



Bingham, S. N., C. C. Young, J. L. Haack-Gaynor , L. W. Morrison, and G. A. Rowell. 2016. Wetland monitoring protocol for Cuyahoga Valley National Park: Narrative. Natural Resource Report NPS/HTLN/NRR—2016/ 1336. National Park Service, Fort Collins, Colorado.

Standard Operating Procedure 12: Vascular Plant Monitoring in Intensively-Assessed Wetlands

Version 1.00 (12/27/2016)

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

Contents

	Page
Standard Operating Procedure 12: Vascular Plant Monitoring in Intensively-Assessed Wetlands	3
Survey Methodology	3
Navigation to Wetlands	3
Plot Set-Up	3
Vascular Plant Survey	4
Woody Plant Survey.....	4
Handling Unknown Plants.....	5
Biomass Sampling	6
Taxonomic References for the Flora of Northeastern Ohio	7
References	7
Attachment 12.1 Survey Sites.....	8
Attachment 12.2 Sentinel Sites	18
Attachment 12.3: Vascular Plant Characterization Data Sheet.....	25
Attachment 12.4: Woody Plant Diameter Characterization Data Sheet	26
Attachment 12.5: Biomass Data Characterization Data Sheet.....	27

Standard Operating Procedure 12: Vascular Plant Monitoring in Intensively-Assessed Wetlands

Survey Methodology

Intensively-assessed wetlands include a probabilistic sample of 60 sampling arrays in 60 wetlands (survey wetlands, Table 5.1) and a subjective sample of 37 sampling arrays in 15 wetlands (sentinel wetlands, Table 6.1). Intensively-assessed wetlands are monitored using the Vegetation Index of Biotic Integrity (VIBI) v 1.5 (Mack and Gara 2015) during the summer months (June 15-September 15) when key plant identification characteristics are most visible. VIBI users should attend a two-day certification course offered by the OEPA, when provided. At a minimum, the VIBI manual should be reviewed before field sampling and referred to regularly throughout the season.

Navigation to Wetlands

See Centroids of Intensively-Assessed Wetlands waypoint file (SOP 2).

Plot Set-Up

1. The corners of each array should already be marked with PVC. Upon arriving at each site, one or more of these PVC stakes should be visible.
2. Consult map of sampling array (Attachment 12.1 for survey sites and 12.2 for sentinel sites).
3. The observer should stand at the observer starting location, marked with an X on the map and orient him/herself with the specified azimuth using a compass.
4. The observer should take note of the module numbering.
5. Locate at least one corner stake if possible. Or, if a corner stake is not visible, begin by using the groundwater well as the reference location, which is generally the centroid of the sampling arrays.
6. Stretch out survey tapes according to the azimuth and array as needed to locate remaining three corners. Tapes should be flush to the ground if possible, and orientated so that zero is always located closer to Module 1. It is important to properly lay out tapes to avoid module numbering confusion during the survey.
7. Wrap the tapes around corner stakes or a chaining pin to provide a taught line. Leave the tapes deployed.
8. Stretch a tape along the central axis for arrays that are 2 modules in width. Stake both ends with a chaining pin.
9. Use pink pin flags to identify all 0 m, 10 m, 20 m, 30 m, 40 m, or 50 m intersections along the survey tapes. There should be 6 intersections in a 1 x 2 array, 9 intersections in a 2 x 2 array, and 18 intersections in a 2 x 5 array.
10. Box in the 10x10-m modules by stretching tapes perpendicular to the appropriate azimuth depicted in Attachment 12. Stake ends with a chaining pin.
11. TIP: In areas with poor visibility, one person can use the compass to direct a second person around or through barriers with the survey tape. The person being directed can hold a long PVC pipe marked with brightly colored pin flag to improve siting.

Vascular Plant Survey

1. The biological purview of the vascular plant survey (VPS) is all vascular plant species with stems covering a portion of the module (regardless of height), as well as bryophyte species (all moss species and the aquatic lichens *Riccia* and *Ricciocarpos*). This changed from the beginning of the baseline monitoring surveys (round 1), where trees > 6 m in height were excluded from the sample and covered only in the Woody Plant Survey. Observers should continue recording BOTH values on the dataform: 1. cover of all species < 6 m in height and 2. total cover of all species with stems in the module (regardless of height). The second value should be circled on the dataform to distinguish it clearly.
2. The modules in a sampling array included within the VPS are identified on each map. Be aware that all modules are not always included in the VPS, and there will never be more than four modules sampled in the VPS.
3. In each VPS module, all vascular species (except trees >6 m in height) and bryophytes are identified and recorded on Attachment A: Vascular Plant Characterization Datasheet (Attachment 12.3). The datasheets contains a column to list all species present. Vascular plant identifications are made to the lowest level possible, generally genus and species. Mosses do not need to be identified beyond (i.e., they are recorded as Moss #1, Moss #2, Moss #3, etc.).
4. The foliar cover is estimated for all species (except trees > 6 m in height) recorded as present within each module using the following cover class scale: 1 = solitary/few plants, 2 = 0-1%, 3 = 1-2%, 4 = 2-5%, 5 = 5-10%, 6 = 10-25%, 7 = 25-50%, 8=50-75%, 9=75-90%, 10=95-99%. Foliar cover is defined as the area of ground covered by the vertical projection of the aerial portion of the plants.
5. To be clear, a single vascular plant species found in four modules will be recorded one time on the species list, but noted as occurring in module 1, module 2, module 3, and module 4, with foliar cover estimates provided for each of those four modules.

Woody Plant Survey

1. The biological purview of the woody plant survey (WPS) is all woody species and or standing or leaning dead stem (i.e., a snag) and vines > 1 m in height.
2. All modules in a sampling array are included in the WPS.
3. In each WPS module, identify the species and record the number of stems and dbh of each living woody plant stem or standing or leaning dead stem (i.e., a snag) greater than 1 m in height that is rooted in the module. Use Attachment B: Woody Plant Diameter Characterization Datasheet (Attachment 12.4).
4. Diameters are measured as diameter at breast height (1.37 m) except for stems between 1 m and 1.37 m in height, which are tallied as diameter class 1, >0 – <1 cm category.
5. Tally marks are used to track the number of stems within a certain size class that belong to each species recorded in each module.
6. This is conducted separately for each module using the following diameter at breast height (dbh) class scale for stems up to 40 cm in diameter: 1 = >0-<1 cm, 2 = 1-<2.5 cm, 3 = 2.5-<5 cm, 4 = 5-<10 cm, 5 = 10-<15 cm, 6 = 15-<20 cm, 7 = 20-<25 cm, 8 = 25-<30 cm, 9 = 30-<35 cm, 10 = 35-<40 cm.

7. For stems 40 cm and greater in diameter, the actual diameter is recorded in centimeters to nearest tenth centimeter (i.e., these stems are not tallied using the dbh class scale).
8. There is one exception to this approach to the collection of diameter data for woody stems: shrubs (we define “shrubs” as woody plants that reach heights less than 5 m in maximum height such as *Alnus*, *Cephalanthus*, *Cornus*, *Sambucus*, *Viburnum*) that reach breast height, but occur with multiple stems arising from a single root may be tallied as a single “shrub clump”.
9. For trees with trunks that are split below breast height, all stems are recorded individually (i.e., treated as if they were multiple single stems).
10. In sloping areas, dbh is measured with the observer standing upslope of the tree.
11. Binoculars are often needed for identifying large trees.
12. In dense thickets, pin flags may be necessary for tracking or a chalk tree marker is used to make sure that stems are not missed or double-counted.
13. Verify that the number of tally marks on the data form match the tree count for that module before moving on to the next module.

Handling Unknown Plants

1. During the VIBI survey, immature plants or plants missing structures (e.g., fruiting bodies) that cannot be identified to species should be identified to genus.
2. Otherwise, record the plant as unknown and make a notation as to its life-form (graminoid, monocot, dicot, forb, etc.) on the field data form.
3. *Mosses and aquatic lichens* (*Riccia* and *Ricciocarpos*) are recorded as moss sp.1, moss sp. 2, moss sp. 3, etc.
4. All unknown plants must be labeled as unknown and described with as much information as possible.
 - a. Closely related unknowns of the same type within the same VIBI plot should be distinguished by assigning a number (e.g., unknown graminoid, Cyperaceae, *Carex* #1,#2, etc.). Write this number on the data form and the voucher label.
 - b. A descriptor (e.g., wide-leaved *Carex*, rather than *Carex* sp. 2) and location information (i.e. wide-lf *Carex* 559 m1, for module 1, plot 559) may also be useful for later identification.
5. Plants that cannot be positively identified in the field should be collected whenever possible.
 - a. Be sure to include all flowering parts, as well as basal leaves. Individuals of intermediate size should be selected.
 - b. If possible, select specimens with fruit and flowers.
 - c. Grasses, sedges, and many other species (e.g., *Ranunculus* and *Galium* spp.), also require that the roots are collected for positive identification. In the case of woody plants, branches that contain leaves, fruit, or flowering structures should be collected.
6. Vouchers can be stored in a field press or a well-labeled ziploc bag depending on the turnover time.
 - a. Vouchers should be processed as soon as possible. Vouchers that cannot be processed within the week should be pressed and dried quickly after collection to preserve their integrity.
 - b. If plants are pressed before identification, some characteristics (e.g., color) may change after they are dried and others are less obvious (e.g., number of petals, ovaries, stamens) on a two-

dimensional surface. These characteristics should be noted on the voucher label for future reference.

- c. If it is a hot day, vouchers stored in a ziploc bag can be placed in a cooler with some ice until end of day and then transferred to a refrigerator prior to identification.
 - d. The label should consist *at a minimum* of collector's name, date, plot, and name.
7. High quality vouchers will become part of a reference collection, stored in the Heartland Network (HTLN) herbarium for Cuyahoga Valley National Park (See SOP 14).

Biomass Sampling

1. If the wetland is an *emergent wetland*, standing biomass is collected from 2x 0.1 m² quadrats at opposite corners in each module. Select the corners that appear least disturbed from the plot set-up process.
 - a. Using pruners, clip all living plant material rooted in the quadrat to ground level (except mosses).
 - b. Fold and place in paper grocery bags.
 - c. Label the bag with the wetland ID (Unique ID), date, module and corner.
2. Determine dry-weight of biomass samples.
 - a. Place well-labeled biomass samples in drying oven at 105 °C for at least 24 hours.
 - b. Remove biomass samples one at a time.
 - c. Immediately after removing from the oven, weigh bag and plant material on a scale that is accurate to within 1/10 of a gram (i.e., total weight).
3. Record weight on the biomass data form (Attachment 12.5).
4. Remove plant material from bag, then weigh the bag only, and record on the data form.
5. Subtract the bag weight from the total weight to determine the dry weight of the plant material.

Taxonomic References for the Flora of Northeastern Ohio

Many of the plant taxonomic references for Ohio use outdated nomenclature and may be missing more recent additions to Ohio's flora. Used in combination, however, with published volumes of the Flora of North America or USDA plants or Andreas et al. (2004), local taxonomic experts still recommend these resources.

Braun, E.L. 1961. The woody plants of Ohio: trees, shrubs and woody climbers, native, naturalized, and escaped. Ohio State University Press, Columbus. 362 p.

Braun, E.L. 1967. The Monocotyledonae of Ohio. Cattails to Orchids. The Ohio State University Press, Columbus, Ohio. 464 p.

Gleason, H. A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada, 2nd edition. The New York Botanical Garden Press. 923 p.

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Holmgren, N.H. 1998. The Illustrated Companion to Gleason and Cronquist's Manual. The New York Botanical Garden Press. 919 p.

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Strausbaugh, P.D. and E.L. Core. 1978. Flora of West Virginia, 2nd edition. Seneca Books, Inc. Morgantown, WV. 1079 p.

Voss, E.G. and A.A. Reznicek. Field Manual of Michigan Flora. The University of Michigan Press, Ann Arbor, Michigan. 990 p.

Weishaupt, C.G. 1971. Vascular Plants of Ohio, 3rd edition. Kendall / Hunt Publishing Company, Dubuque, Iowa. 293 p.

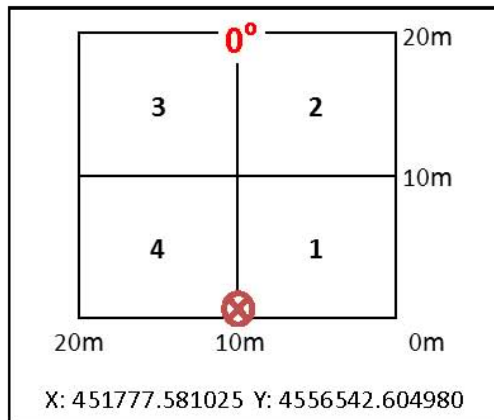
References

Mack, John J. and Brian D. Gara. 2015. Integrated Wetland Assessment Program. Part 9: Field Manual for the Vegetation Index of Biotic Integrity for Wetlands v. 1.5. Ohio EPA Technical Report WET/2015-2. Ohio Environmental Protection Agency, Wetland Ecology Group, Division of Surface Water, Columbus, Ohio. Available at: http://epa.ohio.gov/portals/35/wetlands/Part9_field_manual_v1_5rev15aug15.pdf (accessed 26 September 2016)

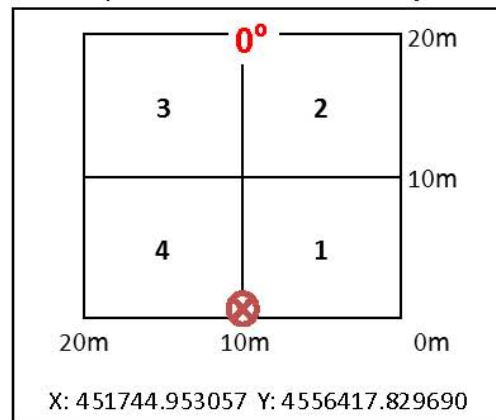
Attachment 12.1 Survey Sites

The circled “x” is the observers location relative to the azimuth shown opposite the observer. This observer-to-azimuth orientation is critical to proper plot layout and numbering.

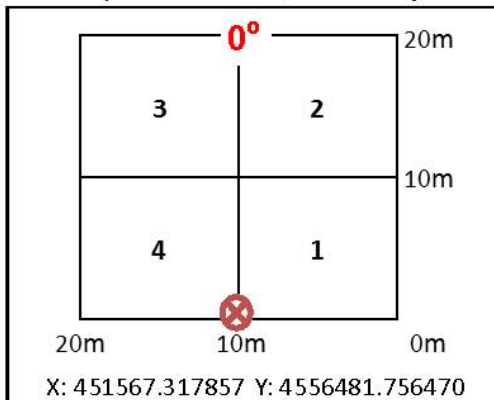
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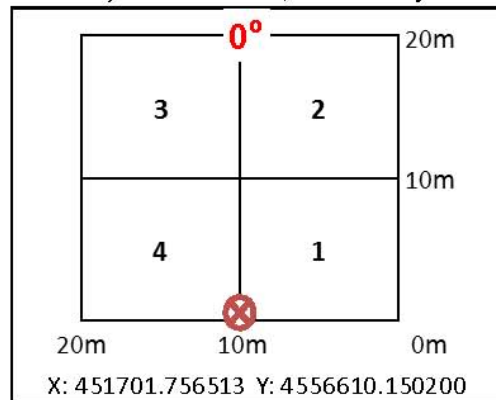
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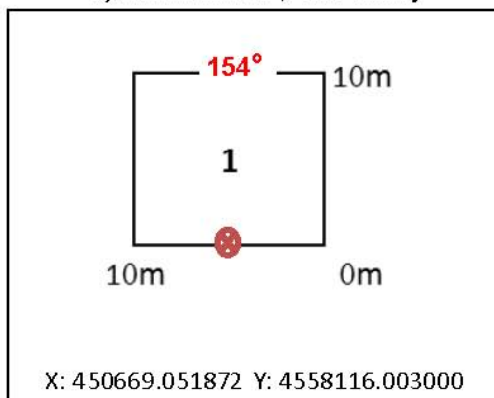
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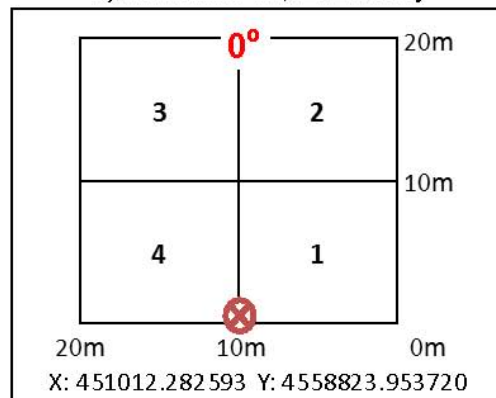
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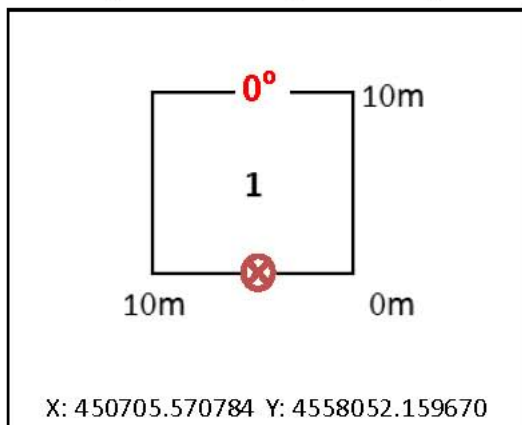
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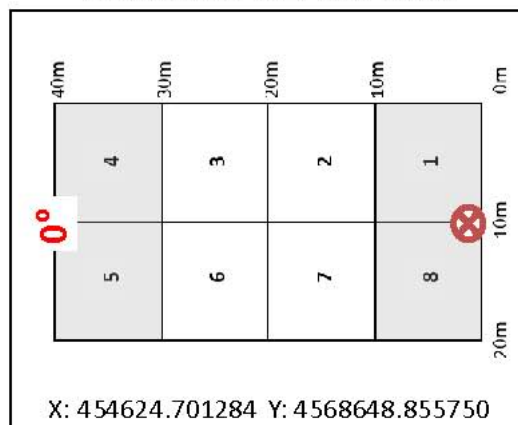
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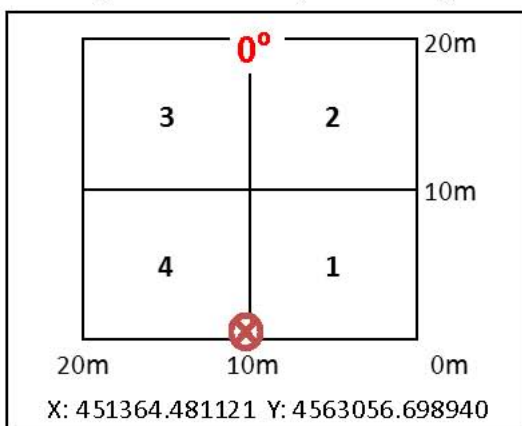
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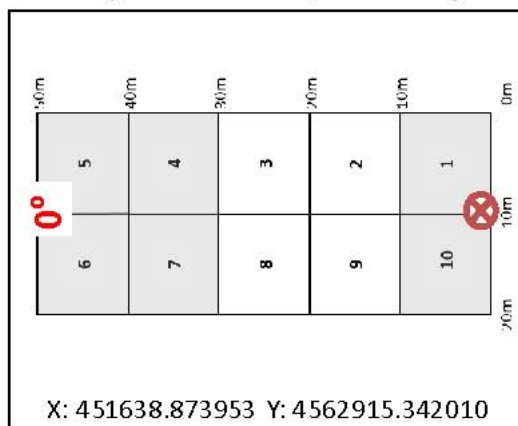
8) Wetland 192, 2x4 array



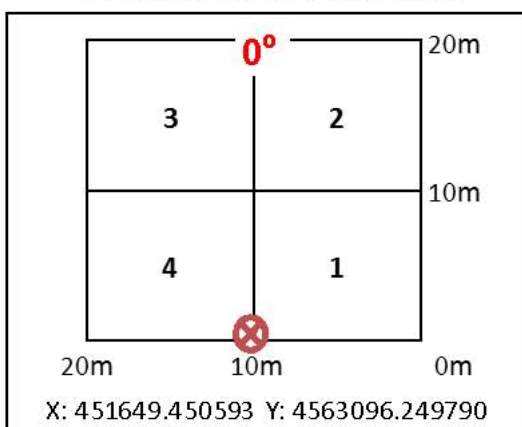
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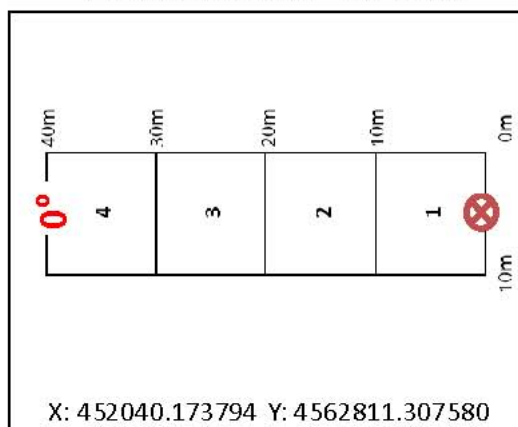
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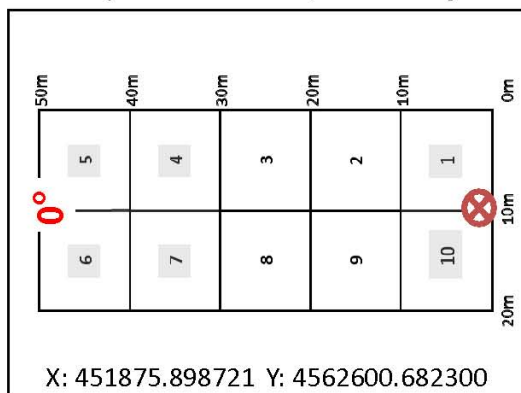
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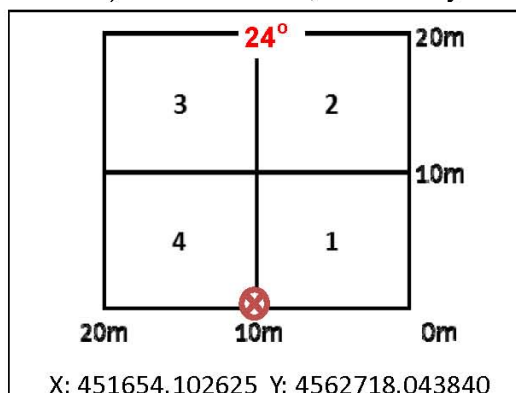
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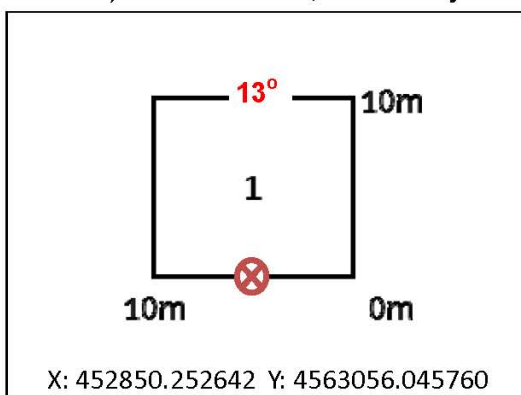
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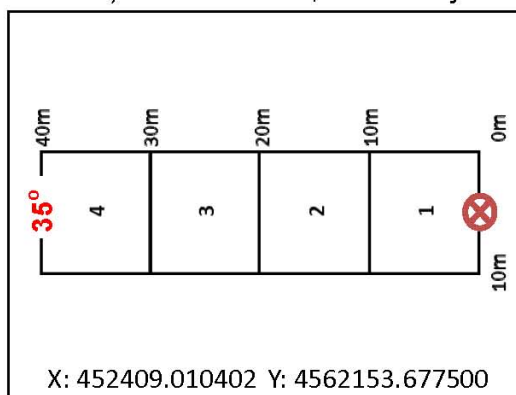
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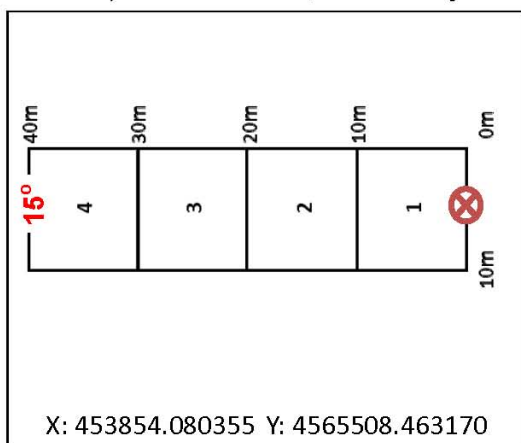
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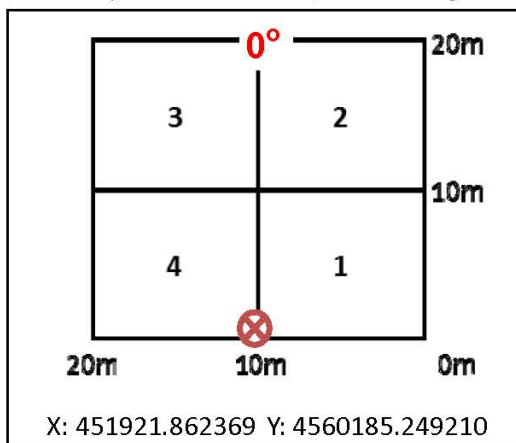
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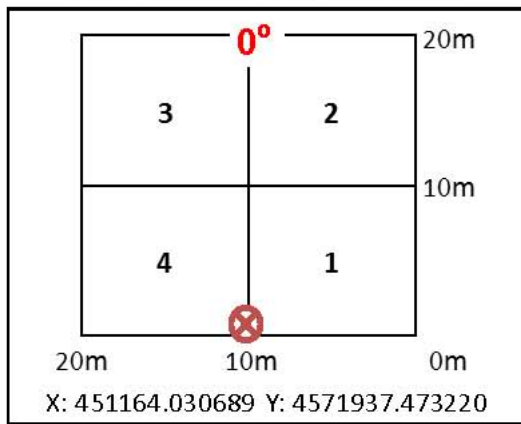
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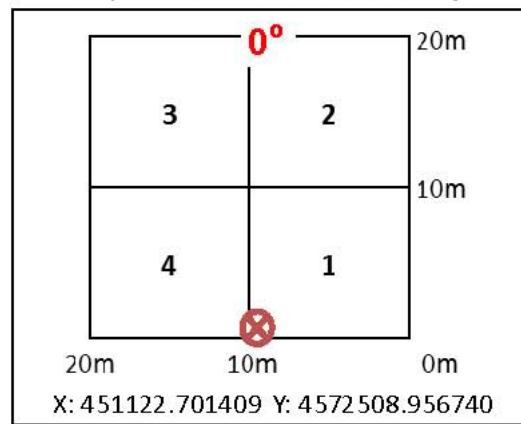
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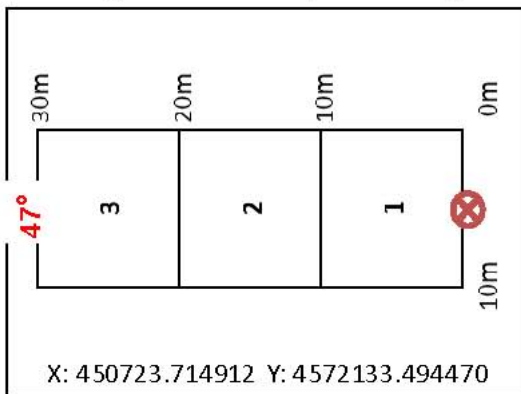
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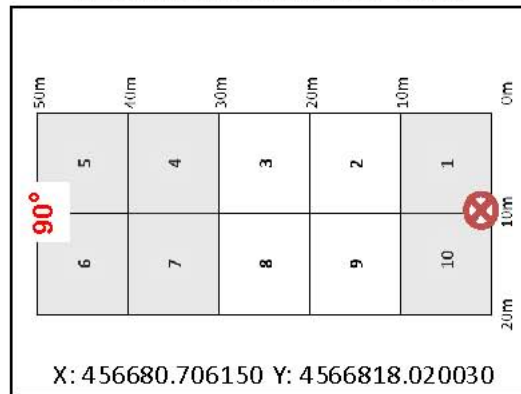
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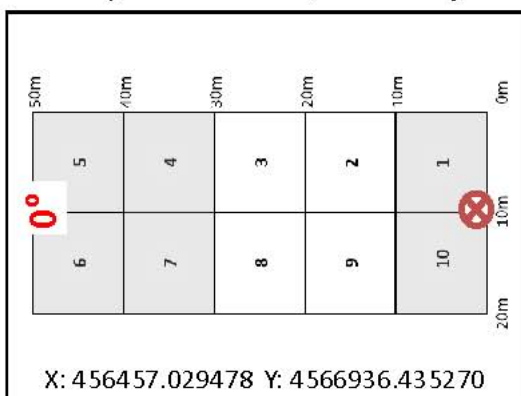
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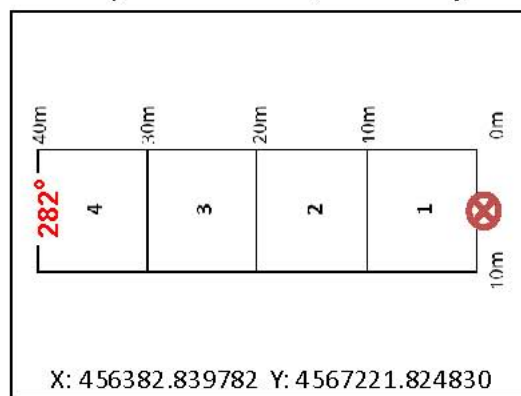
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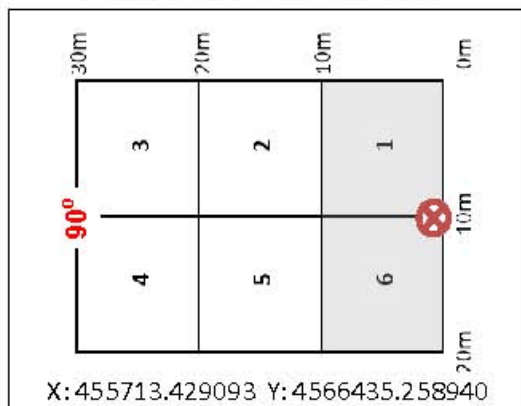
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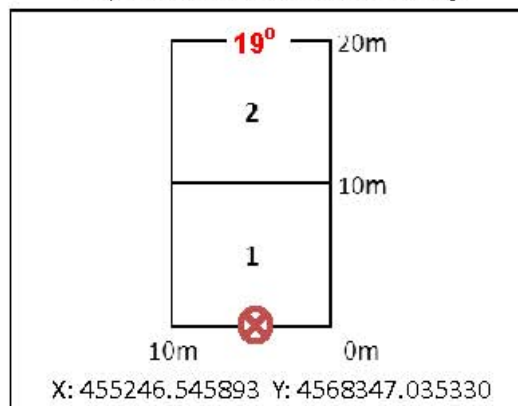
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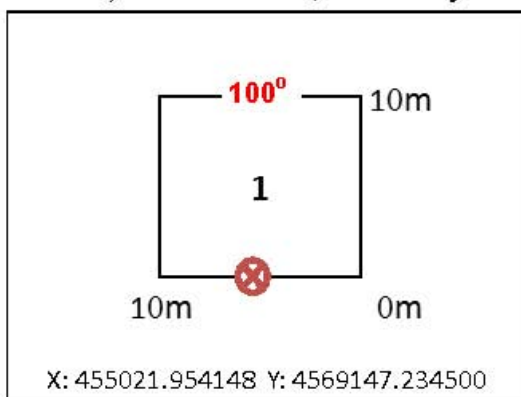
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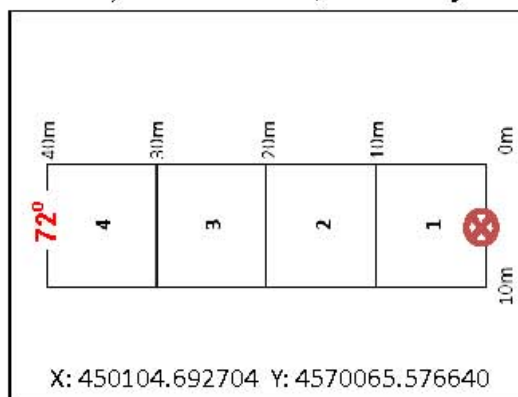
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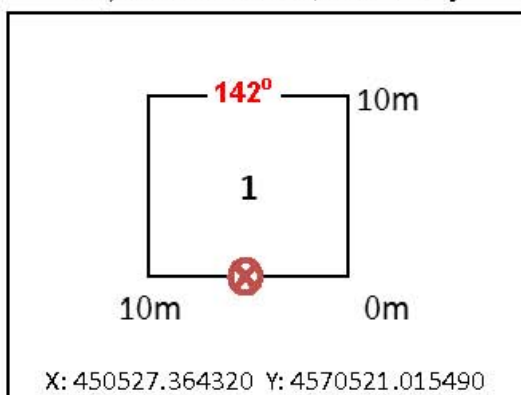
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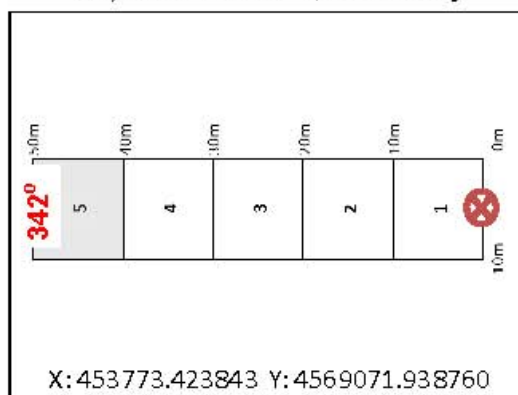
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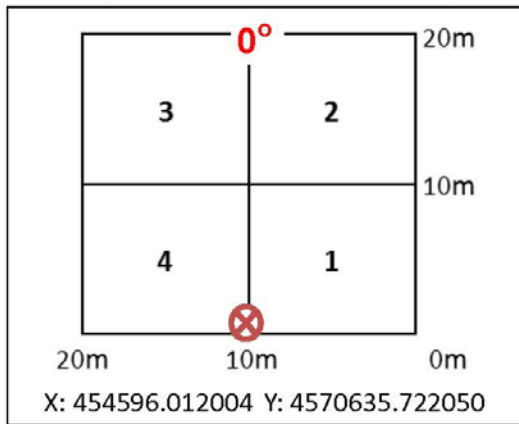
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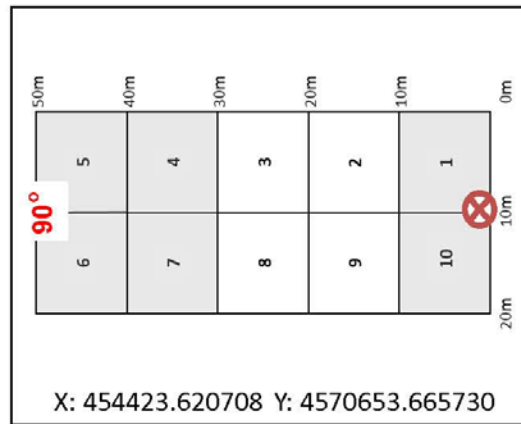
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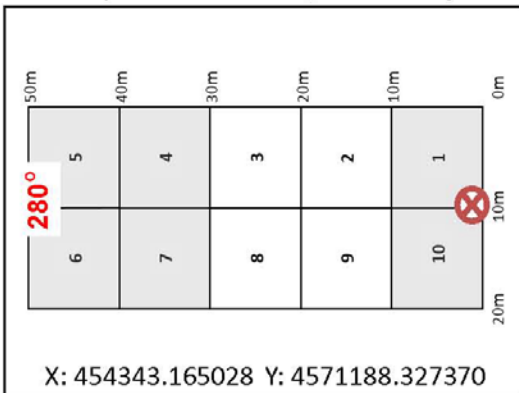
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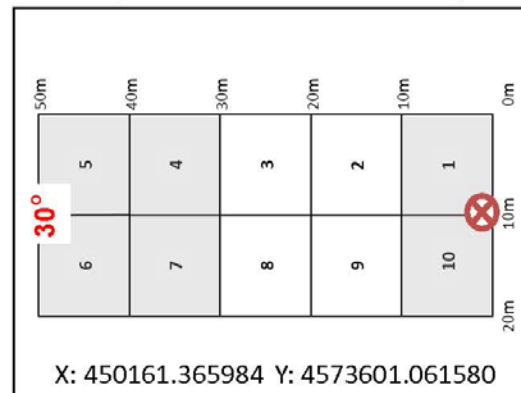
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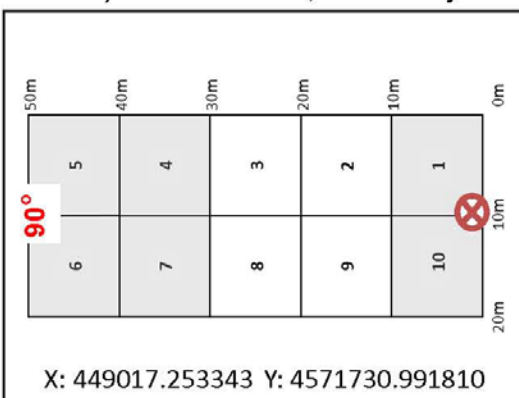
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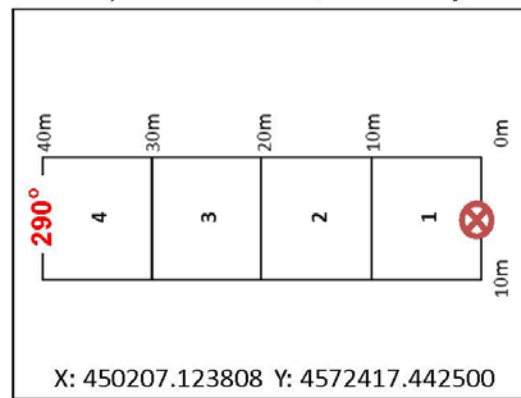
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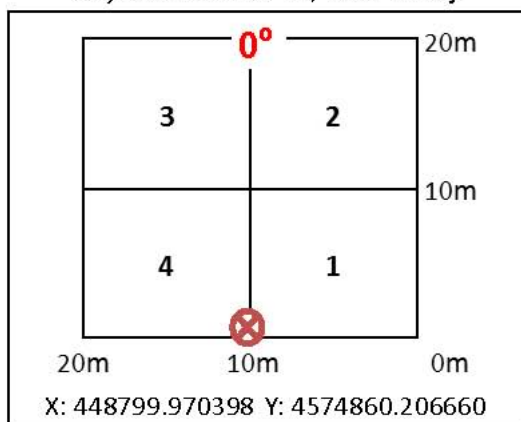
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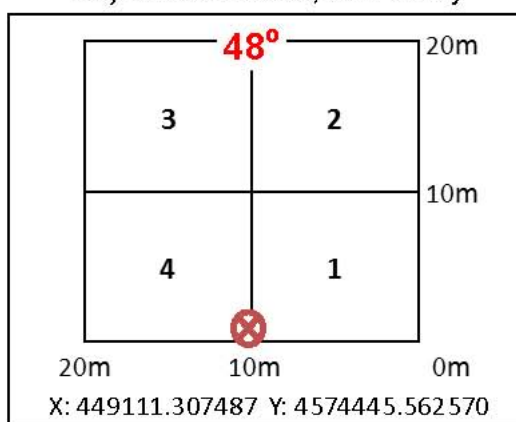
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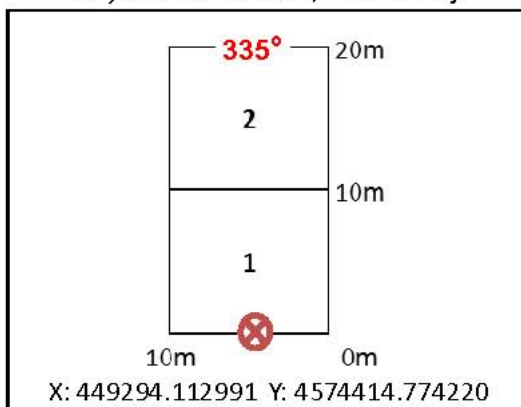
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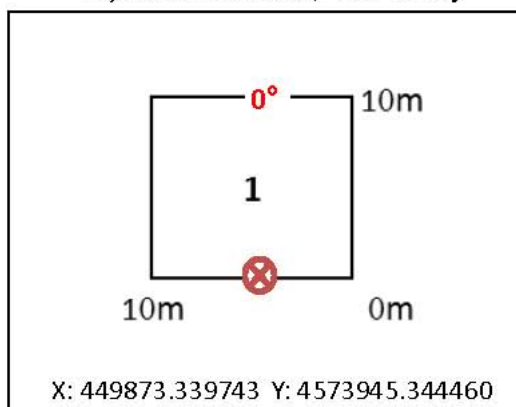
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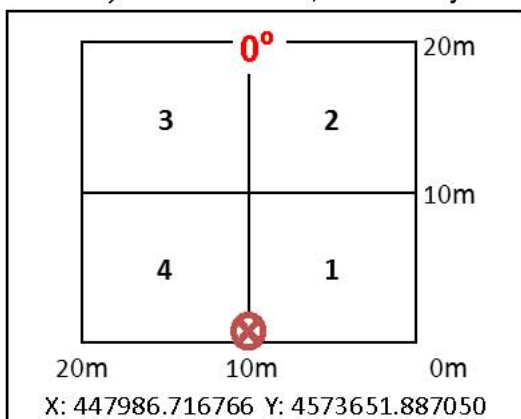
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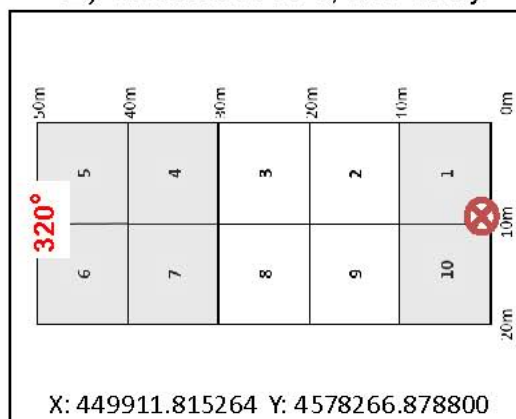
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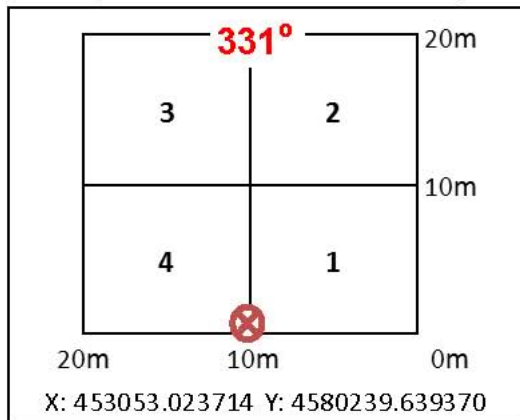
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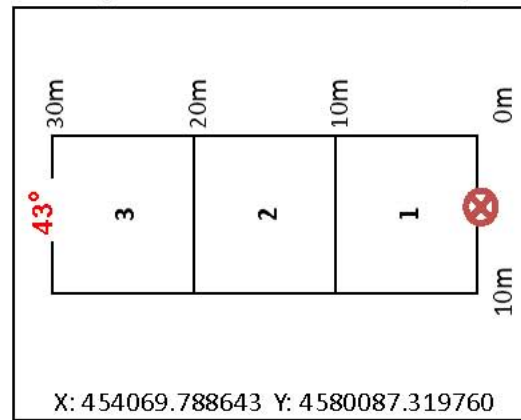
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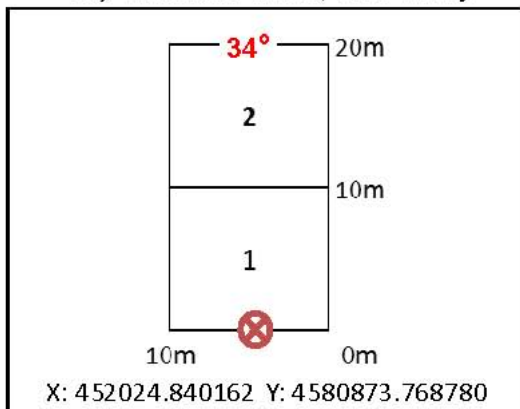
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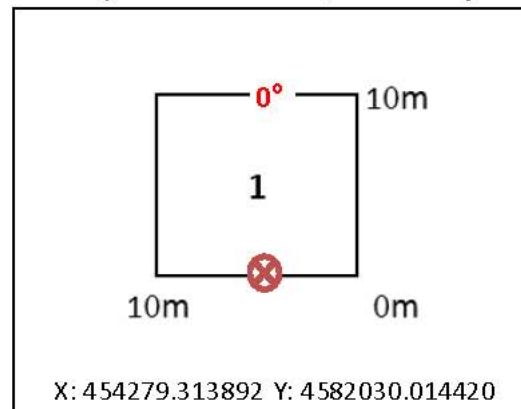
44) Wetland 1017, 1x3 array



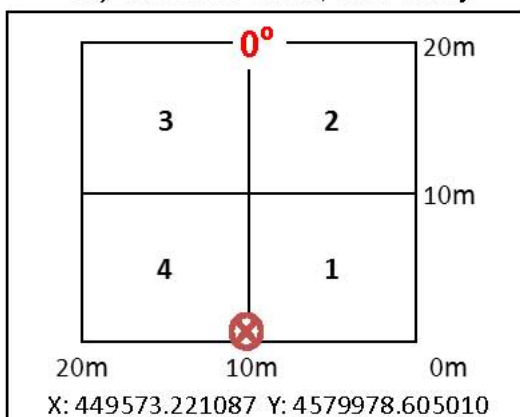
45) Wetland 1034, 1x1 array



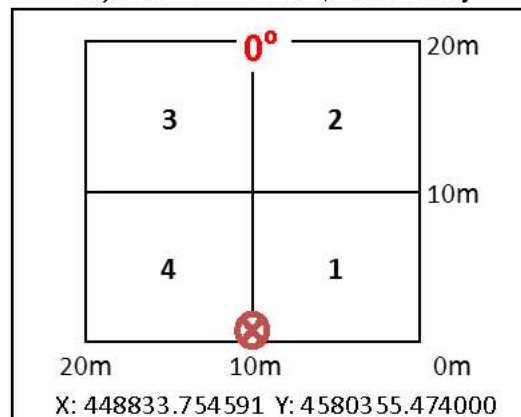
46) Wetland 1036, 2x2 array



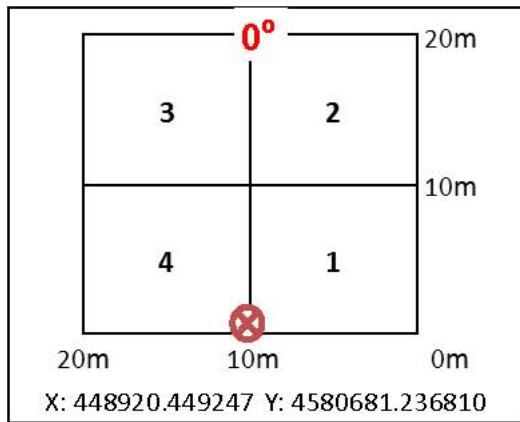
47) Wetland 1058, 2x2 array



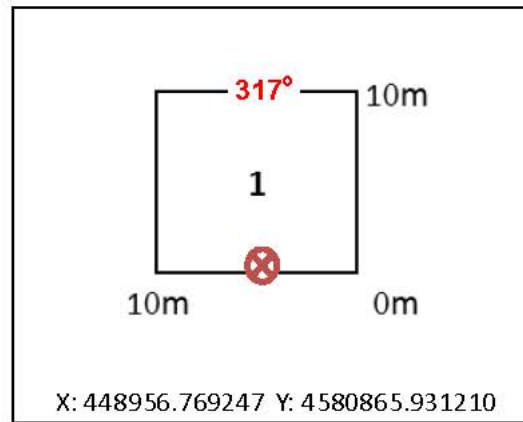
48) Wetland 1068, 2x2 array



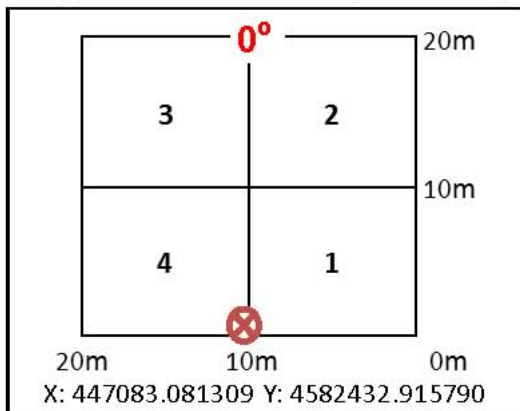
49) Wetland 1069, 2x2 array



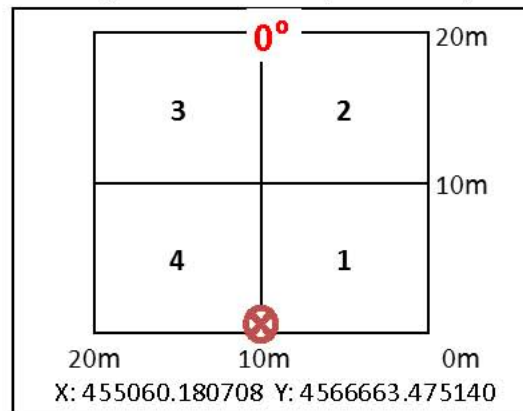
50) Wetland 1070, 1x1 array



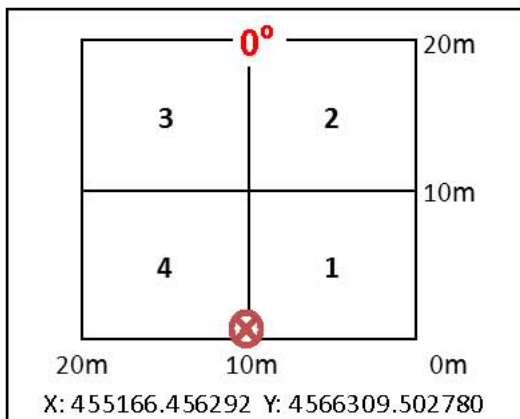
51) Wetland 1079RS2, 2x2 array



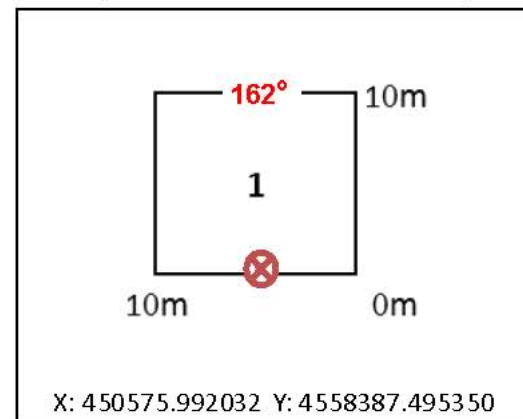
52) Wetland 1188, 2x2 array



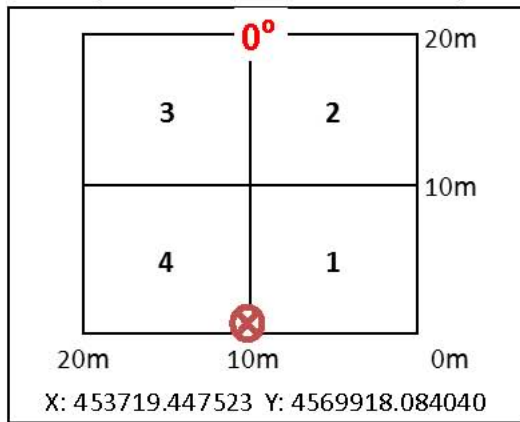
53) Wetland 1196, 2x2 array



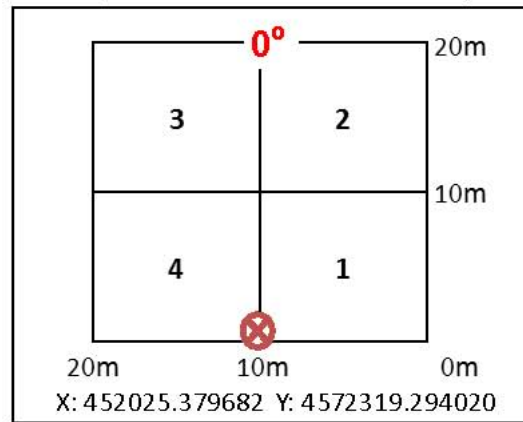
54) Wetland 1205, 1x1 array



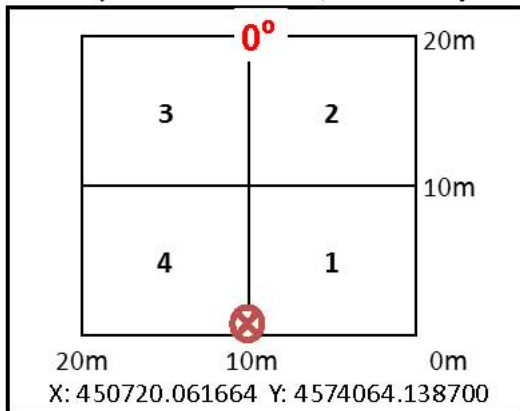
55) Wetland 1221, 2x2 array



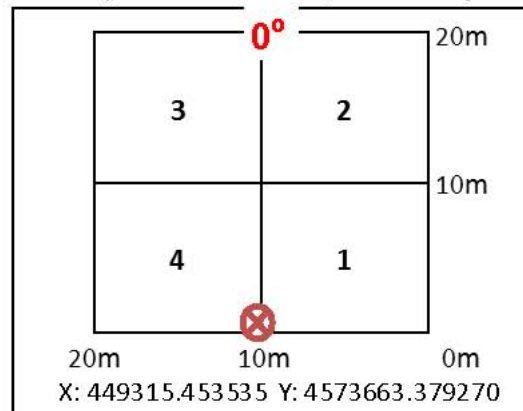
56) Wetland 1351, 2x2 array



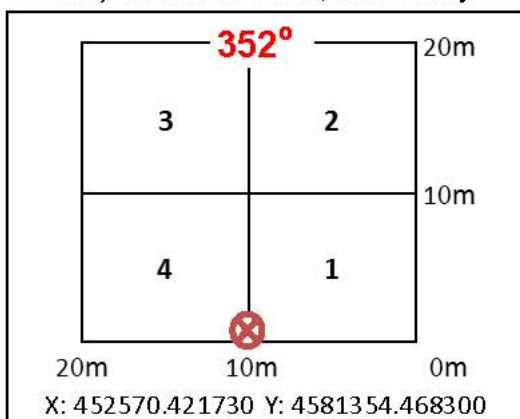
57) Wetland 1364, 2x2 array



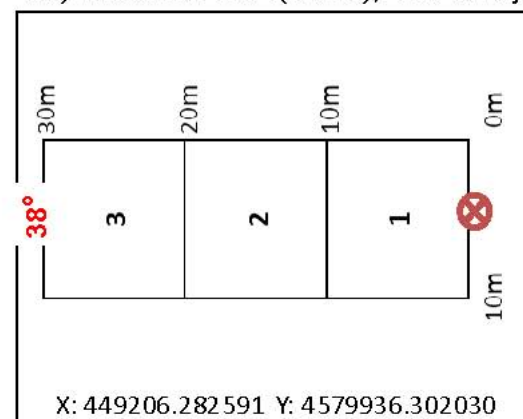
58) Wetland 1468, 2x2 array



59) Wetland 1485, 2x2 array



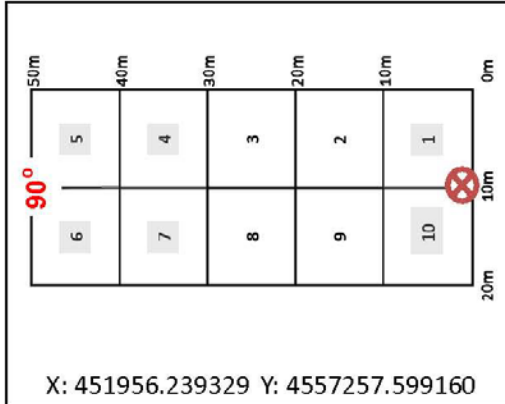
60) Wetland 1104(1620), 1x3 array



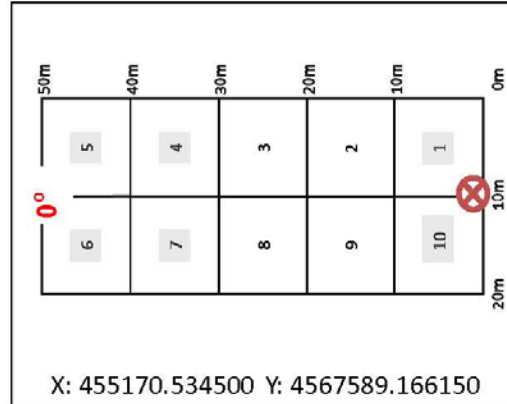
Attachment 12.2 Sentinel Sites

The circled “x” is the observers location relative to the azimuth shown opposite the observer. This observer-to-azimuth orientation is critical to proper plot layout and numbering.

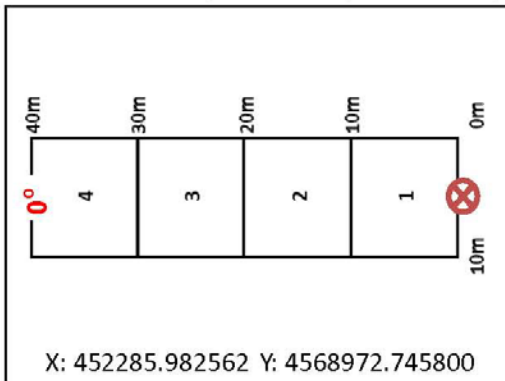
Wetland 1427 (Bath), 2x5 array



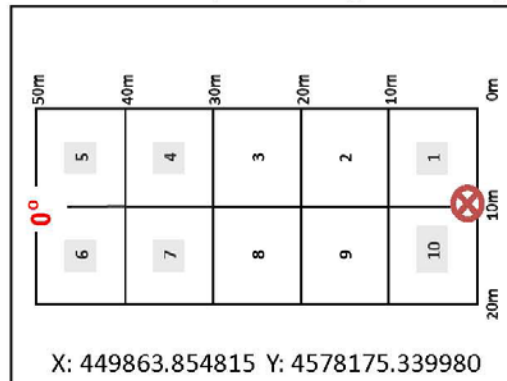
Wetland 683 (Boston Mills), 2x5 array



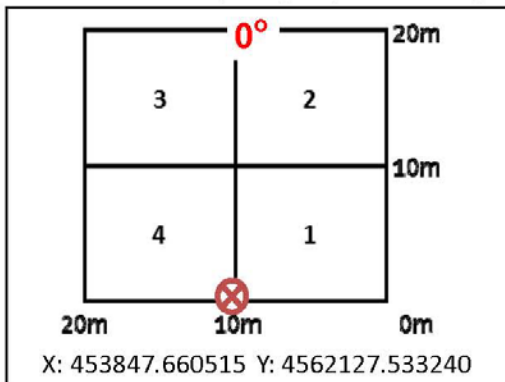
Wetland 554 (Columbia), 1x4 array



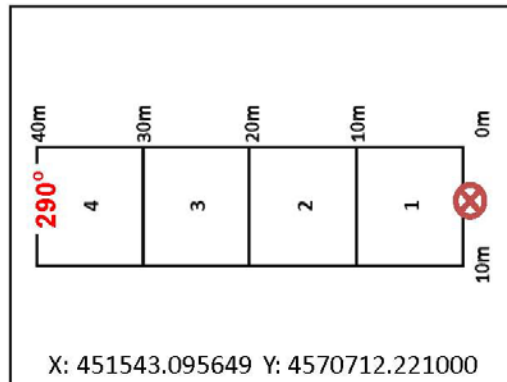
Wetland 970 (Fitzwater), 2x5 array



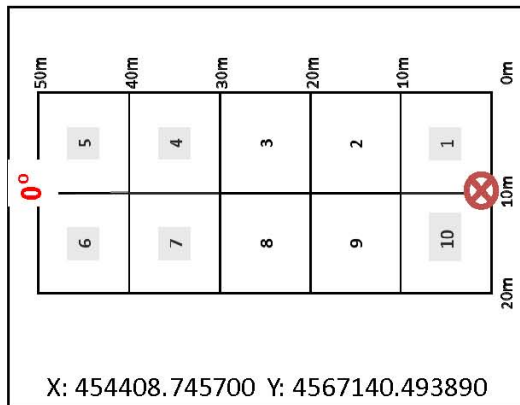
Wetland 124 (Langes), 2x2 array



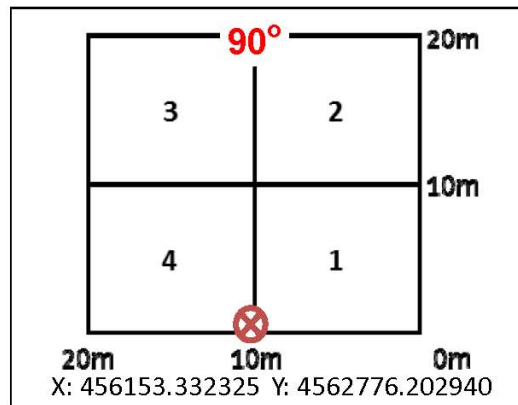
Wetland 398 (Snowville), 1x4 array



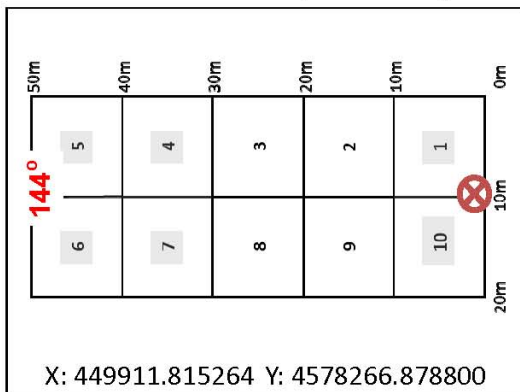
Wetland 526 (Stumpy), 2x5 array



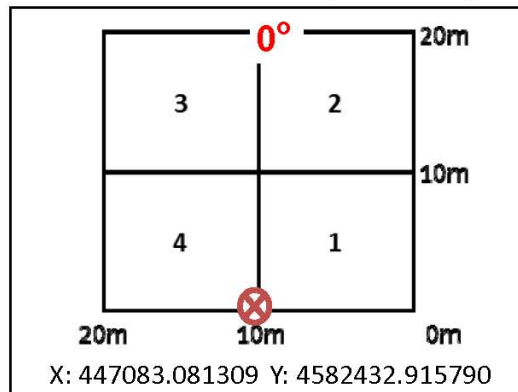
Wetland 241K (VK), 2x2 array



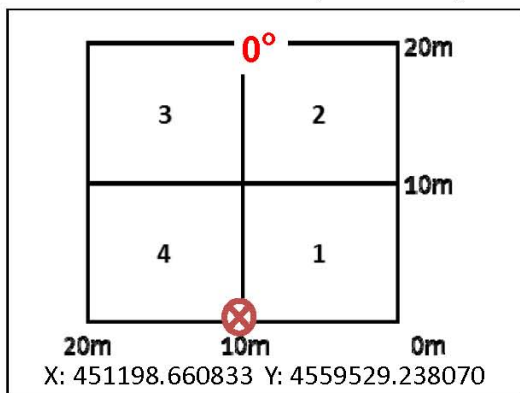
Wetland 970PV, 2x5 array



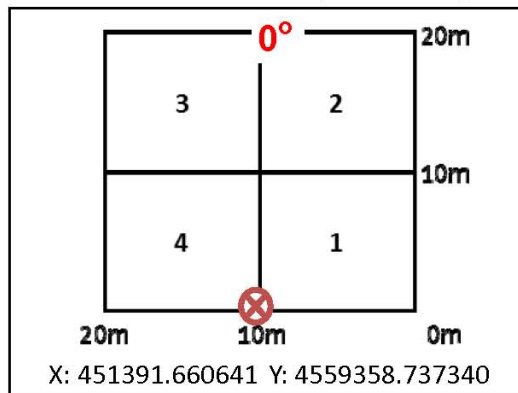
Wetland 1079RS2, 2x2 array



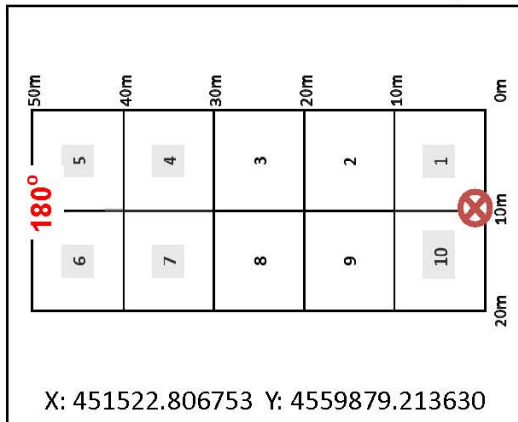
Wetland 365BM2, 2x2 array



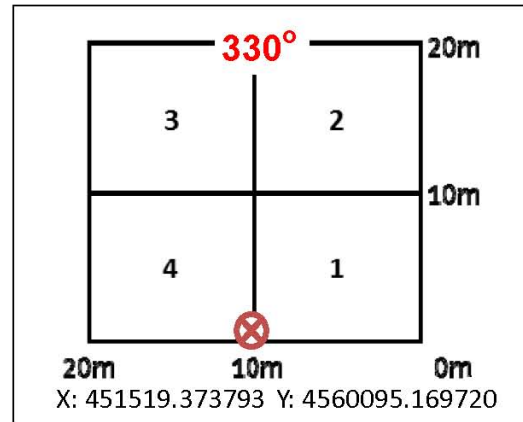
Wetland 365BM3, 2x2 array



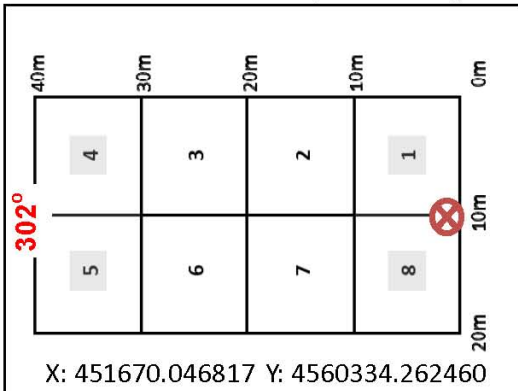
Wetland 365BM4, 2x5 array



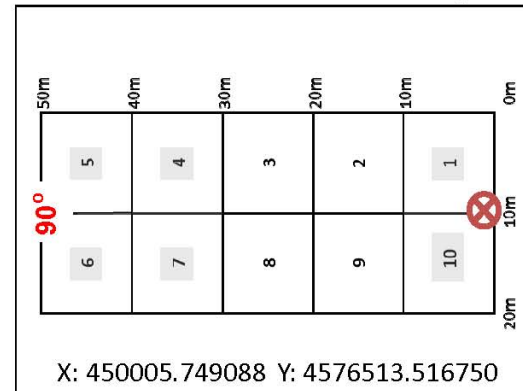
Wetland 365BM5, 2x2 array



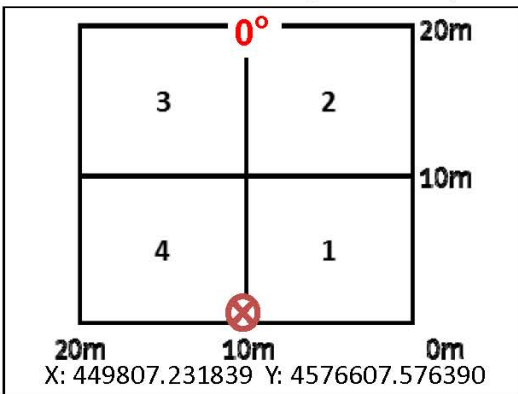
Wetland 365BM6, 2x4 array



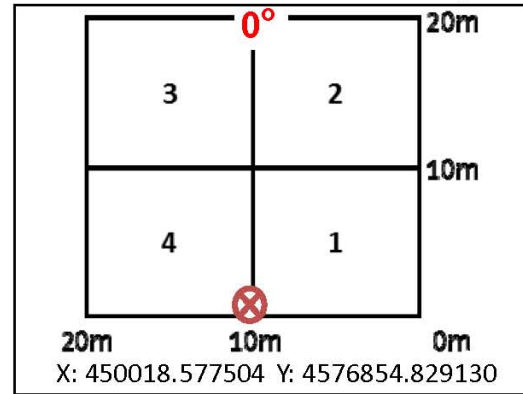
Wetland 977FP1, 2x5 array



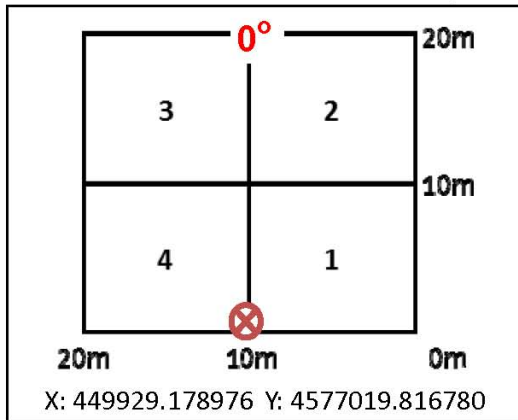
Wetland 977FP2, 2x2 array



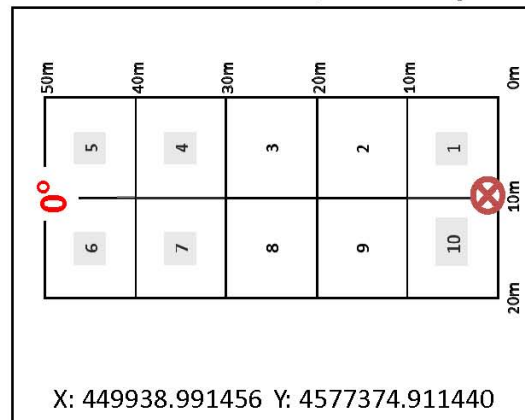
Wetland 977FP3, 2x2 array



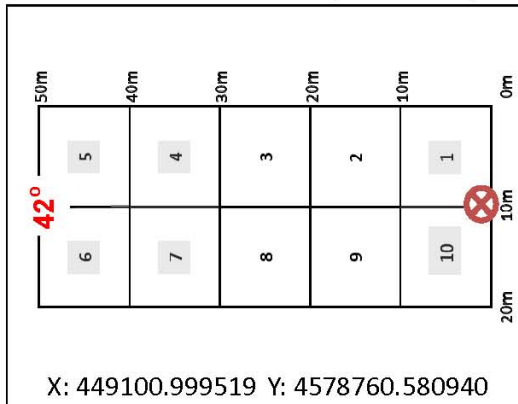
Wetland 977FP4, 2x2 array



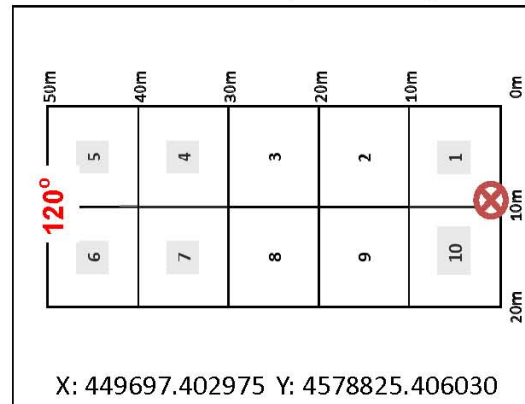
Wetland 977FP5, 2x5 array



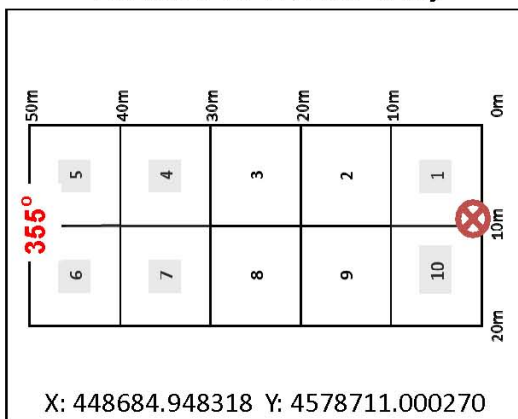
Wetland 968PV968, 2x5 array



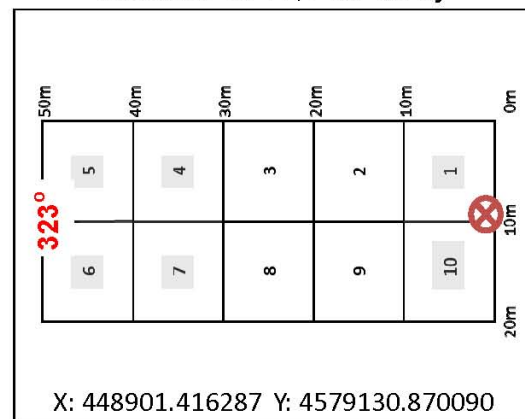
Wetland 969, 2x5 array



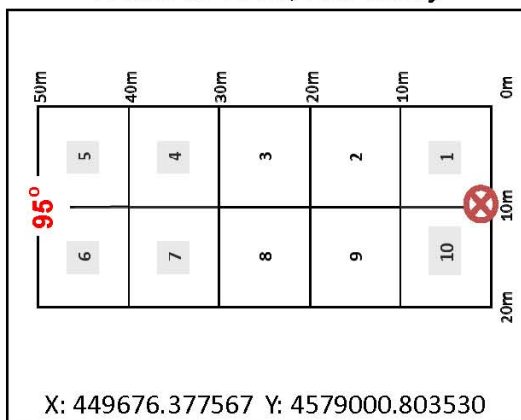
Wetland 1043, 2x5 array



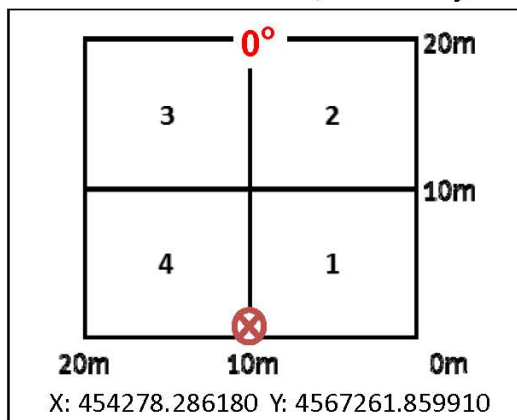
Wetland 1047, 2x5 array



Wetland 1049, 2x5 array



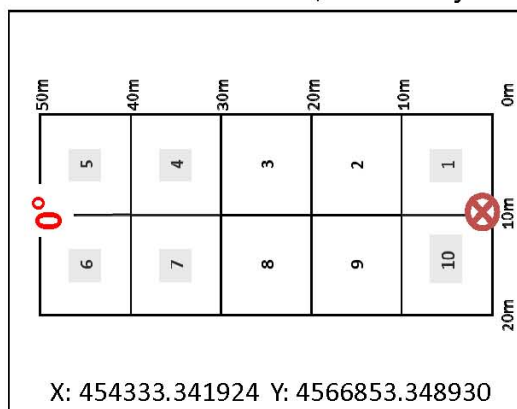
Wetland 526SB1, 2x2 array



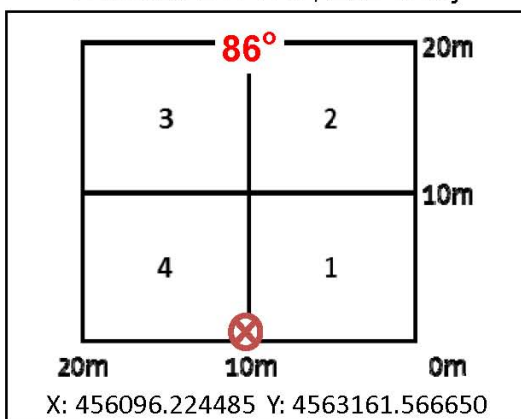
Wetland 526SB2, 2x5 array



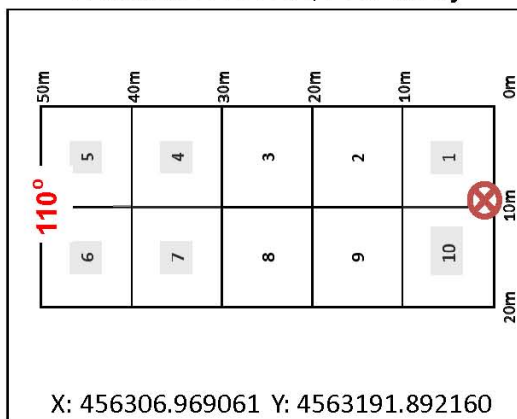
Wetland 526SB3, 2x5 array



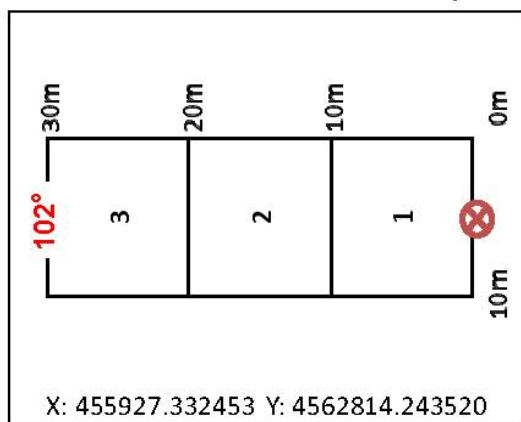
Wetland 241VK1, 2x2 array



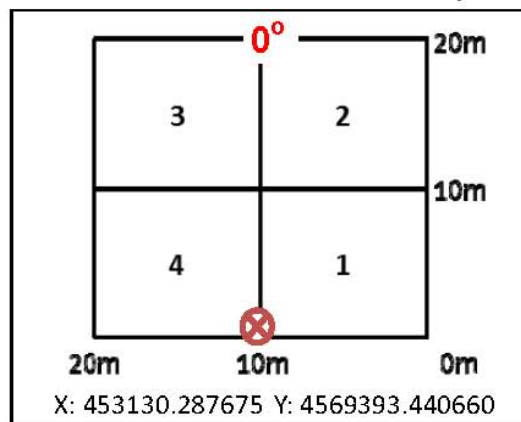
Wetland 241VK2, 2x5 array



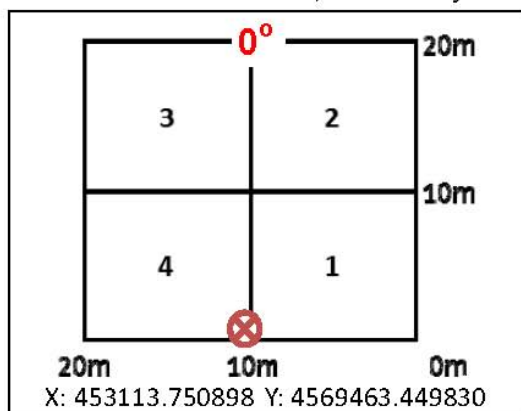
Wetland 241VK4, 1x3 array



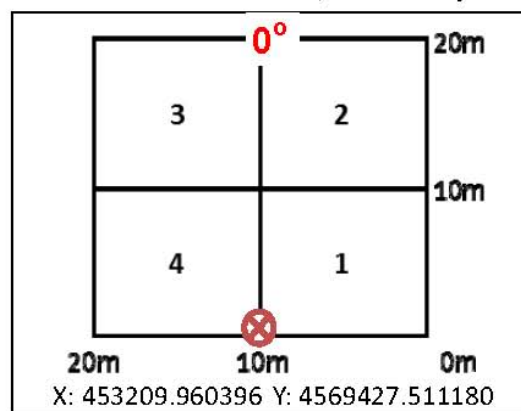
Wetland 540SF1, 2x2 array



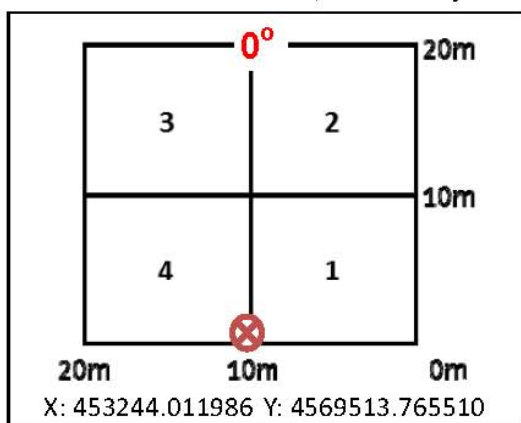
Wetland 540SF2, 2x2 array



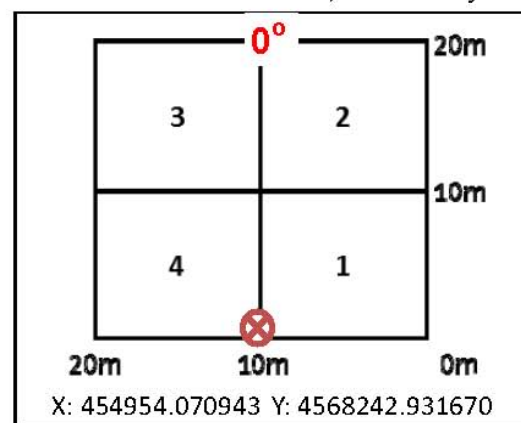
Wetland 540SF3, 2x2 array



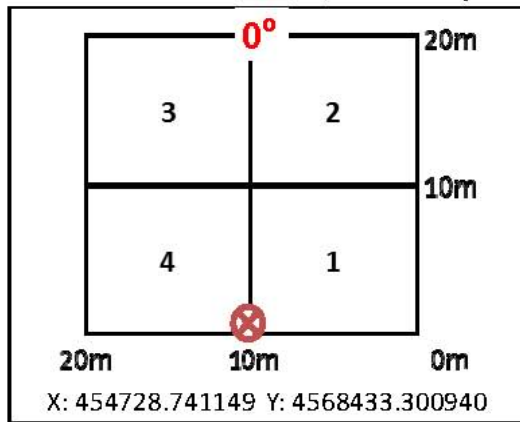
Wetland 540SF4, 2x2 array



Wetland 1622KR1, 2x2 array



Wetland 1627KR2, 2x2 array



Attachment 12.3: Vascular Plant Characterization Data Sheet

Attachment A: Vascular Plant Characterization Data Sheet

Wetland ID # Date Observers pg. of

Intensively sample modules # _____ Non-intensively sampled modules # _____

[illegible]

Attachment 12.4: Woody Plant Diameter Characterization Data Sheet

Attachment B: Woody Plant Diameter Characterization Data Sheet

Wetland ID # _____ Date _____ Observers _____ pg. _____ of _____

Diameters recorded in cm as diameter at breast height (1.37 m).

Module #	Species Name	Shrub clumps	1 0-<1	2 1-<2.5	3 2.5-<5	4 5-<10	5 10-<15	6 15-<20	7 20-<25	8 25-<30	9 30-<35	10 35-<40	11 <40 Record diameter

Attachment 12.5: Biomass Data Characterization Data Sheet

[illegible]