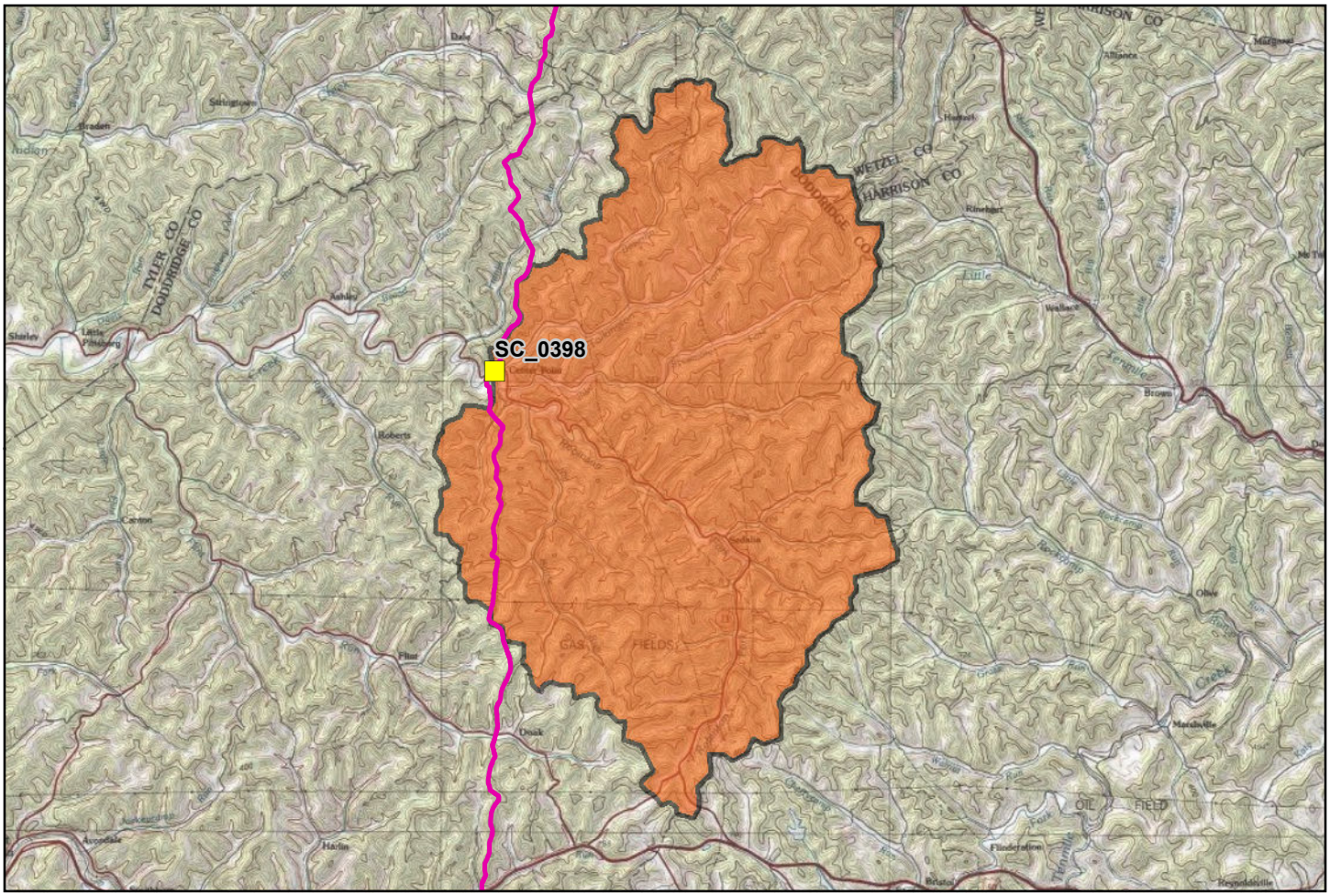


TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0398		TL-635	18.56	West Virginia	Doddridge

Attribute	Value
Stream Name	McElroy Creek
Physiographic Province[1]	Appalachian Plateaus
Drainage Area (square miles)[2]	39.827
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	60
Slope At Crossing Over 200ft Long Reach (%)[4]	0.113
Proposed Construction Method[5]	

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

1:200,000

0 4,500 9,000 18,000 Feet

0 4.5 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0398

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

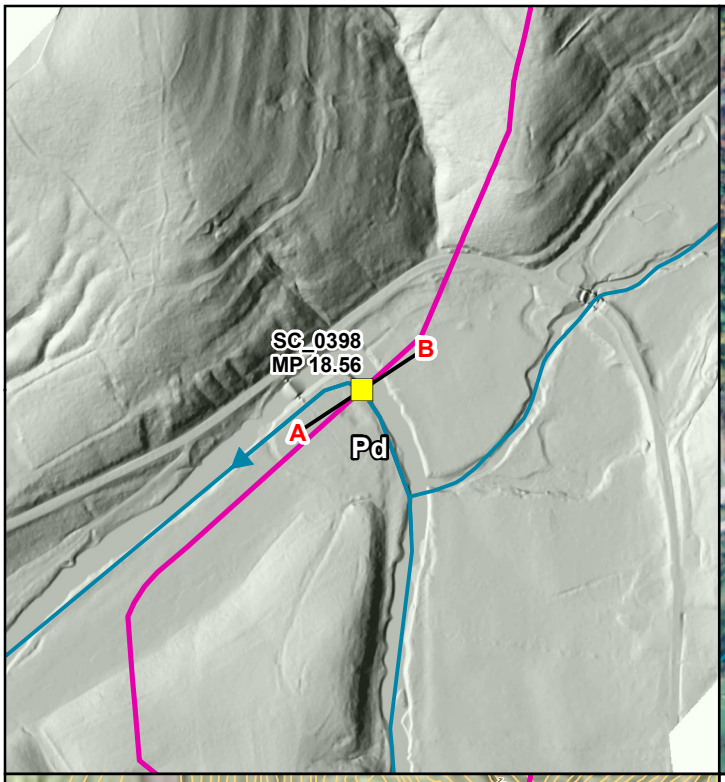
Notes:

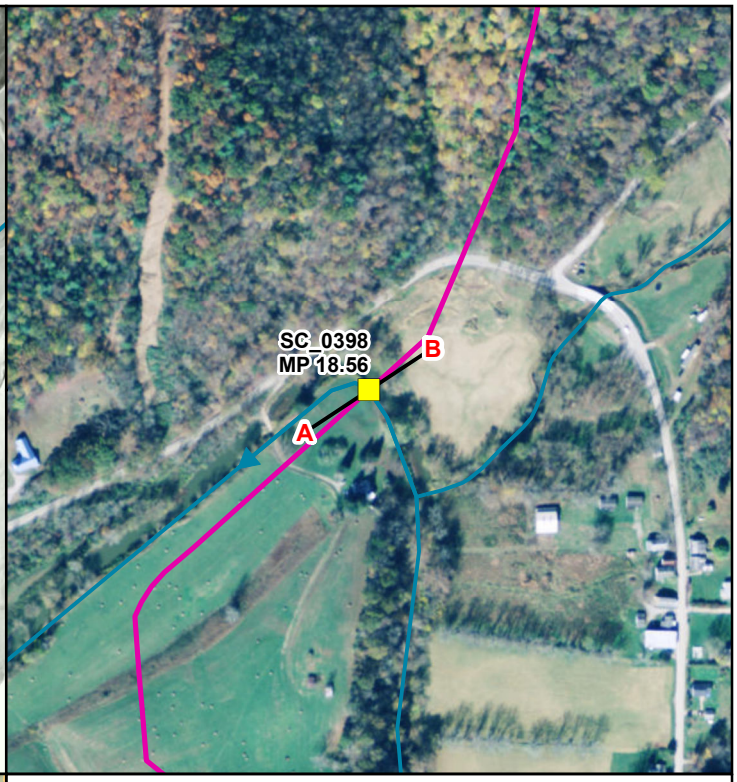
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

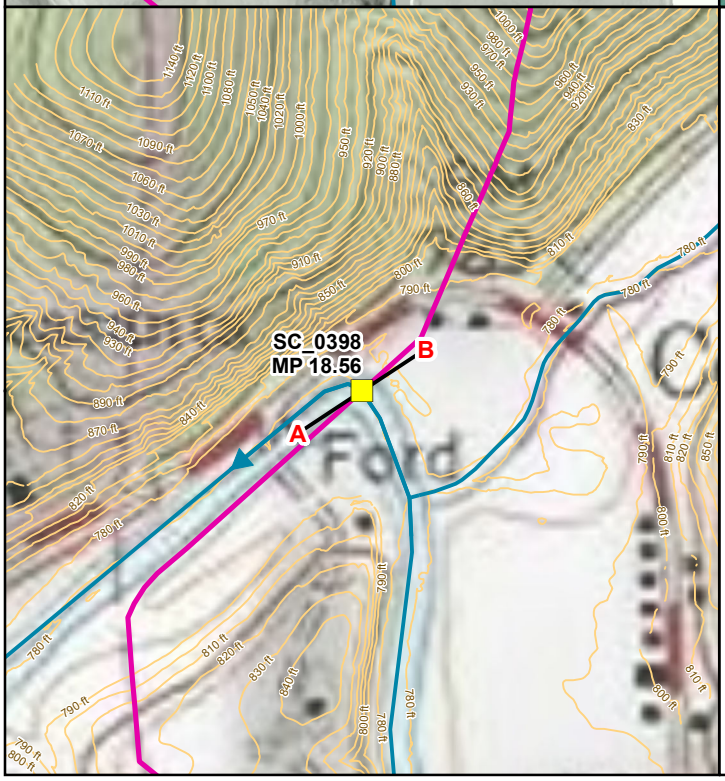
Dominion

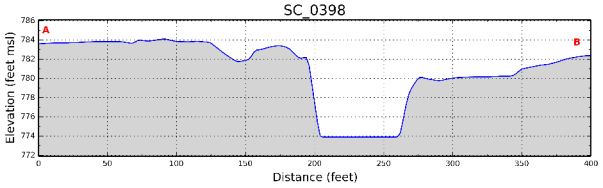
Geosyntec consultants

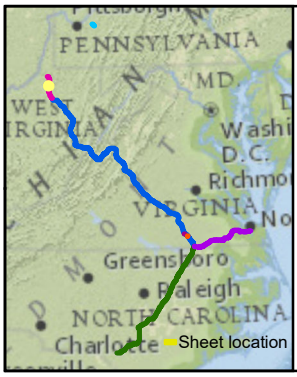
TESSELLATIONS











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:

TID_SC: SC_0398

Stream Name: McElroy 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_0398

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_0398	**ACP Segment**	TL-635
Stream Name	McElroy Creek	**MP**	18.56
Survey Date	11-April-2016	**Start Time**	1345 hrs

- Survey was conducted from the right bank and creek could not be waded at crossing. Stream was waded downstream of crossing where culverts were installed by landowner to place an access road to property.
- Pipeline crossing is located approximately 90 feet upstream from 90 degree bend against State Highway 23. The opposite side of the road is the toe of a steep slope with rock outcrops.
- No riparian buffer on either bank at location of pipeline crossing. Riparian buffer downstream of crossing.
- Stream bed is predominantly fine grained at crossing, but fine gravel-sized armoring observed approximately 300 feet downstream at culverts.
- Banks are steep and approximately 8 feet high and comprised of fine-grained soils (silt/clay).
- Tributary entering river from right bank.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Evaluate scour depth for pipeline burial depth as local scour may be significant. Lateral migration towards the left bank is low, but the potential towards the right bank into floodplain is greater. Evaluate local topography to establish setback for sag bends.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	11-Apr-16	Stream Name:	McElroy Creek
Crossing ID:	SC_0398		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

- [X] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [X] Rural
- [ ] Industrial
- [ ] 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
- [X] 5-10 river widths
- [ ] > 10 river widths

Land Use

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

Vegetation

- [ ] None
- [X] Grass
- [ ] Pasture
- [ ] Orchards
- [ ] Crops
- [ ] 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

- [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

- [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: 60.0'

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
- [ ] 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 [ ] 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	8'	8'
Bank Slope	[X] Steep [ ] Moderate [ ] Shallow	[X] Steep [ ] Moderate [ ] Shallow
Bank Vegetation	[ ] None [ ] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [X] sparse [ ] dense Tree health [ ] good [X] poor tree ages [ ] young [X] mature [ ] old tree diversity [ ] Y [X] N	[ ] None [X] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [X] sparse [ ] dense Tree health [ ] good [X] poor tree ages [ ] young [X] mature [ ] old tree diversity [ ] Y [X] 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_0398, McElroy Creek at MP 18.55 (TL-635)

Photograph 1 (IMG_1044.jpg)	
Date: 11-April-2016	
Direction: Downstream	
Description: View of creek, clayey banks, and 90 degree bend against Hwy. 23 (see vehicle).	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0398, McElroy Creek at MP 18.55 (TL-635)

Photograph 2 (057.jpg)	
Date: 11-April-2016	
Direction: Downstream	
Description: View from 90 degree bend about 30 yards downstream of crossing of elevated pedestrian crossing and culverts. Fluvial erosion undercutting mature tree on right bank is noticeable.	

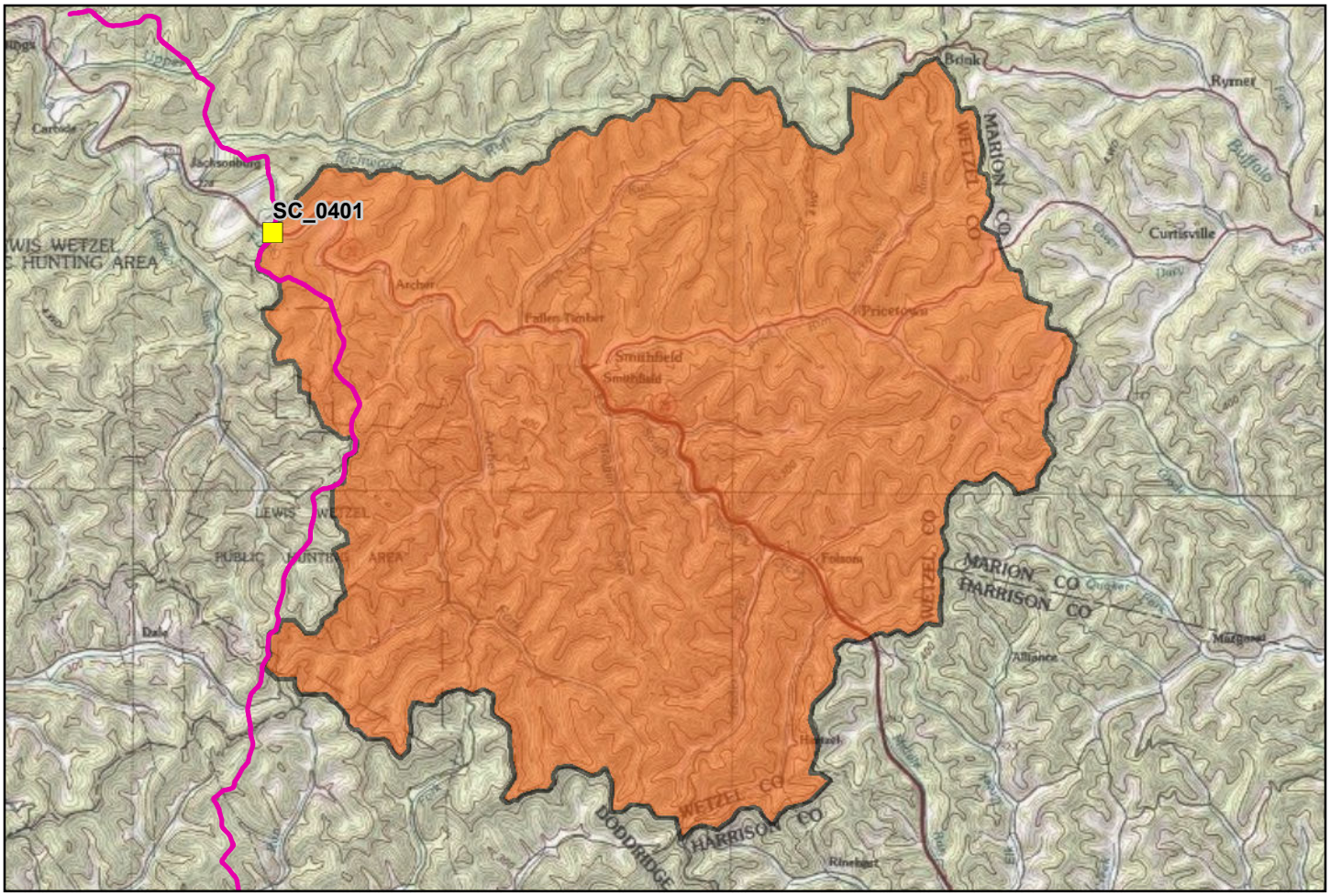
PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0398, McElroy Creek at MP 18.55 (TL-635)

Photograph 3 (055.jpg)	
Date: 11-April-2016	
Direction: Upstream	
Description: View of pipeline crossing survey marker (red arrow), sloping banks, lack of riparian buffer, and floodplain on the right bank (left side of photo).	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0401		TL-635	29.41	West Virginia	Wetzel

Attribute	Value
Stream Name	South Fork Fishing Creek
Physiographic Province[1]	Appalachian Plateaus
Drainage Area (square miles)[2]	45.182
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	Not wadeable
Slope At Crossing Over 200ft Long Reach (%)[4]	0.069
Proposed Construction Method[5]	

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

1:150,000

0 3,350 6,700 13,400 Feet

0 3.5 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0401

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

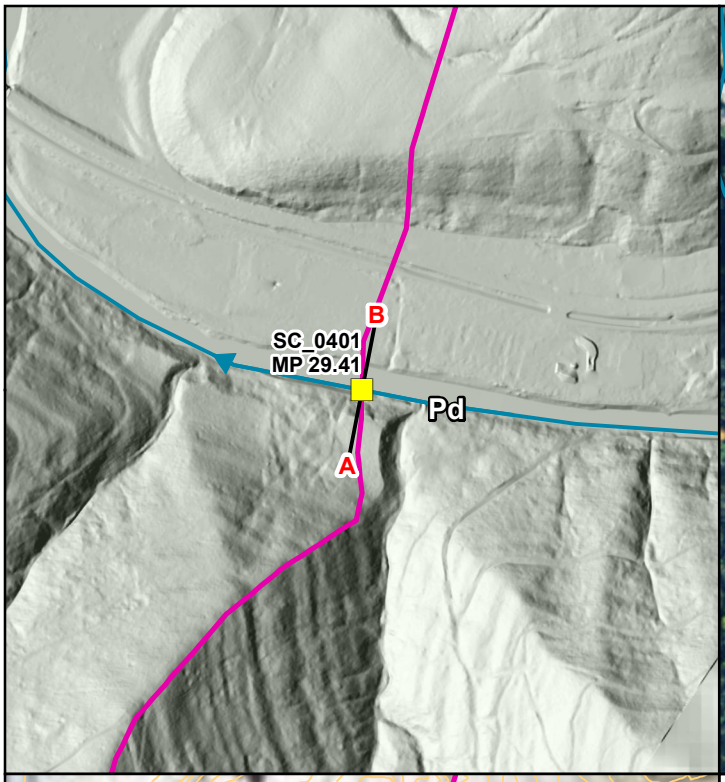
Notes:

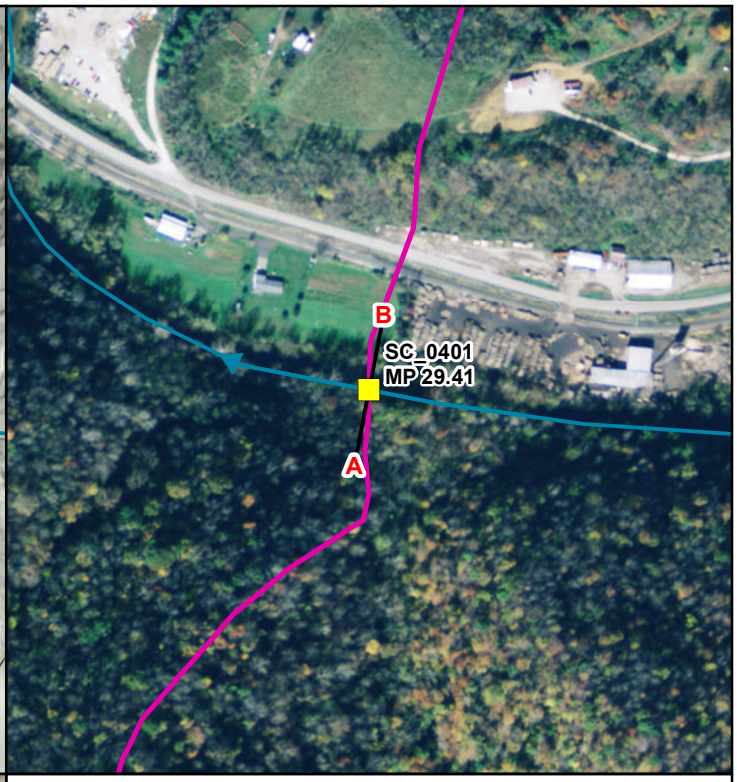
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

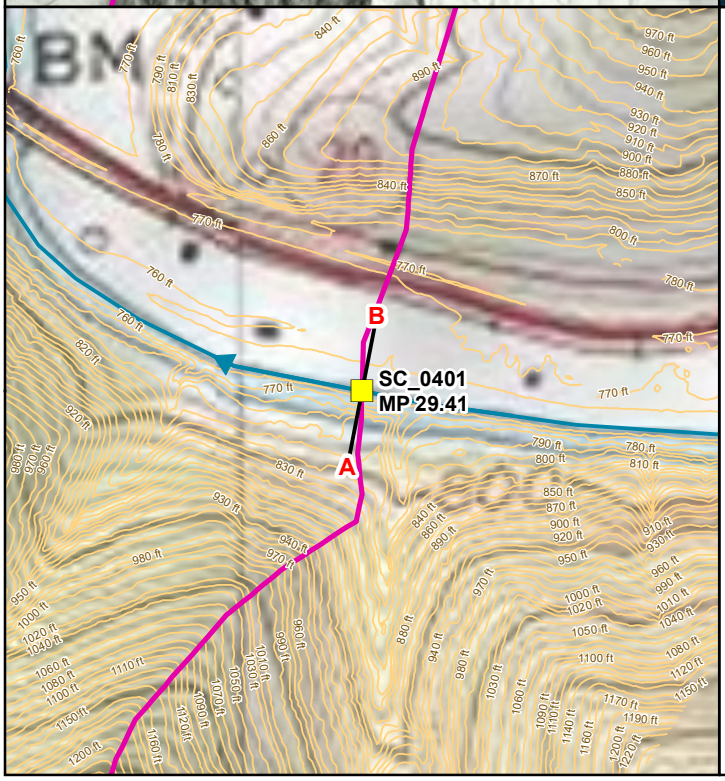
Dominion

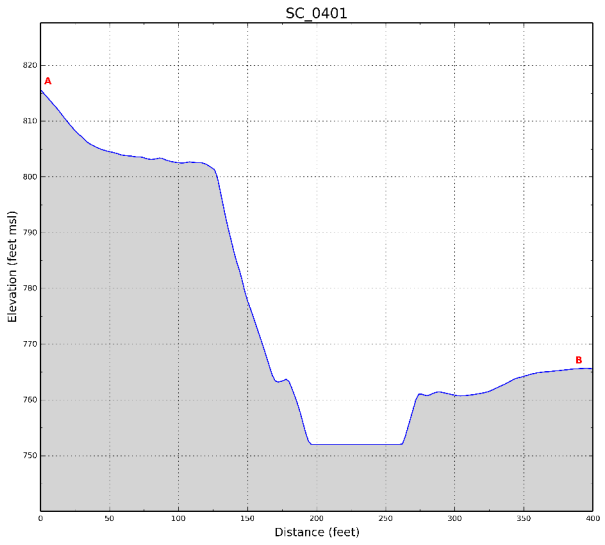
Geosyntec consultants

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:

TID_SC: SC_0401

Stream Name: South Fork Fishing 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_0401

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_0401	**ACP Segment**	TL-635
Stream Name	South Fork Fishing Creek	**MP**	29.41
Survey Date	11-April-2016	**Start Time**	1525 hrs

- Survey was conducted from the right bank and creek could not be waded at crossing.
- Left bank is a natural slope (valley wall) densely forested with deciduous trees.
- Right bank is clayey and next to the stock yard of a wood mill owned by Allegheny Wood Products.
    - Allegheny Wood Products, Mill #11, Outfall #001 entering stream from right bank
- Riparian buffer on the right is thin (less than one stream width) and exhibits falling young trees.
- Stream bed comprises angular and sub-angular boulder and cobble-sized slabs of sandstone and slate.
- Stream has a riffle-pool morphology with pipeline crossing at a riffle with a local scour pool measured at 4 feet deep.
- Two pipes were observed on the left bank at about flood elevation.
    - Signs of high flows approximately 5 feet above observed water levels
- Lateral migration towards the left bank is constrained by valley wall.
- Lateral migration to the right is unlikely given active land use as wood mill and State Hwy. 20.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Evaluate scour depth for pipeline burial depth as local scour may be significant. Place right sag bend at standard set back.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	11-Apr-16	Stream Name:	South Fork Fishing Creek
Crossing ID:	SC_0401		

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
- [X] 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
- [X] Rural
- [X] Industrial
- [ ] Mining
- [ ] Cattle grazing

Vegetation

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

Riparian Buffer Strip

- [ ] None
- [X] < 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

- [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

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

Control Types

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

Other

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

Flow Habit

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

Channel Width: Not wadeable

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*
[X] Clay	[X] None	[ ] Silt	[ ] None	[ ] None
[X] Silt	[ ] Alternate bars	[ ] Sand	[ ] Grasses	[ ] Narrow
[X] Sand	[ ] Point bars	[ ] Gravel	[ ] Reeds/shrubs	[ ] Moderate
[ ] Gravel	[ ] 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 [ ] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock	[X] Clay [ ] 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	4'	6'
Bank Slope	[ ] Steep [X] Moderate [ ] Shallow	[X] Steep [ ] Moderate [ ] Shallow
Bank Vegetation	[ ] None [ ] Grasses/annuals [ ] Reeds/shrubs [X] Trees: Falling trees? [X] Y [ ] N Tree density [ ] sparse [X] dense Tree health [X] good [ ] poor tree ages [X] young [ ] mature [ ] old tree diversity [X] Y [ ] N	[ ] 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
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_0401, South Fork Fishing Creek at MP 29.42 (TL-635)

Photograph 1 (060.jpg)	
Date: 11-April-2016	
Direction: Upstream	
Description: View of sloping left bank (valley wall) as well as approximately 6-ft high right bank. Falling trees noticeable as well as flood debris on.	

PHASE 2 – RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0401, South Fork Fishing Creek at MP 29.42 (TL-635)

Photograph 2 (061.jpg)	
Date: 11-April-2016	
Direction: Downstream	
Description: View of extensive riparian buffer on left bank (valley wall) and sloping ground providing lateral confinement.	

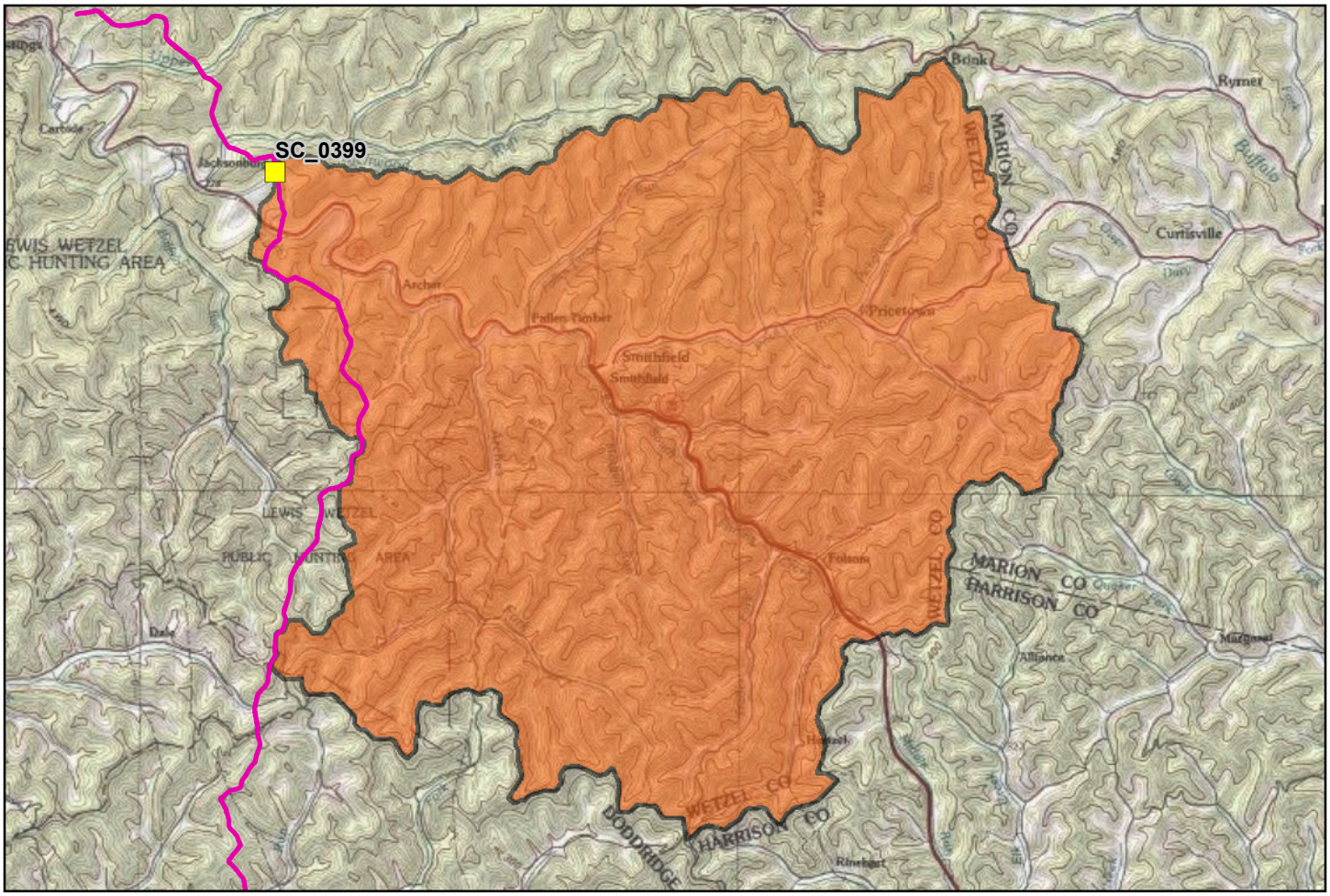
PHASE 2 – RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0401, South Fork Fishing Creek at MP 29.42 (TL-635)

Photograph 3 (070.jpg)	
Date: 11-April-2016	
Direction: Upstream	
Description: View through water of platy cobble sized particles on stream bed. Steel pipes running along left bank are also noticeable (red arrow).	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0399		TL-635	30.09	West Virginia	Wetzel

Attribute	Value
Stream Name	South Fork Fishing Creek
Physiographic Province[1]	Appalachian Plateaus
Drainage Area (square miles)[2]	45.549
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	52
Slope At Crossing Over 200ft Long Reach (%)[4]	0.123
Proposed Construction Method[5]	

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

1:150,000

0 3,350 6,700 13,400 Feet

0 3.5 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0399

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

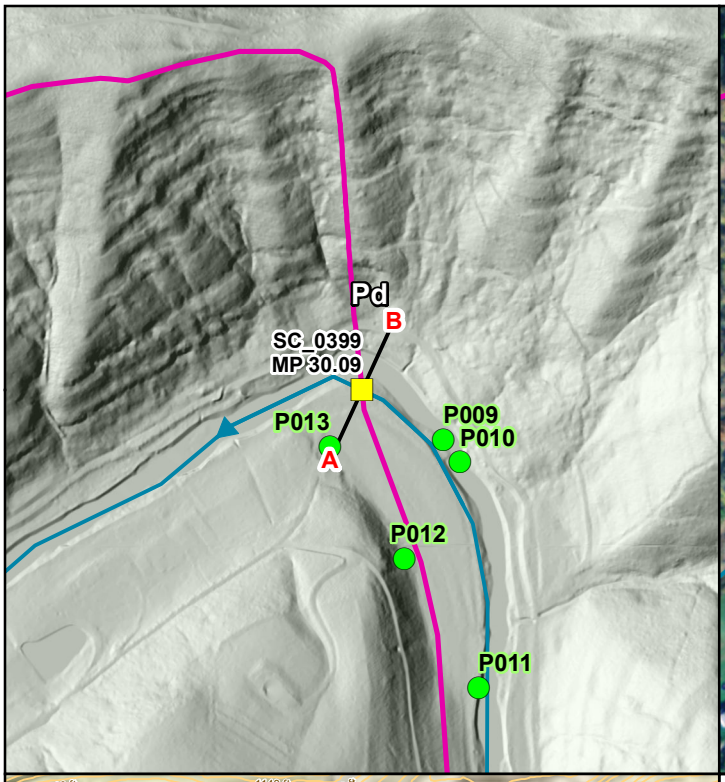
Notes:

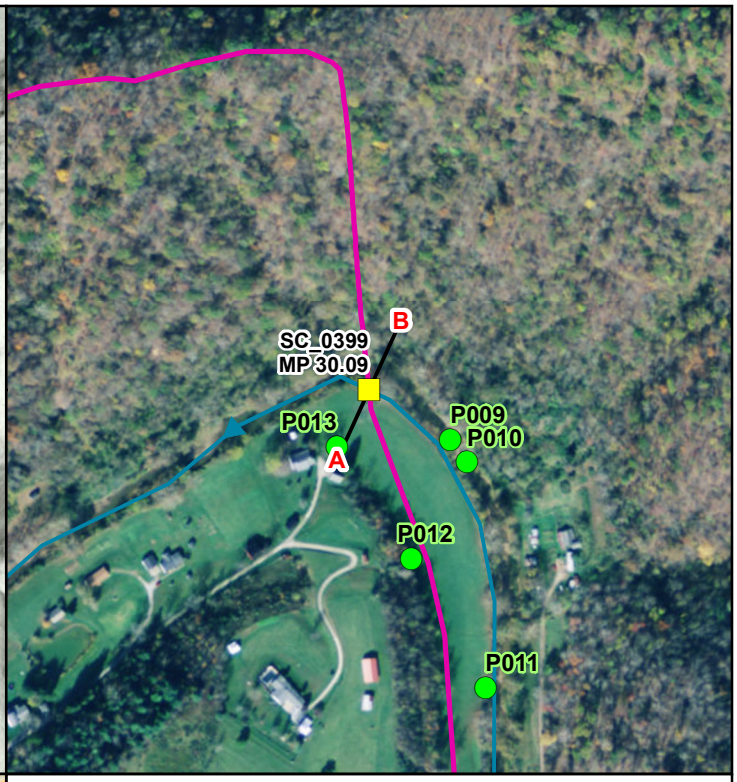
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

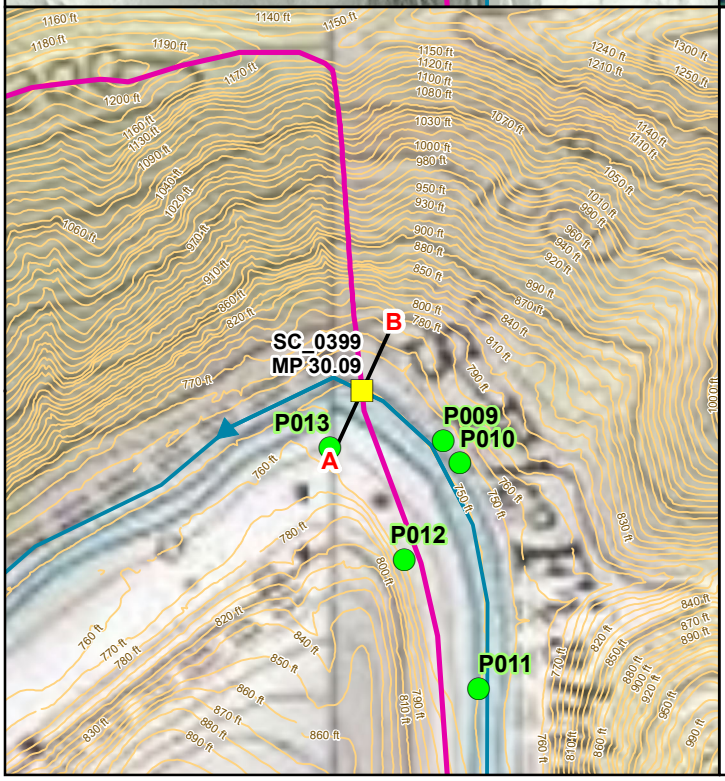
Dominion

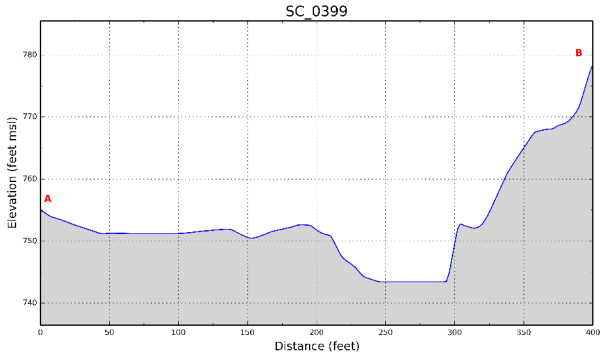
Geosyntec consultants

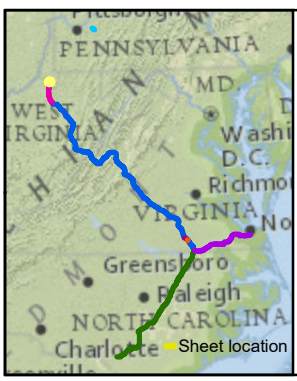
TESSELLATIONS











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:

TID_SC: SC_0399

Stream Name: South Fork Fishing 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_0399

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

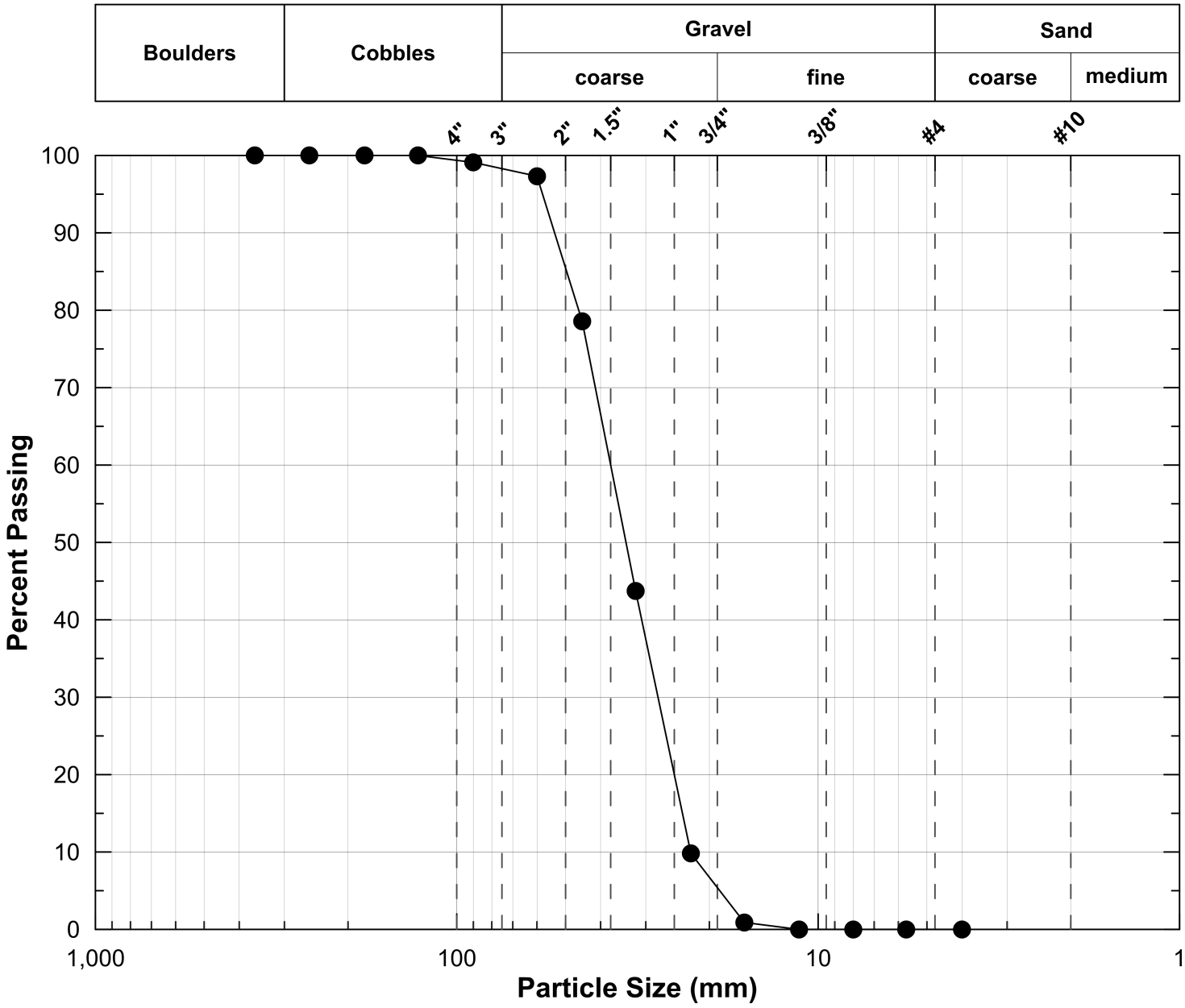
TID	SC_0399	**ACP Segment**	TL-635
Stream Name	South Fork Fishing Creek	**MP**	30.09
Survey Date	11-April-2016	**Start Time**	1615 hrs

- Stream crossing is at a 90 degree bend against valley wall (right bank).
- Bedrock was observed in stream about 300 yards upstream of crossing, but is expected to be shallow at crossing given the valley wall on left bank.
- Right bank is densely forested with deciduous trees.
- Left bank has a thin riparian buffer (less than one stream width) and is connected to the floodplain pasture.
- Left bank is about 6-feet high and comprised of fine grained soils (clay and silt).
- Conducted Wolman Pebble Count on riffle upstream of crossing where gravel was observed; D_{50} is 34 mm (coarse gravel).
- Point bar comprising angular and rounded gravel-sized particles at bend where crossing is located.
- Landowner noted historical observations of floods up to near the house on the left bank floodplain.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Bury pipeline into bedrock with at least 1.5-foot of cover above the crown. Place right sag bend at standard set back. Burial along valley wall within flood plain may encounter bedrock.

Wolman Pebble Count at SC_0399



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:	11-Apr-16	Stream Name:	South Fork Fishing Creek
Crossing ID:	SC_0399		

Section 2 - Region and Valley Description

Part 1: Watershed

Land Use

- [X] Natural
- [ ] Agricultural
- [ ] Urban
- [ ] Suburban
- [X] Rural
- [ ] Industrial
- [ ] 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
- [X] 5-10 river widths
- [ ] > 10 river widths

Land Use

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

Vegetation

- [ ] None
- [X] Grass
- [ ] 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

- [ ] 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

- [ ] 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

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

Width Controls

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

Control Types

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

Other

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

→ Bedrock upstream and downstream-should be shallow

Flow Habit

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

Channel Width: 52'

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	[ ] Silt	[ ] None	[ ] None
[ ] Silt	[ ] Alternate bars	[ ] Sand	[X] Grasses	[ ] Narrow
[ ] Sand	[X] Point bars	[X] Gravel	[ ] Reeds/shrubs	[X] Moderate
[ ] Gravel	[ ] Mid-channel bars	[X] 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 [ ] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock	[X] Clay [ ] 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	6'	6'
Bank Slope	[ ] Steep [ ] Moderate [x] Shallow	[ ] Steep [x] Moderate [ ] Shallow
Bank Vegetation	[ ] None [X] Grasses/annuals [ ] Reeds/shrubs [ ] Trees: NO Falling trees? [ ] Y [X] N Tree density [ ] sparse [ ] dense Tree health [ ] good [ ] poor tree ages [ ] young [ ] mature [ ] old tree diversity [ ] Y [X] N	[ ] None [X] 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 [ ] outside meander bend [X] 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_0399, South Fork Fishing Creek at MP 30.09 (TL-635)

Photograph 1 (087.jpg)	
Date: 11-April-2016	
Direction: Downstream	
Description: Panoramic view of floodplain on left bank and valley wall in background where stream crossing will be located. Notice very thin riparian buffer.	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0399, South Fork Fishing Creek at MP 30.09 (TL-635)

Photograph 2 (083.jpg)	
Date: 11-April-2016	
Direction: Upstream	
Description: Lateral bar upstream of 90 degree bend. Flood debris on branches indicates recent high stages.	

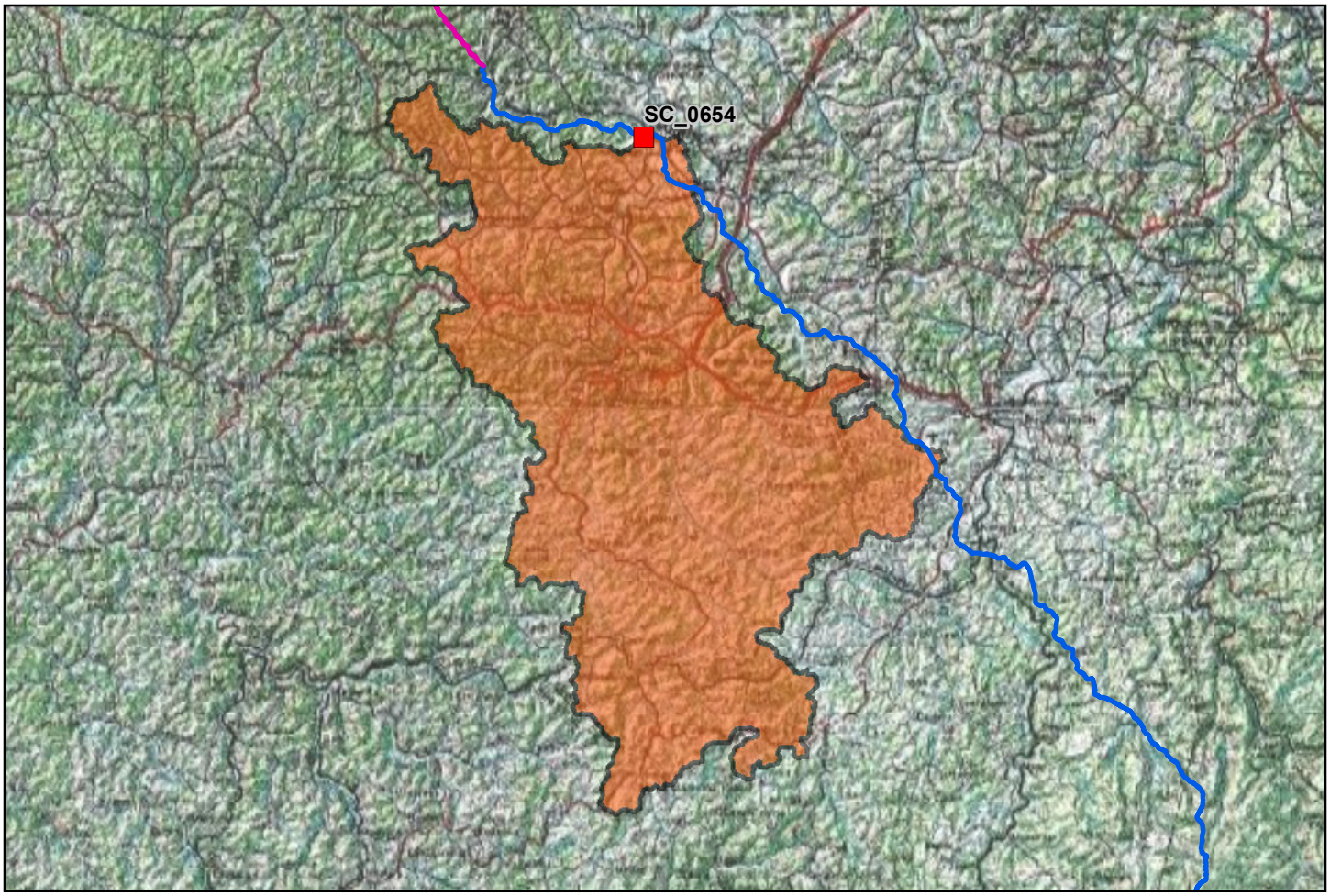
PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0399, South Fork Fishing Creek at MP 30.09 (TL-635)

Photograph 3 (078.jpg)	
Date: 11-April-2016	
Direction: Downstream	
Description: View of 90-degree bend against right valley wall at stream crossing.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0654	sleb009	AP-1	8.17	West Virginia	Lewis

Attribute	Value
Stream Name	West Fork River
Physiographic Province[1]	Appalachian Plateaus
Drainage Area (square miles)[2]	220.693
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	Not wadeable
Slope At Crossing Over 200ft Long Reach (%)[4]	0.005
Proposed Construction Method[5]	Cofferdam

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

1:500,000

0 11,250 22,500 45,000 Feet

0 12 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0654

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

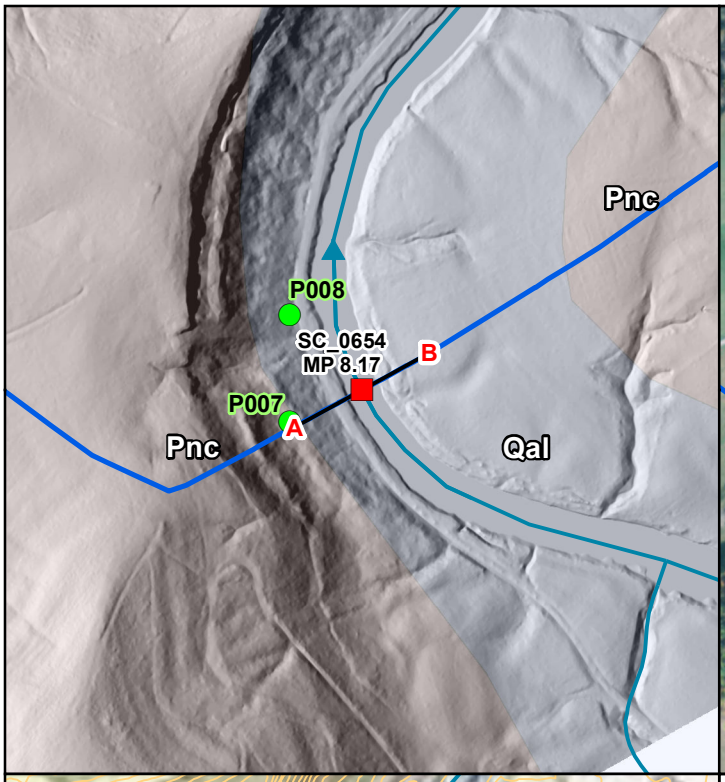
Notes:

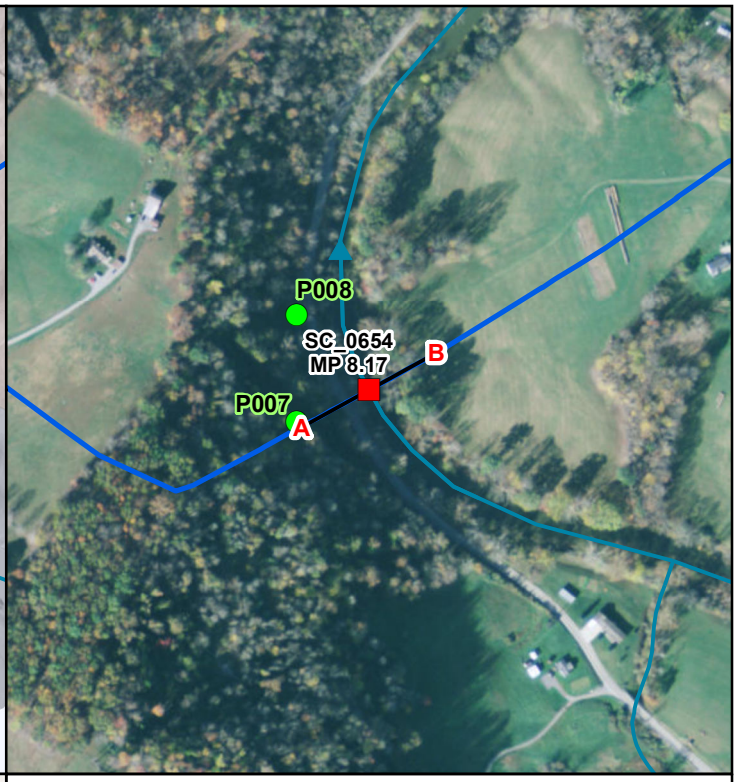
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

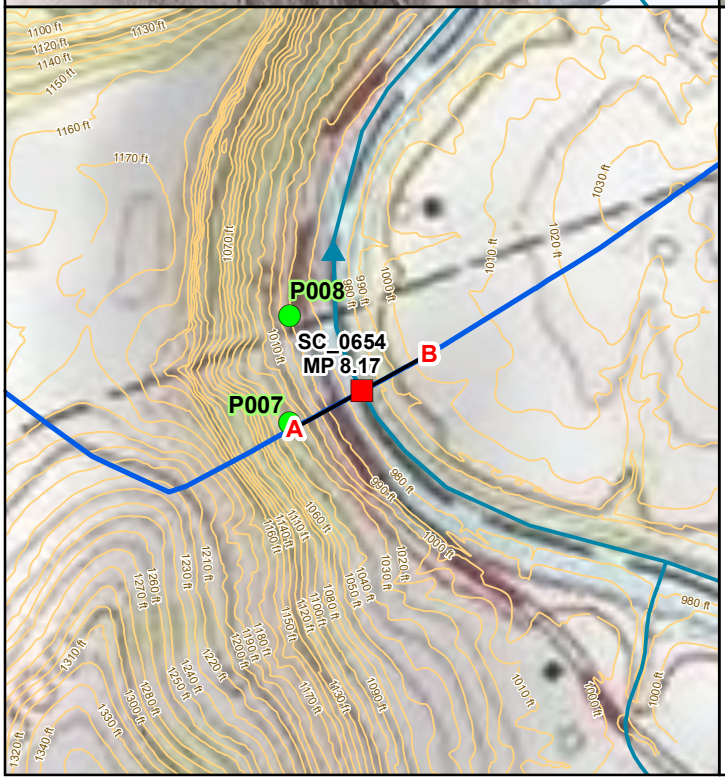
Dominion

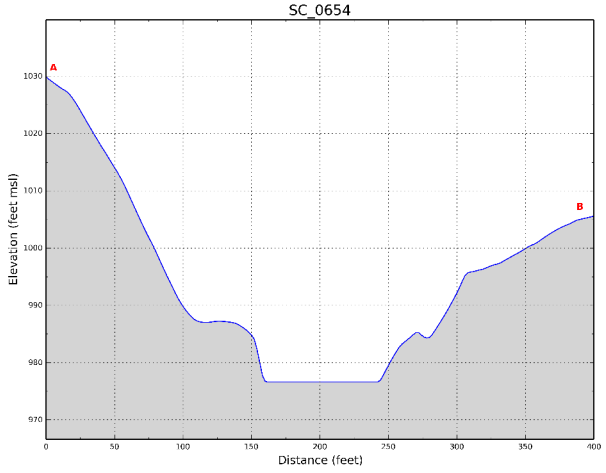
Geosyntec consultants

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: sleb009

TID_SC: SC_0654

Stream Name: West Fork 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_0654

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_0654	**ACP Segment**	AP-1
Stream Name	West Fork River	**MP**	8.17
Survey Date	11-April-2016	**Start Time**	1145 hrs

- Survey was conducted from the left bank and river was could not be waded.
- Pipeline crossing is at a meander bend, and approximately 250 ft upstream of gas pipeline right of way operated by Dominion Transmission.
- Riparian buffer on right bank is narrow (less than one river width). Land on the right bank is rural and utilized as pasture for cattle grazing. Bank height is approximately 5 feet.
- Kincheloe road runs along left bank. One side of the road is the slope of the left bank and the other side of the road is a steep slope, on which outcropping slate with horizontal foliation was identified about 40 feet above the road. Left bank terrace height is approximately 8 feet.
- Deciduous trees on both banks.
- Stream appears to be laterally confined and unlikely to migrate.
- Bank materials are fine-grained soils (i.e., silt and clay).
- Bed material could not be observed, but suspected to be predominantly sandy/fine grained.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Evaluate scour depth for pipeline burial depth as local scour may be significant. Bedrock may be shallower. Lateral migration is unlikely, therefore apply burial depth from valley wall on left bank to standard offset on right bank.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	11-Apr-16	Stream Name:	West Fork River
Crossing ID:	SC_0654		

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
- [ ] 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
- [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
- [X] < 1 river width
- [ ] 1-5 river widths
- [ ] > 5 river widths

Part 4: Vertical Confinement

Terraces

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

Levees

- [ ] 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

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

Width Controls

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

Control Types

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

Other

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

Width appears to be controlled by road on left bank & valley slope

Flow Habit

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

Channel Width: Not wadeable

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*
[X] Clay	[X] None	[ ] Silt	[ ] None	[ ] None
[X] Silt	[ ] Alternate bars	[ ] Sand	[ ] Grasses	[ ] Narrow
[X] Sand	[ ] Point bars	[ ] Gravel	[ ] Reeds/shrubs	[ ] Moderate
[ ] Gravel	[ ] Mid-channel bars	[ ] Cobbles	[ ] Trees	[ ] Wide
[ ] 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 [ ] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock	[X] Clay [ ] 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	8'	5'
Bank Slope	[X] Steep [ ] Moderate [ ] Shallow	[ ] Steep [X] 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 [ ] young [X] mature [ ] old tree diversity [X] Y [ ] N	[ ] None [X] Grasses/annuals [ ] Reeds/shrubs [ ] Trees: Falling trees? [X] Y [ ] N Tree density [X] sparse [ ] dense Tree health [X] good [ ] poor tree ages [ ] 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 [ ] outside meander bend [X] 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_0654, West Fork River at MP 8.17 (AP-1)

Photograph 1 (024.jpg)	
Date: 11-April-2016	
Direction: Upstream	
Description: View at stream crossing (orange tape on left bank) showing falling trees and fluvial erosion along banks. Kincheloe Rd. on left bank with person in view for scale (photo brightened to improve clarity)	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0654, West Fork River at MP 8.17 (AP-1)

Photograph 2 (025.jpg)	
Date: 11-April-2016	
Direction: Downstream	
Description: View of fluvial erosion causing trees to fall and terrace on right bank	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0654, West Fork River at MP 8.17 (AP-1)

Photograph 3	
Date: 11-April-2016	
Direction: towards right bank	
Description: View of gas pipeline right of way on right bank.	

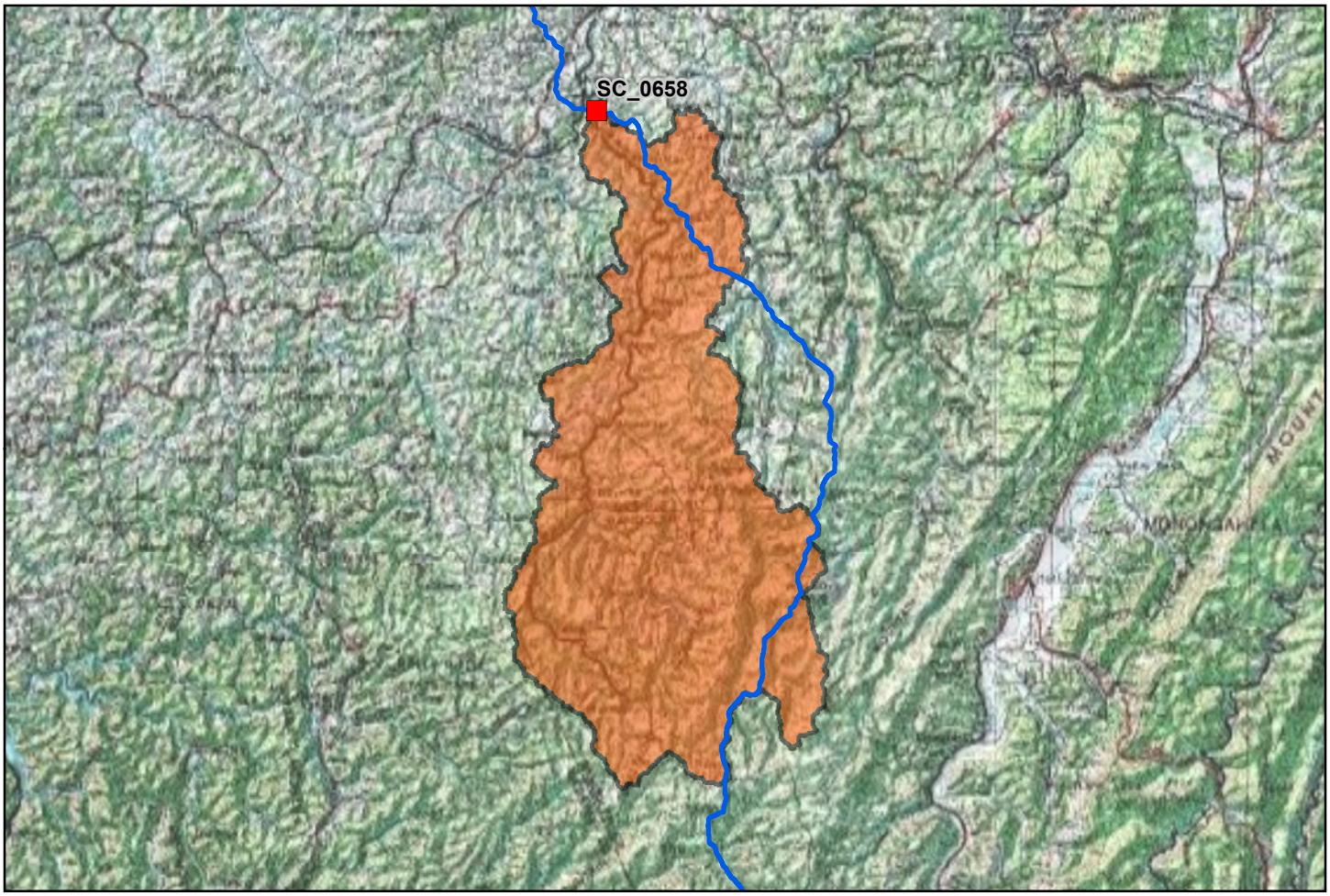
PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0654, West Fork River at MP 8.17 (AP-1)

Photograph 4 (IMG_1038.jpg)	
Date: 11-April-2016	
Direction: Upslope on left bank	
Description: View of existing gas pipeline right of way operated by Dominion.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0658	supa009	AP-1	31.67	West Virginia	Upshur

Attribute	Value
Stream Name	Buckhannon River
Physiographic Province[1]	Appalachian Plateaus
Drainage Area (square miles)[2]	124.371
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	Not wadeable
Slope At Crossing Over 200ft Long Reach (%)[4]	0.107
Proposed Construction Method[5]	Cofferdam

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

1:450,000

0 10,000 20,000 40,000 Feet

0 11 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0658

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

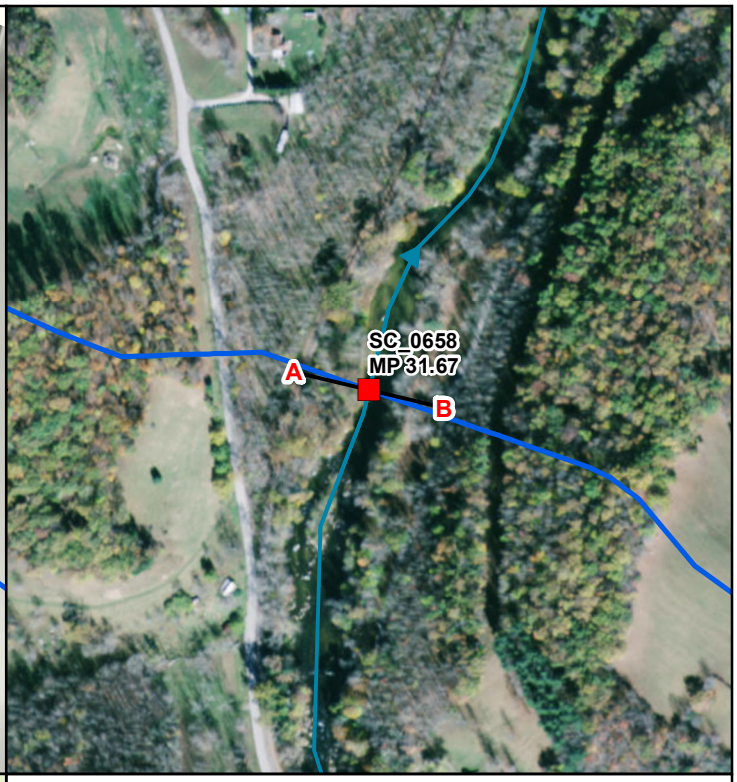
Notes:

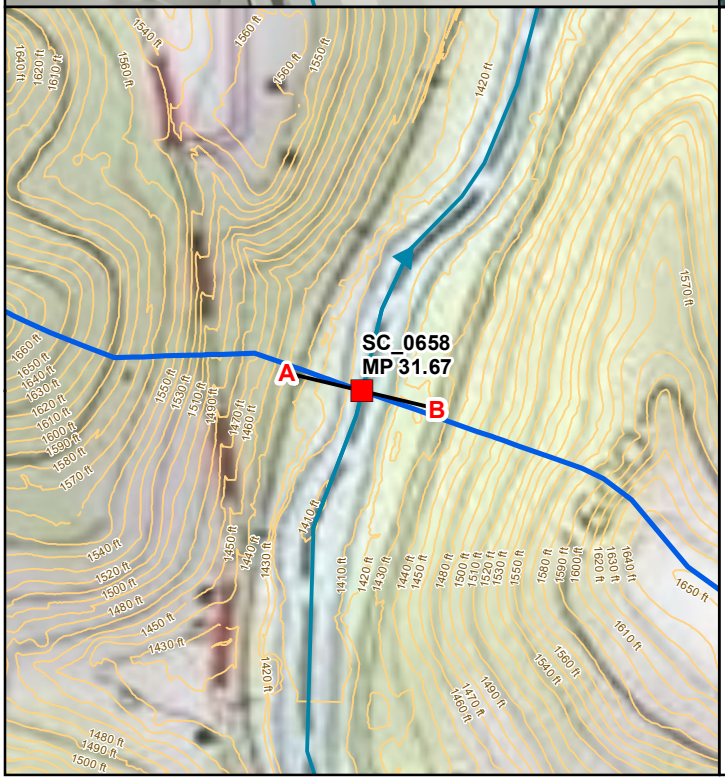
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

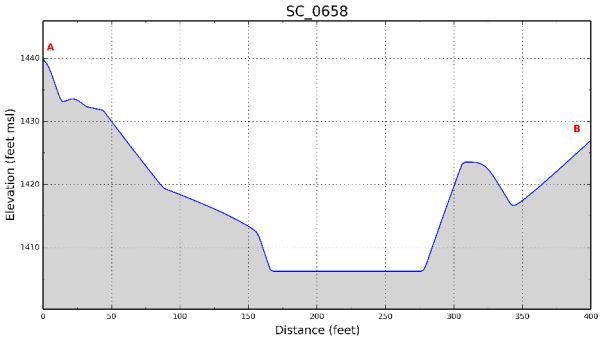
Dominion

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: supa009

TID_SC: SC_0658

Stream Name: Buckhannon 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_0658

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_0658	**ACP Segment**	AP-1
Stream Name	Buckhannon River	**MP**	31.67
Survey Date	11-April-2016	**Start Time**	1020 hrs

- River is laterally confined in relatively narrow floodplain such that lateral migration is unlikely. An active rail line runs along the left bank.
- Observations were conducted on the right bank of the river. Stream could not be waded.
- River is anastomosed as island width is about half the width of the stream.
- Island is vegetated with shrubs and young trees. Height of island is about 6 feet above water line.
- Right bank is steep and about 15 to 20-feet high and comprised of individual cobble-sized particles in a sand and fines matrix.
- Riparian buffer is wide (greater than five river widths).
- Possible outcropping on left bank across island.
- Stream bed comprises fine to medium sized sand.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Evaluate scour depth for pipeline burial depth. Bedrock may be shallower. Lateral migration is unlikely, therefore apply burial depth from valley wall to valley wall.

Additional Work

1. Local scour can be significant (greater than 5 feet). Consideration should be given to identifying depth of bedrock for burial or crossing via HDD rather than dam and pump.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	11-Apr-16	Stream Name:	Buckhannon River
Crossing ID:	SC_0658		

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
- [X] Coniferous Forest/trees

Valley Side Features

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

Failure Locations

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

Part 3: Floodplain

Floodplain Width

- [ ] None
- [X] 1 < river widths
- [ ] 1-5 river widths
- [ ] 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
- [ ] Shrubs
- [X] Deciduous Forest/trees
- [X] Coniferous Forest/trees

Riparian Buffer Strip

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

Part 4: Vertical Confinement

Terraces

- [ ] None
- [X] 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
- [ ] Meandering
- [ ] Braided
- [X] 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

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

Control Types

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

Width Controls

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

Control Types

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

Other

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

Flow Habit

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

Channel Width: Not wadeable

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

Bar Types

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

Bar Material

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

Bar Vegetation

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

Bar Width

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

Percent sand in bed = >80 %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	*Left Bank*	*Right Bank*
Bank Material	[X] Clay [X] Silt [ ] Gravel [ ] Cobbles [X] 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	6'	15'-20'
Bank Slope	[ ] Steep [ ] Moderate [X] Shallow	[X] Steep [ ] Moderate [ ] Shallow
Bank Vegetation	[ ] None [ ] Grasses/annuals [ ] 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 [ ] 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

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0658, Buckhannon River at MP 31.67 (AP-1)

Photograph 1 (012.jpg)	
Date: 11-April-2016	
Direction: Upstream	
Description: View from right bank showing mid-channel island (red arrow). Sandy bank noticeable on foreground.	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0658, Buckhannon River at MP 31.67 (AP-1)

Photograph 2 (014.jpg)	
Date: 11-April-2016	
Direction: Downstream from right bank	
Description: View of terrace on left bank rail as well as rail line upslope of terrace (red arrow). Local scour pools have developed around felled trees.	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0658, Buckhannon River at MP 31.67 (AP-1)

Photograph 3 (019.jpg)	
Date: 11-April-2016	
Direction: Upstream	
Description: View of car-sized boulders in stream to the right of the island.	

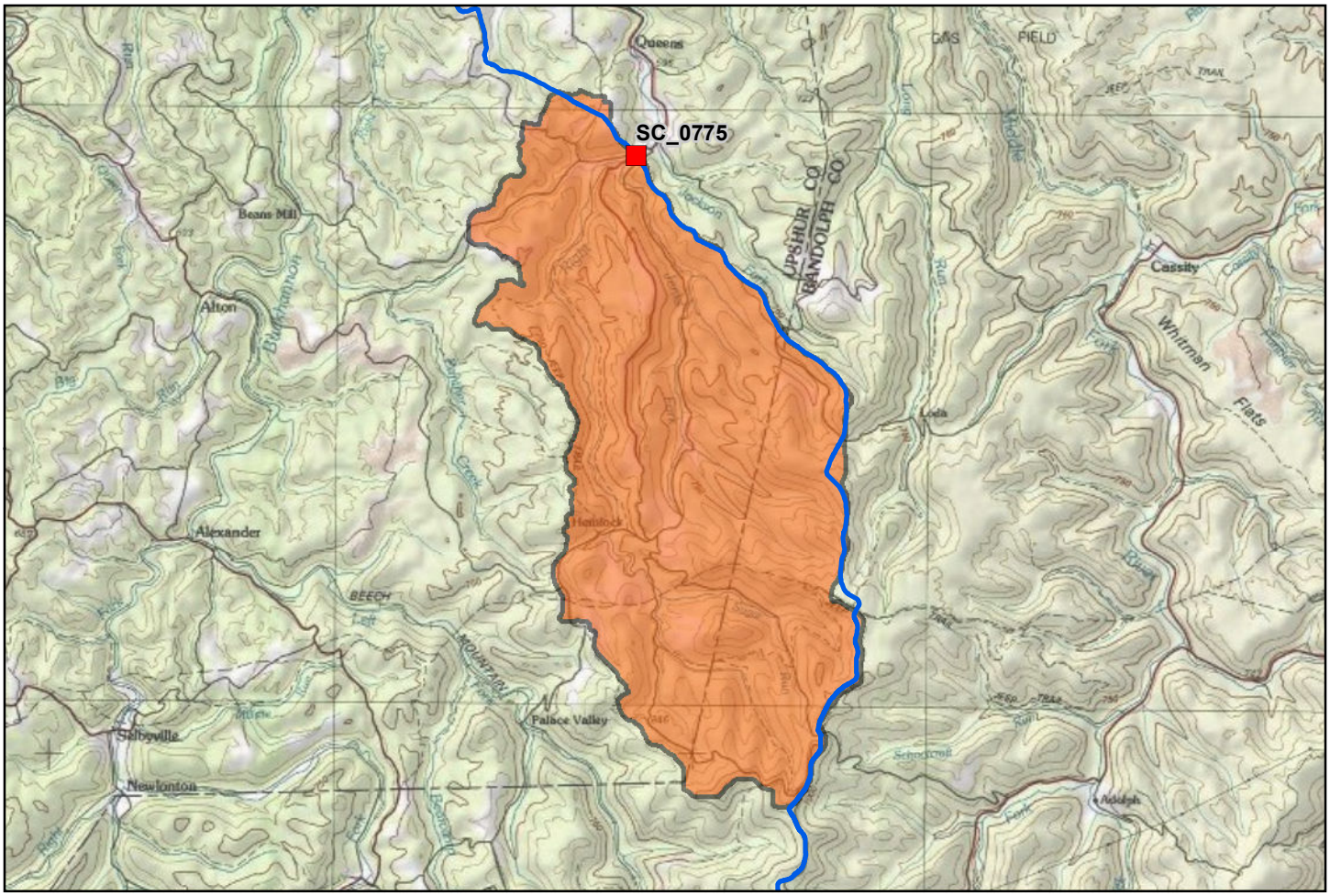
PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0658, Buckhannon River at MP 31.67 (AP-1)

Photograph 4 (013.jpg)	
Date: 11-April-2016	
Direction: Upstream	
Description: View of sloping left bank upstream at island with dense riparian buffer. Also noticeable are car-sized boulders on left bank.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0775	supa015	AP-1	41.3	West Virginia	Upshur

Attribute	Value
Stream Name	Right Fork Middle Fork River
Physiographic Province[1]	Appalachian Plateaus
Drainage Area (square miles)[2]	17.321
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	54
Slope At Crossing Over 200ft Long Reach (%)[4]	1.509
Proposed Construction Method[5]	1) Flume 2) Cofferdam

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

1:150,000

0 3,350 6,700 13,400 Feet

0 3.5 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0775

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

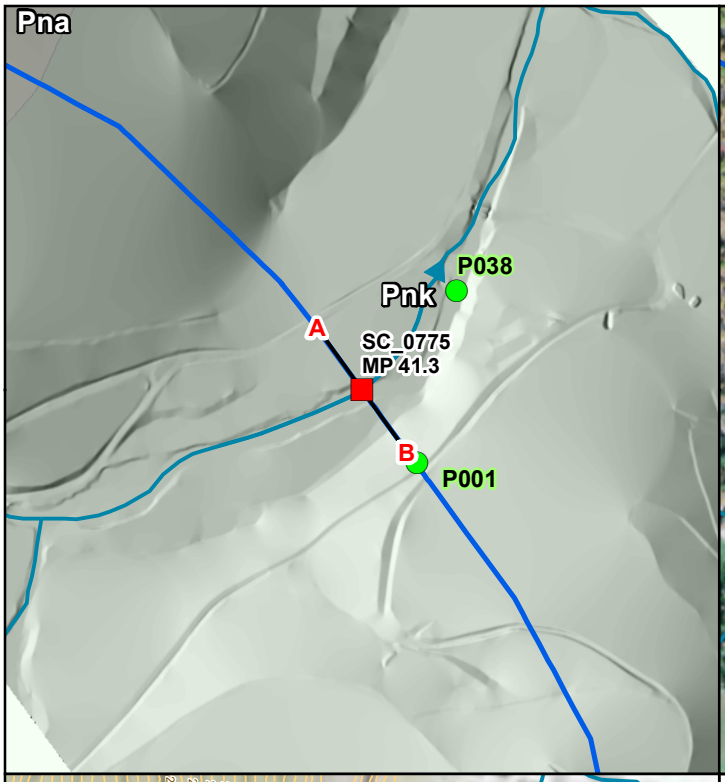
Notes:

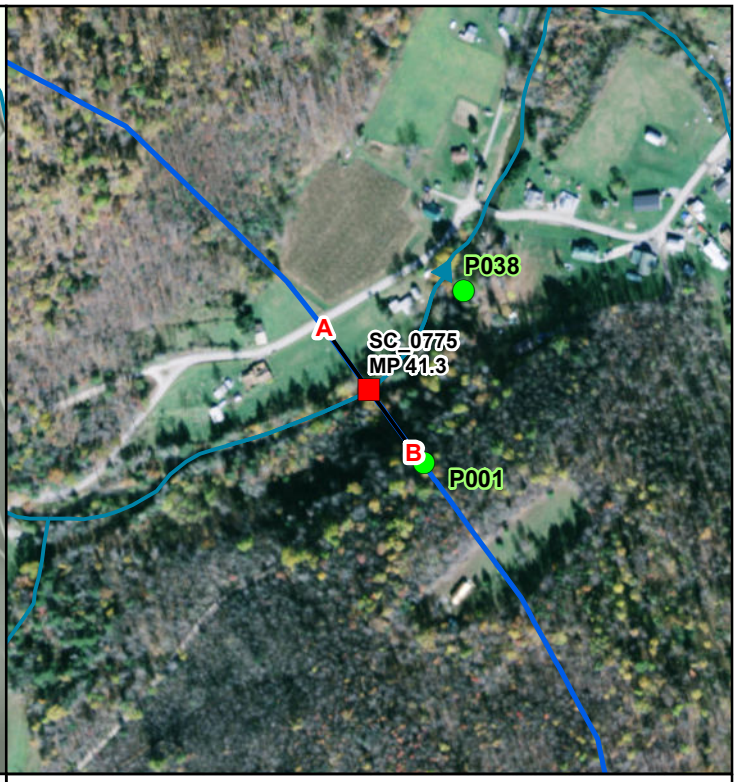
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

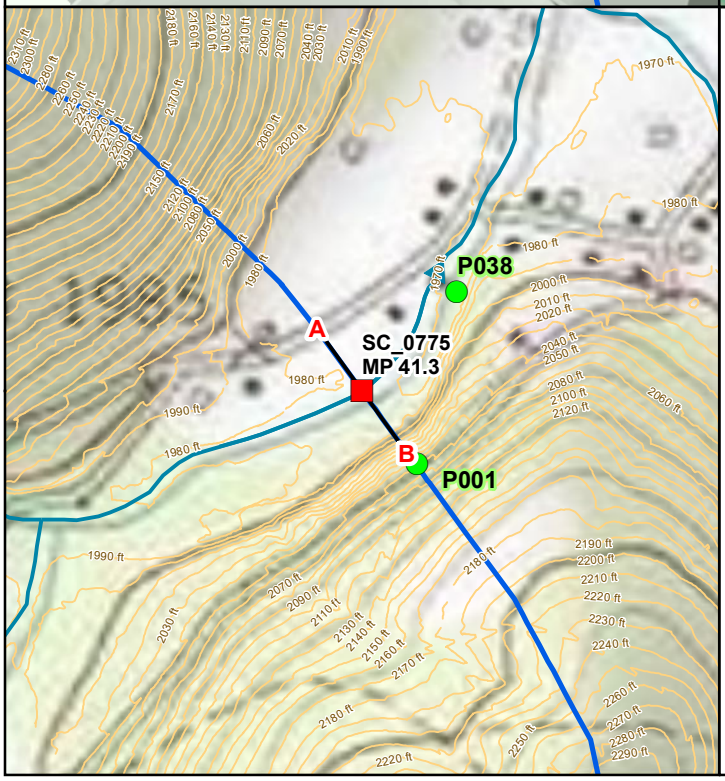
Dominion

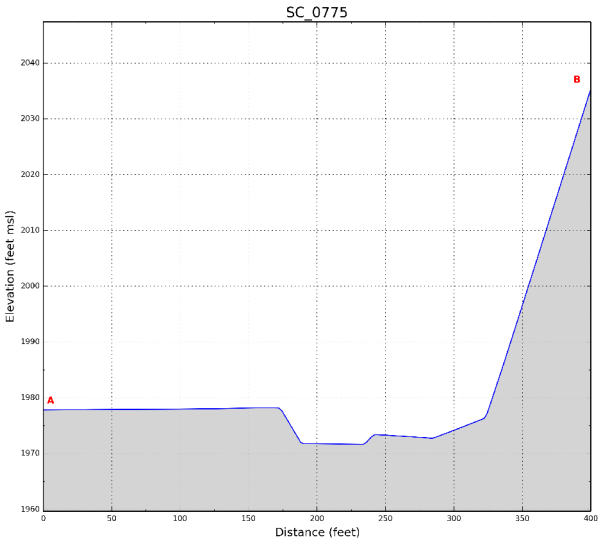
Geosyntec consultants

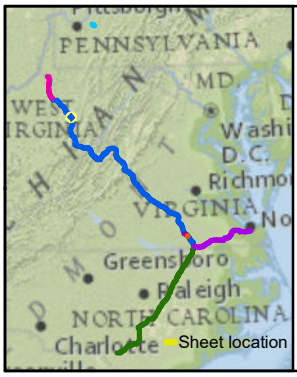
TESSELLATIONS











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: supa015

TID_SC: SC_0775

Stream Name: Right Fork Middle Fork 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_0775

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_0775	**ACP Segment**	AP-1
Stream Name	Right Fork Middle Fork River	**MP**	41.30
Survey Date	11-April-2016	**Start Time**	0910 hrs

- Bankfull channel width is 54 feet and confined on right bank by valley wall.
- Rock outcrops identified on valley wall of the right bank.
- Riparian buffer on the left bank is less than one river width. Buffer on right bank is about one stream width.
- Left and right banks are approximately 2-feet high (bankfull).
- The floodplain to the left slopes gently to road way at far edge.
- Gravel, cobbles, and boulders identified on stream bed. Particles are sub-angular and sub-rounded. Armoring layer mostly comprises cobble and gravel sizes.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Potential for lateral migration towards the left bank requires further evaluation. Given debris flow hazard bury pipeline into bedrock with at least 1.5 foot of cover above the crown from valley wall on right bank to location to be determined to the left of the stream.

Additional Work

1. Given debris flow potential in a degradational area of the watershed, best protection will be achieved by identifying depth to rock either by advancing a boring or by digging a trench.
2. Potential for lateral stream migration towards the left should be evaluated to determine location of left sag bend.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	11-Apr-16	Stream Name:	Right Fork Middle Fork River
Crossing ID:	SC_0775		

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
- [X] Grass
- [ ] Pasture
- [ ] Crops
- [ ] Shrubs
- [X] Deciduous Forest/trees
- [X] 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
- [X] 5-10 river widths
- [ ] > 10 river widths

Land Use

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

Vegetation

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

Riparian Buffer Strip

- [ ] None
- [X] < 1 river width about 1 width on RB
- [ ] 1-5 river widths <1 on LB
- [ ] > 5 river widths

Part 4: Vertical Confinement

Terraces

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

Levees

- [ ] None
- [X] Natural *on LB point*
- [ ] Constructed *bar*

Levee Location

- [X] Along channel bank *on LB*
- [ ] 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
- [X] Frequent
- [ ] Confined

Control Types

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

Width Controls

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

Control Types

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

Other

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

Flow Habit

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

Channel Width: 54'

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	[ ] Silt	[X] None	[ ] None
[ ] Silt	[ ] Alternate bars	[ ] Sand	[ ] Grasses	[X] Narrow
[ ] Sand	[X] Point bars	[X] Gravel	[ ] Reeds/shrubs	[ ] Moderate
[ ] Gravel	[ ] Mid-channel bars	[X] Cobbles	[ ] Trees	[ ] Wide
[X] Cobbles	[ ] Diagonal bars			
[X] 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 [ ] Silt [ ] Gravel [X] Cobbles [X] Boulders [ ] Bedrock	[X] Clay [ ] Silt [ ] Gravel [X] Cobbles [ ] Boulders [X] Bedrock
Layer Material	[ ] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[ ] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	2'	2'
Bank Slope	[ ] Steep [ ] Moderate [X] Shallow	[ ] Steep [ ] Moderate [X] Shallow
Bank Vegetation	[ ] None [X] Grasses/annuals [ ] 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 [x] Grasses/annuals [ ] 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

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0775, Right Fork Middle Fork River at MP 41.3 (AP-1)

Photograph 1 (IMG_0709.jpg)	
Date: 11-April-2016	
Direction: Upstream	
Description: View of 54-ft wide channel showing riparian buffer with felled trees on right bank (red arrow).	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0775, Right Fork Middle Fork River at MP 41.3 (AP-1)

Photograph 2 (IMG_1030.jpg)	
Date: 11-April-2016	
Direction: Downstream	
Description: View of gently sloping left bank covered with gravel and cobbles as well as thin riparian buffer. Rock outcrop is noticeable on right bank (red arrow).	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0775, Right Fork Middle Fork River at MP 41.3 (AP-1)

Photograph 3 (004.jpg)	
Date: 11-April-2016	
Direction: Downstream from left bank	
Description: View of rock outcrops at the toe of the steep slope on the left bank about 50 yards downstream of crossing.	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0775, Right Fork Middle Fork River at MP 41.3 (AP-1)

Photograph 4	
Date: 11-April-2016	
Direction: Upstream	
Description: Photograph from bridge over river on Adrian Abbott Gould Rd. Car-sized subangular boulders on right bank and stream bed.	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

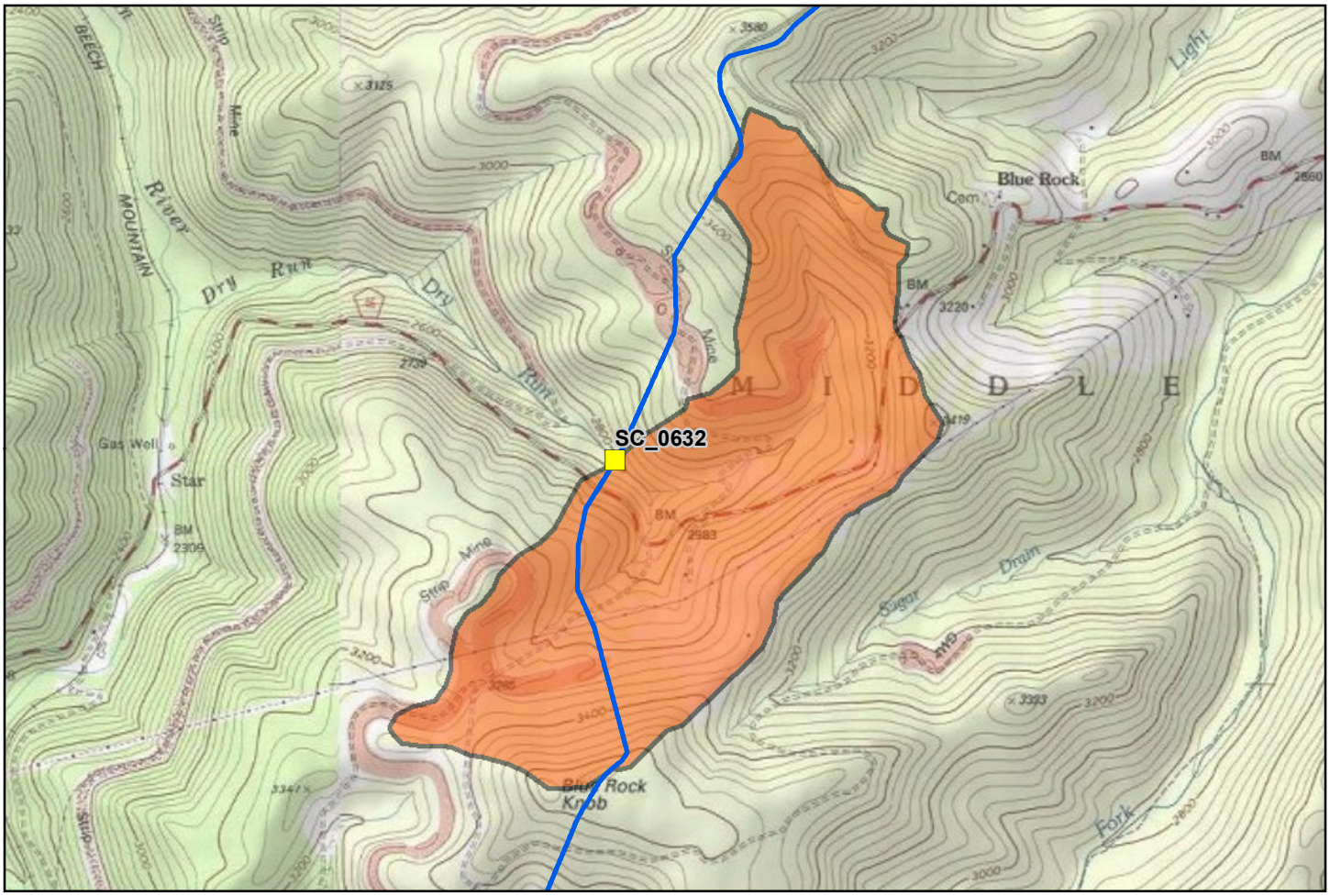
Subject Site: SC_0775, Right Fork Middle Fork River at MP 41.3 (AP-1)

Photograph 5
(010.jpg)

Date: 11-April-2016

Direction: Upstream

Description: View of riparian buffer on right bank as well as subrounded boulders in stream (red arrow).



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0632	srac103	AP-1	50.53	West Virginia	Randolph

Attribute	Value
Stream Name	Dry Run
Physiographic Province[1]	Appalachian Plateaus
Drainage Area (square miles)[2]	0.875
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	5
Slope At Crossing Over 200ft Long Reach (%)[4]	8.511
Proposed Construction Method[5]	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

1:35,000

0 750 1,500 3,000 Feet

0 0.5 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0632

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

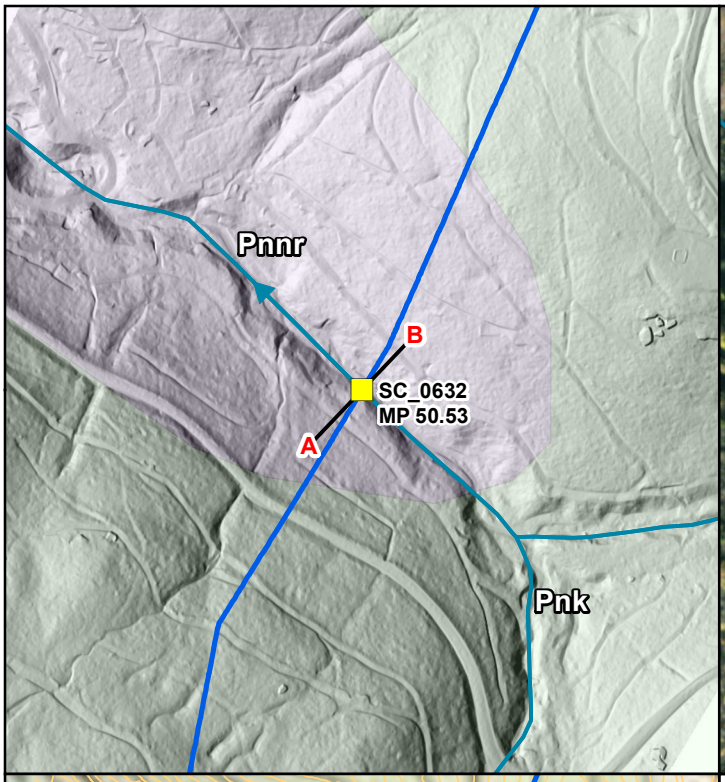
Notes:

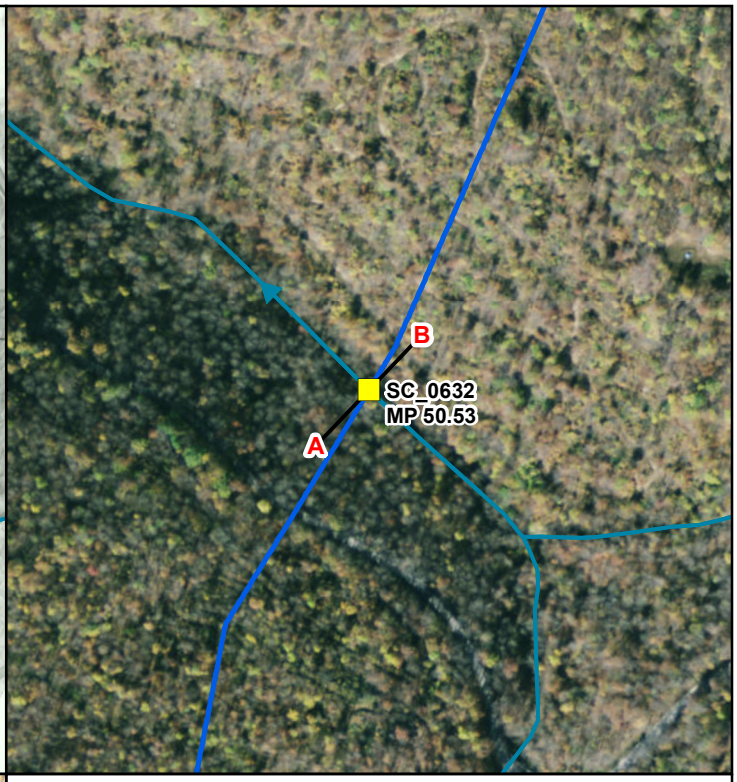
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

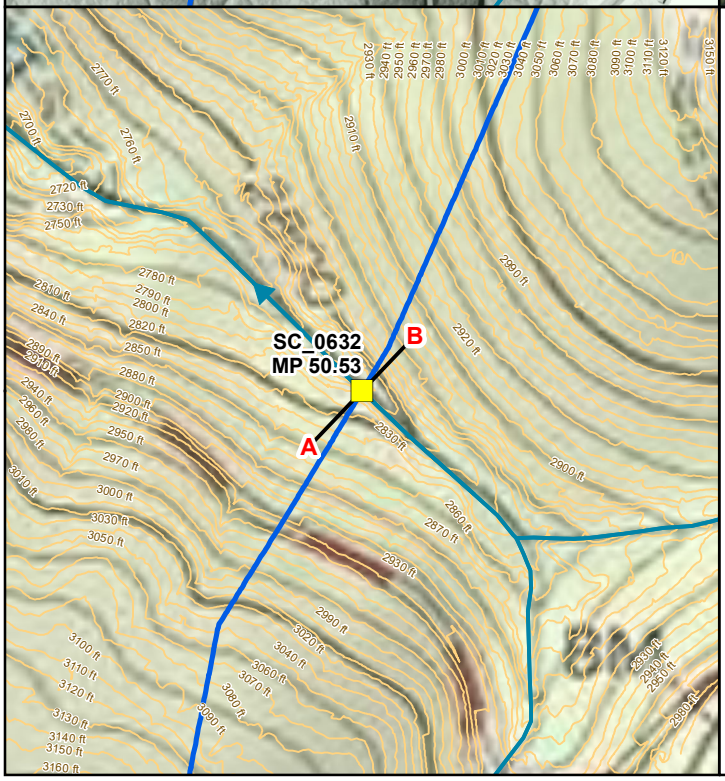
Dominion

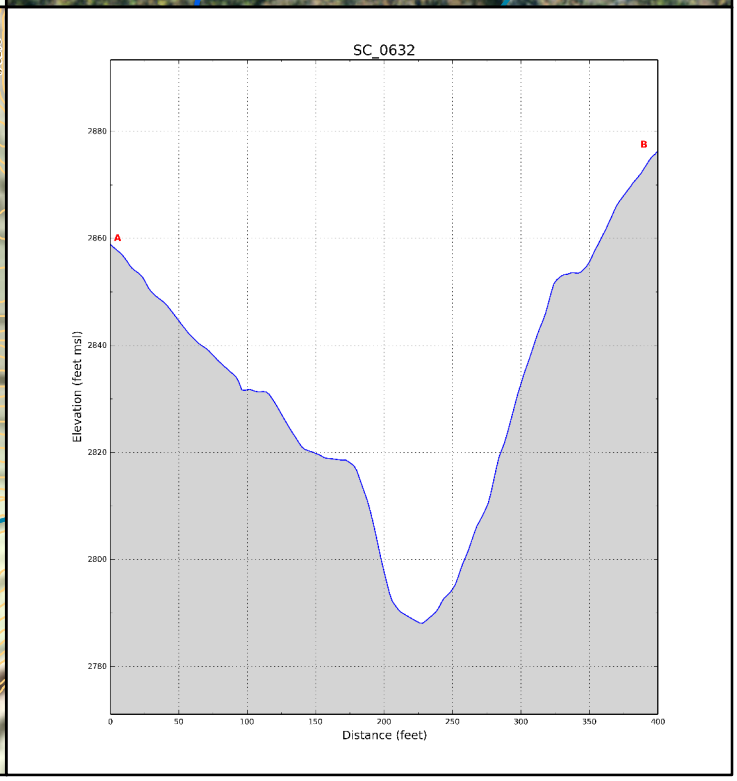
Geosyntec consultants

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: srac103

TID_SC: SC_0632

Stream Name: Dry 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_0632

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_0632	**ACP Segment**	AP-1
Stream Name	Dry Run	**MP**	50.53
Survey Date	10-April-2016	**Start Time**	1700 hrs

- Stream confined in narrow valley with steep side slopes.
- Stream bed and banks comprised of large boulders creating a cascade and step-pool stream morphology.
- Bankfull channel width is 5 feet.
- Stream located in dense forest of deciduous trees (natural setting) in close proximity to coal strip mining areas.
- One foot of snow cover and numerous dead trees strewn about along channel obscured observations of banks.
- Coal seam outcrop within stream bed on right bank. Rock is heavily jointed, horizontally bedded.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Given debris flow hazard bury pipeline into bedrock with at least 1.5 foot of cover above the crown across valley bottom (floodplain).

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	10-Apr-16	Stream Name:	Dry Run
Crossing ID:	SC_0632		

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

X	None
	Away from river
	Along river

Part 3: Floodplain

Floodplain Width

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

Land Use

X	Natural
	Agricultural
	Urban
	Suburban
	Rural
	Industrial
X	Mining
	Cattle grazing

Vegetation

	None
	Grass
	Pasture
	Orchards
	Crops
	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

	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

	None
	Occasional
	Frequent
X	Confined

Control Types

	None
X	Bedrock
	Boulders

Width Controls

	None
	Occasional
	Frequent
X	Confined

Control Types

	None
X	Bedrock
	Boulders

Other

	Debris
	Mining
	Reservoir
	Knickpoint

Flow Habit

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

Channel Width: 5.0'

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 = < 10% %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	*Left Bank*	*Right Bank*
Bank Material	[ ] Clay [ ] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [X] Bedrock	[ ] Clay [ ] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [X] Bedrock
Layer Material	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[X] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	NA	NA
Bank Slope	[X] Steep [ ] Moderate [ ] Shallow	[X] Steep [ ] Moderate [ ] Shallow
Bank Vegetation	[ ] None [ ] Grasses/annuals [ ] 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 [ ] Y [X] N	[ ] None [ ] Grasses/annuals [ ] 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 [ ] Y [X] 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_0632, Dry Run at MP 50.53 (AP-1)

Photograph 1 (IMG_0705.jpg)	
Date: 10-April-2016	
Direction: Downstream	
Description: View of crossing of narrow colluvial valley with steep slopes within dense forest of deciduous trees.	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0632, Dry Run at MP 50.53 (AP-1)

Photograph 2 (IMG_0706.jpg)	
Date: 10-April-2016	
Direction: Upstream	
Description: View of densely forested narrow colluvial valley.	

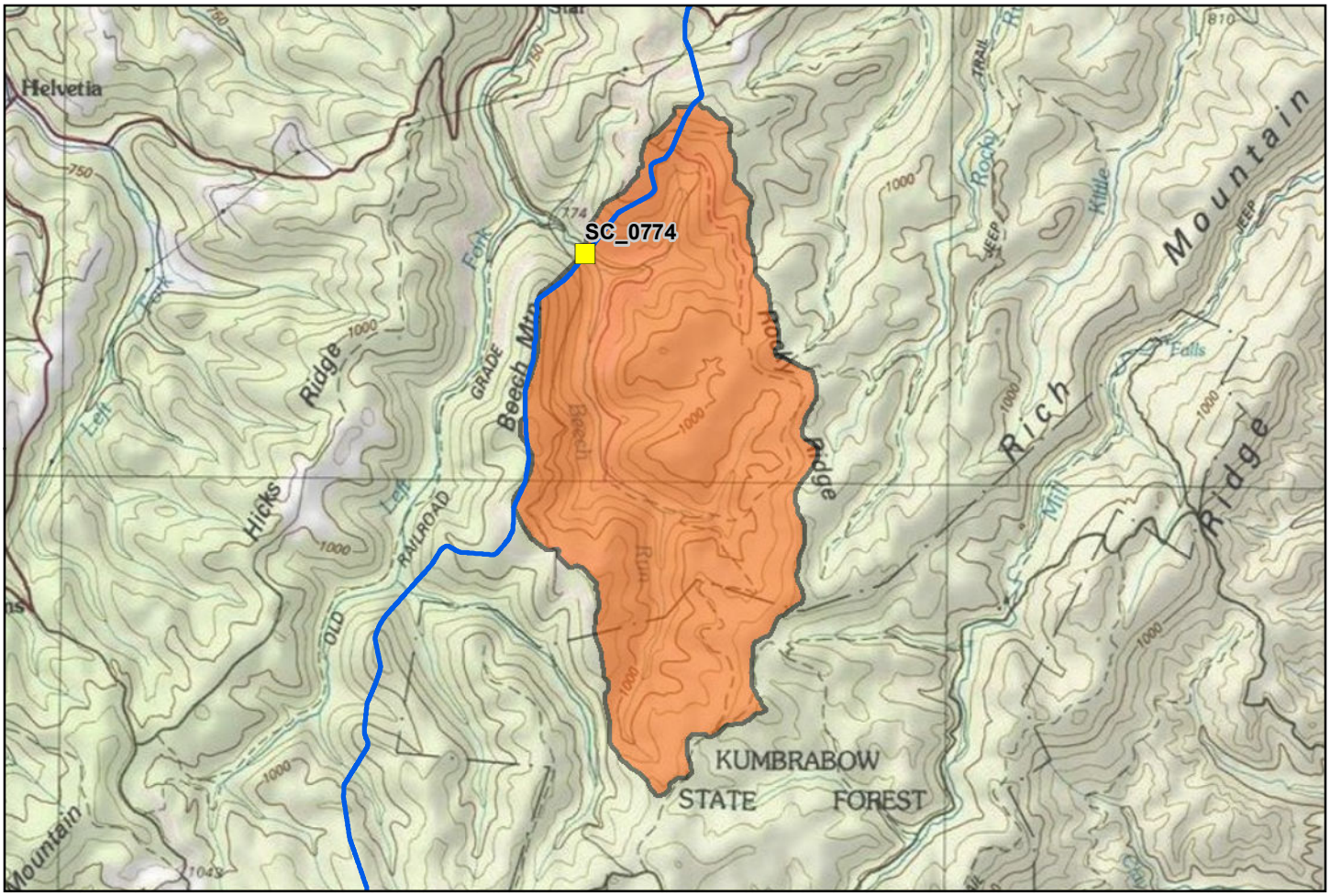
PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0632, Dry Run at MP 50.53 (AP-1)

Photograph 3 (IMG_0707.jpg)	
Date: 10-April-2016	
Direction: looking at right bank	
Description: Outcrop on right bank.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0774	sraa408	AP-1	52.13	West Virginia	Randolph

Attribute	Value
Stream Name	Beech Run
Physiographic Province[1]	Appalachian Plateaus
Drainage Area (square miles)[2]	6.282
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	26
Slope At Crossing Over 200ft Long Reach (%)[4]	2.202
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_0774

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

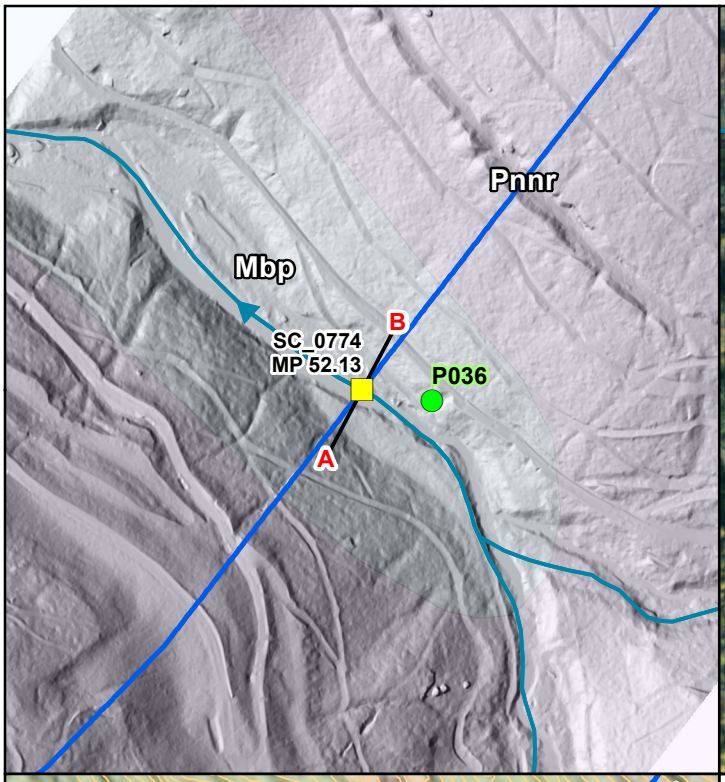
Notes:

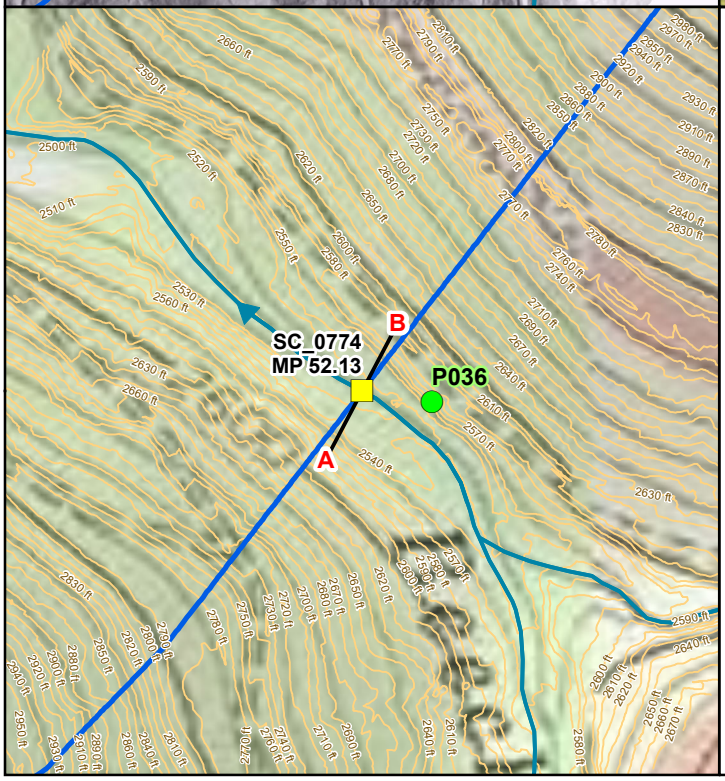
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

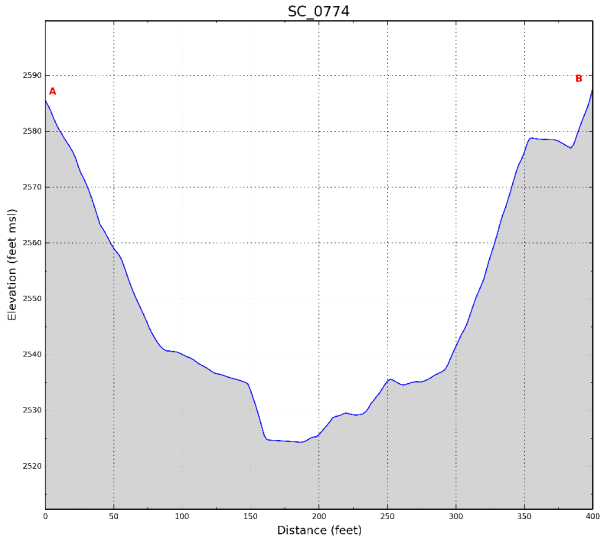
Dominion

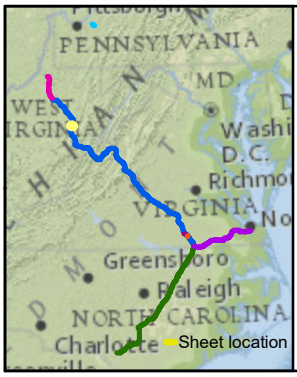
Geosyntec consultants

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: sraa408

TID_SC: SC_0774

Stream Name: Beech 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_0774

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

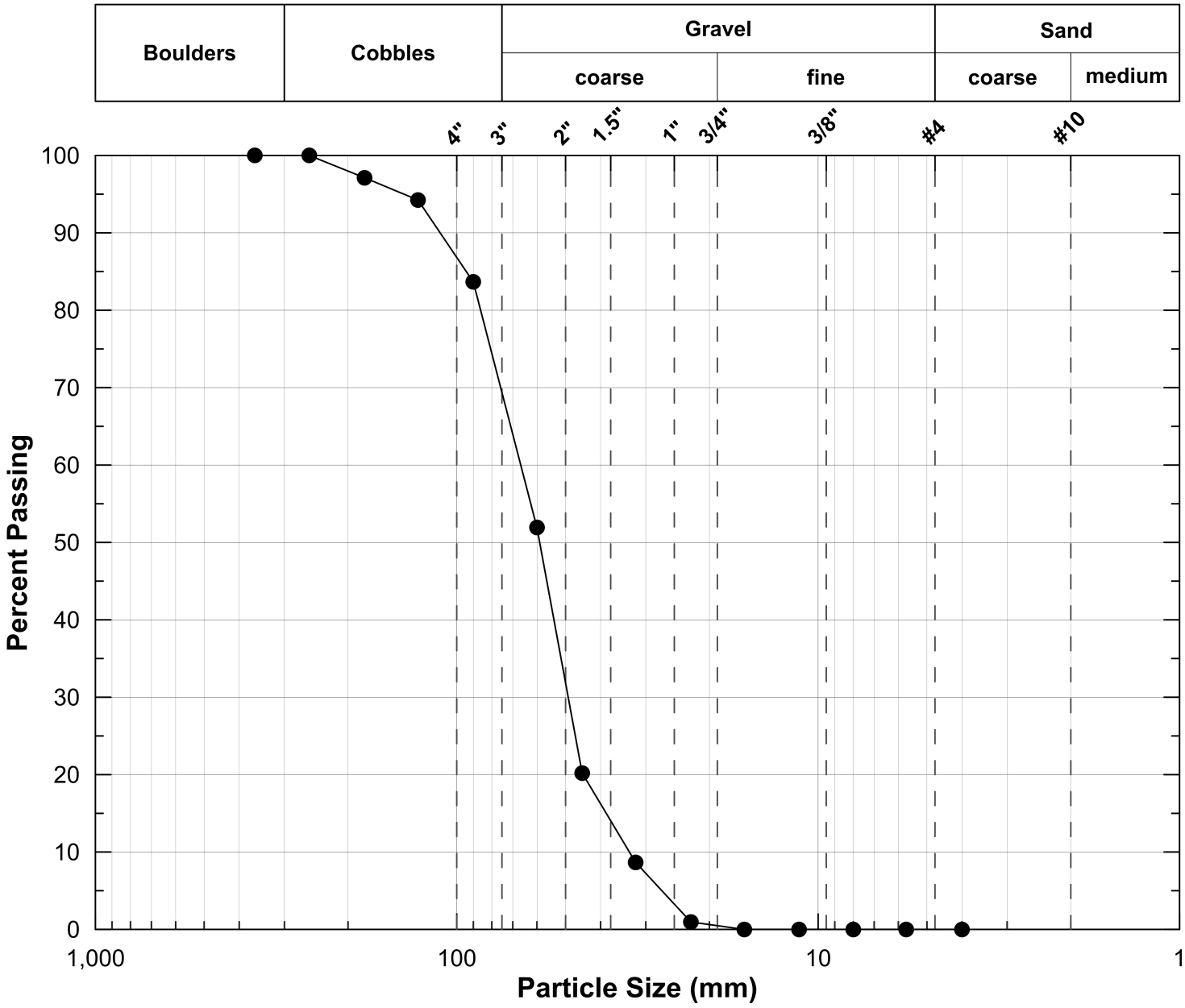
TID	SC_0774	**ACP Segment**	AP-1
Stream Name	Beech Run	**MP**	52.13
Survey Date	10-April-2016	**Start Time**	1400 hrs

- Stream confined in narrow valley with steep side slopes. Bankfull channel width is 26 feet.
- One foot of snow cover obscured direct observations of streambanks.
- Stream located in dense forest of deciduous trees (natural setting) in close proximity to coal strip mining areas.
- Fairly confined laterally by valley walls in vicinity of crossing.
- Left bank terrace height is approximately 10 feet.
- Mostly cobble and small boulder-sized rounded particles in stream bed, but car-sized boulders were also present.
- Conducted Wolman Pebble Count on riffle at crossing; D_{50} is 58 mm (coarse gravel).
- Coarse sandstone outcrop identified on left bank approximately 50 yards upstream of crossing. Bedrock is likely at a relatively shallow depth.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Evaluate scour depth for pipeline burial depth with consideration for the position of the crossing within the watershed and the potential for debris flows. Lateral migration hazard is low; therefore apply burial depth from right bank valley wall to one stream width beyond top of left bank terrace.

Wolman Pebble Count at SC_0774



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:	10-Apr-16	Stream Name:	Beech Run
Crossing ID:	SC_0774		

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
X	Coniferous Forest/trees

Valley Side Features

	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
	Cattle grazing

Vegetation

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

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
X	Frequent
	Confined

Control Types

	None
	Bedrock
X	Boulders

Width Controls

	None
	Occasional
X	Frequent
	Confined

Control Types

	None
X	Bedrock
	Boulders

Other

	Debris
	Mining
	Reservoir
	Knickpoint

Flow Habit

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

Channel Width: 26.0'

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
- [X] Cobbles
- [X] 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

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

Bar Width

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

Percent sand in bed = <10 %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	***Left Bank***	***Right Bank***
Bank Material	[ ] Clay [ ] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock	[ ] Clay [ ] Silt [ ] Gravel [ ] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[ ] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[ ] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	10'	4'
Bank Slope	[ ] Steep [ ] Moderate [ ] Shallow	[ ] Steep [ ] Moderate [ ] Shallow
Bank Vegetation	[ ] None [ ] 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 [ ] 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 [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [ ] general type of erosion [ ] fluvial [ ] geotechnical	location of erosion [ ] outside meander bend [ ] inside meander bend [ ] opposite bar or obstruction [ ] general type of erosion [ ] fluvial [ ] geotechnical

Banks were obscured by 1 foot snow cover

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0774, Beech Run at MP 52.13 MP (AP-1)

Photograph 1 (IMG_0699.jpg)	
Date: 10-April-2016	
Direction: Upstream	
Description: View of car-sized boulder in stream as well as cobbles in stream bed. Also noticeable are the steep left and right banks of the narrow colluvial valley.	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0774, Beech Run at MP 52.13 MP (AP-1)

Photograph 2 (086.jpg)	
Date: 10-April-2016	
Direction: Downstream	
Description: View of stream in dense deciduous forest with some coniferous trees as well as steep left bank and cobble and boulders in stream.	

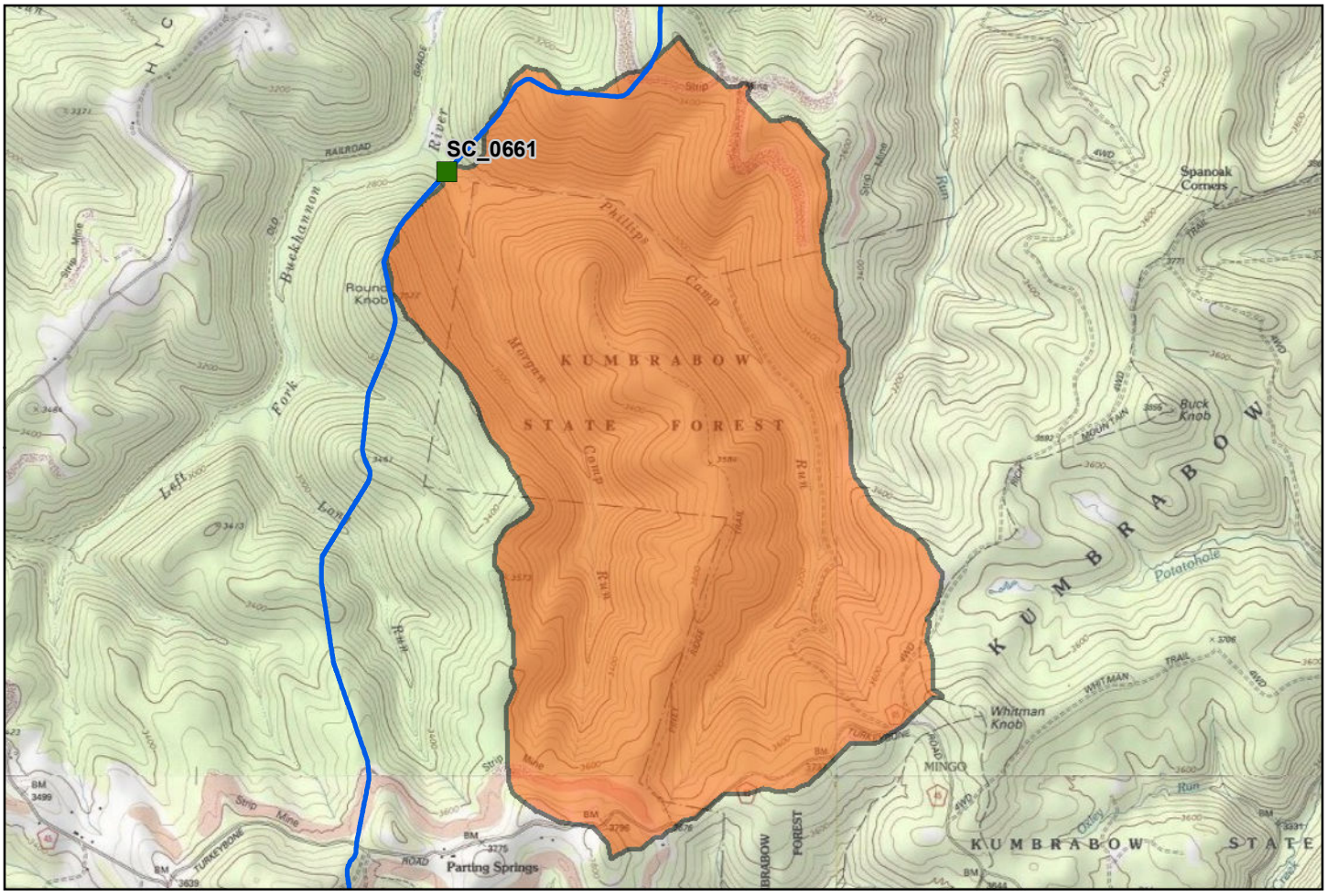
PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0774, Beech Run at MP 52.13 MP (AP-1)

Photograph 3 (089.jpg)	
Date: 10-April-2016	
Direction: towards left bank	
Description: Rock outcrop on left bank approximately 50 yards upstream from pipeline crossing.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0661	sraa409	AP-1	54.35	West Virginia	Randolph

Attribute	Value
Stream Name	Phillips Camp Run
Physiographic Province[1]	Appalachian Plateaus
Drainage Area (square miles)[2]	3.457
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	37
Slope At Crossing Over 200ft Long Reach (%)[4]	1.644
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

1:50,000

0 1,125 2,250 4,500 Feet

0 1 Miles

N

Document Information:

Document No:
DOM_EC_HYD_MA_SER001_SC_0661

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

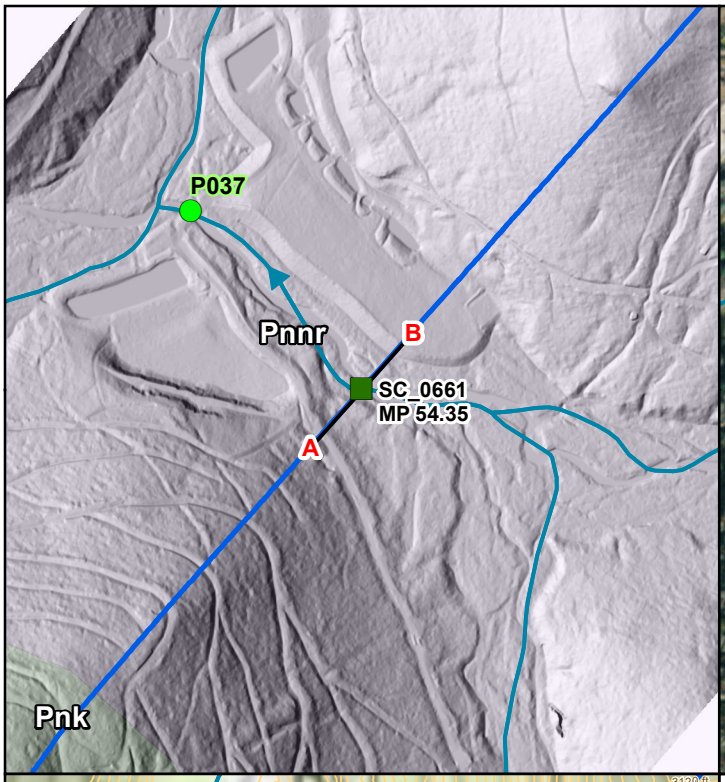
Notes:

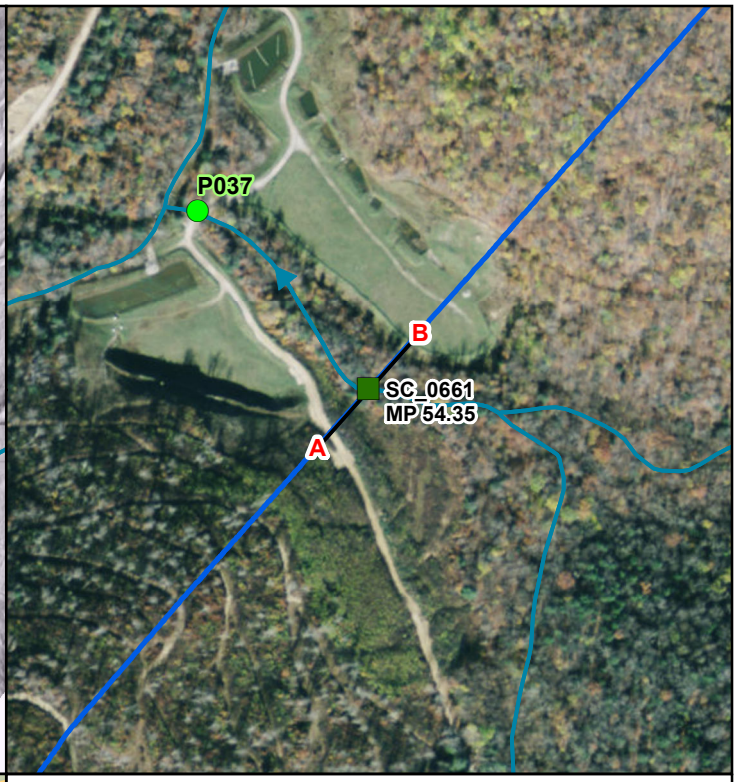
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

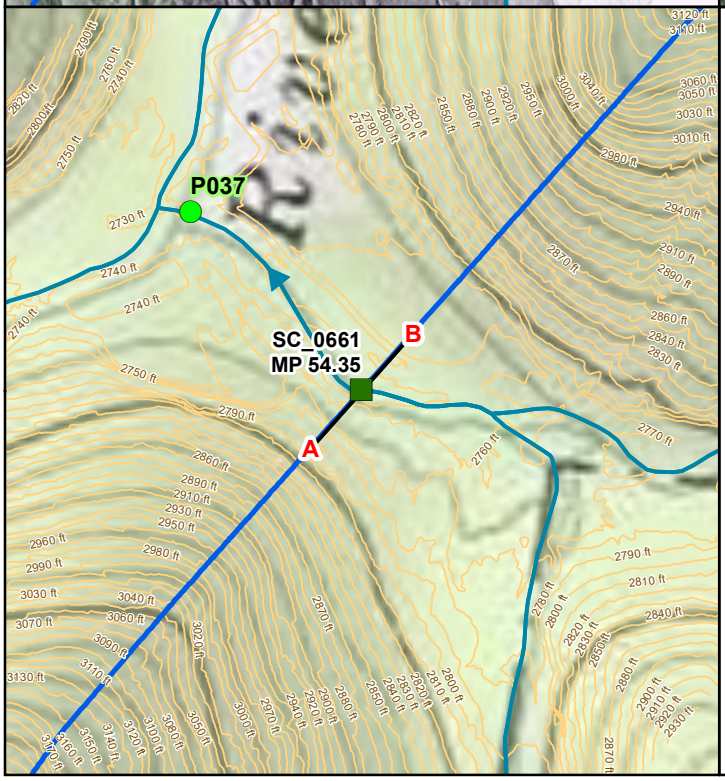
Dominion

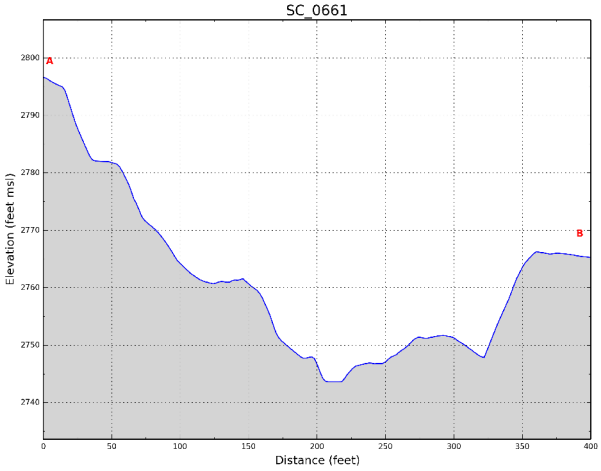
Geosyntec consultants

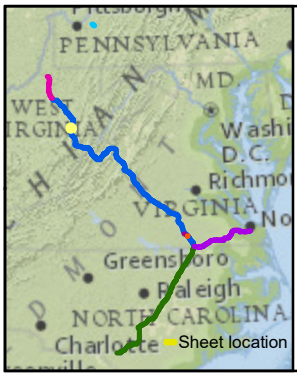
TESSELLATIONS











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: sraa409

TID_SC: SC_0661

Stream Name: Phillips Camp 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_0661

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

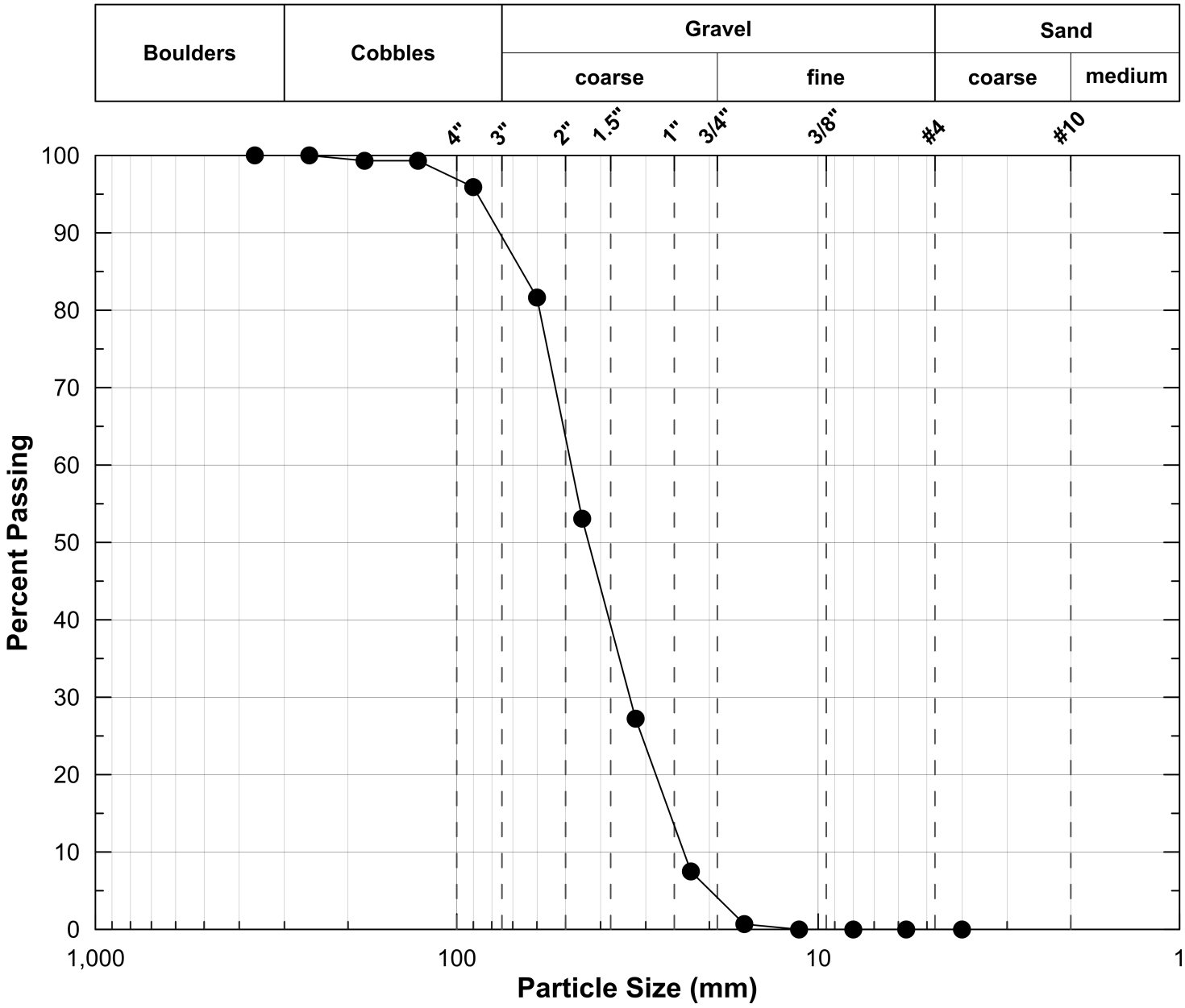
TID	SC_0661	**ACP Segment**	AP-1
Stream Name	Phillips Camp Run	**MP**	54.35
Survey Date	10-April-2016	**Start Time**	1520 hrs

- Survey conducted at pipeline crossing along straight reach.
- One foot of snow cover obscured direct observations of banks.
- Stream located in dense forest of deciduous trees (natural setting) in close proximity to coal strip mining areas.
- Width of riparian buffer is greater than three to five stream widths wide.
- Road over stream with culvert located approximately 250 yards downstream.
- Bankfull channel width is 37 feet and bankfull channel depth is1.7 feet. Both right and left top of bank (terrace) heights are 3 feet above the channel.
- Stream bed comprised of gravel and cobble-sized particles.
- Conducted Wolman Pebble Count on riffle at crossing;
- D_{50} is 45 mm (coarse gravel).
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Evaluate scour depth for pipeline burial depth with consideration for the position of the crossing within the watershed and the potential for debris flows. Lateral migration is likely; therefore apply burial depth across valley bottom (floodplain).

Wolman Pebble Count at SC_0661



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:	10-Apr-16	Stream Name:	Phillips Camp Run
Crossing ID:	SC_0661		

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

- [X] 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
- [ ] Cattle grazing

Vegetation

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

Riparian Buffer Strip

- [ ] None
- [ ] < 1 river width
- [X] 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

- [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

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

Channel Width: 37.0'

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	[ ] Grasses	[X] Narrow
[ ] Sand	[X] Point bars	[ ] Gravel	[X] Reeds/shrubs	[ ] Moderate
[X] Gravel	[ ] Mid-channel bars	[X] Cobbles	[ ] Trees	[ ] Wide
[X] Cobbles	[ ] Diagonal bars			
[ ] Boulders	[ ] Irregular/combination			
[ ] Bedrock	[ ] Braided			

Percent sand in bed = <10 %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	*Left Bank*	*Right Bank*
Bank Material	[X] Clay [X] Silt [ ] Gravel [X] Cobbles [ ] Boulders [ ] Bedrock	[X] Clay [X] Silt [ ] Gravel [X] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[ ] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[ ] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	3'	3'
Bank Slope	[ ] Steep [X] Moderate [ ] Shallow	[ ] Steep [X] Moderate [ ] Shallow
Bank Vegetation	[ ] None [ ] Grasses/annuals [ ] 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

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0661, Phillips Camp Run at MP 54.35 (AP-1)

Photograph 1 (IMG_0701.jpg)	
Date: 10-April-2016	
Direction: Upstream	
Description: Cobble-sized particles in stream located within a natural setting and dense forest of deciduous and coniferous trees. Valley wall in close proximity to right bank also noticeable.	

PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0661, Phillips Camp Run at MP 54.35 (AP-1)

Photograph 2 (100.jpg)	
Date: 10-April-2016	
Direction: Upstream	
Description: Closer view showing armoring on stream bed.	

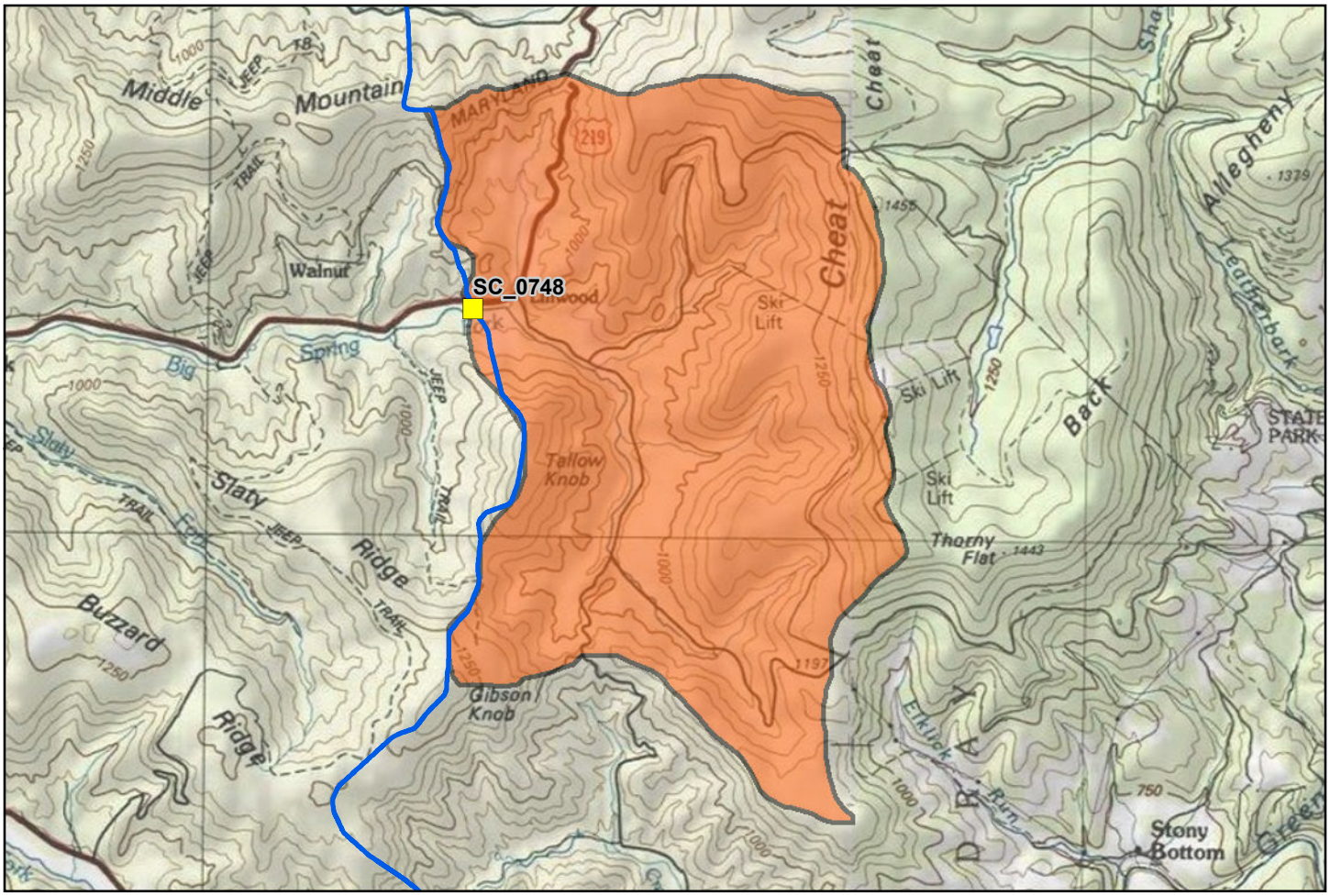
PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0661, Phillips Camp Run at MP 54.35 (AP-1)

Photograph 3 (IMG_0702.jpg)	
Date: 10-April-2016	
Direction: Downstream	
Description: View of gentle bend downstream of the crossing. Also noticeable is the terrace upslope of the left bank (see plan view drawing).	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0748	spoe007	AP-1	69.16	West Virginia	Pocahontas

Attribute	Value
Stream Name	Big Spring Fork
Physiographic Province[1]	Appalachian Plateaus
Drainage Area (square miles)[2]	12.230
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	Not wadeable
Slope At Crossing Over 200ft Long Reach (%)[4]	1.188
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_0748

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

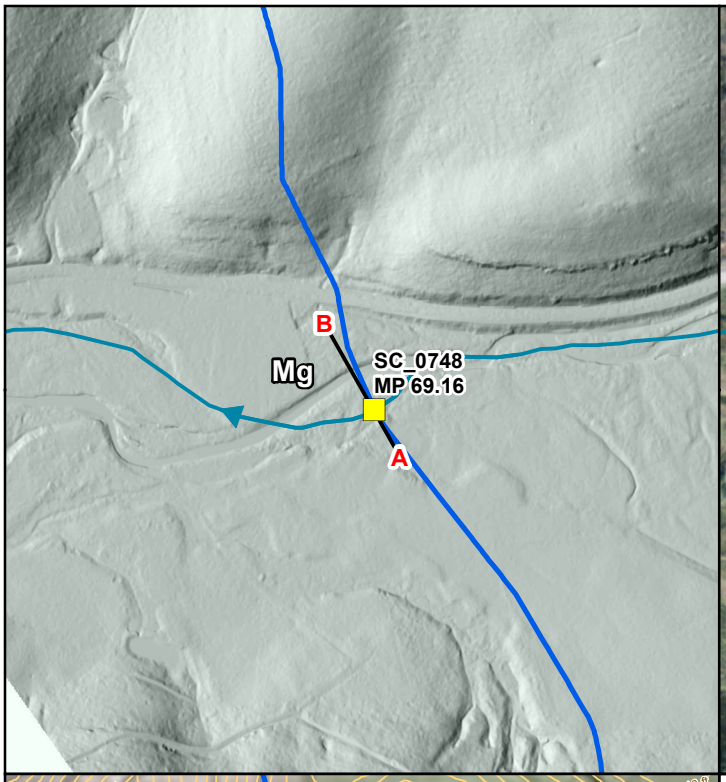
Notes:

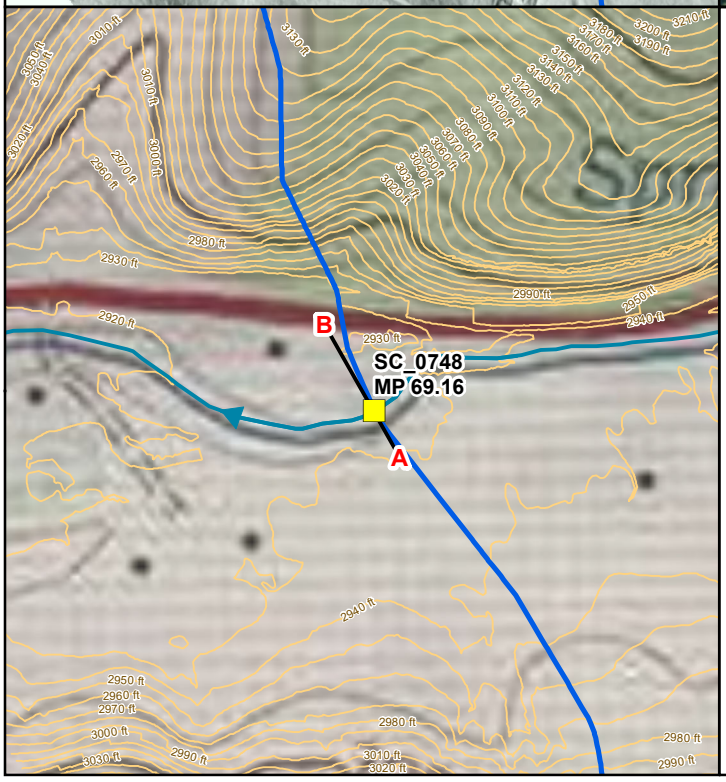
1) After Fenneman (1946)
2) Calculated using USGS 1:24,000 topographic maps and ArcGIS interface.
3) Measured during stream reconnaissance.
4) Calculated using one of four methods described in Section 3.2.3.1.
5) The current alignment centerline and mileposts provided by Dominion/GAI.

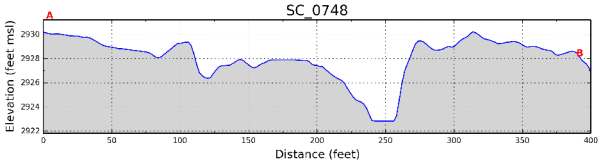
Dominion

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: spoe007

TID_SC: SC_0748

Stream Name: Big Spring Fork

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_0748

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_0748	**ACP Segment**	AP-1
Stream Name	Big Spring Fork	**MP**	69.16
Survey Date	09-April-2016	**Start Time**	1215 hrs

- Stream surveyed from right bank. Wading through stream was not possible.
- Survey conducted while it was snowing and after it had snowed, thus banks were snow covered obscuring our ability to make direct observations bank conditions.
- Right and left bank riparian buffer is comprised of dense deciduous trees and wider than five stream widths at crossing.
- Right top of bank (terrace) height of approximately 6 feet.
- State highway 219/55 is about 200 ft from right bank, which will provide protection from lateral migration (although stream is unlikely to migrate to the right).
- Aerial photo shows evidence of lateral migration downstream of crossing.
- Bankfull channel width was estimated at approximately 18 to 25 feet from field observations and bankfull channel depth was estimated approximately 2 to 3 feet.
- Minor head cut just upstream of crossing.
- Bed comprised of cobbles and some boulders. Wolman Pebble Count not conducted because of poor weather conditions.
- Additional information on stream crossing is available on stream reconnaissance form.

Recommendation:

Evaluate scour depth for pipeline burial depth. Lateral migration hazard is most prominent for the right bank due to location of crossing in a broad meander bend. However, the active floodplain is widest to the left bank (five to six river widths wide). While lateral migration rate is likely low for either bank, sag bend should be placed at least two river widths wide from right bank and at least three river widths from the left bank.

Additional Work

1. Return to stream during fair weather to conduct Wolman Pebble Count.

Stream Reconnaissance (Based on Thorne, 1998)

Section 1 - Site Description

Date:	9-Apr-16	Stream Name:	Big Spring Fork
Crossing ID:	SC_0748		

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
X	Occasional
	Frequent

Failure Locations

X	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
	Cattle grazin X

Vegetation

	None
	Grass
	Pasture
	Orchards
	Crops
	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

	None
X	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
X	Frequent
	Confined

Control Types

	None
	Bedrock
X	Boulders

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: Not wadeable

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	[ ] Silt	[ ] None	[ ] None
[ ] Silt	[ ] Alternate bars	[ ] Sand	[X] Grasses	[ ] Narrow
[ ] Sand	[X] Point bars	[ ] Gravel	[X] Reeds/shrubs	[X] Moderate
[ ] Gravel	[ ] Mid-channel bars	[X] Cobbles	[ ] Trees	[ ] Wide
[X] Cobbles	[ ] Diagonal bars			
[X] Boulders	[ ] Irregular/combination			
[ ] Bedrock	[ ] Braided			

Percent sand in bed = <10 %

Section 4 - Bank Survey (select all that apply)

Bank Characteristic	*Left Bank*	*Right Bank*
Bank Material	[X] Clay [X] Silt [ ] Gravel [X] Cobbles [ ] Boulders [ ] Bedrock	[X] Clay [X] Silt [ ] Gravel [X] Cobbles [ ] Boulders [ ] Bedrock
Layer Material	[ ] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders	[ ] No layers [ ] Cohesive [ ] Sand [ ] Gravel [ ] Cobbles [ ] Boulders
Bank Height	----	6'
Bank Slope	[ ] Steep [ ] Moderate [X] Shallow	[X] Steep [ ] Moderate [ ] Shallow
Bank Vegetation	[ ] None [ ] Grasses/annuals [ ] 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 [ ] Y [X] 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 [ ] Y [X] 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 [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_0748, Big Spring Fork at MP 69.16 (AP-1)

Photograph 1 (087.jpg)	
Date: 09-April-2016	
Direction: Downstream	
Description: Riffle at crossing also showing shrubs and trees on left bank and falling trees on right bank.	

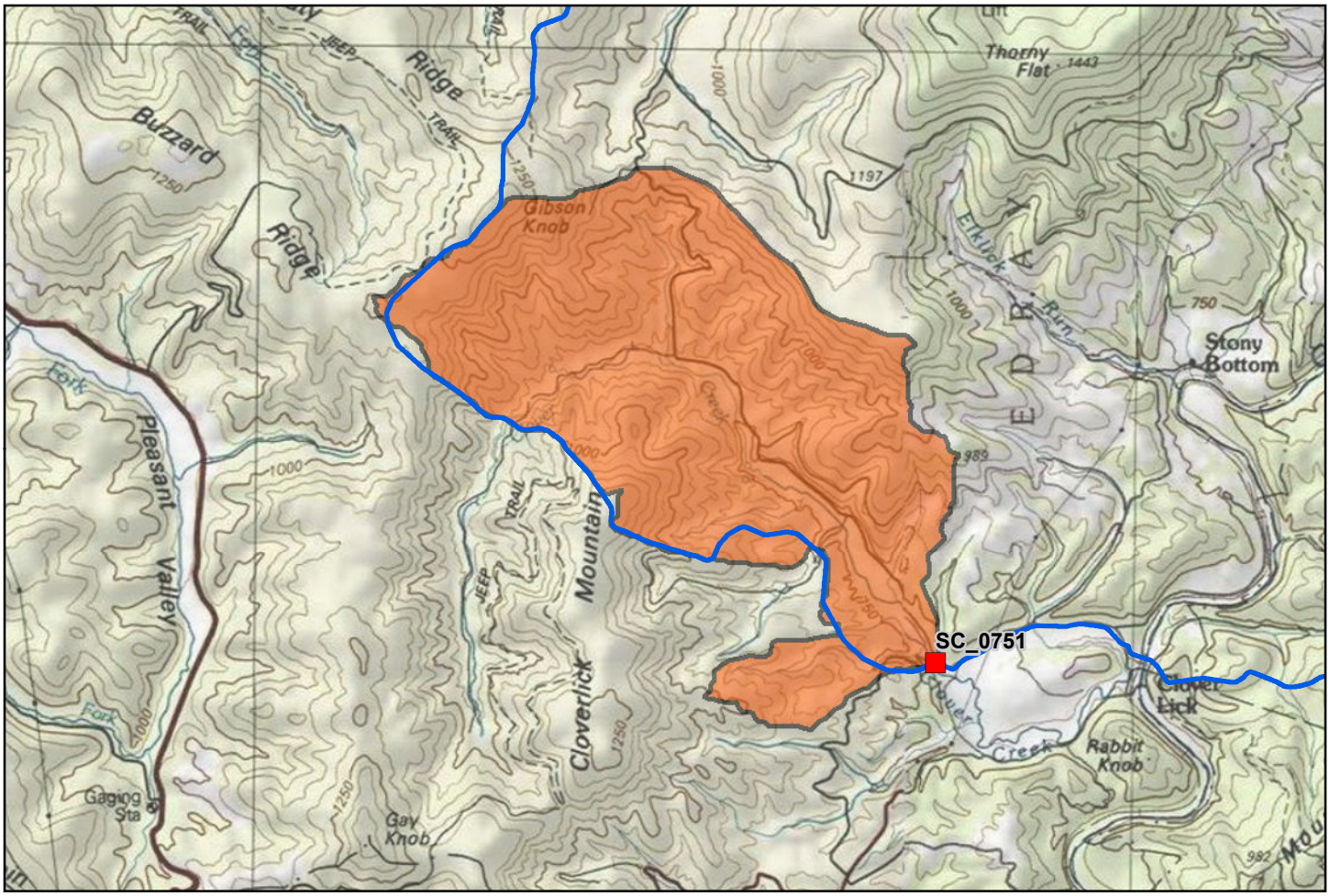
PHASE 2 - RAPID STREAM RECONNAISSANCE
Photographic Record

Geosyntec consultants

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

Subject Site: SC_0748, Big Spring Fork at MP 69.16 (AP-1)

Photograph 2 (IMG_0681.jpg)	
Date: 09-April-2016	
Direction: Upstream	
Description: Stream bed comprises cobbles and boulders.	



TID	Unique ID	ACP Branch	Mile Post	State	County
SC_0751	spoc101	AP-1	75.53	West Virginia	Pocahontas

Attribute	Value
Stream Name	Clover Creek
Physiographic Province[1]	Valley And Ridge
Drainage Area (square miles)[2]	7.878
Flow Regime	Perennial
Measured Bank Full Width (ft)[3]	40
Slope At Crossing Over 200ft Long Reach (%)[4]	0.588
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_0751

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