

Southeast Coast Network

National Park Service
Inventory and Monitoring Division



Standard Operating Procedure 1.4.16

Soil Measurements—Version 1.1

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Summary

This standard operating procedure (SOP) serves to characterize vegetation community soil nutrients in Southeast Coast Network (SECN) vegetation monitoring plots. Instructions on how to collect soil samples in the field and for post-field processing samples are included in this SOP.

The datasheet used for this SOP is *SECN Veg Form 1—Vegetation Plot Establishment* and is included in Appendix A of this document.

Revision Log

Revision Date	Author	Changes Made	Reason for Change	New Version #
March 2020	M.F. Boyle	Revised the “Collecting Soil Samples in the Field” section from separately collecting and storing three soil samples from each plot to mixing three samples in the field into a single collection bag. Revised the “Post-Field Soil Processing” section to include a procedure for using a laboratory oven to dry soil samples.	This protocol only requires one soil sample (taken from three frames) to describe plot-level soil nutrient status. Oven-drying samples at a low temperature to remove excess moisture content reduces the overall cost of analyses from many independent soil processing labs.	1.1

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Overview

This standard operating procedure (SOP) serves to characterize vegetation community soil nutrients in Southeast Coast Network (SECN) vegetation monitoring plots. Along with information that characterizes landform and overall geomorphology, soil data can be used to quantitatively describe the abiotic conditions of a given vegetation plot. Compared to vegetation, soil and landform are relatively stable components of terrestrial ecosystems. By collecting these data, SECN vegetation monitoring plots can be compared to other vegetation reference-quality plots that have soil information within the southeastern Coastal Plain. Three soil samples approximately $10 \times 10 \times 10$ centimeters ($3.9 \times 3.9 \times 3.9$ inches [in]) in size will be collected from the top 10 centimeters of the mineral soil during initial plot establishment sampling events only and will only be collected on selected plots that meet compliance criteria. Targeting a sample from a restricted depth, rather than collecting samples from multiple soil horizons (e.g., Organic, A, E, and B) allows for a standard soil nutrient description across all network park monitoring sites and will allow for comparison to other vegetation plot databases' plot-level soil data (e.g., the Carolina Vegetation Survey, Peet et al. 1998).

Any soil disturbing activity entails a greater opportunity to damage archaeological or cultural resources of importance, should they be present. Therefore, field crews must ensure that appropriate permission from park staff has been granted prior to collecting a soil sample. This will ensure the park has considered the potential impact of the soil collection activity and has completed all necessary cultural resource compliance. Field crews are required to obtain permission to collect soil from park staff prior to vegetation sampling events. If cultural artifacts are encountered at a plot where permission to sample has been granted, do not take a soil sample. Record why a soil sample was not taken.

SOP Source and How It Was Modified

This SOP is an adaptation of SOP 10 *Soil Measurements—Version 1.3* of the *Cumberland Piedmont Network Vegetation Monitoring Protocol* (White et al. 2011). However, the Cumberland Piedmont Network (CUPN) has not implemented this SOP. For a general explanation of how the Southeast Coast Network modified the CUPN protocol and its SOPs, see *Terrestrial Vegetation Monitoring in Southeast Coast Network Parks: Protocol Implementation Plan* (Boyle et al. 2019). With regards to this SOP, the Southeast Coast Network made two specific modifications to the CUPN SOPs, including (1) soil collection implemented only during initial plot establishment, and (2) soil samples only collected from the top 10 centimeters (3.9 in) of mineral soil and no soil horizon depths are recorded. The detailed list of modifications to CUPN SOP 10 is in Appendix B of this SOP.

Data Collection Procedures

Collecting Soil Samples in the Field

- Using a sharpie or other dark marker, pre-label a single soil collection bag with the following naming convention: <Park/Unit Acronym GRTS ID>-<Collection Date (YYYYMMDD)> (e.g., FOFR05-20190717).
- The soil sampling frames consist of a set of three circles each of 2-meter (6.6-foot [ft]) radius that occur above modules 3 and 4 (Figure 1). To determine the location of the middle soil sampling frame (sampling frame 2), extend the line delineating the boundary between modules 3 and 4 another 2 meters beyond the end of the plot (2 meters beyond the module corner). Place a chaining pin at this point. This is the center of soil sampling frame 2. If the 25-meter (82-ft) fuel load transect has been established, then the tape can be used to measure the distance and diameter of the first circle.
- From the center of sampling frame 2, measure 4-meters (13.1-ft) slope distance parallel to the length of the plot in both directions. Place a chaining pin in both locations. This is the center of soil sampling frame 1 and 3 (Figure 1). The three chaining pins should be in a straight line.
- The soil sampling frames must be free from obstructions (e.g., boulder fields, cliffs, standing water) and generally representative of the ground cover through the plot. Soil sampling frames must not include large tree tip-ups, large animal burrows, historic house foundations, fire rings, etc., unless these features are widespread throughout the plot and generally representative of the site conditions. If soil cannot be sampled at this location due to obstructions or site anomalies, abandon these samples and choose the area just outside of the plot between modules 1 and 2, and repeat the process above to establish the plots (Figure 2). If soil cannot be sampled in that location either, pick a different location between modules 2 and 3 or between modules 1 and 4 (see diagram below). In these cases, note the location of the sampling frames in “Frame Location” field on the datasheet.

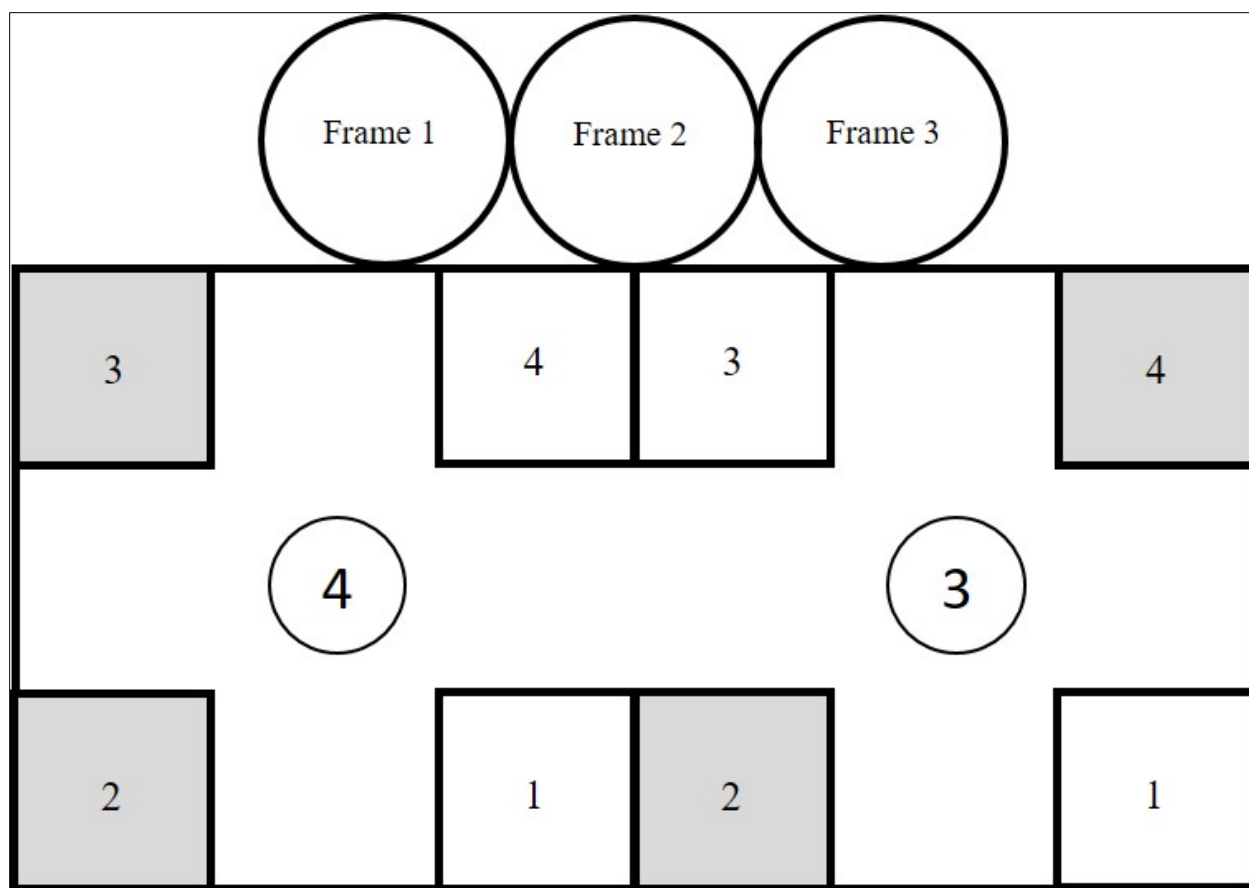


Figure 1. Soil sampling frame placement in relation to the northern half (modules 3 and 4) of the Southeast Coast Network vegetation monitoring plot.

- Next, select a 10×10 -centimeter (3.9×3.9 in) area within sampling frame 1 in which to place a sampling quadrat. The objective is to collect a representative soil sample, so select a location for the quadrat relatively free of rocks, roots, or other obstructions that prevent soil sampling. Do not toss the quadrat into the sampling frame to “randomly” decide the quadrat location.
- Using a pair of clippers, carefully remove all live vegetation from the sample area. Clip living mosses at the base of the green, photosynthetic material. Next, use a digging tool to saw through the unconsolidated litter and the forest floor along the inner surface of the quadrat. Use the digging tool to cut through the consolidated organic horizon to the top of the mineral soil. The organic horizon is light in weight, has a greasy feel, and is made up of materials like peat and decayed plant materials; the mineral soil is denser and is composed of mixtures of sand, silt, and clay, with occasionally some enrichment from organic materials above.

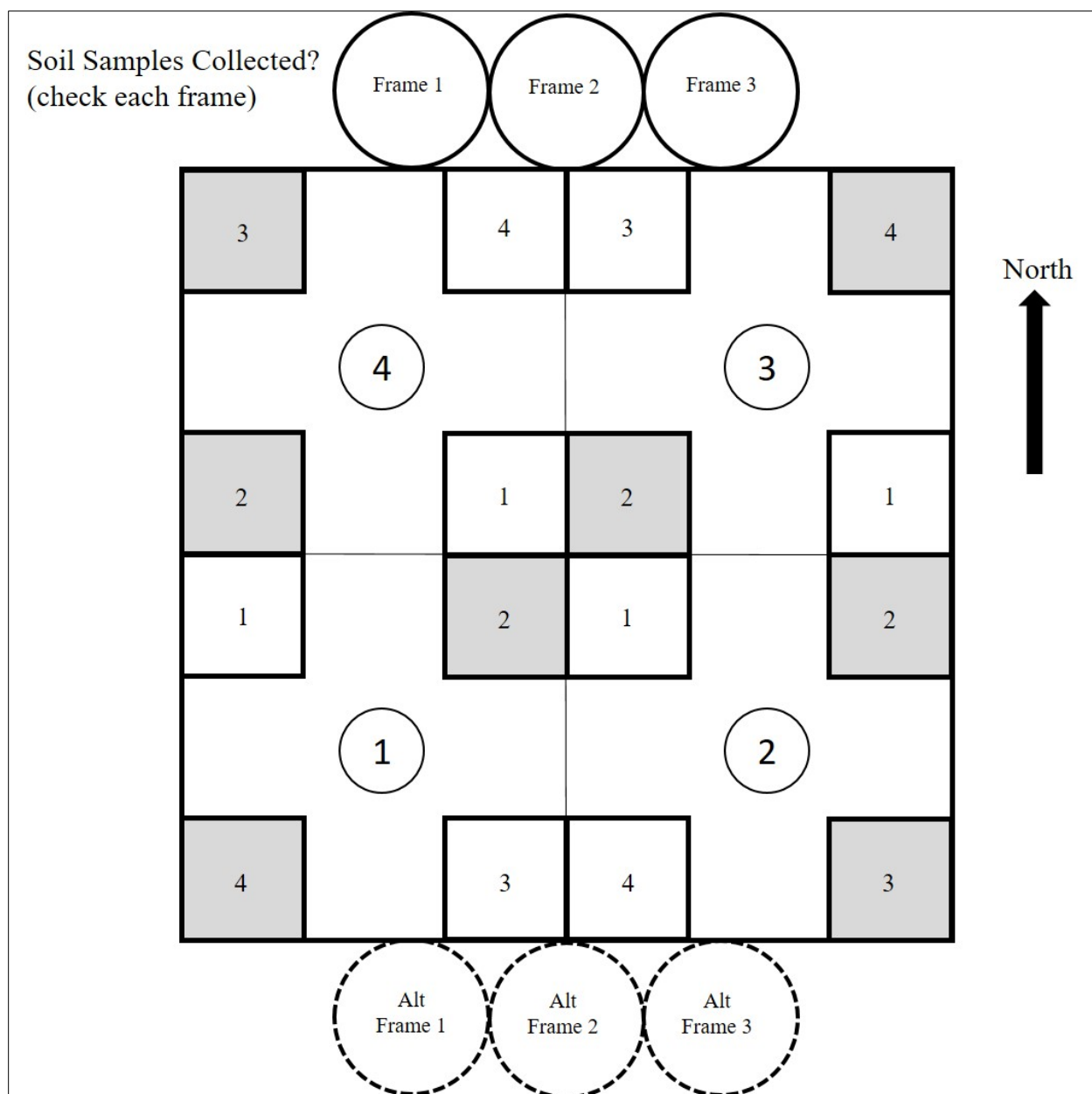


Figure 2. Preferred location of soil sampling frames and alternative location if the preferred location is not feasible.

- Use a trowel to carefully remove the top 10 centimeters (3.9 in) of mineral soil from the first sampling frame and place the sample in the plastic bag; repeat this procedure in the remaining two sampling frames, kneading and working the sample within the bag each time a new frame's sample is added. Once all three samples have been collected, close the bag and knead the contents thoroughly to ensure that there is a homogenous sample.

Post-Field Soil Processing

Upon return from the field, leave soil sample bags open in a safe location to air-dry until the soil no longer appears moist. Bags should not be sealed until they are dry or else anaerobic activity may bias the sample. To test dryness, gently squeeze the soil through the bag to break clumps, and arrange the sample so it has maximum exposure to the air (fold back the bag lip, move soil out of bag corners, and let the sample lay as flat as possible). For this to work properly, use flexible plastic soil sampling bags that are wider at the opening than they are long. As the soil dries, check and mix the sample by gently squeezing from outside the bag.

Some soil samples may contain considerable moisture from ground water or recent rain. These wet soils will not dry properly in plastic bags. Wet soil samples need to be spread out on wax paper or a metal pan to dry completely before being returned to the original plastic bags.

If a soil drying oven is available at the field location, transfer soil samples from the field bag into aluminum baking pans labeled with the soil sample identifier. Occasionally, multiple pans may be necessary to contain an entire sample. Place pans in a laboratory drying oven equipped with exhaust fans to allow for air moisture removal. The temperature of the oven should be maintained at 40°C (104°F) because of the effect of higher temperatures on extractable potassium (K). Samples should be kept in the oven until they feel dry to the touch throughout their entire volume (including middle and bottom of the sample). For extremely wet samples, this could take up to 10 days in the oven. This process should be done with all samples once the field team is back in the main office.

Prior to sending oven-dried samples to a soil processing lab, prepare a master list of sample information. Assign each sample a unique sequential number and mark this number prominently on the bag (using a different color ink than other info on the bag and circling this number). Create a list identifying which sample number corresponds to which park, plot number, frame number, and date collected. Print a copy of this list for the Southeast Coast Network and include a copy with the samples when shipped or delivered to the testing lab.

Mail soil samples to the contracted soil laboratory for analysis. The lab should be able to perform analyses that result in a description of typical soil nutrients (including anion parts per million [ppm]; exchangeable cations pounds per acre [lb/A] and ppm; base saturation percent of calcium, magnesium, potassium, sodium, and hydrogen; and total C and N by dry combustion and extractable ions). Prior to running these tests, the lab should prepare samples by passing each through a 2-millimeter sieve to remove larger particles or debris.

When samples are sent to the laboratory, coordinate with the contractor's lab staff to ensure all unused portions of the samples are retained. Request that all leftover soil be returned in the original bags. Each sample that is returned from the lab should be archived for later analysis, with approval of park resource and curatorial staff. To archive a remaining sample, first prepare a clean, new archive container which resembles a pint-sized cardboard ice cream container. Either place the sample label with the sample's identifying information or write this directly on both the container and the lid. Work with park curatorial staff to submit the required documentation for a natural resource collection and determine where to archive the samples (must be a safe, climate-controlled location).

Table 1. Datasheet field descriptions for *Veg Form 1—Vegetation Plot Establishment*.

Field Name	Field Description
Soil Samples collected (plot diagram)	Check the center of each Soil Sampling Frame once samples have been collected

Equipment List

- Chaining pins
- Meter stick
- Trowel and soil digging tool
- Pre-labeled plastic soil sampling bags
- Permanent marker
- Field datasheets (*SECN Veg Form 1—Vegetation Plot Establishment*)
- Pencil
- Metal pans for soil drying
- Laboratory drying oven
- Archival soil containers

Literature Cited

- Boyle, M. F., M. B. Gregory, M. W. Byrne, P. I. Capece, and S. Corbett. 2019. Terrestrial vegetation monitoring in Southeast Coast Network parks: Protocol implementation plan. Natural Resource Report NPS/SECN/NRR—2019/1930. National Park Service, Fort Collins, Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2263392> (last accessed May 2019).
- Peet, R. K., T. R. Wentworth, and P. S. White. 1998. The North Carolina Vegetation Survey protocol: a flexible, multipurpose method for recording vegetation composition and structure. *Castanea* 63:262–274.
- White, R., C. Nordman, L. Smart, T. Leibfreid, B. Moore, R. Smyth, and T. Govus. 2011. Vegetation Monitoring Protocol for the Cumberland Piedmont Network, Version 1. Natural Resource Report NPS/CUPN/NRR—2011/XXX. National Park Service. Fort Collins, Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2192468> (last accessed May 2019).

Appendix A. Field Data Forms

SECN Vegetation Monitoring Protocol Veg Form 1 – Vegetation Plot Establishment		Plot ID _____ (plot acronym + GRTS Order #)	Start Date _____ (mm/dd/yy)
SOP VEG02 – Site Selection, Plot Establishment, and Return Visits			
Reviewed by: _____			
Park _____	Unit _____	GRTS Order _____	QA/QC Plot Yes or No Start _____
Time _____	Total Time _____		
Crew _____ (circle crew leader)			
GPS file name _____ GPS model _____ GPS Unit ID _____			
Field UTM X _____ m E Field UTM Y _____ m N NAD 83 Zone 16 17 18 (circle one)			
# times averaged _____ GPS error _____ Elevation: _____ m WAAS enabled Yes or No _____			
Directions to plot (Be specific, Including where parked, landmarks used, if any gate keys needed, etc.) _____ _____ _____ _____			
Approximate Travel Time from Vehicle to Plot _____ minutes			
Permanent Plot Established (circle one) Yes or No (if no, provide justification below) _____ _____			
Compass Declination _____ ° (SECN parks range from 4 - 11°)			
Tag 1 Tag # _____ Tag Color _____		Tag 2 Tag # _____ Tag Color _____	
Tag Tree Species _____		Tag Tree Species _____	
DBH of Tag Tree _____ cm		DBH of Tag Tree _____ cm	
Direction Tag is facing (0-360°) _____		Direction Tag is facing (0-360°) _____	
Direction from Tag Tree 1 to Plot Center (0-360°) _____		Direction from Tag Tree 2 to Plot Center (0-360°) _____	
Distance From Tag Tree 1 to Plot Center _____ (m)		Distance From Tag Tree 2 to Plot Center _____ (m)	
office use only (print initials and mm/dd/yy)			
Form Validated By _____ Form Entered By _____ Form Modified By _____			
Reason for Modification _____			
Data Verified By _____ Data Validated By _____ Certified Date _____			

SECN_Vegetation_Monitoring_Protocol
 Data_Form_20190306

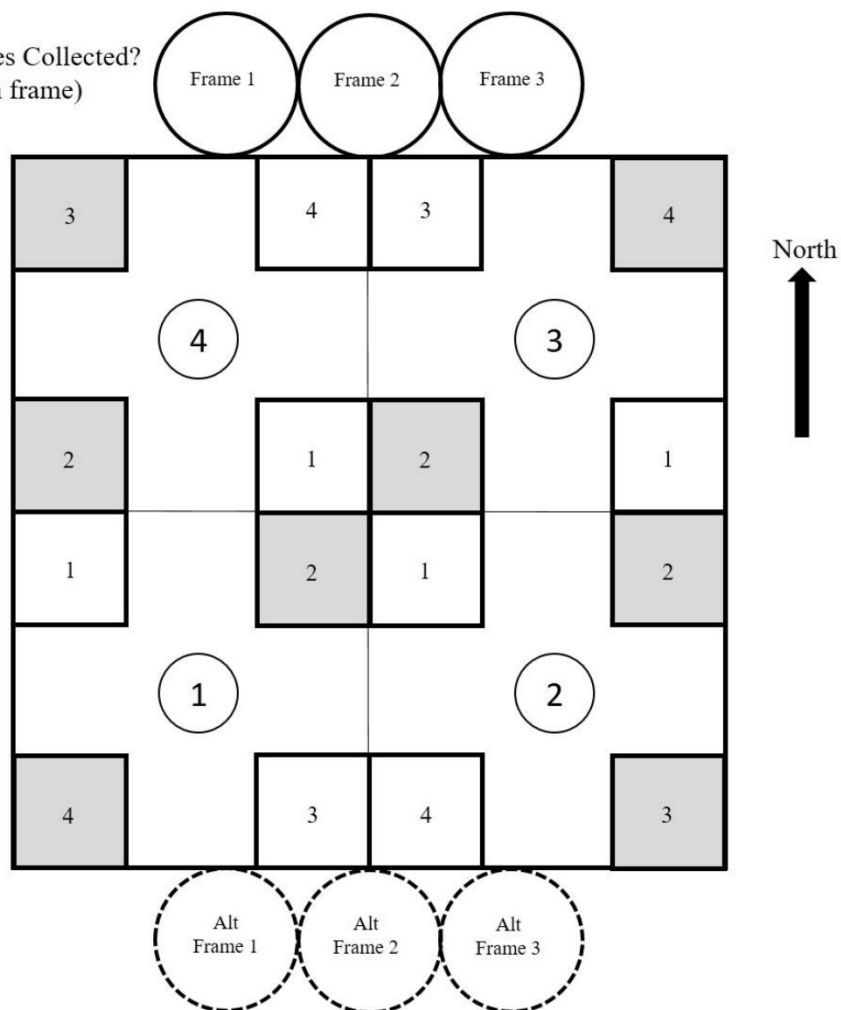
Figure A-1. Sample of *SECN Veg Form 1—Vegetation Plot Establishment* page 1 of 2.

SECN Vegetation Monitoring Protocol
Veg Form 1—Vegetation Plot Establishment

Plot ID _____ Start Date _____
 (plot acronym + GRTS Order#) (mm/dd/yy)

Plot Layout Notes (Unusual plot features, irregularities, or was plot moved?) _____

Soil Samples Collected?
 (check each frame)



SECN_Vegetation_Monitoring_Protocol
 Data_Form_20190306

Figure A-2. Sample of *SECN Veg Form 1—Vegetation Plot Establishment* page 2 of 2.

Appendix B. Modifications to CUPN SOP 10 for SECN SOP 1.4.16

The CUPN SOP 10 was modified to create SECN SOP 1.4.16. The major modifications to these SOPs are listed and explained below.

Soils Collected During Initial Plot Establishment Only

The CUPN vegetation monitoring protocol describes a process where soil samples are collected every 10 years across network parks, although the Cumberland Piedmont Network never implemented soil sampling. In the vegetation monitoring approach used by the Southeast Coast Network, soils are collected only during initial plot establishment. We have chosen to use soil characteristics from each vegetation plot to connect park monitoring sites to reference sites across the Southeast Coast Network. In reference conditions, soil characteristics (as well as geomorphology), such as soil nutrient composition, serve to further classify ecological units beyond vegetation alone. These abiotic components of the unit can be used to guide future efforts in determining reference targets for managed or modified ecosystems.

Samples from the Top 10 Centimeters of Mineral Soil

The Cumberland Piedmont Network collects soil samples across multiple soil horizons (A, E, B, Organic) to get a description of nutrient and texture content across the full soil profile of a site. Because of the extreme variation of soil types located across the geography of the Southeast Coast Network (Piedmont, inland Coastal Plain, Maritime Fringe), this protocol only collects mineral samples from the top 10 centimeters (3.9 inches) of the soil profile (ignoring the Organic horizon). This standard of reference allows for a network-wide inference of soil nutrient assessment.