Utilizing Bioassays to Provide a More Cost Effective Cleanup

CDM

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The Ellisport Creek Greenspace Project site consists of four privately owned contiguous parcels totaling 8.66 acres of which 5.65 acres are tide land at the northwest head of Tramp Harbor on the east coast of Vashon Island, Washington.

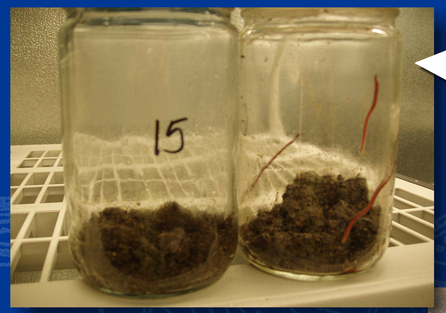
Past industrial use has resulted in Bunker C oil contamination that has complicated ownership transfer of the property. Assessment and cleanup planning has been undertaken by the King County Brownfields Program. Environmental cleanup of this site would substantially reduce ecological threats. Installation of a box culvert would also aid in restoration of the creek's original intertidal habitat. This will provide habitat for juvenile sea-run cutthroat trout and coho salmon.

The Model Toxics Control Act (MTCA) requires a site-specific Terrestrial Ecological Evaluation (TEE) for this wetland site. The goal of the TEE process is protection of terrestrial ecological receptors (plants and animals) from exposure to contaminated soil with the potential to cause significant adverse effects.

Evaluation of assessment data for surface water, marine and freshwater sediment, and soil identified several chemicals of potential concern (COPCs) including pyrene in surface water and arsenic, lead, several PAHs, and Oil as Bunker C in soil.

All COPCs were screened out utilizing literature-based ecotoxicity data with the exception of Bunker C.

Due to the absence of relevant ecotoxicity data, the potential impacts to ecological receptors from exposure to Bunker C was evaluated using laboratory toxicity tests (bioassays) in which earthworms *(Eisenia fetida)* and butter crunch lettuce *(Lactuca sativa)* were exposed to various mixtures of contaminated and non-contaminated soils collected from the site.



The results of the earthworm toxicity testing indicate the following:

- Bunker C in soil is toxic to earthworms (based on survival endpoints) at 18,000 mg/kg (LOEC) but not at 6,700 mg/kg (NOEC).
- The LOEC of 18,000 mg/kg was associated with 26.7 percent survival and was based on measured exposure concentrations (the lowest test concentrations exhibiting toxicity relative to the controls). The *estimated* LC50 (50 percent survival) was 13,700 mg/kg.

These data suggest that an appropriate soil cleanup value for Bunker C would be higher than 6,700 mg/kg but lower than 13,700 mg/kg.

Toxicity test results for lettuce reveal the following:

- At the highest Bunker C concentrations tested, seed germination and seedling survival were not affected.
- Mean seedling biomass was slightly reduced at all test concentrations (930 to 18,000 mg/kg), but in all cases the reduction in biomass was small (less than 20 percent) relative to the background soil tests.
- No clear pattern was noted between percent reduction in biomass and Bunker C concentration, suggesting that other confounding factors may be present.

These data suggest that exposures of terrestrial plants (with sensitivities similar to lettuce) to Bunker C concentrations of up to 18,000 mg/kg are unlikely to result in ecologically significant effects to terrestrial plants.

After consulting with the Washington State Department of Ecology it was agreed that the soil cleanup value for Bunker C would be based on protection of apparently more sensitive soil invertebrates (represented by earthworms) instead of protection of terrestrial plants, and the earthworm NOEC value of 6,700 mg/kg would be protective of soil organisms at the site. The 6,700 mg/kg site-specific cleanup level for Bunker C is significantly higher than the 200 mg/kg default ecological indicator soil concentration in MTCA.

The results of this investigation suggest similar sites containing a weathered hydrocarbon should consider bioassays in the development of a site-specific cleanup level.

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