D16 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	04/16/2014	ECO-01808	Initial release
B	08/28/2015	ECO-03168	Martha Creek replacing Planting Creek. Adding site details for Martha Creek.

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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 D16 aquatic locations: Martha Creek (core), McRae Creek (relocatable), and McRae Creek (STREON). 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)]
RD[05]	US Department of Agriculture US Forest Service. 2011. Environmental Assessment Fish Passage at Martha Creek Dam. Mt. Adams Ranger District, Gifford Pinchot National Forest Skamania County, Washington.

3 DOMAIN 16 AIS SITE CHARACTERIZATION REPORT

3.1 Martha Creek

Martha Creek is a 3rd-order wadeable stream and tributary of Trout Creek that drains a watershed approximately 2,400 acres dominated by old-growth coniferous forest (RD[05]). The creek has a moderate gradient averaging 3-4%. The flow regime of Martha Creek is considered stable and dominated by groundwater input: base discharge typically increases in the fall, remains high during the winter, peaks in spring due to snowmelt and decreases to annual lows during the summer dry season. Sustained periods of high flow during late fall, winter and spring and very high discharge events induced by winter storms or snowmelt events will require consideration when installing sensors and developing access routes. Zero-flow days are considered extremely unlikely, though low base discharge values may prove problematic for sensor deployment during the summers of particularly dry years. In August of 2012, the Martha Creek Dam, located 1.5 miles upstream of the tributary into Trout Creek, was removed.

3.1.1 Aquatic Auxiliary and Aquatic Portal Locations for Construction

The auxiliary and aquatic portal will be placed at the entrance to the site (end of the paved road) so the electrical utility transformer can be collocated with the higher electrical load aquatic equipment. This location will also allow the electrical utility to access the primary power transformer. Putting the portal at this location will need to be verified by the electrical engineers as it will create long secondary power distances of at least 1,700 ft. to the MET station.

The bottom of the hill to the logging road was identified as a possible location during the site visit in Feb 2015. While this is a possible location, the electric utility might require trees to be removed in order to have vehicular access to the transformer.

3.1.2 Sensor Locations for Construction

The GPS coordinates for S1, S2 and Met station presented in Table 1 & 2 were obtained by AQU with support from EHS. 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 **S1** and **S2** sensors were located approximately **500 m** from the parking location on the Forest Service Access Road.

Table 1 Sensors 1 and 2 locations.

Sensor	Latitude	Longitude
S1	45.790797°	-121.933561°
S2	45.792350°	-121.929322°

Table 2 Met sensor location.

Sensor	Latitude	Longitude
Met Station	45.791653°	-121.931914°

The pressure transducer for determining discharge should be co-located with the S2 sensor.

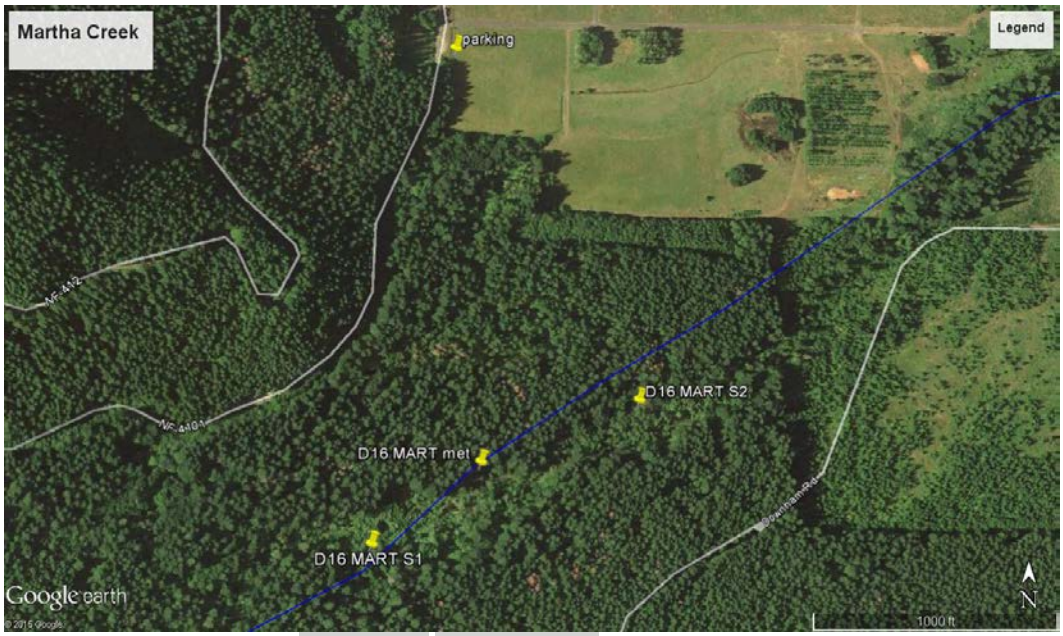

Figure 1 Kmz File of Domain 16 Martha Creek Denoting Locations of S1, S2, and Met Station

Figure 2 S1 Location in a pool at Domain 16 Martha Creek. Shown here is the right bank.

Figure 3 Location of S2 sensor at Domain 16 Martha Creek.

Figure 4 Photo of Met Station Location on the left bank at Domain 16 Martha Creek.

Figure 5 Typical stream reach between S1 and S2 sensors in Martha Creek. The channel is dominated by riffle habitat and is surrounded by deciduous trees that have grown since the area was logged.

3.1.3 Groundwater Wells

A total of 8 groundwater observation wells will be installed along Martha Creek. Well locations are shown in **Figure 6** and were selected to give a suitable coverage of hydraulic conditions along the selected study reach. Monitoring well GPS coordinates are summarized in **Table 3**. Well locations need to be confirmed in the field and will be done following a visit by the NEON hydrologist.

Table 3 Observation Well Locations.

Well ID*	Latitude	Longitude
D17-MART-OW-01	45.790633°	-121.933412°
D17-MART-OW-02	45.791059°	-121.933798°
D17-MART-OW-03	45.790548°	-121.931681°
D17-MART-OW-04	45.791285°	-121.931099°
D17-MART-OW-05	45.791735°	-121.931441°
D17-MART-OW-06	45.792597°	-121.931117°
D17-MART-OW-07	45.792114°	-121.929379°
D17-MART-OW-08	45.792567°	-121.929902°
* All well locations are considered temporary until NEON hydrologist has a chance to visit the site.		

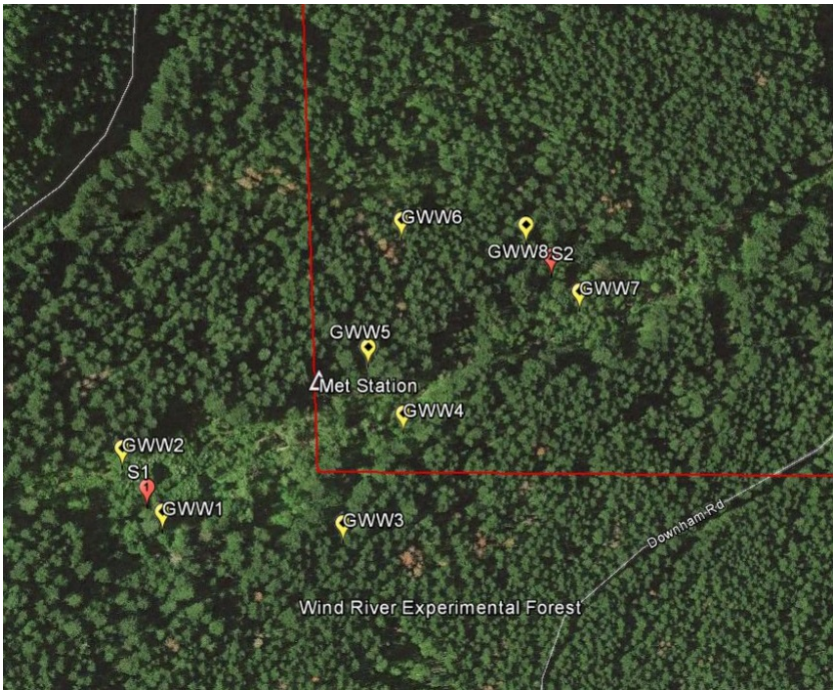

Figure 6 Initial Groundwater Well Locations Based on EMS kmz File at Domain 16 Martha Creek

3.1.4 Riparian Vegetation Cover

During 2015 site visit, the following plant density and type were observed by the AQU team:
The riparian area adjacent to Martha Creek consists of mixed deciduous forest of red alder (*Alnus rubra*) and Pacific dogwood (*Cornus nuttallii*) and large conifers including Western hemlock (*Tsuga heterophylla*) and Pacific silver fir (*Abies amabilis*). Some areas of the stream bank have dense growth of understory shrubs and devil's club. The riparian area between S1 and S2 is littered with downed trees from historic logging activity.

Figure 7 Typical riparian canopy vegetation at Domain 16 Martha Creek

3.1.5 Bank Morphology

During 2015 site visit, AQU observed the following bank conditions at S1 and S2:

A 5-10 m wide, well-vegetated and rocky floodplain one either side (or both sides) of the channel is present at nearly all points along the active channel. This floodplain is likely inundated during episodic high discharge events.

Table 4 Bank conditions at Domain 16 Martha Creek.

Morphology Type	S1	S2
Maximum water height (m)	0.48 m	0.32 m
Wetted width (m)	4.0 m	4.0 m
Substrate composition	Boulder, cobble	Boulder, cobble

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

Figure 9 Typical bank structure of Martha Creek.

3.1.6 Site Photos

The following photos of are representative of the site.

Figure 10 The substrate in Domain 16 Martha Creek is dominated by cobbles, including riffles and pools habitat.

Figure 11 Fallen trees in Martha Creek occasionally cause large obstructions in the channel and on the stream bank.

Figure 12 Occasionally, no riparian floodplain is present where a steep slope abuts against the channel in Martha Creek and shows signs of erosion. Shown here is the right bank between S1 and S2.

3.1.7 Site Access Needs

At the end of Hemlock Road, a decommissioned National Forest road (4101) is blocked to driving but once cleared will allow vehicular access to within 500 m of Martha Creek. A footpath trail has been created through the forest between the forest road and the S2 location, and a walkable portion of the forest access road passes S1 within 200 m or the sensor location. An access path will need to be developed between S1 and S2 on the stream bank due to downed trees and devil's club on the bank.

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

An unimproved footpath through native vegetation along Martha Creek will be necessary to provide access to both sensors and locations within the sensor reach. Such a footpath should be located upslope from the active channel to ensure high flows do not inundate the path and prevent damages to riparian vegetation. Because the sensors are spaced approximately 490 m apart, a footpath of this length will be necessary.

3.1.8 Site Science Construction Constraints and Limitations

Site-specific issues to consider at Domain 16 Martha Creek are:

- Substantial intra-annual variability in seasonal base discharge, from very high values in the winter and spring to low values in the mid- to late-summer.
- Episodic very high flow events will occur in the winter and spring.

Driving and access constraints for Domain 16 Martha Creek are:

- The United States Forest Service road (4101) provides well-maintained vehicular access to within 500 m of the Martha Creek site. Unless significant snowfall ensues, four-wheel drive vehicles will not be necessary to travel this route.

3.1.9 Other Issues

No other science issues are identified at this time.

3.2 McRae Creek

McRae Creek is a 3rd-order wadeable stream that drains a watershed dominated by old-growth coniferous forest. The flow regime of McRae Creek is considered stable and dominated by groundwater input: base discharge typically increases in the fall, remains high during the winter, peaks in spring due to snowmelt and decreases to annual lows during the summer dry season. Sustained periods of high flow during late fall, winter and spring and very high discharge events induced by winter storms or snowmelt events will require consideration when installing sensors and developing access routes. Zero-flow days are considered extremely unlikely, though low base discharge values may prove problematic for sensor deployment during the summers of particularly dry years.

3.2.1 Aquatic Auxiliary and Aquatic Portal Locations for Construction

The site is an alternate power site, therefore, the portal locations will be placed as close to the sensor suites as possible to maximize the power provided.

3.2.2 Sensor Locations for Construction

The GPS coordinates for S1, S2 and Met station presented in Tables 5 & 6 were obtained by AQU with support from EHS. 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 the thick canopy cover at McRae Creek prevented high-quality GPS readings, *the accuracy of the coordinates listed below is unknown*. The **S1** and **S2** sensors were located approximately **670** and **470 m** upstream of the crossing with Road 325, respectively. Coordinates listed below were estimated using these measured distances and a GIS.

Table 5 Sensors 1 and 2 locations.

Sensor	Latitude	Longitude
S1	44.260366	-122.164594
S2	44.258954	-122.166041

Table 6 Met sensor location.

Sensor	Latitude	Longitude
Met Station	44.258417	-122.166367

Pressure transducers and/or velocity sensors for calculating discharge can be co-located with either sensor.

Figure 13 Kmz File of Domain 16 McRae Creek Denoting Locations of S1, S2, and Met Station

Figure 14 Location of S1 at Domain 16 McRae Creek. Shown is the perspective facing downstream.

Figure 15 Location of the S2 sensor at Domain 16 McRae Creek. Shown is the right bank.

Figure 16 Meteorology station location at Domain 16 McRae Creek. Shown is the right bank, where a relatively flat area above the floodplain provides ample space for the station.

3.2.3 Groundwater Wells

A total of 8 groundwater monitoring wells will be installed along the McRae Creek. Well locations are shown in **Figure 21** and were selected to give a suitable coverage of hydraulic conditions along the selected study reach. Well field layout was selected to encompass both the AQU reach as well as the STREON reach with two wells at both the upper AQU S1 and the lower AQU S2 location, with one well located roughly halfway between AQU S1 and S2. Within the STREON reach, one well is located near STREON S1 and two wells are located near STREON S2. In general, topographic complexity and hill slope steepness necessitates that wells are located close to the stream and on relatively flat elevated portions of the floodplain. The well field encompasses the length of the study reach and extends up to 25 meters laterally from the stream on both banks. Monitoring well GPS coordinates are summarized in **Table 7**.

Table 7 Monitoring Well Locations.

Well ID*	Latitude	Longitude
D16-MCRA-OW-01	44.2603776	-122.1648831
D16-MCRA-OW-02	44.2601056	-122.1644193
D16-MCRA-OW-03	44.2595000	-122.1654000
D16-MCRA-OW-04	44.2589052	-122.1662854
D16-MCRA-OW-05	44.2588170	-122.1657500
D16-MCRA-OW-06	44.2577000	-122.1670500
D16-MCRA-OW-07	44.2559552	-122.1683497
D16-MCRA-OW-08	44.2556906	-122.1680510

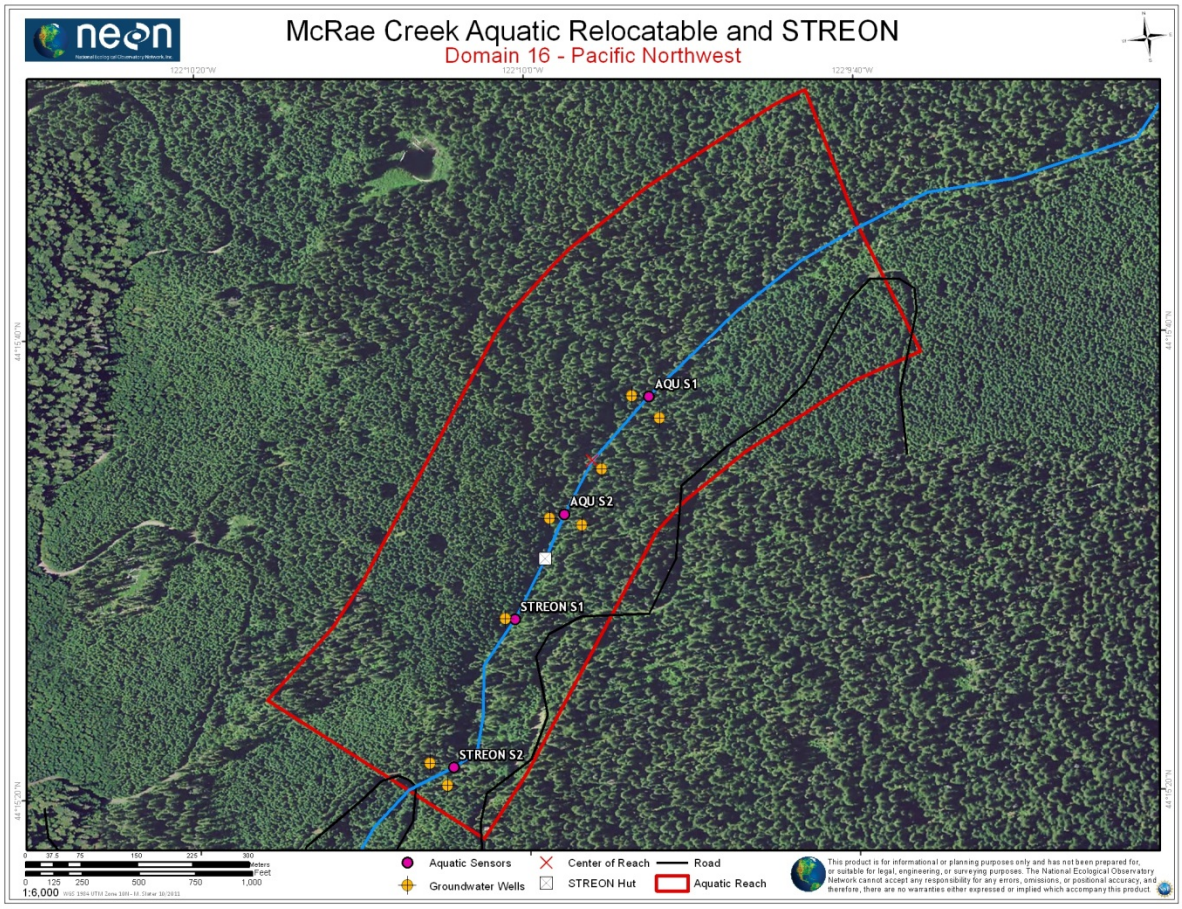

Figure 17 Initial Groundwater Well Locations Based on EMS kmz File at Domain 16 McRae Creek

3.2.4 Riparian Vegetation Cover

During 2010-2011 site visits, the following plant density and type were observed by the AQU team:
The riparian area adjacent to Martha Creek consists of old-growth mixed conifer forest. Mature western hemlock and Douglas fir trees dominate the over-story canopy, while groundcover consists of vine maple, Pacific yew, dogwood and alder. Most mature trees are 200-300 feet tall, while groundcover is often thick in areas adjacent to the stream.

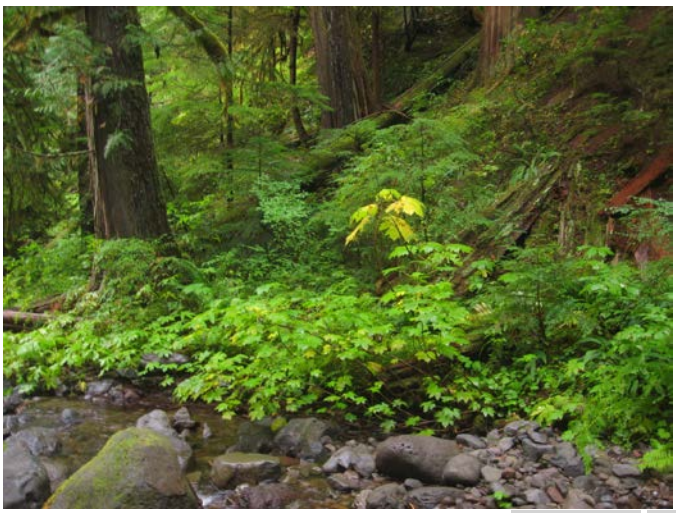

Figure 18 Typical riparian canopy and ground cover at Domain 16 McRae Creek.

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.

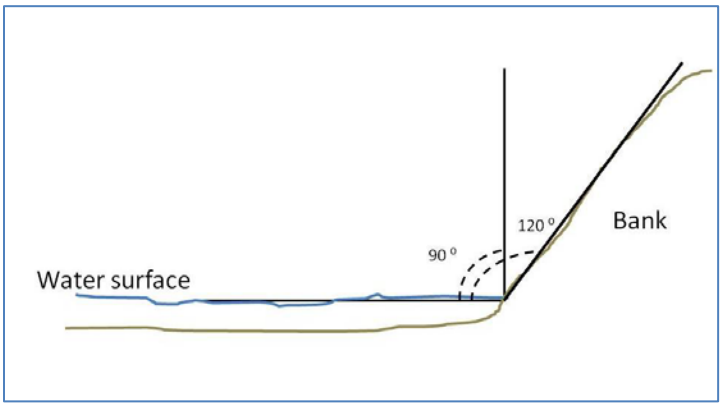

Figure 19 How Bank Angle is Measured

During 2011 site visits, AQU observed the following bank conditions at S1 and S2:
A 5-10 m wide, well-vegetated and rocky floodplain one either side (or both sides) of the channel is present at nearly all points along the active channel. This floodplain is likely inundated during episodic very high discharge events.

Table 8 Bank Conditions At Domain 16 McRae Creek In 2011

Morphology Type	S1	S2
RB* angle	160	170
LB* angle	130	90
Maximum water	2 m	1.2 m

height		
Bankfull width	10.7 m	7 m
Substrate composition	Boulder-dominated, some cobble	Boulder-dominated, some cobble

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

Figure 20 Typical bank structure in McRae Creek.

3.2.6 Site Photos

The following photos of are representative of the site.

Figure 21 Substrate in Domain 16 McRae Creek consists mostly of boulders with patches of cobble, pebble and (very rarely) sand.

Figure 22 Much of the benthic habitat in McRae Creek consists of very large boulders.

Figure 23 Large woody debris falls can be quite sizable and capable of restricting access in the stream and along the channel.

Figure 24 Thick stands of vine maple and large fallen conifer logs can render mobility along the banks of McRae Creek difficult without a footpath.

Figure 25 Above the floodplain of McRae Creek, a moderate slope into upland forested areas is present.

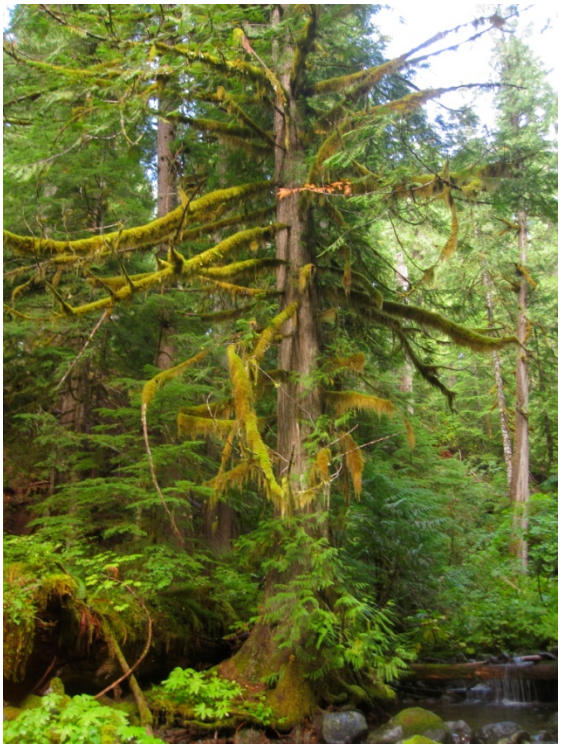

Figure 26 Vegetative growth along McRae Creek can occur immediately adjacent to the channel and define physical characteristics of the stream.

3.2.7 Site Access Needs

McRae Creek will require a footpath in the upland forest immediately adjacent to the riparian area of the stream from Road 325 to the S1 sensor. The footpath may be developed on either bank but should not cross the channel, as high flows will likely render crossing the stream difficult during certain seasons. Alternatively, a series of shorter footpaths could be constructed from Road 325 to the east bank of McRae Creek.

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

Potentially hazardous high flows in the winter and spring demand an access route that does not involve stream crossings. Two options exist for providing access to McRae Creek (Figure 31):

1) *Option 1*- A footpath could be constructed immediately adjacent to the floodplain from the point where Road 325 crosses McRae to the uppermost sensor location (approximately 670 m upstream). Such a path could be constructed on either side of McRae Creek, but whichever side is chosen will become the bank where all sensors and gears are placed, as high flows will disallow safe stream crossing during winter and spring.

2) Option 2- A series of footpaths from Road 325 to the sensor locations could be constructed. This option would require four such paths or one to each sensor and sampling location, with the lowermost one originating where the road crosses the stream. Adopting this option would

require all sensors and gear to be placed on the east side of the stream, as high flows will disallow safe stream crossing during winter and spring

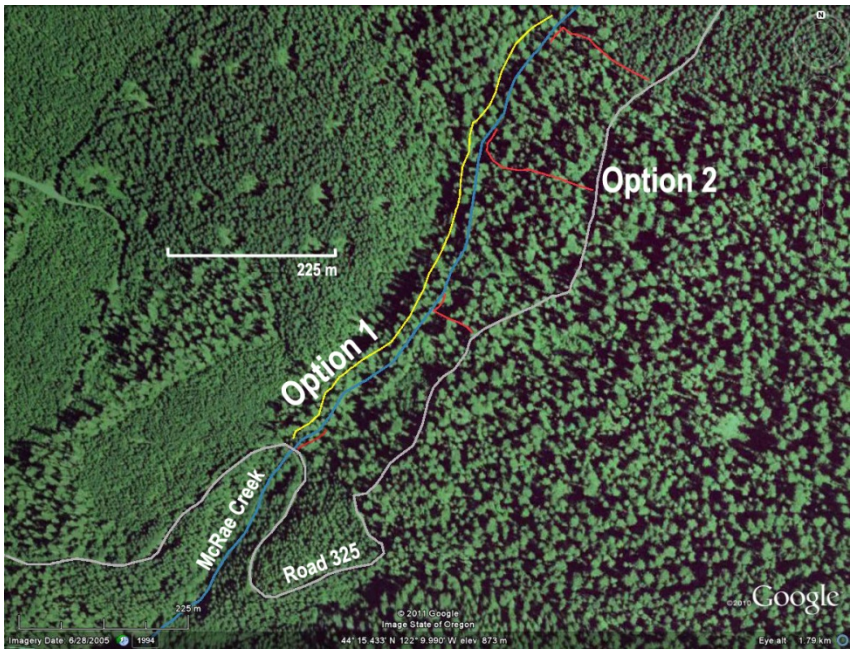

Figure 27 Two options exist to provide access at McRae Creek. 1) A path could be constructed along the length of the stream from the intersection with Road 325 (shown in yellow) and 2) a series of short paths could be constructed from Road 325 to the sensor set

3.2.8 Site Science Construction Constraints and Limitations

Site-specific issues to consider at Domain 16 McRae Creek are:

- Substantial intra-annual variability in seasonal base discharge, from very high values in the winter and spring to low values in the mid- to late-summer.
- Episodic very high flow events will ensue in the winter and spring.

Driving and access constraints for Domain 16 McRae Creek are:

- Road 325 provides direct vehicular access to McRae Creek. Four-wheel drive will not be necessary to traverse this road except when unplowed snow complicates driving conditions.
- Footpaths will need to be developed, either along the entire sensor reach or through a series of short routes from Road 325 to the sensor locations.

3.2.9 Other Issues

No other science issues are identified at this time.

3.3 McRae Creek STREON

McRae Creek STREON is a 3rd-order wadable stream that drains a watershed dominated by old-growth coniferous forest. The flow regime of McRae Creek STREON is considered stable and dominated by groundwater input: base discharge typically increases in the fall, remains high during the winter, peaks in spring due to snowmelt and decreases to annual lows during the summer dry season. Sustained periods of high flow during late fall, winter and spring and very high discharge events induced by winter storms or snowmelt events will require consideration when installing sensors and developing access routes. Zero-flow days are considered extremely unlikely, though low base discharge values may prove problematic for sensor deployment during the summers of particularly dry years.

3.3.1 Aquatic Auxiliary and Aquatic Portal Locations for Construction

The site is an alternate power site, therefore, the portal locations will be placed as close to the sensor suites as possible to maximize the power provided.

3.3.2 Sensor Locations for Construction

The GPS coordinates for STR S1, S2 and Met station presented in Tables 9 & 10 were obtained by AQU with support from EHS. 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 the thick canopy cover at McRae Creek STREON prevented high-quality GPS readings, *the accuracy of the coordinates listed below is unknown*. The STR **S1** and STR **S2** sensors were located approximately **280** and **50 m** upstream of the crossing with Road 325, respectively. Coordinates listed below were estimated using these measured distances and a GIS.

Table 9 Sensors 1 and 2 locations.

Sensor	Latitude	Longitude
STR S1	44.257762	-122.166721
STR S2	44.256013	-122.168203

Pressure transducers and/or additional gear deployed to calculate discharge should be co-located with the S1 sensor. The Meteorology station shall be the same as the AQU reach:

Table 10 Met sensor location.

Sensor	Latitude	Longitude
Met Station	44.258417	-122.166367

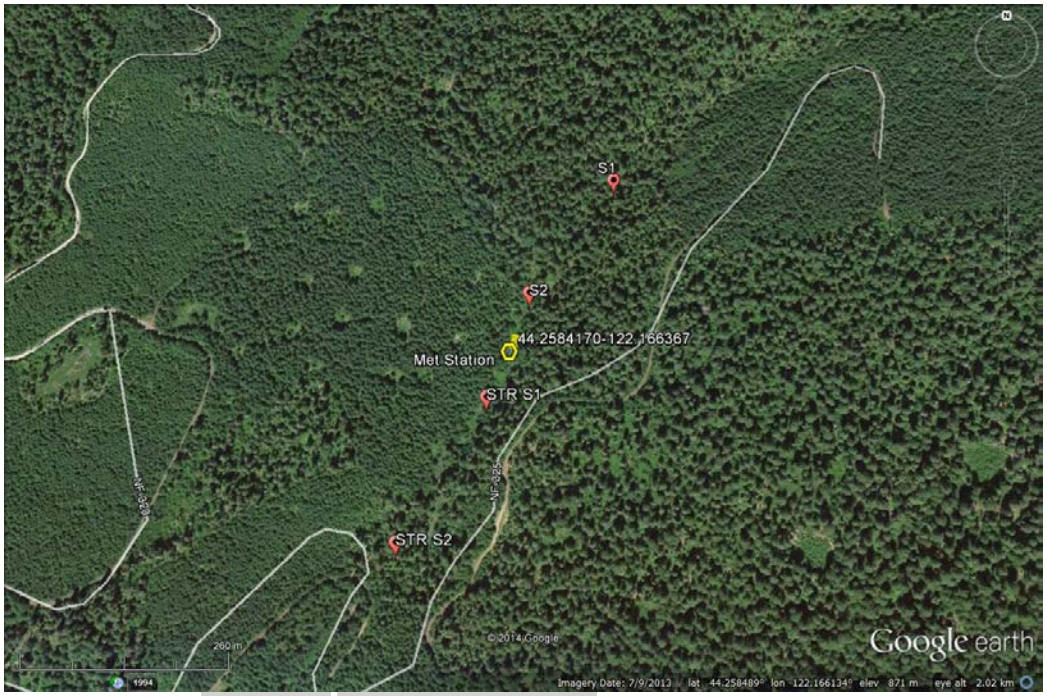

Figure 28 Kmz File of Domain 16 McRae Creek STREON Denoting Locations of STR S1, STR S2, and Met Station

Figure 29 STR S1 location at Domain 16 McRae Creek STREON (STREON). Shown is the right bank.

Figure 30 STR S2 location at Domain 16 McRae Creek STREON (STREON). Taken from the perspective of facing upstream.

Figure 31 Met station and STREON hut location at Domain 16 McRae Creek STREON (STREON). Shown is the right bank, where a relatively flat area above the floodplain provides ample space for the station and hut.

3.3.3 Groundwater Wells

A total of 8 groundwater monitoring wells will be installed along the East Branch of Planting Creek. Well locations are shown in **Figure 36** and were selected to give a suitable coverage of hydraulic conditions along the selected study reach. Well field layout was selected to encompass both the AQU reach as well as the STREON reach with two wells at both the upper STR S1 and the lower STR S2 location, with one well located roughly halfway between STR S1 and S2. Within the STREON reach, one well is located near STREON S1 and two wells are located near STREON S2. In general, topographic complexity and hill slope steepness necessitates that wells are located close to the stream and on relatively flat elevated portions

of the floodplain. The well field encompasses the length of the study reach and extends up to 25 meters laterally from the stream on both banks. Monitoring well GPS coordinates are summarized in **Table 11**.

Table 11 Monitoring Well Locations.

Well ID*	Latitude	Longitude
USRB	44.2603776	-122.1648831
USLB	44.2601056	-122.1644193
USM	44.2595000	-122.1654000
MSRB	44.2589052	-122.1662854
MSLB	44.2588170	-122.1657500
DSM	44.2577000	-122.1670500
DSRB	44.2559552	-122.1683497
DSLB	44.2556906	-122.1680510
* Temporary Well ID – Official Name TBD		

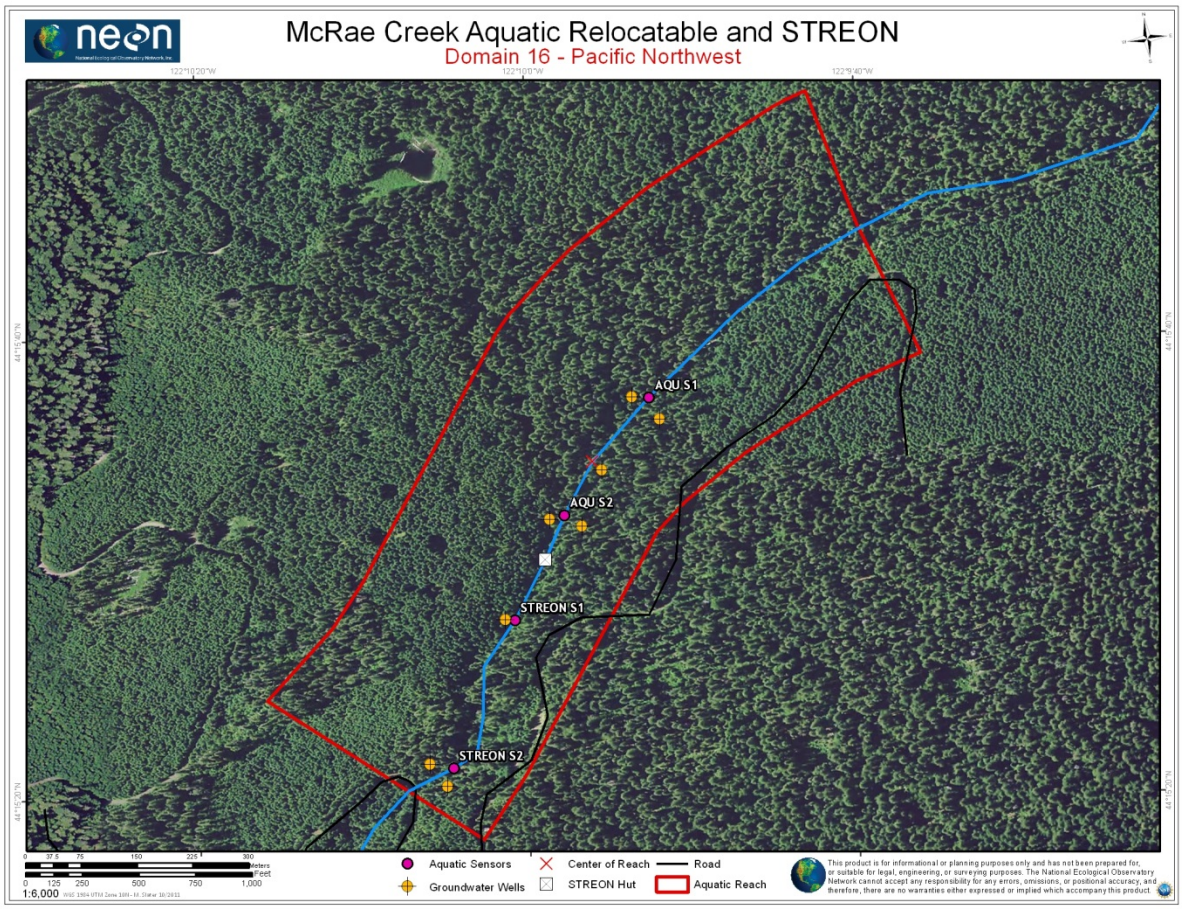

Figure 32 Initial Groundwater Well Locations Based on EMS kmz File at Domain 16 McRae Creek STREON

3.3.4 Riparian Vegetation Cover

During 2010-2011 site visits, the following plant density and type were observed by the AQU team:
The riparian area adjacent to Martha Creek consists of old-growth mixed conifer forest. Mature western hemlock and Douglas fir trees dominate the over-story canopy, while groundcover consists of vine maple, Pacific yew, dogwood and alder. Most mature trees are 200-300 feet tall, while groundcover is often thick in areas adjacent to the stream.

Figure 33 Typical riparian canopy and ground cover vegetation at Domain 16 McRae Creek STREON (STREON).

3.3.5 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.

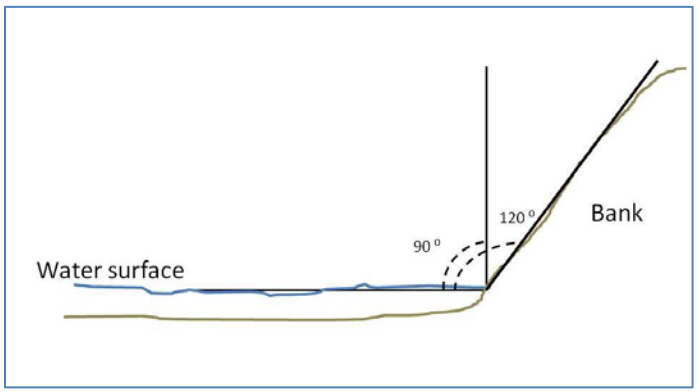

Figure 34 How bank angle is measured.

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

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

Table 12 Bank Conditions At Domain 16 McRae Creek STREON In 2011

Morphology Type	S1	S2
RB* angle	90	100
LB* angle	170	135
Maximum water height	1.2 m	1.3
Bankfull width	6.9 m	12.9
Substrate composition	Boulder-dominated, some cobble	Boulder-dominated, some cobble

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

3.3.6 Site Photos

The following photos of are representative of the site:

Figure 35 Substrate in the STREON reach resembles that of the AQU reach: boulder-dominated with patches of cobble. Shown is upstream of the STREON S1 location.

Figure 36 Although base flows rise to levels substantially higher than those shown in this picture, thick vegetative cover is established in the floodplain, suggesting that it is rarely inundated.

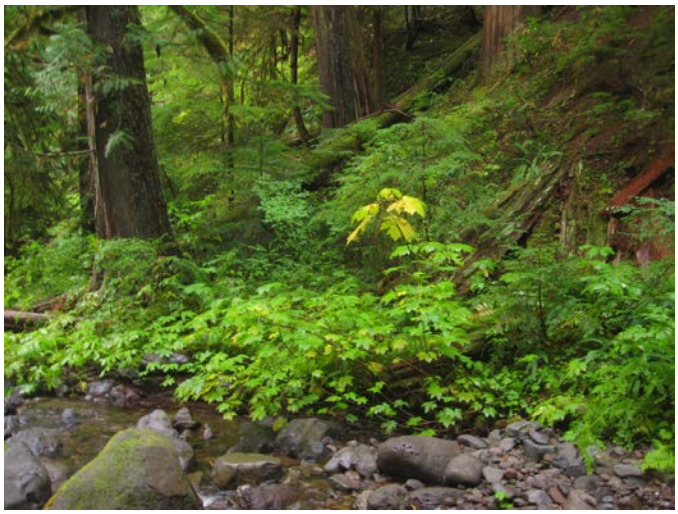

Figure 37 Steep forested slopes typically abut the riparian floodplain area of McRae Creek STREON.

Figure 38 Very large pieces of woody debris are common along McRae Creek STREON.

Figure 39 In some places, riparian ground cover such as vine maple cover the entire width of the wetted channel.

Figure 40 The access road (325) to McRae Creek STREON is well-maintained enough for 2-wheel drive vehicles, except during hazardous winter conditions.

3.3.7 Site Access Needs

McRae Creek STREON will require a footpath in the upland forest immediately adjacent to the riparian area of the stream from Road 325 to the STR S1 sensor. The footpath may be developed on either bank but should not cross the channel, as high flows will likely render crossing the stream difficult during certain seasons. Alternatively, a series of shorter footpaths could be constructed from Road 325 to the east bank of McRae Creek STREON.

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

Potentially hazardous high flows in the winter and spring demand an access route that does not involve stream crossings. Two options exist for providing access to McRae Creek STREON (Figure 45):

1) *Option 1*- A footpath could be constructed immediately adjacent to the floodplain from the point where Road 325 crosses McRae to the uppermost sensor location (approximately 670 m upstream). Such a path could be constructed on either side of McRae Creek STREON but whichever side is chosen will become the bank where all sensors and gears are placed, as high flows will disallow safe stream crossing during winter and spring.

2) Option 2- A series of footpaths from Road 325 to the sensor locations could be constructed. This option would require four such paths or one to each sensor, with the lowermost one originating where the road crosses the stream. Adopting this option would require all sensors and gear to be placed on the east side of the stream, as high flows will disallow safe stream crossing during winter and spring

Figure 41. Two options exist to provide access at McRae Creek STREON. 1) A path could be constructed along the length of the stream from the intersection with Road 325 (shown in yellow) and 2) a series of short paths could be constructed from Road 325 to the sensor locations (shown in red).

3.3.8 Site Science Construction Constraints and Limitations

Site-specific issues to consider at Domain 16 McRae Creek STREON are:

- Substantial intra-annual variability in seasonal base discharge, from very high values in the winter and spring to low values in the mid- to late-summer.
- Episodic very high flow events will ensue in the winter and spring.

Driving and access constraints for Domain 16 McRae Creek STREON are:

- Road 325 provides direct vehicular access to McRae Creek STREON. Four-wheel drive will not be necessary to traverse this road except when unplowed snow complicates driving conditions.
- Footpaths will need to be developed, either along the entire sensor reach or through a series of short routes from Road 325 to the sensor locations.

3.3.9 Other Issues

No other science issues are identified at this time.

4 APPENDIX A. FCC SUMMARY TABLES FOR AIS SITE COMPONENTS AT DOMAIN 16

4.1 Martha Creek FCC Summary Table

Site Component	Latitude	Longitude	Units
Stream, Lake, or Stream+STREON			Description
Aquatic Auxiliary Power Portal location	Site1-AuxLat	Site1-AuxLong	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 McRae Creek FCC Summary Table

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

4.3 McRae Creek STREON FCC Summary Table

Site Component	Latitude	Longitude	Units
Stream, Lake, or Stream+STREON			Description
Aquatic Auxiliary Power Portal location	Site3-AuxLat	Site3-AuxLong	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	Site3-PathStartLat	Site3-PathStartLong	Lat, Long in degrees
Pathway end location	Site3-PathEndLat	Site3-PathEndLong	Lat, Long in degrees
Stairs or ladder needed?			Yes/no, description
Stairs top location	Site3-StairsTopLat	Site3-StairsTopLong	Lat, Long in degrees
Stairs length	Site3-StairsLength		Meters
Ladder top location	Site3-LadderTopLat	Site3-LadderTopLong	Lat, Long in degrees
Ladder length	Site3-LadderLength		Meters
Boardwalk needed? What is length?			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?			Yes/no, description
Fencing needs			Description
Site management			Description
Any additional site specific information			Description

4.4 McRae Creek FCC Summary Table

Site Component	Latitude	Longitude	Units
Stream, Lake, or Stream+STREON			Description
Aquatic Auxiliary Power Portal location	STR-AuxLat	STR-AuxLong	Lat, Long in degrees
Aquatic Portal location			m away from bank, direction
STREON Hut location			m away from bank, direction
Pathway needed? What is length?			Yes/no, description w/ length
Pathway start location	STR-PathStartLat	STR-PathStartLong	Lat, Long in degrees
Pathway end location	STR-PathEndLat	STR-PathEndLong	Lat, Long in degrees
Stairs or ladder needed?			Yes/no, description
Stairs top location	STR-StairsTopLat	STR-StairsTopLong	Lat, Long in degrees
Stairs length	STR-StairsLength		Meters
Ladder top location	STR-LadderTopLat	STR-LadderTopLong	Lat, Long in degrees
Ladder length	STR-LadderLength		Meters
Boardwalk needed? What is length?			Yes/no, description w/ length
Boardwalk start location	STR-BrdwlkStartLat	STR-BrdwlkStartLong	Lat, Long in degrees
Boardwalk end location	STR-BrdwlkEndLat	STR-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 16

5.1 Martha Creek EHS Summary Table

Site Component	Latitude	Longitude	Units
Sensor 1 (S1) location	45.790797°	-121.933561°	Lat, Long in degrees
Sensor 2 (S2) location	45.792350°	-121.929322°	Lat, Long in degrees
Discharge Sensor location (if needed)	Site1-DSLat	Site1-DSLong	Lat, Long in degrees
Met Station location	45.791653°	-121.931914°	Lat, Long in degrees
Aquatic Auxiliary Power Portal location	Site1-AuxLat	Site1-AuxLong	Lat, Long in degrees
Aquatic Portal location	Site1-APLat	Site1-APLong	Lat, Long in degrees

5.2 McRae Creek EHS Summary Table

Site Component	Latitude	Longitude	Units
Sensor 1 (S1) location	44.260366	-122.164594	Lat, Long in degrees
Sensor 2 (S2) location	44.258954	-122.166041	Lat, Long in degrees
Discharge Sensor location (if needed)	Site2-DSLat	Site2-DSLong	Lat, Long in degrees
Met Station location	44.258417	-122.166367	Lat, Long in degrees
Aquatic Auxiliary Power Portal location	Site2-AuxLat	Site2-AuxLong	Lat, Long in degrees
Aquatic Portal location	Site2-APLat	Site2-APLong	Lat, Long in degrees

5.3 McRae Creek STREON EHS Summary Table

Site Component	Latitude	Longitude	Units
Sensor 1 (S1) location	44.257762	-122.166721	Lat, Long in degrees
Sensor 2 (S2) location		-122.168203	Lat, Long in degrees
Discharge Sensor location (if needed)	Site3-DSLat	Site3-DSLong	Lat, Long in degrees
Met Station location	39.105209085	-122.166367	Lat, Long in degrees
Aquatic Auxiliary Power Portal location	Site3-AuxLat	Site3-AuxLong	Lat, Long in degrees
Aquatic Portal location	Site3-APLat	Site3-APLong	Lat, Long in degrees

5.4 McRae Creek EHS Summary Table

Site Component	Latitude	Longitude	Units
Sensor 1 (S1) location	STR-S1Lat	STR-S1Long	Lat, Long in degrees
Sensor 2 (S2) location	STR-S2Lat	STR-S2Long	Lat, Long in degrees
Discharge Sensor location (if needed)	STR-DSLat	STR-DSLong	Lat, Long in degrees
Aquatic Auxiliary Power Portal location	STR-AuxLat	STR-AuxLong	Lat, Long in degrees
Aquatic Portal location	STR-APLat	STR-APLong	Lat, Long in degrees
STREON Hut location	STR-HutLat	STR-HutLong	Lat, Long in degrees