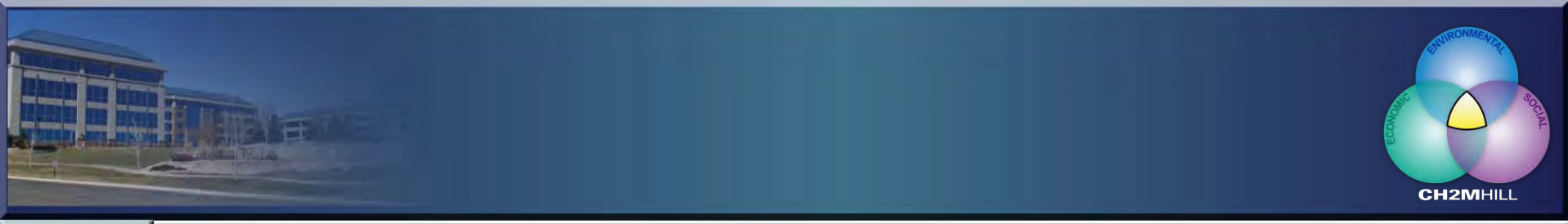

Solar Powered Bioreactor Demonstrates Sustainable Remediation

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CH2M HILL

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
MAY 2009		**00-00-2009 to 00-00-2009**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Solar Powered Bioreactor Demonstrates Sustainable Remediation	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **CH2M HILL,9191 South Jamaica Street,Englewood,CO,80112**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
Presented at the NDIA Environment, Energy Security & Sustainability (E2S2) Symposium & Exhibition held 4-7 May 2009 in Denver, CO. U.S. Government or Federal Rights License

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**19**	

Acknowledgements








- Erica Becvar –AFCEE/TDV
- Mahalingam Ravichandran- AFCEE/TDV
- Glenn Anderson –Travis AFB
- Lonnie Duke – Travis AFB
- Travis Young – CH2M HILL
- Brad Shearer – CH2M HILL

Overview








- Technology Description
- Technical Objectives
- Demonstration Site Description
- Bioreactor Installation
- Monitoring Plan
- Initial Observations
- Technology Transfer

Technology Description








- AFCEE sponsored BAA technology demonstration
- The in situ bioreactor utilizes proven enhancements to reductive dechlorination to biodegrade chlorinated solvents in soil and groundwater.
- Soil was removed from the source area and the excavation was filled with a mixture of tree mulch, gravel, and iron pyrite.
- The in situ bioreactor provides all of the ingredients needed to enhance reductive dechlorination and promote abiotic reactions favorable to TCE destruction.

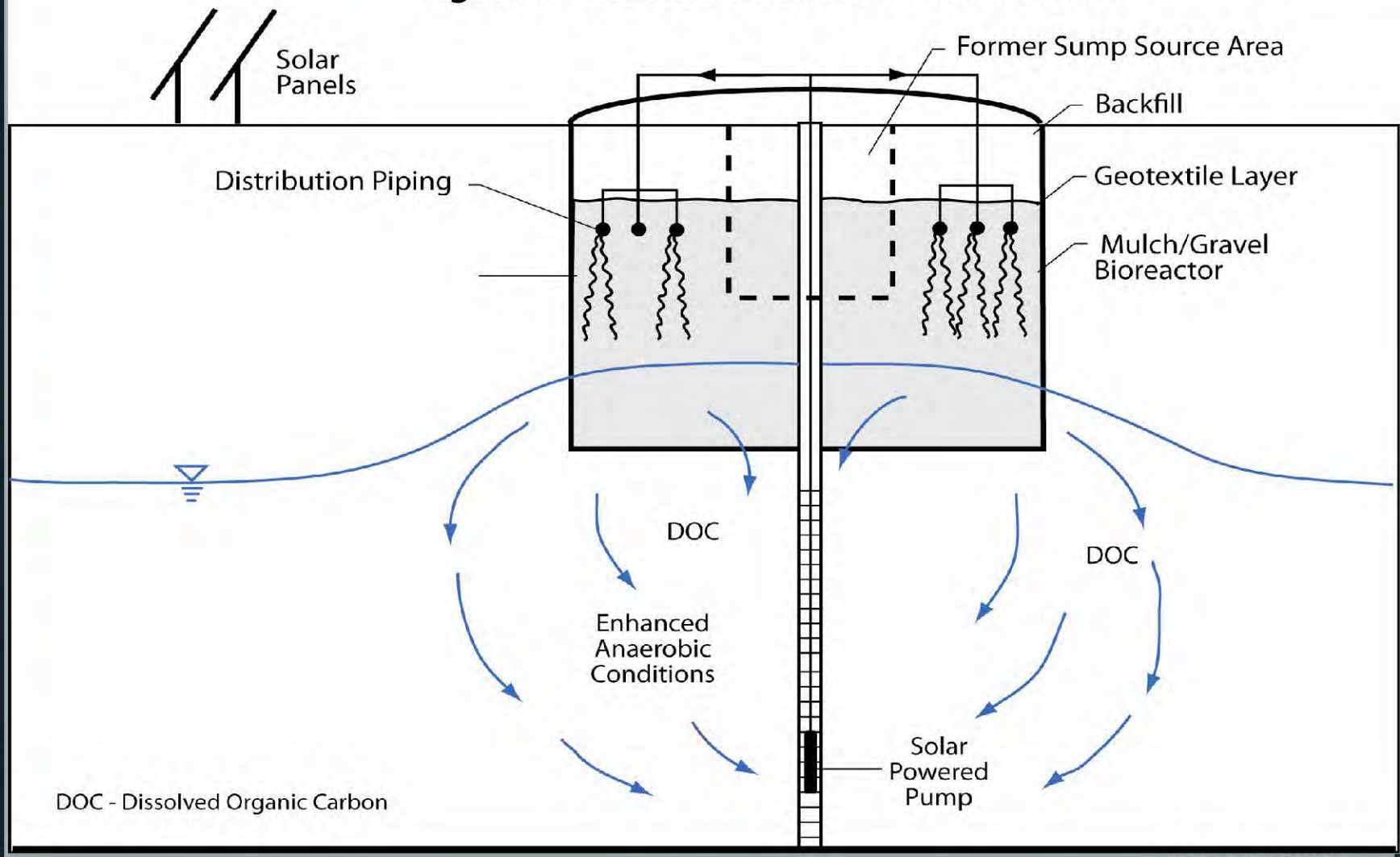
Technology Description








Figure 1 - In Situ Bioreactor Cross Section



Technical Objectives








- Demonstrate that an in situ bioreactor with groundwater recirculation can reduce TCE and daughter products in a source area that was partially remediated with pump and treat technology.
- Demonstrate that solar energy can reliably meet the total power requirements of this remediation project and minimize greenhouse gas emissions.
- Demonstrate that the in situ bioreactor is a cost efficient and sustainable final “remedy in place” to replace the pump and treat interim remedy. Support AF goal of RIP 2012.
- Use this design and the knowledge gained in this demonstration to promote sustainable technologies on other AF sites.

Site DP39 Description








- Pre 1978 - chlorinated solvents and battery waste disposed of in sump behind Bldg 755. Sump and limited soils removed in 1994.
- Historical source area groundwater had TCE at >20 mg/L, plume now extends 2000 feet downgradient
- Aquifer material is layered silts and sands with contaminated interval at ~ 20 to 40 feet bgs.
- Dual-phase extraction system installed in 2001 and has operated since as interim remedy

Site DP39 Description








- Source area TCE concentrations have dropped from 20,000 ppb to 350 ppb of TCE since 2001
- Vapor-phase concentrations have dropped from 2400 ppbv to 230 ppbv since 2001
- Shut down rebound testing completed Oct–Dec 2008
  - Found that TCE still exists at 8,000 ppb in source
- CONCLUSION – pump and treat alone has not been effective for source removal

Bioreactor Construction








- Outstanding Base Support
- Work Plan approved by California regulators and USEPA Region 9 in 60 days
- Push to beat the rainy season and get remedy underway
- Construction Nov 08 – Jan 09
- Excavated soil disposal (~300 CY)
  - hazardous for lead ~ 20 CY
  - non-hazardous for deeper soil

- Allows Travis AFB to remove Land Use Controls for lead contaminated soils

Excavation In Source Area

Mulch and Gravel Mix

Groundwater Distribution Piping

Solar Panels Power the Groundwater Recirculation System

Monitoring Plan








- Completed baseline sampling prior to starting bioreactor recirculation
- Installed 6 new discrete interval monitoring wells in DP39 source area to document organic carbon distribution and VOC reductions at various depths. Also monitor two existing wells
- Evaluate key ERD parameters such as DOC, ORP, TCE, daughter product degradation, and alternate acceptors such as sulfate
- Semi-annual monitoring through May 2010 to evaluate effectiveness of this source area reduction method

Observations at 60 Days








- The solar-powered pump is providing 2-3 gpm of flow during sunlight hours.
  - No maintenance issues.
  - Averaging 9000 gallons of recirculation per week
- We are seeing oxidation reduction potential (ORP) slowly dropping in the shallow monitoring wells near the bioreactor
  - organic substrate spreading downward and laterally
  - source area well ORP decreased from +200 mV to – 350 mV
- Recirculation of organic substrate into deeper wells has not yet occurred possibly due to low vertical permeability through thin silt and clay layers
  - TCE in deeper wells is < 20 ppb

Technical Progress








- BAA Award – Sept 2008
- Regulatory Approval of Work Plan – Dec 2008
- Bioreactor Construction Nov 08 – Jan 09
- Baseline Sampling Completed in Dec 08
- Began Bioreactor Operations in Jan 09
- First Performance Monitoring Event in May 09
- Semi-annual Monitoring Through May 10

Technology Transfer








- EPA Region 9 has highlighted this project as an example of innovative sustainable remediation
- Travis AFB has received “positive press” in a local newspaper article featuring the solar-powered bioreactor
- Technology return on investment (ROI): Approximately 5 years based on replacement of existing pump and treat system on the site

AFCEE's Related Efforts and Additional Information








- AFCEE/TDV Protocol for Biowalls and Bioreactors

http://www.afcee.af.mil/resources/technologytransfer/programsandinitiatives/enhancedinsituanaerobicbioremediation/resources/index.asp.

- This project and a similar project led by Parsons at Hickam AFB are part of the AFCEE BAA
- This work is in coordination with the ITRC permeable reactive barrier initiative

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