



# Project Summary Report 111275954-2100 90 Day Remediation 270,000 Cubic Feet Hydrocarbon Contaminated Soil

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## Version Control

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## 1 EXECUTIVE SUMMARY

Here is the summary of work completed to evaluate the conditions, design equipment, execute and document the results to fully remediate 270,000 cubic feet of hydrocarbon contaminated soil

Quantitative data is provided showing rapid destruction of hydrocarbon contamination resulting in full remediation in 90 days of treatment.

Geographic Areas Affected by the Project: Great Lakes

## 2 SITE DESCRIPTION

Property Name- Leisure Lanes  
Camp Rd Hamburg, NY 14075  
Erie County New York  
Size - One acre

The former Leisure Lanes Site is located on Camp Road in Hamburg, New York. The facility is approximately 10 acres in size, of which about 5 acres were used for servicing transportation industry for fueling and support operations. Lodging and entertainment facilities were part of the complex. Approximately 4 acres are presently in use by the Fisher Transportation Company for the storage and maintenance of their fleet. The site has been used to distribute gasoline, diesel fuel from underground storage tanks since the mid-1960s. Use of the facility ceased in 2005 and the facilities razed following a structural collapse. The site remains inactive. Past waste management practices and releases have impacted soil and groundwater at this site. Area residents are served by a public water supply from a remote location.

At the inception of this project, the contaminated soil and underground tanks were removed from the ground for disposal and the soil was placed on an impermeable membrane at the site.

### 3 NATURE OF CONTAMINATION

Soil that contains volatile organic compounds partially evaporates, losing between 5 and 10 percent of its mass and becoming denser and more viscous. A small percentage of petroleum products may dissolve into the groundwater. Oil residue can disperse almost invisibly in groundwater or form a thick mat with other organic materials. Over time, oil waste weathers (deteriorates) and disintegrates by means of photolysis and biodegradation. The rate of biodegradation depends on the availability of nutrients, oxygen, and microorganisms, as well as temperature.

Hydrocarbon spills present the potential for harm to humans and animal life. The immediate effects may be mass mortality and contamination of fish and other food species, but long-term ecological effects may be poisons the sensitive marine and coastal organic substrate, interrupting the food chain on which fish and aquatic depend, and on which their reproductive success is based.

Wildlife other than fish, including mammals, reptiles, amphibians, and birds that live in or near the lakes, are also poisoned by hydrocarbon waste. The hazards for wildlife include toxic effects of exposure or ingestion, injuries such as smothering and deterioration of thermal insulation, and damage to their reproductive systems and behaviors. Long-term ecological effects that contaminate or destroy the marine organic substrate and thereby interrupt the food chain are also harmful to the wildlife, so species populations may change or disappear.

Lake costal areas are attract many recreational activities and related facilities that have been developed for fishing, boating, snorkeling and scuba diving, swimming, nature parks and preserves, beaches, and other resident and tourist attractions. Petroleum waste that invades and pollutes these areas and negatively affects human activities can have devastating and long-term effects on the local economy and society. Property values for housing tend to decrease, regional business activity declines, and future investment is risky.

The disposition of petroleum residues depends upon composition and properties, the type of soil contacted, the impact of the contaminates on sensitive habitats and wildlife, weather events, and seasonal and climatic conditions. Some petroleum products evaporate, disperse, emulsify, weather, and decompose more easily than others. The weather and seasonal and climatic conditions may accelerate or delay these processes.

Hydrocarbon contamination that coalesces into a tar-like substance or that saturates sediments is especially persistent. Efforts to remove the petroleum products and clean, decontaminate, and remediate an oil-impacted area more visibly attractive, but may be more harmful than helpful in terms of actual recovery.

## 4 EVALUATION OF THE SOIL

### 4.1 Soil Character

The character of the soil is a dense mix of topsoil and concrete fragments, rusted rebar, pea gravel and some clay laden areas. Average depth is around 24 inches.

The greater part of the soil at the site exhibits little or no evidence that it is contaminated but there are pockets that emit a strong odor and a visible sheen.

Soil samples were collected 26 March 2008 and analyzed in accordance with EPA method 8260B ELAP number 10958, data file V54919.D (Table 1). Elevated concentrations of BTEX, sec-butylbenzene, n-propylbenzene naphthalene, 1,2,4 trimethylbenzene, 1,3,5 trimethylbenzene and methyl tritbutyl ether were noted.

### 4.2 STARS Volatiles

Aromatic Compounds	Conditions at Camp Road Site (µg/l)
Benzene	243
Ethylbenzene	291
Toluene	358.3
Mixed Xylenes	146
Isopropyl benzene	101
n-Propylbenzene	262
p-Isopropyl toluene	262
1,2,4 Trimethylbenzene	131
1,3,5 Trimethylbenzene	39
n-Butyl-Benzene	547
sec-Butyl-Benzene	694
Tert-Butyl-Benzene	438
Naphthalene	154
MTBE	52.4

### 4.3 STARS Semi-Volatiles

Soil was evaluated in accordance with STARS semi-volatiles, all sample results were below the method detection limits.

## 5 REMEDIATION METHOD

### 5.1 Techniques

Techniques used to clean up an oil spill depend on oil characteristics and the type of environment involved. Pollution-control measures include containment and removal of the waste. Biodegradation (either natural or assisted), and normal weathering processes.

Oil spill countermeasures to clean up and remove the oil are selected and applied on the basis of many interrelated factors, including ecological protection, socioeconomic effects, and health risk. Contingency plans are in place in order to quickly stop the biodegradation process if required.

Remedial action is based on several criteria:

- Short-term impacts and effectiveness
- Long-term effectiveness and performance
- Reduction of toxicity, mobility, or volume
- Implementability
- Compliance with Clean-up Objectives
- Overall protection of human health and the environment
- Cost

The preferred method of remediation is destruction of the contaminants that will irreversibly destroy or detoxify all or most of the hazardous wastes to acceptable clean-up levels. The treated materials will have no residue containing unacceptable levels of hazardous wastes.

Considering the soil is isolated and shallow depth, microbial degradation using a batch feed process was chosen.

### 5.2 Microbial Degradation of Hydrocarbons

Bio-stimulation involves adding specific nutrients for the indigenous bacteria in an oxygen rich environment, and bio-augmentation is addition of bacteria selected for affinity to the specific contaminants. These methods have proven to be valid under certain site conditions and have been utilized for the effective and successful cleanup of contaminated soil and water. See System Description Ex-Situ Bioremediation System 111275954-3500 for a detailed description of the microbial process.

### 5.3 Oxygen Supply

Utilization of aliphatic hydrocarbons by microorganisms is an aerobic process. The initial oxidation step of aliphatic hydrocarbons involves molecular oxygen as a reactant and one of the oxygen molecules is actually incorporated into the oxidized product. Effective application can result in greatly accelerated cleanups as generally, the greater the mass of oxygen that can be distributed the more rapid and complete the cleanup.

## 6 SELECTION OF BACTERIA

### 6.1 Jar Headspace Test

Four samples were collected from an area of the site with the strongest odor and sheen. Three of them were tested on either substillision, specific petrophylllic pseudonomads and viable bacterial cultures in sodium dodecylbenze; the fourth was kept as the control.

One ounces of each bacteria and six ounces of chloride free water were added to each sample.

The samples were maintained at 68°F and evaluated by jar head space for VOC's after 24 hours. The specific petrophylllic pseudonomads showed the greatest reduction in contamination. There was no change on the control.

The first indication that the petrophylllic pseudonomads were working was the absence of odor from the sample. In 24 hours the sample was odorless and measured less than 10 ppm VOC's by jar head space test.

## 7 DESIGN

### 7.1 Sparge System Design

To provide an environment meeting the aerobic conditions of the hydrocarbon degradation process, a system to dissolve oxygen into the bacteria feed water was designed that can supply enough water at high enough dissolved oxygen content to completely spread the microbes and accelerate the growth process.

Molecular sieves are used to produce high purity oxygen from air employing the pressure-swing adsorption process. Pressurized oxygen is used to sparge feed water for the process to raise the dissolved oxygen content to a specific target at 70F. The high dissolved oxygen content serves to activate the bacteria and is supplied via water sparge to meet the biological oxygen demand of the system.

It was calculated that 5000 gallons of feed water would provide adequate coverage of the contamination area with slightly less water required to add nutrients to the soil. Convenient for process requirements and DOT requirements, a tanker size of 6500 gallons was selected. An economical design based on 6500 gallons of feed water with a high dissolved oxygen content, 4000 gallons of water with s 36-6-6 NPK was developed in accordance with Liberty Engineering documents:

Design Calculations 111275954-400  
System Description Ex-Situ Bioremediation 111275954-3500  
P&ID Ex-Situ Sparger System 111275954-700  
SWD Ex-Situ Sparger System 111275954-800  
Physical Design Sparger System 111275954-1400

## 8 PROJECT EXECUTION

### 8.1 Sparge Equipment

Sparge equipment was built and the adsorber controls were programmed and tested to produce the desired dissolved oxygen content in the feed water in accordance with the specifications.

### 8.2 Activating the Bacteria

To maximize the efficacy of the process, the spore count of the microbial product must be as high as possible. Commercial products for ponds range from half a billion to 3.5 billion per gram. The endosporic microbes were grown from a 5 billion per gram count to a 75 billion per gram in the mix drum under controlled conditions.

### 8.3 Prepare Feed and Water Add Bacteria

The water tanker was sparged until the feed water contained the desired dissolved oxygen content.

Microbe supernatant was introduced into the sparge recirculation flow.

The tanker was recirculated to thoroughly mix it's contents.

### 8.4 Field Application

A pump that delivers approximately 200 gallons per minute is adequate for the size of the site.

Manually spray the microbes using a fire hose and nozzle.

Sparge fertilizer tanker.

Add fertilizer to tanker.

Apply fertilizer to the soil no more than four days after applying microbes.

Till the soil at least monthly.

## 8.5 Periodic Sampling

Period jar head space samples are evaluated by PID for VOC's noting a downward trend overall. PID test results were used to evaluate effectiveness of microbial distribution and hydrocarbon destruction.

## 8.6 Observations and Additional Applications

Odor and sheen were absent from the site after 1 week from the first application. An area produced a garlic odor 45 days into the program. Soil samples were evaluated by scintillation detector to verify sulfur content. Areas with incomplete coverage were noted and treated on the second and third applications. Full sampling was performed 30 days following the third application.

# 9 RESULTS

## 9.1 Final Sample Results

Aromatic Compounds	Conditions at Camp Road Site (µg/l)	Rec. Soil Clean-up Objectives TAGM No. 4046 Table 2 (ppm)
Benzene	*ND	0.06 or MDL
Ethylbenzene	ND	5.5
Toluene	ND	1.5
Mixed Xylenes	ND	1.2
Isopropyl benzene	ND	2.3
n-Propylbenzene	ND	3.7
p-Isopropyl toluene	ND	10.0
1,2,4 Trimethylbenzene	ND	10.0
1,3,5 Trimethylbenzene	ND	3.3
n-Butyl-Benzene	ND	10.0
sec-Butyl-Benzene	ND	10.0
Tert-Butyl-Benzene	ND	10.0
Naphthalene	ND	13.0
MTBE	ND	0.12

\*ND = Non-Detectable

## 9.2 Discussion

Complete remediation was achieved in 90 days.

Soil composed of clay resists water. Heavy clay-laden areas must be tilled thoroughly to promote adequate contact with the microbes and water.

The technique used to apply microbes and fertilizer resulted in incomplete coverage per single application. One area was treated individually between the 3 scheduled applications based on PID testing.

Rainfall June-September 2008 precluded the necessity to add water the soil. Nominal moisture content was 20.8%

Average June temperature was 65°F. No measures were taken to conserve heat. Conditions below 65°F would require a thermal barrier over the entire surface.

## 10 SITE PHOTOGRAPHS



## 11 SITE SAMPLING PHOTOGRAPHS

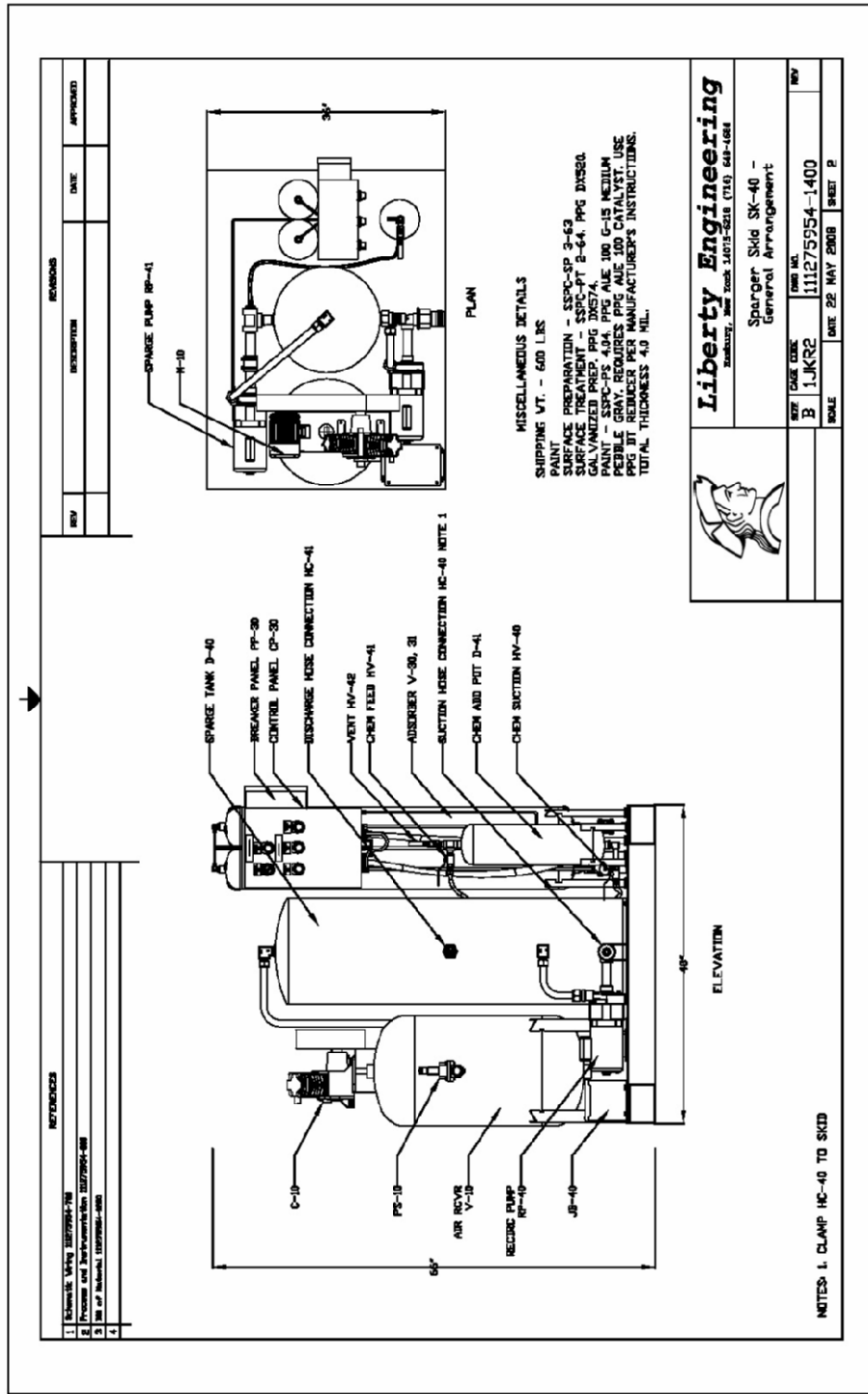


Collecting Samples

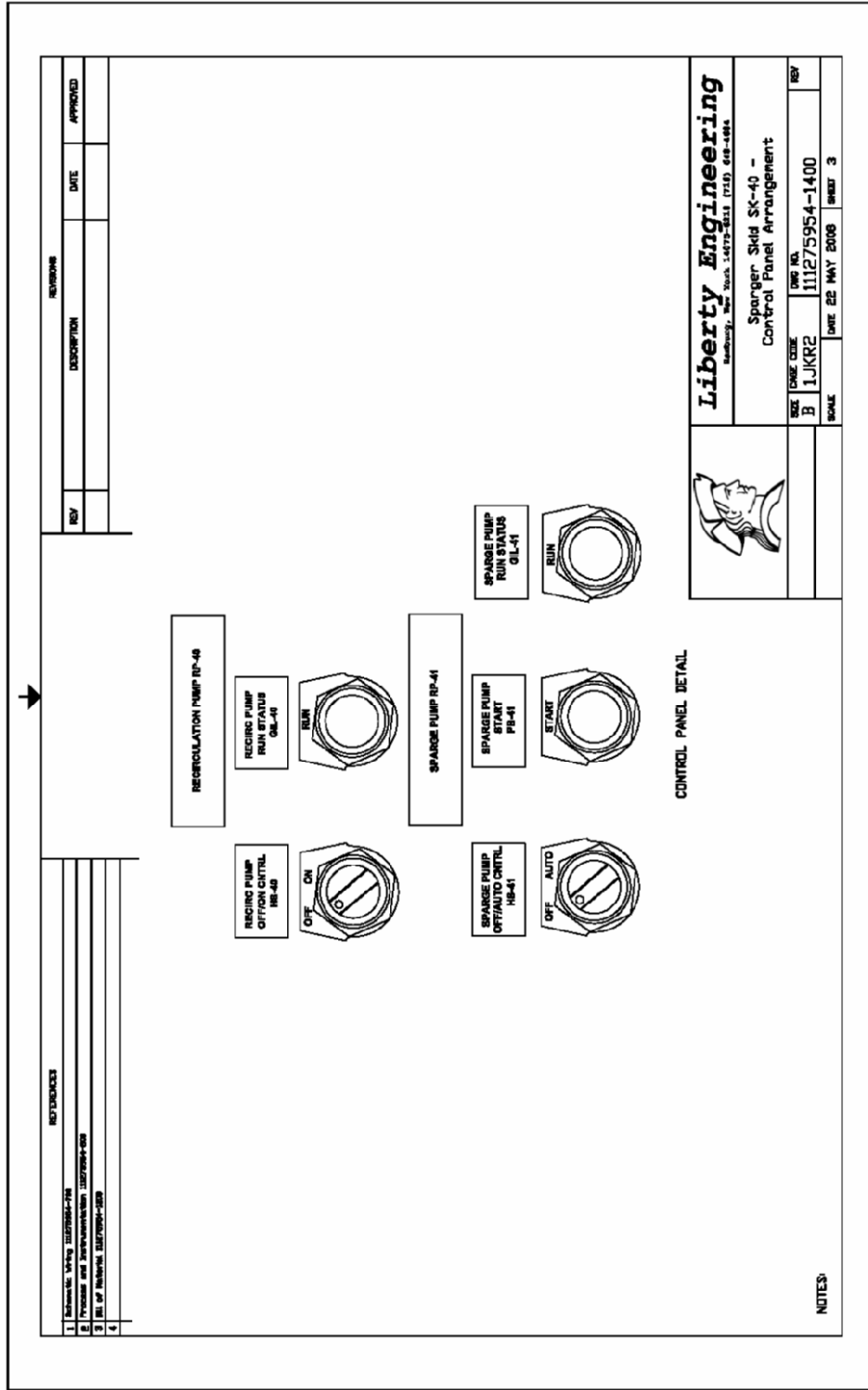


Maintaining Chain of Custody and Sample Map






USER



REVISIONS		
REV	DESCRIPTION	DATE

REFERENCES	
1	Skidmount, Vantage 112775954-2100
2	Process and Instrumentation 112775954-2100
3	Bill of Materials 112775954-2100
4	



**Liberty Engineering**  
Hampton, VA 23060 757-752-6611 (FAX) 757-648-4684

Sparger Skid SK-40 -  
 Control Panel Arrangement

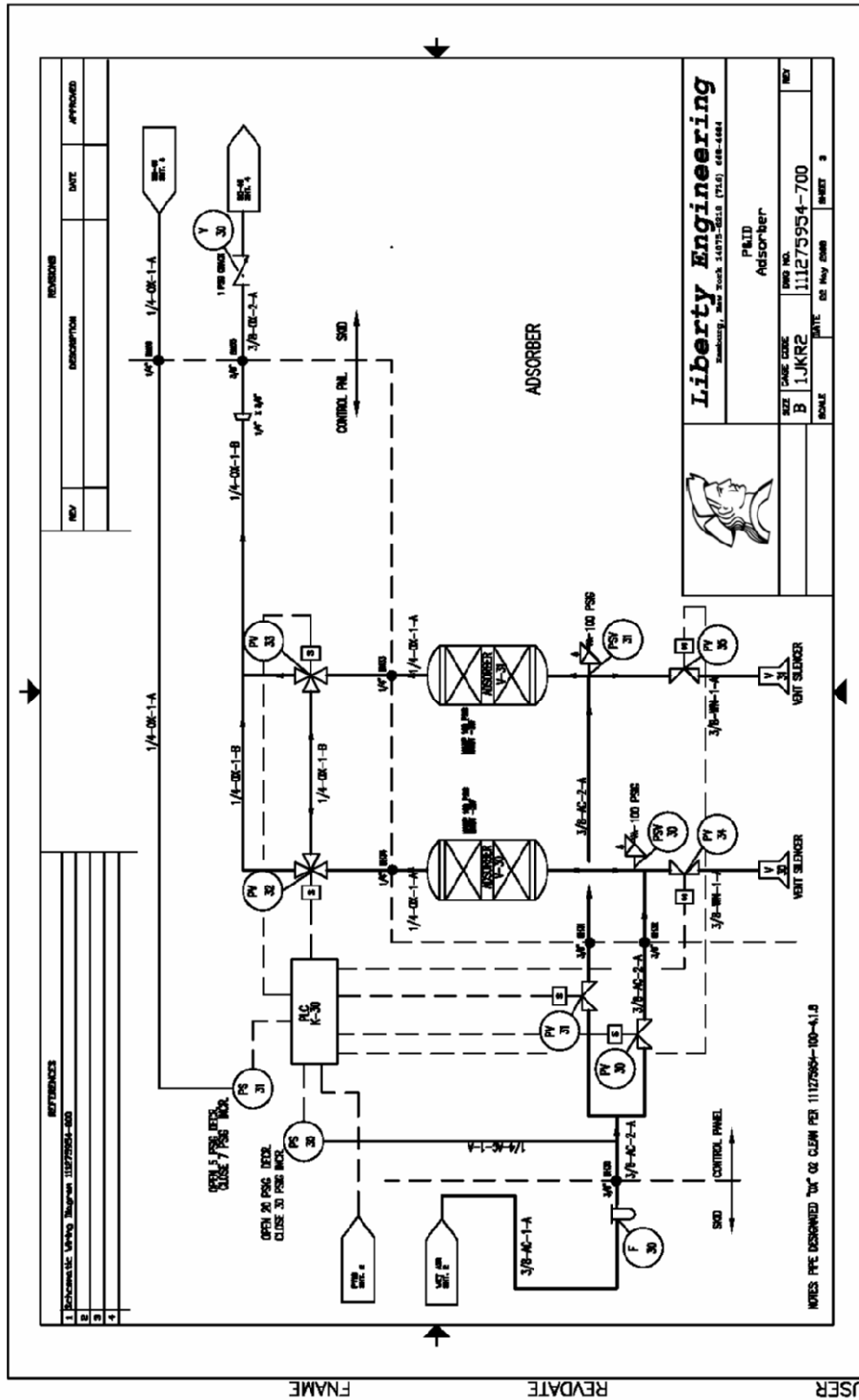
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B	11/27/08	
SCALE	DATE 22 MAY 2008	SHEET 3

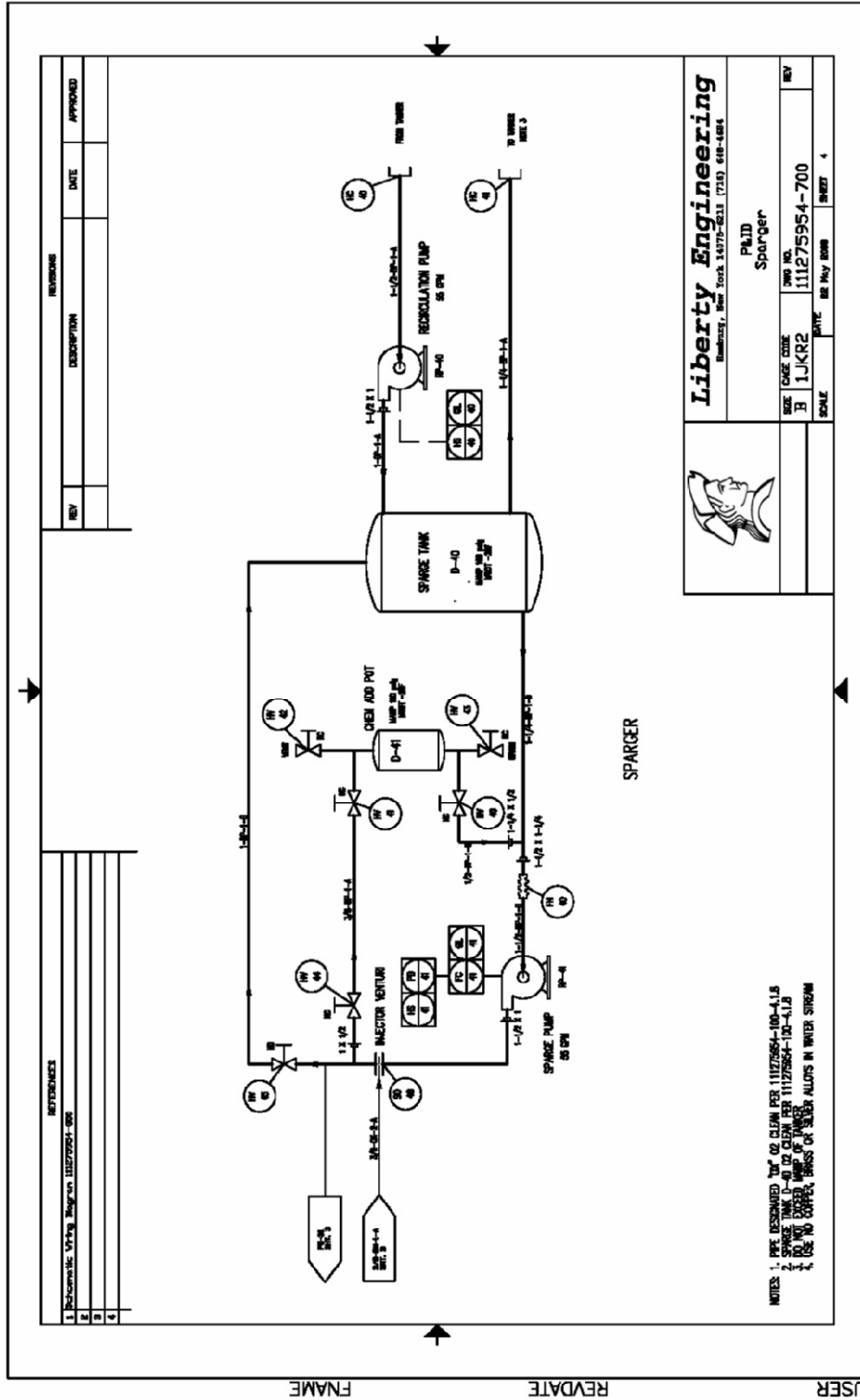
NOTES:

USER









REFERENCES		REVISIONS	
1	111275954-2100	DESCRIPTION	DATE
2			
3			
4			

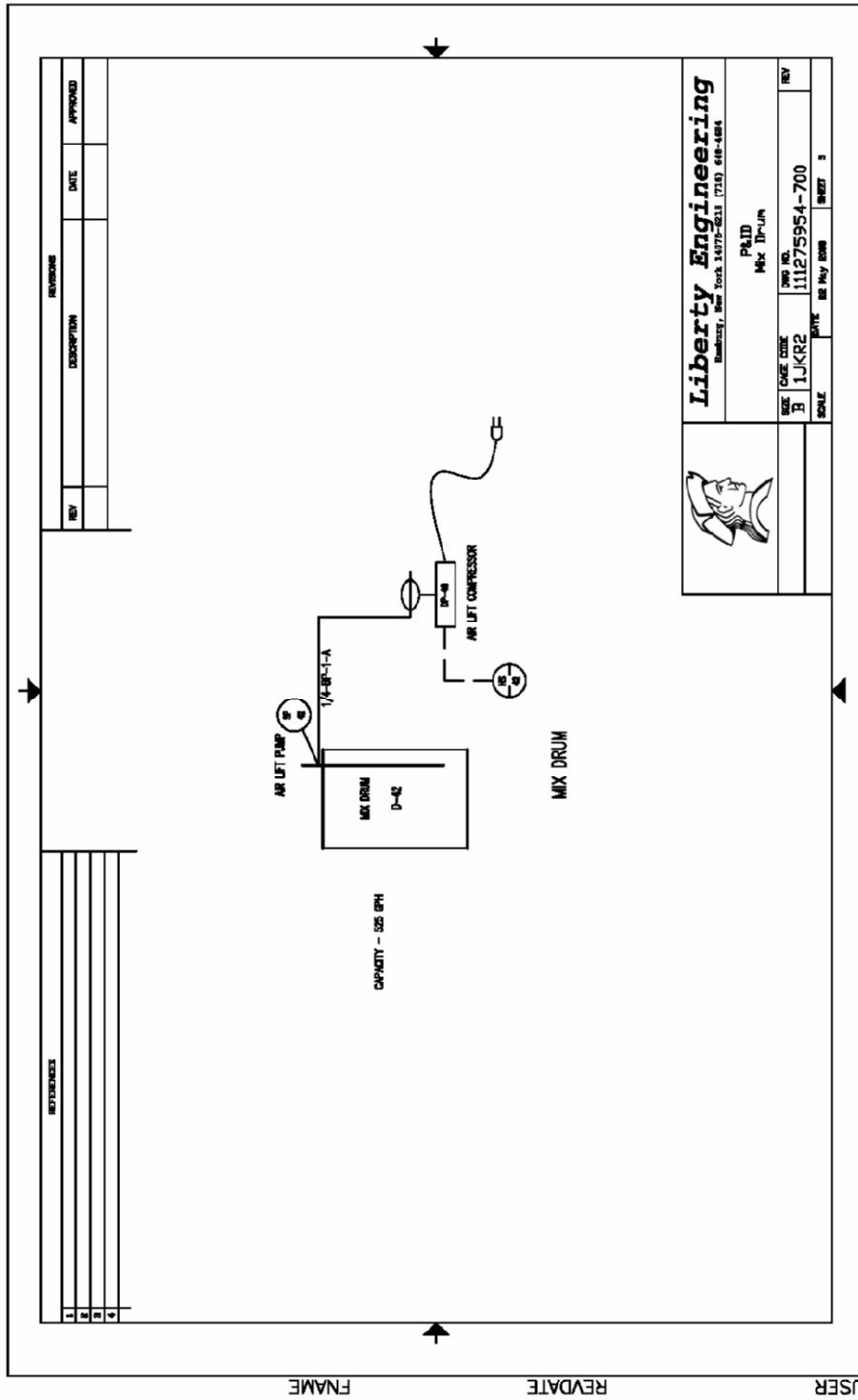
**Liberty Engineering**  
Hamsey, New York 14475-6113 (716) 648-4684

PK ID  
 Sparger

REV	DATE CODE	APP NO.	REV
3	1JKR2	111275954-700	
SCALE	DATE	SHEET	4

- NOTES:
1. USE RESERVED TAG AS CLEAN PER 111275954-100-4.1.5
  2. SPARGE TANK D-10 TO CLEAN PER 111275954-100-4.1.9
  3. DO NOT EXCEED MAXIMUM FLOW
  4. USE NO COPPER BRASS OR SILVER ALLOYS IN WATER STREAM

USER REVDATE FNAME



REVISIONS		
REV	DESCRIPTION	DATE

REFERENCES	
1	
2	
3	
4	

**Liberty Engineering**  
Hamsey, New York 14475-611 (716) 648-4684

PAID  
 Mix Drum

SIZE	DWG CODE	DWG NO.	REV
B	1JKR2	111275954-700	
SCALE	DATE	BY	SHEET
			3

USER      REVDATE      FNAME

## 13 PROJECT EXECUTION PHOTOGRAPHS



Programming Sparge Skid



Dissolved Oxygen Performance Test



Water Tanker at Developer's Site



Sparging Feed Water



Oxygenated Feed Water Return to Tanker



Mixing Microbes



Growing Microbes



Combining Microbes with Feed water



Applying Microbes to Soil



Applying Microbes to Soil



Recirculating Fertilizer Truck



Adding Fertilizer to Prepared Feed Water



Applying Fertilizer to Soil



Tilling the Soil