Job Aid 8

Supplemental Water and Toxicity Monitoring

Job Aid 8 Inclusions **Page**

8.a Water sampling objectives, limitations, and other key points

It is critically important to emphasize that planned or on-going dispersant operations as part of the response effort should not be delayed while assembling the sampling team and equipment necessary to implement water column sampling.

Use the resources in the table below to identify the platforms and personnel that will be used for water column sampling. Use contracted, professional resources (preferably those with previous experience) and develop an incident-specific sampling plan using available resources that will best address the spill event.

- ✓ Minimal water column sampling points would ideally be just under the surface and at 1m, 5m and 10m below the surface. Sampling should occur both inside and outside the slick area, and before and after slick treatment with dispersant.

- ✓ The ideal sampling system would employ a Portable Large Volume Water Sampling System (PLVWSS) that can be deployed via Autonomous Underwater Vehicle (AUV) or Remotely Operated Vehicle (ROV), collect real-time water samples at specified depths pre- and post-dispersant treatment, and not require personnel to be in the slick area to collect samples directly.

- ✓ Efforts to collect water samples from within the upper water column, while reducing duplicate sampling and conflicts with other operations, should be coordinated with SMART (DUP DIS-1-I, Job Aid 5), NRDA, seafood safety, CG, OSROs and other contracted resources to maximize/de-conflict the various sampling platform and personnel utilities.

Other key points (see also pg. 19 of DUP):

- This Job Aid does not directly address sampling of potentially exposed or affected biota (e.g., fish, invertebrates). Biotic sampling is addressed through seafood safety and/or NRDA sampling protocols found elsewhere in the RRT IX Regional Contingency Plan and/or through the various response agencies.

- Subsea (deep water application) of dispersants is not expected in California waters. This Job Aid only addresses in-water sampling within the upper water column (generally <10 m).

- Sampling the upper water column can be challenging during an active oil spill response because of the need to avoid other response vessels and to comply with appropriate safety stand-off distances during aerial dispersant spraying.

There are several possible water column sampling objectives to consider during an oil spill response, including spills where surface-applied dispersants are used. Each objective may employ different strategies and platforms. Some sampling objectives may overlap, allowing an opportunity to combine some sample collection efforts to address multiple sampling needs. However, each water sampling objective has its limitations, and there is as yet no one way to meet all sampling objectives.

Some possible sampling objectives, benefits and limitations are summarized in the table below.

However, this is a very dynamic sector for emerging technology, and any water column sampling plan will benefit from researching technologies available at the time of the incident.

Sampling Objective	Protocol or Platform	Benefits	Limitations	For more info
Dispersant efficacy (Oil concentration, if SMART team collects water samples for later off-site analyses).	SMART	Used in DWH Relatively rapid deployment by CG Strike Teams. May be able to collect some ancillary water samples for later, offsite lab analyses.	Generally qualitative only. Requires sampling personnel in slick area. Tiers II/III, and any ancillary water sample collection, cannot be real-time during aerial dispersant operations.	Job Aid 5 Analysis of DWH samples collected by SMART (BenKinney et al.)
Dispersant efficacy	LISST	Used in DWH Collection of direct (e.g., samples) and indirect (e.g., CTD) data to quantify dispersed oil droplet size, characterize oil plume behavior, etc. Quantitative.	Not real time Requires sampling personnel in slick area. Water samples collected may not be suitable volume to accurately quantify both particulate and dissolved PAH concentrations.	DWH COOGER
Dispersant efficacy Droplet size Dispersed oil concentration	AUVs, ROVs and similar autonomous platforms	Collection of direct (e.g., samples) and indirect (e.g., CTD) data to quantify dispersed oil droplet size, characterize oil plume behavior, etc. Quantitative. Real-time. Can sample without putting people in the slick area. May be useful for far offshore sampling operations.	Limited availability. May be limited on number and volume of water samples that can be collected at multiple times and depths.	NOAA SSC (Job Aid 1) can contact AUV/ROV researchers at NOAA and other research institutions to assess platform capabilities and availability.
Dispersed oil concentration	PLVWSS (Portable Large Volume Water Sampling System)	Water samples collected of suitable volume to accurately quantify both particulate and dissolved PAH concentrations. Can also inform NRDA and seafood safety.	Used in DWH Not real time Requires sampling personnel in slick area. May have limited availability.	Payne Environmental Macondo Part 1 Macondo Part 2 PLVWSS for NRDA

Read below for further detail on various platform capabilities and sampling approaches, excerpted from:

- CG R&D Center: Report No. CG-D-02-18, In-situ Monitoring of Dispersion in the Water Column
- CG R&D Center: Report No. CG-D-06-14, Detection of Oil in Water Column, Prototype Tests
- IPIECA: In-water Surveillance of Oil Spills at Sea
- California Dispersed Oil Monitoring Plan

8.b Sampling platforms and sensors

In-water surveillance, using systems deployed at the sea surface and in the water column, can be performed using a wide range of vehicles and platforms as hosts for the sensing systems. These range from manned surface vessels to autonomous observation vehicles (AOVs). AOVs are inclusive of autonomous underwater vehicles (AUVs) and remotely operated vehicles (ROVs).

i. Surface vessels and aircraft

Manned vessels may include small boats, rigid-hull inflatable boats (RHIBs), fishing and research vessels, and oil supply and support ships. Aircraft (fixed wing or helicopter) and various types of Unmanned Aerial Vehicles (UAVs) and other aerial observation technologies can support aerial observations, photo-document plume behavior, and help direct on-water sampling activities.

Vessel features that should be considered when considering whether it is suitable for deploying surveillance technologies include:

- Vessel size and its ability to support the size, weight and power requirements of the selected sensing systems;
- Vessel range and duration;
- Operability in the response area, given prevailing and forecast weather and sea conditions;
- Personnel capacity (crew and responders);
- Sensor deployment height, which can affect sensing range and projected areal coverage;
- Communications technology available to provide real-time information;
- Vessel availability (e.g., procurement and contracting).

ii. Autonomous oceanographic vehicles (AOVs)

AOVs come in many different types, each with their inherent capabilities and operational constraints. Two principal AOV classes are:

AUVs. Can travel underwater without requiring constant input from an operator; can be operated from a nearby vessel, from the shore, or in some cases completely autonomously. Range in size from lightweight, portable devices to larger-diameter vehicles over 10 m in length. Can carry a wide range of sensors, including compasses, depth sensors, sidescan sonars, magnetometers, thermistors and conductivity probes.

ROVs. Tethered underwater vehicles with a high strength frame, buoyancy material, propulsion systems, power and telemetry systems and a sensor interface that can support the specific requirements of the mission. There are five classes of ROV based on size, depth capability, power and payload. Typically powered and controlled from the surface by an operator/pilot via an umbilical.

AOV compatibility considerations that should be considered for water sampling missions:

- AOV deployment may require several days or longer (i.e., manned vessels may be more readily available, at least initially);
- Larger AOVs are more desirable for extended missions as the spill duration increases, and if spills are over deeper water and farther from shore;
- AOVs can reduce the risks of personnel exposure to hazards during a spill response.

iii. Sensors

Hydrocarbons in the water column exist as a particulate and dissolved fraction mix. Reliable detection usually requires a combination of direct and indirect sensing methods. Oceanographic conditions, which affect oil distribution, are typically measured in addition to water samples taken.

Indirect sensing methods monitor typical oceanographic parameters in the water column, including water temperature, dissolved oxygen (DO), pH, salinity and turbidity. Monitoring these factors establishes a baseline set of oceanographic conditions and allows detection of potential changes in the water that may be related to the presence of oil plumes. For example, DO levels that decrease below baseline reference levels may indicate the presence of hydrocarbons that are undergoing microbial biodegradation.

Direct sensing via collection and evaluation of water samples will allow finite measurements of dispersed oil concentrations. The seawater samples should be filtered at the time of collection and the filtrate (containing the dissolved phase) and the filter (which retains the dispersed oil droplets) are analyzed separately.

iv. Logistics and deployment considerations

Weather and regulatory conditions may limit the operation of more traditional, vessel-based sensor platforms, depending on several factors which could include:

- Size the type of deployment vessel;
- Whether a dedicated launch and recovery system is required

Portable craft (e.g., some AUVs) can be transported by most vehicles and deployed from shore, although a small number of personnel in small boats may be required. Deployment using small boats will be highly dependent on sea state, and the technologies will need to be “ruggedized” for used in the field. See Tables 3-13 in the IPIECA document for further detail on the capabilities of various sensor platforms.

Larger AUVs and ROVs that can be deployed from larger vessels will have better utility for spills occurring farther from shore or extending over long periods of time, but there may be limitations in how long it will take to procure the necessary resources and get them to the spill site. This may limit how much sampling and information is available for the first few days of the response.