Geosyntec consultants

TID	SC_0816	**ACP Segment**	AP-1
Stream Name	Jackson River	**MP**	91.47
Survey Date	12-May-2016	**Start Time**	1105 hrs

- River has a riffle-pool morphology with signs of migrating head cuts.
- Pool depths were measured at 3.8 feet (below water surface) and deeper.
- Wide agricultural floodplain where left bank floodplain is more accessible than right floodplain due to higher terrace elevation on the right bank.
- Outside meander bend stream bank is vertical and being undercut by erosion.
- Eroded bank heights along right bank (outside bend of meander) vary from 4 to 5.4 feet.
- Banks comprised predominantly of silt/clay.
- Deciduous riparian buffer is less than one channel width on both banks.
- Channel bed material comprised of cobble and boulders.
- Bankfull channel width is 55 feet and bankfull depth is 3.2 feet.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Evaluate scour depth for pipeline burial depth. Lateral migration hazard is moderate as meander bends that are eroding continue to migrate. Therefore, sag bends should be placed at least two river widths from the top of the existing stream banks.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	12-May-16	Stream Name:	Jackson River
Crossing ID:	SC_0816		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

- [x] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Cattle grazing

Part 2: River Valley Conditions

Vegetation

- [ ] None
- [ ] Grass
- [ ] Pasture
- [ ] Crops
- [ ] Shrubs
- [x] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Valley Side Features

- [x] None
- [ ] Occasional
- [ ] Frequent

Failure Locations

- [ ] None
- [ ] Away from river
- [ ] Along river

Part 3: Floodplain

Floodplain Width

- [ ] None
- [ ] 1 < river widths
- [ ] 1-5 river widths
- [ ] 5-10 river widths
- [x] > 10 river widths

Land Use

- [ ] Natural
- [x] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Mining
- [ ] Cattle grazing

Vegetation

- [ ] None
- [x] Grass
- [x] Pasture
- [ ] Orchards
- [ ] Crops
- [ ] Shrubs
- [ ] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Riparian Buffer Strip

- [x] None
- [ ] < 1 river width
- [ ] 1-5 river widths
- [ ] > 5 river widths

Part 4: Vertical Confinement

Terraces

- [x] None
- [ ] Left bank
- [ ] Right bank

Levees

- [x] None
- [ ] Natural
- [ ] Constructed

Levee Location

- [ ] Along channel bank
- [ ] Set back < 1 river width
- [ ] Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

- [ ] Straight
- [x] Meandering
- [ ] Braided
- [ ] Anastomosed
- [ ] Engineered

Meander Characteristics

- [x] Mild bends
- [ ] Moderate bends
- [ ] Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

- [x] None
- [ ] Occasional
- [ ] Frequent
- [ ] Confined

Control Types

- [x] None
- [ ] Bedrock
- [ ] Boulders

Width Controls

- [x] None
- [ ] Occasional
- [ ] Frequent
- [ ] Confined

Control Types

- [x] None
- [ ] Bedrock
- [ ] Boulders

Other

- [ ] Debris
- [ ] Mining
- [ ] Reservoir
- [ ] Knickpoint

Flow Habit

- [x] Perennial
- [ ] Flashy perennial
- [ ] Intermittent
- [ ] Ephemeral

Channel Width: 55'

M-B Classification

- [ ] Cascade or step-pool
- [x] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material

- [ ] Clay
- [ ] Silt
- [ ] Sand
- [ ] Gravel
- [x] Cobbles
- [ ] Boulders
- [ ] Bedrock

Bar Types

- [x] None
- [ ] Alternate bars
- [ ] Point bars
- [ ] Mid-channel bars
- [ ] Diagonal bars
- [ ] Irregular/combination
- [ ] Braided

Bar Material

- [ ] Silt
- [ ] Sand
- [ ] Gravel
- [ ] Cobbles

Bar Vegetation

- [ ] None
- [ ] Grasses
- [ ] Reeds/shrubs
- [ ] Trees

Bar Width

- [ ] None
- [ ] Narrow
- [ ] Moderate
- [ ] Wide

Percent sand in bed = _____ %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	*Left Bank*	*Right Bank*
Bank Material	[x] Clay [x] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock	[x] Clay [x] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[ ] No layers [x] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[ ] No layers [x] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	5.4'	1.5'
Bank Slope	[x] Steep [ ] Moderate [ ] Shallow	[ ] Steep [x] Moderate [ ] Shallow
Bank Vegetation	[ ] None [x] Grasses/annuals [x] Reeds/shrubs [ ] Trees: Falling trees? [ ] Y [x] N Tree density [ ] sparse [ ] dense Tree health [ ] good [ ] poor tree ages [ ] young [ ] mature [ ] old tree diversity [ ] Y [ ] N	[ ] None [x] Grasses/annuals [x] Reeds/shrubs [ ] Trees: Falling trees? [ ] Y [x] N Tree density [ ] sparse [ ] dense Tree health [ ] good [ ] poor tree ages [ ] young [ ] mature [ ] old tree diversity [ ] Y [ ] N
Bank Erosion and Failure Location	location of erosion [x] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [ ] general type of erosion [x] fluvial [ ] geotechnical	location of erosion [x] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [ ] general type of erosion [x] fluvial [ ] geotechnical

PHASE 2 – RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0816, Jackson River at MP 91.47 (AP-1)

Photograph 1	
Date: 12 May 2016	
Direction: looking downstream	
Description: Wide, accessible floodplain off left bank entering very wide agricultural valley.	

PHASE 2 – RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0816, Jackson River at MP 91.47 (AP-1)

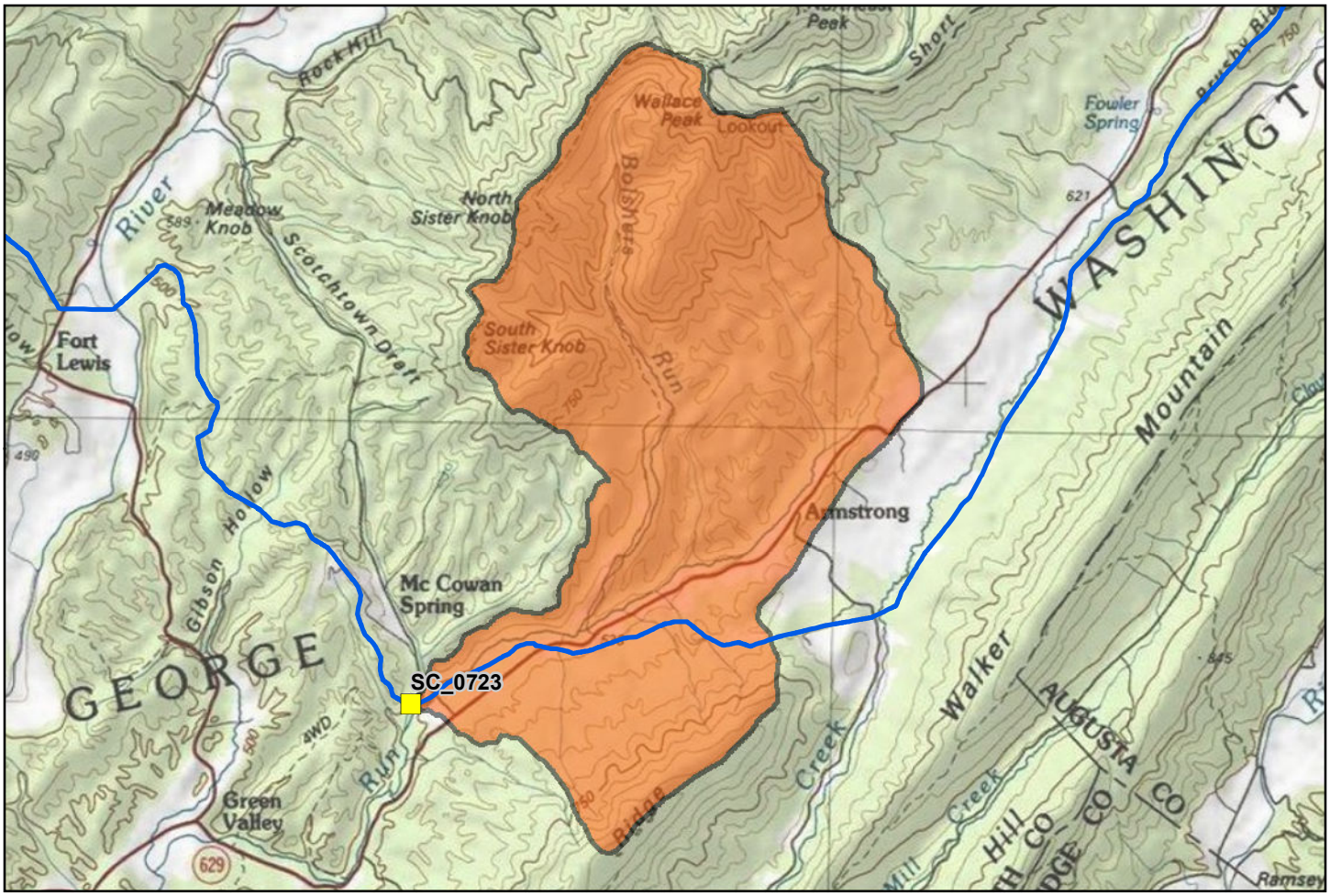
Photograph 2	
Date: 12 May 2016	
Direction: looking downstream	
Description: Steep erodible banks on right bank with little to no riparian buffer.	

PHASE 2 – RAPID STREAM RECONNAISSANCE
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0816, Jackson River at MP 91.47 (AP-1)

Photograph 3	
Date: 12 May 2016	
Direction: looking upstream	
Description: Riffle section with head cut and deep pool at lower end.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0723	sbaa001	AP-1	100.68	Virginia	Bath

Attribute	Value
Stream Name	Stuart Run
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	10.703
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	37.5
Slope At Crossing Over 200ft Long Reach (%)[4]	1.606
Proposed Construction Method[5]	1) Dam and Pump 2) Flume

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:100,000

0 2,250 4,500 9,000 Feet

0 2 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0723

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

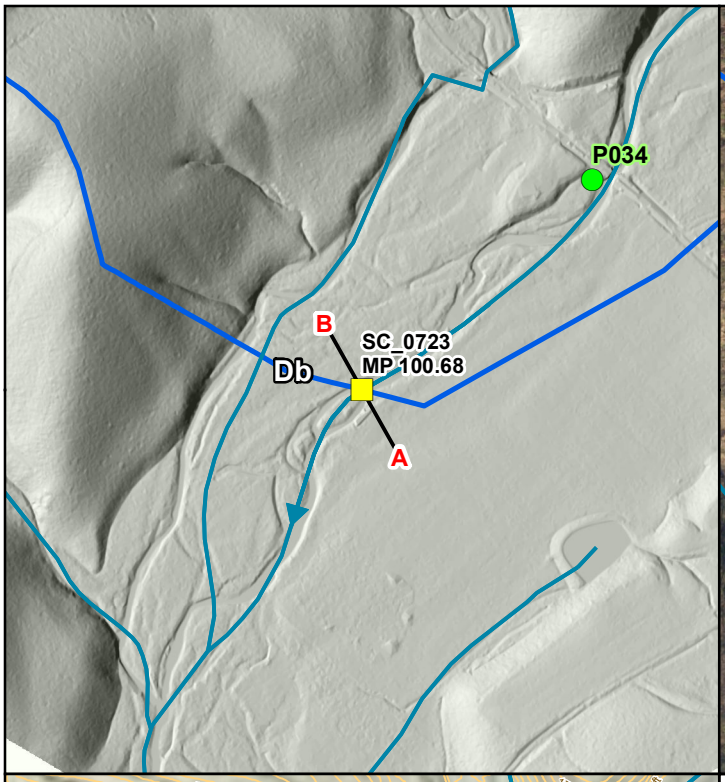
Notes:

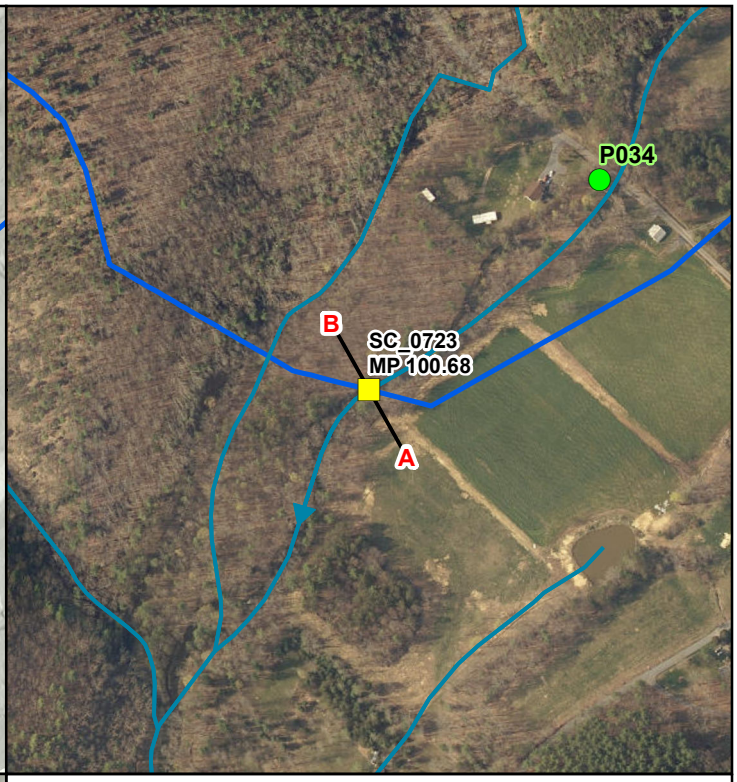
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

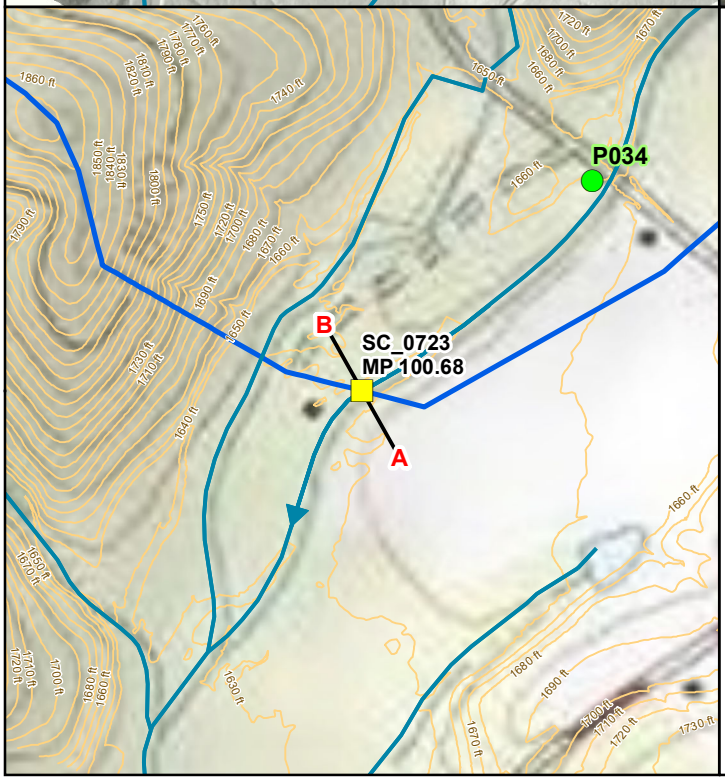
Dominion

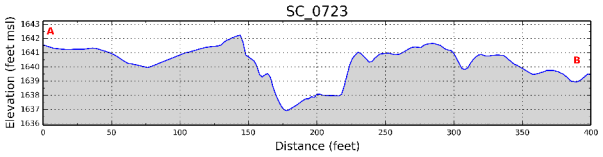
Geosyntec consultants

TESSELATIONS









Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: sbaa001

TID_SC: SC_0723

Stream Name: Stuart Run

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0723

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELATIONS

Geosyntec consultants

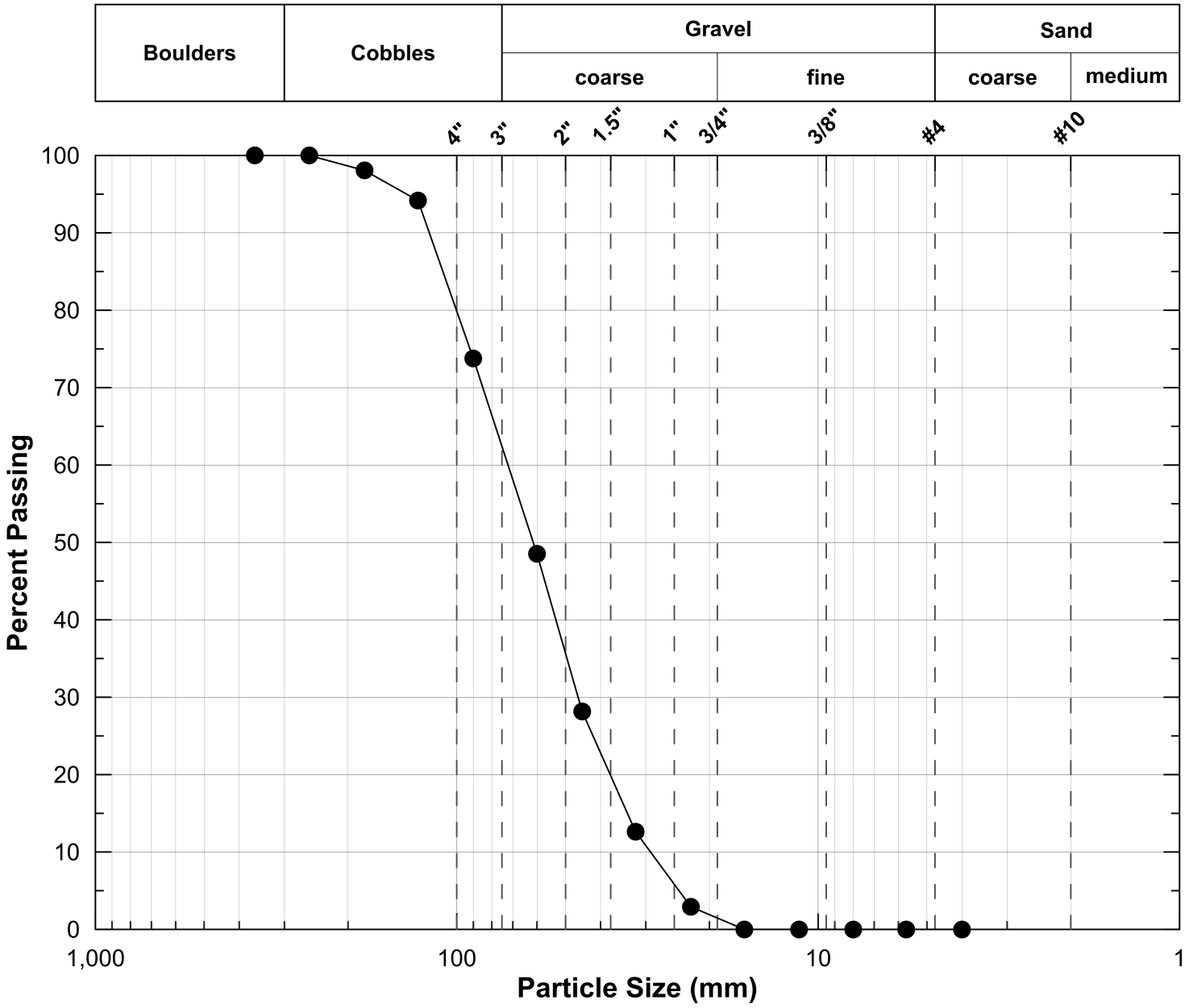
TID	SC_0723	**ACP Segment**	AP-1
Stream Name	Stuart Run	**MP**	100.68
Survey Date	30-September-2016	**Start Time**	0830 hrs

- Riffle-pool morphology.
- Survey conducted under bankfull conditions.
- BFW = 37.5-ft
- Shallow to moderate banks at crossing location with well-connected floodplains, bank heights approximately 2-ft.
- Left floodplain is agricultural and maintained, right floodplain contains natural levee and additional channels towards valley wall along which White Sulphur Spring Branch (SC_0635) is flowing.
- Instability via head cuts (0.5 to 2-ft high) above and below crossing location, which is in relatively straight riffle section but crosses at on oblique angle.
- Eroded banks heights near head cuts of 4-ft
- Gravel bed with cobbles. Wolman Pebble count conducted. D_{50} = 61 mm.
- Banks composed of silty-clay with some sand.
- Although some trees present, no distinctly established riparian buffer off left bank, right bank riparian >5 channel widths

Recommendation:

Evaluate scour depth for pipeline burial depth. Conduct lateral migration evaluation to set location of sag bend on left bank. Bury pipeline throughout floodplain on right bank and up to White Sulphur Spring Branch (SC_0635).

Wolman Pebble Count at SC_0723



Geosyntec consultants

engineers | scientists | innovators

Wolman Pebble Count

Phase 2 Hydrotechnical Characterization Program
Virginia and West Virginia
Atlantic Coast Pipeline
February 2017 Dominion Transmission Inc.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	8-Apr-16	Stream Name:	Stuart Run
Crossing ID:	SC_0723		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

X	Natural
	Agricultural
	Urban
	Suburban
	Rural
	Industrial
X	Cattle grazing

Part 2: River Valley Conditions

Vegetation

	None
X	Grass
X	Pasture
	Crops
	Shrubs
X	Deciduous Forest/trees
	Coniferous Forest/trees

Valley Side Features

	None
X	Occasional
	Frequent

Failure Locations

	None
	Away from river
	Along river

Part 3: Floodplain

Floodplain Width

	None
	1 < river widths
	1-5 river widths
X	5-10 river widths
	> 10 river widths

Land Use

X	Natural
	Agricultural
	Urban
	Suburban
	Rural
	Industrial
	Mining
X	Cattle grazing

Vegetation

	None
X	Grass
X	Pasture
	Orchards
	Crops
	Shrubs
X	Deciduous Forest/trees
	Coniferous Forest/trees

Riparian Buffer Strip

	None
	< 1 river width
X	1-5 river widths
	> 5 river widths

Part 4: Vertical Confinement

Terraces

	None
	Left bank
X	Right bank

Levees

X	None
	Natural
	Constructed

Levee Location

	Along channel bank
	Set back < 1 river width
	Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

	Straight
X	Meandering
	Braided
	Anastomosed
	Engineered

Meander Characteristics

X	Mild bends
	Moderate bends
	Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

	None
X	Occasional
	Frequent
	Confined

Control Types

	None
X	Bedrock
X	Boulders

Width Controls

	None
	Occasional
	Frequent
	Confined

Control Types

	None
	Bedrock
	Boulders

Other

	Debris
	Mining
	Reservoir
	Knickpoint

Flow Habit

- [X] Perennial
- [ ] Flashy perennial
- [ ] Intermittent
- [ ] Ephemeral

Channel Width: 37.5

M-B Classification

- [ ] Cascade or step-pool
- [X] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material

- [ ] Clay
- [ ] Silt
- [ ] Sand
- [ ] Gravel
- [X] Cobbles
- [ ] Boulders
- [X] Bedrock

Bar Types

- [X] None
- [ ] Alternate bars
- [ ] Point bars
- [ ] Mid-channel bars
- [ ] Diagonal bars
- [ ] Irregular/combination
- [ ] Braided

Bar Material

- [ ] Silt
- [ ] Sand
- [ ] Gravel
- [ ] Cobbles

Bar Vegetation

- [ ] None
- [ ] Grasses
- [ ] Reeds/shrubs
- [ ] Trees

Bar Width

- [ ] None
- [ ] Narrow
- [ ] Moderate
- [ ] Wide

Percent sand in bed = < 5 %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	***Left Bank***	***Right Bank***
Bank Material	[X] Clay [X] Silt [X] Gravel [X] Cobbles [ ] Boulders [ ] Bedrock	[X] Clay [X] Silt [X] Gravel [X] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	~2-3'	~2-3"
Bank Slope	[ ] Steep [ ] Moderate [X] Shallow	[ ] Steep [ ] Moderate [X] Shallow
Bank Vegetation	[ ] None [X] Grasses/annuals [X] Reeds/shrubs [X] Trees: Falling trees? [ ] Y [X] N Tree density [X] sparse [ ] dense Tree health [X] good [ ] poor tree ages [X] young [X] mature [ ] old tree diversity [ ] Y [X] N	[ ] None [ ] Grasses/annuals [X] Reeds/shrubs [X] Trees: Falling trees? [ ] Y [X] N Tree density [X] sparse [ ] dense Tree health [X] good [ ] poor tree ages [X] young [X] mature [ ] old tree diversity [ ] Y [X] N
Bank Erosion and Failure Location	location of erosion [X] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [ ] general type of erosion [X] fluvial [ ] geotechnical	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical

GEOSYNTEC CONSULTANTS

Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0723, Stuart Run at MP 100.68 (AP-1)

Photograph 1 (IMG_4322.jpg)	
Date: 30 September 2016	
Direction: looking upstream	
Description: shallow banks with well-connected floodplain at crossing location. Crossing at relatively straight riffle section with 0.5-ft and 1.5-ft high head cuts up and downstream, respectively.	

GEOSYNTEC CONSULTANTS

Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0723, Stuart Run at MP 100.68 (AP-1)

Photograph 2 (IMG_4310.jpg)	
Date: 30 September 2016	
Direction: looking downstream	
Description: steeper, eroded banks near observed head cuts, downstream of crossing. Mid channel bar visible with 1.5-ft high head cuts on both sides of bar.	

GEOSYNTEC CONSULTANTS

Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0723, Stuart Run at MP 100.68 (AP-1)

Photograph 3
(IMG_4314.jpg)

Date: 30 September 2016

Direction: looking upstream

Description: steeper banks near head cuts and significant undercutting of left bank upstream of crossing. Mature tree growth indicates relatively slow rate of erosion.

GEOSYNTEC CONSULTANTS

Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0723, Stuart Run at MP 100.68 (AP-1)

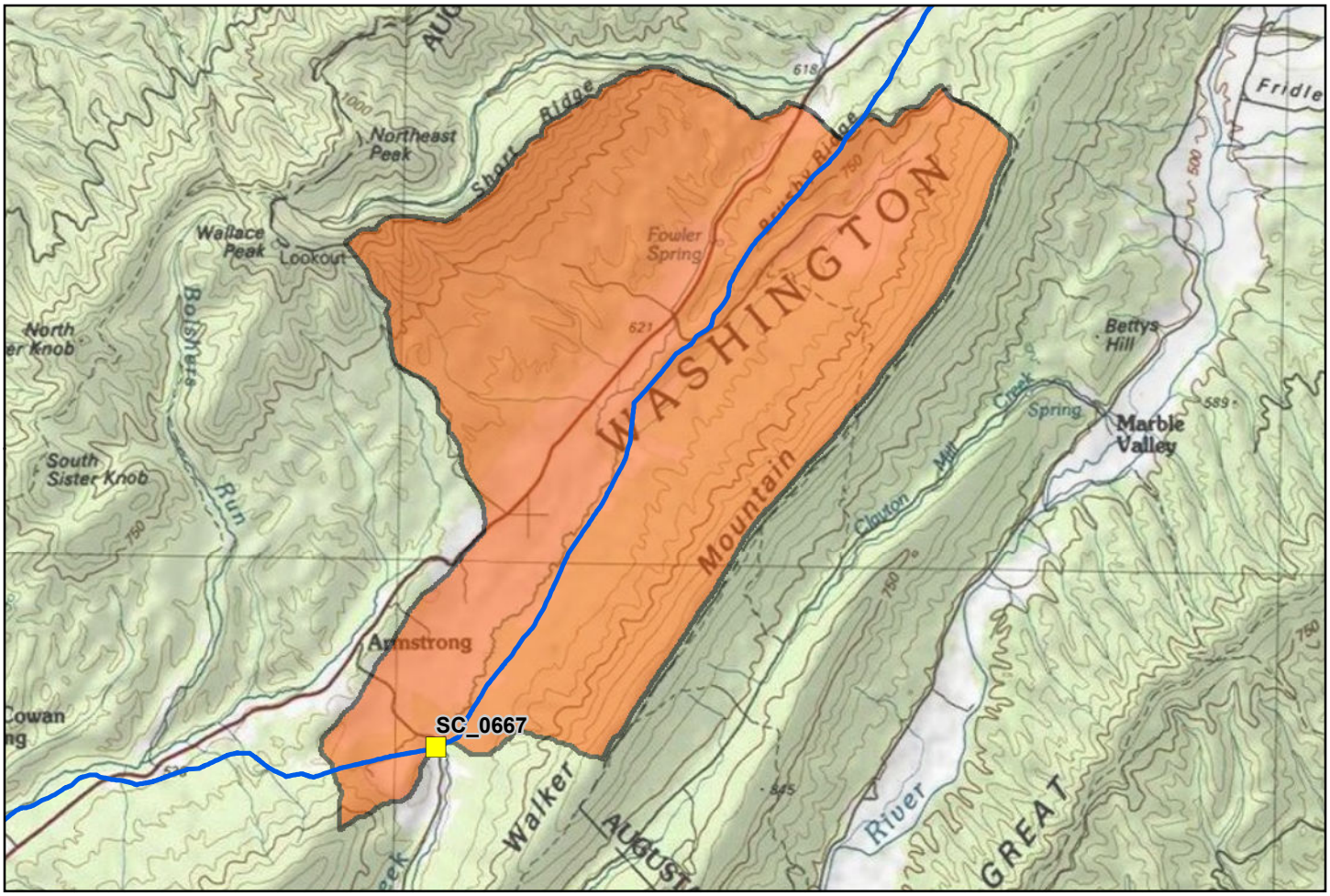
Photograph 4 (IMG_4318.jpg)	
Date: 30 September 2016	
Direction: looking upstream	
Description: transverse bar with head cuts upstream of crossing. Floodplain remains accessible, predominantly off right bank where it shares the floodplain with White Sulphur Spring Branch (SC_0635).	

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0635 (White Sulphur Spring Branch at MP AP-1 100.64)

Photograph 1 (IMG_1622.jpg) Date: 30 September 2016 Direction: Upstream Description: View of stream following precipitation. Left bank is connected to floodplain of Stuarts Run (SC_0723). Right bank is confined.	
Photograph 2 (IMG_1623.jpg) Date: 30 September 2016 Direction: Towards right bank Description: Bedrock outcropping on right bank.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0667	sbar008	AP-1	103.09	Virginia	Bath

Attribute	Value
Stream Name	Mill Creek
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	13.222
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	16.3
Slope At Crossing Over 200ft Long Reach (%)[4]	0.412
Proposed Construction Method[5]	1) Dam and Pump 2) Flume

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:100,000

0 2,250 4,500 9,000 Feet

0 2 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0667

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

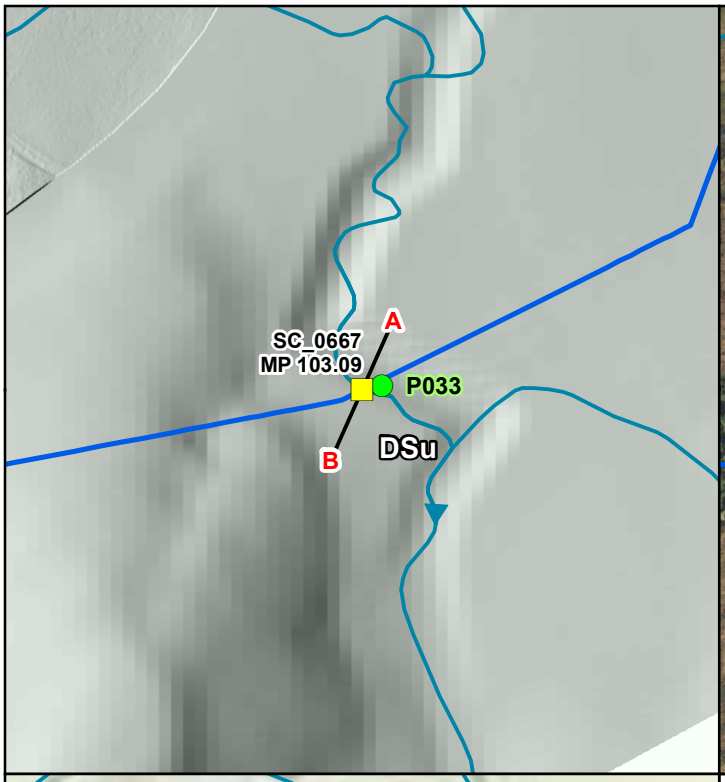
Notes:

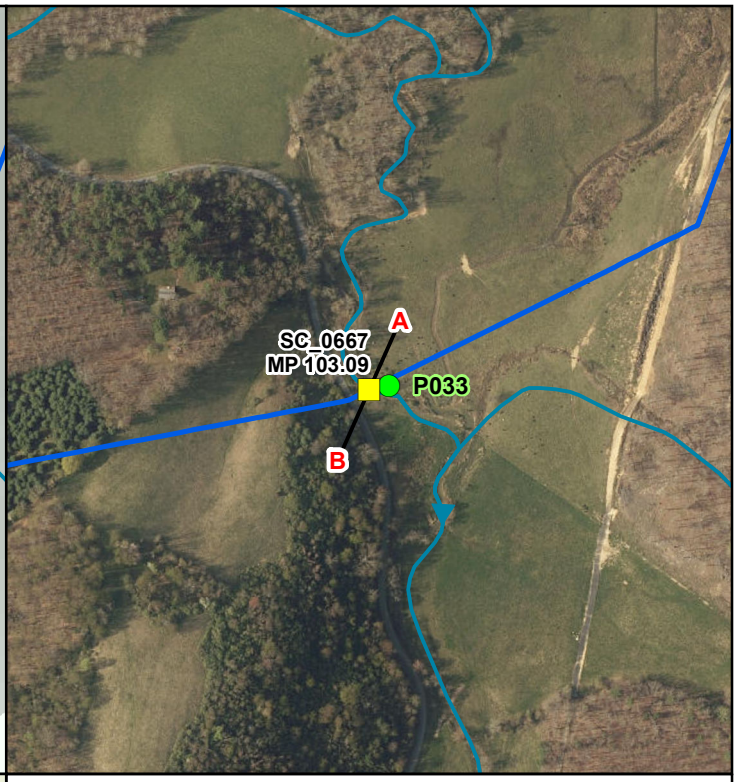
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

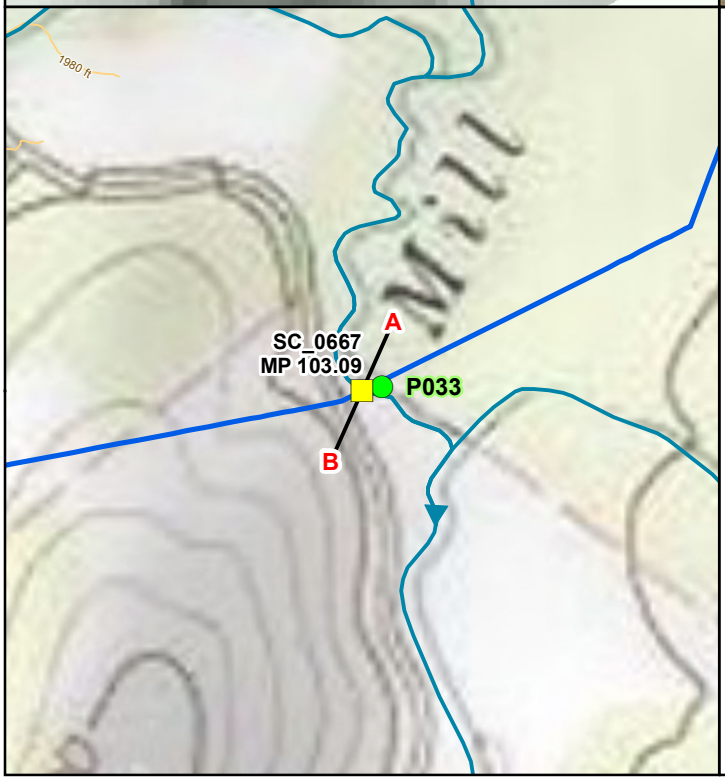
Dominion

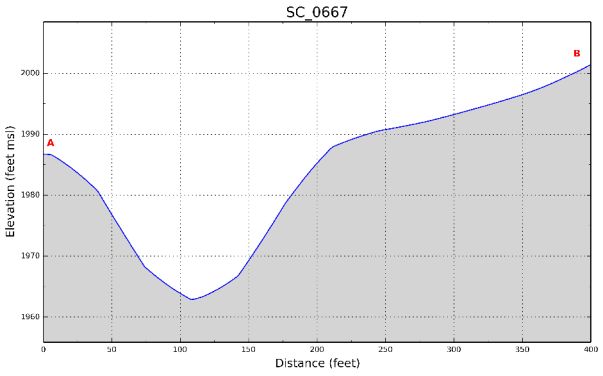
Geosyntec consultants

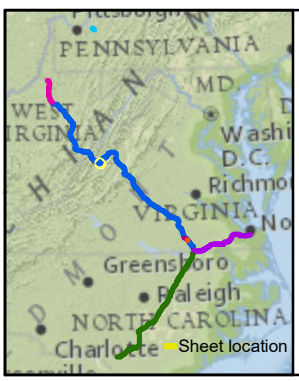
TESSELLATIONS











Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: sbar008

TID_SC: SC_0667

Stream Name: Mill Creek

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0667

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELATIONS

TID	SC_0667	**ACP Segment**	AP-1
Stream Name	Mill Creek	**MP**	103.09
Survey Date	08-April-2016	**Start Time**	1535 hrs

- Stream surveyed at 38.100984N 79.510875W approximately along 2016.04.25_Rev10_Update_Geosyntec route.
- Meandering stream channel with relatively low slope, algae growth on rocks.
- Bankfull channel width is 16.3 feet and bankfull depth is 1.6 feet.
- Stream is located in wide (greater than 400 feet) floodplain utilized as a pasture for cattle grazing.
- Essentially no forested riparian buffer on banks/floodplain.
- Streambanks comprised of silt/clay with top of bank heights in vicinity of crossing up to 6.75 feet on right bank and 2.5 feet on left bank.
- Stream bed comprised of silt, gravel, and cobble-sized particles.
- Pool depths on outside bends approximately 2.5-3 feet (below water surface).
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Stream crossing no longer being crossed by pipeline alignment. However, for the nearby proposed new stream crossings, it is recommended based on the geomorphic attributes of Mill Creek to evaluate scour depth for pipeline burial depth as well as quantifying lateral and vertical instability at the crossing.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	8-Apr-16	Stream Name:	Mill Creek
Crossing ID:	SC_0667		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

	Natural
	Agricultural
	Urban
	Suburban
	Rural
	Industrial
X	Cattle grazing

Part 2: River Valley Conditions

Vegetation

	None
X	Grass
	Pasture
	Crops
	Shrubs
X	Deciduous Forest/trees
	Coniferous Forest/trees

Valley Side Features

	None
X	Occasional
	Frequent

Failure Locations

X	None
	Away from river
	Along river

Part 3: Floodplain

Floodplain Width

	None
	1 < river widths
	1-5 river widths
	5-10 river widths
X	> 10 river widths

Land Use

	Natural
	Agricultural
	Urban
	Suburban
	Rural
	Industrial
	Mining
X	Cattle grazing

Vegetation

	None
X	Grass
	Pasture
	Orchards
	Crops
X	Shrubs
X	Deciduous Forest/trees
	Coniferous Forest/trees

Riparian Buffer Strip

X	None
	< 1 river width
	1-5 river widths
	> 5 river widths

Part 4: Vertical Confinement

Terraces

	None
X	Left bank
X	Right bank

Levees

X	None
	Natural
	Constructed

Levee Location

	Along channel bank
	Set back < 1 river width
	Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

	Straight
X	Meandering
	Braided
	Anastomosed
	Engineered

Meander Characteristics

	Mild bends
	Moderate bends
X	Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

X	None
	Occasional
	Frequent
	Confined

Control Types

X	None
	Bedrock
	Boulders

Width Controls

X	None
	Occasional
	Frequent
	Confined

Control Types

X	None
	Bedrock
	Boulders

Other

	Debris
	Mining
	Reservoir
	Knickpoint

Flow Habit

- [X] Perennial
- [ ] Flashy perennial
- [ ] Intermittent
- [ ] Ephemeral

Channel Width: 16.3

M-B Classification

- [ ] Cascade or step-pool
- [X] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material	*Bar Types*	*Bar Material*	*Bar Vegetation*	*Bar Width*
[ ] Clay	[ ] None	[X] Silt	[ ] None	[ ] None
[X] Silt	[ ] Alternate bars	[ ] Sand	[X] Grasses	[ ] Narrow
[ ] Sand	[ ] Point bars	[ ] Gravel	[ ] Reeds/shrubs	[X] Moderate
[X] Gravel	[X] Mid-channel bars	[ ] Cobbles	[ ] Trees	[ ] Wide
[X] Cobbles	[ ] Diagonal bars			
[ ] Boulders	[ ] Irregular/combination			
[ ] Bedrock	[ ] Braided			

Percent sand in bed = _____ %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	*Left Bank*	*Right Bank*
Bank Material	[X] Clay [X] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock	[X] Clay [X] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[ ] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[ ] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	----	----
Bank Slope	[ ] Steep [X] Moderate [ ] Shallow	[X] Steep [ ] Moderate [ ] Shallow
Bank Vegetation	[ ] None [X] Grasses/annuals [X] Reeds/shrubs [ ] Trees: NO Falling trees? [ ] Y [ ] N Tree density [ ] sparse [ ] dense Tree health [ ] good [ ] poor tree ages [ ] young [ ] mature [ ] old tree diversity [ ] Y [ ] N	[ ] None [X] Grasses/annuals [ ] Reeds/shrubs [ ] Trees: NO Falling trees? [ ] Y [ ] N Tree density [ ] sparse [ ] dense Tree health [ ] good [ ] poor tree ages [ ] young [ ] mature [ ] old tree diversity [ ] Y [ ] N
Bank Erosion and Failure Location	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0667, Mill Creek at MP 103.09 (AP-1)

Photograph 1 (100.jpg)	
Date: 08-April-2016	
Direction: Downstream	
Description: View of stream from right bank showing lack of riparian buffer and wide floodplain	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0667, Mill Creek at MP 103.09 (AP-1)

Photograph 2 (110.jpg)	
Date: 08-April-2016	
Direction: Upstream	
Description: View of steep banks comprising primarily fine grained soils	

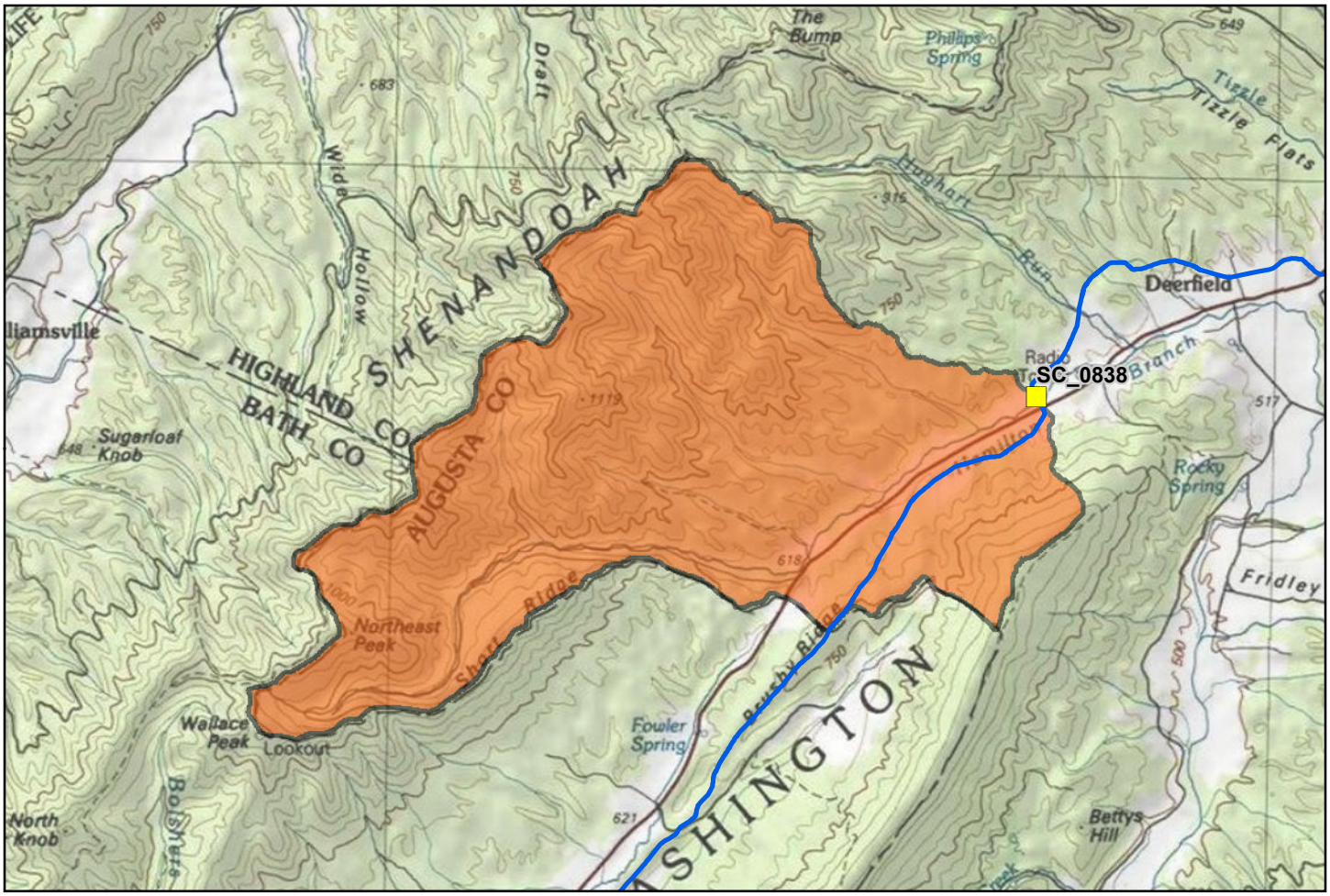
PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0667, Mill Creek at MP 103.09 (AP-1)

Photograph 3 (105.jpg)	
Date: 08-April-2016	
Direction: Panoramic	
Description: Wide view of stream and floodplain showing sinuosity of stream	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0838	sauf003	AP-1	108.32	Virginia	Augusta

Attribute	Value
Stream Name	Hamilton Branch
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	11.013
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	35
Slope At Crossing Over 200ft Long Reach (%)[4]	1.500
Proposed Construction Method[5]	1) Dam and Pump 2) Flume

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:100,000

0 2,250 4,500 9,000 Feet

0 2 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0838

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

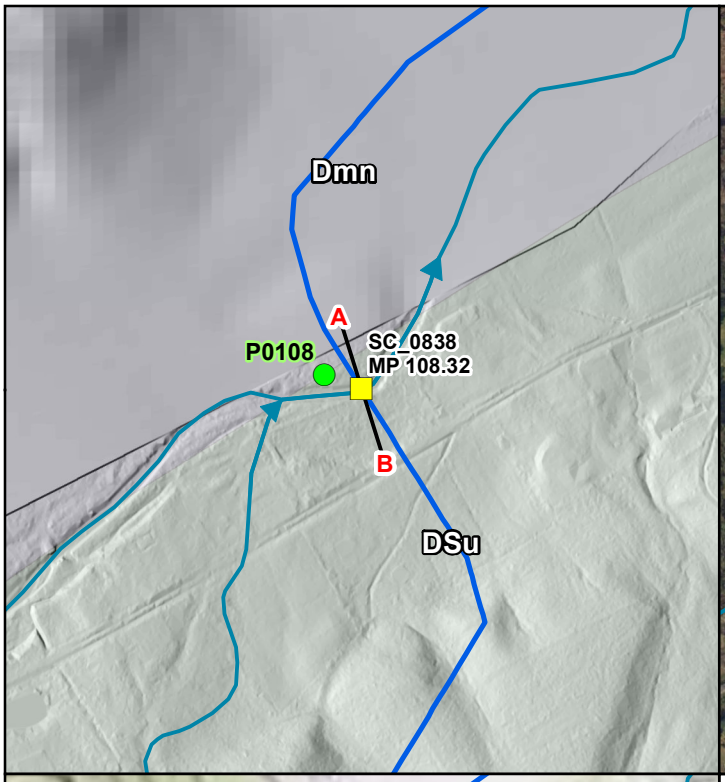
Notes:

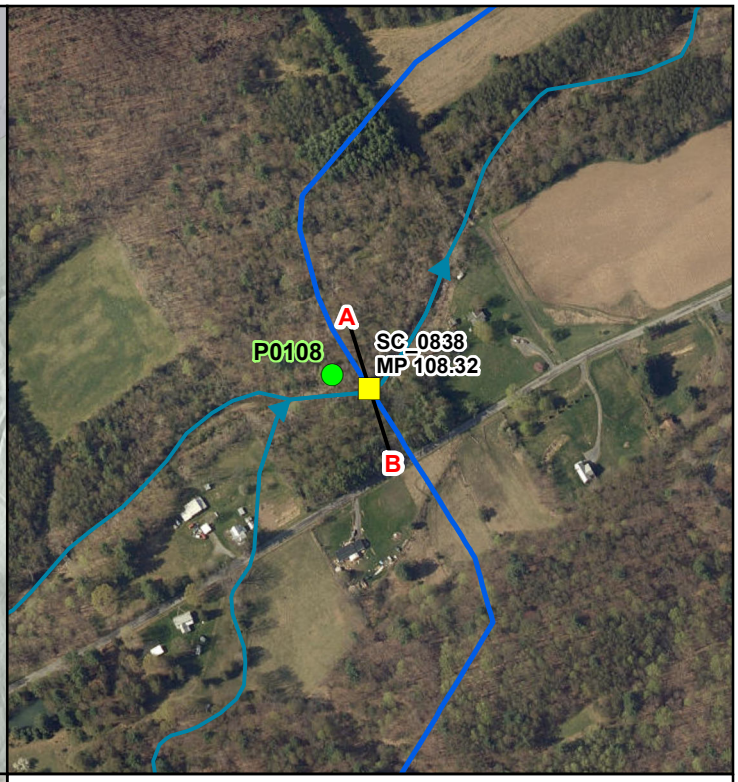
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

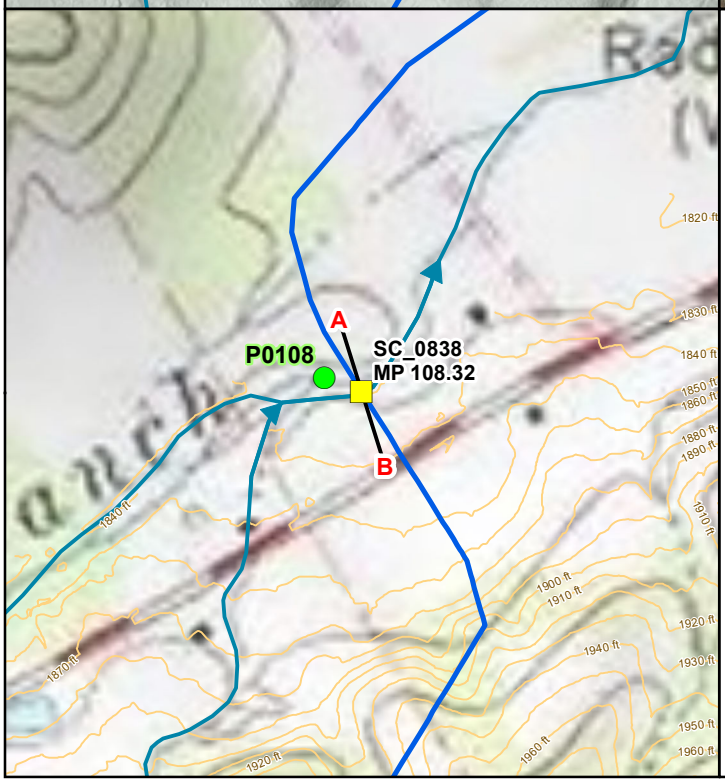
Dominion

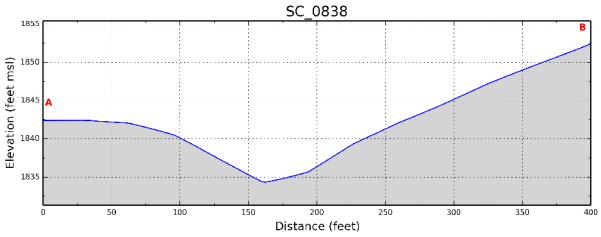
Geosyntec consultants

TESSELLATIONS









Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: sauf003

TID_SC: SC_0838

Stream Name: Hamilton Branch

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0838

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELLATIONS

Geosyntec consultants

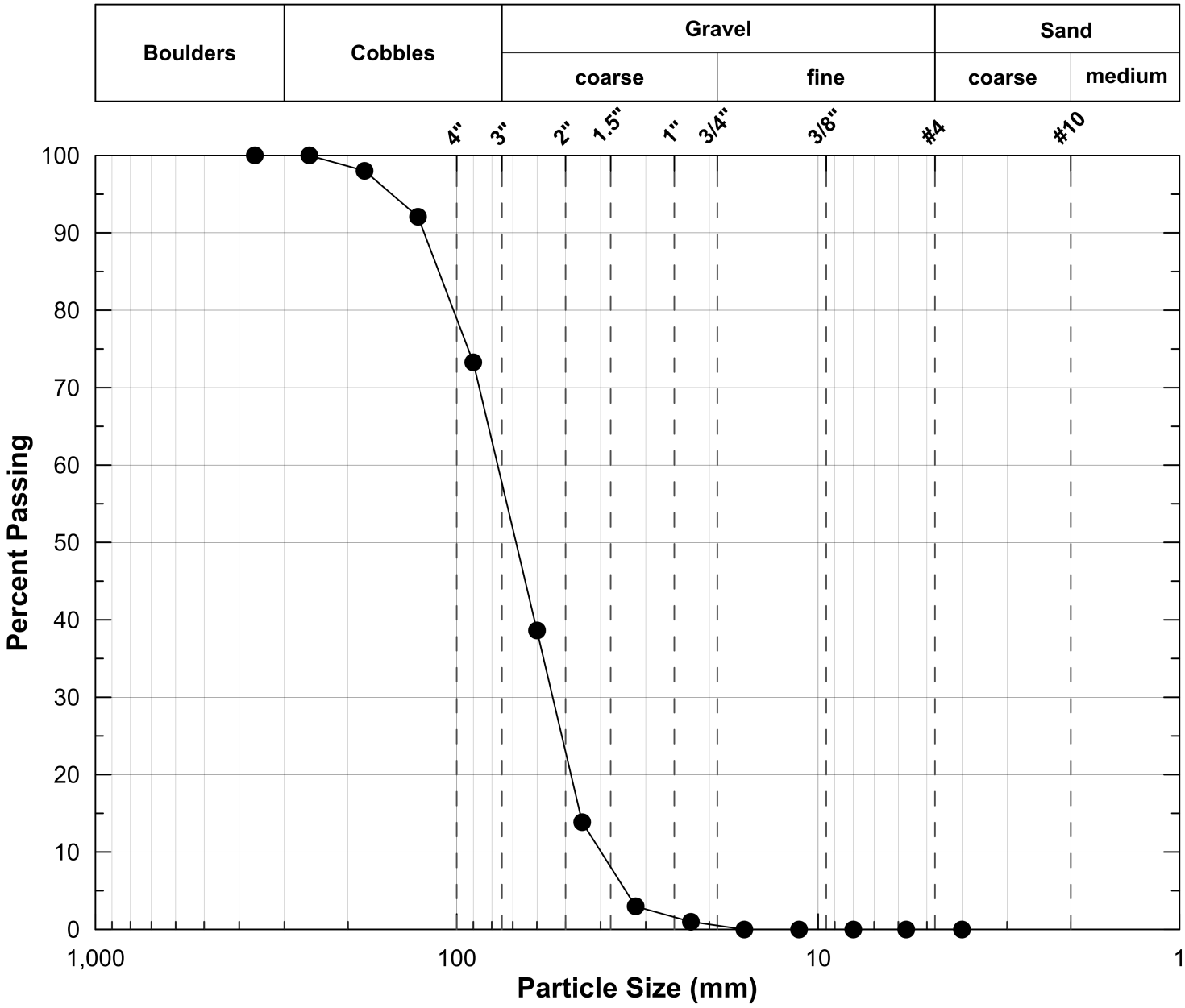
TID	SC_0838	**ACP Segment**	AP-1
Stream Name	Hamilton Branch	**MP**	108.32
Survey Date	29-September-2016	**Start Time**	1525 hrs

- Riffle-pool morphology.
- Bank protection rip-rap present on right bank downstream, near crossing.
- BFW = 35 ft.
- Left bank height is 3.6 ft and right bank height is 5.4 ft.
- Channel bed composed of rounded cobbles with gravels and some boulders. Wolman Pebble count conducted. D_{50} = 68 mm. D_{50} drops to < 0.5 in below cobble armor layer.
- Banks composed of fines matrix with gravels and rounded cobbles.
- Established deciduous riparian buffer > 5 channel widths off both banks.
- Moderate channel gradient at reach. Measured 1.5% slope with autolevel.
- Some meandering within defined channel at low flows.

Recommendation:

Evaluate scour depth for pipeline burial depth. Conduct lateral migration evaluation to set location of sag bends.

Wolman Pebble Count at SC_0838



Geosyntec consultants

engineers | scientists | innovators

Wolman Pebble Count

Phase 2 Hydrotechnical Characterization Program
Virginia and West Virginia
Atlantic Coast Pipeline
February 2017 Dominion Transmission Inc.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	29-Sep-16	Stream Name:	Hamilton Branch
Crossing ID:	SC_0838		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

- [X] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Cattle grazing

Part 2: River Valley Conditions

Vegetation

- [ ] None
- [ ] Grass
- [ ] Pasture
- [ ] Crops
- [ ] Shrubs
- [X] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Valley Side Features

- [X] None
- [ ] Occasional
- [ ] Frequent

Failure Locations

- [ ] None
- [ ] Away from river
- [ ] Along river

Part 3: Floodplain

Floodplain Width

- [ ] None
- [ ] 1 < river widths
- [X] 1-5 river widths
- [ ] 5-10 river widths
- [ ] > 10 river widths

Land Use

- [X] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Mining
- [X] Cattle grazing

Vegetation

- [ ] None
- [ ] Grass
- [X] Pasture
- [ ] Orchards
- [ ] Crops
- [ ] Shrubs
- [X] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Riparian Buffer Strip

- [ ] None
- [ ] < 1 river width
- [X] 1-5 river widths
- [ ] > 5 river widths

Part 4: Vertical Confinement

Terraces

- [X] None
- [ ] Left bank
- [ ] Right bank

Levees

- [X] None
- [ ] Natural
- [ ] Constructed

Levee Location

- [ ] Along channel bank
- [ ] Set back < 1 river width
- [ ] Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

- [ ] Straight
- [X] Meandering
- [ ] Braided
- [ ] Anastomosed
- [ ] Engineered

Meander Characteristics

- [X] Mild bends
- [ ] Moderate bends
- [ ] Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

- [ ] None
- [ ] Occasional
- [X] Frequent
- [ ] Confined

Control Types

- [ ] None
- [ ] Bedrock
- [X] Boulders
- [X] Gravel Armor

Width Controls

- [X] None
- [ ] Occasional
- [ ] Frequent
- [ ] Confined

Control Types

- [ ] None
- [ ] Bedrock
- [ ] Boulders

Other

- [ ] Debris
- [ ] Mining
- [ ] Reservoir
- [ ] Knickpoint

Flow Habit

- [X] Perennial
- [ ] Flashy perennial
- [ ] Intermittent
- [ ] Ephemeral

Channel Width: 35'

M-B Classification

- [ ] Cascade or step-pool
- [X] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material	***Bar Types***	***Bar Material***	***Bar Vegetation***	***Bar Width***
[ ] Clay	[X] None	[ ] Silt	[ ] None	[ ] None
[ ] Silt	[ ] Alternate bars	[ ] Sand	[ ] Grasses	[ ] Narrow
[ ] Sand	[ ] Point bars	[ ] Gravel	[ ] Reeds/shrubs	[ ] Moderate
[X] Gravel	[ ] Mid-channel bars	[ ] Cobbles	[ ] Trees	[ ] Wide
[X] Cobbles	[ ] Diagonal bars			
[ ] Boulders	[ ] Irregular/combination			
[ ] Bedrock	[ ] Braided			

Percent sand in bed = 0 %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	***Left Bank***	***Right Bank***
Bank Material	[X] Clay [X] Silt [X] Gravel [X] Cobbles [ ] Boulders [ ] Bedrock	[X] Clay [X] Silt [X] Gravel [X] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	3.6	5.4
Bank Slope	[ ] Steep [X] Moderate [ ] Shallow	[ ] Steep [X] Moderate [ ] Shallow
Bank Vegetation	[ ] None [ ] Grasses/annuals [X] Reeds/shrubs [X] Trees: Falling trees? [ ] Y [X] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [X] young [X] mature [ ] old tree diversity [X] Y [ ] N	[ ] None [ ] Grasses/annuals [X] Reeds/shrubs [X] Trees: Falling trees? [ ] Y [X] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [X] young [X] mature [ ] old tree diversity [X] Y [ ] N
Bank Erosion and Failure Location	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical

GEOSYNTEC CONSULTANTS

Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

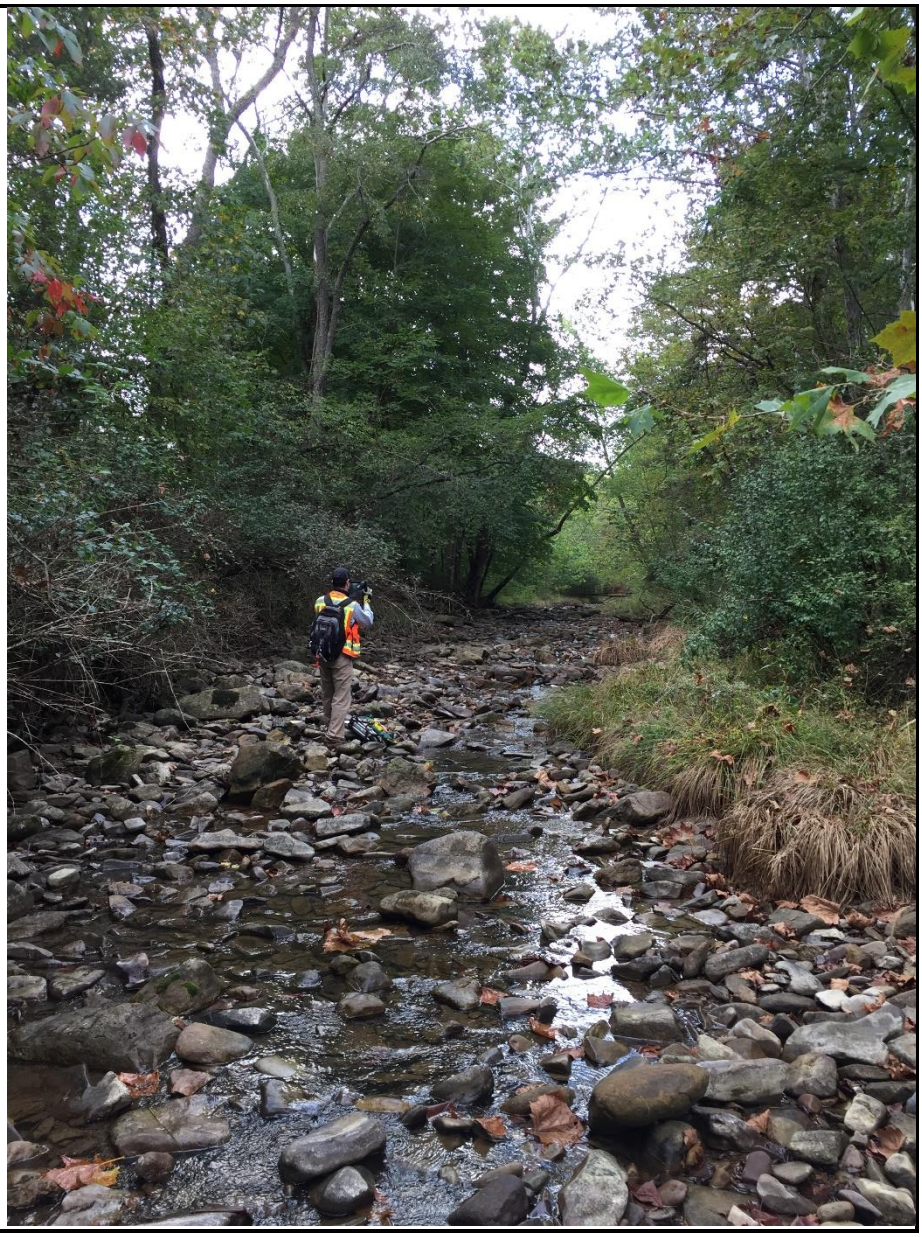
Subject Site: SC_0838, Hamilton Branch at MP 108.32 (AP-1)

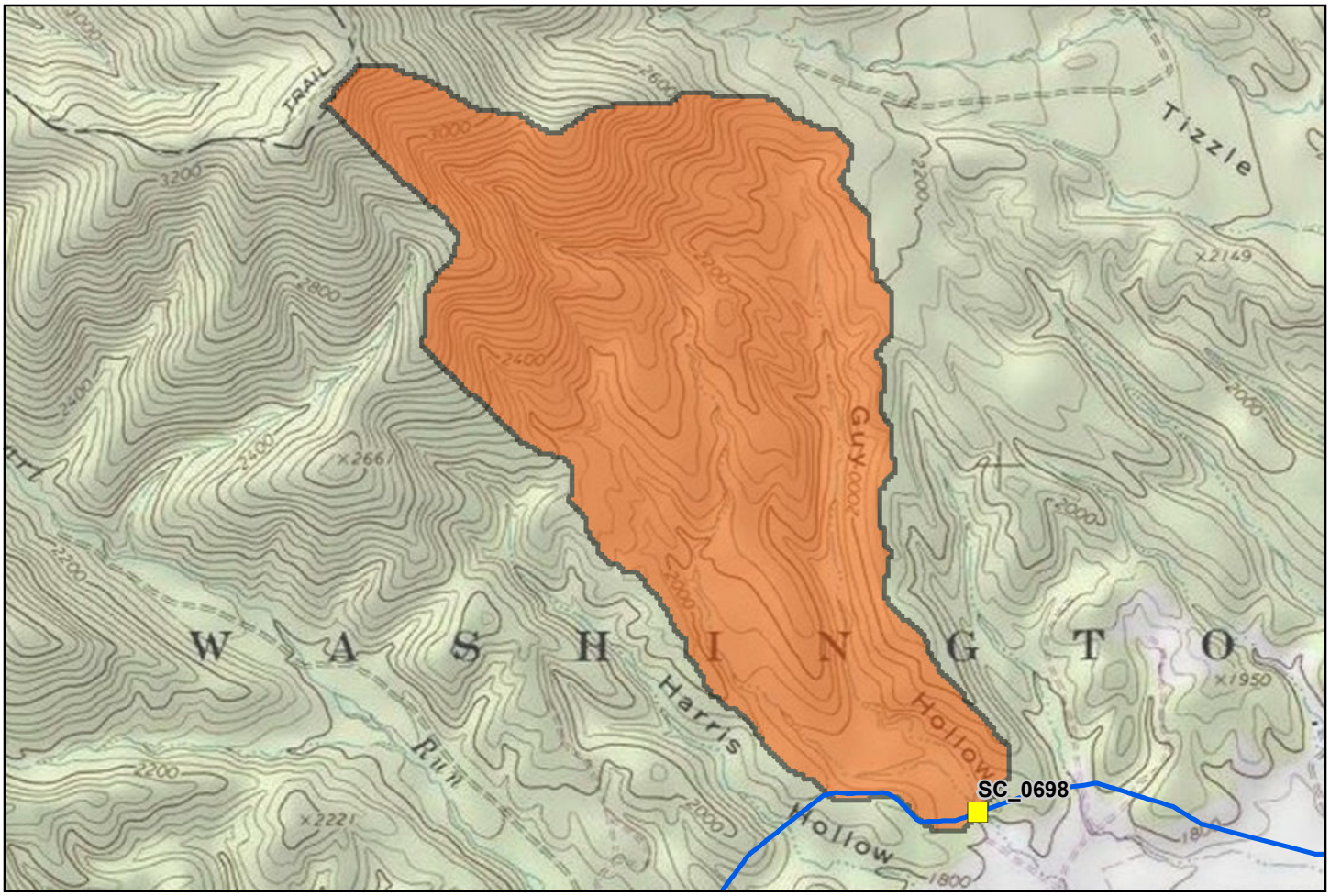
Photograph 1 (IMG_4305.jpg)	
Date: 29 September 2016	
Direction: looking downstream	
Description: Relatively confined channel with cobble bed and some boulders, right bank rip-rap visible on right of photo.	

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0838, Hamilton Branch at MP 108.32 (AP-1)

Photograph 2 (IMG_4307.jpg)	
Date: 29 September 2016	
Direction: looking upstream	
Description: Moderate to shallow bank steepness upstream of crossing. Minor terraced floodplain off left bank. Well established riparian buffer off both banks, extends to road off right bank.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0698	saur006	AP-1	109.2	Virginia	Augusta

Attribute	Value
Stream Name	Guy Hollow
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	0.699
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	Not measured
Slope At Crossing Over 200ft Long Reach (%)[4]	2.786
Proposed Construction Method[5]	1) Dam and Pump 2) Flume

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:24,000

0 500 1,000 2,000 Feet

0 0.5 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0698

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

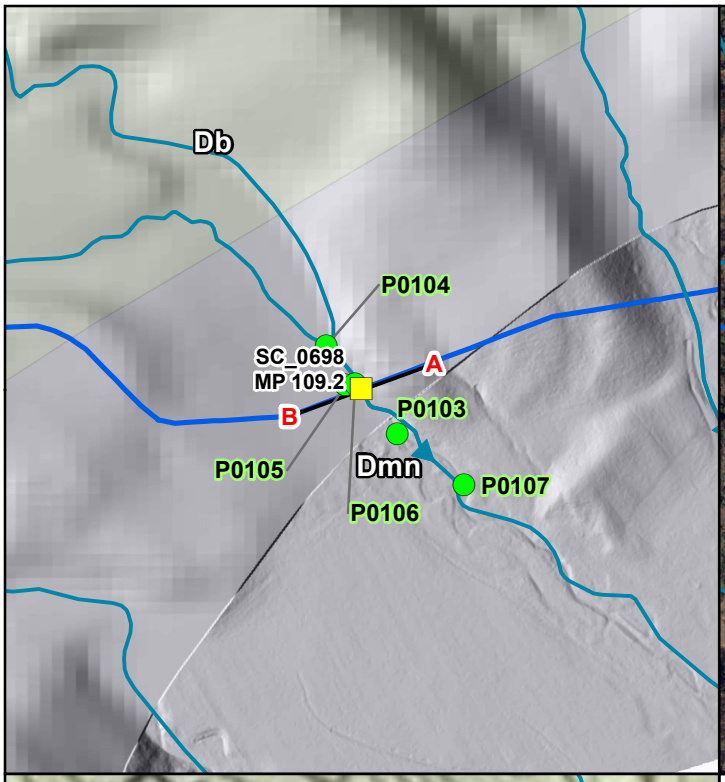
Notes:

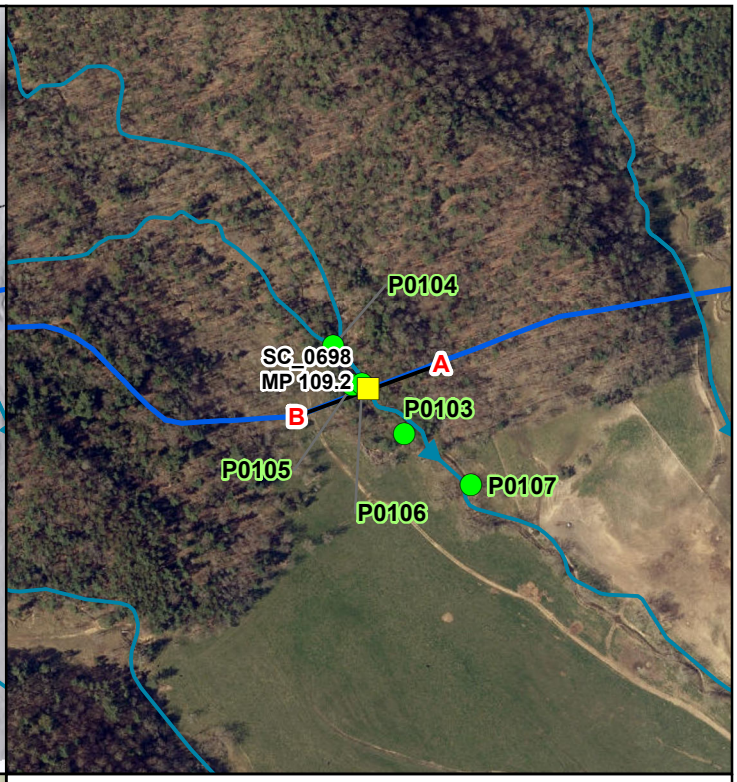
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

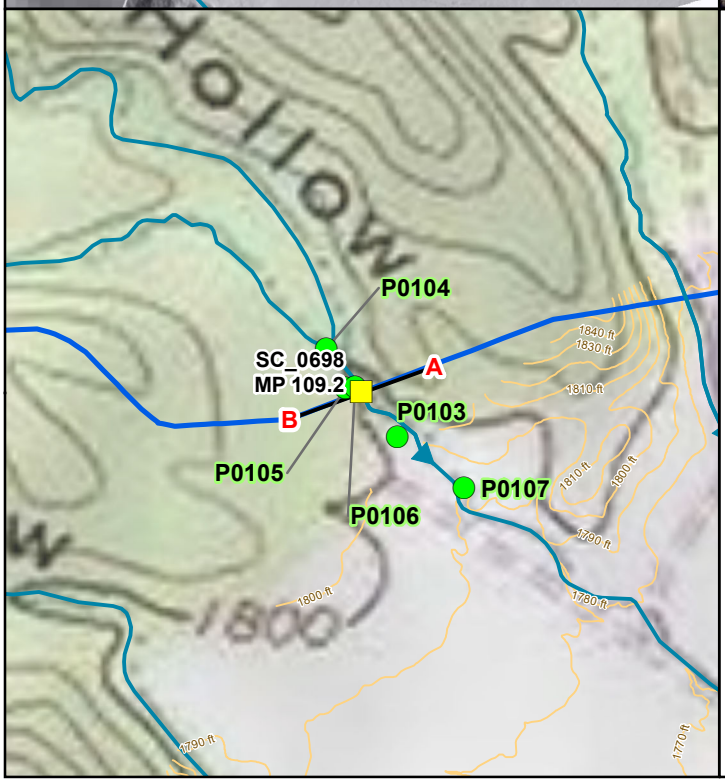
Dominion

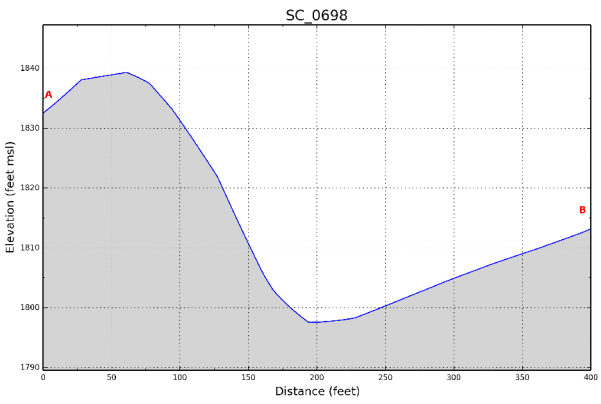
Geosyntec consultants

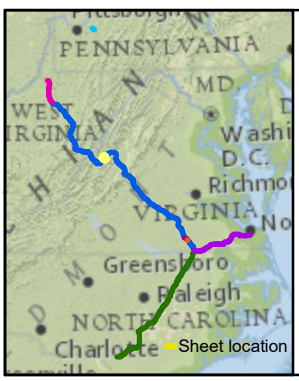
TESSELLATIONS











Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: saur006

TID_SC: SC_0698

Stream Name: Guy Hollow

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0698

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELATIONS

Geosyntec consultants

TID	SC_0698	**ACP Segment**	AP-1
Stream Name	Guy Hollow	**MP**	109.2
Survey Date	29-September-2016	**Start Time**	1330 hrs

- No surface flow at time of survey.
- Riffle-pool morphology.
- Valley-confined on left bank, flow at toe of slope, agricultural floodplain off right bank.
- Bedrock outcroppings exposed near crossing and at crossing downstream.
- 2.2-ft head cut observed downstream of crossing.
- Banks composed of fines matrix with gravels and sub-angular cobbles.
- Bed comprises angular to sub-angular cobbles with gravels. D_{50} in the range of 50 to 75 mm.
- Sparse but established deciduous riparian buffer 1-5 channel widths off right bank and greater than 5 channel widths off left bank.
- Minor braiding upstream of crossing.
- Land owner noted that stream flow often goes from surface flow to subsurface relatively quickly.
- Stream appears to be fairly stable vertically (at crossing location) with potential meandering in right bank floodplain as it is well connected.

Recommendation:

Bury pipeline within shallow bedrock. Placement of right bank sag bend requires additional evaluation.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	29-Sep-16	Stream Name:	Guy Hollow
Crossing ID:	SC_0698		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

- [X] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Cattle grazing

Part 2: River Valley Conditions

Vegetation

- [ ] None
- [ ] Grass
- [ ] Pasture
- [ ] Crops
- [X] Shrubs
- [X] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Valley Side Features

- [ ] None
- [ ] Occasional
- [X] Frequent

Failure Locations

- [ ] None
- [ ] Away from river
- [ ] Along river

Part 3: Floodplain

Floodplain Width

- [ ] None
- [ ] 1 < river widths
- [ ] 1-5 river widths
- [X] 5-10 river widths
- [ ] > 10 river widths

Land Use

- [X] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Mining
- [ ] Cattle grazing

Vegetation

- [ ] None
- [ ] Grass
- [ ] Pasture
- [ ] Orchards
- [ ] Crops
- [X] Shrubs
- [X] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Riparian Buffer Strip

- [ ] None
- [ ] < 1 river width
- [ ] 1-5 river widths
- [X] > 5 river widths

Part 4: Vertical Confinement

Terraces

- [X] None
- [ ] Left bank
- [ ] Right bank

Levees

- [X] None
- [ ] Natural
- [ ] Constructed

Levee Location

- [ ] Along channel bank
- [ ] Set back < 1 river width
- [ ] Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

- [ ] Straight
- [X] Meandering
- [ ] Braided
- [ ] Anastomosed
- [ ] Engineered

Meander Characteristics

- [X] Mild bends
- [ ] Moderate bends
- [ ] Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

- [ ] None
- [ ] Occasional
- [ ] Frequent
- [X] Confined

Control Types

- [ ] None
- [X] Bedrock
- [ ] Boulders

Width Controls

- [ ] None
- [ ] Occasional
- [ ] Frequent
- [X] Confined

Control Types

LB

- [ ] None
- [ ] Bedrock
- [X] Boulders

LBANK

Other

- [ ] Debris
- [ ] Mining
- [ ] Reservoir
- [ ] Knickpoint

Flow Habit

- [X] Perennial
- [ ] Flashy perennial
- [ ] Intermittent
- [ ] Ephemeral

Channel Width: Not measured

M-B Classification

- [ ] Cascade or step-pool
- [X] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material	***Bar Types***	***Bar Material***	***Bar Vegetation***	***Bar Width***
[ ] Clay	[X] None	[ ] Silt	[ ] None	[ ] None
[ ] Silt	[ ] Alternate bars	[ ] Sand	[ ] Grasses	[ ] Narrow
[ ] Sand	[ ] Point bars	[ ] Gravel	[ ] Reeds/shrubs	[ ] Moderate
[X] Gravel	[ ] Mid-channel bars	[ ] Cobbles	[ ] Trees	[ ] Wide
[X] Cobbles	[ ] Diagonal bars			
[ ] Boulders	[ ] Irregular/combination			
[ ] Bedrock	[ ] Braided			

Percent sand in bed = 5< %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	***Left Bank***	***Right Bank***
Bank Material	[X] Clay [X] Silt [X] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock	[X] Clay [X] Silt [X] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[ ] No layers [X] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[ ] No layers [X] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	3.4'	3.4'
Bank Slope	[ ] Steep [X] Moderate [ ] Shallow	[ ] Steep [X] Moderate [ ] Shallow
Bank Vegetation	[ ] None [X] Grasses/annuals [ ] Reeds/shrubs [ ] Trees: Falling trees? [ ] Y [ ] N Tree density [ ] sparse [ ] dense Tree health [ ] good [ ] poor tree ages [ ] young [ ] mature [ ] old tree diversity [ ] Y [ ] N	[ ] None [X] Grasses/annuals [ ] Reeds/shrubs [ ] Trees: Falling trees? [ ] Y [ ] N Tree density [ ] sparse [ ] dense Tree health [ ] good [ ] poor tree ages [ ] young [ ] mature [ ] old tree diversity [ ] Y [ ] N
Bank Erosion and Failure Location	location of erosion [X] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [ ] general type of erosion [X] fluvial [ ] geotechnical	location of erosion [X] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [ ] general type of erosion [X] fluvial [ ] geotechnical

GEOSYNTEC CONSULTANTS

Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0698, Guy Hollow at MP 109.2 (AP-1)

Photograph 1 (IMG_4287.JPG)	
Date: 29 September 2016	
Direction: looking downstream	
Description: Valley wall confinement off left bank, connected agricultural floodplain off right bank. Bedrock outcroppings present on left bank in background.	

GEOSYNTEC CONSULTANTS

Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0698, Guy Hollow at MP 109.2 (AP-1)

Photograph 2 (IMG_4291.JPG)	
Date: 29 September 2016	
Direction: looking upstream	
Description: Angular to sub-angular channel bed. Riparian buffer 1-5 channel widths off right bank.	

GEOSYNTEC CONSULTANTS

Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0698, Guy Hollow at MP 109.2 (AP-1)

Photograph 3 (IMG_4289.JPG)	
Date: 29 September 2016	
Direction: looking downstream	
Description: Bradding of channel upstream of bedrock outcroppings with signs of right bank erosion. Stream begins to flow along left valley wall.	

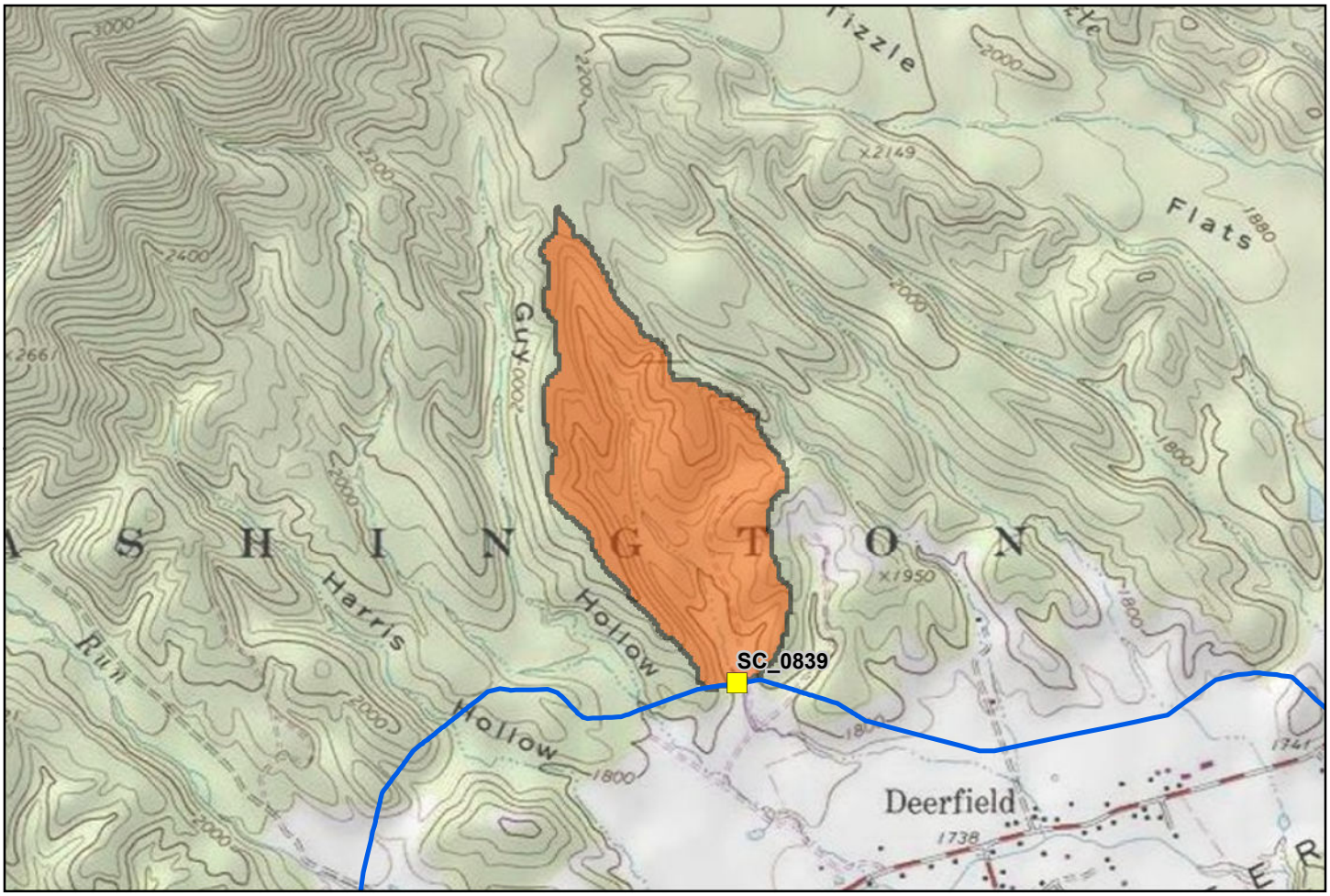
GEOSYNTEC CONSULTANTS

Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0698, Guy Hollow at MP 109.2 (AP-1)

Photograph 4 (IMG_4292.JPG)	
Date: 29 September 2016	
Direction: looking downstream	
Description: Relatively stable section of stream with significant head cuts downstream. Bedrock present just upstream of visible reach.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0839	saur003	AP-1	109.3	Virginia	Augusta

Attribute	Value
Stream Name	UNT to Hamilton Branch
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	0.184
Flow Regime	Intermittent
Measured Bank Full Width (ft)[3]	3.5
Slope At Crossing Over 200ft Long Reach (%)[4]	2.037
Proposed Construction Method[5]	1) Dam and Pump 2) Flume

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:24,000

0 500 1,000 2,000 Feet

0 0.5 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0839

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

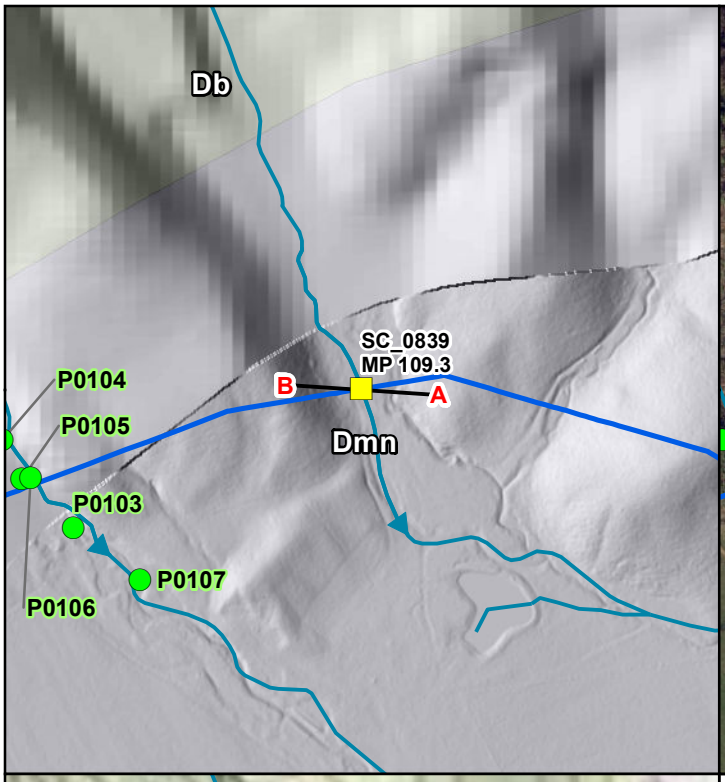
Notes:

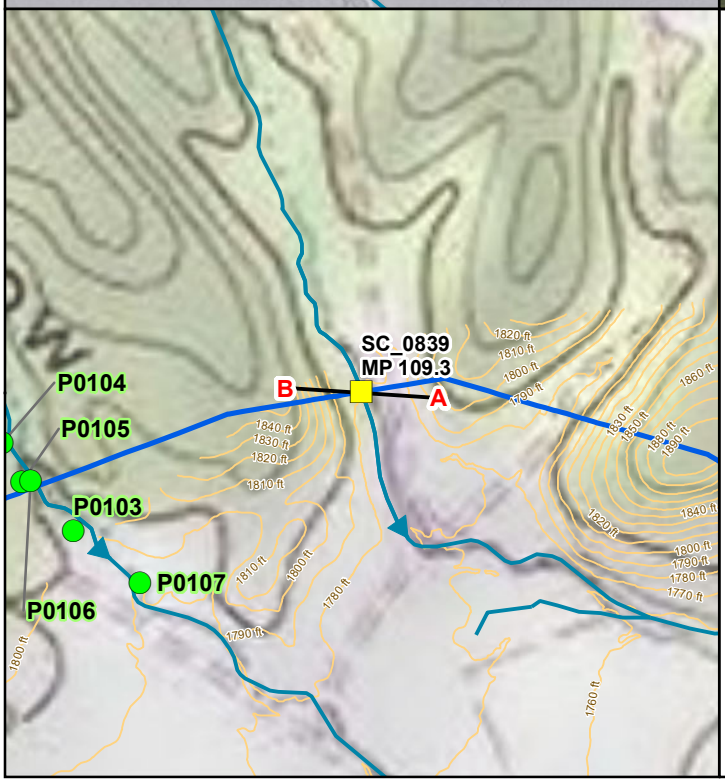
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

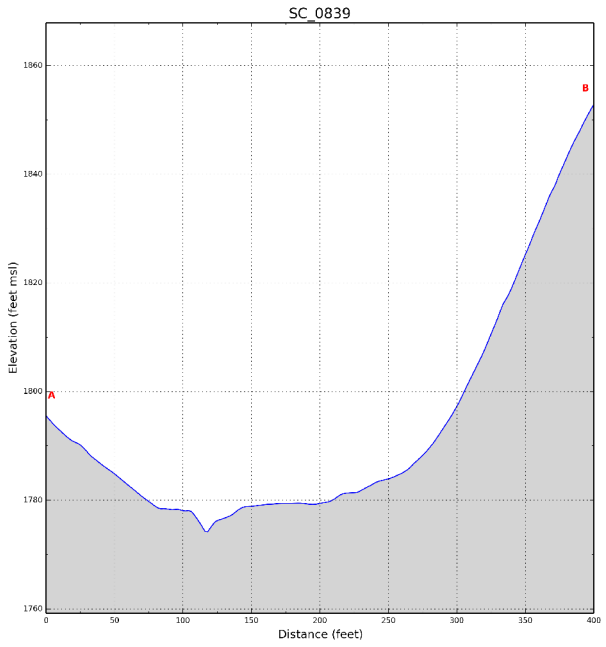
Dominion

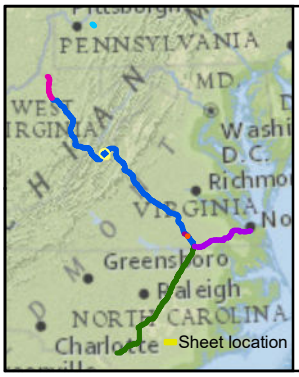
Geosyntec consultants

TESSELLATIONS









Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: saur003

TID_SC: SC_0839

Stream Name: UNT to Hamilton Branch

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0839

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELLATIONS

TID	SC_0839	**ACP Segment**	AP-1
Stream Name	UNT to Hamilton Branch	**MP**	109.3
Survey Date	29-September-2016	**Start Time**	1415 hrs

- Steep banks at crossing location with disconnected floodplains
- Riffle-pool morphology.
- Stream flows closer to the center of the local valley upstream as valley narrows upstream of crossing but with relatively tighter bends.
- Eroded banks heights of 4.2-ft.
- Bed and banks composed of silty-clayey matrix with angular to sub-angular gravels.
- Although some spare trees present, no distinctly established riparian buffer.

Recommendation:

Evaluate scour depth for pipeline burial depth. Bury pipeline from valley wall to valley wall.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	29-Sep-16	Stream Name:	UNT to Hamilton Beach
Crossing ID:	SC_0839		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

X	Natural
	Agricultural
	Urban
	Suburban
	Rural
	Industrial
	Cattle grazing

Part 2: River Valley Conditions

Vegetation

	None
	Grass
	Pasture
	Crops
	Shrubs
X	Deciduous Forest/trees
	Coniferous Forest/trees

Valley Side Features

	None
	Occasional
X	Frequent

Failure Locations

	None
	Away from river
	Along river

Part 3: Floodplain

Floodplain Width

	None
	1 < river widths
	1-5 river widths
	5-10 river widths
X	> 10 river widths

Land Use

X	Natural
	Agricultural
	Urban
	Suburban
	Rural
	Industrial
	Mining
X	Cattle grazing

Vegetation

	None
	Grass
X	Pasture
	Orchards
	Crops
	Shrubs
X	Deciduous Forest/trees
X	Coniferous Forest/trees

Riparian Buffer Strip

X	None
	< 1 river width
	1-5 river widths
	> 5 river widths

Part 4: Vertical Confinement

Terraces

X	None
	Left bank
	Right bank

Levees

X	None
	Natural
	Constructed

Levee Location

	Along channel bank
	Set back < 1 river width
	Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

	Straight
X	Meandering
	Braided
	Anastomosed
	Engineered

Meander Characteristics

	Mild bends
	Moderate bends
X	Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

X	None
	Occasional
	Frequent
	Confined

Control Types

	None
	Bedrock
	Boulders

Width Controls

X	None
	Occasional
	Frequent
	Confined

Control Types

	None
	Bedrock
	Boulders

Other

	Debris
	Mining
	Reservoir
	Knickpoint

Flow Habit

- [ ] Perennial
- [ ] Flashy perennial
- [X] Intermittent
- [ ] Ephemeral

Channel Width: 3.5'

M-B Classification

- [ ] Cascade or step-pool
- [X] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material

- [X] Clay
- [X] Silt
- [ ] Sand
- [X] Gravel
- [ ] Cobbles
- [ ] Boulders
- [ ] Bedrock

Bar Types

- [X] None
- [ ] Alternate bars
- [ ] Point bars
- [ ] Mid-channel bars
- [ ] Diagonal bars
- [ ] Irregular/combination
- [ ] Braided

Bar Material

- [ ] Silt
- [ ] Sand
- [ ] Gravel
- [ ] Cobbles

Bar Vegetation

- [ ] None
- [ ] Grasses
- [ ] Reeds/shrubs
- [ ] Trees

Bar Width

- [ ] None
- [ ] Narrow
- [ ] Moderate
- [ ] Wide

Percent sand in bed = _____ %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	***Left Bank***	***Right Bank***
Bank Material	[X] Clay [X] Silt [X] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock	[X] Clay [X] Silt [X] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	4.2'	4.2'
Bank Slope	[X] Steep [ ] Moderate [ ] Shallow	[X] Steep [ ] Moderate [ ] Shallow
Bank Vegetation	[ ] None [X] Grasses/annuals [ ] Reeds/shrubs [ ] Trees: NO Falling trees? [ ] Y [ ] N Tree density [ ] sparse [ ] dense Tree health [ ] good [ ] poor tree ages [ ] young [ ] mature [ ] old tree diversity [ ] Y [ ] N	[ ] None [X] Grasses/annuals [ ] Reeds/shrubs [ ] Trees: NO Falling trees? [ ] Y [ ] N Tree density [ ] sparse [ ] dense Tree health [ ] good [ ] poor tree ages [ ] young [ ] mature [ ] old tree diversity [ ] Y [ ] N
Bank Erosion and Failure Location	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [X] geotechnical	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [ ] general type of erosion [X] fluvial [X] geotechnical

GEOSYNTEC CONSULTANTS

Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0839, UNT to Hamilton Branch at MP 109.3 (AP-1)

Photograph 1
(IMG_4297.jpg)

Date: 29 September 2016

Direction: looking downstream

Description: Incised channel with silty-clayey bed and bank materials with some gravel sized particles.

GEOSYNTEC CONSULTANTS

Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0839, UNT to Hamilton Branch at MP 109.3 (AP-1)

Photograph 2 (IMG_4300.jpg)	
Date: 29 September 2016	
Direction: looking downstream	
Description: Steep eroded banks, particularly at bends, downstream of crossing.	

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0839, UNT to Hamilton Branch at MP 109.3 (AP-1)

Photograph 3 (IMG_4302.jpg)	
Date: 29 September 2016	
Direction: looking upstream	
Description: Upstream of crossing, stream flows closer to the center of the local valley and is better connected to its floodplains.	

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0839, UNT to Hamilton Branch at MP 109.3 (AP-1)

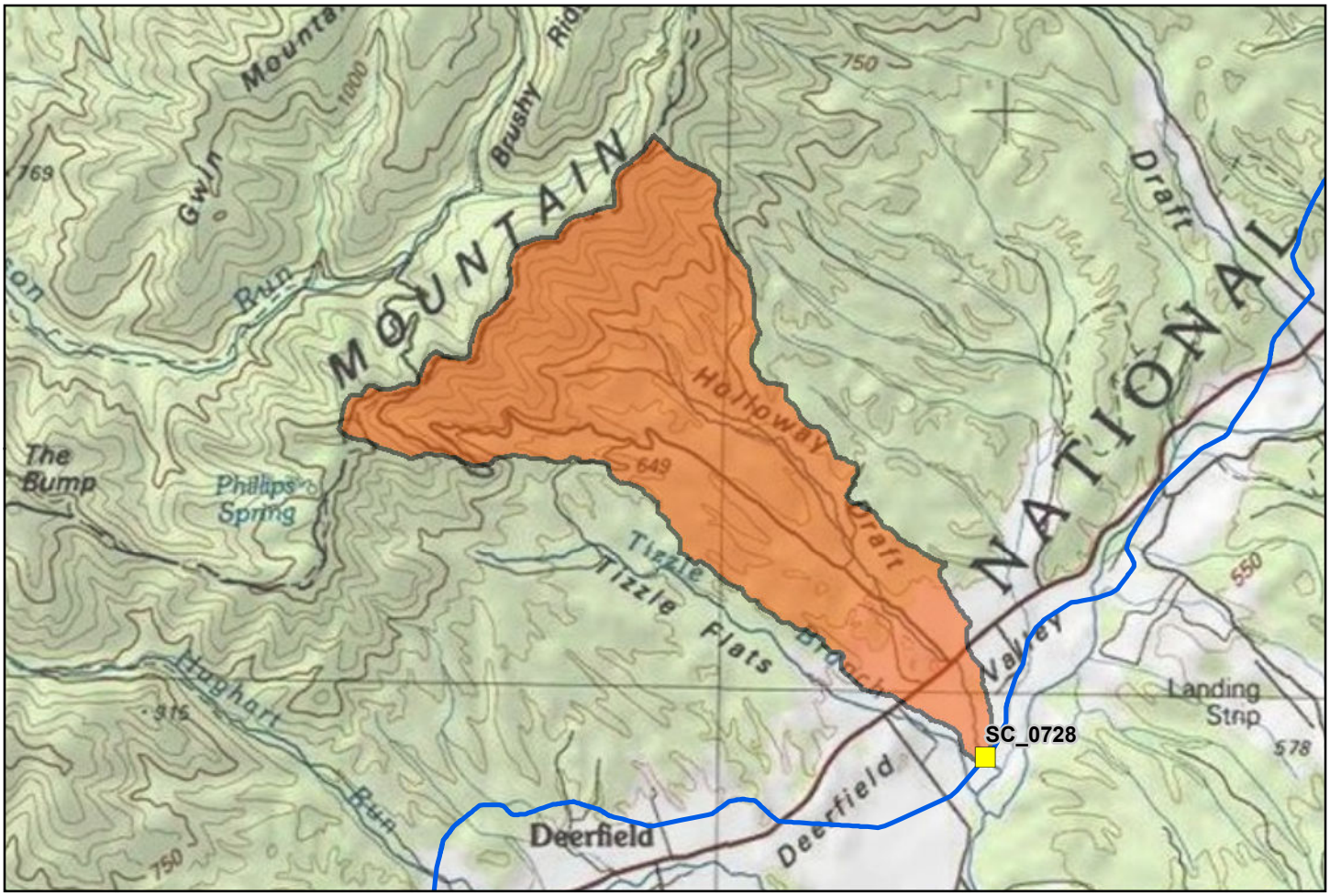
Photograph 4 (IMG_4304.jpg)	
Date: 29 September 2016	
Direction: looking downstream	
Description: Bank erosion at meander bends. Valley confinement off left bank	

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0839, UNT to Hamilton Branch at MP 109.3 (AP-1)

Photograph 5 (IMG_4299.jpg) Date: 29 September 2016 Direction: looking upstream Description: Relatively flat floodplain outside of incised channel valley. Confinement off left bank at crossing. Stream flows closer to the center of the local valley upstream.	
Photograph 6 (IMG_4303.jpg) Date: 29 September 2016 Direction: looking downstream Description: Relatively flat floodplain outside of incised channel (incised banks visible on left of photo). Floodplain is better connected to the channel upstream of crossing.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0728	sauc130	AP-1	110.75	Virginia	Augusta

Attribute	Value
Stream Name	UNT to Tims Draft
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	3.191
Flow Regime	Intermittent
Measured Bank Full Width (ft)[3]	9
Slope At Crossing Over 200ft Long Reach (%)[4]	0.678
Proposed Construction Method[5]	1) Dam and Pump 2) Flume

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:70,000

0 1,550 3,100 6,200 Feet

0 1.5 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0728

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

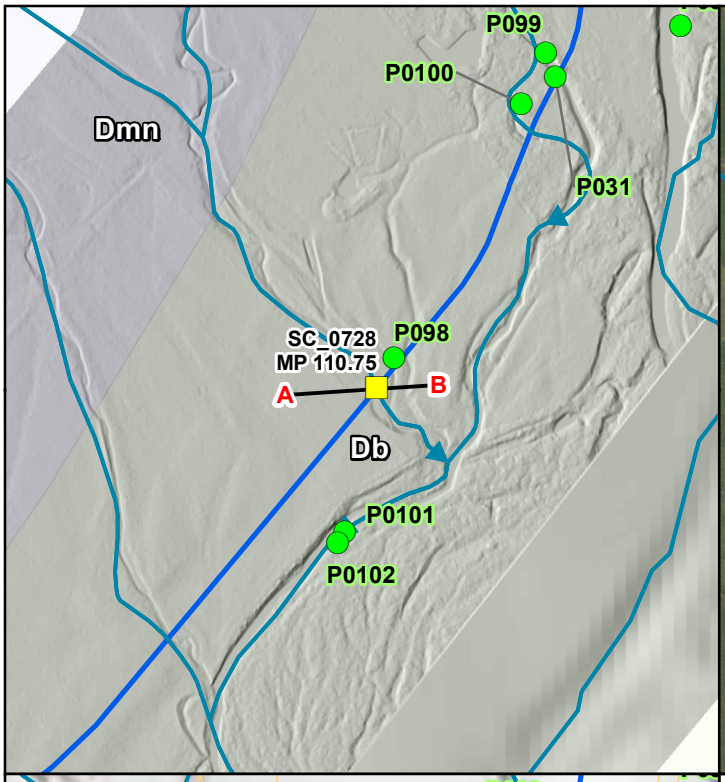
Notes:

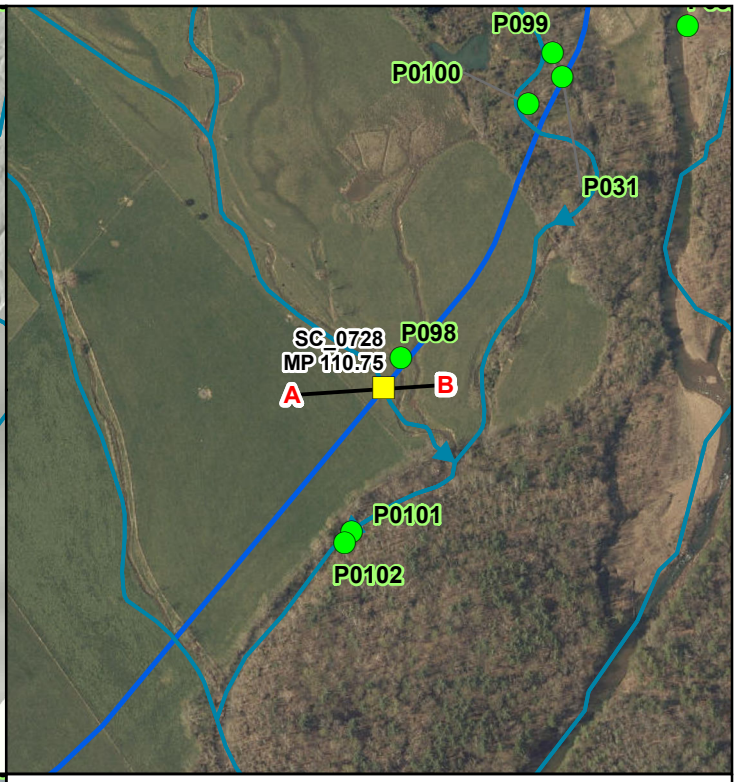
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

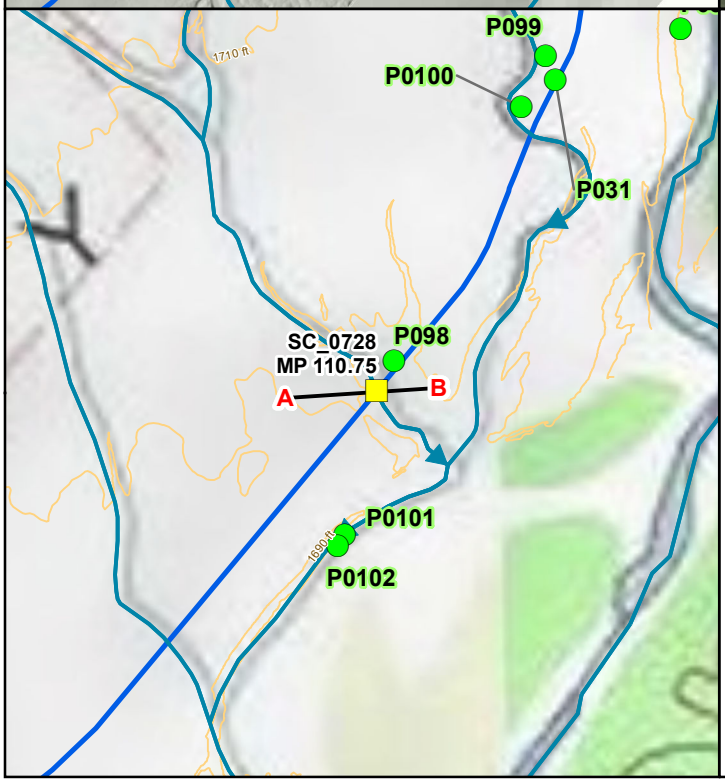
Dominion

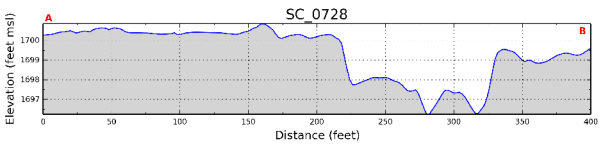
Geosyntec consultants

TESSELLATIONS









Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: sauc130

TID_SC: SC_0728

Stream Name: UNT to Tims

Draft

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0728

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELLATIONS

Geosyntec consultants

TID	SC_0728	**ACP Segment**	AP-1
Stream Name	UNT to Tim's Draft	**MP**	110.75
Survey Date	29-September-2016	**Start Time**	1115 hrs

- No flow at time of survey.
- Riffle-pool morphology.
- Very wide, agricultural floodplains, disconnected due to incision of channel into alluvial deposits.
- Banks moderately stratified with highly erodible fines in upper layer and as the typical matrix material. Rounded cobbles near the downstream section, just above confluence with Tim's Draft.
- Bed comprises rounded cobbles with some gravels and fines.
- No riparian buffer present.
- Generally steep to vertical banks, some undercut.
- Some scour pools present.
- Relatively low gradient reach above but appears to steepen near confluence
- Stream appears to be fairly well confined within current channel with signs of slow to moderate erosion present.

Recommendation:

Evaluate scour depth for pipeline burial depth. Conduct lateral migration evaluation to set location of sag bends.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	29-Sep-16	Stream Name:	UNT To Tims Draft
Crossing ID:	SC_0728		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

- [X] Natural
- [X] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [X] Cattle grazing

Part 2: River Valley Conditions

Vegetation

- [ ] None
- [X] Grass
- [X] Pasture
- [ ] Crops
- [X] Shrubs
- [ ] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Valley Side Features

- [X] None
- [ ] Occasional
- [ ] Frequent

Failure Locations

- [ ] None
- [ ] Away from river
- [ ] Along river

Part 3: Floodplain

Floodplain Width

- [ ] None
- [ ] 1 < river widths
- [ ] 1-5 river widths
- [ ] 5-10 river widths
- [X] > 10 river widths

Land Use

- [ ] Natural
- [X] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Mining
- [X] Cattle grazing

Vegetation

- [ ] None
- [X] Grass
- [X] Pasture
- [ ] Orchards
- [ ] Crops
- [X] Shrubs
- [ ] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Riparian Buffer Strip

- [X] None
- [ ] < 1 river width
- [ ] 1-5 river widths
- [ ] > 5 river widths

Part 4: Vertical Confinement

Terraces

- [X] None
- [ ] Left bank
- [ ] Right bank

Levees

- [X] None
- [ ] Natural
- [ ] Constructed

Levee Location

- [ ] Along channel bank
- [ ] Set back < 1 river width
- [ ] Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

- [ ] Straight
- [X] Meandering
- [ ] Braided
- [ ] Anastomosed
- [ ] Engineered

Meander Characteristics

- [ ] Mild bends
- [X] Moderate bends
- [ ] Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

- [X] None
- [ ] Occasional
- [ ] Frequent
- [ ] Confined

Control Types

- [ ] None
- [ ] Bedrock
- [ ] Boulders

Width Controls

- [X] None
- [ ] Occasional
- [ ] Frequent
- [ ] Confined

Control Types

- [ ] None
- [ ] Bedrock
- [ ] Boulders

Other

- [ ] Debris
- [ ] Mining
- [ ] Reservoir
- [ ] Knickpoint

Flow Habit

- [ ] Perennial
- [ ] Flashy perennial
- [X] Intermittent
- [ ] Ephemeral

Channel Width: 9'

M-B Classification

- [ ] Cascade or step-pool
- [X] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material

- [ ] Clay
- [ ] Silt
- [ ] Sand
- [ ] Gravel
- [ ] Cobbles
- [ ] Boulders
- [X] Bedrock

Bar Types

- [X] None
- [ ] Alternate bars
- [ ] Point bars
- [ ] Mid-channel bars
- [ ] Diagonal bars
- [ ] Irregular/combination
- [ ] Braided

Bar Material

- [ ] Silt
- [ ] Sand
- [ ] Gravel
- [ ] Cobbles

Bar Vegetation

- [ ] None
- [ ] Grasses
- [ ] Reeds/shrubs
- [ ] Trees

Bar Width

- [ ] None
- [ ] Narrow
- [ ] Moderate
- [ ] Wide

Percent sand in bed = 0 %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	***Left Bank***	***Right Bank***
Bank Material	[ ] Clay [ ] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [X] Bedrock	[X] Clay [X] Silt [X] Gravel [X] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	SLOPE	1'
Bank Slope	[ ] Steep [ ] Moderate [ ] Shallow	[ ] Steep [ ] Moderate [ ] Shallow
Bank Vegetation	[ ] None [ ] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [X] sparse [ ] dense Tree health [X] good [ ] poor tree ages [X] young [X] mature [ ] old tree diversity [X] Y [ ] N	[ ] None [X] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [X] sparse [ ] dense Tree health [X] good [ ] poor tree ages [X] young [X] mature [ ] old tree diversity [X] Y [ ] N
Bank Erosion and Failure Location	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0728, UNT to Tim's Draft at MP 110.75 (AP-1)

Photograph 1 (IMG_4270.jpg)	
Date: 29 September 2016	
Direction: looking downstream	
Description: small, vegetated mid-channel and point bars present within channel. Riparian corridor of Tim's Draft visible in background.	

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0728, UNT to Tim's Draft at MP 110.75 (AP-1)

Photograph 2 (IMG_4277.jpg) Date: 29 September 2016 Direction: looking upstream Description: Wide agricultural floodplain off both banks, disconnected due to incision. Threaded channel visible.	
Photograph 3 (IMG_4279.jpg) Date: 29 September 2016 Direction: looking towards left bank Description: Steep to vertical banks with highly erodible materials. Sub-angular cobbles and fines comprise channel bed.	

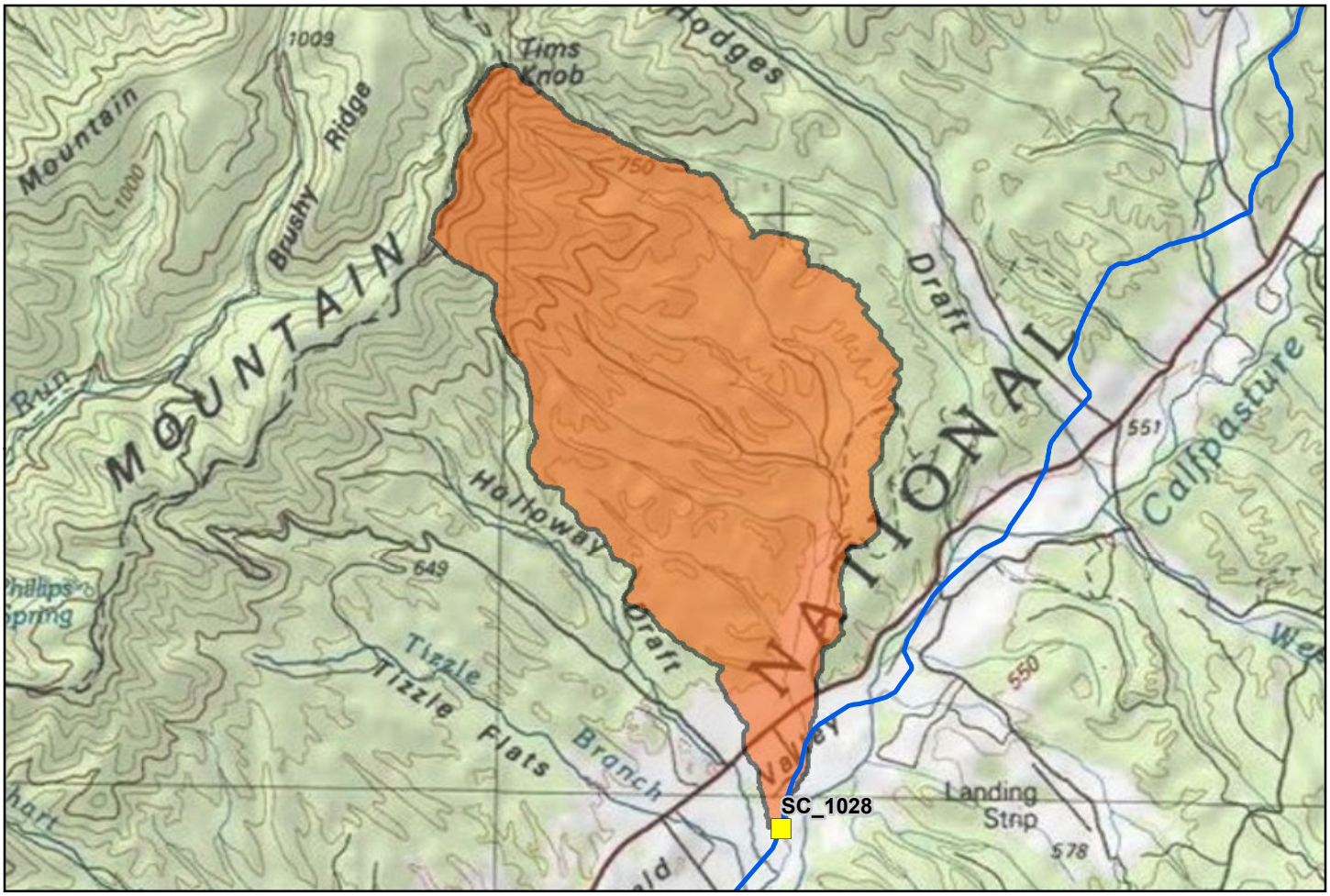
GEOSYNTEC CONSULTANTS

Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0728, UNT to Tim's Draft at MP 110.75 (AP-1)

Photograph 4 (IMG_4281.jpg)	
Date: 29 September 2016	
Direction: looking down on channel bed	
Description: Sub-angular to rounded cobble bed with some gravels in moderately stratified banks.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_1028	sauc133	AP-1	110.87	Virginia	Augusta

Attribute	Value
Stream Name	Tims Draft
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	4.164
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	19
Slope At Crossing Over 200ft Long Reach (%)[4]	1.700
Proposed Construction Method[5]	1) Dam and Pump 2) Flume

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:70,000

0 1,550 3,100 6,200 Feet

0 1.5 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_1028

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

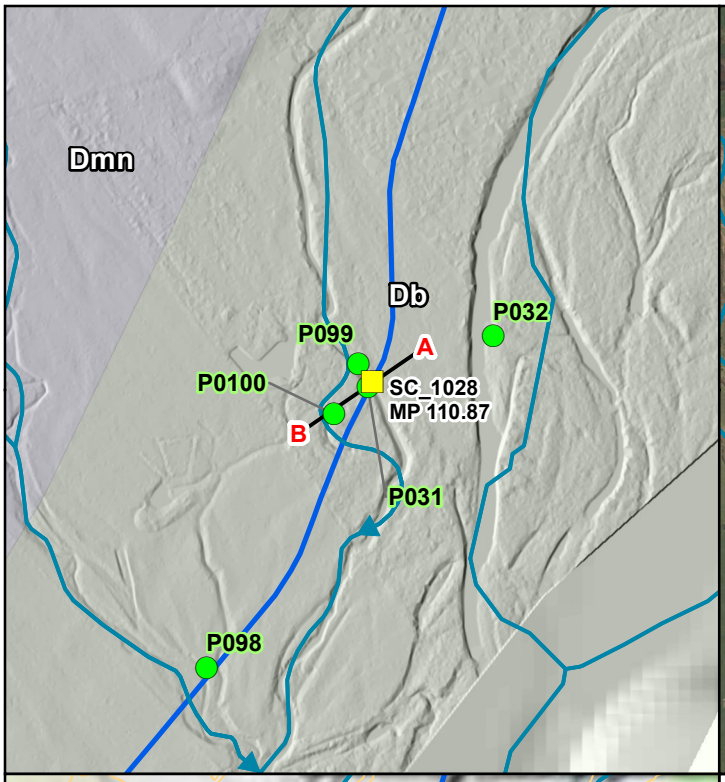
Notes:

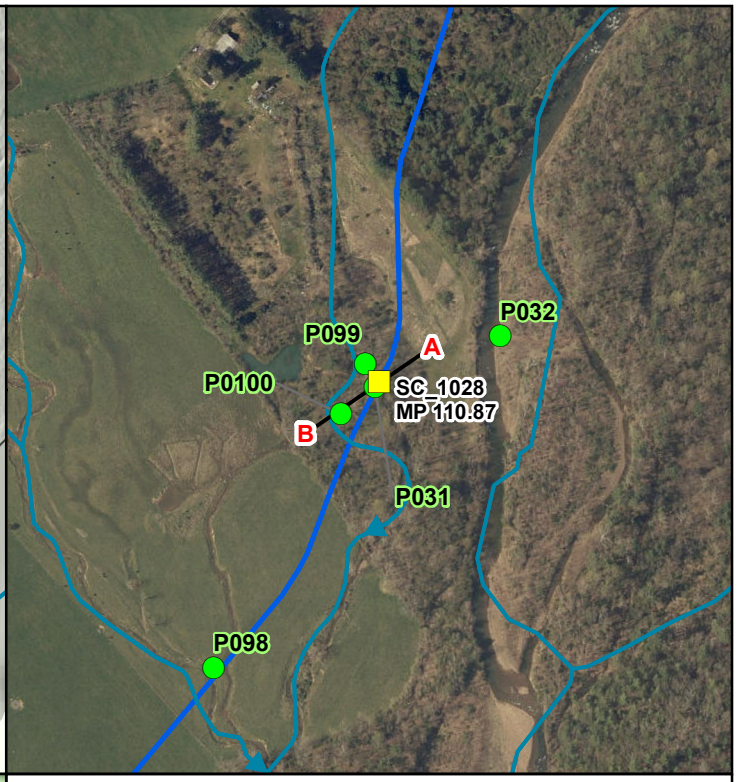
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

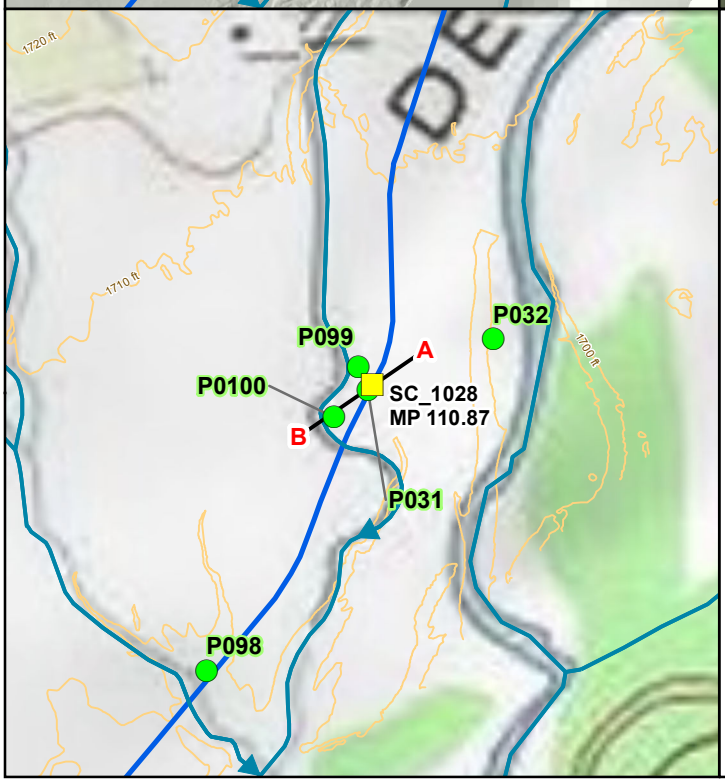
Dominion

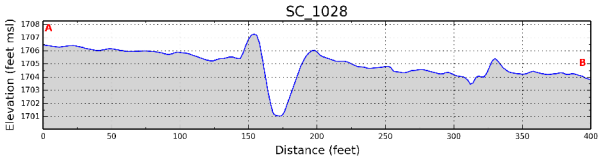
Geosyntec consultants

TESSELLATIONS









Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: sauc133

TID_SC: SC_1028

Stream Name: Tims Draft

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_1028

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELLATIONS

Geosyntec consultants

TID	SC_1028	**ACP Segment**	AP-1
Stream Name	Tim's Draft	**MP**	110.87
Survey Date	29-September-2016	**Start Time**	1210 hrs

- No flow at the time of survey.
- Riffle-pool morphology.
- Banks composed of silty-clayey fines matrix with some gravels.
- Channel bed composed of silty-clayey fines with rounded cobbles.
- BFW = 19 ft. Stream widens downstream to 25 ft following confluence with UNT to Tim's Draft (SC_0728).
- Max pool depths of 1.8-ft.
- Aquatic invertebrate communities and algal growth observed in April 2016 visit indicate typically quiescence flows in vicinity of crossing location.
- Moderate slope at reach. Measured 1.7% slope with autolevel.
- Land owner noted anthropogenic alteration of channel characteristics in the past.

Recommendation:

Evaluate scour depth for pipeline burial depth. Conduct lateral migration evaluation to set location of sag bends.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	29-Sep-16	Stream Name:	Tim's Draft
Crossing ID:	SC_1028		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

- [X] Natural
- [X] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Cattle grazing

Part 2: River Valley Conditions

Vegetation

- [ ] None
- [X] Grass
- [X] Pasture
- [ ] Crops
- [ ] Shrubs
- [X] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Valley Side Features

- [X] None
- [ ] Occasional
- [ ] Frequent

Failure Locations

- [X] None
- [ ] Away from river
- [ ] Along river

Part 3: Floodplain

Floodplain Width

- [ ] None
- [ ] 1 < river widths
- [ ] 1-5 river widths
- [X] 5-10 river widths
- [ ] > 10 river widths

Land Use

- [X] Natural
- [X] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Mining
- [ ] Cattle grazing

Vegetation

- [ ] None
- [ ] Grass
- [ ] Pasture
- [ ] Orchards
- [ ] Crops
- [X] Shrubs
- [X] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Riparian Buffer Strip

- [ ] None
- [ ] < 1 river width
- [X] 1-5 river widths
- [ ] > 5 river widths

Part 4: Vertical Confinement

Terraces

- [X] None
- [ ] Left bank
- [ ] Right bank

Levees

- [X] None
- [ ] Natural
- [ ] Constructed

Levee Location

- [ ] Along channel bank
- [ ] Set back < 1 river width
- [ ] Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

- [X] Straight
- [ ] Meandering
- [ ] Braided
- [ ] Anastomosed
- [ ] Engineered

Meander Characteristics

- [X] Mild bends
- [ ] Moderate bends
- [ ] Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

- [X] None
- [ ] Occasional
- [ ] Frequent
- [ ] Confined

Control Types

- [X] None
- [ ] Bedrock
- [ ] Boulders

Width Controls

- [X] None
- [ ] Occasional
- [ ] Frequent
- [ ] Confined

Control Types

- [X] None
- [ ] Bedrock
- [ ] Boulders

Other

- [ ] Debris
- [ ] Mining
- [ ] Reservoir
- [ ] Knickpoint

Flow Habit

- [ ] Perennial
- [ ] Flashy perennial
- [X] Intermittent
- [ ] Ephemeral

Channel Width: 19'

M-B Classification

- [ ] Cascade or step-pool
- [X] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material	***Bar Types***	***Bar Material***	***Bar Vegetation***	***Bar Width***
[ ] Clay	[X] None	[ ] Silt	[ ] None	[ ] None
[ ] Silt	[ ] Alternate bars	[ ] Sand	[ ] Grasses	[ ] Narrow
[ ] Sand	[ ] Point bars	[ ] Gravel	[ ] Reeds/shrubs	[ ] Moderate
[X] Gravel	[ ] Mid-channel bars	[ ] Cobbles	[ ] Trees	[ ] Wide
[X] Cobbles	[ ] Diagonal bars			
[ ] Boulders	[ ] Irregular/combination			
[ ] Bedrock	[ ] Braided			

Percent sand in bed = <5 %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	***Left Bank***	***Right Bank***
Bank Material	[X] Clay [X] Silt [X] Sand [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock	[X] Clay [X] Silt [X] Sand [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	5'	5'
Bank Slope	[X] Steep [ ] Moderate [ ] Shallow	[X] Steep [ ] Moderate [ ] Shallow
Bank Vegetation	[ ] None [ ] Grasses/annuals [X] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [X] young [X] mature [ ] old tree diversity [X] Y [ ] N	[ ] None [ ] Grasses/annuals [X] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [X] young [X] mature [ ] old tree diversity [X] Y [ ] N
Bank Erosion and Failure Location	location of erosion [X] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [ ] general type of erosion [X] fluvial [ ] geotechnical	location of erosion [X] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [ ] general type of erosion [X] fluvial [ ] geotechnical

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_1028, Tim's Draft at MP 110.87 (AP-1)

Photograph 1
(IMG_4283.jpg)

Date: 29 September 2016

Direction: looking upstream

Description: Stream was dry at the time of our survey. Small, vegetated mid-channel bars present. Riparian corridor typically 1-5 channel widths. Banks comprise silty-clayey materials. Bed comprises gravel with some cobble-sized particles.

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_1028, Tim's Draft at MP 110.87 (AP-1)

Photograph 2 (IMG_4285.jpg)	
Date: 29 September 2016	
Direction: looking downstream	
Description: relatively defined channel with moderately steep and typically vegetated banks. Highly erodible bank materials with deeper incision of channel and head cuts downstream of crossing.	

GEOSYNTEC CONSULTANTS

Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_1028, Tim's Draft at MP 110.87 (AP-1)

Photograph 3 (094.jpg)	
Date: 8 April 2016	
Direction: looking downstream	
Description: Flow observed during April 2016 survey, riffle section visible with quiescent pools above and below.	

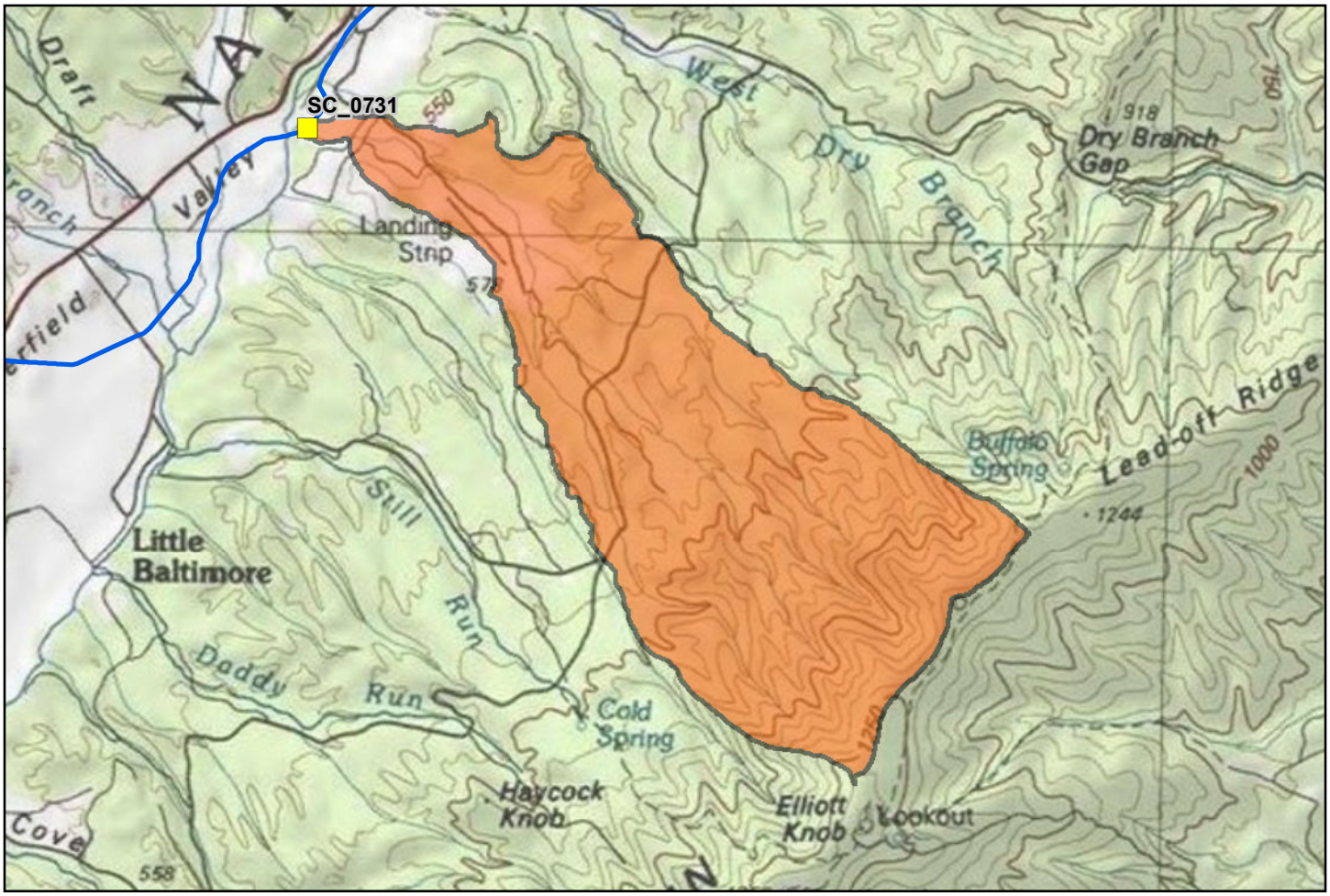
GEOSYNTEC CONSULTANTS

Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_1028, Tim's Draft at MP 110.87 (AP-1)

Photograph 4 (091.jpg)	
Date: 8 April 2016	
Direction: looking upstream	
Description: Pool riffle section with vegetated point bars and filamentous algal growth in channel.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0731	saue302	AP-1	111.51	Virginia	Augusta

Attribute	Value
Stream Name	White Rock Branch
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	4.183
Flow Regime	Intermittent
Measured Bank Full Width (ft)[3]	12.5
Slope At Crossing Over 200ft Long Reach (%)[4]	0.661
Proposed Construction Method[5]	1) Dam and Pump 2) Flume

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:70,000

0 1,550 3,100 6,200 Feet

0 1.5 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0731

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

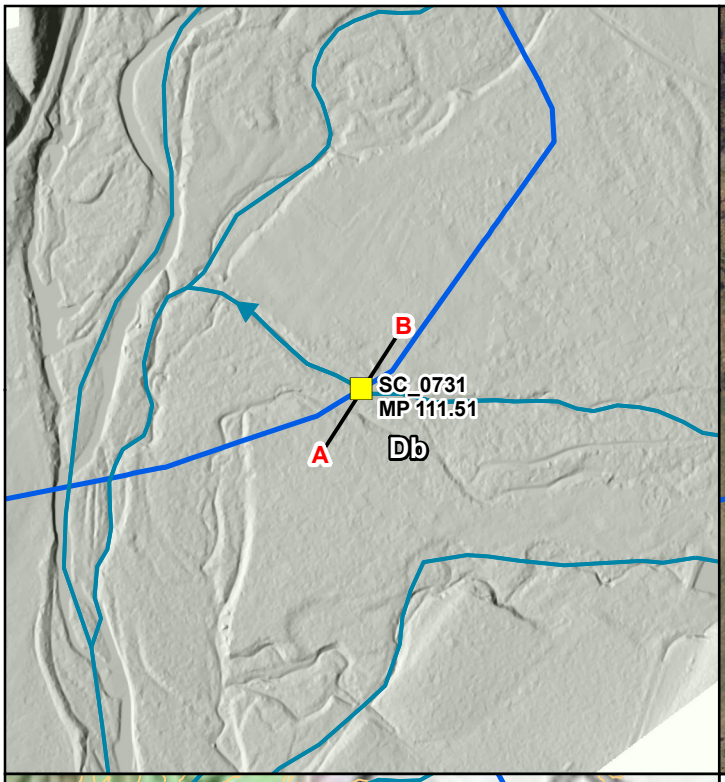
Notes:

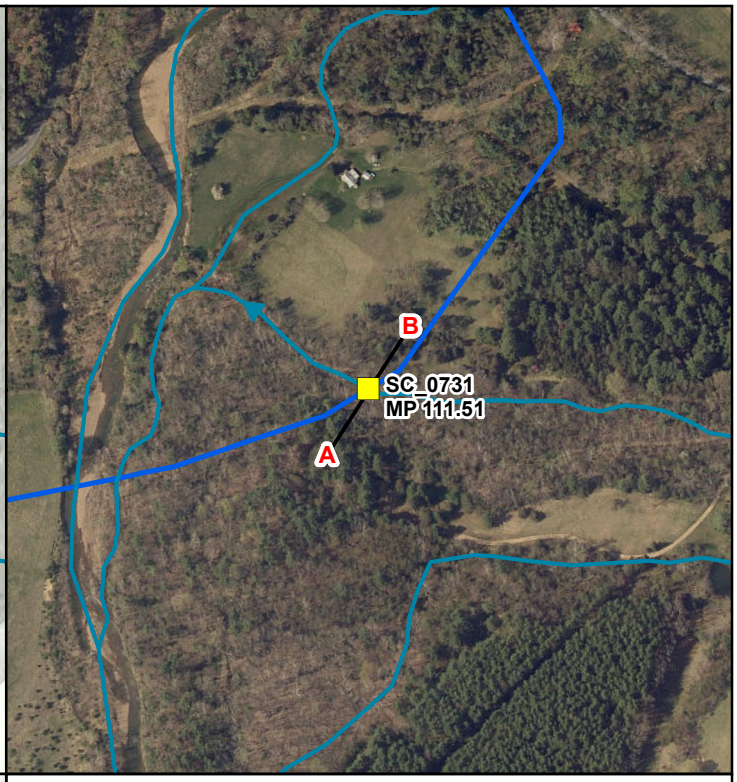
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

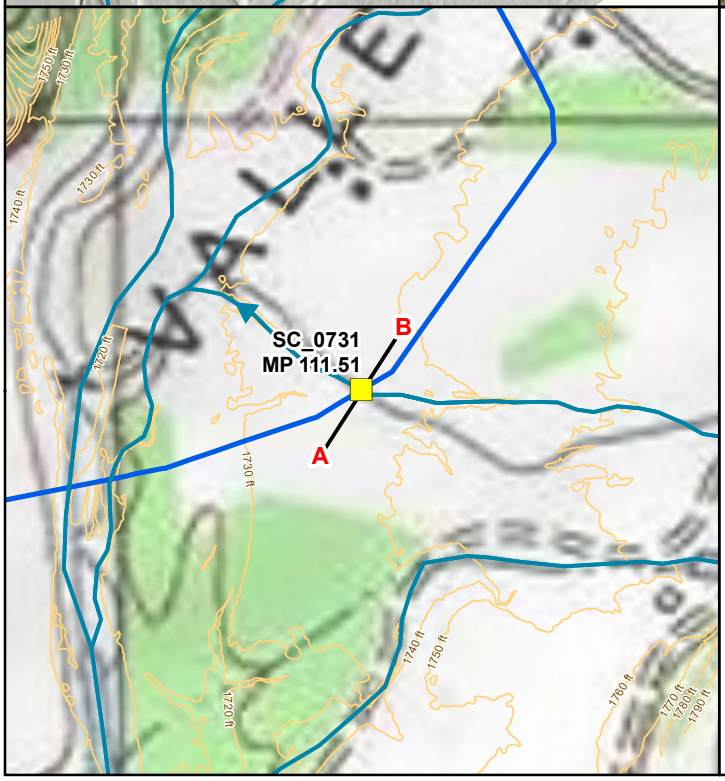
Dominion

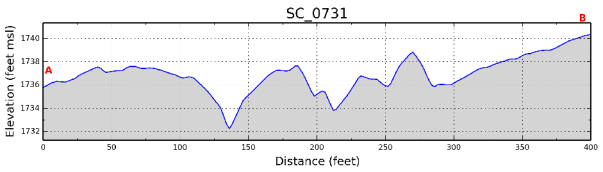
Geosyntec consultants

TESSELLATIONS









Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: saue302

TID_SC: SC_0731

Stream Name: White Rock Branch

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0731

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELLATIONS

Geosyntec consultants

TID	SC_0731	**ACP Segment**	AP-1
Stream Name	White Rock Branch	**MP**	111.51
Survey Date	29-September-2016	**Start Time**	1010 hrs

- Stream was dry at time of survey, vegetation (predominantly grasses and small trees) in channel.
- Riffle-pool morphology.
- Shallow banks with well-connected floodplains (particularly on the right bank).
- BFW = 12.5 ft and BFD < 1 ft.
- Left bank height is 3.5-ft and right bank height is 2.5-ft.
- Bed comprises sub-angular to rounded cobbles with gravels.
- Established deciduous riparian buffer 1-5 channel widths off right bank and greater than 5 channel widths off left bank.
- Hummocky terrain on left floodplain within riparian buffer with signs of historic channels and minor debris materials. Right floodplain appears maintained.
- Some small islands within channel with mature trees.
- Relatively low gradient reach. Measured 0.7% slope with autolevel.
- Stream appears to be fairly stable with potential meandering in floodplains as they are well connected.

Recommendation:

Evaluate scour depth for pipeline burial depth. Conduct lateral migration evaluation to set location of sag bends. Place sag bends within riparian buffer, at least 1 channel width off both banks.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	29-Sep-16	Stream Name:	White Rock Branch
Crossing ID:	SC_0731		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

- [X] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Cattle grazing

Part 2: River Valley Conditions

Vegetation

- [ ] None
- [ ] Grass
- [ ] Pasture
- [ ] Crops
- [ ] Shrubs
- [X] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Valley Side Features

- [X] None
- [ ] Occasional
- [ ] Frequent

Failure Locations

- [ ] None
- [ ] Away from river
- [ ] Along river

Part 3: Floodplain

Floodplain Width

- [ ] None
- [ ] 1 < river widths
- [ ] 1-5 river widths
- [ ] 5-10 river widths
- [X] > 10 river widths

Land Use

- [X] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Mining
- [ ] Cattle grazing

Vegetation

- [ ] None
- [ ] Grass
- [ ] Pasture
- [ ] Orchards
- [ ] Crops
- [X] Shrubs
- [X] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Riparian Buffer Strip

- [ ] None
- [ ] < 1 river width
- [ ] 1-5 river widths
- [X] > 5 river widths

Part 4: Vertical Confinement

Terraces

- [X] None
- [ ] Left bank
- [ ] Right bank

Levees

- [ ] None
- [X] Natural
- [ ] Constructed

Levee Location

- [X] Along channel bank
- [ ] Set back < 1 river width
- [ ] Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

- [X] Straight
- [ ] Meandering
- [ ] Braided
- [ ] Anastomosed
- [ ] Engineered

Meander Characteristics

- [ ] Mild bends
- [ ] Moderate bends
- [ ] Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

- [ ] None
- [ ] Occasional
- [ ] Frequent
- [X] Confined

Control Types

- [ ] None
- [ ] Bedrock
- [ ] Boulders
- [X] Gravel Armor

Width Controls

- [X] None
- [ ] Occasional
- [ ] Frequent
- [ ] Confined

Control Types

- [X] None
- [ ] Bedrock
- [ ] Boulders

Other

- [ ] Debris
- [ ] Mining
- [ ] Reservoir
- [ ] Knickpoint

Flow Habit

- [ ] Perennial
- [ ] Flashy perennial
- [X] Intermittent
- [ ] Ephemeral

Channel Width: 12.5

M-B Classification

- [X] Cascade or step-pool
- [ ] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material	***Bar Types***	***Bar Material***	***Bar Vegetation***	***Bar Width***
[ ] Clay	[ ] None	[ ] Silt	[ ] None	[ ] None
[ ] Silt	[ ] Alternate bars	[ ] Sand	[X] Grasses	[ ] Narrow
[ ] Sand	[ ] Point bars	[X] Gravel	[ ] Reeds/shrubs	[X] Moderate
[X] Gravel	[X] Mid-channel bars	[X] Cobbles	[X] Trees	[ ] Wide
[X] Cobbles	[ ] Diagonal bars			
[ ] Boulders	[ ] Irregular/combination			
[ ] Bedrock	[ ] Braided			

Percent sand in bed = 5< %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	***Left Bank***	***Right Bank***
Bank Material	[X] Clay [X] Silt SAND [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock	[X] Clay [X] Silt SAND [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[ ] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	3.5	2.5
Bank Slope	[ ] Steep [X] Moderate [ ] Shallow	[ ] Steep [X] Moderate [ ] Shallow
Bank Vegetation	[ ] None [ ] Grasses/annuals [X] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [X] young [X] mature [ ] old tree diversity [X] Y [ ] N	[ ] None [ ] Grasses/annuals [ ] Reeds/shrubs [ ] Trees: Falling trees? [X] Y [ ] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [X] young [X] mature [ ] old tree diversity [X] Y [ ] N
Bank Erosion and Failure Location	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0731, White Rock Branch at MP 111.51 (AP-1)

Photograph 1 (IMG_4265.jpg)	
Date: 29 September 2016	
Direction: looking upstream	
Description: small islands present within channel with mature tree growth. Stream was dry at the time of reconnaissance.	

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0731, White Rock Branch at MP 111.51 (AP-1)

Photograph 2 (IMG_4264.jpg)	
Date: 29 September 2016	
Direction: looking downstream	
Description: Cobble channel bottom visible in sections of steeper local slope. No significant signs of vertical or lateral migration hazards.	

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0731, White Rock Branch at MP 111.51 (AP-1)

Photograph 3
(IMG_4266.jpg)

Date: 29 September 2016

Direction: looking downstream

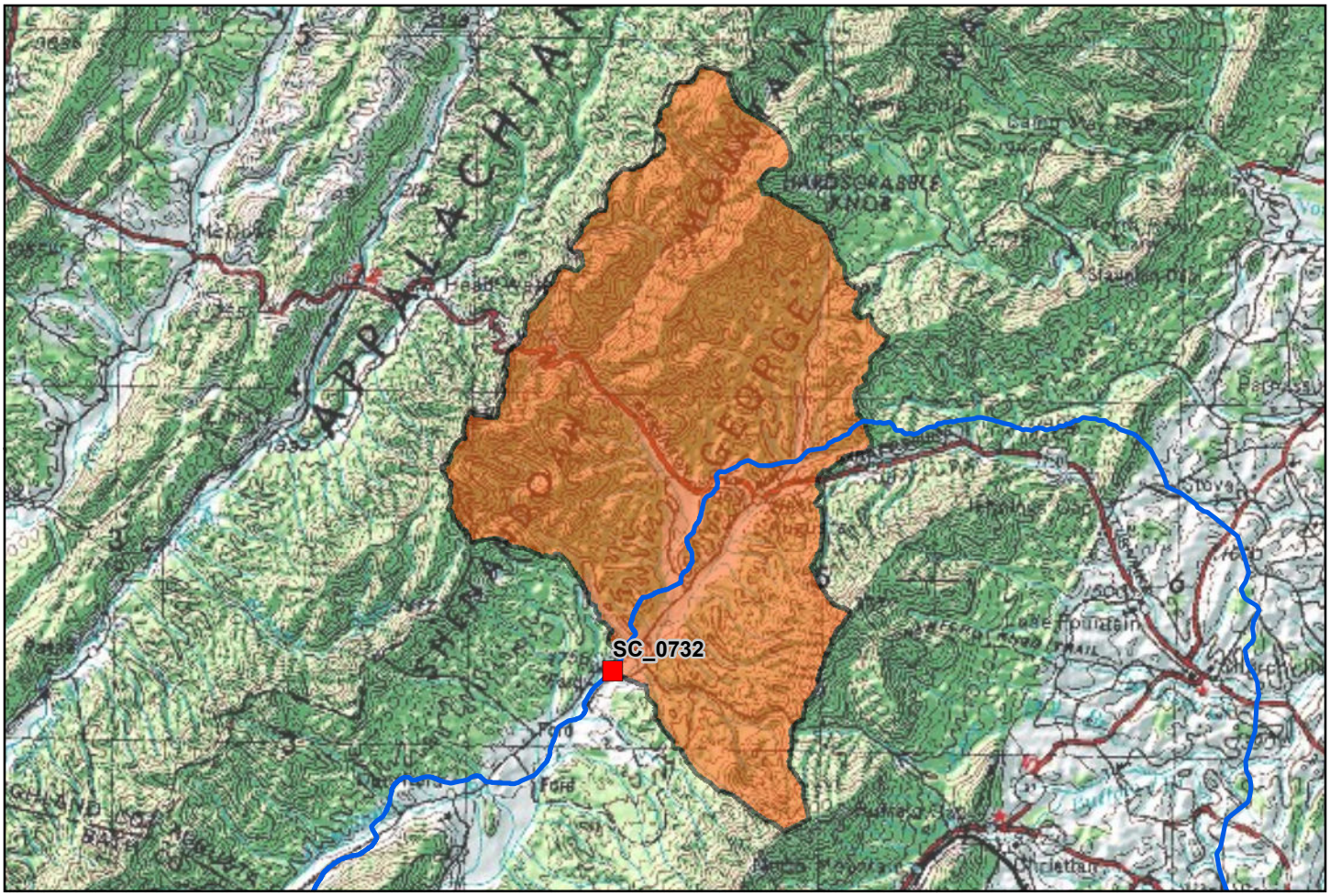
Description: Relatively low gradient channel with vegetation present. Established riparian buffer, particularly off left bank.

GEOSYNTEC CONSULTANTS
Photographic Record

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0731, White Rock Branch at MP 111.51 (AP-1)

Photograph 4 (IMG_4262.jpg)	
Date: 29 September 2016	
Direction: looking down on channel bed	
Description: Sub-angular to rounded gravel and cobble bed.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0732	sauc124	AP-1	112.22	Virginia	Augusta

Attribute	Value
Stream Name	Calfpasture River
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	54.876
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	58
Slope At Crossing Over 200ft Long Reach (%)[4]	0.348
Proposed Construction Method[5]	1) Dam and Pump 2) Flume

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:250,000

0 5,500 11,000 22,000 Feet

0 6 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0732

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

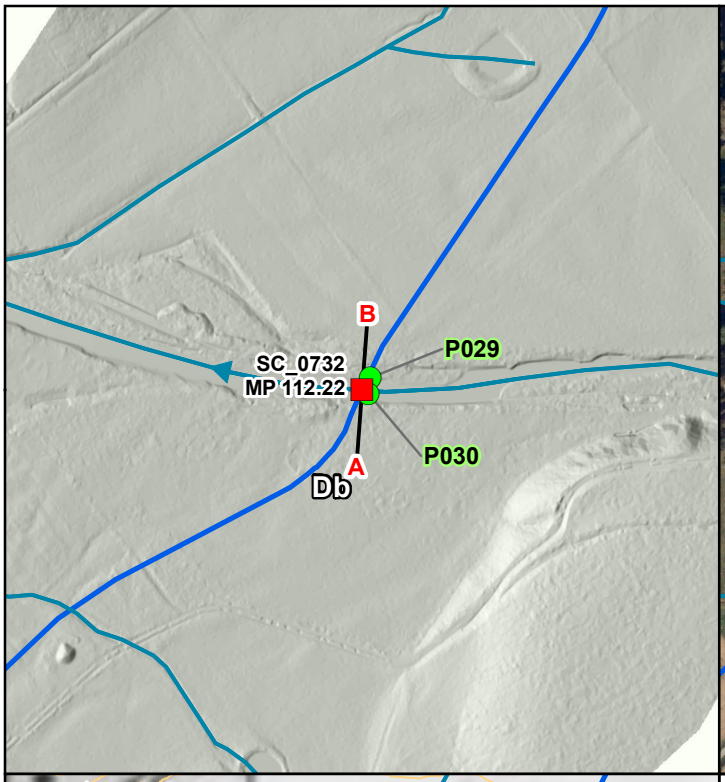
Notes:

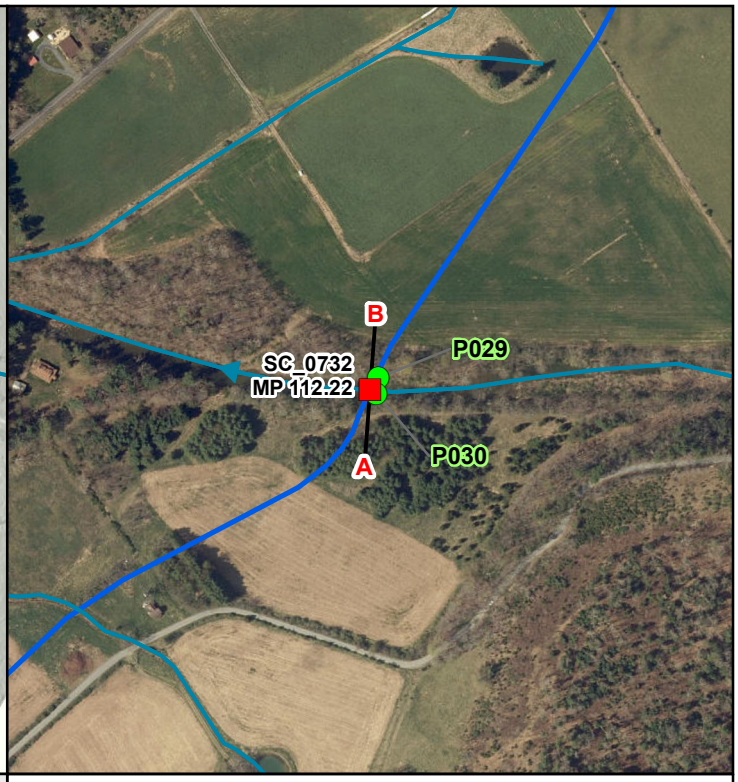
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

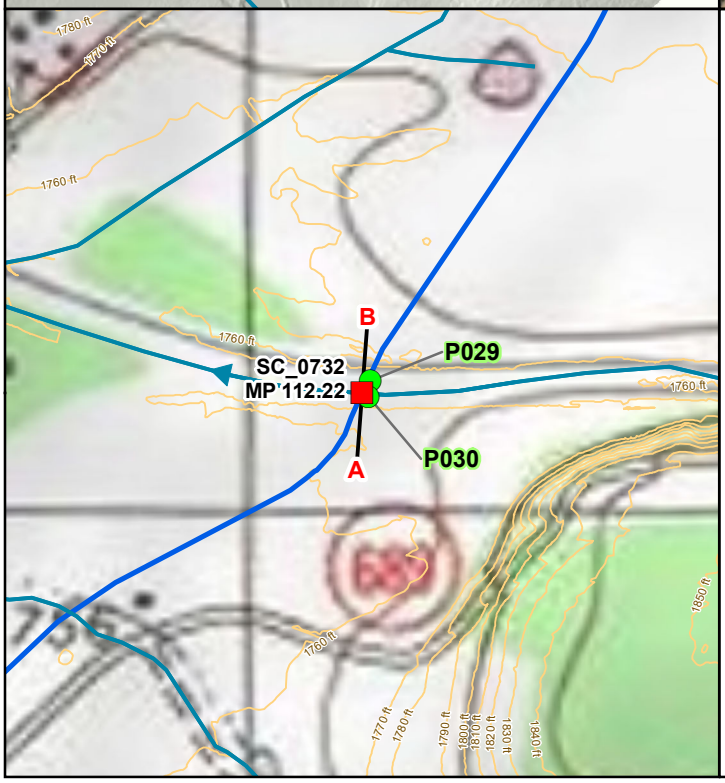
Dominion

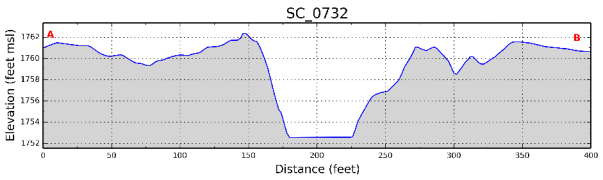
Geosyntec consultants

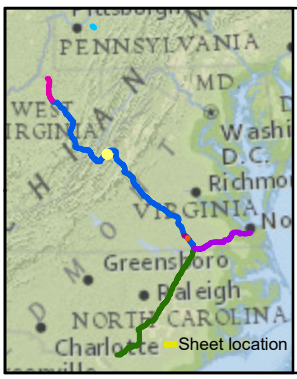
TESSELLATIONS











Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: sauc124

TID_SC: SC_0732

Stream Name: Calfpasture River

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0732

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) The current alignment centerline provided by Dominion/GAI
2) Projection: UTM 17N feet, NAD 83
3) The vertical exaggeration on the profile graph is 4:1
4) Hillshade (azimuth: 280) created from 2 foot lidar data provided by Dominion/GAI
5) In areas that did not have lidar data, hillshade was created from 1/3 arc-second (10m) NED

Dominion

Geosyntec consultants

TESSELLATIONS

TID	SC_0732	**ACP Segment**	AP-1
Stream Name	Calfpasture River	**MP**	112.22
Survey Date	08-April-2016	**Start Time**	1325 hrs

- Stream width is 58 feet at bankfull and is characterized by a step pool morphology with bedrock grade control; stream reach is fairly straight.
- Bedrock outcrops at crossing.
- Left bank terrace is about 6.5 feet high from channel and steep, whereas right bank is only 1 feet high and moderately sloped.
- Both banks comprised of cobbles and boulders.
- Riparian buffer on left bank is over five river widths wide, whereas less than two river widths on the right bank.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Place sag bends at a minimum of two river widths beyond each river bank. Given potential for river to be affected by debris flows it is recommended to bury pipeline into bedrock with at least 1.5 foot of cover above the crown from sag bend to sag to sag bend.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	8-Apr-16	Stream Name:	Calfpasture River
Crossing ID:	SC_0732		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

- [ ] Natural
- [X] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Cattle grazing

Part 2: River Valley Conditions

Vegetation

- [ ] None
- [ ] Grass
- [X] Pasture
- [X] Crops
- [ ] Shrubs
- [X] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Valley Side Features

- [X] None
- [ ] Occasional
- [ ] Frequent

Failure Locations

- [X] None
- [ ] Away from river
- [ ] Along river

Part 3: Floodplain

Floodplain Width

- [ ] None
- [ ] 1 < river widths
- [ ] 1-5 river widths
- [ ] 5-10 river widths
- [X] > 10 river widths

Land Use

- [ ] Natural
- [X] Agricultural
- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Industrial
- [ ] Mining
- [X] Cattle grazing

Vegetation

- [ ] None
- [X] Grass
- [ ] Pasture
- [ ] Orchards
- [ ] Crops
- [ ] Shrubs
- [X] Deciduous Forest/trees
- [ ] Coniferous Forest/trees

Riparian Buffer Strip

- [ ] None
- [X] < 1 river width
- [ ] 1-5 river widths
- [X] > 5 river widths

Part 4: Vertical Confinement

Terraces

- [ ] None
- [ ] Left bank
- [ ] Right bank

Levees

- [X] None
- [ ] Natural
- [ ] Constructed

Levee Location

- [ ] Along channel bank
- [ ] Set back < 1 river width
- [ ] Set back > 1 river width

Part 5: Lateral Relation of Channel to Valley

Planform

- [X] Straight
- [ ] Meandering
- [ ] Braided
- [ ] Anastomosed
- [ ] Engineered

Meander Characteristics

- [X] Mild bends
- [ ] Moderate bends
- [ ] Tight bends

Section 3 - Channel Description (select all that apply)

Part 6: Channel Description (select all that apply)

Bed Controls

- [ ] None
- [ ] Occasional
- [ ] Frequent
- [X] Confined

Control Types

- [ ] None
- [X] Bedrock
- [ ] Boulders
- [ ] Gravel armor

Width Controls

- [ ] None
- [ ] Occasional
- [X] Frequent
- [ ] Confined

Control Types

- [ ] None
- [ ] Bedrock
- [X] Boulders

Other

- [ ] Debris
- [ ] Mining
- [ ] Reservoir
- [ ] Knickpoint

Flow Habit

- [X] Perennial
- [ ] Flashy perennial
- [ ] Intermittent
- [ ] Ephemeral

Channel Width: 58' at bank full

M-B Classification

- [X] Cascade or step-pool
- [ ] Plane, pool-riffle, dune-ripple
- [ ] Braided

Part 7: Bed Sediment Description (select all that apply)

Bed Material

- [ ] Clay
- [ ] Silt
- [ ] Sand
- [ ] Gravel
- [ ] Cobbles
- [ ] Boulders
- [X] Bedrock

Bar Types

- [X] None
- [ ] Alternate bars
- [ ] Point bars
- [ ] Mid-channel bars
- [ ] Diagonal bars
- [ ] Irregular/combination
- [ ] Braided

Bar Material

- [ ] Silt
- [ ] Sand
- [ ] Gravel
- [ ] Cobbles

Bar Vegetation

- [ ] None
- [ ] Grasses
- [ ] Reeds/shrubs
- [ ] Trees

Bar Width

- [ ] None
- [ ] Narrow
- [ ] Moderate
- [ ] Wide

Percent sand in bed = _____ %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	*Left Bank*	*Right Bank*
Bank Material	[ ] Clay [ ] Silt [ ] Gravel [X] Cobbles [X] Boulders [ ] Bedrock	[ ] Clay [ ] Silt [ ] Gravel [X] Cobbles [X] Boulders [ ] Bedrock
Layer Material	[ ] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[ ] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	6.5 from bank full 9.5 from Lew	1' from bank full ~4' current stage
Bank Slope	[X] Steep [ ] Moderate [ ] Shallow	[ ] Steep [X] Moderate [ ] Shallow
Bank Vegetation	[ ] None [ ] Grasses/annuals [X] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [ ] young [X] mature [ ] old tree diversity [X] Y [ ] N	[ ] None [ ] Grasses/annuals [X] Reeds/shrubs [ ] Trees: Falling trees? [ ] Y [X] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [X] young [ ] mature [ ] old tree diversity [X] Y [ ] N
Bank Erosion and Failure Location	location of erosion [X] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [ ] general type of erosion [X] fluvial [ ] geotechnical	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [X] general type of erosion [X] fluvial [ ] geotechnical

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0732, Calfpasture River at MP 112.22 (AP-1)

Photograph 1 (077.jpg)	
Date: 08-April-2016	
Direction: Upstream	
Description: View of step at stream crossing. Rock outcrop identified on left bank (red arrow).	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0732, Calfpasture River at MP 112.22 (AP-1)

Photograph 2 (IMG_1016.jpg)	
Date: 08-April-2016	
Direction: Upstream	
Description: View of rock outcrop in stream on left bank as well as thin riparian buffer on right bank.	

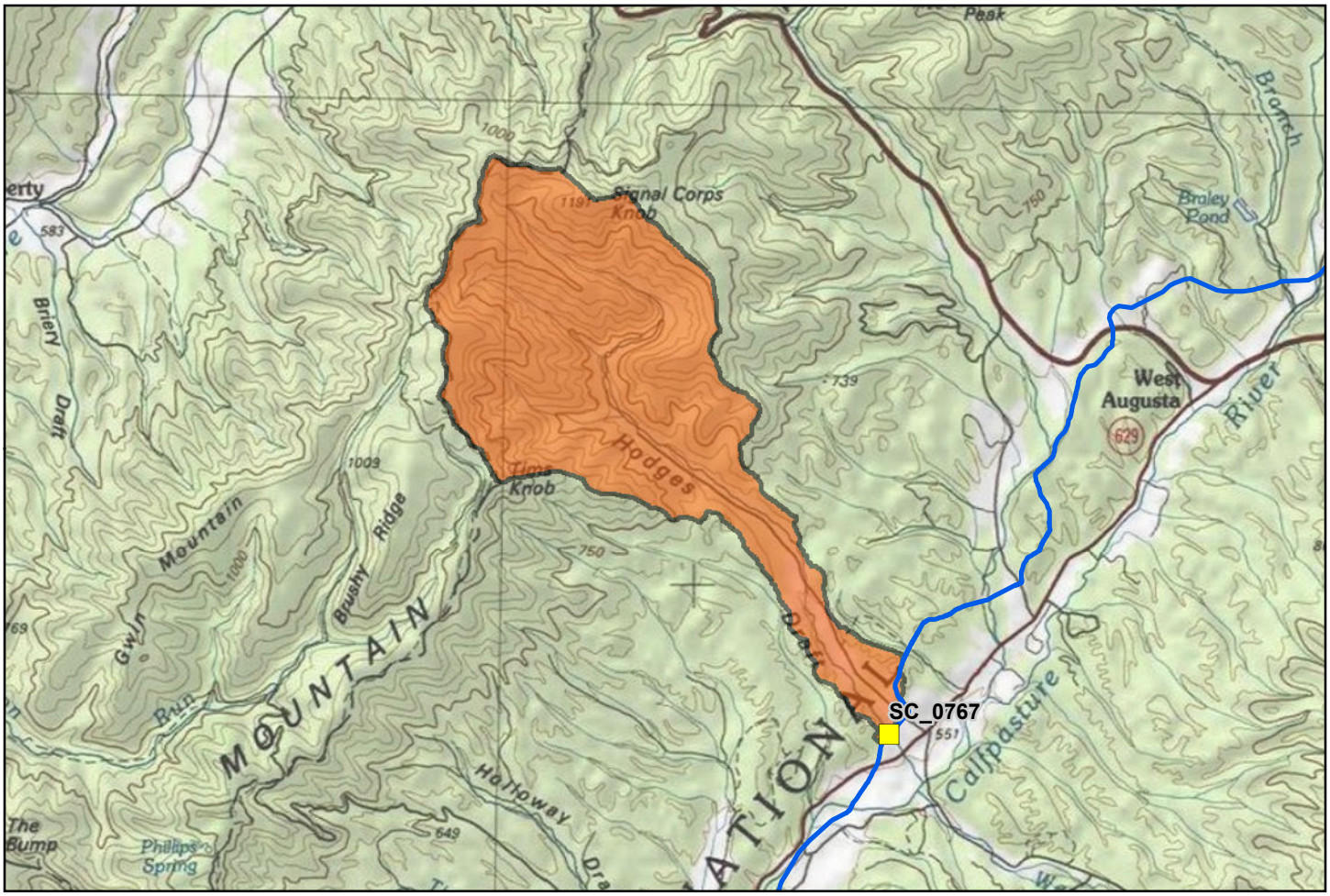
PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

Client: Atlantic Coast Pipeline **Project Number:** TXG0007

Subject Site: SC_0732, Calfpasture River at MP 112.22 (AP-1)

Photograph 3 (IMG_1017.jpg)	
Date: 08-April-2016	
Direction: Downstream	
Description: View of cobbles and occasional boulders in stream bed as well as cobbles lining right bank.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0767	sauc125	AP-1	112.6	Virginia	Augusta

Attribute	Value
Stream Name	Hodges Draft
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	4.651
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	26
Slope At Crossing Over 200ft Long Reach (%)[4]	1.993
Proposed Construction Method[5]	1) Flume 2) Dam and Pump

Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636
- Watershed Boundary

Drainage Area Map

1:100,000

0 2,250 4,500 9,000 Feet

0 2 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0767

Revision	Date	Created By	Approved by
0	08-01-2016	BP	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

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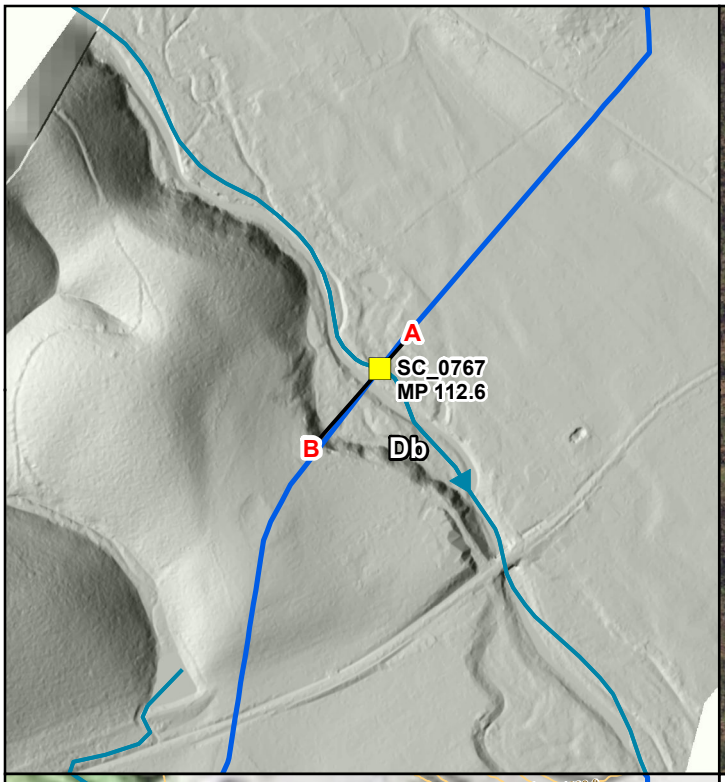
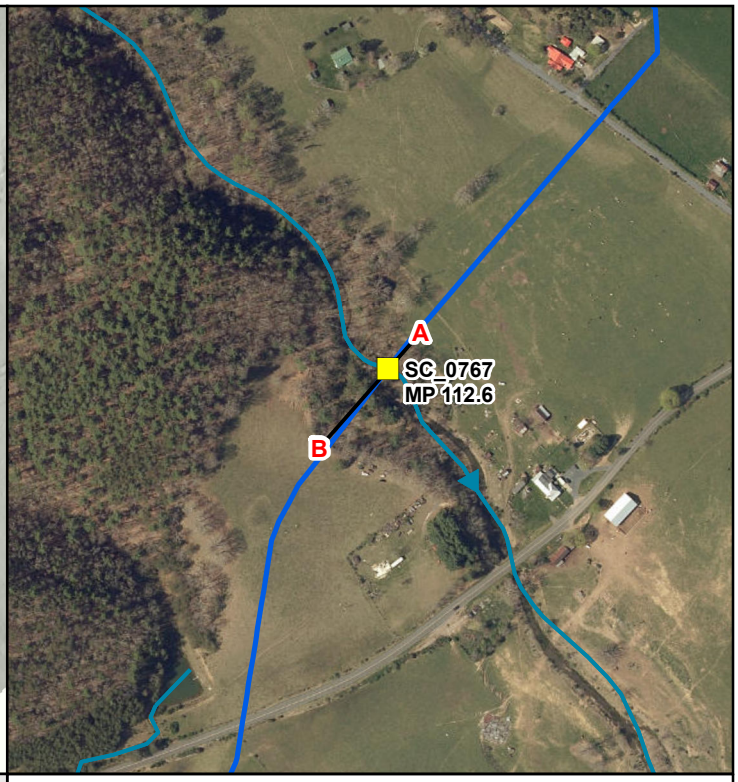
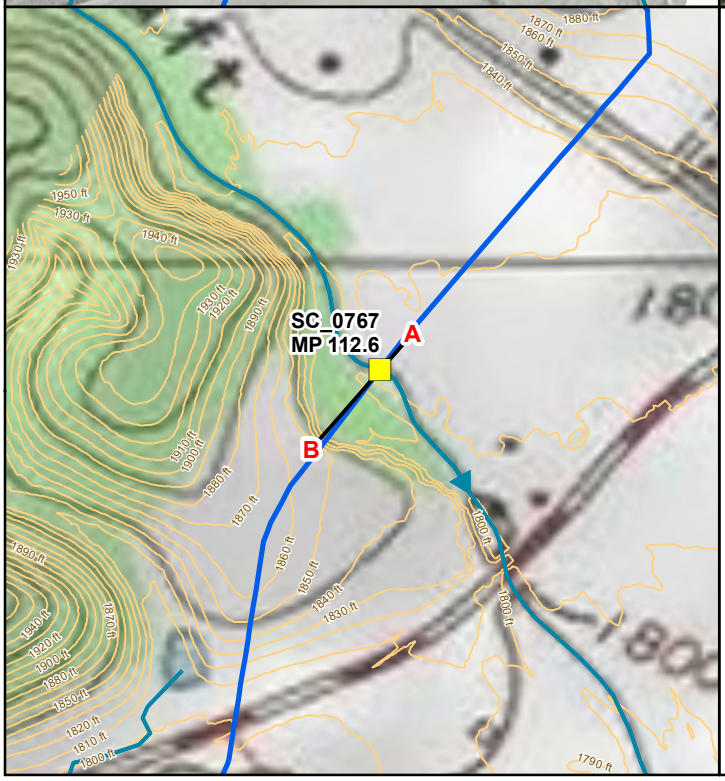
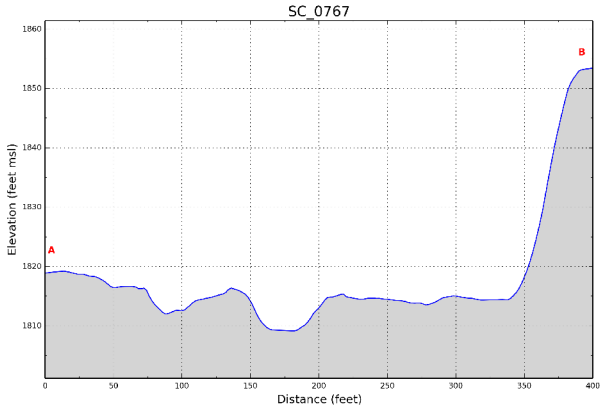
TESSELLATIONS









Legend

Hydrotechnical Hazards

- High
- Moderate
- Low
- Field Observation Locations
- Profile Line (400ft)
- Stream with Flow Direction
- ACP AP-1
- ACP AP-2
- ACP AP-3
- ACP AP-4
- ACP AP-5
- TL-635
- TL-636

Stream Crossing Plan View and Profile

Location ID: sauc125

TID_SC: SC_0767

Stream Name: Hodges Draft

1:6,000

0 125 250 500 Feet

0 0.025 0.05 0.1 Miles

N

Document Information:

Document No:
DOM_EC_CRO_MA_001_SC_0767

Revision	Date	Created By	Approved by
0	07-28-2016	CR	RS
1	03-01-2017	BP	RS
2	04-21-2017	BP	RS

Notes:

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TESSELLATIONS