



# Santa Susana Field Laboratory

## GROUNDWATER PILOT STUDY

### Enhanced In Situ Bioremediation (EISB)

NASA continues to prepare for a final groundwater cleanup at the Santa Susana Field Laboratory (SSFL) and is working closely with the Department of Toxic Substances Control (DTSC) under the 2007 Consent Order for Corrective Action. NASA is conducting pilot studies to identify cleanup strategies that will be most effective and aid in the development of final cleanup plans. One of NASA's pilot studies is designed to test the effectiveness of enhanced in situ bioremediation (EISB) to clean up groundwater beneath NASA areas at SSFL.

## NASA's EISB Pilot Study

NASA is committed to using natural treatment technologies wherever possible to minimize impacts on the unique ecosystem at SSFL. NASA is working on a pilot study that will test the effectiveness of a natural groundwater treatment method--enhanced in situ bioremediation (EISB). EISB uses naturally occurring microbes to remove trichloroethylene (TCE) and other volatile organic compounds (VOCs) from the groundwater beneath NASA areas at SSFL. NASA's pilot study will evaluate whether EISB is an effective treatment at SSFL, given the site's unique conditions, where the groundwater and contaminants have seeped through fractures into the bedrock.



NASA constructed an EISB treatment system for a groundwater pilot study near the spillway of Alfa Test Stand 1.

## Understanding Bioremediation

Bioremediation refers to the use of very small, naturally occurring organisms called microbes to degrade environmental contaminants into harmless byproducts. With EISB, an 'amendment' is used to enhance the growth of the naturally occurring microbes, resulting in greater contaminant degradation. In this study, the amendment is food-grade emulsified vegetable oil (EVO), along with other nutrients and vitamins that are California-approved for injection. The EVO ferments and produces electron donors--hydrogen and acetate. The microbes use the electron donors to sequentially break down the groundwater contaminants through a process called reductive dechlorination. The reductive dechlorination process for TCE, the primary chemical of concern in NASA-administered areas at SSFL, is shown simplified in the illustration below.



Note: Additional byproducts of EISB include hydrogen ions, water, carbon dioxide, methane, and chloride ions

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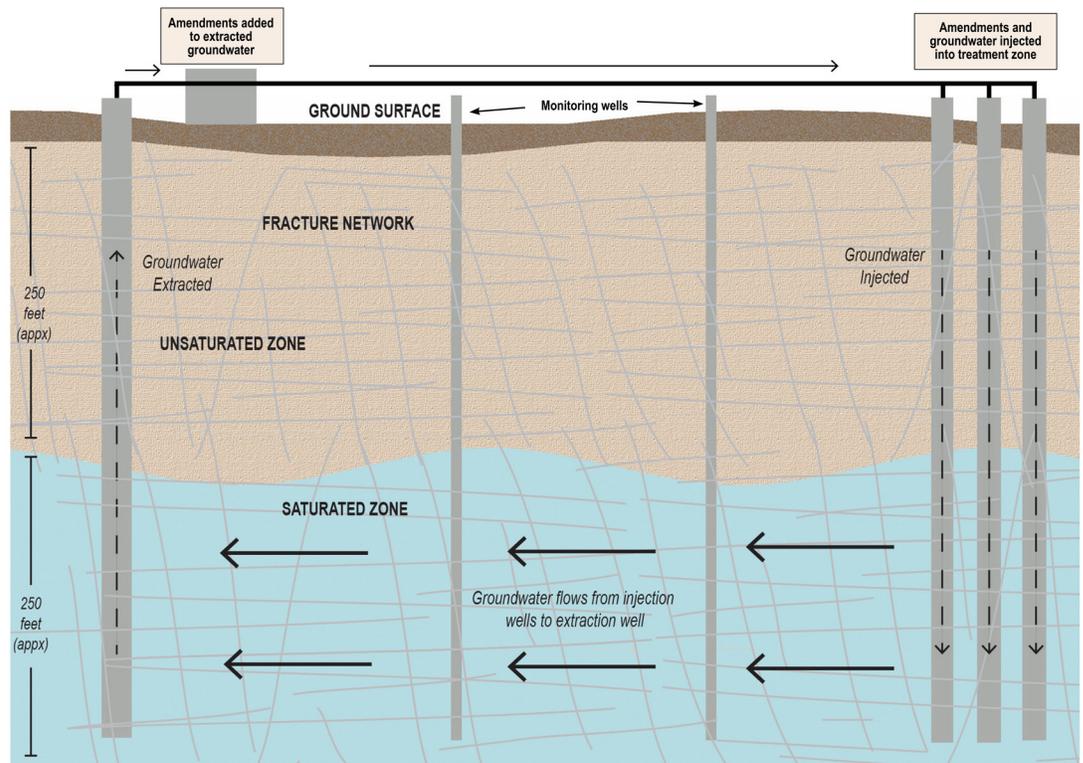
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### Enhanced In Situ Bioremediation

## NASA's EISB Treatment System

In coordination with DTSC and the Los Angeles Regional Water Quality Control Board (LARWQCB), NASA constructed a small, closed-loop extraction-recirculation system in the aquifer below the ground surface near Alfa Test Stand 1. The system extracts groundwater from the aquifer and carries it through a pipeline to the surface, where EVO and amendments are added.

The amended water is then piped into three injection wells and injected back into the aquifer directly beneath SSFL per a LARWQCB Waste Discharge Requirements (WDR) permit. The recirculation loop distributes the amended groundwater and enhances in situ treatment of the groundwater within the area between the extraction well and injection wells. NASA will also use a dye tracer to obtain a greater understanding of how the groundwater migrates through the treatment zone.



Cross-section illustration of NASA's EISB treatment system and the groundwater recirculation zone.

## Evaluating EISB Treatment Success

NASA has a robust monitoring plan to track the effectiveness of the EVO, nutrients, and microbes in reducing contaminants in the groundwater treatment zone given the specific site conditions. If the reductive dechlorination occurs as expected, and contaminant reduction is sufficient, NASA will consider the use of EISB to clean up groundwater in other source areas. In addition to evaluating the large-scale application of EISB across SSFL, the system has the potential to accelerate cleanup by achieving contaminant removal while NASA waits for DTSC to complete their California Environmental Quality Act (CEQA) process and approve final cleanup plans.

## For More Information Contact

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