

APPENDIX D
Wetlands protocol and datasheets

**STANDARD OPERATING PROCEDURE
FOR THE QUICK ASSESSMENT PROTOCOL:
FORESTED AND EMERGENT WETLANDS**

**IN SUPPORT OF
U.S. ENVIRONMENTAL PROTECTION AGENCY**

**UNDER
RCRA ENFORCEMENT, PERMITTING, AND ASSISTANCE (REPA3)
ZONE 2 - REGION 5**

CREATED FOR USE BY EPA REGION 5

**WETLANDS SOP, REVISION NO. 3
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1.0 Scope and Application

Knowledge of ecosystem health and quality is an important component of successful ecosystem management. Ecological assessments are increasingly used in support of adaptive ecosystem management and informed resource management. Rapid ecological assessment is a common technique that is most often used to objectively assess the biological diversity of a relatively unknown ecological area. However, this assessment technique can also be used to evaluate ecological characteristics other than diversity.

The purpose of this standard operating procedure (SOP) is to detail a rapid ecological assessment protocol for evaluation of the condition of wetland ecosystems. This emergent and forested wetlands protocol is one of four protocols originally drafted as a product of a workshop held in June 2003. It was then revised after being field tested by the participants of a second workshop held in spring 2004. When using this SOP, the associated Quality Assurance Project Plan (QAPP) should be consulted. The QAPP serves as a generic plan for all data collection activities conducted under the SOP and offers guidelines for ensuring that data are of sufficient quality and quantity to support project objectives. Decisions regarding the application of data collected while using this SOP should consider the precision, accuracy, and other statistical characteristics of these data.

2.0 Method Summary

This SOP provides instructions for a rapid ecological assessment of forested and emergent wetland ecosystems, using fauna surveys, flora surveys, and soil sampling of a 300-m by 300-m study plot. Generally, the optimal season for implementing this protocol is during the growing season. Late spring offers the best opportunity for sampling nesting birds in most temperate locations; however, this will not be the ideal time to identify all plants. It is most important to sample all sites in a relatively small window (e.g., mid-May to mid-June, depending on latitude and other climatic factors) to make comparisons across sites. The protocol is intended to be completed in approximately four hours and requires a four-person team working together in pairs, as a fauna/soil crew and a flora crew.

The fauna/soil crew conducts the fauna and soil portions of the protocol. Fauna surveys include: 1) 20 minute periods of bird observation from two different observation points within the plot; 2) traversal of areas around four sample points, along which crew members look for fauna signs such as scat and use a D-frame net to aid in animal identification; and 3) collection of soil cores to characterize the depth, color, composition, and redoximorphic features of each soil horizon. This field crew also looks for evidence of disturbance and human impacts.

The flora crew conducts flora surveys at four flora points. During these surveys, 1) plants and trees are surveyed by the Braun-Blanquet sampling method; 2) water depth is measured; and 3) overstory vegetation is estimated within 10 m of each point. Detailed procedures to implement this methodology are provided in Section 7.0.

3.0 Definitions

Coefficient of conservatism (C): The estimated probability that a species is likely to occur in a landscape relatively unaltered from what is believed to be a pre-settlement condition. Coefficients range from 0 (highly tolerant of disturbance, little fidelity to any natural community) to 10 (highly intolerant of disturbance, restricted to pre-settlement remnants) (Bernthal 2003). Coefficients of conservatism are used to calculate FQI values for study areas.

Disturbance: A natural or human-induced (anthropogenic) environmental change that affects an ecosystem's floral, faunal, or microbial communities. Disturbance may include, but is not limited to: roads, gravel, asphalt, trails, berms, ruts in the soil, eroded areas, evidence of digging, hydrologic modifications (e.g., ditches, weirs), evidence of mowing or tree felling, wind throw mounds, evidence of fire, litter, tires, refrigerators, manure, and pig ruts.

Fauna signs: Indications or signs that fauna are, or have recently been, present. May include, but are not limited to: calls, tracks, mounds, burrows, holes, nutshells, scat (e.g., deer-pellet clumps), runways and trails, browse lines, and tree rubbing.

Floristic Quality Assessment (FQA): A tool to assist environmental consultants, scientists, natural resource managers, land stewards, environmental decision-makers, and restorationists in assessing the floristic and, implicitly, natural significance of any given area (Herman et al. 2001). FQA methodologies were originally developed by Swink and Wilhelm (1994) as standardized, repeatable means of evaluating natural area quality (Bernthal 2003).

Floristic Quality Index (FQI): A metric used in FQA that is sensitive to factors that increase species richness. The FQI for a given study site is calculated as the sum of the coefficient of conservatism for each species observed, divided by the square root of the total number of native species observed in the study area (Bernthal 2003).

Hydrogeomorphic Classification (HGM): A wetland classification system based on type and direction of hydrologic conditions, local geomorphology, and climate (Mitsch and Gosselink 2000). The seven hydrogeomorphic classes defined by Smith et al. (1995) include: depression, lacustrine fringe, tidal fringe, slope, riverine, mineral flat, and organic flat. The HGM classification methodology was originally developed by Brinson (1993).

Redoximorphic features: Mineral soil features formed by the reduction, translocation, and/or oxidation of iron and manganese oxides. Reduced soils can develop a black, gray, greenish-gray, or blue-gray color (gleying). Spots of highly oxidized materials (mottles) appear orange/reddish-brown or dark reddish-brown/black (Mitsch and Gosselink 2000).

4.0 Health and Safety

Health and safety concerns for field workers in the wetland ecosystem include:

- slips, trips, and falls;
- thermal conditions such as excessive heat or cold;
- inclement weather, especially lightning; and
- biological hazards, such as insects or other taxa that may bite and plants that may contain substances causing allergic reactions.

Field workers should wear closed shoes, long pants and long sleeves, but are individually responsible for selecting footwear, clothing, gloves and outerwear as appropriate to the situation at hand. Field workers should use insect repellent, as appropriate, and take care to avoid holes, fallen trees and other obstacles that may cause slips, trips, and falls. Workers should increase attentiveness to potential hazards during pre-dawn activities.

5.0 Personnel Qualifications

5.1. General Qualifications

This protocol requires a two-person fauna/soil field team, and a two-person flora field team, with one or more of these team members performing pre-visit preparations. For both pairs, one of the crew members must be an expert (bird and plant, respectively) whereas the other crew member can be a generalist. An expert must be able to identify most or all of the common taxa found in the area to be surveyed and be able to collect appropriate and sufficient field data on less common taxa to enable their later identification. Regardless of their respective areas of specialization, all team members must have had some wetland field work experience. Before formally collecting data in the field, all team members should practice the protocol at least once in a convenient wetland habitat to make sure they are clear on how to collect the data and complete each of the datasheets.

The individual(s) performing the pre-visit preparations should be generally familiar with the flora and fauna found in the specific ecoregion. Preferably, the individual(s) should have an educational background in biology or ecology.

5.2 Fauna/Soil Crew

At least one of the two crew members must be an expert in field identification of birds, both by sightings and by their behaviors (e.g., calls, flight). At least one of the two crew members must have introductory training in soil sampling and be able to identify redoximorphic features in soil samples. One of the crew members must also be skilled in the identification of aquatic organisms such as benthic invertebrates and amphibians. The other crew member should have general wetland familiarity and experience. In addition, expertise in wildlife identification is preferred. One of the two fauna crew members should also have experience with GPS.

5.3 Flora Crew

At least one of the two crew members must be an expert in wetland plant identification and be able to identify at least 100 species appropriate to the wetland community being surveyed. This person must also be trained in discriminating unknown flora. The second crew member should have general wetland familiarity and experience, but no particular expertise is required. One of the two vegetation crew members should also have experience with global positioning systems (GPS).

6.0 **Equipment and Supplies**

6.1 General Equipment Needed

- Two digital cameras with zoom and panorama capabilities
- Two high capacity (128MB) digital data cards appropriate for the digital cameras being used
- Two GPS units and recharger for DC power socket in automobile
- Flagging
- Flashlights
- Two clipboards
- Pens with permanent, waterproof ink
- Two hand lenses
- Two compasses
- Two 5 gal. plastic tubs (must be able to float), for transporting equipment and temporarily storing vouchered plant and soil samples
- Scrub brushes
- Four frame backpacks (i.e., large backpacks)
- Four pairs of chest waders (or hip boots for sites with more shallow water) or breathable waders
- Life jackets if waders are used (i.e., manually inflating)
- Two accurate watches
- Sharpie markers
- Insect repellent
- First aid kit
- Aerial photos, maps, and driving directions to study sites
- Two copies of this SOP, printed on waterproof paper

6.2 Additional Equipment Needed for the Fauna/Soil Crew

- D-frame net with 1-mm mesh
- Photo developing trays
- Sorting trays
- Hand lens (10 power, large diameter)
- Soil probe with wetland soil bit
- Measuring tape (10 m)
- Thermometer to record air temperature
- Flexible forceps for invertebrates
- Munsell chart

- Binoculars
- Fauna reference lists, printed on waterproof paper
- Bird, mammal, herpetofauna, fish, and invertebrate field guides.
- Datasheets W1 through W6, printed on waterproof paper

6.3 Additional Equipment Needed for the Flora Crew

- Measuring tape (10 m)
- BA prism or DBH tape
- Convex spherical crown densiometer
- PVC pipe square (0.5 m x 0.5 m)
- Water depth gauge (1.5-m rope marked at 0.1-m intervals and with weight attached at one end)
- Plastic bags (3 to 5 quart size)
- Flora reference lists, printed on waterproof paper
- Wetland vegetation field guides
- Pruning shears
- Hand saw
- Datasheets W5, W7, and W8, printed on waterproof paper

7.0 Procedure

This protocol requires a four-person field crew working together in pairs to evaluate a 300-m x 300-m site, and is intended to be completed in approximately four hours. One pair will conduct the vegetation portion of the protocol (i.e., flora crew) while the other pair will conduct the fauna and soil portions of the protocol (i.e., fauna/soil crew).

One or more of these crew members will perform pre-visit preparations. To the degree possible, the fauna and flora crews should work together in the same area to facilitate communication. All four crew members should try to minimize trampling of vegetation. The fauna/soil crew field procedures are detailed in Section 7.2, and the flora crew field procedures are detailed in Section 7.3. If water in the study site is ephemeral, careful consideration should be given to the timing of the field event to ensure that the wetland is not dry during sampling.

7.1 Pre-Visit Preparations

Listed below are the steps that must be completed before the start of the field event.

- Step 1. Obtain aerial photographs and maps of the site and surrounding area. These materials will familiarize the field team members with the area and provide them with a context for the site.
- Step 2. Acquire seasonal and decade hydrographs. Compare with weather data from this season to determine how representative the hydrology is.
- Step 3. If possible, determine the HGM classification for the study site, and obtain local wetland soil series information.
- Step 4. Consult the resources listed on pages 18 to 19 of Herman et al. (2001) to obtain any local FQA information that may be available.
- Step 5. Determine the pre-assigned four-character site ID number for the study site. The first character of the site ID number should be “W” for wetland ecosystem, the second character identifies the state in which the site is located (i.e., 1 = Ohio, 2 = Michigan, 3 = Indiana, 4 = Illinois, 5 = Wisconsin, and 6 = Minnesota); and the last two characters should be digits assigned sequentially from 00 to 99.
- Step 6. It may be necessary to obtain permission or a formal permit to access the study site. Check with the land owner or manager to determine the need for such permission or permits. The minimal sample collection envisioned for this protocol will not include vertebrate species and

is not expected to require a scientific collecting permit. This should be verified with environmental and fish and wildlife agencies, as appropriate.

- Step 7. Create reference lists of local flora and fauna species from available databases and resources. For all species: (1) categorize as native or non-native, (2) list the state and Federal status, and (3) categorize as invasive or non-invasive. For flora species, also list the coefficient of conservatism. For fauna, also note whether each species is a generalist/specialist and whether it is common/rare.

Useful information sources for determining species status include:

- Illinois Department of Natural Resources:
<http://dnr.state.il.us/esp/datelists.htm> – state list of threatened and endangered (T&E) species.
- Illinois Natural History Survey:
<http://www.inhs.uiuc.edu/cbd/ilspecies/ilsplist.html> – lists of flora and fauna occurring in Illinois, including state and Federal listing status.
- Indiana Department of Natural Resources:
<http://www.in.gov/dnr/fishwild/endangered/e-list.htm> – lists of T&E fauna;
<http://www.in.gov/dnr/naturepr> – lists of rare, threatened or endangered (RTE) species by county and a list of Indiana’s RTE vascular plants;
<http://www.in.gov/dnr/fishwild/endangered/frogs.htm> – list of frogs and toads in Indiana;
<http://www.in.gov/dnr/invasivespecies/innatcom03.pdf> – lists of characteristic species found in a variety of community types.
- Michigan Department of Natural Resources:
http://www.michigan.gov/dnr/0,1607,7-153-10370_12142---,00.html – links to T&E lists and a rare plant reference guide;
http://www.michigan.gov/dnr/0,1607,7-153-10370_12145---,00.html – links to fauna information;
http://www.michigan.gov/dnr/0,1607,7-153-10370_12146---,00.html – links to flora information.
- Minnesota Department of Natural Resources:
<http://www.dnr.state.mn.us/ets/index.html> – Minnesota’s list of endangered, threatened, and special concern species;
- Ohio Department of Natural Resources:
<http://www.ohiodnr.com/wildlife/resources/default.htm> – links to a variety of wildlife resources, including T&E lists for fauna;
<http://www.ohiodnr.com/forestry/Education/ohiotrees/treesindex.htm> – list of Ohio’s tree species.
- Wisconsin Department of Natural Resources:
<http://www.dnr.state.wi.us/org/land/er/> – lists of state and Federal T&E species occurring in Wisconsin, county maps that list known occurrences of T&E species, and a searchable database of T&E species occurrences in Wisconsin.

- U.S. Fish and Wildlife Service:
www.fws.gov – links to a discussion of the endangered species program and a list of Federally threatened and endangered species.

Useful sources of information on invasive species include:

- Indiana Department of Natural Resources: <http://www.in.gov/dnr/invasivespecies>
- Michigan Invasive Plant Council:
<http://forestry.msu.edu/mipc>
- Minnesota Department of Natural Resources: <http://www.dnr.state.mn.us/exotics/index.html>
- Wisconsin Department of Natural Resources: <http://www.dnr.state.wi.us/org/land/er/invasive>
- National Park Service, Alien Plant Working Group:
<http://www.nps.gov/plants/alien/factmain.htm#p1lists>
- US Department of Agriculture:
<http://www.invasive.org>

- Step 8. Determine coefficients of conservatism for plant species using Bernthal (2003). For additional information, consult FQA Web sites and points of contact listed by Herman et al. (2001) on pages 18 to 19.
- Step 9. Print reference lists developed in the previous step on waterproof paper. Field datasheets should also be printed double-sided on waterproof paper.
- Step 10. Assemble information needed for field crew to efficiently and accurately determine the correct location of the study plot (e.g., develop driving directions, provide latitude/longitude coordinates).
- Step 11. Determine and record the UTM of the four corners of the 300 m cell. From an aerial photograph, locate four points within the cell that characterize the diversity of the landcover. These points should be spread as widely as possible while allowing for sampling as many varied vegetation types visible on the photo. Record the UTM of the four locations and number them one through four starting with the location closest to the entry location of the cell. The area within a square of 20 m by 20 m around the sample point is known as a “sample plot” (see Figure 2).
- Step 12. Assemble field equipment and check it against the list in Section 6.0. Recharge all batteries, inspect nets for tears, and ensure that the GPS unit and digital cameras are in good working order. Ensure that all equipment and personal clothing, particularly footwear, has been washed and dried to decontaminate it from previous field work.
- Step 13. Familiarize all personnel with use of equipment including the GPS unit and digital cameras.

7.2 Fauna/Soil Crew Activities

This section describes the steps to be completed by the fauna/soil crew, including study plot set-up activities, data recording, fauna surveys, and soil characterization.

7.2.1 Data Recording

- The fauna/soil crew should use datasheets W1 through W6. Table 1 describes each of the datasheets and provides cross-references to SOP instructions. Use as many copies of each sheet as necessary to record all fauna observations. Note that all fauna sightings during the four hour sampling period should be recorded, regardless of the activity being performed at the time of the sighting.

- Before entering the study plot complete the header information on the datasheets, including location, site ID number, UTM coordinates, date, and names of investigators. Do not fill out the species categorization columns (e.g., native or non-native, etc.) of the datasheets until all other field activities are completed. If time permits, these columns should be completed in the field using the fauna reference lists. Otherwise they can be completed back in the office.
- For datasheets W3 and W5, the number of sheets required will vary from plot to plot depending on the numbers of observations and photographs. These sheets should be numbered in the spaces provided at the tops of the sheets (i.e., Page ____ of ____) by the field crew members. Numbering the pages will help keep sheets in order and allow verification that all sheets are present and accounted for at the conclusion of field activities.
- Take photographs of any features (whether fauna, fauna signs or habitat, or disturbances) deemed as being potentially meaningful. When in doubt, take the photograph.
- Before taking the first photograph, be sure that the time set in the camera is the same as the time set on field team members' watches so that time can be used to associate the photographs with the appropriate observation point.
- Keep a record of all photographs taken in the photo log on datasheet W5. Include the time the photograph was taken, the subject of the photograph, the direction the photographer was facing while taking the photograph, and a description of the location of the photograph.
- More specific data recording instructions are included in the sections that follow, and on the datasheets themselves.

7.2.2 Field Set-up

- Inspect other field equipment to ensure all equipment was properly disinfected after the previous sampling event. Use scrub brushes, as necessary, to disinfect.
- Synchronize the watches of all field team members and the time displayed on the digital camera to make sure they all show the same time of day.
- Measure the standard walking pace of each team member and adjust to 1 meter per pace so that team members can estimate distances rather than having to measure them. Note that pacing may not be possible in many wetland environments.
- Upon arrival at the site, spend about 10 minutes on reconnaissance and plot set-up activities, as detailed below. When approaching the site location, be particularly aware of any herpetofauna, birds, and mammals in the area that will be defined as the 300 m by 300 m site, because these species will likely leave the area as the field crew approaches and likely will not return so long as people are present in the site. See Section 7.2 for the protocol on data collection for these species.
- Verify that the landcover is consistent with the predetermined wetland type and verify HGM designation through observation. Establish the corner of the study plot nearest to the access point (i.e., fauna/soil survey Point A) using topographic features or other landmarks. Document the wetland with photos covering a 360 degree view. Conspicuously flag the entry corner of the site and record UTM coordinates.
- If a GPS reading can be obtained, verify the UTM coordinates of Point A as indicated on the aerial photographs, maps, and fauna/soil datasheets. If a GPS reading cannot be made at or near Point A, record "NS" for no signal next to the UTM coordinates listed on datasheet W1.
- Mark this starting corner with red flagging and write "F/S Point A" on the flagging, using permanent marker. Establish the direction of the plot boundary lines by placing blue flagging 5 m north or south of the corner, and 5 m east or west of the corner (direction depending on the orientation of plot with respect to the first corner).

- Regardless of which corner is nearest to the study plot access point, the combined fauna/soil transect from Point A to Point D is to be oriented diagonally from the starting corner through the center of the study plot (Figure 1). When proceeding from Point A to Point D, leave flagging periodically to make the return traversal easier and faster.
- To establish the first bird observation point (i.e., Point B), the fauna/soil crew should pace 140 m from Point A diagonally toward the study plot center, using a compass to navigate (Figure 1).

7.2.3 Bird Observations from Points B and C (adapted from Ralph et al. 1993)

- Commence bird data collection approximately half an hour before sunrise. Make as little noise and other types of disturbance as possible before and during the observation period. Ideally, birds will be surveyed at Point B just prior to sunrise and just after sunrise at Point C.
- Bird observation Points B and C should be located 140 m apart and 140 m and 280 m, respectively, from Point A (Figure 1).
- Use datasheet W1 for data recording for this first exercise of the study plot assessment. Complete the weather conditions section and note the start time immediately before bird observations begin.
- Working together at bird observation Point B, both fauna/soil crew members should observe birds over a 20-min observation period, using binoculars and bird reference lists as needed. The more experienced crew member is responsible for identifying birds, while the other crew member should record data. Record species that are seen or heard and the approximate number of individuals for each observation of a species on a separate line in the form.
- Do not double count individuals that may be moving around their territory
- Record the time at the end of the 20-min observation period.
- Flag and label Point B in the same manner as Point A. To avoid disturbing birds before their presence has been observed and recorded, flagging and labeling are to be conducted after the 20-min observation period.
- Using a compass for navigation, pace the 140 m from Point B to Point C.
- At Point C, repeat the bird observation procedures as described for Point B above.

7.2.4 Wandering Survey

- Record weather conditions at the beginning of the first wandering survey and at the end of the fourth wandering survey.
- Beginning on one side of the first sample plot, systematically wander over the sample plot, avoiding the vegetation subplots while the vegetation crew is working. Be particularly alert to frogs, turtles, birds, and mammals that are present and their locations. Since these species may exit the survey site, not returning until the field crews are gone, they should be recorded if their observed locations ultimately fall within the defined site. Take 20-25 minutes to wander each sample plot.
- The expert in aquatic fauna taxonomy should periodically stop to use the D-frame net to collect fish, benthic invertebrates, and amphibian larvae. Manually sort through the net contents, identifying organisms to the lowest practicable taxonomic level, using a hand lens as needed. Call out taxa names and numbers of individuals per taxa for the data recorder. The data recorder should keep a running list on datasheet W2 of taxa and tallies of numbers of individuals per taxon. If individuals of some taxa are too numerous to count, approximate numbers can be recorded. Keep in mind that the purpose is to estimate the relative abundance of the various taxa observed. Return all organisms to the water.
- Both fauna crew members should take note of any herpetofauna, birds, mammals, and fauna sign observed throughout the field event, especially when first approaching the survey area. The data recorder should record data on datasheet W3.

- Record observations of all birds, mammals, and herpetofauna seen or heard within each sample plot of the 300 m by 300 m site. As noted above, highly mobile herpetofauna, bird, and mammal species and their locations relative to the sample plot boundaries should be recorded before they exit the survey area for the duration of the survey. Use field guides as needed to aid species identifications.
- Identify each bird species (or lowest possible taxon) and list all species observed for each sample plot. For each species recorded in each sample plot, list the behavior(s) (if possible) observed as singing (S), swimming (W), flying (F), perched (P), and/or foraging (O). Keep a tally of the number of individuals per species observed in each sample plot.
- Identify each mammal species (or lowest possible taxon) and list all species observed for each sample plot. For each species recorded in each sample plot, list the method(s) of identification as sight (S), call (C), scat (A), track (T), and/or other (O). If O is recorded, provide a brief description of the identification method. For each species recorded in each sample plot, list the behavior(s) observed as swimming (W), calling (C), hiding/resting (H), and/or foraging (O). Keep a tally of the number of individuals per species observed in each sample plot.
- Identify each herpetofaunal species (or lowest possible taxon) and list all species observed for each sample point area. Note that larval amphibians collected using the D-frame net should be listed on W2. For each species recorded in each sample point area, list the method(s) of identification as sight (S), call (C), scat (A), track (T), skin (K) and/or other (O). If O is recorded, provide a brief description of the identification method. Keep a tally of the number of individuals per species observed in each sample plot.
- The data recorder should record on W6 and photograph evidence of human impacts as it is encountered (see datasheet for examples of the types of disturbances that may be encountered), and describe land uses that occur adjacent to the wetland area (e.g., residential, agricultural, industrial). List invasive plant species on datasheet W6.
- At the conclusion of each sample plot's 20-25 minute wandering survey, total the numbers of birds, mammals, and herpetofauna observed for that sample point area. Record this number and circle it. If individuals of any taxa are too numerous to count, record approximate numbers and note in the comments field of the datasheet that numbers are estimated.
- Repeat wandering survey for the remaining three sample plots.

7.2.5 Soil Characterization

- Take a soil sample from the center of the sample plot. Ensure that the wetland soil bit is screwed into the soil probe. Push the soil probe to its fullest extent into the ground. Record the soil depth reached on W5.
- Remove the probe. Measure and record the depth of each horizon. Compare soil horizon colors to a Munsell chart and record the hue, value, and chroma of each horizon. If there are any redoximorphic features in the sample, record the color and size of the feature on W5.
- Determine soil horizon composition by a combination of visual inspection and by moistening a small palm-full of soil with water and rolling it into a ball about the size of a large marble. Classify and record the soil as: "sandy" if the ball will not hold together, "clay" if soil can be rolled into a ball and molded into a cube, or "loam" if soil can be rolled into a ball but cannot be molded into a cube.
- If anything looks strange or questionable (e.g., oily sheen on the soil particles, an unnatural smell), collect a sample for later analysis as follows: Place the soil of interest in an appropriate container as defined by the QAPP. Label the container with the date, collectors' initials, the soil horizon (O, E, A, B, or C) and the sample ID number. Sample ID numbers should be assigned as eight-character combinations of numbers and letters: the first four characters are the site ID number, the fifth character is "S" for soil, the sixth character is the plot number from which the sample was

collected (1 - 8, corresponding to the numbers that set the location of the plot), and the last two characters should be digits assigned sequentially (from 01 to 99). Record the sample ID number on W5.

7.3 Flora Crew Activities

7.3.1 Data Recording

- The flora crew should use datasheets W5, W7, and W8. Table 1 describes each of the datasheets and provides cross-references to SOP instructions. Use as many copies of each sheet as necessary to record all fauna observations.
- Before beginning field activities, complete the header information on the datasheets, including location, site ID number, approximate UTM coordinates of the sampling grid, date, and names of investigators.
- Keep a record of all photos taken in the applicable photo log (W5). Include the time the photo was taken, the subject of the photo, the direction the photographer was facing while taking the photo, a description of the location of the photo, and if appropriate, a map identification number and corresponding datasheet number.
- Do not fill out the species categorization fields (e.g., native or invasive/ introduced) of the vegetation, wildlife, and aquatic organism datasheets; these fields will be completed back in the office.
- For some datasheets, the number of sheets required will vary by study site. The field crew members should number these sheets in the spaces provided at the tops of the sheets (i.e., Page ___ of ___). Numbering the pages will help keep sheets in order and allow verification that all sheets are present and accounted for at the conclusion of field activities.
- More specific data recording instructions are included in the sections that follow, and on the datasheets themselves.

7.3.2 Sample Plot and Subplot Surveys

- Take a GPS reading at sample plot 1 and record on W7. Make every effort to minimize trampling of vegetation while working in each sample plot. Minimize disturbance to vegetation and water in the subplots before documenting them. Within each sample plot, there is a 0.5 m by 0.5 m subplot. Collect data on vegetation and water in the nested 0.5 m by 0.5 m subplot before proceeding to collect data on the sample plot that contains it. Collect data on the vegetation in the sample plot while moving toward the center of the area to collect the water data so the vegetation will not be trampled before it is recorded.
- Proceed from the site corner to sample plot 1. The time spent at each sample plot should be about 30 minutes. Mark each sample point with flagging. Using a measuring tape, mark off four points (north, south, east and west of the sample point) 10m from the center of the sample plot. Place the 0.5 m by 0.5 m PVC pipe square at or near the center, so that it is nested within the 20 m by 20 m sample plot.
- Survey the 0.5 m by 0.5 m subplot by identifying all vegetation occurring within the PVC pipe square and estimate the Braun-Blanquet Cover Classes (Table 2). Cover classes should be assigned for both vegetated and unvegetated areas across the entire subplot. The total of the cover class percentages may be greater than 100 percent because each cover class represents a range of values and some plant species may overlap others. Plants include aquatic macrophytes and algae large enough to be seen easily with an unaided eye. The plant expert should systematically inspect the subplot from one side to the other, announcing species and percent coverage of each species. The other vegetation crew member should list species observed on W7.

- If any species cannot be fully identified in the field, a small amount of appropriate reference material can be placed in a plastic bag for later taxonomic verification, so long as the species is known not to be a species of concern in the area. A slip of paper with the site ID number, datasheet number, and a temporary sequential taxon number (which is also recorded on the datasheet) should be kept in the plastic bag until the reference material is identified and the correct taxon added to the datasheet. This reference material should be identified immediately upon return from the field and it should then be discarded. The collection of reference material for taxonomic verification should be minimized. Photographs of any questionable taxa should be used preferentially whenever appropriate.
- In the 0.5 m by 0.5 m subplot, measure the water depth using the calibrated line and weight and record on W7. Record “0” as the depth if no water is present at the center of the subplot and, if the subplot is not entirely dry, move to a location with water in the subplot to record water depth.
- Survey the 20 m by 20 m plot by identifying all plant species occurring within the plot and estimating the Braun-Blanquet Cover Classes (Table 2) for each species. The plant expert should systematically inspect from one side of the plot to the other announcing each species and the corresponding cover class, while the other vegetation crew member should record data on W7. Also record the Braun-Blanquet Cover Class for areas that are not vegetated (i.e., bare ground or open water). As above, if any species can not be identified in the field, then representative specimens should be vouchered.
- Estimate percent overstory density for the sample plot according to procedures outlined in Section 7.3.4 below and record data on datasheet W8.
- Repeat for each of the remaining three sample locations in the 300 m by 300 m site.

7.3.3 Percent Overstory Density Estimation

- Estimate the percent overstory density at four random locations within the 20 m by 20 m sample plot using a convex spherical crown densiometer according to the following 3 steps. The same person in each crew should make the estimate of overstory density throughout the whole field protocol. Record data on W8.
 - Step 1. Hold the densiometer level (indicated by the round level in the lower left hand corner), and far enough away from your body so that your head is just outside the grid (12 - 18 inches away).
 - Step 2. There are a total of 24 squares on the grid. Count and record the number of squares showing open canopy. Partially filled squares can be added to make a complete square.
Example: 4 completely open squares + 3 half-open squares + 5 quarter-open squares = total of 6.75 open canopy squares.
 - Step 3. Calculate the percent overstory density with the following equation:

$$\% \text{ Overstory density} = 100 - (\text{number of open canopy squares} \times 4.17)$$
 Example: with 10 open squares, the overstory density is 58.3%
- Calculate the average percent overstory density for each plot by summing the four measurements and dividing by four.

7.4 Exiting the Field Study Site

- Remove all flagging and any other material transported to the study site.
- Check all field equipment against the equipment list to ensure that no equipment is inadvertently left at the study site.

7.5 Post-Visit Activities

The following steps should be completed back in the office after the field event.

- Step 1. In a large wash basin, decontaminate field equipment including waders, D-frame nets, and depth gauges. Use non-phosphate detergent and scrub brushes as needed.
- Step 2. Examine any reference material or photographs for taxonomic verification immediately upon returning from the field. Add any additional taxonomic information adjacent to the original labeling of the species on the datasheet (e.g., “Unknown Species 1”) without erasing or crossing out the original information. .
- Step 3. Submit the soil samples to the sample coordinator at the CRL. The sample coordinator will arrange for the soil samples to be analyzed. More detail on the handling of soil samples is provided in the QAPP.
- Step 4. Using the flora and fauna reference lists prepared during the pre-visit activities, complete the Species Categorization fields of datasheets W1-W3.
- Step 5. Complete and/or verify calculations of overstory density on W8 according to instructions given in Section 7.3.3.
- Step 6. Complete the FQA on W7 as follows (equations from Bernthal 2003).
 - Add up and record the total number of native species (N) for each of the sampled areas.
 - Calculate the average coefficient of conservatism (Mean C) for each subplot according to the following equation:
$$\text{Mean C} = \Sigma(c_1 + c_2 + c_3 + \dots c_N)/N$$
where: c is the coefficient of conservatism for each native species (1 through N) identified in the subplot; and
N is the total number of native species inventoried in the subplot.
 - Calculate the FQI for each subplot according to the following equation:

$$\text{FQI} = \text{Mean C} * \sqrt{N}$$

8.0 **Data and Records Management**

Data collected in this project will be made publicly available through an EPA centralized database. Completed datasheets, plant specimens, and soil samples will be kept within the EPA Office of Research and Development according to standard data and record management protocols.

9.0 **Quality Assurance Procedures**

A QAPP is associated with this SOP. It is hereby incorporated into this document by reference. The QAPP should be referred to for details regarding sample handling and quality assurance protocols associated with this field program.

While analytical assessments conducted in the laboratory can be verified in a number of ways, the accuracy of flora, fauna, and human impact assessments in the field cannot be objectively verified with the same degree of precision. Nonetheless, the use of two-person teams will allow each team member to verify the observations and documentation of the other. Photographs taken will provide additional verification of the data collected.

10.0 References

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Table 1: Descriptions of Datasheets

Datasheet #	Datasheet Title	Description of Datasheet Items	Related SOP Section Numbers
W1	Bird Observation Data	Bird species, categorization (e.g., threatened, invasive, numbers observed at observation points)	7.2.3
W2	Aquatic Organism Data	In each sample point area: benthic invertebrate, fish, and larval amphibian species, categorization, and total numbers	7.2.4
W3	Fauna Transect Data for Vertebrates	Table 1: Mammal species, categorization, numbers observed in transects, behaviors observed, identification method (e.g., by tracks or scat). Table 2: For each transect, numbers and characteristics of faunal signs observed. Table 3: Herpetofauna species, categorization, numbers observed in transects, behaviors observed, identification method (e.g., by tracks or scat). Table 4: Bird species, categorization, numbers observed in transects, behaviors observed.	7.2.4
W4	Soil Data	Soil horizon depth, color, and composition, based on one sample from each of the four large subplots	7.2.5
W5	Photo Log	Descriptions of photos taken by the fauna/soil and flora crews	7.2, 7.3
W6	Invasive Species/Human Impacts and Activities	Descriptions/numbers of invasive species and disturbances observed in each transect.	7.2.4
W7	Vegetation Data	For each of the four sample areas: plant species, categorization, Braun-Blanquet cover class, and voucher sample ID numbers	7.3.2
W8	Canopy Cover Estimates and Macrophyte Identification	For each sample point area: canopy cover data and macrophyte sample ID numbers	7.3.3

Table 2. Braun-Blanquet Cover Classes. From *Aims and Methods of Vegetation Ecology*, Mueller-Dombois and Ellenberg, 1974.

Class	Range of Cover (%)	Mean
5	75 - 100	87.5
4	50 - 75	62.5
3	25 - 50	37.5
2	5 - 25	15
1	1 - 5	2.5
t	<1	-

Figure 1. Bird Observation Survey Sampling Scheme. For purposes of this illustration, the study plot corner nearest the access point is assumed to be the northwest (NW) corner; see section 7.2.3 for further explanation.

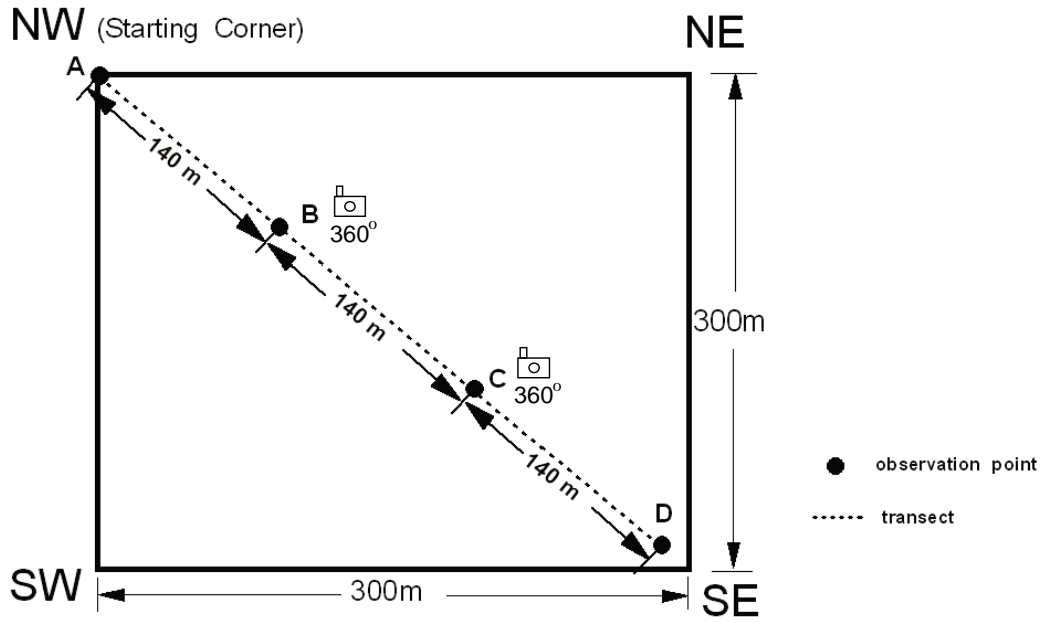
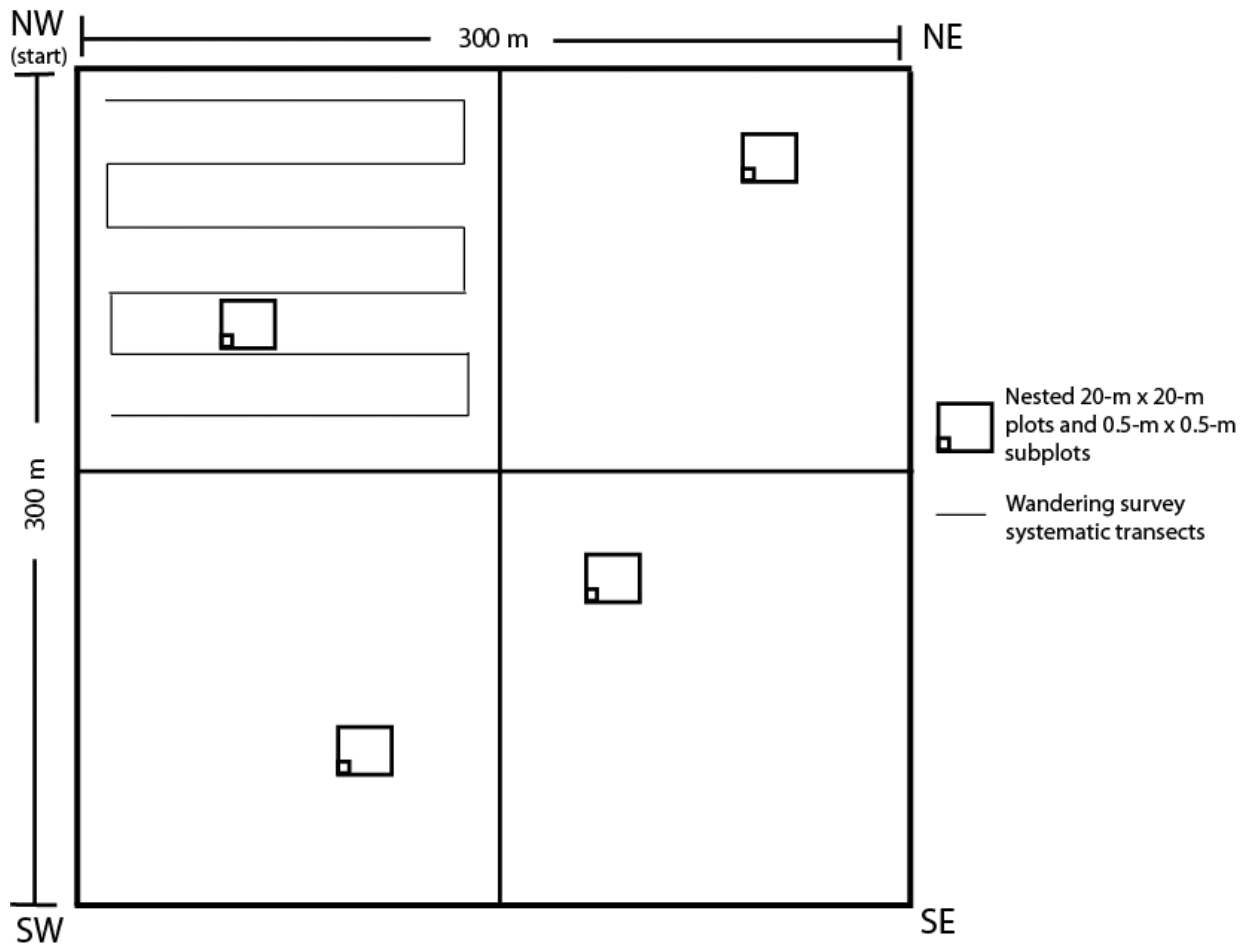


Figure 2. Vegetation and Wandering Survey Sampling Scheme. Scheme follows a stratified random sampling design, with a 0.5-m x 0.5-m subplot nested within a 20-m x 20-m sample plot in each of the four quadrants of the 300-m x 300-m site. Subplots and plots are not drawn to scale.



W3: FAUNA TRANSECT DATA FOR VERTEBRATES

Faunal Signs

Information to be filled in prior to site visit	
Location Name:	Location ID#:
Form Completed By:	Date:
F/S Crew Names:	

Comments:

Faunal Signs	Transect		
	CD	CB	BA
Browse Line	<input type="checkbox"/> Present <input type="checkbox"/> Absent Height _____ cm Associated Fauna: _____ _____	<input type="checkbox"/> Present <input type="checkbox"/> Absent Height _____ cm Associated Fauna: _____ _____	<input type="checkbox"/> Present <input type="checkbox"/> Absent Height _____ cm Associated Fauna: _____ _____
Holes	Diameter _____ cm Diameter _____ cm Diameter _____ cm Diameter _____ cm Associated Fauna: _____ _____	Diameter _____ cm Diameter _____ cm Diameter _____ cm Diameter _____ cm Associated Fauna: _____ _____	Diameter _____ cm Diameter _____ cm Diameter _____ cm Diameter _____ cm Associated Fauna: _____ _____
Nutshells	Total Number _____ Tree Species: _____ _____ Associated Fauna: _____ _____	Total Number _____ Tree Species: _____ _____ Associated Fauna: _____ _____	Total Number _____ Tree Species: _____ _____ Associated Fauna: _____ _____
Tree Rubbing	<input type="checkbox"/> Present <input type="checkbox"/> Absent Associated Fauna: _____ _____	<input type="checkbox"/> Present <input type="checkbox"/> Absent Associated Fauna: _____ _____	<input type="checkbox"/> Present <input type="checkbox"/> Absent Associated Fauna: _____ _____
Other: (describe/enumerate)	Notes: _____ _____ Associated Fauna: _____ _____	Notes: _____ _____ Associated Fauna: _____ _____	Notes: _____ _____ Associated Fauna: _____ _____

W3: FAUNA TRANSECT DATA FOR VERTEBRATES

Mammals

Information to be filled in prior to site visit	
Location Name:	Location ID#:
Form Completed By:	Date:
F/S Crew Names:	

Comments:									
Mammal Species	Species Characterization					Numbers Observed			
	Native (Yes/No)	Invasive (Yes/No)	Regionally Common or Rare (C/R)	T&E Status*		Transect			Other
						CD	CB	BA	
					Individuals				
					Scats				
					Tracks				
					Mounds				
					Other				
					Individuals				
					Scats				
					Tracks				
					Mounds				
					Other				
					Individuals				
					Scats				
					Tracks				
					Mounds				
					Other				
					Individuals				
					Scats				
					Tracks				
					Mounds				
					Other				
					Individuals				
					Scats				
					Tracks				
					Mounds				
					Other				

*T&E Status Codes: FT= Federal Threatened; FE= Federal Endangered; ST=State Threatened; SE=State Endangered; list others as needed.

W3: FAUNA TRANSECT DATA FOR VERTEBRATES

Herpetofauna

Information to be filled in prior to site visit	
Location Name:	Location ID#:
Form Completed By:	Date:
F/S Crew Names:	

Comments:									
Herpetofauna Species	Species Characterization					Numbers Observed			
	Native (Yes/No)	Invasive (Yes/No)	Regionally Common or Rare (C/R)	T&E Status*		Transect			Other
						CD	CB	BA	
					Individuals				
					Scats				
					Tracks				
					Skins				
					Individuals				
					Scats				
					Tracks				
					Skins				
					Individuals				
					Scats				
					Tracks				
					Skins				
					Individuals				
					Scats				
					Tracks				
					Skins				
					Individuals				
					Scats				
					Tracks				
					Skins				

*T&E Status Codes: FT= Federal Threatened; FE= Federal Endangered; ST=State Threatened; SE=State Endangered; list others as needed.

W4: SOIL DATA

Page 1 of 2

Location	
Site ID#	Starting UTM
Investigators	
Form Completed By	Date
Comments	

Soil Horizon	Sample point 1	Sample point 2	Sample point 3	Sample point 4
O	Depth range from surface (cm)			
A	Depth range from surface (cm)			
	Color (from Munsell chart)			
	Hue_____	Hue_____	Hue_____	Hue_____
	Value_____	Value_____	Value_____	Value_____
	Chroma_____	Chroma_____	Chroma_____	Chroma_____
Composition				
<input type="checkbox"/> Sand	<input type="checkbox"/> Sand	<input type="checkbox"/> Sand	<input type="checkbox"/> Sand	<input type="checkbox"/> Sand
<input type="checkbox"/> Loam	<input type="checkbox"/> Loam	<input type="checkbox"/> Loam	<input type="checkbox"/> Loam	<input type="checkbox"/> Loam
<input type="checkbox"/> Clay	<input type="checkbox"/> Clay	<input type="checkbox"/> Clay	<input type="checkbox"/> Clay	<input type="checkbox"/> Clay
Redoxomorphic Features (if any, describe color and size)				
Sample ID # (if applicable)				
E	Depth range from surface (cm)			
	Color (from Munsell chart)			
	Hue_____	Hue_____	Hue_____	Hue_____
	Value_____	Value_____	Value_____	Value_____
	Chroma_____	Chroma_____	Chroma_____	Chroma_____
Composition				
<input type="checkbox"/> Sand	<input type="checkbox"/> Sand	<input type="checkbox"/> Sand	<input type="checkbox"/> Sand	<input type="checkbox"/> Sand
<input type="checkbox"/> Loam	<input type="checkbox"/> Loam	<input type="checkbox"/> Loam	<input type="checkbox"/> Loam	<input type="checkbox"/> Loam
<input type="checkbox"/> Clay	<input type="checkbox"/> Clay	<input type="checkbox"/> Clay	<input type="checkbox"/> Clay	<input type="checkbox"/> Clay
Redoxomorphic Features (if any, describe color and size)				
Sample ID # (if applicable)				
B	Depth range from surface (cm)			
	Color (from Munsell chart)			
	Hue_____	Hue_____	Hue_____	Hue_____
	Value_____	Value_____	Value_____	Value_____
	Chroma_____	Chroma_____	Chroma_____	Chroma_____
Composition				
<input type="checkbox"/> Sand	<input type="checkbox"/> Sand	<input type="checkbox"/> Sand	<input type="checkbox"/> Sand	<input type="checkbox"/> Sand
<input type="checkbox"/> Loam	<input type="checkbox"/> Loam	<input type="checkbox"/> Loam	<input type="checkbox"/> Loam	<input type="checkbox"/> Loam
<input type="checkbox"/> Clay	<input type="checkbox"/> Clay	<input type="checkbox"/> Clay	<input type="checkbox"/> Clay	<input type="checkbox"/> Clay
Redoxomorphic Features (if any, describe color and size)				
Sample ID # (if applicable)				

W4: SOIL DATA

Page 2 of 2

Location	
Site ID#	Starting UTM
Investigators	
Form Completed By	Date
Comments	

Soil Horizon	Sample point 1	Sample point 2	Sample point 3	Sample point 4
Color (from Munsell chart)	Hue_____	Hue_____	Hue_____	Hue_____
	Value_____	Value_____	Value_____	Value_____
	Chroma_____	Chroma_____	Chroma_____	Chroma_____
Composition	<input type="checkbox"/> Sand	<input type="checkbox"/> Sand	<input type="checkbox"/> Sand	<input type="checkbox"/> Sand
	<input type="checkbox"/> Loam	<input type="checkbox"/> Loam	<input type="checkbox"/> Loam	<input type="checkbox"/> Loam
	<input type="checkbox"/> Clay	<input type="checkbox"/> Clay	<input type="checkbox"/> Clay	<input type="checkbox"/> Clay
Redoxomorphic Features (if any, describe color and size)				
Sample ID # (if applicable)				
Depth (m) reached by soil probe*				
Comments				

Note: See Section 7.3.2.3 for soil characterization procedures.

W6: INVASIVE SPECIES/HUMAN IMPACTS AND ACTIVITIES

Page ___ of ___

Location		
Site ID#	UTM-E	UTM-N
Investigators		
Form Completed By	Date	
Comments		

Table 2. Disturbance and Human Management Practices in the Designated Land Cover Type

Map ID Number(s)*	Disturbance Indicator*	Description*	Total Number of Times Encountered	Photo Taken? (Y/N)*
	Paths			
	Car/Vehicle Tracks			
	Off-road vehicle tracks not on well-worn paths			
	Loud noise			
	Bright, artificial lights			
	Evidence of human management practices			
	Trash (appliances/tires)			
	Litter (paper/plastic scraps)			
	Hydrologic modifications (e.g., ditch, weir)			
	Evidence of mowing, tree felling			
	Oily or Soapy Surface Water			
	Other*			

*Notes: Use as many sheets as necessary.
 Map ID numbers should be assigned D1, D2, etc. Use these numbers to identify disturbances drawn on the plot sketch.
 Other disturbance indicators are included in Section 3.0.
 Descriptions of disturbance indicators should include more detailed information about the disturbance, how frequently it was encountered in the plot, and if appropriate, the size of the affected area.
 List any photos taken in the photo log; include the Map ID number in the Subject field of the photo log.

W6: INVASIVE SPECIES/HUMAN IMPACTS AND ACTIVITIES

Page ___ of ___

Location		
Site ID#	UTM-E	UTM-N
Investigators		
Form Completed By	Date	
Comments		

Table 4. Description of other special features in plot.

Feature	Description
Visual variation in vegetation occurring in the plot	
Streams and riparian zones Water sample(s) collected? <input type="checkbox"/> Y <input type="checkbox"/> N How many? _____ (list sample ID numbers in space at right)	
Other surface water Water sample(s) collected? <input type="checkbox"/> Y <input type="checkbox"/> N How many? _____ (list sample ID numbers in space at right)	
Fauna/Fauna remains (list species if known)	

W6: INVASIVE SPECIES/HUMAN IMPACTS AND ACTIVITIES

Page ___ of ___

Location		
Site ID#	UTM-E	UTM-N
Investigators		
Form Completed By	Date	
Comments		

Figure 1. Sketch delineating areas of human disturbance, land cover types, surface water bodies, and other features in plot.

W7: VEGETATION DATA

Page ___ of ___

Location	Site ID#	Starting UTM
Investigators	Date/Time	Form Completed By
Comments		

Plant Species*	Species Categorization*				Braun-Blanquet Cover Class*								
	Native/ invasive	T&E Status	General- ist/ Special- ist	Comm on/ Rare	UTM E: UTM N:		UTM E: UTM N:		UTM E: UTM N:		UTM E: UTM N:		
					point 1 small	point 1 total	point 2 small	point 2 total	point 3 small	point 3 total	point 4 small	point 4 total	

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*Notes: List each species (or lowest practical taxa) on a separate line. Use as many sheets as necessary.
 Species Categorization: For Native/Invasive field, record N if species is native or I if species is invasive or introduced.
 For Generalist/Specialist field, record G if species is a generalist or S if species is a specialist.
 For Common/Rare field, record C if species is regionally common or R if species is regionally rare.
 T&E Status Codes: FT= Federal Threatened; FE= Federal Engangered; ST= State Threatened; SE= State Endangered; list others here as needed.

For Braun-Blanquet Cover Class, record as t (for <1% cover), 1 (for 1 - 5% cover), 2 (for 5 - 25% cover), 3 (for 25 - 50% cover), 4 (for 50 - 75% cover) or 5 (for 75 - 100% cover). See Forested and Emergent Wetland SOP, Section 7.3.2 and Table 2, for more information.

W8: CANOPY COVER ESTIMATES AND MACROPHYTE IDENTIFICATION

Page 1 of 1

Location	
Site ID#	Starting UTM
Investigators	
Form Completed By	Date
Comments	

Sample point area	Canopy Cover*			Macrophyte ID and Comments
	location	Overstory Density (%)	Subplot Average (%)	
1	1			
	2			
	3			
	4			
2	1			
	2			
	3			
	4			
3	1			
	2			
	3			
	4			
4	1			
	2			
	3			
	4			

*Notes: See Section 7.3.3 for canopy cover estimation procedures.

