Guidelines for Collecting Ephemeral Data in the Arctic: SAND BEACH AND TIDAL FLAT INFAUNA

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Note: These guidelines are limited data collection aides that do not necessarily consider all possible scenarios under which samples may be collected. Use best professional judgment to modify these guidelines according to area-specific field conditions.

Guidelines Objectives

The primary objective of this document is to provide guidelines on collecting infauna samples from sand beaches and tidal flats during the early stages of an oil spill in the Arctic to support Natural Resource Damage Assessment (NRDA) exposure and injury evaluations.

Sampling Objectives

Characterize oil

- Determine the concentration and composition of oil compounds in sand beach and tidal flat habitats compared to background concentrations
- Determine the source of contamination via chemical fingerprinting analysis and characterize oil weathering and fate

Describe habitat

- Estimate the areal extent and degree of oiling in sand beach and tidal flat habitats
- Document the presence/absence and species composition, and estimate the abundance or density of sand beach and tidal flat infauna

Study exposure

- Document the extent and duration of exposure to the spilled material and its bioavailability
- Measure oil-related compounds in biological tissues
- Support exposure and transport modeling

Quality assurance/quality control

- Ensure the integrity of the sample(s) throughout sampling, transport, and storage
- Ensure the reliability of chemical and biological characterizations

Collaboration

- Support other ongoing efforts (see Intertidal and Subtidal Sediment guidelines)

Before Field Sampling

- Assure that all personnel have required safety training and protective equipment for Arctic field work (not described in this guideline).
- Arctic weather conditions (e.g., wind direction and speed) are variable within a short timeframe. Be prepared for changing weather conditions, be aware of your surroundings and take precautions to ensure the safety of the sampling team.

Study design

- It is important to have a defined sampling strategy prior to conducting fieldwork. Sand beach/tidal flat infauna are difficult to sample because of their inherent heterogeneity over space, depth, and time.
- The following terminology is used to define general to specific sampling geographies:
  - Area = general area of uniform characteristics, such as degree of oil exposure, physical setting, habitat types present, etc.
  - Location = a specific location that is representative of the area and contains the type of habitat to be sampled, such as a barrier island or lagoon
  - Transect = a line through a site along which samples are collected or observations are made
  - Site = a specific point at which samples are collected or observations are made
- Plan ahead the number of locations and number of sites per location, taking into account level of effort, potential logistical limitations, weather conditions, etc. that may compromise sample integrity.
- Consult ESI maps, state resource guides and other resources to determine what infauna may be present in the sampling area. Adjust the sampling strategy accordingly to target key species of interest.
- Review the guideline and resolve any area-specific issues. Area-specific modification of the guideline may be needed based on environmental conditions, geography, access to remote areas, and shipping capabilities.
- Use a computer or conceptual model of the extent of sand beach/tidal flat contamination or an appropriate power analysis to estimate the number of sampling locations and number of samples per site needed to respond to the sampling objectives.
- A stratified random sampling approach, which divides the sampling location into non-overlapping zones (strata) from which random samples are collected, is recommended if no other sampling strategy has been developed. This type of sampling improves the representative quality of samples by reducing sampling error (variability).
- Contact the laboratories that will be receiving field samples for analysis and assure that they have the capacity to receive and analyze samples from the study. Follow relevant guidelines from the laboratory and consult with them about necessary modifications.
- Shoreline visualization tools (e.g., ESI maps, satellite images, ShoreZone) should be used to develop a sampling strategy and estimate distances, number of sampling transects, transect spacing, sampling zone width, etc. before going into the field.
- The sampling strategy should have flexibility to be adjusted based on conditions in the field.
- Consult appropriate guidelines for the collection of other environmental media and biota concurrent with sand beach/tidal flat infauna sampling. Tarballs, sheens, or other oil residues can be collected opportunistically for chemical analysis and fingerprinting.

Equipment

- Review the list of sampling equipment/containers, make adjustments as needed, and assure that all essential field materials are ready to be taken to the field.
- If not all sampling equipment is available, consult the alternative equipment guidelines or determine if other appropriate options are available.
- Consider area-specific conditions for remote Arctic regions and make adjustments in methodology and equipment as necessary.
- It may be necessary to coordinate with the laboratory that will receive the samples to assure that acceptable materials and conditions are used for sampling and sample storage and shipping.
- Do as much material preparation prior to field deployment, including: labeling sample jars using permanent markers or laboratory labels (e.g., peel and stick waterproof labels); solvent rinsing of jars and aluminum foil for sample storage, etc.

- Make sure that all essential equipment is in working order and operational under Arctic field conditions, and that spare equipment and/materials are available.
- Store solvents carefully to prevent spillage. Follow regulations regarding the shipment and storage of chemicals.

Sampling Areas and Timing

- Follow a sampling plan/work plan if one is available.
- If a sampling plan is not available for ephemeral data collection immediately after a spill, data collection should focus on collecting samples from a range of unoiled, likely to be oiled, and already oiled areas.
- It is important to obtain reliable data that account for spatial and temporal variations of oil impacts.
- When sampling in remote areas with limited shipping capabilities, plan ahead to make sure that the integrity of samples is not compromised by ensuring that the processing laboratory receives the samples within their recommended holding time. Remember that it may take multiple days for shipments from remote areas to reach a laboratory facility. This last stage is the most important and requires due diligence until the samples are safely delivered.
- The number of locations and number of sites per location need to be considered accordingly, making sure that there is enough space in the coolers to accommodate all samples without sacrificing their integrity.
- Plan all sampling strategies within daylight hours; sampling in the dark, even with headlamps, is not recommended. This guideline may not apply during winter or much of the fall.
- The challenges of collecting samples in remote areas, particularly during winter, are great and require adequate planning and careful field implementation to attain the data quality required to meet the objectives of the sampling plan.

Area selection

- Sampling locations should be representative of areas that have been or may be oiled and unoiled reference areas.
- Use trajectory models, conceptual models, overflight information, SCAT data, or other tools to determine what locations have been oiled and which ones are likely to be oiled.
- Samples should also be collected from locations known or suspected to be impacted by other natural or anthropogenic sources of contamination (e.g., oil seeps, coal, peat, mining, combustion engines), as these will be important to differentiate background sources and levels of contamination.
- It may be necessary to prioritize sampling locations. In this case, highest priority samples are to be collected from oiled sand beach and tidal flat areas that are sensitive habitats, biologically productive, or highly relevant for human use. Collecting pre-oiled samples from sensitive/productive areas that are likely to be oiled by the spill in the near future is also a priority. Sampling at unoiled “control” areas and sampling other sources of contamination should be prioritized based on the ephemerality of the data and relative importance to developing a NRDA case.
- Infauna samples should be collected pre-oiling, if possible, as soon as practical after oiling, and periodically thereafter. Sampling frequency is a function of oil persistence, biological community, habitat importance, and resource availability and should be defined in the study design.
- The number of locations and number of sites per location should be defined in the study design. A minimum guideline for collecting sand beach and tidal flat infauna is at least three samples per tidal zone per location of relatively uniform oiling exposure. If logistical limitations are a concern, prioritize sample collection by selecting a minimum of one reference/pre-oiling location and two heavily oiled locations.
- Sample along exposure gradients, starting in the cleanest zone, at regular intervals proportional to the exposure area.

Collaboration

- Infauna samples can be collected in conjunction with intertidal and subtidal sediment sampling, nearshore water sampling, and stranded oil sampling.
- Close collaboration and coordination with other ongoing ephemeral sampling efforts are important.

Field Sampling Methods

Sampling Equipment/Containers

Note: The amount of equipment required depends on the sampling plan, desired sample volumes, and logistics. Analytical laboratories may provide required sampling and sample storage and transport materials – contact the receiving lab before preparing to collect samples in the field.

- Coolers – for sample storage and transport
- Ice packs/collapsible jugs − for storage temperature regulation (if ambient temperature exceeds 4°C)
- Thermometer or temperature logger (1 per cooler)
- Disposable nitrile gloves (preferred), insulated nitrile-coated gloves (less ideal)
- Insulated shoulder-length rubberized gloves preferred for infauna sampling under extreme cold conditions
- Sampling jars – 4 or 8 oz certified organic-clean jars with Teflon-lined lids and labels
- Surveying supplies – site markers (appropriate for substrate type), surveying flags and tape, quadrats (0.25 m^2 and 1.0 m^2), 30 m fiberglass tape measure marked in cm, hand counter, field balance, caliper, box screen with 5 mm mesh, sieve with 0.5 mm mesh, hand coring device (cylindrical, 0.01 m^2 or similar size), rubber stopper for coring device
- Pencils, waterproof pens, waterproof labels, markers
- Large tub or bucket
- Pre-cleaned aluminum foil
- Sample bags/jars
- Shovel
- 10% buffered formalin (in seawater) (preferred), or in 95% ethanol (less ideal) – for sample preservation; and a stain (such as Rose Bengal) if appropriate
- Field Sample forms (template in Appendix A)
- Chain of Custody forms (see Chain of Custody guideline)
- Evidence tape (see Chain of Custody guidelines)
- GPS, camera (with spare batteries), and photo scales
- Shoreline terminology code list and shoreline assessment survey guidelines (see Stranded Oil guidelines)
- Field sample forms (sand beach fauna identification field guides/charts), field notebook (waterproof paper), random number table sheets, shoreline oil terminology code list, other guidelines as needed (Field Photography, Subtidal and Intertidal Sediment guidelines)
- Packaging materials for glass jars (e.g., bubble wrap, sorbent pads, tape) – may be provided by the laboratory
- Suitable disposal bags for oiled PPE and disposable sampling materials

Optional (if single-use sampling equipment is not available):

- Sufficient quantities of pre-cleaned or disposable, single-use equipment are preferable. If equipment will be reused in the field, decontamination is necessary and will require the following materials:
  - Reusable sampling equipment
  - Solvents for cleaning sampling equipment – acetone, methanol, or hexane (Capillary GC Pesticide Residue Grade or equivalent) – consider shipping/airline regulations for solvents

  - Teflon solvent squirt bottles
  - Laboratory-grade, certified-clean distilled water (preferred), store-bought distilled water (less ideal); laboratory-grade detergent
  - Approved, sealed container for collecting solvent rinsate for disposal

Quality Assurance/Control

- Rinsate blanks should be collected if there is a risk of cross contamination from reuse of sampling equipment. After cleaning the equipment in accordance with the procedures described in this method, rinse the clean equipment with solvent or cleaning solution and collect the rinsate in a sample jar. Note on the field sample form where and how rinsate blanks were collected.

Good Sampling Practices and Decontamination

- Good field practices and the development of a consistent sampling routine will help provide for the integrity of the samples and their validity in environmental assessments.
- Disposable nitrile gloves should be worn when sampling and changed between each sample collected or as necessary to prevent cross contamination.
- Disposable nitrile gloves can be worn over low-profile insulated gloves (e.g., neoprene gloves) in cold conditions and should be changed between samples to prevent cross contamination if they become contaminated or damaged. If nitrile gloves are not available or will not fit over insulated gloves in cold conditions, insulated nitrile-coated gloves may be an alternative, but extra precautions will have to be taken to prevent sample contamination; gloves will need to be cleaned with soap and clean water between samples and should not come in contact with the sample or with the surfaces of glassware or tools that will be in direct contact with the sample. Similar precautions should be taken when using insulated shoulder-length rubberized gloves.
- To reduce the need for field decontamination, use pre-cleaned and/or disposable equipment and tools (e.g., pre-cleaned stainless steel spoons).
- The only equipment to be used between sites is a shovel, which should be cleaned with soap and clean water. Alternatively, use a clean dry towel or other dry material to clean the shovel before its next use. Repeated digging in clean sediments can be a last resort for cleaning the shovel. Additional cleaning may be required when working at oiled sites (see below).
- If disposable sampling equipment are not available, reusable sampling equipment MUST be decontaminated between samples collected for chemical analysis:
  - Wash sampling equipment with laboratory-grade detergent and clean with a triple clean-water rinse. Cleaning with laboratory-grade water is preferred, though store-bought distilled water is a less ideal alternative and, as a last resort, “background” water from an up-current clean area can be used
  - Rinse with methanol or acetone, followed by hexane (Capillary GC Pesticide Residue Grade or equivalent). Collect solvent rinsate for proper disposal or shipment to the lab as a rinsate blank. Allow solvents to evaporate from equipment before use. Do not work with solvents downwind of exhaust or other airborne hydrocarbon source. If solvents are not available, use a diluted detergent solution and fresh water, followed by a distilled water rinse. If transporting solvents is not feasible, use single-use sampling material
- Take precautions to avoid cross-contamination of the site from oil on boots, shovels, and other equipment. Sampling unoiled areas first, then lightly oiled areas and finally heavily oiled areas can minimize cross contamination. Personal equipment should be exchanged or cleaned between sites if it becomes contaminated.

Study Design Implementation

- If recent SCAT data are available, it may not be necessary to conduct an overflight or ground survey. Otherwise, if practical, conduct an overflight of the entire affected area within two hours of low tide

(before or after to locate sand beaches and tidal flats and observe the extent of visible contamination). Note that weather, particularly fog, may dictate survey times that may not coincide with tides. Tides may not be a consideration along high Arctic shorelines where tidal range is small and water level is primarily wind driven.

- If an aerial survey is not feasible, survey from the ground. Use topographic maps, nautical charts, vertical aerial photographs, or other detailed maps to record observations. Set a GPS in track mode and take a photograph of the date/time screen so photographs can be geo-referenced later. Observations should include:
  - Locations and approximate lengths of sand beaches and tidal flats in the oiled area
  - Degree of oiling of these habitats (use standard SCAT terminology; see Stranded Oil guideline)
  - Locations of access points, major landmarks, and potential ground-truth and reference stations
- Consider the accessibility of the locations for several methods of access (e.g., plane, helicopter, boat, foot, etc.). It may not be possible to safely access all locations of interest for sampling.
- Mud and glacial silt flats present unique safety risks - people and equipment can become stuck.
- At each selected sampling location, conduct a preliminary visual survey of the shoreline and draw a field sketch showing:
  - Shoreline orientation, type, grain size, etc.
  - Extent and degree of shoreline oiling (use shoreline oil terminology codes and % cover charts)
  - Type or degree of shoreline cleanup, if already performed (particularly note sediment disturbance or removal, flushing of oil and/or sediments into down-slope areas, etc.)
- At each selected location, establish at least three transects at least 30 m spacing apart (Figure 1).

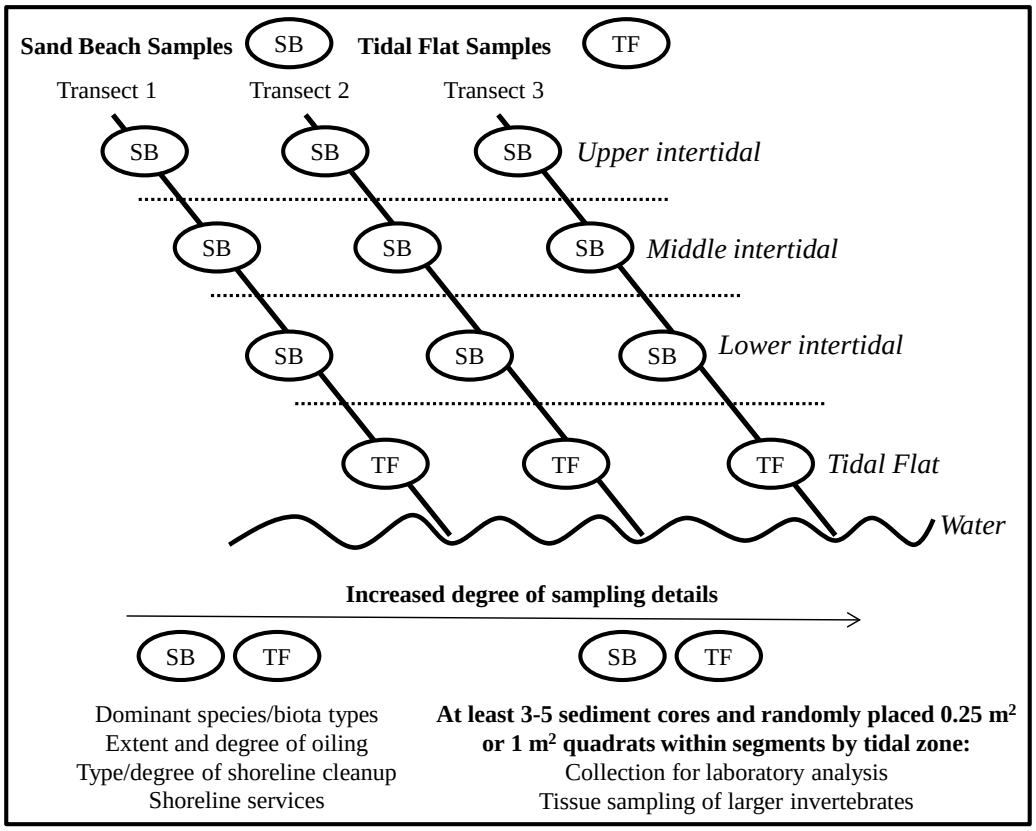

Figure 1. Schematic representation of the recommended sand beach/tidal flat sampling strategy, including transects and sampling sites. Dashed lines represent approximate tidal zones. SB= sand beach, TF= tidal flat. Area-specific modifications may be needed. For example at locations with very narrow intertidal zones, only one or two sampling intervals may be used.

- If no other sampling strategy has been developed, use a stratified random sampling approach by randomly selecting the first transect starting point and expanding the sampling site (other transects) systematically into a grid from that initial point. Randomly select sampling sites within each intertidal zone intervals.
- When establishing ground transects:
  - Record transect location using a GPS, but also accurately plot the transect on a map or aerial photograph (if available)
  - Permanently mark transect locations using "front and back" stakes that line up along the transect lines, and consider stake placement carefully to minimize loss to vandalism, erosion, ice-scouring, etc. Label the stakes to clearly identify the site as a NRDA sampling location. Assure that stakes do not present a hazard to people traveling by ATV or snow machine
  - Record the transect angle with a compass so it can be re-surveyed at a later date, even if one stake is lost; note whether the angle reading is magnetic or corrected to true north
  - Take photographs of the transect at the beginning, middle and end, including upslope, downslope, and longshore images. This takes little time and establishes a reference for future work
- If possible, run transects so that the lower intertidal area can be sampled within two hours of low tide (before or after). In the Chukchi and Beaufort Seas the tide range is limited (<30 cm); wind-driven storm surge is the most determinant factor in water height and should be considered when sampling. Tides are only a consideration south of the Bering Strait where the tidal range is >1 m. Transects should be run perpendicular to the shoreline and encompassing the entire intertidal zone, including the supratidal zone (e.g., first barrier or the vegetation line). This is important because in the Arctic storms are likely to push oil into the suptratidal zone. If feasible, include the lowest accessible tidal flat zone.
- If time/tide constraints exist, focus on sampling the lower and middle intertidal, and the upper edge of the tidal flat.
- On some high-Arctic shorelines, the intertidal zone may be very narrow. If this is the case, two sampling intervals can be defined on each transect, in the upper (or storm surge) and lower intertidal zone, or just one station if the intertidal zone is very narrow.
- Along each transect, use standard oiling terminology codes and estimation charts to record in field sample forms or field notebooks:
  - Date, time, weather conditions (e.g., wind direction and speed), tide level (as observed), and initials of observers
  - Distance of the interval
  - Physical setting (shoreline orientation, exposure to wave energy and tidal currents, etc.)
  - Length of the transect (in meters) and of the sampling zone
  - Sediment type and grain-size (e.g. mud, sand, mixed sand and gravel, etc.)
  - Dominant species or types of biota present (including signs of infaunal organisms such as burrows, worm tubes, fecal mounds, etc.)
  - Presence, condition, and/or altered behavior of visible biota such as amphipods, gastropods, crabs, etc.
  - Extent and degree of shoreline oiling (use shoreline oil terminology codes and % cover charts; see Stranded Oil guideline). Be sure to record depth of oil penetration into the sediments, if any (using a shovel or coring device)
  - Type or degree of shoreline cleanup, if already performed (particularly note sediment disturbance or removal, flushing of oil and/or sediments into down-slope areas, etc.)
  - Presence of snow or ice along shoreline
  - Presence of biological resources and other relevant information
- Collect samples from each intertidal zone (described below) and record the distance along the transect and GPS coordinates of each sampling site.

Sample Collection Methods

- Use field data forms included in the work plan, if one is available. Otherwise, use forms in Appendix A. Coordinate data form development/modification with the data management group.
- Because GPS units will be used to record locations and times, make sure that all units are using the same coordinate system, datum, reporting units, and correct time. Follow the recommended GPS datum of the study plan, if one is available. Alternatively, set the default to WGS84.
- Record GPS coordinates for each sample site.
- Photograph the sampling site prior to sample collection to document the site conditions, as well as the sample collected. Make sure each photograph or series can be later associated with the corresponding sampling locations (e.g., through use of GPS Photo link software or by keeping a detailed photo log with waypoints and/or lat/long). Do not delete or alter any photographs. The numbering sequence of photographs uploaded from your camera must not have any gaps (see Field Photography guideline).
- If time allows a calibration exercise is recommended prior to field sampling to ensure that all field teams consistently perform infauna sampling.
- If sampling sites are covered by snow or ice, carefully remove the snow/ice without mixing or disturbing the sediment underneath and proceed with infauna sampling. Note snow and ice conditions on the field data sheet. If snow or ice present in the intertidal zone are impacted by oil (as opposed to deposited on top of oiled sediments), it may be desirable to collect snow/ice samples for chemical analysis (see Snow guideline).
- Carefully remove stones, sticks, and other debris on the sediment without mixing or disturbing the sediment underneath.
- Sampling can be conducted to document the presence, composition, and general abundance of organisms. In the Arctic, sand beach and tidal flat infauna may include amphipods, bivalves, polychaetes, and oligochaetes.
- If highly quantitative density estimates are needed, or detailed comparisons of oiled vs. un-oiled locations are planned, an experienced sand beach ecologist and statistician should be consulted to plan more detailed studies. If one is not available, the following sampling should be performed.
- For semi-quantitative surveys of infauna:
  - For species presence/absence, composition, or density estimates, take 3 replicate sediment cores at each tidal elevations along each shoreline transect
  - Cores should be taken within 5 m of the transect line
  - Photo-document the sampling locations, sample collection methods, organisms observed, any obvious oil impacts, etc.
- To sample macroinfauna, use a hand coring device, typically a cylinder with an open cross-sectional area of 0.01 m^2 and a small hole on the top:
  - Record the distance along the transect and GPS coordinates of each sediment core location
  - Using a ruler, mark the outside of the corer every ½ cm so that the depth of each core sample can be measured and recorded. Cores should not exceed 15 cm in depth
  - Prior to collecting cores, carefully remove debris, shells, and other material without disturbing the sediments
  - Take photographs of each sediment core location
  - Insert the corer into the sediment (in a vertical position) to a maximum depth of 15 cm
  - Place a finger or thumb over the small hole (or insert a rubber stopper) to create a vacuum and extract the core
  - In coarse-grained sediments, cores often cannot be extracted whole, and a metal plate or other similar object must be slid under and across the bottom of the core before it is removed
  - If field sieving of cores is not possible, empty the contents of the core into a labeled container, such as a large plastic bag. Preserve with 10% buffered formalin (in seawater) (preferred), or in 95% ethanol (less ideal), and stain (such as Rose Bengal) if appropriate

- Core samples can be sieved in the field (using a 0.5 mm screen). When sieving, gently force water up through the bottom of the sieve, by bobbing the sieve up and down in a large bucket or tub of water. This prevents forcing animals into or through the bottom of the sieve
- After sieving, place samples in a sample bag or jar and preserve with 10% buffered formalin (in seawater) (preferred), or in 95% ethanol (less ideal), and stain (such as Rose Bengal) if appropriate
- If field sieving of cores is not possible, preserved whole core contents in 10% buffered formalin (in seawater) (preferred), or in 95% ethanol (less ideal)
- Place a waterproof label with the location, sample number, and date inside the sample container
- To avoid cross contamination, make sure sediment cores are cleaned between samples

- To sample infaunal organisms for chemical analysis, follow Shellfish Tissue guideline. Small infaunal organisms of the same species can be composited to achieve desired sample mass.
- To sample larger macroinfaunal target species, such as bivalves harvested for commercial or recreational purposes:
  - Select a sampling site at random by placing a 0.25 m^2 or 1.0 m^2 quadrat on the sediment surface. Quadrats should be placed within 5 m of the transect line. One approach to random sampling is as follows:
    - Place two tape measures at a 90°angle along two sides of the sampling location
    - Use a random numbers table to randomly select two numbers
    - Place the center of the quadrat at the intersection of the two numbers on the tape measure
  - Record the GPS coordinates of each quadrat
  - Take high-resolution photographs of the entire quadrat from an angle as vertical as practical. This will facilitate computer-based analyses of individual quadrats. When taking photographs observe the following:
    - If the presence of large or abundant motile invertebrates block the view of sessile invertebrates, carefully remove these organisms from the quadrats prior to taking photographs and without disturbing less motile invertebrates, but make sure to document the removal of organisms in the field sample form
    - High-resolution photographs must include all four sides of the quadrat as these will be used to digitally count individuals and measure their coverage on a computer screen
    - Quadrat frames can be split into 2-sided frames to facilitate computer-based analyses
    - Photographs need to be relatively flat so that the entire quadrat falls within a similar focal plane, with minimal shadowing from crevices or projections
    - Ideally, photographs should be taken during the lowest tide and best light conditions (e.g., closest to midday or when overcast). Avoid shooting into the sun and avoid including sky, ocean, or tidepools in the view
    - If possible, use a quadrapod apparatus to support the camera at a constant height (1 m with a 35 mm lens) from the quadrat and position it to capture all four corners of the quadrat:
      - A quadrapod consists of a gray PVC pipe frame with a photoplot-size bottom (0.5 m^2 or 1.0 m^2 internal dimensions) connected by 4 poles to the frame supporting the digital camera
      - Strobes mounted laterally and away from the camera can enhance lighting on the quadrats and reduce shadows
    - The best quality photographs are obtained by optimizing the ISO, aperture, and shutter speed
    - Remember that all quadrat images must be of sufficient quality to allow a positive identification and enumeration of the species in the quadrats
  - Prior to removing quadrat contents, carefully remove debris, shells, and other material without disturbing the sediments

  - Use a shovel to excavate the sediments within the quadrat, commonly 30 cm. It may be necessary to excavate deeper if certain species, such as clams, are present (consult ESI maps and other resources for species information for sampling locations)
  - Sieve the excavated sediments using a 5 mm screen (or larger, depending on the size range of the target species)
  - Identify, count, weigh, and/or size the captured organisms in the field, and release them live, or, place samples in labeled plastic bags or jars and freeze, or preserve in 10% buffered formalin (in seawater) (preferred), or in 95% ethanol (less ideal), and stain (such as Rose Bengal) if appropriate
  - Place a waterproof label with the location, sample number, and date inside the sample container
- If chemical analyses of tissue are planned for larger infauna, such as bivalves, follow the Shellfish Tissue guideline. Briefly:
  - Wrap each individual specimen in pre-cleaned aluminum foil and freeze the sample as soon as practical
  - Take care to avoid cross contamination during sampling and handling
  - Clean sampling equipment, such as shovels, between collections
  - Ship bivalve samples on ice overnight, if possible to the laboratory conducting the analyses
- If increased sampling effort of tidal flats is deemed appropriate, follow sampling protocols as described earlier, but increase the number of quadrats and cores collected within intertidal flat transects. Mark the start of the transect and walk on a straight-line perpendicular to the shore to the farthest end of the tidal flat. Starting from the end, take samples from undisturbed areas as described above at specific intervals (e.g., 10 m) within the transect. At each sampling point, record the approximate distance from the shore transect marker, and record GPS coordinates. Tidal flat sampling should be done during the lowest tide possible.
- If possible, store samples from unoiled areas in one set of coolers, with oiled samples in a separate set of coolers.

Sample Labeling and Record Keeping

- Verify that all samples are properly labeled and that field sample forms are properly filled out.
- Follow chain of custody procedures for securing samples and complete chain of custody forms (See Chain of Custody guidelines).
- Complete the Chain of Custody form, noting where each intertidal sample was collected, sampling equipment used, time/date of collection, size and container type, and sampler name.
- Make special notation on the Chain of Custody form about any problems or observations during sampling.
- Maintain strict chain of custody during sample storage and transportation.
- Record the sample number on both the sample jar label and lid. Record the following on the field sample form:
  - Sample collection site (NRDA sample grid ID and GPS coordinates)
  - Sample matrix (infauna)
  - Sample #, date/time
  - Sampling method (core, excavation), sample collection depth, and core size (m^2)
  - Sediment oiling conditions (using standard shoreline assessment terminology), tidal elevation, weather conditions (e.g., wind direction and speed), presence of biota, vegetation or debris, odors and other relevant information on the field data sheet
  - Sediment characteristics: grain size, texture, color, biota, vegetation, debris, odor, vertical changes in sediment characteristics, etc.

- All sample numbers must be unique. Use the sample number convention provided by data management if available. Otherwise, the sample number should consist of a sample team ID and sequential numbers. For example AKA-0001, AKA-0002, etc.
- Documenting oil distribution in sand beach and tidal flat areas is best accomplished with photography, video, and good field notes and sketches using standard shoreline assessment methods. These data may be collected by SCAT teams and available to support environmental assessments. Samples may be needed for fingerprinting or monitoring weathering, to correlate a degree of oiling term with oil loading, to confirm the presence of oil, or for bioassay purposes.
- Make a quick sketch in a field logbook or sketch form showing the sampling locations in enough detail that the location could be re-occupied by someone else.
- Keep a detailed photo log so that each photograph can be labeled.
- Note any deviations from the recommended guidelines in the field book.

Sample Preservation, Recommended Holding Times and Shipping

- Follow chain of custody procedures for sample storage and shipping.
- Ship highly oiled samples separate from lightly or unoiled samples to reduce risk of cross-contamination.
- Immediately place all infauna samples in cooler and keep at 4°C. DO NOT FREEZE samples preserved in formalin. Tissue samples for chemical analysis can be frozen.
- Freeze samples for chemical analysis as soon as practical or by the end of each day if samples are not going to be analyzed within 7 days of collection.
- Tape lids on sample bottles so that they do not accidentally come off.
- Use packing material, such as bubble wrap or sorbent pads, around glass jars to prevent breakage during transport and shipping.
- Ship samples directly to the laboratory as soon as practical, overnight (preferred), with completed Chain of Custody forms. If necessary, samples can be stored under specified conditions and with complete chain of custody until they can be shipped. Assure that samples are packaged to protect them from breakage, shipping containers are sealed, and use ice packs or dry ice to maintain storage temperatures during shipment to the lab.
- Ship any samples preserved in formalin or other chemicals as hazardous goods.
- NEVER discard any samples even if these have exceeded their recommended holding times or storage temperatures.

Analytical Methods

- Refer to those under Shellfish Tissue, Subtidal, and Intertidal Sediment guidelines.

Key References

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Appendix A
Supporting Documentation - Field Data Form Examples

Unique field data forms may be included in the work plan if one has been developed, otherwise, use the attached form.

- Adapt the form as needed prior to use.
- Print the form on weather-resistant paper (if available). Make more than enough copies of the form before going into the field.
- Fill out forms with waterproof pen or permanent marker. Do not use pencil, or biro (erasable) ink.
- Make any additional notes that do not fit on the form in a field notebook and indicate the presence of associated additional notes on the field data form.
- Fill in blanks with "N/A" if data are not applicable or not available. Avoid leaving blank values on data forms.
- Do not erase or black out erroneous entries on the field data forms. Errors should be corrected by crossing out the entry with a single line and signing and dating the strike-through.
- Electronic versions of field data forms are available. Coordinate data entry with NRDA data management personnel.

Attached Forms:

- Beach Survey Field Data Form – 3 parts: Survey set-up, Surface quadrat, subsurface quadrat or core

Beach/Tidal Flat Survey Field Data Sheet - Set-up (one per transect)

1 Date: _____ Time: _____ Site ID: _____ Team ID: _____

2 Data Recorder / Affiliation: _____

3 Other team members / Affiliations: _____

4 Transect ID: _____

Total Transect Length (m): _____

5 Front Stake Way Point # _____ Latitude (DD) _____ Longitude (DD) _____

Back Stake Way Point # _____ Latitude (DD) _____ Longitude (DD) _____

6 Distance from shoreline to the midpoint of plots in each zone (m):

Supratidal _____ Middle Intertidal _____

Upper Intertidal _____ Low Intertidal _____

7 Photos

Front stake looking inland: _____ Back stake looking shoreward: _____

Front stake looking right: _____ Front stake looking left: _____

Offshore looking inland: _____

8 Plot-wide Sediment and Topography

Primary sediment type: _____ Secondary sediment type: _____

Presence of erosional scarps: yes / no Maximum vertical relief (cm) _____

9 Oiling Impact Extent

Sediment surface oiling coverage (%): _____

Surface oil thickness (circle one): Pooled Cover Coat Stain N/A

Surface oil character (circle one): Fresh Mousse Surface residue Tar Asphalt N/A

10 Transect sketch

Bearing to inland stake: _____

Drawing Legend	
FS	Front Stake
BS	Back Stake
----------	Transect
~~	Water line
□	Surface Quadrat
	Subsurface
■	Quadrat
○	Core Sample
X	Other sample

Notes including but not limited to presence, condition, and/or altered behavior of visible biota such as amphipods, bivalves, etc.

Beach/Tidal Flat Survey Field Data Sheet - Surface Quadrat (one per quadrat)

1 Date: _____ Time: _____ Site ID: _____ Team ID: _____

2 Data Recorder / Affiliation: _____

3 Other team members / Affiliations: _____

4 Transect ID: _____ Quadrat ID: _____

Quadrat location: Supratidal/ High/ Middle/ Low Intertidal/ Tidal Flat

Quadrat Size (m^2): _____

Quadrat Photo: _____

Direction from transect: Left / Right (looking from water towards shoreline)

Distance from Transect: _____

5 Sediment type

Primary _____ Secondary: _____

6 Oiling Impact Extent

Sediment surface oiling coverage (%): _____

Surface oil thickness (circle one): Pooled Cover Coat Stain N/A

Surface oil character (circle one): Fresh Mousse Surface residue Tar Asphalt N/A

7 Quadrat Fauna Information

Photo Only Yes / No Photos:

Species Name	Number	Species Name	Number	Additional Information:

Notes:

Beach/Tidal Flat Survey Field Data Sheet - Subsurface Quadrat or Core (one per sample)

1 Date: _____ Time: _____ Site ID: ____ Team ID:

2 Data Recorder / Affiliation: _____

3 Other team members / Affiliations: _____

_____

4 Transect ID: _____ Quadrat/Core ID: _____

Sample Type (Circle One): Subsurface quadrat Core

Quadrat location: Supratidal/ High/ Middle/ Low Intertidal/ Tidal Flat Quadrat Size (m^2): _____

Quadrat Photo: _____

Direction from transect: Left / Right Distance from Transect: _____

(looking from water towards shoreline) _____

Sample depth (cm): _____

5 Sediment type

Primary _____ Secondary _____

6 Oiling Impact Extent

Sediment surface oiling coverage (%): _____

Subsurface oil evident: yes / no Describe:

7 Subsurface sample

Sample retained: yes / no Sample No.: _____

Sieved: yes / no Sieve screen size (mm): _____

Sample preserved: yes / no Preservation type: Formalin Other

Species	Size Units:	Weight Units:	Count	Additional Information:

Notes: