

**Andy Saberi**  
1045 Airport Boulevard  
South San Francisco, CA 94080

Mr. Jerry Wickham  
Alameda County Health Care Services Agency  
1131 Harbor Bay Parkway, Suite 250  
Alameda, CA 94502-6577

Re: 1230 14<sup>th</sup> Street, Oakland, California  
ACEH Case No. 295

Dear Mr. Wickham:

I, Mr. Andy Saberi, have retained Pangea Environmental Services, Inc. (Pangea) as the environmental consultant for the project referenced above. Pangea is submitting the attached report on my behalf.

I declare, under penalty of perjury, that the information and/or recommendations contained in the attached report are true and correct to the best of my knowledge.

If you have any questions, please call me at (650) 588-3088.

Sincerely,

  
Andy Saberi

**RECEIVED**

*10:09 am, Mar 13, 2012*

Alameda County  
Environmental Health



March 6, 2012

**VIA ALAMEDA COUNTY FTP SITE**

Mr. Jerry Wickham  
Hazardous Materials Specialist  
Alameda County Environmental Health  
1131 Harbor Bay Parkway, Suite 250  
Alameda, California 94502-6577

Re: **Workplan for Enhanced Site Remediation**  
Former Shell Service Station  
1230 14<sup>th</sup> Street, Oakland, California  
Fuel Leak Case No. RO0000433

Dear Mr. Wickham:

On behalf of the Andy Saberi, Pangea Environmental Services, Inc. has prepared this *Workplan for Enhanced Site Remediation* (Workplan) for the subject site. This Workplan was prepared in response to ACEH letter dated February 23, 2012 and verbal agency direction on March 5, 2012.

This Workplan proposes to use a bio-organic catalyst to enhance the effectiveness of ongoing dual phase extraction (DPE) and air sparging (AS) at the site. BOC use is also designed to help reduce air injection flow rates to help optimize capture of hydrocarbon vapors created by sparging, an agency concern reiterated by ACEH letter dated February 23, 2012. Pangea's initial response to the ACEH letter is presented in the *Groundwater Monitoring and Remediation Report – Second Half 2011*.

Due to budget limitations and decreasing hydrocarbon removal rates achieved by the DPE/AS system, Pangea would like to implement this Workplan in the very near future in accordance with the proposed schedule herein. Pangea also respectfully requests your prompt review of this Workplan since the UST Cleanup Fund has provided a limited budget for ongoing remediation system operation this fiscal year. If you have any questions or comments, please call me at (510) 435-8664.

Sincerely,  
**Pangea Environmental Services, Inc.**

A handwritten signature in blue ink that reads "Bob Clark-Riddell".

Bob Clark-Riddell, P.E.  
Principal Engineer

Attachment: *Workplan for Enhanced Site Remediation*

cc: Andy Saberi, 1045 Airport Blvd., South San Francisco, California 94080  
Denis Brown, Shell Oil Products US, 20945 S. Wilmington Avenue, Carson, CA 90810-1039  
SWRCB Geotracker (electronic copy)

**PANGEA Environmental Services, Inc.**

1710 Franklin Street, Suite 200, Oakland, CA 94612 Telephone 510.836.3700 Facsimile 510.836.3709 [www.pangeaenv.com](http://www.pangeaenv.com)



## WORKPLAN FOR ENHANCED SITE REMEDIATION

**Former Shell Service Station  
1230 14<sup>th</sup> Street  
Oakland, California  
Fuel Leak Case No. RO0000433**

**March 6, 2012**

*Prepared for:*

Andy Saberi  
1045 Airport Boulevard  
South San Francisco, California 94080

*Prepared by:*

Pangea Environmental Services, Inc.  
1710 Franklin Street, Suite 200  
Oakland, California 94612

*Written by:*

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Morgan Gillies  
Project Manager



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Bob Clark-Riddell, P.E.  
Principal Engineer

**PANGEA Environmental Services, Inc.**

## **INTRODUCTION**

On behalf of Andy Saberi, Pangea Environmental Services, Inc. has prepared this *Workplan for Enhanced Site Remediation* (Workplan) for the subject site. This workplan proposes to use a bio-organic catalyst (BOC) to enhance the effectiveness of ongoing dual phase extraction and air sparging at the site. BOC use is also designed to help reduce air injection flow rates to help optimize capture of hydrocarbon vapors created by sparging, an agency concern reiterated by ACEH letter dated February 23, 2012. Our proposed scope of work for site investigation is detailed herein.

## **SITE BACKGROUND**

The former Shell-branded service station is located at the northeast corner of 14th Street and Union Street in Oakland, California (Figure 1). Currently, an abandoned one-story station building and a pump-island canopy occupy the site, and much of the property is paved except for the former UST excavation. Land use in the surrounding area is currently residential to the north, south, and east, and is commercial/industrial to the west and southwest. The site topography is essentially flat.

### **Site History**

According to prior reports, the current site building was constructed in 1958 and gas station operations at the site reportedly began in 1958 and ceased in 1993. Petroleum hydrocarbons were first discovered in site soil near the underground storage tanks (USTs) during the completion of three borings at the site in February 1991. Four gasoline USTs and one waste oil storage tank were removed from the site on August 24, 1993. The current property owner, Mr. Andy Saberi, purchased the property in the mid 1980s.

### **Previous Environmental Work**

Previous environmental work has included site assessment, a sensitive receptor evaluation/well survey, risk evaluation, two rounds of feasibility testing (in 2000 and 2006), and several remedial actions. Remedial action included injection of oxygen releasing compound (ORC) into site wells in 1997, groundwater extraction (GWE) and dual-phase extraction (DPE) from 2002 to 2004 (performed with mobile equipment for approximately 11 separate days removing 6.0 lbs aqueous phase and 5.6 lbs vapor phase hydrocarbons), and hydrogen peroxide injection into site wells in 2003. Groundwater monitoring has been performed at the site since 1996. In January 2008, Pangea submitted a *Draft Corrective Action Plan and Pilot Test Work Plan* (Draft CAP/Test Workplan) as required by Alameda County Environmental Health (ACEH). In June 2008, with ACEH approval, Pangea installed new remediation test wells, repaired damaged remediation wells, and destroyed one remediation well, as detailed in the *Well Installation and Destruction Report* dated October 6, 2008. In early July 2008, Pangea conducted the approved pilot testing using the newly installed remediation test wells to determine whether SVE or DPE would most effectively remove contaminants and capture

hydrocarbon vapors resulting from air sparging. In the *SVE/DPE Pilot Test Report* dated October 7, 2008, Pangea recommended DPE/AS as the most effective remedial approach for the site. In a letter dated October 29, 2008, ACEH approved implementation of DPE/AS remediation at the site. On June 15, 2009, the California UST Cleanup Fund completed a 5-year review of the claim and recommended implementation of site remediation. The DPE remediation system was started up on April 27, 2011 but only operated for approximately three weeks in April/May 2011 and two weeks in December 2011 due to equipment issues and budget limitations from the UST Cleanup Fund. The AS system also only operated intermittently due to equipment malfunction. Following repair of the DPE/AS equipment, continuous operation of DPE/AS resumed on February 23, 2012.

## **WORKPLAN FOR ENHANCED SITE REMEDIATION**

Pangea would like to use a bio-organic catalyst (BOC) accelerate cleanup and reduce cleanup costs. The effectiveness of ongoing DPE/AS remediation may be partially limited by residual hydrocarbons sorbed to saturated soil. BOC use should help desorb residual hydrocarbons and accelerate natural attenuation of residual hydrocarbons. Because hydrocarbon removal rates achieved by the DPE/AS system have recently significantly reduced, Pangea would like to implement this Workplan in the near future in conjunction with continued operation of the DPE/AS system. The proposed BOC product is safe and relatively inexpensive. Pangea understands that the San Francisco Bay Region and Los Angeles Water Boards have approved use of BOC or similar products to enhance DPE site remediation. Product information for BOC (also known as NonTox<sup>TM</sup>) is included in Appendix A.

BOC use is also designed to help reduce air injection flow rates to help optimize capture of hydrocarbon vapors created by sparging, an agency concern reiterated by ACEH letter dated February 23, 2012. Remediation system monitoring and vapor capture data will be presented in a technical report as requested by ACEH.

The recent benzene distribution in groundwater is shown on Figure 2. The initial phase of the proposed enhanced DPE/AS remediation with bio-organic catalyst is illustrated on Figure 3. The remediation system layout and well locations are shown on Figure 4.

### **Proposed Remediation Enhancement Technique**

Bio-organic catalyst (BOC) is a highly concentrated liquid form “NONTOX<sup>TM</sup>-TPH Eliminator” designed to help desorb and breakdown petroleum hydrocarbons to enhance product recovery efforts and accelerate biodegradation of petroleum hydrocarbons. BOC has been used effectively on open water spills of petroleum crude oil and is enjoying increasing use for subsurface hydrocarbon remediation applications. BOC is often introduced into existing wells using water flushing and/or air sparging for added BOC distribution and increased dissolved oxygen supply. Petroleum hydrocarbons are decomposed, eventually degrading to carbon

dioxide and water as end products. BOC is non-toxic, 100% biodegradable, and safe to human, animals and plant life. BOC is mostly water, proteins, and enzymes derived from plant and mineral sources (primarily yeast). BOC works in concert with indigenous bacteria. BOC behaves similar to a surfactant and forms small bubbles when agitated by air injection (or shaking of product within a jar or treatment cell). BOC is relatively inexpensive and is considered 'green' remedial technology. Product literature for BOC is presented in Appendix A. BOC is relatively inexpensive, costing approximately \$55 to \$75/gallon depending on purchase quantity.

### **Injection Workplan**

Pangea will introduce a small volume (about 1 to 2 gallons) of BOC into select site wells and monitor hydrocarbon recovery rates in nearby extraction wells. To help distribute the BOC into the subsurface, Pangea will add a larger volume of water (about 5 to 10 gallons) into each well on an approximate 1:5 ratio of BOC to water. The DPE system will then pull the BOC across the residual impact area toward the extraction wells and remove the BOC in aqueous phase. BOC will also be added to select air sparge (deeper) wells to further distribute the BOC and simultaneously provide dissolved oxygen to further stimulate biodegradation. Air sparging will also agitate the BOC to create bubbles and help 'activate' the surfactant qualities of the BOC, bringing together the BOC enzymes, oxygen and contaminants for enhanced biodegradation. Finally, a more dilute BOC and water mixture (1:10 ratio) may be added directly into DPE wells and subsequently extracted after allowing approximately 24 to 48 hours of contaminant desorption. BOC will be added on several episodes depending on remedial effectiveness and observations.

As a pilot test, initial BOC injection will be performed on the three following wells: upgradient wells VW/MW-4 and AS-4 and central plume well AS-2. DPE will be performed primarily from nearby wells DP-1, DP-2, DP-4 and DP-5 to pull the BOC across the residual impact area for extraction. Air sparging will be performed primarily on wells AS-2 and AS-4 to help agitate and distribute the BOC. This initial phase of DPE/AS with BOC is illustrated on Figure 3.

With an active DPE/AS system at the site, the injected BOC enhancement product should be sufficiently captured and/or degraded onsite. Wells MW-1 and MW-5R will not be used for BOC to act as control wells and allow ongoing monitoring of site conditions in the source area. Groundwater monitoring of downgradient perimeter wells MW-6 and MW-7 will also allow evaluation of subsurface conditions and any potential migration of contaminants. As a contingency plan, downgradient extraction can be performed from existing DPE wells DP-2 and DP-3 and, if needed, DPE can be expanded to onsite boundary wells MW-6 and MW-7.

After successful demonstration of BOC capture and hydrocarbon attenuation during the initial BOC phase, BOC injection will be expanded to DPE wells DP-1, DP-2, DP-4 and DP-5. After a brief period of extraction from these DPE wells and subsequent monitoring of plume stability and attenuation, BOC addition can be

expanded to wells VW/MW-2, MW-5R, AS-1 and AS-3. Air sparging in wells AS-1 and AS-3 will help distribute BOC and provide dissolved oxygen for enhanced contaminant biodegradation. If monitoring data suggests that vapor phase hydrocarbons created by air sparging are not fully contained by the DPE system, then air injection rate and frequency will be limited in site wells, especially more downgradient air sparge wells (AS-1, AS-3 and AS-5).

## **Monitoring Plan**

Pangea will primarily monitor contaminant removal rates in vapor phase and aqueous phase by measuring flow rates, analyzing influent vapor/water samples, and recording equipment performance parameters. Before and after BOC addition, Pangea will measure depth to water, DO, ORP and contaminant concentrations in select wells. The primary affect of BOC will likely be increased aqueous-phase removal rate (initially) and decreased contaminant concentrations in groundwater monitoring wells during subsequent sampling.

During BOC activities, field visual screening techniques will be performed to determine the presence of BOC in extracted groundwater. Decreased viscosity on a plate glass sample or soap-like bubbles on a shaken groundwater sample are indicative of BOC presence. The BOC may take a few hours or days to reach the extraction wells. Upon confirmation of BOC in extracted groundwater, Pangea will collect groundwater influent samples for contaminant concentrations analysis by a laboratory to calculate aqueous phase removal rates. Depending on initial observations, additional BOC introduction may be performed. According to vendor information, the enhanced aqueous-phase removal provided by BOC may reach 400 to 800% initially and typically decreases with successive BOC events. After a few events or if removal rates cease to increase with BOC addition, the BOC addition will be discontinued.

The ultimate evaluation of BOC's enhancement is the effect on groundwater quality in site wells. To control cost, primary well sampling will be performed during routine semi-annual monitoring. Additional monthly well sampling may be performed on one or a few select wells (e.g., wells MW-1, MW-5R and MW-6) to evaluate remedial progress and plume stability. To control cost, this more frequent well sampling will include purging of only one well pore volume and grab sampling with a bailer. Water generated during well sampling can be treated and disposed using the existing DPE treatment system. Routine quarterly well monitoring would be performed ideally no sooner than four weeks after DPE/AS and BOC introduction to provide time for desorption and additional contaminant biodegradation. During routine monitoring Pangea will also monitor dissolved oxygen (DO) and oxidation reduction potential (ORP) in site wells. To screen groundwater for residual BOC during routine monitoring, Pangea will analyze groundwater select samples for non-ionic surfactants using Standard Method SM5540BD (dissolved non-ionic foaming agents, cobalt thiocyanate active substances (CTAS)).

This above monitoring plan is in addition to the monitoring performed for routine DPE/AS, which includes monitoring of vapor extraction and air injection rate/pressure, periodic monitoring of soil vapor concentrations in vapor monitoring point VMP-1, and measurement of subsurface vacuum/pressure in perimeter site wells. .

## **Remediation and Monitoring Schedule**

Pangea proposes the following schedule for enhanced remediation and groundwater sampling:

- February and March 2012 – Startup and Continue DPE/AS System Operation/Vapor Monitoring
- April 2012 – Pilot Testing of BOC during DPE/AS Operation with Agency Approval
- May 2012 – Expanded BOC during DPE/AS Operation and System Shutdown/Rebound Test at End
- June 2012 – Sample All Site Wells after 4 Weeks of Subsurface Equilibrium (Semi-Annual Event)

## **CLOSING**

Upon agency approval, Pangea will implement this workplan to enhance DPE/AS remediation, accelerate site cleanup and therefore reduce overall remediation costs. Pangea respectfully requests rapid review of this workplan to meet the proposed implementation and monitoring schedule. To help facilitate your review, Pangea will provide separately the requested information about DPE/AS system monitoring and vapor capture in the near future.

Pangea has also proposed to skip the first quarter 2012 monitoring event since limited active remediation has been performed since the prior monitoring event on December 27-28, 2011. Pangea requests agency concurrence to perform groundwater sampling from *all* site wells (assuming workplan approval) to evaluate site conditions during the next semi-annual monitoring event in June 2012. As required, future groundwater monitoring will be performed quarterly from program wells to help focus any needed future remediation.

## **ATTACHMENTS**

Figure 1 – Vicinity Map

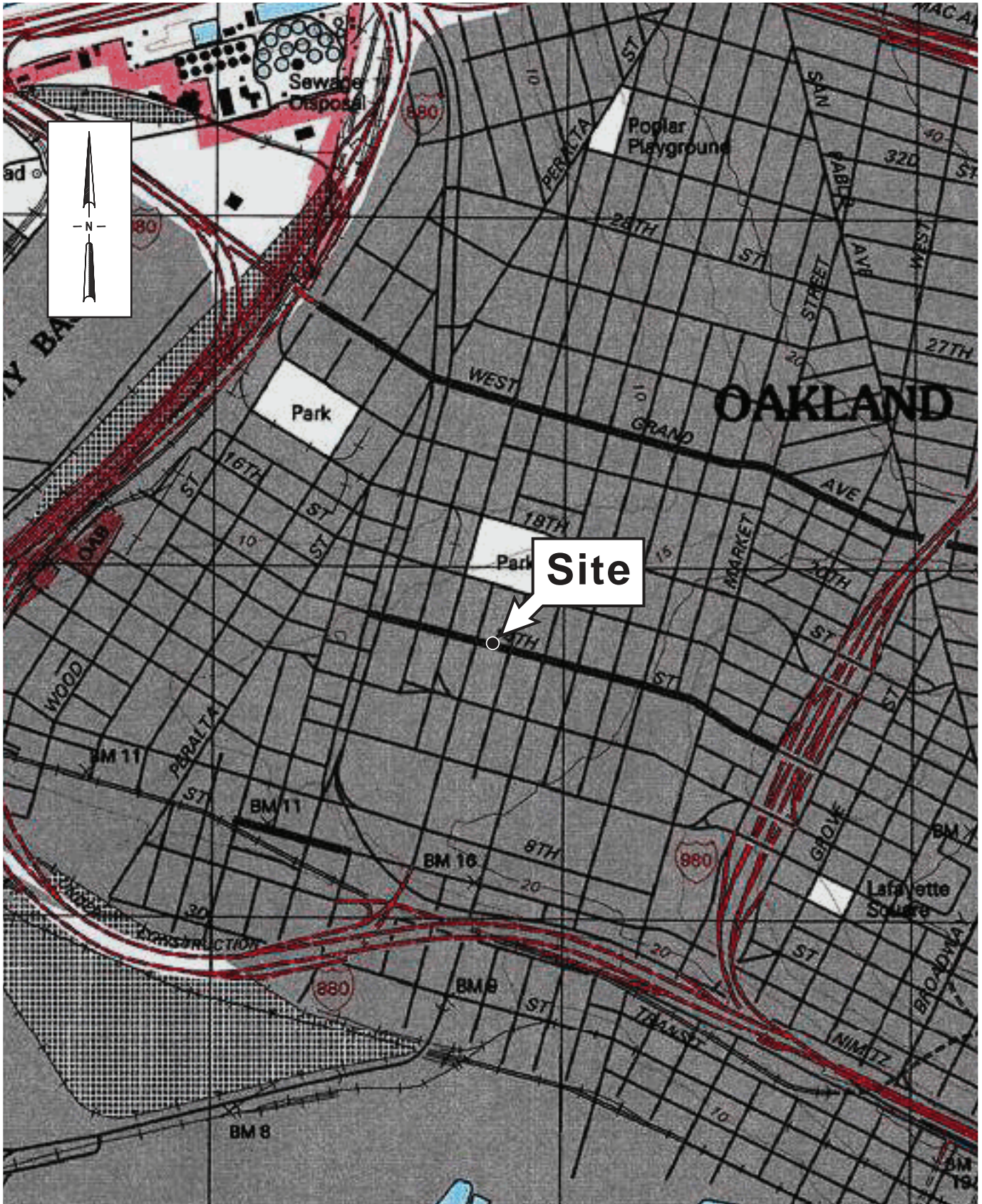
Figure 2 – Benzene Distribution in Groundwater, December 27-28, 2011

Figure 3 – Enhanced Dual Phase Extraction with Bio-organic Catalyst

Figure 4 – DPE/AS Remediation System Layout

Appendix A – Bio-Organic Catalyst Product Information





Figure

**1**

**Former Shell Service Station**

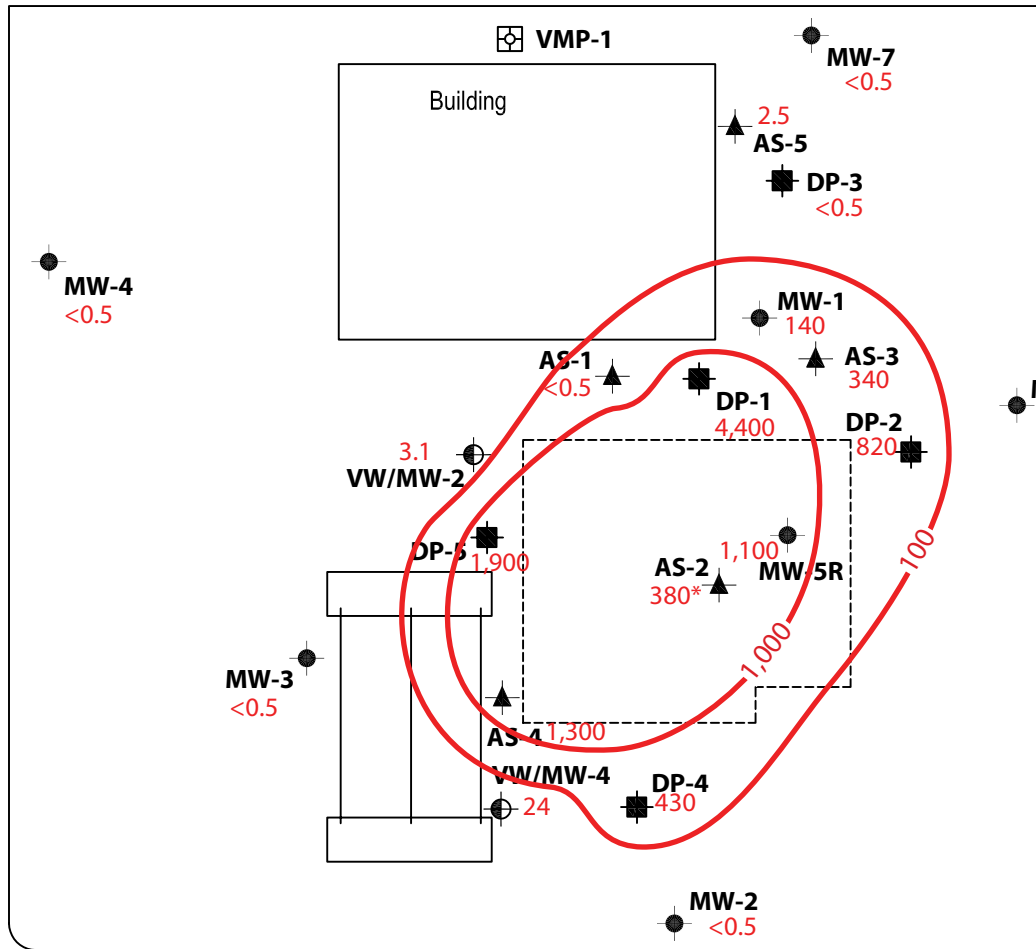
1230 14th Street  
Oakland, California



Vicinity Map



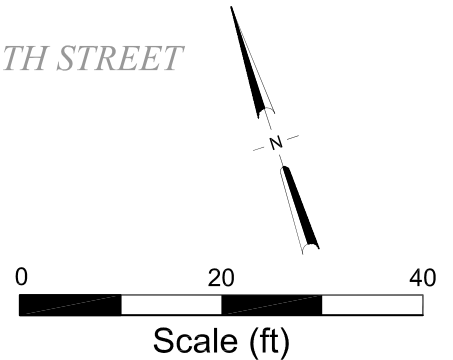
UNION STREET



**EXPLANATION**

- DP-1 ■ Dual phase extraction (DPE) well
- AS-1 ▲ Air sparge well (AS)
- VMP-1 □ Vapor monitoring point
- MW-1 ● Groundwater monitoring well
- VW/MW-4 ⊕ Combination soil vapor extraction well/monitoring well
- GW → Estimated groundwater flow direction
- 140 Benzene in groundwater, concentrations in µg/L
- \* Not used for contouring
- 100 Isoconcentrations of benzene in groundwater, concentrations in µg/L, December 27-28, 2011 or most recent data

14TH STREET

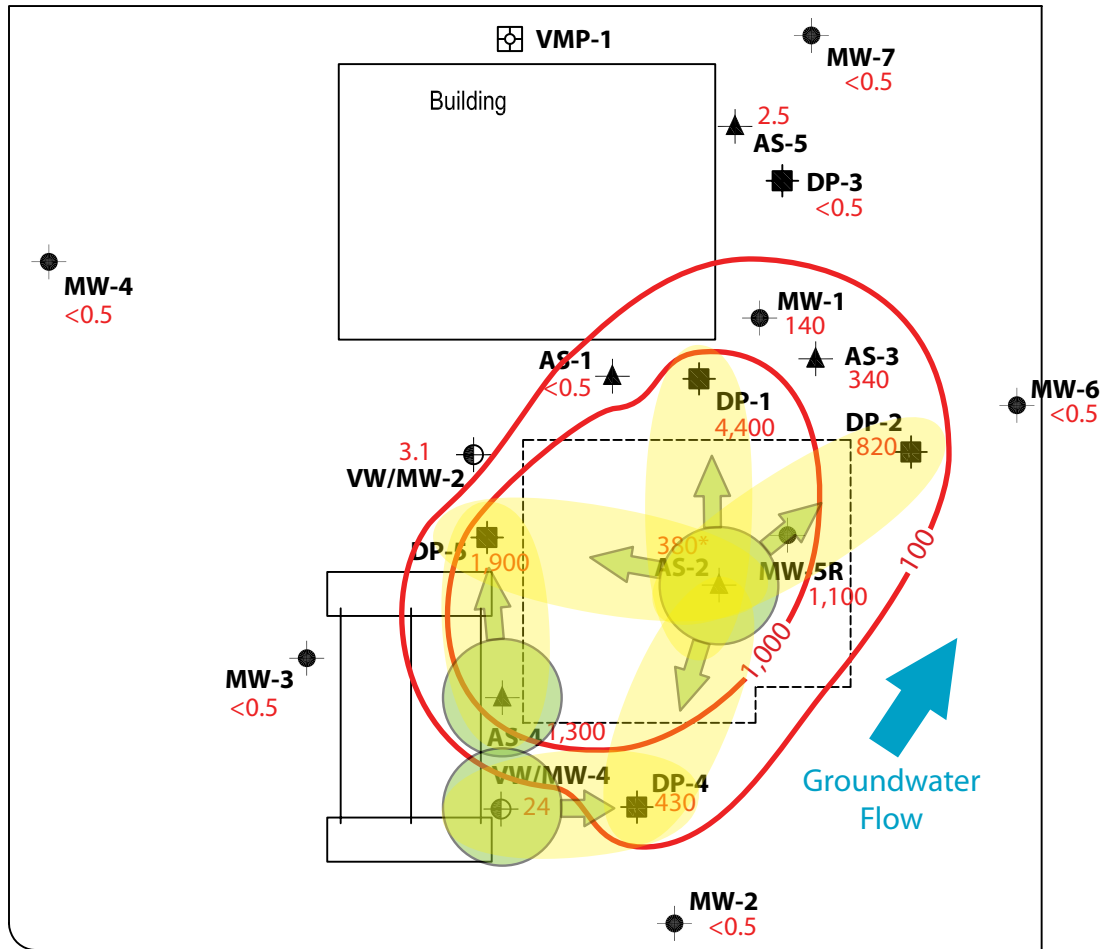


Figure

2



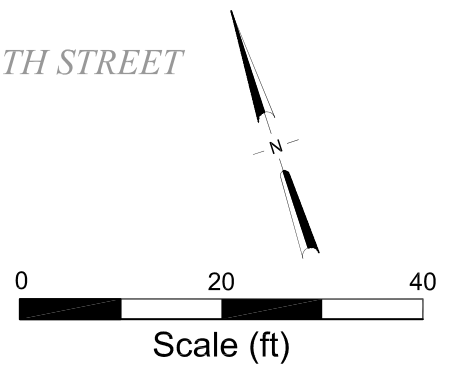
UNION STREET



**EXPLANATION**

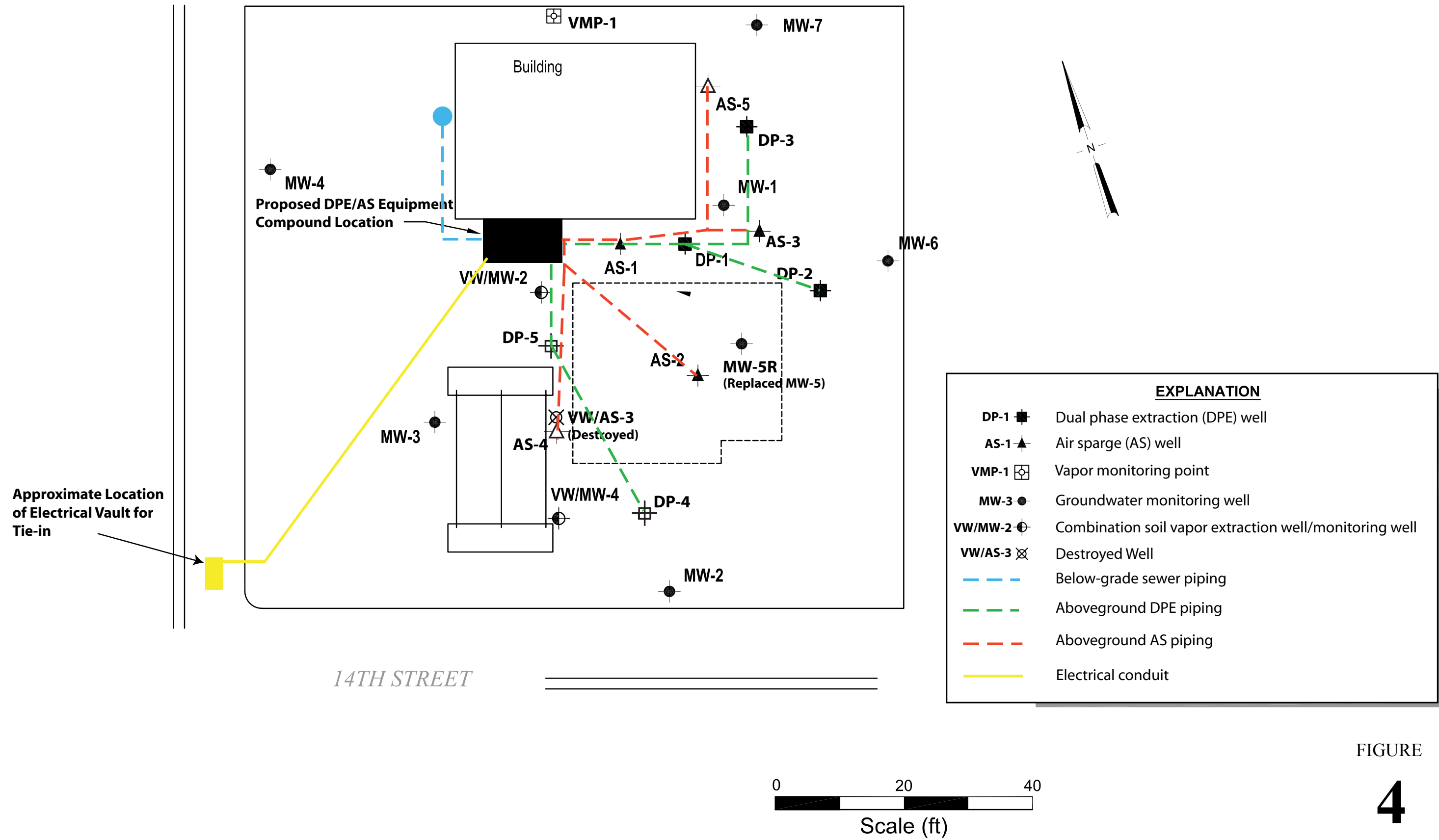
- DP-1** ■ Dual phase extraction (DPE) well
- AS-1** ▲ Air sparge well (AS)
- VMP-1** □ Vapor monitoring point
- MW-1** ● Groundwater monitoring well
- VW/MW-4** ⊕ Combination soil vapor extraction well/monitoring well
- Proposed BOC Location
- Primary BOC Influence Area
- 140 Benzene in groundwater, concentrations in  $\mu\text{g/L}$
- \* Not used for contouring
- 100 Isoconcentrations of benzene in groundwater, concentrations in  $\mu\text{g/L}$ , December 27-28, 2011 or most recent data

14TH STREET



Figure

**3**



FIGURE

**4**

## **APPENDIX A**

### Bio-Organic Catalyst Product Information

# NONTOX™

## **Petroleum Hydrocarbon Remediator:**

The cleaning and remediation of petroleum hydrocarbon contaminated water and soils is a fundamental environmental challenge that impacts most industries and transportation systems, including shipping. NONTOX™ is a specially formulated bio-organic catalytic composition which greatly accelerates remediation rates, at very low relative cost compared to traditional remediation technologies.

NONTOX™ provides a superior cleaning capability when used to wash petroleum hydrocarbon based contaminants, and then allows for their subsequent accelerated remediation, so that the cleaning/remediation process is combined together into a synergistic and complementary procedure.

NONTOX™ is a highly concentrated bio-organic catalyst composition formulated to provide an instant protection from auto ignition risks from petroleum hydrocarbon spills and wastes, and greatly accelerates biodegradation of these hazardous compounds in both water and soil applications.

## **Benefits:**

- Immediate protection from auto ignition of petroleum hydrocarbons
- Able to provide superior cleaning of oil coatings and wastes
- Accelerates biodegradation rates of petroleum hydrocarbons
- Reduces costs associated with soil and water remediation procedures
- Provides treatment to most petroleum hydrocarbon contamination
- Helps in the precipitation of metals in wastewater discharges
- Acts quickly to effectively remove highly soluble elements
- Limits the formation of anoxic "dead zones"

**USDA**  
*Approved*  
**Safe**  
**Non-Toxic**  
**Biodegradable**

## **General Description**

### **NONTOX: PETROLEUM HYDROCARBON REMEDICATION/CLEANING**

- Is a biocatalytic system in a liquid concentrate form that stimulates and accelerates natural biological reactions. When combined with fresh or salt water and oxygen, the product will cause crude oil, jet fuel, diesel oil and other organic substances to rapidly decompose, eventually biodegrading them to carbon dioxide and water as end products.

- It is non-toxic and safe to humans, animals, marine life and plant life. It is 100% biodegradable.

- Works in concert with indigenous bacteria. No cultured or foreign bacteria are introduced into the ecosystem.

- Is nonflammable. It will reduce fire hazards by increasing flash points and autoignition threshold points in substances such as gasoline or fuel oil.

- Eliminates obnoxious odors associated with crude oil, petroleum derivatives and other organic molecules that are proceeding through the natural decomposing process.

- Is fully compatible with most types of application equipment now in use. The product may be easily applied by hand or power sprayers, helicopter, airplane or floating equipment. Its application requires no special safety equipment.

### **TARGETED HYDROCARBON CONTAMINANTS**

In this case, the hydrocarbon compounds found in water, soil and air are the selected targets of NONTOX. This would include such petroleum derived products as crude oil, drilling muds, creosote, kerosene, coal tars, gasoline, diesel, bunker fuels, lubricating and hydraulic fluids. Other contaminant groups would include aliphatic and aromatic hydrocarbons, polynuclear aromatic hydrocarbons, chlorinated aliphatic compounds, chlorinated aromatic compounds and chlorinated and non-chlorinated phenols.

It has been shown that the product has unique features in odor elimination of such gases as hydrogen sulfide, ammonia, mercaptan and other noxious odors emanating from anaerobic decomposition. The odor degradation activity happens in a very short period and effectively eliminates volatilization of light chain organic molecules, such as the BTEX group of petrochemicals, into the atmosphere.

### **TREATMENT METHODOLOGY**

The product is fully compatible with most types of application equipment now in use. NONTOX may be easily applied with hand or power sprayers, standard educator tubes, helicopters, airplane or floating equipment. No special nozzles or hoses are required. Each

treatment site may differ in its requirements and modality of treatment. Factors that can influence the tactical use of NONTOX are:

Redox Potential Temperature Availability of Nutrients Nature and Concentration of Contaminants pH Heavy Metals Should these variables complicate the application and treatment procedures, the NONTOX works well with other commonly accepted treatment modalities such as venting, injection aeration, aeration lagoons and inoculants for removal of heavy metals.

### **Water or Beach Spills**

Reducing the danger of oil reaching beaches and shore structures is best achieved by spraying the oil slick perimeter with a diluted solution of 10 gallons of NONTOX mixed with 150 gallons of sea water or fresh water for each 40,000 square feet of surface area to be treated. If the slick has a heavy consistency, it is recommended that a 1:15 diluted NONTOX solution is applied over a three-day period, using one-third of the mixed solution each day. For best results, the product should be applied at a high pressure – generally above 500 psi.

## **TECHNICAL DATA**

### **Bacterial Proliferation**

The successful biodegradation of petroleum is dependent on two factors: 1) having the bio-organic catalyst reduce the petroleum to a form, which can be readily assimilated, by bacteria and 2) stimulating the proliferation of naturally occurring nonpathogenic heterotrophic bacteria. NONTOX to significantly increase beneficial bacterial activity in bay water by 12,857% and ocean water by 14,333%.

### **Accelerated Bioremediation**

Independent laboratory studies from specialists in petroleum technology have quantified the ability of NONTOX to dramatically reduce petroleum contaminants. showing a 90% reduction in Jet-A, Diesel-2 and Heavy Duty Lube Oil within 96 hours. While treatment time required may vary dependent on conditions previously noted, the mode of action is the same. NONTOX is a unique biocatalytic system that accelerates natural biological reactions with hydrocarbon products in water.

## **METAL CONTAMINANT PRECIPITATION**

Another benefit of NONTOX use is its ability to break the matrix that suspends metals.

## **FLAMMABILITY REDUCTION**

Open cup flash points and auto ignition temperature tests quantify the ability of NONTOX to render petroleum products nonflammable and dramatically increase their auto ignition temperatures. NONTOX alters the molecular structure that dramatically reduces



flammability and the elimination of volatile organic compounds (VOCs) and their odors. The importance of this feature cannot be overstated in terms of shipboard safety and survivability. In addition, the use of other ecologically incompatible materials, such as AFFF Foam, may be significantly reduced.

## **SAFETY PROFILE**

Extensive independent laboratory testing utilizing accepted standards for dermal and ocular effects on animal and human subjects have been performed. Phytotoxicity, bacteria community and internal aquatic organism safety studies are well documented.

## **OTHER POSSIBLE APPLICATIONS**

- Initial Actions for Fire Fighting, i.e. cover the fire hazard with a layer of AFFF and flash point reducing product.
- Fuel or Oil Tank Cleaning
- Engine / Generator Wipe down
- Galley Drain Line Unclogging
- CHT Tank Cleaning / Degreasing
- Flight Deck Cleaning (should be able to hose it over the side).
- Trough Cleaning



## **NONTOX**

Total Petroleum Hydrocarbon (TPH) Bio-Remediation/Bio-Organic Catalyst

The NONTOX product line is an advanced bio-catalytic formula designed to work in concert with indigenous ecologies to accelerate the bio-remediation of petroleum hydrocarbon pollutants (TPH) in water and soils. It is safe and non-toxic to humans, marine life, and plant life. It is 100% biodegradable, and introduces no foreign, or cultured, bacteria into the environment. NONTOX raises dissolved oxygen levels in water bodies, which is critically important to aquatic life.

NONTOX is fully compatible with most types of application equipment, including hand or power sprayers, helicopter, airplane, or floating equipment. Its application requires no special equipment. NONTOX is non-flammable, and will also reduce fire hazards by increasing flash points and auto-ignition thresholds of substances such as gasoline and fuel oil.

The Safety Profile of NONTOX has been established through extensive laboratory testing utilizing accepted standards for dermal and ocular effects on animal and human subjects. Non-toxicity to bacteria colonies and aquatic organisms has been documented.

NONTOX works through the twin factors that are essential to petroleum hydrocarbon bio-remediation: 1) reduction of the hydrocarbons into a form that can be readily assimilated by indigenous ecological microorganisms, 2) stimulation of the proliferation of naturally occurring beneficial microorganisms within sea water, soils, and water bodies.

Independent studies have shown 90% reductions in TPH levels in 96 hours.

NONTOX is a highly concentrated liquid composition that is applied through water delivery spray systems. The dilution levels can be very high, as low as parts per million ranges, depending upon the concentrations of petroleum hydrocarbon pollutants within the water or soil.

The application of NONTOX requires no special installation set ups. It is advisable to be added within water tanks prior to application for proper dilution.

NONTOX is completely safe for use by personnel, and requires no special protective clothing or handling procedures.

NONTOX is a patented and proprietary complex composition of individual ingredients derived from readily available sources, thereby allowing rapid scale up of production to any desired levels.

NONTOX PROTOCOL FOR TOTAL PETROLEUM HYDROCARBON (TPH) BIO-REMEDIATION  
ADVANCED BIO-ORGANIC CATALYST COMPOSITION  
FOR GENERAL GUIDELINES: ONE (1) PART OF NONTOX FOR ONE (1) PART OF TPH CONTAMINATION



APPLICATION RATES:

SOILS: To treat (1) cubic yard, or 4200 lbs.  
up to 500 TPH = 20.5 oz. in (4) Gals. Of Water  
up to 2500 TPH = 25.6 oz. in (4) Gals. Of Water  
over 2500 TPH = 30.7 oz. in (4) Gals. Of Water

Maintain soil moisture @ 15 - 18%, Apply in (3) Equal Applications 5 - 7 Days Apart

(1) Cubic Yard = 4200 Lbs. (1) Ton = 2000 Lbs.

PAVEMENTS: For treating Pavement Surfaces, such as below, use 2.5% Dilution of NONTOX in PowerWasher:  
(For best results: High Pressure, Above 500 psi)

1. Concrete
2. Asphalt
3. Coplestone
4. Compacted Earth
5. Steel or Metal Plate
6. Laminates

WATERS: For treating TPH Contaminated Waters, Use (1) Part of NONTOX for (1) Part of TPH Contamination  
(Good agitation with contaminated waters recommended.)

1. Salt Water
2. Fresh Water
3. Tanker Ships
4. Tanker Trucks

\* For additional nutrient requirements for active biological cultures in waters or soils, a liquid NPK fertilizer is advised.

#### FIRE PREVENTION CAPABILITIES:

1. Open Cup Flash Point Tests: Non-Flammable
2. Auto Ignition Tests: Non-Flammable



NONTOX will significantly reduce ability of fuel spills to ignite.

#### SAFETY PROFILE:

NONTOX is completely non-toxic and safe to marine, animal and human life. 100% Bio-Degradable. Extensive independent laboratory testing utilizing accepted standards for dermal and ocular effects on animal and human subjects have been performed. Phytotoxicity, bacteria community and internal aquatic safety studies are well documented.

#### VOLATILE ORGANIC (VOC) ODORS:

NONTOX will eliminate the noxious odors associated with crude oil, petroleum derivatives, chlorinated aromatic compounds, and other petroleum based products.

#### MECHANISM OF ACTION:

NONTOX works through an accelerated natural breakdown of petroleum hydrocarbon substances (bio-catalysis). Works in concert with indigenous microbiology, introduces no cultured or foreign bacteria into the ecosystem. Natural biological populations in Sea Water ecologies have increased by over 12,000% with NONTOX.

#### APPLICATION EQUIPMENT:

NONTOX is fully compatible with most types of application equipment used, including; hand or power sprayers, standard educator tubes, tankers, helicopters, airplanes, or floating equipment.

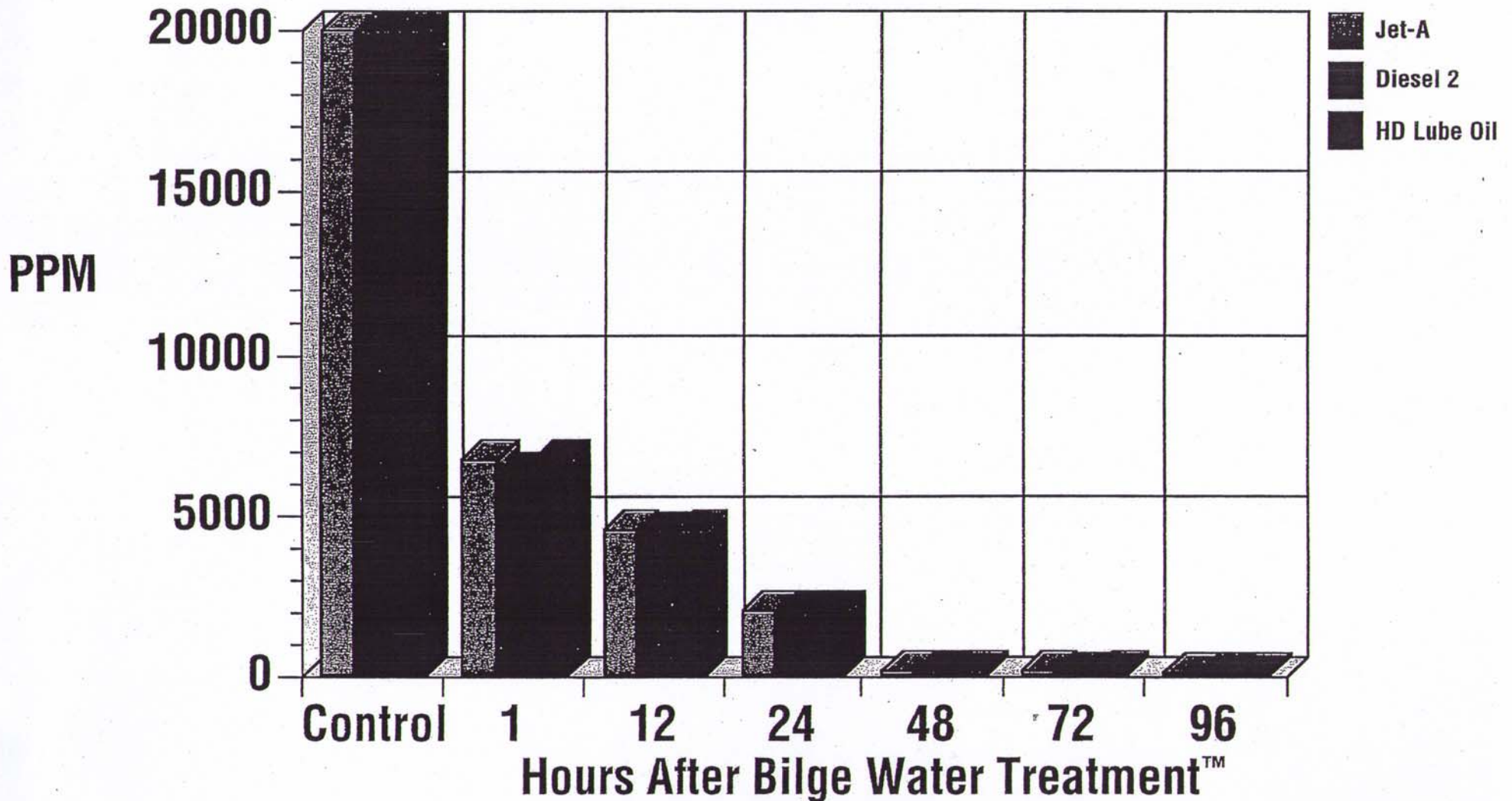
#### TPH BIO-REMEDICATION:

NONTOX has demonstrated in independent studies reductions in TPH levels of up to 90% in jet fuel, diesel fuel, and heavy duty lube oil, within days. Light volatile hydrocarbon reductions are very rapid.



# BILGE WATER TREATMENT™

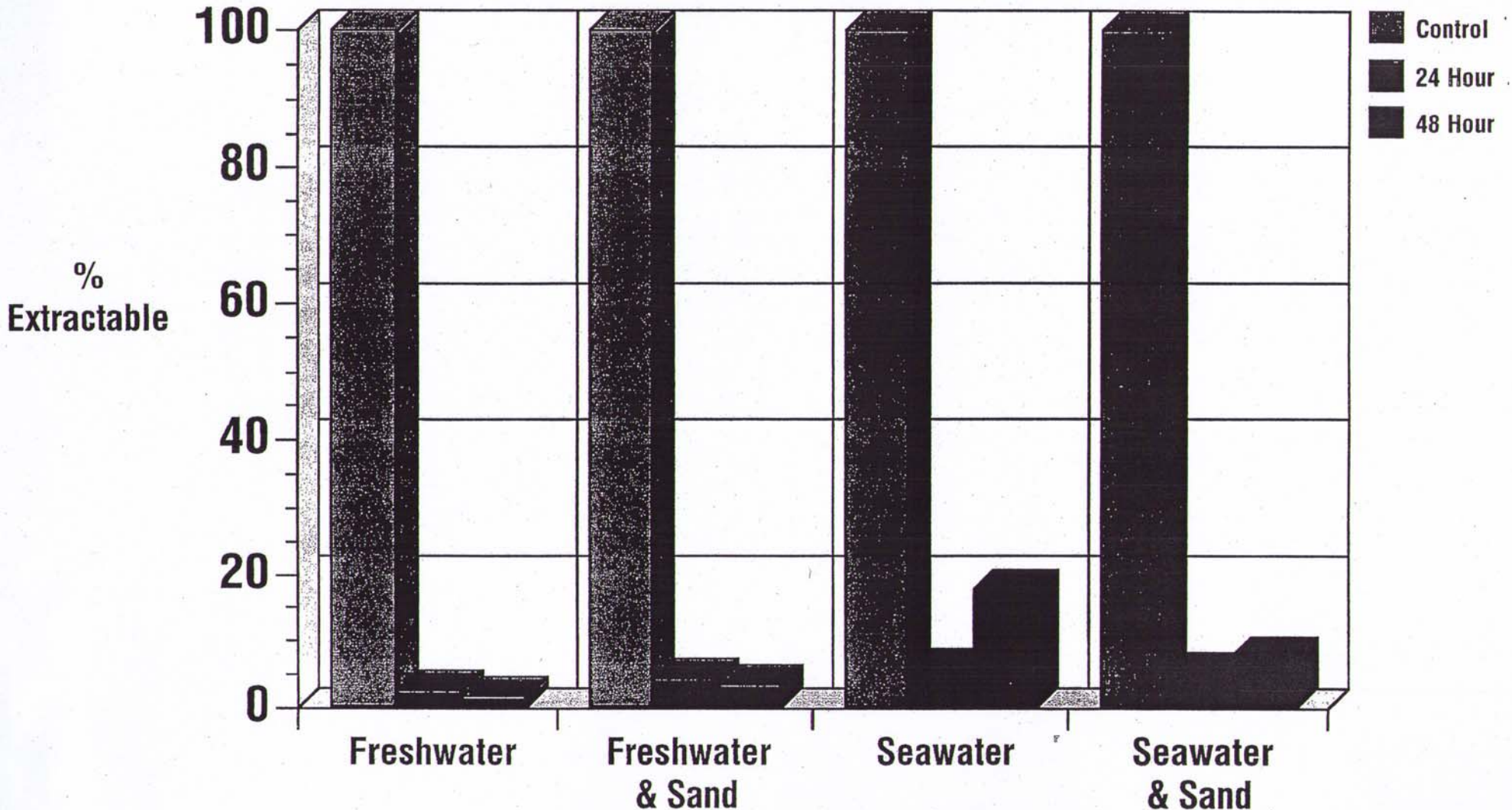
## PETROLEUM REDUCTION



Reference: ACIS Labs - Specialists in Petroleum Technology, Detroit, Michigan. Report Number: 9308-2541-1,  
Report Date: 09/07/03 Test Method: Foam Extract (FOE) - EPA 112.1

# BILGE WATER TREATMENT™

## CRUDE OIL REDUCTION

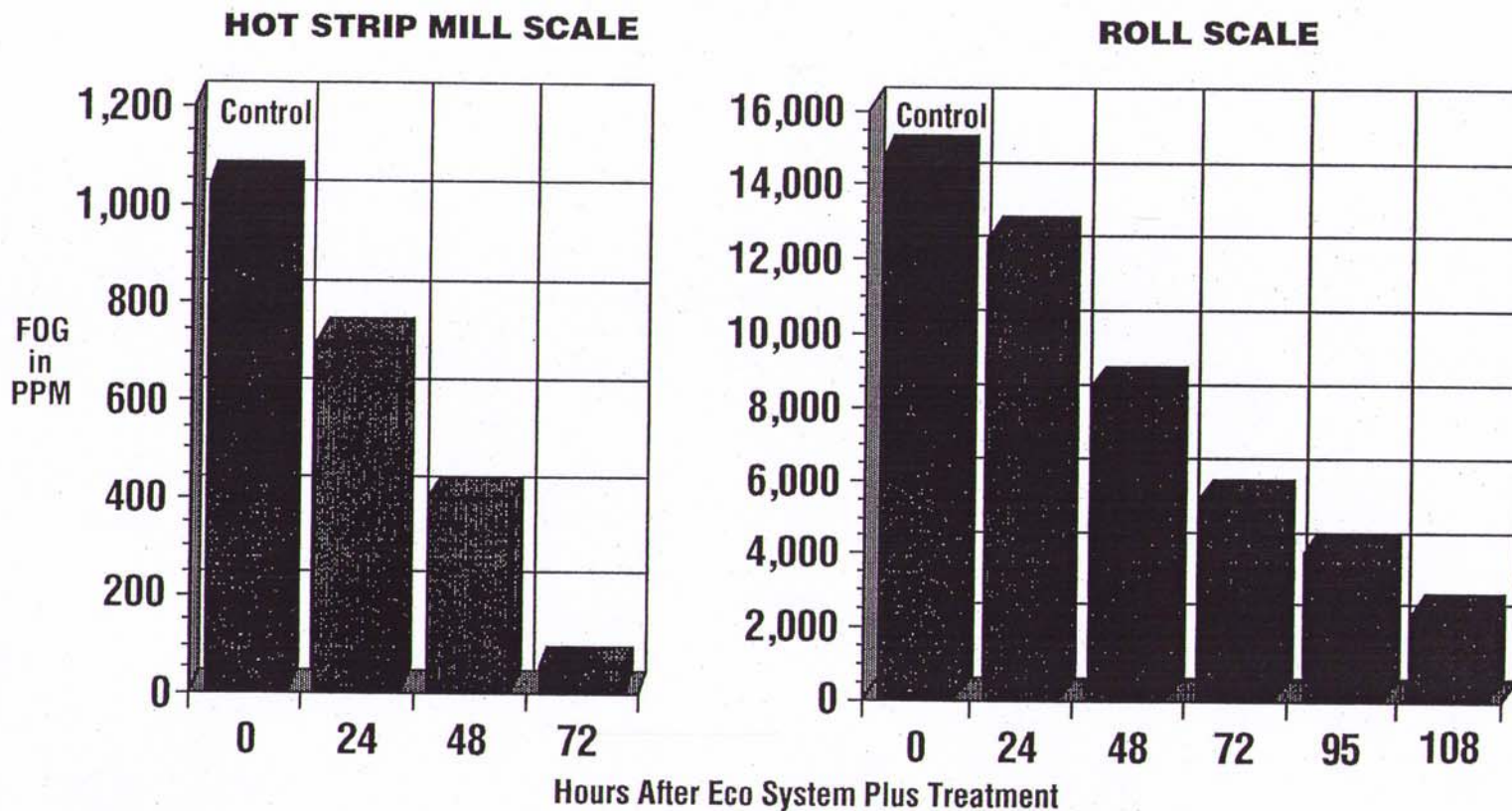


Reference: IT Analytical Services, Cerritos, California. Report Number: A-3817-12,  
Report Date: 11/26/83, Test Method: Freon Extract (FOG) - EPA 413.1.



# STEEL MILL SCALE

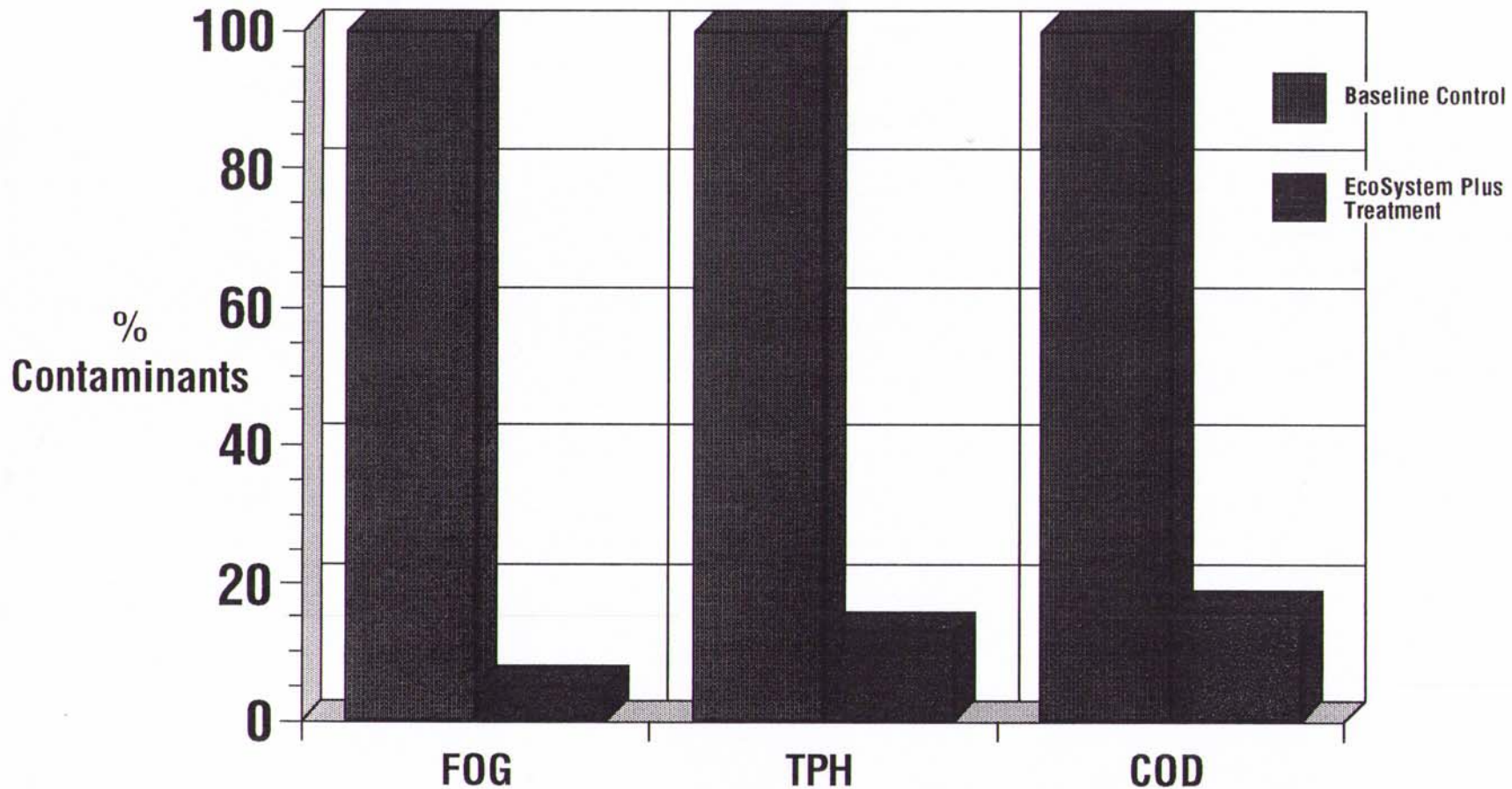
## Hydrocarbon Contaminants



Reference: Hot Strip Mill Scale - ACIS Laboratories, Detroit, Michigan. Report Number: 9405-2935-1A Report Date: 08/12/94 Test Methods: EPA 413.1  
Roll Scale - ACIS Laboratories, Detroit, Michigan. Report Number: 94075-2935-2 Report Date: 05/31/94 Test Methods: EPA 413.1

# DIGESTER GREASE CAP

## Liquification and Treatment After 72 Hours

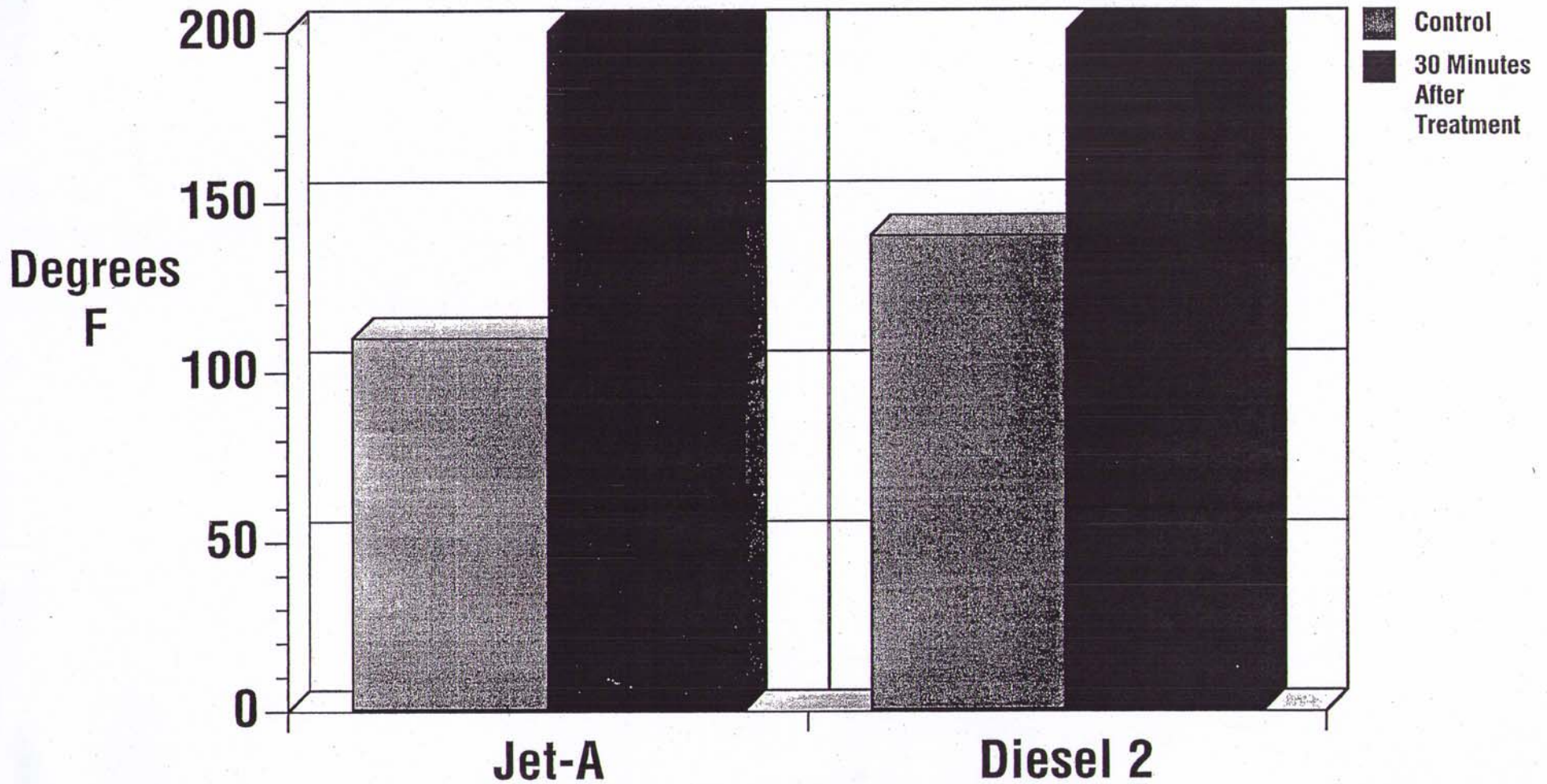


Reference: ACIS Labs - Specialists in Petroleum Technology, Detroit, Michigan. Report Number: 9403-2850  
Report Date: 04/18/94 Test Method: FOG - EPA 413.1; TPH - EPA 418.1; COD - EPA 416.1



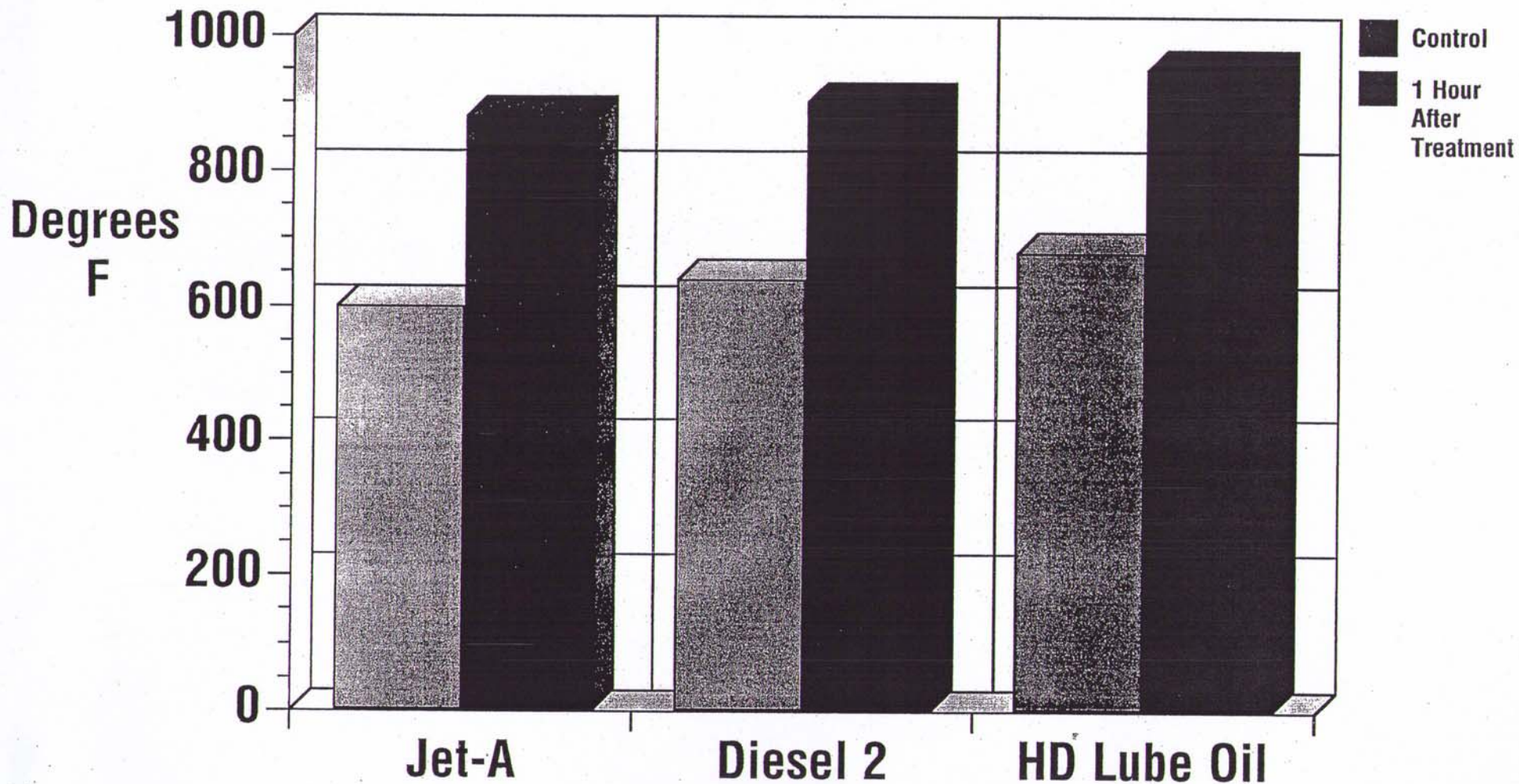
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## OPEN CUP FLASH POINT TEST



# BILGE WATER TREATMENT™

## AUTO IGNITION TEST



Reference: ACIS Labs - Specialists in Petroleum Technology, Detroit, Michigan. Report Number: 9310-2594-1, Report Date: 09/07/93, Test Method: Auto Ignition Temperature - ASTM D2155-66.