D11 FIU SITE CHARACTERIZATION: SUMMARY

PREPARED BY	ORGANIZATION	DATE
E. Ayres/H. Luo /H. Loescher	FIU	01/07/2011

APPROVALS (Name)	ORGANIZATION	APPROVAL DATE
Edward Ayers	FIU	03/10/2015
Jeff Coleman	FCC	02/17/2015

RELEASED BY (Name)	ORGANIZATION	RELEASE DATE
Judy Salazar	CM	03/11/2015

See Configuration Management System for approval history.

Change Record

REVISION	DATE	ECO #	DESCRIPTION OF CHANGE
A	01/21/2011	NEON.FIU.000286.CRE_D11 FIU Site Characterization Reports	INITIAL RELEASE
B	09/26/2011	ECO-00279	Update to new document number's/template throughout document.
C	12/05/2014	ECO-02388	Delete Northcutt site (soft site), and replace it with Witchita Mountain Wildlife Refuge
D	03/11/2015	ECO-02720	Fixing typo in hut and tower positions

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 DESCRIPTION

1.1 Purpose

The data summarized here is used to inform the site design activities for NEON project Teams, EHS (permitting), FCC, ENG and FSU. This document summarizes the FIU site characterization data collected, analyzed, and described in the FIU D11 Site Characterization: Supporting Data (AD[01]).

1.2 Scope

This document summarizes the FIU site characterization data for three D11 tower locations: Caddo-LBJ National Grassland site (Advanced), Northcutt site (Relocatable 1), and Klemme Range Research Station site (Relocatable 2). Issues and concerns for each site that need attention are also addressed in this document according to our best knowledge.

Disclaimer: all latitude and longitude points are subject to the tolerances of our measurement system, i.e., GPS.

2 RELATED DOCUMENTS AND ACRONYMS

2.1 Applicable Documents

AD[01]	NEON.DOC.011059 _ FIU D11 Site Characterization Supporting Data.docx
AD[02]	NEON.DOC.011018 _WID between FIU and FCC
AD[03]	NEON.DOC.011008 _ FIU Tower Science Requirements
AD[04]	NEON.DOC.011029 _ FIU Precipitation Collector Site Design Requirements

2.2 Reference Documents

RD[01]	NEON.DOC.000008	NEON Acronym List
RD[02]	NEON.DOC.000243	NEON Glossary of Terms
RD[03]		
RD[04]		

2.3 Acronyms

m.a.s.l.	Meters above sea level
m.a.g.l.	Meters above ground level

2.4 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 CADDO-LBJ NATIONAL GRASSLAND ADVANCE TOWER SITE

3.1 Desired ecosystem

Table 1. Ecosystem at the LBJ Advanced tower site.

Ecosystem Type	Management activity
Oak-dominated forest	Managed burns every 3-5 years

The LBJ National Grassland has fairly flat terrain and consists of a mosaic of crosstimbers (oak-dominated) forest and grasslands. The ecosystem in the vicinity of the tower (including the airshed) is oak-dominated forest with a dense understory of vines with large thorns and other deciduous trees, which made walking around the site challenging. Note, poison ivy and ticks can be present. The site is (managed) burned every 3-5 years. Cattle sometimes graze this area, but it is unlikely that they enter the forest due to the dense understory (except following a fire when the understory is more open).

Table 2. Ecosystem and site attributes for LBJ Advanced tower site.

Ecosystem attributes	Measure and units
Mean canopy height	13 m
Surface roughness[a]	2 m
Zero place displacement height[a]	10 m
Structural elements	Open deciduous forest, diverse, dense and prickly understory
Time zone	central time zone
Magnetic declination	4° 35' E changing by 0° 7' W/year

Note, [a] From field observation.

3.2 Site Design and Tower Attributes

The site layout is summarized in the table below. Assume the projected area of the tower is square. **Anemometer/temperature boom arm direction** is ***from*** the tower ***toward*** the prevailing wind direction or designated orientation. **Instrument hut orientation vector** is parallel to the long side of the instrument hut. **Instrument hut distance z** is the distance from the center of tower projection to the center of the instrument hut projection on the ground. The numbering of the **measurement levels** is that the lowest is level one, and each subsequent increase in height is numbered sequentially.

Table 3. Site design and tower attributes for LBJ Advanced site.

0° is true north with declination accounted for. Color of Instrument hut exterior shall be tan or best match the surrounding environment.

Attribute	lat	long	degree	meters	notes
Airshed area			135° to 205° (major), 315° to 25° (secondary)		Clockwise from first angle
Tower location	33.40123°,	-97.57000°.	--	--	new site

Instrument hut	33.40118°,	-97.56982°.			
Instrument hut orientation vector	--	--	360° - 180°		
Instrument hut distance z	--	--	--	17	
Anemometer/Temperature boom orientation	--	--	270°	--	
DFIR	33.399418,	-97.566975			
Height of the measurement levels					
Level 1				0.3	m.a.g.l.
Level 2				4.0	m.a.g.l.
Level 3				10.0	m.a.g.l.
Level 4				16.0	m.a.g.l.
Level 5				22.0	m.a.g.l.
Tower Height				22.0	m.a.g.l.

See AD 03 for technical requirement to determine the boom height for the bottom most measurement level.

Eddy covariance, sonic wind and air temperature **boom arms** orientation toward the west will be best to capture signals from all wind directions. **Radiation boom arms** should always be facing south to avoid any shadowing effects from the tower structure.

DFIR location is at 33.399418, -97.566975, which is ~350 m southeast toward tower. **Wet deposition collector** will collocate at the top of the tower. See AD 04 for further information and requirements for bulk precipitation collection and wet deposition collection.

Boardwalks. Ultimately, the decision to use a boardwalk will be, in part, based on owner's preferences. There are strong science requirements that minimize site disturbance to the surrounding area, which will be difficult to manage over a 30-y period. Traffic control is key to minimizing the site disturbance. Confining foot traffic to boardwalks minimizes site impact; this is particularly true in places where wear caused by foot traffic becomes noticeable and grows. For example, in places with snow part of the year, worn footpaths tend to have low places that collect water, or places where the snow pack becomes uneven causing personnel to walk farther and farther around the sides of the original path, causing the path to grow in width. This is a very common phenomenon. Here, FIU assumes that all conduits will be either buried, or placed inside the boardwalk such that it does not extend beyond the 36" (0.914 m). The boardwalk to access the tower is not on any side that has a boom.
Specific Boardwalks at LBJ Advance site:

- Gravel path from the path to instrument hut, pending landowner decision
- Boardwalk from the instrument hut to the tower to intersect on north face of the tower
- Boardwalk to the soil array
- No boardwalk from the soil array boardwalk to the individual soil plots
- No boardwalk needed to DFIR site

The relative locations between tower, instrument hut and boardwalk can be found in the Figure below:

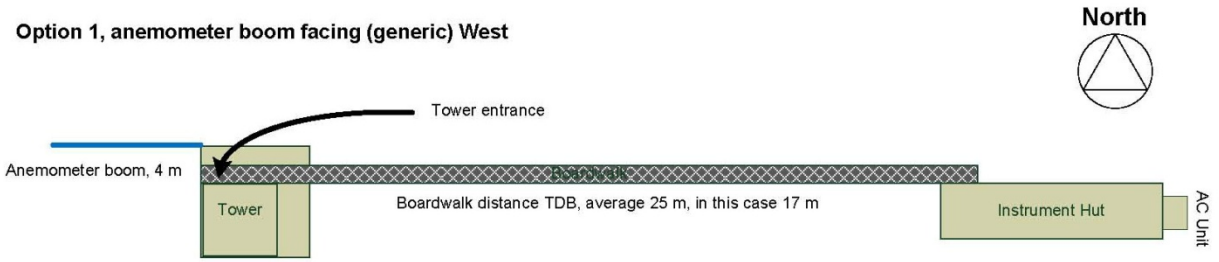


Figure 1. Generic diagram to demonstration the relationship between tower and instrument hut when boom facing west and instrument hut on the east towards the tower.

This is just a generic diagram. The actual layout of boardwalk (or path if no boardwalk required) and instrument hut position will be the joint responsibility of FCC and FIU. At LBJ Advanced site, the boom angle will be 270 degrees, instrument hut will be on the east towards the tower, the distance between instrument hut and tower is ~17 m. The instrument hut vector will be S-N (180^{o}-360^{o}, longwise).

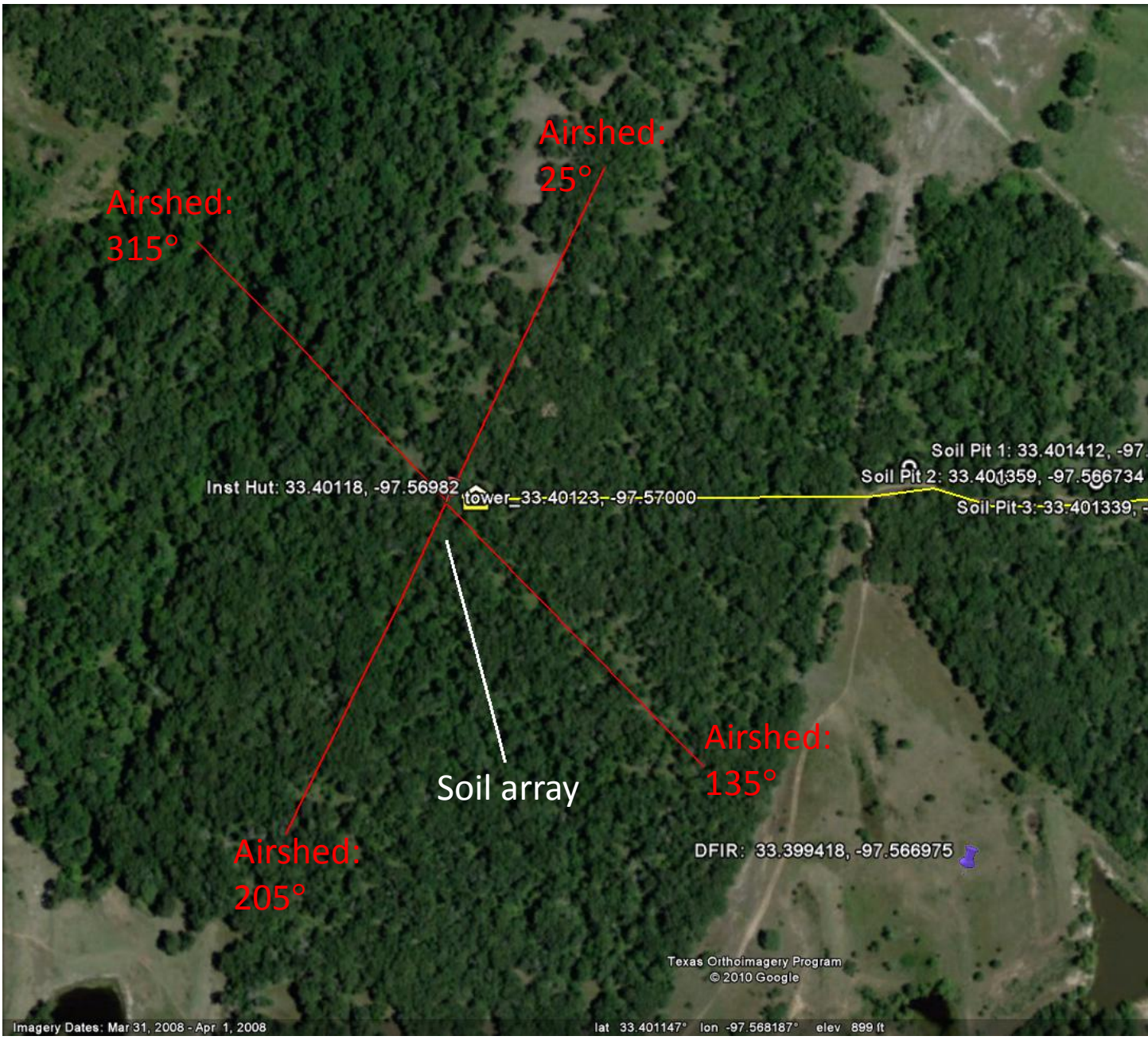


Figure 2. Site layout for LBJ Advanced tower site.
i) Tower location is presented (red pin), ii) red lines indicate the airshed boundaries. Vectors 135° to 205° (clockwise from 135°, major airshed) and 315° to 25° (clockwise from 315°, secondary airshed) are the airshed areas that would have quality wind data without causing flow distortions, respectively. iii) Yellow line is the suggested access road to instrument hut. iv) Purple pin is DFIR location

3.3 Soil Attributes

The soil array vector is ***from*** the soil plot closest to the tower ***toward*** the farthest soil plot. The exact location of each soil plot will be chosen by an FIU team member during site construction to avoid placing a soil plot at an unrepresentative location (e.g., rock outcrop, drainage channel, large tree, etc).

Dominant soil series at the site: Weatherford-Duffau complex, 3 to 8 percent slopes. The taxonomy of this soil is shown below:
Order: Alfisols
Suborder: Ustalfs
Great group: Haplustalfs- Paleustalfs
Subgroup: Ultic Haplustalfs- Udic Paleustalfs
Family: Fine-loamy, siliceous, active, thermic Ultic Haplustalfs- Fine-loamy, siliceous, active, thermic Udic Paleustalfs
Series: Weatherford-Duffau complex, 3 to 8 percent slopes

Table 4. Summary of soil array and soil pit information at LBJ. 0° represents true north and accounts for declination.

Soil plot dimensions	5 m x 5 m
Soil array pattern	B
Distance between soil plots: x	25 m
Distance from tower to closest soil plot: y	20 m
Latitude and longitude of 1st soil plot OR direction from tower	33.401049°, -97.570000°
Direction of soil array	165°
Latitude and longitude of FIU soil pit 1	33.401412, -97.567275 (primary location)
Latitude and longitude of FIU soil pit 2	33.401359, -97.566734 (alternate 1)
Latitude and longitude of FIU soil pit 3	33.401339, -97.566176 (alternate 2)
Dominant soil type	Weatherford-Duffau complex, 3 to 8 percent slopes
Expected soil depth	>2 m
Depth to water table	>2 m

Expected depth of soil horizons	**Expected measurement depths***
0-0.28 m (Very fine sandy loam)	0.14 m[a]
0.28-0.64 m (Sandy clay loam)	0.46 m[a]
0.64-1.19 m (Sandy clay loam)	0.92 m[a]
1.19-2 m (Fine sandy loam)	1.60 m
	2.00 m

*Actual soil measurement depths will be determined based on measured soil horizon depths at the NEON FIU soil pit and may differ substantially from those shown here.
[a]Soil CO_2 probes

3.3.1 Information for ecosystem productivity plots

The tower at LBJ Advanced site has been positioned to optimize the collection of the air/wind signals both temporally and spatially over the desired ecosystem (oak dominated forest). Major airshed area at

this site are from 135° to 205° (clockwise from 135°, major airshed) and 315° to 25° (clockwise from 315°, secondary airshed), and 90% signals for flux measurements are within a distance of 850 m from tower, and 80% within 450 m. We suggest FSU Ecosystem Productivity plots are placed within the major airshed boundaries of 135° to 205° (clockwise from 135°) from tower.

3.4 Issues and attentions

The dense understory of vines with large thorns makes walking around the site very slow (even with a machete). Since the site is burned every ~3-5 years, it would probably make construction easier if NEON requests that the Forest Service burn this site immediately prior to construction. Fire resistant materials shall be used in construction. Controlling the vines and understory just to gain access to the tower, instrument hut and soil array will be challenging during Field Operations, and should be planned for.

The site is sometimes leased for grazing of cattle. Given the density of vines at the site, cattle are unlikely to go near the tower or soil array except following a fire (i.e. when there is little understory). Protection of sensors on the lower level on the tower may be needed. Individual guards may also be needed to protect sensors in the soil plots.

The pathways throughout the site are used by the public (including riding horses). The nearest pathway to the tower location is >200 m away; therefore, people and horses are not expected to commonly be encountered near the tower location, but may be encountered on pathways between the road and the tower.

The roads are prone to erosion, which may influence access by vehicles used in construction and operations.

Access and power could come from north or east of the tower pending landowner (and neighboring landowner) decision. However, this would require access to land owned by the neigbouring landowner.

The access on the current design is from east of the tower, which USFS personnel said would likely be acceptable to the neigbouring landowner. If the neighboring landowner does not agree to NEON access, the access route and power could came from the south, but this route would be approximately twice as long.

4 WICHATA MOUNTAINS WILDLFE REFUGE (WMWR), RELOCATABLE TOWER 1

4.1 Desired ecosystem

Table 5. Ecosystem at the WMWR tower site.

Ecosystem Type	Management activity
Grassland	Bison grazing

The ecosystem at the tower site is grassland. It is grazed by bison, elk, steers, etc. The average canopy height varies with seasons and can reach 0.8 m at the end of the growing season. The vegetation is dominated by grasses (species unknown), and dotted with few small short shrubs (generally lower than the grass by the end of growing season in Fall).

Table 6. Ecosystem and site attributes for WMWR Relocatable site.

Ecosystem attributes	Measure and units
Mean canopy height at construction	0.8 m
Surface roughness at construction	0.35 m
Zero place displacement height at construction	0.45 m
Structural elements	Grassland, homogeneous
Time zone	Central time zone
Magnetic declination	4.73° E changing by 0.13° W per year

4.2 Site Design and Tower Attributes

The site layout is summarized in the table below. Assume the projected area of the tower is square. **Anemometer/temperature boom arm direction** is ***from*** the tower ***toward*** the prevailing wind direction or designated orientation. **Instrument hut orientation vector** is parallel to the long side of the instrument hut. **Instrument hut distance z** is the distance from the center of tower projection to the center of the instrument hut projection on the ground. The numbering of the **measurement levels** is that the lowest is level one, and each subsequent increase in height is numbered sequentially.

Table 7. Site design and tower attributes for WMWR Relocatable site

0° is true north with declination accounted for. Color of Instrument hut exterior shall be tan or best match the surrounding environment.

Attribute	lat	long	degree	meters	notes
Airshed			125° 205° (major) and 335° to 55° (secondary)		Clockwise from first angle.
Tower location	34.74512,	-98.71515	--	--	new site
Instrument hut	34.745038,	-98.714960			
Instrument hut orientation vector	--	--	180°-360°		

Instrument hut distance z	--	--	--	20	
Anemometer/Temperature boom orientation	--	--	90°	--	
Height of the measurement levels					
Level 1				0.3	m.a.g.l.
Level 2				1.5	m.a.g.l.
Level 3				4.0	m.a.g.l.
Level 4				8.0	m.a.g.l.
Tower Height				8.0	m.a.g.l.

Eddy covariance, sonic wind and air temperature **boom arms** orientation toward the east will be best to capture signals from all major wind directions. **Radiation boom arms** should always be facing south to avoid any shadowing effects from the tower structure.

Secondary **precipitation collector** for bulk precipitation collection will be located the top of tower at this site. **Wet deposition collector** will be collocated at the tower top. See AD 04 for further information and requirements for bulk precipitation collection and wet deposition collection.

Boardwalks. Ultimately, the decision to use a boardwalk will be, in part, based on owner's preferences. There are strong science requirements that minimize site disturbance to the surrounding area, which will be difficult to manage over a 30-y period. Traffic control is key to minimizing the site disturbance. Confining foot traffic to boardwalks minimizes site impact; this is particularly true in places where wear caused by foot traffic becomes noticeable and grows. For example, in places with snow part of the year, worn footpaths tend to have low places that collect water, or places where the snow pack becomes uneven causing personnel to walk farther and farther around the sides of the original path, causing the path to grow in width. This is a very common phenomenon. Here FIU assumes that all conduits will be either buried, or placed inside the boardwalk such that it does not extend beyond the 36' wide footprint. While the final design is not yet known, there are some general criteria that can be outlined. We assume that the boardwalk width is 36" (0.914 m). Material is not known, but must be fire proof, and in some locations the site is seasonally flooded and inundated with water. Boardwalks may also provide a scratching structure for grazing animals that in turn, would wear and unduly impact the site. Site by site evaluations must be done.
Specific boardwalks at this site:

- Improve path from the access dirt road to instrument hut, pending landowner decision
- Boardwalk from the instrument hut to the tower, pending landowner decision
- Improve path to soil array
- No boardwalk from soil array boardwalk to individual soil plots.

The relative locations between tower, instrument hut and boardwalk can be found in the diagram below:

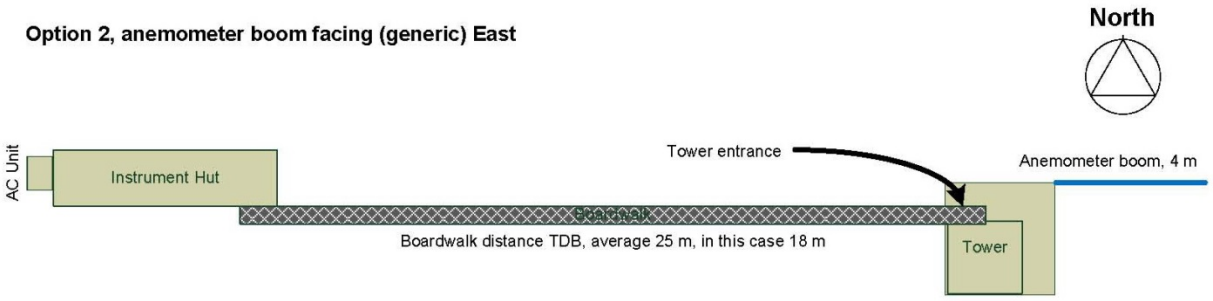


Figure 3. Generic diagram to demonstration the relationship between tower and instrument hut when boom facing east and instrument hut on the west towards the tower.

This is just a generic diagram when boom facing east and instrument hut on the western side of the tower. The actual design of boardwalk (or path if no boardwalk required) and instrument hut position will be joint responsibility of FCC and FIU.

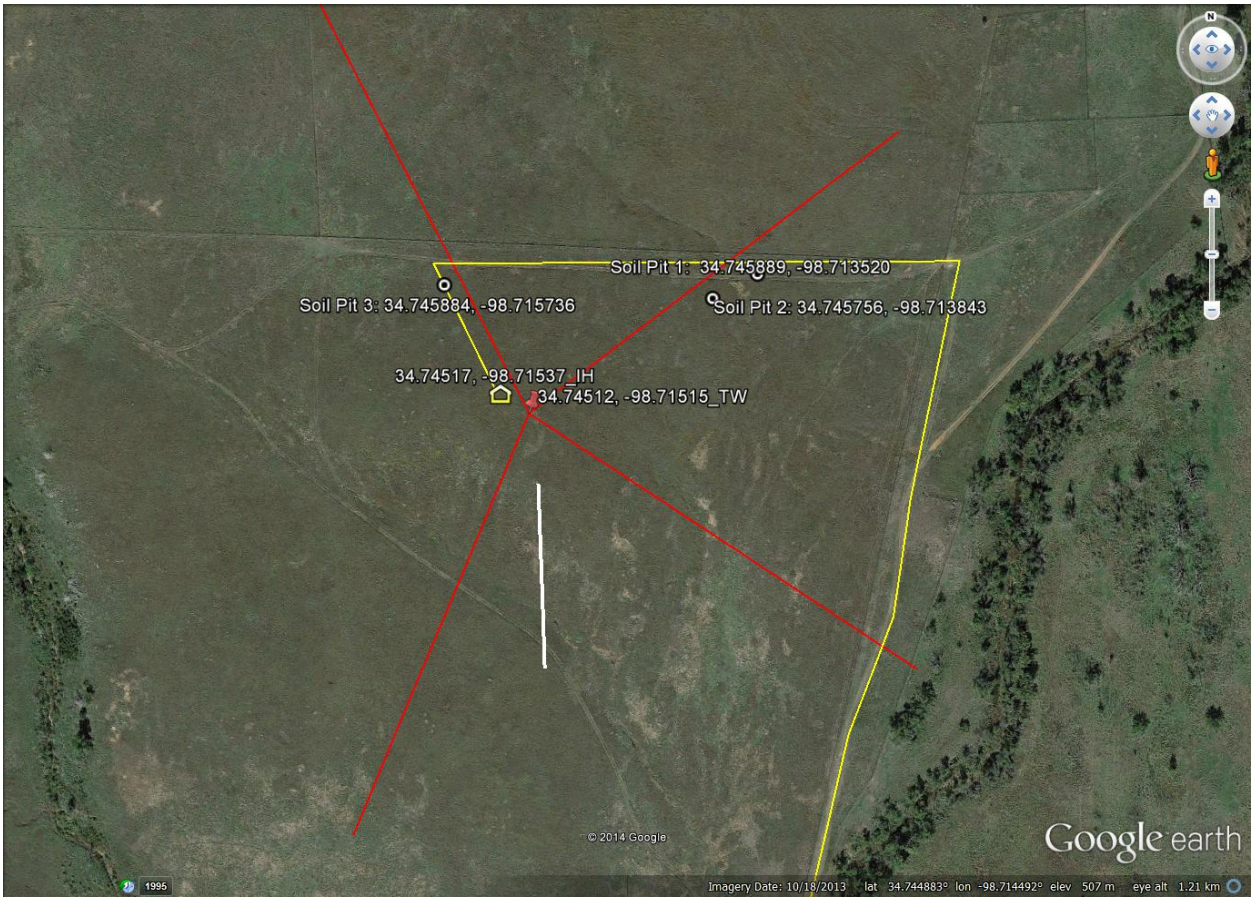


Figure 4. Site layout for Wichita Relocatable site.

4.3 Soil Attributes

The soil array vector is ***from*** the soil plot closest to the tower ***toward*** the farthest soil plot. The exact location of each soil plot will be chosen by an FIU team member during site construction to avoid placing a soil plot at an unrepresentative location (e.g., rock outcrop, drainage channel, large tree, etc).

Dominant soil series at the site: Brico-Rock outcrop complex, 5 to 40 percent slopes. The taxonomy of this soil is shown below:
Order: Mollisols
Suborder: Ustolls
Great group: Argiustolls
Subgroup: Typic Argiustolls
Family: Clayey-skeletal, mixed, active, thermic Typic Argiustolls
Series: Brico-Rock outcrop complex, 5 to 40 percent slopes

Table 8. Summary of soil array and soil pit information at WMWR. 0° represents true north and accounts for declination.

Soil plot dimensions	5 m x 5 m
Soil array pattern	B
Distance between soil plots: x	25 m
Distance from tower to closest soil plot: y	46 m
Latitude and longitude of 1st soil plot OR direction from tower	34.744706°, -98.715134°
Direction of soil array	180°
Latitude and longitude of FIU soil pit 1	34.745889, -98.713520 (primary location)
Latitude and longitude of FIU soil pit 2	34.745756, -98.713843 (alternate 1)
Latitude and longitude of FIU soil pit 3	34.745884, -98.715736 (alternate 2)
Dominant soil type	Brico-Rock outcrop complex, 5 to 40 percent slopes
Expected soil depth	>2 m
Depth to water table	>2 m

Expected depth of soil horizons	**Expected measurement depths***
0-0.28 m (very cobbly loam)	0.14 m
0.28-1.02 m (very cobbly clay loam)	0.65 m
1.02-2 m (extremely cobbly clay loam)	1.51 m

*Actual soil measurement depths will be determined based on measured soil horizon depths at the NEON FIU soil pit and may differ substantially from those shown here.

4.3.1 Information for ecosystem productivity plots

The tower has been positioned to optimize the collection of the air/wind signals both temporally and spatially over the desired ecosystem (grassland). Prevailing winds blow from south (125° to 205°, clockwise from 125°, major airshed) and from north (335° to 55°, clockwise from 335°, secondary airshed). We expect that 90% signals for flux measurements are within a distance of 500 m from tower during daytime convective conditions, and 80% within 300 m. We suggest FSU Ecosystem Productivity plots are placed within the boundaries of 125° to 205° (major, clockwise from 125°) from tower.

4.4 Issues and attentions

This area is grazed and separated by many wire fences and gates for management purpose. The Kiowa lake on the NE of the candidate tower location is one of the major drinking water sources for bisons and other animals when creeks are dry out. Any facilities that NEON adds should not block the pathway for the animals to access this water source. NEON should follow the instructions from WMWR to close/open the gates as needed to accomadate WMWR management activities.

There are about 150 bisons in the WMWR. When the DNA tracking work is conducted annualy around September to October, WMWR staffs use temptation agent (they call it bison candy) to allure the bisons to this area for the convenience of sampling. For this reason, bison may approach people when they see vehicles and people around. But we were told they normally do not attack people unless they feel threatened.

The ecosystem at the tower site is grassland. It is grazed by bison, elk, steers, etc., but this is not expected to adversely affect NEON science at the site. Protection of sensors on the lower level on the tower and soil plots may be needed. Moreover, the standard cattle fence used at other NEON sites may not be sufficient to exclude bison.

5 KLEMME RANGE RESEARCH STATION, RELOCATEABLE TOWER 2

5.1 Desired ecosystem

Table 9. Ecosystem at the Klemme Relocatable site.

Ecosystem Type	Management activity
Shortgrass grazed grassland	Grazing and possibly oil exploration

The ecosystem at the tower site was a shortgrass grassland with flat terrain. The management applied to the field containing the tower was moderate to light grazing and no controlled burns. The field ~400 m to the southwest was ungrazed and unburned, the field ~400 m to the southeast was grazed and burned every 4 years, and the field to the east was grazed and had an unknown burning regime. An oil well ~350 m southeast or southwest of the tower location may be installed in the future. Oil wells were common throughout the region and there was noticeable ongoing oil well development during the site visit. Installation of the oil well is not expected to adversely affect NEON science at this site and may present interesting research opportunities. There were deeply incised drainage channels throughout the area. There was little water in the channels during the site visit, but the banks appeared highly eroded, suggesting that they flow rapidly after a rainstorm. Trees exist only in and around the drainage channels. The soil was rocky, especially below ~10-15 cm.

Table 10. Ecosystem and site attributes for Klemme Relocatable site.

Ecosystem attributes	Measure and units
Mean canopy height	1.0 m
Surface roughness [a]	0.13 m
Zero place displacement height [a]	0.75 m
Structural elements	Shortgrass, uniform
Time zone	Central time zone
Magnetic declination	5° 29' E changing by 0° 7' W/year

Note, [a] From field survey.

5.2 Site Design and Tower Attributes

The site layout is summarized in the table below. Assume the projected area of the tower is square. **Anemometer/temperature boom arm direction** is ***from*** the tower ***toward*** the prevailing wind direction or designated orientation. **Instrument hut orientation vector** is parallel to the long side of the instrument hut. **Instrument hut distance z** is the distance from the center of tower projection to the center of the instrument hut projection on the ground. The numbering of the **measurement levels** is that the lowest is level one, and each subsequent increase in height is numbered sequentially.

Table 11. Site design and tower attributes for Klemme Relocatable site

0° is true north with declination accounted for. Color of Instrument hut exterior shall be tan or best match the surrounding environment.

Attribute	lat	long	degree	meters	notes
Airshed area			130° to 200°		Clockwise from

			(major) and 340° to 80° (secondary) airshed).		first angle
Tower location	35.41059,	-99.05879	--	--	new site
Instrument hut	35.41061,	-99.05898			
Instrument hut orientation vector	--	--	360° - 180°		
Instrument hut distance z	--	--	--	18	
Anemometer/Temperature boom orientation	--	--	90°	--	
Height of the measurement levels					
Level 1				0.3	m.a.g.l.
Level 2				2.0	m.a.g.l.
Level 3				4.0	m.a.g.l.
Level 4				6.0	m.a.g.l.
Tower Height				6.0	m.a.g.l.

See AD 03 for technical requirement to determine the boom height for the bottom most measurement level.

Eddy covariance, sonic wind and air temperature **boom arms** orientation toward the east will be best to capture signals from all major wind directions. **Radiation boom arms** should always be facing south to avoid any shadowing effects from the tower structure.

Secondary **precipitation collector** for bulk precipitation collection will be located the top of tower at this site. W**et deposition collector** will be collocated at the top of the tower. See AD 04 for further information and requirements for bulk precipitation collection and wet deposition collection.

Boardwalks. Ultimately, the decision to use a boardwalk will be, in part, based on owner's preferences. There are strong science requirements that minimize site disturbance to the surrounding area, which will be difficult to manage over a 30-y period. Traffic control is key to minimizing the site disturbance. Confining foot traffic to boardwalks minimizes site impact; this is particularly true in places where wear caused by foot traffic becomes noticeable and grows. For example, in places with snow part of the year, worn footpaths tend to have low places that collect water, or places where the snow pack becomes uneven causing personnel to walk farther and farther around the sides of the original path, causing the path to grow in width. This is a very common phenomenon. Here FIU assumes that all conduits will be either buried, or placed inside the boardwalk such that it does not extend beyond the 36' wide footprint. While the final design is not yet known, there are some general criteria that can be outlined. We assume that the boardwalk width is 36" (0.914 m). Material is not known, but must be fire proof, and in some locations the site is seasonally flooded and inundated with water. Boardwalks may also provide a scratching structure for grazing animals that in turn, would wear and unduly impact the site. Site by site evaluations must be done.

Specific boardwalks at the Klemme Relocatable site

- Gravel path from the access road to instrument hut, pending landowner decision

- Boardwalk from the instrument hut to the tower to intersect on north face of the tower
- Gravel path to the soil array
- No gravel path or boardwalk to individual soil plots

The relative locations between tower, instrument hut and boardwalk can be found in the diagram below:

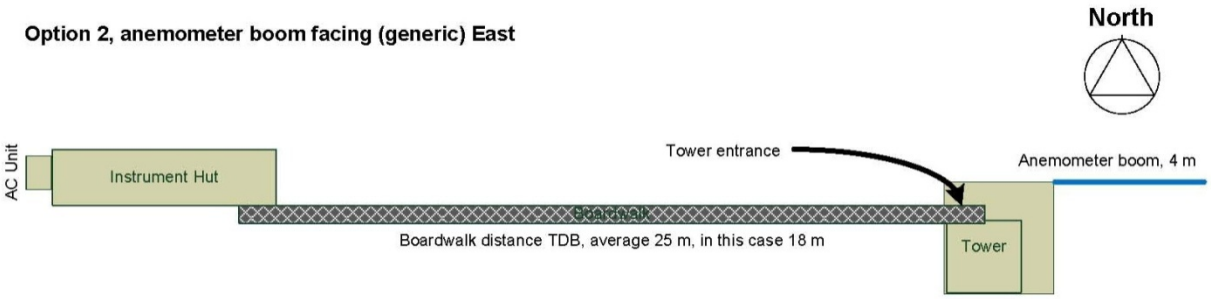


Figure 5. Generic diagram to demonstration the relationship between tower and instrument hut when boom facing east and instrument hut on the west towards the tower.

This is just a generic diagram. The actual layout of boardwalk (or path if no boardwalk required) and instrument hut position will be the joint responsibility of FCC and FIU. At Klemme Relocatable site, the boom angle will be 90^{o}, instrument hut will be on the west towards the tower, the distance between instrument hut and tower is ~18 m. The instrument hut vector will be N-S (360^{o}-180^{o}, longwise).

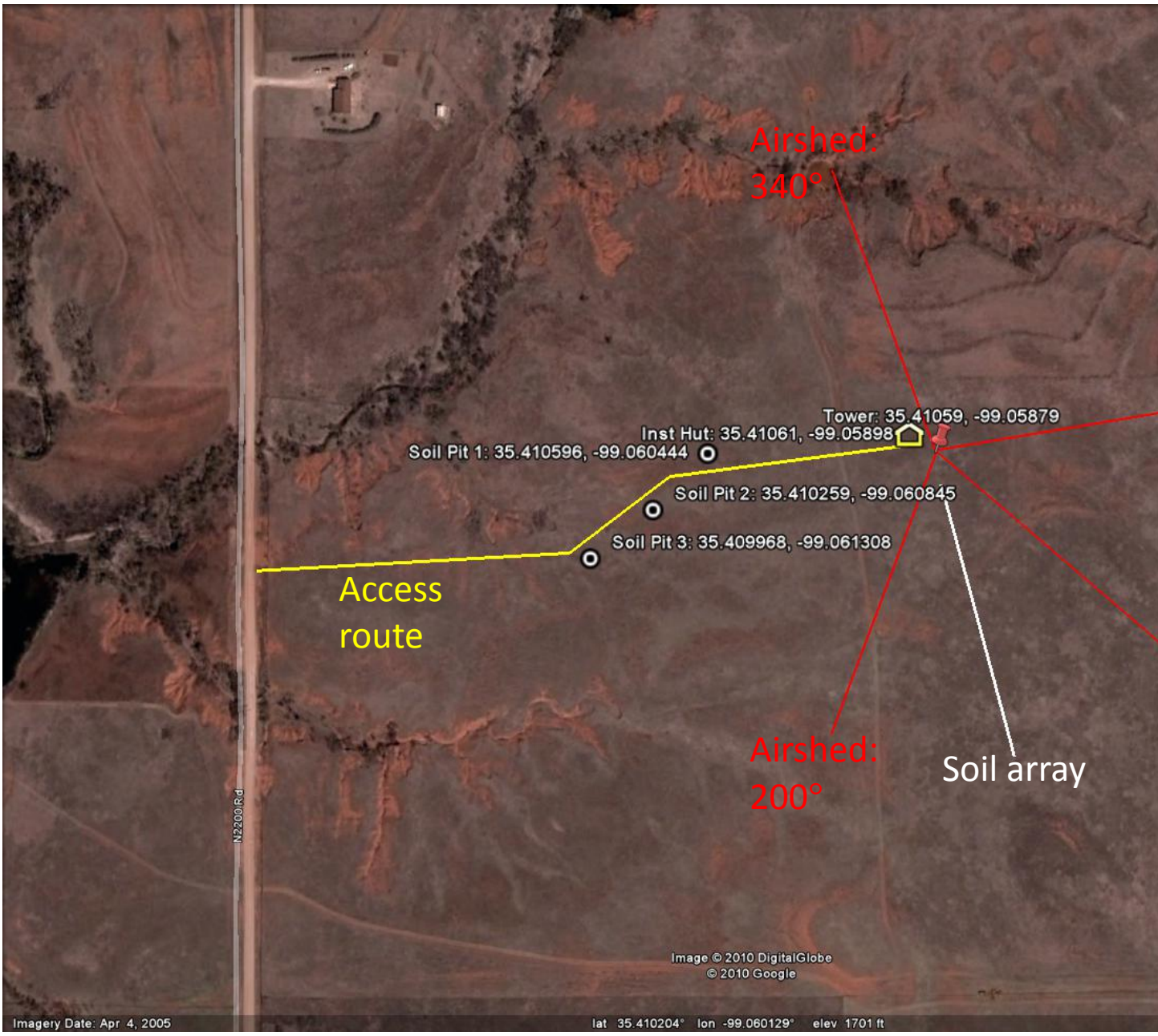


Figure 6. Site layout for Klemme Relocatable site.
i) new tower location is presented (red pin), ii) red lines indicate the airshed boundaries. Vectors 130° to 200° (clockwise from 130°, major airshed) and 340° to 80° (clockwise from 340°, secondary airshed) would have quality wind data without causing flow distortions, respectively. iii) Yellow line is the suggested access road to instrument hut.

5.3 Soil Attributes

The soil array vector is ***from*** the soil plot closest to the tower ***toward*** the farthest soil plot. The exact location of each soil plot will be chosen by an FIU team member during site construction to avoid placing a soil plot at an unrepresentative location (e.g., rock outcrop, drainage channel, large tree, etc).

Dominant soil series at the site: Cordell silty clay loam, 3 to 5 percent slopes-Cordell-Rock outcrop complex, 2 to 15 percent slopes. The taxonomy of this soil is shown below:
Order: Inceptisols
Suborder: Ustepts
Great group: Haplustepts
Subgroup: Lithic Haplustepts
Family: Loamy, mixed, active, thermic Lithic Haplustepts
Series: Cordell silty clay loam, 3 to 5 percent slopes-Cordell-Rock outcrop complex, 2 to 15 percent slopes

Table 12. Summary of soil array and soil pit information at Klemme. 0° represents true north and accounts for declination.

Soil plot dimensions	5 m x 5 m
Soil array pattern	B
Distance between soil plots: x	40 m
Distance from tower to closest soil plot: y	21 m
Latitude and longitude of 1st soil plot OR direction from tower	35.41040, -99.05875
Direction of soil array	165°
Latitude and longitude of FIU soil pit 1	35.410596, -99.060444 (primary location)
Latitude and longitude of FIU soil pit 2	35.410259, -99.060845 (alternate 1)
Latitude and longitude of FIU soil pit 3	35.409968, -99.061308 (alternate 2)
Dominant soil type	Cordell silty clay loam, 3 to 5 percent slopes-Cordell-Rock outcrop complex, 2 to 15 percent slopes
Expected soil depth	0.25-0.51 m
Depth to water table	>2 m

Expected depth of soil horizons	**Expected measurement depths***
0-0.15 m (Silty clay loam)	0.08 m[a]
0.15-0.25 m (Silty clay loam)	0.20 m[a]
0.25-0.36 m (Very gravelly silty clay loam)	0.31 m[a]
0.36-0.43 m (Bedrock)	

*Actual soil measurement depths will be determined based on measured soil horizon depths at the NEON FIU soil pit and may differ substantially from those shown here.
[a]Soil CO_2 probes

5.3.1 Information for ecosystem productivity plots

The tower at Klemme relocatable site has been positioned to optimize the collection of the air/wind signals both temporally and spatially over the desired ecosystem (shortgrass and forbs). Prevailing wind blows from south (130° to 200°, clockwise from 130°, major airshed) and NNE (340° to 80°, clockwise from 340°, secondary airshed). 90% signals for flux measurements during daytime are within a distance

of 550 m from tower, and 80% within 350 m. We suggest FSU Ecosystem Productivity plots are placed within the boundaries of 130° to 200° (major, clockwise from 130°) from tower.

5.4 Issues and attentions

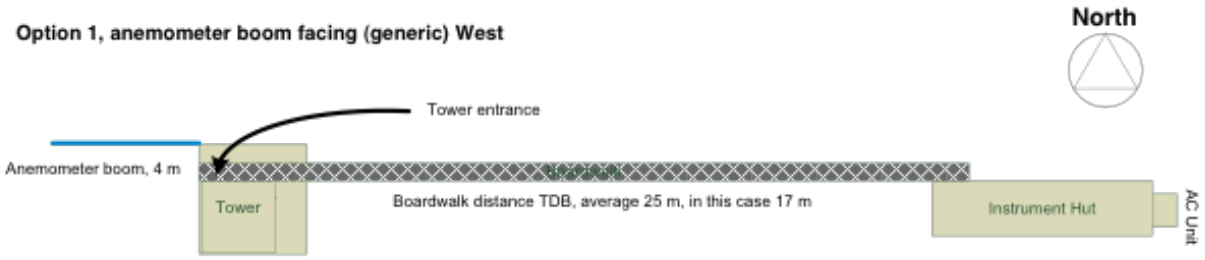
An oil well may be built approximately 350 m southeast or southwest of the tower site, which is close to the 80% isopleth of the expected flux source area. Oil wells are common in this region, therefore, the development is not expected to detrimentally affect science at this site and may present interesting opportunities to study the impact of oil well development on the ecology of this ecosystem.

This is an actively grazed site (light to moderate grazing intensity). Protection of sensors on the lower level on the tower may be needed. Individual guards may also be needed to protect sensors in the soil plots.

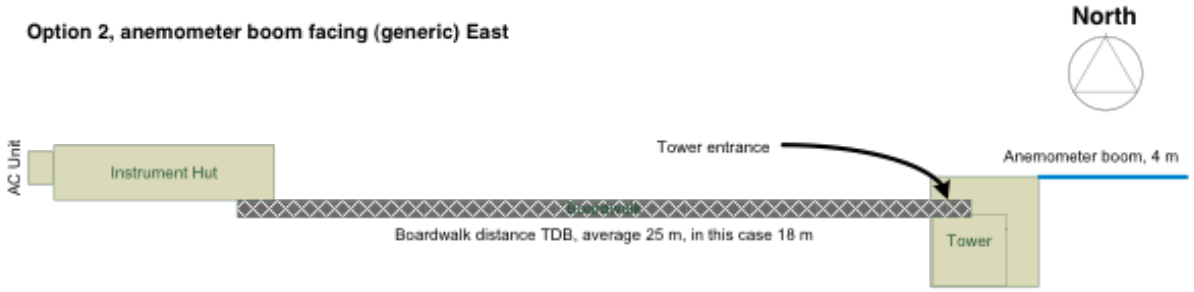
Burning is not a management strategy in the field where the tower is located, but some of the nearby adjacent fields are burnt (every ~4 years). Fire resistant materials are suggested for construction in case a burn spreads to the tower location.

Access to the instrument hut would ideally come from the west, rather than from the south, to avoid travelling through the primary airshed and to reduce the length of the access route and power/communications lines. However, this would require the landowner agreeing to a new gate and dirt road.

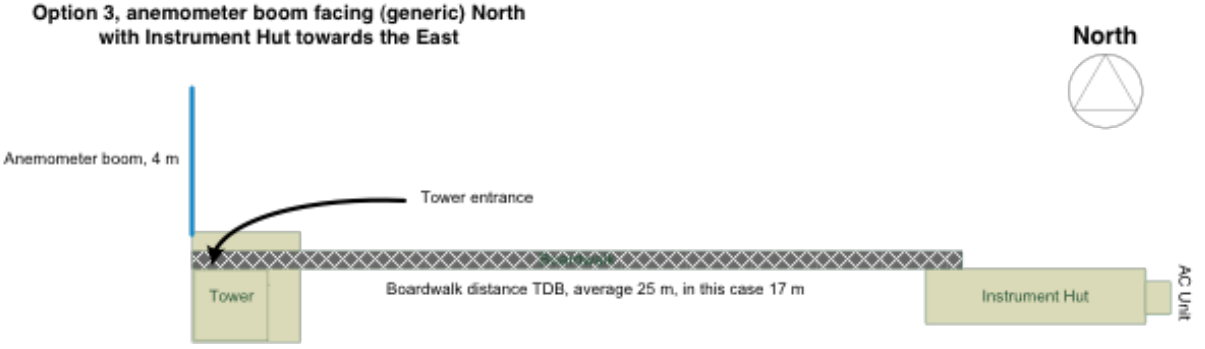
Option 1, anemometer boom facing (generic) West



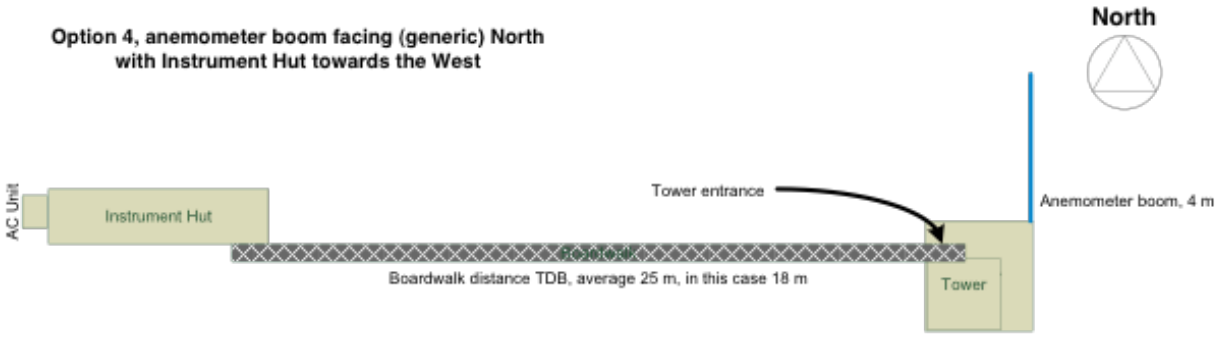
Option 2, anemometer boom facing (generic) East



Option 3, anemometer boom facing (generic) North with Instrument Hut towards the East



Option 4, anemometer boom facing (generic) North with Instrument Hut towards the West



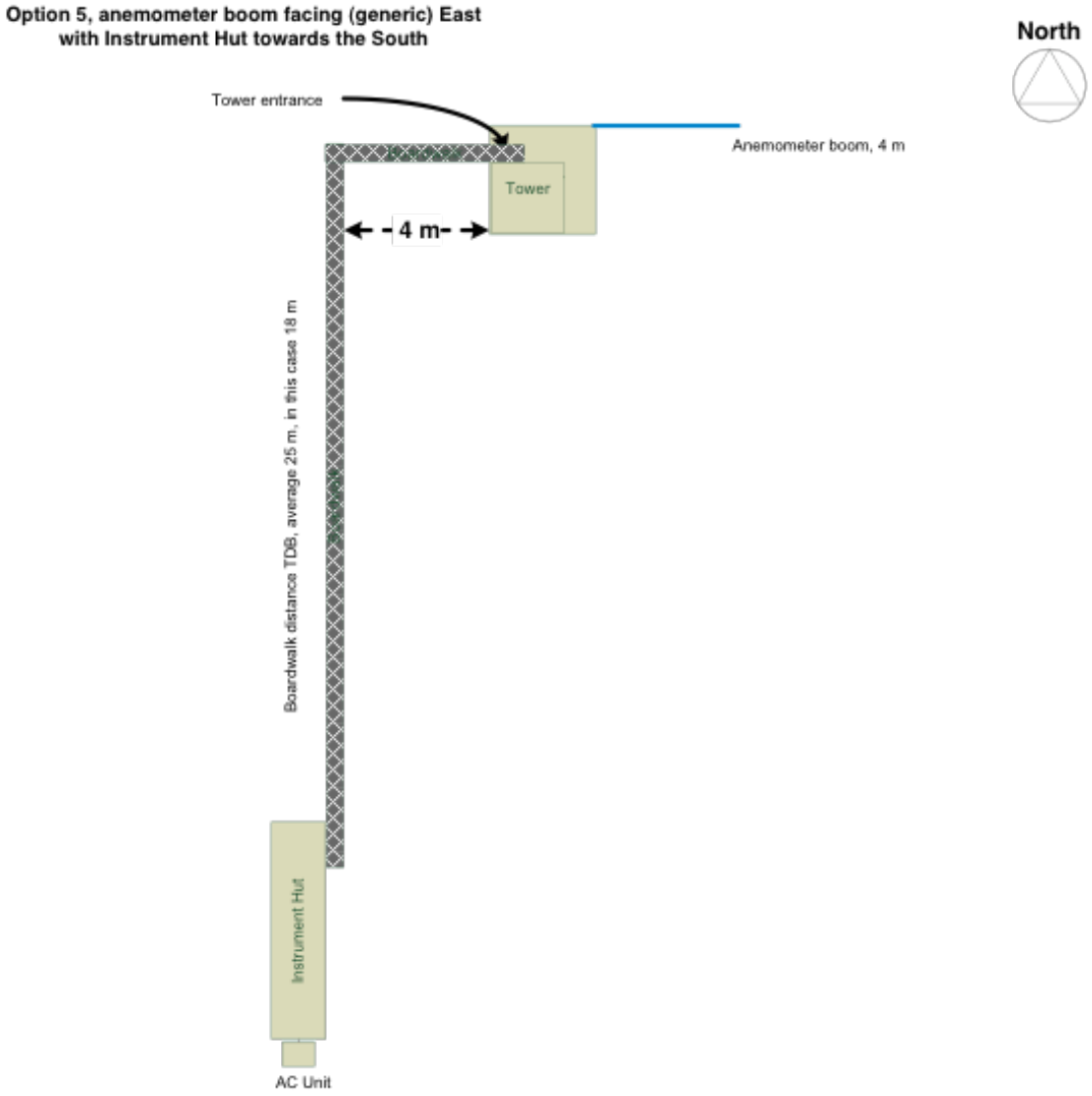
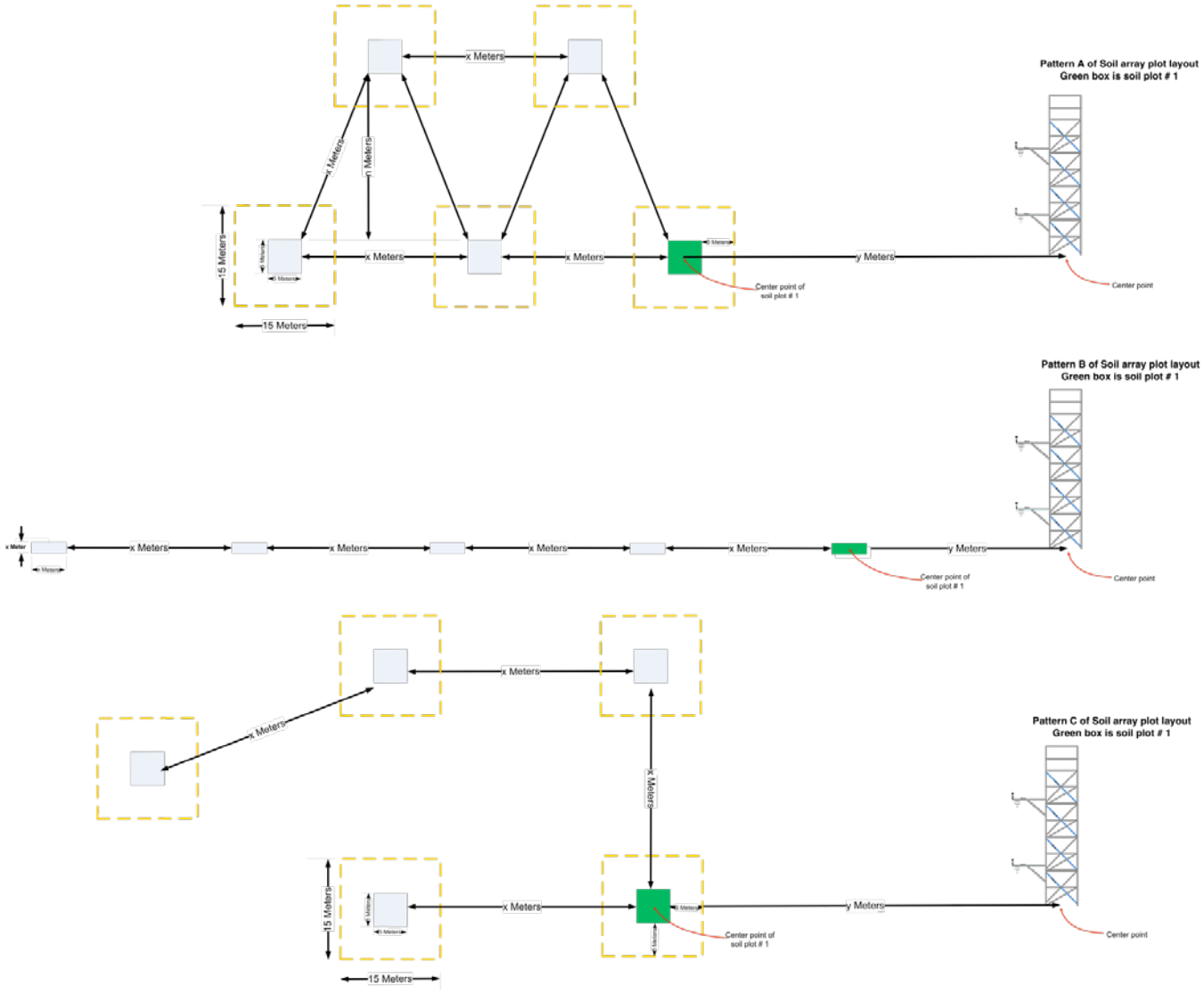

Option 5, anemometer boom facing (generic) East
with Instrument Hut towards the South
North
Tower entrance
Anemometer boom, 4 m
Tower
4 m
Boardwalk distance TDB, average 25 m, in this case 18 m
Instrument Hut
AC Unit

Figure 7. Generic patterns for the boardwalk configuration

These generic configurations are from the instrument hut to the tower based on 5 generic scenarios. The five options are based on anemometer boom orientation and the leeward side of the tower where the instrument hut is located. The tower entrance is always on the North side of the tower. Exact tower and instrument hut location and orientation will be specified at each location and presented in the site characterization document.


Pattern A of Soil array plot layout
Green box is soil plot # 1
x Meters
x Meters
n Meters
15 Meters
15 Meters
x Meters
x Meters
y Meters
Center point of soil plot # 1
Center point
Pattern B of Soil array plot layout
Green box is soil plot # 1
x Meter
x Meters
x Meters
x Meters
x Meters
y Meters
Center point of soil plot # 1
Center point
Pattern C of Soil array plot layout
Green box is soil plot # 1
x Meters
x Meters
x Meters
15 Meters
15 Meters
x Meters
y Meters
Center point of soil plot # 1
Center point

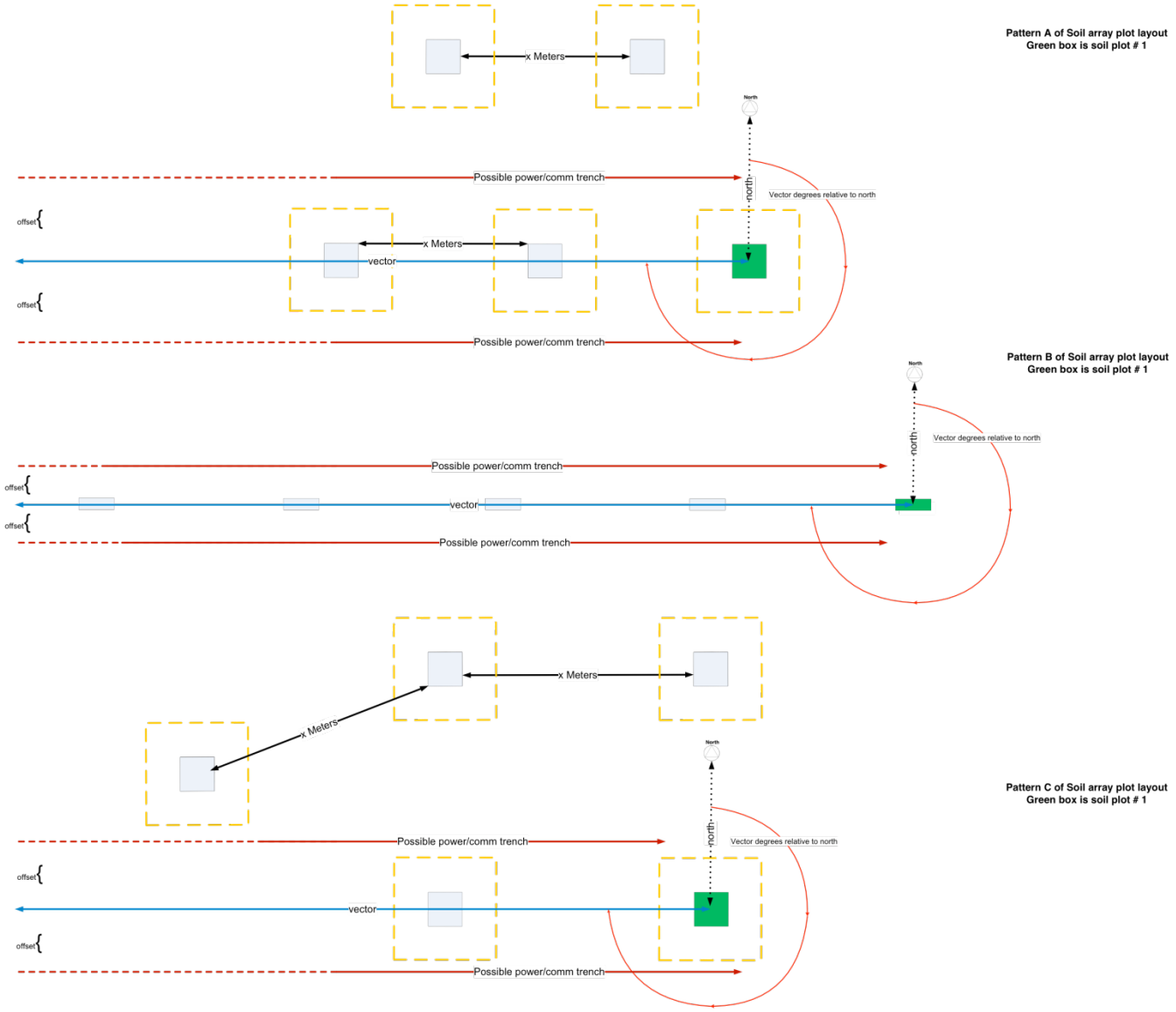


Figure 8. Conceptual diagram of Soil Array Patterns

Outlines the orientation for the soil array and instrument hut from the center point of the tower. The x, y, z distances are i) the distance between soil plots, ii) distance between the tower centerpoint and the closest edge of soil plot, and iii) the distance between the tower centerpoint and the closest edge of the instrument hut, respectively. The yellow outline around each soil plot is the 5 m perimeter keep out zone.

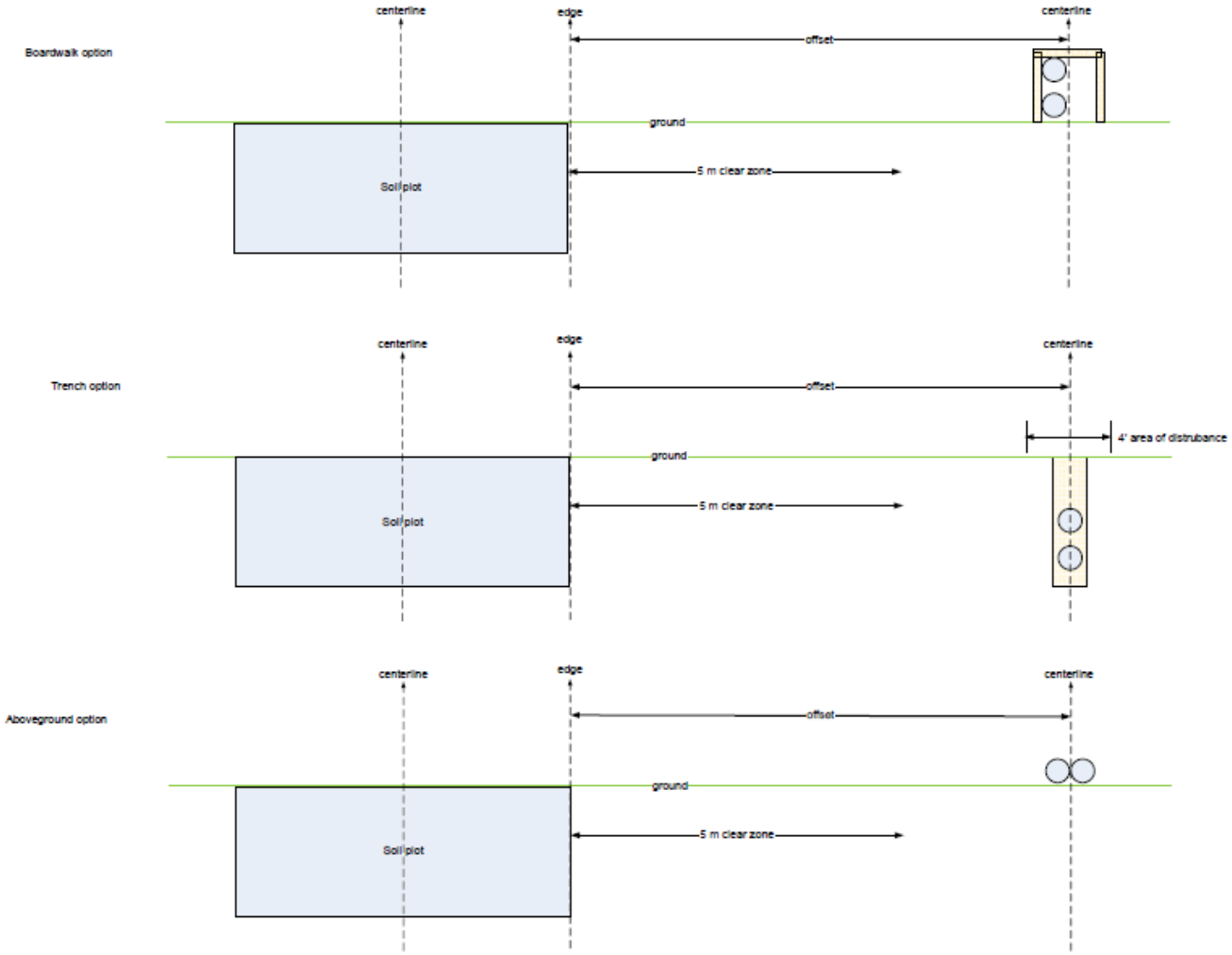


Figure 9. Conceptual diagram of power/communications line and boardwalk/path options in relation to FIU soil plots.

Boardwalk option: When a boardwalk is present the power and communication lines will typically follow the route of the boardwalk and be mounted aboveground (underneath the boardwalk). When no boardwalk is present (or the power/communication lines follow a different route than the boardwalk) the lines can be buried (Trench option) or run aboveground (Aboveground option). The aboveground option will be used instead of the trench option when trenching would be expected to cause significant disturbance to an ecosystem (e.g. cutting the roots of trees), pending landowner approval.

6 APPENDIX A. FCC SUMMARY TABLES

Table 13. FCC Summary Table for FIU site components at D11 LBJ Advanced site

Site Component				**units**
Tower location	33.40123°,	-97.57000°.		Lat, Long, in degrees
Tower location	33° 24' 4.4274"	-97° 34' 11.9994"		Lat, Long in deg min sec
Tower height[f]	22			meters
Tower guying	none			yes/none, notes
Instrument Hut location	33.40118,	-97.56982		Lat, Long, in degrees
Instrument Hut location	33° 24' 4.2474"	-97° 34' 11.352"		Lat, Long in deg min sec
IH orientation[a]	360° - 180°			vector
boom orientation[b]	270°			degrees
distance from center of tower to IH center (z)		17	option 1	distance (m), option #
how the Bwalk intersects the tower access	Boardwalk intersects the north-side of the tower from the east.			description
Air shed vector(s)[c]	135° to 205° (major)	315° to 25° (secondary)		Vector, clock wise from first angle
Boardwalk from AP to IH	yes, gravel path from dirt road to IH, boardwalk to tower and soil array	(see Figure 2)		yes/none, notes
Boardwalk to soil array	yes			yes/none, notes
Boardwalk needed to DFIR	none			yes/none
Power and Communication trench	10 m from edge of plot to the centerline of the power/comms line	whichever side is easiest [e], line above ground		offset, notes
DFIR location	33.399418°,	-97.566975°		Lat, Long in degrees, notes
DFIR location	33° 23' 57.9042"	-97° 34' 1.1094"		Lat, Long in deg min sec
DFIR power supply	30 amp AC power from tower			description
Soil plot 1st location	33.401049°,	-97.570000°		Lat, Long in degrees (center point)
Soil plot 1st location	33° 24' 3.7764"	-97° 34' 11.9994"		Lat, Long in deg min sec

Soil plot distance between plots (x) and from tower (y)	25 m	20 m		x, y (meters)
Soil array pattern and vector[d]	B	165°		A, B, or C, vector
Soil plot dimensions	5 m x 5 m			L x W (meters)
Soil profile pit primary	33.401412	-97.567275°	>2 m	Lat, Long, and expected depth
Soil profile pit primary	33° 24' 5.0832"	-97° 34' 2.1894"		Lat, Long in deg min sec
Soil profile pit alternative 1	33.401359	-97.566734	>2 m	Lat, Long, and expected depth
Soil profile pit alternative 1	33° 24' 4.8918"	-97° 34' 0.2418"		Lat, Long in deg min sec
Soil profile pit alternative 2	33.401339	-97.566176	>2 m	Lat, Long, and expected depth
Soil profile pit alternative 2	33° 24' 4.8204"	-97° 33' 58.233"		Lat, Long in deg min sec
Fencing needs	none	none	none	IH, Soil Arrays, Guy anchors
Presence of large grazing animals	Unlikely, but possible cattle following a managed burn			description
Site management*	Managed burns and grazing in adjacent unfenced grassland			description
Any additional site specific information	Open oak-dominated deciduous forest with diverse, dense and prickly understory			description
Magnetic declination	4° 35' E changing by 0° 7' W/year			At time of site visit

Table 14. FCC Summary Table for FIU site components at D11 WMWR Relocatable 1

Site Component				**units**
Tower location	34.74512,	-98.71515		Lat, Long in degrees
Tower location	~~34°44'42.43"~~ 34° 44' 42.43"	~~-98°42'54.65"~~ -98° 42' 54.54"		Lat, Long in deg min sec
Tower height[f]	8 m			meters
Tower guying	None.			yes/none, notes
Instrument Hut location	34.74517	-98.71537		Lat, Long in degrees
Instrument Hut location	~~34°44'42.61"~~ 34° 44' 42.61"	~~-98°42'55.37"~~ -98° 42' 55.33"		Lat, Long in deg min sec
IH orientation[a]	180-360 °			vector
boom orientation[b]	90°			degrees
distance from center of tower to IH center (z)		20	Option 2	vector, distance (m), option #
how the Bwalk intersects the tower access	Boardwalk intersects the north-side of the tower			description
Air shed vector(s)[c]	125° 205° (major)	335° to 55° (secondary)		vector, clockwise from first angle
Boardwalk from AP to IH	Improved path	(Figure 4)		yes/none, notes
Boardwalk to soil array	Improved path			yes/none, notes
Boardwalk needed to DFIR	no DFIR			yes/none
DFIR location	NA			Lat, Long
Power and Communication line	10 m from edge of plot to the centerline of the power/comms line	whichever side is easiest[e], line can be trenched		offset, notes
DFIR power supply	na.			description
Soil plot 1st location	34.744706°,	-98.715134°		Lat, Long (center point)
Soil plot 1st location	34°44'40.94"	-98°42'54.48"		Lat, Long in deg min sec
Soil plot distance between plots (x) and from tower (y)	25 m	46 m		x, y (meters)
Soil array pattern and vector[d]	B	180°		A, B, or C, vector
Soil plot dimensions	5 m x 5 m			L x W (meters)

Soil profile pit primary	34.745889	-98.713520	>2 m	Lat, Long, and expected depth
Soil profile pit primary	34°44'45.20"	-98°42'48.67"		
Soil profile pit alternative 1	34.745756	-98.713843	>2 m	Lat, Long, and expected depth
Soil profile pit alternative 1	34°44'44.72"	-98°42'49.84"		Lat, Long in deg min sec
Soil profile pit alternative 2	34.745884	-98.715736	>2 m	Lat, Long, and expected depth
Soil profile pit alternative 2	34°44'45.18"	-98°42'56.65"		Lat, Long in deg min sec
Fencing needs	no	yes	maybe	IH, Soil Arrays, Guy anchors
Presence of large grazing animals	Bison, elk, deer			description
Site management*	Grazed by bison. A cattle fence is recommended			description
Any additional site specific information	It is a grazing management site. This area is separated by multiple fences. Every Sep to Oct, WMWR will keep ~150 bison around this area for DNA sampling and tracking			description
Magnetic declination	4.73° E changing by 0.13° W per year			At time of site visit

Table 15. FCC Summary Table for FIU site components at D11 Klemme Relocatable 2

Site Component				**units**
Tower location	35.41059,	-99.05879		Lat, Long in degrees
Tower location	35° 24' 38.1234"	-99° 3' 31.644"		Lat, Long in deg min sec
Tower height[f]	6.0			meters
Tower guying	None			yes/none, notes
Instrument Hut location	35.41061,	-99.05898		Lat, Long in degrees
Instrument Hut location	35° 24' 38.1954"	-99° 3' 32.328"		Lat, Long in deg min sec
IH orientation[a]	360° - 180°			vector
boom orientation[b]	90°			degrees
distance from center of tower to IH center (z)		18	Option 2	distance (m), option #
how the Bwalk intersects the tower access	Boardwalk intersects the north-side of the tower from west.			description
Air shed vector(s)[c]	130° to 200° (major)	340° to 80° (secondary)		vector, Clockwise from first angle
Boardwalk from AP to IH	Yes, Gravel path from access road to IH, boardwalk from IH to tower	(Fig. 6)		yes/none, notes
Boardwalk to soil array	Yes, Gravel path to soil array			yes/none, notes
Boardwalk needed to DFIR	no DFIR			yes/none
Power and Communication line	10 m from edge of plot to the centerline of the power/comms line	whichever side is easiest [e], trench below ground		offset, notes
DFIR location	none			Lat, Long
DFIR power supply	na.			description
Soil plot 1st location	35.41040	-99.05875		Lat, Long in degrees (center point)
Soil plot 1st location	35° 24' 37.44"	-99° 3' 31.5"		Lat, Long in deg min sec
Soil plot distance between plots (x) and from tower (y)	40 m	21 m		X, Y (meters)

Soil array pattern and vector[d]	B	165°		A, B, or C, vector, notes
Soil plot dimensions	5 m x 5 m			L x W (meters)
Soil profile pit primary	35.410596	-99.060444	0.25-0.51 m	Lat, Long, and expected depth
Soil profile pit primary	35° 24' 38.145"	-99° 3' 37.5984"		
Soil profile pit alternative 1	35.410259	-99.060845	0.25-0.51 m	Lat, Long, and expected depth
Soil profile pit alternative 1	35° 24' 36.9324"	-99° 3' 39.042"		Lat, Long in deg min sec
Soil profile pit alternative 2	35.409968	-99.061308	0.25-0.51 m	Lat, Long, and expected depth
Soil profile pit alternative 2	35° 24' 35.8842"	-99° 3' 40.7082"		Lat, Long in deg min sec
Fencing needs	none	none	none	IH, Soil Arrays, Guy anchors
Presence of large grazing animals	Yes, cattle			description
Site management*	Grazing			description
Any additional site specific information	Protection of sensors on the lower level on the tower may be needed. Individual guards may also be needed to protect soil sensors. Additional gate, dirt track may be required from paved road, pending landowner decision.			description
Magnetic declination	5° 29' E changing by 0° 7' W/year			At time of site visit

Notes;
[a]parallel to the long side of the IH
[b]From tower point to this direction
[c]Clockwise from first angle, recommend reviewing FIU site characterization summary report
[d]From 1st plot toward other plots if pattern B, from 1st plot toward nearest neighbor (see diagram of the patterns)
[e]see Appendix A. Options for Soil Array, second figure.
[f]Tower Height is for FIU requirements; actual tower height will increase toward the next section height.
IH = instrument hut
AP = auxillary portal
*burn information that may affect boardwalk, IH, or tower infrastructure, or other management activities