



Ash Migration Investigation Using Sub-Bottom Profiler

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Purpose:

Ash migration has been a major concern following the Kingston Fossil Plant ash spill. Efforts to characterize the extent and amount of submerged ash have been marginally successful due to the logistical constraints in surveying vast areas of waterway. The Tennessee Valley Authority (TVA) purchased an EdgeTech 3200-XS Sub-Bottom Profiling System with an SB-424 Tow Vehicle to overcome these constraints.

Objectives:

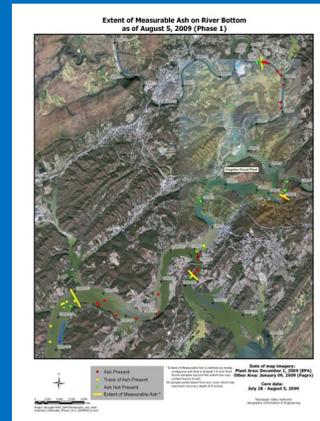
- Phase 1: Identification of the areal extent of ash migration from the ash spill.
- Phase 2: Characterization of the depth of ash throughout deposition area.
- Phase 3: Mapping to depict the extent and depth of ash deposition.

EdgeTech 3200-XS Sub-Bottom Profiling System with SB-424 Tow Vehicle (SBP):

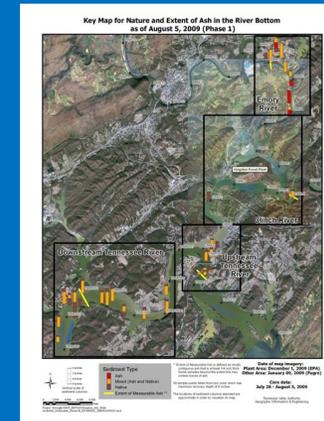
The SBP is a wideband frequency modulated (FM) unit that transmits an FM pulse ("chirp pulse") linearly swept over a full spectrum frequency range between 4-24 kHz for data acquisition (DAQ). The P-wave (acoustic pressure wave or primary wave) reflections are measured by the system and displayed as shades of gray on the computer monitor as reflective imagery. Reflective imagery data are interpreted and digitized into separate stratum.

Experimental Design:

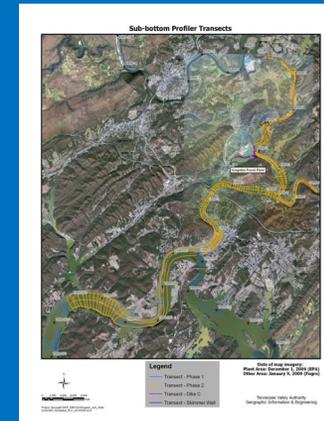
- Phase 1: Box core sediment samples were collected based on cross sectional profile data acquisition performed using the SBP outside the immediate proximity of the spill site.
- Phase 2: SBP data were collected in a grid pattern (transects) between the site and the extent defined in Phase 1. Several coring devices were utilized to determine ash depth and to correlate reflective imagery.
- Phase 3: SBP and coring data were mapped concurrently with Phases 1 and 2.



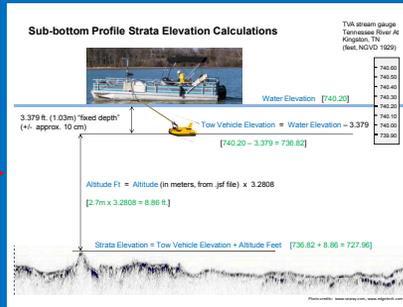
Phase 1 & 3 Activities



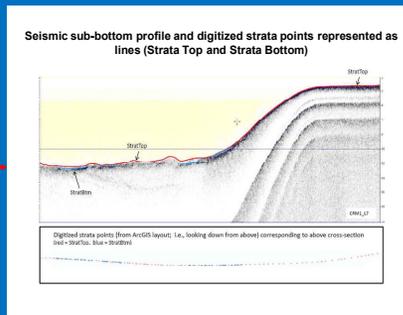
Phase 1 & 3 Activities



Phase 2 & 3 Activities



SBP Profile Strata Elevation Calculations



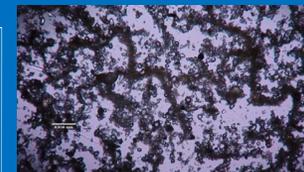
Digitized Strata Points (Top and Bottom)

Results

The extent of measurable ash (see above maps) has been identified at approximately Emory River Mile (RM) 6.0 (upstream of ash spill), Clinch RM 5.0, Tennessee RM 562.0 (downstream), and Tennessee RM 568.7 (upstream). Sediment sampling from Phases 1 and 2 revealed that the ash has either mixed with or been covered by native sediments. These results have caused difficulties in differentiating the two using the SBP reflective imagery. However, ash deposits predating the 2008 ash spill were discovered by microscopy at 1.2 meters below sediment surface near Clinch River Mile 1.0.

Significance and Benefit of Results to Kingston Ash Recovery Program

Using SBP technology, TVA was able to survey vast areas of waterway in a time efficient manner and target sediment coring locations. Sediment core data were used to create maps depicting the depth and extent of ash migration.



Microscopy Image

Continued or Future Studies

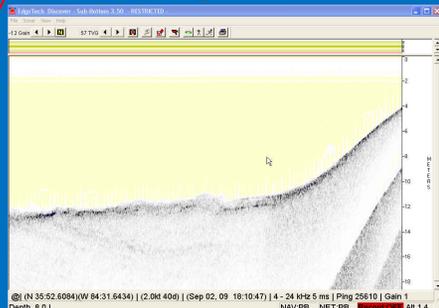
Differentiating between ash and native sediment is a difficult problem that has not currently been solved using the SBP P-wave reflection technology. Sediment cores have not matched the reflective imagery profile interpretations for the Emory, Clinch, or Tennessee Rivers. Data acquisition parameters need to be optimized based on sub-surface properties to obtain data that matches in-situ sediment core samples. Depending on the results of parameter optimization and future high-flow events, portions of this investigation may be repeated.

Acknowledgements

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Pontoon Boat



Reflective Imagery Displayed on Monitor



Winch for Deployment and DAQ



Tow Vehicle