D08 AQUATIC INSTRUMENT SYSTEM (AIS) SITE CHARACTERIZATION REPORT

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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 D08 aquatic locations: Mayfield Creek (core), Black Warrior River (relocatable), and Lower Tombigbee 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.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 D08 AIS SITE CHARACTERIZATION REPORT

3.1 Mayfield Creek

Mayfield Creek site is a 3rd-order, wadeable stream in the coastal plain of west-central Alabama with a watershed size of approximately 20 km^2. The Mayfield Creek catchment is entirely located in the Talladega National Forest, which consists of mixed mature coniferous and hardwood trees. Wetlands comprise a significant proportion of the watershed. The flow regime of Mayfield Creek is typical of forested streams in the southeast. Base flows are highest in the winter and spring (February-May) and lowest in the late summer and fall (July-November). Precipitation-driven high flow events may occur at any point during the year, though wetlands likely attenuate the intensity of floods. Although the banks and channel of Mayfield Creek are comprised of sand, the vegetation appears to provide significant stability and resistance to bank failure.

3.1.1 Aquatic Auxiliary and Aquatic Portal Locations for Construction

The initial estimated location for the Aquatic Auxiliary Portal is:

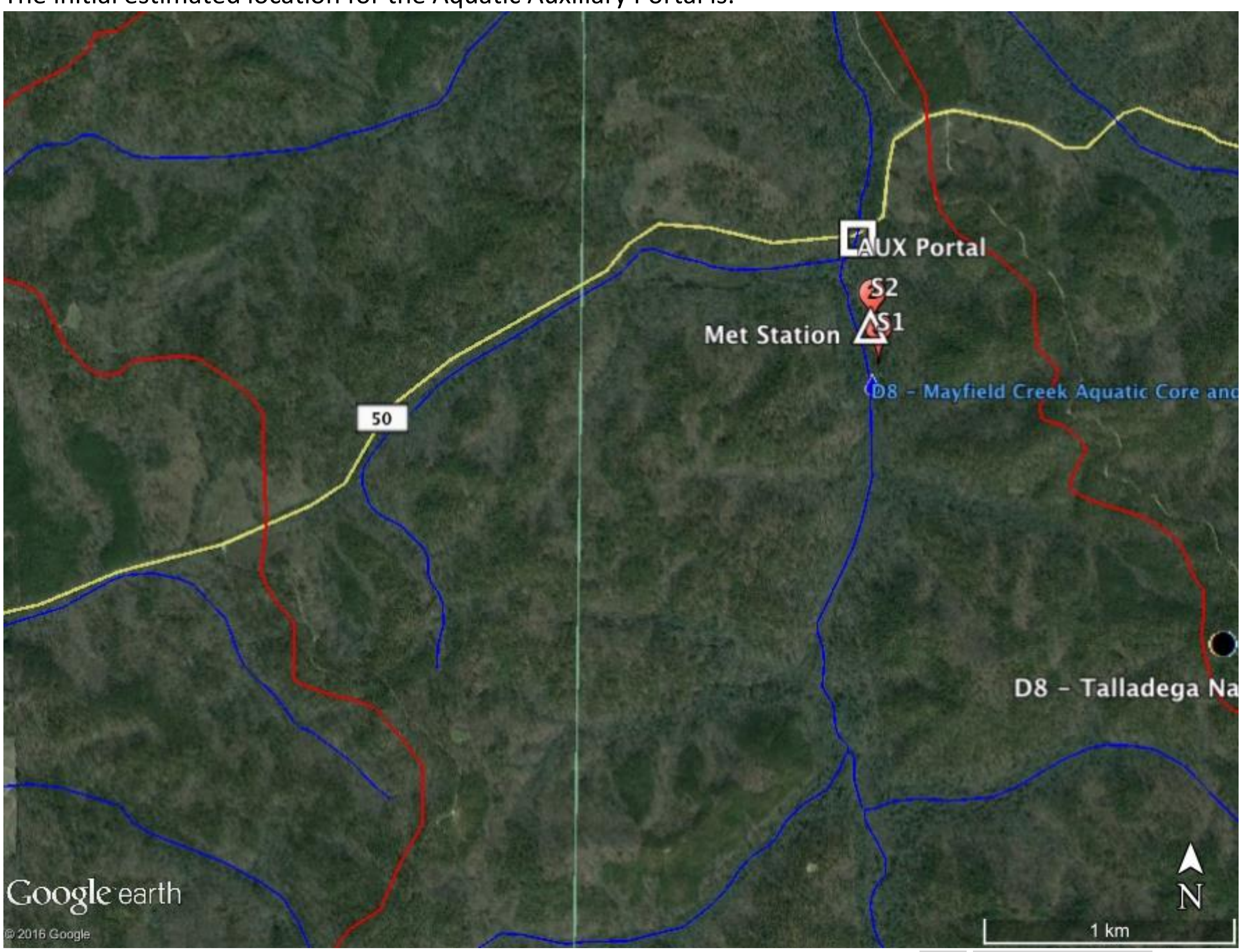

Figure 1.A Google-Earth-Derived Image of Aquatic Auxiliary Portal for D08 Mayfield Creek

Table 1. Aquatic Auxiliary Portal Location

Aquatic Auxiliary Portal	Latitude	Longitude
Location	32.964936	-87.408755

The initial estimated location for the Aquatic Portal is:

Table 2. Aquatic Portal Location

Aquatic Portal	Latitude	Longitude
Location	32.964936	-87.408755

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.

Satellite coverage at Mayfield Creek during site characterization likely produced reasonable estimates of sensor locations. Additionally, a small but perennial tributary enters into Mayfield Creek from the west and the distance from this tributary to the sensor locations were also recorded to verify coordinates.

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

Table 3. Sensor 1 & Sensor 2 Locations

Sensor	Latitude	Longitude
S1	32.960426	-87.407865
S2	32.961673	-87.408134

The above S1 and S2 sensors locations are *475 and 287 m upstream from the west-entering tributary*, respectively. Sensors associated with discharge calculations may be co-located with either the S1 or S2 sensor. The total aquatic stream reach is about 190m in length between S1 and S2.

Table 4. Micrometeorology station locations.

Sensor	Latitude	Longitude
Micrometeorology station	32.96177584	-87.408189

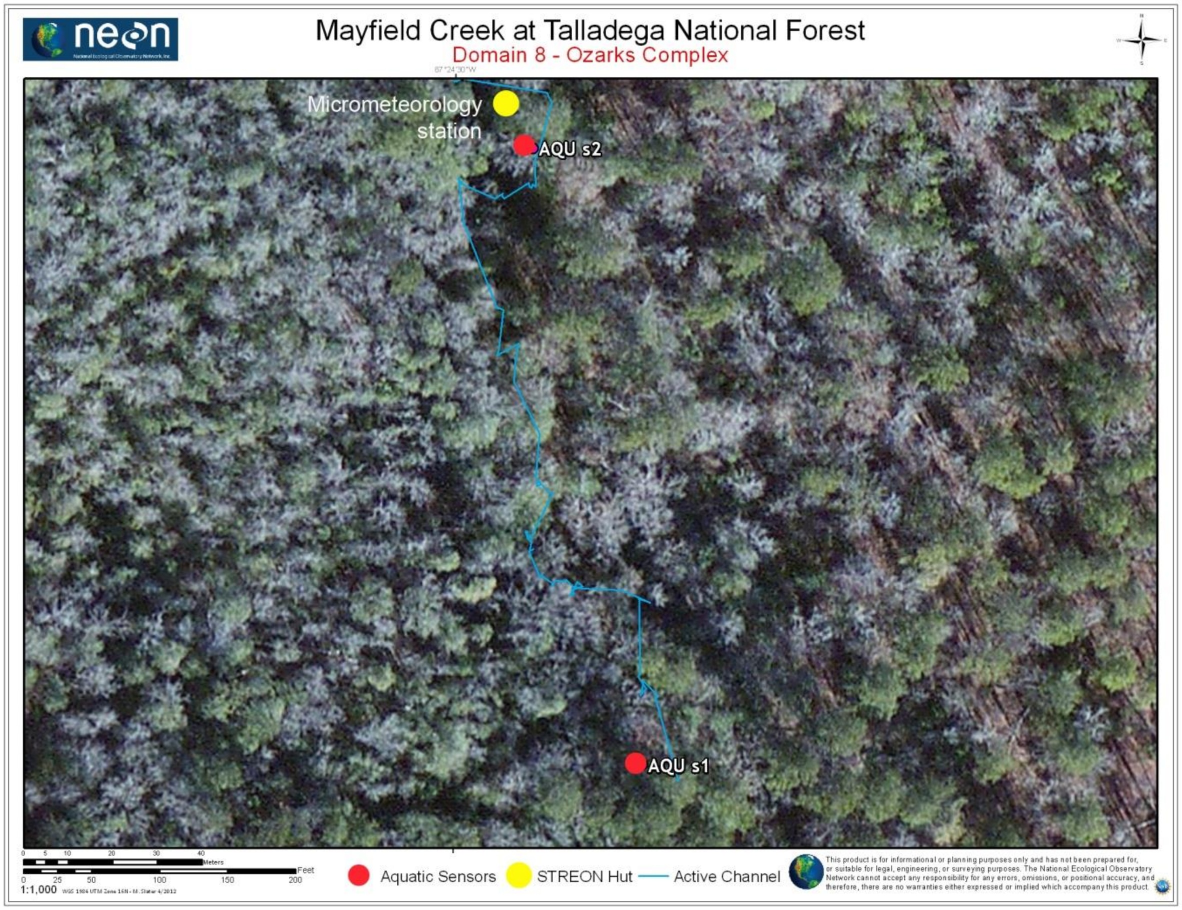

Figure 2. Map of D08 Mayfield Creek denoting locations of S1, S2, and micrometeorology station.

Figure 3. S1 Location at D08 Mayfield Creek. Note that the left bank rises vertically from the channel, while the right bank is more gently graded. Perspective is facing upstream.

Figure 4. S2 location at D08 Mayfield Creek. Perspective is facing downstream.

Figure 5. Micrometeorology station location at D08 Mayfield Creek. Station will be co-located with the STREON equipment hut.

Figure 6. Mayfield Creek banks consist of packed sand stabilized by roots.

3.1.3 Groundwater Wells

The groundwater observation wells network at the site (Figure 7, Table 5) will consist of 6 wells installed using a direct-push rig (i.e. Geoprobe). The well network extends from the start of the Aquatic reach (AQU S1) to the end of the STREON reach (STREON S2). Topography at the site is predominately flat and forested with the forest floor being somewhat open and accessible for the rig. Some downed trees may need to be either cut and/or moved to accommodate the rig access path. The estimated drilling depth is about 30 feet for all wells. Access to the well locations along both sides of the stream will be via overland through the forest. Rig access to the well locations is anticipated to be relatively straightforward and a defined rig path for drilling purposes will be walked and defined prior to work at the site. The exact location of the wells may need to change slightly if the rig is unable to reach the desired locations due to the presence of downed trees, thick underbrush, or seasonal boggy regions.

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 Alabama 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 from a depth of 2 feet below land surface to the top of land surface. No details are provided as to the lateral 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.

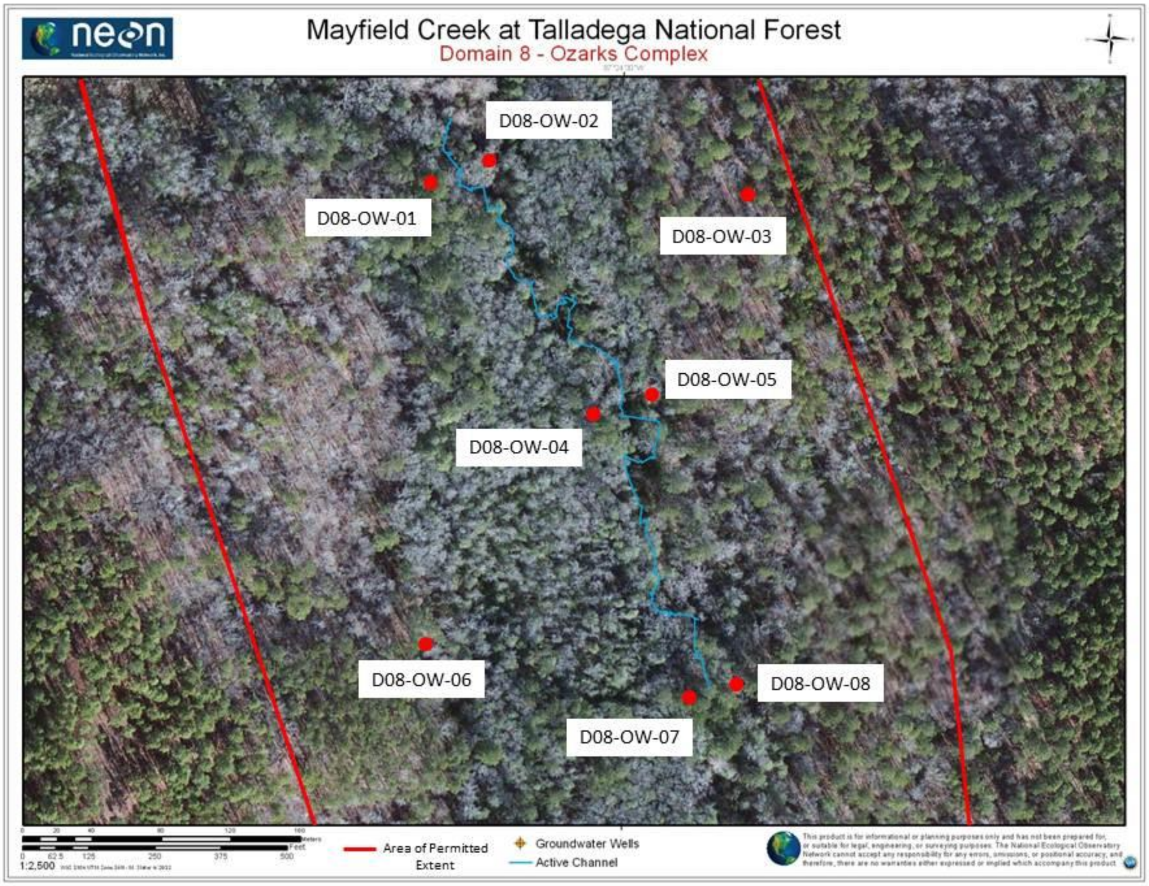

Figure 7. Initial groundwater well locations based on at D08 Mayfield Creek.

Table 5. Groundwater well locations at D08 Mayfield Creek.

Well ID	Latitude	Longitude
D08-OW-01	32.959651	-87.408256
D08-OW-02	32.962832	-87.410092
D08-OW-03	32.963380	-87.408664
D08-OW-04	32.961986	-87.408011
D08-OW-05	32.960145	-87.408079
D08-OW-06	32.960471	-87.407367
D08-OW-07	32.961606	-87.409134
D08-OW-08	32.963147	-87.409442

3.1.4 Riparian Vegetation Cover

Vegetation in the Mayfield Creek watershed consists of mature growth hardwood and conifer trees. Dominant species include various pines (longleaf, shortleaf, yellow and loblolly), oak, hickory, sweetgum, tulip poplar and dogwood. Ground cover vegetation is well-developed but not particularly obstructive. Understory vegetation includes ferns, shrubs, immature trees and vines. Poison ivy is very common throughout the understory.

Figure 8. Typical riparian and upland vegetation in the D08 Mayfield Creek watershed.

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.

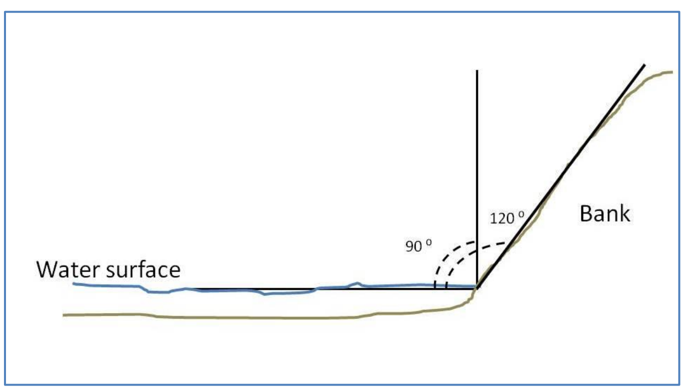

Figure 9. How Bank Angle is Measured

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

Table 6. Bank attributes of D08 Mayfield Creek sensor locations.

Morphology Type	S1	S2
RB* angle	135	90

LB* angle	90	135
Maximum water height	2.2 m (from channel thalweg to top of right bank)	2.4 m (from channel thalweg to top of left bank)
Bankfull width	5.6	6.2 m
Substrate composition	Sand and some pebble	Sand

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

Figure 10. Typical bank attributes at sensor locations. Shown here is the left bank of the S1 location.

3.1.6 Site Photos

The following photos of are representative of the site.

Figure 11. Substrata in Mayfield Creek consists almost entirely of sand which is typically compacted but becomes unconsolidated after significant flood events.

Figure 12. Mayfield Creek is very highly sinuous. Sharp meander bends such as shown above are very common while straight reaches are rarely present.

Figure 13. Small patches of riparian wetland areas that are noncontiguous with the stream channel are present in the Mayfield Creek watershed. The above wetland was separated from the stream channel by about 20 m of dry land. Such areas likely influence hydrologic and biological attributes of Mayfield Creek and should therefore not be disturbed by infrastructure such as trails.

Figure 14. Large woody debris and associated leaf packs are common throughout the Mayfield Creek channel. These features are biologically important and should not be removed or disturbed during infrastructure installation operations.

Figure 15. Isolated sections of Mayfield Creek may be waist-deep during baseflow, though the majority of the channel is under 0.5 m deep.

3.1.7 Site Access Needs

Providing site access at Mayfield Creek will require the development of a footpath through the forest to minimize impact to vegetation in the watershed. A single path upstream from County Road 50 to the uppermost sensor (AQU S1) on either side of the stream will suffice, as topographic features are approximately equivalent on either side of the stream (Figure 16). However, a small tributary enters Mayfield Creek from the west (the left bank) and thus developing the trail on the western side of the channel would require the installation of a small (~5 m long) bridge.

The footpath should entail a clearing of brush for 1-2 feet in width. No gravel, boardwalk or other material is required.

Furthermore, as shown in Figure 13, patches of riparian wetlands are sporadically located in the immediate vicinity of Mayfield Creek. These include any areas with standing water or evidence of prolonged standing water during certain seasons (they may completely dry in the later summer or early fall). *The access pathway must avoid these areas*, as they likely influence the hydrologic and biological attributes of Mayfield Creek. The precise locations of these areas are currently unknown, though developing a pathway that does not disturb these areas should not prove particularly difficult, as these wetlands are small, isolated patches of habitat.

FCC can determine which side of the channel will be easiest to construct a footpath. Thus, AQU has not defined a start and stop location in Table 7.

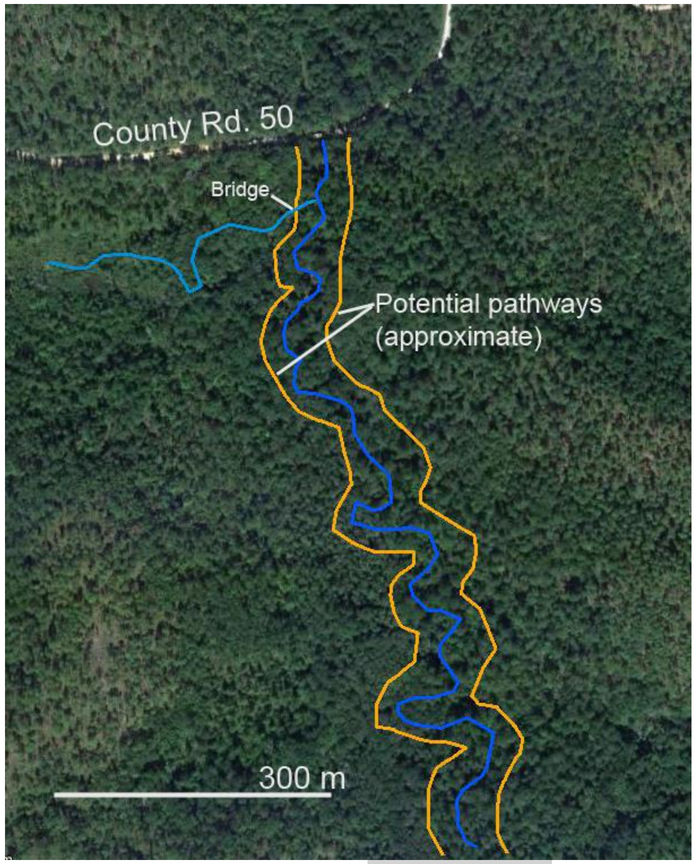

Figure 16. Potential routes for access pathways at Mayfield Creek. The channels shown represent approximations.

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

None. FCC will use the East sitde of the creek for the power and access route to the site.

3.1.8 Power at the Site

The local power utility company is:
Black Warrior Coop
Paul Oglesby
334-624-8665.

This line will be private owned by NEON for about 5 miles from the last power pole to the FIU tower site. We pass the Aqu Aux on the way to the FIU site and will drop a transformer there.

3.1.9 Site Science Construction Constraints and Limitations

Site-specific issues to consider at D08 Mayfield Creek are:

- Construction activities should take care to minimize disturbances to channel banks, which consist of packed sand stabilized by roots. Heavy equipment should remain away from the bank to prevent mass failure.
- Sensor installation and routine maintenance should not involve the removal or destruction of large woody debris dams in the channel of Mayfield Creek.
- Up to five species of venomous snakes are found in the Mayfield Creek vicinity. During site characterization in April 2012, multiple snakes were encountered hanging from riparian trees and adjacent to wetland areas. Personnel should conduct field operations with appropriate protective gear and an Emergency Action Plan.
- Use of Personal Flotation Devices (PFDs) may be required, depending on regional USGS regulations and standards for work in or near lakes, streams, or creeks.

Driving and access constraints for D08 Mayfield Creek are:

- Access to sensor locations at Mayfield Creek will require the development of a footpath along either side of the stream channel. The footpath route must avoid perennial or ephemeral riparian wetlands. The footpath may be routed on either side of the stream channel; however, a path on the western side Mayfield Creek would require the construction of a small bridge over a tributary.
- Due to the instability of bank substrates, small ladders or stairways may need to be installed to provide access from the top of the bank to the sensors. Ladders or stairways would require normal construction standards and wood treatment if left on creek permanently or for temp ladders, would need to extend above bank 36” and be secured during access/egress.
- Access for the drill rig to install the groundwater monitoring wells may require cutting and moving some downed trees and clearing of a small amount of underbrush to allow for an access pathway on both sides of the stream.

3.1.10 Other Issues

No other science issues are identified at this time.

3.2 Black Warrior River

The Black Warrior River site is a non-wadeable river. This is the second site along the ecohydrological gradient in D08. Mayfield Creek flows into he Black Warrior via the Sandy Creek just south of Tuscaloosa, AL. The Black Warrior watershed is 1.62 million hectares and is located in north central Alabama. The site is located in the southern extent of the watershed in Demopolis, AL, 11 km upriver from the confluence with the Tombigbee River. The Mobile River Basin which includes the Black Warrior and Tombigbee basins (see Figure XX) is subject to major precipitation pulses from tropical storms and hurricanes. These major events will affect nutrient and organic matter flux, sediment transport and biota along the gradient as they propagate downstream.

It is expected that in higher order systems the trophic structure of the stream should move from being based on terrestrial litter, grazers and shredders to more primary productivity and higher trophic structure. This is a key feature of the river continuum theory. The domain design across this ecohydrological gradient focuses specifically on addressing the concepts of this theory.

This is a navigable river managed by the Army Corps of Engineers and is subject to restrictions on use and the visibility of infrastructure. Included in the management of this river system are a series of locks and dams which severely impact flow and the transport of sediment. This has a significant impact on the site design (see Section XX below for characterization details). In addition, the river is impacted by coal fired steam power plants as well as urban and agricultural land use. These features will impact the utility of the domain design to address all of the aspect of the river continuum theory. However the connectivity will allow us to assess the response of the system to large events and long term changes in climate.

Figure 17. Map of Black Warrior and Tombigbee Watershed showing site locations along the echohydrological gradient.

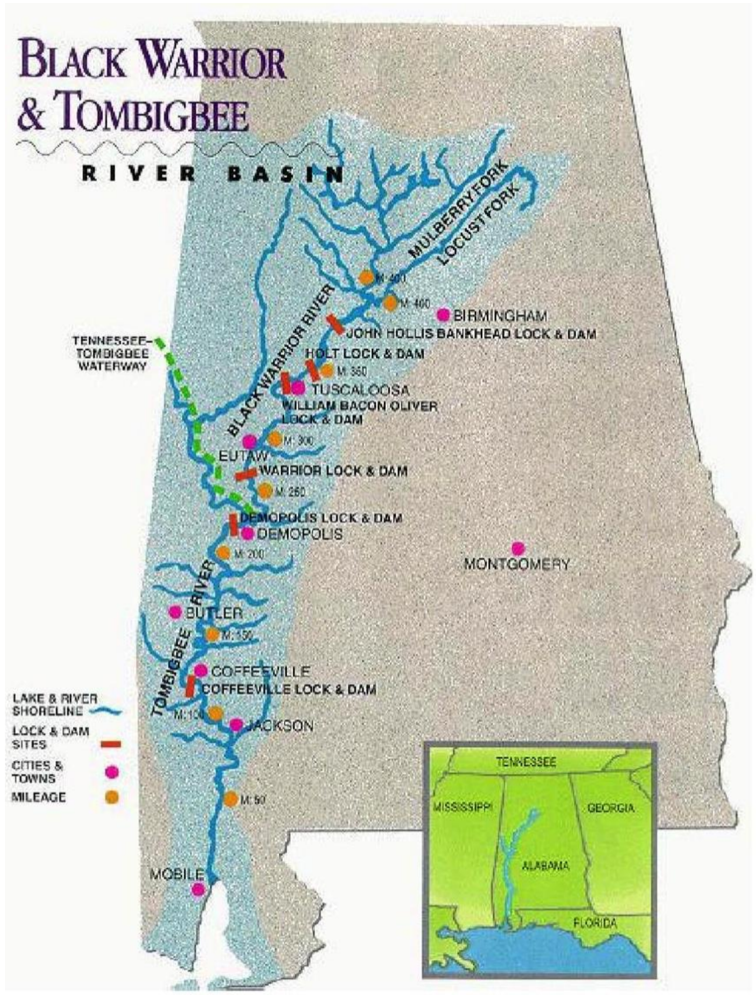

Figure 18. Map of the Black Warrior River watershed, showing the location of the six locks and dams along the water way.

3.2.1 Aquatic Auxiliary and Aquatic Portal Locations for Construction

Because of existing permitting constraints with the US Army Corps of Engineers we are seeking to install on shore infrastructure for this site on private land adjacent to the USACE Dead Lake site. Given the sensitivity of placing infrastructure on private property we are presenting an alternative design that minimizes the visual impact near the river bank. To do this the AQU and AUX Portal will be placed in the existing easement near the power pole to the west of the access road as shown in Figure XX. The radio receiver for the buoy transmission shall be removed from the AQU Portal and placed in an enclosure to be co-located (on the same arbor) with the power and comms box on the field device post for the level gage near the waters edge as shown. Conduit connecting the Portal to the field device posts shall be trenched and buried in a path similar to what is shown pending examination of existing water lines.

The initial estimated location for the Aquatic Auxiliary Portal is

Figure 19. A Google-Earth-Derived Image of Aquatic Auxiliary Portal for D08 Black Warrior River

The initial estimated location for the Aquatic Portal is given in Table 11. The AQU and AUX portal will be co-located (within 1-2 m).

Table 7. Aquatic and Auxiliary Portal Locations

Aquatic and Auxiliary Portals	Latitude	Longitude
Location	32.542581°	-87.798693°

Figure 20. Picture of existing power pole where AQU and AUX Portals shall be installed.

The initial estimate for the location of the field device post for the buoy receiver and level gauge enclosures and antenna is given in Table 8.

Table 8. Field Device Post Location

Field Device Post – Buoy Receiver/Level Gauge	**Latitude**	**Longitude**
Location	32.542570°	-87.798093°

Figure 21. Picture of field device post location.

Figure 22. Picture showing view from field device post location down river toward buoy location.

3.2.2 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.

A profiling buoy is to be located in the river at the S1 location shown in Figure XX. The buoy should be located at a position that is an average of 10m deep over the year. This puts it at 15-25m off of the right bank. The chosen location is consistent with previous characterization work and is approximately 25m from shore and 45m from the navigation channel. The permitting guidelines specify structures shall be at least 100 feet from the navigation channel; therefore the chosen location should meet both the permitting requirements as well as our scientific objectives.

Because of the sensitive permitting situation and the pursuit of NEON to install shore-based infrastructure on private land, NEON SCI has elected to waive the requirement for local micrometeorological measurements. This is justified by the inclusion of meteorological measurements on the buoy itself and the proximity to the TIS Dead Lake tower.

A level (pressure) gage (the LevelTroll) will be needed for continuous water level and discharge measurements. The final design of this system is not complete at this time. However, it will be similar to the design of the inlet/outlet infrastructure at lake sites, without the mounts associated with the underwater PAR sensor which is not present at this location (only on the buoy).

Therefore the complete set of sensors and infrastructure needed for the proposed site include: a profiling buoy supporting surface water and micrometeorological measurements and a pressure sensor to measure water level placed in a static position below the annual mean low water level.

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

Table 9. Sensor 1 & Sensor 2 Locations

Sensor	Latitude	Longitude
S1	32.540673°	-87.798062°
S2	NA	NA

Table 10. Micromet & Discharge Sensor Locations

Sensor	Latitude	Longitude
Micromet	NA	NA
Level Gauge	32.542622°	-87.798018°

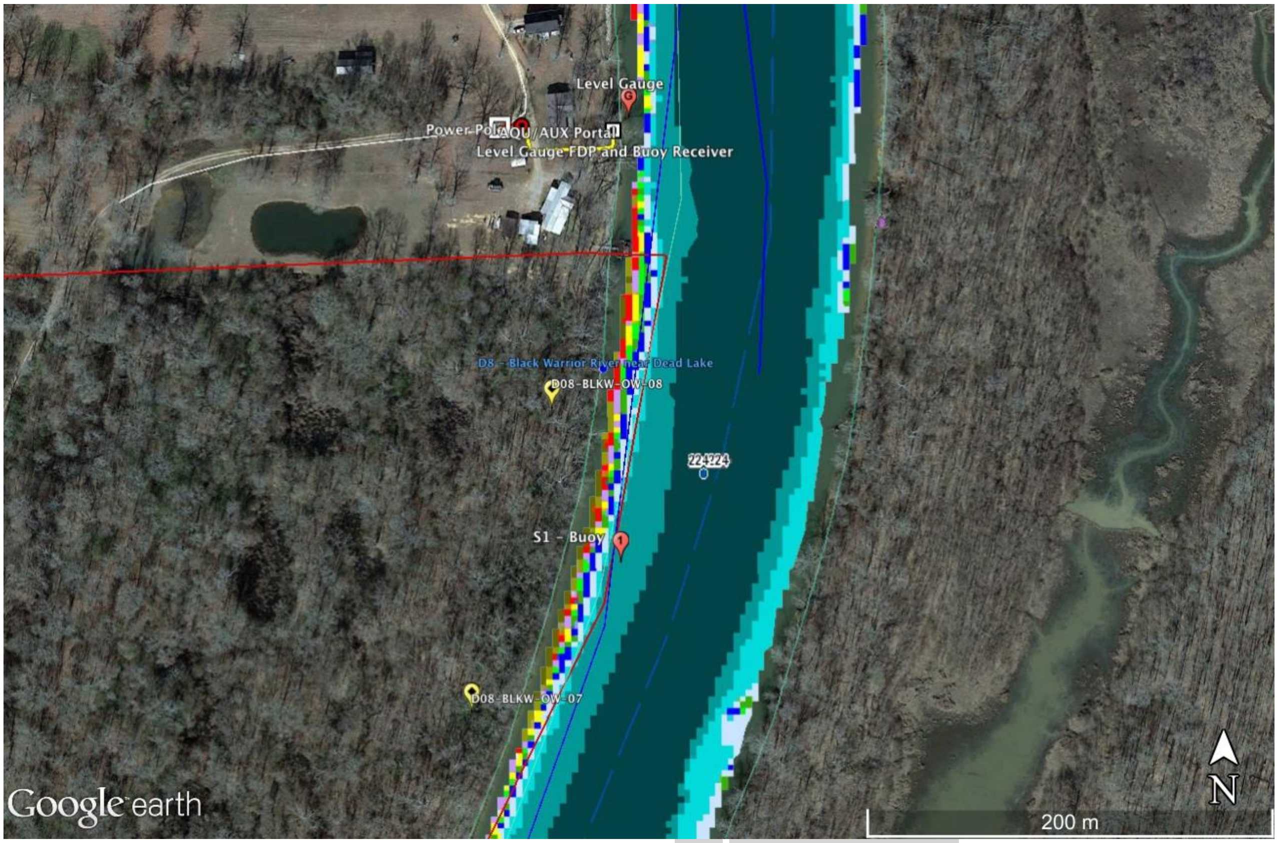

Figure 21 Photo of S1 Location at D08 Black Warrior River

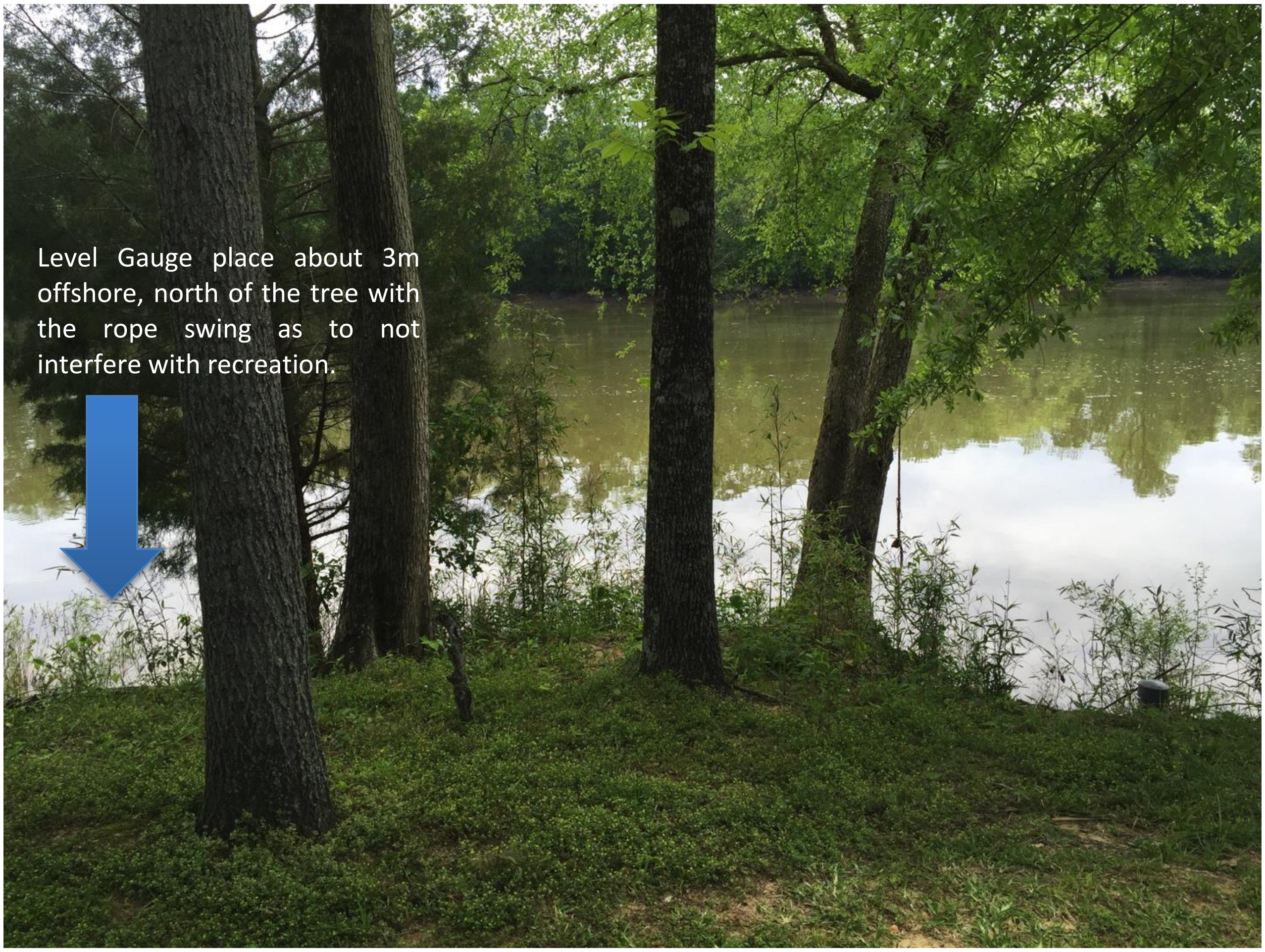

Figure 23. Picture showing location of level gauge just offshore, upriver from dock and rope swing.

Figure 24. View upriver from buoy location showing the line of sight to the FDP and receiver 30location.

Figure 25. View of right bank from buoy location.

Figure 26. View downriver from buoy location.

3.2.3 Groundwater Wells

The groundwater observation wells network at the site will consist of 8 wells installed using a direct-push rig (i.e. Geoprobe). The well network extends west from the right bank along the S1 location throughout the USACE land for the Dead Lake TIS site. Topography at the site is predominately flat with shallow depressions. The area is forested with thick understory. Some downed trees and small understory vegetation may need to be either cut and/or moved to accommodate the rig access path. The estimated drilling depth is about 40 feet for all wells. Access to the well locations will be via overland through the forest. Rig access to the well locations is anticipated to be relatively straightforward and a defined rig path for drilling purposes will be walked and defined prior to work at the site. The exact location of the wells may need to change slightly if the rig is unable to reach the desired locations due to the presence of downed trees, thick underbrush, or seasonal boggy regions.

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 Alabama 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 from a depth of 2 feet below land surface to the top of land surface. No details are provided as to the lateral 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.

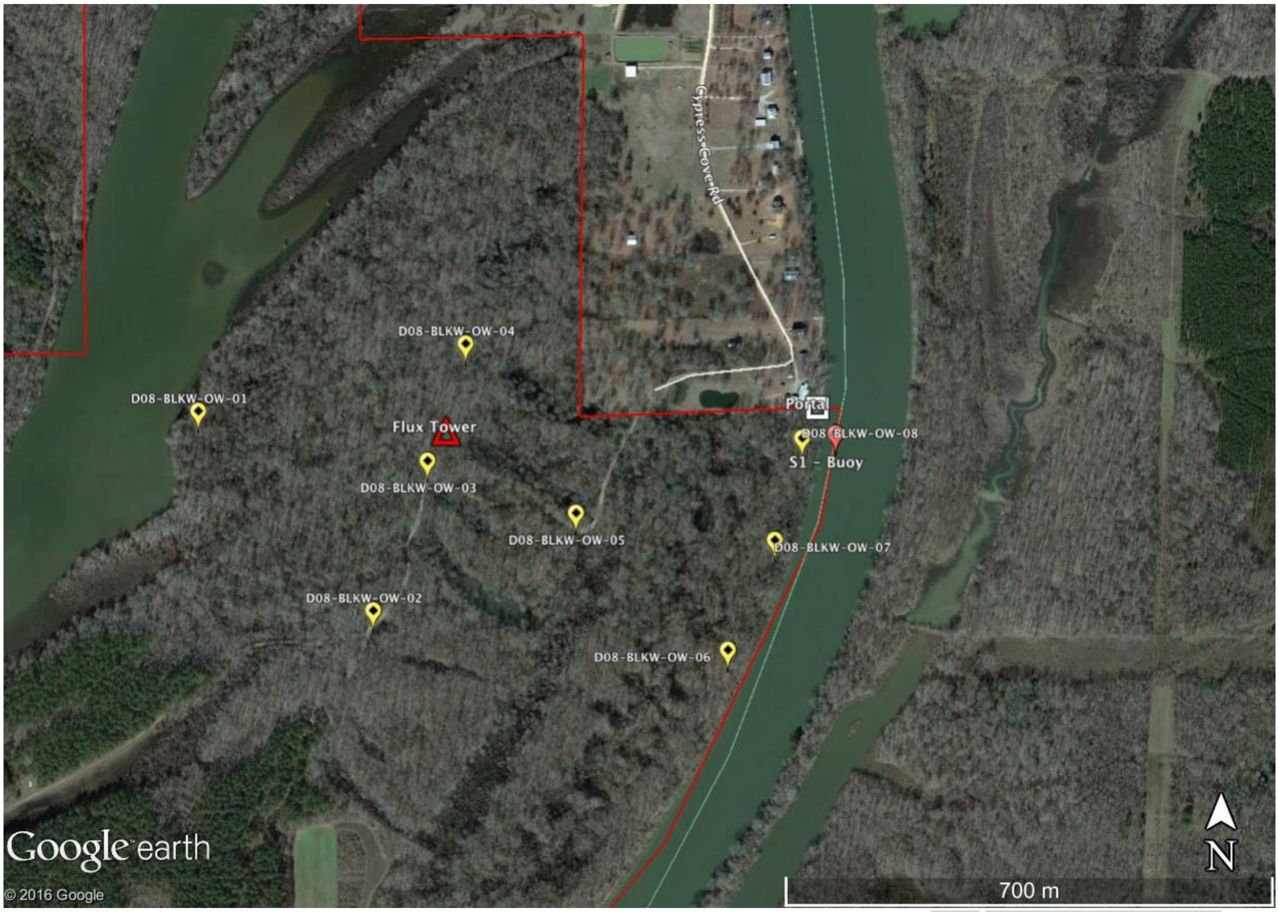

Figure 27. Initial Groundwater Well Locations Based on EMS kmz File at D08 Black Warrior River

Table 11. Groundwater well locations.

Groundwater Well ID	Latitude	Longitude
D08-BLWA-OW-01		
D08-BLWA-OW-02		
D08-BLWA-OW-03		
D08-BLWA-OW-04		
D08-BLWA-OW-05		
D08-BLWA-OW-06		
D08-BLWA-OW-07		
D08-BLWA-OW-08		

3.2.4 Stream Reach Characterization

The site design is determined by the scale and physical characteristics to ensure that we are effectively measuring the system. The six locks and dams along this riverway significantly reduce the flow in the river. Because of this, stratification becomes a concern. Stratification limits the transport of nutrients and chemical constituents which can significantly change the biogeochemical cycling, nutrient flux (downstream), biological diversity, trophic structure and ecosystem metabolism.

In the summer of 2013 we developed a low cost moored buoy to profile the temperature of the river to assess stratification and thermodynamics in the river. Figure 28 shows an illustrated schematic of the design which was deployed in July 2013 and measured temperature at 1m increments through the water column continuously until it was recovered in November 2013.

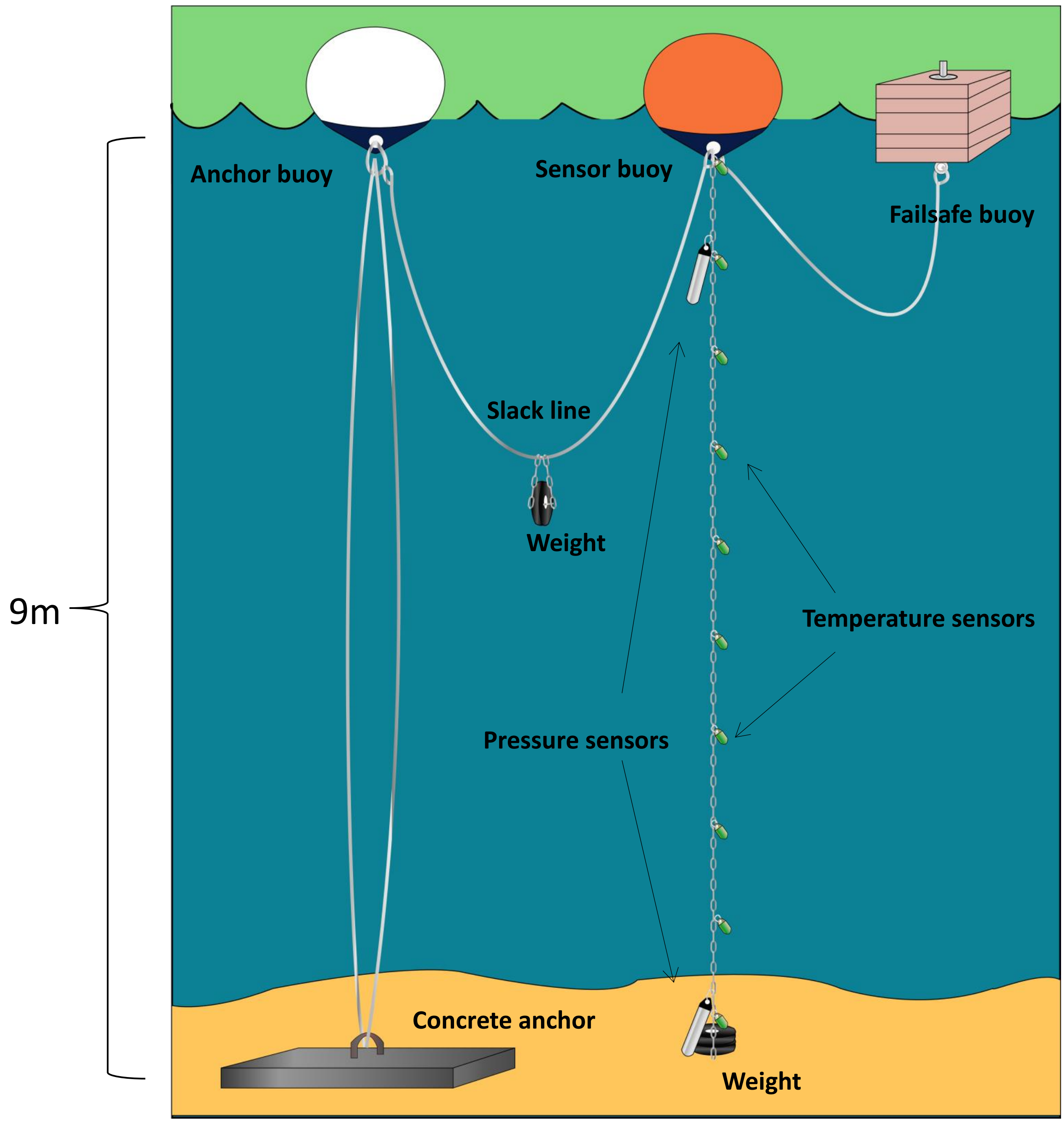

Figure 28. Schematic of moored buoy used to measure temperature profile at Black Warrior River.

Figure 29 shows the time series of the temperature profiles in the river. The bottom sensor experienced data loss during late August and was not recovered from then on. A significant difference in temperature across the water column develops due to surface heating from insolation. A stratification index was calculated as the standard deviation of the temperatures across the profile (Figure 30).

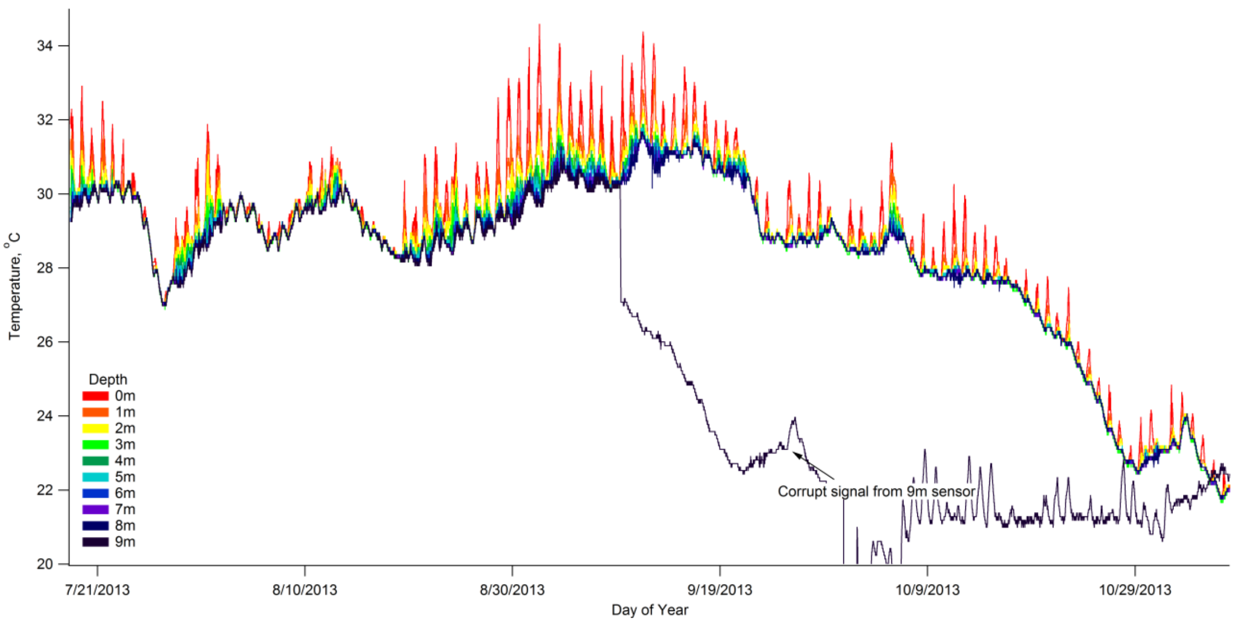

Figure 29. Time series of water temperature profiles during initial characterization.

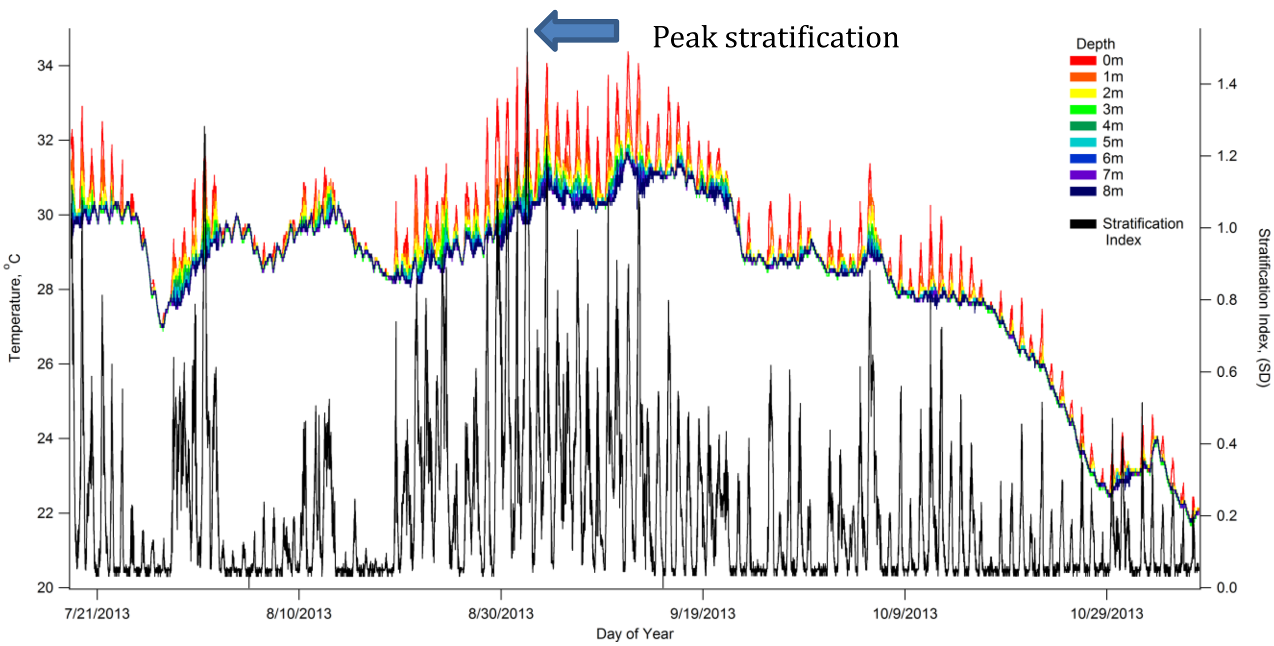

Figure 30. Time series of temperature profiles with stratification index.

At peak stratification the temperature difference from surface to depth was over 4 degrees Celsius (see Figure 31 top), This level of deviation in temperature is significant with the thermocline forming at 2-3m. The light intensity was also measure along this profile. Figure 31 (bottom) shows that the light attenuates quickly past 2m.

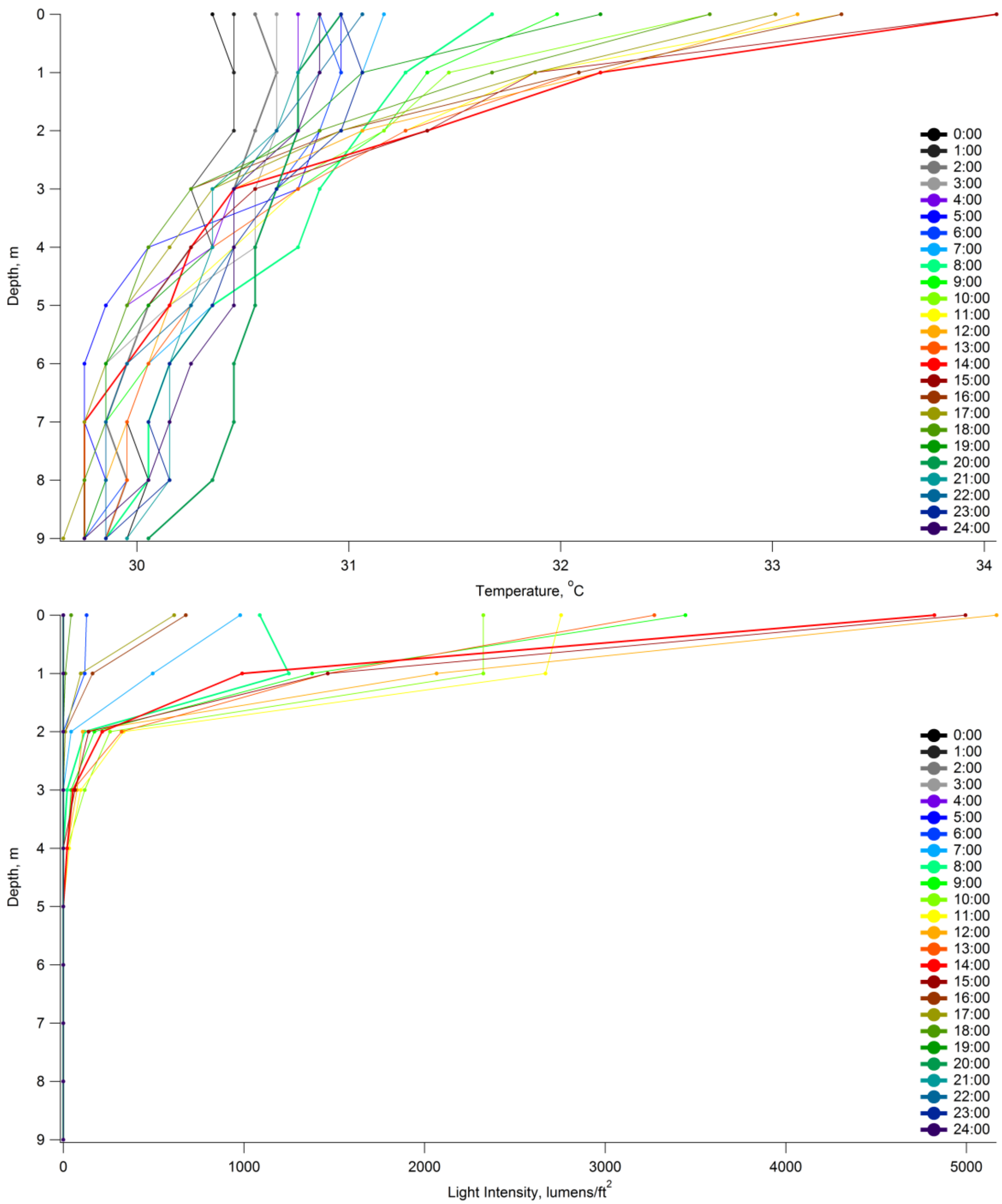

Figure 31. Overlain temperature (top) and light intensity (bottom) profiles during peak stratification.

The stratification that follows strong insolation is negatively correlated with discharge. Figure 32 shows the river temperature profile time series with discharge, air temperature and precipitation. High discharge pulses are the result of the lock and dam releases due to river management. The stratification is also negatively correlated with precipitation. Figure 33 shows the daily averaged values of stratification, discharge, and air temperature to highlight these correlations.

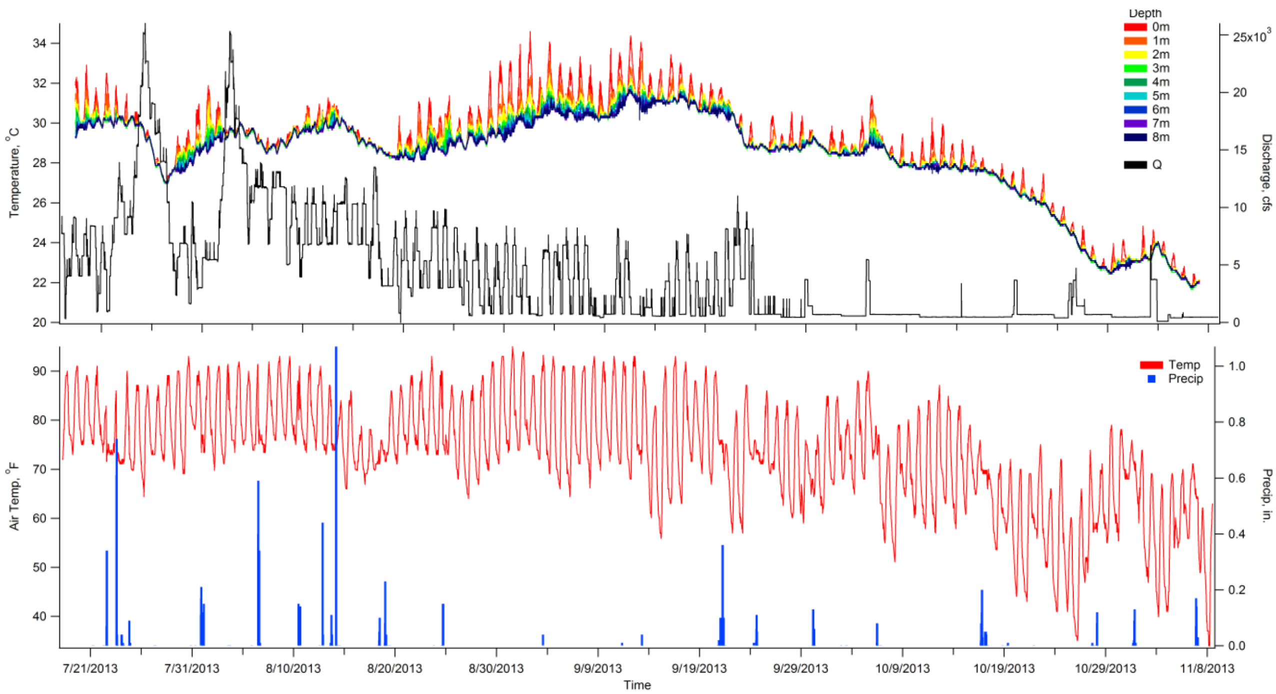

Figure 32.Time series of water temperature profile with discharge (top) and air temperature with precipitation (bottom) during initial characterization.

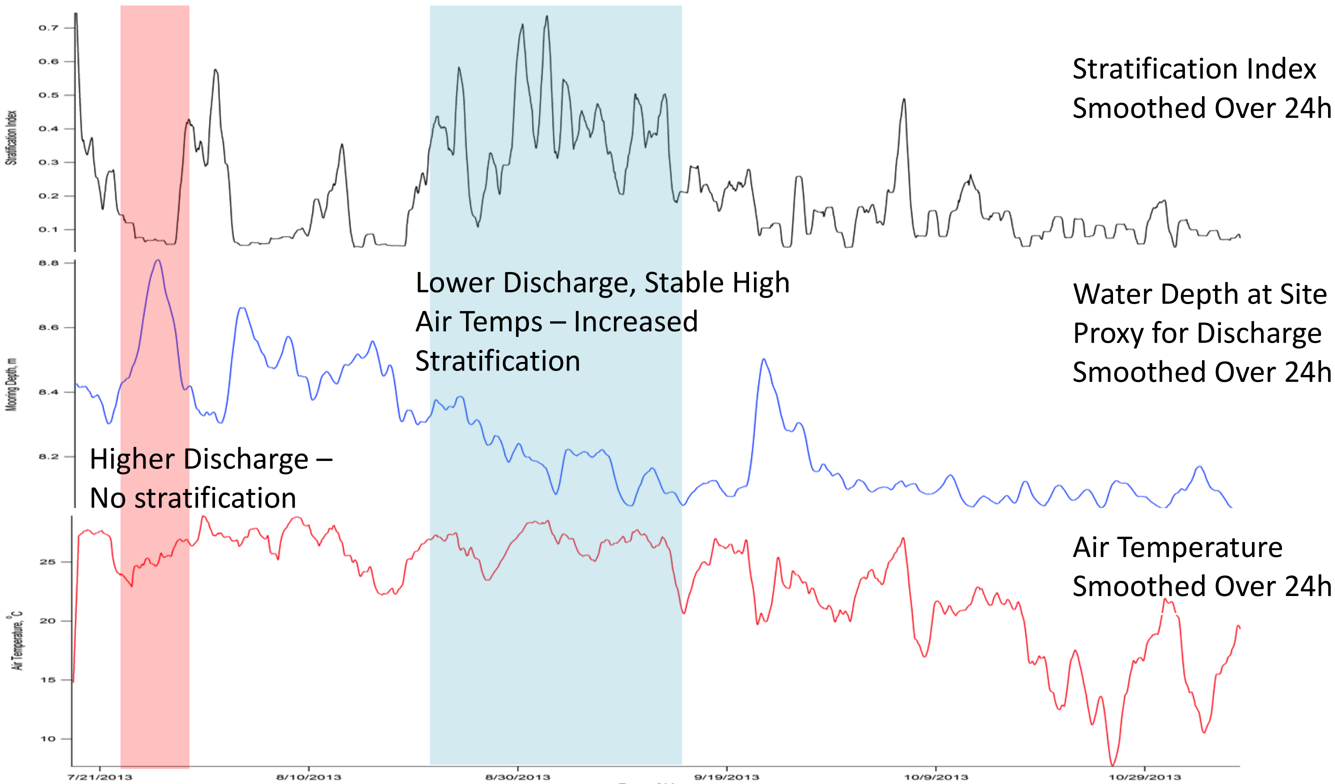

Figure 33. Time series of the stratification index with discharge and air temperature to illustrate the physical drivers of variability.

Based on the profile data which shows diel stratification, we returned to the site in August 2014 to perform water quality profiles over the course of 24 hours during conditions conducive to stratification. We performed four profiles at 9:00pm, 4:00am, 11:00am and 3:00pm at the same location in the river over 7/23/14 – 7/24/14 using a YSI EXO2 Multisonde. The meteorological conditions are shown in Figure 34. There was limited precipitation prior to the first profile, limited wind over the coarse of the profiles and air temperature daily maximums of 30-33 ^{o}C.

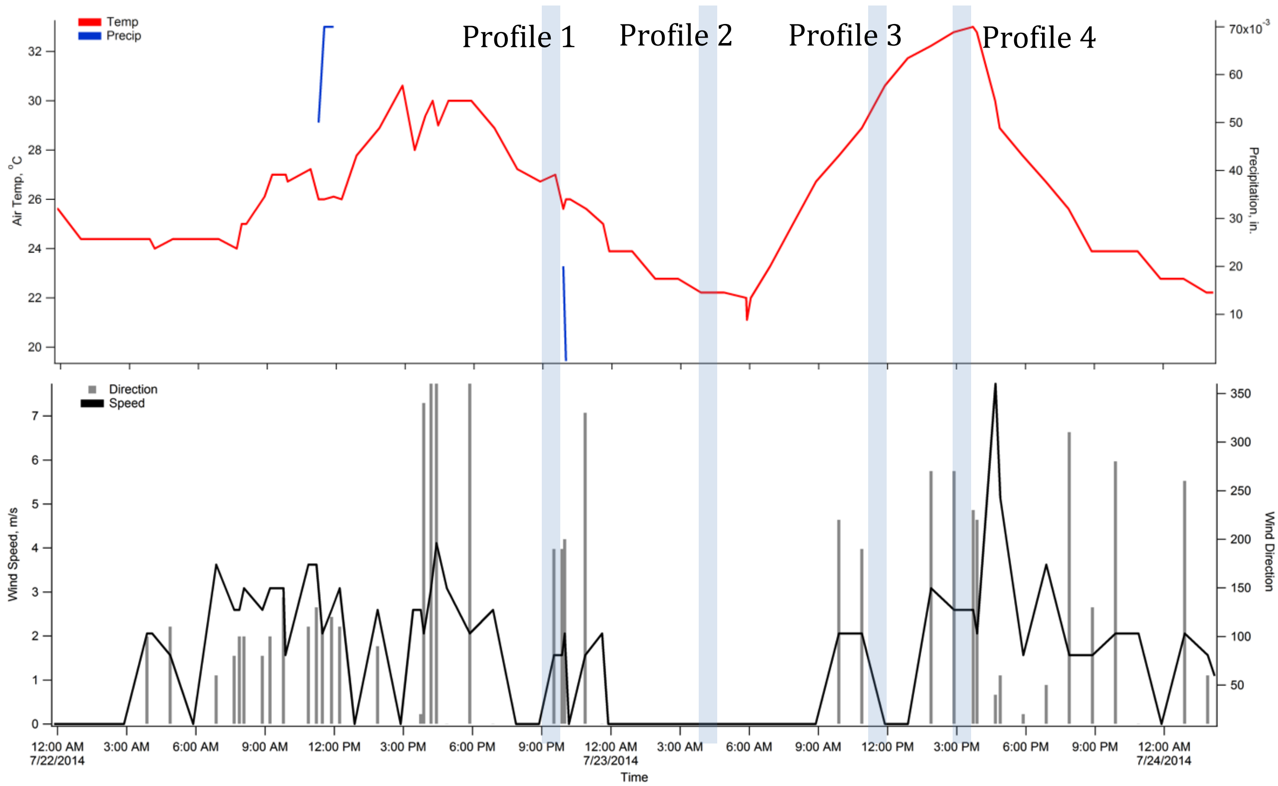

Figure 34. Meteorological conditions during the diurnal water quality sampling profiles.

The four profiles for temperature, conductance, dissolved oxygen, chlorophyll a, fDOM, turbidity and pH are shown in Figure 35. Weak stratification develops with a difference of nearly 2 degrees Celsius. There is a chlorophyll maximum near 1m below the surface. There is a clear gradient of dissolved oxygen and pH that correlate with this level of productivity. These gradients are consistent with the thermal stratification and light attenuation. This level of change in productivity and physio-chemical composition of the water across the water column necessitates at profiling system to measure the system in order to accuracy determine the ecosystem metabolism and nutrient fluxes.

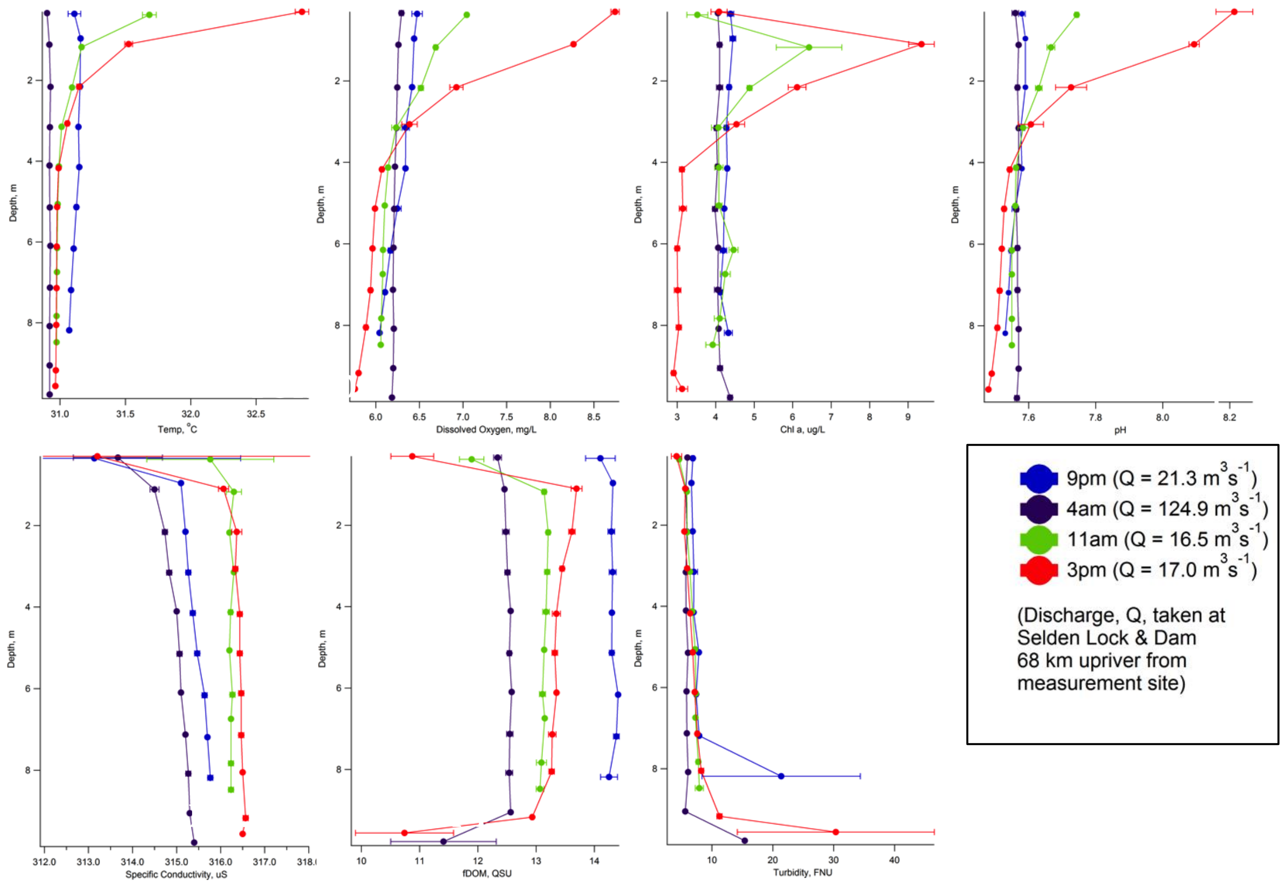

Figure 35. Water quality profiles over a daily cycle taken to investigate the spatiotemporal variability of biogeochemical cycles.

Lastly we investigated the spatial variability across a 650m portion of the river. The YSI EXO2 Multisonde was held at a depth of 2m below the water surface. The boat performed downriver transects at approximately 0.5 m/s. The data was incorporated into a GIS and the surface across the full extent was interpolated. Figure 36 shows the variation in surface temperature, dissolved oxygen, chlorophyll and pH. Hot spots of productivity can be seen. The relative standard deviation for these variables across the trisects were as follows: DO: 9.6%, Chl a: 6.9%, Temp.: 0.02%, pH: 0.05 (Std. Dev. pH units). Further observational sampling can inform the spatial variability over longer time scales in the river.

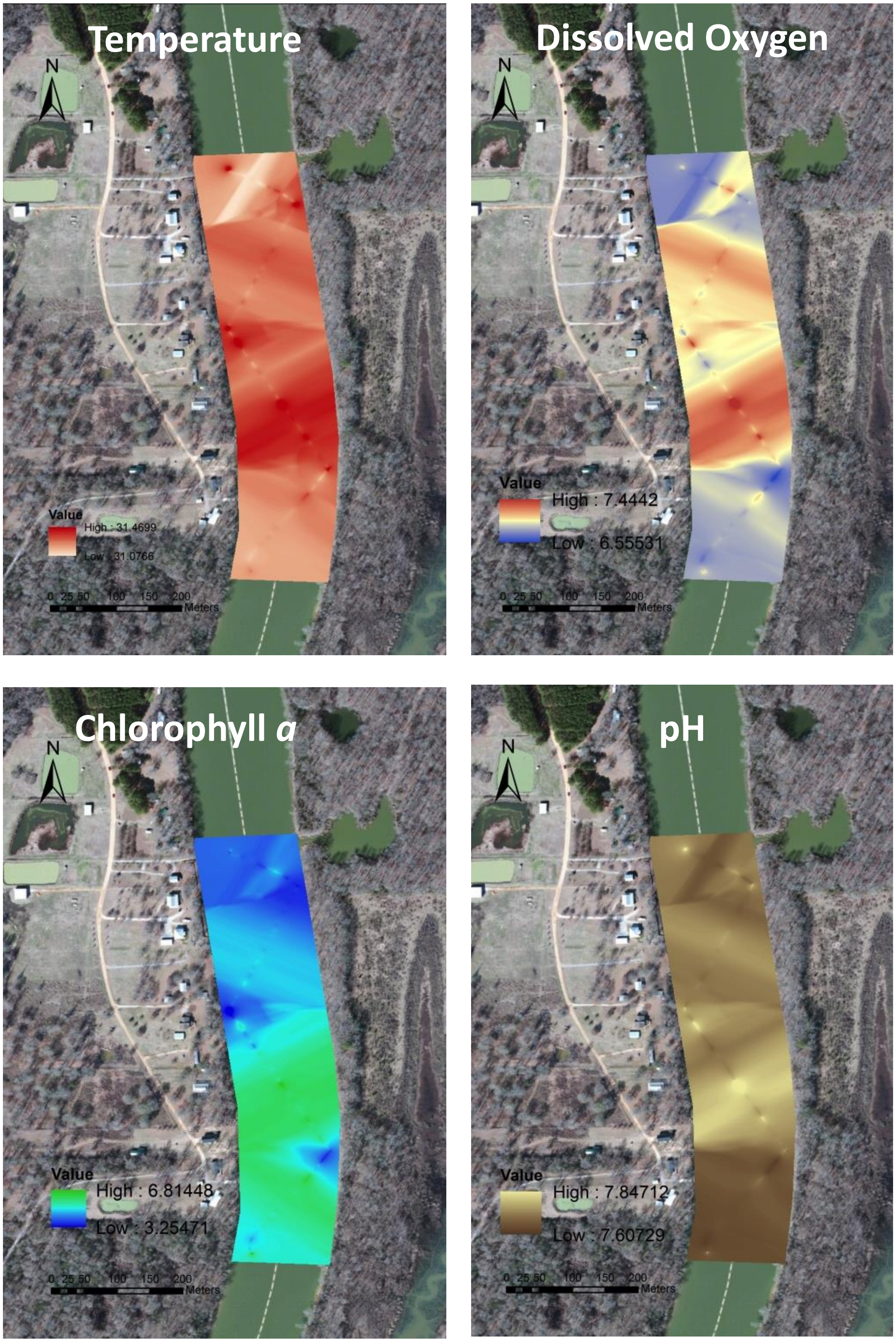

Figure 36. Interpolated surfaces of water quality data from transects performed along the reach.

Figure 37 shows the profiling strategy for AIS. The profiling buoy configured to profile every four hours will allow AIS to capture the physio-chemical dynamics in the river.

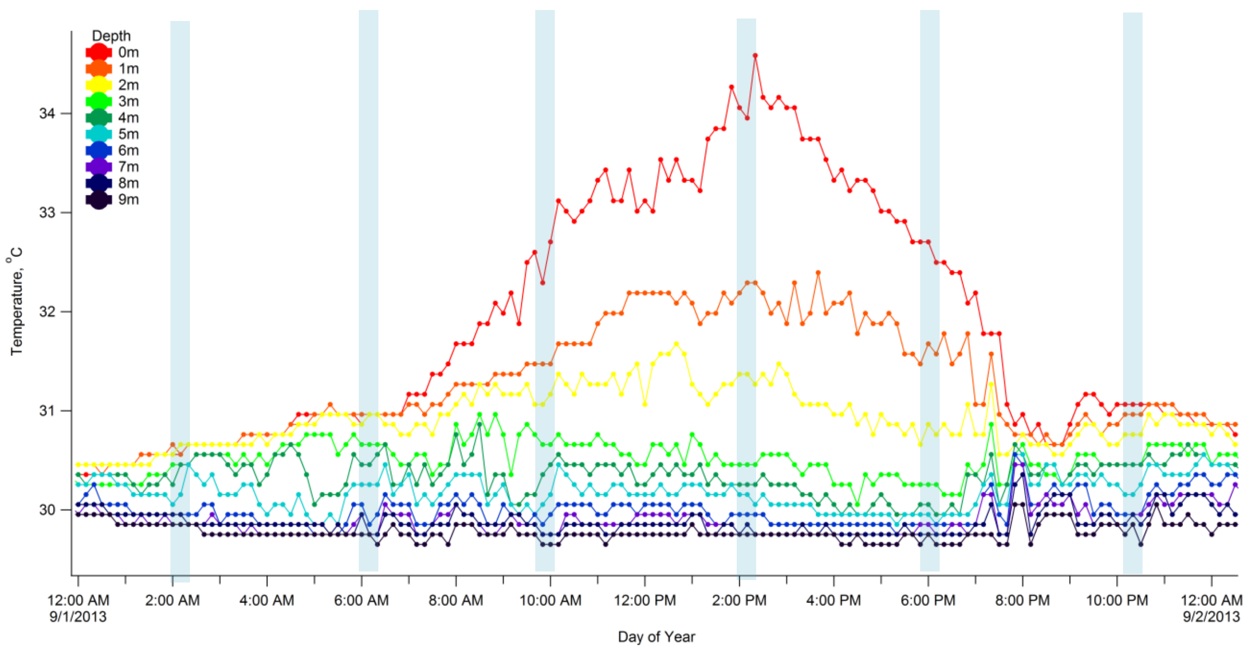

Figure 37. Graph showing the temporal sampling strategy for the profiling buoy.

3.2.5 Historical Data

3.2.5.1 Climate

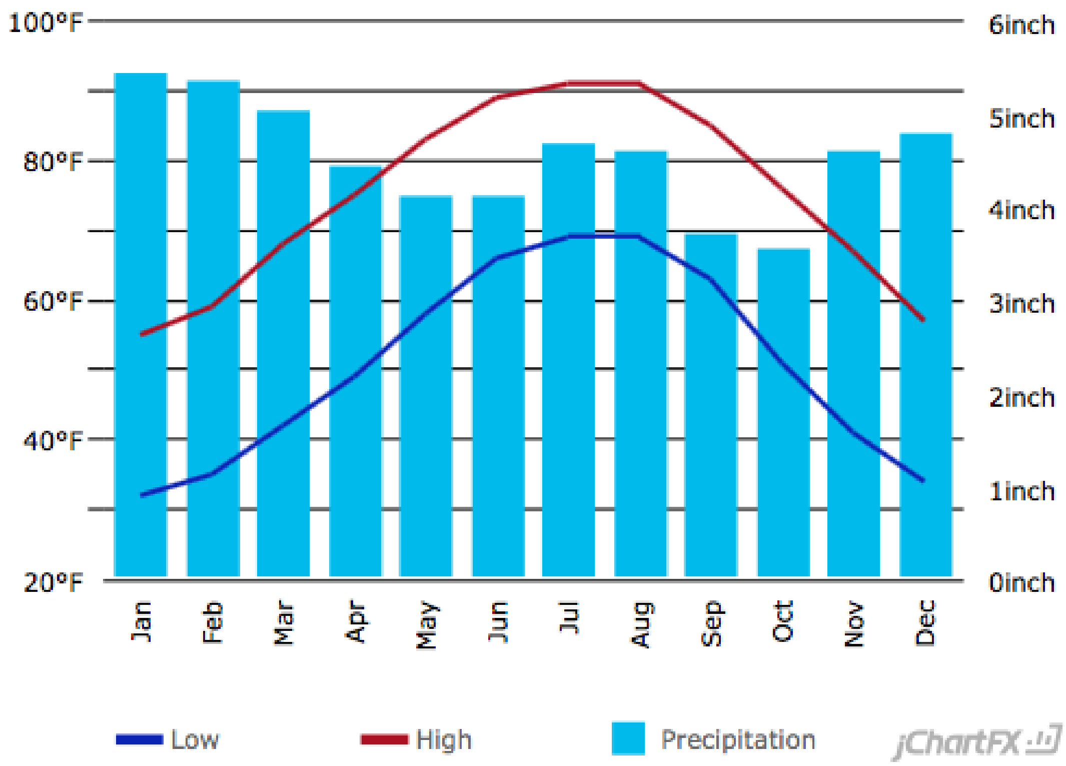

Figure 38. Mean climate taken at Demopolis, AL.

3.2.5.2 Hydrological

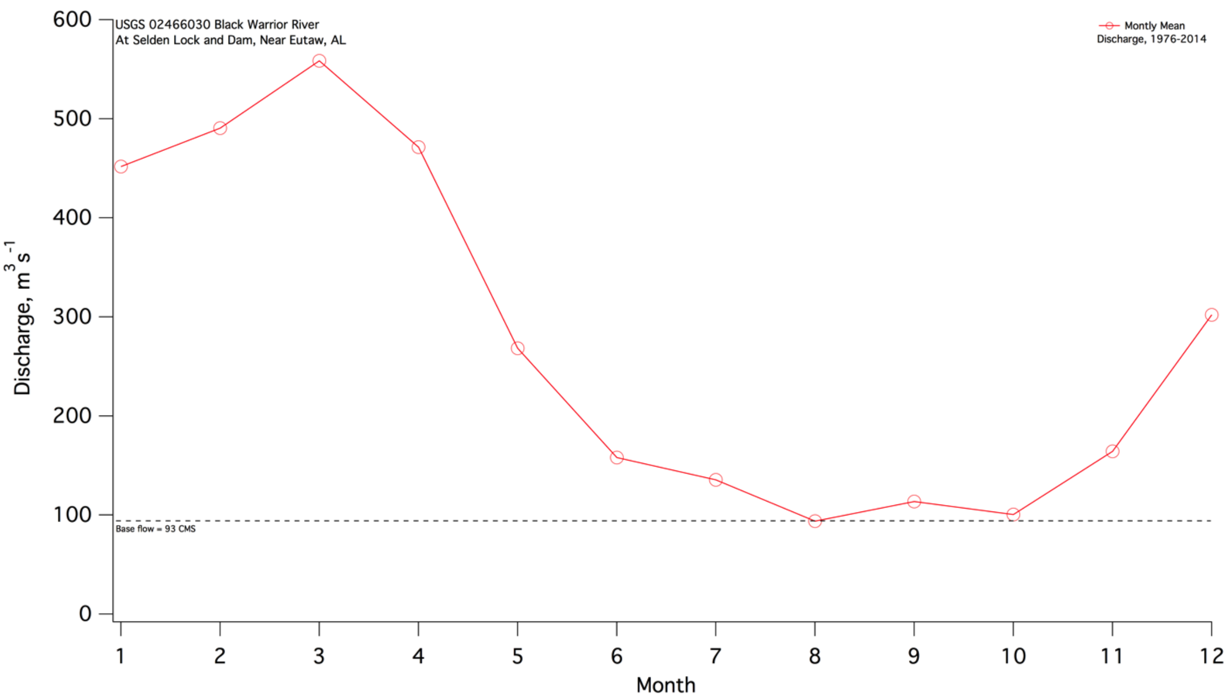

Figure 39. Hydrograph of mean flow from 1976 - 2014 at Selden Lock & Dam.

3.2.6 Riparian Vegetation Cover

During 2013-2016 site visits, the following plant density and type were observed by the AQU team:

Figure 40. The Riparian vegetation at D08 Black Warrior River during spring.

Figure 41. Picture of riparian area during winter.

3.2.7 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.

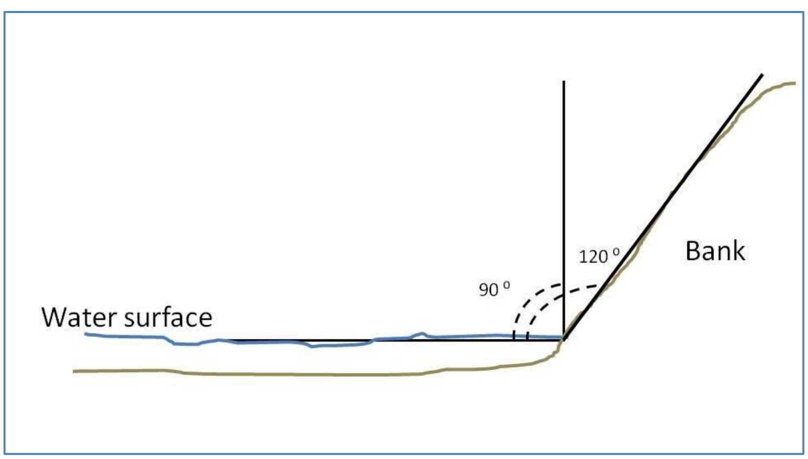

Figure 42. How Bank Angle is Measured

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

Table 12. Bank Conditions At D08 Black Warrior River In 2011

Morphology Type	S1	S2
RB* angle	145	NA
LB* angle	120	NA
Maximum water height	15m	NA
Bankfull width	130m	NA
Substrate composition	Sand, silt, clay	NA

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

Figure 43. Banks are typically shallow approaching the water along the reach.

3.2.8 Site Photos

The following photos of are representative of the site.

Figure 44. The substrate it mostly sand and silt. Rock and riprap have been added by private land owners to limit bank erosion.

Figure 45. Photo of a boat ramp that may be used to access the river.

3.2.9 Site Access Needs

No pathways, boardwalks, stairs, or ladders are needed at D08 Black Warrior River for Science purposes. However for installation and operation NEON will need to use a boat to access the river. The Arcola boat launch is a approximately 5 km upriver from the buoy location.

During construction and operations the buoy may be deployed using this boat launch and then towed using a small boat to and from the deployment location.

3.2.9.1 Science Perspective on Access Needs

Table 13. Public boat launch location

Boat Launch	Latitude	Longitude
Location	32.553551°	-87.782512°

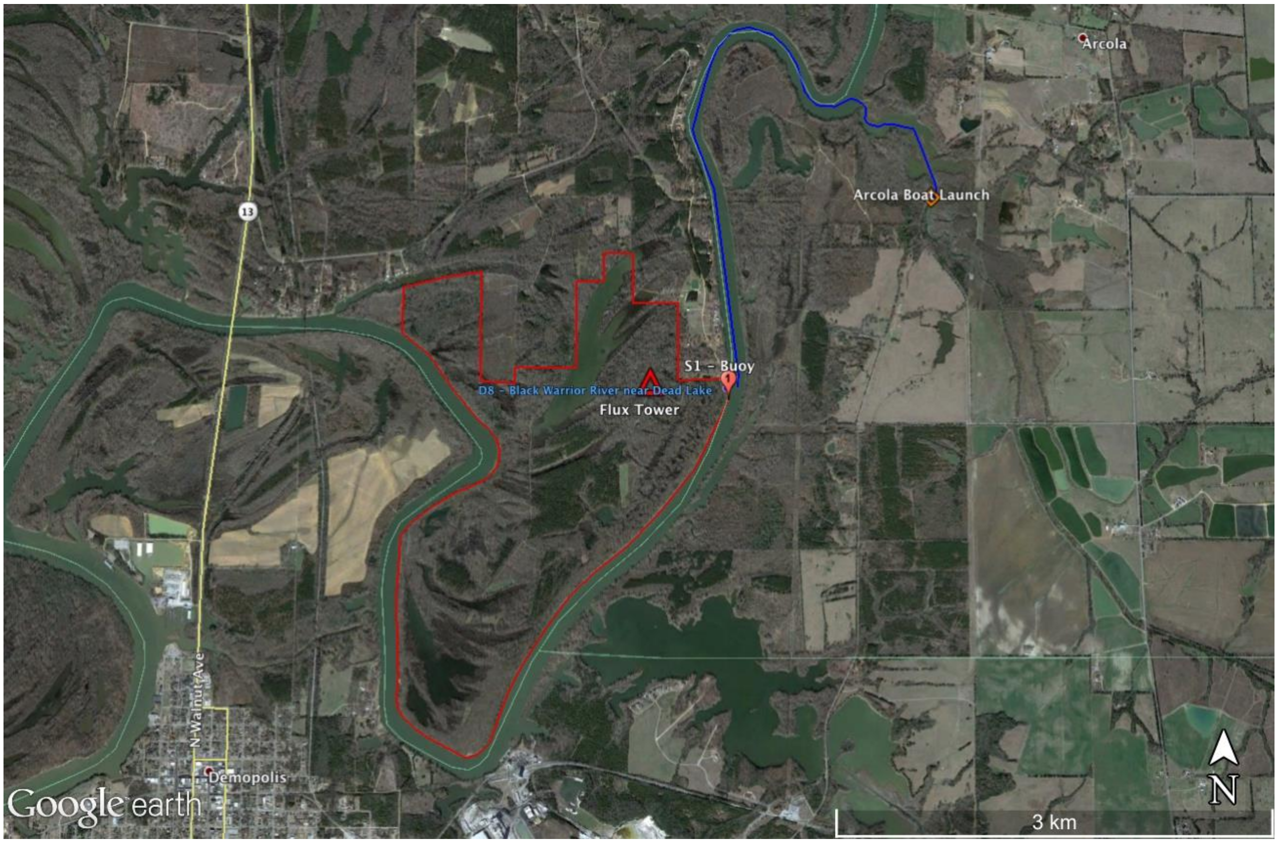

Figure 46. Map showing the location of the Arcola boat launch.

3.2.10 Power at the Site

The local power utility company is Black Warrior Electric.

Contact Info:
1410 Highway 43 S, Demopolis, AL 36732
(334)-289-0845

3.2.11 Site Science Construction Constraints and Limitations

Site-specific issues to consider at D08 Black Warrior River are:

- The land where shore-based infrastructure will be installed is privately owned. Special care needs to be taken in order to minimize construction impacts. All disturbances will need to be completely restored after construction.

- It has been communicated to the land owner that landscaping may be possible in order to obscure the visual impact of the infrastructure. The details of this will be negotiated through the permitting process.

Driving and access constraints for D08 Black Warrior River are:

- The access road to the property is a private drive. Consideration will need to be taken in order to allow access for residents.

3.2.12 Other Issues

No other science issues are identified at this time.

3.3 Lower Tombigbee River

The Lower Tombigbee River site is a non-wadeable stream. This is a navigable river managed by the Army Corps of Engineers and is subject to restrictions on use and the visibility of infrastructure.

This is the third site along the ecohydrological gradient in D08. The Black Warrior flows into the Tombigbee River 11km downstream from the Black Warrior River site (see Section 3.2). The Tombigbee watershed is 3.57 million hectares and spans most of western Alabama. The site is located in the southern extent of the watershed 15km upriver from the Coffeeville lock and dam at Coffeeville.

The Mobile River Basin which includes the Black Warrior and Tombigbee basins (see Figure XX) is subject to major precipitation pulses from tropical storms and hurricanes. These major events will affect nutrient and organic matter flux, sediment transport and biota along the gradient as they propagate downstream.

It is expected that in higher order systems the trophic structure of the stream should move from being based on terrestrial litter, grazers and shredders to more primary productivity and higher trophic structure. This is a key feature of the river continuum theory. The domain design across this ecohydrological gradient focuses specifically on addressing the concepts of this theory.

This is a navigable river managed by the Army Corps of Engineers and is subject to restrictions on use and the visibility of infrastructure. Included in the management of this river system are a series of locks and dams which severely impact flow and the transport of sediment. This has a significant impact on the site design (see Section 3.2 above for details). In addition, the river is impacted by coal fired steam power plants as well as urban and agricultural land use. These features will impact the utility of the domain design to address all of the aspect of the river continuum theory. However the connectivity will allow us to assess the response of the system to large events and long term changes in climate.

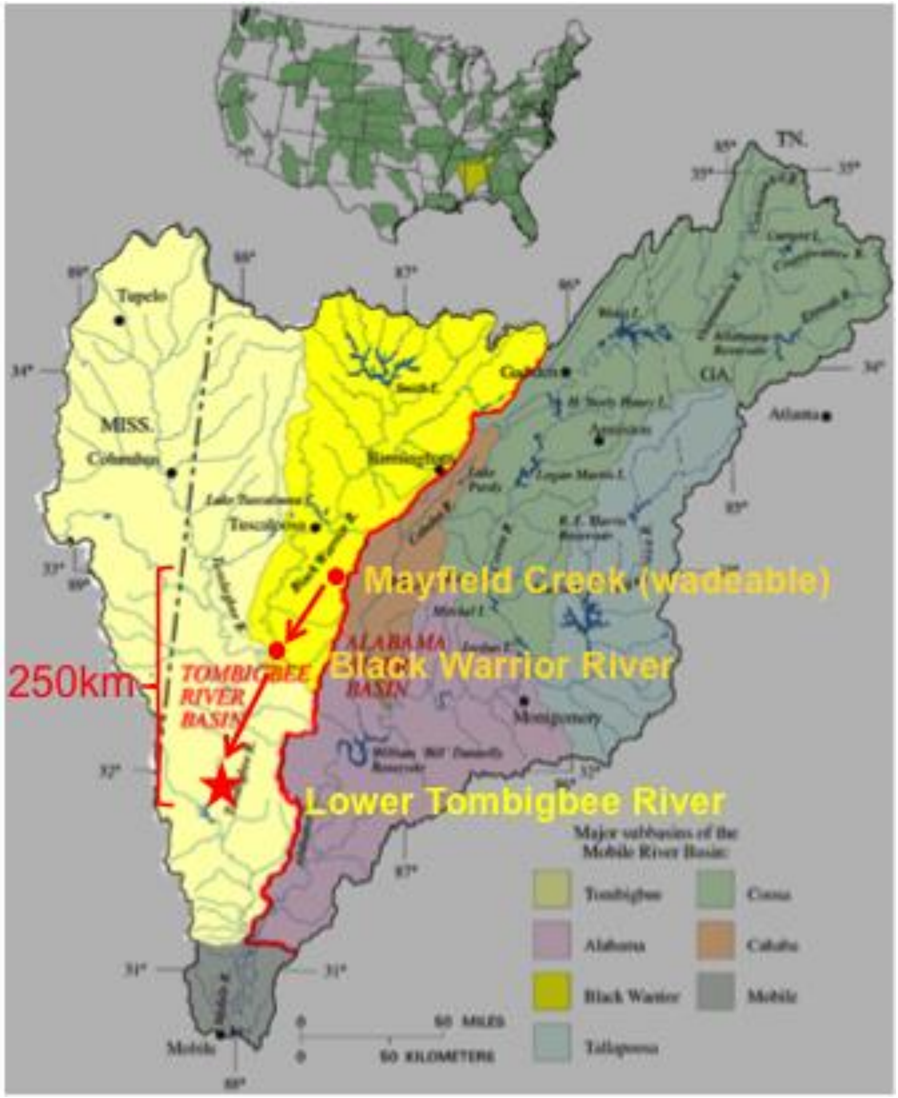

Figure 47. Map showing Tombigbee watershed with site locations along the echohydrological gradient.

3.3.1 Aquatic Auxiliary and Aquatic Portal Locations for Construction

Because of existing permitting constraints with the US Army Corps of Engineers we are seeking to install on shore infrastructure for this site on University of South Alabama land adjacent to the USACE land and the Lenoir Landing TIS site (where the groundwater wells will be located). The Portal will need to be placed next to the river bank with line of site to the buoy and direct line access to the water level gauge. In order to accommodate this, a small patch trees and understory vegetation will need to be cleared. We have met with the land manager and identified the appropriate location with minimal removal. Negotiation of this will this aspect will be handled during permitting.

The initial estimated location for the Aquatic Auxiliary Portal is:

Figure 36 Map showing the location of power pole, the Aquatic and Auxiliary Portal for D08 Lower Tombigbee River, the clearing required (red box) and the conduit run (yellow).

Table 14. Aquatic Auxiliary Portal Location

Aquatic Auxiliary Portal	Latitude	Longitude
Location	31.852139°	-88.161097°

The initial estimated location for the Aquatic Portal is:

Table 15. Aquatic Portal Location

Aquatic Portal	Latitude	Longitude
Location	31.852145°	-88.161108°

It is assumed that the power/comms box and GRAPE for the water level gauge may be mounted on the AUX Portal arbor.

Figure 48. Picture showing the AQU and AUX Portal locations, with clearing area indicated by red box.

3.3.2 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.

Because of the sensitive permitting situation and the pursuit of NEON to install shore-based infrastructure on private land, NEON SCI has elected to waive the requirement for local micrometeorological measurements. This is justified by the inclusion of meteorological measurements on the buoy itself and the proximity to the TIS Lenoir Landing tower.

The sensor sets and infrastructure needed for the proposed site includes: a profiling buoy supporting surface water and micrometeorological measurements and a pressure sensor to measure water level placed in a static position below the annual mean low water level.

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

Table 16. Sensor 1 & Sensor 2 Locations

Sensor	Latitude	Longitude
S1	31.851841°	-88.160937°
S2	NA	NA

Table 17. Micromet & Discharge Sensor Locations

Sensor	Latitude	Longitude
Micromet	NA	NA
Level Gauge	31.852096°	-88.161065°

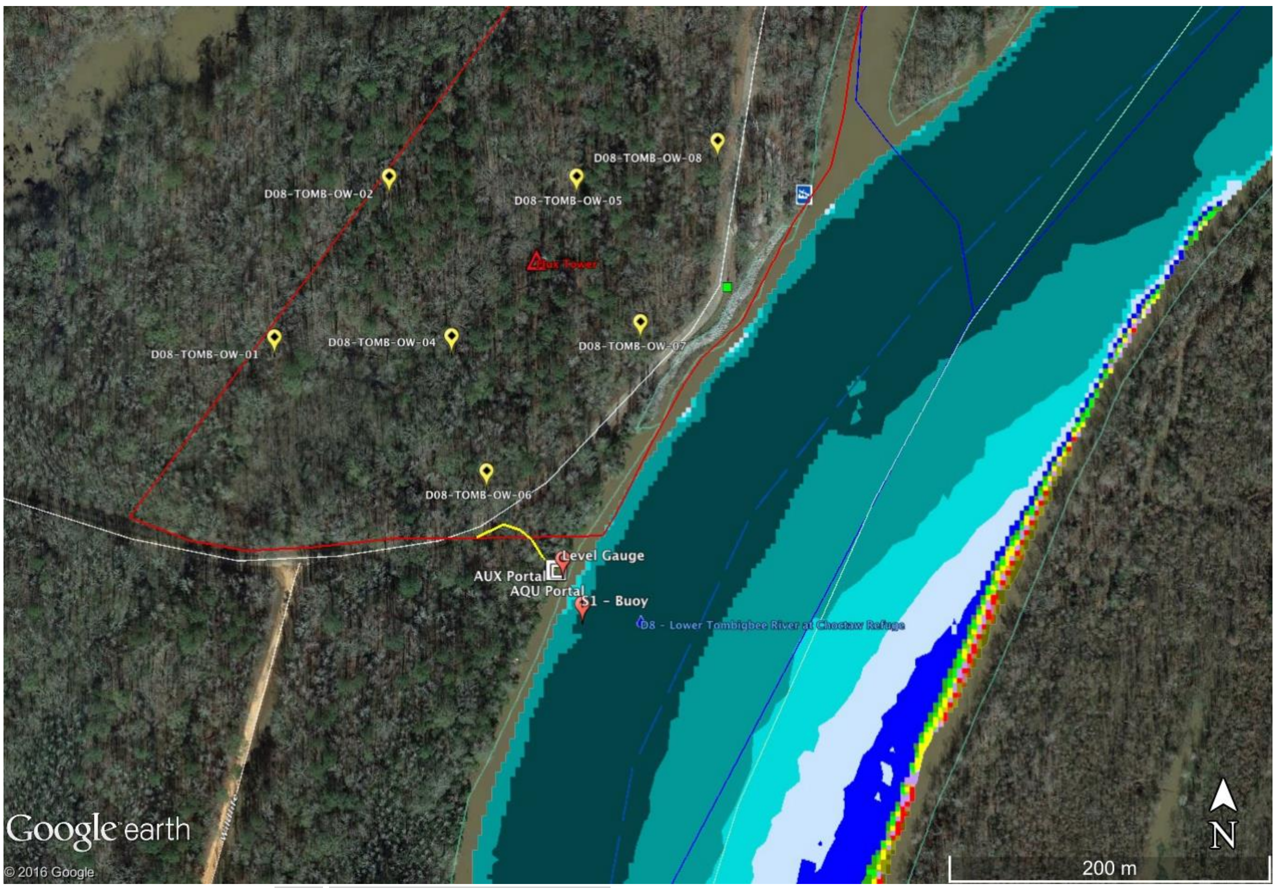

Figure 38 Kmz File of D08 Lower Tombigbee River Denoting Locations of S1 and the level gauge with the bathymetry.

Figure 49. View of buoy location from the Portal location.

Figure 39 Upriver view from S1 Location at D08 Lower Tombigbee River

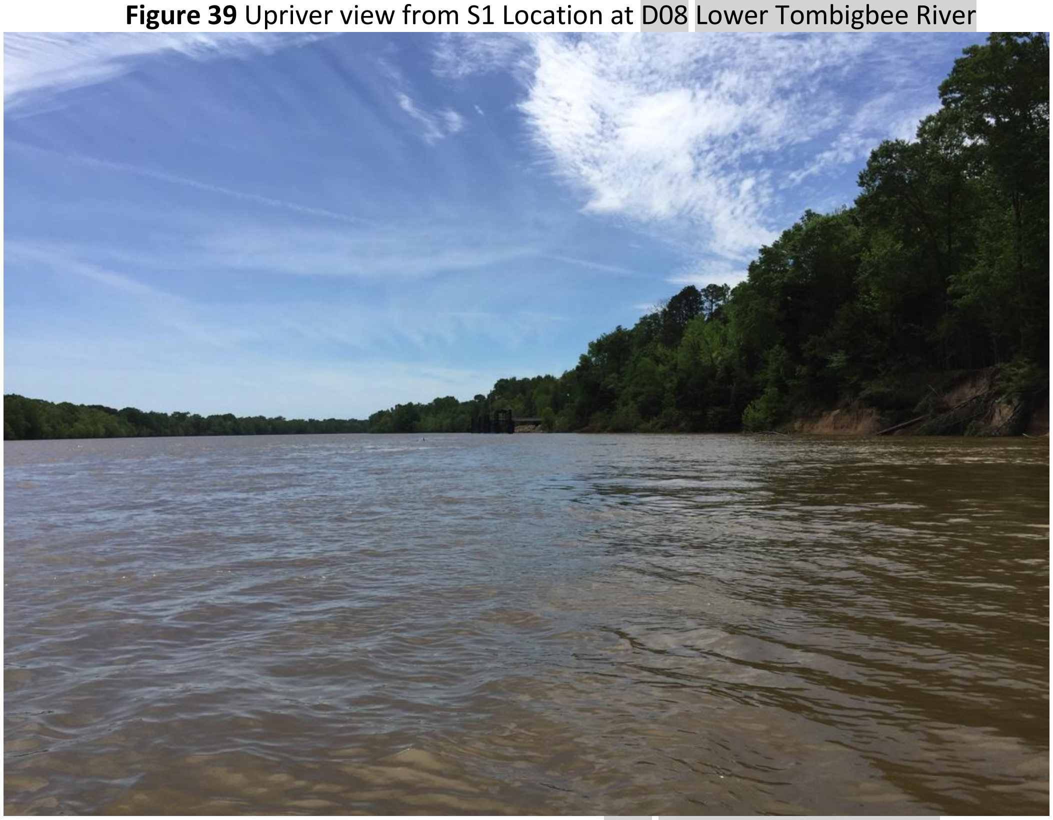

Figure 40 Downriver view from S1 at D08 Lower Tombigbee River

Figure 41 Photo level gauge location and right bank from S1 location at D08 Lower Tombigbee River

3.3.3 Groundwater Wells

The groundwater observation wells network at the site will consist of 8 wells installed using a direct-push rig (i.e. Geoprobe). The well network extends west from the right bank along the S1 location throughout the USACE land for the Dead Lake TIS site. Topography at the site is predominately flat with shallow depressions. The area is forested with thick understory. Some downed trees and small understory vegetation may need to be either cut and/or moved to accommodate the rig access path. The estimated drilling depth is about 40 feet for all wells. Access to the well locations will be via overland through the forest. Rig access to the well locations is anticipated to be relatively straightforward and a defined rig path for drilling purposes will be walked and defined prior to work at the site. The exact location of the wells may need to change slightly if the rig is unable to reach the desired locations due to the presence of downed trees, thick underbrush, or seasonal boggy regions.

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 Alabama 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 from a depth of 2 feet below land surface to the top of land surface. No details are provided as to the lateral 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.

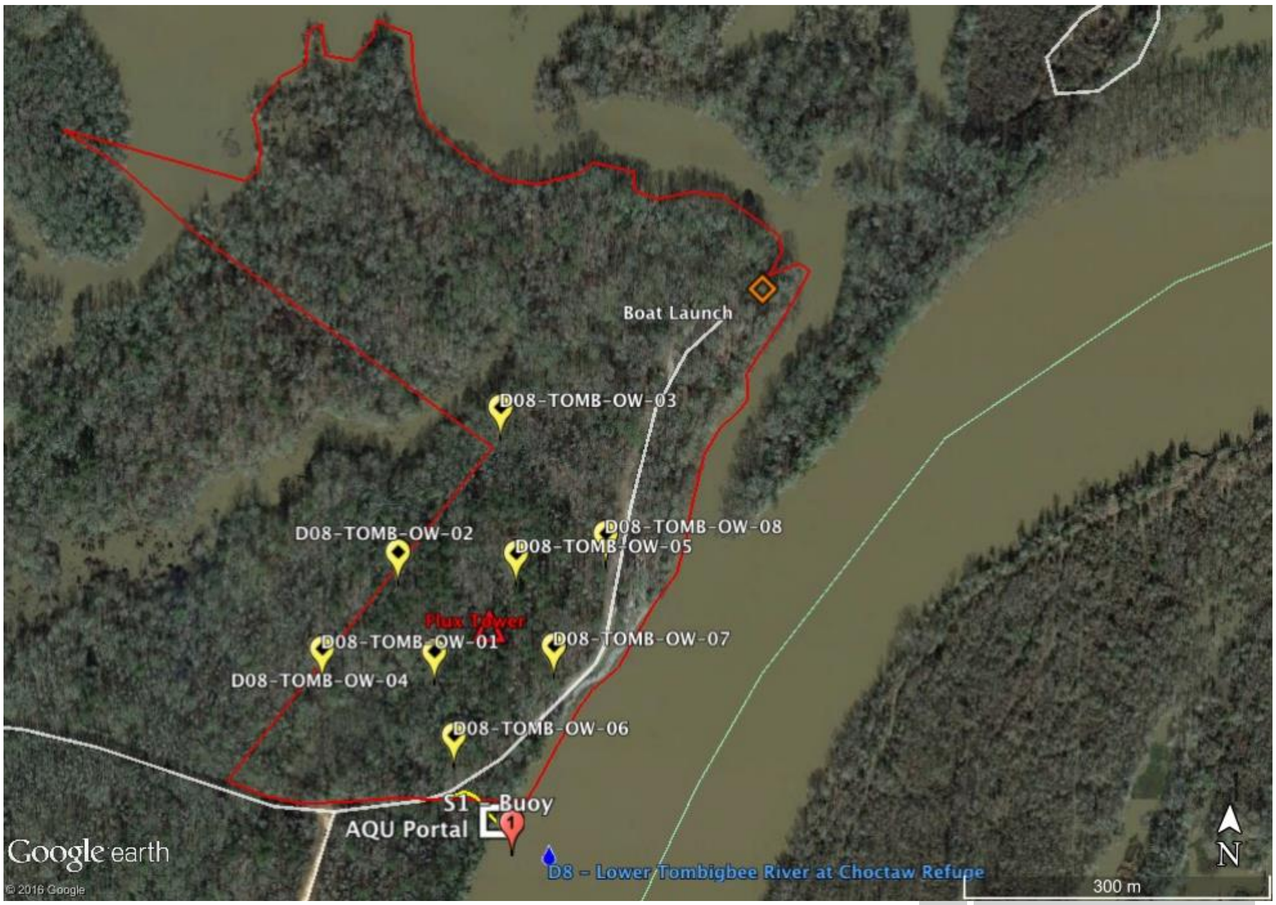

Figure 43 Initial Groundwater Well Locations Based on EMS kmz File at D08 Lower Tombigbee River

Table 18. Groundwater well locations.

Groundwater Well ID	Latitude	Longitude
D08-BLWA-OW-01		
D08-BLWA-OW-02		
D08-BLWA-OW-03		
D08-BLWA-OW-04		
D08-BLWA-OW-05		

D08-BLWA-OW-06		
D08-BLWA-OW-07		
D08-BLWA-OW-08		

3.3.4 Stream Reach Characterization

Initial characterization efforts were deployed in summer of 2013 and included a moored buoy similar to that deployed in the Black Warrior River (see Section XX above). However the buoy was lost and no data was recovered. The system is similar to, albeit larger than, the Black Warrior; therefore, the data illustrating the daily to seasonal spatiotemporal variability in the Black Warrior are used as proxy for this site. We propose that the design for the Tombigbee match that of the Black Warrior River.

3.3.5 Riparian Vegetation Cover

During 2010-2011 site visits, the following plant density and type were observed by the AQU team:

Figure 44 The Riparian Canopy at D08 Lower Tombigbee River

3.3.6 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.

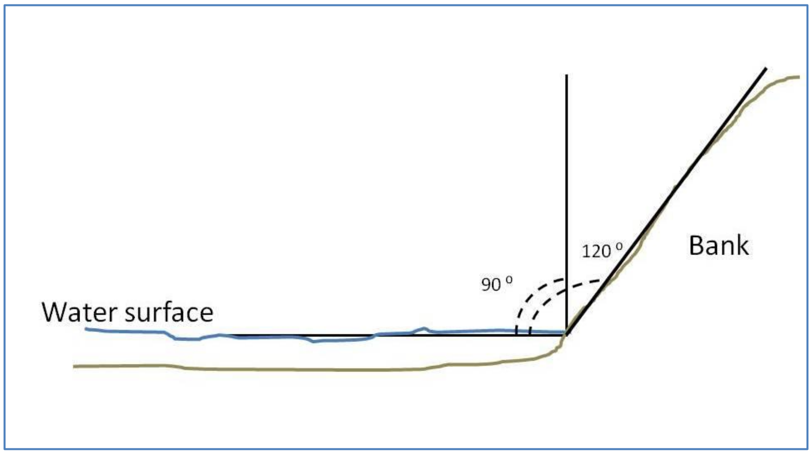

Figure 46 How Bank Angle is Measured

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

Table 19. Bank Conditions At D08 Lower Tombigbee River In 2011

Morphology Type	S1	S2
RB* angle	90 (undercut)	NA
LB* angle	110	NA
Maximum water height	20m	NA
Bankfull width	270m	NA
Substrate composition	Sand, silt	NA

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

Figure 50. Picture of right bank under portal location with Dan as reference. Estimate height to portal location is approximately 5 m.

Figure 47 Photo of typical bank structure along reach. Steep eroding banks ranging 2-7 m in height.

3.3.7 Site Photos

The following photos of are representative of the site.

Figure 47 Substrate in D08 Lower Tombigbee River are mostly sand and silt.

Figure 48 US Coast Guard buoys frequently wash up at the Hunt Refinery dock 500m downriver.

3.3.8 Historical Data

3.3.8.1 Climate Data

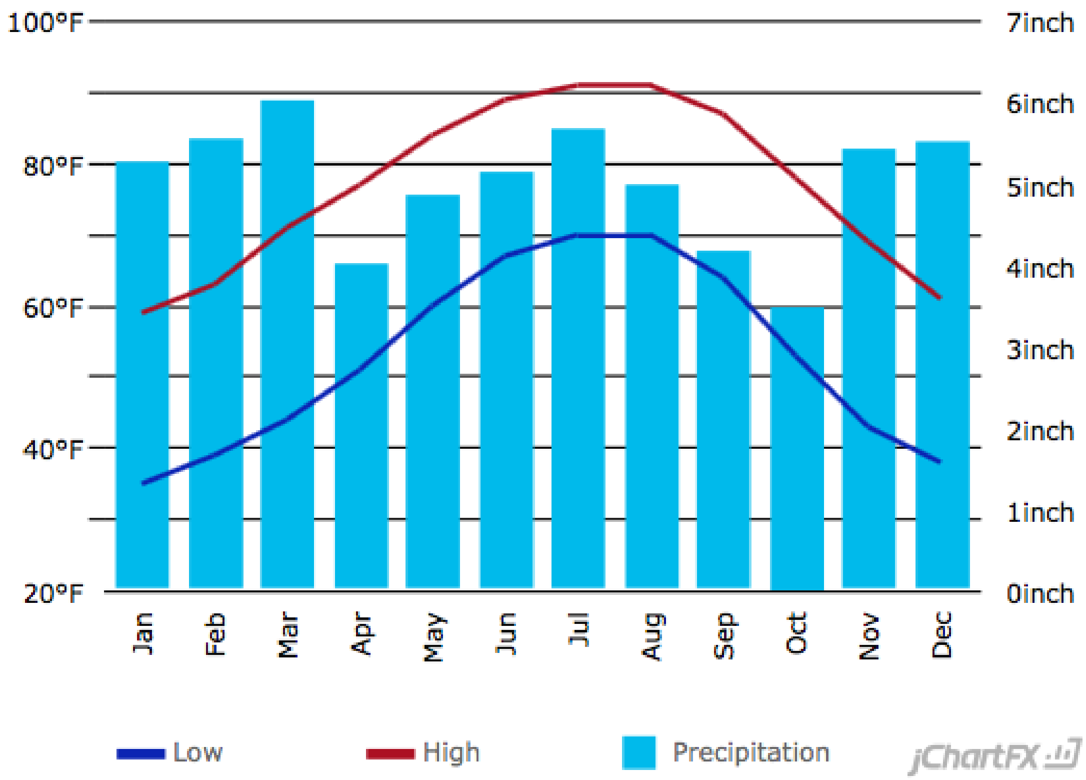

Figure 51. Mean climate data from Jackson, Alabama.

3.3.8.2 Hydrological Data

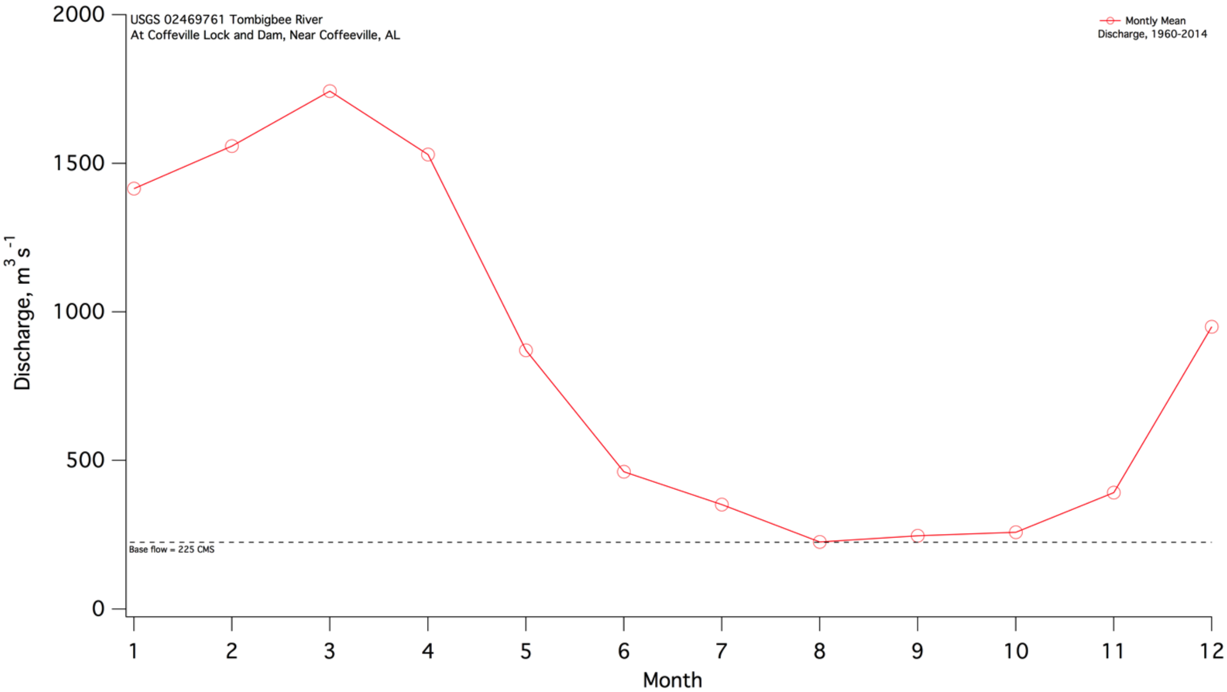

Figure 52 Hydrograph of mean flow from 1960-2014 taken at the Coffeeville Lock & Dam.

3.3.9 Site Access Needs

An unimproved access pathway will be needed during construction and for operations at D08 Lower Tombigbee River for both construction and Science purposes. This will follow the conduit run which is expected to be trenched out to the portal at this site.

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

Table 20. Pathway Location

Pathway	Latitude	Longitude
Start	31.852408°	-88.161452°
End	31.852145°	-88.161108°

Figure 53. Map showing access path (starting at green diamond) and continuing with conduit run (yellow) to portal location.

Table 21. Location of Lenoir Landing boat launch, 730 m from buoy location.

Boat Launch	**Latitude**	**Longitude**
Location	31.856911°	-88.158459°

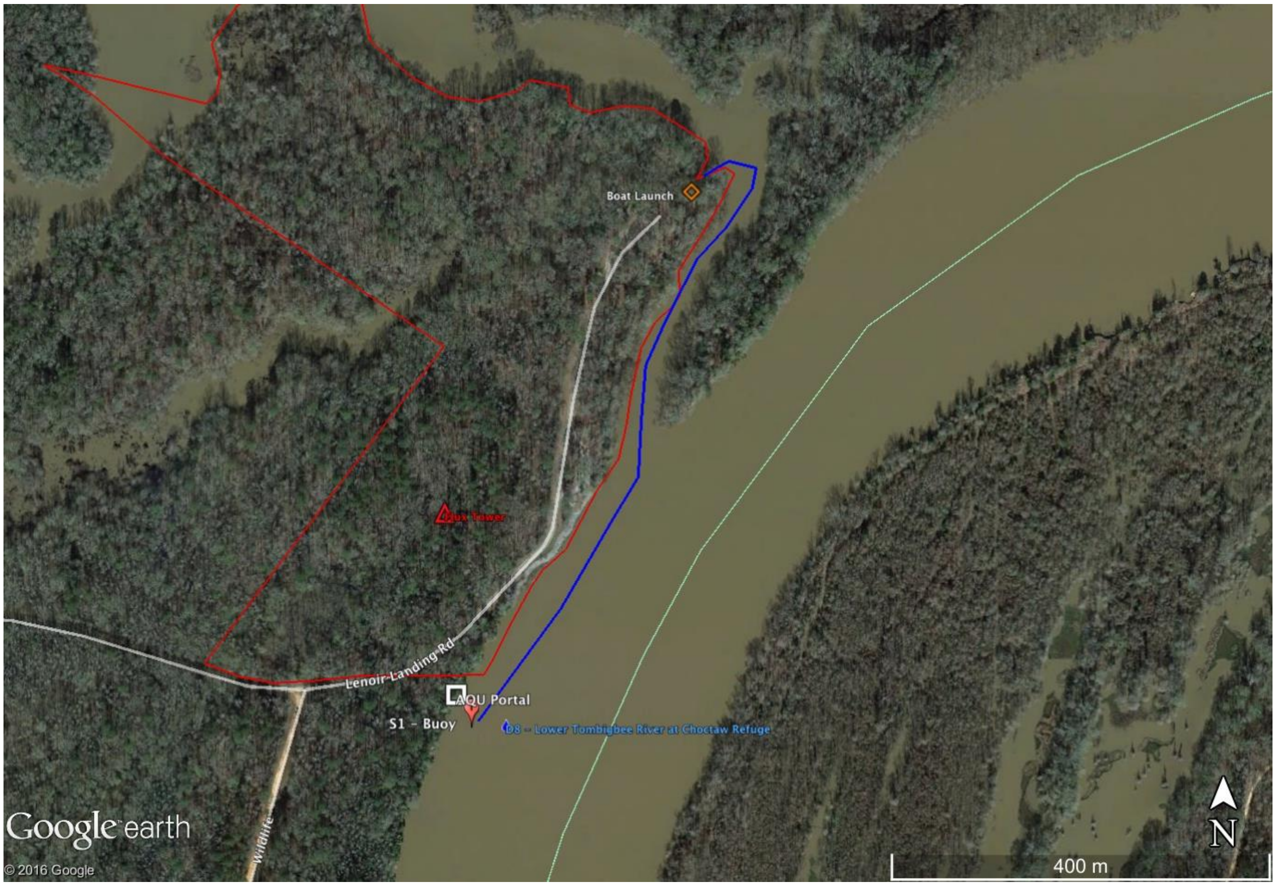

Figure 54. Map showing location of boat launch at Lenoir Landing approximately 730m upriver from S1 location.

3.3.10 Power at the Site

The local power utility company is Black Warrior Electric.

Contact Info:
1410 Highway 43 S, Demopolis, AL 36732
(334)-289-0845

3.3.11 Site Science Construction Constraints and Limitations

Site-specific issues to consider at D08 Lower Tombigbee River are:

- None

Driving and access constraints for D08 Lower Tombigbee River are:

- There are no driving constraints. Paved access roads lead to the power pole and access path location. Flooding may block access road at times and special attention should be paid to the timing of construction and operation activities with this regard.

3.3.12 Other Issues

No other science issues are identified at this time.

4 APPENDIX A. FCC SUMMARY TABLES FOR AIS SITE COMPONENTS AT D08

4.1 Mayfield Creek FCC Summary Table

Site Component	Latitude	Longitude	Units
Stream, Lake, or River	Stream		Description
Aquatic Auxiliary Power Portal location	32.964936	-87.408755	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	Site1-PathStartLat	Site1-PathStartLong	Lat, Long in degrees
Pathway end location	Site1-PathEndLat	Site1-PathEndLong	Lat, Long in degrees
Stairs or ladder needed?			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?			Yes/no, description w/ length
Boardwalk start location	Site1-BrdwlkStartLat	Site1-BrdwlkStartLong	Lat, Long in degrees
Boardwalk end location	Site1-BrdwlkEndLat	Site1-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

4.2 Black Warrior River FCC Summary Table

Site Component	Latitude	Longitude	Units
Stream, Lake, or River	River		Description
Aquatic Auxiliary Power Portal location	32.542581°	-87.798693°	Lat, Long in degrees
Aquatic Portal location			m away from bank, direction
Pathway needed? What is length?	NA		Yes/no, description w/ length
Boat Launch location	32.553551°	-87.782512°	Lat, Long in degrees
Stairs or ladder needed?	NA		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?	NA		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?	NA		Yes/no, description
Fencing needs	NA		Description
Site management	May require landscaping for private landowner to obscure visual impacts from nearshore infrastructure		Description
Any additional site specific information			Description

4.3 Lower Tombigbee River FCC Summary Table

Site Component	**Latitude**	**Longitude**	**Units**
Stream, Lake, or River	River		Description
Aquatic Auxiliary Power Portal location	31.852139°	-88.161097°	Lat, Long in degrees
Aquatic Portal location	31.852145°	-88.161108°	m away from bank, direction
Pathway needed? What is length?	Yes, 45m unimproved access path		Yes/no, description w/ length
Pathway start location	31.852408°	-88.161452°	Lat, Long in degrees
Pathway end location	31.852145°	-88.161108°	Lat, Long in degrees
Stairs or ladder needed?	No		Yes/no, description
Stairs top location	Site3-StairsTopLat	Site3-StairsTopLong	Lat, Long in degrees
Stairs length	Site3-StairsLength		Meters
Boat Launch location	31.856911°	-88.158459°	Lat, Long in degrees
Boardwalk needed? What is length?	No		Yes/no, description w/ length
Boardwalk start location	Site3-BrdwlkStartLat	Site3-BrdwlkStartLong	Lat, Long in degrees
Boardwalk end location	Site3-BrdwlkEndLat	Site3-BrdwlkEndLong	Lat, Long in degrees
Shall stairs, boardwalk be installed during construction?	No		Yes/no, description
Fencing needs	None		Description
Site management	Forest managemed by University of South Alabama (Mobile, AL)		Description
Any additional site specific information			Description

5 APPENDIX B. EHS SUMMARY TABLES FOR AIS SITE COMPONENTS AT D08

5.1 Mayfield Creek EHS Summary Table

Site Component	Latitude	Longitude	Units
S1 location	32.960426°	-87.407865°	
S2 location	32.961673°	-87.408134°	Lat, Long in degrees
Micromet Station location	32.96177584	-87.408189	Lat, Long in degrees
Staff Gauge			Lat, Long in degrees
Camera			Lat, Long in degrees
Aquatic Auxiliary Power Portal location	32.964936°	-87.408755°	Lat, Long in degrees
Aquatic Portal location	32.964936°	-87.408755°	Lat, Long in degrees

5.2 Black Warrior River EHS Summary Table

Site Component	Latitude	Longitude	Units
Buoy (S1) location	32.540673°	-87.798062°	Lat, Long in degrees
Level Gauge	32.542622°	-87.798018°	Lat, Long in degrees
Level Gauge FDP	32.542570°	-87.798093°	Lat, Long in degrees
Micromet Station location	NA	NA	Lat, Long in degrees
Met Station FDP	NA	NA	Lat, Long in degrees
Staff Gauge	NA	NA	Lat, Long in degrees
Camera	NA	NA	Lat, Long in degrees
Aquatic Auxiliary Power Portal location	32.542581°	-87.798693°	Lat, Long in degrees
Aquatic Portal location	32.542581°	-87.798693°	Lat, Long in degrees

5.3 Lower Tombigbee River EHS Summary Table

Site Component	Latitude	Longitude	Units
Buoy (S1) location	31.851841°	-88.160937°	Lat, Long in degrees
Level Gauge	31.852096°	-88.161065°	Lat, Long in degrees
Level Gauge FDP	31.852139°	-88.161097°	Lat, Long in degrees
Micromet Station location	NA	NA	Lat, Long in degrees
Met Station FDP	NA	NA	Lat, Long in degrees
Staff Gauge	NA	NA	Lat, Long in degrees
Camera	31.852139°	-88.161097°	Lat, Long in degrees
Aquatic Auxiliary Power Portal location	31.852139°	-88.161097°	Lat, Long in degrees
Aquatic Portal location	31.852145°	-88.161108°	Lat, Long in degrees

6 APPENDIX B. DESCOPED SITES (STREON)

6.1 Mayfield Creek (STR)

See section 3.1 for a site description for Mayfield Creek (STR). This section describes infrastructure and characteristics specific to the STREON reach of Mayfield Creek. This reach is located downstream of the Aquatic reach.

6.1.1 Aquatic Auxiliary and Aquatic Portal Locations for Construction

The initial estimated location for the Aquatic Auxiliary Portal is:

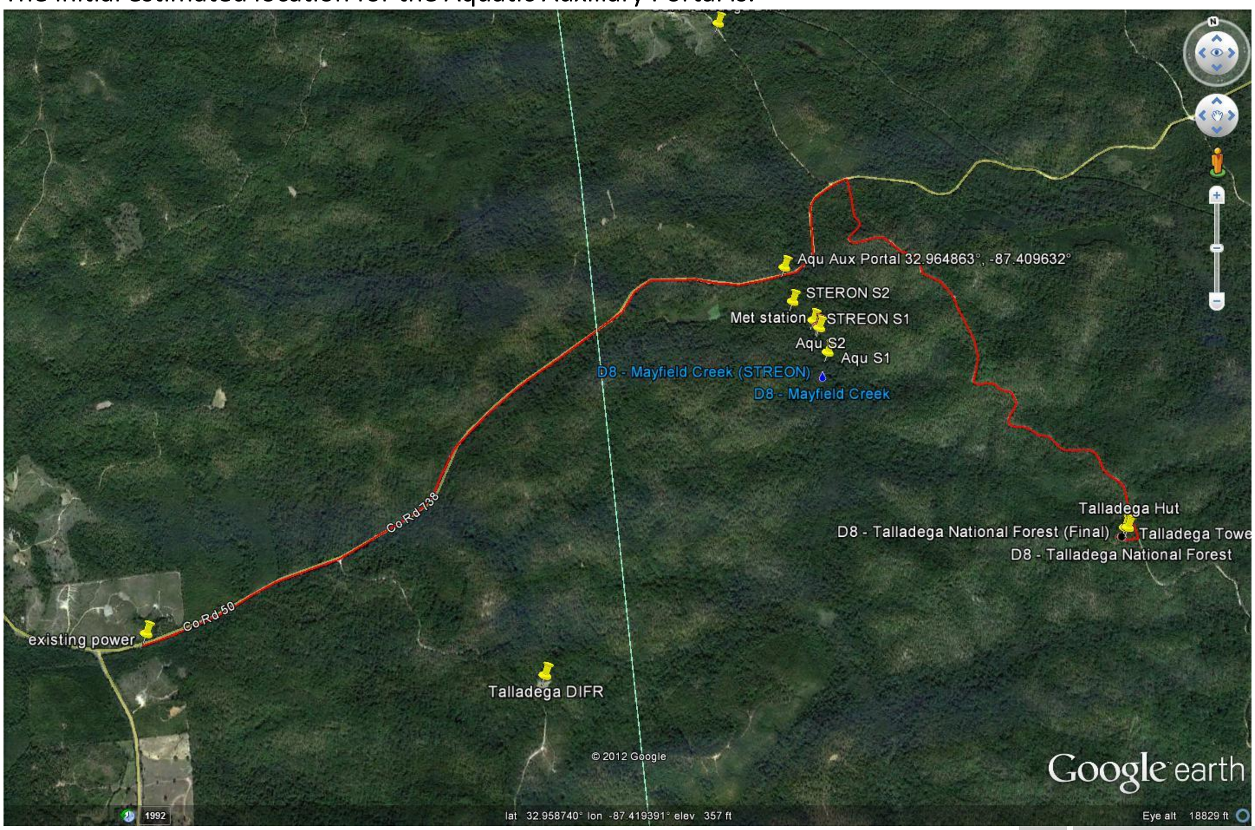

Figure 53 A Google-Earth-Derived Image of Aquatic Auxiliary Portal for D08 Mayfield Creek (STR)

Table 29 Aquatic Auxiliary Portal Location

Aquatic Auxiliary Portal	Latitude	Longitude
Location	32.964936	-87.408755

The initial estimated location for the Aquatic Portal is:

Table 30 Aquatic Portal Location

Aquatic Portal	Latitude	Longitude
Location	32.964936	-87.408755

6.1.2 Sensor Locations for Construction

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

Satellite coverage at Mayfield Creek (STR) during site characterization likely produced reasonable estimates of sensor locations. Additionally, a small but perennial tributary enters into Mayfield Creek (STR) from the west and the distance from this tributary to the sensor locations were also recorded to verify coordinates.

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

Table 31 Sensor locations for Mayfield Creek (STR).

Sensor	Latitude	Longitude
S1	32.96207411	-87.40840885
S2	32.96312813	-87.40942686

The above S1 and S2 sensors locations are *212 and 22 m upstream from the west-entering tributary*, respectively. The total STREON stream reach is about 190m in length.

Sensors associated with discharge calculations may be co-located with either S1 or S2 sensor. The STREON hut may be co-located with the STR S1 sensor. Only one nutrient addition station is required at Mayfield Creek (STR).

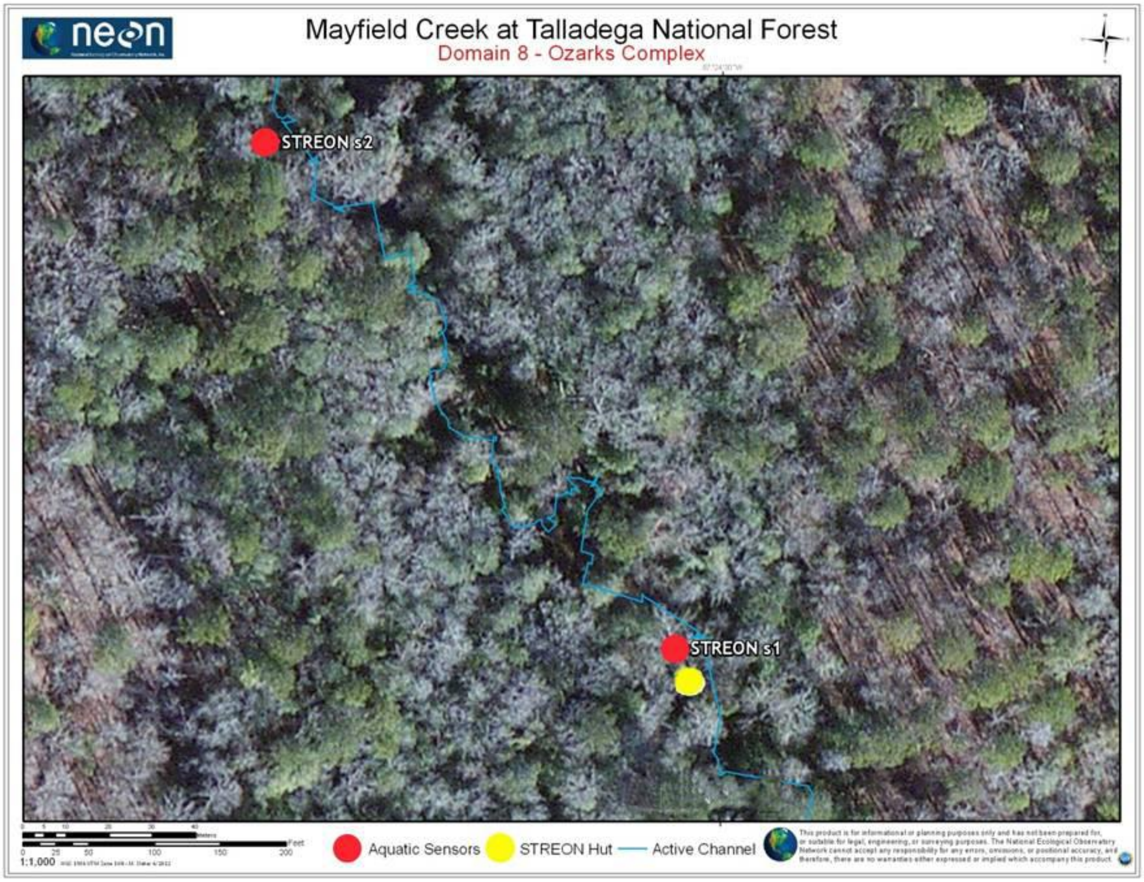

Figure 54 Map of Mayfield Creek (STR) denoting locations of S1, S2, and hut/nutrient addition station.

Figure 55 S1 location at D08 Mayfield Creek (STR). Perspective is facing upstream.

Figure 56 S2 location at D08 Mayfield Creek (STR). Perspective is facing downstream.

Figure 57 Micrometeorology station and STREON hut location at D08 Mayfield Creek (STR).

Figure 58 Typically, at least one bank steeply rises ~2 m from the channel to the floodplain. Shown here is the right bank of the Mayfield Creek (STR) S1 location.

6.1.3 Groundwater Wells

Refer to Section 3.1.3 for groundwater well information.

6.1.4 Riparian Vegetation Cover

See section 3.1.4 for a description of Mayfield Creek (STR) vegetation.

6.1.5 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.

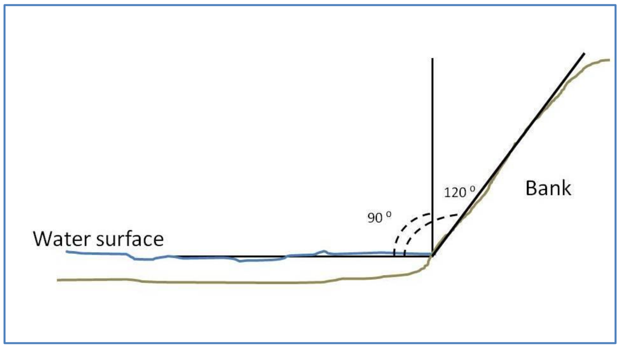

Figure 64 How Bank Angle is Measured

During 2012 site visits, AQU observed the following bank attributes at S1 and S2:

Table 33 Bank attributes at D08 Mayfield Creek (STR) sensor locations.

Morphology Type	S1	S2
RB* angle	110	110
LB* angle	120	100
Maximum water height	2.4 m (from channel thalweg to top of left bank)	1.6 m (from channel thalweg to top of right bank)
Bankfull width	7.5 m	6.7 m
Substrate composition	Sand	sand

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

Figure 59 Some banks are more gently-sloping, though access to any sensor location should be facilitated by a small ladder or stairway. Shown here is the S2 sensor location.

6.1.6 Site Photos

The following photos of are representative of the site.

Figure 60 During moderate to large flood events, large woody debris that may pose a threat to sensor installations likely ensue.

Figure 61 Though the banks and channel of Mayfield Creek (STR) consists of sand, under normal conditions the substrate is compacted and easy to traverse. However, after a large storm event, the substrate becomes relatively unconsolidated and wading the channel will prove difficult.

Figure 62 The Mayfield Creek (STR) channel features an abundance of vegetation and woody debris snags. Disturbance to these structures during construction and maintenance should be minimized. Shown here is the S1 sensor location.

Figure 63 Steep banks ~2 m tall will likely require the installation of a small ladder or stairway to facilitate access to sensors.

6.1.7 Site Access Needs

Refer to Section 3.1.7 for information on site access needs. . FCC will use the East sitde of the creek for the power and access route to the site.

6.1.8 Power at the Site

The local power utility company is:
Black Warrior Coop
Paul Oglesby
334-624-8665.

6.1.9 Site Science Construction Constraints and Limitations

Site-specific issues to consider at D08 Mayfield Creek (STR) are:

- Construction activities should take care to minimize disturbances to channel banks, which consist of packed sand stabilized by roots. Heavy equipment should remain away from the bank to prevent mass failure.
- Sensor installation and routine maintenance should not involve the removal or destruction of large woody debris dams in the channel of Mayfield Creek (STR).
- Up to five species of venomous snakes are found in the Mayfield Creek (STR) vicinity. During site characterization in April 2012, multiple snakes were encountered hanging from riparian trees and adjacent to wetland areas. Personnel should conduct field operations with appropriate protective gear and Emergency Action Plan.
- Please refer to section 3.1.9 for details

Driving and access constraints for D08 Mayfield Creek (STR) are:

- Access to sensor locations at Mayfield Creek (STR) will require the development of a footpath along either side of the stream channel. The footpath route must avoid perennial or ephemeral riparian wetlands. The footpath may be routed on either side of the stream channel; however, a path on the western side Mayfield Creek (STR) would require the construction of a small bridge over a tributary.
- Due to the instability of bank substrates, small ladders or stairways may need to be installed to provide access from the top of the bank to the sensors. From a safety perspective ladders or stairways would require normal construction standards and wood treatment if left on creek permanently or for temp ladders, would need to extend above bank 36” and be secured during access/egress
- Please refer to section 3.1.9 for details.

6.1.10 Other Issues

No other science issues are identified at this time.