→ Binyoti Felix-SER

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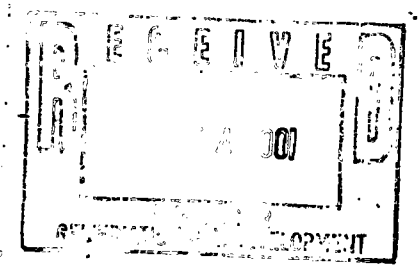
3 April 2001



Mr. Russell D. Hart
Remedial Project Manager (HSRW-6J)
United States Environmental Protection Agency
Region 5
77 West Jackson Boulevard
Chicago, Illinois 60604

RFW Work Order No. 02687.007.003
KMC Work Order No. 40-50-01-AKW-B

Re: Revision 1 Workplan and QAPP Addendum II for Solid-Phase Bioremediation Pilot Test
Moss-American Site, Milwaukee, Wisconsin

Dear Mr. Hart:

Roy F. Weston, Inc. (WESTON), on behalf of Kerr-McGee Chemical, LLC (KMC), is pleased to submit, Revision 1 of the Pilot Test Workplan and Revision 1 of Addendum II to the existing Quality Assurance Project Plan (QAPP) for conducting a solid-phase bioremediation test for contaminated soils at the Moss-American Site in Milwaukee, Wisconsin. Also included are responses to your QAPP comments listed in your letter dated 14 August 2000. All comments were addressed and implemented into the revised QAPP Addendum II, as appropriate. The revised Workplan and revised QAPP Addendum II supercede the previously approved Workplan/QAPP that were submitted on 14 July 2000.

Significant changes to the Workplan include:

- Schedule – The pilot-scale bioremediation test schedule has been extended to encompass a longer testing period. This extended period will allow greater opportunity for us to determine the contaminant degradation kinetics and overall effectiveness of bioremediation in achieving site RCLs. Pilot testing is anticipated to begin in early May and extend to late October 2001.

- Test Pad – The location and layout of the test pad have been modified based on site activities and associated space requirements. The dimensions of the pad have changed from 100 feet by 100 feet to 60 feet by 260 feet. Containment berm height has been reduced to from 2 feet to 6 inches based on access requirements. Pad thickness will remain the same (2 feet).

- Test Cell Thickness – Based on equipment limitations and cost effectiveness, the test cell height was reduced from 18 inches to 12 inches to facilitate use of smaller

equipment that is more suited for a pilot-scale operation. Upon implementation of full-scale bioremediation, test cell thickness would be increased to 18 inches, and larger equipment that is readily available would be used to turn the soil.

- Treatment Variables – In order to address WDNR's concern regarding the effect of volatilization of organic constituents, the test cells have been modified to facilitate monitoring of the organic compound loss through volatilization. A duplicate test cell that will contain both nutrients and the preferred bacteria has been substituted for a test cell where soil would have been augmented by application of bacteria without nutrient addition. This duplicate cell will be closed to the atmosphere to allow for accumulation of volatilized organics in the headspace of the test cell. Organic vapor monitoring results obtained from the headspaces of the identical test cells, one open and one closed to the atmosphere, as well as other measured parameters, will facilitate measurement of contaminant loss through volatilization.

- Analytical Parameters – Additional nutrient parameters that will be monitored include nitrate nitrogen, nitrite nitrogen, and total phosphorous. Degrader populations will also be measured through bacterial enumeration. Based on the extended testing period, the sampling frequency has been reduced from 3 weeks to monthly.

Given that the original version of this document received Agency approval, we are hopeful that the Agency review process can be accelerated. Agency approval, even if limited to conceptual issues in a preliminary communication to us, would allow us to begin construction of the test pad as soon as possible. If you have any questions or require additional information, please do not hesitate to contact me at (847) 918-4142 or Keith Watson at (405) 270-3747.

Very truly yours,

ROY F. WESTON, INC.

Thomas P. Graan

Thomas P. Graan, Ph.D.
Principal Project Manager

TPG:sk
Attachments

cc: K. Watson, KMC
G. Edelstein, WDNR

Response to Comments (14 August 2000)
Revised Addendum II to the Quality Assurance Project Plan for the Pilot-Scale Solid Phase Bioremediation Testing
Moss-American Site
Milwaukee, Wisconsin

RESPONSE TO U.S. EPA COMMENTS:

U.S. EPA Comment 1: *The signature page with date of approval should be included in the Addendum II.*

KMC/WESTON Response to U.S. EPA Comment 1: A signature page has been included in Addendum II.

U.S. EPA Comment 2: *Explanation should be provided why the naphthalene was removed from the revised Summary table 2-1c of the QAPP while the DQOs section 2.8 still includes naphthalene as a parameter of interest.*

KMC/WESTON Response to U.S. EPA Comment 2: Naphthalene is a PAH and shall be analyzed by method 8310 as indicated in Table 2-1c.

U.S. EPA Comment 3: *Table 4-1b. The following should be addressed/corrected:*

a. *SOP for TOC has the Method Detection Limit for soil samples 50ppm, while in the table it's only 12ppm*
b. *SOP for Ammonia-N has the Method Detection Limit for Soil Samples 50ppm, while in the table it's only 0.2ppm and Project Detection Limit is 20ppm. May be different method should be used for achieving lower detection limits.*
c. *The Method detection limit for Total P is 10ppm. The Method Detection limit should be at least 5-10 times lower than Project Required Detection Limits*

KMC/WESTON Response to U.S. EPA Comment 3:

a. The Limit of Quantitation (LOQ) indicated in the Lancaster Laboratory (Lancaster) SOPs corresponds to the Project Detection Limits column in Table 4-1b. The Method Detection Limits of Table 4-1b are obtained from the J-Value column of the table in Section 9, page 15 of the Laboratory Quality Assurance Plan (QAP) provided as Appendix B of the original QAPP (October 1999). A copy of Section 9 of the laboratory QAP (revised per below comments) is included as Appendix B. Therefore, the TOC detection limits in Table 4-1b are correct.

b. The LOQ of 50 mg/kg specified in the Lancaster SOP for analysis #0573 (Ammonia-Nitrogen for Soils) is erroneous. The actual LOQ is 20 mg/kg, as specified in the table on page 15 in Section 9 of the revised Lancaster QAP (see Appendix B). Lancaster is currently in the process of updating all of their SOPs. In the interim, Lancaster has provided a procedural amendment for analysis #0573 that specifies referral to the WANG (Lancaster's

in-house database that contains LOQs & J-Values for analyses) for the current LOQ for analysis #0573. A copy of the procedural amendment is provided in Appendix C.

c. The table on page 15 of Section 9 of the Lancaster QAP (Appendix B) has been updated to reflect the project and method detection limits for analysis #5893 (total phosphorous as P in solids). The project detection limit for this analysis is 10 mg/kg, and the method detection limit is 2.3 mg/kg.

U.S. EPA Comment 4: *The SOP for Total Phosphorus in soil samples should include the detailed sample preparation/digestion procedure.*

KMC/WESTON Response to U.S. EPA Comment 4: The Lancaster SOP for analyses #0227, 0345, 1546, 1547, 5893, and 5894 (Determination of Total, Soluble, and Acid Hydrolyzable Phosphorous in Water, Wastewater, and Soils) has been amended to refer to analyses #8261, 8262, 8263, and 8264 (Digestion of Total, Soluble, and Acid Hydrolyzable Phosphorous in Water, Wastewater, and Soils) for preparation and digestion of samples. Copies of the procedural amendment and the SOP for preparation and digestion of soil samples for analysis of total phosphorous are provided in Appendix C.

U.S. EPA Comment 5: *The Orthophosphate (ORT-P) analysis are not included in the QAPP. The SOP for Phosphorus referenced analysis #0226 (page 10 of 20) for the orthophosphates. The step by step procedure should be included in the SOP for analyzing the soil samples.*

KMC/WESTON Response to U.S. EPA Comment 5: Soil samples will be analyzed for orthophosphate (ORP-P), as indicated in Table 2-1c. The soil samples are digested and the digests are then analyzed colorimetrically. Page 10 of 20 of the phosphorous SOP (#5893) refers to the calculation for hydrolyzable phosphorous (#1547). This calculation does include the orthophosphate result for analysis #0226; however, this is only applicable to water samples. The SOP for analysis #0226 was included in Appendix C of Addendum No. I to the QAPP. The step-by-step procedure for analysis #5893 begins on page 6 of 20 in the phosphorous SOP.

Kerr-McGee Chemical, LLC
Moss-American Site
Solid-Phase Bioremediation Pilot Test
Revised Work Plan

Prepared for:

Kerr-McGee Chemical, LLC

Prepared by:

Roy F. Weston, Inc.
Suite 500
750 East Bunker Court
Vernon Hills, IL 60061

April 2001

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SECTION 1

INTRODUCTION

1.1 BACKGROUND

Kerr-McGee Chemical, LLC (KMC), is implementing remedial actions at the Moss-American Site in Milwaukee, Wisconsin. To date, implementation of groundwater treatment elements of the remedy has resulted in the excavation and staging of contaminated soils requiring treatment in order to meet on-site disposal standards set forth in the amended Record of Decision (ROD). Some of the staged soils are considered to be candidates for on-site treatment by solid-phase bioremediation (SPB). In order to evaluate this option, KMC plans to perform a field scale SPB pilot test at the Moss-American site. This Workplan provides an outline of the SPB pilot test.

SPB typically provides for aerobic biodegradation of target constituents in soils by placing the soils in (typically) 12- to 18-inch thick layers, adjusting environmental parameters as needed, and periodically tilling for mixing and aeration. Under these conditions, aerobically degradable contaminants are remediated by naturally occurring (and/or supplemental) microorganisms within the soil matrix. The process is technically simple and efficient, with the primary operating constraint being the need for a relatively large treatment area per unit volume of soils.

In the past, the following categories of contaminated soil were identified as being amenable to treatment with bioremediation:

> ***Category A*** – Soil with naphthalene concentrations between 0.4 and 100 mg/kg and concentrations of total carcinogenic polycylcic aromatic hydrocarbons (CPAHs) <1.9 mg/kg.
>
> ***Category B*** – Soil with naphthalene concentrations between 0.4 and 100 mg/kg and total CPAH between 1.9 and 3.1 mg/kg.
>
> ***Category C*** – Soil with naphthalene concentrations between 0.4 and 100 mg/kg and total CPAH between 3.1 and 10 mg/kg .

These soil classifications have been revised to correlate to the categories of soil that were developed for the low-temperature thermal desorption design and revised in the Soil Management Plan dated 9 November 2000. Category A and B soil was consolidated and is currently referred to as Type III soil. The Category C soil definition was revised and corresponds to soil that is currently referred to as Type II. Type I soil will be treated using low-temperature thermal desorption (LTTD), and will not undergo solid-phase bioremediation testing at the pilot- or full-scale levels. Descriptions of the contaminant levels contained within Types I, II, and III soil are as follows:

- Type I soil – These soils contain any of the following: visible free product; naphthalene or fluorene at concentrations greater than 100 mg/kg; or total CPAHs at concentrations greater than 6.2 mg/kg (benzo[a]pyrene [BaP] equivalent concentration).

- Type II – These soils contain naphthalene and fluorene concentrations less than 100 mg/kg and total CPAH concentrations between 3.1 and 6.2 mg/kg (BaP equivalent concentration).

- Type III – These soils contain naphthalene and fluorene concentrations less than 100 mg/kg and total CPAH concentrations less than 3.1 mg/kg (BaP equivalent concentration).

KMC/WESTON will make an effort to use Type II soil (CPAH concentrations in the 3.1 to 6.2 mg/kg range) for construction of the test cells; however, it is possible that initial CPAH concentrations of the test soil may fall outside the desired range.

1.2 OBJECTIVE

The objective of this pilot test will be to demonstrate that solid-phase bioremediation can effectively treat lesser-contaminated excavated soil to meet all direct contact and migration to groundwater residual contaminant levels (RCLs), allowing disposal of treated soils on-site under a 6-inch vegetated topsoil cover.

This objective will be achieved in the pilot test by treating small volumes of candidate soils under varying treatment conditions and comparing reductions in contaminant levels against the RCLs and against performance of a control treatment.

SECTION 2

TECHNICAL APPROACH

2.1 GENERAL APPROACH

The SPB pilot test at the Moss-American site will use a series of small test plots, or treatment cells, to evaluate treatment conditions and effectiveness. The scale of each test plot will be sufficient to effectively simulate full-scale materials handling and treatment conditions.

The pilot test will consist of the following principal steps:

- Selection of test soil conditions.
- Selection of amendments and additives, as appropriate, to enhance the biodegradation process. Selection of amendments/additives will be based on prior experience and literature data for similar applications..
- Site preparation and construction of test treatment pad meeting environmental and regulatory (WDNR) requirements, as appropriate.
- Preparation of test soil mixtures.
- Preparation of amended soils for testing.
- Initiation of testing and process monitoring.
- Completion of testing including final performance sampling and analysis.
- Demobilization of the test site.
- Preparation of Pilot Test Technical Memorandum.

If successful, the results of the pilot test will be used to develop plans for full-scale operation.

The Moss-American site SPB demonstration will use five test plots to evaluate a range of treatment conditions. The base period for pilot-scale testing is expected to begin in early May

and extend until late October to mid-November, based on climatic conditions. If necessary, and weather permitting, the pilot-test may be extended to mid-December.

2.2 SELECTION OF AMENDMENTS AND ADDITIVES

Several treatment conditions including, but not necessarily limited to, amendments and additives will be evaluated for their potential to enhance the biodegradation process for the Moss-American site soils. The initial evaluation and selection of materials is based upon prior experience and literature data for similar applications. The types of additives considered include nutrients, microbial formulations, and ingredients such as sand, mulch, and/or straw to modify test soil texture as necessary, and other materials that have been demonstrated to assist bioremediation in similar settings. Based upon this review, test conditions were selected that are considered to have the best promise for performance enhancements.

The pilot-scale testing will use blended soils to ensure homogeneous starting conditions with respect to soil texture/physical properties and contaminant concentrations. Moisture content and turning frequency will be held constant for all test plots, while additives and microbial formulations will vary among the plots. In addition, one test cell will be closed to the atmosphere to evaluate the loss of contaminants due to volatilization. Test Cell No. 1 (TC-1) will serve as the control plot. Blended soil in TC-1 will not receive any additives and/or amendments; therefore, contaminant level reduction in TC-1 will be through volatilization and unenhanced biodegradation. TC-1 soil will be turned or mixed at a frequency and maintained at a moisture content that is similar to conditions in the other test cells.

The following provides an initial summary of the selected test conditions.

- Test Cell No. 1 (TC-1) - Control cell; will undergo no enhanced bioremediation.
- Test Cell No. 2 (TC-2) – Will contain a nutrient formulation.
- Test Cell No. 3 (TC-3) – Will contain both nutrient formulation and the selected microbial formulation.

- Test Cell No. 4 (TC-4) – Will contain both nutrient formulation and a secondary microbial formulation.

- Test Cell No. 5 (TC-5) – Will contain both nutrient formulation and the selected microbial formulation (TC-5 is identical to TC-3; however, TC-5 will be closed to the atmosphere).

Locations of the test cells on the treatment pad are indicated in Figure 2-1.

Soil in all test cells will be turned once per week. TC-1 (control cell) will be turned first each week to prevent introduction of nutrients or bacteria from the amended test cells. Similarly, TC-2 will be the second cell mixed each week to minimize introduction of bacteria to the cell.

The specific amendments (nutrients, microbial additive products and proprietary process amendments) will be selected from those available commercially for full-scale application. Selection criteria will include the nature of the product, and available data for similar applications to maximize the likelihood of success. At present, microbial additive products and proprietary process amendments under review include Daramend Bioremediation Technology (W.R. Grace & Co.), proprietary formulations produced by Sybron Biochemicals and BSI Environmental, Inc., and *Mycobacterium* Sp. RHGII (Strain 135) developed by the University of Cincinnati. Final selection of microbial additive products and proprietary process amendments will be communicated to the agencies in the near future.

Nutrient quantities will be sufficient to provide an slight stoichiometric excess of nutrients based upon the measured TOC level in the blended soil stockpile and an target C:N:P ratio of 100:14:1.

Microbial formulations and proprietary process additives will be added to the soil at rates based upon recommendations from the product manufacturer, as well as literature data, as appropriate. For planning purposes, it is assumed that the inoculum bacterial level for the test soils should be in the range of 10^3 to 10^6 colony forming units per gram (CFU/g), or as otherwise determined by the vendor. Active degradation levels are typically $>10^6$ CFU/g; however, attainment of bacterial levels specified by the vendor will be implemented for the pilot testing.

2.3 SITE PREPARATION AND CONSTRUCTION OF TREATMENT PAD AND CELLS

Following approval of the Workplan, site development will proceed with the construction of the treatment pad. This will include site clearing and preparation as required, establishment of site controls, and building of the test cells. The location of the treatment pad is shown in Figure 2-2.

The treatment pad will consist of 2 feet (ft) of compacted clay to preclude migration of rainwater into subsurface soils. Clay will be imported from an off-site borrow source and will be placed in 8-inch, loose lifts. Each lift will be compacted to 95% of standard Proctor density. The treatment pad will be approximately 60 x 260 ft in size. A perimeter berm will be constructed around the treatment pad and the 5 cells will be placed within the bermed area. Upon placement, the cells will be segregated in a manner that prevents mixing of soils from the various treatments. Each test cell will be approximately 30 x 30 ft in size. The berm will be designed to permit equipment access and have a height of 6 inches. Plan and sectional views of the treatment pad, as well as the location and layout of the treatment cells, are shown in Figure 2-1.

Pilot test operations will be conducted in such a manner as to minimize the generation of leachate. At the same time, the pad design provides for management of non-contact and contact water.

The working surface of the treatment pad will be sloped to direct incident precipitation and leachate (if any) away from the test cells and to a collection sump. The treatment pad will be tarped during treatment (between maintenance and sampling activities) to divert precipitation from the treatment pad. Precipitation that comes in contact with the contaminated soils will be collected from the sump on an as-needed basis. Water collected from the sump will either be disposed of off-site or treated and discharged to a sanitary sewer on-site. The impermeable layer on the base of the cell will be covered with a sacrificial indicator layer of sand, gravel, or straw to ensure that the base is not penetrated during soil treatment.

The overall sequence of construction will be as follows:

1. Clearing and grading of the treatment pad area, as needed.
2. Utilities clearance.
3. Establishment of erosion and sediment controls.
4. Sub-grade preparation, if any.
5. Placement and compaction of specified clay material to a minimum thickness of 6 inches. Surface to be sloped (1 to 2%).
6. Construction of berms with a minimum height of 6 inches around the pad.
7. Installation of sump pump and temporary piping for stormwater/leachate conveyance system.
8. Placement of test cells.

2.4 PREPARATION OF TEST SOIL MIXTURE

The Moss-American site SPB pilot test will use five cells, all residing on the treatment pad, to evaluate treatment conditions and effectiveness. Each test cell will contain of approximately 30 cubic yards (CY) of Type II soil. The dimensions of each test cell will be approximately 30 ft by 30 ft by 1 ft high. Arrangement of the treatment cells is shown in Figure 2-2.

The SPB pilot test (and subsequent full-scale remediation) will use soils blended to achieve reasonably homogeneous starting conditions with respect to soil texture/physical properties and contaminant concentrations. The objective for the pilot test blending is to provide similar soil texture/physical properties and initial contaminant levels both within each test cell and among the five test cells so that performance data can be compared under similar conditions. For the SPB pilot test, soils will be blended with a backhoe or similar equipment. Blending will occur on Stockpile #2, adjacent to the treatment pad. Soil samples will be collected from the blended stockpile to provide initial characterization data and to estimate final additive quantities for the amended test cells.

2.5 PREPARATION OF AMENDED SOILS FOR TESTING

The blended soil mixture will be amended with the selected additives once the test cells are constructed. Additives will be prepared and applied according to the vendor's specifications. The test cells will subsequently be disked or turned to distribute the additives throughout the test cell thickness. Preparation of the amended soils will constitute the initiation of the active testing phase and the initial sampling events will occur once the test cell has been amended and mixed.

2.6 INITIATION OF TESTING AND PROCESS MONITORING

The amended soils will be initially sampled upon application of amendments and periodically through the test phase to assess contaminant degradation efficiency and progress toward the remediation objectives. Each sampling event will consist of preparation of a composite soil sample for each cell. The composite sample will be created by homogenizing four grab soil samples collected from the test cell. Specific sampling and analysis procedures will be in accordance with the approved Quality Assurance and Project Plan (QAPP).

Field measurements will be collected and recorded before each turning event to ensure that soil conditions remain within desired ranges for biodegradation. The field parameters would include soil pH, soil temperature, and soil moisture content. Additionally, the test plots will be sampled and analyzed every month for polynuclear aromatic hydrocarbons (PAHs), total organic carbon (TOC), total Kjeldahl nitrogen (TKN), ammonia-nitrogen (NH_3-N), nitrate-nitrogen (NO_3-N), nitrite-nitrogen (NO_2-N), total phosphorous (Total P), phosphate-phosphorus (PO_4-P), orthophosphate-phosphorous (ORP-P), and microbial enumeration (total heterotrophic and total degrader CFUs) to assess contaminant degradation efficiency and progress toward the remediation objectives.

Soil samples for field measurements (other than temperature) and laboratory parameters will be collected at four discrete points within each test plot and homogenized to create one composite sample for each cell. Temperature will be recorded at each of the four sampling points within

each test plot. The sampling protocol of the composite sample will be in accordance with the approved QAPP.

Prior to removing the tarpaulin cover to TC-5 each week, organic vapors in the headspace above the test cell will be aggregately measured using a flame-ionization detector (FID). Similar measurements will be performed for TC-3, which will be tested under the same conditions as TC-5; however, TC-3 will be open to the atmosphere. Data obtained from headspace monitoring, as well as other parameters, will be used to assess contaminant loss via the volatilization pathway. In addition, oxygen levels under the tarpaulins will be monitored to ensure that an oxygen deficiency is not affecting biodegradation rates.

2.7 SOIL PROCESSING

2.7.1 Routine Operations

Placement of Treatment Layer

Blended contaminated soil placed in the treatment area will be spread in an even layer 12 inches thick in a manner that avoids compaction. The final thickness of the treatment layer will not exceed effective mixing depth of the mixing equipment (discs, roto-tillers, etc.). The treatment layer will be amended with additives according to the desired treatment conditions and thoroughly aerated (mixed/tilled) on a regular basis. A tillage frequency of 1 week will provide adequate soil aeration.

2.7.2 Adjustment of Environmental Conditions

The following procedures will be used as necessary to adjust and maintain desired soil conditions during treatment.

2.7.2.1 Soil pH

Adjustment of pH during treatment is not anticipated. Soil pH may be adjusted during initial mixing if data indicate it is outside of desired range. The most likely event is low soil pH, in which case it would be amended at the start of the test by application of agricultural lime.

2.7.2.2 Moisture

Moisture may be lost from the soils during mixing and treatment primarily by evaporative loss. Moisture monitoring will be conducted to assess soil moisture content. If moisture falls to below desired ranges, supplemental water will be added and immediately mixed into the soils. All moisture addition will be conducted immediately prior to a mixing event to distribute the water though the soil and minimize the likelihood for runoff. Moisture addition will be controlled by calculating the total quantity of water needed (based upon moisture measurements), and adding the required amount evenly and at a controlled rate from a calibrated supply (metering pump if from a water tank, or a calibrated hose supply if from a water line). The water will be added at a sufficiently slow rate as to allow its incorporation into the soil matrix, and avoid ponding/runoff.

2.7.2.3 Nutrients

For nutrient-amended treatments, the objective is to provide a modest stoichiometric excess of nutrients in this initial mixture. The nutrient dosages will be determined based upon initial characterization of the blended soil stockpile. Supplemental nutrient addition is not anticipated during the baseline testing phase in order to allow evaluation of the adequacy of this nutrient application rate; however, if a nutrient deficiency is observed during the base period of testing, supplemental nutrients may be added to the applicable test cells.

2.7.2.4 Amendments

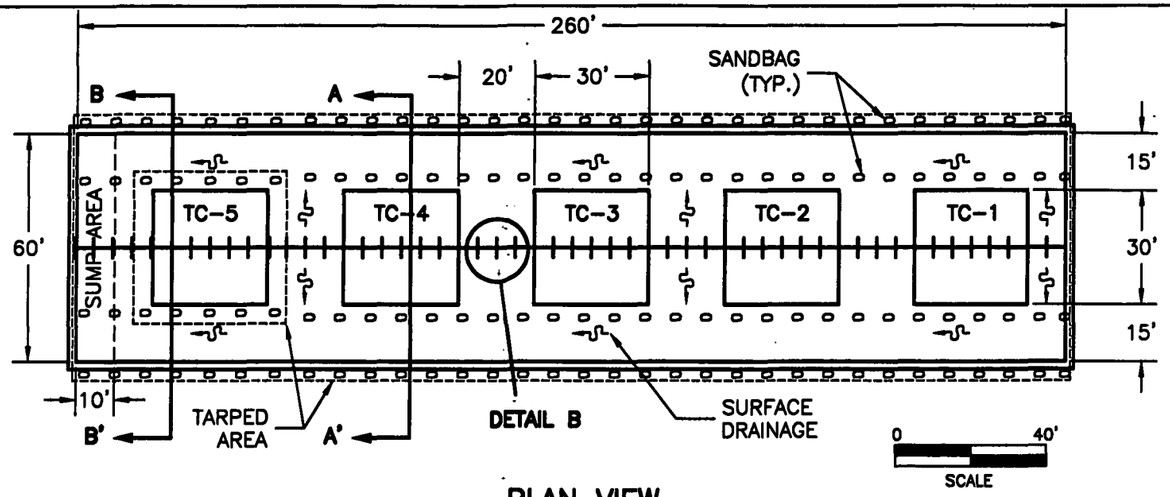
For amended treatments, the objective is to evaluate the effect of the selected dosage on performance. Supplemental amendment addition is not anticipated during the baseline testing phase. If the data suggest that performance is limited by the amendment quantity (as compared to the nature of the amendment itself), supplemental amendments may be added to the applicable test cells.

2.8 COMPLETION OF TESTING, AND FINAL PERFORMANCE SAMPLING AND ANALYSIS

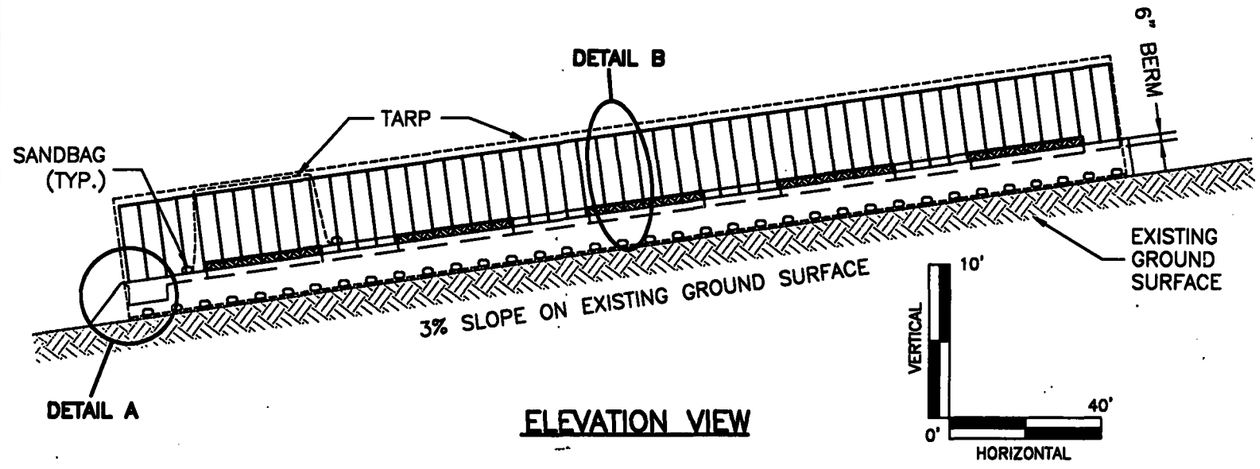
At the completion of the test period, the test soils will be sampled to assess contaminant degradation efficiency relative to the RCLs. Sampling will consist of preparation of a composite soil sample for each test cell. The composite sample will be created by homogenizing of four grab soil samples collected from the test cell. In general, specific sampling and analysis procedures will be in accordance with the approved QAPP.

2.9 DEMOBILIZATION OF THE TEST SITE

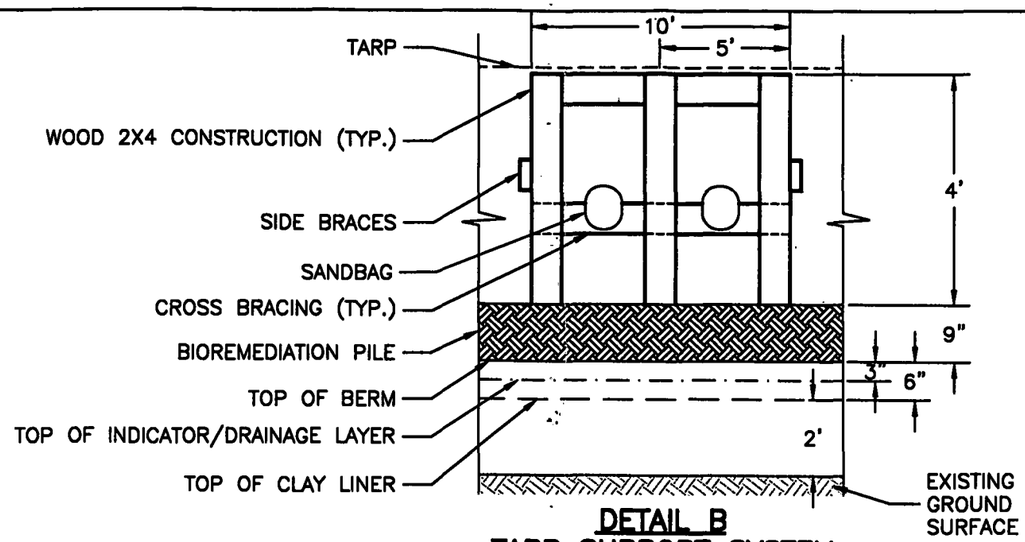
At the completion of the SPB pilot test, the test site will be demobilized as appropriate depending on determinations for its future reuse. If additional testing and/or full-scale treatment is to be considered and the test cells can effectively be integrated into full-scale operations, the site will be secured as necessary to prevent releases or damage pending reuse. If no additional work is anticipated, the test site will be returned to pretesting conditions. Contaminated equipment and materials will be decontaminated, where possible. Contaminated materials that cannot be effectively decontaminated (such as the test bed base soils) will be properly disposed. Uncontaminated construction materials will be staged for reuse in other site areas or disposed as appropriate.



PLAN VIEW

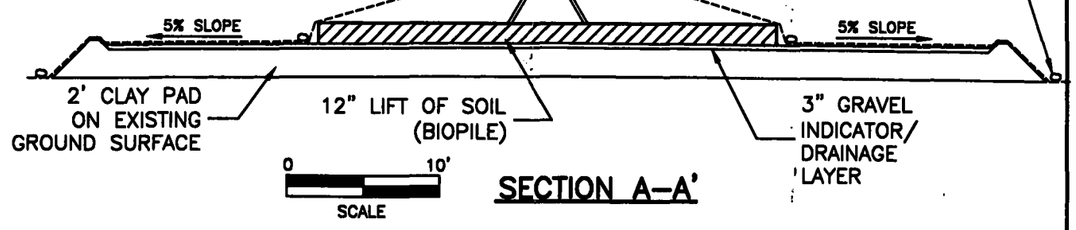


ELEVATION VIEW

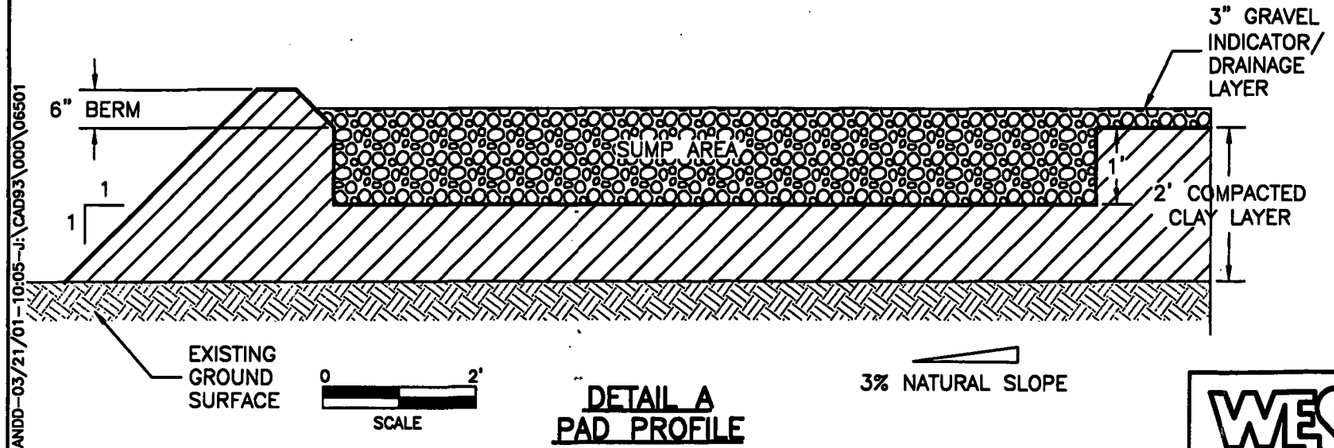


DETAIL B
TARP SUPPORT SYSTEM
NOT TO SCALE

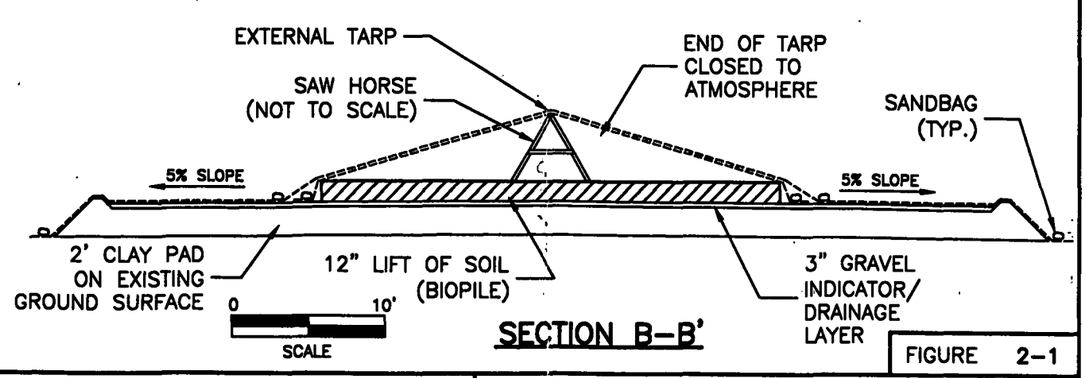
NOTE:
26 SAWHORSES NEEDED; BUTT END TO END ALONG CENTER OF PAD.



SECTION A–A'



DETAIL A
PAD PROFILE



SECTION B–B'

FIGURE 2–1

WESTON MANAGERS DESIGNERS/CONSULTANTS

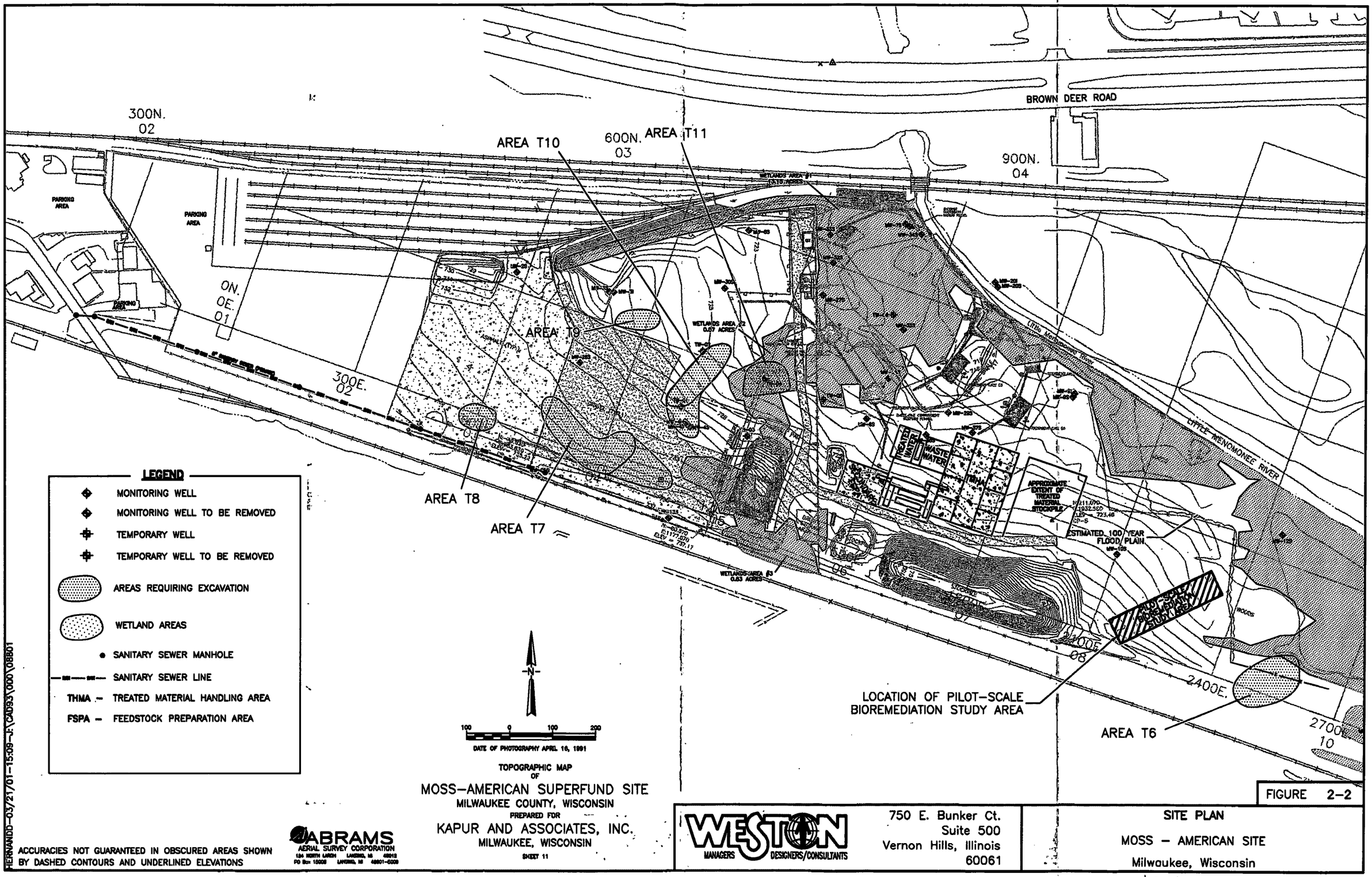
750 E. Bunker Ct.
Suite 500
Vernon Hills, Illinois
60061

BIOREMEDIATION PAD DESIGN

MOSS–AMERICAN SITE

Milwaukee, Wisconsin

HERNANDD–03/21/01–10:05–J:\CAD93\000\06501



TOPOGRAPHIC MAP
OF
MOSS-AMERICAN SUPERFUND SITE
MILWAUKEE COUNTY, WISCONSIN
PREPARED FOR
KAPUR AND ASSOCIATES, INC.
MILWAUKEE, WISCONSIN
SHEET 11

ABRAMS
AERIAL SURVEY CORPORATION
124 NORTH LAREN LANSING, MI 48912
PO Box 15008 LANSING, MI 48901-5008

ACCURACIES NOT GUARANTEED IN OBSCURED AREAS SHOWN BY DASHED CONTOURS AND UNDERLINED ELEVATIONS

WESTON MANAGERS DESIGNERS/CONSULTANTS
750 E. Bunker Ct.
Suite 500
Vernon Hills, Illinois
60061

FIGURE 2-2

SITE PLAN
MOSS - AMERICAN SITE
Milwaukee, Wisconsin

HERNANDD-03/21/01-15:09-J:\CAD93\000\08801

SECTION 3

SAMPLING AND ANALYSIS PROCEDURES

Samples will be collected for analysis of contaminants of concern and selected parameters to assess treatment performance. In general, sampling and analysis procedures will be in accordance with the approved QAPP. A summary of the overall sampling schedule is provided in Tables 3-1 and 3-2. Analytical methods, containers, preservation requirements and handling times are provided in Table 3-3. Samples will be collected, prepared and shipped under Chain-of-Custody documentation. QAPP procedures will apply.

Composite samples will be collected as follows. Discrete grab samples will be collected from individual quadrants of the treatment cell. Approximately equal volumes of the grab samples will be placed in clean stainless steel bowls for compositing. The samples will be blended with a stainless steel spoon or a dedicated and disposable plastic scoop. Portions of the blended sample will then be collected for filed screening (pH and moisture content) and for laboratory analysis of contaminant, nutrient, and biological parameters. Clean (new or decontaminated) sampling and compositing equipment will be used for each sample.

Table 3-1

Summary of Sampling Effort for Field Parameters
Pilot-Scale Solid Phase Bioremediation Testing
Moss-American Site
Milwaukee, Wisconsin

Sample Matrix	Field Parameters[1]	Characterization Samples		
		Number	Frequency	Total
Soil	pH	135	1	540
	Moisture Content	135	1	540
	Temperature	540	1	540
Air	Headspace (using FID)	54	1	54
	Oxygen Level	54	1	54

Note: Field parameters are measured in the field prior to samples being collected.

1 – Soil temperature will be measured on a weekly basis for 27 weeks at four locations in each of the five test cells. Soil pH and moisture content will be measured on a weekly basis (for 27 weeks) on a sample that is composited from material collected at the four sampling points in each cell. Estimated start date of 30 April 2001 and end date of 2 November 2001. Air parameters are measured in air above TC-3 and TC-5 weekly.

Table 3-2

Summary of Sampling Effort for Laboratory Parameters
Pilot-Scale Solid Phase Bioremediation Testing
Moss-American Site
Milwaukee, Wisconsin

Sample Matrix	Laboratory Parameters[1]	Characterization Samples			Field Duplicate Samples			Matrix Spike/Matrix Duplicate Samples			Matrix Total
		No.	Freq.	Total	No.	Freq.	Total	No.	Freq.	Total	
Soil	PAHs[2]	35	1	35	4	1	4	7	1	7	46
	TOC[3]	35	1	35	--	--	--	--	--	--	35
	TKN[4]	35	1	35	--	--	--	--	--	--	35
	NH_3-N[5]	35	1	35	--	--	--	--	--	--	35
	NO_3-N[6]	35	1	35	--	--	--	--	--	--	35
	NO_2-N[7]	35	1	35	--	--	--	--	--	--	35
	Total P[8]	35	1	35	--	--	--	--	--	--	35
	PO_4-P[9]	35	1	35	--	--	--	--	--	--	35
	ORP-P[10]	35	1	35	--	--	--	--	--	--	35
	Total Heterotrophs	35	1	35	--	--	--	--	--	--	35
	Total Degraders	35	1	35	--	--	--	--	--	--	35

Note: Figures are based on a pilot operation period from 30 April 2001 to 2 November 2001 and include initial analysis at kickoff of test. Four soil samples from each test cell will be collected and homogenized to comprise one sample per cell every month. MS/MSD are not additional samples, MS/MSD samples are characterization samples that are to undergo a MS/MSD analysis. One MS/MSD is required with every batch of soil samples.

1 – Soil samples are collected at test initiation and at the end of every month.
2 – Polynuclear Aromatic Hydrocarbons.
3 – Total Organic Carbon.
4 – Total Kjeldahl Nitrogen.
5 – Ammonia Nitrogen.
6 – Nitrate Nitrogen.
7 – Nitrite Nitrogen.
8 – Total Phosphorous.
9 – Phosphate Phosphorous.
10 – Orthophosphate Phosphorous.

Table 3-3

Required Sample Volume, Containers, and Sample Preservation
Pilot-Scale Solid Phase Bioremediation Testing
Moss-American Site
Milwaukee, Wisconsin

Sample Matrix	Analysis	No. Of Containers	Container Type	Preservatives	Holding Time
Soil	PAHs[1]	1	16-oz clear glass wide-mouth (Teflon-lined cap)	--	14 days to extract; analyze within 40 days of extracting
	TOC[2]	1	8-oz clear glass wide-mouth (Teflon-lined cap)	--	28 days
	TKN[3]	1	8-oz clear glass wide-mouth (Teflon-lined cap)		28 days
	NH_3-N[4]	1	8-oz clear glass wide-mouth (Teflon-lined cap)	--	28 days
	NO_3-N[5]	1	8-oz clear glass wide-mouth (Teflon-lined cap)	--	28 days
	NO_2-N[6]	1	8-oz clear glass wide-mouth (Teflon-lined cap)	--	48 hours
	Total P[7]	1	8-oz clear glass wide-mouth (Teflon-lined cap)	--	28 days
	PO_4-P[8]	1	8-oz clear glass wide-mouth (Teflon-lined cap)	--	48 hours
	ORP-P[9]	1	8-oz clear glass wide-mouth (Teflon-lined cap)	--	28 days
	Total Heterotrophs	1	8-oz clear glass wide-mouth (Teflon-lined cap)	--	48 hours
	Total Degraders	1	8-oz clear glass wide-mouth (Teflon-lined cap)	--	48 hours

Note: No additional soil volume is required for analysis of MS/MSD (organics) and duplicates (inorganics). No trip blanks will be collected for soil samples or inorganic or extractable analyses.

1 – Polynuclear Aromatic Hydrocarbons.
2 – Total Organic Carbon.
3 – Total Kjeldahl Nitrogen.
4 – Ammonia Nitrogen.
5 – Nitrate Nitrogen.
6 – Nitrite Nitrogen.
7 – Total Phosphorous.
8 – Phosphate Phosphorous.
9 – Orthophosphate Phosphorous.

SECTION 4

DATA ANALYSIS AND REPORTING

4.1 DATA MANAGEMENT

Raw data reports from the analytical laboratory will be used to prepare summaries of results for contaminants of concerns and other analytical parameters as appropriate. Analytical data will be summarized and maintained in electronic spreadsheet format (Microsoft Excel) for interpretation and reporting.

Field logs will be maintained for all materials handling and field monitoring activities. As appropriate, data from field measurements will be added to the electronic spreadsheet database for interpretation and reporting. Field-measured parameters that may affect performance (i.e., pH, temperature, moisture content) and will be evaluated in conjunction with contaminant removal data will also be entered into the electronic database format.

4.2 DATA REDUCTION

As appropriate for specific parameters, data reduction will include summaries of analytical results and appropriate statistics (ranges, arithmetic mean) using statistical tools in the electronic spreadsheet. In addition, data will be plotted, typically as average concentrations over time for purposes of assessing contaminant removal.

To the extent supported by the data, kinetic analysis will be considered. The general expected response of the lighter end PAH fraction will be relatively rapid initial removal followed by a tailing off effect which may appear to be asymptotic in nature. Although first order kinetics are often used to describe these events, it is often found that this approximation does not fit the data well, possibly because the rate limiting steps may not be simply the degradability of the compound but also other factors such as, but not limited to, sorption to/desorption from the soils

and other mass transfer limitations. Therefore, an effort will be made to interpret the data kinetically, though the limitations of the rate estimates obtained should be recognized.

4.3 PREPARATION OF PILOT TEST TECHNICAL MEMORANDUM

A pilot test Technical Memorandum will be prepared to document the performance of the test and provide recommendations for further application as appropriate. The Technical Memorandum will document all phases of the test and provide all analytical data in summary form (with raw data provided as appendices). Data interpretation regarding efficiency of the treatment will be summarized and recommendations regarding full-scale application will be provided.

SECTION 5

SCHEDULE

Figure 5-1 shows the anticipated schedule for the pilot-scale testing.

ID	Task Name	Duration	Start	Finish
1	Workplan Approval	0 days	Fri 4/6/01	Fri 4/6/01
2	Mobilization	5 days	Mon 4/9/01	Fri 4/13/01
3	Test Soil Homogenization	1 day	Mon 4/16/01	Mon 4/16/01
4	Pad Construction	5 days	Mon 4/16/01	Fri 4/20/01
5	Analysis of Test Soil Contaminant Levels	4 days	Tue 4/17/01	Sun 4/22/01
6	Construction of Test Cells	5 days	Mon 4/23/01	Fri 4/27/01
7	Amendment Application/Test Initiation	0 days	Mon 4/30/01	Mon 4/30/01
8	Testing Period	135 days	Mon 4/30/01	Fri 11/2/01
9	Sampling Event	132 days	Mon 4/30/01	Tue 10/30/01
17	Site Demobilization (as necessary)	5 days	Mon 11/5/01	Fri 11/9/01
18	Receipt of Final Analytical Data Package	0 days	Fri 11/30/01	Fri 11/30/01
19	Preparation of Draft Technical Memorandum	45 days	Mon 12/3/01	Fri 2/1/02
20	Agency Review	25 days	Mon 2/4/02	Fri 3/8/02
21	Submission of Final Technical Memorandum	20 days	Mon 3/11/02	Sat 4/6/02

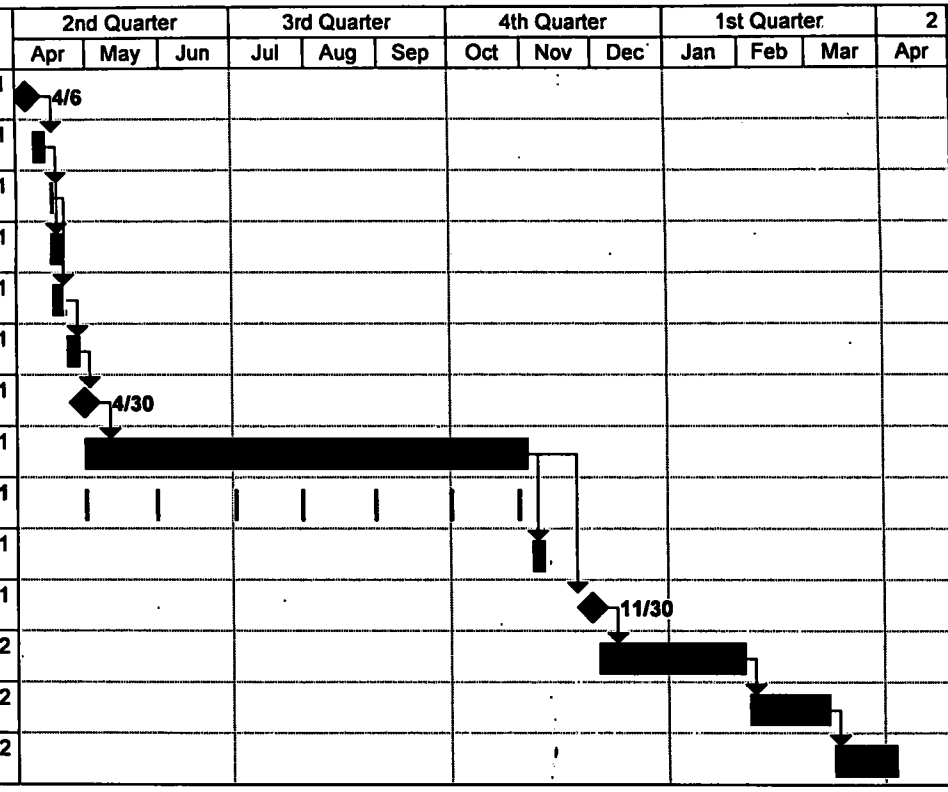


Figure 5-1 Schedule for Pilot Scale Solid Phase Bioremediation Testing
Date: Wed 3/7/01

Task
Split
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Split
Rolled Up Milestone
Rolled Up Progress
External Tasks
Project Summary