

<i>Title:</i> D02 AIS Site Characterization Report	<i>Author:</i> M. Fitzgerald	<i>Date:</i> 03/10/2016
<i>NEON Doc. #:</i> NEON.DOC.001589		<i>Revision:</i> B

## D02 AQUATIC INSTRUMENT SYSTEM (AIS) SITE CHARACTERIZATION REPORT

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See configuration management system for approval history.

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## Change Record

<b>REVISION</b>	<b>DATE</b>	<b>ECO #</b>	<b>DESCRIPTION OF CHANGE</b>
A	05/14/2014	ECO-01626	Initial release; Posey Creek only
B	03/10/2016	ECO-03735	Adding details for Lewis Run

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## 1 DESCRIPTION

### 1.1 Purpose

Information collected and described here is used to inform the site design activities for the NEON project Aquatic Instrument System (AIS). This report includes information gathered by the Aquatic (AQU) and Environmental, Health, & Safety (EHS) teams. The purpose of this report is for the science team to outline what is desired at each site within a domain in order to obtain the best scientific data possible to help answer NEON’s Grand Challenge Questions; therefore, this is not a design document, but a report that is an input to the design process.

This report takes precedence over other documents and reports that may repeat the information contained herein.

The Appendices include summary tables for the convenience of the multiple audiences of this report; some of the information in the tables is repeated from the body of this report while other information is exclusive to the summary tables.

### 1.2 Scope

AQU site characterization information presented in this document is for the **D02** aquatic locations: Posey Creek (core) and Lewis Run (relocatable). Issues and concerns for each site that need further review are also addressed in this document according to our best knowledge. Unless otherwise noted, the information contained herein takes precedence over the same information repeated elsewhere; thereby, this document contains the official change-controlled information pertinent to these sites.

Disclaimer: All latitude and longitude coordinates are subject to the variation inherent in our GPS equipment and the conditions at the site. Some of the Aquatic sites are in narrow canyons with limited satellite coverage; resulting in coordinates that are not accurate to within 50 cm.

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## 2 RELATED DOCUMENTS AND ACRONYMS

### 2.1 Applicable Documents

AD[01]	
AD[02]	
AD[03]	
AD[04]	

### 2.2 Reference Documents

RD[01]	NEON.NPR.000008	NEON Acronym List
RD[02]	NEON.NPR.000243	NEON Glossary of Terms
RD[03]	[Reference to photos]	
RD[04]	[Reference to map(s)]	

### 2.3 Verb Convention

"Shall" is used whenever a specification expresses a provision that is binding. The verbs "should" and "may" express non-mandatory provisions. "Will" is used to express a declaration of purpose on the part of the design activity.

### 3 D02 AIS SITE CHARACTERIZATION REPORT

#### 3.1 Posey Creek

The Posey Creek site is a wadeable stream near Front Royal, VA and is located on the Smithsonian Conservation Biology Institute land. It is a shallow stream (<40 cm at average flow) and 3 – 5 m wide (6 meters wide during high flows).

##### 3.1.1 Aquatic Auxiliary and Aquatic Portal Locations for Construction

The initial estimated location for the Aquatic Auxiliary Portal is:

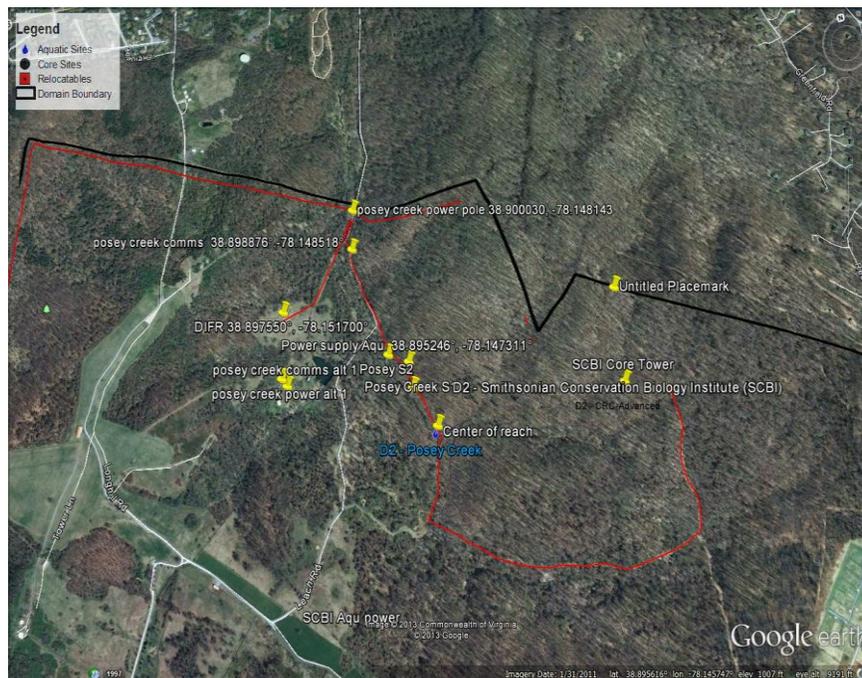


Figure 1 A Google-Earth-Derived Image of Aquatic Auxiliary Portal for D02 Posey Creek

Table 1 Aquatic Auxiliary Portal Location

Aquatic Auxiliary Portal	Latitude	Longitude
Location	38.895246	-78.147311

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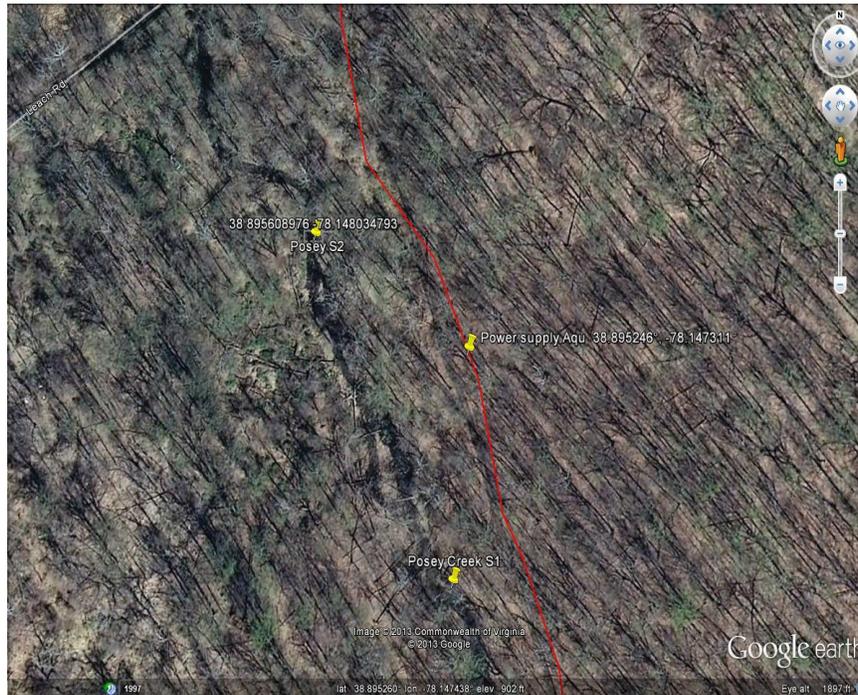


Figure 2 A Google-Earth-Derived Image of Aquatic Portal for D02 Posey Creek

Table 2 Aquatic Portal Location

Aquatic Portal	Latitude	Longitude
Location	38.895246	-78.147311

### 3.1.2 Sensor Locations for Construction

The GPS coordinates for S1, S2 and the Met Station obtained by AQU, with input from EHS, are presented in Table 3. Many aquatic sites are in narrow canyons or covered by dense canopy, which reduces satellite availability. In these situations, AQU will provide a description of the location and an approximate GPS location (e.g. not accurate to within <1 m). This description will suffice for the planning stages, but sites will likely need to be physically marked prior to construction.

These coordinates are to be used for the input to the AIS design:

Table 3 Sensor 1 & Sensor 2 Locations

Sensor	Latitude	Longitude
S1	38.894520	-78.147384
S2	38.895608	-78.148034

Table 4 Met Station Sensor Locations

Sensor	Latitude	Longitude
Met Station	38.894520	-78.147265

S1 is located ~ 50 m downstream of where the small braid converges to 1 main stream. S1 will be located in a riffle/run. S2 is ~191 m downstream of stream convergence. This location was chosen because it

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has a nice deep location in a confined channel for sensors. Suggest measuring discharge at this location. There is a nice deep run during high flows and should have enough water during low flows. The total distance between S1 and S2 is ~ 140 m.

The Met station is located approximately 10 m from the stream bank, at a large flat area between S1 and the access road. The forest canopy and understory are similar to that surrounding the stream reach.

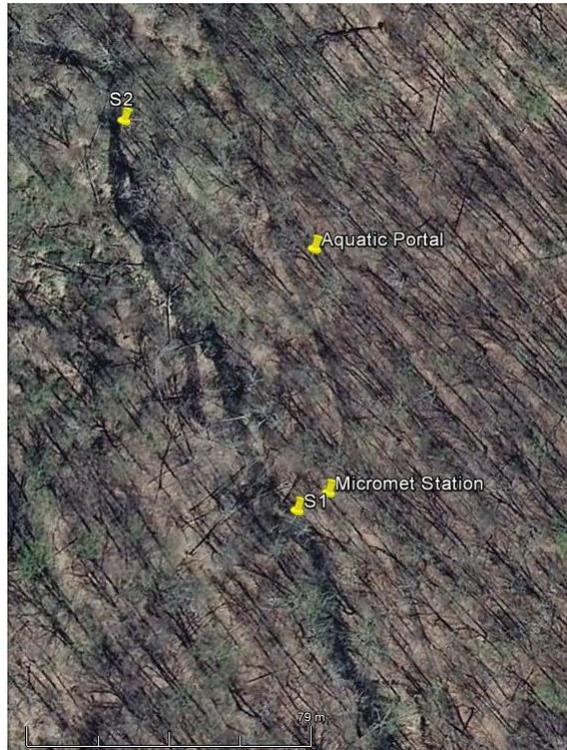


Figure 3 Kmz File of D02 Posey Creek Denoting Locations of S1, S2, and Met Station



Figure 4 Photo of S1 Location at D02 Posey Creek

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Figure 5 Photo of S2 Location at D02 Posey Creek



Figure 6 Photo of Met Station Location at D02 Posey Creek

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Figure 7 Posey understory allows for easy access to and along streambank.

### 3.1.3 Groundwater Wells

The groundwater observation wells network at the site (Figure 8, Table 5) will consist of 8 wells installed using either a direct-push or hand powered auger system. Topography at the site is dominated by a relatively flat flood plain near the stream reach and steeper gradients originating laterally away from the stream. The wells will be installed mainly in the flood plain region, where the required drilling depth will vary between 5-15 feet below ground surface. Access to the site will be via the existing gravel road directly to the east of the stream. Access to the well locations is anticipated to be relatively straightforward and a defined path for drilling purposes will be defined prior to work at the site.

The exact location of wells may vary during the drilling process due to the dense presence of boulders in the subsurface which were observed during the visit. These will be hard to detect from the surface using geophysical methods due to their size and may pose an issue if one is encountered during the drilling activities. Thus, actual locations of wells will vary slightly from the plan if subsurface obstructions are encountered.

AQU prefers the surface completion of the wells to include an above-grade stick-up protective cover and be minimally invasive. However, the State of Virginia has several requirements for construction of groundwater monitoring wells that NEON will either need to meet or apply for a waiver. Chief among the State requirements are 1) an acceptable grout to fill the annular space such as neat cement, bentonite chips, or a bentonite / cement mixture; 2) surface seal of the well requires a poured concrete or cement slab poured around a steel outer casing with a locking cap; and 3) a licensed well driller is required to be onsite.

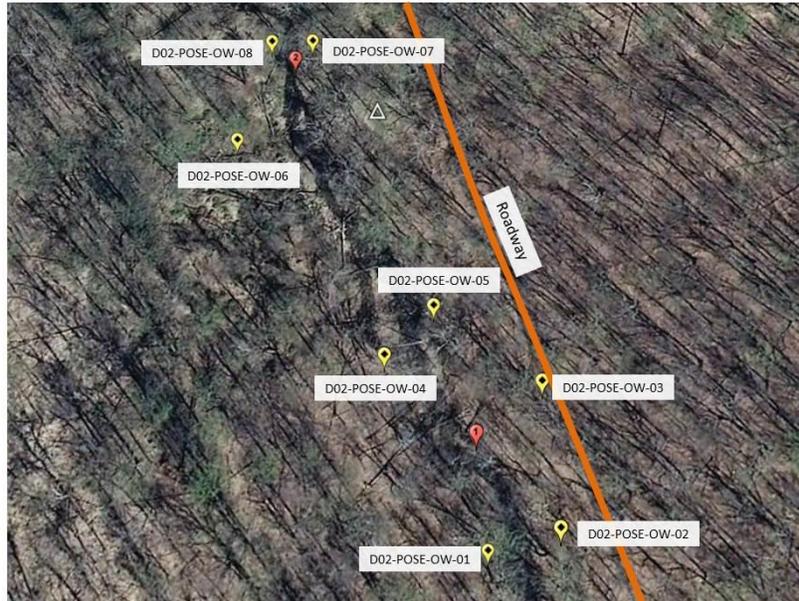


Figure 8 Initial Groundwater Well Locations Based on EMS kmz File at D02 Posey Creek

Table 5 Coordinates for Groundwater Observation Wells

Well ID	Latitude	Longitude
D02-POSE-OW-01	38.894228°	-78.147348°
D02-POSE-OW-02	38.894279°	-78.147115°
D02-POSE-OW-03	38.894648°	-78.147163°
D02-POSE-OW-04	38.894721°	-78.147686°
D02-POSE-OW-05	38.894854°	-78.147521°
D02-POSE-OW-06	38.895334°	-78.148222°
D02-POSE-OW-07	38.895644°	-78.147967°
D02-POSE-OW-08	38.895644°	-78.148117°

### 3.1.4 Riparian Vegetation Cover

During 2010-2011 site visits, the following plant density and type were observed by the AQU team: Broadleaf hardwood forest, Tulip poplars are dominant. 80% of the canopy is closed. Understory is small shrubs, grasses and young trees. The % cover of understory is 80%, but the understory is short and easy to walk through.

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Figure 9 The Riparian Canopy at D02 Posey Creek

### 3.1.5 Bank Morphology

The bank angle is estimated from the top of the bank, where one might stand to observe the stream, to the top of the water. The estimated angle is from the water to the bank, as illustrated in the figure below.

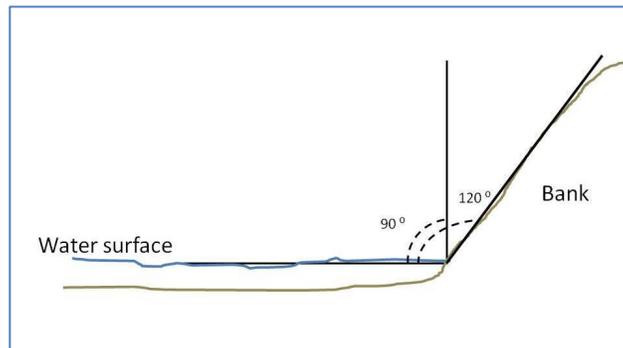


Figure 10 How Bank Angle is Measured

During 2011 site visits, AQU observed the following bank conditions at S1 and S2:

Table 6 Bank Conditions At D02 Posey Creek In 2011

Morphology Type	S1	S2
RB* angle	175	170
LB* angle	170	170
Maximum water height	0.71 m	0.54 m
Bankfull width	7.6 m	3.6 m
Substrate composition	Boulders, smaller substrate than channel, lots of woody debris and organic matter	Organic matter, woody debris, boulders and vegetative cover.

\* RB (right bank) and LB (left bank) are determined by facing downstream.

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Figure 11 a) Right bank at S1 with R. Utz. Note access road in background. b) Right bank at S2 with K. Goodman.

### 3.1.6 Site Photos

The following photos of are representative of the site.

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Figure 12 Typical Substrate in D02 Posey Creek are mostly large cobbles.



Figure 13 Posey during high flows showing lots of large boulders and large woody debris.

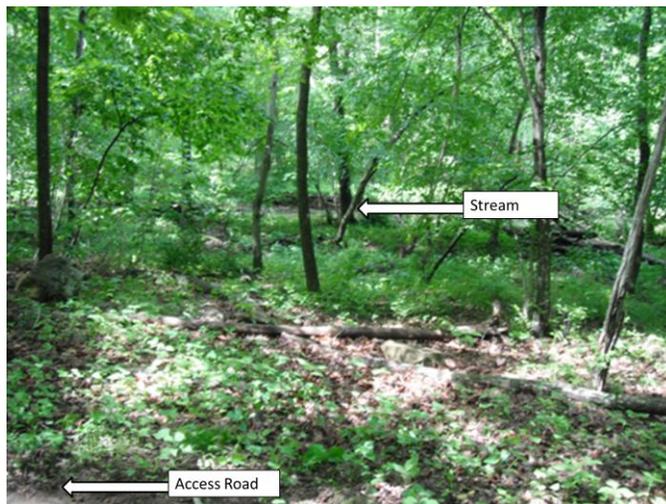


Figure 14 View of Posey creek and surrounding forest from access road. Easy access to stream.

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Figure 15 Access road running along stream reach.



Figure 16 Posey during low flows.



Figure 17 Lots of ecological collection devices near stream.

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### 3.1.7 Site Access Needs

No pathways, boardwalks, stairs, or ladders are needed at D02 Posey Creek for Science purposes.

### 3.1.8 Communications at the Site

There are two locations where we found communication boxes #1 is along the proposed power run and is at 38.898876, -78.148518. The other alt communication box is at 38.895531, -78.152121  
- See table in Appendix C for additional IT info  
Fiber from TIS hut.



Figure 18 Photo of power pole at site

### 3.1.9 Power at the Site

The local power utility company is Rappahannock Electric Cooperative.  
137 Kelley Court  
Front Royal, VA 22630  
(540) 622-5173

### 3.1.10 Site Science Construction Constraints and Limitations

Site-specific issues to consider at D02 Posey Creek are:  
Potential for very low flows in this stream. Sensors need to be installed in narrow confined channels within the stream to ensure they stay wet for as long as possible. Some concern about large woody debris movement in channel during extremely high flow events (very infrequent).

Driving and access constraints for D02 Posey Creek are:

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- Access to the site is via a relatively steep gradient gravel road. Potential winter access issues may be present and Field Operations crew may require chains or 4WD vehicles for winter access. Modification to the road is not necessary to mitigate this issue.

### 3.1.11 Other Issues

No other science issues are identified at this time.

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### 3.2 Lewis Run

The Lewis Run site is a small 2<sup>nd</sup> order wadeable stream. The majority of the stream reach characterized in this report flows past and through agricultural lands on the Casey Trees property. Casey Trees raises trees for planting in and around the Washington DC Area.

#### 3.2.1 Aquatic Auxiliary and Aquatic Portal Locations for Construction

The initial estimated location for the Aquatic Auxiliary Portal is:



Figure 19 A Google-Earth-Derived Image of Aquatic Portal for D02 Lewis Run

Table 7 Aquatic Portal Location

Aquatic Portal	Latitude	Longitude
Location	39.093926°	-77.979002°

#### 3.2.2 Sensor Locations for Construction

AQU, with support from EHS, has the following field GPS coordinates for S1 and S2 and met station locations. Many aquatic sites are in narrow canyons or covered by dense canopy, which reduces satellite availability. In these situations, AQU will provide a description of the location and an approximate GPS location (e.g. not accurate to within <1m). This description will suffice for the planning stages, but sites will likely need to be physically marked prior to construction.

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These coordinates are to be used for the input to the AIS design:

Table 8 Sensor 1 & Sensor 2 Locations

Sensor	Latitude	Longitude
S1	39.095569°	-77.983068°
S2	39.094214°	-77.981427°

Table 9 Met Station & Discharge Sensor Locations

Sensor	Latitude	Longitude
Met Station	39.094486°	-77.981458°
Discharge Transect (~3m downstream of S1)	39.095569°	-77.983068°

Show below in Figure 20 is the layout of the stream on the landscape and the proposed locations for sensors in the stream. The blue line in Figure 20 represents the stream channel, of which approximately 1.6km of the reach is located on the Casey Trees Property. Near the top of the AOS reach, two small (70-100m) portions of the stream channel cross landowner boundary lines and travels through a neighbor's property. The AOS stream reach was selected to start below the first cutout, leaving only one small section of the AOS reach traveling through the neighbor's property. The red line shows an access pathway/unimproved roadway large enough for a truck to drive on. The access pathway extends the full length of the creek on the Casey Tree's Property.



Figure 20 Kmz File of D02 Lewis Run Denoting Locations of S1, S2, and Meteorological Station

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Figure 21 Photo of S1 Location at D02 Lewis Run



Figure 22 Photo of S2 Location at D02 Lewis Run

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Figure 23 Photo of Met Station Location at D02 Lewis Run



Figure 24 Photo of tributary and spring/pump house just above S1 location



Figure 25 Photo of Lewis Creek average section of stream channel

### 3.2.3 Groundwater Wells

The groundwater observation wells network at the site (Figure 26, Table 10) will consist of 8 wells installed using either a direct-push or small rotary auger system. Topography at the site is dominated by a relatively flat flood plain near the stream reach and steeper gradients originating laterally away from the stream. The wells will be installed mainly in the flood plain region, where the required drilling depth will vary between 10-15 feet below ground surface. Access to the site will be via the existing access road directly to the east of the stream. Access to the well locations is anticipated to be relatively straightforward and a defined path for drilling purposes will be defined prior to work at the site.

In general the subsurface is anticipated to be relatively free of boulders and the depth of drilling is unlikely to encounter bedrock; however, the exact location of wells may vary during the drilling process should subsurface obstructions be encountered. Groundwater wells will be constructed in accordance with the State of Virginia rules and regulations for constructing shallow observation wells. The State of Virginia, at the present moment, does not require a licensed well driller or professional geologist for observation well construction.

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Figure 26 Initial Groundwater Well Locations Based on EMS kmz File at D02 Lewis Run

Table 10 Coordinates for Groundwater Observation Wells

Well ID	Latitude	Longitude
D02-LEWI-OW-01	39.095589°	-77.982930°
D02-LEWI-OW-02	39.095482°	-77.983089°
D02-LEWI-OW-03	39.094975°	-77.982428°
D02-LEWI-OW-04	39.095000°	-77.982211°
D02-LEWI-OW-05	39.095430°	-77.982433°
D02-LEWI-OW-06	39.094126°	-77.981461°
D02-LEWI-OW-07	39.094341°	-77.982249°
D02-LEWI-OW-08	39.094260°	-77.981355°

### 3.2.4 Riparian Vegetation Cover

During January 2016 site visit, the following plant density and type were observed by the AQU team:

Riparian vegetation at the site is comprised of moderately spaced largely mature oak and poplar trees with moderately dense ground coverage of tall grasses and briar bushes. Vegetation was largely dormant during the visit and dense vegetation near the stream channel may be anticipated during the spring and summer months, when the understory begins growing again.

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Figure 27 The Riparian Vegetation at D02 Lewis Run

### 3.2.5 Bank Morphology

The bank angle is estimated from the top of the bank, where one might stand to observe the stream, to the top of the water. The estimated angle is from the water to the bank, as illustrated in the figure below.

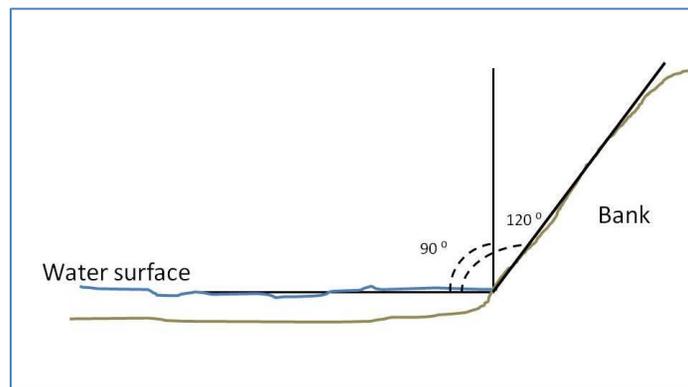


Figure 28 How Bank Angle is Measured

During January 2016 site visit, AQU observed the following bank conditions at S1 and S2: The stream banks at the Lewis Creek site on average are very steep as shown in Figure 29 and Figure 30. Active erosion was observed during the characterization activities and probing of the stream bed showed significant portions of the stream channel where very soft unconsolidated deposits of silt are present. Unconsolidated silt deposits ranged in depth of a few centimeters to over half a meter throughout the entire stream reach surveyed. Prior to the visit the region was behind on snowfall and precipitation events in general which may assist the stream in reducing the amount of silt impacted areas following a good flushing of the stream channel due to a high discharge event.

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Table 11 Bank Conditions At D02 Lewis Run In 2011

<b>Morphology Type</b>	<b>S1</b>	<b>S2</b>
RB* angle	160°	90°
LB* angle	100°	90°
Maximum water height	1.00m	1.30m
Bankfull width	2.35m	4.15m
Substrate composition	gravel, soft sands	soft sands/silts

\* RB (right bank) and LB (left bank) are determined by facing downstream.



Figure 29 Average stream bank along D02 Lewis Run stream reach



Figure 30 Average stream bank along D02 Lewis Run stream reach

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### 3.2.6 Site Photos

The following photos of are representative of the site.



Figure 31 Typical Substrate in D02 Lewis Run are mostly silt/sands/gravel.



Figure 32 Access pathway along D02 Lewis Run



Figure 33 Access road crosses channel below Sensor S2



Figure 34 Culvert at downstream end of AOS reach

### 3.2.7 Site Access Needs

Access to and along the **D02 Lewis Run** stream channel is relatively straightforward due to the access pathway to the east of the creek and easy access from a State maintained roadway. Access to the actual stream channel may require a small set of stairs to reduce erosion of the stream banks, due to the steepness of the banks near the sensor sets (S1, S2). The met station location is easily accessible from the access pathway.

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### 3.2.8 Communications at the Site

The local communications company is

ALL - See table in Appendix C for additional IT info

### 3.2.9 Power at the Site

The local power utility company is Rappahannock Electric Coop 540-622-2091.

### 3.2.10 Site Science Construction Constraints and Limitations

Site-specific issues to consider at **D02 Lewis Run** are:

- The site is also used as a TOS site and location of power portal/conduit run should take into consideration the location of established sampling plots prior to determining the power run from the aquatic portal to the sensor sets.
- The site is an actively managed tree farm, though farming fields are not near the selected stream reach.
- The site has stables and a mansion located near the stream reach. There's a desire from the site host to limit visual impacts of the NEON aquatic site/infrastructure from the public's view at these locations. The portion of stream reach was selected to limit visual impacts of the in-stream sensors, however care should be taken when selecting the PDS components for the site.
- The fence at the access road crossing the stream below S2 may need to be raised in order to allow fish to freely travel up and downstream for the AOS reach.

Driving and access constraints for **D02 Lewis Run** are:

- The stream reach is located on private property and access with the site host needs to be defined for working outside of normal hours. The site is easily accessed from State maintained roads, so access during mildly inclement weather should not be an issue.

### 3.2.11 Other Issues

No other science issues are identified at this time.

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#### 4 APPENDIX A. FCC SUMMARY TABLES FOR AIS SITE COMPONENTS AT D02

##### 4.1 Posey Creek FCC Summary Table

<b>Site Component</b>	<b>Latitude</b>	<b>Longitude</b>	<b>Units</b>
Stream, Lake, or Stream	Stream		Description
Aquatic Auxiliary Power Portal location	38.895246	-78.147311	Lat, Long in degrees
Aquatic Portal location			m away from bank, direction
Pathway needed? What is length?	No		Yes/no, description w/ length
Pathway start location	Site1-PathStartLat	Site1-PathStartLong	Lat, Long in degrees
Pathway end location	Site1-PathEndLat	Site1-PathEndLong	Lat, Long in degrees
Stairs or ladder needed?	No		Yes/no, description
Stairs top location	Site1-StairsTopLat	Site1-StairsTopLong	Lat, Long in degrees
Stairs length	Site2-StairsLength		Meters
Ladder top location	Site1-LadderTopLat	Site1-LadderTopLong	Lat, Long in degrees
Ladder length	Site1-LadderLength		Meters
Boardwalk needed? What is length?	No		Yes/no, description w/ length
Boardwalk start location	Site1-BrdwlcStartLat	Site1-BrdwlcStartLong	Lat, Long in degrees
Boardwalk end location	Site1-BrdwlcEndLat	Site1-BrdwlcEndLong	Lat, Long in degrees
Shall stairs, boardwalk be installed during construction?	No		Yes/no, description
Fencing needs	No		Description
Site management			Description
Any additional site specific information			Description

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#### 4.2 Lewis Run FCC Summary Table

<u>Site Component</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Units</u>
Stream, Lake, or Stream			Description
Aquatic Auxiliary Power Portal location	39.093926°	-77.979002°	Lat, Long in degrees
Aquatic Portal location			m away from bank, direction
Pathway needed? What is length?			Yes/no, description w/ length
Pathway start location	Site2-PathStartLat	Site2-PathStartLong	Lat, Long in degrees
Pathway end location	Site2-PathEndLat	Site2-PathEndLong	Lat, Long in degrees
Stairs or ladder needed?			Yes/no, description
Stairs top location	Site2-StairsTopLat	Site2-StairsTopLong	Lat, Long in degrees
Stairs length	Site2-StairsLength		Meters
Ladder top location	Site2-LadderTopLat	Site2-LadderTopLong	Lat, Long in degrees
Ladder length	Site2-LadderLength		Meters
Boardwalk needed? What is length?			Yes/no, description w/ length
Boardwalk start location	Site2-BrdwlkStartLat	Site2-BrdwlkStartLong	Lat, Long in degrees
Boardwalk end location	Site2-BrdwlkEndLat	Site2-BrdwlkEndLong	Lat, Long in degrees
Shall stairs, boardwalk be installed during construction?			Yes/no, description
Fencing needs			Description
Site management			Description
Any additional site specific information			Description

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## 5 APPENDIX B. EHS SUMMARY TABLES FOR AIS SITE COMPONENTS AT D02

### 5.1 Posey Creek EHS Summary Table

<u>Site Component</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Units</u>
Sensor 1 (S1) location	38.894520	-78.147384	Lat, Long in degrees
Sensor 2 (S2) location	38.895608	-78.148034	Lat, Long in degrees
Discharge Sensor location (if needed)	Site1-DSLat	Site1-DSLlong	Lat, Long in degrees
Micromet Station location	38.894520	-78.147265	Lat, Long in degrees
Aquatic Auxiliary Power Portal location	38.895246	-78.147311	Lat, Long in degrees
Aquatic Portal location	Site1-APLat	Site1-APLong	Lat, Long in degrees

### 5.2 Lewis Run EHS Summary Table

<u>Site Component</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Units</u>
Sensor 1 (S1) location	39.095569°	-77.983068°	Lat, Long in degrees
Sensor 2 (S2) location	39.094214°	-77.981427°	Lat, Long in degrees
Discharge Sensor location (if needed)	39.095569°	-77.983068°	Lat, Long in degrees
Micromet Station location	39.094486°	-77.981458°	Lat, Long in degrees
Aquatic Auxiliary Power Portal location	39.093926°	-77.979002°	Lat, Long in degrees
Aquatic Portal location	Site2-APLat	Site2-APLong	Lat, Long in degrees

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## 6 APPENDIX C. IT SUMMARY TABLES FOR AIS SITE COMPONENTS AT D02

### 6.1 Posey Creek IT Summary Table

<u>Site Component</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Units</u>
<b>REQUIRED</b>			
Aquatic Auxiliary Power Portal location	38.895246	-78.147311	Lat, Long in degrees
Aquatic Portal location	Site1-APLat	Site1-APLong	Lat, Long in degrees
<b>DESIRED</b>			
Cell tower visible from site			Yes/no
Cell phone signal at site			Yes/no, which carrier?
Strength of cell phone signal			Description
Facility on property			Yes/no
Internet connectivity at facility			Yes/no, description
Phone number at facility location			Area code & first 3 needed

### 6.2 Lewis Run IT Summary Table

<u>Site Component</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Units</u>
<b>REQUIRED</b>			
Aquatic Auxiliary Power Portal location	39.093926°	-77.979002°	Lat, Long in degrees
Aquatic Portal location	Site2-APLat	Site2-APLong	Lat, Long in degrees
<b>DESIRED</b>			
Cell tower visible from site			Yes/no
Cell phone signal at site			Yes/no, which carrier?
Strength of cell phone signal			Description
Facility on property			Yes/no
Internet connectivity at facility			Yes/no, description
Phone number at facility location			Area code & first 3 needed