Oil Spill Assessment, Treatment, and Recovery in a Bahamian Caribbean Pine Forest

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On 1 September 2019, Hurricane Dorian impacted Grand Bahama Island with 185 mph winds which damaged the roof coverings on 5 storage tanks at the South Riding Point tank farm and released an estimated 55,000 bbls of crude oil into the surrounding environment. Ground observations, satellite imagery and unconfirmed social media posts indicated that oil was present on the terminal, the forest area north of the terminal, and possibly shorelines and open water between Grand Bahama and Abaco Island.

A Shoreline Cleanup Assessment Technique Program (SCAT) was quickly mobilized, as part of the Environmental Unit (EU) of the response, to assess oiling impacts and develop treatment recommendations. SCAT is a systematic method for surveying affected areas following an oil spill, using standardized terminology and metrics to document oiling conditions designed to support decision-making for oil spill cleanup.

The initial goal of any SCAT Program is to "scale the problem" or to determine the extent of oil in the environment. The focus for the SCAT program was both the oiling observed near the terminal and forest, but also unconfirmed observations of oil on the shorelines and ocean between Grand Bahama and Abaco. A helicopter with a winch was used to lower a person to the shoreline on Abaco and locations between Grand Bahama and Abaco where overflights indicated potential oil. This suspected oil was determined to be seaweed/eel grass accumulations. SCAT then focused their efforts on the shorelines of Grand Bahama and surveyed 146 kilometers by foot and boat with no oiling related to this incident observed. This left the only oiling inland on the terminal and in the Caribbean Pine Forest and wetlands to the north.

The forested area provided logistical challenges due to limited road access, hard and unstable limestone substrate, and downed trees. The response focused on these areas with up to 10 SCAT teams surveying over 4200 acres (17 km^2) of forest. Within this surveyed area over 52% consisted of no observed oiling (~2290 acres). The remaining oiled areas consisted of varying degrees of oiling on the limestone substrate and/or vegetation including oiled crowns atop the pine trees. The heaviest oiling category, with both oiled vegetation and sediment/substrate, made up 3.8% (~146 acres) of the total surveyed area in the forest.

As initial surveys were completed, SCAT recommended possible treatment methods with the objectives that any remaining oil should pose no contact threat to wildlife nor limit the forest's ability to recover naturally. Treatment methods included the vacuum recovery of free phase oil, absorption of thick and sticky oil with natural adsorbent, clipping of heavily oiled vegetation, and collecting heavily oiled loose organic matter. New vegetation growth along with thin and weathered

oil on substrate or vegetation was recommended to be left to naturally degrade. Based on a body of scientific understanding of the risks of treating oiled wetlands, no treatment was recommended for the interiors; however, limited cutting and raking was completed along oiled wetland edges.

To prevent treatment from inhibiting natural attenuation, No Further Treatment (NFT) guidelines, or treatment "endpoints" were developed to give Operations understandable, visual goals allowing them to determine when treatment was complete. These NFT guidelines included: no free phase oil, no oil-saturated soil, no heavily oiled vegetation that represents a transfer risk to wildlife, no oiled debris, and some coat-stain may remain if it does not easily transfer.

The SCAT Program developed Treatment Recommendations (STRs) which included descriptions and maps of the area for treatment, access points, example photos of the characteristic oiling, recommended treatment methods, NFT guidelines, and suggested equipment. STRs were reviewed and approved by the EU, Operations Section Chief, and the Incident Commander.

The identified area for treatment was subdivided into working units called "OPS zones" allowing Operations and SCAT to delineate, treat, and track progress efficiently in the large forest area. Zones were delineated in a desktop GIS and each zone had at least one side bordering a defined road providing access. SCAT worked closely with Operations by delineating work zones with ropes and tape, discussing treatment methods, tracking personnel and waste, and confirming no further treatment was required once Operations felt a zone was complete. SCAT surveyed each zone before, during, and after treatment to ensure NFT guidelines were successfully met, and a final survey was conducted with an Equinor representative before the zone was deemed complete.

Approximately 143 acres (0.58 km^2) of oiled pine forest and wetland edges were treated by Operations following these procedures. On 13 March 2021, after 210 workdays, forest operations were completed with the Government of the Bahamas providing "No Further Action" approval on 30 August 2021.

To help document the treatment effectiveness and recovery of the forest, SCAT set up photo-monitoring stations and implemented a long-term vegetation monitoring plan. Nineteen photo-monitoring stations were established, and photographs were taken from the same location at each station approximately monthly. The vegetation monitoring plan consisted of measuring percent cover, species richness, and species diversity at 10 forest plots located in areas of no observed oiling, oiled with no treatment, and oiled with treatment. Spartina stem counts were conducted at 12 wetland plots in locations of no observed oiling and oiled with no treatment. Data collection visits have been conducted at 2-, 5-, 17-, and 29-months post-spill, with additional visits planned for 5- and 10-years post-spill. All forest plots showed increasing precent cover, species richness, and species diversity while the wetland plot groups showed increasing stem counts. Results indicate there is no significant difference in species richness, diversity (forest plots), or stem counts (wetland plots) between the oiled and unoiled plots. Percent cover of the forest plots showed a statistical difference between the Reference (69.6%) and Oiled (59.4%) sites, indicating there may be a difference in the recovery of the oiled forest relative to the unimpacted forest.

While the effects of an unprecedented storm, the unique environment, and oiling conditions presented challenges, the flexible nature of the SCAT process allowed for a successful program which supported the assessment, treatment, and recovery of the forest.