# Domain 11 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 | 12/18/2014 | ECO-02255 | Initial release |
| B | 04/28/2016 | ECO-03784 | Blue River details and content added |
| | | | |
| | | | |

**TABLE OF CONTENTS**

**LIST OF TABLES**

**LIST OF FIGURES**

# 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 Domain 11 aquatic locations: Pringle Creek (core), Blue River (relocatable). Details for South Pond Klemme (relocatable) have been moved to Appendix D since this site is no longer considered for construction under the current scope of the project. 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] | none |
| 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 External References

| | |
| --- | --- |
| ER [01] | none |
| ER [02] | |
| ER [03] | |

# 3 DOMAIN 11 AIS SITE CHARACTERIZATION REPORT

## 3.1 Pringle Creek

Pringle Creek is a deeply incised stream, typical of the central plains. The streambed and banks consist of some bedrock, but is mostly sand and gravel. Banks are eroded in many areas, and covered in grasses, hardwood, and evergreen vegetation. The stream is mostly an open-canopy stream, but does have several areas of shading by riparian vegetation. Lots of surface and benthic algae grow in the stream. The stream is mostly pool and run, with one riffle section. Pools are deep and should provide ample depth for sensors when steam is not dry. The stream has been dry given the recent drought in the Midwest.

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

The initial estimated location for the Aquatic Auxiliary Portal is:

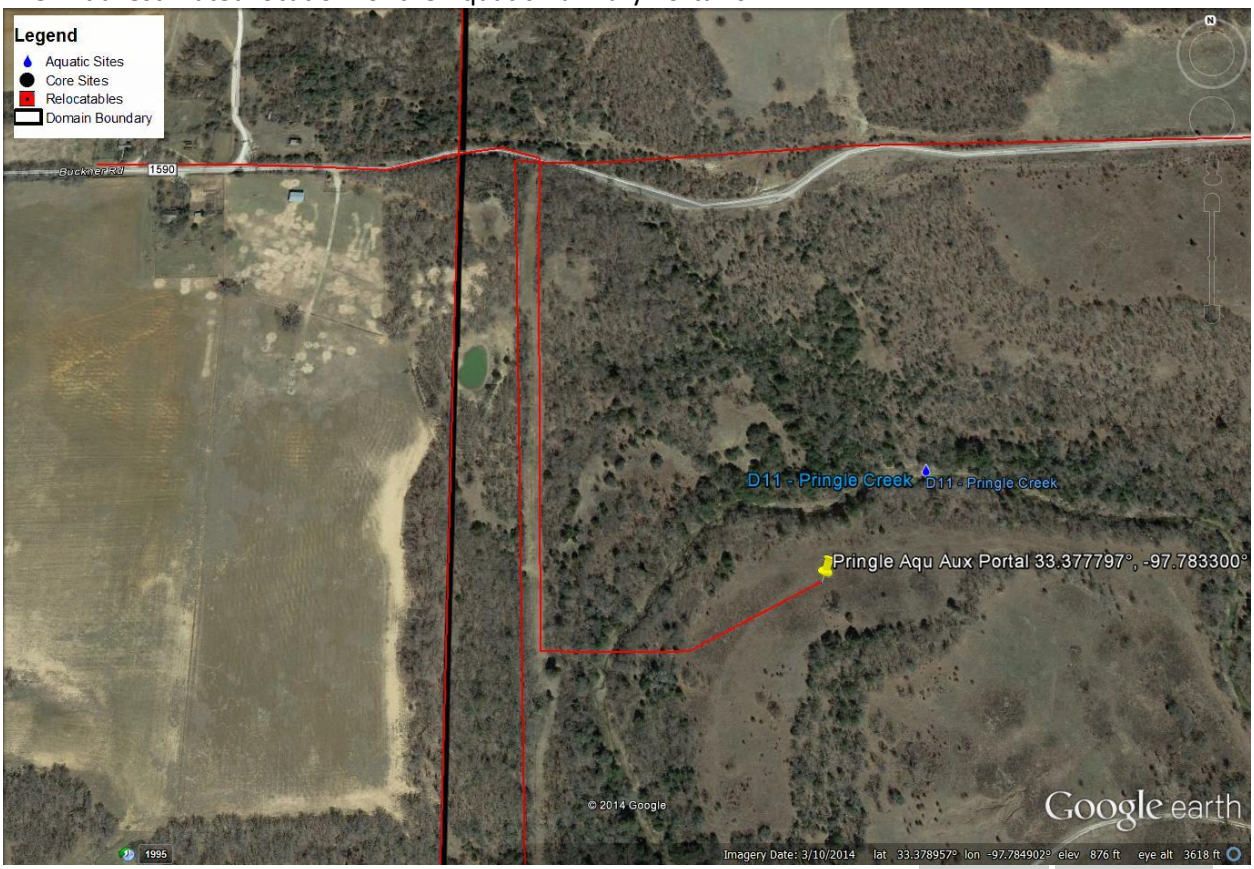


Figure 1 A Google-Earth-Derived Image of Aquatic Auxiliary Portal for Domain 11 Pringle Creek

Table 1 Aquatic Auxiliary Portal Location

| Aquatic Auxiliary Portal | Latitude | Longitude |
|---|---|---|
| Location | 33.377797° | -97.783300° |

The initial estimated location for the Aquatic Portal is collocated with the Aquatic Auxiliary Portal (Table 2).

Table 2 Aquatic Portal Location

| Aquatic Portal | Latitude | Longitude |
| --- | --- | --- |
| Location | 33.377797° | -97.783300° |

### 3.1.2 Sensor Locations for Construction

AQU, with support from EHS, has the following field GPS coordinates for S1, S2, Micromet station and precipitation sensor (where applicable) 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.

Personnel access and electrical resources will be on the right bank at all sensor locations. Where locations coincide with a high vertical bank, an access stairs will be required.

S2 is located approximately 430m upstream from where the current access (Forest Service) road passes through the stream. S1 is approximately 200m upstream from S2. A tributary enters the reach approximately 80m downstream from S1.

The field to the south of the stream reach provides the ideal location for the suite of meteorological sensors including the AQU Micromet Station, a Primary Precipitation Sensor Assembly (DFIR) and a Wet Deposition Collector (NADP). This site is listed as grazing land and will need protection for field-based NEON infrastructure and sensors. A cattle fence shall enclose all field based sensor assemblies, their associated infrastructure and device posts (power/comms boxes). Cattle fences shall be constructed per AQU requirements.

Figure 1 shows a map of the Pringle Creek site with the locations of all sensor sets. Figure 2 shows the fence dimensions for field based sensors.

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

Table 3 Sensors 1 and 2 locations.

| Sensor | Latitude | Longitude |
| --- | --- | --- |
| S1 | 33.378403 | -97.783671 |
| S2 | 33.378470 | -97.781502 |

Table 4 Micromet and Precipitation sensor locations.

| Sensor | Latitude | Longitude |
| --- | --- | --- |
| Micromet | 33.377200 | -97.781783 |
| Primary Precipitation (DFIR) | 33.377200 | -97.781566 |
| Wet Deposition Collector(NADP) | 33.377252 | -97.781659 |
| Micromet Field Device Post (FDP) | 33.377255 | -97.781783 |
| Precip. Field Devise Post (FDP) | 33.377252 | -97.781603 |

The pressure transducer, staff gauge and digital camera for determining discharge should be co-located with the S2 sensor.

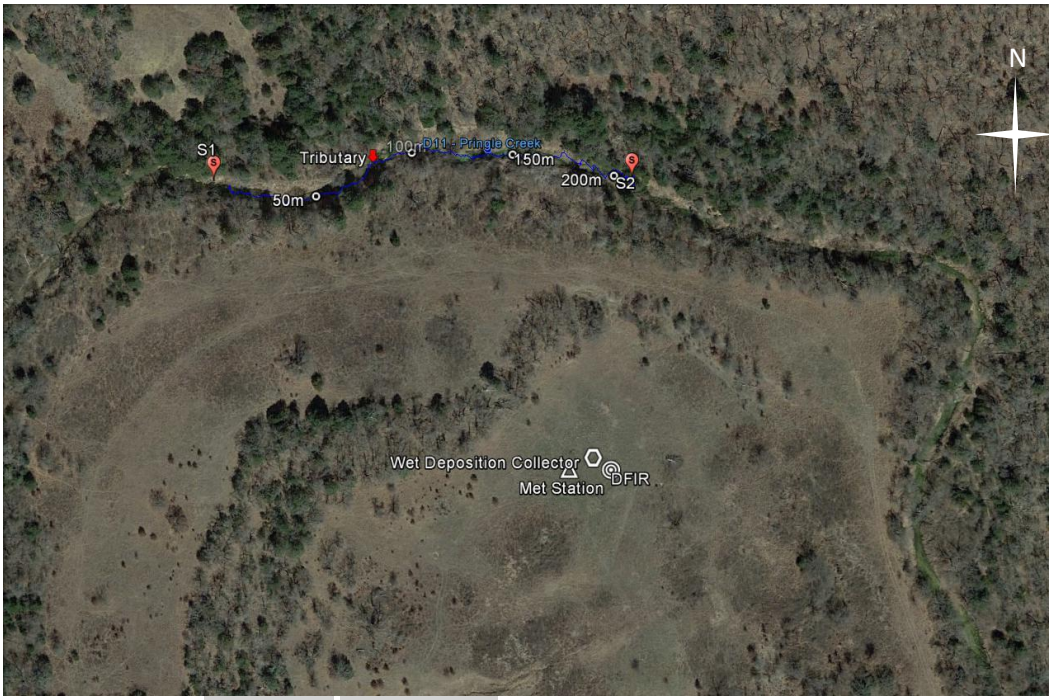


Figure 2 Kmz File of Domain 11 Pringle Creek Denoting Locations of S1, S2, Micromet Station, DFIR and Wet Deposition Collector.

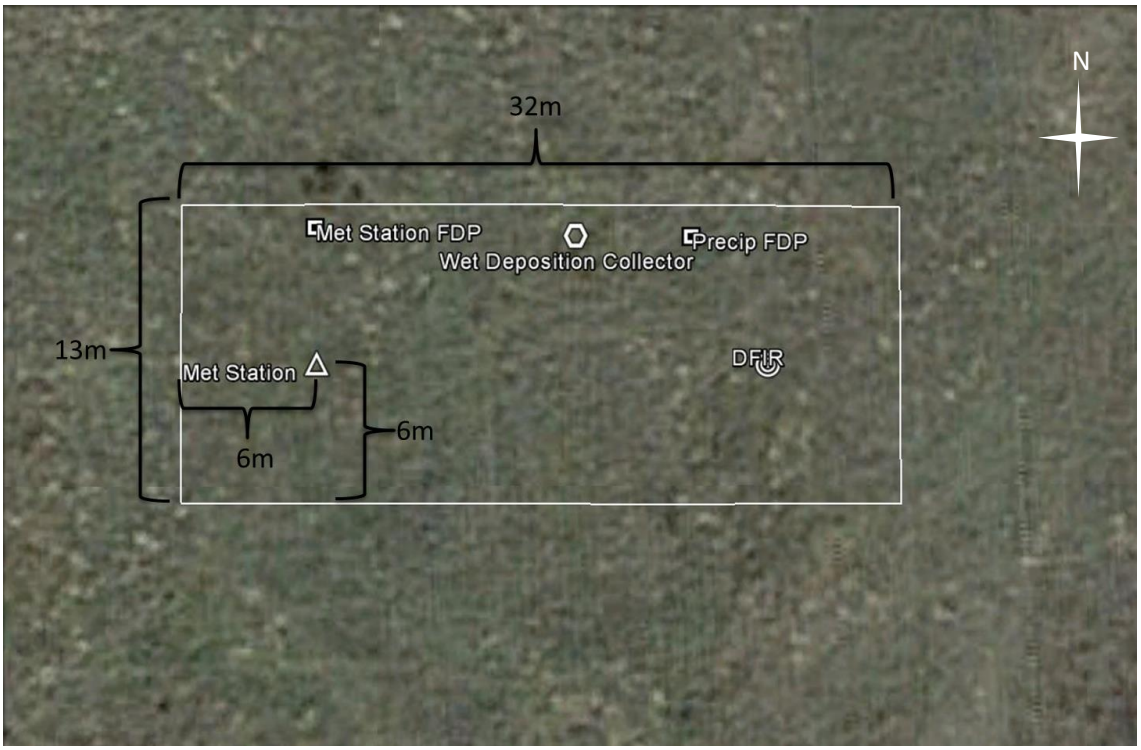


Figure 3 Map of cattle fence (white) that encloses the Micromet Station, DFIR, Wet Deposition Collector, their respective field device posts. Dimensions given.

Figure 4 S1 location at Domain 11 Pringle Creek. Shown here is the right bank.

Figure 5 Location of S1 showing both banks.

Figure 6 Location of pool for S1 showing large boulder in left bank to provide stable habitat for sensor installation.

Figure 7 Location of S2 sensor at Domain 11 Pringle Creek, looking directly at left bank where this is a large tree overhanging the stream.

Figure 8 Photo of Micromet Station Location at Domain 11 Pringle Creek.

### 3.1.3 Groundwater Wells at Pringle Creek

The groundwater observation wells network at the site (Figure 9,

Table 5) will consist of 8 – 2" diameter wells installed using a geoprobe or powered hand auger. Topography at the site is dominated by fairly flat grasslands sounding the steeply incised stream in some cases exposing tall bedrock walls at the streams edge, and forming portions of the stream banks.

The wells will be installed in grassland and riparian buffer surrounding the stream reach. The required drilling depth will vary between 10-25 feet below ground surface. Access to the site for drilling activities will be via the gravel USFS road. Access to well locations to the south will be via the open field between the road and stream reach. Access to the well locations to the north is anticipated to be relatively challenging due to the dense riparian vegetation extending beyond the stream banks. Access to the north will be via a defined access path for each well. Prior to initiation of the drilling activity, the access pathway will be established to provide easier access to the drilling locations.

The exact location of wells may vary during the drilling process due to the presence of boulders and bedrock in the subsurface which were observed during the visit. Probing of the subsurface will be performed prior to drilling the wells to establish depth to bedrock and to locate obstructions. Thus, actual locations of wells will vary slightly from the plan if subsurface obstructions are encountered.

AQU prefers the surface completion of the wells to include an above-grade stick-up protective cover and be minimally invasive.

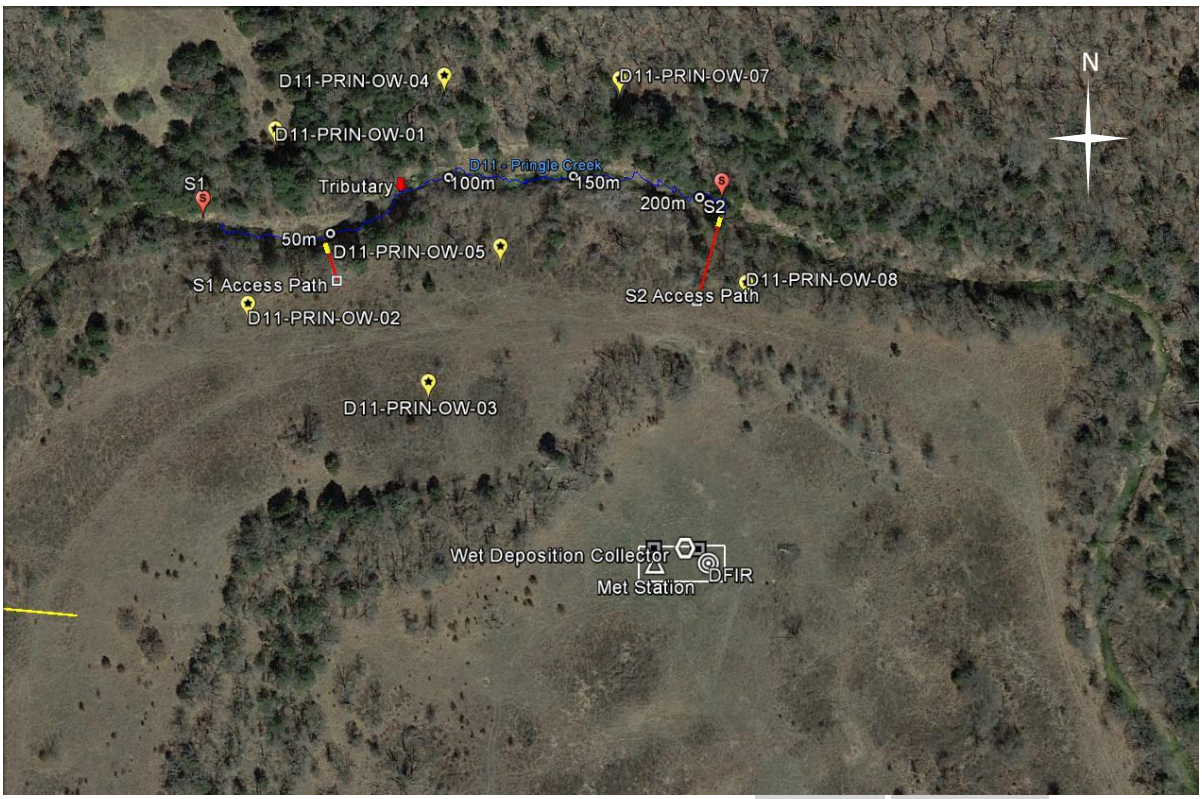


Figure 9 Initial Groundwater Well Locations at Domain 11 Pringle Creek

Table 5 Groundwater well locations at Domain 11 Pringle Creek.

| Well ID | Latitude | Longitude |
| --- | --- | --- |
| D11-PRIN-OW-01 | 33.378652° | -97.783377° |
| D11-PRIN-OW-02 | 33.378032° | -97.783471° |
| D11-PRIN-OW-03 | 33.377757° | -97.782715° |
| D11-PRIN-OW-04 | 33.378842° | -97.782669° |
| D11-PRIN-OW-05 | 33.378235° | -97.782427° |
| D11-PRIN-OW-06 | 33.379226° | -97.782270° |
| D11-PRIN-OW-07 | 33.378832° | -97.781931° |
| D11-PRIN-OW-08 | 33.378108° | -97.781403° |

### 3.1.4 Riparian Vegetation Cover

Figure 10 Typical riparian canopy vegetation at Domain 11 Pringle Creek

### 3.1.5 Bank Morphology

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

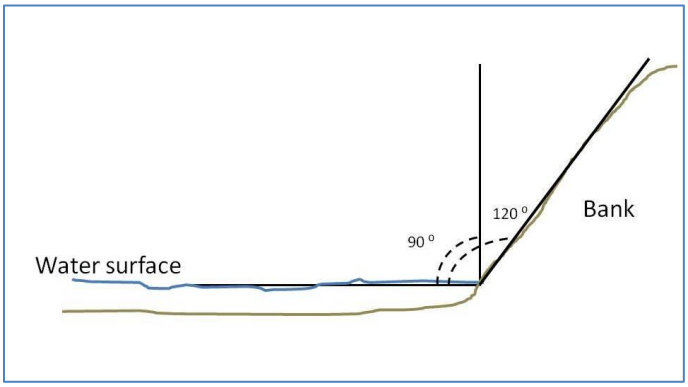


Figure 11 How Bank Angle is Measured

During 2014 site visits, AQU observed the following bank conditions at S1:

At nearly all points along the active channel, banks are typically characterized by a 1-4 m high, deeply incised clay abutment on right bank and a more gradually sloping bank on the left bank.

Table 6 Bank conditions at Domain 11 Pringle Creek

| Morphology Type | S1 | S2 |
| --- | --- | --- |
| RB* angle | 90 | 50 |
| LB* angle | 45 | 70 |
| Maximum water height (bankful height; m) | 4.83 | 4.68 |
| Bankful width (m) | 25 | 21.5 |
| Substrate composition | Sand/roots/large boulders | Sand/grasses |

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

Figure 12 Typical bank structure of Domain 11 Pringle Creek.

### 3.1.6 Site Photos

The following photos of are representative of the site.

Figure 13 Substrate in Domain 11 Pringle Creek consists of sand, silt and gravel.

Figure 14 Some sections of stream consist of bedrock and boulders.

Figure 15 Picture of the only riffle in Pringle Creek.

Figure 16 Example of a typical run in Pringle Creek surrounded by grasses, hardwood and evergreen vegetation.

Figure 17 Tributary from left bank that enters the middle of the reach. This picture was taken during a drought when the streams were dry.

### 3.1.7 Site Access Needs

Parking is available at the USFS gate (Figure 18). We propose to receive gate access keys from the USFS so that field techs may drive to within 130m of the met station and DFIR, which will be 260m directly south from S2. The USFS road entering the site passes directly through the creek approximately 420m downstream of the AQU reach (Figure 18 below). We request that a culvert be installed to allow continued access during period of moderate to high flow while minimizing damage to the ecosystem and road maintenance (Figure 19 below). The magnitude and frequency of the high flow events is unknown for this creek. In the absence of historical data for Pringle Creek, Big Sandy Creek is used as a proxy. Figure 21 below shows that while discharge is typically very low, 1 event on the order of 5-6000 cfs may be expected over the duration of the project (30 year core site); events on the order of 1500-3000 cfs can be expected on a 2-5 year frequency. There is high level of uncertainty associated with these estimates for Pringle Creek given both the lack of data and projected climate change. Therefore we anticipate the culvert to be built based on conservative estimates. Table 7 provides the coordinates for the location of the culvert to be installed.

Table 7 Culvert Location

| Access Requirement | Latitude | Longitude |
| --- | --- | --- |
| Culvert | 33.375923 | -97.779315 |

Figure 18 Parking area at Forest Service Gate

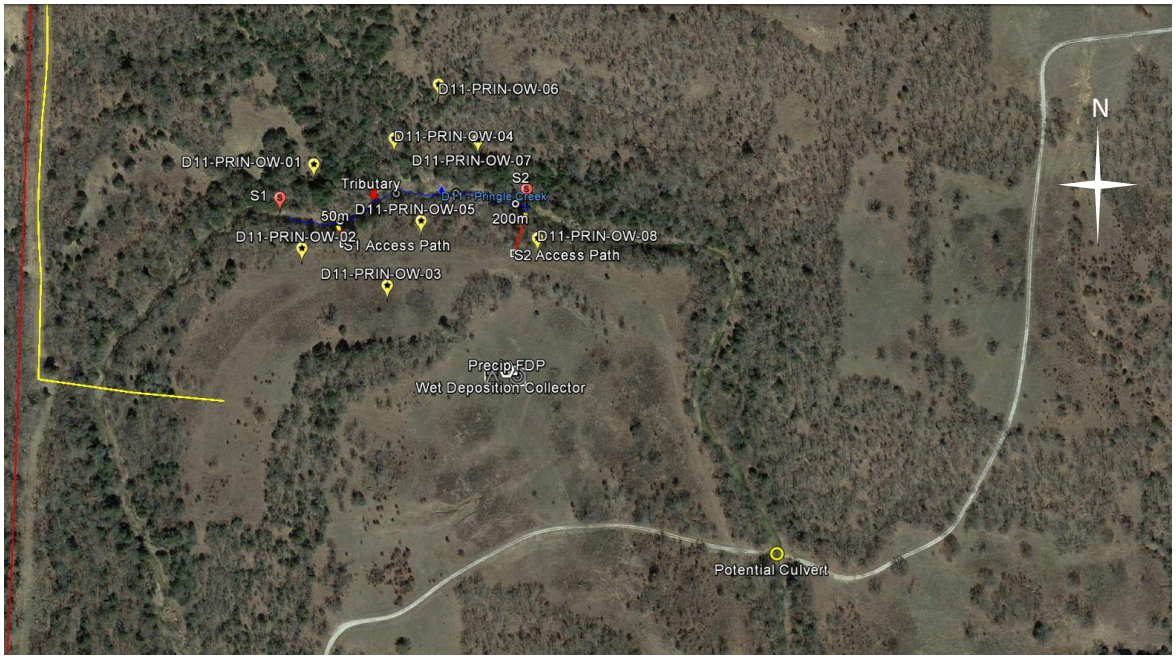


Figure 19 Site map showing proposed culvert installation (yellow circle) where road passes through the creek.

Figure 20 View of USFS road that passes through the creek where culvert is proposed to be installed.

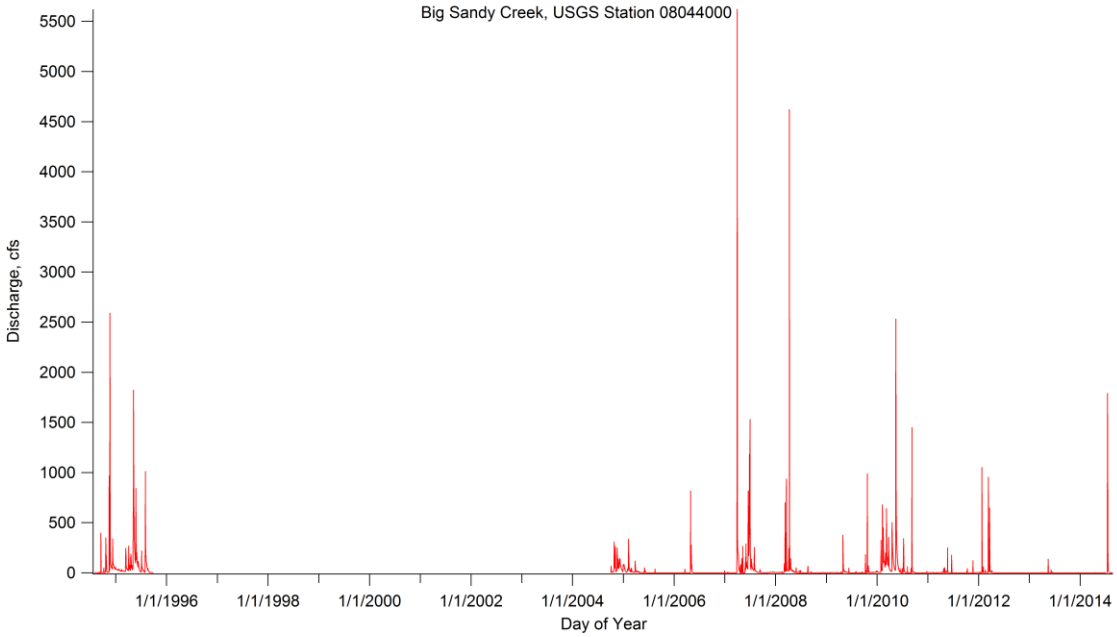


Figure 21 Discharge from 1994-2014 at USGS 08044000 Big Sandy Creek, ~9km from Pringle Creek. This serves as a proxy record in the absence of historical flow data for Pringle Creek.

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

It is suggested that footpaths be cut through riparian vegetation and aluminum stairs be added for field techs to safely access the stream while reducing erosion and highly accessed sites. The locations of the

access paths for S1 and S2 are shown in Figure 22 and their respective coordinates are given in Table 8-Table 11. Pictures of the access locations are shown in Figure 23Figure 24.


Figure 22 Map showing the proposed paths (red) and stairs (yellow) needed to access S1 and S2.

Figure 23 Approximate location of the stairs at the end of a proposed pathway to be constructed to access sensors. Shown are paths to both the AQU sensors.

Figure 24 Location where pathway will need to be cut through riparian vegetation and stairs installed leading to S2.

Table 8 S1 Pathway Location

| Pathway | Latitude | Longitude |
| --- | --- | --- |
| Start | 33.378182 | -97.783108 |
| End | 33.378321 | -97.783169 |

Table 9 S2 Pathway Location

| Pathway | Latitude | Longitude |
| --- | --- | --- |
| Start | 33.378111 | -97.781608 |
| End | 33.378410 | -97.781508 |

Table 10 S1 Stairs Location & Length

| Stairs | Latitude | Longitude |
| --- | --- | --- |
| Top of Stairs | 33.378289 | -97.783154 |
| Length of Stairs | 4m | |

Table 11 S2 Stairs Location & Length

| Ladder | Latitude | Longitude |
| --- | --- | --- |
| Top of Ladder | 33.378379 | -97.781519 |
| Length of Ladder | 6m | |

In addition to the south side access, a path to the north side groundwater wells will be needed. It is assumed paths will need to be made for drilling rig access to install the wells. These paths shall be maintained as an unimproved path for routine access to the groundwater wells. Figure 25 shows a map of the north side path (red line). This path shall extend to S1 so that it may be accessed from the stream reach as well.


Figure 25 Map of D11 Pringle Creek showing the footpath (red) needed to access the groundwater wells on the north side of the creek.

### 3.1.8 Communications at the Site

ALL - See table in Appendix C for additional IT info

### 3.1.9 Power at the Site

Line power may be run to site by extending existing overhead lines from nearby residential use. Figure shows a potential route (in yellow) for extending overhead lines. Pole may be installed and lines run down an existing cleared path that runs along the west boundary of the USFS land. Trees will need to be removed to pass the line power over the stream. Tree removal should be kept the minimum necessary.

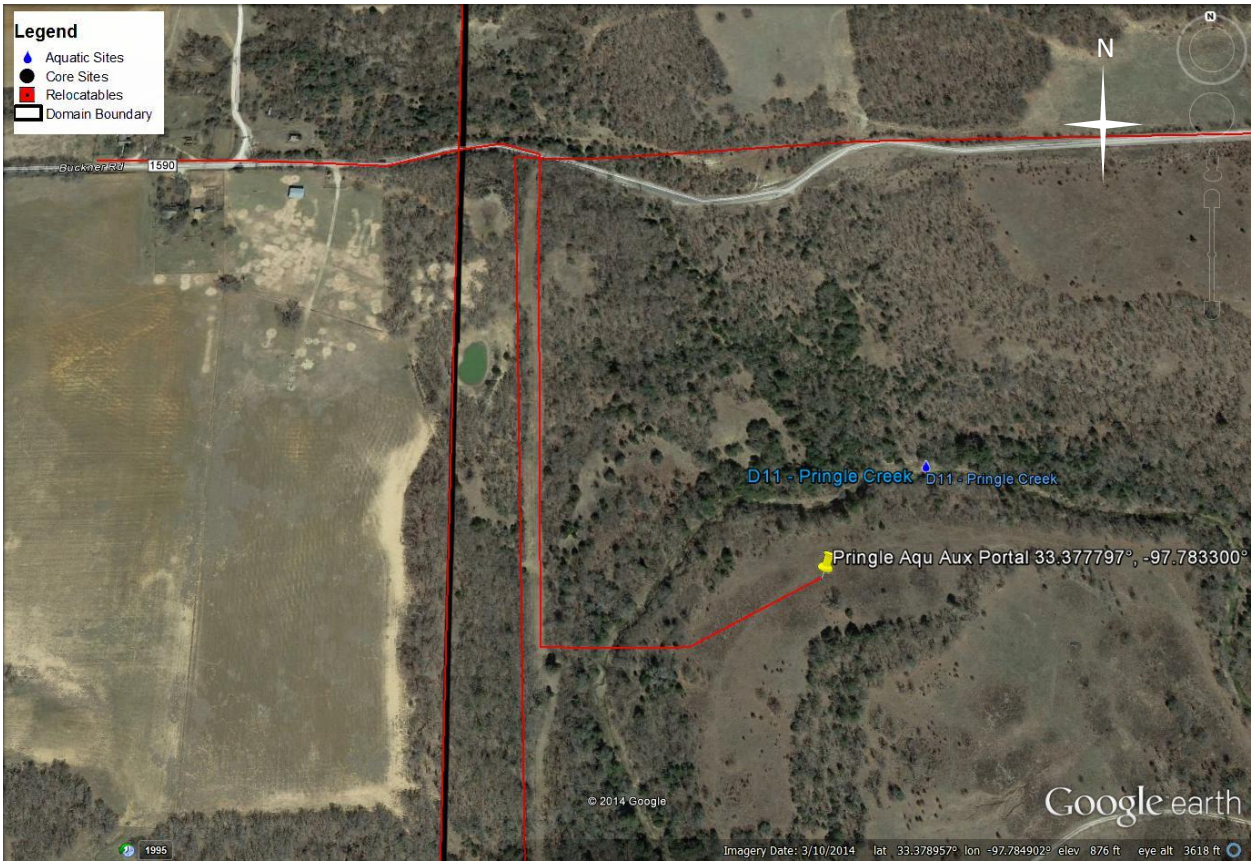


Figure 26 Pringle Creek site map showing potential power run as overhead lines along the path shown in red.

### 3.1.10 Site Science Construction Constraints and Limitations

Site-specific issues to consider at Domain 11 Pringle Creek are:

- Extended periods (5+ months) of zero-flow will pose challenges for sensor installment and maintenance.
- Sensor installation will require consideration of episodic high flow events that will likely cause high risks of equipment damage.

Driving and access constraints for Domain 11 Pringle Creek are:

- Parking is available off of Forest Service Road 970 from CR1590. The distance between the parking area and NEON aquatic sites is approximately 1000 m along a gated Forest Service Road and through a field.
- It is proposed that we receive keys for gate access and permission to use USFS road to drive in and park just south of micromet station and precipitation sensors.
- The road currently goes through the creek, which will be inaccessible during periods of high flow. The magnitude and frequency of high flow in this creek is unknown. Beyond that driving through the creek at a frequency of bi-weekly or more may damage the ecosystem. It is proposed that a culvert be installed at the location given (Figure 19).

### 3.1.11 Other Issues

Locals use this area to shoot guns and sell drugs. Use caution.

### 3.2 Blue River

Blue River, a bedrock controlled channel, is an undammed or otherwise controlled stream in Oklahoma. The stream originates in the Arbuckle Plains, an area characterized by limestone geology and gentle riffles and low waterfalls along the Blue River. There are no significant urban areas upstream of the NEON aquatic reach, limiting human impacts to historic land use, mostly cattle grazing and possible removal of hardwood forests. The stream is mostly wadeable, with a few deeper sections that may be unwadeable at high water. The stream is wide with relatively high flow volume compared to other NEON sites. Downstream, the stream is stocked with non-native trout species for sport fishing. No evidence exists that the trout are propagating in the Blue River past the spring and summer fishing season.

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

The initial estimated location for the Aquatic Auxiliary Portal is:


Figure 27 Sensor set 1 and 2 locations at Blue River

Table 12 Aquatic Auxiliary Portal Location

| Aquatic Auxiliary Portal | Latitude | Longitude |
| --- | --- | --- |
| Location | 34.447131° | -096.623761° |

The initial estimated location for the Aquatic Portal is collocated with the Aquatic Auxiliary Portal (Table 2).

Table 13 Aquatic Portal Location

| Aquatic Portal | Latitude | Longitude |
| --- | --- | --- |
| Location | 34.447131° | -96.623761° |

### 3.2.2 Sensor Locations for Construction

AQU, with support from EHS, has the following field GPS coordinates for S1, S2, micromet station and precipitation sensor (where applicable) 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.

Personnel access and electrical resources will be on the right bank at all sensor locations. Where locations coincide with a high vertical bank, and access stair may be required.

S1 is located approximately 230 meters downstream from the Harris Ranch Road bridge at the top of the property. S2 is approximately 400 meters downstream from S1. A run-off channel enters Blue River just below the bridge at the top of the reach.

The field to the East of the stream reach provides a good location for the meteorological sensors including the AQU Micromet Station, a Primary Precipitation Sensor Assembly (DFIR), and a Wet Deposition Collector (NADP). This site is located on land managed by The Nature Conservancy and prescribed fire is used as a tool to manage woody vegetation.

The Aquatics team recommends the use of the bedrock/cobble anchor kit for both S1 and S2 locations. Due to the high banks at several locations along the reach and on both sides, the Extreme High Water infrastructure variation is also recommended for D11 Blue River.

Figure 27 shows a map of the Blue River site with the locations of all sensor sets. Figure 289 shows the layout for field based sensors.

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

Table 14 Sensors 1 and 2 locations

| Sensor | Latitude | Longitude |
| --- | --- | --- |
| S1 | 34.446660 | -96.623501 |
| S2 | 34.443494 | -96.623888 |

Note, due to the width of the Blue River, and the uniform bottom (e.g. lack of significant thalweg), the sensor sets may be shifted towards the bank of the river if needed.

Table 15 Micromet and Precipitation sensor locations

| Sensor | Latitude | Longitude |
| --- | --- | --- |
| Micromet | 34.442447° | -96.623314° |
| Primary | 34.442508° | -96.623467° |

| | | |
| --- | --- | --- |
| Precipitation (DFIR) | | |
| Wet Deposition Collector(NADP) | 34.442447° | -96.623467° |
| Micromet Field Device Post (FDP) | 34.442533° | -96.623389° |
| Precip. Field Device Post (FDP) | 34.4425333° | -096.6234083° |

The pressure transducer, staff gauge, and digital camera for determining discharge should be co-located with the S1 sensor.


Figure 28 D11 Blue River locations of S1, S2, Micromet Station, DFIR, and Wet Deposition Collector.

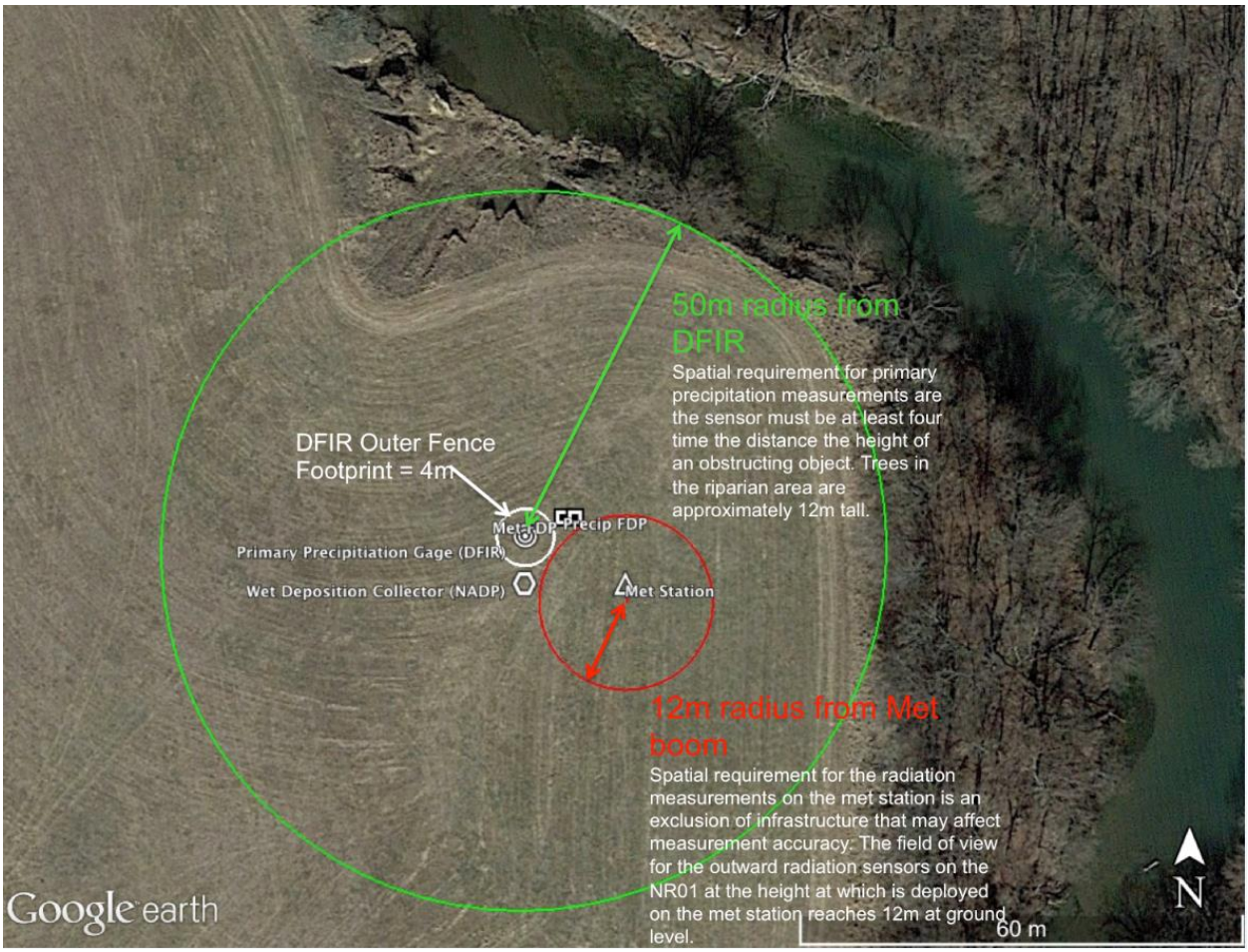


Figure 29 Map of Micromet Station, DFIR, and Wet Deposition Collector, with respective dimensions.

Figure 30 S1 Location at D11 Blue River. Shown here is the right bank from S1.

Figure 31 S2 Location at D11 Blue River. Shown here is the left bank from S2.

Figure 32 Photo of Micromet Station Location at D11 Blue River. The proposed location is in the field on the upper right of the photo.

### 3.2.3 Groundwater Wells

The groundwater observation wells network at the site (Figure 33, Table 16) will consist of 8 wells installed using a rotary auger rig. Topography at the site is dominated by relatively flat agricultural and forested lands surrounding the river. The wells will be installed along the river on both sides. Drilling depths are estimated to be around 20-30 feet below ground surface. Drill rig access to both sides of the river appears to be straightforward as established roadways border the site on all sides. Access to the east side may require permission from adjacent landowner. The exact location of wells may vary during the drilling process if obstructions are encountered in the subsurface. Wells will be constructed according to State guidelines for observation well construction. Wells located in the agricultural land to the west of the stream will likely require fencing to protect the wells.

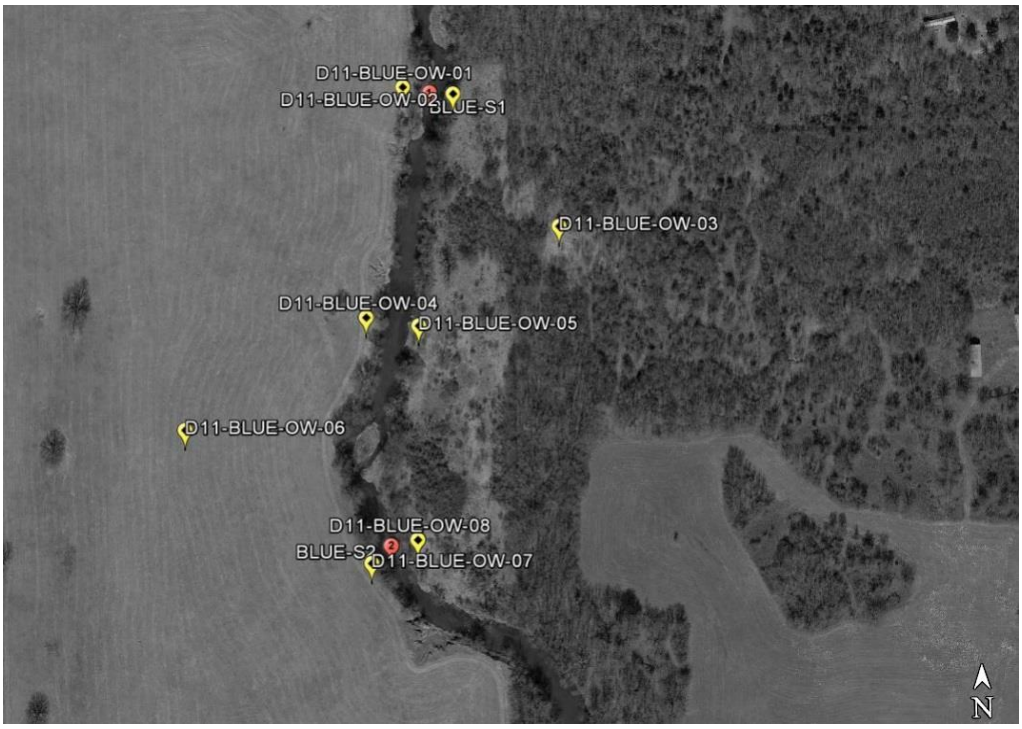


Figure 33 Initial Groundwater Well Locations Based on EMS kmz File at D11 Blue River

Table 16 Groundwater well locations at D11 Blue River

| Well ID | Latitude | Longitude |
| --- | --- | --- |
| D11-BLUE-OW-01 | 34.446701° | -96.623726° |
| D11-BLUE-OW-02 | 34.446643° | -96.623305° |
| D11-BLUE-OW-03 | 34.445681° | -96.622451° |
| D11-BLUE-OW-04 | 34.445073° | -96.624064° |
| D11-BLUE-OW-05 | 34.445009° | -96.623629° |
| D11-BLUE-OW-06 | 34.444314° | -96.625568° |
| D11-BLUE-OW-07 | 34.443378° | -96.624050° |
| D11-BLUE-OW-08 | 34.443529° | -96.623670° |

### 3.2.4 Riparian Vegetation Cover

Figure 34 Typical riparian vegetation at Domain 11 Blue River.

Figure 35 Typical riparian canopy over Domain 11 Blue River.

### 3.2.5 Bank Morphology

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

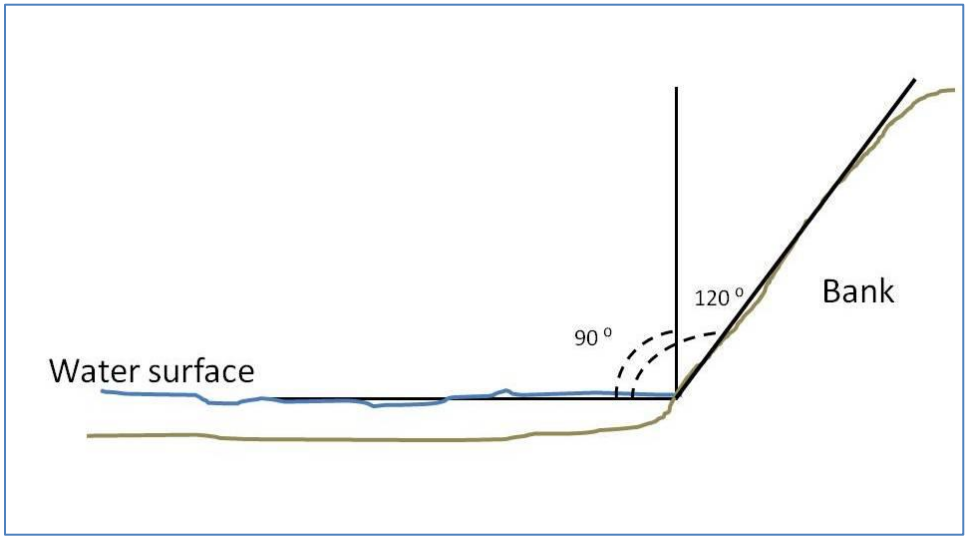


Figure 36 How Bank Angle is Measured

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

At nearly all points along the active channel, banks are typically characterized by a 1-4 m high, deeply incised clay and rock abutment on right bank and a more gradually sloping bank on the left bank. Occasionally, this generality is reversed and the right bank is more gradually sloping.

Table 17 Bank conditions at Domain 11 Blue River

| Morphology Type | S1 | S2 |
| --- | --- | --- |
| RB* angle | 90 | 50 |
| LB* angle | 50 | 90 |
| Maximum water height (bankful height; m) | 4.0 | 4.0 |
| Bankful width (m) | 25m | 30m |
| Substrate composition | Cobble/Bedrock | Cobble/Bedrock |

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

Figure 37 Typical left bank angle at D11 Blue River.

Figure 38 Typical right bank at some locations of Domain 11 Blue River.

### 3.2.6 Site Photos

The following photos are representative of the site.

Figure 39 Substrate in Domain 11 Blue River consists of bedrock and cobbles, with some smaller material.

Figure 40 Aquatics vegetation and algal species create habitat at Domain 11 Blue River.

Figure 41 Domain 11 Blue River includes large runs with some riffles and few pools.

Figure 42 Large flood plains characterize both side of Domain 11 Blue River.

### 3.2.7 Site Access Needs

The Nature Conservancy recently gained the property that includes the Blue River. Currently, A low-usage double track is used to access the site. The access route is controlled by property fence and gates located along the nearest road, approximately 1 km from the river. We request that the two-track road be improved enough to sustain typical NEON maintenance and protocol activities to minimize damage

to the ecosystem. Figure 43, below, shows the current two-track road. Table 18 gives coordinates for the start and end of the two-track and also the nearest power. The route of the proposed improved road should be laid out in coordination with the site host.

Figure 43 Vehicle access to Domain 11 Blue River.

Table 18 Access locations

| Access Requirement | Latitude | Longitude |
| --- | --- | --- |
| Start of two-track road | 34.438808° | -96.635911° |
| End of two-track road | 34.443531° | -96.624189° |
| Power | 34.448544° | -96.623631° |

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

It is suggested that stairs be constructed at a few locations near Sensor Set 1 and Sensor Set 2. These may not be necessary, given that some of the banks have gullies eroded into them already, but the possibility exists that they may be needed for technicians to regularly access the sensor sets. The site host should be consulted and the decision for stairs should be made in the permitting process.

An old fence runs along sections of the eastern bank. It is suggested that portions of this fence be removed to allow access along both side of Blue River. The Nature Conservancy has periodic volunteer workdays and the possibility of requesting the removal of the fence would create a more natural riparian area as well as improved access.

Figure 44 Old fencing running along the right bank of Domain 11 Blue River.

### 3.2.8 Communications at the Site

### 3.2.9 Power at the Site

Line power may be run from the road at the top of the Aquatic study reach. See Table 18, above, for the nearest power pole location. The site host may use prescribed burns in the area for maintenance, so trenching is suggested for power runs.

### 3.2.10 Site Science Construction Constraints and Limitations

Site-specific issues to consider at Domain 11 Blue River are:

- The Nature Conservancy manages most of the area around the Blue River
- A private land-owner owns some of the left bank area

Driving and access constraints for Domain 11 Blue River are:

- Driving and access should be minimal until road improvements are considered

### 3.2.11 Other Issues

The state of Oklahoma stocks the Blue River with trout for sport fishing each year. The stocking location is several river miles downstream from the proposed study reach.

# 4 APPENDIX A. FCC SUMMARY TABLES FOR AIS SITE COMPONENTS AT DOMAIN 11

## 4.1 Pringle Creek FCC Summary Table

| Site Component | Latitude | Longitude | Units |
|---|---|---|---|
| Stream, Lake, or Stream+STREON | Stream (Core site) | | Description |
| Aquatic Auxiliary Power Portal location | 33.377797° | -97.783300° | Lat, Long in degrees |
| Aquatic Portal location | | | m away from bank, direction |
| Pathway needed? What is length? | Yes - Two pathways are needed to access S1 and S2 | | Yes/no, description w/ length |
| S1 Pathway start location | 33.378182 | -97.783108 | Lat, Long in degrees |
| S1 Pathway end location | 33.378321 | -97.781369 | Lat, Long in degrees |
| S2 Pathway start location | 33.378111 | -97.781608 | Lat, Long in degrees |
| S2 Pathway end location | 33.378410 | -97.781508 | Lat, Long in degrees |
| Stairs or ladder needed? | Yes - Two sets of stairs are needed to access S1 and S2 | | Yes/no, description |
| S1 Stairs top location | 33.378289 | -97.783154 | Lat, Long in degrees |
| S1 Stairs length | 4m | | Meters |
| S2 Stairs top location | 33.378379 | -97.781519 | Lat, Long in degrees |
| S2 Stairs length | 6m | | Meters |
| Ladder needed? What is length? | No | | Yes/no, description |
| Ladder top location | Site1-LadderTopLat | Site1-LadderTopLong | Lat, Long in degrees |
| Ladder length | Site1-LadderLength | | Meters |
| Boardwalk needed? What is length? | No | | Yes/no, description w/ length |
| Boardwalk start location | Site1-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, stairs shall be installed during FCC site installation to accommodate sensor deployment | | Yes/no, description |
| Special Access Needs | Yes – request culvert be installed where road cross creek | | Description |
| Culvert | 33.375923 | -97.779315 | Lat, Long in degrees |
| Fencing needs | No fencing required for this site | | Description |
| Site management | | | Description |
| Any additional site specific information | This site is known to be frequented by drug dealers/ing which poses a risk to NEON property and personnel | | Description |

## 4.2 South Pond Klemme FCC Summary Table

| Site Component | Latitude | Longitude | Units |
|---|---|---|---|
| Stream, Lake, or Stream+STREON | Lake | | Description |
| Aquatic Auxiliary Power Portal location | 35.398083 | -99.062518 | 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 | 35.398295 | -99.062493 | Lat, Long in degrees |
| Pathway end location | 35.398350 | -99.062367 | Lat, Long in degrees |
| Stairs or ladder needed? | | | Yes/no, description |
| Stairs top location | Site2-StairsTopLat | Site2-StairsTopLong | Lat, Long in degrees |
| Stairs length | Site2-StairsLength | | Meters |
| Ladder top location | Site2-LadderTopLat | Site2-LadderTopLong | Lat, Long in degrees |
| Ladder length | Site2-LadderLength | | Meters |
| Boardwalk needed? What is length? | | | Yes/no, description w/ length |
| Boardwalk start location | Site2-BrdwlkStartLat | Site2-BrdwlkStartLong | Lat, Long in degrees |
| Boardwalk end location | Site2-BrdwlkEndLat | Site2-BrdwlkEndLong | Lat, Long in degrees |
| Shall stairs, boardwalk be installed during construction? | | | Yes/no, description |
| Fencing needs | | | Description |
| Site management | | | Description |
| Any additional site specific information | | | Description |

### 4.3 Blue River FCC Summary Table

| Site Component | Latitude | Longitude | Units |
|---|---|---|---|
| Stream, Lake, or Stream+STREON | Lake | | Description |
| Aquatic Auxiliary Power Portal location | 34.447131° | -096.623761° | 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 | | | Lat, Long in degrees |
| Pathway end location | | | Lat, Long in degrees |
| Stairs or ladder needed? | Yes – on the west bank of the site for access to S2 | | Yes/no, description |
| Stairs top location | Site2-StairsTopLat | Site2-StairsTopLong | Lat, Long in degrees |
| Stairs length | Site2-StairsLength | | Meters |
| Ladder top location | Site2-LadderTopLat | Site2-LadderTopLong | Lat, Long in degrees |
| Ladder length | Site2-LadderLength | | Meters |
| Boardwalk needed? What is length? | | | Yes/no, description w/ length |
| Boardwalk start location | Site2-BrdwlkStartLat | Site2-BrdwlkStartLong | Lat, Long in degrees |
| Boardwalk end location | Site2-BrdwlkEndLat | Site2-BrdwlkEndLong | Lat, Long in degrees |
| Shall stairs, boardwalk be installed during construction? | | | Yes/no, description |
| Fencing needs | | | Description |
| Site management | | | Description |
| Any additional site specific information | | | Description |

# 5 APPENDIX B. EHS SUMMARY TABLES FOR AIS SITE COMPONENTS AT DOMAIN 11

## 5.1 Pringle Creek EHS Summary Table

| Site Component | Latitude | Longitude | Units |
|---|---|---|---|
| Sensor 1 (S1) location | 33.378403 | -97.783671 | Lat, Long in degrees |
| Sensor 2 (S2) location | 33.378470 | -97.781502 | Lat, Long in degrees |
| Micromet Station location | 33.377200 | -97.781783 | Lat, Long in degrees |
| Primary Precipitation (DFIR) Location | 33.377200 | -97.781566 | Lat, Long in degrees |
| Wet Deposition Collector (NADP) Location | 33.377252 | -97.781659 | Lat, Long in degrees |
| Micromet Field Device Post (FDP) | 33.377255 | -97.781783 | Lat, Long in degrees |
| Precipitation FDP | 33.377252 | -97.781603 | Lat, Long in degrees |
| Aquatic Portal location | 33.377797° | -97.783300° | Lat, Long in degrees |

## 5.2 South Pond Klemme EHS Summary Table

| Site Component | Latitude | Longitude | Units |
|---|---|---|---|
| Sensor 1 (S1) location | 35.398350 | -99.062366 | Lat, Long in degrees |
| Micromet Station location | 35.398254 | -99.062666 | Lat, Long in degrees |
| Aquatic Auxiliary Power Portal location | 35.398083 | -99.062518 | Lat, Long in degrees |
| Aquatic Portal location | 35.398083 | -99.062518 | Lat, Long in degrees |

## 5.3 Blue River EHS Summary Table

| Site Component | Latitude | Longitude | Units |
|---|---|---|---|
| Sensor 1 (S1) Location | 34.446660 | -96.623501 | Lat, Long in degrees |
| Sensor 2 (S2) Location | 34.443494 | -96.623888 | Lat, Long in degrees |
| Micromet Station Location | 34.442447 | -96.623314 | Lat, Long in degrees |
| Primary Precipitation (DFIR) Location | 34.442508 | -96.623467 | Lat, Long in degrees |
| Wet Deposition Collector (NADP) | 34.442447 | -96.623467 | Lat, Long in degrees |
| Micromet Field Device Post (FDP) | 34.442533 | -96.623389 | Lat, Long in degrees |
| Precipitation Field Device Post (FDP) | 34.442533 | -96.623408 | Lat, Long in degrees |
| Aquatic Portal Location | 34.447131 | -96.623761 | Lat, Long in degrees |

# 6 APPENDIX C. IT SUMMARY TABLES FOR AIS SITE COMPONENTS AT DOMAIN 11

## 6.1 Pringle Creek IT Summary Table

| Site Component | Latitude | Longitude | Units |
|---|---|---|---|
| **REQUIRED** | | | |
| Aquatic Auxiliary Power Portal location | 33.377797° | -97.783300° | Lat, Long in degrees |
| Aquatic Portal location | 33.377797° | -97.783300° | Lat, Long in degrees |
| **DESIRED** | | | |
| Cell tower visible from site | | | Yes/no |
| Cell phone signal at site | | | Yes/no, which carrier? |
| Strength of cell phone signal | | | Description |
| Facility on property | | | Yes/no |
| Internet connectivity at facility | | | Yes/no, description |
| Phone number at facility location | | | Area code & first 3 needed |

## 6.2 South Pond Klemme IT Summary Table

| Site Component | Latitude | Longitude | Units |
|---|---|---|---|
| **REQUIRED** | | | |
| Aquatic Auxiliary Power Portal location | 35.398083 | -99.062518 | Lat, Long in degrees |
| Aquatic Portal location | 35.398083 | -99.062518 | Lat, Long in degrees |
| **DESIRED** | | | |
| Cell tower visible from site | | | Yes/no |
| Cell phone signal at site | | | Yes/no, which carrier? |
| Strength of cell phone signal | | | Description |
| Facility on property | | | Yes/no |
| Internet connectivity at facility | | | Yes/no, description |
| Phone number at facility location | | | Area code & first 3 needed |

# 7 APPENDIX D. SOUTH POND KLEMME

South Pond Klemme site is a pond that drains a mixed agricultural, pasture (livestock) and primary agricultural commodity crops include small grains, alfalfa, soybeans, forage legumes and forage grasses. The vegetation type is a shallow mixed grass eroded plains (NRCS, Oklahoma Biological Survey). Situated in the Prairies, the soils are typical iron rich (oxidized hematite and ferrihydrite) silty sands derived from the underlying sandstones and shales. Areas around the site have gas and oil wells. The site is located 183 m above sea level and has 1070 mm average precipitation with 25 degree C average summer temperature and 0 degree C average winter temperature. Large fluctuations in water level can occur – up to 3.8 meters (from dry to full). The water levels during the 2012 sampling campaign were very low, with the areal coverage of the pond being approximately 1/5 of the usual level (Figure 45).

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

The initial estimated location for the Aquatic Auxiliary Portal is:


Figure 45 A Google-Earth-Derived Image of Aquatic Auxiliary Portal for Domain 11 South Pond Klemme

Table 19 Aquatic Auxiliary Portal Location

| Aquatic Auxiliary Portal | Latitude | Longitude |
|---|---|---|
| Location | 35.398083 | -99.062518 |

The initial estimated location for the Aquatic Portal is collocated with the Aquatic Auxiliary Portal (Table 13).

Table 20 Aquatic Portal Location

| Aquatic Portal | Latitude | Longitude |
|---|---|---|
| Location | 35.398083 | -99.062518 |

### 7.1.2 Sensor Locations for Construction

AQU, with support from EHS, has the following field GPS coordinates for S1 (buoy), temperature/pressure sensors (T/P1 and T/P2) 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.

The following sensor coordinates are a draft version, subject to change due to actual levels of water (Table 21-Table 22). AQU has preliminarily identified S1 and micromet locations (Figure 47) and T/P1 and T/P2 (Figure 48) based expected flow of water in this watershed and the likely deep point of the lake.

This information should be sufficient for determining the location of the Aquatic Portal and the Aquatic Auxiliary Portal. The landscape is relatively flat and the sensors should have direct line of site to the Portals regardless of any revision in their location.

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

Table 21 T/P1, T/P2 and S1 Locations

| Sensor | Latitude | Longitude |
| --- | --- | --- |
| T/P1 | 35.398439 | -99.062327 |
| T/P2 | 35.398143 | -99.062305 |
| S1 | 35.398350 | -99.062366 |

Table 22 Micromet sensor location

| Sensor | Latitude | Longitude |
| --- | --- | --- |
| Micromet | 35.398254 | -99.062666 |


Figure 46 Kmz File of Domain 11 South Pond Klemme Denoting Locations of S1 and Micromet Station.

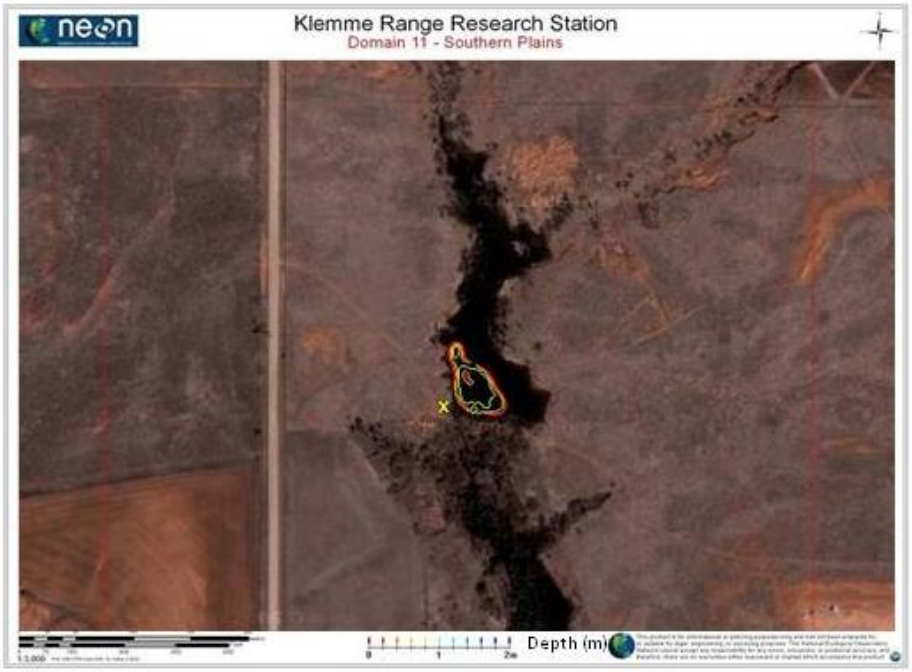


Figure 47 Location of S1 (red x) and micromet (yellow x) station at Domain 11 South Pond Klemme.

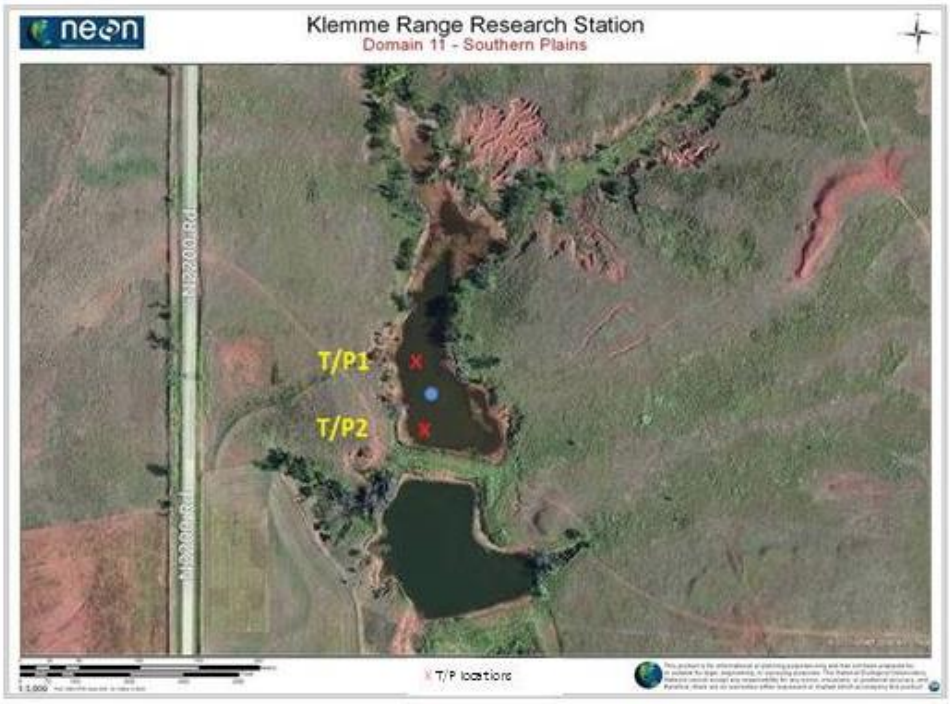


Figure 48 Photo of T/P1 and T/P2 Locations at Domain 11 South Pond Klemme denoted by red X.

### 7.1.3 Groundwater Wells

The groundwater observation wells network at the site (Figure 49, Table 23) will consist of 6 wells installed using a rotary auger rig. Topography at the site is dominated by rolling hills surrounding the pond. The wells will be installed at varying positions along the rolling hills and the required drilling depth will vary with total depths between 60-80 feet below ground surface. Drill rig access along the west side of the lake will be via the existing roadway. Along the east side access will be easiest from the roadway to the south. 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.

The exact location of wells may vary during the drilling process due to the presence of a dense consolidated layer located several feet below the ground surface. Outcroppings of this layer were observed during the visit. The ranch manager also mentioned this layer with relation to water wells he had drilled at his residential property located approximately ¼-mile from the site. Thus, actual locations of wells and the path of the drill rig will vary slightly from the plan if the augers are not able to penetrate this layer in a specific area.

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 Oklahoma 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.

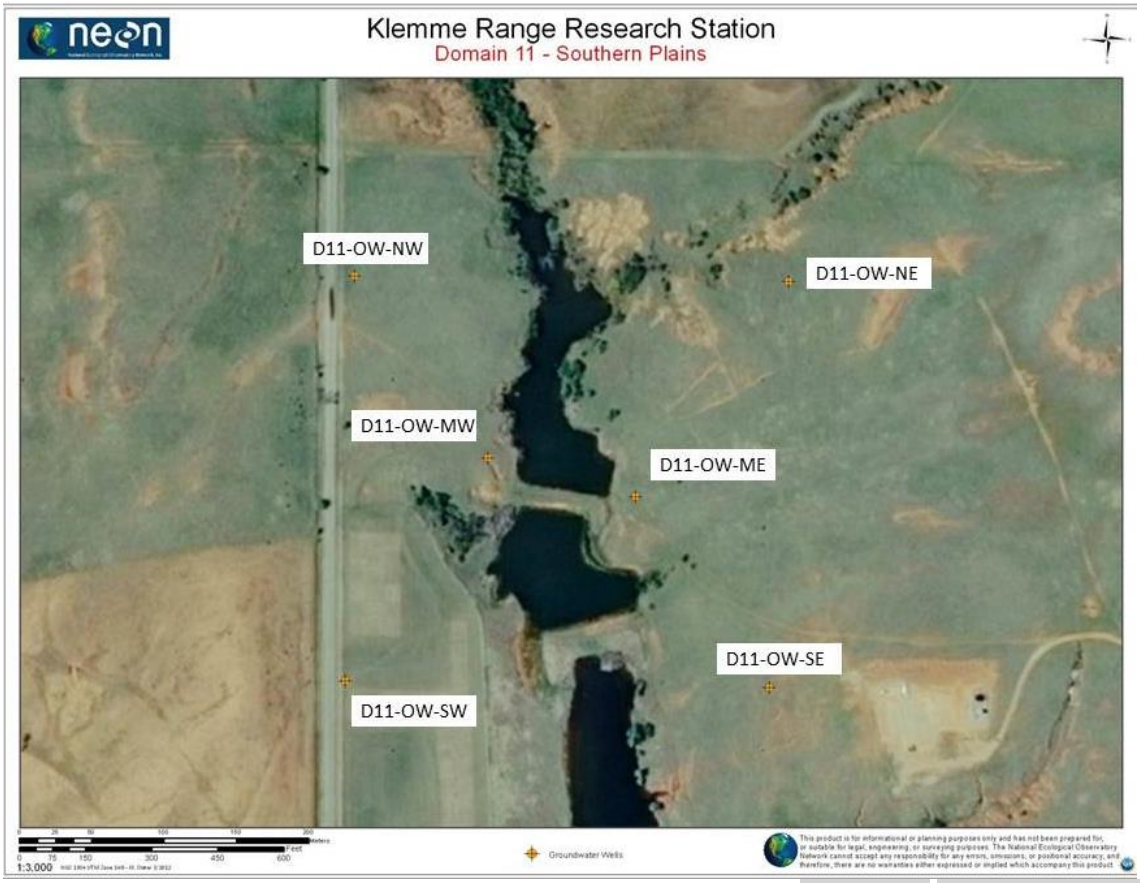


Figure 49 Initial Groundwater Well Locations Based on EMS kmz File at Domain 11 South Pond Klemme.

Table 23 Groundwater well locations at Domain 11 South Pond Klemme.

| Well ID | Latitude | Longitude |
| --- | --- | --- |
| D11-OW-NW | 35.3993583 | -99.0637990 |
| D11-OW-MW | 35.3982223 | -99.0627829 |
| D11-OW-SW | 35.3968369 | -99.0638659 |
| D11-OW-SE | 35.3967950 | -99.0606377 |
| D11-OW-ME | 35.3979834 | -99.0616589 |
| D11-OW-NE | 35.3993254 | -99.0604912 |

### 7.1.4 Riparian Vegetation Cover

During 2012 site visits, the following plant density and type were observed by the AQU team:

The majority of the higher riparian vegetation (oaks and willows) at North Pond has been removed. A few trees remain near the high water mark (bankful) on the upstream end of the pond. Ground cover consists of shrubs, bushes and forbs that cover 70-90% of the area. The bank edges of the berm consist primarily of cattails near the high water mark and a presence of Indian grass. Sparse presence of macrophytes was noted, with a few algal species identified near the shore edges (*Nitella*, an alga in the Order Charales – Stephanie Parker Pers. Comm.).

Figure 50 The riparian ground cover at Domain 11 South Pond Klemme.

### 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.

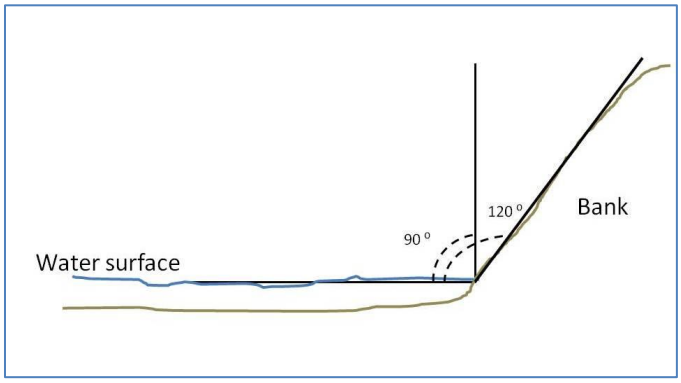


Figure 51 How Bank Angle is Measured.

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

Both right and left banks in South Pond Klemme consist of moderate sloping, partially vegetated, 10 m high silt clay embankments. Although isolated locations with somewhat gradual slopes allow access to the pond, high erosion may occur at low water levels. A floating narrow dock may be needed to access the pond in order to decrease the potential for increased soil erosion on the banks. The slopes generally have three characteristic sections with increasing steepness towards the high water level.

The presence of seasonal grazing will impact the type of structure required for installation in the pond. Reinforcement and protection will be required.

Table 24 Bank Conditions At Domain 11 South Pond Klemme In 2012

| Morphology Type | S1 | S2** |
| --- | --- | --- |
| RB* angle | 172.2 | 165.2 |
| LB* angle | 170.5 | |
| Maximum water height | 3.8 | |
| Bankful width | 70.1 | |
| Substrate composition | Silty clay | |

* RB (right bank) and LB (left bank) are determined by facing downstream.
** denotes the slope angle to the south towards the central berm.

Figure 52 Typical bank structure in Domain 11 South Pond Klemme.

### 7.1.6 Site Photos

The following photos of are representative of the site.

Figure 53 Site access to Domain 11 South Pond Klemme.


Figure 54 Proposed floating platform location for profiling system in Domain 11 South Pond Klemme. The length of the proposed platform would be approximately 13 m. Due to the steeper slope at the berm and the longer distance to the deepest section of the pond (30 m), a side access from the West is being proposed.

Figure 55 Substrate in Domain 11 South Pond Klemme consists mostly of silty clay sand with a high iron content producing a strong red color. The soils are highly erodible as witnessed by the large number of gullies in the area and with low tensile strength.

Figure 56 Example of substrate that is usually submerged. This substrate displays high wetting and drying cycles producing surface crusting at Domain 11 South Pond Klemme.

Figure 57 Example of more gravelly nature of the substrate on the berm banks. A large quantity of other dry vegetation and shells were also observed.

### 7.1.7 Site Access Needs

South Pond Klemme will require:

1. A flexible floating platform that can handle large water level fluctuations annually (~3m).

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

Temporary access using removable non-permanent platforms to access locations of S1 and S2, particularly during low water level conditions to reduce erosion and impact on the site.


Figure 58 Approximate location of required footpath (shown in yellow) for Domain 11 South Pond Klemme.

Table 25 Pathway Location

| Pathway | Latitude | Longitude |
| --- | --- | --- |
| Start | 35.398268 | -99.062576 |
| Middle | 35.398295 | -99.062493 |
| End | 35.398350 | -99.062367 |

### 7.1.8 Communications at the Site

ALL - See table in Appendix C for additional IT info

### 7.1.9 Power at the Site

### 7.1.10 Site Science Construction Constraints and Limitations

Site-specific issues to consider at Domain 11 South Pond Klemme are:

- Steeper slope angles near the pond mean there is a potential restriction for access to the pond (particularly at low water level) during construction.
- The high degree of erodibility of the soils of the area, limit the weight and type of equipment that may be able to safely and non-destructively access the site.
- Turbidity- poor water clarity will pose difficulties for certain procedures.

Driving and access constraints for Domain 11 South Pond Klemme are:

- Steeper slope angles near the pond mean there is a potential restriction for access to the pond (particularly at low water level) during construction.
- The high degree of erodibility of the soils of the area, limit the weight and type of equipment that may be able to safely and non-destructively access the site.
- Parking is possible at the site, however, continuous access to the site will cause rutting and potential erosion of the soils. The walking distance between the parking area and sampling reaches is approximately 350 meters.
- Movement through or along the channel on foot will prove difficult or impossible due to deep pools, extensive riparian vegetation, fine-grained sediment composition, and poor water clarity.

#### 7.1.11 Other Issues

No other science issues are identified at this time.