

FIELD TRIALS TO LOCATE AND DELINEATE SUBSURFACE OIL ON LAND AND SHORELINES USING DETECTION DOGS

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Abstract

The American Petroleum Institute (API) Joint Industry Task Force (JITF) Oil Spill Preparedness and Response program has completed several studies to evaluate the current state-of-the-art in Subsurface Oil Detection and Delineation technologies in support of inland and shoreline oil spill response. Current practice for locating and delineating subsurface oiling involves visual observations in excavated pits and trenches, which can be labor intensive, time consuming, and relies on small “spot” samples to represent the area under investigation. API reviewed existing and developing technologies for subsurface oil detection, and identified significant potential for the use of oil detection dogs to support Shoreline Cleanup Assessment Technique (SCAT) teams and provide full coverage of the entire horizontal area. Field trials to demonstrate and evaluate the applicability of using oil detection dogs, and to identify further development needs, were conducted in the first week of June 2015.

Field Trial Objectives

The objectives of the dog team field trials included:

- Demonstration of successful imprinting of a crude oil odor on two search-trained canines.
- Evaluation of trained dog teams to detect subsurface oil and clear non-oiled areas by Wide Area Search (off leash) surveys.
- Evaluation of accurate delineation of various configurations of subsurface oil using on-lease survey procedures.
- Evaluation of the coordination and training required between Dog Teams (dog and handler) and SCAT personnel.

Results and lessons learned will be used to develop a Canine Subsurface Oil Detection Manual for planners and decision makers to determine the appropriate situations for which an Oil Detection Dog team could usefully support a subsurface oil assessment (SCAT) survey related to pipeline or other land spills, river spills, marine shoreline spills, lake shoreline spills, or spills under ice or snow.

Test Design

- Two canines were trained for the project by K2 Solutions at their K9 Training Center, Jackson Springs, NC, using a Texas Intermediate crude.
- The use of two canines allowed evaluation of the repeatability of the tests.
- A total of 21 tests involved 704 targets over four days (1-4 June, 2015). All tests were “blind”, that is, the dog handler teams did not know the location of the oiled targets.

K2 Solutions provided an accredited evaluator to document the results of the tests and OCC evaluated the applicability of the tests to real oil spill scenarios.

Two primary test types were conducted:

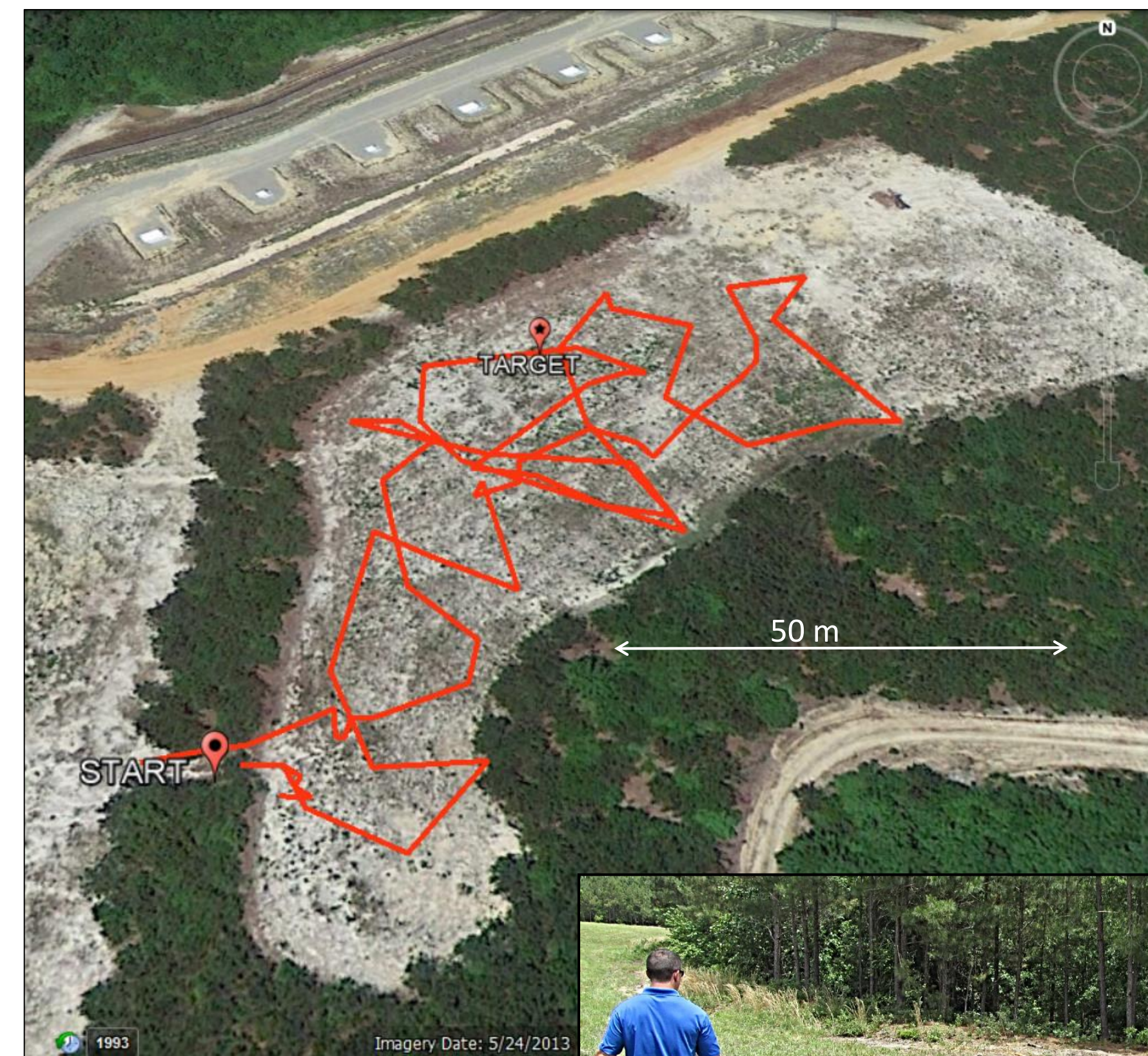
- Seven (7) Wide Area Search pattern surveys (on a scale of over 0.5 ha) for (a) detection of a single subsurface oil target in large areas; and (b) “clearance” of non-oiled areas.
- Fourteen (14) Delineation tests using a series of 50 prepositioned empty bottom open plastic tubes:
 - at a 5-m offset spacing (diamond pattern)
 - within a 1,250m² area
- Smaller insert tubes were filled several weeks prior to the tests with either blanks or oiled sediments:
 - then set in the open tubes in six different configurations to represent either continuous, discontinuous, isolated, or pipeline alignment subsurface oiling
 - targets sediments were arranged at a range of depths (30cm, 45cm, 55cm, 60cm and 90cm).

The canines were fitted with GPS units to record their tracks. Evaluation and survey forms, and video and still photography were used to record each test.

The trials involved a half-day Visitor’s Program for government and industry representatives, which included a project briefing and a field demonstration of a Wide Area Search pattern and 3 Delineation tests. The Visitor’s Program provided a valuable opportunity for the team to receive input and answer questions from important stakeholders.

Off Leash Wide Area Search

Raw GPS trackline for a Wide Area Search test (~0.5 hectare area)



Detection Dog Survey Forms

OIL DETECTION DOG FIELD TRIAL SURVEY FORM: DELINEATION									
I. GENERAL INFORMATION									
Date: (dd/mm/yyyy)	Weather: Sun / Clouds / Fog / Rain (circle)	Air Temp: °F							
Time Start: (hh:MM)	Humidity: %	Wind Direction:							
Time End: (hh:MM)	Pressure: mb rising / falling (circle)	Wind Speed: mph							
II. DOG TEAM									
Team Number:	Handler Name:								
Dog Name:	Tracking Collar #:								
III. TARGET LAYOUT									
Layout Design: (A, B, C...)									
IV. TARGET DESCRIPTION									
Target #	Oil Type/ Material	Cloning Depth (cm-cm)	Oil Volume	Substrate/ water cover	Target #	Oil Type/ Material	Cloning Depth (cm-cm)	Oil Volume	Substrate/ water cover
A1					B1				
A2					B2				
A3					B3				
A4					B4				
A5					B5				
A6					B6				
A7					B7				
A8					B8				
A9					B9				
A10					B10				
B1					B11				
B2					B12				
B3					B13				
B4					B14				
B5					B15				
B6					B16				
B7					B17				
B8					B18				
B9					B19				
B10					B20				
B11					B21				
B12					B22				
B13					B23				
B14					B24				
B15					B25				
B16					B26				
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B20					B30				
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B28					B38				
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B30					B40				
B31					B41				
B32					B42				
B33					B43				
B34					B44				
B35					B45				
B36					B46				
B37					B47				
B38					B48				
B39					B49				
B40					B50				
V. COMMENTS									
VI. TEST RESULTS									
Target #	Oiled Target? (Y/N)	Result - Select only one	Blank correct ignored	Blank false alert	Oiled correct identified	Oiled false identified	Correct (Y/N)		
1									
2									
3									
4									
5									
Photographs? Yes / No Numbers: () Videos? Yes/No Video Time: ()									
Completed by: _____									

Delineation

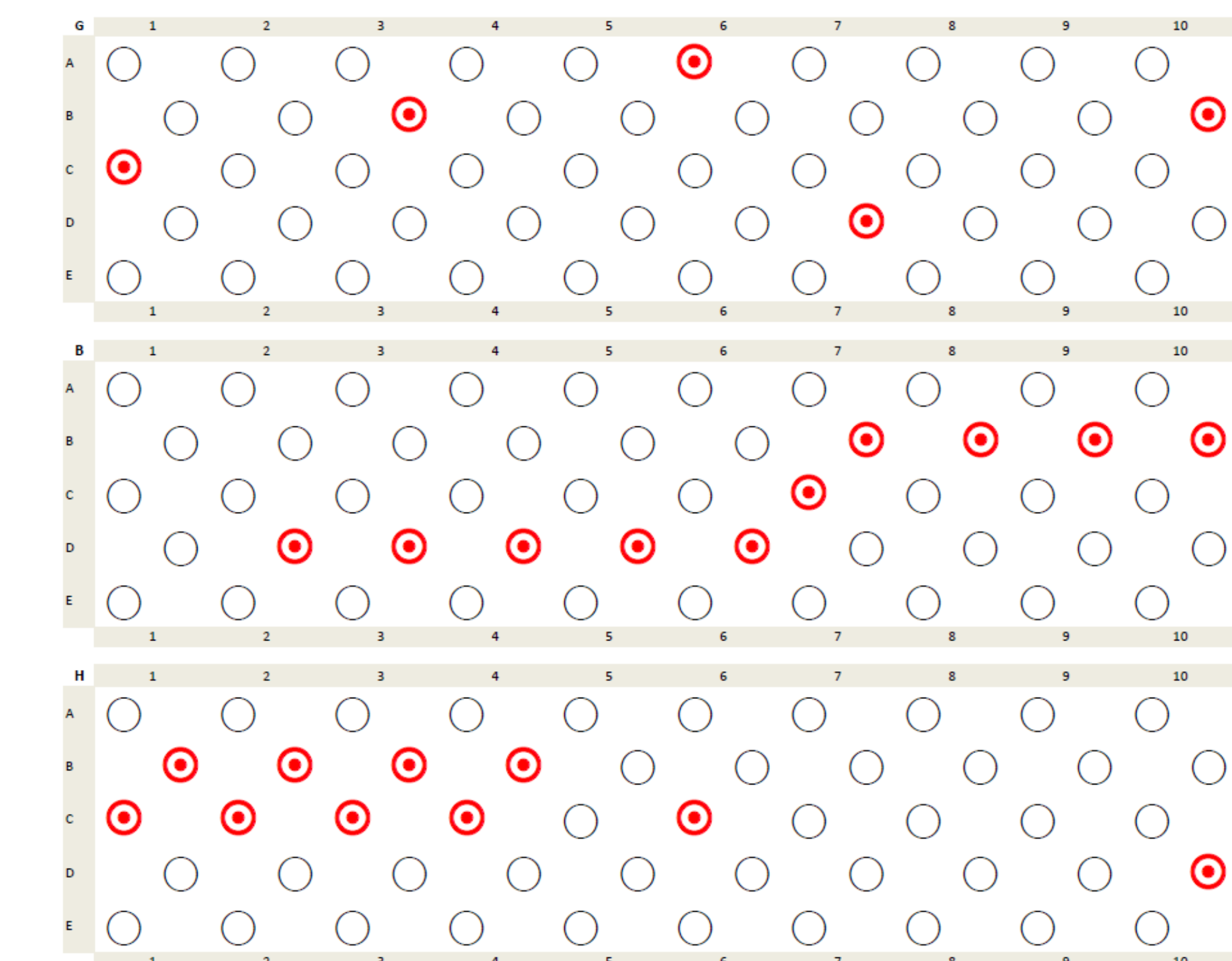
Wide Area Search

On Leash Delineation Tests



Delineation Test Designs

Three of the six 50-target delineation test designs: representing discontinuous oiling, pipeline, and continuous oiling with two isolated outliers:



Targets



Initial Results and Conclusions

- The field trial involved a total of 704 targets in seven (7) Wide Area Search tests and fourteen (14) Delineation tests.
- The dog teams detected and located every Wide Area Search target and cleared (No Oil Detected) the remaining areas searched with no false alerts (100% accuracy).
- One missed target and one false alert during the delineation tests, out of the 704 targets, cannot be attributed to experiment procedure/design or search pattern issues (99.7 % accuracy).
- From an effort/benefit analysis perspective:
 - The average time for the Wide Area Search tests (areas approximately 50m wide by 100m long: 0.5 ha) was 3 minutes:
 - equivalent to 2km/hour or on the order of 15-25 linear km/day for a High Confidence-Low Risk survey with 100% coverage of a 50m wide shoreline or pipeline alignment.
 - The average time for the fourteen 1,250m² Delineation tests was eleven (11) minutes for 100% ground coverage.
 - typically a SCAT team is able to complete 1 or 2 pits over that size area during this period.

Lessons Learned

- Trained dog teams have demonstrated unprecedented potential for detection and horizontal delineation of subsurface oil.
- A Team Approach is essential involving:
 - Trained and imprinted canine
 - Certified handler
 - SCAT-Canine Liaison (who has trained with canine teams)
- Search patterns may vary depending on the search objectives (area delineation, area clearance, pipeline or tank farm leak detection, etc.)
- Environmental conditions (wind, temperature and humidity) affect airborne odor distribution

Applications

Pipelines

- leak or spill searches
- smart pig inspection anomaly support

Shorelines, River and Inland

- Wide Area Search surveys to detect and/or clear segments with No Detectable Oil
- delineation surveys for subsurface continuous, discontinuous and isolated oil for:
 - SCAT support during ground surveys,
 - reconfirmation before Operations implement an STR, and/or
 - confirmation after treatment.
- clearance as part of Shoreline Inspection Report (SIR) surveys.

Next Step Research Needs

Tests with variations in key parameters, such as:

- alternate search patterns,
- detection level and concentration discrimination tests,
- sediment type, oil type and environmental controls (temperature, humidity, barometric pressure) tests, and
- discrimination of multiple oil types tests (e.g. background versus spilled oil).



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