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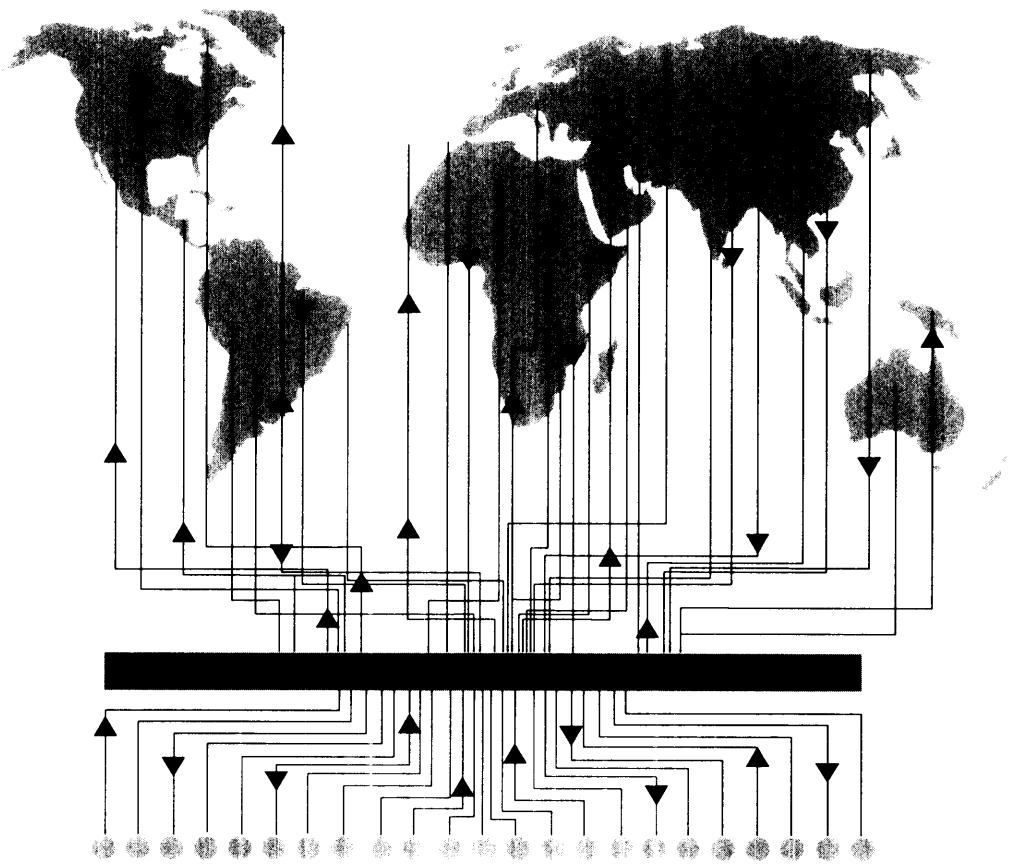
Bioremediation in the Field Search System (BFSS)

User Documentation



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The Bioremediation Field Initiative is a cooperative effort of the U.S. EPA's Office of Research and Development (ORD), Office of Solid Waste and Emergency Response (OSWER), and regional offices, and other federal agencies, state agencies, industry, and universities to expand the nation's field experience in bioremediation technologies for Superfund and other contaminated sites. The Initiative established the Bioremediation in the Field Search System (BFSS) to provide EPA and state project managers, consulting engineers, and industry personnel with timely information on new developments in field applications of bioremediation. Information in the database is also reported in EPA's quarterly *Bioremediation in the Field* bulletin, which is published by ORD and OSWER. The bulletin is a valuable information-sharing resource for site managers using or considering the use of bioremediation. To sign up to receive *Bioremediation in the Field*, as well as announcements of updates to BFSS, call 513-569-7562.

BIOREMEDIATION
Field Initiative

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NOTICE

The data contained in the Bioremediation in the Field Search System (BFSS) have been reviewed by the U.S. Environmental Protection Agency (EPA). EPA, however, must rely on the cooperation of site contacts for data accuracy and completeness. For each site, the individual who provides the information for BFSS is listed as the primary contact on site reports and view screens.

CONTENTS

ONE

Introduction:
THE BIOREMEDIATION IN THE FIELD SEARCH SYSTEM 7

1.1 Background 8
1.2 Overview of the User Documentation 8

TWO

Getting Started:
HOW TO INSTALL AND RUN BFSS 9

2.1 Technical Requirements 10
2.1.1 Hard Disk Space 10
2.1.2 Free RAM 10
2.1.3 Memory Problems and Error Messages 11
2.2. Making a Backup Copy of BFSS 12
2.3 Installing BFSS 12
2.4 Running BFSS 13

THREE

Interacting with BFSS:
HOW TO UNDERSTAND AND CONTROL THE BFSS USER INTERFACE 15

3.1 Screen Components 16
3.2 System Inputs 16
3.2.1 Selecting Menu Options 16
3.2.2 Executing Command Functions 16
3.3 The On-line Help System 16

FOUR

Searching for Sites:
HOW TO CONSTRUCT AND PERFORM A SEARCH 19

4.1 Selecting Search Criteria 20
4.1.1 Constructing a Single-Criterion Search 20
4.1.2 Constructing a Multiple-Criteria Search 20
4.1.3 Clearing Search Criteria 22
4.2 Performing a Search 22
4.3 Example Search 23

FIVE

Accessing Site Information:
HOW TO VIEW ON-SCREEN INFORMATION 25

5.1 Customizing the Qualifying Sites List 26
5.2 Viewing On-screen Information 28
5.2.1 General Site Information 28
5.2.2 Biotreatment Process Information 29

SIX

Generating Reports:
HOW TO PRINT AND SAVE BFSS SITE INFORMATION REPORTS 31

6.1 Selecting a Type of Report 32
6.2 Selecting Report Output Options 33

APPENDIXES

A

Networking:
HOW TO INSTALL AND RUN BFSS ON A LOCAL AREA NETWORK (LAN) AS A MULTIUSER SYSTEM 35

A.1 Installing BFSS on a Network Drive 36
A.2 Configuring BFSS as a Multiuser System 36

A.2.1 Setting Up Unique User Identifications 36
A.2.2 Specifying the Directory Path for User Work Area Directories 37
A.2.3 Specifying Access Parameters for Instances of File Contention 37
A.3 Common Network Errors and Troubleshooting Tips . . 38
A.3.1 Invalid Name for User Work Area Directory 38
A.3.2 Invalid Directory for User Work Area Directories . 39
A.3.3 Problems Caused by System Crashes or Power Outages 39

B

Sample Reports 41

C

Bioremediation in the Field Questionnaire 49

D

Comment Form 69

CHAPTER

ONE

Introduction:

THE BIOREMEDIATION IN THE FIELD SEARCH SYSTEM

This chapter provides background information on the Bioremediation in the Field Search System (BFSS) and briefly outlines the contents of the user documentation.

1.1 Background

BFSS is a PC-based software application developed by the U.S. Environmental Protection Agency's (EPA's) Bioremediation Field Initiative. BFSS provides access to a database of information compiled by the Initiative on sites where bioremediation is being tested or implemented, or has been completed. The database currently contains information on over 400 bioremediation sites—a number that is expected to increase in subsequent versions of BFSS. For each site, the database contains information on the site location; media and contaminants being treated; and the operation, status, and costs of the treatment technologies being used.

BFSS allows the user to access information on specific types of bioremediation sites, such as those using a particular technology or those treating a particular type of waste. The user identifies these sites by selecting search criteria from menus provided by BFSS. BFSS then generates a list of sites that satisfy the selected criteria and allows the user to view on-screen information about these sites and to print site reports, which contain detailed information on each site.

1.2 Overview of the User Documentation

This document is designed to provide the user with all the information necessary to operate BFSS. Chapter Two contains technical information related to installing and running BFSS. Chapter Three provides information on the BFSS user interface. Chapter Four explains how to specify search criteria and perform site searches. Chapter Five explains how to view on-screen site information, and Chapter Six provides guidance on generating site information reports. Appendix A provides instructions for installing BFSS on a local area network (LAN) and for configuring the system for use on a LAN. Appendix B contains samples of the reports that can be generated by BFSS. Appendix C is a copy of the questionnaire used to solicit information for the BFSS database, and Appendix D is a comment form on which the user can report problems, suggest enhancements, or provide names of additional sites for inclusion in the database.

CHAPTER

Getting Started:

HOW TO INSTALL AND RUN BFSS

This chapter outlines the technical requirements for installing and running BFSS, and provides instructions for making a backup copy of the BFSS diskette, using the BFSS installation program, and running the BFSS application.

2.1 Technical Requirements

BFSS is designed to be run on IBM PCs or IBM-compatible computers, 286-class or better, with DOS version 3.3 or higher. The following sections outline BFSS's requirements for hard disk space and random access memory (RAM), and explain problems associated with insufficient memory.

2.1.1 Hard Disk Space

The BFSS data and execution files occupy approximately 5 megabytes (Mb) of memory. Therefore, to install BFSS on a hard disk drive, a user must have at least 5 Mb of hard disk space available. To run BFSS from a hard disk drive, however, a user might need additional hard disk space to accommodate temporary "swap" files created by BFSS when running in low-RAM environments. (BFSS uses these files to save portions of the program on the hard disk, freeing up conventional memory for other parts of the application.) Swap files can occupy as much as 500 Kb of disk space; therefore, a total of about 5.5 Mb of hard disk space is sufficient to install and run BFSS in almost any PC configuration. Users running BFSS from a LAN drive do not need hard disk space for the system files, or, if BFSS is configured properly, for the swap files.

2.1.2 Free RAM

BFSS is designed to be run on machines with at least 640 kilobytes (Kb) of RAM, of which approximately 500 Kb must be free. Users operating computers close to this threshold should check the amount of free memory prior to running BFSS. To run a simple check, type "CHKDSK" at the DOS prompt. DOS returns several lines of information, including a line indicating the number of "bytes free," which is the amount of free RAM. Some of the free RAM, however, might be unavailable to BFSS, depending on the user's system configuration. Certain parameters specified in the CONFIG.SYS file, such as file buffers and stacks, reduce the amount of RAM available to applications. (Each file buffer, for example, consumes about 500 bytes.) Thus, a system could seem to have more than 500 Kb of free memory but experience memory problems when running the program because not enough RAM is available to BFSS.

2.1.3 Memory Problems and Error Messages

When a memory problem occurs, BFSS will usually display an error message indicating the type of problem being experienced. In most cases, the problem can be solved by increasing the hard disk space, conventional memory, or overall RAM available to BFSS. Conventional memory is the PC's primary 640 Kb of RAM. Any RAM beyond the 640 Kb of conventional memory is used by BFSS if there is an expanded or extended memory manager installed. BFSS may fail due to shortages of conventional memory or may fail when the combination of disk space and expanded/extended RAM are insufficient for temporary swap files. Additional space often can be created on the hard disk by removing or compressing large files. Available conventional RAM often can be increased by removing or unloading any terminate-stay-resident (TSR) files, by reducing the number of file buffers or stacks allocated in the CONFIG.SYS file, or by loading necessary TSRs or device drivers in high memory using an expanded or extended memory manager. For specific guidance on increasing available memory, consult a DOS manual or the manual for your expanded or extended memory manager. In most cases, a memory shortfall will result in a warning or error message, after which BFSS will terminate. In certain cases, however, the memory shortfall prevents even the error processing, and the system may lock up and fail to respond to any user input. Table 2-1 lists some of the most likely error messages, and suggests how to overcome the problem.

Table 2-1 Potential Error/Warning Messages

Error or warning message(s)	Response
BASE/5300 Memory low, or **5302 Conventional memory exhausted, or** **5304 Conventional memory exhausted, or** **5306 Conventional memory exhausted.** **Problem:** **Insufficient conventional memory**	Quit BFSS and try to free up more of the 640 Kb of conventional RAM.
5312 Conventional memory exhausted, or **5313 Conventional memory exhausted.** **Problem:** **BFSS is unable to swap data or executable segments to/from either the hard disk or expanded/extended RAM.**	Increase either hard disk space or available extended/expanded RAM. RAM is preferable for performance reasons.

BFSS will perform better when more than 500 Kb of memory is available to the program. This allows the program to keep more data and executable segments in memory rather than on the system's hard disk. Since memory transactions are dramatically faster than those of hard disk drives, performance can degrade significantly when BFSS runs in lower-memory environments. Most PCs are equipped with an indicator light that flashes when the hard disk is accessed. It is normal for this light to flash when BFSS is loading program executable segments or database information from the disk; however, if the indicator light seems to flash with almost any BFSS activity, this suggests that BFSS might be swapping data and code to the hard disk excessively. If this is the case, and if the system is running too slowly, try making more RAM available to BFSS.

2.2 Making a Backup Copy of BFSS

All of the files needed to operate BFSS are contained on one 5¼-in., double-sided, high-density, 1.2-Mb diskette, or one 3½-in., double-sided, double-density, 720 Kb diskette. Before installing BFSS, make a backup copy of the BFSS diskette. Any command or utility for copying diskettes can be used; the following are instructions for using the DOS command DISKCOPY:

1. Insert the BFSS diskette in drive A.
2. Type "A:" and press ENTER to ensure that drive A is the current drive.
3. Type "DISKCOPY" and press ENTER.
4. Insert the source and target diskettes in drive A as prompted by DOS. The original BFSS diskette is the source diskette. Any diskette of the same size, capacity, and format can be used as a target diskette. Executing the DISKCOPY command overwrites *all* existing files on the target diskette.

2.3 Installing BFSS

The BFSS diskette contains an installation program that expands all of the BFSS execution and data files and saves them to a directory specified by the user. This directory will be created if it does not already exist. If the user does not specify a directory, \BFSS will be used.This directory, hereafter referred to as the BFSS operating directory, can be located on a hard disk drive or a LAN drive. (For more information on in-

stalling and running BFSS on a LAN as a multiuser system, see Appendix A.)

To run the BFSS installation program, use the following steps:

1. Place the BFSS diskette in drive A.
2. At the DOS prompt, type "A:INSTALL" and press ENTER.
3. Follow the instructions on the screen. The installation program confirms that the minimum hardware requirements are met, prompts the user to specify an operating drive and directory for BFSS, and copies the BFSS data and execution files from the diskette to the specified directory.

BFSS requires that the number of open files that DOS can access be greater than or equal to 31. If the FILES= command in the CONFIG.SYS file is set to less than 31, the installation program saves the original CONFIG.SYS file as CONFIG.BFS and modifies the CONFIG.SYS file to allow DOS to access 31 open files.

2.4 Running BFSS

BFSS runs like any other DOS application. To run BFSS, use the following steps:

1. At the DOS prompt, change to the BFSS operating directory.
2. Type "BFSS" and press ENTER.

CHAPTER

THREE

Interacting with BFSS:

HOW TO UNDERSTAND AND CONTROL THE BFSS USER INTERFACE

This chapter describes the BFSS user interface, which is the combination of screen components and system inputs that allows the user to interact with the search system. This chapter also explains the on-line help system.

3.1 Screen Components

Each screen in BFSS has several components, including a main window that displays the primary information on each screen and other text lines that indicate whether the system is searching for or displaying information, which menu options and command functions are available, and what a highlighted menu option will do if selected. Figure 3-1 illustrates the screen components and describes their functions.

3.2 System Inputs

BFSS is driven by two types of system inputs: menu options and command functions.

3.2.1 Selecting Menu Options

The available menu options are displayed in the menu bar above the main window. To select a menu option, highlight the option and press ENTER, press the boldfaced letter in the name of the option (e.g., **M** for **M**edia), or align the mouse pointer with the menu option and press the mouse button. (The last procedure is known as "clicking on" the menu option.)

3.2.2 Executing Command Functions

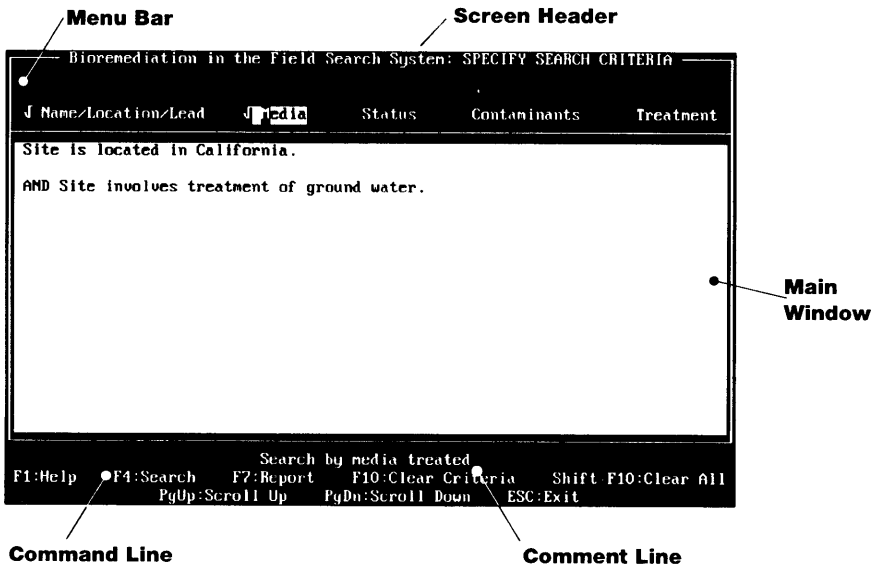
The available command functions are displayed in the command line at the bottom of each screen. To execute a BFSS command function, press the function key for the particular command or click directly on the command in the command line. Certain functions are available only when the user is performing a specific task (i.e., searching for or viewing information). Table 3-1 describes the BFSS command functions and indicates when each function is available.

3.3 The On-line Help System

The on-line help system provides a quick way to look up information about system operation. Help categories replicate sections of the user documentation, including an introduction to BFSS and guidance on interacting with the system, searching for sites, viewing site information, and reporting site information. The help system also includes a glossary of bioremediation terms and an option to display the criteria used to construct a particular search. The final help option is a printable com-

ment form, similar to the one at the back of this guide. To access the on-line help system, press or click on F1 and select a help category from the pop-up window. To exit the help system, select ESC.

Figure 3-1 BFSS Screen Components



Screen header	Provides a short description of what is being displayed in the main window, as well as information about the current search, site, or treatment process (e.g., the source of information on a particular site).
Menu bar	Presents the available menu options. For information on selecting menu options, refer to section 3.2.1.
Main window	Displays the current search criteria when a search is being constructed, the qualifying sites list immediately after a search is performed, and specific site information when sites are being viewed.
Comment line	Displays information about a highlighted menu option or screen area.
Command line	Presents available command functions. For information on executing command functions, refer to section 3.2.2.

Table 3-1 BFSS Command Functions

Command	Function	Available When... Searching	Available When... Viewing	Description
F1	Help	■	▼	Activates the on-line help system.
F4	Search	■		Initiates a specified search.
F5	Customize/Sort Site List	■	▼	Retrieves a menu of options for sorting and viewing the qualifying sites list.
F7	Report	■		Activates the reports menu for printing reports or saving reports to a file.
F10	Clear	■		Removes all search criteria from a highlighted criteria category. Removes checkmarks from all criteria in a pop-up list.
SHIFT-F10	Clear All	■		Removes all search criteria from the main window.
ENTER	Toggle Checkmark (✓) Select/View	■		Toggles checkmark (✓) on and off next to a highlighted item in a pop-up menu. Selects a highlighted item from a menu bar. Menu items also can be selected by clicking on the option.
			▼	Accesses information on a highlighted site. Information on a specific site also can be accessed by double clicking on the site. Advances site view from general site data to treatment process data, and from treatment process data to contaminant data.
ESC	Done/Exit	■	▼	Quits current screen or pop-up menu. Exits BFSS from the criteria categories menu. ESC also can be selected by pressing the right-hand mouse button.
↓/↑ **or** ←/→	Move Cursor	■	▼	Moves highlight cursor between menu items or sites.
PgUp	Scroll Up	■	▼	Scrolls main window text to previous page.
PgDn	Scroll Down	■	▼	Scrolls main window text to next page.
HOME	Go to Top	■	▼	Scrolls main window text to top of first page.
END	Go to Bottom	■	▼	Scrolls main window text to end of last page.

CHAPTER

FOUR

Searching for Sites:

HOW TO CONSTRUCT AND PERFORM A SEARCH

This chapter explains how to select search criteria and perform a specified search. A step-by-step example search is provided.

4.1 Selecting Search Criteria

To retrieve information on sites in the database, the user must specify the type of sites in which he or she is interested. This process, hereafter referred to as constructing a search, involves selecting search criteria from lists of criteria provided by BFSS. A search may have a single criterion or a combination of criteria. The criteria selected limit the number of sites retrieved by a particular search. A search with no specified criteria retrieves a list of all sites in the database.

When selecting search criteria, bear in mind that bioremediation site data are collected via a questionnaire distributed to site contacts, and information is therefore provided with a range of specificity and completeness. For this reason, it is best to include a search that specifies the broadest applicable criteria in any investigation. The more restrictive the search, the greater the likelihood that sites of interest do not qualify. For example, a user might search for sites where PAHs are treated in sandy soil; however, sites for which the contact did not provide soil texture information still may be of interest.

Figure 4-1 shows the user interface displayed when a site search is being constructed. The menu bar provides access to specific search criteria, which are arranged hierarchically under the five menu options described in Table 4-1.

4.1.1 Constructing a Single-Criterion Search

To construct a single-criterion search, select a criteria category from the menu bar and follow the guidance provided by pop-up windows to select a specific criterion. After selecting a criterion, select ESC to return to the main window, which displays text describing the selected criterion.

4.1.2 Constructing a Multiple-Criteria Search

To construct a search consisting of more than one criterion, simply repeat the procedure for selecting a single criterion as many times as necessary. Multiple search criteria are combined by the logical operators AND and OR. A search defined by criterion 1 AND criterion 2 retrieves only sites that satisfy *both* criteria. A search defined by criterion 1 OR criterion 2 retrieves all sites that satisfy *either* criterion. After multiple criteria are selected, the main window displays the criteria and their logical combination.

Figure 4-1 BFSS User Interface

```
Bioremediation in the Field Search System: SPECIFY SEARCH CRITERIA

J Name/Location/Lead   J Media   Status   Contaminants   Treatment

Site is located in U.S. EPA Region 1 or U.S. EPA Region 2 or U.S. EPA
        Region 3.

AND Site involves treatment of ground water.

                    Search by media treated
F1:Help   F4:Search   F7:Report   F10:Clear Criteria   Shift-F10:Clear All
          PgUp:Scroll Up   PgDn:Scroll Down   ESC:Exit
```

BFSS allows logical operators to be selected between some criteria and automatically inserts logical operators between other criteria. BFSS uses the following rules to insert logical operators:

- AND is inserted between criteria from different criteria categories (e.g., criteria from Name/Location/Lead and criteria from Treatment).
- AND is inserted between criteria related to the general nature of a treatment process (i.e., whether it is ex situ, in situ, aerobic, or anaerobic, and whether it involves indigenous or exogenous organisms).
- OR is inserted between criteria related to site location; site lead; soil and sediment classification; status of laboratory-, pilot-, or full-scale activities; and specific in situ and ex situ treatment technologies.

These rules are designed to preclude search expressions that are logically impossible (e.g., site is located in EPA Region 1 AND EPA Region 2), too exclusive (e.g., site involves treatment of soil classified as silt AND clay), not exclusive at all (e.g., site is using a treatment that involves an ex situ OR an in situ process), or easily replicated by performing two independent searches (e.g., site is located in EPA Region 1 OR site involves treatment of vadose soil).

4.1.3 Clearing Search Criteria

To clear all criteria from the main window, move to the main search criteria menu bar and select SHIFT-F10. To clear all criteria in a specific category, highlight the category and select F10. To clear the specific criteria within a subcategory, move to the appropriate menu (or submenu) and select F10.

4.2 Performing a Search

After selecting the desired search criteria, press or click on F4 to perform the search. BFSS compares the selected criteria with the characteristics of each site in the database and generates a list of qualifying sites. If no sites satisfy the criteria, the system suggests that less-exclusive search criteria be selected. BFSS maintains the most recent search until it is replaced with a new search, even if the user exits BFSS and turns off the computer.

Table 4-1 Major Categories of Search Criteria

Menu Option	Description
Name/ Location/Lead	Retrieves a submenu that can be used to (1) specify the whole name or a key word in the name of a site, (2) designate a site location by U.S. state or EPA region, or international province or territory, or (3) specify the lead authority under which remediation is taking place.
Media	Retrieves a submenu of specific media, including air, soil, sediment, sludge, and water.
Status	Retrieves a list of criteria related to the status of remedial activities, i.e., whether site remediation is at laboratory, pilot, or full scale.
Contaminants	Retrieves a submenu that provides access to (1) a list of predominant types of contamination, such as wood preserving wastes, or (2) a list of contaminant categories, such as PAHs, or (3) a list of specific contaminants, such as PCP. Certain contaminants on this list are grouped and indented. Selecting a contaminant with others indented beneath it is equivalent to selecting all of the indented contaminants.
Treatment	Retrieves a submenu of types of treatment, including ex situ and in situ processes, which provides access to lists of specific technologies.

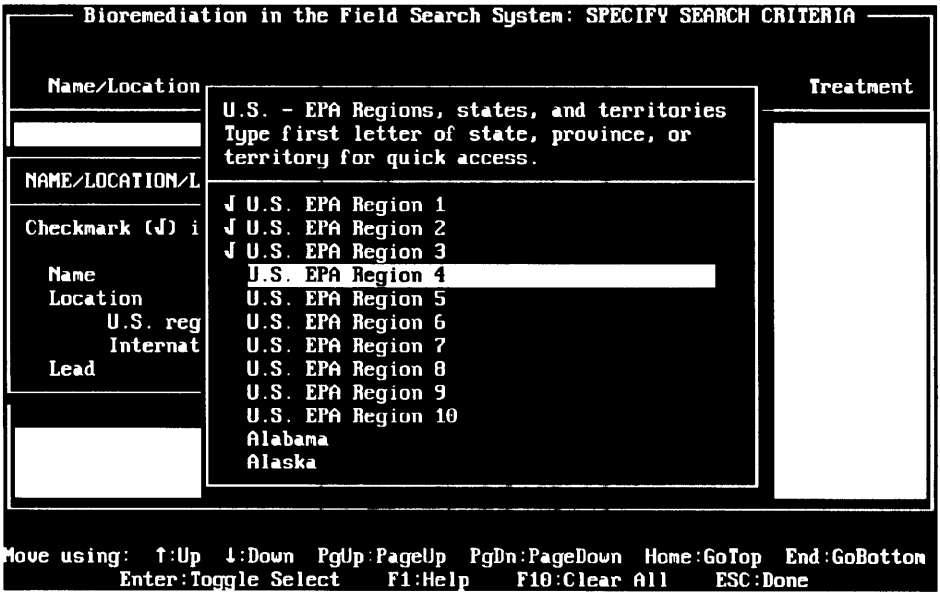
4.3 Example Search

The following example illustrates the steps involved in constructing and performing a search. In this example, the goal is to find all sites in EPA Regions 1, 2, or 3.

❶ Select Name/Location/Lead from the search menu. The following pop-up window appears:

```
Bioremediation in the Field Search System: SPECIFY SEARCH CRITERIA

Name/Location/Lead     Media     Status     Contaminants     Treatment

NAME/LOCATION/LEAD

Checkmark (√) indicates active criteria.

  Name
  Location
      U.S. region(s), state(s), or territory(s)
      International province(s) or territory(s)
  Lead

Press Enter to specify site location by region(s), state(s), or territory(s)
                F1:Help    F10:Clear Criteria    ESC:Done
```

❷ Select Location from this menu. Another pop-up window appears. Move to the appropriate choices and press ENTER or the mouse button to place a checkmark next to each desired region, as shown below.



❸ Select ESC two times to page back through the pop-up menus to the main menu, where the search expression "Site is located in EPA Region 1 or EPA Region 2 or EPA Region 3" is exhibited. Paging back through, note that a checkmark now appears next to the active criterion in the Name/Location/Lead and the main search menus.

❹ To perform the search, press or click on F4. BFSS retrieves sites located in the three specified regions.

CHAPTER

FIVE

Accessing Site Information:

HOW TO VIEW ON-SCREEN INFORMATION

This chapter explains how to customize the qualifying sites list and view on-screen site information.

5.1 Customizing the Qualifying Sites List

Figure 5-1 shows the user interface immediately after a search is performed. The main window presents a list of qualifying sites. The screen header displays the number of sites satisfying the search criteria. If more than 15 sites are retrieved by a search, the list must be scrolled to view additional sites using PgUp and PgDn.

Figure 5-1 User Interface Immediately After Search Is Performed

```
Bioremediation in the Field Search System: VIEW QUALIFYING SITES

Sites satisfying the search criteria: 26 of 164 (15.9%)
Sorted by lead or regulatory authority

LOC   SITE NAME                                LEAD OR REGULATORY AUTHORITY

 9 CA Koppers Company, Inc.                    CERCLA enforcement lead
 9 CA Montrose Chemical Corporation of Cal     CERCLA enforcement lead
 9 CA Hamburg Ranch                            CERCLA state lead
 9 CA Harmon Field                             CERCLA state lead
 9 CA Hercules Incorporated                    CERCLA state lead
 9 CA Moore Aviation                           CERCLA state lead
 9 CA Solvent Service                          CERCLA state lead
 9 CA Southern Pacific Transportation Comp     CERCLA state lead
 9 CA Growers Air Service                      CRWQCB Lead
 9 CA Marine Corps Air/Ground Combat Cente     DOD section of Superfund: Defense
 9 CA Beale Air Force Base                     Federal facility
 9 CA Naval Weapons Station--Seal Beach        Federal facility (state priority 1
 9 CA BKK Landfill                             RCRA lead (federal)
 9 CA SEGS Solar Project                       State Lead

Move using:  ↑:Up  ↓:Down  PgUp:PageUp  PgDn:PageDown  Home:GoTop  End:GoBottom

F1:Help   ENTER:View Site   F5:Customize/Sort List   F7:Report   ESC:Done
```

The qualifying sites list has three columns. The first column displays the site location (U.S. EPA region and state or country, if the site is a non-U.S. site), and the second column displays the name of each site. The first time a new user performs a search, the third column displays the category of organizational affiliation for each site's primary contact. The third column can be modified, however, to display various blocks of information about each site, including each site's regulatory lead; predominant types of contamination at the site; or laboratory-, pilot-, or full-scale status. The list also can be sorted based on any of these variables.

Table 5-1 Options for Third Column Information

Menu Option	Description
Lead or regulatory authority	Displays the lead or regulatory authority under which site cleanup or investigation is taking place (e.g., CERCLA, RCRA, TSCA, or UST lead).
Predominant contaminant	Displays the predominant type of contaminant at the site, as characterized by the site contact (e.g., pesticides, petroleum, solvents, or wood preserving wastes).
Primary contact affiliation	Displays the organizational affiliation of the primary contact (e.g., federal agency, state agency, municipal agency, industry, contractor/engineering firm, or technology vendor).
Status of treatment operations	Displays the status of treatment operations (e.g., operational at full-scale, completed at pilot-scale, or planning lab-scale). If a site has more than one biotreatment process, the most advanced treatment status is displayed.

To customize the qualifying sites list, press or click on F5. Selecting F5 retrieves a pop-up menu of options for information to be displayed in the third column (see Table 5-1), as well an option to sort sites based on information in the third column, location, or site name. If the list is sorted based on third-column information, sites are grouped with others having the same lead, predominant contaminant, contact affiliation, or status. These groups are sorted in alphabetical order for all variables except site status.

Groups sorted based on site status are in descending order by stage of treatment operations (e.g., sites completed at full scale appear before sites operational at full scale, sites operational at full scale appear before sites completed at pilot scale). Within each group, sites are sorted based on site location—in ascending numerical order by EPA region and ascending alphabetical order by state within each region.

Once a third-column option and sort order are selected, BFSS uses these parameters to customize all subsequent qualifying sites lists until a new third-column option and sort order are specified.

5.2 Viewing On-screen Information

To view detailed information about a site, highlight the site in the qualifying sites list and select ENTER or double click on the site. BFSS provides two types of site information: (1) general site information and (2) biotreatment process information.

5.2.1 General Site Information

Figure 5-2 shows the user interface immediately after a specific site is selected. The screen header displays the name and location of the selected site. The main window contains general site information, including the site lead; names, phone numbers, addresses, and affiliations of site contacts; and a short description of the site. Depending on the amount of information available for a particular site, this information might need to be scrolled using PgUp and PgDn. Select ESC to return to the qualifying sites list.

Figure 5-2 User Interface Immediately After a Specific Site Is Selected

```
Bioremediation in the Field Search System: VIEW SITE INFORMATION

Moore Aviation
EPA Region 9, Colusa, CA                          (First entered 05/01/92)
United States                                      (Last updated 06/07/94)

SITE LEAD:  CERCLA State Lead

PREDOMINANT CONTAMINANT(S):  pesticides/herbicides

FACILITY OR SITE DESCRIPTION:  Commercial pesticide applicator site, air
    strip.

PRIMARY SITE CONTACT:                          AFFILIATION:

    Christine Holm                                 State (or provincial)
    CA Regional Water Quality Control Board        organization
    3443 Routier Road
    Sacramento, CA 95827
    Phone: (916)255-3103
    Fax:   not supplied

↑:Up   ↓:Down   PgUp:Scroll Up   PgDn:Scroll Down   Home:Top   End:Bottom
     Enter:Biotreatment Information   F1:Help   F7:Report   ESC:Done
```

5.2.2 Biotreatment Process Information

To access information about the operation and performance of the biotreatment processes being used or considered for use at the site, press or click on ENTER. If the selected site has more than one biotreatment process, selecting ENTER retrieves a pop-up window providing access to a summary of each biotreatment process. Use the PgUp and PgDn keys to display each site's process summaries. The window will display all biotreatment processes, regardless of whether they satisfy the search criteria. However, processes satisfying search criteria are indicated by the phrase "satisfies search criteria" in the upper right corner of the window. To select a particular process to view in greater detail, press or click on ENTER when you are viewing the summary of interest.

After a process is selected, the main window displays general information about the process. This information includes media and contaminants undergoing treatment with the process, contaminants present at the site that are not undergoing bioremediation, costs associated with the use or testing of the process, the volume of media being treated by the process, and any additional comments about the process. Depending on the amount of information available for a particular process, this information might need to be scrolled using PgUp and PgDn. Select ESC to return to the general site information screen.

Additional performance data are available for each contaminant being treated or considered for treatment by the biotreatment process, including data on the maximum original concentration, target cleanup level, and lowest concentration achieved for each contaminant. To access this information, press or click on ENTER. Contaminant information is sorted alphabetically by media and contaminant name. Selecting ENTER brings up information about the first contaminant. Use PgDn to view information on all of the contaminants being treated or considered for treatment by the biotreatment process. Select ESC to return to the biotreatment process information screen.

CHAPTER

SIX

Generating Reports:

HOW TO PRINT AND SAVE BFSS SITE INFORMATION REPORTS

This chapter explains how to generate reports of information contained in BFSS.

6.1 Selecting a Type of Report

BFSS produces three types of reports: (1) site reports, (2) search criteria, and (3) qualifying sites lists. Appendix B contains samples of each of these types of reports.

Selecting F7 retrieves a menu of report options. Certain options may not be available, depending on whether the user is (1) constructing a search, (2) viewing the qualifying sites list, or (3) viewing information about a particular site. Table 6-1 describes the three types of reports generated by BFSS and indicates when each option is available.

Selecting the Site Report menu option while viewing the qualifying sites list brings up a second menu. This menu allows the report to be generated for a highlighted site or for all qualifying sites, as outlined in Table 6-2.

Table 6-1 Report Options

Menu Option	Available...	Description
Site report	When viewing qualifying sites list or site information	Provides complete records of site information, including lists of site contacts, general site information, and detailed biotreatment process information.
Search criteria	At any time	Lists the criteria used to construct the current search.
Qualifying sites list	Only when viewing qualifying sites list	Identifies the number of sites satisfying the search criteria; lists the search criteria; and lists the qualifying sites, including the region, state, city, site name, and primary contact name and phone number for each site.

Menu Option	Description
Current site only	Produces a report for the site highlighted on the qualifying sites list or the site currently being viewed.
All qualifying sites	Produces reports for all qualifying sites.

6.2 Selecting Report Output Options

Selecting a type of report brings up a menu that allows reports to be output to a file, the current printer, or another printer. The options contained in this menu are outlined in Table 6-3.

Selecting the Choose Another Printer option retrieves a list of over 900 available printers. If a desired printer is not on this list, try selecting another printer made by the same manufacturer. If no printers on the list are made by the same manufacturer, consult a printer manual to determine whether the printer can be reconfigured to emulate a printer made by a major manufacturer, such as EPSON, Hewlett-Packard, or IBM. Reconfigure the printer accordingly, and select a corresponding printer from the list of available printers.

BFSS assumes that each user's printer is attached to LPT1. The DOS MODE command must be used to specify an alternative printer port. For instructions on how to use this command, consult a DOS manual.

Table 6-3 Report Output Options

Menu Option	Description
Output to file	Saves the report to an ASCII DOS file with a ".PRN" file extension in the BFSS operating directory. If you are running BFSS as a multiuser system on a network, report files will be located in your work area directory as identified by the value of the DOS environment variable BFSSUSER.
Output to current printer	Prints hard copy of the current report. Before selecting this option, make sure the printer is on, ready, and matches the printer selected for BFSS.
Choose another printer	Presents a pop-up menu of available printers. Highlight the appropriate printer and press ENTER or click on the desired printer.

APPENDIX

A

Networking:

HOW TO INSTALL AND RUN BFSS ON A LOCAL AREA NETWORK (LAN) AS A MULTIUSER SYSTEM

This appendix provides instructions for installing BFSS on a network drive and configuring BFSS for operation as a multiuser system. These instructions are intended for the individual responsible for overseeing operation of the LAN, not for system users. Individual users should never modify the BFSS configuration file, which affects the operation of BFSS for all users.

A.1 Installing BFSS on a Network Drive

The procedure for installing BFSS on a network drive in a multiuser environment is the same as that for installing the system on a local hard drive. During the installation routine, select a network drive and directory path for system files in lieu of a local hard drive. Make sure that all users have rights to read, write, and modify files in the BFSS operating directory.

A.2 Configuring BFSS as a Multiuser System

Three variables in the BFSS configuration file, BFSS.CFG, are critical to setting up BFSS as a multiuser system. The first variable defines a unique network identity for each BFSS user, the second variable identifies a directory path in which BFSS creates user-specific work area directories, and the third variable specifies the length of time BFSS attempts to access locked data files during instances of network file contention. Any DOS program editor can be used to change these variables in the BFSS configuration file. As a precaution, make a copy of the existing BFSS.CFG file before making any changes.

A.2.1 Setting Up Unique BFSS User Identifications

In a multiuser environment, each BFSS user must have a unique identity. BFSS takes the identity of each user from the value of a particular DOS environment variable. Most LANs already have a variable for which each value is a unique user identity, such as a login name. This variable can be used by BFSS, *provided that all values of the variable constitute valid DOS directory names.* This means values of the variable must contain no more than eight characters; contain only acceptable filename characters, such as alphanumerics or underscores (_), carets (^), dollar signs ($), tildes (~),exclamation points (!), number signs (#), percent signs (%), ampersands (&), hyphens (-), braces ({}), and parentheses (); and contain no spaces ( ), periods (.), commas (,), or backslashes (\).

The default network identity variable is BFSSUSER. To specify an alternative variable, type the name of the variable on the appropriate line in the BFSS configuration file. If there is no suitable preexisting variable defining a unique identity for each user, values of BFSSUSER can be assigned in each user's AUTOEXEC.BAT file or in any network login or initialization batch routine executed by every user prior to accessing BFSS. The DOS command to set the environment variable is

BFSSUSER=<USERID>, where <USERID> is an actual unique user identification (for example: BFSSUSER=USER0001). Keep in mind that <USERID> must meet the aforementioned DOS directory name criteria.

To check the environment variable, type "SET" at the DOS command line. One line in the output returned by the SET command shows BFSSUSER=. If the environment variable is not displayed as expected, the user might not have enough DOS environment space allocated in his or her CONFIG.SYS file. Consult a DOS manual for further instructions on setting environment variables and allocating environment space.

A.2.2 Specifying the Directory Path for User Work Area Directories

BFSS creates directories for work area files for each user of BFSS, totalling about 130 Kb per user. The first time a new user runs BFSS, the following files are copied to the user's work area directory: CHOICES.DBF, CHOICES.NTX, CHOINAME.NTX, CONTAMS.DBF, CONTAMS.NTX, CONTNAME.NTX, CONTCHCK.NTX, SEARCHP.DBF, MEMOBANK.DBF, MEMOBANK.DBT, and DFLT_PRN.MEM.

BFSS uses these files to store information about searches constructed by each user and each user's desired printer for output of BFSS printed reports. In addition, when a user saves a BFSS site report as an ASCII file, the file is saved in the user's work area directory with the filename extension "PRN".

The default directory path for the work area file directories is the BFSS operating directory (i e., the directory to which BFSS originally was installed). To specify an alternative directory, type the directory path on the appropriate line in the BFSS configuration file. This can be a directory on a network "home" drive or a local hard disk drive, in which case each user's work area files would be saved on his or her individual home or hard drive. Again, make sure that every user has rights to read, write, and modify files in his or her work area directory.

A.2.3 Specifying Access Parameters for Instances of File Contention

Certain searches require that the searching user be granted exclusive access to data files for a brief period (approximately 5 to 30 seconds on 386-class PCs and 30 to 90 seconds on most 286- or AT-class PCs). When a user performs an exclusive-access search, BFSS locks the data files and records the user's identification variable in SEARCHER.MEM, a file in the BFSS operating directory. When the search is complete, the data files are unlocked and SEARCHER.MEM is cleared. In a multiuser

environment, file locking can lead to instances of file contention. If two users attempt to perform a search requiring exclusive access to search files at the same time, one user must wait for the data files to be unlocked, and BFSS provides the following message:

Another user (<USERID from SEARCHER.MEM) has exclusive use of search files. Please wait.

BFSS attempts repeatedly to access the locked files. If the files cannot be accessed after a specified period, BFSS informs the user of the file contention and recommends that the user try the search again in a few minutes.

The default value for the length of time BFSS attempts to access search files is 20 seconds. To change this value, type the desired number of seconds on the appropriate line in the BFSS configuration file. To make BFSS attempt to access the search files only once, specify a value of 0. To make BFSS attempt to access the search files until access is gained, specify a very high value.

A.3 Common Network Errors and Troubleshooting Tips

The following sections describe potential problems experienced when running BFSS as a multiuser system.

A.3.1 Invalid Name for User Work Area Directory

When BFSS is run by a user in a multiuser BFSS installation for the first time, BFSS will create a directory for that user's files based on the unique user ID found as the value of the environment variable specified in the file BFSS.CFG (see A.2). For example, suppose BFSS.CFG specifies that BFSSUSER is the environment variable whose value will uniquely identify each user. When the user runs BFSS for the first time, BFSS obtains the value of BFSSUSER. Suppose this value is NETUSER1. BFSS will create a directory called NETUSER1 in the directory identified in BFSS.CFG to contain user work area directories (see A.2.2). If the value of BFSSUSER is not unique for each user, conflicts can arise when users simultaneously access their user files, resulting in system crashes. If the value of BFSSUSER is not valid as a DOS directory name (see A.2.1), BFSS cannot create the new user's work area, and the following messages are given:

Can't create directory <name of directory> for user work area.
Environment variable <name of environment variable> BFSSUSER might not identify a DOS directory.

Please assign a valid DOS directory name to <name of environment variable>.
Consult Appendix A of the BFSS userdoc for guidance on network configuration.
Execution will terminate.

If this occurs, check the value of the user's network identity environment variable. If this value appears to be a valid DOS directory name, the problem might be that the user does not have sufficient network rights to create the directory.

A.3.2 Invalid Directory for User Work Area Directories

If an invalid DOS directory name is specified in BFSS.CFG as a directory path for user work area directories, the following message is displayed:

Invalid DOS directory for network user work areas provided in BFSS.CFG.
Directory for network user work areas must exist. Please correct in BFSS.CFG.
Consult Appendix A of the BFSS userdoc for guidance on network configuration.
Execution will terminate.

To correct this problem, edit the BFSS.CFG file accordingly.

A.3.3 Problems Caused by System Crashes or Power Outages

A system crash or power outage experienced during the critical stage of a search can have one or both of the following results:

- BFSS data files might remain locked by the failed session, preventing other users from performing searches. If this occurs, check SEARCHER.MEM for the user's BFSSUSER identification and close the failed network session to release the BFSS file locks.
- BFSS data files or indexes might become corrupted. Symptoms of this problem vary but can include system hanging during initialization or system crashes while opening or updating BFSS files. If this occurs, reinstall BFSS to replace the corrupted files. BFSS user work areas should not require any action, with the possible exception of the work area for the individual searching during the initial system crash or power outage. If this user cannot run BFSS while other users can, delete the user's work area directory, and it will be reinitialized the next time he or she accesses BFSS.

APPENDIX

B

Sample Reports

Bioremediation in the Field Search System
U.S. Environmental Protection Agency

Date: 06/14/95
Time: 10:56 am

Moore Aviation, **SUPPLIED BY STATE (OR PROVINCIAL)**
EPA Region 9, Colusa, CA
United States

(First entered 05/01/92)
(Last updated 06/07/94)

SITE LEAD: CERCLA State Lead

PREDOMINANT CONTAMINANT(S): pesticides/herbicides

FACILITY OR SITE DESCRIPTION: Commercial pesticide applicator site, air strip.

PRIMARY SITE CONTACT:

Christine Holm
CA Regional Water Quality Control Board
3443 Routier Road
Sacramento, CA 95827
Phone: (916)255-3103
Fax: not supplied
E-Mail: not supplied

AFFILIATION:

State (or provincial) organization

ADDITIONAL SITE CONTACT:

Bruce Locken
Western Environmental Science and Technology
1046 Olive Drive, No. 3

AFFILIATION:

Contractor/engineering firm

Davis, CA 95616
Phone: (916)753-9500
Fax: not supplied
E-Mail: not supplied

BIOTREATMENT PROCESS 1 OF 1

STATUS:

Full-scale bioremediation has been underway since 09/91.
Laboratory-scale studies were completed 01/90.
Pilot-scale studies have been completed.

Total expected cost: $35K.

PROBLEMS, OBSTACLES, OR OTHER SIGNIFICANT INFORMATION ON THE STATUS OF BIOREMEDIATION: There are some problems with QA/QC on analyses; two independent labs are giving conflicting results. Endosulfans have been particularly recalcitrant. This has not allowed the project to come to a full completion, in part due to the fact that the cleanup levels are somewhat stringent.

TREATMENT SUMMARY:

Ex situ land treatment. Aerobic and anaerobic conditions, indigenous organisms.

BIOTREATMENT PROCESS DESCRIPTION:

Soils were excavated, placed in aboveground shallow bins (tomato carriers), and mixed with lime, manure, and rice hulls. Bins were fitted with a drainage and recovery system and flooded to create anaerobic conditions; some bins also were drained and tilled to create aerobic conditions. Degradation was most efficient under the anaerobic regime. One bin was covered with clear plastic to create a solarization experiment, which showed promise.

All of the bins will now be emptied onto a concrete pad, with contents exposed to sunlight to try to get further degradation.

IS MIGRATION OF CONTAMINANTS AN ISSUE? IF SO, WHAT CONTAINMENT OR CONFINEMENT TECHNOLOGY IS BEING USED: No.

MEDIA AND CONTAMINANTS:

Vadose soil (DDE, chlorpyrifos, disulfoton, 2,4-D, 2,4,5-TCPA, atrazine, endosulfan I, endosulfan II, parathion, propazine)

ARE ANY CONTAMINANTS PRESENT THAT WILL NOT UNDERGO BIOREMEDIATION:

bis(2-ethylhexyl)pthalate, phenols

VOLUME OF MEDIA BEING TREATED OR CONSIDERED FOR TREATMENT:

MEDIUM: vadose soil
VOLUME UNDER BIOREMEDIATION: 75.0 cubic yards
TOTAL VOLUME AT SITE: not supplied
PERCENT OF TOTAL VOL. AT SITE: not supplied

ADDITIONAL CONTAMINANT CLEANUP DATA:

Contaminant: 2,4,5-trichlorophenoxypropionic acid (2,4,5-TCPA)
Media: vadose soil

Maximum original concentration..: 4.20 mg/kg
Target or required cleanup level: 0.10 mg/kg
Basis for cleanup level.....: beneficial use water quality criteria
Lowest concentration achieved...: 0.530 mg/kg
Time to achieve cleanup levels..: 1 year(s)

Contaminant: 2,4-dichlorophenoxyacetic acid (2,4-D)
Media: vadose soil

Maximum original concentration..: 106.0 mg/kg
Target or required cleanup level: 1.0 mg/kg
Basis for cleanup level.....: beneficial use water quality criteria
Lowest concentration achieved...: 2.0 mg/kg
Time to achieve cleanup levels..: 120 day(s)

Contaminant: atrazine
Media: vadose soil

Maximum original concentration..: 1.0 mg/kg
Target or required cleanup level: 0.030 mg/kg
Basis for cleanup level.....: beneficial use water quality criteria
Lowest concentration achieved...: 0.020 mg/kg
Time to achieve cleanup levels..: 120 day(s)

Contaminant: chlorpyrifos
Media: vadose soil

Maximum original concentration..: 5.30 mg/kg
Target or required cleanup level: 2.0 mg/kg

```
                                        Basis for cleanup level.........: beneficial use water quality criteria
                                        Lowest concentration achieved...: 2.30 mg/kg
                                        Time to achieve cleanup levels..: 1 year(s)

Contaminant: dichlorodiphenyl dichloroethylene (DDE)
      Media: vadose soil
                                        Maximum original concentration..: 2.40 mg/kg
                                        Target or required cleanup level: 1.0 mg/kg
                                        Basis for cleanup level.........: beneficial use water quality criteria
                                        Lowest concentration achieved...: 1.0 mg/kg
                                        Time to achieve cleanup levels..: 1 year(s)

Contaminant: disulfoton                 Maximum original concentration..: 2.0 mg/kg
      Media: vadose soil                Target or required cleanup level: 0.10 mg/kg
                                        Basis for cleanup level.........: beneficial use water quality criteria
                                        Lowest concentration achieved...: 0.10 mg/kg
                                        Time to achieve cleanup levels..: 1 year(s)

Contaminant: endosulfan I               Maximum original concentration..: 69.40 mg/kg
      Media: vadose soil                Target or required cleanup level: 7.40 mg/kg
                                        Basis for cleanup level.........: beneficial use water quality criteria
                                        Lowest concentration achieved...: 10.0 mg/kg
                                        Time to achieve cleanup levels..: 1 year(s)

Contaminant: endosulfan II              Basis for cleanup level.........: beneficial use water quality criteria
      Media: vadose soil

Contaminant: parathion                  Maximum original concentration..: 4.70 mg/kg
      Media: vadose soil                Target or required cleanup level: 3.0 mg/kg
                                        Basis for cleanup level.........: beneficial use water quality criteria
                                        Lowest concentration achieved...: 0.10 mg/kg
                                        Time to achieve cleanup levels..: 4 year(s)

Contaminant: propazine                  Maximum original concentration..: 6.40 mg/kg
      Media: vadose soil                Target or required cleanup level: 0.140 mg/kg
                                        Basis for cleanup level.........: beneficial use water quality criteria
                                        Lowest concentration achieved...: 0.10 mg/kg
                                        Time to achieve cleanup levels..: 120 day(s)
```

Site Report (cont.)

Bioremediation in the Field Search System
U.S. Environmental Protection Agency

Date: 06/14/95
Time: 10:58 am

SEARCH CRITERIA

Site lead is CERCLA Fund Lead or CERCLA Enforcement Lead or CERCLA State Lead.

AND Site involves treatment of soil or water.

AND Site involves treatment of any contaminant(s) categorized as BTEX.

Search Criteria

Bioremediation in the Field Search System
U.S. Environmental Protection Agency

Date: 06/14/95
Time: 10:59 am

Sites satisfying the search criteria: 16 of 420
Sorted by site location (EPA region, state)/(Country)

Site is located in U.S. EPA Region 9.

AND Site involves treatment of water.

LOC	NAME	PRIMARY CONTACT AFFILIATION	PRIMARY SITE CONTACT	PHONE
9 CA	BKK Landfill	Federal (or national) organization	Carmen Santos	(415)744-2037
9 CA	Benjamin Moore/Technical Coatings	Industry	Dennis Owen	(408)727-3400
9 CA	Former Golden Eagle Refinery	Contractor/engineering firm	Doug Cotton/Lori Patras	(714)505-1800
9 CA	Former Service Station	Industry	Tony Palagyi	(206)774-6090
9 CA	Fort Ord Army Base	Federal (or national) organization	John Chesnutt	(415)744-2387
9 CA	J.H. Baxter	Federal (or national) organization	Kathy Setian	(415)744-2254
9 CA	JASCO	Federal (or national) organization	Rose Marie Caraway	(415)744-2356
9 CA	Lawrence Livermore Laboratory -- Main Site	Federal (or national) organization	Paul Ko	(510)422-1075
9 CA	Lawrence Livermore Laboratory -- Site 300	Federal (or national) organization	Mike Brown	(510)423-7061
9 CA	Naval Weapons Station--Seal Beach	Federal (or national) organization	Carmen LeBron	(805)982-1616
9 CA	Oakland Chinatown	Contractor/engineering firm	Donald Smallbeck	(415)883-0112
9 CA	Queen Anne Property	Contractor/engineering firm	D. Clinton Williams	(619)554-0510
9 CA	San Diego Gas and Electric	Federal (or national) organization	Paul Hadley	(916)324-3823
9 CA	Solvent Service	State (or provincial) organization	Tony Mancini	(510)286-0825
9 CA	Wolco Oil Station	Contractor/engineering firm	Kenneth Meleen	(408)244-7202
9 NV	Naval Air Station--Fallon	Federal (or national) organization	Ron Hoeppel	(805)982-1655

Qualifying Sites List

APPENDIX

C

Bioremediation in the Field Questionnaire

BIOREMEDIATION IN THE FIELD QUESTIONNAIRE

The purpose of this questionnaire is to collect information about sites where bioremediation is being considered or implemented, or has been completed. The following questions request information on the current status of your site. This information will be added to a data base of site information being developed by the U.S. Environmental Protection Agency (EPA) as a resource for EPA and state project managers, consulting engineers, and industry personnel considering the use of bioremediation at contaminated sites. The data base currently contains information on over 160 bioremediation sites—a number that is expected to increase markedly over the next few years.

Information in the data base is accessible through the Bioremediation in the Field Search System (BFSS), a software application available on EPA's Alternative Treatment Technology Clearinghouse (ATTIC) (703-908-2138), Cleanup Information (CLU-IN) (301-589-8366), and Office of Research and Development (ORD) (513-569-7610) electronic bulletin board systems. It also is available on diskette from EPA by calling 513-569-7562. BFSS will allow the user to search for information on specific types of sites, such as those treating a particular medium or contaminant or those using a particular treatment technology. A summary of information in the data base also appears in EPA's *Bioremediation in the Field* bulletin, a quarterly update on field applications of bioremediation distributed to over 5,000 individuals.

The usefulness of both BFSS and the bulletin depends largely on the accuracy and completeness of responses in this questionnaire.

Please answer all questions that apply to your site. For questions that do not apply, answer "NA." For information that has not yet been established, please answer "NYE." If you have responded to previous questionnaires, some answers already are completed. Please verify that the answers are correct and current. If anything is inaccurate or has changed, please supply the correct information. Refer to the glossary of terms on pages 12 and 13, if necessary.

Sent _____ to:

Return by _____ to:

Ann Tran
Eastern Research Group, Inc. (ERG)
110 Hartwell Avenue
Lexington, MA 02173

Public reporting burden for this collection of information is estimated to average 5 hours for first time respondents and 0.5 hours for respondents updating previous responses, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding these burden estimates or any other aspect of this collection of information, including suggestions for reducing the burden, to Chief, Information Policy Branch, PM-233, U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460; and to Paperwork Reduction Project (OMB #2040-0048), Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503.

PART ONE: GENERAL SITE INFORMATION

Part one of this questionnaire (questions #1 through #11) requests general information about the site, including the name and location of the site; names, addresses, and phone numbers of site contacts; the regulatory authority or lead under which the site is being remediated; the predominant contaminant at the site; and a brief site description.

***** PLEASE NOTE *****

If you have filled out a previous questionnaire, please check to make sure that all printed responses are correct, current, and complete. If the site has **never used or tested** bioremediation and is no longer considering bioremediation, you do not need to fill out the rest of this questionnaire. In either case, we need this information to update our site data base and bulletin, so please check the appropriate box below and send the questionnaire back to us by the date indicated on the front page of the questionnaire.

- ❑ All printed responses are correct, current, and complete.
- ❑ This site has never used or tested bioremediation and is no longer considering bioremediation.

If the site has tested bioremediation at laboratory or pilot scale, please complete the questionnaire, even if the tests were unsuccessful and full-scale bioremediation is not being considered.

PART ONE: GENERAL SITE INFORMATION

Site Identification

1. Site Name: _____
2. City/State or Province: _____
3. Country: _____
4. EPA Region (if U.S. site): _____
5. ZIP or Mail Code: _____

Site Contact(s)

5. **Information Supplied by:**

Name: _____
Phone: _____
Fax: _____
Address: _____
_____
_____
_____
E-Mail: _____

Affiliation:
- ❑ Federal (or National) Organization
- ❑ State (or Provincial) Organization
- ❑ Municipal (or Local) Organization
- ❑ Industry
- ❑ Contractor/Engineering Firm
- ❑ Technology Vendor
- ❑ Other (specify): _____

(Providing the e-mail address will allow us to send you future questionnaires via the Internet. If you do not have this capability or prefer not to exercise it, you do not need to fill in this piece of information.)

6. **Additional Government Agency Contact:**

Name: _____
Phone: _____
Fax: _____
Address: _____
_____
_____
E-Mail: _____

Affiliation:
- ❑ Federal (or National) Organization
- ❑ State (or Provincial) Organization
- ❑ Municipal (or Local) Organization
- ❑ Other (specify): _____

7. **Additional Private Sector Contact:**

Name: _____
Phone: _____
Fax: _____
Address: _____
_____
_____
E-Mail: _____

Affiliation:
- ❑ Industry
- ❑ Contractor/Engineering Firm
- ❑ Technology Vendor
- ❑ Other (specify): _____

PART ONE: GENERAL SITE INFORMATION

8. Site Lead

(In most cases, check only one box. If there is more than one lead, please explain under comments below how the authority is divided, e.g., ground-water contamination is under RCRA jurisdiction; soil contamination is under UST jurisdiction.)

United States Sites:

- ☐ CERCLA Fund Lead: Covers Federal Lead.
- ☐ CERCLA Enforcement Lead: Covers PRP Lead, Enforcement Lead for RA, Federal Facility Enforcement Lead.
- ☐ CERCLA State Lead: Covers State Lead Enforcement, State/Federal Lead.
- ☐ Federal Facility: Covers DIRP, DOE, other federal agency facilities conducting remedial activities.
- ☐ RCRA Lead (Federal): Varies based on state authorization for RCRA enforcement acceptance.
- ☐ RCRA Lead (State): See RCRA Lead (Federal).
- ☐ UST Lead (Federal): Depends on whether the state is authorized for enforcement.
- ☐ UST Lead (State): See UST Lead (Federal).
- ☐ TSCA Lead (Federal): Depends on whether the state is authorized for enforcement.
- ☐ TSCA Lead (State): See TSCA Lead (Federal).
- ☐ Other (please specify) _____

International Sites:

- ☐ Government Lead (please specify) _____
- ☐ Private Sector Lead (please specify) _____

Comments:

PART ONE: GENERAL SITE INFORMATION

Site Characterization/Description

9. How would you characterize the contamination ***being bioremediated or considered for bioremediation*** at this site? Check all that apply.

- ❑ Wood Preserving
- ❑ Petroleum
- ❑ Pesticide/Herbicide
- ❑ Solvent
- ❑ Munitions
- ❑ Other (please specify) _____

(Please categorize the contamination using one of the named categories, whenever possible, rather than listing an individual contaminant(s). The purpose of the question is to allow a broad characterization of the site. You will have an opportunity to list *all* individual contaminants to be treated in a later question.)

10. Please provide a short description of the facility or contaminated site (e.g., inactive wood preserving site, leaking underground storage tank, RCRA land treatment facility to treat oil refinery sludges):

(If your site has a number of separate areas being treated or considered for treatment using the same or different bioremediation processes, please list and describe the separate subsites here.)

Other Sites

11. If you are aware of other bioremediation sites not already in BFSS or listed in the "Field Applications of Bioremediation" table in the *Bioremediation in the Field* bulletin, please specify the site(s) below.

Site Name:	_____	Site Name:	_____
City/State:	_____	City/State:	_____
Contact:	_____	Contact:	_____
Phone:	_____	Phone:	_____

PART TWO: BIOTREATMENT PROCESS INFORMATION

Part two of this questionnaire (questions #12 through #31) requests information about a specific biotreatment process being considered or implemented at the site, including the type of technology being used; the laboratory-, pilot-, or full-scale status of the technology; the media and contaminants being treated; the target cleanup levels; and the costs and performance of the technology. If a biotreatment process is being tested at laboratory or pilot scale, your answers to part two of the questionnaire (e.g., cost and performance data) should apply to the current scale of the technology, not to anticipated full-scale activities.

***** PLEASE NOTE *****

If more than one biotreatment process is being considered or implemented at this site, or if the same process is being used to treat separate areas of contamination, please photocopy and complete part two of the questionnaire ***for each process or separate contaminated area.***

Please enter the number of separate biotreatment processes at your site. ___

PART TWO: BIOTREATMENT PROCESS _ OF _

Treatment Technology

12. Please identify one biotreatment process being considered or implemented at this site.

(In most cases, check only one technology. Checking more than one technology implies that the two or more technologies are being used together in a *single process treatment train*. If this is the case, please explain in question #19 how these technologies are used in conjunction with one another.)

Ex Situ Processes

Treatments Involving a Reactor

- ❑ Activated Sludge Reactor
- ❑ Extended Aeration Reactor
- ❑ Contact Stabilization Reactor
- ❑ Attached Growth
  - ❑ Fixed Film Reactor
  - ❑ Fluidized Bed Reactor
- ❑ Sequencing Batch Reactor
- ❑ Slurry Reactor
- ❑ Other (please specify) _____

Treatments Not Involving a Reactor

- ❑ Aerated Lagoon
- Solid Phase
  - ❑ Prepared Bed (Land Treatment)
  - ❑ Pile Treatment
- ❑ Other (please specify) _____

In Situ Processes

- ❑ Intrinsic Bioremediation
- ❑ Air Sparging (Biosparging)
- ❑ Bioventing
- ❑ Confined Treatment Facility for Sediments
- ❑ In Situ Ground Water Bioremediation
- ❑ In Situ Sediment Bioremediation
- ❑ In Situ Soil Bioremediation (In Situ Land Treatment)
- ❑ Other (please specify) _____

13. If the technology is in situ, what amendments are used?

- ❑ Hydrogen Peroxide
- ❑ Oxygen Source
- ❑ Nutrients (please specify) _____
- ❑ Other (please specify) _____

PART TWO: BIOTREATMENT PROCESS _ OF _

14. If the technology involves a reactor, does the reactor treat the material as a solid, liquid, or gas?

- ❑ Solid
- ❑ Liquid
- ❑ Gas

15. If the technology involves a reactor, how would you describe the reactor flow?

- ❑ Batch
- ❑ Plug
- ❑ Completely Mixed

16. What are the growth conditions for the microorganisms?

- ❑ Aerobic
- ❑ Anaerobic

17. What is the source of the microorganisms?

(Check exogenous only if the organisms are actually brought in from another site, cultured in the lab, or engineered. If organisms are merely moved for application from one part of the site to another or from a contaminated area to a reactor or other treatment unit on site, then the source is still considered *indigenous*.)

- ❑ Indigenous
- ❑ Exogenous

Specify type(s) of exogenous organism: _____

PART TWO: BIOTREATMENT PROCESS _ OF _

18. Please check any nonbiological technologies that are being tested or implemented at the site in conjunction with this technology.

- ❑ Chemical Extraction
- ❑ Chemical Treatment
- ❑ In Situ Soil Flushing
- ❑ In Situ Vitrification
- ❑ Soil Washing
- ❑ Vacuum Extraction
- ❑ Thermal Desorption
- ❑ Other (please specify) _____

_____

19. Please describe the treatment process in more detail.

(If the bioremediation process is used in conjunction with a nonbiological technology, or two distinct bioremediation technologies are being used sequentially in the same treatment train, explain how the technologies are being used together in a single process.)

20. Is migration of contaminants an issue with the use of this technology at this site? If so, what containment or confinement technology is being used?

PART TWO: BIOTREATMENT PROCESS _ OF _

Contaminated Media

21. Please identify the contaminated medium or media ***being treated or considered for treatment by this biological technology***.

- ❑ Air
- ❑ Sediments
- ❑ Sludge
- ❑ Soil (please indicate zone below)
  - ❑ Vadose Zone
  - ❑ Saturated Zone
- ❑ Water (please indicate type below)
  - ❑ Ground Water
  - ❑ Surface Water

22a. What texture classification system are you using for *soil*?

- ❑ United States Department of Agriculture (USDA)
- ❑ ASTM/Unified Soil Classification System (USCS)
- ❑ Canada Soil Survey Committee (CSSC)
- ❑ International Soil Science Society (ISSS)
- ❑ British Standards Institution (BSI)
- ❑ Other (please specify) _____

(Please fill in the information for the corresponding texture classification system only.)

USDA Texture Class

❑ Sand	❑ Loam	❑ Clay Loam	❑ Silty Clay
❑ Loamy Sand	❑ Silt	❑ Silty Clay Loam	❑ Clay
❑ Sandy Loam	❑ Silt Loam	❑ Sandy Clay	

Typical Particle Size Distribution

_____ % Clay (<0 002 mm) _____ % Sand (0.05 to 2.0 mm)

_____ % Silt (0.002 to 0.05 mm) _____ % Coarse Fragments (>2.0 mm)

ASTM/USCS Texture Class

❑ CH	❑ CL	❑ MH	❑ ML	❑ SC	❑ SM
❑ SP	❑ SW	❑ GC	❑ GM	❑ GP	❑ GW

CSSC Typical Particle Size Distribution

_____ % Clay (<0.002 mm) _____ % Sand (0.05 to 2.0 mm)

_____ % Silt (0.002 to 0.05 mm) _____ % Coarse Fragments (>2.0 mm)

ISSS Typical Particle Size Distribution

_____ % Clay (<0.002 mm) _____ % Sand (0.02 to 2.0 mm)

_____ % Silt (0.002 to 0.02 mm) _____ % Coarse Fragments (>2.0 mm)

BSI Typical Particle Size Distribution

_____ % Clay (<0.002 mm) _____ % Sand (0.06 to 2.0 mm)

_____ % Silt (0.002 to 0.06 mm) _____ % Coarse Fragments (>2.0 mm)

Other Typical Particle Size Distribution

_____ % Clay (<___ mm) _____ % Sand (__ to __ mm)

_____ % Silt (__ to __ mm) _____ % Coarse Fragments (>___ mm)

PART TWO: BIOTREATMENT PROCESS _ OF _

22b. What texture classification system are you using for *sediments*?

- ❑ United States Department of Agriculture (USDA)
- ❑ ASTM/Unified Soil Classification System (USCS)
- ❑ Canada Soil Survey Committee (CSSC)
- ❑ International Soil Science Society (ISSS)
- ❑ British Standards Institution (BSI)
- ❑ Other (please specify) _____

(Please fill in the information for the corresponding texture classification system only.)

USDA Texture Class

❑ Sand	❑ Loam	❑ Clay Loam	❑ Silty Clay
❑ Loamy Sand	❑ Silt	❑ Silty Clay Loam	❑ Clay
❑ Sandy Loam	❑ Silt Loam	❑ Sandy Clay	

Typical Particle Size Distribution

_____ % Clay (<0.002 mm) _____ % Sand (0.05 to 2.0 mm)

_____ % Silt (0.002 to 0.05 mm) _____ % Coarse Fragments (>2.0 mm)

ASTM/USCS Texture Class

❑ CH	❑ CL	❑ MH	❑ ML	❑ SC	❑ SM
❑ SP	❑ SW	❑ GC	❑ GM	❑ GP	❑ GW

CSSC Typical Particle Size Distribution

_____ % Clay (<0.002 mm) _____ % Sand (0.05 to 2.0 mm)

_____ % Silt (0.002 to 0.05 mm) _____ % Coarse Fragments (>2.0 mm)

ISSS Typical Particle Size Distribution

_____ % Clay (<0.002 mm) _____ % Sand (0.02 to 2.0 mm)

_____ % Silt (0.002 to 0.02 mm) _____ % Coarse Fragments (>2.0 mm)

BSI Typical Particle Size Distribution

_____ % Clay (<0.002 mm) _____ % Sand (0.06 to 2.0 mm)

_____ % Silt (0.002 to 0.06 mm) _____ % Coarse Fragments (>2.0 mm)

Other Typical Particle Size Distribution

_____ % Clay (<___ mm) _____ % Sand (__ to __ mm)

_____ % Silt (__ to __ mm) _____ % Coarse Fragments (>___ mm)

PART TWO: BIOTREATMENT PROCESS _ OF _

23. Please indicate the volume of contaminated media ***being treated or considered for treatment by this technology***, the total volume of these contaminated media at the site, and the percent of the total being treated or considered for treatment with this process. (One row has been completed as an example.)

Medium	Volume Under Bioremediation	Total Volume at Site	Percent of Total Volume at Site
Soil (vadose)	2,000 cubic yards	10,000 cubic yards	20%

PART TWO: BIOTREATMENT PROCESS _ OF _

Contaminants and Cleanup Level Data

24. For each medium, please specify the contaminants ***being treated or considered for treatment by this biotreatment process*** and fill in any available information pertaining to original contaminant concentrations, cleanup levels, and technology performance. Do ***not*** fill in information on contaminants not undergoing bioremediation (see question #25). If you need more space, please photocopy the table. (One row has been completed as an example.)

(The data included in this table for rate of reaction, lowest concentration achieved, and time to achieve cleanup level should be based on whatever scale of testing or remediation you are currently undergoing, e.g., if you are doing pilot-scale testing, these data should reflect pilot-scale results.)

Medium (Please select from list in question #21)	Contaminant	Maximum Original Concentration	Target or Required Cleanup Level	Basis for Cleanup Level	Rate of Reaction	Lowest Concentration Achieved	Time to Achieve Cleanup Level
soil (vadose)	carcinogenic PAHs	1,500 mg/kg	160 mg/kg	Risk-based	2 mg/kg/day	100 mg/kg	2 years

25a. What other contaminants are present that will not undergo bioremediation (e.g., heavy metals, such as lead, mercury, zinc)?

b. Does the presence of the other contaminants affect the performance of the biological technology at the site? If so, how?

PART TWO: BIOTREATMENT PROCESS _ OF _

Status

26. Are LABORATORY-SCALE treatability or feasibility studies of this biotreatment process *being considered, being conducted,* or *completed* on material from the site?

- ❑ Yes, being considered.
- ❑ Yes, being conducted.
- ❑ Yes, completed.
- ❑ No.

If so, provide the expected or actual dates for start and completion of laboratory-scale activity:

Start: _____ Completion: _____

27. Are PILOT-SCALE treatability or feasibility studies of this biotreatment process *being considered, being conducted,* or *completed* at the site?

- ❑ Yes, being considered.
- ❑ Yes, being conducted.
- ❑ Yes, completed.
- ❑ No.

If so, provide the expected or actual dates for start and completion of pilot-scale activity:

Start: _____ Completion: _____

28. Is FULL-SCALE remediation using this biotreatment process *being considered, being conducted,* or *completed* at the site?

- ❑ Yes, being considered.
- ❑ Yes, being conducted.
- ❑ Yes, completed.
- ❑ No. (Please elaborate in question #30.)

If so, please check the current stage of full-scale remediation and provide the expected or actual date for the *start* of each stage:

- ❑ Predesign _____
- ❑ Design _____
- ❑ Installation _____
- ❑ Operational _____
- ❑ Completed _____

29. Please identify any problems or obstacles associated with bioremediation or other significant information on the status of bioremediation. (These might include technical, cost-related, or regulatory obstacles.)

30. If full-scale bioremediation has not been considered or is no longer being considered at this site, please explain why.

PART TWO: BIOTREATMENT PROCESS _ OF _

Costs

31. Please indicate the capital costs (startup and construction) and operation and maintenance (O&M) costs *associated with the use or testing of this technology*. If separate figures for capital and O&M costs are not available, enter the total incurred and expected costs.

Costs	Per Year	Incurred	Total Expected
Capital	NA		
O&M			
Total			

GLOSSARY OF BIOREMEDIATION TERMS

Site Lead	Agency or program having jurisdiction over site cleanup.
Ex Situ Treatment Processes	
Treatments Involving a Reactor	
Ex Situ Process	Process that involves the removal of the contaminated medium or media from its original location to another area for treatment. Processes that involve removal of the contaminated material, mixing, and then replacement at the original site are also considered ex situ.
Reactor	A contained vessel in which biological treatment takes place.
Activated Sludge Reactor	Technology in which biomass is suspended in liquid, captured in the clarifier, and recycled to the reactor; the contact time between the waste and the biomass is controlled by wasting excess biomass.
Extended Aeration Reactor	Technology in which biomass is suspended in liquid, captured in the clarifier, and recycled to the reactor; a long contact time is created by enlarging the aeration basin.
Contact Stabilization Reactor	Technology in which waste contacts the biomass suspended in liquid in the first aeration tank and contaminants are adsorbed to the clarified biomass; then they are digested in the second aeration tank.
Fixed Film Reactor	Technology in which biomass is retained in the system by using static support media (e.g., a trickling filter).
Fluidized Bed Reactor	Technology in which bacteria are attached to a support medium, which is fluidized in the reactor.
Sequencing Batch Reactor	A self-contained treatment system that incorporates equalization, aeration, and clarification using a draw and fill approach on wastewater sludges.
Slurry Reactor	Technology in which contaminants are treated in a soil slurry (a thin mixture of soil and water), with nutrients and oxygen added as needed; water and soil must be separated after treatment, but clean soil is left on site.
Treatments Not Involving a Reactor	
Aerated Lagoon	Treatment in which soil, sludge, or sediment is mixed with water to form a slurry. The slurry is placed in a lagoon and mechanically agitated so that the biomass is kept suspended in liquid with aeration. Nutrient, oxygen, pH, and temperature conditions are controlled. After the process is completed, the slurry is dewatered and the treated material is disposed of.
Prepared Bed (Land Treatment)	Process in which waste is applied onto or incorporated into the soil surface in a facility or lined treatment bed. Contaminants are treated with microorganisms typically indigenous to the existing soil matrix; nutrients, moisture, and oxygen can be added to optimize growth conditions. If the waste remains at the facility after closure, the land treatment facility becomes a disposal facility.
Pile Treatment	Process in which a noncontainerized accumulation of solid, nonflowing waste is treated or stored under controlled nutrient, oxygen, pH, and temperature conditions.

In Situ Treatment Processes	
In Situ Process	Process that leaves contaminated medium or media in place for treatment.
Intrinsic Bioremediation	Intrinsic bioremediation relies on naturally occurring processes including biodegradation, absorption, dilution, and dispersion accompanied by such human interventions as site characterization, institutional and source controls, and monitoring.
Air Sparging (Biosparging)	Air is injected below the water table, creating bubbles in contaminated ground water. The air bubbles contact dissolved and adsorbed contaminants in the aquifer, increasing oxygen concentrations and stimulating indigenous microbial activity. Sparging also causes contaminants to volatilize and be transported to the vadose zone, where they can be treated by another technology, such as bioventing or soil vapor extraction.
Bioventing	Injection or extraction wells are used to induce a dynamic flow of air through contaminated soil above the water table. Air flow rates are adjusted to increase soil oxygen concentrations and stimulate indigenous microbial activity without releasing volatile emissions. In some bioventing systems, a nutrient solution is injected with the air or percolated through the soil.
Confined Treatment Facility for Sediments	Caissons are constructed to contain the sediments in the environment in which they are found. Stirring mechanisms then can be used to agitate the contaminated material, and incorporate microorganisms, nutrients, and electron acceptors.
In Situ Ground Water Treatment	Injection wells are used to circulate microorganisms, nutrients, and oxygen through contaminated aquifers. In most systems, ground water is pumped through a recovery well downgradient of the contaminated area, treated to some extent, then reinjected upgradient of the contaminated area with additives that enhance biodegradation. The effectiveness of in situ ground water bioremediation depends on maintaining contact between contaminants and injected amendments.
In Situ Sediment Treatment	Biodegradable contaminants are treated by microorganisms within the environment in which they are found. This process usually is anaerobic and involves the delivery of electron acceptors and other appropriate amendments to the contaminated sediments.
In Situ Soil Treatment (Land Treatment)	Biodegradable contaminants are treated by microorganisms within the environment in which they are found. This process usually is aerobic and involves injection of oxygen, other electron acceptors, and other appropriate amendments to the contaminated soil. Permeable soils with high moisture content are most appropriate for in situ treatment.
Amendment	Nonmicroorganism addition to in situ processes for assistance in biodegradation (e.g., nitrogen, phosphorus).
Media	
Sediments	Sediments refer to aquifer materials including gravelly sand, clayey sand, and sandy clay originating from sedimentary rock. Sediments also are accumulations of such materials as sand and volcanic ash from the atmosphere; of stream gravel, sand, and mud on the lands; and of gravels, sand, clay, and organic remains on the sea floor.
Soil	Soil is the loose surface material of the earth in which plants grow.

Media (continued)	
Vadose Zone	The vadose zone is the region extending from the ground surface of the earth to the upper surface of the principal water-bearing formation.
Saturated Zone	The saturated zone extends from the upper surface of saturation down to underlying impermeable rock. Generally, the water table forms the upper surface of the zone of saturation. This is defined as the surface of atmospheric pressure and appears as the level at which water stands in a well penetrating the aquifer.
Ground Water	Groundwater is water occurring in the zone of saturation.
Microorganism Growth Conditions	
Aerobic	In the presence of oxygen. Aerobic metabolism involves energy-yielding oxidation reactions in which hydrogen is transferred to oxidized pyridine nucleotides (NAD and NADP).
Anaerobic	In the absence of oxygen. Anaerobic metabolism involves energy-yielding reactions in which the final electron acceptor is a compound other than molecular oxygen, such as sulfate or nitrate.
Microorganism Source	
Indigenous	Occurring naturally at a site. Organisms that are moved from one location at the site to another (e.g. to a reactor) to facilitate treatment of the original contaminated medium are still considered indigenous.
Exogenous	Not native to a site. These include organisms that are brought in from another site, cultured in a lab, or engineered.
Contaminants and Cleanup Level Data	
Maximum Original Concentration	Maximum level of contamination detected prior to start of bioremediation.
Basis for Cleanup Level	Regulatory or other standard that establishes cleanup levels.
Rate of Reaction	Reduction of contaminant concentration per unit time (mg/L/day).
Lowest Concentration Achieved	Lowest contaminant concentration at current scale of remediation, or final concentration if full-scale bioremediation has been completed.
Time to Achieve Cleanup Level	Time required to achieve cleanup goals for the entire contaminated area being treated or tested.
Treatment Status	
Laboratory Scale	Undertaken in the laboratory under controlled conditions.
Treatability or Feasibility Studies	Studies to test the effectiveness of specific techniques for remediating specific media and contaminants. These studies also identify existing site problems and examine potential remedial alternatives, considering technical, regulatory, environmental, public health, and cost issues.
Pilot Scale	Performed on test plots and control plots under field conditions. If a contaminated area is small enough, pilot-scale treatment may be able to achieve cleanup level goals.
Full-Scale Remediation	Remediation employing a specific technology or technologies to clean up contaminants over an entire site or contaminated area. Full-scale remediation often is preceded by treatability or feasibility studies.

APPENDIX

D

Comment Form

BIOREMEDIATION IN THE FIELD SEARCH SYSTEM (BFSS)

Comment Form

Please complete this form and send it to BFSS Technical Support, Eastern Reseach Group, Inc., 110 Hartwell Ave., Lexington, MA 02173, or fax it to 617-674-2851.

Your Name:_____ Date: _____

Phone Number: _____ Fax Number:_____

Comment

(Please attach any supporting material, such as printed screens or reports.)

Additional sites

(If you are aware of other bioremediation sites not currently in BFSS, please provide information on the second page.)

Date Received:_____ ERG Software Applications Development Group

BFSS Comment Form (cont.)

Site Name: _____

City/State: _____

Contact: _____

Phone: _____

Site Name: _____

City/State: _____

Contact: _____

Phone: _____

Site Name: _____

City/State: _____

Contact: _____

Phone: _____