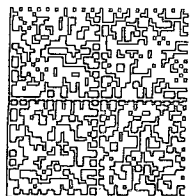


George Eidel  
Doddridge County FloodPlain MGT  
108 Court St., Ste 1  
West Union, WV 26456

**CERTIFIED MAIL**



7013 2250 0001 6914 9671



HASLER

\$006.74<sup>0</sup>

05/06/2016 ZIP 26456  
012E14643162

US POSTAGE

DELIVERED

2016 MAY -9 AM 11:40

05/06/2016  
000000000000  
DODDRIDGE COUNTY, WV

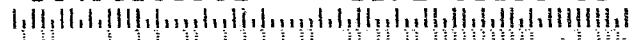
Lois Arcuri  
9142 Chathan  
North Ridgeville,

NIXIE 250 NFE 1 16ID0005/06/16

RETURN TO SENDER  
NOT DELIVERABLE AS ADDRESSED  
UNABLE TO FORWARD

BC: 26456209501 \*2271-08230-06-45

4400666740 PNC



PLACE STICKER AT TOP OF ENVELOPE TO THE RIGHT  
OF THE RETURN ADDRESS, FOLD AT DOTTED LINE

**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:

**Lois Arcuri**  
**9142 Chatham Circle**  
**North Ridgeville, OH 44039**

216-423

2. Article Number  
(Transfer from service label)

7013 2250 0001 6914 9671

PS Form 3811, July 2013

Domestic Return Receipt

**COMPLETE THIS SECTION ON DELIVERY**

A. Signature

X

Agent

Addressee

B. Received by (Printed Name)

C. Date of Delivery

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

3. Service Type

Certified Mail®

Priority Mail Express™

Registered

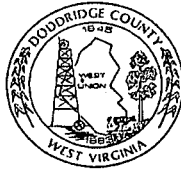
Return Receipt for Merchandise

Insured Mail

Collect on Delivery

4. Restricted Delivery? (Extra Fee)

Yes



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

Dear Sir or Ma'am,

You are receiving this letter because you have been identified as a land surface and/or mineral rights owner for property or adjacent property related to the proposed development project identified by the following page.

No action is required of you. This letter is simply to inform you of the proposed development.

If you would like to comment on this proposed project, or would like additional information, you may contact the Doddridge County Floodplain Manager at the above address.

Respectfully yours,

Doddridge County Floodplain Manager  
304-873-2631 or 304-873-1343  
[doddridgecountyfpm@gmail.com](mailto:doddridgecountyfpm@gmail.com)

# NAVITUS

ENERGY ENGINEERING

151 Windy Hill Lane, Winchester, VA 22602

December 8, 2015

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

Attn: *George Eidel*, Doddridge County Floodplain Administrator

Re: Addie Well Pad and Water Containment Pad - Floodplain Analysis

Navitus Engineering has completed a floodplain analysis for the access road entrance to the proposed Addie Well Pad and Water Containment Pad site along WV Route 18 and Middle Island Creek, west of Crystal Lake, in Doddridge County, West Virginia. The entrance to the proposed site is located within FEMA Flood Zone "A" as shown on the Flood Insurance Rate Maps (FIRM) from the National Flood Insurance Program (NFIP), Map Number 54017C0110C dated October 4, 2011 however, based upon the analysis detailed in the attached report the entrance is actually mapped within Flood Zone "AE". Base flood elevations for this area of Middle Island Creek have been established, and detailed information for Middle Island Creek can be found within the Flood Insurance Study for Doddridge County, dated October 4, 2011.

In order to establish base flood elevations for this site, a hydrologic and hydraulic analysis was performed as outlined in the current Doddridge County Floodplain Ordinance, enacted May 21<sup>st</sup>, 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 Middle Island Creek drainage shed. Upon establishing the peak flow drainage calculations for the 100-year storm event, a HEC-RAS river analysis was conducted for a section of Middle Island Creek and Slaughter Run adjacent to the Addie Well Pad and Water Containment Pad Site and Base Flood Elevations (BFE) were established. The resulting BFEs were used to establish adjusted floodplain boundaries for the segment of Middle Island Creek being studied. These boundaries are shown on the attached Existing Conditions Plan. In addition to establishing BFEs, a proposed conditions analysis was performed to determine the impacts of proposed grading from the access road to the Addie Well Pad and Water Containment Pad Site. The proposed grading was added into the cross sections of the respective models and the manning's "n" values were adjusted where necessary. The models were run with these changes to determine the proposed impacts to the floodplain.

The results of this analysis indicate that the proposed improvements will not cause an increase in the BFEs along Middle Island Creek or Slaughter Run and no upstream or downstream properties will be adversely impacted.

Attached are the following documents associated with this submission:

- A Floodplain Analysis of Middle Island Creek and Slaughter Run 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.

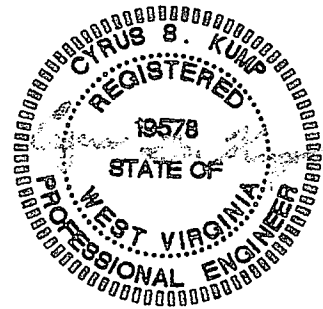
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www.navituseng.com

- The Addie Well Pad and Water Containment Site Plan, prepared by Navitus Engineering, Inc. which includes additional site design and construction specifications.
- Project Cost Estimate
- Doddridge County Improvement Location Permit Application
- Floodplain Permit Application Fee

Should any questions or comments arise during the review, please let us know and we will work to address them. Copies of all permits required for this site will be provided by the operator. 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.

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



7014 0150 0001 7356 7887

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<b>Total Postage &amp; Fees</b>	<b>\$ 6.74</b>
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Certified Fee	3.45
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Restricted Delivery Fee (Endorsement Required)	
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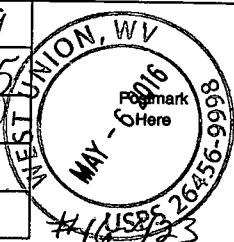
7014 0150 0001 7356 7870

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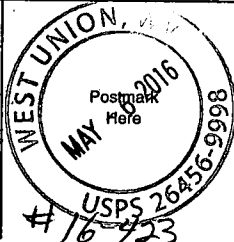
7013 2250 0001 6914 9664

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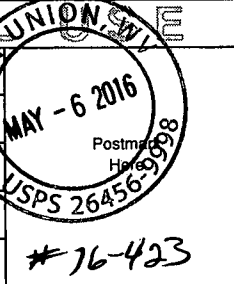
7013 2250 0001 6914 9688

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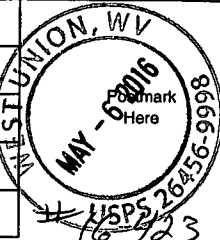
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Return Receipt Fee (Endorsement Required)	2.80
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Total Postage & Fees	\$ 6.74



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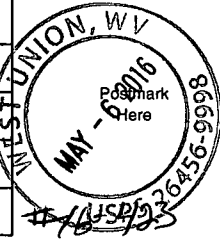
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Return Receipt Fee (Endorsement Required)	2.80
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Total Postage & Fees	\$ 6.74



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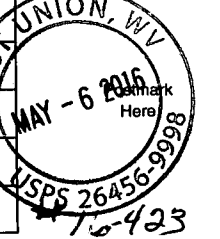
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Restricted Delivery Fee (Endorsement Required)	
Total Postage & Fees	\$ 6.74



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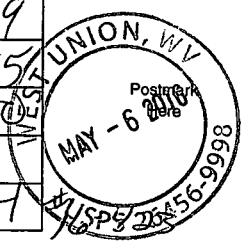
7013 2250 0001 6914 9671

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Certified Fee	3.45
Return Receipt Fee (Endorsement Required)	2.80
Restricted Delivery Fee (Endorsement Required)	
Total Postage & Fees	\$ 6.74



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PS Form 3800, August 2006 See Reverse for Instructions

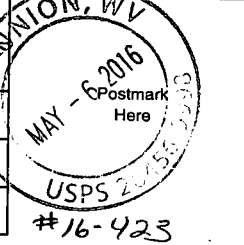
7013 2250 0001 6914 9657

U.S. Postal Service  
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Certified Fee	3.45
Return Receipt Fee (Endorsement Required)	2.80
Restricted Delivery Fee (Endorsement Required)	
Total Postage & Fees	\$ 6.74



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- 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:

**Michael Montgomery**  
**404 Gabriels Way**  
**West Union, WV 26456**

#16-423

**COMPLETE THIS SECTION ON DELIVERY**

A. Signature  Agent  
 Addressee  
 B. Received by (Printed Name) C. Date of Delivery  
 Michael A. Montgomery 5-9-16  
 D. Is delivery address different from item 1?  Yes  
 If YES, enter delivery address below:  No

3. Service Type  
 Certified Mail®  Priority Mail Express™  
 Registered  Return Receipt for Merchandise  
 Insured Mail  Collect on Delivery  
 4. Restricted Delivery? (Extra Fee)  Yes

2. Article Number (Transfer from service label) 7013 2250 0001 6914 9688

PS Form 3811, July 2013 Domestic Return Receipt

**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:

**Thomas & Penny Porter**  
**457 Cedar Lane**  
**Vest Union, WV 26456**

#16-423

**COMPLETE THIS SECTION ON DELIVERY**

A. Signature  Agent  
 Addressee  
 B. Received by (Printed Name) C. Date of Delivery  
 Penny A. Porter 5-18-16  
 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

2. Article Number (Transfer from service label)

PS Form 3811, February 2004 Domestic Return Receipt 102595-02-M-1540

**SENDER: COMPLETE THIS SECTION**

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- Print your name and address on the reverse so that we can return the card to you.
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1. Article Addressed to:

Doris Wiseman  
1 First American Way  
West Lake, TX 76262

# 16-423

2. Article Number

(Transfer from service label)

7013 2250 0001 6914 9626

PS Form 3811, July 2013

Domestic Return Receipt

**COMPLETE THIS SECTION ON DELIVERY**

A. Signature

x **David Empey**  Agent  
 Addressee

B. Received by (Printed Name)

C. Date of Delivery

5/10/16

D. Is delivery address different from item 1?  Yes

If YES, enter delivery address below:

No

3. Service Type

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

4. Restricted Delivery? (Extra Fee)

Yes



**SENDER: COMPLETE THIS SECTION**

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- 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:

Gains, Perry Blackburn & Ryan Webb  
 P.O. Box 2512  
 Clarksburg, WV 26302

#16-423

2. Article Number  
 (Transfer from service label)

7013 2250 0001 6914 9640

PS Form 3811, July 2013

Domestic Return Receipt

**COMPLETE THIS SECTION ON DELIVERY**

A. Signature

X


 Agent Addressee

B. Received by (Printed Name)

PERRY BLACKBURN

C. Date of Delivery

5-12-16

D. Is delivery address different from item 1?  Yes

If YES, enter delivery address below:

 No

3. Service Type

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

4. Restricted Delivery? (Extra Fee)

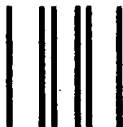
 Yes

UNITED STATES POSTAL SERVICE  
CHARLESTON

WV 250

12 MAY '95

PM 311



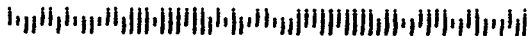
First-Class Mail  
Postage & Fees Paid  
USPS  
Permit No. G-10

- Sender, please print your name, address, and ZIP+4® in this box•

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



Party



**SENDER: COMPLETE THIS SECTION**

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- 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:

James & Lynda Beatty  
 P.O. Box 295  
 West Union, WV 26456

#16-423

2. Article Number  
 (Transfer from service label)

7013 2250 0001 6914 9657

PS Form 3811, July 2013

Domestic Return Receipt

**COMPLETE THIS SECTION ON DELIVERY**

A. Signature

X *Lynda Beatty*  Agent  
 Addressee

B. Received by (Printed Name)

C. Date of Delivery

5-17-16

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

3. Service Type

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

4. Restricted Delivery? (Extra Fee)  Yes

UNITED STATES POSTAL SERVICE

CHARLESTON

WV 250

17 MAY '16



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

PM 4 L

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

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



6209501



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1. Article Addressed to:

**Beverly Whitecotton**  
**3867 Glendale Rd.**  
**Cairo, WV 26337**

#16-423

2. Article Number  
(Transfer from service label)

7013 2250 0001 6914 9633

PS Form 3811, July 2013

Domestic Return Receipt

**COMPLETE THIS SECTION ON DELIVERY**

A. Signature

*Beverly Whitecotton*  Agent  
 Addressee

B. Received by (Printed Name)

*Beverly Whitecotton* C. Date of Delivery  
*MAY 19*

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

3. Service Type

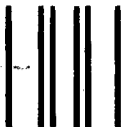
- Certified Mail®  Priority Mail Express™
- Registered  Return Receipt for Merchandise
- Insured Mail  Collect on Delivery

4. Restricted Delivery? (Extra Fee)  Yes

UNITED STATES POSTAL SERVICE

WV 250

20 MAY 15



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USPS  
Permit No. G-10

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



209501



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1. Article Addressed to:

**Charles Cottrill**  
**3839 Smithton Rd.**  
**West Union, WV 26456**

#76-423

2. Article Number  
(Transfer from service label)

7013 2250 0001 6914 9695

PS Form 3811, July 2013

Domestic Return Receipt

**COMPLETE THIS SECTION ON DELIVERY**

A. Signature

Agent  
 Addressee

B. Received by (Printed Name)

C. Date of Delivery

5/1/2014

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

3. Service Type

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 Insured Mail  Collect on Delivery

4. Restricted Delivery? (Extra Fee)  Yes

UNITED STATES POSTAL SERVICE

CHARLESTON

WV 250

09 MAY '85

PM 11



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George Eidel

Doddridge County FloodPlain MGT

108 Court St., Ste 1

West Union, WV 26456





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- 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:

Addie Marie Leadmon  
Rt 3 Box 341B  
Elizabeth, WV 26143

#16-423

2. Article Number

*(Transfer from service label)*

7013 2250 0001 6914 9664

**COMPLETE THIS SECTION ON DELIVERY**

A. Signature

X *Marie Leadmon* Agent AddresseeB. Received by *(Printed Name)*

C. Date of Delivery

5-10-06

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

3. Service Type

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

UNITED STATES POSTAL SERVICE

CHARLESTON

WV 250

10 MAY '16

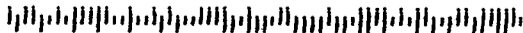


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USPS  
Permit No. G-10

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

FILE  
MAY 12 AM 11:11  
2016  
COUNTY  
CLINTON  
POST OFFICE

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



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- 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:

Clifford & Ora Montgomery  
 208 E. Miles Ave  
 Apt. 456  
 Pennsboro, WV 26415

#16423

2. Article Number

*(Transfer from service label)***COMPLETE THIS SECTION ON DELIVERY**

A. Signature



- 
- Agent
- 
- 
- Addressee

B. Received by (*Printed Name*)

C. Date of Delivery

05/10/2016

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

3. Service Type

- |   |   |
|---|---|
| <input type="checkbox"/> Certified Mail | <input type="checkbox"/> Express Mail                   |
| <input type="checkbox"/> Registered     | <input type="checkbox"/> Return Receipt for Merchandise |
| <input type="checkbox"/> Insured Mail   | <input type="checkbox"/> C.O.D.                         |

4. Restricted Delivery? (*Extra Fee*) Yes

UNITED STATES POSTAL SERVICE

WV 250

10 MAY '16



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

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

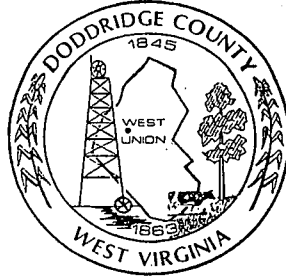
FILED

MAY 12 AM 11:00

WEST VIRGINIA  
BOYD COUNTY, WV

George Eidell  
Boydridge County FloodPlain MGT  
118 East Court St., Room 102  
West Union, WV 26456





# Floodplain Development Permit

## Doddridge County, WV Floodplain Management

This permit gives approval for the development/ project listed that impacts the FEMA-designated floodplain and/or floodway of Doddridge County, WV, pursuant to the rules and regulations established by all applicable Federal, State and local laws and ordinances, including the Doddridge County Floodplain Ordinance. This permit must be posted at the site of work as to be clearly visible, and must remain posted during entirety of development.

**Permit #: 16-423**

**Date Approved: June 6, 2016**

**Expires: June 6, 2017**

**Issued to: Antero Resources**

**POC: Rachel Grzybek**

**Company Address: 535 White Oaks Blvd Bridgeport, WV 26330**

**Project Address: Route 18 at Slaughter Run**

**Firm: 54017C0110C**

**Lat/Long: 39.334574N,80.808146W**

**Purpose of development: Addie Well Pad - Access Road Improvements for Well Pad**

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

**Date:**

---

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

---



ANTERO RESOURCES  
1615 WYNKOOP STREET  
DENVER, COLORADO 80202

FILED

Vendor Name	Vendor No.	Date	Check Number	Check Total
DODDRIDGE COUNTY COMMISSION	12312	May 10-2016	129504	\$500.00

MAY 16 PM 1:50

INV #	INV DATE	DESCRIPTION	AMOUNT	DISCOUNTS	NET AMOUNT
KAD4252016A	04/25/16	ADDIE PAD FLOODPLAIN PERMIT APPLICA	500.00	0.00	500.00

COUNTY CLERK  
DODDRIDGE COUNTY, WV

# 16-423  
Re-issue

3

TOTAL INVOICES PAID ==>>>> 500.00 0.00 500.00

DETACH AND RETAIN FOR TAX PURPOSES

THIS CHECK HAS A COLORED FACE ON WHITE STOCK AND AN ARTIFICIAL WATERMARK ON THE BACK.



ANTERO RESOURCES  
1615 WYNKOOP STREET  
DENVER, COLORADO 80202

Wells Fargo  
Denver, CO

Check No. 129504

11-24  
412

400 - AP ASCT WELLS FARGO

Void After 90 Days

CHECK NUMBER	DATE	PAY EXACTLY
129504	May-10-2016	\$500.00

PAY EXACTLY **500dols00cts**  
Five Hundred Dollars and Zero Cents

TO  
THE  
ORDER  
OF

DODDRIDGE COUNTY COMMISSION  
BETH A ROGERS, CLERK~118 EAST COURT STREET~ROOM 10  
2  
WEST UNION, WV 26456

*[Handwritten Signature]*

⑈ 129504 ⑈ ⑆ 04 1203824 ⑆ 9647481952 ⑈



ANTERO RESOURCES  
1615 WYNKOOP STREET  
DENVER, COLORADO 80202

Vendor Name	Vendor No.	Date	Check Number	Check Total
DODDRIDGE COUNTY COMMISSION	43312	Apr-26-2016	128297	\$500.00

INV #	INV DATE	DESCRIPTION	AMOUNT	DISCOUNTS	NET AMOUNT
KAD4252016A	04/25/16	ADDIE PAD FLOODPLAIN PERMIT APPLICA	500.00	0.00	500.00

#16-423

FILED  
 2016 APR 28 PM 1:03  
 BETH A. ROGERS  
 COUNTY CLERK  
 DODDRIDGE COUNTY, WY

TOTAL INVOICES PAID =====> 500.00 0.00 500.00

DETACH AND RETAIN FOR TAX PURPOSES

THIS CHECK HAS A COLORED FACE ON WHITE STOCK AND AN ARTIFICIAL WATERMARK ON THE BACK



ANTERO RESOURCES  
1615 WYNKOOP STREET  
DENVER, COLORADO 80202

**Wells Fargo**  
Denver, CO

Check No. **128297**

11-24  
412

400 - AP ACCT WELLS FARGO

Void After 90 Days

CHECK NUMBER	DATE	PAY EXACTLY
128297	Apr-26-2016	\$500.00

PAY EXACTLY **\$500dols00cts**  
Five Hundred Dollars and Zero Cents

TO  
THE  
ORDER  
OF

DODDRIDGE COUNTY COMMISSION  
BETH A ROGERS, CLERK~118 EAST COURT STREET~ROOM 10  
2  
WEST UNION, WY 26456

*Beth A Rogers*

⑈ 1 28 29 7 ⑈ ⑆ 0 4 1 20 38 2 4 ⑆ 9 6 4 7 4 8 1 9 5 2 ⑈



**ANTERO RESOURCES**  
 1615 WYNKOOP STREET  
 DENVER, COLORADO 80202

Vendor Name	Vendor No.	Date	Check Number	Check Total
DODDRIDGE COUNTY COMMISSION	43312	Apr-26-2016	128297	\$500.00

INV #	INV DATE	DESCRIPTION	AMOUNT	DISCOUNTS	NET AMOUNT
KAD4252016A	04/25/16	ADDIE PAD FLOODPLAIN PERMIT APPLICA	500.00	0.00	500.00

#16-423

## Doddridge County, West Virginia

RECEIPT NO: 7021

DATE: 2016/05/12

FROM: ANTERO RESOURCES

AMOUNT: \$ 500.00

FIVE HUNDRED DOLLARS AND 00 CENTS

FOR: #16-423 ADDIE PAD FLOODPLAIN PERMIT

00000128297 FP-BUILDING PERMITS

020-318

TOTAL: \$500.00

MICHAEL HEADLEY

SHERIFF & TREASURER

MEC

CLERK

Customer Copy

DETACH AND RETAIN FOR TAX PURPOSES



## Doddridge County Floodplain Permits

(Week of May 16, 2016)

Please take notice that on the 5th day of May, 2016, Antero Resources filed an application for a Floodplain Permit (**#16-423**) to develop land located at or about 39.334574N,80.808146W. 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 June 6, 2016 (20 calendar days after the announcement at the regularly scheduled Doddridge County Commission Meeting) delivered to the Clerk of the County Court at 108 Court Street Ste. 1, West Union, WV 26456.

NEWS Paper  
ad sent to  
Doddridge Independent  
5-6-16



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

REPLY TO  
ATTENTION OF

MAY 04 2016

MAY 5 16 3:53PM

Regulatory Division  
Energy Resource Branch  
LRH-2016-00062-OHR

Mr. Cole Kilstrom  
Antero Resources Appalachian Corporation  
1615 Wynkoop Street  
Denver, Colorado, 80202

Dear Mr. Kilstrom:

I refer to the Pre-Construction Notification (PCN), received in this office on January 20, 2016, with final information received on March 18, 2016, requesting a Department of the Army (DA) authorization to discharge dredged and/or fill material into waters of the United States for maintenance activities associated with an access road for the with the Addie Well Pad and Water Containment Pad Project. The project is located near the town of West Union, in Doddridge County, West Virginia, (39.334406°N, 80.805730°W). The project has been assigned the following file number: LRH-2016-00062-OHR-Slaughter Run. Please reference this number on all future correspondence related to this project.

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

Based on a review of the aquatic resources included in the PCN, this office has determined that seven (7) streams, (Streams S1-S7), totaling 3,125 linear feet (lf), two (2) emergent wetlands, (Wetlands W1 and W2), totaling 0.018 acres, and one (1) open-water pond, (Pond 1), totaling 0.062 acre, are located within the preliminary jurisdictional determination (JD) boundary, as described in the enclosed preliminary JD Form. These on-site aquatic resources may be waters of the United States in accordance with the Regulatory Guidance Letter (RGL) for JDs issued by the Corps on June 26, 2008 (RGL No. 08-02). As indicated in the guidance, this preliminary JD is non-binding and cannot be appealed (33 CFR 331.2) and only provides a written indication that waters of the United States, including wetlands, may be present on-site.

You have declined to exercise the option to obtain an approved JD in this instance and at this time. However, for the purposes of the determination of impacts, compensatory mitigation, and other resource protection measures for activities that require authorization from this office, the aquatic resources identified above will be evaluated as if it is a water of the United States.

Enclosed please find two copies of the preliminary JD form. If you agree with the findings of this preliminary JD and understand your options regarding the same, please sign and date one copy of the preliminary JD form and return it to this office within 30 days of receipt of this letter. You should submit the signed copy via email to [Aric.J.Payne@usace.army.mil](mailto:Aric.J.Payne@usace.army.mil) or to the following address:

United States Army Corps of Engineers  
Huntington District, Regulatory Division  
Attn: Aric Payne (LRH-2016-00062)  
Energy Resource Branch  
502 Eighth Street  
Huntington, West Virginia 25701.

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

In the PCN received in this office, you have requested a DA permit authorization for the discharge of dredged and/or fill material into 97 lf of two (2) streams, Streams S2 and S4, involving two (2) separate and distant crossings. Project construction activities will also involve the temporary discharge of dredged and/or fill material into 10 lf of Stream S4. Upon project completion, the temporarily affected waters of the United States will be restored to their pre-construction contours and elevations. The proposed discharges of dredged and/or fill material into waters of the United States are described within Table 1 below. In addition, the information submitted in the PCN indicates that construction of the well pad, water containment pad, new access road, and topsoil material stockpile areas will be constructed in uplands and will not involve a discharge of dredged or fill material into waters of the United States.

Based on your description of the proposed maintenance activities, and other information available to us, it has been determined the proposed discharge of dredged and/or fill material into waters of the United States for the Addie Well Pad and Water Containment Pad Project meets the criteria for Nationwide Permit (NWP) No. 3 under the February 21, 2012 Federal Register, Reissuance of NWPs (77 FR 10184) provided you comply with all terms and conditions of the enclosed material, the enclosed special condition, and the 401 Water Quality Certification (WQC) issued by the West Virginia Department of Environmental Protection (WVDEP). A copy of this NWP can be found on our website at <http://www.lrh.usace.army.mil/Missions/Regulatory.aspx>.

In view of the above, your project is authorized subject to the terms and conditions of the enclosed material, including the enclosed special conditions. It is your responsibility to ensure

that your work conforms to all of the environmental management conditions listed within the enclosed material. Please be aware this NWP verification does not obviate the requirement to obtain any state or local assent required by law for the activities.

This verification is valid until the expiration date of the NWPs, unless the NWP authorization is modified, suspended, or revoked. The verification will remain valid if the NWP authorization is reissued without modification or the activity complies with any subsequent modification of the NWP authorization. All of the existing NWPs are scheduled to be modified, reissued, or revoked on March 18, 2017. Prior to this date, it is not necessary to contact this office for re-verification of your project unless the plans for the proposed activity are modified. Furthermore, if you commence or under contract to commence this activity before March 18, 2017, you will have twelve (12) months from the date of the modification or revocation of the NWP to complete the activity under the present terms and conditions of this NWP.

A copy of this NWP verification letter and NWP handout must be supplied to your project engineer responsible for construction activities. A copy of the verification letter must be kept at the site during construction. If you have any questions concerning the above, please contact Mr. Aric Payne at (304) 399-5396 or by email at [aric.j.payne@usace.army.mil](mailto:aric.j.payne@usace.army.mil).

Sincerely,

A handwritten signature in black ink, appearing to read "Audrey Richter". The signature is written in a cursive style with a large, prominent "A" and "R".

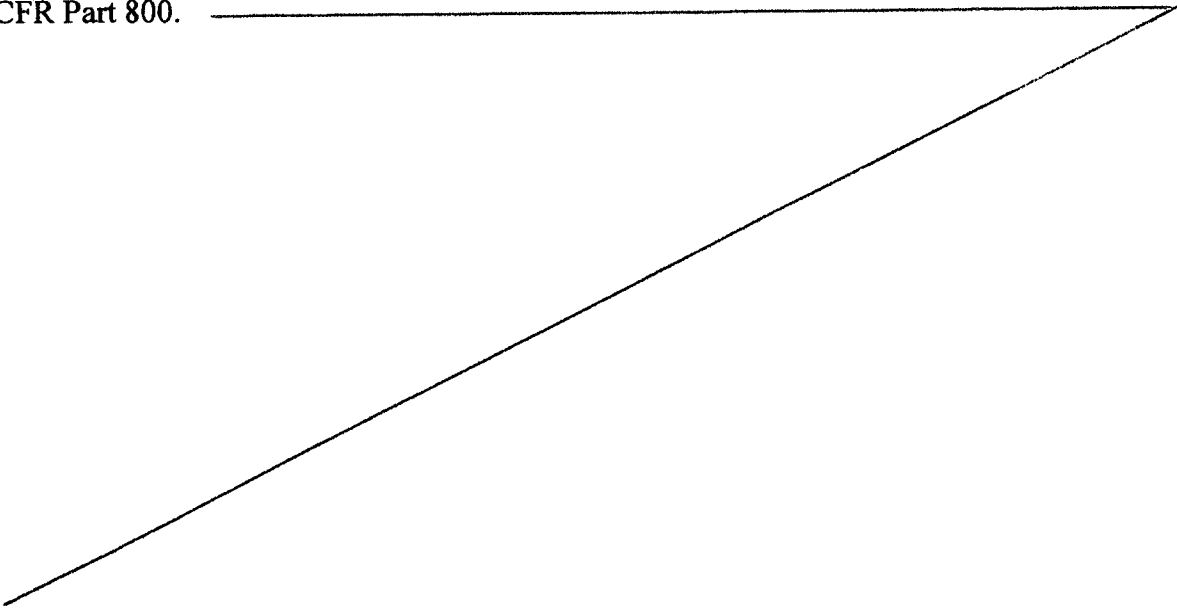
Audrey M. Richter  
Regulatory Project Manager  
East Branch

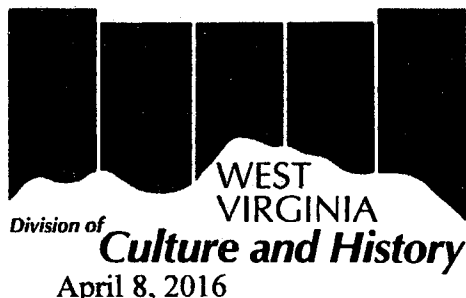
Enclosure

**Table 1. Authorized discharge of dredged and/or fill material into waters of the United States in association with the Antero Resources Appalachian Corporation, Addie Well Pad and Water Containment Pad Project  
LRH-2016-00062-OHR-Slaughter Run**

<b>Aquatic Resource ID</b>	<b>Flow Regime</b>	<b>Fill Length of Stream (lf)</b>	<b>Fill Area of Stream (ac)</b>	<b>Regulated Discharge of Fill Material Activity</b>
S2	Perennial	4	0.001	Maintenance- culvert replacement
S4	Intermittent	44	0.003	Maintenance- culvert replacement
S4	Intermittent	49	0.004	Gabion Wall Installation and Inlet/Outlet Protection
S4	Intermittent	10	0.001	Temporary E&S controls (rock filter outlet) to be removed upon project completion

**Nationwide Permit 3 Verification Special Conditions for the  
Antero Resources Appalachian Corporation  
Addie Well Pad and Water Containment Pad Project  
LRH-2016-00062-OHR-Slaughter Run  
Page 1 of 1**

1. Construction activities will be performed during low flow conditions. Due to the proximity of the project to Middle Island Creek, a waterway known to harbor Federally-listed mussel species, appropriate site specific best management practices, as approved by the United States Fish and Wildlife Services on December 21, 2015 for sediment and erosion control will be fully implemented during construction activities at this site.
  
  2. Section 7 obligations under Endangered Species Act must be reconsidered if new information reveals impacts of the project that may affect federally listed species or critical habitat in a manner not previously considered, the proposed project is subsequently modified to include activities which were not considered during Section 7 consultation with the United States Fish and Wildlife Service, or new species are listed or critical habitat designated that might be affected by the subject project.
  
  3. Should new information regarding the scope and/or impacts of the project become available that was not submitted to this office during our review of the proposal, the permittee shall submit written information concerning proposed modification(s) to this office for review and evaluation, as soon as practicable.
  
  4. In the event any previously unknown historic or archaeological sites or human remains are uncovered while accomplishing the activity authorized by this nationwide permit authorization, the permittee must cease all work in waters of the United States immediately and contact local, state and county law enforcement offices (only contact law enforcement on findings of human remains), the Corps at 304-399-5210 and Ohio Historic Preservation Office at 614-298-2000. The Corps will initiate the Federal, state and tribal coordination required to comply with the National Historic Preservation Act and applicable state and local laws and regulations. Federally recognized tribes are afforded a government-to-government status as sovereign nations and consultation is required under Executive Order 13175 and 36 CFR Part 800.
- 



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

**Randall Reid-Smith, Commissioner**

Phone 304.558.0220 • www.wvculture.org  
Fax 304.558.2779 • TDD 304.558.3562

EEO/AA Employer

Mr. Richard Petyk  
Senior Project Archaeologist  
GAI Consultants, Inc.  
385 East Waterfront Drive  
Homestead, PA 15120-5005

RE: Addie Well Pad Project  
FR#: 14-283-DO-1

MAY 5 16 3:58 AM

Dear Mr. Petyk:

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

Archaeological Resources:

According to the archaeological technical report, Phase I archaeological survey was conducted within two study areas. The study areas are centered on two US Army Corps of Engineers (USACE) jurisdictional waterbody crossings that located in the proposed project's limits of disturbance. The survey, which included pedestrian reconnaissance and shovel probe excavation, determined that Study Area 1 and most of Study Area 2 were comprised of steep slope and previously disturbed terrain and not conducive to subsurface Testing. An upland bench identified within Study Area 2 underwent shovel probe excavation. No cultural materials were identified. As a result, we concur that no archaeological historic properties are located within the study areas and that no further archaeological investigations are warranted within these areas. However, if intact archaeological materials are encountered while the well pad is being constructed, all activity should be ceased within the discovery area this office contacted immediately.

Architectural Resources:

According to the submitted letter report titled *Architectural and Historical Resources Investigation*, the only architectural resource that is fifty (50) years or older within the direct or indirect APEs is the Farmstead at WV-18 at Iron Bridge Road, identified by field survey number GAI-01. It is your recommendation that this resource, GAI-01, is not eligible for inclusion in the National Register of Historic Places. We concur with this determination. No further consultation is necessary regarding architectural resources; however, we ask that you contact our office if your project should change.

April 8, 2016  
Mr. Petyk  
FR#:14-283-DO-1  
Page 2

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

Sincerely,

A handwritten signature in cursive script, appearing to read "Susan M. Pierce". The signature is written in black ink and is positioned above the printed name.

Susan M. Pierce  
Deputy State Historic Preservation Officer

SMP/LLD/MKS







# United States Department of the Interior



## FISH AND WILDLIFE SERVICE

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

Contact Name: Cole Kilstrom

Email Address or Fax Number: ckilstrom@anteroresources.com

TAILS # 2015-TA-0292 All future correspondence submitted on this project should clearly reference this TAILS #.

Project: Addie Well Pad Project, Doddridge County, West Virginia

Date of Letter Request: October 16, 2015

MAY 5 16 4:02PM

This is in response to your letter requesting threatened and endangered species information in regard to the proposed project listed above. These comments are provided pursuant to the Endangered Species Act (ESA, 87 Stat. 884, as amended; 16 U. S. C. 1531 *et seq.*).

### Federally Listed Bats

Two federally listed bat species could occur in the project area, the endangered Indiana bat (*Myotis sodalis*), and the threatened northern long-eared bat (NLEB) (*M. septentrionalis*).

The Indiana bat and NLEB may use the project area for foraging and roosting between April 1 and November 15. Indiana bat summer foraging habitats are generally defined as riparian, bottomland, or upland forest, and old fields or pastures with scattered trees. Roosting/maternity habitat consists primarily of live or dead hardwood tree species which have exfoliating bark that provides space for bats to roost between the bark and the bole of the tree. Tree cavities, crevices, splits, or hollow portions of tree boles and limbs also provide roost sites. Similar to the Indiana bat, NLEB bat foraging habitat includes forested hillsides and ridges, and small ponds or streams. NLEB are typically associated with large tracts of mature, upland forests with more canopy cover than is preferred by Indiana bats. Northern long-eared bats seem to be flexible in selecting roosts, choosing roost trees based on suitability to retain bark or provide cavities or crevices, and this species is known to use a wider variety of roost types than the Indiana bat. Males and non-reproductive females may also roost in cooler places, like caves and mines. This bat has also been found rarely roosting in structures, like barns and sheds. In West Virginia, the Service considers all forest habitats containing trees greater than or equal to 3 inches in diameter at breast height (DBH) to be potentially suitable as summer roosting and foraging habitat for the Indiana and northern long-eared bat.

Indiana bats and NLEB use caves or mine portals for winter hibernation between November 15 and March 31. These species also use the hibernacula and the areas around them for fall-swarming and spring-staging activity (August 15 to November 14 and April 1 to May 14,

respectively). Some males have been known to stay close to the hibernacula during the summer and may use the hibernacula as a summer roosts. There may be other landscape features being used by NLEB during the winter that have yet to be documented.

Based on documented travel distances of Indiana bats, Indiana bats are most likely to use suitable habitat within 10 miles of a known priority 1 or 2 Indiana bat hibernaculum, 5 miles from a known priority 3 or 4 Indiana bat hibernaculum, or 2.5 miles from any known maternity roost, or 5 miles from summer detection site where no roosts were identified. Similarly, NLEB are most likely to use suitable habitat within 5 miles from a NLEB hibernaculum or 1.5 miles of a known NLEB maternity roost or 3 miles of a NLEB detection site with no roost identified area. Areas within these distances from documented locations are referred to as known use or buffer areas.

The Service has evaluated the availability of suitable foraging and roosting habitats on the West Virginia landscape relative to the best estimate of the statewide population of Indiana bats. On that basis, we have determined projects affecting less than 17 acres of suitable forest habitat, are not within any Indiana bat or NLEB buffer areas as described above, and will not affect any potential hibernacula, and that are completed before the end of the 2015 calendar year<sup>1</sup> are very unlikely to result in direct or indirect impacts to these species. The effects of such projects are considered discountable and the projects, therefore, are not likely to adversely affect the Indiana bat or NLEB<sup>2</sup>. Tree removal associated with such projects can occur at any time of year. The proposed project does not pass through any of these buffer zones, proposes to clear less than 17 acres, and thus is not likely to adversely affect the Indiana bat or NLEB.

#### Freshwater Mussels

The proposed project occurs within ¼-mile of Middle Island Creek which provides habitat for snuffbox (*Epioblasma triquetra*) and clubshell (*Pleurobema clava*) mussels, which are listed as endangered under the ESA. Freshwater mussels feed by filtering food particles from the water column. Juvenile and adult freshwater mussels have been documented to feed on detritus, diatoms, phytoplankton, and zooplankton. Freshwater mussels rely on fish to complete their life histories. When mussel larvae (glochidia) are released into the water by adult females, they must attach themselves within a few days to an appropriate fish host, which they then parasitize for a short time while developing into juvenile mussels. The loss of many historic populations and the continuing degradation of current populations are due to the impacts of impoundments, navigation projects, water quality degradation from agricultural and industrial wastes, deforestation and other forms of habitat alteration, including gravel and sand dredging. Impacts that directly affect the species also include reduction or elimination of fish hosts.

Freshwater mussels play a key role in the health of aquatic environments by helping to maintain water quality, cycle nutrients, stabilize substrates, remove suspended sediments, and create habitat complexity (Anderson and Kreeger, 2012). Mussels remove suspended particulates from

<sup>1</sup> It should be noted that the WVFO is currently reviewing existing data and available literature on the NLEB to determine how our recommendations should be modified to address the NLEB. **We expect that the 17 acre threshold may change on or before the end of the 2015 calendar year.** In the interim, our office will be using the threshold developed for the Indiana bat to make determinations regarding the NLEB.

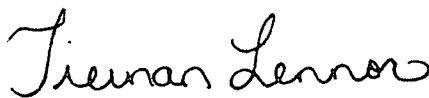
<sup>2</sup> Different recommendations and analyses are applied to wind projects due to the differences in types of effects that may occur.

water by filter-feeding, which involves straining water over gills to remove microscopic food particles. Filter-feeding makes mussels very sensitive to excessive sedimentation caused by runoff from streambank and upland activities. Excessive sedimentation into a stream reduces suitable habitat for mussels and can smother them, causing death. Excessive suspended sediments can also impair feeding processes of mussels, leading to acute short-term or chronic long-term stress. Both excessive sedimentation and excessive suspended sediments can lead to reduced populations of mussels and therefore reduced benefits to the ecosystem (Anderson and Kreeger, 2010; Box and Mossa, 1999; Ellis, 1931; Ellis, 1936; Houp, 1993).

In correspondence dated November 18, 2015, the project proponent stated their commitment to the erosion and sedimentation best management practices listed on the attached summary sheet.

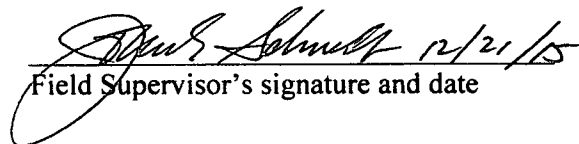
These best management practices will help minimize affects of sedimentation and erosion to waterways that provide habitat to federally listed mussels near the action area. In addition, the project proponent will comply with the requirements set forth in the West Virginia Department of Environmental Protection's 2006 Best Management Protection Manual and the 2012 Erosion and Sediment Control Field Oil and Gas Manual. This office should be notified immediately if any deviations from the submitted plans are anticipated during construction of the project.

As a result of this information, the Service has concluded that the project may affect, but is not likely to adversely affect any federally listed endangered and threatened species. No biological assessment or further section 7 consultation under the ESA is required with the Service. Should project plans change or amendments be proposed that we have not considered in your proposed action, or if additional information on listed and proposed species becomes available, or if new species become listed or critical habitat is designated, this determination may be reconsidered. If you have any questions regarding this letter, please contact Tiernan Lennon of my staff at (304) 636-6586, Ext. 12, or at the letterhead address.



12/1/2015

Biologist signature and date



Field Supervisor's signature and date

**Erosion and Sedimentation Best Management Practices**

- Triple-stack compost filter sock
- Super silt fence
- Corrugated metal fencing
- Armored outlets
- Green space buffers
- Other: seeding and mulching disturbed areas
- Other: diversion ditches
- Other: \_\_\_\_\_
- Other: \_\_\_\_\_



**Antero Resources**  
535 White Oaks Blvd.  
Bridgeport, WV 26330  
Office 304.842.4100  
Fax 304.842.4102

April 25, 2016

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

Mr. Eidel:

Antero Resources Corporation would like to submit a Doddridge County floodplain permit application for our *Addie Pad*. Our project is located in Doddridge County, West Union District where the pad entrance begins at coordinates 39.334574N, 80.808146W. Per the FIRM Map #54017C0110C, this location is in the floodplain.

Attached you will find the following:

- Doddridge County Floodplain Permit Application
- Site Design
- H&H Study
- Bid Sheet
- Property Owner Information
- WV Flood Tool Map
- FIRM Map

If you have any questions please feel free to contact me at (304) 842-4008.

MAY 5 16 3:52PM

Thank you in advance for your consideration.

Sincerely,

A handwritten signature in black ink, appearing to read "Rachel Grzybek".

Rachel Grzybek  
Environmental Specialist II  
Antero Resources Corporation

Enclosures

# DODDRIDGE COUNTY FLOODPLAIN DEVELOPMENT PERMIT APPLICATION

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

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

APPLICANT'S SIGNATURE



DATE 4/25/16

## 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:



Randy Kloberdanz

ADDRESS: 1615 Wynkoop Street, Denver, CO 80202

TELEPHONE NUMBER: (303) 357-7310

**BUILDER'S NAME:** Antero Resources Corporation  
**ADDRESS:** 1615 Wynkoop Street, Denver, CO 80202  
**TELEPHONE NUMBER:** (303)-357-7310

**ENGINEER'S NAME:** \_\_\_\_\_  
**ADDRESS:** \_\_\_\_\_  
**TELEPHONE NUMBER:** \_\_\_\_\_

**PROJECT LOCATION:**

**NAME OF SURFACE OWNER/OWNERS (IF NOT THE APPLICANT)** Please see Surface Owner Table  
**ADDRESS OF SURFACE OWNER/OWNERS (IF NOT THE APPLICANT)** Please see Surface Owner Table  
**DISTRICT:** \_\_\_\_\_  
**DATE/FROM WHOM PROPERTY PURCHASED:** \_\_\_\_\_  
**LAND BOOK DESCRIPTION:** Please see Surface Owner Table  
**DEED BOOK REFERENCE:** Please see Surface Owner Table  
**TAX MAP REFERENCE:** Please see Surface Owner Table  
**EXISTING BUILDINGS/USES OF PROPERTY:** None  
**NAME OF AT LEAST ONE ADULT RESIDING IN EACH RESIDENCE LOCATED UPON THE SUBJECT PROPERTY** Please see Surface Owner Table  
**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**

- |                          |                         |                          |                                  |
|--------------------------|-------------------------|--------------------------|----------------------------------|
| X                        | 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:**

- X    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
- Subdivision (including new expansion)
- Individual Water or Sewer System
- Other (please specify)
- 

**C. STANDARD SITE PLAN OR SKETCH**

- 1. SUBMIT ALL STANDARD SITE PLANS, IF ANY HAVE BEEN PREPARED.**
- 2. IF STANDARD SITE PLANS HAVE NOT BEEN PREPARED:**  
SKETCH ON A SEPARATE 8 ½ X 11 INCH SHEET OF PAPER THE SHAPE AND LOCATION OF THE LOT. SHOW THE LOCATION OF THE INTENDED CONSTRUCTION OR LAND USE INDICATING BUILDING SETBACKS, SIZE & HEIGHT. IDENTIFY EXISTING BUILDINGS, STRUCTURES OR LAND USES ON THE PROPERTY.
- 3. SIGN AND DATE THE SKETCH.**

**ACTUAL TOTAL CONSTRUCTION COSTS OF THE COMPLETE DEVELOPMENT IRRESPECTIVE OF WHETHER ALL OR ANY PART OF THE SUBJECT PROPOSED CONSTRUCTION PROJECT IS WITHIN THE FLOODPLAIN \$ 44,925.84**

**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 landowner  
**ADDRESS:** information  
 \_\_\_\_\_  
 \_\_\_\_\_

**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:** Please see attached landowner  
**ADDRESS:** information  
 \_\_\_\_\_  
 \_\_\_\_\_

**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): Randy Kloberdanz

SIGNATURE: \_\_\_\_\_



DATE: 4/25/16

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

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

**THE PROPOSED DEVELOPMENT:**

THE PROPOSED DEVELOPMENT IS LOCATED ON:

FIRM Panel: \_\_\_\_\_

Dated: \_\_\_\_\_

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

Is located in Special Flood Hazard Area.

FIRM zone designation \_\_\_\_\_

100-Year flood elevation is: \_\_\_\_\_ NGVD (MSL)

Unavailable

The proposed development is located in a floodway.

FBFM Panel No. \_\_\_\_\_

Dated \_\_\_\_\_

See section 4 for additional instructions.

SIGNED \_\_\_\_\_

DATE \_\_\_\_\_

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

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

- A plan showing the location of all existing structures, water bodies, adjacent roads, lot dimensions and proposed development.
- Development plans, drawn to scale, and specifications, including where applicable: details for anchoring structures, storage tanks, proposed elevation of lowest floor, (including basement or crawl space), types of water resistant materials used below the first floor, details of flood proffing of utilities located below the first floor and details of enclosures below the first floor. Also \_\_\_\_\_  
\_\_\_\_\_
- Subdivision or other development plans (If the subdivision or development exceeds 50 lots or 5 acres, whichever is the lesser, the applicant must provide 100-year flood elevations if they are not otherwise available).
- Plans showing the extent of watercourse relocation and/or landform alterations.
- Top of new fill elevation \_\_\_\_\_ Ft. NGVD (MSL).  
For floodproofing structures applicant must attach certification from registered engineer or architect.
- Certification from a registered engineer that the proposed activity in a regulatory floodway will not result in any increase in the height of the 100-year flood. A copy of all data and calculations supporting this finding must also be submitted.
- Manufactured homes located in a floodplain area must have a West Virginia Contractor's License and a Manufactured Home Installation License as required by the Federal Emergency Management Agency (FEMA).

Other:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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

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

SIGNED \_\_\_\_\_ DATE \_\_\_\_\_

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

APPEALS:   Appealed to the County Commission of Doddridge County?  Yes  No  
Hearing Date: \_\_\_\_\_  
County Commission Decision - Approved  Yes  No

CONDITIONS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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

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

COMPLETE 1 OR 2 BELOW:

- 1 Actual (As-Built) Elevation of the top of the lowest floor (including basement or crawl space is \_\_\_\_\_ FT. NGVD (MSL)
- 2 Actual (As Built) elevation of floodproofing is \_\_\_\_\_ FT. NGVD (MSL)

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

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

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

**INSPECTIONS:**

DATE: \_\_\_\_\_ BY: \_\_\_\_\_  
DEFICIENCIES ? Y/N

COMMENTS \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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

Certificate of Compliance issued: DATE: \_\_\_\_\_ BY: \_\_\_\_\_

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

**PERMIT NUMBER:** \_\_\_\_\_

**PERMIT DATE:** \_\_\_\_\_

**PURPOSE –**

**CONSTRUCTION LOCATION:** \_\_\_\_\_

**OWNER'S ADDRESS:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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

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

**SIGNED** \_\_\_\_\_ **DATE** \_\_\_\_\_

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

WEST UNION DISTRICT, DODDRIDGE COUNTY, WEST VIRGINIA  
CONAWAY RUN-MIDDLE ISLAND CREEK WATERSHED

### LOCATION COORDINATES:

ACCESS ROAD ENTRANCE  
LATITUDE: 39.334574 LONGITUDE: -80.808146 (NAD 83)  
N 4353923.29 E 516534.48 (UTM ZONE 17 METERS)

CENTER OF TANK  
LATITUDE: 39.334581 LONGITUDE: -80.805175 (NAD 83)  
N 4353924.60 E 516790.48 (UTM ZONE 17 METERS)

CENTROID OF PAD  
LATITUDE: 39.333805 LONGITUDE: -80.805504 (NAD 83)  
N 4353816.14 E 518782.38 (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 NOTES:

THE PROPOSED SITE IS LOCATED IN FLOOD ZONES "X" & "A" PER FEMA MAP NUMBER #54017C010C. THE SITE ENTRANCE IS LOCATED IN FLOOD ZONE "A" AND THE REST OF THE SITE IS LOCATED IN FLOOD ZONE "X". MINOR EXCAVATION IS REQUIRED FOR THE INSTALLATION OF THE ENTRANCE AND E&S CONTROL IS THE ONLY DISTURBANCE PROPOSED IN FLOOD ZONE "A". NO FILL IS PROPOSED IN FLOOD ZONE "A".

### MISS UTILITY STATEMENT:

ANTERO RESOURCES CORPORATION WILL NOTIFY MISS UTILITY OF WEST VIRGINIA FOR THE LOCATING OF UTILITIES PRIOR TO THIS PROJECT DESIGN. TICKET #1504305428. IN ADDITION, MISS UTILITY WILL BE CONTACTED BY THE CONTRACTOR PRIOR TO THE START OF CONSTRUCTION FOR THIS 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:

STREAM AND WETLAND DELINEATIONS WERE PERFORMED IN DECEMBER, 2015 BY GAI CONSULTANTS, INC. TO REVIEW THE SITE FOR WATERS AND WETLANDS THAT ARE MOST LIKELY WITHIN THE REGULATORY JURISDICTION OF THE U.S. ARMY CORPS OF ENGINEERS (USACE) AND/OR THE WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION (WVDEP). THE DECEMBER 8, 2015 POTENTIALLY JURISDICTIONAL WATERS MAP WAS PREPARED BY GAI CONSULTANTS, INC. 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.

### GEOTECHNICAL NOTES:

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 REPRESENTATIVE OF THE GEOTECHNICAL ENGINEER OR PROJECT DESIGN ENGINEER DURING CONSTRUCTION. A SUBSURFACE INVESTIGATION OF THE PROPOSED SITE WAS PERFORMED BY PENNSYLVANIA SOIL & ROCK, INC. BETWEEN FEBRUARY 26, 2015 & MARCH 3, 2015. THE REPORT PREPARED BY PENNSYLVANIA SOIL & ROCK, INC. DATED APRIL 10, 2015, REFLECTS THE RESULTS OF THE SUBSURFACE INVESTIGATION. THE INFORMATION AND RECOMMENDATIONS CONTAINED IN THIS REPORT WERE USED IN THE PREPARATION OF THESE PLANS. PLEASE REFER TO THE SUBSURFACE INVESTIGATION REPORT BY PENNSYLVANIA SOIL & ROCK, INC. FOR ADDITIONAL INFORMATION, AS NEEDED.

### PROJECT CONTACTS:

#### OPERATOR:

ANTERO RESOURCES CORPORATION  
435 WHITE OAKS BLVD.  
BRIDGEPORT, WV 28330  
PHONE: (304) 842-4100  
FAX: (304) 842-4102

#### BLI WAGONER - ENVIRONMENTAL ENGINEER

OFFICE: (304) 842-4068 CELL: (304) 476-9770

#### JON McEVERS - OPERATIONS SUPERINTENDENT

OFFICE: (303) 357-8799 CELL: (303) 808-2423

#### JARON KUNZLER - CONSTRUCTION SUPERVISOR

CELL: (405) 227-8344

#### ANTHONY SMITH - FIELD ENGINEER

OFFICE: (304) 842-4208 CELL: (304) 673-8196

#### MARK JOHNSON - SURVEYING COORDINATOR

OFFICE: (304) 842-4162 CELL: (304) 719-8449

#### RICHARD LYLES - LAND AGENT

CELL: (770) 378-6833

#### ENGINEER/SURVEYOR:

NAVITUS ENGINEERING, INC.

CYRUS S. KUMP, PE - PROJECT MANAGER/ENGINEER

OFFICE: (888) 662-4185 CELL: (540) 686-6747

#### ENVIRONMENTAL:

GAI CONSULTANTS, INC.

JASON A. COOK - SENIOR ENVIRONMENTAL SPECIALIST

OFFICE: (304) 928-8100 CELL: (303) 709-3306

#### GEOTECHNICAL:

PENNSYLVANIA SOIL & ROCK, INC.

CHRISTOPHER W. SAMIOS - PROJECT ENGINEER

OFFICE: (412) 372-4000 CELL: (412) 589-0862

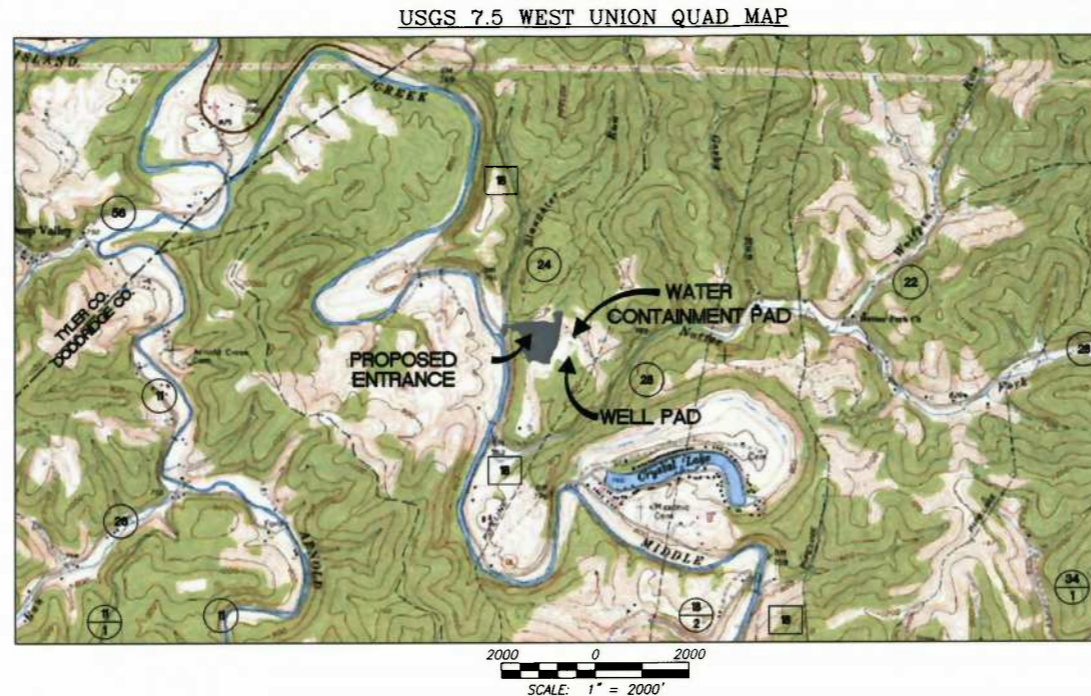
### RESTRICTIONS NOTES:

- THERE ARE NO PERENNIAL STREAMS, WETLANDS, LAKES, PONDS, OR RESERVOIRS WITHIN 100 FEET OF THE WELL PAD AND LOD.
- 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.

### REPRODUCTION NOTE

THESE PLANS WERE CREATED TO BE PLOTTED ON 22"x34" (ANSI D) PAPER. HALF SCALE DRAWINGS ARE ON 11"x17" (ANSI B) PAPER.

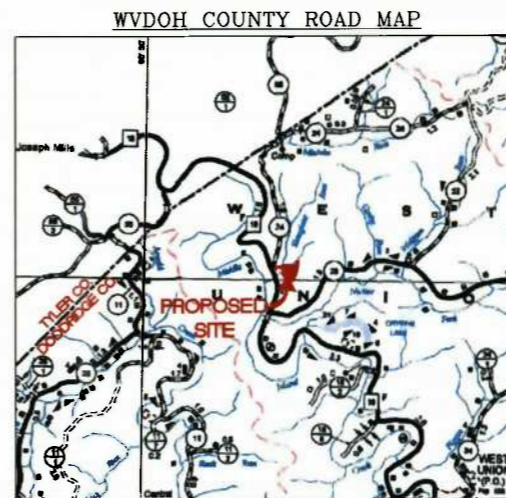
THESE PLANS WERE CREATED FOR COLOR PLOTTING AND ANY REPRODUCTIONS IN GRAY SCALE OR COLOR MAY RESULT IN A LOSS OF INFORMATION AND SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.



WEST VIRGINIA STATE PLANE COORDINATE SYSTEM  
NORTH ZONE, NAD83  
ELEVATION BASED ON NAVD83  
ESTABLISHED BY SURVEY GRADE GPS & OPUS  
POST-PROCESSING



(NOT TO SCALE)



SCALE: 1" = 500'

### DESIGN CERTIFICATION:

THE DRAWINGS, CONSTRUCTION NOTES, AND REFERENCE DIAGRAMS 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:

- COVER SHEET
- CONSTRUCTION AND E&S CONTROL NOTES
- LEGEND
- MATERIAL QUANTITIES
- STORM DRAINAGE COMPUTATIONS
- EXISTING CONDITIONS
- EXISTING STRUCTURES & FEATURES
- OVERALL PLAN SHEET INDEX & VOLUMES
- ACCESS ROAD & WATER CONTAINMENT PAD PLAN
- ACCESS ROAD, WATER CONTAINMENT PAD & WELL PAD PLAN
- WELL PAD GRADING PLAN
- WATER CONTAINMENT PAD GRADING PLAN
- ACCESS ROAD PROFILES
- ACCESS ROAD SECTIONS
- WELL PAD & WATER CONTAINMENT PAD SECTIONS
- WELL PAD & STOCKPILE SECTIONS
- STREAM CROSSING "A" & GABION WALL DETAILS
- CONSTRUCTION DETAILS
- ACCESS ROAD & WATER CONTAINMENT PAD RECLAMATION PLAN
- ACCESS ROAD, WATER CONTAINMENT PAD & WELL PAD RECLAMATION PLAN
- FIRM EXHIBIT
- GE500-GE504 - GEOTECHNICAL DETAILS

ADDIE LIMITS OF DISTURBANCE AREA (AC)	
Total Site	
Access Road "A" (1.468')	4.76
Well Pad	6.99
Water Containment Pad	2.36
Excess/Topsoil Material Stockpiles	3.24
<b>Total Affected Area</b>	<b>17.35</b>
<b>Total Wooded Acres Disturbed</b>	<b>3.89</b>
Impacts to Antero Resources Corporation TM 3-17	
Access Road "A" (1.468')	4.76
Well Pad	5.19
Water Containment Pad	2.36
Excess/Topsoil Material Stockpiles	3.24
<b>Total Affected Area</b>	<b>15.55</b>
<b>Total Wooded Acres Disturbed</b>	<b>3.89</b>
Impacts to Antero Resources Corporation M 3-17.1	
Well Pad	1.80
<b>Total Affected Area</b>	<b>1.80</b>
<b>Total Wooded Acres Disturbed</b>	<b>0.00</b>

Proposed Well Name	WV North NAD 27	WV North NAD 83	UTM (METERS) Zone 17	NAD 83 Lat & Long
Michels Unit 1H	N 306254 33 E 1630648 02	N 306289 50 E 1596206 83	N 4353811 33 E 516750 05	LAT 39-20-00 8214 LONG -80-48-20 3052
Michels Unit 2H	N 306254 09 E 1630658 02	N 306289 26 E 1596216 83	N 4353811 31 E 516753 86	LAT 39-20-00 8204 LONG -80-48-20 1779
Warrior Unit 1H	N 306253 85 E 1630668 01	N 306289 02 E 1596226 82	N 4353811 29 E 516756 74	LAT 39-20-00 8196 LONG -80-48-20 0506
Warrior Unit 2H	N 306253 61 E 1630678 01	N 306288 78 E 1596236 82	N 4353811 25 E 516759 79	LAT 39-20-00 8186 LONG -80-48-19 9234
Addie Unit 1H	N 306253 37 E 1630668 01	N 306288 54 E 1596246 82	N 4353811 24 E 516762 83	LAT 39-20-00 8177 LONG -80-48-19 7061
Addie Unit 2H	N 306253 13 E 1630668 00	N 306288 30 E 1596256 82	N 4353811 22 E 516765 86	LAT 39-20-00 8167 LONG -80-48-19 6688
Cobra Unit 1H	N 306252 89 E 1630708 00	N 306288 07 E 1596266 81	N 4353811 20 E 516768 93	LAT 39-20-00 8158 LONG -80-48-19 5416
Cobra Unit 2H	N 306252 65 E 1630718 00	N 306287 83 E 1596276 81	N 4353811 18 E 516771 97	LAT 39-20-00 8149 LONG -80-48-19 4143
Well Pad Elevation	890.0			

ADDIE PERENNIAL STREAM IMPACT (LINEAR FEET)					
Stream and Impact Cause	Permanent Impacts		Temp. Impacts	Temp. Disturb.	Total Disturbance (LF)
	Culvert / Fill (LF)	Inlets/Outlets Structures (LF)	Cofferdam/ E&S Controls (LF)	Distance to L.O.D. (LF)	
Perennial Stream 2 (Access Road "A")	4	0	0	0	4

ADDIE INTERMITTENT STREAM IMPACT (LINEAR FEET)					
Stream and Impact Cause	Permanent Impacts		Temp. Impacts	Temp. Disturb.	Total Disturbance (LF)
	Culvert / Fill (LF)	Inlets/Outlets Structures (LF)	Cofferdam/ E&S Controls (LF)	Distance to L.O.D. (LF)	
Intermittent Stream 4 (Access Road "A")	44	49	10	26	129

**NAVITUS**  
ENERGY ENGINEERING

DATE	REVISION	REVISION
10/28/2015	REVISED WATER CONTAINMENT TANK	
12/08/2015	REVISED PER STREAM & WETLAND DELINEATION	
02/09/2016	REVISED PER WDEP COMMENTS	
02/17/2016	REVISED PLAN TO SHOW EXISTING DWELLING	

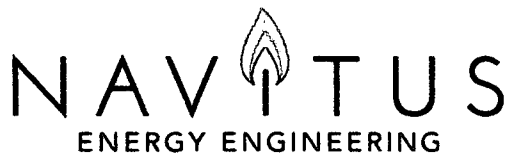
**Antero**  
THIS DOCUMENT WAS PREPARED FOR ANTERO RESOURCES CORPORATION

COVER SHEET  
**ADDIE**  
WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 04/13/2015  
SCALE: AS SHOWN  
SHEET 1 OF 28



  
NAVITUS  
ENERGY ENGINEERING

151 Windy Hill Lane, Winchester, VA 22602

December 8, 2015

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

Attn: Edwin "Bo" Wriston, Doddridge County Floodplain Administrator

Re: Addie Well Pad and Water Containment Pad - Floodplain Analysis

Dear Mr. Wriston:

Navitus Engineering has completed a floodplain analysis for the access road entrance to the proposed Addie Well Pad and Water Containment Pad site along WV Route 18 and Middle Island Creek, west of Crystal Lake, in Doddridge County, West Virginia. The entrance to the proposed site is located within FEMA Flood Zone "A" as shown on the Flood Insurance Rate Maps (FIRM) from the National Flood Insurance Program (NFIP), Map Number 54017C0110C dated October 4, 2011 however, based upon the analysis detailed in the attached report the entrance is actually mapped within Flood Zone "AE". Base flood elevations for this area of Middle Island Creek have been established, and detailed information for Middle Island Creek can be found within the Flood Insurance Study for Doddridge County, dated October 4, 2011.

In order to establish base flood elevations for this site, a hydrologic and hydraulic analysis was performed as outlined in the current Doddridge County Floodplain Ordinance, enacted May 21<sup>st</sup>, 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 Middle Island Creek drainage shed. Upon establishing the peak flow drainage calculations for the 100-year storm event, a HEC-RAS river analysis was conducted for a section of Middle Island Creek and Slaughter Run adjacent to the Addie Well Pad and Water Containment Pad Site and Base Flood Elevations (BFE) were established. The resulting BFEs were used to establish adjusted floodplain boundaries for the segment of Middle Island Creek being studied. These boundaries are shown on the attached Existing Conditions Plan. In addition to establishing BFEs, a proposed conditions analysis was performed to determine the impacts of proposed grading from the access road to the Addie Well Pad and Water Containment Pad Site. The proposed grading was added into the cross sections of the respective models and the manning's "n" values were adjusted where necessary. The models were run with these changes to determine the proposed impacts to the floodplain.

The results of this analysis indicate that the proposed improvements will not cause an increase in the BFEs along Middle Island Creek or Slaughter Run and no upstream or downstream properties will be adversely impacted.

Attached are the following documents associated with this submission:

- A Floodplain Analysis of Middle Island Creek and Slaughter Run 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.

Engineering Dedicated to the Development and Transmission of Energy  
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www.navituseng.com

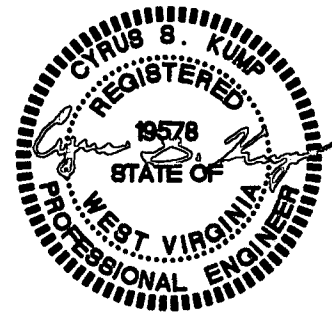
- The Addie Well Pad and Water Containment Site Plan, prepared by Navitus Engineering, Inc. which includes additional site design and construction specifications.
- Project Cost Estimate
- Doddridge County Improvement Location Permit Application
- Floodplain Permit Application Fee

Should any questions or comments arise during the review, please let us know and we will work to address them. Copies of all permits required for this site will be provided by the operator. 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®)



# FIRM EXHIBIT



LANDOWNER TABULATION

<b>A</b>	TM 3-10 JAMES. W. & LINDA S. BEATTY DB 259 PG 310 75 ACRES PO BOX 295 WEST UNION, WV 26456	<b>D</b>	TM 3-18.2 DAVID J. & DEBRA S. SMITH DB 232 PG 135 6 ACRES HC 89 BOX 39A WEST UNION, WV 26456	<b>G</b>	TM 3-19 SKYLAR O. & CLIFFORD W. MONTGOMERY WB 047 PG 333 21.84 ACRES 1607 RAYON DRIVE PARKERSBURG, WV 26101	<b>J</b>	TM 3-11 RONALD P., PERRY B., & RYAN W. GAINS DB 283 PG 682 43 ACRES PO BOX 2512 CLARKSBURG, WV 26302	<b>M</b>	TM 3-24 CHARLES L. & CAROL J. COTTRILL DB 256 PG 474 2.449 ACRES 3839 SMITHTON ROAD WEST UNION, WV 26456	<b>P</b>	TM 3-20 CATHLEEN SHULTZ 1106 GOLF COURSE DRIVE SEARCY, AR 72143 ROBERT GODDARD 507 PETERSON COURT INVERNESS, FL 34450 BONNIE PERSCHN 1214 MICK ROAD WELLSVILLE, OH 43968 COLIN GODDARD 48560 SPRUCE COURT EAST LIVERPOOL, OH 43920 LOIS ARCURI 9142 CHATHAM CIRCLE NORTH RIDGEVILLE, OH 44039 AP 041 PG 150 25.5 ACRES	<b>Q</b>	TM 4-22 GARY M. & MARY ANN EIFF DB 302 PG 640 39.49 ACRES 12954 SOUNDINGS ROAD LUSBY, MD 20857
<b>B</b>	TM 3-10.1 JAMES. W. & LINDA S. BEATTY DB 259 PG 310 25 ACRES PO BOX 295 WEST UNION, WV 26456	<b>E</b>	TM 3-18 THOMAS K. JR. & PENAY A. PORTER DB 228 PG 723 6.84 ACRES 457 CEDAR LANE WEST UNION, WV 26456	<b>H</b>	TM 3-17.1 ANTERO RESOURCES CORPORATION DB 358 PG 562 9.3 ACRES 535 WHITE OAKS BLVD. BRIDGEPORT, WV 26330	<b>K</b>	TM 3-12 PERRY GAINS DB 266 PG 045 45 ACRES PO BOX 2512 CLARKSBURG, WV 26302	<b>N</b>	TM 3-21.1 CHARLES L. & CAROL J. COTTRILL DB 256 PG 479 3 ACRES 3839 SMITHTON ROAD WEST UNION, WV 26456	<b>O</b>	TM 3-21 ADDIE M. LEADMON DB 250 PG 084 19.84 ACRES ROUTE 3 BOX 341 ELIZABETH, WV 26143	<b>R</b>	TM 3-17.2 (UNASSIGNED) LESS & ACCEPT FROM TM 3-17.1 MICHAEL A. MONTGOMERY DB 358 PG 562 0.562 ACRES 404 GABRIELS WAY WEST UNION, WV 26456
<b>C</b>	TM 3-16 DORIS F. WISEMAN AP 040 PG 512 26 ACRES 1 FIRST AMERICAN WAY WESTLAKE, TX 76262	<b>F</b>	TM 3-18.3 THOMAS K. JR. & PENAY A. PORTER DB 199 PG 700 126.376 ACRES 457 CEDAR LANE WEST UNION, WV 26456	<b>I</b>	TM 3-17 ANTERO RESOURCES CORPORATION DB 349 PG 553 25.9 ACRES 535 WHITE OAKS BLVD. BRIDGEPORT, WV 26330	<b>L</b>	TM 4-12 CHARLES L. COTTRILL, ADDIE M. COTTRILL, LEADMON, JAMES A. COTTRILL, CINDY K. COTTRILL WHITE, & KENNETH C. COTTRILL DB 260 PG 464 40.55 ACRES ROUTE 3 BOX 341 ELIZABETH, WV 26143						

**NFIP** NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0110C

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

PANEL 110 OF 325  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

COMMUNITY: DODDRIDGE COUNTY  
FIRMED: 1984  
EFFECTIVE: 1984

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**  
54017C0110C

**MAP REVISED**  
OCTOBER 4, 2011

Federal Emergency Management Agency

DATE: 10/20/2011  
REVISED: 12/09/2015  
DATE: 02/09/2016  
DATE: 02/17/2016

REVISION: REVISED WATER CONTAINMENT TANK LAYOUT PER PERMITS & RETAINING STRUCTURES  
REVISED PER WYDFP COMMENTS  
REVISED PLAN TO SHOW EXISTING WELLLINE

**FLOODPLAIN NOTES:**  
THE PROPOSED SITE IS LOCATED IN FLOOD ZONES "A" & "X" PER FEMA FLOOD MAP #64017C0110C



**NAVITUS**  
ENERGY ENGINEERING

Telephone: 888.662.4165 | www.NavitusEng.com

FIRM EXHIBIT

DATE	REVISION
10/20/2011	REVISED WATER CONTAINMENT TANK LAYOUT PER PERMITS & RETAINING STRUCTURES
12/09/2015	REVISED PER WYDFP COMMENTS
02/09/2016	REVISED PLAN TO SHOW EXISTING WELLLINE
02/17/2016	REVISED PLAN TO SHOW EXISTING WELLLINE



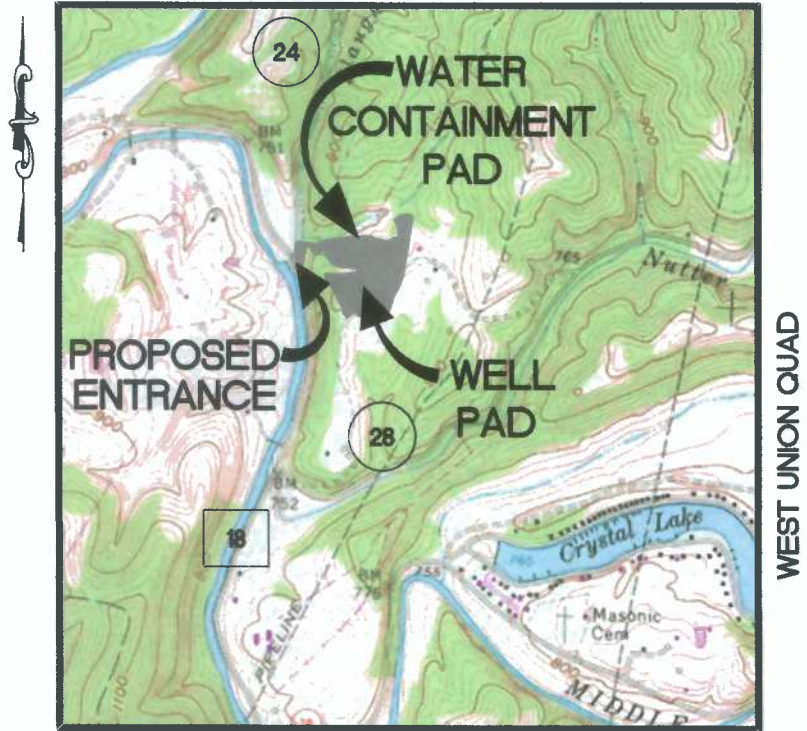
THIS DOCUMENT WAS PREPARED FOR ANTERO RESOURCES CORPORATION

**ADDIE**  
WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 04/13/2015  
SCALE: 1" = 200'  
SHEET 28 OF 28

FLOODPLAIN ANALYSIS OF  
MIDDLE ISLAND CREEK & SLAUGHTER RUN  
ADDIE WELL PAD &  
WATER CONTAINMENT PAD



VICINITY MAP  
1" = 2,000'

**NAVITUS**  
ENERGY ENGINEERING

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

Prepared For:



535 White Oaks Blvd.  
Bridgeport, WV 26330  
(304) 842-4100

Contacts:

Aaron Kunzler, Project Manager  
(405) 227-8344  
Anthony Smith, Field Engineer  
(304) 673-6196  
Richard Lyles, Land Agent  
(770) 378-6833



Designed By:  
Navitus Engineering Inc.

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

Tax Parcel:  
Map 3 Parcel 17, 17.1

Surface Owner (s)  
Antero Resources Corporation

Location:  
West Union District, Doddridge County  
West Virginia

Date: December 8, 2015

## 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. The proposed condition includes the installation of an access road for a well pad and water containment pad facility within FEMA floodplain.

## 2. Existing Conditions

### 2.1. Property Description

This site is located in Doddridge County, West Virginia along Middle Island Creek, Slaughter Run and West Virginia Route 18, west of Crystal Lake. The proposed access road entrance is located along the east side of WV 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 54017C0110C effective October 4, 2011. This floodplain is located in flood zone designation "A" however, based upon the analysis detailed in this report the entrance to the access road is mapped within Flood Zone "AE".

### 2.3. Floodplain Ordinance

This site is administered under the Doddridge County Floodplain Ordinance, enacted May 31st, 2013.

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. This requirement can be satisfied by utilization of the floodway area where determined.

Per Section 5.1 of this ordinance Permits are required for the construction of the entrance to the well pad and water containment pad facility. The format of the permit will coincide with the requirements set forth in Section 5.2 of the ordinance.

Per Section 6.1E of this ordinance any fill associated with the project shall be only used in manner which does not affect upstream and downstream properties. The access road entrance has been designed with this in mind. The access road will consist primarily of excavation with negligible fill. Impacts to the 100 year are demonstrated later in this report, however, the max increase of the construction within the mapped limits of FEMA Flood Zone will be 0.0'

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, a conveyance ditch along WV. Rte 18 and continued along the site access road been proposed at the entrance to allow adequate drainage through the drainage shed.

Per Section 6.1.H a flood protection setback equal to twice the width of the watercourse channel measuring from the top of one bank to the top of the opposite bank or 50 feet, whichever is less, shall be maintained as much as possible from the top of the banks of all watercourses.

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.F, 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. Middle Island Creek Characteristics*

Middle Island Creek is located in the Smithburg and West Union Districts of Doddridge County, includes the Buckeye Creek and Meathouse Fork drainage sheds, and flows in a northwesterly direction. The drainage area flowing to Middle Island Creek within the project area is approximately 127.717 square miles of forested and agricultural land with an average basin slope of 35.87%.

#### *2.5. Slaughter Run Characteristics*

Slaughter Run is located in the West Union District of Doddridge County, and flows in a southwesterly direction. The drainage area flowing to Slaughter Run within the project area is approximately 0.633 square miles of forested land with an average basin slope of 35.89%.

### **3. Analysis Information**

#### *3.1. HEC-RAS*

A HEC-RAS hydraulic analysis was performed for the portions of the Middle Island Creek and Slaughter Run that have 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 shot topography by Blue Mountain Aerial Mapping and two foot interval field shot data by Navitus Engineering. The upstream analysis limit for Middle Island Creek is located approximately 1,260 feet upstream from the proposed entrance to the Addie Site Plan and represents the 40+90.965 section. The downstream analysis limit for Middle Island Creek is located approximately 1,830 feet downstream of the proposed entrance to the Addie Site Plan and represents the 10+00.000 section. The upstream limit for Slaughter run is located approximately 725 feet upstream of the proposed entrance to the Addie Site Plan and represents the 17+24.607 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)	Note
Upper Middle Island Creek	76,838 Ac.	13,650	Upper Reach
Slaughter Run	405.12 Ac.	475.4	
Lower Nutter Fork	4241.90 Ac.	1080.8	
Lower Middle Island Creek	81,738.55 Ac.	14,965.8	Downstream Reach

### 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, bridges, 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.

<b>Manning's n value</b>	<b>Description</b>	<b>Portion Used</b>
.04	Clean, winding, some pools and shoals	Main Channel
.04	Mountain Stream, gravels, cobbles, and few boulders	Main Channel
.1	Heavy stand of timber, few down trees, little undergrowth, flow below branches	Floodplains (Normal)
.013	Asphalt	Floodplains
.035	High grass	Floodplains
.033	Rip Rap Dry Rubble	Floodplains
.06	Light Brush and trees, in summer	Floodplains
.05	Scattered brush, heavy weeds	Floodplains

#### 4. Results

##### 4.1. Existing Conditions

Since the site is mapped within Zone "AE" floodplain area as based upon the detailed study and as shown adjacent to the site plan on the FIRM, there has been a detailed study analysis with one foot interval 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, field shot data and existing drainage computations. This information was processed in HEC-RAS to determine the existing conditions of the Base Flood Elevations and then compared with the FIS for accuracy. To best match BFE's in the FIS, the downstream flow condition was set as the know water surface elevation of 749.0'. With this condition set BFE's were mapped higher than the BFE's within the FIS however elevations were within 1-3 feet. This can be attributed to higher accuracy in channel definition and manning's values set for floodplain conditions. Max flows at the downstream section of the model were 14,965 cfs which is 235 cfs less than the peak discharge of 15,200 cfs for the 100 year storm in Middle Island Creek at the Doddridge/Tyler County Line. We have determined the flows and BFE's associated with this project to be within tolerable limits of established engineering design practice and closely match the FIS Study for Doddridge County. Station 10+00 of Middle Island Creek, the downstream extents of this analysis, is approximately 1.3 miles from the Doddridge/Tyler County Line.

##### 4.2. Proposed Conditions

The proposed conditions model was based on the proposed topography for the site access road. 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 in the appendix. As shown in the table, the proposed development, which the portions contained within in the floodplain are entirely in cut, will not increase the existing BFEs throughout the project area.

## **5. Conclusion**

The results of this floodplain analysis indicate that there will be no changes in the 100 year base flood elevation and no impacts to upstream and downstream adjacent properties along Middle Island Creek or Slaughter Run.

**Property Owner Table-Doddridge County Floodplain Permit  
Antero Resources Corporation-Addie Pad**

Property Owner Name	Mailing Address	Parcel ID	Deed Book Reference
<b>Host Properties-Inside Floodplain</b>			
Beverly M Whitecotton (Antero Owned)	3867 Glendale Rd, Cairo, WV 26337	8-3-17	Book 246, Page 175
<b>Host Properties-Outside Floodplain</b>			
Charles Cottrill	3839 Smithton Rd, West Union, WV 26456	8-4-12	Book 250, Page 464
Michael A Montgomery (Antero Owned)	404 Gabriels Way, West Union, WV 26456	8-3-17.1	Book 261, Page 508
Lois Arcuri	9142 Chatham Circle, North Ridgevill, OH 44039	8-3-20	Book AP41, Page 150
Addie Marie Leadmon	Rt 3 Box 341B, Elizabeth, WV 26143	8-3-21	Book 250, Page 84
<b>Properties Abutting Host Properties-Inside Floodplain</b>			
James W & Lynda S Beatty	P.O. Box 295, West Union, WV 26456	8-3-10	Book 259, Page 310
Perry Gains, Perry Blackburn & Ryan Webb	P.O. Box 2512, Clarksburg, WV 26302	8-3-11	Book 283, Page 682
Doris Wiseman	1 First American Way, West Lake, TX 76262	8-3-16	Book AP40, Page 512
Thomas and Penny Porter	457 Cedar Lane, West Union, WV 26452	8-3-18	Book 228, Page 723
Thomas and Penny Porter	457 Cedar Lane, West Union, WV 26452	8-3-18.3	Book 199, Page 700
Clifford and Ora Montgomery	208 E Miles Ave, Apt 456, Pennsboro, WV 26415	8-3-19	Book WB47, Page 333

# 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 PLAN. 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 AND/OR GIS DATA. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO VERIFY THE EXACT HORIZONTAL AND VERTICAL LOCATIONS 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 PIPELINES. 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 ARE A RESULT OF HIS CONSTRUCTION PROJECT WITHIN OR CONTIGUOUS WITH 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 PLACEMENT REQUIRED DURING THE CONSTRUCTION OF THIS PROJECT. ALL MATERIAL TESTS SHALL BE CONDUCTED BY THE CONTRACTOR. ALL TEST RESULTS SHALL BE SUBMITTED TO THE ENGINEER CERTIFYING THE CONSTRUCTED FACILITY. FAILURE TO CONDUCT THE DENSITY TESTS AND/OR NECESSARY REPAIRS TO DEFICIENT AREAS AS A RESULT OF THE DENSITY TESTING SHALL BE CAUSE FOR NON-ACCEPTANCE OF THE CONSTRUCTED FACILITY.
- 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 HERON.
- SUPER SILT FENCE CAN BE USED IN PLACE OF ANY COMPOST FILTER SOCK.
- IT SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR TO COMPLY WITH ALL FEDERAL, STATE, AND LOCAL SAFETY REQUIREMENTS, INCLUDING THE 1970 OSHA ACT. PRECAUTION FOR THE PROTECTION OF PERSONS, INCLUDING EMPLOYEES AND PROPERTY, SHALL ALWAYS BE EXERCISED BY THE CONTRACTOR. INITIATION, MAINTENANCE, AND SUPERVISION OF ALL SAFETY REQUIREMENTS, PRECAUTIONS, AND PROGRAMS IN CONNECTION WITH THE WORK, INCLUDING ALL REQUIREMENTS PER CFR 1910.148, SHALL ALSO BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR.
- CONSTRUCTION ACTIVITIES SHALL BE RESTRICTED TO THE AREAS SHOWN ON THE PLANS WITHIN THE LIMITS OF DISTURBANCE, UNLESS OTHERWISE AUTHORIZED BY ANTERO RESOURCES CORPORATION. MODIFICATION PLAN MUST BE SUBMITTED TO THE DEP FOR ANY ACTIVITIES PERFORMED OUTSIDE OF THE LIMITS OF DISTURBANCE.
- PRESERVATION OF BENCHMARKS, PROPERTY CORNERS, REFERENCE POINTS, STAKES AND OTHER SURVEY REFERENCE MONUMENTS OR MARKERS IS THE RESPONSIBILITY OF THE CONTRACTOR. IN CASES OF WILLFUL OR CARELESS DESTRUCTION THE CONTRACTOR SHALL BE REQUIRED TO REPLACE OR RESTORE SAID MONUMENT OR MARKER. RESETTING OF MARKERS SHALL BE PERFORMED BY PROFESSIONAL SURVEYOR AS APPROVED BY ANTERO RESOURCES CORPORATION.
- THE CONTRACTOR SHALL MAINTAIN ADEQUATE CLEARANCE FROM ALL ELECTRIC LINES, IF ANY, IN ACCORDANCE WITH NATIONAL ELECTRICAL SAFETY CODE.
- THE CONTRACTOR SHALL MINIMIZE ALL CLEARING AND DISTURBANCE TO THE ENVIRONMENT TO THE MAXIMUM EXTENT POSSIBLE. CLEARING, GRUBBING, AND TOPSOIL STRIPPING SHALL BE LIMITED TO THOSE AREAS DESCRIBED IN EACH STAGE OF THE CONSTRUCTION SEQUENCE.
- ANY DIGITAL FILES PROVIDED TO THE CONTRACTOR BY NAVITUS ENGINEERING, INC. ARE PROVIDED FOR THE CONVENIENCE OF THE CONTRACTOR ONLY. THE CONSTRUCTION OF THE SITE SHALL MEET ALL DESIGN PARAMETERS OF THE WDEP APPROVED NAVITUS ENGINEERING, INC. DESIGN PLANS. NAVITUS ENGINEERING, INC. WILL NOT BE HELD LIABLE FOR THE CONTRACTOR USING THE DIGITAL FILES TO WAIVER FROM THE APPROVED DESIGN PLANS.
- ANY CONSTRUCTION ISSUES OR QUESTIONS SHALL BE BROUGHT TO THE ENGINEER IMMEDIATELY. THE CONSTRUCTION INSPECTOR SHALL BE CONTACTED AND MUST RELAY THESE ISSUES OR QUESTIONS TO THE ENGINEER FOR RESOLUTION. TEMPORARY STABILIZATION SHALL BE APPLIED AS NECESSARY.
- ALL EXISTING AND DESIGNED CULVERTS AND CULVERT SUMPS SHALL BE CLEANED AND CLEARED OF DEBRIS DURING THE COURSE OF CONSTRUCTION. ANY EXCESS EROSION DUE TO THE PLUGGING OF A CULVERT SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR.

## 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 ST. RT. 18, 0.02 MILES SOUTH OF THE INTERSECTION OF ST. RT. 18 & CO. RT. 24 IN WEST UNION DISTRICT, DODDRIIDGE COUNTY, WEST VIRGINIA. THE TOTAL APPROXIMATE LAND DISTURBANCE ASSOCIATED WITH THIS PROJECT IS 17.35 ACRES.
- EXISTING SITE CONDITIONS:** THE EXISTING SITE IS APPROXIMATELY 22.4% WOODED. THE TOPOGRAPHY RANGES FROM MODERATE TO STEEP TERRAIN (2% TO 80% SLOPES). PRESENT ON SITE ARE ACCESS ROADS, OVERHEAD UTILITIES, EXISTING PIPELINES, EXISTING STRUCTURES, AN EXISTING GAS WELL, AND TANKS ASSOCIATED WITH THE EXISTING GAS WELL. 2 PERENNIAL STREAM(S), 4 INTERMITTENT STREAM(S), 2 EPHEMERAL STREAM(S), 2 WETLAND(S), AND 6 PONDS(S) ARE LOCATED ONSITE. THE SITE IS LOCATED ON A RIDGE AND DRAINS TO MIDDLE ISLAND CREEK AND TRIBUTARIES OF MIDDLE ISLAND CREEK. NO EROSION WAS NOTICED ON SITE.
- ADJACENT PROPERTY:** THE SITE IS BORDERED BY FORESTED LANDS ON ALL SIDES. ST. RT. 18 AND MIDDLE ISLAND CREEK ARE LOCATED TO THE WEST. EXISTING OCCUPIED DWELLINGS ARE LOCATED TO THE EAST, SOUTH, & WEST.
- 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:** 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 REPRESENTATIVE OF THE GEOTECHNICAL ENGINEER OR PROJECT DESIGN ENGINEER DURING CONSTRUCTION.
- A SUBSURFACE INVESTIGATION OF THE PROPOSED SITE WAS PERFORMED BY PENNSYLVANIA SOIL & ROCK, INC. BETWEEN FEBRUARY 28, 2015 & MARCH 3, 2015. THE REPORT PREPARED BY PENNSYLVANIA SOIL & ROCK, INC. DATED APRIL 10, 2015, REFLECTS THE RESULTS OF THE SUBSURFACE INVESTIGATION. THE INFORMATION AND RECOMMENDATIONS CONTAINED IN THIS REPORT WERE USED IN THE PREPARATION OF THESE PLANS. PLEASE REFER TO THE SUBSURFACE INVESTIGATION REPORT BY PENNSYLVANIA SOIL & ROCK, INC. FOR ADDITIONAL INFORMATION, AS NEEDED.**
- 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 AND/OR SILT FENCE 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.
  - 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. ALL RUNOFF FROM DISTURBED AREAS SHALL PASS THROUGH A SEDIMENT FILTERING DEVICE LOCATED BELOW THE DISTURBED AREA. AT NO TIME WILL UNFILTERED SEDIMENT LADEN RUNOFF BE ALLOWED TO LEAVE THE SITE AND ENTER STATE WATERS.**
- 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 AS ENGINEERED FILL ON THE STOCKPILES.**
- INLETS AND OUTLETS OF DITCH RELIEF CULVERTS SHALL BE CHECKED REGULARLY FOR SEDIMENT BUILD-UP. IF THE INLET AND/OR OUTLET IS CLOGGED BY 50% OR GREATER, IT SHALL BE REMOVED AND CLEANED OR REPLACED IMMEDIATELY.**
- SEDIMENT TRAPPED 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 SWEEPED INTO ANY ROADSIDE DITCH, CULVERT OR SURFACE WATER.**
- ANY DISTURBED AREAS ALONG THE ACCESS ROAD SHALL BE STABILIZED AS CONSTRUCTION PROCEEDS, PRIOR TO CONTINUING FURTHER ACCESS ROAD CONSTRUCTION, 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), SED 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/FLAG ALL IDENTIFIED WETLANDS, STREAMS, UTILITIES, 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 WINDOWED IN APPROPRIATE AREAS FOR USE AS SEDIMENT BARRIERS AT WATER DRAINAGE OUTLETS (AS SHOWN ON THE PLANS), WINDOWED 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 UNWEAVING SITE. ALL STRIPPED TOPSOIL SHALL BE STOCKPILED IN AREAS SHOWN IN THE PLANS OR RE-SPREAD AT AN APPROXIMATE DEPTH OF 2-4 INCHES ON ALL PROPOSED 2:1 OR FLATTER SLOPES, 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 AS OUTLINED IN THE GEOTECHNICAL REPORT. 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 OF STOCKPILES. AFTER STOCKPILES ARE CONSTRUCTED, TOPSOIL IS TO BE REAPPLIED AT A DEPTH OF 2"-4". 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 UNWEAVING SITE. ALL STRIPPED TOPSOIL SHALL BE STOCKPILED IN AREAS SHOWN IN THE PLANS, OR RE-SPREAD AT AN APPROXIMATE DEPTH OF 2-4 INCHES ON ALL PROPOSED 2:1 OR FLATTER SLOPES, 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 PUMPS (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 SEED AND MULCH. INSTALL ALL STRAW WATTLES AS SHOWN ON PLANS. 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 WDEP.
  - ANY AREAS DISTURBED BY REMOVAL OF CONTROLS SHALL BE REPAIRED, STABILIZED, AND PERMANENTLY SEEDED.

## CONSTRUCTION STANDARDS:

- THE DESIGN, CONSTRUCTION, AND REMOVAL OF FILL FOR OIL AND GAS SITES MUST BE ACCOMPLISHED IN SUCH A MANNER AS TO PROTECT THE HEALTH AND SAFETY OF THE PEOPLE, THE NATURAL RESOURCES, AND ENVIRONMENT OF THE STATE. THE SITE SHALL BE DESIGNED, CONSTRUCTED, AND MAINTAINED TO BE STRUCTURALLY SOUND AND REASONABLY PROTECTED FROM UNAUTHORIZED ACTS OF THIRD PARTIES.
- ALL FILL AREAS SHOULD BE CLEARED OF TREES, STUMPS, AND ANY VEGETATION AND STRIPPED OF TOPSOIL/ORGANIC SOILS PRIOR TO THE START OF FILL PLACEMENT.
  - ANY GROUNDWATER ENCOUNTERED DURING CONSTRUCTION SHALL BE DRAINED TO THE OUTSIDE/DOWNSTREAM TOE OF THE SLOPE. CONSTRUCTED DRAIN SECTION SHALL BE AN EXCAVATED 2' x 2' TRENCH AND BACK FILLED WITH #57 STONE. COMPACTED BY HAND TAMPER. GEOTEXTILE FABRIC SHALL BE USED TO LINE TRENCH.
  - 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.
  - GENERALLY, UNSATISFACTORY MATERIALS INCLUDE MATERIALS CLASSIFIED IN ASTM D-2487 AS PT, CH, MH, OL, OH, AND ANY SOIL TOO WET TO FACILITATE CONSTRUCTION. CH AND MH SOILS MAY BE USED SUBJECT TO APPROVAL OF THE ENGINEER.
  - ALL FILL AREAS SHALL BE "KEYED IN" AND COMPACTED IN HORIZONTAL LIFTS WITH A MAXIMUM LOOSE LIFT THICKNESS OF 12" AND MAXIMUM PARTICLE SIZE AS OUTLINED IN THE GEOTECHNICAL REPORT. 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.
  - ROCK LIFTS ARE NOT PROPOSED FOR THE CONSTRUCTION OF THIS SITE. HOWEVER, LARGER ROCK PARTICLES OR BOULDERS THAT ARE ENCOUNTERED DURING CONSTRUCTION NEED TO BE BROKEN DOWN TO A MANAGEABLE SIZE (MAXIMUM 3'x3'x1' THICK) TO BE PLACED AS FILL. DURING PLACEMENT OF FILL CONTAINING LARGE SIZE ROCK PARTICLES, IT IS CRITICAL THAT NO VOID SPACES BE LEFT BETWEEN THE ROCKS. SMALLER ROCK FRAGMENTS AND SOIL MUST BE WORKED INTO ANY OPENINGS BETWEEN THE BOULDERS AFTER THEY ARE PUT IN PLACE. ADDITIONAL GUIDANCE REGARDING ENCOUNTERED ROCK CAN BE FOUND IN THE GEOTECHNICAL REPORT.
  - THE PLACEMENT OF ALL FILL MATERIAL SHALL BE FREE OF WOOD, STUMPS AND ROOTS, LARGE ROCKS AND BOULDERS, AND ANY OTHER NONCOMPACTABLE SOIL MATERIAL. NO FILL SHALL CONTAIN OR BE PLACED ON FROZEN MATERIAL. THE FILL SHALL BE COMPACTED TO A MINIMUM OF VISIBLE NON-MOVEMENT, HOWEVER, THE COMPACTION EFFORT SHALL NOT EXCEED THE OPTIMUM MOISTURE LIMITS.
  - ALL EXPOSED AREAS, NOT COVERED BY COMPACTED GRAVEL OR RIP-RAP SHALL BE LIMED, FERTILIZED, SEEDED AND MULCHED. PERMANENT VEGETATIVE GROUND COVER IN COMPLIANCE WITH THE WV DEP EROSION AND SEDIMENT CONTROL FIELD MANUAL MUST BE ESTABLISHED UPON THE COMPLETION OF CONSTRUCTION. SLOPES SHALL BE MAINTAINED WITH A GRASSY VEGETATIVE COVER AND FREE OF BRUSH AND/OR TREES.
  - IF STANDING WATER IS PRESENT ON SITE, CONTRACTOR TO CORRECT DRAINAGE ISSUE BY DIRECTING WATER TO PROPER E&S CONTROLS OR OUTLET WITH POSITIVE DRAINAGE. IF NECESSARY, CONTACT ENGINEER FOR GUIDANCE IN CORRECTING DRAINAGE ISSUES.
  - ALL DRAINAGE DITCHES, DIVERSIONS, AND CULVERTS SHALL HAVE POSITIVE DRAINAGE AND PROPER OUTLET PROTECTION OR LEVEL SPREADING DEVICE. SUPER SILT FENCE, OR APPROVED ALTERNATIVE, SHALL BE INSTALLED WITHIN 5 FEET OF THE OUTLET PROTECTION OR LEVEL SPREADING DEVICE TO PREVENT EROSION DOWNSTREAM. IF EROSION IS PRESENT DOWNSTREAM OF AN EROSION CONTROL DEVICE, CONTRACTOR TO INSTALL ADDITIONAL EROSION CONTROLS AND STABILIZATION TO PREVENT FURTHER EROSION.
  - ALL DRAINAGE DITCHES AND DIVERSIONS THAT ARE ROCK LINED SHALL BE INSTALLED PER THE DETAILS ON THIS PLAN INCLUDING THE NECESSARY INSTALLATION OF ANY GEOTEXTILE FABRIC UNDERNEATH THE ROCK LINING.
  - IF THE EROSION CONTROL DEVICES SHOW EVIDENCE OF BEING INADEQUATE DUE TO CONSTRUCTION MEANS AND METHODS, THE CONTRACTOR IS TO INSTALL ADDITIONAL DRAINAGE DEVICES OR EROSION CONTROLS TO PREVENT FURTHER EROSION FROM OCCURRING.
  - CONTRACTOR IS TO EXTEND ALL KEYWAY AND BONDING BENCH OUTLET DRAINS A MINIMUM OF ONE FOOT PAST THE FINISHED GRADE OF THE SLOPE AND INSTALL THE PROPER OUTLET PROTECTION PER THE DETAIL ON THESE PLANS. ALL OUTLET DRAINS ARE TO BE CLEARLY VISIBLE AND MARKED.
  - ALL SLOPES SHALL BE TRACKED IN PER THE DETAILS ON THESE PLANS. CONTRACTOR SHALL REPEAT THIS METHOD ANY TIME AN AREA HAS BEEN DISTURBED PRIOR TO THAT AREA BEING STABILIZED.
  - ALL MAINTENANCE OF EROSION AND SEDIMENT CONTROLS MUST BE PERFORMED IMMEDIATELY ONCE THE CONTRACTOR IS NOTIFIED OF THE DISCREPANCY. CONTRACTOR TO PERFORM MAINTENANCE OR IMMEDIATELY NOTIFY THE SUB-CONTRACTOR PERFORMING THE E&S TASKS. ANY EROSION CONTROL MAINTENANCE THAT IS DEEMED TO BE AN EMERGENCY SHALL BE PERFORMED IMMEDIATELY UPON THE CLIENT, ENGINEER, OR STATE'S REQUEST.
  - ALL LANDOWNER ACCESS ROADS AND EXISTING WELL ROADS THAT ARE BEING MAINTAINED SHALL BE KEPT OPEN DURING THE ENTIRE COURSE OF CONSTRUCTION TO PROVIDE CONTINUOUS ACCESS. IF CLOSURE IS NECESSARY, THE CONTRACTOR SHALL PROVIDE AN EQUIVALENT DETOUR ROUTE TO THE SATISFACTION OF THE LANDOWNER OR WELL OWNER.
  - ANY WATER INFILTRATING AROUND THE WELL PAD DEWATERING SYSTEM SHALL BE CORRECTED IMMEDIATELY TO PREVENT THE FAILURE OF THE SOILS AND DESIGN ASPECTS OF THE DEWATERING SYSTEM. ANY EXCESS EROSION OR SLOPE FAILURES DUE TO WATER INFILTRATION IN THE SUMP AREA SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR.
  - ALL DITCH RELIEF AND STREAM CROSSING CULVERTS SHALL MEET ALL MANUFACTURER SPECIFICATIONS INCLUDING THE MINIMUM AND MAXIMUM COVER. IF MANUFACTURER SPECIFICATIONS CANNOT BE MET, CONTRACTOR SHALL CONSULT THE ENGINEER OR MANUFACTURER FOR ALTERNATIVES.
- 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 ANTERO RESOURCES CORPORATION AND THE WDEP OFFICE OF OIL AND GAS. (EMERGENCY #1-800-642-3074)

DATE: 10/28/2015 REVISION: REVISOR: WATER CONTAINMENT TANK 12/08/2015 REVISION: PER STREAM & WETLAND DELINEATION 02/09/2016 REVISION: PER WDEP COMMENTS 02/17/2016 REVISION: PLAN TO SHOW EXISTING DWELLING	DATE: 04/13/2015 SCALE: N/A SHEET 2 OF 28

ADDIE  
 WEST UNION DISTRICT  
 DODDRIIDGE COUNTY, WEST VIRGINIA

THIS DOCUMENT WAS PREPARED FOR: ANTERO RESOURCES CORPORATION

CONSTRUCTION AND E&S CONTROL NOTES  
 WELL PAD & WATER CONTAINMENT PAD

02/17/2016

ANTERO RESOURCES CORPORATION

# LEGEND

LEGEND	
EX. INDEX CONTOUR & CONTOUR LABEL	PR. INDEX CONTOUR (10' INTERVAL) & CONTOUR LABEL
EX. INTERMEDIATE CONTOUR	PR. INTERMEDIATE CONTOUR (2' INTERVAL)
EX. PROPERTY LINE	PR. INTERMEDIATE CONTOUR (1' INTERVAL)
EX. EDGE OF GRAVEL/DIRT	PR. INDEX ROAD CONTOUR (10' INTERVAL) & CONTOUR LABEL
EX. EDGE OF PAVEMENT	PR. INTERMEDIATE ROAD CONTOUR (2' INTERVAL)
EX. ROAD CENTERLINE	PR. PADS/STOCKPILE TOPO LIMITS
EX. EDGE OF CONCRETE	PR. LIMITS OF DISTURBANCE
EX. GUARDRAIL	PR. ROAD/IMPOUNDMENT EDGE OF GRAVEL
EX. BRIDGE	PR. ROAD CENTERLINE
EX. DITCHLINE/DRAINAGE FEATURE	PR. GUARDRAIL
EX. RIP-RAP	PR. ROCK CONSTRUCTION ENTRANCE
EX. CULVERT	PR. AIR BRIDGE
EX. TREELINE	PR. CULVERT
EX. BUILDING	PR. DITCH
EX. MISCELLANEOUS FEATURE	PR. RIP-RAP TRAPEZOIDAL DITCH
EX. 100-YR FEMA FLOODPLAIN	PR. OUTLET PROTECTION
EX. DELINEATED STREAM	PR. DIVERSION
EX. DELINEATED WETLAND/POND	PR. ROCK FILTER OUTLET
100' WETLAND/STREAM BUFFER	PR. COMPOST FILTER SOCK
STREAM/WETLAND DELINEATION STUDY AREA	PR. SUPER SILT FENCE
EX. FENCELINE/PERIMETER SAFETY FENCE	PR. STRAW WATTLE
EX. GATE	PR. WELL HEAD
EX. ACCESS GATE WITH EMERGENCY LIFELINE	PR. PAD DEWATERING SYSTEM
EX. WELL HEAD ON DESIGNED PAD	PR. TOP OF PAD CONTAINMENT BERM
EX. GAS WELL	PR. 220' X 320' PAD FOOTPRINT
EX. PIPELINE	PR. SPOT SHOT
EX. PIPELINE R/W	PR. PERIMETER SAFETY FENCE
EX. PIPELINE METER	PR. ACCESS GATE WITH EMERGENCY LIFELINE
EX. PIPELINE VALVE	PR. PIPELINE
EX. PIT	PR. PIPELINE R/W
EX. POWER POLE/GUY WIRE	PR. OVERHEAD UTILITY
EX. OVERHEAD UTILITY	PR. POWER POLE/GUY WIRE
EX. UNDERGROUND ELECTRIC	PR. OVERHEAD UTILITY R/W
EX. UNDERGROUND TELEPHONE	PR. TELEPHONE LINE
EX. UNDERGROUND FIBER OPTIC	PR. WATERLINE
EX. UTILITY R/W	BORING LOCATION
EX. WATERLINE	X-SECTION/PROFILE GRID INDEX
EX. SANITARY LINE	X-SECTION/PROFILE GRID INTERMEDIATE
EX. WATER WELL/EX. SPRING	X-SECTION/PROFILE PROPOSED GRADE
EX. COMPOST SOCK	X-SECTION/PROFILE EXISTING GRADE
EX. SUPER SILT FENCE	X-SECTION/PROFILE WATER SURFACE
EX. SILT FENCE	X-SECTION/PROFILE CULVERT
EX. STRAW WATTLE	MATCHLINE

DATE	REVISION
10/29/2015	REVISED WATER CONTAINMENT TANK
12/08/2015	REVISED PER STREAM & WETLAND DELINEATION
02/09/2016	REVISED PER WDEP COMMENTS
02/17/2016	REVISED PLAN TO SHOW EXISTING DWELLING



THIS DOCUMENT WAS PREPARED FOR:  
ANTERO RESOURCES CORPORATION

LEGEND  
**ADDIE**  
WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 04/13/2015  
SCALE: N/A  
SHEET 3 OF 28

# MATERIAL QUANTITIES

MATERIAL QUANTITIES				
WELL PAD & WATER CONTAINMENT PAD SITE: ADDIE				
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	3.89	AC	\$	\$
2.1.2 Open Field	13.48	AC	\$	\$
2.2 Super Silt Fence	3,747.4	LF	\$	\$
2.3 18" Compost Filter Sock	1,191.5	LF	\$	\$
2.4 Straw Wattles	873.3	LF	\$	\$
2.5 Rock Filter Outlet	7.0	LF	\$	\$
2.6 Ditch Lining - Turf Reinforcement Mat (TRM)	9,298.7	SF	\$	\$
3.0 Unclassified Earthwork				
3.1 Access Road "A"				
3.1.1 Topsoil Removal to Stockpile (Assume 12" Depth)	4,184.1	CY	\$	\$
3.1.2 Excavation (Cut to Compact Fill)	2,585.5	CY	\$	\$
3.1.3 Excavation (Export to Stockpile)	20,439.2	CY	\$	\$
3.2 Well Pad				
3.2.1 Topsoil Removal to Stockpile (Assume 12" Depth)	8,159.0	CY	\$	\$
3.2.2 Excavation (Cut to Compact Fill)	14,672.2	CY	\$	\$
3.2.3 Excavation (Import from Stockpile)	18,661.6	CY	\$	\$
3.3 Water Containment Pad				
3.3.1 Topsoil Removal to Stockpile (Assume 12" Depth)	2,677.0	CY	\$	\$
3.3.2 Excavation (Cut to Compact Fill)	4,377.5	CY	\$	\$
3.3.3 Excavation (Export to Stockpile)	860.4	CY	\$	\$
3.4 Excavation/Undiggable Material (Hammering)		CY	\$	\$
3.5 Excavation/Undiggable Material (Blasting)		CY	\$	\$

4.0 Stone and Aggregate Surfacing				
4.1 Construction Entrance/Broad Based Dip				
4.1.1 2"-3" Clean Aggregate (10" Depth)	89.9	TONS	\$	\$
4.1.2 Geotextile Fabric (US 200 or Equal)	1,949.4	SF	\$	\$
4.2 Access Road "A"				
4.2.1 2"-3" Clean Aggregate (6" Depth)	1,064.3	TONS	\$	\$
4.2.2 3/4"-1 1/2" Crusher Run (2" Depth)	355.5	TONS	\$	\$
4.2.3 Geotextile Fabric (US 200 or Equal)	38,313.0	SF	\$	\$
4.3 Well Pad				
4.3.1 2"-3" Clean Aggregate (6" Depth)	4,292.7	TONS	\$	\$
4.3.2 3/4"-1 1/2" Crusher Run (2" Depth)	1,365.5	TONS	\$	\$
4.3.3 Geotextile Fabric (US 200 or Equal)	147,177.0	SF	\$	\$
4.4 Water Containment Pad				
4.4.1 2"-3" Clean Aggregate (6" Depth)	1,639.8	TONS	\$	\$
4.4.2 3/4"-1 1/2" Crusher Run (2" Depth)	547.7	TONS	\$	\$
4.4.3 Geotextile Fabric (US 200 or Equal)	59,032.8	SF	\$	\$
4.5 Rip-Rap				
4.5.1 R-3 (3-6" Stone, 9" Depth)	540.9	TONS	\$	\$
4.5.2 R-4 (6-12" Stone, 18" Depth)	292.4	TONS	\$	\$
4.5.3 R-5 (9-18" Stone, 27" Depth)	54.2	TONS	\$	\$
4.5.4 Geotextile Fabric (US 200 or Equal)	13,370.9	SF	\$	\$
4.6 Rock Fill Check Dams (#1 Stone)	7.5	TONS	\$	\$
4.7 Stream Crossing Fill Material				
4.7.1 3/4"-1" Aggregate - Class I Backfill Material	96.3	TONS	\$	\$
4.7.2 0"-1/2" Aggregate - Bedding Material	28.5	TONS	\$	\$
5.0 Ditch Relief and Drainage Culverts				
5.1 15" HDPE (total)	263.0	LF	\$	\$
5.2 30" HDPE (total)	44.0	LF	\$	\$
6.0 Well Pad Dewatering System				
6.1 102"x78"x54" Pre-Cast Low Profile Tank Catch Basins	6	EA	\$	\$
6.2 6" Sch 40 PVC Riser and 4" PVC Valve	6	EA	\$	\$
6.3 4" PVC Discharge Pipe	202.8	LF	\$	\$
6.4 Compacted Limestone Sand or #8 Limestone	255.6	TONS	\$	\$
6.5 500 psi Flowable Fill	96.8	CY	\$	\$
6.6 12" Compost Filter Sock Around Grate	90.0	LF	\$	\$
6.7 6" Bollard (8' length)	28	EA	\$	\$
7.0 Liner System				
7.1 Well Pad Containment Berm				
7.1.1 Primary Liner (60 Mil Textured)	13,849.8	SF	\$	\$
7.1.2 Non-woven Geotextile Fabric Cushion (16 oz.)	13,849.8	SF	\$	\$
8.0 Miscellaneous				
8.1 Seeding and Mulching				
8.1.1 Temporary Seeding (Vegetation & Mulch)	0.00	AC	\$	\$
8.1.2 Permanent Seeding (Hydro Seeding - includes Hall's Pasture Seed Mix, Lime, & Fertilizer) with Hay Mulch w/Tack	12.47	AC	\$	\$
8.2 3'x3'x6' Gabion Cages with Stone	13	EA	\$	\$
8.3 4'x20' Matting Board	6	EA	\$	\$

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THIS DOCUMENT WAS PREPARED FOR:  
ANTERO RESOURCES CORPORATION

MATERIAL QUANTITIES  
**ADDIE**  
WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 04/13/2015  
SCALE: N/A  
SHEET 4 OF 28

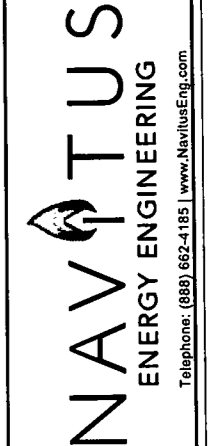
**NOTES:**  
1. THE SQUARE FOOTAGE FOR THE GEOTEXTILE FABRIC AND THE LINER SYSTEM DOES NOT ACCOUNT FOR MATERIAL OVERLAP AND WASTE.

# STORM DRAINAGE COMPUTATIONS

CULVERT COMPUTATIONS																					
Culvert No.	Access Road Station	Drainage Area (Ac.)	Runoff Coefficient (C factor)	10-year Rainfall Intensity (in/hr)	Tc, Time of Conc. (Min)	Total Discharge (cfs)	Upstream Invert Elevation	Downstream Invert Elevation	Culvert Size (in)	Length (ft)	Culvert Slope (%)	Culvert Manning's "n"	Culvert Material	Inlet (Ke)	Maximum Headwater Elev. (ft)	Headwater Elevation (ft)	Headwater Depth (ft)	Outlet Flow Depth (ft)	Flow Type	Tailwater Elevation (ft)	Outlet Velocity (ft/s)
1	0+80.4	1.38	0.34	6.5	5.0	3.03	743.90	743.00	15	40.0	2.2	0.012	HDPE	0.2	745.15	744.94	1.04	0.46	Outlet Control	743.46	7.41
2	2+96.4	0.45	0.38	6.5	5.0	1.12	767.78	765.60	15	31.0	7.0	0.012	HDPE	0.2	769.03	768.38	0.60	0.22	Outlet Control	765.82	7.86
3	3+95.9	6.40	N/A	N/A	5.0	16.86	773.75	772.00	30	44.0	4.0	0.012	HDPE	0.2	776.25	775.81	2.06	0.74	Inlet Control	772.74	13.97
4	5+00.0	0.63	0.48	6.5	5.0	1.95	788.31	786.50	15	46.0	3.9	0.012	HDPE	0.2	789.56	789.12	0.81	0.32	Outlet Control	786.82	7.99
5	7+00.0	0.62	0.47	6.5	5.0	1.90	818.31	816.50	15	46.0	3.9	0.012	HDPE	0.2	819.58	819.11	0.80	0.31	Outlet Control	816.81	7.93
6	9+00.0	0.59	0.59	6.5	5.0	0.73	846.18	846.40	15	50.0	3.6	0.012	HDPE	0.2	849.43	848.66	0.48	0.20	Outlet Control	846.60	5.78
7	10+08.8	0.58	0.73	6.5	5.0	2.76	862.87	862.32	15	50.0	1.1	0.012	HDPE	0.2	864.12	863.66	0.99	0.53	Outlet Control	862.85	5.57

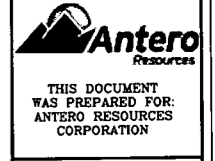
DITCH COMPUTATIONS																	
Ditch No.	Length (ft)	Drainage Area (Ac.)	Runoff Coefficient (C factor)	10-year Rainfall Intensity (in/hr)	Tc, Time of Conc. (Min)	Total Discharge (cfs)	Channel Slope (%)	Channel Section	Channel Width (ft)	Left Side Slope	Right Side Slope	Channel Depth (ft)	Normal Depth (ft)	Freeboard (ft)	Velocity (ft/s)	Manning's "n"	Ditch Lining
1	109.37	1.22	0.33	6.5	5.0	2.62	4.4	Triangular	0.0	2:1	2:1	1.50	0.63	0.87	3.33	0.04	TRM
2	114.75	0.16	0.40	6.5	5.0	0.42	21.4	Triangular	0.0	2:1	2:1	1.50	0.22	1.28	4.22	0.035	R-3
3	3.00	0.03	0.40	6.5	5.0	0.08	9.0	Triangular	0.0	2:1	2:1	1.50	0.15	1.35	1.91	0.04	TRM
4	83.73	0.42	0.38	6.5	5.0	1.04	7.4	Triangular	0.0	2:1	2:1	1.50	0.40	1.10	3.22	0.04	TRM
5	21.74	0.05	0.48	6.5	5.0	0.16	1.2	Triangular	0.0	2:1	2:1	1.50	0.31	1.16	0.88	0.05	Grass Lined
6	39.41	0.00	0.00	6.5	5.0	13.63	50.0	Trapezoidal	4.0	2:1	2:1	1.50	0.35	1.15	8.42	0.055	R-5
7	107.18	1.11	0.43	6.5	5.0	3.07	17.9	Triangular	0.0	2:1	2:1	1.50	0.49	1.01	6.50	0.035	R-3
8	198.74	0.63	0.48	6.5	5.0	1.95	17.2	Triangular	0.0	2:1	2:1	1.50	0.41	1.09	5.71	0.035	R-3
9	203.42	0.62	0.47	6.5	5.0	1.90	17.2	Triangular	0.0	2:1	2:1	1.50	0.41	1.09	5.68	0.035	R-3
10	102.79	0.19	0.59	6.5	5.0	0.73	16.0	Triangular	0.0	2:1	2:1	1.50	0.29	1.21	4.35	0.035	R-3
11	17.49	0.52	0.73	6.5	5.0	2.47	12.9	Triangular	0.0	2:1	2:1	1.50	0.48	1.02	5.44	0.035	R-3
12	26.89	0.51	0.74	6.5	5.0	2.44	9.2	Trapezoidal	2.0	2:1	2:1	1.50	0.23	1.27	4.25	0.035	R-3
13	272.27	0.45	0.74	6.5	5.0	2.16	1.0	Trapezoidal	2.0	2:1	2:1	1.50	0.49	1.01	1.48	0.05	Grass Lined
14	255.48	0.39	0.74	6.5	5.0	1.87	1.5	Trapezoidal	2.0	2:1	2:1	1.50	0.41	1.09	1.63	0.05	Grass Lined
15	223.30	0.57	0.66	6.5	5.0	2.44	1.0	Triangular	0.0	2:1	2:1	1.50	0.88	0.62	1.59	0.05	Grass Lined
16	46.10	1.91	0.74	6.5	5.0	8.13	5.0	Trapezoidal	4.0	2:1	2:1	1.50	0.47	1.03	3.89	0.045	R-4
17	34.23	0.90	0.80	6.5	5.0	4.68	50.0	Trapezoidal	4.0	2:1	2:1	1.50	0.16	1.34	6.59	0.045	R-4
18	83.24	1.00	0.68	6.5	5.0	4.39	27.1	Triangular	0.0	2:1	2:1	1.50	0.57	0.83	6.88	0.045	R-4
19	162.33	0.22	0.40	6.5	5.0	0.57	1.9	Triangular	0.0	2:1	2:1	1.50	0.45	1.05	1.41	0.05	Grass Lined
20	169.54	0.19	0.40	6.5	5.0	0.49	1.8	Triangular	0.0	2:1	2:1	1.50	0.43	1.07	1.33	0.05	Grass Lined
21	1.00	0.72	0.80	6.5	5.0	3.74	50.0	Trapezoidal	4.0	2:1	2:1	1.50	0.14	1.36	6.07	0.045	R-4
22	72.13	0.85	0.76	6.5	5.0	4.19	14.9	Triangular	0.0	2:1	2:1	1.50	0.64	0.86	5.09	0.045	R-4
23	10.06	0.76	0.80	6.5	5.0	3.95	50.0	Trapezoidal	4.0	2:1	2:1	1.50	0.15	1.35	6.21	0.045	R-4
24	20.34	1.00	0.61	6.5	5.0	3.88	50.0	Triangular	0.0	2:1	2:1	1.50	0.15	1.35	6.22	0.045	R-4
25	221.88	0.78	0.56	6.5	5.0	2.83	13.3	Triangular	0.0	2:1	2:1	1.50	0.50	1.00	5.69	0.035	R-3
26	280.68	1.45	0.57	6.5	5.0	5.41	5.6	Trapezoidal	1.0	2:1	2:1	1.50	0.54	0.96	4.80	0.035	R-3
27	137.88	0.52	0.40	6.5	5.0	1.35	11.1	Triangular	0.0	2:1	2:1	1.50	0.39	1.11	4.41	0.035	R-3
28	38.20	0.19	0.40	6.5	5.0	0.49	11.7	Triangular	0.0	2:1	2:1	1.50	0.27	1.23	3.50	0.035	R-3
29	101.58	0.16	0.40	6.5	5.0	0.42	2.5	Triangular	0.0	2:1	2:1	1.50	0.38	1.12	1.44	0.05	Grass Lined

OUTLET PROTECTION COMPUTATIONS													
Outlet Protection No.	Outlet Type	No.	Tailwater Condition	Velocity (ft/s)	Do (in)	Total Discharge (cfs)	D50 (ft)	3Do (ft) 5' Min.	Min. La (ft)	Min. W (ft)	Rip-Rap Size	Rip-Rap Volume (CY)	
1	Culvert	2	Tw<0.5Do	7.86	15	1.12	0.50	5	8	10	R-3	11.9	
2	Culvert	3	Tw<0.5Do	13.97	30	16.86	0.67	8	10	13	R-4	14.2	
3	Culvert	4	Tw<0.5Do	7.99	15	1.95	0.50	5	8	10	R-3	9.3	
4	Culvert	5	Tw<0.5Do	7.93	15	1.90	0.50	5	8	10	R-3	8.5	
5	Culvert	6	Tw<0.5Do	5.78	15	0.73	0.50	5	8	10	R-3	6.9	
6	Ditch	26	Tw<0.5Do	4.80	18	5.41	0.50	5	10	12	R-3	13.2	
7	Ditch	28	Tw<0.5Do	3.50	18	0.49	0.50	5	8	10	R-3	5.1	
8	Ditch	27	Tw<0.5Do	4.41	18	1.35	0.50	5	8	10	R-3	6.3	
9	Ditch	16	Tw<0.5Do	3.89	18	8.13	0.67	5	10	12	R-4	11.6	
10	Ditch	18	Tw<0.5Do	6.88	18	4.39	0.67	5	10	12	R-4	19.3	
11	Ditch	20	Tw<0.5Do	1.33	18	0.49	0.50	5	8	10	R-3	5.9	
12	Ditch	21	Tw<0.5Do	6.07	18	3.74	0.67	5	8	10	R-4	8.4	
13	Ditch	22	Tw<0.5Do	5.09	18	4.19	0.67	5	10	12	R-4	10.9	
14	Ditch	24	Tw<0.5Do	6.22	18	3.88	0.67	5	8	10	R-4	6.4	



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STORM DRAINAGE COMPUTATIONS  
**ADDIE**  
WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 04/13/2015  
SCALE: N/A  
SHEET 5 OF 28

NOTES:  
1. DITCH 21 IS SHOWN FOR COMPUTATIONAL PURPOSES ONLY AND IS USED TO CONSERVATIVELY COMPUTE THE OUTLET FLOW AND VELOCITY OF THE WELL PAD DEWATERING SYSTEM. NO CONSTRUCTION IS ASSOCIATED WITH THIS DITCH.

# EXISTING CONDITIONS

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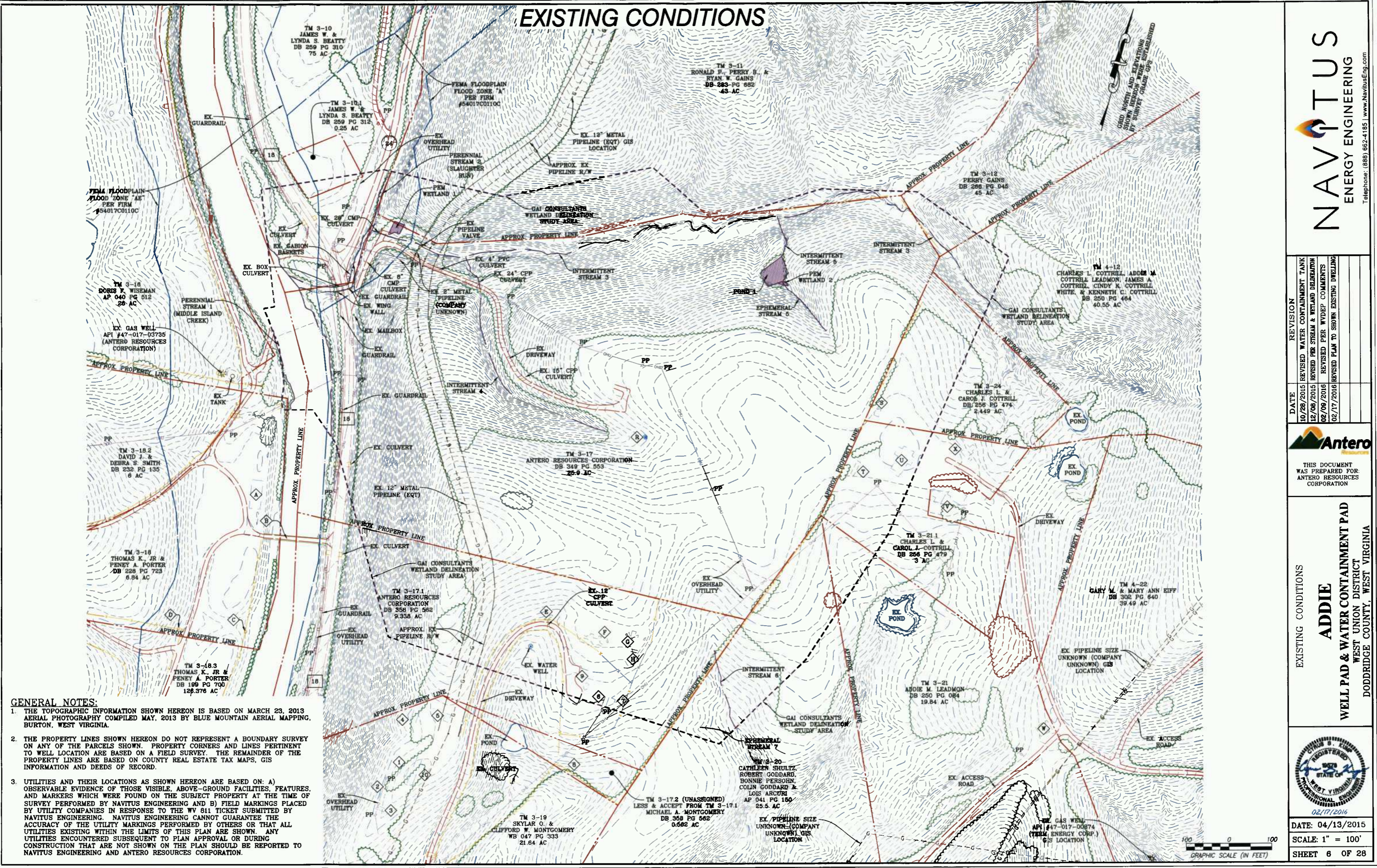
THIS DOCUMENT WAS PREPARED FOR ANTERO RESOURCES CORPORATION

EXISTING CONDITIONS  
**ADDIE**  
WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 04/13/2015  
SCALE: 1" = 100'  
SHEET 6 OF 28

- GENERAL NOTES:**
1. THE TOPOGRAPHIC INFORMATION SHOWN HEREON IS BASED ON MARCH 23, 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.



# EXISTING STRUCTURES & FEATURES



A EXISTING BARN



B EXISTING BRIDGE



C EXISTING WATER TROUGH / DEVELOPED SPRING



D EXISTING WATER TROUGH / DEVELOPED SPRING



E EXISTING WATER TROUGH



F EXISTING OPEN STORAGE



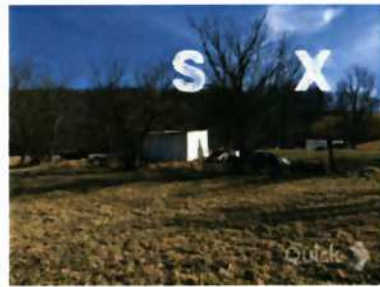
G EXISTING OPEN STORAGE



H EXISTING VEHICLE STORAGE



R EXISTING WELL HOUSE (PLUG & ABANDON WELL)



S EXISTING STORAGE SHED & OCCUPIED DWELLING



T EXISTING OCCUPIED DWELLING & CAMPER



U EXISTING CAMPER & OCCUPIED DWELLING



V EXISTING ABANDONED BARN



X EXISTING GREENHOUSE/SHED



X EXISTING OCCUPIED DWELLING



1 EXISTING SHED  
2 EXISTING SHED  
3 EXISTING SHED  
10 EXISTING OCCUPIED DWELLING



4 EXISTING BARN



5 EXISTING CAR PORT



6 EXISTING SHED  
7 EXISTING SHED



8 EXISTING SHED



9 EXISTING RUINS (POOL DECK)

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

EXISTING STRUCTURES & FEATURES  
**ADDIE**  
WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 04/13/2015  
SCALE: N/A  
SHEET 7 OF 28

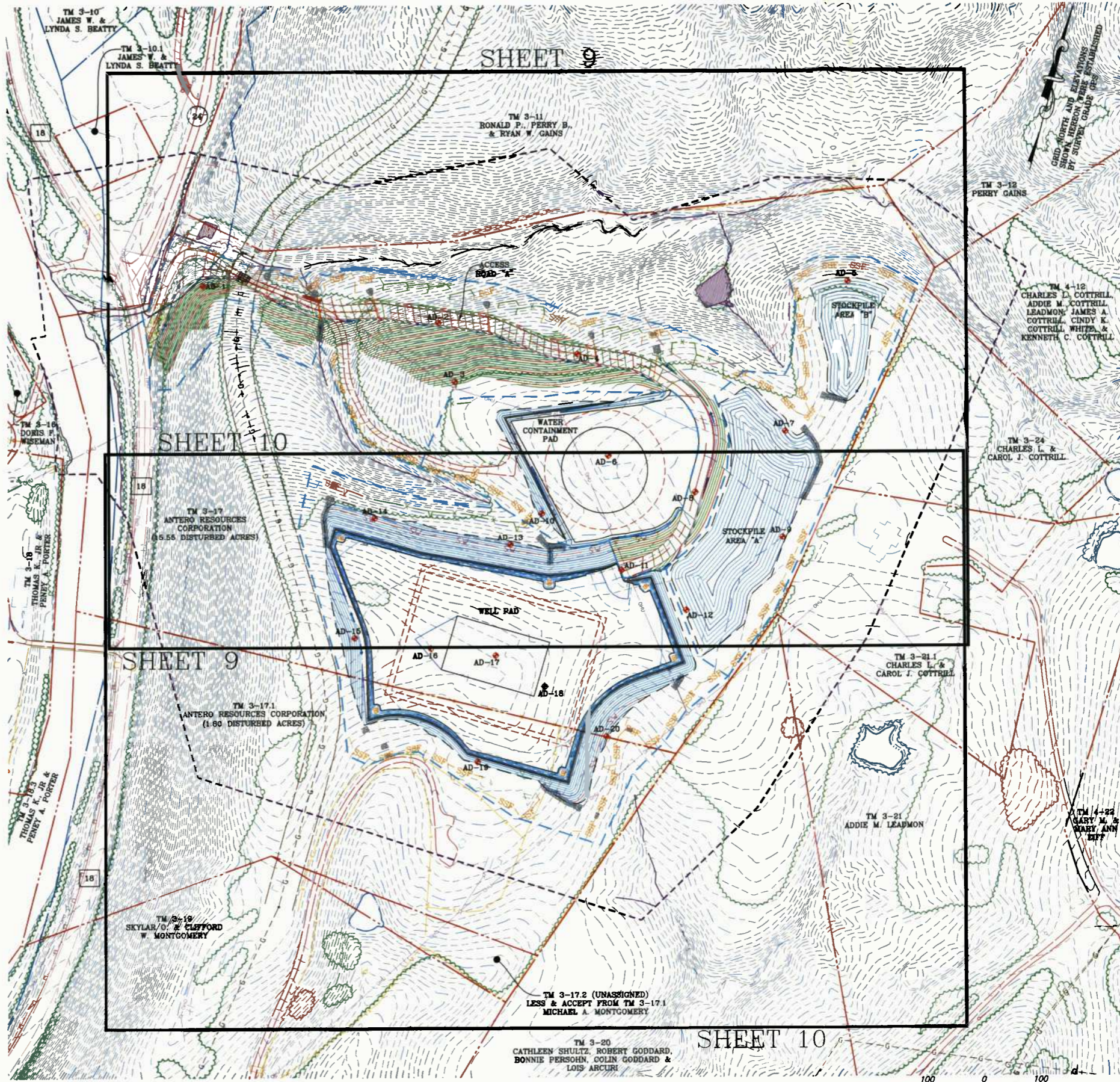


# OVERALL PLAN SHEET INDEX & VOLUMES

MATERIAL STOCKPILES		
Name	Excess	Topsoil
3" Topsoil Respread	N/A	1,010
A	4,205	15,945
B	3,140	0
<b>TOTAL</b>	<b>7,345</b>	<b>16,955</b>

ADDIE WELL PAD & WATER CONTAINMENT PAD						
Description	Cut (CY)	Fill (CY)	Spoil (CY)	Borrow (CY)	Max. Slope (%)	Length of Slope (FT)
Access Road "A"	23,024.7	2,585.5	20,439.2	0.0	20.0	20.0
Well Pad	14,672.2	33,333.8	0.0	18,661.8	n/a	n/a
Water Containment Pad	5,237.9	4,377.5	860.4	0.0	n/a	n/a
Stripped Topsoil (12")	15,020.1	0.0	15,020.1	0.0	n/a	n/a
Material Stockpiles	0.0	24,300.0	0.0	24,300.0	n/a	n/a
<b>Totals</b>	<b>57,954.9</b>	<b>64,596.8</b>	<b>36,319.7</b>	<b>42,961.8</b>	<b>n/a</b>	<b>n/a</b>
<b>Total Spoil (CY) =</b>			<b>-6,641.9</b>			

ADDE TOE BENCH QUANTITIES							
Description	Keyway #1A	Keyway #1B	Keyway #1C	Keyway #1D	Keyway #1E	Keyway #1F	Total
<b>Drainage Method</b>	#2	#2	#1	#1	D1	D1	N/A
<b>Toe Bench</b>							
Approximate Depth (LF)	5	5	6	5	6	6	N/A
Approximate Width (15' min.) (LF)	15	15	15	15	15	15	N/A
Length (LF)	350	710	275	700	560	290	2,885
Perimeter Drain (LF)	350	710	275	700	560	290	2,885
AASHTO #57 Gravel (TONS)	53	100	495	949	825	427	2,767
6 oz. Non-woven Geotextile (SF)	2,254	4,572	8,117	19,177	16,520	8,560	59,209
Overexcavation (CY)	3,011	6,109	2,744	6,023	5,588	2,894	26,370
<b>Toe Bench Outlet Drain</b>							
Average Length of Outlet Drain Pipe (LF)	50	50	55	40	65	85	N/A
Outlet Drain Pipe (LF)	200	400	165	200	300	255	1,690
6 oz. Non-woven Geotextile (SF)	1,400	2,800	1,155	1,960	2,730	1,785	11,830
AASHTO #57 Gravel (TONS)	22	44	18	31	43	28	188
<b>Bonding Bench</b>							
Approximate Depth (LF)	0	0	0	0	0	0	N/A
Approximate Width (LF)	0	0	0	0	0	0	N/A
Number of Benches (EA)	0	0	0	0	0	0	N/A
Length (LF)	0	0	0	0	0	0	0
Perimeter Drain (LF)	0	0	0	0	0	0	0
AASHTO #57 Gravel (TONS)	0	0	0	0	0	0	0
6 oz. Non-woven Geotextile (SF)	0	0	0	0	0	0	0
Overexcavation (CY)	0	0	0	0	0	0	0
<b>Bonding Bench Outlet Drain</b>							
Average Length of Outlet Drain Pipe (LF)	0	0	0	0	0	0	N/A
Outlet Drain Pipe (LF)	0	0	0	0	0	0	0
6 oz. Non-woven Geotextile (SF)	0	0	0	0	0	0	0
AASHTO #57 Gravel (TONS)	0	0	0	0	0	0	0
<b>Additional Excavation</b>							
Column Material Rework (CY)	N/A	N/A	N/A	N/A	N/A	N/A	0



**NOTES:**

- THE EARTHWORK QUANTITIES PROVIDED ARE AN ESTIMATE FOR CONSIDERATION. THE QUANTITIES SHOWN ARE CALCULATED USING A 1:1 CUT/SWELL & FILL SHRINK FACTOR. THE EXCESS MATERIAL & TOPSOIL STOCKPILES ARE SIZED TO ACCOMMODATE A CUT/SWELL FACTOR OF 1.1:1. THIS ADDITIONAL MATERIAL IS REFLECTED IN THE TOTAL SPOIL SHOWN ON THE MATERIAL QUANTITIES TABLE. IF THE CALCULATED SWELL IS LESS THAN 1.1:1, THE STOCKPILES SIZES CAN BE REDUCED DURING CONSTRUCTION. 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 THEIR ACCURACY.
- THE TOE BENCH DEPTHS AND QUANTITIES PROVIDED IN THE TABLE ARE AN ESTIMATE, CALCULATED FROM THE RECOMMENDATIONS PROVIDED IN THE GEOTECHNICAL REPORT PREPARED BY PENNSYLVANIA SOIL & ROCK, INC. SEE PAGES GE500-GE504 & GEOTECHNICAL INVESTIGATION REPORT PROVIDED BY PENNSYLVANIA SOIL & ROCK, INC. FOR TOE BENCH DETAILS, VOLUMES, AND SPECIFICATIONS.

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

DATE	REVISION
10/26/2015	REVISED WATER CONTAINMENT TANK
12/09/2015	REVISED PER STREAM & WETLAND DELINEATION
02/09/2016	REVISED PER WDEP COMMENTS
02/17/2016	REVISED PLAN TO SHOW EXISTING DWELING

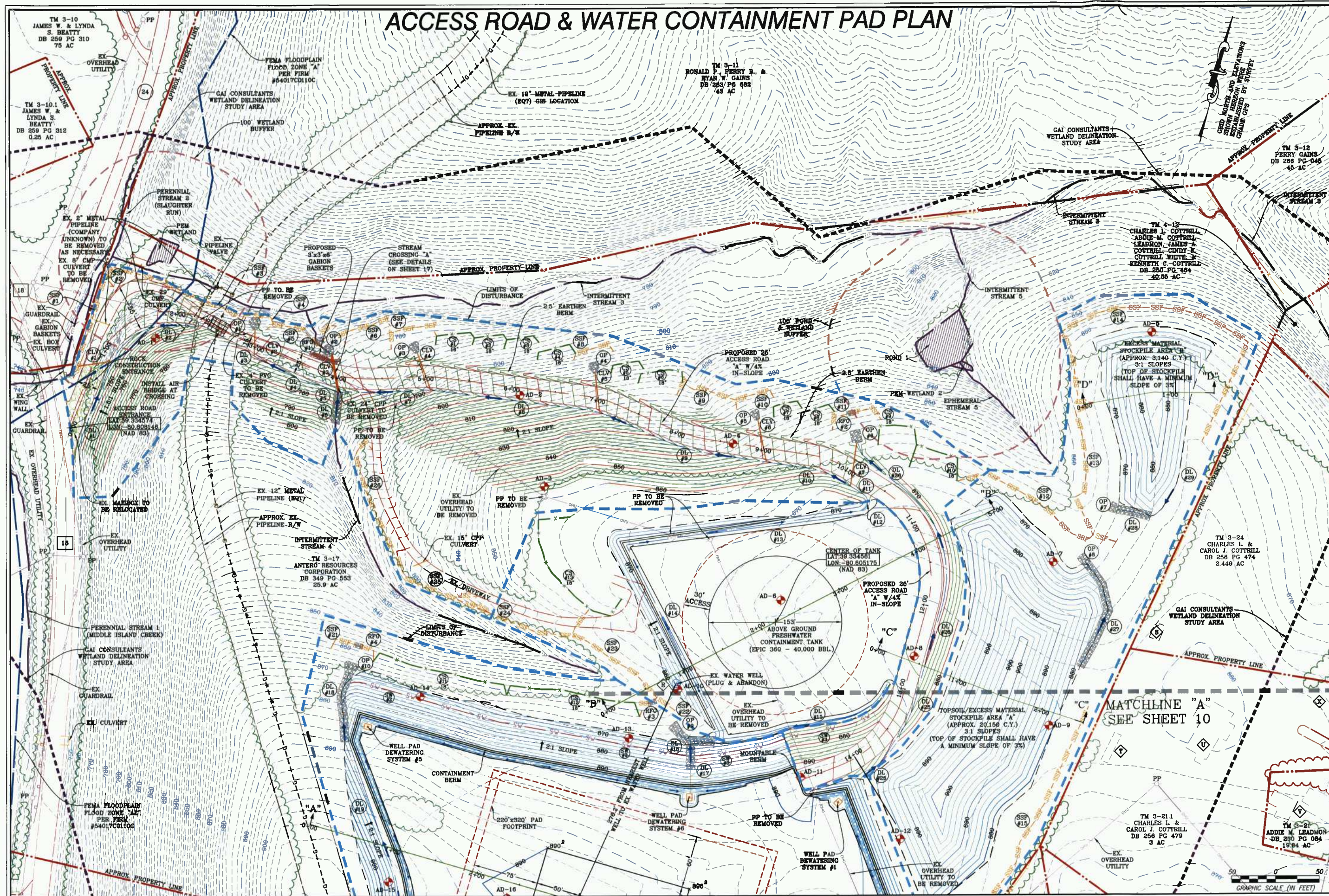
**Antero**  
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OVERALL PLAN SHEET INDEX & VOLUMES  
**ADDIE**  
WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 04/13/2015  
SCALE: 1" = 100'  
SHEET 8 OF 28

# ACCESS ROAD & WATER CONTAINMENT PAD PLAN



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**Antero**

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ACCESS ROAD & WATER CONTAINMENT PAD PLAN

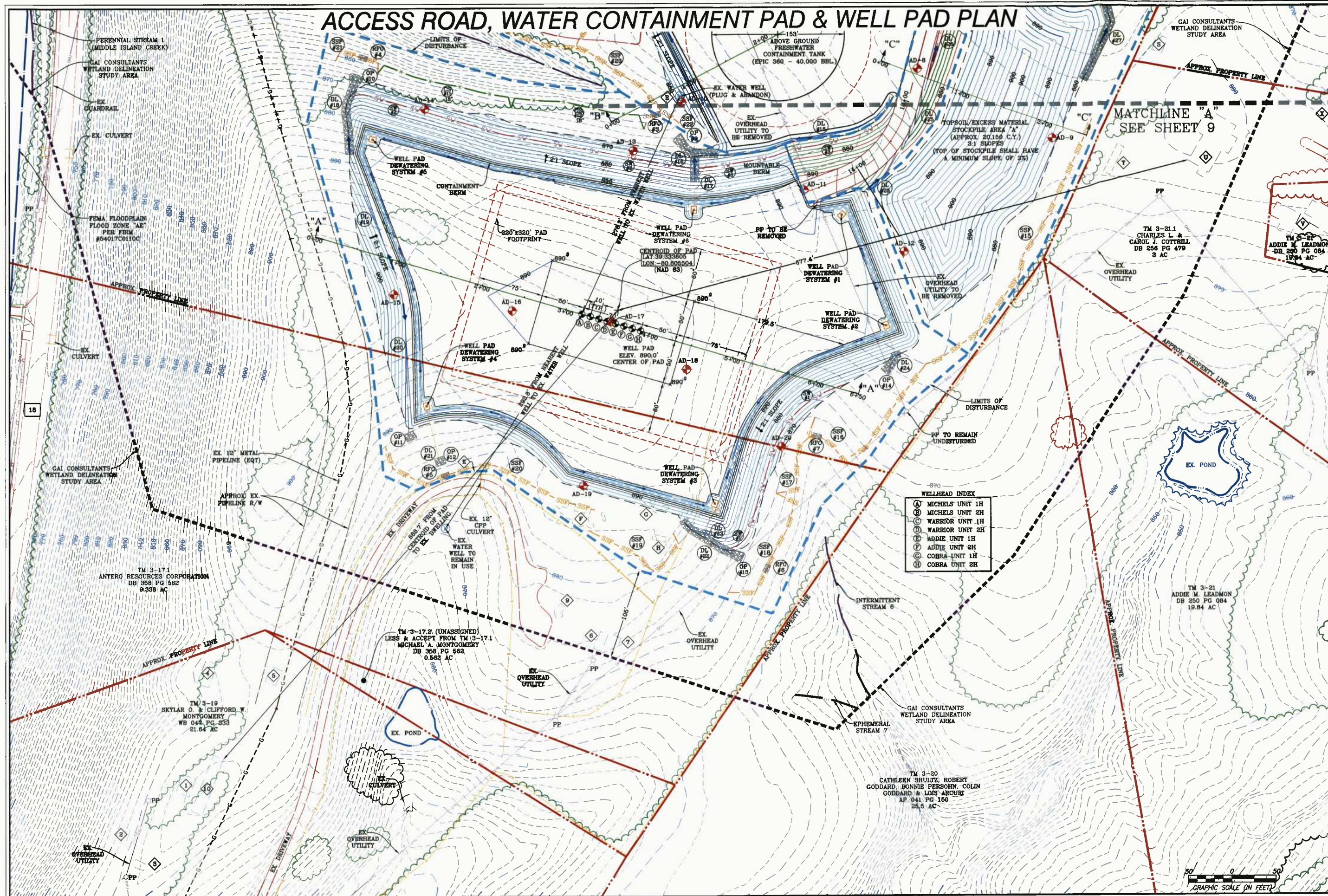
**ADDIE**

WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 04/13/2015  
SCALE: 1" = 50'  
SHEET 9 OF 28

# ACCESS ROAD, WATER CONTAINMENT PAD & WELL PAD PLAN



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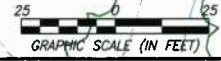
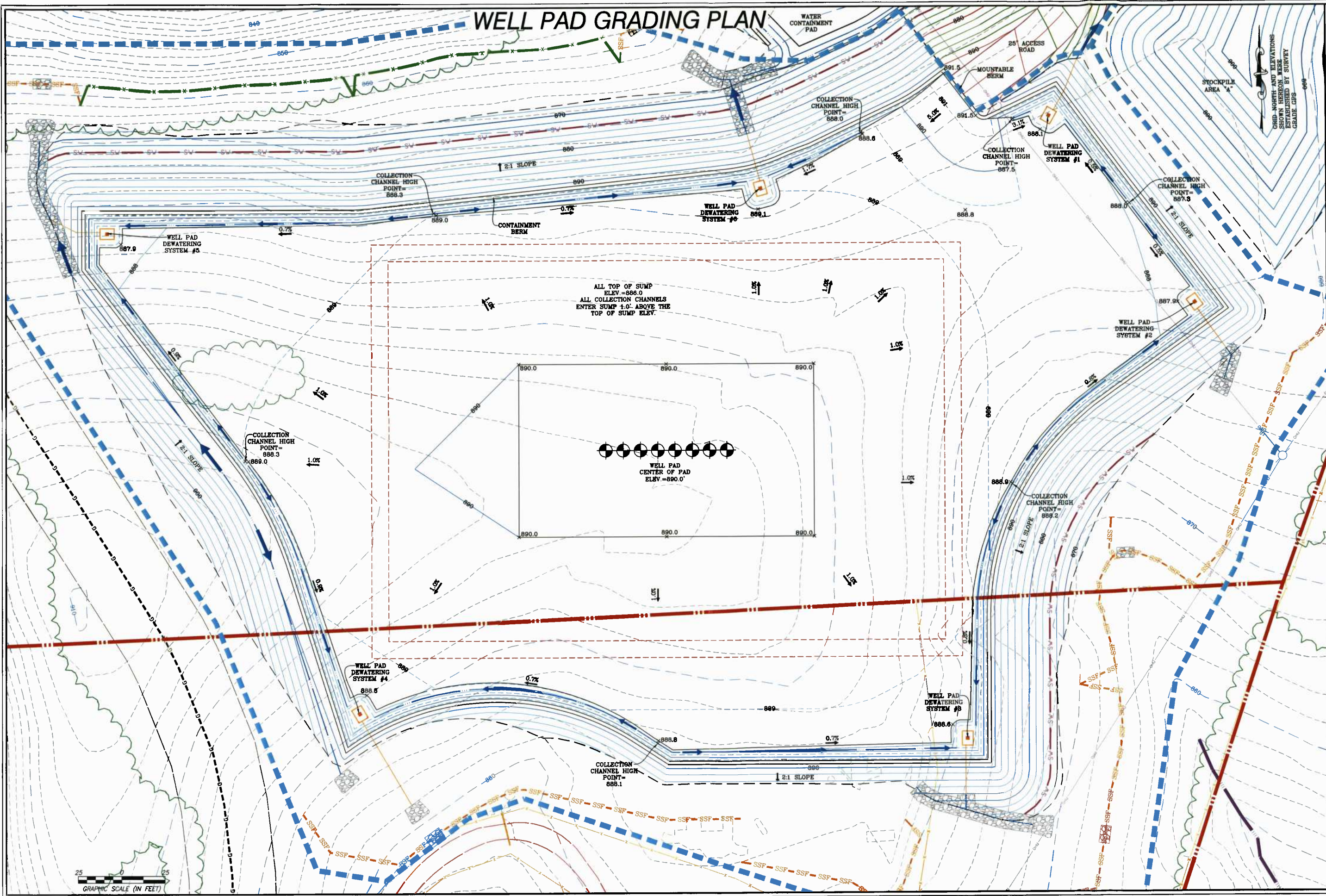
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10/28/2015	REVISED WATER CONTAINMENT TANK
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ACCESS ROAD, WATER CONTAINMENT PAD & WELL PAD PLAN  
**ADDIE**  
WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 04/13/2015  
SCALE: 1" = 50'  
SHEET 10 OF 28



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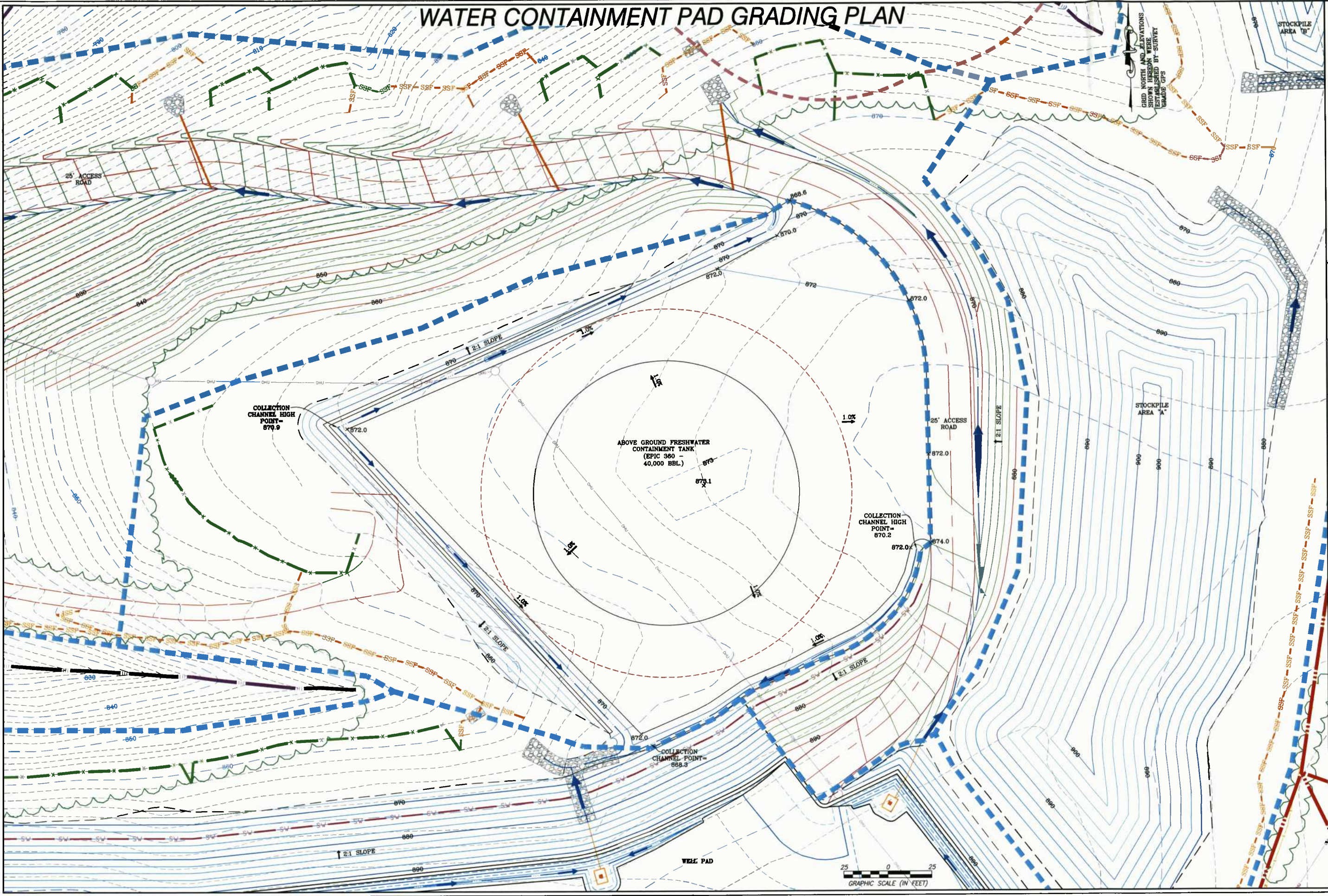
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WELL PAD GRADING PLAN  
**ADDIE**  
WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 04/13/2015  
SCALE: 1" = 25'  
SHEET 11 OF 28

# WATER CONTAINMENT PAD GRADING PLAN



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02/17/2016	REVISED PLAN TO SHOW EXISTING DWELLING

**Antero**

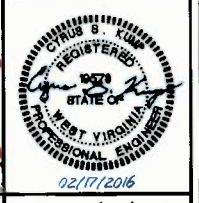
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**WATER CONTAINMENT PAD GRADING PLAN**

**ADDIE**

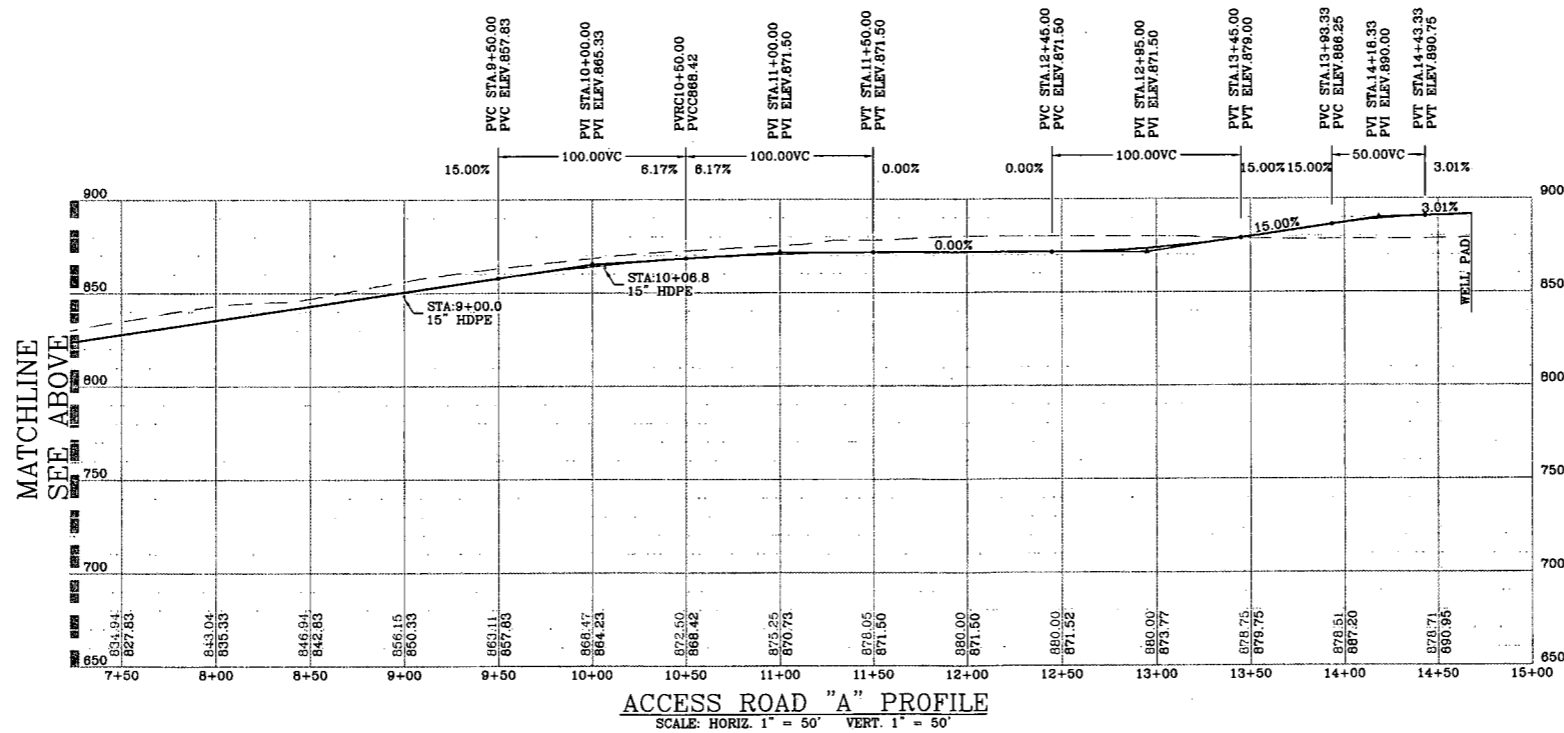
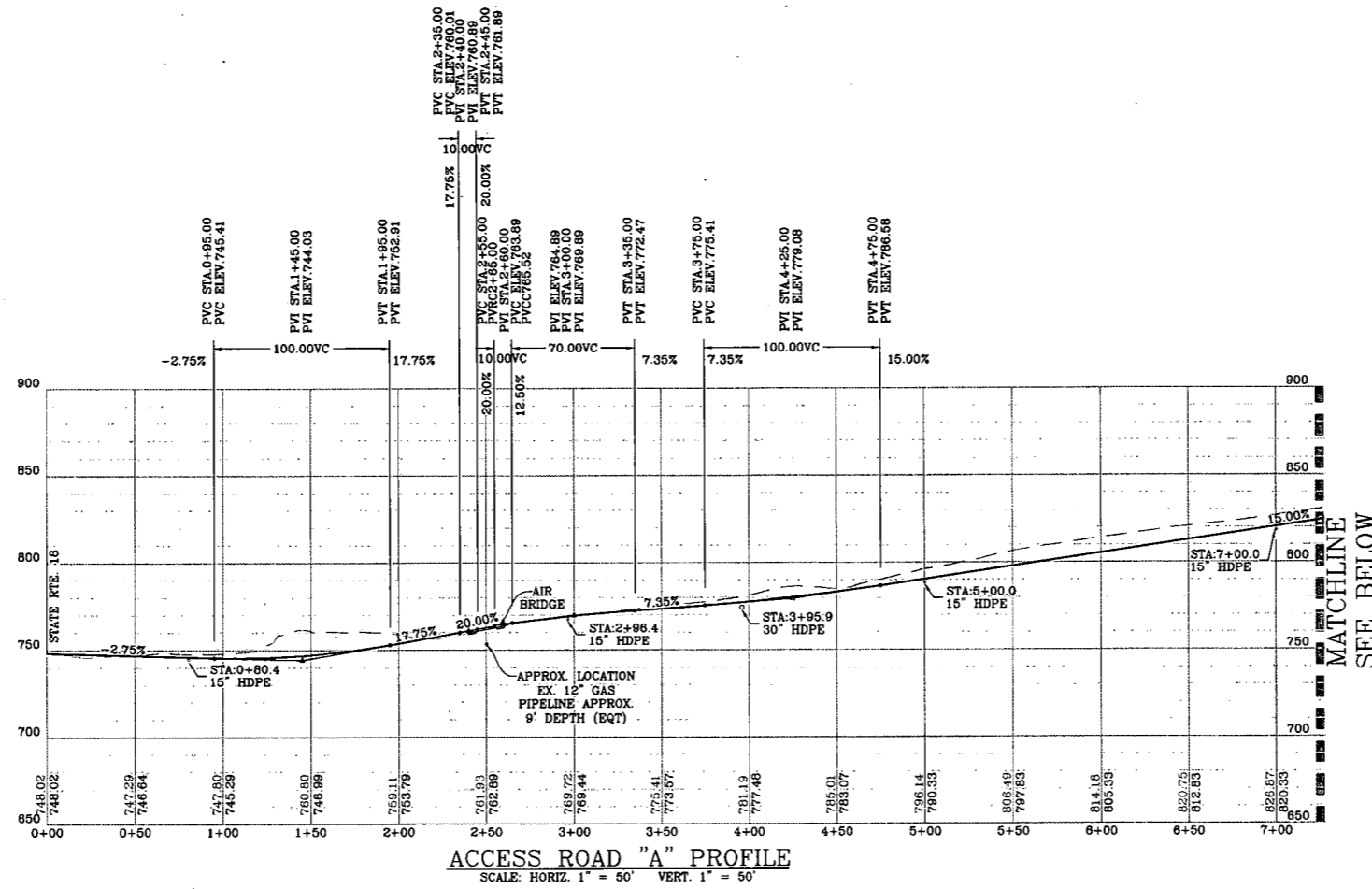
**WELL PAD & WATER CONTAINMENT PAD**

WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 04/13/2015  
SCALE: 1" = 25'  
SHEET 12 OF 28

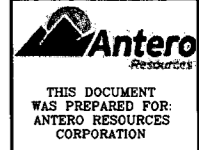
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SEE BELOW

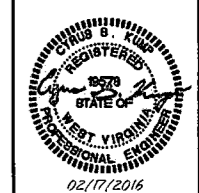
MATCHLINE  
SEE ABOVE

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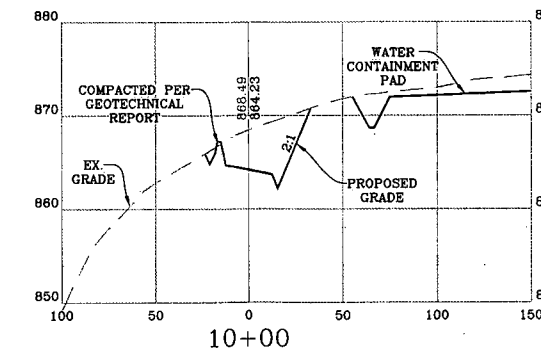
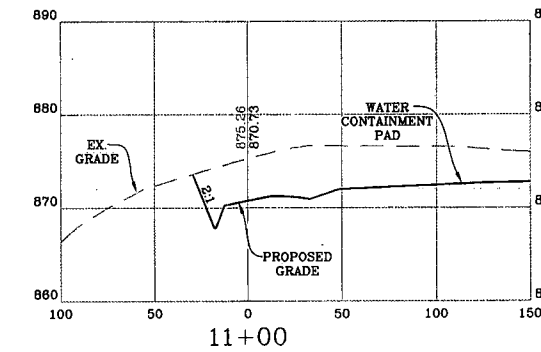
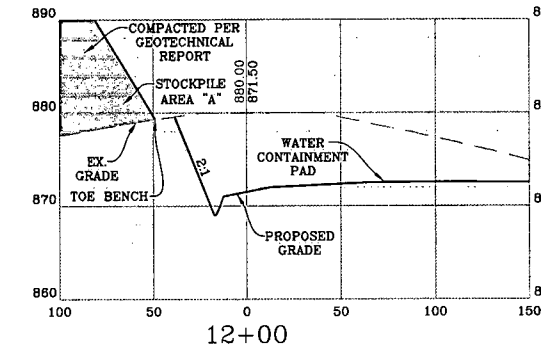
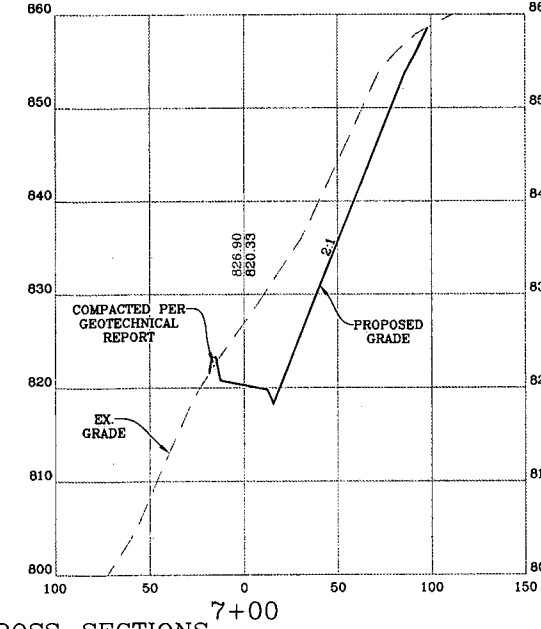
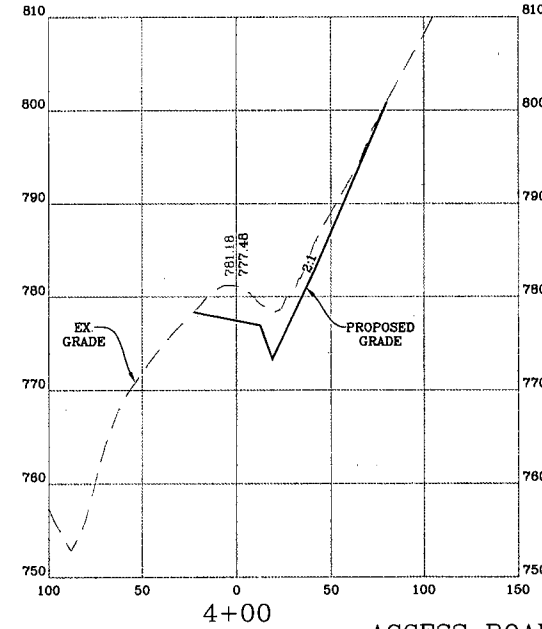
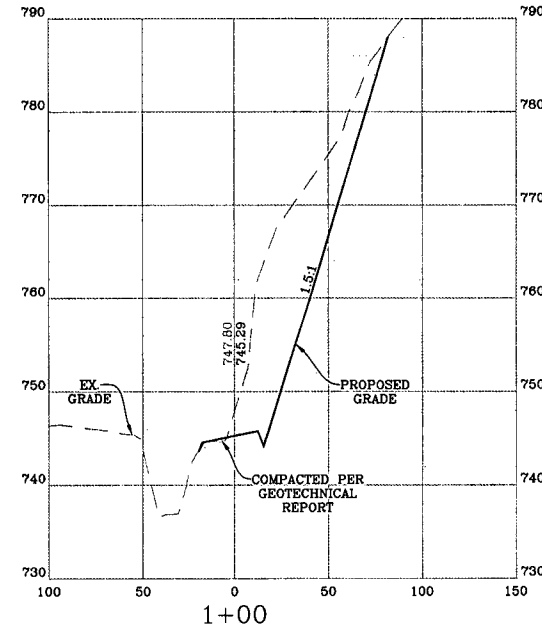
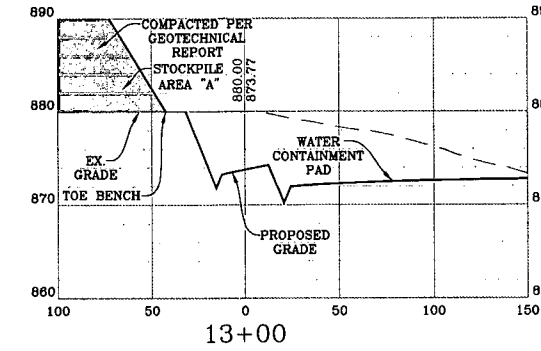
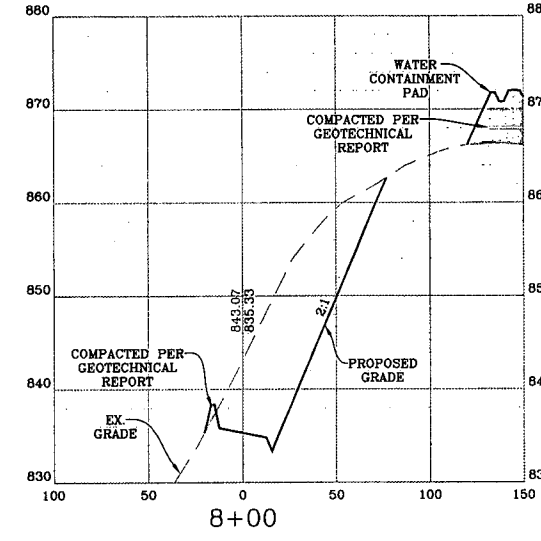
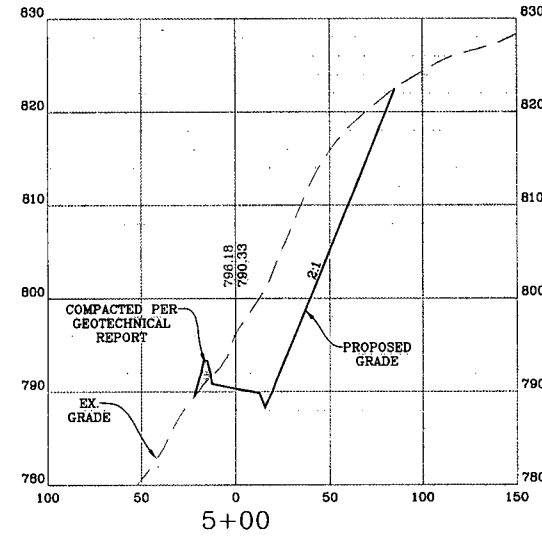
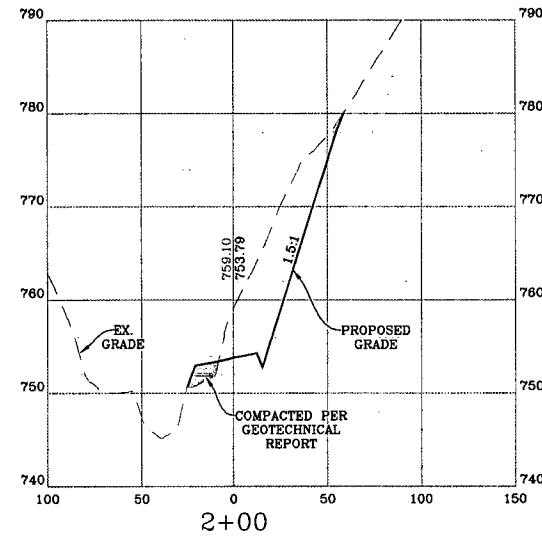
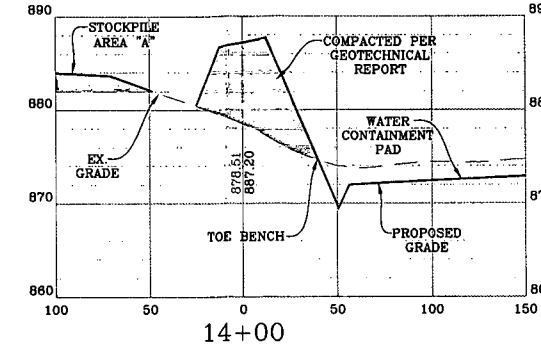
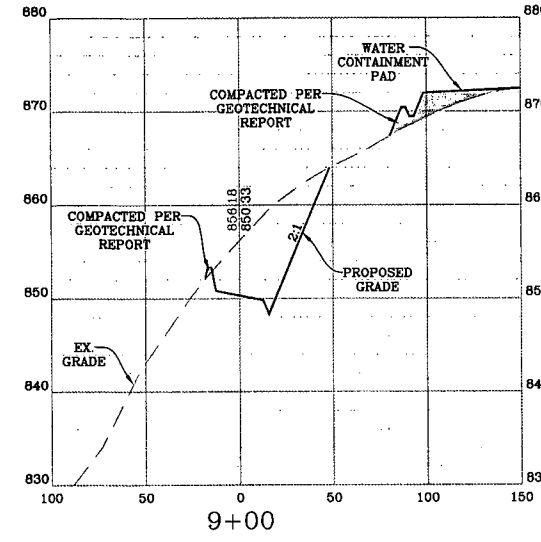
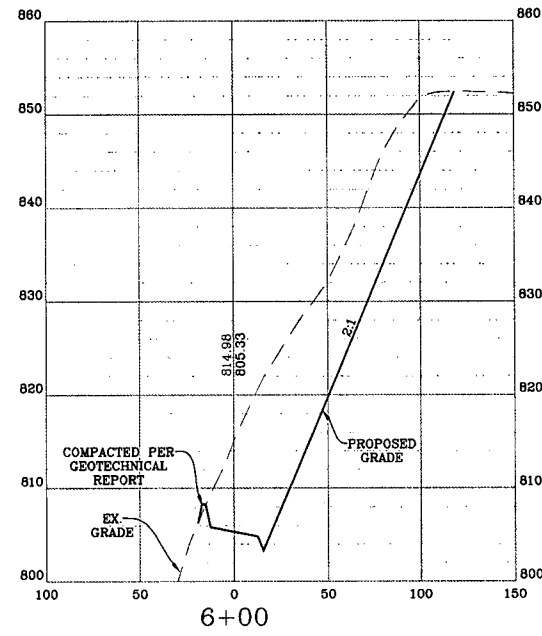
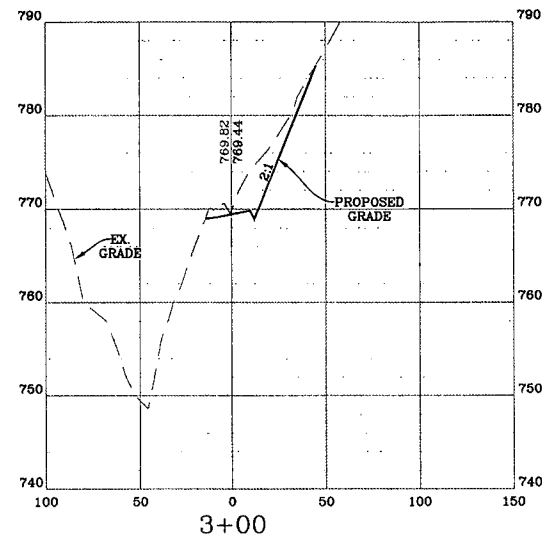


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ACCESS ROAD PROFILES  
**ADDIE**  
WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



# ACCESS ROAD SECTIONS



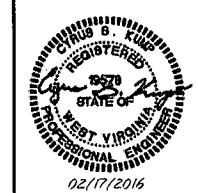
ACCESS ROAD "A" CROSS-SECTIONS  
SCALE: HORIZ. 1" = 50' VERT. 1" = 10'

DATE	REVISION
10/28/2015	REVISED WATER CONTAINMENT TANK
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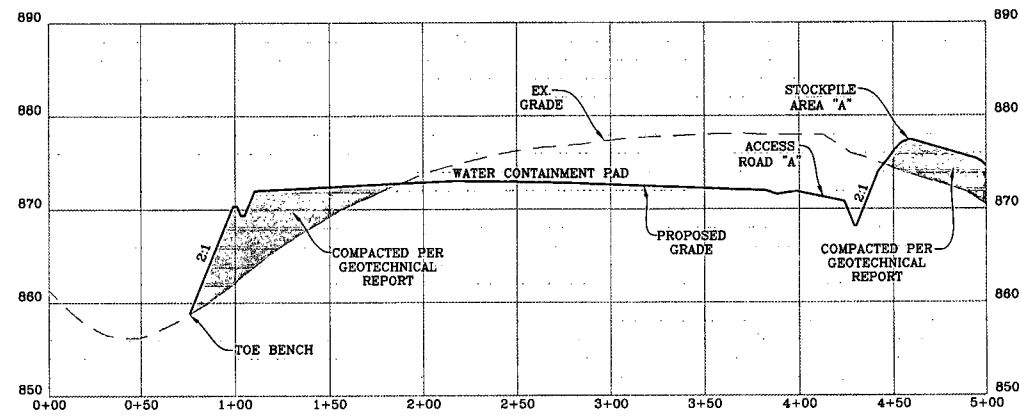


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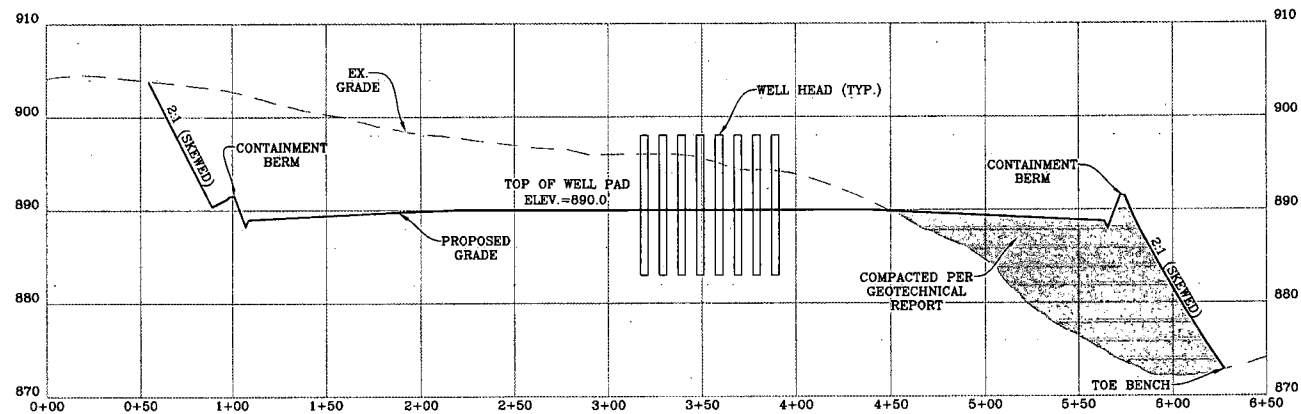


# WELL PAD & WATER CONTAINMENT PAD SECTIONS



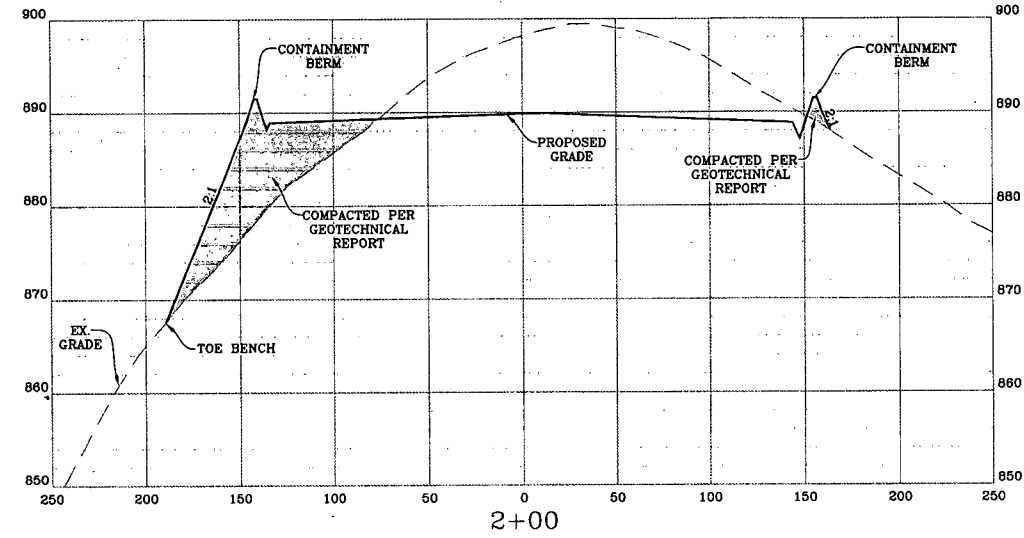
**WATER CONTAINMENT PAD CROSS-SECTION "B-B"**

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



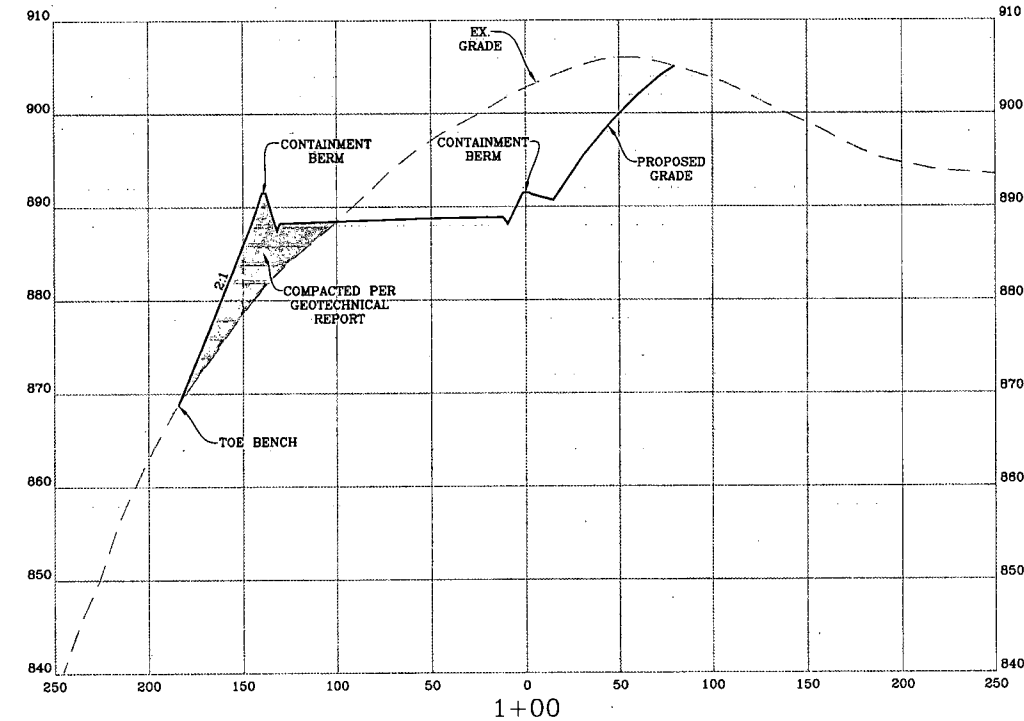
**WELL PAD CROSS-SECTION "A-A"**

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



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

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

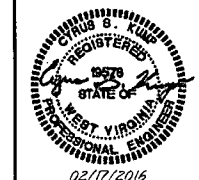


DATE	REVISION
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WELL PAD & WATER CONTAINMENT PAD SECTIONS  
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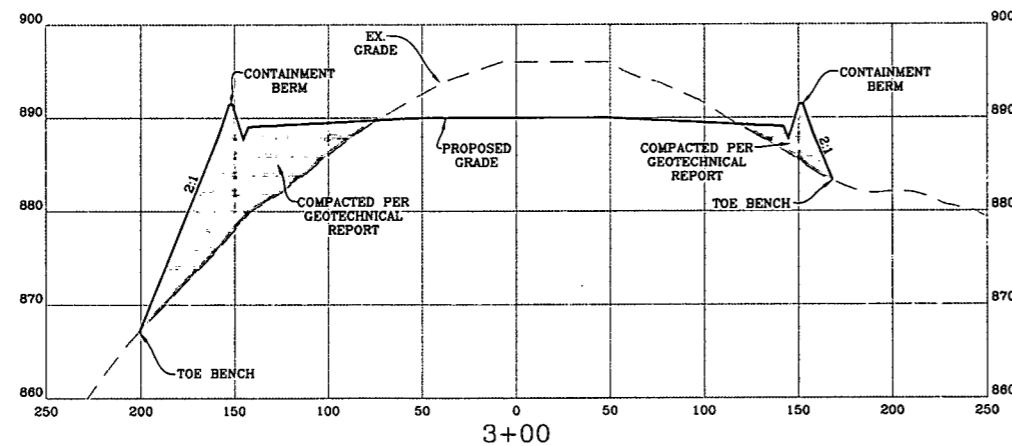
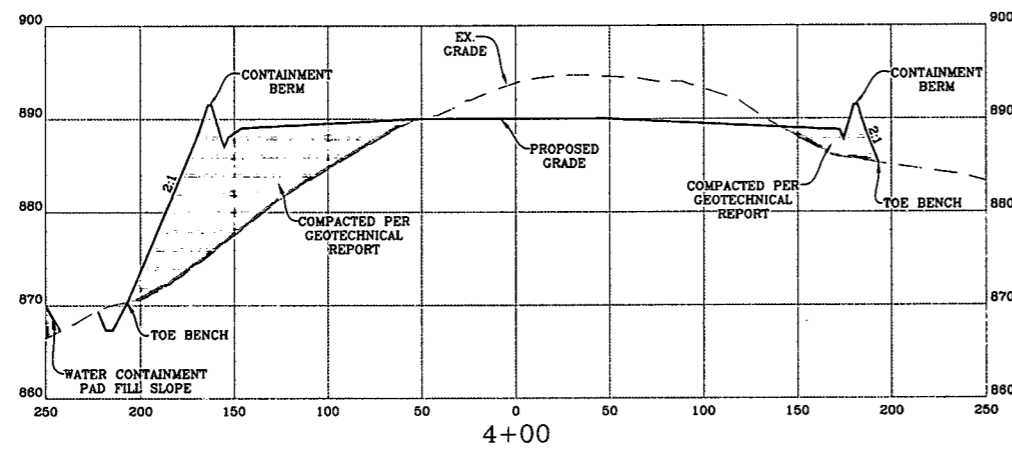
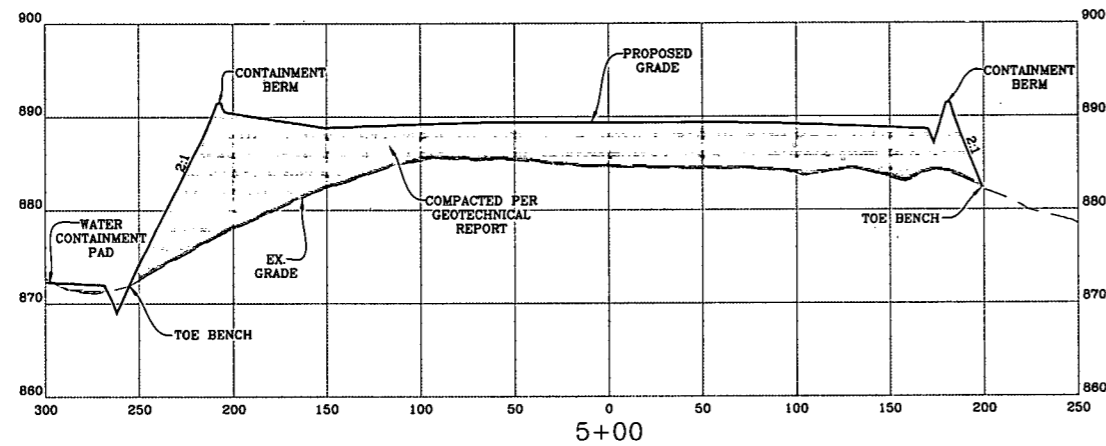
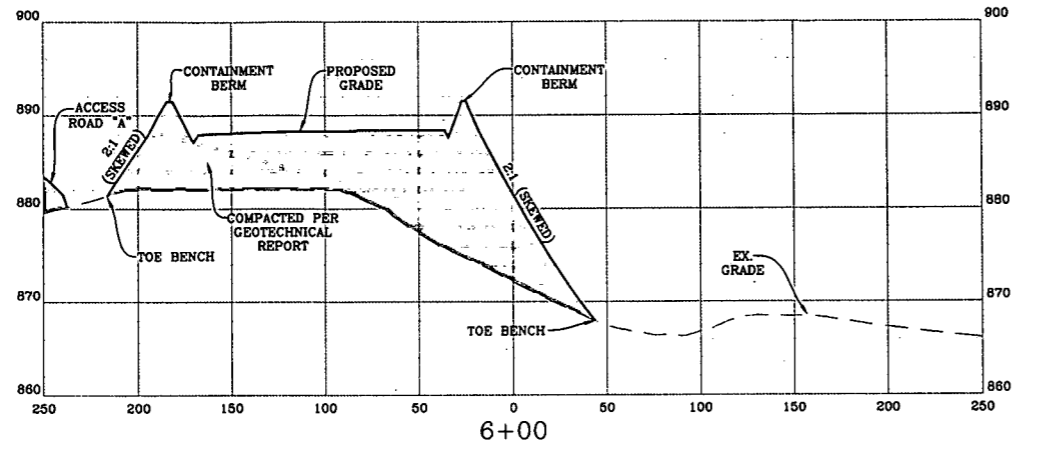
DATE: 04/13/2015

SCALE: AS SHOWN

SHEET 15 OF 28

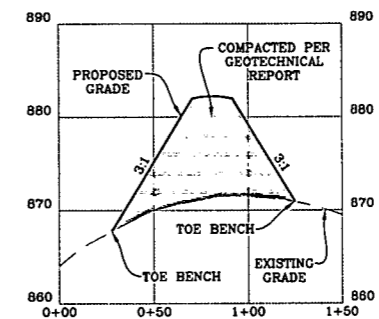


# WELL PAD & STOCKPILE SECTIONS

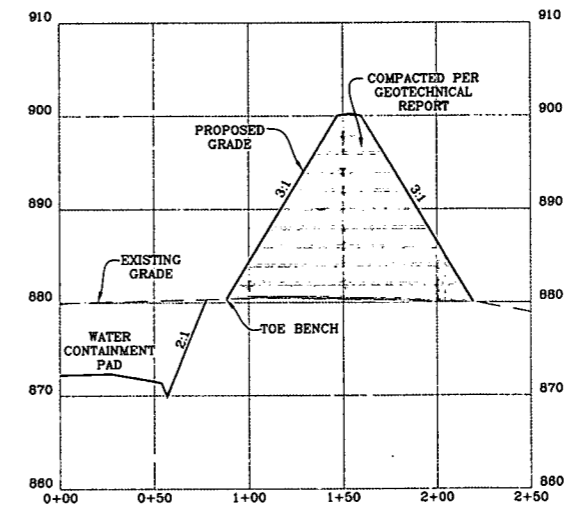


WELL PAD CROSS-SECTIONS ALONG BASELINE "A-A"

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



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



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

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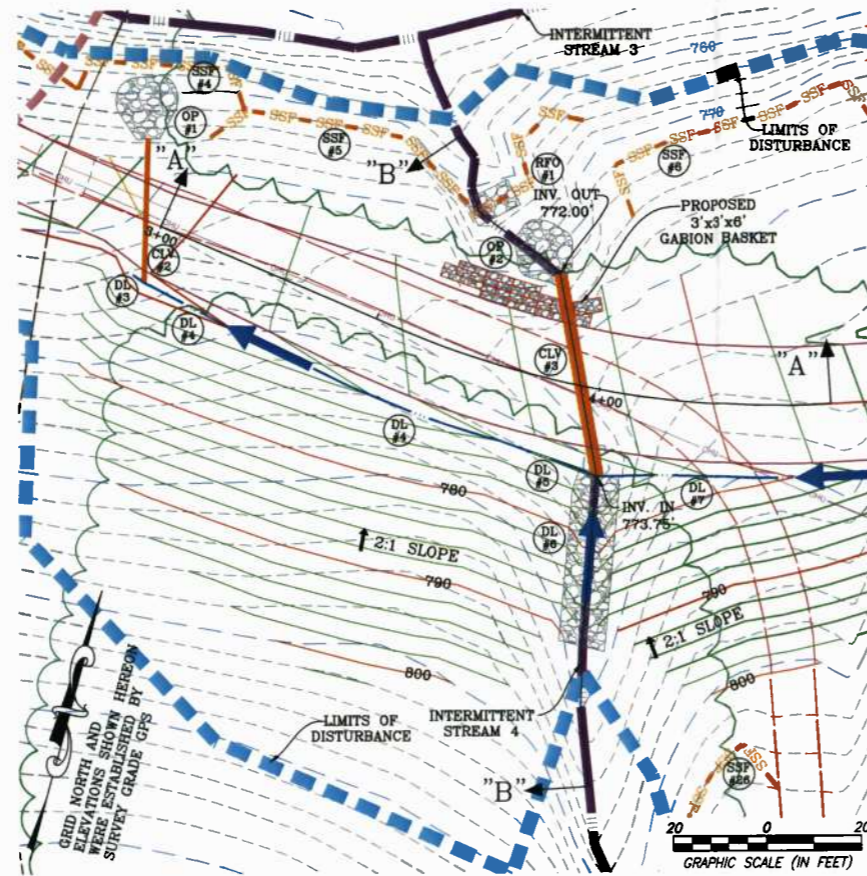
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SHEET 16 OF 28

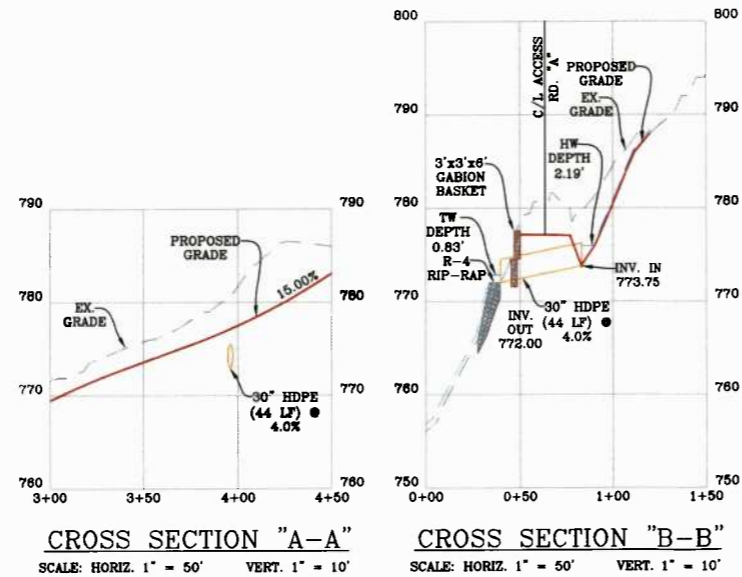
**GENERAL STREAM CROSSING NOTES:**

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

**STREAM CROSSING "A" DETAILS**



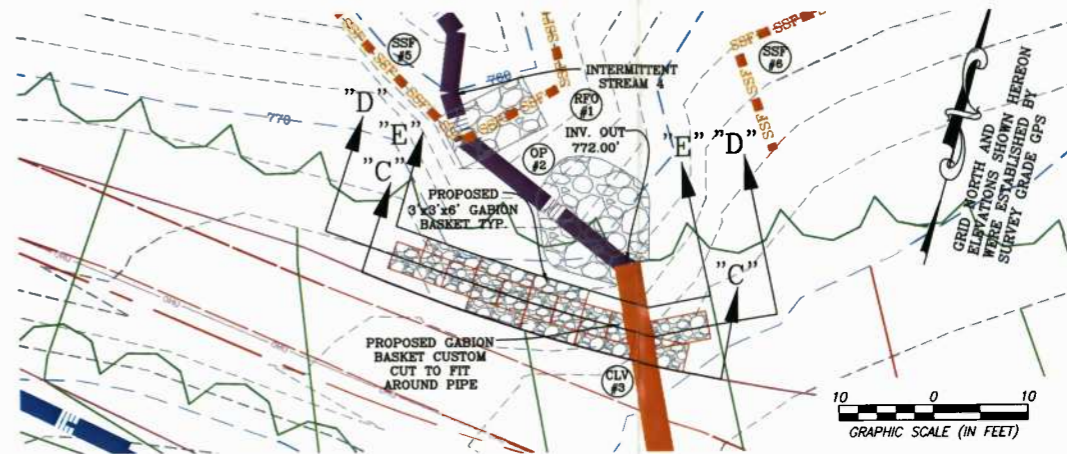
**STREAM CROSSING "A" SECTIONS**



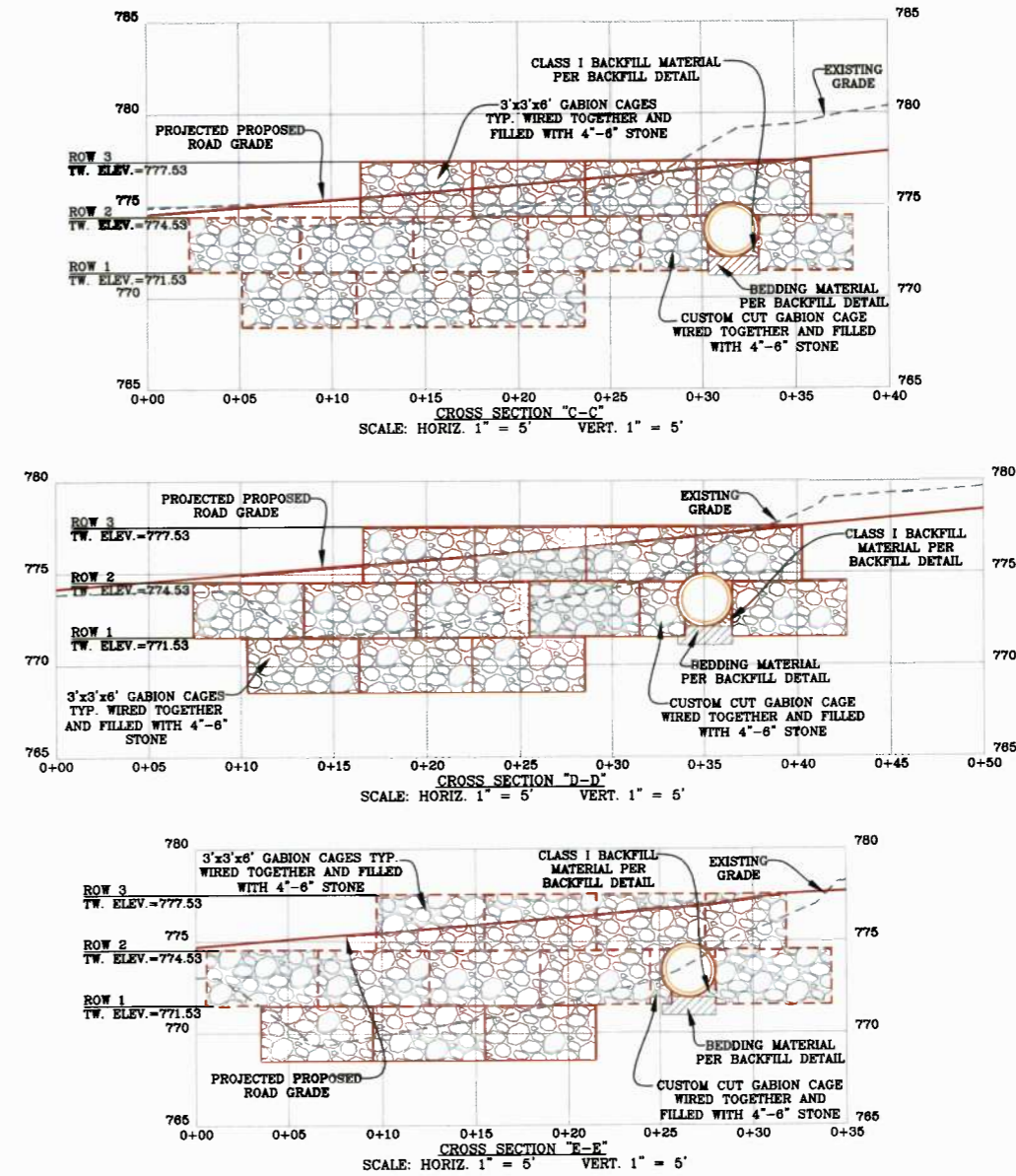
**NOTES:**

- SEE STREAM CROSSING REPORT BY NAVITUS ENGINEERING FOR CULVERT AND DRAINAGE COMPUTATIONS.
- ANTERO RESOURCES SHALL OBTAIN A STREAM ACTIVITY PERMIT THROUGH THE PUBLIC LAND CORPORATION OFFICE OF LAND AND STREAMS FOR STREAM CROSSING "A".
- E&S CONTROLS TO BE FIELD ADJUSTED DURING CONSTRUCTION AS NECESSARY. ADDITIONAL E&S CONTROLS MAY BE REQUIRED.
- ROW 1 GABION BASKETS AROUND CULVERT 3 ARE TO BE SHAPED AROUND THE CULVERT AND NOT CUT.
- ROW 2 CUSTOM GABION BASKET TO BE CUT AND SHAPED AROUND CULVERT AS NECESSARY.
- ALL GABION BASKETS SHOULD BE INSTALLED ON SOLID UNYIELDING MATERIAL. IF POOR MATERIAL IS ENCOUNTERED DURING EXCAVATION THE ENGINEER SHOULD BE NOTIFIED IMMEDIATELY.

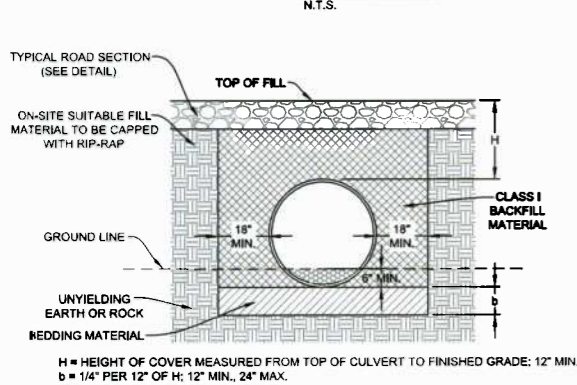
**GABION WALL DETAILS**



**GABION WALL SECTIONS**



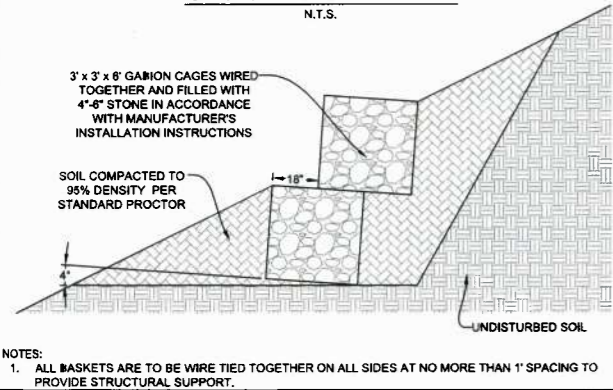
**PIPE CULVERT BACKFILL DETAIL (MINOR CROSSING)**



- CLASS I BACKFILL MATERIAL**  
(3/4" - 1" MAX. AGGREGATE SIZE)  
IN ACCORDANCE WITH SECTIONS 804 AND 704 OF THE WVDOT ROAD & BRIDGE STANDARD SPECIFICATIONS, BACKFILL SHALL BE COMPACTED IN HORIZONTAL LAYERS NOT MORE THAN 6 INCHES IN THICKNESS. BACKFILL SHALL BE PLACED IN HORIZONTAL LAYERS AND IN A MANNER TO DETER IMPROVEMENT OF WATER AND FACILITATE EXISTING DRAINAGE.
- BEDDING MATERIAL**  
(0" - 1/2" MAX. AGGREGATE SIZE)  
IN ACCORDANCE WITH SECTION 718.1.1.2 OF THE WVDOT ROAD & BRIDGE STANDARD SPECIFICATIONS.
- EMBEDMENT MATERIAL**  
STREAMBED MATERIAL SHALL BE IN ACCORDANCE WITH THE U.S. ARMY CORPS OF ENGINEERS NATIONWIDE 14 PERMIT.

- NOTES:  
1. ALL OPENINGS TO BACKFILLED MATERIAL SHALL BE DEWATERED PRIOR TO FILLING.

**GABION BASKET WALL**



- NOTES:  
1. ALL BASKETS ARE TO BE WIRE TIED TOGETHER ON ALL SIDES AT NO MORE THAN 1" SPACING TO PROVIDE STRUCTURAL SUPPORT.

DATE	REVISION
10/28/2015	REVISED WATER CONTAINMENT TANK
12/08/2015	REVISED PER STREAM & WETLAND DELINEATION
02/09/2016	REVISED PER WDEP COMMENTS
02/17/2016	REVISED PLAN TO SHOW EXISTING DWELLING



THIS DOCUMENT WAS PREPARED FOR:  
ANTERO RESOURCES CORPORATION

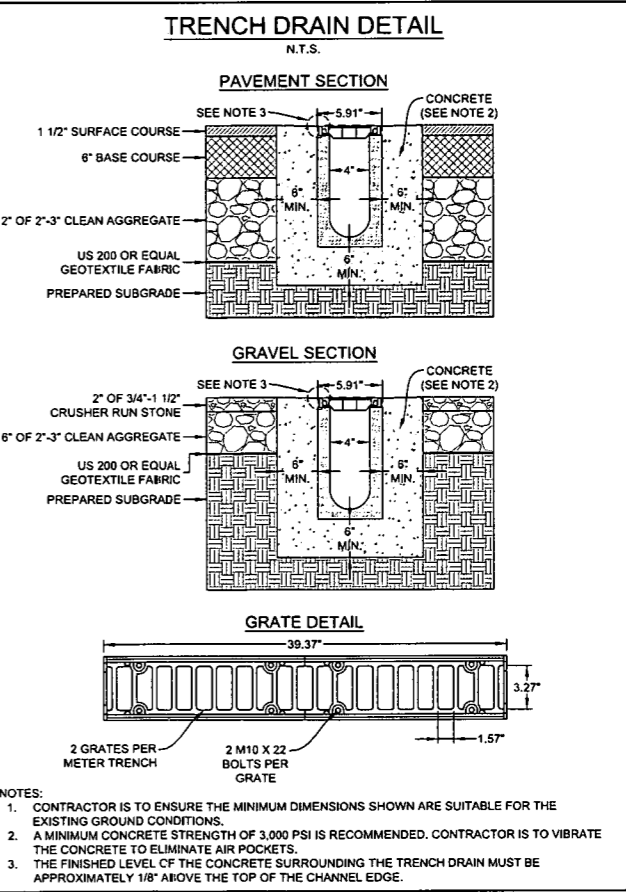
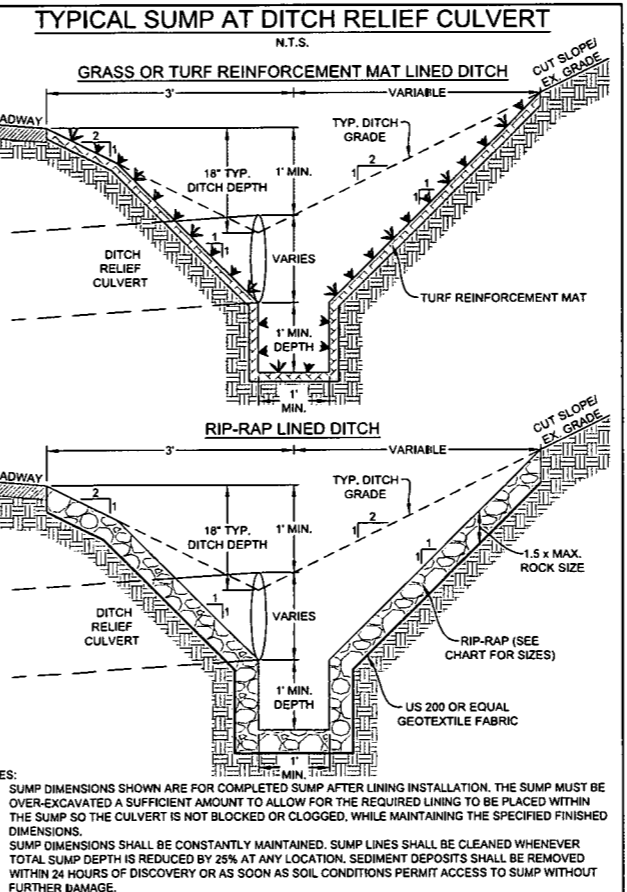
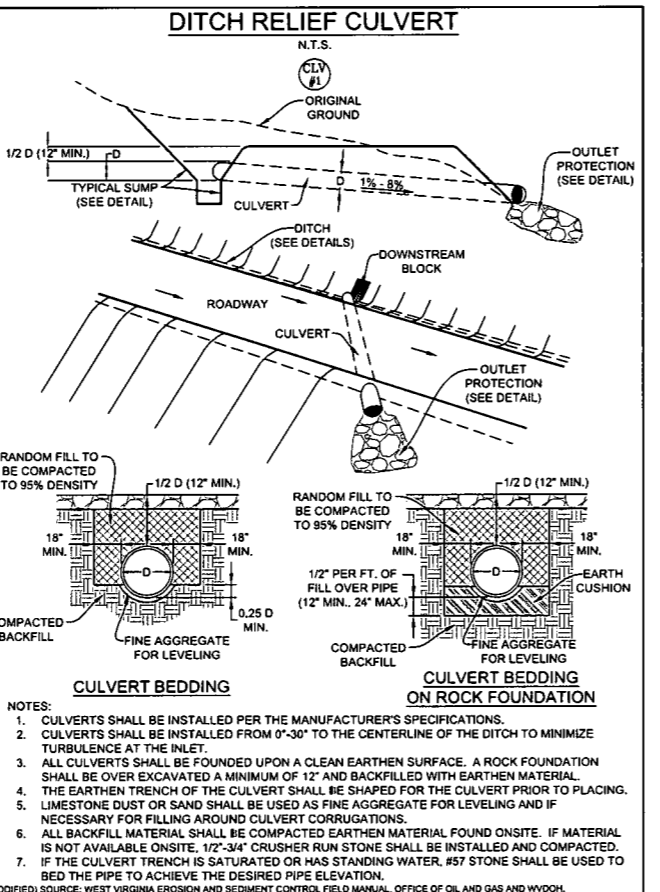
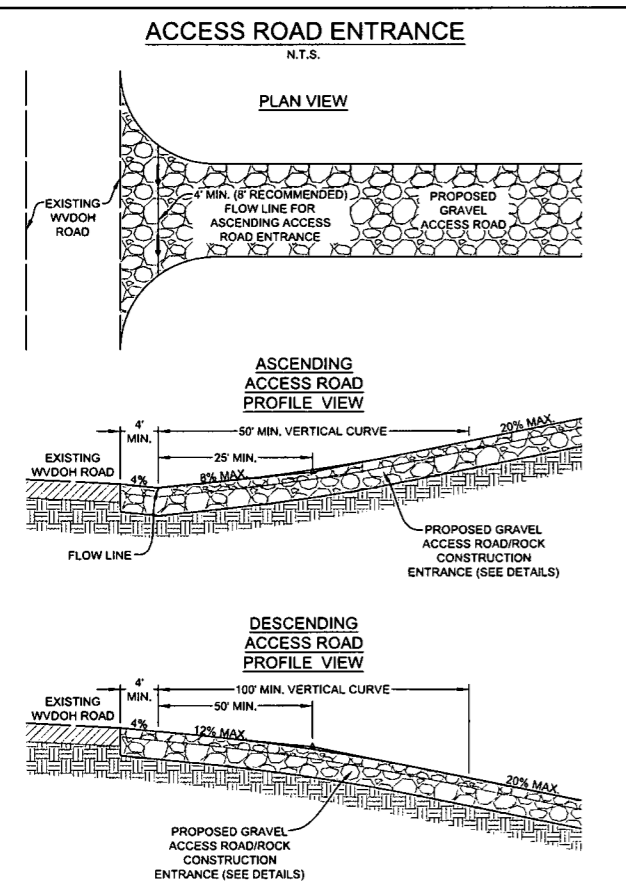
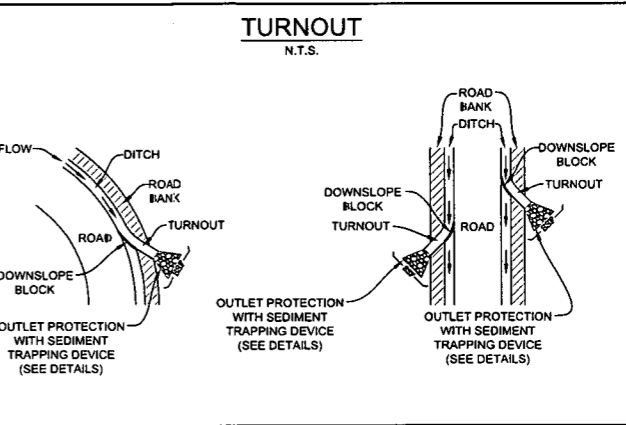
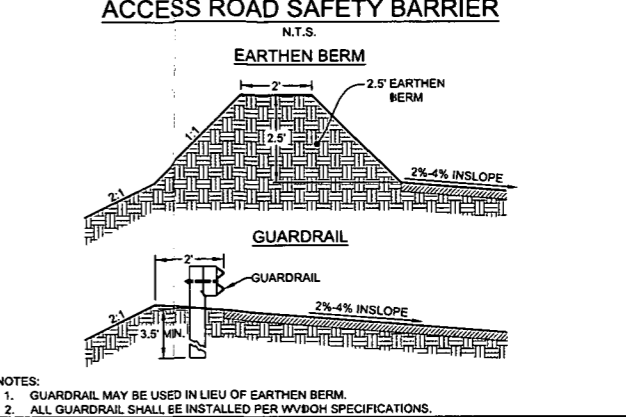
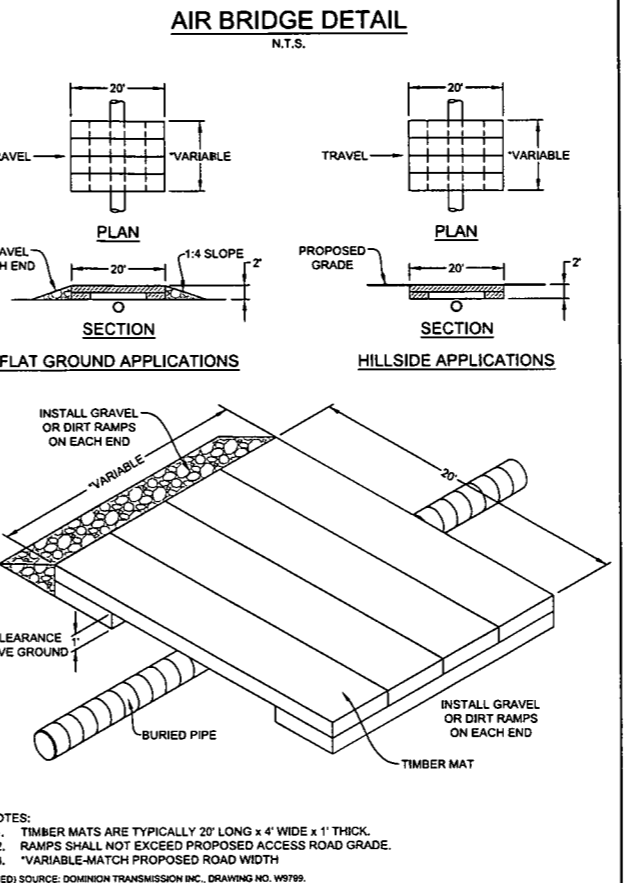
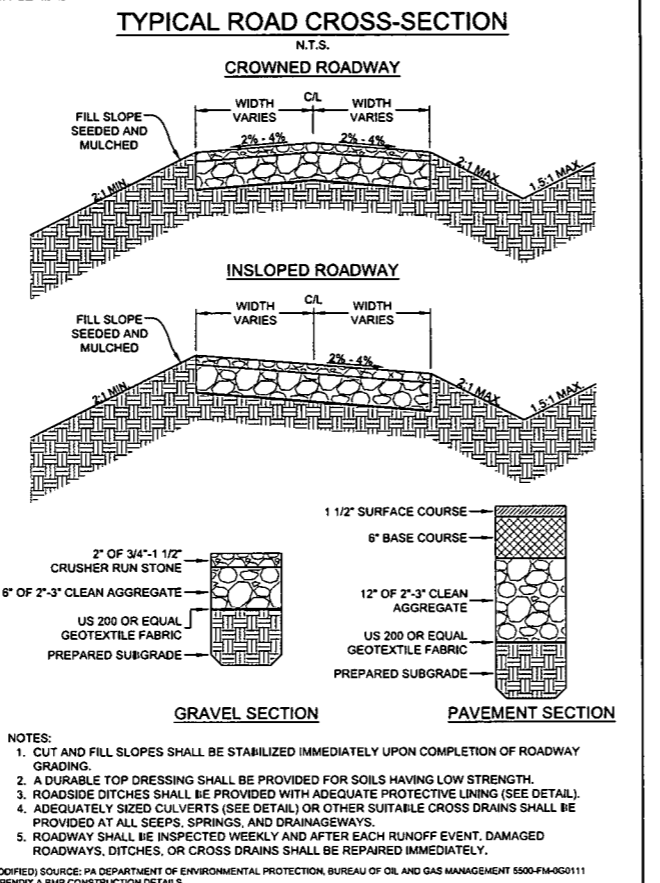
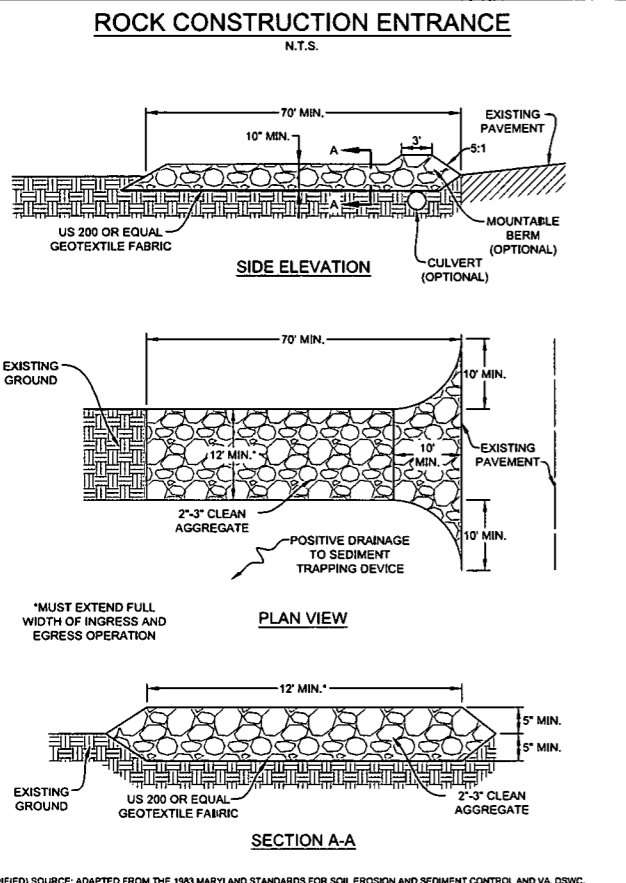
STREAM CROSSING "A" & GABION WALL DETAILS  
**ADDIE**  
WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 04/13/2015

SCALE: AS SHOWN

SHEET 17 OF 28



# NAVATUS

ENERGY ENGINEERING

Telephone: (888) 662-4185 | www.NavatusEng.com

DATE	REVISION
10/28/2015	REVISED WATER CONTAINMENT TANK
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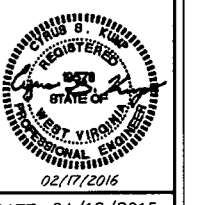
**Antero**  
Resources

THIS DOCUMENT WAS PREPARED FOR:  
ANTERO RESOURCES CORPORATION

CONSTRUCTION DETAILS

**ADDIE**

WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 04/13/2015  
SCALE: N/A  
SHEET 18 OF 28

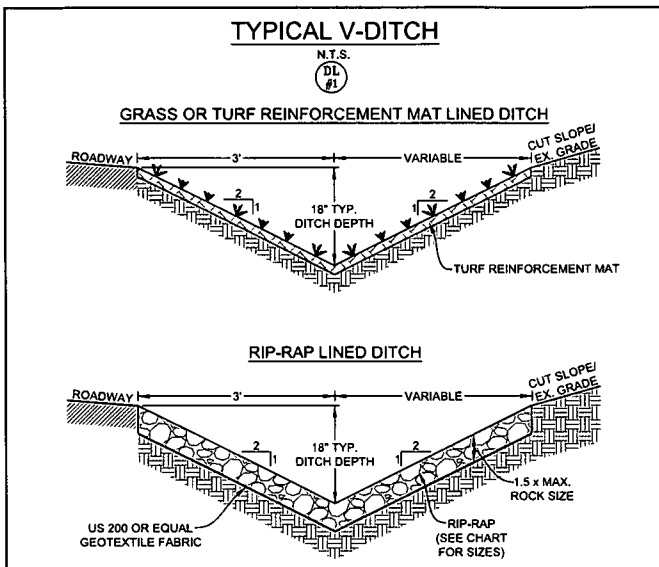
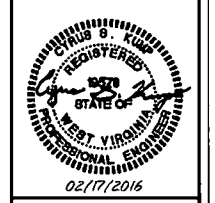
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02/17/2016	REVISED PLAN TO SHOW EXISTING DREDGING



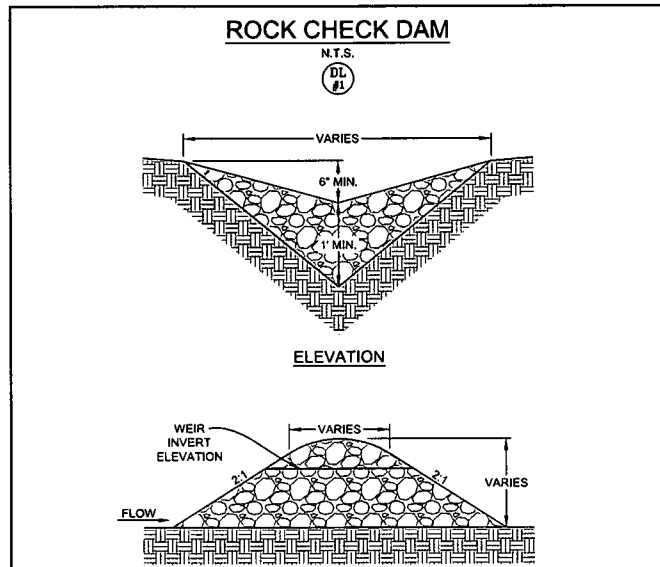
CONSTRUCTION DETAILS

## ADDIE

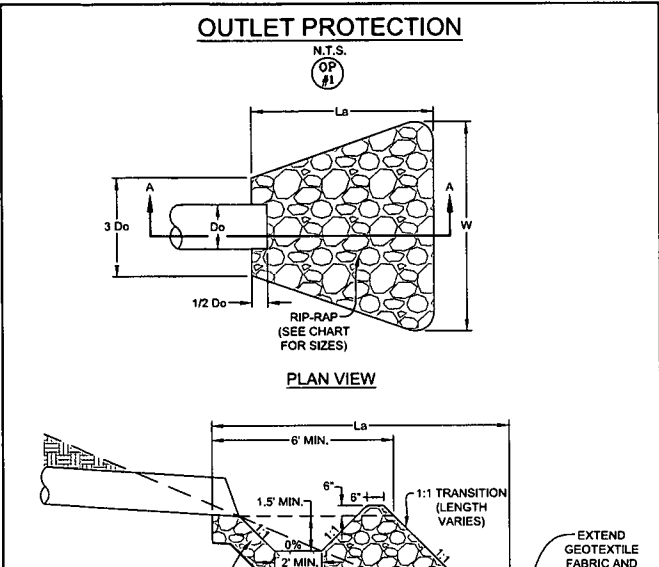
WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



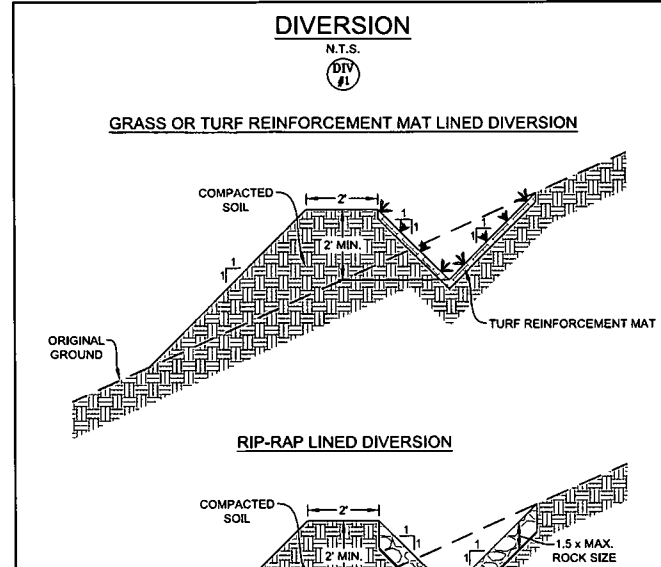
- NOTES:
- ALL DITCH LINE PROTECTION SHALL BE INSTALLED AS RECOMMENDED IN THE WEST VIRGINIA EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICE (BMP) MANUAL. DITCH LINE PROTECTION SHALL BE BASED ON THE FOLLOWING GRADES:
    - LESS THAN 3% = GRASS.
    - 3%-9% = TURF REINFORCEMENT MAT OR GRASS WITH ROLLED EROSION CONTROL PRODUCTS (R.E.C.P.).
    - GREATER THAN 9% = RIP-RAP. SEE CHART FOR SIZES.
  - TYPICAL OUTLET PROTECTION SHALL BE INSTALLED AT DOWNSTREAM END OF ALL DITCH LINES. SEE OUTLET PROTECTION DETAIL.
  - DITCH DIMENSIONS SHOWN ARE FOR COMPLETED DITCH AFTER LINING INSTALLATION. THE DITCH MUST BE OVER-EXCAVATED A SUFFICIENT AMOUNT TO ALLOW FOR THE REQUIRED LINING TO BE PLACED WITHIN THE DITCH WHILE MAINTAINING THE SPECIFIED FINISHED DIMENSIONS.
  - DITCH DIMENSIONS SHALL BE CONSTANTLY MAINTAINED. DITCH LINES SHALL BE CLEANED WHENEVER TOTAL DITCH DEPTH IS REDUCED BY 25% AT ANY LOCATION. SEDIMENT DEPOSITS SHALL BE REMOVED WITHIN 24 HOURS OF DISCOVERY OR AS SOON AS SOIL CONDITIONS PERMIT ACCESS TO DITCH WITHOUT FURTHER DAMAGE.
  - DAMAGED LINING SHALL BE REPAIRED OR REPLACED WITHIN 48 HOURS OF DISCOVERY.
  - IF HIGH EROSION SOILS ARE ENCOUNTERED DURING CONSTRUCTION, THE ENGINEER SHOULD BE CONTACTED FOR FURTHER EVALUATION.



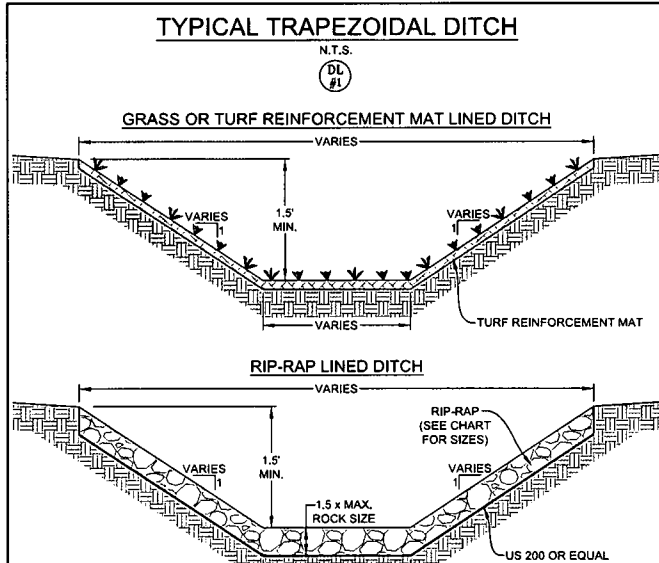
- NOTES:
- CHECK DAMS SHALL BE INSTALLED IN ALL DITCHES AND DIVERSIONS.
- (MODIFIED) SOURCE: WEST VIRGINIA EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICE MANUAL.



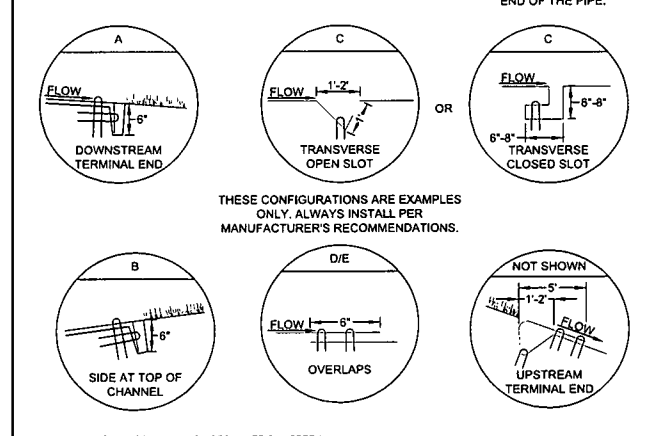
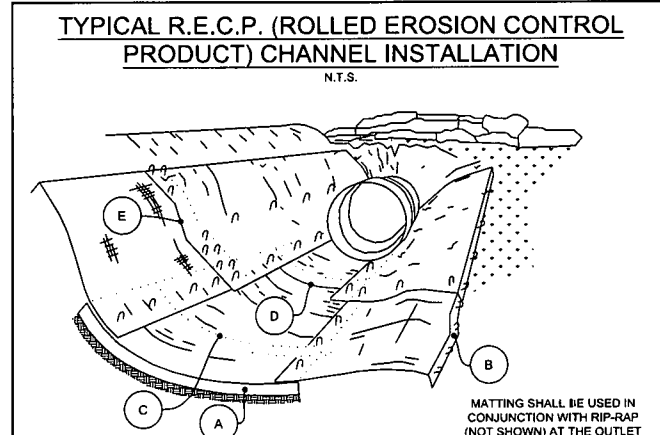
- NOTES:
- ALL APRONS SHALL BE CONSTRUCTED TO THE DIMENSIONS SHOWN IN CHART. TERMINAL WIDTHS SHALL BE ADJUSTED AS NECESSARY TO MATCH RECEIVING CHANNELS.
  - ALL APRONS SHALL BE INSPECTED AT LEAST WEEKLY AND AFTER EACH RUNOFF EVENT. DISPLACED RIP-RAP WITHIN THE APRON SHALL BE RESTORED IMMEDIATELY.
  - EXTEND RIP-RAP ON BACK SIDE OF APRON TO AT LEAST 1/2 DIAMETER OF PIPE ON BOTH SIDES TO PREVENT SCOUR AROUND THE PIPE.
  - TURF REINFORCEMENT MAT (TRM) SHALL BE INSTALLED FROM OUTLET PROTECTION TO DOWNSTREAM EROSION AND SEDIMENT CONTROL TO PREVENT SOIL RILLING.
- (MODIFIED) SOURCE: WEST VIRGINIA EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICE MANUAL.



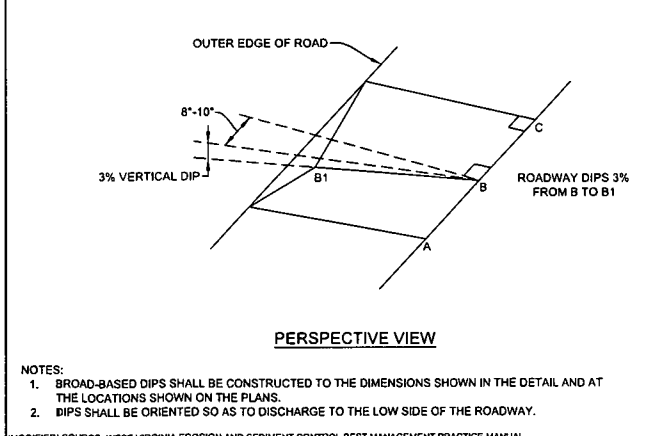
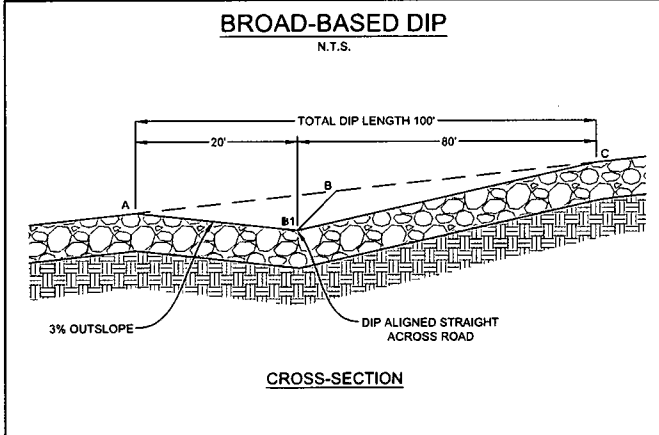
- NOTES:
- DIVERSION DIMENSIONS SHOWN ARE FOR COMPLETED DIVERSION AFTER LINING INSTALLATION. THE DIVERSION MUST BE OVER-EXCAVATED A SUFFICIENT AMOUNT TO ALLOW FOR THE REQUIRED LINING TO BE PLACED WITHIN THE DIVERSION WHILE MAINTAINING THE SPECIFIED FINISHED DIMENSIONS. DIVERSION DIMENSIONS SHALL BE CONSTANTLY MAINTAINED. DIVERSION LINES SHALL BE CLEANED WHENEVER TOTAL DIVERSION DEPTH IS REDUCED BY 25% AT ANY LOCATION. SEDIMENT DEPOSITS SHALL BE REMOVED WITHIN 24 HOURS OF DISCOVERY OR AS SOON AS SOIL CONDITIONS PERMIT ACCESS TO DIVERSION WITHOUT FURTHER DAMAGE.



- NOTES:
- 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:
    - LESS THAN 3% = GRASS.
    - 3%-9% = TURF REINFORCEMENT MAT OR GRASS WITH ROLLED EROSION CONTROL PRODUCTS (R.E.C.P.).
    - GREATER THAN 9% = RIP-RAP. SEE CHART FOR SIZES.
  - TYPICAL OUTLET PROTECTION SHALL BE INSTALLED AT DOWNSTREAM END OF ALL DITCH LINES. SEE OUTLET PROTECTION DETAIL.
  - DITCH DIMENSIONS SHOWN ARE FOR COMPLETED DITCH AFTER LINING INSTALLATION. THE DITCH MUST BE OVER-EXCAVATED A SUFFICIENT AMOUNT TO ALLOW FOR THE REQUIRED LINING TO BE PLACED WITHIN THE DITCH WHILE MAINTAINING THE SPECIFIED FINISHED DIMENSIONS.
  - DITCH DIMENSIONS SHALL BE CONSTANTLY MAINTAINED. DITCH LINES SHALL BE CLEANED WHENEVER TOTAL DITCH DEPTH IS REDUCED BY 25% AT ANY LOCATION. SEDIMENT DEPOSITS SHALL BE REMOVED WITHIN 24 HOURS OF DISCOVERY OR AS SOON AS SOIL CONDITIONS PERMIT ACCESS TO DITCH WITHOUT FURTHER DAMAGE.
  - DAMAGED LINING SHALL BE REPAIRED OR REPLACED WITHIN 48 HOURS OF DISCOVERY.
  - IF HIGH EROSION SOILS ARE ENCOUNTERED DURING CONSTRUCTION, THE ENGINEER SHOULD BE CONTACTED FOR FURTHER EVALUATION.



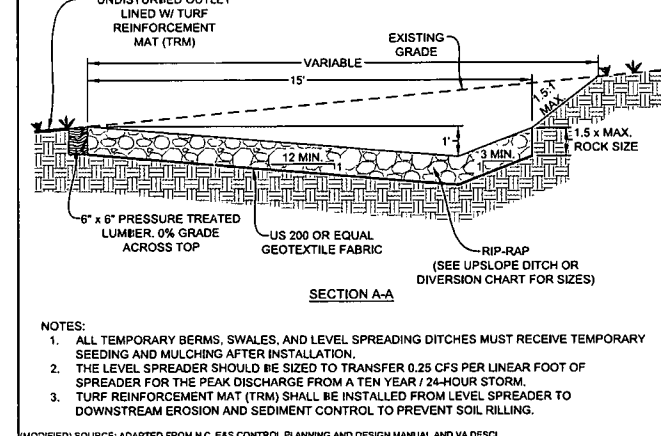
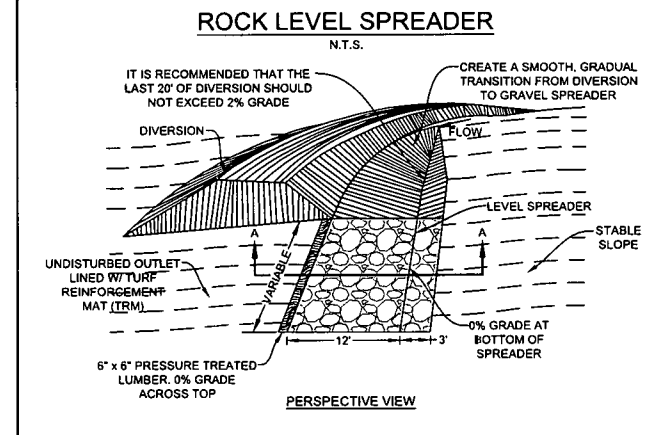
(MODIFIED) SOURCE: VA DCR-DSWC AND NORTH AMERICAN GREEN.



NOTES:

- BROAD-BASED DIPS SHALL BE CONSTRUCTED TO THE DIMENSIONS SHOWN IN THE DETAIL AND AT THE LOCATIONS SHOWN ON THE PLANS.
- DIPS SHALL BE ORIENTED SO AS TO DISCHARGE TO THE LOW SIDE OF THE ROADWAY.

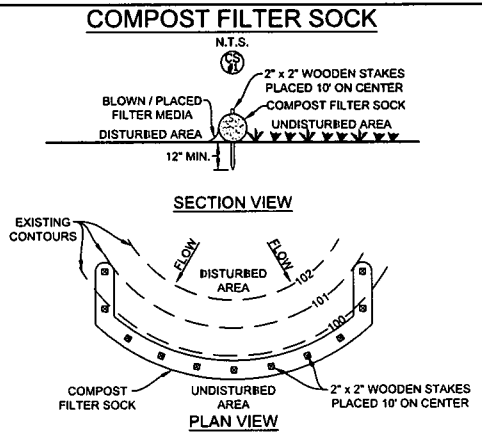
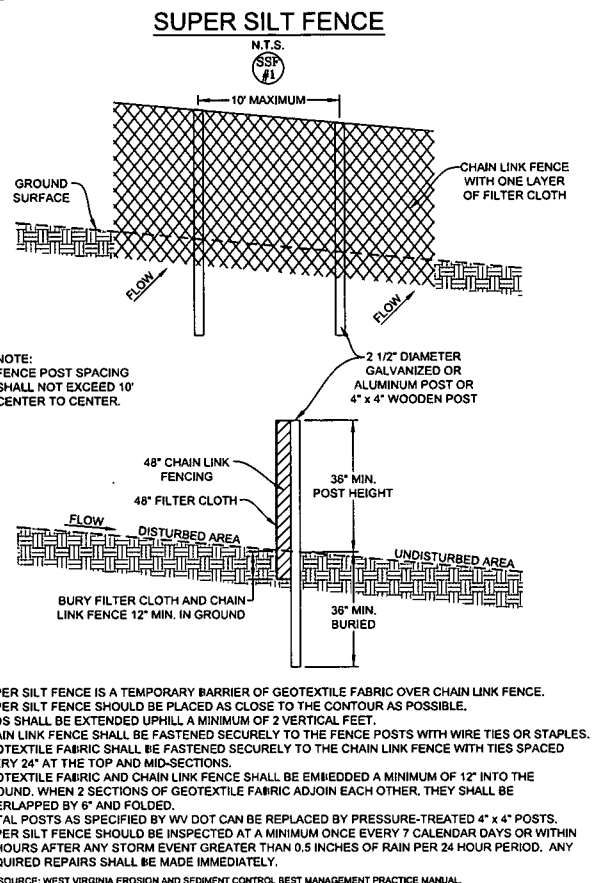
(MODIFIED) SOURCE: WEST VIRGINIA EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICE MANUAL.



NOTES:

- ALL TEMPORARY BERMS, SWALES, AND LEVEL SPREADING DITCHES MUST RECEIVE TEMPORARY SEEDING AND MULCHING AFTER INSTALLATION.
- THE LEVEL SPREADER SHOULD BE SIZED TO TRANSFER 0.25 CFS PER LINEAR FOOT OF SPREADER FOR THE PEAK DISCHARGE FROM A TEN YEAR / 24-HOUR STORM.
- TURF REINFORCEMENT MAT (TRM) SHALL BE INSTALLED FROM LEVEL SPREADER TO DOWNSTREAM EROSION AND SEDIMENT CONTROL TO PREVENT SOIL RILLING.

(MODIFIED) SOURCE: ADAPTED FROM N.C. EAS CONTROL PLANNING AND DESIGN MANUAL AND VA DESCI.

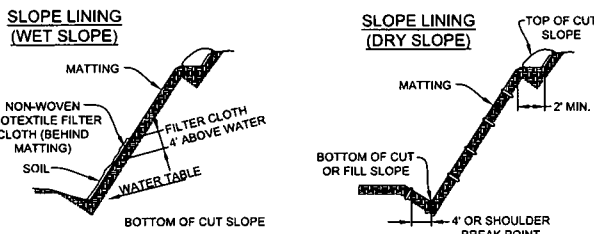
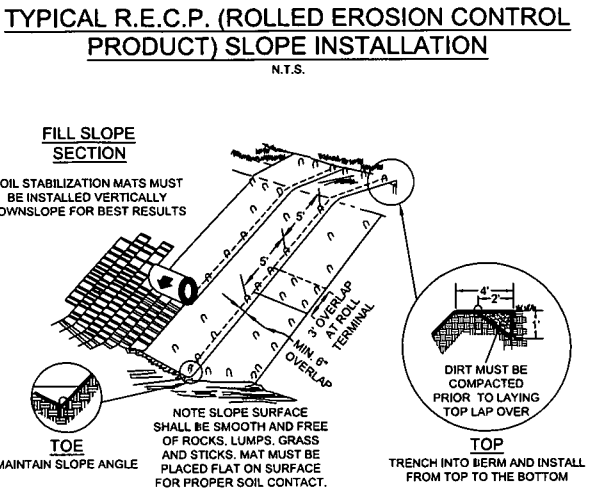


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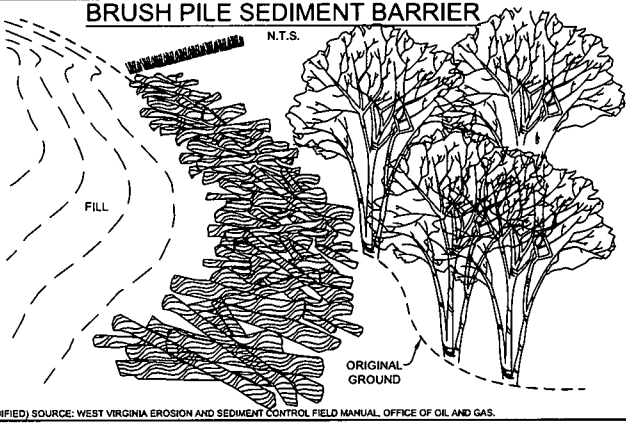
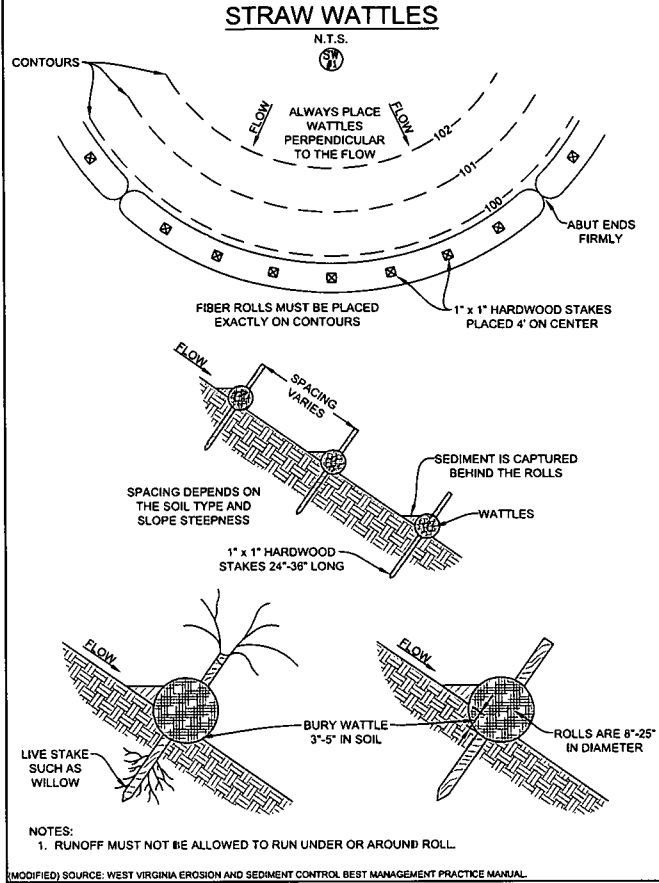
SOCK FABRIC SHALL MEET STANDARDS OF TABLE 4.1. COMPOST SHALL MEET THE FOLLOWING STANDARDS.

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

- NOTES:
1. COMPOST FILTER SOCK SHALL BE PLACED AT EXISTING LEVEL GRADE. BOTH ENDS OF THE SOCK SHALL BE EXTENDED AT LEAST 8' UP THE SLOPE OR TO A HEIGHT EQUAL TO THE EFFECTIVE SOCK HEIGHT, WHICHEVER IS GREATER, AT 45° TO THE MAIN SOCK ALIGNMENT. MAXIMUM SLOPE LENGTH ABOVE ANY SOCK SHALL NOT EXCEED MANUFACTURER'S MAXIMUM PERMISSIBLE SLOPE LENGTH.
  2. TRAFFIC SHALL NOT BE PERMITTED TO CROSS FILTER SOCKS.
  3. 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.
  4. 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.
  5. BIODEGRADABLE FILTER SOCKS SHALL BE REPLACED AFTER 6 MONTHS; PHOTODEGRADABLE SOCKS AFTER 1 YEAR. POLYPROPYLENE SOCKS SHALL BE REPLACED ACCORDING TO MANUFACTURER'S RECOMMENDATIONS.
  6. 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.
  7. 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.



(MODIFIED) SOURCE: VDOT STANDARDS AND VIRGINIA DCR-DSWC.



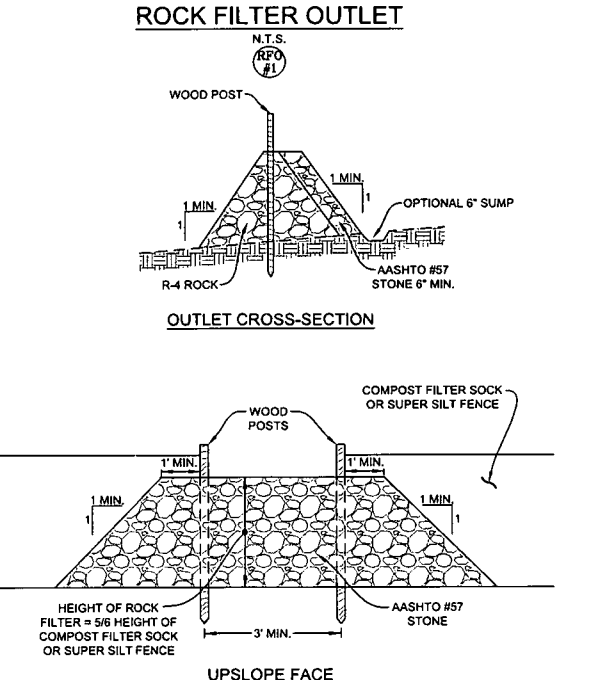
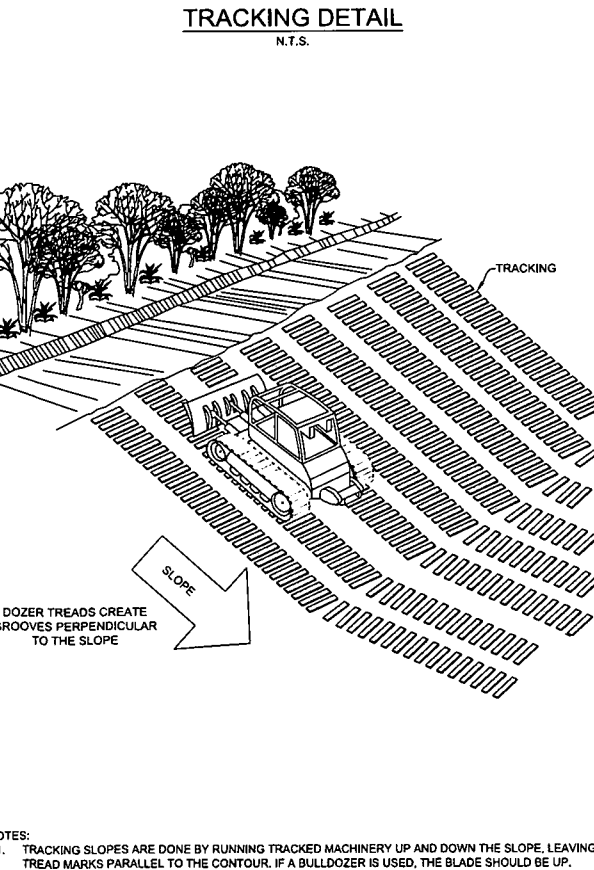
### COMPOST SOCK FABRIC MINIMUM SPECIFICATIONS (TABLE 4.1)

MATERIAL TYPE	3 MIL. HDPE			5 MIL. HDPE		MULTI-FILAMENT POLYPROPYLENE (MFPP)	HEAVY DUTY MULTI-FILAMENT POLYPROPYLENE (HDMFPP)
	PHOTO-DEGRADABLE	PHOTO-DEGRADABLE	BIO-DEGRADABLE	PHOTO-DEGRADABLE	PHOTO-DEGRADABLE		
SOCK DIAMETERS	12" 18"	12" 18" 24" 32"	12" 18" 24" 32"	12" 18" 24" 32"	12" 18" 24" 32"	12" 18" 24" 32"	12" 18" 24" 32"
MESH OPENING	3/8"	3/8"	3/8"	3/8"	3/8"	3/8"	1/8"
TEXTILE STRENGTH		26 PSI	26 PSI	44 PSI	202 PSI		
ULTRAVIOLET STABILITY % ORIGINAL STRENGTH (ASTM G-155)	23% AT 1000 HR.	23% AT 1000 HR.		100% AT 1000 HR.	100% AT 1000 HR.		
MINIMUM FUNCTIONAL LONGEVITY	6 MONTHS	9 MONTHS	8 MONTHS	1 YEAR	2 YEARS		

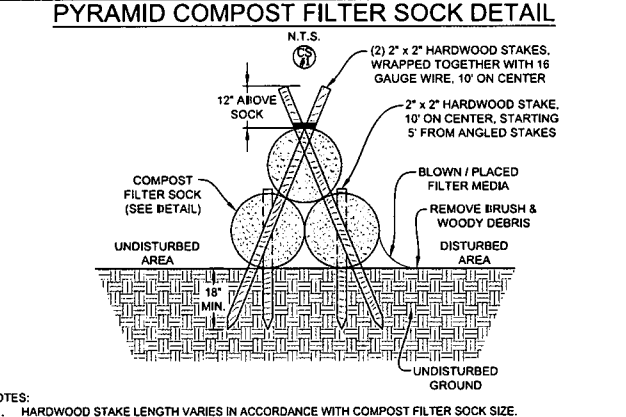
TWO-PLY SYSTEMS

INNER CONTAINMENT NETTING	HOPE BIAXIAL NET CONTINUOUSLY WOUND FUSION-WELDED JUNCTURES 3/4" x 3/4" MAX. APERTURE SIZE
OUTER FILTRATION MESH	COMPOSITE POLYPROPYLENE FABRIC (WOVEN LAYER & NON-WOVEN FLEECE MECHANICALLY FUSED VIA NEEDLE PUNCH) 3/16" MAX. APERTURE SIZE

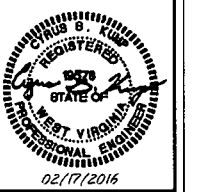
SOCK FABRICS COMPOSED OF BURLAP MAY BE USED ON PROJECTS LASTING 6 MONTHS OR LESS.



- NOTES:
1. A ROCK FILTER OUTLET SHALL BE INSTALLED WHERE FAILURE OF SUPER SILT FENCE OR COMPOST FILTER SOCK HAS OR MAY OCCUR DUE TO CONCENTRATED FLOW.
  2. SEDIMENT SHALL BE REMOVED WHEN ACCUMULATIONS REACH 1/3 THE HEIGHT OF THE OUTLET.
- (MODIFIED) SOURCE: PENNSYLVANIA EROSION AND SEDIMENT POLLUTION CONTROL PROGRAM MANUAL.



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**STANDARD STAKEOUT RIBBON COLOR SCHEME**

N.T.S.

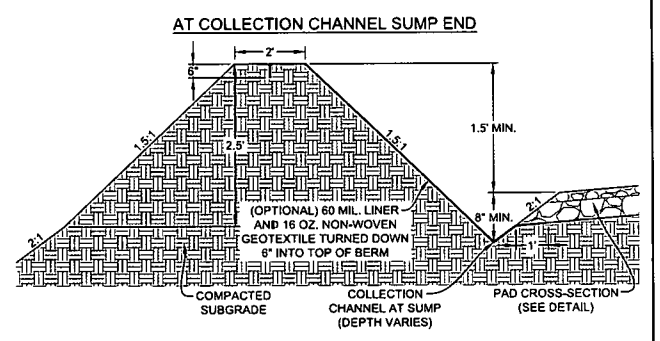
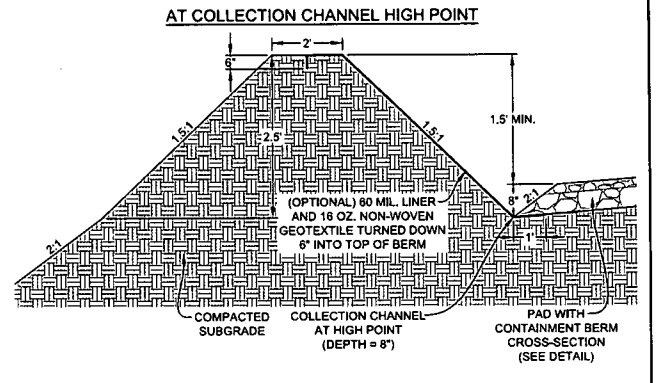


	<b>YELLOW RIBBON:</b> YELLOW RIBBON USED TO INDICATE TOP OF CUTS (C) CUT TO BE DETERMINED AT TIME OF STAKEOUT SLOPE DETERMINED BY SITE DESIGN
	<b>YELLOW &amp; ORANGE RIBBON:</b> YELLOW AND ORANGE RIBBON USED TO INDICATE GRADE AT TOP OF PAD/POND/PIT
	<b>ORANGE RIBBON:</b> ORANGE RIBBON USED TO INDICATE 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 STRIPE RIBBON:</b> PINK & BLACK STRIPE RIBBON USED TO INDICATE VERTICAL CUT (VC) AT PAD/POND/PIT CORNER OR EDGE PINK & BLACK STRIPE 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 STRIPE RIBBON:</b> BLUE & WHITE STRIPE RIBBON USED TO INDICATE CLEARING LIMITS/CONSTRUCTION LIMITS
	<b>ORANGE &amp; BLACK STRIPE RIBBON:</b> ORANGE & BLACK STRIPE RIBBON USED TO INDICATE VERTICAL CUT (VC) AT CENTERLINE OR EDGE OF ACCESS ROAD ORANGE & BLACK STRIPE RIBBON USED TO INDICATE VERTICAL FILL (VF) AT CENTERLINE OR EDGE OF ACCESS ROAD
	<b>PINK &amp; WHITE STRIPE RIBBON:</b> PINK & WHITE STRIPE 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 STRIPE RIBBON:</b> ORANGE & WHITE STRIPE RIBBON USED TO INDICATE TOPSOIL STOCKPILE LOCATIONS
	<b>BLUE RIBBON:</b> BLUE RIBBON USED TO INDICATE CENTERLINE (CL) DITCH BLUE RIBBON USED TO INDICATE BOTTOM (BTM) SEDIMENT TRAPS

MODIFIED SOURCE: ANTERO RESOURCES CORPORATION

**PAD CONTAINMENT BERM**

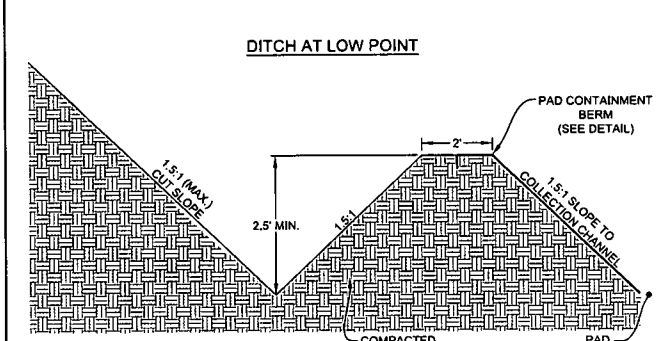
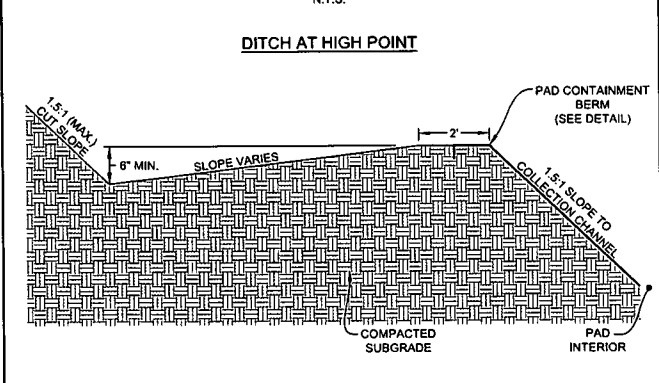
N.T.S.



**NOTES:**  
1. THE CONTAINMENT BERM SHALL BE CONSTRUCTED TO FULL BASE WIDTH AND COMPACTED TO 95% DENSITY. FOLLOWING COMPACTION THE SIDE SLOPES SHALL BE RE-SHAPED AT 1.5:1 SLOPE.  
2. IT IS RECOMMENDED THAT THE CONTAINMENT BERM LINER BE INSTALLED TO PREVENT INFILTRATION. IF INFILTRATION CAN BE ADEQUATELY PREVENTED WITHOUT THE USE OF THE LINER, INSTALLATION IS AT THE OPERATOR'S DISCRETION.

**PAD WITH CONTAINMENT BERM**

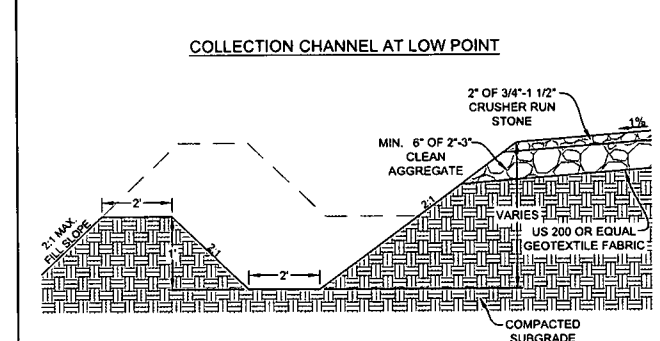
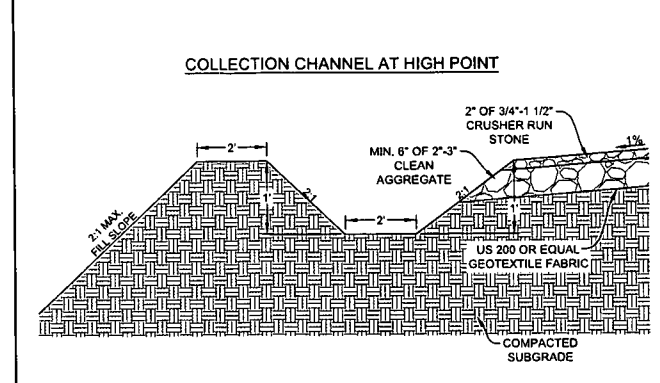
N.T.S.



**NOTES:**  
1. DITCH SHALL MAINTAIN A 1% MIN. GRADE TO THE OUTLET.  
2. NO RUNOFF FROM THE CUT SLOPE SHALL ENTER THE INTERIOR OF THE PAD CONTAINMENT BERM.

**COLLECTION CHANNEL ON PAD WITHOUT**

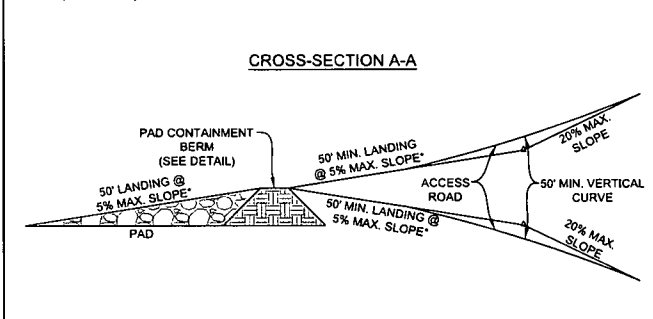
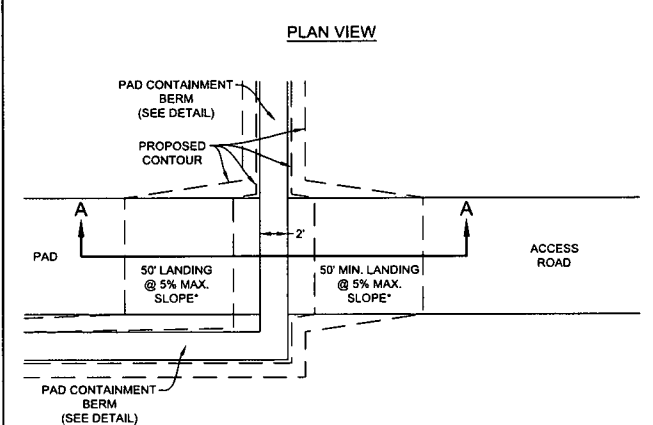
N.T.S.



**NOTES:**  
1. COLLECTION CHANNEL SHALL MAINTAIN A 1% MIN. GRADE TO THE OUTLET.

**MOUNTABLE BERM DETAIL**

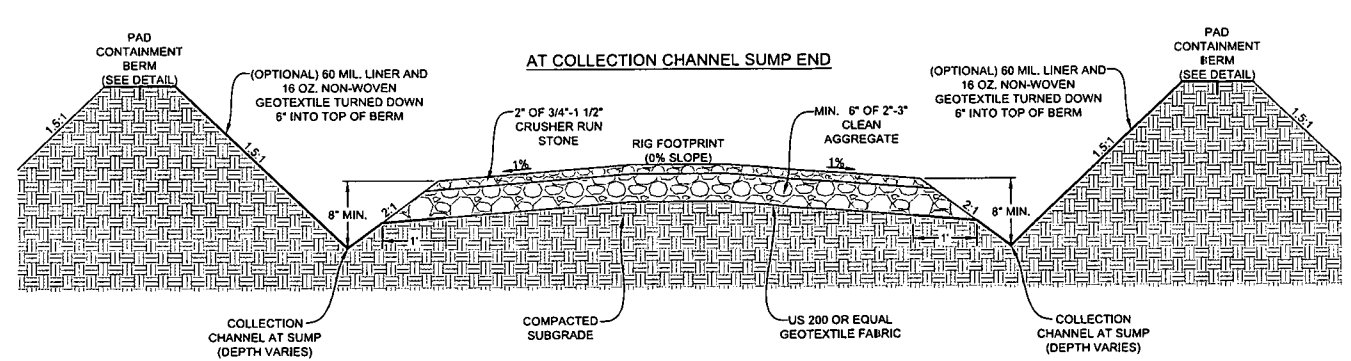
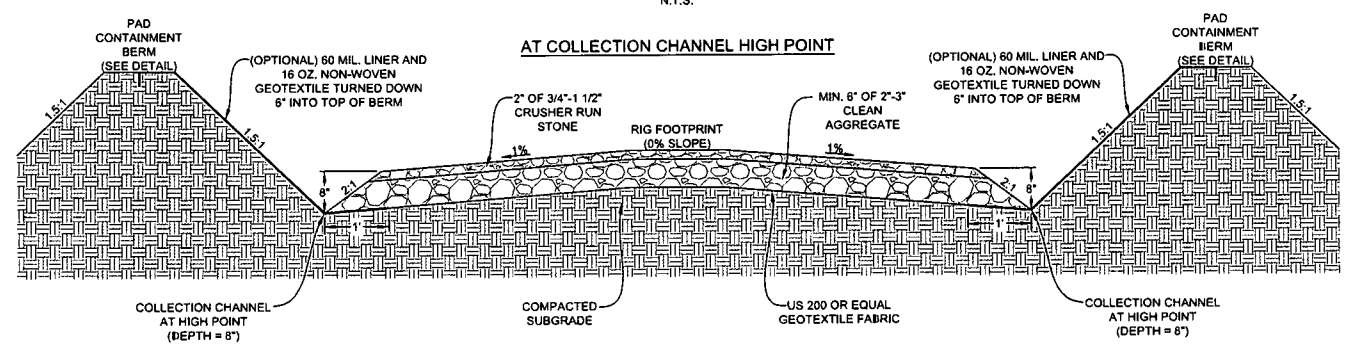
N.T.S.



**NOTES:**  
1. MOUNTABLE BERMS THAT DO NOT SERVE AS THE MAIN PAD ACCESS MAY BE STEEPER THAN 5% IF NOTED IN THE PLANS.

**PAD WITH CONTAINMENT BERM**

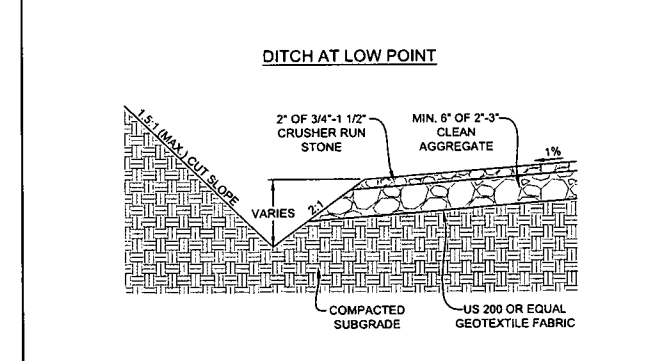
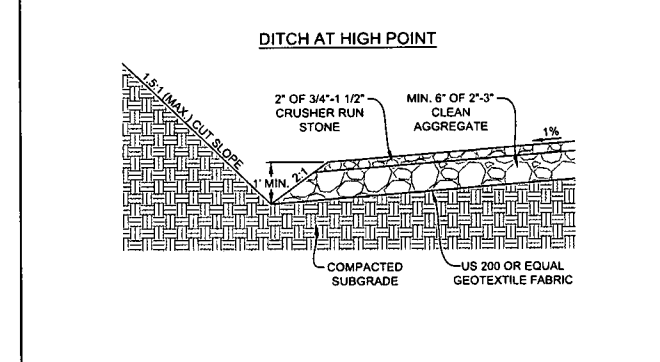
N.T.S.



**NOTES:**  
1. CRUSHER RUN STONE SHALL SLOPE TO COLLECTION CHANNEL AT 1% GRADE FROM RIG FOOTPRINT.  
2. COMPACTED SUBGRADE SHALL HAVE POSITIVE SLOPE TO THE COLLECTION CHANNELS OR SUMPS.  
3. IT IS RECOMMENDED THAT THE CONTAINMENT BERM LINER BE INSTALLED TO PREVENT INFILTRATION. IF INFILTRATION CAN BE ADEQUATELY PREVENTED WITHOUT THE USE OF THE LINER, INSTALLATION IS AT THE OPERATOR'S DISCRETION.

**PAD WITHOUT CONTAINMENT BERM**

N.T.S.



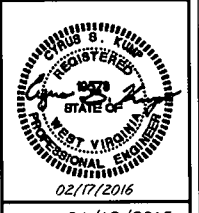
**NOTES:**  
1. DITCH SHALL MAINTAIN A 1% MIN. GRADE TO THE OUTLET.  
2. NO RUNOFF FROM THE CUT SLOPE SHALL ENTER THE INTERIOR OF THE PAD.

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DATE	REVISION
10/28/2015	REVISED WATER CONTAINMENT TANK
12/08/2015	REVISED PER STREAM & WETLAND DELINEATION
02/09/2016	REVISED PER WDEP COMMENTS
02/17/2016	REVISED PLAN TO SHOW EXISTING DWELLING

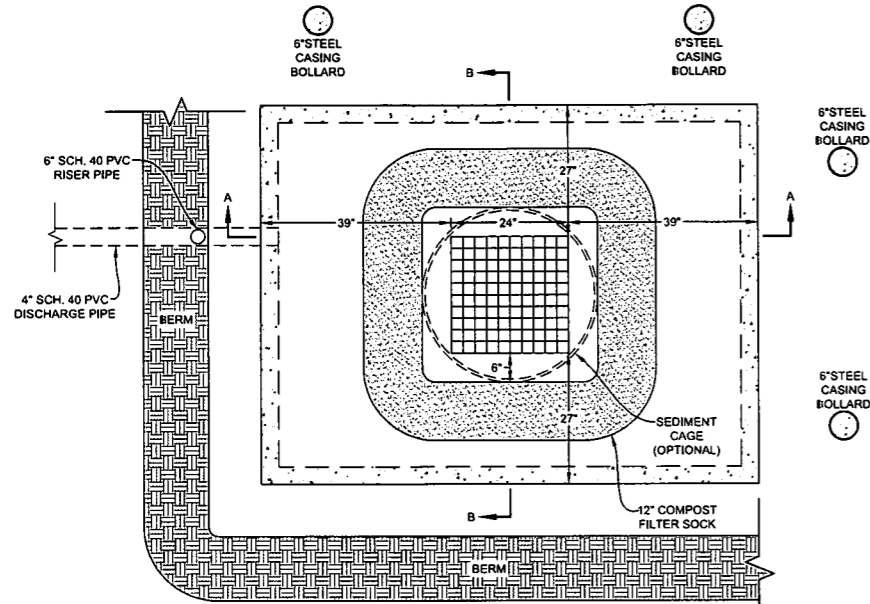
**Antero**  
Resources  
THIS DOCUMENT WAS PREPARED FOR:  
ANTERO RESOURCES CORPORATION

**CONSTRUCTION DETAILS**  
**ADDIE**  
WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA

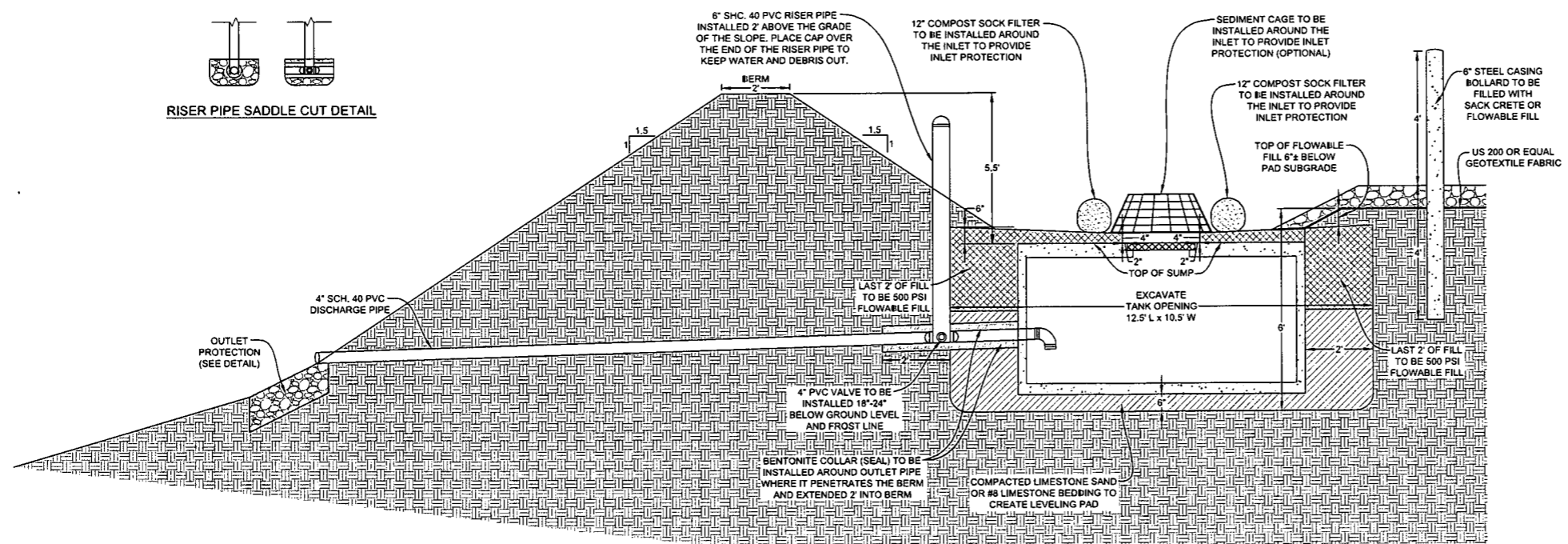
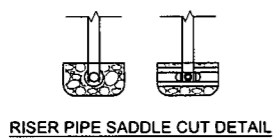
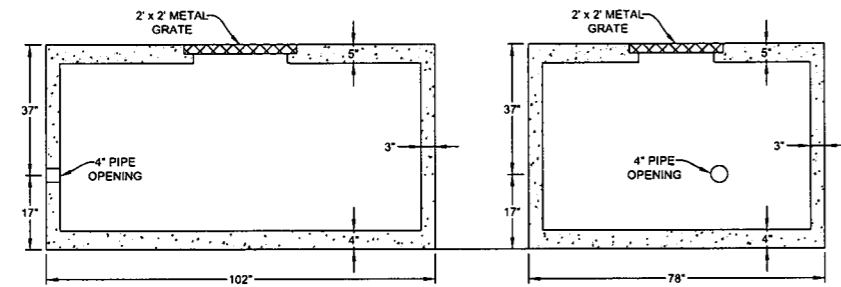
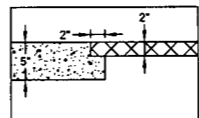


DATE: 04/13/2015  
SCALE: N/A  
SHEET 21 OF 28

**PAD DEWATERING SYSTEM**  
N.T.S.



RITCHEE CONCRETE LOW PROFILE TANK CATCH BASIN 1,000 GALLON CAPACITY



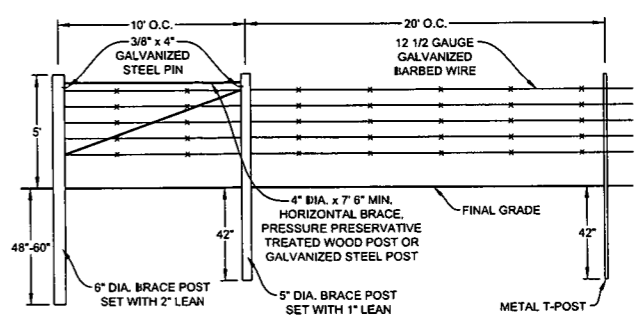
PAD DEWATERING SYSTEM

**INSTALLATION SEQUENCE**

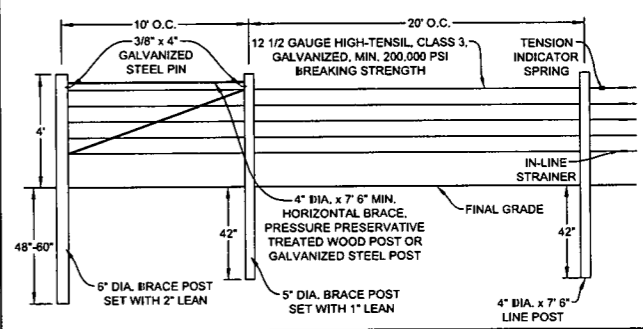
1. CONSTRUCT PAD TO SUBGRADE.
2. EXCAVATE THE SUMP HOLE 2' LARGER THAN THE LENGTH AND WIDTH OF THE TANK AND 1' LARGER THAN THE HEIGHT OF TANK.
3. USE COMPACTED LIMESTONE SAND OR #8 LIMESTONE TO PREPARE THE BOTTOM OF THE EXCAVATION. MAKE SURE TO LEVEL THE TANK FROM SIDE TO SIDE.
4. MAKE CERTAIN THE OUTLET 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 ENSURE POSITIVE SEAL. INSTALL BENTONITE COLLAR (SEAL) AROUND OUTLET PIPE WHERE IT PENETRATES THE BERM.
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 6" SCH. 40 RISER 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 FIT A "T" HANDLE (ALTERNATE HANDLE) ONTO THE EXPOSED PLUG ON THE TOP OF THE VALVE.
13. BEGIN BACKFILLING THE DISCHARGE DITCH. USE THE SOIL EXCAVATED FROM THE TANK HOLE TO BACKFILL THE DISCHARGE DITCH. BACKFILL AROUND THE TANK WITH COMPACTED LIMESTONE SAND OR #8 LIMESTONE TO AN ELEVATION WITHIN 2" OF THE TOP OF THE SUMP. FINISH BACKFILLING THE UPPER 2' AROUND THE TANK AND ON TOP THE TANK WITH 500 PSI FLOWABLE FILL. DO NOT BACKFILL WITH ANY LARGE ROCKS AGAINST THE TANK AND BE CERTAIN NOT TO OVER-COMPACT AROUND THE TANK. IMPROPER BACKFILLING AND OVER-COMPACTING AROUND THE TANK WILL LEAD TO THE TANK COLLAPSING. IT IS RECOMMENDED THAT FINER SOILS ARE USED TO BACKFILL AROUND THE DISCHARGE PIPE TO REDUCE VOIDS AND EXCESSIVE SETTLING.
14. ONCE BACKFILLING IS COMPLETE, THE TOP OF THE FLOWABLE FILL SHOULD BE 6" BELOW THE SUBGRADE.
15. CUT THE RISER PIPE OFF 2' ABOVE SUBGRADE 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 TRAPEZOIDAL DITCH FROM THE DISCHARGE PIPE OUTLET TO THE BOTTOM OF THE SLOPE. THE RIP-RAP TRAPEZOIDAL DITCH WILL DISCHARGE THROUGH OUTLET PROTECTION TO EROSION AND SEDIMENT CONTROLS OR DISCHARGE FROM THE RIP-RAP TRAPEZOIDAL DITCH INTO AN ACCESS ROAD DITCH.
18. WITH TANK INSTALLATION COMPLETE, THE PAD CAN THEN BE STONED. WHEN USING GEOTEXTILE FABRIC (US 200 OR EQUAL), BE SURE TO LAP THE FABRIC OVER THE EDGE OF THE FLOWABLE FILL ON THE TANK. THIS LAP WILL HELP RUNOFF TO FLOW INTO THE TANK. TAPER STONE DOWN FROM THE PAD TO THE TANK (2:1 SLOPE), 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 6" STEEL CASING BOLLARDS 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.

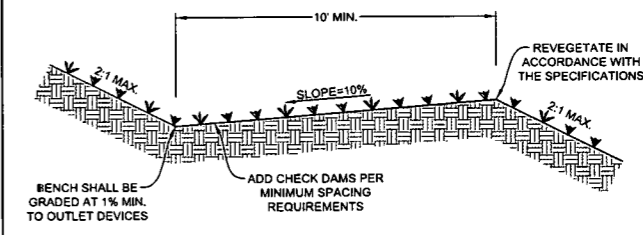
**5-STRAND BARBED WIRE FENCE DETAIL**  
N.T.S.



**4' FARM FENCE DETAIL**  
N.T.S.

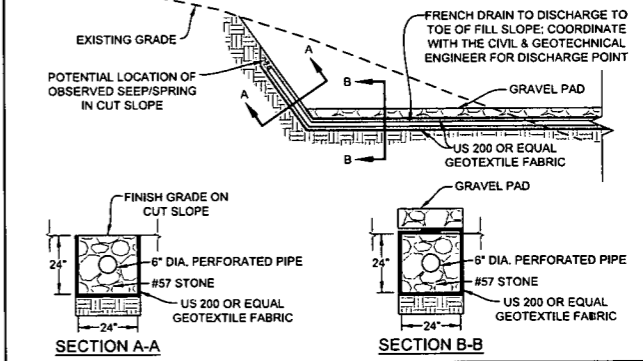


**FILL BENCH DETAIL**  
N.T.S.



- NOTES:**
1. ALL BENCH PROTECTION SHALL BE INSTALLED AS RECOMMENDED IN THE WEST VIRGINIA EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICE (BMP) MANUAL. BENCH PROTECTION SHALL BE BASED ON THE FOLLOWING GRADES:
    - 1.1. LESS THAN 3% = GRASS.
    - 1.2. 3%-9% = TURF REINFORCEMENT MAT OR GRASS WITH ROLLED EROSION CONTROL PRODUCTS (R.E.C.P.).
    - 1.3. GREATER THAN 9% = RIP-RAP. SEE CHART FOR SIZES.

**SEEP/SPRING FRENCH DRAIN DETAIL**  
N.T.S.

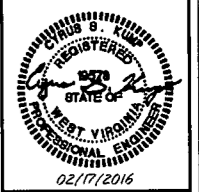


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DATE	REVISION
10/28/2016	REVISED WATER CONTAINMENT TANK
12/08/2015	REVISED PER STREAM & WETLAND DELINEATION
02/09/2016	REVISED PER WYDRP COMMENTS
02/17/2016	REVISED PLAN TO SHOW EXISTING DRILLING

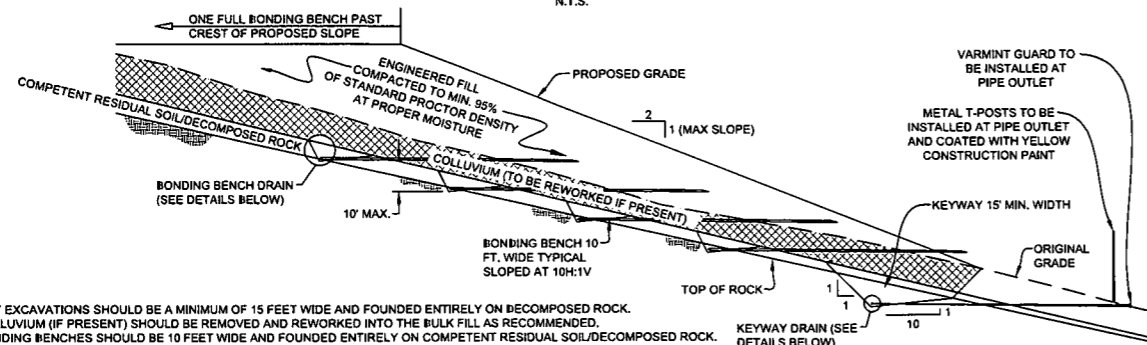
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DODDRIDGE COUNTY, WEST VIRGINIA



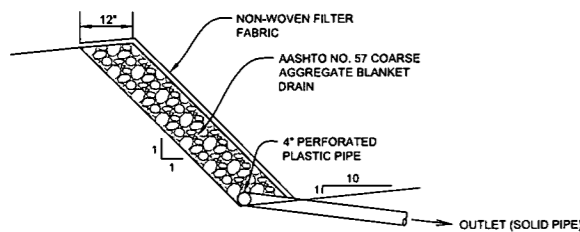
DATE: 04/13/2015  
SCALE: N/A  
SHEET 22 OF 28

**D1 TYPICAL WELL AND TANK PAD KEYWAY, BENCH, AND DRAINAGE**  
N.T.S.



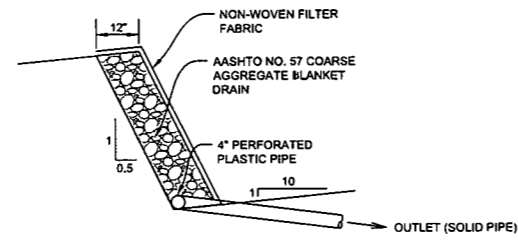
- NOTES:**
- KEYWAY EXCAVATIONS SHOULD BE A MINIMUM OF 15 FEET WIDE AND FOUNDED ENTIRELY ON DECOMPOSED ROCK.
  - ALL COLLUVIUM (IF PRESENT) SHOULD BE REMOVED AND REWORKED INTO THE BULK FILL AS RECOMMENDED.
  - ALL BONDING BENCHES SHOULD BE 10 FEET WIDE AND FOUNDED ENTIRELY ON COMPETENT RESIDUAL SOIL/DECOMPOSED ROCK.
  - WHERE SAFETY CONCERNS PROHIBIT INSTALLATION OF KEYWAY OR BONDING BENCH DRAINS AS SHOWN, SUBSTITUTE ALTERNATE DRAIN DETAIL.

**KEYWAY DRAIN DETAIL - AGGREGATE**  
N.T.S.



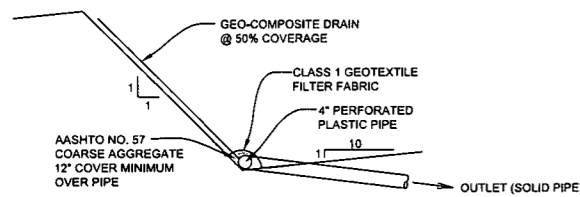
- \*OUTLETS AT 100 FT. CENTERS MAX. OR AS DEEMED NECESSARY  
\*ALL OUTLET DRAINS TO BE COVERED WITH 12" OF NO. 57 AGGREGATE AND WRAPPED IN NON-WOVEN FILTER FABRIC

**BONDING BENCH DRAIN DETAIL - AGGREGATE**  
N.T.S.



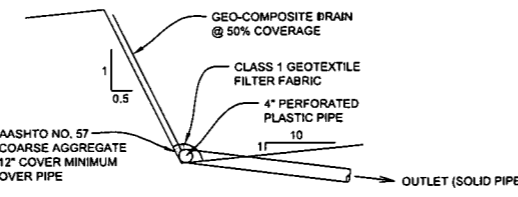
- \*SLOPE OUTLET TO PROVIDE POSITIVE DRAINAGE TO SLOPE FACE  
\*OUTLETS AT 250 FT. CENTERS MAX. OR AS DEEMED NECESSARY  
\*ALL OUTLET DRAINS TO BE COVERED WITH 12" OF NO. 57 AGGREGATE AND WRAPPED IN NON-WOVEN FILTER FABRIC

**KEYWAY DRAIN DETAIL - GEO-COMPOSITE**  
N.T.S.



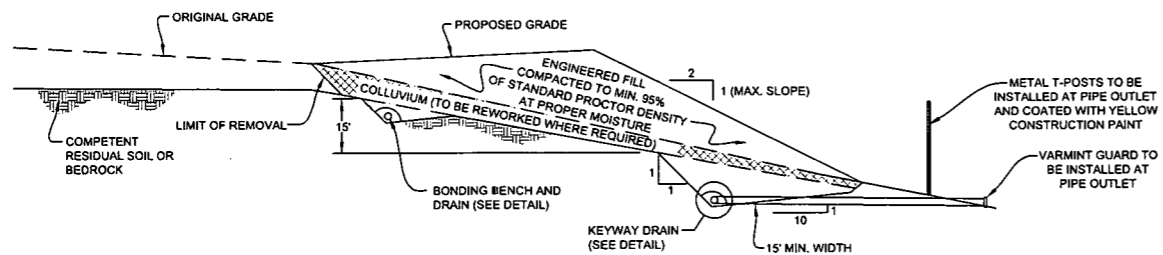
- \*OUTLETS AT 100 FT. CENTERS MAX. OR AS DEEMED NECESSARY  
\*ALL OUTLET DRAINS TO BE COVERED WITH 12" OF NO. 57 AGGREGATE AND WRAPPED IN NON-WOVEN FILTER FABRIC  
\*GEO-COMPOSITE DRAIN TO CONSIST OF HANES GEO COMPONENTS TERRADRAIN 104Z, MIRAFI G200N, OR EQUIVALENT.

**BONDING BENCH DRAIN DETAIL - GEO-COMPOSITE**  
N.T.S.



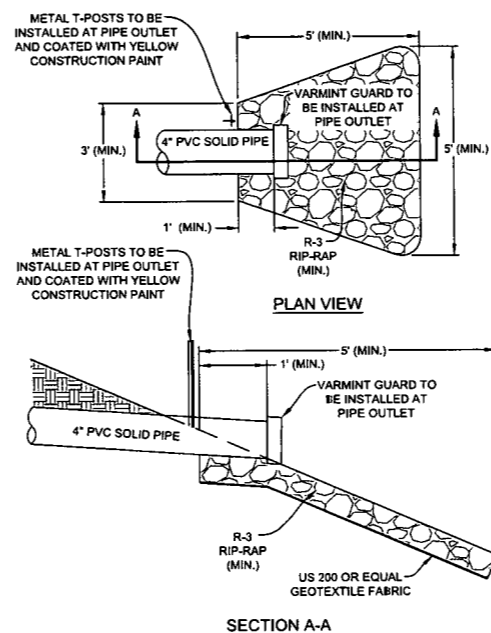
- \*SLOPE OUTLET TO PROVIDE POSITIVE DRAINAGE TO SLOPE FACE  
\*OUTLETS AT 250 FT. CENTERS MAX. OR AS DEEMED NECESSARY  
\*ALL OUTLET DRAINS TO BE COVERED WITH 12" OF NO. 57 AGGREGATE AND WRAPPED IN NON-WOVEN FILTER FABRIC  
\*GEO-COMPOSITE DRAIN TO CONSIST OF HANES GEO COMPONENTS TERRADRAIN 104Z, MIRAFI G200N, OR EQUIVALENT.

**D2 TYPICAL ACCESS DRIVE KEYWAY, BENCH, AND DRAINAGE DETAIL**  
N.T.S.



- NOTES:**
- KEYWAY EXCAVATIONS SHOULD BE A MINIMUM OF 15 FEET WIDE AND EXTEND THROUGH ALL COLLUVIUM AND/OR RESIDUAL SOIL TO BE FOUNDED ENTIRELY ON DECOMPOSED ROCK.
  - 4" PERFORATED KEYWAY DRAIN SHOULD BE INSTALLED ALONG THE ENTIRE LENGTH OF THE KEYWAY WITH OUTLETS AT 100 FT. CENTERS.
  - A 10" BONDING BENCH AND DRAIN SHOULD BE INSTALLED 15 FEET HIGHER IN ELEVATION ABOVE THE TOP OF THE REAR WALL OF THE KEYWAY EXCAVATION.

**TYPICAL KEYWAY / BONDING BENCH DRAIN OUTLET PROTECTION**  
N.T.S.



- NOTES:**
- ALL APRONS SHALL BE INSPECTED AT LEAST WEEKLY AND AFTER EACH RUNOFF EVENT. DISPLACED RIP-RAP WITHIN THE APRON SHALL BE RESTORED IMMEDIATELY.
  - IF EROSION IS OCCURRING DOWNSTREAM OF OUTLET PROTECTION, CONTRACTOR TO EXTEND OUTLET PROTECTION TO DOWNSTREAM EROSION CONTROL DEVICES.
  - CONTRACTOR IS TO EXTEND ALL KEYWAY AND BONDING BENCH OUTLET DRAINS A MINIMUM OF ONE FOOT PAST THE FINISHED GRADE OF THE SLOPE.

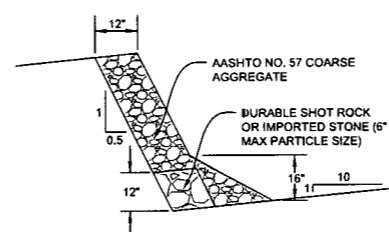
**GENERAL SITE EARTHWORK RECOMMENDATIONS**

- ALL FILL AREAS SHOULD BE CLEARED OF TREES, STUMPS, AND VEGETATION AND STRIPPED OF TOPSOIL/ORGANIC SOILS PRIOR TO THE START OF FILL PLACEMENT.
- THE DISTRIBUTION AND GRADATION OF FILL MATERIALS SHALL BE SUCH THAT THE FILL WILL BE FREE OF LENSES, POCKETS, OR LAYERS OF MATERIALS DIFFERING SUBSTANTIALLY IN GRADATION FROM THE SURROUNDING MATERIALS WITHIN THE DESIGNATED FILL AREAS.
- FILL SHALL BE PLACED AND SPREAD IN SUCCESSIVE AND APPROXIMATE HORIZONTAL LAYERS OF UNIFORM THICKNESS BASED ON THE NOMINAL PARTICLE SIZE OF MATERIAL AND THE SIZE AND TYPE OF THE AVAILABLE COMPACTION EQUIPMENT. IN GENERAL, SOIL SHOULD BE PLACED IN NOMINAL 12 INCH MAXIMUM LOOSE LIFTS. LARGER ROCK INCORPORATED INTO THE FILL SHOULD TYPICALLY BE LIMITED TO 12 INCHES THICK X 3 FEET X 3 FEET, WITH ALL VOID SPACE CHOKED WITH SMALLER PARTICLE SIZE MATERIAL.
- ADEQUATE COMPACTION EFFORT IS APPLIED BY UTILIZING THE PROPER COMPACTION EQUIPMENT FOR THE COMPOSITION OF THE FILL MATERIALS BEING PLACED. SEGMENTED, SHEEPSFOOT, AND/OR PADFOOT ROLLERS SHOULD BE USED WHEN PLACING PREDOMINATELY CLAYEY (COHESIVE) FILL MATERIALS. THESE TYPES OF ROLLERS ARE ALSO EFFECTIVE ON CLAYEY SHALES, CLAYSTONE, AND SOFTER SANDSTONE TO BREAK DOWN THE ROCK PARTICLES. SMOOTH DRUM VIBRATORY ROLLERS SHOULD BE UTILIZED ON PREDOMINATELY GRANULAR FILL MATERIALS AND TO SEAL CLAYEY SOILS TO HELP PREVENT SURFACE WATER INFILTRATION AND/OR TO PROMOTE DRAINAGE.
- ALL FILL MATERIALS SHALL BE COMPACTIONED BY A SUFFICIENT NUMBER OF COMPLETE TRIPS (I.E. PASSES) OF THE APPROPRIATE COMPACTION EQUIPMENT TO ATTAIN A MINIMUM OF 95% OF THE MAXIMUM DRY DENSITY AS DETERMINED IN ACCORDANCE WITH ASTM TEST DESIGNATION D698 (STANDARD PROCTOR). MAINTAIN THE MOISTURE CONTENT OF THE FILL MATERIALS AS NECESSARY TO ATTAIN THE DESIRED COMPACTION DENSITY.
- UNDISTURBED AND/OR FILL MATERIALS PLACED WITHIN THE UPPER 12 INCHES OF FINAL GRADE SHOULD BE COMPACTIONED TO ATTAIN A MINIMUM OF 100% OF THE MAXIMUM DRY DENSITY AS DETERMINED IN ACCORDANCE WITH ASTM TEST DESIGNATION D698 (STANDARD PROCTOR) AT AN IN-PLACE MOISTURE WITHIN 2% OF THE MATURE CONTENT OF THE FILL MATERIALS. THE ENTIRE SUBGRADE SURFACE SHOULD BE THOROUGHLY SEALED USING A VIBRATORY SMOOTH DRUM ROLLER.
- TO VERIFY THE SPECIFIED DEGREE OF COMPACTION AND TO DETERMINE THE IN-PLACE MOISTURE CONTENT AS STATED ABOVE, IN-PLACE FIELD DENSITY TESTS SHOULD BE PERFORMED IN ACCORDANCE TO THE PROCEDURES OF ASTM D2922 (NUCLEAR DENSOMETER).
- IN ADDITION TO IN-PLACE FIELD DENSITY TESTING, ACCEPTANCE SHOULD ALSO BE PREDICATED ON A VISUAL PERFORMANCE CRITERIA. OBVIOUS SURFACE RUTTING AND/OR DEFLECTION THAT ARE JUDGED TO BE DETRIMENTAL TO THE OVERALL STABILITY OF THE FILL AREA SHOULD BE REMOVED, MOISTURE CONDITIONED AND RECOMPACTIONED, OR OTHERWISE ADDRESSED PRIOR TO ACCEPTING THE LIFT.
- WHERE PREDOMINATELY "ROCKY" FILL MATERIALS ARE PLACED OR WHERE REPRESENTATIVE NUCLEAR DENSOMETER TESTS CANNOT BE OBTAINED, A VISUAL NON-DEFLECTION CRITERIA SHOULD BE DEVELOPED IN CONJUNCTION WITH AN ADEQUATE NUMBER OF ROLLER PASSES FOR ACCEPTANCE.

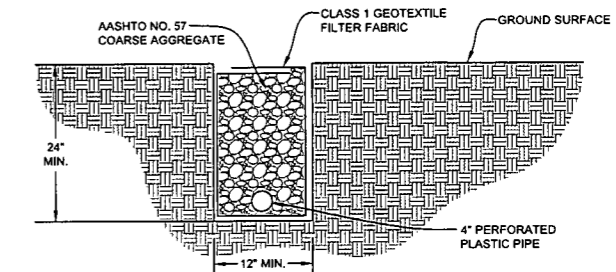
**NOTE:**

- THE GEOTECHNICAL NOTES AND DETAILS SHOWN ON THIS SHEET ARE FOR THE GENERAL EARTHWORK AND SUBSURFACE DRAINAGE ASSOCIATED WITH THE CONSTRUCTION OF THIS SITE. THE CONTRACTOR SHALL REFER TO THE GEOTECHNICAL INVESTIGATION REPORT FOR ADDITIONAL GUIDANCE AND RECOMMENDATIONS.

**ALTERNATE KEYWAY/BONDING BENCH DRAIN DETAIL**  
N.T.S.

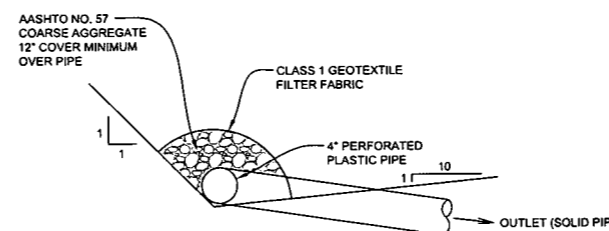


**D3 TYPICAL SPRING DRAIN DETAIL**  
N.T.S.



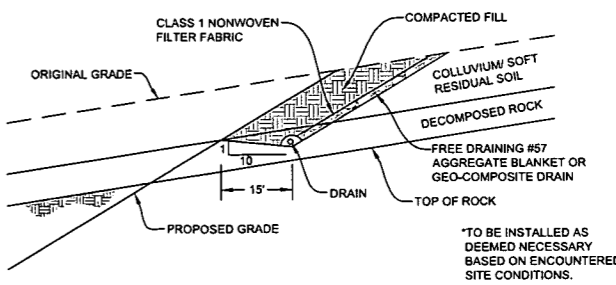
- NOTES:**
- 4" PERFORATED PLASTIC PIPE EXTENDED TO DRAIN AWAY FROM SLOPE AND WATER DIVERTED OR COLLECTED IF NECESSARY TO PREVENT EMBANKMENT DAMAGE.
  - PROVIDE DRAINAGE OUTLETS AT 50-FOOT HORIZONTAL INTERVALS.

**KEYWAY DRAIN DETAIL**  
N.T.S.



- \*OUTLETS AT 100 FT. CENTERS MAX FOR KEYWAY  
\*OUTLETS AT 250 FT. CENTERS MAX. FOR BONDING BENCH  
\*ALL OUTLET DRAINS TO BE COVERED WITH 12" OF NO. 57 AGGREGATE AND WRAPPED IN NON-WOVEN FILTER FABRIC

**D4 TYPICAL SLOPE PROTECTION DETAIL**  
N.T.S.



- \*OUTLET AT ENDS AND AT 250' CENTERS MAX SIMILAR TO KEYWAY DRAIN DETAIL  
\*ALL OUTLET DRAINS TO BE COVERED WITH 12" MINIMUM NO. 57 AGGREGATE AND WRAPPED IN NON-WOVEN FILTER FABRIC

**NAVITUS**  
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DATE	REVISION
10/26/2015	REVISED WATER CONTAINMENT TANK
12/08/2015	REVISED PER STREAM & WETLAND DELINEATION
02/09/2016	REVISED PER WDEP COMMENTS
02/17/2016	REVISED PLAN TO SHOW EXISTING DWELLING

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

CONSTRUCTION DETAILS  
**ADDIE**  
**WELL PAD & WATER CONTAINMENT PAD**  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA

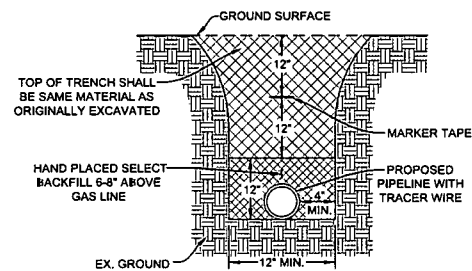


DATE: 04/13/2015  
SCALE: N/A  
SHEET 23 OF 28



**PIPELINE RELOCATION TRENCH**

N.T.S.



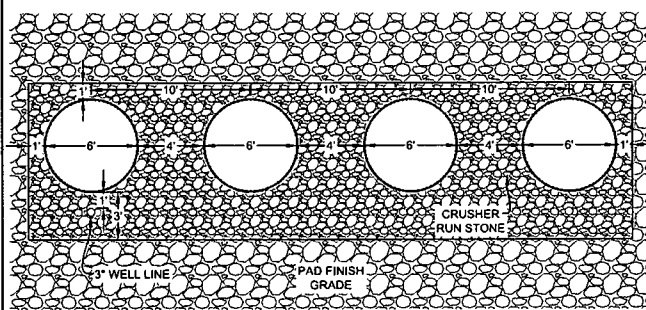
**NOTES:**

1. THE DEPTH OF COVER SHOWN ON ALL TRENCH DETAILS ARE MINIMUM DEPTHS.
2. WEEPS INSTALLED EVERY 100' AND AT ALL LOW POINTS.
3. BACKFILL 6-8" ABOVE GAS LINE TO BE FREE FROM ROCKS 6" AND LARGER.
4. REMAINDER OF TRENCH TO BE BACKFILLED WITH MATERIAL FROM TRENCH AND COMPACTED TO SURROUNDING GROUND DENSITY.
5. MARKER TAPE TO BE PLACED 1' BELOW ORIGINAL GROUND LEVEL.

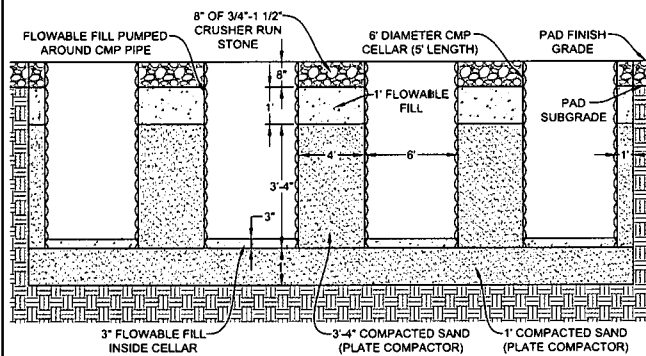
**MARCELLUS CELLAR TRENCH**

N.T.S.

**PLAN VIEW**



**SECTION VIEW**



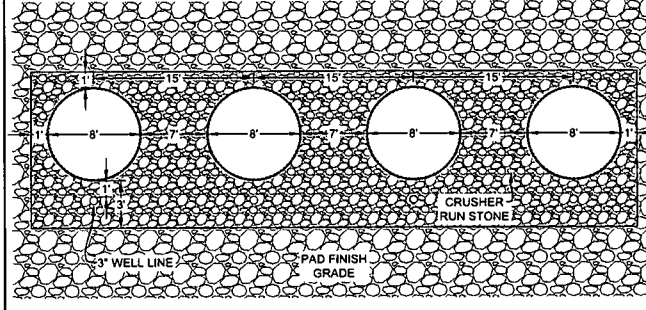
**NOTES:**

1. CELLARS ARE SET TO 4'-4" BELOW PAD SUBGRADE WHICH WILL HAVE CELLAR PIPE AND CRUSHER RUN STONE 8" ABOVE WELL PAD SUBGRADE PRIOR TO STABILIZING AND STONING PAD.
2. ALL STONE PLACED ON PAD AND AROUND THE CELLARS SHALL BE COMPACTED.

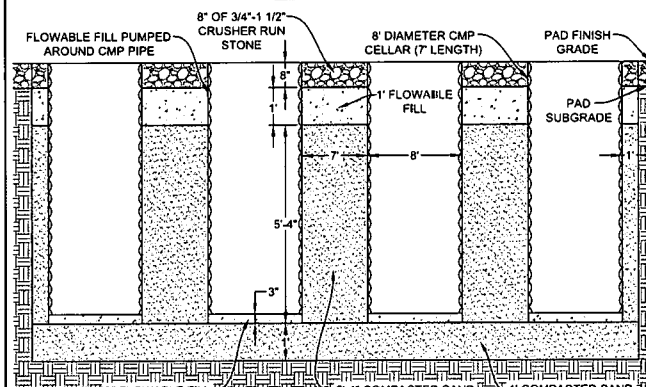
**UTICA CELLAR TRENCH**

N.T.S.

**PLAN VIEW**



**SECTION VIEW**



**NOTES:**

1. CELLARS ARE SET TO 6'-4" BELOW PAD SUBGRADE WHICH WILL HAVE CELLAR PIPE AND CRUSHER RUN STONE 8" ABOVE WELL PAD SUBGRADE PRIOR TO STABILIZING AND STONING PAD.
2. ALL STONE PLACED ON PAD AND AROUND THE CELLARS SHALL BE COMPACTED.

DATE	REVISION
10/26/2015	REVISED WATER CONTAINMENT TANK
12/08/2015	REVISED PER STREAM & WETLAND DELINEATION
02/06/2016	REVISED PER WDEP COMMENTS
02/17/2016	REVISED PLAN TO SHOW EXISTING DWELLING



THIS DOCUMENT WAS PREPARED FOR:  
ANTERO RESOURCES CORPORATION

**CONSTRUCTION DETAILS**

**ADDIE**

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



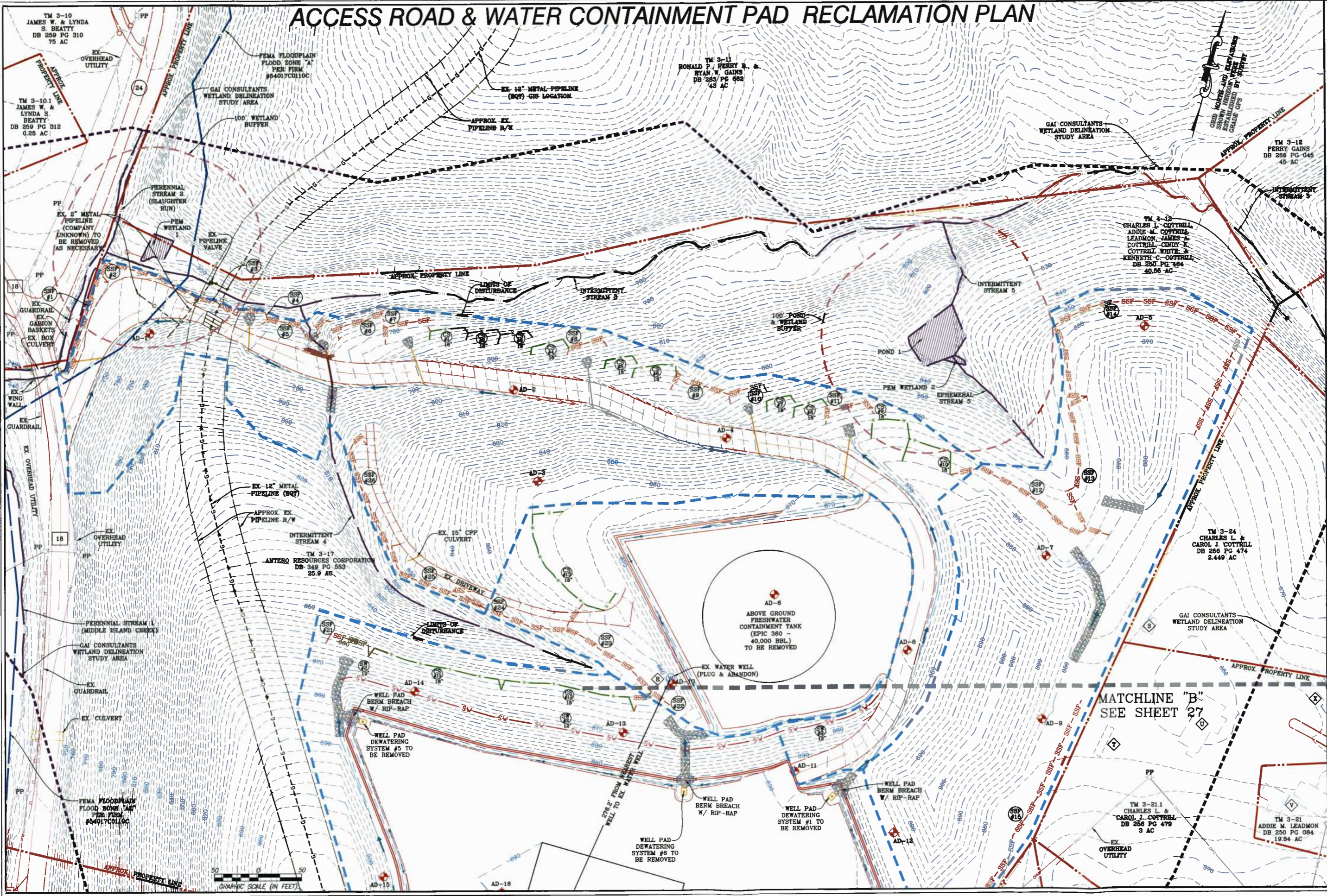
DATE: 04/13/2015

SCALE: N/A

SHEET 24 OF 28



# ACCESS ROAD & WATER CONTAINMENT PAD RECLAMATION PLAN



**NAVITUS**  
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DATE	REVISION
10/28/2015	REVISED WATER CONTAINMENT TANK
12/09/2015	REVISED PER STREAM & WETLAND DELINEATION
02/09/2016	REVISED PER WDEP COMMENTS
02/17/2016	REVISED PLAN TO SHOW EXISTING DWELLING

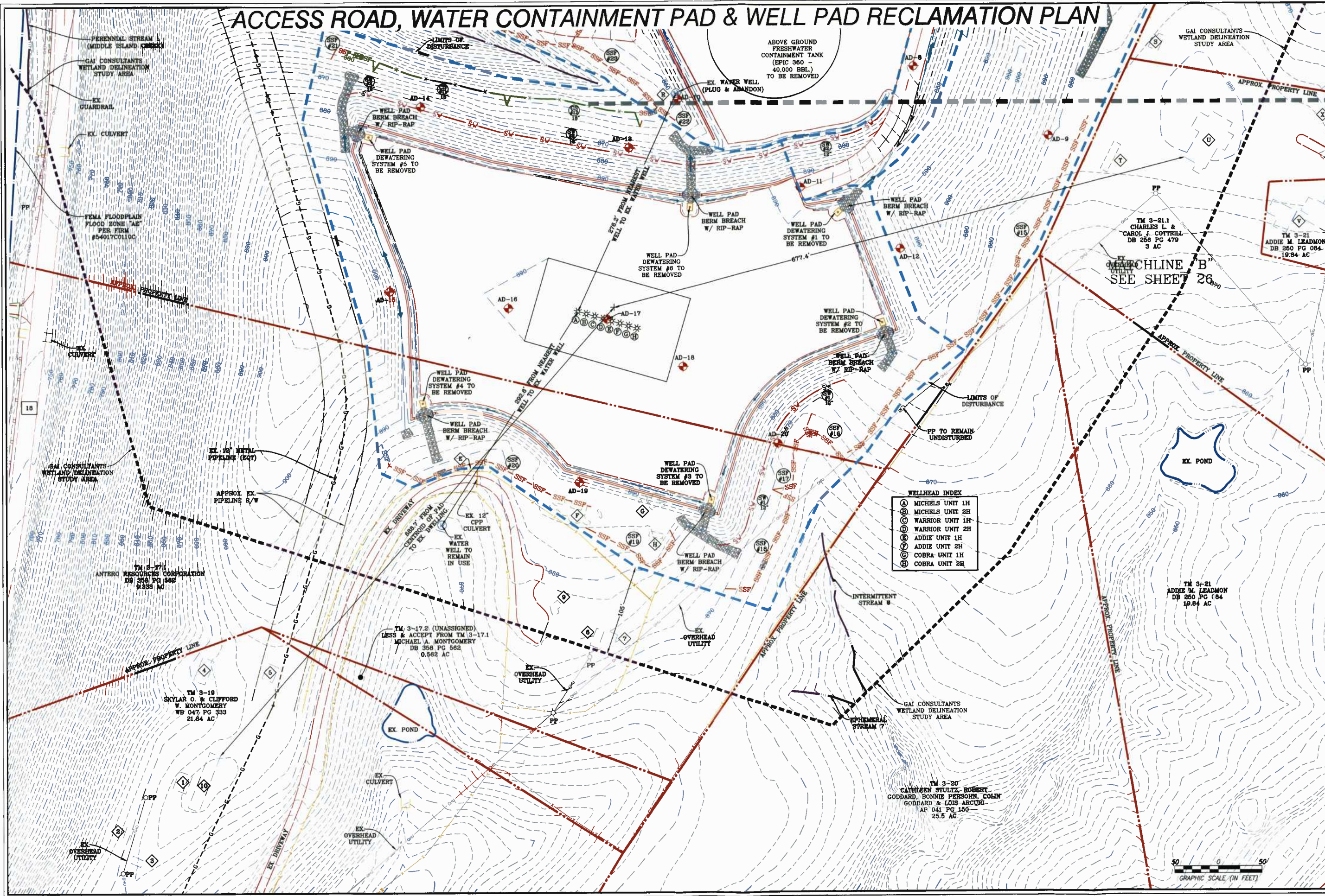
**Antero**  
THIS DOCUMENT WAS PREPARED FOR:  
ANTERO RESOURCES CORPORATION

ACCESS ROAD & WATER CONTAINMENT PAD RECLAMATION PLAN  
**ADDIE**  
WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 04/13/2015  
SCALE: 1" = 50'  
SHEET 26 OF 28

# ACCESS ROAD, WATER CONTAINMENT PAD & WELL PAD RECLAMATION PLAN



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02/09/2016	REVISED PER WDEP COMMENTS
02/17/2016	REVISED PLAN TO SHOW EXISTING DWELLING

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

ACCESS ROAD, WATER CONTAINMENT PAD & WELL PAD RECLAMATION PLAN  
**ADDIE**  
WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 04/13/2016  
SCALE: 1" = 50'  
SHEET 27 OF 28

- WELLHEAD INDEX**
- (A) MICHELS UNIT 1H
  - (B) MICHELS UNIT 2H
  - (C) WARRIOR UNIT 1H
  - (D) WARRIOR UNIT 2H
  - (E) ADDIE UNIT 1H
  - (F) ADDIE UNIT 2H
  - (G) COBRA UNIT 1H
  - (H) COBRA UNIT 2H



# FIRM EXHIBIT



## LANDOWNER TABULATION

<b>A</b>	TM 3-10 JAMES. W. & LINDA S. BEATTY DB 259 PG 310 75 ACRES PO BOX 295 WEST UNION, WV 26456	<b>D</b>	TM 3-18.2 DAVID J. & DEBRA S. SMITH DB 232 PG 135 6 ACRES HC 69 BOX 39A WEST UNION, WV 26456	<b>G</b>	TM 3-19 SKYLAR O. & CLIFFORD W. MONTGOMERY WB 047 PG 333 21.64 ACRES 1607 RAYON DRIVE PARKERSBURG, WV 26101	<b>J</b>	TM 3-11 RONALD P., PERRY B., & RYAN W. GAINS DB 283 PG 682 43 ACRES PO BOX 2512 CLARKSBURG, WV 26302	<b>M</b>	TM 3-24 CHARLES L. & CAROL J. COTTRILL DB 256 PG 474 2.449 ACRES 3839 SMITHTON ROAD WEST UNION, WV 26456	<b>P</b>	TM 3-20 CATHLEEN SHULTZ 1106 GOLF COURSE DRIVE SEARCY, AR 72143 ROBERT GODDARD 507 PETERSON COURT INVERNESS, FL 34450 BONNIE PERSOHN 1214 MICK ROAD WELLSVILLE, OH 43968 COLIN GODDARD 48560 SPRUCE COURT EAST LIVERPOOL, OH 43920 LOIS ARCURI 9142 CHATHAM CIRCLE NORTH RIDGEVILLE, OH 44039 AP 041 PG 150 25.5 ACRES	<b>Q</b>	TM 4-22 GARY M. & MARY ANN EIFF DB 302 PG 640 39.49 ACRES 12954 SOUNDINGS ROAD LUSBY, MD 20657
<b>B</b>	TM 3-10.1 JAMES. W. & LINDA S. BEATTY DB 259 PG 310 .25 ACRES PO BOX 295 WEST UNION, WV 26456	<b>E</b>	TM 3-18 THOMAS K. JR. & PENEY A. PORTER DB 228 PG 723 6.84 ACRES 457 CEDAR LANE WEST UNION, WV 26456	<b>H</b>	TM 3-17.1 ANTERO RESOURCES CORPORATION DB 358 PG 562 9.3 ACRES 535 WHITE OAKS BLVD. BRIDGEPORT, WV 26330	<b>K</b>	TM 3-12 PERRY GAINS DB 266 PG 045 45 ACRES PO BOX 2512 CLARKSBURG, WV 26302	<b>N</b>	TM 3-21.1 CHARLES L. & CAROL J. COTTRILL DB 256 PG 479 3 ACRES 3839 SMITHTON ROAD WEST UNION, WV 26456	<b>O</b>	TM 3-21 ADDIE M. LEADMON DB 250 PG 084 19.84 ACRES ROUTE 3 BOX 341 ELIZABETH, WV 26143	<b>R</b>	TM 3-17.2 (UNASSIGNED) LESS & ACCEPT FROM TM 3-17.1 MICHAEL A. MONTGOMERY DB 358 PG 562 0.562 ACRES 404 GABRIELS WAY WEST UNION, WV 26456
<b>C</b>	TM 3-16 DORIS F. WISEMAN AP 040 PG 512 26 ACRES 1 FIRST AMERICAN WAY WESTLAKE, TX 76262	<b>F</b>	TM 3-18.3 THOMAS K. JR. & PENEY A. PORTER DB 199 PG 700 126.376 ACRES 457 CEDAR LANE WEST UNION, WV 26456	<b>I</b>	TM 3-17 ANTERO RESOURCES CORPORATION DB 349 PG 553 25.9 ACRES 535 WHITE OAKS BLVD. BRIDGEPORT, WV 26330	<b>L</b>	TM 4-12 CHARLES L. COTTRILL, ADDIE M. COTTRILL LEADMON, JAMES A. COTTRILL, CINDY K. COTTRILL WHITE, & KENNETH C. COTTRILL DB 250 PG 464 40.55 ACRES ROUTE 3 BOX 341 ELIZABETH, WV 26143						

**PANEL 0110C**

**FIRM**

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

**PANEL 110 OF 325**  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

**CONTAINS:**

COMMUNITY	NUMBER	PANEL	SUFFIX
DODDRIDGE COUNTY	540224	0110	C

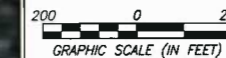
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

**MAP NUMBER**  
**54017C0110C**

**MAP REVISED**  
**OCTOBER 4, 2011**

Federal Emergency Management Agency

**FLOODPLAIN NOTES:**  
THE PROPOSED SITE IS LOCATED IN  
FLOOD ZONES "A" & "X" PER FEMA  
FLOOD MAP #54017C0110C



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ENERGY ENGINEERING

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DATE	REVISION
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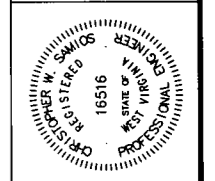
**Antero**

THIS DOCUMENT  
WAS PREPARED FOR:  
ANTERO RESOURCES  
CORPORATION

FIRM EXHIBIT  
**ADDIE**  
WELL PAD & WATER CONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WEST VIRGINIA



DATE: 04/13/2015  
SCALE: 1" = 200'  
SHEET 28 OF 28



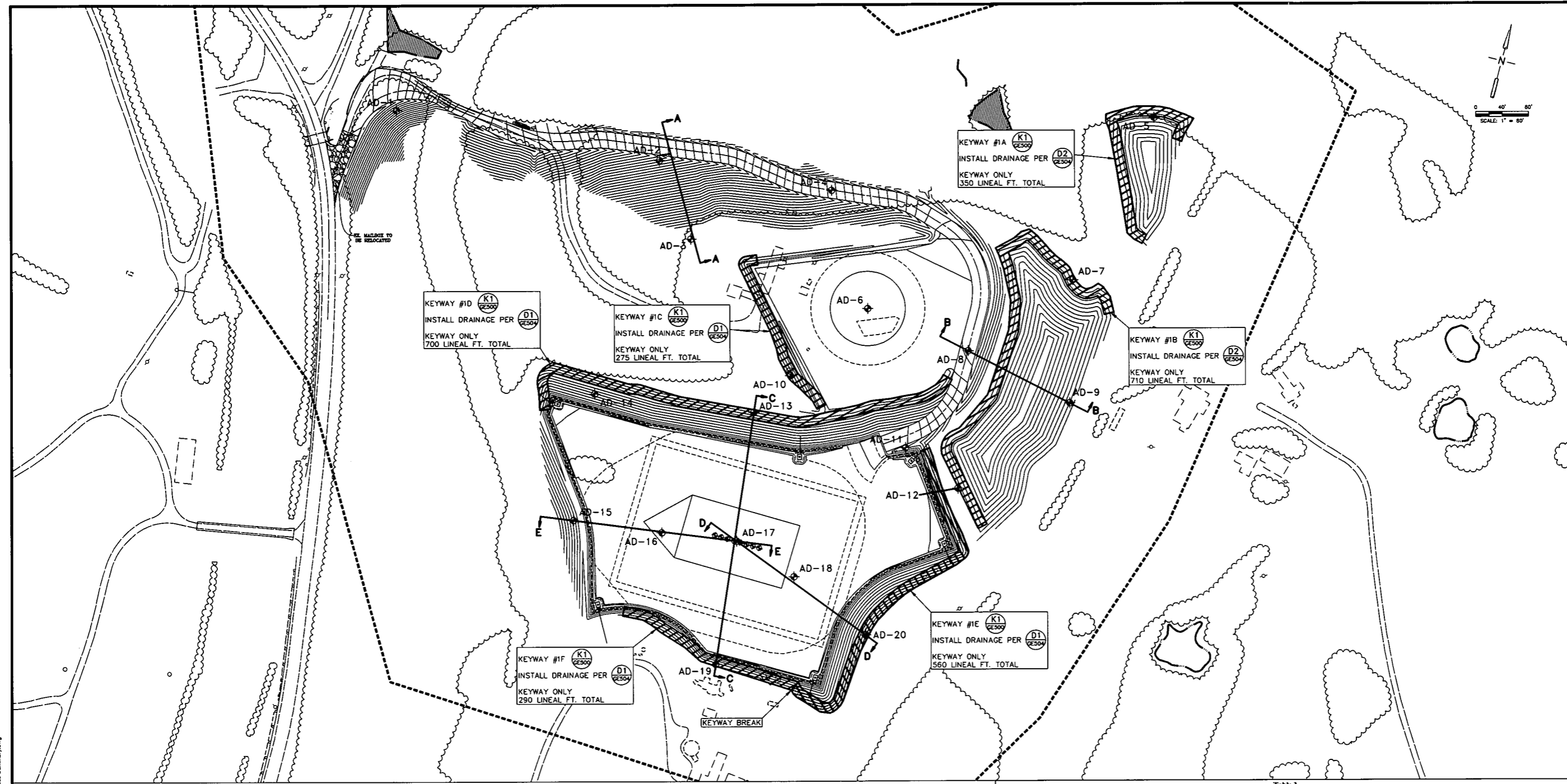
REVISION RECORD	
No.	Date

ADDIE WELL AND TANK SITES  
 WEST UNION DISTRICT,  
 DODDRIDGE COUNTY, WEST VIRGINIA

PREPARED FOR:  
**NAVITUS ENERGY ENGINEERING**  
 151 WINDY HILL LANE  
 WINCHESTER, VIRGINIA 22602

GEOTECHNICAL  
 SUBSURFACE  
 SUMMARY

Project Number: 15-095  
 Drawing Scale: AS NOTED  
 Date Issued: 04/10/15  
 Issue Number:  
 Drawn By: EAH  
 Checked By: CWS  
 Project Manager: CWS



PLAN AND LOCATION OF BORINGS  
 SCALE: 1" = 80'

Table 2  
 Summary of Laboratory Test Data - Addie Well Pad and Water Containment Pad Site  
 West Union District, Doddridge County, West Virginia

Boring No.	Sample No.	Visual Classification	Atterberg Limits			Standard Proctor Information			Notes					
			LL	PL	PI	Sym	In-Situ W.C. %	Max Density		Sp. W.C. %				
AD-6	S-1	Brown CLAY	41	23	20	CL	19.0	107.8	17.5	Phi = 23.5 degrees, Cohesion c = 259 pcf				
AD-14	S-1.5	Red-Brown Fat CLAY	57	28	29	CH	49	25	24	CL	20.7	105.9	19.1	Phi = 24.1 degrees, Cohesion c = 259 pcf
AD-15	S-2	Brown CLAY with Decomposed Claystone	49	25	24	CL	20.7	105.9	19.1					
AD-16	S-2	Red-Brown Fat CLAY	53	27	25	CH								

\*In-situ water content from auger cuttings, which may include both overburden soil and the underlying decomposed rock, are generally lower than actual subsurface conditions. The actual in-situ water content of the upper level overburden soils can be anticipated to be considerably higher and will likely require moisture conditioning (i.e. drying)

Table 3  
 Estimated Excavation Quantities - Addie Well & Water Containment Site  
 West Union District, Doddridge County, West Virginia

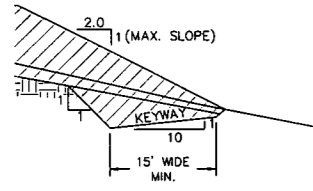
Location	Estimated Keyway Lengths / Depths	Estimated Keyway Volumes	Notes
Keyway #1A	350 ft x 5 ft avg depth	1,750 cubic yards	min. 15 ft wide founded entirely on decomposed rock
Keyway #1B	710 ft x 5 ft avg depth	3,550 cubic yards	min. 15 ft wide founded on stiff residual soil and/or dec. rock
Keyway #1C	275 ft x 6 ft avg depth	1,550 cubic yards	min. 15 ft wide founded entirely on decomposed rock
Keyway #1D	700 ft x 4-7 ft depth	3,900 cubic yards	min. 15 ft wide founded entirely on decomposed rock
Keyway #1E	560 ft x 6 ft avg depth	3,100 cubic yards	min. 15 ft wide founded entirely on decomposed rock
Keyway #1F	290 ft x 6 ft avg depth	1,600 cubic yards	min. 15 ft wide founded entirely on decomposed rock
<b>Totals</b>	<b>Keyway 2,885 ft</b>	<b>Keyway Volume 15,450 cubic yards</b>	

\*The quantities listed above should be considered estimates based on the available data and interpolations between test borings. Final excavation quantities are subject to change based on actual encountered conditions.  
 \*\*The keyway depths listed above are estimated at the front (downslope) edge of the keyway.

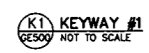
Table 1  
 Summary of Drilling Data - Addie Well Pad and Water Containment Pad Site  
 West Union District, Doddridge County, West Virginia

Boring No.	Approximate Surface Elevation (ft)	Total Drill Depth (ft)	Topsoil Thickness (ft)*	Overburden Soils			Decomposed Rock		Bedrock		ROD Range %	Water Levels (ft) 8-hr / 24-hr	Notes
				Thickness (ft)	Avg. Soil N-value	Top of Decomp. Rock Elevation	Thickness (ft)	Top of Bedrock Elevation	Depth to Bedrock (ft)				
AD-1	762	9.6	0.3	6.0	8	756.0	3.6	752.4	9.6			Dry / BF	
AD-2	823	6.4	0.2	6.0	8	817.0	0.4	816.6	6.4			Dry / BF	
AD-3	860	5.3	0.3	3.0	2	857.0	1.3	854.7	4.3			Dry / BF	
AD-4	850	9.2	0.2	3.1	5	846.9	6.1	840.8	9.2			Dry / BF	
AD-5	863	9.4	0.4	4.0	5	859.0	5.4	853.6	9.4			Dry / BF	
AD-6	875	25.7	0.5	6.5	10	868.5	6.2	862.3	12.7	57 - 86		22.9 / BF	bulk sample S-1 taken
AD-7	869	12.2	0.7	6.0	8	863.0	6.2	856.8	12.2			Dry / BF	
AD-8	880	18.0	0.8	12.0	7	868.0	> 6.0	N/A	N/A			Dry / 14.3'	
AD-9	880	14.9	0.8	12.0	8	868.0	2.9	865.1	14.9			Dry / BF	
AD-10	860	6.2	0.5	6.0	9	854.0	0.2	853.8	6.2			Dry / BF	
AD-11	879	15.0	0.4	14.5	14	864.5	> 0.5	N/A	N/A			Dry / BF	
AD-12	882	16.5	0.3	15.0	9	867.0	> 1.5	N/A	N/A			Dry / BF	
AD-13	868	8.8	0.4	3.3	15	864.7	3.5	859.2	8.8			Dry / BF	
AD-14	875	9.8	0.5	6.7	6	868.3	3.1	865.2	9.8			Dry / BF	
AD-15	906	14.9	0.4	6.7	7	899.3	6.6	892.7	13.3			Dry / BF	bulk sample S-2 taken
AD-16	898	15.0	0.5	4.0	3	894.0	> 11.0	N/A	N/A			Dry / BF	
AD-17	896	25.0	0.4	6.4	14	889.6	12.7	876.9	19.1	21 - 77		3.0 / 6.8	
AD-18	890	14.7	0.8	4.0	8	886.0	10.7	875.3	14.7			Dry / BF	
AD-19	890	13.4	*	6.0	8	884.0	7.4	876.6	13.4			Dry / BF	
AD-20	864	13.7	0.8	6.0	8	861.0	1.0	862.0	7.0			Dry / BF	

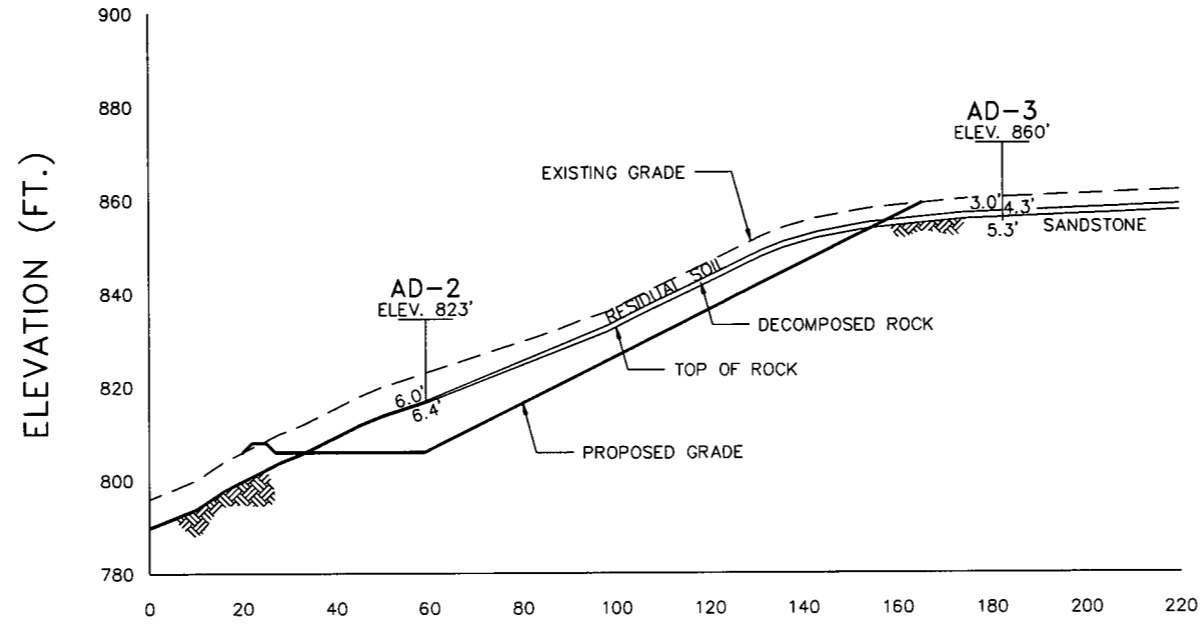
\* some locations had no significant topsoil thickness below the vegetation/leaves.



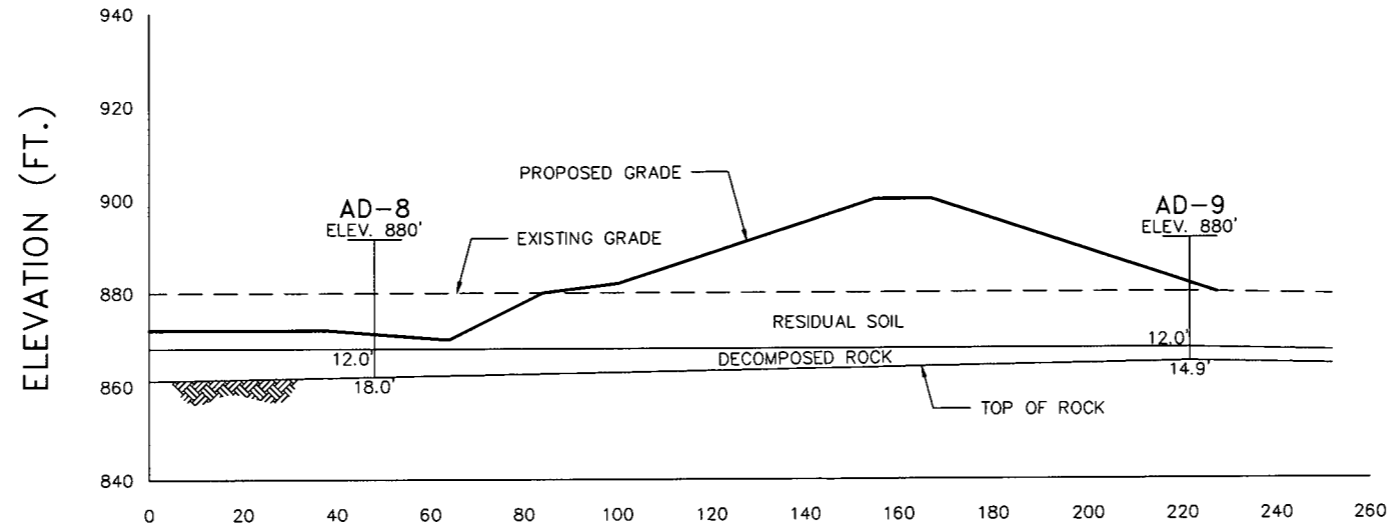
15' WIDE KEYWAY FOUNDED ENTIRELY ON DECOMPOSED ROCK (4' TO 7' DEEP)



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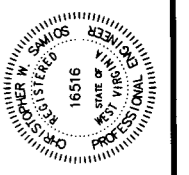
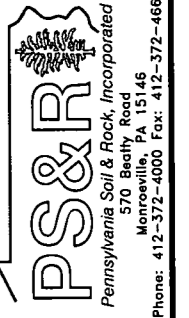


SECTION A-A



SECTION B-B

THE GENERALIZED SOIL PROFILE SHOWN AND DESCRIBED IN THE TEXT IS BASED ON INFORMATION OBTAINED AT THE TEST BORING LOCATIONS AND IS INTENDED TO CONVEY TRENDS IN SUBSURFACE CONDITIONS. THE BOUNDARIES BETWEEN STRATA BOTH HORIZONTALLY AND VERTICALLY ARE APPROXIMATE AND IDEALIZED AND HAVE BEEN DEVELOPED BY INTERPRETATIONS ON THE TEST BORING EXPLORATIONS. ACTUAL SOIL TRANSITIONS BETWEEN TEST BORING LOCATIONS MAY VARY.



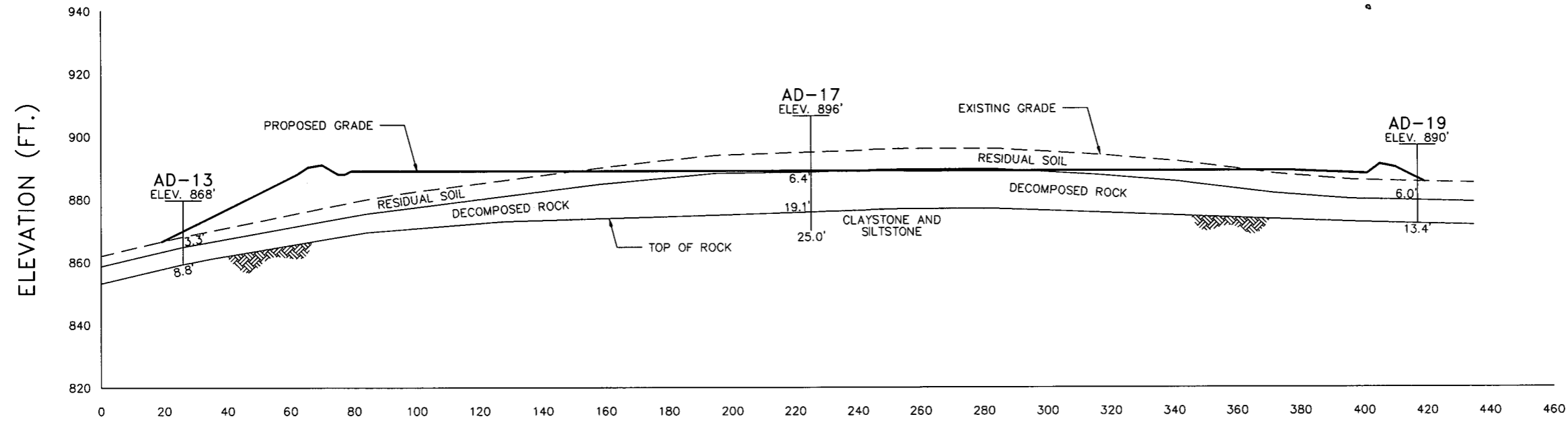
No.	Date	REVISION RECORD

ADDIE WELL AND TANK SITES  
 WEST UNION DISTRICT  
 DODDRIDGE COUNTY, WEST VIRGINIA  
 PREPARED FOR:  
**NAVITUS ENERGY ENGINEERING**  
 151 WINDY HILL LANE  
 WINCHESTER, VIRGINIA 22602

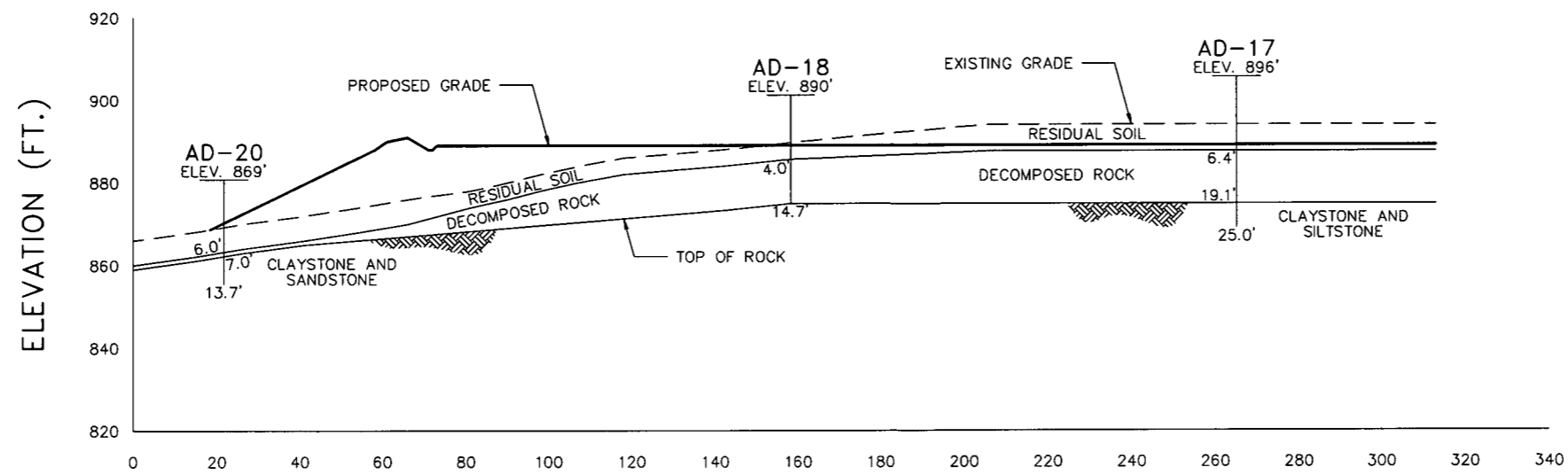
CROSS SECTIONS

Project Number: 15-095  
 Drawing Scale: 1" = 20'  
 Date Issued: 04/10/16  
 Index Number:  
 Drawn By: EAH  
 Checked By: CWS  
 Project Manager: CWS

GE501



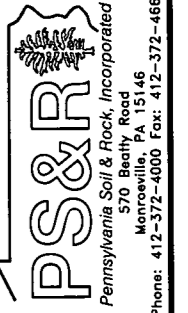
SECTION C-C



SECTION D-D

THE GENERALIZED SOIL PROFILE SHOWN AND DESCRIBED IN THE TEXT IS BASED ON INFORMATION OBTAINED AT THE TEST BORING LOCATIONS AND IS INTENDED TO CONVEY TRENDS IN SUBSURFACE CONDITIONS. THE BOUNDARIES BETWEEN STRATA BOTH HORIZONTALLY AND VERTICALLY ARE APPROXIMATE AND IDEALIZED AND HAVE BEEN DEVELOPED BY INTERPRETATIONS ON THE TEST BORING EXPLORATIONS. ACTUAL SOIL TRANSITIONS BETWEEN TEST BORING LOCATIONS MAY VARY.

P:\ah & Filtration\15-095\Drawings\GE502 - Cross Sections.dwg  
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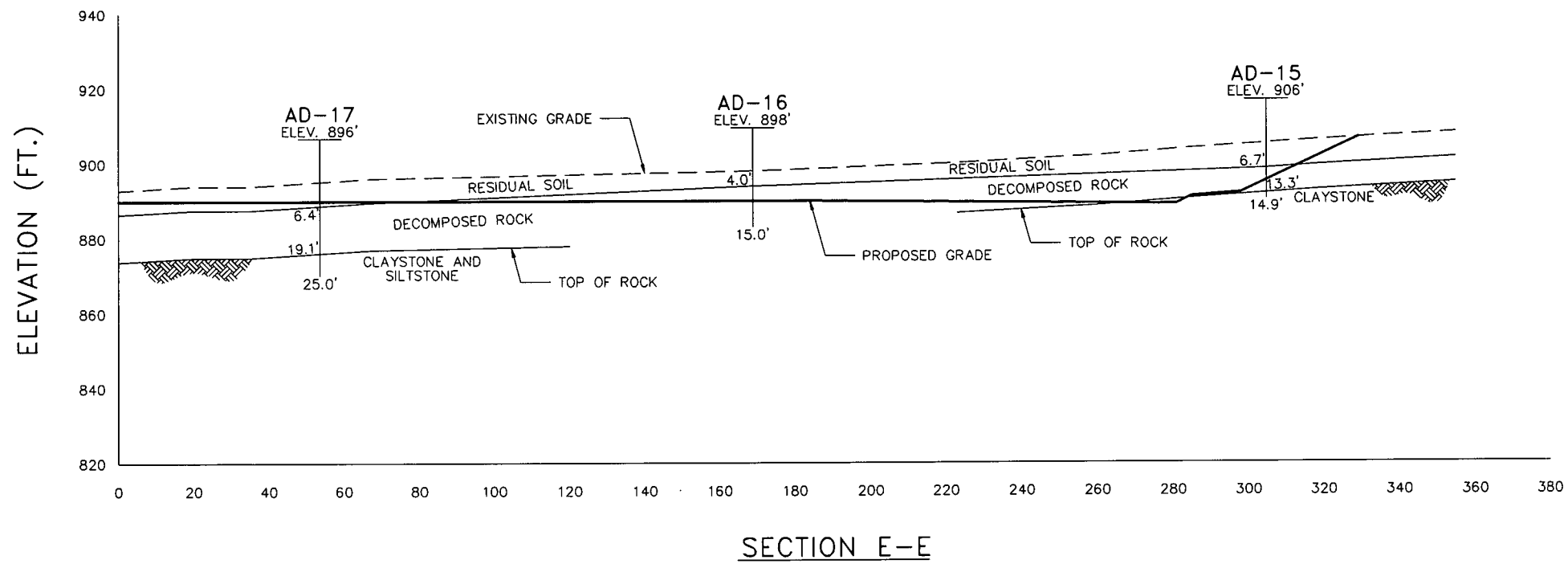
REVISION RECORD
No
Date

ADDIE WELL AND TANK SITES  
 WEST UNION DISTRICT  
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 PREPARED FOR:  
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 151 WINDY HILL LANE  
 WINCHESTER, VIRGINIA 22602

CROSS SECTIONS  
 Project Number: 15-095  
 Drawing Scale: 1" = 20'  
 Date Issued: 02/10/15  
 Index Number:  
 Drawn By: EAH  
 Checked By: CWS  
 Project Manager: CWS  
**GE502**

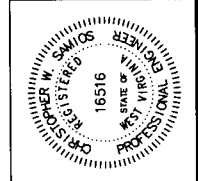


Path & Filename: \\P:\projects\15-095 Addie Well Site (Antico)GE503 - Cross Sections.dwg  
 P:\1 Date: 4/10/15 10:37 AM PSR



THE GENERALIZED SOIL PROFILE SHOWN AND DESCRIBED IN THE TEXT IS BASED ON INFORMATION OBTAINED AT THE TEST BORING LOCATIONS AND IS INTENDED TO CONVEY TRENDS IN SUBSURFACE CONDITIONS. THE BOUNDARIES BETWEEN STRATA BOTH HORIZONTALLY AND VERTICALLY ARE APPROXIMATE AND IDEALIZED AND HAVE BEEN DEVELOPED BY INTERPRETATIONS ON THE TEST BORING EXPLORATIONS. ACTUAL SOIL TRANSITIONS BETWEEN TEST BORING LOCATIONS MAY VARY.

**PS&R**  
 Pennsylvania Soil & Rock, Incorporated  
 570 Beatty Road  
 Monroeville, PA 15146  
 Phone: 412-372-4000 Fax: 412-372-4664



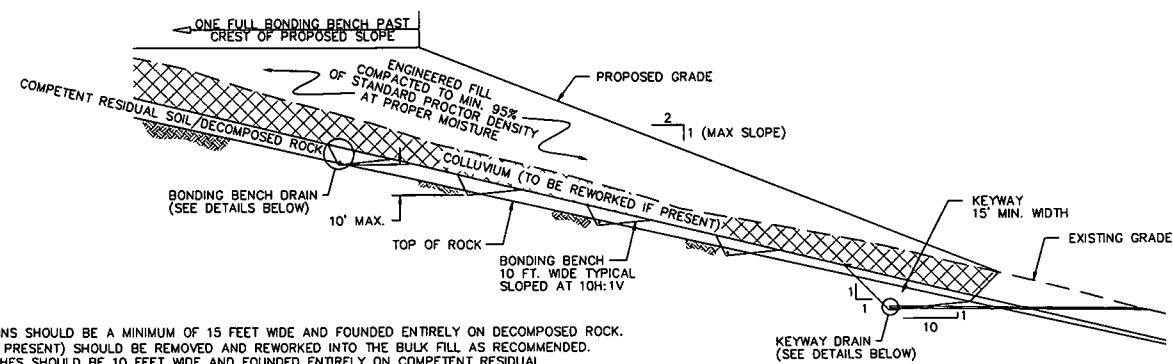
REVISION RECORD	
No.	Date

**ADDIE WELL AND TANK SITES**  
 WEST UNION DISTRICT  
 DODDRIEGE COUNTY, WEST VIRGINIA  
 PREPARED FOR:  
**NAVITUS ENERGY ENGINEERING**  
 151 WINDY HILL LANE  
 WINCHESTER, VIRGINIA 22602

**CROSS SECTIONS**

Project Number: 15-095  
 Drawing Scale: 1" = 20'  
 Date Issued: 04/10/15  
 Index Number:  
 Drawn By: EAH  
 Checked By: CWS  
 Project Manager: CWS

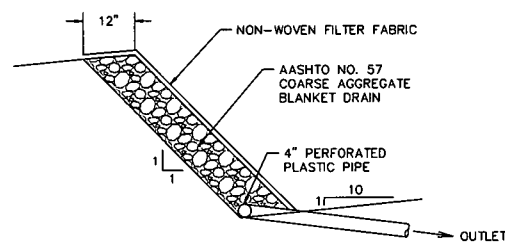
**GE503**



**NOTES:**

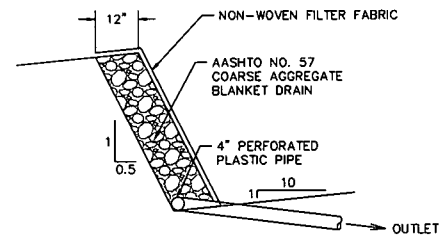
1. KEYWAY EXCAVATIONS SHOULD BE A MINIMUM OF 15 FEET WIDE AND FOUNDED ENTIRELY ON DECOMPOSED ROCK.
2. ALL COLLUVIUM (IF PRESENT) SHOULD BE REMOVED AND REWORKED INTO THE BULK FILL AS RECOMMENDED.
3. ALL BONDING BENCHES SHOULD BE 10 FEET WIDE AND FOUNDED ENTIRELY ON COMPETENT RESIDUAL SOIL/DECOMPOSED ROCK.
4. WHERE SAFETY CONCERNS PROHIBIT INSTALLATION OF KEYWAY OR BONDING BENCH DRAINS AS SHOWN, SUBSTITUTE ALTERNATE DRAIN DETAIL.

**D1 TYPICAL WELL AND TANK PAD KEYWAY, BENCH, AND DRAINAGE DETAIL**  
GE504 NOT TO SCALE



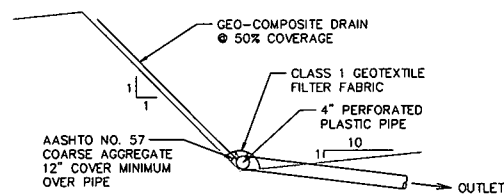
- \*OUTLETS AT 100 FT. CENTERS MAX. OR AS DEEMED NECESSARY
- \*ALL OUTLET DRAINS TO BE COVERED WITH 12" MINIMUM NO. 57 AGGREGATE AND WRAPPED IN NON-WOVEN FILTER FABRIC

**KEYWAY DRAIN DETAIL - AGGREGATE**  
NOT TO SCALE



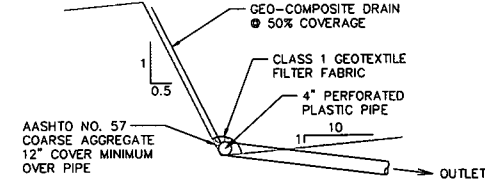
- \*SLOPE OUTLET TO PROVIDE POSITIVE DRAINAGE TO SLOPE FACE
- \*OUTLETS AT 250 FT. CENTERS MAX. OR AS DEEMED NECESSARY
- \*ALL OUTLET DRAINS TO BE COVERED WITH 12" MINIMUM NO. 57 AGGREGATE AND WRAPPED IN NON-WOVEN FILTER FABRIC

**BONDING BENCH DRAIN DETAIL - AGGREGATE**  
NOT TO SCALE



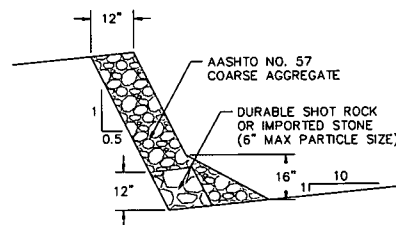
- \*OUTLETS AT 100 FT. CENTERS MAX. OR AS DEEMED NECESSARY
- \*ALL OUTLET DRAINS TO BE COVERED WITH 12" MINIMUM NO. 57 AGGREGATE AND WRAPPED IN NON-WOVEN FILTER FABRIC
- \*GEO-COMPOSITE DRAIN TO CONSIST OF HANES GEO COMPONENTS TERRADRAIN 104/2, MIRAFI G200N, OR EQUIVALENT.

**KEYWAY DRAIN DETAIL - GEO-COMPOSITE**  
NOT TO SCALE

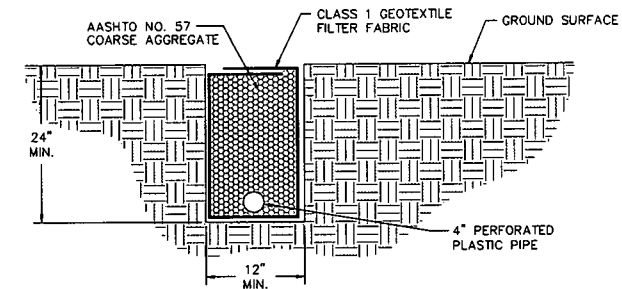


- \*SLOPE OUTLET TO PROVIDE POSITIVE DRAINAGE TO SLOPE FACE
- \*OUTLETS AT 250 FT. CENTERS MAX. OR AS DEEMED NECESSARY
- \*ALL OUTLET DRAINS TO BE COVERED WITH 12" MINIMUM NO. 57 AGGREGATE AND WRAPPED IN NON-WOVEN FILTER FABRIC
- \*GEO-COMPOSITE DRAIN TO CONSIST OF HANES GEO COMPONENTS TERRADRAIN 104/2, MIRAFI G200N, OR EQUIVALENT.

**BONDING BENCH DRAIN DETAIL - GEO-COMPOSITE**  
NOT TO SCALE



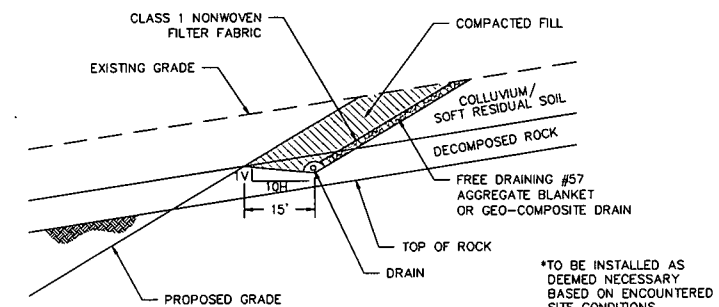
**ALTERNATE KEYWAY/BONDING BENCH DRAIN DETAIL**  
NOT TO SCALE



**NOTE:**

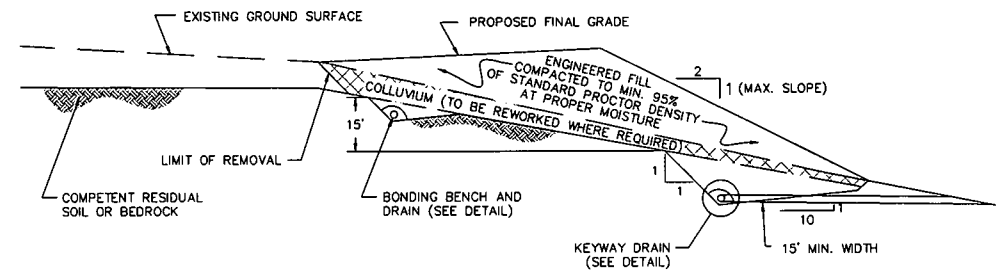
- 1) 4" PERFORATED PLASTIC PIPE EXTENDED TO DRAIN AWAY FROM SLOPE AND WATER DIVERTED OR COLLECTED IF NECESSARY TO PREVENT EMBANKMENT DAMAGE.
- 2) PROVIDE DRAINAGE OUTLETS AT 50-FOOT HORIZONTAL INTERVALS.

**D3 TYPICAL SPRING DRAIN DETAIL**  
GE504 NOT TO SCALE



- \*OUTLET AT ENDS AND AT 250' CENTERS MAX SIMILAR TO KEYWAY DRAIN DETAIL
- \*ALL OUTLET DRAINS TO BE COVERED WITH 12" MINIMUM NO. 57 AGGREGATE AND WRAPPED IN NON-WOVEN FILTER FABRIC

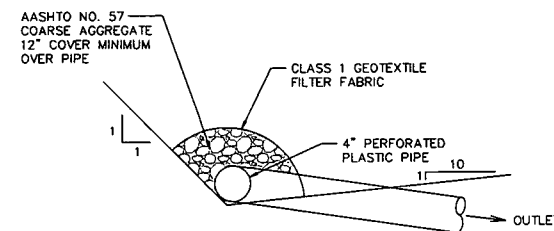
**D4 TYPICAL SLOPE PROTECTION DETAIL**  
GE504 NOT TO SCALE



**NOTES:**

1. KEYWAY EXCAVATIONS SHOULD BE A MINIMUM OF 15 FEET WIDE AND EXTEND THROUGH ALL COLLUVIUM AND/OR RESIDUAL SOIL TO BE FOUNDED ENTIRELY ON DECOMPOSED ROCK.
2. 4" PERFORATED KEYWAY DRAIN SHOULD BE INSTALLED ALONG THE ENTIRE LENGTH OF THE KEYWAY WITH OUTLETS AT 100 FT. CENTERS.
3. A 10' BONDING BENCH AND DRAIN SHOULD BE INSTALLED 15 FEET HIGHER IN ELEVATION ABOVE THE TOP OF THE REAR WALL OF THE KEYWAY EXCAVATION.

**D2 TYPICAL ACCESS DRIVE KEYWAY, BENCH, AND DRAINAGE DETAIL**  
GE504 NOT TO SCALE

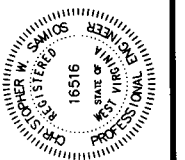


- \*OUTLETS AT 100 FT. CENTERS MAX FOR KEYWAY
- \*OUTLETS AT 250 FT. CENTERS MAX. FOR BONDING BENCH
- \*ALL OUTLET DRAINS TO BE COVERED WITH 12" MINIMUM NO. 57 AGGREGATE AND WRAPPED IN NON-WOVEN FILTER FABRIC

**KEYWAY DRAIN DETAIL**  
NOT TO SCALE

**GENERAL SITE EARTHWORK RECOMMENDATIONS**

1. ALL FILL AREAS SHOULD BE CLEARED OF TREES, STUMPS, AND VEGETATION AND STRIPPED OF TOPSOIL/ORGANIC SOILS PRIOR TO THE START OF FILL PLACEMENT.
2. THE DISTRIBUTION AND GRADATION OF FILL MATERIALS SHALL BE SUCH THAT THE FILL WILL BE FREE OF LENSES, POCKETS, OR LAYERS OF MATERIALS DIFFERING SUBSTANTIALLY IN GRADATION FROM THE SURROUNDING MATERIALS WITHIN THE DESIGNATED FILL AREAS.
3. FILL SHALL BE PLACED AND SPREAD IN SUCCESSIVE AND APPROXIMATE HORIZONTAL LAYERS OF UNIFORM THICKNESS BASED ON THE NOMINAL PARTICLE SIZE OF MATERIAL AND THE SIZE AND TYPE OF THE AVAILABLE COMPACTION EQUIPMENT. IN GENERAL, SOIL SHOULD BE PLACED IN NOMINAL 12 INCH MAXIMUM LOOSE LIFTS. LARGER ROCK INCORPORATED INTO THE FILL SHOULD TYPICAL BE LIMITED TO 12 INCHES THICK X 3 FEET X 3 FEET, WITH ALL VOID SPACE CHOKED WITH SMALLER PARTICLE SIZE MATERIAL.
4. ADEQUATE COMPACTION EFFORT IS APPLIED BY UTILIZING THE PROPER COMPACTION EQUIPMENT FOR THE COMPOSITION OF THE FILL MATERIALS BEING PLACED. SEGMENTED, SHEEPSFOOT, AND/OR PADFOOT ROLLERS SHOULD BE USED WHEN PLACING PREDOMINATELY CLAYEY (COHESIVE) FILL MATERIALS. THESE TYPES OF ROLLERS ARE ALSO EFFECTIVE ON CLAYEY SHALES, CLAYSTONE, AND SOFTER SANDSTONE TO BREAK DOWN THE ROCK PARTICLES. SMOOTH DRUM VIBRATORY ROLLERS SHOULD BE UTILIZED ON PREDOMINATELY GRANULAR FILL MATERIALS AND TO SEAL CLAYEY SOILS TO HELP PREVENT SURFACE WATER INFILTRATION AND/OR TO PROMOTE DRAINAGE.
5. ALL FILL MATERIALS SHALL BE COMPACTIONED BY A SUFFICIENT NUMBER OF COMPLETE TRIPS (I.E. PASSES) OF THE APPROPRIATE COMPACTION EQUIPMENT TO ATTAIN A MINIMUM OF 95% OF THE MAXIMUM DRY DENSITY AS DETERMINED IN ACCORDANCE WITH ASTM TEST DESIGNATION D698 (STANDARD PROCTOR). MAINTAIN THE MOISTURE CONTENT OF THE FILL MATERIALS AS NECESSARY TO ATTAIN THE DESIRED COMPACTION DENSITY.
6. UNDISTURBED AND/OR FILL MATERIALS PLACED WITHIN THE UPPER 12 INCHES OF FINAL GRADE SHOULD BE COMPACTIONED TO ATTAIN A MINIMUM OF 100% OF THE MAXIMUM DRY DENSITY AS DETERMINED IN ACCORDANCE WITH ASTM TEST DESIGNATION D698 (STANDARD PROCTOR) AT AN IN-PLACE MOISTURE WITHIN 3% OF THE MATERIAL'S OPTIMUM MOISTURE CONTENT. THE ENTIRE SUBGRADE SURFACE SHOULD BE THOROUGHLY SEALED USING A VIBRATORY SMOOTH DRUM ROLLER.
7. TO VERIFY THE SPECIFIED DEGREE OF COMPACTION AND TO DETERMINE THE IN-PLACE MOISTURE CONTENT AS STATED ABOVE, IN-PLACE FIELD DENSITY TESTS SHOULD BE PERFORMED IN ACCORDANCE TO THE PROCEDURES OF ASTM D2922 (NUCLEAR DENSOMETER).
8. IN ADDITION TO IN-PLACE FIELD DENSITY TESTING, ACCEPTANCE SHOULD ALSO BE PREDICATED ON A VISUAL PERFORMANCE CRITERIA. OBVIOUS SURFACE RUTTING AND/OR DEFLECTION THAT ARE JUDGED TO BE DETRIMENTAL TO THE OVERALL STABILITY OF THE FILL AREA SHOULD BE REMOVED, MOISTURE CONDITIONED AND RECOMPACTION, OR OTHERWISE ADDRESSED PRIOR TO ACCEPTING THE LIFT.
9. WHERE PREDOMINATELY "ROCKY" FILL MATERIALS ARE PLACED OR WHERE REPRESENTATIVE NUCLEAR DENSOMETER TESTS CANNOT BE OBTAINED, A VISUAL NON-DEFLECTION CRITERIA SHOULD BE DEVELOPED IN CONJUNCTION WITH AN ADEQUATE NUMBER OF ROLLER PASSES FOR ACCEPTANCE.



REVISION RECORD

No.

Date

ADDIE WELL AND TANK SITES  
 WEST UNION DISTRICT  
 DODDRIIDGE COUNTY, WEST VIRGINIA

PREPARED FOR:  
**NAVITUS ENERGY ENGINEERING**  
 151 WINDY HILL LANE  
 WINCHESTER, VIRGINIA 22602

TYPICAL KEYWAY, BENCH, AND DRAINAGE DETAILS

Project Number: 15-095  
 Drawing Scale: AS NOTED  
 Date Issued: 04/10/15  
 Index Number:  
 Drawn By: EAH  
 Checked By: CWS  
 Project Manager: CWS

**GE504**

# NAVITUS

ENERGY ENGINEERING

151 Windy Hill Lane, Winchester, VA 22602

December 8, 2015

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

Attn: Edwin "Bo" Wriston, Doddridge County Floodplain Administrator

Re: Addie Well Pad and Water Containment Pad - Floodplain Analysis

Dear Mr. Wriston:

Navitus Engineering has completed a floodplain analysis for the access road entrance to the proposed Addie Well Pad and Water Containment Pad site along WV Route 18 and Middle Island Creek, west of Crystal Lake, in Doddridge County, West Virginia. The entrance to the proposed site is located within FEMA Flood Zone "A" as shown on the Flood Insurance Rate Maps (FIRM) from the National Flood Insurance Program (NFIP), Map Number 54017C0110C dated October 4, 2011 however, based upon the analysis detailed in the attached report the entrance is actually mapped within Flood Zone "AE". Base flood elevations for this area of Middle Island Creek have been established, and detailed information for Middle Island Creek can be found within the Flood Insurance Study for Doddridge County, dated October 4, 2011.

In order to establish base flood elevations for this site, a hydrologic and hydraulic analysis was performed as outlined in the current Doddridge County Floodplain Ordinance, enacted May 21<sup>st</sup>, 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 Middle Island Creek drainage shed. Upon establishing the peak flow drainage calculations for the 100-year storm event, a HEC-RAS river analysis was conducted for a section of Middle Island Creek and Slaughter Run adjacent to the Addie Well Pad and Water Containment Pad Site and Base Flood Elevations (BFE) were established. The resulting BFEs were used to establish adjusted floodplain boundaries for the segment of Middle Island Creek being studied. These boundaries are shown on the attached Existing Conditions Plan. In addition to establishing BFEs, a proposed conditions analysis was performed to determine the impacts of proposed grading from the access road to the Addie Well Pad and Water Containment Pad Site. The proposed grading was added into the cross sections of the respective models and the manning's "n" values were adjusted where necessary. The models were run with these changes to determine the proposed impacts to the floodplain.

The results of this analysis indicate that the proposed improvements will not cause an increase in the BFEs along Middle Island Creek or Slaughter Run and no upstream or downstream properties will be adversely impacted.

Attached are the following documents associated with this submission:

- A Floodplain Analysis of Middle Island Creek and Slaughter Run 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.

Engineering Dedicated to the Development and Transmission of Energy  
**Serving PA-WV-OH-NY**  
Engineering Surveying Environmental GIS  
www.navituseng.com

- The Addie Well Pad and Water Containment Site Plan, prepared by Navitus Engineering, Inc. which includes additional site design and construction specifications.
- Project Cost Estimate
- Doddridge County Improvement Location Permit Application
- Floodplain Permit Application Fee

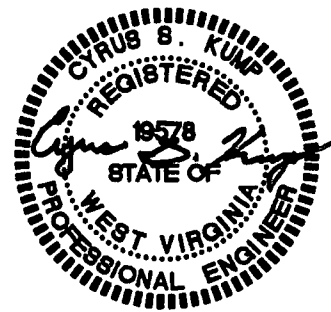
Should any questions or comments arise during the review, please let us know and we will work to address them. Copies of all permits required for this site will be provided by the operator. Please let me know if you should need additional information. You can reach me by phone (540) 336-9486 or email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

Sincerely,  
Navitus Engineering, Inc.

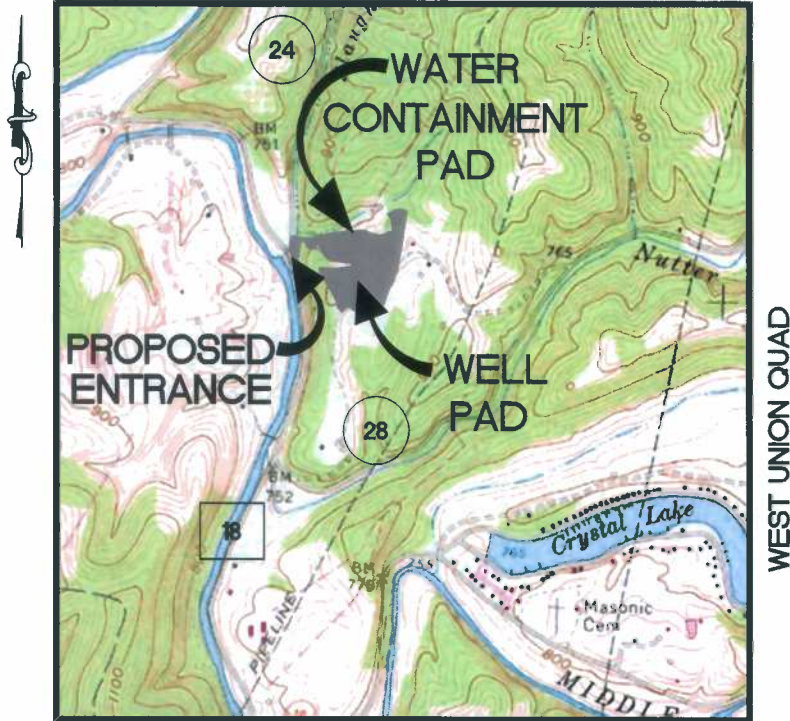
 CFM

Daniel E. Murphy, CFM  
#US-13-07064

Certified Floodplain Manager (CFM®)



FLOODPLAIN ANALYSIS OF  
MIDDLE ISLAND CREEK & SLAUGHTER RUN  
ADDIE WELL PAD &  
WATER CONTAINMENT PAD



VICINITY MAP  
1" = 2,000'

**NAVITUS**  
ENERGY ENGINEERING

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

Prepared For:



535 White Oaks Blvd.  
Bridgeport, WV 26330  
(304) 842-4100

Contacts:

Aaron Kunzler, Project Manager  
(405) 227-8344  
Anthony Smith, Field Engineer  
(304) 673-6196  
Richard Lyles, Land Agent  
(770) 378-6833



Designed By:  
Navitus Engineering Inc.

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

Tax Parcel:  
Map 3 Parcel 17, 17.1

Surface Owner (s)  
Antero Resources Corporation

Location:  
West Union District, Doddridge County  
West Virginia

Date: December 8, 2015

## 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. The proposed condition includes the installation of an access road for a well pad and water containment pad facility within FEMA floodplain.

## 2. Existing Conditions

### 2.1. Property Description

This site is located in Doddridge County, West Virginia along Middle Island Creek, Slaughter Run and West Virginia Route 18, west of Crystal Lake. The proposed access road entrance is located along the east side of WV 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 54017C0110C effective October 4, 2011. This floodplain is located in flood zone designation "A" however, based upon the analysis detailed in this report the entrance to the access road is mapped within Flood Zone "AE".

### 2.3. Floodplain Ordinance

This site is administered under the Doddridge County Floodplain Ordinance, enacted May 31st, 2013.

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. This requirement can be satisfied by utilization of the floodway area where determined.

Per Section 5.1 of this ordinance Permits are required for the construction of the entrance to the well pad and water containment pad facility. The format of the permit will coincide with the requirements set forth in Section 5.2 of the ordinance.

Per Section 6.1E of this ordinance any fill associated with the project shall be only used in manner which does not affect upstream and downstream properties. The access road entrance has been designed with this in mind. The access road will consist primarily of excavation with negligible fill. Impacts to the 100 year are demonstrated later in this report, however, the max increase of the construction within the mapped limits of FEMA Flood Zone will be 0.0'

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, a conveyance ditch along WV. Rte 18 and continued along the site access road been proposed at the entrance to allow adequate drainage through the drainage shed.

Per Section 6.1.H a flood protection setback equal to twice the width of the watercourse channel measuring from the top of one bank to the top of the opposite bank or 50 feet, whichever is less, shall be maintained as much as possible from the top of the banks of all watercourses.

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.F, 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. Middle Island Creek Characteristics*

Middle Island Creek is located in the Smithburg and West Union Districts of Doddridge County, includes the Buckeye Creek and Meathouse Fork drainage sheds, and flows in a northwesterly direction. The drainage area flowing to Middle Island Creek within the project area is approximately 127.717 square miles of forested and agricultural land with an average basin slope of 35.87%.

#### *2.5. Slaughter Run Characteristics*

Slaughter Run is located in the West Union District of Doddridge County, and flows in a southwesterly direction. The drainage area flowing to Slaughter Run within the project area is approximately 0.633 square miles of forested land with an average basin slope of 35.89%.

### **3. Analysis Information**

#### *3.1. HEC-RAS*

A HEC-RAS hydraulic analysis was performed for the portions of the Middle Island Creek and Slaughter Run that have 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 shot topography by Blue Mountain Aerial Mapping and two foot interval field shot data by Navitus Engineering. The upstream analysis limit for Middle Island Creek is located approximately 1,260 feet upstream from the proposed entrance to the Addie Site Plan and represents the 40+90.965 section. The downstream analysis limit for Middle Island Creek is located approximately 1,830 feet downstream of the proposed entrance to the Addie Site Plan and represents the 10+00.000 section. The upstream limit for Slaughter run is located approximately 725 feet upstream of the proposed entrance to the Addie Site Plan and represents the 17+24.607 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)	Note
Upper Middle Island Creek	76,838 Ac.	13,650	Upper Reach
Slaughter Run	405.12 Ac.	475.4	
Lower Nutter Fork	4241.90 Ac.	1080.8	
Lower Middle Island Creek	81,738.55 Ac.	14,965.8	Downstream Reach

### 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, bridges, 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.

<b>Manning's n value</b>	<b>Description</b>	<b>Portion Used</b>
.04	Clean, winding, some pools and shoals	Main Channel
.04	Mountain Stream, gravels, cobbles, and few boulders	Main Channel
.1	Heavy stand of timber, few down trees, little undergrowth, flow below branches	Floodplains (Normal)
.013	Asphalt	Floodplains
.035	High grass	Floodplains
.033	Rip Rap Dry Rubble	Floodplains
.06	Light Brush and trees, in summer	Floodplains
.05	Scattered brush, heavy weeds	Floodplains

#### 4. Results

##### 4.1. Existing Conditions

Since the site is mapped within Zone "AE" floodplain area as based upon the detailed study and as shown adjacent to the site plan on the FIRM, there has been a detailed study analysis with one foot interval 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, field shot data and existing drainage computations. This information was processed in HEC-RAS to determine the existing conditions of the Base Flood Elevations and then compared with the FIS for accuracy. To best match BFE's in the FIS, the downstream flow condition was set as the know water surface elevation of 749.0'. With this condition set BFE's were mapped higher than the BFE's within the FIS however elevations were within 1-3 feet. This can be attributed to higher accuracy in channel definition and manning's values set for floodplain conditions. Max flows at the downstream section of the model were 14,965 cfs which is 235 cfs less than the peak discharge of 15,200 cfs for the 100 year storm in Middle Island Creek at the Doddridge/Tyler County Line. We have determined the flows and BFE's associated with this project to be within tolerable limits of established engineering design practice and closely match the FIS Study for Doddridge County. Station 10+00 of Middle Island Creek, the downstream extents of this analysis, is approximately 1.3 miles from the Doddridge/Tyler County Line.

##### 4.2. Proposed Conditions

The proposed conditions model was based on the proposed topography for the site access road. 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 in the appendix. As shown in the table, the proposed development, which the portions contained within in the floodplain are entirely in cut, will not increase the existing BFEs throughout the project area.

## **5. Conclusion**

The results of this floodplain analysis indicate that there will be no changes in the 100 year base flood elevation and no impacts to upstream and downstream adjacent properties along Middle Island Creek or Slaughter Run.

**APPENDIX**

Exhibit A	FIRM Panel 54017C0110C
Exhibit B	Overall Plan
Exhibit C	Existing Conditions Plan
Exhibit D	Proposed Conditions Plan
Supplement 1	Drainage Computations
Supplement 2	Summary of Computed Elevations
Supplement 3	HEC-RAS Analysis –Existing Conditions Summary
Supplement 4	HEC-RAS Analysis –Proposed Conditions Summary w/ Cross Sections

**Exhibit A**

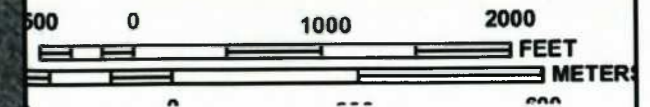
**FIRM Panel 54017C0110C**



**DODDRIDGE COUNTY  
UNINCORPORATED AREAS  
540024**



MAP SCALE 1" = 1000'



PANEL 0110C

**NFIP**  
**NATIONAL FLOOD INSURANCE PROGRAM**


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

PANEL 110 OF 325  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

**CONTAINS:**

COMMUNITY	NUMBER	PANEL	SUFFIX
DODDRIDGE COUNTY	540024	0110	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**  
 54017C0110C  
**MAP REVISED**  
 OCTOBER 4, 2011  
 Federal Emergency Management Agency

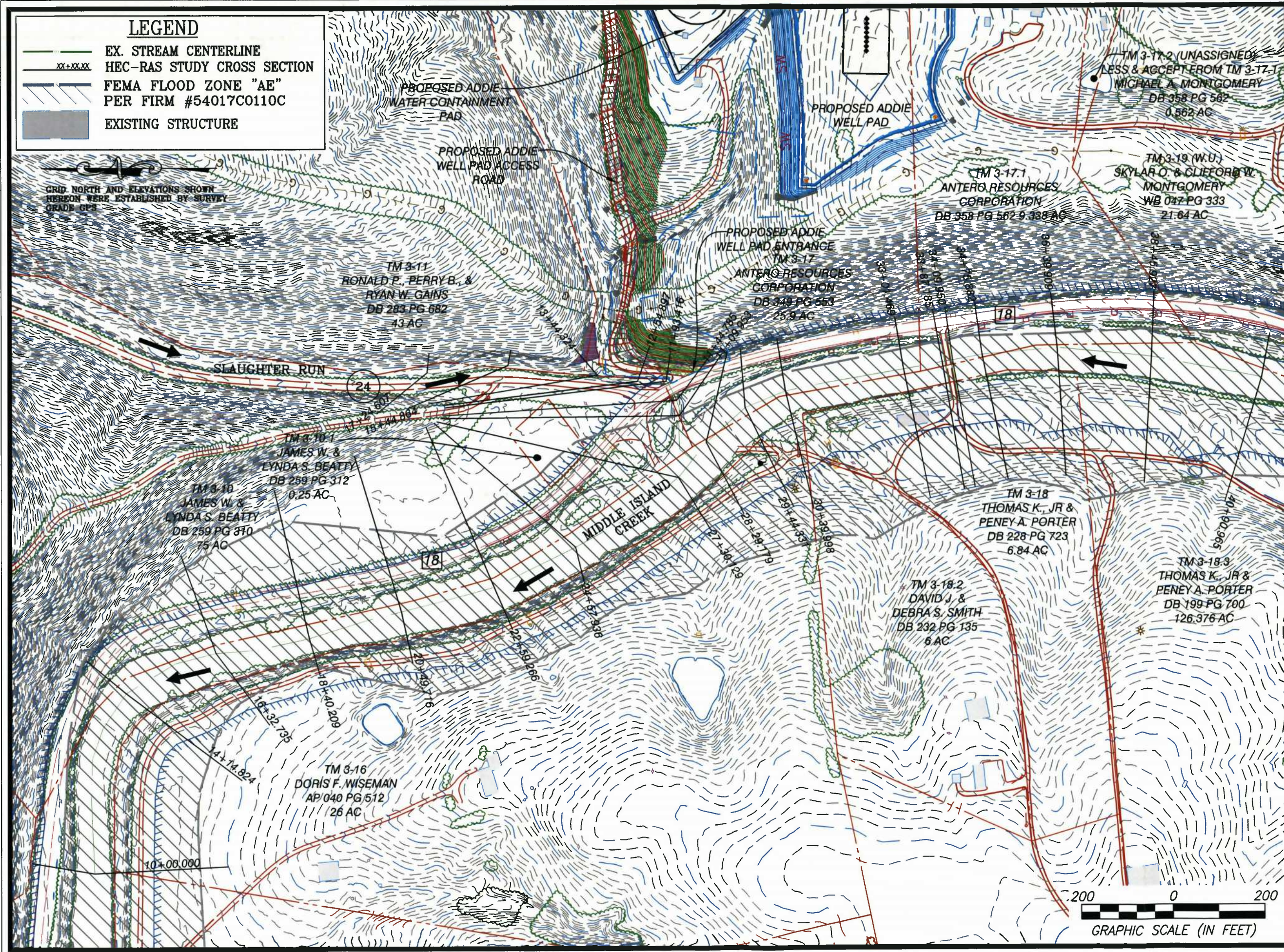
This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program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

**Exhibit B**  
**Overall Plan**

**LEGEND**

-  EX. STREAM CENTERLINE
-  HEC-RAS STUDY CROSS SECTION
-  FEMA FLOOD ZONE "AE" PER FIRM #54017C0110C
-  EXISTING STRUCTURE

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



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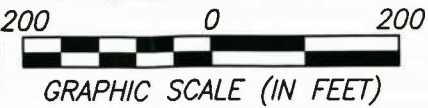
OVERALL PLAN  
**ADDIE**  
WELL PAD & WATERCONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WV

SCALE: 1" = 200'

ADDIE

DATE: 12/08/2015




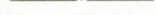
SHEET 1 OF 8

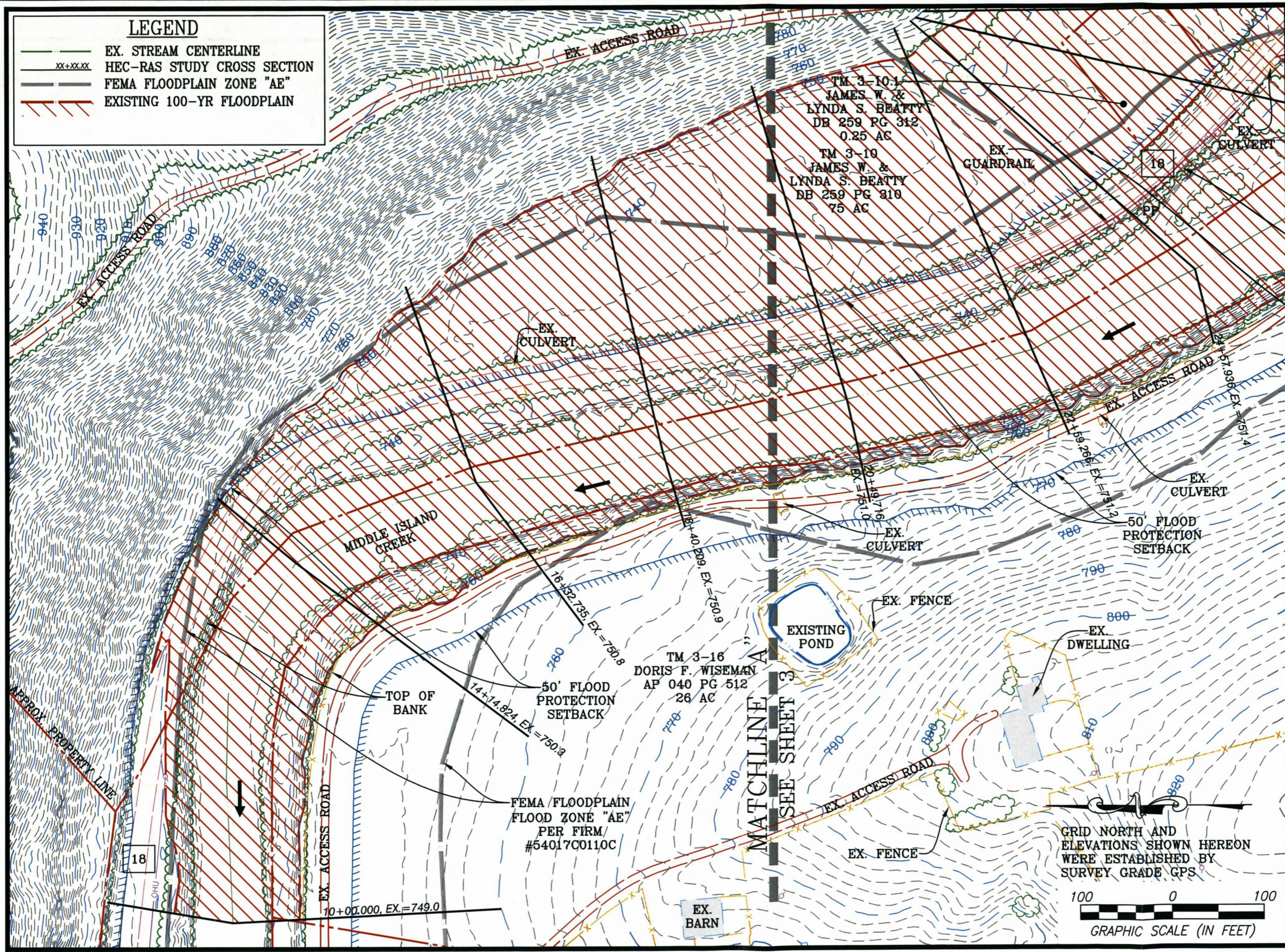


**Exhibit C**  
**Existing Conditions Plan**



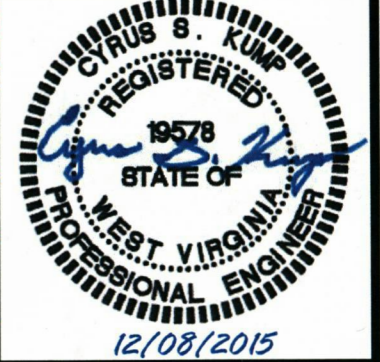
**LEGEND**

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



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EXISTING CONDITIONS PLAN

**ADDIE**

WELL PAD & WATERCONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WV

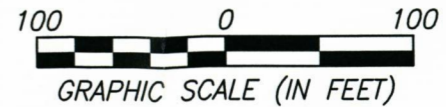
SCALE: 1" = 100'

ADDIE


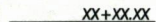


DATE: 12/08/2015

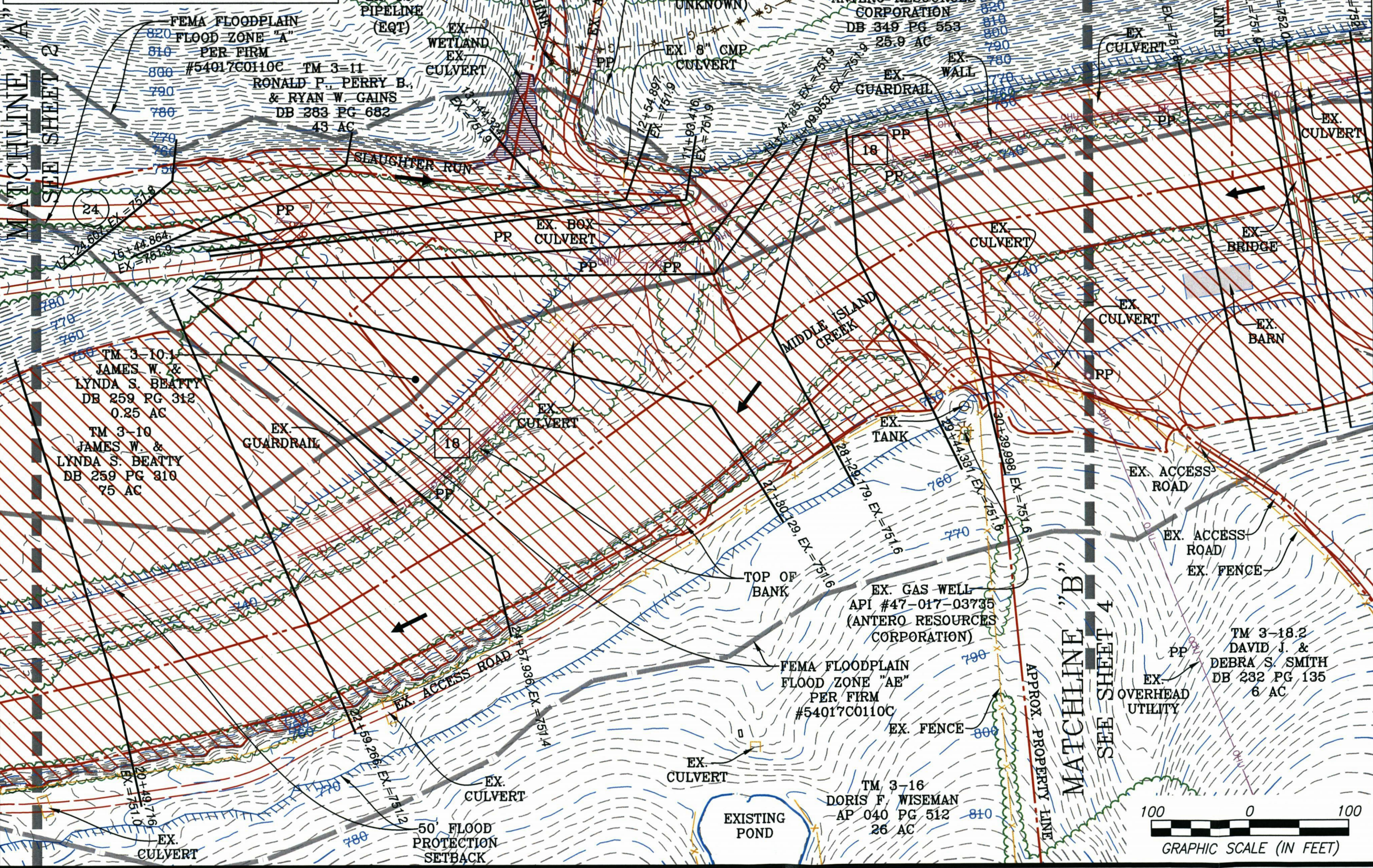
SHEET 2 OF 8

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



**LEGEND**

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



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

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**CYRUS S. KUMP**  
REGISTERED  
1957  
STATE OF  
WEST VIRGINIA  
PROFESSIONAL ENGINEER  
12/08/2015

**Antero Resources**

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EXISTING CONDITIONS PLAN

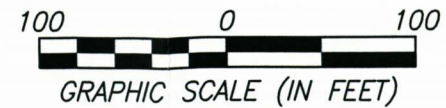
**ADDIE**

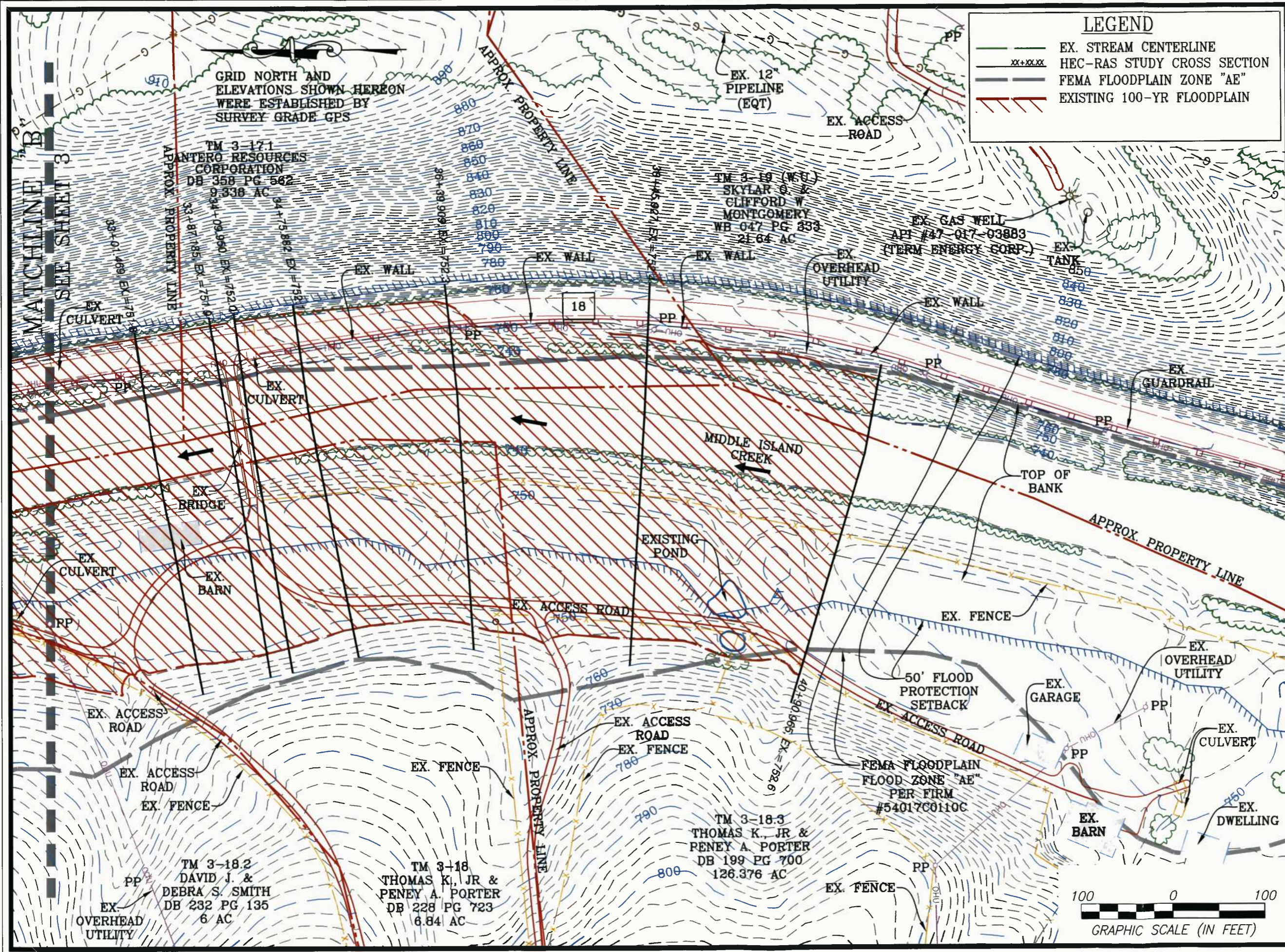
WELL PAD & WATERCONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WV

SCALE: 1" = 100'

**ADDIE**

DATE: 12/08/2015  
SHEET 3 OF 8





**LEGEND**

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

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ENERGY ENGINEERING

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CYRUS S. KUMP  
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12/08/2015

**Antero**  
Resources

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CORPORATION

EXISTING CONDITIONS PLAN

**ADDIE**

WELL PAD & WATERCONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WV

SCALE: 1" = 100'


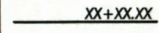



ADDIE

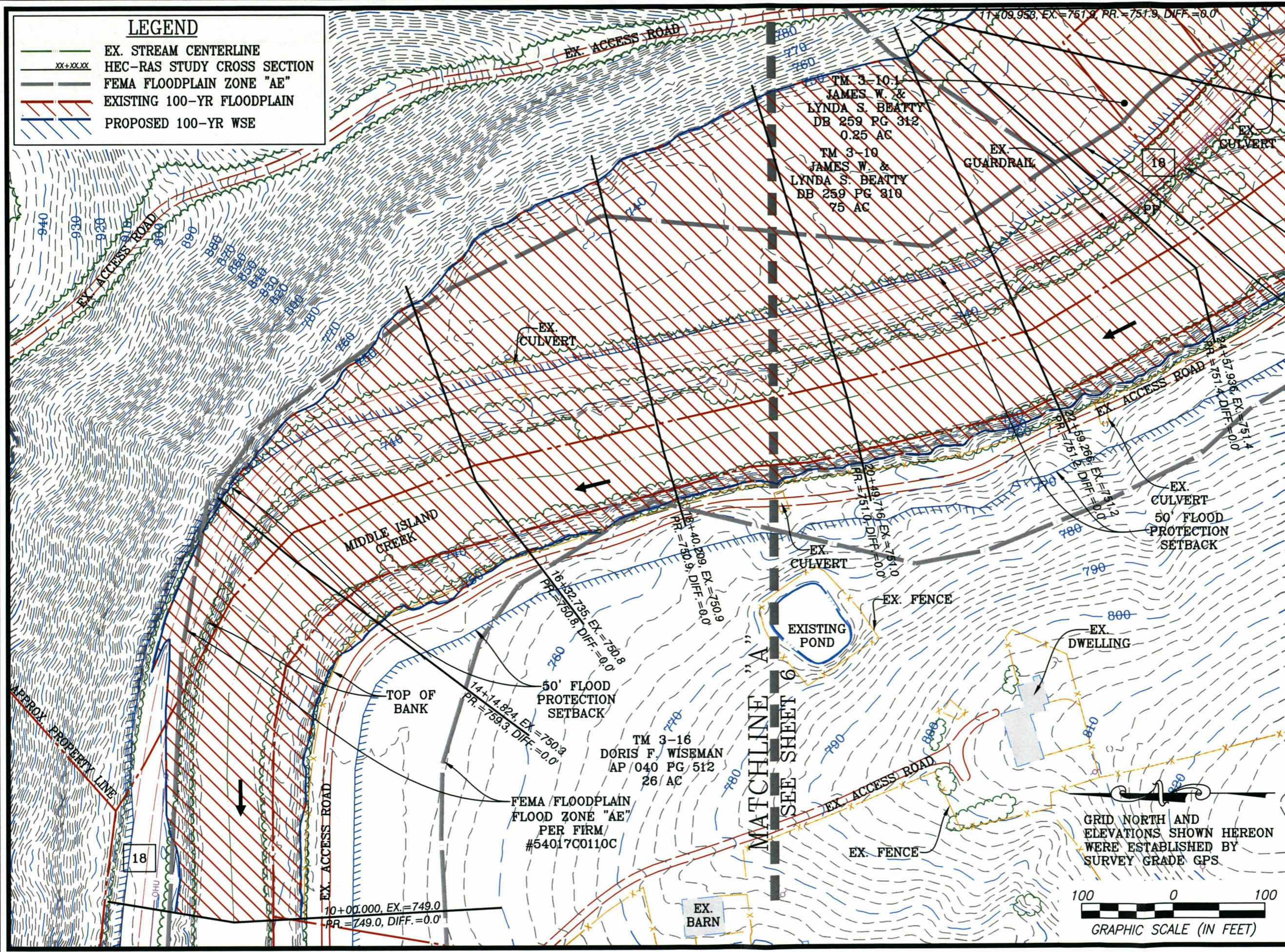
DATE: 12/08/2015

SHEET 4 OF 8

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

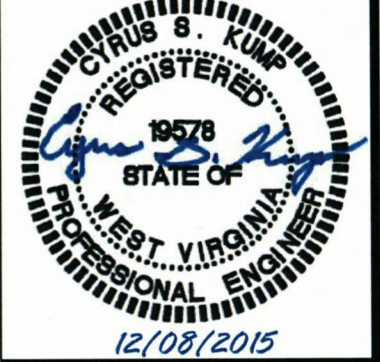
# LEGEND

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



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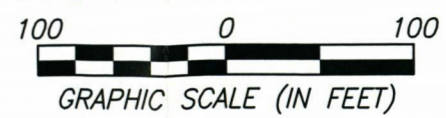
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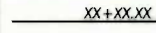



PROPOSED CONDITIONS PLAN  
**ADDIE**  
WELL PAD & WATERCONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WV

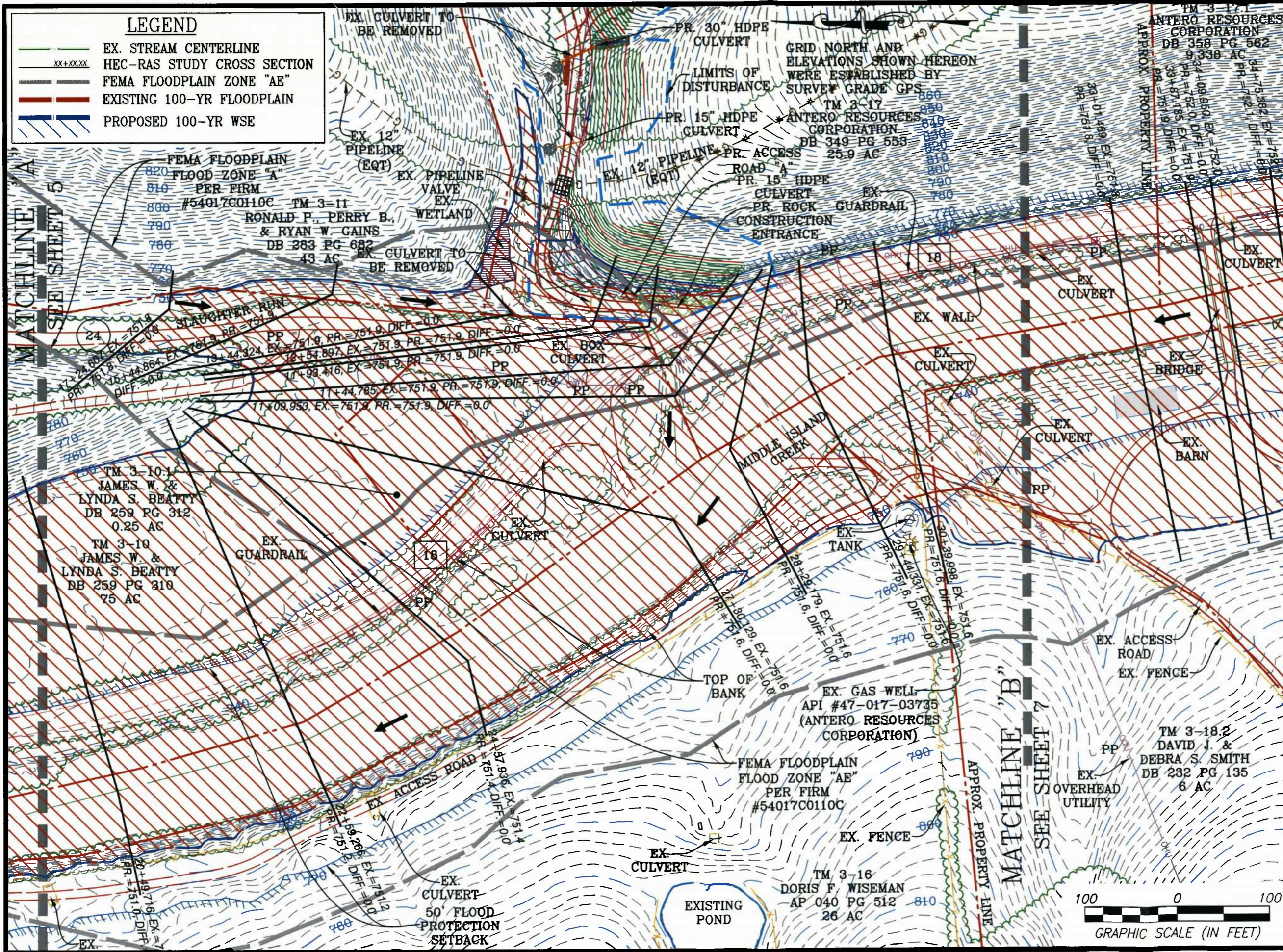
SCALE: 1" = 100'  
**ADDIE**  
DATE: 12/08/2015  
SHEET 5 OF 8



MATCHLINE "A"  
SEE SHEET 6

**LEGEND**

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



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WAS PREPARED FOR:  
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PROPOSED CONDITIONS PLAN  
**ADDIE**  
WELL PAD & WATERCONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WV

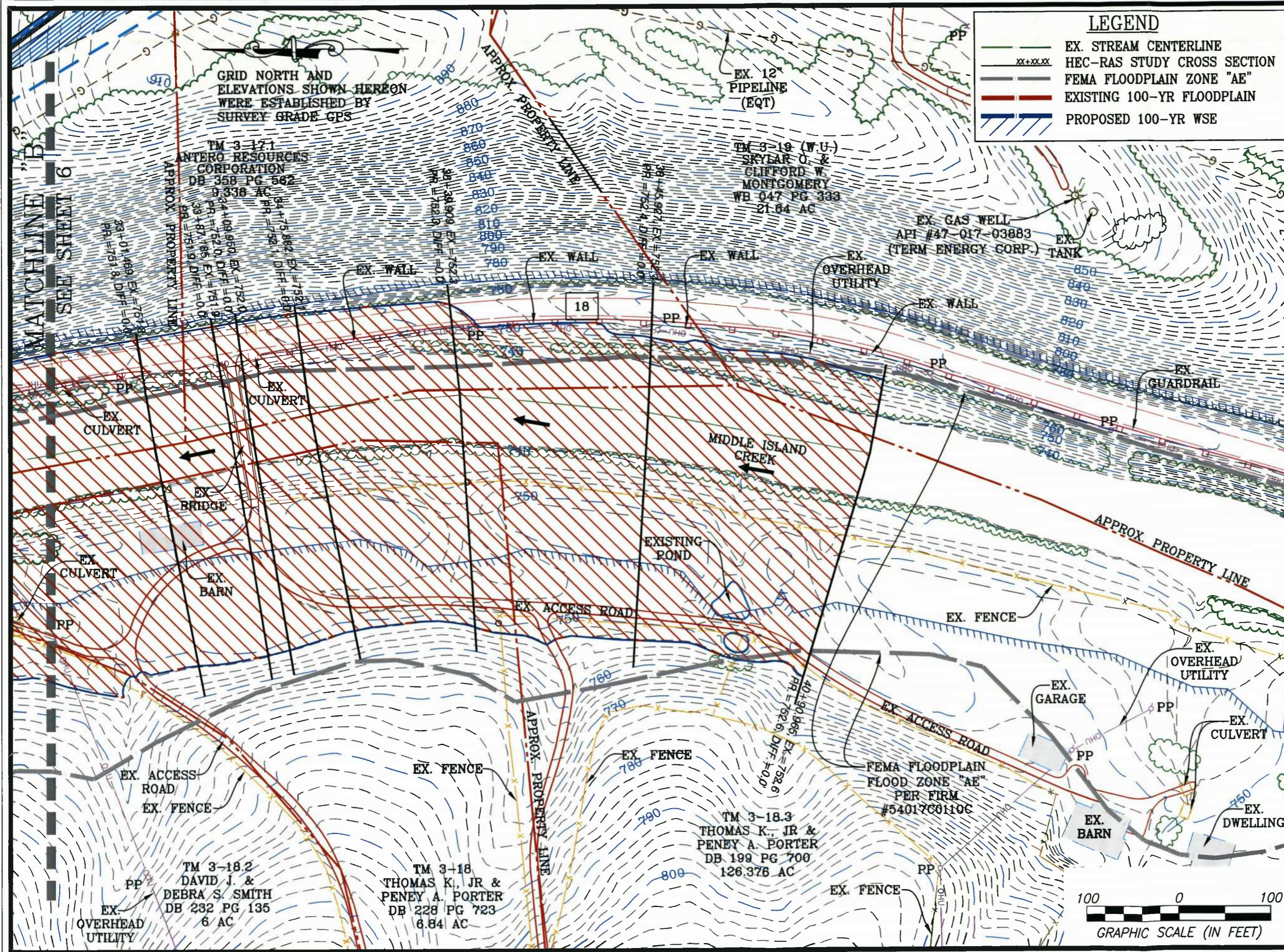
SCALE: 1" = 100'

ADDIE

DATE: 12/08/2015

SHEET 6 OF 8





MATCHLINE "B"  
SEE SHEET 6

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

**LEGEND**

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

TM 3-17.1  
ANTERO RESOURCES CORPORATION  
DB 358 PG 562  
9.338 AC

TM 3-19 (W.U.)  
SKYLAR O. &  
CLIFFORD W. MONTGOMERY  
WB 047 PG 333  
21.64 AC

TM 3-18.2  
DAVID J. &  
DEBRA S. SMITH  
DB 232 PG 135  
6 AC

TM 3-18  
THOMAS K., JR &  
PENNEY A. PORTER  
DB 228 PG 723  
6.84 AC

TM 3-18.3  
THOMAS K., JR &  
PENNEY A. PORTER  
DB 199 PG 700  
126.378 AC

EX. GAS WELL  
API #47-017-03883  
EX. (TERM ENERGY CORP.) TANK

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CYRUS S. KUMP  
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19578  
STATE OF  
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PROFESSIONAL ENGINEER  
*Cyrus S. Kump*  
12/08/2015

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ANTERO RESOURCES CORPORATION

PROPOSED CONDITIONS PLAN

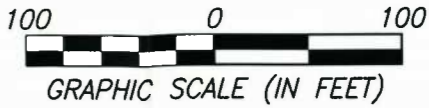
**ADDIE**

WELL PAD & WATERCONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WV

SCALE: 1" = 100'

ADDIE

DATE: 12/08/2015  
SHEET 7 OF 8



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

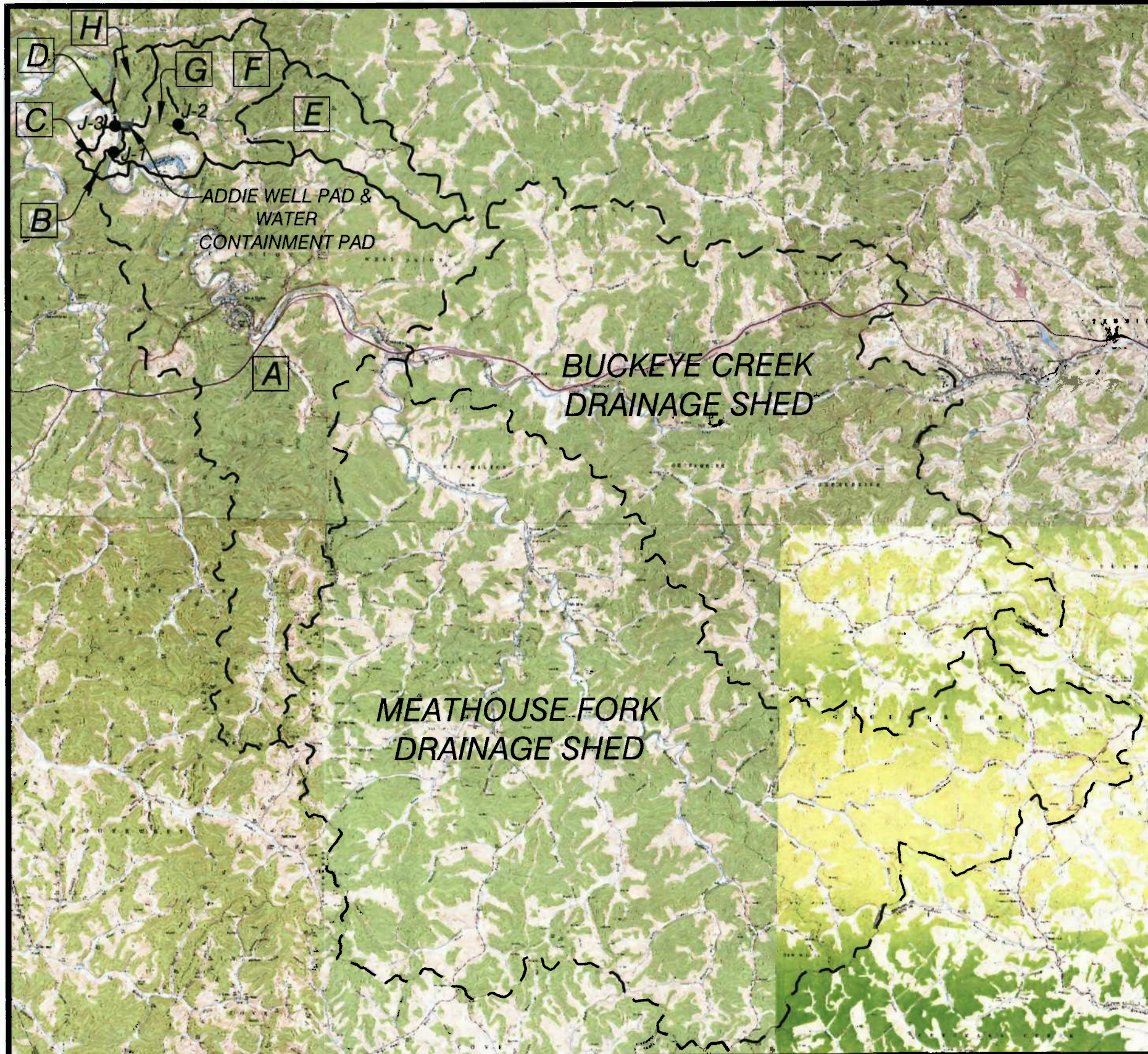


# DRAINAGE MAP

USGS 7.5 WEST UNION QUAD MAP

USGS 7.5 SMITHBURG QUAD MAP

USGS 7.5 SMITHBURG QUAD MAP



USGS 7.5 OXFORD QUAD MAP

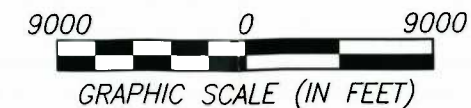
USGS 7.5 NEW MILTON QUAD MAP

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

KEY	HYDROLOGIC ELEMENT	DRAINAGE AREA (SQ. MI.)
<b>MIDDLE ISLAND CREEK</b>		
A	Upper Middle Island Creek	120.060
B	Upper1 Middle Island Creek	0.120
C	Middle Island Creek	0.221
D	Lower Middle Island Creek	0.055
E	Upper Nutter Fork	2.969
F	Wolfpen Run	2.641
G	Lower Nutter Fork	1.018
H	Slaughter Run	0.633



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DRAINAGE MAP

**ADDIE**

WELL PAD & WATERCONTAINMENT PAD  
WEST UNION DISTRICT  
DODDRIDGE COUNTY, WV

SCALE: 1" = 9000'

ADDIE

DATE: 12/08/2015

SHEET OF 8

Project: Addie

Simulation Run: Existing

Start of Run: 18Feb2015, 00:00  
 End of Run: 19Feb2015, 00:05  
 Compute Time: 18Feb2015, 14:20

Basin Model: Existing  
 Meteorologic Model: 100 YR  
 Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Upper Nutter Fork	2.969	690.3	18Feb2015, 14:30	283.5
Reach-2	2.969	690.2	18Feb2015, 15:50	273.1
Wolfpen Run	2.641	727.6	18Feb2015, 14:05	266.1
Junction-2	5.61	1159.8	18Feb2015, 15:05	539.2
Reach-3	5.61	1159.4	18Feb2015, 16:00	525.6
Lower Nutter Fork	1.018	490.4	18Feb2015, 13:05	114.3
Upper1 Middle Island Creek	0.12	176.8	18Feb2015, 12:05	14.8
Upper Middle Island Creek	120.06	13650	18Feb2015, 11:55	27168.4
Reach-1	120.06	13650	18Feb2015, 12:10	27168.4
Junction-1	126.808	14907.4	18Feb2015, 15:55	27823.1
Reach-4	126.808	14907.4	18Feb2015, 16:10	27818.2
Slaughter Run	0.633	475.4	18Feb2015, 12:30	72
Middle Island Creek	0.221	200.2	18Feb2015, 12:25	27.2
Junction-3	127.662	14962.9	18Feb2015, 16:05	27917.4
Reach-5	127.662	14962.7	18Feb2015, 16:20	27912.7
Lower Middle Island Creek	0.055	77.8	18Feb2015, 12:05	6.6
Downstream	127.717	14965.8	18Feb2015, 16:20	27919.2

**Supplement 2**  
**Summary of Computed Elevations**

**ADDIE WELL PAD & WATER CONTAINMENT PAD  
FLOODPLAIN STUDY  
SUMMARY OF COMPUTED ELEVATIONS**

CROSS SECTION STATION	RIVER NAME	100 Year Base Flood Elevation		
		EXISTING CONDITIONS MODEL	PROPOSED CONDITIONS MODEL	PROPOSED DIFFERENCE
40+90.965	Middle Island Creek-Upper	752.6	752.6	0.0
38+45.927	Middle Island Creek-Upper	752.4	752.4	0.0
36+39.909	Middle Island Creek-Upper	752.3	752.3	0.0
34+75.882	Middle Island Creek-Upper	752.1	752.1	0.0
34+09.950	Middle Island Creek-Upper	752.0	752.0	0.0
33+99.610	Middle Island Creek-Upper	Bridge		
33+87.185	Middle Island Creek-Upper	751.9	751.9	0.0
33+01.469	Middle Island Creek-Upper	751.8	751.8	0.0
30+39.998	Middle Island Creek-Upper	751.6	751.6	0.0
29+44.331	Middle Island Creek-Upper	751.6	751.6	0.0
28+29.179	Middle Island Creek-Upper	751.6	751.6	0.0
17+24.607	Slaughter Run	751.8	751.8	0.0
15+44.864	Slaughter Run	751.9	751.9	0.0
13+44.324	Slaughter Run	751.9	751.9	0.0
12+54.897	Slaughter Run	751.9	751.9	0.0
11+93.416	Slaughter Run	751.9	751.9	0.0
11+72.840	Slaughter Run	Bridge		
11+44.785	Slaughter Run	751.9	751.9	0.0
11+09.953	Slaughter Run	751.9	751.9	0.0
27+30.129	Middle Island Creek-Lower	751.6	751.6	0.0
24+57.936	Middle Island Creek-Lower	751.4	751.4	0.0
22+59.266	Middle Island Creek-Lower	751.2	751.2	0.0
20+49.716	Middle Island Creek-Lower	751.0	751.0	0.0
18+40.209	Middle Island Creek-Lower	750.9	750.9	0.0
16+32.735	Middle Island Creek-Lower	750.8	750.8	0.0
14+14.824	Middle Island Creek-Lower	750.3	750.3	0.0
10+00.000	Middle Island Creek-Lower	749.0	749.0	0.0

**Supplement 3**

**HEC-RAS Analysis –Existing 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
XXXXXXXX XXXX   X           XXX XXXX   XXXXXXXX   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: Addie  
Project File : Addie.prj  
Run Date and Time: 3/3/2015 6:17:08 AM

Project in English units

\*\*\*\*\*

PLAN DATA

Plan Title: Existing  
Plan File : x:\Navitus Jobfiles\Antero Resources\ANT202-Addie\Engineering\Drainage  
Comp\Floodplain\Computations\HEC-RAS\Addie.p01

Geometry Title: Existing  
Geometry File : x:\Navitus Jobfiles\Antero Resources\ANT202-Addie\Engineering\Drainage  
Comp\Floodplain\Computations\HEC-RAS\Addie.g01

Flow Title : Existing 100YR  
Flow File : x:\Navitus Jobfiles\Antero Resources\ANT202-Addie\Engineering\Drainage  
Comp\Floodplain\Computations\HEC-RAS\Addie.f01

Plan Summary Information:

Number of:	Cross Sections =	25	Multiple Openings =	0
	Culverts =	0	Inline Structures =	0
	Bridges =	2	Lateral Structures =	0

Computational Information

Water surface calculation tolerance =	0.01
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 100YR
Flow File : x:\Navitus Jobfiles\Antero Resources\ANT202-Addie\Engineering\Drainage
Comp\Floodplain\Computations\HEC-RAS\Addie.f01

Flow Data (cfs)

Table with 4 columns: River, Reach, RS, PF 1. Rows include Middle Island (Upper/Lower), Trib1, and Slaughter Run (Upper).

Boundary Conditions

Table with 4 columns: River, Reach, Profile, Upstream, Downstream. Row for Middle Island Lower with Profile PF 1 and Downstream Known WS = 749.

\*\*\*\*\*

GEOMETRY DATA

Geometry Title: Existing
Geometry File : x:\Navitus Jobfiles\Antero Resources\ANT202-Addie\Engineering\Drainage
Comp\Floodplain\Computations\HEC-RAS\Addie.g01

Reach Connection Table

Table with 4 columns: River, Reach, Upstream Boundary, Downstream Boundary. Rows for Middle Island (Upper/Lower) and Slaughter Run (Upper).

JUNCTION INFORMATION

Name: 1  
 Description:  
 Energy computation Method

Length across Junction	Tributary	Length	Angle
River Reach	River Reach		
Middle Island Upper	to Middle Island Lower	99.05	
Slaughter Run Upper	to Middle Island Lower	159.48	

CROSS SECTION

RIVER: Middle Island  
 REACH: Upper RS: 4090.965

INPUT

Description:

Station Elevation Data num= 43

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	6.54	758	14.26	756	22.24	754	33.86	752
39.65	750.86	44.1	750.18	47.74	750.21	56.72	750.41	58.49	750
61.73	749.26	70.55	748.7	85.19	748.46	106.16	748	122.8	747.04
135.26	746.25	150.93	746.99	172.34	747.93	175.77	747.8	191.37	746.39
193.28	746	203.79	744	212.24	742	226.25	740	234.45	739.21
235.37	738	236.99	736	238.67	734.35	326.72	734.4	327.27	736
327.79	738	328.27	740	328.51	740.72	340.58	742	346.58	744
352.24	746	357.71	748	362.79	750	367.84	752	372.6	754
377.18	756	381.9	758	385.5	760				

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	47.74	.033	56.72	.035	226.25	.05
326.72	.06	367.84	.035			238.67	.04

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	234.45	328.51		180.89	245.04	268.68	.1
							.3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 753.02	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.44	* Wt. n-Val.	* 0.037	* 0.042	* 0.060
* W.S. Elev (ft)	* 752.58	* Reach Len. (ft)	* 180.89	* 245.04	* 268.68
* Crit w.s. (ft)	*	* Flow Area (sq ft)	* 1146.49	* 1697.85	* 293.09
* E.G. Slope (ft/ft)	*0.000667	* Area (sq ft)	* 1146.49	* 1697.85	* 293.09
* Q Total (cfs)	*14907.00	* Flow (cfs)	* 4059.89	*10154.66	* 692.45
* Top width (ft)	* 338.77	* Top Width (ft)	* 203.99	* 94.06	* 40.72
* Vel Total (ft/s)	* 4.75	* Avg. Vel. (ft/s)	* 3.54	* 5.98	* 2.36
* Max chl Dpth (ft)	* 18.23	* Hydr. Depth (ft)	* 5.62	* 18.05	* 7.20



* Conv. Total (cfs)	*576995.9	* Conv. (cfs)	*157143.8	*393049.9	* 26802.2	*
* Length wtd. (ft)	* 235.25	* Wetted Per. (ft)	* 205.16	* 101.07	* 42.69	*
* Min Ch El (ft)	* 734.35	* Shear (lb/sq ft)	* 0.23	* 0.70	* 0.29	*
* Alpha	* 1.24	* Stream Power (lb/ft s)	* 385.50	* 0.00	* 0.00	*
* Frctn Loss (ft)	* 0.19	* Cum Volume (acre-ft)	* 11.49	* 78.68	* 5.05	*
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 3.13	* 5.13	* 0.77	*

\*\*\*\*\*

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Upper RS: 3845.927

INPUT

Description:

Station	Elevation	Data	num=	57							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	760	6.02	758	12.08	756	21.26	754	30.63	752		
33.79	751.34	37.51	752.02	44.08	751.12	48.16	750	50.04	749.44		
53.97	749.44	62.48	749.8	68.93	748.97	81.26	748.9	97.16	749.11		
113.59	749.83	119.85	750	125.58	750.21	137.32	750.39	155.75	751.06		
171.74	750.23	173.43	750	187.48	748	193.88	746	200.21	744		
207.14	742	214.6	740.53	223.78	740	228.68	738	231.67	736		
234.78	734.28	332.4	734.32	332.84	736	333.26	738	333.69	740		
333.99	741.25	336.14	742	337.94	742.67	347.57	743.58	348.29	744		
351.77	746	355.11	748	358.29	750	361.55	752	365.18	754		
370.29	756	375.03	758	376.42	758.54	376.43	759	384.07	759.88		
403.39	760.78	409.67	759.74	414.54	762	417.57	764	419.06	766		
420.67	768	422.54	770								

Manning's n Values	num=	8							
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	.035	53.97	.033	62.48	.035	214.6	.05	234.78	.04
332.4	.06	384.07	.013	403.39	.035				

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
155.75	376.43	171.39	206.02	224.81	.1	.3	

CROSS SECTION OUTPUT Profile #PF 1

*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
* E.G. Elev (ft)	* 752.83	* Element	* Left OB	* Channel	* Right OB	*			
* Vel Head (ft)	* 0.45	* Wt. n-Val.	* 0.035	* 0.044	*				
* W.S. Elev (ft)	* 752.38	* Reach Len. (ft)	* 171.39	* 206.02	* 224.81	*			
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 304.38	* 2567.94	*				
* E.G. Slope (ft/ft)	*0.000972	* Area (sq ft)	* 304.38	* 2567.94	*				
* Q Total (cfs)	*14907.00	* Flow (cfs)	* 743.34	*14163.67	*				
* Top width (ft)	* 333.38	* Top width (ft)	* 126.89	* 206.49	*				

				Addie.rep				
* Vel Total (ft/s)	* 5.19	* Avg. Vel. (ft/s)	* 2.44	* 5.52	*	*	*	*
* Max Chl Dpth (ft)	* 18.10	* Hydr. Depth (ft)	* 2.40	* 12.44	*	*	*	*
* Conv. Total (cfs)	*478257.6	* Conv. (cfs)	* 23848.3	*454409.3	*	*	*	*
* Length wtd. (ft)	* 202.55	* Wetted Per. (ft)	* 127.45	* 217.41	*	*	*	*
* Min Ch El (ft)	* 734.28	* Shear (lb/sq ft)	* 0.14	* 0.72	*	*	*	*
* Alpha	* 1.08	* Stream Power (lb/ft s)	* 422.54	* 0.00	*	* 0.00	*	*
* Frctn Loss (ft)	* 0.15	* Cum Volume (acre-ft)	* 8.48	* 66.69	*	* 4.15	*	*
* C & E Loss (ft)	* 0.04	* Cum SA (acres)	* 2.44	* 4.28	*	* 0.64	*	*

\*\*\*\*\*

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Upper RS: 3639.909

INPUT

Description:

Station Elevation Data		num=	55						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
*****									
0	760	6.51	758	13.06	756	19.94	754	27.82	752
35.34	750	41.84	748.7	45.32	748	46.97	747.67	48.8	748
49.72	748.2	58.68	747.8	66.16	746.42	78.77	746.28	87.87	746
108.3	745.29	122.02	746	145.53	746.32	154.27	746.6	165.4	746
170	745.77	183.96	744.32	185.61	744	196.82	742	208.66	740.29
224.14	741.27	225.73	740	231.66	736	234.48	734.22	325.66	734.25
327.27	736	328.99	738	332.12	740	333.65	740.97	337.21	742
340.84	743.06	343.69	744	347.96	745.35	349.91	746	352.53	746.85
355.01	748	356.74	749	356.75	750	362.66	751.18	382.33	752.31
386.79	752.19	388.73	754	390.93	756	393.14	758	394.82	760
396.26	762	397.64	764	398.96	766	400.97	768	404.33	770

Manning's n Values		num=	8						
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
*****									
0	.035	49.72	.033	58.68	.035	208.66	.05	234.48	.04
325.66	.05	362.66	.013	382.33	.035				

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	154.27	356.75		126.21	164.03	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

*****						
* E.G. Elev (ft)	* 752.64	* Element	* Left OB	* Channel	* Right OB	*
* Vel Head (ft)	* 0.31	* Wt. n-Val.	* 0.035	* 0.042	* 0.025	*
* W.S. Elev (ft)	* 752.33	* Reach Len. (ft)	* 126.21	* 164.03	* 167.32	*
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 697.71	* 2723.73	* 22.28	*
* E.G. Slope (ft/ft)	*0.000561	* Area (sq ft)	* 697.71	* 2723.73	* 22.28	*
* Q Total (cfs)	*14907.00	* Flow (cfs)	* 2258.88	*12615.64	* 32.47	*

Addie.rep

* Top width (ft)	* 360.44	* Top width (ft)	* 127.77	* 202.48	* 30.19
* Vel Total (ft/s)	* 4.33	* Avg. Vel. (ft/s)	* 3.24	* 4.63	* 1.46
* Max Chl Dpth (ft)	* 18.11	* Hydr. Depth (ft)	* 5.46	* 13.45	* 0.74
* Conv. Total (cfs)	*629195.0	* Conv. (cfs)	* 95343.0	*532481.3	* 1370.6
* Length wtd. (ft)	* 160.08	* wetted Per. (ft)	* 128.53	* 210.08	* 30.40
* Min Ch El (ft)	* 734.22	* Shear (lb/sq ft)	* 0.19	* 0.45	* 0.03
* Alpha	* 1.05	* Stream Power (lb/ft s)	* 404.33	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.10	* Cum Volume (acre-ft)	* 6.50	* 54.17	* 4.09
* C & E Loss (ft)	* 0.02	* Cum SA (acres)	* 1.94	* 3.32	* 0.56

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Upper RS: 3475.882

INPUT

Description:

Station Elevation Data		num= 51		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	6.41	758	12.92	756	21.63	754	31.56	752
42.43	750	46.45	749.35	51.42	748.11	58.27	749.22	67.82	748.41
70.89	748	72.16	747.8	78.06	748	81.75	748.12	94.97	748.4
110.45	748.47	121.89	748.83	133.93	749.37	147.02	750	152.67	750.32
168.61	750.76	182.2	750	187.81	748	193.4	746	199.32	744
205.19	742	210.65	740	212.11	739.42	228.24	739.86	230.18	738
232.26	736	234.29	734.17	328.69	734.2	329.42	736	330.07	738
330.7	740	330.97	740.8	334.44	742	338.12	743.43	341.82	744
346.03	744.95	346.04	748	353.71	748.11	372.85	748.46	379.29	747.97
382.98	750	386.64	752	389.64	754	391.4	756	393.15	758
394.96	760								

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	.035	58.27	.033	67.82	.035	228.24	.05	234.29	.04
328.69	.035	353.71	.013	372.85	.035				

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 182.2 346.04 73.91 65.93 65.37 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 752.53	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.46	* Wt. n-Val.	* 0.035	* 0.038	* 0.018
* W.S. Elev (ft)	* 752.07	* Reach Len. (ft)	* 73.91	* 65.93	* 65.37
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 419.57	* 2367.10	* 143.33
* E.G. slope (ft/ft)	*0.000663	* Area (sq ft)	* 419.57	* 2367.10	* 143.33

Addie.rep

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* Q Total (cfs)          *14907.00 * Flow (cfs)           * 913.81 *13305.82 * 687.37 *
* Top width (ft)        * 355.53 * Top width (ft)      * 150.98 * 163.84 * 40.70 *
* Vel Total (ft/s)     * 5.09  * Avg. Vel. (ft/s)   * 2.18  * 5.62  * 4.80  *
* Max Chl Dpth (ft)    * 17.90 * Hydr. Depth (ft)   * 2.78  * 14.45 * 3.52  *
* Conv. Total (cfs)    *578762.1 * Conv. (cfs)        * 35478.5 *516596.4 * 26687.2 *
* Length wtd. (ft)     * 66.43 * Wetted Per. (ft)   * 151.62 * 176.29 * 41.78 *
* Min Ch El (ft)       * 734.17 * Shear (lb/sq ft)   * 0.11  * 0.56  * 0.14  *
* Alpha                 * 1.14  * Stream Power (lb/ft s) * 394.96 * 0.00  * 0.00  *
* Frctn Loss (ft)      * 0.05  * Cum Volume (acre-ft) * 4.89  * 44.59 * 3.77  *
* C & E Loss (ft)      * 0.00  * Cum SA (acres)     * 1.54  * 2.63  * 0.43  *
*****

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Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Upper

RS: 3409.950

INPUT

Description:

Station Elevation Data num= 49

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	5.74	758	11.48	756	17.58	754	26.67	752
36.9	750	45.13	748.94	56.79	748.36	72.5	748.2	83.36	748.48
94.5	748.36	102.53	748.97	120.84	749.3	128.22	749.14	145.17	749.83
162.4	749.89	178.94	749.7	193.68	749.67	197.45	748	201.63	746
205.4	744	209.61	742	213.67	740	216.27	738.74	233.55	739.92
234.43	738	235.59	736	236.75	734.15	326.61	734.17	327.99	736
329.21	738	330.44	740	334.95	742	337.57	743.24	339.5	744
343.68	746	346.92	748	353.73	748	358.39	747.94	360.12	747.7
379.34	747.8	384.65	747.34	385.74	748	389.09	750	392.46	752
395.09	754	397.21	756	399.39	758	401.77	760		

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	102.53	.033	120.84	.035	236.75	.04	326.61	.05
360.12	.013	379.34	.035						

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 193.68 346.92 24.47 22.76 27.59 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

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*****
* E.G. Elev (ft)      * 752.48 * Element              * Left OB * Channel * Right OB *
* Vel Head (ft)       * 0.48  * Wt. n-Val.          * 0.035  * 0.040  * 0.020  *
* W.S. Elev (ft)      * 752.00 * Reach Len. (ft)     * 3.50   * 3.50   * 3.50   *
* Crit W.S. (ft)      * 743.28 * Flow Area (sq ft)   * 457.33 * 2237.97 * 176.41 *
* E.G. Slope (ft/ft)  *0.000754 * Area (sq ft)        * 457.33 * 2237.97 * 176.41 *

```

Addie.rep

* Q Total (cfs)	*14907.00	* Flow (cfs)	* 1059.80	*12967.19	* 880.01
* Top Width (ft)	* 365.76	* Top Width (ft)	* 166.99	* 153.24	* 45.53
* Vel Total (ft/s)	* 5.19	* Avg. Vel. (ft/s)	* 2.32	* 5.79	* 4.99
* Max Chl Dpth (ft)	* 17.85	* Hydr. Depth (ft)	* 2.74	* 14.60	* 3.87
* Conv. Total (cfs)	*542702.9	* Conv. (cfs)	* 38583.0	*472082.4	* 32037.6
* Length wtd. (ft)	* 3.50	* wetted Per. (ft)	* 167.31	* 164.22	* 46.85
* Min Ch El (ft)	* 734.15	* Shear (lb/sq ft)	* 0.13	* 0.64	* 0.18
* Alpha	* 1.15	* Stream Power (lb/ft s)	* 401.77	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.00	* Cum Volume (acre-ft)	* 4.14	* 41.10	* 3.53
* C & E Loss (ft)	* 0.01	* Cum SA (acres)	* 1.27	* 2.39	* 0.36

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.

Note: Manning's n values were composited to a single value in the main channel.

BRIDGE

RIVER: Middle Island

REACH: Upper RS: 3399.61

INPUT

Description:

Distance from Upstream XS = 3.5

Deck/Roadway width = 15

Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates

num= 2

Sta Hi Cord Lo Cord Sta Hi Cord Lo Cord

193.68	749.67	748.67	346.92	748	747
--------	--------	--------	--------	-----	-----

Upstream Bridge Cross Section Data

Station Elevation Data num= 49

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	5.74	758	11.48	756	17.58	754	26.67	752
36.9	750	45.13	748.94	56.79	748.36	72.5	748.2	83.36	748.48
94.5	748.36	102.53	748.97	120.84	749.3	128.22	749.14	145.17	749.83
162.4	749.89	178.94	749.7	193.68	749.67	197.45	748	201.63	746
205.4	744	209.61	742	213.67	740	216.27	738.74	233.55	739.92
234.43	738	235.59	736	236.75	734.15	326.61	734.17	327.99	736
329.21	738	330.44	740	334.95	742	337.57	743.24	339.5	744
343.68	746	346.92	748	353.73	748	358.39	747.94	360.12	747.7
379.34	747.8	384.65	747.34	385.74	748	389.09	750	392.46	752
395.09	754	397.21	756	399.39	758	401.77	760		

Manning's n Values

num= 7

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

Addie.rep

0	.035	102.53	.033	120.84	.035	236.75	.04	326.61	.05
360.12	.013	379.34	.035						

Bank Sta:	Left	Right	Coeff	Contr.	Expan.
	193.68	346.92		.1	.3

Downstream Deck/Roadway Coordinates

num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
*****	*****	*****	*****	*****	*****
172.14	750.63	749.63	353.52	747.87	746.87

Downstream Bridge Cross Section Data

Station Elevation Data num= 51

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	760	5.8	758	11.62	756	17.59	754	25.31	752
33.23	750	44.4	748.8	54.17	748.3	70.42	748.07	87.75	748.4
102.47	748.42	108.59	748.57	134.14	749.03	140.23	749.4	172.14	750.63
176.47	750	177.72	749.78	180.17	749.82	194.3	749.33	197.47	748
202.09	746	205.98	744	207.88	742.96	210.07	742	218.01	740
221.01	739.31	235.69	738.99	236.1	738	236.87	736	237.57	734.15
324.46	734.17	325.63	736	326.66	738	327.17	739	329.63	740
333.99	742	337.51	744	343.14	746	344.8	746.36	348.16	747.58
353.52	747.87	361.11	747.72	380.72	747.65	385.57	747.42	386.47	748
389.58	750	392.79	752	395.47	754	397.73	756	400.03	758
402.52	760								

Manning's n Values num= 8

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	.035	140.23	.033	172.14	.035	237.57	.04	324.46	.05
353.52	.033	361.11	.013	380.72	.035				

Bank Sta:	Left	Right	Coeff	Contr.	Expan.
	194.3	348.16		.1	.3

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 Bridge Coefficient Sets = 1

Low Flow Methods and Data

Energy

Selected Low Flow Methods = Highest Energy Answer

High Flow Method

Energy Only

Additional Bridge Parameters

Add Friction component to Momentum  
 Do not add weight component to Momentum  
 Class B flow critical depth computations use critical depth  
 inside the bridge at the upstream end  
 Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT Profile #PF 1

```

*****
* E.G. US. (ft) * 752.48 * Element *Inside BR US *Inside BR DS *
* W.S. US. (ft) * 752.00 * E.G. Elev (ft) * 752.47 * 752.42 *
* Q Total (cfs) * 14907.00 * W.S. Elev (ft) * 751.92 * 751.82 *
* Q Bridge (cfs) * 9377.67 * Crit W.S. (ft) * 743.28 * 743.49 *
* Q Weir (cfs) * * Max Chl Dpth (ft) * 17.77 * 17.67 *
* Weir Sta Lft (ft) * * Vel Total (ft/s) * 5.54 * 5.66 *
* Weir Sta Rgt (ft) * * Flow Area (sq ft) * 2692.37 * 2634.80 *
* Weir Submerg * * Froude # Chl * 0.25 * 0.26 *
* Weir Max Depth (ft) * * Specif Force (cu ft) * 20822.32 * 20310.09 *
* Min El Weir Flow (ft) * 747.43 * Hydr Depth (ft) * 7.37 * 7.19 *
* Min El Prs (ft) * 748.64 * W.P. Total (ft) * 676.02 * 682.13 *
* Delta EG (ft) * 0.10 * Conv. Total (cfs) * 277647.1 * 268967.5 *
* Delta WS (ft) * 0.11 * Top Width (ft) * 365.24 * 366.49 *
* BR Open Area (sq ft) * 1602.31 * Frctn Loss (ft) * 0.04 * 0.01 *
* BR Open vel (ft/s) * 5.85 * C & E Loss (ft) * 0.00 * 0.03 *
* Coef of Q * * Shear Total (lb/sq ft) * 0.72 * 0.74 *
* Br Sel Method *Energy only * Power Total (lb/ft s) * 0.00 * 0.00 *
*****
    
```

Note: Manning's n values were composited to a single value in the main channel.  
 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.  
 Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Upper RS: 3387.185

INPUT

Description:

```

Station Elevation Data num= 51
Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
*****
0 760 5.8 758 11.62 756 17.59 754 25.31 752
33.23 750 44.4 748.8 54.17 748.3 70.42 748.07 87.75 748.4
102.47 748.42 108.59 748.57 134.14 749.03 140.23 749.4 172.14 750.63
176.47 750 177.72 749.78 180.17 749.82 194.3 749.33 197.47 748
202.09 746 205.98 744 207.88 742.96 210.07 742 218.01 740
    
```

Addie.rep

221.01	739.31	235.69	738.99	236.1	738	236.87	736	237.57	734.15
324.46	734.17	325.63	736	326.66	738	327.17	739	329.63	740
333.99	742	337.51	744	343.14	746	344.8	746.36	348.16	747.58
353.52	747.87	361.11	747.72	380.72	747.65	385.57	747.42	386.47	748
389.58	750	392.79	752	395.47	754	397.73	756	400.03	758
402.52	760								

Manning's n Values num= 8

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	140.23	.033	172.14	.035	237.57	.04	324.46	.05
353.52	.033	361.11	.013	380.72	.035				

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
194.3	348.16	75.87	85.72	83.81	.1	.3	

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 752.38	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.50	* Wt. n-Val.	* 0.035	* 0.040	* 0.019
* W.S. Elev (ft)	* 751.89	* Reach Len. (ft)	* 75.87	* 85.72	* 83.81
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 464.61	* 2190.95	* 172.43
* E.G. Slope (ft/ft)	*0.000800	* Area (sq ft)	* 464.61	* 2190.95	* 172.43
* Q Total (cfs)	*14907.00	* Flow (cfs)	* 1125.73	*12850.92	* 930.35
* Top width (ft)	* 366.85	* Top width (ft)	* 168.54	* 153.86	* 44.45
* Vel Total (ft/s)	* 5.27	* Avg. Vel. (ft/s)	* 2.42	* 5.87	* 5.40
* Max Chl Dpth (ft)	* 17.74	* Hydr. Depth (ft)	* 2.76	* 14.24	* 3.88
* Conv. Total (cfs)	*526929.4	* Conv. (cfs)	* 39792.1	*454251.6	* 32885.7
* Length Wtd. (ft)	* 84.98	* wetted Per. (ft)	* 168.97	* 163.73	* 45.76
* Min Ch El (ft)	* 734.15	* Shear (lb/sq ft)	* 0.14	* 0.67	* 0.19
* Alpha	* 1.15	* Stream Power (lb/ft s)	* 402.52	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.07	* Cum Volume (acre-ft)	* 3.91	* 40.02	* 3.44
* C & E Loss (ft)	* 0.01	* Cum SA (acres)	* 1.18	* 2.31	* 0.34

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
REACH: Upper

RS: 3301.469

INPUT

Description:

Station	Elevation	Data	num=	50						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Elev
0	760	6.89	758	13.83	756	22.99	754	32.94	752	
34.13	751.75	46.11	750.33	50.17	750	54.61	749.58	70.05	749.12	
88.69	748.94	105.51	748.41	121.18	748.68	133.4	749.02	137.3	749.08	
149.02	749.75	155.8	749.23	160.14	749.28	201.96	748.45	203.01	748	



Addie.rep

207.62	746	212.21	744	218.34	742	222.08	740.75	233.69	740.66
234.27	740	236.04	738	237.81	736	239.56	734.12	339.5	734.14
340.73	736	341.89	738	342.15	738.42	345.51	740	347.8	741.08
350.65	742	353.3	742.91	355.45	744	359.07	746	360.57	746.97
368.52	747.91	388.35	748	392.63	747.78	392.96	748	396.04	750
399.12	752	401.21	754	402.73	756	404.25	758	405.77	760

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	137.3	.033	149.02	.035	239.56	.04	339.5	.05
368.52	.013	388.35	.035						

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

201.96	368.52	254.19	261.44	260.76	.1	.3
--------	--------	--------	--------	--------	----	----

Blocked Obstructions num= 1

Sta L	Sta R	Elev
164.74	191.08	755

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 752.31	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.48	* Wt. n-Val.	* 0.035	* 0.041	* 0.015
* W.S. Elev (ft)	* 751.83	* Reach Len. (ft)	* 254.19	* 261.44	* 260.76
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 370.96	* 2383.72	* 106.41
* E.G. Slope (ft/ft)	*0.000742	* Area (sq ft)	* 370.96	* 2383.72	* 106.41
* Q Total (cfs)	*14907.00	* Flow (cfs)	* 797.37	*13455.26	* 654.37
* Top Width (ft)	* 338.79	* Top Width (ft)	* 141.89	* 166.56	* 30.34
* Vel Total (ft/s)	* 5.21	* Avg. Vel. (ft/s)	* 2.15	* 5.64	* 6.15
* Max Chl Dpth (ft)	* 17.71	* Hydr. Depth (ft)	* 2.61	* 14.31	* 3.51
* Conv. Total (cfs)	*547135.6	* Conv. (cfs)	* 29266.0	*493851.9	* 24017.7
* Length wtd. (ft)	* 261.06	* Wetted Per. (ft)	* 147.89	* 175.32	* 31.55
* Min Ch El (ft)	* 734.12	* Shear (lb/sq ft)	* 0.12	* 0.63	* 0.16
* Alpha	* 1.13	* Stream Power (lb/ft s)	* 405.77	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.23	* Cum Volume (acre-ft)	* 3.18	* 35.51	* 3.17
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.91	* 1.99	* 0.27

Warning: Divided flow computed for this cross-section.  
 Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Upper RS: 3039.998

INPUT

Description:

Station	Elevation	Data	num=	49	Sta	Elev	Sta	Elev	Sta	Elev
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Elev

Addie.rep

```

*****
0      760  12.39      758  26.71      756  41.67      754  68.47      752
94.57  750  99.85  749.23  104.84  748.24  113.69  748.1  114.71  748
121.14 747.32 124.11 746.21 133.18 746.74 139.18 746.53 145.41 748
146.24 748.26 159.37 748.33 162.17      748 172.26 746.41 172.97 746
177.37      744 182.15      742 184.83 740.97 193.27 740.21 194.25 740
200.88 738.55 202.06      738 207.17      736 209.08 735.38 218.37 734.04
311    734.05 312.24      736 313.45      738 315.31      740 319.87 742
327.96      744 332.22      746 336.98      748 344.02 749.03 354.1 749.48
363.84 749.64 365.59 749.57 369.58 748.26 372.09      750 374.54 752
376.65      754 378.82      756 381.03      758 383.21      760

```

```

Manning's n Values      num=      7
Sta  n Val      Sta  n Val      Sta  n Val      Sta  n Val      Sta  n Val
*****
0      .035 124.11      .033 133.18      .06 218.37      .04 311      .05
344.02      .013 363.84      .035

```

```

Bank Sta: Left  Right      Lengths: Left Channel  Right      Coeff Contr.  Expan.
          159.37 344.02      44.51 95.67      83.59      .1      .3

```

CROSS SECTION OUTPUT Profile #PF 1

```

*****
* E.G. Elev (ft)      * 752.07 * Element      * Left OB * Channel * Right OB *
* Vel Head (ft)      * 0.46  * Wt. n-Val.   * 0.042 * 0.049 * 0.016 *
* W.S. Elev (ft)     * 751.61 * Reach Len. (ft) * 44.51 * 95.67 * 83.59 *
* Crit W.S. (ft)     *      * Flow Area (sq ft) * 265.82 * 2498.39 * 65.87 *
* E.G. Slope (ft/ft) *0.001083 * Area (sq ft) * 265.82 * 2498.39 * 65.87 *
* Q Total (cfs)      *14907.00 * Flow (cfs) * 694.09 *13886.30 * 326.61 *
* Top width (ft)     * 300.55 * Top width (ft) * 85.85 * 184.65 * 30.05 *
* Vel Total (ft/s)   * 5.27  * Avg. Vel. (ft/s) * 2.61 * 5.56 * 4.96 *
* Max Chl Dpth (ft) * 17.57 * Hydr. Depth (ft) * 3.10 * 13.53 * 2.19 *
* Conv. Total (cfs) *453009.2 * Conv. (cfs) * 21092.8 *421991.2 * 9925.2 *
* Length wtd. (ft)  * 90.36 * wetted Per. (ft) * 86.54 * 191.49 * 31.39 *
* Min Ch El (ft)    * 734.04 * Shear (lb/sq ft) * 0.21 * 0.88 * 0.14 *
* Alpha             * 1.07  * Stream Power (lb/ft s) * 383.21 * 0.00 * 0.00 *
* Frctn Loss (ft)   * 0.07  * Cum Volume (acre-ft) * 1.32 * 20.86 * 2.66 *
* C & E Loss (ft)   * 0.03  * Cum SA (acres) * 0.25 * 0.94 * 0.09 *
*****

```

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Upper

RS: 2944.331

INPUT

Description:

```

Station Elevation Data      num=      54
Sta  Elev      Sta  Elev      Sta  Elev      Sta  Elev      Sta  Elev

```

Addie.rep

```
*****
0      760    5.61    758    12.19  756.34  15.89    756    30.8   754.45
35.57  754    46.32  753.29  63.3   752.27  64.91    752    71.34  750.96
79.13  750    81.24  749.75  87.8   748.79  98.49    748.86  106    748.46
107.22 748.27 110.17    748    117.89 747.17 120.57    746    125.38  744
128.03 742.77 130.01    742    134.87 740.25 146.9     740.3   151.7   740.95
160.28 740    164.72 739.86 168.05 739.87 170.61    738    173.84  736
177.21 734.01 295.77 734.03 297.08    736 298.59    738    300.21  740
300.5  740.34 304.87    742    310.21 744    312.65 744.86    317.2   746
331.46 748    333.34 748.29 343.82 748.81 353.59 749.19 355.66 749
358.74 748    360.17 747.52 360.74    748 362.53    750    364.73  752
366.88 754    369.04    756 371.41    758 373.67    760
```

```
Manning's n Values      num=      9
Sta  n Val      Sta  n Val      Sta  n Val      Sta  n Val      Sta  n Val
*****
0      .035    87.8    .033    98.49    .035    134.87    .033    146.9    .06
177.21  .04    295.77    .05    333.34    .013    353.59    .035
```

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 168.05 333.34 110.34 115.15 29.86 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

```
*****
* E.G. Elev (ft) * 751.97 * Element * Left OB * Channel * Right OB *
* Vel Head (ft) * 0.35 * Wt. n-Val. * 0.042 * 0.044 * 0.016 *
* W.S. Elev (ft) * 751.62 * Reach Len. (ft) * 110.34 * 115.15 * 29.86 *
* Crit W.S. (ft) * * * Flow Area (sq ft) * 639.45 * 2500.14 * 86.53 *
* E.G. Slope (ft/ft) * 0.000592 * Area (sq ft) * 639.45 * 2500.14 * 86.53 *
* Q Total (cfs) * 14907.00 * Flow (cfs) * 2233.81 * 12298.44 * 374.75 *
* Top width (ft) * 297.07 * Top width (ft) * 100.80 * 165.29 * 30.97 *
* Vel Total (ft/s) * 4.62 * Avg. Vel. (ft/s) * 3.49 * 4.92 * 4.33 *
* Max Chl Dpth (ft) * 17.61 * Hydr. Depth (ft) * 6.34 * 15.13 * 2.79 *
* Conv. Total (cfs) * 612417.0 * Conv. (cfs) * 91770.6 * 505250.8 * 15395.5 *
* Length Wtd. (ft) * 111.83 * Wetted Per. (ft) * 102.55 * 171.29 * 32.94 *
* Min Ch El (ft) * 734.01 * Shear (lb/sq ft) * 0.23 * 0.54 * 0.10 *
* Alpha * 1.04 * Stream Power (lb/ft s) * 373.67 * 0.00 * 0.00 *
* Frctn Loss (ft) * 0.06 * Cum Volume (acre-ft) * 0.86 * 15.37 * 2.51 *
* C & E Loss (ft) * 0.03 * Cum SA (acres) * 0.15 * 0.55 * 0.03 *
*****
```

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Upper RS: 2829.179

INPUT  
 Description:  
 Station Elevation Data num= 44

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	15.46	758.8	21.78	758	27.76	757.29	33.37	756
38.79	754.76	41.12	754	47.44	752	48.19	751.76	50.8	750.43
59.93	750.58	67.06	750	71.88	748	76.81	746	79.63	745.11
84.75	744	92.88	742	96.99	740	101.27	738	105.7	736
110.69	733.9	262.47	734	264.58	736	266.6	737.43	269.9	738
280.14	740	288.31	742	301.19	744	315.68	745.16	319.31	746
329.89	745.23	337.23	747.84	349.5	748.42	360.61	748.85	362.66	748.73
364.91	748	367.6	747.15	369.14	748	371.67	750	374.3	752
376.92	754	378.07	756	381.77	758	382.68	760		

Manning's n values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	50.8	.033	59.93	.06	110.69	.04	262.47	.06
337.23	.013	360.61	.035						

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
67.06 319.31 80.82 99.05 654.35 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 751.87	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.23	* Wt. n-Val.	* 0.042	* 0.049	* 0.027
* W.S. Elev (ft)	* 751.64	* Reach Len. (ft)	* 99.05	* 99.05	* 99.05
* Crit w.s. (ft)	*	* Flow Area (sq ft)	* 21.49	* 3654.25	* 216.71
* E.G. Slope (ft/ft)	*0.000474	* Area (sq ft)	* 21.49	* 3654.25	* 216.71
* Q Total (cfs)	*14907.00	* Flow (cfs)	* 18.34	*14230.95	* 657.71
* Top width (ft)	* 325.41	* Top width (ft)	* 18.64	* 252.25	* 54.52
* Vel Total (ft/s)	* 3.83	* Avg. Vel. (ft/s)	* 0.85	* 3.89	* 3.03
* Max Chl Dpth (ft)	* 17.74	* Hydr. Depth (ft)	* 1.15	* 14.49	* 3.97
* Conv. Total (cfs)	*684912.1	* Conv. (cfs)	* 842.7	*653850.4	* 30219.1
* Length wtd. (ft)	* 99.05	* wetted Per. (ft)	* 18.96	* 257.33	* 56.74
* Min Ch El (ft)	* 733.90	* Shear (lb/sq ft)	* 0.03	* 0.42	* 0.11
* Alpha	* 1.01	* Stream Power (lb/ft s)	* 382.68	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.05	* Cum Volume (acre-ft)	* 0.02	* 7.24	* 2.41
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	*	*	*

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
REACH: Lower

RS: 2730.129

INPUT

Description:

Station Elevation Data num= 62

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-----	------	-----	------	-----	------	-----	------

Addie.rep

```
*****
0      760    7.79  759.62  20.79    758    27.89    756    34.94    754
38.06  753.1  40.77  752.26  48.68    752.61  58.69    752.44  59.41    752
62.37   750    65     748     66.4     746.9   69.82    746.49  70.33    746
72.42   744    74.52   742     76.62    740     77.73    738.93  79.13    738
82.15   736    85.19   733.79  197.73   733.76  202.18   734.31  214.21   736
219.7   738    226.2   740     231.1    741.23  235.3    741.55  244.77   742
256.1   742.26  257.37   742     267.63    740     269.16   739.32  275.28   740
287.27  740.69  296.15   741.15  299.2    742     305.05   743.67  305.93   744
314.18  746.25  325.21   746.08  337.3    745.45  343.5    743.75  344.56   746
347.71   748     353     748.52  377.19   748.34  406.73   748.54  441.12   748.18
477.15  747.71  506.49   747.65  552.32   748.56  572.32    750    593.14   749.18
617.42  749.96  641.36   750.59  643.69    752    654.67   754    662.64   756
673.77   758    680.5    760
```

```
Manning's n values      num=      7
Sta  n Val      Sta  n Val      Sta  n Val      Sta  n Val      Sta  n Val
*****
0      .035    40.77  .033    48.68    .06    85.19    .04    197.73    .06
314.18  .013    337.3  .1
```

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 58.69 231.1 300.11 271.21 6.63 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

```
*****
* E.G. Elev (ft) * 751.82 * Element * Left OB * Channel * Right OB *
* Vel Head (ft) * 0.22 * Wt. n-Val. * * 0.048 * 0.054 *
* W.S. Elev (ft) * 751.61 * Reach Len. (ft) * 300.11 * 271.21 * 6.63 *
* Crit W.S. (ft) * * * Flow Area (sq ft) * * 2714.12 * 1902.02 *
* E.G. Slope (ft/ft) * 0.000472 * Area (sq ft) * * 2714.12 * 1902.02 *
* Q Total (cfs) * 14963.00 * Flow (cfs) * * 11248.04 * 3714.96 *
* Top width (ft) * 583.05 * Top width (ft) * * 171.11 * 411.94 *
* Vel Total (ft/s) * 3.24 * Avg. Vel. (ft/s) * * 4.14 * 1.95 *
* Max Chl Dpth (ft) * 17.85 * Hydr. Depth (ft) * * 15.86 * 4.62 *
* Conv. Total (cfs) * 688632.5 * Conv. (cfs) * * 517661.2 * 170971.3 *
* Length wtd. (ft) * 224.28 * wetted Per. (ft) * * 178.27 * 415.78 *
* Min Ch El (ft) * 733.76 * Shear (lb/sq ft) * * 0.45 * 0.13 *
* Alpha * 1.32 * Stream Power (lb/ft s) * 680.50 * 0.00 * 0.00 *
* Frctn Loss (ft) * 0.12 * Cum Volume (acre-ft) * 0.04 * 91.90 * 30.43 *
* C & E Loss (ft) * 0.01 * Cum SA (acres) * 0.05 * 6.12 * 4.33 *
*****
```

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Lower

RS: 2457.936

INPUT

Description:

Station Elevation Data		num= 44		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	2.82	758	5.6	756	8.31	754	10.36	752
11.86	750	13.35	748	15.2	746	16.74	744	19.35	742
22.41	740	27.07	738	30.66	736	32.89	734	32.99	733.42
144.52	733.14	153.59	734	158.95	736	162.28	738	164.89	739.65
170.09	740	174.64	742	177.77	744	183.38	746	187.79	746.86
208.11	745.65	211.81	746	213.69	748	217.98	748.25	248.38	748.11
282.67	747.52	290.9	748	316.87	746.03	350.31	748	368.38	748.53
399.75	748.82	430.19	748.88	450.09	749.45	467.58	750.41	470.33	752
479.1	754	486.53	756	492.91	758	496.59	760		

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	.06	32.99	.04	153.59	.06	187.79	.013	208.11	.1

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	0	187.79		186.5	198.67	19.33	.1
							.3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 751.69	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.33	* Wt. n-Val.	* 0.048	* 0.051	*
* W.S. Elev (ft)	* 751.36	* Reach Len. (ft)	* 186.50	* 198.67	* 19.33
* Crit W.S. (ft)	*	* Flow Area (sq ft)	*	* 2759.05	* 937.21
* E.G. Slope (ft/ft)	*0.000664	* Area (sq ft)	*	* 2759.05	* 937.21
* Q Total (cfs)	*14963.00	* Flow (cfs)	*	*13369.79	* 1593.21
* Top Width (ft)	* 458.37	* Top width (ft)	*	* 176.95	* 281.43
* Vel Total (ft/s)	* 4.05	* Avg. Vel. (ft/s)	*	* 4.85	* 1.70
* Max Chl Dpth (ft)	* 18.22	* Hydr. Depth (ft)	*	* 15.59	* 3.33
* Conv. Total (cfs)	*580687.0	* Conv. (cfs)	*	*518857.4	* 61829.6
* Length Wtd. (ft)	* 177.13	* Wetted Per. (ft)	*	* 186.83	* 282.80
* Min Ch El (ft)	* 733.14	* Shear (lb/sq ft)	*	* 0.61	* 0.14
* Alpha	* 1.30	* Stream Power (lb/ft s)	* 496.59	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.13	* Cum Volume (acre-ft)	* 0.04	* 74.86	* 30.21
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.05	* 5.04	* 4.28

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Lower RS: 2259.266

INPUT

Description:  
 Station Elevation Data num= 66

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	3.91	758.7	12.64	759.09	21.31	758	23.8	756
25.88	754	27.88	752	29.92	750	31.83	748	33.82	746
36.01	744	38.06	742	41.06	740	44.45	738	47.12	736
49.45	734	50.45	733.18	154.03	732.96	157.9	734	159.78	736
161.85	738	163.64	740	172.34	742	178.96	742.8	182.35	744
187.5	746	194.04	747.9	214.03	747.1	217	746	219.14	746.49
220.89	746	223.55	748	228.58	748.66	232.14	748.35	238.55	748
246.56	747.69	258.71	746.96	268.78	746.43	276.71	746.26	281.67	746
292.15	745.59	298.81	745.25	307.15	745.09	314.17	744.78	321.02	744.35
330.05	744.37	338.47	744.44	346.05	744.32	353.61	744.47	360.76	744.46
369.07	744.65	375.86	744.99	382.01	745.18	396.02	746	406.55	746.3
412.91	746.79	421.3	748	430.99	750	443.59	750.78	450.62	751.21
459.94	752	467.83	753.18	472.08	754	477.16	756	480.95	758
485.02	760								

Manning's n values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	3.91	.033	12.64	.06	50.45	.04	154.03	.06
194.04	.013	214.03	.1						

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 21.31 194.04 230.22 209.54 168.29 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 751.55	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.38	* Wt. n-Val.	* 0.049	* 0.074	*
* W.S. Elev (ft)	* 751.17	* Reach Len. (ft)	* 230.22	* 209.54	* 168.29
* Crit W.S. (ft)	*	* Flow Area (sq ft)	*	* 2465.30	* 1204.50
* E.G. Slope (ft/ft)	*0.000878	* Area (sq ft)	*	* 2465.30	* 1204.50
* Q Total (cfs)	*14963.00	* Flow (cfs)	*	*12962.09	* 2000.91
* Top width (ft)	* 421.24	* Top width (ft)	*	* 165.31	* 255.93
* Vel Total (ft/s)	* 4.08	* Avg. Vel. (ft/s)	*	* 5.26	* 1.66
* Max Chl Dpth (ft)	* 18.21	* Hydr. Depth (ft)	*	* 14.91	* 4.71
* Conv. Total (cfs)	*504952.3	* Conv. (cfs)	*	*437428.2	* 67524.1
* Length wtd. (ft)	* 202.31	* Wetted Per. (ft)	*	* 175.75	* 257.48
* Min Ch El (ft)	* 732.96	* Shear (lb/sq ft)	*	* 0.77	* 0.26
* Alpha	* 1.46	* Stream Power (lb/ft s)	* 485.02	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.16	* Cum Volume (acre-ft)	* 0.04	* 62.95	* 29.73
* C & E Loss (ft)	* 0.02	* Cum SA (acres)	* 0.05	* 4.26	* 4.16

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Lower

RS: 2049.716

INPUT

Description:

Station Elevation Data		num= 68		Sta		Elev		Sta		Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	5.62	758.31	14.62	758.95	21.75	758.74	30.13	758.63		
34.31	758	39.5	756	41.26	754	42.49	752	43.55	750		
44.68	748	46.03	746	47.58	744	49.91	742	52.26	740		
55.13	738	59.26	736	65.76	734	68.32	732.9	160.8	732.76		
161.51	734	163.68	736	165.98	738	169.67	740	171.68	740.38		
178.26	740.98	180.86	742	184.72	744	190.13	746	197.16	746.99		
218	746.11	223.77	745.21	224.39	746	227.12	746.61	231.66	746.21		
234.49	746	239.68	745.6	249.26	744.91	260.8	744.11	263.3	744		
270.95	743.74	280.72	743.55	291.91	743.46	301.38	743.35	312.27	743.37		
321.84	743.08	332.31	743.26	341.81	743.39	353.72	743.55	364.46	743.78		
373.48	743.73	385.52	743.77	394.8	743.47	406.12	743.2	415.97	743		
425.43	743.11	430.52	743.27	437.13	744	440.62	744.45	443.39	744.9		
447.68	746	452.9	748	457.43	750	461.57	752	465.23	754		
468.85	756	472.2	758	475.44	760						

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	5.62	.033	14.62	.035	34.31	.06	68.32	.04		
160.8	.06	180.86	.035	197.16	.013	218	.1				

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 30.13 197.16 204 209.45 191.89 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 751.37	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.32	* Wt. n-Val.	* 204.00	* 0.047	* 0.079
* W.S. Elev (ft)	* 751.05	* Reach Len. (ft)	* 204.00	* 209.45	* 191.89
* Crit W.S. (ft)	*	* Flow Area (sq ft)	*	* 2321.19	* 1769.35
* E.G. Slope (ft/ft)	*0.000741	* Area (sq ft)	*	* 2321.19	* 1769.35
* Q Total (cfs)	*14963.00	* Flow (cfs)	*	*11716.40	* 3246.60
* Top Width (ft)	* 416.60	* Top width (ft)	*	* 154.16	* 262.44
* Vel Total (ft/s)	* 3.66	* Avg. Vel. (ft/s)	*	* 5.05	* 1.83
* Max Chl Dpth (ft)	* 18.29	* Hydr. Depth (ft)	*	* 15.06	* 6.74
* Conv. Total (cfs)	*549551.6	* Conv. (cfs)	*	*430312.4	*119239.1
* Length Wtd. (ft)	* 205.09	* Wetted Per. (ft)	*	* 165.02	* 264.38
* Min ch El (ft)	* 732.76	* Shear (lb/sq ft)	*	* 0.65	* 0.31
* Alpha	* 1.55	* Stream Power (lb/ft s)	* 475.44	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.15	* Cum Volume (acre-ft)	* 0.04	* 51.44	* 23.99
* C & E Loss (ft)	* 0.01	* Cum SA (acres)	* 0.05	* 3.49	* 3.16

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION



Addie.rep

RIVER: Middle Island  
 REACH: Lower

RS: 1840.209

INPUT

Description:

Station Elevation Data num= 69

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	5.41	758	8.59	756.65	16.89	755.65	24.02	755.23
25.56	754	28.83	752	33.17	750	35.4	748	37.07	746
38.68	744	40.55	742	42.26	740	44	738	45.22	736
47.06	734	56.01	732.64	134.95	732.54	138.43	734	143.03	736
146.98	738	148.39	738.56	151.78	739.64	155.36	740	161.5	740.92
166.33	742	169.21	742.82	172.96	743.55	177.21	744	185.83	744.34
205.92	744.34	208.52	744	211.25	743.68	212.97	744	218.02	744.8
224.99	744	227.66	743.84	235.34	743.15	244.43	742.81	250.35	742.71
256.52	742.41	263.5	742.14	264.81	742	274.95	741.44	282.47	741.52
290.84	741.25	299.29	740.82	306.98	740.52	315.67	740.43	323.58	740.46
333.1	740	335.32	739.85	353.71	739.66	364.08	739.79	365.26	740
367.85	740.39	371.31	740.98	374.01	742	377.25	744	380.29	746
384.45	748	388.92	750	391.31	750.84	395.91	752	400.43	753.02
405.21	754	411.61	756	415.92	758	420.6	760		

Manning's n values num= 8

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	8.59	.033	16.89	.06	56.01	.04	134.95	.06
166.33	.035	185.83	.013	205.92	.1				

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 24.02 185.83 154.95 206.96 249.3 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 751.21	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.28	* wt. n-Val.	* 0.048	* 0.071	*
* W.S. Elev (ft)	* 750.93	* Reach Len. (ft)	* 154.95	* 206.96	* 249.30
* Crit W.S. (ft)	*	* Flow Area (sq ft)	*	* 2265.15	* 1780.18
* E.G. Slope (ft/ft)	* 0.000712	* Area (sq ft)	*	* 2265.15	* 1780.18
* Q Total (cfs)	* 14963.00	* Flow (cfs)	*	* 10772.13	* 4190.88
* Top width (ft)	* 360.51	* Top width (ft)	*	* 154.68	* 205.83
* Vel Total (ft/s)	* 3.70	* Avg. Vel. (ft/s)	*	* 4.76	* 2.35
* Max Chl Dpth (ft)	* 18.39	* Hydr. Depth (ft)	*	* 14.64	* 8.65
* Conv. Total (cfs)	* 560791.1	* Conv. (cfs)	*	* 403723.4	* 157067.8
* Length wtd. (ft)	* 219.75	* wetted Per. (ft)	*	* 164.22	* 208.62
* Min Ch El (ft)	* 732.54	* Shear (lb/sq ft)	*	* 0.61	* 0.38
* Alpha	* 1.30	* Stream Power (lb/ft s)	* 420.60	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.15	* Cum Volume (acre-ft)	* 0.04	* 40.41	* 16.17
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.05	* 2.75	* 2.13

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island

REACH: Lower

RS: 1632.735

INPUT

Description:

Station Elevation Data		num= 68		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	6.67	759.82	13.74	759.39	21.44	759.07	28.32	758.62
40.49	758	43.51	757.87	50.81	757.15	54.87	756.51	58.3	756
60.12	755.574	62.59	755.54	68.87	754.82	74.25	754	80.92	752
81.88	751.6	90.17	751.53	97.37	751.97	100.07	750.94	102.49	750
105.12	748.89	108.38	748	111.1	747.11	113.19	746	116.44	744
119.24	742	121.26	740	123.21	738	126.12	736	128.32	734.98
131.28	734	136.11	732.44	141.62	732.85	148.67	732.39	231.24	732.31
237.6	732.89	238.69	734	241.22	736	243.25	738	246.18	740
249.19	741.2	254.6	740.9	262.86	740.59	268.43	740.86	271.37	741.14
274.46	742	280.33	742.79	291.6	742.86	311.69	743.15	320.34	742.41
329.94	742.41	334.52	742	343.24	741.85	346.91	742	352.68	742.18
365.46	742.87	372.31	743.25	380.79	743.46	386.86	744	391.88	744.71
394.97	746	398.72	748	402.29	750	405.58	752	409.12	754
414.07	756	419.64	758	424.77	760				

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	.035	81.88	.033	90.17	.06	136.11	.04	231.24	.06
274.46	.035	291.6	.013	311.69	.1				

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	97.37	231.24		135.91	215.58	310.45	.1 .3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 751.06	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.30	* Wt. n-Val.	* 135.91	* 0.046	* 0.048
* W.S. Elev (ft)	* 750.75	* Reach Len. (ft)	* 215.58	* 310.45	* 310.45
* Crit W.S. (ft)	* 0.000620	* Flow Area (sq ft)	* 2065.65	* 1489.46	* 1489.46
* E.G. Slope (ft/ft)	* 14963.00	* Area (sq ft)	* 2065.65	* 1489.46	* 1489.46
* Q Total (cfs)	* 302.97	* Flow (cfs)	* 10110.82	* 4852.18	* 4852.18
* Top Width (ft)	* 4.21	* Top width (ft)	* 130.69	* 172.29	* 172.29
* Vel Total (ft/s)	* 18.44	* Avg. Vel. (ft/s)	* 4.89	* 3.26	* 3.26
* Max Chl Dpth (ft)	* 600872.8	* Hydr. Depth (ft)	* 15.81	* 8.65	* 8.65
* Conv. Total (cfs)	* 233.31	* Conv. (cfs)	* 406022.6	* 194850.2	* 194850.2
* Length Wtd. (ft)	* 732.31	* Wetted Per. (ft)	* 135.74	* 177.00	* 177.00
* Min ch El (ft)		* Shear (lb/sq ft)	* 0.59	* 0.33	* 0.33

Addie.rep

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* Alpha * 1.11 * Stream Power (lb/ft s) * 424.77 * 0.00 * 0.00 *
* Frctn Loss (ft) * 0.19 * Cum Volume (acre-ft) * 0.04 * 30.12 * 6.82 *
* C & E Loss (ft) * 0.02 * Cum SA (acres) * 0.05 * 2.07 * 1.04 *
*****
```

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
REACH: Lower

RS: 1414.824

INPUT

Description:

Station Elevation Data num= 61

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	15.24	759.21	22.73	758.8	34.79	758	45.46	757.43
59.07	756	73.06	754.93	84.94	754	94.61	753.52	101.71	753.38
109.31	753.09	115.45	752.83	123.04	752.68	130.29	752.54	136.24	752.62
143.41	752.66	150.86	752.66	158.35	752.63	166.21	752.53	174.36	752.33
177.31	752	185.01	750.8	196.69	750.63	202.85	750.59	206.36	750
208.6	749.59	213.63	749.25	219.02	749.16	222.05	748	227.01	746
229.91	744	233.09	742	234.66	741.34	236.65	740.82	242.66	740.95
247.97	741.69	250.05	740	252.33	738	254.66	736	258.37	734
265.53	732.11	361.05	732.08	364.02	734	366.21	736	368.1	738
369.87	740	371.88	742	373.1	743.04	375.75	744	380.91	744.76
384.5	745.24	390.03	746	391.36	746.17	412.16	748.21	420.39	747.69
424.21	750	425.66	752	426.73	754	427.63	756	428.59	758
429.75	760								

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	185.01	.033	196.69	.06	265.53	.04
391.36	.013	412.16	.1			361.05	.06

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
219.02 375.75 191.41 401.52 460.36 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

```
*****
* E.G. Elev (ft) * 750.84 * Element * Left OB * Channel * Right OB *
* Vel Head (ft) * 0.55 * Wt. n-Val. * 0.060 * 0.049 * 0.028 *
* W.S. Elev (ft) * 750.30 * Reach Len. (ft) * 191.41 * 401.52 * 460.36 *
* Crit W.S. (ft) * * Flow Area (sq ft) * 11.67 * 2367.31 * 170.47 *
* E.G. slope (ft/ft) *0.001133 * Area (sq ft) * 11.67 * 2367.31 * 170.47 *
* Q Total (cfs) *14963.00 * Flow (cfs) * 8.42 *14206.92 * 747.66 *
* Top width (ft) * 219.82 * Top width (ft) * 14.42 * 156.73 * 48.67 *
* Vel Total (ft/s) * 5.87 * Avg. Vel. (ft/s) * 0.72 * 6.00 * 4.39 *
* Max chl Dpth (ft) * 18.22 * Hydr. Depth (ft) * 0.81 * 15.10 * 3.50 *
```

Addie.rep

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* Conv. Total (cfs)      *444458.9 * Conv. (cfs)          * 250.0 *422000.5 * 22208.4 *
* Length wtd. (ft)     * 402.93 * Wetted Per. (ft)    * 14.49 * 166.11 * 49.74 *
* Min Ch El (ft)      * 732.08 * Shear (lb/sq ft)    * 0.06 * 1.01 * 0.24 *
* Alpha                * 1.02 * Stream Power (lb/ft s) * 429.75 * 0.00 * 0.00 *
* Frctn Loss (ft)     * 0.70 * Cum Volume (acre-ft) * 0.03 * 19.15 * 0.90 *
* C & E Loss (ft)     * 0.05 * Cum SA (acres)      * 0.03 * 1.36 * 0.26 *
*****
```

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.

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island

REACH: Lower

RS: 1000.000

INPUT

Description:

Station Elevation Data num= 67

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	13.65	759.56	24.39	759.09	34.94	758.26	38.89	758
44.36	757.66	55.43	756.67	61.73	756	66.32	755.56	72.83	754.89
81.77	754	86.43	753.67	95.07	752.79	104.9	752.17	108.34	752
113.62	751.73	124	751.33	133.43	751.24	144.81	751.3	154.89	751.12
164.51	751.07	174.03	751.16	188.47	751.26	196.86	751.48	205.18	751.9
211.19	751.57	213.78	751.46	218.37	750	221.01	748	223.06	746
225.12	744	226.42	742.79	228.11	742.11	230.89	742	233.81	742
243.16	740.46	247.53	740	249.81	739.66	250.95	738	252.44	736
254.3	734	255.38	732.98	256.61	732	257.98	731.75	331.51	731.75
333.07	732	335.16	733.09	335.55	734	337.34	736	339.17	738
341.23	740	344.23	742	347.24	744	350.56	746	355.52	748
360.34	750	366.98	751.5	377.89	750	378.67	750	394.79	751.71
415.43	752.41	422.23	750.57	425.08	752	427.86	754	429.52	756
431.27	758	432.66	760						

Manning's n Values num= 9

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	188.47	.033	196.86	.035	218.37	.06	257.98	.04
331.51	.06	360.34	.035	394.79	.013	415.43	.1		

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 205.18 366.98 1 1 1 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

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Addie.rep

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* E.G. Elev (ft)      * 750.09 * Element      * Left OB * Channel * Right OB *
* Vel Head (ft)      * 1.09  * Wt. n-Val.   *         * 0.051  *         *
* W.S. Elev (ft)     * 749.00 * Reach Len. (ft) *         *         *         *
* Crit W.S. (ft)     * 742.26 * Flow Area (sq ft) *         * 1788.63 *         *
* E.G. Slope (ft/ft) * 0.003001 * Area (sq ft) *         * 1788.63 *         *
* Q Total (cfs)      * 14963.00 * Flow (cfs) *         * 14963.00 *         *
* Top width (ft)     * 138.24 * Top width (ft) *         * 138.24 *         *
* Vel Total (ft/s)   * 8.37  * Avg. Vel. (ft/s) *         * 8.37 *         *
* Max Chl Dpth (ft) * 17.25 * Hydr. Depth (ft) *         * 12.94 *         *
* Conv. Total (cfs) * 273117.8 * Conv. (cfs) *         * 273117.8 *         *
* Length wtd. (ft)  *         * Wetted Per. (ft) *         * 150.33 *         *
* Min Ch El (ft)    * 731.75 * Shear (lb/sq ft) *         * 2.23 *         *
* Alpha            * 1.00  * Stream Power (lb/ft s) * 432.66 * 0.00 * 0.00 *
* Frctn Loss (ft)  *         * Cum Volume (acre-ft) *         *         *         *
* C & E Loss (ft)  *         * Cum SA (acres) *         *         *         *
*****

```

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Slaughter Run  
 REACH: Upper RS: 1724.607

INPUT

Description:

Station		Elevation Data		num= 34		Sta		Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	770	4.22	768	6.73	766	8.72	764	10.66	762
12.93	760	15.43	758	18.64	756	22.38	754	26.37	752
30.11	750	34.79	748	42.87	746.45	54.53	748	57.95	749.38
68.01	750	80.39	750.15	100.88	751.34	112.37	750.54	117.6	752
120.95	754	123.6	756	125.96	758	128.31	760	130.56	762
133.39	764	138.66	766	144.19	768	149.31	770	155.92	772
162.13	774	168.14	776	176.8	778	185.46	780		

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	.1	30.11	.04	57.95	.1	80.39	.033	100.88	.1		

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 30.11 57.95 178.86 177.7 69.15 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

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*****
* E.G. Elev (ft)      * 751.94 * Element      * Left OB * Channel * Right OB *
* Vel Head (ft)      * 0.16  * Wt. n-Val.   * 0.100 * 0.040 * 0.069 *
* W.S. Elev (ft)     * 751.78 * Reach Len. (ft) * 178.86 * 177.70 * 69.15 *
* Crit W.S. (ft)     *         * Flow Area (sq ft) * 2.95 * 113.42 * 75.58 *
*****

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Addie.rep

* E.G. slope (ft/ft)	*0.001415	* Area (sq ft)	* 2.95	* 113.42	* 75.58
* Q Total (cfs)	* 475.00	* Flow (cfs)	* 1.40	* 395.53	* 78.07
* Top width (ft)	* 90.02	* Top width (ft)	* 3.32	* 27.84	* 58.85
* Vel Total (ft/s)	* 2.47	* Avg. Vel. (ft/s)	* 0.48	* 3.49	* 1.03
* Max chl Dpth (ft)	* 5.33	* Hydr. Depth (ft)	* 0.89	* 4.07	* 1.28
* Conv. Total (cfs)	* 12627.4	* Conv. (cfs)	* 37.3	* 10514.7	* 2075.4
* Length wtd. (ft)	* 137.17	* Wetted Per. (ft)	* 3.77	* 28.77	* 59.10
* Min Ch El (ft)	* 746.45	* Shear (lb/sq ft)	* 0.07	* 0.35	* 0.11
* Alpha	* 1.68	* Stream Power (lb/ft s)	* 185.46	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.02	* Cum Volume (acre-ft)	* 2.67	* 12.82	* 14.08
* C & E Loss (ft)	* 0.05	* Cum SA (acres)	* 0.39	* 0.65	* 1.16

\*\*\*\*\*

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: Slaughter Run  
 REACH: Upper RS: 1544.864

INPUT

Description:

Station Elevation Data		num= 35							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	770	3.52	768	4.96	766	6.39	764	7.84	762
9.29	760	10.93	758	12.71	756	14.46	754	17.32	752
20.42	750	23.25	748	26.21	746	29.82	744	34.38	742.83
45.36	743.64	46.96	744	51.65	745.5	57.63	746	98.36	746.57
141.37	747.74	144.96	748	153.32	747.02	165.06	748.53	178.02	750
202.13	752	215.31	754	225.96	756	233.57	758	241.78	760
248.39	762	253.76	764	258.94	766	265.03	768	272.91	770

Manning's n values		num= 5							
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	.1	26.21	.04	51.65	.1	98.36	.033	141.37	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
26.21	51.65	139.44	197.68	45.42	.1	.3	

CROSS SECTION OUTPUT Profile #PF 1

\*\*\*\*\*

* E.G. Elev (ft)	* 751.87	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.01	* Wt. n-Val.	* 0.100	* 0.040	* 0.059
* W.S. Elev (ft)	* 751.87	* Reach Len. (ft)	* 139.44	* 197.68	* 45.42
* Crit w.s. (ft)	*	* Flow Area (sq ft)	* 25.22	* 204.35	* 620.07
* E.G. Slope (ft/ft)	*0.000043	* Area (sq ft)	* 25.22	* 204.35	* 620.07
* Q Total (cfs)	* 475.00	* Flow (cfs)	* 4.39	* 193.94	* 276.66

Addie.rep

* Top width (ft)	* 182.99	* Top width (ft)	* 8.68	* 25.44	* 148.87
* Vel Total (ft/s)	* 0.56	* Avg. Vel. (ft/s)	* 0.17	* 0.95	* 0.45
* Max Chl Dpth (ft)	* 9.04	* Hydr. Depth (ft)	* 2.90	* 8.03	* 4.17
* Conv. Total (cfs)	* 72737.0	* Conv. (cfs)	* 672.8	* 29698.6	* 42365.6
* Length wtd. (ft)	* 104.11	* Wetted Per. (ft)	* 10.48	* 26.41	* 149.24
* Min Ch El (ft)	* 742.83	* Shear (lb/sq ft)	* 0.01	* 0.02	* 0.01
* Alpha	* 1.55	* Stream Power (lb/ft s)	* 272.91	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.00	* Cum Volume (acre-ft)	* 2.62	* 12.17	* 13.52
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.36	* 0.54	* 1.00

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: Slaughter Run  
 REACH: Upper RS: 1344.324

INPUT

Description:

Station Elevation Data num= 32

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	4.04	758	7.62	756	11.58	754	15.68	752
25.02	750	41.88	748	61.45	746	66.01	744	69.95	742
76.19	740	77.9	739.37	85.32	740	101.2	742	119.76	744
150.87	744.63	202.84	744.89	223.62	744.84	240.93	746	243.11	746.15
303.6	746.78	306.41	746.24	315.79	747.28	331.19	748.59	340.83	748.44
366.21	750	392.08	752	406.19	754	420.92	756	439.7	758
448.78	759	454.39	760						

Manning's n Values num= 8

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	61.45	.04	119.76	.1	150.87	.033	202.84	.035
315.79	.033	331.19	.035	366.21	.1				

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
61.45	119.76	164.89	88.64	32.96	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 751.87	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.00	* wt. n-Val.	* 0.100	* 0.040	* 0.039
* W.S. Elev (ft)	* 751.87	* Reach Len. (ft)	* 164.89	* 88.64	* 32.96
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 151.88	* 582.62	* 1447.26
* E.G. Slope (ft/ft)	* 0.000003	* Area (sq ft)	* 151.88	* 582.62	* 1447.26
* Q Total (cfs)	* 475.00	* Flow (cfs)	* 8.39	* 164.38	* 302.23
* Top width (ft)	* 374.12	* Top width (ft)	* 45.16	* 58.31	* 270.64

```

* Vel Total (ft/s)      * 0.22 * Avg. Vel. (ft/s)      * 0.06 * 0.28 * 0.21 *
* Max Chl Dpth (ft)    * 12.50 * Hydr. Depth (ft)     * 3.36 * 9.99 * 5.35 *
* Conv. Total (cfs)    * 285002.9 * Conv. (cfs)         * 5034.5 * 98627.1 * 181341.4 *
* Length wtd. (ft)    * 55.75 * Wetted Per. (ft)    * 45.58 * 59.89 * 270.98 *
* Min Ch El (ft)      * 739.37 * Shear (lb/sq ft)    * 0.00 * 0.00 * 0.00 *
* Alpha                * 1.17 * Stream Power (lb/ft s) * 454.39 * 0.00 * 0.00 *
* Frctn Loss (ft)     * 0.00 * Cum Volume (acre-ft) * 2.33 * 10.39 * 12.45 *
* C & E Loss (ft)     * 0.00 * Cum SA (acres)      * 0.28 * 0.35 * 0.78 *
*****

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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: Slaughter Run  
REACH: Upper RS: 1254.897

INPUT

Description:  
Station Elevation Data num= 49

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	774	6.71	772	13.4	770	20.15	768	25.35	766
29.5	764	30.7	762	31.77	760	32.78	758	33.69	756
34.75	754	35.95	752	39.1	750	41.52	748	43.87	746
46.23	744.15	49.79	744.39	60.16	744.23	67.51	742.7	67.82	742
71.05	740	76.02	737.59	81.46	737.55	100.58	737.85	105.82	740
115.66	742	119.14	742.92	131.71	744	145.57	744.96	174.61	745.03
206.51	744	215.82	744	227.49	744.1	251.17	746	284.04	746
323.85	745.22	331.07	745.3	341.07	746	363.98	745.71	385.79	748
393.89	748	407.64	748	423.18	748.38	444.59	750.74	460.85	752
470.94	754	483.96	756	494.99	758	510.78	760		

Manning's n Values num= 8

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	49.79	.033	60.16	.04	119.14	.035	145.57	.033
206.51	.035	423.18	.033	444.59	.035				

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
67.51 119.14 46.86 61.48 6.24 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

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*****
* E.G. Elev (ft)      * 751.87 * Element              * Left OB * Channel * Right OB *
* Vel Head (ft)      * 0.00 * wt. n-Val.          * 0.042 * 0.040 * 0.034 *
* W.S. Elev (ft)     * 751.87 * Reach Len. (ft)    * 46.86 * 61.48 * 6.24 *
* Crit W.S. (ft)     * * * Flow Area (sq ft) * 204.43 * 659.34 * 1967.35 *
* E.G. Slope (ft/ft) * 0.000001 * Area (sq ft)      * 204.43 * 659.34 * 1967.35 *

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Addie.rep

* Q Total (cfs)	* 475.00	* Flow (cfs)	* 27.28	* 139.89	* 307.83
* Top width (ft)	* 423.03	* Top width (ft)	* 31.36	* 51.63	* 340.04
* Vel Total (ft/s)	* 0.17	* Avg. Vel. (ft/s)	* 0.13	* 0.21	* 0.16
* Max Chl Dpth (ft)	* 14.32	* Hydr. Depth (ft)	* 6.52	* 12.77	* 5.79
* Conv. Total (cfs)	*441223.3	* Conv. (cfs)	* 25336.8	*129944.7	*285941.8
* Length Wtd. (ft)	* 29.24	* Wetted Per. (ft)	* 34.16	* 53.96	* 340.55
* Min Ch El (ft)	* 737.55	* Shear (lb/sq ft)	* 0.00	* 0.00	* 0.00
* Alpha	* 1.07	* Stream Power (lb/ft s)	* 510.78	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.00	* Cum Volume (acre-ft)	* 1.66	* 9.12	* 11.15
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.13	* 0.24	* 0.55

CROSS SECTION

RIVER: Slaughter Run  
 REACH: Upper RS: 1193.416

INPUT

Description:

Station Elevation Data num= 43

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	769.65	6.83	768	10.93	766	14.43	764	17.56	762
20.4	760	23.37	758	26.25	756	29.19	754	32.17	752
35.12	750	38.14	748	40.99	746	41.4	745.86	51.01	745.83
55.47	744.2	58.11	742	61.5	735.2	66.2	734.58	113.09	736.59
121.35	738	130.88	740	137.58	742	148.24	744	162.44	744.96
192.93	745.02	221.11	744.7	241.98	744	248.7	744	262.31	744.6
335.28	744.72	369.64	745.02	385.58	746	400.02	745.43	434.47	748
440.24	747.75	465.68	748.74	477.59	749.01	507.57	752.62	511.48	754
519.66	756	533.72	758	553.37	760				

Manning's n Values num= 10

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	41.4	.033	51.01	.04	148.24	.035
221.11	.035	369.64	.1	440.24	.035	477.59	.033

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 51.01 148.24 87.84 47.78 18.54 .1 .3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
38.14	58.28	747.2	F
74.11	335.28	746.86	F

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 751.87	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.00	* Wt. n-Val.	* 0.038	* 0.040	* 0.039
* W.S. Elev (ft)	* 751.87	* Reach Len. (ft)	* 14.10	* 14.10	* 14.10
* Crit W.S. (ft)	* 738.29	* Flow Area (sq ft)	* 85.48	* 1352.61	* 2144.75

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Addie.rep
* E.G. Slope (ft/ft)      *0.000001 * Area (sq ft)          * 85.48 * 1352.61 * 2144.75 *
* Q Total (cfs)          * 475.00 * Flow (cfs)            * 7.74 * 229.88 * 237.37 *
* Top Width (ft)         * 468.99 * Top width (ft)        * 18.65 * 97.23 * 353.11 *
* Vel Total (ft/s)       * 0.13 * Avg. vel. (ft/s)     * 0.09 * 0.17 * 0.11 *
* Max Chl Dpth (ft)     * 17.29 * Hydr. Depth (ft)     * 4.58 * 13.91 * 6.07 *
* Conv. Total (cfs)     *576360.2 * Conv. (cfs)          * 9395.9 *278939.9 *288024.4 *
* Length Wtd. (ft)      * 14.10 * Wetted Per. (ft)     * 20.48 * 103.41 * 353.50 *
* Min Ch El (ft)        * 734.58 * Shear (lb/sq ft)     * 0.00 * 0.00 * 0.00 *
* Alpha                  * 1.15 * Stream Power (lb/ft s) * 553.37 * 0.00 * 0.00 *
* Frctn Loss (ft)       * 0.00 * Cum Volume (acre-ft) * 1.50 * 7.70 * 10.86 *
* C & E Loss (ft)       * 0.00 * Cum SA (acres)       * 0.11 * 0.14 * 0.50 *
*****

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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.

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

BRIDGE

RIVER: Slaughter Run

REACH: Upper RS: 1172.84

INPUT

Description:

Distance from Upstream XS = 14.1

Deck/Roadway width = 29

Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates

num= 24

Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
38.91	747.97			44.64	747.87	49.28	747.77							
53.96	747.69			57.85	747.4	60.17	747.2							
60.28	747.03	742.87		72.11	746.86	742.87	80.15	746.76						
89.97	746.74			101.09	746.73	107.02	746.72							
118.44	746.63			128.62	746.55	142.45	746.44							
153.74	746.39			166.47	746.33	174.57	746.26							
181.98	746.19			191.82	746.1	206.71	745.92							
216.95	745.8			248.79	745.65	335.28	744.72							

Upstream Bridge Cross Section Data

Station Elevation Data

num= 43

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	769.65	6.83	768	10.93	766	14.43	764	17.56	762
20.4	760	23.37	758	26.25	756	29.19	754	32.17	752
35.12	750	38.14	748	40.99	746	41.4	745.86	51.01	745.83
55.47	744.2	58.11	742	61.5	735.2	66.2	734.58	113.09	736.59
121.35	738	130.88	740	137.58	742	148.24	744	162.44	744.96

Addie.rep

192.93	745.02	221.11	744.7	241.98	744	248.7	744	262.31	744.6
335.28	744.72	369.64	745.02	385.58	746	400.02	745.43	434.47	748
440.24	747.75	465.68	748.74	477.59	749.01	507.57	752.62	511.48	754
519.66	756	533.72	758	553.37	760				

Manning's n Values num= 10

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.1	41.4	.033	51.01	.04	148.24	.035	162.44	.033
221.11	.035	369.64	.1	440.24	.035	477.59	.033	507.57	.035

Bank Sta: Left Right Coeff Contr. Expan.

51.01	148.24		.1	.3
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Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
38.14	58.28	747.2	F
74.11	335.28	746.86	F

Downstream Deck/Roadway Coordinates

num= 5

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
41.8	748.1		118.23	746.59	743.11	130.06	746.49	743.11
156.06	746.16		187.51	745.74				

Downstream Bridge Cross Section Data

Station Elevation Data num= 60

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760.84	1.23	760	4.37	758	8.08	756	12.62	754
16.99	752	21.72	750	26.55	748	29.76	746.62	37.08	747.87
41.8	748.1	61.45	747.61	83.96	746.73	97.41	746	106.75	744
111.11	742	114.3	740	115.76	738	117.93	736	118.38	735.2
124.15	735.31	130.78	735.26	131.28	736	132.43	738	134.6	740
142.86	742	149.35	744	156.83	746	160.11	746.1	179.98	746.4
198.4	746.6	215.57	745.9	226.09	744.98	234.79	747.15	249.23	746
258.11	745.58	264.24	746	298.31	743.53	317.21	743.35	329.96	743.64
357.21	744.08	366.32	746	375.86	744.98	391.56	744.82	412.11	744.59
419.91	746	438.14	746	447.48	744.64	483.57	746.05	500.41	748
512.6	749.14	517.62	750	525.5	750	547.2	749.4	572.66	750.84
582.58	752	591.91	754	603.91	756	621.74	758	636.46	760

Manning's n Values num= 9

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	41.8	.013	83.96	.04	156.83	.04	160.11	.013
198.4	.033	215.57	.035	329.96	.1	547.2	.035		

Bank Sta: Left Right Coeff Contr. Expan.

97.41	156.83		.1	.3
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Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-------	-------	------	-----------

61.45 116.23 746.59 F  
 132 160.11 746.49 F

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 Bridge Coefficient Sets = 1

Low Flow Methods and Data

Energy

Selected Low Flow Methods = Highest Energy Answer

High Flow Method

Energy Only

Additional Bridge Parameters

Add Friction component to Momentum

Do not add weight component to Momentum

Class B flow critical depth computations use critical depth  
 inside the bridge at the upstream end

Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT Profile #PF 1

```

*****
* E.G. US. (ft) * 751.87 * Element *Inside BR US *Inside BR DS *
* W.S. US. (ft) * 751.87 * E.G. Elev (ft) * 751.87 * 751.87 *
* Q Total (cfs) * 475.00 * W.S. Elev (ft) * 751.87 * 751.87 *
* Q Bridge (cfs) * 9.77 * Crit W.S. (ft) * 738.65 * 738.88 *
* Q Weir (cfs) * * * Max Chl Dpth (ft) * 17.29 * 16.67 *
* Weir Sta Lft (ft) * * * Vel Total (ft/s) * 0.18 * 0.15 *
* Weir Sta Rgt (ft) * * * Flow Area (sq ft) * 2612.36 * 3154.16 *
* Weir Submerg * * * Froude # chl * 0.01 * 0.01 *
* Weir Max Depth (ft) * * * Specif Force (cu ft) * 8472.65 * 10519.10 *
* Min El Weir Flow (ft) * 745.03 * Hydr Depth (ft) * 5.57 * 5.59 *
* Min El Prs Flow (ft) * 742.87 * W.P. Total (ft) * 509.82 * 606.23 *
* Delta EG (ft) * 0.00 * Conv. Total (cfs) * 304019.0 * 381968.1 *
* Delta WS (ft) * 0.00 * Top width (ft) * 468.98 * 564.18 *
* BR Open Area (sq ft) * 93.77 * Frctn Loss (ft) * 0.00 * 0.00 *
* BR Open vel (ft/s) * 0.10 * C & E Loss (ft) * 0.00 * 0.00 *
* Coef of Q * * * Shear Total (lb/sq ft) * 0.00 * 0.00 *
* Br Sel Method *Energy only * Power Total (lb/ft s) * 0.00 * 0.00 *
*****
    
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Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

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

CROSS SECTION

RIVER: Slaughter Run  
 REACH: Upper

RS: 1144.785

INPUT

Description:

Station Elevation Data num= 60

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760.84	1.23	760	4.37	758	8.08	756	12.62	754
16.99	752	21.72	750	26.55	748	29.76	746.62	37.08	747.87
41.8	748.1	61.45	747.61	83.96	746.73	97.41	746	106.75	744
111.11	742	114.3	740	115.76	738	117.93	736	118.38	735.2
124.15	735.31	130.78	735.26	131.28	736	132.43	738	134.6	740
142.86	742	149.35	744	156.83	746	160.11	746.1	179.98	746.4
198.4	746.6	215.57	745.9	226.09	744.98	234.79	747.15	249.23	746
258.11	745.58	264.24	746	298.31	743.53	317.21	743.35	329.96	743.64
357.21	744.08	366.32	746	375.86	744.98	391.56	744.82	412.11	744.59
419.91	746	438.14	746	447.48	744.64	483.57	746.05	500.41	748
512.6	749.14	517.62	750	525.5	750	547.2	749.4	572.66	750.84
582.58	752	591.91	754	603.91	756	621.74	758	636.46	760

Manning's n Values num= 9

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	41.8	.013	83.96	.04	156.83	.04	160.11	.013
198.4	.033	215.57	.035	329.96	.1	547.2	.035		

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

97.41	156.83	26.39	34.4	7.76		.1	.3
-------	--------	-------	------	------	--	----	----

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
61.45	116.23	746.59	F
132	160.11	746.49	F

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 751.87	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.00	* wt. n-Val.	* 0.019	* 0.040	* 0.043
* W.S. Elev (ft)	* 751.87	* Reach Len. (ft)	* 26.39	* 34.40	* 7.76
* Crit W.S. (ft)	* 738.56	* Flow Area (sq ft)	* 343.61	* 653.64	* 2417.71
* E.G. Slope (ft/ft)	* 0.000001	* Area (sq ft)	* 343.61	* 653.64	* 2417.71
* Q Total (cfs)	* 475.00	* Flow (cfs)	* 75.39	* 115.48	* 284.13
* Top width (ft)	* 564.18	* Top width (ft)	* 80.11	* 59.42	* 424.64
* Vel Total (ft/s)	* 0.14	* Avg. Vel. (ft/s)	* 0.22	* 0.18	* 0.12
* Max Chl Dpth (ft)	* 16.67	* Hydr. Depth (ft)	* 4.29	* 11.00	* 5.69
* Conv. Total (cfs)	* 460391.4	* Conv. (cfs)	* 73069.6	* 111930.0	* 275391.9
* Length Wtd. (ft)	* 18.21	* Wetted Per. (ft)	* 81.33	* 66.04	* 425.99
* Min Ch El (ft)	* 735.20	* Shear (lb/sq ft)	* 0.00	* 0.00	* 0.00

Addie.rep

```
* Alpha * 1.21 * Stream Power (lb/ft s) * 636.46 * 0.00 * 0.00 *
* Frctn Loss (ft) * 0.00 * Cum Volume (acre-ft) * 1.31 * 7.00 * 8.48 *
* C & E Loss (ft) * 0.00 * Cum SA (acres) * 0.06 * 0.05 * 0.08 *
*****
```

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

CROSS SECTION

RIVER: Slaughter Run  
 REACH: Upper RS: 1109.953

INPUT

Description:

Station Elevation Data		num= 58		Sta Elev		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	759.43	2.25	758	5.45	756	8.53	754	11.78	752		
15.12	750	18.18	748	21.1	746.74	27.9	748	30.33	748.45		
32.44	748.47	48.94	748.04	67.05	747.35	89.08	746	111.6	745.1		
126.39	744.76	129.04	744	136.03	742	138.04	741.43	146.99	740.41		
151.91	740	158.65	738	163.62	736	167.15	734.64	175.36	734.91		
177.73	736	182.13	738	185.9	740	188.22	741.15	201.54	741.65		
207.13	742	217.57	743.23	224.43	744	237.81	744.66	249.05	745.59		
262.25	746.09	280.07	746.36	290.86	744.38	299.17	746.92	316.27	746		
333.3	743.4	341.68	744	356.62	742.84	369.66	744	381.83	743.71		
394.69	746	440.99	748	484.92	746	490.89	746	516.83	745.5		
543.79	748	578.09	750	607.43	749.72	634.46	752	651.44	754		
665.32	756	674.29	758	689.35	760						

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	.035	32.44	.013	67.05	.04	237.81	.033	249.05	.013
280.07	.035	333.3	.1	607.43	.035				

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 126.39 188.22 1 1 1 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

```
*****
* E.G. Elev (ft) * 751.87 * Element * Left OB * Channel * Right OB *
* Vel Head (ft) * 0.00 * Wt. n-Val. * 0.028 * 0.040 * 0.046 *
* W.S. Elev (ft) * 751.87 * Reach Len. (ft) * 159.48 * 159.48 * 159.48 *
* Crit W.S. (ft) * * Flow Area (sq ft) * 566.23 * 796.16 * 2491.15 *
* E.G. Slope (ft/ft) * 0.000001 * Area (sq ft) * 566.23 * 796.16 * 2491.15 *
* Q Total (cfs) * 475.00 * Flow (cfs) * 83.08 * 146.49 * 245.43 *
* Top width (ft) * 620.93 * Top width (ft) * 114.39 * 61.83 * 444.71 *
* Vel Total (ft/s) * 0.12 * Avg. Vel. (ft/s) * 0.15 * 0.18 * 0.10 *
* Max chl Dpth (ft) * 17.23 * Hydr. Depth (ft) * 4.95 * 12.88 * 5.60 *
```

Addie.rep

* Conv. Total (cfs)	* 510920.4	* Conv. (cfs)	* 89358.5	* 157567.3	* 263994.6	*
* Length Wtd. (ft)	* 159.48	* Wetted Per. (ft)	* 116.01	* 64.75	* 446.37	*
* Min Ch El (ft)	* 734.64	* Shear (lb/sq ft)	* 0.00	* 0.00	* 0.00	*
* Alpha	* 1.27	* Stream Power (lb/ft s)	* 689.35	* 0.00	* 0.00	*
* Frctn Loss (ft)	* 0.03	* Cum Volume (acre-ft)	* 1.04	* 6.43	* 8.04	*
* C & E Loss (ft)	* 0.02	* Cum SA (acres)	*	*	*	*

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SUMMARY OF MANNING'S N VALUES

River: Middle Island

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* Reach	* River Sta.	* n1	* n2	* n3	* n4	* n5	* n6	* n7	* n8	* n9
---------	--------------	------	------	------	------	------	------	------	------	------

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* Upper	* 4090.965	* .035*	* .033*	* .035*	* .05*	* .04*	* .06*	* .035*	*
* Upper	* 3845.927	* .035*	* .033*	* .035*	* .05*	* .04*	* .06*	* .013*	* .035*
* Upper	* 3639.909	* .035*	* .033*	* .035*	* .05*	* .04*	* .05*	* .013*	* .035*
* Upper	* 3475.882	* .035*	* .033*	* .035*	* .05*	* .04*	* .035*	* .013*	* .035*
* Upper	* 3409.950	* .035*	* .033*	* .035*	* .04*	* .05*	* .013*	* .035*	*
* Upper	* 3399.61	* Bridge	*	*	*	*	*	*	*
* Upper	* 3387.185	* .035*	* .033*	* .035*	* .04*	* .05*	* .033*	* .013*	* .035*
* Upper	* 3301.469	* .035*	* .033*	* .035*	* .04*	* .05*	* .013*	* .035*	*
* Upper	* 3039.998	* .035*	* .033*	* .06*	* .04*	* .05*	* .013*	* .035*	*
* Upper	* 2944.331	* .035*	* .033*	* .035*	* .033*	* .06*	* .04*	* .05*	* .013*
* Upper	* 2829.179	* .035*	* .033*	* .06*	* .04*	* .06*	* .013*	* .035*	*
* Lower	* 2730.129	* .035*	* .033*	* .06*	* .04*	* .06*	* .013*	* .1*	*
* Lower	* 2457.936	* .06*	* .04*	* .06*	* .013*	* .1*	*	*	*
* Lower	* 2259.266	* .035*	* .033*	* .06*	* .04*	* .06*	* .013*	* .1*	*
* Lower	* 2049.716	* .035*	* .033*	* .035*	* .06*	* .04*	* .06*	* .035*	* .013*
* Lower	* 1840.209	* .035*	* .033*	* .06*	* .04*	* .06*	* .035*	* .013*	* .1*
* Lower	* 1632.735	* .035*	* .033*	* .06*	* .04*	* .06*	* .035*	* .013*	* .1*

*Lower	*	1414.824	*	.035*	.033*	Addie.rep .06*	.04*	.06*	.013*	.1*	*
*Lower	*	1000.000	*	.035*	.033*	.035*	.06*	.04*	.06*	.035*	.013*

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River:Slaughter Run

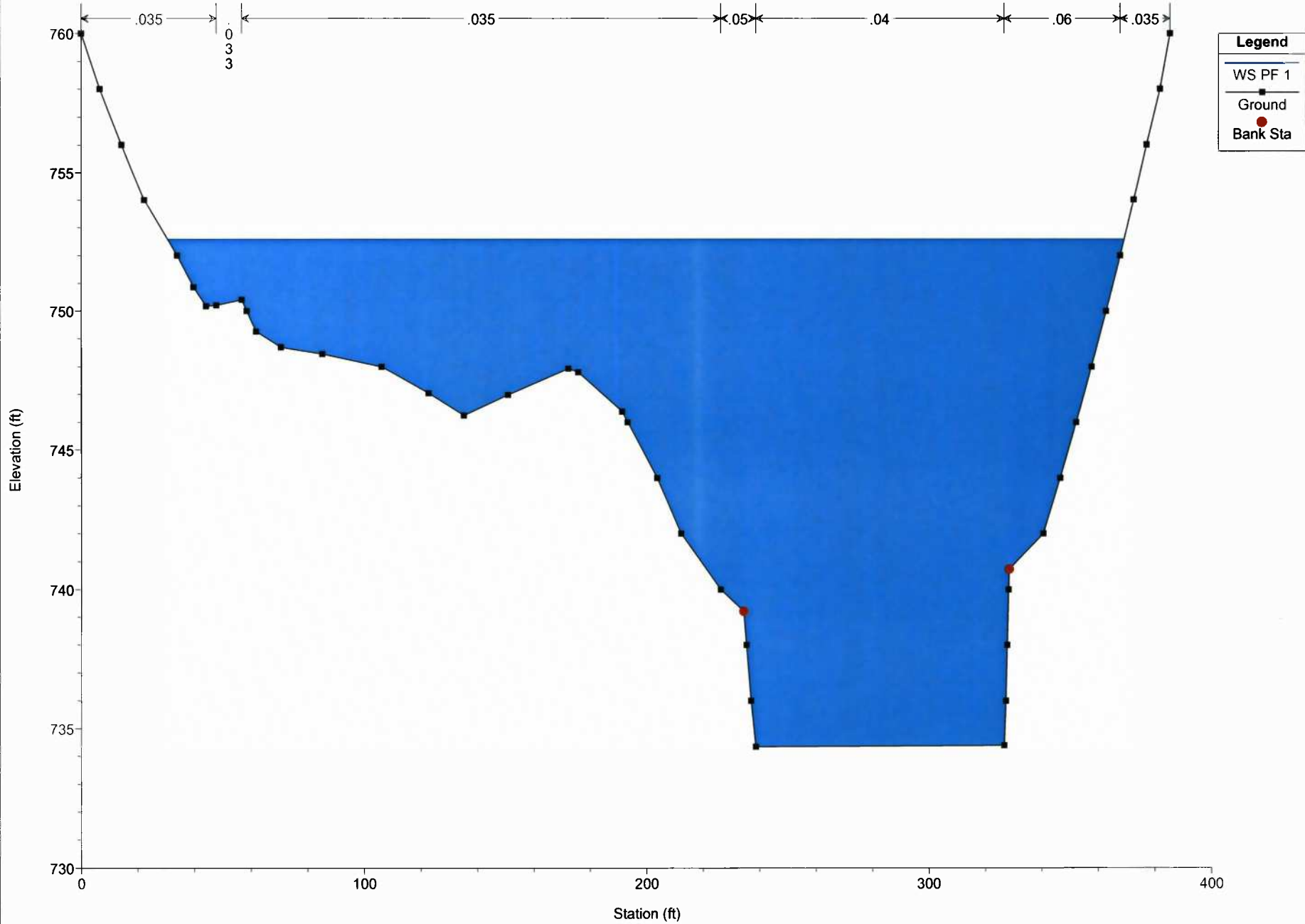
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\*\*\*\*\*

* Reach	* River Sta.	* n1	* n2	* n3	* n4	* n5	* n6	* n7	* n8	* n9
* n10										
*Upper	* 1724.607	* .1*	* .04*	* .1*	* .033*	* .1*	* *	* *	* *	
*Upper	* 1544.864	* .1*	* .04*	* .1*	* .033*	* .1*	* *	* *	* *	
*Upper	* 1344.324	* .1*	* .04*	* .1*	* .033*	* .035*	* .033*	* .035*	* .1*	
*Upper	* 1254.897	* .1*	* .033*	* .04*	* .035*	* .033*	* .035*	* .033*	* .035*	
*Upper	* 1193.416	* .1*	* .033*	* .04*	* .035*	* .033*	* .035*	* .1*	* .035*	
*Upper	* 1172.84	* Bridge	* *	* *	* *	* *	* *	* *	* *	
*Upper	* 1144.785	* .035*	* .013*	* .04*	* .04*	* .013*	* .033*	* .035*	* .1*	
*Upper	* 1109.953	* .035*	* .013*	* .04*	* .033*	* .013*	* .035*	* .1*	* .035*	

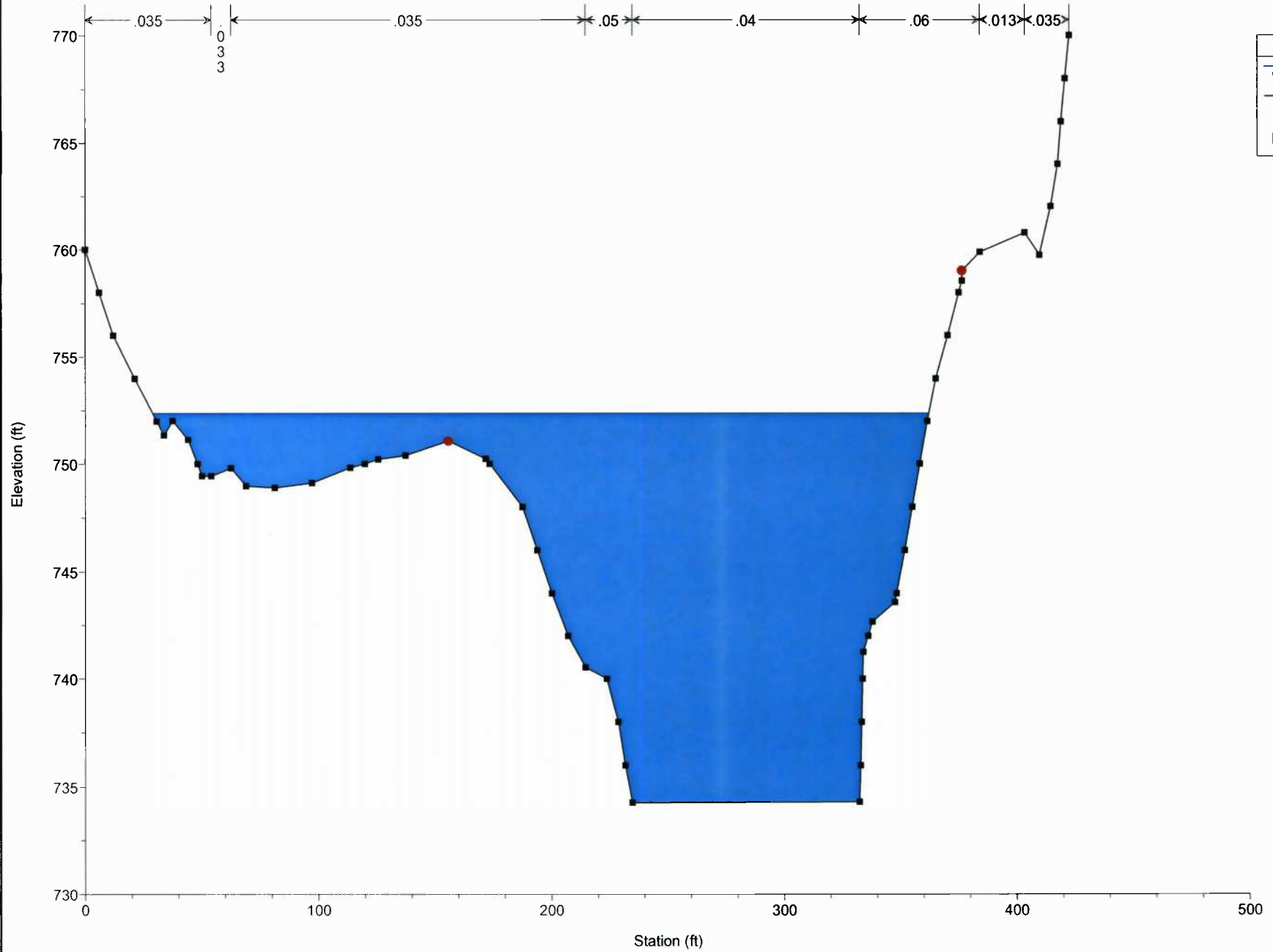
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Addie Plan: Existing  
Geom: Existing Flow: Existing 100YR  
River = Middle Island Reach = Upper RS = 4090.965

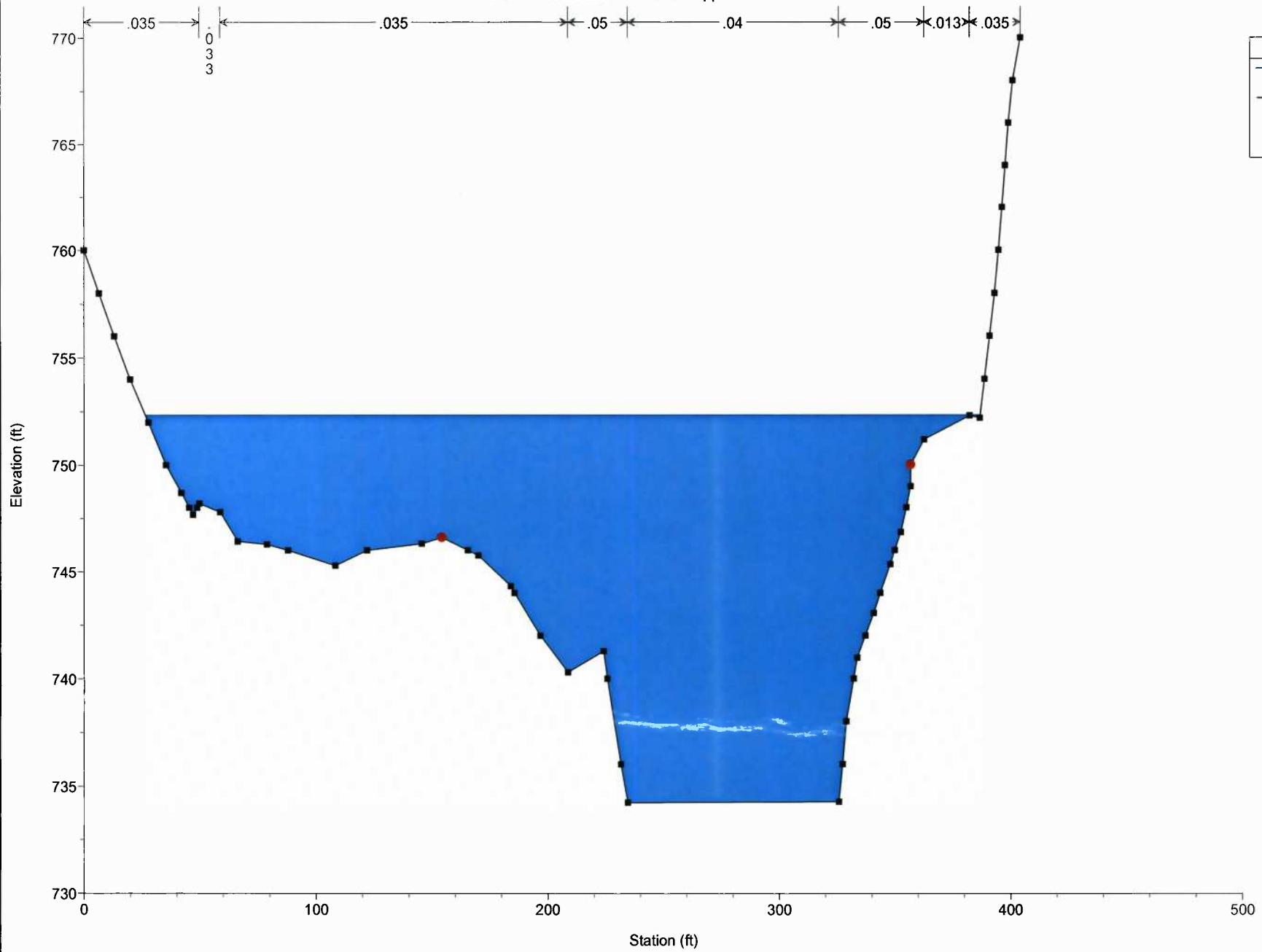


Addie Plan: Existing  
Geom: Existing Flow: Existing 100YR  
River = Middle Island Reach = Upper RS = 3845.927

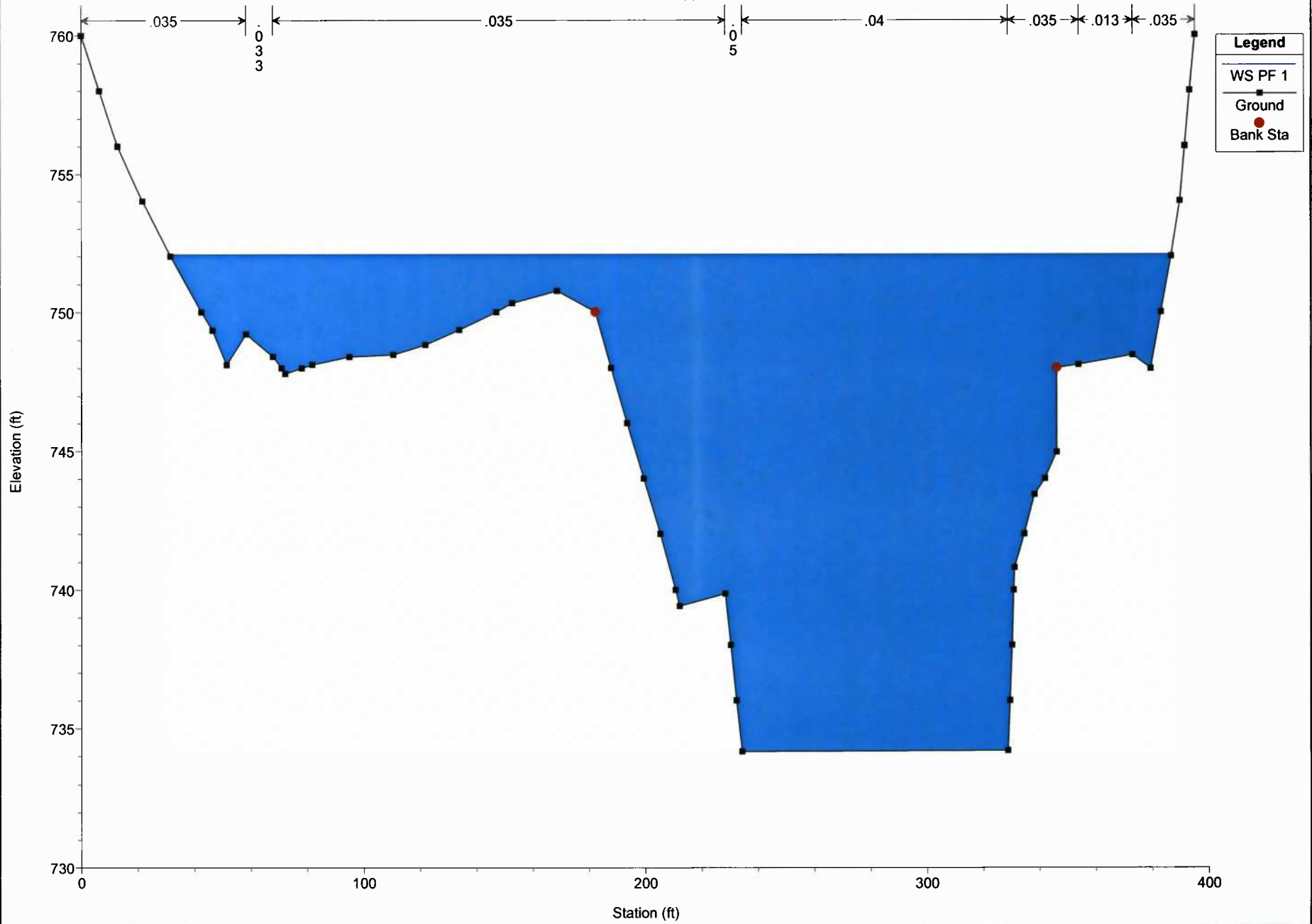


Legend	
WS PF 1	■
Ground	■
Bank Sta	●

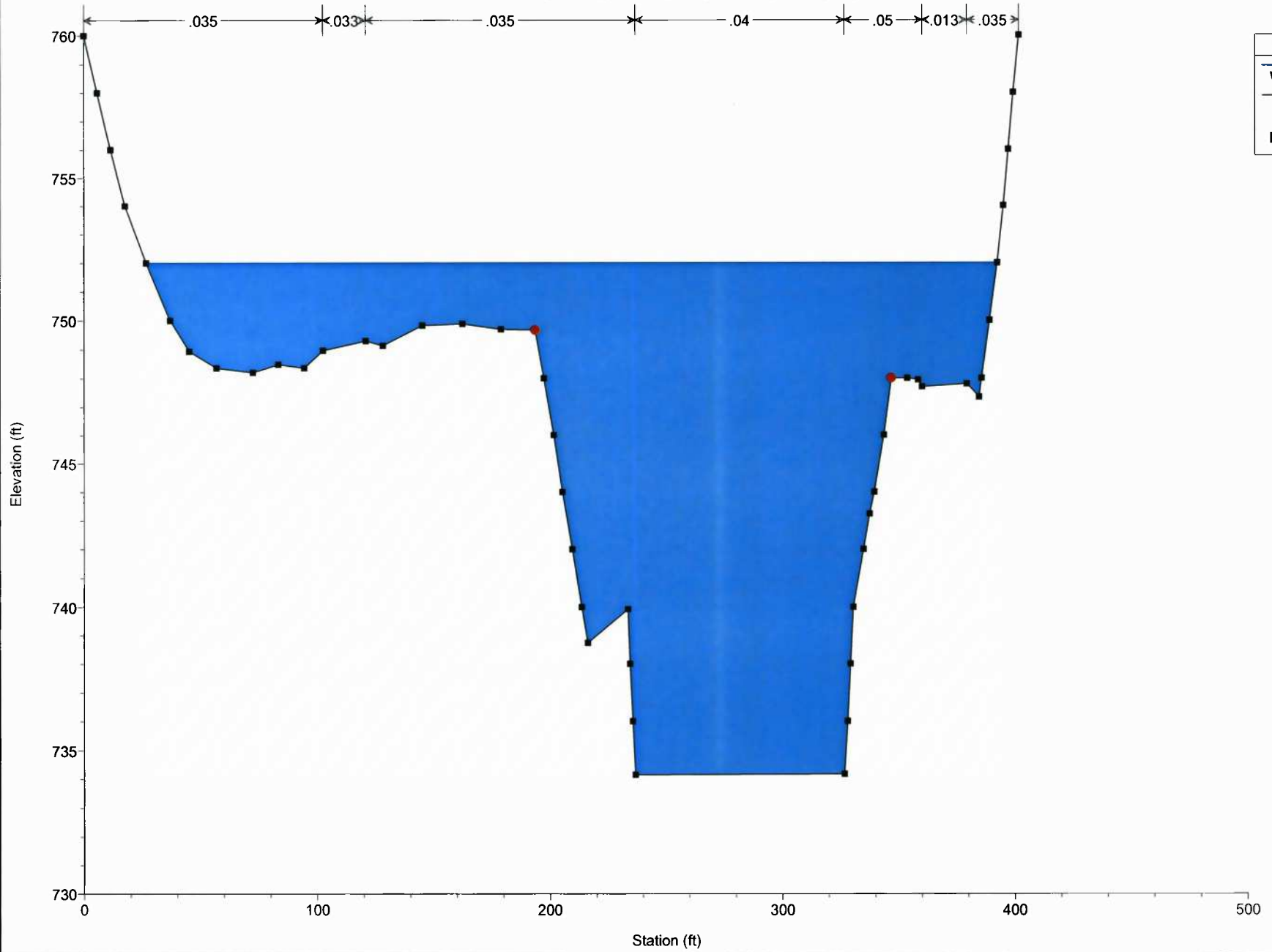
Addie Plan: Existing  
Geom: Existing Flow: Existing 100YR  
River = Middle Island Reach = Upper RS = 3639.909



Addie Plan: Existing  
Geom: Existing Flow: Existing 100YR  
River = Middle Island Reach = Upper RS = 3475.882



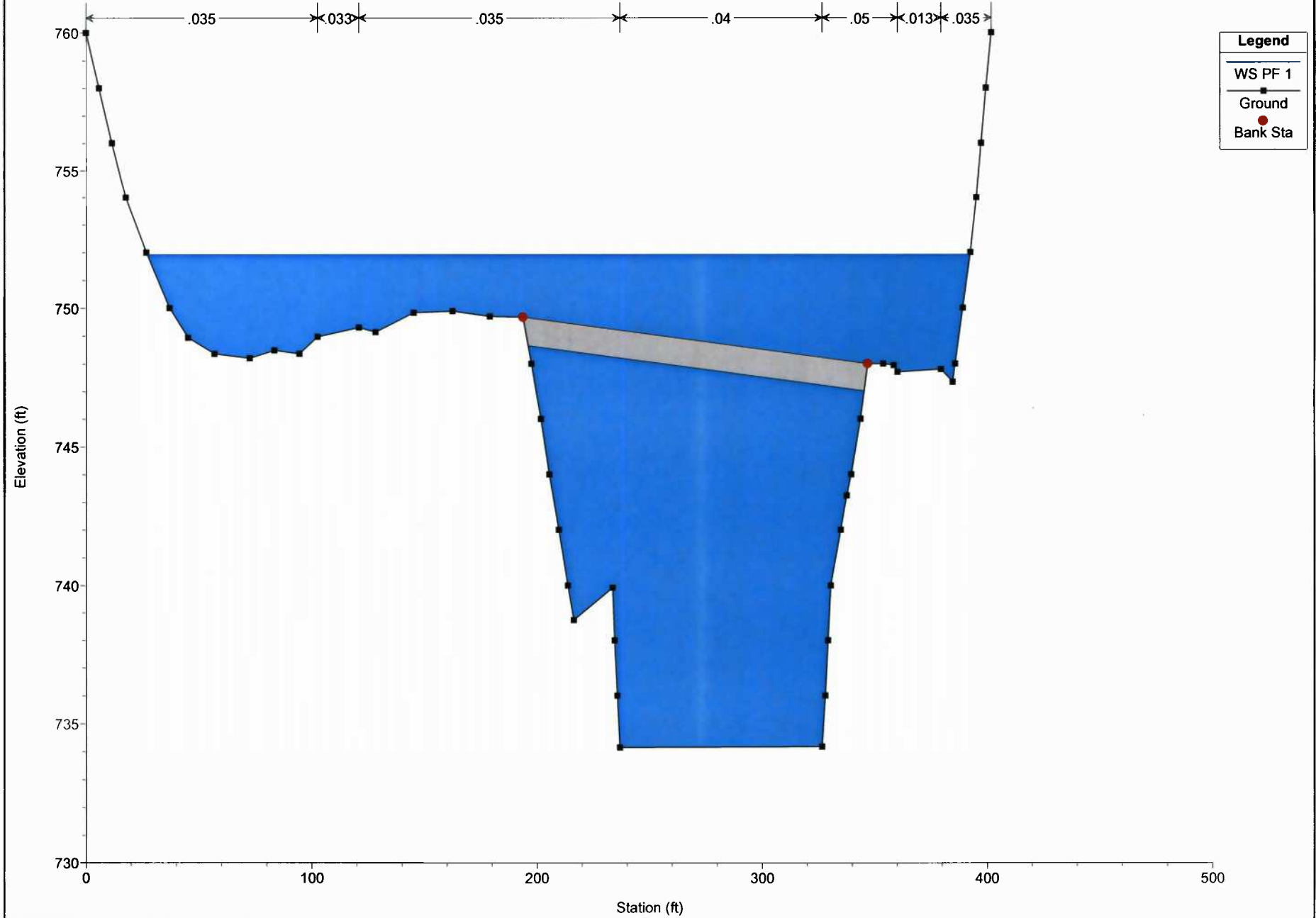
Addie Plan: Existing  
Geom: Existing Flow: Existing 100YR  
River = Middle Island Reach = Upper RS = 3409.950



Addie Plan: Existing

Geom: Existing Flow: Existing 100YR

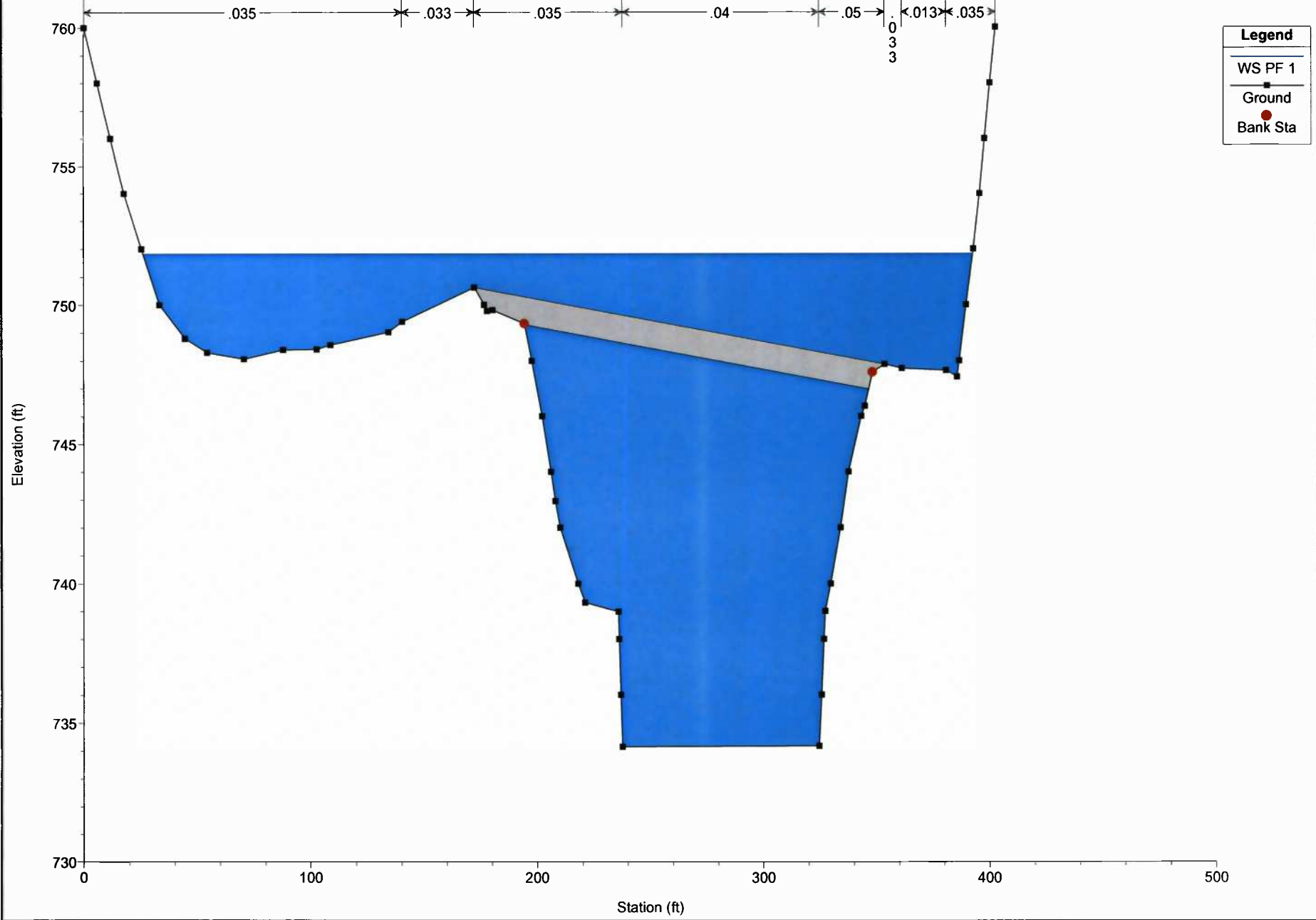
River = Middle Island Reach = Upper RS = 3399.61 BR



Addie Plan: Existing

Geom: Existing Flow: Existing 100YR

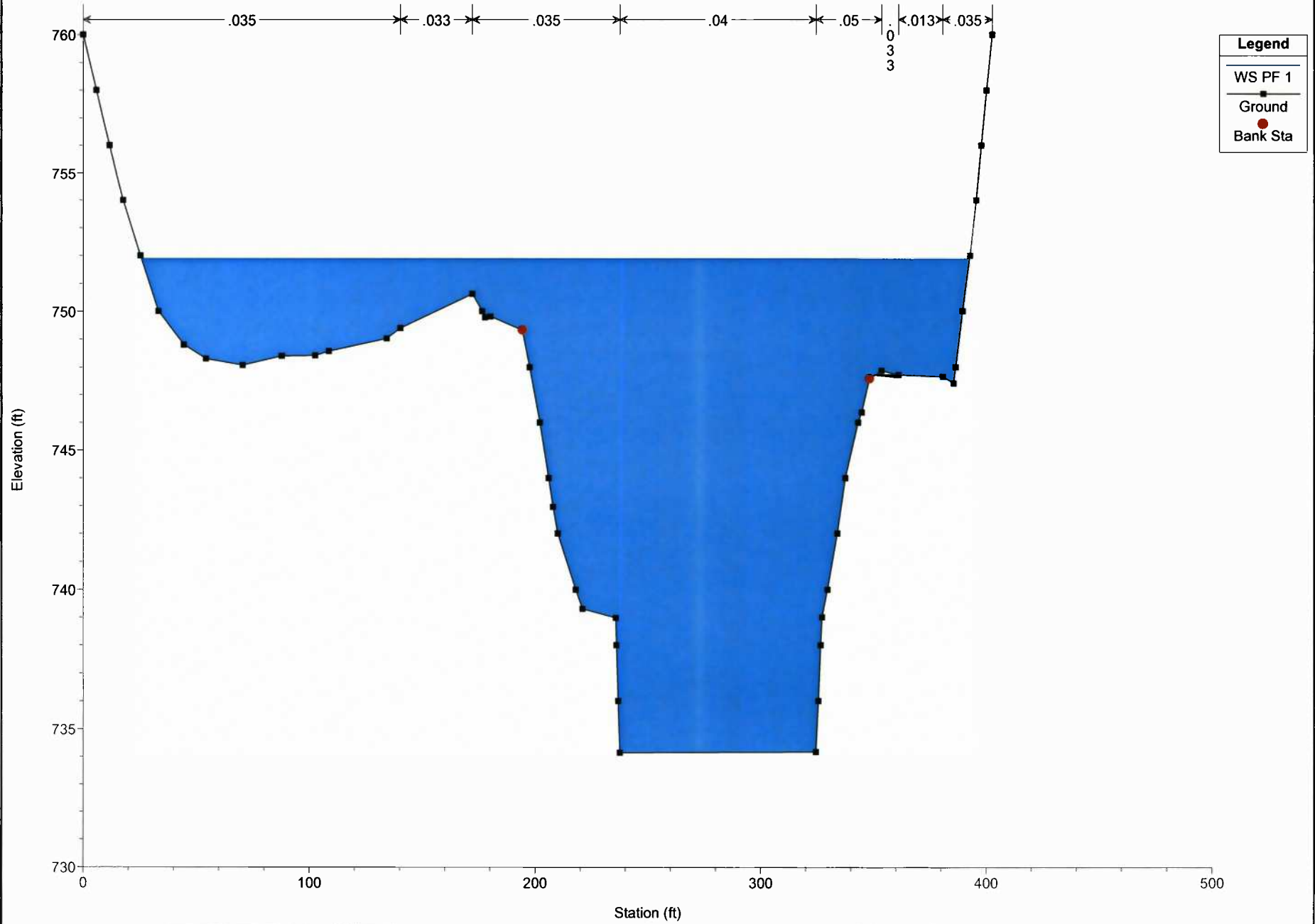
River = Middle Island Reach = Upper RS = 3399.61 BR



Addie Plan: Existing

Geom: Existing Flow: Existing 100YR

River = Middle Island Reach = Upper RS = 3387.185

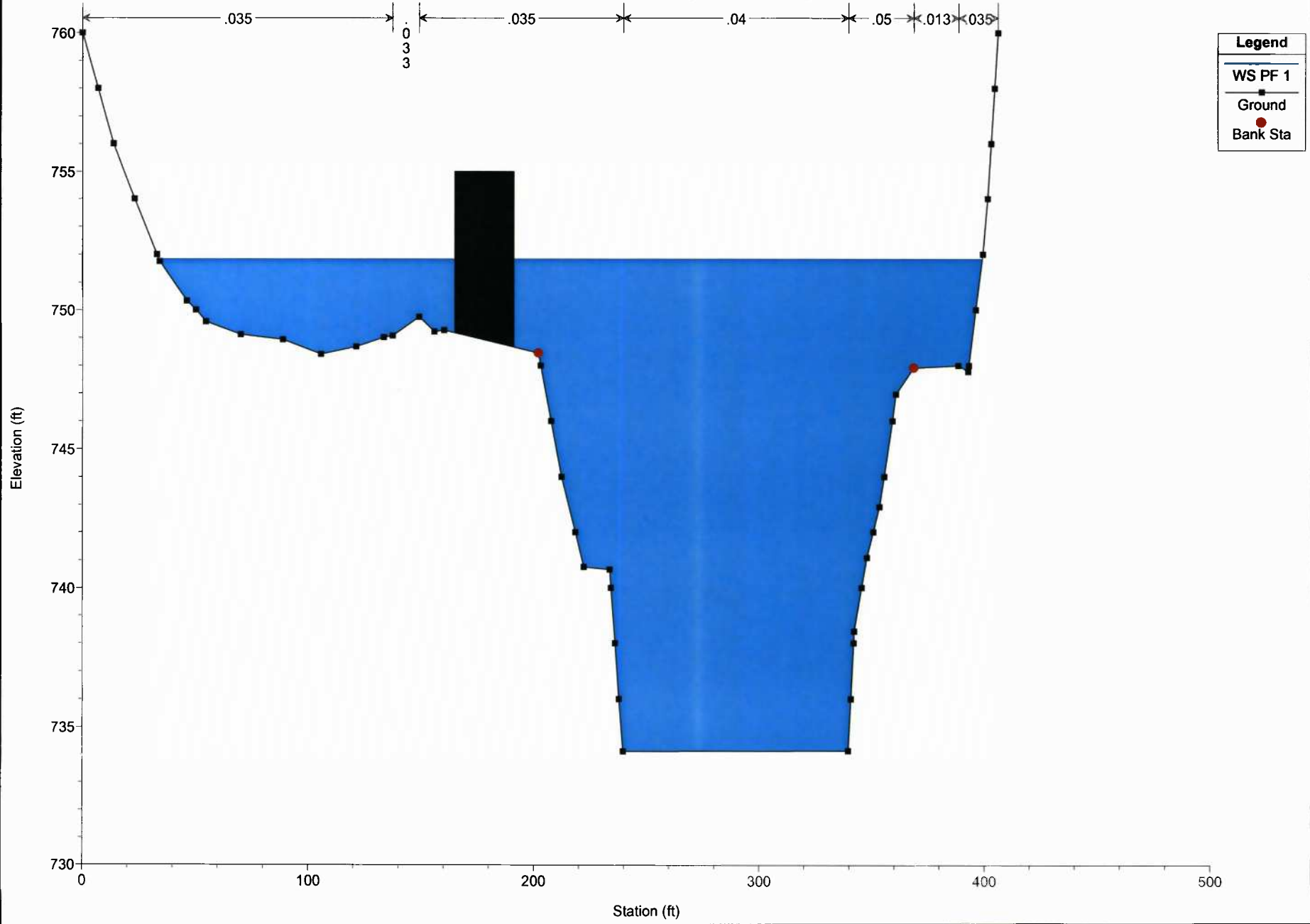




Addie Plan: Existing

Geom: Existing Flow: Existing 100YR

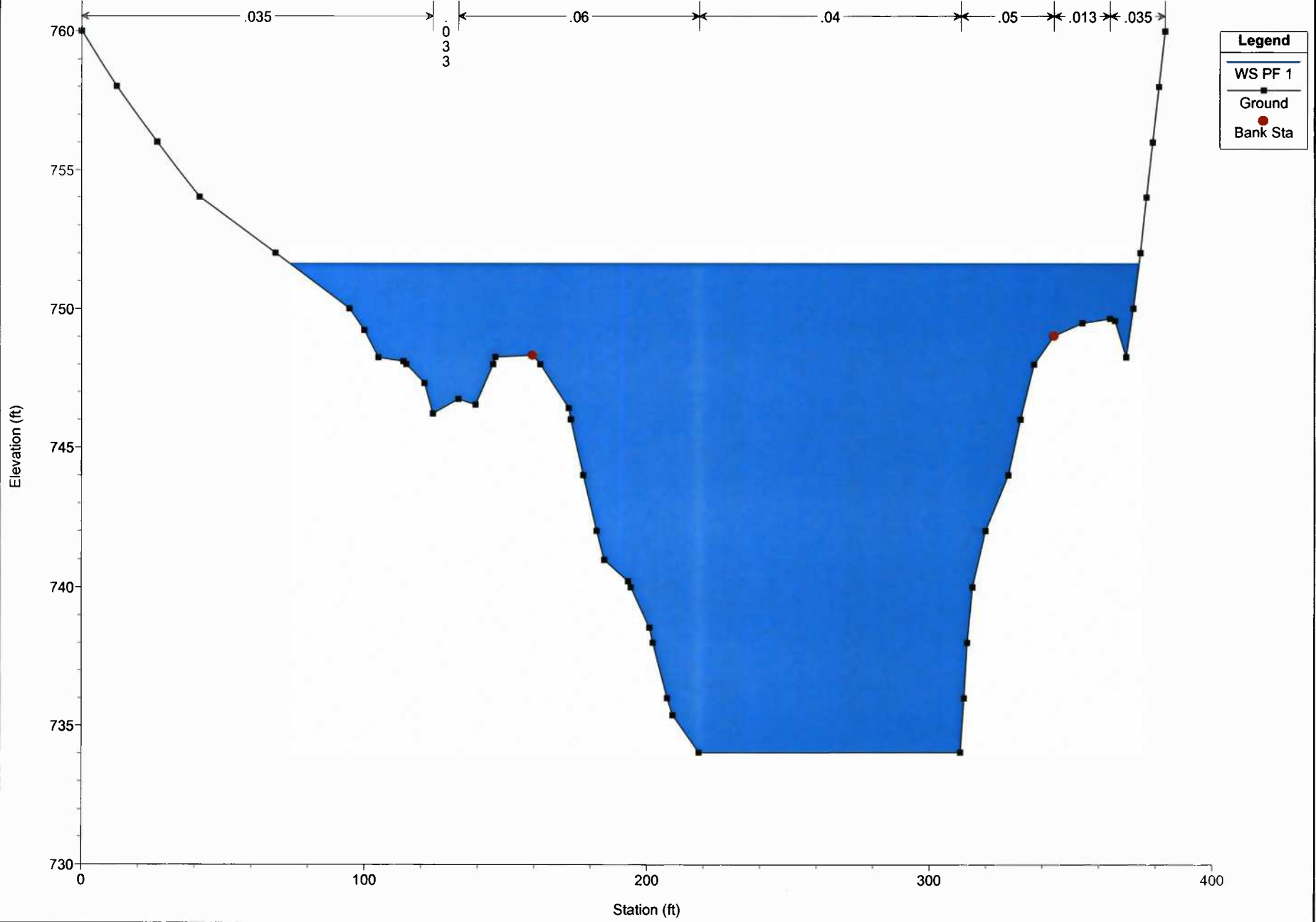
River = Middle Island Reach = Upper RS = 3301.469



Addie Plan: Existing

Geom: Existing Flow: Existing 100YR

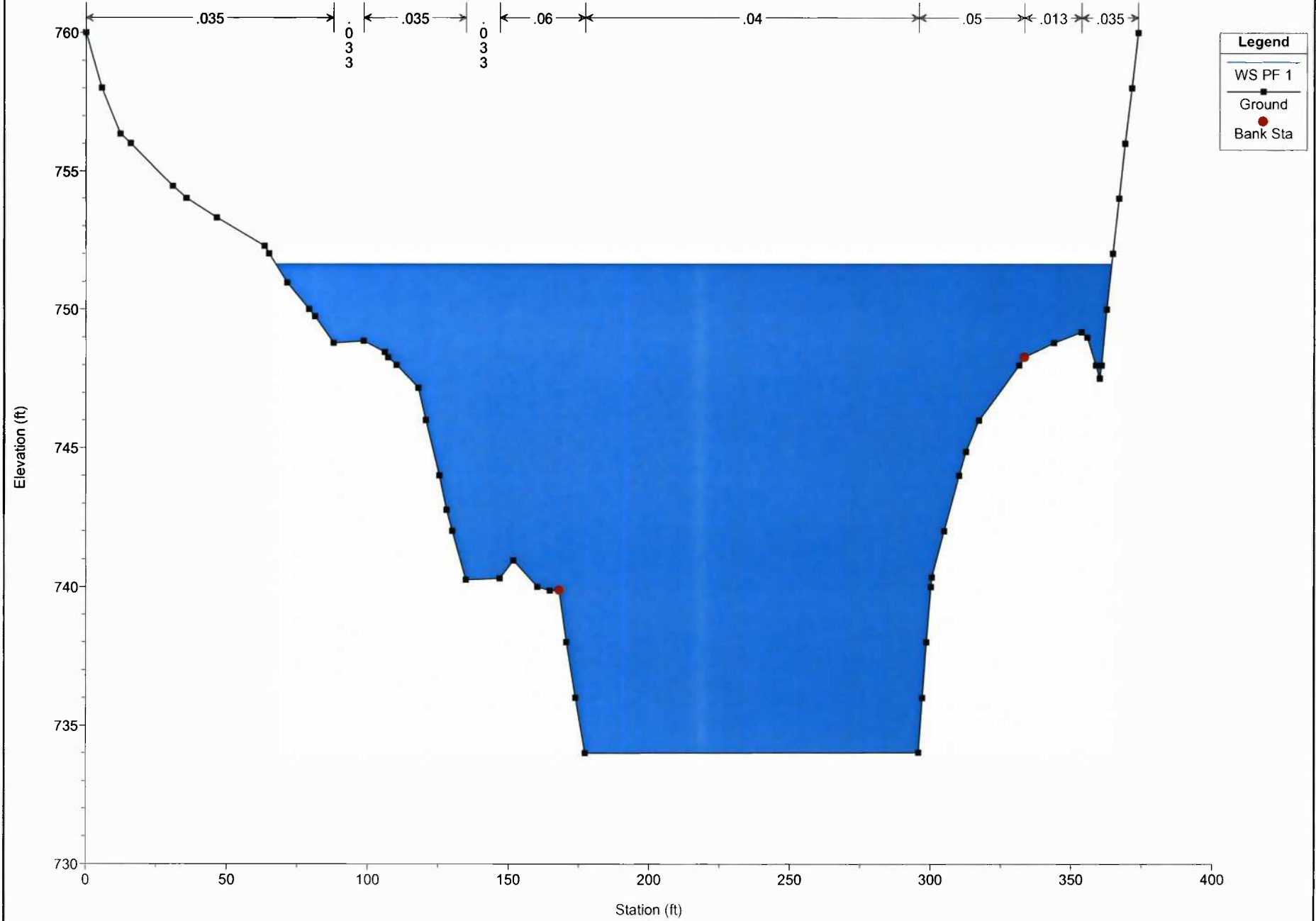
River = Middle Island Reach = Upper RS = 3039.998



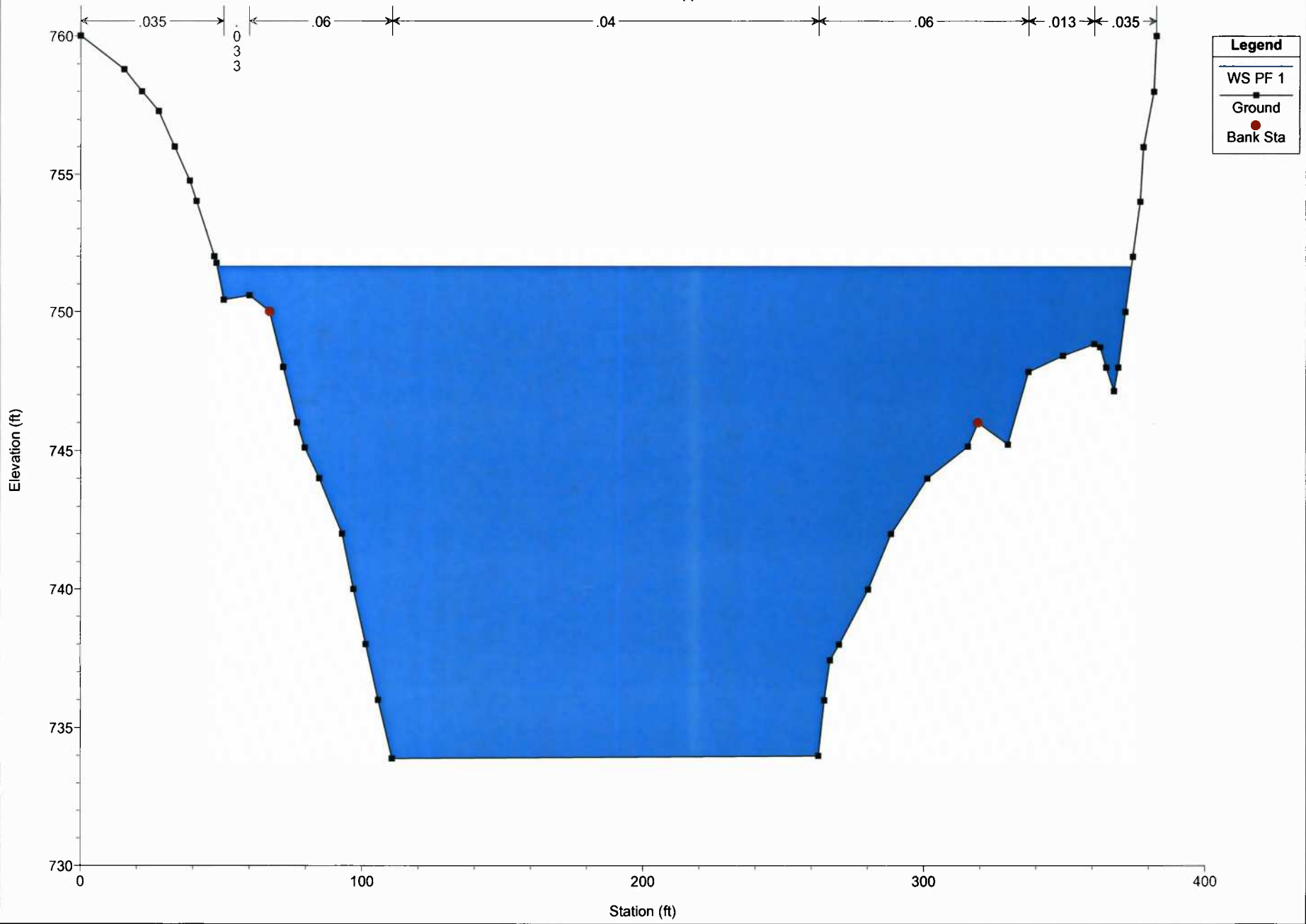
Addie Plan: Existing

Geom: Existing Flow: Existing 100YR

River = Middle Island Reach = Upper RS = 2944.331



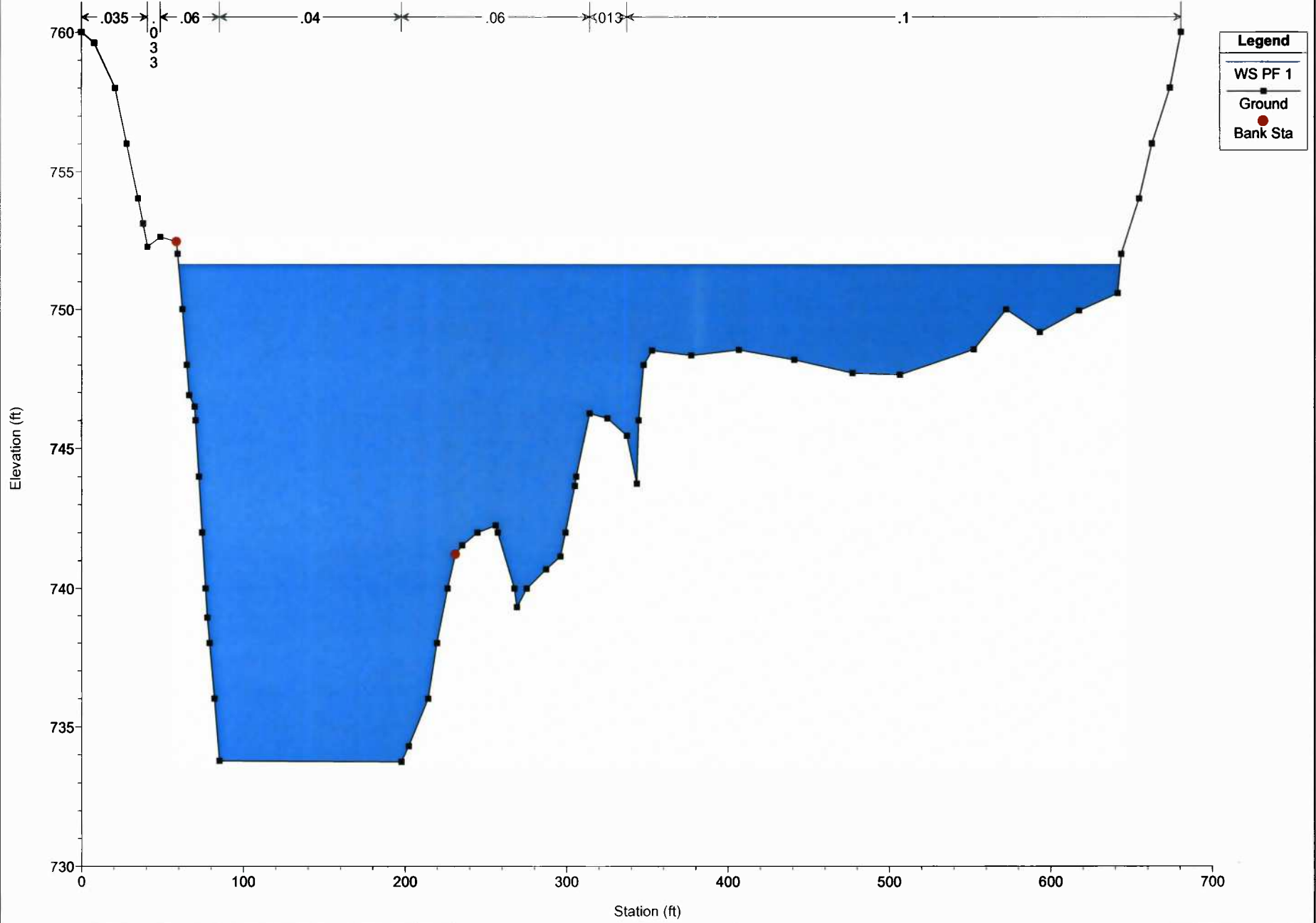
Addie Plan: Existing  
Geom: Existing Flow: Existing 100YR  
River = Middle Island Reach = Upper RS = 2829.179



Addie Plan: Existing

Geom: Existing Flow: Existing 100YR

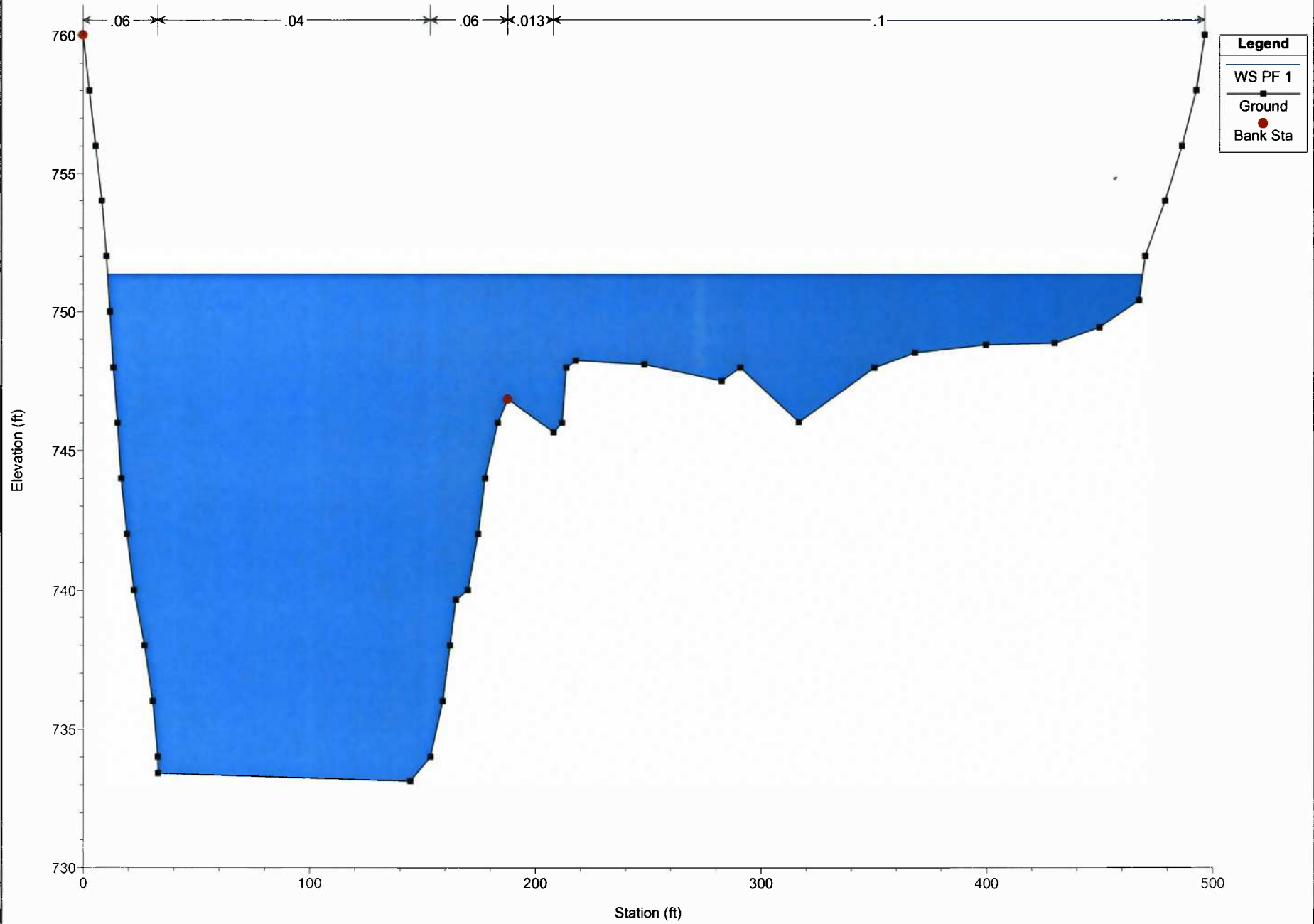
River = Middle Island Reach = Lower RS = 2730.129



Addie Plan: Existing

Geom: Existing Flow: Existing 100YR

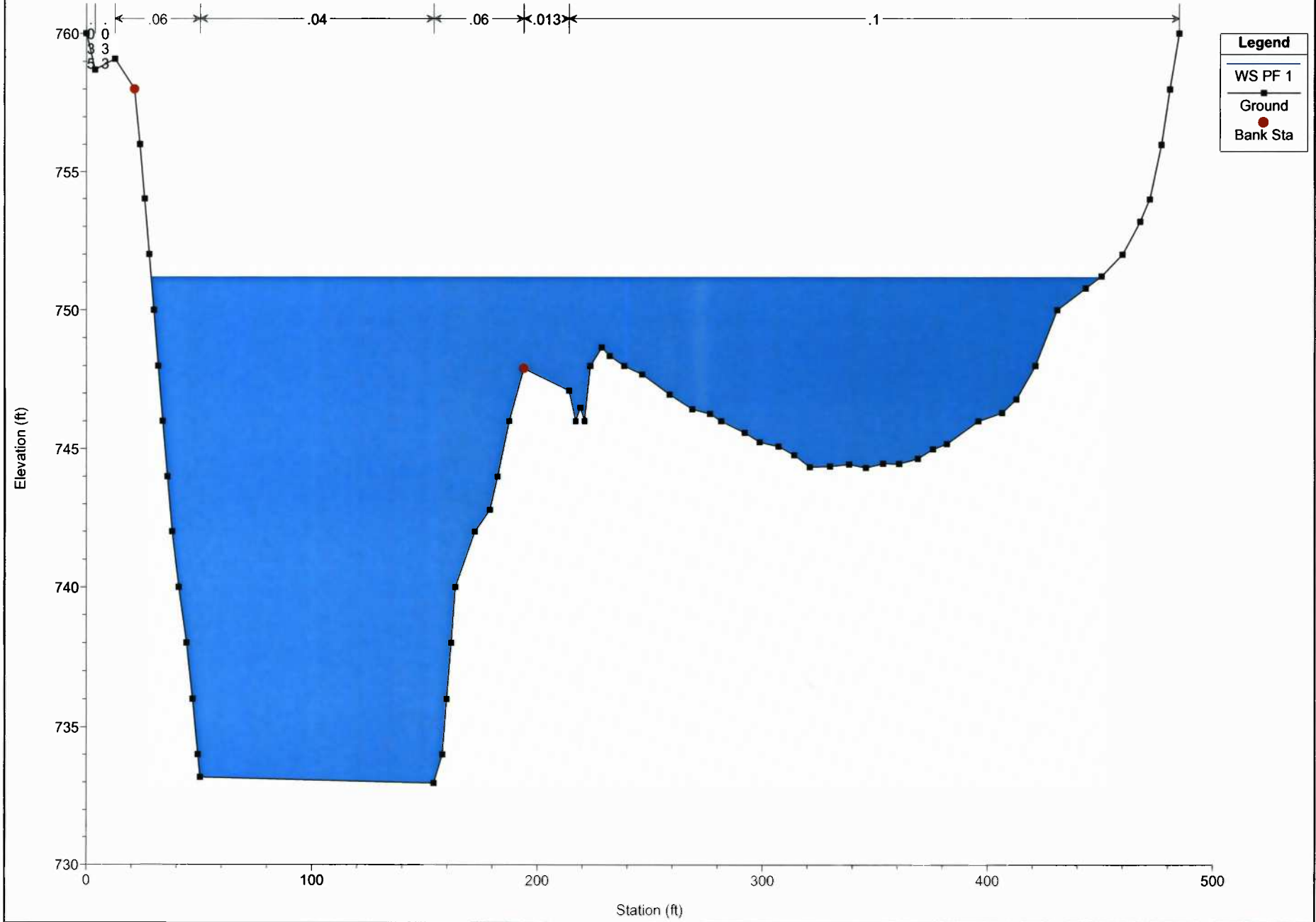
River = Middle Island Reach = Lower RS = 2457.936



Addie Plan: Existing

Geom: Existing Flow: Existing 100YR

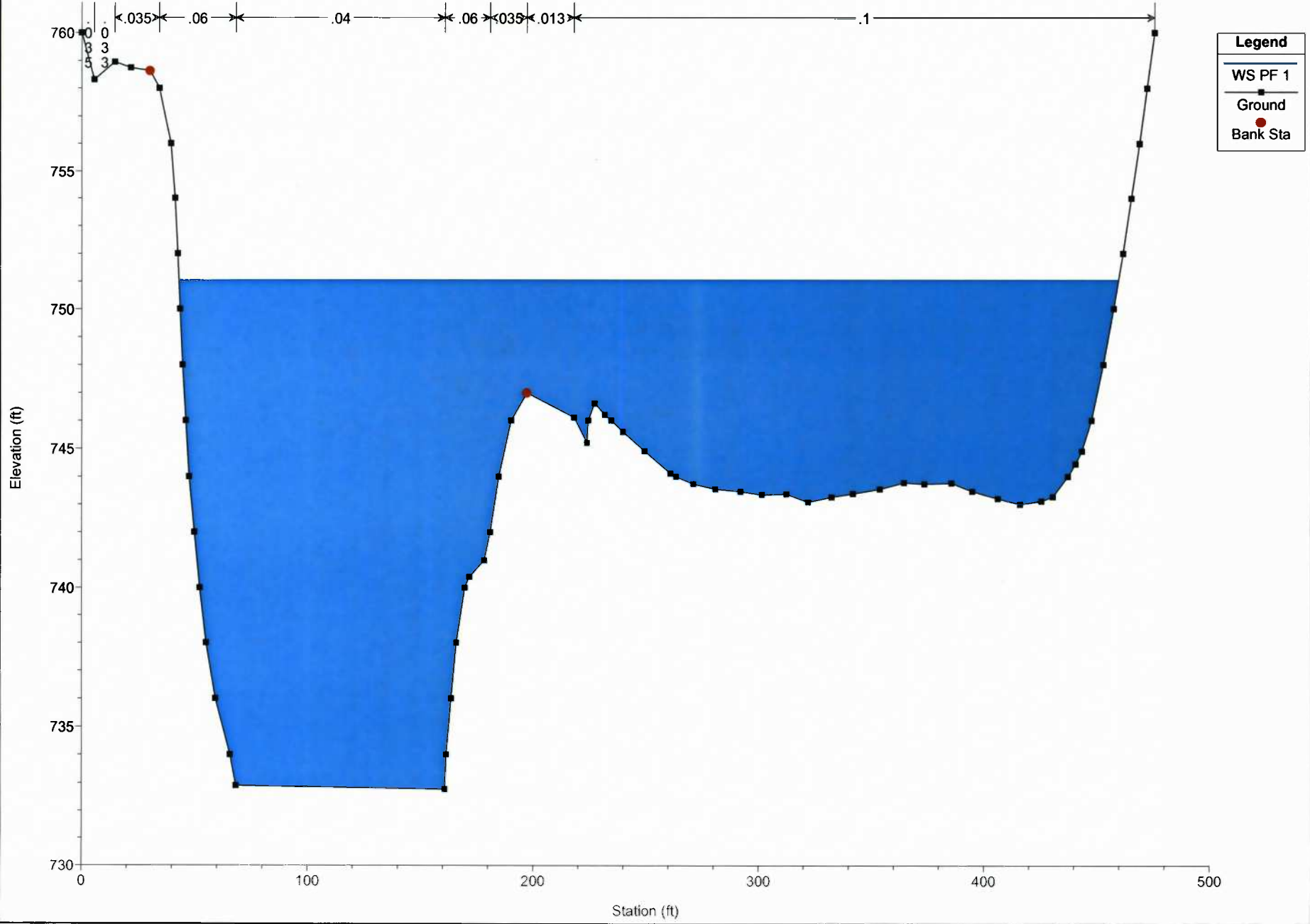
River = Middle Island Reach = Lower RS = 2259.266



Addie Plan: Existing

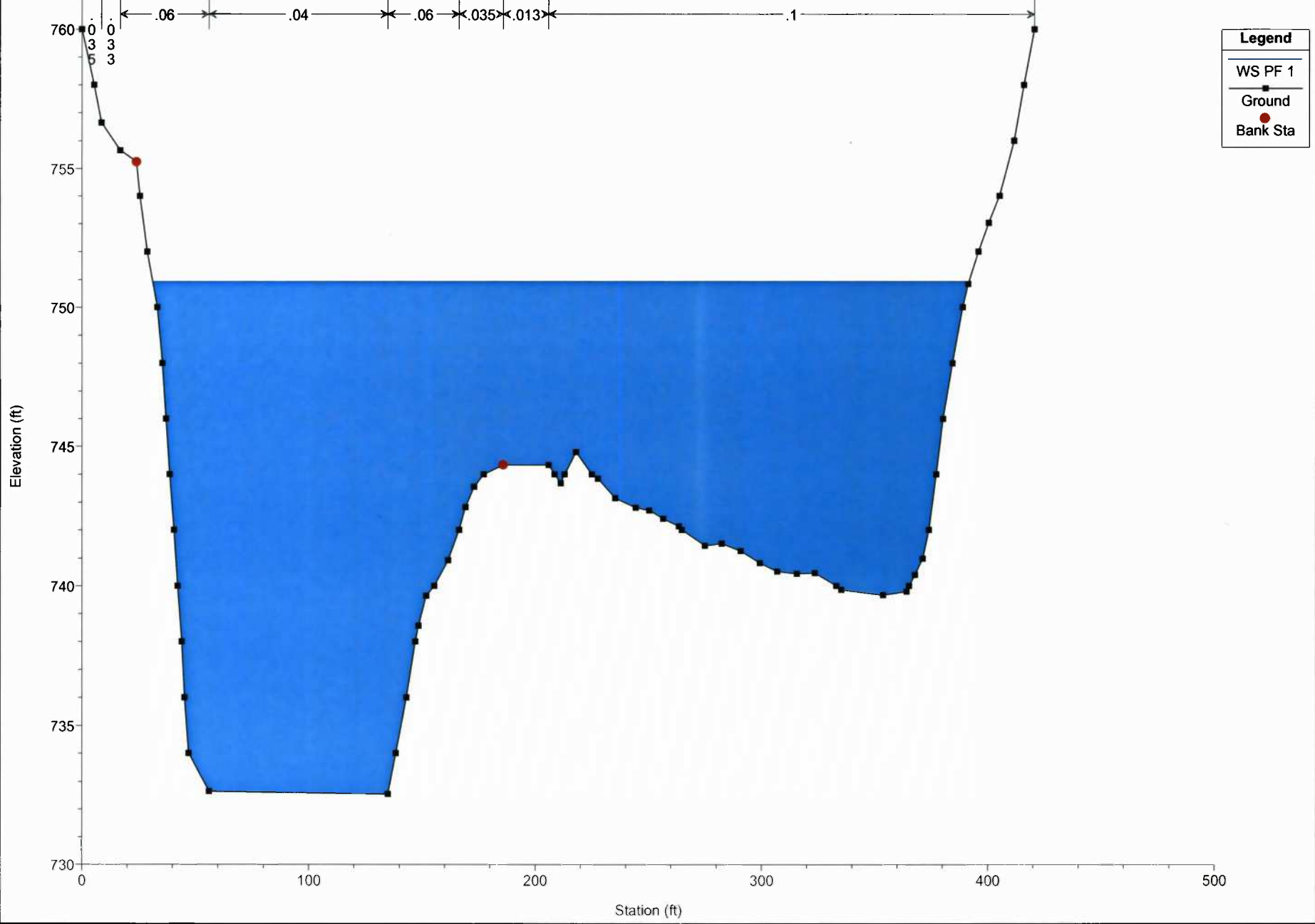
Geom: Existing Flow: Existing 100YR

River = Middle Island Reach = Lower RS = 2049.716





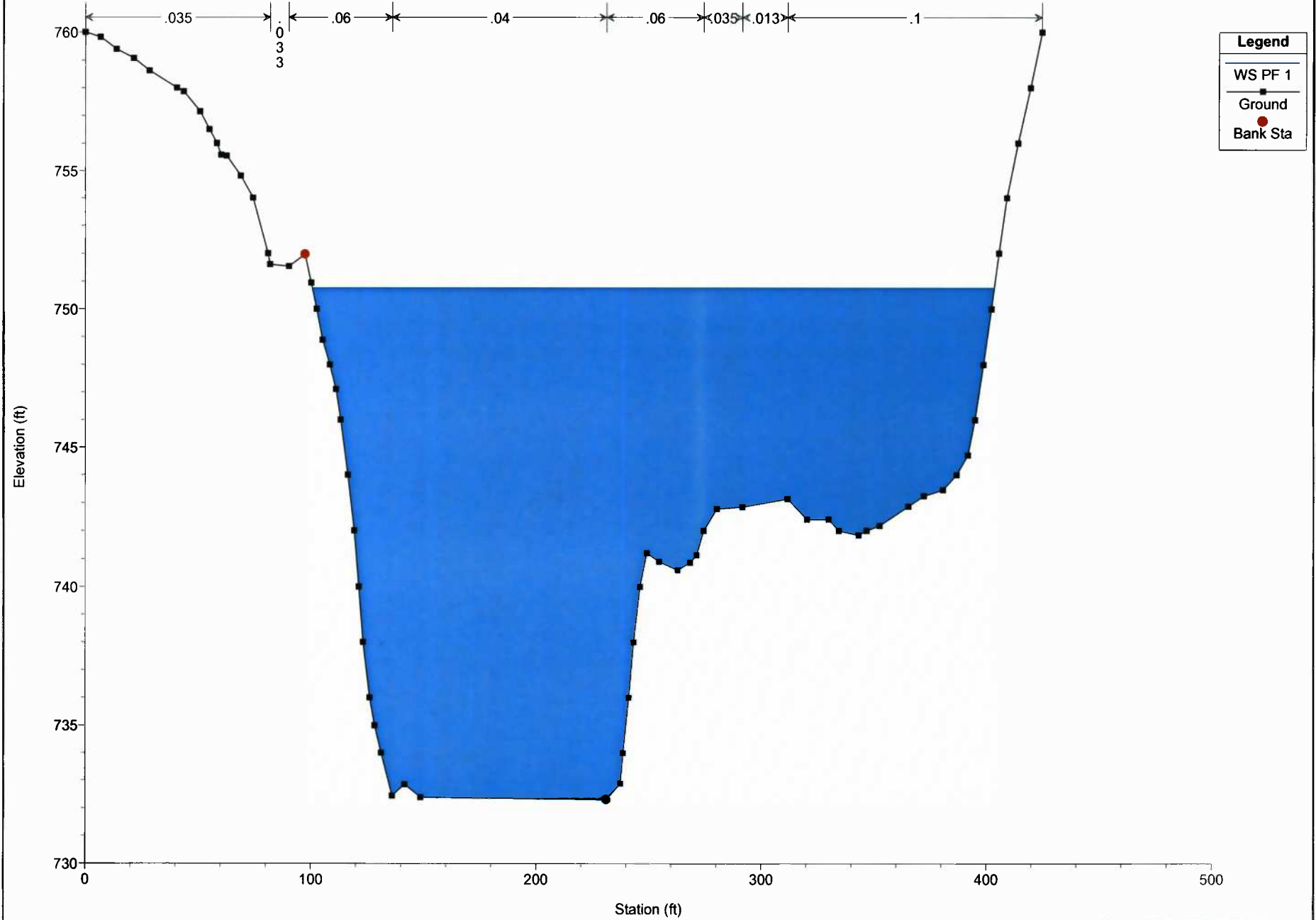
Addie Plan: Existing  
Geom: Existing Flow: Existing 100YR  
River = Middle Island Reach = Lower RS = 1840.209



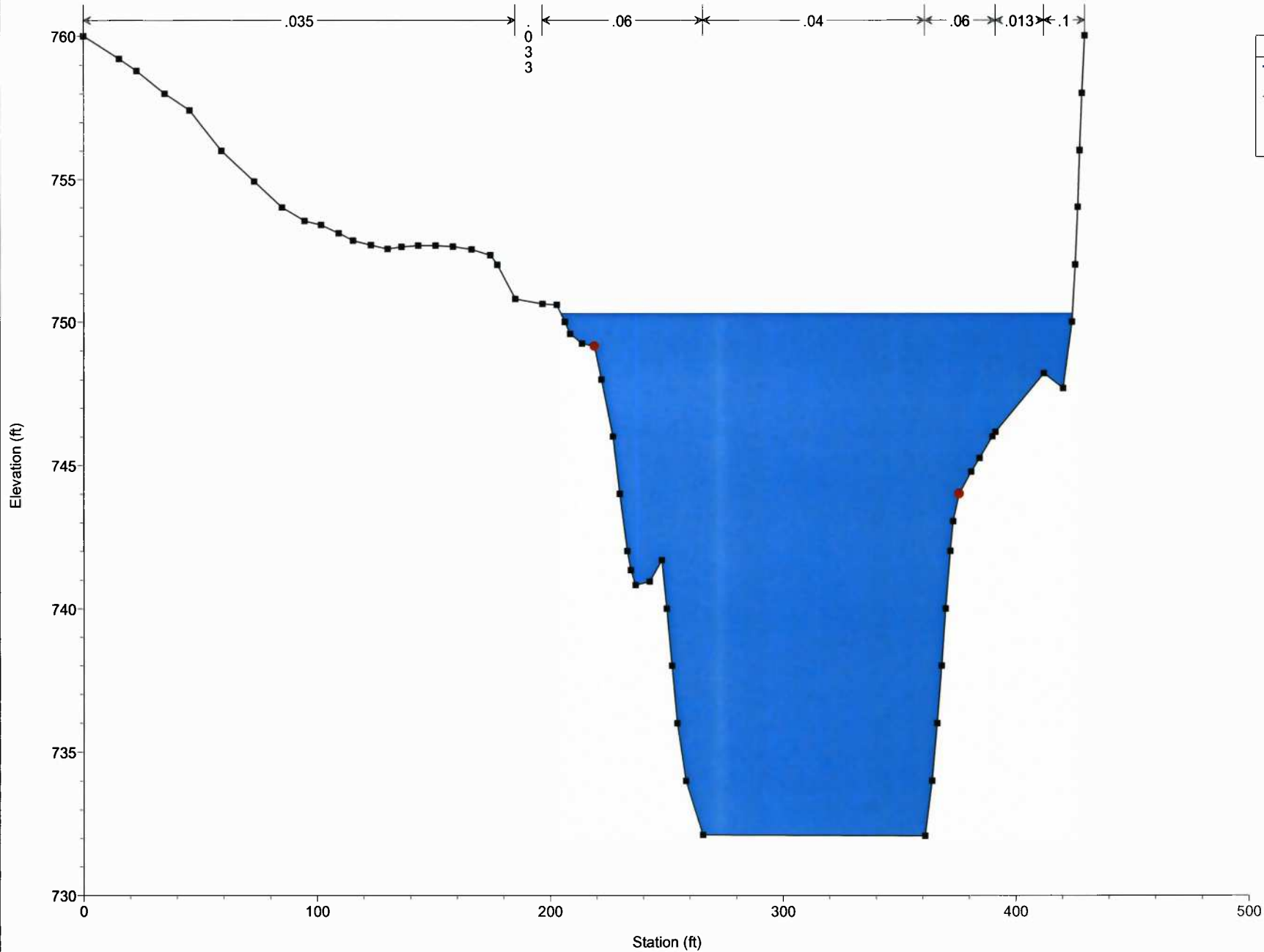
Addie Plan: Existing

Geom: Existing Flow: Existing 100YR

River = Middle Island Reach = Lower RS = 1632.735



Addie Plan: Existing  
Geom: Existing Flow: Existing 100YR  
River = Middle Island Reach = Lower RS = 1414.824

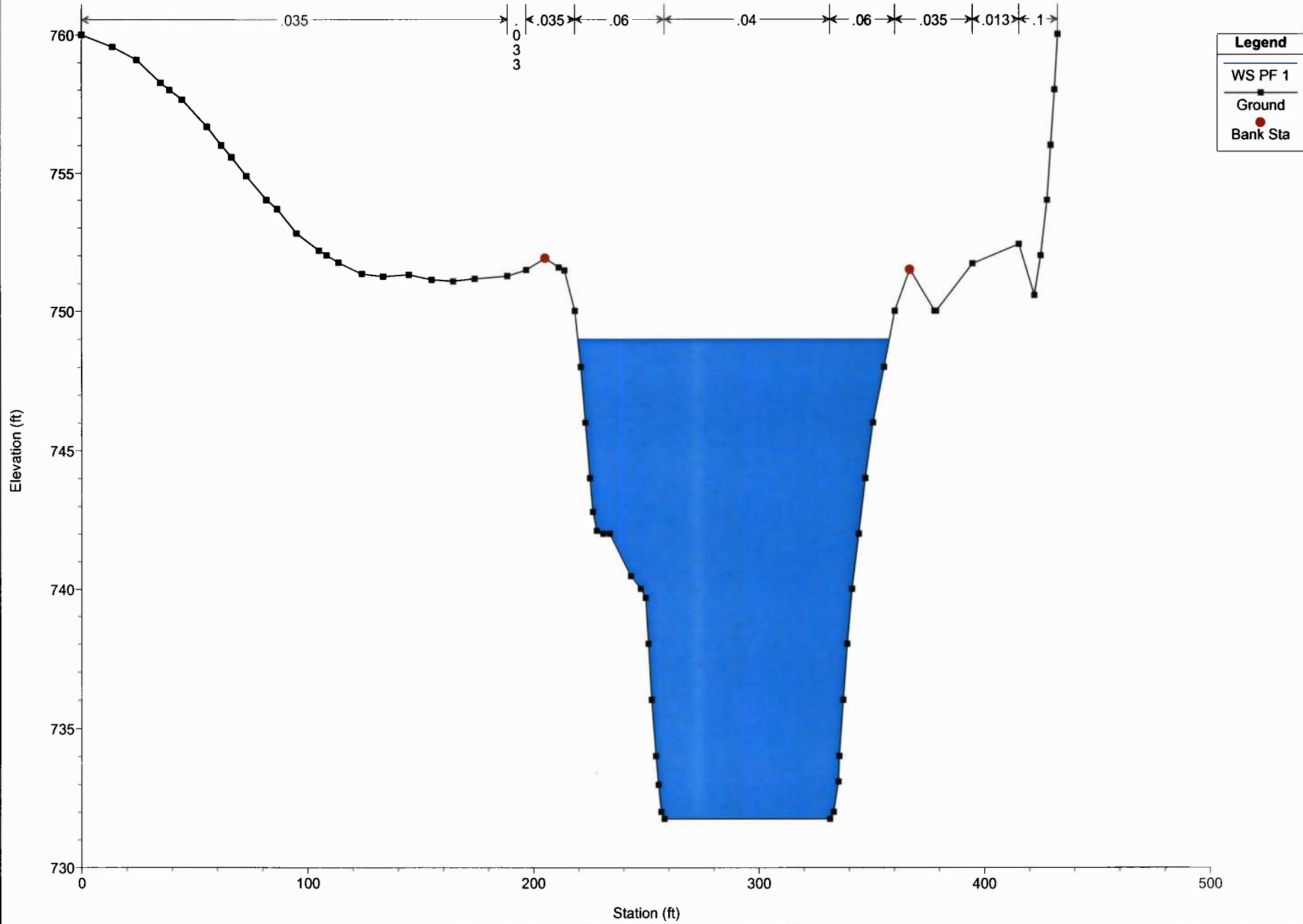


**Legend**  
WS PF 1  
Ground  
Bank Sta

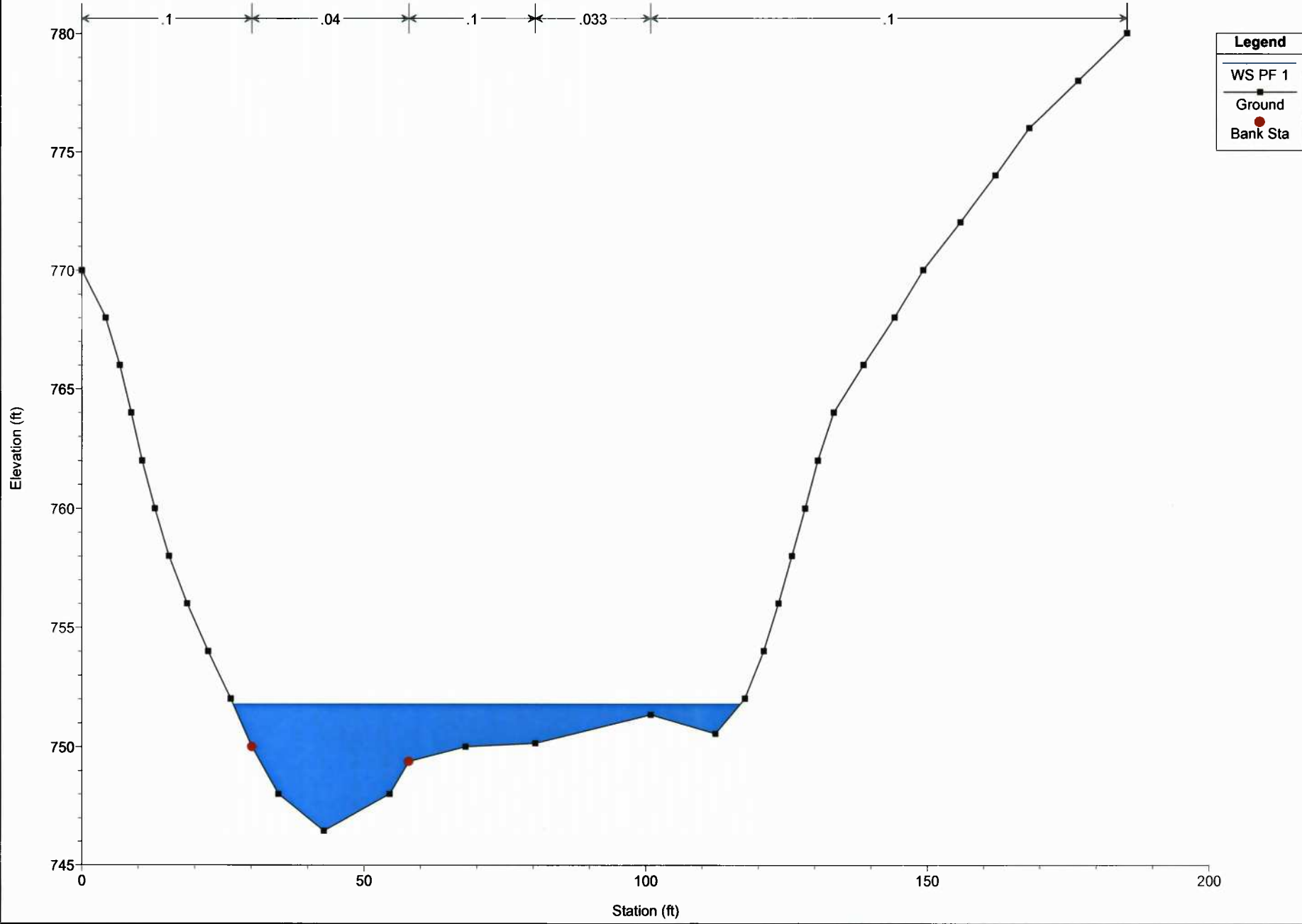
Addie Plan: Existing

Geom: Existing Flow: Existing 100YR

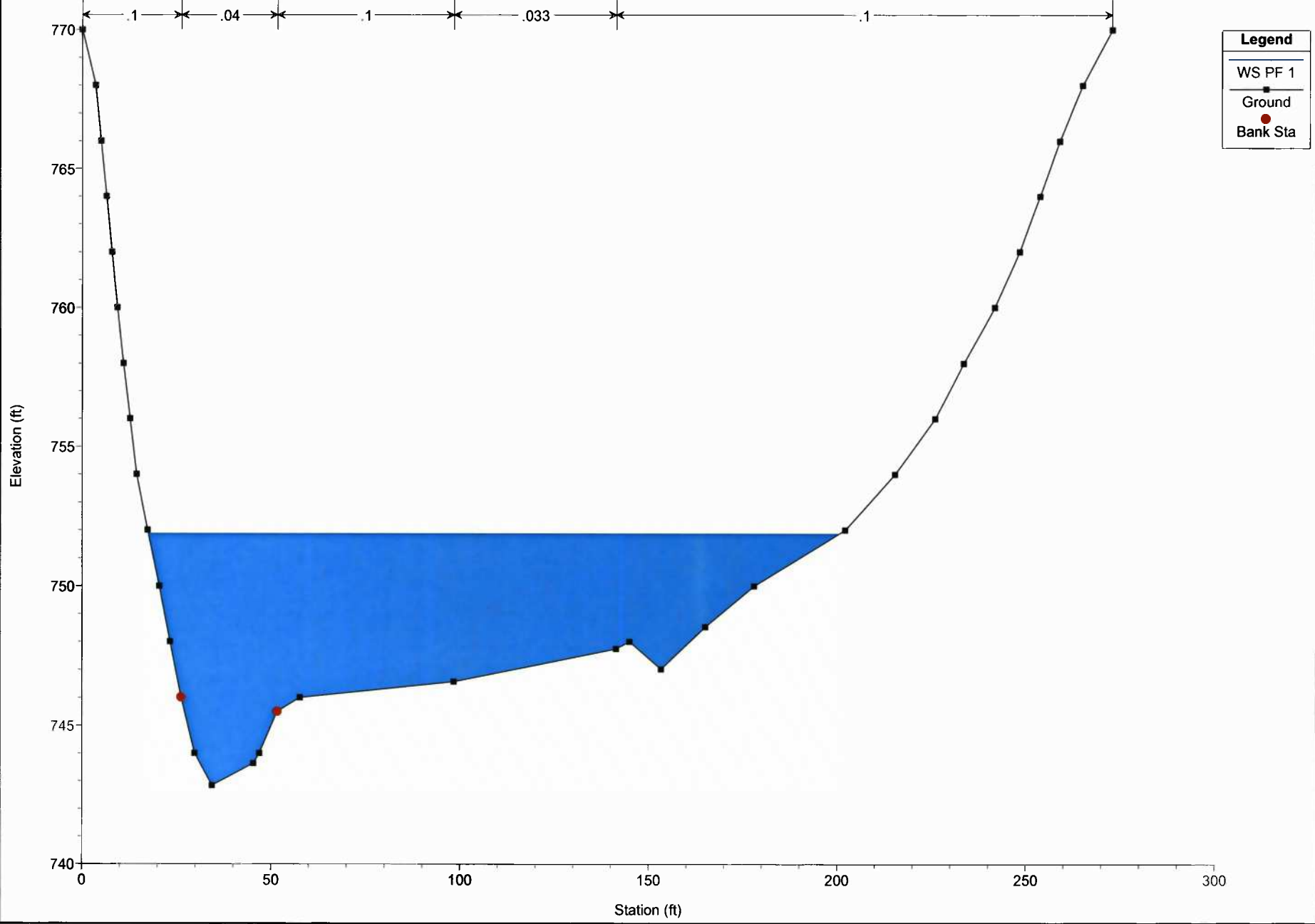
River = Middle Island Reach = Lower RS = 1000.000



Addie Plan: Existing  
Geom: Existing Flow: Existing 100YR  
River = Slaughter Run Reach = Upper RS = 1724.607



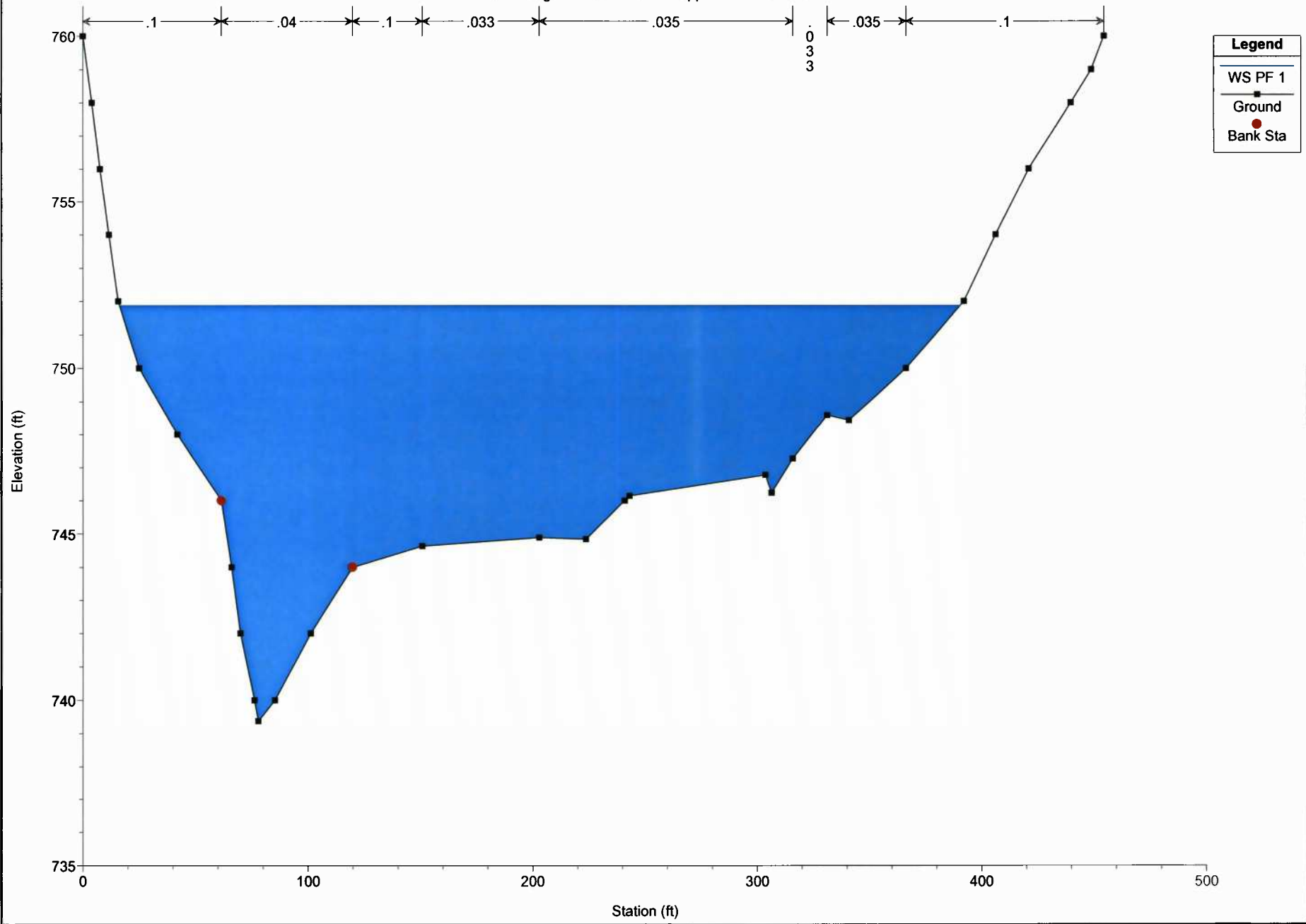
Addie Plan: Existing  
Geom: Existing Flow: Existing 100YR  
River = Slaughter Run Reach = Upper RS = 1544.864



Addie Plan: Existing

Geom: Existing Flow: Existing 100YR

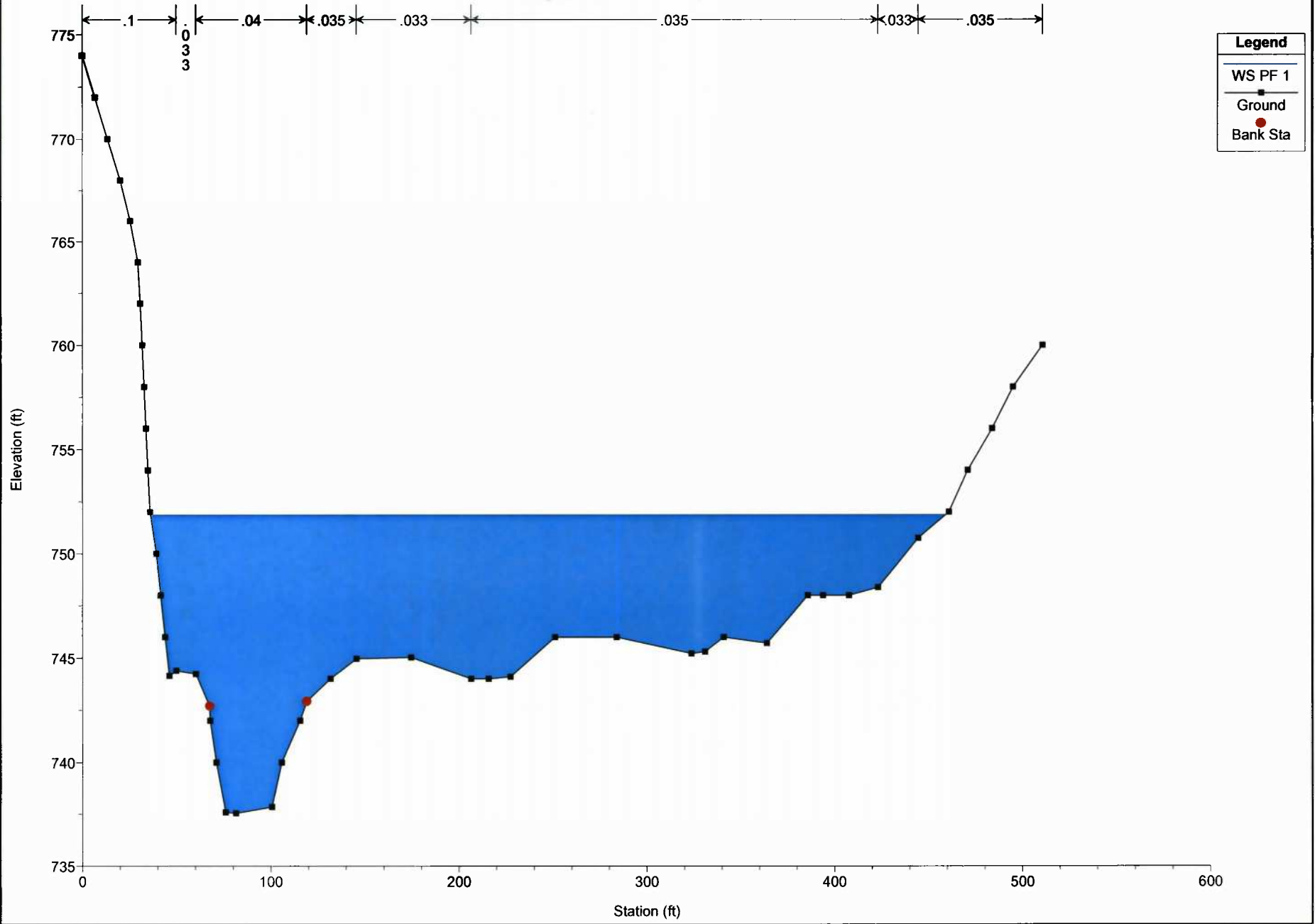
River = Slaughter Run Reach = Upper RS = 1344.324



Addie Plan: Existing

Geom: Existing Flow: Existing 100YR

River = Slaughter Run Reach = Upper RS = 1254.897

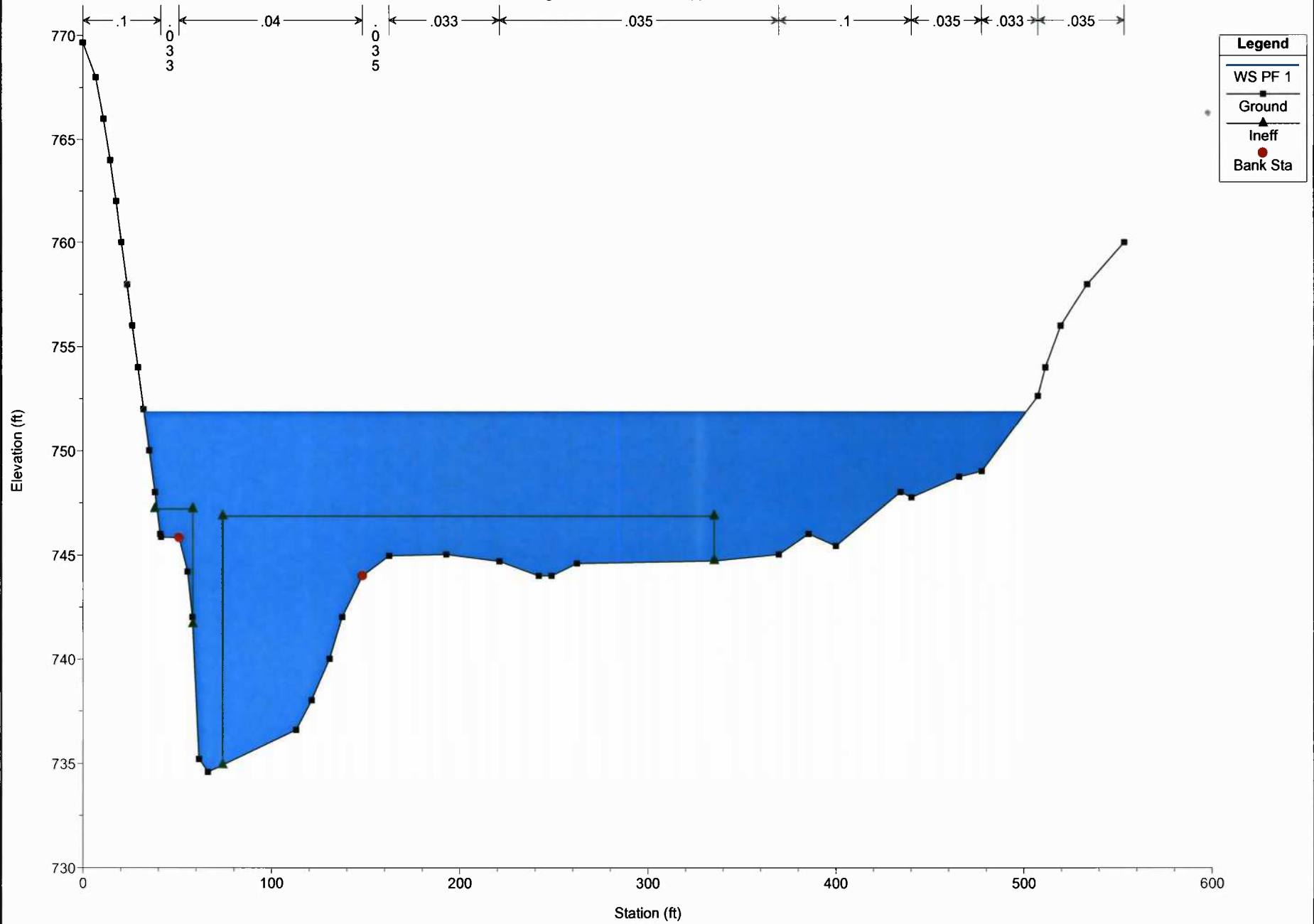




Addie Plan: Existing

Geom: Existing Flow: Existing 100YR

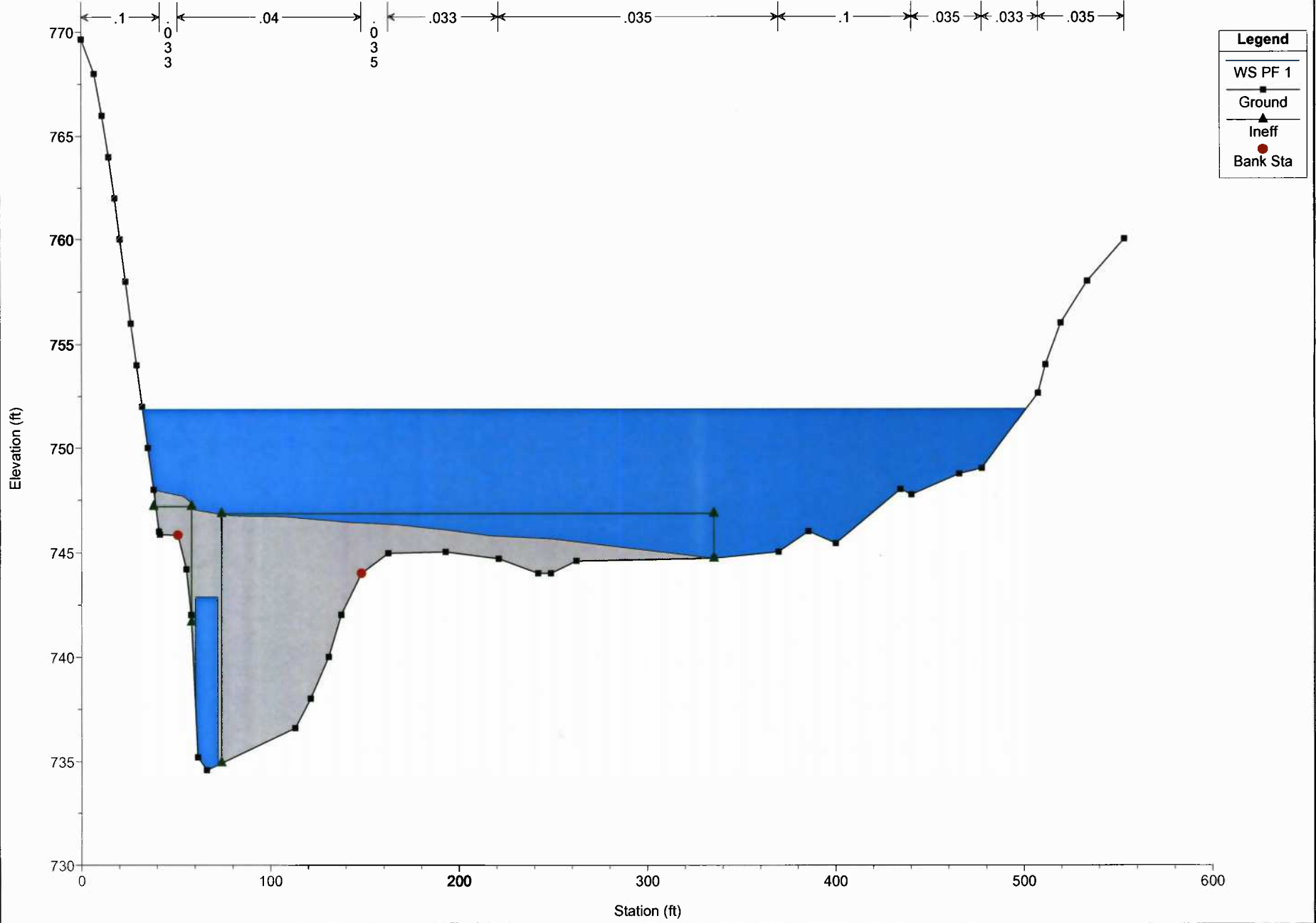
River = Slaughter Run Reach = Upper RS = 1193.416



Addie Plan: Existing

Geom: Existing Flow: Existing 100YR

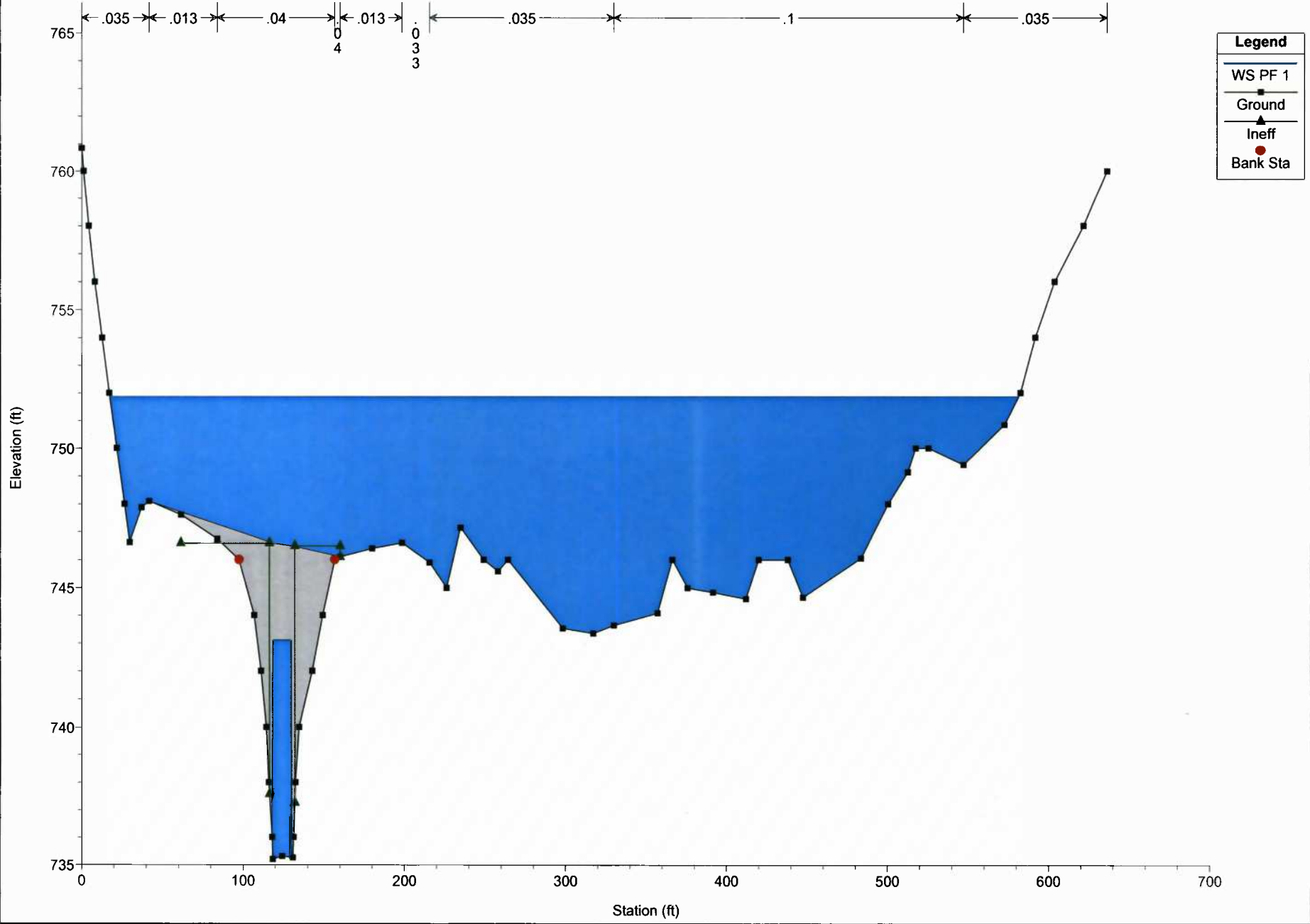
River = Slaughter Run Reach = Upper RS = 1172.84 BR



Addie Plan: Existing

Geom: Existing Flow: Existing 100YR

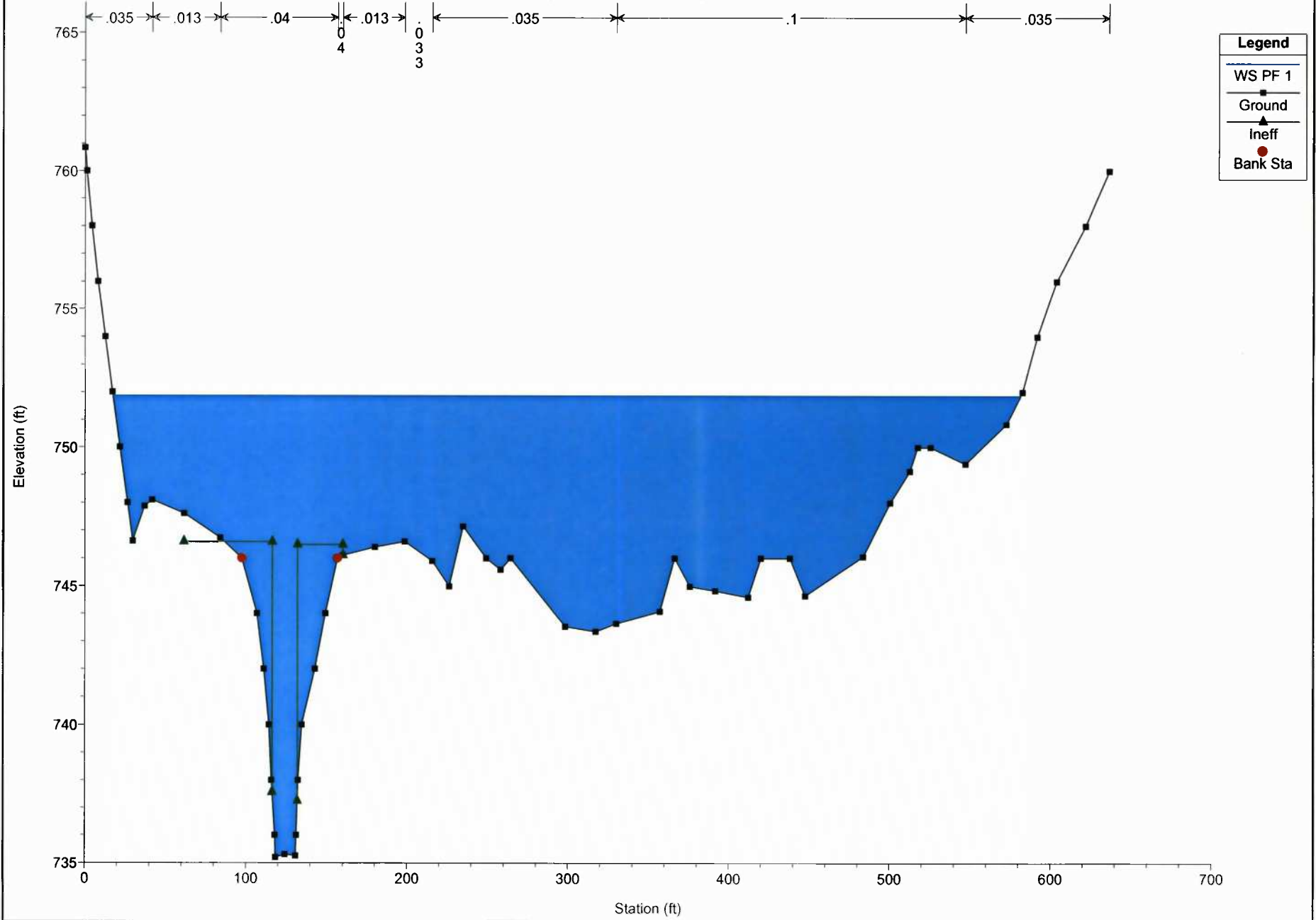
River = Slaughter Run Reach = Upper RS = 1172.84 BR



Addie Plan: Existing

Geom: Existing Flow: Existing 100YR

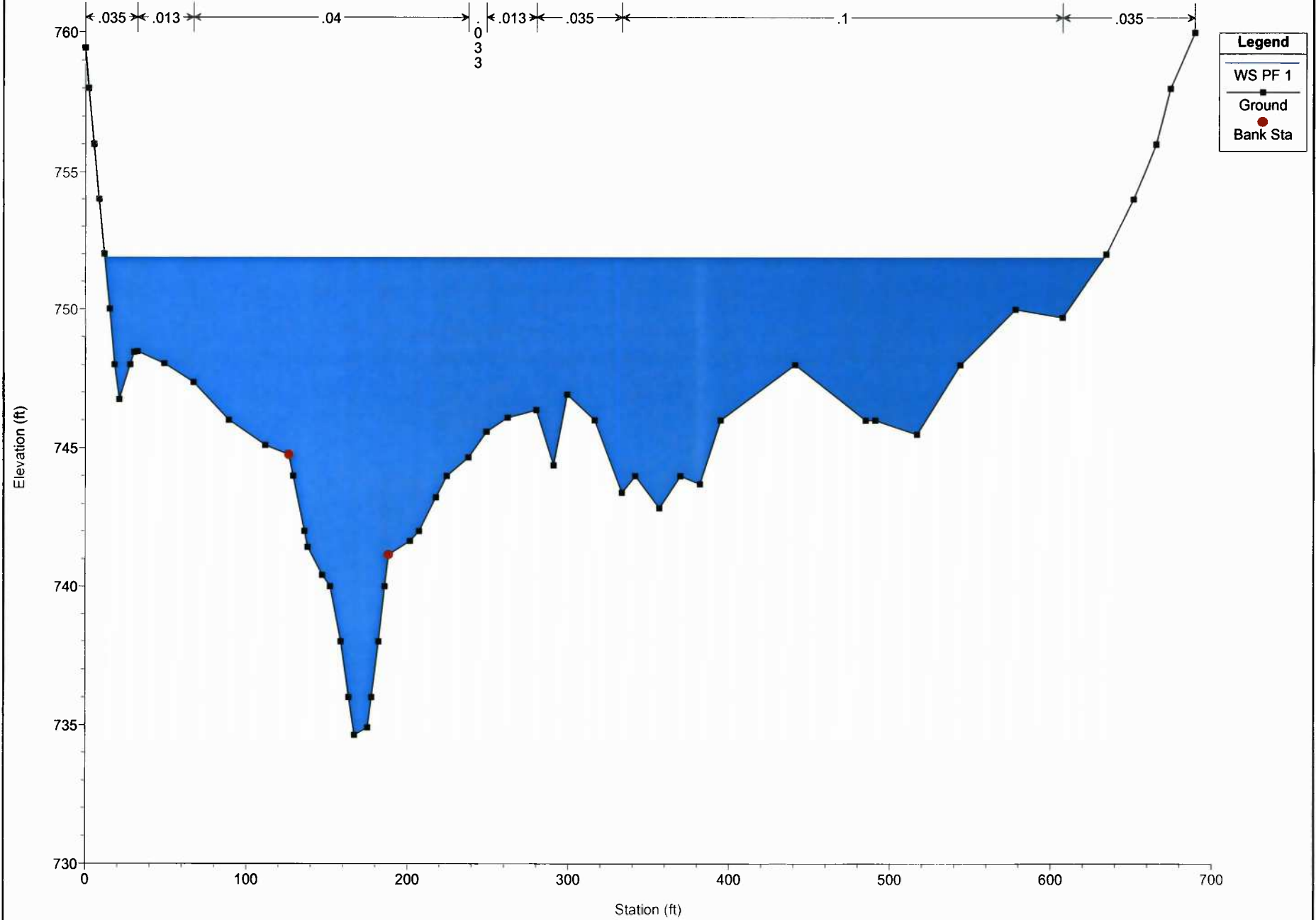
River = Slaughter Run Reach = Upper RS = 1144.785



Addie Plan: Existing

Geom: Existing Flow: Existing 100YR

River = Slaughter Run Reach = Upper RS = 1109.953



**Supplement 4**

**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
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       XXXXXX
```

\*\*\*\*\*

PROJECT DATA

Project Title: Addie  
Project File : Addie.prj  
Run Date and Time: 3/3/2015 6:23:31 AM

Project in English units

\*\*\*\*\*

PLAN DATA

Plan Title: Proposed  
Plan File : x:\Navitus Jobfiles\Antero Resources\ANT202-Addie\Engineering\Drainage  
Comp\Floodplain\Computations\HEC-RAS\Addie.p02

Geometry Title: Proposed  
Geometry File : x:\Navitus Jobfiles\Antero Resources\ANT202-Addie\Engineering\Drainage  
Comp\Floodplain\Computations\HEC-RAS\Addie.g02

Flow Title : Existing 100YR  
Flow File : x:\Navitus Jobfiles\Antero Resources\ANT202-Addie\Engineering\Drainage  
Comp\Floodplain\Computations\HEC-RAS\Addie.f01

Plan Summary Information:

Number of:	Cross Sections =	25	Multiple Openings =	0
	Culverts =	0	Inline Structures =	0
	Bridges =	2	Lateral Structures =	0

Computational Information

Water surface calculation tolerance =	0.01
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 100YR
Flow File : x:\Navitus Jobfiles\Antero Resources\ANT202-Addie\Engineering\Drainage
Comp\Floodplain\Computations\HEC-RAS\Addie.f01

Flow Data (cfs)

Table with 4 columns: River, Reach, RS, PF 1. Rows include Middle Island (Upper/Lower), Trib1, and Slaughter Run (Upper).

Boundary Conditions

Table with 4 columns: River, Reach, Profile, Upstream, Downstream. Row for Middle Island Lower with Profile PF 1 and Downstream Known WS = 749.

\*\*\*\*\*

GEOMETRY DATA

Geometry Title: Proposed
Geometry File : x:\Navitus Jobfiles\Antero Resources\ANT202-Addie\Engineering\Drainage
Comp\Floodplain\Computations\HEC-RAS\Addie.g02

Reach Connection Table

Table with 4 columns: River, Reach, Upstream Boundary, Downstream Boundary. Rows for Middle Island (Upper/Lower) and Slaughter Run (Upper).



JUNCTION INFORMATION

Name: 1  
 Description:  
 Energy computation Method

Length across Junction		Tributary		Reach	Length	Angle
River	Reach	River				
Middle Island	Upper	to Middle Island	Lower		99.05	
Slaughter Run	Upper	to Middle Island	Lower		159.48	

CROSS SECTION

RIVER: Middle Island  
 REACH: Upper RS: 4090.965

INPUT

Description:

Station Elevation Data num= 43

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	6.54	758	14.26	756	22.24	754	33.86	752
39.65	750.86	44.1	750.18	47.74	750.21	56.72	750.41	58.49	750
61.73	749.26	70.55	748.7	85.19	748.46	106.16	748	122.8	747.04
135.26	746.25	150.93	746.99	172.34	747.93	175.77	747.8	191.37	746.39
193.28	746	203.79	744	212.24	742	226.25	740	234.45	739.21
235.37	738	236.99	736	238.67	734.35	326.72	734.4	327.27	736
327.79	738	328.27	740	328.51	740.72	340.58	742	346.58	744
352.24	746	357.71	748	362.79	750	367.84	752	372.6	754
377.18	756	381.9	758	385.5	760				

Manning's n Values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	47.74	.033	56.72	.035	226.25	.05
326.72	.06	367.84	.035				

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	234.45	328.51		180.89	245.04	268.68	.1 .3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 753.02	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.44	* Wt. n-Val.	* 0.037	* 0.042	* 0.060
* W.S. Elev (ft)	* 752.58	* Reach Len. (ft)	* 180.89	* 245.04	* 268.68
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 1146.49	* 1697.85	* 293.09
* E.G. Slope (ft/ft)	* 0.000667	* Area (sq ft)	* 1146.49	* 1697.85	* 293.09
* Q Total (cfs)	* 14907.00	* Flow (cfs)	* 4059.89	* 10154.66	* 692.45
* Top width (ft)	* 338.77	* Top width (ft)	* 203.99	* 94.06	* 40.72
* Vel Total (ft/s)	* 4.75	* Avg. Vel. (ft/s)	* 3.54	* 5.98	* 2.36
* Max chl Dpth (ft)	* 18.23	* Hydr. Depth (ft)	* 5.62	* 18.05	* 7.20

Addie.rep

```
* Conv. Total (cfs)      *576995.9 * Conv. (cfs)          *157143.8 *393049.9 * 26802.2 *
* Length wtd. (ft)     * 235.25 * Wetted Per. (ft)    * 205.16 * 101.07 * 42.69 *
* Min Ch El (ft)      * 734.35 * Shear (lb/sq ft)    * 0.23 * 0.70 * 0.29 *
* Alpha                * 1.24 * Stream Power (lb/ft s) * 385.50 * 0.00 * 0.00 *
* Frctn Loss (ft)     * 0.19 * Cum Volume (acre-ft) * 11.49 * 78.68 * 5.05 *
* C & E Loss (ft)     * 0.00 * Cum SA (acres)      * 3.13 * 5.13 * 0.77 *
*****
```

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Upper RS: 3845.927

INPUT

Description:

```
Station Elevation Data num= 57
Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
*****
0 760 6.02 758 12.08 756 21.26 754 30.63 752
33.79 751.34 37.51 752.02 44.08 751.12 48.16 750 50.04 749.44
53.97 749.44 62.48 749.8 68.93 748.97 81.26 748.9 97.16 749.11
113.59 749.83 119.85 750 125.58 750.21 137.32 750.39 155.75 751.06
171.74 750.23 173.43 750 187.48 748 193.88 746 200.21 744
207.14 742 214.6 740.53 223.78 740 228.68 738 231.67 736
234.78 734.28 332.4 734.32 332.84 736 333.26 738 333.69 740
333.99 741.25 336.14 742 337.94 742.67 347.57 743.58 348.29 744
351.77 746 355.11 748 358.29 750 361.55 752 365.18 754
370.29 756 375.03 758 376.42 758.54 376.43 759 384.07 759.88
403.39 760.78 409.67 759.74 414.54 762 417.57 764 419.06 766
420.67 768 422.54 770
```

```
Manning's n Values num= 8
Sta n Val Sta n Val Sta n Val Sta n Val Sta n Val
*****
0 .035 53.97 .033 62.48 .035 214.6 .05 234.78 .04
332.4 .06 384.07 .013 403.39 .035
```

```
Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
155.75 376.43 171.39 206.02 224.81 .1 .3
```

CROSS SECTION OUTPUT Profile #PF 1

```
*****
* E.G. Elev (ft) * 752.83 * Element * Left OB * Channel * Right OB *
* Vel Head (ft) * 0.45 * wt. n-Val. * 0.035 * 0.044 * *
* W.S. Elev (ft) * 752.38 * Reach Len. (ft) * 171.39 * 206.02 * 224.81 *
* Crit W.S. (ft) * * * Flow Area (sq ft) * 304.38 * 2567.94 * *
* E.G. Slope (ft/ft) *0.000972 * Area (sq ft) * 304.38 * 2567.94 * *
* Q Total (cfs) *14907.00 * Flow (cfs) * 743.34 *14163.67 * *
* Top Width (ft) * 333.38 * Top Width (ft) * 126.89 * 206.49 * *
```

```

* Vel Total (ft/s) * 5.19 * Avg. Vel. (ft/s) * 2.44 * 5.52 *
* Max Chl Dpth (ft) * 18.10 * Hydr. Depth (ft) * 2.40 * 12.44 *
* Conv. Total (cfs) *478257.6 * Conv. (cfs) * 23848.3 *454409.3 *
* Length Wtd. (ft) * 202.55 * Wetted Per. (ft) * 127.45 * 217.41 *
* Min Ch El (ft) * 734.28 * Shear (lb/sq ft) * 0.14 * 0.72 *
* Alpha * 1.08 * Stream Power (lb/ft s) * 422.54 * 0.00 * 0.00 *
* Frctn Loss (ft) * 0.15 * Cum Volume (acre-ft) * 8.48 * 66.69 * 4.15 *
* C & E Loss (ft) * 0.04 * Cum SA (acres) * 2.44 * 4.28 * 0.64 *
*****

```

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Upper

RS: 3639.909

INPUT

Description:

```

Station Elevation Data num= 55
Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
*****
0 760 6.51 758 13.06 756 19.94 754 27.82 752
35.34 750 41.84 748.7 45.32 748 46.97 747.67 48.8 748
49.72 748.2 58.68 747.8 66.16 746.42 78.77 746.28 87.87 746
108.3 745.29 122.02 746 145.53 746.32 154.27 746.6 165.4 746
170 745.77 183.96 744.32 185.61 744 196.82 742 208.66 740.29
224.14 741.27 225.73 740 231.66 736 234.48 734.22 325.66 734.25
327.27 736 328.99 738 332.12 740 333.65 740.97 337.21 742
340.84 743.06 343.69 744 347.96 745.35 349.91 746 352.53 746.85
355.01 748 356.74 749 356.75 750 362.66 751.18 382.33 752.31
386.79 752.19 388.73 754 390.93 756 393.14 758 394.82 760
396.26 762 397.64 764 398.96 766 400.97 768 404.33 770

```

```

Manning's n Values num= 8
Sta n Val Sta n Val Sta n Val Sta n Val Sta n Val
*****
0 .035 49.72 .033 58.68 .035 208.66 .05 234.48 .04
325.66 .05 362.66 .013 382.33 .035

```

```

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
154.27 356.75 126.21 164.03 167.32 .1 .3

```

CROSS SECTION OUTPUT Profile #PF 1

```

*****
* E.G. Elev (ft) * 752.64 * Element * Left OB * Channel * Right OB *
* Vel Head (ft) * 0.31 * Wt. n-Val. * 0.035 * 0.042 * 0.025 *
* W.S. Elev (ft) * 752.33 * Reach Len. (ft) * 126.21 * 164.03 * 167.32 *
* Crit W.S. (ft) * * * Flow Area (sq ft) * 697.71 * 2723.73 * 22.28 *
* E.G. slope (ft/ft) *0.000561 * Area (sq ft) * 697.71 * 2723.73 * 22.28 *
* Q Total (cfs) *14907.00 * Flow (cfs) * 2258.88 *12615.64 * 32.47 *

```

* Top width (ft)	* 360.44	* Top width (ft)	* 127.77	* 202.48	* 30.19
* Vel Total (ft/s)	* 4.33	* Avg. Vel. (ft/s)	* 3.24	* 4.63	* 1.46
* Max Chl Dpth (ft)	* 18.11	* Hydr. Depth (ft)	* 5.46	* 13.45	* 0.74
* Conv. Total (cfs)	* 629195.0	* Conv. (cfs)	* 95343.0	* 532481.3	* 1370.6
* Length Wtd. (ft)	* 160.08	* Wetted Per. (ft)	* 128.53	* 210.08	* 30.40
* Min Ch El (ft)	* 734.22	* Shear (lb/sq ft)	* 0.19	* 0.45	* 0.03
* Alpha	* 1.05	* Stream Power (lb/ft s)	* 404.33	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.10	* Cum Volume (acre-ft)	* 6.50	* 54.17	* 4.09
* C & E Loss (ft)	* 0.02	* Cum SA (acres)	* 1.94	* 3.32	* 0.56

\*\*\*\*\*

Addie.rep

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Upper

RS: 3475.882

INPUT

Description:

Station	Elevation	Data	num=	51					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	760	6.41	758	12.92	756	21.63	754	31.56	752
42.43	750	46.45	749.35	51.42	748.11	58.27	749.22	67.82	748.41
70.89	748	72.16	747.8	78.06	748	81.75	748.12	94.97	748.4
110.45	748.47	121.89	748.83	133.93	749.37	147.02	750	152.67	750.32
168.61	750.76	182.2	750	187.81	748	193.4	746	199.32	744
205.19	742	210.65	740	212.11	739.42	228.24	739.86	230.18	738
232.26	736	234.29	734.17	328.69	734.2	329.42	736	330.07	738
330.7	740	330.97	740.8	334.44	742	338.12	743.43	341.82	744
346.03	744.95	346.04	748	353.71	748.11	372.85	748.46	379.29	747.97
382.98	750	386.64	752	389.64	754	391.4	756	393.15	758
394.96	760								

Manning's n Values	num=	8							
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	.035	58.27	.033	67.82	.035	228.24	.05	234.29	.04
328.69	.035	353.71	.013	372.85	.035				

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	182.2	346.04		73.91 65.93	65.37	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

*****	*****	*****	*****	*****	*****	*****	*****
* E.G. Elev (ft)	* 752.53	* Element	* Left OB	* Channel	* Right OB	* 752.53	* 752.53
* Vel Head (ft)	* 0.46	* wt. n-Val.	* 0.035	* 0.038	* 0.018	* 0.035	* 0.035
* W.S. Elev (ft)	* 752.07	* Reach Len. (ft)	* 73.91	* 65.93	* 65.37	* 73.91	* 65.93
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 419.57	* 2367.10	* 143.33	* 419.57	* 2367.10
* E.G. Slope (ft/ft)	* 0.000663	* Area (sq ft)	* 419.57	* 2367.10	* 143.33	* 419.57	* 2367.10

Addie.rep

* Q Total (cfs)	*14907.00	* Flow (cfs)	* 913.81	*13305.82	* 687.37	*
* Top width (ft)	* 355.53	* Top width (ft)	* 150.98	* 163.84	* 40.70	*
* Vel Total (ft/s)	* 5.09	* Avg. Vel. (ft/s)	* 2.18	* 5.62	* 4.80	*
* Max Chl Dpth (ft)	* 17.90	* Hydr. Depth (ft)	* 2.78	* 14.45	* 3.52	*
* Conv. Total (cfs)	*578762.1	* Conv. (cfs)	* 35478.5	*516596.4	* 26687.2	*
* Length wtd. (ft)	* 66.43	* Wetted Per. (ft)	* 151.62	* 176.29	* 41.78	*
* Min Ch El (ft)	* 734.17	* Shear (lb/sq ft)	* 0.11	* 0.56	* 0.14	*
* Alpha	* 1.14	* Stream Power (lb/ft s)	* 394.96	* 0.00	* 0.00	*
* Frctn Loss (ft)	* 0.05	* Cum Volume (acre-ft)	* 4.89	* 44.59	* 3.77	*
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 1.54	* 2.63	* 0.43	*

\*\*\*\*\*

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Upper RS: 3409.950

INPUT

Description:

Station	Elevation	Data	num=	49					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	760	5.74	758	11.48	756	17.58	754	26.67	752
36.9	750	45.13	748.94	56.79	748.36	72.5	748.2	83.36	748.48
94.5	748.36	102.53	748.97	120.84	749.3	128.22	749.14	145.17	749.83
162.4	749.89	178.94	749.7	193.68	749.67	197.45	748	201.63	746
205.4	744	209.61	742	213.67	740	216.27	738.74	233.55	739.92
234.43	738	235.59	736	236.75	734.15	326.61	734.17	327.99	736
329.21	738	330.44	740	334.95	742	337.57	743.24	339.5	744
343.68	746	346.92	748	353.73	748	358.39	747.94	360.12	747.7
379.34	747.8	384.65	747.34	385.74	748	389.09	750	392.46	752
395.09	754	397.21	756	399.39	758	401.77	760		

Manning's n values	num=	7							
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	.035	102.53	.033	120.84	.035	236.75	.04	326.61	.05
360.12	.013	379.34	.035						

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
193.68	346.92	24.47	22.76	27.59	.1	.3	

CROSS SECTION OUTPUT Profile #PF 1

*****	*****	*****	*****	*****	*****	*****	*****
* E.G. Elev (ft)	* 752.48	* Element	* Left OB	* Channel	* Right OB	*	*
* Vel Head (ft)	* 0.48	* Wt. n-Val.	* 0.035	* 0.040	* 0.020	*	*
* W.S. Elev (ft)	* 752.00	* Reach Len. (ft)	* 3.50	* 3.50	* 3.50	*	*
* Crit W.S. (ft)	* 743.28	* Flow Area (sq ft)	* 457.33	* 2237.97	* 176.41	*	*
* E.G. Slope (ft/ft)	*0.000754	* Area (sq ft)	* 457.33	* 2237.97	* 176.41	*	*

Addie.rep

* Q Total (cfs)	*14907.00	* Flow (cfs)	* 1059.80	*12967.19	* 880.01	*
* Top Width (ft)	* 365.76	* Top Width (ft)	* 166.99	* 153.24	* 45.53	*
* Vel Total (ft/s)	* 5.19	* Avg. Vel. (ft/s)	* 2.32	* 5.79	* 4.99	*
* Max Chl Dpth (ft)	* 17.85	* Hydr. Depth (ft)	* 2.74	* 14.60	* 3.87	*
* Conv. Total (cfs)	*542702.9	* Conv. (cfs)	* 38583.0	*472082.4	* 32037.6	*
* Length wtd. (ft)	* 3.50	* Wetted Per. (ft)	* 167.31	* 164.22	* 46.85	*
* Min Ch El (ft)	* 734.15	* Shear (lb/sq ft)	* 0.13	* 0.64	* 0.18	*
* Alpha	* 1.15	* Stream Power (lb/ft s)	* 401.77	* 0.00	* 0.00	*
* Frctn Loss (ft)	* 0.00	* Cum Volume (acre-ft)	* 4.14	* 41.10	* 3.53	*
* C & E Loss (ft)	* 0.01	* Cum SA (acres)	* 1.27	* 2.39	* 0.36	*

\*\*\*\*\*

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.

Note: Manning's n values were composited to a single value in the main channel.

BRIDGE

RIVER: Middle Island

REACH: Upper

RS: 3399.61

INPUT

Description:

Distance from Upstream XS = 3.5

Deck/Roadway width = 15

Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates

num= 2

Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
193.68	749.67	748.67	346.92	748	747				

\*\*\*\*\*

Upstream Bridge Cross Section Data

Station Elevation Data

num= 49

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	5.74	758	11.48	756	17.58	754	26.67	752
36.9	750	45.13	748.94	56.79	748.36	72.5	748.2	83.36	748.48
94.5	748.36	102.53	748.97	120.84	749.3	128.22	749.14	145.17	749.83
162.4	749.89	178.94	749.7	193.68	749.67	197.45	748	201.63	746
205.4	744	209.61	742	213.67	740	216.27	738.74	233.55	739.92
234.43	738	235.59	736	236.75	734.15	326.61	734.17	327.99	736
329.21	738	330.44	740	334.95	742	337.57	743.24	339.5	744
343.68	746	346.92	748	353.73	748	358.39	747.94	360.12	747.7
379.34	747.8	384.65	747.34	385.74	748	389.09	750	392.46	752
395.09	754	397.21	756	399.39	758	401.77	760		

Manning's n Values

num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val

\*\*\*\*\*

Addie.rep

0	.035	102.53	.033	120.84	.035	236.75	.04	326.61	.05
360.12	.013	379.34	.035						

Bank Sta:	Left	Right	Coeff	Contr.	Expan.
	193.68	346.92		.1	.3

Downstream Deck/Roadway Coordinates

num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
*****	*****	*****	*****	*****	*****
172.14	750.63	749.63	353.52	747.87	746.87

Downstream Bridge Cross Section Data

Station Elevation Data num= 51

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	760	5.8	758	11.62	756	17.59	754	25.31	752
33.23	750	44.4	748.8	54.17	748.3	70.42	748.07	87.75	748.4
102.47	748.42	108.59	748.57	134.14	749.03	140.23	749.4	172.14	750.63
176.47	750	177.72	749.78	180.17	749.82	194.3	749.33	197.47	748
202.09	746	205.98	744	207.88	742.96	210.07	742	218.01	740
221.01	739.31	235.69	738.99	236.1	738	236.87	736	237.57	734.15
324.46	734.17	325.63	736	326.66	738	327.17	739	329.63	740
333.99	742	337.51	744	343.14	746	344.8	746.36	348.16	747.58
353.52	747.87	361.11	747.72	380.72	747.65	385.57	747.42	386.47	748
389.58	750	392.79	752	395.47	754	397.73	756	400.03	758
402.52	760								

Manning's n Values

num= 8

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0	.035	140.23	.033	172.14	.035	237.57	.04	324.46	.05
353.52	.033	361.11	.013	380.72	.035				

Bank Sta:	Left	Right	Coeff	Contr.	Expan.
	194.3	348.16		.1	.3

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 Bridge Coefficient Sets = 1

Low Flow Methods and Data

Energy  
Selected Low Flow Methods = Highest Energy Answer

High Flow Method

Energy Only

Additional Bridge Parameters

Add Friction component to Momentum  
 Do not add weight component to Momentum  
 Class B flow critical depth computations use critical depth  
 inside the bridge at the upstream end  
 Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT Profile #PF 1

```

*****
* E.G. US. (ft)          *      752.48 * Element          *Inside BR US *Inside BR DS *
* W.S. US. (ft)         *      752.00 * E.G. Elev (ft)  *      752.47 *      752.42 *
* Q Total (cfs)         *    14907.00 * W.S. Elev (ft)  *      751.92 *      751.82 *
* Q Bridge (cfs)        *     9377.67 * Crit W.S. (ft)  *      743.28 *      743.49 *
* Q Weir (cfs)          *              * Max Chl Dpth (ft) *      17.77 *      17.67 *
* Weir Sta Lft (ft)     *              * Vel Total (ft/s) *       5.54 *       5.66 *
* Weir Sta Rgt (ft)     *              * Flow Area (sq ft) *     2692.37 *     2634.80 *
* Weir Submerg          *              * Froude # Chl     *       0.25 *       0.26 *
* Weir Max Depth (ft)   *              * Specif Force (cu ft) *    20822.32 *    20310.09 *
* Min El Weir Flow (ft) *     747.43 * Hydr Depth (ft)  *       7.37 *       7.19 *
* Min El Prs (ft)       *     748.64 * W.P. Total (ft)  *     676.02 *     682.13 *
* Delta EG (ft)         *       0.10 * Conv. Total (cfs) *    277647.1 *    268967.5 *
* Delta WS (ft)         *       0.11 * Top width (ft)   *     365.24 *     366.49 *
* BR Open Area (sq ft)  *    1602.31 * Frctn Loss (ft)  *       0.04 *       0.01 *
* BR Open Vel (ft/s)    *       5.85 * C & E Loss (ft)  *       0.00 *       0.03 *
* Coef of Q             *              * Shear Total (lb/sq ft) *     0.72 *     0.74 *
* Br Sel Method         *Energy only * Power Total (lb/ft s) *     0.00 *     0.00 *
*****
    
```

Note: Manning's n values were composited to a single value in the main channel.  
 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.  
 Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Upper RS: 3387.185

INPUT

Description:

```

Station Elevation Data      num=      51
Sta      Elev      Sta      Elev      Sta      Elev      Sta      Elev      Sta      Elev
*****
      0      760      5.8      758      11.62     756      17.59     754      25.31     752
    33.23     750     44.4     748.8     54.17     748.3     70.42     748.07     87.75     748.4
   102.47   748.42   108.59   748.57   134.14   749.03   140.23   749.4   172.14   750.63
   176.47     750     177.72   749.78   180.17   749.82   194.3    749.33   197.47     748
   202.09     746     205.98     744     207.88   742.96   210.07     742     218.01     740
    
```



Addie.rep

221.01	739.31	235.69	738.99	236.1	738	236.87	736	237.57	734.15
324.46	734.17	325.63	736	326.66	738	327.17	739	329.63	740
333.99	742	337.51	744	343.14	746	344.8	746.36	348.16	747.58
353.52	747.87	361.11	747.72	380.72	747.65	385.57	747.42	386.47	748
389.58	750	392.79	752	395.47	754	397.73	756	400.03	758
402.52	760								

Manning's n values num= 8

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	140.23	.033	172.14	.035	237.57	.04	324.46	.05
353.52	.033	361.11	.013	380.72	.035				

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

194.3	348.16	75.87	85.72	83.81	.1	.3
-------	--------	-------	-------	-------	----	----

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 752.38	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.50	* wt. n-Val.	* 0.035	* 0.040	* 0.019
* W.S. Elev (ft)	* 751.89	* Reach Len. (ft)	* 75.87	* 85.72	* 83.81
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 464.61	* 2190.95	* 172.43
* E.G. Slope (ft/ft)	* 0.000800	* Area (sq ft)	* 464.61	* 2190.95	* 172.43
* Q Total (cfs)	* 14907.00	* Flow (cfs)	* 1125.73	* 12850.92	* 930.35
* Top width (ft)	* 366.85	* Top width (ft)	* 168.54	* 153.86	* 44.45
* Vel Total (ft/s)	* 5.27	* Avg. vel. (ft/s)	* 2.42	* 5.87	* 5.40
* Max chl Dpth (ft)	* 17.74	* Hydr. Depth (ft)	* 2.76	* 14.24	* 3.88
* Conv. Total (cfs)	* 526929.4	* Conv. (cfs)	* 39792.1	* 454251.6	* 32885.7
* Length wtd. (ft)	* 84.98	* Wetted Per. (ft)	* 168.97	* 163.73	* 45.76
* Min Ch El (ft)	* 734.15	* Shear (lb/sq ft)	* 0.14	* 0.67	* 0.19
* Alpha	* 1.15	* Stream Power (lb/ft s)	* 402.52	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.07	* Cum Volume (acre-ft)	* 3.91	* 40.02	* 3.44
* C & E Loss (ft)	* 0.01	* Cum SA (acres)	* 1.18	* 2.31	* 0.34

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
REACH: Upper

RS: 3301.469

INPUT

Description:

Station Elevation Data num= 50

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	6.89	758	13.83	756	22.99	754	32.94	752
34.13	751.75	46.11	750.33	50.17	750	54.61	749.58	70.05	749.12
88.69	748.94	105.51	748.41	121.18	748.68	133.4	749.02	137.3	749.08
149.02	749.75	155.8	749.23	160.14	749.28	201.96	748.45	203.01	748

Addie.rep

207.62	746	212.21	744	218.34	742	222.08	740.75	233.69	740.66
234.27	740	236.04	738	237.81	736	239.56	734.12	339.5	734.14
340.73	736	341.89	738	342.15	738.42	345.51	740	347.8	741.08
350.65	742	353.3	742.91	355.45	744	359.07	746	360.57	746.97
368.52	747.91	388.35	748	392.63	747.78	392.96	748	396.04	750
399.12	752	401.21	754	402.73	756	404.25	758	405.77	760

Manning's n values num= 7

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	137.3	.033	149.02	.035	239.56	.04	339.5	.05
368.52	.013	388.35	.035						

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

201.96	368.52	254.19	261.44	260.76	.1	.3
--------	--------	--------	--------	--------	----	----

Blocked Obstructions num= 1

Sta L	Sta R	Elev
164.74	191.08	755

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 752.31	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.48	* Wt. n-Val.	* 0.035	* 0.041	* 0.015
* W.S. Elev (ft)	* 751.83	* Reach Len. (ft)	* 254.19	* 261.44	* 260.76
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 370.96	* 2383.72	* 106.41
* E.G. Slope (ft/ft)	* 0.000742	* Area (sq ft)	* 370.96	* 2383.72	* 106.41
* Q Total (cfs)	* 14907.00	* Flow (cfs)	* 797.37	* 13455.26	* 654.37
* Top width (ft)	* 338.79	* Top width (ft)	* 141.89	* 166.56	* 30.34
* Vel Total (ft/s)	* 5.21	* Avg. Vel. (ft/s)	* 2.15	* 5.64	* 6.15
* Max chl Dpth (ft)	* 17.71	* Hydr. Depth (ft)	* 2.61	* 14.31	* 3.51
* Conv. Total (cfs)	* 547135.6	* Conv. (cfs)	* 29266.0	* 493851.9	* 24017.7
* Length wtd. (ft)	* 261.06	* Wetted Per. (ft)	* 147.89	* 175.32	* 31.55
* Min Ch El (ft)	* 734.12	* Shear (lb/sq ft)	* 0.12	* 0.63	* 0.16
* Alpha	* 1.13	* Stream Power (lb/ft s)	* 405.77	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.23	* Cum Volume (acre-ft)	* 3.18	* 35.51	* 3.17
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.91	* 1.99	* 0.27

Warning: Divided flow computed for this cross-section.  
 Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Upper RS: 3039.998

INPUT

Description:

Station	Elevation	Data	num=	49	Sta	Elev	Sta	Elev	Sta	Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

Addie.rep

```
*****
0      760  12.39      758  26.71      756  41.67      754  68.47      752
94.57  750  99.85  749.23  104.84  748.24  113.69  748.1  114.71  748
121.14 747.32 124.11 746.21 133.18 746.74 139.18 746.53 145.41 748
146.24 748.26 159.37 748.33 162.17      748 172.26 746.41 172.97 746
177.37      744 182.15      742 184.83 740.97 193.27 740.21 194.25 740
200.88 738.55 202.06      738 207.17      736 209.08 735.38 218.37 734.04
311    734.05 312.24      736 313.45      738 315.31      740 319.87      742
327.96      744 332.22      746 336.98      748 344.02 749.03 354.1 749.48
363.84 749.64 365.59 749.57 369.58 748.26 372.09      750 374.54 752
376.65      754 378.82      756 381.03      758 383.21      760
```

```
Manning's n values      num=      7
Sta  n Val      Sta  n Val      Sta  n Val      Sta  n Val      Sta  n Val
*****
0      .035 124.11  .033 133.18      .06 218.37      .04 311      .05
344.02  .013 363.84  .035
```

```
Bank Sta: Left  Right      Lengths: Left Channel  Right      Coeff Contr.  Expan.
159.37 344.02      44.51 95.67 83.59      .1      .3
```

CROSS SECTION OUTPUT Profile #PF 1

```
*****
* E.G. Elev (ft)      * 752.07 * Element      * Left OB * Channel * Right OB *
* Vel Head (ft)      * 0.46 * Wt. n-Val.   * 0.042 * 0.049 * 0.016 *
* W.S. Elev (ft)     * 751.61 * Reach Len. (ft) * 44.51 * 95.67 * 83.59 *
* Crit W.S. (ft)     *      * Flow Area (sq ft) * 265.82 * 2498.39 * 65.87 *
* E.G. Slope (ft/ft) * 0.001083 * Area (sq ft) * 265.82 * 2498.39 * 65.87 *
* Q Total (cfs)      * 14907.00 * Flow (cfs) * 694.09 * 13886.30 * 326.61 *
* Top width (ft)     * 300.55 * Top width (ft) * 85.85 * 184.65 * 30.05 *
* Vel Total (ft/s)   * 5.27 * Avg. vel. (ft/s) * 2.61 * 5.56 * 4.96 *
* Max Chl Dpth (ft) * 17.57 * Hydr. Depth (ft) * 3.10 * 13.53 * 2.19 *
* Conv. Total (cfs) * 453009.2 * Conv. (cfs) * 21092.8 * 421991.2 * 9925.2 *
* Length Wtd. (ft)  * 90.36 * Wetted Per. (ft) * 86.54 * 191.49 * 31.39 *
* Min Ch El (ft)    * 734.04 * Shear (lb/sq ft) * 0.21 * 0.88 * 0.14 *
* Alpha              * 1.07 * Stream Power (lb/ft s) * 383.21 * 0.00 * 0.00 *
* Frctn Loss (ft)   * 0.07 * Cum Volume (acre-ft) * 1.32 * 20.86 * 2.66 *
* C & E Loss (ft)   * 0.03 * Cum SA (acres) * 0.25 * 0.94 * 0.09 *
*****
```

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Upper RS: 2944.331

INPUT

Description:

```
Station Elevation Data      num=      54
Sta  Elev      Sta  Elev      Sta  Elev      Sta  Elev      Sta  Elev
```

Addie.rep

```

*****
0      760    5.61    758    12.19  756.34  15.89    756    30.8   754.45
35.57  754    46.32   753.29  63.3   752.27  64.91    752    71.34  750.96
79.13   750    81.24   749.75  87.8   748.79  98.49    748.86  106    748.46
107.22  748.27  110.17    748    117.89  747.17  120.57    746    125.38  744
128.03  742.77  130.01    742    134.87  740.25  146.9     740.3   151.7   740.95
160.28   740    164.72   739.86  168.05  739.87  170.61    738    173.84  736
177.21  734.01  295.77   734.03  297.08    736    298.59    738    300.21  740
300.5   740.34  304.87    742    310.21    744    312.65    744.86  317.2   746
331.46   748    333.34   748.29  343.82  748.81  353.59    749.19  355.66  749
358.74   748    360.17   747.52  360.74    748    362.53    750    364.73  752
366.88   754    369.04    756    371.41    758    373.67    760

```

```

Manning's n Values      num=      9
Sta  n Val      Sta  n Val      Sta  n Val      Sta  n Val      Sta  n Val
*****
0      .035    87.8    .033    98.49    .035    134.87    .033    146.9    .06
177.21  .04    295.77  .05    333.34    .013    353.59    .035

```

```

Bank Sta: Left  Right  Lengths: Left Channel  Right  Coeff Contr.  Expan.
          168.05  333.34          110.34  115.15  29.86          .1          .3

```

CROSS SECTION OUTPUT Profile #PF 1

```

*****
* E.G. Elev (ft)      * 751.97 * Element      * Left OB * Channel * Right OB *
* Vel Head (ft)      * 0.35  * Wt. n-val.   * 0.042  * 0.044  * 0.016  *
* W.S. Elev (ft)     * 751.62 * Reach Len. (ft) * 110.34 * 115.15 * 29.86  *
* Crit W.S. (ft)     *        * Flow Area (sq ft) * 639.45 * 2500.14 * 86.53  *
* E.G. Slope (ft/ft) * 0.000592 * Area (sq ft) * 639.45 * 2500.14 * 86.53  *
* Q Total (cfs)      * 14907.00 * Flow (cfs) * 2233.81 * 12298.44 * 374.75 *
* Top width (ft)     * 297.07 * Top width (ft) * 100.80 * 165.29 * 30.97  *
* Vel Total (ft/s)   * 4.62  * Avg. Vel. (ft/s) * 3.49  * 4.92  * 4.33  *
* Max Chl Dpth (ft) * 17.61 * Hydr. Depth (ft) * 6.34  * 15.13 * 2.79  *
* Conv. Total (cfs)  * 612417.0 * Conv. (cfs) * 91770.6 * 505250.8 * 15395.5 *
* Length wtd. (ft)  * 111.83 * wetted Per. (ft) * 102.55 * 171.29 * 32.94  *
* Min Ch El (ft)    * 734.01 * Shear (lb/sq ft) * 0.23  * 0.54  * 0.10  *
* Alpha              * 1.04  * Stream Power (lb/ft s) * 373.67 * 0.00  * 0.00  *
* Frctn Loss (ft)   * 0.06  * Cum Volume (acre-ft) * 0.86  * 15.37 * 2.51  *
* C & E Loss (ft)   * 0.03  * Cum SA (acres) * 0.15  * 0.55  * 0.03  *
*****

```

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Upper RS: 2829.179

INPUT  
 Description:  
 Station Elevation Data num= 44

						Addie.rep			
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	15.46	758.8	21.78	758	27.76	757.29	33.37	756
38.79	754.76	41.12	754	47.44	752	48.19	751.76	50.8	750.43
59.93	750.58	67.06	750	71.88	748	76.81	746	79.63	745.11
84.75	744	92.88	742	96.99	740	101.27	738	105.7	736
110.69	733.9	262.47	734	264.58	736	266.6	737.43	269.9	738
280.14	740	288.31	742	301.19	744	315.68	745.16	319.31	746
329.89	745.23	337.23	747.84	349.5	748.42	360.61	748.85	362.66	748.73
364.91	748	367.6	747.15	369.14	748	371.67	750	374.3	752
376.92	754	378.07	756	381.77	758	382.68	760		

Manning's n Values		num= 7							
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	50.8	.033	59.93	.06	110.69	.04	262.47	.06
337.23	.013	360.61	.035						

Bank Sta:	Left	Right	Lengths:		Left Channel	Right	Coeff	Contr.	Expan.
	67.06	319.31	80.82	99.05	654.35		.1	.3	

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 751.87	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.23	* Wt. n-Val.	* 0.042	* 0.049	* 0.027
* W.S. Elev (ft)	* 751.64	* Reach Len. (ft)	* 99.05	* 99.05	* 99.05
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 21.49	* 3654.25	* 216.71
* E.G. Slope (ft/ft)	* 0.000474	* Area (sq ft)	* 21.49	* 3654.25	* 216.71
* Q Total (cfs)	* 14907.00	* Flow (cfs)	* 18.34	* 14230.95	* 657.71
* Top Width (ft)	* 325.41	* Top width (ft)	* 18.64	* 252.25	* 54.52
* Vel Total (ft/s)	* 3.83	* Avg. vel. (ft/s)	* 0.85	* 3.89	* 3.03
* Max Chl Dpth (ft)	* 17.74	* Hydr. Depth (ft)	* 1.15	* 14.49	* 3.97
* Conv. Total (cfs)	* 684912.1	* Conv. (cfs)	* 842.7	* 653850.4	* 30219.1
* Length Wtd. (ft)	* 99.05	* Wetted Per. (ft)	* 18.96	* 257.33	* 56.74
* Min Ch El (ft)	* 733.90	* Shear (lb/sq ft)	* 0.03	* 0.42	* 0.11
* Alpha	* 1.01	* Stream Power (lb/ft s)	* 382.68	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.05	* Cum Volume (acre-ft)	* 0.02	* 7.24	* 2.41
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	*	*	*

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island

REACH: Lower

RS: 2730.129

INPUT

Description:

Station Elevation Data

num= 62

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-----	------	-----	------	-----	------	-----	------	-----	------

Addie.rep

```
*****
0      760    7.79  759.62  20.79    758    27.89    756    34.94    754
38.06  753.1  40.77  752.26  48.68    752.61  58.69    752.44  59.41    752
62.37   750     65    748     66.4    746.9    69.82    746.49  70.33    746
72.42   744    74.52   742    76.62    740    77.73    738.93  79.13    738
82.15   736    85.19   733.79 197.73   733.76  202.18   734.31  214.21   736
219.7   738    226.2    740    231.1    741.23   235.3    741.55  244.77   742
256.1   742.26  257.37   742    267.63   740    269.16   739.32  275.28   740
287.27  740.69  296.15   741.15  299.2    742    305.05   743.67  305.93   744
314.18  746.25  325.21   746.08  337.3    745.45   343.5    743.75  344.56   746
347.71   748     353    748.52  377.19   748.34  406.73   748.54  441.12   748.18
477.15  747.71  506.49   747.65  552.32   748.56  572.32    750    593.14   749.18
617.42  749.96  641.36   750.59  643.69    752    654.67   754    662.64   756
673.77   758    680.5    760
```

```
Manning's n Values      num=      7
Sta  n Val      Sta  n Val      Sta  n Val      Sta  n Val      Sta  n Val
*****
0      .035    40.77   .033    48.68     .06    85.19     .04    197.73     .06
314.18  .013    337.3     .1
```

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 58.69 231.1 300.11 271.21 6.63 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

```
*****
* E.G. Elev (ft) * 751.82 * Element * Left OB * Channel * Right OB *
* Vel Head (ft) * 0.22 * Wt. n-Val. * * 0.048 * 0.054 *
* W.S. Elev (ft) * 751.61 * Reach Len. (ft) * 300.11 * 271.21 * 6.63 *
* Crit W.S. (ft) * * * Flow Area (sq ft) * * 2714.12 * 1902.02 *
* E.G. Slope (ft/ft) * 0.000472 * Area (sq ft) * * 2714.12 * 1902.02 *
* Q Total (cfs) * 14963.00 * Flow (cfs) * * 11248.04 * 3714.96 *
* Top width (ft) * 583.05 * Top width (ft) * * 171.11 * 411.94 *
* Vel Total (ft/s) * 3.24 * Avg. vel. (ft/s) * * 4.14 * 1.95 *
* Max Chl Dpth (ft) * 17.85 * Hydr. Depth (ft) * * 15.86 * 4.62 *
* Conv. Total (cfs) * 688632.5 * Conv. (cfs) * * 517661.2 * 170971.3 *
* Length wtd. (ft) * 224.28 * wetted Per. (ft) * * 178.27 * 415.78 *
* Min Ch El (ft) * 733.76 * Shear (lb/sq ft) * * 0.45 * 0.13 *
* Alpha * 1.32 * Stream Power (lb/ft s) * 680.50 * 0.00 * 0.00 *
* Frctn Loss (ft) * 0.12 * Cum Volume (acre-ft) * 0.04 * 91.90 * 30.43 *
* C & E Loss (ft) * 0.01 * Cum SA (acres) * 0.05 * 6.12 * 4.33 *
*****
```

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Lower

RS: 2457.936

INPUT

Description:

Station Elevation Data num= 44											
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	2.82	758	5.6	756	8.31	754	10.36	752		
11.86	750	13.35	748	15.2	746	16.74	744	19.35	742		
22.41	740	27.07	738	30.66	736	32.89	734	32.99	733.42		
144.52	733.14	153.59	734	158.95	736	162.28	738	164.89	739.65		
170.09	740	174.64	742	177.77	744	183.38	746	187.79	746.86		
208.11	745.65	211.81	746	213.69	748	217.98	748.25	248.38	748.11		
282.67	747.52	290.9	748	316.87	746.03	350.31	748	368.38	748.53		
399.75	748.82	430.19	748.88	450.09	749.45	467.58	750.41	470.33	752		
479.1	754	486.53	756	492.91	758	496.59	760				

Manning's n values num= 5											
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.06	32.99	.04	153.59	.06	187.79	.013	208.11	.1		

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
0	187.79		186.5	198.67	19.33	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 751.69	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.33	* Wt. n-Val.	* 0.048	* 0.051	*
* W.S. Elev (ft)	* 751.36	* Reach Len. (ft)	* 186.50	* 198.67	* 19.33
* Crit W.S. (ft)	*	* Flow Area (sq ft)	*	* 2759.05	* 937.21
* E.G. Slope (ft/ft)	* 0.000664	* Area (sq ft)	*	* 2759.05	* 937.21
* Q Total (cfs)	* 14963.00	* Flow (cfs)	*	* 13369.79	* 1593.21
* Top width (ft)	* 458.37	* Top width (ft)	*	* 176.95	* 281.43
* Vel Total (ft/s)	* 4.05	* Avg. Vel. (ft/s)	*	* 4.85	* 1.70
* Max chl Dpth (ft)	* 18.22	* Hydr. Depth (ft)	*	* 15.59	* 3.33
* Conv. Total (cfs)	* 580687.0	* Conv. (cfs)	*	* 518857.4	* 61829.6
* Length wtd. (ft)	* 177.13	* Wetted Per. (ft)	*	* 186.83	* 282.80
* Min Ch El (ft)	* 733.14	* Shear (lb/sq ft)	*	* 0.61	* 0.14
* Alpha	* 1.30	* Stream Power (lb/ft s)	* 496.59	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.13	* Cum Volume (acre-ft)	* 0.04	* 74.86	* 30.21
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.05	* 5.04	* 4.28

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Lower RS: 2259.266

INPUT

Description:  
 Station Elevation Data num= 66

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	3.91	758.7	12.64	759.09	21.31	758	23.8	756
25.88	754	27.88	752	29.92	750	31.83	748	33.82	746
36.01	744	38.06	742	41.06	740	44.45	738	47.12	736
49.45	734	50.45	733.18	154.03	732.96	157.9	734	159.78	736
161.85	738	163.64	740	172.34	742	178.96	742.8	182.35	744
187.5	746	194.04	747.9	214.03	747.1	217	746	219.14	746.49
220.89	746	223.55	748	228.58	748.66	232.14	748.35	238.55	748
246.56	747.69	258.71	746.96	268.78	746.43	276.71	746.26	281.67	746
292.15	745.59	298.81	745.25	307.15	745.09	314.17	744.78	321.02	744.35
330.05	744.37	338.47	744.44	346.05	744.32	353.61	744.47	360.76	744.46
369.07	744.65	375.86	744.99	382.01	745.18	396.02	746	406.55	746.3
412.91	746.79	421.3	748	430.99	750	443.59	750.78	450.62	751.21
459.94	752	467.83	753.18	472.08	754	477.16	756	480.95	758
485.02	760								

Manning's n values		num= 7	
Sta	n Val	Sta	n Val
0	.035	3.91	.033
194.04	.013	214.03	.1

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	21.31	194.04		230.22	209.54	168.29	.1 .3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 751.55	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.38	* Wt. n-Val.	* 230.22	* 209.54	* 168.29
* W.S. Elev (ft)	* 751.17	* Reach Len. (ft)	* 2465.30	* 1204.50	* 1204.50
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 2465.30	* 1204.50	* 1204.50
* E.G. Slope (ft/ft)	* 0.000878	* Area (sq ft)	* 12962.09	* 2000.91	* 2000.91
* Q Total (cfs)	* 14963.00	* Flow (cfs)	* 165.31	* 255.93	* 255.93
* Top width (ft)	* 421.24	* Top width (ft)	* 5.26	* 1.66	* 1.66
* Vel Total (ft/s)	* 4.08	* Avg. vel. (ft/s)	* 14.91	* 4.71	* 4.71
* Max Chl Dpth (ft)	* 18.21	* Hydr. Depth (ft)	* 437428.2	* 67524.1	* 67524.1
* Conv. Total (cfs)	* 504952.3	* Conv. (cfs)	* 175.75	* 257.48	* 257.48
* Length wtd. (ft)	* 202.31	* wetted Per. (ft)	* 0.77	* 0.26	* 0.26
* Min Ch El (ft)	* 732.96	* Shear (lb/sq ft)	* 485.02	* 0.00	* 0.00
* Alpha	* 1.46	* Stream Power (lb/ft s)	* 0.04	* 62.95	* 29.73
* Frctn Loss (ft)	* 0.16	* Cum volume (acre-ft)	* 0.05	* 4.26	* 4.16
* C & E Loss (ft)	* 0.02	* Cum SA (acres)	*	*	*

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Lower

RS: 2049.716



Addie.rep

INPUT

Description:

Station Elevation Data		num= 68		Sta Elev		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	5.62	758.31	14.62	758.95	21.75	758.74	30.13	758.63		
34.31	758	39.5	756	41.26	754	42.49	752	43.55	750		
44.68	748	46.03	746	47.58	744	49.91	742	52.26	740		
55.13	738	59.26	736	65.76	734	68.32	732.9	160.8	732.76		
161.51	734	163.68	736	165.98	738	169.67	740	171.68	740.38		
178.26	740.98	180.86	742	184.72	744	190.13	746	197.16	746.99		
218	746.11	223.77	745.21	224.39	746	227.12	746.61	231.66	746.21		
234.49	746	239.68	745.6	249.26	744.91	260.8	744.11	263.3	744		
270.95	743.74	280.72	743.55	291.91	743.46	301.38	743.35	312.27	743.37		
321.84	743.08	332.31	743.26	341.81	743.39	353.72	743.55	364.46	743.78		
373.48	743.73	385.52	743.77	394.8	743.47	406.12	743.2	415.97	743		
425.43	743.11	430.52	743.27	437.13	744	440.62	744.45	443.39	744.9		
447.68	746	452.9	748	457.43	750	461.57	752	465.23	754		
468.85	756	472.2	758	475.44	760						

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	5.62	.033	14.62	.035	34.31	.06	68.32	.04
160.8	.06	180.86	.035	197.16	.013	218	.1		

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.	
	30.13	197.16		204	209.45	191.89	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 751.37	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.32	* Wt. n-Val.	* 0.047	* 0.079	*
* W.S. Elev (ft)	* 751.05	* Reach Len. (ft)	* 204.00	* 209.45	* 191.89
* Crit w.s. (ft)	*	* Flow Area (sq ft)	*	* 2321.19	* 1769.35
* E.G. slope (ft/ft)	* 0.000741	* Area (sq ft)	*	* 2321.19	* 1769.35
* Q Total (cfs)	* 14963.00	* Flow (cfs)	*	* 11716.40	* 3246.60
* Top width (ft)	* 416.60	* Top width (ft)	*	* 154.16	* 262.44
* Vel Total (ft/s)	* 3.66	* Avg. Vel. (ft/s)	*	* 5.05	* 1.83
* Max chl Dpth (ft)	* 18.29	* Hydr. Depth (ft)	*	* 15.06	* 6.74
* Conv. Total (cfs)	* 549551.6	* Conv. (cfs)	*	* 430312.4	* 119239.1
* Length wtd. (ft)	* 205.09	* Wetted Per. (ft)	*	* 165.02	* 264.38
* Min ch El (ft)	* 732.76	* Shear (lb/sq ft)	*	* 0.65	* 0.31
* Alpha	* 1.55	* Stream Power (lb/ft s)	* 475.44	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.15	* Cum Volume (acre-ft)	* 0.04	* 51.44	* 23.99
* C & E Loss (ft)	* 0.01	* Cum SA (acres)	* 0.05	* 3.49	* 3.16

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Lower

RS: 1840.209

INPUT

Description:

Station Elevation Data num= 69

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	5.41	758	8.59	756.65	16.89	755.65	24.02	755.23
25.56	754	28.83	752	33.17	750	35.4	748	37.07	746
38.68	744	40.55	742	42.26	740	44	738	45.22	736
47.06	734	56.01	732.64	134.95	732.54	138.43	734	143.03	736
146.98	738	148.39	738.56	151.78	739.64	155.36	740	161.5	740.92
166.33	742	169.21	742.82	172.96	743.55	177.21	744	185.83	744.34
205.92	744.34	208.52	744	211.25	743.68	212.97	744	218.02	744.8
224.99	744	227.66	743.84	235.34	743.15	244.43	742.81	250.35	742.71
256.52	742.41	263.5	742.14	264.81	742	274.95	741.44	282.47	741.52
290.84	741.25	299.29	740.82	306.98	740.52	315.67	740.43	323.58	740.46
333.1	740	335.32	739.85	353.71	739.66	364.08	739.79	365.26	740
367.85	740.39	371.31	740.98	374.01	742	377.25	744	380.29	746
384.45	748	388.92	750	391.31	750.84	395.91	752	400.43	753.02
405.21	754	411.61	756	415.92	758	420.6	760		

Manning's n values num= 8

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	8.59	.033	16.89	.06	56.01	.04	134.95	.06
166.33	.035	185.83	.013	205.92	.1				

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 24.02 185.83 154.95 206.96 249.3 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 751.21	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.28	* wt. n-Val.	* 0.048	* 0.071	*
* W.S. Elev (ft)	* 750.93	* Reach Len. (ft)	* 154.95	* 206.96	* 249.30
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 2265.15	* 1780.18	*
* E.G. Slope (ft/ft)	*0.000712	* Area (sq ft)	* 2265.15	* 1780.18	*
* Q Total (cfs)	*14963.00	* Flow (cfs)	* 10772.13	* 4190.88	*
* Top width (ft)	* 360.51	* Top width (ft)	* 154.68	* 205.83	*
* Vel Total (ft/s)	* 3.70	* Avg. Vel. (ft/s)	* 4.76	* 2.35	*
* Max Chl Dpth (ft)	* 18.39	* Hydr. Depth (ft)	* 14.64	* 8.65	*
* Conv. Total (cfs)	*560791.1	* Conv. (cfs)	*403723.4	*157067.8	*
* Length wtd. (ft)	* 219.75	* wetted Per. (ft)	* 164.22	* 208.62	*
* Min Ch El (ft)	* 732.54	* Shear (lb/sq ft)	* 0.61	* 0.38	*
* Alpha	* 1.30	* Stream Power (lb/ft s)	* 420.60	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.15	* Cum volume (acre-ft)	* 0.04	* 40.41	* 16.17
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.05	* 2.75	* 2.13

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
 REACH: Lower RS: 1632.735

INPUT

Description:

Station Elevation Data		num= 68		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	6.67	759.82	13.74	759.39	21.44	759.07	28.32	758.62
40.49	758	43.51	757.87	50.81	757.15	54.87	756.51	58.3	756
60.12	755.574	62.59	755.54	68.87	754.82	74.25	754	80.92	752
81.88	751.6	90.17	751.53	97.37	751.97	100.07	750.94	102.49	750
105.12	748.89	108.38	748	111.1	747.11	113.19	746	116.44	744
119.24	742	121.26	740	123.21	738	126.12	736	128.32	734.98
131.28	734	136.11	732.44	141.62	732.85	148.67	732.39	231.24	732.31
237.6	732.89	238.69	734	241.22	736	243.25	738	246.18	740
249.19	741.2	254.6	740.9	262.86	740.59	268.43	740.86	271.37	741.14
274.46	742	280.33	742.79	291.6	742.86	311.69	743.15	320.34	742.41
329.94	742.41	334.52	742	343.24	741.85	346.91	742	352.68	742.18
365.46	742.87	372.31	743.25	380.79	743.46	386.86	744	391.88	744.71
394.97	746	398.72	748	402.29	750	405.58	752	409.12	754
414.07	756	419.64	758	424.77	760				

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	.035	81.88	.033	90.17	.06	136.11	.04	231.24	.06
274.46	.035	291.6	.013	311.69	.1				

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 97.37 231.24 135.91 215.58 310.45 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 751.06	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.30	* wt. n-Val.	* 135.91	* 0.046	* 0.048
* W.S. Elev (ft)	* 750.75	* Reach Len. (ft)	* 215.58	* 215.58	* 310.45
* Crit w.s. (ft)	*	* Flow Area (sq ft)	* 2065.65	* 2065.65	* 1489.46
* E.G. Slope (ft/ft)	*0.000620	* Area (sq ft)	* 2065.65	* 2065.65	* 1489.46
* Q Total (cfs)	*14963.00	* Flow (cfs)	* 10110.82	* 10110.82	* 4852.18
* Top width (ft)	* 302.97	* Top width (ft)	* 130.69	* 130.69	* 172.29
* Vel Total (ft/s)	* 4.21	* Avg. Vel. (ft/s)	* 4.89	* 4.89	* 3.26
* Max Chl Dpth (ft)	* 18.44	* Hydr. Depth (ft)	* 15.81	* 15.81	* 8.65
* Conv. Total (cfs)	*600872.8	* Conv. (cfs)	* 406022.6	* 406022.6	* 194850.2
* Length wtd. (ft)	* 233.31	* Wetted Per. (ft)	* 135.74	* 135.74	* 177.00
* Min Ch El (ft)	* 732.31	* Shear (lb/sq ft)	* 0.59	* 0.59	* 0.33

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* Alpha * 1.11 * Stream Power (lb/ft s) * 424.77 * 0.00 * 0.00 *
* Frctn Loss (ft) * 0.19 * Cum Volume (acre-ft) * 0.04 * 30.12 * 6.82 *
* C & E Loss (ft) * 0.02 * Cum SA (acres) * 0.05 * 2.07 * 1.04 *
*****

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Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island  
REACH: Lower RS: 1414.824

INPUT

Description:

Station Elevation Data		num= 61		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	15.24	759.21	22.73	758.8	34.79	758	45.46	757.43
59.07	756	73.06	754.93	84.94	754	94.61	753.52	101.71	753.38
109.31	753.09	115.45	752.83	123.04	752.68	130.29	752.54	136.24	752.62
143.41	752.66	150.86	752.66	158.35	752.63	166.21	752.53	174.36	752.33
177.31	752	185.01	750.8	196.69	750.63	202.85	750.59	206.36	750
208.6	749.59	213.63	749.25	219.02	749.16	222.05	748	227.01	746
229.91	744	233.09	742	234.66	741.34	236.65	740.82	242.66	740.95
247.97	741.69	250.05	740	252.33	738	254.66	736	258.37	734
265.53	732.11	361.05	732.08	364.02	734	366.21	736	368.1	738
369.87	740	371.88	742	373.1	743.04	375.75	744	380.91	744.76
384.5	745.24	390.03	746	391.36	746.17	412.16	748.21	420.39	747.69
424.21	750	425.66	752	426.73	754	427.63	756	428.59	758
429.75	760								

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	185.01	.033	196.69	.06	265.53	.04	361.05	.06
391.36	.013	412.16	.1						

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
219.02 375.75 191.41 401.52 460.36 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 750.84	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.55	* Wt. n-Val.	* 0.060	* 0.049	* 0.028
* W.S. Elev (ft)	* 750.30	* Reach Len. (ft)	* 191.41	* 401.52	* 460.36
* Crit w.s. (ft)	*	* Flow Area (sq ft)	* 11.67	* 2367.31	* 170.47
* E.G. Slope (ft/ft)	* 0.001133	* Area (sq ft)	* 11.67	* 2367.31	* 170.47
* Q Total (cfs)	* 14963.00	* Flow (cfs)	* 8.42	* 14206.92	* 747.66
* Top width (ft)	* 219.82	* Top width (ft)	* 14.42	* 156.73	* 48.67
* Vel Total (ft/s)	* 5.87	* Avg. Vel. (ft/s)	* 0.72	* 6.00	* 4.39
* Max chl Dpth (ft)	* 18.22	* Hydr. Depth (ft)	* 0.81	* 15.10	* 3.50

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* Conv. Total (cfs)      *444458.9 * Conv. (cfs)          * 250.0 *422000.5 * 22208.4 *
* Length Wtd. (ft)      * 402.93 * Wetted Per. (ft)    * 14.49 * 166.11 * 49.74 *
* Min Ch El (ft)       * 732.08 * Shear (lb/sq ft)    * 0.06 * 1.01 * 0.24 *
* Alpha                 * 1.02 * Stream Power (lb/ft s) * 429.75 * 0.00 * 0.00 *
* Frctn Loss (ft)      * 0.70 * Cum Volume (acre-ft) * 0.03 * 19.15 * 0.90 *
* C & E Loss (ft)      * 0.05 * Cum SA (acres)      * 0.03 * 1.36 * 0.26 *
*****
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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.

Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Middle Island

REACH: Lower

RS: 1000.000

INPUT

Description:

Station Elevation Data		num= 67									
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760	13.65	759.56	24.39	759.09	34.94	758.26	38.89	758		
44.36	757.66	55.43	756.67	61.73	756	66.32	755.56	72.83	754.89		
81.77	754	86.43	753.67	95.07	752.79	104.9	752.17	108.34	752		
113.62	751.73	124	751.33	133.43	751.24	144.81	751.3	154.89	751.12		
164.51	751.07	174.03	751.16	188.47	751.26	196.86	751.48	205.18	751.9		
211.19	751.57	213.78	751.46	218.37	750	221.01	748	223.06	746		
225.12	744	226.42	742.79	228.11	742.11	230.89	742	233.81	742		
243.16	740.46	247.53	740	249.81	739.66	250.95	738	252.44	736		
254.3	734	255.38	732.98	256.61	732	257.98	731.75	331.51	731.75		
333.07	732	335.16	733.09	335.55	734	337.34	736	339.17	738		
341.23	740	344.23	742	347.24	744	350.56	746	355.52	748		
360.34	750	366.98	751.5	377.89	750	378.67	750	394.79	751.71		
415.43	752.41	422.23	750.57	425.08	752	427.86	754	429.52	756		
431.27	758	432.66	760								

Manning's n values		num= 9									
Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	188.47	.033	196.86	.035	218.37	.06	257.98	.04		
331.51	.06	360.34	.035	394.79	.013	415.43	.1				

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 205.18 366.98 1 1 1 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

\*\*\*\*\*

```

Addie.rep
* E.G. Elev (ft)      * 750.09 * Element      * Left OB * Channel * Right OB *
* Vel Head (ft)      * 1.09  * Wt. n-Val.   *         * 0.051  *         *
* W.S. Elev (ft)     * 749.00 * Reach Len. (ft) *         *         *         *
* Crit W.S. (ft)     * 742.26 * Flow Area (sq ft) *         * 1788.63 *         *
* E.G. Slope (ft/ft) * 0.003001 * Area (sq ft) *         * 1788.63 *         *
* Q Total (cfs)      * 14963.00 * Flow (cfs) *         * 14963.00 *         *
* Top Width (ft)     * 138.24 * Top Width (ft) *         * 138.24 *         *
* Vel Total (ft/s)   * 8.37  * Avg. Vel. (ft/s) *         * 8.37 *         *
* Max Chl Dpth (ft)  * 17.25 * Hydr. Depth (ft) *         * 12.94 *         *
* Conv. Total (cfs)  * 273117.8 * Conv. (cfs) *         * 273117.8 *         *
* Length wtd. (ft)   *         * Wetted Per. (ft) *         * 150.33 *         *
* Min Ch El (ft)     * 731.75 * Shear (lb/sq ft) *         * 2.23 *         *
* Alpha              * 1.00  * Stream Power (lb/ft s) * 432.66 * 0.00 * 0.00 *
* Frctn Loss (ft)    *         * Cum Volume (acre-ft) *         *         *         *
* C & E Loss (ft)    *         * Cum SA (acres) *         *         *         *
*****

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Note: Manning's n values were composited to a single value in the main channel.

CROSS SECTION

RIVER: Slaughter Run  
 REACH: Upper RS: 1724.607

INPUT

Description:

Station Elevation Data		num= 34		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	770	4.22	768	6.73	766	8.72	764	10.66	762
12.93	760	15.43	758	18.64	756	22.38	754	26.37	752
30.11	750	34.79	748	42.87	746.45	54.53	748	57.95	749.38
68.01	750	80.39	750.15	100.88	751.34	112.37	750.54	117.6	752
120.95	754	123.6	756	125.96	758	128.31	760	130.56	762
133.39	764	138.66	766	144.19	768	149.31	770	155.92	772
162.13	774	168.14	776	176.8	778	185.46	780		

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	.1	30.11	.04	57.95	.1	80.39	.033	100.88	.1

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.  
 30.11 57.95 178.86 177.7 69.15 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

```

*****
* E.G. Elev (ft)      * 751.94 * Element      * Left OB * Channel * Right OB *
* Vel Head (ft)      * 0.16  * Wt. n-Val.   * 0.100 * 0.040 * 0.069 *
* W.S. Elev (ft)     * 751.78 * Reach Len. (ft) * 178.86 * 177.70 * 69.15 *
* Crit W.S. (ft)     *         * Flow Area (sq ft) * 2.95 * 113.41 * 75.57 *
*****

```

Addie.rep

* E.G. slope (ft/ft)	*0.001415	* Area (sq ft)	* 2.95	* 113.41	* 75.57	*
* Q Total (cfs)	* 475.00	* Flow (cfs)	* 1.40	* 395.54	* 78.06	*
* Top width (ft)	* 90.01	* Top width (ft)	* 3.32	* 27.84	* 58.85	*
* Vel Total (ft/s)	* 2.47	* Avg. Vel. (ft/s)	* 0.48	* 3.49	* 1.03	*
* Max chl Dpth (ft)	* 5.33	* Hydr. Depth (ft)	* 0.89	* 4.07	* 1.28	*
* Conv. Total (cfs)	* 12626.5	* Conv. (cfs)	* 37.3	* 10514.2	* 2075.1	*
* Length wtd. (ft)	* 137.18	* Wetted Per. (ft)	* 3.77	* 28.77	* 59.10	*
* Min Ch El (ft)	* 746.45	* Shear (lb/sq ft)	* 0.07	* 0.35	* 0.11	*
* Alpha	* 1.68	* Stream Power (lb/ft s)	* 185.46	* 0.00	* 0.00	*
* Frctn Loss (ft)	* 0.02	* Cum Volume (acre-ft)	* 3.06	* 12.88	* 14.08	*
* C & E Loss (ft)	* 0.05	* Cum SA (acres)	* 0.46	* 0.66	* 1.16	*

\*\*\*\*\*

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: Slaughter Run  
 REACH: Upper RS: 1544.864

INPUT

Description:

Station Elevation Data	num=	35								
Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev										
*****										
0 770 3.52 768 4.96 766 6.39 764 7.84 762										
9.29 760 10.93 758 12.71 756 14.46 754 17.32 752										
20.42 750 23.25 748 26.21 746 29.82 744 34.38 742.83										
45.36 743.64 46.96 744 51.65 745.5 57.63 746 98.36 746.57										
141.37 747.74 144.96 748 153.32 747.02 165.06 748.53 178.02 750										
202.13 752 215.31 754 225.96 756 233.57 758 241.78 760										
248.39 762 253.76 764 258.94 766 265.03 768 272.91 770										

Manning's n Values	num=	5								
Sta n Val Sta n Val Sta n Val Sta n Val Sta n Val										
*****										
0 .1 26.21 .04 51.65 .1 98.36 .033 141.37 .1										

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
26.21	51.65	139.44	197.68	45.42	.1	.3	

CROSS SECTION OUTPUT Profile #PF 1

\*\*\*\*\*

* E.G. Elev (ft)	* 751.87	* Element	* Left OB	* Channel	* Right OB	*
* Vel Head (ft)	* 0.01	* Wt. n-Val.	* 0.100	* 0.040	* 0.059	*
* W.S. Elev (ft)	* 751.87	* Reach Len. (ft)	* 139.44	* 197.68	* 45.42	*
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 25.22	* 204.35	* 620.06	*
* E.G. Slope (ft/ft)	*0.000043	* Area (sq ft)	* 25.22	* 204.35	* 620.06	*
* Q Total (cfs)	* 475.00	* Flow (cfs)	* 4.39	* 193.94	* 276.66	*

				Addie.rep					
* Top width (ft)	* 182.99	* Top width (ft)	* 8.68	* 25.44	* 148.87	*			*
* Vel Total (ft/s)	* 0.56	* Avg. Vel. (ft/s)	* 0.17	* 0.95	* 0.45	*			*
* Max Chl Dpth (ft)	* 9.04	* Hydr. Depth (ft)	* 2.90	* 8.03	* 4.17	*			*
* Conv. Total (cfs)	* 72735.7	* Conv. (cfs)	* 672.8	* 29698.2	* 42364.7	*			*
* Length wtd. (ft)	* 104.11	* Wetted Per. (ft)	* 10.48	* 26.41	* 149.23	*			*
* Min Ch El (ft)	* 742.83	* Shear (lb/sq ft)	* 0.01	* 0.02	* 0.01	*			*
* Alpha	* 1.55	* Stream Power (lb/ft s)	* 272.91	* 0.00	* 0.00	*			*
* Frctn Loss (ft)	* 0.00	* Cum Volume (acre-ft)	* 3.00	* 12.23	* 13.52	*			*
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.43	* 0.55	* 1.00	*			*

\*\*\*\*\*

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: Slaughter Run  
 REACH: Upper RS: 1344.324

INPUT

Description:

Station Elevation Data	num=	32							
Sta Elev Sta Elev	Sta Elev	Sta Elev	Sta Elev	Sta Elev	Sta Elev	Sta Elev	Sta Elev	Sta Elev	Sta Elev
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0 760 4.04 758	7.62 756	11.58 754	15.68 752						
25.02 750 41.88 748	61.45 746	66.01 744	69.95 742						
76.19 740 77.9 739.37	85.32 740	101.2 742	119.76 744						
150.87 744.63 202.84 744.89	223.62 744.84	240.93 746	243.11 746.15						
303.6 746.78 306.41 746.24	315.79 747.28	331.19 748.59	340.83 748.44						
366.21 750 392.08 752	406.19 754	420.92 756	439.7 758						
448.78 759 454.39 760									

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	Sta n Val	Sta n Val	Sta n Val
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
0 .1 61.45 .04	119.76 .1	150.87 .033	202.84 .035						
315.79 .033	331.19 .035	366.21 .1							

Bank Sta: Left Right	Lengths: Left Channel Right	Coeff Contr.	Expan.
61.45 119.76	164.89 88.64 32.96	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
* E.G. Elev (ft)	* 751.87	* Element	* Left OB	* Channel	* Right OB	*			*
* Vel Head (ft)	* 0.00	* Wt. n-Val.	* 0.100	* 0.040	* 0.039	*			*
* W.S. Elev (ft)	* 751.87	* Reach Len. (ft)	* 164.89	* 88.64	* 32.96	*			*
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 151.88	* 582.62	* 1447.24	*			*
* E.G. Slope (ft/ft)	* 0.000003	* Area (sq ft)	* 151.88	* 582.62	* 1447.24	*			*
* Q Total (cfs)	* 475.00	* Flow (cfs)	* 8.39	* 164.38	* 302.23	*			*
* Top Width (ft)	* 374.12	* Top Width (ft)	* 45.16	* 58.31	* 270.64	*			*



Addie.rep

* Vel Total (ft/s)	* 0.22	* Avg. Vel. (ft/s)	* 0.06	* 0.28	* 0.21
* Max Chl Dpth (ft)	* 12.50	* Hydr. Depth (ft)	* 3.36	* 9.99	* 5.35
* Conv. Total (cfs)	* 284998.6	* Conv. (cfs)	* 5034.3	* 98626.1	* 181338.2
* Length wtd. (ft)	* 58.87	* Wetted Per. (ft)	* 45.58	* 59.89	* 270.98
* Min Ch El (ft)	* 739.37	* Shear (lb/sq ft)	* 0.00	* 0.00	* 0.00
* Alpha	* 1.17	* Stream Power (lb/ft s)	* 454.39	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.00	* Cum Volume (acre-ft)	* 2.72	* 10.45	* 12.45
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.35	* 0.36	* 0.78

\*\*\*\*\*

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: Slaughter Run  
 REACH: Upper RS: 1254.897

INPUT

Description:

Station Elevation Data		num= 38	
Sta	Elev	Sta	Elev
0	761	1.22	760
40.39	745.26	63.88	744.31
76.02	737.59	81.46	737.55
119.14	742.92	131.71	744
215.82	744	227.49	744.1
331.07	745.3	341.07	746
407.64	748	423.18	748.38
483.96	756	494.99	758

Manning's n Values		num= 8	
Sta	n Val	Sta	n Val
0	.035	27.84	.033
206.51	.035	423.18	.033

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
63.88	119.14	46.86	61.48	6.24	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

\*\*\*\*\*

* E.G. Elev (ft)	* 751.87	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.00	* wt. n-val.	* 0.033	* 0.035	* 0.034
* W.S. Elev (ft)	* 751.87	* Reach Len. (ft)	* 46.86	* 61.48	* 6.24
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 311.02	* 690.79	* 1967.35
* E.G. Slope (ft/ft)	* 0.000001	* Area (sq ft)	* 311.02	* 690.79	* 1967.35
* Q Total (cfs)	* 475.00	* Flow (cfs)	* 45.53	* 149.94	* 279.53
* Top Width (ft)	* 445.85	* Top Width (ft)	* 50.55	* 55.26	* 340.04

Addie.rep

* Vel Total (ft/s)	* 0.16	* Avg. Vel. (ft/s)	* 0.15	* 0.22	* 0.14
* Max Chl Dpth (ft)	* 14.32	* Hydr. Depth (ft)	* 6.15	* 12.50	* 5.79
* Conv. Total (cfs)	* 485893.9	* Conv. (cfs)	* 46572.8	* 153379.3	* 285941.8
* Length wtd. (ft)	* 31.67	* Wetted Per. (ft)	* 53.20	* 57.76	* 340.55
* Min Ch El (ft)	* 737.55	* Shear (lb/sq ft)	* 0.00	* 0.00	* 0.00
* Alpha	* 1.13	* Stream Power (lb/ft s)	* 510.78	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.00	* Cum Volume (acre-ft)	* 1.84	* 9.15	* 11.15
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.17	* 0.25	* 0.55

\*\*\*\*\*

CROSS SECTION

RIVER: Slaughter Run  
 REACH: Upper RS: 1193.416

INPUT

Description:

Station Elevation Data		num= 34	
Sta	Elev	Sta	Elev
*****	*****	*****	*****
0	761	.6	760
38.23	746.37	50.74	745.86
113.09	736.59	121.35	738
162.44	744.96	192.93	745.02
262.31	744.6	335.28	744.72
434.47	748	440.24	747.75
511.48	754	519.66	756

Manning's n Values		num= 10	
Sta	n Val	Sta	n Val
*****	*****	*****	*****
0	.035	25.72	.033
221.11	.035	369.64	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
50.74	148.24	87.84	47.78	18.54	.1	.3	

Ineffective Flow	num= 2		
Sta L	Sta R	Elev	Permanent
25.72	58.28	747.03	F
74.11	335.28	746.86	F

CROSS SECTION OUTPUT Profile #PF 1

\*\*\*\*\*

* E.G. Elev (ft)	* 751.87	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.00	* Wt. n-Val.	* 0.033	* 0.035	* 0.039
* W.S. Elev (ft)	* 751.87	* Reach Len. (ft)	* 14.10	* 14.10	* 14.10
* Crit W.S. (ft)	* 738.29	* Flow Area (sq ft)	* 188.13	* 1357.40	* 2144.73
* E.G. Slope (ft/ft)	* 0.000001	* Area (sq ft)	* 188.13	* 1357.40	* 2144.73
* Q Total (cfs)	* 475.00	* Flow (cfs)	* 18.05	* 240.63	* 216.32
* Top width (ft)	* 488.58	* Top width (ft)	* 37.97	* 97.50	* 353.11
* Vel Total (ft/s)	* 0.13	* Avg. vel. (ft/s)	* 0.10	* 0.18	* 0.10

Addie.rep

```
* Max Chl Dpth (ft)      * 17.29 * Hydr. Depth (ft)      * 4.95 * 13.92 * 6.07 *
* Conv. Total (cfs)     *632448.2 * Conv. (cfs)          * 24035.5 * 320392.8 * 288019.9 *
* Length wtd. (ft)      * 14.10 * Wetted Per. (ft)    * 40.43 * 103.55 * 353.50 *
* Min Ch El (ft)        * 734.58 * Shear (lb/sq ft)    * 0.00 * 0.00 * 0.00 *
* Alpha                  * 1.26 * Stream Power (lb/ft s) * 553.37 * 0.00 * 0.00 *
* Frctn Loss (ft)       * 0.00 * Cum Volume (acre-ft) * 1.57 * 7.71 * 10.86 *
* C & E Loss (ft)       * 0.00 * Cum SA (acres)      * 0.12 * 0.14 * 0.50 *
*****
```

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.

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

BRIDGE

RIVER: Slaughter Run

REACH: Upper RS: 1172.84

INPUT

Description:

Distance from Upstream XS = 14.1

Deck/Roadway width = 29

Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates

num= 19

Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
25.72	746.88		60.28	747.03	742.87	72.11	746.86	742.87	
80.15	746.76		89.97	746.74		101.09	746.73		
107.02	746.72		118.44	746.63		128.62	746.55		
142.45	746.44		153.74	746.39		166.47	746.33		
174.57	746.26		181.98	746.19		191.82	746.1		
206.71	745.92		216.95	745.8		248.79	745.65		
335.28	744.72								

Upstream Bridge Cross Section Data

Station Elevation Data num= 34

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	761	.6	760	21.56	746	22.72	745.23	25.72	746.88
38.23	746.37	50.74	745.86	58.11	742	61.5	735.2	66.2	734.58
113.09	736.59	121.35	738	130.88	740	137.58	742	148.24	744
162.44	744.96	192.93	745.02	221.11	744.7	241.98	744	248.7	744
262.31	744.6	335.28	744.72	369.64	745.02	385.58	746	400.02	745.43
434.47	748	440.24	747.75	465.68	748.74	477.59	749.01	507.57	752.62
511.48	754	519.66	756	533.72	758	553.37	760		

Manning's n Values num= 10

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val

Addie.rep

\*\*\*\*\*  
 0 .035 25.72 .033 50.74 .035 148.24 .035 162.44 .033  
 221.11 .035 369.64 .1 440.24 .035 477.59 .033 507.57 .035

Bank Sta: Left Right Coeff Contr. Expan.  
 50.74 148.24 .1 .3

Ineffective Flow num= 2  
 Sta L Sta R Elev Permanent  
 25.72 58.28 747.03 F  
 74.11 335.28 746.86 F

Downstream Deck/Roadway Coordinates

num= 5  
 Sta Hi Cord Lo Cord Sta Hi Cord Lo Cord Sta Hi Cord Lo Cord  
 \*\*\*\*\*  
 41.8 748.1 118.23 746.59 743.11 130.06 746.49 743.11  
 156.06 746.16 187.51 745.74

Downstream Bridge Cross Section Data

Station Elevation Data num= 60  
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev  
 \*\*\*\*\*  
 0 760.84 1.23 760 4.37 758 8.08 756 12.62 754  
 16.99 752 20.71 750 24.32 748 26.84 746.55 31.19 748.52  
 41.8 748.1 61.45 747.61 83.96 746.73 97.41 746 106.75 744  
 111.11 742 114.3 740 115.76 738 117.93 736 118.38 735.2  
 124.15 735.31 130.78 735.26 131.28 736 132.43 738 134.6 740  
 142.86 742 149.35 744 156.83 746 160.11 746.1 179.98 746.4  
 198.4 746.6 215.57 745.9 226.09 744.98 234.79 747.15 249.23 746  
 258.11 745.58 264.24 746 298.31 743.53 317.21 743.35 329.96 743.64  
 357.21 744.08 366.32 746 375.86 744.98 391.56 744.82 412.11 744.59  
 419.91 746 438.14 746 447.48 744.64 483.57 746.05 500.41 748  
 512.6 749.14 517.62 750 525.5 750 547.2 749.4 572.66 750.84  
 582.58 752 591.91 754 603.91 756 621.74 758 636.46 760

Manning's n Values num= 10  
 Sta n Val Sta n Val Sta n Val Sta n Val Sta n Val  
 \*\*\*\*\*  
 0 .035 31.19 .033 41.8 .013 83.96 .04 156.83 .04  
 160.11 .013 198.4 .033 215.57 .035 329.96 .1 547.2 .035

Bank Sta: Left Right Coeff Contr. Expan.  
 97.41 156.83 .1 .3

Ineffective Flow num= 2  
 Sta L Sta R Elev Permanent  
 61.45 116.23 746.59 F  
 132.06 160.11 746.49 F

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 Bridge Coefficient Sets = 1

Low Flow Methods and Data  
 Energy  
 Selected Low Flow Methods = Highest Energy Answer

High Flow Method  
 Energy Only

Additional Bridge Parameters  
 Add Friction component to Momentum  
 Do not add weight component to Momentum  
 Class B flow critical depth computations use critical depth  
 inside the bridge at the upstream end  
 Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT Profile #PF 1

```

*****
* E.G. US. (ft) * 751.87 * Element *Inside BR US *Inside BR DS *
* W.S. US. (ft) * 751.87 * E.G. Elev (ft) * 751.87 * 751.87 *
* Q Total (cfs) * 475.00 * W.S. Elev (ft) * 751.87 * 751.87 *
* Q Bridge (cfs) * 10.34 * Crit w.s. (ft) * 738.63 * 738.88 *
* Q Weir (cfs) * * * Max Chl Dpth (ft) * 17.29 * 16.67 *
* Weir Sta Lft (ft) * * * Vel Total (ft/s) * 0.17 * 0.15 *
* Weir Sta Rgt (ft) * * * Flow Area (sq ft) * 2729.83 * 3151.15 *
* Weir Submerg * * * Froude # Chl * 0.01 * 0.01 *
* Weir Max Depth (ft) * * * Specif Force (cu ft) * 8811.77 * 10501.01 *
* Min El weir Flow (ft) * 745.03 * Hydr Depth (ft) * 5.59 * 5.58 *
* Min El Prs (ft) * 742.87 * W.P. Total (ft) * 529.90 * 606.93 *
* Delta EG (ft) * 0.00 * Conv. Total (cfs) * 329325.7 * 381653.6 *
* Delta WS (ft) * 0.00 * Top width (ft) * 488.57 * 564.24 *
* BR Open Area (sq ft) * 94.02 * Frctn Loss (ft) * 0.00 * 0.00 *
* BR Open Vel (ft/s) * 0.11 * C & E Loss (ft) * 0.00 * 0.00 *
* Coef of Q * * * Shear Total (lb/sq ft) * 0.00 * 0.00 *
* Br Sel Method *Energy only * Power Total (lb/ft s) * 0.00 * 0.00 *
*****
    
```

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

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

CROSS SECTION

RIVER: Slaughter Run  
 REACH: Upper

RS: 1144.785

INPUT

Description:

Station Elevation Data num= 60

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	760.84	1.23	760	4.37	758	8.08	756	12.62	754
16.99	752	20.71	750	24.32	748	26.84	746.55	31.19	748.52
41.8	748.1	61.45	747.61	83.96	746.73	97.41	746	106.75	744
111.11	742	114.3	740	115.76	738	117.93	736	118.38	735.2
124.15	735.31	130.78	735.26	131.28	736	132.43	738	134.6	740
142.86	742	149.35	744	156.83	746	160.11	746.1	179.98	746.4
198.4	746.6	215.57	745.9	226.09	744.98	234.79	747.15	249.23	746
258.11	745.58	264.24	746	298.31	743.53	317.21	743.35	329.96	743.64
357.21	744.08	366.32	746	375.86	744.98	391.56	744.82	412.11	744.59
419.91	746	438.14	746	447.48	744.64	483.57	746.05	500.41	748
512.6	749.14	517.62	750	525.5	750	547.2	749.4	572.66	750.84
582.58	752	591.91	754	603.91	756	621.74	758	636.46	760

Manning's n Values num= 10

Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val	Sta	n Val
0	.035	31.19	.033	41.8	.013	83.96	.04	156.83	.04
160.11	.013	198.4	.033	215.57	.035	329.96	.1	547.2	.035

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

97.41	156.83	26.39	34.4	7.76	.1	.3
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Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
61.45	116.23	746.59	F
132.06	160.11	746.49	F

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 751.87	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.00	* Wt. n-Val.	* 0.018	* 0.040	* 0.043
* W.S. Elev (ft)	* 751.87	* Reach Len. (ft)	* 26.39	* 34.40	* 7.76
* Crit W.S. (ft)	* 738.56	* Flow Area (sq ft)	* 340.60	* 653.64	* 2417.71
* E.G. Slope (ft/ft)	* 0.000001	* Area (sq ft)	* 340.60	* 653.64	* 2417.71
* Q Total (cfs)	* 475.00	* Flow (cfs)	* 75.12	* 115.56	* 284.32
* Top Width (ft)	* 564.24	* Top width (ft)	* 80.18	* 59.42	* 424.64
* Vel Total (ft/s)	* 0.14	* Avg. Vel. (ft/s)	* 0.22	* 0.18	* 0.12
* Max chl Dpth (ft)	* 16.67	* Hydr. Depth (ft)	* 4.25	* 11.00	* 5.69
* Conv. Total (cfs)	* 460076.9	* Conv. (cfs)	* 72755.1	* 111930.0	* 275391.9
* Length wtd. (ft)	* 18.21	* Wetted Per. (ft)	* 82.03	* 66.04	* 425.99
* Min Ch El (ft)	* 735.20	* Shear (lb/sq ft)	* 0.00	* 0.00	* 0.00
* Alpha	* 1.22	* Stream Power (lb/ft s)	* 636.46	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.00	* Cum volume (acre-ft)	* 1.31	* 7.00	* 8.48
* C & E Loss (ft)	* 0.00	* Cum SA (acres)	* 0.06	* 0.05	* 0.08

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

CROSS SECTION

RIVER: Slaughter Run  
 REACH: Upper

RS: 1109.953

INPUT

Description:

Station Elevation Data		num= 58		Sta Elev		Sta Elev		Sta Elev		Sta Elev	
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	759.43	2.25	758	5.45	756	8.53	754	11.78	752		
15.12	750	18.18	748	21.1	746.74	27.9	748	30.33	748.45		
32.44	748.47	48.94	748.04	67.05	747.35	89.08	746	111.6	745.1		
126.39	744.76	129.04	744	136.03	742	138.04	741.43	146.99	740.41		
151.91	740	158.65	738	163.62	736	167.15	734.64	175.36	734.91		
177.73	736	182.13	738	185.9	740	188.22	741.15	201.54	741.65		
207.13	742	217.57	743.23	224.43	744	237.81	744.66	249.05	745.59		
262.25	746.09	280.07	746.36	290.86	744.38	299.17	746.92	316.27	746		
333.3	743.4	341.68	744	356.62	742.84	369.66	744	381.83	743.71		
394.69	746	440.99	748	484.92	746	490.89	746	516.83	745.5		
543.79	748	578.09	750	607.43	749.72	634.46	752	651.44	754		
665.32	756	674.29	758	689.35	760						

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	Sta	n Val	Sta	n Val
0	.035	32.44	.013	67.05	.04	237.81	.033	249.05	.013		
280.07	.035	333.3	.1	607.43	.035						

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	126.39	188.22		1	1	1		.1	.3

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 751.87	* Element	* Left OB	* Channel	* Right OB
* Vel Head (ft)	* 0.00	* Wt. n-Val.	* 0.028	* 0.040	* 0.046
* W.S. Elev (ft)	* 751.87	* Reach Len. (ft)	* 159.48	* 159.48	* 159.48
* Crit W.S. (ft)	*	* Flow Area (sq ft)	* 566.23	* 796.16	* 2491.15
* E.G. Slope (ft/ft)	* 0.000001	* Area (sq ft)	* 566.23	* 796.16	* 2491.15
* Q Total (cfs)	* 475.00	* Flow (cfs)	* 83.08	* 146.49	* 245.43
* Top Width (ft)	* 620.93	* Top width (ft)	* 114.39	* 61.83	* 444.71
* Vel Total (ft/s)	* 0.12	* Avg. vel. (ft/s)	* 0.15	* 0.18	* 0.10
* Max Chl Dpth (ft)	* 17.23	* Hydr. Depth (ft)	* 4.95	* 12.88	* 5.60
* Conv. Total (cfs)	* 510920.4	* Conv. (cfs)	* 89358.5	* 157567.3	* 263994.6
* Length wtd. (ft)	* 159.48	* wetted Per. (ft)	* 116.01	* 64.75	* 446.37
* Min Ch El (ft)	* 734.64	* Shear (lb/sq ft)	* 0.00	* 0.00	* 0.00
* Alpha	* 1.27	* Stream Power (lb/ft s)	* 689.35	* 0.00	* 0.00
* Frctn Loss (ft)	* 0.03	* Cum volume (acre-ft)	* 1.04	* 6.43	* 8.04
* C & E Loss (ft)	* 0.02	* Cum SA (acres)	*	*	*

\*\*\*\*\*

SUMMARY OF MANNING'S N VALUES

River:Middle Island

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* Reach	* River Sta.	* n1	* n2	* n3	* n4	* n5	* n6	* n7	* n8	* n9
*Upper	* 4090.965	* .035*	.033*	.035*	.05*	.04*	.06*	.035*		*
*Upper	* 3845.927	* .035*	.033*	.035*	.05*	.04*	.06*	.013*	.035*	
*Upper	* 3639.909	* .035*	.033*	.035*	.05*	.04*	.05*	.013*	.035*	
*Upper	* 3475.882	* .035*	.033*	.035*	.05*	.04*	.035*	.013*	.035*	
*Upper	* 3409.950	* .035*	.033*	.035*	.04*	.05*	.013*	.035*		*
*Upper	* 3399.61	* Bridge	*	*	*	*	*	*	*	*
*Upper	* 3387.185	* .035*	.033*	.035*	.04*	.05*	.033*	.013*	.035*	
*Upper	* 3301.469	* .035*	.033*	.035*	.04*	.05*	.013*	.035*		*
*Upper	* 3039.998	* .035*	.033*	.06*	.04*	.05*	.013*	.035*		*
*Upper .035*	* 2944.331	* .035*	.033*	.035*	.033*	.06*	.04*	.05*	.013*	
*Upper	* 2829.179	* .035*	.033*	.06*	.04*	.06*	.013*	.035*		*
*Lower	* 2730.129	* .035*	.033*	.06*	.04*	.06*	.013*	.1*		*
*Lower	* 2457.936	* .06*	.04*	.06*	.013*	.1*	*	*		*
*Lower	* 2259.266	* .035*	.033*	.06*	.04*	.06*	.013*	.1*		*
*Lower .1*	* 2049.716	* .035*	.033*	.035*	.06*	.04*	.06*	.035*	.013*	
*Lower	* 1840.209	* .035*	.033*	.06*	.04*	.06*	.035*	.013*	.1*	
*Lower	* 1632.735	* .035*	.033*	.06*	.04*	.06*	.035*	.013*	.1*	
*Lower	* 1414.824	* .035*	.033*	.06*	.04*	.06*	.013*	.1*		*
*Lower .1*	* 1000.000	* .035*	.033*	.035*	.06*	.04*	.06*	.035*	.013*	

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Addie.rep

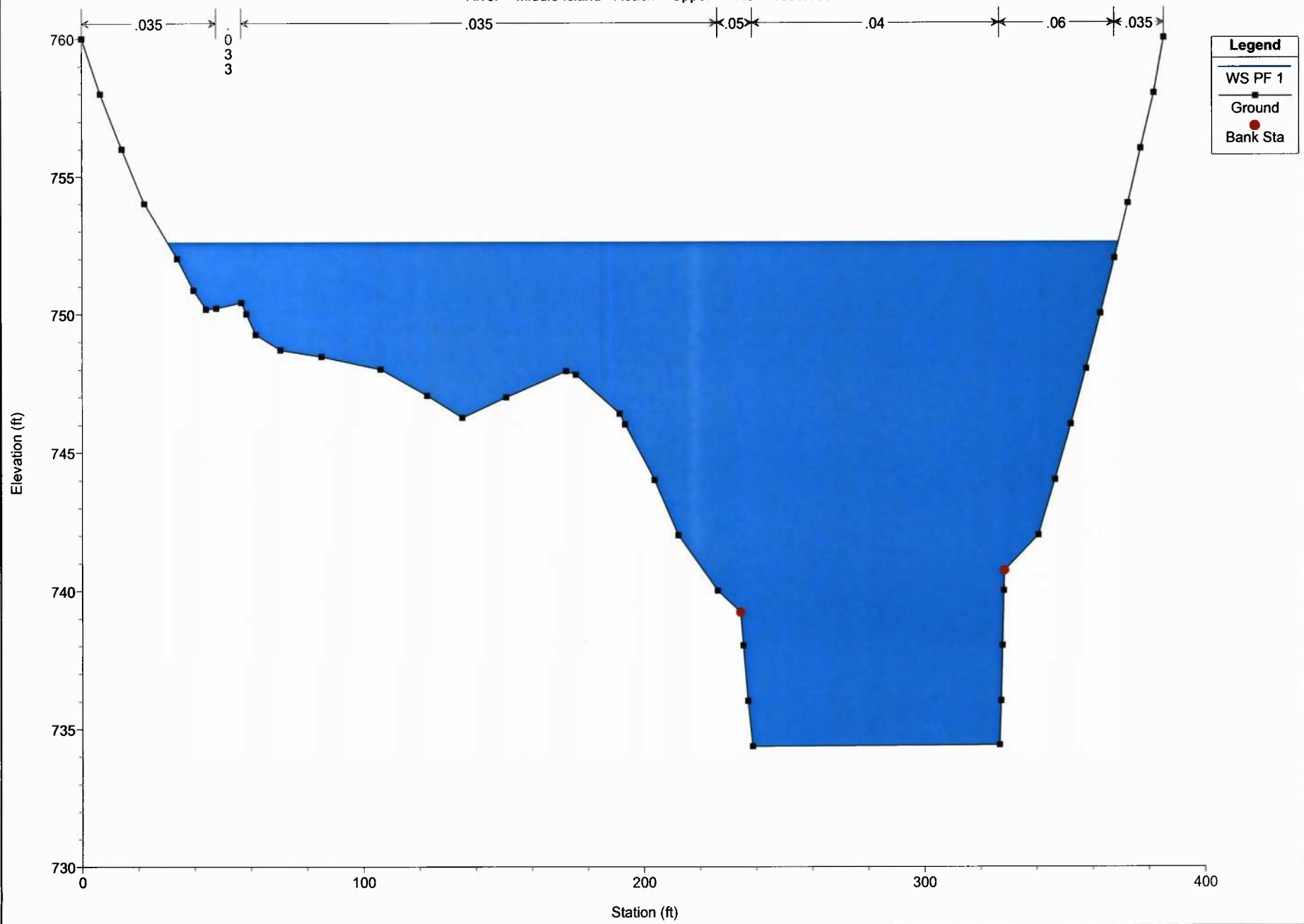
River:Slaughter Run

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*****
*   Reach   *   River Sta.   *   n1   *   n2   *   n3   *   n4   *   n5   *   n6   *   n7   *   n8   *   n9
*   n10     *
*****
*****
*Upper      *   1724.607   *   .1*   .04*   .1*   .033*   .1*   *   *   *
*   *       *
*Upper      *   1544.864   *   .1*   .04*   .1*   .033*   .1*   *   *   *
*   *       *
*Upper      *   1344.324   *   .1*   .04*   .1*   .033*   .035*   .033*   .035*   .1*
*   *       *
*Upper      *   1254.897   *   .035*   .033*   .035*   .035*   .033*   .035*   .033*   .035*
*   *       *
*Upper      *   1193.416   *   .035*   .033*   .035*   .035*   .033*   .035*   .1*   .035*
.033*   .035*
*Upper      *   1172.84   *Bridge*   *   *   *   *   *   *   *
*   *       *
*Upper      *   1144.785   *   .035*   .033*   .013*   .04*   .04*   .013*   .033*   .035*
.1*   .035*
*Upper      *   1109.953   *   .035*   .013*   .04*   .033*   .013*   .035*   .1*   .035*
*   *       *
*****
*****

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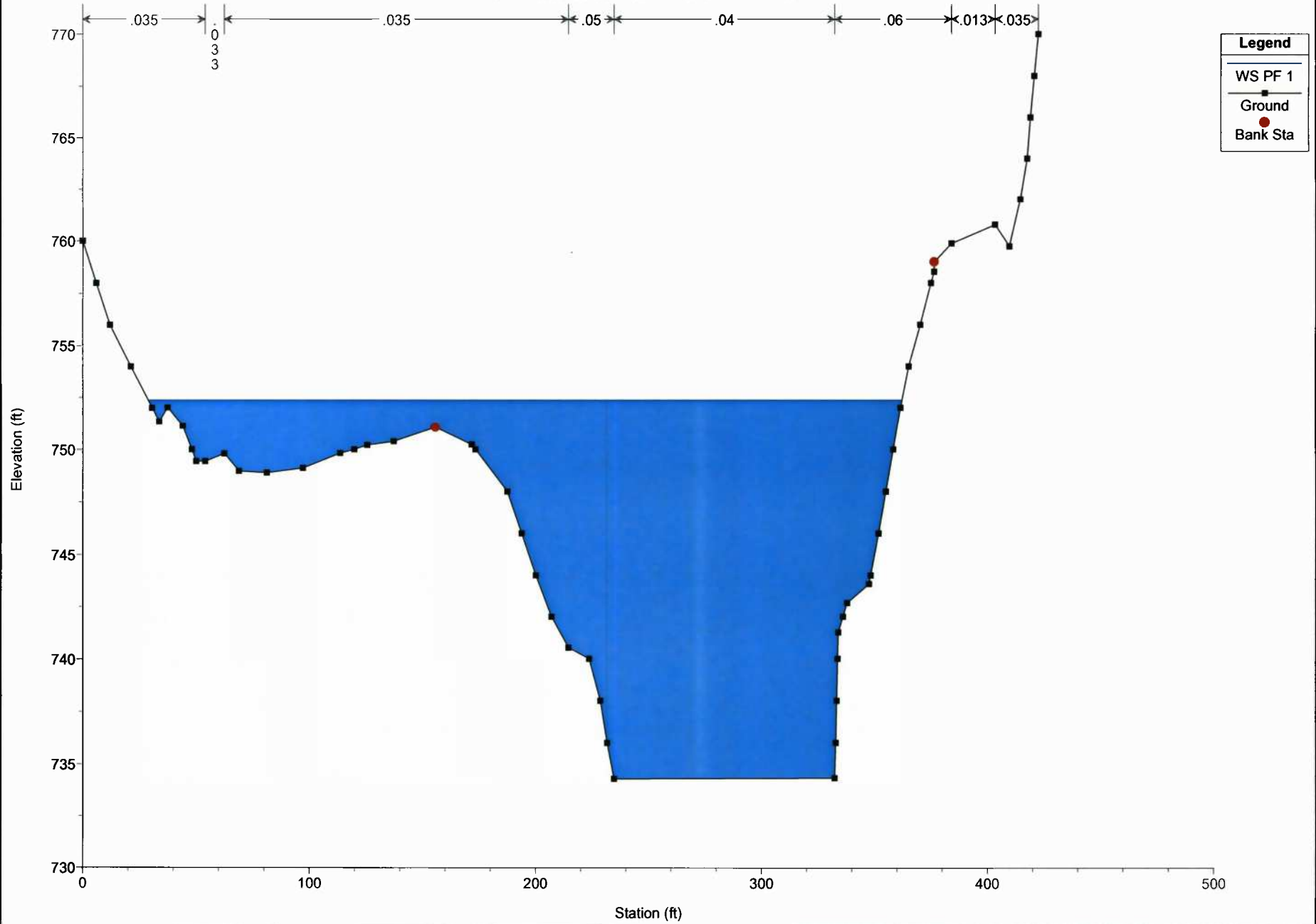
Addie Plan: Proposed  
Geom: Proposed Flow: Existing 100YR  
River = Middle Island Reach = Upper RS = 4090.965



Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

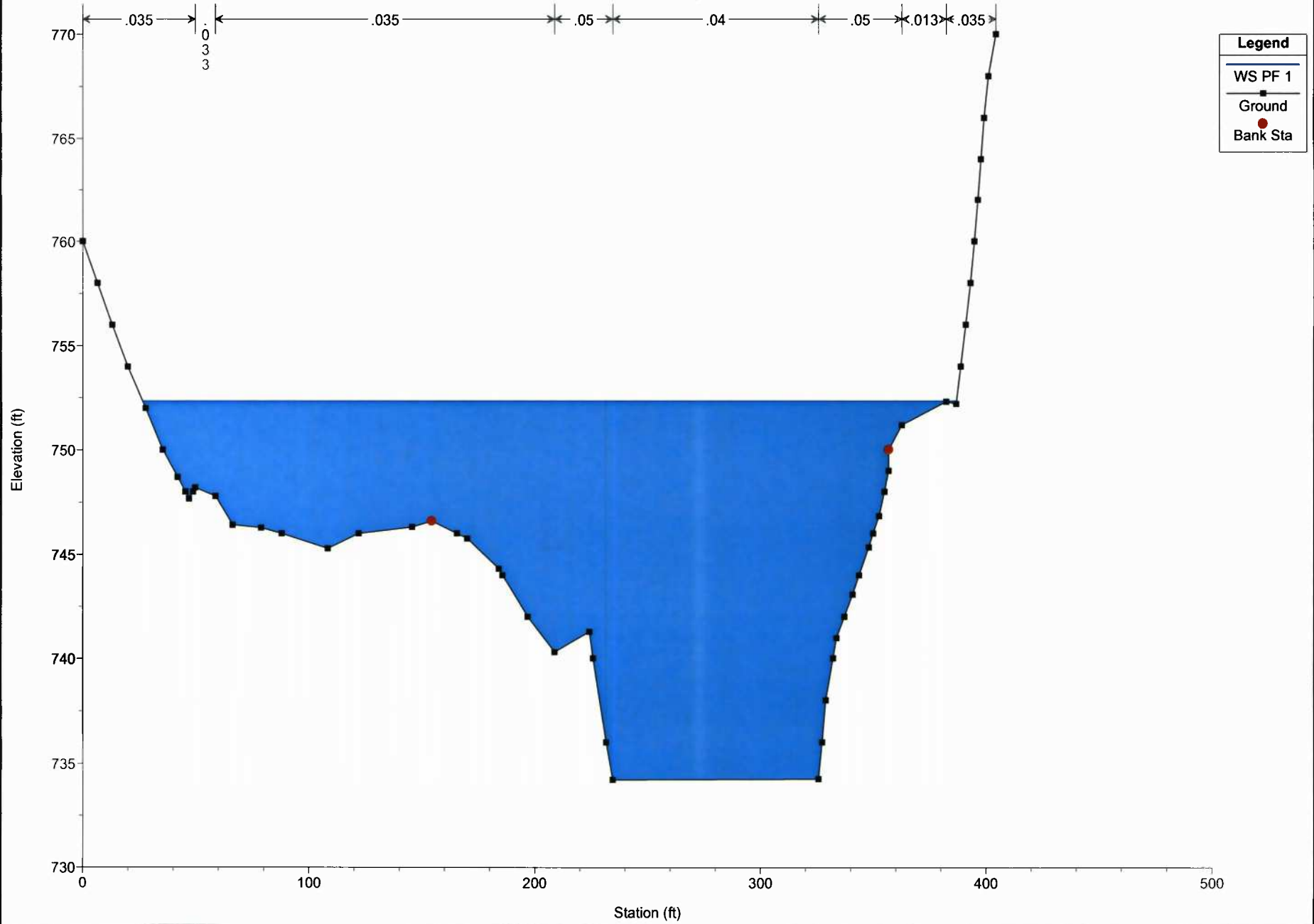
River = Middle Island Reach = Upper RS = 3845.927



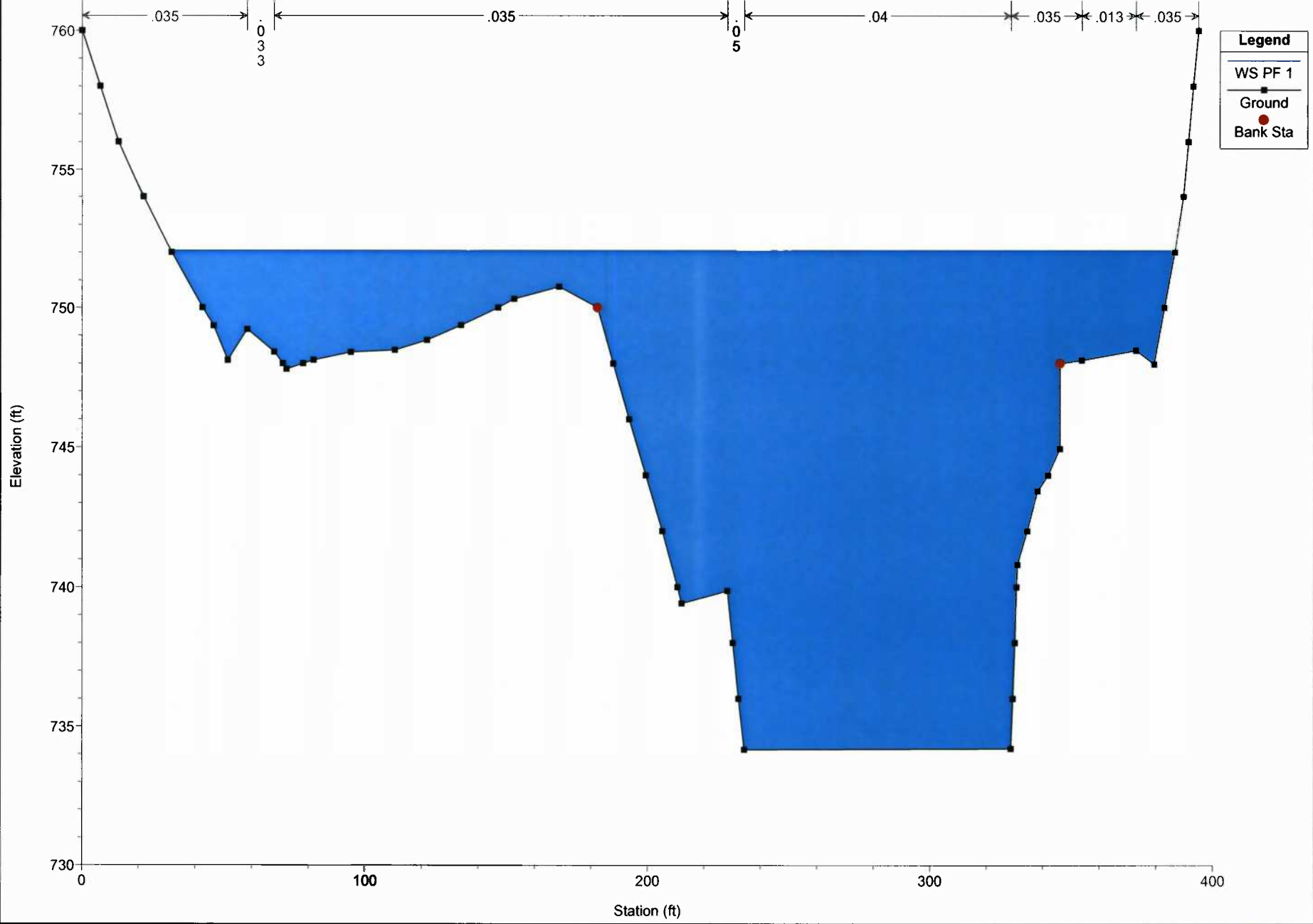
Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

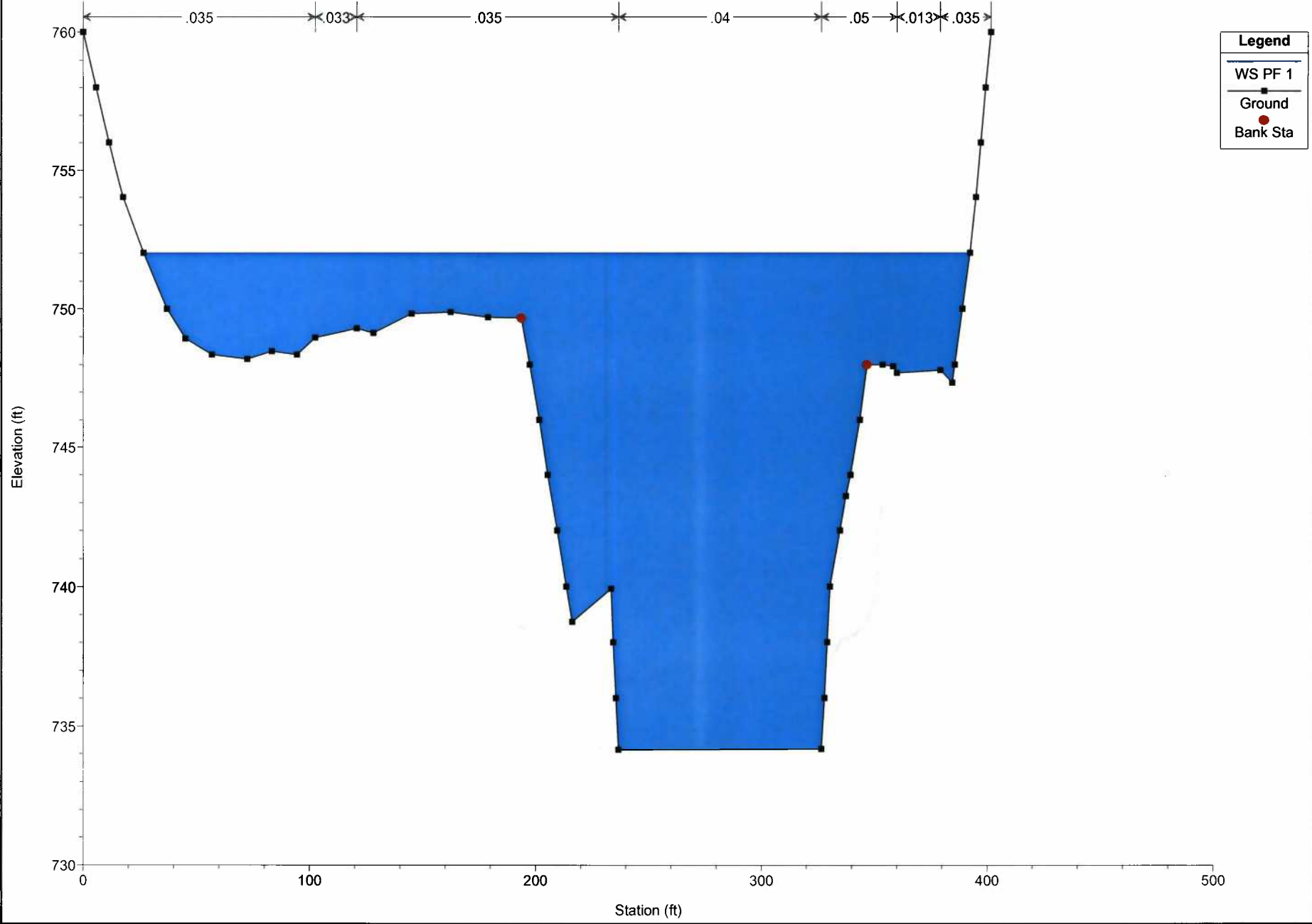
River = Middle Island Reach = Upper RS = 3639.909



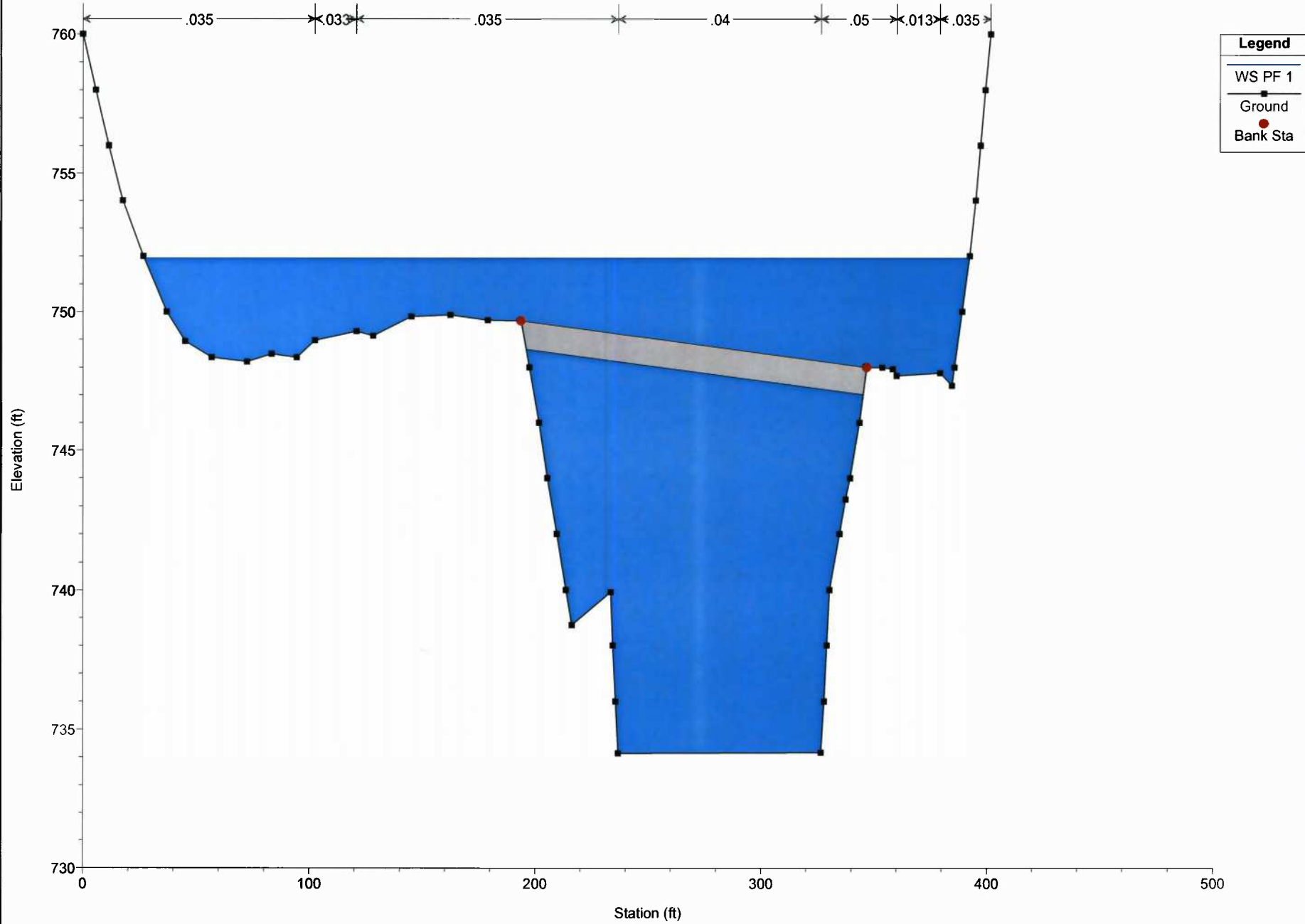
Addie Plan: Proposed  
Geom: Proposed Flow: Existing 100YR  
River = Middle Island Reach = Upper RS = 3475.882



Addie Plan: Proposed  
Geom: Proposed Flow: Existing 100YR  
River = Middle Island Reach = Upper RS = 3409.950



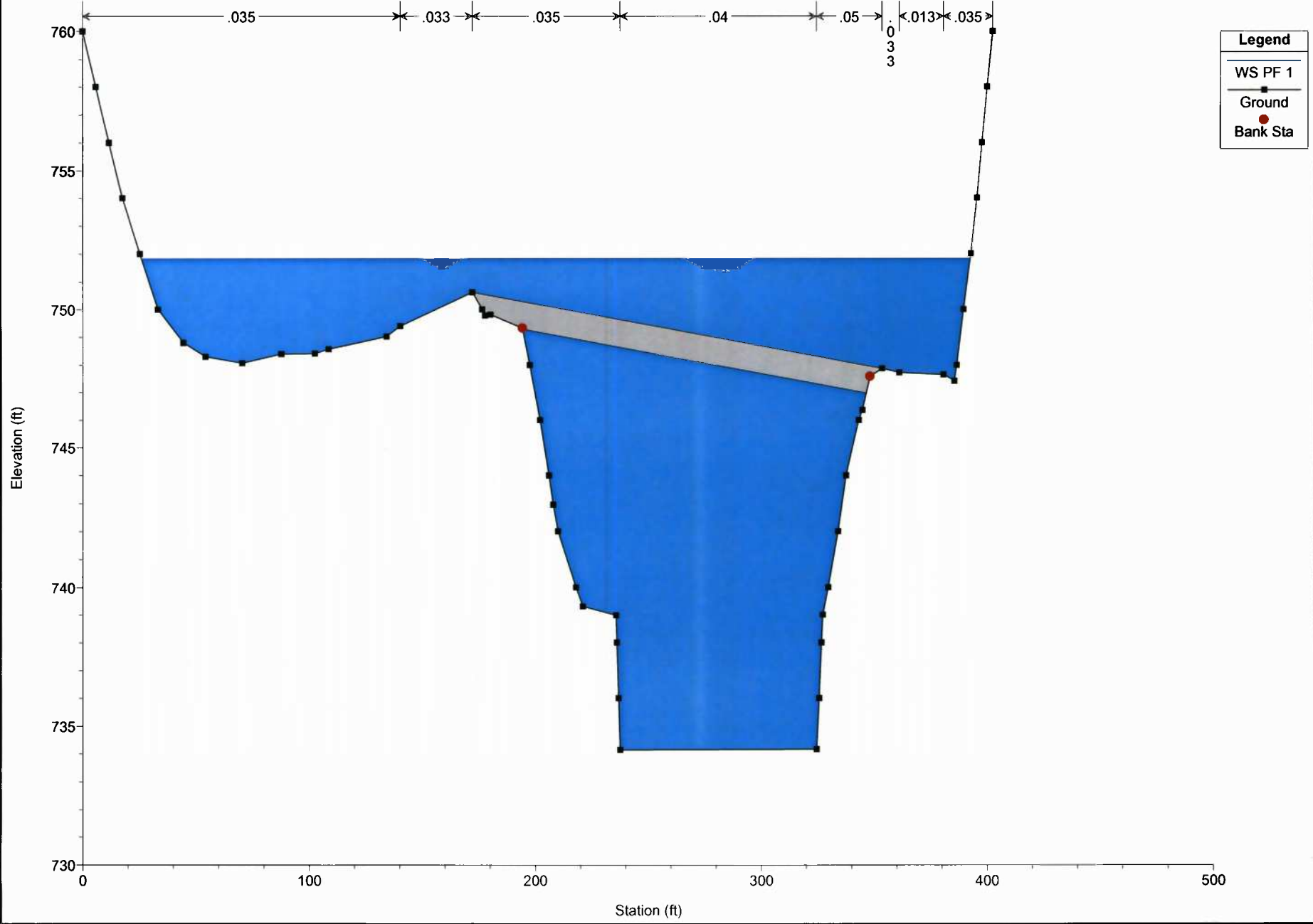
Addie Plan: Proposed  
Geom: Proposed Flow: Existing 100YR  
River = Middle Island Reach = Upper RS = 3399.61 BR



Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

River = Middle Island Reach = Upper RS = 3399.61 BR

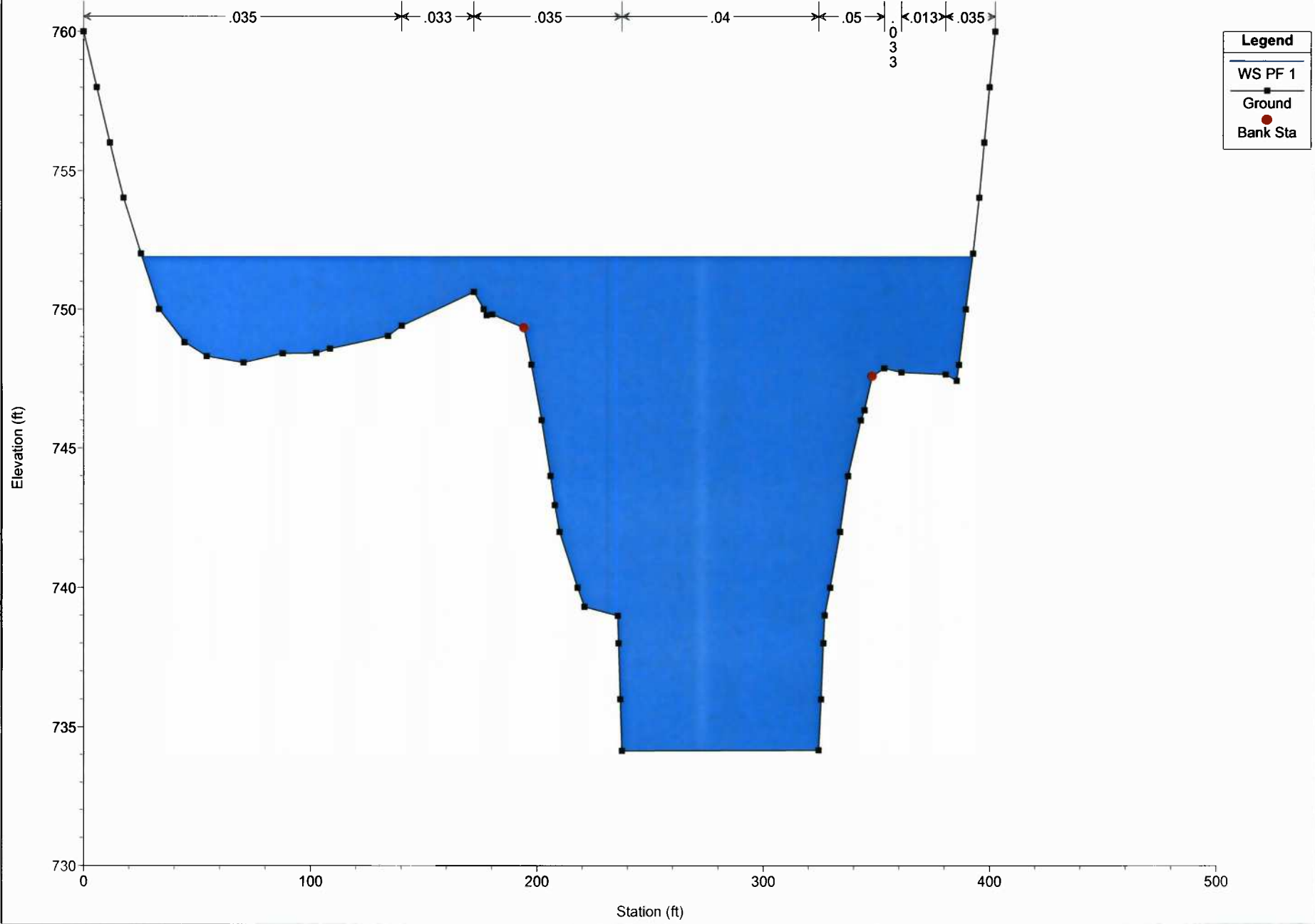




Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

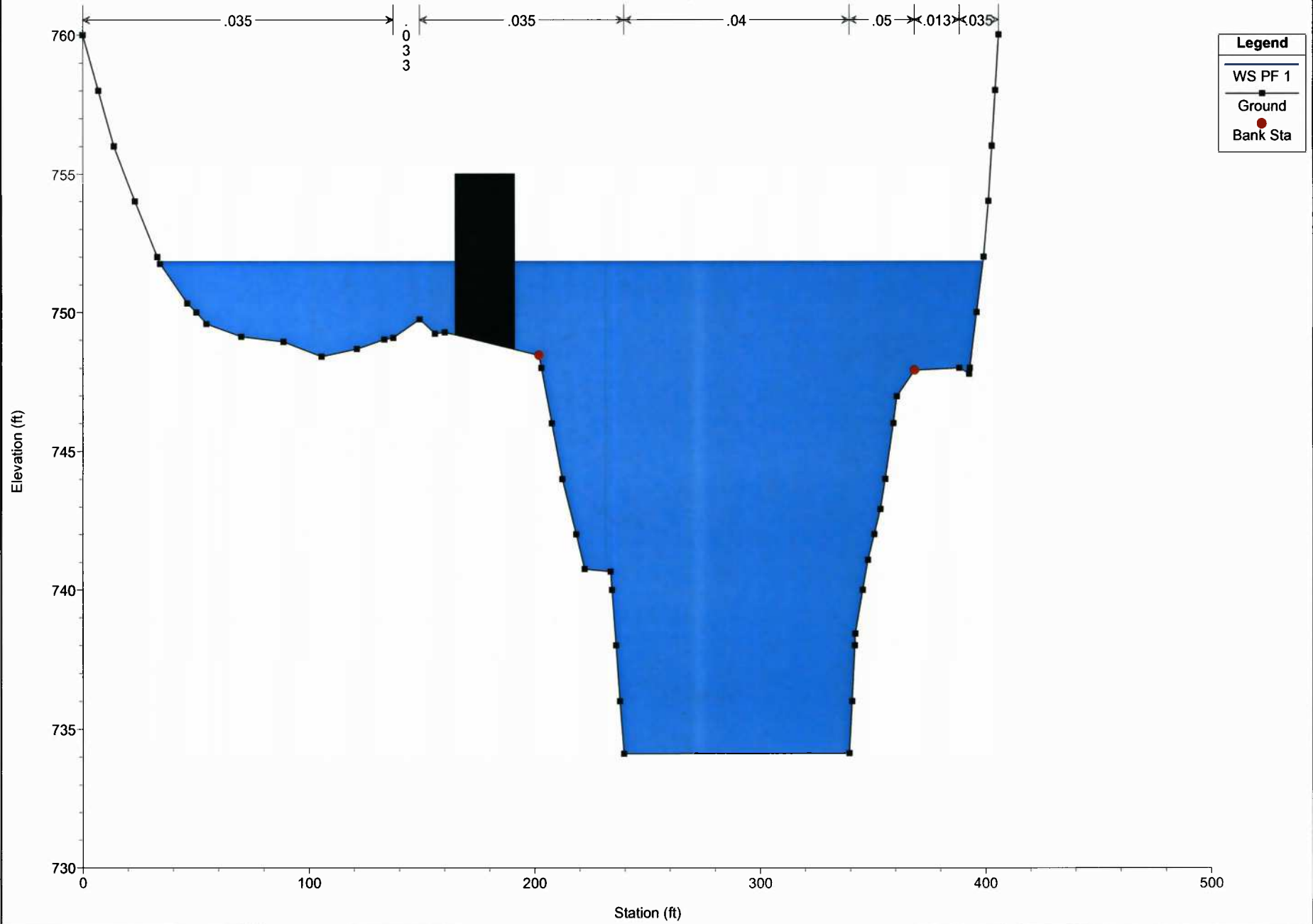
River = Middle Island Reach = Upper RS = 3387.185



Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

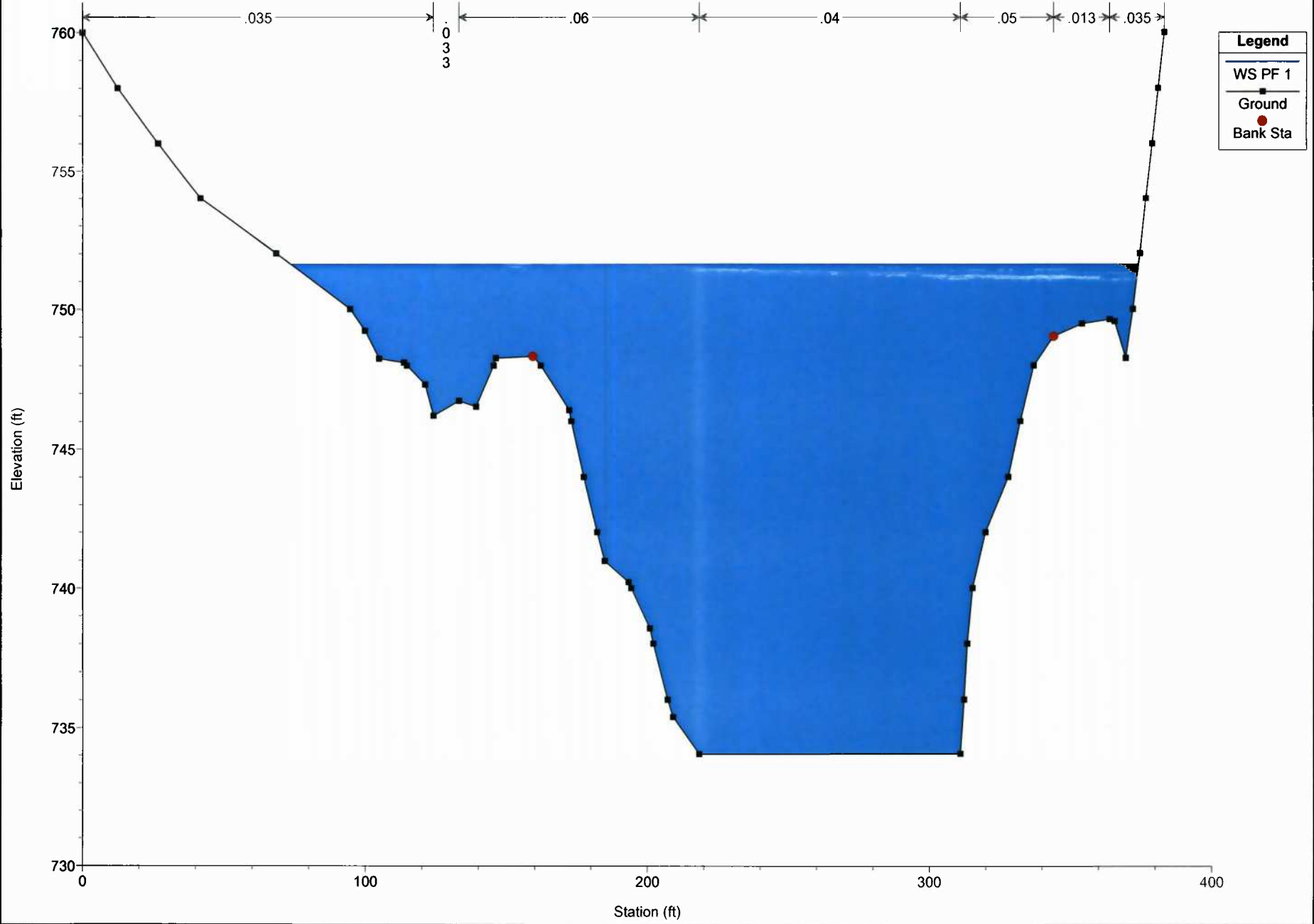
River = Middle Island Reach = Upper RS = 3301.469



Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

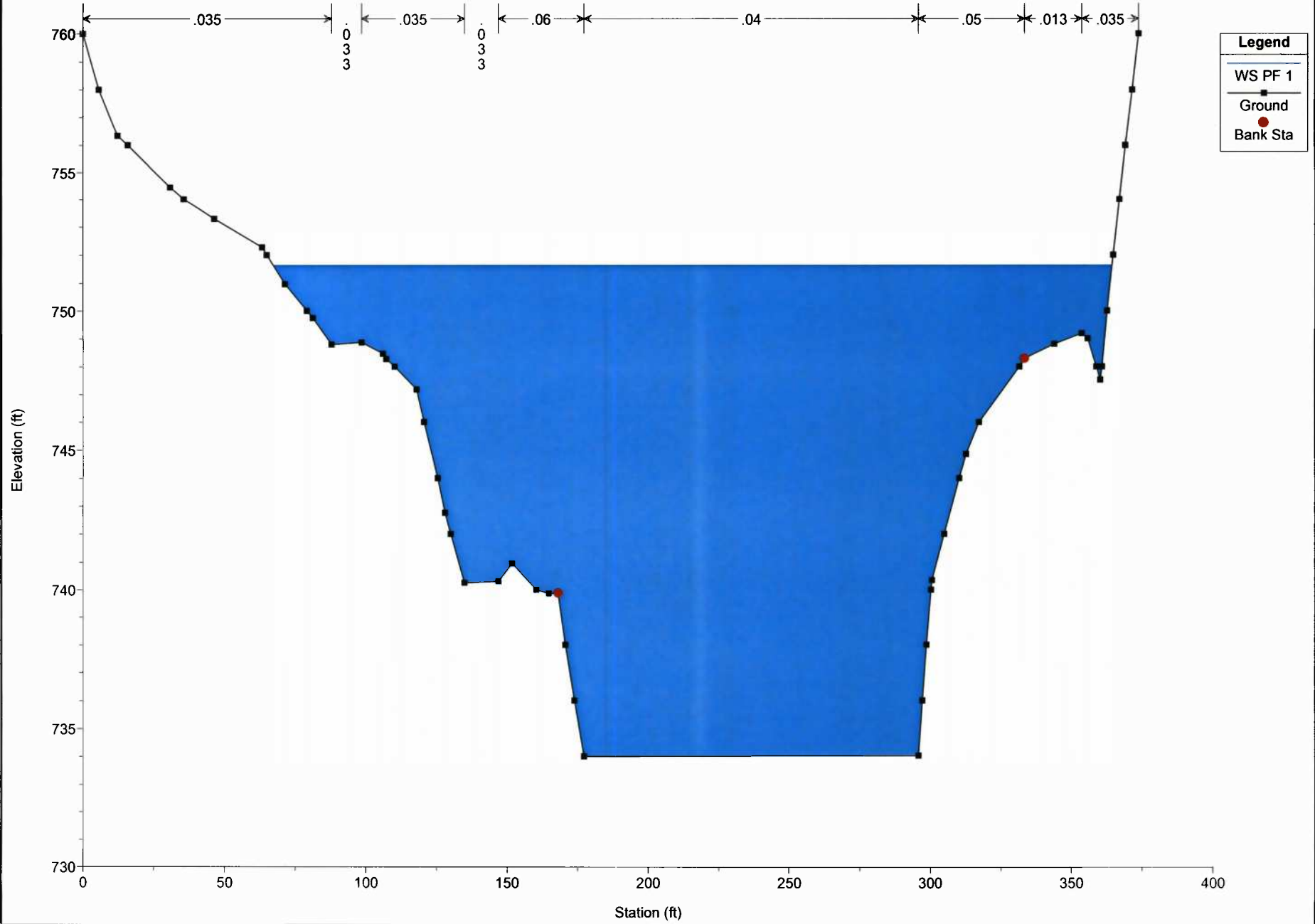
River = Middle Island Reach = Upper RS = 3039.998



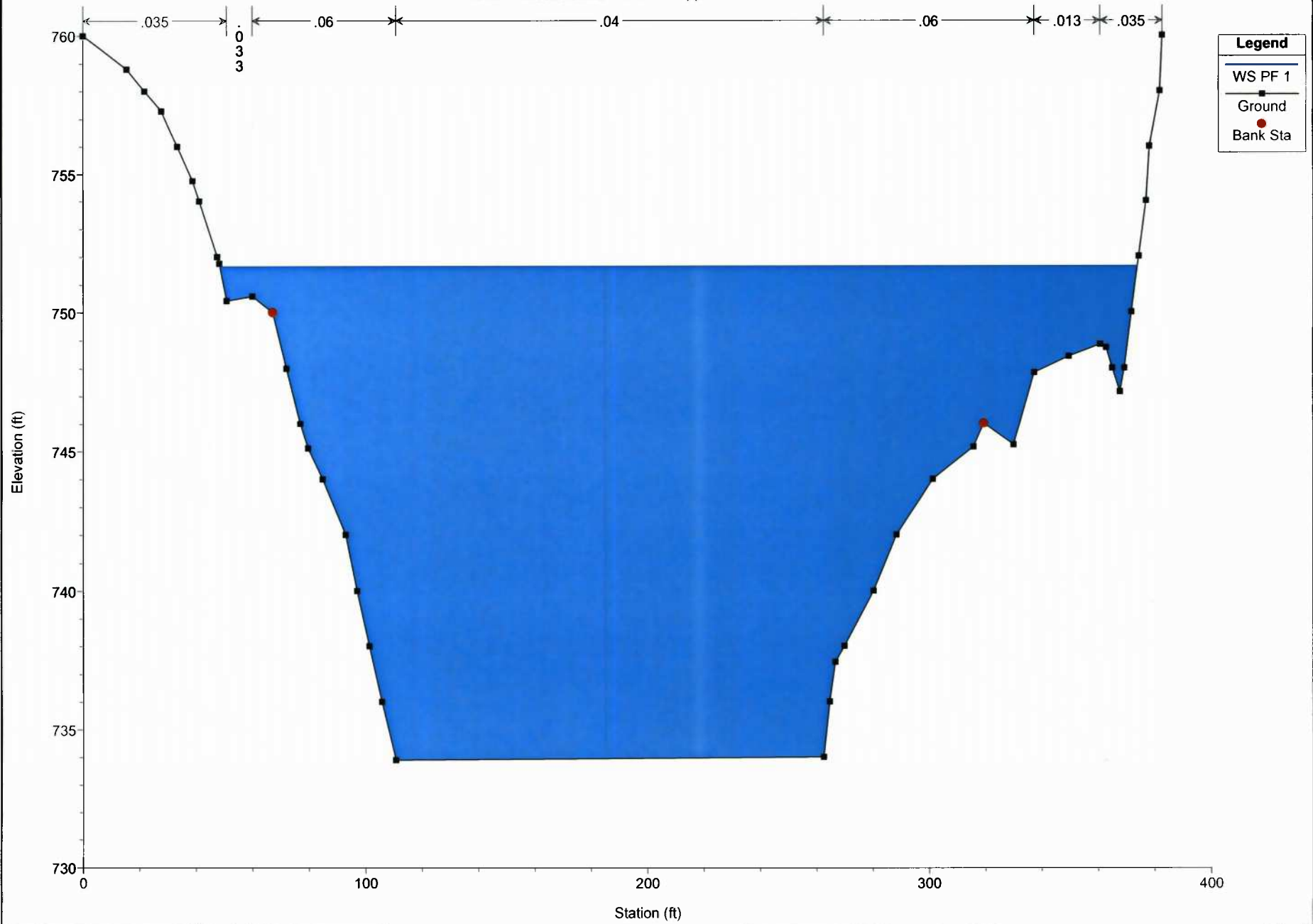
Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

River = Middle Island Reach = Upper RS = 2944.331



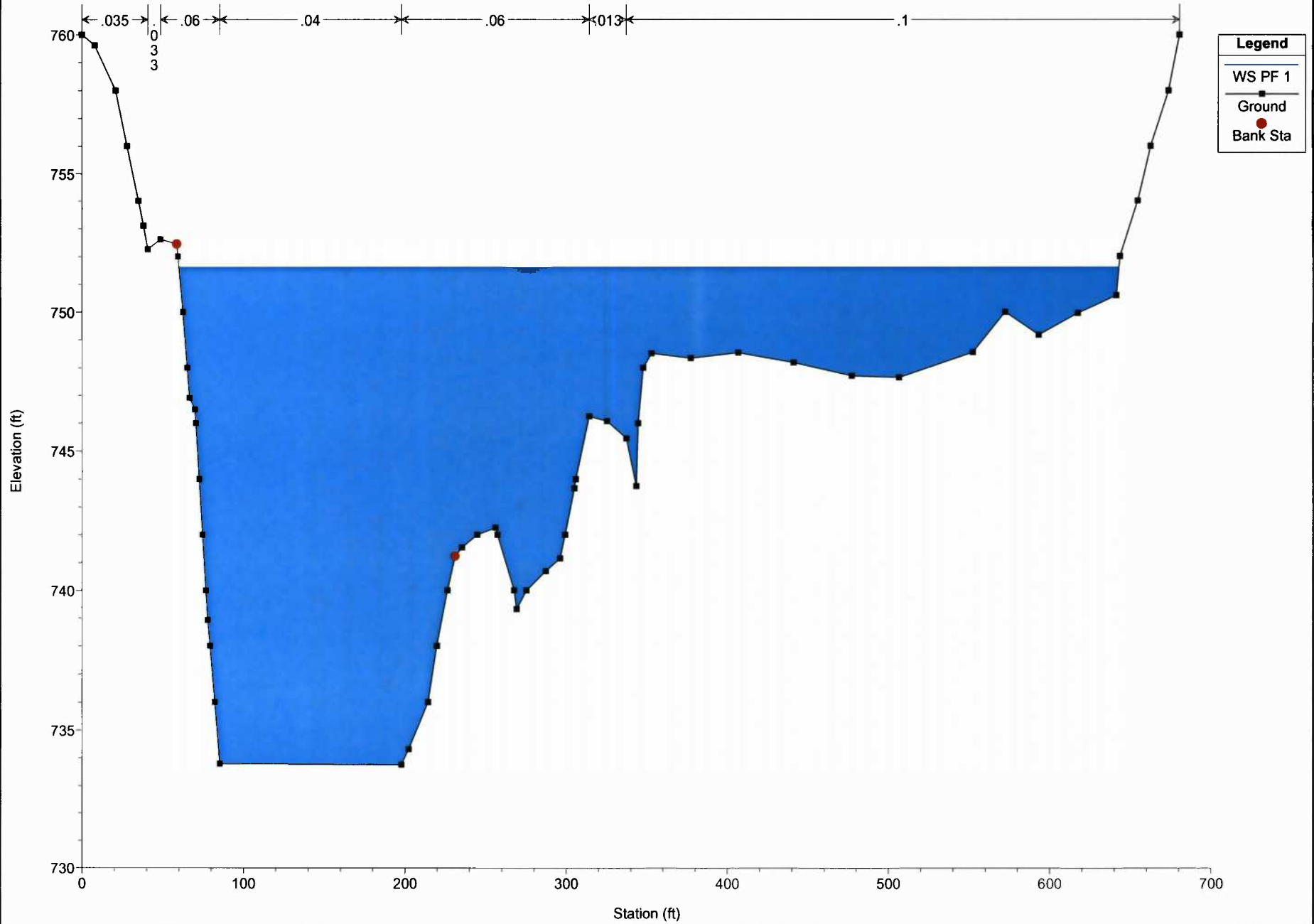
Addie Plan: Proposed  
Geom: Proposed Flow: Existing 100YR  
River = Middle Island Reach = Upper RS = 2829.179



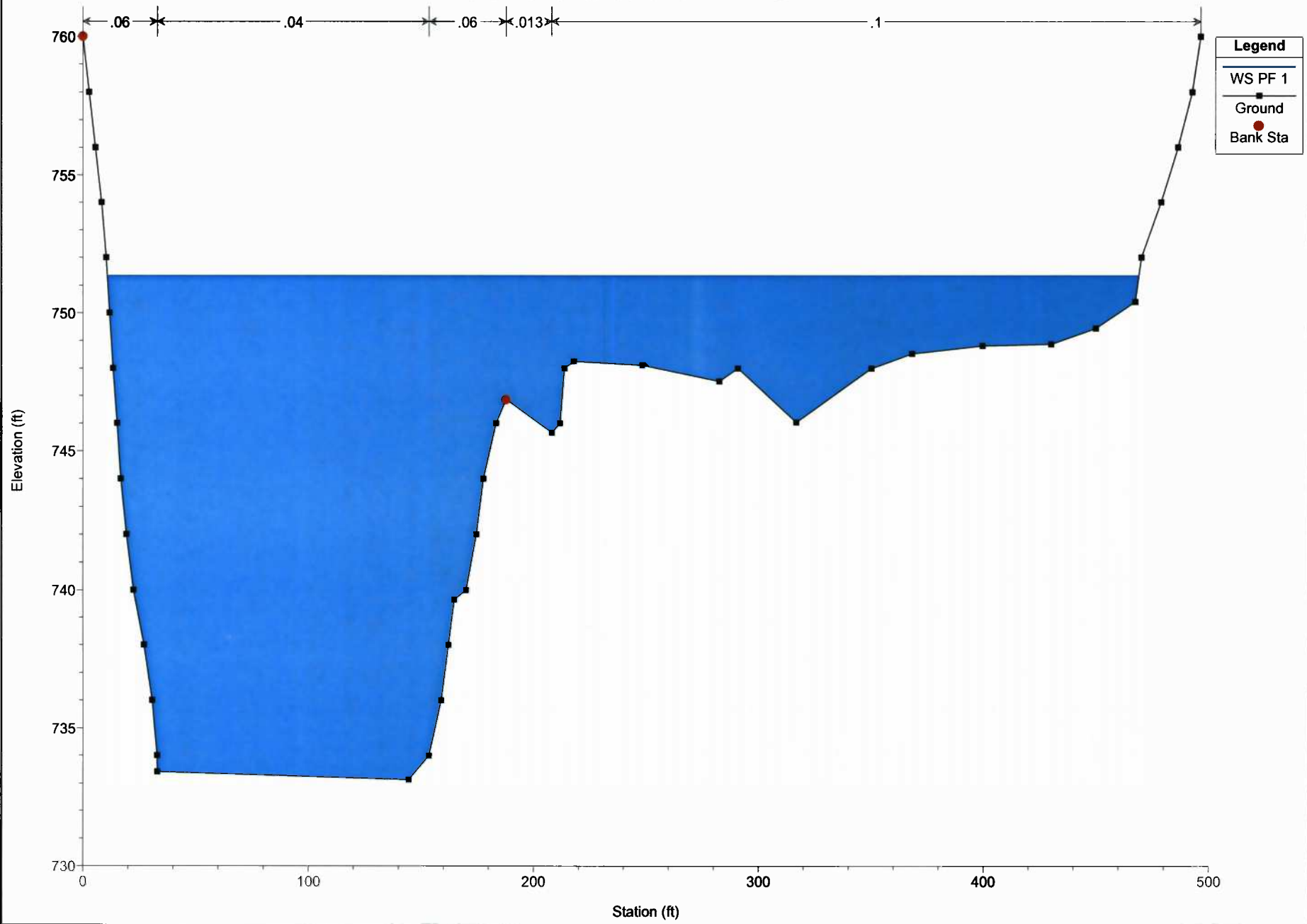
Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

River = Middle Island Reach = Lower RS = 2730.129



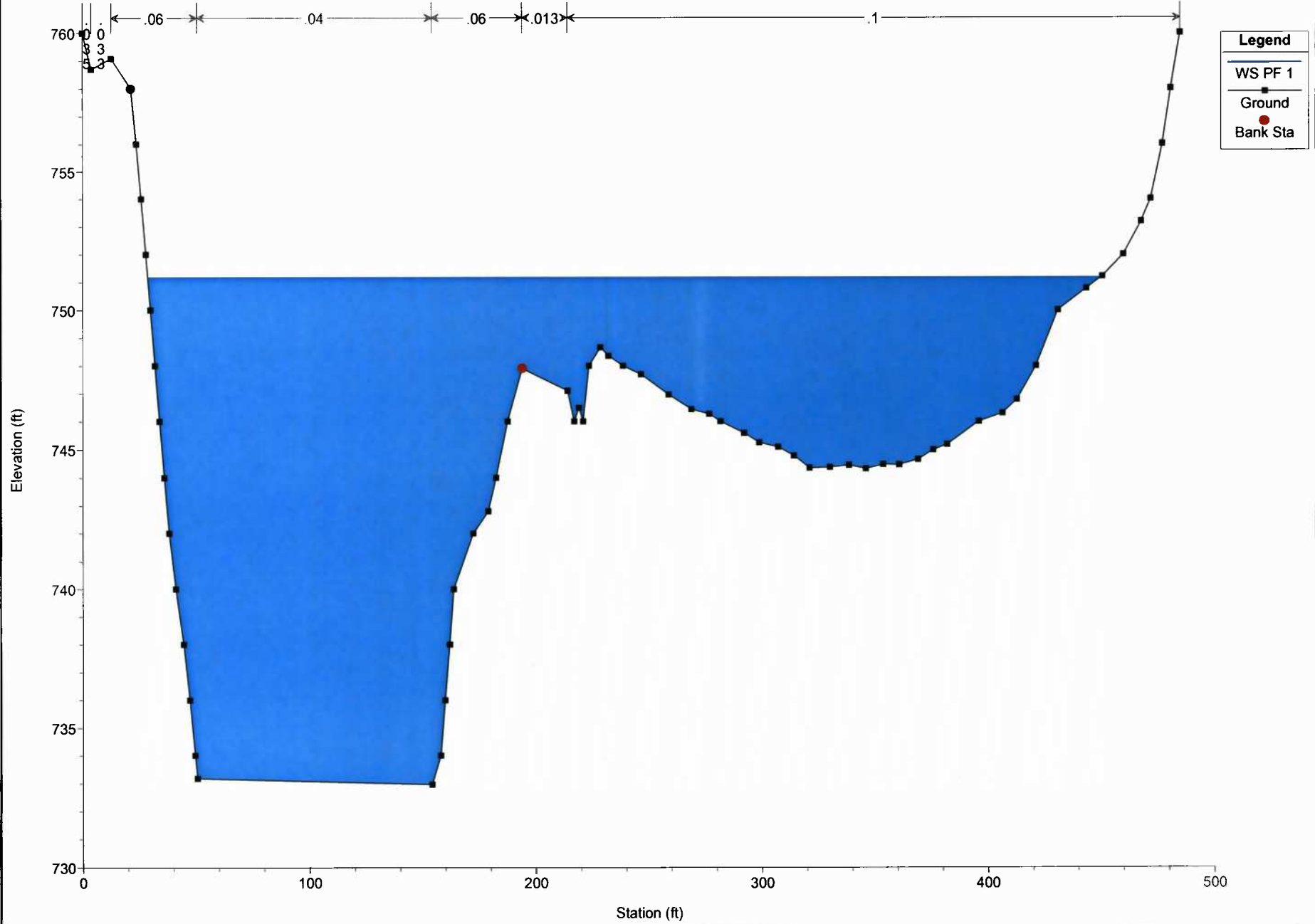
Addie Plan: Proposed  
Geom: Proposed Flow: Existing 100YR  
River = Middle Island Reach = Lower RS = 2457.936



Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

River = Middle Island Reach = Lower RS = 2259.266

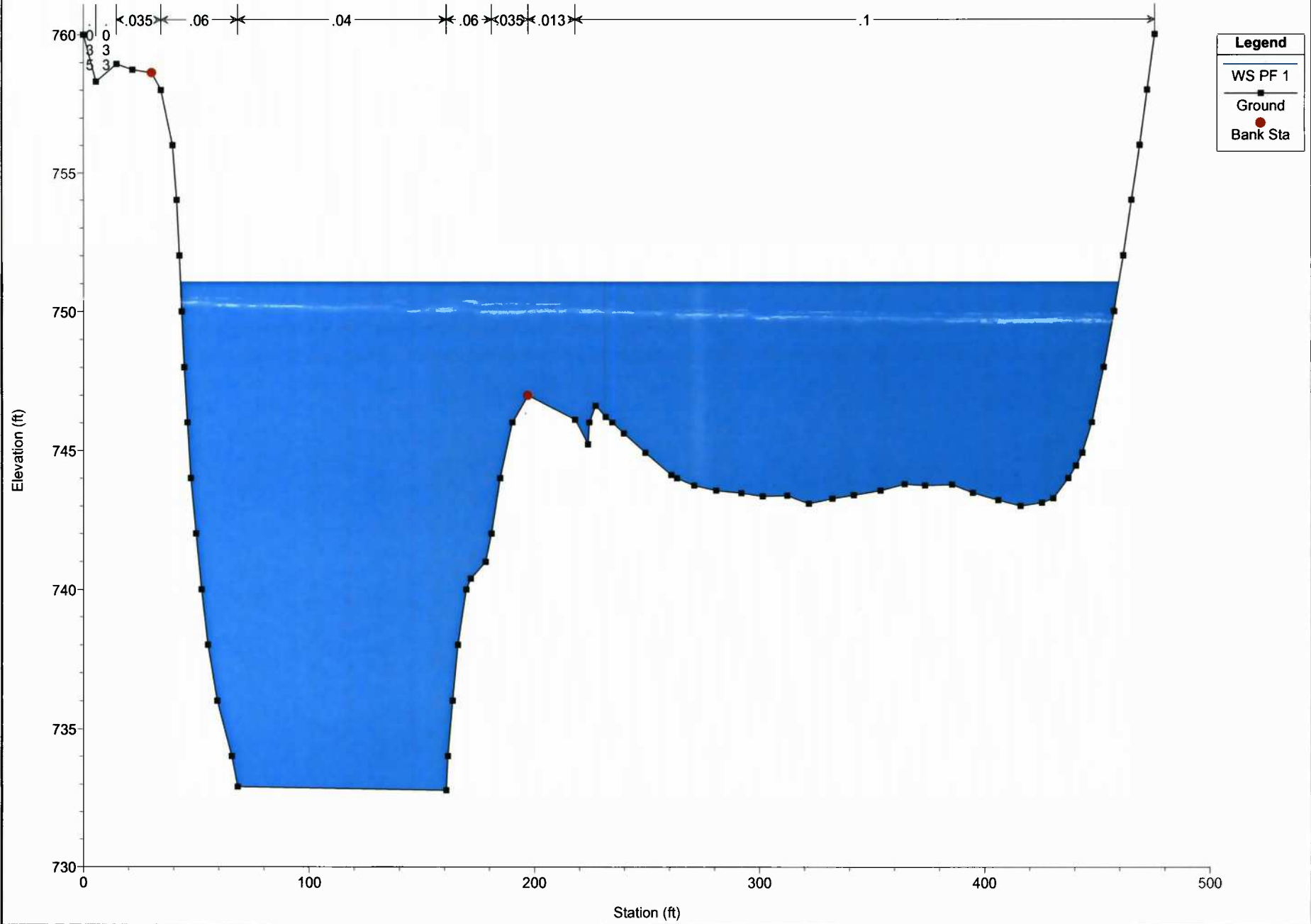




Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

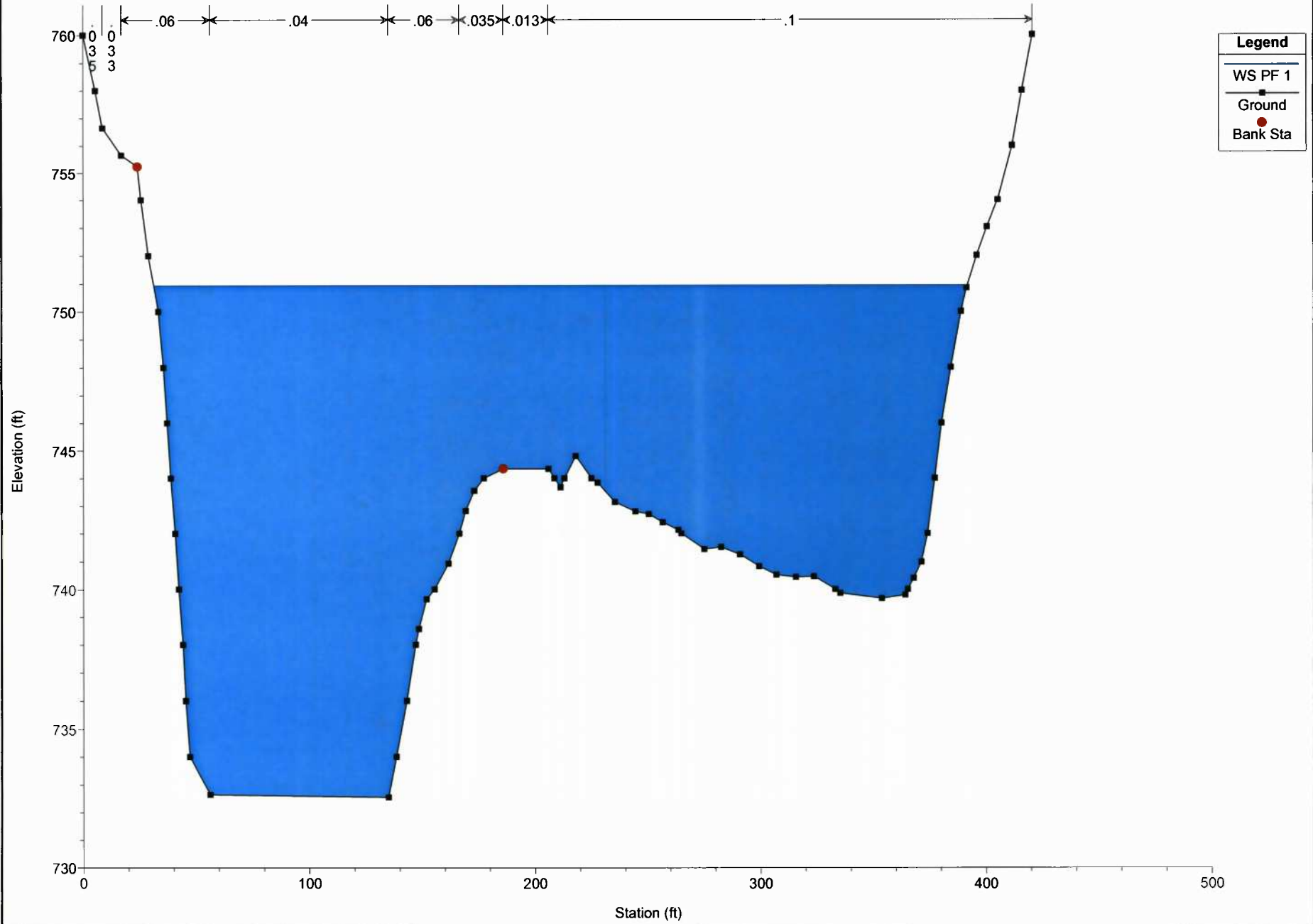
River = Middle Island Reach = Lower RS = 2049.716



Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

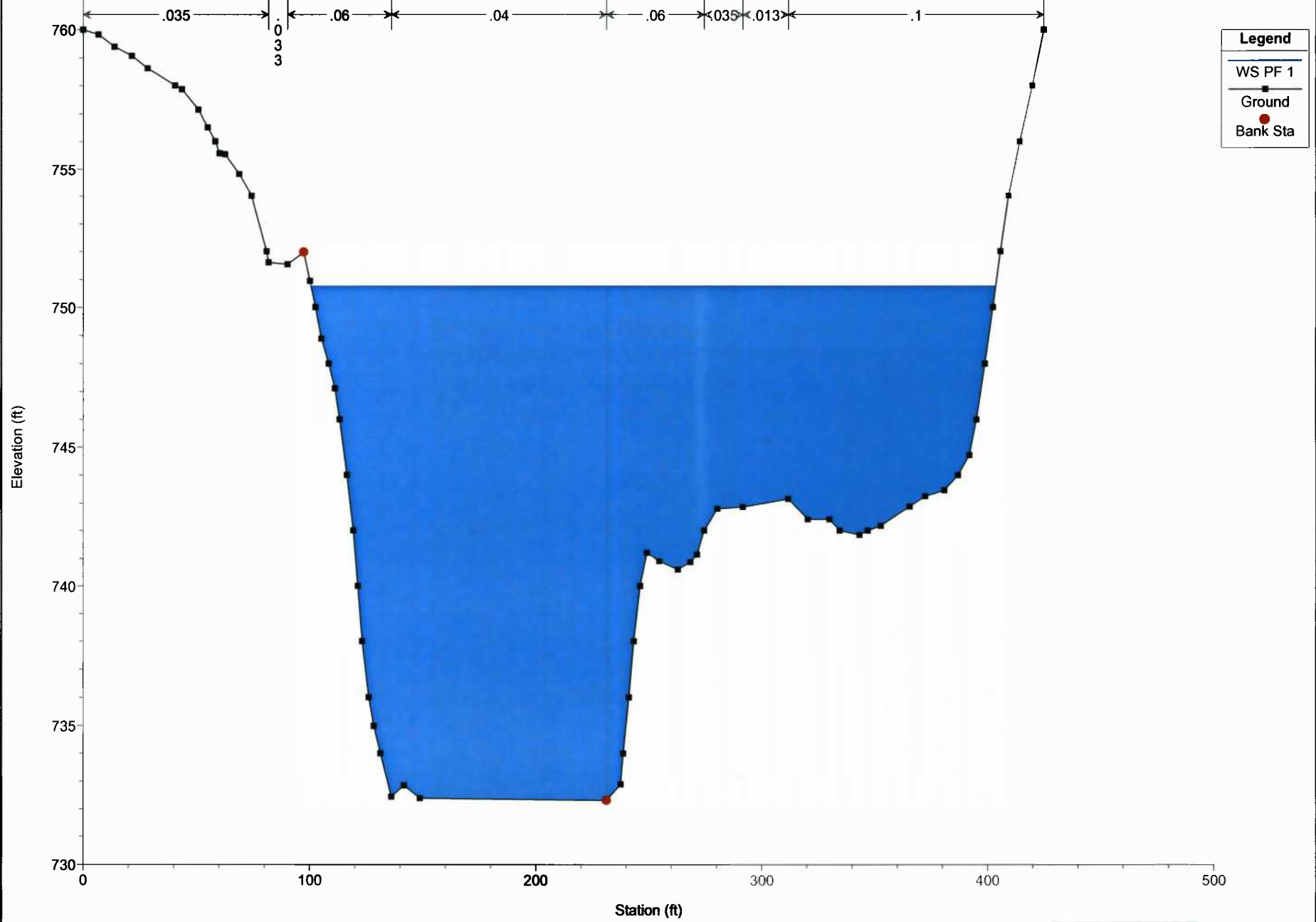
River = Middle Island Reach = Lower RS = 1840.209



Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

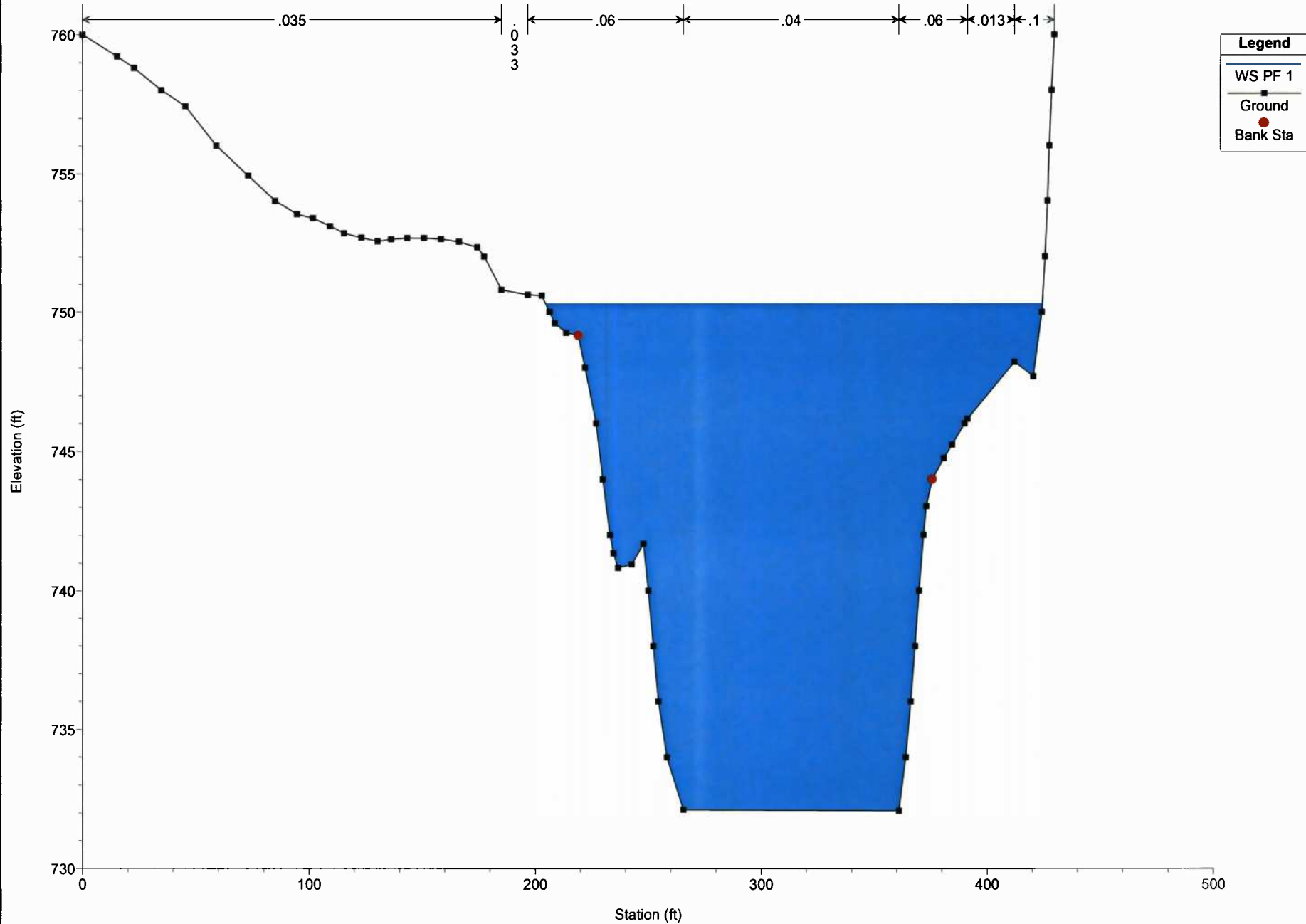
River = Middle Island Reach = Lower RS = 1632.735



Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

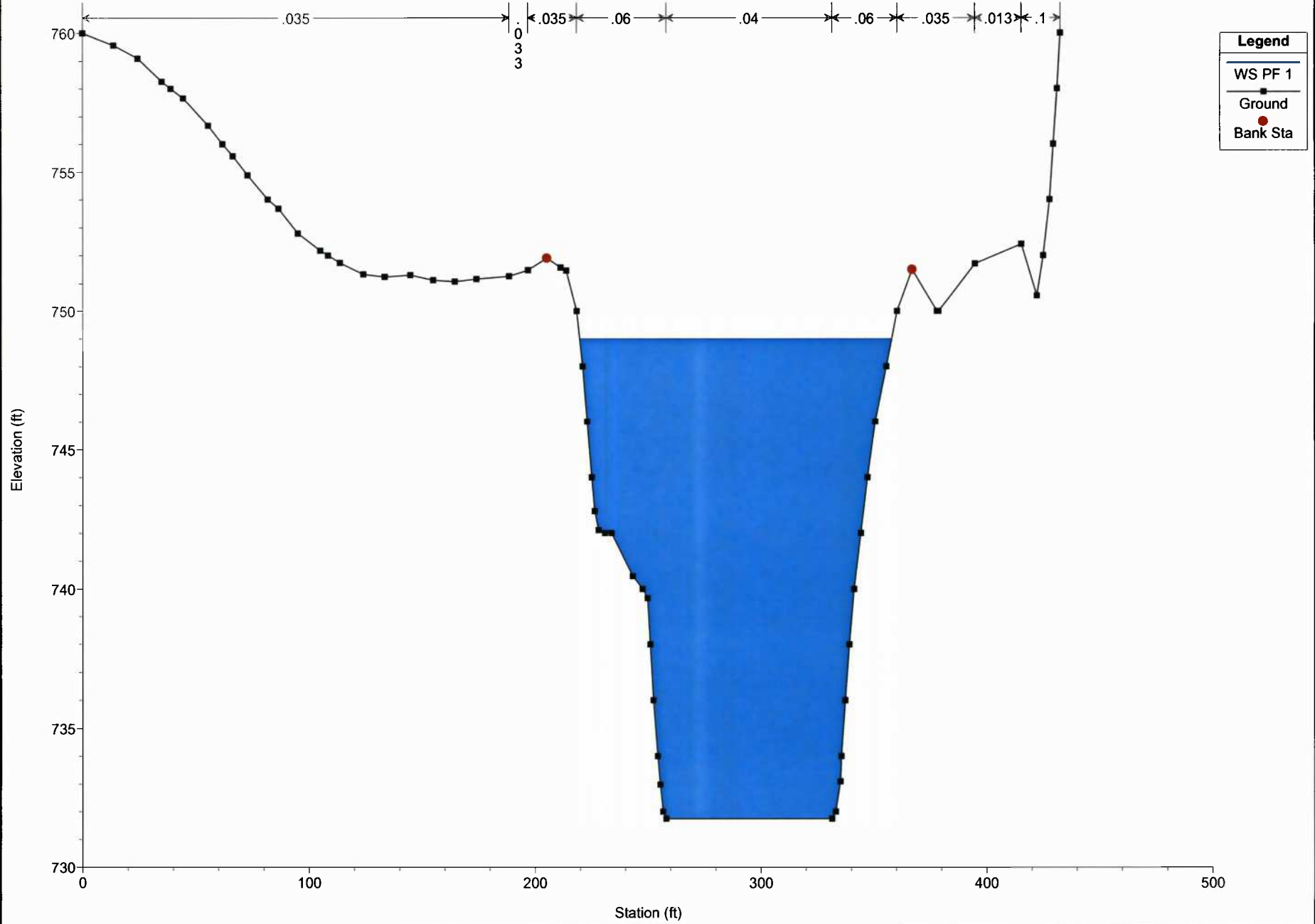
River = Middle Island Reach = Lower RS = 1414.824



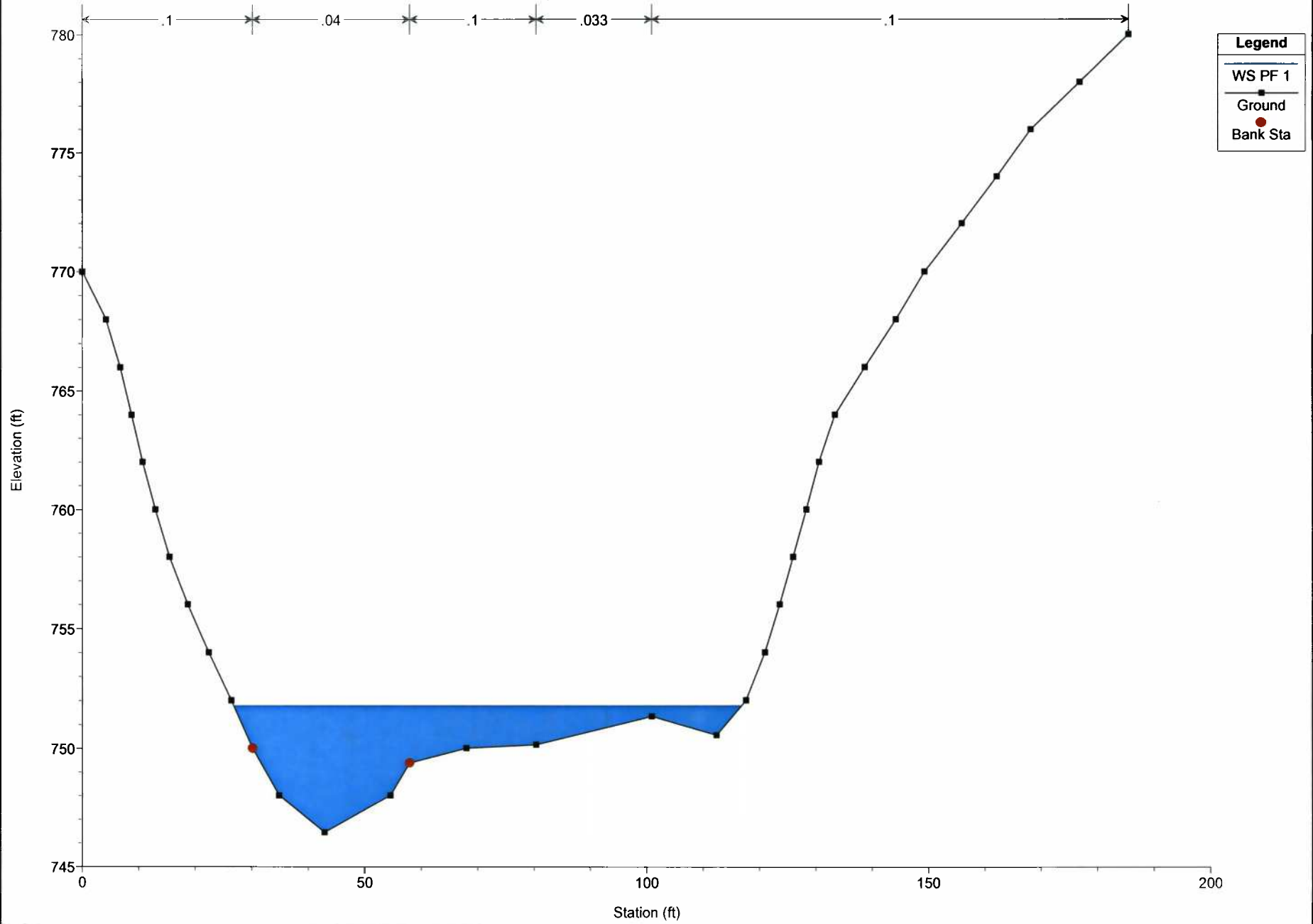
Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

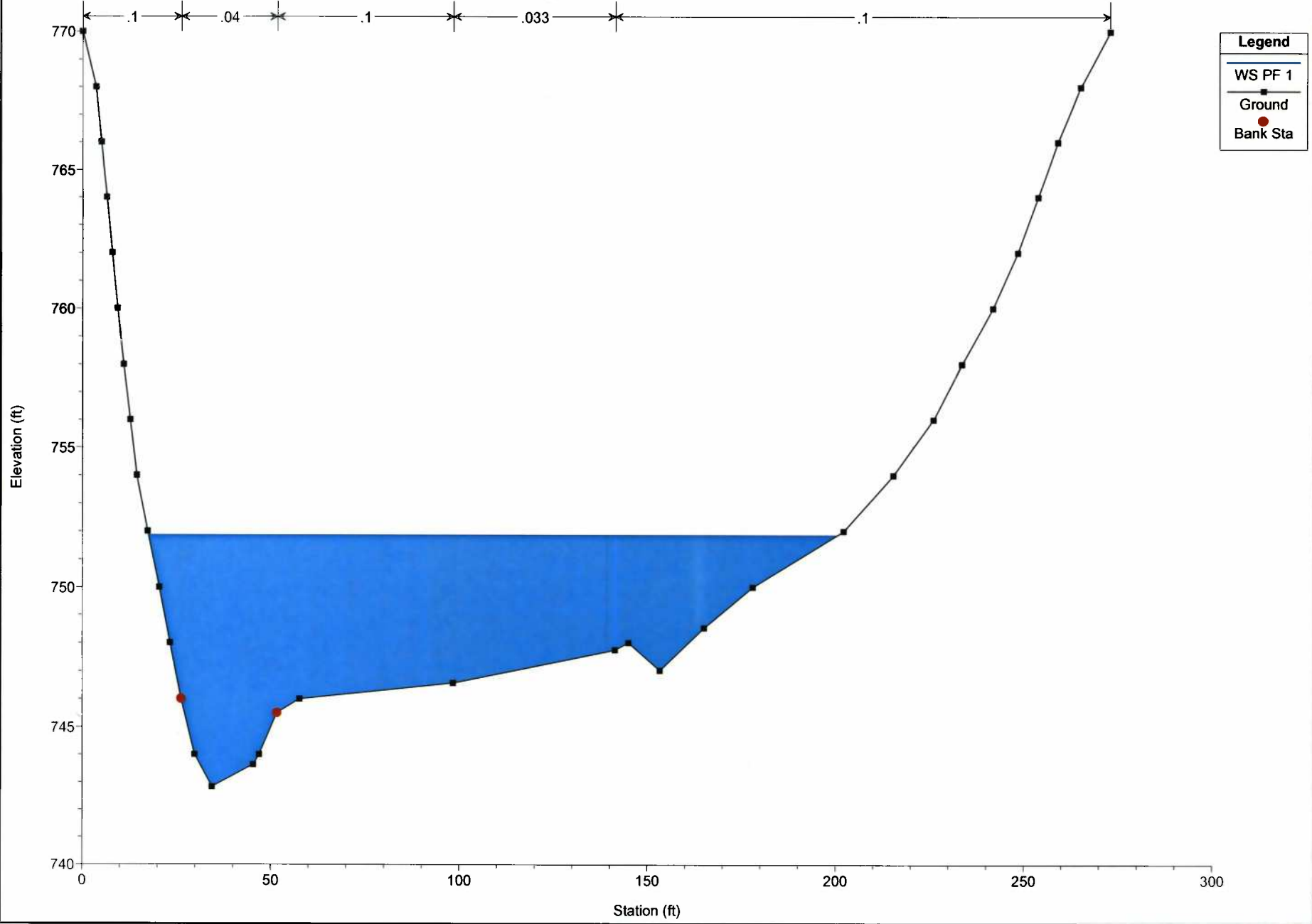
River = Middle Island Reach = Lower RS = 1000.000



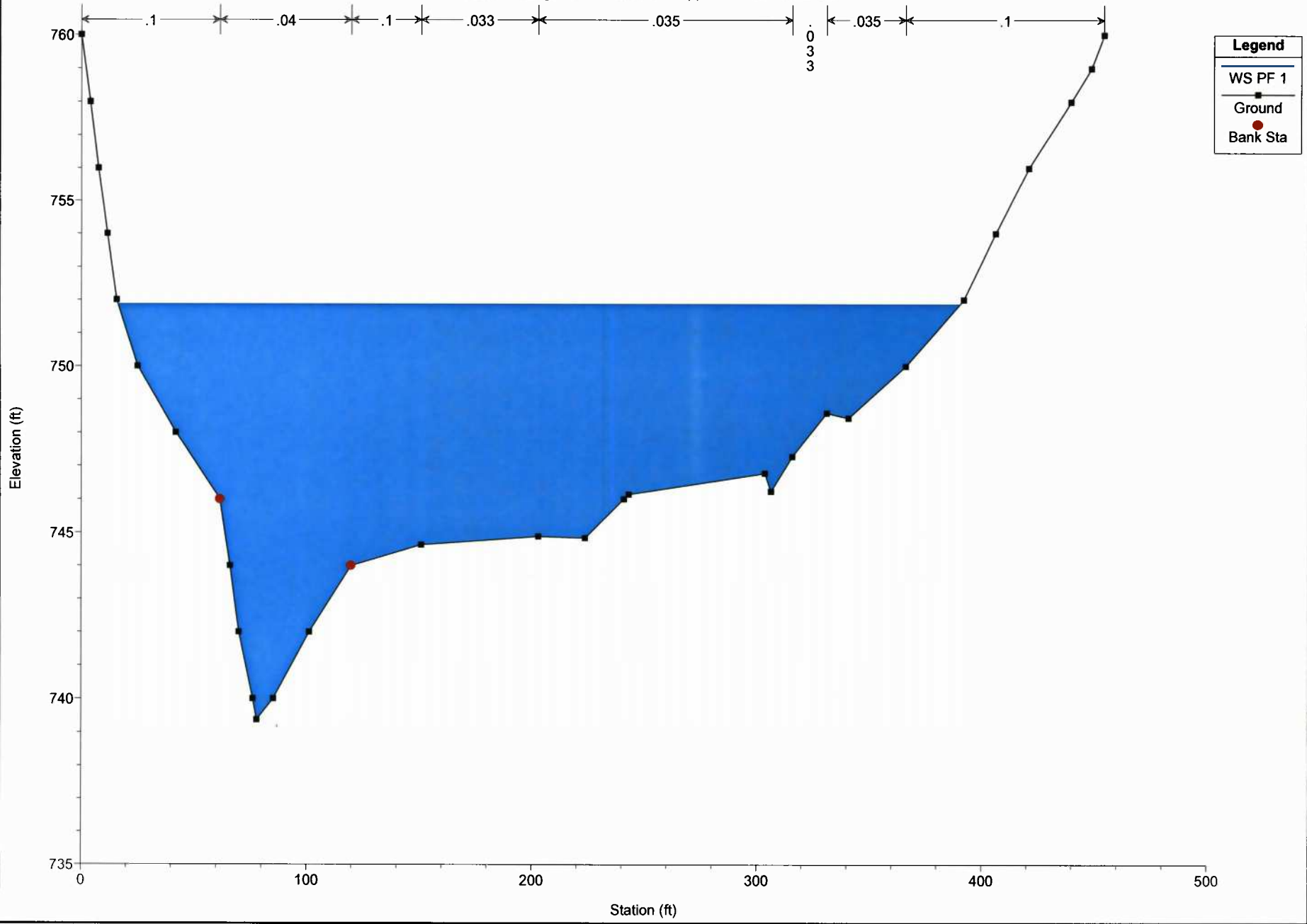
Addie Plan: Proposed  
Geom: Proposed Flow: Existing 100YR  
River = Slaughter Run Reach = Upper RS = 1724.607



Addie Plan: Proposed  
Geom: Proposed Flow: Existing 100YR  
River = Slaughter Run Reach = Upper RS = 1544.864

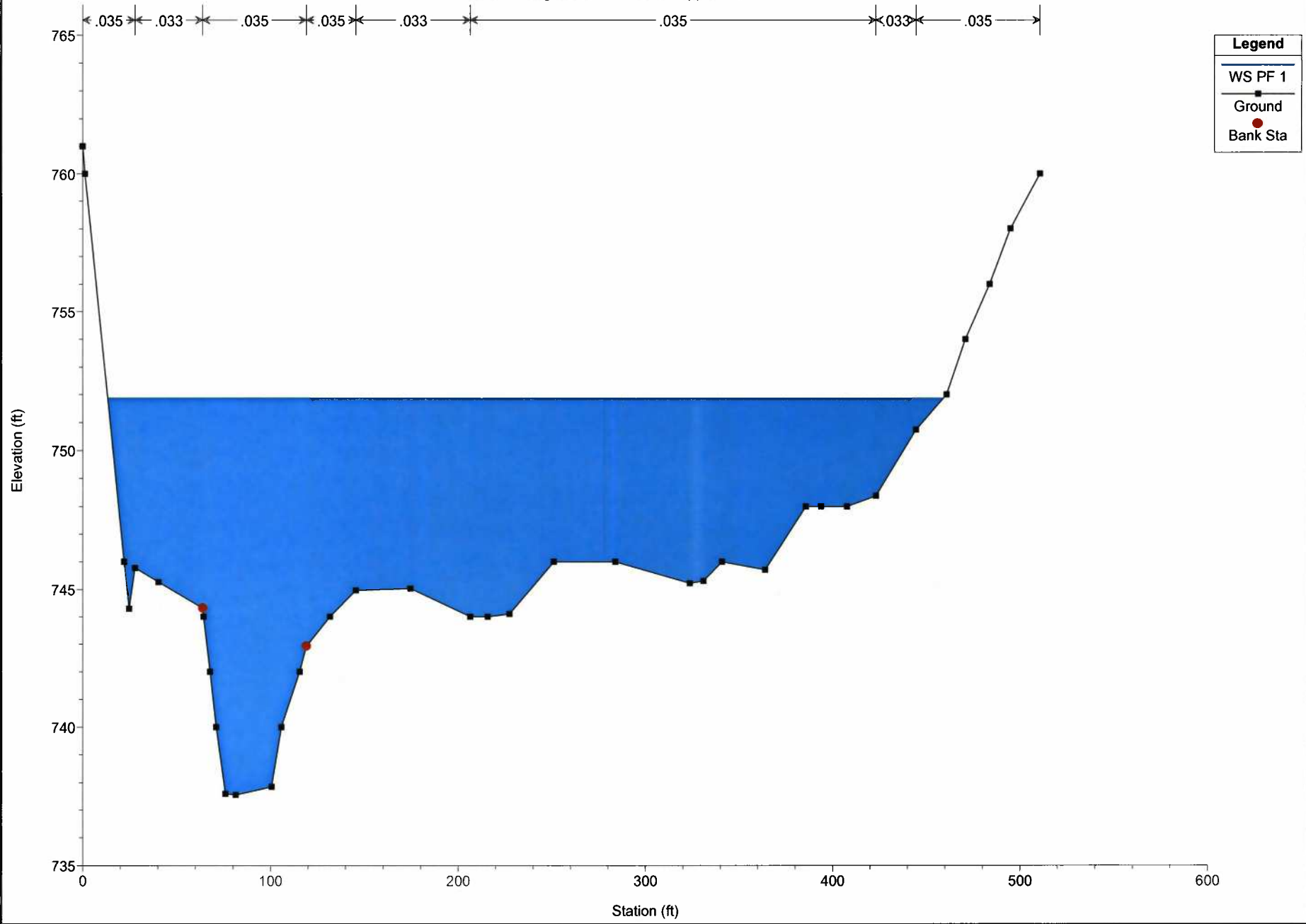


Addie Plan: Proposed  
Geom: Proposed Flow: Existing 100YR  
River = Slaughter Run Reach = Upper RS = 1344.324





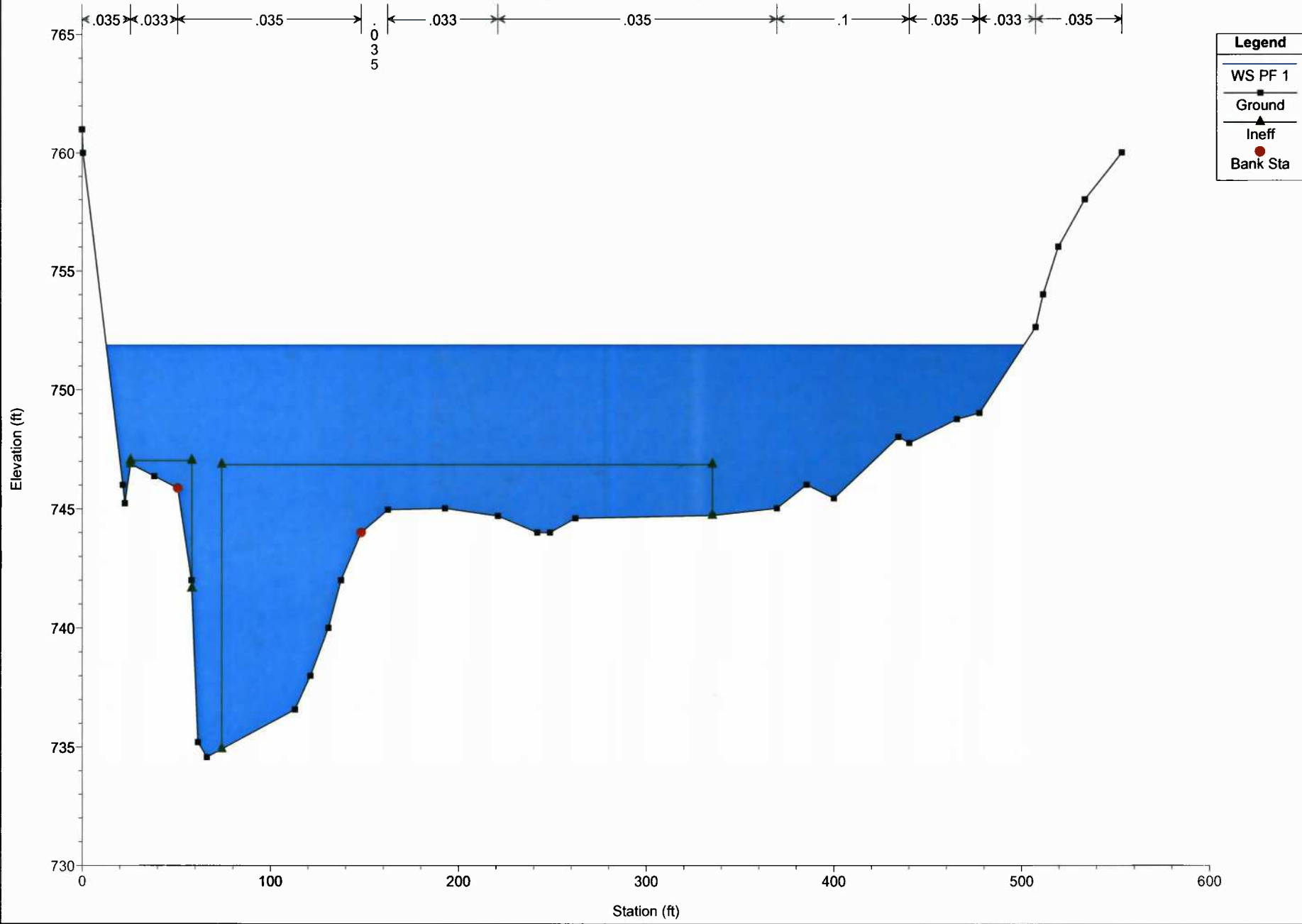
Addie Plan: Proposed  
Geom: Proposed Flow: Existing 100YR  
River = Slaughter Run Reach = Upper RS = 1254.897



Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

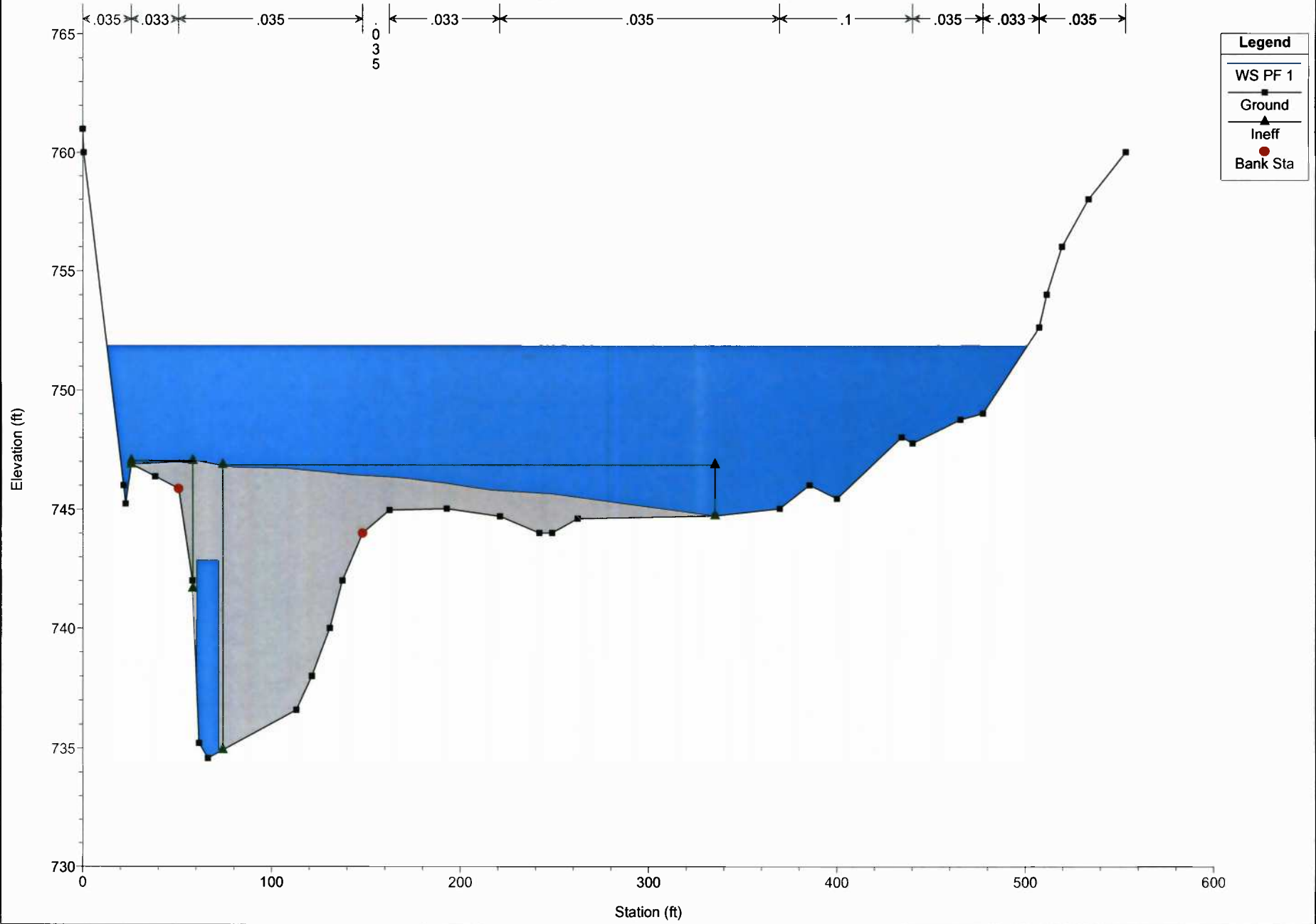
River = Slaughter Run Reach = Upper RS = 1193.416



Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

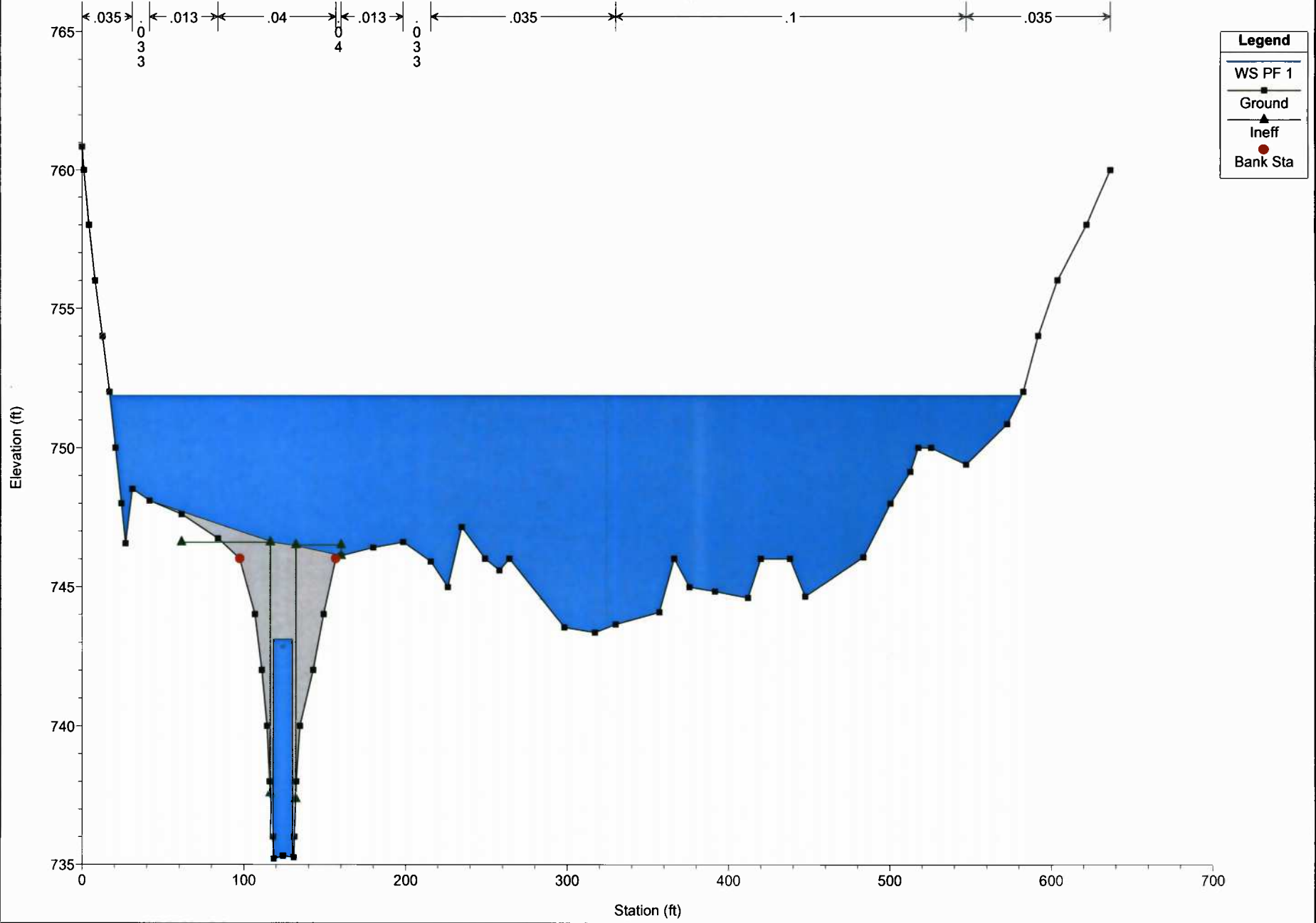
River = Slaughter Run Reach = Upper RS = 1172.84 BR



Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

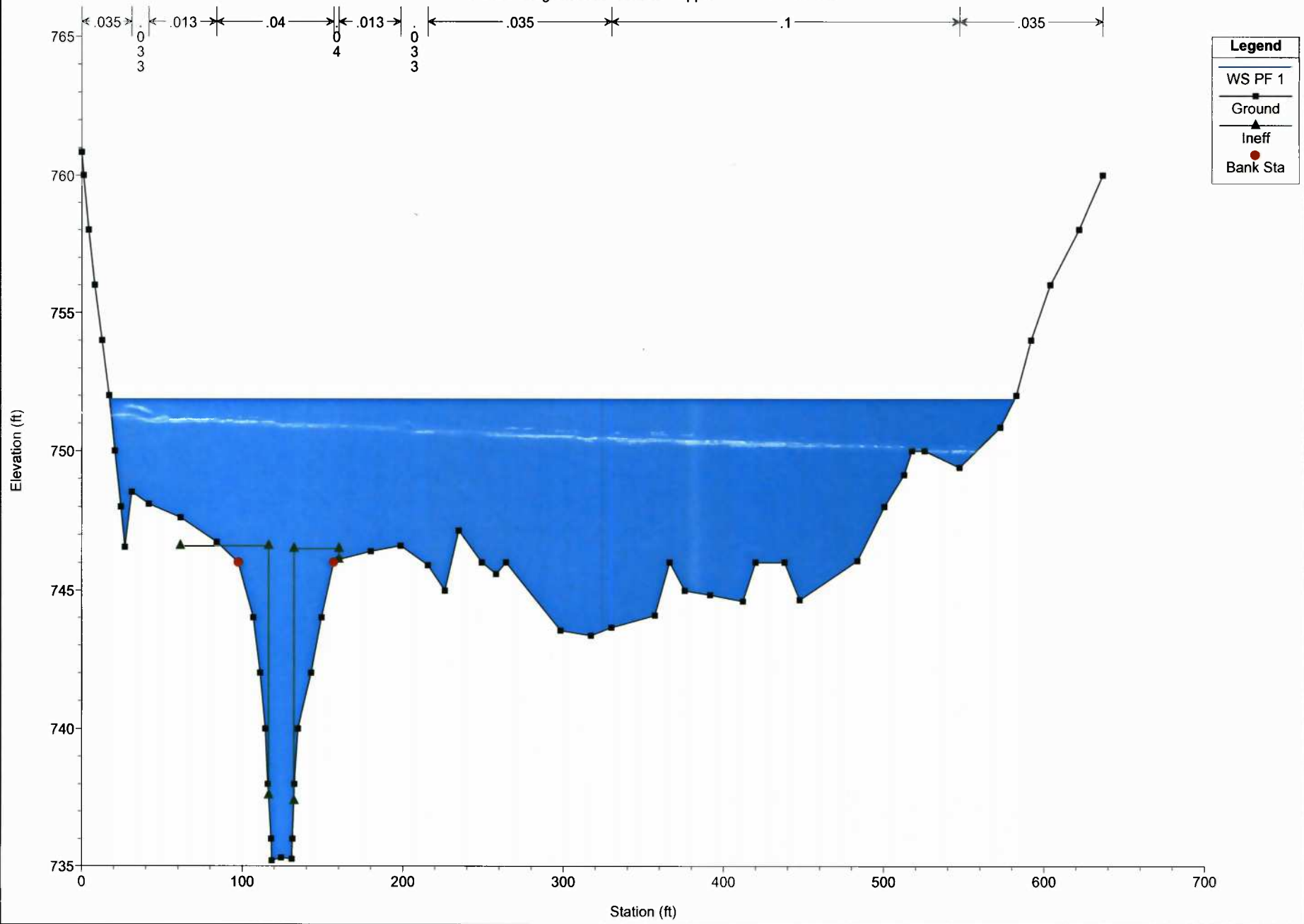
River = Slaughter Run Reach = Upper RS = 1172.84 BR



Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

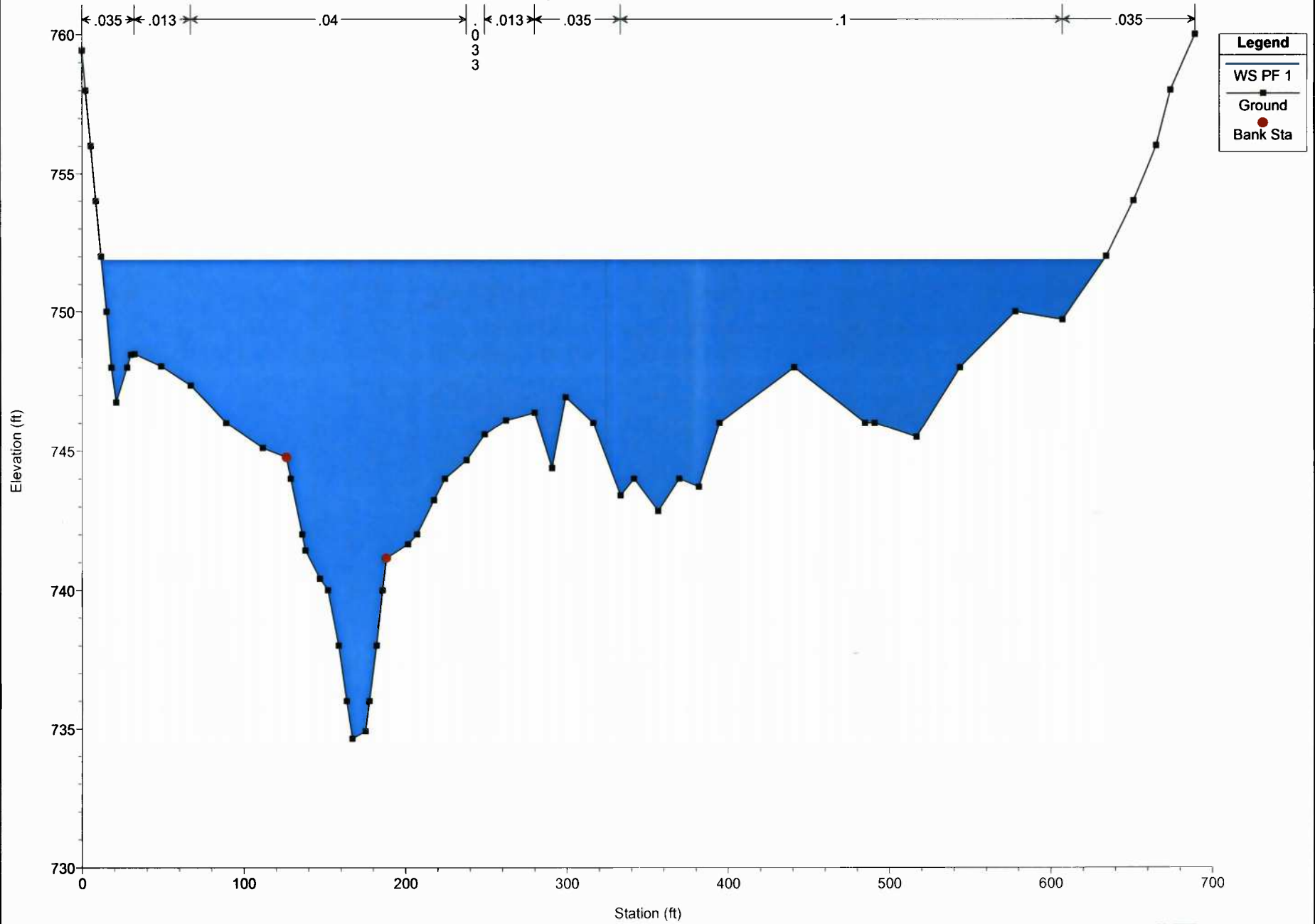
River = Slaughter Run Reach = Upper RS = 1144.785



Addie Plan: Proposed

Geom: Proposed Flow: Existing 100YR

River = Slaughter Run Reach = Upper RS = 1109.953

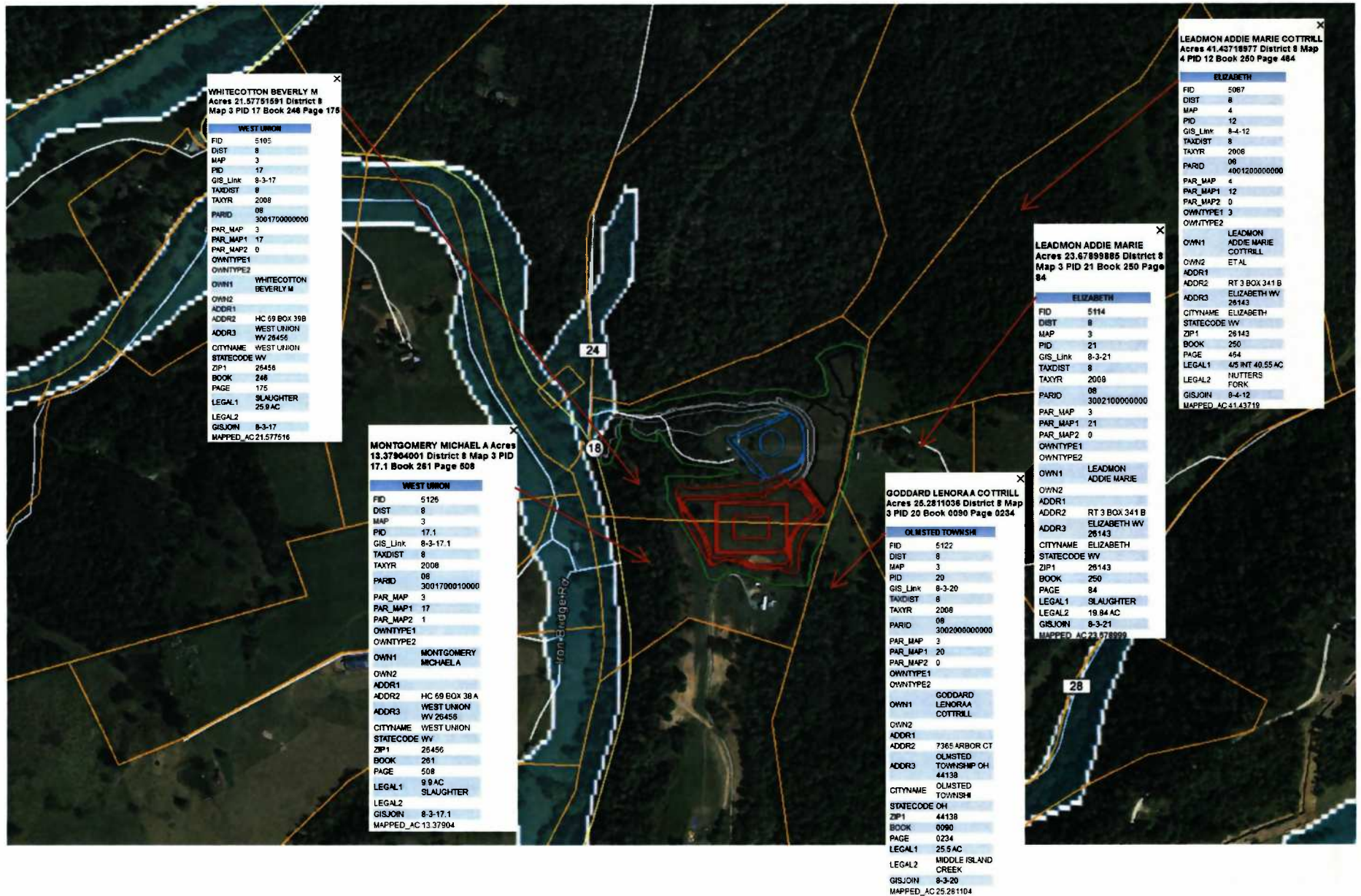


**ANTERO RESOURCES CORPORATION**

**COST ESTIMATE**

<b>CLEARING &amp; GRUBBING, EROSION, &amp; SEDIMENT CONTROLS</b>	<b>ADDIE WELL PAD &amp; WATER CONTAINMENT PAD</b>			
	<b>QUANTITY</b>	<b>UNIT</b>	<b>UNIT PRICE</b>	<b>FINAL PRICE</b>
MOBILIZATION	1.0	EA	\$24,830.09	\$24,830.09
CLEARING AND GRUBBING (TREE REMOVAL = 0 ACRES)	0.19	AC	\$4,125.34	\$783.81
SUPER SILT FENCE	265.0	LF	\$7.79	\$2,064.35
<b>TOTAL</b>				<b>\$27,678.25</b>
<b>SITE UNCLASSIFIED EXCAVATION</b>				
	<b>QUANTITY</b>	<b>UNIT</b>	<b>UNIT PRICE</b>	<b>FINAL PRICE</b>
ACCESS ROADS	1,199.4	CY	\$5.12	\$6,140.93
TOPSOIL STOCKPILES	237.0	CY	\$4.41	\$1,045.17
<b>TOTAL</b>				<b>\$7,186.10</b>
<b>AGGREGATE SURFACING - SPREADING, COMPACTION, and/or INSTALLATION</b>				
	<b>QUANTITY</b>	<b>UNIT</b>	<b>UNIT PRICE</b>	<b>FINAL PRICE</b>
ACCESS ROADS 2" OR 3" CLEAN AGGREGATE (6" THICK)	149.1	TON	\$30.00	\$4,473.00
ACCESS ROADS 1 1/2" OR 3/4" CRUSHER RUN AGGREGATE (2" THICK)	49.8	TON	\$30.00	\$1,494.00
ACCESS ROADS GEOTEXTILE FABRIC (US 200)	596.4	SY	\$5.00	\$2,982.00
<b>TOTAL</b>				<b>\$8,949.00</b>
<b>ROAD CULVERTS</b>				
	<b>QUANTITY</b>	<b>UNIT</b>	<b>UNIT PRICE</b>	<b>FINAL PRICE</b>
15" HDPE	42.0	LF	\$21.55	\$905.10
AASHTO #1 STONE (DITCH CHECKS)	0.2	TON	\$53.76	\$10.75
<b>TOTAL</b>				<b>\$915.85</b>
<b>SEEDING</b>				
	<b>QUANTITY</b>	<b>UNIT</b>	<b>UNIT PRICE</b>	<b>FINAL PRICE</b>
SITE SEEDING (HYDRO SEEDING - INCLUDES HALL'S PASTURE SEED MIX, LIME, & FERTILIZER) WITH HAY MULCH w/TACK	0.07	AC	\$2,809.13	\$196.64
<b>TOTAL</b>				<b>\$196.64</b>
<b>GRAND TOTAL</b>				<b>\$44,925.84</b>

# Addie Pad: Surface Owner Information



**WHITECOTTON BEVERLY M**  
Acres 21.57751591 District 8  
Map 3 PID 17 Book 248 Page 175

WEST UNION	
FID	5105
DIST	8
MAP	3
PID	17
GIS_Link	8-3-17
TAXDIST	8
TAXYR	2008
PARID	08
PARID	3001700000000
PAR_MAP	3
PAR_MAP1	17
PAR_MAP2	0
OWNTYPE1	
OWNTYPE2	
OWN1	WHITECOTTON BEVERLY M
OWN2	
ADDR1	
ADDR2	HC 69 BOX 39B
ADDR3	WEST UNION WV 26456
CITYNAME	WEST UNION
STATECODE	WV
ZIP1	26456
BOOK	248
PAGE	175
LEGAL1	SLAUGHTER 25.9 AC
LEGAL2	
GISJOIN	8-3-17
MAPPED_AC	21.577516

**MONTGOMERY MICHAEL A** Acres 13.37904001 District 8 Map 3 PID 17.1 Book 261 Page 508

WEST UNION	
FID	5126
DIST	8
MAP	3
PID	17.1
GIS_Link	8-3-17.1
TAXDIST	8
TAXYR	2008
PARID	08
PARID	3001700010000
PAR_MAP	3
PAR_MAP1	17
PAR_MAP2	1
OWNTYPE1	
OWNTYPE2	
OWN1	MONTGOMERY MICHAEL A
OWN2	
ADDR1	
ADDR2	HC 69 BOX 38 A
ADDR3	WEST UNION WV 26458
CITYNAME	WEST UNION
STATECODE	WV
ZIP1	26456
BOOK	261
PAGE	508
PARC	9.9 AC
LEGAL1	SLAUGHTER
LEGAL2	
GISJOIN	8-3-17.1
MAPPED_AC	13.37904

**GODDARD LENORAA COTTRILL** Acres 25.2811036 District 8 Map 3 PID 20 Book 0090 Page 0234

OLMSTED TOWNSHIP	
FID	5122
DIST	8
MAP	3
PID	20
GIS_Link	8-3-20
TAXDIST	8
TAXYR	2008
PARID	08
PARID	3002000000000
PAR_MAP	3
PAR_MAP1	20
PAR_MAP2	0
OWNTYPE1	
OWNTYPE2	
OWN1	GODDARD LENORAA COTTRILL
OWN2	
ADDR1	
ADDR2	7365 ARBOR CT
ADDR3	OLMSTED TOWNSHIP OH 44138
CITYNAME	OLMSTED TOWNSHIP
STATECODE	OH
ZIP1	44138
BOOK	090
PAGE	0234
LEGAL1	25.5 AC
LEGAL2	MIDDLE ISLAND CREEK
GISJOIN	8-3-20
MAPPED_AC	25.281104

**LEADMOM ADDIE MARIE** Acres 23.67899885 District 8 Map 3 PID 21 Book 250 Page 84

ELIZABETH	
FID	5114
DIST	8
MAP	3
PID	21
GIS_Link	8-3-21
TAXDIST	8
TAXYR	2008
PARID	08
PARID	3002100000000
PAR_MAP	3
PAR_MAP1	21
PAR_MAP2	0
OWNTYPE1	
OWNTYPE2	
OWN1	LEADMOM ADDIE MARIE
OWN2	
ADDR1	
ADDR2	RT 3 BOX 341 B
ADDR3	ELIZABETH WV 26143
CITYNAME	ELIZABETH
STATECODE	WV
ZIP1	26143
BOOK	250
PAGE	84
LEGAL1	SLAUGHTER
LEGAL2	19.84 AC
GISJOIN	8-3-21
MAPPED_AC	23.678999

**LEADMOM ADDIE MARIE COTTRILL** Acres 41.43718977 District 8 Map 4 PID 12 Book 260 Page 484

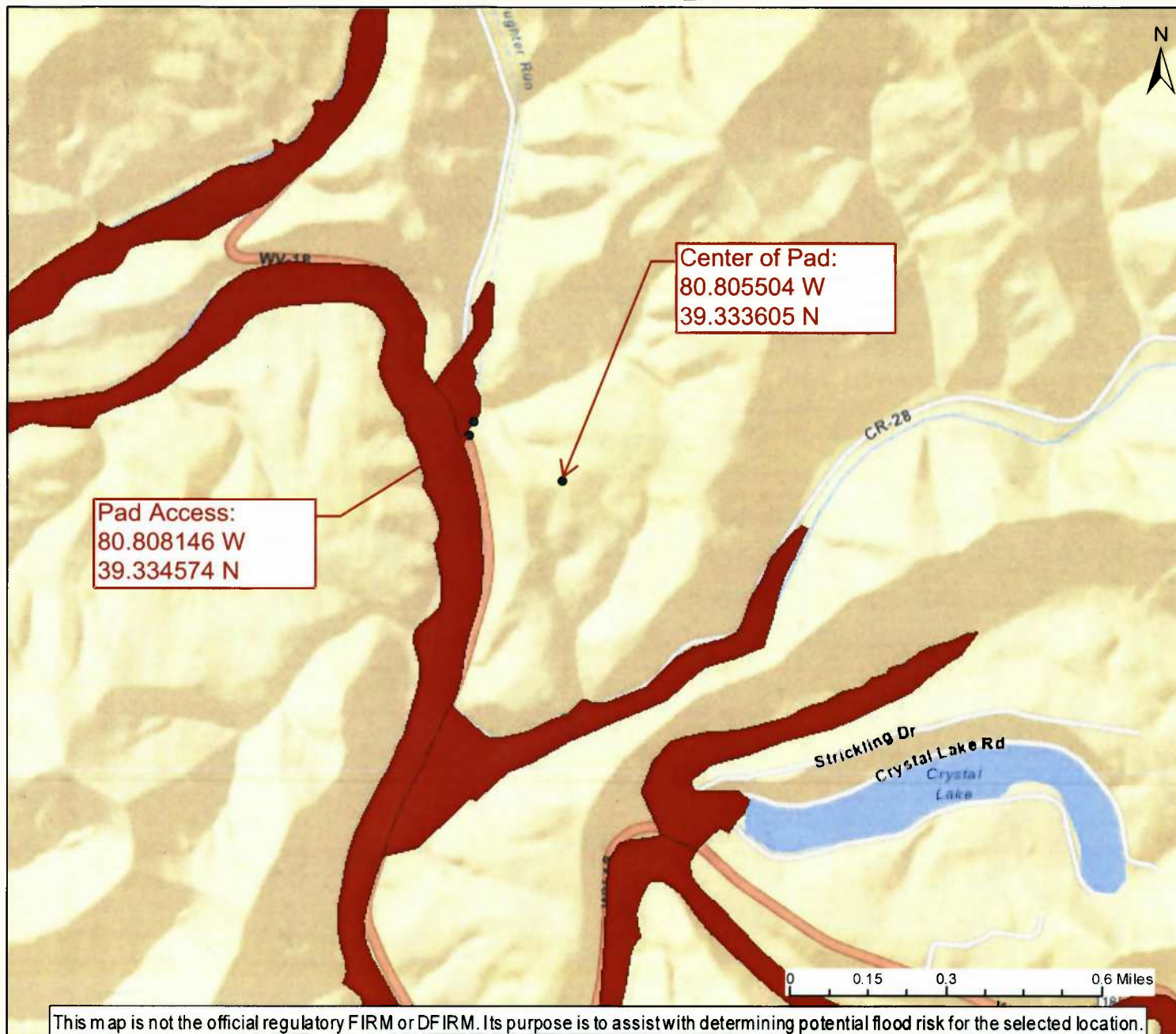
ELIZABETH	
FID	5067
DIST	8
MAP	4
PID	12
GIS_Link	8-4-12
TAXDIST	8
TAXYR	2008
PARID	08
PARID	4001200000000
PAR_MAP	4
PAR_MAP1	12
PAR_MAP2	0
OWNTYPE1	3
OWNTYPE2	
OWN1	LEADMOM ADDIE MARIE COTTRILL
OWN2	ETAL
ADDR1	
ADDR2	RT 3 BOX 341 B
ADDR3	ELIZABETH WV 26143
CITYNAME	ELIZABETH
STATECODE	WV
ZIP1	26143
BOOK	260
PAGE	484
LEGAL1	45 INT 40.65 AC
LEGAL2	MUTTERS FORK
GISJOIN	8-4-12
MAPPED_AC	41.43719



**Property Owner Table-Doddridge County Floodplain Permit  
Antero Resources Corporation-Addie Pad**

Property Owner Name	Mailing Address	Parcel ID	Deed Book Reference
<b>Host Properties-Inside Floodplain</b>			
Beverly M Whitecotton (Antero Owned)	3867 Glendale Rd, Cairo, WV 26337	8-3-17	Book 246, Page 175
<b>Host Properties-Outside Floodplain</b>			
Charles Cottrill	3839 Smithton Rd, West Union, WV 26456	8-4-12	Book 250, Page 464
Michael A Montgomery (Antero Owned)	404 Gabriels Way, West Union, WV 26456	8-3-17.1	Book 261, Page 508
Lois Arcuri	9142 Chatham Circle, North Ridgevill, OH 44039	8-3-20	Book AP41, Page 150
Addie Marie Leadmon	Rt 3 Box 341B, Elizabeth, WV 26143	8-3-21	Book 250, Page 84
<b>Properties Abutting Host Properties-Inside Floodplain</b>			
James W & Lynda S Beatty	P.O. Box 295, West Union, WV 26456	8-3-10	Book 259, Page 310
Perry Gains, Perry Blackburn & Ryan Webb	P.O. Box 2512, Clarksburg, WV 26302	8-3-11	Book 283, Page 682
Doris Wiseman	1 First American Way, West Lake, TX 76262	8-3-16	Book AP40, Page 512
Thomas and Penny Porter	457 Cedar Lane, West Union, WV 26452	8-3-18	Book 228, Page 723
Thomas and Penny Porter	457 Cedar Lane, West Union, WV 26452	8-3-18.3	Book 199, Page 700
Clifford and Ora Montgomery	208 E Miles Ave, Apt 456, Pennsboro, WV 26415	8-3-19	Book WB47, Page 333

# WV Flood Map



### User Notes:

- Flood Hazard Zone
- Flood Point of Interest

### Disclaimer:

The online map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. To obtain more detailed information in areas where Base Flood Elevations have been determined, users are encouraged to consult the latest Flood Profile data contained in the official flood insurance study. These studies are available online at [www.msc.fema.gov](http://www.msc.fema.gov). *WV Flood Tool* (<http://www.MapWV.gov/flood>) is supported by FEMA, WV NFIP Office, and WV GIS Technical Center.

Map created on April 25, 2016

### Flood Hazard Area:

Flood Hazard Area: Location is WITHIN the FEMA 100-year floodplain.

**FEMA Issued Flood Map:** 54017C0110C

**Watershed (HUC8):** Little Musringum-Middle Island (5

**Elevation:** About 764 ft

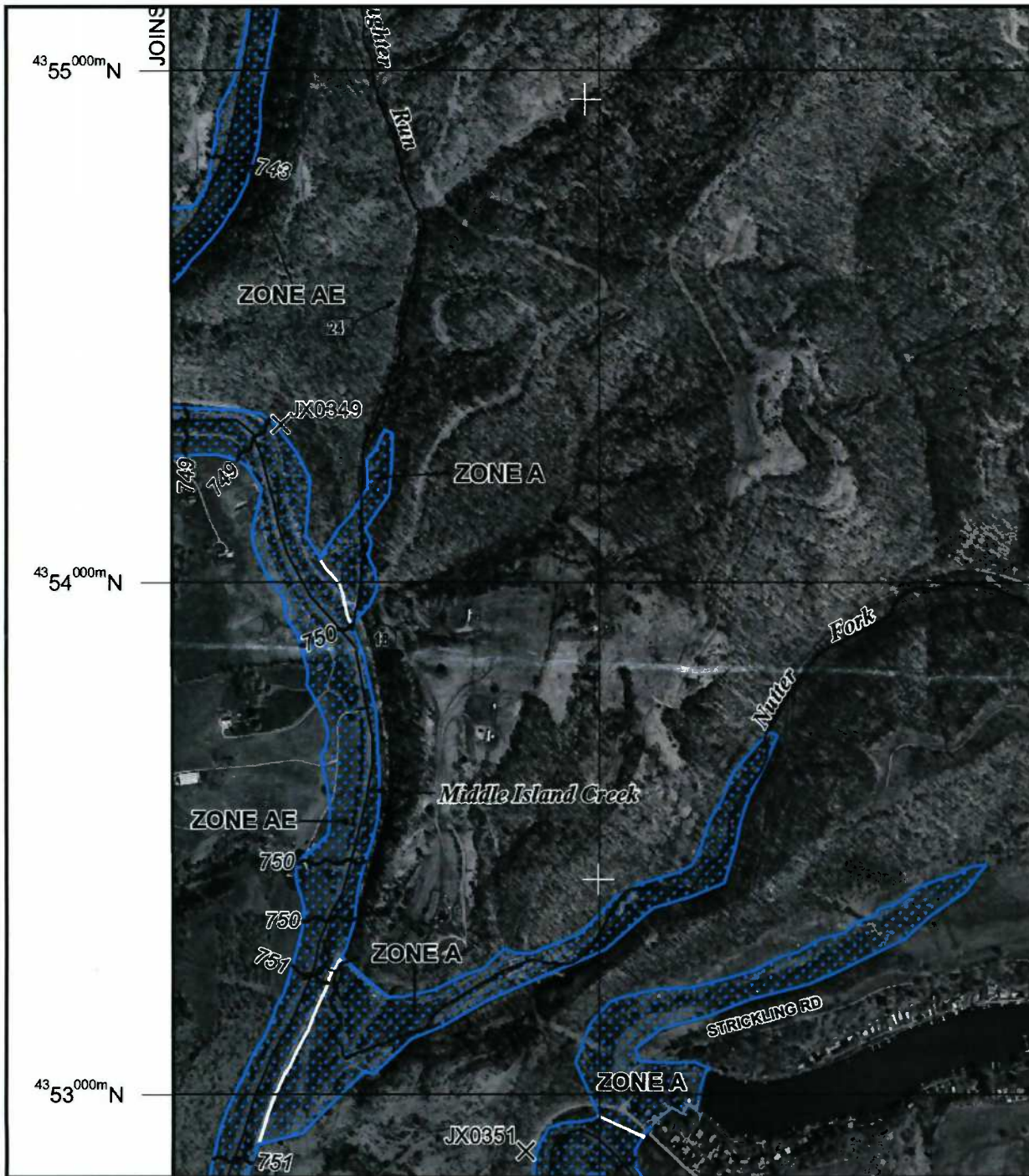
**Location (long, lat):** (80.808021 W, 39.334874 N)

**Location (UTM 17N):** (516545, 4353956)

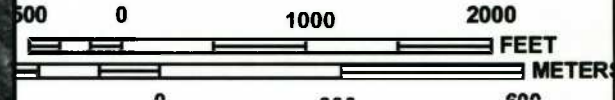
**Contacts:** Doddridge

**CRS Information:** N/A

**Parcel Number:**



MAP SCALE 1" = 1000'



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0110C

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

PANEL 110 OF 325  
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DODDRIDGE COUNTY	540024	0110	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**  
**54017C0110C**  
**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)