US EPA RECORDS CENTER REGION 5
1013510

SOLUTIA - 125

~~APPENDIX B~~
~~SURFACE WATER, UNDERDRAIN, AND LEAK DETECTOR FIELD INFORMATION LOGS~~

SOLUTIA

Solutions for a better life.

Solutia Inc.
575 Maryville Centre Drive
St. Louis, Missouri 63141

P.O. Box 66760
St. Louis, Missouri 63166-6760
Tel: 314-674-1000

September 11, 2003

Mr. Ken Bardo
RCRA Division
U. S. Environmental Protection Agency, Region 5
77 West Jackson Blvd.
Chicago, IL 60604

Re: Area 2 Human Health and Baseline Ecological Risk Assessment
Sauget, Illinois

Dear Mr. Bardo:

Attached are copies of the human health and ecological risk assessments that were prepared for the Sauget Area 2 Sites as part of the Remedial Investigation and Feasibility Study being performed at these sites. These reports are being submitted in support of the CA 725 Human Health and CA 750 Groundwater Environmental Indicators evaluations being carried out at the Solutia W. G. Krummrich Plant.

At a recent meeting on August 18, 2003, you indicated that any existing human health risks that might be associated with groundwater discharges to the surface sediments and surface water in the Mississippi River needed to be evaluated. This evaluation is included in the attached Human Health Risk Assessment and the results show that the risks are within acceptable limits.

At that meeting, you also indicated that recent sediment and surface water toxicity data were required to evaluate the significance of the groundwater discharges to the river for purposes of completing the CA 750 Environmental Indicator assessment. Sediment and surface water samples were collected in the late summer of 2002 along six transects upstream of Site R. These results are included in the Ecological Risk Assessment report. They demonstrate that the media sampled were not toxic to the test organisms, indicating that the groundwater discharges from the Krummrich Plant upstream of Site R are within acceptable limits.

We trust that this information allows you to complete your Environmental Indicator assessments. Please call me if you have any questions.

Sincerely,
Solutia Inc.

Gary W. Vandiver for.
Project Manager.

cc: Nabil Fayoumi, USEPA, (w/o Attachments)
Sandra Bron, IEPA, (w/o Attachments)
Jim Moore, IEPA
Gina Search, IEPA
Linda Tape, Husch & Eppenberger (w/o Attachments)
Richard Williams, Solutia
Cathy Bumb (w/o Attachments)

SOLUTIA - 127

SOLUTIA

Solutions for a better life.

Solutia Inc.
575 Maryville Centre Drive
St. Louis, Missouri 63141

P.O. Box 66760
St. Louis, Missouri 63166-6760
Tel: 314-674-1000

September 30, 2003

Mr. Ken Bardo
RCRA Division
U. S. Environmental Protection Agency, Region 5
77 West Jackson Blvd.
Chicago, IL 60604

Re: Plume Map - Solutia W.G. Krummrich Plant
Sauget, Illinois

Dear Mr. Bardo:

Attached are copies of plume boundary maps for VOCs and SVOCs migrating from the W.G. Krummrich Plant to be included in the CA 750 Environmental Indicators Report - Migration of Contaminated Groundwater Under Control. This map was prepared using groundwater analytical results from samples collected between Summer 2002 and Summer 2003. Groundwater analytical data were supplemented with the results of a particle tracking model to determine the VOC and SVOC plume boundaries downgradient of the western boundary of Lot F. Lot F is the downgradient limit of the Krummrich plant and it is difficult, if not impossible, to separate the Krummrich VOC and SVOC plumes downgradient of Lot F from VOC and SVOC plumes associated with Migration from Sauget Area 2 Sites O, Q, R and S.

Solutia believes that the enclosed VOC and SVOC plume boundary maps, based on a composite of observed groundwater concentrations and predicted contaminant migration pathways, is the best, if not the only, way to address CA 750 Question No. 3;

> Question No. 3 - "Has the migration of contaminated groundwater stabilized (such that contaminated groundwater is expected to remain within "existing area of contaminated groundwater as defined by the monitoring locations designated at the time of this determination?

Particle tracking, as described in the attached Tech Memo prepared by Groundwater Services, Inc., indicates that particles leaving the downgradient boundaries of the Krummrich plant will discharge to the Mississippi River. Particles discharging to the river form a plume that extends from the south end of Sauget Area 2 Site R to 2100 ft. north of the north end of Site R. Groundwater data collected in 2002/2003 confirms the north and south plume boundaries as predicted by the particle tracking model upgradient of the western boundary of Lot F. For this reason, it is considered appropriate to use

particle tracking to define the potential boundaries of the Krummrich plumes downgradient of Lot F.

Contaminated groundwater is expected to remain within the existing area of contamination because groundwater flow and discharge patterns are controlled by the Mississippi River, which is the regional groundwater discharge point.

We trust that this information allows you to complete your Environmental Indicator assessments. Please call me if you have any questions.

Sincerely,
Solutia Inc.

Gary W. Vandiver
Project Manager.

cc: Nabil Fayoumi, USEPA, (w/o Attachments)
Sandra Bron, IEPA, (w/o Attachments)
Jim Moore, IEPA
Gina Search, IEPA
Linda Tape, Husch & Eppenberger (w/o Attachments)
Richard Williams, Solutia
Cathy Bumb (w/o Attachments)

Attachments:
Total VOC Plume Map
Total SVOC Plume Map
Total VOC and Total SVOC Data Table
Plume Boundary Estimate Tech Memo

~~APPENDIX B-10~~

~~FIELD TASK MODIFICATION REQUEST FORMS~~

SOLUTIA - 131

SOLUTIA

Solutions for a better life.

Solutia Inc.
W.G. Krummrich Plant
500 Monsanto Avenue
Sauget, Illinois 62206-1198
Tel 618-271-5835

October 15, 2003

Mr. Nabil S. Fayoumi
U. S. Environmental Protection Agency - Region 5
Superfund Division
77 West Jackson Boulevard (SR-6J)
Chicago, Illinois 60604-3590

Re: Project Plans
Groundwater Migration Control System
Sauget Area 2 – Sites O, Q, R And S
Sauget, Illinois

Dear Mr. Fayoumi:

Attached to this letter are three copies of each of four project plans submitted to Solutia by the slurry wall contractor, Inquip Associates. These plans are being submitted for your information. They include the following:

- The contractor's Project Health and Safety Plan, which is consistent with the Project Health and Safety Plan submitted to you by Solutia on January 31, 2003.

- The Construction and Quality Control Plan, which describes the methods to be used for construction of the slurry wall and the Construction Quality Control tests to be performed as part of the overall Quality Assurance Plan.. That plan was initially submitted to you on January 31, 2003 and a revised version specifically directed at slurry wall construction was submitted on July 3, 2003.

- The Hydraulic Barrier Plan. This plan includes construction specifications and drawings for the barrier wall.

- The Stormwater Pollution Prevention Plan. This plan is required by the General NPDES permit issued by the Illinois Environmental Protection Agency for construction of the barrier wall.

If you have any questions about the attached plans please do not hesitate to call me.

Sincerely,

Solutia Inc.

Gary W. Vandiver for Richard Williams

Gary W. Vandiver
Project Coordinator

cc: Steven D. Acree - USEPA
Ken Bardo - USEPA
Sandra Bron - IEPA
Tim Gouger – USACE
Mike Coffey - USF&W
Peter Barrett – CH2M Hill
Linda Tape - Husch & Eppenberger
Cathy Bumb - Solutia
Bruce Yare – Solutia
Richard Williams - Solutia

Solutia Area 2 Superfund Site

Solutia - Sauget Area 2
Project Health and Safety Plan

Revision 1

August 2003

Prepared by

Inquip Associates, Inc

for

Solutia, Inc
575 Maryville Centre Drive
St. Louis, MO 63141

HEALTH AND SAFETY POLICY

Employees are our most valuable and an important asset. Preventing personal injuries and occupational illnesses will be given the highest priority. It is the policy of Inquip Associates, Inc. (Inquip) to provide and maintain a safe and healthful working environment by eliminating unsafe acts and conditions and following operating practices which will assist in safeguarding all employees.

All levels of management at Inquip are responsible for providing the resources necessary to maintain a safe working environment. Every effort will be made to ensure that employees accomplish their assigned tasks safely.

Safety is everyone's responsibility. It is Inquip's goal to create a safety culture among its employees, and to foster an understanding that he or she has the ultimate responsibility to work safely. Inquip is committed to safety and expects the same commitment of all employees.

Project Manager

9-3-03
Date

ABSTRACT

The purpose of this Health and Safety Plan (HASP) is to provide a written assessment of potential safety and health hazards associated with the performance of work at the Solutia - Sauget Area 2 Superfund Site (Area 2 site), and to specify minimum acceptable protective equipment that will be used and procedures that shall be followed during the performance of work. The requirements of this plan are applicable to all Subcontractor personnel, including lower-tier Subcontractors.

The Subcontractor and lower-tier Subcontractors are responsible for Subcontractor contractual agreements and for full compliance, including compliance by lower-tier Subcontractors, with all applicable standards of 29 CFR 1910, 29 CFR 1926, the U.S. Environmental Protection Agency (EPA), Illinois State regulations, and Solutia regulations and orders that are in effect at the Area 2 site.

TABLE OF CONTENTS

SECTION **PAGE**

LIST OF APPENDICES ix
1. INTRODUCTION 1-1
1.1 Site History 1-1
1.2 Site Description 1-2
1.3 General Safety Provisions and Inspections 1-2
1.3.1 Inquip Management/Supervisor Responsibilities 1-2
1.3.2 Equipment and Tool Inspections 1-3
1.3.3 Temporary Facilities 1-3
1.4 Nonconforming Conditions and Practices 1-4
1.4.1 Safety Violation Notice 1-5
1.5 Incident Reporting 1-6
2. CONTAMINANT AND HAZARD DESCRIPTION 2-1
2.1 Area 2 Contaminants in Controlled Areas 2-1
3. WORK PRACTICES AND ENGINEERING CONTROLS 3-1
3.1 Special Requirements for Entry Into Confined Spaces 3-1
3.2 Hearing Conservation Program 3-3
3.3 Hazard Communication Program 3-4
3.3.1 Requirements for Personnel using regulated Materials 3-4
3.3.2 Service Subcontractor MSDS Requirements 3-5
3.4 Control of Ozone Depleting Substances 3-5
3.5 Dust (Particulate) Control Requirements 3-5
3.6 Extreme Temperature Requirements 3-6
3.7 Requirements Applicable to Controlled Areas 3-6
3.7.1 Contamination Control 3-6
3.7.2 Communication Systems 3-7
3.8 Requirements for Removing Samples from Site 3-7
3.8.1 Notification Requirements 3-7
3.8.2 Chain of Custody Requirements 3-7
3.9 Requirements for Work Inside Controlled Areas 3-7
4. PERSONAL PROTECTIVE EQUIPMENT 4-1
4.1 Safety Apparel for Work at the Area 2 Site 4-1
4.2 Safety Apparel for Work in Restricted Areas Inside Controlled Areas 4-2
4.3 Additional Personal Protective Equipment Requirements for Controlled and Uncontrolled Areas 4-2
4.4 Respirator Usage at the Area 2 Site 4-3
4.4.1 Supplied Air Systems Requirements 4-6
4.5 Donning and Doffing 4-6

TABLE OF CONTENTS

SECTION **PAGE**

5. MONITORING 5-1
5.1 Monitoring Program Elements 5-1
5.1.1 Personnel Contamination Monitoring 5-1
5.1.2 Noise Monitoring 5-1
5.1.3 Heat Stress Monitoring 5-1
5.1.4 Confined Space Entry Monitoring 5-1
5.1.5 Oxygen 5-3
5.1.6 Explosive Atmosphere 5-3
5.1.7 Monitoring for Other Contaminants 5-3
5.1.8 Posting of Monitoring Results 5-8
6. GENERAL SAFETY 6-1
6.1 Safety Reporting Requirements for Injury, Illness, and Property Damage 6-1
6.2 Tagging of Defective Tools, Materials, or Equipment 6-1
6.2.1 Equipment Caution Tagout 6-2
6.3 Housekeeping 6-2
6.4 Sanitation 6-2
6.4.1 General Requirements 6-2
6.4.2 Requirements for Controlled Areas 6-2
6.5 Illumination 6-2
6.6 Fall Protection 6-3
6.6.1 Fall Restraint, Fall Arrest Systems 6-4
6.7 Slip, Trip, and Fall Hazards 6-4
6.8 Fire Protection and Prevention 6-4
6.9 Fuel Storage Tanks 6-5
6.10 Waste Storage Tanks 6-6
6.11 Material Handling and Storage 6-6
6.12 Tools 6-7
6.13 Torch/Plasma Arc Cutting, Welding, and Open Flame Requirements 6-8
6.14 Lockout/Tagout/Try of Energy Sources 6-9
6.15 Electrical 6-9
6.16 Ladders 6-10
6.17 Scaffolding 6-11
6.18 Power-Driven Staging and Platforms 6-12
6.19 Manbaskets 6-13
6.20 Signs, Barricades, Guardrails, Handrails, Covers, Stairs, Decks, and Ramps 6-13
6.21 Cranes 6-14
6.21.1 Crane Inspection 6-18

TABLE OF CONTENTS

SECTION **PAGE**

6.21.2 Mast or Tower Crane 6-18
6.21.3 Movement of Cranes (Under Their Own Power) 6-18
6.21.4 Critical Lifts 6-20
6.21.5 Crane Work Near Overhead Power Lines 6-21
6.22 Rigging 6-21
6.22.1 General 6-21
6.22.2 Equipment Inspection and Testing 6-22
6.22.3 Safe Working Loads 6-22
6.22.4 Wire Ropes 6-23
6.22.5 Slings 6-23
6.22.6 Shackles, Hooks, and Bolts 6-24
6.22.7 Knots 6-24
6.22.8 Weather Conditions 6-25
6.22.9 Incident Reporting 6-25
6.23 Motor Vehicles and Heavy Equipment 6-25
6.24 Underground Utilities and Communication Lines 6-26
6.25 Excavations 6-27
6.26 Clearing and Grubbing 6-28
6.27 Electrical Transmission Lines 6-28
6.28 Concrete Placement 6-28
6.29 Nuclear Soil Density/Moisture Testing 6-29
7. MEDICAL SURVEILLANCE PROGRAM 7-1
7.1 General Medical Surveillance Program for Personnel Working at the Area 2 Site 7-1
7.1.1 Respirator Medical Monitoring Requirements 7-1
7.1.2 Audiometric Testing 7-1
7.1.3 Additional OSHA Specific Medical Monitoring Requirements 7-1
7.2 Medical Surveillance Program for Personnel Working in Controlled Areas 7-2
7.2.1 Medical Surveillance Program for Hazardous Waste Workers 7-2
8. TRAINING AND QUALIFICATIONS 8-1
8.1 General Training Requirements for Personnel Working at the Area 2 Site 8-1
8.1.1 General Employee Training 8-1
8.1.2 Respirator Training and Fit-Testing 8-1
8.1.3 Task-Specific Safety Briefing 8-1
8.1.4 Hazard Communication Program 8-1
8.1.5 Hearing Conservation Program 8-2
8.1.6 Supervisor Qualifications 8-2
8.1.7 Permit Required Confined Space Entry Training 8-2

TABLE OF CONTENTS

SECTION **PAGE**

8.1.8 Excavation Awareness Training for Excavations 8-2
8.1.9 Lockout Tagout Training 8-2
8.2 Additional Training Requirements for Personnel Working in Controlled Areas 8-3
8.2.1 Hazardous Waste Operations Site Worker Training Requirements 8-3
8.2.2 Site Visitor Requirements 8-4
8.2.3 Torch/Plasma Arc Cutting, Welding, and Open Flame Training 8-4
9. SITE CONTROL 9-1
9.1 Access Control 9-1
9.2 Buddy System 9-1
9.3 Prohibited Items 9-1
10. WORK ZONE EXIT REQUIREMENTS, DECONTAMINATION, AND CLEANING ... 10-1
10.1 Uncontrolled Area Work Zone Exit Requirements 10-1
10.2 Controlled Area Work Zone Exit and Contamination Control Requirements 10-1
10.2.1 Work Zone Exit Requirements When Showers Are Not Required 10-1
10.2.2 Additional Requirements for PCBs 10-1
10.2.3 Equipment Decontamination Requirements Applicable at Work Zone Exits 10-2
10.2.4 Temporary Restroom Facilities in Controlled Areas 10-2
10.2.5 Personal Protective Clothing Segregation and Disposal Requirements ... 10-2
10.3 Controlled Area Exit Requirements 10-3
10.3.1 Personnel 10-3
10.3.2 Equipment 10-6
11. EMERGENCY RESPONSE 11-1
11.1 Emergency Plan 11-1
11.1.1 Training 11-1
11.2 First Aid/Medical Care For Injuries 11-1
11.3 Heat/Cold Stress 11-2
11.4 Fire 11-2
11.5 Inclement Weather 11-2
11.6 Unusual Occurrence 11-2
11.7 Contingency Plan For Spills 11-2
11.7.1 Spill Notification 11-2
11.7.2 Response Procedures 11-3
11.7.3 Reporting 11-3
11.8 Equipment and Services 11-3
11.9 Confined Space Rescue 11-4
12. REFERENCES 12-1
COMPONENTS OF MEDICAL EXAMINATION 1

TABLE OF CONTENTS

SECTION **PAGE**

LIST OF TABLES

TABLE

1	Contaminants –	Known Soil Contaminate Concentrations Known Groundwater Contaminants
2	Physical Hazards	
3	Not used	
4	Additional Personal Protective Equipment Guidelines for Specific Tasks	
5	Monitoring Program Summary	
6	Not used	
7	Not used	
8	Not used	
9	Not used	
10	Area and Material Decontamination Methods	

LIST OF APPENDICES

APPENDIX

A	Not used
B	Not used
C	Not used
D	List of Ozone-Depleting Chemicals
E	Mobile Crane Safety Inspection Report
F	Medical Evaluation Report Form
G	Components of Medical Examinations
H	Emergency and Spill Response Equipment List
I	Emergency Evacuation Roster/Emergency Response Plan
J	Not used
K	Competent Persons Checklist

1. INTRODUCTION

The purpose of this Health and Safety Plan (HASP) is to provide a written assessment of potential safety and health hazards associated with the performance of work at the Area 2, and to specify minimum acceptable protective equipment that will be used and procedures that shall be followed during the performance of work. The requirements of this plan are applicable to all Subcontractor personnel, including lower-tier Subcontractors.

All work performed at the Area 2 site shall be performed in a safe and orderly manner that will not create a hazard to health, property, and/or the environment. The implementation of safe working practices and the safety of equipment and facilities shall be subject to Inquip approval. However, Inquip approval does not constitute direction to employ specific safety practices nor does it relieve the Subcontractor from its responsibility for safety. Failure of the Subcontractor to comply with safety regulations and/or to conduct activities in a safe manner shall constitute cause for issuance of a Safety Violation Notice or a Stop Work Order.

Any Subcontractor and lower-tier Subcontractors are responsible for Subcontractor contractual agreements and for full compliance, including compliance by lower-tier Subcontractors, with all applicable standards of 29 CFR 1910, 29 CFR 1926, the U.S. Environmental Protection Agency (EPA), Illinois State regulations, and Solutia regulations and orders that are in effect at the Area 2 site. Inquip will make inspections under the Occupational Safety and Health Administration (OSHA) format and require corrective actions for all deficiencies discovered. Willful violation, refusal, or failure to abate violations of safety, health, and/or environmental standards or rules may be justification for removal of personnel from the site and/or contract termination.

Inquip reserves the right to invoke the OSHA general duty clause on any operation which, in the opinion of Inquip, is being conducted in an unsafe manner, even though the infraction is not specifically spelled out in the regulations or this Health and Safety Plan. This will be based on the concept of prior knowledge as represented by other industry consensus standards.

All employees are encouraged to report environmental, health, and safety concerns to their management. Subcontractors or subtiers shall not reprimand or otherwise take disciplinary action against their employees for reporting such concerns. If environmental, safety, and health concerns are not resolved by the employee's management, they may be brought to Inquip's attention either informally through verbal communication or formally by letter delivered to the onsite Inquip safety officer.

1.1 Site History

Insert Site History

1.2 Site Description

The site and surrounding properties are generally categorized as either Uncontrolled Areas or Controlled Areas:

- Uncontrolled Areas are those areas of the site and surrounding properties where special controls are not needed to protect workers from potential health hazards or hazardous constituents left by previous or current activities at the area 2 site. Uncontrolled Areas include the Office Trailer Area and support facilities outside potentially contaminated areas.

- Controlled Areas are those portions of the site and surrounding properties where special controls are needed to protect workers from potential health hazards or hazardous constituents left by previous activities or current activities. Controlled Areas will be determined by performing real time area sampling.

During the course of work, the work may create hazards in Uncontrolled Areas that warrant worker protection as identified in this HASP. These hazards include, but are not limited to, the use of heavy construction equipment, chemicals, electrical power, and the performance of activities such as excavation or bentonite mixing. Additional worker protection issues that are applicable in Uncontrolled Areas include biological hazards (e.g., biting and stinging insects, venomous snakes) and temperature extremes.

The specifications may describe work that is to be done in Uncontrolled Areas that will convert the work site to a Controlled Area. For example, excavations into the cover over the existing landfill. The landfill as is presents no hazard to workers. However, excavation of the cover material would create the potential for worker exposure to the contents of the landfill. The work zone for that task would be classified as a Controlled Area.

Work inside Controlled Areas involves the potential for worker exposure to some or all of the contaminants remaining from past activities, as well as any hazards introduced based on the type of work being performed, work methods, and materials used.

1.3 General Safety Provisions and Inspections

1.3.1 Inquip Management/Supervisor Responsibilities

Inquip shall make and document daily work area safety inspections and take corrective actions. These safety inspection documents shall be made available to the Solutia upon request. The Inquip supervisor shall inspect work activities against the hazardous work controls that are specified in applicable permits or this plan. In addition, a competent person designated as the Inquip safety representative shall participate with the onsite management in inspections of all

work areas. Where danger to personnel is imminent, the construction engineer, safety supervisor, or any Inquip personnel will stop the activity until the hazard has been abated.

To control or eliminate hazards and other exposures that may result in injury or illness, the Inquip supervisor shall instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to their work environment.

Safety meetings shall also be conducted before work begins at the start of each workday. All personnel are required to attend these meetings. Each day, records of the topics covered during these meetings and sign-in sheets of the attendees shall be forwarded to construction engineer.

1.3.2 Equipment and Tool Inspections

All equipment and tools shall be subject to a safety inspection conducted by Inquip, upon arrival at the site, prior to being placed into service. Additional equipment inspection requirements are detailed in Section 6.

1.3.3 Temporary Facilities

The locations for all temporary facilities, including but not limited to, office trailers, and laydown areas, shall be approved by the construction engineer prior to being placed on site.

1.4 Nonconforming Conditions and Practices

Inquip and Subcontractor personnel have the authority to stop activities when violations of safety, health, or environmental requirements are observed until such violations are corrected. Such violations may include, but are not limited to, the following examples:

- Lack of proper PPE as specified in this plan (e.g., hard hats, safety glasses, hearing protection, respirators, coveralls, gloves, and taped interfaces).
- Lack of fire watch during torch cutting operations.
- Unavailability of specified emergency equipment (fire extinguishers, emergency eyewash, spill absorbent, and first-aid supplies).
- Improper PPE doffing sequence.
- Unsecured ladders.
- Lack of GFCI protection, when such equipment is required.
- Inadequate dust control (as evidenced by visible dust emissions or instrument readings above specified action levels).
- Inadequate posting or barricades (e.g., flagging of open trenches, or the swing radius of cranes).
- Wearing torn coveralls or gloves in contaminated areas.
- Inadequate lighting (as evidenced by instrument readings).
- Scaffolding without locked wheels or guardrails.
- Climbing scaffolds without an approved access ladder.
- Extension cords with missing ground prongs.
- Unlabeled or improperly labeled containers.
- Failure to report a spill of an unidentified substance or reportable quantity of a hazardous material.

- Flagrant violations of the health and safety requirements of this health and safety plan and applicable OSHA regulatory requirements.

1.4.1 Safety Violation Notice

The Safety Violation Notice is a form used by Inquip to document safety violations and housekeeping problems on site.

Safety Violation Notices will be issued by the on-site safety officer. The on-site safety officer does not have to witness the violation, but can serve the notice from information he receives from other Inquip staff.

Safety Violation Notices shall include, at a minimum, a corrective action program and the date the corrective actions must be taken.

Disciplinary Actions

When disciplinary action is required, the party will be identified. If two Safety Violation Notices have been written against an employee in 1 year, the employee shall be removed from the project for three work days. If an employee receives three notices in 1 year, the employee shall be barred from the project. Under some very serious violations, an employee may be barred from the site without notice. Examples of serious violations include, but are not limited to, theft of property, vandalism, fall protection violation, fighting, or possession of contraband substances or articles.

- Employees who commit unsafe acts that result in injuries to themselves, or others, or property damage may be terminated and barred from area 2 site for the remainder of the project's existence.

- Employees involved in repetitive safety violations and who are terminated for safety violations will be barred from area 2 site for a minimum of 1 year. Should the employees be involved in safety violations after rehire, they will be barred from the area 2 site for the balance of the project's existence.

1.5 Incident Reporting

Personnel are responsible for immediately reporting to the on-site safety officer any event, that may adversely impact personnel or the environment or result in damage to equipment, regardless of the severity. All "near-misses" must also be reported. A "near-miss" is an event that did not, but had the potential to, cause injury or damage.

It is the responsibility of Inquip to investigate all injuries, property damage, environmental events, and near-misses.

After any injury, including those requiring only minor first-aid, the on-site safety officer shall immediately be notified.

Except as may be necessary to protect personnel and to minimize environmental or equipment damage, the accident/incident scene shall be preserved so as to allow an accurate investigation as to what occurred, the causes, and corrective measures to prevent recurrence.

2. CONTAMINANT AND HAZARD DESCRIPTION

Potential hazards associated with work at the area 2 site include construction safety hazards as well as chemical exposure hazards.

Examples of potential construction hazards in Controlled Areas and Uncontrolled Areas may include, but are not limited to the following:

- Slips, trips, or falls from working on wet surfaces or in poorly illuminated areas.
- Improperly secured loads during lifting or rigging activities.
- Operation of power tools or equipment.
- Utility installation and maintenance.
- Building construction.
- Falling or flying objects.
- Falls from ladders or elevated work platforms.
- Clearing and grubbing.
- Confined spaces.
- Heavy equipment operation.
- Motor vehicle operation.
- Road grading and paving.
- Excavations.
- Drowning.
- Off-loading/on-loading mobile equipment.
- Use/exposure to chemical products.

2.1 Area 2 Contaminants in Controlled Areas

(NOTE: Additional chemical and physical hazards may exist from materials brought on site by Inquip to perform work.)

The health effects and potential chemical hazards associated with the contaminants identified in Appendixes B are included in this section. The contaminants are classified into the following categories: "VOCs", "SVOCs", "PCBs", "Dioxins", "Heavy Metals" and "Pesticides." Separate tables address each of the categories.

The contaminants are listed by common name. The action level for each chemical contaminant is based on the lower of the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) or the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV). For contaminants not listed as confirmed or suspected human carcinogens, one-half the lower of the PEL or TLV is listed. For contaminants listed as confirmed or suspected human carcinogens, one-fifth of the lower of the PEL or TLV is listed.

These levels are based upon the as-low-as-reasonably-achievable (ALARA) concept utilized by the Department of Energy. Inquip shall utilize engineering controls as the primary means to maintain employee exposures below the action levels listed in the tables. If this cannot be accomplished, these controls shall be supplemented with other controls listed in Sections 4 and 5.

Table 1 lists contaminants at the site. The list includes solids, liquids, or gases which may be a potential exposure hazard.

Table 1
Solutia Area 2
Maximum Known Soil Contaminate Concentrations

Constituents	Concentrations
VOCs	
1,1,1-Trichlorethane	12,000
Benzene	30,769
4-Methyl-2-Pentanone	250,000
Toluene	2,400,000
Chlorobenzene	100,000
Ethylbenzene	790,000
Total Xylenes	620,000
1,4-Dichlorobenzene*	1,200,000
Bis (2-Ethylhexyl) Phthalate*	1,100,000
Di-n-Butyl Phthalate*	900,000
o-Xylene	2,300,000
SVOCs	
1,4-Dichlorobenzene	1,030,000
1,2-Dichlorobenzene	606,000
1,2,4-Trichlorophenol	26,923
Naphthalene	200,000
2-Methylnaphthalene	160,256
n-Nitrosodiphenylamine	50,000
Pentachlorophenol	1,620,000
Phenanthrene	230,000
Fluoranthene	74,000
Pyrene	282,051
Butyl Benzyl Phthalate	3,646,154
Benzo(a)anthracene	121,795
1,2,4-Trichlorobenzene	0.0653
Chrysene	282.051
Phenol	3,875
Di-n-butyl Phihalate*	1,500,000
Bis(2-Ethylhexyl) Phthalate*	20,000,000
Di-n-Octyl Phthalate	310,000
PCBs	
Aroclor 1232	30,366
Aroclor 1242	1,871,795
Aroclor 1254	360,000
Aroclor 1248	85,000
Aroclor 1260	16,000,000
Dioxins	
Tetrachlorodibenzo-p-Dioxin	170 ng/g
Heavy Metals	
Cadmium	0.152
Copper	1.63
Mercury	0.0063
Nickel	0.371
Zinc	9.52
Lead	392
Cyanide	0.015

Constituents	Concentrations
Antimony	17.9
Arsenic	216
Chromium	3.65
Selenium	0.0599
Silver	0.0302
Thallium	0.00089
Aluminum	ND
Iron	ND
Magnesium	ND
Pesticides	ND

Notes-
Units – Parts Per Billion (ppb)
*URS HASP

Table 1
Solutia Area 2
Maximum Known Groundwater Contaminants*

Constituents	
VOCs	
Methylene Chloride	52,000
Trans-1,2-Dicholorethene	14,000
2-Butanone	62,000
Trichloroethene	83,000
Benzene	190,000
4-Methyl-2-Pentanone	38,000
Tetrachloroethene	10,000
1,1,2,2-Tetrachloroethane	12,000
Toluene	15,000
Chlorobenzene	180,000
1,2-Dichloroethane	3,000
2-Hexznone	3,500
SVOCs	
Phenol	190,00
1,4-Dichlorobenzene	15,000
1,2-Dichlorobenzene	11,000
4-Methylphenol	23,000
4-Chloroanaline	15,000
2-Chlorophenol	33,000
2,4-Dimethylphenol	2,800
2,4,6-Trichlorophenol	6,000
2-Nitroaniline	2,000
Pentachlorophenol	35,000
Acenaphthylene	3,900
Heavy Metals	
Arsenic	133
Cadmium	11
Lead	6,350
Cyanide	1,560
Pesticides	ND
PCBs	ND
Dioxin/Furan	ND

Notes –
Units – Parts Per Billion (ppb)
* Reference URS Hasp

In addition to the above, workers may be exposed to physical hazards such as temperature extremes and noise. Table 2 lists the potential health effects related to heat stress, cold stress, and noise.

In addition to the hazards listed in this section, there is a potential for worker exposure to biological hazards. The primary biological hazards of concern include insect bites, venomous or nonvenomous snake bites, and exposure to poison ivy. The Illinois area is a potential area for Lyme disease, a disease carried by some types of ticks.

Table 2 Physical Hazards

PHYSICAL HAZARD	ACTION LEVEL	HEALTH EFFECTS
Cold Stress	None	Acute Response: Hypothermia - Acute problem resulting from prolonged cold exposure and heat loss. If fatigued during physical activity, an employee will be more prone to heat loss. As exhaustion approaches, the blood circulatory system which helps maintains body warmth is overcome. Shivering is one of the body mechanisms to produce heat for body heat maintenance. If body temperature continues to fall, shivering ceases. Rapid loss of heat then occurs and critical cooling begins. Frostbite - Without proper cold weather attire, exposed skin in the presence of temperature or wind chill temperatures below freezing may result in sharp tingling sensations of exposed skin, numbness, and partial or complete loss of sensation to exposed skin areas. Continued exposure without preventive action may result in permanently damaged skin tissue. Chronic response: Trench-foot - Without proper foot protection, swelling, tingling, itching, and painful foot tissue may occur due to a combination of cold temperatures and persistent dampness or wet feet. Small areas of skin may blister or skin tissue may be damaged due to the cold and wet condition.
Heat stress	Oral temperature of 38^0C (100.4°F) and/or pulse rate of 110.	**Chronic response**: Physical disability caused by excessive heat exposure - in order of severity: Heat rash - itching skin. Caused by the opening of sweat ducts become clogged due to swelling of the surface of the skin which leads to inflammation of the sweat glands. Heat cramps - muscle spasm and pain in muscles of the abdomen and extremities. Caused by replacement of water without adequate replacement of salts (sodium, potassium, calcium). Heat exhaustion - fatigue, exhaustion, headache, nausea, cool clammy skin, and appearance which may be pale or flushed. Caused by extreme loss of fluids and salts. The supply of blood plasma and cardiac output are rapidly becoming inadequate to meet continuing demand to regulate body heat. Heat stroke - flushed skin, high body temperature (usually above 105^0F), cessation of sweating, headache, numbness, fast pulse, rapid breathing rate, confusion, convulsions, and loss of consciousness. Complete breakdown of body heat regulatory system due to lack of fluids necessary for sweat production.

Table 2 Physical Hazards (Continued)

PHYSICAL HAZARD	ACTION LEVEL	HEALTH EFFECTS
Hearing loss	85 dBA: Suitable hearing protection. 90 dBA: Posting of area as noise hazard.	**Acute loss**: Sudden loss due to damage to the ear drum or the middle ear noise conductive network. May occur as a result of a severe head injury. Extremely loud noises or sudden intense pressure waves could cause acute loss; however, these are highly unlikely at this site. **Chronic loss**: Gradual loss as a result of some medications such as mycins, aspirin, and some diabetic medication, from some diseases such as mumps or diabetes, from aging, or from nerve deafness due to continuous and long-term exposure to high noise levels without use of hearing protection both at work and off work. Hearing loss due to nerve deafness is gradual and usually unrecognized. Initial symptoms may include ringing of the ears at the end of the workday or a temporary decrease in ability to hear sound. The ringing and temporary decrease is a result of inner ear nerve fatigue; recovery is usually complete after a 14-hour quiet period. Without hearing protection, repeated noise exposures may damage the inner ear and permanent loss may occur.

3. WORK PRACTICES AND ENGINEERING CONTROLS

Sections 3.1 through 3.8 are applicable to work in Uncontrolled and Controlled Areas. Section 3.9 is only applicable to work in Controlled Areas.

3.1 Special Requirements for Entry Into Confined Spaces

All confined space entries at the Area 2 will be in accordance with Occupational Safety and Health Administration (OSHA) 29 CFR 1910.146 and the following requirements. Inquip shall maintain a written Permit-Required Confined Space Entry Program and all training records required by 29 CFR 1910.146.

Entry into a confined space will be considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

A confined space is considered to be any space that is large enough and so configured that it can be bodily entered to perform work, *and* has limited or restricted means of entry or exit, *and* is not designed for continuous employee occupancy.

Permit-required confined spaces are those spaces that have one or more of the following characteristics:

- Contain or have the potential to contain a hazardous atmosphere.
- Contain a material that has the potential for engulfing an entrant.
- Have internal configurations such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross section.
- Contain any other serious safety or health hazards.

All confined spaces at the area 2 site are considered to be permit required confined spaces unless otherwise determined by the on-site safety officer.

The following list is provided as an outline of the major requirements for entering confined spaces at the area 2 site:

- All personnel shall coordinate entry operations with the on-site safety office.

- All personnel shall participate in a debriefing meeting with the on-site safety officer upon completion of all permit-required confined space entries. Debriefing comments shall be included on the Confined Space Entry Permit.

- Hazard identification and assessment must as a minimum include:

  - Posting of permit-required confined spaces that can be inadvertently entered.

  - Initial atmospheric monitoring as necessary.

  - Continuous air monitoring in confined spaces that cannot be isolated.

  - Pre-entry atmospheric monitoring performed immediately prior to entry (as specified in Section 5).

  - Physical characteristics, configuration, and location.

  - Methods for entry and exit.

  - Energy and hazardous material sources.

  - Potential for changing conditions.

- Implementation of appropriate control measures for permit required confined spaces must include, as a minimum, the following:

  - Ventilation (as required per Table 5-1).

  - Atmospheric monitoring as specified on the confined space entry permit.

  - Mechanical retrieval equipment for personnel entering vertical confined spaces greater than 5 ft in depth.

  - Full-body harness with retrieval line attached at the center of the back between the shoulders or above the head for all entry personnel. The retrieval line may be detached if the retrieval equipment would increase the overall risk of the entry or would not contribute to the rescue of the entrant. Retrieval system detachment must be authorized by the on-site safety officer and documented on the Confined Space Entry Permit.

  - Fall protection as required on the permit.

- Isolation and lockout/tagout as indicated on the permit.
- Cleaning and decontaminating space, using remote methods where feasible.
- Selection and use of personal protective equipment (PPE) in accordance with the work and hazards involved.
- Proper barricading/signing to prevent unauthorized entry and dropping of tools or equipment into the opening.

- Attendants shall maintain communication with and account for the well being of authorized entrants during the course of work in the confined space. One attendant must be available for each confined space entry. Simultaneous monitoring of more than one confined space by an attendant is prohibited. Should rescue become necessary, attendants may attempt only non-entry rescue operations.

3.2 Hearing Conservation Program

Personnel shall comply with 1910.95, *Occupational Noise Exposure*. Inquip has established the American Congress of Governmental Industrial Hygienist (ACGIH) TLV of 85 decibels A-weighted (dBA) 8-hour time weighted average (TWA) as the project exposure level (based on 3 dB exchange rate). No unprotected exposures to noise levels above 115 dBA will be permitted.

Whenever feasible, engineering controls shall be instituted to attenuate noise at the source to attain acceptable low noise levels, preferably below the 85-dBA TLV-TWA. All equipment brought on site shall be fitted with proper noise control devices (mufflers, pads, etc.) to limit both worker exposure and ambient noise levels. Equipment shall also be maintained to limit excessive noise resulting from poor maintenance or lubrication practices.

All HPDs shall have a minimum noise reduction rating (NRR) capable of attenuating the wearer's noise exposure to below 85 dBA.

Field attenuation and hearing protector efficiency will be evaluated by the guidelines in Appendix B of OSHA 29 CFR 1910.95, *Occupational Noise Exposure* using the 7dB reduction method.

Posting requirements for noise hazards shall be instituted for those areas routinely exhibiting noise levels at or above 90 dBA. HPDs will generally be worn for noise levels exceeding 85 dBA. Typical situations using equipment where noise levels may exceed 85 dBA include, but are not limited to, the following:

- Compressor use
- Drill rig operation
- Electrically powered hand tool use
- Gas-powered hand tool and equipment use
- Generator use
- Heavy equipment operations
- Man lift operation

3.3 Hazard Communication Program

3.3.1 Requirements for Personnel using regulated Materials

Inquip shall comply with all the requirements of the OSHA Hazard Communication Standard (29 CFR 1926.59). Each Inquip employee shall be trained in accordance with the Hazard Communication Program. Inquip shall maintain a copy of the MSDS for each hazardous chemical as defined in the OSHA Hazard Communication Standard. Secondary containers shall be labeled in accordance with the Hazard Communication Program with minimum labeling requirements of 29 CFR 1926.59.

Each MSDS will be reviewed to determine if the product contains 0.1% or more of a carcinogen or suspected carcinogen. According to 29 CFR 1910.1200(d)(4), the following resources shall be used to establish that a chemical is a carcinogen or potential carcinogen for hazard communication purposes.

- National Toxicology Program (NTP), *Annual Report on Carcinogens* (latest edition); Carcinogens are those chemicals listed by NTP as "known carcinogens" and potential carcinogens are those listed by NTP as "reasonably anticipated to be carcinogens."

- International Agency for Research on Cancer (IARC) *Monographs* (latest editions); carcinogens are those chemicals listed in Group I *Carcinogenic to Humans* and potential carcinogens are those listed in Group IIA *Probably Carcinogenic to Humans.*

- 29 CFR Part 1910, Subpart Z, *Toxic and Hazardous Substances, Occupational Safety and Health Administration.*

Products determined to be carcinogenic shall not be used at the Area 2 site unless a suitable replacement material cannot be found. If a suitable replacement material cannot be found, Inquip shall develop written procedures to keep exposures as low as reasonably achievable (ALARA).

These control procedures should include a description of intended use, establishment of a regulated area, engineering controls, warning signs, appropriate hygiene practices, and emergency response procedures.

Inquip, including each lower-tier Subcontractor, shall maintain copies of MSDSs (at the work site) for products they will be using and shall maintain a copy of the Company's written Hazard Communication Program. Documentation of employee training shall be available for inspection, upon request. Hazards shall be properly labeled and posted as required by 29 CFR 1926.59.

Inquip is responsible for adherence to all the rules and regulations of this site especially as they pertain to the storage, labeling, and placarding of chemical products as written in, but not limited to, National Fire Protection Association (NFPA) and the Code of Federal Regulations (CFR).

3.3.2 Service Subcontractor MSDS Requirements

Second tier Subcontractors who bring small quantities of materials on site to maintain Inquip office equipment, fire extinguisher system, or other similar tasks will be exempt from submitting a MSDS, provided the following requirements are observed:

- Subcontractor must have the MSDS for materials brought on site with them at all times.
- None of the materials brought on site shall be stored at the area 2 site and must be removed at the end of the day.

3.4 Control of Ozone Depleting Substances

Title VI of the *Clean Air Act* (CAA) regulates the protection of stratospheric ozone. The use of ozone depleting substances (including materials with substances containing ozone depleting substances) is not allowed at the area 2 site. A list of ozone depleting substances is included in Appendix D. Note: Class 2 substances may be allowed on a case-by-case basis upon approval from Inquip, if no substitute can be identified.

3.5 Dust (Particulate) Control Requirements

Inquip shall use water spraying or other Solutia approved methods as necessary to suppress dust emissions to the lowest practical level. Inquip shall also minimize dust emissions by minimizing drop heights when transferring material. Excessive visible emissions of particulates shall not be permitted. Total airborne dust concentrations, as measured in the Controlled Areas, shall at no time exceed a limit of 1 mg/m^3 unless otherwise authorized in writing by the on-site safety officer.

The limit in Uncontrolled Areas is 5 mg/m^3. Excessive runoff due to dust control operations shall not be permitted.

If measurement of the total airborne particulate concentration is not feasible or practical, Inquip will evaluate the airborne particulate levels by visual inspection, and if, in the Inquip's judgment, the airborne particulate is visible, then additional particulate control measures will be implemented.

Inquip shall be responsible for ensuring that all operations are conducted in a manner that prevents airborne contaminants and total airborne particulate from exceeding established limits.

3.6 Extreme Temperature Requirements

Heat stress and cold stress prevention programs shall be implemented during periods of warm and cold weather. The heat stress prevention program shall include provisions for worker acclimatization and implementation of heat stress prevention measures as described below and in Table 5-1. The on-site safety officer may monitor personnel for temperature and heart rate as detailed in Table 5-1. For cold stress prevention, personnel shall use properly insulated clothing for the head, hands, feet, and body.

During periods of hot weather or when workers may be affected by heat stress, an adequate supply of cool drinking water and a shaded rest area shall be made available. During cold weather periods, a heated shelter area shall be readily available near the work site.

Responsibilities for providing drinking water, cold weather clothing, ice vests, and any other equipment, supplies, and facilities necessary to ensure an effective program for temperature extremes are contained in the Health and Safety Plan (HASP) checklist.

3.7 Requirements Applicable to Controlled Areas

3.7.1 Contamination Control

Inquip shall mark and secure all hoses and cords crossing the boundaries of controlled areas to help minimize the spread of contamination and safety hazards. Electrical cords and lines that are not under pressure may be taped in place and tagged near the end to indicate that external surfaces may be contaminated. Hoses containing water under high pressure shall be secured, where possible, to prevent whiplash motions caused by loss of operator control. Hoses that may contain contamination shall be conspicuously labeled "CAUTION-INTERNAL CONTAMINATION." Labels or tags shall have a yellow background. Labeling is not required on portions of hose inside restricted areas. Labels or tags shall be placed on opposing sides of the

hose, where necessary, to ensure that they are clearly visible from all vantage points and hose positions. At a minimum, labels or tags should be placed every 40 ft along the length of the hose.

Unless otherwise specified by the on-site safety officer, personnel shall procure sufficient tools so that tools frequently required in the Contamination Area may be dedicated for that use. In the event repairs or modifications to tools or equipment are needed, the repairs or changes shall be made, where reasonably practical, in an Uncontrolled Area or a portion of the Controlled Area with low levels of contamination.

3.7.2 Communication Systems

When working within Controlled Areas, personnel shall check radios for operability.

3.8 Requirements for Removing Samples from Site

When required to ship materials off-site for analysis, Inquip personnel shall comply with the requirements of this section.

3.8.1 Notification Requirements

Inquip shall notify the laboratory of the potential contaminants in the materials that the laboratory is expected to analyze. All samples that are removed from the site shall be returned to the site for proper disposal upon completion of the analysis.

3.8.2 Chain of Custody Requirements

Inquip personnel are required to complete a Chain of Custody Form for all environmental and personnel samples collected at the area 2 site and sent off site for chemical, or physical analysis. This includes groundwater, surface water, soil, rock, sediment, air, and other samples.

Chain of custody must be maintained to ensure that samples are not tampered with or altered, before laboratory receipt or while in the possession of the laboratory. Chain of custody records provide accurate documentation of each sample from the time of collection through receipt of samples to analytical laboratory.

3.9 Requirements for Work Inside Controlled Areas

Requirements for work inside Controlled Areas include:

- Entry/exit through an Access Control point: Each worker and all equipment must enter at the established access point for the Controlled Area where the employee will

perform his work. Every worker must sign in (and out) so that all workers can be accounted for in the event of an emergency

- Training: Training requirements for hands-on work inside Controlled Areas are detailed in Section 8 and typically include, at a minimum, OSHA hazardous waste training, general employee training.

- Medical surveillance: Initial and annual physicals are required for workers and supervisors required to wear respirators while working inside Controlled Areas, as detailed in Section 7.

- Monitoring: Workers are monitored for chemical exposures as detailed in Section 5.

- Personal protective equipment (PPE): Workers are required to wear protective clothing and equipment for many activities performed inside Controlled Areas, as detailed in Section 4.

- Contamination Control: Work inside Controlled Areas must be performed in a manner that prevents track-out of contaminants on equipment and personnel, minimizes worker exposures, and protects the environment, as detailed in Sections 3 and 10.

4. PERSONAL PROTECTIVE EQUIPMENT

The use of appropriate personal protective equipment (PPE) shall be required for personnel involved in operations where exposure to hazardous conditions exists or where such equipment is needed to reduce hazards. Personal protective equipment shall be selected and utilized in accordance with Occupational Safety and Health Administration (OSHA) standards and this Health and Safety Plan (HASP). All modifications to PPE requirements shall require on-site safety officer authorization prior to implementation.

4.1 Safety Apparel for Work at the Area 2 Site

Personnel performing work at the area 2 site shall, at a minimum, be required to wear the following standard safety apparel:

- Hard hats (with the bill facing forward) meeting the requirements of ANSI Z89.1 for protection from falling objects.
- Safety glasses with side shields meeting the requirements of 29 CFR 1910.133(a)(2) and (b)(1) or (2), as appropriate.
- Sturdy work shoes or boots

NOTE: Exemption for surveying services may be made for safety glasses and hard hats.

Long pants and shirts with sleeves at least 4 in. long will be required. Tank tops, cut-off pants, and tennis shoes will not be permitted. Loosely fitting clothes will not be permitted near rotating machinery or equipment. Inquip strongly recommends that personnel do not wear jewelry in construction areas.

Employees working at the site will be required to wear hard hats that meet the American National Standards Institute (ANSI) Z 89.1 standard, as prescribed in 29 CFR 1910.135, *Head Protection*. Hard hats shall be worn with the peak forward and the suspension properly installed. Hard hats shall not be damaged, painted, deformed, or marked in any way except for markings required to identify the employee, company, craft, or title.

Eye protection shall, at a minimum, consist of safety glasses with permanently affixed side shields that meet the ANSI Z 87.1 standard. Prescription glasses shall also meet the ANSI standard and be provided with side shields. Cover glasses used over prescription glasses will be permitted. Safety glasses shall be worn at all times in Controlled Areas and in any other area where construction activities are taking place. Face shields shall not be worn in lieu of safety glasses.

4.2 Safety Apparel for Work in Restricted Areas Inside Controlled Areas

Employees performing work in soil contamination areas may be required to wear the following additional standard safety apparel:

- Sturdy work shoes with disposable or reusable boot covers or chemical-resistant steel-toed safety boots (16 in. minimum polyvinyl chloride (PVC) or equivalent.
- Cotton work gloves.
- Coveralls.

4.3 Additional Personal Protective Equipment Requirements for Controlled and Uncontrolled Areas

Additional PPE requirements for specific tasks or operations in Controlled and Uncontrolled Areas are described in Table 4-1.

Hearing protection devices (HPDs) are required for noise exposure levels that exceed 85 dBA, 8 hour TWA. However, HPDs are recommended whenever noise exposure levels exceed 85 dBA.

Leather work gloves will be required when handling material or performing work that could cause cuts, abrasions, or other mechanical injury. Chemical protective gloves (selection shall be based on published chemical protective clothing guidelines) shall be worn where there is a reasonable probability of direct contact with hazardous chemicals. Protective gloves shall be worn, as required, depending on the nature of work activity and hazard potential. When there is risk of injury to the metatarsal bones, such as in the use of jumping jack soil compactors, metatarsal guards shall be worn.

Each affected employee shall wear protective footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects or objects piercing the sole, and where such employee's feet are exposed to electrical hazards. Such footwear shall meet the requirement of 29 CFR 1910.136, *Foot Protection*.

Reflective safety vests and/or high visibility clothing shall be worn by personnel in unbarricaded areas where there are moving vehicles or construction equipment; when directing traffic; working in an excavation where a bucket is operating; working within 10 ft of a highway; and in a temporary storage area.

4.4 Respirator Usage at the Area 2 Site

Inquip shall require workers to wear respirators as specified in Table 4-1. The use of positive pressure respiratory protection devices is recommended as appropriate to alleviate worker fatigue and increase comfort.

Respirator fit-testing shall be performed for all employees required to wear such equipment. All employees required to wear respirators shall inspect their respirators before and after each use. Routine inspection, cleaning, and storage of respirators is the responsibility of the Subcontractor and shall be in accordance with OSHA 1910.134. Respirators shall be cleaned with a mild soap and clean warm water or equivalent on at least a weekly basis when in use.

Table 4-1 Additional Personal Protective Equipment Guidelines for Specific Tasks

TASK DESCRIPTION [a]	ADDITIONAL PERSONAL PROTECTIVE EQUIPMENT[b][	RESPIRATORY UPGRADE IF REQUIRED BASED ON MONITORING RESULTS
Clearing and grubbing, (chainsaw operations; brush saw operations).	Steel-toed boots. Hearing protection devices.	Full-face piece APRs with HEPA cartridges.
Excavation of contaminated soils.	Where excavations contain contaminated water, waterproof coveralls (or jacket and pants), and gloves will be required.	Full-face piece APRs or PAPR with HEPA cartridges.
Welding/cutting/grinding.	Proper eye and face protection consistent with OSHA 1910.133, *Filter Lenses Protection Against Radiant Energy*: fire resistant coveralls, leather gloves Respirator usage is as follows: • Full-face air purifying respirators with HEPA cartridges[c] required for cutting/welding/grinding on galvanized steel, stainless steel, non-ferrous metals, and metals with toxic material coatings, such as lead or cadmium-bearing paints. Full face-piece APRs with HEPA cartridges may also be required where generated smoke could contain radioactive contamination. • Air supplied respirator is required for all plasma arc cutting in conjunction with good ventilation. • Full-face piece respirator with HEPA cartridges with arc cutting or gouging in conjunction with good ventilation.	Full-face piece powered air purifying respirators (PAPRs) with HEPA cartridges.
Heavy equipment operation	No coveralls are necessary for operators who do not perform work on the ground and only enter and exit the work zones to access their equipment. They would be required where respirator usage is required.	Full-face piece APRs with HEPA cartridges.
Use of pressure washing equipment for cleaning/decontamination of equipment.	Face shield, waterproof gloves, and coveralls (or rain suit). Boot covers or chemical resistant boots.	N/A

Table 4-1 Additional Personal Protective Equipment Guidelines for Specific Tasks (Continued)

TASK DESCRIPTION [a]	ADDITIONAL PERSONAL PROTECTIVE EQUIPMENT[b](	RESPIRATORY UPGRADE IF REQUIRED BASED ON MONITORING RESULTS
Use of commercial chemical products, including paints and coatings.	Proper protective equipment per Material Safety Data Sheet (MSDS) requirements or use of acceptable published chemical protective clothing selection guidelines. (Modifications subject to review by the Contractor.)	Respirator upgrade depends on nature of material and monitoring results.
Pumping hazardous liquids and removing hazardous sludges, debris, and equipment from sumps, trenches, and pits.	Polyethylene-coated or Saranex-coated Tyvek coveralls with hoods, neoprene or nitrile outer gloves/cotton or surgical inner gloves, taped interfaces.	Full-face piece APRs with HEPA cartridges and/or Organic Vapor/Acid Gas cartridges depending on the nature of the contaminant.
Draining oils from equipment.	Neoprene or nitrile gloves, polyethylene-coated Tyvek coveralls over cotton coveralls.	
PCB decontamination and/or PCB waste handling.	Disposable boot covers, Saranex-coated Tyvek coveralls with hoods, neoprene or silvershield outer gloves/surgical inner gloves, taped interfaces.	Full-face piece APRs with combination HEPA/organic vapor cartridges
Installing fibrous glass insulation or other types of materials containing man-made mineral fibers.	Cotton coveralls[d] or disposable coveralls[e], work gloves.	Full-face piece APRs with HEPA cartridges.
Working on or near water.	Life vest floatation device (staged safety belt, lifeline, ring, and buoy).	N/A

Table 4-1 Additional Personal Protective Equipment Guidelines for Specific Tasks (Continued)

TASK DESCRIPTION [a]	ADDITIONAL PERSONAL PROTECTIVE EQUIPMENT[b][	RESPIRATORY UPGRADE IF REQUIRED BASED ON MONITORING RESULTS
Heavy equipment maintenance workers.	No additional requirements.	Full-face piece APR with appropriate cartridges.
Potential contact with acids and bases.	Chemical-resistant suit and outer gloves (as determined by the most recent edition of the Quick Selection Guide to Chemical Protective Clothing), inner surgical gloves, face shield, chemical splash goggles, chemical resistant boots, and taped interfaces.	Full-face piece air purifying respirators (APRs) with combination acid gas/organic vapor/HEPA cartridges or pressure demand air supplied respirator.
Potential contact with contaminated/ potentially contaminated water.	Chemical-resistant suit, neoprene or nitrile outer gloves, inner surgical gloves, face shield, chemical splash goggles, chemical resistant boots, and taped interfaces.	N/A
Sampling of process water and flushing of process water to the drains.	Face shield, chemical resistant boots, surgical gloves, splash apron.	N/A
Handling of sludges or contaminated solids.	Saranex or polyethylene coated Tyvek coveralls with hood, inner cotton coveralls (no street clothing allowed), neoprene 4 H Silvershield, nitrile outer gloves, inner surgical gloves, 16 in. chemical-resistant boots, and taped interfaces.	Full-face piece air purifying respirator (possible downgrade to no respiratory protection based on monitoring results), face shield with chemical splash goggles with combination acid gas/organic vapor/HEPA cartridges.
Potential exposure to untreated or partially treated water.	Chemical splash goggles. Splash apron. Neoprene, nitrile, or PVC gloves.	N/A
Handling of uncontaminated filter media.	No additional requirements.	N/A

Table 4-1 Additional Personal Protective Equipment Guidelines for Specific Tasks (Continued)

TASK DESCRIPTION [a]	ADDITIONAL PERSONAL PROTECTIVE EQUIPMENT[b][	RESPIRATORY UPGRADE IF REQUIRED BASED ON MONITORING RESULTS
Handling of small quantities of chemicals in the laboratory.	Face shield or chemical splash goggles and chemical resistant surgical gloves. Laboratory coat.	N/A
Operational startup of water treatment plants.	Splash apron, waterproof gloves, waterproof boots or boot covers, and face shield.	Full-face with HEPA/organic vapor/acid gas cartridges.

(a) Tasks described in this table are not applicable to all subcontracts.
(b) PPE specified in this column is required in addition to standard safety apparel.
(c) Half-face respirators may be worn upon prior written approval of the on-site safety officer.
(d) When cotton coveralls are used, they shall be removed after each work shift and left on site until the completion of the operation. When the operation is complete, coveralls shall containerized
(e) When disposable coveralls are used, the disposable coveralls shall be removed after each shift, bagged, and marked as per Section 3 of this plan. The open end of the trash bag shall then be sealed with duct tape and disposed of in the trash bin.

The on-site safety officer shall ensure that adequate corrective actions are implemented to abate any deficiencies discovered during routine inspection and maintenance of respiratory protection equipment. Any deficiencies and corresponding corrective actions shall be documented.

4.4.1 Supplied Air Systems Requirements

When using supplied air systems, on-site safety officer shall ensure that breathing air couplings are incompatible with outlets for non-respirable plant air or other gas systems. This will prevent inadvertent servicing of air line respirators with non-respirable gasses or oxygen.

4.5 Donning and Doffing

Instructions for donning and doffing protective clothing will be posted at the dress-out and exit points for the controlled work area when required. Potentially contaminated protective clothing must be removed without spreading contamination and in particular without contaminating the skin or inner garments. Workers shall exercise care to avoid touching the skin or inner garments with contaminated clothing, and shall not place anything in the mouth during the removal of protective clothing.

5. MONITORING

When Inquip performs monitoring for personnel exposures, it is done to verify engineering controls and PPE/respirator selection. The following sections describe the monitoring program (which is summarized in Table 5-1), exposure limits, and action levels which require additional engineering control measures and personal protective equipment (PPE).

Where feasible, engineering controls shall be used to maintain personnel exposures to hazardous chemicals below the threshold limit.

Tampering with monitoring devices will not be tolerated and may result in removal of the culpable individual from the site.

5.1 Monitoring Program Elements

5.1.1 Personnel Contamination Monitoring

Before exiting Contamination Areas, all personnel shall monitor themselves for visual signs of contamination. Personnel will be instructed in self-monitoring procedures, as necessary, during General Employee Training as described in Section 8 of this plan.

5.1.2 Noise Monitoring

Sound pressure levels will be monitored to delineate hearing protection areas. The on-site safety officer shall determine monitoring frequency and sample quantity. The frequency will be sufficient to adequately monitor areas where workers may be exposed to noise levels in excess of 85 dBA TWA (3 dB exchange rate). Suitable hearing protection shall be worn in areas with noise levels greater than 85 dBA TLV exposure level, or 90 dBA instantaneous.

5.1.3 Heat Stress Monitoring

Monitoring will consist of periodic measurement of worker body temperature during periods when work area temperatures exceed 85°F and protective clothing is required for the work activity. Monitoring may also be required for workers engaged in strenuous activities regardless of the protective clothing requirements. Monitoring frequency will be determined by the on-site safety officer and will be based on the work area temperature and the type of work being performed. Heart rate monitoring will not be required except when the action level for body temperature is exceeded, or when physical signs of stress are observed.

5.1.4 Confined Space Entry Monitoring

Prior to any confined space entry as defined in Section 3, a competent individual shall perform the atmospheric monitoring as described on the confined space entry permit to determine if a hazardous atmosphere exists. Typical areas of monitoring include oxygen, combustible gas, carbon monoxide, hydrogen sulfide, photoionizable substances, and any other toxic atmospheric contaminants that may be present based on information available on previous use of the confined space. If a hazardous atmosphere exists, as specified in Table 5-1, ventilation or ventilation in conjunction with respiratory upgrade will be required before entry. In no case shall a confined space be entered where the atmosphere exhibits greater than 5% of the lower explosive limit (LEL). For confined spaces that cannot be isolated, continuous monitoring in the space shall be required.

5.1.5 Oxygen

The on-site safety officer will monitor oxygen levels. Such monitoring includes, but is not limited to, excavation, material handling, welding, etc.

5.1.6 Explosive Atmosphere

The on-site safety officer will monitor explosive atmospheres. Such monitoring includes, but is not limited to, excavation, material handling, welding, etc.

5.1.7 Monitoring for Other Contaminants

It may be necessary to perform air monitoring for other airborne contaminants or IDLH conditions depending on the nature of work, the materials used, and the potential hazards involved.

Table 5-1 Monitoring Program Summary

HAZARD/SAMPLE TYPE	ACTION LEVEL (50% of either the current TLV or the PEL)	PRECAUTION IF ACTION LEVEL IS EXCEEDED	MONITORING FREQUENCY
CONFINED SPACE ENTRY[a]			
Explosive gas.	>5% of the lower explosive limit (LEL)[b].	Ventilation. If exceeded during entry operations, the space will be immediately evacuated. The on-site safety officer will be notified immediately and the permit will be canceled.	Prior to confined space entry and as designated on the confined space entry permit, or more frequently as determined by the on-site safety officer.

Table 5-1 Monitoring Program Summary (Continued)

HAZARD/SAMPLE TYPE	ACTION LEVEL (50% of either the current TLV or the PEL)	PRECAUTION IF ACTION LEVEL IS EXCEEDED	MONITORING FREQUENCY
Oxygen.	<19.5% or >23.5%.	Ventilation/upgrade to supplied air respirators (SARs) pressure demand (SCBA or airline respirator with 5-minute escape bottle[c]. If exceeded during entry operations, the space will be immediately evacuated. The on-site safety officer will be notified immediately and the permit will be canceled.	Prior to confined space entry and as designated on the confined space entry permit, or more frequently as determined by the on-site safety officer.
Carbon monoxide.	12.5 ppm 8-hour TWA.	Ventilation/appropriate respiratory and dermal protection.	Prior to confined space entry and as designated on the confined space entry permit, or more frequently as determined by the on-site safety officer.
Hydrogen sulfide.	5 ppm 8-hour TWA.	Ventilation/appropriate respiratory and dermal protection.	Prior to confined space entry and as designated on the confined space entry permit, or more frequently as determined by the on-site safety officer.
Photoionizable substances (for undetermined air contaminants).	5 ppm.	Ventilation/appropriate respiratory and dermal protection.	Prior to confined space entry and as designated on the confined space entry permit, or more frequently as determined by the on-site safety officer.
Any other toxic atmospheric contaminant that may be present based on available information on previous use of the confined space.	One-half of the PEL or TLV for the contaminant, or 20% for carcinogens, whichever is more stringent.	Ventilation/appropriate respiratory and dermal protection.	Prior to confined space entry and as designated on the confined space entry permit, or more frequently as determined by the on-site safety officer.

Table 5-1 Monitoring Program Summary (Continued)

HAZARD/SAMPLE TYPE	ACTION LEVEL (50% of either the current TLV or the PEL)	PRECAUTION IF ACTION LEVEL IS EXCEEDED	MONITORING FREQUENCY
GENERAL SITE ACTIVITIES (OTHER THAN CONFINED SPACES)			
TORCH/PLASMA ARC:			
Explosive gas.	>5% LEL.	No torch/plasma arc or abrasive saw cutting.	Prior to and during cutting.
Oxygen for processes where inerting is required.	>5%	No torch/plasma arc or abrasive saw cutting.	Prior to and during cutting.
Airborne contaminant fumes: zinc (galvanized steel) and nickel (stainless steel)	Zinc oxide 5.0 mg/m^3 Zinc metal dust 10.0 mg/m^3 Nickel metal dust 1.0 mg/m^3 Nickel tetra carbonyl 0.12 mg/m^3	No torch/plasma arc cutting	Prior to and during cutting.

Table 5-1 Monitoring Program Summary (Continued)

HAZARD/SAMPLE TYPE	ACTION LEVEL (50% of either the current TLV or the PEL)	PRECAUTION IF ACTION LEVEL IS EXCEEDED	MONITORING FREQUENCY
PCB's:			
Personnel.	0.5 mg/m^3 (8-hour TWA).	Ventilation/appropriate respiratory and dermal protection.	At the discretion of the on-site safety officer.

Table 5-1 Monitoring Program Summary (Continued)

HAZARD/SAMPLE TYPE	ACTION LEVEL (50% of either the current TLV or the PEL)	PRECAUTION IF ACTION LEVEL IS EXCEEDED	MONITORING FREQUENCY
OXYGEN:			
Area.	<19.5% or >25%	Ventilate the area. Stop work activities.	At the discretion of the on-site safety officer.
EXPLOSIVE GAS: (Other than Confined Space)			
Area.	>5%	Ventilate the area. Stop work activities.	At the discretion of the on-site safety officer.
CARBON MONOXIDE:			
Area.	12.5 ppm	Ventilate the area. Stop work until levels fall below action level.	At the discretion of the on-site safety officer.
PHOTOIONIZABLE GASES AND VAPORS (IP<10.2 V)			
Photoionizable substances (for undetermined air contaminants).	5 ppm (g)	Ventilation/appropriate respiratory and dermal protection.	When organic gases/vapors are suspected.
Photoionizable substances (for known air contaminants).	One half of the TLV or PEL or 10% of the PEL or TLV for carcinogens for the contaminant based on the relative response of the equipment. (g)	Ventilate. Don appropriate respiratory protection. Minimum upgrade is full-face piece APR.	When organic gases/vapors are suspected.

Table 5-1 Monitoring Program Summary (Continued)

HAZARD/SAMPLE TYPE	ACTION LEVEL (50% of either the current TLV or the PEL)	PRECAUTION IF ACTION LEVEL IS EXCEEDED	MONITORING FREQUENCY
NOISE:			
Area/Personnel.	85 dBA TWA.	Suitable hearing protection.	At discretion of the on-site safety officer.
	90 dBA.	Posting of area as noise hazard.	At discretion of the on-site safety officer.
HEAT STRESS:			
Oral temperature and heart rate monitoring(f).	Oral temperature of 38°C (100.4°F) and/or a heart rate of 110 bpm.	Use of ice vests, reduction in work cycle duration, or other approved measures.	Monitoring frequency will be dependent on work area temperature and the discretion of the on-site safety officer.
AIRBORNE DUST:			
Work area.	1 mg/m^3 total instantaneous at work zone perimeters.	Improve effectiveness of dust control measures or upgrade to full-face piece APRs with HEPA cartridges.	At discretion of the on-site safety officer.
OTHER CONTAMINANTS:			
Any other toxic atmospheric contaminant that may be present based on available information.	One-half of the PEL or TLV for the contaminant or 20% for carcinogens, whichever is more stringent.	Upgrade to an appropriate respirator and dermal protection as determined by the on-site safety officer.	At the discretion of the on-site safety officer.

(a) If action levels are exceeded, ventilation shall first be used to obtain acceptable conditions. If ventilation does not provide acceptable conditions, suitable protective clothing and respirators shall be worn for entry, in conjunction with ventilation.
(b) In no case shall confined spaces be entered with an atmosphere exhibiting greater than 5% LEL.
(c) Supplied air respirators (SARs) include full face-piece pressure demand self-contained breathing apparatus (SCBA) or full face-piece pressure demand airline respirators with escape SCBA.
(d) DAC — Derived air concentration.
(f) Monitoring will be performed when work area temperature exceeds 32°C (90°F), 29°C (85°F) when chemical protective clothing is required.
(g) If photoionizable substances are detected above 5 ppm, colormetric tubes shall be utilized to further identify the source. Benzene tubes will be pulled first followed by Chlorobenzene tubes.

5.1.8 Posting of Monitoring Results

Inquip shall review monitoring results with employees. Inquip shall notify and supply employees with the results of any exposure monitoring in accordance with any OSHA standard requiring such written notification.

6. GENERAL SAFETY

Inquip and Subcontractors are solely responsible for providing a safe workplace for their personnel who will be exposed to various hazards related to work at the area 2 site. These policies or rules and the Occupational Safety and Health Administration (OSHA) regulations must be strictly adhered to. Occasionally, site policies or rules can be modified to meet the needs of the chosen work method. OSHA regulations shall not be modified unless a formal variance is applied for and granted.

Where the provisions of the individual Subparts of Occupational Safety and Health Administration (OSHA) 29 CFR 1910 or 1926 require a "competent person", Inquip shall provide a qualified competent person meeting the specific requirements indicated in the Competent Person Checklist included in Appendix K.

6.1 Safety Reporting Requirements for Injury, Illness, and Property Damage

Injury, illness, and property damage reporting is taken very seriously by Inquip. Therefore, personnel are expected to comply with reporting requirements in an accurate and timely manner.

The on-site safety officer shall receive immediate notification of any occupational injury or illness to an employee. After proper notifications have been made, the on-site safety officer to ensure that required documentation is being completed shall use the Injury/Illness Checklist. Guide to Recordability of Cases Under the Occupational Safety and Health Act, provides guidelines for determining if the case is recordable under OSHA guidelines.

The on-site safety officer shall maintain a file for injury and illness documentation at the job site.

6.2 Tagging of Defective Tools, Materials, or Equipment

Defective tools, materials, and equipment shall not be used. The on-site safety officer shall take defective tools, materials and/or equipment out of service immediately by tagging, destroying, or removing them from the project. Personnel shall remove the tag only when the equipment has been properly repaired and is declared serviceable. Defective equipment tags shall be dated, sequentially numbered, and signed by the person tagging the equipment. Defective equipment tags shall also contain a description of the problem that requires the equipment, tools, or materials to be tagged. The Subcontractor shall maintain a defective equipment log. Standard tags shall be of nonreusable nylon fasteners to secure tags.

6.2.1 Equipment Caution Tagout

A caution tag is a warning device to identify operational equipment, systems and/or tools that require precaution or other items of information prior to operation. NOTE: Caution tags shall not be used for personnel protection (i.e., as a lockout/tagout).

6.3 Housekeeping

Inquip will strictly enforce housekeeping. All material, scrap, tools and toolboxes, and other equipment shall be stored in a neat and orderly fashion. Trash and scrap shall be removed from the work area on a regular basis (i.e., at least daily, before the end of each work shift) and shall never be allowed to accumulate, especially in walkways, under stairs, at the bases and landings of stairs and ladders, and near flammable substances.

6.4 Sanitation

6.4.1 General Requirements

Potable and nonpotable water containers and construction toilets shall comply with OSHA 29 CFR 1910.141 requirements. In addition to these requirements, single-use cup dispensers shall be provided adjacent to all potable water dispensers. Water shall not be dipped from containers. Water dispensers shall be clearly identified as drinking water. Drink stations shall only be installed in locations approved by the on-site safety officer. Rest areas shall be kept clean, and trash shall be removed from them daily. Trash receptacles shall be stationed in all eating areas and emptied regularly.

6.4.2 Requirements for Controlled Areas

For drink stations that are set up within the Controlled Areas of the site, personnel are required wash hands and face before receiving drinking water.

6.5 Illumination

Adequate illumination intensity shall be provided in all active work areas and accessways. Specified areas, outlined in the OSHA standard 29 CFR 1926.56 are included in Table 6-1. Working at night without proper illumination and at times when 5 ft candles cannot be achieved will not be permitted.

Table 6-1 Minimum Illumination Intensities in Foot-Candles

FOOT-CANDLES	AREA OR OPERATION
5	General construction area lighting.
3	General construction areas, concrete placement, excavation and waste areas, accessways, active storage areas, loading platforms, refueling, and field maintenance areas.
5	Indoors: warehouses, corridors, hallways, and exitways.
5	Tunnels, shafts, and general underground work areas: (Exception: minimum of 10 foot-candles is required at tunnel and shaft heading during drilling, mucking, and scaling. Bureau of Mines approved cap lights shall be acceptable for use in the tunnel heading.)
10	General construction plant and shops (e.g., batch plants, screening plants, mechanical and electrical equipment rooms, carpenter shops, rigging lofts and active storerooms, barracks or living quarters, locker or dressing rooms, mess halls, and indoor toilets and workrooms).
30	First aid stations, infirmaries, and offices.

6.6 Fall Protection

Inquip personnel shall utilize 100% fall protection practices. The term "100% fall protection" means the design and use of a fall protection system such that no exposure to an elevated fall hazard occurs. The OSHA fall protection standard will be strictly enforced. This standard requires, under certain conditions, that a fall protection plan be written, special training be conducted for each task, and several other additional requirements. This may require more than one fall protection system or a combination of prevention or protection measures. Section 6.6.3 provides definitions for the terminology used throughout this section. Fall protection is required in areas which include, but are not limited to:

- Any and all elevated work areas.
- Scaffolding.
- Power driven staging and platforms.
- Manbaskets.
- Roofs.
- Excavations.

A full body harness is required for elevated work above 6 ft. Safety belts will not be permitted. All fall protection equipment shall be inspected before use by the user and quarterly by a competent person.

Vertical lifelines may only be used in conjunction with a manufactured rope-grab system. Wire rope lifelines shall have a minimum of three wire rope clips. Cutting or burning around manila or nylon lifeline ropes is prohibited.

- Identify all fall hazards in the work area.

- Describe the method of fall arrest or fall restraint to be provided, including any drawings that may be deemed necessary.

6.6.1 Fall Restraint, Fall Arrest Systems

When employees are exposed to a potential fall hazard of 6 ft or more in height, Inquip shall ensure that fall restraint and/or fall arrest systems are provided, installed, and implemented according to the requirements in OSHA 29 CFR 1926 Subpart M, *Fall Protection*.

6.6.1.1 Fall Restraint

In general, all fall restraint protection shall be engineered out, if possible, by installing handrails or other types of passive systems. Fall arrest protection shall comply with the requirements of 29 CFR 1926.502, *Fall Protection Systems Criteria and Practices*.

6.7 Slip, Trip, and Fall Hazards

The construction site, especially roadways, access ways, aisles, stairways, scaffolds, and ladders, shall be kept clean and clear of hoses, extension cords, welding leads, and other obstructions, which may cause tripping, or other accident hazards. Slipping hazards such as grease, oil, water, ice, snow, or other liquids shall be cleaned up or eliminated on walkways, ladders, scaffolds, or other access ways or working areas. If slipping and/or tripping hazards cannot be completely eliminated, the area shall be barricaded and posted with applicable hazard postings.

6.8 Fire Protection and Prevention

Inquip shall take all necessary and appropriate precautions to prevent fires. Sufficient water and fire fighting equipment shall be available at all times to control fires as specified in Appendix H, and below. A 5-lb dry chemical fire extinguisher rated ABC must be located in all trailers as per National Fire Protection Association (NFPA) 10. A 20-lb fire extinguisher rated ABC must be provided within 75 ft, but no closer than 10 ft to all fueling operations and flammable storage areas. All vehicles transporting 50 gal or more of flammable or combustible liquids are required to carry 5-lb ABC fire extinguishers or larger units.

Access routes to fire extinguishers shall be kept clear at all times. All fire extinguishers shall be inspected monthly, annually, and every 6 years in accordance with the NFPA 10 standard on fire extinguisher inspections.

Open burning of trash and debris shall not be permitted. If there is a danger of accidental fire, a person shall be designated as fire watch and shall be dedicated solely to this effort during cutting/welding operations and shall continue this duty for 30 minutes after such operations are completed.

Flammable or combustible liquid storage shall comply with NFPA 30 and OSHA 1926.152. All gas cans shall be free of deformities and constructed of metal, with self-closing lids and flame arresters. Fuel cans shall be labeled as to their contents. Fuel cans shall not be transported in vehicle passenger enclosures (i.e., vans, truck cabs, inside vehicles, etc.). Fuel cans must be secured during transport. All equipment shall be fueled through funnels or spouts to prevent spills.

6.9 Fuel Storage Tanks

All stationary fuel storage tanks shall be equipped with a secondary containment device of compatible material that has the capacity to collect 100% of the contents of the largest tank.

Secondary containment structures for all fixed tanks and portable tanks containing 660 gallons or more should meet following criteria:

- Dikes shall not exceed 6 ft, unless the additional provisions of NFPA are considered.
- The outside base of the dikes must not be within 10 ft of any property line or greater as determined by the quantities identified in NFPA and OSHA, whichever is more stringent.
- Bottoms of dikes must have a minimum 1% slope away from the tanks contained therein.
- No loose combustible material, empty or full drum or barrel shall be permitted within the diked area.
- If two or more tanks are within a dike area they must be further subdivided by drainage channels or intermediated dikes with a minimum height of 18 in.
- Provisions for draining dikes, when provided, shall be accessible from the outside in the event of a fire, and be controlled in a manner to prevent discharge into natural water courses, public sewers, and public drains.

- Diked areas must provide for sufficient volume of the largest tank, and any additional volume of all other tanks within the common diked area at the level of the dike.

- Must include additional volume for freeboard to contain additional precipitation or be provided with a means of preventing the accumulation of precipitation.

- If precipitation does accumulate in the containment, the Subcontractor shall have this material pumped out from the containment in a timely manner. This will require coordination with the Contractor's Compliance Department and the use of the Discharge Disposition Form (DDF).

Portable tanks less than 660 gallons must meet the minimum following requirements:

- Surround the portable tank with a curb at least 6 in. high with provisions for draining accumulations of ground or rainwater of spills of liquids. Drains must terminate at a safe location and shall be accessible to operation under fire conditions.

- Grading surfaces in a manner to divert possible spills away from buildings or other exposures is not an option *Spill Prevention Control and Countermeasure (SPCC) Plan.*

Finally, where discrepancies exist between definition or fire protection requirements, resolution should be coordinated with the individual site needs and with individuals having jurisdiction in this area.

6.10 Waste Storage Tanks

Tanks containing hazardous waste as defined by 40 CFR 261 should be designed and managed according to 40 CFR 264 Subpart J. Tanks containing materials regulated under *Toxic Substance Control Act* (TSCA) should be properly marked and managed according to 40 CFR 761. TSCA storage containers must meet the requirements stated in 40 CFR 761.65(c)(6) and (7). Tanks that contain liquids that are not regulated under existing environmental regulations should be marked with a description of the contents.

6.11 Material Handling and Storage

All new material shall be stored on dunnage and secured as necessary to prevent blowing, falling, sliding, or collapsing. Debris and scrap material need not be stored on dunnage if the material is not to be moved with rigging and can be maintained in a stable manner.

Walkways and aisles shall be kept clear at all times, and laydown areas shall be neat and orderly. Material shall be stored on level ground, and the boundaries of laydown areas shall be identified. Material shall not be stored within 6 ft of hoistways or floor openings, or within 10 ft of roof edges. Poles, pipe, and other stock that may roll shall be wedged to prevent spreading and rolling.

Nails shall be removed from lumber that is to be reused. Nails in scrap lumber that will not be reused shall be bent back.

No material, tools, or equipment shall be leaned against other objects or walls unless they are secured from movement. Employees moving material by hand shall use proper lifting techniques and gloves. Safe working load limits shall be labeled on all temporary elevated floors or platforms and these limits shall not be exceeded.

6.12 Tools

All tools shall be kept in good condition and properly stored. Tools shall not be altered, and they shall be used only for their intended purposes and within manufacturer guidelines. Guards shall not be removed from tools, and all nip points, open drums, and fly wheels shall be guarded. All tools shall be inspected by the user before use with special attention given to power cords and the condition of teeth. If a power cord has been damaged, the tool shall be tagged defective in accordance with Section 6.2, and not used until a new power cord is installed.

Power tools shall be equipped with constant pressure switches that will shut the tool off when the switch is released. All power tools and electrical equipment shall be double insulated or be equipped with ground plugs.

Employees using powder-actuated tools shall be qualified and have on their person a card stating such. The loads for powder-actuated tools shall be kept in a locked red box labeled "EXPLOSIVES" which shall be kept in a locked area with restricted access.

All bench mounted and floor mounted tools shall be secured. Bench mounted grinders shall be set up and operated according to 29 CFR 1926.303. Tools equipped with handles shall have the handles installed. Cracked, splintered, or taped wooden handles shall be replaced. Cheater bars will not be permitted.

Impact tools shall be free of mushroomed heads and cracks. Work benches and sawhorses shall be provided when needed. All cords, hoses, and leads must be kept out of walkways. They must be strung seven ft or more over walkways or along the sides of walkways. Cords, hoses, and leads are not to be exposed to vehicle or equipment traffic unless protected. Cords, hoses, or leads must never be attached to the handrails of any type of manlift, scissorslift, or scaffold unless

breakaway attachment is used. They must never be supported by a conductive material or ran through doorways, manways, or other wall or floor openings unless protected from damage. Any damage detected on cords, hoses, and leads will require removal from the project. Repairs are not permitted.

6.13 Torch/Plasma Arc Cutting, Welding, and Open Flame Requirements

Personnel shall identify the need to conduct cutting, burning, or open flame work. When the need has been identified, the on-site safety officer shall complete Section 1 of a Cutting/Welding/Open Flame Permit.

The term "open flame" designates flame produced by gas, arc welding, acetylene burning, blowtorches, or any other spark or flame-producing device. A permit is also required prior to the use of torpedo heaters.

At a minimum, fire prevention equipment shall consist of one 10 lb, dry chemical extinguisher rated ABC. A live water line meeting the requirements of OSHA 29 CFR 1926.150 or a water pump extinguisher may be used to supplement a dry chemical extinguisher. The work area shall be barricaded and posted; the equipment shall be inspected; exits shall be identified; emergency procedures shall be in place.

The approved permit shall be available for inspection and review in the immediate work area. Adjoining work areas shall be inspected and workers in the immediate vicinity shall be notified.

Upon completion of the above requirements and the precautionary items addressed in the permit, work may commence. The permit may be issued for more than 1 day.

Torch/plasma arc cutting or welding on galvanized steel, stainless steel, or nonferrous metals shall be performed using the PPE requirements in Section 4. In addition, engineering controls (local exhaust with HEPA filtration) shall be required to reduce exposure levels to below action levels identified in Section 5. Respiratory protection is necessary until monitoring indicates exposure levels below the action levels identified in Section 5.

Compressed gas cylinders shall be secured in an upright position at all times. Burning rigs shall be broken down at the end of each shift. Fuel gas hoses shall be stored in a ventilated area (never in gang boxes). Compressed fuel gas cylinders shall not be taken into confined spaces. All other rigs shall be stored in accordance with OSHA standards. Empty cylinders shall be removed at the end of each shift. Burning rigs shall be equipped with flashback arrestors at the torch end of each hose.

If there is the potential for accidental fire during burning or welding operations, a trained fire watch shall be established in accordance with OSHA and DOE requirements and continued until 30 minutes after the work has been completed. When there is possibility of injury during burning or welding operations, overhead burning signs and welding blinds shall be installed. A 10 lb dry chemical fire extinguisher rated ABC must be readily available to any welder or employee operating a burning or welding rig.

Welding leads, including lugs on the welder and lead connections, shall be fully insulated at all times. Damaged leads and dry-rotted fuel hoses shall be removed from service. Leads and hoses shall be protected from vehicle or equipment traffic.

6.14 Lockout/Tagout/Try of Energy Sources

Individuals or crews applying locks and or tags to isolate energy or potential energy shall prepare and enforce a LOTO plan for each point of operation or system being locked and/or tagged out. A lead, trade, or crew chief, will not be permitted to LOTO on behalf of the crew. Inquip requires a LOTO for each crew member. Where a lock or locking device cannot be installed, a tag only shall be used (one for each worker). However, additional cautions and barricades will be required.

6.15 Electrical

Work on energized circuits will not be permitted without approval from the on-site safety officer. Repairs to electrical equipment shall be performed by a qualified electrician only. The authorized employee must be a qualified person as defined in OSHA 1910 Subpart S, *Electrical*.

Ground fault circuit interrupters (GFCIs) shall be required at all times.

Lighting must be hooked to a GFCI unless the electrical connections are different from all other electrical hookups and cannot be mistakenly exchanged. All lights must be equipped with protective, nonconductive covers, and all light bulbs in light stringers must be shatterproof. Exposed, empty light sockets or broken bulbs are not permitted. Burned-out bulbs shall be replaced in a timely manner. Portable lighting used in wet or in other conductive locations shall be operated at 12 volts or less. However, 120 volt lighting may be used if it is hooked up to a GFCI.

Electrical installations must have on-site safety officer approval before being energized. Electrical installations in potentially hazardous locations must have approval prior to being installed. Electrical panels, boxes, etc., with open knockouts through which no service has been installed must be covered. All job trailers shall have a main service disconnect located at a readily accessible location outside and within 30 ft of the trailer, but not attached to the trailer.

Electrical cords and equipment shall not be hung or tied to steel or hung with wire unless a nonconductive material is used to insulate the cord from the metal. Plastic coated wire shall not be used to hang electrical cords. Cords that pass through doorways, holes, or are exposed to vehicle or equipment traffic shall be protected from damage. Flexible electrical cords shall not be spliced or have insulation repaired with tape. Replacement cord ends used for repair of flexible electrical cords shall be constructed of plastic or rubber and shall encapsulate all connections. Extension cords shall be made of #14 conductor or larger. Portable electrical equipment and extension cords used in highly conductive work locations (e.g., areas inundated with water or other conductive liquids) or in locations where employees are likely to have contact with water or conductive liquids, shall be approved for use in those locations. Employees shall not plug or unplug flexible electrical cords while their hands are wet or when standing in accumulated water or other conductive liquids.

All breaker boxes, electrical receptacles, and feed lines shall be labeled to identify the circuits they are feeding or are being fed from. All breaker boxes and disconnects shall be provided with unobstructed access 36 in. in front of the unit. All 480-volt lines shall be clearly labeled. When passing over or through walkways, electrical cords shall be strung at least seven ft above the walking surface.

Inquip shall comply with codes in the current NFPA, National Electric Codes (NEC), and 29 CFR 1926 Subpart K.

6.16 Ladders

All ladders shall be inspected before use and properly stored on dunnage or ladder racks. Tools and material shall not be left on the top platforms of unattended ladders, and material shall never be stored on ladders. All ladders shall be labeled with legible manufacturer instructions and warning labels. Ladders shall not be painted except for identification marks.

All ladders shall be type 1A and shall be wooden or have fiberglass siderails with metal rungs. The bases and landings of all ladders shall be kept clear of obstacles. Stepladders shall not be used as straight ladders, and extension ladders shall not be separated for use. All ladders shall be equipped with skid-resistant feet. If a ladder is used in a doorway, the doorway must be barricaded. Ladders shall not be used in lieu of elevated work platforms.

Employees shall never carry material when climbing ladders, nor shall tools or equipment be thrown to or from personnel on ladders. Handlines shall always be used to hoist material. Personnel shall not climb to the top step or top platform of any ladder. When in use, ladders shall be held or secured by tying off. Personnel working on ladders shall not straddle the ladder or overreach so that the body is no longer between the siderails.

Job-built ladders shall be inspected by a competent person and shall meet the OSHA standards contained in 29 CFR 1910 Subpart D, *Walking-Working Surfaces*. In addition, all job-built ladders shall have a furring strip attached over the filler block and rung.

6.17 Scaffolding

Inquip shall develop a scaffold erection, inspection, and tagging system for scaffolds and other elevated work platforms.

Scaffolding shall be erected and used according to the most stringent interpretation of the applicable safety regulations. Only heavy-duty (75-psf) scaffolds will be permitted. All scaffolding shall be erected, modified, used, moved, maintained, dismantled, and inspected under supervision of a competent person. The competent person must also ensure that scaffolds comply with the requirements of OSHA 29 CFR 1926.451 (Subpart L). All scaffolding shall be built as completely as possible. This means all decks must be complete (e.g., if handrails, midrails, and toeboards can be installed, they must be installed). An access ladder or a built-on scaffold ladder shall be used for personnel to reach their work areas. Personnel shall not climb on or use scaffold cross members or end buck supports for access.

All scaffolds shall be equipped with access gates. Climbing through hand rails shall not be permitted. If a chain or slide bar is used as a gate, a landing between the ladder and the gate shall be erected so that personnel can safely leave the ladder before unchaining the gate or moving the slide bar. A landing shall not be required if a self-closing gate is used. All scaffolds shall be equipped with handrails (if possible), regardless of the height of the scaffold. If personnel are required to work under or pass under a scaffold, the area between the guardrail and toeboard shall be screened with No. 18 gauge 1/2-in. mesh wire or equivalent.

Aluminum scaffold boards shall be used whenever possible. Scaffold boards shall not be notched, nailed, used as bearers, or used on the ground as walkways. All scaffold boards shall be cleated and tied with No. 9 gauge wire to prevent displacement. Scaffold boards shall be placed together tightly with a maximum space between the planking and toeboard of 1/4 in. Crawling boards and chicken ladders are prohibited.

Parts from scaffolds made by different manufacturers shall not be interchanged. Welded frame scaffolding shall not be repaired or altered. **Anti-sway bars shall be installed on all rolling scaffolds**; only welded frame scaffolds may be used as rolling scaffolds. Personnel shall not ride on rolling scaffolds.

- Fall protection and ladders shall be used whenever feasible during erection and dismantlement.

- Scaffolds shall be in complete compliance with all items on the Stationary Scaffold Inspection Checklist or Rolling Tower Inspection Checklist before and during use.
- If a scaffold is out of compliance, a competent person shall remove the signed Scaffold Approval Tag (Appendix A) and attach a Danger Tag (Appendix A).
- Scaffolds shall not be used until the Scaffold Approval Tag is signed, dated, and located at all access points to a scaffold by a Subcontractor competent person.
- Fall protection shall be used when scaffold height exceeds 6 ft unless scaffolds are complete with a full deck, toeboards, midrails, and handrails on all unprotected sides.
- Riding on scaffolds will not be permitted.
- If a deficiency is identified or a modification is required, the Subcontractor competent person shall remove all scaffold approval tags and replace with Danger Tags. These scaffolds shall not be used until an inspection has been completed by both Subcontractor and PMC competent persons.

6.18 Power-Driven Staging and Platforms

All equipment discussed in this section must be inspected by the on-site safety officer before initial use and by the employees prior to every use. In addition, a documented inspection by a competent person must be conducted quarterly.

The employees shall ensure that any hoses, cords, and leads are routed away from foot and vehicular traffic areas. Vehicular traffic is prohibited from running over exposed cords, hoses, and leads.

All operators of power-driven staging and platforms shall be trained in their use, and the training records shall be submitted to the Contractor. A copy of the owner's manual shall also be kept on each platform. All power-driven staging and platforms shall be properly placarded, and controls shall be clearly labeled.

Operators shall use a check sheet during pre-operational inspections and shall verify the inspection by signing the sheet. The Subcontractor shall keep these check sheets on file. All manufacturer's recommendations for inspections and operation shall be followed.

Handrails and complete midrails shall be kept in good repair. Secondary independent lifelines shall always be used on power staging, and all personnel shall be secured to it.

Power platforms shall not be used to hoist material nor shall personnel exit platforms except when the platform is on the ground. If welding or cutting operations are performed on a power platform, the loadlines and lifelines shall be protected.

All Subcontractor personnel who operate or use power-driven staging and platforms at area 2 shall be instructed on proper operation prior to use.

6.19 Manbaskets

Manbaskets shall not be used except when the total exposure of performing the task by another method would be more hazardous. The on-site safety officer will inspect manbaskets before initial use, and the employee will inspect them prior to each use. Test lifts and crane requirements will be strictly enforced.

A checklist shall be completed and signed during pre-lift meetings, and safety instructions shall be read by personnel entering the basket as well as by the crane operator.

All manbaskets shall be equipped with overhead protection. When cutting or welding is being done from a manbasket, the rigging shall be protected. During welding, a nonconductive link shall be installed on the load line. Only rigging that has never been used for any other purpose shall be used with the manbasket.

6.20 Signs, Barricades, Guardrails, Handrails, Covers, Stairs, Decks, and Ramps

All signs shall be properly colored and labeled as prescribed by OSHA standards. Signs shall be constructed of metal, fiberglass, or plastic and shall be promptly removed when no longer needed. Signs shall also be conspicuously placed in conjunction with barricades. No minimum spacing is required unless otherwise specified in 29 CFR.

The types of barricades permitted on the project include rope, tape, and hard barricades. The color of the barricades shall coincide with the OSHA color classifications. If hazard information is not printed on barricades at doorways, signs or tags shall be attached to the doorways. Construction fences are physical barriers.

Tape barricades shall be installed at a height of 42 in. and at a distance of 5 ft from the hazard. If a hazard is more than 10 ft high, the barricade shall be 1 ft farther away for each additional 5 ft of hazard height. Hard barricades may be adjacent to hazards unless the hazard is elevated. Hard barricades shall be 42 in. high, include midrails, and be capable of withstanding a 200-lb force in any direction. If work is taking place beneath a barricaded area, hard barricades shall be equipped with toeboards. If the area below is a walkway or passageway, the area between the barricade

midrail and toeboard shall be screened or blocked. All areas where there is a potential for falling objects shall be barricaded.

Turnbuckles shall be used when a barricade is constructed of wire rope.

Guardrails shall be erected whenever a walking surface changes elevation by more than 2 ft. Tape barricades may be used for this purpose, but such a barricade must be 5 ft from the change in elevation. All changes in elevation shall be marked with some kind of warning such as yellow and black tape or fluorescent orange paint. Handrails shall have smooth surfaces or be taped to prevent splinters. All wall openings shall be guarded. When a door opens onto a platform, the width of the door shall not reduce the effective width of the platform to less than 20 in.

Runs and risers on all stairs shall be constructed in accordance with OSHA regulations. Ramps shall have a maximum angle of 7°.

Stairs leading to office and warehouse trailers shall be firmly anchored and equipped with handrails. Risers, including the top and bottom steps, shall be of equal height.

Floor hole covers shall be labeled "WARNING - TEMPORARY HOLE COVER - DO NOT REMOVE OR STORE MATERIAL." Hole covers shall be cleated and constructed of 3/4-in. plywood with supports 18 in. on center or less.

6.21 Cranes

Before they may be used, all cranes shall be inspected by the on-site safety officer according to the Mobile Crane Safety Inspection Report that outlines requirements with respect to American National Standards Institute (ANSI) standards, and OSHA regulations.

Cranes that do not pass inspection will not be permitted to operate at the area 2 site until all faults are corrected. All cranes must have annual inspections by independent Contractors and must be accompanied by a signed copy of an Annual Inspection Checklist. Operators shall complete a pre-operation checklist before each shift. This checklist shall be maintained by the operator and made available upon request. The operator shall comply with the manufacturer's specifications and limitations on the operation of any crane. Rated load capacities, warnings, and other instructions shall be legible and conspicuously posted on all cranes. No modifications shall be made to a crane without written approval from the manufacturer.

All cranes shall be set up within 1° of level. Unless otherwise approved, all lifts shall be made on fully extended outriggers, and outrigger pads shall always be used. These pads shall be constructed of hardwood and sized three times larger in area than the float. The crane shall be

standing on a firm, uniform supporting surface with outriggers fully extended and tires raised free of the supporting surface. Picks off rubber shall be performed as specified by the manufacturer's load chart.

For pick and carry operations, the boom must be centered over the front of the crane with the swing brake locked or the mechanical swing lock engaged. Minimum boom point height shall be used and loads shall be carried close to ground surface. No on-tire operation shall be performed with the jib erected. Pick and carry operations shall be done according to manufacturer's recommended load charts and tire pressures.

All picks that exceed 75% of the capacity of a crane (the configuration and the chart rated capacity in that configuration), all tandem picks, and all picks adjacent to power lines or over critical process piping require critical lift plans. These plans shall, at a minimum, detail the load to be lifted, the maximum load radius and boom angle, the picking points, the capacity of the rigging, and the rigging configuration. All critical lifts must be approved by the on-site safety officer

The weights of all loads must be known, or a load-indicating device must be used. Only qualified operators shall operate cranes. Operators shall be provided with rigging and crane handbooks. All cranes shall be equipped with anti-two-blocking devices. All cranes equipped with outriggers shall be marked indicating full extension, and telescoping boom cranes shall have markings on the boom indicating the length of boom extended. Each crane shall have a 5 lb dry chemical fire extinguisher rated ABC.

All lattice boom cranes with structural damage to cords and/or lacings shall be immediately removed from service. All structural repairs to damaged booms shall be approved by the crane manufacturer and shall be performed in accordance with specifications and procedures prescribed by the crane manufacturer. Following all repairs to a boom, the crane shall be load tested prior to initial use. Test loads shall not exceed 110% of the rated load at any working radius. Testing shall be in accordance with SAE recommended practice, *Crane Load Stability Test Code* J765 (April 1961).

Wire rope inspections shall be made and records shall be maintained by the operator and made available upon request.

Cranes shall be operated only by the following qualified/competent personnel: designated operators, trainees under the direct supervision of a qualified trainer, maintenance and test personnel when necessary in the performance of their duties, and crane qualified inspectors.

Crane operators shall be in visual or radio contact with a qualified flag person before and during every lift. If visual or radio contact is interrupted for any reason, the operator shall stop the lift until full contact is restored.

The crane shall be capable, within manufacturer specifications, of fulfilling all requirements of the work without endangering personnel or equipment.

The operator shall check the load line brake and the crane for stability when the load is only inches from the ground before proceeding with any lift.

The operator shall be responsible for the equipment and load during a lift or pick. The operator shall not attempt any lift which might compromise the safety of the operation. The operator shall ensure proper rigging techniques are used prior to lift. A suspended load shall never be left unattended. Cranes shall be operated smoothly, avoiding sudden stops and starts. The hoist line shall be vertical at all times. Personnel shall not stand or pass under suspended loads. Personnel shall not be allowed to ride the hook or load. The boom hoist drum pawl shall be engaged at all times except when lowering the boom. Operators shall ensure that all frequent and periodic inspections are current before operating the crane.

Safety latches on hooks shall be serviceable, and two pair of orange gloves shall be kept on each crane for use by flagmen.

An operator shall not leave the control station of a crane during a lift or pick except under the following conditions:

- When the load is lowered or raised to a safe landing area with no tension on the load line.
- After placing all brakes, pawls, switches, and clutches in a safe position.
- After turning the crane over to another qualified operator.
- After supporting the load by other means, such as cribbing, manufacturer sleds or frames, suspended rigging, or another crane.

Employees shall not get on or off a crane while it is in motion. Adjustments, repairs, or lubrication shall not be permitted on operating equipment unless it is required by manufacturer recommendations.

Tag lines shall be required on all loads. Use as many tag lines as necessary to adequately control the load during the lift and while landing.

Unless installed by the manufacturer, tool boxes, oil cans, choker racks, water coolers, or other items shall not be placed within the swing radius of the counterweight. The oiler shall stand clear

of the swing radius and assist the operator in keeping other employees outside the swing radius. The swing radius of the rotating counterweight shall be barricaded with a complete "no entry" barricade.

Crane load charts and the operator's manual for that particular crane configuration shall be located in the cab of each crane along with rated load capacities, recommended operation speeds, special hazard warnings, or instructions. Crane load chart capacities shall not be exceeded.

If a rental or Subcontractor crane is to be used and the load chart is 85% capacity, the chart shall be reduced to 75%. This is done by establishing 100% capability of the crane and reducing the capability by 25%. For hoisting of personnel, 50% maximum is allowed.

The superintendent of the crane operator shall ensure that the qualified operator is fit for duty. The superintendent shall check the area with the operator for any unusual conditions that could interfere with the lift or pick; shall conduct a safety briefing session concerning the lift or pick; shall tell the operator to stop the lift if there are any questions or concerns and contact the foreman immediately; shall check the mechanical and operating condition of the crane with the operator; shall assist the operator as needed for difficult or critical lifts; shall make sure the counterweight is barricaded; and shall coordinate the lift with the operator and the flagmen of the crew using the crane.

The foreman of the crew using the crane shall ensure that the area is checked for any unusual conditions and take action as needed to ensure a safe lift. The foreman shall give a lift safety briefing session to the crew and shall include the operator in lift instructions. One or more flagmen, who are specifically trained and qualified in accordance with hoisting, rigging, and operating procedures shall be assigned, as needed, to provide all signals to the crane operator and coordinate signals and other means of communication between multiple flagmen and the operator.

All riggers/signalmen shall be properly trained, qualified, and provided with a rigging handbook. They shall: clear the lift path prior to signaling the operator to start the lift and be present during the entire lift until replaced by another qualified flagman; be constantly aware of the location of the load in relation to line of travel and potential interferences; and watch for unauthorized personnel in the lift area or within the swing radius of the crane counterweight. No one shall be allowed to stand or pass under a suspended load. Flagmen shall assist the operator in checking for interferences within the swing radius of the counterweight; shall assist the operator in checking the boom location in relation to other interferences, obstructions, or power lines; and shall be in full view of the operator or in direct communication by radio or other approved sound-powered phones. Flagmen shall also give clear hand or voice directions, coordinate responsibility with other flagmen if more than one is needed for the lift, and stop the lift if any unusual condition or event occurs that could jeopardize the safe completion of the lift.

If there is an on-site crane related accident or incident, the equipment, rigging, and load are not to be moved (except for life saving activities) until after a investigation has been completed.

6.21.1 Crane Inspection

Applicable ANSI B30 series daily, monthly, quarterly, semiannual, annual, and special inspections shall be completed prior to operating any crane. All inspections shall be completed by a qualified inspector following manufacturer's recommendations and specifications.

Crane inspections shall include, at a minimum, all control mechanisms for maladjustment interfering with proper operation, excessive wear of components, and contamination by lubricants; all safety devices for malfunction; hydraulic, air, oil, and coolant systems for leaks; proper operation of electrical systems and condition of wiring; crane hooks for deformations or cracks; rope reeving in compliance with crane manufacturer's recommendations; and wire rope condition. Kinking, crushing, birdcaging, unstranding, corrosion, broken wires, broken strands, excessive wear, reduction of rope diameter, or improperly applied end connections are factors which determine whether further use of rope would constitute a safety hazard.

Completed daily, monthly, and annual inspection forms shall be available in a weather-proof container on the crane at all times. Copies of all completed forms shall be maintained for every crane.

6.21.2 Mast or Tower Crane

A special safety harness continuously attached to a lifeline shall be provided and used by all personnel climbing to the crane cab. Only one person shall be permitted in the cab of the mast crane.

Loads shall be lifted with the load line only. The boom shall be in a fixed position before raising the load line.

The operator shall shut down the crane if the wind velocity reaches the maximum recommended by the manufacturer, as measured by the anemometer mounted on the crane.

6.21.3 Movement of Cranes (Under Their Own Power)

The superintendent of the crane operator shall assign a qualified crew to the crane and ensure the proper operating and mechanical condition of the crane.

The superintendent shall ensure the proper loading and securing of the crane on the lowboy; provide a qualified flagman for signaling in close quarters, such as turns, gates, intersections,

congested areas, overtaking traffic, etc.; and ride as escort with the responsible supervisor in the escort vehicle immediately in front of the tractor, to assist the supervisor in observing for anticipated obstructions, interferences, and road problems.

The foreman of the electrical escort (where electrical escort is required) shall ensure that a fully qualified electrical lineman escort is assigned and shall fully instruct the assigned lineman as to his position in the caravan (number two directly behind patrol). His responsibilities include observing all potential electrical or overhead line interferences, relaying such information to the escort superintendent before questionable conditions become a problem, and "on foot" observation of the interferences at gates, congested turns, and other constricted areas.

A superintendent or safety supervisor shall be responsible for each crane movement and shall personally direct planning of the movement with consideration to routing, turns, speeds, stops, terrain, weather conditions, and traffic. The safety supervisor or superintendent shall inspect and approve the positioning and securing of the crane on the lowboy before movement begins; halt the movement operation if any question arises concerning safe movement of the crane; and ensure that proper permits are completed before going into Controlled Areas.

The foreman of the crane operator shall also ensure the proper operating and mechanical condition of the crane, know the hazards on the travel route, include in the safety briefing for the operator and flagman that one or more flagman shall escort the crane when en route over congested roads, and minimize the need for travel during heavy traffic periods. An escort vehicle equipped with yellow caution lights may be used when traveling long distances or when the boom or any of its attachments extends more than 20 ft in front of the crane. The foreman shall ensure that travel speed is commensurate with traffic and road conditions, that a qualified electrical lineman escort is available if the crane is to come within 20 ft of any power lines, and that all cranes are equipped with a horn signal system (i.e., one blast to move forward, two blasts to stop, and three blasts to back up).

The flagman shall be qualified and competent, maintain a position in full view of the operator and use proper hand signals, wear a high visibility vest and high visibility gloves, and watch for any unusual condition or event that could interfere with the safe movement of the crane.

The safety supervisor shall personally direct planning of the move; consider routing, turns, speeds, stops, terrain, and weather conditions; and ensure compliance with the plan for movement.

6.21.4 Critical Lifts

A critical lift plan shall be prepared by the superintendent of the crane operator for all critical lifts. The following minimum information shall be included:

- Reason for the necessity of the critical lift
- Type of crane
- Crane location
- Load location
- Boom angle
- Radius
- Weight of total load (weighing may be necessary)
- Dimensions of load
- Attachment points for rigging
- Obstructions in path of load
- Rigging hardware and configuration
- Crane operator qualifications
- Crane load chart (or copy thereof)
- Other equipment or cranes involved

The Contractor Hoisting and Rigging Committee shall approve all critical lifts. If any deviation from crane manufacturer recommendations is anticipated, approval shall be secured from the manufacturer and included for evaluation.

Critical lifts are lifts that require exceptional care because of size, weight (any lift with a total weight in excess of 75% of the capacity of the crane), close-tolerance installation, high susceptibility to damage, use of two cranes, or other unusual factors. An example of a critical lift is one in which a collision, upset, or drop could result in:

- An unacceptable delay to the schedule or another significant program impact due to damage.

- A significant release of radioactive material or other hazardous material.

- An unacceptable risk of injury or a significant adverse health impact.

- Undetectable damage that would jeopardize future operations or the safety of a facility.

6.21.5 Crane Work Near Overhead Power Lines

When planning crane placements, every effort shall be made to select locations that are least likely to allow any part of the crane or load to come within 15 ft of a power line by rotation, boom extension/elevation, or crane movement.

When frequent, repetitive crane work is to be performed near overhead power lines, consideration shall be given to having the lines relocated or de-energized.

When the job requires that a crane or the load come within 10 ft of an overhead power line, a written plan shall be prepared. All power lines shall be de-energized and grounded whenever possible.

The minimum clearance to any power line rated at 50 kV or below shall be 10 ft. For lines rated over 50 kV, minimum clearance shall be as required per OSHA 29 CFR 1926.550.

A written plan shall be developed to specify job details and special safety measures provided to ensure worker safety. The plan shall be approved by the on-site safety officer who shall review the measures taken to make the job safe (e.g., special tools, equipment, grounding). Written plans shall include unexpected situations (e.g., equipment drawing arcs, emergency responses, electrical shocks, the need to quickly de-energize the line), and instructions for handling them.

The following shall be considered before starting work within 10 ft of overhead energized power lines: allow daylight work only; allow no work on a rainy or foggy day; place a rubber blanket on the line; provide lineman's gloves and boots for operators and other exposed persons (riggers, etc.); provide rubber boots for operators; place rubber blanket on the operator's seat; insulate the crane boom; provide insulated tag lines; ground cranes per OSHA 29 CFR 1926.550; allow no one on a rig but the operator; post a special signalman to maintain line clearance; and provide detailed drawings and controls to ensure that equipment does not violate "minimum clearances."

Cranes and other heavy equipment shall not be operated within 3 ft of power poles or guy wires supporting these poles.

6.22 Rigging

6.22.1 General

All rigger's signalmen shall be properly trained and provided with a rigging handbook. Documentation of training shall be provided to the Contractor. Major rigging operations must

be planned and supervised by competent personnel to ensure that the best methods and most suitable equipment are employed.

The on-site safety officer shall have the authority to cancel hoisting and rigging operations based on consideration of weather, condition of lifting hardware, electrical line clearances, or any other factor, which in the judgement of the on-site safety officer may adversely affect the successful conclusion of the lift. All rigging must be protected from flame cutting and electric welding operations and from contact with solvents and chemicals.

6.22.2 Equipment Inspection and Testing

When special fabricated devices are required for hoisting and rigging operations (e.g., lifting beams, material baskets, and spreader beams), the design and calculations for the device shall be reviewed and approved by the on-site safety officer.

All rigging shall be inspected by a competent person before each use and marked as inspected at least annually. All rigging shall be clearly labeled with its capacity. All rigging shall be stored in a rigging loft or an equivalent area where it will not be exposed to the elements.

Hoisting and rigging equipment for material handling shall be visually inspected prior to use on each shift, and as necessary during its use to ensure that it is safe. Hoisting and rigging equipment shall be load tested at least annually by a competent person, who by training and experience, is capable of recognizing defects and taking the appropriate action to correct or eliminate them.

6.22.3 Safe Working Loads

Hoisting and rigging equipment shall not be loaded in excess of its recommended safe working load, as prescribed in Tables H-1 through H-20 of OSHA 29 CFR, 1926 Subpart H, (1926.251, *Rigging Equipment for Material Handling*). Special hoisting devices, slings, chokers, hooks, clamps, or other lifting accessories shall be marked to indicate the safe working loads and shall be proof-tested prior to initial use to 125% of their rated load.

The load weight must be determined before it is rigged. The gross load, which is the sum of the weight of the rigging, block, hooks, lifting beam, stowed or erected jibs, headache ball, other elements of rigging or equipment and the load, must be accounted for when determining hoisting equipment. Safe working loads of hoisting equipment apply only to freely suspended loads on plumb hoist lines. If hoist line is not plumb, additional side loads will compromise the stability and introduce stresses which exceed equipment designs. Rapid swinging of loads also adds additional stresses and minimizes stability. The load must always be directly below the boom point or upper load block.

The center of gravity must be below the hook and below the lowest point of attachment to ensure stability. Softeners must be used to protect slings at sharp corners. Sharp bends, pinching, and crushing should be avoided. The eye section of wire rope slings must not be bent around corners.

6.22.4 Wire Ropes

Wire ropes shall be kept in good repair and without deformities. Wire ropes with visual signs of kinking, crushing, unstranding, birdcaging, main strand displacement, core protrusion, loss of rope diameter, unevenness of outer strands, corrosion, heat damage, abrasion, broken wires or strands and cracked, worn, or deformed end attachments should be considered in evaluation of sling replacement. Wire rope shall not be used if in one rope lay there are 10 randomly distributed broken wires or five broken wires in one strand.

Tables H-3 through H-14 of OSHA 29 CFR 1926, Subpart H, (1926.251, *Rigging Equipment for Materials Handling*) shall be used to determine the safe working loads of various sizes and classifications of improved plow steel wire rope and wire rope slings with various types of terminals. For sizes, classifications, and grades not included in these tables, the safe working load recommended by the manufacturer for specific, identifiable products shall be followed, provided that a safety factor of not less than 5 is maintained. Wire rope with protruding ends of strands in splices on slings and bridles shall be covered or blunted. Wire rope application use limitations shall be in accordance with 29 CFR 1926.251(c)(4). When U-bolt wire rope clips are used to form eyes, Table H-20 of OSHA 29 CFR 1926, Subpart H, (1926.251, *Rigging Equipment for Materials Handling*) shall be used to determine the number and spacing of clips. A minimum of three clips shall always be used. More clips may be needed when large-dimension wire is used.

6.22.5 Slings

Synthetic slings shall be carefully maintained. Any synthetic sling with the red warning line exposed is to be removed from the WSSRAP immediately regardless of the extent of the exposure and the use of the sling.

Slings should not be dragged from beneath loads. Knotted and kinked slings will be considered permanently damaged and shall be removed from the site. When estimating sling capacity using multi-legged slings, only two of the legs shall be considered to carry the full load. All loose pieces of material shall be removed from the load prior to moving. Gloves shall be worn when handling wire rope. Hands shall be kept free from pinch points as slack is taken up. The load shall be controlled at all times. Personnel shall keep body parts out of pinch points. Tag lines shall be used.

Tables H-15 through H-18 of OSHA 29 CFR 1926, Subpart H, (1926.251, *Rigging Equipment for Materials Handling*), shall apply when using natural or synthetic fiber rope slings.

All splices in rope slings shall be made in accordance with fiber rope manufacturer's recommendations and 29 CFR 1926.251(d)(2).

Synthetic webbing (nylon, polyester, and polypropylene) shall be identified by the name of the manufacturer, the rated capacities for the type of hitch, and the type of material.

Synthetic web slings shall be immediately removed if there are signs of acid or caustic burns, melting or charring of any part of the sling surface, snags, punctures, tears or cuts, broken or worn stitches, distortion of fittings, discoloration or rotting, or red warning line showing.

6.22.6 Shackles, Hooks, and Bolts

Table H-19 of OSHA 29 CFR 1926, Subpart H, (1926.251, *Rigging Equipment for Materials Handling*) shall be used to determine the safe working loads of various sizes of shackles.

Only one-eye hooks shall be used, and hooking back to the load line will not be permitted in either mechanical rigging or hand rigging. Only one eye of a sling shall be used in a hook. A shackle shall be used to hold two or more eyes. The pin of the shackle should be placed in the hook with the eyes of chokers bearing on the shank.

Only shouldered eyebolts shall be used, except where it is not possible due to the configuration of the item to which the eyebolt is attached. Unshouldered eyebolts shall not be used when the load is to be lifted at an angle, because they are subjected to bending, and the load they can safely carry is severely reduced. Eyebolts should never be welded. Shouldered eyebolts must be installed with the shoulder at a right angle to the axis of the hole and must contact the working surface to keep bending to a minimum; the loads should be applied to the plane of the eye. The tapped hole for screwed eyebolts shall have a minimum depth of one and one-half times the bolt diameter. The point of a hook must never be inserted in an eyebolt; a shackle must be used instead.

The manufacturer's recommendations shall be followed in determining the safe working loads of the various sizes and types of specific and identifiable hooks.

Shackles and hooks shall be constructed of forged alloy steel with the identifiable load rating and manufacturer on the shackle or hook. All hooks except for sorting hooks and sliding choker hooks shall be equipped with a safety latch.

6.22.7 Knots

Knots shall not be tied in rigging for any purpose, and all rigging shall be used only for its intended purpose. Rigging used to hoist man baskets shall be identified as such and not used for any other purpose.

6.22.8 Weather Conditions

No rigging or hoisting operation shall be carried out when weather conditions could cause the operation to be hazardous to personnel or property. The size and shape of loads must be examined to determine if a hazard exists during high winds. Wind loading may not exceed equipment capacity. When wind speeds reach 25 to 30 mph, or when visibility is impaired by darkness, snow, fog, or rain, the operation shall be suspended.

When the temperature is below freezing, caution must be used to ensure that no part of the hoisting equipment is shock loaded, as steel fracture can result. Stress factors that reduce rigging capacity and safe working load must be considered when using slings at angles or when slings are choked.

6.22.9 Incident Reporting

Any incident occurring during hoisting/rigging activities that may affect personal safety or the operational safety of equipment shall be reported immediately to the on-site safety officer.

6.23 Motor Vehicles and Heavy Equipment

Drivers and/or operators of vehicles and heavy equipment must have the appropriate State license certifying their qualifications to drive or operate each piece of equipment or vehicle. When State certification is not available for a piece of heavy equipment evidence of operator qualification for each operator, listing each piece of heavy equipment that operator is qualified to operate must be available.

Inquip shall be responsible for the safe operation of all vehicles and heavy equipment operated by Inquip personnel. Drivers and/or operators of vehicles and heavy equipment shall use caution when operating in close proximity to other equipment and tools (e.g., vehicles, heavy equipment, scaffolding, hoses, cords, etc.).

Drivers shall be responsible for the safety of all passengers and the stability of materials being hauled. Personnel shall not mount or dismount moving vehicles. Personnel shall not ride in the bed of any vehicle. Vehicles used to transport employees shall have seats firmly secured and adequate for the number of employees to be carried. The use of seat belts shall be mandatory when operating or riding in vehicles.

Rubber-tired unattended vehicles and heavy equipment shall not be left running unless the wheels are chocked and the parking brake set.

All blades and buckets shall be lowered when the operator leaves the cab unless physically locked or properly blocked. Workers may not work under or between machinery, equipment, or parts of machinery or equipment until the material is physically blocked or otherwise supported.

Heavy equipment shall be maintained in proper operating condition at all times. All machines shall be equipped with Roll-Over Protective Structure (ROPS) cabs as identified by 29 CFR 1926.1000. Operators shall be trained in the proper method of working on slopes.

All heavy equipment with ROPS cabs shall be labeled as required by 29 CFR 1926.1000. Seat belts shall be installed and used in all equipment with ROPS attachments except for compactors and rubber-tired skid steer equipment. All heavy equipment shall be equipped with functioning back-up alarm systems that are clearly audible above surrounding noise.

All equipment and tools shall be subject to a safety inspection conducted by the on-site safety officer, upon arrival at the site, prior to being placed into service. Operators shall perform daily inspections of machinery and equipment. Records of these inspections shall be made and kept by the Subcontractor. These records shall be available upon request. Defective equipment that could potentially endanger personnel or the environment shall be tagged defective, and immediately repaired or removed from service. All machinery shall be subject to inspection by the Safety Department. Operators/owner's manuals must be available for review upon request. The owner's manual will be strictly adhered to. All operators shall review and understand the operator's manual. Equipment may not run over hoses, manhole covers, debris, or any other material. Caution must be used in operating equipment around scaffolding and other elevated platforms. If the task requires equipment to operate around elevated platforms, a "Safe Zone" must be designated around the elevated platform using tape barricade or other type of warning system.

Oils or other fluids (except water) that leak onto the ground shall be cleaned up and the contaminated soil shall be disposed of in accordance with Section 11 of this plan.

All equipment is designed for a particular function and shall be operated according to the manufacturer's recommendations and within the manufacturer's limitations.

All tire servicing, including inflation, shall be done in compliance with 29 CFR 1910.177 and 29 CFR 1926.600.

6.24 Underground Utilities and Communication Lines

Before any ground penetration or excavation can begin, an excavation permit is required. See Section 6.25 subsection for additional information. The drawings and as-builts for the area shall be reviewed for underground utilities. The owner of the underground utility or any other adjacent utility must be notified. Underground utilities within 5 ft of excavation boundaries shall be marked by flagging or staking every 20 ft. When known, the depth of the utilities should be indicated. Any excavation being performed 5 ft or closer to an underground utility shall be done by hand until the utility is positively located. Once the utility is positively located and the on-site safety officer has given approval, the remaining excavation can be performed by mechanical equipment. Personnel shall comply with the Lockout/Tagout/Try requirements identified above when danger from energized underground utilities is present or any taps or line breaks are anticipated.

6.25 Excavations

The OSHA (29 CFR 1926, Subpart P, *Excavations)* standards are very specific with respect to excavations. The term "excavation" applies to any excavation whether by equipment or by hand. The permit system will assist in regulating excavation methods that could cause a personnel safety hazard, damage to a buried or unburied utility or other item, or that could cause a spill.

A competent person must be present at an excavation greater than 4 ft in depth at all times while personnel are working in it or when the excavation is deemed critical. Spoil must not be less than 3 ft from the excavation, and the excavation must be barricaded at all times. The Subcontractor must maintain a record of excavation inspections, including reinspection of excavations after weather changes and extended absence from the excavation.

Access to excavations must be via secured ladders that extend 36 in. above the excavation, have adequate landings at the top and base, and are located within 25 ft of personnel.

If a professional engineer is required to design shoring systems, he or she shall be registered in the State of Illinois.

Fall protection shall be required for excavations with slopes steeper than 1:1 or 45° and depths 6 ft and greater. Standard guard rails or shoring that extends 42 in. above the ground level can serve as fall restraint. When fall arrest systems such as anchored rope or cable systems are used they should be capable of supporting 5,000 lbs for each person and shall be rigged to allow the movement of employees only as far as the excavations edge.

6.26 Clearing and Grubbing

Personnel shall be trained in the proper method of felling, limbing, and bucking logs. This includes such matters as looking for dead limbs before felling trees, making proper cuts to ensure the trees fall in the area intended, positioning to avoid being exposed to falling or rolling trees, making sure that branches are not spring loaded, and handling chain saws to prevent binding.

Heavy equipment used for clearing and grubbing must be equipped with cabs to protect operators from falling or flying objects. The appropriate personal protective equipment (PPE), as specified in Section 4, must be worn in all clearing and grubbing operations

6.27 Electrical Transmission Lines

Any overhead wire shall be considered to be an energized line unless the person owning such line or the electrical utility authorities indicate that it is not an energized line and it has been visibly grounded.

All parts of cranes, excavators, lift trucks, trucks with dump bodies, or other lifting equipment working in the area of energized overhead electrical lines shall maintain a minimum clearance of 10 ft from such lines. A person shall be designated to observe equipment clearance and give timely warning of all operations where it is difficult for the operator to maintain the desired clearance by visual means.

6.28 Concrete Placement

Persons who place concrete shall be trained in the chemical hazards associated with handling concrete, a mild corrosive. Inquip shall maintain sufficient quantities of clean water nearby the work area for workers to wash concrete from their skin and eyes. Safety glasses shall be worn during concrete placement.

All protruding reinforcing steel, onto and into which employees could fall, shall be guarded to eliminate the hazard of impalement.

Concrete pumping systems shall be provided with positive fail-safe joint connections with all pins and latches in place to prevent separation when pressurized.

Powered and rotating type concrete troweling machines that are manually guided shall be equipped with a control switch that will automatically shut off the power whenever the operator's hands are removed from the equipment handles.

Bull float handles, used where they may contact energized electrical conductors, shall be constructed of nonconductive material or shall be insulated with a nonconductive sheath which has electrical and mechanical characteristics which would provide the equivalent protection of a handle constructed of nonconductive material.

6.29 Nuclear Soil Density/Moisture Testing

The use of a nuclear soil density/moisture meter will be allowed after the Subcontractor submits evidence of the following:

- The Subcontractor shall supply copies of all licensing and operator certification regarding use of the nuclear density/moisture meter.
- Meters shall not be left unattended when removed from storage.
- The source shall be tested for leakage and/or contamination at intervals not to exceed applicable the conditions under the U.S. Nuclear Regulatory Commission (NRC) materials license.
- Radiation dosimetry for personnel operating such equipment (where required) shall be the responsibility of the Subcontractor, in accordance with the provisions of the applicable NRC license and regulations.

7. MEDICAL SURVEILLANCE PROGRAM

7.1 General Medical Surveillance Program for Personnel Working at the Area 2 Site

7.1.1 Respirator Medical Monitoring Requirements

Any Subcontractor employees wearing respirators during the course of the contract shall participate in a medical surveillance program which meets the requirements of 29 CFR 1910.134, *Respiratory Protection*. This requires an examination prior to being issued a respirator and at least annually thereafter. The medical examination report shall be signed by an American Board of Preventive Medicine (or equivalent) certified occupational physician and shall include a written opinion that the employee is medically qualified to wear respiratory protection and other personal protective equipment. The report shall also include a description of any recommended work limitations placed on the employee as a result of medical conditions detected from the examination. A copy of the required Medical Evaluation Report Form is provided in Appendix F.

Frequency: Examinations shall be provided more frequently under the following circumstances:

- If determined necessary by the examining physician.
- If an employee is injured or becomes ill, or develops signs or symptoms possibly due to an overexposure.
- As soon as possible following an emergency incident.

All medical examination reports shall be signed by an American Board of Preventive Medicine certified occupational physician.

7.1.2 Audiometric Testing

Any employees who may be exposed to noise levels at or above 85 dBA 8-hour time weighted average, without regard to hearing protection devices, are required to participate in an audiometric testing program.

7.1.3 Additional OSHA Specific Medical Monitoring Requirements

As may be applicable to a particular work activity, Inquip will provide and adhere to the medical monitoring requirements specified in Occupational Safety and Health Administration (OSHA) 29 CFR 1910 *Subpart Z Toxic and Hazardous Substances* and OSHA 29 CFR 1926. It has been necessary to institute medical monitoring programs for torch cutting where cadmium and/or lead

exposure levels may exist. There may be additional work practices that require implementation of the above referenced medical monitoring requirements.

7.2 Medical Surveillance Program for Personnel Working in Controlled Areas

In addition to the medical surveillance requirements identified in Section 7.1 above, Inquip personnel working in Controlled Areas shall participate in the following medical surveillance program, where applicable.

7.2.1 Medical Surveillance Program for Hazardous Waste Workers

Subcontractor employees with 29 CFR 1910.120 40-hour training for hazardous waste site workers, and (HAZMAT) team members and/or hazardous materials specialists whose job involves the use of respiratory protection shall participate in a medical surveillance program which meets the requirements of 29 CFR 1910.120 (f) for hazardous waste work. This requires a comprehensive physical examination be performed prior to assignment, at least annually thereafter, and upon termination of employment. Medical examinations shall, at a minimum, consist of those components listed in Appendix G. An American Board of Preventive Medicine certified occupational physician shall include a written opinion of an employee's medical fitness to wear respiratory protection and other personal protective equipment.

All reports shall also include a description of any recommended work limitations placed on the employee as a result of medical conditions detected from medical examinations. A copy of the required Medical Evaluation Report Form is provided in Appendix F.

Frequency: Examinations shall be provided more frequently under the following circumstances:

- If determined necessary by the examining physician.
- If an employee is injured or becomes ill, or develops signs or symptoms possibly due to an overexposure.
- As soon as possible following an emergency incident.

All medical examination reports shall be signed by an American Board of Preventive Medicine certified occupational physician.

Site workers who receive 24-hour training under 29 CFR 1910.120(e) are not authorized to wear respirators and are therefore not required to participate in a medical surveillance program. However, should this status change, i.e., the worker is upgraded to 40-hour training, as would be

necessary to wear respiratory protection, then all the requirements specified above would become applicable.

8. TRAINING AND QUALIFICATIONS

The following training requirements shall apply to Inquiip personnel, including lower-tier Subcontractors, performing work at the Area 2 Site. Unless otherwise specified, training shall be the responsibility of Inquip.

8.1 General Training Requirements for Personnel Working at the Area 2 Site

8.1.1 General Employee Training

Prior to working at the Area 2 Site, all employees shall attend a site-specific safety and health orientation provided by the on-site safety officer.

The only exception to this requirement shall be for temporary visitors, delivery personnel, and lower-tier Subcontractor personnel on site in Uncontrolled Areas only for less than 8 hours per week, when under direct Inquip oversight.

8.1.2 Respirator Training and Fit-Testing

Where the Inquip is required to provide respirators, training, and fit-testing, it is Inquips responsibility to fit-test and train each employee who wears a tight fitting respirator in accordance with Inquip's respiratory protection program. The procedures for quantitative fit-testing and training outlined in the Respiratory Protection Program shall be at least as stringent as those outlined in American National Standards Institute (ANSI) Z88.2-1992 and governing Occupational Safety and Health Administration (OSHA) (e.g., 29 CFR 1910.134) standards. Respirator training shall instruct individuals as to when to leave the work area if they experience respirator failure, and when they should remove a respirator to avoid a life-threatening situation. Inquip shall maintain written evidence that each employee has received proper respirator training and fit-testing in accordance with 29 CFR 1910.134.

8.1.3 Task-Specific Safety Briefing

All Subcontractor personnel performing work on site shall receive on-the-job, task-specific hazard recognition and safety training.

8.1.4 Hazard Communication Program

All personnel exposed to materials shall be trained in the use of the materials, the personal protective equipment (PPE) required, and the emergency procedures associated with the materials they will be expected to use. All personnel shall be trained and shall know the location of their

company's written Hazard Communication Program and have access to the Material Safety Data Sheets (MSDS) for all materials to which they may be exposed. To check the effectiveness of the Subcontractor Hazard Communication Program, the Contractor will conduct periodic inspections and will ask Subcontractor employees' questions about the materials they are handling.

8.1.5 Hearing Conservation Program

Employees shall have received appropriate hearing conservation training as specified in 29 CFR 1910.95. Training shall include, at a minimum, a description of the effects of noise on hearing, and the purposes, advantages, disadvantages, and attenuation of various types of hearing protective devices (HPDs). Instructions should also include selection, fitting, use, and care of HPDs. Finally, training shall address the purpose of audiometric testing and an explanation of the test procedures.

8.1.6 Supervisor Qualifications

The Subcontractor shall submit the names and qualifications of on-site supervisory personnel, including alternates, having overall responsibility for employee safety and health.

8.1.7 Permit Required Confined Space Entry Training

Inquip shall have employees who are trained according to their responsibilities outlined in OSHA 29 CFR 1910.146 whenever entry into confined spaces is to be performed. Any employees designated as emergency rescue personnel must have cardiovascular pulmonary resuscitation (CPR) and first-aid training. These certifications must be current. In addition, rescue personnel must have annual training in rescue operation simulation in actual confined space conditions.

8.1.8 Excavation Awareness Training for Excavations

Inquip shall have employees designated as competent persons, where applicable, for the purpose of determining the safety and stability of excavations. In addition, special training and/or experience which qualifies each individual as a competent person shall be documented and submitted to the Contractor upon request.

8.1.9 Lockout Tagout Training

Inquip shall have employees capable of working in areas with energy sources regardless of the type of work who are trained in the Lockout Tagout Program.

8.2 Additional Training Requirements for Personnel Working in Controlled Areas

Except as otherwise specified herein, the following training requirements are applicable to all Inquip and lower-tier Subcontractor personnel working inside Controlled Areas and are in addition to the training requirements identified in Section 8.1.

8.2.1 Hazardous Waste Operations Site Worker Training Requirements

Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) training programs shall meet the requirements of 29 CFR 1910.120(e).

Training certificates or equivalent documentation certifying completion of training, per the above referenced OSHA standard, shall be maintained for review and acceptance prior to the start of on-site work. Documentation of actual field experience must be submitted prior to unsupervised work. This includes copies of certificates for initial training and annual refresher training.

Outside restricted areas, hands-on work does not include activities such as off-loading equipment, repairing equipment, performing job-site inspections, or advising on the use of a manufacturer's product. Delivery personnel who remain in nonrestricted areas are not considered hands-on workers.

8.2.1.1 Hazardous Waste Operations Site Worker 24-Hour Training Requirements

Each employee who will enter a restricted area (whether in a vehicle or not) or who will perform any hands-on work in a Controlled Area, and who is not required to wear respiratory protection, shall receive training in accordance with the 29 CFR 1910.120(e) the OSHA *Hazardous Waste Operations and Emergency Response Standard* (HAZWOPER). This standard requires a 24-hour training course and a minimum of 1 day of actual documented field experience under the supervision of a trained supervisor. An additional 8 hours of training beyond the HAZWOPER is required for field supervisors and managers responsible for field operations.

Eight hours of HAZWOPER refresher training are required annually for all applicable personnel.

8.2.1.2 Hazardous Waste Operations Site Worker 40-Hour Training Requirements

Each employee who will enter a restricted area (whether in a vehicle or not) or perform any hands-on work in a Controlled Area (where the potential for exposure exists) and who is required to wear respiratory protection shall, at a minimum, have completed a 40-hour training course and a minimum of 3 days of actual field experience in accordance with 29 CFR 1910.120(e).

An additional 8 hours of training beyond the HAZWOPER is required for field supervisors and managers responsible for field operation.

8.2.2 Site Visitor Requirements

Personnel (visitors) who will not perform hands-on work in Controlled Areas will not be required to complete HAZWOPER training. Visitors are required to remain outside restricted areas, to be escorted 100% of the time when in Controlled Areas, and to read and sign a visitor site-orientation form.

8.2.3 Torch/Plasma Arc Cutting, Welding, and Open Flame Training

Personnel exposed to welding, torch/plasma arc cutting, and open flame work will be trained and documented in the use of, and understand the reasons for, protective clothing and equipment.

9. SITE CONTROL

9.1 Access Control

Access to the work site will be controlled by the owners representative at all times during the course of the project.

9.2 Buddy System

In general, work in Controlled Areas should be performed by crews of at least two persons (the "buddy system") where there is potential for injury, illness, or emergency conditions, based on the nature of work. On occasions where there is minimal potential for such conditions, an individual may work alone subject to the on-site safety officer approval.

9.3 Prohibited Items

The introduction of certain controlled commodities is prohibited throughout the Area 2 Site. Prohibited items include firearms, archery equipment, alcoholic beverages, narcotics, and explosives. Cameras are authorized subject to Solutia approval. All personnel and vehicles entering and leaving the project are subject to property checks. Also, beverage and food containers (including empty containers) shall not be permitted in Controlled Areas.

10. WORK ZONE EXIT REQUIREMENTS, DECONTAMINATION, AND CLEANING

10.1 Uncontrolled Area Work Zone Exit Requirements

When the work zone is in the Uncontrolled Area, all vehicles, heavy equipment, and tools being removed from the work zone shall be free of gross debris, dirt, and mud.

10.2 Controlled Area Work Zone Exit and Contamination Control Requirements

10.2.1 Work Zone Exit Requirements When Showers Are Not Required

When shower facilities are not required, but there is potential for contamination of equipment and personnel, Inquip shall establish an area for decontamination at the exit from the work zone. The purpose is to remove gross contamination from personnel and equipment prior to exit from the work zone and to minimize the spread of contamination outside the work zone. The area shall include the following materials:

- An equipment drop or storage area for storing reusable PPE and equipment that does not need to be removed from the work zone.
- A boot wash station with brushes.
- Containers for disposable clothing (either bags or barrels).
- Chairs or benches for personnel to use while doffing PPE.
- PPE doffing protocol posting as needed.

Responsibility for providing the above equipment shall be as described in the HASP checklist.

All PPE (i.e., coveralls, gloves, and boots) shall be washed, or removed as appropriate, in the CRZ to remove gross contamination that may have adhered to them

10.2.2 Additional Requirements for PCBs

When the employee contacts materials that are potentially contaminated with PCBs, the employee shall comply with the decontamination requirements stated below.

A decontamination area shall be established at the perimeter of each PCB work area for decontamination and/or disposal of items potentially contaminated with PCBs. Decontamination

areas shall be lined with non-slip polyethylene sheeting (or approved alternate) to reduce the potential for spread of contamination outside the work area.

Prior to removal from decontamination area, equipment/materials shall be decontaminated by flushing/rinsing all PCB contaminated surfaces with diesel fuel or other approved solvent. This diesel fuel may be used or reused for decontamination until it contains 50 ppm PCBs. All non-porous items (i.e., hand tools, movable equipment, etc.) shall be rinsed with diesel fuel. All liquids generated shall be properly containerized in a 1A1 DOT approved container. All personnel conducting decontamination activities shall take measures so that no diesel fuel, dust or particulate emissions containing PCBs are released from the decontamination area. Disposable items, and equipment with permeable surfaces (such as wood or fabric) shall be placed in PCB waste containers. Granular absorbent clay (or equivalent) shall be placed in a 1A2 DOE approved container to absorb any free liquids before they are sealed and transported.

10.2.3 Equipment Decontamination Requirements Applicable at Work Zone Exits

All vehicles, heavy equipment, tools, and equipment being removed from the work zone shall be free of gross debris, dirt, and mud. Equipment and tools shall be cleaned within the confines of the work zones.

10.2.4 Temporary Restroom Facilities in Controlled Areas

Where required to provide temporary restroom facilities, the restroom shall be located at the exit point from the work zone. The restrooms shall be maintained in a clean and sanitary condition at all times. Visual inspections of the facilities may be conducted to ensure clean and sanitary conditions.

10.2.5 Personal Protective Clothing Segregation and Disposal Requirements

Upon removal of outer PPE, inner clothing shall be inspected for dirt and debris.

Subcontractor shall segregate and dispose of PPE in accordance with the following:

- Where applicable, any PPE exposed to contaminants above the specific OSHA standards (e.g., lead, cadmium) shall be labeled and packaged in accordance with applicable OSHA standards.

10.3 Controlled Area Exit Requirements

10.3.1 Personnel

Except as provided below, all personnel exiting a Contamination Area shall survey themselves for contamination. In the event contamination is found on the person's skin or clothing, one or more of the decontamination methods shown in Table 10-1 may be implemented before the individual is permitted to leave the area. When contamination is detected, the individual shall:

1. Remain at the exit point.
2. Notify the on-site safety officer.

The on-site safety officer will then:

1. Resurvey all contaminated areas.

2. Direct decontamination in accordance with required procedures and the methods described in Table 10-1. The individual will be resurveyed after each decontamination attempt.

3. Each step or method described in Table 10-1 will be repeated at least one time before the next sequential method is tried.

Table 10-1 Personnel Decontamination Methods

PERSONNEL DECONTAMINATION						
STEP	METHOD	SURFACE	ACTION	TECHNIQUE	ADVANTAGES	DISADVANTAGES
1&2	1. Wet wipes 2. Soap and water	Skin and hands	Emulsifies and dissolves contaminant	Wash and monitor. Do not wash more than 3-4 times.	Readily available and effective for most contamination.	Continued washing will defat the skin. Indiscriminate washing of other than affected parts may spread contamination. Never allow contamination to flow into eyes, ears, nose or mouth.
3	Lava soap, soft brush and water	Skin and hands	Emulsifies, dissolves, and erodes	Use light pressure with heavy lather. Wash for 2 minutes, three times. Rinse and monitor. Use care not to scratch or erode skin. Apply lanolin or hand cream to prevent chapping.	Readily available and effective for most contamination.	Continued washing will abrade the skin.
4	Laundry detergent (plain)	Skin and hands	Emulsifies, dissolves, and erodes	Make into a paste. Use with additional water with a mild scrubbing action. Use care not to erode the skin.	Slightly more effective than washing with soap.	Will defat and abrade skin and must be used with care.
5	Soap and water	Hair	Emulsifies and dissolves contaminant	Shampoo hair in sink (not shower) and dry. If contamination is not lowered to acceptable level, cut off contaminated hair area(s).	Readily available and effective.	

Table 10-1 Personnel Decontamination Methods (Continued)

PERSONNEL DECONTAMINATION						
STEP	METHOD	SURFACE	ACTION	TECHNIQUE	ADVANTAGES	DISADVANTAGES
6	Flushing	Eyes, ears, nose and mouth	Physical removal by flushing	Roll back the eyelid as far as possible, flush with large amounts of water. If isotonic irritants are available, apply to eye continually and then flush with large amounts of water. (Isotonic irritant [0.9% NaCl solution]: 9 grams NaCl in beaker, fill to 1000cc with water). Can be purchased from drug suppliers, etc. Further decontamination must be done under medical supervision.	If used immediately will remove contamination. May also be used for ears, nose, and throat.	When using for nose and mouth, contaminated individual should be warned not to swallow the rinses.
1	Flushing	Wounds	Physical removal by flushing	Wash wound with large amounts of water and spread edges gently to stimulate bleeding, if not profuse. Further decontamination must be done under medical supervision.	Quick and efficient if wound is not severe.	May spread contamination to other areas of the body if it is not done carefully.

10.3.2 Equipment

All vehicles, heavy equipment, tools, and equipment being removed from a Contamination Area shall be surveyed for contamination and will not be released to uncontrolled areas until it meets release criteria. The employee shall be responsible for washing his equipment and tools. Such equipment may be cleaned at the site decontamination pad by personnel. Additional methods of equipment decontamination are listed from least to most intensive in Table 10-2.

Table 10-2 Area and Material Decontamination Methods

METHOD	SURFACE	ACTION	TECHNIQUE	ADVANTAGES	DISADVANTAGES
METHOD 1 Vacuum cleaning	Dry surfaces	Removes contaminated dust by suction.	Use conventional vacuum technique with HEPA filter.	Good on dry, porous surfaces. Avoids water reactions.	All dust must be filtered out of exhaust. Machine is contaminated.
METHOD 2 Water	All nonporous surfaces (metal, painted, plastic, etc.)	Dissolves and erodes.	For large surfaces: Hose with high-pressure water at an optimum distance of 15 ft to 20 ft. Spray vertical surfaces at an angle of incidence of 30° to 40°; work from top to bottom to avoid recontamination. Work upwind to avoid spray. Determine cleaning rate experimentally if possible; otherwise, use a rate of 4 sq ft per minute.	All water equipment may be utilized. Allows operation to be carried out from a distance. Contamination may be reduced by 50%. Water equipment may be used for solutions of other decontaminating agents.	Drainage must be controlled. Not suitable for porous materials. Oiled surfaces cannot be decontaminated. Not applicable on dry contaminated surfaces (use vacuum); not applicable on porous surfaces such as wood, concrete, canvas, etc. Spray will be contaminated.
	All surfaces	Dissolves and erodes.	For small surfaces: Blot up liquid and hand wipe with water and appropriate commercial detergent.	Extremely effective if done immediately after spill and on nonporous surfaces.	Of little value in the decontamination of large areas, longstanding contaminants and porous surfaces.
METHOD 3 Steam	Nonporous surfaces (especially painted or oiled surfaces).	Dissolves and erodes.	Work from top to bottom and from upwind. Clean surface at a rate of 4 sq ft/minute. The cleaning efficiency of steam will be greatly increased by using detergents.	Contamination may be reduced approximately 90% on painted surfaces.	Steam subject to same limitations as water. Spray hazard makes the wearing of waterproof outfits necessary.

Table 10-2 Area and Material Decontamination Methods (Continued)

METHOD	SURFACE	ACTION	TECHNIQUE	ADVANTAGES	DISADVANTAGES
METHOD 4 Detergents	Nonporous surfaces (metal, painted, glass, plastic, etc.).	Emulsifies contaminant and increases wetting power of water and cleaning efficiency of steam.	Rub surface 1 minute with a rag moistened with detergent solution then wipe with dry rag; use clean surface of the rag for each application. Use a power rotary brush with pressure feed for more efficient cleaning. Apply solution from a distance with a pressure proportioner. Do not allow solution to drip onto other surfaces. Mist application is all that is necessary.	Dissolves industrial film and other materials which hold contamination. Contamination may be reduced by 90%.	May require personal contact with surface. May not be efficient on long standing contamination.
METHOD 6 Organic solvents	Nonporous surfaces (greasy or waxed surfaces, paint or plastic finishes, etc.).	Dissolves organic materials (oil, paint, etc.).	Immerse entire unit in solvent or apply by wiping procedure (see Detergents).	Quick dissolving action. Recovery of solvent possible by distillation.	Requires good ventilation and fire precautions. Toxic to personnel. Material bulky. Mixed waste is likely to be generated, requiring special treatment/disposal methods.

Table 10-2 Area and Material Decontamination Methods (Continued)

METHOD	SURFACE	ACTION	TECHNIQUE	ADVANTAGES	DISADVANTAGES
METHOD 10 Trisodium phosphate	Painted surfaces (vertical, overhead).	Softens paint (mild method).	Apply hot 10% solution by rubbing and wiping procedure (see Detergent).	Contamination may be reduced to tolerance in one or two applications.	Destructive effect on paint. Should not be used on aluminum or magnesium.
METHOD 11 Abrasion	Nonporous surfaces.	Removes surface.	Use conventional procedures, such as sanding, filing and chipping; keep surface damp to avoid dust hazard.	Contamination may be reduced to as low a level as desired.	Impractical for porous surfaces because of penetration by moisture.
METHOD 12 Abrasive Grit Blasting	Nonporous surfaces.	Removes surface.	Keep grit wet to lessen spread of contamination. Collect used abrasive or flush away with water.	Practical for large surface area.	Contamination spread over area must be removed. Contaminated dust is personnel hazard and requires air supplied hoods and other special protective measures. Waste volume may increase significantly.
METHOD 13 Vacuum blasting	Porous and nonporous surfaces.	Removes surface; traps and controls contaminated waste.	Hold tool flush to surface to prevent escape of contamination.	Contaminated waste ready for disposal.	Contamination of equipment.

11. EMERGENCY RESPONSE

11.1 Emergency Plan

An emergency plan shall be developed and implemented describing Inquip response plans for anticipated emergencies (i.e., personal injuries, heat/cold stress, fire, severe weather, and chemical spills). The plan shall be in accordance with 29 CFR 1910.120, (L), (1), (2), (3), in writing.

11.1.1 Training

All personnel shall be instructed in basic site emergency notification and response procedures, including the capabilities and limitations of Contractor resources. This training will be included as part of the site safety and health orientation described in Section 8 of this plan. In addition, all employees shall be provided with training on the emergency plan. This training shall be provided and documented before field work begins.

11.2 First Aid/Medical Care For Injuries

Inquip shall ensure that at least one employee on the job site, per shift, has current first-aid and cardiopulmonary resuscitation (CPR) training as required by 29 CFR 1926.50(c), Medical Services and First Aid. In the event of an accident involving personal injury, the Inquip supervisor or his designee shall administer first aid and primary care with backup assistance as required.

Arrangements have been made with the local ambulance service to provide service to the Area 2 Site. Inquip shall maintain the capability to make emergency calls to ambulance services at all times. In most circumstances, an injured person will be taken to the nearest emergency room (St. Mary's Hospital). However, the ambulance staff may determine that another medical facility may be better suited to treat the individual based on the nature of the injury.

External Emergency Telephone Numbers	Telephone Numbers
Sauget Fire Department	911 or 618/332-6700
Cahokia Fire Department	618/337-5080
Sauget Police Department	911 or 618/332-6507 or 6997
Cahokia Police Department	618/337-9505
St. Claire County Sheriff	911 or 618/277-3500
Illinois State Police	618/346-3990 (District 11)
St. Marys Hospital (East St. Louis, IL) (Emergency/Trauma Center)	618/274-1900
Ambulance Service	911
Poison Control Center	800/942-5969
National Response Center Washington, D.C.	800/424-8802

11.3 Heat/Cold Stress

In the event of a heat-related illness, protective clothing shall be removed and the worker relocated to a cool location for administration of first aid. Off-site medical assistance shall be requested immediately if heat stroke is suspected or if symptoms persist after first aid is administered.

Cold related injuries range from frostbite to hypothermia. Victims should be moved to a warm place and affected parts should be gently warmed by submersing them in warm water.

11.4 Fire

If a fire occurs in an area where combustible or flammable materials are present, the first action shall be evacuation of all personnel from the area to a remote location upwind of the fire. The local fire protection district shall be notified immediately and dispatched to the scene. Only those personnel trained in the use of fire extinguishers will be permitted to fight fires and then only in limited situations, such as small fires in uncontaminated areas where flammable liquids are not stored. Roll calls shall be made at designated rally points to verify that all persons have been accounted for.

11.5 Inclement Weather

In the event of tornado or severe thunderstorm warnings or the threat of other severe weather conditions, the on-site safety officer will notify employees. Employees shall immediately perform those tasks necessary to stabilize the work site and proceed to shelter.

11.6 Unusual Occurrence

If any unusual materials or substances are uncovered during operations, work shall cease in the affected work area and the Solutia representative shall be notified immediately.

11.7 Contingency Plan For Spills

11.7.1 Spill Notification

If unidentified or unanticipated substances are released during construction or excavation operations, Inquip shall cease operation and contact the Solutia representative immediately.

11.7.1.1 Spill Notification for Water Treatment Plants

Upon discovery of any spill or leak of process water, water treatment chemicals, or other hazardous materials, the applicable access control monitor shall be immediately notified of the following information:

- Materials involved.
- Estimated quantity.
- Location.
- Affected personnel.
- Other hazardous conditions.

An effort to shut down the system shall be made, as applicable, and response measures shall be implemented provided that no unprotected exposures occur.

In the event of accidental exposure to hazardous chemicals, appropriate emergency response action will be taken to remove the contaminated clothing. An emergency shower and eyewash station will be used to flush exposed skin and eyes, respectively. This equipment shall be maintained in a readily accessible location adjacent to the active work area.

If an acute exposure to airborne chemicals occurs or is suspected, and the affected individuals are unable to escape from the work area, Inquip shall immediately notify the Solutia representative for on-site and off-site assistance. No rescue operations shall be performed unless the rescuers are properly suited in Level B (SCBA) protection.

11.7.2 Response Procedures

Procedures for response to spills of hazardous material shall be developed in coordination with Solutia procedures. All spills of hazardous material must be properly cleaned-up and disposed of.

11.7.3 Reporting

The Subcontractor shall provide a complete report of any incident, outlining the causes, corrective actions, and measures taken to prevent recurrence of similar incidents.

11.8 Equipment and Services

Appropriate equipment and services shall be available to respond promptly to emergency events involving personal injury or other emergency situations.

An inventory list describing the minimum emergency response and spill equipment to be maintained by Inquip and made available for emergency use. These items shall be maintained in an accessible location near the work area.

11.9 Confined Space Rescue

All personnel designated as emergency rescue personnel for confined spaces must meet training requirements under Section 8.1.7 of the HASP and 29 CFR 1910.146, Permit Required Confined Spaces.

12. REFERENCES

American Conference of Governmental Industrial Hygienists, Inc. *TLVs and BEIs: Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices*. ISBN: 1-882417-19-7.

Sax, N.I. and R. J. Lewis, Sr. *Dangerous Properties of Industrial Materials*, Seventh Edition, Volume ll. Van Nostrand Reinhold, New York. 1989.

U. S. Department of Health and Human Services. *NIOSH Pocket Guide to Chemical Hazards*, DHHS (NIOSH) Publication No. 90-117. June 1990.

URS Corporation. *Groundwater Migration Control systemSauget Area 2 Superfund Site Volume 3C Health and Safety Plan* ,. Prepared for Solutia Inc., Maryland Heights, MO. December 2002.

REGULATIONS

10 CFR 835	*Occupational Radiation Protection*
29 CFR 1910	*Occupational Safety and Health Standards*
29 CFR 1926	*OSHA Construction Industry Standards*
40 CFR 761.125	*EPA PCB Regulations*
10 CSR 10-6	*Air Quality Standards, Definitions, Sampling, and Reference Methods and Air Pollution Control Regulations for the Entire State of Missouri*

STANDARDS

ANSI B30	*Safety Standards for Cableways, Cranes, Derricks, Hoists, Hoods, Jacks, and Slings*
ANSI 288.2-180	*Practices for Respiratory Protection*
ANSI Z89.1	*Protective Headware for Industrial Workers*
ANSI N543	*General Safety Standard for Installation using Non Medical X-Ray and Sealed Gamma-Ray Sources, Energies Up to 10 MeV*
ANSI Z87.1	*Occupational and Educational Eye and Face Protection*
ANSI UL586	*High Efficiency Particulate Air Units*

APPENDIX D
List of Ozone-Depleting Chemicals

LIST OF OZONE-DEPLETING CHEMICAL	
Class I Substance	Class II Substances
Group 1	Hydrochlorofluorocarbon-21 (HCFC-21)
Chlorofluorocarbon-11 (CFC-11)	Hydrochlorofluorocarbon-22 (HCFC-22)
Chlorofluorocarbon-12 (CFC-12)	Hydrochlorofluorocarbon-31 (HCFC-31)
Chlorofluorocarbon-113 (CFC-113)	Hydrochlorofluorocarbon-121 (HCFC-121)
Chlorofluorocarbon-114 (CFC-114)	Hydrochlorofluorocarbon-122 (HCFC-122)
Chlorofluorocarbon-115 (CFC-115)	Hydrochlorofluorocarbon-123 (HCFC-123)
	Hydrochlorofluorocarbon-124 (HCFC-124)
Group II	Hydrochlorofluorocarbon-131 (HCFC-131)
Halon-1211	Hydrochlorofluorocarbon-132 (HCFC-132)
Halon-1301	Hydrochlorofluorocarbon-133 (HCFC-133)
Halon-2402	Hydrochlorofluorocarbon-141 (HCFC-141)
	Hydrochlorofluorocarbon-142 (HCFC-142)
Group III	Hydrochlorofluorocarbon-221 (HCFC-221)
Chlorofluorocarbon-13 (CFC-13)	Hydrochlorofluorocarbon-222 (HCFC-222)
Chlorofluorcarbon-111 (CFC-111)	Hydrochlorofluorocarbon-223 (HCFC-223)
Chlorofluorcarbon-112 (CFC-112)	Hydrochlorofluorocarbon-224 (HCFC-224)
Chlorofluorocarbon-211 (CFC-221)	Hydrochlorofluorocarbon-225 (HCFC-225)
Chlorofluorocarbon-212 (CFC-212)	Hydrochlorofluorocarbon-226 (HCFC-226)
Chlorofluorocarbon-213 (CFC-213)	Hydrochlorofluorocarbon-231 (HCFC-231)
Chlorofluorocarbon-214 (CFC-214)	Hydrochlorofluorocarbon-232 (HCFC-232)
Chlorofluorocarbon-215 (CFC-215)	Hydrochlorofluorocarbon-233 (HCFC-233)
Chlorofluorocarbon-216 (CFC-216)	Hydrochlorofluorocarbon-234 (HCFC-234)
Chlorofluorocarbon-217 (CFC-217)	Hydrochlorofluorocarbon-236 (HCFC-235)
	Hydrochlorofluorocarbon-241 (HCFC-241)
Group IV	Hydrochlorofluorocarbon-242 (HCFC-242)
Carbon tetrachloride	Hydrochlorofluorocarbon-243 (HCFC-243)
	Hydrochlorofluorocarbon-244 (HCFC-244)
Group V	Hydrochlorofluorocarbon-251 (HCFC-251)
Methyl chloroform	Hydrochlorofluorocarbon-252 (HCFC-252)
	Hydrochlorofluorocarbon-253 (HCFC-253)
	Hydrochlorofluorocarbon-261 (HCFC-261)
	Hydrochlorofluorocarbon-262 (HCFC-262)
	Hydrochlorofluorocarbon-271 (HCFC-271)

APPENDIX E
Mobile Crane Safety Inspection Report

MOBILE CRANE SAFETY INSPECTION REPORT

CUSTOMER:		CONTACT:		JOB NO:	AUTHORITY: OSHA 1910.180 ☐ OSHA 1926.550 ☐ STATE:___ ☐ ANNUAL: ☐ QUADRENNIAL: ☐ _____ ☐
ADDRESS:		PHONE NO:	LOCATION:	INSPECT. DATE:	
MANUFACTURER:	CAPACITY:	SER. NO:	MODEL NO:	UNIT NO:	

DESCRIPTION	*ITEM NO.*	*SAT.*	*UNSAT.*	*N/A*	*COMMENTS*
RECORDS					
Annual Inspection	1				
· Operator instructions	2				
· Preventive maintenance records	3				
Hand signal charts	4				
· Proper load charts	5				
Properly marked operator controls, levels, diagrams	6				
Required information/warning decals	7				
	8				
	9				
SAFETY EQUIPMENT					
Warning device(s)/Backup alarm	10				
Safety and machine guards	11				
Access provisions (railings, etc.)	12				
Fire extinguishers	13				
Anti-two block	14				
	15				
	16				

HOIST SYSTEMS					
Sheave assemblies	17				
· Equalizer sheave and pin	18				
· Load block assembly(s)	19				
Counterweight hooks and bolts	20				
· Hooks tram/throat	21				
Hook NDT	22				
	23				
	24				
BOOM/JIB					
· Boom and attachments	25				
· Boom rotation assy. locks & brakes	26				
· Boom hoist lock or pawl	27				
· Boom and jib back stops	28				
· Automatic boom kickout	29				
· Outrigger assembly(s)	30				
· Wedge sockets	31				
· Wedge sockets	32				
Drums	33				
	34				
	35				

LUBE SYSTEMS/GAUGES					
Gauges (oil, etc.) and gauge ports	36				
	37				
	38				
MISCELLANEOUS					
Superstructure (main frame, glass)	39				
Bolts, nuts, rivets, mounts, brackets	40				
· Air/hydraulic system; cylinders	41				
· Hoses; fittings	42				
Muffler/exhaust system	43				
Housekeeping	44				
Brakes	45				
	46				
CRAWLER CAR BODY					
Steering	47				
Weldments	48				
Bolts	49				
Tracks	50				
Track drive	51				
	52				
	53				

WIRE ROPE & HOOK CONDITION REPORT					
Main Hoist	54				
Aux. Hoist	55				
Aux. Hoist	56				
Pendants	57				
Pendants	58				
Jib Stays	59				
Boom Hoist	60				
	61				
	62				

ALL UNSATISFACTORY WIRE ROPE SHALL BE REPLACED AS PER ORIGINAL MANUFACTURER'S RECOMMENDATIONS

As of this date _____, the unit described above has been found to be in the above condition. It is understood that this inspection does not preclude the necessity to perform frequent and periodic inspections in conjunction with a regular maintenance program in accordance with manufacturer's specifications and/or Federal, State and local guidelines, as applicable. This inspection does not constitute a warranty or guaranty of the performance of the above equipment.

Company Representative
Date

Inspector Date

APPENDIX F
Medical Evaluation Report Form

MEDICAL EVALUATION REPORT

PATIENT'S NAME: _____

DATE OF EXAMINATION: _____

TYPE OF EXAMINATION: ☐BASELINE ☐ANNUAL ☐EXIT ☐SPECIAL

☐ *I hereby certify that the above named patient has completed a medical examination on the date indicated above in accordance with that specified by the MK-Ferguson Company and the applicable OSHA standard(s) cited below. Based upon my examination, I certify that the above named individual:*

☐ IS QUALIFIED TO WEAR AIR PURIFYING AND AIR SUPPLIED RESPIRATORS IN ACCORDANCE WITH 29 CFR 1910.134.

☐ IS MEDICALLY QUALIFIED FOR WORK AT HAZARDOUS WASTE SITES, INCLUDING WEARING OF RESPIRATORS AND CHEMICAL PROTECTIVE CLOTHING, IN ACCORDANCE WITH 29 CFR 1910.120.

☐ IS MEDICALLY QUALIFIED FOR ASBESTOS ABATEMENT WORK, INCLUDING THE USE OF RESPIRATORS AND PROTECTIVE CLOTHING, IN ACCORDANCE WITH 29 CFR 1926.1101.

☐ SHOULD BE RESTRICTED FROM THE FOLLOWING ACTIVITIES:

_____

_____

PLEASE CHECK THE FOLLOWING COMPONENTS INCLUDED AS PART OF THE MEDICAL EXAMINATION:

☐ IN DEPTH MEDICAL HISTORY	☐ CHEST X-RAY	☐ VISION
☐ IN DEPTH OCCUPATIONAL HISTORY	☐ URINALYSIS	☐ EKG
☐ FULL PHYSICAL EXAMINATION	☐ COMPLETE BLOOD COUNT	☐ ARSENIC-URINE
☐ VITAL SIGNS	☐ BLOOD CHEMISTRY PROFILE	☐ PCB-SERUM
☐ AUDIOMETRY	☐ TETANUS IMMUNIZATION	☐ BLOOD LEAD (optional)
SPIROMETRY	CARDIAC STRESS TEST	CADIUM-LEAD AND URINE (optional)

PHYSICIANS COMMENTS AND/OR RECOMMENDATIONS FOR FURTHER MEDICAL EVALUATION BY PERSONAL PHYSICIAN:

_____

_____ _____

PHYSICIAN'S SIGNATURE PRINT NAME OF PHYSICIAN

_____

DATE

APPENDIX G
Components of Medical Examinations

COMPONENTS OF MEDICAL EXAMINATION

1. In-Depth Medical History
2. In-Depth Occupational History
4. Full Physical Examination by an Occupational Health Physician
5. Vital Signs
6. Audiometry
7. Spirometry (Pulmonary Function Test)
   - Forced Vital Capacity
   - Forced Expiratory Volume at One Second
8. Chest X-ray (every 5 years or at discretion of attending physician).
9. Urinalysis with microscopic Examination
10. Complete Blood Count (CBC) with Differential
11. Blood Chemistry Profile (SMAC 24)
    - Alb/Glob Ratio
    - Albumin
    - Alkaline Phosphatase
    - Bilirubin (direct, indirect and total)
    - BUN/Creatinine Ratio
    - Calcium
    - Chloride
    - Cholesterol
    - Creatinine
    - Globulin
    - Glucose
    - Iron
    - LDH
    - Phosphorus
    - Potassium
    - SGOT/SGPT
    - Sodium
    - Total Protein
    - Triglycerides
    - Urea Nitrogen (BUN)
    - Uric Acid
12. Tetanus Immunization (current)
13. Cardiac Stress Test (for all personnel involved in heavy manual lifting activities)
14. Vision
15. EKG (every year or at discretion of attending physician).
16. Arsenic-Urine
17. PCB-Serum

ADDITIONAL OPTIONS

- Blood Lab - when significant potential for lead exposure exists.
- Cadmium - personnel performing torch cutting activities.

APPENDIX H
Emergency and Spill Response Equipment List

Subcontractor Emergency and Spill Response Equipment List

ITEM	MINIMUM QUANTITY
Fire extinguishers - Dry chemical	(a)
Portable eye wash	one unit within 50 ft of personnel working with corrosives or other materials which can damage the eye. [b]
First-aid kit, 24-unit construction type	one for every 10 employees [c]
Granular absorbent clay	Sufficient quantities to contain any spills which may potentially occur.
Containers for spill cleanup materials	[d]

(a) 20-lb ABC extinguisher shall be provided for each fueling area. 5-lb ABC extinguishers shall be kept at each job trailer. 2.5 gal water extinguishers (or an equivalent water supply) shall be kept near torch cutting or abrasive saw cutting operations. All vehicles transporting 50 gal or more of flammable or combustible liquids are required to carry 5-lb ABC fire extinguishers or larger units.

(b) Eyewash units shall have sufficient capacity to provide 15 minutes of flushing of both eyes.

(c) May use equivalent bulk supplies in the job trailer.

(d) Containers shall be of sufficient quantity and capacity to contain the required quantity of absorbent clay, as well as associated spill-cleanup debris.

APPENDIX I
Emergency Evacuation Roster/Emergency Response Plan

EMPERGENCY EVACUATION ROSTER

Department: _____

PERSONNEL MISSING? YES/NO

Department Personnel

Missing	Present	Off-site	Name	Missing	Present	Off-site	Name

Visitor/TDY

Person Responsible for Visitor

Missing	Present	Off-site	Name	Missing	Present	Off-site	Name

APPENDIX K
Competent Persons Checklist

Competent Persons Checklist

Project Title: _____
Prime Subcontractor: _____
Subcontract No.: _____

Competent Person Requirements

The *Competent Person* requirements contained in 29 CFR 1926 Construction Standards have been specifically reprinted in this checklist to highlight the specific OSHA standards that requires a *Competent Person.*

- Employers, managers and supervisors who appoint individuals as *Competent Persons*, shall ensure that those individuals know the requirements and accept the responsibility of a *Competent Person.*

- Individuals appointed to be a *Competent Person* shall be trained in the recognition and avoidance of unsafe conditions and in the regulations/standards and equipment for which they are appointed as *Competent Person.* Training records shall be available upon request.

- Individuals appointed as a *Competent Person* shall have the authority to control, eliminate or correct any hazards or other exposures to illness or injury.

1. 1926.20 (1) (2) **ACCIDENT PREVENTION RESPONSIBILITIES - SUBPART C**

   Applicable to Project: Yes _____ No _____
   (If Yes) Competent person is _____

2. 1926.58 (e) (6) (ii) **REQUIREMENTS FOR ASBESTOS COMPETENT PERSON**

   Applicable to Project: Yes _____ No _____
   (If Yes) Competent person is _____

3. 1926.58 (e) (6) (iii) **TRAINING**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

6. 1926.101 (b) **PROTECTIVE EQUIPMENT SUBPART E**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

7. 1926.345 (a) **WELDING SUBPART I**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

8. 1926.404 (b) (i) (iii) (B) **ELECTRICAL SUBPART K**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

9. 1926.451 (a) (3) **SCAFFOLDING SUBPART L**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

10. 1926.451 (h) (14) **SCAFFOLDING SUBPART L**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

12. 1926.550 (a) (5) **CRANES AND DERRICKS SUBPART N**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

13. 1926.550 (a) (6) **CRANES AND DERRICKS SUBPART N**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

14. 1926.550 (g) (5) (iv) **CRANES AND DERRICKS SUBPART N**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

15. 1926.550 (g) (5) (vi) **CRANES AND DERRICKS**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

16. 1926.552 (c) (15) **HOISTING EQUIPMENT**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

17. 1926.651 (c) (1) (i) **ACCESS OR EGRESS**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

18. 1926.651 (h) (2) **EXCAVATIONS SUBPART P**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

19. 1926.651 (h) (3) **EXCAVATIONS SUBPART P**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

20. 1926.651 (k) (1) **EXCAVATIONS SUBPART P**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

21. 1926.651 (k) (2) **EXCAVATIONS SUBPART P**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

22. 1926.652 (a) (l) (ii) **EXCAVATIONS SUBPART P**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

23. 1926.652 (d) (3) **EXCAVATIONS SUBPART P**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

37. 1926.803 (a) (l) **COMPRESSED AIR**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

42. 1926.1053 (b) (15) **LADDER INSPECTIONS**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

43. 1926.1060 (a) (l) **TRAINING REQUIREMENTS FOR STAIRWAYS AND LADDERS SUBPART X**

Applicable to Project: Yes _____ No _____
(If Yes) Competent person is _____

September 29, 2003

INQUIP ASSOCIATES, INC.
CONTRACTOR'S BARRIER WALL CONSTRUCTI0N & QUALITY CONTROL PLAN

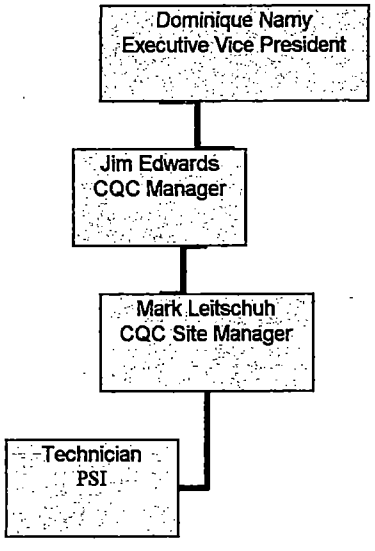
SOIL-BENTONITE SLURRY WALL
ST. LOUIS, MS

1. Quality Control

Quality Control Organization

Inquip Associates, Inc., is committed to conducting all phases of this project with a consistently high level of quality and reliability. Utilization of proven construction methods and attention to consistent and systematic quality control testing will allow Inquip to achieve these goals. The designated CQC Manager for the project is Jim Edwards and the CQC Site Manager is Mark Leitschuh. They will review all quality control data on a daily basis to ensure that the work is performed to the specified standards. The chart below shows the lines of authority for Inquip's Quality Control Organization. The resumes of the individuals named are attached.

INQUIP ASSOCIATES, INC.
QC ORGANIZATION CHART



Executive Vice President: Dominique Namy as Executive Vice President of Inquip has the overall responsibility for the quality of work produced by the company on all east coast projects. He has total authority to do whatever is necessary to ensure a high level of quality on every project. He routinely reviews testing reports and discusses them with the CQC Managers and the CQC Site Managers to ensure adherence to Inquip's CQC Program.

CQC Manager: Jim Edwards as CQC Manager for the project reports directly to the Executive Vice President on all matters regarding the quality of work on the project. He is responsible for the overall management of CQC Plan. Mr. Edwards has the authority to act on all CQC matters for Inquip Associates, Inc.

CQC Site Manager: Mark Leitschuh as CQC Site Manager reports to the CQC Manager on all matters regarding Quality Control on the project site. He is responsible for monitoring all activities on the site to ensure compliance with the contract CQC plan. His duties include performing inspections, overseeing testing, keeping records, and notifying the CQC Manager of any noncompliance with the contract requirements. He has direct access to the CQC Manager and the Executive Vice President who will ensure that the proper corrective action is taken.

Quality Control Technician: Provided by Precision Service Industries the quality control technician will be responsible for performing the contractor's quality control testing and monitoring. The technician will report directly to the CQC Site Manager and perform additional quality control duties as necessary.

Submittals

Submittals will be managed as specified in the project documents. For the slurry trench work we anticipate using Pangea Inc. for portions of the site preparation work. The only material to be incorporated into the work is the premium grade sodium montmorillonite bentonite for which manufacture certificates of compliance will be provided per truckload delivered to the site.

Control Procedures

Procedures for controlling activities related to inspection, testing, and noncompliance conditions are outlined below.

Inspection: Preparatory, initial, and follow-up inspections will be performed by the CQC Site Manager to verify compliance with the plans and specifications. These inspections include visually examining the material, equipment, workmanship, and test records for all aspects of the project. Results of these inspections will be noted on the daily quality control sheets.

Testing: Tests will be performed as specified in the project documents. All field tests will be performed by the CQC Site Manager or one of his staff fully qualified by experience to perform the test. A testing lab approved by the engineer will provide laboratory testing for gradations and hydraulic conductivity. Bentonite slurry testing and slump and density testing of the soil bentonite backfill will be performed on the site.

The CQC Site Manager will verify the following:

- That the testing procedures comply with contract requirements
- That the testing equipment is available and complies with testing standards
- That the testing instruments are properly calibrated
- That recording forms including all of the test documentation requirements have been prepared

Noncompliance: The CQC Site Manager will notify the CQC Manager of any noncompliance with the contract requirements. Inquip shall after receipt of such notice immediately take corrective action. The cause of the noncompliance will be determined and corrective action in the system will be made to preclude recurrence of noncompliance.

Reporting Procedures

Inquip Associates, Inc. uses a daily on-site reporting system that documents the quality control testing conducted and involves the clients engineer in all QC/QA observations. Inquip's daily Slurry Trench Quality Control form will be filled out each day by the CQC Site Manager and reviewed with the Engineer and the CQC Manager for compliance. These forms will be filled out in triplicate with one copy to the engineer, one to the CQC Manager, and one left on site at all times. A copy of the daily report is attached.

2. **List of Equipment:** (Submittal 2290, 1.4, A. 1,2,&3)
   Following is a listing of the equipment anticipated for the work:

   a. A Koehring Model 1266 (or equivalent) hydraulic backhoe with extended dipper stick capable of excavating in excess of 90 feet will be used for excavating the upper trench. A heavy duty "V" bottom rock bucket a minimum of 3 feet wide will be used to excavate through the upper clay and sand/gravel layers as shown on the project drawings.

   b. Two KS3000 hydraulic clamshells will be used to excavate the trench from where the backhoe stops to the top of bedrock.

   c. Caterpillar JD 850 dozer (or equivalent) will be used for mixing and blending of the backfill and also for placement into the trench when the mixing takes place adjacent to the trench.

   d. A small excavator will be used to load trucks with backfill for delivery from the remote backfill mix area.

   e. Contractor's slurry plant consisting of a venturi-type slurry mixer, sumps, pumps, piping, valves, fittings and hose/piping will be used for mixing and distribution of the slurry. Plant capacity is 400 to 500 gpm of continuous slurry output.

   f. Welding Machine for necessary repairs to equipment, etc.

   g. Caterpillar JD 644H (or equivalent) with a 3-$^{1}/_{4}$ cu. yd. loader bucket and forklift attachments will be used for unloading and setting up mixing plant, unloading bentonite

in jumbo bags from trucks, handling bentonite during the mixing operation, handling and moving of slurry and water lines, and for any other required on-site work.

h. A 4-inch 75 horse power mission pump will be used for pumping bentonite slurry to the trench from the hydration ponds and recirculation within the ponds.

3. Methods of Construction: Anticipated methods of construction for specific operations are as follows:

a. **Preparation of the Working Platform Erosion Control:** Erosion control devices will be installed in accordance with the Storm Water Pollution Prevention Plan (SWPPP). Pretrenching to a depth of twenty feet will be done ahead of the formal wall construction to expose any abandoned or unknown utilities or obstacles. Typically, the work pad will be leveled, or have a small longitudinal slope, so that we can maintain the specified slurry elevation in the open trench. It will be a minimum of 12 feet wide on the outside of the new slurry trench. Its width on the inside will vary depending upon the location. A graveled work pad for the KS 3000 clams to work from will be installed along the trench. This work will involve the following operations:

- Stripping, clearing and grubbing the existing vegetation.
- Leveling of the trench alignment using cut and fill operations.

b. **Staging Area:** The site office area, slurry mixing, and staging area slurry hydration ponds will be centrally located inside the work area. Upon approval by the owner, the exact location of the staging area will be determined in the field, prior to mobilization.

c. **Bentonite Slurry Preparation:** (Submittal 2290, 1.4, A.1) Federal Jel 90 sodium montmorillonite bentonite clay meeting the specifications will be used (see attached data sheets and certification letter). Submittals for the bentonite will contain the Technical Data Sheets showing physical and chemical properties and a Material Safety Data Sheets (MSDS). Certificates of compliance with the specifications will be provide by the manufacturer and submitted to the owner upon delivery of the materials. Bentonite for the trench stabilization slurry will be delivered by pneumatic unloading tractor-trailers. Bentonite for mixing dry into the backfill (if required) will be either powered or granular delivered in approximately 4,000 pounds jumbo bags or delivered by tractor-trailers. A hydrant adjacent to the work area will provide the water for preparation of the slurry. Four-inch HDPE pipe will be used for delivery of water to the mixing area from the hydrant and connected directly to the mixer. The mixing of bentonite and water will be performed in a venturi (high shear) mixer along with necessary pumps, hose and piping to result in slurry exceeding the specification slurry after recirculation and/or hydration in a storage pond. Higher than required viscosity slurry is necessary to compensate for any rain or other dilution that may occur in the hydration pond. Density

and marsh funnel tests will be used to control the production of the slurry. Viscosity adjustment of the slurry that exceeds the minimum specification requirement may be made as the slurry is pumped from the storage ponds by thinning with water at the pump suction or by recirculation and thinning. Control of thinning will be done by using the marsh funnel to measure viscosity.

d. **Bentonite Slurry for Trench Stabilization:** The bentonite slurry for stabilization of the slurry wall excavation shall be introduced into the trench at the time trenching is begun and shall be maintained within three feet of the top of the trench at all times during excavation and at least three feet above the groundwater level.

e. **Slurry Wall Excavation:** (Submittal 2290, 1.4, A.3) A Koehring 1266 hydraulic backhoe with extended dipper stick and a 36-inch (minimum) wide bucket will be used for slurry wall excavation to approximately 85 feet below the work pad. The KS 3000 clamshells will excavate from where the backhoe stopped to the top of bedrock. The trench stationing shall be offset from the centerline by 20 feet and staked at 50 foot intervals. The centerline shall be marked with small painted stakes or wire flags for the backhoe operator to line up on. The trench will be maintained full with bentonite slurry, pumped from the slurry pond. The excavation will proceed by making successive cuts approximately 30 feet long. The excavation process will provide for insurance of trench continuity. The depth of the trench will be recorded upon reaching the top of the bedrock. The Owner's Representative will verify the top of bedrock for every cut. The material excavated from the trench to be used in the backfill will be cast to the mixing area adjacent to the working platform or loaded into trucks for transport to the remote mixing area. Material not to be used as backfill will be transported to the disposal area on site. An earth berm will be constructed along the outer side of the trench as necessary to prevent runoff from carrying sediments and excavated material into the trench. When the desired depth of the bottom of the trench has been reached as determined by the Engineer, it shall be cleaned and sounded to the satisfaction of the Engineer. Soundings for the final bottom of the excavated trench shall be made from the working platform surface at 10 foot intervals performed to the satisfaction of the Engineer. Samples of the key strata material shall be obtained with the clamshell bucket. Where corners are required on the slurry wall alignment, overlaps on the trench bottom of 5 feet in each direction will be made. The corner shall be cleaned in each direction by re-excavation by the clamshell to assure that there is no loose or un-excavated material at or immediately adjacent to a corner on the slurry wall alignment.

f. **Soil-Bentonite Backfill:** (Submittal 2290, 1.4, A.4) The soil-bentonite backfill mixture shall consist of the soils from the trench excavation. Dry bentonite (if required) will be placed on the working platform in advance of the trench excavation as required to meet the specifications. Four thousand (4000) pound jumbo bags will be prepositioned along the working platform in the backfill mixing area according to calculations using the profile

as shown on the drawings. The dry bentonite and excavated soils shall be mixed with slurry either from the trench or from the hydration pond so that the final mixture will have the proper slump upon placement into the trench. It is anticipated that the final soil-bentonite mixture will have a slump of between 2 and 6 inches upon placement in the trench. The soil-bentonite backfill mixture will be mixed on the working platform alongside the trench or in the remote mixing area using a JD850 (or equivalent) dozer. The dozer will mix and knead the material until it results in a homogeneous mixture. Except for occasional soil lumps of up to 3 inches in size, the mixture will be homogeneous. Initial trench backfill at the beginning of each slurry wall shall be placed by constructing a lead in trench on a 1(h):1(v) slope at the beginning of trench excavation. Sounding of the trench bottom will be performed prior to the placement or progress of the toe of the backfill in the trench in accordance with paragraph e. above. The initial trench backfill will be pushed into the trench at the beginning of this slope by the dozer and allowed to slide down until sufficient backfill has been place to result in the natural angle of repose of the backfill under the slurry. Then the dozer will place additional backfill where the point of placement is adjacent to the backfill mixing area. This backfill will be placed into the trench on the face of the previously placed backfill as it daylights above the slurry. At the terminal end of the trench the bentonite slurry shall be removed using the backhoe bucket as the backfill comes into contact with the vertical face of the trench that joins the previously completed slurry wall. This process will insure that pockets of slurry are not trapped in the backfill as it rises from the bottom to the top of at the terminus of the trench. Some of this slurry will be used to mix backfill. Soil-bentonite backfill will be placed to the top of the trench at all locations. Mixing and placing of trench backfill will not be performed during cold weather when ice forms or is contained in the backfill mixture.

g. **Excessive Slurry Loss:** (Submittal 2290, 1.4, A.5 & 6): Sudden slurry loss usually occurs when a pipeline which intersects the trench alignment is damaged during excavation. When this occurs, a large volume of bentonite slurry is allowed to flow out of the trench. To help prevent this type of slurry loss, Inquip will review with the Construction Manager the available site drawings which show previously installed pipes, culverts, etc.. The general locations will be laid out in the field. We will then excavate a 2' wide to 20' deep pretrench along the slurry wall centerline. This trench will be excavated under bentonite slurry. We will attempt to locate the suspected pipe and slurry wall intersections. All abandoned pipes will be removed and their ends plugged. If an unknown pipe is ruptured during slurry trench excavation, resulting in sudden slurry loss, soil material excavated from the trench will be dumped or bulldozed at the location of the excavation equipment where the breach in the pipe occurred. The pump operator will pump slurry from the ponds to the trench and soil bentonite backfill will also be placed to raise the slurry level. Excavation of the slurry wall will cease in this area until the pipe is located, by potholing, on both sides of the slurry wall. When located the pipe will be plugged on either side of trench centerline and excavation will resume. Sudden slurry loss can also occur in porous

soil conditions. If this should occur we will proceed, as described above, to backfill the trench and raise the slurry level. After the sudden slurry loss is stopped, we will attempt to begin re-excavation of the porous area. During this re-excavation process the operator will repeatedly dump the soil out of the bucket and through the bentonite slurry, increasing the soil particles in suspension. Using this method we attempt to seal the porous area using a thickened slurry. Dry bentonite in 100# bags can also be added at the location of the sudden slurry loss by directly dropping the 100# bag of bentonite through the trench slurry at the location of the sudden slurry loss. If neither method eliminates the sudden loss of bentonite slurry, it may be necessary to grout the porous zone. A drill rig would be mobilized as quickly as practical, and a permeation grouting program started. The extent of the grouting required would be determined mutually by Inquip and the Construction Manager.

h. **Slurry Wall Cap:** Upon completion of backfilling sections of the slurry trench and prior to drying of the backfill, a curing cap of backfill material will be placed over the backfilled trench as shown on the drawings.

i. **Site Cleanup:** (Submittal 2290, 1.4, A. 13) During construction or after completion of the cap all remaining excess and waste materials left on the working platform will be properly graded and leveled to a state acceptable to the Engineer. Excess slurry from the terminal end of the trench which is not used in the backfill mixture shall be disposed of in the designated area by spreading on the working platform or adjacent area and mixing into the top 6 inches of surface soil. Slurry ponds shall be pumped dry. Excess slurry from ponds may be mixed with soil and allowed to dry out and then placed back into the ponds as approved by the Engineer.

4. Materials Test Log: See attached Materials Test Log.

5. Barrier Wall Design: To be submitted under separate cover will be the design documents produced by Mueser Rutledge Consulting Engineers and stamped by a Professional Engineer registered in the state of Illinois. The design documents consist of trench stability calculations, construction drawings 1 to 9, and a specification for soil bentonite slurry wall construction.

GENERAL TEST LOG
7603, Groundwater Mitigation Control System, Sauget Area 2

Section 2290, Soil-Bentonite Barrier Wall	Frequency	Specification
Water Sample	Water to be used in mixing operations, once prior to the start of mixing operations then once per month thereafter.	hardness <500ppm
Initial Slurry prior to placement in trench, viscosity, filtration, density, sand content & pH	2 times daily while mixing / 1 time daily when not mixing	Viscosity 40 - 65 seconds Density ≥ 63.5 pcf Filtration ≤ 20 cc. in 30 minutes Sand Content ≤ 2% pH 7 - 9
Trench slurry tested for viscosity, filtration, density, sand content & pH	1 time daily for top sample taken from within 100 ft of excavation toe, sampled 5 ft below the slurry surface. 2 times daily for bottom sample taken from within 100 ft of the excavation toe, sampled 5 ft above the trench bottom	Viscosity 40 - 100 seconds Density 64 – 80 pcf, bottom sample always 15 pcf < backfill Filtration ≤ 20 cc. in 30 minutes, filter cake ≤ ¼ inch Sand Content ≤ 20% pH 7 – 10.5
Slump of Backfill ASTM C-143	One/ 200cy or 2 per day min.	3" – 5", avg. of all tests ≤ 4 inches
Backfill Soil Gradation	One/ 800cy or 1 per day min.	3" – 100% 1" – 85% ½" – 75-100% #4 – 60-100% #10 – 50-100% #40 – 35-75% #200 – 20-40%
Backfill Bulk Wet Density	One/300cy or 2 per day min.	N/A
Backfill Water Content	One/300cy or 2 per day min.	N/A
Backfill Permeability Determinations	One/1,200cy or 1 per week minimum	1.0×10^{-7}
Sediment Thickness	At 20 ft construction stations after cleaning sediment immediately before backfill placement with flat weight within 50 to 60 feet from the backfill toe.	Pointed and flat weight measurement within 0.25 ft. or deeper from initial trench bottom. Thickness of sediment not to exceed 0.25 ft.
Backfill Sampling	Minimum of three locations with split spoon sampler daily, in presence of owner, before placing backfill to determine if backfill surface must be cleaned.	< 2 inches of sediment
Settlement Monitoring Plates	Placed 18" below backfill surface at 200 ft spacing along barrier wall within 24 hours of backfill completion within 50 ft of plate location.	Elevation recorded daily until owner indicates that cap installation may begin.
Backfill Slope	At 20 foot interval within 100 ft of the toe and at 60 feet intervals otherwise	Performed with flat weight

Backfill Samples	1 per week	Two 20lb. samples to owner for QA testing
Bentonite Certifications	As each new lot is delivered	API Specification 13A, Section 4 and 5

Section 2320, Construction Spoils Handling	**Frequency**	**Specification**
TCL/TAL Testing	For each new off site borrow source. One per every 5000 yd3	Compare to TACO Tier 1 criteria
Compacted Fill Testing Requirement: ASTM D2216 ASTM D4318 ASTM D1140 ASTM D698	 1 per 15,000 yd3 1 per 15,000 yd3 1 per 15,000 yd3 1 per 15,000 yd3	For 4" leveling layer or 12" stockpile cover soil: Silty to Clayey Sands SP, SP-SM, SC-SM Clayey Silts to Silty Clays CL Silty Sandy Clays CL Combinations of the above For Berms: Clayey Silts to Silty Clays CL Silty Sandy Clays CL Gravelly Clay CL Combinations of the above The plasticity index shall be 7 or greater
Post Constructed Quality Control Compacted Fill In –place density ASTM D2922 ASTM D3017 In-place density verification ASTM D2937 ASTM D2216	 1 per 2,000 yd3 placed and compacted 1 per 15,000 yd3 placed and compacted	 90% ± 4% of optimum 90% ±4% of optimum

SECTION 02222
HYDRAULIC BARRIER

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

Construct a minimum 3.0 ft wide soil-bentonite backfill barrier to the limits shown on the Contract Drawings. Minimum criteria for construction and criteria for the completed barrier are specified on the Contract Drawings and in this Section.

The Owner's Engineer is performing compatibility testing to evaluate backfill performance when permeated with site groundwater, and mix design testing to determine if added dry bentonite or imported clay are beneficial to backfill performance. The requirement for imported materials referenced in this Section will be determined by the Owner.

Determine, provide, and operate detailed designs, means, methods, and equipment required to meet the specifications and to account for field conditions. Prepare and manage slurry. Excavate trench to the limits shown. Blend trench excavation spoils, imported clay or dry bentonite (if required), and bentonite slurry into a low permeability backfill. Place backfill in a controlled manner to cover prepared and approved trench bottom. Perform Quality Control sampling, testing, and measurements. Manage storm water during construction to divert storm water from construction areas; collect and transport water impounded in active work areas for disposal. Stabilize and dispose waste slurry and excess excavation spoils on site. Clean the site of construction spoils, mud, and debris. Place storm water diversion berms around work areas, and maintain storm water runoff for duration of work.

1.02 SECTION INCLUDES

Provision of all materials, labor and equipment required for the complete installation of the hydraulic barrier, including but not limited to the following:

A. Furnish, prepare, and maintain bentonite slurry.

B. Provide survey and support Quality Assurance testing/measurements.

C. Protect adjacent utilities, structures, test wells and piezometers from damage.

D. Excavate 3.0 ft wide slurry-filled trenches to the limits shown on the Contract Drawings.

E. Furnish trench inspection tools, and labor.

F. Clean trench bottom and backfill surface of sediment, excavation spoils, or other material before placing backfill.

G. Prepare Soil-Bentonite backfill using excavation spoils, imported clay or dry bentonite (if required), and slurry. Perform backfill Quality Control testing.

H. Place backfill in a controlled manner on a clean and approved trench bottom.

I. Provide daily reports summarizing construction.

J. Stabilize waste slurry and leave on site where directed by the Owner.

K. Place compacted clay fill cap over cutoff as shown. Place excavation spoils on site where directed by the Owner.

L. Restore slurry trench work areas and adjacent ground to original conditions. Grade to promote storm water runoff. Re-establish drainage swales.

1.03 RELATED WORK

None

1.04 REFERENCES

The work shall be performed in accordance with the applicable rules, regulations, codes and ordinances of Local, State and Federal authorities, and in accordance with the following references:

A. American Petroleum Institute (API) Reference Procedure 13-A for bentonite materials and 13B-1 for Testing Water Based Drilling Fluids:

1. Filtration
2. Viscosity (Marsh Funnel)
3. pH

B. <u>American Society for Testing and Materials</u> (ASTM):

1.	ASTM C 143	Slump of Hydraulic-Cement Concrete
2.	ASTM D 2216	Laboratory Determination of Water (Moisture) Content of Soil and Rock
3.	ASTM D 2217	Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants (See D below)
4.	ASTM D 422	Method for Particle-Size Analysis of Soils
5.	ASTM D 4380	Density Of Bentonitic Slurries

6. ASTM D 4381 Sand Content By Volume Of Bentonitic Slurries
7. ASTM D 5084 Measurement of Hydraulic Conductivity of Saturated Porous Materials Using A Flexible Wall Permeameter

C. Bulk Unit Weight shall be measured using a standard 1/10 cubic ft mold of known weight. Prepared backfill shall be placed in the mold in the three lifts, each lift rodded 25 times. Excess backfill shall be screeded off, and the mold cleaned of spoil. The total weight of the test specimen shall be determined to the nearest 20 g (0.05 lb); the bulk unit weight shall be computed from the weight of this known volume.

D. Particle-Size analysis sample weighing more than 8 lbs shall be split for moisture content and sieve analysis. Measured moisture content and measured total weight of sieve analysis specimen shall be used to determine dry weight of sieve analysis specimen. Sieve analysis specimen shall be washed on the No. 200 sieve. Hydrometer testing is not required. The fraction larger than the No. 200 sieve shall be oven dried before sieving. Sieve analysis shall be performed using sieves identified in Part 2.04.C.

1.05 DEFINITIONS

A. Soil Blend -Mixture of excavation spoils and imported clay (if required), meeting gradation specification for Prepared Backfill

B. Prepared Backfill - Homogeneous mixture of Soil Blend, dry bentonite (if required), and bentonite slurry, blended, and tested to specified slump.

C. Slurry Trench - Excavated slurry-filled trench, depth D.

D. Hydraulic Barrier (Cutoff) - Backfilled Slurry Trench with clay cap

1.06 SUBMITTALS

Cost proposal has been submitted to include a hydraulic track excavator capable of reaching depths of 75 ft or greater, and a clamshell excavator(s) to complete trench to final depth.

A. Submit - Upon Mobilizing for Slurry Trench Construction.

1. Name and qualifications of field personnel performing site survey. Name, number of Professional Licensed Surveyor.

2. Supplier name and location of source proposed for imported fill. Provide product QC test data and 100 lb sample.

3. Supplier and type of bentonite proposed for use in backfill. Provide cut sheets.

4. Contractor shall design or provide for approval by Owner:

   (a) Construction details, size, and location of slurry plant, ponds, desanding operation, and trench-side backfill mixing areas.
   (b) Planned sequence of trench construction.
   (c) Method for measuring and sampling excavation spoils to define wet unit weight, dry unit weight, and gradation, for proportioning spoils, imported gravel, dry bentonite, and hydrated slurry to prepare S-B backfill.
   (d) Example mix proportion calculations and data sheets.
   (e) Storm water management controls at each phase of slurry trench progress.
   (f) Materials and means for stabilizing excavation spoils.

5. Survey plan showing location and elevation control points. Place offset baseline stakes to identify construction stations in the field at 10 ft station. Provide elevation of Work Platform for each 10 ft construction station (along centerline of trench).

6. Name and qualifications of Contractor's independent testing company performing Quality Control testing.

7. Complete list of sampling and laboratory test equipment which will be provided in the field for testing of slurry and backfill.

8. Blank test data sheets and summary tables proposed for Quality Control testing of slurry and backfill. All data sheets and computations shall be organized, identifying as a minimum:

   (a) Sample and batch number.
   (b) Sampling location, date, and time.
   (c) Tests performed.
   (d) Specimen weights, measurements, test readings, and test result.
   (e) Summary tables which identify sampling date, time, location, testing date, test results, and specification requirements.

B. Submit **Daily** During Construction:

1. Barrier Construction Progress Reports, including at a minimum:

   (a) Day, month, year, time or work beginning and end; names of workers on site, equipment used (hours) and materials deliveries received.
   (b) Maintain profile of excavation and backfill work performed daily, showing progress of excavation, final trench bottom elevation, and surface of backfill by construction station. Submit part plan 1in=10ft scale daily.

(c) Quantity of bentonite, imported clay, etc. received.
(d) Amount of slurry produced, description and amount of slurry additives used (if any).
(e) Occurrence of special events such as unexpected slurry loss, observed trench side wall instability, obstructions encountered, ground settlement and/or heave, etc.
(f) Summary of downtime or other unproductive time, including time duration, and reason.

2. Quality Control Reports (Submit end of next work day)

(a) Pond and trench slurry Quality Control test results.
(b) Summary of QC tests performed, or samples taken for testing.
(c) Results of Quality Control testing and mix computations performed on Prepared Backfill.
(d) Quantity of approved backfill placed, placement station, source location or batch (relate batch to QA and QC testing).
(e) Settlement plate readings of soil-bentonite backfill settlement, read daily.

C. Submit **At Completion** Of Barrier Construction:

1. Prepare and submit four copies of a construction quality assurance report after completing barrier wall construction. The report shall include the results of all quality control testing and quality assurance testing on the permanent soil-bentonite backfill, and document that the cutoff was constructed in accordance with the drawings and specifications. Include:

(a) As-built survey drawing showing location of barrier centerline every 50 feet along the alignment, and locating any trench excavations outside of the formal barrier alignment. Provide survey control coordinates for construction baseline. Submit five copies stamped and signed by Licensed Surveyor.
(b) List of depth and elevation of final trench bottom, at construction stations 10 ft on center and at turning points in the alignment.

1.07 QUALITY CONTROL

A. The Contractor shall measure the trench excavation, monitor backfill placement, and perform the specified Quality Control testing of slurry and prepared backfill.

B. The Contractor shall perform all sampling for Quality Control testing and Quality Assurance testing by the Owner.

1.08 QUALITY ASSURANCE

A. The Contractor shall have a minimum of five years soil-bentonite backfill slurry trench experience with comparable projects. The Contractor's key supervisory personnel shall each have a minimum of three years experience in slurry trench construction.

B. The Owner shall have access to the Contractor's Quality Control testing facilities at all times.

C. The Contractor shall perform all sampling for Quality Assurance testing.

D. The Contractor shall provide samples to the Owner's laboratory for Quality Assurance testing of the prepared backfill.

PART 2 PRODUCTS

2.01 GENERAL

Materials and equipment required for the work, which are not part of the completed Hydraulic Barrier, shall be determined by the Contractor. Products and equipment shall meet OSHA safety requirements, and conform to any pertinent Federal, State or local law, regulation, or Code.

2.02 MATERIALS

A. Bentonite shall be a pure, high swelling 90 barrel yield, premium grade, 200 mesh or finer, sodium cation base bentonite, consisting primarily of montmorillonite. Dry Bentonite Addition, if required, shall be a pure, high swelling 85 barrel yield premium 30 mesh (or finer) sodium cation base bentonite, consisting primarily of montmorillonite. Bentonite shall conform to the standards set forth in American Petroleum Institute (API) RP-13A, latest revision. Chemically treated bentonite shall be permitted only with the Owner's approval. Bentonite shall have manufacturer's certification that it meets the following API RP-13A requirements:

1. Viscosity – 30 min @ 600 rpm
2. Fltrate Volume 15 cc max
3. >75 Micron 4% wt max
4. Moisture – 10% wt max
5. Yield Point/Plastic Viscosity 3 max

B. Imported Clay, if required, shall be sound, well-graded, mixture of silt and clay, free of organic and other deleterious substances. Imported clay shall have no more than 10% larger tha the No. 200 sieve. The clay borrow source shall be pre-approved by the Owner. Haul trucks shall be empty of soil or water when filled, and shall be weighed empty and full for payment. Trucks shall be covered during haul.

C. Slurry Make-up Water will be supplied by the Owner. It shall be clean, fresh, potable water, free of oil, acid, alkali, organic matter, or other deleterious substances. Total hardness shall be less than 500 ppm.

2.03 SLURRY

A. Slurry shall be mixed in a high shear venturi mixer, and shall be allowed to hydrate for 12 hours or more before placing in the trench. The slurry pond shall be recirculated.

B. Fresh slurry shall consist of a stable suspension of powdered bentonite and water. One day's excavation production of hydrated slurry shall be maintained at all times for use in the event of unanticipated losses from the trench. Fresh slurry shall meet the following requirements:

1. Filtration: 20 cc maximum filtrate loss or less.

2. Viscosity by Marsh Funnel: 40 - 65 seconds.

3. Sand Content: Maximum 2 percent (by volume) maximum.

4. pH: 7 to 9

5. Density: Not less than 63.5 pcf.

(a) Trench slurry and reconditioned slurry shall consist of a stable suspension of powdered bentonite, natural fines, natural sand, and water. Additives which reduce the capacity for suspending sand shall not be added in the trench; treated slurry shall be desanded before it is returned to the trench (settling pond or mechanical desander). Trench slurry shall be sampled from a location within 100 ft of the excavation toe. It shall be sampled 10 ft below the slurry surface, and 10 ft above the trench bottom, and shall meet the following requirements:

(i) Filtration: Filtrate loss 20 cc maximum, with filter cake thickness less than 1/4 inch.

(ii) Viscosity by Marsh Funnel: 40 - 100 seconds.

(iii) pH - 7 to 10.5

(b) Density: 64 pcf to 80 pcf. The bulk density of slurry at bottom of trench shall always be 15 pcf lower than the bulk unit weight of Prepared Backfill.

(c) The Contractor shall be prepared to immediately adjust the pH of the trench slurry as necessary, recirculate slurry within the trench and clean slurry in the trench of debris, sediment, or sand as necessary to achieve the desired properties. In particular, slurry at the bottom of the trench may require recirculation and desanding prior to backfilling the trench with prepared backfill.

C. Slurry Additives

1. Additives such as dispersants, plugging agents, softeners, or thinners, may be added to the make-up water or slurry so as to obtain proper workability of the slurry and efficient use of the bentonite.

2. Additives to the slurry must be approved by Owner prior to use.

3. Additives shall not be added or mixed in the trench, but conditioned slurry may be added to the trench.

2.04 PREPARED BACKFILL

A. Soil Blend used for backfill preparation shall be composed of selected trench excavation spoils, and imported clay fill (if required), thoroughly blended to a uniform distribution of particle sizes and consistency. Soil clods shall be broken down to small sizes (1/4") to the satisfaction of the Owner, only occasional presence of soil clods larger than 3 inches may be accepted. Soil fines shall be evenly distributed throughout. The Soil Blend shall be free of deleterious materials, frozen soil, wood, vegetation, or other debris. All aggregate larger than 3" shall be separated from the soil blend, and excluded from the soil-bentonite backfill. The Owner may require the Contractor to segregate soils with visible signs of contamination, or soils with unusually high VOC concentrations from the excavation spoils or soils stockpiled for backfill mixing.

B. Prepared Backfill shall be composed of a mixture of the Soil Blend, dry bentonite (if required), and bentonite slurry. The proportioning and mixing methods and procedures shall provide uniform distribution of all materials throughout. If dry bentonite is required, the Contractor shall measure soil blend volumes, wet unit weights, and water contents, and shall provide material inventory, haul tickets, weights, etc. to demonstrate that the required minimum amount of dry bentonite has been added based on dry weight of soil blend.

C. The Contractor shall segregate and blend excavation spoils. Sand, gravel, and cobbles shall be separated from the spoils. Imported Clay may be added to the spoils (if required). The Contractor shall attempt to create a Soil Blend within the following gradation range:

U. S. Standard	Percent Passing by Dry Weight	
Sieve Size	Min	Max

3 inches	100	
1 inch	85	-
½ inch	5	100
# 4	60	100
#10	50	100
#40	35	75
#200	20	40

D. Prepared Backfill shall be mixed to a uniform consistency, having a slump ranging from 3 inches to 5 inches. The average of all slump measurements shall be 4 inches or lower. Slump shall be tested immediately prior to placement. Slump may require adjustment after addition of dry bentonite (if required).

E. Prepared Backfill shall have a laboratory tap water permeability of $1x10^{-7}$ cm/sec or lower, except 20% of the test specimens may have a permeability as high as $5x10^{-7}$ cm/sec and 5% of the test specimen may have a permeability as high as $1x10^{-6}$ cm/sec. Consistent permeability greater than $1x10^{-7}$ cm/sec shall be reason for review and revision of backfill materials, preparation procedures, and equipment.

F. Quality Control of backfill is specified in Part 3.

2.05 EQUIPMENT & SUPPLIES

A. The excavator bucket shall be 36 inches wide. Clamshell buckets shall be 36 inches wide. Minor extension of teeth beyond the bucket sides will be considered in the width. Side cutters shall not be used.

B. Backfill mixing equipment shall be capable of shredding clay excavation spoils and thoroughly blending spoils, imported fill, and dry bentonite to a consistent uniform product.

C. Quality Control testing equipment shall meet the requirements of the references and shall be subject to the Owner's approval.

D. Provide mats as needed to permit trench crossings and for equipment support in soft ground areas.

E. Trench sounding tools

1. Trench inspection tools shall be adequate for their intended purpose, shall meet the minimum requirements of this specification, and shall be subject to the Owner's approval.

2. The final depth of the trench may be measured with the pointed weight (described below) or with clamshell excavation equipment outfitted with a calibrated electronic depth control device.

3. Pointed weight: having an end area of 1 square inch, weighing 7 pounds to 9 pounds.

4. Flat weight: having an end area of 20 square inches, and the same weight as pointed weight ± 0.5 lb. It shall have a ½ inch high lip at the edge of the bottom flat area.

5. Measuring tapes shall be marked in 0.1 ft graduations and shall be reinforced.

F. Slurry sampling device shall contain sufficient volume of slurry in a single recovery to perform the complete suite of required tests on untested slurry. The sampling device shall have attached a dedicated measuring tape to permit sampling at known depths.

G. 3 inch OD split spoon soil sampler attached to a plastic coated 1/8" diameter cable. The spoon shall be outfitted with spring retainer baskets. Sampler will be used for sampling the surface of placed backfill.

H. Samples bags shall be air tight re-sealable plastic bags of minimum 20 mil thickness. The exterior of sample bags shall be washed clean to remove soil and contamination. Bags shall be labeled with tags attached to each bag by twisted wire.

2.06 STORAGE AND HANDLING OF MATERIALS

A. Material stockpiles, plant, and equipment laydown shall be placed in areas designated by Owner. Handling and storage of materials and equipment are subject to the Owner's approval.

B. Storage for sample bags shall be in a sheltered room, out of sunlight, in boxes clearly identifying content by date. Sample shipping containers shall be water tight and structurally sound.

PART 3 EXECUTION

3.01 MOBILIZATION

A. Furnish and maintain services and facilities to the extent and at the time the Contractor deems them necessary for operations, consistent with the requirements of the work and this Contract.

B. Examine the site, verify conditions depicted on the Contract Drawings necessary for completion of the work, and determine site preparation needs not enumerated in the Contract Drawings.

3.02 GENERAL

A. The work required to provide facilities, equipment, and services required by this Section shall be done in a safe and workmanlike manner and shall conform with any pertinent local or State law, regulation or code, and jurisdiction of public or private utility companies.

B. Employ construction methods and provide containment or protective coverings which prevent the leakage, spillage, or wind blown excursions of excavated materials, dry bentonite, cement, backfill, or bentonite slurry off site.

C. Place a spill control berm and protect the surface of areas at the river edge to prevent contamination from excavated material, bentonite slurry, or backfill.

D. At the completion of hydraulic barrier construction, all surfaces of adjacent areas and structures shall be restored to their original condition.

E. During construction control storm water to direct storm water away from construction areas.

F. Take all necessary precautions and construction measures to prevent collapse of the excavated slurry trench prior to backfilling.

G. Provide and maintain trench inspection tools.

3.03 WORK PLATFORM

A. A work platform shall be constructed by placing compacted soil across the trench alignment of sufficient width to support the excavation equipment.

B. Suitable materials, moisture content, and compaction effort shall be provided to create a compact working surface which will support the equipment in inclement weather.

C. The surface of the work platform shall be symmetrical and provide even support to the excavator to maintain trench verticality.

D. The surface of the work platform shall be sloped to return slurry to the trench.

E. The work platform shall be removed after construction, but not before the Owner reviews settlement plate readings and authorizes cap construction.

3.04 PROTECTION OF EXISTING TEST WELLS AND PIEZOMETERS

Work of this section will be performed by the Owner. The Contractor shall be aware of the locations and protect them from damage by trench excavation and backfill work.

A. Survey the location of wells or piezometers to be protected.

B. Excavate soil around wells or piezometer.

C. Cut off existing riser pipes 1 ft below the Contractor's working level, and cap pipe.

D. Cover capped pipe with metal plate to protect the well or piezometer from damage and backfill to ground level.

E. Re-establish wells and piezometers to original condition after barrier construction process moves beyond well/piezometer location.

3.05 TRENCH EXCAVATION

A. Use backhoe, excavator, dragline, and/or cable operated clam shell buckets which can excavate the trench full width (see 2.05B) in one pass.

B. Excavation equipment provided shall be capable of removing material of any nature within the limits of the trench required for barrier construction. Clamming, drilling, scraping, chiseling, or other methods shall be used, subject to approval of the Owner. Trench excavation shall be performed with minimum ground vibration.

C. The excavation shall penetrate the subsurface soils to the elevations shown on the Drawings, and shall penetrate bedrock 1-foot, or obtain refusal. Boulders will not be considered as bedrock, and shall be removed from the trench.

D. The Contractor shall place a bar across the trench to mark the toe of the backfill slope. The backhoe bucket shall not extend beyond that marking when removing excavation spoils from the trench.

E. Excavation methods shall not cause slurry waves to overtop the trench and spill onto the work platform. The Contractor shall take all measures necessary to contain losses of bentonite slurry into abandoned utilities, underground voids, or adjacent structures.

F. The slurry trench shall be excavated in a continuous manner to close with the top of bedrock at the elevations shown on the contract drawings. Trench continuity shall be demonstrated by the movement of the trench excavation equipment such that the digging tools can be passed vertically from top to bottom of the trench as well as moved horizontally along the axis of the trench without encountering unexcavated material or obstruction.

G. Samples of the weathered limestone at trench bottom shall be taken with excavation equipment at the Owner's request to demonstrate suitable closure has been provided.

H. Bottom soundings and samples shall be taken and documented to demonstrate that the trench bottom is clear of sand sediment before backfill is placed to cover the bottom.

I. Corner excavation details shall not extend more than 10 ft beyond the barrier alignment shown. Initial lead-in slopes shall be 1V:1 H or flatter.

J. Cross-cut closures shall extend a minimum of 5 ft beyond the barrier centerline at the bottom of the excavation.

K. Overlap closures shall extend 10 ft minimum beyond the previously approved final bottom. Backfill shall be removed to clear the bottom for measurement. Installation of sheeting or end stop pipe to limit removal, if desired, shall be performed in a manner approved by the Owner.

L. Excavation spoils, Soil Blend, and Prepared Backfill shall be stored and stockpiled to minimize ponding or collection of rainfall, and to prevent erosion or cross-mixing.

3.06 TRENCH STABILITY

A. Furnish and maintain all labor, equipment, materials, and supplies necessary for the preparation, mixing, hydration, storage, transportation, circulation, cleaning, desanding, Quality Control testing, chemical testing, maintenance, and disposal of bentonite slurry to provide the stability of the open slurry trench at all times for its full depth.

B. Slurry trenches shall be filled and maintained with a stable suspension of bentonite slurry. Slurry level shall be maintained within two feet of the workplatform surface at all times during excavation. Slurry levels shall be raised to within 0.5 ft of the workplatform surface before excavation work stoppages of 8 hours or more.

C. Maintain the slurry properties within the specified limits. Trench slurry shall be maintained by removing old slurry from the trench and replacing with fresh slurry, circulating and cleaning trench slurry to remove coarse material throughout its depth, or use of chemical additives.

D. Excavation and backfill mixing equipment shall be operated outside the area influencing slurry trench stability as described below where D is the depth of the open slurry-filled-trench below the work platform at the location in question.

1. Equipment shall not straddle the open slurry trench.

2. Track equipment for clamshell excavation shall not be permitted to operate closer than 14 ft from the side of the open slurry trench. Multiple clamshell operations shall be separated by D/2, or more, along the trench length.

3. No equipment loading, spoils placement, or backfill preparation will be permitted within 5 ft of the open slurry trench.

4. Backfill mixing may not take place within D/2 of the open slurry trench. Mixing equipment shall operate perpendicular to the trench in this zone to move excavation spoils.

5. Excavation spoil deposits shall be limited to an average thickness of 1 ft within D/2 of the open trench.

6. The toe of waste excavation spoil stockpiles shall be placed more than 2D/3 from the slurry trench. Stockpile slopes shall be 1V:2H or flatter, and stockpiles shall be no higher than 10 feet above the ground surface.

E. If slurry trench walls cave, slide, or slough, the Contractor shall, at no additional expense, re-excavate the trench to remove all material displaced and all backfill contaminated with soil. The reason for trench instability shall be investigated by the Contractor and the Owner. The Contractor shall revise methods, equipment, and materials, and take approved corrective action to prevent further deterioration of the affected area, and to prevent future trench wall instability.

3.07 QUALITY CONTROL OF BENTONITE SLURRY

A. Fresh bentonite slurry shall be tested at least twice daily when mixing and once daily when not mixing to demonstrate compliance with requirements of Part 2. Submit test results daily.

B. Bottom samples of trench slurry shall be sampled and tested twice daily, and top slurry samples shall be sampled once daily, to demonstrate compliance with requirements of Part 2. Submit test results daily.

C. The Contractor shall notify the Owner and investigate and correct slurry deficiencies immediately upon discovery.

3.08 TOLERANCES

A. Trench walls shall be vertical, within 2% of wall depth. The excavator shall be leveled to provide a vertical trench. The Contractor shall demonstrate the excavation equipment is level.

B. The barrier centerline shall be within two feet of the design alignment at any location. Alignment changes necessary to accomplish turns or to bypass obstructions, utilities, structures, etc., may be made only with the approval of the Owner, and shall be documented by survey.

C. If for any reason the excavation method begins to result in a trench width greater than twice the specified width at any depth, or begins to result in misalignment of the trench, the Contractor shall cease trench excavation and revise procedures and equipment to prevent further enlargement or trench misalignment.

3.09 BOTTOM MEASUREMENT AND SAMPLING

A. Reference elevations for determining bottom elevations shall be surveyed and staked in the field at each 10 ft construction stations where bottom measurements are taken. A string line or offset grade stakes shall be established within 3 ft of the trench walls for depth measurement reference. Reference elevations shall be checked and re-established by survey periodically and when requested.

B. Sediment thickness at the bottom of the trench shall be defined as the difference in bottom depth measurements using the flat weight and the pointed weight at the same construction station. The pointed weight shall be advanced to within 0.25 ft of the sounding taken after final excavation, or deeper, when measuring sediment thickness.

C. Sediment thickness shall be determined at 10 ft construction stations after cleaning sediment and immediately before backfill placement.

D. The pointed and flat weights shall be lowered plumb and extracted between readings; at depths below 40 ft, these tools cannot be pulled plumb within viscous trench slurry.

E. When the Contractor believes that bedrock has been encountered, the Contractor shall notify the Owner and measure the depth of the trench and determine the top of rock elevation. Depth may be measured using the clamshell depth gage. Depths shall be measured at 10 ft spacing. The bedrock surface shall be sampled with the clamshell, or other suitable sampling device, at the Owner's request. Bottom materials will be evaluated by the Owner. The Owner will determine if the top of bedrock has been encountered.

F. The Contractor shall remove weathered rock with the clamshell excavator, at the direction of the Owner. Chiseling will not be employed. The Owner will determine the bottom of excavation.

When the excavation is complete, the Contractor shall measure the depth of the trench and determine the trench bottom elevation. Depth may be measured using the clamshell depth gage. Depths shall be measured at 10 ft spacing, at same construction stations as above.

G. The elevation of the trench bottom shall be determined daily, before excavating, at 20 ft spacing within 100 ft each side of the backfill toe and at 60 ft spacing beyond, for the full length of the slurry-supported trench.

H. Sediment thickness shall be determined at 10 ft spacing along the prepared bottom before the bottom is covered with backfill. Pointed weight depths may be used for final depth documentation if sediment is determined to meet the criteria of Part 3.10.

I. The backfill surface shall be sampled with a split spoon sampler or grab sampler at a minimum of three locations, in the presence of the Owner, daily before placing backfill, to determine if the backfill surface must be cleaned.

J. The Contractor shall verify trench bottom and backfill surface depth and elevation, sediment thickness, and reference elevations when requested.

3.10 BOTTOM CLEANING

A. The exposed bottom of the slurry-filled trench shall be cleaned of all loose material daily prior to backfill placement.

B. The toe of the backfill slope shall be excavated every 100 ft of advance to remove accumulated soft materials pushed ahead of the backfill. Cleaning may be performed by any combination of an extended reach backhoe, clamshell, airlifts, suction pumps, etc. Cleaning spoils may be used for preparation of Backfill.

C. If the pointed weight cannot be advanced to within 0.25 ft of the recorded maximum bottom depth when measuring sediment thickness, the bottom shall be cleaned of sediment before backfill is placed.

D. If more than 0.5 ft of sediment is measured on the bottom, the bottom shall be cleaned of sediment before backfill is placed.

E. If any split spoon sample taken from the backfill surface contains more than 0.25 ft (3 inches) of sand sediment, sand-laden bentonite, or material other than prepared backfill, the backfill surface shall be cleaned before backfill is placed.

3.11 BACKFILL PREPARATION

A. Backfill material may be mixed adjacent to the trench or at a remote mixing area approved by the Owner. After clearing and grubbing, remote backfill mixing areas shall be prepared by placing a compacted layer of soil suitable for inclusion within the backfill. Backfill mixing surfaces shall be reconstructed with borrow fill to prevent incorporating underlying soil into the backfill.

B. Segregation and stockpiling of excavation spoils shall be performed as required to obtain the specified backfill gradation with the minimum addition of imported fill. Use of imported soil to augment the Soil Blend shall be approved by the Owner.

C. Soil clods shall be reduced in size to one-quarter inch (1/4 inch) or less. Some spoils may require special mechanical shredding. Cemented soil or rock shall be reduced to gravel sizes meeting the backfill gradation, or shall be removed from the backfill. Cemented particles which survive standard gradation testing methods need not be broken down further.

D. Slurry shall be added to the backfill to control slump. Addition of storm water is prohibited. Test slump immediately before placing backfill.

E. Dry bentonite, if required, shall be added to the Prepared Backfill by dry weight of Soil Blend. Up to 2% dry bentonite may be added to reduce slump, if required.

F. Other than the addition of slurry or dry bentonite to adjust the slump, no soil or gravel may be added after samples for laboratory testing are taken. Mixing may continue.

G. Backfill shall be placed at the slump required in Part 2.

H. Frozen backfill shall not be placed in the trench. Backfill mixing and placement shall cease at temperatures below 30°F or when, in the opinion of the Owner, adverse weather conditions do not permit proper mixing.

I. Back-blading shall be used where possible to prevent overexcavation and inclusion of unmixed soils with prepared backfill.

3.12 BACKFILL PLACEMENT

A. Trench bottom and backfill slope shall be measured, sampled, cleaned if required, and approved by the Owner immediately before backfill placement.

B. All backfill Quality Control tests shall be completed and backfill shall meet the specification requirements before it may be placed.

C. Initially, the S-B backfill shall be placed into the trench at one location only, by clamshell, tremie, or on a lead-in slope, until backfill emerges from the slurry surface and has achieved a natural angle of repose extending to the trench bottom.

D. Free dropping of backfill through slurry will not be permitted. Backfill shall be placed on the surface of previously placed backfill, no closer than 5 ft from the point at which the backfill enters the slurry surface. Backfill shall be placed in such a manner that the backfill displaces the slurry and intermixing of the backfill and slurry does not occur.

E. In order to promote mudwave type displacement of slurry and sediment in the trench, backfill shall be placed at a single location until the backfill slope fails to advance with additional backfill placement.

F. Backfill placement method shall not splash backfill or slurry outside the top of the trench.

G. The toe of the advancing backfill slope shall be a minimum of 40 ft and a maximum of 100 ft from the closest point of excavation. The toe of the backfill slope shall be established to prevent cross contamination of the backfill by excavation spoils.

H. The trench shall be backfilled to within 6 inches of the work platform but no higher than the work platform.

I. The toe of the backfill material that rises to the top of trench at the terminal end shall be re-excavated as necessary to remove entrapped slurry, silt, sediment, and sand that may exist. This material shall be replaced with new prepared backfill.

J. Settlement Monitoring of Completed Backfill:

1. Settlement plates illustrated on the Contract Drawings shall be installed 18" below the surface of the completed trench backfill at 200 ft spacing along the barrier within 24 hours of completion of backfilling within 50 ft of the plate location. A PVC sleeve shall be installed over the riser to separate the riser from the soil-bentonite backfill outside of the sleeve. The elevation of the top of each settlement platform riser pipe shall be determined immediately after installation, then daily thereafter until the Owner indicates that cap construction may begin. Settlement plate readings shall be provided to the Owner in the daily quality control report. Settlement plates shall be removed during cap construction.

3.13 QUALITY CONTROL OF PREPARED BACKFILL

A. Sample selection, labeling and packing.

1. Samples of Prepared Backfill shall be taken in the presence of the Owner. Samples shall be acquired from the mixing area, the completed trench, or as directed by the Owner.

2. Record Backfill samples shall be clearly labeled with sample number, batch, mix location, and date and time sampled. If samples are acquired from the trench, sampling station and elevation shall be recorded.

3. Quality assurance samples shall be split for Owner and Contractor use. The Contractor shall ship two 20 lb samples of Prepared Backfill to the Owner's Quality Assurance testing facility by overnight express each week during the project, or when directed.

B. Testing Schedule for Prepared Backfill:

1. The minimum number of Quality Control tests performed by the Contractor shall be as described below. Testing does not need to be performed if backfill mixing is not

occurring. The Contractor shall perform additional tests to confirm mix proportions and bentonite addition, etc., or as directed by the Owner:

Test	Volume of Prepared Backfill
Gradation	800 cy or 1 per day min
Bulk Wet Density	300 cy or 2 per day min
Water Content	300 cy or 2 per day min
Slump	300 cy or 2 per day min
Permeability	1,200 cy or 1 per week min

2. Bulk wet density of the backfill shall be measured using a standard 1/10 cubic ft mold of known weight, screeding off the excess, and cleaning and weighing the filled mold. The test specimens shall be placed in the mold in three lifts, rodding each lift 25 times.

C. The Owner's laboratory will provide Quality Assurance permeability testing of Prepared Backfill. One QA test shall be performed for every 3,000 cy of backfill prepared and placed.

D. Permeability samples shall be scalped in the lab to remove particles larger than the 3/8 inch sieve. Permeability test specimens shall be isotopically consolidated to an effective stress of 15 psi, with a total cell pressure of 50 psi or higher. Laboratory tap water shall be used to define permeability.

3.14 STABILIZATION AND PLACEMENT OF BARRIER CONSTRUCTION BYPRODUCTS

A. Excess backfill hall be used to temporarily cover the completed Hydraulic Barrier. Wet spoils remaining after cover soil use shall be stabilized by desiccation or by the thorough addition of cement (2% to 3% by dry weight of spoils). Spoils shall be stabilized to allow handling and compaction by earthwork equipment.

B. At completion of slurry trench excavation and backfill, waste slurry shall be stabilized by evaporation, addition of cement, or addition of other stabilizing material for controlled disposal on site. Slurry shall be stabilized to meet the requirements of General Fill. Slurry ponds shall be emptied and leveled after slurry stabilization. Slurry shall not be discharged into any sanitary sewer, storm sewer, or natural drainage channel.

C. Waste slurry shall be treated and dried or stabilized by cement addition before the contractor demobilizes.

D. Stabilized waste materials shall be left on site at an area designated by the Owner.

E. Grade spoils piles to promote storm water runoff towards appropriate draining systems.

3.15 SITE CLEAN-UP AND CAP OVER BARRIER

A. Construct cap over barrier as illustrated on Contract Drawings. Imported clay fill used for cap construction shall be approved by the Owner. Place reinforcement grid to separate clay fill cap from soil-bentonite backfill. Re-establish drainage swales to original grades, place topsoil and seed over areas affected by the work.

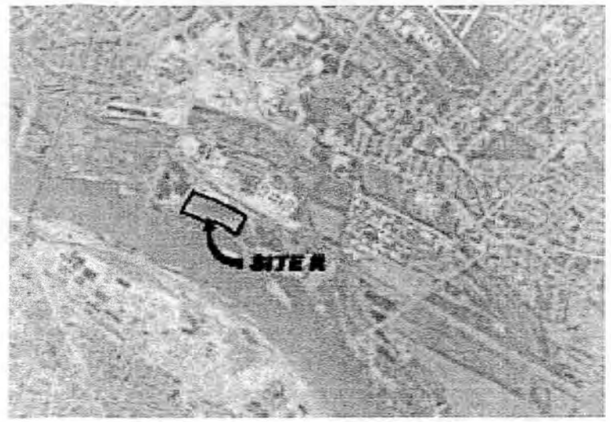
B. Remove or shape the Work Platform and clean slurry trench and backfill mixing work surfaces and adjacent ground to restore original grade. Scrape work surfaces clean of excavation spoils, soils containing bentonite, siltation, and softened surface soils. Slurry tanks, temporary roads or other earthwork, ditches, drainage culverts, etc. shall be filled and left in a condition acceptable to the Owner. Grade work areas to promote storm water runoff. Spoils resulting from cleaning shall be placed on site in a controlled manner where designated by the Owner.

- END OF SECTION -

DEEP SOIL–BENTONITE BARRIER
SOLUTIA, INC.
SAUGET, ILLINOIS

Inquip Associates, Inc.

SOLUTIA™
Applied Chemistry, Creative Solutions



LOCATION MAP

CONTRACT DRAWINGS

DRAWING NO.	FILE NAME	TITLE
1	1	TITLE SHEET
2	2	KEY PLAN
3	3	BARRIER PLAN AND PROFILE, STA. 5+00 TO STA. 11+27.5
4	4	BARRIER PLAN AND PROFILE, STA. 11+27.5 TO STA. 18+00
5	5	BARRIER PLAN AND PROFILE, STA. 18+00 TO STA. 25+00
6	6	BARRIER PLAN AND PROFILE, STA. 25+00 TO STA. 31+8.78
7	7	BARRIER PLAN AND PROFILE, STA. 31+8.78 TO STA. 37+96.51
8	8	CONTROL POINTS
9	9	CAP DETAILS
10	10	BACKFILL SETTLEMENT MONITORING

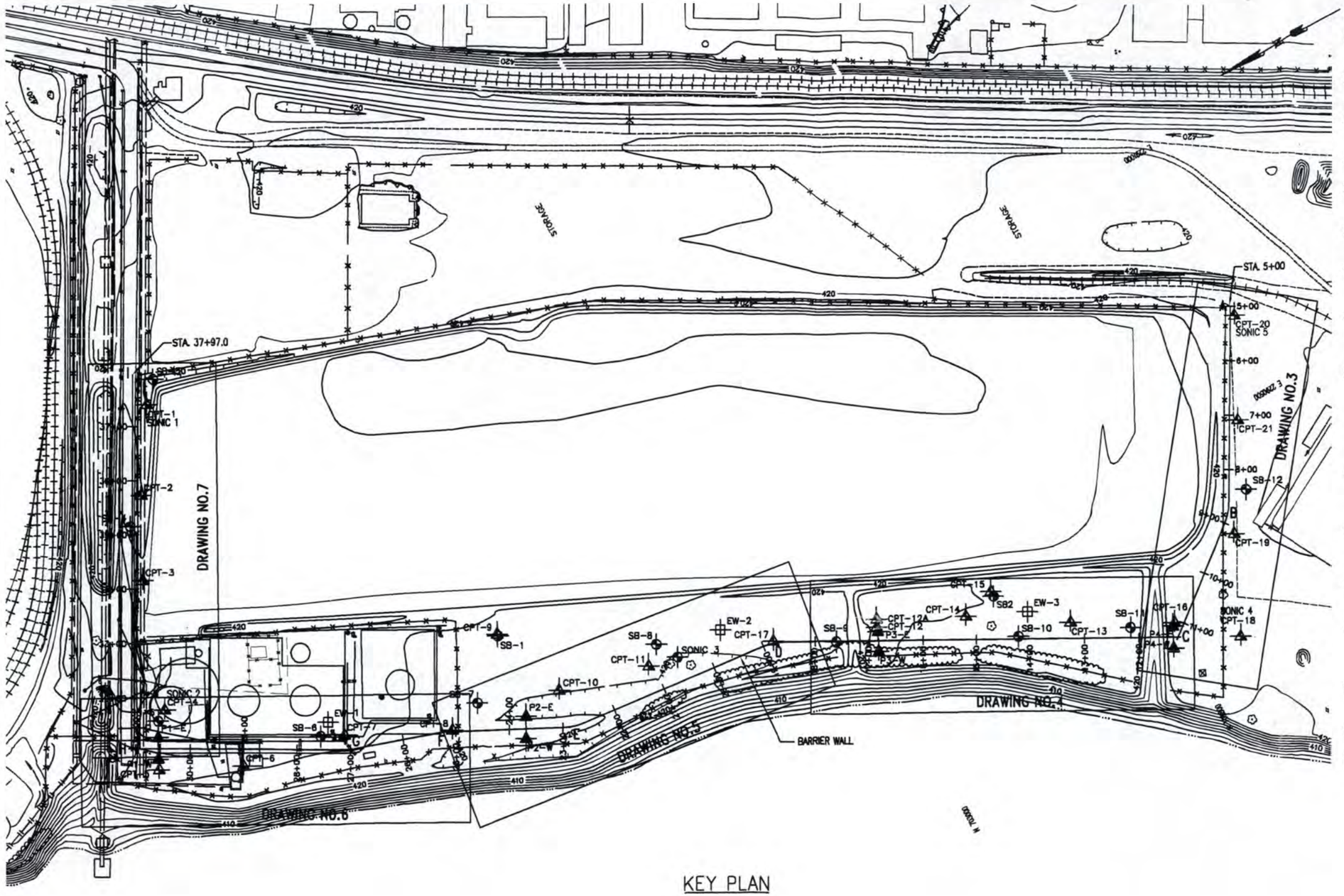
PRELIMINARY
09–16–03

SOLUTIA, INC
SITE R
SAUGET ILLINOIS

INQUIP ASSOCIATES, INC
McLEAN VIRGINA

MUESER RUTLEDGE CONSULTING ENGINEERS
14 PENN PLAZA – 225 W. 34TH STREET, NY, NY 10122

SCALE	MADE BY E.C.	DATE 08–14–03	FILE NO.
N.T.S.	CHKD BY K.R.	DATE 08–14–03	10060
TITLE SHEET			DRAWING NO. 1



NOTES:

1. Base plan and graphic boring logs were taken from July 03, 2003 AutoCAD files provided by URS.
2. Graphic logs depict generalized soil conditions. Refer to individual boring log records for details.
3. Borings are projected to section. Actual elevation of the bedrock surface may vary.
4. Overhead and subsurface obstructions are not shown.
5. Lead-in slope to be located by the contractor. Lead-in slope shall be 1V:1H or flatter.
6. Overlap closures shall extend 10 ft beyond the toe of the lead-in slope at the bottom of the trench.
7. Cross-cut closures shall extend 5 ft beyond the outside edge of the cutoff at the bottom of the trench.
8. Contractor shall construct the final barrier alignment within 2 ft of the centerline given by the Control Points provided on Drawing 8.
9. Contractor's Surveyor shall establish the construction stations shown with stakes at 10 ft intervals. Construction station markers shall remain in place at 10 ft intervals throughout construction. Construction station markers shall remain in place at 100 ft intervals after cap construction.
10. Contractor's Surveyor shall establish reference elevations for trench depth measurements at each 10 ft construction station.
11. Control Points A through I provided on Drawing 8 shall be identified in the field. Other control points may be required.
12. The contractor is responsible for maintaining trench stability and construction quality.
13. Work platform surface elevation grades may change + 1% within 200 ft distance, but must not drop more than −0.1% over 1400 ft.
14. Typical freeboard (slurry level to work platform surface) shall be 1 ft or less. Maximum freeboard permitted is 2 ft.
15. Contractor shall mark and protect wells and piezometers.
16. See URS Drawing No.s 2-06, 2-07, and 2-08 for utilities.

PRELIMINARY
09-16-03

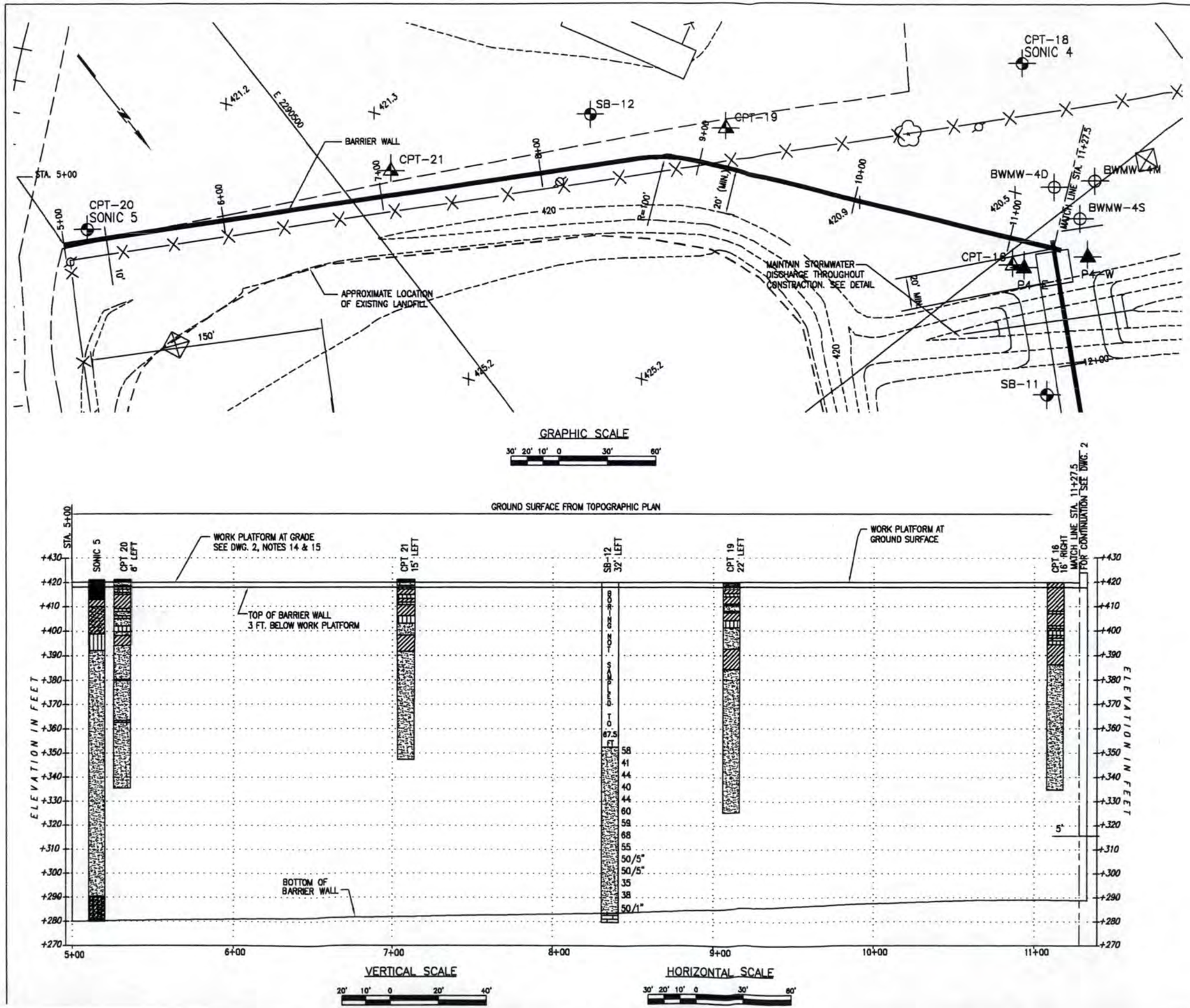
KEY PLAN

GRAPHIC SCALE
100' 50' 0 100' 200'

LEGEND

- CPT – CONE PENETROMETER LOCATION (2001)
- SONIC – SONIC BORING LOCATION (2002)
- SB – STANDARD PENETRATION TEST BORING (2001 AND 2002)

SOLUTIA, INC SITE R SAUGET ILLINOIS			
INQUIP ASSOCIATES, INC McLEAN VIRGINA			
MUESER RUTLEDGE CONSULTING ENGINEERS 14 PENN PLAZA – 225 W. 34TH STREET, NY, NY 10122			
SCALE AS NOTED	MADE BY E.C CH'KD BY K.R.	DATE 8-11-03 DATE 8-11-03	FILE NO. 10060
KEY PLAN			DRAWING NO. 2



PLAN LEGEND

62	STANDARD PENETRATION TEST BLOW COUNT (N). BLOWS /12" PENETRATION OF SAMPLER UNLESS INDICATED OTHERWISE
P	HYDRAULICALLY PUSHED SAMPLE
10+00	WALL STATION AT CENTERLINE OF BARRIER WALL
CPT-1	CONE PENETROMETER TEST NUMBER (2001)
SONIC 1	SONIC BORING NUMBER (2002)
SB-1	SOIL BORING NUMBER (2002)

PROFILE LEGEND

- CLAY (CL OR CH)
- SILT (ML)
- CLAYEY SAND (SC)
- SAND (SP OR SW)
- GRAVEL AND/OR COBBLES
- LIMESTONE
- PROPOSED SCREENED INTERVAL OF EXTRACTION WELL OR PIEZOMETER

NOTES:

1. For notes, see Drawing No. 2.

PRELIMINARY
09-16-03

SOLUTIA, INC
SITE R
SAUGET ILLINOIS

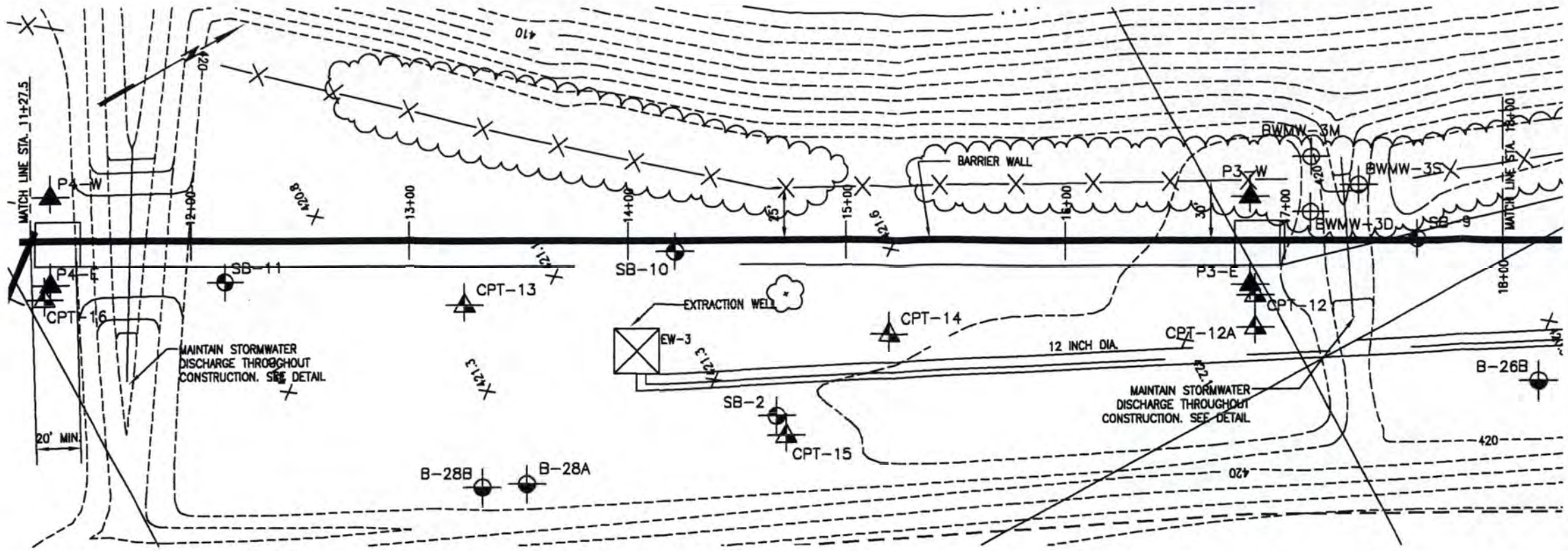
INQUIP ASSOCIATES, INC
McLEAN VIRGINA

MUESER RUTLEDGE CONSULTING ENGINEERS
14 PENN PLAZA – 225 W. 34TH STREET, NY, NY 10122

SCALE	MADE BY E.C.	DATE 8-07-03	FILE NO.
AS NOTED	CHKD BY K.R.	DATE 8-07-03	10060

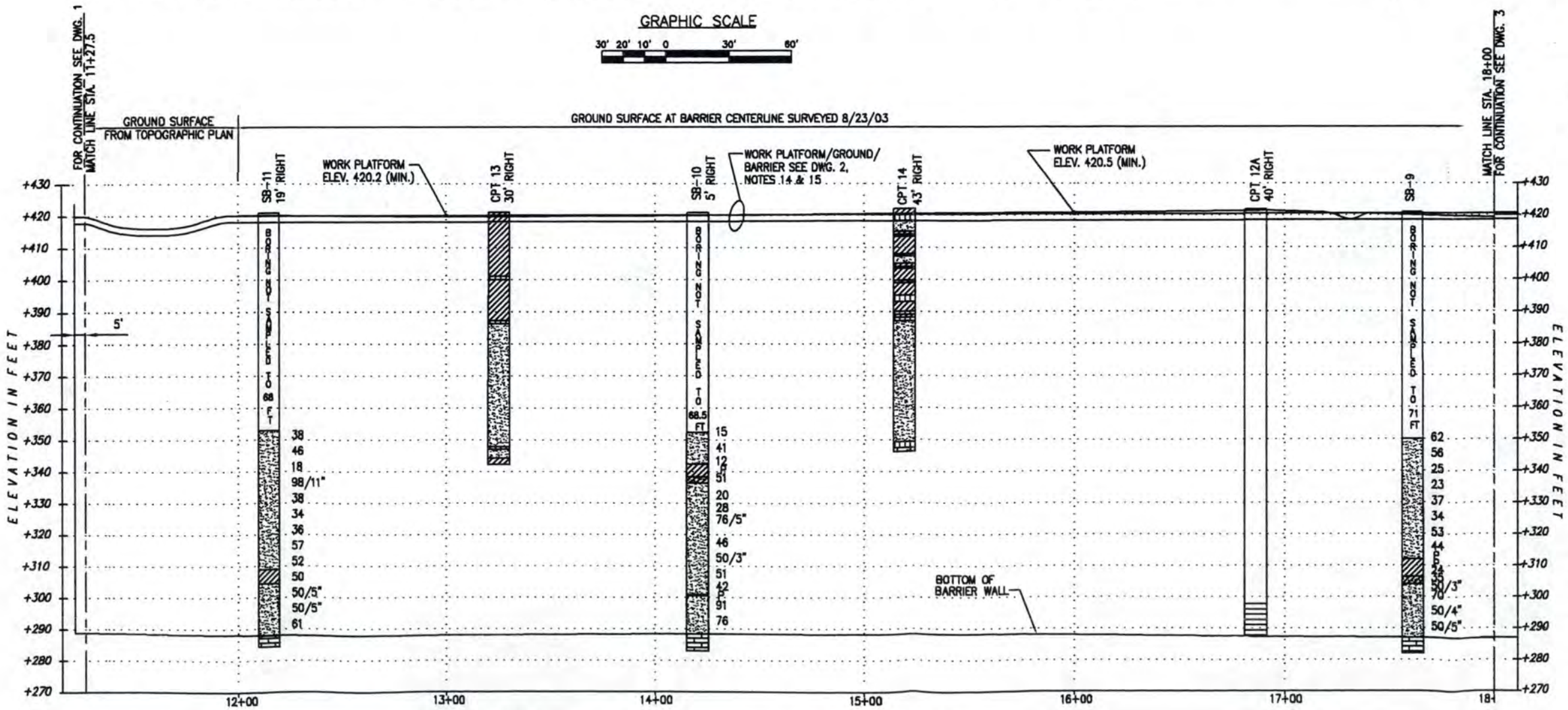
BARRIER PLAN AND PROFILE, STA. 5+00 TO 11+27.5

DRAWING NO. 3



GRAPHIC SCALE

30' 20' 10' 0 30' 60'



VERTICAL SCALE

20' 10' 0 20' 40'

HORIZONTAL SCALE

30' 20' 10' 0 30' 60'

PLAN LEGEND

62	STANDARD PENETRATION TEST BLOW COUNT (N). BLOWS /12" PENETRATION OF SAMPLER UNLESS INDICATED OTHERWISE
P	HYDRAULICALLY PUSHED SAMPLE
10+00	WALL STATION AT CENTERLINE OF BARRIER WALL
CPT-1	CONE PENETROMETER TEST NUMBER (2001)
SONIC 1	SONIC BORING NUMBER (2002)
SB-1	SOIL BORING NUMBER (2002)

PROFILE LEGEND

- CLAY (CL OR CH)
- SILT (ML)
- CLAYEY SAND (SC)
- SAND (SP OR SW)
- GRAVEL AND/OR COBBLES
- LIMESTONE
- PROPOSED SCREENED INTERVAL OF EXTRACTION WELL OR PIEZOMETER

NOTES:

1. For notes, see Drawing No. 2.

PRELIMINARY
09-16-03

SOLUTIA, INC
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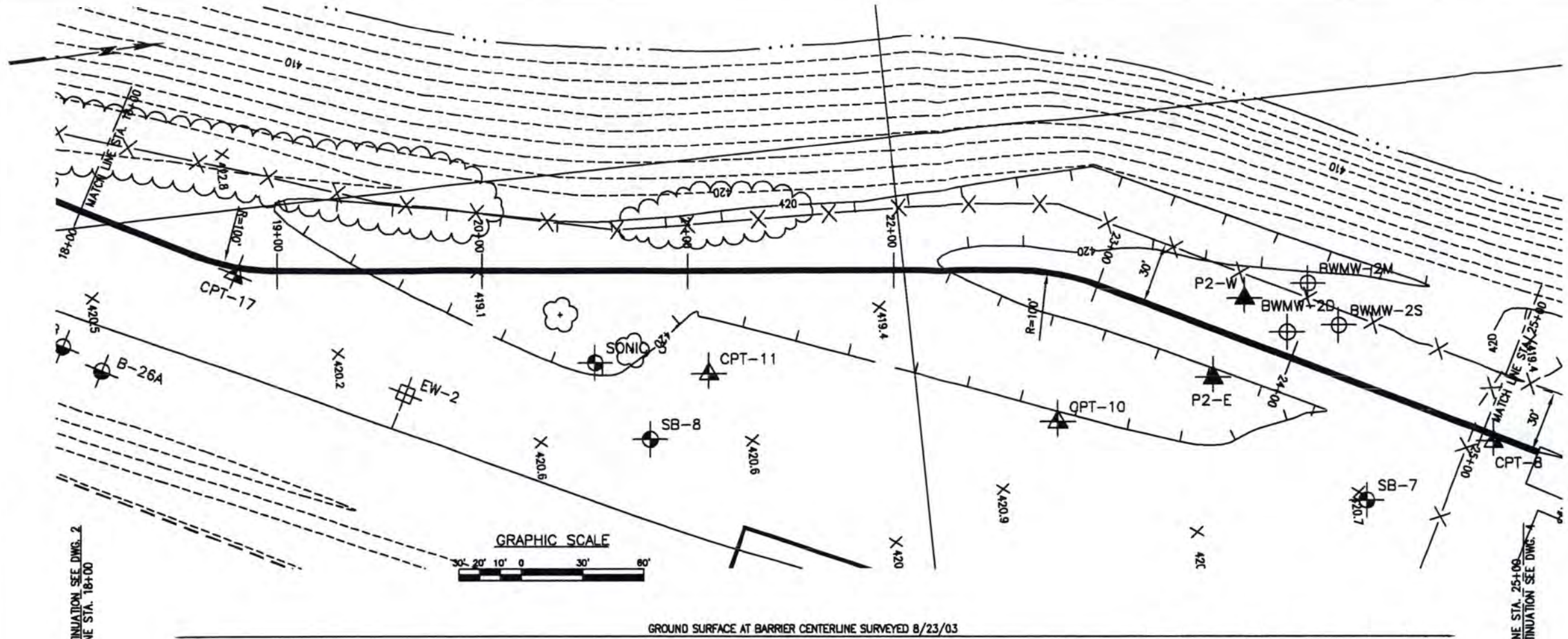
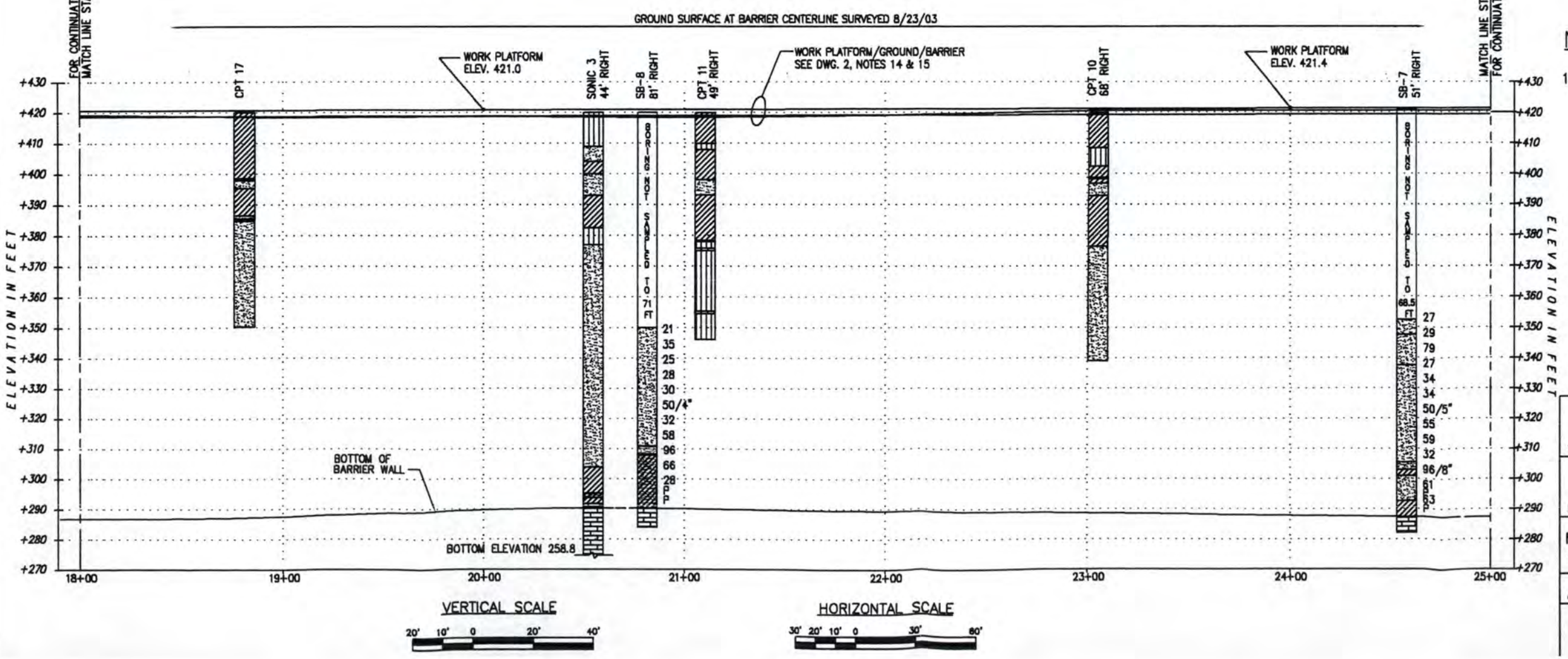
14 PENN PLAZA – 225 W. 34TH STREET, NY, NY 10122

SCALE	MADE BY E.C.	DATE 8-07-03	FILE NO.
AS NOTED	CH'KD BY K.R.	DATE 8-07-03	10060

BARRIER PLAN AND PROFILE, STA. 11+27.5 TO STA. 18+00

DRAWING NO. 4





PLAN LEGEND

62	STANDARD PENETRATION TEST BLOW COUNT (N). BLOWS /12" PENETRATION OF SAMPLER UNLESS INDICATED OTHERWISE
P	HYDRAULICALLY PUSHED SAMPLE
10+00	WALL STATION AT CENTERLINE OF BARRIER WALL
CPT-1	CONE PENETROMETER TEST NUMBER (2001)
SONIC 1	SONIC BORING NUMBER (2002)
SB-1	SOIL BORING NUMBER (2002)

PROFILE LEGEND

- CLAY (CL OR CH)
- SILT (ML)
- CLAYEY SAND (SC)
- SAND (SP OR SW)
- GRAVEL AND/OR COBBLES
- LIMESTONE
- PROPOSED SCREENED INTERVAL OF EXTRACTION WELL OR PIEZOMETER

NOTES:

1. For notes, see Drawing No. 2.

PRELIMINARY
09-16-03

SOLUTIA, INC
SITE R
SAUGET ILLINOIS

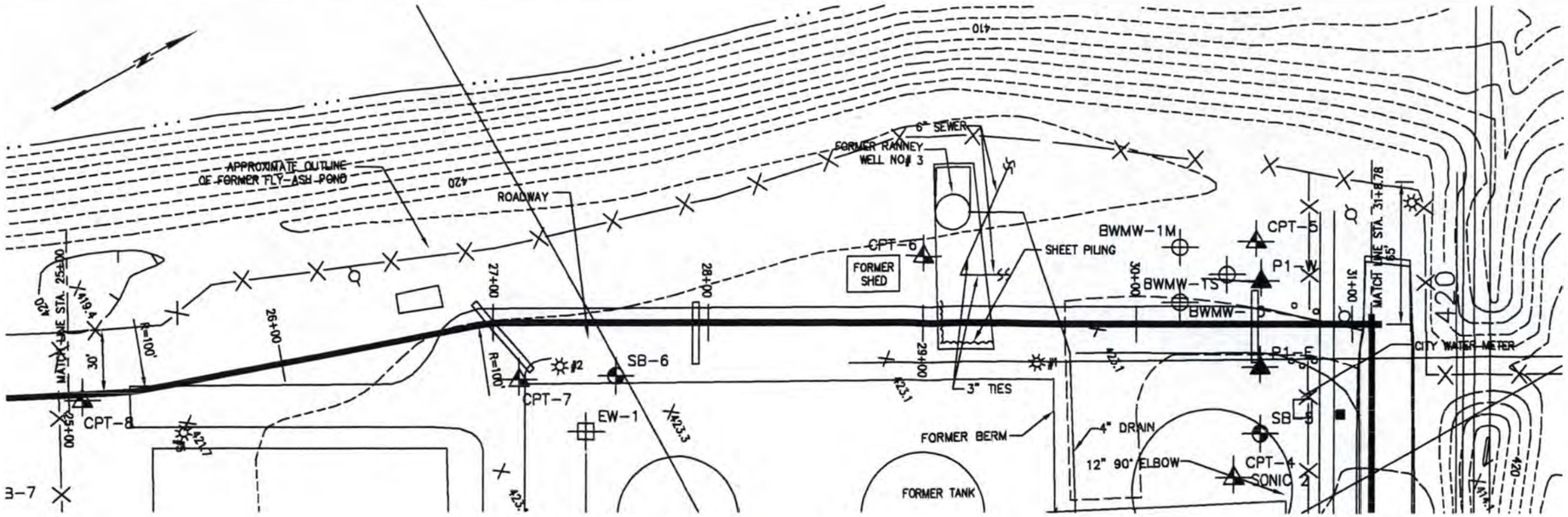
INQUIP ASSOCIATES, INC
McLEAN VIRGINA

MUESER RUTLEDGE CONSULTING ENGINEERS
14 PENN PLAZA – 225 W. 34TH STREET, NY, NY 10122

SCALE	MADE BY E.C.	DATE 8-07-03	FILE NO.
AS NOTED	CH'KD BY K.R.	DATE 8-07-03	10060

BARRIER PLAN AND PROFILE, STA. 18+00 TO STA. 25+00

DRAWING NO. 5



GRAPHIC SCALE

30' 20' 10' 0 30' 60'

PLAN LEGEND

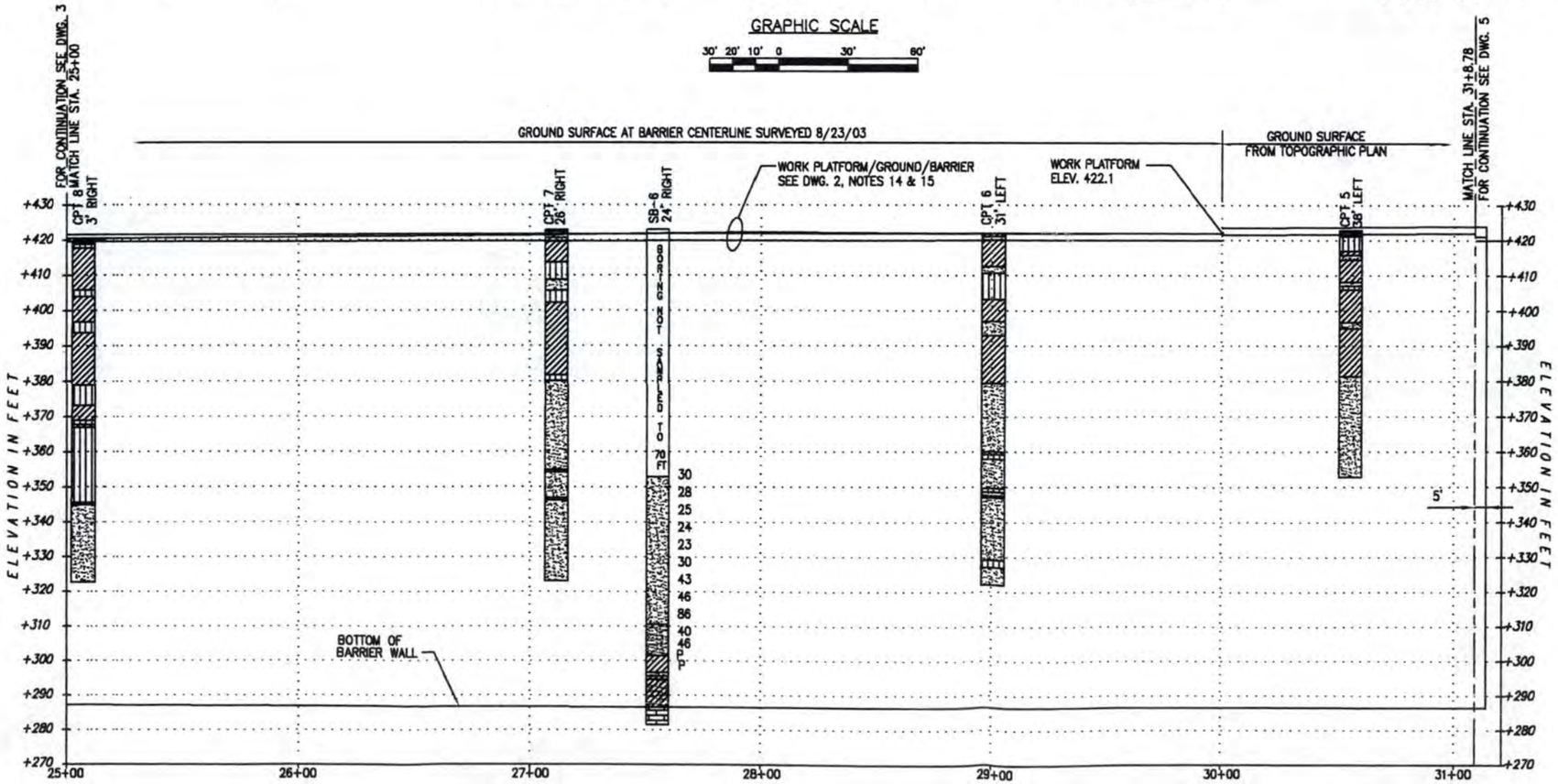
62	STANDARD PENETRATION TEST BLOW COUNT (N). BLOWS /12" PENETRATION OF SAMPLER UNLESS INDICATED OTHERWISE
P	HYDRAULICALLY PUSHED SAMPLE
10+00	WALL STATION AT CENTERLINE OF BARRIER WALL
CPT-1	CONE PENETROMETER TEST NUMBER (2001)
SONIC 1	SONIC BORING NUMBER (2002)
SB-1	SOIL BORING NUMBER (2002)

PROFILE LEGEND

- CLAY (CL OR CH)
- SILT (ML)
- CLAYEY SAND (SC)
- SAND (SP OR SW)
- GRAVEL AND/OR COBBLES
- LIMESTONE
- PROPOSED SCREENED INTERVAL OF EXTRACTION WELL OR PIEZOMETER

NOTES:

1. For notes, see Drawing No. 2.



VERTICAL SCALE

20' 10' 0 20' 40'

HORIZONTAL SCALE

30' 20' 10' 0 30' 60'

PRELIMINARY
09-16-03

SOLUTIA, INC
SITE R

SAUGET ILLINOIS

INQUIP ASSOCIATES, INC

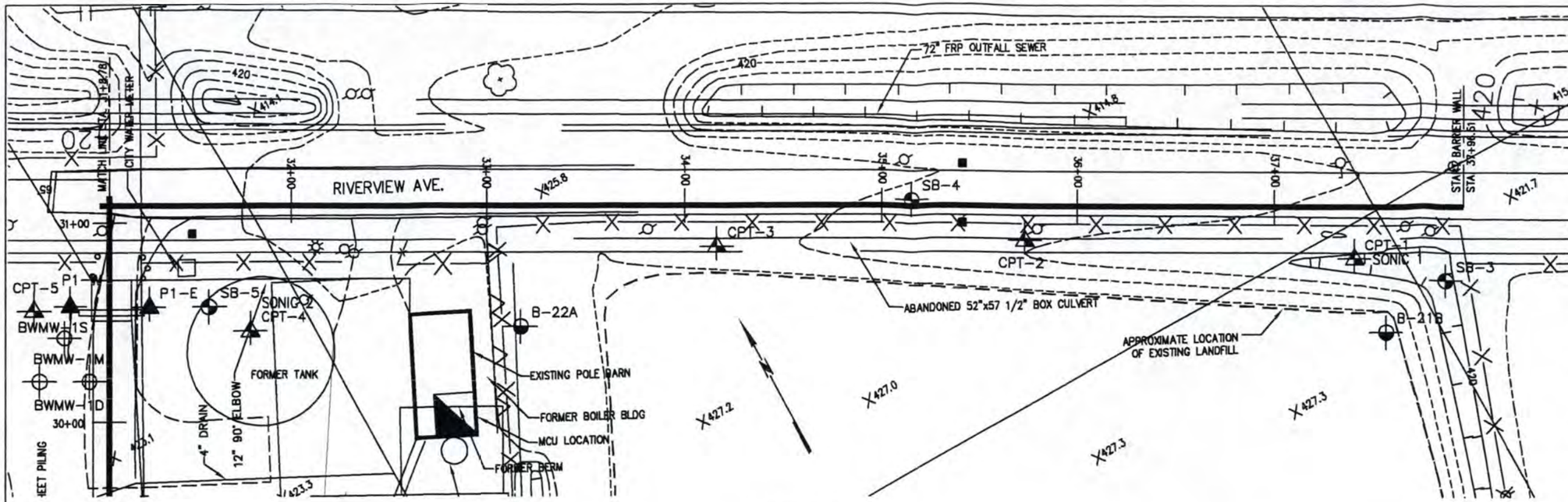
McLEAN VIRGINA

MUESER RUTLEDGE CONSULTING ENGINEERS
14 PENN PLAZA – 225 W. 34TH STREET, NY, NY 10122

SCALE	MADE BY E.C.	DATE 8-07-03	FILE NO.
AS NOTED	CH'KD BY K.R.	DATE 8-07-03	10060

BARRIER PLAN AND PROFILE, STA. 25+00 TO STA. 31+8.78

DRAWING NO. 6



PLAN LEGEND

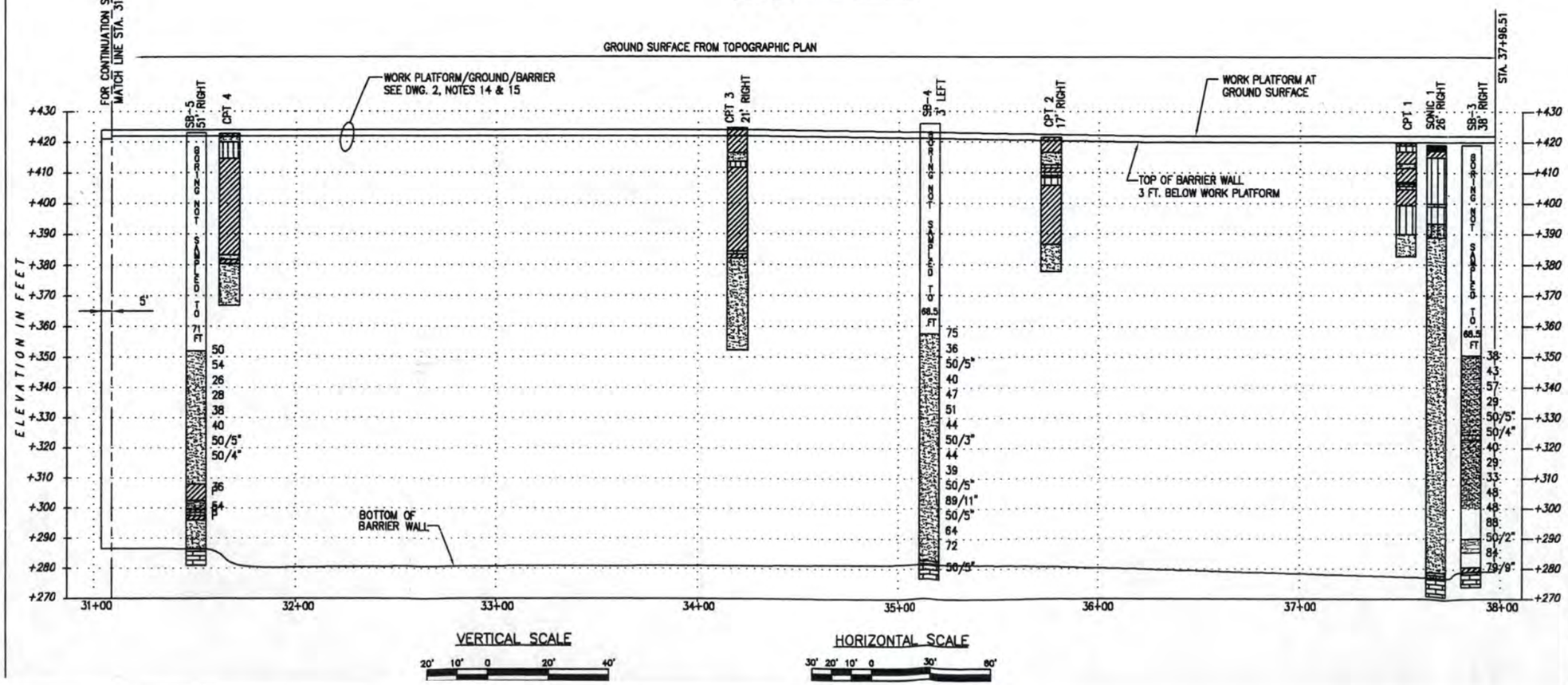
62	STANDARD PENETRATION TEST BLOW COUNT (N). BLOWS /12" PENETRATION OF SAMPLER UNLESS INDICATED OTHERWISE
P	HYDRAULICALLY PUSHED SAMPLE
10+00	WALL STATION AT CENTERLINE OF BARRIER WALL
CPT-1	CONE PENETROMETER TEST NUMBER (2001)
SONIC 1	SONIC BORING NUMBER (2002)
SB-1	SOIL BORING NUMBER (2002)

PROFILE LEGEND

- CLAY (CL OR CH)
- SILT (ML)
- CLAYEY SAND (SC)
- SAND (SP OR SW)
- GRAVEL AND/OR COBBLES
- LIMESTONE
- PROPOSED SCREENED INTERVAL OF EXTRACTION WELL OR PIEZOMETER

NOTES:

1. For notes, see Drawing No. 2.



PRELIMINARY
09-16-03

SOLUTIA, INC
SITE R
SAUGET ILLINOIS

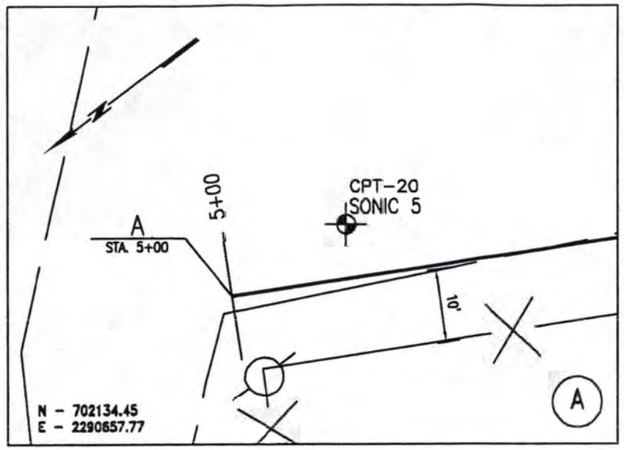
INQUIP ASSOCIATES, INC
McLEAN VIRGINA

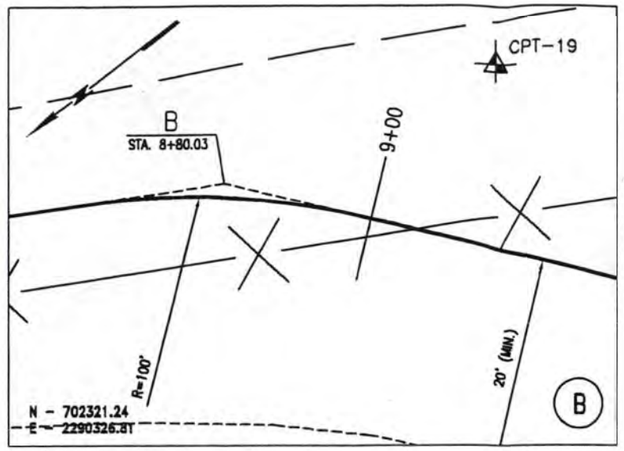
MUESER RUTLEDGE CONSULTING ENGINEERS
14 PENN PLAZA – 225 W. 34TH STREET, NY, NY 10122

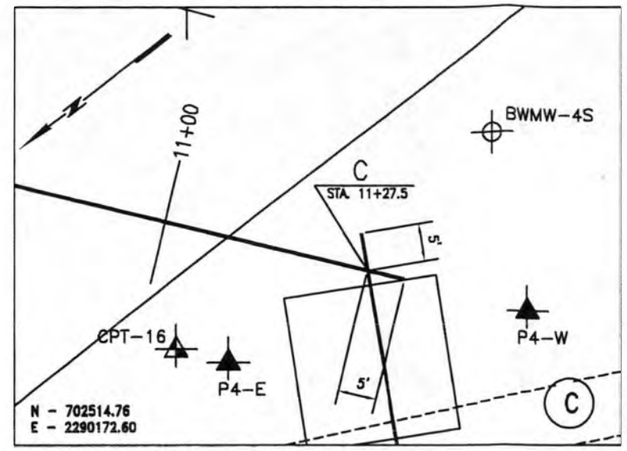
SCALE	MADE BY E.C.	DATE 8-07-03	FILE NO.
AS NOTED	CH'KD BY K.R.	DATE 8-07-03	10060

BARRIER PLAN AND PROFILE, STA. 31+8.78 TO STA. 37+96.51

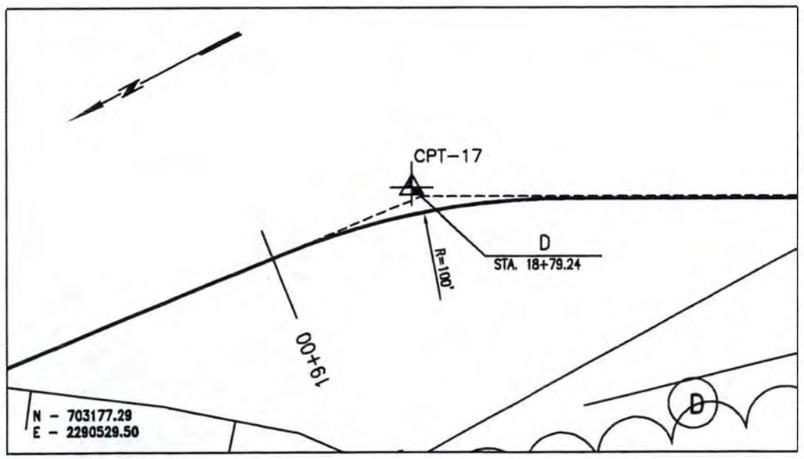
DRAWING NO. 7

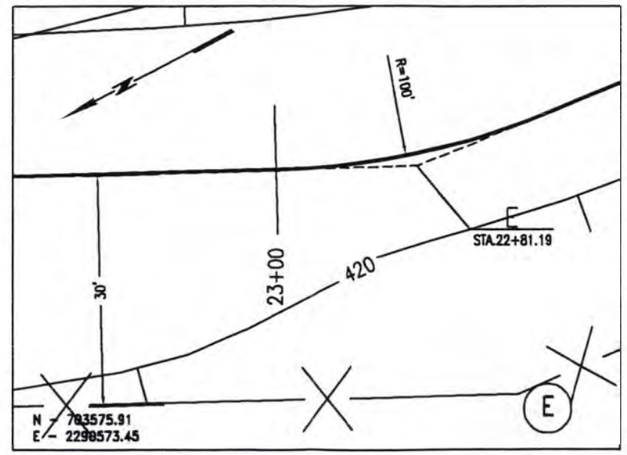


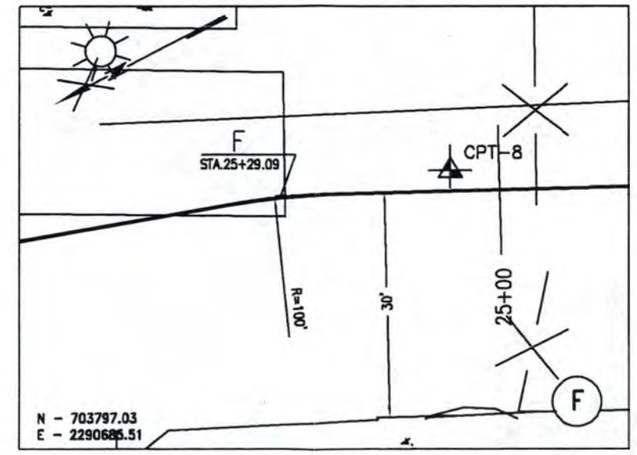


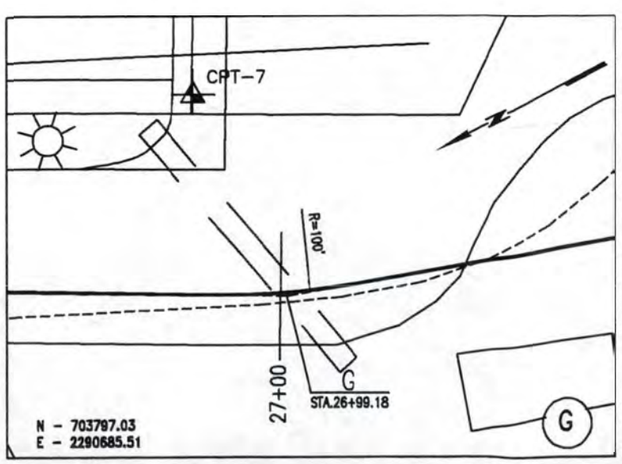


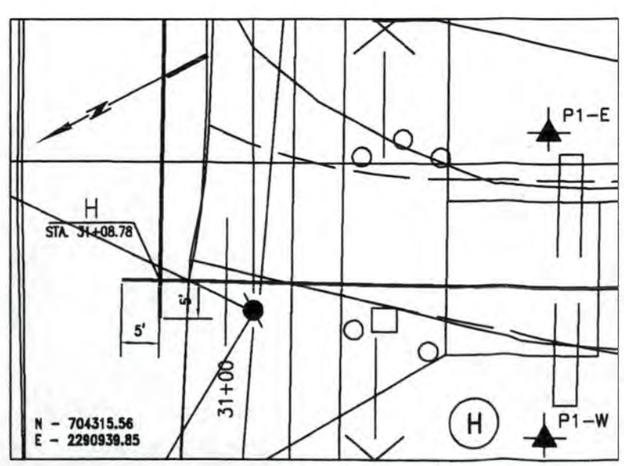
NOTE:
Stations shown are at barrier centerline.

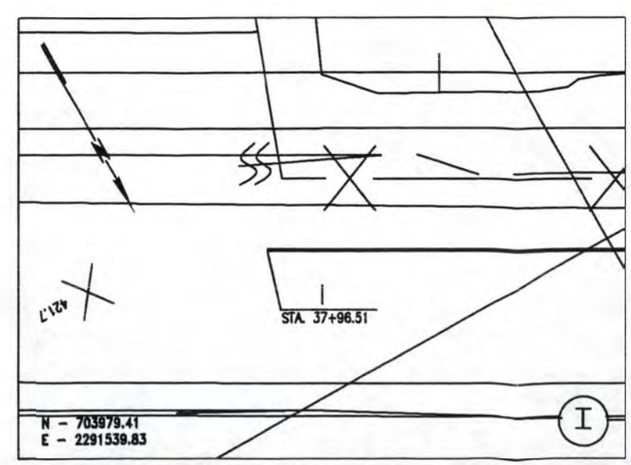








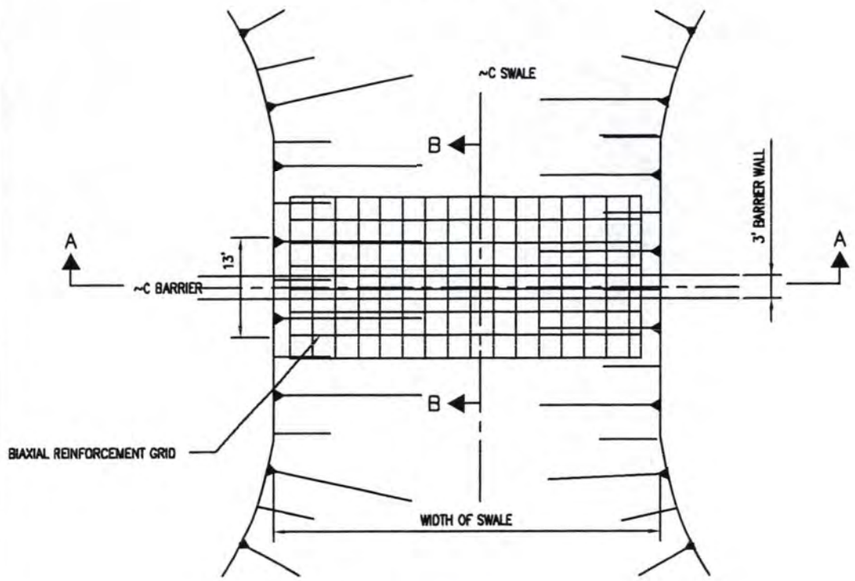




PRELIMINARY
09-16-03

SOLUTIA, INC SITE R SAUGET ILLINOIS	
INQUIP ASSOCIATES, INC McLEAN VIRGINA	
MUESER RUTLEDGE CONSULTING ENGINEERS 14 PENN PLAZA – 225 W. 34TH STREET, NY, NY 10122	
SCALE: AS NOTED MADE BY E.C. DATE 8-12-03 CH'KD BY K.R. DATE 8-12-03	FILE NO. 10060
CONTROL POINTS	DRAWING NO. 8

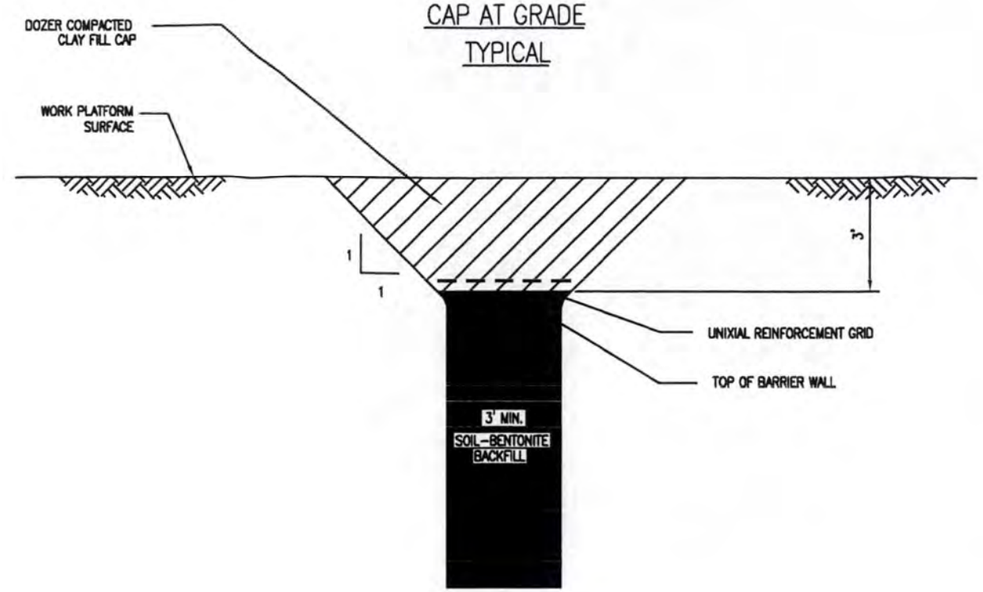
CAP BELOW SWALE



GRAPHIC SCALE

10' 5' 0 10' 20'

CAP AT GRADE
TYPICAL

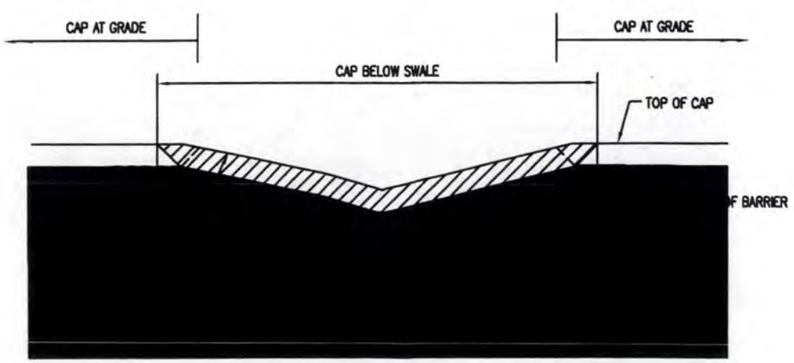


CAP DETAILS

GRAPHIC SCALE

2' 1' 0 2' 4'

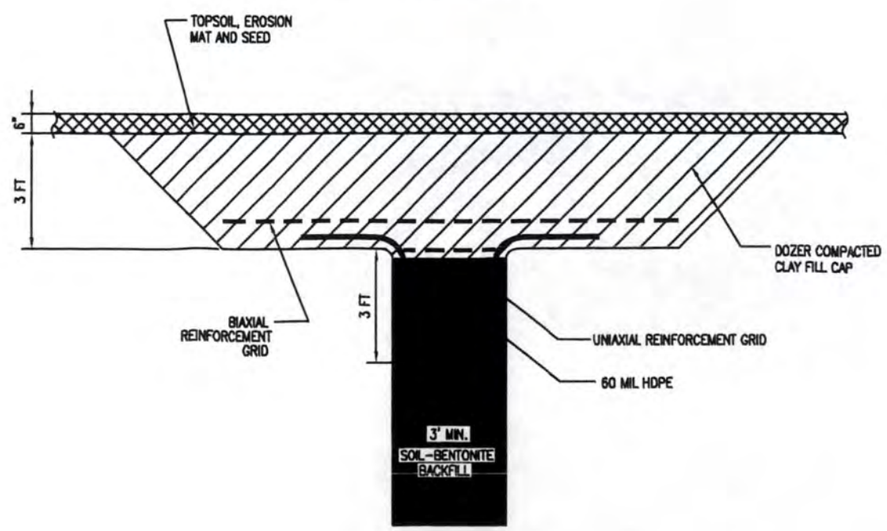
CAP BELOW SWALE



SECTION A–A

GRAPHIC SCALE

10' 5' 0 10' 20'



SECTION B–B

GRAPHIC SCALE

2' 1' 0 2' 4'

CAP BELOW SWALE

A. Remove work platform to preconstruction grade.

B. Excavate backfill and place HDPE liner. Hold liner in place with pins.

C. Replace backfill in loose lifts (not to exceed 18").

D. Place uniaxial reinforcement grid.

E. Place biaxial reinforcement grid.

F. Place compacted clay cap and topsoil.

CAP AT GRADE

A. Excavate backfill and notch top of trench.

B. Place uniaxial reinforcement grid.

C. Place clay fill above work platform, in loose lifts (not to exceed 18"), and compact with dozer, taking care not to mud–wave backfill.

D. Allow cap settlement for 5 days. Compact with two dozer passes each day.

E. Cut cap level with ground/work platform.

NOTES:

1. Uniaxial Reinforcement Grid tensile strength at 5% strain shall be greater than or equal to 2000 lb/ft (Tensar UX1400HS or equiv.) Grid shall be a minimum of 3 ft wide.

2. Biaxial Reinforcement Grid tensile strength at 5% strain shall be greater than or equal to 1300 lb/ft (Tensar BX1500 or equiv.) Grid shall be a minimum of 13 ft wide.

PRELIMINARY
09–16–03

SOLUTIA, INC
SITE R

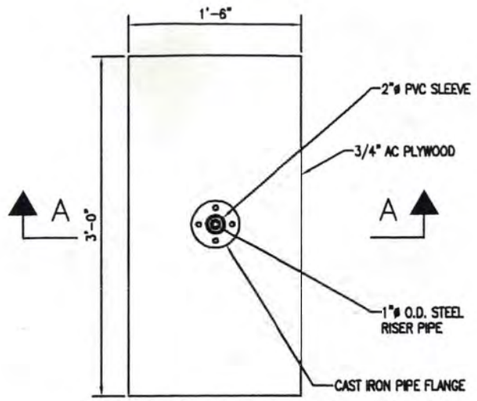
SAUGET ILLINOIS

INQUIP ASSOCIATES, INC

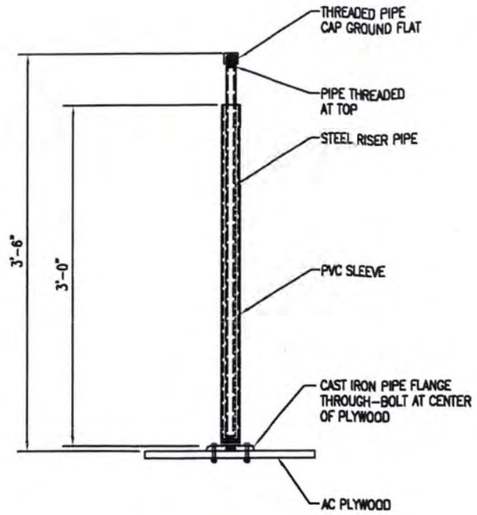
McLEAN VIRGINA

MUESER RUTLEDGE CONSULTING ENGINEERS
14 PENN PLAZA – 225 W. 34TH STREET, NY, NY 10122

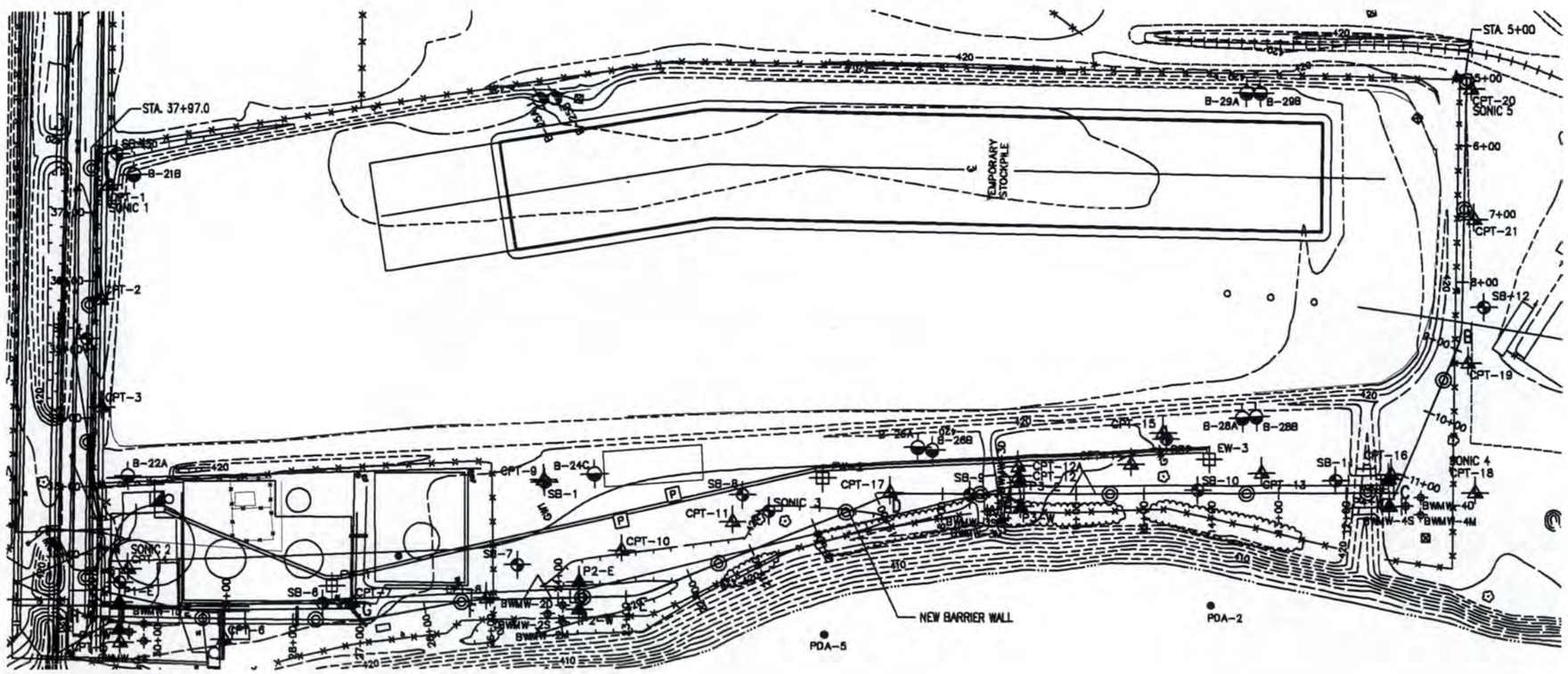
SCALE	MADE BY E.C	DATE 8–21–03	FILE NO.
AS NOTED	CK'KD BY K.R.	DATE 8–21–03	10060
CAP DETAILS			DRAWING NO. 9



BACKFILL SETTLEMENT MONITORING PLATE
SCALE: 1 1/2"=1'-0"



SECTION A-A
SCALE: 1 1/2"=1'-0"



LEGEND

- CPT - CONE PENETROMETER LOCATION (2001)
- SONIC - SONIC BORING LOCATION (2002)
- SB - STANDARD PENETRATION TEST BORING (2001 AND 2002)
- SETTLEMENT PLATE

NOTES:

1. Backfill Settlement Monitoring Plates shall be place at 200 ft spacing along barrier centerline. At lead-in slope, plates shall be placed after the overlap joint is completed and backfill has progressed for the second placement.
2. Place settlement plat on S-B backfill surface 18" below ground level after backfill placement has moved 50 ft beyond plate location.
3. Survey elevation of top of riser pipe immediately after installation. Survey daily thereafter (except Saturday and Sunday). Provide tabular summary of survey to Owner.
4. Settlement plates shall be identified by construction station at actual location.
5. Remove plates before cap placement.

PRELIMINARY
09-16-03

SOLUTIA, INC
SITE R
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14 PENN PLAZA - 225 W. 34TH STREET, NY, NY 10122

SCALE	MADE BY E.C	DATE 9-04-03	FILE NO.
AS NOTED	CH'KD BY K.R.	DATE 9-04-03	10060

BACKFILL SETTLEMENT MONITORING

DRAWING NO. 10

STORMWATER POLLUTION PREVENTION PLAN FOR CONSTRUCTION ACTIVITIES REVISION TO PLAN FOR PIPELINE CONSTRUCTION

BARRIER WALL
GMCS AREA 2 – SITE R

Solutia Inc.
Sauget, Illinois
Illinois Permit No. ILR108258

Prepared for:
Inquip Associates, Inc.
P. O. Box 6277
McLean, VA 22106

August 14, 2003

URS

URS Corporation
1001 Highland Plaza Drive West, Suite 300
St. Louis, MO 63100
(314) 429-0100
Project # 21561236.00001

TABLE OF CONTENTS

SECTION 1 REQUIREMENTS AND CERTIFICATIONS 1-1

1.1 Requirements 1-1
1.2 Permitting 1-1
1.3 Certifications 1-2
1.3.1 Plan Preparer 1-2
1.3.2 Owner 1-2
1.3.3 Contractor 1-2

SECTION 2 PROJECT DESCRIPTION 2-1

2.1 Description of Site and Project 2-1
2.2 Current Activities 2-1
2.3 Site Maps 2-3

SECTION 3 STORMWATER MANAGEMENT CONTROLS 3-1

3.1 Erosion and Sediment Controls During Construction Activities 3-1
3.2 Final Stabilization Practices 3-1
3.3 Stormwater Management Controls 3-1
3.4 Other Wastes 3-2
3.5 Off-site Vehicle Tracking 3-2
3.6 Dust Suppression 3-3

SECTION 4 MAINTENANCE 4-1

SECTION 5 TRAINING 5-1

SECTION 6 INSPECTIONS 6-1

SECTION 7 NON-STORMWATER DISCHARGES 7-1

7.1 Inventory for Pollution Prevention Plan 7-1
7.2 Spill Prevention 7-1
7.2.1 Good Housekeeping 7-1
7.2.2 Hazardous Products 7-2
7.2.3 Product Specific Practices 7-2
7.2.4 Spill Prevention Practices 7-2

TABLE OF CONTENTS

List of Figures

Figure 1 SWPPP Site Plan

Figure 2 Details (from: Storm Water Management for Construction Activities, EPA, 1992)
- Earth Dike
- Drainage Swale
- Interceptor Dikes and Swales
- Temporary Stream Crossing
- Temporary Storm Drain Diversion
- Pipe Slope Drains
- Silt Fence
- Gravel or Stone Filter Berm
- Sediment Trap
- Temporary Sediment Basin
- Check Dams
- Stabilized Construction Entrance

Figure 3 BMP Fact Sheets(from: Storm Water Management for Construction Activities, EPA, 1992)
- Silt Fence
- Pipe Slope Drain
- Stabilized Construction Entrance
- Filter Fabric Inlet Protection
- Excavated Gravel Inlet Protection
- Block and Gravel Inlet Protection
- Check Dams
- Earth Dike
- Drainage Swale
- Temporary Sediment Trap

List of Appendices

Appendix A Notice of Coverage Under Construction Storm Water General Permit, issued by IEPA May 27, 2003

Appendix B Letter Notice to IEPA of Amendment to Existing SWPPP

Appendix C Notice of Termination of Coverage Under the General Permit

Appendix D Inspection Forms

Appendix E Product Specific and Spill Prevention Practices

Appendix F General State Operating Permit

SECTIONONE Requirements

1.1 REQUIREMENTS

Stormwater Pollution Prevention Plans (SWPPP) are required by the State of Illinois Environmental Protection Agency (IEPA) to ensure the design, implementation, management and maintenance of Best Management Practices (BMP) in order to reduce the amount of sediment and other pollutants in stormwater discharges associated with land disturbance activities, comply with the Illinois Water Quality Standards, and insure compliance with the terms and conditions of the general land disturbance permit.

This SWPPP is an amendment to National Pollution Discharge Elimination System (NPDES) Permit No. ILR108258 issued by IEPA May 27, 2003 for related activities at the site. The following documents shall be kept on site during the life of this project:

- This SWPPP
- The original SWPPP for the Permanent Discharge Pipeline
- Copies of signed application forms (Notice of Intent)
- Specific NPDES permit issued by IEPA
- Inspection reports
- Amendments to the SWPPP
- Notice of Termination upon completion of all land disturbance activities.

1.2 PERMITTING

The State of Illinois Environmental Protection Agency has issued a specific NPDES Permit for construction activities at this site. A copy of this Permit is in Appendix A. In order to obtain coverage under this general permit, the following permitting sequence is to be followed:

- Solutia will submit a letter to IEPA requesting an addendum to the existing SWPPP. A copy of this letter is in Appendix B.
- The next step is to implement this SWPPP.
- After construction and all land disturbance work is complete, and final ground cover has been established, submit Notice of Termination (NOT) (Appendix C) of coverage under the General Permit for stormwater discharges associated with construction site activities.

1.3 CERTIFICATIONS

1.3.1 Plan Preparer

This plan has been prepared in accordance with the General State Stormwater Permit (NPDES Permit No. ILR10) and related IEPA guidance manuals.

Plan Prepared by URS Corporation — Date 8/14/03

1.3.2 Owner

We hereby certify that we are aware of and will comply with the terms and conditions of the General State Stormwater Permit and this SWPPP.

Site Manager
Solutia, Inc. — Date 9/4/03

1.3.3 Contractor

I certify under penalty of law that I understand the terms and conditions of the general National Pollution Discharge Elimination System (NPDES) permit (ILR100000) that authorizes the storm water discharges associated with industrial activity from the construction site identified as part of this certification.

Site Superintendent — Date
Contractor: Inquip Associates, Inc., P. O Box 6277, McLean, VA 22106, 703-442-0143
Site address: 5 Riverview Avenue, Sauget, Illinois

SECTION TWO Project Description

2.1 DESCRIPTION OF SITE AND PROJECT

The work area for the Barrier Wall construction activities is located at Site R, at 5 Riverview Avenue in the City of Sauget, St. Clair County, Illinois. Site R is a closed industrial-waste disposal area. The work area lies along the east bank of the Mississippi River. The Barrier Wall is being constructed as a part of a project to control groundwater migration from the site to the Mississippi River.

Site R contains approximately 34 acres of land, not all of which will be disturbed by the construction of the barrier wall. The wall is approximately 3,500 feet long. The width of the area directly impacted by the wall construction equipment will vary from 50 feet to 150 feet. Other areas required for the construction of the wall include mixing of wall materials and backfill, and stockpiles of excavated materials that are not suitable for final wall construction. The work area is on terrain that slopes gently from east to west toward the Mississippi River.

Spoils excavated for the wall construction below the groundwater level should be considered to be impacted by hazardous materials. For this reason, special care shall be taken to control stormwater. Stormwater may be classified for the purposes of this project into three groups:

1. Run-on stormwater is that which is generated off site, beyond the boundaries of Site R. This stormwater shall be directed around the work areas and channeled to the Mississippi River without coming into contact with the disturbed areas.

2. Contact stormwater is that rainwater which comes into contact with excavated spoils from the barrier wall, groundwater which may be contained in the spoils, and that which is used to generate the slurry for the wall construction. All excess contact stormwater, that is not used in wall construction, shall be directed to a storage tank and treatment system supplied by Solutia, Inc.

3. Non-contact stormwater is that rainwater which falls on the site, that is not in contact with the wall construction activity. This stormwater may be directed to the Mississippi River through and using appropriate erosion and sediment controls as described herein.

2.2 CURRENT ACTIVITIES

Site R is a closed industrial-waste disposal area owned by Solutia Inc. Activities such as groundwater monitoring and cap maintenance are routinely performed at this site by Solutia Inc.

SECTION TWO Project Description

Solutia Inc. has constructed a permanent discharge pipeline, that is part of the groundwater migration control system that will address groundwater impact under the site. There are no full time employees at the site.

Overall, construction may be summarized as follows:

- Install erosion and sedimentation control measures prior to any land disturbance activity. Install stabilized construction entrances at Riverview. Sedimentation control measures may be installed in stages as the barrier wall construction proceeds. While the barrier wall is being constructed in Riverview, a second stabilized construction entrance may be required at the southern end of the site.
- Clear and grub the site as the work progresses in stages.
- Construct the Stormwater Treatment System (by others)
- Perform exploratory excavation along route of the barrier wall from approximately Station 12+50 to 31+50. This excavation is only expected to be 20 feet deep and should not intercept the groundwater. Therefore, only non-contact stormwater may be generated. The trench will be backfilled immediately with the excavated material. A temporary silt fence may be used for control of sedimentation runoff.
- Construct the barrier wall in stages starting at Station 12+50 and working northerly toward Station 31+50.
- A temporary stockpile will be constructed on the eastern portion of the existing landfill to contain excess excavated material. Runoff from this area should be considered to be contact stormwater.
- Perform exploratory excavation along Riverview Avenue. This excavation is only expected to be 20 feet deep and should not intercept the groundwater. Therefore, only non-contact stormwater may be generated. The trench will be backfilled immediately with the excavated material. A temporary silt fence may be used for control of sedimentation runoff.
- Continue to construct the barrier wall in Riverview Avenue.
- Perform exploratory excavation from Station 12+50 to 5+00. This excavation is only expected to be 20 feet deep and should not intercept the groundwater. Therefore, only non-contact stormwater may be generated. The trench will be backfilled immediately

with the excavated material. A temporary silt fence may be used for control of sedimentation runoff.

- Construct the barrier wall from Station 12+50 to 5+00.
- Temporarily stabilize denuded areas within 14-days of last construction activity in that area. After the barrier wall is constructed in any area, the control devices may be converted from contact stormwater to non-contact stormwater function. Install additional erosion and sediment control devices as required.
- As outdoor construction activity is completed and the site is stabilized, reseed and fertilize any remaining areas disturbed by construction
- Stabilize disturbed areas following completion of final construction
- Continue inspections and maintenance until site is finally stabilized
- File Notice of Termination (NOT) of coverage under the General Permit for stormwater discharges associated with construction site activities.

2.3 SITE MAPS

A site location map is in the general construction documents. Locations of the proposed erosion and sediment controls are provided in the site plans contained herein.

SECTION THREE Stormwater Management Controls

3.1 EROSION AND SEDIMENT CONTROLS DURING CONSTRUCTION ACTIVITIES

The general locations of erosion and sediment controls are shown on Figure 1. Filter fabric fencing will be used along the down gradient construction boundaries to trap sediment migrating from the work area and may be used to define and segregate work areas. All erosion and sediment controls shall be in place prior to disturbing the soils.

Due to the nature of the construction, it is anticipated that stormwater from any particular area may be classified as contact or non-contact at different times depending on the activity and stage of the construction. The Contractor may install and remove control devices to contain or segregate stormwater to accommodate the construction. No device that has been in contact with or used in a control for contact stormwater may be reused in a non-contact application. However, devices that have been used in a non-contact application may be reused in a contact application.

During the construction process, the Contractor may install temporary swales and berms to control erosion. Mulch shall be applied if the disturbed area will not receive final stabilization within 14 calendar days. Existing grass swales should be protected and utilized to slow the velocity of stormwater leaving the site.

The discharge rate used for sizing pumps, channels and swales, etc. should be calculated for a 24-hour, 25-year storm as follows:

- The volume and rate of run-off may be determined by use of the Rational Method $Q = C*I*A$
- The run-off coefficient used for the site is 0.1
- From Rainfall Frequency Atlas of the Midwest, assuming a time of concentration of 15 minutes, the precipitation is 1.63 inches, giving a rate of $I = 4*1.63 = 6.52$ inches per hour
- $Q = 0.1*6.52*1 = 6.52$ cfs per acre = 49 gpm per acre

3.2 FINAL STABILIZATION PRACTICES

After final construction is completed, the newly graded areas and exposed soils will be seeded, fertilized and mulched. Disturbed areas will be stabilized, either temporarily or permanently as soon as possible, but no later than 14 days after completion of construction activities at that area.

3.3 STORMWATER MANAGEMENT CONTROLS

The wall construction activities will not result in runoff flows that are higher than pre-construction levels. Therefore, long-term stormwater management controls for this project are not warranted, nor are any such controls included as part of this SWPPP.

3.4 OTHER WASTES

Any solid waste materials excavated during the construction process will be collected and stored in securely lidded metal drums or roll-off containers provided by a licensed waste management company under contract to Solutia. The containers will meet local and state waste management regulations. Solid wastes include metal objects, pipe, rebar and concrete, and does not include soil that can be reused as backfill.

Concrete pavement from Riverview Avenue may be disposed in the temporary stockpile or hauled off to a construction demolition landfill.

Trash and construction debris from the site will be deposited in a separate suitable container. The trash and debris will be hauled to an approved landfill. No construction waste material will be buried onsite.

Any liquid wastes that show up in the excavated material may be mixed as part of the slurry and deposited back into the trench as part of the barrier wall.

Personnel will be instructed regarding the correct procedure for waste disposal. Notices stating these practices will be posted in the office trailer and the site operations manager will be responsible for seeing that these procedures are followed.

All excess contact stormwater shall be pumped to the Stormwater Treatment System provided by Solutia. The site operations manager will be responsible for seeing that these practices are followed.

All sanitary waste will be regularly collected from the portable units by a licensed sanitary waste management contractor.

3.5 OFF-SITE VEHICLE TRACKING

Access to the site is via paved roads. A stabilized construction entrance/exit will be required. All construction equipment will be decontaminated by means of a high-pressure water wash to obtain a visibly clean condition prior to exiting the site.

3.6 DUST SUPPRESSION

Water sprays will be used to control dust during extended dry periods. Chemical dust suppressants shall not be used.

SECTIONFOUR

Maintenance

Stabilization practices will include stabilization of co cess, staging and parking areas. Graded surfaces will be seeded and fertilized.

Structural practices will include filter fabric fencing, and porary swales. Filter fabric fences will be installed at the bottom of long graded slop

To maintain the above practices, the following will be pe

- Maintenance and repairs will be conducted wit of inspection report (see Section 5).
- Sediment will be removed from behind the sed and traps when it becomes greater than 1/3 the height of the sediment contr Sediment shall be managed as required by its water content. If considered t stormwater, then sediment shall be placed in the temporary stockpile.
- Conveyance structures shall be maintained so e in the design condition. Velocity attenuating channels shall provide vegetor other means as designed to accomplish the desired result. Foreign debris, ves and lawn cuttings shall not be allowed to accumulate in drainage ditches.
- Permanent seeding shall be inspected weekly du of establishment for bare spots and areas of insufficient germination or gr ial action shall be taken to establish a stabilized surface in these areas once i
- The street entrance to the access drive shall be k , dust, and debris.

SECTIONFIVE Training

Periodic training of all employees at all levels of responsibility will be conducted to assure compliance with the requirements of this SWPPP. Training topics will include spill response, materials/equipment handling procedures, and good housekeeping strategies. Additional discussion topics will include maintenance and inspection procedures for the stormwater erosion control structures.

SECTIONSIX Inspections

The Contractor will designate a qualified person or persons to perform the following inspections:

- Disturbed areas and areas used for storage or materials that are exposed to precipitation will be inspected for evidence of, or the potential for, pollutants entering the drainage system.
- Erosion and sediment control measures identified in the plan will be observed to ensure that they are operating correctly.
- Where discharge locations or points are accessible, they will be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters.
- Locations where vehicles enter or exit the site will be inspected for evidence of offsite sediment tracking.

The inspection will be conducted by the site operations manager at least once every seven calendar days and within 24-hours after a storm of 0.5 inch or greater until the area is stabilized. After that portion of the site is finally stabilized, inspection will be conducted at least once every month until the stormwater permit is terminated.

Based on the results of the inspection, the site description and control measures of this SWPPP will be revised as appropriate, but in no case later than seven calendar days following the inspection.

A report summarizing the scope of the inspection, name and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the SWPPP, and actions taken in accordance with the above will be made and retained as part of the SWPPP for at least three years from the date that the site is finally stabilized. The report will be signed in accordance with the General Permit.

Copies of the forms to be used for the Inspection and Maintenance Report are included in Appendix D of this SWPPP.

7.1 INVENTORY FOR POLLUTION PREVENTION PLAN

The following substances are expected to be present onsite during construction and have the potential for polluting stormwater:

- Fuels
- Lubricants
- Fertilizer
- Bentonite
- Attapulgite, a clay material
- Clayey borrow
- Cement

7.2 SPILL PREVENTION

The following are the material management practices that will be used to reduce the risk of spills or other accidental exposure of the materials and substances described above to stormwater runoff.

7.2.1 Good Housekeeping

The following good housekeeping practices will be followed onsite during the construction project.

- An effort will be made to store only enough product required to do the job.
- All materials stored onsite will be stored in a neat, orderly manner in their appropriate containers, and, if possible, under a roof or other enclosure.
- Products will be kept in their original containers with the original manufacturer's label.
- Substances will not be mixed with one another unless recommended by the manufacturer.
- Whenever possible, all of a product will be used before disposing of the container.
- Manufacturer's recommendations for proper use and disposal will be followed.
- The site superintendent will inspect daily to ensure proper use and disposal of materials onsite.

7.2.2 Hazardous Products

These practices will be used to reduce the risks associated with hazardous material, if hazardous materials are used.

- Products will be kept in the original containers unless they are not resealable.
- Original labels and material safety data will be retained.
- Fuels will be stored in double walled tanks with less than 1,000 gallon capacity.
- If surplus product must be disposed of, manufacturer's or local and State recommended methods for proper disposal will be followed.

7.2.3 Product Specific Practices

The product specific practices to be followed are provided in Appendix E.

7.2.4 Spill Prevention Practices

The spill prevention practices to be followed are provided in Appendix E.

Figures

Figure 1 SWPPP Site Plan

Figure 2 Details (from: Storm Water Management for Construction Activities, EPA, 1992)

- Earth Dike
- Drainage Swale
- Interceptor Dikes and Swales
- Temporary Stream Crossing
- Temporary Storm Drain Diversion
- Pipe Slope Drains
- Silt Fence
- Gravel or Stone Filter Berm
- Sediment Trap
- Temporary Sediment Basin
- Check Dams
- Stabilized Construction Entrance

Earth Dike

What Is It

An earth dike is a ridge or ridge and channel combination used to protect work areas from upslope runoff and to divert sediment-laden water to appropriate traps or stable outlets. The dike consists of compacted soil and stone, riprap, or vegetation to stabilize the channel.

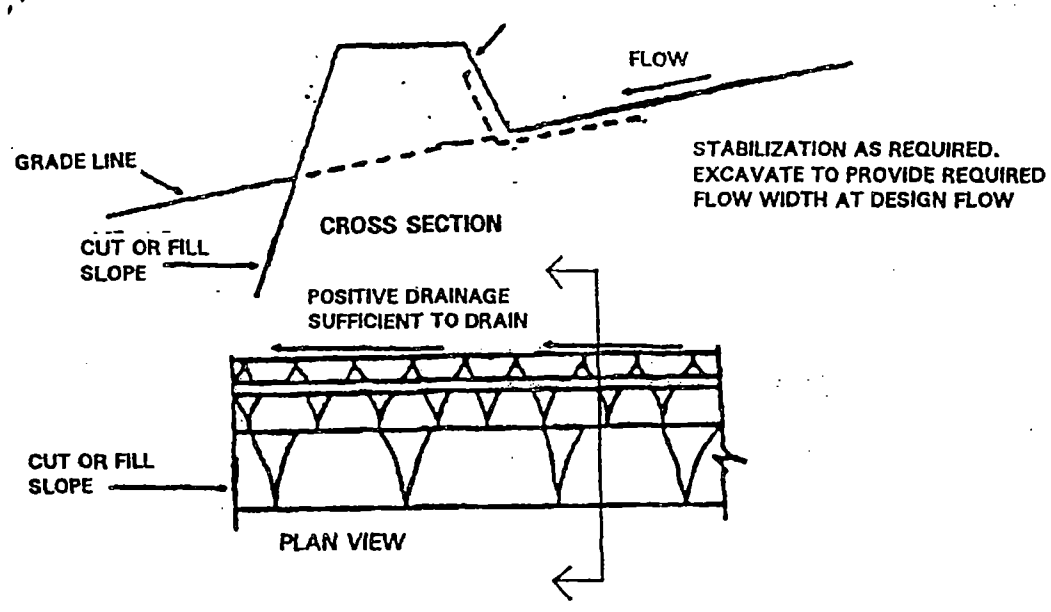


FIGURE 3.10 EARTH DIKE
(Modified from Maryland Department of the Environment, 1991)

When and Where to Use It

Earth dikes are used in construction areas to control erosion, sedimentation, or flood damage. Earth dikes can be used in the following situations:

- Above disturbed existing slopes and above cut or fill slopes to prevent runoff over the slope
- Across unprotected slopes, as slope breaks, to reduce slope length
- Below slopes to divert excess runoff to stabilized outlets
- To divert sediment laden water to sediment traps
- At or near the perimeter of the construction area to keep sediment from leaving the site

- Above disturbed areas before stabilization to prevent erosion and maintain acceptable working conditions
- Temporary diversions may also serve as sediment traps when the site has been overexcavated on a flat grade or in conjunction with a sediment fence.

What to Consider

Despite an earth dike's simplicity, improper design can limit its effectiveness; therefore, the State or local requirements should be consulted. Some general considerations include proper compaction of the earth dike, appropriate location to divert the intercepted runoff, and properly designed ridge height and thicknesses. Earth dikes should be constructed along a positive grade. There should be no dips or low points in an earth dike where the storm water will collect (other than the discharge point). Also, the intercepted runoff from disturbed areas should be diverted to a sediment-trapping device. Runoff from undisturbed areas can be channeled to an existing swale or to a level spreader. Stabilization for the dike and flow channel of the drainage swale should be accomplished as soon as possible. Stabilization materials can include vegetation or stone/riprap.

Advantages of an Earth Dike
• Can be constructed from materials and equipment which are typically already present on a construction site
Disadvantages of an Earth Dike
• Frequent inspection and maintenance required

Drainage Swale

What Is It

A drainage swale is a channel with a lining of vegetation, riprap, asphalt, concrete, or other material. It is constructed by excavating a channel and applying the appropriate stabilization.

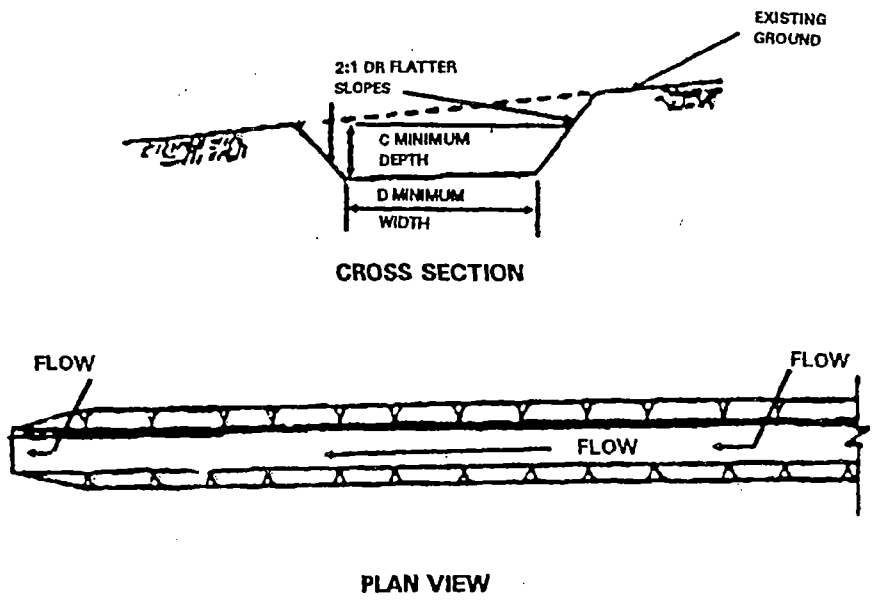


FIGURE 3.11 TEMPORARY SWALE
(Modified from Maryland Department of the Environment, 1991)

When and Where to Use It

A drainage swale applies when runoff is to be conveyed without causing erosion. Drainage swales can be used to convey runoff from the bottom or top of a slope. Drainage swales accomplish this by intercepting and diverting the flow to a suitable outlet. For swales draining a disturbed area, the outlet can be to a sediment trapping device prior to its release.

What to Consider

Since design flows, channel linings, and appropriate outlet devices will need to be considered, consult your State's requirements on such erosion control measures prior to constructing a drainage swale. General considerations include:

- Divert the intercepted runoff to an appropriate outlet.

- The swale should be lined using geotextiles, grass, sod, riprap, asphalt, or concrete. The selection of the liner is dependent upon the volume and the velocity of the anticipated runoff.
- The swale should have a positive grade. There should be no dips or low points in the swale where storm water will collect.

Advantages of a Drainage Swale
• Excavation of swale can be easily performed with earth moving equipment • Can transport large volumes of runoff
Disadvantages of a Drainage Swale
• Stabilization and design costs can make construction expensive • Use is restricted to areas with relatively flat slopes

Interceptor Dikes and Swales

What Are They

Interceptor dikes (ridges of compacted soil) and swales (excavated depressions) are used to keep upslope runoff from crossing areas where there is a high risk of erosion. They reduce the amount and speed of flow and then guide it to a stabilized outfall (point of discharge) or sediment trapping area (see sections on Sediment Traps and Temporary Sediment Basins). Interceptor dikes and swales divert runoff using a combination of earth dike and vegetated swale. Runoff is channeled away from locations where there is a high risk of erosion by placing a diversion dike or swale at the top of a sloping disturbed area. Dikes and swales also collect overland flow, changing it into concentrated flows. Interceptor dikes and swales can be either temporary or permanent storm water control structures.

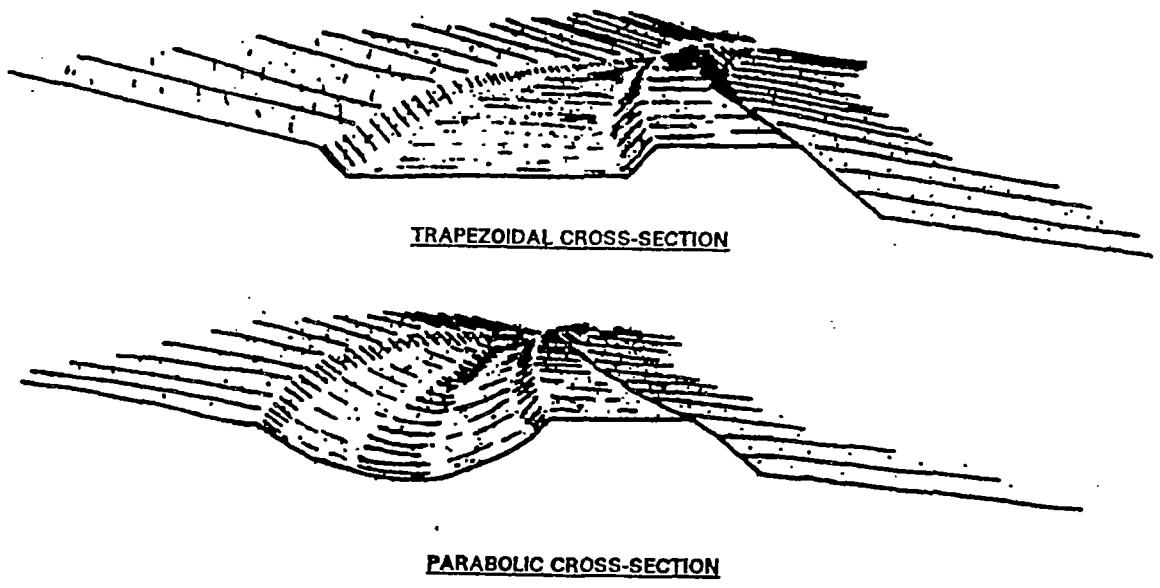


FIGURE 3.12 TYPICAL INTERCEPTOR DIKES AND SWALES
(Modified from State of Maryland, 1983)

When and Where to Use Them

Interceptor dikes and swales are generally built around the perimeter of a construction site before any major soil disturbing activity takes place. Temporary dikes or swales may also be used to protect existing buildings; areas, such as stockpiles; or other small areas that have not yet been fully stabilized. When constructed along the upslope perimeter of a disturbed or high-risk area (though not necessarily all the way around it), dikes or swales prevent runoff from uphill areas from crossing the unprotected slope. Temporary dikes or swales constructed on the down slope side of the disturbed or high-risk area will prevent runoff that contains sediment from leaving the site before sediment is removed. For short slopes, a dike or swale at the top of the slope reduces the

amount of runoff reaching the disturbed area. For longer slopes, several dikes or swales are placed across the slope at intervals. This practice reduces the amount of runoff that accumulates on the face of the slope and carries the runoff safely down the slope. In all cases, runoff is guided to a sediment trapping area or a stabilized outfall before release.

What to Consider

Temporary dikes and swales are used in areas of overland flow; if they remain in place longer than 15 days, they should be stabilized. Runoff channeled by a dike or swale should be directed to an adequate sediment trapping area or stabilized outfall. Care should be taken to provide enough slope for drainage but not too much slope to cause erosion due to high runoff flow speed. Temporary interceptor dikes and swales may remain in place as long as 12 to 18 months (with proper stabilization) or be rebuilt at the end of each day's activities. Dikes or swales should remain in place until the area they were built to protect is permanently stabilized. Interceptor dikes and swales can be permanent controls. However, permanent controls: should be designed to handle runoff after construction is complete; should be permanently stabilized; and should be inspected and maintained on a regular basis. Temporary and permanent control measures should be inspected once each week on a regular schedule and after every storm. Repairs necessary to the dike and flow channel should be made promptly.

Advantages of Interceptor Dikes and Swales
• Are simple and effective for channeling runoff away from areas subject to erosion • Can handle flows from large drainage areas • Are inexpensive because they use materials and equipment normally found onsite
Disadvantages of Interceptor Dikes and Swales
• If constructed improperly, can cause erosion and sediment transport since flows are concentrated • May cause problems to vegetation growth if water flow is too fast • Require additional maintenance, inspections, and repairs

Temporary Stream Crossing

What Is It

A temporary stream crossing is a bridge or culvert across a stream or watercourse for short-term use by construction vehicles or heavy equipment. Vehicles moving over unprotected stream banks will damage the bank, thereby releasing sediments and degrading the stream bank. A stream crossing provides a means for construction vehicles to cross streams or watercourses without moving sediment to streams, damaging the streambed or channel, or causing flooding.

When and Where to Use It

A temporary stream crossing is used when heavy equipment should be moved from one side of a stream channel to another, or where light-duty construction vehicles have to cross the stream channel frequently for a short period of time. Temporary stream crossings should be constructed only when it is necessary to cross a stream and a permanent crossing is not yet constructed.

- Bridges—Where available materials and designs are adequate to bear the expected loadings, bridges are preferred as a temporary stream crossing.
- Culverts—Culverts are the most common type of stream crossings and are relatively easy to construct. A pipe, which is to carry the flow, is laid into the channel and covered by gravel.

What to Consider

When feasible, one should always attempt to minimize or eliminate the need to cross streams. Temporary stream crossings are a direct source of pollution; therefore, every effort should be made to use an alternate method (e.g., longer detour), when feasible. When it becomes necessary to cross a stream, a well planned approach will minimize the damage to the stream bank and reduce erosion. The design of temporary stream crossings requires knowledge of the design flows and other information; therefore, a professional engineer and specific State and local requirements should be consulted. State/local jurisdictions may require a separate permit for temporary stream crossings; contact them directly to learn about their exact requirements.

The specific loads and the stream conditions will dictate what type of stream crossing to employ. Bridges are the preferred method to cross a stream as they provide the least obstruction to flows and fish migration.

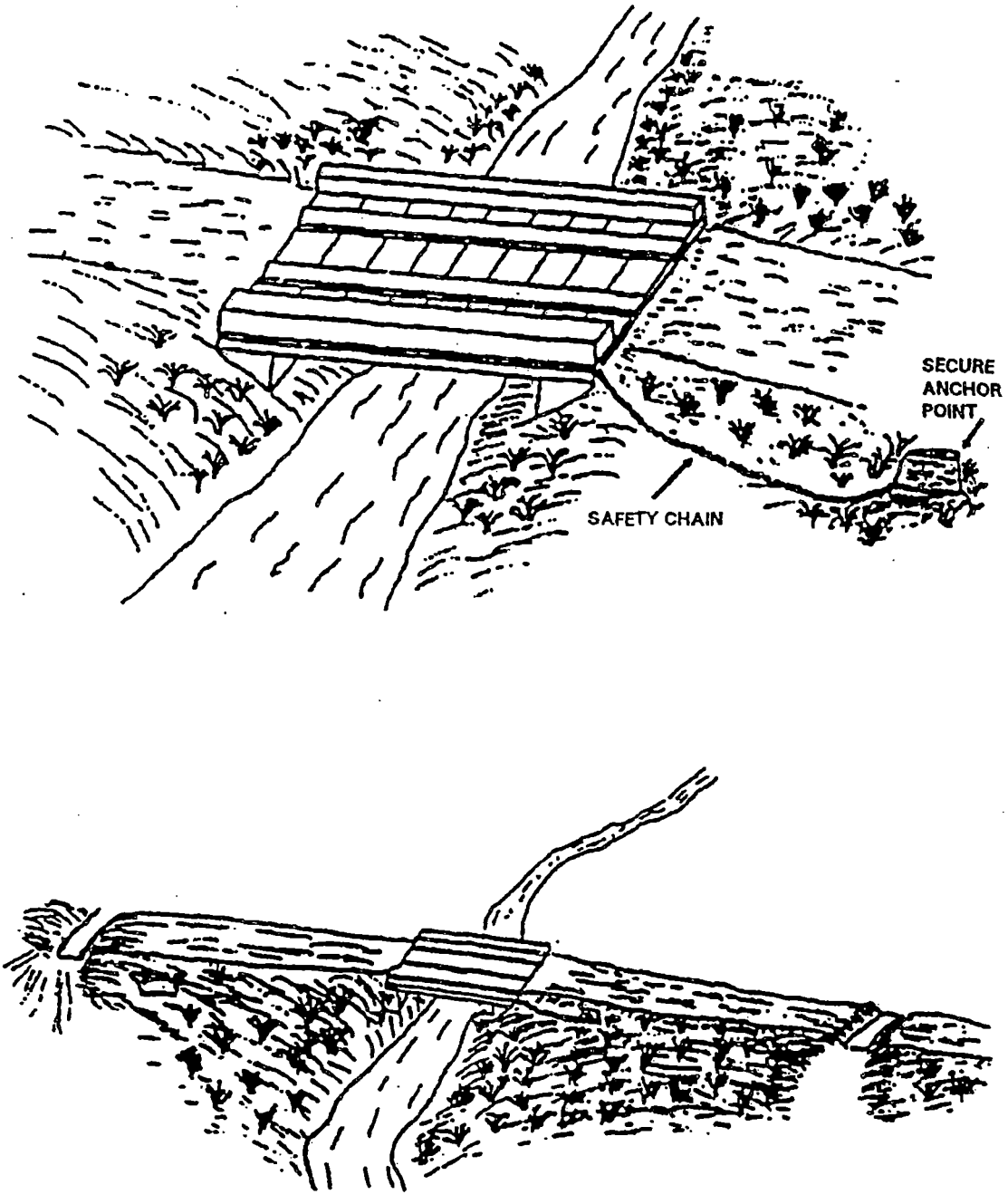


FIGURE 3.13 TEMPORARY ACCESS BRIDGE
(Modified from Maryland Department of the Environment, 1991)

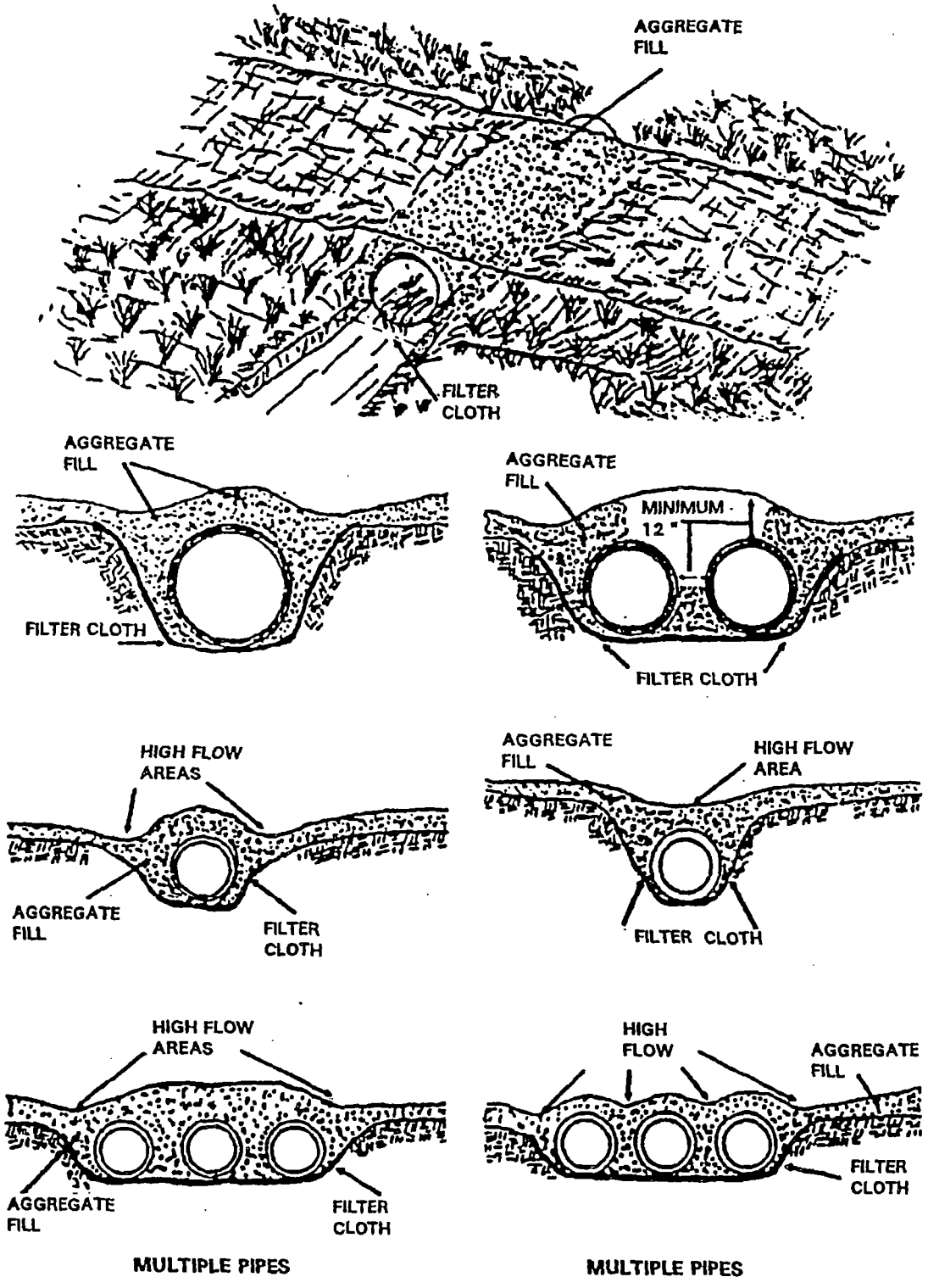


FIGURE 3.14 TEMPORARY ACCESS CULVERT
(Modified from Maryland Department of the Environment, 1991)

Advantages of a Temporary Stream Crossing
• Bridges provide the least obstruction to flow and fish migration and the construction material can be salvaged • Culverts are inexpensive and easily installed structures
Disadvantages of a Temporary Stream Crossing
• Bridges are expensive to design and install • Culverts cause greater disturbances during installation and removal

Temporary Storm Drain Diversion

What Is It

A temporary storm drain is a pipe which redirects an existing storm drain system or outfall channel to discharge into a sediment trap or basin.

When and Where to Use It

Use storm drain diversions to temporarily divert flow going to a permanent outfall. This diverted flow should be directed to a sediment-trapping device. A temporary storm drain diversion should remain in place as long as the area draining to the storm sewer remains disturbed. Another method is to delay completion of the permanent outfall and instead using temporary diversions to a sediment trapping device before discharge. Finally, a sediment trap or basin can be constructed below a permanent storm drain outfall. The basin would be designed to trap any sediment before final discharge.

What to Consider

Since the existing storm draining systems will be modified, careful consideration to piping configuration and resulting impact of installing a temporary storm drain diversion should be given. The temporary diversions will also need to be moved, once the construction has ceased and it is necessary to restore the original storm drainage systems. Therefore, appropriate restoration measures such as flushing the storm drain prior to removal of the sediment trap or basin, stabilizing the outfall, restoration of grade areas, etc. should be taken. And finally, the State or local requirements should be consulted for detailed requirements.

Advantages of a Temporary Storm Drain Diversion
• Requires little maintenance once installed
Disadvantages of a Temporary Storm Drain Diversion
• Disturbs existing storm drainage patterns

Pipe Slope Drains

What Are They

Pipe slope drains reduce the risk of erosion by discharging runoff to stabilized areas. Made of flexible or rigid pipe, they carry concentrated runoff from the top to the bottom of a slope that has already been damaged by erosion or is at high risk for erosion. They are also used to drain saturated slopes that have the potential for soil slides. Pipe slope drains can be either temporary or permanent depending on the method of installation and material used.

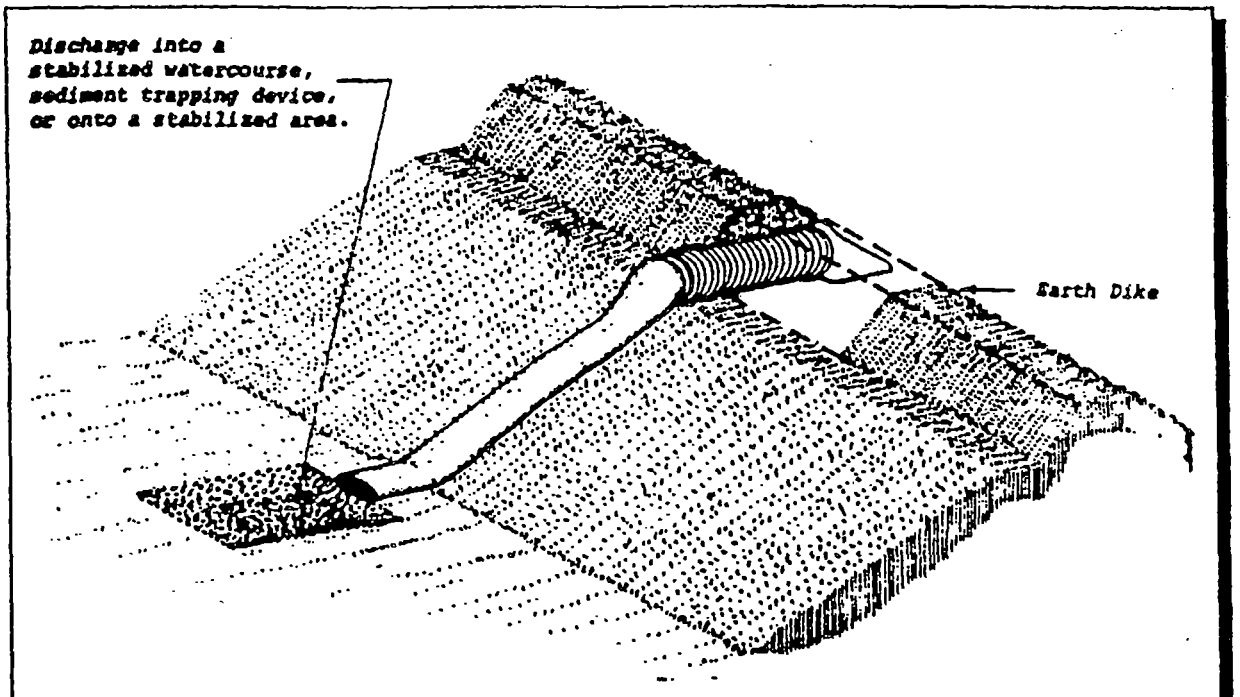


FIGURE 3.15 FLEXIBLE PIPE SLOPE DRAIN
(Modified from State of Maryland, 1983)

When and Where to Use Them

Pipe slope drains are used whenever it is necessary to convey water down a slope without causing erosion. They are especially effective before a slope has been stabilized or before permanent drainage structures are ready for use. Pipe slope drains may be used with other devices, including diversion dikes or swales, sediment traps, and level spreaders (used to spread out storm water runoff uniformly over the surface of the ground). Temporary pipe slope drains, usually flexible tubing or conduit, may be installed prior to the construction of permanent drainage structures. Permanent slope drains may be placed on or beneath the ground surface; pipes, sectional downdrains, paved chutes, or clay tiles may be used.

Paved chutes may be covered with a surface of concrete or other impenetrable material. Subsurface drains can be constructed of concrete, PVC, clay tile, corrugated metal, or other permanent material.

What to Consider

The drain design should be able to handle the volume of flow. The inlets and outlets of a pipe slope drain should be stabilized. This means that a flared end section should be used at the entrance of the pipe. The soil around the pipe entrance should be fully compacted. The soil at the discharge end of the pipe should be stabilized with riprap (a combination of large stones, cobbles, and boulders). The riprap should be placed along the bottom of a swale which leads to a sediment trapping structure or another stabilized area.

Pipe slope drains should be inspected on a regular schedule and after any major storm. Be sure that the inlet from the pipe is properly installed to prevent bypassing the inlet and undercutting the structure. If necessary, install a headwall, riprap, or sandbags around the inlet. Check the outlet point for erosion and check the pipe for breaks or clogs. Install outlet protection if needed and promptly clear breaks and clogs.

Advantages of Pipe Slope Drains
• Can reduce or eliminate erosion by transporting runoff down steep slopes or by draining saturated soils • Are easy to install and require little maintenance
Disadvantages of Pipe Slope Drains
• Require that the area disturbed by the installation of the drain should be stabilized or it, too, will be subject to erosion • May clog during a large storm

Silt Fence

What Is It

A silt fence, also called a "filter fence," is a temporary measure for sedimentation control. It usually consists of posts with filter fabric stretched across the posts and sometimes with a wire support fence. The lower edge of the fence is vertically trenched and covered by backfill. A silt fence is used in small drainage areas to detain sediment. These fences are most effective where there is overland flow (runoff that flows over the surface of the ground as a thin, even layer) or in minor swales or drainageways. They prevent sediment from entering receiving waters. Silt fences are also used to catch wind blown sand and to create an anchor for sand dune creation. Aside from the traditional wooden post and filter fabric method, there are several variations of silt fence installation including silt fence which can be purchased with pockets presewn to accept use of steel fence posts.

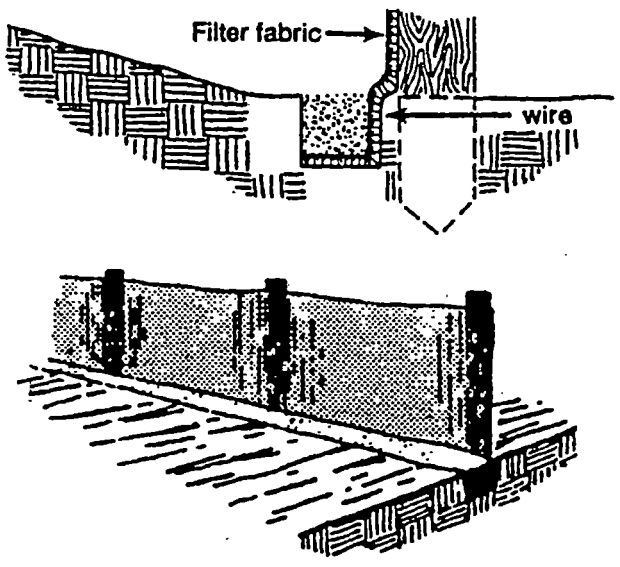


FIGURE 3.17 SILT FENCE DETAILS
(Modified from State of North Carolina, 1988; and State of Wisconsin, 1988)

When and Where to Use It

A silt fence should be installed prior to major soil disturbance in the drainage area. The fence should be placed across the bottom of a slope along a line of uniform elevation (perpendicular to the direction of flow). It can be used at the outer boundary of the work area. However, the fence does not have to surround the work area completely. In addition, a silt fence is effective where sheet and rill erosion may be a problem. Silt fences should not be constructed in streams or swales.

What to Consider

A silt fence is not appropriate for controlling runoff from a large area. This type of fence can be more effective than a straw bale barrier if properly installed and maintained. It may be used in combination with other erosion and sediment practices.

The effective life span for a silt fence depends upon the material of construction and maintenance. The fence requires frequent inspection and prompt maintenance to maintain its effectiveness. Inspect the fence after each rainfall. Check for areas where runoff eroded a channel beneath the fence, or where the fence was caused to sag or collapse by runoff flowing over the top. Remove and properly dispose of sediment when it is one-third to one-half the height of the fence or after each storm.

Advantages of a Silt Fence
• Removes sediments and prevents downstream damage from sediment deposits • Reduces the speed of runoff flow • Minimal clearing and grubbing required for installation • Inexpensive
Disadvantages of a Silt Fence
• May result in failure from improper choice of pore size in the filter fabric or improper installation • Should not be used in streams • Is only appropriate for small drainage areas with overland flow • Frequent inspection and maintenance is necessary to ensure effectiveness

Gravel or Stone Filter Berm

What Is It

A gravel or stone filter berm is a temporary ridge constructed of loose gravel, stone, or crushed rock. It slows and filters flow, diverting it from an exposed traffic area. Diversions constructed of compacted soil may be used where there will be little or no construction traffic within the right-of way. They are also used for directing runoff from the right-of-way to a stabilized outlet.

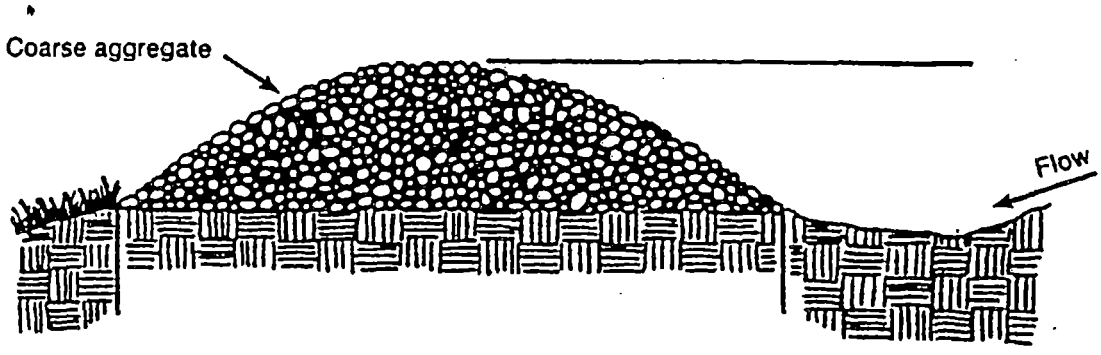


FIGURE 3.18 TYPICAL GRAVEL FILTER BERM
(Modified from Commonwealth of Virginia, 1980)

When and Where to Use It

This method is appropriate where roads and other rights-of-way under construction should accommodate vehicular traffic. Berms are meant for use in areas with gentle slopes. They may also be used at traffic areas within the construction site.

What to Consider

Berm material should be well graded gravel or crushed rock. The spacing of the berms will depend on the steepness of the slope: berms should be placed closer together as the slope increases. The diversion should be inspected regularly after each rainfall, or if breached by construction or other vehicles. All needed repairs should be performed immediately. Accumulated sediment should be removed and properly disposed of and the filter material replaced, as necessary.

Advantages of a Gravel or Stone Filter Berm
• Is a very efficient method of sediment control • Reduces the speed of runoff flow
Disadvantages of a Gravel or Stone Filter Berm
• Is more expensive than methods that use onsite materials • Has a very limited life span • Can be difficult to maintain because of clogging from mud and soil on vehicle tires

Sediment Trap

What Is It

A sediment trap is formed by excavating a pond or by placing an earthen embankment across a low area or drainage swale. An outlet or spillway is constructed using large stones or aggregate to slow the release of runoff. The trap retains the runoff long enough to allow most of the silt to settle out.

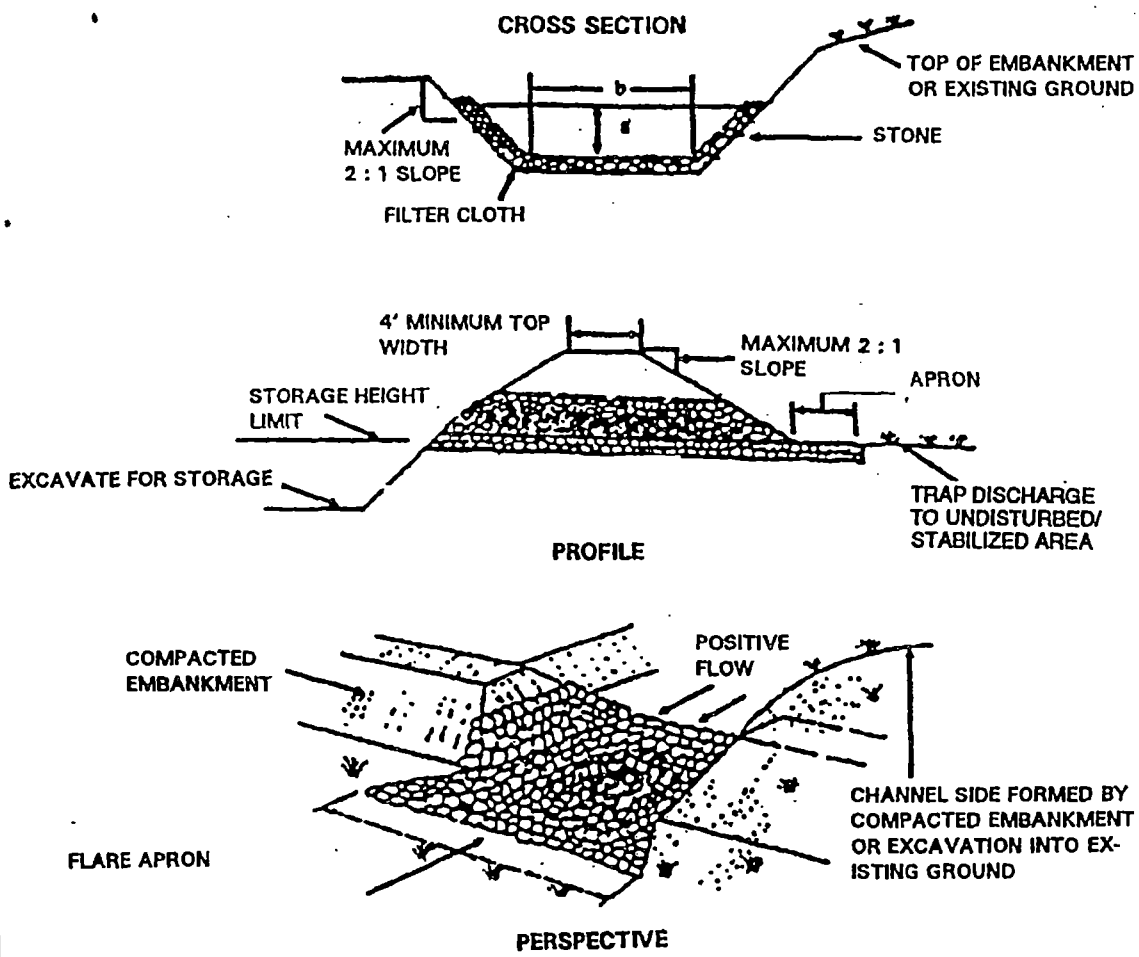


FIGURE 3.20 TYPICAL SEDIMENT TRAP
(Modified from State of Maryland, 1991)

When and Where to Use It

A temporary sediment trap may be used in conjunction with other temporary measures, such as gravel construction entrances, vehicle wash areas, slope drains, diversion dikes and swales, or diversion channels.

What to Consider

Sediment traps are suitable for small drainage areas, usually no more than 10 acres. The trap should be large enough to allow the sediments to settle and should have a capacity to store the collected sediment until it is removed. The volume of storage required depends upon the amount and intensity of expected rainfall and on estimated quantities of sediment in the storm water runoff. Check your Permit to see if it specifies a minimum storage volume for sediment traps.

The effective life of a sediment trap depends upon adequate maintenance. The trap should be readily accessible for periodic maintenance and sediment removal. Traps should be inspected after each rainfall and cleaned when no more than half the design volume has been filled with collected sediment. The trap should remain in operation and be properly maintained until the site area is permanently stabilized by vegetation and/or when permanent structures are in place.

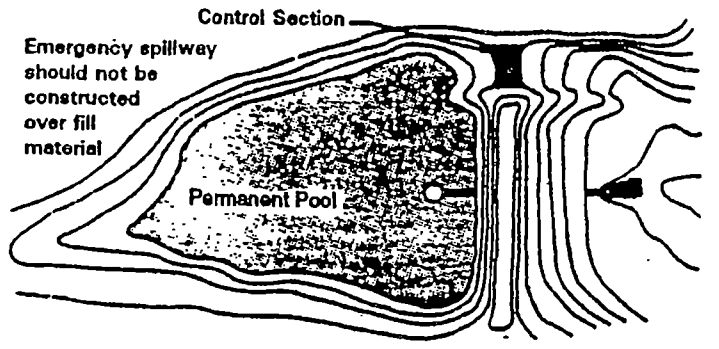
Advantages of a Temporary Sediment Trap
• Protects downstream areas from clogging or damage due to sediment deposits • Is inexpensive and simple to install • Can simplify the design process by trapping sediment at specific spots onsite
Disadvantages of a Temporary Sediment Trap
• Is suitable only for a limited area • Is effective only if properly maintained • Will not remove very fine silts and clays

Temporary Sediment Basin

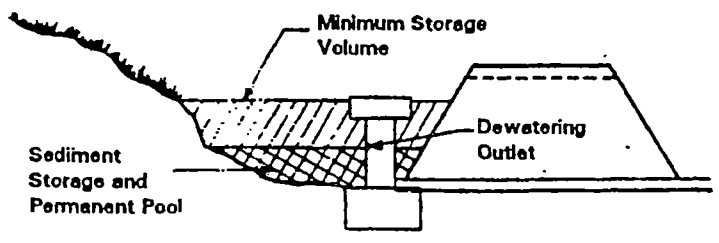
What Is It

A temporary sediment basin is a settling pond with a controlled storm water release structure used to collect and store sediment produced by construction activities. A sediment basin can be constructed by excavation and/or by placing an earthen embankment across a low area or drainage swale. Sediment basins can be designed to maintain a permanent pool or to drain completely dry. The basin detains sediment-laden runoff from larger drainage areas long enough to allow most of the sediment to settle out.

The pond has a riser and pipe outlet with a gravel outlet or spillway to slow the release of runoff and provide some sediment filtration. By removing sediment, the basin helps prevent clogging of offsite conveyance systems and sediment-loading of receiving waterways. In this way, the basin helps prevent destruction of waterway habitats.



Plan View



Cross Section

FIGURE 3.21 TEMPORARY SEDIMENT BASIN
(Modified from Commonwealth of Virginia, 1980)

When and Where to Use It

A temporary sediment basin should be installed before clearing and grading is undertaken. It should not be built on an embankment in an active stream. The creation of a dam in such a site may result in the destruction of aquatic habitats. Dam failure can also result in flooding. A temporary sediment basin should be located only if there is sufficient space and appropriate topography. The basin should be made large enough to handle the maximum expected amount of site drainage. Fencing around the basin may be necessary for safety or vandalism reasons.

A temporary sediment basin used in combination with other control measures, such as seeding or mulching, is especially effective for removing sediments.

What to Consider

Temporary sediment basins are usually designed for disturbed areas larger than 5 acres. The pond should be large enough to hold runoff long enough for sediment to settle. Sufficient space should be allowed for collected sediments. Check the requirements of your permit to see if there is a minimum storage requirement for sediment basins. The useful life of a temporary sediment basin is dependent upon adequate maintenance.

Sediment trapping efficiency is improved by providing the maximum surface area possible. Because finer silts may not settle out completely, additional erosion control measures should be used to minimize release of fine silt. Runoff should enter the basin as far from the outlet as possible to provide maximum retention time.

Sediment basins should be readily accessible for maintenance and sediment removal. They should be inspected after each rainfall and be cleaned out when about half the volume has been filled with sediment. The sediment basin should remain in operation and be properly maintained until the site area is permanently stabilized by vegetation and/or when permanent structures are in place. The embankment forming the sedimentation pool should be well compacted and stabilized with vegetation. If the pond is located near a residential area, it is recommended for safety reasons that a sign be posted and that the area be secured by a fence. A well built temporary sediment basin that is large enough to handle the post construction runoff volume may later be converted to use as a permanent storm water management structure.

The sediment basins outlet pipe and spill way should be designed by an engineer based upon an analysis of the expected runoff flow rates from the site. Consult your state/local requirements to determine the frequency of the storm for which the outlet must be designed.

EPA BASELINE GENERAL PERMIT REQUIREMENTS

Sediment Basin Requirements

Part IV.D.2.a.(2).(a).

For common drainage locations that serve an area with 10 or more disturbed acres at one time, a temporary (or permanent) sediment basin providing 3,600 cubic feet of storage per acre drained, or equivalent control measures, shall be provided where attainable until final stabilization of the site. The 3,600 cubic feet of storage area per acre drained does not apply to flows from offsite areas and flows from onsite areas that are either undisturbed or have undergone final stabilization where such flows are diverted around the sediment basin. For drainage locations which serve 10 or more disturbed acres at one time and where a temporary sediment basin providing 3,600 cubic feet of storage per acre drained, or equivalent controls is not attainable, sediment traps, silt fences, or equivalent sediment controls are required for all sideslope and downslope boundaries of the construction area.

Advantages of a Temporary Sediment Basin
• Protects downstream areas from clogging or damage due to sediment deposits generated during construction activities
• Can trap smaller sediment particles than sediment traps can because of the longer detention time
• Can be converted to a permanent storm water detention structure, once construction is complete
Disadvantages of a Temporary Sediment Basin
• Is generally suitable for small areas
• Requires regular maintenance and cleaning
• Will not remove very fine silts and clays unless used in conjunction with other measures
• Is a more expensive way to remove sediment than several other methods
• Requires careful adherence to safety practices since ponds are attractive to children

Check Dams

What Are They

A check dam is a small, temporary or permanent dam constructed across a drainage ditch, swale, or channel to lower the speed of concentrated flows. Reduced runoff speed reduces erosion and gullying in the channel and allows sediments to settle out.

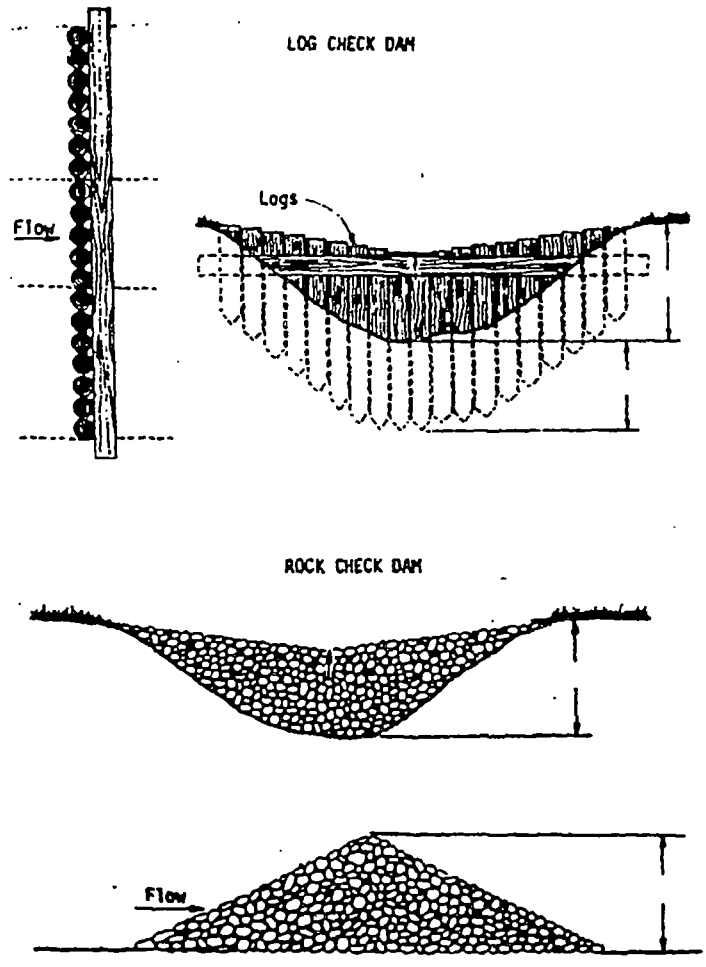


FIGURE 3.23 TYPICAL CHECK DAMS
(Modified from Commonwealth of Virginia, 1980)

When and Where to Use Them

A check dam should be installed in steeply sloped swales, or in swales where adequate vegetation cannot be established. A check dam may be built from logs, stone, or pea gravel-filled sandbags.

What to Consider

Check dams should be used only in small open channels which will not be overtopped by flow once the dams are constructed. The dams should not be placed in streams (unless approved by appropriate State authorities). The center section of the check dam should be lower than the edges. Dams should be spaced so that the toe of the upstream dam is at the same elevation as the top of the downstream dam.

After each significant rainfall, check dams should be inspected for sediment and debris accumulation. Sediment should be removed when it reaches one half the original dam height. Check for erosion at edges and repair promptly as required. After construction is complete, all stone and riprap should be removed if vegetative erosion controls will be used as a permanent erosion control measure. It will be important to know the expected erosion rates and runoff flow rate for the swale in which this measure is to be installed. Contact the State/local storm water program agency or a licensed engineer for assistance in designing this measure.

Advantages of Check Dams
• Are inexpensive and easy to install
• May be used permanently if designed properly
• Allow a high proportion of sediment in the runoff to settle out
• Reduce velocity and may provide aeration of the water
• May be used where it is not possible to divert the flow or otherwise stabilize the channel
Disadvantages of Check Dams
• May kill grass linings in channels if the water level remains high after it rains or if there is significant sedimentation
• Reduce the hydraulic capacity of the channel
• May create turbulence which erodes the channel banks

4.3 MINIMIZING OFFSITE VEHICLE TRACKING OF SEDIMENTS

Day-to-day site practices can have a major impact on storm water contamination because of their potential for generating sediments. A common problem area is offsite vehicle tracking. Two practices are commonly used for minimizing offsite vehicle tracking of sediments: stabilized construction entrances and construction access road stabilization.

Q. What measures have you taken to prevent offsite vehicle tracking?

Controlling offsite tracking of sediments may require attention at most times when there is vehicle traffic at the construction site. The measures listed here are effective if used properly.

- A stabilized construction entrance and construction road are very effective methods for reducing offsite tracking of mud, dirt, and rocks
- Paved streets adjacent to the site should be swept to remove any excess mud, dirt, or rock tracked from the site
- Deliveries or other traffic should be scheduled at a time when you will have personnel available to provide cleanup if it is required.

4.3.1 Construction Road Stabilization

What Is It

A stabilized construction road is a road built to provide a means for construction vehicles to move around the site without causing significant erosion. A stabilized construction road is designed to be well drained so that water does not puddle or flood the road during wet weather. It typically will have a swale along one or both sides of the road to collect and carry away runoff. Stabilized construction roads should be have a layer of crushed stone or gravel which will cover and protect the soil below from erosion.

When and Where to Use It

A stabilized construction road should be installed in a disturbed area where there will be a high volume of construction traffic expected. A construction road should be stabilized at the beginning of construction and maintained throughout construction. Construction parking areas should be stabilized as well as the roads. A stabilized construction road should not be located in a cut or fill area until after grading has been performed.

What to Consider

Stabilized construction roads should be built to conform to the site grades; this will require a minimum amount of cut and fill. They should also be designed so that the side slopes and road grades are not excessively steep. Construction roads should not be constructed in areas which are wet, or on highly erodible soils.

Advantages of Construction Road Stabilization
• Reduces the amount of erosion, dust, and tracking of soil off of the site • Provides an effective way for vehicles to move around the construction site, even during wet weather
Disadvantages of Construction Road Stabilization
• Can be expensive • May require maintenance to replace gravel or repair ruts

4.3.2 Stabilized Construction Entrance

What Is It

A stabilized construction entrance is a portion of the construction road which is constructed with filter fabric and large stone. The primary purpose of a stabilized construction entrance is to reduce the amount of soil tracked off of the construction site by vehicles leaving the site. The rough surface of the stone will shake and pull the soil off of the vehicles tires as it drives over the entrance. The stone will also reduce erosion and rutting on the portion of the road where it is installed by protecting the soil below. The filter fabric separates the stone from the soil below, preventing the large stone from being ground into the soil. The fabric also reduces the amount of rutting caused by the vehicle tires by spreading the weight of the vehicles over a larger soil area than just the tire width.

When and Where to Use It

A stabilized construction entrance should be installed at every point where traffic leaves or enters a disturbed area before construction begins on the site. Typically, stabilized construction entrances are installed at the locations where the construction traffic enters or leaves an existing paved road; however, a stabilized construction entrance should not be installed over an existing pavement (except for a slight overlap as shown in Figure 4.1). Where the construction will require a permanent access road or driveway, it is recommended that a stabilized construction entrance be installed in this location prior to the permanent pavement.

What to Consider

Stabilized construction entrances should be wide enough and long enough so that the largest construction vehicle will fit in the entrance with room to spare. If a large amount of traffic is expected at an entrance, then the stabilized construction entrance should be wide enough to fit two vehicles across with room to spare.

If the stabilized construction entrance has to cross a swale or stream, then a stream crossing should be provided (see page 3-42).

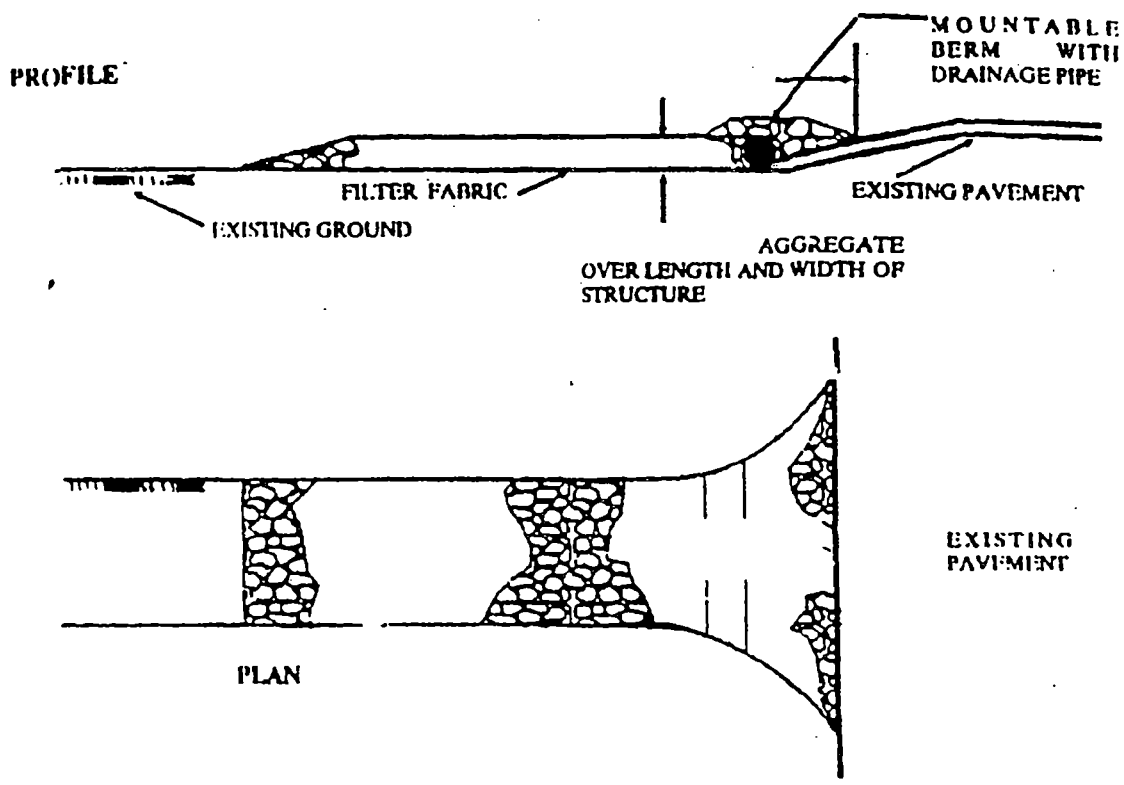


FIGURE 4.1 STABILIZED CONSTRUCTION ENTRANCE
(Modified from Maryland Department of the Environment, 1991)

Stone used for the construction entrance should be large enough so that it is does not get picked up and tracked off of the site by the vehicle traffic. Sharp edged stone should not be used to avoid puncturing tires.

If vehicles will be turning onto the paved road or drive from the stabilized construction entrance, then an apron should be provided as shown above so that vehicles do not go off of the stabilized construction entrance before they leave the site.

The temporary construction entrance may be provided with a vehicle wash rack which drains to a temporary sediment trap or other sediment removing measure. This will allow vehicle tires to be washed prior to leaving the site and ensure that wash water sediments are removed and can be properly disposed of.

Advantages of a Stabilized Construction Entrance
• Is an effective means for reducing the amount of soil tracked off of a construction site • Can improve the appearance of the construction site from the public's point of view
Disadvantages of a Stabilized Construction Entrance
• Only works if it is installed at every location where traffic leaves and enters the site • Cannot always remove all of the soil tracked off of the disturbed areas by vehicles; when soil is tracked onto a road, it should be cleaned up immediately • Stone may have to be added to keep it effective

Figure 3 BMP Fact Sheets(from: Storm Water Management for Construction Activities, EPA, 1992)

- Silt Fence
- Pipe Slope Drain
- Stabilized Construction Entrance
- Filter Fabric Inlet Protection
- Excavated Gravel Inlet Protection
- Block and Gravel Inlet Protection
- Check Dams
- Earth Dike
- Drainage Swale
- Temporary Sediment Trap

SILT FENCE

September 1992

Design Criteria

- Silt fences are appropriate at the following general locations:
  - Immediately upstream of the point(s) of runoff discharge from a site before flow becomes concentrated (maximum design flow rate should not exceed 0.5 cubic feet per second).
  - Below disturbed areas where runoff may occur in the form of overland flow.
- Ponding should not be allowed behind silt fences since they will collapse under high pressure; the design should provide sufficient outlets to prevent overtopping.
- The drainage area should not exceed 0.25 acre per 100 feet of fence length.
- For slopes between 50:1 and 5:1, the maximum allowable upstream flow path length to the fence is 100 feet; for slopes of 2:1 and steeper, the maximum is 20 feet.
- The maximum upslope grade perpendicular to the fence line should not exceed 1:1.
- Synthetic silt fences should be designed for 6 months of service; burlap is only acceptable for periods of up to 60 days.

Materials

- Synthetic filter fabric should be a pervious sheet of polypropylene, nylon, polyester, or polyethylene yarn conforming to the requirements in Table 1 below.

TABLE 1. SYNTHETIC FILTER FABRIC REQUIREMENTS

Physical Property	Requirements
Filtering Efficiency	75% - 85% (minimum)
Tensile Strength at 20% (maximum) Elongation	Standard Strength - 30 lb/linear inch (minimum)
	Extra Strength - 50 lb/linear inch (minimum)
Slurry Flow Rate	0.3 gal/ft^2/min (minimum)

- Synthetic filter fabric should contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0 to 120°F.
- Burlap of 10 ounces per square yard of fabric can also be used.
- The filter fabric should be purchased in a continuous roll to avoid joints.
- While not required, wire fencing may be used as a backing to reinforce standard strength filter fabric. The wire fence (14 gauge minimum) should be at 22-48 inches wide and should have a maximum mesh spacing of 6 inches.
- Posts should be 2-4 feet long and should be composed of either 2" x 2-4" pine (or equivalent) or 1.00 to 1.33 lb/linear ft steel. Steel posts should have projections for fastening wire and fabric to them.

Construction Specifications

- The maximum height of the filter fence should range between 18 and 36 inches above the ground surface (depending on the amount of upslope ponding expected).

- Posts should be spaced 8 to 10 feet apart when a wire mesh support fence is used and no more than 6 feet apart when extra strength filter fabric (without a wire fence) is used. The posts should extend 12 to 30 inches into the ground.
- A trench should be excavated 4 to 8 inches wide and 4 to 12 inches deep along the upslope side of the line of posts.
- If standard strength filter fabric is to be used, the optional wire mesh support fence may be fastened to the upslope side of the posts using 1 inch heavy duty wire staples, tie wires, or hog rings. Extend the wire mesh support to the bottom of the trench. The filter fabric should then be stapled or wired to the fence, and 8 to 20 inches of the fabric should extend into the trench (Figure 1).
- Extra strength filter fabric does not require a wire mesh support fence. Staple or wire the filter fabric directly to the posts and extend 8 to 20 inches of the fabric into the trench (Figure 1).
- Where joints in the fabric are required, the filter cloth should be spliced together only at a support post, with a minimum 6-inch overlap, and securely sealed.
- Do not attach filter fabric to trees.
- Backfill the trench with compacted soil or 0.75 inch minimum diameter gravel placed over the filter fabric.

Maintenance

- Inspect filter fences daily during periods of prolonged rainfall, immediately after each rainfall event, and weekly during periods of no rainfall. Make any required repairs immediately.
- Sediment must be removed when it reaches one-third to one-half the height of the filter fence. Take care to avoid damaging the fence during cleanout.
- Filter fences should not be removed until the upslope area has been permanently stabilized. Any sediment deposits remaining in place after the filter fence has been removed should be dressed to conform with the existing grade, prepared, and seeded.

Sources

- Commonwealth of Virginia - County of Fairfax, 1987. 1987 Check List For Erosion And Sediment Control - Fairfax County, Virginia.
- State of North Carolina, 1988. Erosion and Sediment Control Planning and Design Manual. North Carolina Sedimentation Control Commission, Department of Natural Resources and Community Development.
- Maryland Department of the Environment, 1991. 1991 Maryland Standards And Specifications For Soil Erosion And Sediment Control - Draft.

PIPE SLOPE DRAIN

September 1992

Design Criteria

- Pipe Slope Drains (PSD) are appropriate in the following general locations:
  - On cut or fill slopes before permanent storm water drainage structures have been installed.
  - Where earth dikes or other diversion measures have been used to concentrate flows.
  - On any slope where concentrated runoff crossing the face of the slope may cause gullies, channel erosion, or saturation of slide-prone soils.
  - As an outlet for a natural drainageway.
- The drainage area may be up to 10 acres; however, many jurisdictions consider 5 acres the recommended maximum.
- The PSD design should handle the peak runoff for the 10-year storm. Typical relationships between area and pipe diameter are shown in Table 2 below.

TABLE 2. RELATIONSHIP BETWEEN AREA AND PIPE DIAMETER

Maximum Drainage Area (Acres)	Pipe Diameter (D) (Inches)
0.5	12
0.75	15
1.0	18

Materials

- Pipe may be heavy duty flexible tubing designed for this purpose, e.g., nonperforated, corrugated plastic pipe, corrugated metal pipe, bituminous fiber pipe, or specially designed flexible tubing.
- A standard flared end section secured with a watertight fitting should be use for the inlet. A standard T-section fitting may also be used.
- Extension collars should be 12-inch long sections of corrugated pipe. All fittings must be watertight.

Construction Specifications

- Place the pipe slope drain on undisturbed or well-compacted soil.
- Soil around and under the entrance section must be hand-tamped in 4-inch to 8-inch lifts to the top of the dike to prevent piping failure around the inlet.
- Place filter cloth under the inlet and extend 5 feet in front of the inlet and be keyed in 6-inches on all sides to prevent erosion. A 6-inch metal toe plate may also be used for this purpose.
- Ensure firm contact between the pipe and the soil at all points by backfilling around and under the pipe with stable soil material hand compacted in lifts of 4-inches to 8-inches.
- Securely stake the PSD to the slope using grommets provided for this purpose at intervals of 10 feet or less.
- Ensure that all slope drain sections are securely fastened together and have watertight fittings.

- Extend the pipe beyond the toe of the slope and discharge at a nonerosive velocity into a stabilized area (e.g., rock outlet protection may be used) or to a sedimentation trap or pond.
- The PSD should have a minimum slope of 3 percent or steeper.
- The height at the centerline of the earth dike should range from a minimum of 1.0 foot over the pipe to twice the diameter of the pipe measured from the invert of the pipe. It should also be at least 6 inches higher than the adjoining ridge on either side.
- At no point along the dike will the elevation of the top of the dike be less than 6 inches higher than the top of the pipe.
- Immediately stabilize all areas disturbed by installation or removal of the PSD.

Maintenance

- Inspect regularly and after every storm. Make any necessary repairs.
- Check to see that water is not bypassing the inlet and undercutting the inlet or pipe. If necessary, install headwall or sandbags.
- Check for erosion at the outlet point and check the pipe for breaks or clogs. Install additional outlet protection if needed and immediately repair the breaks and clean any clogs.
- Do not allow construction traffic to cross the PSD and do not place any material on it.
- If a sediment trap has been provided, clean it out when the sediment level reaches 1/3 to 1/2 the design volume.
- The PSD should remain in place until the slope has been completely stabilized or up to 30 days after permanent slope stabilization.

Sources

- Commonwealth of Virginia - County of Fairfax, 1987. 1987 Check List For Erosion And Sediment Control - Fairfax County, Virginia.
- State of North Carolina, 1988. Erosion and Sediment Control Planning and Design Manual. North Carolina Sedimentation Control Commission, Department of Natural Resources and Community Development.
- Maryland Department of the Environment, 1991. 1991 Maryland Standards And Specifications For Soil Erosion And Sediment Control - Draft.
- Storm Water Management Manual for the Puget Sound Basin. State of Washington, Department of Ecology, 1991.
- Cost Data:
  - Draft Sediment and Erosion Control, An Inventory of Current Practices, April 20, 1990. Prepared by Kamber Engineering for the U.S. Environmental Protection Agency, Office of Water Enforcement and Permits, Washington, D.C. 20460.

STABILIZED CONSTRUCTION ENTRANCE

September 1992

Design Criteria

- A Stabilized Construction Entrance (SCE) is appropriate in the following locations:
  - Wherever vehicles are leaving a construction site and enter onto a public road
  - At any unpaved entrance/exit location where there is risk of transporting mud or sediment onto paved roads.
- The width should be at least 10 feet to 12 feet or the as wide as the entire width of the access. At sites where traffic volume is high the entrance should be wide enough for two vehicles to pass safely.
- The length should be between 50 to 75 feet in length.
- Flare the entrance where it meets the existing road to provide a turning radius.
- Runoff from a stabilized construction entrance should drain to a sediment trap or sediment basin.
- Pipe placed under the entrance to handle runoff should be protected with a mountable berm.
- Dust control should be provided in accordance with Section 3.2.1.

Materials

- Crushed stone 2-inches-4-inches in diameter
- Geotextile (filter fabric) with the properties listed in Table 3 below.

TABLE 3. GEOTEXTILE REQUIREMENTS

Physical Property	Requirements
Grab Tensile Strength	220 lbs. (ASTM D1682)
Elongation Failure	60 % (ASTM D1682)
Mullen Burst Strength	430 lbs. (ASTM D3768)
Puncture Strength	125 lbs. (ASTM D751) (modified)
Equivalent Opening	Size 40-80 (US std Sieve) (CW-02215)

Construction Specifications

- Clear all vegetation, roots and all other obstructions in preparation for grading.
- Prior to placing geotextile (filter fabric) make sure that the entrance is properly graded and compacted.

- To reduce maintenance and loss of aggregate place geotextile fabric (filter cloth) over the existing ground before placing the stone for the entrance.
- Stone should be placed to a depth of 6-inches or greater for the entire width and length of the SCE.

Maintenance

- Inspect the measure on a regular basis and after there has been a high volume of traffic or storm event.
- Apply additional stone periodically and when repair is required.
- Immediately remove sediments or any other materials tracked onto the public roadway.
- Ensure that associated sediment control measures are in good working condition.

Sources

- Commonwealth of Virginia - County of Fairfax, 1987. 1987 Check List For Erosion And Sediment Control - Fairfax County, Virginia.
- State of North Carolina, 1988. Erosion and Sediment Control Planning and Design Manual. North Carolina Sedimentation Control Commission, Department of Natural Resources and Community Development.
- Maryland Department of the Environment, 1991. 1991 Maryland Standards And Specifications For Soil Erosion And Sediment Control - Draft.
- Storm Water Management Manual for the Puget Sound Basin. State of Washington, Department of Ecology, 1991.
- Cost Data:
  - Draft Sediment and Erosion Control, An Inventory of Current Practices, April 20, 1990. Prepared by Kamber Engineering for the U.S. Environmental Protection Agency, Office of Water Enforcement and Permits, Washington, D.C. 20460.

FILTER FABRIC INLET PROTECTION

September 1992

Design Criteria

- Inlet protection is appropriate in the following locations:
  - In small drainage areas (less than 1 acre) where the storm drain inlet is functional before the drainage area has been permanently stabilized.
  - Where there is danger of sediment silting in an inlet which is in place prior to permanent stabilization.
- Filter fabric inlet protection is appropriate for most types of inlets where the drainage area is one acre or less.
- The drainage area should be fairly flat with slopes of 5% or less and the area immediately surrounding the inlet should not exceed a slope of 1%.
- Overland flow to the inlet should be no greater than 0.5 cfs.
- This type of inlet protection is not appropriate for use in paved areas because the filter fabric requires staking.
- To avoid failure caused by pressure against the fabric when overtopping occurs, it is recommended that the height of the filter fabric be limited to 1.5 feet above the crest of the drop inlet.
- It is recommended that a sediment trapping sump of 1 to 2 feet in depth with side slopes of 2:1 be provided.

Materials

- Filter fabric (see the fabric specifications for silt fence).
- Wooden stakes 2" x 2" or 2"x 4" with a minimum length of 3 feet.
- Heavy-duty wire staples at least ½ inch in length.
- Washed gravel ¾ inches in diameter.

Construction Specifications

- Place a stake at each corner of the inlet and around the edges at no more than 3 feet apart. Stakes should be driven into the ground 18 inches or at a minimum 8 inches.
- For stability a framework of wood strips should be installed around the stakes at the crest of the overflow area 1.5 feet above the crest of the drop inlet.
- Excavate a trench of 8 inches to 12 inches in depth around the outside perimeter of the stakes. If a sediment trapping sump is being provided then the excavation may be as deep as 2 feet.
- Staple the filter fabric to the wooden stakes with heavy-duty staples, overlapping the joints to the next stake. Ensure that between 12 inches to 32 inches of filter fabric extends at the bottom so it can be formed into the trench.
- Place the bottom of the fabric in the trench and backfill the trench all the way around using washed gravel to a minimum depth of 4 inches.

Maintenance

- Inspect regularly and after every storm. Make any repairs necessary to ensure the measure is in good working order.
- Sediment should be removed and the trap restored to its original dimensions when sediment has accumulated to ½ the design depth of the trap.
- If the filter fabric becomes clogged it should be replaced immediately.
- Make sure that the stakes are firmly in the ground and that the filter fabric continues to be securely anchored.
- All sediments removed should be properly disposed.
- Inlet protection should remain in place and operational until the drainage area is completely stabilized or up to 30 days after the permanent site stabilization is achieved.

Sources

- Commonwealth of Virginia - County of Fairfax, 1987. 1987 Check List For Erosion And Sediment Control - Fairfax County, Virginia.
- State of North Carolina, 1988. Erosion and Sediment Control Planning and Design Manual. North Carolina Sedimentation Control Commission, Department of Natural Resources and Community Development.
- Maryland Department of the Environment, 1991. 1991 Maryland Standards And Specifications For Soil Erosion And Sediment Control - Draft.
- Storm Water Management Manual for the Puget Sound Basin. State of Washington, Department of Ecology, 1991.
- Cost Data:
  - Draft Sediment and Erosion Control, An Inventory of Current Practices, April 20, 1990. Prepared by Kamber Engineering for the U.S. Environmental Protection Agency, Office of Water Enforcement and Permits, Washington, D.C. 20460.

EXCAVATED GRAVEL INLET PROTECTION

September 1992

Design Criteria

- Inlet protection is appropriate in the following locations:
  - In small drainage areas (less than 1 acre) where the storm drain inlet is functional before the drainage area has been permanently stabilized.
  - Where there is danger of sediment silting in an inlet which is in place prior to permanent stabilization.
  - Where ponding around the inlet structure could be a problem to traffic on site.
- Excavated gravel and mesh inlet protection may be used with most inlets where overflow capability is needed and in areas of heavy flows, 0.5 cfs or greater.
- The drainage area should not exceed 1 acre.
- The drainage area should be fairly flat with slopes of 5% or less.
- The trap should have a sediment trapping sump of 1 to 2 feet measured from the crest of the inlet. Side slopes should be 2:1. The recommended volume of excavation is 35 yd^3/acre disturbed.
- To achieve maximum trapping efficiency the longest dimension of the basin should be oriented toward the longest inflow area.

Materials

- Hardware cloth or wire mesh with ½ inch openings.
- Filter fabric (see the fabric specifications for silt fence).
- Washed gravel ¾ inches to 4 inches in diameter.

Construction Specifications

- Remove any obstructions to excavating and grading. Excavate sump area, grade slopes and properly dispose of soil.
- The inlet grate should be secured to prevent seepage of sediment laden water.
- Place wire mesh over the drop inlet so that the wire extends a minimum of 1 foot beyond each side of the inlet structure. Overlap the strips of mesh if more than one is necessary.
- Place filter fabric over the mesh extending it at least 18 inches beyond the inlet opening on all sides. Ensure that weep holes in the inlet structure are protected by filter fabric and gravel.
- Place stone/gravel over the fabric/wire mesh to a depth of at least 1 foot.

Maintenance

- Inspect regularly and after every storm. Make any repairs necessary to ensure the measure is in good working order.
- Sediment should be removed and the trap restored to its original dimensions when sediment has accumulated to ½ the design depth of the trap.
- Clean or remove and replace the stone filter or filter fabric if they become clogged.
- Inlet protection should remain in place and operational until the drainage area is completely stabilized or up to 30 days after the permanent site stabilization is achieved.

Sources

- Commonwealth of Virginia - County of Fairfax, 1987. 1987 Check List For Erosion And Sediment Control - Fairfax County, Virginia.
- State of North Carolina, 1988. Erosion and Sediment Control Planning and Design Manual. North Carolina Sedimentation Control Commission, Department of Natural Resources and Community Development.
- Maryland Department of the Environment, 1991. 1991 Maryland Standards And Specifications For Soil Erosion And Sediment Control - Draft.
- Storm Water Management Manual for the Puget Sound Basin. State of Washington, Department of Ecology, 1991.
- Cost Data:
  - Draft Sediment and Erosion Control, An Inventory of Current Practices, April 20, 1990. Prepared by Kamber Engineering for the U.S. Environmental Protection Agency, Office of Water Enforcement and Permits, Washington, D.C. 20460.

BLOCK AND GRAVEL INLET PROTECTION

September 1992

Design Criteria

- Inlet protection is appropriate in the following locations:
  - In drainage areas (less than 1 acre) where the storm drain inlet is functional before the drainage area has been permanently stabilized.
  - Where there is danger of sediment silting in an inlet which is in place prior to permanent stabilization.
- Block and gravel inlet protection may be used with most types of inlets where overflow capability is needed and in areas of heavy flows 0.5 cfs or greater.
- The drainage area should not exceed 1 acre.
- The drainage area should be fairly flat with slopes of 5% or less.
- To achieve maximum trapping efficiency the longest dimension of the basin should be oriented toward the longest inflow area.
- Where possible the trap should have sediment trapping sump of 1 to 2 feet in depth with side slopes of 2:1.
- There are several other types of inlet protection also used to prevent siltation of storm drainage systems and structures during construction, they are:
  - Filter Fabric Inlet Protection
  - Excavated Gravel Inlet Protection

Materials

- Hardware cloth or wire mesh with ½ inch openings
- Filter fabric (see the fabric specifications for silt fence)
- Concrete block 4 inches to 12 inches wide.
- Washed gravel ¾ inches to 4 inches in diameter

Construction Specifications

- The inlet grate should be secured to prevent seepage of sediment laden water.
- Place wire mesh over the drop inlet so that the wire extends a minimum of 12 inches to 18 inches beyond each side of the inlet structure. Overlap the strips of mesh if more than one is necessary.
- Place filter fabric (optional) over the mesh and extend it at least 18 inches beyond the inlet structure.
- Place concrete blocks over the filter fabric in a single row lengthwise on their sides along the sides of the inlet. The foundation should be excavated a minimum of 2 inches below the crest of the inlet and the bottom row of blocks should be against the edge of the structure for lateral support.
- The open ends of the block should face outward not upward and the ends of adjacent blocks should abut. Lay one block on each side of the structure on its side to allow for dewatering of the pool.
- The block barrier should be at least 12 inches high and may be up to a maximum of 24 inches high and may be from 4 inches to 12 inches in depth depending on the size of block used.
- Prior to backfilling, place wire mesh over the outside vertical end of the blocks so that stone does not wash down the inlet.
- Place gravel against the wire mesh to the top of the blocks.

Maintenance

- Inspect regularly and after every storm. Make any repairs necessary to ensure the measure is in good working order.
- Sediment should be removed and the trap restored to its original dimensions when sediment has accumulated to ½ the design depth of the trap.
- All sediments removed should be properly disposed of.
- Inlet protection should remain in place and operational until the drainage area is completely stabilized or up to 30 days after the permanent site stabilization is achieved.

Sources

- Commonwealth of Virginia - County of Fairfax, 1987. 1987 Check List For Erosion And Sediment Control - Fairfax County, Virginia.
- State of North Carolina, 1988. Erosion and Sediment Control Planning and Design Manual. North Carolina Sedimentation Control Commission, Department of Natural Resources and Community Development.
- Maryland Department of the Environment, 1991. 1991 Maryland Standards And Specifications For Soil Erosion And Sediment Control - Draft.
- Storm Water Management Manual for the Puget Sound Basin. State of Washington, Department of Ecology, 1991.
- Cost Data:
  - Draft Sediment and Erosion Control, An Inventory of Current Practices, April 20, 1990. Prepared by Kamber Engineering for the U.S. Environmental Protection Agency, Office of Water Enforcement and Permits, Washington, D.C. 20460.

CHECK DAMS

September 1992

Design Criteria

- Check dams are appropriate for use in the following locations:
  - Across swales or drainage ditches to reduce the velocity of flow.
  - Where velocity must be reduced because a vegetated channel lining has not yet been established.
- Check dams may never be used in a live stream unless approved by the appropriate government agency.
- The drainage area above the check dam should be between 2 acres and 10 acres.
- The dams must be spaced so that the toe of the upstream dam is never any higher than the top of the downstream dam.
- The center of the dam must be 6 inches to 9 inches lower than either edge, and the maximum height of the dam should be 24 inches.
- The check dam should be as much as 18 inches wider than the banks of the channel to prevent undercutting as overflow water re-enters the channel.
- Excavating a sump immediately upstream from the check dam improves its effectiveness.
- Provide outlet stabilization below the lowest check dam where the risk of erosion is greatest.
- Consider the use of channel linings or protection such as plastic sheeting or riprap where there may be significant erosion or prolonged submergence.

Materials

- Stone 2 inches to 15 inches in diameter
- Logs 6 inches to 8 inches in diameter
- Sandbags filled with pea gravel
- Filter fabric (see the fabric specifications for silt fence)

Construction Specifications

- Rock Check Dams
  - Place the stones on the filter fabric either by hand or using appropriate machinery; do not simply dump them in place.
  - Extend the stone 18 inches beyond the banks and keep the side slopes 2:1 or flatter.
  - Lining the upstream side of the dam with ¾ inch to 1¼ inch gravel 1 foot in depth is a suggested option.
- Log Check Dams
  - Logs must be firmly embedded in the ground; 18 inches is the recommended minimum depth.
- Sand Bag Check Dams
  - Be sure that bags are all securely sealed.
  - Place bags by hand or use appropriate machinery.

Maintenance

- Inspect regularly and after every storm. Make any repairs necessary to ensure the measure is in good working order.
- Accumulated sediment and leaves should be removed from behind the dams and erosive damage to the channel restored after each storm or when ½ the original height of the dam is reached.
- All accumulated material removed from the dam shall be properly disposed.
- Replace stone as necessary for the dams to maintain their correct height.
- If sand bags are used, the fabric of the bags should be inspected for signs of deterioration.
- Remove stone or riprap if grass lined channel requires mowing.
- Check dams should remain in place and operational until the drainage area and channel are completely stabilized or up to 30 days after the permanent site stabilization is achieved.
- Restore the channel lining or establish vegetation when each check dam is removed.

Sources

- Commonwealth of Virginia - County of Fairfax, 1987. 1987 Check List For Erosion And Sediment Control - Fairfax County, Virginia.
- State of North Carolina, 1988. Erosion and Sediment Control Planning and Design Manual. North Carolina Sedimentation Control Commission, Department of Natural Resources and Community Development.
- Maryland Department of the Environment, 1991. 1991 Maryland Standards And Specifications For Soil Erosion And Sediment Control - Draft.
- Storm Water Management Manual for the Puget Sound Basin. State of Washington, Department of Ecology, 1991.
- Cost Data:
  - Draft Sediment and Erosion Control, An Inventory of Current Practices, April 20, 1990. Prepared by Kamber Engineering for the U.S. Environmental Protection Agency, Office of Water Enforcement and Permits, Washington, D.C. 20460.

September 1992

Design Criteria

- Earth dikes are appropriate in the following situations:
  - To divert upslope flows away from disturbed areas such as cut or fill slopes and to divert runoff to a stabilized outlet
  - To reduce the length of the slope runoff will cross
  - At the perimeter of the construction site to prevent sediment-laden runoff from leaving the site
  - To direct sediment-laden runoff to a sediment trapping device.
- When the drainage area to the earth dike is greater than 10 acres, the United States Department of Agriculture - Soil Conservation Service (USDA - SCS) standards and specification for diversions should be consulted.
- Table 4 contains suggested dike design criteria.

TABLE 4. SUGGESTED DIKE DESIGN CRITERIA

Drainage Area	Under 5 Acres	Between 5-10 Acres
Dike Height	18 inches	30 inches
Dike Width	24 inches	36 inches
Flow Width	4 feet	6 feet
Flow Depth	12 inches	24 inches
Side Slopes	2:1 or less	2:1 or less
Grade	0.5% - 10%	0.5% - 10%

- The base for a dike 18 inches high and 24 wide at the top should be between 6 feet - 8 feet. The height of the dike is measured on the upslope side.
- If the dike is constructed using coarse aggregate the side slopes should be 3:1 or flatter.
- The channel formed behind the dike should have a positive grade to a stabilized outlet. The channel should be stabilized with vegetative or other stabilization measures.
- Grades over 10% may require an engineering design.
- Construct the dike where it will not interfere with major areas of construction traffic so that vehicle damage to the dike will be kept to the minimum.
- Diversion dikes should be installed prior to the majority of soil disturbing activity, and may be removed when stabilization of the drainage area and outlet are complete.

Materials

- Compacted Soil
- Coarse Aggregate

Construction Specifications

- Clear the area of all trees, brush, stumps or other obstructions.
- Construct the dike to the designed cross-section, line and grade making sure that there are no irregularities or bank projections to impede the flow.
- The dike should be compacted using earth moving equipment to prevent failure of the dike.
- The dike must be stabilized as soon as possible after installation.

Maintenance

- Inspect regularly and after every storm, make any repairs necessary to ensure the measure is in good working order.
- Inspect the dike, flow channel and outlet for deficiencies or signs of erosion.
- If material must be added to the dike be sure it is properly compacted.
- Reseed or stabilize the dike as needed to maintain its stability regardless if there has been a storm event or not.

Sources

- Commonwealth of Virginia - County of Fairfax, 1987. 1987 Check List For Erosion And Sediment Control - Fairfax County, Virginia.
- State of North Carolina, 1988. Erosion and Sediment Control Planning and Design Manual. North Carolina Sedimentation Control Commission, Department of Natural Resources and Community Development.
- Maryland Department of the Environment, 1991. 1991 Maryland Standards And Specifications For Soil Erosion And Sediment Control - Draft.
- Storm Water Management Manual for the Puget Sound Basin. State of Washington, Department of Ecology, 1991.
- Cost Data:
  - Draft Sediment and Erosion Control, An Inventory of Current Practices, April 20, 1990. Prepared by Kamber Engineering for the U.S. Environmental Protection Agency, Office of Water Enforcement and Permits, Washington, D.C. 20460.

DRAINAGE SWALE

September 1992

Design Criteria

- Temporary drainage swales are appropriate in the following situations:
  - To divert upslope flows away from disturbed areas such as cut or fill slopes and to divert runoff to a stabilized outlet
  - To reduce the length of the slope runoff will cross
  - At the perimeter of the construction site to prevent sediment-laden runoff from leaving the site
  - To direct sediment-laden runoff to a sediment trapping device.
- When the drainage area is greater than 10 acres the United States Department of Agriculture - Soil Conservation Service (USDA - SCS) standards and specifications for diversions should be consulted.
- Swales may have side slopes ranging from 3:1 to 2:1.
- The minimum channel depth should be between 12 inches and 18 inches.
- The minimum width at the bottom of the channel should be 24 inches and the bottom should be level.
- The channel should have a uniform positive grade between 2% and 5%, with no sudden decreases where sediments may accumulate and cause overtopping.
- The channel should be stabilized with temporary or permanent stabilization measures.
- Grades over 10% may require an engineering design.
- Construct the swale away from areas of major construction traffic.
- Runoff must discharge to a stabilized outlet.

Materials

- Grass seed for temporary or permanent stabilization
- Sod
- Coarse aggregate or riprap

Construction Specifications

- Clear the area of all trees, brush, stumps or other obstructions.
- Construct the swale to the designed cross-section, line and grade making sure that there are no irregularities or bank projections to impede the flow.
- The lining should be well compacted using earth moving equipment and stabilization initiated as soon as possible.
- Stabilize lining with grass seed, sod, or riprap.
- Surplus material should be properly distributed or disposed of so that it does not interfere with the functioning of the swale.
- Outlet dissipation measures should be used to avoid the risk of erosion.

Maintenance

- Inspect regularly and after every storm, make any repairs necessary to ensure the measure is in good working order.
- Inspect the flow channel and outlet for deficiencies or signs of erosion.
- If surface of the channel requires material to be added be sure it is properly compacted.
- Reseed or stabilize the channel as needed to prevent erosion during a storm event.

Sources

- Commonwealth of Virginia - County of Fairfax, 1987. 1987 Check List For Erosion And Sediment Control - Fairfax County, Virginia.
- State of North Carolina, 1988. Erosion and Sediment Control Planning and Design Manual. North Carolina Sedimentation Control Commission, Department of Natural Resources and Community Development.
- Maryland Department of the Environment, 1991. 1991 Maryland Standards And Specifications For Soil Erosion And Sediment Control - Draft.
- Storm Water Management Manual for the Puget Sound Basin. State of Washington, Department of Ecology, 1991.
- Cost Data:
  - Draft Sediment and Erosion Control, An Inventory of Current Practices, April 20, 1990. Prepared by Kamber Engineering for the U.S. Environmental Protection Agency, Office of Water Enforcement and Permits, Washington, D.C. 20460.

September 1992

Design Criteria

- Temporary sediment traps are appropriate in the following locations:
  - At the outlet of the perimeter controls installed during the first stage of construction.
  - At the outlet of any structure which concentrates sediment-laden runoff, e.g. at the discharge point of diversions, channels, slope drains, or other runoff conveyances.
  - Above a storm water inlet that is in line to receive sediment-laden runoff.

- Temporary sediment traps may be constructed by excavation alone or by excavation in combination with an embankment.
- Temporary sediment traps are often used in conjunction with a diversion dike or swale.
- The drainage area for the sediment trap should not exceed 5 disturbed acres.
- The trap must be accessible for ease of regular maintenance which is critical to its functioning properly.
- Sediment traps are temporary measures and should not be planned to remain in place longer than between 18 and 24 months.
- The capacity of the sedimentation pool should provide storage volume for 3,600 cubic feet/acre drainage area.
- The outlet should be designed to provide a 2 foot settling depth and an additional sediment storage area 1½ feet deep at the bottom of the trap.
- The embankment may not exceed 5 feet in height.
- The recommended minimum width at the top of the embankment is between 2 feet and 5 feet.
- The minimum recommended length of the weir is between 3 feet and 4 feet, and the maximum is 12 feet in length.
- Table 5 illustrates the typical relationship between the embankment height, the height of the outlet (H_o), and the width (W) at the top of the embankment.

TABLE 5. EMBANKMENT HEIGHT vs. OUTLET HEIGHT AND WIDTH

H	H_o	W
1.5	0.5	2.0
2.0	1.0	2.0
2.5	1.5	2.5
3.0	2.0	2.5
3.5	2.5	3.0
4.0	3.0	3.0
4.5	3.5	4.0
5.0	4.0	4.5

Materials

- Filter fabric (see fabric requirement for silt fence)
- Coarse aggregate or riprap 2 inches to 14 inches in diameter
- Washed gravel ¾ to 1½ inches in diameter
- Seed and mulch for stabilization

Construction Specifications

- Clear the area of all trees, brush, stumps or other obstructions.
- Construct the embankment in 8 inch lifts compacting each lift with the appropriate earth moving equipment. Fill material must be free of woody vegetation, roots, or large stones.
- Keep cut and fill slopes between 3:1 and 2:1 or flatter.
- Line the outlet area with filter fabric prior to placing stone or gravel.
- Construct the gravel outlet using heavy stones between 6 inches and 14 inches in diameter and face the upstream side with a 12 inch layer of ¾ inch to 1½ inch washed gravel on the upstream side.
- Seed and mulch the embankment as soon as possible to ensure stabilization.

Maintenance

- Inspect regularly and after every storm. Make any repairs necessary to ensure the measure is in good working order.
- Frequent removal of sediment is critical to the functioning of this measure. At a minimum sediment should be removed and the trap restored to its original volume when sediment reaches ⅓ of the original volume.
- Sediment removed from the trap must be properly disposed.
- Check the embankment regularly to make sure it is structurally sound.

Sources

- Commonwealth of Virginia - County of Fairfax, 1987. 1987 Check List For Erosion And Sediment Control - Fairfax County, Virginia.
- State of North Carolina, 1988. Erosion and Sediment Control Planning and Design Manual. North Carolina Sedimentation Control Commission, Department of Natural Resources and Community Development.
- Maryland Department of the Environment, 1991. 1991 Maryland Standards And Specifications For Soil Erosion And Sediment Control - Draft.
- Storm Water Management Manual for the Puget Sound Basin. State of Washington, Department of Ecology, 1991.
- Cost Data:
  - Draft Sediment and Erosion Control, An Inventory of Current Practices, April 20, 1990. Prepared by Kamber Engineering for the U.S. Environmental Protection Agency, Office of Water Enforcement and Permits, Washington, D.C. 20460.

APPENDIX A Notice of Coverage Under Construction Stormwater General Permit

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276
JAMES R. THOMPSON CENTER, 100 WEST RANDOLPH, SUITE 11-300, CHICAGO, IL 60601

ROD R. BLAGOJEVICH, GOVERNOR RENEE CIPRIANO, DIRECTOR

217/782-0610

May 27, 2003

SOLUTAI INC
575 MARYVILLE CENTRE DR
ST LOUIS, MO 63166

Re: FACILITY: SITE R SAUGET
NPDES Permit No: ILR108258
COUNTY: ST CLAIR

Notice of Coverage Under Construction Storm Water General Permit

Dear NPDES Permittee:

We have reviewed your application and determined that storm water discharges associated with industrial activity from construction sites are appropriately covered by the attached General NPDES Permit issued by the Agency.

Your discharge is covered by this permit effective as of the date of this letter. The Permit as issued covers application requirements, a storm water pollution prevention plan and reporting requirements.

This letter shows your facility permit number below the construction site name. Please save this number and reference it in all future correspondance. Should you have any questions concerning the Permit, please contact the Permit Section at the above telephone number and address.

Very truly yours,

Toby Frevert

Toby Frevert, P.E.
Manager
Division of Water Pollution Control

TF:med:concoverage 3

Enclosure

cc: Records Unit

Region 6

APPENDIX B

Letter Notice To IEPA of Amendment

SOLUTIA

Solutions for a better life.

Solutia Inc.
W.G. Krummrich Plant
500 Monsanto Avenue
Sauget, Illinois 62206-1198
Tel 618-271-5835

August 13, 2003

Ms. Marilyn Davenport
Permit Section
Division of Water Pollution Control
Illinois Environmental Protection Agency
1021 North Grand Avenue East
Springfield, Illinois 62794-9276

Re: Notice of Intent Addendum
General Permit to Discharge Storm Water
Construction Site Activities
Site R – Sauget, Illinois

Dear Ms. Davenport:

Pursuant to your conversation with Mr. Martin Swanson of URS on August 12, 2003, we are submitting this addendum to the Notice of Intent (NOI) which was prepared for Site R, 5 Riverview Avenue, Sauget, Illinois. The original NOI was submitted on April 24, 2003 for coverage under the Illinois Environmental Protection Agency (IEPA) General Permit to discharge storm water from construction activities. The IEPA issued the Notice of Coverage under the Construction General Storm Water Permit (NPDES Permit No. ILR108258) on May 27, 2003. A copy of the original NOI and the IEPA Notice of Coverage are attached.

This addendum is submitted to cover additional construction activities being performed at the same site. These additional activities will increase the total size of the construction site to encompass 4.5 acres. These construction activities are scheduled to begin on August 22, 2003 and should be completed by March, 2004. The contractor for the work will be Inquip Associates, Inc., P.O. Box 6277, McLean, Virginia, 22106. The contact person for our contractor is Mr. James C. Edwards (703-442-0143).

The storm water pollution prevention plan (SWPPP) that was prepared for the initial construction activities is being modified to reflect the additional work to be performed at the site. This SWPPP will be finalized prior to the start of construction and will be adhered to throughout the construction activities.

Please be advised that I am the new contact person for Solutia on the project. I can be reached at 314-674-6768. Should you have any questions, or require additional information regarding this NOI addendum, please feel free to call.

Sincerely,
Solutia Inc.

Gary W. Vandiver per Richard Kulla

Gary W. Vandiver
Project Coordinator

Attachments

NOTICE OF INTENT (NOI)

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
GENERAL PERMIT TO DISCHARGE STORM WATER
CONSTRUCTION SITE ACTIVITIES

Please use the tab or arrow keys

OWNER INFORMATION

NAME:	LAST Solutia Inc. FIRST MIDDLE			OWNER TYPE: Private	
MAILING ADDRESS:	575 Maryville Centre Drive				
CITY:	St. Louis	STATE:	MO	ZIP:	63166
CONTACT PERSON:	Steve Smith	TELEPHONE NUMBER:	AREA CODE 314	NUMBER 674-4660	

CONTRACTOR INFORMATION

NAME:	LAST (To Be Determined) FIRST MIDDLE			TELEPHONE NUMBER:	AREA CODE	NUMBER	
MAILING ADDRESS:		CITY:		STATE:		ZIP:	

CONSTRUCTION SITE INFORMATION

SELECT ONE:	Existing Site	NOTE: WHEN SELECTING CHANGE OF INFORMATION ENTER PERMIT NO. ILR10									
FACILITY NAME:	Site R	OTHER NPDES PERMIT NOS.:									
FACILITY LOCATION:	5 Riverview Avenue	TELEPHONE NUMBER:	AREA CODE 618	NUMBER 875-0268							
CITY:	Sauget	STATE:	IL	ZIP:	62201	LATITUDE:	38° 35'	55"	LONGITUDE:	90° 11'	2"
COUNTY:	St. Clair	SECTION:		TOWNSHIP:		RANGE:					
APPROX. CONST. START DATE:	05 / 12 / 03	APPROX. CONSTRUCTION END DATE:	10 / 10 / 03	TOTAL SIZE OF CONSTRUCTION SITE IN ACRES:	2.9						

TYPE OF CONSTRUCTION (SELECT ALL THAT APPLY)

☐ RESIDENTIAL ☑ COMMERCIAL ☐ INDUSTRIAL ☐ RECONSTRUCTION ☐ TRANSPORTATION ☐ OTHER

HISTORIC PRESERVATION AND ENDANGERED SPECIES COMPLIANCE

HAS THIS PROJECT SATISFIED APPLICABLE REQUIREMENTS FOR COMPLIANCE WITH ILLINOIS LAW ON:

HISTORIC PRESERVATION	☑ YES	☐ NO
ENDANGERED SPECIES	☑ YES	☐ NO

I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage this system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. In addition, I certify that the provisions of the permit, including the development and implementation of a storm water pollution prevention plan and a monitoring program plan, will be complied with.

OWNER SIGNATURE: _____ DATE: 4/24/03.

FOR OFFICE USE ONLY

MAIL COMPLETED FORM TO:	ILLINOIS ENVIRONMENTAL PROTECTION AGENCY DIVISION OF WATER POLLUTION CONTROL ATTN: PERMIT SECTION POST OFFICE BOX 19276 SPRINGFIELD, ILLINOIS 62794-9276	LOG:
(DO NOT SUBMIT ADDITIONAL DOCUMENTATION UNLESS REQUESTED)		PERMIT NO. ILR10
		DATE:

ormation required by this form must be provided to comply with 415 ILCS 5/39 (1996). Failure to do so may prevent this form from being processed and could result in your application being denied. is form has been approved by the Forms Management Center.

IL 532 2104
WPC 623 Rev. 5/99

APPENDIX C Notice of Termination of Coverage

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

NOTICE OF TERMINATION (NOT)

OF COVERAGE UNDER THE GENERAL PERMIT FOR STORM WATER DISCHARGES ASSOCIATED WITH CONSTRUCTION SITE ACTIVITIES

Please use the tab or arrow keys

OWNER INFORMATION

NAME:	LAST	FIRST	MIDDLE		OWNER TYPE: PRIVATE (Select One)	
MAILING ADDRESS:						
CITY:			STATE:		ZIP:	
CONTACT PERSON:		TELEPHONE NUMBER:	AREA CODE	NUMBER		

CONTRACTOR INFORMATION

NAME:	LAST	FIRST	MIDDLE	TELEPHONE NUMBER:	AREA CODE	NUMBER	
MAILING ADDRESS:		CITY:		STATE:		ZIP:	

CONSTRUCTION SITE INFORMATION

FACILITY NAME:		OTHER NPDES PERMIT NOS.:	I	L	R	1	0								
FACILITY LOCATION:															
CITY:		STATE:	IL	ZIP:		LATITUDE:				LONGITUDE:					
COUNTY:		SECTION:		TOWNSHIP:		RANGE:									

I certify under penalty of law that disturbed soils at the identified facility have been finally stabilized or that all storm water discharges associated with industrial activity from the identified facility that are authorized by an NPDES general permit have otherwise been eliminated. I understand that by submitting this notice of termination, that I am no longer authorized to discharge storm water associated with industrial activity by the general permit, and that discharging pollutants in storm water associated with industrial activity to Waters of the State is unlawful under the Environmental Protection Act and the Clean Water Act where the discharge is not authorized by an NPDES permit.

OWNER SIGNATURE:_____ **DATE:** _____

MAIL COMPLETED FORM TO:

(DO NOT SUBMIT ADDITIONAL DOCUMENTATION UNLESS REQUESTED)

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
DIVISION OF WATER POLLUTION CONTROL
ATTN: PERMIT SECTION
POST OFFICE BOX 19276
SPRINGFIELD, ILLINOIS 62794-9276

FOR OFFICE USE ONLY

LOG:
PERMIT NO. ILR10 __ __ __ __
DATE:

Information required by this form must be provided to comply with 415 ILCS 5/39 (1996). Failure to do so may prevent this form from being processed and could result in your application being denied. This form has been approved by the Forms Management Center.

L 532 2102
WPC 621 Rev. 6/98

GUIDELINES FOR COMPLETION OF NOTICE OF TERMINATION (NOT) FORM

Please adhere to the following guidelines:

Submit original, photocopy or facsimile copies. Facsimile and/or photo copies should be followed-up with an original signature copy as soon as possible. Please write "copy" under the "For Office Use Only" box in the lower right hand corner.

- Submit completed forms to:

  Illinois Environmental Protection Agency
  Division of Water Pollution Control
  Permit Section
  Post Office Box 19276
  Springfield, Illinois 62794-9276
  217/782-0610

- Reports must be typed or printed legibly and signed.

- <u>NOTE: FACILITY LOCATION IS NOT NECESSARILY THE FACILITY MAILING ADDRESS, BUT SHOULD DESCRIBE WHERE THE FACILITY IS LOCATED.</u>

- Use the formats given in the following examples for correct form completion.

	Example	Format
SECTION	12	1 or 2 numerical digits
TOWNSHIP	12N	1 or 2 numerical digits followed by "N" or "S"
RANGE	12W	1 or 2 numerical digits followed by "E" or "W"

APPENDIX D

Inspection Forms

STORMWATER POLLUTION PREVENTION PLAN
INSPECTION AND MAINTENANCE REPORT
BARRIER WALL – SITE R, SAUGET, ILLINOIS

Inspector's Name:_____ Date:_____

Days Since Last Rainfall:_____ Amount of Last Rainfall:____ Inches

Stabilization Measures

Area	Date Since Last Disturbed	Date of Next Disturbance	Stabilized (Yes/No)	Stabilized With	Condition

Stabilization Required:

_____

_____

_____

_____

_____

To Be Performed By:_____On or Before:_____

STORMWATER POLLUTION PREVENTION PLAN
INSPECTION AND MAINTENANCE REPORT
BARRIER WALL – SITE R, SAUGET, ILLINOIS

Structural Controls

Inspector's Name:_____ Date:_____

Temporary Diversion Swales

From Point	To Point	Stabilized (Y/N)	Evidence of Washout or Over-Topping (Y/N)

Maintenance Required for Temporary Diversion Swales:

_____

_____

_____

_____

To Be Performed By:_____ On or Before:_____

STORMWATER POLLUTION PREVENTION PLAN
INSPECTION AND MAINTENANCE REPORT
BARRIER WALL – SITE R, SAUGET, ILLINOIS

Structural Controls

Inspector's Name:_____ Date:_____

Silt Fence Sediment Traps

Location	Bottom of Fabric Still Buried?	Fabric Deteriorated or Sagging?	Posts Tipping Over?	Depth of Sediment

Maintenance Required for Silt Fence:

_____
_____
_____
_____
_____
_____

To Be Performed By:_____ On or Before:_____

STORMWATER POLLUTION PREVENTION PLAN
INSPECTION AND MAINTENANCE REPORT
BARRIER WALL – SITE R, SAUGET, ILLINOIS

Changes Required to the Pollution Prevention Plan:

_____
_____
_____
_____
_____
_____

Reasons for Changes:

_____
_____
_____
_____
_____
_____

Inspector's Signature _____

Date:_____

APPENDIX E

Product Specific and Spill Prevention Practices

APPENDIXE Product Specific and Spill Prevention Practices

Product Specific Practices

The following product specific practices will be followed onsite:

- **Petroleum Products**: All onsite vehicles will be monitored for leaks and receive regular preventative maintenance to reduce the potential for leakage. Petroleum products will be stored in tightly sealed containers, which are clearly labeled.

- **Fertilizers**: Fertilizers used will be applied only in the maximum amounts recommended by the manufacturer. Once applied, fertilizer will be worked in the soil to limit exposure to storm water. The contents of any partially used bags of fertilizer will be transferred to a sealable plastic bin to avoid spills.

- **Bentonite and other clayey materials:** These materials will be brought on site as needed to complete the barrier wall and stored in a staging area.

Spill Prevention Practices

In addition to the good housekeeping and material management practices discussed in the previous sections of this plan, the following practices will be followed for spill prevention and cleanup:

- Manufacturer's recommended methods for spill cleanup will be clearly posted and site personnel will be made aware of the procedures and the location of the information and cleanup supplies.

- Materials and equipment necessary for spill cleanup will be kept in the material storage area onsite. Equipment and materials will include but not be limited to brooms, dust pans, mops, rags, gloves, goggle, kitty litter, sand, sawdust, and plastic and metal trash containers specifically for this purpose.

- Spills will be cleaned up immediately after discovery.

- The spill area will be kept well ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance.

- Spills of toxic or hazardous material will be reported to the appropriate State or local government agency, regardless of the size.

- The spill prevention plan will be adjusted to include measures to prevent this type of spill from reoccurring and how to clean up the spill if there is another. A description of the spill, what caused it, and the cleanup measures will also be included.

APPENDIX E Product Specific and Spill Prevention Practices

- The site superintendent responsible for the day-to-day site operations, and will be the spill prevention and cleanup coordinator. The names of responsible spill personnel will be posted in the material storage area and in the office trailer onsite.

APPENDIX F

General State Operating Permit

NPDES Permit No. ILR10

Illinois Environmental Protection Agency
Division of Water Pollution Control
1021 North Grand East
Post Office Box 19276
Springfield, Illinois 62794-9276

CONSTRUCTION SITE ACTIVITIES

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) Storm Water Permit

Expiration Date: May 31, 2003

Issue Date: May 14-, 1998

Effective Date: June 1, 1998

In compliance with the provisions of the Illinois Environmental Protection Act, the Illinois Pollution Control Board Rules and Regulations (35 Ill. Adm. Code, Subtitle C, Chapter I), and the Clean Water Act, and the regulations thereunder the following discharges are authorized by this permit, in accordance with the conditions and attachments herein:

Thomas G. McSwiggin, P.E.
Manager, Permit Section
Division of Water Pollution Control

Part I. COVERAGE UNDER THIS PERMIT

A. **Permit Area.** The permit covers all areas of the State of Illinois with discharges to any waters of the State.

B. **Eligibility.**

1. This permit shall authorize all discharges of storm water associated with industrial activity from construction sites, (those sites or common plans of development or sale that will result in the disturbance of five or more acres total land area), (heretofore referred to as storm water discharges from construction activities) occurring after the effective date of this permit (including discharges occurring after the effective date of this permit where the construction activity was initiated before the effective date of this permit), except for discharges identified under paragraph I.B.3 (Limitations on Coverage).

2. This permit may only authorize a storm water discharge associated with industrial activity from a construction site that is mixed with a storm water discharge from an industrial source other than construction, where:

   a. the industrial source other than construction is located on the same site as the construction activity;

   b. storm water discharges associated with industrial activity from the areas of the site where construction activities are occurring are in compliance with the terms of this permit; and

   c. storm water discharges associated with industrial activity from the areas of the site where industrial activity other than construction are occurring (including storm water discharges from dedicated asphalt plants and dedicated concrete plants) are covered by a different NPDES general permit or individual permit authorizing such discharges.

3. **Limitations on Coverage.** The following storm water discharges from construction sites are not authorized by this permit:

   a. storm water discharges associated with industrial activity that originate from the site after construction activities have been completed and the site has undergone final stabilization.

   b. discharges that are mixed with sources of non-storm water other than discharges identified in Part III.A (Prohibition on Non-Storm Water Discharges) of this permit and in compliance with paragraph IV.D.5 (Non-Storm Water Discharges) of this permit.

   c. storm water discharges associated with industrial activity that are subject to an existing NPDES individual or general permit or which are issued a permit in accordance with Part VI.N (Requiring an Individual Permit or an Alternative General Permit) of this permit. Such discharges may be authorized under this permit after an existing permit expires provided the existing permit did not establish numeric limitations for such discharges; and

   d. storm water discharges from construction sites that the Agency has determined to be or may reasonably be expected to be contributing to a violation of a water quality standard.

e. Storm water discharges that the Agency, at its discretion, determines are not appropriately authorized or controlled by this general permit.

C. **Authorization.**

1. In order for storm water discharges from construction sites to be authorized to discharge under this general permit a discharger must submit a Notice of Intent (NOI) in accordance with the requirements of Part II below, using an NOI from provided by the Agency, or be covered by a valid Illinois General NPDES Construction Site Activities Permit.

2. Where a new operator (contractor) is selected after the submittal of an NOI under Part II below, a new Notice of Intent (NOI) must be submitted by the owner in accordance with Part II.

3. For projects that have complied with State law on historic preservation and endangered species prior to submittal of the NOI, through coordination with the Illinois Historic Preservation Agency and the Illinois Department of Natural Resources or through fulfillment of the terms of interagency agreements with those agencies, the NOI shall indicate that such compliance has occurred.

   Unless notified by the Agency to the contrary, dischargers who submit an NOI in accordance with the requirements of this permit are authorized to discharge storm water from construction sites under the terms and conditions of this permit either:

   a. 48 hours after the date the NOI is postmarked, if the project had established compliance with Illinois law regarding historic preservation and endangered species prior to submittal of the NOI;
   or

   b. 30 days after the date the NOI is postmarked, if the project had not established compliance with Illinois historic preservation and endangered species requirements prior to submittal of the NOI.

   The Agency may deny coverage under this permit and require submittal of an application for an individual NPDES permit based on a review of the NOI or other information.

Part II. NOTICE OF INTENT REQUIREMENTS

A. **Deadlines for Notification.**

1. To receive authorization under this general permit, a discharge must either be covered by a valid Illinois General NPDES Construction Site Permit, or a Notice of Intent (NOI) in accordance with the requirements of this part must be submitted prior to the commencement of construction. For projects that have established compliance with Illinois law regarding historic preservation and endangered species prior to submittal of the NOI, the NOI must be submitted at least 48 hours prior to the commencement of construction. For all other projects, the NOI must be submitted at least 30 days prior to the commencement of construction.

2. Discharges that are covered by a valid Illinois General NPDES Construction Site Activities Permit are automatically covered by this permit.

3. A discharger may submit an NOI in accordance with the requirements of this part after the start of construction. In such instances, the Agency may bring an enforcement action for any discharges of storm water associated with industrial activity from a construction site that have occurred on or after the start of construction.

B. **Failure to Notify.** Dischargers who fail to notify the Agency of their intent to be covered, and discharge storm water associated with construction site activity to Waters of the State without an NPDES permit, are in violation of the Environmental Protection Act and Clean Water Act.

C. **Contents of Notice of Intent.** The Notice of Intent shall be signed in accordance with Part VI.G (Signatory Requirements) of this permit by all of the entities identified in paragraph 2 below and shall include the following information:

1. The mailing address, and location of the construction site for which the notification is submitted. Where a mailing address for the site is not available, the location can be described in terms of the latitude and longitude of the approximate center of the facility to the nearest 15 seconds, or the nearest quarter section (if the section, township and range is provided) that the construction site is located in;

2. The owner's name, address, telephone number, and status as Federal, State, private, public or other entity.

3. The name, address and telephone number of the general contractor(s) that have been identified at the time of the NOI submittal;

4. The name of the receiving water(s), or if the discharge is through a municipal separate storm sewer, the name of the municipal operator of the storm sewer and the ultimate receiving water(s);

5. The number of any NPDES permit for any discharge (including non-storm water discharges) from the site that is currently authorized by an NPDES permit.

6. A yes or no indication of whether the owner or operator has existing quantitative data which describes the concentration of pollutants in storm water discharges (existing data should not be included as part of the NOI); and

7. A brief description of the project, estimated timetable for major activities, estimates of the number of acres of the site on which soil will be disturbed, and a certification that a storm water pollution prevention plan has been prepared for the facility in accordance with Part IV of this permit, and such plan provides compliance with local sediment and erosion plans or permits and/or storm water management plans or permits in accordance with paragraph VI.G.1 (Signatory Requirements) of this permit. **(A copy of the plans or permits <u>should not</u> be included with the NOI submission).**

D. **Where to Submit.**

1. Facilities which discharge storm water associated with construction site activity must use a NOI form provided by the Agency. NOIs must be signed in accordance with Part VI.G (Signatory Requirements) of this permit. NOIs are to be submitted certified mail to the Agency at the following address:

   Illinois Environmental Protection Agency
   Division of Water Pollution Control
   Attention: Permit Section
   1021 North Grand East
   Post Office Box 19276
   Springfield, Illinois 62794-9276

2. A copy of the letter of notification of coverage or other indication that storm water discharges from the site are covered under an NPDES permit shall be posted at the site in a prominent place for public viewing (such as alongside a building permit).

E. **Additional Notification.** Facilities which are operating under approved local sediment and erosion plans, grading plans, or storm water management plans, in addition to filing copies of the Notice of Intent in accordance with Part D above, shall also submit signed copies of the Notice of Intent to the local agency approving such plans in accordance with the deadlines in Part A above. See Part IV.D.2.d (Approved State or Local Plans).

F. **Notice of Termination.** Where a site has been finally stabilized and all storm water discharges from construction sites that are authorized by this permit are eliminated, the permittee of the facility may submit a Notice of Termination that is signed in accordance with Part VI.G (Signatory Requirements) of this permit.

1. The Notice of Termination shall include the following information:

   a. The mailing address, and location of the construction site for which the notification is submitted. Where a mailing address for the site is not available, the location can be described in terms of the latitude and longitude of the approximate center of the facility to the nearest 15 seconds, or the nearest quarter section (if the section, township and range is provided) that the construction site is located in;

   b. The owner's name, address, telephone number, and status as Federal, State, private, public or other entity.

   c. The name, address and telephone number of the general contractor(s);

   d. The following certification signed in accordance with Part VI.G (Signatory Requirements) of this permit:

      "I certify under penalty of law that all storm water discharges associated with construction site activity from the identified facility that are authorized by NPDES general permit ILR100000 have otherwise been eliminated. I understand that by submitting this notice of termination, that I am no longer authorized to discharge storm water associated with construction site activity by the general permit, and that discharging pollutants in storm water associated with construction site activity to Waters of the State is unlawful under the Environmental Protection Act and Clean Water Act where the discharge is not authorized by a NPDES permit. I also understand that the submittal of this notice of termination does not release an operator from liability for any violations of this permit or the Clean Water Act."

      For the purposes of this certification, elimination of storm water discharges associated with industrial activity means that all disturbed soils at the identified facility have been finally stabilized and temporary erosion and sediment control measures have been removed or will be removed at an appropriate time, or that all storm water discharges associated with construction activities from the identified site that are authorized by a NPDES general permit have otherwise been eliminated.

2. All Notices of Termination are to be sent, using the form provided by the Agency to the address in paragraph II.D.1.

Part III. SPECIAL CONDITIONS, MANAGEMENT PRACTICES, AND OTHER NON-NUMERIC LIMITATIONS

A. **Prohibition on Non-Storm Water Discharges.**

1. Except as provided in paragraph I.B.2 and 2 below, all discharges covered by this permit shall be composed entirely of storm water.

2. a. Except as provided in paragraph b below, discharges of materials other than storm water must be in compliance with a NPDES permit (other than this permit) issued for the discharge.

   b. The following non-storm water discharges may be authorized by this permit provided the non-storm water component of the discharges is in compliance with paragraph IV.D.5 (Non-Storm Water Discharges): discharges from fire fighting activities; fire hydrant flushings; waters used to wash vehicles or control dust; potable water sources including waterline flushings; irrigation drainages; routine external building washdown which does not use detergents; pavement washwaters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents are not used; air conditioning condensate; springs; uncontaminated ground water; and foundation or footing drains where flows are not contaminated with process materials such as solvents.

Part IV. STORM WATER POLLUTION PREVENTION PLANS

A storm water pollution prevention plan shall be developed for each construction site covered by this permit. Storm water pollution prevention plans shall be prepared in accordance with good engineering practices. The plan shall identify potential sources of pollution which may reasonably be expected to affect the quality of storm water discharges associated with construction site activity from the facility. In addition, the plan shall describe and ensure the implementation of practices which will be used to reduce the pollutants in storm water discharges associated with construction site activity and to assure compliance with the terms and conditions of this permit. Facilities must implement the provisions of the storm water pollution prevention plan required under this part as a condition of this permit.

A. **Deadlines for Plan Preparation and Compliance.**

The plan shall:

1. Be completed prior to the start of the construction to be covered under this permit and updated as appropriate;

2. Provide for compliance with the terms and schedule of the plan beginning with the initiation of construction activities.

B. **Signature and Plan Review.**

1. The plan shall be signed in accordance with Part VI.G (Signatory Requirements), and be retained on-site at the facility which generates the storm water discharge in accordance with Part VI.E (Duty to Provide Information) of this permit.

2. The permittee shall make plans available upon request from this Agency or a local agency approving sediment and erosion plans, grading plans, or storm water management plans; or in the case of a storm water discharge associated with industrial activity which discharges through a municipal separate storm sewer system with an NPDES permit, to the municipal operator of the system.

3. The Agency may notify the permittee at any time that the plan does not meet one or more of the minimum requirements of this Part. Such notification shall identify those provisions of the permit which are not being met by the plan, and identify which provisions of the plan requires modifications in order to meet the minimum requirements of this part. Within 7 days from receipt of notification from the Agency, the permittee shall make the required changes to the plan and shall submit to the Agency a written certification that the requested changes have been made. Failure to comply shall terminate authorization under this permit.

4. All storm water pollution prevention plans required under this permit are considered reports that shall be available to the public under Section 308(b) of the CWA. The permittee shall make plans available to members of the public upon request by the public. However, the permittee may claim any portion of a storm water pollution prevention plan as confidential in accordance with 40 CFR Part 2.

C. **Keeping Plans Current.** The permittee shall amend the plan whenever there is a change in design, construction, operation, or maintenance, which has a significant effect on the potential for the discharge of pollutants to the Waters of the State and which has not otherwise been addressed in the plan or if the storm water pollution prevention plan proves to be ineffective in eliminating or significantly minimizing pollutants from sources identified under paragraph D.2 below, or in otherwise achieving the general objectives of controlling pollutants in storm water discharges associated with construction site activity. In addition, the plan shall be amended to identify any new contractor and/or subcontractor that will implement a measure of the storm water pollution prevention plan. Amendments to the plan may be reviewed by the Agency in the same manner as Part IV.B above.

D. **Contents of Plan.** The storm water pollution prevention plan shall include the following items:

1. **Site Description.** Each plan shall, provide a description of the following:

   a. A description of the nature of the construction activity;

   b. A description of the intended sequence of major activities which disturb soils for major portions of the site (e.g. grubbing, excavation, grading);

   c. Estimates of the total area of the site and the total area of the site that is expected to be disturbed by excavation, grading, or other activities;

   d. An estimate of the runoff coefficient of the site after construction activities are completed and existing data describing the soil or the quality of any discharge from the site;

   e. A site map indicating drainage patterns and approximate slopes anticipated before and after major grading activities, locations where vehicles enter or exit the site and controls to prevent offsite sediment tracking, areas of soil disturbance, the location of major structural and nonstructural controls identified in the plan, the location of areas where stabilization practices are expected to occur, surface waters (including wetlands), and locations where storm water is discharged to a surface water; and

   f. The name of the receiving water(s) and the ultimate receiving water(s), and areal extent of wetland acreage at the site.

2. **Controls.** Each plan shall include a description of appropriate controls that will be implemented at the construction site. The plan will clearly describe for each major activity identified in paragraph D.1 above, appropriate controls and the timing during the construction process that the controls will be implemented. (For example, perimeter controls for one portion of the site will be installed after the clearing and grubbing necessary for installation of the measure, but before the clearing and grubbing for the remaining portions of the site. Perimeter controls will be actively maintained until final stabilization of those portions of the site upward of the perimeter control. Temporary perimeter controls will be removed after final stabilization). The description of controls shall address as appropriate the following minimum components:

   a. **Erosion and Sediment Controls.**

      (i). **Stabilization Practices.** A description of interim and permanent stabilization practices, including site-specific scheduling of the implementation of the practices. Site plans should ensure that existing vegetation is preserved where attainable and that disturbed portions of the site are stabilized. Stabilization practices may include: temporary seeding, permanent seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, protection of trees, preservation of mature vegetation, and other appropriate measures. A record of the dates when major grading activities occur, when construction activities temporarily or permanently cease on a portion of the site, and when stabilization measures are initiated shall be included in the plan. Except as provided in paragraphs (A) and (B) below, stabilization measures shall be initiated as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased.

         (A). Where the initiation of stabilization measures by the 14th day after construction activity temporary or permanently cease is precluded by snow cover, stabilization measures shall be initiated as soon as practicable.

(B). Where construction activity will resume on a portion of the site within 21 days from when activities ceased, (e.g. the total time period that construction activity is temporarily ceased is less than 21 days) then stabilization measures do not have to be initiated on that portion of site by the 14th day after construction activity temporarily ceased.

(ii). Structural Practices. A description of structural practices to the degree attainable, to divert flows from exposed soils, store flows or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Such practices may include silt fences, earth dikes, drainage swales, sediment traps, check dams, subsurface drains, pipe slope drains, level spreaders, storm drain inlet protection, rock outlet protection, reinforced soil retaining systems, gabions, and temporary or permanent sediment basins. Structural practices should be placed on upland soils to the degree attainable. The installation of these devices may be subject to Section 404 of the CWA.

b. **Storm Water Management.** A description of measures that will be installed during the construction process to control pollutants in storm water discharges that will occur after construction operations have been completed. Structural measures should be placed on upland soils to the degree attainable. The installation of these devices may be subject to Section 404 of the CWA. This permit only addresses the installation of storm water management measures, and not the ultimate operation and maintenance of such structures after the construction activities have been completed and the site has undergone final stabilization. Permittees are responsible for only the installation and maintenance of storm water management measures prior to final stabilization of the site, and are not responsible for maintenance after storm water discharges associated with industrial activity have been eliminated from the site.

(i). Such practices may include: storm water detention structures (including wet ponds); storm water retention structures; flow attenuation by use of open vegetated swales and natural depressions; infiltration of runoff onsite; and sequential systems (which combine several practices). The pollution prevention plan shall include an explanation of the technical basis used to select the practices to control pollution where flows exceed predevelopment levels.

(ii). Velocity dissipation devices shall be placed at discharge locations and along the length of any outfall channel as necessary to provide a non-erosive velocity flow from the structure to a water course so that the natural physical and biological characteristics and functions are maintained and protected (e.g. maintenance of hydrologic conditions, such as the hydroperiod and hydrodynamics present prior to the initiation of construction activities).

c. **Other Controls.**

(i). **Waste Disposal.** No solid materials, including building materials, shall be discharged to Waters of the State, except as authorized by a Section 404 permit.

(ii). The plan shall ensure and demonstrate compliance with applicable State and/or local waste disposal, sanitary sewer or septic system regulations.

d. **Approved State or Local Plans.**

(i). The management practices, controls and other provisions contained in the storm water pollution prevention plan must be at least as protective as the requirements contained in Illinois Environmental Protection Agency's Illinois Urban Manual, 1995. Facilities which discharge storm water associated with construction site activities must include in their storm water pollution prevention plan procedures and requirements specified in applicable sediment and erosion site plans or storm water management plans approved by local officials. Requirements specified in sediment and erosion site plans or site permits or storm water management site plans or site permits approved by local officials that are applicable to protecting surface water resources are, upon submittal of an NOI to be authorized to discharge under this permit, incorporated by reference and are enforceable under this permit even if they are not specifically included in a storm water pollution prevention plan required under this permit. This provision does not apply to provisions of master plans, comprehensive plans, non-enforceable guidelines or technical guidance documents that are not identified in a specific plan or permit that is issued for the construction site.

(ii) Dischargers seeking alternative permit requirements are not authorized by this permit and shall submit an individual permit application in accordance with 40 CFR 122.26 at the address indicated in Part II.D (Where to Submit) of this permit, along with a description of why requirements in approved local plans or permits should not be applicable as a condition of an NPDES permit.

3. **Maintenance.** A description of procedures to maintain in good and effective operating conditions vegetation, erosion and sediment control measures and other protective measures identified in the site plan.

4. **Inspections.** Qualified personnel (provided by the permittee) shall inspect disturbed areas of the construction site that have not been finally stabilized, structural control measures, and locations where vehicles enter or exit the site at least once every seven calendar days and within 24 hours of the end of a storm that is 0.5 inches or greater or equivalent snowfall.

a. Disturbed areas and areas used for storage of materials that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion and sediment control measures identified in the plan shall be observed to ensure that they are operating correctly. Where discharge locations or points are accessible, they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Locations where vehicles enter or exit the site shall be inspected for evidence of offsite sediment tracking.

b. Based on the results of the inspection, the description of potential pollutant sources identified in the plan in accordance with paragraph IV.D.1 (Site Description) of this permit and pollution prevention measures identified in the plan in accordance with paragraph IV.D.2 (Controls) of this permit shall be revised as appropriate as soon as practicable after such inspection. Such modifications shall provide for timely implementation of any changes to the plan within 7 calendar days following the inspection.

c. A report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph b above shall be made and retained as part of the storm water pollution prevention plan for at least three years after the date of inspection. The report shall be signed in accordance with Part VI.G (Signatory Requirements) of this permit.

d. The permittee shall complete and submit within 5 days an "Incidence of Noncompliance" (ION) report for any violation of the storm water pollution prevention plan observed during an inspection conducted, including those not required by the Plan. Submission shall be on forms provided by the Agency and include specific information on the cause of noncompliance, actions which were taken to prevent any further causes of noncompliance, and a statement detailing any environmental impact which may have resulted from the noncompliance.

e. All reports of noncompliance shall be signed by a responsible authority as defined in Part VI.G (Signatory Requirements).

f. All reports of noncompliance shall be mailed to the Agency at the following address:

Illinois Environmental Protection Agency
Division of Water Pollution Control
Compliance Assurance Section
1021 North Grand East
Post Office Box 19276
Springfield, Illinois 62794-9276

5. **Non-Storm Water Discharges** - Except for flows from fire fighting activities, sources of non-storm water listed in paragraph III.A.2 of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and insure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

E. **Additional requirements for storm water discharge from industrial activities other than construction, including dedicated asphalt plants, and dedicated concrete plants.** - This permit may only authorize a storm water discharge associated with industrial activity from a construction site that is mixed with a storm water discharge from an industrial source other than construction, where:

1. the industrial source other than construction is located on the same site as the construction activity;

2. storm water discharges associated with industrial activity from the areas of the site where construction activities are occurring are in compliance with the terms of this permit; and

3. storm water discharges associated with industrial activity from the areas of the site where industrial activity other than construction are occurring (including storm water discharges from dedicated asphalt plants (other than asphalt emulsion facilities) and dedicated concrete plants) are in compliance with the terms, including applicable NOI or application requirements, of a different NPDES general permit or individual permit authorizing such discharges.

F. **Contractors.**

1. The storm water pollution prevention plan must clearly identify for each measure identified in the plan, the contractor(s) or subcontractor(s) that will implement the measure. All contractors and subcontractors identified in the plan must sign a copy of the certification statement in paragraph 2 below in accordance with Part VI.G (Signatory Requirements) of this permit. All certifications must be included in the storm water pollution prevention plan except for owners that are acting as contractor.

2. **Certification Statement.** All contractors and subcontractors identified in a storm water pollution prevention plan in accordance with paragraph 1 above shall sign a copy of the following certification statement before conducting any professional service at the site identified in the storm water pollution prevention plan:

"I certify under penalty of law that I understand the terms and conditions of the general National Pollutant Discharge Elimination System (NPDES) permit (ILR100000) that authorizes the storm water discharges associated with industrial activity from the construction site identified as part of this certification."

The certification must include the name and title of the person providing the signature in accordance with Part VI.G of this permit; the name, address and telephone number of the contracting firm; the address (or other identifying description) of the site; and the date the certification is made.

Part V. RETENTION OF RECORDS

A. The permittee shall retain copies of storm water pollution prevention plans and all reports and notices required by this permit, and records of all data used to complete the Notice of Intent to be covered by this permit, for a period of at least three years from the date that the site is finally stabilized. This period may be extended by request of the Agency at any time.

B. The permittee shall retain a copy of the storm water pollution prevention plan required by this permit at the construction site from the date of project initiation to the date of final stabilization.

Part VI. STANDARD PERMIT CONDITIONS

A. **Duty to Comply.**

1. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of Illinois Environmental Protection Act and the CWA and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application.

2. **Penalties for Violations of Permit Conditions.**

a. Criminal

(1). Negligent Violations The CWA provides that any person who negligently violates permit conditions implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than 1 years, or both. The Environmental Protection Act provides that any person who negligently violates subsection (f) of Section 12 of the Act, any provision of any regulation, standard, or filing requirement under subsection (b) of Section 39 of the Act, or any

NPDES permit issued under the Act is subject to a fine not to exceed $10,000 for each day of violation.

(2). Knowing Violations The CWA provides that any person who knowingly violates permit conditions implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to a fine of not less than $5,000 nor more than $50,000 per day of violation, or by imprisonment for not more than 3 year, or both. The Environmental Protection Act provides that any person who knowingly violates subsection (f) of Section 12 of the Act, any provision of any regulation, standard, or filing requirement under subsection (b) of Section 39 of the Act, or any NPDES permit issued under the Act commits a Class 4 felony, and in addition to any other penalty prescribed by law is subject to a fine not to exceed $25,000 for each day of violation.

(3). Knowing Endangerment The CWA provides that any person who knowingly violates permit conditions implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act and who knows at that time that he is placing another person in imminent danger of death or serious bodily injury is subject to a fine of not more than $250,000, or by imprisonment for not more than 15 years, or both.

(4). False Statement The CWA provides that any person who knowingly makes any false material statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under the Act or who knowingly falsifies, tampers with, or renders inaccurate, any monitoring device or method required to be maintained under the Act, shall upon conviction, be punished by a fine of not more than $10,000 or by imprisonment for not more than 2 years, or by both. If a conviction of a permitee is for a violation committed after a first conviction of such person under this paragraph, punishment shall be by a fine of not more than $20,000 per day of violation, or by imprisonment of not more than 4 years, or by both. (See Section 309.c.4 of the Clean Water Act). The Environmental Protection Act provides that any person who knowingly makes any false statement, representation, or certification in an application form, or form pertaining to a NPDES permit or who knowingly renders inaccurate any monitoring device or record required in connection with any such permit or with any discharge which is subject to the provisions of subsection (f) of Section 12 of the Act commits a Class A misdemeanor, and in addition to any other penalties provided by law is subject to a fine not to exceed $10,000 for each day of violation.

b. Civil Penalties - The CWA provides that any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to a civil penalty not to exceed $25,000 per day for each violation. The Environmental Protection Act provides that any person who violates subsection (f) of Section 12 of the Act, any provision of any regulation, standard, or filing requirement under subsection (b) of Section 39 of the Act, or any NPDES permit issued under the Act is subject to a civil penalty not to exceed $50,000 for each violation and an additional civil penalty of not to exceed $10,000 for each day during which the violation continues.

c. Administrative Penalties - The CWA provides that any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to an administrative penalty, as follows:

(1). Class I penalty Not to exceed $10,000 per violation nor shall the maximum amount exceed $25,000.

(2). Class II penalty Not to exceed $10,000 per day for each day during which the violation continues nor shall the maximum amount exceed $125,000.

B. **Continuation of the Expired General Permit.** This permit expires five years from the date of issuance. An expired general permit continues in force and effect until a new general permit or an individual permit is issued. Only those facilities authorized to discharge under the expiring general permit are covered by the continued permit.

C. **Need to halt or reduce activity not a defense.** It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. **Duty to Mitigate.** The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

E. **Duty to Provide Information.** The permittee shall furnish within a reasonable time to the Agency or local agency approving sediment and erosion plans, grading plans, or storm water management plans; or in the case of a storm water discharge associated with industrial activity which discharges through a municipal separate storm sewer system with an NPDES permit, to the municipal operator of the system, any information which is requested to determine compliance with this permit. Upon request, the permittee shall also furnish to the Agency or local agency approving sediment and erosion plans, grading plans, or storm water management plans; or in the case of a storm water discharge associated with industrial activity which discharges through a municipal separate storm sewer system with an NPDES permit, to the municipal operator of the system, copies of records required to be kept by this permit.

F. **Other Information.** When the permittee becomes aware that he or she failed to submit any relevant facts or submitted incorrect information in the Notice of Intent or in any other report to the Agency, he or she shall promptly submit such facts or information.

G. **Signatory Requirements.** All Notices of Intent, storm water pollution prevention plans, reports, certifications or information either submitted to the Agency or the operator of a large or medium municipal separate storm sewer system, or that this permit requires be maintained by the permittee, shall be signed.

1. All Notices of Intent shall be signed as follows:

a. For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means: (1) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or (2) the manager of one or more manufacturing, production or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25,000,000 (in second-quarter 1980 dollars) if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

b. For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

c. For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes (1) the chief executive officer of the agency, or (2) a senior executive officer

having responsibility for the overall operations of a principal geographic unit of the agency.

2. All reports required by the permit and other information requested by the Agency shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described above and submitted to the Agency.

   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of manager, operator, superintendent, or position of equivalent responsibility or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position).

   c. **Changes to authorization.** If an authorization under paragraph I.C (Authorization) is no longer accurate because a different individual or position has responsibility for the overall operation of the construction site, a new authorization satisfying the requirements of paragraph I.C must be submitted to the Agency prior to or together with any reports, information, or applications to be signed by an authorized representative.

   d. **Certification.** Any person signing documents under this Part shall make the following certification:

      "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

H. **Penalties for Falsification of Reports.** Section 309(c)(4) of the Clean Water Act provides that any person who knowingly makes any false material statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including reports of compliance or noncompliance shall, upon conviction, be punished by a fine of not more than $10,000, or by imprisonment for not more than 2 years, or by both. Section 44(j)(4) and (5) of the Environmental Protection Act provides that any person who knowingly makes any false statement, representation, or certification in an application form, or form pertaining to a NPDES permit commits a Class A misdemeanor, and in addition to any other penalties provided by law is subject to a fine not to exceed $10,000 for each day of violation.

I. **Penalties for Falsification of Monitoring Systems.** The CWA provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by fines and imprisonment described in Section 309 of the CWA. The Environmental Protection Act provides that any person who knowingly renders inaccurate any monitoring device or record required in connection with any NPDES permit or with any discharge which is subject to the provisions of subsection (f) of Section 12 of the Act commits a Class A misdemeanor, and in addition to any other penalties provided by law is subject to a fine not to exceed $10,000 for each day of violation.

J. **Oil and Hazardous Substance Liability.** Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under section 311 of the CWA.

K. **Property Rights.** The issuance of this permit does not convey any property rights of any sort, nor any exclusive privileges, nor does it authorize any injury to private property nor any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

L. **Severability.** The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

M. **Transfers.** This permit is not transferable to any person except after notice to the Agency. The Agency may require the discharger to apply for and obtain an individual NPDES permit as stated in Part I.C (Authorization).

N. **Requiring an Individual Permit or an Alternative General Permit.**

   1. The Agency may require any person authorized by this permit to apply for and/or obtain either an individual NPDES permit or an alternative NPDES general permit. Any interested person may petition the Agency to take action under this paragraph. Where the Agency requires a discharger authorized to discharge under this permit to apply for an individual NPDES permit, the Agency shall notify the discharger in writing that a permit application is required. This notification shall include a brief statement of the reasons for this decision, an application form, a statement setting a deadline for the discharger to file the application, and a statement that on the effective date of the individual NPDES permit or the alternative general permit as it applies to the individual permittee, coverage under this general permit shall automatically terminate. Applications shall be submitted to the Agency indicated in Part II.D (Where to Submit) of this permit. The Agency may grant additional time to submit the application upon request of the applicant. If a discharger fails to submit in a timely manner an individual NPDES permit application as required by the Agency under this paragraph, then the applicability of this permit to the individual NPDES permittee is automatically terminated at the end of the day specified by the Agency for application submittal.

   2. Any discharger authorized by this permit may request to be excluded from the coverage of this permit by applying for an individual permit. In such cases, the permittee shall submit an individual application in accordance with the requirements of 40 CFR 122.26(c)(1)(ii), with reasons supporting the request, to the Agency at the address indicated in Part II.D (Where to Submit) of this permit. The request may be granted by issuance of any individual permit or an alternative general permit if the reasons cited by the permittee are adequate to support the request.

   3. When an individual NPDES permit is issued to a discharger otherwise subject to this permit, or the discharger is authorized to discharge under an alternative NPDES general permit, the applicability of this permit to the individual NPDES permittee is automatically terminated on the effective date of the individual permit or the date of authorization of coverage under the alternative general permit, whichever the case may be. When an individual NPDES permit is denied to a discharger otherwise subject to this permit, or the discharger is denied for coverage under an alternative NPDES general permit, the applicability of this permit to the individual NPDES permittee remains in effect, unless otherwise specified by the Agency.

O. **State/Environmental Laws.** No condition of this permit shall release the permittee from any responsibility or requirements under other environmental statutes or regulations.

P. **Proper Operation and Maintenance.** The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit and with the requirements of storm water pollution prevention plans. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. Proper operation and maintenance requires the operation of backup or auxiliary facilities or similar systems, installed by a permittee only when necessary to achieve compliance with the conditions of the permit.

Q. **Inspection and Entry.** The permittee shall allow the Agency or, in the case of a construction site which discharges through a municipal separate storm sewer, an authorized representative of the municipal operator or the separate storm sewer receiving the discharge, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted or where records must be kept under the conditions of this permit;

2. Have access to and copy at reasonable times, any records that must be kept under the conditions of this permit; and

3. Inspect at reasonable times any facilities or equipment (including monitoring and control equipment).

R. **Permit Actions.** This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

Part VII. REOPENER CLAUSE

A. If there is evidence indicating potential or realized impacts on water quality due to any storm water discharge associated with industrial activity covered by this permit, the discharger may be required to obtain individual permit or an alternative general permit in accordance with Part I.C (Authorization) of this permit or the permit may be modified to include different limitations and/or requirements.

B. Permit modification or revocation will be conducted according to provisions of 35 Ill. Adm. Code, Subtitle C, Chapter I and the provisions of 40 CFR 122.62, 122.63, 122.64 and 124.5.

Part VIII. DEFINITIONS

"Agency" means the Illinois Environmental Protection Agency.

"Best Management Practices" ("BMPs") means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the United States. BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

"Commencement of Construction" - The initial disturbance of soils associated with clearing, grading, or excavating activities or other construction activities.

"CWA" means Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972) Pub.L. 92-500, as amended Pub. L. 95-217, Pub. L. 95-576, Pub. L. (96-483 and Pub. L. 97-117, 33 U.S.C. 1251 et.seq.)

"Dedicated portable asphalt plant" - A portable asphalt plant that is located on or contiguous to a construction site and that provides asphalt only to the construction site that the plant is located on or adjacent to. The term dedicated portable asphalt plant does not include facilities that are subject to the asphalt emulsion effluent limitation guideline at 40 CFR 443.

"Dedicated portable concrete plant" - A portable concrete plant that is located on or contiguous to a construction site and that provides concrete only to the construction site that the plant is located on or adjacent to.

"Dedicated sand or gravel operation" - An operation that produces sand and/or gravel for a single construction project.

"Director" means the Director of the Illinois Environmental Protection Agency or an authorized representative.

"Final Stabilization" means that all soil disturbing activities at the site have been completed, and that a uniform perennial vegetative cover with a density of 70% the cover for unpaved areas and areas not covered by permanent structures has been established or equivalent stabilization measures (such as the use of riprap, gabions or geotextiles) have been employed.

"Large and Medium municipal separate storm sewer system" means all municipal separate storm sewers that are either:

(i) located in an incorporated place (city) with a population of 100,000 or more as determined by the latest Decennial Census by the Bureau of Census (these cities are listed in Appendices F and G of 40 CFR Part 122); or

(ii) located in the counties with unincorporated urbanized populations of 100,000 or more, except municipal separate storm sewers that are located in the incorporated places, townships or towns within such counties (these counties are listed in Appendices H and I of 40 CFR Part 122); or

(iii) owned or operated by a municipality other than those described in paragraph (i) or (ii) and that are designated by the Director as part of the large or medium municipal separate storm sewer system.

"NOI" means notice of intent to be covered by this permit (see Part II of this permit.)

"Point Source" means any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which pollutants are or may be discharges. This term does not include return flows from irrigated agriculture or agricultural storm water runoff.

"Runoff coefficient" means the fraction of total rainfall that will appear at the conveyance as runoff.

"Storm Water" means storm water runoff, snow melt runoff, and surface runoff and drainage.

"Storm Water Associated with Industrial Activity" means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing or raw materials storage areas at an industrial plant. The term does not include discharges from facilities or activities excluded from the NPDES program. For the categories of industries identified in subparagraphs (i) through (x) of this subsection, the term includes, but is not limited to, storm water discharges from industrial plant yards; immediate access roads and rail lines used or traveled by carriers of raw materials, manufactured products, waste material, or by-products used or created by the facility; material handling sites; refuse sites; sites used for the application or disposal of process waste waters (as defined at 40 CFR 401); sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas (including tank farms) for raw materials, and intermediate and finished products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water. For the categories of industries identified in subparagraph (xi), the term includes only storm water discharges from all areas listed in the previous sentence (except access roads) where material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, or industrial machinery are exposed to storm water. For the purposes of this paragraph, material handling activities include the: storage, loading and unloading, transportation, or conveyance of any raw material, intermediate product, finished product, by-product or waste product. The term excludes areas located on plant lands separate from the plant's industrial activities, such as office buildings and accompanying parking lots as long as the drainage from the excluded areas is not mixed with storm water drained from the above described areas. Industrial facilities (including industrial facilities that are Federally or municipally owned or operated that meet the description of the facilities listed in this paragraph (i)- (xi)) include those facilities designated under 40 CFR 122.26(a)(1)(v). The following categories of facilities are considered to be engaging in "industrial activity" for purposes of this subsection:

(i) Facilities subject to storm water effluent limitations guidelines, new source performance standards, or toxic pollutant effluent standards under 40 CFR Subchapter N (except facilities with toxic pollutant effluent standards which are exempted under category (xi) of this paragraph);

(ii) Facilities classified as Standard Industrial Classifications 24 (except 2434), 26 (except 265 and 267), 28, 29, 311, 32, 33, 3441, 373;

(iii) Facilities classified as Standard Industrial Classifications 10 through 14 (mineral industry) including active or inactive mining operations (except for areas of coal mining operations meeting the definition of a reclamation area under 40 CFR 434.11(l)) and oil and gas exploration, production, processing, or treatment operations, or transmission facilities that discharge storm water contaminated by contact with or that has come into contact with, any overburden, raw material, intermediate products, finished products, byproducts or waste products located on the site of such operations; inactive mining operations are mining sites that are not being actively mined, but which have an identifiable owner/operator;

(iv) Hazardous waste treatment, storage, or disposal facilities, including those that are operating under interim status or a permit under Subtitle C of RCRA;

(v) Landfills, land application sites, and open dumps that have received any industrial wastes (waste that is received from any of the facilities described under this subsection) including those that are subject to regulation under Subtitle D of RCRA;

(vi) Facilities involved in the recycling of materials, including metal scrapyards, battery reclaimers, salvage yards, and automobile junkyards, including but limited to those classified as Standard Industrial Classification 5015 and 5093;

(vii) Steam electric power generating facilities, including coal handling sites;

(viii) Transportation facilities classified as Standard Industrial Classifications 40, 41, 42, 44, and 45 which have vehicle maintenance shops, equipment cleaning operations, or airport deicing operations. Only those portions of the facility that are either involved in vehicle maintenance (including vehicle rehabilitation, mechanical repairs, painting, fueling, and lubrication), equipment cleaning operations, airport deicing operations, or which are otherwise identified under subparagraphs (i)-(vii) or (ix)-(xi) of this subsection are associated with industrial activity;

(ix) Treatment works treating domestic sewage or any other sewage sludge or wastewater treatment device or system, used in the storage treatment, recycling, and reclamation of municipal or domestic sewage, including land dedicated to the disposal of sewage sludge that are located within the confines of the facility, with a design flow of 1.0 mgd or more, or required to have an approved pretreatment program under 40 CFR 403. Not included are farm lands, domestic gardens or lands used for sludge management where sludge is beneficially reused and which are not physically located in the confines of the facility, or areas that are in compliance with 40 CFR 503;

(x) Construction activity including clearing, grading and excavation activities except: operations that result in the disturbance of less than five acres of total land area which are not part of a larger common plan of development or sale;

(xi) Facilities under Standard Industrial Classifications 20, 21, 22, 23, 2434, 25, 265, 267, 27, 283, 31 (except 311), 34 (except 3441), 35, 36, 37 (except 373), 38, 39, 4221-25, (and which are not otherwise included within categories (i)-(x)).

"Waters" mean all accumulations of water, surface and underground, natural, and artificial, public and private, or parts thereof, which are wholly or partially within, flow through, or border upon the State of Illinois, except that sewers and treatment works are not included except as specially mentioned; provided, that nothing herein contained shall authorize the use of natural or otherwise protected waters as sewers or treatment works except that in-stream aeration under Agency permit is allowable.

~~APPENDIX B-7~~

~~SURFACE WATER SAMPLE LOG SHEETS~~

SOLUTIA - 132

Kenneth Bardo
10/22/03 11:19 AM

To: "Vandiver, Gary W" <gwvand@solutia.com>
Subject: RE: Site R Groundwater - Increased Flow

Gary - The new pumping rate is good news. Please forward potentiometric surface maps after a few weeks of pumping. The maps should be able to demonstrate that the plume from the RCRA facility is being effectively captured. We can then evaluate whether any discharges to the river are "significant" and determine whether the plume from the RCRA facility has been "stabilized". - Ken

~~APPENDIX G-1~~

~~CALCULATIONS OF RISK-BASED SCREENING CONCENTRATIONS AND SSLS FOR RADIONUCLIDES~~

SOLUTIA - 133

Kenneth Bardo
10/23/03 09:54 AM

To: "Vandiver, Gary W" <gwvand@solutia.com>
Subject: RE: Site R Groundwater - Increased Flow

Gary - As required by Section VI.2 of the RCRA Consent Order, an Environmental Indicators Report is necessary to demonstrate that the migration of contaminated groundwater at or from the Solutia Krummrich facility is stabilized. The report should demonstrate that with the current pumping of groundwater with the interim remedy at Site R, the plume is stabilized to remain within the existing area of contamination and that any discharge to the river is either insignificant or shown to be currently acceptable. - Ken

~~APPENDIX G-2~~

~~RAGS-PART D TABLES~~
~~AND~~
~~RISK ASSESSMENT CALCULATIONS~~

SOLUTIA - 134

Kenneth
Bardo/R5/USEPA/US
10/28/2003 04:17 PM

To gwvand@solutia.com
cc GARY CYGAN/R5/USEPA/US@EPA
bcc

Subject Solutia CA 750

Gary - We have evaluated your September 30, 2003, letter providing VOC and SVOC plume boundary maps, and particle tracking performed by GSI. More specific information is needed regarding the particle tracking model. I will provide you a list of specific information we would like to see sometime later this week.

Now that the three extraction wells have been pumping at a total rate of 1,800 gpm since October 22, an updated CA 750 report should be submitted as soon as possible (a CA 750 Report was submitted on 12/17/02 and found to be inadequate on 1/16/03). The new CA 750 report should incoporate all the necessary data to demonstrate that the migration of contaminated groundwater from the Krummrich plant has stabilized.

We envision necessary data to include, the particle tracking model under various pumping and river level scenarios, a discussion of the interim groundwater remedy and its effects on capturing the contaminant plume, updated piezometric and chemical data for groundwater at and dowgradient of the Krummrich Plant, all available surface water and sediment data from the Mississippi River, and a monitoring program capable of verifying that contaminated groundwater remains within the "existing area".

If you have any questions regarding the CA 750 report, I can be reached via e-mail or at (312) 886-7566. - Ken

~~APPENDIX G-3~~

~~EXAMPLE RISK ASSESSMENT CALCULATIONS~~

SOLUTIA - 135

KEN BARDO
<kbardo@prodigy.net>
10/31/03 01:51 PM

To: gwvand@solutia.com
cc: Kenneth Bardo/R5/USEPA/US@EPA
Subject: Particle Tracking

Gary - Attached is our additional response to the particle tracking performed at the Solutia facility to address the CA 750 EI. - Ken SolutiaPartTrack.d

Date: 31 October, 2003

From: G. Cygan
Geolgist

To: K. Bardo
Project Manager, Solutia

Re: Solutia, IL Particle Tracking Issues

Particle Tracking is a computer routine that is typically generated through the use of commonly available software, the most robust of which is MODPATH (Pollock, 1994). This routine is designed to work with the U.S. Geological Survey's finite-difference ground-water-flow model MODFLOW (McDonald and Harbaugh, 1996) and its subsequent re-issued versions. Output from steady state or transient MODFLOW simulations is used in MODPATH to compute paths for imaginary "particles" of water moving through the simulated ground-water system. In addition to computing particle paths, MODPATH keeps track of the time of travel for particles moving through the system. By defining starting locations of particles, it is possible to perform a wide range of analyses such as delineating capture and recharge areas or drawing flow nets.

The accuracy of particle-tracking simulations is limited by the accuracy of the numerical model on which the simulations are based, estimates of the effective porosity of the flow system, and the approximation of the cell flow velocities to the local ground-water flow velocities (Luukkonen and Westjohn, 2000). In addition, the modeling only addresses advective ground-water flow processes, if fracture-flow were present additional misrepresentation would result.

As stated, the sophistication of the MODFLOW portion of this exercise is paramount in effecting the MODPATH results. As is traditional and necessary in well-constructed MODFLOW models, I include a listing below of the principle modeling issues with a brief description of their potential influences upon both MODFLOW and MODPATH:

- Grid-size of the model – it is important to develop the appropriate grid size and density to avoid potential influences to the region of focus

- Layers in Model – are all appropriate stratigraphic layers addressed in model

- Calibration – calibration is crucial to determining whether the constructed model results in the natural system's behavior such as spatial head differences at the site and region. However, calibration is non-unique, that is, darcy's law for flow in porous media, $q = -ki$, where q is Darcy flux, k is the hydraulic

conductance, and I is the hydraulic gradient. Using hydraulic head differences alone does not guarantee flow through the aquifer system, q, is reasonable. In this area, large uncertainties exist in the natural setting such as grossly varying river stages, local and regional well pumping, lack of pertinent ground-water, surface-water interface (GSI) data for the Mississippi to accurate define the GSI conditions both at the near surface, but also at depth. For these reasons and others, a large number of reasonable q and k value combinations can satisfy the Darcy flux. Many modelers will use other techniques to add credence to the calibration exercise

- Verification – In problematic sites such as this, I urge verification be used to gain confidence in the flow model used to generate particle tracking maps. One technique used to obtain verification may be to measure ground-water Tritium concentrations and match those to the simulation of particle path travel times.

The intent of this memo is to give pause to interpreting particle tracking presentations without having a firm foundation provided to USEPA, that is, a calibrated and verified ground-water flow model to generate reasonable particle paths. The above mentioned points of concern are not intended to be complete…there exist long lists of parameters exerting first and second order control upon modeling results. MODFLOW and any other accepted flow models are notorious for their ease to get an answer, but may be extraordinarily difficult to get accurate results that apply to the site.

References

Harbaugh, A.W. and McDonald, M.G., (1996) User's Documentation for MODFLOW-96, and update to the U.S. Geological Survey Modular Finite Difference Ground-Water Flow Model. Open File Report 96-485.

Luukkonen, C.L. and Westjohn, D.B., (2000) Ground-Water Flow and Contributing Areas to Public-Supply Wells in Kingsford and iron Mountain, Michigan, U.S. Geological Survey Water-Resources Investigation 00-4226, Lansing, MI 2001.

Pollock, D.W., (1994) User's Guide for MODPATH/MODPATH-PLOT, Version 3: A particle tracking post-processing package for MODFLOW, the U.S. Geological Survey finite-difference ground-water flow model: U.S. Geological Survey Open-File Report 94-464, 234p.

~~APPENDIX G-4~~

~~TOXICITY PROFILES~~

SOLUTIA - 136

November 5, 2003

DE-9J

<u>Via E-mail and First-Class Mail</u>

Mr. Gary Vandiver
Solutia Inc.
575 Maryville Centre Drive
St. Louis, MO 63141

RE: DNAPL Potential
Solutia Inc.
ILD 000 802 702

Dear Mr. Vandiver:

We have reviewed data provided in the *Description of Current Conditions* (DOCC) report (August 2000) and the *Discharge Control Study* (November 2001) to evaluate whether DNAPL is a potential concern at the Solutia facility. Only chlorobenzene was evaluated as a potential DNAPL. Chlorobenzene is manufactured at the Solutia facility and has been identified in area groundwater and samples from the Mississippi River.

Enclosed is a memo providing our evaluation of the potential presence of DNAPL at the Solutia facility. The presence of a bedrock trough (old river channel) at the Solutia facility is also discussed. We conclude that there is a potential for DNAPL to be present beneath and in the area of the Solutia facility. If DNAPL is present, the bedrock trough may influence its migration. Investigations are needed to fully delineate the extent of DNAPL and the bedrock trough.

If you have any questions regarding this matter or would like to request a meeting, I can be reached at (312) 886-7566 or at bardo.kenneth@epa.gov.

Sincerely yours,

Kenneth S. Bardo

Kenneth S. Bardo, EPA Project Manager
Corrective Action Section

Enclosure

cc: Richard Williams (via E-mail), Solutia
Jim Moore, Illinois EPA
Gina Search, Illinois EPA

bcc: Nabil Fayoumi, RRB #1

DE-9J:KBARDO:6-7566:kb:11/04/03 Solutia DNAPL Letter

OFFICIAL FILE COPY.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

DATE: November 4, 2003

SUBJECT: Potential for DNAPL to be Present at the
W.G. Krummrich Facility, Sauget, IL
Solutia Inc., ILD 000 802 702

FROM: Kenneth S. Bardo, Environmental Scientist Ken Bardo

TO: Official File

Background

EPA files were reviewed to evaluate whether DNAPL is a potential concern at the Solutia facility. Background data was reviewed from the *Description of Current Conditions* (DOCC) report (August 2000) and the *Discharge Control Study* (November 2001). Chlorobenzene was the only site constituent of concern evaluated as a potential DNAPL. It is manufactured at the Solutia facility and has been identified in area groundwater and samples from the Mississippi River.

Bedrock Surface

Bedrock beneath the facility and west to the Mississippi River is shown in a generalized geologic cross-section to be relatively flat, varying in elevation from approximately 280' to 290' AMSL (Attachment A). A regional bedrock elevation map (Attachment B) depicts a trough (old river channel) at less than 280' AMSL in the bedrock surface just east of Site R and just west of the Solutia facility.

The bedrock trough depicted in Attachment B is supported at its western boundary by data from the DOCC report. Bedrock elevations were derived from data presented in the DOCC report (Geraghty & Miller, 1986) for five bedrock wells (GM106, B101, B102, B103, B105). The bedrock surface is encountered at 298.3' at GM106, 276.2' at B101, 279.2' at B102, 282.1' at B103, and 289.7' at B105. The bedrock surface at the Mississippi River and Site R is shown in Attachment C. Bedrock elevations drop 22' across Site R (approximately 770' lateral distance) from GM106 to B101. The north-south trending bedrock trough likely extends further east to the Solutia facility as shown in Attachment B.

Historical Chlorobenzene Data

Historical data (Geraghty & Miller, 1986) shows significant differences in contaminant levels between wells GM106 and B101. GM106 had a total organic compound contamination of 0.774 ppm while B101 had 163 ppm. B102 had only 0.030 ppm of total organic compound contamination. Chlorobenzene levels in well B101 were 14.4 ppm.

The water solubility of chlorobenzene at 20°C is 490 ppm. Its density is 1.106 (heavier than water). The concentration of 14.4 ppm of chlorobenzene at well B101 is 3% of its solubility. Recent data from the year 2000 at wells MW-3C, MW-5C, MW-7C, GM-31C, and GM-10C, located east of B101 and at the Solutia facility (Attachment D), shows chlorobenzene levels at 9.5 ppm (2% solubility), 1.0 ppm (<1% solubility), 7.8 ppm (2% solubility), 2.0 ppm (<1% solubility), and 2.5 ppm (<1% solubility), respectively. Well GM-27C at the river and Site R had 1.7 ppm of chlorobenzene (<1% solubility).

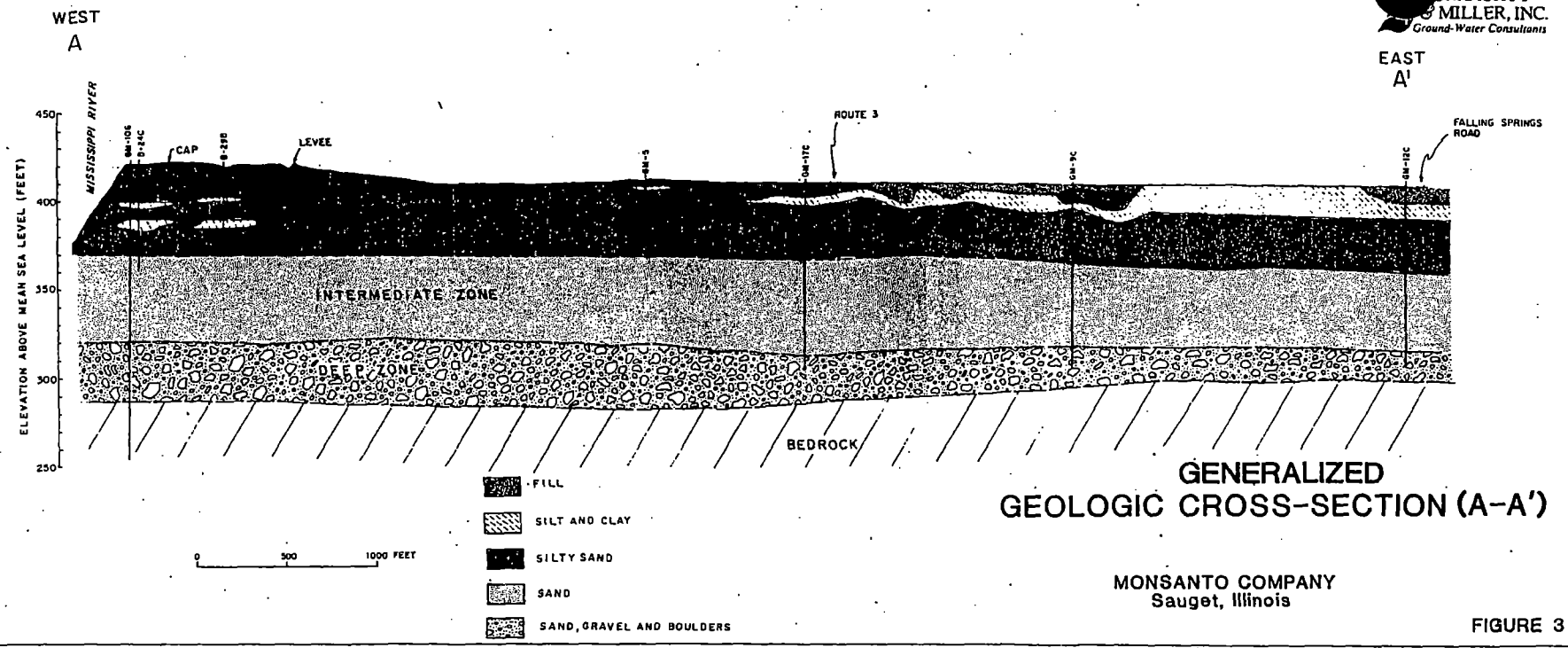
Wells GM-4C and GM-17C, located just downgradient of the manufacturing portion of the Solutia facility and east of MW-3C and MW-5C, have had historical concentrations of chlorobenzene greater than 1% of its solubility. Well GM-4C had 9.2 ppm chlorobenzene (2% solubility) in 1985 and 20.4 ppm in 1992 (4% solubility). GM-17C had 9.5 ppm chlorobenzene (2% solubility) in 1984 and 27 ppm in 1994 (5.5% solubility).

DNAPL Discussion and Investigations

Conditions that indicate the potential for DNAPL at a facility include the presence of DNAPL-related chemicals in groundwater greater than 1% of their solubility (U.S. EPA, 1992). Therefore, chlorobenzene DNAPL is potentially present at the Solutia facility, in the vicinity of wells MW-3C, MW-7C, GM-4C, and GM-17C. Additionally, in 2000 and 2001, over 59,000 pounds of chlorobenzene was reported to have been spilled and released to the subsurface at the Solutia facility.

The bedrock trough present just west of the Solutia facility and in the vicinity of wells MW-3C, MW-7C, GM-4C, and GM-17C may be pooling chlorobenzene DNAPL (and other DNAPLs). The trough may also provide preferential migration of DNAPL along the bedrock surface in directions independent of groundwater flow. Further investigations are necessary to delineate: 1) the extent of DNAPL, if any, at the Solutia facility; 2) the extent of the bedrock trough (old river channel) near the western boundary of the facility; and 3) the extent of its control on DNAPL migration. This may involve borings, wells, and geophysics. The investigations should also determine whether the interim groundwater remedy is capable of capturing any DNAPL found to be present.

Attachments



GENERALIZED GEOLOGIC CROSS-SECTION (A-A')

MONSANTO COMPANY
Sauget, Illinois

FIGURE 3

Attachment A.1
Geologic Cross-Section
Geraghty & Miller

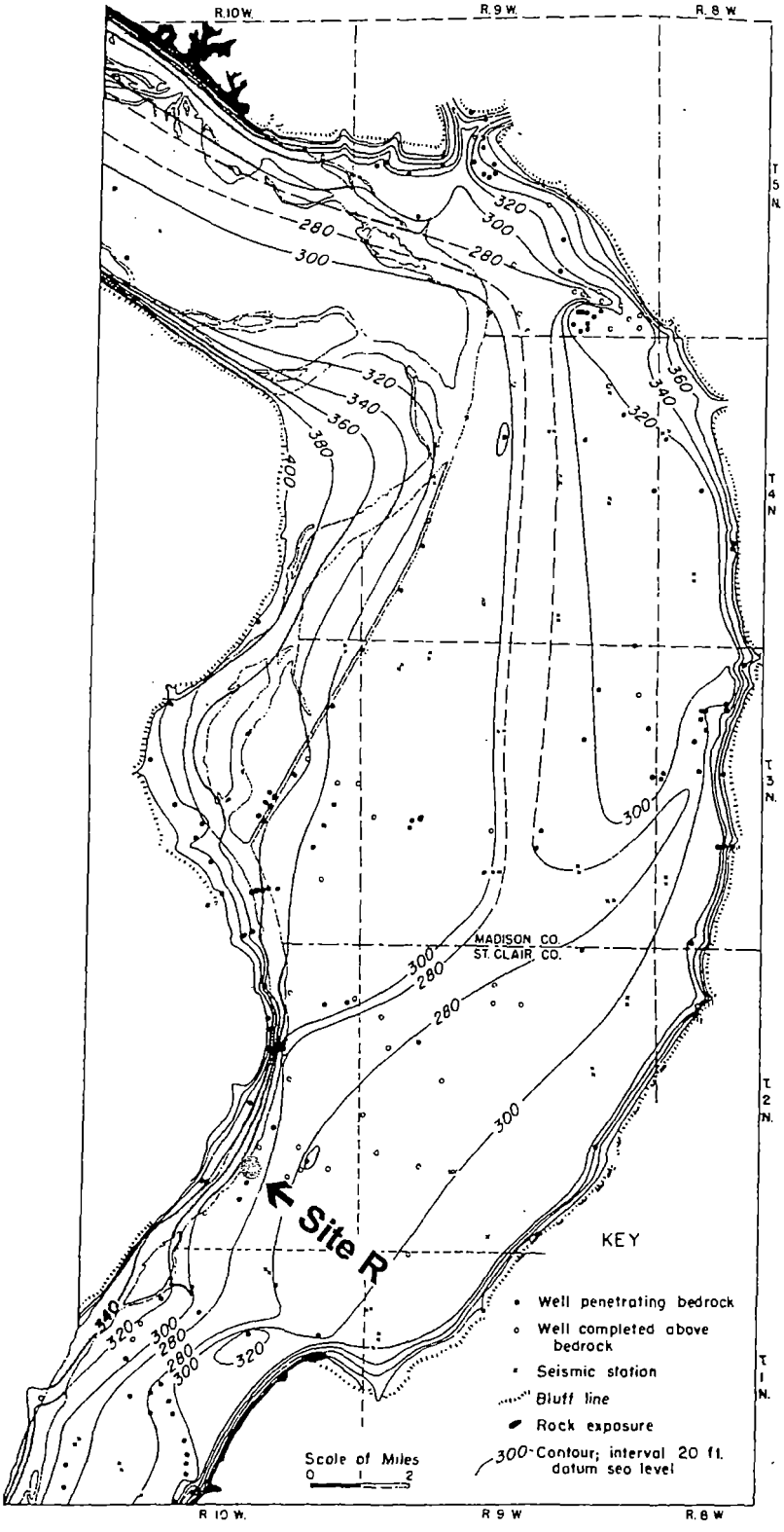
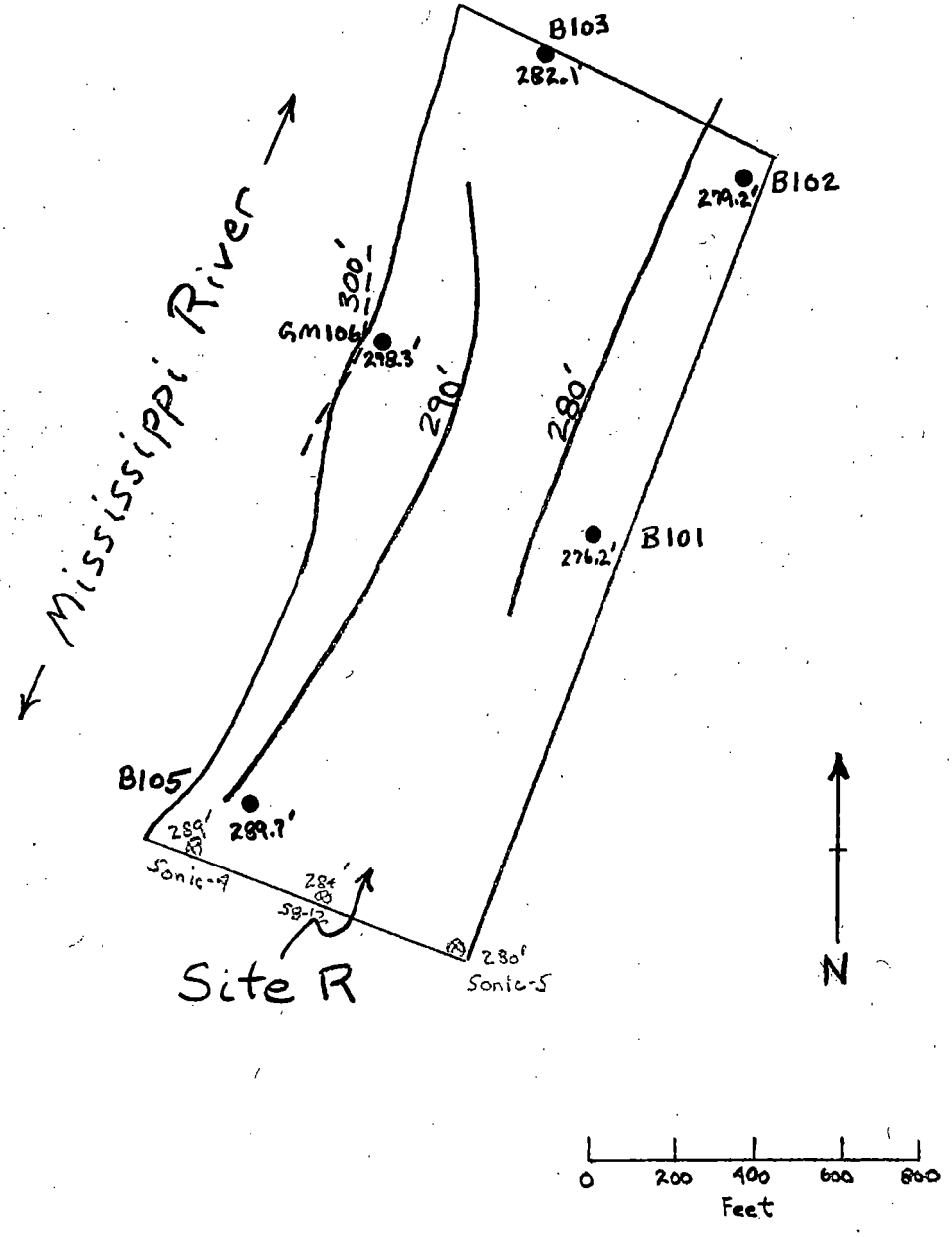


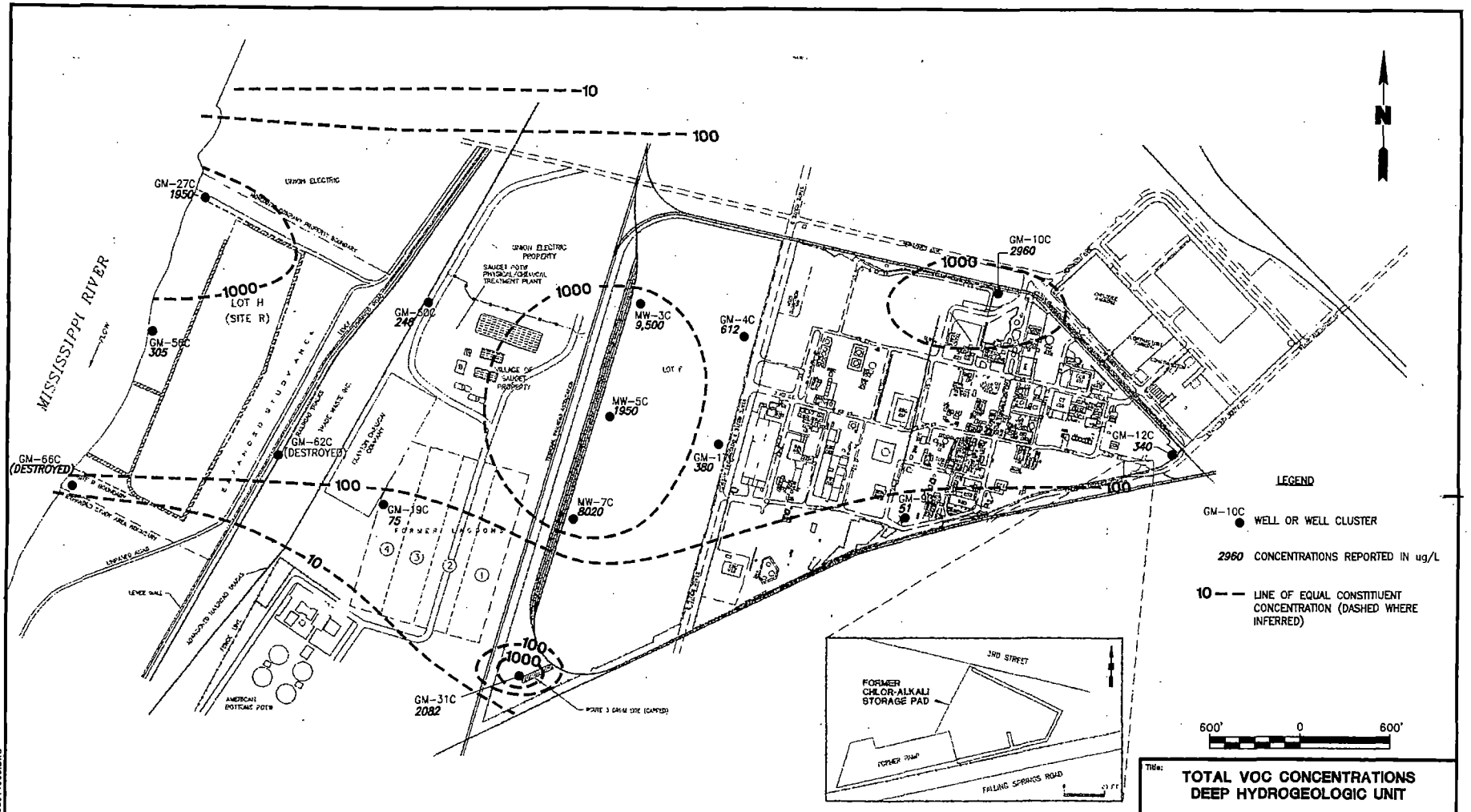
FIG. 2.—Bedrock surface map of the East St. Louis area, Ill.

Attachment B
Bedrock Elevation

Attachment C



BEDROCK ELEVATION



Attachment D

~~APPENDIX B-2~~

~~MONITORING WELL DEVELOPMENT RECORDS~~

SOLUTIA - 139

SOLUTIA

Solutions for a better life.

Solutia Inc.
W.G. Krummrich Plant
500 Monsanto Avenue
Sauget, Illinois 62206-1198
Tel 618-271-5835

November 13, 2003

Mr. Nabil S. Fayoumi
U. S. Environmental Protection Agency - Region 5
Superfund Division
77 West Jackson Boulevard (SR-6J)
Chicago, Illinois 60604-3590

Re: Groundwater Treatability Study Report
Groundwater Migration Control System
Sauget Area 2 – Sites O, Q, R And S
Sauget, Illinois

Dear Mr. Fayoumi:

Attached to this letter are three copies of a report that summarizes the results of the groundwater treatability test that was performed at Site R in May 2003. This report is being submitted to your for your information.

If you have any questions about the attached document please do not hesitate to call me.

Sincerely,

Solutia Inc.

Gary W. Vandiver for Richard Miller

Gary W. Vandiver
Project Coordinator

cc: ~~Ken Bardo – USEPA~~
Sandra Bron - IEPA
Tim Gouger – USACE
Mike Coffey - USF&W
Peter Barrett – CH2M Hill
Richard Williams - Solutia
Linda Tape - Husch & Eppenberger
Cathy Bumb - Solutia
Bruce Yare – Solutia

SOLUTIA-139

TREATABILITY STUDY REPORT SAUGET AREA 2 INTERIM GROUNDWATER REMEDY

Prepared for:

SOLUTIA

SOLUTIA INC.

Sauget, Illinois

Prepared by:

THE **ADVENT** GROUP, INC.

October 2003

Innovative solutions to environmental challenge

THE **ADVENT** GROUP, INC.

October 30, 2003

Mr. Richard Williams
Sauget Sites Project Manager
Solutia Inc.
500 Monsanto Avenue
Sauget, IL 62206-1198

Subject: **Treatability Study Report – Sauget Area 2 Interim Groundwater Remedy**
ADVENT Project 02689

Dear Mr. Williams:

Please find attached 20 copies of the report titled, *Treatability Study Report – Sauget Area 2 Interim Groundwater Remedy.* We have enjoyed working with you on this project and look forward to working with you in the future.

Should you have questions regarding this report, please do not hesitate to call us.

Sincerely,

The ADVENT Group, Inc.

Todd Lusk
Project Engineer

Janet B. Egli, P.E.
Project Manager

Carl E. Adams, Jr., P.E., PH.D.
President

cc: Bruce Yare

201 Summit View Drive • Suite 300 • Brentwood, TN 37027 • 615/377-4775 • Fax 615/377-4976

TREATABILITY STUDY REPORT
SAUGET AREA 2
INTERIM GROUNDWATER REMEDY

Prepared for:

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TABLE OF CONTENTS

Title | Page No.

TABLE OF CONTENTS i
LIST OF TABLES ii
LIST OF FIGURES ii
LIST OF ATTACHMENTS ii
1.0 INTRODUCTION AND BACKGROUND **1-1**
- **1.1** INTRODUCTION 1-1
- **1.2** PROJECT OBJECTIVES 1-1
- **1.3** PERMIT REQUIREMENTS 1-2

2.0 PROJECT APPROACH **2-1**
- **2.1** PILOT SYSTEM DESIGN 2-1
- **2.2** BENCH SCALE TREATABILITY DESIGN 2-1
- **2.3** DEVELOPMENT WATER TREATMENT 2-2
- **2.4** SAMPLING AND ANALYTICAL PLAN 2-3

3.0 SYSTEM OPERATION **3-1**
- **3.1** MOBILIZATION AND STARTUP 3-1
- **3.2** PILOT SYSTEM OPERATIONS 3-2
  - 3.2.1 Flow 3-2
  - 3.2.2 Pressure 3-2
- **3.3** TREATABILITY UNIT OPERATIONS 3-3
  - 3.3.1 Rapid Small-Scale Column Test 3-3
  - 3.3.2 Ozonation Tests 3-4
- **3.4** DEVELOPMENT WATER TREATMENT OPERATIONS 3-4

4.0 ANALYTICAL RESULTS **4-1**
- **4.1** PILOT SYSTEM 4-1
  - 4.1.1 Onsite Analyses 4-1
  - 4.1.2 Offsite Analyses 4-2
- **4.2** BENCH SCALE TREATABILITY UNITS 4-5
- **4.3** DEVELOPMENT WATER TREATMENT 4-6

5.0 CONCLUSIONS AND RECOMMENDATIONS **5-1**
- **5.1** PROJECTED GAC USAGE 5-1
- **5.2** COMPARISON OF PILOT SYSTEM AND RSSCT 5-1
- **5.3** APPLICABILITY OF OZONATION 5-2

LIST OF TABLES

Table No.	Title
2-1	GAC Treatment of Site R Pump Test Groundwater Preliminary Process Design – Pilot-Scale System
2-2	GAC Treatment of Site R Pump Test Groundwater Preliminary Process Design – Rapid-Scale System (RSSCT)
2-3	Ozone Treatment of Site R Pump Test Groundwater Preliminary Process Design – Bench-Scale System
2-4	Sampling Matrix for Pilot System
2-5	Analytical Methods
3-1	Pilot System Flow and Pressure Measurements
3-2	Design and Results for RSSCT Breakthrough Determination Test
4-1	Pilot System Onsite Analytical Results
4-2	Pilot System Offsite Analytical Results
4-3	Influent Characterization
4-4	Comparison of Analytical Results for Split Composite Samples
4-5	Bench-Scale Treatability Unit Analytical Results
5-1	Calculation of Activated Carbon Capacity
5-2	Effluent Quality

LIST OF FIGURES

Figure No.	Title
2-1	Bench-Scale Ozone Treatability Apparatus
3-1	Pilot System Flow
3-2	Pilot System Pressure
4-1	COD Breakthrough Curve for Pilot System Lead Column
4-2	Pilot System Breakthrough Curves for TOC and Specific Organics

LIST OF ATTACHMENTS

Attachment No.	Title
1	American Bottoms Regional Treatment Facility Temporary User Discharge Permit
2	ASTM Method D6586 - Performing Rapid Small-Scale Column Test

1.0 INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

In accordance with the Administrative Order for Remedial Design and Interim Remedial Action (Docket No. V-W-02-C-716), issued by USEPA Region 5 on October 3, 2002, a Remedial Design for a Groundwater Migration Control System is being prepared that consists of a 3,300 ft. long, U-shaped barrier wall and three groundwater extraction wells installed on the upgradient side of the barrier wall. This Groundwater Migration Control System is being installed to control the discharge of impacted groundwater to surface water downgradient of Sauget Area 2 Sites O, Q (Dog Leg), R and S; Sauget Area 1 Sites G, H I and L; the W.G. Krummrich plant, and other industrial facilities in the Sauget Area.

In preparation for the eventual collection and discharge of the Site R groundwater to ABRTF, Solutia authorized the drilling and development of one of the recovery wells at the site. The development and testing of the well was conducted during May 2003, with the groundwater being discharged to ABRTF. ABRTF issued a temporary user discharge permit to Solutia to allow the discharge of carbon treated groundwater to their treatment facility. Accordingly, Solutia contracted ADVENT to oversee the installation and operation of an activated carbon treatment system. The full-scale pump test also served as a means to collect representative characterization data for the groundwater aquifer and to establish carbon usage rates while determining the effectiveness of GAC treatment of this groundwater.

1.2 PROJECT OBJECTIVES

In preparation for the execution of the pilot system and bench-scale treatability tests described above, ADVENT prepared and submitted a Work Plan to Solutia outlining the methods to be used during the study. These objectives were as follows:

- Install and operate a pilot-scale activated carbon system capable of treating 200 gpm;
- Generate and analyze characterization data to determine the composition of the groundwater;

- Determine the projected carbon usage rate for a full-scale GAC treatment system;
- Treat and discharge the water associated with the development of the first collector well through the pilot system;
- Determine the effectiveness of ozone as a pretreatment or post-treatment technology to be coupled with activated carbon; and,
- Operate the pilot system within the constraints specified in the ABRTF temporary user discharge permit

1.3 PERMIT REQUIREMENTS

A copy of the temporary user discharge permit is included in Attachment 1. This permit included limits on a wide variety of compounds, including but not limited to the following:

- Ammonia nitrogen (NH_3-N);
- Volatile organic compounds (VOCs);
- Semi-volatile organic compounds (SVOCs);
- Pesticides and PCBs;
- Metals; and,
- Cyanide.

A discussion of the details of sample collection and analytical methods for permit compliance is included in Section 2.4.

2.0 PROJECT APPROACH

2.1 PILOT SYSTEM DESIGN

In order to produce an accurate model of the previously developed design for full-scale backup activated carbon treatment system for the Site R groundwater, ADVENT designed the pilot system to achieve a hydraulic loading of 3-4 gpm/ft^2. A flow rate of 200 gpm was selected for the study to provide representative groundwater characterization data and simulate the full-scale application. A minimum surface area of 50 sq ft was required to meet the desired hydraulic loading rate. A copy of the preliminary process design for the pilot system is included in Table 2-1.

ADVENT solicited input from various activated carbon equipment vendors and ultimately selected the Calgon Mobile Adsorber as the equipment for use in the pilot system. The Mobile Adsorber is an 8-ft diameter vessel containing approximately 12,000 lb of activated carbon, and these units can be rapidly mobilized and transported to a site. For this study, Calgon DSR-C was chosen as the activated carbon for study. DSR-C is an 8x30 mesh reactivated granular carbon commonly used in groundwater and wastewater treatment applications. This carbon will most likely be selected for the full-scale system due to its cost-effectiveness for this type of application.

In order to replicate the design of the backup full-scale system, two Mobile Adsorbers were placed in a lead-lag configuration. This configuration provided the ability to establish a breakthrough curve for the influent groundwater (lead column), while providing permit compliance (lag column). Breakthrough was defined as an effluent Chemical Oxygen Demand (COD) concentration equal to or greater than 50 percent of the influent concentration. A process flow diagram of the pilot system is shown in Figure 2-1. The monitoring sample locations are described in Section 2.4.

2.2 BENCH SCALE TREATABILITY DESIGN

In addition to the pilot-scale GAC treatment, ADVENT concurrently designed and executed several bench-scale treatability tests for the Area 2 groundwater. These tests were performed in order to help predict the performance of the pilot system and to

determine the effectiveness of additional treatment technologies in reducing the carbon usage rate.

The first bench-scale test conducted was a Rapid Small-Scale Column Test (RSSCT) per ASTM D6586. A copy of the ASTM method is included in Attachment 2. The RSSCT method was designed to serve as a means of quickly establishing the breakthrough curve anticipated for a full-scale system. The RSSCT tests conducted at the site were designed based on the parameters of the pilot system. The preliminary process design used for this test is shown in Table 2-2. The expected run time of the pilot system was established using the effluent COD concentration to define breakthrough. Comparisons of the RSSCT results and pilot system results is provided in Section 5.2.

Ozonation was evaluated as supplemental treatment technology for the Area 2 groundwater. Samples of both the influent and lag column effluent from the pilot system were subjected to ozone treatment to determine the effectiveness of ozone as a pretreatment of polishing technology for GAC. Analytical results from the ozonation of the influent were used to estimate carbon usage rates based on an ozone pretreatment, and results from the effluent ozonation were analyzed to determine if the ozonated water achieved ambient water quality criteria. The preliminary process design for the influent bench-scale ozone test is provided in Table 2-3, and a schematic of the treatability unit designed for ozone testing is shown in Figure 2-2.

2.3 WELL DEVELOPMENT WATER TREATMENT

Prior to startup of the pilot system, one of the three proposed collector wells was drilled and developed to provide the groundwater influent for treatment. The initial surge of groundwater (i.e., the development water) from the well pump was expected to contain a high level of suspended solids that would negatively impact performance of the GAC. Thus, this water was diverted to a 250,000-gallon modular tank. Once breakthrough of the pilot system lead column was observed, the well pump was shut down. The system was then reconfigured so that the lag column of the pilot system functioned as the lead column during development water treatment. A third Mobile Adsorber was placed in

operation as the new lag column. This reconfiguration was performed in order to offer the maximum level of treatment and permit compliance.

2.4 SAMPLING AND ANALYTICAL PLAN

Data were collected throughout the operation of the study for multiple purposes, including the following:

- Characterization of raw groundwater;
- Determination of the breakthrough curve for the lead column of the pilot system for TOC and key individual parameters;
- Comparison of the RSSCT and pilot systems;
- Determination of the effectiveness of ozone as a pre and post treatment technology; and,
- Demonstration of compliance with permit limits.

For the pilot system, samples were collected and analyzed at three locations.

- Point A represents influent groundwater to the pilot system, as well as untreated development water during the development water treatment;
- Point B represents the effluent from the lead column of the pilot system; and,
- Point C represents the effluent from the lag column. This was also the point of sampling to demonstrate compliance. Samples for onsite analysis were collected every two hours of operation, while samples for offsite analysis were collected every six hours.

A complete sampling matrix for the pilot system, including sampling frequency, is shown in Table 2-4. Samples of influent and effluent from each bench-scale treatability test were collected and analyzed.

The following parameters were measured on site by ADVENT operators:

- Flow;
- pH;

- Temperature;
- Conductivity;
- Total suspended solids (TSS); and,
- Chemical oxygen demand (COD).

The following parameters were analyzed by various contract laboratories:

- Total organic carbon (TOC);
- Volatile and semi-volatile organic constituents (VOCs and SVOCs);
- Dioxins;
- PCBs;
- Metals (including mercury);
- Cyanide;
- Herbicides; and,
- Pesticides.

Samples for dioxin analyses were shipped to Severn Trent Laboratories in Sacramento, CA. All other offsite samples were shipped to Severn Trent Laboratories in Savannah, GA. A complete listing of the analytical methods used on these samples is included in Table 2-5.

Compliance demonstration samples were collected and delivered to ABRTF for compositing and analysis. Cyanide samples were the lone exception to this compliance sampling, and these samples were analyzed by the Savannah laboratory.

TABLE 2-1. GAC TREATMENT OF SITE R PUMP TEST GROUNDWATER
PRELIMINARY PROCESS DESIGN - PILOT-SCALE SYSTEM

PARAMETER	UNITS	VALUE	COMMENTS
DESIGN BASIS			
Influent			
Design Flow	gpm	200	
	mgd	0.29	
TSS	mg/L	12	Assumed for design
	lb/d	29	
TOC	mg/L	300	Average Concentration from 1992
	lb/d	720	Used for Design
ACTIVATED CARBON REQUIREMENTS			
Activated Carbon System			
Design Hydraulic Loading Rate	gpm/ft^2	3	
Total Carbon Area Required	ft^2	67	Based on design flow
Columns			
Carbon Bed Height	ft	9	
Column Diameter (Each)	ft	8	Calgon Mobile Adsorbers
Surface Area Per Column	ft^2	50.3	
Number of Columns Required	--	1.3	
Number of Columns Provided	--	1	
Surface Area Provided	ft^2	50.3	
Actual Hydraulic Loading Rate	gpm/ft^2	4.0	
Contact Time	min	33.8	
Lead Carbon per Column	lb	12,000	
Total Lead Carbon Charge	lb	12,000	
Carbon Demand			
Carbon Capacity	g TOC/g carbon	0.15	To be confirmed during test
Design Flow			
Estimated Carbon Usage	ton/d	2.4	
Estimated Run Time	days	2.5	Assumes complete exhaustion

TABLE 2-2. GAC TREATMENT OF SITE R PUMP TEST GROUNDWATER PRELIMINARY PROCESS DESIGN - RAPID-SCALE SYSTEM (RSSCT)

PARAMETER	UNITS	VALUE		COMMENTS
		RSCCT	PILOT	
DESIGN BASIS				
Column Diameter	cm	1	243.8	
Carbon Particle Radius	mm	0.106	0.792	
Empty Bed Contact Time	min	0.30	16.9	
Hydraulic Loading Rate	gpm/ft^2	29.74	3.98	
Required Time to Breakthrough	days	0.104	5.80	To Determine Pilot Breakthrough Curve
		0.125		With 20% safety factor
Run Time	hr	2.99		
RSSCT REQUIREMENTS				
Column Cross-section	ft^2	0.00102	50.3	
Flow	gpm	0.0304	200	
Flow	mL/min	115.14		
Bed Volume	mL	34.85		
Bed Depth	cm	36.68		
Influent Required Per Test	gal	**5.46**		
Influent Required Per Test	L	**20.67**		

TABLE 2-3. OZONE TREATMENT OF SITE R PUMP TEST GROUNDWATER PRELIMINARY PROCESS DESIGN - BENCH-SCALE SYSTEM

PARAMETER	UNITS	VALUE	COMMENTS
DESIGN BASIS			
Influent			
Sample Volume	L	15	Set for analytical requirements
	gal	4.01	
TSS	mg/L	12	Assumed for design
TOC	mg/L	300	Average Concentration from 1992
COD	mg/L	900	Assumed 3:1 COD:TOC ratio
OZONE TREATMENT REQUIREMENTS			
Ozone Generator			
Air flow	scfh	10	
Ozone Generation Rate	mg/hr	1,500	Vendor information
Ozone Requirements	mg O_3 / mg COD	3	Set for design
Required Run Time	min	1,620	
	hours	27.0	

TABLE 2-4. SAMPLING MATRIX FOR PILOT SYSTEM SAMPLING LOCATIONS

SAMPLE TIME			ONSITE BY ADVENT					OFFSITE TO ABRTF[a]					
Day	Time	Run Time	pH	Temp	Cond	COD	TSS	VOCs	SVOCs	Metals	PCBs	Pest.	Herb.
1	12:00	0	A, B, C	A, B, C	A, B, C	A, B	A, B	A, C	A, C	A, C	A, C	A, C	A, C
	14:00	2	A, B, C	A, B, C	A, B, C	A, B							
	16:00	4	A, B, C	A, B, C	A, B, C	A, B							
	18:00	6	A, B, C	A, B, C	A, B, C	A, B	A, B	A, C	A, C	A, C	A, C	A, C	A, C
	20:00	8	A, B, C	A, B, C	A, B, C	A, B							
	22:00	10	A, B, C	A, B, C	A, B, C	A, B							
	0:00	12	A, B, C	A, B, C	A, B, C	A, B	A, B	A, C	A, C	A, C	A, C	A, C	A, C
	2:00	14	A, B, C	A, B, C	A, B, C	A, B							
2	4:00	16	A, B, C	A, B, C	A, B, C	A, B							
	6:00	18	A, B, C	A, B, C	A, B, C	A, B	A, B						
	8:00	20	A, B, C	A, B, C	A, B, C	A, B							
	10:00	22	A, B, C	A, B, C	A, B, C	A, B							
	12:00	24	A, B, C	A, B, C	A, B, C	A, B	A, B						
	14:00	26	A, B, C	A, B, C	A, B, C	A, B							
	16:00	28	A, B, C	A, B, C	A, B, C	A, B							
	18:00	30	A, B, C	A, B, C	A, B, C	A, B	A, B						
	20:00	32	A, B, C	A, B, C	A, B, C	A, B							
	22:00	34	A, B, C	A, B, C	A, B, C	A, B							
	0:00	36	A, B, C	A, B, C	A, B, C	A, B	A, B						
	2:00	38	A, B, C	A, B, C	A, B, C	A, B							
3 [c]	4:00	40	A, B, C	A, B, C	A, B, C	A, B							
	6:00	42	A, B, C	A, B, C	A, B, C	A, B	A, B	A, C	A, C	A, C	A, C	A, C	A, C
	8:00	44	A, B, C	A, B, C	A, B, C	A, B							
	10:00	46	A, B, C	A, B, C	A, B, C	A, B							
	12:00	48	A, B, C	A, B, C	A, B, C	A, B	A, B	A, C	A, C	A, C	A, C	A, C	A, C
	14:00	50	A, B, C	A, B, C	A, B, C	A, B							
	16:00	52	A, B, C	A, B, C	A, B, C	A, B							
	18:00	54	A, B, C	A, B, C	A, B, C	A, B	A, B	A, C	A, C	A, C	A, C	A, C	A, C
	20:00	56	A, B, C	A, B, C	A, B, C	A, B							
	22:00	58	A, B, C	A, B, C	A, B, C	A, B							
	0:00	60	A, B, C	A, B, C	A, B, C	A, B	A, B	A, C	A, C	A, C	A, C	A, C	A, C
	2:00	62	A, B, C	A, B, C	A, B, C	A, B							

TABLE 2-4. SAMPLING MATRIX FOR PILOT SYSTEM SAMPLING LOCATIONS

SAMPLE TIME			ONSITE BY ADVENT					OFFSITE TO ABRTF[a]					
Day	Time	Run Time	pH	Temp	Cond	COD	TSS	VOCs	SVOCs	Metals	PCBs	Pest.	Herb.
4-6	4:00	64	A, B, C	A, B, C	A, B, C	A, B							
	6:00	66	A, B, C	A, B, C	A, B, C	A, B	A, B						
	8:00	68	A, B, C	A, B, C	A, B, C	A, B							
	10:00	70	A, B, C	A, B, C	A, B, C	A, B							
	12:00	72	A, B, C	A, B, C	A, B, C	A, B	A, B						
	14:00	74	A, B, C	A, B, C	A, B, C	A, B							
	16:00	76	A, B, C	A, B, C	A, B, C	A, B							
	18:00	78	A, B, C	A, B, C	A, B, C	A, B	A, B						
	20:00	80	A, B, C	A, B, C	A, B, C	A, B							
	22:00	82	A, B, C	A, B, C	A, B, C	A, B							
	0:00	84	A, B, C	A, B, C	A, B, C	A, B	A, B						

TABLE 2-4. SAMPLING MATRIX FOR PILOT SYSTEM SAMPLING LOCATIONS

SAMPLE TIME			OFFSITE TO SEVERN TRENT LABORATORIES[b]								
Day	Time	Run Time	CN[a]	VOCs	SVOCs	Metals	TOC	PCBs	Pest.	Herb.	Dioxins
1	12:00	0	A, C	A, B	A, B	A, B	A, B	A, B	A, B	A, B	A, B
	14:00	2									
	16:00	4									
	18:00	6		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	20:00	8									
	22:00	10									
	0:00	12		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	2:00	14									
2	4:00	16									
	6:00	18		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	8:00	20									
	10:00	22									
	12:00	24		A, B	A, B	A, B	A, B	A, B	A, B	A, B	A, B
	14:00	26									
	16:00	28									
	18:00	30		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	20:00	32									
	22:00	34									
	0:00	36		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	2:00	38									
3 [c]	4:00	40									
	6:00	42		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	8:00	44									
	10:00	46									
	12:00	48	A, C	A, B	A, B	A, B	A, B	A, B	A, B	A, B	A, B
	14:00	50									
	16:00	52									
	18:00	54		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	20:00	56									
	22:00	58									
	0:00	60		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	2:00	62									

TABLE 2-4. SAMPLING MATRIX FOR PILOT SYSTEM SAMPLING LOCATIONS

SAMPLE TIME			OFFSITE TO SEVERN TRENT LABORATORIES[b]								
Day	Time	Run Time	CN^-	VOCs	SVOCs	Metals	TOC	PCBs	Pest.	Herb.	Dioxins
4-6	4:00	64									
	6:00	66		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	8:00	68									
	10:00	70									
	12:00	72		A, B	A, B	A, B	A, B	A, B	A, B	A, B	A, B
	14:00	74									
	16:00	76									
	18:00	78		A, B	A, B	A, B	A, B	A, B	A, B	A, B	
	20:00	80									
	22:00	82									
	0:00	84		A, B	A, B	A, B	A, B	A, B	A, B	A, B	

Notes:
(a) Sampling for ABRTF shall consist of 5 VOA vials for VOC analysis and a common jug for all other analyses
(b) Dioxins shipped to STL Sacramento, all other parameters sent to STL Savannah
Location A - Pilot Influent
Location B - Lead Column Effluent
Location C - Lag Column Effluent

TABLE 2-5. ANALYTICAL METHODS

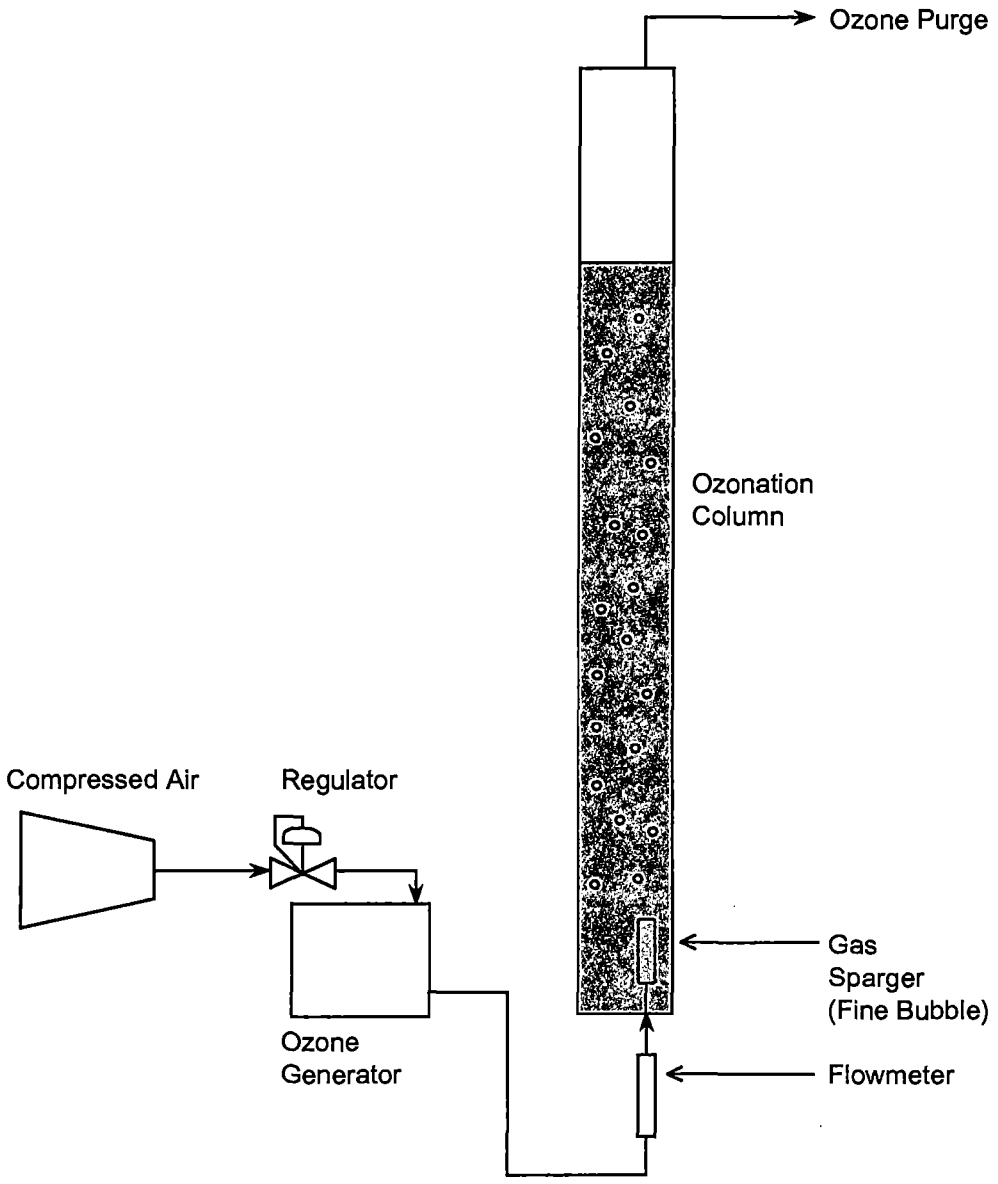
PARAMETER	ANALYST	METHOD	REFERENCE
pH	ADVENT	4500	Standard Methods [a]
Conductivity	ADVENT	2510	Standard Methods [a]
Temperature	ADVENT	2550	Standard Methods [a]
Chemical Oxygen Demand (COD)	ADVENT	8000	Hach Handbook [b]
Herbicides	Contract Lab	615	EPA
PCBs	Contract Lab	680	EPA
Dioxin	Contract Lab	1613	EPA
Metals	Contract Lab	200.7	EPA
Mercury	Contract Lab	245.1	EPA
Cyanide, total	Contract Lab	335.2	EPA
Total Organic Carbon (TOC)	Contract Lab	415.1	EPA
Volatile Organics (VOCs)	Contract Lab	624	EPA
Semivolatile Organics (SVOCs)	Contract Lab	625	EPA
Pesticides	Contract Lab	608	EPA

Notes:

(a) *Standard Methods for the Examination of Water and Wastewater*, 19th Edition, APHA-AWWA-WPCF, 1995.

(b) *Water Analysis Handbook*, HACH Company, 1997.

FIGURE 2-1. BENCH-SCALE OZONE TREATABILITY APPARATUS



3.0 SYSTEM OPERATION

3.1 MOBILIZATION AND STARTUP

The components of the pilot system were delivered and assembled during the week of May 12, 2003. Calgon delivered two Mobile Adsorbers to the project site via hydraulic lift trailers, and the columns were placed onsite adjacent to the storage building and project trailer. Once the columns were set, potable water was supplied to the units via a 1 inch hose in order to wet the carbon and remove any entrained air. Sample ports were constructed using steel pipe spools with ½ inch copper pipe taps and ½ inch ball valves. Connections to and from the 6 inch PVC header pipe from the collector well were made using 4 inch flexible hose with Kamlock style quick-connect couplings.

Immediately before startup of the pilot system, the well pump was activated and water was diverted to the modular tank to flush collected solids from the line. After several minutes of flushing, the flow was shut off and the valves on the header pipe were operated to direct flow to the pilot system. Flow was then restarted and slowly increased to the target rate of 200 gpm. Flow through the system was measured through two magnetic flowtubes located on the 6 inch header pipe. The first sampling event occurred at 12:00 PM on May 19, 2003.

Several characteristics of the influent groundwater were noted and recorded during the study. First, the influent samples taken at Point A exhibited a noticeable odor, described as similar to formaldehyde or phenol. As the carbon in the lead column became exhausted, this odor was detected in samples at Point B as well. Second, the collected samples would become colored reddish-brown and cloudy after exposure to air and light for several hours, with samples from Point A exhibiting the most drastic changes. Analytical results, as will be discussed in Chapter 4, later confirmed that this color and turbidity change were likely due to the presence of iron in the groundwater. Weakly colored ferrous iron from the aquifer (Fe^{2+}) oxidizes after prolonged exposure to air and will result in the formation of the reddish-brown ferric iron (Fe^{3+}).

3.2 PILOT SYSTEM OPERATIONS

The pilot system ran from 12:00 p.m. on May 19 to 10:00 a.m. on May 24, 2003. During operations, two ADVENT operators remained onsite around the clock to record operating parameters, conduct bench-scale tests, and collect and ship samples for analysis. Operators conducted a walkthrough of the system every two hours to measure parameters and collect the necessary samples as outlined in Table 2-4. In addition, Mr. Robert Mooshegian of Golder and Associates was the site certified Class K wastewater operator of the system. Mr. Mooshegian was onsite or on call throughout the study.

3.2.1 Flow

Flow to the pilot system was controlled using a gate valve located near the well pump. ADVENT operators recorded both the instantaneous and totalized flow as part of each walkthrough. Due to the gradual buildup of solids and potential wear on the pump impeller, the flow gradually decreased over the course of operations. When the flow dropped below 190 gpm, the valve at the well pump was adjusted to return the flow to the target rate of 200 gpm. Towards the end of the test, the buildup of suspended solids in the lead column caused the flow to drop below 190 gpm, even with the gate valve in the fully open position. The recorded flow to the pilot system is shown in Table 3-1 and presented graphically in Figure 3-1. The sharp increases in flow on Figure 3-1 correspond to the instances when the gate valve at the well pump was actuated to increase flow.

3.2.2 Pressure

After approximately 6 hours of operation, pressure gauges were installed on the influent and effluent lines of the lead column in order to monitor the operating pressure of the lead column and the differential pressure across the carbon bed. The onsite Calgon Carbon Representative requested that the operation be ceased if the lead carbon column operating pressure exceeded 35 psig. Any increase in differential pressure would indicate a buildup of suspended solids in the carbon bed and would also cause a decrease in flow, as was observed. After installation of the pressure gauges, ADVENT operators monitored the pressure across the lead column as part of their bi-hourly

walkthrough. The lead and lag column pressures were initially 17 and 12 psig, respectively, resulting in a differential pressure of 5 psig. The operating pressure of the two columns gradually increased throughout the test period. However, the delta pressure remained fairly constant until approximately 68 hours of operation. At that time, the operating pressures of the two columns were 22.5 and 15.5 psig. The lead column pressure continued to rise, while the lag column operating pressure remained steady then slightly decreased. The operating pressure of the lead column had reached 29 psig with a differential pressure of 15 psig when the system was shutdown after 118 hours of operation. Pressure data recorded on the pilot system are also included in Table 3-1 and shown on Figure 3-2.

3.3 TREATABILITY UNIT OPERATIONS

Equipment for the bench-scale treatability units was transported to the site from the ADVENT laboratory in Nashville, Tennessee by ADVENT personnel, along with other equipment necessary for operations and onsite analyses. Treatability tests were conducted during the operation of the pilot system. Where possible, influent samples for the bench-scale tests were collected immediately after a six-hour sampling event so that the analytical results from the pilot system sampling would correspond to the influent characteristics of the bench-scale study.

3.3.1 Rapid Small-Scale Column Test

Two RSSCT units were operated during the study. The first test was conducted to determine an estimated breakthrough time of the pilot system. To accomplish this, effluent samples were collected at 10-minute intervals for three hours and analyzed for COD. The results of this analysis are shown in Table 3-2 and will be discussed in Sections 4.2 and 5.2. Once a tentative breakthrough curve had been established, a second column study was conducted to generate sufficient treated effluent for a full analytical scan comparable to analyses required for permit compliance as shown in Table 2-4.

3.3.2 Ozonation Tests

The ozone tests were conducted to determine the effectiveness of ozonation as both a pretreatment and post-treatment technology in series with activated carbon. To accomplish this, batch ozone testing was conducted on samples taken at Point A (lead column influent) and Point C (lag column effluent). Each test consisted of 15 L of influent placed in a 6 inch vertical column and subjected to 1500 mg/hr of ozone at an air flow rate of 10 scfh. A compressed air cylinder supplied the feed to the ozone generator. The ozone-enriched air was then introduced into the bottom of the reactor via a ceramic air sparger. The duration of each test was determined based on the influent COD, and the water was subjected to ozonation for a period long enough to provide 3 mg of ozone per mg of COD. During operation of the ozone tests, the reddish-brown color observed in the analytical samples appeared rapidly and was far more pronounced, providing additional evidence that the color change was likely due to the oxidation of ferrous iron.

3.4 DEVELOPMENT WATER TREATMENT OPERATIONS

After completion of the pilot system testing, the remaining water in the columns was purged from the system with an air compressor by closing the inlet valve and forcing water through the discharge piping. The lead column was taken out of service since the GAC was exchanged. The flow path was then rerouted to use the pilot system lag column as the development water treatment system lead column. A third column delivered to the site was used as the run lag column. Once the reconfiguration of the carbon columns had been completed, development water from the modular tank was pumped through the units until the full contents of the tank had been treated. Treated development water was routed to ABRTF.

The development water treatment system ran for approximately 12 hours. During operations, an ADVENT operator remained onsite to collect and ship samples for analysis. The samples taken were collected specifically for compliance monitoring as stipulated in the ABRTF permit. Samples collected were hand delivered to American Bottoms with the exception of cyanide, which was shipped to Severn Trent in Savannah. The operator conducted a walkthrough of the system every two hours to collect the

necessary samples. Flow to the pilot system was delivered at the maximum velocity for the available pump but was not monitored.

TABLE 3-1. PILOT SYSTEM FLOW AND PRESSURE MEASUREMENTS

DAY	TIME	RUN TIME (hr)	FLOW		PRESSURE		
			(gpm)	(total gal)	LEAD (psig)	LAG (psig)	DELTA (psig)
19-May	12:00	0	202.7	5,760			
	14:00	2	205.6	41,270			
	16:00	4	202.3	65,740			
	18:00	6	204.6	89,010			
	20:00	8	203.9	113,960	17	12	5
	22:00	10	202.6	139,636	18	12	6
20-May	0:00	12	201.5	164,228	17	12	5
	2:00	14	201.3	187,960	17	12	5
	4:00	16	200.2	213,350	17	12	5
	6:00	18	201.2	237,688	17	12	5
	8:00	20	200.2	260,510	17.5	12	5.5
	10:00	22	200.1	283,430	17.5	12	5.5
	12:00	24	199.4	308,970	18	12.5	5.5
	14:00	26	198.6	331,571	18	12.5	5.5
	16:00	28	198.2	355,425	17.9	12	5.9
	18:00	30	197.5	378,760	18	13	5
	20:00	32	196.7	403,796	18	14	4
	22:00	34	195.8	427,789	18	14	4
21-May	0:00	36	196.0	449,944	18	14	4
	2:00	38	194.5	474,128	18	14	4
	4:00	40	194.4	497,596	19	14	5
	6:00	42	193.2	522,339	19	14	5
	8:00	44	203.0	544,400	20	14.4	5.6
	10:00	46	201.6	565,850	20.1	14.5	5.6
	12:00	48	200.4	590,540	20	15	5
	14:00	50	200.0	614,420	20.5	15	5.5
	16:00	52	199.0	638,370	21.1	15	6.1
	18:00	54	197.8	663,290	21	15	6
	20:00	56	197.1	687,526	21	16	5
	22:00	58	196.3	712,320	22	16	6
22-May	0:00	60	196.0	734,778	21	16	5
	2:00	62	201.6	759,620	22	16	6
	4:00	64	200.3	783,692	22	16	6
	6:00	66	199.6	805,332	22	16	6
	8:00	68	197.6	830,454	22.5	15.5	7
	10:00	70	199.0		23	14.5	8.5
	12:00	72	198.0	877,530	23	15	8
	14:00	74	197.0	902,160	23	15	8
	16:00	76	196.1	925,970			
	18:00	78	201.3	948,570	24	15	9
	20:00	80	200.7	973,836	22	15	7
	22:00	82	199.4	998,599	24	16	8

TABLE 3-1. PILOT SYSTEM FLOW AND PRESSURE MEASUREMENTS

DAY	TIME	RUN TIME (hr)	FLOW		PRESSURE		
			(gpm)	(total gal)	LEAD (psig)	LAG (psig)	DELTA (psig)
23-May	0:00	84	198.6	1,021,080	24	15	9
	2:00	86	197.2	1,046,273	22	15	7
	4:00	88	195.6	1,069,100	24	15	9
	6:00	90	195.0	1,090,722	25	15	10
	8:00	92	194.4	1,115,180	25	14.5	10.5
	10:00	94	191.1	1,138,130	26	14.5	11.5
	12:00	96	190.1	1,160,825	26	14.5	11.5
	14:00	98	189.0	1,184,322	27	14.5	12.5
	16:00	100	188.3	1,206,930	27	14.5	12.5
	18:00	102	187.0	1,228,777	27	14	13
	20:00	104	185.9	1,252,342	27	14	13
	22:00	106	184.7	1,274,310	28	14	14
24-May	0:00	108	183.9	1,295,136	28	14	14
	2:00	110	183.3	1,317,700	28	14	14
	4:00	112	180.4	1,340,300	28	14	14
	6:00	114	180.6	1,360,556	28	14	14
	8:00	116	179.0	1,384,330	29	14	15

TABLE 3-2. DESIGN AND RESULTS FOR RSSCT BREAKTHROUGH DETERMINATION TEST

RSSCT DESIGN - COD BREAKTHROUGH TEST

PARAMETER	RSCCT	PILOT
Column Diameter, cm	1	243.8
Carbon Particle Radius, mm	0.106	0.792
Empty Bed Contact Time, min	0.30	16.9
Hydraulic Loading Rate, gpm/ft^2	29.73	3.98
Required Time to Breakthrough*, days	0.104	5.80
- with 20% safety factor	0.125	
Run Time, hr	2.99	
Column Cross-section, ft^2	0.00102	50.3
Flow, gpm	0.0304	200
Flow, mL/min	115.10	
Bed Volume, mL	34.88	
Bed Depth, cm	36.71	
Influent Required Per Test, gal	**5.46**	
Influent Required Per Test, L	**20.66**	

Actual Bed Depth, cm	37
Influent COD (mg/L)	596

Time	Flow (mL/min)	COD (mg/L)
0:00	94	75
0:10	94	65
0:20	94	70
0:30	94	83
0:40	94	108
0:50	94	117
1:00	96	123
1:10	94	152
1:20	95	184
1:30	99	227
1:40	99	269
1:50	94	300
2:00	98	335
2:10	98	358
2:20	100	376
2:30	96	400
2:40	98	439
2:50	98	457
3:00	96	446

FIGURE 3-1. PILOT SYSTEM FLOW

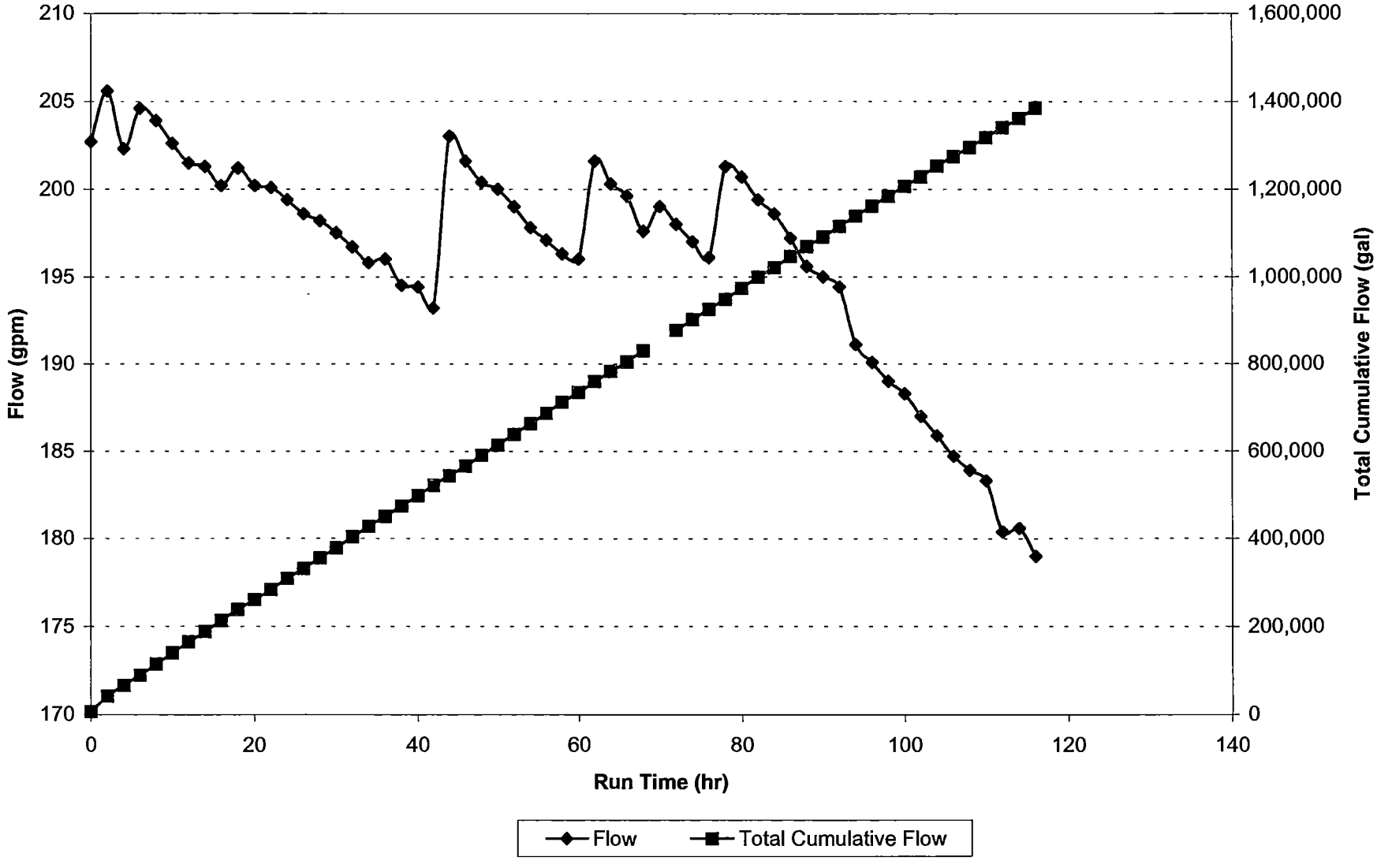
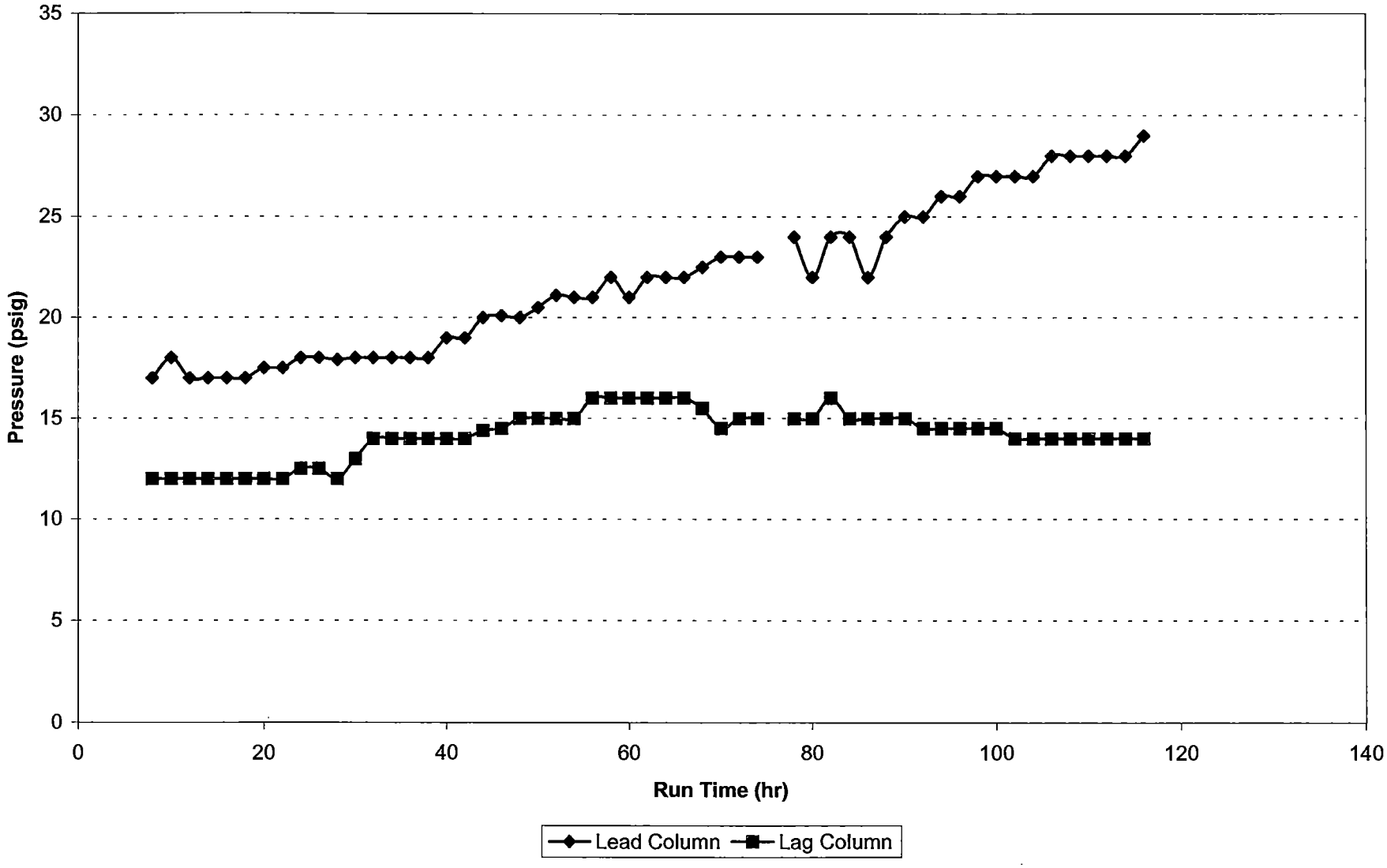


FIGURE 3-2. PILOT SYSTEM PRESSURE



4.0 ANALYTICAL RESULTS

4.1 PILOT SYSTEM

As described in Section 2.4, three locations were sampled during the study.

1. Point A represented influent groundwater to the pilot system.
2. Point B represented the effluent from the lead column of the pilot system.
3. Point C represented the effluent from the lag column.

4.1.1 Onsite Analyses

Analytical results from testing conducted onsite by ADVENT operators are presented in Table 4-1. Initial pH measurements showed an increase as the groundwater passed through the carbon, though after 6 hours of operation the read ings stabilized in the range of 6.4-6.7 s.u. This is consistent with the leaching of residual ash in the activated carbon during initial flow, which would cause a pH increase. Conductivity remained relatively constant throughout the study, typically ranging from 1,800-2,400 μS-cm. Temperature readings displayed a cyclical pattern consistent with the alternating periods of warm, sunny days and cool evenings. Typical temperature measurements ranged from 14 to 20 °C.

Initial samples of pilot system influent indicated a COD of approximately 600 mg/L, considerably lower than the anticipated value of 900 mg/L. After approximately 14 hours of operation, the influent COD stabilized in the range of 480-500 mg/L for the five-day duration of the study. COD measurements for the lead column effluent (Point B) gradually increased throughout the operation of the pilot system, with the highest recorded value at 219 mg/L. The breakthrough curve observed for the lead column, defined as the percentage of influent COD observed in the effluent, is shown in Figure 4-1.

Operators began regularly monitoring the COD of the lag column effluent (Point C) after approximately three days of operation. This monitoring was conducted to monitor for permit compliance. Earlier COD measurements at Point B indicated a refractory COD of 40-50 mg/L during the period when few or no compounds had broken through the lead column. Based on these data, it was determined that COD concentration of 55 to 60 mg/L at Point C would signal the onset of breakthrough in the lag column, and thus would present a higher potential for a permit violation of associated specific organics. Such measurements were observed Saturday, May 24, at which time the flow to the pilot system was ceased.

4.1.2 Offsite Analyses

Analytical results for all samples analyzed through Severn Trent Laboratories are presented in Table 4-2. These samples were collected and analyzed independent of the permit requirements to provide more complete groundwater characterization and evaluate treatment effectiveness. Cyanide was the only parameter monitored for compliance purposes. Because the permit-required sampling schedule for cyanide differed from the other samples sent to Severn Trent, the cyanide results are shown separately in Table 4-2a. Most parameters analyzed were not detected in the influent, or sporadically detected at concentrations near the listed detection limits.

4.1.3 Influent Characterization

Table 4-3 presents results of all constituents analyzed in the extracted groundwater prior to GAC treatment. Parameters identified at an influent concentration of 1 mg/L or higher are summarized below:

Parameter	Units	Influent Concentration Range
Metals		
Calcium	mg/L	260 – 280
Iron	mg/L	17 – 20
Magnesium	mg/L	61 – 65
Manganese	mg/L	2.6 – 2.9
Potassium	mg/L	14 – 15
Sodium	mg/L	120 – 150
Total Organic Carbon	mg/L	130 – 180
Chemical Oxygen Demand	mg/L	446 – 600
Biochemical Oxygen Demand	mg/L	126 – 143

Parameter	Units	Influent Concentration Range
Total Suspended Solids	mg/L	4 – 36
Ammonia	mg/L	10.3 – 14.9
Total Kjeldahl Nitrogen	mg/L	14.8 – 27.6
Volatiles		
Chlorobenzene	mg/L	2.3 – 3.9
Toluene	mg/L	0.7 – 1.2
Acetone	mg/L	3.0 – 6.7
Semi-Volatiles		
2-Chloroaniline	mg/L	22 – 31
4-Chloroaniline	mg/L	12 – 21
Aniline	mg/L	17 – 35
Phenol	mg/L	3.4 – 6.5
2-Nitrochlorobenzene	mg/L	3.7 – 25
3-Chloroaniline	mg/L	14 – 37
4-Chlorophenol	mg/L	2.8 – 7.1
4-Nitrochlorobenzene	mg/L	1.1 – 7.5

As predicted by the color change in the samples (Section 3.1), the groundwater contained an appreciable quantity of iron, in addition to other metals typically present in moderately hard water. The major contributors to the total organic carbon (TOC) in the groundwater include a variety of semivolatile organics, typically chlorinated and/or aminated aromatics.

4.1.4 Treated Effluent Quality

Only a few of the compounds listed in the above table were detected in the effluent at levels suggesting they had begun to break through the GAC bed. The following matrix shows which compounds were detected at the three sampling locations. (Refer to Sections 4.1.3 and 5.1 for complete influent and effluent summaries).

PARAMETER	POINT A	POINT B	POINT C
Metals			
Barium	X	X	X
Iron	X	X	X
Potassium	X	X	
Magnesium	X	X	
Manganese	X	X	X
Sodium	X	X	
Zinc	X	X	X
Volatiles			
Benzene	X	X	
Chlorobenzene	X	X	X*
Chloroethane	X	X	
Toluene	X	X	X*
Vinyl chloride	X	X	
Acetone	X	X	X

PARAMETER	POINT A	POINT B	POINT C
Semi-Volatiles			
2-Chlorophenol	X	X	
2-Chloroaniline	X	X	X*
Aniline	X	X	X
Phenol	X	X	X
3-Chloroaniline	X	X	
4-Chlorophenol	X	X	
Herbicides			
2,4-D	X	X	

Notes:

* Constituents detected at Point C by ABRTF but below the MDLs used by Severn Trent Laboratories.

Among the organic compounds, only acetone was detected at a concentration near or above the influent level. Figure 4-2 shows the progressive breakthrough of various compounds detected at high effluent concentrations, in addition to the breakthrough curve for TOC. As shown, the effluent concentration of acetone is higher than the influent concentration for samples collected after approximately 50 hours of run time. It is believed that this apparent increase in concentration may be due to the displacement of adsorbed acetone in the upper portion of the carbon bed by larger, more readily adsorbed compounds. As a result, the saturation capacity of acetone in the carbon decreases, and the desorbed acetone is discharged in the lead column effluent in addition to the influent acetone that is unable to be adsorbed in the bed.

4.1.5 Analytical Validation

In order to provide a cross-check between laboratories, splits of the ABRTF composite samples for Points A and C were shipped to STL Savannah for analysis. These split composite samples were analyzed for semi-volatile compounds only, as this analysis would provide the largest number of individual parameters for comparison. The complete results for these composite samples, from ABRTF and STL, are provided in Table 4-4. There was no apparent difference between the two laboratories in the analytical results obtained from samples collected at Point C. For most data points collected for Point A, where both laboratories provided a result above their respective detection limits, the results fall within the same order of magnitude. The following summarizes the data points in which the relative percent difference between the reported results exceeded 50 percent.

PARAMETER	UNITS	5/19/03			5/20/03			5/21/03		
		STL	ABRTF	% Diff	STL	ABRTF	% Diff	STL	ABRTF	% Diff
1,2-Dichlorobenzene	µg/l	450	378	17.4%	480	443	8.0%	430	212	67.9%
1,4-Dichlorobenzene	µg/l	420	414	1.4%	390	345	12.2%	360	91	119.3%
2-Chloroaniline	µg/l	32,000	35,500	10.4%	26,000	29,600	12.9%	24,000	14,100	52.0%
2-Nitrochlorobenzene	µg/l	4,200	944	126.6%	12,000	9,940	18.8%	18,000	4,800	115.8%
3-Chloroaniline	µg/l	20,000	11,100	57.2%	21,000	9,830	72.5%	20,000	3,970	133.8%
4-Chloroaniline	µg/l	19,000	23,300	20.3%	16,000	17,900	11.2%	13,000	6,280	69.7%
4-Nitrochlorobenzene	µg/l	2,000	2,990	39.7%	3,800	2,900	26.9%	5,200	1,620	105.0%

4.2 BENCH SCALE TREATABILITY UNITS

Analytical results from all of the bench-scale studies conducted at the site, including both onsite and offsite analyses, are presented in Table 4-4.

The influent and effluent results for the RSSCT indicate that its performance was comparable to the pilot system. Acetone was the only organic contaminant detected in the RSSCT effluent, indicating that its initial adsorptive capacity was comparable to that observed for the pilot system. In contrast to the pilot system, however, the RSSCT removed iron from the groundwater due to its oxidation and precipitation in the bed.

Results from the ozonation of pilot system influent (Point A) indicate that certain organic constituents in the groundwater may be fully removed by ozone, while others can be treated at lower degrees of effectiveness. A summary of the various ozone removal efficiencies is shown below:

Compound	Ozone Removal Efficiency (%)
Acetone	0%
Phenol	13%
4-Nitrochlorobenzene	37%
2-Chloroaniline	68%
Aniline	75%
4-Chloroaniline	79%
Chlorobenzene	> 99%
COD (total)	15%
TOC (total)	15%

Ozonation of water from Point C (GAC pilot effluent) did not provide useful data, since acetone was the only organic component detected in the influent to the ozonation system, and it was not removed by ozone.

4.3 DEVELOPMENT WATER TREATMENT

In order to comply with the sampling requirements of the ABRTF permit, grab samples for cyanide analysis were taken at Point A and Point C during development water treatment. The results for these samples are listed in Table 4-2a under the sample identification "5/29 12 PM," which constituted the seventh day of operation. All other samples for permit compliance were collected and analyzed by ABRTF personnel.

TABLE 4-1. PILOT SYSTEM ONSITE ANALYTICAL RESULTS

DAY	TIME	RUN TIME (hr)	COD (mg/L)			pH (s.u.)			TEMPERATURE (°C)			CONDUCTIVITY (uS-cm)			TSS (mg/L)	
			Pt. A	Pt. B	Pt. C	Pt. A	Pt. B	Pt. C	Pt. A	Pt. B	Pt. C	Pt. A	Pt. B	Pt. C	Pt. A	Pt. B
19-May	12:00	0				6.46	7.19	8.73	17.5	17.5	19.9	2,520	2,530	1,930	9	3
	14:00	2	600	62	62 [a]	6.44	6.68	7.15	20.3	23.2	21.2	2,500	2,460	2,440		
	16:00	4	589	46	40 [a]	6.59	6.6	6.77	19.4	22.5	19.7	2,490	2,590	2,490		
	18:00	6	544	45		6.58	6.59	6.69	17.3	17.7	18	1,920	2,200	2,280	18	3
	20:00	8	538	42		6.53	6.51	6.52	17.5	17.9	18.1	2,230	1,970	2,350		
	22:00	10	527	40		6.49	6.48	6.51	16.7	18.4	18	2,190	2,230	2,200		
20-May	0:00	12	550	44		6.51	6.54	6.52	16.9	16.4	16.7	2,240	2,340	2,380	3.6	0.8
	2:00	14	517	38		6.47	6.54	6.49	17.7	17.3	17.5	2,250	2,270	2,210		
	4:00	16	525	33		6.56	6.64	6.58	16.4	16.4	16.4	2,290	2,300	2,300		
	6:00	18	518	41		6.43	6.37	6.47	15.7	15.4	15.6	1,830	1,850	1,810	20.8	16.5
	8:00	20	510	42		6.59	6.6	6.5	15.1	14.8	14.9	2,340	2,290	2,250		
	10:00	22	499	44		6.63	6.68	6.61	16.3	16.2	16.2	2,430	2,430	2,430		
	12:00	24	497	65	65 [a]	6.61	6.59	6.59	17.2	17.1	17.1	2,380	2,390	2,300	20.4	4.6
	14:00	26	500	81		6.48	6.51	6.49	19.1	22.8	17.3	2,260	2,300	2,320		
	16:00	28	500	62		6.59	6.59	6.54	17.9	18.1	18.1	2,270	2,270	2,300		
	18:00	30	495	72		6.53	6.55	6.57	16.6	18.6	16.9	1,860	1,850	1,890	18.2	4.4
	20:00	32	479	65		6.5	6.51	6.54	16.6	17.3	16.9	1,820	1,860	1,850		
	22:00	34	482	69		6.11	6.44	6.51	16	16.2	16.3	2,280	2,300	2,190		
21-May	0:00	36	485	74		6.31	6.46	6.5	15.7	15.8	15.7	1,750	1,850	1,810	4.6	3.2
	2:00	38	501	83		6.55	6.51	6.56	15.3	15.3	14.8	1,780	1,810	1,840		
	4:00	40	488	68		6.58	6.52	6.53	14.8	14.4	14	2,220	2,210	2,230		
	6:00	42	485	72		6.53	6.54	6.61	14.8	14.1	15	2,090	2,190	1,830	4.4	3.2
	8:00	44	471	64		6.5	6.61	6.91	15.9	15.9	16.1	2,060	2,020	2,030		
	10:00	46	488	66		6.63	6.67	6.58	17.7	18.1	19.1	2,360	2,390	2,330		
	12:00	48	495	67		6.63	6.66	6.57	16.3	17.6	17	2,300	2,350	2,110	26.2	4.4
	14:00	50	458	81		6.54	6.57	6.57	17.8	19	17.3	2,040	2,220	2,150		
	16:00	52	469	84					17.1	17.1	17.1					
	18:00	54	517	96		6.55	6.6	6.6	16.1	16.3	16.4	1,920	1,880	1,870	12.4	8.8
	20:00	56	513	85		6.61	6.7	6.69	16.4	17.3	16.8	1,880	1,940	2,030		
	22:00	58	475	96		6.5	6.56	6.59	15.8	15.7	15.4	2,170	2,300	2,222		

TABLE 4-1. PILOT SYSTEM ONSITE ANALYTICAL RESULTS

DAY	TIME	RUN TIME (hr)	COD (mg/L)			pH (s.u.)			TEMPERATURE (°C)			CONDUCTIVITY (uS-cm)			TSS (mg/L)	
			Pt. A	Pt. B	Pt. C	Pt. A	Pt. B	Pt. C	Pt. A	Pt. B	Pt. C	Pt. A	Pt. B	Pt. C	Pt. A	Pt. B
22-May	0:00	60	539	89		6.51	6.59	6.61	15.1	14.9	15.3	2,140	2,220	2,190	2.6	8.8
	2:00	62	482	89		6.53	6.58	6.54	14.6	13.6	14.2	2,140	2,180	2,120		
	4:00	64	446	98		6.49	6.61	6.5	14.8	14.5	14.4	2,190	2,200	2,240		
	6:00	66	480	114		6.57	6.55	6.63	14.2	14.3	14.2	2,100	2,220	2,240	1.2	0.6
	8:00	68	476	104		6.51	6.61	6.59	15.9	15.6	16.2	2,310	2,220	2,280		
	10:00	70	487	113	40	6.56	6.57	6.57	17.1	16.6	17	2,390	2,300	2,030		
	12:00	72	508	107	43	6.66	6.67	6.7	17.1	17.2	17.1	2,330	2,390	2,330	36.2	11.4
	14:00	74	470	118	44	6.66	6.62	6.6	17	18.8	18.9	2,140	2,410	2,180		
	16:00	76	487	119	44	6.6	6.58	6.6	18.8	18.4	17.1	2,410	2,340	2,150		
	18:00	78	479	121	40	6.58	6.56	6.64	16.9	20.5	17.3	2,290	2,340	2,320	12.4	2.6
	20:00	80	519	125	41	6.56	6.64	6.63	17.2	19.7	16.7	2,160	2,390	2,170		
	22:00	82	567	123	37	6.55	6.55	6.6	15.5	16.3	15.8	2,300	2,340	2,300		
23-May	0:00	84	514	125	47	6.62	6.62	6.64	14.2	14.6	14.5	2,210	2,070	2,160	5.6	5.8
	2:00	86	478	97	46	6.6	6.61	6.61	13.4	13.9	14.1	2,020	2,220	2,210		
	4:00	88	506	142	47	6.63	6.67	6.65	14.5	14.5	13.8	2,230	2,220	2,250		
	6:00	90	486	131	35	6.58	6.6	6.6	14.4	13.7	13.8	2,120	2,060	2,150		
	8:00	92	483	138	33	6.55	6.5	6.62	15.9	15.7	16.3	2,370	2,250	2,350		
	10:00	94	482	143	41	6.61	6.59	6.72	18.7	17.7	16.8	2,460	2,380	2,370		
	12:00	96	501	145	37	6.62	6.61	6.63	16.6	17	17.3	2,410	2,420	2,400		
	14:00	98	478	152	44	6.61	6.63	6.59	18.1	25.2	18.6	2,390	2,660	2,420		
	16:00	100	480	146	38	6.54	6.61	6.66	17.2	16.6	17.2	2,130	2,330	2,390		
	18:00	102	474	168	48	6.61	6.57	6.59	16.6	16.8	16.8	2,330	2,140	2,200		
	20:00	104	472	162	52	6.6	6.64	6.63	16.7	18	16.7	2,100	2,170	2,200		
	22:00	106	450	174	48	6.56	6.63	6.6	16.1	16.1	16.1	2,280	2,280	2,200		
24-May	0:00	108	455	182	57	6.55	6.61	6.62	14.9	14.7	14.5	2,090	2,170	2,190		
	2:00	110	475	186	55	6.56	6.62	6.63	14.6	14.7	15	2,140	2,130	2,100		
	4:00	112	469	190	58	6.57	6.6	6.61	14.6	14.2	14.4	2,090	2,080	2,040		
	6:00	114	465	218	69	6.61	6.58	6.58	14.6	14.1	14.9	2,180	2,120	2,160		
	8:00	116	485	191	55	6.63	6.62	6.63	16.3	16.6	16.5	2,380	2,390	2,340		

Notes:

(a) Initial COD analyses at Point C were run using the high range Hach method. Subsequent samples were analyzed using the low range HACH method and are assumed to be more indicative of the actual COD concentrations at Point C.

TABLE 4-2. PILOT SYSTEM OFFSITE ANALYTICAL RESULTS

PARAMETER	UNITS	POINT A														POINT A					
		5/19/03		5/20/03				5/21/03				5/22/03				5/23/03				5/24/03	
		12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM
Miscellaneous																					
Total Organic Carbon	mg/l	180	150	150	150	150	140	140	140	140	140	140	140	140	130	130	130	130	140	140	130
Volatiles																					
1,1-Dichloroethene	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
1,2-Dichloroethene (total)	ug/l	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
2-Butanone (MEK)	ug/l	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
2-Hexanone	ug/l	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
Benzene	ug/l	440	410	430	440	450	430	470	460	500	470	480	450	460	460	460	450	440	450	480	300
4-Methyl-2-pentanone (MIBK)	ug/l	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
Bromoform	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Carbon tetrachloride	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Chlorobenzene	ug/l	3300	3300	3000	3200	3200	3000	3200	3200	3900	3200	3300	3100	3100	3100	3000	3100	3000	3600	3600	2300
cis-1,3-Dichloropropene	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
trans-1,3-Dichloropropene	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Chloroethane	ug/l	<20	<20	28	27	29	30	30	35	58	30	32	26	28	26	26	28	24	40	63	25
2-Chloroethylvinyl ether	ug/l	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
Chloroform	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
1,1-Dichloroethane	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
1,2-Dichloroethane	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
1,2-Dichloropropane	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	330	<20	<20	<20	<20	<20	<20	<20
Ethylbenzene	ug/l	85	83	81	90	92	89	91	93	100	93	98	91	92	92	89	90	92	97	100	66
Methylene chloride (Dichloromethane)	ug/l	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
1,1,2,2-Tetrachloroethane	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Toluene	ug/l	1000	960	920	980	1000	950	1000	990	1200	1000	1000	940	930	980	950	970	940	1000	1100	720
trans-1,2-Dichloroethene	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
1,1,1-Trichloroethane	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
1,1,2-Trichloroethane	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Vinyl chloride	ug/l	35	28	30	30	30	27	27	30	36	29	26	25	24	26	24	24	23	27	31	<20
Acetone	ug/l	6700	5900	4700	4600	3900	4200	4000	4100	5200	3600	4500	3700	4300	3600	4100	3700	3600	4900	3400	3000
Bromodichloromethane	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Bromomethane (Methyl bromide)	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Chloromethane	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Carbon disulfide	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Dibromochloromethane	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Styrene	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Tetrachloroethene	ug/l	<20	20	<20	<20	20	<20	20	<20	32	20	20	20	24	20	<20	20	<20	32	25	<20
Trichloroethene	ug/l	31	36	33	37	34	32	34	33	39	33	32	31	32	30	29	30	31	34	35	22
Xylenes, Total	ug/l	400	460	440	480	510	490	520	530	620	530	560	520	520	510	500	500	500	550	580	370
Semi-Volatiles																					
2-Chlorophenol	ug/l	<10	400	500	380	320	340	240	360	260	320	<250	340	350	330	280	300	290	280	260	250
Acenaphthene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
2,2'-Oxybis(1-Chloropropane) (bis-2-chloroisopropyl ether)	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
2-Nitroaniline	ug/l	<50	<250	<500	<500	<500	<500	<500	<500	<500	<500	<1200	<500	<1000	<500	<500	<500	<500	<1000	<250	<1000
2-Chloroaniline	ug/l	16	27000	32000	28000	29000	29000	23000	27000	24000	25000	<250	27000	31000	27000	24000	27000	25000	22000	24000	26000
2-Methylnaphthalene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
2-Methylphenol (o-Cresol)	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
2,4-Dichlorophenol	ug/l	<10	180	250	240	220	260	200	280	210	260	<250	300	280	300	260	250	300	260	270	230
Acenaphthylene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
3-Nitroaniline	ug/l	<50	<250	<500	<500	<500	<500	<500	<500	<500	<500	<1200	<500	<1000	<500	<500	<500	<500	<1000	<250	<1000
2,4-Dimethylphenol	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Anthracene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
4,6-Dinitro-2-methylphenol	ug/l	<50	<250	<500	<500	<500	<500	<500	<500	<500	<500	<1200	<500	<1000	<500	<500	<500	<500	<1000	<250	<1000
4-Chloroaniline	ug/l	<20	17000	21000	18000	17000	18000	16000	17000	14000	14000	<500	12000	19000	16000	14000	16000	15000	14000	16000	12000
4-Chloro-3-methylphenol	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
3-Methylphenol/4-Methylphenol (m&p-Cresol)	ug/l	<10	300	540	420	360	440	300	420	310	380	<250	410	430	390	340	340	350	350	300	320
4-Nitroaniline	ug/l	<50	<250	<500	<500	<500	<500	<500	<500	<500	<500	<1200	<500	<1000	<500	<500	<500	<500	<1000	<250	<1000
2,4-Dinitrophenol	ug/l	<50	<250	<500	<500	<500	<500	<500	<500	<500	<500	<1200	<500	<1000	<500	<500	<500	<500	<1000	<250	<1000
2-Nitrophenol	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Benzo(a)pyrene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
4-Nitrophenol	ug/l	<50	<250	<500	<500	<500	<500	<500	<500	<500	<500	<1200	<500	<1000	<500	<500	<500	<500	<1000	<250	<1000
Aniline	ug/l	18E	25000	35000	26000	27000	24000	24000	25000	23000	29000	3000	17000	24000	27000	23000	26000	24000	26000	24000	33000
Benzo(a)anthracene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Benzo(b)fluoranthene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Diethylphthalate	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Pyridine	ug/l	<50	<250	<500	<500	<500	<500	<500	<500	<500	<500	<1200	<500	<1000	<500	<500	<500	<500	<1000	<250	<1000
2,4,5-Trichlorophenol	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200

TABLE 4-2. PILOT SYSTEM OFFSITE ANALYTICAL RESULTS

PARAMETER	UNITS	POINT A														POINT A					
		5/19/03		5/20/03				5/21/03				5/22/03				5/23/03				5/24/03	
		12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM
Benzo(g,h,i)perylene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Pentachlorophenol	ug/l	<50	<250	<500	<500	<500	<500	<500	<500	<500	<500	<1200	<500	<1000	<500	<500	<500	<500	<1000	<250	<1000
Phenol	ug/l	<10	5500	6500	5200	4800	5000	4000	4900	3700	4900	<250	4200	4900	4600	3900	5000	3800	3400	3700	3800
bis(2-Chloroethoxy)methane	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
2,4,6-Trichlorophenol	ug/l	<10	80	<100	<100	<100	<100	<100	110	<100	<100	<250	100	<200	<100	<100	<100	100	<200	94	<200
bis(2-Chloroethyl)ether	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	1600	<200	<100	<100	<100	<100	<200	<50	<200
bis(2-Ethylhexyl)phthalate	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
4-Bromophenylphenyl ether	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Butylbenzylphthalate	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
2-Chloronaphthalene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
4-Chlorophenylphenyl ether	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Chrysene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Dibenzo(a,h)anthracene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	50	<200
1,2-Dichlorobenzene	ug/l	<10	510	550	460	360	460	380	580	390	570	<250	610	620	600	540	520	490	520	480	450
1,3-Dichlorobenzene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
1,4-Dichlorobenzene	ug/l	<10	510	510	390	280	370	300	480	330	470	<250	490	500	490	430	430	400	420	410	370
3,3'-Dichlorobenzidine	ug/l	<20	<100	<200	<200	<200	<200	<200	<200	<200	<200	<500	<200	<400	<200	<200	<200	<200	<400	<100	<400
Dimethylphthalate	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Di-n-butylphthalate	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
2,4-Dinitrotoluene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
2,6-Dinitrotoluene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Di-n-octylphthalate	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
1,2-Diphenylhydrazine	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Fluoranthene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Fluorene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Hexachlorobenzene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Hexachlorobutadiene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Hexachlorocyclopentadiene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Hexachloroethane	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Indeno(1,2,3-cd)pyrene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Isophorone	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Naphthalene	ug/l	<10	<50	1500	1200	960	1200	860	1100	820	<100	<250	<100	<200	1100	810	920	1000	<200	<50	<200
Nitrobenzene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
N-Nitrosodimethylamine	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
N-Nitrosodiphenylamine	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Phenanthrene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Pyrene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
1,2,4-Trichlorobenzene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Benzo(k)fluoranthene	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Benzoic acid	ug/l	<50	<50	<500	<500	<500	<500	690	910	700	1200	<1200	1100	<1000	720	<500	1000	1100	<1000	720	<1000
Benzyl alcohol	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Carbazole	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	<100	<100	<100	<100	<200	<50	<200
Dibenzofuran	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	100	<100	<100	<100	<200	<50	<200
Dinoseb	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	100	<100	<100	<100	<200	<50	<200
N-Nitroso-di-n-propylamine	ug/l	<10	<50	<100	<100	<100	<100	<100	<100	<100	<100	<250	<100	<200	100	<100	<100	<100	<200	<50	<200
2-Nitrochlorobenzene	ug/l	<10	3700	11000	14000	15000	14000	14000	19000	18000	25000	10	24000	16000	25000	22000	22000	24000	18000	21000	15000
3-Chloroaniline	ug/l	<10	15000	37000	29000	26000	20000	17000	23000	20000	27000	14	25000	18000	16000	14000	22000	15000	18000	18000	15000
3-Nitrochlorobenzene	ug/l	<10	<1000	<5000	<2000	<2500	<2000	<2000	<2000	<2000	<2500	<10	<2000	<2000	<2000	<2200	<2000	<2000	1300	<2000	1100
4-Chloro-2,6-Dinitrophenol	ug/l	<200	<20000	<100000	<40000	<50000	<40000	<40000	<40000	<40000	<50000	<200	<40000	<40000	<40000	<40000	<40000	<40000	<20000	<40000	<20000
4-Chlorophenol	ug/l	<10	3300	7100	5500	4500	3600	3000	4000	3400	5600	<10	4900	3300	4200	3300	3800	3900	3500	2900	2800
4-Nitrochlorobenzene	ug/l	<10	1100	<5000	4000	4200	3800	3600	5500	4900	7600	<10	7500	4900	6700	5800	6300	6300	5400	6000	4700
Benzidine	ug/l	<80	<8000	<40000	<16000	<20000	<16000	<16000	<16000	<16000	<20000	<80	<16000	<16000	<16000	<16000	<16000	<16000	<8000	<16000	<8000
Pesticides																					
Aldrin	ug/l		<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
alpha-BHC	ug/l		<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.11P	0.094P	<0.05	0.099P	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
beta-BHC	ug/l		<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
gamma-BHC (Lindane)	ug/l		<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
delta-BHC	ug/l		<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chlordane (technical)	ug/l		<0.25	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4,4'-DDT	ug/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	ug/l		<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan II	ug/l		<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
4,4'-DDE	ug/l		<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
4,4'-DDD	ug/l		<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	ug/l		<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan sulfate	ug/l		<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

TABLE 4-2. PILOT SYSTEM OFFSITE ANALYTICAL RESULTS

PARAMETER	UNITS	POINT A														POINT A					
		5/19/03		5/20/03				5/21/03				5/22/03				5/23/03				5/24/03	
		12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM
Endrin	ug/l		<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin aldehyde	ug/l		<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	ug/l		<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor epoxide	ug/l		<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Toxaphene	ug/l		<2.5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
alpha-Chlordane	ug/l		<0.03	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Endrin ketone	ug/l		<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	ug/l		<0.03	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Methoxychlor	ug/l		<0.25	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Herbicides																					
2,4,5-TP (Silvex)	ug/l		<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
2,4-DB	ug/l		<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
2,4-D	ug/l		84	55	64	59	64	73	70	67	72	67	75	76	74	75	68	57	60	56	57
2,4,5-T	ug/l		4.7	5.5E	4.4	6.1E	8.1E	7E	5.9EP	6E	5.2E	5.5E	5.3E	6E	4.6P	5.7E	4.2P	4.8E	6.3E	5.8E	6E
Pentachlorophenol	ug/l		2.2P	2.5	3.3P	3.3	2.3P	3	3.1	3.2	2.1	2.8	2.8	2.8	3.2	3.3	2.2	2.6	2.8P	2.1	2.2P
Dalapon	ug/l		<240	<120.0	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120
Dicamba	ug/l		<2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2
Dichloroprop	ug/l		97E	92E	86E	74E	79E	82E	88E	78E	81E	76E	86E	79E	76E	79E	71E	69E	77E	75E	65E
MCPA[(4-chloro-2-methylphenoxy)-acetic acid]	ug/l		<240	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120
MCPP[2-(4-chloro-2-methylphenoxy)-propanoic acid]	ug/l		<240	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120
PCBs																					
Decachlorobiphenyl	ug/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorobiphenyl	ug/l		<0.1	<0.1	<0.1	<0.1	<0.1	0.62	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlorobiphenyl	ug/l		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Hexachlorobiphenyl	ug/l		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Monochlorobiphenyl	ug/l		<0.1	<0.1	<0.1	<0.1	<0.1	0.32	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.19	<0.1	<0.1	<0.1	0.28	0.2	0.25
Nonachlorobiphenyl	ug/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5
Octachlorobiphenyl	ug/l		<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Pentachlorobiphenyl	ug/l		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Tetrachlorobiphenyl	ug/l		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trichlorobiphenyl	ug/l		<0.1	<0.1	<0.1	0.75	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor-1242	ug/l		<0.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aroclor-1254	ug/l		<0.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aroclor-1221	ug/l		<1.0	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Aroclor-1232	ug/l		<0.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aroclor-1248	ug/l		<0.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aroclor-1260	ug/l		<0.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aroclor-1016	ug/l		<0.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Dioxins																					
2,3,7,8-TCDD	pg/L	ND				ND				ND				ND				ND			
Total TCDD	pg/L	2000				3700				800				340				300			
1,2,3,7,8-PeCDD	pg/L	ND				ND				ND				ND				ND			
Total PeCDD	pg/L	1200				2000				620				28				ND			
1,2,3,4,7,8-HxCDD	pg/L	ND				ND				ND				ND				ND			
1,2,3,6,7,8-HxCDD	pg/L	ND				ND				ND				ND				ND			
1,2,3,7,8,9-HxCDD	pg/L	ND				ND				ND				ND				ND			
Total HxCDD	pg/L	1800				1700				1200				ND				ND			
1,2,3,4,6,7,8-HpCDD	pg/L	ND				ND				ND				ND				ND			
Total HpCDD	pg/L	ND				ND				ND				ND				ND			
OCDD	pg/L	ND				ND				ND				ND				ND			
2,3,7,8-TCDF	pg/L	ND				ND				ND				ND				ND			
Total TCDF	pg/L	ND				ND				ND				ND				ND			
1,2,3,7,8-PeCDF	pg/L	ND				ND				ND				ND				ND			
2,3,4,7,8-PeCDF	pg/L	ND				ND				ND				ND				ND			
Total PeCDF	pg/L	ND				ND				ND				ND				ND			
1,2,3,4,7,8-HxCDF	pg/L	ND				ND				ND				ND				ND			
1,2,3,6,7,8-HxCDF	pg/L	ND				ND				ND				ND				ND			
2,3,4,6,7,8-HxCDF	pg/L	ND				ND				ND				ND				ND			
1,2,3,7,8,9-HxCDF	pg/L	ND				ND				ND				ND				ND			
Total HxCDF	pg/L	ND				ND				ND				ND				ND			
1,2,3,4,6,7,8-HpCDF	pg/L	ND				ND				ND				ND				ND			
1,2,3,4,7,8,9-HpCDF	pg/L	ND				ND				ND				ND				ND			
Total HpCDF	pg/L	ND				ND				ND				ND				ND			
OCDF	pg/L	ND				ND				ND				ND				ND			

TABLE 4-2. PILOT SYSTEM OFFSITE ANALYTICAL RESULTS

PARAMETER	UNITS	POINT A														POINT A					
		5/19/03		5/20/03				5/21/03				5/22/03				5/23/03				5/24/03	
		12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM
Metals																					
Silver	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aluminum	mg/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Barium	mg/l	0.4	0.41	0.45	0.45	0.47	0.48	0.48	0.48	0.48	0.48	0.49	0.49	0.49	0.51	0.52	0.51	0.5	0.5	0.52	0.5
Beryllium	mg/l	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Calcium	mg/l	270	260	270	260	270	270	270	270	270	260	270	260	260	270	270	270	270	260	280	270
Cadmium	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	mg/l	0.035	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.03	<0.02	<0.02	<0.02
Iron	mg/l	19	17	19	18	19	19	19	19	19	18	19	19	19	19	19	19	20	19	19	19
Mercury	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Potassium	mg/l	15	14	15	15	15	15	15	15	15	14	14	14	14	14	15	14	14	14	15	15
Magnesium	mg/l	62	61	64	62	64	65	63	63	63	62	63	62	62	64	64	64	62	61	65	62
Manganese	mg/l	2.9	2.6	2.8	2.7	2.8	2.9	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.9	2.8	2.8	2.8	2.8	2.9	2.8
Sodium	mg/l	150	130	130	120	130	130	120	120	120	120	120	120	120	120	130	120	120	120	120	120
Nickel	mg/l	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Lead	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Antimony	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Selenium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/l	0.064	0.041	0.063	0.052	0.044	0.044	0.045	0.046	0.046	0.042	0.044	0.044	0.043	0.044	0.046	0.045	0.061	0.048	0.05	0.055

Qualifiers:
E = Estimated value
P = Presence of parameter confirmed but accuracy of result suspect
ND = Not Detected

TABLE 4-2. PILOT SYSTEM OFFSITE ANALYTICAL RESULTS

PARAMETER	UNITS	POINT B										POINT B										POINT C
		5/19/03		5/20/03				5/21/03				5/22/03				5/23/03				5/24/03		5/24/03
		12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	10 AM
Miscellaneous																						
Total Organic Carbon	mg/l	14	16	16	17	18	19	21	23	26	28	31	34	39	42	46	49	54	57	59	63	
Volatiles																						
1,1-Dichloroethene	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
1,2-Dichloroethene (total)	ug/l	<5	<5	<10	<50	<50	<50	<50	<5	<100	<100	<100	<100	<100	<50	<50	<50	<50	<50	<50	<50	<120
2-Butanone (MEK)	ug/l	<10	<10	<20	<100	<100	<100	<100	14	<200	<200	<200	<200	<200	<100	<100	<100	<100	<100	<100	<100	<250
2-Hexanone	ug/l	<10	<10	<20	<100	<100	<100	<100	<10	<200	<200	<200	<200	<200	<100	<100	<100	<100	<100	<100	<100	<250
Benzene	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	26	36	40	53	71	49	93	<25
4-Methyl-2-pentanone (MIBK)	ug/l	<10	<10	<20	<100	<100	<100	<100	<10	<200	<200	<200	<200	<200	<100	<100	<100	<100	<100	<100	<100	<250
Bromoform	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
Carbon tetrachloride	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
Chlorobenzene	ug/l	2.8	<1	2.8	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	13	<25
cis-1,3-Dichloropropene	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
trans-1,3-Dichloropropene	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
Chloroethane	ug/l	<1	<1	<2	<10	<10	<10	<10	7.8	<20	<20	<20	<20	<20	22	24	21	29	26	33	62	<25
2-Chloroethylvinyl ether	ug/l	<10	<10	<20	<100	<100	<100	<100	<10	<200	<200	<200	<200	<200	<100	<100	<100	<100	<100	<100	<100	<250
Chloroform	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
1,1-Dichloroethane	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
1,2-Dichloroethane	ug/l	<1	<1	<2	<10	<10	<10	<10	1.2	<20	<20	<20	<20	<20	<10	11	<10	<10	13	<10	15	<25
1,2-Dichloropropane	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
Ethylbenzene	ug/l	1.4	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
Methylene chloride (Dichloromethane)	ug/l	<5	<5	<10	<50	<50	<50	<50	<5	<100	<100	<100	<100	<100	<50	<50	<50	<50	<50	<50	<50	<120
1,1,2,2-Tetrachloroethane	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
Toluene	ug/l	<1	<1	2.7	<10	<10	<10	<10	1.3	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	16	<25
trans-1,2-Dichloroethene	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
1,1,1-Trichloroethane	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
1,1,2-Trichloroethane	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
Vinyl chloride	ug/l	<1	<1	<2	<10	<10	<10	<10	3.2	<20	<20	<20	<20	<20	11	<10	<10	12	21	12	23	<25
Acetone	ug/l	<25	<25	370	1000	1500	2000	2600	3000	5100	4400	4600	5300	6200	5400	5200	5200	5100	5900	3900	5400	6000
Bromodichloromethane	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
Bromomethane (Methyl bromide)	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
Chloromethane	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
Carbon disulfide	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
Dibromochloromethane	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
Styrene	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
Tetrachloroethene	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	14	<10	<10	<25
Trichloroethene	ug/l	<1	<1	<2	<10	<10	<10	<10	<1	<20	<20	<20	<20	<20	<10	<10	<10	<10	<10	<10	<10	<25
Xylenes, Total	ug/l	3.7	<2	<4	<20	<20	<20	<20	<2	<40	<40	<40	<40	<40	<20	<20	<20	<20	<20	<20	<20	<50
Semi-Volatiles																						
2-Chlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	10	<10
Acenaphthene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
2,2'-Oxybis(1-Chloropropane) (bis-2-chloroisopropyl ether)	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
2-Nitroaniline	ug/l	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<250	<500	<500	<1000	<500	<1200	<1200	<50	<50
2-Chloroaniline	ug/l	<10	<10	<10	<10	<10	21	17	16	13	<100	<10	<10	1100	<100	150	250	450	380	760	670	<10
2-Methylnaphthalene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
2-Methylphenol (o-Cresol)	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
2,4-Dichlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Acenaphthylene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
3-Nitroaniline	ug/l	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<250	<500	<500	<1000	<500	<1200	<1200	<50	<50
2,4-Dimethylphenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Anthracene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
4,6-Dinitro-2-methylphenol	ug/l	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<250	<500	<500	<1000	<500	<1200	<1200	<50	<50
4-Chloroaniline	ug/l	<20	<20	<20	<20	<20	<10	<20	<20	<20	<20	<20	<20	<100	<200	<200	<400	240	<500	<500	<20	<20
4-Chloro-3-methylphenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
3-Methylphenol/4-Methylphenol (m&p-Cresol)	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
4-Nitroaniline	ug/l	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<250	<500	<500	<1000	<500	<1200	<1200	<50	<50
2,4-Dinitrophenol	ug/l	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<250	<500	<500	<1000	<500	<1200	<1200	<50	<50
2-Nitrophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Benzo(a)pyrene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
4-Nitrophenol	ug/l	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<250	<500	<500	<1000	<500	<1200	<1200	<50	<50
Aniline	ug/l	<20	<20	<20	<20	<20	21	51	180	630	1200	2300	3400	5900	6600	7600	9200	11000	12000	14000	14000	92
Benzo(a)anthracene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Benzo(b)fluoranthene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Diethylphthalate	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Pyridine	ug/l	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<250	<500	<500	<1000	<500	<1200	<1200	<50	<50
2,4,5-Trichlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10

TABLE 4-2. PILOT SYSTEM OFFSITE ANALYTICAL RESULTS

PARAMETER	UNITS	POINT B										POINT B										POINT C
		5/19/03		5/20/03				5/21/03				5/22/03				5/23/03				5/24/03		5/24/03
		12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	10 AM
Benzo(g,h,i)perylene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Pentachlorophenol	ug/l	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<250	<500	<500	<1000	<500	<1200	<1200	<50	<50
Phenol	ug/l	<10	<10	<10	<10	<10	<10	<10	24	<10	93	210E	300	610	690	1100	1400	1900	1400	1900	1600	13
bis(2-Chloroethoxy)methane	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
2,4,6-Trichlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
bis(2-Chloroethyl)ether	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
bis(2-Ethylhexyl)phthalate	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
4-Bromophenylphenyl ether	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Butylbenzylphthalate	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
2-Chloronaphthalene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
4-Chlorophenylphenyl ether	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Chrysene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Dibenzo(a,h)anthracene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
1,2-Dichlorobenzene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
1,3-Dichlorobenzene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
1,4-Dichlorobenzene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
3,3'-Dichlorobenzidine	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<100	<200	<200	<400	<200	<500	<500	<20	<20
Dimethylphthalate	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Di-n-butylphthalate	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
2,4-Dinitrotoluene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
2,6-Dinitrotoluene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Di-n-octylphthalate	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
1,2-Diphenylhydrazine	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Fluoranthene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Fluorene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Hexachlorobenzene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Hexachlorobutadiene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Hexachlorocyclopentadiene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Hexachloroethane	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Indeno(1,2,3-cd)pyrene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Isophorone	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Naphthalene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Nitrobenzene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
N-Nitrosodimethylamine	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	33	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
N-Nitrosodiphenylamine	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Phenanthrene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Pyrene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
1,2,4-Trichlorobenzene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Benzo(k)fluoranthene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Benzoic acid	ug/l	<50	<50	<50	<50	<50	<50	74	170	<50	<50	<50	<50	<250	<500	<500	<1000	<500	<1200	<1200	<50	<50
Benzyl alcohol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Carbazole	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Dibenzofuran	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
Dinoseb	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
N-Nitroso-di-n-propylamine	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<100	<100	<200	<100	<250	<250	<10	<10
2-Nitrochlorobenzene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<20	<100	<50	<100	<10
3-Chloroaniline	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	32	<10	<50	31	280	320	610	<10
3-Nitrochlorobenzene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<20	<100	<50	<100	<10
4-Chloro-2,6-Dinitrophenol	ug/l	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<1000	<400	<2000	<500	<2000	<200
4-Chlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50	<20	<100	<50	160	<10
4-Nitrochlorobenzene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	11	<10	<10	<10	<10	<10	<10	110	<20	<100	<50	<100	<10
Benzidine	ug/l	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<400	<160	<800	<400	<800	<80
Pesticides																						
Aldrin	ug/l	<0.025	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
alpha-BHC	ug/l	<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
beta-BHC	ug/l	<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
gamma-BHC (Lindane)	ug/l	<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
delta-BHC	ug/l	<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
Chlordane (technical)	ug/l	<0.25	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
4,4'-DDT	ug/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Endosulfan I	ug/l	<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
Endosulfan II	ug/l	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
4,4'-DDE	ug/l	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
4,4'-DDD	ug/l	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Dieldrin	ug/l	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Endosulfan sulfate	ug/l	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	

TABLE 4-2. PILOT SYSTEM OFFSITE ANALYTICAL RESULTS

PARAMETER	UNITS	POINT B										POINT B										POINT C
		5/19/03		5/20/03				5/21/03				5/22/03				5/23/03				5/24/03		5/24/03
		12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	10 AM
Endrin	ug/l	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Endrin aldehyde	ug/l	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Heptachlor	ug/l	<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
Heptachlor epoxide	ug/l	<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
Toxaphene	ug/l	<2.5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	5	<5	<5	<5	<5	<5	<5	
alpha-Chlordane	ug/l	<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
Endrin ketone	ug/l	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
gamma-Chlordane	ug/l	<0.025	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
Methoxychlor	ug/l	<0.25	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Herbicides																						
2,4,5-TP (Silvex)	ug/l	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
2,4-DB	ug/l	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
2,4-D	ug/l	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	0.82	1.3	1.7	2.6	3.3	3.5	4.1	4.3	
2,4,5-T	ug/l	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Pentachlorophenol	ug/l	<2	<1	<1	<1	<1	<1	<10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
Dalapon	ug/l	<240	<120	<120	<120	<120	<120	<1200	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	
Dicamba	ug/l	<2.4	<1.2	<1	<1.2	<1.2	<1.2	<12	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	
Dichloroprop	ug/l	<12	<6.0	<6	<6.0	<6	<6	<60	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	
MCPA[(4-chloro-2-methylphenoxy)-acetic acid]	ug/l	<240	<120.0	<120	<120.0	<120	<120	<1200	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	
MCPP[2-(4-chloro-2-methylphenoxy)-propanoic acid]	ug/l	<240	<120.0	<120	<120.0	<120	<120	<1200	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	<120	
PCBs																						
Decachlorobiphenyl	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Dichlorobiphenyl	ug/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Heptachlorobiphenyl	ug/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	
Hexachlorobiphenyl	ug/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
Monochlorobiphenyl	ug/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	
Nonachlorobiphenyl	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Octachlorobiphenyl	ug/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	
Pentachlorobiphenyl	ug/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
Tetrachlorobiphenyl	ug/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
Trichlorobiphenyl	ug/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Aroclor-1242	ug/l	<0.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
Aroclor-1254	ug/l	<0.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
Aroclor-1221	ug/l	<1.0	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	
Aroclor-1232	ug/l	<0.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
Aroclor-1248	ug/l	<0.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
Aroclor-1260	ug/l	<0.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
Aroclor-1016	ug/l	<0.5	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
Dioxins																						
2,3,7,8-TCDD	pg/L	ND				ND				ND				ND				ND				
Total TCDD	pg/L	ND				ND				ND				ND				ND				
1,2,3,7,8-PeCDD	pg/L	ND				ND				ND				ND				ND				
Total PeCDD	pg/L	ND				ND				ND				ND				ND				
1,2,3,4,7,8-HxCDD	pg/L	ND				ND				ND				ND				ND				
1,2,3,6,7,8-HxCDD	pg/L	ND				ND				ND				ND				ND				
1,2,3,7,8,9-HxCDD	pg/L	ND				ND				ND				ND				ND				
Total HxCDD	pg/L	ND				ND				ND				ND				ND				
1,2,3,4,6,7,8-HpCDD	pg/L	ND				ND				ND				ND				ND				
Total HpCDD	pg/L	ND				ND				ND				ND				ND				
OCDD	pg/L	ND				ND				ND				ND				ND				
2,3,7,8-TCDF	pg/L	ND				ND				ND				ND				ND				
Total TCDF	pg/L	ND				ND				ND				ND				ND				
1,2,3,7,8-PeCDF	pg/L	ND				ND				ND				ND				ND				
2,3,4,7,8-PeCDF	pg/L	ND				ND				ND				ND				ND				
Total PeCDF	pg/L	ND				ND				ND				ND				ND				
1,2,3,4,7,8-HxCDF	pg/L	ND				ND				ND				ND				ND				
1,2,3,6,7,8-HxCDF	pg/L	ND				ND				ND				ND				ND				
2,3,4,6,7,8-HxCDF	pg/L	ND				ND				ND				ND				ND				
1,2,3,7,8,9-HxCDF	pg/L	ND				ND				ND				ND				ND				
Total HxCDF	pg/L	ND				ND				ND				ND				ND				
1,2,3,4,6,7,8-HpCDF	pg/L	ND				ND				ND				ND				ND				
1,2,3,4,7,8,9-HpCDF	pg/L	ND				ND				ND				ND				ND				
Total HpCDF	pg/L	ND				ND				ND				ND				ND				
OCDF	pg/L	ND				ND				ND				ND				ND				

TABLE 4-2. PILOT SYSTEM OFFSITE ANALYTICAL RESULTS

PARAMETER	UNITS	POINT B										POINT B										POINT C
		5/19/03		5/20/03				5/21/03				5/22/03				5/23/03				5/24/03		5/24/03
		12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	12 PM	6 PM	12 AM	6 AM	10 AM
Metals																						
Silver	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Aluminum	mg/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
Arsenic	mg/l	0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Barium	mg/l	0.3	0.36	0.38	0.40	0.42	0.42	0.43	0.44	0.45	0.45	0.47	0.47	0.48	0.48	0.49	0.5	0.51	0.50	0.50	0.54	
Beryllium	mg/l	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	
Calcium	mg/l	260	260	260	260	260	260	260	260	260	260	270	270	260	270	260	270	270	270	270	280	
Cadmium	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Cobalt	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	
Chromium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	
Copper	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	
Iron	mg/l	0.65	8.9	13	15	17	17	17	18	18	18	18	18	18	18	18	19	20	20	19	20	
Mercury	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	
Potassium	mg/l	16	15	14	14	15	15	14	14	14	14	14	14	14	14	14	14	14	15	15	15	
Magnesium	mg/l	63	61	61	61	62	62	62	62	62	61	63	62	62	62	62	63	64	62	63	65	
Manganese	mg/l	3.4	2.8	2.7	2.7	2.7	2.8	2.7	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.9	2.8	2.9	
Sodium	mg/l	150	130	130	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	
Nickel	mg/l	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.040	<0.04	<0.040	<0.04	<0.04	<0.04	
Lead	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Antimony	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	
Selenium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Thallium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Vanadium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.010	<0.01	<0.01	<0.01	
Zinc	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.020	<0.02	<0.020	0.027	0.055	<0.02	

Qualifiers:
E = Estimated value
P = Presence of parameter confirmed but accuracy of result suspect
ND = Not Detected

TABLE 4-2a. PILOT SYSTEM CYANIDE RESULTS

SAMPLE DATE	RUN DAY	UNITS	POINT A	POINT C
5/19/03 12 PM	1	mg/L	<0.01	<0.01
5/21/03 12 PM	3	mg/L	<0.01	<0.01
5/22/03 12 PM	4	mg/L	<0.01	<0.01
5/23/03 12 PM	5	mg/L	<0.01	<0.01
5/29/03 12 PM	7	mg/L	<0.01	<0.01

TABLE 4-3. GROUNDWATER CHARACTERIZATION SUMMARY

PARAMETER	UNITS	AVERAGE	MINIMUM	MAXIMUM
Miscellaneous				
Total Organic Carbon	**mg/L**	**142**	**130**	**180**
Ammonia	**mg/L**	**13**	**10**	**15**
TKN	**mg/L**	**19**	**16**	**23**
TSS	**mg/L**	**13**	**3**	**36**
BOD	**mg/L**	**138**	**126**	**162**
COD	**mg/L**	**497**	**446**	**600**
Volatiles				
1,1-Dichloroethene	ug/L	<20	<20	<20
1,2-Dichloroethene (total)	ug/L	<100	<100	<100
2-Butanone (MEK)	ug/L	<200	<200	<200
2-Hexanone	ug/L	<200	<200	<200
Benzene	**ug/L**	**447**	**300**	**500**
4-Methyl-2-pentanone (MIBK)	ug/L	<200	<200	<200
Bromoform	ug/L	<20	<20	<20
Carbon tetrachloride	ug/L	<20	<20	<20
Chlorobenzene	**ug/L**	**3,185**	**2,300**	**3,900**
cis-1,3-Dichloropropene	ug/L	<20	<20	<20
trans-1,3-Dichloropropene	ug/L	<20	<20	<20
Chloroethane	**ug/L**	**31**	**20**	**63**
2-Chloroethylvinyl ether	ug/L	<200	<200	<200
Chloroform	ug/L	<20	<20	<20
1,1-Dichloroethane	ug/L	<20	<20	<20
1,2-Dichloroethane	ug/L	<20	<20	<20
1,2-Dichloropropane	**ug/L**	**36**	**20**	**330**
Ethylbenzene	**ug/L**	**90**	**66**	**100**
Methylene chloride (Dichloromethane)	ug/L	<100	<100	<100
1,1,2,2-Tetrachloroethane	ug/L	<20	<20	<20
Toluene	**ug/L**	**977**	**720**	**1,200**
trans-1,2-Dichloroethene	ug/L	20	20	20
1,1,1-Trichloroethane	ug/L	20	20	20
1,1,2-Trichloroethane	ug/L	20	20	20
Vinyl chloride	**ug/L**	**28**	**20**	**36**
Acetone	**ug/L**	**4,285**	**3,000**	**6,700**
Bromodichloromethane	ug/L	20	20	20
Bromomethane (Methyl bromide)	ug/L	20	20	20
Chloromethane	ug/L	20	20	20
Carbon disulfide	ug/L	20	20	20
Dibromochloromethane	ug/L	20	20	20
Styrene	ug/L	20	20	20
Tetrachloroethene	**ug/L**	**22**	**20**	**32**
Trichloroethene	**ug/L**	**32**	**22**	**39**
Xylenes, Total	**ug/L**	**505**	**370**	**620**

TABLE 4-3. GROUNDWATER CHARACTERIZATION SUMMARY

PARAMETER	UNITS	AVERAGE	MINIMUM	MAXIMUM
Semi-Volatiles				
2-Chlorophenol	**ug/L**	**303**	**10**	**500**
Acenaphthene	ug/L	113	10	250
2,2'-Oxybis(1-Chloropropane) (bis-2-chloroisopropyl e	ug/L	113	10	250
2-Nitroaniline	**ug/L**	**563**	**50**	**1,200**
2-Chloroaniline	**ug/L**	**23,863**	**16**	**32,000**
2-Methylnaphthalene	ug/L	113	10	250
2-Methylphenol (o-Cresol)	ug/L	113	10	250
2,4-Dichlorophenol	**ug/L**	**241**	**10**	**300**
Acenaphthylene	ug/L	113	10	250
3-Nitroaniline	**ug/L**	**563**	**50**	**1,200**
2,4-Dimethylphenol	ug/L	113	10	250
Anthracene	ug/L	113	10	250
4,6-Dinitro-2-methylphenol	**ug/L**	**563**	**50**	**1,200**
4-Chloroaniline	**ug/L**	**14,326**	**20**	**21,000**
4-Chloro-3-methylphenol	ug/L	113	10	250
3-Methylphenol/4-Methylphenol (m&p-Cresol)	**ug/L**	**348**	**10**	**540**
4-Nitroaniline	ug/L	563	50	1,200
2,4-Dinitrophenol	ug/L	563	50	1,200
2-Nitrophenol	ug/L	113	10	250
Benzo(a)pyrene	ug/L	113	10	250
4-Nitrophenol	ug/L	563	50	1,200
Aniline	**ug/L**	**24,474**	**3,000**	**35,000**
Benzo(a)anthracene	ug/L	113	10	250
Benzo(b)fluoranthene	ug/L	113	10	250
Diethylphthalate	ug/L	113	10	250
Pyridine	ug/L	563	50	1,200
2,4,5-Trichlorophenol	ug/L	113	10	250
Benzo(g,h,i)perylene	ug/L	113	10	250
Pentachlorophenol	ug/L	563	50	1,200
Phenol	**ug/L**	**4,103**	**10**	**6,500**
bis(2-Chloroethoxy)methane	ug/L	113	10	250
2,4,6-Trichlorophenol	ug/L	117	10	250
bis(2-Chloroethyl)ether	ug/L	188	10	1,600
bis(2-Ethylhexyl)phthalate	ug/L	113	10	250
4-Bromophenylphenyl ether	ug/L	113	10	250
Butylbenzylphthalate	ug/L	113	10	250
2-Chloronaphthalene	ug/L	113	10	250
4-Chlorophenylphenyl ether	ug/L	113	10	250
Chrysene	ug/L	113	10	250
Dibenzo(a,h)anthracene	ug/L	113	10	250
1,2-Dichlorobenzene	ug/L	468	10	620
1,3-Dichlorobenzene	ug/L	113	10	250
1,4-Dichlorobenzene	**ug/L**	**392**	**10**	**510**
3,3'-Dichlorobenzidine	ug/L	226	20	500
Dimethylphthalate	ug/L	113	10	250
Di-n-butylphthalate	ug/L	113	10	250
2,4-Dinitrotoluene	ug/L	113	10	250
2,6-Dinitrotoluene	ug/L	113	10	250

TABLE 4-3. GROUNDWATER CHARACTERIZATION SUMMARY

PARAMETER	UNITS	AVERAGE	MINIMUM	MAXIMUM
Di-n-octylphthalate	ug/L	113	10	250
1,2-Diphenylhydrazine	ug/L	113	10	250
Fluoranthene	ug/L	113	10	250
Fluorene	ug/L	113	10	250
Hexachlorobenzene	ug/L	113	10	250
Hexachlorobutadiene	ug/L	113	10	250
Hexachlorocyclopentadiene	ug/L	113	10	250
Hexachloroethane	ug/L	113	10	250
INAeno(1,2,3-cd)pyrene	ug/L	113	10	250
Isophorone	ug/L	113	10	250
Naphthalene	**ug/L**	**632**	**10**	**1,500**
Nitrobenzene	ug/L	113	10	250
N-Nitrosodimethylamine	ug/L	113	10	250
N-Nitrosodiphenylamine	ug/L	113	10	250
Phenanthrene	ug/L	113	10	250
Pyrene	ug/L	113	10	250
1,2,4-Trichlorobenzene	ug/L	113	10	250
Benzo(k)fluoranthene	ug/L	113	10	250
Benzoic acid	**ug/L**	**747**	**50**	**1,200**
Benzyl alcohol	ug/L	113	10	250
Carbazole	ug/L	113	10	250
Dibenzofuran	ug/L	113	10	250
Dinoseb	ug/L	113	10	250
N-Nitroso-di-n-propylamine	ug/L	113	10	250
2-Nitrochlorobenzene	**ug/L**	**16,036**	**10**	**25,000**
3-Chloroaniline	**ug/L**	**18,751**	**10**	**37,000**
3-Nitrochlorobenzene	**ug/L**	**1,881**	**10**	**5,000**
4-Chloro-2,6-Dinitrophenol	**ug/L**	**37,020**	**200**	**100,000**
4-Chlorophenol	**ug/L**	**3,631**	**10**	**7,100**
4-Nitrochlorobenzene	**ug/L**	**4,666**	**10**	**7,600**
Benzidine	**ug/L**	**14,808**	**80**	**40,000**
Pesticides				
Aldrin	ug/L	<0.05	<0.03	<0.05
alpha-BHC	ug/L	<0.05	<0.03	<0.05
beta-BHC	ug/L	<0.05	<0.03	<0.05
gamma-BHC (LiNAane)	ug/L	<0.05	<0.03	<0.05
delta-BHC	ug/L	<0.05	<0.03	<0.05
Chlordane (technical)	ug/L	<0.5	<0.3	<0.5
4,4'-DDT	ug/L	<0.1	<0.1	<0.1
ENAosulfan I	ug/L	<0.05	<0.03	<0.05
ENAosulfan II	ug/L	<0.1	<0.1	<0.1
4,4'-DDE	ug/L	<0.1	<0.1	<0.1
4,4'-DDD	ug/L	<0.1	<0.1	<0.1
Dieldrin	ug/L	<0.1	<0.1	<0.1
ENAosulfan sulfate	ug/L	<0.1	<0.1	<0.1
ENArin	ug/L	<0.1	<0.1	<0.1
ENArin aldehyde	ug/L	<0.1	<0.1	<0.1
Heptachlor	ug/L	<0.05	<0.03	<0.05
Heptachlor epoxide	ug/L	<0.05	<0.03	<0.05

TABLE 4-3. GROUNDWATER CHARACTERIZATION SUMMARY

PARAMETER	UNITS	AVERAGE	MINIMUM	MAXIMUM
Toxaphene	ug/L	<5	<3	<5
alpha-Chlordane	ug/L	<0.05	<0.03	<0.05
ENArin ketone	ug/L	<0.1	<0.1	<0.1
gamma-Chlordane	ug/L	<0.05	<0.03	<0.05
Methoxychlor	ug/L	<0.5	<0.3	<0.5
Herbicides				
2,4,5-TP (Silvex)	ug/L	0.5	0.5	1
2,4-DB	ug/L	0.5	0.5	1
2,4-D	**ug/L**	**67**	**55**	**84**
2,4,5-T	**ug/L**	**4.6**	**4.4**	**4.7**
Pentachlorophenol	**ug/L**	**2.8**	**2.1**	**3.3**
Dalapon	ug/L	<126	<120	<240
Dicamba	ug/L	<1.3	<1.2	<2.4
Dichloroprop	ug/L	ND	ND	ND
MCPA[(4-chloro-2-methylphenoxy)-acetic acid]	ug/L	<126	<120	<240
MCPP[2-(4-chloro-2-methylphenoxy)-propanoic acid]	ug/L	<126	<120	<240
PCBs				
Decachlorobiphenyl	ug/L	<0.5	<0.5	<0.5
Dichlorobiphenyl	ug/L	0.13	0.1	0.62
Heptachlorobiphenyl	ug/L	<0.3	<0.3	<0.3
Hexachlorobiphenyl	ug/L	<0.2	<0.2	<0.2
Monochlorobiphenyl	ug/L	0.14	0.1	0.32
Nonachlorobiphenyl	ug/L	<0.5	<0.5	<0.5
Octachlorobiphenyl	ug/L	<0.3	<0.3	<0.3
Pentachlorobiphenyl	ug/L	<0.2	<0.2	<0.2
Tetrachlorobiphenyl	ug/L	<0.2	<0.2	<0.2
Trichlorobiphenyl	ug/L	0.13	0.1	0.75
Aroclor-1242	ug/L	<1	<1	<1
Aroclor-1254	ug/L	<1	<1	<1
Aroclor-1221	ug/L	<2	<1	<2
Aroclor-1232	ug/L	<1	<1	<1
Aroclor-1248	ug/L	<1	<1	<1
Aroclor-1260	ug/L	<1	<1	<1
Aroclor-1016	ug/L	<1	<1	<1
Dioxins				
2,3,7,8-TCDD	ug/L	NA	NA	NA
Total TCDD	**ug/L**	**1,428**	**300**	**3,700**
1,2,3,7,8-PeCDD	ug/L	NA	NA	NA
Total PeCDD	**ug/L**	**962**	**28**	**2,000**
1,2,3,4,7,8-HxCDD	ug/L	NA	NA	NA
1,2,3,6,7,8-HxCDD	ug/L	NA	NA	NA
1,2,3,7,8,9-HxCDD	ug/L	NA	NA	NA
Total HxCDD	**ug/L**	**1,567**	**1,200**	**1,800**
1,2,3,4,6,7,8-HpCDD	ug/L	NA	NA	NA
Total HpCDD	ug/L	NA	NA	NA
OCDD	ug/L	NA	NA	NA
2,3,7,8-TCDF	ug/L	NA	NA	NA
Total TCDF	ug/L	NA	NA	NA
1,2,3,7,8-PeCDF	ug/L	NA	NA	NA

TABLE 4-3. GROUNDWATER CHARACTERIZATION SUMMARY

PARAMETER	UNITS	AVERAGE	MINIMUM	MAXIMUM
2,3,4,7,8-PeCDF	ug/L	NA	NA	NA
Total PeCDF	ug/L	NA	NA	NA
1,2,3,4,7,8-HxCDF	ug/L	NA	NA	NA
1,2,3,6,7,8-HxCDF	ug/L	NA	NA	NA
2,3,4,6,7,8-HxCDF	ug/L	NA	NA	NA
1,2,3,7,8,9-HxCDF	ug/L	NA	NA	NA
Total HxCDF	ug/L	NA	NA	NA
1,2,3,4,6,7,8-HpCDF	ug/L	NA	NA	NA
1,2,3,4,7,8,9-HpCDF	ug/L	NA	NA	NA
Total HpCDF	ug/L	NA	NA	NA
OCDF	ug/L	NA	NA	NA
Metals				
Silver	mg/L	<0.01	<0.01	<0.01
Aluminum	mg/L	<0.2	<0.2	<0.2
Arsenic	mg/L	<0.01	<0.01	<0.01
Barium	mg/L	0.4805	0.4	0.52
Beryllium	mg/L	<0.004	<0.004	<0.004
Calcium	**mg/L**	**268**	**260**	**280**
Cadmium	mg/L	<0.005	<0.005	<0.005
Cobalt	mg/L	<0.01	<0.01	<0.01
Chromium	mg/L	<0.01	<0.01	<0.01
Copper	mg/L	0.02125	0.02	0.035
Iron	**mg/L**	**18.9**	**17**	**20**
Mercury	mg/L	<0.0002	<0.0002	<0.0002
Potassium	**mg/L**	**14.6**	**14**	**15**
Magnesium	**mg/L**	**63**	**61**	**65**
Manganese	**mg/L**	**2.8**	**2.6**	**2.9**
Sodium	**mg/L**	**124**	**120**	**150**
Nickel	mg/L	<0.04	<0.04	<0.04
Lead	mg/L	<0.005	<0.005	<0.005
Antimony	mg/L	<0.02	<0.02	<0.02
Selenium	mg/L	<0.01	<0.01	<0.01
Thallium	mg/L	<0.01	<0.01	<0.01
Vanadium	mg/L	<0.01	<0.01	<0.01
Zinc	**mg/L**	**0.048**	**0.041**	**0.064**

Notes:
(a) If Average, Minimum, and Maximum are the same then there were no detections beyond the MDL.
(b) If there are "<" before each number, then there were no detections above the MDL but the detection limits were different on some samples.
(c) Parameters in **BOLD** are constituents that were detected at >1 ppb.

TABLE 4-4. COMPARISON OF ANALYTICAL RESULTS FOR SPLIT COMPOSITE SAMPLES

PARAMETER	UNITS	POINT A									Point C								
		5/19/03			5/20/03			5/21/03			5/19/03			5/20/03			5/21/03		
		STL	ABRTF	% Diff	STL	ABRTF	% Diff	STL	ABRTF	% Diff	STL	ABRTF	% Diff	STL	ABRTF	% Diff	STL	ABRTF	% Diff
1,2,4-Trichlorobenzene	ug/l	<100	24		<100	0		<100	21		<10	0		<10	0		<10	0	
1,2-Dichlorobenzene	ug/l	450	378	17.4%	480	443	8.0%	430	212	67.9%	<10	0		<10	0		<10	0	
1,2-Diphenylhydrazine	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
1,3-Dichlorobenzene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
1,4-Dichlorobenzene	ug/l	420	414	1.4%	390	345	12.2%	360	91	119.3%	<10	0		<10	0		<10	0	
2,2'-Oxybis(1-Chloropropane) (bis-2-chloroisopropyl ether)	ug/l	<100			<100			<100			<10			<10			<10		
2,4,5-Trichlorophenol	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
2,4,6-Trichlorophenol	ug/l	<100	94		<100	0		<100	0		<10	0		<10	0		<10	0	
2,4-Dichlorophenol	ug/l	220	322	37.6%	250	299	17.9%	230	212	8.1%	<10	0		<10	0		<10	0	
2,4-Dimethylphenol	ug/l	<100	187		<100	0		<100	0		<10	0		<10	0		<10	0	
2,4-Dinitrophenol	ug/l	<500	0		<500	0		<500	0		<50	0		<50	0		<50	0	
2,4-Dinitrotoluene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
2,6-Dinitrotoluene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
2-Chloroaniline	ug/l	32,000	35,500	10.4%	26,000	29,600	12.9%	24000	14,100	52.0%	<10	2		<10	0		<10	1	
2-Chloronaphthalene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
2-Chlorophenol	ug/l	460	724	44.6%	<350	409		270	176		<10	0		<10	0		<10	0	
2-Methylnaphthalene	ug/l	<100			<100			<100			<10			<10			<10		
2-Methylphenol (o-Cresol)	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
2-Nitroaniline	ug/l	<500	0		<500	0		<500	0		<50	0		<50	0		<50	0	
2-Nitrochlorobenzene	ug/l	4200	944	126.6%	12000	9,940	18.8%	18000	4,800	115.8%	<10	0		<10	0		<10	0	
2-Nitrophenol	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
3,3'-Dichlorobenzidine	ug/l	<200	0		<200	0		<200	0		<20	0		<20	0		<20	0	
3-Chloroaniline	ug/l	20000	11,100	57.2%	21000	9,830	72.5%	20000	3,970	133.8%	<10	0		<10	0		<10	0	
3-Methylphenol/4-Methylphenol (m&p-Cresol)	ug/l	500	621	21.6%	440	397	10.3%	320	215	39.3%	<10	0		<10	0		<10	0	
3-Nitroaniline	ug/l	<500			<500			<500			<50			<50			<50		
3-Nitrochlorobenzene	ug/l	<2000	302		<2500	775		1000	700	35.3%	<10	0		<10	0		<10	0	
4,6-Dinitro-2-methylphenol	ug/l	<500	0		<500	0		<500	0		<50	0		<50	0		<50	0	
4-Bromophenylphenyl ether	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
4-Chloro-2,6-Dinitrophenol	ug/l	<40000	0		<40000	0		<20000	0		<200	0		<200	0		<200	0	
4-Chloro-3-methylphenol	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
4-Chloroaniline	ug/l	19000	23,300	20.3%	16000	17,900	11.2%	13000	6,280	69.7%	<20	2		<20	0		<20	0	
4-Chlorophenol	ug/l	4200			4200			3300			<10			<10			<10		
4-Chlorophenylphenyl ether	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
4-Nitroaniline	ug/l	<500	0		<500	0		<500	0		<50	0		<50	0		<50	0	
4-Nitrochlorobenzene	ug/l	2000	2,990	39.7%	3800	2,900	26.9%	5200	1,620	105.0%	<10	0		<10	0		<10	0	
4-Nitrophenol	ug/l	<500	0		<500	0		<500	0		<50	0		<50	0		<50	0	
Acenaphthene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Acenaphthylene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Aniline	ug/l	33000	43,600	27.7%	25000	33,500	29.1%	23000	18,800	20.1%	<20	3		<20	0		<20	0	
Anthracene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Benzidine	ug/l	<16000	0		<20000	0		<8000	0		<80	0		<80	0		<80	0	
Benzo(a)anthracene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	

TABLE 4-4. COMPARISON OF ANALYTICAL RESULTS FOR SPLIT COMPOSITE SAMPLES

PARAMETER	UNITS	POINT A									Point C								
		5/19/03			5/20/03			5/21/03			5/19/03			5/20/03			5/21/03		
		STL	ABRTF	% Diff	STL	ABRTF	% Diff	STL	ABRTF	% Diff	STL	ABRTF	% Diff	STL	ABRTF	% Diff	STL	ABRTF	% Diff
Benzo(a)pyrene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Benzo(b)fluoranthene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Benzo(g,h,i)perylene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Benzo(k)fluoranthene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Benzoic acid	ug/l	740			780			760			<50			<50			<50		
Benzyl alcohol	ug/l	<100			<100			<100			<10			<10			<10		
bis(2-Chloroethoxy)methane	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
bis(2-Chloroethyl)ether	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
bis(2-Ethylhexyl)phthalate	ug/l	<100	35		<100	0		<100	0		<10	0		<10	0		<10	0	
Butylbenzylphthalate	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Carbazole	ug/l	<100			<100			<100			<10			<10			<10		
Chrysene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Dibenzo(a,h)anthracene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Dibenzofuran	ug/l	<100			<100			<100			<10			<10			<10		
Diethylphthalate	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Dimethylphthalate	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Di-n-butylphthalate	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Di-n-octylphthalate	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Dinoseb	ug/l	<100			<100			<100			<10			<10			<10		
Fluoranthene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Fluorene	ug/l	<100	12		<100	0		<100	0		<10	0		<10	0		<10	0	
Hexachlorobenzene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Hexachlorobutadiene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Hexachlorocyclopentadiene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Hexachloroethane	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Indeno(1,2,3-cd)pyrene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Isophorone	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Naphthalene	ug/l	1500	0		<100	0		840	0		<10	0		<10	0		<10	0	
Nitrobenzene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
N-Nitrosodimethylamine	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
N-Nitroso-di-n-propylamine	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
N-Nitrosodiphenylamine	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Pentachlorophenol	ug/l	<500	0		<500	0		<500	0		<50	0		<50	0		<50	0	
Phenanthrene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Phenol	ug/l	6500	7,860	18.9%	4500	4,720	4.8%	3900	2,690	36.7%	<10	0		<10	0		<10	0	
Pyrene	ug/l	<100	0		<100	0		<100	0		<10	0		<10	0		<10	0	
Pyridine	ug/l	<500			<500			<500			<50			<50			<50		

TABLE 4-5. BENCH-SCALE TREATABILITY UNIT ANALYTICAL RESULTS

PARAMETER	UNITS	RSSCT		POINT A OZONE		POINT C OZONE	
		INF	EFF	INF	EFF	INF	EFF
Miscellaneous							
Total Organic Carbon	mg/l	140	19	130	110	14	14
Chemical Oxygen Demand	mg/l	596	65	501	425	40	65
Volatiles							
1,1-Dichloroethene	ug/l	<20	<10	<20	<20	<1	<1
1,2-Dichloroethene (total)	ug/l	<100	<50	<100	<100	<5	<5
2-Butanone (MEK)	ug/l	<200	<100	<200	260	<10	<10
2-Hexanone	ug/l	<200	<100	<200	<200	<10	<10
Benzene	ug/l	390	<10	440	<20	<1	<1
4-Methyl-2-pentanone (MIBK)	ug/l	<200	<100	<200	<200	<10	<10
Bromoform	ug/l	<20	<10	<20	<20	<1	<1
Carbon tetrachloride	ug/l	<20	<10	<20	<20	<1	<1
Chlorobenzene	ug/l	2800	<10	3000	<20	<1	<1
cis-1,3-Dichloropropene	ug/l	<20	<10	<20	<20	<1	<1
trans-1,3-Dichloropropene	ug/l	<20	<10	<20	<20	<1	<1
Chloroethane	ug/l	24	<10	24	<20	<1	<1
2-Chloroethylvinyl ether	ug/l	<200	<100	<200	<200	<10	<10
Chloroform	ug/l	<20	<10	<20	<20	<1	<1
1,1-Dichloroethane	ug/l	<20	<10	<20	<20	<1	<1
1,2-Dichloroethane	ug/l	<20	<10	<20	<20	<1	<1
1,2-Dichloropropane	ug/l	<20	<10	<20	<20	<1	<1
Ethylbenzene	ug/l	74	<10	92	<20	<1	<1
Methylene chloride (Dichloromethane)	ug/l	<100	<50	<100	<100	<1	<1
1,1,2,2-Tetrachloroethane	ug/l	<20	<10	<20	<20	<1	<1
Toluene	ug/l	850	<10	940	<20	<1	<1
trans-1,2-Dichloroethene	ug/l	<20	<10	<20	<20	<1	<1
1,1,1-Trichloroethane	ug/l	<20	<10	<20	<20	<1	<1
1,1,2-Trichloroethane	ug/l	<20	<10	<20	<20	<1	<1
Vinyl chloride	ug/l	22	<10	23	<20	<1	<1
Acetone	ug/l	4100	2900	3600	3600	100	150
Bromodichloromethane	ug/l	<20	<10	<20	<20	<1	<1

TABLE 4-5. BENCH-SCALE TREATABILITY UNIT ANALYTICAL RESULTS

PARAMETER	UNITS	RSSCT		POINT A OZONE		POINT C OZONE	
		INF	EFF	INF	EFF	INF	EFF
Volatiles (continued)							
Bromomethane (Methyl bromide)	ug/l	<20	<10	<20	<20	<1	<1
Chloromethane	ug/l	<20	<10	<20	<20	<1	<1
Carbon disulfide	ug/l	<20	<10	<20	<20	<1	<1
Dibromochloromethane	ug/l	<20	<10	<20	<20	<1	<1
Styrene	ug/l	<20	<10	<20	<20	<1	<1
Tetrachloroethene	ug/l	<20	<10	<20	<20	<1	<1
Trichloroethene	ug/l	28	<10	31	<20	<1	<1
Xylenes, Total	ug/l	420	20	500	<40	<2	<2
Semi-Volatiles							
2-Chlorophenol	ug/l	430	<10	290	<200	<10	<10
Acenaphthene	ug/l	<100	<10	<100	<200	<10	<10
2,2'-Oxybis(1-Chloropropane) (bis-2-chloroisopropyl ether)	ug/l	<100	<10	<100	<200	<10	<10
2-Nitroaniline	ug/l	<500	<50	<500	<1000	<50	<50
2-Chloroaniline	ug/l	33000	<10	25000	8000	<10	<10
2-Methylnaphthalene	ug/l	<100	<10	<100	<200	<10	<10
2-Methylphenol (o-Cresol)	ug/l	<100	<10	<100	<200	<10	<10
2,4-Dichlorophenol	ug/l	270	<10	300	<200	<10	<10
Acenaphthylene	ug/l	<100	<10	<100	<200	<10	<10
3-Nitroaniline	ug/l	<500	<50	<500	<1000	<50	<50
2,4-Dimethylphenol	ug/l	<100	<10	<100	<200	<10	<10
Anthracene	ug/l	<100	<10	<100	<200	<10	<10
4,6-Dinitro-2-methylphenol	ug/l	<500	<50	<500	<1000	<50	<50
4-Chloroaniline	ug/l	20000	<20	15000	3200	<20	<20
4-Chloro-3-methylphenol	ug/l	<100	<10	<100	<200	<10	<10
3-Methylphenol/4-Methylphenol (m&p-Cresol)	ug/l	500	<10	350	240	<10	<10
4-Nitroaniline	ug/l	<500	<50	<500	<1000	<50	<50
2,4-Dinitrophenol	ug/l	<500	<50	<500	<1000	<50	<50
2-Nitrophenol	ug/l	<100	<10	<100	<200	<10	<10
Benzo(a)pyrene	ug/l	<100	<10	<100	<200	<10	<10
4-Nitrophenol	ug/l	<500	<50	<500	<1000	<50	<50
Aniline	ug/l	28000	<20	24000	6000	<20	<20

TABLE 4-5. BENCH-SCALE TREATABILITY UNIT ANALYTICAL RESULTS

PARAMETER	UNITS	RSSCT		POINT A OZONE		POINT C OZONE	
		INF	EFF	INF	EFF	INF	EFF
Semi-Volatiles (continued)							
Benzo(a)anthracene	ug/l	<100	<10	<100	<200	<10	<10
Benzo(b)fluoranthene	ug/l	<100	<10	<100	<200	<10	<10
Diethylphthalate	ug/l	<100	<10	<100	<200	<10	<10
Pyridine	ug/l	<500	<50	<500	<1000	<50	<50
2,4,5-Trichlorophenol	ug/l	<100	<10	<100	<200	<10	<10
Benzo(g,h,i)perylene	ug/l	<100	<10	<100	<200	<10	<10
Pentachlorophenol	ug/l	<500	<50	<500	<1000	<50	<50
Phenol	ug/l	5800	<10	3800	3300	<10	<10
bis(2-Chloroethoxy)methane	ug/l	<100	<10	<100	<200	<10	<10
2,4,6-Trichlorophenol	ug/l	<100	<10	100	<200	<10	<10
bis(2-Chloroethyl)ether	ug/l	<100	<10	<100	<200	<10	<10
bis(2-Ethylhexyl)phthalate	ug/l	<100	<10	<100	<200	<10	<10
4-Bromophenylphenyl ether	ug/l	<100	<10	<100	<200	<10	<10
Butylbenzylphthalate	ug/l	<100	<10	<100	<200	<10	<10
2-Chloronaphthalene	ug/l	<100	<10	<100	<200	<10	<10
4-Chlorophenylphenyl ether	ug/l	<100	<10	<100	<200	<10	<10
Chrysene	ug/l	<100	<10	<100	<200	<10	<10
Dibenzo(a,h)anthracene	ug/l	<100	<10	<100	<200	<10	<10
1,2-Dichlorobenzene	ug/l	550	<10	490	<200	<10	<10
1,3-Dichlorobenzene	ug/l	<100	<10	<100	<200	<10	<10
1,4-Dichlorobenzene	ug/l	460	<10	400	<200	<10	<10
3,3'-Dichlorobenzidine	ug/l	<200	<20	<200	<400	<20	<20
Dimethylphthalate	ug/l	<100	<10	<100	<200	<10	<10
Di-n-butylphthalate	ug/l	<100	<10	<100	<200	<10	<10
2,4-Dinitrotoluene	ug/l	<100	<10	<100	<200	<10	<10
2,6-Dinitrotoluene	ug/l	<100	<10	<100	<200	<10	<10
Di-n-octylphthalate	ug/l	<100	<10	<100	<200	<10	<10
1,2-Diphenylhydrazine	ug/l	<100	<10	<100	<200	<10	<10
Fluoranthene	ug/l	<100	<10	<100	<200	<10	<10
Fluorene	ug/l	<100	<10	<100	<200	<10	<10
Hexachlorobenzene	ug/l	<100	<10	<100	<200	<10	<10

TABLE 4-5. BENCH-SCALE TREATABILITY UNIT ANALYTICAL RESULTS

PARAMETER	UNITS	RSSCT		POINT A OZONE		POINT C OZONE	
		INF	EFF	INF	EFF	INF	EFF
Semi-Volatiles (continued)							
Hexachlorobutadiene	ug/l	<100	<10	<100	<200	<10	<10
Hexachlorocyclopentadiene	ug/l	<100	<10	<100	<200	<10	<10
Hexachloroethane	ug/l	<100	<10	<100	<200	<10	<10
Indeno(1,2,3-cd)pyrene	ug/l	<100	<10	<100	<200	<10	<10
Isophorone	ug/l	<100	<10	<100	<200	<10	<10
Naphthalene	ug/l	1400	<10	1000	<200	<10	<10
Nitrobenzene	ug/l	<100	<10	<100	<200	<10	<10
N-Nitrosodimethylamine	ug/l	<100	<10	<100	<200	<10	<10
N-Nitrosodiphenylamine	ug/l	<100	<10	<100	<200	<10	<10
Phenanthrene	ug/l	<100	<10	<100	<200	<10	<10
Pyrene	ug/l	<100	<10	<100	<200	<10	<10
1,2,4-Trichlorobenzene	ug/l	<100	<10	<100	<200	<10	<10
Benzo(k)fluoranthene	ug/l	<100	<10	<100	<200	<10	<10
Benzoic acid	ug/l	<500	<50	1100	<1000	<50	<50
Benzyl alcohol	ug/l	<100	<10	<100	<200	<10	<10
Carbazole	ug/l	<100	<10	<100	<200	<10	<10
Dibenzofuran	ug/l	<100	<10	<100	<200	<10	<10
Dinoseb	ug/l	<100	<10	<100	<200	<10	<10
N-Nitroso-di-n-propylamine	ug/l	<100	<10	<100	<200	<10	<10
2-Nitrochlorobenzene	ug/l	13000	<10	24000	13000	<10	<10
3-Chloroaniline	ug/l	29000	<10	15000	9600	<10	<10
3-Nitrochlorobenzene	ug/l	<2000	<10	<2000	<1000	<10	<10
4-Chloro-2,6-Dinitrophenol	ug/l	<40000	<200	<40000	<20000	<200	<200
4-Chlorophenol	ug/l	5900	<10	3900	1900	<10	<10
4-Nitrochlorobenzene	ug/l	3600	<10	6300	4000	<10	<10
Benzidine	ug/l	<16000	<80	<16000	<8000	<80	<80
Pesticides							
Aldrin	ug/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
alpha-BHC	ug/l	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05
beta-BHC	ug/l	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05
gamma-BHC (Lindane)	ug/l	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05

TABLE 4-5. BENCH-SCALE TREATABILITY UNIT ANALYTICAL RESULTS

PARAMETER	UNITS	RSSCT		POINT A OZONE		POINT C OZONE	
		INF	EFF	INF	EFF	INF	EFF
Pesticides (continued)							
delta-BHC	ug/l	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05
Chlordane (technical)	ug/l	<0.50	<0.50	<0.5	<0.5	<0.50	<0.50
4,4'-DDT	ug/l	<0.10	<0.10	<0.1	<0.1	<0.10	<0.10
Endosulfan I	ug/l	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05
Endosulfan II	ug/l	<0.10	<0.10	<0.1	<0.1	<0.1	<0.1
4,4'-DDE	ug/l	<0.10	<0.10	<0.1	<0.1	<0.1	<0.1
4,4'-DDD	ug/l	<0.10	<0.10	<0.1	<0.1	<0.1	<0.1
Dieldrin	ug/l	<0.10	<0.10	<0.1	<0.1	<0.1	<0.1
Endosulfan sulfate	ug/l	<0.10	<0.10	<0.1	<0.1	<0.1	<0.1
Endrin	ug/l	<0.10	<0.10	<0.1	<0.1	<0.1	<0.1
Endrin aldehyde	ug/l	<0.10	<0.10	<0.1	<0.1	<0.1	<0.1
Heptachlor	ug/l	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05
Heptachlor epoxide	ug/l	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05
Toxaphene	ug/l	<5.00	<5.0	<5	<5.0	<5	<5
alpha-Chlordane	ug/l	<0.05	<0.1	<0.05	<0.1	<0.05	<0.05
Endrin ketone	ug/l	<0.10	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	ug/l	<0.05	<0.1	<0.05	<0.1	<0.05	<0.05
Methoxychlor	ug/l	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5
Herbicides							
2,4,5-TP (Silvex)	ug/l	<1	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-DB	ug/l	<1	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-D	ug/l	63	<0.5	57	58	<0.5	<0.5
2,4,5-T	ug/l	5.2P	<0.5	4.8E	5.9EP	<0.5	<0.5
Pentachlorophenol	ug/l	3.2	<1.0	2.6	3.1	<1	<1
Dalapon	ug/l	<120	<120	<120	<120	<120	<120
Dicamba	ug/l	<1	<1.2	<1.2	<1.2	<1.2	<1.2
Dichloroprop	ug/l	88E	<6.0	69E	74E	<6	<6
MCPA[(4-chloro-2-methylphenoxy)-acetic acid]	ug/l	<120	<120	<120	<120	<120	<120
MCPP[2-(4-chloro-2-methylphenoxy)-propanoic acid]	ug/l	<120	<120	<120	<120	<120	<120

TABLE 4-5. BENCH-SCALE TREATABILITY UNIT ANALYTICAL RESULTS

PARAMETER	UNITS	RSSCT		POINT A OZONE		POINT C OZONE	
		INF	EFF	INF	EFF	INF	EFF
PCBs							
Decachlorobiphenyl	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dichlorobiphenyl	ug/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlorobiphenyl	ug/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Hexachlorobiphenyl	ug/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Monochlorobiphenyl	ug/l	3.7	<0.1	<0.1	<0.1	<0.1	<0.1
Nonachlorobiphenyl	ug/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Octachlorobiphenyl	ug/l	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Pentachlorobiphenyl	ug/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Tetrachlorobiphenyl	ug/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trichlorobiphenyl	ug/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aroclor-1242	ug/l	<1	<1	<1	<1.0	<1	<1
Aroclor-1254	ug/l	<1	<1	<1	<1.0	<1	<1
Aroclor-1221	ug/l	<2	<2	<2	<2.0	<2	<2
Aroclor-1232	ug/l	<1	<1	<1	<1.0	<1	<1
Aroclor-1248	ug/l	<1	<1	<1	<1.0	<1	<1
Aroclor-1260	ug/l	<1	<1	<1	<1.0	<1	<1
Aroclor-1016	ug/l	<1	<1	<1	<1.0	<1	<1
Metals							
Silver	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aluminum	mg/l	<0.20	<0.20	<0.2	<0.20	<0.2	<0.2
Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Barium	mg/l	0.47	0.33	0.5	0.27	0.43	0.43
Beryllium	mg/l	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Calcium	mg/l	270	260	270	120	260	260
Cadmium	mg/l	<0.01	<0.01	<0.005	<0.01	<0.01	<0.01
Cobalt	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	mg/l	<0.02	<0.02	<0.03	<0.02	<0.02	<0.02
Iron	mg/l	19	<0.05	20	16	17	17
Mercury	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Potassium	mg/l	15	15	14	14	14	14

TABLE 4-5. BENCH-SCALE TREATABILITY UNIT ANALYTICAL RESULTS

PARAMETER	UNITS	RSSCT		POINT A OZONE		POINT C OZONE	
		INF	EFF	INF	EFF	INF	EFF
Metals (continued)							
Magnesium	mg/l	64	61	62	61	62	62
Manganese	mg/l	2.8	2.7	2.8	0.71	2.8	2.7
Sodium	mg/l	130	130	120	120	120	120
Nickel	mg/l	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Lead	mg/l	<0.01	<0.01	<0.005	0.0054	<0.01	<0.01
Antimony	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Selenium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/l	0.042	0.03	0.061	0.045	<0.02	<0.02

Qualifiers:
E = Estimated value
P = Presence of parameter confirmed but accuracy of result suspect

FIGURE 4-1. COD BREAKTHROUGH CURVE FOR PILOT SYSTEM LEAD COLUMN

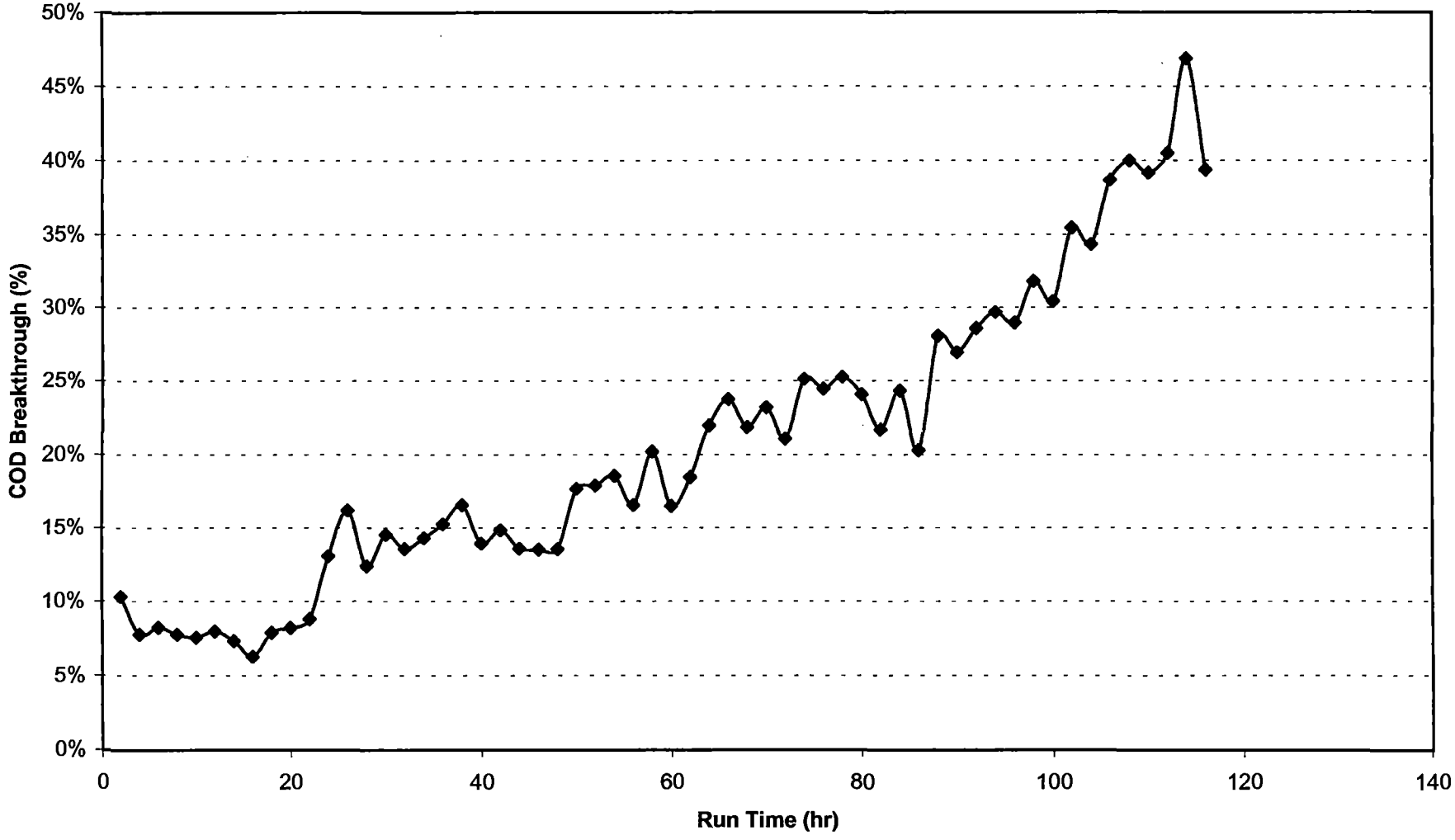


FIGURE 4-2. ACETONE BREAKTHROUGH CURVE FOR PILOT SYSTEM LEAD COLUMN

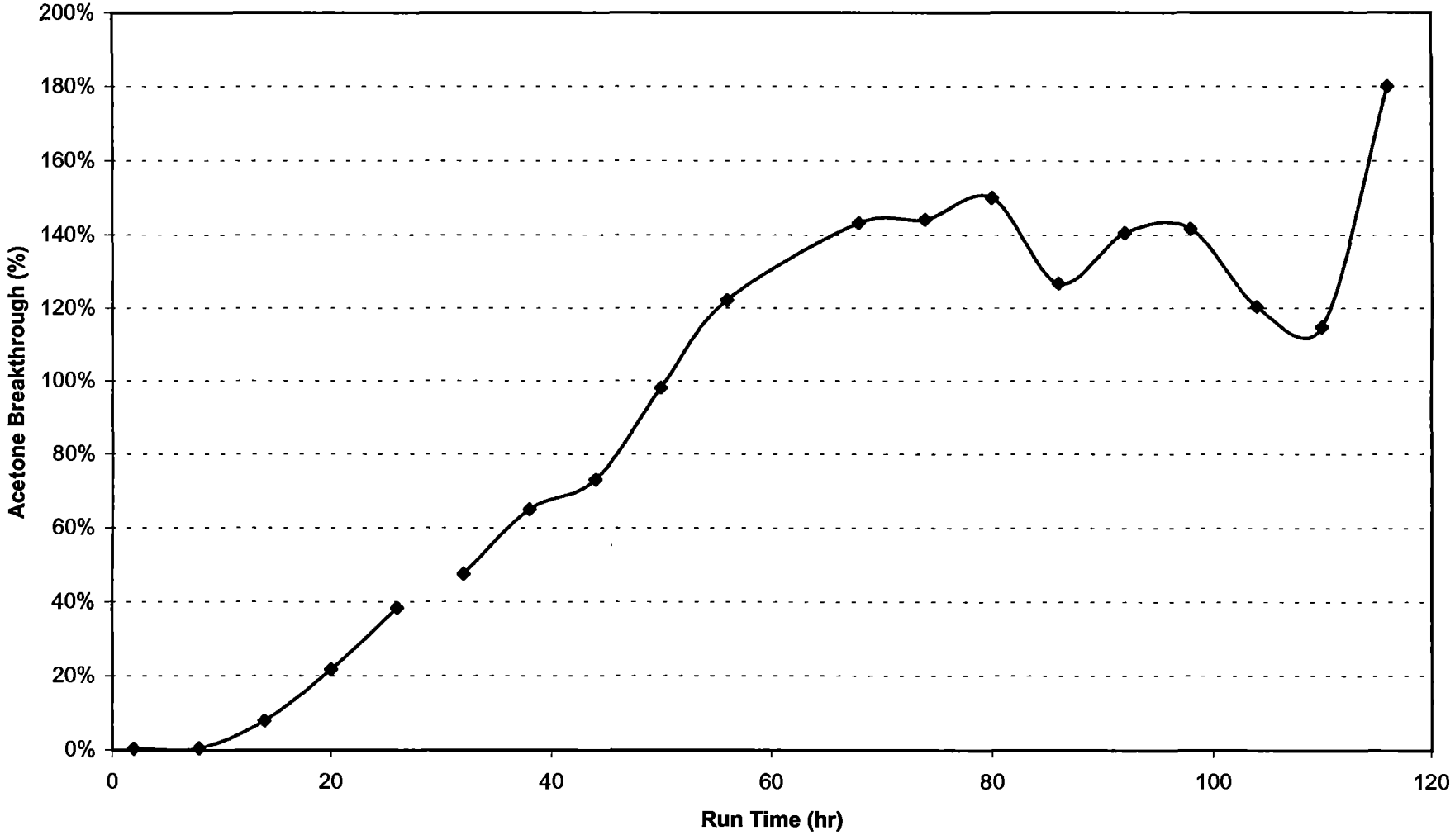
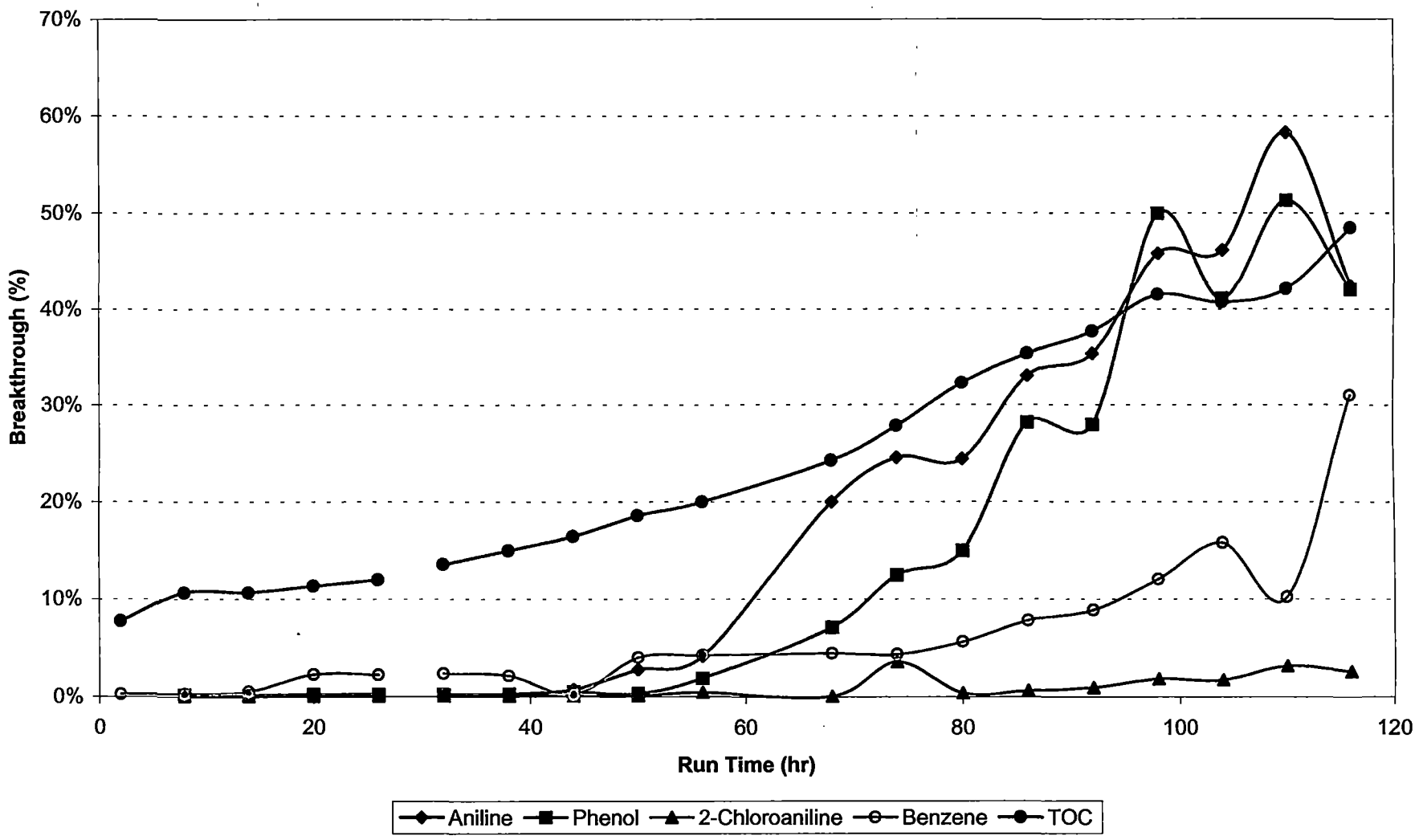


FIGURE 4-3. TOC AND SPECIFIC ORGANICS BREAKTHROUGH CURVES FOR PILOT SYSTEM LEAD COLUMN



5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 GAC TREATMENT

The pilot system at the Krummrich site operated nearly twice as long as the original projection of 60 hours based on the preliminary process design. This increased run time can be attributed to the lower influent TOC concentration – an average of 141 mg/L versus the projected 300 mg/L. Based on the flow and TOC data collected during the study, Calgon DSR-C activated carbon has a capacity of 0.103 lb TOC per lb of GAC for the Krummrich Area 2 groundwater. Capacity calculations are provided in Table 5-1. Because the lead column was not run to total exhaustion, this capacity represents a conservative estimate for projecting GAC usage in the full-scale system, should it be implemented in the future. If the groundwater TOC concentration remains constant, the GAC capacity can also be expressed as 8.7 lb of GAC exhausted per 1,000 gallons of treated groundwater. Assuming an average forward flow of 600 gpm for the full-scale system, coupled with a lead carbon column changeout of 20,000 lb per train, a changeout would be required every 64 hours (2.7 days). The time between changeouts may be increased if the lead columns are run to complete exhaustion and the lag column effluent closely monitored, as the capacities shown above and in Table 5-1 are calculated based on only 45-50 percent breakthrough of the lead column.

The effluent quality achieved following lead-lag carbon treatment is shown in Table 5-2. As expected, for a polar, volatile, low molecular weight compound carbon did not effectively remove acetone from the groundwater.

5.2 COMPARISON OF PILOT SYSTEM AND RSSCT

TOC data were not tracked during operation of the RSSCT due to limited quantities of available effluent; therefore, the TOC capacity for the unit cannot be determined. However, the design of the RSSCT can be used to compare COD breakthrough observed in both the bench-scale and pilot scale units. From the design parameters in Table 3-2, one hour of RSSCT operation correlates to 56 hours of pilot system operation. The target value of 50 percent COD breakthrough occurred in the RSSCT after 110 minutes of operation, which equates to 102 hours of pilot system operation.

However, the pilot system was operated for 116 hours (i.e. 14 percent longer) and approached but did not achieve 50 percent breakthrough of COD. This discrepancy between the projected and actual run times for the pilot system is likely due to the high COD concentration in the RSSCT influent relative to the pilot system. Influent for the RSSCT was collected early in the operation of the pilot system, before the influent COD stabilized in the range of 480-500 mg/L. As a result, the influent COD was approximately 20 percent higher for the RSSCT than for the pilot system. This increase in COD would result in a more rapid saturation of the activated carbon in the small-scale column, thus causing breakthrough to occur more quickly than in the pilot system. However, the projected run time for the RSSCT agrees with the observed operation of the pilot system within 15 percent, suggesting that the RSSCT can be used to predict full-scale operations with a reasonable degree of accuracy. The RSSCT was operated for 3 hours. During this time, approximately 76 percent of the influent COD had broken through. Thus, assuming that the RSSCT operation can reasonably predict full-scale performance, the full-scale system would require a 20,000 lb carbon changeout every 4 days rather than every 2.7 days as estimated in Section 5.1.

5.3 APPLICABILITY OF OZONATION

Results from ozonation of the pilot system influent indicate that portions of the groundwater TOC can be treated by ozone. However, the results shown in Section 4.2 indicate that ozone will treat the various organic compounds in the groundwater at varying degrees of effectiveness. Acetone, which achieved rapid breakthrough in the carbon bed, was not removed by ozone. For the ozone dose studied (3 lb per lb of COD), the observed TOC removal of 15 percent would not appreciably lower the carbon demand. An increase in the ozone dosage or a combined treatment of ozone and ultraviolet light catalyst would likely increase this removal efficiency. The capital and operating costs of an ozone or ozone-UV pretreatment system would need to be compared to the savings obtained by lowering the carbon usage rate.

The effectiveness of ozone as a post-treatment technology could not be determined due to the limited number of detectable organics in the pilot system effluent. However, the limited number of detectable organics in the effluent suggests that post-treatment would not be necessary to achieve desired effluent quality.

TABLE 5-1. CALCULATION OF ACTIVATED CARBON CAPACITY

Run Time (hr)	Total Flow (gal)	Influent TOC (mg/L)	Effluent TOC (mg/L)	TOC Removed	
				(mg/L)	(lb)
0	5,760				
2	41,270	180	14	166	49.2
8	113,960	150	16	134	91.0
14	187,960	150	16	134	82.7
20	260,510	150	17	133	80.5
26	331,571	150	18	132	78.3
32	403,796	140	19	121	72.9
38	474,128	140	21	119	69.8
44	544,400	140	23	117	68.6
50	614,420	140	26	114	66.6
56	687,526	140	28	112	68.3
62	759,620	140	31	109	65.6
68	830,454	140	34	106	62.7
74	902,160	140	39	101	60.4
80	973,836	130	42	88	52.6
86	1,046,273	130	46	84	50.8
92	1,115,180	130	49	81	46.6
98	1,184,322	130	54	76	43.8
104	1,252,342	140	57	83	47.1
110	1,317,700	140	59	81	44.2
116	1,384,330	130	63	67	37.3

TOTAL TOC REMOVED (lb):	1,239
TOTAL GAC LOAD (lb):	12,000
GAC CAPACITY (lb TOC/lb GAC):	0.103
GAC CAPACITY (lb GAC/1,000 gal):	8.70

TABLE 5-2. EFFLUENT QUALITY ACHIEVED[a]

PARAMETER	UNITS	RESULT[b]
Miscellaneous		
TKN	mg/L	9.4
Ammonia	mg/L	9.0
BOD	mg/L	30
Volatiles		
1,1-Dichloroethene	ug/L	ND
1,2-Dichloroethene (total)	ug/L	ND
2-Butanone (MEK)	ug/L	ND
Benzene	ug/L	ND
4-Methyl-2-pentanone (MIBK)	ug/L	ND
Acrolein	ug/L	ND
Acrylonitrile	ug/L	ND
Bromoform	ug/L	ND
Carbon tetrachloride	ug/L	ND
Chlorobenzene	ug/L	ND
cis-1,3-Dichloropropene	ug/L	ND
trans-1,3-Dichloropropene	ug/L	ND
Chloroethane	ug/L	ND
2-Chloroethylvinyl ether	ug/L	ND
Chloroform	ug/L	ND
1,1-Dichloroethane	ug/L	ND
1,2-Dichloroethane	ug/L	ND
1,2-Dichloropropane	ug/L	ND
1,3-Dichloropropene (total)	ug/L	ND
Ethylbenzene	ug/L	ND
Methylene chloride (Dichloromethane)	ug/L	2.9
1,1,2,2-Tetrachloroethane	ug/L	ND
Toluene	ug/L	0.42
1,1,1-Trichloroethane	ug/L	ND
1,1,2-Trichloroethane	ug/L	ND
Vinyl chloride	ug/L	ND
Acetone [c]	ug/L	6,000
Bromodichloromethane	ug/L	ND
Bromomethane (Methyl bromide)	ug/L	ND
Chloromethane	ug/L	ND
Carbon disulfide	ug/L	ND
Dibromochloromethane	ug/L	ND
Tetrachloroethene	ug/L	ND
Trichloroethene	ug/L	ND
m and p-Xylene	ug/L	ND
o-Xylene	ug/L	ND
Xylenes, Total	ug/L	ND

TABLE 5-2. EFFLUENT QUALITY ACHIEVED[a]

PARAMETER	UNITS	RESULT[b]
Semi-Volatiles		
2-Chlorophenol	ug/L	ND
Acenaphthene	ug/L	ND
2,2'-Oxybis(1-Chloropropane) (bis-2-chloroisopropyl ether)	ug/L	ND
2-Nitroaniline	ug/L	ND
2-Chloroaniline	ug/L	1
2-Methylphenol (o-Cresol)	ug/L	ND
2,4-Dichlorophenol	ug/L	ND
Acenaphthylene	ug/L	ND
2,4-Dimethylphenol	ug/L	ND
Anthracene	ug/L	ND
4,6-Dinitro-2-methylphenol	ug/L	ND
4-Chloroaniline	ug/L	ND
4-Chloro-3-methylphenol	ug/L	ND
3-Methylphenol/4-Methylphenol (m&p-Cresol)	ug/L	ND
4-Nitroaniline	ug/L	ND
2,4-Dinitrophenol	ug/L	ND
2-Nitrophenol	ug/L	ND
Benzo(a)pyrene	ug/L	ND
4-Nitrophenol	ug/L	ND
Aniline	ug/L	5
Benzo(a)anthracene	ug/L	ND
Benzo(b)fluoranthene	ug/L	ND
Diethylphthalate	ug/L	ND
2,4,5-Trichlorophenol	ug/L	ND
Benzo(g,h,i)perylene	ug/L	ND
Pentachlorophenol	ug/L	ND
Phenol	ug/L	ND
bis(2-Chloroethoxy)methane	ug/L	ND
2,4,6-Trichlorophenol	ug/L	ND
bis(2-Chloroethyl)ether	ug/L	ND
bis(2-Ethylhexyl)phthalate	ug/L	ND
4-Bromophenylphenyl ether	ug/L	ND
Butylbenzylphthalate	ug/L	ND
2-Chloronaphthalene	ug/L	ND
4-Chlorophenylphenyl ether	ug/L	ND
Chrysene	ug/L	ND
Dibenzo(a,h)anthracene	ug/L	ND
1,2-Dichlorobenzene	ug/L	ND
1,3-Dichlorobenzene	ug/L	ND

TABLE 5-2. EFFLUENT QUALITY ACHIEVED[a]

PARAMETER	UNITS	RESULT[b]
1,4-Dichlorobenzene	ug/L	ND
3,3'-Dichlorobenzidine	ug/L	ND
Dimethylphthalate	ug/L	ND
2,4-Dinitrotoluene	ug/L	ND
2,6-Dinitrotoluene	ug/L	ND
Di-n-octylphthalate	ug/L	ND
1,2-Diphenylhydrazine	ug/L	ND
Fluoranthene	ug/L	ND
Fluorene	ug/L	ND
Hexachlorobenzene	ug/L	ND
Hexachlorobutadiene	ug/L	ND
Hexachlorocyclopentadiene	ug/L	ND
Hexachloroethane	ug/L	ND
Indeno(1,2,3-cd)pyrene	ug/L	ND
Isophorone	ug/L	ND
Naphthalene	ug/L	ND
Nitrobenzene	ug/L	ND
N-Nitrosodimethylamine	ug/L	ND
N-Nitrosodiphenylamine	ug/L	ND
Phenanthrene	ug/L	ND
Pyrene	ug/L	ND
1,2,4-Trichlorobenzene	ug/L	ND
Benzo(k)fluoranthene	ug/L	ND
Dinoseb	ug/L	ND
N-Nitroso-di-n-propylamine	ug/L	ND
2-Nitrochlorobenzene	ug/L	ND
3-Chloroaniline	ug/L	ND
3-Nitrochlorobenzene	ug/L	ND
4-Chloro-2,6-Dinitrophenol	ug/L	ND
4-Nitrochlorobenzene	ug/L	ND
Benzidine	ug/L	ND
Pesticides		
Aldrin	ug/L	ND
alpha-BHC	ug/L	ND
beta-BHC	ug/L	ND
gamma-BHC (Lindane)	ug/L	ND
delta-BHC	ug/L	ND
Chlordane (technical)	ug/L	ND
4,4'-DDT	ug/L	ND
Endosulfan I	ug/L	ND
Endosulfan II	ug/L	ND

TABLE 5-2. EFFLUENT QUALITY ACHIEVED[a]

PARAMETER	UNITS	RESULT[b]
4,4'-DDE	ug/L	ND
4,4'-DDD	ug/L	ND
Dieldrin	ug/L	ND
Endosulfan sulfate	ug/L	ND
Endrin	ug/L	ND
Endrin aldehyde	ug/L	ND
Heptachlor	ug/L	ND
Heptachlor epoxide	ug/L	ND
Toxaphene	ug/L	ND
Methoxychlor	ug/L	ND
Herbicides		
2,4,5-TP (Silvex)	ug/L	ND
2,4-D	ug/L	ND
2,4,5-T	ug/L	ND
Pentachlorophenol	ug/L	ND
Dalapon	ug/L	ND
PCBs		
Aroclor-1242	ug/L	ND
Aroclor-1254	ug/L	ND
Aroclor-1221	ug/L	ND
Aroclor-1232	ug/L	ND
Aroclor-1248	ug/L	ND
Aroclor-1260	ug/L	ND
Aroclor-1016	ug/L	ND
Metals		
Silver	mg/L	ND
Aluminum	mg/L	ND
Arsenic	mg/L	ND
Barium	mg/L	0.376
Beryllium	mg/L	ND
Calcium	mg/L	ND
Cadmium	mg/L	ND
Cobalt	mg/L	ND
Chromium	mg/L	ND
Copper	mg/L	ND
Iron	mg/L	18
Mercury	mg/L	ND
Potassium	mg/L	ND
Magnesium	mg/L	ND
Manganese	mg/L	2.9
Sodium	mg/L	ND

TABLE 5-2. EFFLUENT QUALITY ACHIEVED[a]

PARAMETER	UNITS	RESULT[b]
Nickel	mg/L	ND
Lead	mg/L	ND
Antimony	mg/L	ND
Selenium	mg/L	ND
Thallium	mg/L	ND
Vanadium	mg/L	ND
Zinc	mg/L	0.04

Notes:

(a) Based on ABRTF effluent analysis after lag column May 21, 2003 (except acetone, see note c).

(b) ND = Non Detect

(c) Data from STL effluent analysis after lag column May 24, 2003.

ATTACHMENT 1

AMERICAN BOTTOMS REGIONAL TREATMENT FACILITY TEMPORARY USER DISCHARGE PERMIT

27

AMERICAN BOTTOMS
REGIONAL WASTEWATER TREATMENT FACILITY
1 AMERICAN BOTTOMS ROAD
SAUGET, ILLINOIS 62201-1075
(618) 337-1710
FAX (618) 337-8919

May 9, 2003

HAND DELIVERED

Mr. Richard S. Williams
Project Manager, Sauget Sites Project
Solutia Inc.
500 Monsanto Avenue
Sauget, IL 62206-1198

RE: Draft Permit No. 03-138

Dear Mr. Williams:

Herewith is the draft Wastewater Discharge Permit No.03-138 for your review.

We have modified the draft permit per your comments in the May 5th meeting and have also modified section part 4.E to include the following changes.

1. E.3 - Monitoring Location A was added for mercury and cyanide monitoring to remain consistent with E.12;
   - Monitoring for parameters that reference part 4.C were removed and consolidated to parameters in part E.12;
   - COD monitoring was removed from Location C;

2. The monitoring frequency language in section E.5 was modified for Solutia to daily for the first, third, seventh and every seven days thereafter. Language was added to clarify the first day of discharge to include 6-hour grabs during the period of discharge.

3. Language was added to E.6 to define a sampling day.

4. Language was added to E.7 stating that compliance at Location C will be determined only on parameters listed in 4.C.

5. Language was added to E.8-10 to clarify how composite and grab samples are to be collected.

We envision issuing the final permit by the end of next week.

If you have any questions, please call me at 337-1710.

Sincerely,

Jerry G. Richardson II

Jerry G. Richardson II
Pretreatment Coordinator

enclosure

VILLAGE OF SAUGET

DRAFT

AMERICAN BOTTOMS REGIONAL

WASTEWATER TREATMENT FACILITY

WASTEWATER DISCHARGE PERMIT

for

SOLUTIA, INC. - Site R

PERMIT NO. 03-138

DRAFT

Permit No. 03-138
Solutia, Inc.
Site R - Temporary Discharge

VILLAGE OF SAUGET
AMERICAN BOTTOMS REGIONAL WASTEWATER TREATMENT FACILITY

TABLE OF CONTENTS

Wastewater Discharge Permit No. 03-138 1
PART 1 - GENERAL CONDITIONS OF PERMIT 2
A. General 2
B. Prohibitive Standards 2
C. Prohibition of Improper Dilution 2
D. Duration 2
E. Transfer 2
F. Change in Conditions 3
G. Access 3
H. Retention of Records 3
I. Analytical Methods 4
J. Pretreatment Facilities 4
K. Spill Containment 4
L. Permit Modifications 5
M. Civil and Criminal Penalties 5
N. Additional Information 6
O. Upset 6
P. Bypass 6
Q. Affirmative Defense 6
R. Resampling 6
S. Notifications 7
T. Report Submittal 8
U. Revocation of Permit 8
V. Rate and other Ordinance 9

PART 2 - GENERAL AND SPECIFIC REPORTING REQUIREMENTS 9
A. General 9
B. Specific 9
1. Monitoring Reports 9
2. Compliance Deadline Report 9

PART 3 - GENERAL SAMPLING AND TESTING REQUIREMENTS 10

PART 4 - EFFLUENT LIMITATIONS, SAMPLING AND TESTING REQUIREMENTS 11
A. Local Limits 11
B. State Limits 12
C. Site Specific Parameter Limits 13
D. National Categorical Pretreatment Standards 14
E. Monitoring Schedule 14

PART 5 - SPECIAL CONDITIONS 16

FIGURE 1 - MONITORING LOCATION 18

DRAFT

May 9, 2003

Solutia, Inc. - W.G. Krummrich Plant - Site R - Temporary Discharge

500 Monsanto Avenue
Sauget, Illinois 62206-1198

Wastewater Discharge Permit No. 03-138

Dear Sirs:

In accordance with all the terms and conditions of Ordinance 632 of the Village of Sauget; the 1977 Regional Agreement as amended; Section 46 of the Illinois Environmental Protection Act of 1970 (Ill. Rev. Stat. 1987. Ch. 1111/2, Sec. 1046) as amended; and Ill. Rev. Stat. 1987, Ch 24, Sec. 11-141-7; permission is hereby granted to Solutia Inc., to discharge treated groundwater into sewer lines tributary to the American Bottoms Regional Wastewater Treatment Plant in accordance with and subject to the provisions of attached American Bottoms Regional Wastewater Discharge Permit No. 03-138 ("Permit").

This Permit is granted in response to the application filed on January 28, 2003 in the office of the General Manager, #1 American Bottoms Road, Sauget, Illinois 62201, and in conformity with plans, specifications and other data submitted in support of the above application, all of which are filed with and considered as a part of this Permit, together with the attached conditions and requirements.

Nothing herein shall be construed as a permit or as permission for the permittee to violate the provisions of any sewer use ordinance in effect within the jurisdiction of any unit of local government in which the permittee's facility is located.

This Permit will take effect on May 15, 2003, and will expire on June 15, 2003.

VILLAGE OF SAUGET

By: _____
General Manager

PART 1 - GENERAL CONDITIONS OF PERMIT

A. General - This Wastewater Discharge Permit shall be expressly subject to all provisions of Ordinance 632 of the Village of Sauget, including any further amendments thereto (hereinafter "the Ordinance") and all other applicable regulations, user charges, and fees established by the Village of Sauget. In consideration of the granting of this Permit, the permittee shall comply with all provisions of the Ordinance, Permit conditions, and the Implementation procedures including, but not limited to the specific requirements of these General Condition Articles. Any Permit noncompliance constitutes a violation of the Ordinance, and is grounds for enforcement action.

B. Prohibitive Standards - The permittee shall comply with all prohibitive discharge standards pursuant to Section 3.2 of the Ordinance and all Local, State, and Federal discharge limits set forth in the Permit.

C. Prohibition of Improper Dilution - Improper dilution shall be prohibited pursuant to Section 3.6 of the Ordinance.

D. Duration - This Permit is issued effective May 15, 2003, and shall expire on June 15, 2003.

E. Transfer - Pursuant to Section 4.11 of the Ordinance, this Wastewater Discharge Permit may be reassigned or transferred, in whole or in part, to a new owner and/or operator only if the permittee gives at least thirty (30) days advance notice to the POTW and the POTW approves the Wastewater Discharge Permit transfer. The notice to the POTW must include a written certification by the new owner and/or operator which:

1. States that the new owner and/or operator has no immediate intent to change the facility's operations and processes;

2. Identifies the specific date on which the transfer is to occur; and

3. Acknowledges full responsibility for complying with the Wastewater Discharge Permit.

F. Change in Conditions - Pursuant to Section 4.7 of the Ordinance, in the event the type, quality, character or volume of Pollutants in a Discharge, including the listed or characteristic hazardous wastes for which the permittee has submitted initial notification under Section 4.13.5 of the Ordinance, is expected to substantially change as reasonably determined by the permittee or POTW, the permittee or his assignee (see paragraph E. above) shall give sixty (60) days advance notice in writing to the POTW and shall make a new application to the POTW and the Sewer System Owner prior to said change. No permittee shall substantially change the type, quality, character or volume of its Wastewater beyond that allowed by this Permit without prior approval of the Sewer System Owner and the POTW.

G. Access - Pursuant to Section 4.15 of the Ordinance, persons or occupants of premises in which a Discharge source or treatment system is located or in which records are kept shall allow the POTW or its representative ready access upon presentation of credentials at reasonable times to all parts of said premises for the purposes of inspection, sampling, examination and photocopying of records required to be kept by the Ordinance and this Permit, and in the performance of any of their duties. The POTW shall have the right to set up on the permittee's property such devices as are necessary to conduct sampling, monitoring and metering operations.

H. Retention of Records - Pursuant to Section 4.15 of the Ordinance, the permittee shall maintain records of all information resulting from any monitoring activities required by this Ordinance and shall include:

1. The date, exact place, method and time of sampling and the names of the Person or Persons taking the samples;

2. The dates analyses were performed;

3. Who performed the analyses;

4. The analytical techniques/methods used; and

5. The results of such analyses.

The permittee shall maintain for inspection by the POTW, IEPA or USEPA such records for a minimum of three (3) years.

This period of retention shall be extended during the course of any unresolved litigation regarding the Discharge of Pollutants by the permittee or operation of the POTW Pretreatment program or when requested by the Regional Administrator of USEPA or the Director of IEPA.

I. Analytical Methods - All measurements, sampling, tests, and analyses to which reference is made in this Permit shall be determined and performed in accordance with the procedures established by the Administrator of the United States Environmental Protection Agency (hereafter "Administrator") pursuant to Section 304(g) of the Act and contained in 40 CFR Part 136 and amendments thereto or with any other test procedures approved by the Administrator. Sampling shall be performed in accordance with the techniques approved by the Administrator. Where 40 CFR Part 136 does not include sampling or analytical techniques for the Pollutants in question, or where the Administrator determines that the Part 136 sampling and analytical techniques are inappropriate for the Pollutant in question, sampling and analyses shall be performed using validated analytical methods or any other sampling and analytical procedures, including procedures suggested by the POTW or other parties, approved by the Administrator.

J. Pretreatment Facilities - The permittee shall provide necessary Wastewater Pretreatment as required to comply with the Ordinance and shall achieve compliance with all applicable Pretreatment Requirements and Standards within the time limitations as specified by appropriate statutes, regulations, and the Ordinance. Any facilities required to pretreat Wastewater to a level acceptable to the POTW shall be provided, properly operated and maintained at the permittee's expense. Such Pretreatment facilities shall be under the control and direction of an IEPA certified Wastewater Treatment Operator.

K. Spill Containment - Pursuant to Section 3.7 of the Ordinance, any permittee having the ability to cause Interference or Pass-Through of the POTW or to violate the regulatory provisions of the Ordinance shall provide protection from Accidental or Slug Discharges to the POTW of prohibited materials or other substances regulated by the Ordinance. Any facilities required to prevent Accidental or Slug Dis-

charge of prohibited materials shall be provided and maintained at the permittee's own cost and expense.

L. Permit Modifications - The terms and conditions of this Permit may be modified by the POTW during the term of the Permit for good cause including, but not limited to, the following: to incorporate any new or revised Federal, State, or local Pretreatment Standards or Requirements; to address significant alterations or additions to the permittee's operation, processes, or Wastewater volume or character since the time of Wastewater Discharge Permit issuance; a change in the POTW that requires either a temporary or permanent reduction or elimination of the authorized Discharge; misrepresentation or failure to fully disclose all relevant facts in the Wastewater Discharge Permit application or in any required reporting; revision of or a grant of variance from Categorical Pretreatment Standards pursuant to 40 CFR 403.13; to correct typographical errors in the Wastewater Discharge Permit; or to reflect a transfer of the facility ownership and/or operation to a new owner/operator (as provided in paragraph E. above). The permittee shall be informed of any proposed changes in its Permit at least 30 days prior to the effective date of any modification, and shall have all rights of appeal as provided in Section 4.12 of the Ordinance.

M. Civil and Criminal Penalties - Pursuant to Part 6 of the Ordinance, any permittee who is found to have violated an Order of the POTW or who has failed to comply with any provision of the Ordinance, and the orders, rules, and regulations and Wastewater Discharge Permits issued thereunder, may be fined by appropriate suit at law in an amount not less than one hundred dollars ($100) nor more than one thousand dollars ($1000) per day for each violation. In addition to the penalties provided herein, the POTW may recover reasonable attorney's fees, court costs, court reporter fees and other expenses of litigation by appropriate suit at law against the Person found to have violated this Ordinance or the orders, rules, regulations and Permits issued thereunder.

Any Person who knowingly makes any false statements, representation or certification in any application, record, report, plan or other document filed or required to be

maintained pursuant to the Ordinance or Wastewater Discharge Permit, or who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required under the Ordinance, shall in addition be guilty of a misdemeanor and upon conviction, be punished by a fine of $500 to $1,000, for each offense.

N. Additional Information - The permittee shall furnish any additional information as may be reasonably requested by the Village of Sauget from time to time.

O. Upset - The permittee shall have an affirmative defense for actions defined in Section 3.8 of the Ordinance. In any enforcement proceeding, the permittee seeking to establish the occurrence of an Upset shall have the burden of proof.

P. Bypass - Bypass provisions pursuant to Section 3.9 of the Ordinance are applicable to this Permit and are hereby incorporated by reference.

Q. Affirmative Defenses - The Permittee shall have an affirmative defense in any action brought against it alleging a violation of Section 3.2.1, 3.2.2.2, 3.2.2.4, 3.2.2.5, or 3.2.2.7.

R. Resampling - Pursuant to Section 4.13.3.7 of the Ordinance, if sampling performed by the permittee indicates a violation, the permittee shall notify the POTW within 24 hours of becoming aware of the violation. The permittee shall also repeat the sampling and analysis and submit the results of the repeat analysis to the POTW within 30 days after becoming aware of the violation, except the permittee is not required to resample if:

1. The POTW performs sampling at the permittee at a frequency of at least once per month, or

2. The POTW performs sampling at the permittee between the time when the permittee performs its initial sampling and the time when the permittee receives the results of this sampling.

3. The POTW may waive the resampling requirements if the SIU performs compliance self-monitoring at a frequency of at least once per month.

Resampling is only required for those parameters for which the violation has been identified.

S. Notifications - The following verbal and written notifications are required:

1. Pursuant to Section 4.13.3.7 of the Ordinance, if sampling performed by the permittee indicates a violation of any requirements of the Ordinance or this Permit, the permittee shall notify the POTW within 24 hours of becoming aware of the violation. Such notification may be made orally by telephone.

2. Pursuant to Section 3.7.4 of the Ordinance, in the case of an Accidental or Slug Discharge of Pollutants which may cause Interference at the POTW or may Pass Through the POTW or violate any other requirements of the Ordinance or this Permit, it shall be the responsibility of the permittee to immediately telephone and notify the POTW and the Sewer System Owner of the incident. The notification shall include name of caller, location and time of Discharge, type of Wastewater, estimated concentration and volume. For permittees discharging to the P-Chem Plant, notice to the POTW only is required.

3. Within five days following an Accidental Discharge, the permittee shall submit to the POTW and the Sewer System Owner a detailed written report describing the cause of the Accidental Discharge and the measures to be taken by the permittee to prevent similar future occurrences.

4. A permittee wishing to establish the affirmative defense of Upset for noncompliance with National Categorical Pretreatment Standards shall, in addition to the 24-hour verbal notification required in 1. above, and under Section 3.8.3.3 of the Ordinance, provide a written submission containing the information required by Section 3.8.3.3 of the Ordinance within five days of becoming aware of the Upset.

5. Pursuant to Section 3.9.2.1 of the Ordinance, if the permittee knows in advance of the need for a Bypass, it shall submit prior written notice to the POTW, if possible at least ten days before the date of the Bypass.

6. Pursuant to Section 3.9.2.2 of the Ordinance, the permittee shall submit oral notice to the POTW of an unanticipated Bypass that exceeds applicable Pretreatment Standards or Requirements to the POTW within 24 hours from the time the permittee becomes aware of the Bypass. A written submission meeting the requirements of Section 3.9.2.2 of the Ordinance shall also be provided to the POTW within 5 days of the time the permittee becomes aware of the Bypass.

7. Pursuant to Section 4.13.5.3 of the Ordinance, in the case of any new regulations under Section 3001 of RCRA identifying additional characteristics of hazardous waste or listing any additional substance as a hazardous waste, the permittee must notify the POTW, the EPA Regional Waste Management Division Director, and the State hazardous waste authorities of the Discharge of such substance within 90 days of the effective date of such regulations.

T. Report Submittal - All reports and/or notifications required by this Permit shall be submitted to:

Pretreatment Coordinator
American Bottoms Regional Wastewater
Treatment Facility
#1 American Bottoms Road
Sauget, Illinois 62201
Telephone: (618) 337-1710
Facsimile: (618) 337-8919

U. Revocation of Permit Pursuant to Section 5.3 of the Ordinance, this Permit may be revoked by the POTW for violations as identified in Section 5.3.1 of the Ordinance, and in accordance with the procedures set forth in Section 5.3.2 of the Ordinance.

V. Rate Ordinance: The Significant Industrial User to which this permit is issued is subject to the following Rate Ordinance(s) of the Village of Sauget:

1. Ordinance No. 536, as amended, which establishes user charges for the American Bottoms Regional Wastewater Treatment Facility.

2. Ordinance No. 596, as amended, which regulates the disposal of sewage, industrial wastes and other wastewater into and the use of the public sewage system served by the American Bottoms Regional Wastewater Treatment Facility.

3. Ordinance No. 380, as amended, which establishes user charges for the Village of Sauget Physical-Chemical Wastewater Treatment Plant.

PART 2 - GENERAL AND SPECIFIC REPORTING REQUIREMENTS

A. General - The General Pretreatment Regulations of 40 CFR 403.12 and Ordinance 632 have set forth basic reporting requirements that apply to the permittee.

B. Specific - The specific reporting requirements of this Permit include the following reporting requirements:

1. Monitoring Reports - Monitoring results obtained shall be summarized and reported on a monthly basis. Except as otherwise provided in Part 6 of the Permit, the report is due on or before 45 days after the end of the month in which the sampling was performed. The report shall indicate the nature and concentration of all pollutants in the wastewater discharges which are regulated by the standards set forth in this Permit and include measured or estimated maximum and average daily flows. These reports will satisfy the requirement for the Periodic Compliance Report, provided they contain all the information and certifications required pursuant to Section 4.13.3 of the Ordinance.

2. Compliance Deadline Report - Pursuant to Section 4.13.2 of the Ordinance, within ninety (90) days following the date for final compliance with any applicable Pretreatment Standards, or in the case of a New Source, within ninety (90) days following commencement of the Discharge of Wastewater into the POTW, any permittee subject to any Pretreatment Standards shall submit a report on compliance with any applicable Pretreatment Standards in a form prescribed and furnished by the POTW. This report shall con-

tain information as described in Section 4.13.2.2 of the Ordinance.

PART 3 - GENERAL SAMPLING AND TESTING REQUIREMENTS

A. The permittee is responsible for compliance sampling. The monitoring facilities designated by this Permit are shown on Figure 1.

B. Compliance monitoring results and frequencies may be reviewed periodically by the Village of Sauget and appropriate adjustments made to frequencies and parameters in a modified or revised Wastewater Discharge Permit.

C. All handling and preservation of collected samples and laboratory analyses shall be performed in accordance with procedures contained in 40 CFR Part 136 and amendments thereto unless specified otherwise in the monitoring conditions of this Permit. Composite sampling, where called for, shall be performed over a twenty-four (24) hour period by flow or time proportionate methods.

The test procedures for all samples shall conform to one of the USEPA approved test methods which provides the most sensitive detection limits for the pollutant under investigation listed in the current issue of the Code of Federal Regulations, and the most recent addendum published by the Federal Register. The testing for priority organic pollutants shall be conducted utilizing gas chromatograph/mass spectrometer (GC/MS) methods and procedures. Other test procedures may be approved by the USEPA, pursuant to Section 4.15.2 of the Ordinance.

If more than one method for analysis of a substance is approved for use, a method having a detection limit lower than the permit limit shall be used. If the detection limit of all methods is higher than the permit limit, the method having the lowest detection limit shall be used and a report of less than detection limit shall constitute compliance. However should EPA approve a method with a lower detection limit during the term of this permit, the permittee shall use the newly approved method.

D. The appropriate flow measurement devices and methods consistent with approved scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated and maintained to ensure that

the accuracy of the measurements are consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than 10% from true discharge rates throughout the range of expected discharge volumes.

E. For each measurement or sample taken pursuant to the requirements of this Permit, the permittee shall maintain and submit records which include:

1. The date, location, and type of sample collected;
2. The dates analyses were performed;
3. The analytical techniques/methods used;
4. The results of such analyses; and
5. The average daily and maximum daily flows.

F. In the event of a sampling failure, including, but not limited to, failure of sampling equipment, or sample damage, contamination, or breakage, sampling shall be repeated as soon as possible at all applicable required monitoring locations for those parameters for which the analysis of the original sample(s) was intended.

G. The 30 day resampling requirement of Part 1.Q. of this Permit shall apply to all monitoring locations identified in this Permit. Where a violation of a plant mass limitation has occurred, all sites which contribute to the calculation of the plant mass shall be resampled concurrently. Only those parameters for which the violation has been identified are required to be analyzed as part of the resampling.

H. Where agreed upon in advance by both parties, the POTW may perform monitoring and testing for a parameter(s) regulated by this permit and such POTW monitoring shall satisfy the self-monitoring requirement for the subject parameter(s).

PART 4 - EFFLUENT LIMITATIONS, SAMPLING AND TESTING REQUIREMENTS

A. Local Limits: The Village of Sauget reserves the right, in Ordinance 632 and as amended, to establish limitations or requirements on discharges to the wastewater disposal system if deemed necessary to comply with the objectives presented in Section 1.4 of the Ordinance.

Parameter	Limitations
Ammonia nitrogen	50 mg/L (24-hour composite) 75 mg/L (grab) 50 lb/day (Daily maximum mass)

Ammonia nitrogen mass in a discharge shall be determined by multiplying the daily flow volume times the 24-hour composite sample concentration times the appropriate conversion factor or, if a 24-hour composite sample is not available, times the Grab sample concentration, for the same day.

pH	For Users discharging to the P-Chem plant: Any wastewater having a pH which causes or significantly contributes to the pH of the P-Chem Plant effluent to be greater than pH 10.0

B. State Limits: These limits are stated in 35 Ill. Adm. Code Part 307. This Part 307 places restrictions on the types, concentrations, and quantities of contaminants which can be discharged into sewer systems in the State.

Limitations:

Parameters	Monthly Average (mg/L)	Daily Composite (mg/L)	Grab Sample (mg/L)
Mercury	0.0005	0.001	0.0025
Cyanide (Total)	--	--	10.0

Any sample tested shall not release more than 2 mg/l of cyanide when tested at a pH of 4.5 and at a temperature of 66°C (150°F) for a period of 30 minutes.

Subject to the averaging rule of Ill Adm. Code 304.104, the monthly average for mercury shall be the numerical average of all daily composites for mercury taken during a calendar month. A monthly average must be based on at least three daily composites.

C. Site Specific Parameter Discharge Limits

Parameter	Daily Maximum Limit	Sample Type
Benzene	0.5 mg/l	Grab
Carbon tetrachloride	0.5 mg/l	Grab
Chlorobenzene	100 mg/l	Grab
Chloroform	6.0 mg/l	Grab
1,2-Dichloroethane	0.5 mg/l	Grab
1,2-Dichloroethylene	0.7 mg/l	Grab
Methyl ethyl ketone	200 mg/l	Grab
Tetrachloroethylene	0.7 mg/l	Grab
Trichloroethylene	0.5 mg/l	Grab
Vinyl chloride	0.2 mg/l	Grab
o-Cresol	200 mg/l	Comp
m-Cresol	200 mg/l	Comp
p-Cresol	200 mg/l	Comp
Cresol, total	200 mg/l	Comp
1,4-Dichlorobenzene	7.5 mg/l	Comp
2,4-Dinitrotoluene	0.13 mg/l	Comp
Hexachlorobenzene	0.1 lb/day	Comp
Hexachlorobutadiene	0.5 mg/l	Comp
Hexachloroethane	3.0 mg/l	Comp
Nitrobenzene	2.0 mg/l	Comp
Pentachlorophenol	10 lb/day	Comp
Pyridine	5.0 mg/l	Comp
2,4,5-Trichlorophenol	400 mg/l	Comp
2,4,6 Trichlorophenol	2.0 mg/l	Comp
Chlordane	0.02 lb/day	Comp
Endrin	0.02 lb/day	Comp
Heptachlor (and its epoxide)	0.02 lb/day	Comp
Lindane	0.02 lb/day	Comp
Methoxychlor	0.02 lb/day	Comp
Toxaphene	0.02 lb/day	Comp
2,4-D	0.02 lb/day	Comp
2,4,5-TP Silvex	0.02 lb/day	Comp
Arsenic	1.0 lb/day	Comp
Barium	100 lb/day	Comp
Cadmium	1.0 mg/l	Comp
Chromium	5.0 mg/l	Comp
Lead	5.0 mg/l	Comp
Mercury	0.2 mg/l	Comp
Selenium	1.0 mg/l	Comp
Silver	10.0 lb/day	Comp
2-Chloroaniline	monitoring only	Comp
4-Chloroaniline	monitoring only	Comp

Composite and Grab - See Part 4.E.8 and 9 below.

D. National Categorical Pretreatment Standards (NCPS):
Not Applicable

E. Monitoring Schedule

1. The monitoring schedule requirements are required as of the effective date of this Permit.

2. Monitoring locations are shown in the attached diagram - Figure 1, which is incorporated into and made a part of this Permit.

3. Monitoring frequencies:

Parameter (Units)	Monitoring Location	Monitoring Frequency	Sample Type
Ammonia nitrogen (mg/L)	C	See 4. below	Composite
Mercury (mg/L)	A, C	See 5. below	See 8. below
Cyanide (mg/L)	A, C	See 5. below	See 10. below
Flow (MGD)	C	Daily	Meter
Parameters per part 4.E.12	A, C	See 5. below	See 8. & 9. below
COD	A, B	See Part 6.C below	Grab

Monitoring Locations
A - Influent location before GAC treatment
B - Effluent of lead GAC column
C - Effluent location after GAC treatment

4. Compliance with the ammonia nitrogen local limit will be determined by testing performed by the POTW. Permittee self-monitoring for ammonia nitrogen is not required.

5. Monitoring frequency for the Permittee will be daily for the first, third, seventh day of discharge, and every seven days thereafter. The sample for first day of discharge shall include 6-hour grabs collected during the period of discharge.

6. A sampling day is 6am to 6am with the sample date designated as the date beginning the 24-hr period.

7. Compliance at Location C will be determined only on parameters listed in part 4.C above.

8. Daily composite samples for parameters other than volatile organic and cyanide shall consist of (4) four grab samples taken approximately every 6 hours. The individual grab samples shall be equally composited in the field or laboratory into one sample for analysis.

9. Grab samples for volatile organics shall consist of (4) four grab samples taken approximately every 6 hours in 40ml VOA septa lined containers without air bubbles. The

individual 40ml VOA grabs shall be equally composited in the laboratory into one sample for analysis.

10. Grab samples for cyanide shall consist of a single grab sample collected during the sampling day.

11. All monitoring data shall be submitted no later than 45 days after the last day of discharge.

12. Pollutant Monitoring for Influent and Effluent.

Volatiles (ug/L)	Sample type
Benzene	Grab
Bromoform	Grab
Carbon tetrachloride	Grab
Chlorobenzene	Grab
Chlorodibromomethane	Grab
Chloroethane	Grab
Chloromethane	Grab
2-chloroethylvinyl ether	Grab
Chloroform	Grab
Dichlorobromomethane	Grab
1,1-dichloroethane	Grab
1,2-dichloroethane	Grab
1,1-dichloroethylene	Grab
1,2-dichloropropane	Grab
1,3-dichloropropylene	Grab
ethylbenzene	Grab
methyl bromide	Grab
methyl chloride	Grab
methylene chloride	Grab
methyl ethyl ketone	Grab
1,1,2,2-tetrachloroethane	Grab
tetrachloroethylene	Grab
toluene	Grab
1,2-trans-dichloroethylene	Grab
1,1,1-trichloroethane	Grab
1,1,2-trichloroethane	Grab
trichloroethylene	Grab
vinyl chloride	Grab
xylenes	Grab
4-methyl-2-pentanone	Grab
Acid Compounds (ug/L)	
2-chlorophenol	Comp
2,4-dichlorophenol	Comp
2,4-dimethylphenol	Comp
4,6-dinitro-o-cresol	Comp
2,4-dinitrophenol	Comp
2-nitrophenol	Comp
4-nitrophenol	Comp
p-chloro-m-cresol	Comp
pentachlorophenol	Comp
phenol	Comp
2,4,5-trichlorophenol	Comp
2,4,6-trichlorophenol	Comp
4-Nitrophenolamine	Comp
4-Chlorophenol	Comp
4-Chloro-3-methylphenol	Comp
4-Chloro-2,6-dinitrophenol	Comp

Composite and Grab - See Part 4.E.8, 9 & 10 above.

Base/Neutral (ug/L)	Sample Type
Acenaphthene	Comp
Acenaphthylene	Comp
Aniline	Comp
Anthracene	Comp
Benzidine	Comp
Benzo(a)anthracene	Comp
Benzo(a)pyrene	Comp
3,4-benzofluoranthene	Comp
benzo(ghi)perylene	Comp
benzo(k)fluoranthene	Comp
benzoic acid	Comp
benzyl alcohol	Comp
bis(2-chloroethoxy)methane	Comp
bis(2-chloroethyl)ether	Comp
bis(2-chloroisopropyl)ether	Comp
bis(2-ethylhexyl)phthalate	Comp
4-bromophenyl phenyl ether	Comp
butylbenzyl phthalate	Comp
2-chloronaphthalene	Comp
4-chlorophenyl phenyl ether	Comp
chrysene	Comp
dibenzo(a,h)anthracene	Comp
1,2-dichlorobenzene	Comp
1,3-dichlorobenzene	Comp
1,4-dichlorobenzene	Comp
3,3'-dichlorobenzidine	Comp
diethyl phthalate	Comp
dimethyl phthalate	Comp
di-n-butyl phthalate	Comp
2,4-dinitrotoluene	Comp
2,6-dinitrotoluene	Comp
di-n-octyl phthalate	Comp
1,2-diphenylhydrazine (as azobenzene)	Comp
fluoranthene	Comp
fluorene	Comp
hexachlorobenzene	Comp
hexachorobutadiene	Comp
hexachlorocyclopentadiene	Comp
hexachloroethane	Comp
indeno(1,2,3,-cd)pyrene	Comp
isophorone	Comp
naphthalene	Comp
nitrobenzene	Comp
N-nitrosodimethylamine	Comp
N-notrosodi-n-propylamine	Comp
N-nitrosodiphenylamine	Comp
Phenanthrene	Comp
Pyridine	Comp
1,2,4-trichlorobenzene	Comp
2-chloroaniline	Comp
4-chloroaniline	Comp
2-Nitroaniline	Comp
2-Nitrochlorobenzene	Comp
3-Chloroaniline	Comp

Base/Neutral Cont	Sample Type
3-Nitrochloro benzene	Comp
4-Nitroaniline	Comp
4-Nitrochloro benzene	Comp
o-Cresol	Comp
m-Cresol	Comp
p-Cresol	Comp
Pesticides (ug/L)	
Aldrin	Comp
Alpha-BHC	Comp
Beta-BHC	Comp
Gamma-BHC	Comp
Delta-BHC	Comp
Chlordane	Comp
2,4 - D	Comp
2,4,5-TP Silvex	Comp
4,4'-DDT	Comp
4,4'-DDE	Comp
4,4'-DDD	Comp
dielrin	Comp
alpha-endosulfan	Comp
beta-endosulfan	Comp
endosulfan sulfate	Comp
endrin	Comp
endrin aldehyde	Comp
heptachlor	Comp
heptachlor epoxide	Comp
methoxychlore	Comp
PCB-1242	Comp
PCB-1254	Comp
PCB-1221	Comp
PCB-1232	Comp
PCB-1248	Comp
PCB-1260	Comp
PCB-1016	Comp
toxaphene	Comp
Metals (mg/L)	
Arsenic, total	Comp
Barium, total	Comp
Cadmium, total	Comp
Chromium, total	Comp
Copper, total	Comp
Lead, total	Comp
Mercury, total	Comp
Nickel, total	Comp
Selenium, total	Comp
Silver, total	Comp
Zinc, total	Comp
Cyanide, total	Grab
Iron, total	Comp

PART 5 - COMPLIANCE SCHEDULE

A. General:

Authority Citation: Section 4.13 Village of Sauget Pretreatment Ordinance No. 632.

Permit No. 03-138

Industry Name: Solutia, Inc. - Site R

B. Final Compliance Date: Not applicable

PART 6 - SPECIAL CONDITIONS

A. Cost of Service: Ordinance No. 632 (Pretreatment Ordinance) provides that the cost of the Pretreatment Program, including special sampling analysis, Monitoring, etc. be recovered from the customer causing the incurrence of the cost.

Separate billings are prepared regarding these costs and issued to the industries in the program. Monthly billings will be prepared for routine and special analytical services, and quarterly billing will be prepared for general and administrative costs. Payment is due within 21 days of billing.

B. Prior commencement of construction, Solutia shall provide the POTW detailed construction drawings and plans of the discharge pipe showing where and how the discharge pipe to the P-Chem Plant is to be installed. The construction of the discharge pipe shall not commence prior to receipt of written authorization thereof by the POTW. Solutia shall also provide details as to the type, specifications and drawings of the flowmeters that are to be used. The selected flowmeters must be submitted to the Pretreatment Coordinator for review and approval prior to discharge.

C. Breakthrough Monitoring: The permittee shall monitor for COD every 2 hours at the sampling ports of the lead carbon column influent and effluent to determine carbon breakthrough of the lead GAC column daily during discharge. Daily visual observations and COD results shall be recorded in a logbook that is maintained at the site.

Immediate cessation of discharge shall occur upon detection of breakthrough in the carbon filters from COD results.

D. Start-up/Shut-down of Pilot Treatment System: Solutia shall notify the American Bottoms Pretreatment Coordinator 24 hours prior to each start-up of discharge. Start-up shall only occur during weekdays between the hours of 6 am and 6 pm.

Discharge from the Temporary Pilot Treatment System shall not resume once this Permit expires.

E. Safety: Solutia shall operate under all proper safety measures during this temporary discharge permit that includes, but is not limited to installation of discharge pipe through the levee and immediate removal of discharge pipe from the levee if necessary.

F. Discharge of hazardous waste as defined in 40 CFR 261.33 is expressly prohibited.

G. The following certification statement shall be included in the self-monitoring report and signed by an authorized representative, "I certify that no hazardous waste, as defined in 40 CFR 261.33, has been discharged from this facility for this reporting period."

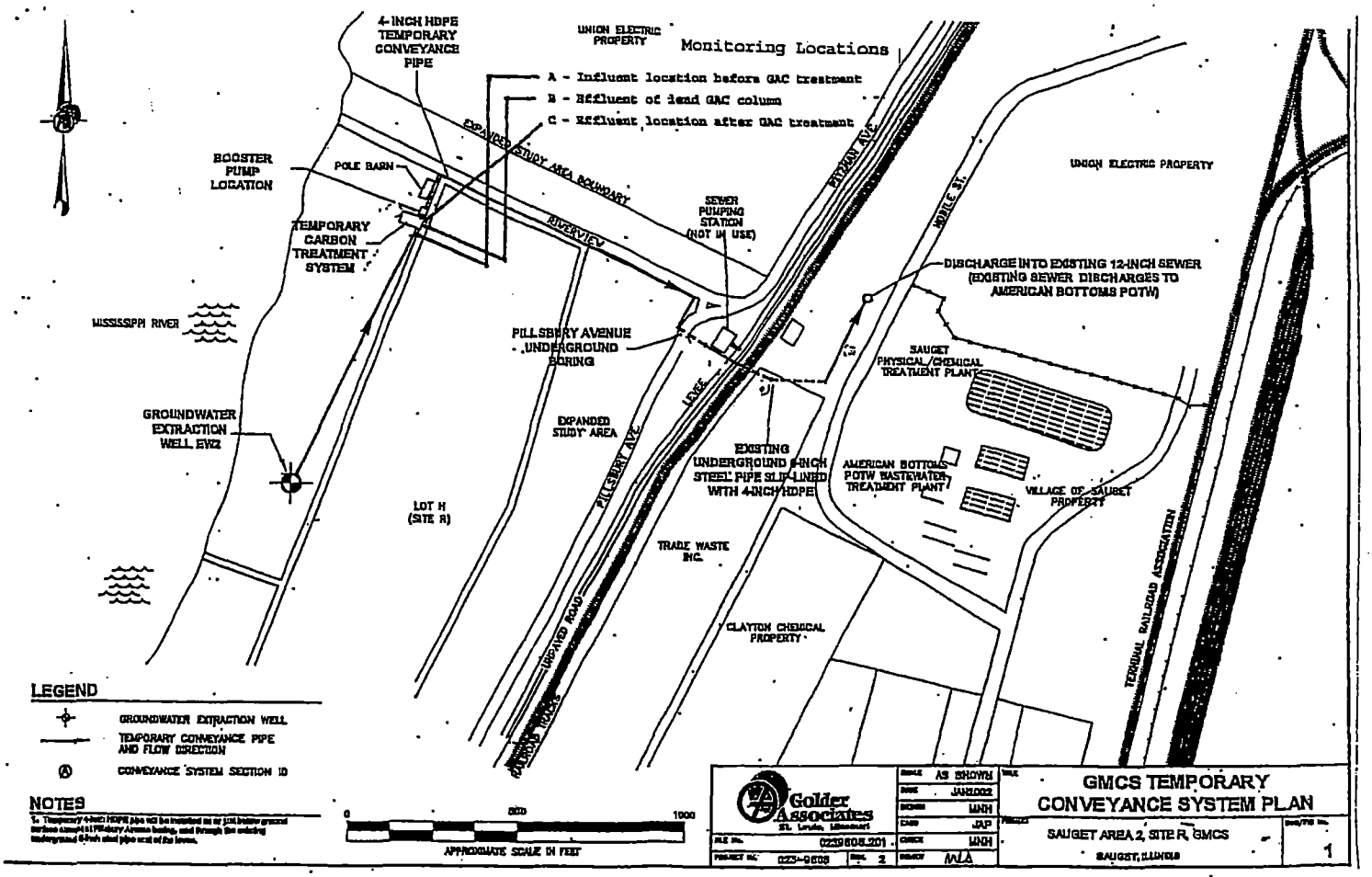
H. Solutia shall remove the temporary discharge pipe that is between control structures 1 and 2 to P-Chem within 60-days following the expiration of this discharge permit.

I. Discharge of untreated groundwater is strictly prohibited.

DRAFT

Permit No. 03-138
Solutia, Inc.
Site R - Temporary Discharge

FIGURE 1 - MONITORING LOCATION



ATTACHMENT 2

ASTM METHOD D6586 - PERFORMING RAPID SMALL-SCALE COLUMN TEST

Designation: D 6586 – 00
Standard Practice for the Prediction of Contaminant Adsorption On GAC In Aqueous Systems Using Rapid Small-Scale Column Tests[1]

This standard is issued under the fixed designation D 6586; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (e) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers a test method for the evaluation of granular activated carbon (GAC) for the adsorption of soluble pollutants from water. This practice can be used to estimate the operating capacities of virgin and reactivated granular activated carbons. The results obtained from the small-scale column testing can be used to predict the adsorption of target compounds on GAC in a large column or full scale adsorber application.

1.2 This practice can be applied to all types of water including synthetically contaminated water (prepared by spiking high purity water with selected contaminants), potable waters, industrial waste waters, sanitary wastes and effluent waters.

1.3 This practice is useful for the determination of breakthrough curves for specific contaminants in water, the determination of the lengths of the adsorbates mass transfer zones (MTZ) and the prediction of GAC usage rates for larger scale adsorbers.

1.4 The following safety caveat applies to the procedure section, Section 10, of this practice: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices anddetermine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*
D 1129 Terminology Relating to Water[2]
D 1193 Specifications for Reagent Water[2]
D 2652 Terminology Relating to Activated Carbon[3]
D 2854 Test Method Apparent Density of Activated Carbon[3]
D 2867 Test Method Moisture Content of Activated Carbon[3]
D 2862 Test Method Particle Size Distribution of Granular Activated Carbon[3]

3. Terminology

3.1 *Definitions*:

3.1.1 For definitions of terms in this practice relating toactivated carbon, refer to Terminology D 2652.

3.1.2 For definitions of terms in this practice relating to water, refer to Terminology D 1129.

4. Summary of Practice

4.1 This practice consists of a method for the rapid determination of breakthrough curves and the prediction of GAC usage rates for the removal of soluble contaminants from water. This is accomplished by passing the contaminated water at a constant controlled rate down flow through a bed

of a specially sized granular activated carbon until predetermined levels of breakthrough have occurred.

4.2 When the assumption is made that conditions of constant diffusivity exist within the GAC column, the breakthrough data obtained from the column test can be used to estimate the size and operational conditions for a full-scale carbon adsorber.

5. Significance and Use

5.1 Granular activated carbon (GAC) is commonly used to remove contaminants from water. However if not used properly, GAC can not only be expensive but can at times be ineffective. The development of engineering data for the design of full-scale adsorbers often requires time-consuming and expensive pilot plant studies. This rapid standard practice has been developed to predict adsorption in large-scale adsorbers based upon results from small column testing. In contrast to pilot plant studies, the small-scale column test presented in this practice does not allow for a running evaluation of factors that may affect GAC performance over time. Such factors may include, for example, an increased removal of target compounds by bacterial colonizing GAC[4] or long term fouling of GAC caused by inorganic compounds or background organic matters[5]. Nevertheless, this practice offers more relevant operational data than isotherm testing without the principal drawbacks of pilot plant studies, namely time and expense; and unlike pilot plant studies, small scale studies can be performed in a laboratory using water sampled from a remote location.

5.2 This practice known as the rapid small-scale column test (RSSCT) uses empty bed contact time (EBCT) and hydraulic loading to describe the adsorption process. Mean carbon particle diameter is used to scale RSSCT results to predict the performance of a full-scale adsorber.

5.3 This practice can be used to compare the effectiveness of different activated carbons for the removal of contaminants from a common water stream.

6. Summary of Practice

6.1 The development of the RSSCT is based on the dispersed-flow pore surface diffusion model (DFPSDM) (Crittenden, et al[6]) which takes into account many of the mechanisms that are known to occur in fixed-bed adsorption. The following mechanisms, which cause the breakthrough curves for an adsorber to spread out and create the mass transfer zone are included in the DFPSDM: external mass-transfer resistance or film transfer, axial mixing due to dispersion and the internal mass-transfer resistances of pore and surface diffusion.

6.2 To simulate full-scale performance, the amount of spreading in the breakthrough curve relative to column depth must be identical for the RSSCT and the full-scale column. To achieve this, the relative contributions of the mechanisms that cause most of the spreading are matched by maintaining similarity as the GAC process is scaled. Crittenden et. al.[6] have shown that matching of the spreading of the breakthrough curve can be achieved by assuming intraparticle diffusivities are independent of the carbon particle radius, i.e. the condition of constant diffusivity. Under these conditions of constant diffusivity, the following equation describes the relationship between the small and large columns:

$$\frac{EBCT_{sc}}{EBCT_{lc}} = \frac{|R_{sc}|}{|R_{lc}|} = \frac{t_{sc}}{t_{lc}} \quad (1)$$

where: $EBCT_{sc}$ and $EBCT_{lc}$ are the empty-bed contact times for the small-column (RSSCT) and the large-column (full-scale adsorber), respectively; R_{sc} and R_{lc} are the radii of the carbon particles used in the small and large columns, respectively; and t_{sc} and t_{lc} are the elapsed times required to conduct the small and large-column tests, respectively. The condition of constant diffusivity also requires the Reynolds numbers for the RSSCT and the large-column be equal. This means the following equation must also be satisfied:

V_{sc}
V_{lc}
5
R_{lc}
R_{rc}
(2)

where: V_{sc} and V_{lc} are the hydraulic loadings in the RSSCT and large columns, respectively. Based upon the above equations, the operating conditions for the RSSCT can be selected to precisely simulate the desired (specified) operating conditions for a full-scale adsorber. NOTE 1—Empty-bed contact time (EBCT) is defined as the volume (in liters) of carbon in the adsorber bed divided by the water flow rate in litres/minute. For example if a full scale adsorber holds 20 000 L of activated carbon and the water flow rate is 2500 L/min, the EBCT would be equal to 20 000/2500 or 8.0 min.

6.3 The assumption that conditions of constant diffusivity exist within the GAC column does not apply to all waters or all target compounds. For example this assumption does not apply for the decolorization of water and the adsorption of large molecules, such as humic acids. It is recommended that at least one RSSCT pilot-column comparison be conducted to aid in selecting the RSSCT design variables for a given water matrix (Crittenden, et al[6]). A detailed comparison between the constant diffusivity and proportional diffusivity approaches and their respective domains of application is beyond the scope of this practice.

6.4 GAC bed volume and preparation methods are important design parameters for the RSSCT. The GAC bed volume used will determine the required water pumping rate and affect the amount of water needed to complete the test. The minimum column diameter needed to avoid channeling and to minimize column head loss should be 50 particle diameters. For the 10-mm diameter column commonly used in RSSCT systems, a 60 by 80 mesh carbon should be used. Proper GAC sampling (Practice E 300) and preparation (grinding, classification and washing) are required for reproducible results.

6.5 Based upon the water feed rate to the column, the time required to reach the desired breakpoint and the weight of carbon used, GAC usage rates for treating the water can be calculated. Breakthrough curves for each contaminant being monitored during the column test can also be generated.

7. Interferences

7.1 Insoluble materials such as oils and greases, suspended solids, and emulsions will interfere with the adsorption ofsoluble materials by the GAC. Suspended solids in the column feed can lead to increased pressure drop and interfere with the operation of the column. These materials must be removed by suitable means before the water being treated is introduced to the column.

7.2 Air bubbles can interfere with water flow through the column and lead to misleading results. A means for removing air bubbles that are introduced into the system with the feed water should be incorporated to prevent these problems from occurring.

8. RSSCT Test Apparatus

8.1 The RSSCT test apparatus should be constructed of glass, PTFE and/or stainless steel, to minimize the adsorption of organic compounds. The apparatus shown in diagram form in Fig. 1 consists of a metering pump, inlet filter, pressure and flow indicators, up to three columns operating in series and

means for water sample collection and analysis.

8.1.1 *Glass columns*, vertically supported, 10.5 6 0.5 mm inside diameter and approximately 35 cm in length with threaded joints at both ends are most commonly used. Threaded PTFE end caps with seats for neoprene o-ring seals and tubing connectors should be provided at the top and bottom of the column for the admission and discharge of water. For operation at other than room temperature, a means for heating or cooling the columns and the water being treated should be established. 8.1.2 *GAC Support*—A column of fine glass wool installed to give a flat surface across the diameter of the column can be used for support of the GAC column. Alternatively the carbon bed can be supported on a 100-mesh stainless steel screen placed between two short sleeves made from 1.2in. PTFE tubing (see Fig. 2). The sleeves should be sized to fit tightly in the column to prevent any fluid from flowing between the sleeves and the column wall.

8.1.3 *Feed Pumps*—A liquid metering pump capable of maintaining a steady flow rate of 6 0.05 mL/min at a column back pressure of up to 100 psig should be used. To prevent over-pressurization of the column system in the event of column plugging during operation, the pump should be set up with a bypass loop that allows the discharge from the pump to be vented back to the pump inlet through an adjustable pressure relief device. The column inlet pressure and water flow rate should be monitored and recorded throughout the run.

8.1.4 *Water Filtration*—A filter to remove suspended solids that may be present in the water should be installed after the metering pump. A 47-mm inline filter housing with a 1.5 μm glass micro-fiber filter has been found to be adequate to remove suspended solids that may prematurely plug the carbon bed. Care must be exercised to ensure organic contaminants in the water being treated are not removed by the filter paper.

8.1.5 *Feed Water Containment*—The feed water should be maintained at the same temperatures as the carbon columns. If the feed water contains volatile organic compounds (VOCs), special care must be taken to prevent their loss during the test. For short duration column tests where a relatively small amount of water is to be treated, the feed water can be stored under zero head space conditions in pillow shaped bags manufactured from PTFE or similar material (typically used for the collection of gas samples). Gas sampling bags up to 100 L in volume can be conveniently used if properly supported. If larger volumes of water containing VOCs are to be treated, a 55-gal open top drum outfitted with a collapsible PTFE liner or other material that will prevent VOC loss, can be used. The liner is attached to the feed pump inlet tube and collapses as water is removed from the drum, thus always maintaining zero headspace conditions. Jacketed columns with temperature regulated circulation water can be used or the drum can be placed in a temperature-controlled cabinet if control of the feed water temperature is required.

8.1.6 *Sample Collection System*—Water effluent samples for analysis should be collected on a regular basis under zero headspace conditions. The collected samples should be refrigerated during collection or as soon as possible after collection to prevent degradation prior to analysis. The use of an automated sampler that is capable of collecting zero head space samples for extended unattended column tests has been found to be useful for sample collection and preservation. Water flow used in the collection of samples by means of the auto-sampler can be directed to a refrigerated container thus assuring the samples are maintained at cold temperatures during long duration sample collection. The size of the sample collected will be dependent on the type of analysis to be performed. Typically 35 mL vials with PTFE lined screw caps are used for sample collection. Larger water samples (up to 1 or 2 L) can be taken, but due to the low flow rates being used in the column test they will represent the operation of the column over an extended period of time.

8.1.7 *Alternative Column Feed System*—Fig. 3 shows an alternative feed system for the RSSCT. A spiked feed water containing a high concentration of the contaminants to be studied is contained in a zero headspace container as described in 8.1.5. This spiked feed is pumped at a slow rate and mixed with the source water. The flow rates of the two liquid metering pumps are adjusted to give the desired contaminant concentration in the column feed and at the same time the desired total column flow

rate to the columns. This setup allows for the easy study of the effect a particular water source matrix on the carbon's ability to adsorb different contaminants at different concentrations.

8.1.8 *Sample Analysis*—For column tests of extended duration, the samples collected using the auto-sampler should be analyzed in reverse order, that is, the last sample collected should be analyzed first. If the last sample collected does not indicate breakthrough, the earlier samples collected can be discarded. If breakthrough has occurred, the earlier samples can be analyzed to establish the exact time.

9. Reagents

9.1 *Granular Activated Carbon (GAC).*

9.2 *Water*, ASTM Type IV.

10. Experimental Procedures

10.1 *Carbon Sample Preparations*—A representative sample of the GAC collected according to Test E 300 is crushed and screened to yield a 60 3 80-mesh fraction (Test Method D 2862). The screened carbon is thoroughly washed with water until all dust is removed and the pH of the wash water shows no significant change. The well-washed carbon is dried at 150°C for 4 h and stored in an amber colored bottle until it is ready for use.

10.2 *Column Loading*—The moisture content (Test Method D 2867) and apparent density (Test Method D 2854) of the test carbon are determined and recorded. A predetermined quantity of the 60 by 80-mesh carbon is weighed to 6 0.1 mg into a 100-mL beaker (see note). Approximately 40 mL of Type IV water is added to the carbon in the beaker and stirred. The carbon water slurry is heated to boiling for 10 min for the purpose of replacing the air in the carbon's pores with water. After cooling to room temperature, the entire sample of wet deaerated carbon is slurried into the column in such a way as to exclude air bubbles from the column. After loading, the settled height of the carbon column is recorded. NOTE 2—To determine quantity of carbon needed, first its volume is calculated from the EBCT for the column that is required to simulate the full-scale adsorber EBCT (see equation in 6.2), the water feed rate and the diameter of the column being used. Multiplying the volume of carbon by its apparent density will give the weight of carbon to be used.

10.3 *Water Feed Rate*—The water feed rate is determined by the empty bed contact time (EBCT) that is required to simulate specified operation in a large-scale adsorber. For example, using the quation from 6.2 and assuming that the $EBCT_{1c}$ is 10 min for the full scale adsorber and R_{1c} = 0.0792cm (the average particle radius for an 8 by 30 mesh carbon) and the particle radius (R_{sc}) for the 60 by 80 mesh carbon used in the column test is 0.0106 cm, the $EBCT_{sc}$ time for the column test would be 0.179 min. The average particle radii for the 8 by 30 mesh and 60 by 80 mesh carbons is determined experimentally by measuring their respective mean particle size (Test Method D 2862). In that the volume of the small column (10 mm diameter by 18 cm in depth) to be used is 14.13 cm^3, this example would require a water flow rate of 78.91 mL/min (14.13/0.179) to simulate the full-scale adsorber. The hydraulic loading for the above full-scale adsorber (assuming 10 ft diameter and a water flow rate of 260 gpm) would be 3.3 gpm/ft^2(135 L/min/m^2). For the RSSCT the hydraulic loading would be 24.7 gpm/ft^2 (1006 L/min/m^2). Eq 2 states the ratio of the hydraulic loadings for the small column to that of the large column should be the same as the ratio of the carbon particle sizes used. Therefore for the condition of constant diffusivity to be satisfied, in this example 24.7/3.3 should equal 0.0792/0.0106.

NOTE 3—The average particle radius for the 60 by 80 mesh and 8 by 30 mesh carbons need to be determined experimentally as the magnitude of these values will significantly affect the calculated EBCT. The particle radius can be assumed to be equal to one-half the mean particle diameter as measured using Test Method D 2862.

10.4 *Column Operation*—It is often desirable to start the operation of the column(s) using high purity water as the feed. This will allow proper flow rates to be established and ensure there are no air bubbles in the system that will eventually find their way to the carbon column. Once flow rates have been

established, column feed is switched to the test water and the auto-sampler (if used) is actuated. The column(s) influent and effluent are sampled and analyzed periodically for the pollutants of interest. The frequency of the sampling will depend on the expected length of the run and the accuracy desired for the determination of the exact breakpoints. The column operation is continued until the effluent analysis equals the influent concentration or until other agreed upon pollutant concentrations are reached. If full breakthrough curves are developed for each contaminate, the length of the mass transfer zone (MTZ) for each compound of interest can be measured. The length of the MTZ can be estimated by first determining the ratio of the time required to go from 5 % breakthrough to 95 % of full breakthrough and the time that has elapsed from the start of the column test to full breakthrough for the compound of interest. Multiplying this ratio by the length of the carbon column measured in centimeters gives the length of the MTZ in centimetres.

10.5 *Data Collection*—The following data is collected during column operation and through subsequent sample analysis and used for the performance predictions:

10.5.1 Carbon bed volume,
10.5.2 Carbon mass used,
10.5.3 Feed water flow rate,
10.5.4 RSSCT EBCT,
10.5.5 Time to specified breakthrough for each contaminate of interest, and
10.5.6 Time to full breakthrough for each contaminate of interest (If Determined).

11. Calculation

11.1 Using data collected from the analysis of the influent and effluent samples and column operating parameters, the following can be calculated:

11.1.1 *RSSCT Bed Life* = Time in minutes to specified breakthrough level

11.1.2 *Treatable Bed Volumes* = RSSCT Bed Life/RSSCT EBCT

11.1.3 *Total Volume of Water Fed to RSSCT Until Breakthrough* = RSSCT bed life by water flow rate,

11.1.4 *Specific Throughput* = Total Volume Fed to RSSCT/ Carbon Mass

11.1.5 *Carbon Usage Rate* = 1/Specific Throughput

11.1.6 *Length of MTZ*:

~time to 95 % of full BT! – ~time to 5 % BT!
~time to 95 % of Full BT! 3 L (3)
where: L = column length.

12. Precision and Bias

12.1 The precision of this practice is limited both by the precision of the standard practices used in determining the concentration of the constituents and the precision of the determination of the exact breakthrough time for each constituent.

12.2 The bias of this practice is limited by the bias of the test methods used in determining the concentration of the constituents and the bias in the determination of the exact breakthrough time for each constituent.

13. Keywords

13.1 activated carbon; column testing; granular activated carbon; RSSCT

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