D03 AQUATIC INSTRUMENT SYSTEM (AIS) SITE CHARACTERIZATION REPORT

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See configuration management system for approval history

Change Record

REVISION	DATE	ECO #	DESCRIPTION OF CHANGE
A	05/14/2014	ECO-01627	Initial release
B	07/31/2014	ECO-01981	Minor updates
C	03/30/2016	ECO-03742	Descoped Ichawaynochaway; added Flint River as relocatable site that was characterized

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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)/STREON (STR) 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 D03 aquatic locations: Lake Barco (core), Lake Suggs (core) and Flint River (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.

2 RELATED DOCUMENTS AND ACRONYMS

2.1 Applicable Documents

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

2.2 Reference Documents

RD[01]	NEON.DOC.000008 NEON Acronym List
RD[02]	NEON.DOC.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 D03 AIS SITE CHARACTERIZATION REPORT

3.1 Lake Barco

The Lake Barco site is a nutrient poor, relatively clear lake with an average secchi depth of 5.4m and chlorophyll a content of 1 ug/L. The lake is clear with light penetrating through most of the lake depth. The lake is situated on limestone geology overlain by a variable mixture of sand, gravel, clay, phosphate, and carbonate sediments. Barco Lake is 0.13 km^2 in area, situated in watershed that I 0.81 km^2. It is classified as a seepage lake dominated by groundwater, acting as a discharge and recharge system to the regional Upper Floridian aquifer. Fluctuation in the water table is between 1 to 1.5 m (per John Hayes) but can reach up to 3 to 4 m during storm event. There is no discernable inflow or outflow to Barco Lake, although there is some evidence of water inflow from the northern edge of the lake with a flow pattern to the S and SE; mean inflow/outflow rate of $1.7*10^4$ m^3/yr. The groundwater input accounts for between 5 and 14% of the annual hydrologic input. The mean hydraulic residence time of the lake is 32 years. Barco Lake has a mean depth of 4.3 m and a maximum depth of 5.2 m and is mostly isothermal (does not stratify). The lake is classified as acidic with a mean pH of 4.5.

3.1.1 Aquatic Auxiliary and Aquatic Portal Locations for Construction

Power and communication will not come from the FIU site, however will come from the same provider The initial estimated location for the Aquatic Auxiliary Portal is illustrated in Figure 1.

Figure 1 A Google-Earth-Derived Image of Aquatic Auxiliary Portal for D03 Lake Barco

Table 1 Aquatic Auxiliary Portal Location

Sensor	Latitude	Longitude
Location	29.676790	-82.010190

The Aquatic Portal will be co-located with the Aquatic Auxillary Portal.

Table 2 Aquatic Portal Location

Sensor	Latitude	Longitude
Location	29.676790	-82.010190

3.1.2 Sensor Locations for Construction

The GPS coordinates for S1, the Met Station and the inlet and outlet locations obtained by AQU, with input from EHS, are presented in Tables 3 and 4. 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.

The coordinates to be used for the input to the AIS design are summarized in Table 3 and 4 and shown in Figure 2-4. Figure 3 provides bathymetric lines for Barco (e.g. water depth in feet). This map is from Florida Lakewatch and has not yet been verified by AQU.

Table 3 Sensor 1 & Sensor 2 Locations

Sensor	Latitude	Longitude
S1	29.676057	-82.008369
S2	NA	NA

Cannot	Delete	Table
S1	Click here to enter text.	Click here to enter text.
S2	Click here to enter text.	Click here to enter text.

The Meteorological station (Met Station 1) is located on land near the AQU portal. A secondary met station (met Station 2) is co-located with the Buoy (S1). In addition, there is a staff gauge and inlet and outlet sensor infrastructure located in the nearshore areas of the lake (Table 4).

Table 4 Met Station, Staff Gauge & Pressure Sensor Locations

Sensor	Latitude	Longitude
Met Station	29.676961	-82.009788
Inlet	29.677519	-82.008153
Outlet	29.674985	-82.008728
Camera	29.676600	-82.009896

Figure 2 Map of D03 Lake Barco Denoting Sensor Locations. The red cross denotes the location of S1 (buoy) and the co-located Met station 2. The red cylinder denotes the location of the staff gauge near the lake access point (yellow arrow). The red sar denotes the location of Met Station 1. The red Dots denote the locations of the inlet and outlet infrastructure.

Figure 3 Map of D03 Lake Barco bathymetry denoting water depths (in feet) and the location of the profiling buoy and inlet and outlet infrastructure.

Figure 4 Photo of S1 Location at D03 Lake Barco

3.1.3 Groundwater Wells

The groundwater observation wells network at the site (Figure 5, Table 5) will consist of 8 wells installed using a rotary auger rig. Topography at the site is dominated by rolling hills surrounding the lake. The wells will be installed at varying positions along the rolling hills and the required drilling depth will vary with total depths between 40-80 feet below ground surface. Access to the site will be via the existing sand road directly to the west of the lake. Rig access to the well locations is anticipated to be relatively straightforward and a defined rig path for drilling purposes will be defined prior to work at the site.

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 Florida 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. No details are provided as to the thickness or size of the ground surface seal.

The AQU team prefers a steel casing with a non-cement pad and will apply for a waiver for each well. However, EHS should prepare the landowner for this State regulation and the real possibility that cement will need to be used.

The groundwater wells will transmit data back to either the S1 (buoy) or the AQU portal location through either wireless or cellular technologies. To do this an antenna may need to be installed on the top of the protective steel casing and an additional power source (batteries) may need to be used. The antenna is anticipated to extend to a maximum height of 8 feet above ground surface. The batteries will be contained in either a box mounted to the protective steel casing or positioned on the ground and fixed to the protective steel casing. The maximum anticipated size of the box is one cubic foot.

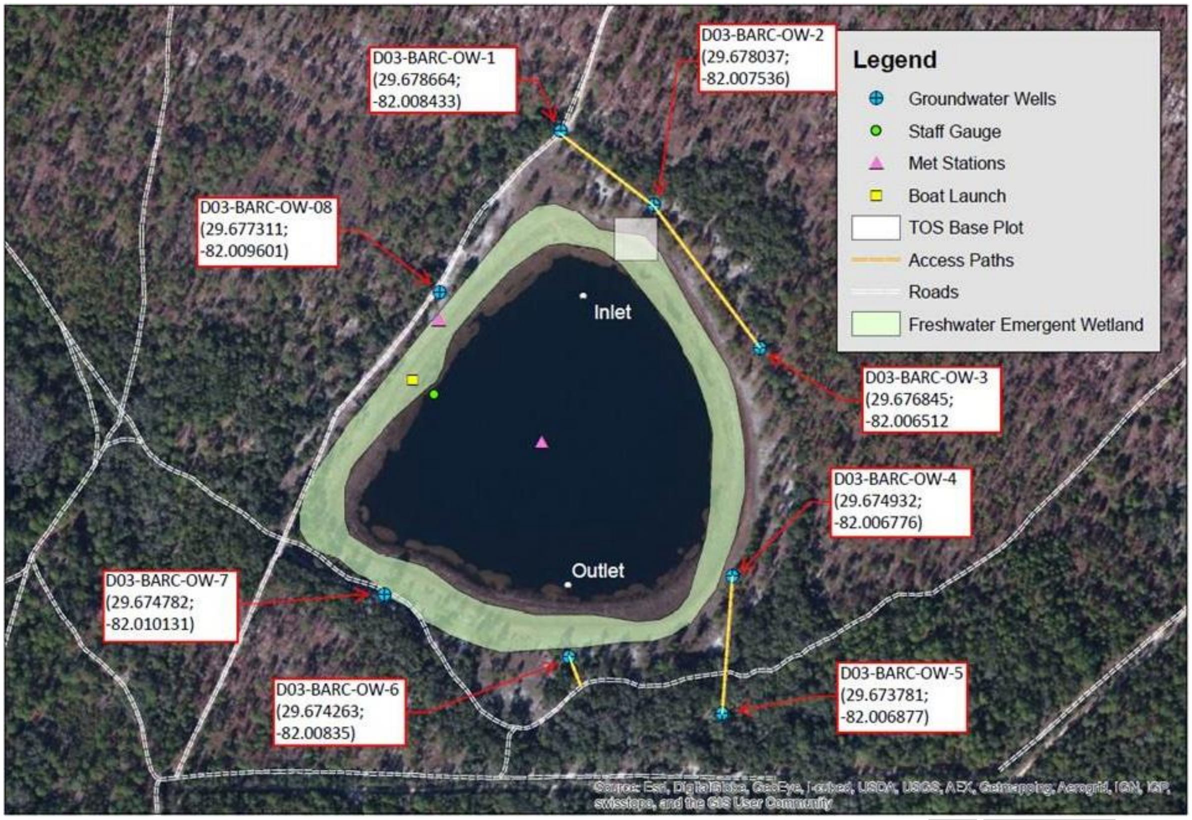

Figure 5 Initial Groundwater Well Locations Based on EMS kmz File at D03 Lake Barco

Table 5 Groundwater Observation Well Locations

Well ID	Latitude	Longitude
D03-BARC-OW-01	29.678664	-82.008433
D03-BARC-OW-02	29.678037	-82.007536
D03-BARC-OW-03	29.676845	-82.006512
D03-BARC-OW-04	29.674932	-82.006776
D03-BARC-OW-05	29.673781	-82.006877
D03-BARC-OW-06	29.674263	-82.008350
D03-BARC-OW-07	29.674782	-82.010131
D03-BARC-OW-08	29.677311	-82.009601

3.1.4 Riparian Vegetation Cover

During 2010-2011 site visits, the dominant type of vegetation was a combination of evergreen forest and mixed shrub/grassland (Figure 6).

Figure 6 The Riparian Canopy at D03 Lake Barco

3.1.5 Bank Morphology

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

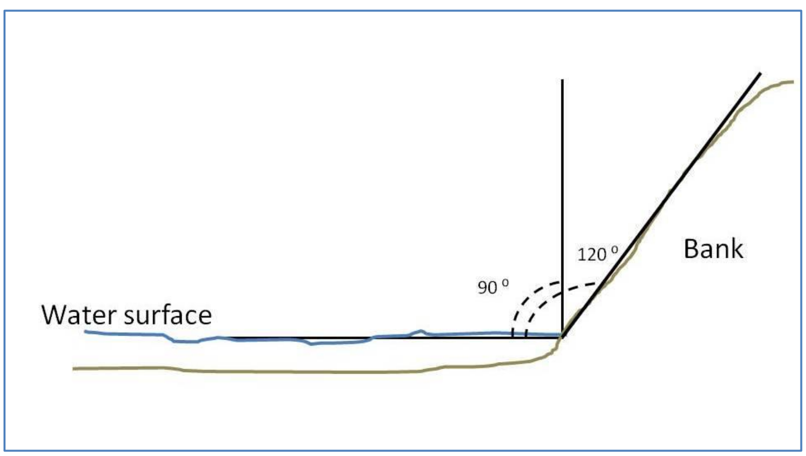

Figure 7 How Bank Angle is Measured

During 2011 site visits, AQU observed the following bank conditions at the access point of the lake:

The banks of Barco Lake are stable; composed primarily of compacted sand. The average bank angle near the access location is 135 to 170° (Table 6).

Table 6 Bank Conditions At D03 Lake Barco In 2011

Morphology Type	Lake Wide
Average bank angle	135 to 170 °
Lake Max Length	380 m
Lake Max Width	396 m
Maximum water height	tbd
Lake Area	0.13 km^2
Substrate composition	Sand

3.1.6 Site Photos

The following photos ~~of~~ are representative of the site:

Figure 8 Typical Substrate in D03 Lake Barco are mostly sandy.

Figure 9 The existing pier in D03 Lake Barco with old staff gauge. The water levels are low and the end of the pier isnot submerged.

Figure 10 Current access location in D03 Lake Barco and the existing pier.

Figure 11 Existing groundwater wells in D03 Lake Barco

Figure 12 Additional groundwater wells and lake edge in D03 Lake Barco

3.1.7 Site Access Needs

The existing pier/boardwalk does not provide access to the lake water when water levels are low.
The safety of personnel and integrity of Barco Lake would be improved and erosion reduced if a movable floating pier was installed. This is a soft requirement from Science, as

- Alligator use of the lake is unknown
- Erosion potential at this site is largely unknown. The site has a stable bank including plant covering.

NEON may want to consider Operating the site for a year before determining if a pier at Barco Lake would improve worker safety or reduce erosion.

3.1.7.1 Science Perspective on Access Needs (Pathways, Stairs, Etc.) to Reduce Site Erosion/Impact

If a pier is constructed, it must include:
- a rubber movable floating pier, 30 meters long and 1 meter wide (standard pier)
- a 1 meter wire fence along the edge to prevent access to alligators accessing the pier

If a floating pier were installed, AQU would prefer to mount the pressure transducer near the pier (Table 7) where access would be easy and safe (e.g. field technician would not need to enter water to maintain sensor, thus reducing likelihood of accidental contact with potential alligators).

Table 7 Boardwalk/Pier Location

Boardwalk	Latitude	Longitude
Start	29.676724	-82.010069
End	29.676426	-82.009682

3.1.8 Communications at the Site

The local communications company is Windstream; the coordinate is 29.67319, -82.01221 (Figure 13). ALL - See table in Appendix C for additional IT info.

Figure 13 The power pedestal nearest Barco Lake.

The Ordway/Swisher Biological Station does have communications.

3.1.9 Power at the Site

The local power utility company is Clay Electric. The contact is Bill Strausberger at 352-473-8000 ext 8294.

3.1.10 Site Science Construction Constraints and Limitations

Site-specific issues to consider at D03 Lake Barco are:

- Lake Barco is part of the Ordway Swisher Biological Station (OSBS) owned by the University of Florida. It is, therefore, a working facility used by the University of Florida and other researchers from a multitude of institutions. Care should be taken to ensure construction activities do not interfere with existing activities or research.
- Construction related erosion should be minimized. This can be ensured by
  - staying back 10 feet from the water edge,
  - minimizing vehicle and equipment use near the water edge, except for boat and associated truck and trailer,
  - access to the lake edge should be from one location, taking care not to excessively erode the access point (e.g. use planks if truck is stuck, do not rock car back and forth such that a groove is created),
  - utilizing pads to redirect water or sediment away from the lake during construction.

Driving and access constraints for D03 Lake Barco are:

- A 4X4 truck is required to access this site. The roads are mostly sandy.
- The OSBS facility routinely performs prescribed forest burns. Care should be taken when accessing this site and prior information regarding management activities is advised.

3.1.11 Other Issues

No other science issues are identified at this time.

3.2 Lake Suggs

The Lake Suggs site is a moderately nutrient rich and partially clear lake with an average secchi depth of 0.5 m and chlorophyll a content of 4 ug/L. The lake water is turbid, with light penetrating through the first two feet of water surface. The lake is situated on limestone geology overlain by a variable mixture of sand, gravel, clay, phosphate, and carbonate sediments. Suggs Lake is primarily surface water dominated, although it does interact with the regional aquifer to some extent. This lake lies within a greater flow through wetland complex. Inflow lies on the SW part of the lake with a smaller inflow from the E edge of the lake. Outflow is through the NW part of the lake as part of the greater wetland complex. Suggs Lake is a 0.73 km^2 in area. It is classified as a seepage lake dominated by groundwater flow with the local aquifer, but it is also fed by the local surface and subsurface flow through the wetland complex. Fluctuation in the water table is between 1 to 1.5 m. There is no discernable inflow or outflow to Suggs Lake, although there is some evidence of water inflow from the south western edge of the lake with a flow pattern to the N and NW. Suggs Lake has a mean depth of 2.5 m and a maximum depth of 3.7 m and is isothermal (does not stratify). The lake is classified as acidic with a mean pH of 4.9.

3.2.1 Aquatic Auxiliary and Aquatic Portal Locations for Construction

The initial estimated location for the Aquatic Auxiliary Portal is summarized in Table 8 and illustrated in Figure 14.

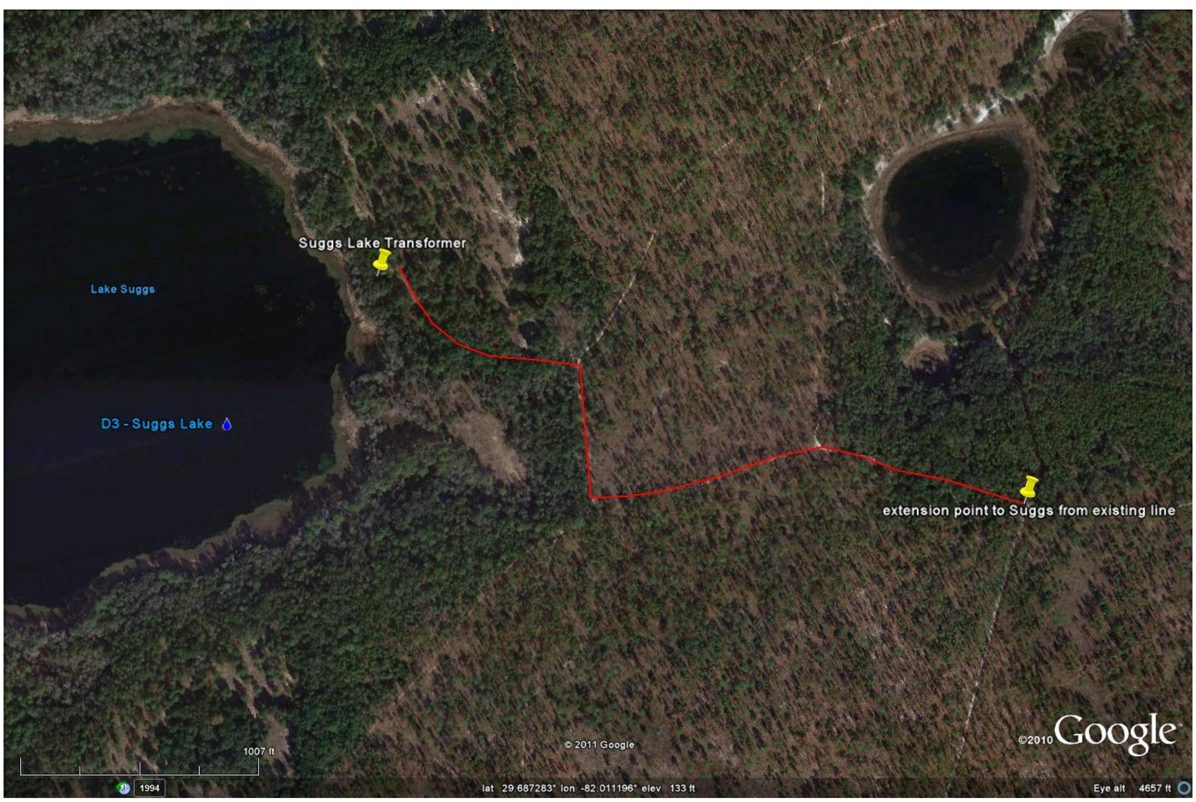

Figure 14 A Google-Earth-Derived Image of Aquatic Auxiliary Portal for D03 Lake Suggs

Table 8 Aquatic Auxiliary Portal Location

Aquatic Auxiliary Portal	Latitude	Longitude
Location	29.688425	-82.013976

The aquatic portal will be co-located with the Aquatic Aux Portal (Table 8).

Table 9 Aquatic Portal Location

Aquatic Portal	Latitude	Longitude
Location	29.688425	-82.013976

3.2.2 Sensor Locations for Construction

The GPS coordinates for S1, the Met Station and the inlet and outlet locations obtained by AQU, with input from EHS, are presented in Tables 10 and 11. 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.

The coordinates to be used for the input to the AIS design are summarized in Table 10 and 11 and shown in Figure 15. Figure 16 provides bathymetric lines for Suggs (e.g. water depth in feet).

Table 10 Sensor 1 & Sensor 2 Locations

Sensor	Latitude	Longitude
S1	29.687323	-82.018633
S2	NA	NA

The Meteorological station (Met Station 1) is located on land near the AQU portal. A secondary met station (met Station 2) is co-located with the Buoy (S1). In addition, there is a staff gauge and inlet and outlet sensor infrastructure located in the nearshore areas of the lake (Table 11).

Table 11 Met station & Discharge/Pressure Sensor Locations

Sensor	Latitude	Longitude
Met Station	29.688416	-82.013637
Inlet	29.685553	-82.019685
Outlet	29.690379	-82.017599
Camera	29.688314	-82.014336

Figure 15 Map of D03 Suggs Lake Denoting Sensor Locations. The red cross denotes the location of S1 (buoy) and the co-located Met Station 2. The red star denotes the location of Met Station 1. The red cylinder denotes the location of the pressure sensor near the lake access point (yellow arrow). The red dots denote the location of the inlet and outlet sensors.

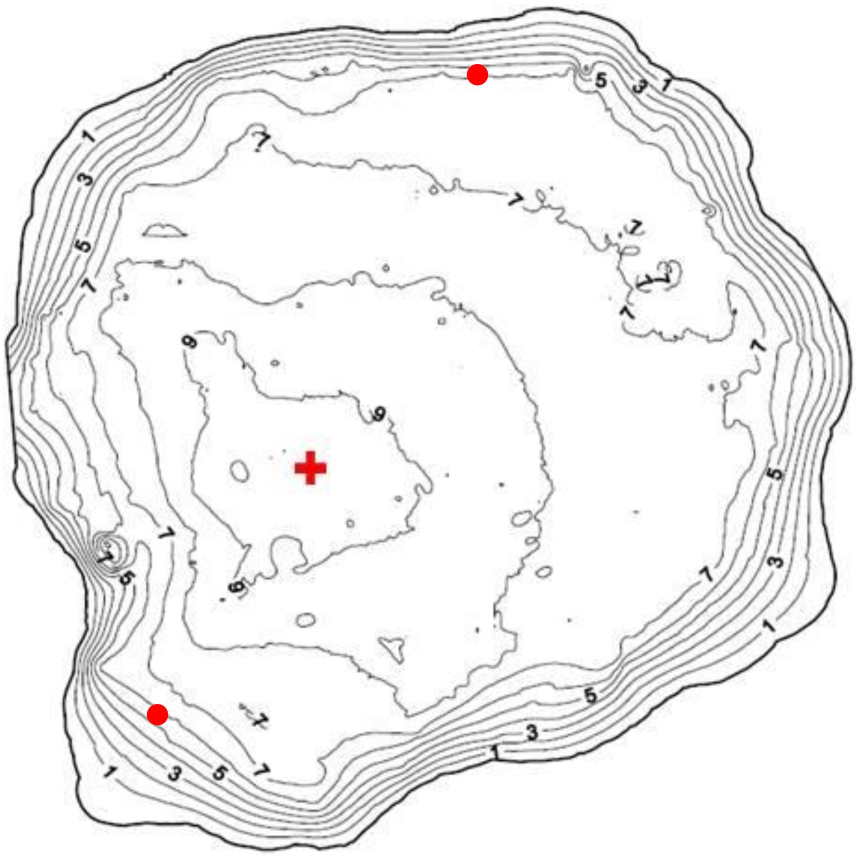

Figure 16 Map of D03 Lake Suggs bathymetry denoting water depths (in feet) and the location of the profiling buoy and the inlet and outlet infrastructure. Map is from Florida Lakewatch.

Figure 17 Photo of S1 Location at D03 Lake Suggs

3.2.3 Groundwater Wells

The groundwater observation wells network at the site (Figure 18, Table 12) will consist of 8 wells installed using a rotary auger rig. Topography at the site is dominated by rolling hills surrounding the lake. The wells will be installed at varying positions along the rolling hills and the required drilling depth will vary with total depths between 30-60 feet below ground surface. Access to the site will be via the existing gravel road directly to the east of the lake. Rig access to most of the well locations is anticipated to be relatively straightforward and a defined rig path for drilling purposes will be defined prior to work at the site. Two well locations (D03-SL-OW-1 and D03-SL-OW-8) are located in or near wetlands areas and will require alternate means (powered hand auger) for drilling the wells.

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 Florida 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. No details are provided as to the thickness or size of the ground surface seal.

The AQU team prefers a steel casing with a non-cement pad and will apply for a waiver for each well. However, EHS should prepare the landowner for this State regulation and the real possibility that cement will need to be used.

The groundwater wells will transmit data back to either the S1 (buoy) or the AQU portal location through either wireless or cellular technologies. To do this an antenna may need to be installed on the top of the protective steel casing and an additional power source (batteries) may need to be used. The antenna is anticipated to extend to a maximum height of 8 feet above ground surface. The batteries will be contained in either a box mounted to the protective steel casing or positioned on the ground and fixed to the protective steel casing. The maximum anticipated size of the box is one cubic foot.

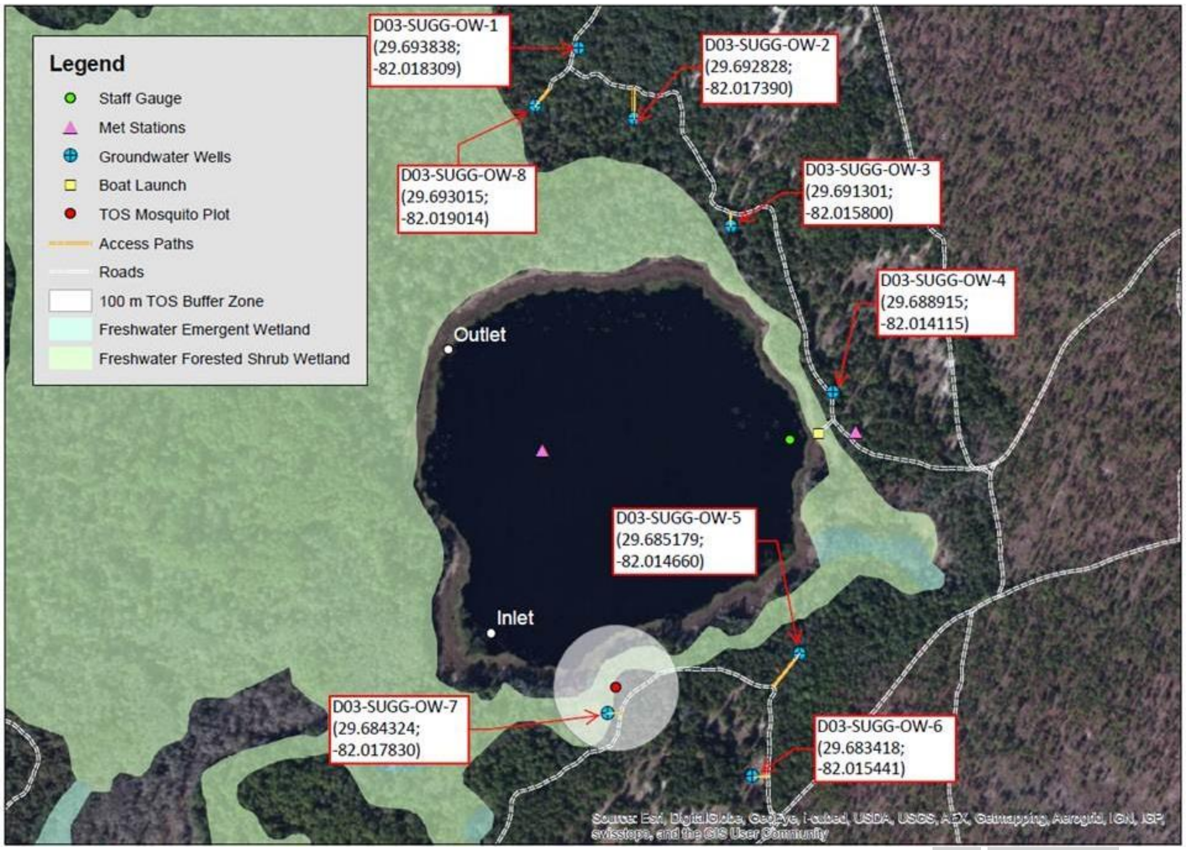

Figure 18 Initial Groundwater Well Locations Based on EMS kmz File at D03 Lake Suggs

Table 12 Groundwater Observation Well Locations

Well ID	Latitude	Longitude
D03-SUGG-OW-01	29.693838	-82.018309
D03-SUGG-OW-02	29.692828	-82.017390
D03-SUGG-OW-03	29.691301	-82.015800
D03-SUGG-OW-04	29.688915	-82.014115
D03-SUGG-OW-05	29.685179	-82.014660
D03-SUGG-OW-06	29.683418	-82.015441
D03-SUGG-OW-07	29.684324	-82.017830
D03-SUGG-OW-08	29.693015	-82.019014

3.2.4 Riparian Vegetation Cover

During 2010-2011 site visits, the dominant type of vegetation was a combination of evergreen forest and conifers (Figure 19). Trees dominate the area.

The riparian areas have an extensive cover of emergent macrophyte vegetation (e.g weedy plants). The southern and western edges of the lake are dominated by wetlands vegetation.

Figure 19 The Riparian Canopy at D03 Lake Suggs

3.2.5 Bank Morphology

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

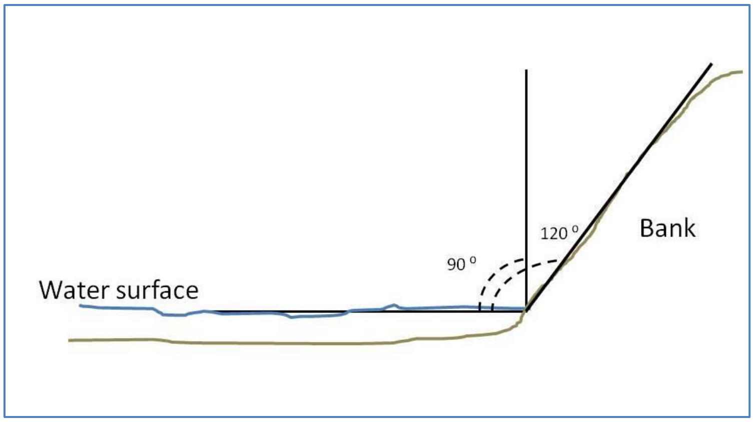

Figure 20 How Bank Angle is Measured

During 2011 site visits, AQU observed the following bank conditions at the access point of the lake:

The banks of Suggs Lake are stable; composed primarily of compacted sand. The average bank angle near the access location is 160 to 170^{o} (Table 13).

Table 13 Bank Conditions At D03 Lake Suggs In 2011

Morphology Type	Lake Wide
Average bank angle	160 to 170 ^{o}
Bankfull Length	637 m
Bankfull Width	696 m
Maximum water height	
Lake Area	0.73 km^2
Substrate composition	Sand

3.2.6 Site Photos

The following photos are representative of the site.

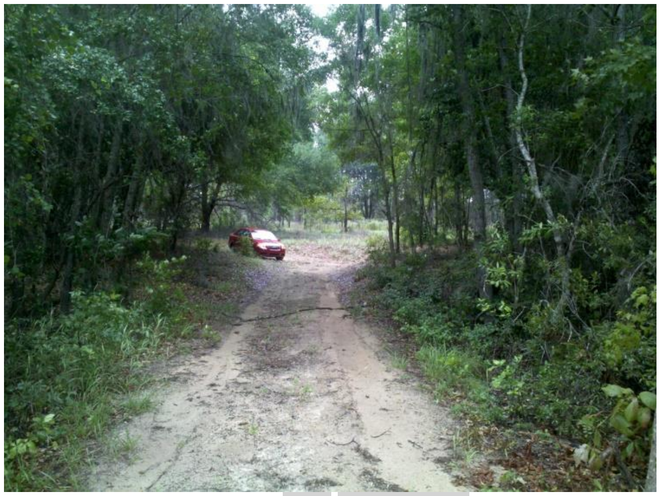

Figure 21 Typical Substrate in D03 Lake Suggs are mostly fine sands.

Figure 22 Staff gauge in D03 Lake Suggs

Figure 23 Access road to D03 Lake Suggs

Figure 24 Access point to D03 Lake Suggs where a crushed concrete access has been proposed by OSBS

Figure 25 A suite of piezometers exists on the eastern edge of the lake

3.2.7 Site Access Needs

A pathways and pier (boardwalk) are needed at D03 Lake Suggs for science purposes to reduce erosion into the lake.

3.2.7.1 Science Perspective on Access Needs (Pathways, Stairs, Etc.) to Reduce Site Erosion/Impact

A 25 m access pathway is needed to enter Suggs Lake. This is envisioned to run from the end of the current sand pathway into the lake. OSBS has proposed running crushed concrete from the main road, which would make the total path length approximately 90 m. Table 14 are the coordinates for the 25 m stretch. While on the site visit and talking with Steve Coates, he requested a concrete slab installed for the last 30' of the assess path for a boat dock (8' wide and 4" thick).

Table 14 Pathway Location

Pathway	Latitude	Longitude
Start	29.688514	-82.013977
End	29.688240	-82.014429

As for Barco Lake, a movable, floating pier may reduce safety concerns when accessing Suggs Lake. This lake is known to have a resident alligator population.

If a pier was established, AQU would co-locate the pressure sensor near the pier for ease of access.

Please refer to the Barco Lake section for pier specifications. The location of a proposed pier at Suggs Lake is summarized in Table 15.

Table 15 Pier/Boardwalk Location

Boardwalk	Latitude	Longitude
Start	29.688324	-82.014414
End	29.688233	-82.014818

3.2.8 Communications at the Site

The local communications company is Windstream. The location is 29.67319, -82.01221 (Figure 26).

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ALL - See table in Appendix C for additional IT info

Figure 26 The power pedestal nearest Suggs Lake.

3.2.9 Power at the Site

The local power utility company is Clay Electric. The contact is Bill Strausberger at 352-473-8000 ext 8294.

3.2.10 Site Science Construction Constraints and Limitations

Site-specific issues to consider at D03 Lake Suggs are the same as those for Barco Lake and are not repeated here.

In addition, Suggs Lake has a resident population of alligators that should be avoided (Figure 27). Alligators will hide in the plants at the water's edge, thus foot-travel near the edge of the lake should be minimized.

Figure 27 Juvenile alligator found near the bank of Suggs Lake.

Driving and access constraints for D03 Lake Suggs are the same as those at Barco Lake.

3.2.11 Other Issues

No other science issues are identified at this time.

3.3 Flint River

The Flint River site is a non-wadeable river with a watershed size of approximately 2.19 Mha (see Figure 1.). The headwaters of the Flint River are located in the Piedmont Lowlands just south of Atlanta, GA. The Flint extends 554 km into the wetlands of the Gulf Coastal Plain until joining the Chattahoochee River in the southwestern extent of Georgia.

The proposed NEON site is located in the Jones Ecological Research Center (JERC) in the southern extend of the watershed near the confluence with Ichawaynochaway Creek. JERC encompasses 11,735 ha within Baker county. The ecological questions for D03 revolve around the drivers and processes associated with restored ecosystems. In this case, the Jones Center site will be removing oak-encroached systems and restoring the nature stand density and fire regime that supports native Longleaf Pine and wiregrass plant communities.

The research center was initially established as a hunting reserve in the 1920s. Previous research at this center has focused on the ecology and management of longleaf pine woodlands and wetland/aquatic resources.

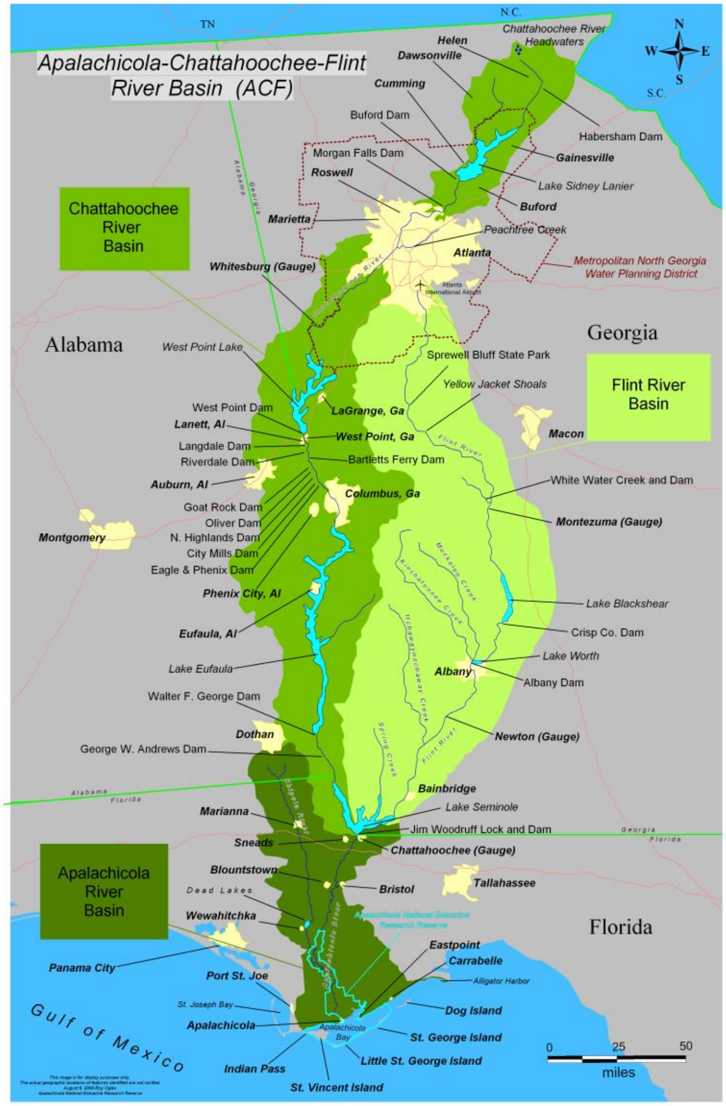

Figure 28 Map of the Flint River watershed.

3.3.1 Infrastructure and Construction

3.3.1.1 Aquatic Auxiliary and Aquatic Portal Locations for Construction

The initial estimated location for the Aquatic and Auxiliary Portal is shown in Figure 11. There is a power pole located at 31.190883°, -84.439250° (see Figure 11) that is approximately 1km from the proposed Portal location.

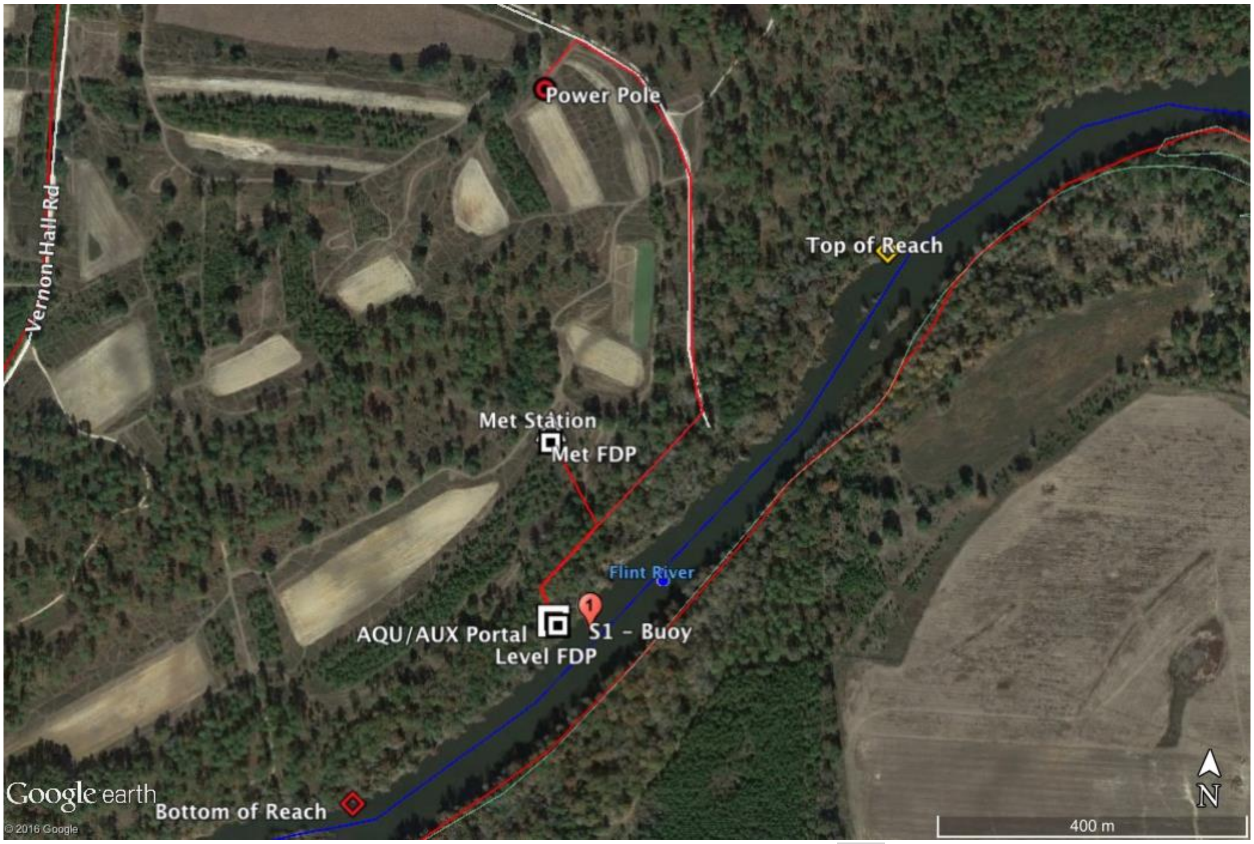

Figure 29 Map of Aquatic and Auxiliary Portals for D03 Flint River.

Table 16 Aquatic Auxiliary Portal Location.

Aquatic Auxiliary Portal	Latitude	Longitude
Location	31.184728	-84.438933

The initial estimated location for the Aquatic Portal is:

Table 17 Aquatic Portal Location.

Aquatic Portal	Latitude	Longitude
Location	31.184728	-84.438933

3.3.1.2 Sensor Locations for Construction

AQU, with support from EHS, has the following field GPS coordinates for S1 and S2 and micromet 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.

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

Table 18 Aquatic Sensor Set Locations.

Sensor	Latitude	Longitude
S1	31.184565	-84.438431
S1 – FDP	NA	NA
Level Gage	31.184597	-84.438719
Level – FDP	31.184698	-84.438852

Table 19 Met Station, Precipitation Sensors and Infrastructure Locations.

Sensor	Latitude	Longitude
Met Station	31.186975	-84.439049
Met - FDP	31.186803	-84.439032
Primary Precipitation Gauge (DFIR)	NA	NA
Secondary Precipitation Gauge (Tipping Bucket)	NA	NA
Wet Deposition Collector (NADP)	NA	NA
Precip - FDP	NA	NA

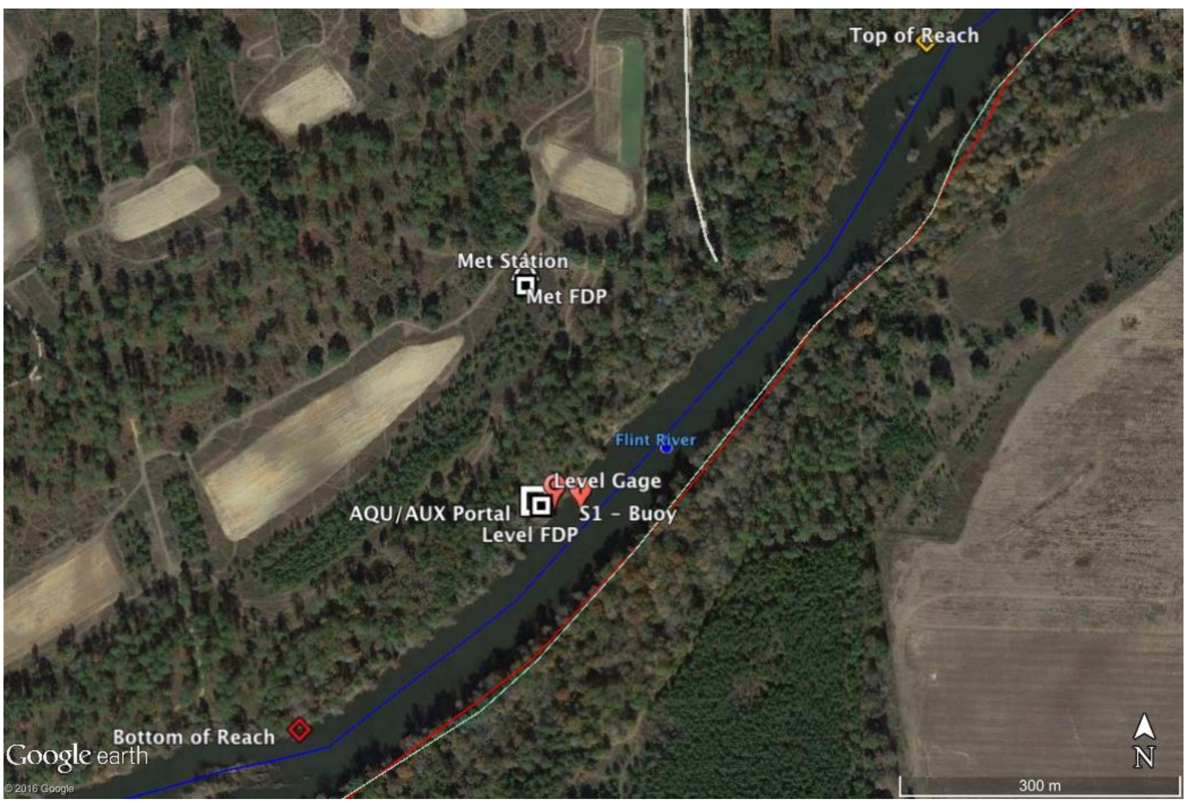

Figure 30 Locations of S1, S2, Met Station, Secondary Precipitation Gauge and associated Field Device Posts for D03 Flint River.

Figure 15 shows an upriver perspective of the S1 location where a buoy is to be installed. Figure 16 shows the a view of the left bank from the perspective of the right bank at the location of the discharge transect (see Section below). Figure 17 shows a picture of the level gage (LevelTroll) location. The ADCP was temporarily installed here during characterization (see Section below).

Figure 15 Upriver view of S1 Location at D03 Flint River showing the approximate location of the buoy.

Figure 31 Photo of discharge locations at D03 Flint River. Buoy is located approximately 10 m down river.

Figure 32 Picture of location of the level gage. (shows temporary infrastructure for deploying ADCP used to measure discharge and velocity fields.)

3.3.2 Stream Reach Characterization

During our site visit in January 2016 we surveyed the 21 km stretch of river along the JERC property boundary (see Figure 18). There are many shoals throughout this reach of the river. We sought a straight stretch of river that is well mixed with few shoals and therefore minimal impacts to existing NEON protocols. We found a 1000m reach between two river bends that is also buffeted by shoals with no shoals throughout the reach (see Figure 19).

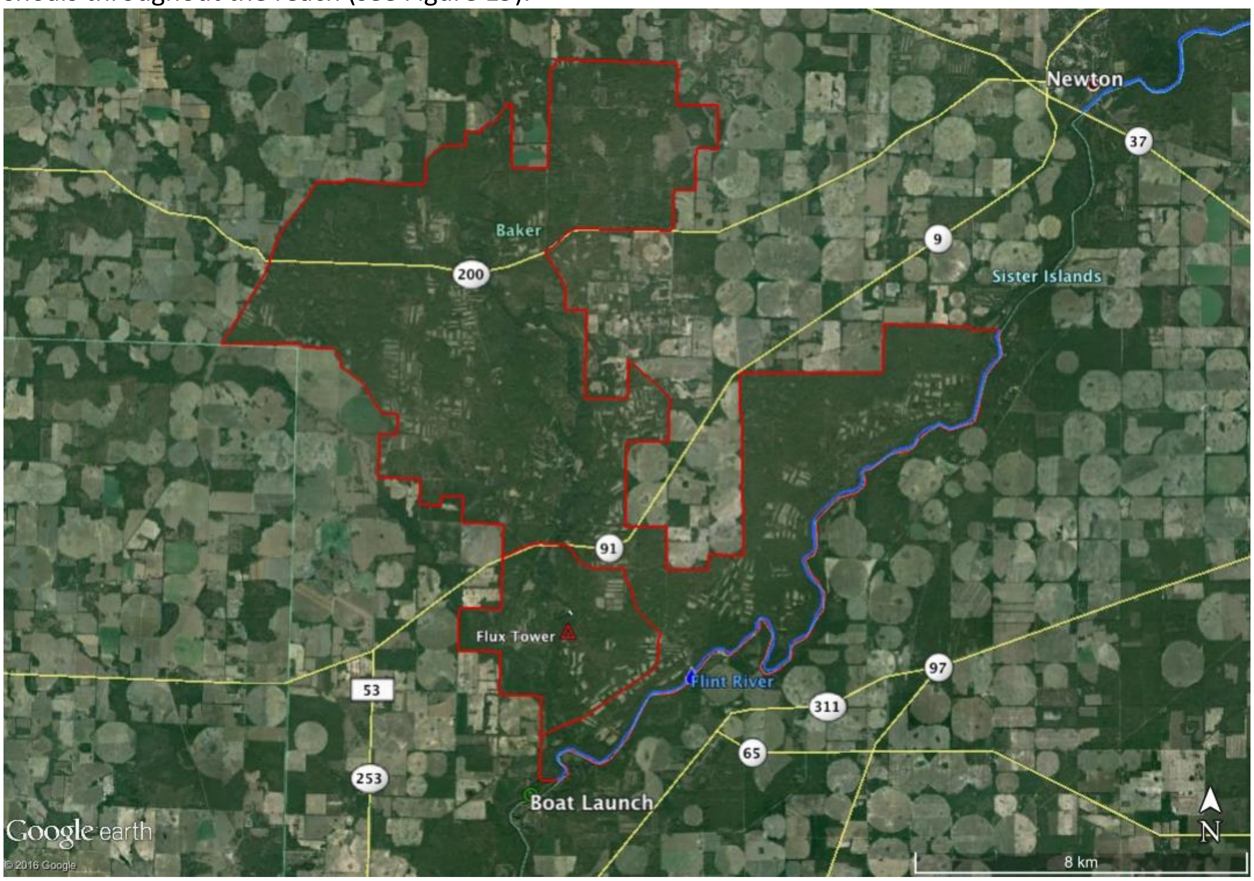

Figure 33 Map showing the 21 km stretch of the Flint River bordering the JERC property. A public boat launch is also shown (green circle).

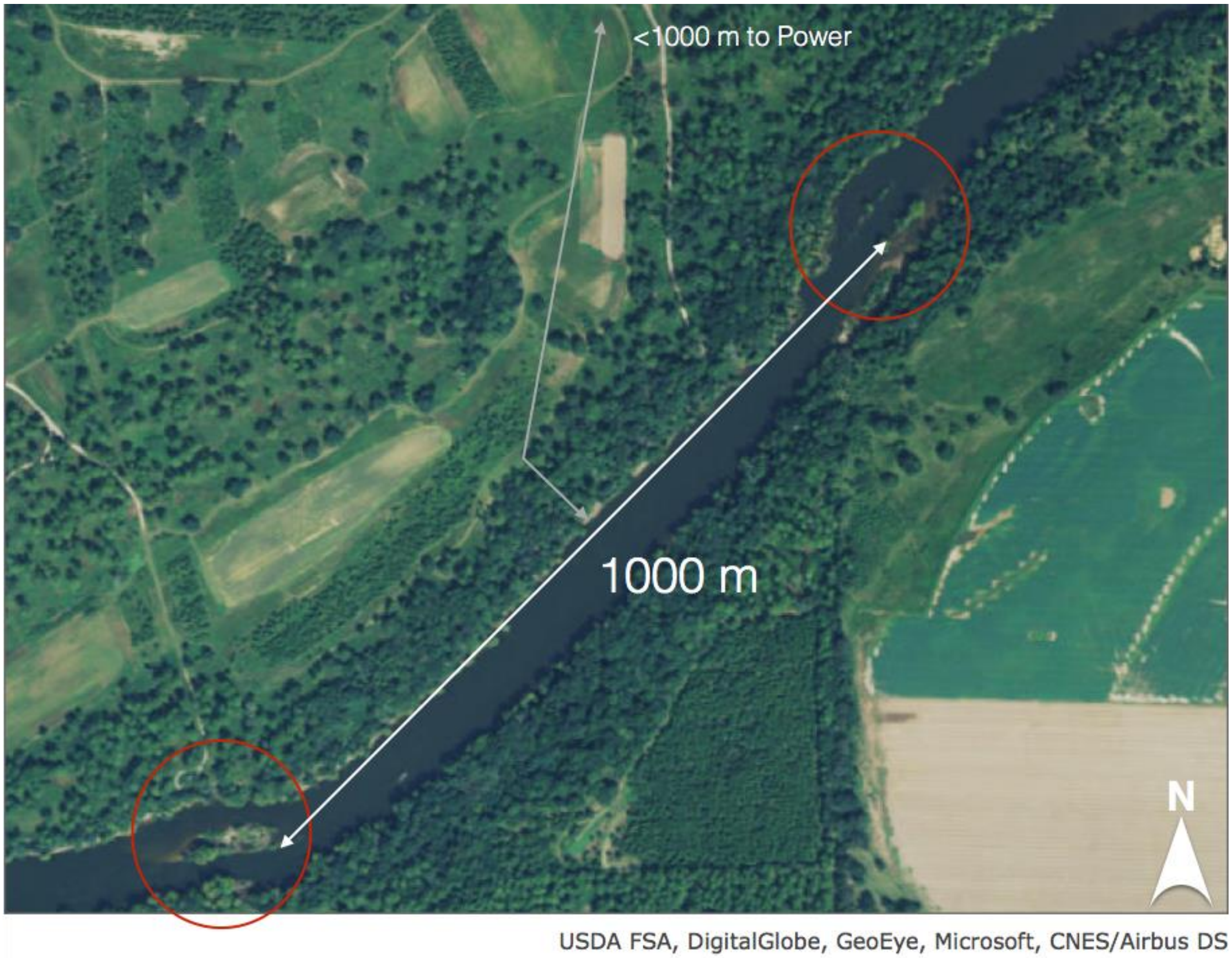

Figure 34 Map showing chosen AQU reach between shoals and river bend in proximity to existing power.

Upon identifying the reach with the appropriate characteristics, we performed a bathymetric survey. Unfortunately at the time of the initial survey we were only able to complete 75% of the coverage before losing power to the system. However sufficient data was captured to both generate a bathymetric map of the reach and determine the appropriate measurement location for the buoy. Figure 20 shows the preliminary bathymetric map of the reach.

To determine the discharge and velocity profile of the river, we deployed a Sontek Argonaut SL 500 from the level gage location shown in Figures 14 and 17. The wetted width of the river was measured using satellite imagery for the discharge location and was determined to be 92 m. The mean depth was estimate at 5 m based on preliminary bathymetric data. A standard trapezoid geometry was used for the calculation of discharge. Table 5 shows the measured velocity (speed and direction) for the 10m cells at the discharge transect. The discharge at the time was measured to be 230 m3s-1 which is consistent with hydrographic record shown above. The bathymetry measured at the discharge was linearly interpolated across the transect (see Figure 23). The speed of the flow of water was interpolated along this surface to show an integrated velocity profile of the river and is shown in Figure 21. The velocity measurements show a high flow, particularly through the thalweg of the river.

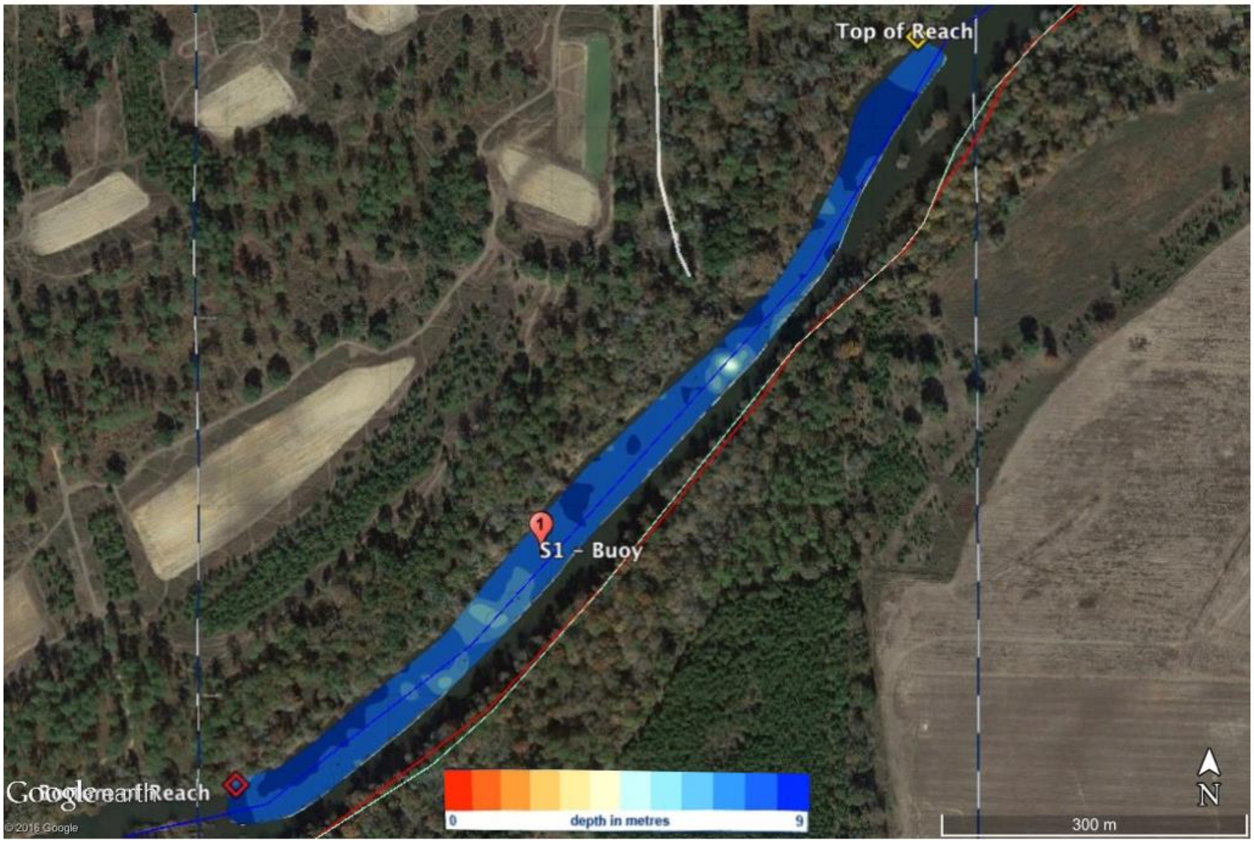

Figure 35 Map showing the bathymetry capture along the river reach.

Table 20 Velocity Profile Results from ADCP.

Distance from LB, m	Speed, cm/s	Direction, degree
0-10	2	90
10-20	39.3	89.6
20-30	77.87	87.5
30-40	91.26	87.9
40-50	99.97	104.2
50-60	89.7	106.1
60-70	73.97	108.1
70-80	27.42	97.3
80-90	21.55	101.8
90-92	1.5	216.9

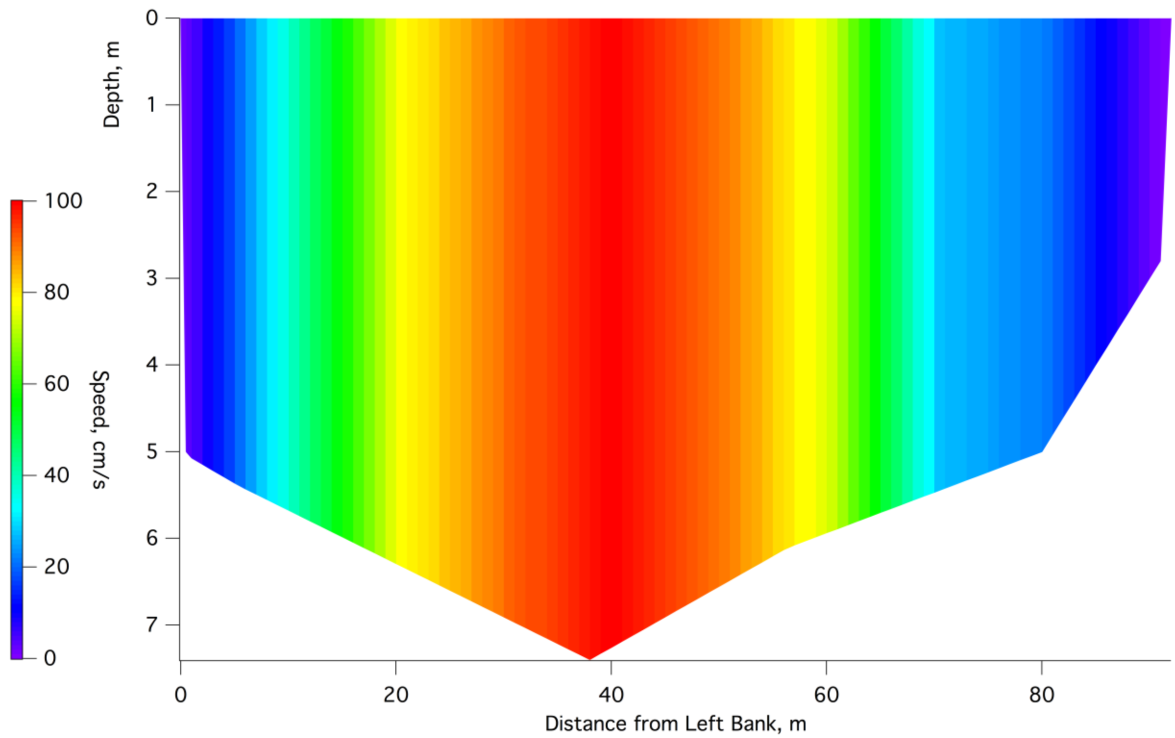

Figure 36 Map showing the locations of additional pools that may be considered as options should we need to move S1 to adjust the reach length in light of future flow data.

To determine how well mixed the river is we attempted to perform a cross-sectional water quality survey. However, the high-speed flow made this impossible with the standard characterization equipment. In place of a full cross-sectional survey, we performed profile measurements near the left and right banks as well as a transect at 0.5m below the water surface across the discharge transect. Key parameters, temperature, conductance, dissolved oxygen, and fluorescent dissolved organic matter are shown in Figure 22. The data are scaled to color according to time for visual separation of the variable with depth. Each of these four parameters shows weak or no significant difference between surface and deep values indicating that the river is well-mixed.

Based on the flow characteristics, the buoy shall be placed at approximately 25 m from the left bank. This is approximately a quarter of the way across the river channel and will allow the buoy to be placed in an area of slightly less energy while maintaining measurements that are representative of the bulk of the water mass across the river at that location.

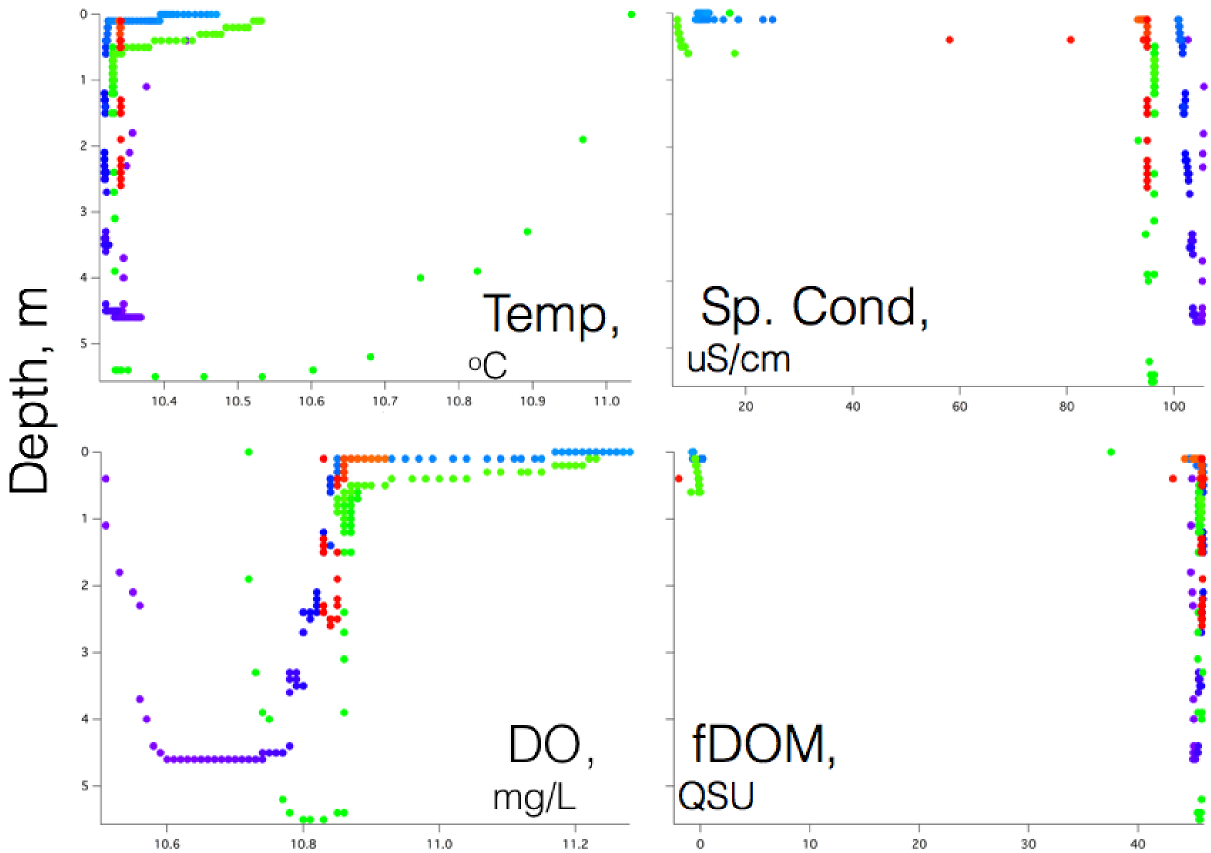

Figure 37 Graphs of profile and transect measurements of water quality parameters: temperature, specific conductance, dissolved oxygen and fluorescent dissolved organic matter.

3.3.2.1 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.

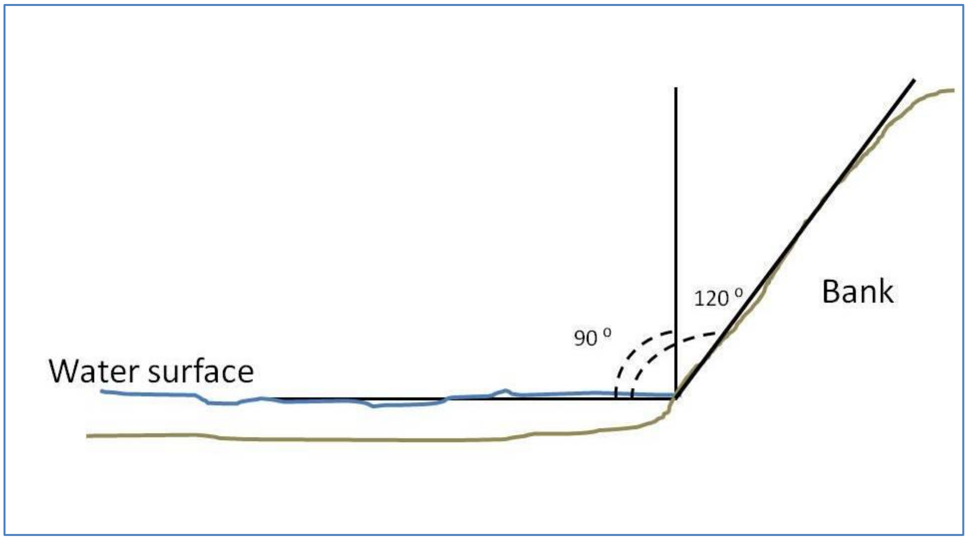

Figure 38 How Bank Angle is Measured

During *2016* site visits, AQU observed the following bank conditions at S1 and S2:

Table 21 Bank conditions at Flint River in *2016*.

Morphology Type	S1	S2
RB* angle	90	NA
LB* angle	100	NA
Maximum water height	10 m	NA
Bankfull width	100 m	NA
Substrate composition	Sand, clay, rock, LWD	NA

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

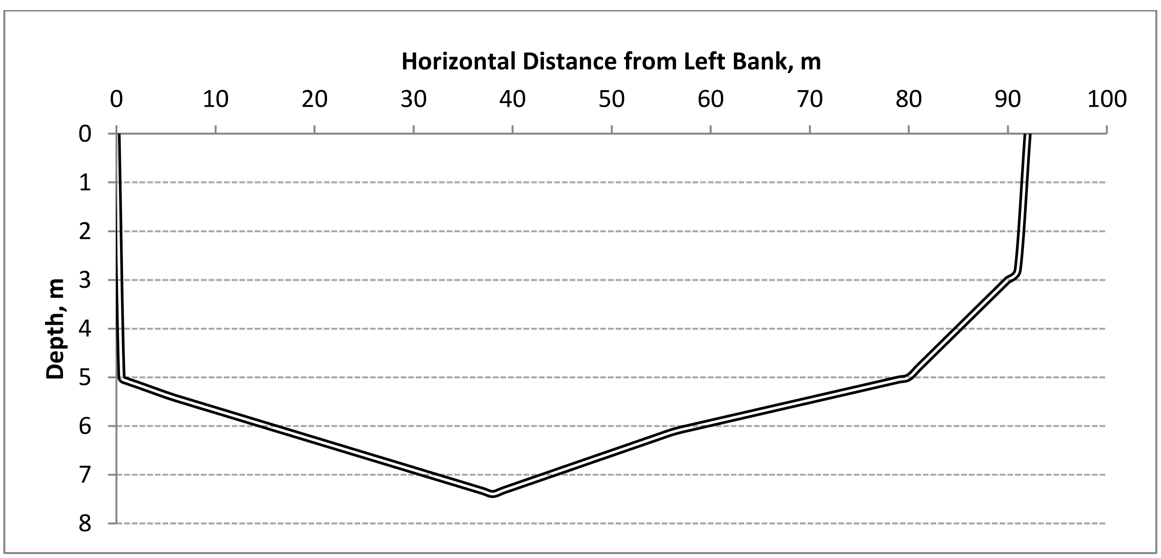

Figure 39 Cross section bathymetry at the discharge location.

3.3.3 Groundwater Wells

This section will be revised once the NEON hydrologist has had a chance to visit the site and determine well locations and installation method. Shown in Figure 24 is an idealized well layout for the site. This figure will be updated following a visit by the NEON hydrologist and the coordinates will be supplied in Table 7.

The groundwater observation wells network at the site (Figure 32, Table 20) will consist of 7 wells installed using a rotary auger rig. Topography at the site is relatively flat for a substantial distance from the stream channel. The wells will be along the flat region of the site and the required drilling depth will be up to 50 feet below ground surface. Access to the site will be via the existing roads on JERC property. Rig access to the well locations is anticipated to be relatively straightforward and a defined rig path for drilling purposes will be defined prior to work at the site.

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 Georgia 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. No details are provided as to the thickness or size of the ground surface seal.

The groundwater wells will transmit data back to the location controller located within the AQU portal via a radio-based wireless DAS system. The system will be power by solar with a panel of approximately 27" and transmit radio signals using an antenna mounted to the well casing.

Figure 40 Initial groundwater well locations at D03 Flint River.

Table 22 Groundwater well locations at D03 Flint River.

Well ID	Latitude	Longitude
DO3-FLNT-OW-01	--	--
DO3- FLNT -OW-02	--	--
DO3- FLNT -OW-03	--	--
DO3- FLNT -OW-04	--	--
DO3- FLNT -OW-05	--	--
DO3- FLNT -OW-06	--	--
DO3- FLNT -OW-07	--	--

3.3.4 Site Access Needs

No pathways, boardwalks, stairs, or ladders are needed at D03 Flint River for Science purposes.

3.3.5 Communications at the Site

THE FOLLOWING INFO IS DESIRED (NOT REQUIRED) AND MAY SAVE AN ADDITIONAL TRIP TO SITE IF IT CAN BE OBTAINED DURING AN FCC OR AQU SITE VISIT:

FCC provides local telephone company name and telephone number
The local communications company is XXXXXXX.
ALL - See table in Appendix C for additional IT info

Photo of nearest "Communications Pedestal" located on nearest road to site, if available

Location of nearest telephone pole (can be approximated on a map)
Is there a facility onsite with communications?

3.3.6 Power at the Site

FCC provides local power company name and telephone number
The local power utility company is XXXXXXX.

3.3.7 Site Science Construction Constraints and Limitations

Site-specific issues to consider at D03 Flint River are:

- The banks of the river are very steep and slippery; and the river moves very swiftly. Great care must be taken when working on the banks of the river. The appropriate safety equipment, including personal floatation devices, should be used as needed.

Driving and access constraints for D03 Flint River are:

- Vehicles may be driven on existing roads within JERC. Unpaved roads have a base of sand and clay and may become difficult to drive on especially during wet conditions. Care should be taken to both not get vehicles stuck on small unpaved roads as well as minimize erosion on or near roads.

3.3.8 Other Issues

No other science issues are identified at this time.

4 APPENDIX A. FCC SUMMARY TABLES FOR AIS SITE COMPONENTS AT D03

4.1 Lake Barco FCC Summary Table

Site Component	Latitude	Longitude	Units
Stream, Lake, or River	Lake		Description
Aquatic Auxiliary Power Portal location	29.67679	-82.01019	Lat, Long in degrees
Aquatic Portal location	29.67679	-82.01019	Lat, Long in degrees
Pathway needed? What is length?			Yes/no, description w/ length
Pathway start location	Click here to enter text.	Click here to enter text.	Lat, Long in degrees
Pathway end location	Click here to enter text.	Click here to enter text.	Lat, Long in degrees
Stairs or ladder needed?			Yes/no, description
Stairs top location			Lat, Long in degrees
Stairs length			Meters
Ladder top location			Lat, Long in degrees
Ladder length			Meters
Boardwalk needed? What is length?			Yes/no, description w/ length
Boardwalk start location	29.676724	-82.010069	Lat, Long in degrees
Boardwalk end location	29.676426	-82.009682	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

4.2 Lake Suggs FCC Summary Table

Site Component	**Latitude**	**Longitude**	**Units**
Stream, Lake, or River	Lake		Description
Aquatic Auxiliary Power Portal location	29.68851	-82.01414	Lat, Long in degrees
Aquatic Portal location	29.68851	-82.01414	Lat, Long in degrees
Pathway needed? What is length?			Yes/no, description w/ length
Pathway start location	29.688514	-82.013977	Lat, Long in degrees
Pathway end location	29.688240	-82.014429	Lat, Long in degrees
Stairs or ladder needed?			Yes/no, description
Stairs top location			Lat, Long in degrees
Stairs length			Meters
Ladder top location			Lat, Long in degrees
Ladder length			Meters
Boardwalk needed? What is length?			Yes/no, description w/ length
Boardwalk start location	29.688324	-82.014414	Lat, Long in degrees
Boardwalk end location	29.688233	-82.014818	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

4.3 Flint River FCC Summary Table

Site Component	**Latitude**	**Longitude**	**Units**
Stream, Lake, or River	River		Description
Aquatic Auxiliary Power Portal location	31.184728	-84.438933	Lat, Long in degrees
Aquatic Portal location	31.184728	-84.438933	Lat, Long in degrees
Pathway needed? What is length?	No		Yes/no, description w/ length
Pathway start location	NA	NA	Lat, Long in degrees
Pathway end location	NA	NA	Lat, Long in degrees
Stairs or ladder needed?	No		Yes/no, description
Stairs top location	NA	NA	Lat, Long in degrees
Stairs length	NA		Meters
Ladder top location	NA	NA	Lat, Long in degrees
Ladder length	NA		Meters
Boardwalk needed? What is length?	No		Yes/no, description w/ length
Boardwalk start location	NA	NA	Lat, Long in degrees
Boardwalk end location	NA	NA	Lat, Long in degrees
Shall stairs, boardwalk be installed during construction?	NA		Yes/no, description
Fencing needs	NA		Description
Site management	NA		Description
Any additional site specific information	NA		Description

5 APPENDIX B. EHS SUMMARY TABLES FOR AIS SITE COMPONENTS AT D03

5.1 Lake Barco EHS Summary Table

Site Component	Latitude	Longitude	Units
Sensor 1 (S1) location	29.676057	-82.008369	Lat, Long in degrees
Sensor 2 (S2) location	NA	NA	Lat, Long in degrees
Inlet	29.677519	-82.008153	Lat, Long in degrees
Outlet	29.674985	-82.008728	Lat, Long in degrees
Met Station location	29.676961	-82.009788	Lat, Long in degrees
Met FDP	29.676882	-82.009838	Lat, Long in degrees
Primary Precipitation Gauge (DFIR)	NA	NA	Lat, Long in degrees
Secondary Precipitation Gauge (Tipping Bucket)	NA	NA	Lat, Long in degrees
Wet Deposition Collector (NADP)	NA	NA	Lat, Long in degrees
Precipitation FDP	NA	NA	Lat, Long in degrees
Aquatic Auxiliary Power Portal location	29.676790	-82.010190	Lat, Long in degrees
Aquatic Portal location	29.676790	-82.010190	Lat, Long in degrees

5.2 Lake Suggs EHS Summary Table

Site Component	Latitude	Longitude	Units
Sensor 1 (S1) location	29.687323	-82.018633	Lat, Long in degrees
Sensor 2 (S2) location	NA	NA	Lat, Long in degrees
Inlet	29.685553	-82.019685	Lat, Long in degrees
Outlet	29.690379	-82.017599	Lat, Long in degrees
Met Station location	29.688416	-82.013637	Lat, Long in degrees
Met FDP	29.688450	-82.013655	Lat, Long in degrees
Primary Precipitation Gauge (DFIR)	NA	NA	Lat, Long in degrees
Secondary Precipitation Gauge (Tipping Bucket)	NA	NA	Lat, Long in degrees
Wet Deposition Collector (NADP)	NA	NA	Lat, Long in degrees
Precipitation FDP	NA	NA	Lat, Long in degrees
Aquatic Auxiliary Power Portal location	29.688425	-82.013976	Lat, Long in degrees
Aquatic Portal location	29.688425	-82.013976	Lat, Long in degrees

5.3 Flint River EHS Summary Table

Site Component	Latitude	Longitude	Units
Sensor 1 (S1) location	31.184565	-84.438431	Lat, Long in degrees
Sensor 2 (S2) location	NA	NA	Lat, Long in degrees
Level Gage	31.184597	-84.438719	Lat, Long in degrees
Level Gage FDP	31.184698	-84.438852	Lat, Long in degrees
Met Station location	31.186975	-84.439049	Lat, Long in degrees
Met FDP	31.186803	-84.439032	Lat, Long in degrees
Primary Precipitation Gauge (DFIR)	NA	NA	Lat, Long in degrees
Secondary Precipitation Gauge (Tipping Bucket)	NA	NA	Lat, Long in degrees
Wet Deposition Collector (NADP)	NA	NA	Lat, Long in degrees
Precipitation FDP	NA	NA	Lat, Long in degrees
Aquatic Auxiliary Power Portal location	31.184728	-84.438933	Lat, Long in degrees
Aquatic Portal location	31.184728	-84.438933	Lat, Long in degrees

6 APPENDIX C: SUPPLEMENTAL MATERIALS

6.1.1 Geology, Flora and Fauna

6.1.1.1 Geology

The Piedmont is formed of ancient eroded mountain chains and now consists of rolling hills of 50-300m in elevation. The geology in this region is complex with numerous rock formations. The soils of the Piedmont are typically clay-like.

The Gulf Coastal Plain soils developed from the sedimentation during sea level fluctuations during the Cretaceous, Tertiary and Quaternary periods and the erosion of the Appalachian Mountains. As such these soils are poorly developed and consist of silt, sand, and clay types.

6.1.1.2 Flora

TBD

Figure 41 Photo of vegetation characteristic of the riparian area.

Figure 42 Photo of vegetation characteristic of the riparian area.

6.1.1.3 Fauna

The Flint River represents a large spatial extend and contains a large variety of aquatic species in a diverse ecosystem. The river is known contain many species of turtle (Barbours Map, Spotted, Alligator Snapping, Eastern Mud, Loggerhead Musk, Chicken, Yellow Bellied Slider and Eastern River Cooter), American alligators, American eels, several species of salamanders, many species of bass (Largemouth, Smallmouth, White, Striped, Hybrid), catfish, bream, and several other fish. Freshwater shellfish are also present in the system.

There are four federally protected mussel species (Shinyrayed pocketbook, Gulf mocassinshell, Oval pigtoe, and Purlpe bankclimer).

Figure 43 Photo of oval pigtoe freshwater mussel.

Figure 44 Photos of Barbours Map Turtles, adult (left) and juvenile (right) seen during 2016 visit in the Flint River.

6.1.2 Historic Data

Historical data was captured from the USGS and JERC stations nearest to the proposed NEON stie.

6.1.2.1 Hydrology

There are many gaging stations along the Flint River. The nearest station (USGS 02355662 near Hopeful, GA) is approximately 8.3 km downriver of the proposed buoy location. This gaging station is downriver of the confluence with

Ichawaynochaway Creek. There is another gaging station (USGS 02353000 near Newton, GA) that is located approximately 22.5 km upriver from the proposed buoy location. There are no major tributaries between the upriver station and the proposed buoy site.

There are hydropower dams located upriver from the proposed site. One is located near Albany, GA, approximately 80 km upriver from the site. Another is located near Cordele, GA, another 49 km upriver from Albany.

The hydrograph shown in Figure 6 shows the mean monthly discharge from 2002-2015. It shows a base flow of approximately 93 m^3s^{-1} in autumn and peak flow of approximately 330 m^3s^{-1} in the spring. This annual variability in flow corresponds to a change in water level of approximately 2 m.

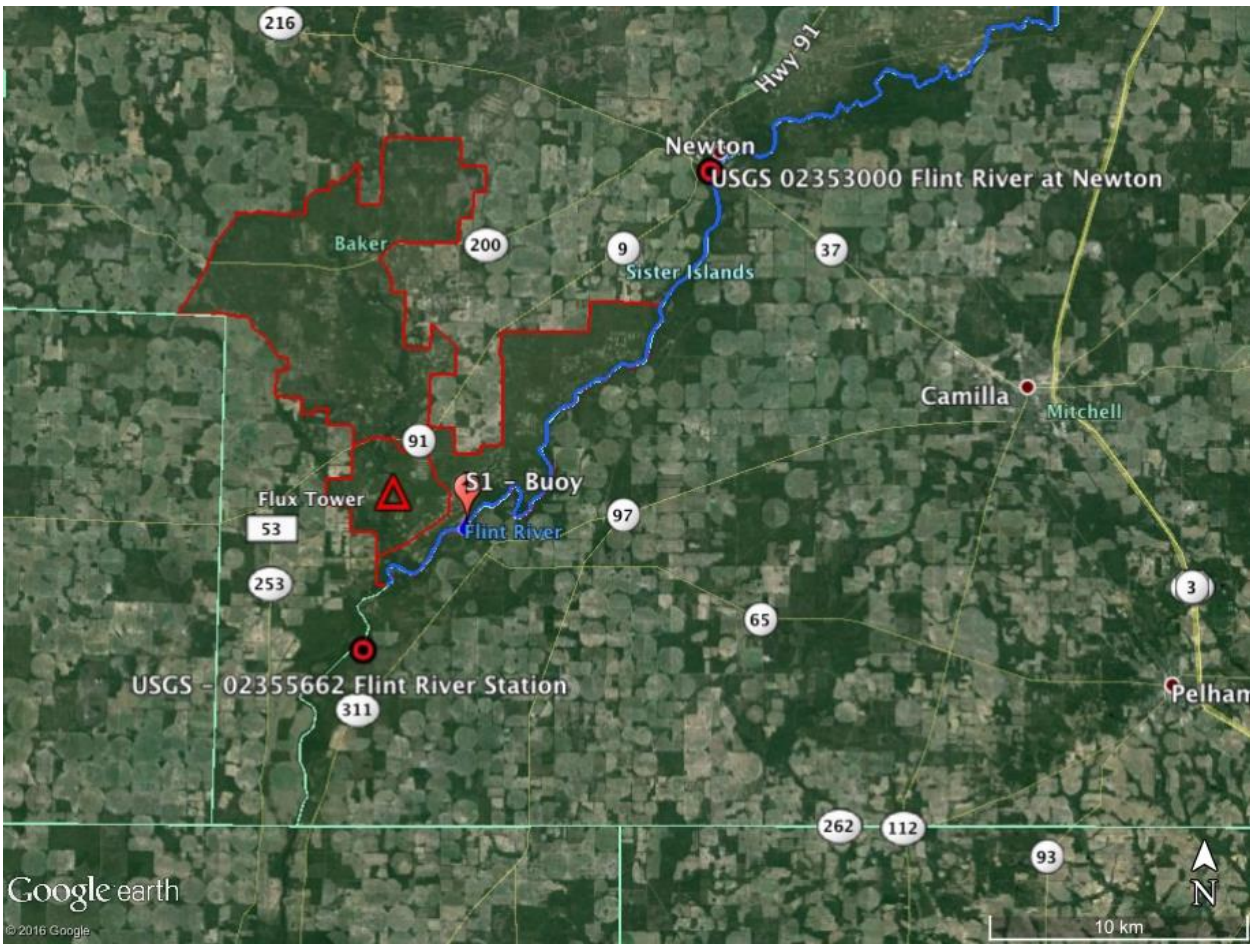

Figure 45 Map showing the location USGS gauging stations 02353000 and 0235562 relative to the

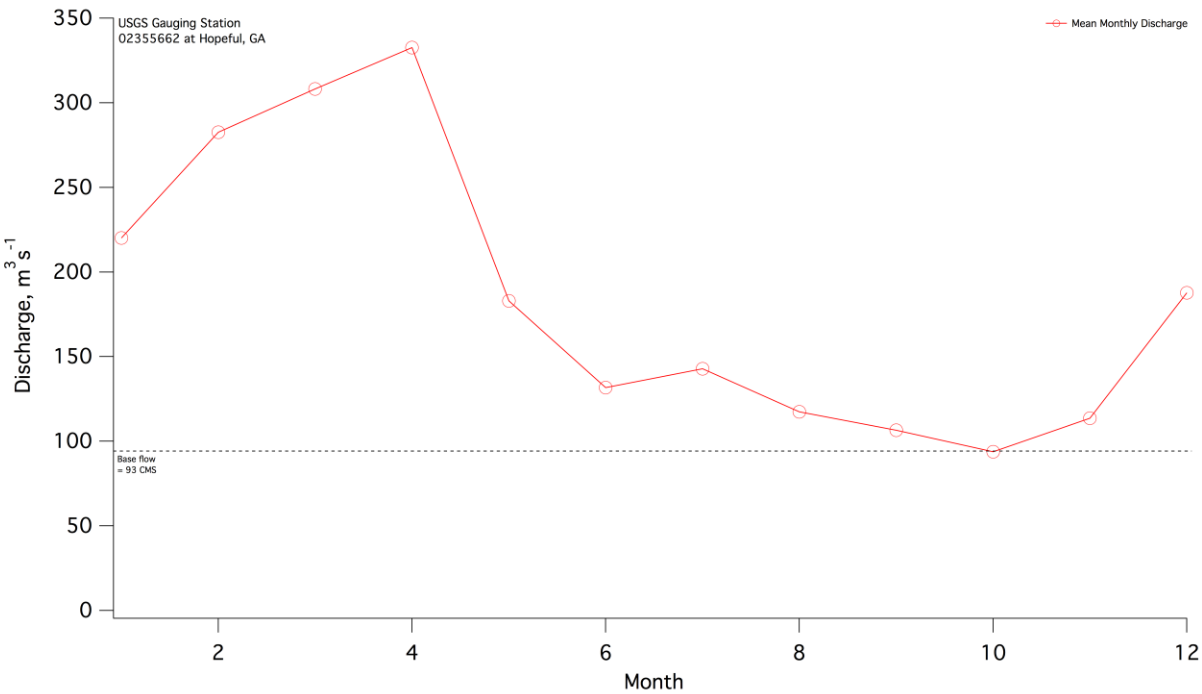

Figure 46 Hydrograph of mean monthly discharge from 2002-2015.

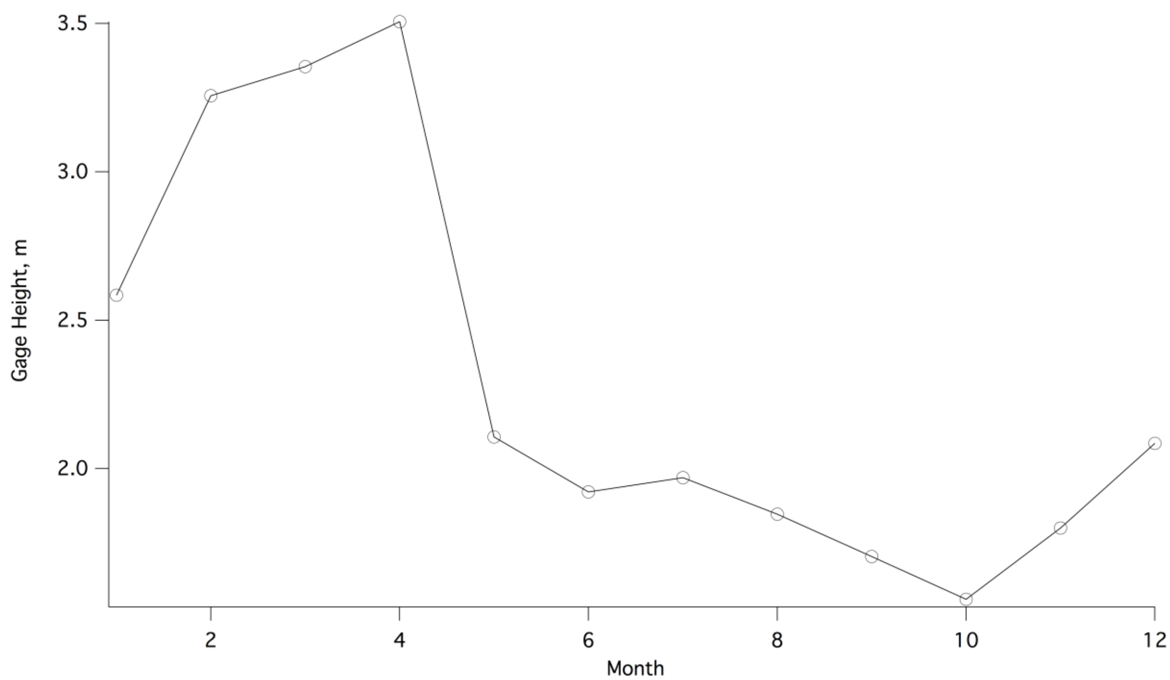

Figure 47 Mean monthly gage height from 2002-2015.

6.1.2.2 Meteorology

The climate at JERC is relatively mild and wet with an average of 124 cm of precipitation per year with approximately 2.5 cm as snow. The number of days of precipitation is 106 per year with 217 sunny days on average. Annual temperatures range from January low of 3 ^{o}C to a July high of 34 ^{o}C.

The closest weather station that measures both precipitation and air temperature is located within the JERC property approximately 5.6 km from the proposed AQU site.

The data show a mean daily variability in air temperature of approximately 20^{o}C. Precipitation is heaviest in the early spring and mid summer months with the driest months being in the autumn; however, the relative annual variability is somewhat low.

Wind roses produced by FIU for the NEON terrestrial site and flux tower at JERC are shown in Figure 12. They shown the predominant wind is out of the NE. These are used to inform the position of the AQU met station.

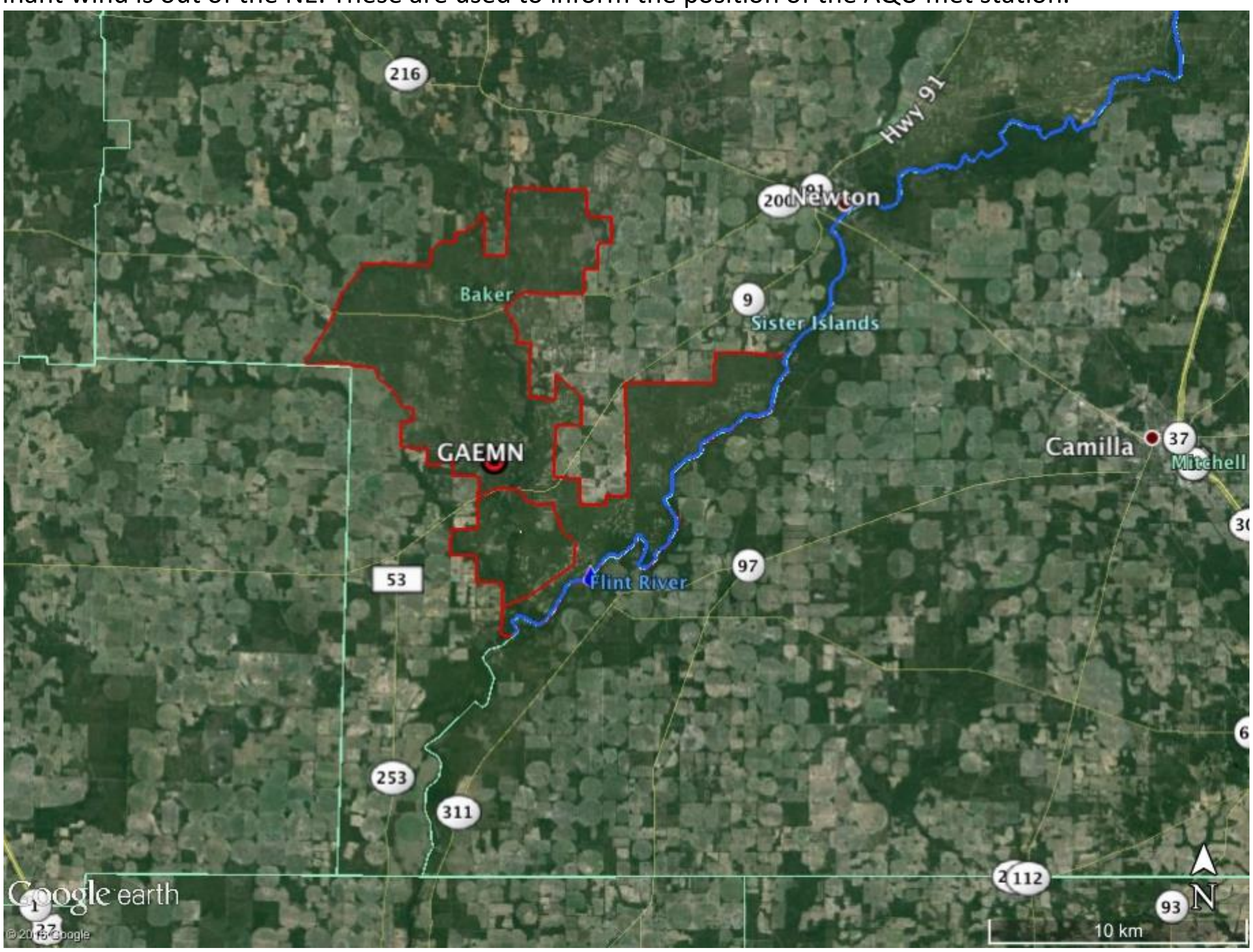

Figure 48 Map showing the nearest weather station from which historic meteorological data was captured.

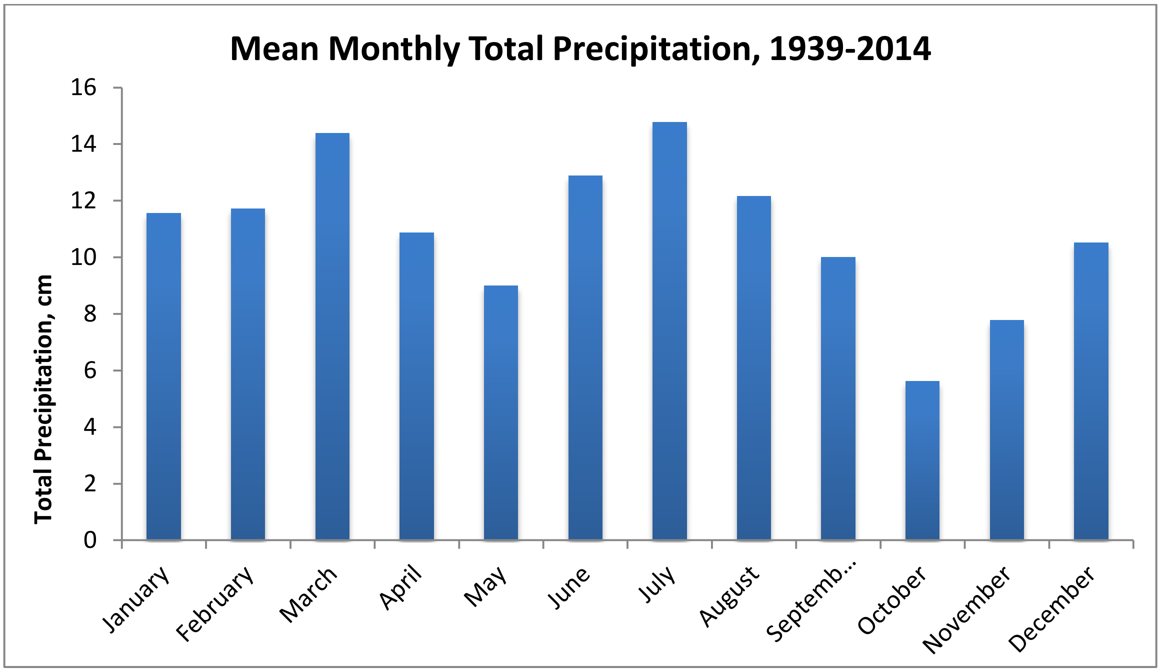

Figure 49 Time series of the accumulated daily precipitation for 1939-2014.

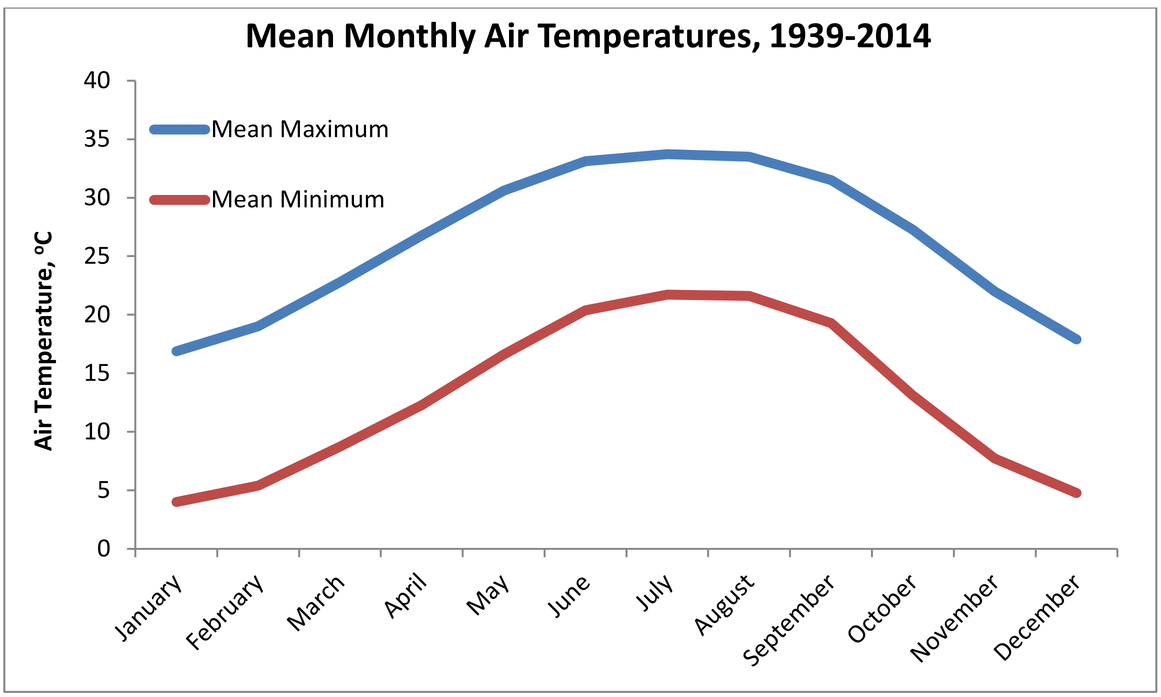

Figure 50 Time series for the air temperature for 1939-2014.

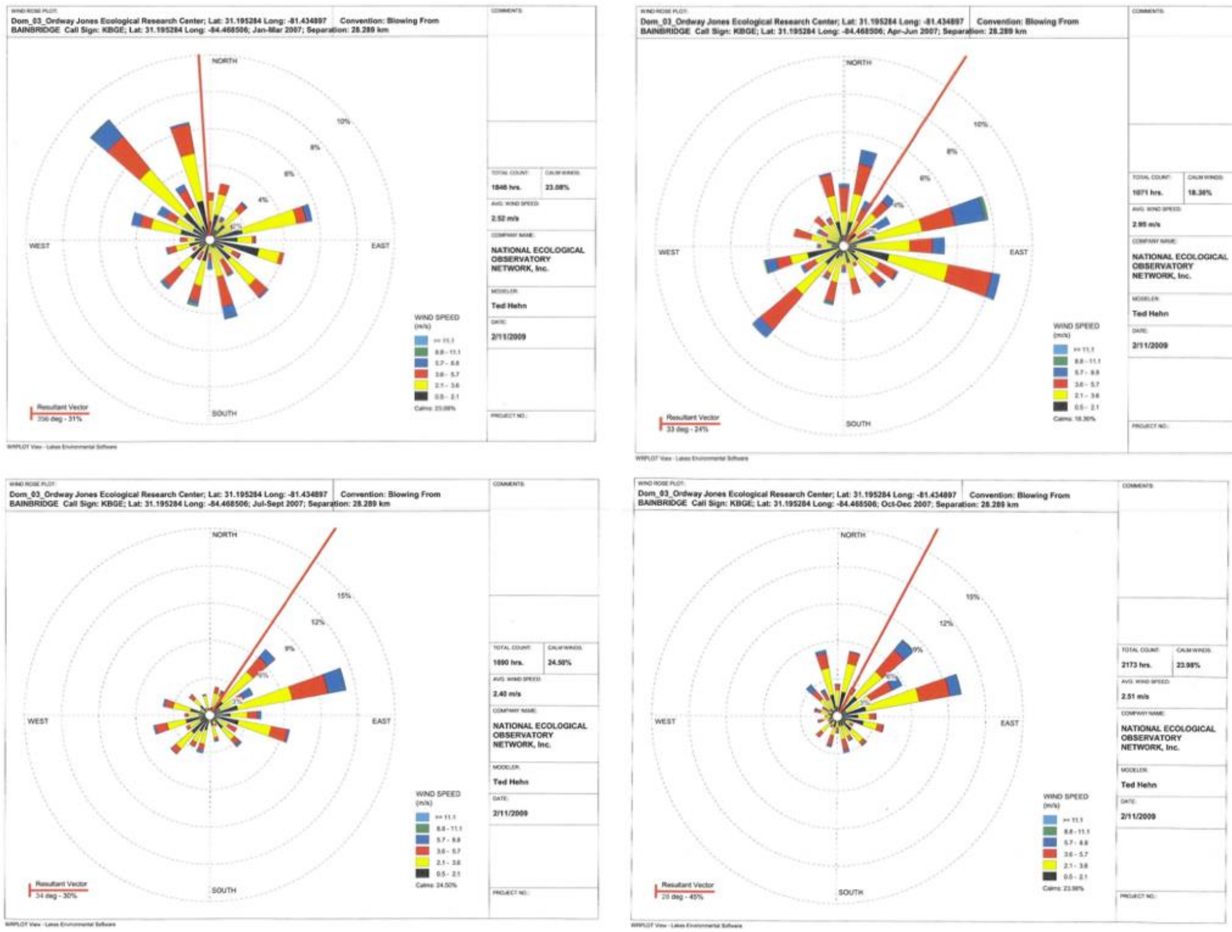

Figure 51 Windroses generated by FIU during the terrestrial JERC site characterization.

7 APPENDIX D: DE-SCOPED SITES

7.1 Ichawaynochaway Creek

Ichawaynochaway Creek was descoped because its scale and variability requires a significant change to current deployment strategies. The water level at Ichawaynochaway regularly fluctuates from less than 1m deep to over 10 m deep over an annual cycle. This wide change necessitates an overhead cableway system typical for measuring discharge in non-wadeable streams. This strategy was explored, key design elements were identified and a full trade study performed. It was determined that this effort would not be pursued at this time and the site was removed from consideration.

The Ichawaynochaway Creek site is a non-wadeable creek contained in the Flint River Basin (FRB) and is classified as a HUC-8 watershed. The creek flows on a roughly north to south trajectory and empties into the Flint River approximately 4km downstream of the NEON site. The creek is predominately surface water fed originating from rainfall, with localized additions through variable amounts of groundwater inflow. The substrata beneath the site are predominately deformed igneous and metamorphic rocs of the Piedmont, with approximately 30 feet of unconsolidated sand and soils above the bedrock. The local topography near the creek is predominately flat with a steep ravine dropping down to the creek surface. The creek, though classified as non-navigable, is quite wide and deep, ranging from 20-30 meters wide and approximately 3 meters in depth (as noted in April 2012). The region suffers from periodic droughts and in April 2012 was experiencing the second year of a drought. In addition to droughts the area experiences periodic floods with a relatively recent flood causing a rise in the creek stage of approximately 35 feet above April 2012 conditions.

7.1.1 Aquatic Auxiliary and Aquatic Portal Locations for Construction

The initial estimated location for the Aquatic Auxiliary Portal is shown in Figure 28.

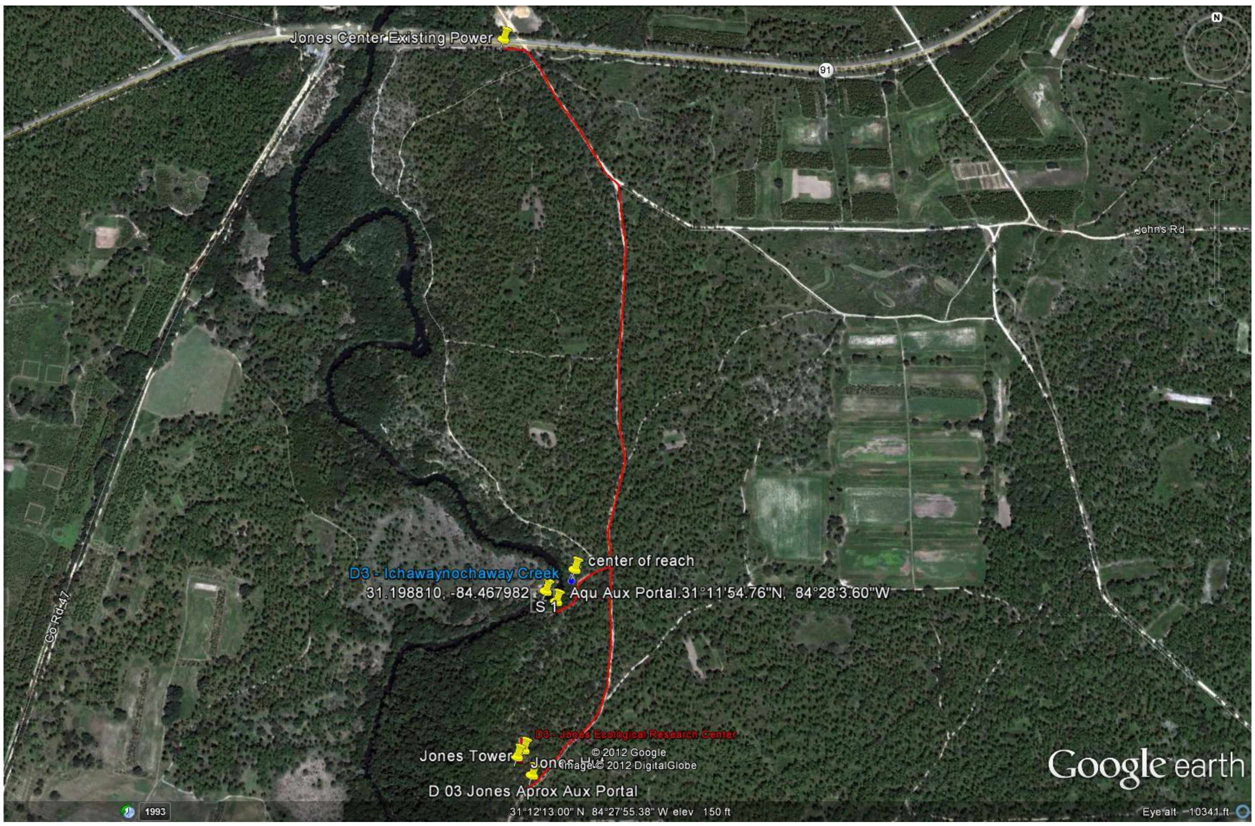

Figure 52 A Google-Earth-Derived Image of Aquatic Auxiliary Portal for D03 Ichawaynochaway Creek

Table 16 Aquatic Auxiliary Portal Location

Aquatic Auxiliary Portal	Latitude	Longitude
Location	31.198544°	-84.467667°

The initial estimated location for the Aquatic Portal is:

Table 17 Aquatic Portal Location

Aquatic Portal	Latitude	Longitude
Location	Site3-APLat	-84.467667

7.1.2 Sensor Locations for Construction

The GPS coordinates for S1, the Met Station and the inlet and outlet locations obtained by AQU, with input from EHS, are presented in Tables 18 and 19. 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. Draft locations for anchors for AQU sensor infrastructure have been noted.

The coordinates be used for the input to the AIS design are in Table 18. Note that only one sensor location is required for Ichawaynochaway Creek.

Table 18 Sensor 1 Location

Sensor	Latitude	Longitude
S1	31.198810	-84.468085
Anchor 1	31.198497	-84.467711
Anchor 2	31.199135	-84.468466

Table 19 Met Station & Discharge Sensor Locations

Sensor	Latitude	Longitude
Met Station	31.198646	-84.467657
Pressure	31.198716	-84.467971

Figure 29 Kmz File of D03 Ichawaynochaway Creek Denoting Locations of S1 and Met Station

Figure 30 Photo of S1 Location at D03 Ichawaynochaway Creek

Figure 31 Photo of Met Station Location at D03 Ichawaynochaway Creek

7.1.3 Groundwater Wells

The groundwater observation wells network at the site (Figure 32, Table 20) will consist of 8 wells installed using a rotary auger rig. Topography at the site is dominated by a steep ravine where the stream channel is located. Above the steep ravine, the topography is relatively flat for a substantial distance from the stream channel. The wells will be along the flat region of the site and the required drilling depth will be up to 70 feet below ground surface. Access to the site will be via the existing compacted sand roads directly to the east and north of the stream channel, and on the existing roadway on the west of the stream channel. Rig access to the well locations is anticipated to be relatively straightforward and a defined rig path for drilling purposes will be defined prior to work at the site.

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 Georgia 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. No details are provided as to the thickness or size of the ground surface seal.

The AQU team prefers a steel casing with a non-cement pad and will apply for a waiver for each well. However, EHS should prepare the landowner for this State regulation and the real possibility that cement will need to be used.

The groundwater wells will transmit data back to the AQU portal location through either wireless or cellular technologies. To do this an antenna may need to be installed on the top of the protective steel casing and an additional power source (batteries) may need to be used. The antenna is anticipated to extend to a maximum height of 8 feet above ground surface. The batteries will be contained in either a box mounted to the protective steel casing or positioned on the ground and fixed to the protective steel casing. The maximum anticipated size of the box is one cubic foot.

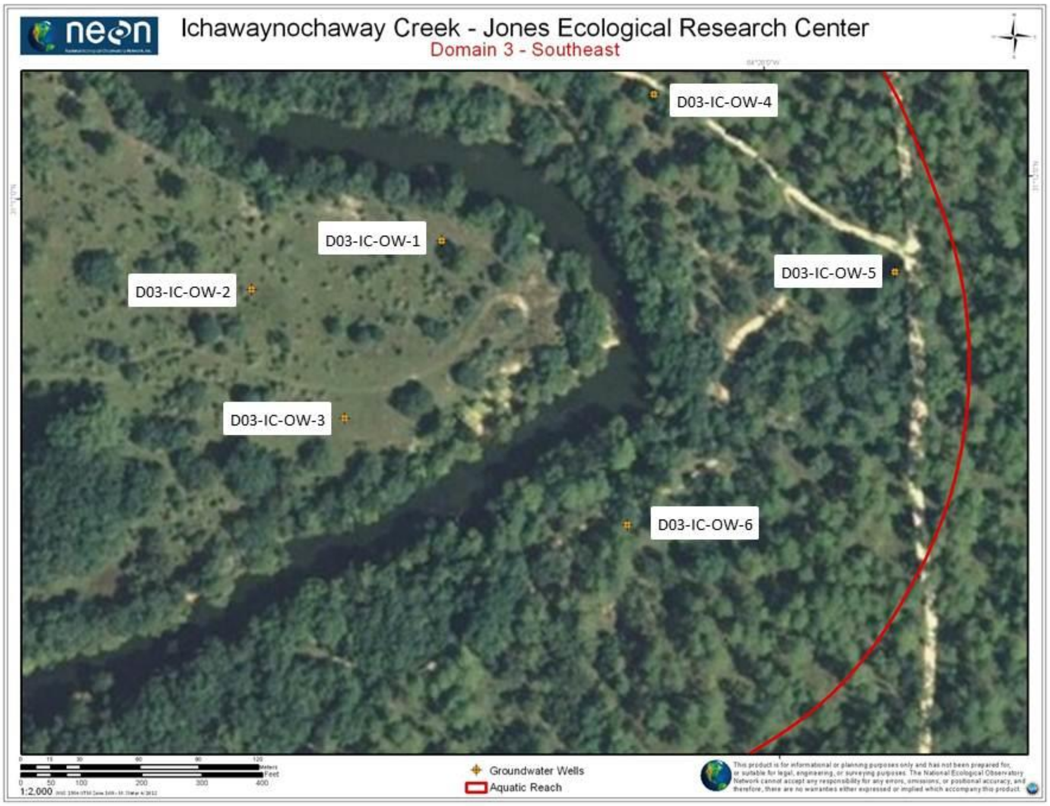

Figure 32 Initial Groundwater Well Locations Based on EMS kmz File at D03 Ichawaynochaway Creek

Table 20 Groundwater Observation Well Locations

Well ID	Latitude	Longitude
D03-IC-OW-1	31.199765	-84.468434
D03-IC-OW-2	31.199564	-84.469449
D03-IC-OW-3	31.198967	-84.468972
D03-IC-OW-4	31.200410	-84.467293
D03-IC-OW-5	31.199576	-84.466040
D03-IC-OW-6	31.198453	-84.467487

7.1.4 Riparian Vegetation Cover

Riparian vegetation surrounding the Ichawaynochaway Creek is predominantly Cyprus trees and Long Needle Pines forming a canopy in the riparian area with approximately 50% canopy cover (Figure 33), though canopy cover was observed a few weeks following leaf flush and will likely increase as the season progresses. Understory vegetation in the riparian region is a mix of small shrubs including vines and briar bushes (Figure 34). Poison ivy and poison oak are prevalent.

Figure 33 The Riparian Canopy at D03 Ichawaynochaway Creek

Figure 34 The Riparian Vegetation at D03 Ichawaynochaway Creek

7.1.5 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.

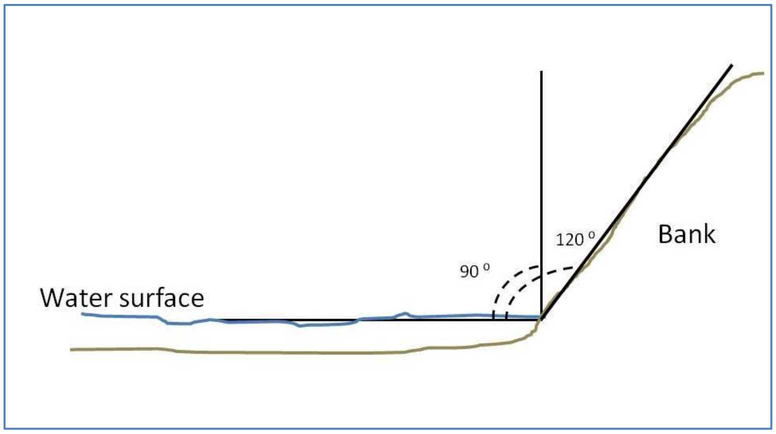

Figure 35 How Bank Angle is Measured

During 2012 site visit, AQU observed the following bank conditions at S1. The banks were predominately sand based with some vegetation growing in the sand limiting bank erosion. At the observed creek stage (drought conditions) bedrock was observed cropping out from the banks to a height of a meter above the stage. Several large rocks are within the creek channel forming a section of riffles approximately 40m upstream from the selected S1 location.

Table 21 Bank Conditions At D03 Ichawaynochaway Creek In 2012

Morphology Type	S1
RB* angle	145 º
LB* angle	115 º
Maximum water height	Non-wadeable (~10 feet)
Bankfull width	50-70m
Substrate composition	Sand and bedrock

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

Figure 36 Typical bank substrate in D03 Ichawaynochaway Creek is mostly sand with a few rocks and Cyprus knees.

7.1.6 Site Photos

The following photos are representative of the site.

Figure 37 Access path to west bank of D03 Ichawaynochaway Creek. Outside the riparian corridor on the west bank is a large grassy field with a relatively sparse population of long needle pines.

Figure 38 Looking downstream towards the S1 position. Note the presence of rocks and riffles in the creek channel. Also shows a good perspective on the bank morphology.

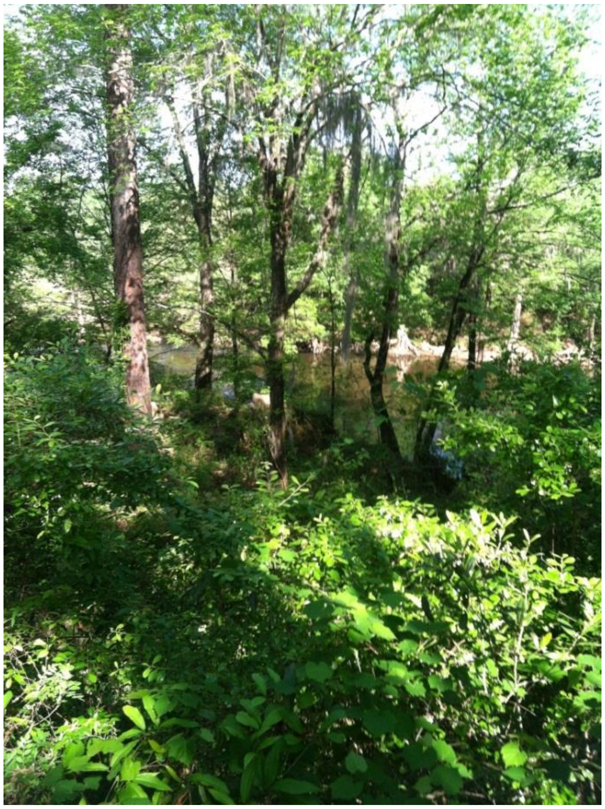

Figure 39 Density of vegetation on the east bank of the creek, same bank that the S1 sensor will be mounted to / maintained from.

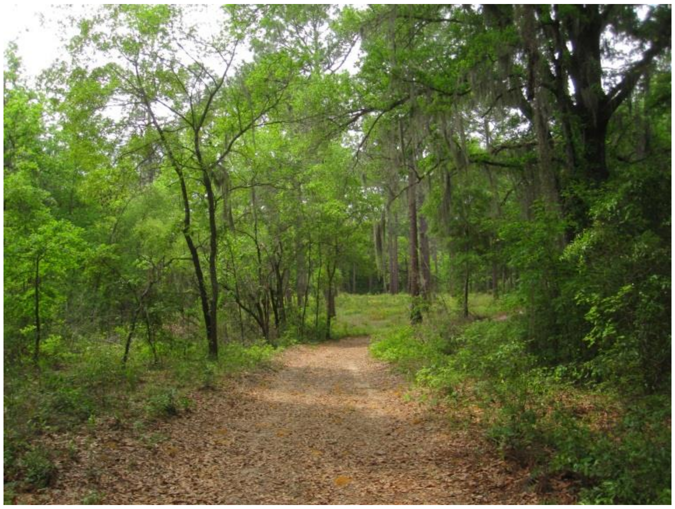

Figure 40 Photo of access road on the east side of the creek. Same side as the tower.

7.1.7 Site Access Needs

This site has well defined access roads to get near the site at the top of the banks on the left bank (east side) of the creek. The road is comprised of semi-compacted sand and does have a few soft spots. On the west side of the creek is a small undeveloped (single lane over grass) road that the Jones Center researchers use to access the right bank.

From the left (east side) bank, a stair-type access will need to be installed for safe access to the stream edge. FCC has installed a roll out boardwalk to avoid erosion and stabilize the bank. This is very steep and the host asked that we not extend any further because of seasonal flooding. FCC may need to install a pipe handrail along the path to help with access.

7.1.7.1 Science Perspective on Access Needs (Pathways, Stairs, Etc.) to Reduce Site Erosion/Impact

Access from the road along the left bank (east side) to the S1 sensor will require clearing a small amount of the understory vegetation and the installation of rudimentary stairs to facilitate access to the creek edge. An area with a suitable bank angle was identified during the April 2012 characterization visit that can connect the selected S1 sensor location to the access road. Bench-cut stairs with a 2x6 hammered into the soil to limit sloping of the stairs should be sufficient. Table 22 provides a coordinates for the stairs.

Table 22 Stairs Location & Length

Stairs	Latitude	Longitude
Top of Stairs	31.198633	-84.467578
Length of Stairs	~ 30m	

7.1.8 Power at the Site

The local power utility company is Mitchell EMC Billy Pate 229-336-5221.

7.1.9 Site Science Construction Constraints and Limitations

Site-specific issues to consider at D03 Ichawaynochaway Creek are:

- The site experiences episodes of drought and significant flood events. All equipment kept near the stream should be submergible and able to withstand the forces of a flood or be designed such that it can be removed during a flood. Flooding can be extensive (several feet high at the road), but are generally slow moving. Sand/silt and woody debris (e.g. tree limbs, brush, whole trees) are likely to be moving with the flowing water.
- Soils near the creek banks are largely unconsolidated sand, care should be taken to not cause additional erosion during the construction activities.
- The section of the Ichawaynochaway Creek passing through the Jones Center is classified as non-navigable.

Driving and access constraints for D03 Ichawaynochaway Creek are:

- Access roadway on the east side of the creek, the main access point for the aquatic site, is composed of unconsolidated (but packed) sand. At least one soft spot was noted during the April 2012 characterization activities. EHS and the Domain manager may want to consider discussing likely wear-and-tear on the road due to regular access to the site.

- Vehicles should stay on the sand roadways and avoid pulling off into the vegetated understory for parking purposes. Park in the roadway.
- Poison ivy and oak are **very** prevalent at the site and care should be taken while walking around in the riparian area.
- Venomous snakes are in the area and care should be taken while walking around in the riparian area.

7.1.10 Other Issues

No other science issues are identified at this time.