

# Bioremediation Inc.

## Surface Cleaner Soil Contamination Study

### Natural Project DPW- Environmental Division Fort Hood, Texas

This report details the field work and analysis completed as part of the “natural” project. The field work was divided into two phases. This report provides:

- Summary of Project Goals
- Summary of Results
- Recommendations to the Current Program
- Other Benefits of the Project
- Continuing Actions of CERL in Support of This Project

#### Summary of Project Goals:

The primary purpose of the project was to investigate alternative methods to the current bio-remediation process to remediate POL-contaminated soil. Phase I of this project compared the “regular” method which uses fertilizer (18-10-5) to the “natural” method which uses microbes. The purpose of Phase II of the project was: (1) to verify the data received from Phase I; and (2) to introduce other selected commercial methods of remediation for comparison. The field portion of this project used current Fort Hood and the Texas Commission on Environmental Quality (“TCEQ”) Standards and Requirements to determine the effectiveness and cost of the methods used to remediate POL-contaminated soil. While these Standards and Requirements are not universally accepted, they are accepted by the TCEQ. See “Other Benefits of the Project” for detailed notes and assumptions.

#### Summary of Results:

**Table of Results** (See Attachments for detailed results.)

	<u>0803W Regular Method</u>	<u>0408G Natural Method</u> CI – BioRem™
Total cost/yd. <sup>3</sup> (\$)	\$7.98	\$4.50
Material cost/yd. <sup>3</sup> (\$)	\$0.94	\$0.19
Labor cost/yd. <sup>3</sup> (\$)	\$1.12	\$0.66
Labor hrs./yd. <sup>3</sup>	0.05	0.03
Days to Remediate to Acceptable Levels:	229	52

- All laboratory costs removed from Total cost/yd.<sup>3</sup> (\$) shown in this table.
- Phase I showed that the natural method required fewer labor hours per cubic yard (yd.<sup>3</sup>) and had a lower material cost per yd.<sup>3</sup> than the regular method.

Natural Project Final Report

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- Phase II confirmed that the remediation process is greatly reduced when a pro-active aeration program is followed.
- Phase II confirmed that the natural method required fewer labor hours per cubic yard (yd.<sup>3</sup>), had a lower material cost per yd.<sup>3</sup> and had a faster remediation time than the regular method.

### **Recommendations to the Current Program:**

- Change to “bugs” at the bio-site.
- Discontinue the use of 18-10-5 fertilizer.
- Develop and follow an established, and proven, remediation timeline that includes weekly aeration and irrigation.
- Develop and follow sampling procedures which will compensate for composite sampling fluctuations.
- Continue to separate the POL-contaminated absorbent from the POL contaminated soil.

### **Other Benefits and Notes of the Project:**

#### **Benefits:**

- This report also serves to document results on time and material requirements for remediation.
- An established and maintained aeration and irrigation program is just as important to the remediation process as the materials used. Phase II proved that weekly aeration (when followed) reduces remediation time exponentially; which means that the more aeration there is, the faster the remediation.
- Equally important is the moisture content. It is also the hardest to manage. The results from both Phases show that the desired moisture content was rarely reached and maintained. This project proved that the remediation process must rely on moisture probes and established irrigation schedules for effective remediation.

#### **Notes:**

- The piles were evaluated until they reached appropriate regulatory levels for placement in a class I municipal solid waste landfill. The requirements for placement are detailed in TCEQ Regulatory Guidance RG-87, dtd September 1996. The required concentration levels for use as cover in class I landfill.
  - TPH < 600 mg./kg.
  - Pb < 30 mg./kg.
  - Benzene < 10 mg./kg.

Fort Hood’s current practice is to use this remediated soil on a solid waste management unit (“SWMU”) or a cover on our Class I landfill.

- Since the sampling cost of laboratory analysis would be the same for each pile, that cost is not shown as a per cubic yard cost. However, the overall laboratory cost is included in the total cost per cubic yard.
- This report covers the field analysis portion of the project. It must be noted that the conditions and actions in the field rarely mirror laboratory conditions. The field portion is conducted in the manner in which the installation will actually conduct the remediation.

### **Continuing Actions of CERL in Support of This Project:**

This project has proven something that has been taken for granted for some time. The nature of remediation of POL-contaminated soil often produces conflicting results. Composite samples taken from a pile on one day can yield a lower TPH than composite samples taken from the same pile a month later. While this is contributed to "hot spots" in the pile, Fort Hood's current policy is to continue to remediate and sample the soil until meeting the Requirements set forth in TCEQ's RG-87. Once these levels are attained, the process is stopped and the soil is re-used on a SWMU, as daily cover at the municipal solid waste landfill, or placed in the special waste trench. To assist Fort Hood in finding a suitable solution to this situation, CERL is:

- Continuing to investigate new remediation techniques that would have a positive effect on significantly reducing or eliminating "hot spots."

#### Attachments:

- A – Field Analysis for Phase I
- B – Field Analysis for Phase II

## Attachment A – Field Analysis for Phase I

This is the initial draft of the Field Analysis for the “natural” project. This particular phase of the project compared our regular remediation method to a “natural” remediation method.

The natural method includes the use of microorganisms (“Bugs”). The regular method includes the use of fertilizer (18-10-5). Both methods required watering to maintain optimum moisture content of 20-25% and weekly plowing and tilling to aerate and mix the soil. The purpose of this report is to present the results from the field-tests and to make a short-term recommendation for procedures. A detailed report is forthcoming from CERL.

The results of the two methods are detailed in the attached data.

### Project Highlights:

The “natural” method:

- Total cost was \$3.48 lower than the cost/yard<sup>3</sup> for the regular method. This is 43.6% lower than the regular method
- Labor hours per yard for the “natural” method were 0.03 hours, while the regular method was 0.05 hours. This represents a 40% decrease.
- Material cost per yard for the “natural” method was \$0.19, while the regular method was \$0.94. This represents an 80% decrease.

Method	Soil Volume (yd. <sup>3</sup> )	Cost/yd. <sup>3</sup>	Total Labor hrs.	Labor hrs./yd. <sup>3</sup>	Total Labor Cost	Labor Cost/yd. <sup>3</sup>	Total Material Cost	Material Cost/ yd. <sup>3</sup>	Lab Cost	TPH Decrease (ppm)	TPH Decrease %
Regular	123.94	\$7.98	5.65	0.05	\$138.69	\$1.12	\$115.90	\$0.94	\$735.00	4293.50	98.0 %
Natural	201.54	\$4.50	5.89	0.03	\$133.32	\$0.66	\$39.00	\$0.19	\$735.00	5367.00	99.9 %

### Project Observations:

Soils remediated through the “natural” method meets RG-87 Standards for grit trap waste disposal. If aeration had followed the established plan, remediation process would have been faster. Established percentage moisture levels were never achieved and maintained throughout the project.

### Sampling Notes:

This test required additional sampling above what our normal amount would be. This was to verify the progress of the test. The TPH spike on 3/9/05 in the “natural” pile is attributed to a sampling deviation.

### Short-term Recommendations:

- Continue testing “natural” methods to include vendor products.
- Continue the use of “bugs” at the bio-site.
- Discontinue use of 18-10-5 fertilizer.
- Follow an established, consistent aeration and irrigation schedule.
- Develop and follow sampling procedures to assure accurate and reproducible results.

Natural Project Final Report

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## Attachment B – Field Analysis for Phase II

### Fort Hood Natural Project Phase II

#### Fort Hood Natural Project- CI Baad Bugs Surface Cleaner

##### Baad Bugs Surface Cleaner

Start Date: 06/07/05

Size of Project: 40.9 cubic yards

Start TPH: 2480      Start B: ND      T: ND      E: ND      Xy: ND

% moisture: 15.5

Cost for Initial Sampling: \$60.00

##### Project Work: 06/09/05

Application: 2.0 gals. @ \$14.40/gal. = \$28.80, Labor 0.33 hrs. @ \$22.18/hr. = \$7.32

Water: Labor 0.33 hrs. @ \$22.18/hr. = \$7.32

Pile Prep (Initial): Labor .75 hrs. @ \$22.18/hr. = \$16.64

Plowing/Tilling: Labor 0.75 hrs. @ \$22.18/hr. = \$16.64

Data Analyst: Labor 0.33 hrs. @ \$22.18/hr. = \$7.32

Supervisor: Labor 0.167 hrs. @ \$26.00/hr. = \$4.34

Notes/Special Comments:

Product sprayed after plowing before tilling.

Total spent for project work on 6/09/05: \$ 88.38

##### Project Work: 06/15/05

Application: 2.0 gals. @ \$14.40/gal. = \$28.80, Labor 0.1667 hrs. @ \$22.18/hr. = \$3.70

Water: Labor 0.33 hrs. @ \$22.18/hr. = \$7.32

Plowing/Tilling: Labor 0.5 hrs. @ \$22.18/hr. = \$11.06

Notes/Special Comments:

Total spent for project work on 06/15/05: \$50.88

Project Note: Due to water restrictions, no work was done on the piles during the week of June 20-24. Due to Inland Spill Training, no work was conducted on the piles during the week of June 27- July 1. Due to lack of rain and no watering, Fort Hood decided to leave the piles as is instead of plowing and tilling and not being able to water.

##### Project Work: 07/05/05

Application: 2.0 gals. @ \$14.40 = \$ 28.80, Labor 0.1667 hrs. @ \$22.18/hr. = \$3.70

Water: Labor 0.33 hrs. @ \$22.18/hr. = \$7.32

Plowing/Tilling: Labor 0.5 hrs. @ \$22.18/hr. = \$11.09

Supervisor: Labor 0.167 hrs. @ \$26.00/hr. = \$4.34

Notes/Special Comments:

Due to dry conditions watered for approx. 4 hours

Total spent for project work on 07/05/05: \$55.25

##### Project Work: 07/13/05

Application: 2.0 gals. @ \$14.40 = \$28.80, Labor 0.1667 hrs. @ \$22.18/hr. = \$3.70

Water: Labor 0.33 hrs. @ \$22.18/hr. = \$7.32

Plowing/Tilling: Labor 0.5 hrs. @ \$22.18/hr. = \$11.09

Supervisor: Labor 0.167 hrs. @ \$26.00/hr. = \$4.34

Natural Project Final Report

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Notes/Special Comments: Received a small amount of rain in AM. Not enough to stop work. Pile is still very dry. Received over 1" of rain in PM. Total spent for project work on 07/13/05: \$55.25.  
TPH: 2330, % moisture: 4.42 (pile was sampled before rains came)  
Sample cost: \$50.00

Project Work: 07/20/05

Application: 2.0 gals. @ \$14.40 = \$28.80, Labor 0.1667 hrs. @ \$22.18/hr. = \$3.70  
Water: Labor 0.33 hrs. @ \$22.18/hr. = \$7.32  
Plowing/Tilling: Labor 0.5 hrs. @ \$22.18/hr. = \$11.09  
Supervisor: Labor 0.167 hrs. @ \$26.00/hr. = \$4.34  
Pile was sampled. Watered for approximately 3 hours. Total spent for project work on 07/20/05: \$55.25.

Project Work: 07/26/05

Checked moisture with probe. Top 3/4" of pile read 2 (dry). When probe was inserted into bottom of pile, probe read 10 (very wet).

Project Work: 07/27/05 and 7/28/05

Application: 2.0 gals. @ \$14.40 = \$28.80, Labor 0.1667 hrs. @ \$22.18/hr. = \$3.70  
Water: Labor 0.33 hrs. @ \$22.18/hr. = \$7.32  
Plowing/Tilling: Labor 0.5 hrs. @ \$22.18/hr. = \$11.09  
Supervisor: Labor 0.167 hrs. @ \$26.00/hr. = \$4.34  
Pile was sampled after plowing and before tilling. Watered for approximately 2 hours. Total spent for project work on 07/20/05: \$55.25.  
TPH: 95.5, % moisture: 14.1 (pile was sampled before rains came)  
Sample cost: \$50.00

At this sampling event, regulatory levels were achieved. Remediation using CI – Baad Bugs Surface Cleaner achieved desired results.

Total Cost Spent on Method Using CI Baad Bugs Surface Cleaner:

Lab work: \$160.00  
Materials: \$ 172.80  
Labor: \$187.46  
Total: \$520.26

% Moisture Data:

Date	% Moisture
06/09/05	15.5
07/13/05	4.42
07/28/05	14.1

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