

Subsurface Oil Detection and Delineation in Shoreline Sediments

Phase 2—Field Guide

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Field Guide for Subsurface Oil Detection and Delineation in Shoreline Sediments

1.0 Introduction

When oil strands on a dynamic shoreline, unless it is removed immediately, there is potential for:

- burial due to shifting beach sediments;
- mixing with underlying sediments; or
- penetration into porous sediments.

These processes result in subsurface accumulations consisting of:

- continuous layer(s) of solid or emulsified oil;
- discontinuous deposits; or
- oil saturated sediments.

In such cases, the detection and delineation of subsurface oil is required to ensure complete documentation of oiling and the development of recommendations for treatment end points and recovery or treatment techniques to achieve these end points. There are different stages at which subsurface detection observations are desirable:

- initial delineation;
- following significant events (such as, storms; post-treatment);
- during monitoring of the progress and effectiveness of treatment;
- detection of changes over time in oil characteristics which might impact recovery operations; and
- post-treatment inspections.

A key factor when choosing survey techniques is to compare detection efficiencies.

Although there exist a variety of survey techniques for vertical delineation of subsurface oiling, there are currently no proven efficient methods for horizontal detection and delineation of subsurface oil. Current accepted tactics, such as pitting, trenching and auguring, provide a relatively small data point regarding the horizontal distribution and character of subsurface deposits.



2.0 Objectives of the Field Guide

- Provide emergency responders and planners with practical guidance on the selection and use of currently accepted tactics for the detection, description, delineation and documentation of subsurface of oil in shoreline sediments.
- Provide a mechanism for consideration and field testing of new and developing tactics.

3.0 Format

The Field Guide is divided into three sections which should be reviewed sequentially:

- **Identification of Applicable Tactics (4.0)**
- **Survey Design Plan (5.0)**
- **Tactical Implementation (6.0)**

Attachment A discusses **horizontal and vertical positioning** and describes **beach profiling**, which is a tool that can document the horizontal and vertical positions of subsurface oil deposits and can provide a time-series picture of elevation changes on beaches with known subsurface oil.

Attachment B provides a “User’s Matrix” for **tactics that are either in development or are not universally accepted** at this time. These tactics may be considered in the screening of applicable options.

4.0 Identification of Applicable Tactics

A 5-step process is presented to identify appropriate detection and delineation tactics. Figure 4.1 provides a screening tool intended for the initial evaluation process (Step 1). Two matrices (Figures 4.2 and 4.3) summarize the key variables that affect the applicability and usefulness of the current accepted techniques (Step 5).

STEP 1: Evaluate Tactical Feasibility

The first step involves a preliminary screening of what can and cannot be attempted on a particular shoreline in terms of physical access and what type(s) and level of mechanical equipment could be used. Three classes are included:

- suitable for manual tactics (that is, access by foot);
- limited mechanical tactics (access with low surface pressure equipment only), and
- unlimited tactics (access with most mechanical equipment is feasible).

Considerations include access and trafficability as an initial step for the elimination of tactics that are unlikely to be feasible or practical. Figure 4.1 provides guidance for this initial screening.

STEP 2: Evaluate Existing Surface Oiling and Sedimentary Processes

This step involves field observations of the current shoreline oiling conditions, typically undertaken as part of a Shoreline Cleanup Assessment Technique (SCAT) survey program to systematically document surface and subsurface oiling.

Beaches change constantly in response to wave and wind processes at the shorelines, particularly during storm events. Changes can include rapid erosion, accretion, and the redistribution of sediments and subsurface oil. Understanding these processes and the accurate location of subsurface features is important.

Factors to consider include:

- **Penetration Potential:** Typically penetration is determined by the oil character, the smallest grain size of sediments in a beach, and water content.
- **Burial Mechanisms:** Consider how the oil came ashore (calm or high wave energy conditions; discrete slicks or scattered tar balls; etc.) as this provides information on the manner in which oil has been deposited.
- **Presence and Location of Existing Surface Oil:** Surface oiling may indicate areas where oil may have been buried, has been reworked into the subsurface by wave action, or has penetrated into the sediments.
- **Recent and Prevailing Coastal Processes:** Evaluate the recent and current shore-zone processes which control sediment reworking, sand accretion by wave action or alongshore transport.
- **Requirement for Beach Profiling Survey:** If a short-term data set (weeks) on beach elevation changes would be informative, determine appropriate profile locations, spacing and survey frequency.
- **Erosion/Accretion Status:** Evaluate whether the beach is currently undergoing accretion or erosion.
- **On-going Beach Restoration Projects:** Identify any local or nearby recent or current beach nourishment, dredging and/or bypassing activities as these can affect the sediment regime.

STEP 3: Identify Field or Operational Constraints

There may be regional or local issues, related to environmental concerns, land use, land management or land ownership that potentially could limit detection and delineation activities.