# D01 FIU SITE CHARACTERIZATION: SUMMARY

| PREPARED BY | ORGANIZATION | DATE |
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|---|---|---|
| Anne Balsley | CCB ADMINISTRATOR/DCS | 10/06/2011 |

See Configuration Management System for approval history.

# Change Record

| REVISION | DATE | ECO # | DESCRIPTION OF CHANGE |
|---|---|---|---|
| A | 09/29/2010 | NEON.FIU.000246.CRE | INITIAL RELEASE |
| B | 12/10/2010 | NEON.FIU.000278.CRE | UPDATES SEE CRE |
| C | 09/23/2011 | ECO-00279 | Update to new document number's/template throughout document. |

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# 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 D01 Site Characterization: Supporting Data (AD[01]).

## 1.2 Scope

This document summarizes the FIU site characterization data for three D01 tower locations: Harvard Forest site (Advanced), Bartlett Experimental Forest site (Relocatable 1), and Plum Island Subauban Relocatable site (Relocatable 2). Issues and concerns for each site that need attentions 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.011028 _ FIU D01 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 HARVARD FOREST ADVANCE TOWER SITE

## 3.1 Desired ecosystem

**Table 1**. Ecosystem at Harvard Forest Advanced tower site.

| Ecosystem Type | Management activity |
|---|---|
| Eastern Deciduous forest | Managed Forest |

Harvard Forest is one of the oldest forest research sites in the United States, and has been intensively studied since its acquisition by Harvard University in 1907. There is an existing tower site and a measurement platform next to NEON Advanced Tower site. The existing tower is located at 42.537755 N latitude, 72.171478 W longitude and 340 m (ASL) elevation; the walkup platform is ~130m away (42.536875 N, 72.172602 W). The Harvard Forest is designated as an LTER site. Ecological measurements and climate measurements are conducted in the tower footprint. The NEON tower is approximately 18 m east of the walkup platform; however, Bill Munger said that the walkup platform tower will be removed.

Ecosystem around NEON tower and in the tower airshed is Eastern deciduous forest. Canopy height is ~26 m around tower site with lowest branches at ground level. Oak and other tree species form upper understory with height ~ 16 m. Seedlings and sapling of maple, hemlock and other species forms the lower understory with mean height ~ 5 m. Grass and new seedling form the understory at ground level with height ~ 1m.

**Table 2**. Ecosystem and site attributes for Harvard Forest Advanced tower site.

| Ecosystem attributes | Measure and units |
|---|---|
| Mean canopy height | 26 m |
| Surface roughness[a] | 0.8 m |
| Zero place displacement height[a] | 22.5 m |
| Structural elements | Closed canopy, understory present, uniform |
| Time zone | Eastern time |
| Magnetic declination | 14° 38' W changing by 0° 3' E year$^{-1}$ |

Note, [a] From model output.

## 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, in this case, level 6 being the upper most level at this tower site.

**Table 3**. Site design and tower attributes for Harvard Forest Advanced site.

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

| Attribute | lat | long | degree | meters | notes |
|---|---|---|---|---|---|
| Airshed area | | | 190° to 335° | | Clockwise from 190° |
| Tower location | 42.53690 | -72.17266 | -- | -- | new site |
| Instrument hut | 42.53683 | -72.17251 | | | |
| Instrument hut orientation vector | -- | -- | 90° - 270° | | |
| Instrument hut distance z | -- | -- | -- | 15 | |
| Anemometer/Temperature boom orientation | -- | -- | 270° | -- | |
| DFIR | 42.53308, | -72.18986 | | | |
| **Height of the measurement levels** | | | | | |
| Level 1 | | | | 0.3 | m.a.g.l. |
| Level 2 | | | | 5.0 | m.a.g.l. |
| Level 3 | | | | 16.0 | m.a.g.l. |
| Level 4 | | | | 23.0 | m.a.g.l. |
| Level 5 | | | | 29.0 | m.a.g.l. |
| Level 6 | | | | 38.0 | m.a.g.l. |
| Tower Height | | | | 38.0 | 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 major wind directions. **Radiation boom arms** should always be facing south to avoid any shadowing effects from the tower structure.

**DFIR** (Double Fenced International Reference) will be used for bulk precipitation collection. We had difficulty to find adequate open area to meet USCRN class 1 and class 2 criteria for DFIR within 500 m radius from tower. The best and closest open area we can find is on the south west side of tower and ~1.4 km away from tower, which is next to existing Harvard Forest weather station. Coordinates are 42.53308, -72.18986. Power is available at site. **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**.

Specific Boardwalks at Harvard Forest site

- Boardwalk is from the access dirt road to instrument hut, pending landowner decision
- Boardwalk from the instrument hut to the tower to intersect on north face of the tower
- Boardwalk to soil array, except where it crosses the forest road.
- No boardwalk from the soil array boardwalk to the individual soil plots
- No boardwalk needed at DFIR site

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

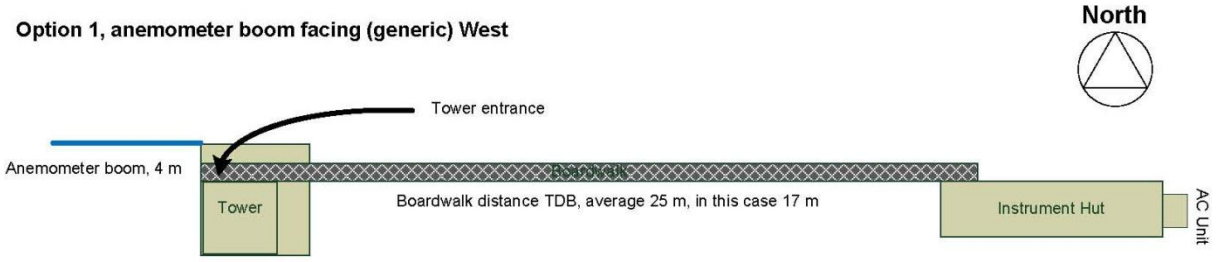



**Figure 1.** Generic diagram to demonstration the relationship between tower and instrument hut when boom facing west and instrument hut on the east towards the tower.

This is just a generic diagram. The actual design of boardwalk (or path if no boardwalk required) and instrument hut position will be the responsibility of FCC and FIU. Harvard Forest Advanced site, the boom angle will be 270 degrees, instrument hut will be on the southeast towards the tower, the distance between instrument hut and tower is ~15 m. The instrument hut vector will be E-W (90°-270°).

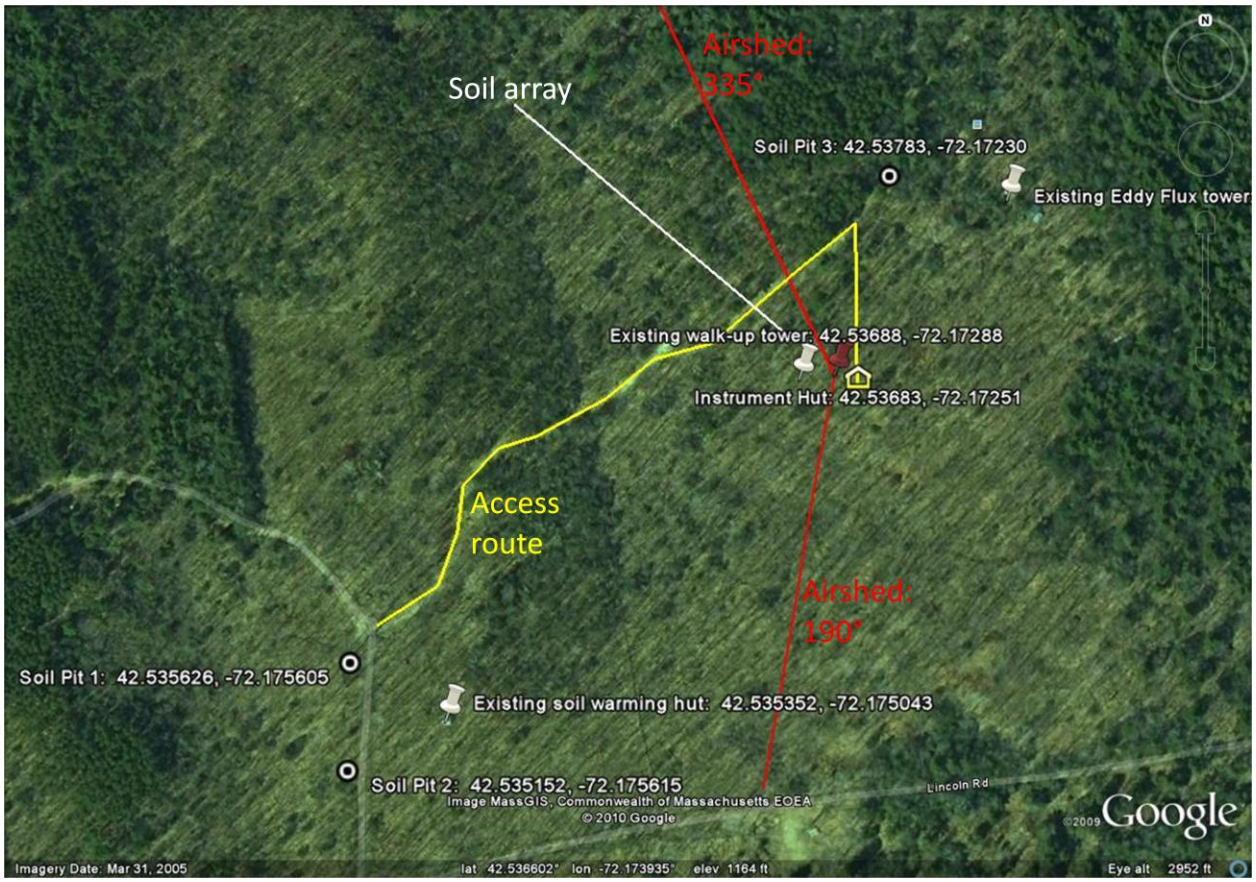



**Figure 2.** Site layout for Harvard Forest Advanced tower site.

i) Tower location is presented (red pin), ii) red lines indicate the airshed boundaries. Vectors 190° to 335° (clockwise from 190°) are the airshed area that would have quality wind data without causing flow distortions, respectively. iii) Yellow line is the suggested access road to instrument hut.


**Figure 3.** DFIR location at Harvard Forest Advanced tower site.
Purple pin indicates the DFIR location, which is close to Harvard Forest buildings, but is about 1.4 km away from tower 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: Becket-Skerry association, 3 to 15 percent slopes, extremely stony. The taxonomy of this soil is shown below:
**Order**: Spodosols
**Suborder**: Orthods
**Great group**: Haplorthods
**Subgroup**: Oxyaquic Haplorthods-Aquic Haplorthods
**Family**: Coarse-loamy, isotic, frigid Oxyaquic Haplorthods-Coarse-loamy, isotic, frigid Aquic Haplorthods
**Series**: Becket-Skerry association, 3 to 15 percent slopes, extremely stony

**Table 4**. Summary of soil array and soil pit information at Harvard Forest. 0° represents true north and accounts for declination.
All the expected soil depths are used for soil temperature and soil water content measurements. [a] is noted for soil $CO_2$ measurement depths.

| | |
|---|---|
| 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 | 29 m |
| Latitude and longitude of 1st soil plot OR direction from tower | 42.537093, -72.172956 |
| Direction of soil array | 310° |
| Latitude and longitude of FIU soil pit 1 | 42.535626, -72.175605 (primary location) |
| Latitude and longitude of FIU soil pit 2 | 42.535152, -72.175615 (alternate 1) |
| Latitude and longitude of FIU soil pit 3 | 42.53783, -72.17230 (alternate 2) |
| Dominant soil type | Becket-Skerry association, 3 to 15 percent slopes, extremely stony |
| Expected soil depth | 0.45- 0.89 m |
| Depth to water table | 0.61-1.07 m |

| **Expected depth of soil horizons** | **Expected measurement depths** |
|---|---|
| [a] 0-0.10 m (Fine sandy loam) | 0.05 m |
| 0.10-0.33 m (Fine sandy loam) | 0.27 m |
| [a] 0.33-0.46 m (Sandy loam) | 0.40 m |
| 0.46-0.64 m (Gravelly sandy loam) | 0.55 m |
| [a] 0.64-1.65 m (Gravelly fine sandy loam) | 1.15 m |

### 3.4 Information for ecosystem productivity plots.

The tower at Harvard Forest Advanced site has been positioned to optimize the collection of the air/wind signals both temporally and spatially over the desired ecosystem (Northern hardwood forest). Major airshed area at this site are from 190° to 335° (clockwise from 190°), and 90% signals for flux measurements are in a distance of 700 m from tower, and 80% within 500 m. We suggest FSU Ecosystem Productivity plots be placed within the boundaries of 190° to 335° (clockwise from 190°) from tower.

### 3.5 Issues and attentions

The DFIR site we picked is in an existing open area, which is the closest clearing to our tower location that we could find (1370 m away). This open area is currently use by Harvard Forest as a weather station, but it does not currently include a DFIR.

# 4 BARTLETT EXPERIMENTAL FOREST, RELOCATEABLE TOWER 1

## 4.1 Desired ecosystem

**Table 5**. Ecosystem at the Bartlett Experimental Forest Relocatable site.

| Ecosystem Type | Management activity |
|---|---|
| Eastern Deciduous Forest, Boreal ecotone | Managed Forest |

The Bartlett Experimental Forest (BEF) is a field laboratory for research on the ecology and management of northern hardwoods and associated ecosystems. Ecosystem is Eastern deciduous forest. Canopy height is ~23 m around tower site with lowest branches at ground level. Maple and beech form upper understory, which varies from 14 to 16 m in height. Seedlings and sapling of maple, hemlock and beech forms the lower understory with mean height ~ 4 m. Grass and other short vegetation form the understory at ground level with height ~ 0.2 m. Canopy area density was estimated to be ~ 4.6 in summer and ~ 1.4 $m^2$ $m^{-2}$ in winter season.

**Table 6**. Ecosystem and site attributes for the Bartlett Experiment Forest Relocatable site.

| Ecosystem attributes | Measure and units |
|---|---|
| Mean canopy height | 23 m |
| Surface roughness[a] | 1.5 m |
| Zero place displacement height[a] | 19.5 m |
| Structural elements | Closed-canopy, uniform, homogeneous |
| Time zone | Eastern time |
| Magnetic declination | 15° 35' W changing by 0° 4' E $year^{-1}$ |

Note, [a] From field survey.

## 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, in this case, level 6 being the upper most level at this tower site.

**Table 7**. Site design and tower attributes for Bartlett Experimental Forest Relocatable site

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

| Attribute | lat | long | degree | meters | notes |
|---|---|---|---|---|---|
| Airshed | | | 280° to 335° (major) and 140° to 200° | | Clockwise from first angle |
| Tower location | 44.06388° | -71.28731° | -- | -- | new site |

| | | | | |
|---|---|---|---|---|
| Instrument hut | 44.06403° | -71.28730° | | |
| Instrument hut orientation vector | -- | -- | 130°-310° | |
| Instrument hut distance z | -- | -- | -- | 15 |
| Anemometer/Temperature boom orientation | -- | -- | 270° | -- |

| **Height of the measurement levels** | | |
|---|---|---|
| Level 1 | 0.1 | m.a.g.l. |
| Level 2 | 4.0 | m.a.g.l. |
| Level 3 | 16.0 | m.a.g.l. |
| Level 4 | 20.0 | m.a.g.l. |
| Level 5 | 26.0 | m.a.g.l. |
| Level 6 | 35.0 | m.a.g.l. |
| Tower Height | 35.0 | 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 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 collocate at the top of the tower. See AD 04 for further information and requirements for bulk precipitation collection and wet deposition collection.

**Boardwalks**.
Specific boardwalks at the Bartlett site

- Boardwalk is from the access dirt road to instrument hut and must avoid crossing the area used for measuring soil respiration by University of New Hampshire scientists, pending landowner decision
- Boardwalk from the instrument hut to the tower to intersect on north face of the tower
- Boardwalk to soil array.
- No boardwalk from the soil array boardwalk to the individual soil plots

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

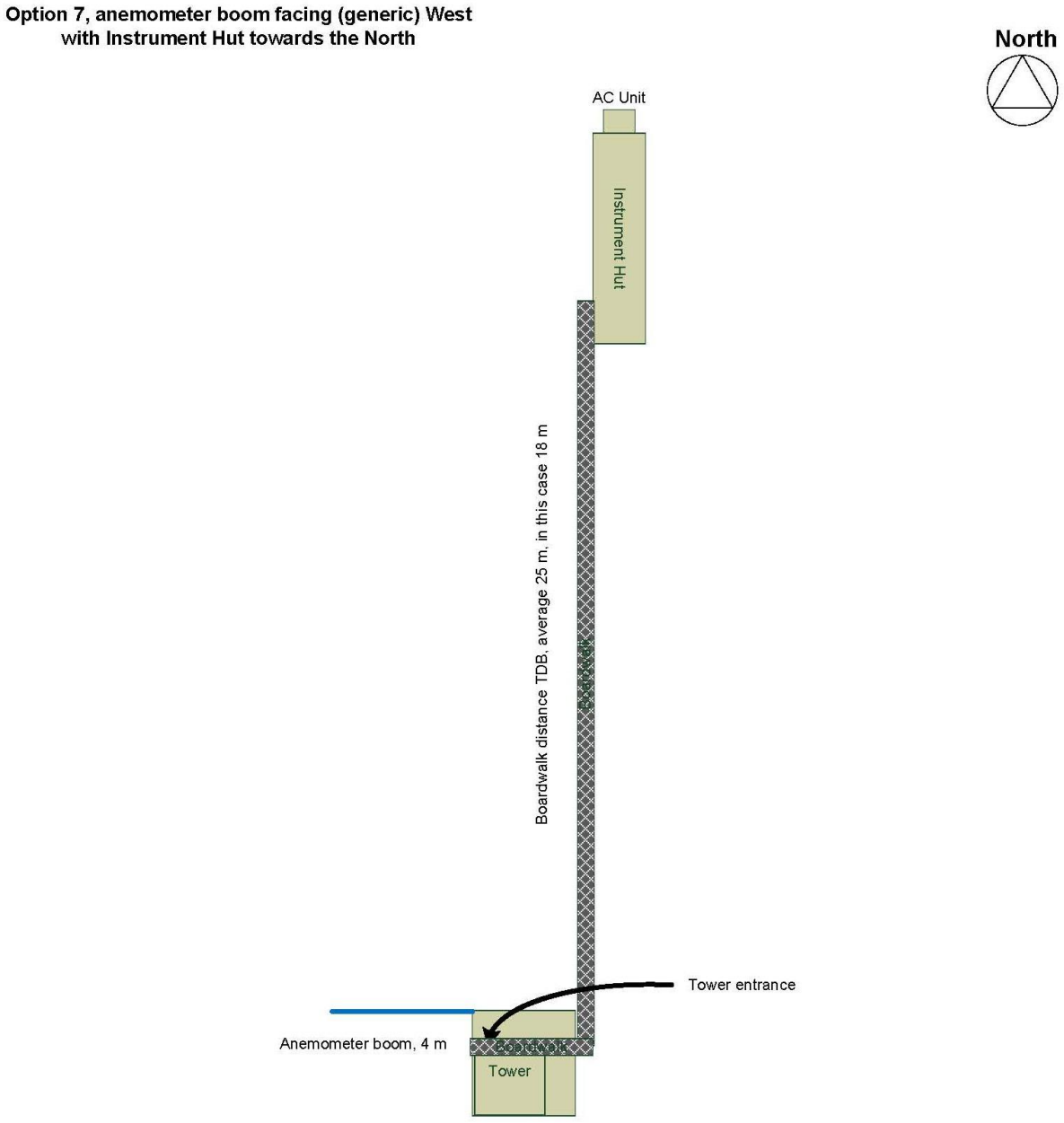



**Figure 4.** Generic diagram to demonstration the relationship between tower and instrument hut when boom facing west and instrument hut on the north towards the tower.

This is a generic diagram. The actual design of boardwalk (or path if no boardwalk required) and instrument hut position will be the responsibility of FCC and LAD following FIU's guidelines. At Bartlett Experimental Forest relocatable site, the boom angle will be 270 degrees, instrument hut will be on the north towards the tower, the distance between instrument hut and tower is ~15 m. The instrument hut vector will be SE-NW (130$^{o}$-310$^{o}$).

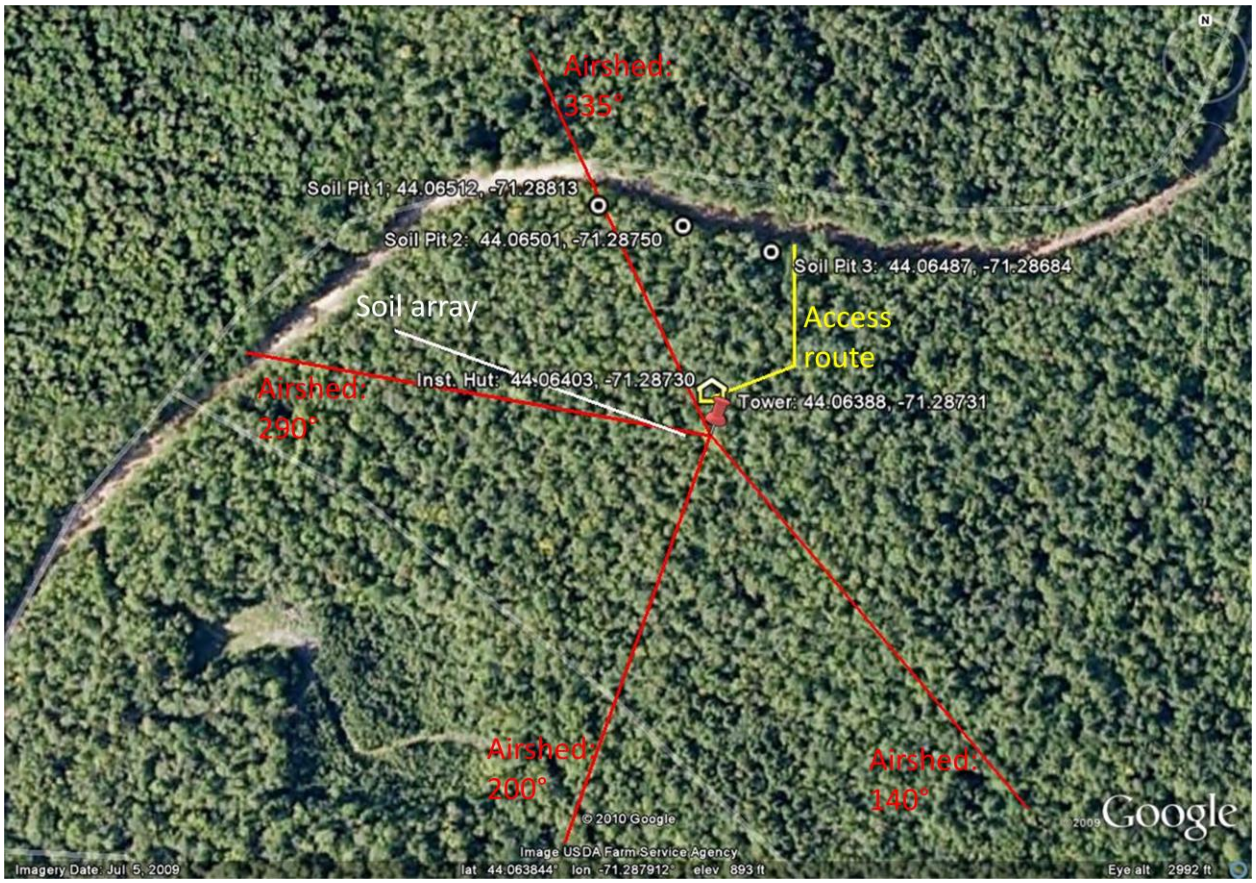



**Figure 5.** Site layout for Bartlett Experimental Forest Relocatable site.

i) new tower location is presented (red pin), ii) red lines indicate the airshed boundaries. Vectors 280° to 335° (clockwise from 280°, major airshed) or from 140° to 200° (clockwise from 140°, secondary airshed) that would have quality wind data without causing flow distortions, respectively. iii) Yellow line is the suggested access road to instrument hut.

### 4.3 Soil Attributes

The soil array vector is ***from*** soil plot closest to the tower ***toward*** the farthest soil plot from the tower. 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: Not available from NRCS (a nearby dominant soil, used here as a proxy, is: Marlow-Peru fine sandy loams association, sloping, very stony). The taxonomy of this soil is shown below:
**Order**: Spodosols*
**Suborder**: Orthods*
**Great group**: Haplorthods*
**Subgroup**: Oxyaquic Haplorthods - Aquic Haplorthods*

**Family**: Coarse-loamy, isotic, frigid Oxyaquic Haplorthods - Coarse-loamy, isotic, frigid Aquic Haplorthods*
**Series**: Marlow-Peru fine sandy loams association, sloping, very stony*

*The NRCS soil survey did not cover the tower and soil array site, therefore, this soil type is used here as a proxy.

**Table 11**. Summary of soil array and soil pit information at Bartlett. 0° represents true north and accounts for declination.
Soil depths will be determined during the soil pit excavation.

| | |
|---|---|
| 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 | 15 m |
| Latitude and longitude of 1st soil plot OR direction from tower | 44.06388°, -71.28750° |
| Direction of soil array | 290° |
| Latitude and longitude of FIU soil pit 1 | 44.06512°, -71.28813° (primary location) |
| Latitude and longitude of FIU soil pit 2 | 44.06501°, -71.28750° (alternate 1) |
| Latitude and longitude of FIU soil pit 3 | 44.06487°, -71.28684° (alternate 2) |
| Dominant soil type | Marlow-Peru fine sandy loams association, sloping, very stony* |
| Expected soil depth | >2 m* |
| Depth to water table | 0.30-1.07 m* |

| Expected depth of soil horizons | Expected measurement depths |
|---|---|
| 0-0.15 m (Fine sandy loam)* | 0.07 m* |
| 0.15-0.51 m (Gravelly fine sandy loam)* | 0.33 m* |
| 0.51-1.07 m (Fine sandy loam)* | 0.79 m* |

*The NRCS soil survey did not cover the tower and soil array site. Therefore, this soil type, which is found nearby, is used here as a proxy.

### 4.4 Information for ecosystem productivity plots.

The tower at Bartlett Experimental Forest Relocatable site has been positioned to optimize the collection of the air/wind signals both temporally and spatially over the desired ecosystem (hardwood forest). Airshed at this site is from 280° to 335° (clockwise from 280°, major airshed) and from 140° to 200° (clockwise from 140°, secondary airshed), and 90% signals for flux measurements are within a distance of 800 m from tower, and 80% within 500 m. We suggest FSU Ecosystem Productivity plots be placed within the major airshed boundaries of 280° to 335° (clockwise from 250°) from tower.

### 4.5 Issues and attentions

Researchers from the University of New Hampshire and USDA FS use the area east of the existing tower (44.06388, -71.28731) to monitor soil respiration. NEON should avoid disturbing this area, i.e. the access route and power lines should go around this area.

Some of the Forest Service representatives expressed concern about trenching power/communications lines in the soil and running them in conduit above the soil. However, they recognized that power and communications lines were needed at the NEON site. EH&S will have to continue this conversation with the local site personnel.

# 5 PLUM ISLAND SUBURBAN (BURLINGTON, MA), RELOCATEABLE TOWER 2

## 5.1 Desired ecosystem

NEON tower site (42.52395, -71.18293) is located within Sawmill brook conservation, Burlington, MA, which is next to the Aquatic/STREON site. Inside the park boundary, vegetation is mainly the Central Appalachian Dry Oak-Pine Forest, followed by Appalachian (Hemlock-) Northern Hardwood Forest. According to FIU site characterization. Canopy height is ~24 m around tower site with lowest branches at ground level, and with canopy area density of 4.6 in summer and 1.4 in winter. Maple and oak form the upper understory, which is ~ 14 m in height. Pine and some deciduous trees form second understory layers, which is ~ 8 m in mean canopy height. Recruitments of maple, oak, pine and beech forms the lower understory with mean height ~ 4 m. Grass and other short vegetation form the lowest understory at ground level with height ~ 0.4 m.

**Table 9**. Ecosystem at Plum Island Suburban Relocatable site.

| Ecosystem Type | Management activity |
|---|---|
| Eastern mixed, urban forest | Managed forest |

**Table 10**. Ecosystem and site attributes for the Plum Island Suburban Relocatable site.

| Ecosystem attributes | Measure and units |
|---|---|
| Mean canopy height[a] | 24 m |
| Surface roughness[a] | 1.5 m |
| Zero place displacement height[a] | 20.5 m |
| Structural elements | Closed forest, relatively homogeneous, understory presents |
| Time zone | Eastern time |
| Magnetic declination | 15° 7' W changing by 0° 3' E year$^{-1}$ |

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, in this case, level 6 being the upper most level at this tower site.

**Table 11**. Site design and tower attributes for Plum Island Suburban Relocatable site

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

| Attribute | lat | long | degree | meters | notes |
|---|---|---|---|---|---|
| Airshed | | | 220° to 320° | | Clockwise from 220° |

| | | | | | |
|---|---|---|---|---|---|
| Tower location | 42.52395° | -71.18293° | -- | -- | new site |
| Instrument hut | 42.52398° | -71.18278° | | | |
| Instrument hut orientation vector | -- | -- | 90°-270° | | |
| Instrument hut distance z | -- | -- | -- | 15 | |
| Anemometer/Temperature boom orientation | -- | -- | 270° | -- | |

| **Height of the measurement levels** | | |
|---|---|---|
| Level 1 | 0.2 | m.a.g.l. |
| Level 2 | 4.0 | m.a.g.l. |
| Level 3 | 12.0 | m.a.g.l. |
| Level 4 | 21.0 | m.a.g.l. |
| Level 5 | 27.0 | m.a.g.l. |
| Level 6 | 36.0 | m.a.g.l. |
| Tower Height | 36.0 | 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 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. No w**et deposition collector** will deployed at this site. See AD 04 for further information and requirements for bulk precipitation collection and wet deposition collection.

**Boardwalks**.
Specific boardwalks at the Plum Island Suburban Relocatable site

- No boardwalk is from the access dirt road to instrument hut, pending landowner decision
- Boardwalk from the instrument hut to the tower to intersect on north face of the tower
- No boardwalk to the soil array.
- No boardwalk from the soil array boardwalk to the individual soil plots

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

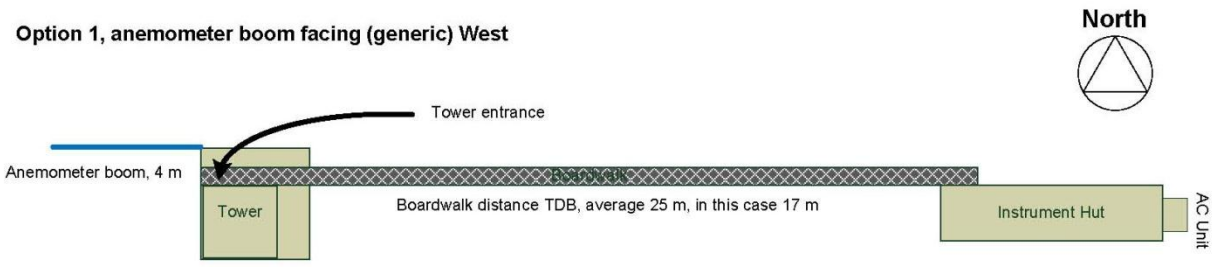


**Figure 6** Generic diagram to demonstration the relationship between tower and instrument hut when boom facing west and instrument hut on the east towards the tower.
This is just a generic diagram when boom facing west and instrument hut on the general east (includes northeast and east) towards the tower. The actual design of boardwalk (or path if no boardwalk required) and instrument hut position will be the responsibility of FCC and LAD following FIU's guidelines. At Plum Island Suburban Relocatable site, the boom angle will be 270 degrees, instrument hut will be on the northeast towards the tower, the distance between instrument hut and tower is ~15 m. The instrument hut vector will be E-W (90°-270°).

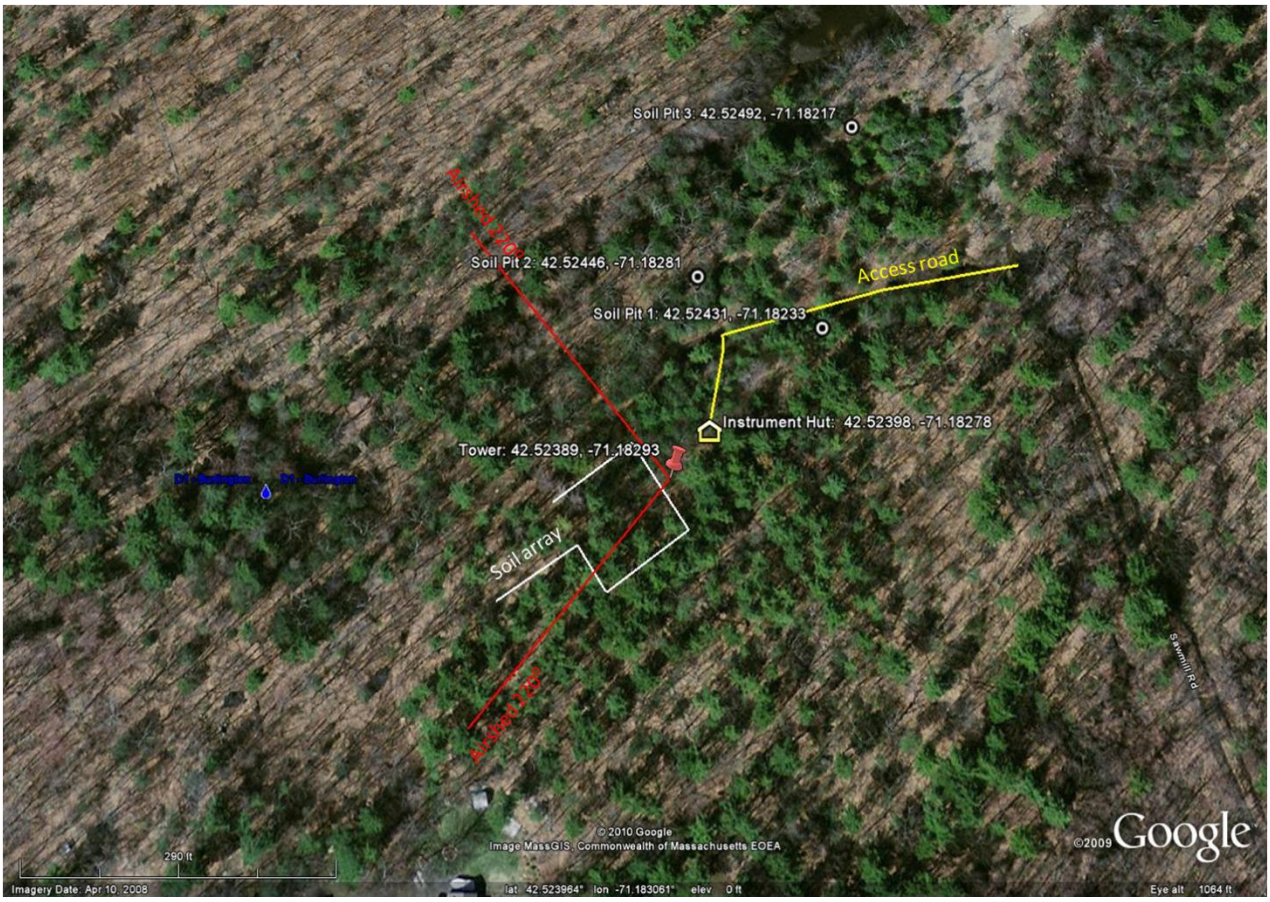


**Figure 7.** Site layout for Plum Island Suburban Relocatable site.

i) new tower location is presented (red pin), ii) red lines indicate the airshed boundaries. Vectors 220° to 320° (clockwise from 220°) would have quality wind data without causing flow distortions, respectively. iii) Yellow line is the suggested access road to instrument hut. Correct tower location is in the table and FCC report.

### 5.3 Soil Attributes

The soil array vector is ***from*** the soil plot closest to the tower ***toward*** next soil plot away from the tower (Fig. 8).

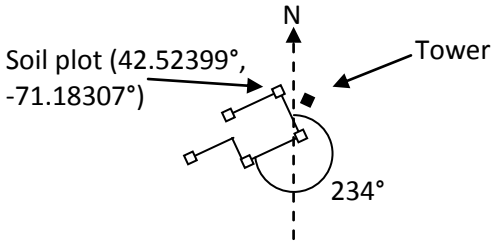


**Figure 8**. Schematic diagram of soil array layout in relation to tower. Soil plot positions are approximate. The exact location of each soil plot will be chosen by an FIU team member during site construction to avoid placing a soil plot at an unrepresentative location (e.g., rock outcrop, drainage channel, large tree, etc).

Dominant soil series at the site: Scituate fine sandy loam, 3 to 8 percent slopes, extremely stony. The taxonomy of this soil is shown below:
**Order**: Inceptisols
**Suborder**: Udepts
**Great group**: Dystrudepts
**Subgroup**: Oxyaquic Dystrudepts
**Family**: Coarse-loamy, mixed, active, mesic Oxyaquic Dystrudepts
**Series**: Scituate fine sandy loam, 3 to 8 percent slopes, extremely stony

**Table 12**. Summary of soil array and soil pit information at Plum Island Suburban Relocatable site. 0° represents true north and accounts for declination.
All the expected soil depths are used for soil temperature and soil water content measurements. [a] is noted for soil $CO_2$ measurement depths.

| | |
|---|---|
| Soil plot dimensions | 5 m x 5 m |
| Soil array pattern | C |
| Distance between soil plots: x | 25 m |
| Distance from tower to closest soil plot: y | 16 m |
| Latitude and longitude of 1st soil plot OR direction from tower | 42.52399°, -71.18307° |
| Direction of soil array | 234° |
| Latitude and longitude of FIU soil pit 1 | 42.52431°, -71.18233° (primary location) |
| Latitude and longitude of FIU soil pit 2 | 42.52446°, -71.18281° (alternate 1) |
| Latitude and longitude of FIU soil pit 3 | 42.52492°, -71.18217° (alternate 2) |
| Dominant soil type | Scituate fine sandy loam, 3 to 8 percent slopes, extremely stony |
| Expected soil depth | 0.46-0.84 m |
| Depth to water table | 0.46-0.61 m |

| **Expected depth of soil horizons** | **Expected measurement depths** |
|---|---|
| [a] 0-0.20 m (Fine sandy loam) | 0.10 m |
| [a] 0.20-0.51 m (Sandy loam) | 0.36 m |
| 0.51-0.69 m (Loamy fine sand) | 0.60 m |
| [a] 0.69-1.65 m (Gravelly loamy sand) | 1.17 m |

### 5.4 Information for ecosystem productivity plots.

The tower at Plum Island Suburban Relocatable site has been positioned to optimize the collection of the air/wind signals both temporally and spatially over the desired ecosystem (hardwood deciduous urban forest). Airshed at this site is from 190° to 20° (clockwise from 190°), but has higher frequency

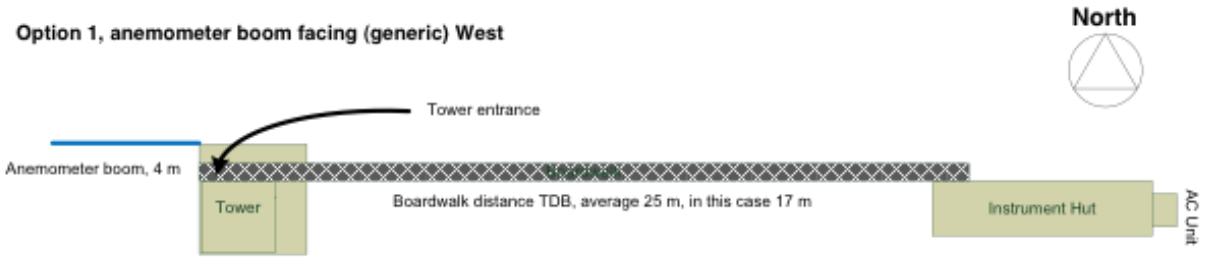
wind from 220$^{o}$ to 320$^{o}$ (clockwise from 220$^{o}$) throughout the whole year. 90% signals for flux measurements are within a distance of 1000 m from tower, and 80% within 800 m. Therefore, we suggest FSU Ecosystem Productivity plots are placed within the major tower airshed boundaries of 220$^{o}$ to 320$^{o}$ (clockwise from 220$^{o}$).

### 5.5 Issues and attentions

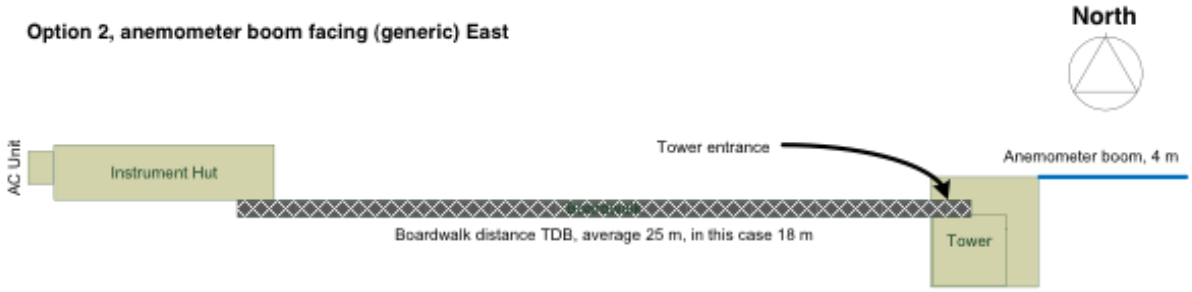
Wil Wollheim indicated that security would be an issue at the Plum Island Suburban Relocatable site, since it is an urban conservation area with residential areas within a few hundred meters of the tower site. Fencing around the tower will likely be necessary and possibly around the instrument hut. The currently location of the instrument hut is close to one of the major paths through the conservation area, the tower is approximately 20 m from the path.

The conservation area is small and the tower airshed will likely extend beyond the conservation area into the residential area and beyond.

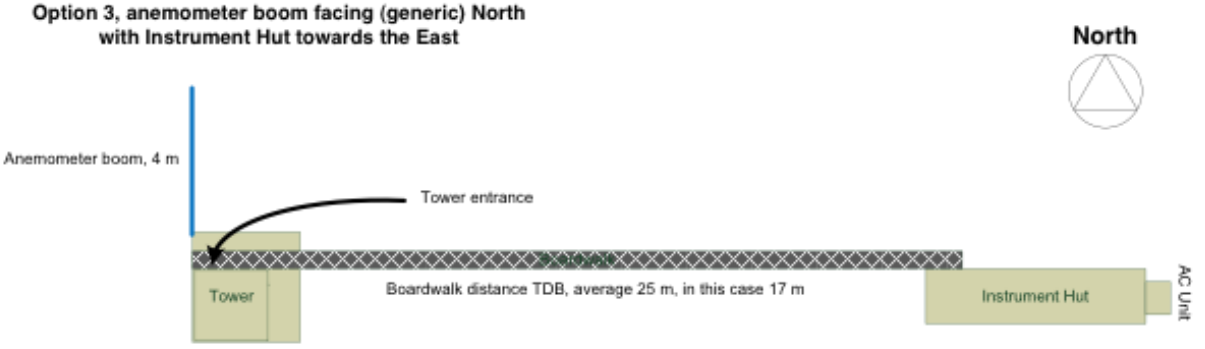
**Option 1, anemometer boom facing (generic) West**



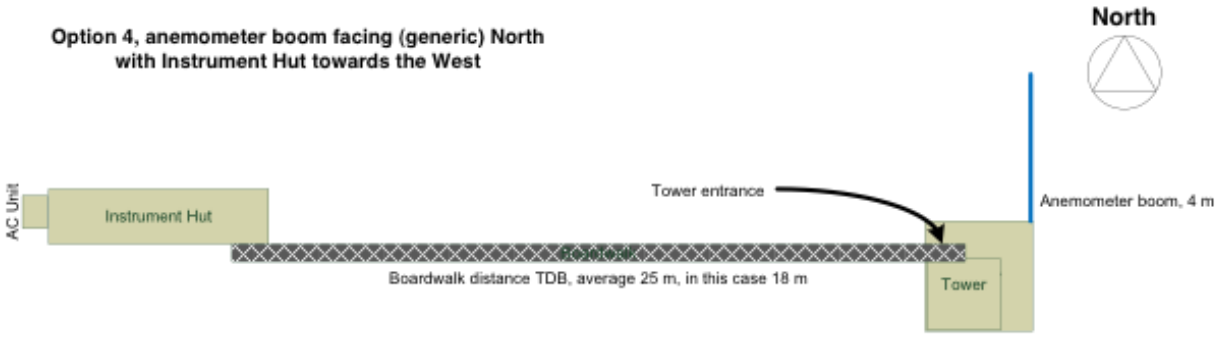

**Option 2, anemometer boom facing (generic) East**



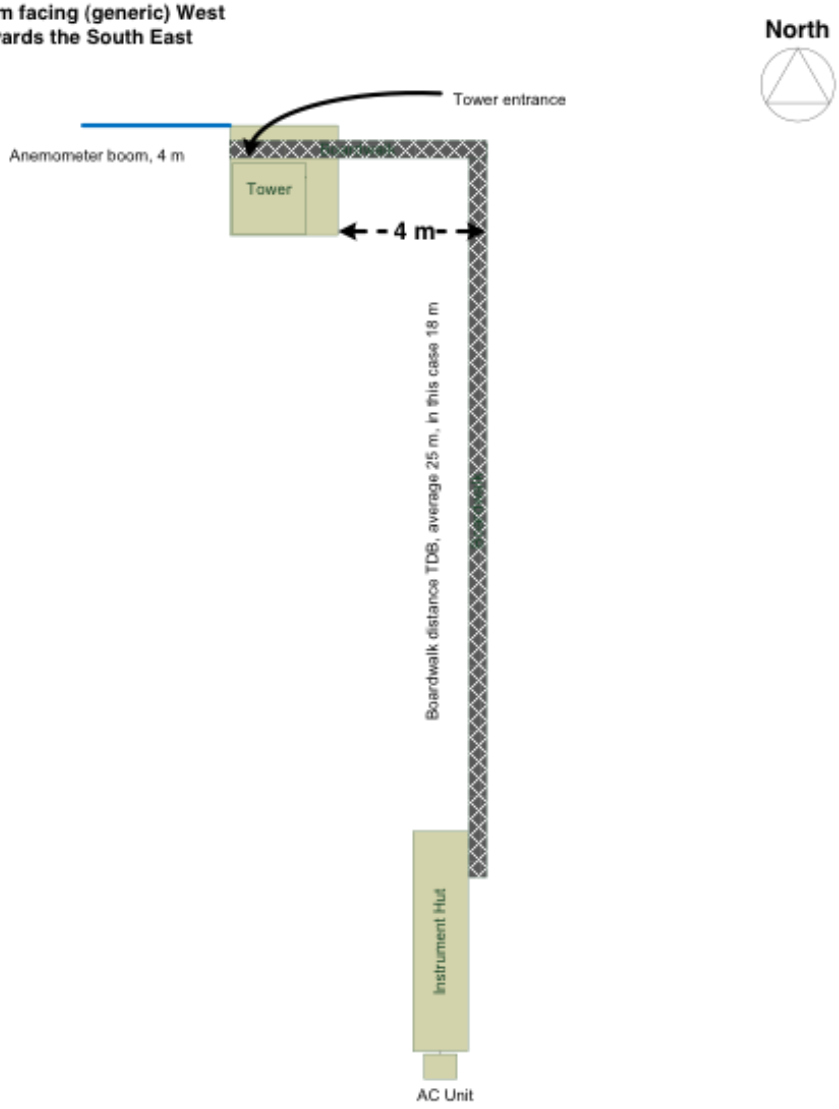

**Option 3, anemometer boom facing (generic) North with Instrument Hut towards the East**



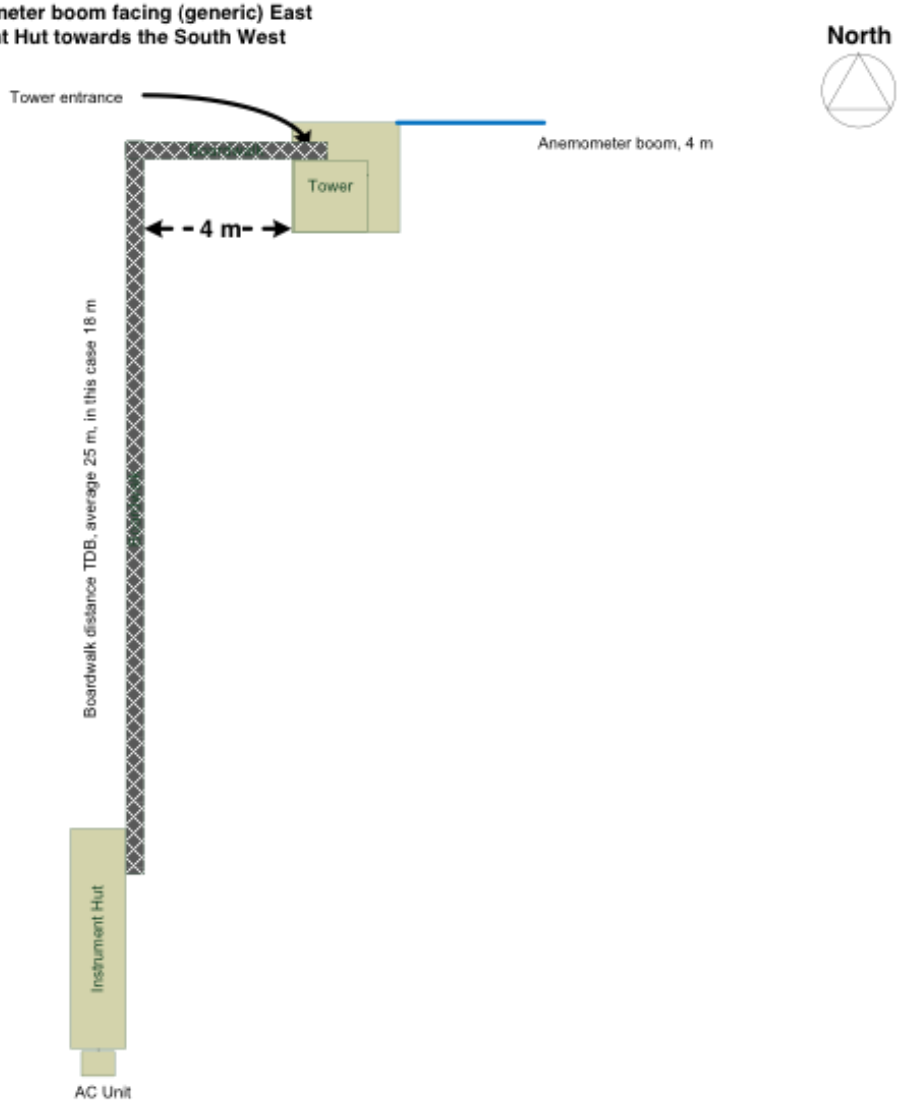

**Option 4, anemometer boom facing (generic) North with Instrument Hut towards the West**



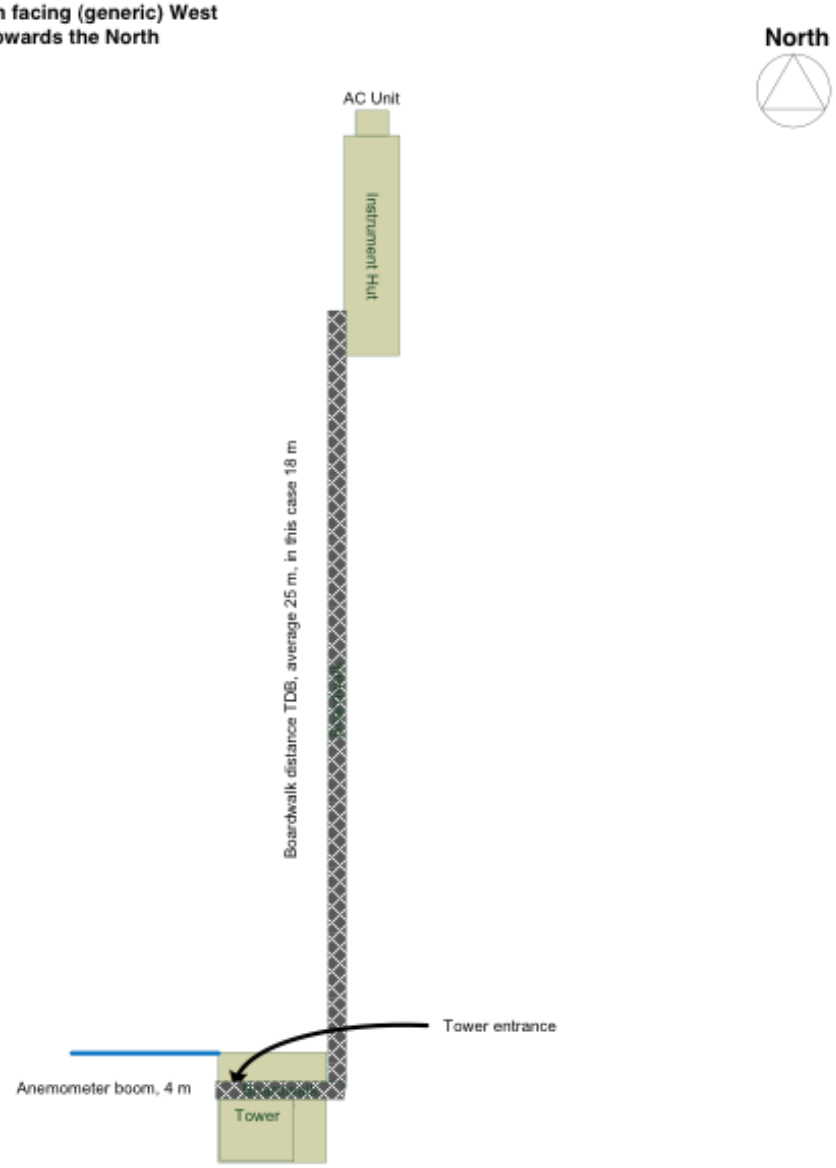
**Option 5, anemometer boom facing (generic) West with Instrument Hut towards the South East**



**Option 6, anemometer boom facing (generic) East with Instrument Hut towards the South West**



**Option 7, anemometer boom facing (generic) West with Instrument Hut towards the North**



**Option 8, anemometer boom facing (generic) South with Instrument Hut towards the North**

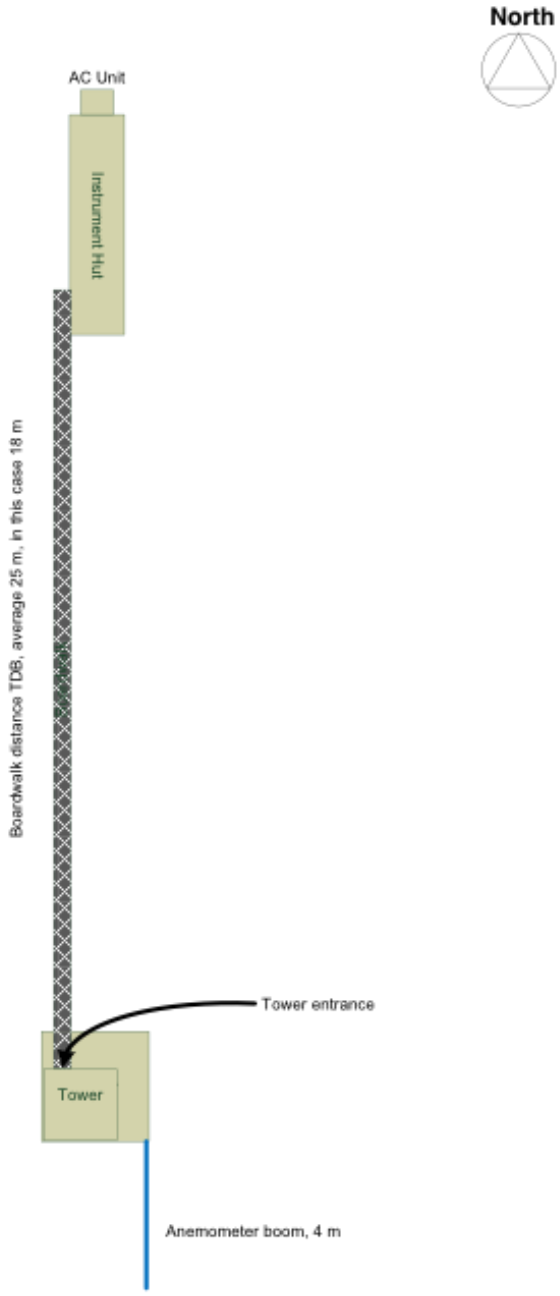
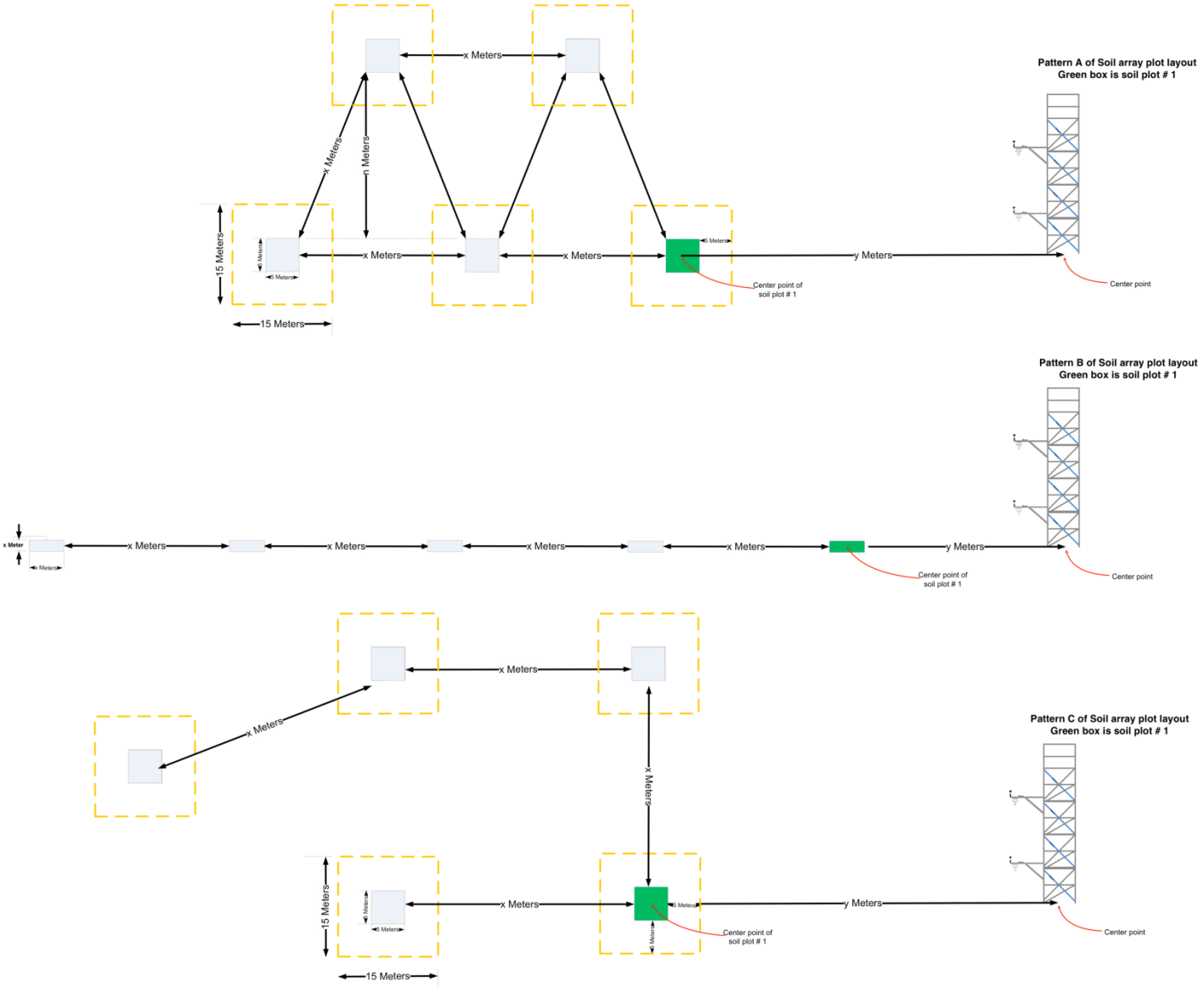


**Figure 9.** Generic patterns for the boardwalk configuration

These generic configurations are from the instrument hut to the tower based on 8 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
x Meters
x Meters
y Meters
15 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
x Meters
y Meters
15 Meters
Center point of soil plot # 1
Center point

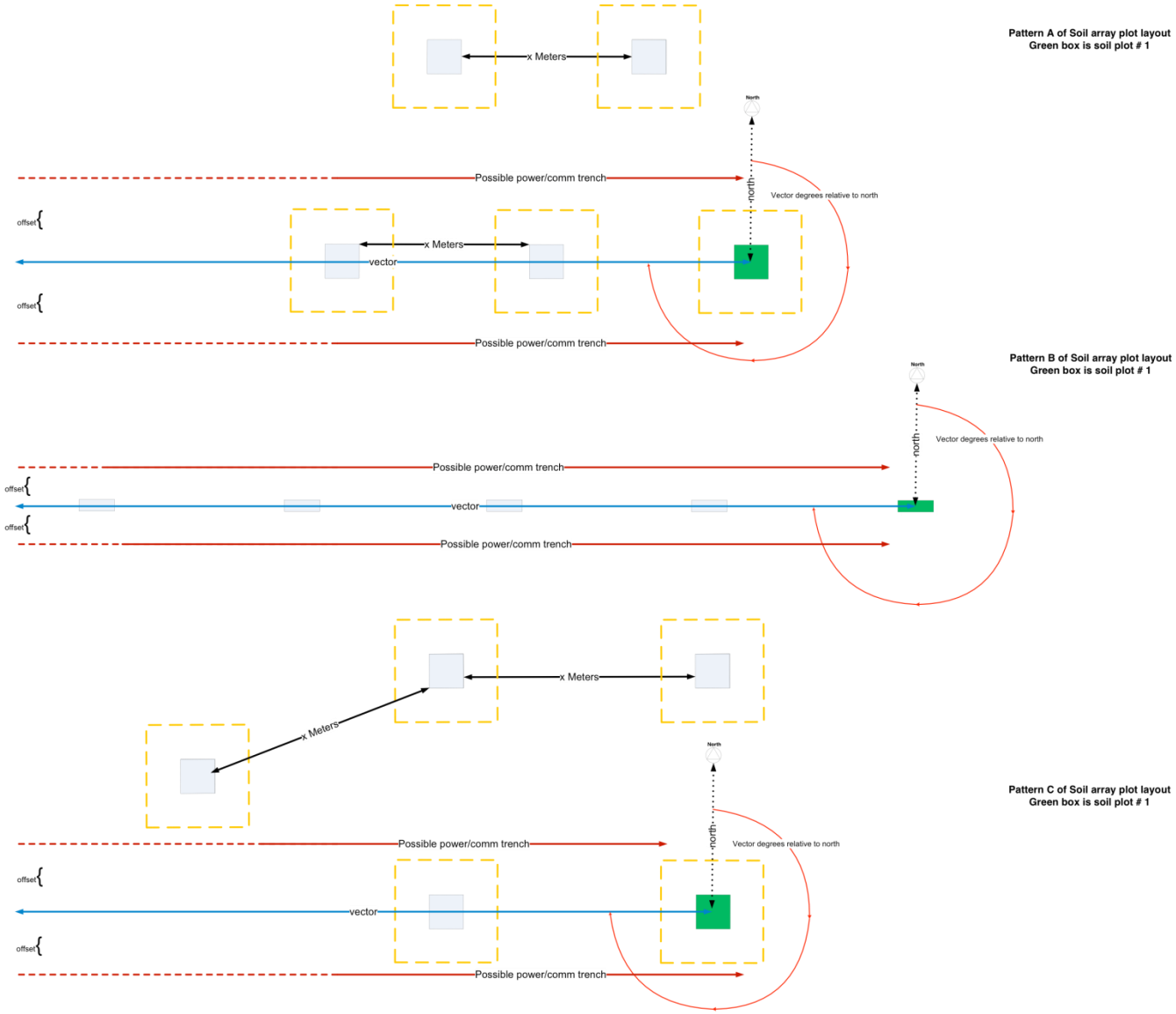

Pattern A of Soil array plot layout
Green box is soil plot # 1
x Meters
North
Possible power/comm trench
north
Vector degrees relative to north
offset
x Meters
vector
offset
Possible power/comm trench
Pattern B of Soil array plot layout
Green box is soil plot # 1
North
north
Vector degrees relative to north
Possible power/comm trench
offset
vector
offset
Possible power/comm trench
x Meters
x Meters
Pattern C of Soil array plot layout
Green box is soil plot # 1
North
Possible power/comm trench
north
Vector degrees relative to north
offset
vector
offset
Possible power/comm trench

**Figure 9**. 10.

**Figure 10.** 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.

## 6 APPENDIX A. FCC SUMMARY TABLES

**Table A1.** FCC Summary Table for FIU site components at D01 Harvard Forest Core

| **Site Component** | | | | **units** |
|---|---|---|---|---|
| Tower location | 42.53690° | -72.17266° | | Lat, Long |
| Tower height | 38.0 | | | meters |
| Tower guying | yes | prefer not removing any branches | | yes/none, notes |
| Instrument Hut location | 42.53683° | -72.17251° | | Lat, Long |
| IH orientation[a] | 90° - 270° | | | vector |
| boom orientation[b] | 270° | | | degrees |
| Min distance from face of tower to IH face | | 15 | Option 1 | distance (m), option # |
| how the Bwalk intersects the tower access | Boardwalk intersects the north-side of the tower from the east. | | | description |
| how the Boardwalk intersects the tower access | Boardwalk to skirt around the east side of tower with 4 m (min) distance away from the tower base | | | description |
| how the Boardwalk intersects the tower access | No Boardwalk within 8 m perpendicular to south face of tower (plan view) | | | description |
| Air shed vector(s)[c] | 190° to 335° | Clockwise from 190° | | vector, notes |
| Boardwalk from AP to IH | yes | access SE from the road to IH (Fig. 1) | | yes/none, notes |
| Boardwalk from tower to soil array | yes, except where it crosses forest road | | | yes/none, notes |
| Boardwalk needed to DFIR | none | | | yes/none |
| Power and Communication line | 10 m from edge of plot to the centerline of power/comms line | whichever side is easiest[e], line above ground | | offsetr |
| DFIR location | 42.53308° | -72.18986° | | Lat, Long |
| DFIR power supply | Line power needed and available | | | description |
| Soil plot 1st location | 42.537093° | -72.172956° | | Lat, Long (center point) |
| Soil plot distance between plots (x) | 40 m | | | meters, |
| Soil array pattern and vector[d] | B | 310° | | A, B, or C, vector |
| Soil plot dimensions | 5 m x 5 m | | | L x W (meters) |
| Soil profile pit primary | 42.535626° | -72.175605° | 1.2 m | Lat, Long, and expected depth |

| | | | | |
|---|---|---|---|---|
| Soil profile pit alternative 1 | 42.535152° | -72.175615° | 1.2 m | Lat, Long, and expected depth |
| Soil profile pit alternative 2 | 42.53783° | -72.17230° | 1.2 m | Lat, Long, and expected depth |
| Fencing needs | none | none | none | IH, Soil Arrays, Guy anchors |
| Presence of large grazing animals | none | | | description |
| Site management* | Managed Forest | | | description |
| Any additional site specific information | Eastern Deciduous forest | | | description |
| Magnetic declination | 14° 38' W changing by 0° 3' E year$^{-1}$ | | | At time of site visit |

**Table A2**. FCC Summary Table for FIU site components at D01 Bartlett Experimental Forest Relocatable 1

| **Site Component** | | | | **units** |
|---|---|---|---|---|
| Tower location | 44.06388° | -71.28731° | | Lat, Long |
| Tower height | 35.0 | | | meters |
| Tower guying | yes | prefer not removing any branches | | yes/none, notes |
| Instrument Hut location | 44.06403° | -71.28730° | | Lat, Long |
| IH orientation[a] | 130°-310° | | | vector |
| boom orientation[b] | 270° | | | degrees |
| Min distance from face of tower to IH face | | 15 | Option 7 | 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] | 280° to 335°, 140° to 200° | Clockwise from first angle | | vector, notes |
| Boardwalk from AP to IH | yes | access S from the road to IH (Fig. 2) | | yes/none, notes |
| Boardwalk from tower to soil array | yes | | | yes/none, notes |
| Boardwalk needed to DFIR | No DFIR | | | yes/none |
| Power and Communication line | 10 m from edge of plot to centerline of power/comms line | whichever side is easiest[e], line above ground | | offset, notes |
| DFIR location | none | | | Lat, Long |
| DFIR power supply | na. | | | description |
| Soil plot 1st location | 44.06388° | -71.28750° | | Lat, Long (center point) |
| Soil plot distance between plots (x) | 40 m | | | meters |
| Soil array pattern and vector[d] | B | 290° | | A, B, or C, vector |
| Soil plot dimensions | 5 m x 5 m | | | L x W (meters) |
| Soil profile pit primary | 44.06512° | -71.28813° | 0.9 m | Lat, Long, and expected depth |
| Soil profile pit alternative 1 | 44.06501° | -71.28750° | 0.9 m | Lat, Long, and expected depth |
| Soil profile pit alternative 2 | 44.06487° | -71.28684° | 0.9 m | Lat, Long, and expected depth |
| Fencing needs | none | none | none | IH, Soil Arrays, Guy anchors |
| Presence of large grazing animals | none | | | description |
| Site management* | Managed Forest | | | description |
| Any additional site specific information | Eastern Deciduous forest, Boreal Ecotone | | | description |
| Magnetic declination | 15° 35' W changing by 0° 4' E year$^{-1}$ | | | At time of site visit |

**Table A3**. FCC Summary Table for FIU site components at D01 Plum Island (Burlington Conservation Area) Relocatable 2

| **Site Component** | | | | **units** |
|---|---|---|---|---|
| Tower location | 42.52395° | -71.18293° | | Lat, Long |
| Tower height | 36.0 | | | meters |
| Tower guying | yes | prefer not removing any branches | | yes/none, notes |
| Instrument Hut location | 42.52398° | -71.18278° | | Lat, Long |
| IH orientation[a] | 90°-270° | | | vector |
| boom orientation[b] | 270° | | | degrees |
| Min distance from face of tower to IH face | | 15 | Option 7 | 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] | 220° to 320° | Clockwise from 220° | | vector, notes |
| Boardwalk from AP to IH | no | access straight S from the road to IH (Fig. 3) | | yes/none, notes |
| Boardwalk from tower to soil array | no | | | yes/none, notes |
| Boardwalk needed to DFIR | no DFIR | | | yes/none |
| Power and Communication line | 10 m from edge of plot to centerline of power/comms line | whichever side is easiest[e], line above ground | | offset, notes |
| DFIR location | none | | | Lat, Long |
| DFIR power supply | na. | | | description |
| Soil plot 1st location | 42.52399° | -71.18307° | | Lat, Long (center point) |
| Soil plot distance between plots (x) | 25 m | | | meters |
| Soil array pattern and vector[d] | C | 234° | | A, B, or C, vector |
| Soil plot dimensions | 5 m x 5 m | | | L x W (meters) |
| Soil profile pit primary | 42.52431° | -71.18233° | 1.2 m | Lat, Long, and expected depth |
| Soil profile pit alternative 1 | 42.52446° | -71.18281° | 1.2 m | Lat, Long, and expected depth |
| Soil profile pit alternative 2 | 42.52492° | -71.18217° | 1.2 m | Lat, Long, and expected depth |
| Fencing needs | none | none | none | IH, Soil Arrays, Guy anchors |
| Presence of large grazing animals | none | | | description |
| Site management* | Managed Forest | | | description |
| Any additional site specific information | Eastern mixed, urban forest | | | description |
| Magnetic declination | 15° 7' W changing by 0° 3' E year$^{-1}$ | | | 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

[d]From 1st plot toward other plots if pattern B, from 1st plot toward nearest neighbor (see diagram of the patterns)

[e]see FIGURE 10. Options for Soil Array, second figure.

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