Guidelines for Collecting Ephemeral Data in the Arctic: SHEEN

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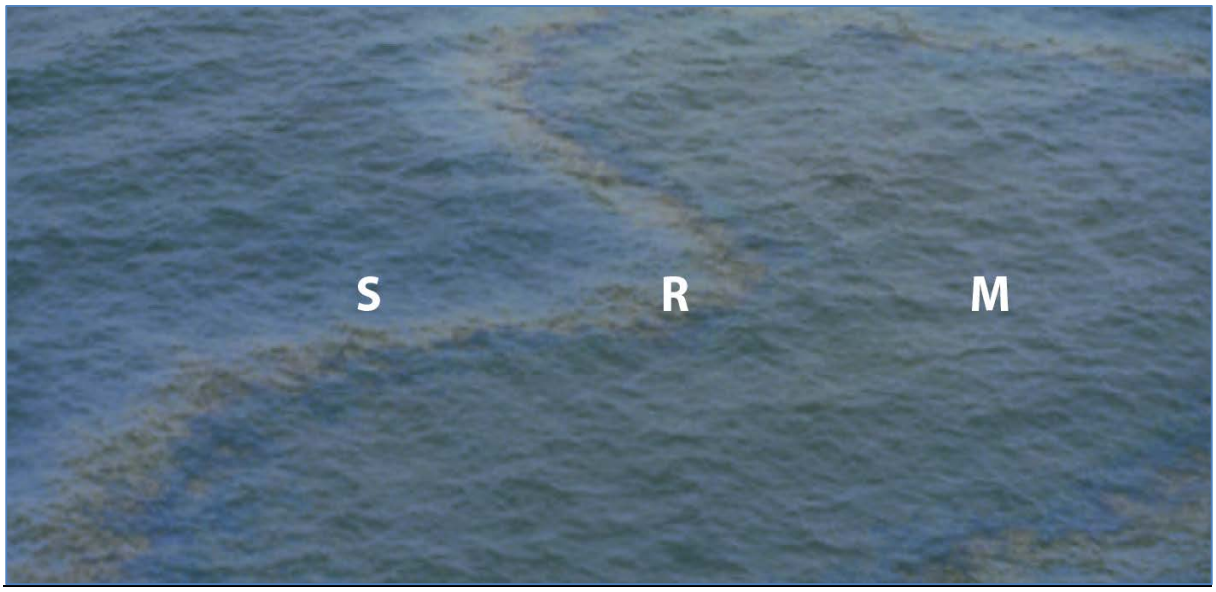
Note: These guidelines are limited data collection aides that do not necessarily consider all possible scenarios under which samples may be collected. Use best professional judgment to modify these guidelines according to area-specific field conditions.

Guideline Objectives

The primary objective of this document is to provide guidelines on collection of sheen samples for chemical analysis from the water surface during the early stages of an oil spill in the Arctic to support Natural Resource Damage Assessment (NRDA) exposure and injury evaluations. By definition, sheen is a very thin layer of oil on the water surface that is described as silver (S), rainbow (R), or metallic (M) as shown in the image below.



Sampling Objectives

Characterize oil

- Document the presence of oil, and characterize oil weathering and fate
- Determine the source of contamination via chemical fingerprinting analysis
- Document the presence of oil, and characterize oil weathering and fate
- Characterize other sources of oil or hydrocarbons in the environment

Study exposure

- Document exposure of water-surface organisms to oil sheen compounds
- Support exposure modeling

Quality control

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

Collaboration

- Support other assessment efforts (see Water, Snow, Ice, and/or Source Oil guidelines)

Before Field Sampling

- Assure that all personnel have required safety training and protective equipment for Arctic field work (not described in these guidelines).
- Arctic weather conditions are notoriously 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; however, realize that it may have to be modified based on actual conditions in the field because sheens are very dynamic. Sampling sheens may be opportunistic if one is encountered during other sampling efforts.
- 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 an eelgrass bed or lagoon
  - Site = a specific point at which samples are collected or observations are made
- Plan ahead the number of sites and samples to be collected at each site, taking into account level of effort, potential logistical limitations, weather conditions, and other unanticipated issues that may compromise sample integrity.
- Area-specific modification to this 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 sheen contamination to estimate the number of sampling locations and number of samples per location needed to meet the sampling plan objectives.
- 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 sampling guidelines from the laboratory and consult with them about necessary modifications.

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 water-proof labels); solvent rinsing of jars and aluminum foil for polycyclic aromatic hydrocarbons (PAH) analyses, 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.

- Sheens are collected for the purpose of determining the origin of the oil, and are useful for: determining the source of the oil when sheens are the only indication of source oil (e.g., diesel spills); fingerprinting sheens of unknown origin (e.g., biogenic, other sources of contamination); and documenting the spatial extent of the spilled oil as it spreads.
- Sheen samples should be collected from specific locations to answer specific questions, such as what is the source of a reported sheen, what is the spatial extent of oiling, or how is the oil on the water surface weathering over time and distance?
- When sampling in remote areas with limited storage and shipping capabilities, plan ahead to make sure that the integrity of samples is not compromised and sample holding times are not exceeded. Remember that it may take multiple days for shipments from rural areas to reach a laboratory facility.
- The number of samples collected 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, if possible. However, working from a vessel with deck lights that allow safe operations would permit nighttime sampling. This guidance may not apply during winter.
- 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 goals of the sampling plan.

Area selection

- Well-defined study plans and sampling protocols should direct sample collection efforts. If a sampling plan is not available for ephemeral data collection immediately after a spill, sampling should focus on collecting samples of sheens from the spill and other natural or non-spill sources if they are observed.
- Use trajectory models, overflight observations, SCAT observations, or other sources to determine where sheens are likely to be present.
- Opportunistic sheen samples should be collected if sheens are observed during other field data collection activities.
- The number of locations and number of samples per location should be defined in the study design. A minimum guideline for collecting sheen samples is one per sampling location for fingerprinting. Additional samples may be required for other analyses.

Collaboration

- Sheen samples can be collected in conjunction with water/snow, ice, and source oil samples.
- Close collaboration and coordination with other ongoing sampling efforts is important.

Field Sampling Methods

Sampling Equipment/Containers

Note: The type 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)
- Thermometer or temperature logger (1 per cooler)
- Disposable nitrile gloves (preferred), insulated nitrile-coated gloves (less ideal)
- Insulated shoulder-length rubberized gloves (preferred) when sampling for sheen under extreme cold conditions
- 125 mL wide-mouth sampling jars – certified organic clean glass jars (solvent rinsed) with Teflon lined lids and labels
- Teflon (PTFE-fluorocarbon polymer) nets/pads (preferred) - 4 inch diameter, and deployment gear (wand, pole, line). Sorbent pads (less ideal)

- Tweezers, hemostats, or pliers; one for each sample, pre-cleaned, wrapped in foil and sealed for transport
- Field Sample Forms, field notebook, chain of custody forms
- Evidence tape (see Chain of Custody guidelines)
- GPS, camera (with spare batteries), and photo scales
- Tape measure and ruler
- Packaging materials (bubble wrap and sorbent pads, tape) for glass jars (may be provided by the analytic laboratory)
- Suitable disposal bags for oiled PPE and disposable sampling materials.

Optional (if single-use deployment gear is not available):

- Sufficient quantities of pre-cleaned or disposable deployment gear are preferable. If equipment will be reused in the field, decontamination is necessary and will require the following materials:
  - Reusable sampling utensils
  - 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

- Obtaining an adequate number of quality control samples is essential. At a minimum, a trip blank (accounts for contamination introduced during shipping and handling) and field blank (account for contamination introduced during sampling) should be maintained for each sampling effort and generally be collected at a rate of 5% and 10%, respectively, of all samples.
- A trip blank is an unopened sampling jar and should be transported with the samples and remain sealed in the cooler during sampling activities.
- A field blank should be collected at approximately every third sampling site by leaving the field blank sample jar open for the duration of the sampling period at that site. Record where field blanks were taken on the log sheet.
- Ideally, trip and field blanks are a sampling jar with Teflon sampling material in them.
- If possible, store samples from field/trip blanks in one set of coolers, with oiled samples in a separate set of coolers. If possible, do not include other types of samples in the coolers for the sheen samples; otherwise, take precautions to prevent cross contamination.

Good Sampling Practices and Decontamination

- Good field practices and the development of a consistent sampling routine will ensure the integrity of the samples and their validity in environmental assessments.
- Disposable nitrile gloves should be changed between samples to prevent cross contamination or if they become contaminated or damaged. Nitrile gloves can be worn over low-profile insulated gloves (e.g., neoprene gloves) in cold conditions. 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 such as washing gloves with detergent and/or solvents between samples and avoiding contact with the sample material.
- Decontaminate used Teflon net deployment gear (wand/pole, or similar) prior to each use:
  - Wash gear with laboratory-grade detergent and clean water, with a triple clean water rinse (laboratory grade – preferred, distilled water from a local store – less ideal). If distilled water is not available, use “background” water from an up-current clean area
  - 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 deployment gear 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

- Potential contamination while sampling from vessels (exhaust fumes, oily surfaces) is a very serious concern. Work up-wind of any exhausts, consider sampling sheens from non-motorized craft that is paddled upwind/current from the motorboat. Avoiding sampling from the stern of motorboats.

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 photos. The numbering sequence of photos uploaded from your camera must not have any gaps (see Field Photography guidelines).
- A description of the characteristics and spatial extent of the sheen that the samples are collected from should be recorded in the field data sheet or the field notebook.
- Sheen samples can be collected from boats, from the shoreline, or by wading in shallow water.
- When sampling through ice:
  - Clear loose ice and snow away from the sampling location and drill through the ice
  - Clean the drill hole area from potential sources of contamination, and allow several minutes for the water to flow freely under the ice before taking a sheen sample
- Teflon nets and pads are the preferred method for sampling sheen as they allow a concentration of light sheens into a relatively small sample size.
- Teflon (PTFE-fluorocarbon polymer) nets (50 to 70 micron-mesh screen, preferable) or pads, can be hand-held, attached to a sampling wand/pole, or attached to the line of a fishing pole. Slowly drag the net or pad through the sheen at least five times or until the net or pads are visibly oiled, and transfer the material into a 125 mL glass container touching the Teflon material as little as possible. To avoid contamination clean tweezers, hemostats, or pliers are to be used to handle the Teflon net or pad. If Teflon nets are not available, the least preferred method would be collection of sheen samples with sorbent pads cut to fit into the sampling jars.
- Minimum guidelines per area are one sample collected with Teflon nets though additional samples may be required.
- Because light PAH fractions are extremely volatile, NEVER split sheen samples after sample collection.

Sample Labeling and Record Keeping

- Verify that all samples are properly labeled, and that field forms are properly filled out. See appendix A for an example field data form.
- Follow chain of custody procedures for securing samples and complete the Chain of Custody form, noting sample size, sampling device used and any other relevant information for the receiving laboratory in addition to the basic information about the sample indicated on the form. (See Chain of Custody guidelines).
- Record the sample number on both the label and lid. Record the following on the field log sheet:
  - Location of sample collection (NRDA sample grid ID and GPS coordinates)
  - Sample matrix (sheen)
  - Sample #, date/time

  - Sampling method (deployment gear)
  - Note if sample is for QA/QC (field blank, trip blank, rinsate blank)
  - Describe the oiling conditions (using standard shoreline assessment terminology), tidal elevation and weather conditions
  - Characteristics (using standard terminology) and spatial extent of the sheen
  - Characteristics of floating material in the sheen: texture, color, presence of biota, vegetation or debris, odors and other relevant information on the field data sheet
- 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.
- Maintain strict chain of custody during sample storage and transportation.
- Note any deviations from the recommended guidelines in the field book.

Sample Preservation, Holding Times and Shipping

- Follow chain of custody procedures for sample storage and shipping.
- Immediately following collection, place all sheen samples in cooler and keep at approximately 4°C. Use frozen gel packs to maintain the temperature if ambient temperatures are above freezing. In below freezing temperatures, collapsible water jugs filled with warm water can be used to maintain the temperature. A programmable temperature logger or thermometer should be placed in each cooler to maintain a record of storage temperatures.
- Depending on the remoteness of the sampling location, the holding time (7 days) may not be achievable. Under these conditions freeze samples as soon as it is practical to preserve the integrity of the sample.
- Protect the samples from direct sun exposure (e.g., UV radiation).
- Tape lids on sample jars in accordance with chain of custody guidelines and so that they do not accidentally come off.
- Sheen samples should be stored and transported in a separate set of coolers.
- Samples should be stored at 4°C and refrigeration temperature shall be recorded upon sample storage, and monitored and recorded periodically to ensure proper refrigeration.
- Use packing material, such as bubble wrap or sorbent pads, around containers to prevent breakage during handling and shipping. The receiving laboratory may provide packaging materials and shipping containers.
- Ship samples directly to the laboratory as soon as possible with complete 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.
- NEVER discard ANY samples even if these have exceeded their recommended holding times or storage temperatures.

Sample Volume and Requirements

Analytical Method	Sample volume	Minimum Detection Levels [a]	Recommended Holding time [b]	Minimum number of samples per location
PAH (including alkylated PAHs) by GC/MS-SIM	Teflon nets or pads	Not applicable	7 days	One Teflon net or pad per location [c]
Petroleum biomarkers (fingerprinting)				

[a] µg/L= ppb; [b] Store at 4 °C (± 1°C) in the dark; [c] Several analyses can be made from a single sample.

Analytical Methods

- **Polynuclear aromatic hydrocarbons** (PAH). Because most of the toxicity in oil is due to PAHs, it is the preferred analysis. It is important that the analytes include the alkyl-substituted PAH homologs, in addition to the standard PAH "priority pollutants." This method is referred to as Modified EPA Method 8270, because the list of PAHs is expanded to include the alkylated homologs, using GC/MS in the selected ion monitoring (SIM) mode. Detection levels should be at least 0.1 ppb for individual PAHs to support injury assessment using toxicity thresholds. The lab should analyze a sample of the source oil if one is available.
- **Petroleum biomarkers** These compounds are highly resistant to degradation and have a unique distribution for each oil type. Thus, they are valuable for differentiating among different sources of hydrocarbons. However, few laboratories have the capability for quantitative analysis of biomarkers, which is a specialized method using GC/MS in the SIM mode.

Key References

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NOAA. 1993. Sampling and analytical methods of the National Status and Trends Program, National Benthic Surveillance and Mussel Water Projects, 1984-1992. Volume IV, Comprehensive descriptions of trace organic analytical methods. Lauenstein, G.G. and A.Y. Cantillo (eds.). NOAA Tech. Memo NOA ORCA 71, Silver Spring, MD. 181 pp.

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USEPA. 1986. Test methods for evaluating solid waste. SW 846 Third Edition (and updates).

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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.

- 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 form:
- Oil/Tarball/Water and Snow/Ice sample collection form

Sample Collection Form - OIL/TARBALL/WATER/SNOW/ICE/SHEEN										
Lead Sampler's Name/Phone								**Sampler Team Code**		
Lead Sampler's Affiliation								**Resource Group**		
NRDA Contact/Phone								**Resource Group Leader**		
Incident Name								**Habitat (e.g., sand beach)**		
General Location Description								**Sample date (mm/dd/yyyy)**		
Location Code	**Matrix**	**Sample Number (two digits)**	**Sample Time**	**Sampling Method**	**Sample Position/ Depth**	**Sample Size and Units**	**Sample QA/QC Type**	**Latitude**	**Longitude**	**Sample Notes**
NRDA Sample Grid ID	*(O)il, Tarball (B), (W)ater (SN)ow, (I)ce, (SH)een*	*Sample # (Team ID – sequential number) and A, B, or C for portion of composite*	*(24-hr clock, local time)*	*Teflon net, sorbent pad (or other)*	*Collection depth of water sample. Use 0 for surface samples.*	*Volume of sample with units*	*Normal sample or Field QA/QC type*	*Latitude in DD XX.XXXXXX*	*Longitude in DD -YYY.YYYYYY*	*Description of sample, equipment used, photo numbers, etc.*

Survey Notes - (weather, wildlife, field team composition, sampling design changes, photos, etc.)

Samples relinquished by:				Received by:			
Date	**Time**	**Signature - Field Sampler**	**Print Name- Field Sampler**	**Date**	**Time**	**Signature - Sample Runner/ Command Post**	**Print Name - Sample Runner/ Command Post**

Matrix	Sample methods and descriptions		Sample Area Sketch
Sediment or Soil	**Sampling Method**	**Depth units**	
(S)ediment Soil (L) Blan(K) Water	(GR)ab (CO)re	(c)m (m) (i)nches (f)eet	
Oil, Tarball, Water, Snow, Ice, Sheen	**Sampling Method**	**Sample Position/Depth**	
(O)il Tarball (B) (W)ater Blan(K) Water Other (H) (SN)ow (I)ce (SH)een	(GR)ab (SC)rape (OT)her	(FLOAT)ing (SUB)merged (STRAND)ed (COV)ering 0 - (Surf)ace <depth in meters> m	
Tissue or Wrack	**Tissue Type**	**Tissue Type (Continued)**	
(T)issue Wrack (R) Blan(K) Water	(WH)ole body Whole body w/o shell (WNS) Chorioallantoic Membrane (CAM) Egg (EM)bryo Fillet with skin (FS) Fillet without skin (FWOS) Gall Bladder (GB) Leaves (LEV) Leaves and stems (LVS) (LI)ver	(MU)scle Yolk NA <for Wrack only> **Species** <enter species> NA <for Wrack only>	
Sample Identifier system			
Sample IDs : Team ID-Sequential Numbers (ex. AKA-0001) QA/QC types: Field Blank (FB) Rinsate Blank (RB) Trip Blank (TB) (D)uplicate		Other sample types: (S)plit	