: N/A  
SHEET 21 OF 26



# ACCESS ROAD RECLAMATION PLAN



## SITE RECLAMATION NARRATIVE

POST CONSTRUCTION - THE CONSTRUCTION SITE SHALL BE STABILIZED AS SOON AS POSSIBLE AFTER COMPLETION. THE ESTABLISHMENT OF FINAL COVER MUST BE INITIATED NO LATER THAN 7 DAYS AFTER REACHING FINAL GRADE. THE ACCESS ROADS, WATER CONTAINMENT PAD, AND WELL PAD ARE TO BE MAINTAINED THROUGHOUT THE LIFE OF THE FACILITY. ALL CULVERTS, ROADSIDE DITCHES, BROAD-BASED DIPS, DIVERSION DITCHES, ETC. MUST BE MAINTAINED IN PROPER WORKING ORDER. ANY SOIL THAT IS DISTURBED ALONG THE ACCESS ROAD, WATER CONTAINMENT PAD, OR WELL PAD MUST BE REVEGETATED ACCORDING TO THESE PLANS AND THE WDEP OFFICE OF OIL AND GAS FIELD MANUAL. IF NECESSARY, ALL TEMPORARY BMP MEASURES CAN BE REMOVED AFTER THE SITE IS PERMANENTLY STABILIZED AND APPROVAL IS RECEIVED FROM THE WDEP. ANY AREAS DISTURBED BY REMOVAL OF THE BMPS SHALL BE REPAIRED, STABILIZED, AND PERMANENTLY SEEDDED.

POST USE - WITHIN 6 MONTHS OF THE COMPLETION OF THE FINAL HORIZONTAL WELL ON THE PAD OR THE EXPIRATION OF THE FIVE-YEAR MAXIMUM AGGREGATE PARTIAL RECLAMATION PERIOD, WHICHEVER OCCURS FIRST, THE OPERATOR SHALL COMPLETE FINAL RECLAMATION OF THE WELL PAD & WATER CONTAINMENT PAD AS SET FORTH IN THESE PLANS. ALL EXISTING BMP'S SHOWN SHALL BE INSPECTED FOR DAMAGE AND REPLACED AS NECESSARY BEFORE RECLAMATION CAN BEGIN. DRILL CUTTINGS, DRILLING MUD, AND LINERS FOR WELLS PERMITTED UNDER WV CODE 22-6A AND 35CSR-8, MUST BE REMOVED FROM SITE AND DISPOSED OF AT AN APPROVED SOLID WASTE FACILITY OR, IF THE SURFACE OWNER CONSENTS, THE DRILL CUTTINGS AND ASSOCIATED DRILLING MUD MAY BE MANAGED ON SITE IN A MANNER APPROVED BY THE SECRETARY. THE WATER CONTAINMENT SYSTEM AND ALL PIPING, WATER LINES, AND ASSOCIATED STRUCTURES SHALL BE REMOVED. THE SITE SHALL BE REGRADED AS INDICATED ON THE PLANS. STOCKPILED TOPSOIL SHOULD BE RE-SPREAD OVER DISTURBED AREA. TOPSOIL SHOULD NOT BE ADDED TO SLOPES STEEPER THAN 2:1 UNLESS GOOD BONDING TO THE SUB-SOIL CAN BE ACHIEVED. UPON COMPLETION OF THE GRADING, THE SITE SHALL BE SEEDDED AND MULCHED PER THE REVEGETATION DETAILS. A NOTICE OF TERMINATION MUST BE FILED WITH THE WDEP WHEN THE SITE REACHES FINAL STABILIZATION. FINAL STABILIZATION MEANS THAT ALL SOIL-DISTURBING ACTIVITIES ARE COMPLETED AND THAT EITHER A PERMANENT VEGETATIVE COVER WITH A DENSITY OF 70% OR GREATER HAS BEEN ESTABLISHED OR THAT THE SURFACE HAS BEEN STABILIZED BY HARD COVER SUCH AS GRAVEL AND PAVEMENT ACCESS ROADS OR BUILDINGS. IT SHOULD BE NOTED THAT THE 70% REQUIREMENT REFERS TO THE TOTAL AREA VEGETATED AND NOT JUST A PERCENT OF THE SITE.

### 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. MOISTURE CONTENT WILL BE CONTROLLED IN ACCORDANCE WITH THE STANDARD PROCTOR TEST (ASTM-D698) RESULTS.

## LEGEND

EX. INDEX CONTOUR	---	700	PROP. INDEX CONTOUR	---	700
EX. INTERMEDIATE CONTOUR	---	700	PROP. INTERMEDIATE CONTOUR	---	700
EX. PROPERTY LINE	---	700	PROP. INDEX CONTOUR (ROAD)	---	700
EX. ROAD EDGE OF GRAVEL/DIRT	---	700	PROP. INTERMEDIATE CTR (ROAD)	---	700
EX. ROAD EDGE OF PAVEMENT	---	700	PROP. LIMITS OF DISTURBANCE	---	700
EX. ROAD CENTERLINE	---	700	PROP. WELL HEAD	---	700
EX. DITCHLINE	---	700	PROP. PERIMETER SAFETY FENCE	---	700
EX. CULVERT	---	700	PROP. ACCESS GATE WITH EMERGENCY LIFELINE	---	700
EX. FENCELINE	---	700	PROP. ROAD EDGE OF GRAVEL	---	700
EX. OVERHEAD UTILITY	---	700	PROP. ROAD CENTERLINE	---	700
EX. POWER POLE/GUY WIRE	---	700	PROP. V-DITCH W/ CHECK DAMS	---	700
EX. PIPELINE & WELL	---	700	PROP. CULVERT W/ RIP-RAP	---	700
EX. TRENCH	---	700	PROP. COMPOST FILTER SOCK	---	700
EX. DELINEATED STREAM	---	700	PROP. COMPOST SOCK DIVERSION	---	700
EX. DELINEATED WETLAND/POND	---	700	PROP. SUPER SILT FENCE	---	700
EX. BUILDING	---	700	MATCHLINE	---	700
100' WETLAND/STREAM BUFFER DELINEATION STUDY AREA	---	700	BRUSH PILE SEDIMENT BARRIER	---	700

**NAVITUS ENGINEERING INC.**  
 Engineering Survey Environmental GIS  
 151 Windy Hill Lane  
 Winchester, Virginia 22602  
 Telephone: (888) 662-4185  
 www.navituseng.com

DATE	REVISION

**ANTERO RESOURCES**  
 THIS DOCUMENT WAS PREPARED FOR ANTERO RESOURCES CORPORATION

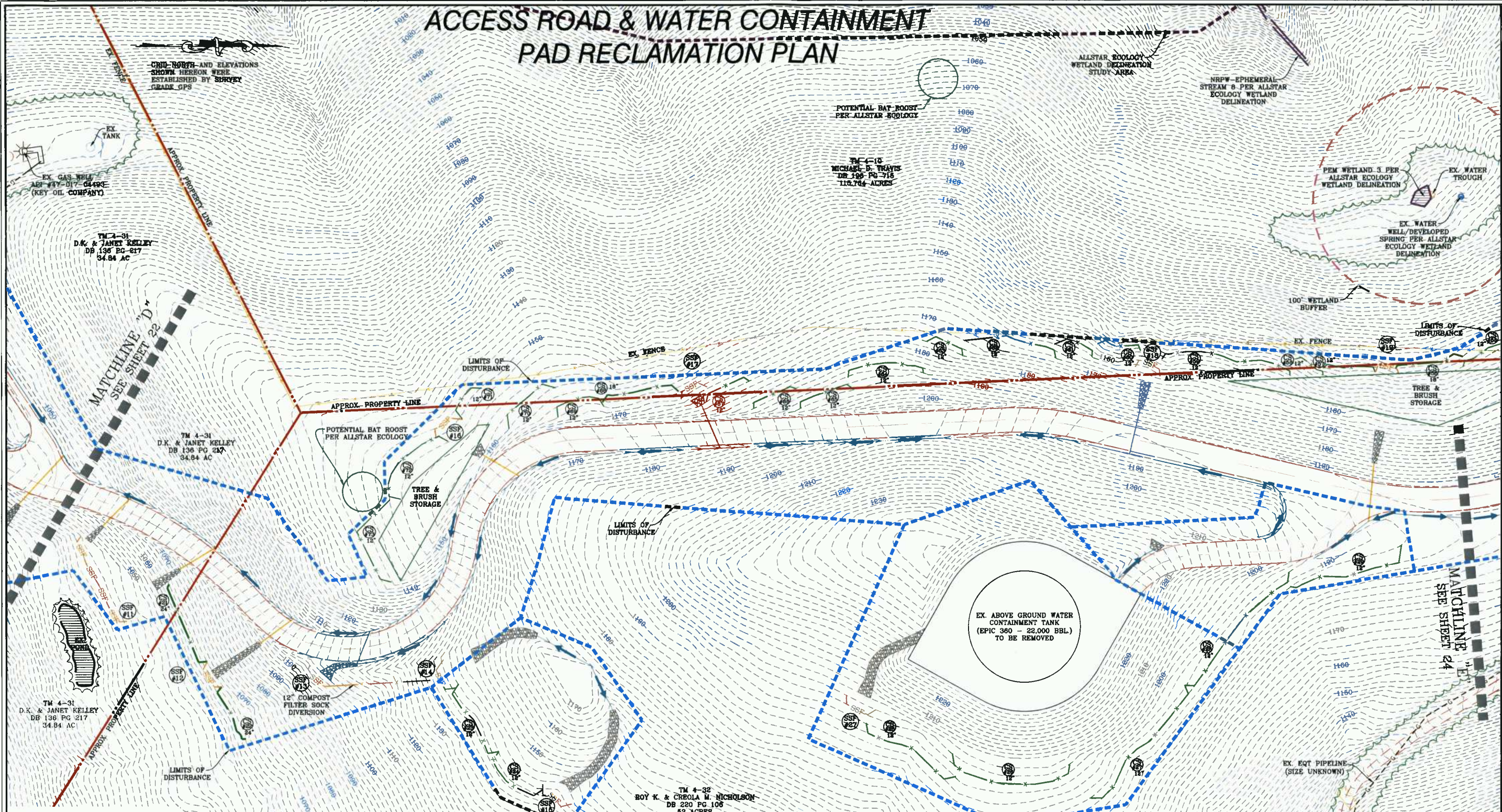
ACCESS ROAD RECLAMATION PLAN  
**WILLARD**  
 WELL PAD & WATER CONTAINMENT PAD  
 NEW MILTON DISTRICT  
 DODDRIDGE COUNTY, WEST VIRGINIA

REGISTERED PROFESSIONAL ENGINEER  
 STATE OF WEST VIRGINIA  
 01/16/2013

DATE: 09/16/2013  
 SCALE: 1" = 50'  
 SHEET 22 OF 26



# ACCESS ROAD & WATER CONTAINMENT PAD RECLAMATION PLAN



## SITE RECLAMATION NARRATIVE

POST CONSTRUCTION - THE CONSTRUCTION SITE SHALL BE STABILIZED AS SOON AS POSSIBLE AFTER COMPLETION. THE ESTABLISHMENT OF FINAL COVER MUST BE INITIATED NO LATER THAN 7 DAYS AFTER REACHING FINAL GRADE. THE ACCESS ROADS, WATER CONTAINMENT PAD, AND WELL PAD ARE TO BE MAINTAINED THROUGHOUT THE LIFE OF THE FACILITY. ALL CULVERTS, ROADSIDE DITCHES, BROAD-BASED DIPS, DIVERSION DITCHES, ETC. MUST BE MAINTAINED IN PROPER WORKING ORDER. ANY SOIL THAT IS DISTURBED ALONG THE ACCESS ROAD, WATER CONTAINMENT PAD, OR WELL PAD MUST BE REVEGETATED ACCORDING TO THESE PLANS AND THE WVDEP OFFICE OF OIL AND GAS FIELD MANUAL. IF NECESSARY, ALL TEMPORARY BMP MEASURES CAN BE REMOVED AFTER THE SITE IS PERMANENTLY STABILIZED AND APPROVAL IS RECEIVED FROM THE WVDEP. ANY AREAS DISTURBED BY REMOVAL OF THE BMP'S SHALL BE REPAIRED, STABILIZED, AND PERMANENTLY SEEDDED.

POST USE - WITHIN 6 MONTHS OF THE COMPLETION OF THE FINAL HORIZONTAL WELL ON THE PAD OR THE EXPIRATION OF THE FIVE-YEAR MAXIMUM AGGREGATE PARTIAL RECLAMATION PERIOD, WHICHEVER OCCURS FIRST, THE OPERATOR SHALL COMPLETE FINAL RECLAMATION OF THE WELL PAD & WATER CONTAINMENT PAD AS SET FORTH IN THESE PLANS. ALL EXISTING BMP'S SHOWN SHALL BE INSPECTED FOR DAMAGE AND REPLACED AS NECESSARY BEFORE RECLAMATION CAN BEGIN. DRILL CUTTINGS, DRILLING MUD, AND LINERS FOR WELLS PERMITTED UNDER WV CODE 22-8A AND 35CSR-8, MUST BE REMOVED FROM SITE AND DISPOSED OF AT AN APPROVED SOLID WASTE FACILITY OR, IF THE SURFACE OWNER CONSENTS, THE DRILL CUTTINGS AND ASSOCIATED DRILLING MUD MAY BE MANAGED ON SITE IN A MANNER APPROVED BY THE SECRETARY. THE WATER CONTAINMENT SYSTEM AND ALL PIPING, WATER LINES, AND ASSOCIATED STRUCTURES SHALL BE REMOVED. THE SITE SHALL BE REGRADED AS INDICATED ON THE PLANS. STOCKPILED TOPSOIL SHOULD BE RE-SPREAD OVER DISTURBED AREA. TOPSOIL SHOULD NOT BE ADDED TO SLOPES STEEPER THAN 2:1 UNLESS GOOD BONDING TO THE SUB-SOIL CAN BE ACHIEVED. UPON COMPLETION OF THE GRADING, THE SITE SHALL BE SEEDDED AND MULCHED PER THE REVEGETATION DETAILS. A NOTICE OF TERMINATION MUST BE FILED WITH THE WVDEP WHEN THE SITE REACHES FINAL STABILIZATION. FINAL STABILIZATION MEANS THAT ALL SOIL-DISTURBING ACTIVITIES ARE COMPLETED, AND THAT EITHER A PERMANENT VEGETATIVE COVER WITH A DENSITY OF 70% OR GREATER HAS BEEN ESTABLISHED OR THAT THE SURFACE HAS BEEN STABILIZED BY HARD COVER SUCH AS GRAVEL AND PAVEMENT ACCESS ROADS OR BUILDINGS. IT SHOULD BE NOTED THAT THE 70% REQUIREMENT REFERS TO THE TOTAL AREA VEGETATED AND NOT JUST A PERCENT OF THE SITE.

**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. MOISTURE CONTENT WILL BE CONTROLLED IN ACCORDANCE WITH THE STANDARD PROCTOR TEST (ASTM-D698) RESULTS.

## LEGEND

EX. INDEX CONTOUR	700	PROP. INDEX CONTOUR	700
EX. INTERMEDIATE CONTOUR		PROP. INTERMEDIATE CONTOUR	
EX. PROPERTY LINE		PROP. INDEX CONTOUR (ROAD)	700
EX. ROAD EDGE OF GRAVEL/DIRT		PROP. INTERMEDIATE CTR (ROAD)	
EX. ROAD EDGE OF PAVEMENT		PROP. LIMITS OF DISTURBANCE	
EX. ROAD CENTERLINE		PROP. WELL HEAD	
EX. DITCHLINE		PROP. PERMETER SAFETY FENCE	
EX. CULVERT		PROP. ACCESS GATE WITH EMERGENCY LIFELINE	
EX. FENCELINE		PROP. ROAD EDGE OF GRAVEL	
EX. OVERHEAD UTILITY		PROP. ROAD CENTERLINE	
EX. POWER POLE/GUY WIRE		PROP. V-DITCH W/ CHECK DAMS	
EX. PIPELINE & WELL		PROP. CULVERT W/ RIP-RAP	
EX. TREELINE		PROP. COMPOST FILTER SOCK	
EX. DELINEATED STREAM		PROP. COMPOST FILTER SOCK DIVERSION	
EX. DELINEATED WETLAND/POND		PROP. SUPER SILT FENCE (SSP)	
EX. BUILDING		MATCHLINE	
100' WETLAND/STREAM BUFFER		BRUSH PILE SEDIMENT BARRIER	



**NAVITUS ENGINEERING INC.**  
 Engineering Survey Environmental GIS  
 151 Windy Hill Lane  
 Winchester, Virginia 22602  
 Telephone: (888) 662-4185  
 www.navituseng.com

DATE	REVISION

**ANTERO RESOURCES**  
 THIS DOCUMENT WAS PREPARED FOR:  
**ANTERO RESOURCES CORPORATION**

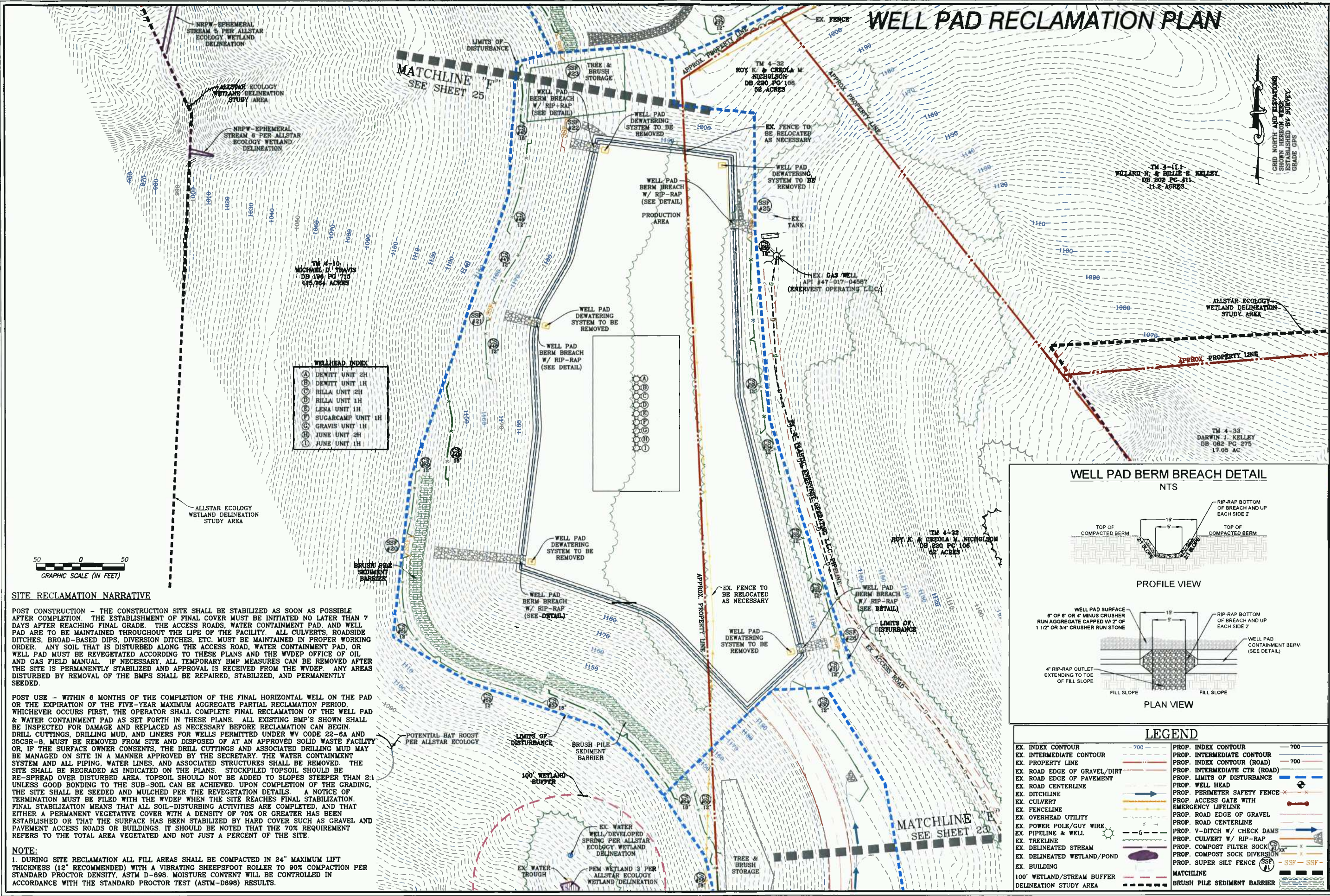
ACCESS ROAD & WATER CONTAINMENT PAD RECLAMATION PLAN  
**WILLARD**  
 WELL PAD & WATER CONTAINMENT PAD  
 NEW MILTON DISTRICT  
 DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 09/16/2013  
 SCALE: 1" = 50'  
 SHEET 23 OF 26

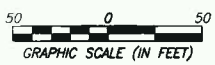


# WELL PAD RECLAMATION PLAN



**WELLHEAD INDEX**

(A)	DEWITT UNIT 2H
(B)	DEWITT UNIT 1H
(C)	RILLA UNIT 2H
(D)	RILLA UNIT 1H
(E)	LENA UNIT 1H
(F)	SUGARCAMP UNIT 1H
(G)	GRAVIS UNIT 1H
(H)	JUNE UNIT 2H
(I)	JUNE UNIT 1H



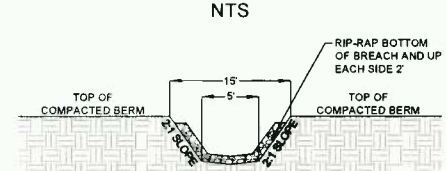
**SITE RECLAMATION NARRATIVE**

POST CONSTRUCTION - THE CONSTRUCTION SITE SHALL BE STABILIZED AS SOON AS POSSIBLE AFTER COMPLETION. THE ESTABLISHMENT OF FINAL COVER MUST BE INITIATED NO LATER THAN 7 DAYS AFTER REACHING FINAL GRADE. THE ACCESS ROADS, WATER CONTAINMENT PAD, AND WELL PAD ARE TO BE MAINTAINED THROUGHOUT THE LIFE OF THE FACILITY. ALL CULVERTS, ROADSIDE DITCHES, BROAD-BASED DIPS, DIVERSION DITCHES, ETC. MUST BE MAINTAINED IN PROPER WORKING ORDER. ANY SOIL THAT IS DISTURBED ALONG THE ACCESS ROAD, WATER CONTAINMENT PAD, OR WELL PAD MUST BE REVEGETATED ACCORDING TO THESE PLANS AND THE WVDEP OFFICE OF OIL AND GAS FIELD MANUAL. IF NECESSARY, ALL TEMPORARY BMP MEASURES CAN BE REMOVED AFTER THE SITE IS PERMANENTLY STABILIZED AND APPROVAL IS RECEIVED FROM THE WVDEP. ANY AREAS DISTURBED BY REMOVAL OF THE BMPS SHALL BE REPAIRED, STABILIZED, AND PERMANENTLY SEEDED.

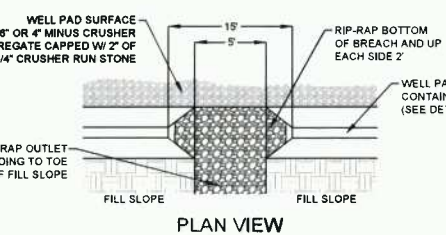
POST USE - WITHIN 6 MONTHS OF THE COMPLETION OF THE FINAL HORIZONTAL WELL ON THE PAD OR THE EXPIRATION OF THE FIVE-YEAR MAXIMUM AGGREGATE PARTIAL RECLAMATION PERIOD, WHICHEVER OCCURS FIRST, THE OPERATOR SHALL COMPLETE FINAL RECLAMATION OF THE WELL PAD & WATER CONTAINMENT PAD AS SET FORTH IN THESE PLANS. ALL EXISTING BMP'S SHOWN SHALL BE INSPECTED FOR DAMAGE AND REPLACED AS NECESSARY BEFORE RECLAMATION CAN BEGIN. DRILL CUTTINGS, DRILLING MUD, AND LINERS FOR WELLS PERMITTED UNDER WV CODE 22-6A AND 35CSR-8, MUST BE REMOVED FROM SITE AND DISPOSED OF AT AN APPROVED SOLID WASTE FACILITY OR, IF THE SURFACE OWNER CONSENTS, THE DRILL CUTTINGS AND ASSOCIATED DRILLING MUD MAY BE MANAGED ON SITE IN A MANNER APPROVED BY THE SECRETARY. THE WATER CONTAINMENT SYSTEM AND ALL PIPING, WATER LINES, AND ASSOCIATED STRUCTURES SHALL BE REMOVED. THE SITE SHALL BE REGRADED AS INDICATED ON THE PLANS. STOCKPILED TOPSOIL SHOULD BE RE-SPREAD OVER DISTURBED AREA. TOPSOIL SHOULD NOT BE ADDED TO SLOPES STEEPER THAN 2:1 UNLESS GOOD BONDING TO THE SUB-SOIL CAN BE ACHIEVED. UPON COMPLETION OF THE GRADING, THE SITE SHALL BE SEEDED AND MULCHED PER THE REVEGETATION DETAILS. A NOTICE OF TERMINATION MUST BE FILED WITH THE WVDEP WHEN THE SITE REACHES FINAL STABILIZATION. FINAL STABILIZATION MEANS THAT ALL SOIL-DISTURBING ACTIVITIES ARE COMPLETED, AND THAT EITHER A PERMANENT VEGETATIVE COVER WITH A DENSITY OF 70% OR GREATER HAS BEEN ESTABLISHED OR THAT THE SURFACE HAS BEEN STABILIZED BY HARD COVER SUCH AS GRAVEL AND PAVEMENT ACCESS ROADS OR BUILDINGS. IT SHOULD BE NOTED THAT THE 70% REQUIREMENT REFERS TO THE TOTAL AREA VEGETATED AND NOT JUST A PERCENT OF THE SITE.

**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. MOISTURE CONTENT WILL BE CONTROLLED IN ACCORDANCE WITH THE STANDARD PROCTOR TEST (ASTM-D698) RESULTS.

**WELL PAD BERM BREACH DETAIL**



**PROFILE VIEW**



**PLAN VIEW**

**LEGEND**

EX. INDEX CONTOUR	- - - 700 - - -	PROP. INDEX CONTOUR	- - - 700 - - -
EX. INTERMEDIATE CONTOUR	- - - - - 700 - - - - -	PROP. INTERMEDIATE CONTOUR	- - - - - 700 - - - - -
EX. PROPERTY LINE	- - - - - 700 - - - - -	PROP. INDEX CONTOUR (ROAD)	- - - - - 700 - - - - -
EX. ROAD EDGE OF GRAVEL/DIRT	- - - - - 700 - - - - -	PROP. INTERMEDIATE CTR (ROAD)	- - - - - 700 - - - - -
EX. ROAD EDGE OF PAVEMENT	- - - - - 700 - - - - -	PROP. LIMITS OF DISTURBANCE	- - - - - 700 - - - - -
EX. ROAD CENTERLINE	- - - - - 700 - - - - -	PROP. WELL HEAD	- - - - - 700 - - - - -
EX. DITCHLINE	- - - - - 700 - - - - -	PROP. PERMETER SAFETY FENCE	- - - - - 700 - - - - -
EX. CULVERT	- - - - - 700 - - - - -	PROP. ACCESS GATE WITH EMERGENCY LIFELINE	- - - - - 700 - - - - -
EX. FENCELINE	- - - - - 700 - - - - -	PROP. ROAD EDGE OF GRAVEL	- - - - - 700 - - - - -
EX. OVERHEAD UTILITY	- - - - - 700 - - - - -	PROP. ROAD CENTERLINE	- - - - - 700 - - - - -
EX. POWER POLE/GUY WIRE	- - - - - 700 - - - - -	PROP. V-DITCH W/ CHECK DAMS	- - - - - 700 - - - - -
EX. PIPELINE & WELL	- - - - - 700 - - - - -	PROP. CULVERT W/ RIP-RAP	- - - - - 700 - - - - -
EX. TRELINE	- - - - - 700 - - - - -	PROP. COMPOST FILTER SOCK	- - - - - 700 - - - - -
EX. DELINEATED STREAM	- - - - - 700 - - - - -	PROP. COMPOST SOCK DIVERSION	- - - - - 700 - - - - -
EX. DELINEATED WETLAND/POND	- - - - - 700 - - - - -	PROP. SUPER SILT FENCE (SSF)	- - - - - 700 - - - - -
EX. BUILDING	- - - - - 700 - - - - -	MATCHLINE	- - - - - 700 - - - - -
100' WETLAND/STREAM BUFFER DELINEATION STUDY AREA	- - - - - 700 - - - - -	BRUSH PILE SEDIMENT BARRIER	- - - - - 700 - - - - -

**NAVITUS ENGINEERING INC.**  
 Engineering Survey Environmental GIS  
 151 Windy Hill Lane  
 Winchester, Virginia 22602  
 Telephone: (888) 662-4185  
 www.navituseng.com

REVISION	DATE

**ANTERO RESOURCES**  
 THIS DOCUMENT WAS PREPARED FOR ANTERO RESOURCES CORPORATION

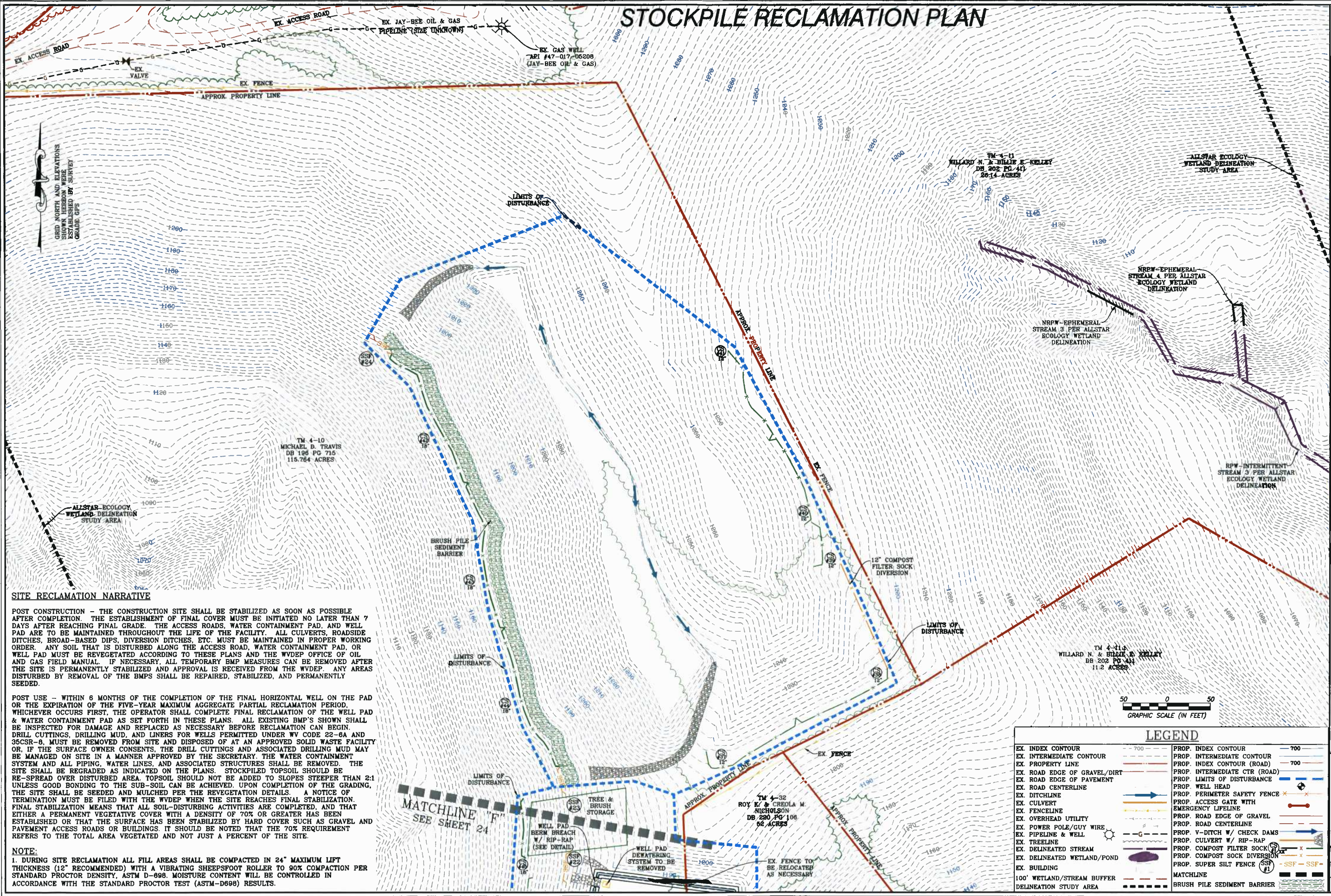
**WILLARD RECLAMATION PLAN**  
**WILLARD**  
 WELL PAD & WATER CONTAINMENT PAD  
 NEW MILTON DISTRICT  
 DODDRIDGE COUNTY, WEST VIRGINIA

REGISTERED PROFESSIONAL ENGINEER  
 STATE OF WEST VIRGINIA  
 01/16/2013

DATE: 09/16/2013  
 SCALE: 1" = 50'  
 SHEET 24 OF 26



# STOCKPILE RECLAMATION PLAN

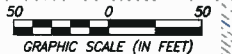


## SITE RECLAMATION NARRATIVE

**POST CONSTRUCTION -** THE CONSTRUCTION SITE SHALL BE STABILIZED AS SOON AS POSSIBLE AFTER COMPLETION. THE ESTABLISHMENT OF FINAL COVER MUST BE INITIATED NO LATER THAN 7 DAYS AFTER REACHING FINAL GRADE. THE ACCESS ROADS, WATER CONTAINMENT PAD, AND WELL PAD ARE TO BE MAINTAINED THROUGHOUT THE LIFE OF THE FACILITY. ALL CULVERTS, ROADSIDE DITCHES, BROAD-BASED DIPS, DIVERSION DITCHES, ETC. MUST BE MAINTAINED IN PROPER WORKING ORDER. ANY SOIL THAT IS DISTURBED ALONG THE ACCESS ROAD, WATER CONTAINMENT PAD, OR WELL PAD MUST BE REVEGETATED ACCORDING TO THESE PLANS AND THE WVDEP OFFICE OF OIL AND GAS FIELD MANUAL. IF NECESSARY, ALL TEMPORARY BMP MEASURES CAN BE REMOVED AFTER THE SITE IS PERMANENTLY STABILIZED AND APPROVAL IS RECEIVED FROM THE WVDEP. ANY AREAS DISTURBED BY REMOVAL OF THE BMP'S SHALL BE REPAIRED, STABILIZED, AND PERMANENTLY SEEDED.

**POST USE -** WITHIN 6 MONTHS OF THE COMPLETION OF THE FINAL HORIZONTAL WELL ON THE PAD OR THE EXPIRATION OF THE FIVE-YEAR MAXIMUM AGGREGATE PARTIAL RECLAMATION PERIOD, WHICHEVER OCCURS FIRST, THE OPERATOR SHALL COMPLETE FINAL RECLAMATION OF THE WELL PAD & WATER CONTAINMENT PAD AS SET FORTH IN THESE PLANS. ALL EXISTING BMP'S SHOWN SHALL BE INSPECTED FOR DAMAGE AND REPLACED AS NECESSARY BEFORE RECLAMATION CAN BEGIN. DRILL CUTTINGS, DRILLING MUD, AND LINERS FOR WELLS PERMITTED UNDER WV CODE 22-6A AND 35CSR-8, MUST BE REMOVED FROM SITE AND DISPOSED OF AT AN APPROVED SOLID WASTE FACILITY OR, IF THE SURFACE OWNER CONSENTS, THE DRILL CUTTINGS AND ASSOCIATED DRILLING MUD MAY BE MANAGED ON SITE IN A MANNER APPROVED BY THE SECRETARY. THE WATER CONTAINMENT SYSTEM AND ALL PIPING, WATER LINES, AND ASSOCIATED STRUCTURES SHALL BE REMOVED. THE SITE SHALL BE REGRADED AS INDICATED ON THE PLANS. STOCKPILED TOPSOIL SHOULD BE RE-SPREAD OVER DISTURBED AREA. TOPSOIL SHOULD NOT BE ADDED TO SLOPES STEEPER THAN 2:1 UNLESS GOOD BONDING TO THE SUB-SOIL CAN BE ACHIEVED. UPON COMPLETION OF THE GRADING, THE SITE SHALL BE SEEDED AND MULCHED PER THE REVEGETATION DETAILS. A NOTICE OF TERMINATION MUST BE FILED WITH THE WVDEP WHEN THE SITE REACHES FINAL STABILIZATION. FINAL STABILIZATION MEANS THAT ALL SOIL-DISTURBING ACTIVITIES ARE COMPLETED, AND THAT EITHER A PERMANENT VEGETATIVE COVER WITH A DENSITY OF 70% OR GREATER HAS BEEN ESTABLISHED OR THAT THE SURFACE HAS BEEN STABILIZED BY HARD COVER SUCH AS GRAVEL AND PAVEMENT ACCESS ROADS OR BUILDINGS. IT SHOULD BE NOTED THAT THE 70% REQUIREMENT REFERS TO THE TOTAL AREA VEGETATED AND NOT JUST A PERCENT OF THE SITE.

**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. MOISTURE CONTENT WILL BE CONTROLLED IN ACCORDANCE WITH THE STANDARD PROCTOR TEST (ASTM-D698) RESULTS.



LEGEND	
EX. INDEX CONTOUR	--- 700 ---
EX. INTERMEDIATE CONTOUR	--- 700 ---
EX. PROPERTY LINE	---
EX. ROAD EDGE OF GRAVEL/DIRT	---
EX. ROAD EDGE OF PAVEMENT	---
EX. ROAD CENTERLINE	---
EX. DITCHLINE	---
EX. CULVERT	---
EX. FENCELINE	---
EX. OVERHEAD UTILITY	---
EX. POWER POLE/GUY WIRE	---
EX. PIPELINE & WELL	---
EX. TRENCH	---
EX. DELINEATED STREAM	---
EX. DELINEATED WETLAND/POND	---
EX. BUILDING	---
100' WETLAND/STREAM BUFFER DELINEATION STUDY AREA	---
PROP. INDEX CONTOUR	---
PROP. INTERMEDIATE CONTOUR	---
PROP. PROPERTY LINE (ROAD)	---
PROP. INTERMEDIATE CTR (ROAD)	---
PROP. LIMITS OF DISTURBANCE	---
PROP. WELL HEAD	---
PROP. PERIMETER SAFETY FENCE	---
PROP. ACCESS GATE WITH EMERGENCY LIFELINE	---
PROP. ROAD EDGE OF GRAVEL	---
PROP. ROAD CENTERLINE	---
PROP. V-DITCH W/ CHECK DAMS	---
PROP. CULVERT W/ RIP-RAP	---
PROP. COMPOST FILTER SOCK	---
PROP. COMPOST SOCK DIVERSION	---
PROP. SUPER SILT FENCE	---
MATCHLINE	---
BRUSH PILE SEDIMENT BARRIER	---

**NAVITUS ENGINEERING INC.**  
 Engineering Survey Environmental GIS  
 151 Windy Hill Lane  
 Winchester, Virginia 22602  
 Telephone: (888) 662-1185  
 www.navituseng.com

REVISION	DATE

**ANTERO RESOURCES**  
 THIS DOCUMENT WAS PREPARED FOR ANTERO RESOURCES CORPORATION


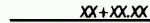


STOCKPILE RECLAMATION PLAN  
**WILLARD**  
 WELL PAD & WATER CONTAINMENT PAD  
 NEW MILTON DISTRICT  
 DODDRIDGE COUNTY, WEST VIRGINIA



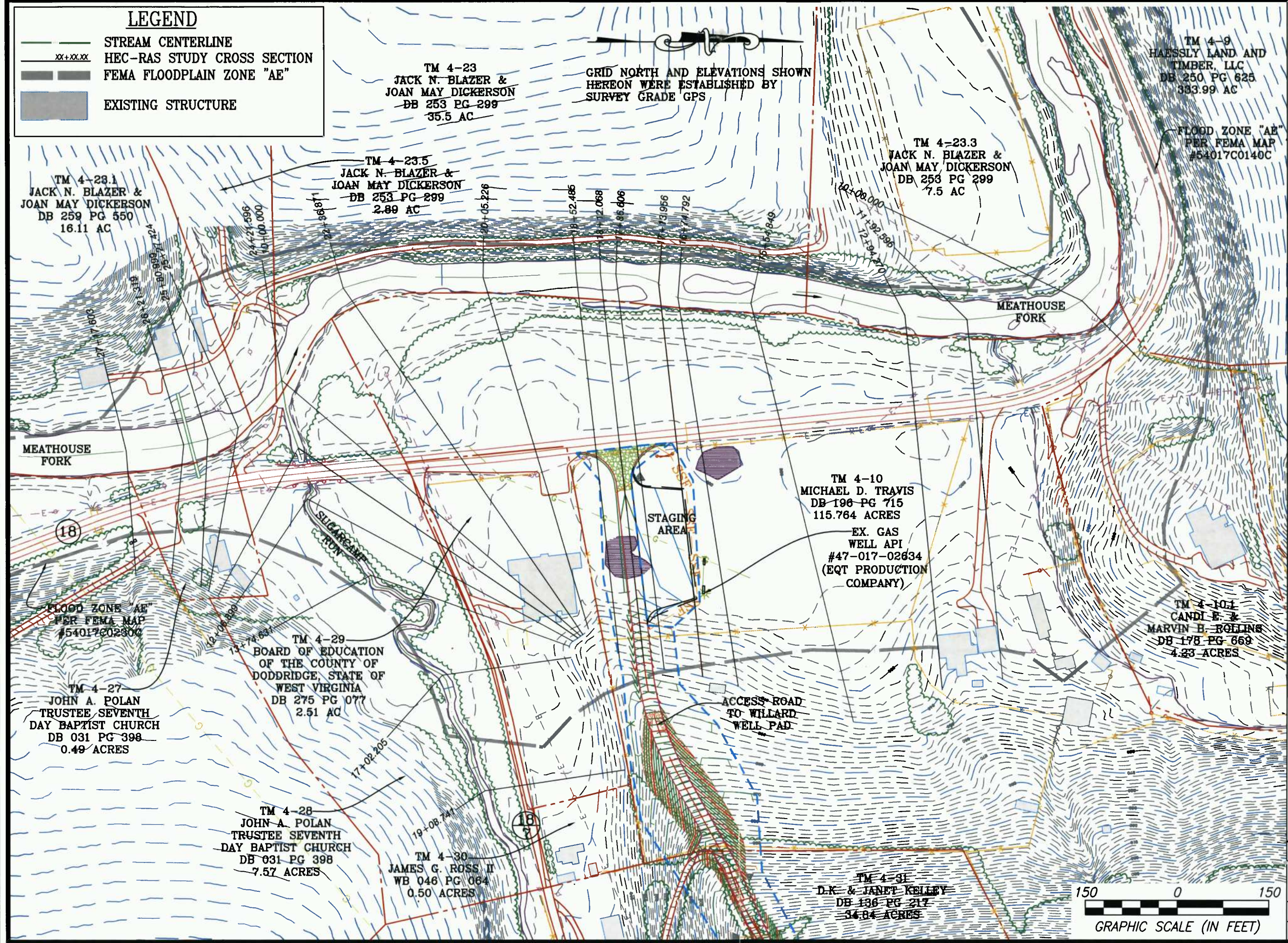
DATE: 09/16/2013  
 SCALE: 1" = 50'  
 SHEET 25 OF 26



**LEGEND**

-  STREAM CENTERLINE
-  HEC-RAS STUDY CROSS SECTION
-  FEMA FLOODPLAIN ZONE "AE"
-  EXISTING STRUCTURE

GRID NORTH AND ELEVATIONS SHOWN  
HEREON WERE ESTABLISHED BY  
SURVEY GRADE GPS



TM 4-28.1  
JACK N. BLAZER &  
JOAN MAY DICKERSON  
DB 259 PG 550  
16.11 AC

TM 4-23.5  
JACK N. BLAZER &  
JOAN MAY DICKERSON  
DB 253 PG 299  
2.89 AC

TM 4-23.3  
JACK N. BLAZER &  
JOAN MAY DICKERSON  
DB 253 PG 299  
7.5 AC

TM 4-9  
HAESSLY LAND AND  
TIMBER, LLC  
DB 250 PG 625  
333.99 AC

FLOOD ZONE "AE"  
PER FEMA MAP  
#54017C0140C

MEATHOUSE  
FORK

MEATHOUSE  
FORK

STAGING  
AREA

TM 4-10  
MICHAEL D. TRAVIS  
DB 196 PG 715  
115.764 ACRES  
EX. GAS  
WELL API  
#47-017-02634  
(EQT PRODUCTION  
COMPANY)

TM 4-101  
CANDLE F.W.  
MARVIN B. ROLLINS  
DB 178 PG 669  
4.23 ACRES

FLOOD ZONE "AE"  
PER FEMA MAP  
#54017C0230C

TM 4-29  
BOARD OF EDUCATION  
OF THE COUNTY OF  
DODDRIDGE, STATE OF  
WEST VIRGINIA  
DB 275 PG 077  
2.51 AC

TM 4-27  
JOHN A. POLAN  
TRUSTEE SEVENTH  
DAY BAPTIST CHURCH  
DB 031 PG 398  
0.49 ACRES

TM 4-28  
JOHN A. POLAN  
TRUSTEE SEVENTH  
DAY BAPTIST CHURCH  
DB 031 PG 398  
7.57 ACRES

TM 4-30  
JAMES G. ROSS II  
WB 046 PG 064  
0.50 ACRES

ACCESS ROAD  
TO WILLARD  
WELL PAD

TM 4-31  
D.K. & JANET KELLEY  
DB 136 PG 217  
34.84 ACRES



**NAVITUS**  
ENGINEERING INC.

151 Windy Hill Lane  
Winchester, Virginia 22602  
Telephone: (888) 662-4185  
www.navituseng.com

Engineering Survey Environmental GIS

CYRUS S. KUMP  
REGISTERED  
19578  
STATE OF  
WEST VIRGINIA  
PROFESSIONAL ENGINEER

09/16/2013

**ANTERO**  
RESOURCES

THIS DOCUMENT  
WAS PREPARED  
FOR:  
ANTERO RESOURCES  
CORPORATION

OVERALL CONDITIONS PLAN

**WILLARD**  
FLOODPLAIN STUDY

NEW MILTON DISTRICT  
DODDRIDGE COUNTY, WV

SCALE: 1" = 150'

WILLARD  
JOB NO. ANT044

DATE: 09/16/2013