

Non-native Invasive Vegetation Monitoring Protocol

Virginia Invasive Vegetation Management Team

Background: Through the years, parks within the NER-Virginia Subcluster have recognized the presence and introduction of non-native (alien or exotic) vegetation. Many are notable because of their aggressive, invasive nature displacing native species and impacting whole ecosystems. Though many invasives have been documented, there has been little monitoring to determine whether they are expanding or otherwise increasing their impacts upon our resources. We recognize the need for survey/monitoring to follow those trends as well as determine whether control efforts are successful. The VIVMT (Virginia Invasive Vegetation Management Team) will conduct the following monitoring tasks.

I. Parkwide Invasive Vegetation Survey, Monitoring & Mapping

Description of Duties: (1) Locate invasive vegetation centers. The intent is to focus on accessible areas near developments, and adjacent to roads, trails and property boundaries. (2) Identify and inventory vegetation. This focuses on targeted non-native invasives. Threatened or endangered species natives should be noted in the comments. (3) Aerial photo interpretation, map reconnaissance, and mapping of non-native species concentrations. (4) Geographic positioning through GPS electronics. This is for epicenter referencing and/or boundary delineation, depending on available equipment, available satellites, and site configuration. (5) Writing location reports and invasive vegetation summaries. This includes estimates of infestation levels, sources, spread direction, and spread rates.

Duration: This will vary greatly depending on the remaining need of individual parks. COLO and SHEN will not require added surveying. Some monitoring of previous surveys may be needed in the out-year. The remaining parks require supplementary surveying from what was accomplished in 1999, including APCO, BOWA, FRSP, GEWA, PETE, and RICH.

Task Protocols:

I.1. – Systematic Survey/Monitoring

The survey/monitoring scheme is intended to facilitate understanding the presence and infestation levels of invasives within areas likely to become infested. This focus, rather than a parkwide cameo, is necessary due to the narrow time frame of the commissioned VIVMT, and its premier goal of implementing control activities. Since a vast majority of non-native invasives favor areas of open sun and disturbed soils, the survey/monitoring layout will focus on areas of full sun, “edge,” and recent or continual soil scarification. Deep forest or undeveloped /unimpacted areas will not be surveyed in this project.

Survey/monitoring will entail the following steps.

- (A) Establish starting points for 200-meter (m) line transects. The vicinity of starting points will be done to assure random placement within bounds. On the one hand, randomness is essential to avoid bias, while “bounds” will help distribute transects throughout the park.
- (1) Estimate the amount of “edge” within the park. For instance road edge equals the distance of roads times 2 sides of each road (1 mile of road x 2 sides = 2 miles of edge unless the road is a park boundary). The same procedure is done for major trails. Developed area edge equals the circumference or perimeter of all sites combined.
 - (2) Once these three domains are tallied (roads, trails and developments) calculate the percent of each. For instance, roads-47%; trails-39%, and developed-14%.
 - (3) Decide whether 10, 20 or 30 transects are needed for the park in question based on park size and apparent initial magnitude of infestation problem.
 - (4) Using point 2 above as an example, if you decide that 20 transects are needed for park-X, then plan on distributing 50% along roads (10 transects), 40% along trails (8 transects), and 15% around developments (2 transects).
 - (5) Assign potential transect start points every $\frac{1}{4}$ mile throughout the infested portion of the park (remember: on each side of roads and trails). Give each potential transect start point a number (1+ for roads, 1+ for trails, and 1+ for developments).
 - (6) Randomly choose the actual transect set for each domain using a random number table.

Transect starting points shall be on the edge of a roadway, treadpath or yard, parking lot or building, respectively. In the field, describe transect starting points on the *Invasive Vegetation Survey Site Record*. The GPS location of the starting point should also be noted.

- (B) From the starting point, establish a compass bearing to follow for the transect layout that is perpendicular to the road, trail or development edge at that point. Note the compass bearing on the *Invasive Vegetation Survey Data Sheet*. The compass bearing should be recorded in magnetic reading rather than with declination correction. (This is to avoid mistaken setting by the crew serving eight different parks.)

Use a random number table to establish the first plot center at a range of 1-to-10 meters from the start point. The remaining nine plot centers shall be systematically placed every 20-m along the transect from the initial plot center. (Note Figure 1.)

Plot rejection criteria (I.1.B.). Reject the plot location (and attempt establishment 10-m further along the transect) if the plot location:

- (1) Is wholly or partial on a road.
- (2) Is clearly unsafe.
- (3) Is on non-forest/non-field such as boulder, cliff or water, etc.

(Note your reasons for plot rejection on the *Interplot Comment/Notes* sheet.)

(C) At the plot center, temporarily establish and measure data within three subplots using the *Data Sheet*. (Measuring the three subplot radiuses can be practically done using a rope with knots or measuring tape with adhesive tape at three lengths from the end.) Use the 6-digit species codes for the invasive target species provided in the appendix. If you detect a highly invasive plant not on the target list, create a species code using by using the first three letters of its genus plus first three letters of its species names.

- 1-m² subplot (radius=0.564m) – **Herbaceous layer**
For herbs of any height:
 - Identify and count all targeted non-native species.
 - Identify and estimate crown cover of all non-native species within this layer.
(Example 1: all ten individuals of one species make up 25% of the subplot. Therefore, document the species with the count=10, and the percent cover=25%.)
- 10-m² subplot (radius=1.784m) – **Shrub layer**
For woody vegetation falling between 1-to-5-m (or obvious woody seedlings less than 1m):
 - Identify and count all targeted non-native species.
 - Identify and estimate crown cover of all non-native species within this layer.
(Example 2: there are no rooting individuals in the subplot but the area has 30% cover by a vine. Document the species with the count=0, and the cover=30%.)
- 100-m² subplot (radius=5.642m) – **Tree layer**
For woody vegetation taller than 5-m:
 - Identify and count all targeted non-native species.
 - Identify and estimate crown cover of all non-native species within the layer.
(Examples 1 & 2 apply.)

(D) Between plots, note the species and cover estimates of invasives, comments on site disturbance, and other information that has implications to non-native invasive potential upon the *Invasive Vegetation Survey Interplot Comment/Notes* sheet.

(E) Enter the field information into the Alien_survey database program. (See Part III below.)

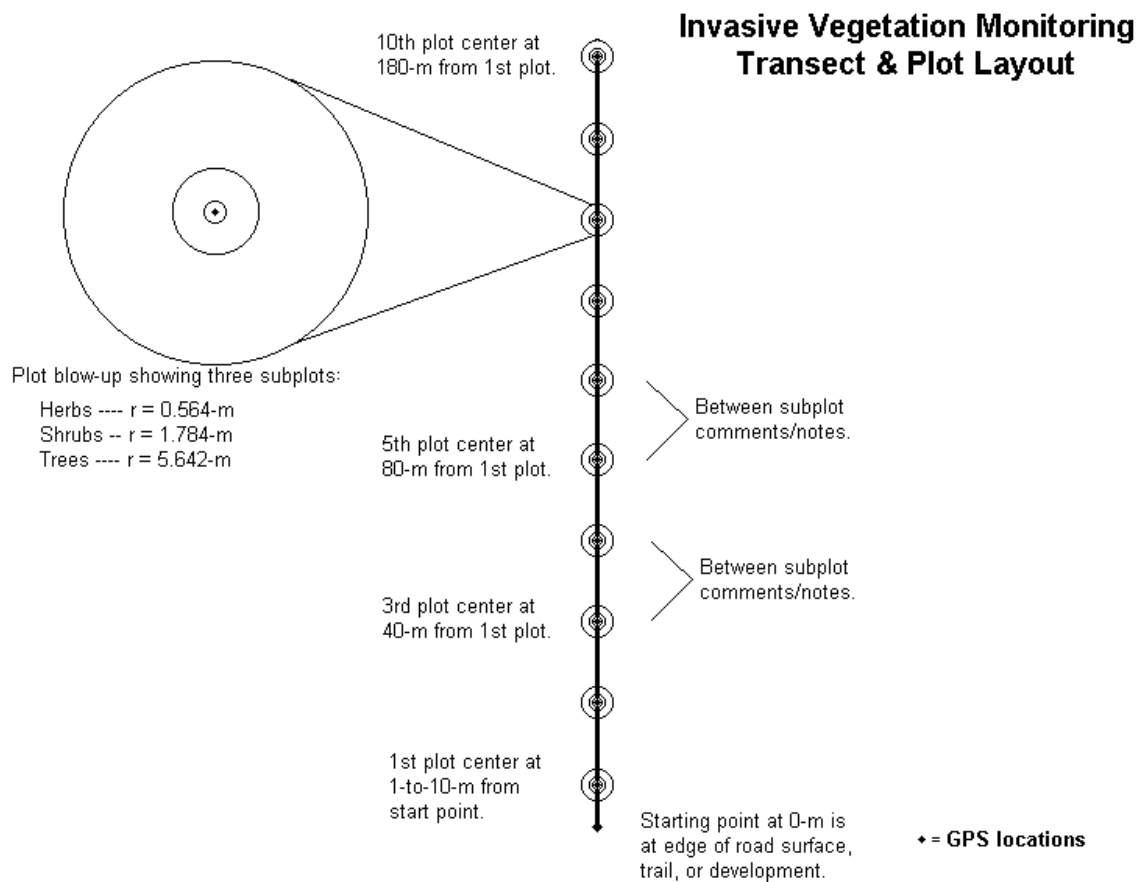


Figure 1. Transect and plot diagram.

I.2. – Epicenter Mapping

Map the locations of concentrated (single or multiple) invasive species epicenters. Using the *Invasive Vegetation Survey Site Record*, and appropriate attachments, do the following.

- (A) Map the infestation using a photocopy of appropriate USGS 7.5-minute quadrangles and the most recent aerial photography.
- (B) Identify on your map the USGS quadrangle name; site name, and UTM coordinates of the site center (using GPS). Landmark features such as roads, trails, bridges, fences, etc., should be clearly indicated. Natural features, including large trees, forest/field edges, rock outcrops, and streams may also be useful for relocating exotic sites.
- (C) Where possible, use GPS to delineate the exterior epicenter boundary.
- (D) Enter the information into the Alien_Ops database program. (See Part III below.)
 Download and correct the GPS data, ensuring that the data is correctly identified with the field transect data name.

The *Site record* and accompanying maps should be filed with the other known alien epicenter location files being maintained by the SHEN-NCR-Operations & Planning Branch Chief. Copies of materials should be made freely available to host parks upon request.

II. Invasive Treatment Monitoring

Description of Duties: Monitoring transects will be established at each treatment site prior to treatment. Follow-up monitoring will take place after one year to determine change and indicate effectiveness. Initial transects may take 1-to-3 hours to install, while follow-up monitoring will take 1-to-1-1/2 hours to complete if transect monuments are easily found. Control objectives are two-fold: (1) effectively eliminate invasive vegetation within designated epicenters; and (2) create a positive track record of safety, efficiency and effectiveness. Treatment monitoring is essential, therefore, to document progress toward both objectives. Treatment monitoring includes elements of survey & monitoring described above.

Task Protocols:

II.1. – Treatment Monitoring

The treatment site monitoring protocol is very similar to the systematic survey/monitoring protocol described above. The differences include: (1) the plots/subplots must fall fully within the treated area and (2) transect direction will not be perpendicular to a road, trail or development. Each treatment site will have two transects that each start from easily relocated points (road, trail or development edges) at generally apposite ends of the unit creating an “X” through the unit. Transect direction (orientation) for a given unit may be subjectively created and will vary from other units to achieve the “X”. This system is intended to make annual relocation of transects and plots easily done.

Each treatment site should have 4-to-10 monitoring plots; a portion along each of the two transects. Space the plots apart from one another based on the following table.

Plot spacing along both monitoring transects (based on the longest transect).

- If longest transect is up to 50-m long, space the plots 20-m apart.
- If longest transect is 51-100-m long, space the plots 30-m apart.
- If the longest transect is greater than 100-m long, space the plots 40-m apart.

The first plot of each transect shall be established as with the systematic survey by using a random number table to determine where it falls 1-to-10-m from the transect start point.

Transect start points should be **well documented** with both GPS and on-site monumentation to facilitate finding the point after treatment. Plot monumentation should include two-foot long re-bar and ribbon flagging. Transect start points should be monumented similarly with other ribbon flagging on nearby vegetation. Enter the information on the *Invasive Vegetation Survey Site Record* and into the Alien_survey database program. (See Part III below.)

Plot rejection criteria (II.1). Reject the plot location (and attempt establishment 10-m further along the transect) if the plot location:

- (1) Is wholly or partial out of the treatment site.
- (2) Falls partially within a plot from the other transect.
- (3) Ten plots have already been tallied.

(Note your reasons for plot rejection on the *Interplot Comment/Notes* sheet.)

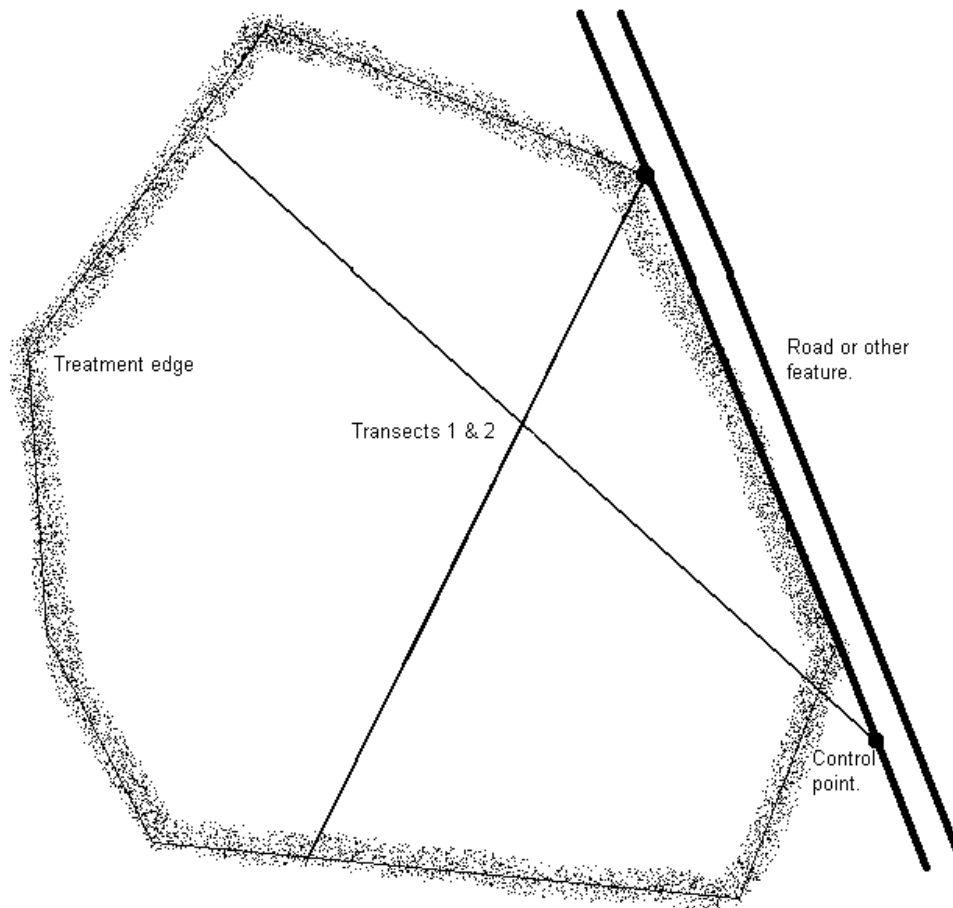


Figure 2. Treatment monitoring diagram.

II.2. – Treatment Site Mapping

Map the location of treatment sites for follow-up and effectiveness monitoring. Create this map only if the treatment area differs from the epicenter mapping already noted above.

- (a) Maps should be developed using a photocopy of appropriate USGS 7.5-minute quadrangles and the most recent aerial photography.
- (b) Each map should identify its quadrangle name; site name, UTM coordinates of the site center (using GPS), and sketch of the area. Landmark features such as roads, trails, bridges, fences, etc., should be clearly indicated. Natural features, including large trees, forest/field edges, rock outcrops, and streams may also be useful for relocating exotic sites.

- (c) Where possible, use GPS to delineate the exterior epicenter boundary.
- (d) Complete an *Invasive Vegetation Management Site Record* for each mapped site and enter the appropriate information into the Alien_Ops database program. (See Part III below.)

The site record and accompanying maps should be filed with the other known alien epicenter location files being maintained by the SHEN-NCR-Operations & Planning Branch Chief. Copies of materials should be made freely available to host parks upon request.

Data sheets (Protocols):

[Where “9” and “1-a” represent single-digit numeric and alpha entries, respectively.]

Invasive Vegetation Survey Site Record -- Record information about the transect location.

Verifications:

- Field checked: Initials of person who field checked the data to ensure all field information was correctly entered.
- Entered in DB: Date and initials of person(s) who entered the data into the database.
- DB verified: Date & initials of the person(s) who verified the accuracy of the electronic data to the hard copy.

Field Information:

- Invasive Plant [6-a]: Species code. Leave this blank for the survey. It is used for specific epicenter or treatment mapping.
- Site Name [20-a]: create a name no longer than 20 characters. Examples: “Snead Farm Trail,” or “Ailanthus-001.”
- Park [4-a]: as in APCO/BOWA/COLO/FRSP/GEWA/PETE/RICH/SHEN.
- Area of Park [20-a]: general area descriptor.
- Size of Site [999.9]: Square meters. Leave this blank for the survey. It is used for specific epicenter or treatment mapping. (Refer to *Various Methods of Estimating Area in the Field.*)
- Elevation [9999]: feet above sea level.
- UTM: E:_____N:_____: from GPS finding.
- USGS Quad [15-a]: USGS quad sheet name.
- Site Management Status: Active_____ Inactive_____: Leave this blank for the survey. It is used for specific epicenter or treatment mapping. Acronym indicating the level of exotic control:
 - “AA” -- site is ACTIVE and OUT OF CONTROL (predominant cover by exotics);
 - “AI” -- site is at an INTERMEDIATE STAGE OF CONTROL (few plants found during last inspection);
 - “II” -- site is UNDER CONTROL (no plants found during last inspection) and needs to be checked annually.
- Directions to Starting Point [memo field]: freely describe how to locate the transect starting point. Include referencing trees and other monuments, distances, direction of travel.
- Distance and Magnetic Azimuth to Site: freely describe the distance in meters, and direction in degrees (360 compass points).
- General Site Comments [memo field]: freely describe any notable site features. Pictures and diagrams are very helpful.

Invasive Vegetation Survey **Transect Data Sheet** -- Record information about plot information.
This form accommodates 4 plots.

Verifications:

- Field checked: Initials of person who field checked the data to ensure all field information was correctly entered.
- Entered into DB: Date and initials of person(s) who entered the data into the database.
- DB verified: Date & initials of the person(s) who verified the accuracy of the electronic data to the hard copy.

Header information:

- Park [4-a]: NPS 4-digit park code.
- Site name [20-a]: same as site record sheet.
- Crew [14-a]: crewmember first & last initials separated by spaces between people.
- Transect number ["EX"--4-a--99]: "EX" (dash) park code (dash) a unique two-digit number.
- Bearing [999]: transect magnetic compass bearing.
- Date [mm/dd/yyyy]: date of fieldwork.
- Slope % [99]: slope at plot (or average of epicenter) in percent.
- Aspect [4-a]: the direction of downslope, such as NW, NNW, etc., or "Flat."
- Cover type [4-a]: CONI=conifer; HDWD=hardwood; MIX=mixed conifer & hardwood; COVE=cove hardwood, or moist site; OPEN=open field, grass, or agricultural field.
- Slope position [2-a]: SU=summit; SH=shoulder, upper slope; BS=back slope, mid-slope; FS=foot slope, lower slope; TS=toe slope, bottom slope; TE=terrace, bench or flat; FP=flood plain, stream bottom.

Specific plot information:

- Subplot number [99]: the plot numbers along transect.
- Distance (m) from origin [99]: in meters. Though the first plot will be of various lengths from the point of origin, subsequent plots will be at 20-m multiples from the first plot for systematic surveys and various length multiples for monitoring surveys.
- Species [6-a]: use the target invasive species codes. For species not on that list, create a 6-digit code by using the first 3 digits of genus and first 3 digits of species.
- Count by layer [99]: number of stems by species & layer (herbaceous/shrub/tree) within the subplot. (Plants must be rooted in the subplot.)
- Cover % [999]: percent cover by species & layer (herbaceous/shrub/tree) within the subplot (whether or not it is rooted in the subplot). The cover percent for an area may potentially be 300%, that is 100% for each layer.

Invasive Vegetation Survey **Interplot Comments/Notes** -- Record information about conditions between plots along the transect.

Verifications:

- Field checked: Initials of person who field checked the data to ensure all field information was correctly entered.
- Entered into DB: Date and initials of person(s) who entered the data into the database.

- DB verified: Date & initials of the person(s) who verified the accuracy of the electronic data to the hard copy.

Field data:

- Site name [20-a]: same as site record sheet.
- Crew [14-a]: crewmember first & last initials separated by spaces between people.
- Transect number [99]: same as data sheet.
- Bearing [999]: transect magnetic compass bearing.
- Date [mm/dd/yyyy]: date of fieldwork.
- Between plot numbers [9-9]: referring to the area between plots, 1&2, for example.
- Comments [memo field]: freely describe the area between plots and any impacting features such as openings, disturbance, erosion, invasive species, etc.
Record the slope.

Field checked _____
Entered in DB _____
DB verified _____

NPS-NER-Virginia Invasive Vegetation Management Team
INVASIVE VEGETATION SURVEY
SITE RECORD

INVASIVE PLANT _____ SITE NAME _____

PARK (4-code) _____

AREA OF PARK _____

SIZE OF SITE _____

ELEVATION _____ UTM: E: _____ N: _____

USGS QUAD _____

SITE MANAGEMENT STATUS: ACTIVE ____ INACTIVE ____

1. DIRECTIONS TO STARTING POINT / EPICENTER (circle one and provide narrative):

DISTANCE AND MAGNETIC AZIMUTH TO SITE:

2. GENERAL SITE COMMENTS:

Field checked _____
Entered in DB _____
DB verified _____

Page ____ of ____

NPS-NER-Virginia Invasive Vegetation Management Team
INVASIVE VEGETATION SURVEY
TRANSECT DATA SHEET

Park (4-code): _____ Site name: _____ Crew: _____

Transect number: _____ Bearing: _____ Date(s): _____

Slope %: _____ Aspect: _____ Cover type: _____ Slope position: _____

Subplots

Subplot number: _____

Distance (m) from origin: _____

Species (6-digit)	Count by layer			Cover (%) H / S / T
	Herb.	Shrub	Tree	
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____

Subplot number: _____

Distance (m) from origin: _____

Species (6-digit)	Count by layer			Cover (%) H / S / T
	Herb.	Shrub	Tree	
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____

Subplot number: _____

Distance (m) from origin: _____

Species (6-digit)	Count by layer			Cover (%) H / S / T
	Herb.	Shrub	Tree	
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____

Subplot number: _____

Distance (m) from origin: _____

Species (6-digit)	Count by layer			Cover (%) H / S / T
	Herb.	Shrub	Tree	
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____
_____	_____	_____	_____	____/____/____

Field check _____
Entered in DB _____
DB verified _____

NPS-NER-Virginia Invasive Vegetation Management Team
INVASIVE VEGETATION SURVEY
INTERPLOT COMMENTS / NOTES

Site name: _____ Crew: _____

Transect number: _____ Bearing: _____ Date: _____

Between plot numbers: _____

COMMENTS:

Between plot numbers: _____

COMMENTS:

Various Methods of Estimating Area in the Field¹

A. Trees

Total number of trees ≥ 3 -cm diameter at breast height (DBH = 1.37-meters above ground) multiplied by 2 square meters.

B. Shrub Species and Multiple Tree Seedlings

1. Contiguous Cover: Multiply length measurement and width measurement taken to the nearest 0.5 square meters.

2. Non-Contiguous Cover: To estimate the area coverage of a site with non-contiguous cover:

(a) Measure the total area of the site using the methodology for contiguous cover;

(b) Stand at a location that allows visual assessment of the entire site;

(c) Using a density scale. Density rating scale for estimating percent cover by an exotic species), estimate the percent area covered by the exotic species. This step is to be completed by two different field personnel and a consensus must be reached; and,

(d) Divide the estimated percent cover by one hundred and multiply by the total area of the site to compute the estimate total coverage by the exotic species.

Estimated Percent Cover / 100 x Total Area = Estimated Total Coverage

C. Ground Cover

1. Contiguous Cover: Multiply length measurement and width measurement taken to the nearest 0.5 square meters.

2. Non-Contiguous Cover: Same as B-2

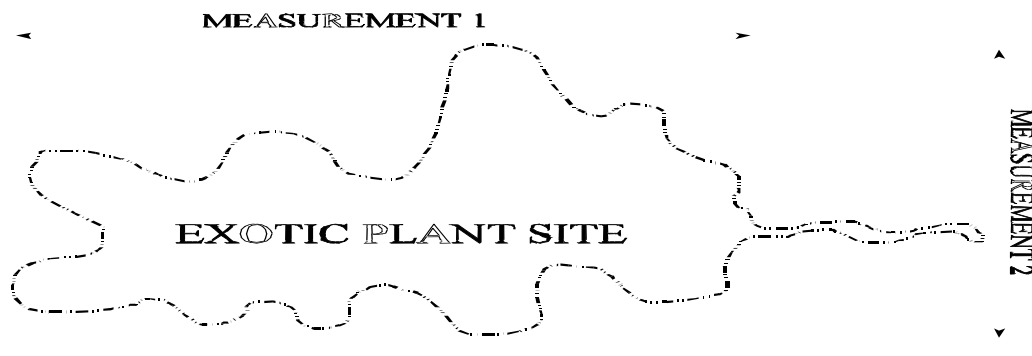
Estimated Percent Cover / 100 x Total Area = Estimated Total Coverage

D. Single Plant Herbs

Number of plants is tallied and multiplied by 0.2 square meters.

E. Extremely Large Sites

For exotic sites that are extremely large and with a varied degree of coverage, area measurements may not be feasible (e.g. thousands of mimosa growing on a road cut for several miles). These sites should not be measured for area but conveyed in the REMARKS section of the database.



¹ Provided by Kris Johnson, Vegetation Management Specialist, NPS-GSRM.

Monitoring Equipment List

_____ Compass (declination correction set to zero)

_____ Clinometer

_____ 100-m tape

_____ 30-m tape

_____ Magnifying glass

_____ Spherical densiometer

_____ GPS unit (is battery charged?)

_____ Field notes holder (aluminum)

_____ Field sheets:

 Site Record

 Transect Data Sheet

 Interplot Comments/Notes

_____ Monitoring protocols

_____ Invasive species code sheet

_____ Random number table

_____ Slope correction table

_____ Pencils
