Section 2
Overview of Field Operations

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This section presents a general overview of the activities that an EMAP field team conducted during a typical one-day sampling visit to a non-wadeable river site. General guidelines for recording data and using standardized field data forms and sample labels are also presented in this section. Finally, safety and health considerations and guidelines related to field operations are provided. Depending on the survey region, river sampling distances are defined as either 40 or 100 times the wetted width in the vicinity of the point of entry (Figure 2.1). One reason for the length difference is that in the Oregon river pilot, an objective is to determine a reach length that will usually yield 95% of the vertebrate species collected in a full day of electrofishing or from a reach 100 channel widths long. Note, subsequently it was found that this reach length is 85 channel widths for Oregon rivers (Hughes et al. In Review). River reaches of 40 channel widths long were used in the Mid-Atlantic region in order to make this aspect of field methods consistent between wadeable and non-wadeable streams. In eastern rivers, one 14-16 foot john boat and one 11-13 foot inflatable raft, outfitted with a 4 horse powered motor were used. The john boats were used only for electrofishing and drift net retrieval, and were outfitted with 6.6 - 15 horsepower outboard motors. Two 12-14 foot inflatable rafts were used in a large river pilot in Oregon because river access, flow, depth, obstructions and State or Federal restrictions usually made it impractical, dangerous, or impossible to use rigid boats and outboard motors. In both studies, the larger crafts were generally used on the larger or faster rivers. Two trucks were used in each survey, with one pulling a boat trailer. These boats, motors and truck configurations are only examples of what were

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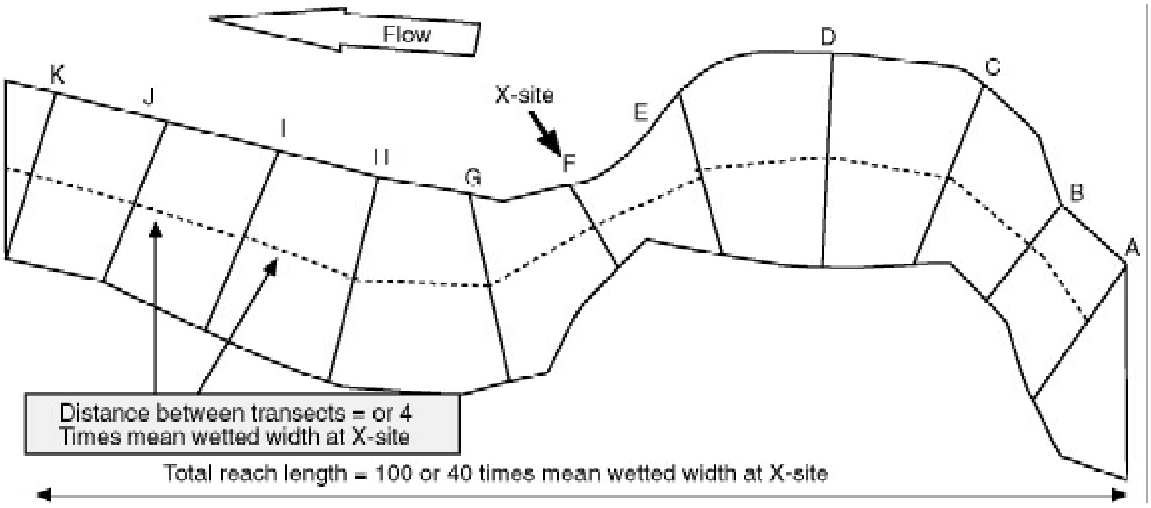

Figure 2-1. Stream reach characteristics.

used in the MAIA and Oregon Studies. Other types, numbers or sizes of boats, motors, trucks and trailers can be used as long as local boating regulations are met and the health and safety of the crews can be maintained.

2.1 Daily Operational Scenario

For western streams a 4-person field team consisted of two people in the "habitat" boat and two people in the "fish" boat. Each boat was staffed by one rower and one primary data collector. The crew in the habitat boat was primarily responsible for conducting the intensive physical habitat characterization. The crew in the fish boat is primarily responsible for collecting biological samples. Rowers assist with sampling when possible, although their primary responsibilities were rowing the rafts and river navigation. Table 2-1 presents the range of times required to conduct various field activities. Tables 2-2 a and b present the general sequence of activities conducted at each river reach for non-wadeable streams in the west and east.

In eastern non-wadeable streams a 4 or 5 person crew was used depending on whether additional research indicators were also sampled. In the eastern pilot, the electrofishing boat had 2 people while the raft crew had 2-3 people. Times presented in Table 2-1 were similar in eastern streams with the exception of additional time needed for processing additional indicator samples.

Upon arrival at a river site, the crew chief was responsible for verifying and documenting the site location, determining the length of stream reach to be sampled, and determining boat launching and retrieving locations (in the western pilot the crew chief was also establishing the required transects, Figure 2.1) (Section 4). The crew chief was also responsible for preparing samples for transport and shipment (Section 3). In addition to aquatic vertebrate sampling (Section 10), the western fish crew collected water chemistry and microbial samples (Section 5), sediment for the sediment metabolism determination (Section 8), periphyton (Section 7), macroinvertebrate samples (Sections 9),

Table 2-1. Range of Times for Field Activities.

Activity	Time Required (ranges)
Scout access locations	0 to 1.5 hours
Unload rafts and all equipment	0.5 hours
Shuttle vehicles and set up for float	0.5 to 1.5 hours
Row or float from put-in to start of reach	0 to 1 hour
Conduct field sampling activities	5 to 8 hours
Row or float from end of reach to take-out	0 to 1 hour
Load rafts and shuttle vehicles	0.5 to 1 hour
Sediment metabolism processing	0.5 hours
Sample tracking and packing	1 hour
SUMMARY	8 to 16* hours per site

*Indicates the longest total time spent on sampling activities; does not equal the sum of the greatest times spent to accomplish each task.

aquatic vertebrates (Section 10), and prepared samples for tissue contaminants (Section 11). The habitat crew conducted the intensive physical habitat characterization (Section 6), visual stream assessment (Section 12), and the habitat rower took water chemistry measurements (Section 5). The eastern three person raft crew collected all these indicators except for fish. A separate two person electroshocking crew was used for fish and also for deploying and retrieving drift nets.

2.2 Guidelines for Recording Data and Information

During the one-day visit to a river, a field team is required to obtain and record a substantial amount of data and other information for all of the various ecological indicators described in Section 1.3. In addition, all the associated information for each sample collected must be recorded on labels and field data forms to ensure accurate tracking and subsequent linkage of other data with the results of sample analyses.

It is imperative that field and sample information be recorded accurately, consistently, and legibly. Measurement data that cannot be accurately interpreted by others besides the field teams, and/or samples with incorrect or illegible information associated with them, are lost to the program. The cost of a sampling visit, coupled with the short index period, severely limits the ability to re-sample a river when the initial information recorded was inaccurate or illegible. Some guidelines to assist field personnel with recording information are presented in Table 2-3. Examples of completed data forms and labels are presented in the sections describing field sampling and measurement procedures for different indicators.

2.3 Safety and Health

Collection and analysis of samples (e.g., benthic invertebrates, fish, periphyton, sediment) can involve significant risks to personal safety and health (drowning, electrical shock, pathogens, etc.). While safety is often not considered an integral part of field sampling routines, personnel must be aware of unsafe working conditions, hazards connected with the operation of sampling gear, boats, and

Table 2-2a. General Sequence of Activities Conducted at a Non-wadeable River Reach in the West.

NOTE: Sample odd numbered site ID's along the left shore (facing downriver); sample even numbered sites along the right shore. Large obstructions or hazards may require temporary diversion.

A. Pre-Launch

1. Pack and ship the previous day's samples (if necessary).
2. Obtain ice for the day's samples.
3. At the launch site, all crew members unload all gear and sample containers. During unloading, no time is spent loading the boats, setting up gear, etc.
4. Two crew members each shuttle a vehicle to the take-out. The two remaining crew members load each boat, label sample containers, and prepare data sheets and clipboards. The crew chief determines the transect length.
5. Set macroinvertebrate drift nets at the most ideal location (put-in or take-out ramps).
6. The shuttlers return, and all crew members complete loading preparations and launch.

B. Sampling Procedures

1. If a float is required to reach the first transect, this time should be spent completing all data form headers, labeling, situating gear on the rafts, etc. If no float, proceed to step B-2.
2. At Transect A, the habitat crew implements the habitat sampling protocol and records the GPS coordinates. The fish crew sets up the electroshocking equipment, and takes the site identification and river photos.
3. Floating between transects (e.g., Transect A downriver to Transect B, a laser rangefinder can be used to measure between transects), the habitat crew collects thalweg measurements in the deep part of the channel while the fish crew electrofishes along the designated shoreline. Both rafts cease this activity when the next transect is reached.
4. Upon reaching each transect, the habitat and fish boats pull over and "tie-off" at the designated shoreline.
   a) Habitat boat duties: The rower takes all measurements requiring instruments while the habitat lead records the measurements on field sheets. The rower then collects shore macroinvertebrate samples while the habitat lead completes the remainder of the data form and marks the transect location on the topographic map.
   b) Fish boat duties: The fish ID specialist processes the catch (identification, measurements, weights) while the rower records. Appropriate specimens are retained and stored on board. Additionally, the rower collects sediments and periphyton samples.
   c) Sample container labeling: For QA purposes, the person responsible for taking certain samples should be the one to label the sample containers for those samples.
5. Repeat steps B-3 and B-4 for each transect.
6. At the final transect (Transect K), water chemistry and microbial samples are collected.

C. Take-Out Duties

1. At the take-out location, two crew members process macroinvertebrate and periphyton composite samples, and set up for sediment metabolism processing. The two other crew members unload the rafts and load the equipment into the vehicle. All crew members assist with loading the rafts onto the trailer.
2. The crew chief reviews data forms while the other crew members tie down the rafts, clean thoroughly and stow equipment, and ready the vehicles. Data forms are reviewed for completeness, accuracy, and legibility.
3. Call in to supervisor and declare "Off River Safely."
4. Proceed to lodging facility. Take the final DO reading for sediment metabolism.

Table 2-2b. General Sequence of Activities Conducted on Eastern Non-Wadeable Streams.

NOTE: Sample odd numbered site ID's along the left shore (facing downriver); sample even numbered sites along the right shore. Large obstructions or hazards may require temporary diversion.

In the Mid-Atlantic Pilot non-wadeable sampling required two boats operating independently of each other. One boat (the fish crew) was responsible for fishing the river reach and the other boat (the bio-hab crew) collects the physical habitat, chemistry, macroinvertebrates, periphyton, and sediment (respiration and toxicity) samples, and fills in the site verification, site assessment, and TM validation forms.

A. Pre-Launch

1. Before beginning to sample, assess the river for the applicability of wadeable stream or non-wadeable stream protocols. If 50% or greater of the river reach is wadeable, than EMAP-SW Stream (Wadeable) Protocols are to be used. If not, EMAP-SW River (Non-Wadeable) Protocols will be used. For rivers non-wadeable throughout the thalweg but wadeable along the shoreline, shock thalweg and as much of the shoreline with non-wadeable protocols as possible.
2. If River protocols are used, then only one side of the river is sampled. If the site number is odd the left side (facing downstream) of the river is sample. Even numbered sites are sampled on the right side.
3. If 'X' is easily accessible, verify, using maps and GPS, its location and collect chemistry samples before traveling to the upper end of the study reach (Transect K). If 'X ' is not easily accessible, travel to the point which you believe will be the upper end of the study reach.
4. Determine average river width using one of three methods (listed in order of preference):
   a. If at 'X' measure wetted width using the rangefinder or tape;
   b. If 'X' is not accessible, estimate width based on width at nearest river crossing; or
   c. Estimate width from the 7.5 minute USGS topo map.
5. Once average width has been determined, multiply it by 40 to determine reach length to be sampled (e.g., Width=80m, reach length =3200m).
6. Once 'X' has been verified, the fish crew and one of the bio-hab crew members, travels upstream, by river or road, to the top of the reach (Transect K) and begins sampling, the bio-hab person that has gone with the fish crew drives the fish crew vehicle and trailer to the take out area and regroups with the bio-hap crew. While the fish crew and bio-hab person are launching and returning, respectively, the other two bio-hab crew members travel downstream to the bottom of the reach (Transect A) to set the drift nets.

B. Sampling Procedures

1. After setting the drift nets (drift nets should not be set by one person alone in a boat) and meeting up with the one bio-hab person that has returned the fish crew vehicle/trailer, the bio-hab crew travels to the top of the reach and begins sampling.
2. The fish crew will work downstream collecting fish through the entire reach.
3. At the end of the reach, the fish crew begins sorting fish for vouchers, tissue, and biomarkers.
4. Once the fishing crew has cleared the area, the bio-hab boat may begin their sampling of the transect. At each transect, the bio-hab boat will beach and collect physical habitat information, macroinvertebrates, periphyton, and sediment. All samples are combined with previous samples of that type (e.g., all macroinvertebrate kick samples are combined, all periphyton samples are combined and all sediment samples are combined. Sediment samples may be collected using grab samples and/ or ponar sampler.
5. Between transects the bio-hab crew will measure thalweg depths, substrate and channel form.
6. The 6th transect (Transect F) downstream should be where you verified 'X'. Chemistry samples need to be collected. TM validation form needs to be completed. Secchi depth needs to be measured and recorded in one of the comment sections on the "Field Measurements Form-Streams/Rivers".
7. Proceed downstream collecting transect, thalweg, and biology samples as in the upper half of the stream reach.

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Table 2-2b. Continued.

8. At the bottom of the reach (Transect A), the bio-hab crew sets-up metabolism, bags sediments for toxicity, collects drift nets (if deployed) and processes macroinvertebrate and periphyton samples.
9. Bio-hab crew joins fish processing or begins shuttling vehicles and carrying equipment to the vehicles.

C. TAKE-OUT DUTIES

1. At the take-out location, two crew members process macroinvertebrate and periphyton composite samples, and set up for sediment metabolism processing. The two other crew members unload the rafts and thoroughly clean and load all the equipment into the vehicle. All crew members assist with loading the rafts onto the trailer.
2. The crew chief reviews data forms while the other crew members tie down the rafts, stow equipment, and ready the vehicles. Data forms are reviewed for completeness, accuracy, and legibility.
3. Call in to supervisor and declare "Off River Safely."
4. Proceed to lodging facility. Take the final DO reading for sediment metabolism.

Table 2-3. Guidelines for Recording Field Data and Other Information.

Activity	Guidelines
	Field Measurements:
Data Recording	Record measurement values and/or observations on data forms preprinted on water-resistant paper. Record information on forms using No. 2 pencil only. Erase mistakes completely and write the correct value whenever you can. If you must line out an incorrect value, place the correct value nearby so the data entry operator can easily find it. Headers on the second pages of all forms link the data. Fill in all headers of all pages (to save time this can be filled out the night before if site is known to be accessible) or data will be lost (this is a good one to review at the end of the day). Record data and information so that all entries are obvious. Enter data completely in every field that you use. Follow the "comb" guidelines--print each number or letter in the individual space provided. Keep letters and numerals from overlapping. Record data to the number of decimal places provided on the forms. Illegible information is equivalent to no information. Print neatly, using block capital letters in alphabetical fields. Clearly distinguish letters from numbers (e.g., 0 versus O, 2 versus Z, 7 versus T or F, etc.). Do not put lines through 7's, 0's, or Z's. Do not use slashes. Record information on each line, even if it has to be recorded repeatedly on a series of lines (e.g., fish species codes or physical habitat characteristics). Do not use "ditto marks" (") or a straight vertical line. When recording comments, print or write legibly. Make notations in comments field only. Avoid marginal notes, etc. Be concise, but avoid using abbreviations and/or "shorthand" notations. If you run out of space, attach a sheet of paper with the additional information, rather than trying to squeeze everything into the space provided on the form.
Data Qualifiers (Flags)	Use only defined flag codes and record on data form in appropriate field. K Measurement not attempted and/or not recorded.

(continued)

Table 2-3. Continued.

Activity	Guidelines
	Field Measurements:
	Q Failed quality control check; re-measurement not possible. U Suspect measurement; re-measurement not possible. Fn Miscellaneous flags (n=1, 2, etc.) assigned by a field team during a particular sampling visit (also used for qualifying samples). Explain all flags in comments section on data form.
Review of Data Forms	Field team reviews data forms for accuracy, completeness, and legibility before leaving a river. Data forms from all teams are reviewed for completeness, accuracy, and legibility before transfer to the information management staff.
	Sample Collection and Tracking
Sample Labels	Use adhesive labels with preprinted ID numbers and a standard recording format for each type of sample. Record information on labels using a fine-point indelible marker. Cover completed labels with clear tape.
Sample Collection Information	Record sample ID number from the label and associated collection information on sample collection form preprinted on water-resistant paper. Record information on field data forms using No. 2 pencil only (fine-point indelible fine-tipped markers can be used if necessary). Record collection information using correct format as provided on the collection form.
Sample Qualifiers (Flags)	Use only defined flag codes and record on sample collection form in appropriate field. K Sample not collected or lost before shipment; re-sampling not possible. U Suspect sample (e.g., possible contamination, does not meet minimum acceptability requirements, or collected using a nonstandard procedure) Fn Miscellaneous flags (n=1, 2, etc.) assigned by a field team during a particular sampling visit (also used for field measurements). Explain all flags in comments section on sample collection form.
Review of Labels and Collection Forms	The field team compares information recorded on labels and sample collection form for accuracy before leaving a stream. The field team reviews labels and collection form for accuracy, completeness, and legibility before leaving a stream. Sample collection forms are reviewed for completeness, accuracy, and legibility before transfer to the information management staff.

other risks (Berry et al., 1983). Personnel safety and health are of the highest priority for all investigative activities and must be emphasized in safety and health plans for field, laboratory, and materials handling operations. Preventive safety measures and emergency actions must be emphasized. Management should assign health and safety responsibilities and establish a program for training in safety, accident reporting, and medical and first aid treatment. Safety documents and standard operating procedures (SOPs) containing

necessary and specific safety precautions should be available to all field personnel. Additional sources of information regarding field and laboratory safety related to biomonitoring studies include Berry et al. (1983), U.S. EPA (1986) and Ohio EPA (1990).

2.3.1 General Considerations

Important considerations related to field safety are presented in Table 2-4. It is the responsibility of the group safety officer or project leader to ensure that the necessary safety courses are taken by all field personnel and that all safety policies and procedures are followed. Sources of information regarding safety-related training include the American Red Cross (1989), the National Institute for Occupational Safety and Health (1981), U.S. Coast Guard (1987) and Ohio EPA (1990).

Persons using sampling devices should become familiar with the hazards involved and establish appropriate safety practices prior to using them. Individuals involved in electrofishing must be trained by a person experienced in this method or by attending a certified electrofishing training course. Reynolds (1983) and Ohio EPA (1990) provide additional information regarding electrofishing safety procedures and practices.

Because boats are used to access sampling sites, personnel must consider and prepare for hazards associated with water conditions (e.g., obstacles, rapids), safe loading and unloading of rafts, and the operation of motor vehicles, tools, and other incidental equipment. Boat operators should be familiar with U.S. Coast Guard rules and regulations for safe boating contained in a pamphlet, "Federal Requirements for Recreational Boats, "available from a local U.S. Coast Guard Director or Auxiliary or State Boating Official (U.S. Coast Guard, 1987). The electrofishing raft must have a fire extinguisher, and both rafts must have whistles, Personal Flotation Devices (PFD) and communication devices.

A communications plan to address safety and emergency situations is essential. All field personnel need to be fully aware of all lines of communication. Field personnel should have a daily check-in procedure for safety. An emergency communications plan should include contacts for police, ambulance, fire departments, and search and rescue personnel.

Proper field clothing should be worn to prevent hypothermia, heat exhaustion, sunstroke, drowning, or other dangers. Field personnel should be able to swim. PFD's must always be worn while in the boat, and felted wading boots must be available for use when crew members are sampling outside of the raft.

Many hazards lie out of sight in the bottoms of rivers. Broken glass or sharp pieces of metal embedded in the substrate can cause serious injury if care is not exercised when walking or working with the hands in such environments. Infectious agents and toxic substances that can be absorbed through the skin or inhaled may also be present in the water or sediment. Personnel who may be exposed to water that is known or suspected to contain human or animal wastes or that carry causative agents or pathogens must be immunized against tetanus, hepatitis, typhoid fever, and polio. Biological wastes can also be a threat in the form of viruses, bacteria, rickettsia, fungi, or parasites. [Note that nearly one-third of Oregon river reaches sampled in the summer of 1997 supported bacteria exceeding or

Table 2-4. General Health and Safety Considerations.

Training:

- First aid
- Cardiopulmonary resuscitation (CPR)
- Swiftwater rescue
- Vehicle safety (e.g., operation of 4-wheel drive vehicles)
- Boating and water safety
- Field safety (e.g., weather conditions, personal safety, orienteering, reconnaissance of sites prior to sampling)
- Equipment design, operation, and maintenance
- Electrofishing safety
- Handling of chemicals and other hazardous materials

Communications

- Check-in schedule
- Sampling itinerary (vehicle used and its description, time of departure, travel route, estimated time of return)
- Contacts for police, ambulance, fire departments, search and rescue personnel
- Emergency services available near each sampling site and base location
- Radios for boat to boat communications and cell phones for emergancies.

Personal Safety

- Field clothing and other protective gear
- Medical and personal information (allergies, personal health conditions)
- Personal contacts (family, telephone numbers, etc.)
- Physical exams and immunizations

closely approaching body contact standards. Microbes can be transferred from fish or the water itself, so wash hands before eating and avoid contact between open wounds and water or fish].

Prior to a sampling trip, personnel should determine that all necessary equipment is in safe working condition. Good housekeeping practices should be followed in the field. These practices protect staff from injury, prevent or reduce exposure to hazardous or toxic substances, and prevent damage to equipment and subsequent down time and/or loss of valid data. It is also recommended that at least one person on each crew should have First Aide and CPR training, especially if the crew(s) are electrofishing.

2.3.2 Safety Equipment and Facilities

Appropriate safety apparel such as PFD's, felted wading boots, lab coats, insulated gloves, safety glasses, etc. must be available and used when necessary. It is recommended that whenever two boat crews are used there are some type of communication devices on board each boat so that they can keep in contact with each other for both safety and logical reasons.

First aid kits, fire extinguishers, and blankets must be readily available in the field. A properly installed and operating fume hood must be provided in the laboratory for use when working with carcinogenic chemicals

(e.g., formaldehyde, formalin) that may produce dangerous fumes. Cellular telephones or portable radios should be provided to field teams working in remote areas for use in case of an emergency. Facilities and supplies must be available for cleaning of exposed body parts that may have been contaminated by pollutants in the water. Soap and an adequate supply of clean water or ethyl alcohol, or equivalent, should be suitable for this purpose.

2.3.3 Safety Guidelines for Field Operations

General safety guidelines for field operations are presented in Table 2-5. Personnel participating in field activities on a regular or infrequent basis should be in sound physical condition and have a physical exam annually or in accordance with Regional, State, or organizational requirements. All surface waters and sediments should be considered potential health hazards due to toxic substances or pathogens. Persons must become familiar with the health hazards associated with using chemical fixing and/or preserving agents. Formaldehyde (or formalin) is highly allergenic, toxic, and dangerous to human health (carcinogenic) if utilized improperly. Chemical wastes can cause various hazards due to flammability, explosiveness, toxicity, causticity, or chemical reactivity. All chemical wastes must be discarded according to standardized health and hazards procedures (e.g., National Institute for Occupational Safety and Health [1981]; U.S. EPA [1986]).

Table 2-5. General Safety Guidelines for Field Operations

- The two rafts must be in view of each other while floating down rivers or streams.
- The river must be adequately scouted prior to sampling to avoid potential hazards (e.g., dangerous rapids, obstacles, sweepers, wood jams, portage locations).
- Exposure to river water and sediments should be minimized as much as possible. Use gloves if necessary,
  and clean exposed body parts as soon as possible after contact.
- All electrical equipment must bear the approval seal of Underwriters Laboratories and must be properly grounded to protect against electric shock.
- Use heavy gloves when hands are used to agitate the substrate during collection of benthic macroinvertebrate samples and when turning over rocks during hand picking.
- Use appropriate protective equipment (e.g., gloves, safety glasses) when handling and using hazardous chemicals
- Persons working in areas where poisonous snakes may be encountered must check with the local Drug and Poison Control Center for recommendations on what should be done in case of a bite from a poisonous snake.

  Carry a snake bite kit and be familiar with its use.

- Any person allergic to bee stings, other insect bites, or plants must take proper precautions and have any needed medications handy.
- Field personnel should also protect themselves against the bite of deer or wood ticks because of the potential risk of acquiring pathogens that cause Rocky Mountain spotted fever and Lyme disease.
- All field personnel should be familiar with the symptoms of hypothermia and know what to do in case symptoms occur. Hypothermia can kill a person at temperatures much above freezing (up to 10°C or 50°F)
  if he or she is exposed to wind or becomes wet.
- Handle and dispose of chemical wastes properly. Do not dispose any chemicals in the field.

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