6.0 SAMPLE COLLECTION

6.1 Sediment Quality Component

The sediment quality portion of the White Rose EEM Program is conducted every two years, usually in late August/early September, from a suitable offshore supply vessel fitted with a temporary processing laboratory and supporting equipment. Sediment is collected using a large-volume corer (mouth diameter = 35.6 cm, depth = 61 cm) designed to mechanically take an undisturbed sediment sample over approximately 0.1 m^2 (0.0995 m^2) of seabed (Figures 6-1). After collection, core samples are moved to a working area near the laboratory facility for processing. Oxidation and reduction potential (redox) and core temperature are recorded. A core photograph with station identifier is taken.

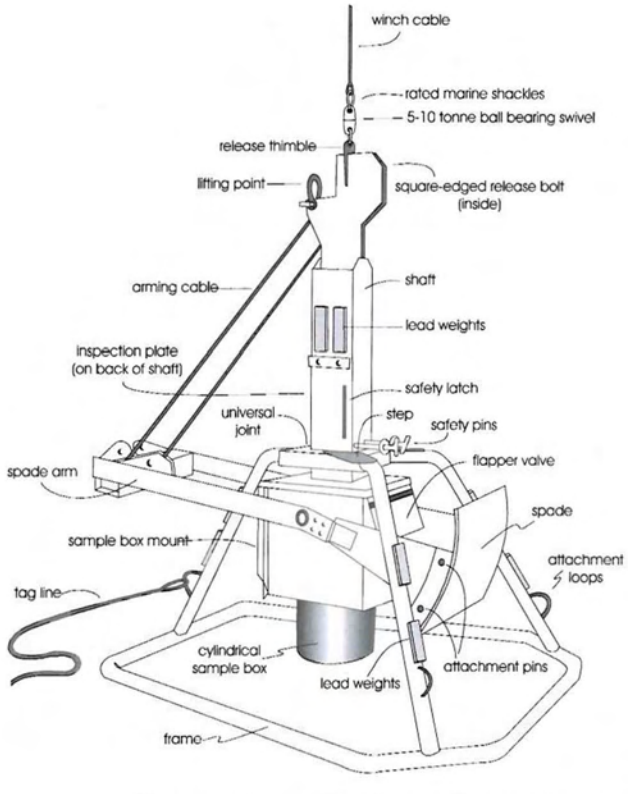

Figure 6-1 Sediment Corer Diagram

Sediment samples remain inside the core barrel until all sub-sampling for particle size, chemistry and toxicity is completed. Sediment sub-samples for particle size, chemistry and toxicity, as well as for archive, are taken from the centre portion of the core (away from the edges that come in contact with the core barrel). These samples are a composite from the top 3 cm of all three cores. All sediment samples are well compacted using the sub-sampling device. Between each scoop of sample, the sample jar is gently tapped on the bottom with the palm of the hand to further compact the soil to ensure that no settling occurs during storage (settling would lead to development of headspace in the jars, which would compromise tests on more volatile substances). Sediment samples collected for toxicity are collected from the top 7.5 cm of one core. After these

collections, the core barrel is removed and samples for benthic community analysis are taken from the top 15 cm of two cores. A summary of sample allocation for sediment stations is provided in Figure 6-2. Storage conditions are provided in Table 6-1.

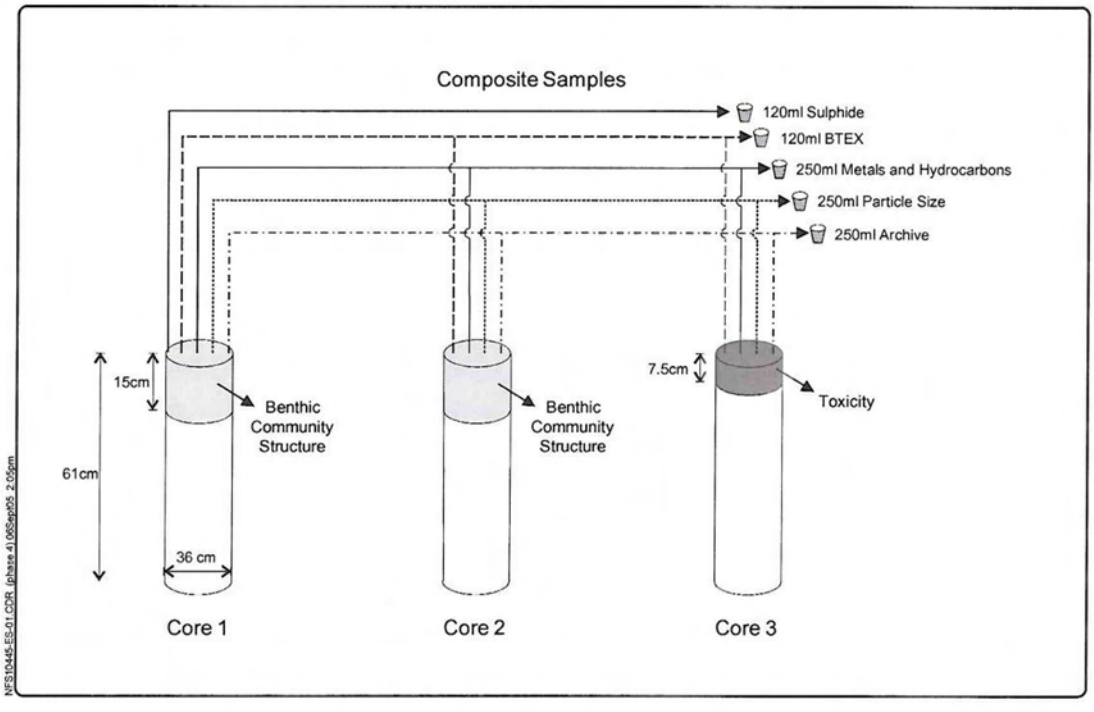

Figure 6-2 Allocation of Samples at Sediment Stations

Table 6-1 Sediment Sample Storage

Analysis	Sample Container	Preservative Description	Hold Time	Storage Temperature
Low-level TEH (C_{10}-C_{32}) / PAH / Mercury / Ammonia / Sulphur / TIC/TOC / Total Metals / Li / Low-level Cd	2 x 250 ml glass jar	Fill with no headspace	LL TEH & PAH = 14 days; Metals, Hg and Sulphur = 6 months; TIC/TOC & Ammonia = 28 days	-20°C
BTEX / VPH (C_6-C_{10})	1 x 120 ml glass jar	Fill with no headspace	7 days	-20°C
Sulphide	1 x 120 ml glass jar	No preservative	7 days	4°C
Particle Size	1 x 250 ml glass jar	Fill with no headspace	Indefinite	-20°C
Archive Samples	2 x 250 ml glass jar	Fill with no headspace	Indefinite	-20°C
Amphipod Toxicity	1 x 4 L pail	Pails lined with plastic bag and tied with as little air space as possible	42 days	4°C in dark
Microtox	100 g of sediment in Whirl-Pak	As little air space as possible	42 days	4°C in dark
Benthic Community	2 x 11 L pails	Store with 1 L of 10% buffered formalin	12 months	Ambient

A field blank obtained from the analytical laboratory is opened as soon the core sample from three randomly chosen stations is brought on board vessel. Blanks remain open until chemistry samples from each station are processed. Chemistry field blanks include tests for hydrocarbons, metals and sulphides (the first three rows in Table 6-1). Blanks are sealed at the same time as sediment chemistry samples from each of the three stations and stored with the remainder of chemistry samples.

Duplicate samples (Quality Assurance/Quality Control (QA/QC) samples) are collected at five randomly selected stations. Duplicate samples are collected for most analyses, but exclude analyses of particle size analysis, amphipod and Microtox toxicity, and benthic community structure.

6.2 Water Quality Component

Water sampling as part of the White Rose EEM Program is conducted every two years, usually in conjunction with the sediment quality component of the Program, in late August/early September. Water samples are collected at 10 m below surface, 40 m below surface and 10 m above bottom using a string of three Teflon-lined, 10 L Niskin-X bottle water samplers (Figure 6-3). All stations are sampled for physical and chemical characteristics. Groups or specific compounds analyzed include BTEX, $>C_{10}$-C_{21} and $>C_{21}$-C_{32} hydrocarbons, PAHs and alkyl-PAHs, phenols and alkyl-phenols, volatile organic acids, metals, total inorganic and organic carbon (TIC and TOC, respectively), total suspended solids (TSS), ammonia. Samples are stored as detailed in Table 6-2.

Figure 6-3 Niskin Bottle Water Samples

Table 6-2 Water Sample Storage

Analysis	Storage Container	Preservative Description and Comments	Storage Temperature	Holding Time
Atlantic MUST[1]	2 – 250 ml clear glass bottles 2 – 40 ml vials	Sodium bisulphate Sodium bisulphate	4°C	7 days
PAHs & Alkyl PAHs	1 – I L amber glass bottle	None	4°C	7 days
Phenols & Alkyl Phenols & Volatile Organic Acids	1 – 1 L amber glass bottle	None	4°C	7 days
Trace Metals	1 - 120 (or 200 mL) plastic bottle	Nitric acid	4°C	6 month
Mercury	1 - 100 ml amber glass	Potassium dichromate (K2Cr2O7 in nitric acid)	4°C	28 days
Ammonia	1 – 100 ml amber glass bottle	Sulphuric acid	4°C	28 days
TOC	1 – 100 ml amber glass bottle	Sulphuric acid	4°C	28 days
TSS	1 L plastic bottle	None	4°C	7 days
TIC	1 – 200 ml plastic bottle	No preservative required. Fill to top	4°C	28 Days
XCide450[2]	Analysis conducted in-site in test tubes Water drawn off into bottles	Test to be conducted as soon as water sample is retrieved	none	None – test to be conducted as soon as samples is retrieved
SCW4453[2]	1 – 125 ml plastic bottle	None	4°C	14 days

[1] BTEX, $>C_{10}$-C_{21} and $>C_{21}$-C_{32} hydrocarbons.

[2] Husky Energy is currently exploring the use of these two process chemicals as tracers for produced water. If this effort does not yield useful results, the measurement of process chemicals will be discontinued.

A conductivity, temperature, depth (CTD) recorder cast is performed at all water quality stations to assess the depth of the thermocline relative to Niskin bottle sample location, if warranted by results.

Field blanks for BTEX, $>C_{10}$-C_{21} and $>C_{21}$-C_{32} hydrocarbons, PAHs and alkyl PAHs, phenols and alkyl phenols, organic acids, metals and ammonia are collected at three randomly selected station *X* depth combinations (i.e., three samples). QA/QC samples are collected at the same station *X* depths combinations.

In addition to sampling for seawater *in-situ* as described above, Husky Energy also regularly samples produced water on-board the *SeaRose FPSO* to characterize the produced water discharge. As of 2014, a produced water sample will be collected opportunistically on-board the *SeaRose FPSO* immediately before the discharge point by the *SeaRose* Laboratory Technician (or designate) during the at-sea collection timeframe. The sample, though not part of the EEM design or statistical analysis, may serve to provide a reference for the water quality characteristics at the time of EEM sampling.

Sediment is currently sampled for chemistry analysis at water quality stations at White Rose. Collection methods are the same as those for sediment collected at sediment quality station (Section 6.1), but only one core, for chemistry analysis, is collected at these stations.

6.3 Commercial Fish Component

6.3.1 Sample Platform and Target Sample Requirements

American plaice and snow crab are collected on-board a commercial fishing trawler every two years, typically in late June or early July. Sampling is currently conducted under an experimental fishing license issued by Fisheries and Oceans Canada.

American Plaice

A minimum 10 trawls with six American plaice in each trawl are collected from within the Study Area. These trawls are distributed in close proximity to the drill centres, but outside the White Rose Safety Zone. A minimum of 3 trawls with 10 American plaice are collected in each of the four Reference Areas. American plaice larger than 30 cm[1] are selected from the catch at the Study and Reference Areas to allow splitting of livers between body burden analysis and fish health analyses. If numbers per trawl are low, trawl contents can be combined (once ashore) to generate the required number of plaice. A minimum of 1500 g of plaice top fillet tissue is required from each of the Study and the combined Reference Areas, for taste test. Tissue for taste test is collected from the same trawls used for body burden and fish health analyses. See Section 7.3.1 for additional detail on how tissues are allocated to each test.

Snow Crab

To date, snow crab have been collected using a commercial trawl. A minimum of 10 trawls with six crab in each trawl are collected in the Study Area. Trawls are distributed evenly around the drill centres, outside the White Rose Safety Zone. A minimum of three trawls with six crab in each trawl are collected in the each of the four Reference Area. Only crab larger than 60 mm in carapace width are selected from the catch. If numbers per trawl are low, trawl contents can be combined (once ashore) to generate the required number of crab. A minimum of 6000 g (left legs with shell) of crab is required from each of the Study Area and the combined Reference Areas for taste tests. Tissue for taste test is collected from the same trawls used for body burden. See Section 7.3.1 for additional detail on how tissues are allocated to each test.

6.3.2 On-board processing

Preliminary processing of samples is on board the vessel. Plaice and crab that have suffered obvious trawl damage are discarded. Tissue samples, top fillet for plaice and left legs for crab, are frozen at -20°C for taste analysis. Bottom fillets and liver (left half only) for plaice and right legs for crab are frozen at -20°C for body burden analysis. Blood, gill, liver (right half), heart, spleen, gonad, kidney and otolith samples from plaice are preserved for fish health analysis (see below). Additional measurements on plaice include fish length, weight (whole and gutted), sex and maturity stage, liver weight and gonad weight. For crab, measurements include carapace width, shell condition, sex and chela height.

[1] The practice has been to select fish larger than 25 cm, but this has not provided sufficient liver for chemistry analysis in recent years.

For fish health, each fish is assessed visually for any parasites and/or abnormalities on the skin and fins. Approximately 0.5 to 1.0 ml of blood is drawn from a dorsal vessel near the tail, dispensed carefully into a labelled tube containing an anticoagulant (EDTA) and gently mixed. Two blood smears are prepared for each fish within one hour of blood collection according to standard haematological methods (Platt 1969). The entire liver is excised and bisected. A 4 to 5 mm thick slice is cut from the centre portion of the right half of the liver (along the longitudinal axis) and placed in Dietrich's fixative for histological processing. The remainder of the right half is frozen on dry ice for MFO analysis. The first gill arch on the right side of the fish is removed and placed in 10% buffered formalin for histological processing. Tissue samples of heart, spleen, gonad and head-kidney are removed and placed in Dietrich's fixative for histological processing, if required. A pair of otoliths is removed for ageing. Throughout the dissection process, any internal parasites and/or abnormal tissues are recorded and preserved in 10% Dietrich's fixative subsequent identification.

6.4 Documentation

6.4.1 Survey Plan

Survey plans are developed prior to the start of the sediment and water collection survey, and the commercial fish collection survey. Survey plans provide the overall plan for the field surveys and contain specific information regarding field crew (including personnel certifications), equipment certifications, fishing licenses, contact information for field and land personnel involved in the survey, emergency procedures, details on samples to be collected including sample locations and storage procedure, sample labeling, and ancillary information to be collected and priorities for the survey. The survey plan is intended as a general overview of the anticipated field operations for use by White Rose operations personnel, the vessel crew and the field survey team.

6.4.2 Survey Report

Survey reports are developed once the sediment, water, and commercial fish surveys are complete. Survey reports document the collection of samples by providing a summary of the field operations including vessel, personnel, mobilization, sampling station coordinates, a detailed report of the survey activities, demobilization and reporting from the field. Survey reports also append (as applicable) the sediment sample log, core description log, positioning report, daily field reports, any incident reports (e.g., damaged equipment, survey crew member injury), and trawl start and finish coordinates.