FIELD OPERATIONS JOB INSTRUCTION TRAINING PLAN

PREPARED BY	ORGANIZATION	DATE
B Kao- Protocol Training	FSU	03/31/2011
K Ruiz – Corporate Training	OPS	03/31/2011
T-Lucera	EHS	03/31/2011
Liz Knapp	EDU	01/05/2016

APPROVALS	ORGANIZATION	APPROVAL DATE
Kirsten Ruiz	OPS	11/30/2016
Mike Stewart	PSE	12/11/2016

RELEASED BY	ORGANIZATION	RELEASE DATE
Judy Salazar	CM	12/12/2016

See configuration management system for approval history.

The National Ecological Observatory Network is a project solely funded by the National Science Foundation and managed under cooperative agreement by Battelle. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Change Record

REVISION	DATE	ECO #	DESCRIPTION OF CHANGE
-	3/31/2011	ECO-00174	INITIAL DRAFT RELEASE
A_DRAFT	10/06/2014	ECO-00284	Update to new document numbers/template throughout document.
B_DRAFT	6/30/2014	ECO-01821	Complete revision of training program: content, materials, lesson plans.
C	01/05/2016	ECO-03642	Revised to reflect current training program including trainer certification. Protocol-specific learning objectives removed.

TABLE OF CONTENTS

1 DESCRIPTION

1.1 Purpose

The primary purpose of this document is to describe the process used to design, develop, and deliver training for Field Operations personnel responsible for biological sampling as defined for the Terrestrial Observation System (TOS) and Aquatic Observation Systems (AOS) and instrument maintenance as required for the Terrestrial Instrument System (TIS) and Aquatic Instrument System (AIS).

1.2 Scope

This Job Instruction Training Plan addresses the need for training temporary field technicians (TFTs) and regular technicians on protocols and procedures (RD[03]-RD[49]) associated with the AIS, AOS, TIS, and TOS subsystems. Training is provided to ensure that procedures are consistently implemented across NEON domains. Corporate and safety training programs are not covered in this document. In addition, the training program for compliance with requirements of NEON's Institutional Animal Care and Use Committee (IACUC) is provided in the NEON Animal Care and Use Program: Training Plan for Personnel Working with Live Vertebrate Animals (RD[50]).

Target Audience

TFTs have a background in ecology or a related field, have conducted field and/or laboratory work, and have a minimum of a high school diploma (or equivalent). Though not required, many lead TFTs have a Master's degree. There are up to 25 TFTs at each domain. One or two may assist with AOS sampling. The remaining TFTs are dedicated to implementing TOS protocols. When the Observatory is in full operation (in October 2017), approximately 500 TFTs will need training each year. Of these, about one third are expected to be returning staff.

Regular Field Technicians (regular technicians) are the target audience for annual refresher training and initial training of new hires. Regular technicians are fulltime employees with a background in ecology or related field and have conducted field and/or laboratory work, have a bachelor's degree or higher, and have some field leadership experience. Each domain has up to six technicians that fall into this category. Areas of expertise align with one or more of NEON's sampling foci, such as botany, small mammals, aquatic ecology/hydrology, or ecological instrumentation. NEON anticipates retention of regular technicians will be three to five years. The training program addresses the need to train new hires as well as to provide refresher training on an annual basis. Each year, approximately 100 regular field technicians will participate in refresher training.

The target audience and type and frequency of training are summarized in the table below.

Table 1 Summary of Training Needs and Frequency for Field Operations Personnel

Target Audience	Initial Training Frequency	Recertification/Refresher
Temporary Field Technicians (new hires)	Annually (new hires)	Annually (re-hires)
Regular Field Technician	Occasionally (new hire)	Annually (all)

Assumptions

The job instruction program described in this document will be fully implemented in January 2018, when NEON transitions from construction into operations. The program is based on the following assumptions:

- By January 2018, each domain is fully staffed with regular field technicians and a domain manager capable of providing training and assessing trainees for all AIS, AOS, TIS, and TOS subsystems.
- Protocols and procedures for NEON subsystems that are needed for developing training materials are available.
- Training will be developed and delivered primarily by NEON personnel.
- Curriculum and associated materials will be developed by NEON with select components contracted to outside entities when internal resources are not available.
- Training will occur primarily at the Domain Support Facility.
- A field site (or an equivalent outdoor area) is available for training.
- Each domain's support facility is fully equipped and operational at the time of training.
- Teaching and reference collections are available.
- Site-specific field guides are available and, as needed, developed by each domain.

2 RELATED DOCUMENTS AND ACRONYMS

2.1 Applicable Documents

Applicable documents contain information that shall be applied in the current document. Examples are higher level requirements documents, standards, rules and regulations.

AD[01]	NEON.DOC.004316	Operations Field Safety and Security Plan
AD[02]	NEON.DOC.000724	Chemical Hygiene Plan and Biosafety Manual Template
AD[03]	NEON.DOC.004300	NEON EHSS Policy, Program and Management Plan

2.2 Reference Documents

Reference documents contain information complementing, explaining, detailing, or otherwise supporting the information included in the current document.

RD[01]	NEON.DOC.000008	NEON Acronym List
RD[02]	NEON.DOC.000243	NEON Glossary of Terms
RD[03]	NEON.DOC.014050	Ground Beetle Sampling
RD[04]	NEON.DOC.001152	NEON Aquatic Sampling Strategy
RD[05]	NEON.DOC.001024	Canopy Foliage Chemistry and Leaf Mass Per Area
RD[06]	NEON.DOC.014045	Tick and Tick-Borne Pathogen Sampling
RD[07]	NEON.DOC.001717	TruPulse Rangefinder Use and Calibration
RD[08]	NEON.DOC.014049	Mosquito Sampling
RD[09]	NEON.DOC.014042	Plant Diversity
RD[10]	NEON.DOC.014040	Plant Phenology
RD[11]	NEON.DOC.014038	Core Sampling for Plant Belowground Biomass
RD[12]	NEON.DOC.001711	Coarse Downed Wood
RD[13]	NEON.DOC.001710	Litterfall and Fine Woody Debris
RD[14]	NEON.DOC.001709	Bryophyte Productivity
RD[15]	NEON.DOC.014037	Measurement of Herbaceous Biomass
RD[16]	NEON.DOC.014039	Measurement of Leaf Area Index
RD[17]	NEON.DOC.000987	Measurement of Vegetation Structure
RD[18]	NEON.DOC.001025	Plot Establishment
RD[19]	NEON.DOC.000481	Small Mammal Sampling
RD[20]	NEON.DOC.014048	Soil Physical, Chemical, and Microbial Measurements
RD[21]	NEON.DOC.001714	Aboveground Productivity for Agricultural Crops
RD[22]	NEON.DOC.002984	Minimizing Site Disturbance during TOS Sampling
RD[23]	NEON.DOC.001715	Cactus Biomass and Handling
	NEON.DOC.001716	Toxicodendron Biomass and Handling
	NEON.DOC.001271	Manual Data Transcription
	NEON.DOC.001025	Plot Establishment
	NEON.DOC.001718	DSLR Camera Use and Settings
	NEON.DOC.014044	Rodent-borne Pathogen Sampling
RD[24]	NEON.DOC.003039	Aquatic Plant, Bryophyte, Lichen and Macroalgae Sampling
RD[25]	NEON.DOC.001197	Bathymetry and Morphology of Lakes and Non-Wadeable Streams
RD[26]	NEON.DOC.003162	Wadeable Stream Morphology
RD[27]	NEON.DOC.001296	Fish Sampling in Lakes
RD[28]	NEON.DOC.001295	Fish Sampling in Wadeable Streams
RD[29]	NEON.DOC.003046	Aquatic Macroinvertebrate Sampling
RD[30]	NEON.DOC.003044	Aquatic Microbial Sampling
RD[31]	NEON.DOC.003045	Periphyton, Seston and Phytoplankton Sampling

~~RD[32]~~	~~NEON.DOC.001195~~	~~Riparian Habitat Assessment in Lakes and Non-Wadeable Streams~~
~~RD[33]~~	~~NEON.DOC.001196~~	~~Riparian Habitat Assessment in Wadeable Streams~~
RD[32]	NEON.DOC.003826	Riparian Habitat Assessment
RD[34]	NEON.DOC.001193	Sediment Chemistry in Wadeable Streams
RD[35]	NEON.DOC.001085	Stream Discharge
RD[36]	NEON.DOC.000693	Reaeration in Streams
RD[37]	NEON.DOC.002905	Water Chemistry Sampling in Surface Waters and Groundwaters
RD[38]	NEON.DOC.001886	Stable Isotope Sampling in Surface and Ground Waters
RD[39]	NEON.DOC.001194	Zooplankton Sampling in Lakes
RD[40]	NEON.DOC.001468	TIS Preventive Maintenance Plan
RD[41]	NEON.DOC.001485	TIS Site Maintenance Procedures
RD[42]	NEON.DOC.001486	TIS Sensor Preventive Maintenance Procedures
RD[43]	NEON.DOC.001271	Manual Data Transcription
RD[44]	NEON.DOC.001154	Aquatic Decontamination
RD[45]	NEON.DOC.001199	Surface Water Dissolved Gas Sampling
RD[46]	NEON.DOC.002792	Secchi Disk and Depth Profile Sampling in Lakes and Non Wadeable Streams
RD[47]	NEON.DOC.001191	Sediment Chemistry Sampling in Lakes and Non-Wadeable Streams
RD[48]	NEON.DOC.XXXXXX written	Maintenance documents for each TIS Sensor – to be
RD[49]	NEON.DOC.XXXXXX written	Maintenance procedures for each AIS system – to be
RD[50]	NEON.DOC 002979	Training Plan for Personnel Working with Live Vertebrates
RD[51]	NEON.DOC.014051	NEON FSU Field and Laboratory Procedures Quality Assurance Plan

2.3 Acronyms

See RD[01] for acronyms not defined here.

Acronym	Definition
OJT	On-the-Job Training
SIV	Systems Integration and Verification
TFT	Temporary Field Technician

3 TRAINING MATERIALS

Implementation of the training plan requires the development and use of a curriculum for each NEON subsystem. Example curricular materials are in Appendix A. The curriculum includes lesson plans that provide trainers with a framework for effective delivery of training. Each lesson plan provides a roadmap

for integrating the different training components so that content and activities flow smoothly and there is cohesiveness to the entire training. Each lesson plan includes the following sections:

Objectives: This section provides a clear statement of what students will know/be able to do after completion of training. Objectives are developed from written procedures and discussions with the NEON Science staff and experienced Field Operations personnel. Objectives will be performance-based focusing on what students are able to do after they have completed training. Objectives range from knowing how to operate a piece of equipment, to identifying a plant, to being able to problem solve a complex scenario.

Time Required: This section lists the amount of time required for delivering training. This is broken down by component (e.g. instructor-led classroom presentation, field practicum, and laboratory practicum).

Protocol-Specific Terminology: This section lists terms that students must know in order to understand and implement a protocol. These are simply listed here as a reminder to trainers of terms that may be unfamiliar to students. Definitions are provided in the training materials in the context of learning a particular protocol or procedure.

Handouts: Printed training aids and resources for students used for activities or exercises during training are provided in this section. Examples of handouts are flow charts, tables, worksheets, or drawings.

Materials: This section contains a table of materials needed for implementing training. It includes the name and location of digital resources (for example, recorded talks, videos, PowerPoint presentations, tutorials, etc.); relevant documents such as protocols and datasheets (with NEON document numbers) and training manuals; and equipment or specimens needed for demonstrations or hands-on practice. The list only includes protocol/procedural specific materials: the general equipment needed for training, such as a projector, white board, internet connection etc., is provided in a curriculum guide for trainers.

Preparation: This section indicates what the trainer needs to do before training and provides a timeframe for completion of these tasks. Some preparation is as simple as making copies of handouts, quizzes, protocols, or datasheets. Other preparation might be more complex and time consuming, such as inserting domain-specific content into presentations, or setting up troubleshooting scenarios in the field or on a tower, or collecting and drying plant specimens for a lab activity.

Lesson Development: This section provides guidance on how to progress through a lesson. It describes the sequence of events (including when and how to use teaching materials), teaching strategies (such as implementing guided and independent practice), commonly asked questions, and real-world scenarios to present to students to deepen and challenge understanding. This section is also a place where particularly difficult aspects of a protocol, common procedural

pitfalls, or complex concepts are mentioned with suggestions to trainers on how to help students understand these topics. Guidance is also provided on how to organize a group and set up training so that all students have the opportunity to learn and actively participate in training.

Quiz/Assessment Checklist: Quizzes (and an answer sheet) for use after classroom presentations are included in this section. Some quizzes may be given online, however, a hardcopy will be provided in the lesson plan. There are checklists for the trainer to use when observing and assessing student performance during the field, lab, and on-the-job training (OJT) components. Students will be given timely feedback so that deficiencies can be addressed.

While each lesson plan has the same structure, there are organizational differences between subsystems, as summarized in Table 2. For TOS, there is one lesson plan for each protocol. AOS lesson plans are grouped thematically by physical, chemical and biological measurements. The organization of lesson plans for TIS and AIS are based on the training format. With one lesson plan focusing on the OJT component of training, another on classroom/instructor led content, and a third covering use of the self-guided modules and resources. Finally there are lesson plans that cover content applicable to multiple subsystems.

Table 2. Organization of Lesson Plans by NEON Subsystem

Subsystem	Lesson Plans (#)
TOS	One per protocol (16)
AOS	Physical Components (4) Chemical Components (2) Biological Components (6)
TIS	On-the-Job Training (1) Self-Guided Study (1)
AIS	On-the-Job Training (1) Self-Guided Study (1)
Multi-subsystem or Non-Protocol Training	Field Basics (1) Research and Field Ethics (1) Leadership (1) Problem Tickets (1) Maximo (1) Decontamination/Cross-Contamination (1) Data Entry (1)

3.1 Roles and Responsibilities for Developing Training Materials

Development of the training materials is a collaborative effort. The curriculum designer is responsible for coordinating the design and development of the training curriculum including instructional design, content, evaluation, and implementation. Content for training materials is based on written procedures

developed by Science and Engineering team members. Personnel from these groups also serve as subject matter experts and review all training materials for accuracy and completeness.

Recognizing that Field Operations personnel have the greatest amount of hands-on experience actually implementing NEON protocols and procedures, their input into development of training materials is critical. Field Operations personnel provide structured feedback through evaluation forms, problem tickets, and direct communication with the curriculum designer. FOPS personnel are also responsible for incorporating domain-specific content into AOS and TOS materials, such as images or site-specific situations and challenges. The lesson plans indicate where site-specific information should be inserted. NEON Science is responsible for providing a final review of training materials. For instrumented system training materials, field technicians work with the curriculum designer so that their expertise in installing, calibrating, maintaining, and troubleshooting sensors and the infrastructure are incorporated into training materials.

Additional support in developing training materials will also be needed from Field Operations and NEON Science for specimen acquisition, material selection, and video production.

Other personnel required for development and delivery of training materials include:

- Interactive media specialist to develop templates and graphics for delivery of instructor led and online content, including development of interactive elements, animations, and e-learning modules.
- Web developer to provide programming support for a learning management system used for distributing training materials and tracking training.
- Videographer to film and edit video segments to incorporate into training materials.

All of these personnel work directly with the curriculum designer to ensure a cohesive and effective training program for Field Operations personnel. A program manager is responsible for ensuring institutional support and resources are available for implementation of the training plan.

3.1.1 Updating Training Materials

Over the life of the Observatory, training materials will require updating. Changes may be small, for example, a modification in a datasheet, or extensive, such as the addition of a new type of sensor to one of the instrumented systems. Changes to training material content will originate at NEON HQ and then be distributed to domains. How the change is actually incorporated into the training materials will depend on the nature of the change, the delivery method, and whether or not the training material contains domain-specific content.

For TOS and AOS protocols, there is an annual review and revision cycle for training materials. During this time, field technicians selected by domain managers and NEON Science provide new and revised content for training materials. The curriculum designer coordinates and reviews all revisions. A final review of updated materials is provided by NEON Science.

Updated TOS and AOS training materials with major changes will require distribution of new presentations, lesson plans, handouts, etc. to each domain. Regular field technicians are then responsible for incorporating domain-specific content as indicated in the lesson plan.

For training materials with minor changes, NEON HQ will provide a list of edits to be made, indicating for example, which slides in a PowerPoint to replace, or where to incorporate new videos, recorded talks, or digital tutorials. Regular technicians are then responsible for incorporating the required changes into the training materials. A checklist will be provided to each domain to guide and document the updating process. This approach (as opposed to distributing all new materials) is used to reduce the workload of regular technicians. Gathering and inserting site specific information (such as images, scenarios, etc.) is time-consuming. To the extent possible, the updating process will avoid the need for domain staff to do this each year.

For TIS and AIS systems, updates to training materials will occur on an annual basis. Addenda to the training materials will be posted on an as-needed basis so new technicians who onboard between revision cycles have correct information.

4 OBSERVATION AND INSTRUMENTATION SYSTEMS

The specific content covered in training varies for each protocol, however there are some general topics that are required for each subsystem.

4.1 AOS and TOS

General content covered for AOS and TOS training includes:

- Preparing for sampling, such as gathering and checking needed equipment and supplies
- Locating sample sites
- Deploying equipment
- Collecting and processing samples/making observations
- Recording metadata, completing datasheets, using mobile data recorders
- Handling and transporting samples
- Processing and storage of samples/data/equipment on sampling day
- Processing samples/data/equipment post-collection in the lab
- Shipping samples to external labs
- Contingency plans
- Common procedural difficulties and pitfalls
- Data entry
- Troubleshooting
- Resources and documentation

4.2 AIS and TIS

General content covered for AIS and TIS training includes:

- Site overview, layout, and access
- Infrastructure maintenance
- Power distribution system
- Data acquisition system
- Sensors: location, purpose, maintenance, replacement, and monitoring
- Tower boom operation and maintenance
- Rigging and hardware
- Resources
- Troubleshooting
- Documentation

5 CURRICULUM

Training will be delivered in several different contexts and may include a combination of classroom presentations, hands-on activities, practice, self-paced study, and on-the-job training.

The guiding principle for training is that in order to learn to properly and competently implement a procedure, students need to 1) acquire skills and content knowledge, 2) have a chance to practice, and 3) receive constructive feedback. To achieve this, a variety of delivery methods are used throughout training. In addition, information is presented to accommodate different learning styles.

In-Person Instructor Led Training

Regular field technicians provide in-person training in the classroom, field, and lab. Trainers provide direct instruction on skills, content, and concepts while guiding students through facilitated discussions and collaborative exercises that require use and synthesis of information. The in-person interactions allow trainers to incorporate site-specific information. This is particularly important for training NEON technicians, as sites span multiple eco-climatic systems and each has unique challenges. In addition, the local knowledge and experience of the trainer in implementing procedures is critical for helping students develop job competency and decision-making skills. In-person presentations also allow the trainer to foster teamwork among the students, get a sense of student understanding, and easily address questions as they arise.

Self-Guided Learning

Independent, self-paced learning modules allow for instructional scaffolding such that students can quickly move through content they know and focus their time on filling in the gaps in their skills, conceptual understanding, and content knowledge. The self-guided learning can provide background information required prior to subsequent group training as well as opportunities to

delve into more complex problem-solving situations as a follow-up to completion of other training components. Independent learning materials can be easily referred to multiple times, making them useful for refresher training.

On-the-Job Training

On-the-job training (OJT) provides guided instruction to help students develop familiarity and proficiency while implementing a protocol/procedure during a sampling bout or maintenance round. It is in this real world environment where students are able to put all the pieces together, manipulate equipment/collect samples, and encounter (and problem solve) the difficulties that inevitably arise during field work.

During OJT, students will be accompanied by a fully trained regular field technician or a returning lead TFT or the domain manager who will guide, observe, and assess performance. Because OJT occurs over the entire sampling bout (or maintenance round), it provides an opportunity for technicians to demonstrate improvement of techniques. At the completion of OJT, the trainer will use qualitative and quantitative assessments to determine if the student is ready for independent sampling or if additional training or supervision is needed.

5.1 Delivery Methods

A variety of methods are available for delivery of in-person classroom presentations and self-guided learning. While each is listed separately below, during training, many of these components will be blended together. For example, an instructor-led presentation can contain short videos.

PowerPoint Presentations

PowerPoint presentations provide the structure for instructor-led presentations. In addition to visually displaying information and major points, they also include prompts within the slides and slide notes to guide the trainer through content and best practices for effective teaching. Prompts include discussion topics, workflow, and decision-making information; these are to emphasize particular aspects of a procedure that are challenging, questions to ask, when/how to demonstrate a procedure or use a handout, and challenge activities. The slides include interactive exercises that give students a chance to practice a concept and also provide the instructor with immediate feedback on student understanding. Exercises include scenarios that require students to use tables, protocols, decision-trees, images, artifacts, or datasheets. All require students to be active participants through sharing and discussion.

PowerPoint presentations also provide an easy way for each trainer to insert site-specific content. There are specific locations in presentations where trainers are instructed to do this. For example, in the plant phenology presentation, the trainer replaces examples of different phenological phases with images of plant species that are monitored at a particular site. Similarly, in aquatic training materials, trainers can insert images of site-specific sampling locations into presentations.

Controlled Documents: Learning objectives are developed from written documents (procedures and protocols) that are part of NEON's document control management system. These written materials are an essential component of job instruction. Trainees must read protocol(s) for the taxa/media/instruments to which they are assigned. The protocols will be used throughout training, particularly for problem-based learning exercises to ensure that trainees are able to effectively use the protocols.

Digital tutorials: Digital tutorials may be used for self-directed study providing background information, demonstrations of complex procedures, and exercises requiring decision making and problem solving. Interactive elements can also enable students to practice procedures. Embedded assessments may be incorporated into digital tutorials, providing students with immediate feedback on understanding. The digital platform allows for easy layering of information and exercises. For example, if a student has difficulty with a particular exercise, the needed information to fill the content gap can be immediately accessed, whereas students who successfully complete an exercise, can move on to the next level of complexity or topic. Digital materials, though typically time consuming and expensive to produce, are a resource that can be used independently multiple times and are also a good tool for refresher training. A relatively inexpensive way to initially develop self-guided digital materials is to use PowerPoint.

Short instructional videos: These short videos (1-2 minutes) show particular aspects of a protocol, for example, assembling equipment, handling samples, servicing a trap, collecting soil, or pressing a plant. They are used in conjunction with classroom training but can also be a reference resource for refresher training.

Long instructional videos: Longer videos (10 -15 minutes) can provide a comprehensive overview of an entire protocol or delve into the details of particularly complex procedures and common errors. Videos provide context and a visualization that makes the written documents more accessible to students. Seeing someone actually using equipment or manipulating fauna provides how-to and workflow details that are difficult to capture in text. These videos may be segmented, so that a trainer can pause the video at a logical spot to demonstrate a technique, answer questions, or to discuss a concept or procedure.

Recorded lectures: Recorded lectures presented by Observatory scientists provide an overview of NEON goals and objectives and explain how the field sampling program addresses ecology's Grand Challenges. Protocol-, subsystem-, or module-specific presentations can provide background on reasons for targeting a specific taxon/medium, explain why it is important, and provide an example of how the collected data have been or might be used in the future. These presentations are incorporated into classroom training but can also be viewed independently.

Training manuals: These manuals provide instruction on content that requires a significant amount of study time, organization, or detailed steps to master. Examples include identifying ground beetles or small mammal species, or determining whether a forked particle of a downed tree should be tallied. Manuals may also include the examination of specimens, either included with the manual or collected at

the domain by the trainer, for students to use. Manuals are also used to provide structure to a task that integrates multiple procedures. For example, the annual sensor refresh training manual encompasses tasks that begin weeks ahead of the actual replacement of sensors and ends with sensors being shipped back to HQ.

Hands-on classroom and lab demonstrations, exercises, and activities: Familiarity and comfort with equipment is best accomplished by actually working with the equipment and providing opportunities to use new skills. Classroom presentations include using field and lab equipment, working with specimens and/or samples, and operating laboratory equipment.

Field practicum: A series of outdoor stations and/or teaching plots provide an opportunity for practicing a protocol, discovering common pitfalls and sources of errors, and assessing how to deal with them. Training materials include specific suggestions on how to implement the practicum, including set up, scenarios that require troubleshooting, questions to stretch/challenge student understanding, and opportunities to hone decision-making skills. During the practicum, the role of the trainer is to guide and observe, allowing technicians to discover some of the difficulties in the sample collection process or maintenance procedures, and to discuss solutions. The trainer provides feedback as needed and offers workflow suggestions.

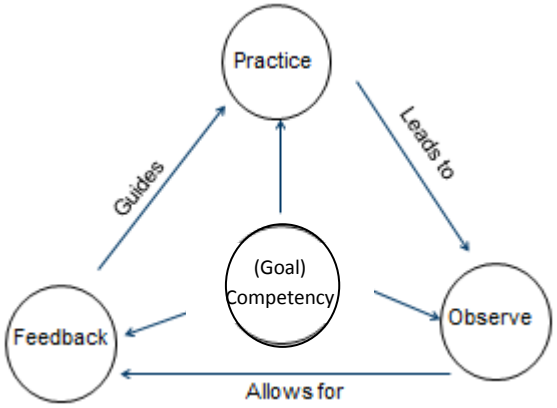
Laboratory practicum: For procedures that have laboratory components, hands-on training in the laboratory will be provided**.** For instrumented systems, this might include training materials that revolve around remote monitoring of AIS or TIS or equipment maintenance. For the practicum, the trainer needs to set up the lab or situations ahead of time, perhaps with partially processed samples, stations for different activities, etc. The trainer assesses student competency through observation and questions. A checklist is used to document student strengths and weaknesses and immediate feedback is provided so that students have the opportunity to remediate deficiencies.

Roundtable discussions: Using a distance learning platform, asynchronous and real time discussions with NEON staff scientists provide an opportunity for trainers and technicians to interact, ask questions, and discuss procedures/problems. To the extent possible, sessions will be scheduled with multiple domains at the same time.

Problem tickets and FAQ documents: NEON uses a problem reporting system for domain and HQ staff to discuss and resolve issues that inevitably arise when sampling and/or servicing instrumented systems. The problem reporting system is searchable and has a tagging system that enables easy retrieval of information. As part of training, domain personnel will review protocol-specific problem tickets. In addition, for some procedures, FAQ documents will be used to help students become familiar with solutions to common challenging situations. FAQ documents are also useful for refresher training. The reporting system will also be used to track issues related to the training materials.

6 ASSESSMENT

Assessments are designed to provide students with a chance to apply knowledge. They are a learning opportunity built around the model that obtaining competency stems from practice and targeted feedback and is based on observation. This then guides what additional skills, knowledge, or content needs to be learned and/or practiced. This is an ongoing process (as shown in the image below) that continues beyond the formal training program.



Assessments will be integrated into various components of the training program with the goal of providing immediate feedback on areas of strength and weakness and providing qualitative and quantitative data. Evaluations will use a combination of traditional assessments, which focus on content knowledge, and authentic assessments, which require students to apply their knowledge. For example, to answer a quiz question, students might refer to the protocol, interpret images, or troubleshoot a situation. Quizzes are designed to be a learning opportunity, not to simply have students spew back memorized information. After completing the quiz, students and trainers discuss the answers. The quizzes are self-graded and students may keep the hardcopy quizzes as a reference.

Student readiness will be based on performance during hands-on exercises, written and/or oral quizzes, and observations in the field and laboratory during the first sampling period and early maintenance bouts. Trainers will use checklists during field, lab, and OJT components of training to ensure that critical aspects of a protocol are evaluated and that performance is documented. Assessment results will be used to determine if additional training is required. Where additional training is required, technicians will receive clear recommendations for improvement from trainers.

Assessment continues beyond the initial training. Lesson plans provide guidance on how and when to conduct regular check-ins with the sampling crew. These include technicians identifying problem areas themselves during the first few sampling bouts. For procedures that are done throughout the year by

full-time technicians, such as preventative maintenance on instrumented systems, an annual survey can be used to identify areas in which technicians would like additional training. In this manner, refresher/recertification training can be targeted.

Each domain is responsible for documenting and recording completion of training and certifying the readiness of technicians to independently implement field activities.

7 TRAINER CERTIFICATION PROGRAM

The training plan relies on the ability of regular field technicians to deliver high-quality and accurate training to temporary employees and new hires. To develop a cadre of effective trainers, a train-the-trainer model is used.

A brief description of the train-the-trainer program implemented during construction is required in order to fully understand the competency of NEON's domain-based trainers. The development of trainers was a multi-year process, timed to meet the requirements of each domain's transition to initial Operations. The models for developing trainers for TOS, AOS, and the instrumented systems (AIS and TIS) have been slightly different, and are therefore described separately.

Initial Development of TOS Trainers

Development of TOS trainers began with the initial training of technicians from three domains by NEON Science in 2013. The following field season (2014), these technicians participated in a train-the-trainer workshop developed and delivered by NEON HQ staff (see below). The technicians who participated in this workshop, then provided training to fulltime technicians from six domains at a gathering in Florida. The newly trained "Florida trainers" then trained TFTs at their domains using the same curriculum used for their own training. The following year (2015), there was another round of trainer training, this time with technicians from five domains participating in the train-the-trainer workshop. These trainers then provided training to fulltime technicians from seven other domains at a gathering in Alabama also in 2015. The "Alabama trainers" (and trainers from previous years) then provided training to TFTs at their domains using the same curriculum. Another round of train-the-trainer was held in preparation for the 2016 field season. In preparation for the 2017 field season, a gather of all TFTs is planned, after which, every domain will have qualified trainers.

Initial Development of AOS Trainers

Initially, NEON Science staff trained aquatic technicians on implementing protocols. Several domain technicians attended multiple training sessions and then led portions of the training under the guidance of NEON Science and using the curriculum used for their own training. These technicians then participated in a train-the-trainer workshop, receiving support from NEON HQ on using the curriculum and from NEON Science on content. The technicians were certified by NEON Science to then provide training at domains to aquatic technicians.

Initial Development of AIS and TIS Trainers

During construction, instrument technicians are trained by embedding with Systems Integration and Verification (SIV) during initial installation of sensors at their domain. These technicians are then responsible for training new instrument technicians using checklists and self-guided materials used for their own training. Prior to training new technicians, trainers participate in a train-the-trainer workshop.

Train-the-Trainer Workshop and Annual Trainer Preparation

Trainers participate in a train-the-trainer/curriculum workshop prior to delivering training. The purpose of this workshop is to ensure that each trainer is 1) able to locate and effectively use the training curriculum and 2) knowledgeable, skilled, and up-to-date on protocols and procedures.

During the workshop, participants will learn how to use the Curriculum Guide and lesson plans to prepare, organize, and deliver domain-based training. The Curriculum Guide provides each trainer with guidance on structuring training and includes a comprehensive list of all training materials, a suggested order of presentation, how to facilitate engaged learning, how to handle questions, and a review of best practices. During the workshop, trainers work with the lesson plans, which provide the structure for each training session, as described earlier in this document. The workshop also includes an introduction/review of best practices for adult learners, an exploration of different learning styles, example lessons, and practice time.

Using NEON's videoconferencing system, trainers have the opportunity to give practice presentations and receive feedback from NEON Science, the curriculum designer, and/or colleagues at other domains. In this manner trainers receive feedback on effective use of the training materials and on content. These presentations also provide structured time for trainers to practice and prepare for training. Trainers can work on presentation skills, receive guidance on how to ask questions that stretch/challenge student understanding, and instruction on how to create opportunities that help students hone decision-making skills. Trainers can also receive guidance on how to guide and observe students during practicums and OJT so that students can discover difficulties in procedures and problem-solve and discuss solutions. During these sessions, trainers can also practice techniques for providing constructive feedback and guidance.

Preparing for training also necessitates verifying that trainer content knowledge is up-to-date. For subsystems with an annual review cycle (AOS and TOS), there will be pre-season seminars with FOPs and NEON Science. These remote meetings provide a forum for discussing updates to protocols (what they are and the scientific rationale for them) and clarifying procedures. There is also a recertification process, described later in this document, for each trainer.

Training New Hires

Recognizing that some trainers will leave NEON, a process for training new hires to be trainers is required. The method for training replacement technicians on the technical aspects of the

protocol/procedure is described in Section 8 of this document. Training on using the Curriculum Guide and delivering effective training will be provided by a train-the-trainer/curriculum workshop. This will be provided by NEON HQ on an as-needed basis if the timing does not coincide with the annual offering of this workshop. Domains in which training is conducted by first-year trainers, will have an early season/first bout check in with NEON Science to address any questions and verify that protocols are fully understood and properly implemented.

Trainer Conferences

If funding allows, in-person conferences will be held with trainers, NEON Science, and the curriculum designer. The conference would focus on hands-on practice and demonstrations of protocols and procedures in the field and lab and include roundtable discussions. The conference could be conducted every few years or potentially each year, focusing on different disciplines (i.e. botany, instrumentation, etc.) or eco-climatic zones (i.e. desert, forests, etc.). Any combination provides a critical, in-person check that procedures are being implemented in a consistent manner throughout the Observatory. These conferences also provide an opportunity for development of training skills. Attendees could give presentations using the curriculum used for training TFTs. Feedback on using the materials and sharing of effective techniques used by others will help improve all attendees training skills.

8 SUBSYSTEM-SPECIFIC TRAINING PROGRAM

The basic components of the training curriculum are the same for AIS, AOS, TIS, and TOS. However, the personnel that need training and the timing varies between subsystems. To accommodate this and to optimize training, each subsystem has a customized training program.

8.1 Regular Field Technicians

Initial Training

TIS, AIS, and AOS Subsystems: Each domain typically has two regular technicians responsible for maintaining the instrumented tower and soil system (TIS) and two responsible for the aquatic instrumented and observation systems (AIS and AOS). Training a new tower or aquatic technician is the responsibility of the remaining technician. Should both leave, then a technician from another domain will provide training. In these instances, a weekly check in with NEON Science and/or engineering will be scheduled so that questions can be addressed early on.

Training is primarily on-the-job, with the new technician working alongside the experienced technician. The training content is guided by a comprehensive checklist of skills that must be learned and mastered. Supporting the hands-on training, are materials for self-guided learning on topics such as system design and Science; monitoring software; troubleshooting; the power and data distribution system; and sensor function, use, and maintenance for instrumented systems. Careful reading of procedural documents is also an important component of learning about the systems and procedures. Short instructional videos demonstrating maintenance procedures for sensors and equipment use, operation, and maintenance

will also be available as a training resource. For the aquatic observation system, training materials cover all AOS protocols. For fish sampling, one technician from each domain participates in a training offered by the manufacturer of the electrofishing equipment.

TOS Subsystem: Each regular TOS technician has a subject area of expertise that aligns with one or more of the TOS target areas, such as botany, small mammals, invertebrates, or soil. Therefore, new regular technicians typically require training for only a subset of TOS protocols. Training of new hires includes reading the relevant science design, protocols, and standard operating procedures. The materials used for training TFTs will also be used to provide training to new regular technicians. The instructor-led materials can be presented by a colleague from another domain or viewed independently. Hands-on training may also be provided by a fully trained technician from another domain. New regular technicians implementing TOS protocols for the first time will also receive training on using the TOS training curriculum, as they will be responsible for training TFTs.

Cross-Training: While each technician has a content area of expertise, cross-training will be provided to the extent that logistics allow. This training will be primarily hands-on, OJT, with the "secondary" technician working alongside other primary technician(s) for a particular system. Independent review of the documents and supporting training materials will also be part of the cross-training program. Cross-training is essential for decreasing the vulnerability of potentially missing maintenance and sampling activities (and knowledge gaps) that could occur when staff are ill or leave. In addition, it provides an opportunity for professional development, which will help NEON retain skilled personnel.

Inter-Domain Training: Depending on staff turnover, training may be provided by technicians from different domains. Whether this occurs at the trainer's domain or the trainee's domain will depend on logistics, such as weather, schedules, and cost. Fully trained technicians may participate in an inter-domain exchange, where a technician is temporarily assigned to another domain. These exchanges could also include a formal audit to help ensure that methodologies are being implemented in the same manner across NEON's varied eco-climatic regions.

Multi-Domain Conferences: Communication between domains and with NEON HQ is an essential part of training. Discussions and seminars addressing challenges, solutions, outreach, and data analysis/findings may occur remotely via a web-based platform or, if funding allows, at in-person conferences. These gatherings and interactions may be regionally or topically based. Multi-domain training sessions help ensure consistent implementation of procedures as well as provide opportunities for professional development.

8.1.1 Refresher Training/Recertification

The refresher training program has a dual purpose. First, to ensure that previously trained personnel have sufficient recall and understanding of previously acquired knowledge and skills. Secondly, to ensure that modifications and updates to procedures are understood and can be properly implemented. The refresher program consists of self-paced, independent learning and assessments.

For AOS and TOS protocols, the development and distribution of refresher training materials will be aligned with the annual review cycle for these protocols. Following the release of revised protocols, technicians will review protocols, paying particular attention to the change record section of each document. Regular technicians will review training materials for TFTs to prepare for refresher assessments and in preparation for delivering training in the upcoming field season. Technicians will take self-graded quizzes focusing on changes to procedures and common procedural pitfalls. Technicians compare their answers to those written by NEON Science, rate their own responses, and then record what they have learned. This immediate feedback and self-reflection provides the technician with an opportunity to check understanding and to review material as needed.

Preparing for refresher assessment also entails interactions with NEON Science. The problem reporting system will be used to address questions and uncertainties about protocol changes. For each protocol/topic/procedure, a problem ticket will be created and answers will be provided by NEON science. These tickets are a reference for all regular technicians. If needed, a remote question and answer session with scientists can be arranged. This may be particularly useful as new protocols or procedures are introduced.

For TOS protocols, recertification/refresher training will occur annually, prior to the arrival of TFTs. Personnel will have approximately two to three weeks to review protocol changes and resolve questions with authors prior to assessment.

AIS, AOS, and TIS procedures are conducted year round, and without the influx of TFTs that occurs with TOS protocols. Therefore, refresher training need not occur at the same time at all domains. For these subsystems, refresher training will be targeted and to some extent customized based on site inspections by an auditor (if available), a review of problem tickets to identify trouble spots, and self-identification of training gaps. In addition, digital tutorials (with embedded assessments) can be developed to help instrument technicians keep their skills up-to-date.

To ensure that AIS, AOS, TIS, and TOS protocols and maintenance procedures are implemented properly and consistently across domains and over the 30-year life span of the Observatory, recertification of regular field technicians will include observation and performance-based assessments. This will be conducted accordance with the Science QA/QC Performance Plan (in development) in-person, with audits conducted by NEON personnel with procedural expertise. Auditors can be culled from NEON Science, domain staff, and curriculum developers and will entail the use of checklists to document evaluations. For certain protocols, a remote assessment is possible, with field technicians filming their work. Videos will then be self-reviewed and then reviewed by colleagues and HQ staff.

8.2 Temporary Field Technicians

TFTs are hired at each domain to implement TOS protocols. One or two TFTs assist with AOS protocols. Protocol-specific training is domain based and provided by regular field technicians at each domain. Technicians use the curricular materials described previously. Following a lesson plan for each protocol,

training consists of instructor-led classroom components and self-paced study during which TFTs are introduced to the science and procedures. This is followed by a field practicum where TFTs work with equipment in the field and practice collecting data and samples. A lab practicum provides hands-on training with post-collection equipment and procedures. Trainees take quizzes and have performance-based assessments to determine competency.

Following completion of these components, students then receive OJT training. Depending on the protocol, this may be a practice bout or occur during the first sampling bout. Trainers guide and observe implementation of procedures. Using the lesson plan objectives, trainers assess competency and determine if trainees are ready to work without direct supervision or if additional OJT/supervision is required.

NEON anticipates that one third of the TFTs will return for a second field season. Returning TFTs will take the same refresher training quizzes and assessments as regular technicians. In addition to the self-graded feedback, TFTs will review their assessment responses with the regular technician. Based on the results of the assessment and review, TFTs may need to participate in the full TFT training program or components of it. Similarly, participation of TFTs in the OJT component of training will depend on competency and is at the discretion of domain trainers.

When a TFT is required to assist with AOS sampling, OJT will be provided. This entails the TFT receiving direct instruction and supervision from the aquatic technician. After assessing field and laboratory skills and demonstration of competency, a TFT may perform select procedures without direct supervision.

TFTs will not assist with AIS or TIS procedures and therefore, a training program is not needed.

8.3 Training Schedule

Classroom and practicum training of TFTs on TOS protocols will occur during the two weeks prior to the first sampling effort. The duration for classroom training for each protocol ranges from 1 to 2 hours. The hands-on practicum will vary depending on the protocol but is expected to range from 2 to 4 hours. During the two-week period, three days should be allocated for technicians to receive training from Safety, HR, and IT.

The OJT will occur during a practice bout or during the first sampling period. The amount of time required for OJT will depend on the TOS protocol. An estimate is that each TOS protocol will take approximately 25 percent more time to complete when OJT is occurring as compared to the sampling time with a fully trained team.

The above schedule works well when a group of TFTs onboard at the same time. At some domains, TFTs arrive in waves, with sampling beginning for some TOS protocols before others. In these instances, targeted training for the early-start protocols may occur outside of the 2-week training window. Recognizing that it is best to conduct training as close to the onset of sampling as possible, domain managers are allowed flexibility in scheduled the training of TFTs. For example, if plant diversity work

will not occur until six weeks into the field season, then it may make sense to delay the training until closer to the start date.

For training a new fulltime technician on AOS and TOS protocols, approximately one to four weeks is needed. This includes classroom time (instructor led and/or self-directed), field and lab practice and assessments. OJT component occurs during a practice or first bout. OJT will increase sampling time by approximately 20 to 30 percent for TOS and AOS protocols.

Training a new fulltime technician on AIS or TIS occurs over a four- to six-week period, with the new technician working alongside the experienced technician. Regularly scheduled work will take approximately 50 percent longer to complete during the first two to four weeks of on-the-job training. By week 6, the new hire should be able to work with limited guidance.

9 TRAINING EVALUATION

The effectiveness of the training program will be evaluated internally and externally. Students and trainers will provide feedback using an online evaluation form. TFTs will be asked to complete evaluations after each component of TOS training (classroom session, field practicum, lab practicum, and OJT). Collected data will be used to evaluate instructors, course materials, content, and delivery methods. An additional evaluation will be given to trainees after completion of one or two sampling periods. This is to help identify gaps in the training program. For AOS training, students will complete online evaluations for the classroom and field component of training.

For assessing AIS and TIS training, students will complete online evaluations after OJT and completion of self-guided training modules. Feedback from trainers will be collected through self-evaluations of their training and their assessment of the training materials. In addition, verbal debriefs with the curriculum designer and the Field Operations manager will be conducted.

Each year, the curriculum designer will observe training in 1 to 3 domains to monitor the implementation and quality of training. Indirect methods of evaluating effectiveness of training will also be used to guide modification and updating of training materials. This entails reviewing the problem tickets (and resolutions). From this review, gaps in the content can be discerned as can insufficient implementation of the training curriculum.

In addition to internal self-evaluations, an external evaluator will assess the effectiveness of the training program (if funding allows). This evaluation may occur every three to five years, depending on funding. Audits of field activities as described in the NEON FSU Field and Laboratory Procedures Quality Assurance Plan (RD[51]) will also be used to assess the training program.

10 QUALITY CONTROL

The effectiveness of training is dependent on the quality of trainers, the training materials, the protocols, and site-specific challenges. These factors are inter-related and a method for ensuring

collection of quality data must take all of these into consideration.

A number of possible methods for monitoring quality that pertains to training include:

- Site audits by NEON staff with expertise in the procedure(s).
- Audits of sampling by outside parties, using a checklist of evaluation criteria.

- Inter-domain observation of/participation in sampling/maintenance. This provides a way to check if protocols and procedures are implemented in the same manner in different ecosystems.

- Video recordings. This would entail technicians filming their work (using a tripod- or body-mounted camera). The video would then go through a series of reviews, beginning with a self-assessment by the sampler to identify deviations from the protocol. Issues are recorded on a log and the video is then reviewed by another colleague at the same domain who is familiar with the protocol. Deviations or areas where improvements could be made are logged and discussed with the sampler. The video is then reviewed, and issues logged, by a technician at another domain, preferably one with a different ecosystem. The video (and log) then comes to HQ for review by the curriculum designer and/or the protocol author. In the end, consolidated feedback on protocol implementation is provided to the sampler as well as to each reviewer.

In the absence of conferences with a gathering of technicians from multiple domains, much of the training of newly hired regular technicians relies on self-guided, independent learning. To ensure that technicians actually complete modules, a learning management system is desirable and is recommended as part of the quality control program.

11 CORPORATE TRAINING

The corporate training program is described in other documents (AD[01] – AD[03]). Training covers new employee orientation, laboratory safety, vehicle safety, and field safety. A brief summary of content is provided below.

New Employee Orientation

- Timekeeping
- Expense Reimbursement
- Purchasing and Credit Card Use
- Accessing IT/Network Resources

New Employee Safety and Security Orientation

- Emergency Action Planning

- Active Shooter and Site-Specific Security Guidance
- Accident/Incident Reporting
- Electrical Safety Awareness
- Introduction to Personal Protective Equipment
- Hazard Communication/Globally Harmonized System for Hazard Classification and Labelling
- Environmental Stewardship and Protection – Permit Communications

Laboratory Safety

NEON provides employees with information and training to ensure they are informed of the work area hazards and instructed on avoidance of those hazards.

One of the major provisions of the Laboratory Standard - as well as the NEON Safety Program - is a requirement to provide employee information and training. Training is required for:

- All new employees
- Employees given new job assignments involving exposure situations for which training has not previously been received
- Whenever the employer is made aware of a new or previously unrecognized hazard for which training has not previously been received

The Domain Manager and the designated Chemical Hygiene Officer (CHO) has the responsibility to ensure personnel have had training on the elements listed below. NEON Safety, with the Domain Manager and CHO, are also responsible to ensure training records are maintained. They are also responsible for ensuring employees are trained on the specific hazards and work practices appropriate for their laboratory beyond the scope of this session. The Laboratory Safety training includes:

- Employee rights and responsibilities under the OSHA Laboratory Standard and other regulations.
- The contents of the Chemical Hygiene Plan and its relation to the Laboratory Standard.
- The contents of the lab-specific Chemical Hygiene Plan, including any Standard Operating Procedures (SOPs) that have been developed.
- The physical and health hazards of hazardous materials including signs and symptoms of overexposure, particularly those defined as Particularly Hazardous Substances. As appropriate, training can address entire classes of hazardous materials (e.g., carcinogens) rather than individual substances.
- Appropriate use and maintenance of control measures including engineering controls, personal protective equipment, and work practices.
- The permissible exposure limits for OSHA-regulated substances.
- Hazardous materials labeling, storage, and signage requirements.
- Use of Safety Data Sheet (SDS) and other informational references and resources pertinent to the lab.
- Hazardous waste minimization and disposal practices.
- Spill response and emergency procedures.

Field Safety

Field safety training will include a 4 hour class for Bloodborne Pathogen Awareness and First Aid/ CPR certification. Training will be provided upon employee's initial assignment to field status designation and on an ongoing basis. The courses selected are intended to provide field staff with pertinent health and safety information needed to evaluate and protect them from potentially hazardous environments.

Specific field training requirements for employees are based upon their designated tasks. Employees are not permitted to engage in field activities until they have been trained and certified to a level commensurate with the degree of anticipated hazards.

Basic Level: All employees will be provided an initial health and safety training prior to becoming involved in normal, routine field activities. Training will include but not be limited to classroom instruction which includes the following objectives:

- To make the employee aware of the potential hazards they may encounter.
- To provide the knowledge and skills necessary to perform the work with minimal risk to worker health and safety.
- To make the employee aware of the purpose and limitation of safety equipment.
- To ensure the employees can safely avoid and escape emergent situations.

Tower and Aquatic Instrument Safety: All employees working on a NEON tower must have Fall Protection Training, tower access safety training, DEUS® Rescue Training and Control of Hazardous Energy (lock out/tag out) training. Any technician involved with sensor maintenance must also have lock out/tag out training. These trainings are provided by Safety, or others who are certified by Safety.

Vehicle Safety

All employees authorized to operate company owned or leased vehicles will participate in initial and annual driver safety training which includes:

- Strategies to recognize and manage driver fatigue and in-vehicle distractions.
- An emphasis on the need to follow safe driving practices on and off the job.
- Defensive driving
- Vehicle inspection procedures
- Accident procedures
- Hazardous weather driving
- Procedure for notification of unsafe vehicle
- Cargo area storage and security and loading & unloading
- UTV/Boating/Snowmobile Safety as applicable

12 TRAINING HARDWARE AND SOFTWARE REQUIREMENTS

The requirements provided in this section are for equipment and capabilities needed specifically for training. The software and hardware required for implementing protocols or procedures are not included in this section. However, to successfully deliver training, all the protocol and procedural equipment, and infrastructure must be available during training.

Software Requirements

The following software is required to develop and/or present training:

- Microsoft Office programs
    - PowerPoint
    - Excel
    - Access
- GPS software
- Adobe Photoshop
- Adobe Illustrator
- Video editor (such as iMovie, Final Cut, Premiere, etc.)
- Captivate (or similar multimedia program for creating interactive digital modules)
- Access to SharePoint for all TFTs and regular field technicians.
- Learning management system for delivery of training materials and to track completion of training components by TFTs and regular technicians. System should include a platform for conducting online assessments and running digital tutorials.

Hardware Requirements

All hardware required for training is available as part of the general Domain Support Facility operations. It includes:

- Servers
- Webinar equipment
- Computers
- ThinClients
- Mobile data recorders (as specified in protocols)
- Video conferencing system
- Storage on NEON network or other device for all training materials.
- Internet connectivity, which includes transmission rates adequate for downloading video files in a reasonable amount of time.

- Additional materials required for training on each protocol as indicated in lesson plans.

APPENDICES

Examples of curricular materials from a variety of NEON subsystems are provided in this appendix.

Example Lesson Plan (A.1)

Example Curriculum Guide – Table of Contents (A.2)

Checklist (Partial) for OJT for Tower Technician (A.3)

Example Field Audit Form (A.4)

Example Field Audit Form for Specific Protocol (A.5)

Example Evaluation Forms (A.6)

Additional training materials can be found on the NEON network and NEON intranet.

TOS Materials:

Lesson Plans and Presentations N:/DSF/Training Materials/YYYY TOS Training

Recertification quizzes on SharePoint: Department → Field Operations→ Field Operations Wiki→ TOS

TIS Materials:

SharePoint: Department →Field Operations →Systems TIS →Training

SharePoint: Department → Systems Integration & Verification → SIV Shared Documents →Training Resources

AOS Materials:

SharePoint: Department→Field Operations→Systems AOS→AOS Resources→AOS Training Presentations

13 APPENDIX A.1 EXAMPLE LESSON PLAN

2016

2016 TOS Training Curriculum

Ground Beetle Sampling

Curriculum based on TOS Protocol and Procedure: Ground Beetle Sampling (NEON.DOC.014050_revision J) and datasheets (NEON.DOC.001580 revision D)

neon THE NATIONAL ECOLOGICAL OBSERVATORY NETWORK

TABLE OF CONTENTS

1. PART I: OVERVIEW

The classroom presentation introduces seasonal field technicians to methods for collecting and sorting ground beetles. The field and lab practicums provide hands-on experience. Challenges particular to this protocol are identification of ground beetles and sample labeling/management, all of which occurs in the lab.

1.1 Objectives

At the end of training, seasonal field technicians will be able to:

- Install and service a pitfall trap
- Store and transport field samples.
- Recognize problems with pitfall traps.
- Know how to handle vertebrate bycatch.
- Conduct an ethanol rinse.
- Find, print, and properly utilize locality labels, ethanol rinse labels, and determination labels.
- Describe timeframe for lab processing.
- Safely handle and dispose of chemicals.
- Label samples.
- Use datasheets to document field and lab work.

1.2 Time Required

Classroom presentation: 1 hour plus 15 minutes for quiz and follow-up discussion
Field Methods: 1 hour
Lab practicum: .5 hours

1.3 Protocol Specific Terminology

Pitfall trap
Bycatch
Carabid
Morphospecies
Web UI (user interface)

1.4 Handouts

See next page.

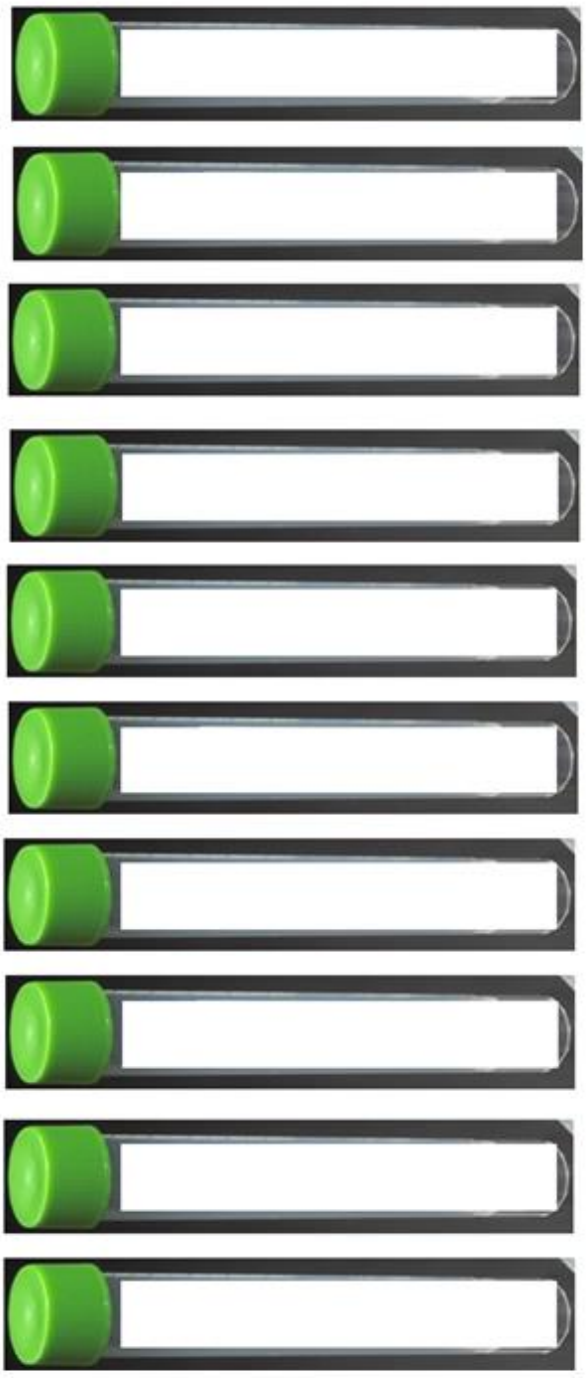
Sample Collection Flash Cards

Trainer: Cut the cards and scramble the order. Ask technicians to place the cards in step order.

Place locality labels in collection cup.	Dump sample (w/ labels) into whirl-pak.
Swirl and pour contents of collection cup into filter assembly.	Rinse any sample remaining in filter assembly into whirl-pak.
Rinse any sample remaining in catch cup into filter assembly.	Remove screen from filter and place in whirl-pak.
Rinse sample with water.	Add enough ethanol to cover sample.
Rinse sample with ethanol	Seal whirl-pak.

Vertebrate Bycatch Exercise Worksheet 1 copy for every 2-3 students

TAXA	# of ind.



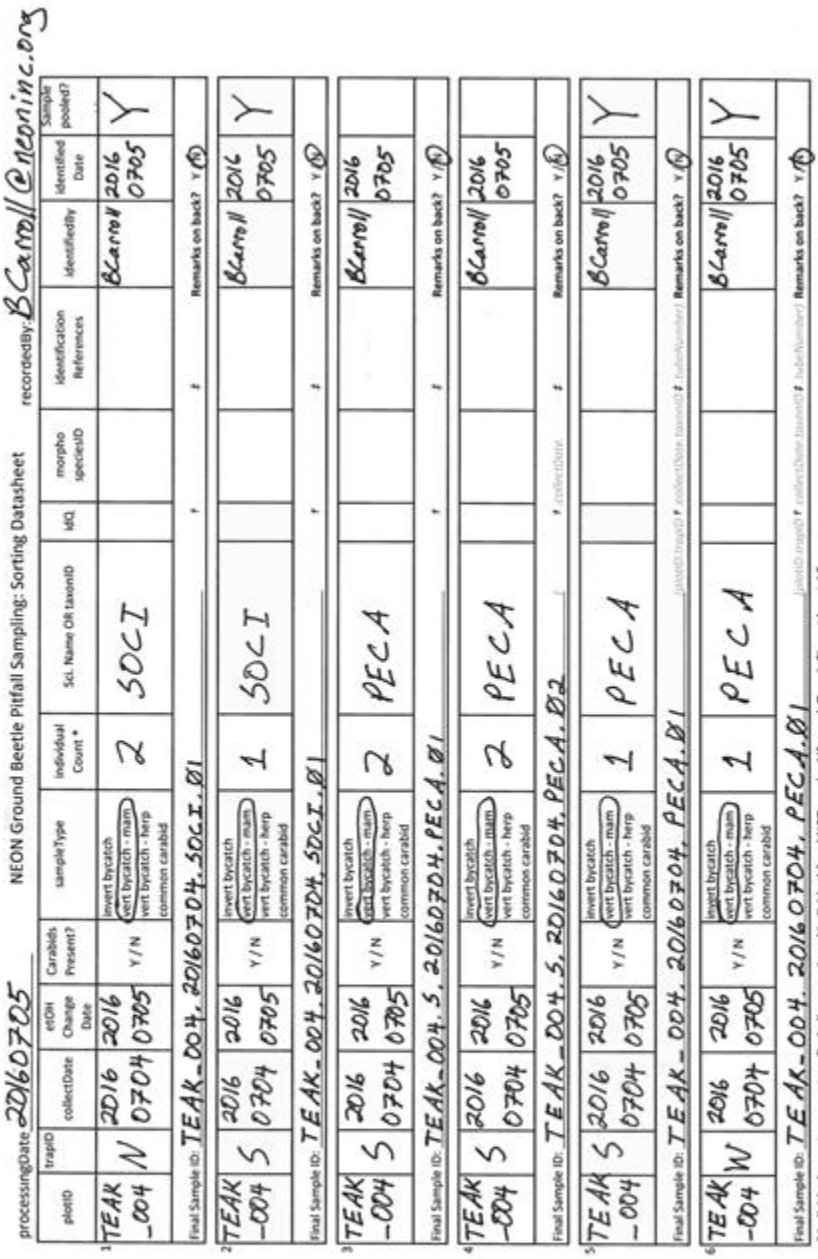
2016 Lesson Plan: Ground Beetle Sampling, February rev a

Vertebrate Bycatch Exercise: **ANSWER SHEETS (FOR TRAINER REFERENCE)**

The answer sheets here are provided for the trainer. Copies for each student are **not** needed as the answers are incorporated into the PowerPoint presentation (on the slides that follow the exercise)

TAXA	# of ind.	
SHREWS	3	TEAK_004.20160704.SOCI.01
MICE	2	TEAK_004.S.20160704.PECA.01
MICE	2	TEAK_004.S.20160704.PECA.02
MICE	2	TEAK_004.20160704.PECA.01
FROGS	2	TEAK_004.N20160704.RANDRA.01
FROG	1	TEAK_004.E.20160704.RANDRA.01
SALAMANDERS	4	TEAK_004.E.20160704.VB.01
SALAMANDERS	2	TEAK_004.E.20160704.VB.02
SALAMANDERS	2	TEAK_004.W.20160704.VB.01

Vertebrate Sorting Exercise: Answer Sheet for Mammals (FOR TRAINER REFERENCE)



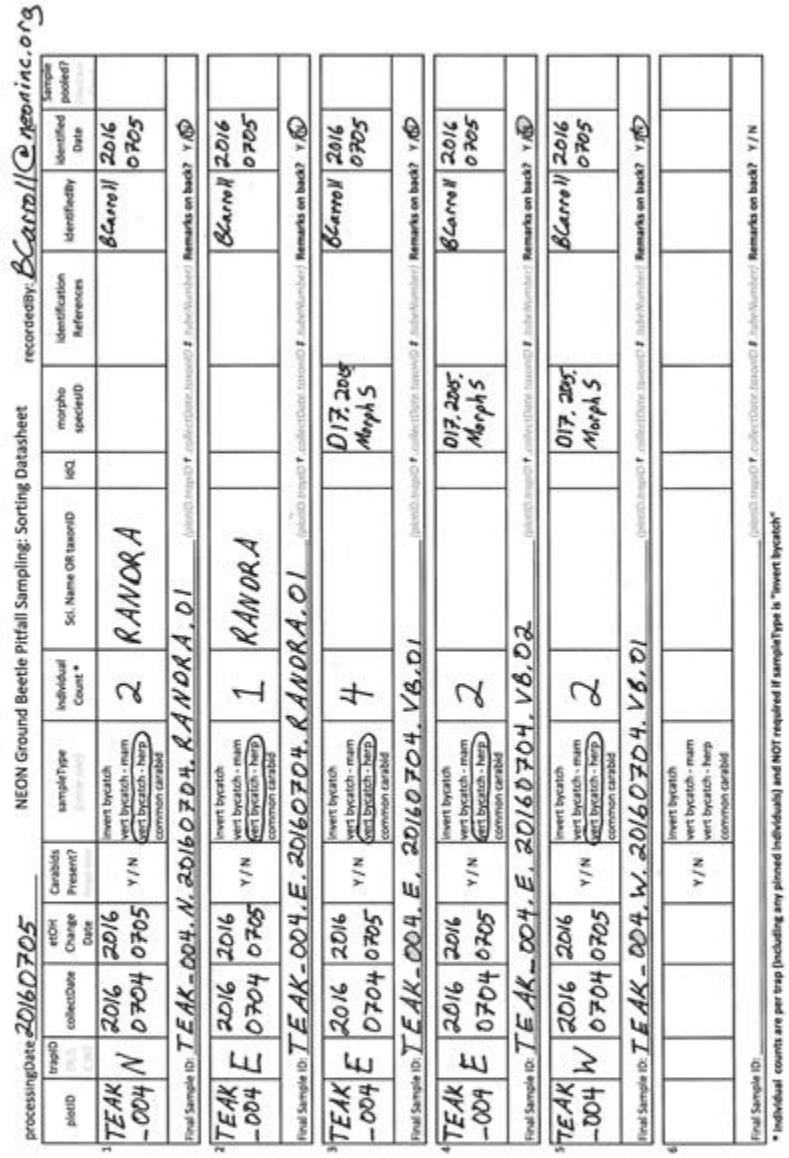
NEON Ground Beetle Pitfall Sampling: Sorting Datasheet

processingDate: 20160725 recordedBy: BCarroll@neoninc.org

	plotID	trapID	collectDate	etOH Change Date	Carabids Present?	sampleType	Individual Count *	Sci. Name OR taxonID	MQL	morpho speciesID	Identification References	identifiedBy	Identified Date	Sample pooled?
1	TEAK_004	N	2016 0704	2016 0705	Y / N	invert bycatch / vert bycatch - mam / vert bycatch - herp / common carabid	2	SOCI				BCarroll	2016 0705	Y
	Final Sample ID: TEAK_004_20160704_SOCI_01												Remarks on back? Y / N	
2	TEAK_004	S	2016 0704	2016 0705	Y / N	invert bycatch / vert bycatch - mam / vert bycatch - herp / common carabid	1	SOCI				BCarroll	2016 0705	Y
	Final Sample ID: TEAK_004_20160704_SOCI_01												Remarks on back? Y / N	
3	TEAK_004	S	2016 0704	2016 0705	Y / N	invert bycatch / vert bycatch - mam / vert bycatch - herp / common carabid	2	PECA				BCarroll	2016 0705	
	Final Sample ID: TEAK_004_S_20160704_PECA_01												Remarks on back? Y / N	
4	TEAK_004	S	2016 0704	2016 0705	Y / N	invert bycatch / vert bycatch - mam / vert bycatch - herp / common carabid	2	PECA				BCarroll	2016 0705	
	Final Sample ID: TEAK_004_S_20160704_PECA_02												Remarks on back? Y / N	
5	TEAK_004	S	2016 0704	2016 0705	Y / N	invert bycatch / vert bycatch - mam / vert bycatch - herp / common carabid	1	PECA				BCarroll	2016 0705	Y
	Final Sample ID: TEAK_004_20160704_PECA_01												Remarks on back? Y / N	
6	TEAK_004	W	2016 0704	2016 0705	Y / N	invert bycatch / vert bycatch - mam / vert bycatch - herp / common carabid	1	PECA				BCarroll	2016 0705	Y
	Final Sample ID: TEAK_004_20160704_PECA_01												Remarks on back? Y / N	

* individual counts are per trap (including any pinned individuals) and NOT required if sampleType is "invert bycatch"

Vertebrate Sorting Exercise: Answer Sheet for Herps (FOR TRAINER REFERENCE)



NEON Ground Beetle Pitfall Sampling: Sorting Datasheet

processingDate: 20160705 recordedBy: BCarroll@neoninc.org

	plotID	trapID	collectDate	etOH Change Date	Carabids Present?	sampleType	Individual Count *	Sci. Name OR taxonID	IdQ	morpho speciesID	Identification References	IdentifiedBy	Identified Date	Sample pooled?
1	TEAK_004	N	2016 0704	2016 0705	Y / N	invert bycatch; vert bycatch - mam; vert bycatch - herp; common carabid	2	RANORA				BCarroll	2016 0705	
	Final Sample ID: TEAK_004.N.20160704.RANORA.01													Remarks on back? Y/N
2	TEAK_004	E	2016 0704	2016 0705	Y / N	invert bycatch; vert bycatch - mam; vert bycatch - herp; common carabid	1	RANORA				BCarroll	2016 0705	
	Final Sample ID: TEAK_004.E.20160704.RANORA.01													Remarks on back? Y/N
3	TEAK_004	E	2016 0704	2016 0705	Y / N	invert bycatch; vert bycatch - mam; vert bycatch - herp; common carabid	4			017. 2005 Morph S		BCarroll	2016 0705	
	Final Sample ID: TEAK_004.E.20160704.V8.01													Remarks on back? Y/N
4	TEAK_004	E	2016 0704	2016 0705	Y / N	invert bycatch; vert bycatch - mam; vert bycatch - herp; common carabid	2			017. 2005 Morph S		BCarroll	2016 0705	
	Final Sample ID: TEAK_004.E.20160704.V8.02													Remarks on back? Y/N
5	TEAK_004	W	2016 0704	2016 0705	Y / N	invert bycatch; vert bycatch - mam; vert bycatch - herp; common carabid	2			017. 2005 Morph S		BCarroll	2016 0705	
	Final Sample ID: TEAK_004.W.20160704.V8.01													Remarks on back? Y/N
6					Y / N	invert bycatch; vert bycatch - mam; vert bycatch - herp; common carabid								
	Final Sample ID:													Remarks on back? Y/N

* Individual counts are per trap (including any pinned individuals) and NOT required if sampleType is "invert bycatch"

1.5 Resources

Following is a summary of NEON resources related to implementing this protocol. These resources and their locations are provided as a reference for trainers. Some of these resources may contain site-specific information that trainers might want to incorporate into training.

Wikis on SharePoint are currently under construction in an effort to consolidate all the needed resources for a particular protocol in one place. The wiki should be fully operational by the end of February/middle of March at which time, technicians should refer to the wiki to find resources. (Department →Field Operations→Field Operations Wiki (top banner) →scroll down to TOS.) For the time being, below is a list of resources along with their current location on SharePoint.

SharePoint Landing Page for TOS: This is the place to start. To get to the landing page navigate to: Department →Field Operations→ TOS. Here is how to get to other resources from the TOS landing page (unless otherwise indicated):

- **Protocol:**
  - Scroll to the "Protocols and Datasheets" heading about halfway down the page, on the right hand side.
- **Datasheets:**
  - Scroll to the "Protocols and Datasheets" heading about halfway down the page, on the right hand side.

IMPORTANT NOTE: See the cover of this Lesson Plan for the protocol and datasheet version to be used at the start of the 2016 field season. If this is NOT the version in the document warehouse, navigate to the folder containing a pre-release, draft of the protocol or datasheet to use at the start of the 2016 field season: Scroll down TOS landing page to the "Sampling Support Documentation" section, then select folder <tosProtocols2016>. See the 2016 TOS Curriculum Guide for additional information about protocol versions.

2016 Refresher Quiz. Scroll down. From the left hand side of page, select "2016 Refresher Quizzes." On the page that opens, select the appropriate quiz.

- **Morphospecies Tracking:**
  - Scroll down to the "Sampling Support Documentation" heading
  - Select "MorphospeciesTracking" (folder)
    - BeetleMorphospeciesTracking (Excel file)
- **Cryptic Species Tracking:**
  - Scroll down to the "Sampling Support Documentation" heading
  - Select "Taxon Tables " (folder)
    - CrypticSpeciesGroups (Excel file)

- **Taxon Tables:**
  - Scroll down to the "Sampling Support Documentation" heading
  - Select "Taxon Tables" (folder)
    - There are multiple CSV files with IDs for different taxon in the folder.
- **IACUC bycatch report:**
  - Scroll to the "Sampling Support Documentation" heading
  - Select "IACUC" (folder)
    - YEAR IACUC bycatch report (Excel file)
- **Endangered Invertebrate Species Identification Resources:**
  - Scroll to the "Sampling Support Documentation" heading
  - Select "IdentificationReferences" (folder)
  - Select "Beetle Identification Resources (folder)
  - Select "Information About Endangered --- (folder)
    - Resource ENDANGERED invertebrate list (Excel file)
    - Resource ENDANGERED Nicrophorus key (PDF)

- **Endangered Vertebrates:** Accessed from the "Field Ops Only" area in SharePoint
  - Navigate: Department →Field Operations →Field Ops Only
  - Under the "Links" heading on the right hand side of page, Select "Edit and Review Documents"
  - Scroll to domain specific document (Word): DomainXX Site Specific Information, NEON.DOC.004316_Appendix--
- **Beetle Discussion Board:** Beetle identification discussion board
- **WebUI Training:**
  - Scroll to the "Sampling Support Documentation" heading
  - Select "WebUI Data Entry" (folder)
  - Select "Ground Beetle WebUI (folder)
    - Beetle WebUI Demo (PPT)
    - Bet_dataingest_NEONDOC001400 (cvs)

Domain specific resources: These resources will be developed and maintained by domain staff. They should be located in a place readily accessible by permanent and seasonal staff, i.e. SharePoint, OneDrive, N: drive…

- **Packing List**
- **Site maps with beetle plots**
- **Ethanol change labels (these are not required to be digital)**
- **Determination labels**
- **Locality labels**

GIS Network Drive: (GISData, you have to be on the network to access.) This is where you find Domain/Site/Plot level information for protocol implementation. You will also find all of your plot level geographic information, including post-processed .IMP files of plot corners (used when navigating).

WebUI: (SQMportal) Data transcription, entry, and QA/QC process is covered in a separate training.

2. PART II: CLASSROOM PRESENTATION

2.1 Materials

Item	Quantity/Notes
PPT file: Ground Beetle Sampling Field and Lab Methods 2016 Training	1
Protocol (NEON.DOC.014050))	1 copy per student
Field Datasheets (NEON.DOC.001580)	1 copy per student
Sorting Datasheets (NEON.DOC.001580)	1 copy per student
Sample collection flash cards (**Section 1.4**)	1 set for every 2-3 students
Tube labeling handout (**Section 1.4**)	1 copy for every 2-3 students
Recorded talk: Introduction to Animal Sampling	Not needed if students have already viewed it.
All pitfall trap equipment (cups, spacers, nails, lid)	2 sets
Equipment for installing trap	2 sets
Locality labels	1 set of three for each student
Equipment for processing in field (empty bottles okay)	2 sets
Dry mounted ground beetles (if available)	Variable
Plastic beetles	A few
Plastic vertebrates	At least 2 (different species)

2.2 Preparation

- Gather all required materials and make needed number of copies of the protocol, datasheets, handouts, locality labels, and quiz.
- Download electronic files to your hard drive.
- Place tabs in your copy of the protocol so that you can easily flip to relevant sections and show materials to students.
- Take students on a little trip to the lab to show them your domain's collection of mounted beetles. This gives them a good idea of what they are working towards.

2.3 Lesson Development

NOTE: The training is based on use of datasheets as PDAs will not be used for this protocol during the 2016 field season. Most of the lesson development for this presentation is embedded in the slides and slide notes.

1. Show the "Introduction to Animal Sampling" recorded talk. Skip if students have already seen it.
2. As you go through presentation, refer students to appropriate sections of the protocol.
3. Discuss with students the various datasheets and the importance of care when transcribing information. Give an example of the domino effect when a transcription error occurs.
4. During the labeling exercise, discuss method used to keep the tiny locality labels organized when in the field.
5. After reviewing the collection process, distribute sample collection flash cards (1 set for every 2 to 3 students). Have students put them in step order. Circle around room to review results.

6. Administer the vertebrate bycatch exercise.
   a) Keep the "Vertebrate Bycatch Exercise" slide displayed.
   b) Split students into groups of 2-3
   c) Distribute a copy of the Vertebrate Bycatch Sorting Datasheet to each group. (Students should already have the Sorting Datasheet.)
   d) Assign half of the groups mammals and the other half herps
   e) Have each group fill out the Worksheet
   f) Have each group fill out a Sorting Datasheet
   g) Discuss the answers together. Answers are provided in the PowerPoint presentation on the slides that follow the exercise. Answer sheets for trainer reference are provided in the handout section of this lesson plan.
7. Administer quiz and discuss.
8. Have students complete evaluation form.

2.4 Quiz

See next page.

Ground Beetle Sampling: Classroom Assessment of Field and Lab Methods

Name: _____ Domain: _____Trainer: _____

Date: _____ Score: _____/16

1) You arrive at a pitfall trap location and discover that the lid is missing from the trap. There are only a few invertebrates in the trap and the top cup is filled to the top with fluid. Describe what you would do with the collection from this trap and how you would record trap condition. (2 pt)

2) Oh no, your pre-printed locality labels just blew away! Luckily, you always carry out some blank spares. Complete the label below for a South trap collected today. (2 pt)

USA, GEORGIA Baker County.
Jones Ecological res Ctr. 47m
N31.2034 W84.4631 Pitfall trap
RNelson
NEON.JERC_406.

3) When servicing a trap, you notice that the preserving fluid in the top cup is below the 150 mL fill line. When you re-set the trap for the next sampling bout, what will you do? (2 pt)

4) You are re-setting the last two traps at a plot for the next sampling bout. It is the last plot of the 10 included in the bout and you discover that you only have enough preserving fluid to re-set one trap. What will you do? Circle all that apply. (2 pt)

a) Split the remaining preserving fluid equally between the two traps and note in the field datasheet that there was less than 150 mL in each trap.
b) Set one trap with correct amount of fluid and leave the other trap un-set.
c) Reuse some of the filtered preserving fluid collected that day.
d) Return next day with more preserving fluid to set trap(s).
e) Record situation on datasheet.

5) The top cup of a pitfall trap is filled with which of the following fluids? Circle all that apply. (2 pt)

   a) A 1:1 solution of distilled water and ethanol.
   b) A 1:1 solution of distilled water and propylene glycol.
   c) A 1:1 solution of ethanol and propylene glycol.
   d) A 1:1 solution of deionized water and propylene glycol.
   e) None of the above.

6) While servicing a trap, you find a salamander in the top catch cup. It shows signs of rigor mortis and is clearly dead. What are the next steps? Circle all that apply (2 pt)

   a) Place salamander in its own whirlpak with a locality label separate from the rest of the catch.
   b) Perform vertebrate euthanasia procedure.
   c) Observe animal for 2 minutes.
   d) Collect sample as usual, including the salamander in the whirl-pak bag.
   e) None of the above.

7) Why is it important to change the ethanol in the whirlpak bags and remove vertebrate bycatch within 24 hours of sample collection? (2 pt)

8) You remove the top cup and discover there are a few beetles in the bottom cup of the pitfall trap. What will you do with these specimens? Circle your answer. (2 pt)
   a) Process them with the catch in the top cup and make a note on the datasheet.
   b) Process them as you would the catch from the top cup, but store in a separate whirlpak bag with a locality label.
   c) Toss them and make a note on the datasheet.
   d) None of the above.

ANSWER SHEET
Ground Beetle Sampling: Classroom Assessment of Field and Lab Methods

1) You arrive at a pitfall trap location and discover that the lid is missing from the trap. There are only a few invertebrates in the trap and the top cup is filled to the top with fluid. Describe what you would do with the collection from this trap and how you would record trap condition. (2 pt)

- Collect and process sample as usual.
- Check that trap is still properly installed.
- Indicate on datasheet that lid was disturbed and explain condition in notes.
- Indicate high fluid level on datasheet.

2) Oh no, your pre-printed locality labels just blew away! Luckily, you always carry out some blank spares. Complete the label below for a South trap collected today. (2 pt)

USA, GEORGIA Baker County.
Jones Ecological res Ctr. 47m
N31.2034 W84.4631 Pitfall trap
07 Aug2015 RNelson
NEON.JERC_406.S.20150807

Write in the date and complete the sampleID on bottom by adding the trapID (N, S, E, or W) and sample date (YYYYMMDD) on three labels.

(Example shown is for sample collected August 7, 2015

Place labels in the top catch cup and process them the same as the catch.

3) When servicing a trap, you notice that the preserving fluid in the top cup is below the 150 mL fill line. When you re-set the trap for the next sampling bout, what will you do? (2 pt)
Fill the top cup to the maximum fill line for the next sampling bout. Note on datasheet that the fluid level was low when the trap was checked. Indicate if specimens were exposed to air (i.e. not submerged in the preserving fluid).

4) You are re-setting the last two traps at a plot for the next sampling bout. It is the last plot of the 10 included in the bout and you discover that you only have enough preserving fluid to re-set one trap. What will you do? Circle all that apply. (2 pt)

a) Split the remaining preserving fluid equally between the two traps and note in the field datasheet that there was less than 150 mL in each trap.
b) Set one trap with correct amount of fluid and leave the other trap un-set.
c) Reuse some of the filtered preserving fluid collected that day.
d) Return next day with more preserving fluid to set trap(s). **(Do not do this!)**
e) Record situation on datasheet.

Discussion Point: Do not reset traps outside of the 14 day sampling window. A shortened sampling bout for only a few traps means they are not comparable to other samples. Wait until the next bout to reset.

5) The top cup of a pitfall trap is filled with which of the following fluids? Circle all that apply (2 pt)

a) A 1:1 solution of distilled water and ethanol.
b) A 1:1 solution of distilled water and propylene glycol.
c) A 1:1 solution of ethanol and propylene glycol.
d) A 1:1 solution of deionized water and propylene glycol.
e) None of the above.

Either deionized or distilled water is appropriate, whatever is easier (cheaper) to obtain.

6) While servicing a trap, you find a salamander in the top catch cup. It shows signs of rigor mortis and is clearly dead. What are the next steps? Circle all that apply (2 pt)

a) Place salamander in its own whirl-pak with a locality label separate from the rest of the catch.
b) Perform vertebrate euthanasia procedure.
c) Observe animal for 2 minutes.
d) Collect sample as usual, including the salamander in the whirlpak bag.
e) None of the above.

7) Why is it important to change the ethanol in the whirlpak bags and remove vertebrate bycatch within 24 hours of sample collection? (2 pt.)

As the ethanol replaces the bodily fluids of your catch, water and other fluids move into solution and degrade the quality of the ethanol. Replacing the ethanol ensures that specimens will be preserved properly.

8) You remove the top cup and discover there are a few beetles in the bottom cup of the pitfall trap. What will you do with these specimens? Circle your answer. (2 pt)

a) Process them with the catch in the top cup and make a note on the datasheet.
b) Process them as you would the catch from the top cup, but store in a separate whirlpak bag with a locality label.
c) Toss them and make a note on the datasheet.
d) None of the above.

3. PART III: FIELD ACTIVITY

3.1 Materials

Students should bring their protocol that was distributed during the classroom presentation.

Item	Quantity
Equipment checklist	2
All pitfall trap equipment (cups, spacers, nails, lid)	2 sets
Equipment for installing trap	2 sets
Equipment for processing in field	2 sets
Installed pitfall traps	2
Plastic beetles	A few
Plastic vertebrates	At least 2 (different species)

3.2 Preparation

Before showing the presentation:

- Purchase plastic beetles and vertebrates. Designate one vertebrate as endangered the other as not having status.
- Install two (or more) pitfall traps. Set up pitfall traps with mock specimens (plastic insects).
- Place plastic beetles in both traps and plastic vertebrates in one of the traps.
- Create some problems in one of the pitfall traps. Such as:
    - Fluid level below 150 mL
    - Lid disturbed (This might be the cause of the vertebrate bycatch)
    - Catch cup not flush with ground
    - Maybe its missing a lid, or some nails, this will drive home the point of bringing extra trap parts

Before field activity

- Have students use the checklist to gather all supplies needed for trap installation and sampling.
    - This should include finding and printing locality labels and datasheets.
    - You can also show them where the various chemicals are stored (ethanol and PG).
- Print out Field Assessment Checklist.

3.3 Lesson Development

Throughout the field activity, guide technicians as much as needed, ask questions to help them with decision making, and discuss how to make efficient use of a two-person team. Create scenarios that require troubleshooting.

1. Begin with installation of pitfall trap. Students should work in teams of two and have them check each other's work.

2. Have students service the previously set traps. If they do not notice problems, ask them some questions to help focus their observations.

3. Practice the method you are most likely to use at your site; either filtering at the trap, or collecting the sample and then filtering at the truck.

4. Ask/discuss why fluid level matters and other conditions that are recorded on the datasheet.

5. When students service a trap with vertebrate bycatch, ask about procedure for processing them.

6. Each two-person team should fill in a datasheet.

7. As students work, complete field assessment checklist for each student. Ask questions, or for a student to repeat a step, if you did not observe a particular activity.

8. Review results of assessment checklist with students.

3.4 Assessment Checklist

See next page

Ground Beetle Sampling: Field Assessment Checklist

Trainer: _____ Domain: _____

Date: _____

Directions: Use this form to assess technician skills during field training activities.

Indicate proficiency: Enter ✓ for proficient

Enter X for not proficient

Any question with an "X" should be explained below. In addition, trainer should provide direct feedback to technician in the field.

Question abbrev.		Technician/Domain	Phobe Buffay/D02										
1	Deployment		✓										
2	Condition		✓										
3	Stragglers		x										
4	Filtering fluids		✓										
5	Preserving		✓										
6	Label & datasheet		✓										
7	Catch and bycatch		✓										
8	Sample storage		✓										

Questions Technician:

1) Deployed pitfall trap?
2) Evaluated condition of pitfall trap during sample collection?
3) Checked cup for "stragglers"?
4) Filtered samples with correct fluids?
5) Preserved sample with correct fluid?
6) Completed locality label and filled in datasheet?
7) Processed catch and bycatch?
8) Grouped and stored samples?

Explain any "X" entries here and on back. Indicate question number, technician, and issue.

Q3, Phobe Buffay: Left some specimens in cup.

4. PART IV: LAB ACTIVITY

Laboratory processing of ground beetles is a multi-phased procedure. The ethanol rinse (covered in this lab activity) must be completed within 24 hours of sample collection. It is typically done by seasonal field technicians concurrent with the sorting and documentation of any vertebrate bycatch. Sorting of ground beetles from invertebrate bycatch, identification, and pinning is covered in the Insect Lab Lesson Plan.

4.1 Materials

Students should bring their protocol and datasheet(s) distributed during the classroom presentations and used during field training. Any samples collected in the field should be used during this lab activity.

Item	Quantity
Whirl-pak bags with specimens collected during the field activity	2 (or more)
All equipment needed for ethanol rinse	1 set per every 2-3 students.

4.2 Preparation

Gather all lab processing materials.

Copy Lab Assessment Checklist.

4.3 Lesson Development

1. Orient students to the lab area and chemical storage
2. Have students follow the protocol steps for the ethanol rinse. Demonstrate the swirling method used for putting specimens into suspension before emptying Whirl-pak bag.
3. Have students sort out the vertebrate bycatch.
4. Make sure they include all the necessary labeling (ethanol rinse label, determination label, and locality label)
5. Have students label (make sure they are using the correct pen and labeling tape), sort, and store samples; learning how to keep samples and labels together when using multiple sorting cups.
6. Work through filling in the sorting datasheet. Provide scenarios as needed, for example, a vertebrate with status.
7. Have students properly dispose of used chemicals and return other chemicals to their correct storage location.

4.4 Assessment Checklist

See next page.

Ground Beetle Sampling: Lab Assessment Checklist

Trainer: _____ Domain: _____
Date: _____

Directions: Use this form to assess technician skills during field training activities.
Indicate proficiency: Enter ✓ for proficient
Enter X for not proficient
Any question with an "X" should be explained below. In addition, trainer should provide direct feedback to technician in the field.

Question abbrev.		Technician/Domain	Phobe Buffaly/D21										
1	Timing		✓										
2	etOH rinse		✓										
3	Stragglers		x										
4	Documentation		✓										
5	Chemicals		✓										
6	Samples		✓										
7	Vertebrates		✓										

Questions Technician:

1) Knows required timeframe for ethanol rinse?
2) Completed ethanol rinse?
3) Checked whirlpak bag for stragglers?
4) Documented ethanol rinse on label and datasheet?
5) Handled chemicals and waste safely?
6) Stored, labeled and tracked samples?
7) Processed vertebrate bycatch?

Explain any "X" entries here and on back. Indicate question number, technician, and issue.
Q3, Phobe Buffaly: Left some specimens in cup.

5. PART IV: ON-THE-JOB TRAINING

The goal of on-the-job training (OJT) is to provide an opportunity for the trainer to pass on skills and knowledge in a manner that allows the trainee to really absorb the information and to demonstrate proficiency. Best practices for trainers to incorporate into OJT include referring to the protocol (a hard copy should always be on hand), covering workflow efficiency, and allowing the trainee to actually perform the procedure rather than simply observe.

5.1 Training/Initial Sampling Bout

During the first sampling bout, the newly trained technicians and the trainer complete the work together. The trainer should observe, demonstrate, and guide as appropriate. The Field Assessment Checklist and Lab Assessment Checklist (if applicable) can be used as a framework for determining when the newly trained technicians are ready for independent sampling.

For beetle sampling, particular aspects of the protocol that commonly pose challenges and should be thoroughly covered during OJT include:

- Navigating to the plot and the need to minimize trampling within the plot.
- Using the correct sequence of chemicals during rinsing.
- Verifying that the trap matched the locality label.
- Thoroughly rinsing catch cups and using water to squirt out any stragglers.
- Using forceps to make sure filter is at the bottom of the Whirl-pak and fully submerged.
- Compromising sample by setting forceps on ground when grabbing the bottle of ethanol, thus possibly introducing extra debris and bycatch to sample.
- Rinsing forceps into Whirl-pak to dislodge any attached specimens.
- Organizing samples so that they are grouped by plots in the cooler.
- Filling out datasheet completely, leaving no blank lines or using arrows.
- Including ethanol rinse labeling when rinsing the next day.
- Reporting vertebrate bycatch and tracking on a per plot basis.

5.2 Ongoing Check-ins

Once technicians are sampling independently, it is important for trainers to check in with the sampling crew on a regular basis. Because the field component of this protocol is typically completed in one day with fourteen days between bouts, a good time to check in is the day before while the crew is packing and preparing. Check on supply levels to determine if you going to need to order anything soon. Did the crew check datasheets from last bout to verify set date, bout number, and how many traps are set at each plot? As plots dry out through the season, are crews checking each cardinal to see if a new trap can be deployed? Have there been any recent JIRA tickets that require a change in sampling? Check-ins should also include:

- Answering any questions
- Reviewing datasheets

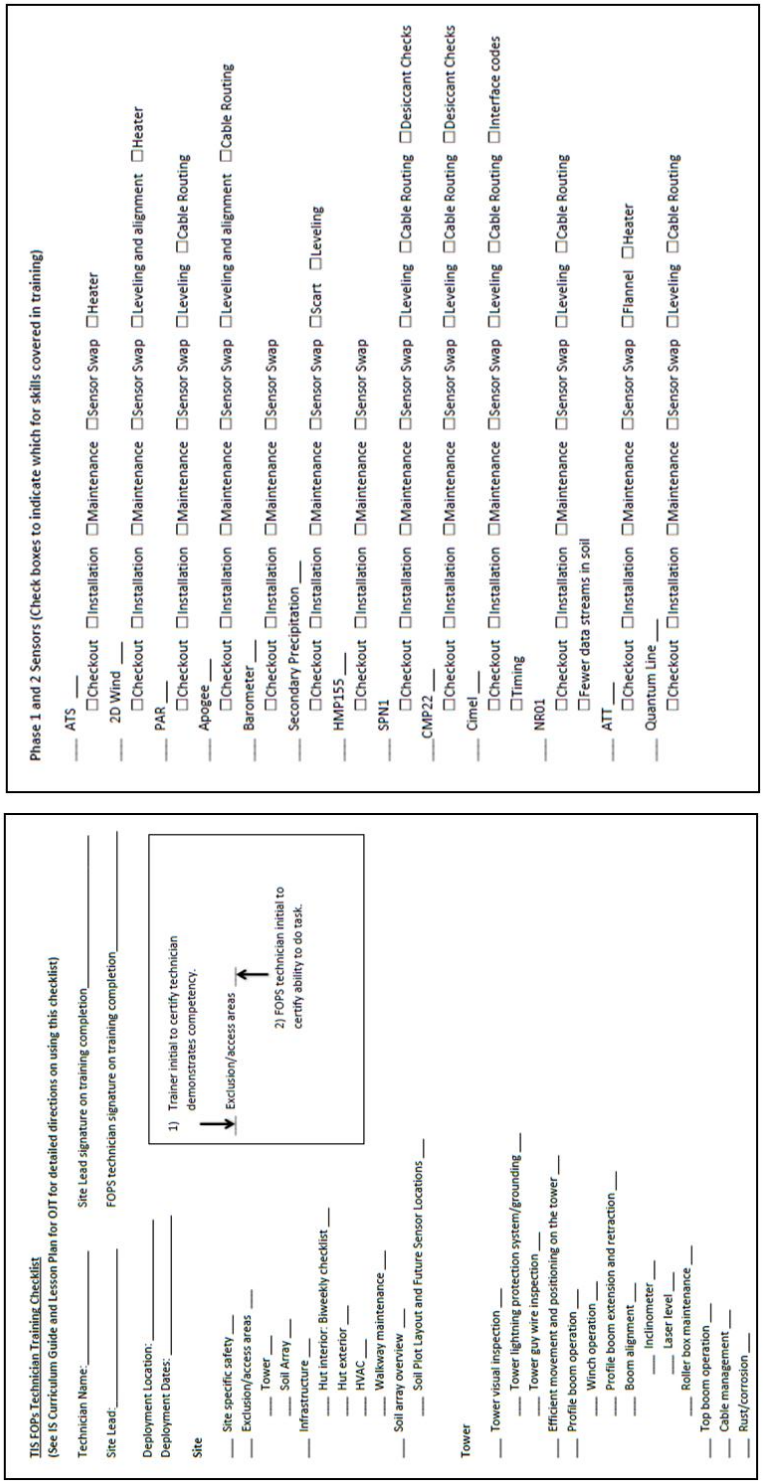
- Verifying that all the traps from the previous set were collected
- Checking sample labeling and storage
- Recording MAXIMO hours

14 APPENDIX A.2 CURRICULUM GUIDE – TABLE OF CONTENTS

Table of Contents

2016 TOS Curriculum Guide, January 2016 rev a

15 APPENDIX A.3 CHECKLIST (PARTIAL) FOR OJT OF TOWER TECHNICIANS



TIS FOPs Technician Training Checklist
(See IS Curriculum Guide and Lesson Plan for OJT for detailed directions on using this checklist)

Technician Name:_____ Site Lead signature on training completion_____

Site Lead:_____ FOPS technician signature on training completion_____

Deployment Location: _____
Deployment Dates: _____

Site

___ Site specific safety ___
___ Exclusion/access areas ___
___ Tower ___
___ Soil Array ___
___ Infrastructure ___
___ Hut interior. Biweekly checklist ___
___ Hut exterior ___
___ HVAC ___
___ Walkway maintenance ___
___ Soil array overview ___
___ Soil Plot Layout and Future Sensor Locations ___

1) Trainer initial to certify technician demonstrates competency.
→ Exclusion/access areas
2) FOPS technician initial to certify ability to do task.

Tower

___ Tower visual inspection ___
___ Tower lightning protection system/grounding ___
___ Tower guy wire inspection ___
___ Efficient movement and positioning on the tower ___
___ Profile boom operation ___
___ Winch operation ___
___ Profile boom extension and retraction ___
___ Boom alignment ___
___ Inclinometer ___
___ Laser level ___
___ Roller box maintenance ___
___ Top boom operation ___
___ Cable management ___
___ Rust/corrosion ___

Phase 1 and 2 Sensors (Check boxes to indicate which for skills covered in training)

___ ATS ___
☐Checkout ☐Installation ☐Maintenance ☐Sensor Swap ☐Heater
___ 2D Wind ___
☐Checkout ☐Installation ☐Maintenance ☐Sensor Swap ☐Leveling and alignment ☐Heater
___ PAR___
☐Checkout ☐Installation ☐Maintenance ☐Sensor Swap ☐Leveling ☐Cable Routing
___ Apogee___
☐Checkout ☐Installation ☐Maintenance ☐Sensor Swap ☐Leveling and alignment ☐Cable Routing
___ Barometer___
☐Checkout ☐Installation ☐Maintenance ☐Sensor Swap
___ Secondary Precipitation___
☐Checkout ☐Installation ☐Maintenance ☐Sensor Swap ☐Scart ☐Leveling
___ HMP155___
☐Checkout ☐Installation ☐Maintenance ☐Sensor Swap
___ SPN1
☐Checkout ☐Installation ☐Maintenance ☐Sensor Swap ☐Leveling ☐Cable Routing ☐Desiccant Checks
___CMP22___
☐Checkout ☐Installation ☐Maintenance ☐Sensor Swap ☐Leveling ☐Cable Routing ☐Desiccant Checks
___ Cimel___
☐Checkout ☐Installation ☐Maintenance ☐Sensor Swap ☐Leveling ☐Cable Routing ☐Interface codes
☐Timing
___ NR01
☐Checkout ☐Installation ☐Maintenance ☐Sensor Swap ☐Leveling ☐Cable Routing
☐Fewer data streams in soil
___ ATT___
☐Checkout ☐Installation ☐Maintenance ☐Sensor Swap ☐Flannel ☐Heater
___ Quantum Line___
☐Checkout ☐Installation ☐Maintenance ☐Sensor Swap ☐Leveling ☐Cable Routing

16 APPENDIX A.4 EXAMPLE FIELD AUDIT FORM

(TOS Protocol)

Technician(s): _____

Trainer: _____ Date:_____

Protocol: _____

Instructions to trainer: Use this form to assess technicians during the first sampling period. Any question with an answer of "No" should be explained in the "comments/recommendations" section. In addition, the trainer should provide immediate feedback to the technician.

Preparing for Field Sampling

1. Is all required equipment for field work prepared, packed, and properly stowed in field vehicle/field packs? (YES or NO)

Comments/Recommendations:

2. Does equipment include replacement parts? (YES or NO)

Comments/Recommendations:

3. Does the field crew have maps and GPS coordinates needed to properly navigate to sample locations? (YES or NO)

Comments/Recommendations:

4. Is the field crew properly attired for task? (YES or NO)

Comments/Recommendations:

Field Sampling

5. Has field crew navigated to correct sample location? (YES or NO)
Comments/Recommendations:

6. Is equipment properly set-up for sampling? (YES or NO)
Comments/Recommendations:

7. Are datasheets completed with correct information, format, and codes? (YES or NO)
Comments/Recommendations:

8. Was data collected using the proper methods and techniques, including proper and accurate use of field equipment? (YES or NO)
Comments/Recommendations:

9. Was equipment properly stowed/decontaminated? (YES or NO)
Comments/Recommendations:

10. Are specimens properly stowed for transportation? (YES or NO)
Comments/Recommendations:

Returning to Support Facility Lab

11. Was all field equipment properly cleaned and returned to correct location in the lab? (YES or NO)

Comments/Recommendations:

12. Were specimens/images properly handled and stowed in lab? (YES or NO)

Comments/Recommendations:

13. Were datasheets filed and/or scanned as needed? (YES or NO)

Comments/Recommendations:

Additional Comments:

17 APPENDIX A.5 EXAMPLE FIELD AUDIT FORM FOR SPECIFIC PROTOCOL

Measurement of Woody Vegetation Structure Protocol

Technician(s): _____

Trainer: _____ Date: _____

Instructions to trainer: Use this form to assess technicians during the first sampling period. Any question with an answer of "No" should be explained in the "comments/recommendations" section. In addition, the trainer should provide immediate feedback to the technician.

1. Is the plot size correct for the distribution of vegetation? (YES or NO)
2. Are stems properly tagged. (YES or NO)
3. Are stem/tree health properly characterized? (YES or NO)
4. Are plant identifications and species code on datasheet correct? (YES or NO)
5. If grouped saplings/shrubs present, is the group of stems properly mapped? (YES, NO, or NA)
6. If lianas are present, were DBH measurements taken at correct locations? (YES, NO, or NA)
7. Are duplicate measurements within acceptable percentage (TBD by Science) of each other and those obtained by the trainer? Use the table(s) below to record data:

a) Tree Measurements

	Tech Meas 1	Tech Meas 2	Percent Diff	% Diff Acceptable (Y or N)	Trainer Meas	Percent Diff (Trainer and Tech)+	% Diff Acceptable (Y or N)
DBH							
Canopy Diameter 1							
Canopy Diameter 2							
Tree Height – VD 1							
Tree Height – VD 2							

+Use average of technician measurements to calculate percent difference.

b) Grouped Saplings/Shrub Measurements

	Tech Meas 1	Tech Meas 2	Percent Diff	% Diff Acceptable (Y or N)	Trainer Meas	Percent Diff (Trainer and Tech)+	% Diff Acceptable (Y or N)
DBH							
Tallest Stem Height VD 1							
Tallest Stem Height VD 2							

+Use average of technician measurements to calculate percent difference.

Comments/Recommendations:

Indicate question number to which comment/recommendation applies.

Question Number: ____

Question Number: ____

Question Number: ____

Other:

Trainer/Auditor Sign-Off

Technician_____ is adequately trained and ready for independent sampling (YES or NO)

Trainer signature:

Trainer/Auditor Sign-Off

Technician_____ is adequately trained and ready for independent sampling (YES or NO)

Trainer signature: _____

APPENDIX A.6 EXAMPLE TRAINING EVALUATION

TOS Training Evaluation 2016

Your Domain/Training Location: _____ Trainer(s): _____

Protocol: _____ Date: _____

Did you read the science design before this session?	Please circle: YES or NO
Did you read the protocol before this session?	Please circle: YES or NO
Did you work for NEON during the previous field season?	Please circle: YES or NO

Please rate the quality of the following:	Excellent	Very Good	Good	Fair	Poor	NA/Don't Know
Overall content of course						
Classroom Session						
Field Practicum						
Lab Practicum						
Presentation of material by trainer						
Knowledge of material by trainer						
Amount of material covered						
Activities and exercises						

1) Was there anything you found confusing? If yes, please specify.

2) What was least valuable about this training?

3) What was most valuable about this training?

4) What would you do to improve this training?

Use back of form for additional comments as needed

2016 TOS Curriculum Guide, January 2016 rev a