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## Drilling and Sampling in Hanford's Highly Radioactive Environment

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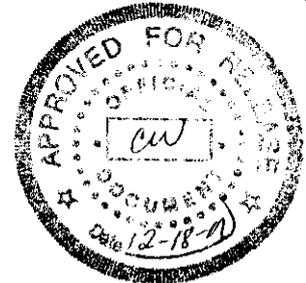
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# Drilling and Sampling in Hanford's Highly Radioactive Environment

Groundwater/Vadose  
Zone Integration Project

## Abstract

In the summer of 2000, a drilling and sampling program was performed to assess the highly radioactive contaminated vadose zone adjacent to and beneath the 241-SX-108 Single-Shell Tank (SX-108 SST) located at the Hanford Site in Washington State. The drilling and sampling effort was designed to retrieve contaminated samples where cesium-137 concentrations could be at the theoretical maximum concentration of 108 pCi/g. Handling of drill cuttings at this concentration was not an option, because dose rates to workers would have been several R/hr. A special drill rig and drilling and sampling system were designed, constructed, and fully tested to advance a casing string at an angle to collect periodic samples without damaging the SX-108 SST, generating any unnecessary wastes, or exposing workers to excessive radiation.

The drilling method used was a driven closed-end casing with a removable tip. An industry standard diesel pile driver was selected to provide optimum means for advancing the casing. A removable internal drill string was designed to provide access for sampling tools and to provide additional energy to the tip of the driver casing during its advancement. The drill rig used a remote-controlled articulating mechanical arm to maneuver casing and split- spoon samplers, avoiding direct worker contact with contaminated components or samplers. A lead shielded split-spoon sampler was designed to reduce personnel exposure from samples as the sampler was extracted from the borehole and placed in shipping containers. To further reduce dose rates, the sample size was limited to the minimum volume required for laboratory analysis.

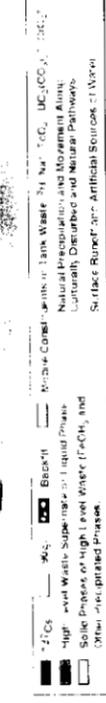
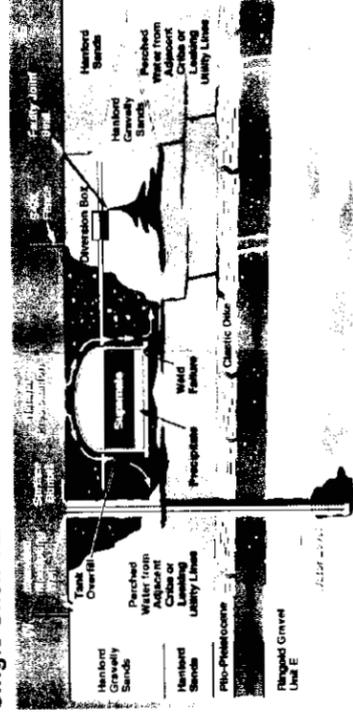
Sample intervals were selected based on existing samples and geophysical logs from adjacent wells. Samples were physically constrained to one sample per 5 ft of advancement. Seventeen intervals were selected for sampling and 16 samples were successfully retrieved. Overall, sample recovery was 80%. The borehole was advanced at a 30 degree angle with a total distance of 172 ft (149 vertical ft).

These techniques provided exceptional contamination control and reduced worker exposure as well as providing representative soil samples. The maximum dose rate measured was 2 R/hr at 4 in. from the sampler on location and 14 R/hr in the laboratory on contact. Doses received by workers were kept well within administrative guidelines. The techniques deployed were extremely successful and provided results otherwise unachievable through standard practices. These techniques have far reaching applications and can provide viable alternatives for collecting characterization data during site investigations where high levels of radiological contamination are present.

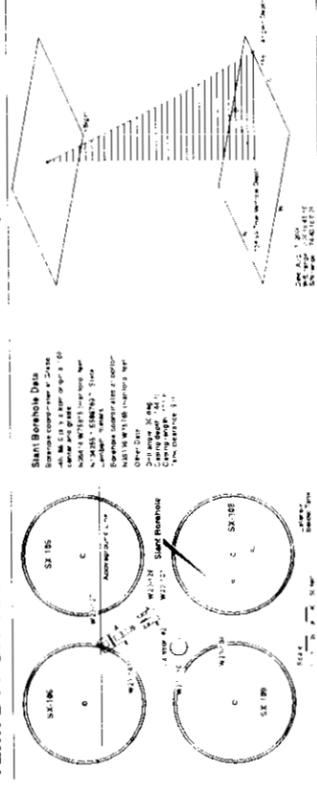


Remote Handling of Drill Tools

Preliminary Conceptual Model of Fluid Flow Beneath Single Shell Tanks



Slant Borehole Location near Tank 241-SX-108



Rig Setup in Tank Farm

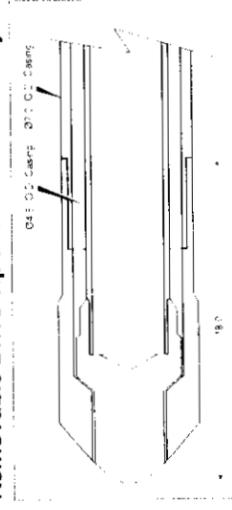


Tip and Shoe

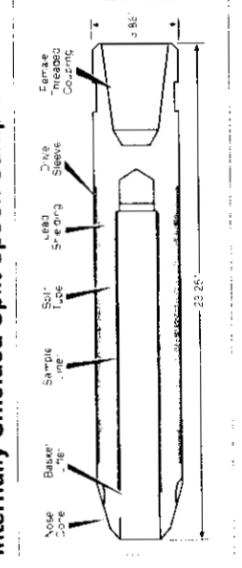


Packaging Sample

Removable Drive Tip and Shoe Assembly



Internally Shielded Split Spoon Sampler



Sample Breakout Table



Soil Samples

SX-108 <sup>137</sup>Cs Distribution



Borehole Geophysics



## Project Team

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Resonant Sonic, International  
Pacific Northwest National Laboratory

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Project Management, Design, Implementation, Field Oversight  
Drilling, Tool Design and Fabrication  
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