

WORK PLAN (rev. 02)

**Biotreatability Study
Mahoning River**

Prepared by:
Waste Science Inc.

Prepared for: **Eastgate Regional Council of Governments and
US Army Corps of Engineers – Pittsburgh District**



EASTGATE
Regional Council of Governments



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WORK PLAN

BIOTREATABILITY STUDY – MAHONING RIVER

NOVEMBER 2003

1.0 INTRODUCTION

This Work Plan has been written for use by Waste Science Inc. (WSI) personnel, their subcontractors, and any other individuals authorized to perform work associated with the Biotreatability Study of the Mahoning River under this contract. Strict adherence to this plan will ensure that the project will meet high quality project standards and the requirements of the project objectives. This plan was prepared specifically for activities for this project and should not be used on any other project without modification.

The Work Plan consists of the following elements:

- Project objectives and background;
- Description of project tasks and the treatability study process;
- Procedures for performing work;
- Qualifications of personnel performing work;
- Project Management;
- Project Schedule; and
- Plan approval.

Specifics about the activities that will be performed, equipment and instrumentation, measurement methods, quality control, project management structure, health and safety requirements, data management, performance controls, and other project details can be found in the appendices to this plan. These appendices include the following documents:

Appendix A - Safety and Health Plan (SAHP) describing the methods and standards applied to protecting workers and the environment from accidental exposures or releases, emergency procedures, and required monitoring;

Appendix B - Sampling and Analysis Plan (SAP) describing the sampling and laboratory program required for field sampling activities and laboratory analysis

of the samples, including documentation, analytical methods, and reporting requirements;

Part 1 - Field Sampling Plan (rev. 02) (FSP) describing the methods, instruments, and equipment to be used to collect field samples, including decontamination procedures, sample handling, and waste disposal; and

Part 2 - Quality Assurance Project Plan (QAPP) describing the standards and methods that will be applied to ensure the quality of project data, including laboratory and field QA/QC requirements.

In addition to these appendices, a Quality Control Plan (QCP) has been written to describe the procedures to follow to ensure the project will meet quality objectives established by WSI and the client for a timely, well-managed, and high quality project. The Work Plan and QCP comprise the project planning documents produced for the treatability study project.

2.0 PROJECT OBJECTIVES AND BACKGROUND

The Biotreatability Study project involves testing the suitability and effectiveness of using microbes as a remedial alternative to restore Mahoning River quality. The treatability study is part of a much larger and complex project to restore the quality of a 31-mile stretch of the Mahoning River from the Ohio-Pennsylvania border to the dam at Leavittsburg, Ohio.

2.1 Overall Restoration Objectives

The overall river restoration objectives are to:

“Restore the Aquatic ecosystem and biotic integrity of the Mahoning River within the project area [31 miles] to a level existing on a model reach on the Mahoning River just upstream of the project area and to eliminate the Ohio Department of Health Human Health Advisory currently in effect.” (In-Situ Biotreatability Study Statement of Work, November 25, 2002)

The Model Reach is defined as a baseline condition where the Mahoning River meets Ohio Environmental Protection Agency (OEPA) standards and is located roughly from River Mile (r.m.) 44.0 to r.m. 46.2.

2.2 Background

The Mahoning River served for years as a receiving stream for both untreated municipal wastes and industrial discharges. As a result, sediments in the river became contaminated and the aquatic ecosystem severely impacted. The larger remediation project is expected to restore the Mahoning River, within the 31-mile project area, to a fishable and swimmable stream in compliance with the Clean Water Act. Restoration could be accomplished in a number of ways. Remedial technologies currently under consideration include dredging and biotechnologies, among others.

Bioremediation is one of the remedial alternatives under consideration. Before this technology can be compared to other alternatives being considered, it will be tested on contaminated sediments from the Test Site to demonstrate its effectiveness on the particular combination of pollutants found there. This demonstration will be conducted through performance of a treatability study at the Test Site selected by the client (tentatively identified as immediately upstream of Girard dam). This treatability study will produce all of the information and data necessary to demonstrate the effectiveness of the technology and allow its comparison to other alternatives.

2.3 Biotreatability Study Project Objectives

There are a number of project objectives for the Test Site biotreatability study, including the following:

- Demonstrate the technology;
- Evaluate the technology's effectiveness at the Test Site;
- Assess whether the technology can be successfully implemented on a large scale;
- Investigate the scale-up potential of the technology for the entire 31 miles of the Mahoning River in the project area or portions of the project area;
- Estimate the unit cost for full scale implementation;
- Estimate the duration of a full scale cleanup; and
- Provide data to allow the evaluation of the technology compared to other remedial alternatives.

The Model Reach will be used as the cleanup goals for the Test Site.

3.0 PROJECT TASKS AND PROCEDURES FOR PERFORMING WORK

The treatability study will be conducted by performing six tasks, as described in the Statement of Work. These tasks are discussed below.

3.1 Task 1: Records, Documents, References, and Literature Review

The first task to be performed is the review of documents pertaining to the project. These consist of technical documents summarizing work that has been performed previously on the river, and documents and manuals specifying how the work will be conducted. The major study regarding the Mahoning River and evaluation of the resources is Biological and Water Quality Study of the Mahoning River Basin, OEPA Technical Report MAS/1995-12-14, May 1, 1996 for the Ohio EPA Division of Surface Water. Similar to previous surveys of 1980, 1983, and 1986, this report documents the methods and results of collecting quantitative and qualitative biological, chemical, and physical data through the study area on the Mahoning River main stream, the Beaver River, the Shenango River, Little Yankee Creek, Yankee Creek, Pymatuning Creek, and other selected tributaries. Other studies include: USACE - Pittsburgh District report *Feasibility Study on the Removal of Bank and River Bottom Sediments in the Mahoning River*, 1976; and the *Environmental Dredging Reconnaissance Report*.

In addition to the 1996 study and reports listed above, other documents will be reviewed as they pertain to river water quality and the ecological life associated with the river. Information gleaned from these documents will be used to develop an understanding of the existing conditions and will help in the design of the biotreatability study parameters. Also from the literature, a list of Contaminants of Concern (COC) will be identified. These will be the parameters for which treatment success will be measured. The COCs will represent each type of contaminant that exceeds Ohio Environmental Protection Agency (OEPA) criteria.

3.2 Task 2: Preparation of Quality Control Plan

A Quality Control Plan (QCP) will be developed during Task 2. This plan presents the quality policy, project quality objectives, and the methods and mitigative procedures that will be used on the project to ensure that the project meets high quality standards. Quality standards and the procedures used to ensure that the quality is maintained are set in the plan. Potential quality issues are raised and likely mitigative procedures identified to minimize the impact of any quality problems on the success of the project. Both USEPA and USACE guidance documents and manuals are used to produce the QCP. WSI's Quality Manager is tasked with the enforcement of the procedures presented in the QCP.

In addition to a discussion of quality procedures, the QCP identifies the qualifications and experience of staff that has been selected to perform this work. The plan describes the education, experience, and training that is necessary to fill any particular project role. The Independent Technical Review Team (ITR), consisting of three senior professionals in the areas of chemistry, engineering, and biology, is tasked with performing independent review of project deliverables. These individuals report directly to the Project Manager and do not participate directly in any project activities. The QCP also specifies which documents will be input into the DrChecks database.

3.3 Task 3: Coordination of Meetings

A minimum of four project meetings will be held for WSI and the client. The first meeting will be a project kick-off meeting to establish project procedures and communication that is to be used during the project. In addition, project expectations will be discussed during the first meeting.

The second meeting will be used to discuss field work and will be attended by WSI's Project Manager and the field work coordinator. At this meeting the field work to gather samples and to inoculate the site will be discussed.

The third meeting will be held at the Test Site location, tentatively identified as being immediately upstream of the Girard dam. This meeting will be used to introduce the client to the procedures used to treat the Test Site and to observe the inoculation.

The fourth meeting, anticipated to be the final meeting, will be conducted by the Project Manager and the Biological Director. It will be a formal presentation of the study results, including a description of methods used to conduct the work, sampling results used to characterize the contamination, and efficacy sampling used to measure the effectiveness of the treatment. In addition, conclusions regarding the feasibility and likely costs of applying this technology to large sections of the river system will be presented, along with the limitations of this remedial alternative.

Other meetings may be held, as requested by the client.

3.4 Task 4: Development of Site-Specific Project Work Plans

This Work Plan is the primary project document. It describes the activities to be conducted and the methods for accomplishing the project objectives. The Work Plan addresses all aspects of the project, from quality, health and safety, and performance, to actual methods, instrumentation, and documentation to be used.

The significance of the Work Plan is central to the approval of the project approach and methods. Along with the client, the OEPA will be reviewing this document. Approval of the Work Plan by Ohio regulators will constitute approval to conduct the work and will be used in lieu of a formal permit. It is anticipated that approval of the Work Plan will be the only state or federal approval needed from a regulatory body. Approval of the Work Plan by the client, of course, will be required prior to the initiation of any field or laboratory work.

3.5 Task 5: Treatability Study

The treatability study will consist of office, field, and laboratory work. The technical approach is subdivided into nine steps of logical progression, discussed below.

Step 1: Identify Sampling Target Areas

The first step of Task 5 is the identification of target areas to sample. Although sampling in this study is too limited to fully characterize the nature and distribution of all Test Site river sediments and bank deposits, it will be used to evaluate existing microbial population, the

ecosystem, and chemical constituents that are present. The SAP and FSP fully describe the sampling that will take place, constituents that will be quantified, and the number and depths of samples to be collected.

There are three areas to be sampled: 1) the Model Reach to characterize background conditions and to quantify target cleanup concentrations, 2) the Test Site that represents the most contaminated area to be treated, and 3) a Recovering Zone that represents the microbial population that has begun to adapt to contamination in and along the river. The Test Site is anticipated to be so highly contaminated at this time that it could be toxic to unprepared, indigenous microbes. Microbes will be effective treating contamination at the Test Site only after they have undergone Lambda's laboratory enhancement, described in subsequent steps. This is the rationale for using microbes from the Recovering Zone; they already have begun to adapt to the contamination and can be acclimated in the laboratory to survive what would ordinarily be toxic levels of the Test Site.

Step 2: Sample Three Areas for Chemical and Biological Analyses

Soils and sediment from three locations (Model Reach, Test Site, and Recovering Zone) will be used to design the treatment. Samples will be collected from three soil types at each of these three locations. Because different microbial communities are found in each of these soil types, all three need to be characterized and used to design the bioremediation treatment that will be most effective in these different ecosystems.

One set of samples will be collected at the water/sediment interface in the river to represent the aqueous ecosystem. Another set of samples will be taken from the ecotone, an area that is currently above the water line, but is frequently inundated. A third set of samples will be collected from the riparian zone, those sediments that are occasionally flooded, but usually above the water line. It is reported that some ecotone and most riparian zone contamination is buried under approximately one to two feet of relatively clean material, the result of recent decreases in hazardous discharges along the river.

All samples will be characterized chemically and biologically. The specific analyses that will be performed are detailed in the SAP. The characterization will quantify soil parameters, such as pH and oxidation-reduction potential, that can affect the viability of microbes. The microbes that are indigenous to the samples will be identified.

Step 3: Consult Database for Full Suite of Microbes

The next step in the process is to consult the literature and various databases to identify the full suite of microbes (as many as 300 to 400) necessary to treat the mixture of contaminants found at the Test Site. Enzymes and other metabolic products produced by the microorganisms are key to accomplishing treatment. Enzymes generally are specific to the substances they affect, so many types may be required to completely biodegrade the contaminants. Degradation takes place in a series of steps, with some microbes performing the primary metabolism while others provide support. Not only do the COC's have to be metabolized, but all of the toxic and many of the non-toxic breakdown (intermediate) products also must be metabolized or made unavailable for leaching for successful treatment.

Step 4: Identify Key Microbes in Bioscan™

Once the entire suite of microbes needed to degrade the contamination has been identified, the project team will analyze samples from the Model Reach, Recovering Zone, and Test Site for 30 to 40 key microbes. The existence and behavior of key microbes directly depends on sediment properties such as soil moisture, organic content, oxygen, and chemistry. Samples will be

prepared in the laboratory and each sample will be placed in an appropriate medium to determine the presence or absence and the adaptability of the key microbes. Then a comparison between the key microbes that are present and the full suite of microbes that are needed to degrade the contamination will be made, using Lambda's Bioscan™ procedures.

Step 5: Microecological Profile™

Based on the types of contamination to be treated, soil types, and climatic conditions found at the Test Site, an ideal profile is selected and defined for the algae, protozoa, fungi and bacteria necessary for treatment. Sediment samples are inoculated into test tubes of fresh mediums that will grow the selected microbes. The normal range of microbes selected is between 250 and 400. Therefore, 1,250 to 2,000 test tubes are inoculated for seven to 10 days. After incubation, each test tube is read under a video enhanced microscope and rated for population density, viability and proper activity.

This process produces an accurate Microecological profile of the Test Site and can more accurately determine its biodegradation potential. This profile must be made before any acclimation or scale-up can be initiated. If this vital quality control step is omitted, the efficacy of the treatment may be in question.

Step 6: Acclimation

The purpose of the acclimation step is to produce strong hybrids of indigenous microbes with viable strains that will thrive in the most hostile environment through natural selection. Organisms from the Recovering Zone form the basis of the treatment consortium, capitalizing on their already established adaptation to moderate contamination. Enzymes, co-enzymes, vitamins, nutrients, and other materials are introduced into the treatment consortium during this step to create the optimal environment for key microbe growth. Each hybrid population in the consortium is evaluated for density and viability. Those essential microbes that are weak or missing will be supplemented with type cultures, purchased from American Type Culture Collection (ATCC). No engineered microbes will be used. The result of the acclimation process is a microbial consortium of strengthened, indigenous microbes that are adapted to the contamination and able to degrade the highest concentrations of COC's and achieve Model Reach conditions at the Test Site.

Step 7: Scale-Up

The scale-up process produces the quantities of microbes needed to inoculate the Test Site. The consortium is introduced into a 5000-gallon scale-up tank. There they will be nurtured and allowed to multiply under ideal conditions until a sufficient quantity is available. It is anticipated that approximately 1000 gallons may be necessary to inoculate the Test Site. The growth process is monitored daily until the consortium exhibits sufficient density.

Step 8: Site Inoculation

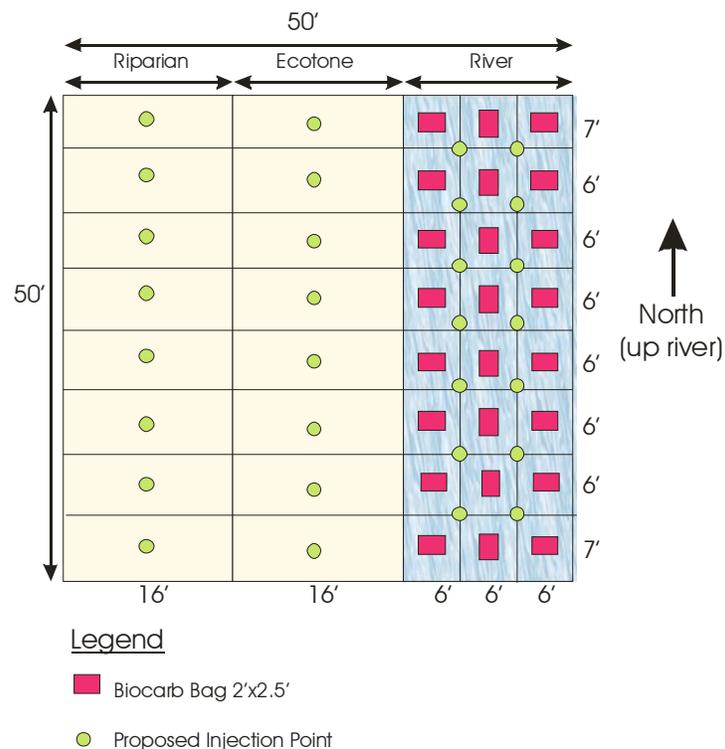
Based on sampling performed at the Test Site, geological data will be used to design the most effective treatment delivery system. It is anticipated that the inoculum will be injected into the subsurface of the ecotone and riparian areas of the Test Site through jetting techniques. Preparation in the laboratory for injection inoculation consists of the transfer of inoculum into a tank for transport to the site and the use of jetting tubes to introduce the treatment liquid.

For treatment of the river sediments below the water line, jetting and Lambda's BioCarb™ bags will be used. Each bag consists of feed bags filled with approximately 30 pounds of granular activated carbon. The bags are impregnated with inoculum and placed on the river bottom in a grid pattern. They will be anchored, as necessary, to stay in place.

The bags will act as small incubators, providing an ideal environment for continued microbe growth. As the river water passes through and around the bags, microbes are released into the water column to treat the water. As the bags contact the underlying sediments, microbes are released into the river sediments. Treatment will continue as long as there is a food source (contamination). After the contamination levels decrease to Model Reach conditions, the microbial populations will die down to normal, pre-contamination levels, described as the “carrying capacity” of the sediments. Because all microbes are indigenous to the Test Site, they will become integrated as part of the healthy ecosystem that results.

Figure 3-1 is a diagram of the inoculation proposed for the Test Site.

Figure 3-1. Proposed Inoculation Layout



Notes:

1. Within river, pressure injection of microbes below sediment surface will be performed at each bag location. Bags of microbes and medium will then be placed approximately as shown.
2. On land, pressure injection of microbes into contaminated layer will be attempted at approximate locations shown. Microbes will also be pressure-sprayed into surface soil throughout ecotone and riparian areas.

Step 9: Efficacy Testing

Although the effectiveness of this process has been demonstrated at numerous, similar sites¹, its effectiveness at the Test Site will be documented through sampling. Samples of ecotone, riparian, and river sediments will be collected six weeks after inoculation and shortly before the conclusion of the project. The samples will be analyzed for biological and chemical content. Sampling will confirm that the microbes are viable and continuing to thrive at the Test Site. It also will measure the reduction in contaminant concentrations. Details regarding the efficacy testing are presented in the SAP and FSP, Appendix B.

Measuring efficacy will be based on a comparison of the treated Test Site sediments with the baseline untreated Test Site sediments and the sediments from the Model Reach. Because microbes take time to digest and transform contamination, the remedial effect generally is measured by a decrease in concentrations until the food source is reduced and microbes die back to the carrying capacity that is maintained in a non-contaminated state. The duration of the study is relatively short, so full treatment of the contamination will probably not be able to be accomplished in the time allotted. However, the success of the treatment will be demonstrated by a measurable decrease in concentrations of the Test Site sediments, throughout the study period.

Concentrations for each COC will be established from sampling in the Model Reach and Test Site. Although establishing concentrations based on one set of samples is not ideal, an opportunity is available to better establish contaminant concentrations from future sampling that is scheduled as part of another study. The difference between the two measurements will be taken. If the treatment can reduce the concentrations for all COC's in the Test Site by at least 50 percent of the total difference during the course of the study, it will be concluded that the technology can succeed in the treatment of the contaminants in the Mahoning River sediments. It should be kept in mind that some contaminants will respond more slowly to the treatment than others (e.g., PCBs degrade more slowly than volatile organics), but a 50 percent reduction should be reasonable for all COC's.

$$\text{(Test Site concentration – Model Reach concentration)} / 2 = \text{Target reduction in concentration during study period}$$

Continuing reductions should be measurable, even after the study has concluded, that will show decreases in the contamination in the Test Site sediments until they achieve Model Reach concentrations, assuming that re-contamination is not a factor. Re-contamination may be a factor for the river sediments, but should be less of a factor the farther away from contamination in the surface water one gets.

$$\text{(Test Site concentration – Model Reach concentration)} = \text{Target reduction in concentration over long-term river restoration}$$

¹ Jo Davison and Katy Makeig, "Winning the Race Against Time", Environmental Protection Magazine, January 2001. Jo Davison, "Tee Up and Batter Up," Environmental Protection Magazine, July 1989.

3.6 Task 6: Treatability Study Report

The treatability study report will document all project activities, findings, and conclusions. Methods and procedures will be described. Analytical chemistry and biological characterization will be tabulated for all parameters of interest. Graphical data will be presented in a format compatible with MicroStation and IPlot. The report will present all calculations and estimates used to assess the technology and its effectiveness, both for the Test Site and as a remedial alternative for the entire 31 miles of larger study area. The following estimates or conclusions will be generated in the report:

- Unit costs for bioremediation;
- Ease of implementation;
- Length of time to meet the cleanup criteria;
- Ability to treat all of the COC's;
- Impact on the environment;
- Reduction of toxicity;
- Uncertainties and limitations; and
- New data that can be added to the microbial database.

The feasibility of using this technology to treat the estimated 286,000 cubic yards of contaminated river bank soils and 462,000 cubic yards of river sediment will be the focus of the discussion of the future application of in-situ bioremediation. Bioremediation will be discussed in the context of a stand-alone technology, and one that could be coupled with other technologies, such as dredging.

3.7 Site Security and Access

It may be necessary to install temporary fixtures at the Test Site and to leave them there over several months. This is particularly true if it is found that the sediments are relatively impermeable and that injection is the preferred means of inoculating the site. In that event, polyvinyl chloride (PVC) standpipes or other materials may be installed in the ground and left there for some time.

USACE will place signs at the site that indicate it is a federal site and to warn trespassers to keep out. Eastgate will contact the local police to perform periodic patrols, and Eastgate personnel will make weekly visits to the site to inspect it. Flagging will be placed around the site to cordon it off.

Eastgate has obtained the Rights-of-Entry for access to the Test Site, which is located on the west bank of the Mahoning River immediately upstream of the Girard Dam. No other formal Rights-of-Entry is required, since other sampling will be performed from public property.

4.0 QUALIFICATIONS OF PERSONNEL PERFORMING WORK

Project Management for this study is discussed in detail in the QAPP (Appendix B). Table 4-1 is a list of personnel, their role in this study, and a brief summary of their qualifications. Specific details as to their qualifications and background can be found in the QCP (Section 4.0 and Appendix C).

Table 4-1. Qualifications of Personnel Performing Work

Personnel	Role	Qualifications
Katy Makeig, CPG	Project Manager	MS. Hydrogeology, 20 years of project management experience
Jo Davison	Biological Director	MS. Biology/Environmental Sciences, 18 years of bioremediation research and implementation
Paul Mills	Quality Manager	BA. Biochemistry, MBA, 25 years as QA/QC specialist
Barbara Cook, PE	Sr. Engineer, Field Sampling Crew Chief, Site Health and Safety Officer	ME. Geotechnical Engineering, 26 years of environmental engineering and cost estimating for remedial projects
Susan Jones	Lab Supervisor	15 years of biological laboratory experience
Hank Hedges, CSP	Health and Safety Manager	BS. Industrial Safety, 25 years as health and safety specialist
Jared Ford	Field and Laboratory Biologist	BS. Biology, 2 years of bioremediation laboratory and field experience
James Shiu, PE	Graphics Coordinator, CAD Operator	PhD. Civil Engineering, 20 years of graphic design and CAD coordination
Kirt Suomela, PE	Independent Technical Review Team	MS. Environmental Engineering, 17 years of remedial design and cost estimating
Ken Lang	Independent Technical Review Team	MS. Environmental Health, 34 years of environmental studies
Al Iannacone	Independent Technical Review Team	MS. Chemistry, 20 years of environmental chemistry and analytical QA/QC
GPL Laboratories	Analytical Chemistry	USACE-certified, full service laboratory

Table 4-2 presents a list of project personnel and their specific project assignments, by task, according to the Statement of Work.

Table 4-2. Project Assignments

Task 1 - Records, document, references and literature review

Barbara Cook - Senior Project Engineer
Jo Davison - Senior Project Biologist

Task 2 - Preparation of Quality Control Plan

Paul Mills – Quality Manager, Project Chemist
Katy Makeig - Corporate QA/QC Officer

Task 3 - Coordination Meetings

Katy Makeig - Project Manager
Staff, as Required

Task 4 - Development of Site-Specific Work Plans

Barbara Cook - Field Sampling Plan, Sampling and Analysis Plan
Katy Makeig and Paul Mills - Quality Assurance Project Plan, Quality Control Plan
Katy Makeig and Hank Hedges – Safety and Health Plan
Katy Makeig – Work Plan

Task 5 - Treatability Study

Jo Davison - Study Design and Implementation
Jared Ford – Biologist and Laboratory and Field Support
Susan Jones – Laboratory Supervisor
GPL Laboratories - Laboratory Chemical Analysis
Paul Mills - Laboratory Coordination
Ken Lang – Biologist, Independent Technical Review Team

Task 6 - Treatability Study Report

Katy Makeig - Report and Production Coordinator
Jo Davison - Treatability Reporting
Barbara Cook - Field Work Reporting, Cost Estimating
Paul Mills - Analytical Chemistry Reporting
James Shiu - CAD Production
Kirt Suomela - ITR
Ken Lang - ITR
Al Iannacone – ITR

Task 7 – Project Management

Katy Makeig – Project Manager, Professional Geologist

All components of the project organization are important to ensure coordinated efforts and logical flow of information. The clients, Eastgate Regional Council of Governments (Eastgate) and the Pittsburgh District of the Corps of Engineers (Pittsburgh District), are an integral part of

the project team and have direct input into the project process. Figure 4-1 is an organization chart that includes positions for WSI personnel and subcontractors working on this project.

All personnel involved in this project are responsible for implementing the practices described in this plan. However, the Project Manager and Biological Director will have the primary roles in implementing and enforcing these procedures and policies.

WSI's President and Project Manager, Katy Makeig, is accountable for the safe overall operation of WSI and has the ultimate management responsibility for the establishment and enforcement of this Work Plan and project success. Environmental work at WSI is conducted as a corporate activity under the management responsibility of the President. Therefore, the President/Project Manager has direct and overall corporate responsibility for enforcing the quality and environmental policies affecting this project.

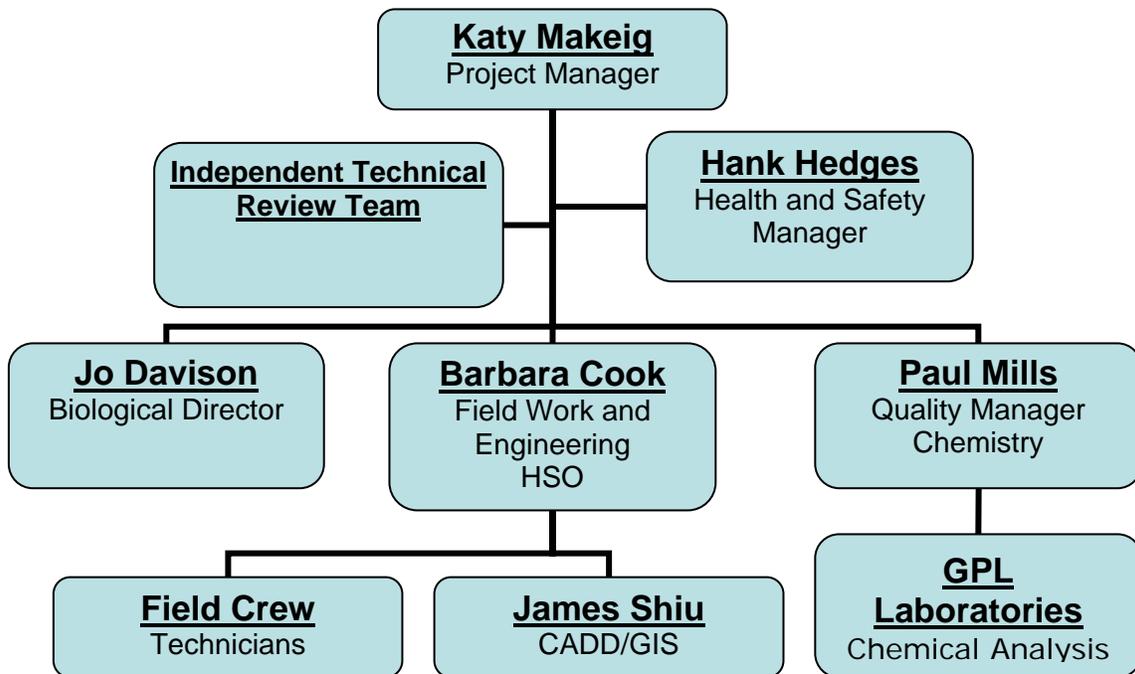


FIGURE 4-1. PROJECT ORGANIZATION CHART

Specifics as to Subcontractor responsibilities and management can be found in the QCP's Section 5.0 and their project roles are briefly listed in Table 4-3 below.

Table 4-3. Subcontractors and Their Roles

Subcontractor	Contact	Project Role
Lambda Bioremediation Systems, Inc.	Jo Davison	Biological laboratory analysis, inoculum growth, treatability study research
GPL Laboratories, Inc.	David Howell	Analytical chemistry
ECO Integration, Inc.	James Shiu	MicroStation and IPlot integration with USACE systems

The Project Manager is responsible for the performance of all subcontractors on this project. Performance deficiencies or noncompliance by the subcontractor will be addressed directly by the Project Manager.

5.0 PROJECT SCHEDULE

The project milestones and schedule is presented in Table 5-1. Authorization to begin work was issued by the client on March 24, 2003.

Table 5-1. Proposed Project Milestones

Project Milestone	Timeframe
Deliverables	
Notice to Proceed	March 24, 2003
Submit 4 Draft copies of Quality Control Plan	By March 31, 2003
Responses to comments on QCP	By April 25, 2003
Submit Final QCP	Within 7 days of comment resolution
Submit 4 copies of Draft Work Plan, S&A Plan, and SAHP	April 23, 2003
Submit responses to comments on Plans	Within 14 days of receiving Corps comments on Plans
Submit Final plans	Within 7 calendar days after Plan comment resolution
Mobilize for project	Within 14 days after submitting Final Plans
Submit 4 copies of Draft Treatability Study Report	Within 180 days after submission of Final Plans
Submit responses to comments on Report	Within 14 days of Corps review of Report
Submit 4 copies of Final Treatability Study Report	Within 7 calendar days of comment resolution
Quarterly Progress Reports	Within one month after completion of every quarter
Invoices	Monthly throughout duration
Other Milestones	
Initial field sampling	Immediately after mobilization is complete
Inoculation	10 to 12 weeks after mobilization
Progress sampling	6 weeks after inoculation
Final sampling	Within 160 to 170 days after submission of Final Plans

Project Milestone	Timeframe
First Meeting	By April 4, 2003
Second Meeting	During project mobilization
Third Meeting	During project inoculation
Final Meeting	Within 7 days of submittal of Draft Treatability Study Report

6.0 WORK PLAN APPROVAL AND SIGNOFF

This Work Plan and associated appendices, along with the Quality Control Plan constitute the project planning documentations that are required for the Mahoning River Biotreatability Study project under the current Statement of Work. The Work Plan has been written for the exclusive use of WSI, its employees, and subcontractors. The plan is written for the specified site conditions, dates, and personnel. It must be amended if these conditions change. This plan is valid only when all signatures appear below. Signatures by the Ohio Environmental Protection Agency constitute approval of the project and will be used in lieu of a formal permit to perform this work.

Approval by: _____

Ohio EPA Manager

Date: _____

Concurrence by: _____

WSI Project Manager

Date: _____

Concurrence by: _____

Eastgate Project Manager

Date: _____

Concurrence by: _____

USACE Project Manager

Date: _____

Appendix A
Safety and Health Plan

Appendix B

Sampling and Analysis Plan

Sampling and Analysis Plan

Part 1: Field Sampling Plan

Sampling and Analysis Plan

Part 2: Quality Assurance Project Plan