Ian Robb
Project Manager
Marketing Business Unit

Chevron Environmental Management Company
6111 Bollinger Canyon Road
San Ramon, CA 94583
Tel (925) 543-2375
Fax (925) 543-2324
irobb@chevron.com

Alameda County Health Care Services
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577

Re: Former Chevron Service Station No. 21-1253
930 Springtown Road
Livermore, California

I have reviewed the attached Pilot Test Work Plan dated July 22, 2010.

I agree with the conclusions and recommendations presented in the referenced report. This information in this report is accurate to the best of my knowledge and all local Agency/Regional Board guidelines have been followed. This Pilot Test Work Plan was prepared by Conestoga Rovers & Associates, upon whose assistance and advice I have relied.

This letter is submitted pursuant to the requirements of California Water Code Section 13267(b)(1) and the regulating implementation entitled Appendix A pertaining thereto.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.

Sincerely,

Ian Robb
Project Manager

Attachment: Pilot Test Work Plan

CONESTOGA-ROVERS & ASSOCIATES

5900 Hollis Street, Suite A
Emeryville, California 94608
Telephone: (510) 420-0700 Fax: (510) 420-9170
www.CRAworld.com

TRANSMITTAL

DATE: July 22, 2010

REFERENCE NO.: 060058

PROJECT NAME: Former Chevron 21-1253, Livermore

ACHES RO #189

TO: Mr. Jerry Wickham
Alameda County Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502 65770

Please find enclosed:
- ☐ Draft
- ☐ Originals
- ☐ Prints
- ☒ Final
- ☐ Other

Sent via:
- ☐ Mail
- ☐ Overnight Courier
- ☐ Same Day Courier
- ☒ Other ftp upload

QUANTITY	DESCRIPTION
1	Remedial Action Plan

- ☐ As Requested
- ☐ For Your Use
- ☒ For Review and Comment
- ☐ For Review and Signature
- ☐

COMMENTS:
Please contact Kiersten Hoey of CRA at (5109) 420-3347 or Ian Robb of Chevron at (925) 543-2375 with any questions or concerns

Copy to: Mr. Ken Hilliard, 7-Eleven, Inc

Mr. Kirk Sniff, Strasburger & Price, LLP

Completed by: Kiersten Hoey [Please Print]

Signed: Kiersten Hoey

Filing: **Correspondence File**

PILOT TEST WORK PLAN

FORMER TEXACO STATION 21-1253
930 SPRINGTOWN BOULEVARD
LIVERMORE, CALIFORNIA

Fuel Leak Case No. RO 0000189

Prepared For:
Mr. Jerry Wickham
Alameda County Environmental Health Services
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502

Prepared by:
Conestoga-Rovers & Associates

5900 Hollis Street, Suite A
Emeryville, California
U.S.A. 94608

Office: (510) 420-0700
Fax: (510) 420-9170

web: http:\\www.CRAworld.com

JULY 22, 2010
REF. NO. 060058 (8)
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PILOT TEST WORK PLAN

FORMER TEXACO STATION 21-1253
930 SPRINGTOWN BOULEVARD
LIVERMORE, CALIFORNIA

Kiersten Hoey

Brandon S. Wilken PG #7564

PROFESSIONAL GEOLOGIST
BRANDON S. WILKEN
No. 7564
STATE OF CALIFORNIA

Prepared by:
Conestoga-Rovers & Associates

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web: http:\\www.CRAworld.com

JULY 22, 2010
REF. NO. 060058 (8)
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(Following Text)

1.0 INTRODUCTION

Conestoga-Rovers & Associates (CRA) has prepared this *Surfactant-Enhanced LNAPL Recovery Work Plan* on behalf of Chevron Environmental Management Company (Chevron) for the site referenced above. In a letter dated July 24, 2009 (Appendix A), Alameda County Environmental Health Services (ACEH) requested the submittal of a pilot test work plan or draft corrective action plan. CRA proposes to perform surfactant-enhanced recovery treatment (SERT) at the site to remove light non-aqueous phase liquid (LNAPL) and eliminate LNAPL recurrence.

1.1 SITE BACKGROUND

The site is a former Texaco service station located on the south corner of Springtown Boulevard and Lassen Road in Livermore, California (Figure 1). In the summer of 1985, Texaco sold the site to Southland Corporation who constructed a 7-Eleven convenience store and concurrently removed the underground storage tanks (USTs), dispenser islands, and product piping. The site is still occupied by a 7-Eleven convenience store, surrounded by a paved parking area (Figure 2).

After the tanks were removed in 1985, 10 monitoring wells, 1 soil vapor extraction well, 1 air sparge well, and 1 groundwater extraction well were installed, 6 soil borings were advanced, and a soil vapor extraction (SVE) system operated for approximately nine months. In 2002, all previous site wells were destroyed based on ACEH and the San Francisco Bay Region-Regional Water Quality Control Board (RWQCB) concurrence that no further action was required. No remedial action completion certificate was ever issued by the RWQCB. In 2007, ACEH requested investigative work to fill data gaps prior to issuing case closure. Since then, seven cone penetration test borings (CPT) have been advanced and eight wells have been installed. A summary of environmental investigations and remediation conducted at the site is included as Appendix B.

1.2 SITE GEOLOGY AND HYDROGEOLOGY

Regional subsurface soil is identified as a heterogeneous mixture of alluvial and colluvial silty clays, clayey silts, sandy silts, silty sands, and gravelly sands of Holocene age. These regional sediments have a maximum thickness of approximately 150 feet. The Pliocene-aged Tassajara Formation, described by California Department of Water Resources (DWR), consists of sandstone, shale and limestone, and forms the bedrock beneath the site. Soil encountered beneath the site consists of clay, silt and sandy silt to

approximately 10 feet below grade (fbg), underlain by sand, gravels, and silty sand to the maximum depth explored of 60 fbg.

The site is located in the Mocho II sub-basin of the Main Basin in the Livermore Valley, as defined by the DWR and the Zone 7 Water Agency. The Mocho II sub-basin is defined by the Livermore Fault on the west, thinning Quaternary alluvium on the east, the Livermore Uplands to the south, and the Tassajara Formation to the north. Main Basin groundwater is currently used as a drinking water resource. Depth to groundwater beneath the site is approximately 9.50 to 13 feet below grade, and groundwater flows toward the west.

The nearest surface water bodies are Arroyo Seco and Arroyo Las Positas, which converge approximately one mile west of the site.

2.0 SURFACTANT-ENHANCED RECOVERY TREATMENT WORK PLAN

In a letter dated July 24, 2009, ACEH requested the submittal of a pilot test work plan or draft corrective action plan by August 19, 2010. Since July 2009, dissolved concentrations have been decreasing in wells MW-10, MW-11, MW-12, and MW-15, stable in wells MW-9 and MW-13, and no hydrocarbons have been detected in MW-16 in the last two quarterly sampling events. Dissolved concentrations are limited to the northern portion of the site. During the May 24, 2010 sampling event, 0.31 foot of LNAPL was detected well MW-14. To remove residual LNAPL in well MW-14, CRA proposes SERT.

The objective of SERT is to remove residual LNAPL from the subsurface and prevent LNAPL recurrence. SERT consists of applying a low concentration solution of a surfactant and water to affected monitoring wells, and recovering the resulting mixture of groundwater, surfactant, and liberated hydrocarbons using groundwater extraction. Surfactants are wetting agents with the ability to lower the interfacial surface tension between two liquids (such as oil and water). Surfactants can effectively emulsify and release LNAPL adsorbed to soil, thereby allowing subsequent removal by fluid extraction. Specific procedures are detailed below.

2.1 PROPOSED SURFACTANT

The proposed surfactant is Ivey-Sol®. As presented in Appendix C, Ivey-Sol® is listed as non-hazardous and non-toxic, and is not regulated by the Department of Transportation.

Ivey-Sol® is non-ionic and as such is not expected to act as a germicide or cause exothermic reactions in the subsurface. Ivey-Sol® does not contain salts or phosphates and is pH neutral. Manufacturer-provided laboratory analytical results indicate that any residual surfactant will achieve 90 0percent biodegradation within 28 days. The byproducts of this biodegradation process are carbon dioxide and water. A copy of the Material Safety Data Sheet, specifications, and a biodegradability study for Ivey-Sol® surfactant is included as Appendix C.

2.2 SURFACTANT PREPARATION AND APPLICATION

CRA will prepare 50 gallon batches of a 4 percent surfactant solution onsite by mixing 2 gallons of concentrated surfactant with 48 gallons of potable water. The resulting 4 percent solution will be gravity fed into well MW-14. The application rate will be controlled with a valve to prevent overflow in the application well. The maximum amount of surfactant solution to be applied will be 500 gallons. The final volume of surfactant applied to the well will be determined by the rate at which the formation accepts the solution. Application will cease after 6 hours if the maximum volume has not been injected into the well. The surfactant solution will be allowed to soak in the formation for a maximum of 24 hours to envelop and micro-emulsify the residual LNAPL prior to recovery.

Wells MW-9 through MW-13 and MW-15 will be monitored for changes in water level and the presence of surfactant during the application process. The wells will be monitored for water level changes during the application and equilibration periods to assess the radial influence of the surfactant application. A field test for the presence of surfactant will be performed during injection, at the completion of injection and prior to extraction in each of the monitoring wells listed above. This test is a qualitative visual analysis, based on an observation of suds when a sample of the groundwater is shaken vigorously in a sample bottle. The injection will be stopped immediately if surfactant foaming occurs in any monitoring well other than well MW-14 during the event.

2.3 LIQUID RECOVERY

After the surfactant solution has soaked in the aquifer for no longer than 24 hours, the resulting mixture of surfactant, LNAPL, and groundwater will be recovered using a vacuum truck or submersible pump. The recovery will be complete when the volume of recovery is at least four times the volume of surfactant solution applied. Groundwater

levels will be monitored in wells MW-9 through MW-13 and MW-15 during fluid recovery to assess the recovery radial influence.

2.4 GROUNDWATER MONITORING

Prior to surfactant application, groundwater in the wells MW-9 through MW-15 will be gauged. CRA will continue with routine groundwater monitoring pursuant to regulatory requirements. Follow-up LNAPL gauging of well MW-14 will occur monthly for three months to monitor LNAPL presence. CRA will evaluate additional SERT should LNAPL be detected in the wells after three months of monitoring.

2.5 HEALTH AND SAFETY PLAN

CRA will prepare a site- and activity-specific health and safety plan (HASP) to protect site workers. The plan will be kept onsite and followed during all field activities, reviewed and signed by all site workers and visitors.

2.6 REPORT PREPARATION

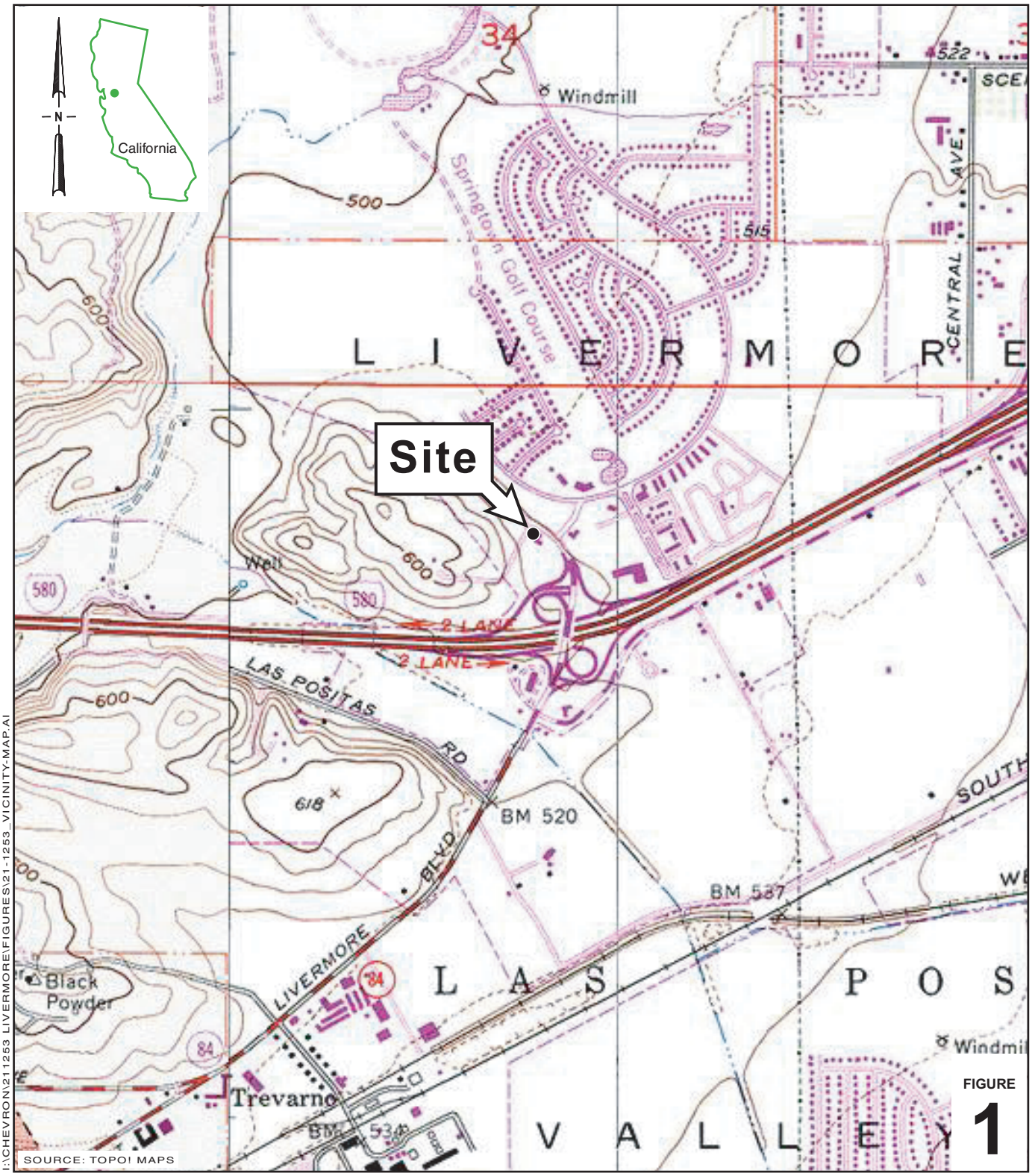
CRA will prepare a report 30 days after the final post-treatment LNAPL monitoring event. This report will include a discussion of the field procedures, laboratory results, completion dates, and results of subsequent groundwater monitoring. CRA will continue to report monitoring results and provide an evaluation of the effectiveness of this remedial action in subsequent semi-annual monitoring reports.

3.0 SCHEDULE

CRA proposes to commence work upon receipt of regulatory approval of this work plan. Delivery of surfactant and preparations to begin work will require a minimum of 4 to 6 weeks after site access is granted.

FIGURES

04/06/07



I:\CHEVRON\211253 LIVERMORE\FIGURES\21-1253_VICINITY-MAP.AI

FIGURE 1

0 1/8 1/4 1/2 1

SCALE : 1" = 1/4 MILE

Former Texaco Service Station

930 Springtown Boulevard

Livermore, California

CONESTOGA-ROVERS & ASSOCIATES

Vicinity Map

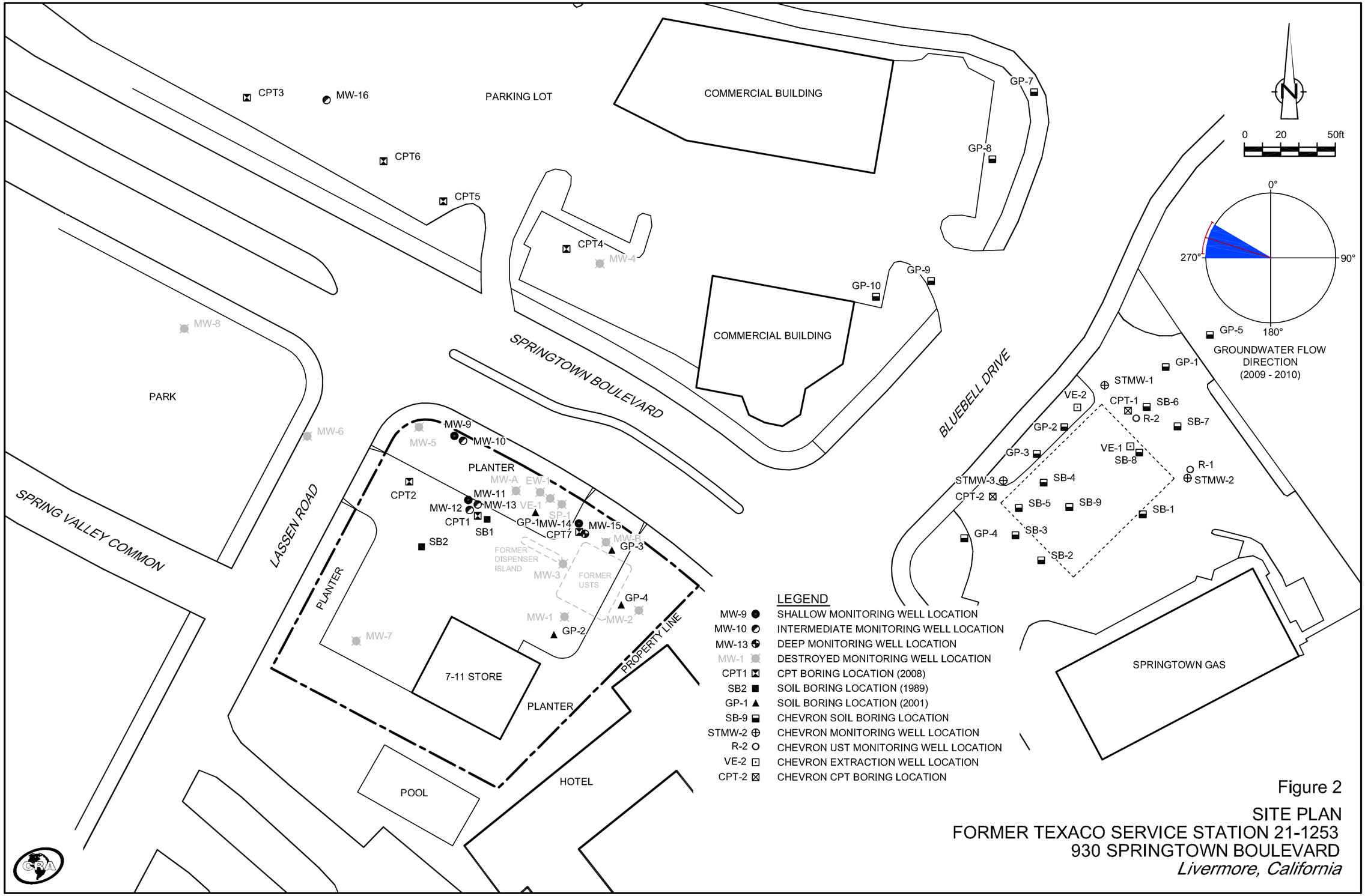


Figure 2

SITE PLAN
FORMER TEXACO SERVICE STATION 21-1253
930 SPRINGTOWN BOULEVARD
Livermore, California

60058-2010(PRES001)GN-WA003 MAY 26/2010

APPENDIX A

REGULATORY CORRESPONDENCE

ALAMEDA COUNTY
HEALTH CARE SERVICES
AGENCY
DAVID J KEARS, Agency Director

ENVIRONMENTAL HEALTH SERVICES
ENVIRONMENTAL PROTECTION
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577
(510) 567-6700
FAX (510) 337-9335

July 24, 2009

Mr Ian Robb
Chevron Environmental Management Company
6001 Bollinger Canyon Rd , K2256
San Ramon, CA 94583-2324

Mr Ken Hilliard
Environmental Services
7-Eleven, Inc
One Arts Plaza, 1722 Routh St , Suite 1000
Dallas, TX 75201

Subject Fuel Leak Case No RO0000189 and Geotracker Global ID T0600101353, Chevron #21-1253/Texaco, 930 Springtown Boulevard, Livermore, CA 94550 – Groundwater Monitoring Requirements

Dear Mr Robb and Mr Hilliard

The purpose of this correspondence is to inform you of changes to groundwater monitoring requirements for all fuel leak cases in California The California State Water Resources Control Board (State Water Board) has approved Resolution No 2009-0042 (*Actions to Improve Administration of the UST Cleanup Fund and UST Cleanup Program*) Resolution No 2009-0042 states that, "*Regional Water Board and LOP agencies shall reduce quarterly groundwater monitoring requirements to semiannual or less frequent monitoring at all site unless site-specific needs warrant otherwise and shall notify all responsible parties of the new requirements no later than August 1, 2009 If more than semiannual monitoring is required for a case, the responsible party and State Water board shall be notified of the rationale and the notice shall be posted on Geotracker*"

Six groundwater monitoring wells were recently installed at your site The installation of new monitoring wells constitutes a site-specific condition that warrants quarterly monitoring The six wells are to be sampled on a quarterly basis for a period of one year Following the completion of four quarterly sampling events and in accordance with Resolution No 2009-0042, groundwater monitoring for your site may be modified to a semiannual basis unless site-specific needs warrant otherwise As requested in previous ACEH correspondence dated July 1, 2009, a Pilot Test Work Plan or Draft Corrective Action Plan is to be submitted no later than August 19, 2010 Please present results from the four quarterly groundwater monitoring events in groundwater monitoring reports no later than 30 days following the end of each quarter

If you have any questions, please call me at 510-567-6791 or send me an electronic mail message at jerry wickham@acgov org

Sincerely,

Jerry Wickham, California PG 3766, CEG 1177, and CHG 297
Senior Hazardous Materials Specialist

Enclosure ACEH Electronic Report Upload (ftp) Instructions

cc George Lockwood, State Water Resources Control Board, Division of Water Quality, 1001 I Street, Sacramento, CA 95814

Danielle Stefani, Livermore Pleasanton Fire Department, 3560 Nevada St, Pleasanton, CA 94566 (*Sent via E-mail to* dstefani@lpfire org)

Cheryl Dizon (QIC 8021), Zone 7 Water Agency, 100 North Canyons Pkwy, Livermore, CA 94551 (*Sent via E-mail to* cdizon@zone7water com)

Charlotte Evans
Conestoga-Rovers & Associates
5900 Hollis Street, Suite A,
Emeryville, CA 94608

Donna Drogos, ACEH (*Sent via E-mail to donna drogos@acgov org*)
Jerry Wickham, ACEH

Geotracker, File

RESPONSIBLE PARTY OF RECORD AS OF 07/22/2009

RO0000189, CHEVRON #21-1253 / TEXACO, 930 SPRINGTOWN BLVD , Livermore, CA, 94550

Alameda County Environmental Health (ACEH) has the following information on record regarding the Responsible Party(ies) for the above referenced site Please update the following information for our records Should you have contact information regarding additional Responsible Parties, please correct the information accordingly Also, please check the "e-mail preferred" box to receive all future correspondences and notifications by e-mail

☐ E-mail Preferred ☐ Hardcopy Preferred

ACEH is requesting your e-mail address so that we can correspond with you quickly and efficiently regarding your case Please note that ACEH respects your privacy Your e-mail address will remain confidential and will not be provided to any third party

Current Information	Corrections or Additions
KEN HILLIARD 7-ELEVEN INC ONE ARTS PLAZA, 1722 ROUTH STREET, SUITE 1000 DALLAS TX 75201	Name _____ Company _____ Address _____ City _____ State _____ Zip _____ E-mail _____ Home Phone (___) _____ Office Phone (___) _____ Cell Phone (___) _____
IAN ROBB CHEVRON CORPORATION 6111 BOLLINGER CANYON RD RM 3612 SAN RAMON CA 945832324 ianrobb@chevron com 9255432375 9255491182	Name _____ Company _____ Address _____ City _____ State _____ Zip _____ E-mail _____ Home Phone (___) _____ Office Phone (___) _____ Cell Phone (___) _____

Alameda County Environmental Cleanup Oversight Programs (LOP and SLIC)	**ISSUE DATE** July 5, 2005
	REVISION DATE March 27, 2009
	PREVIOUS REVISIONS December 16, 2005, October 31, 2005
SECTION Miscellaneous Administrative Topics & Procedures	**SUBJECT** Electronic Report Upload (ftp) Instructions

The Alameda County Environmental Cleanup Oversight Programs (LOP and SLIC) require submission of all reports in electronic form to the county's ftp site Paper copies of reports will no longer be accepted The electronic copy replaces the paper copy and will be used for all public information requests, regulatory review, and compliance/enforcement activities

REQUIREMENTS

- Entire report including cover letter must be submitted to the ftp site as **a single portable document format (PDF) with no password protection** (Please do not submit reports as attachments to electronic mail)
- It is **preferable** that reports be converted to PDF format from their original format, (e g , Microsoft Word) rather than scanned
- Signature pages and perjury statements **must** be included and have either original or electronic signature
- **Do not password protect the document** Once indexed and inserted into the correct electronic case file, the document will be secured in compliance with the County's current security standards and a password **Documents with password protection will not be accepted**
- Each page in the PDF document should be rotated in the direction that will make it easiest to read on a computer monitor
- Reports must be named and saved using the following naming convention
  RO#_Report Name_Year-Month-Date (e g , RO#5555_WorkPlan_2005-06-14)

Additional Recommendations

- A separate copy of the tables in the document should be submitted by e-mail to your Caseworker in **Excel** format These are for use by assigned Caseworker only

Submission Instructions

1) Obtain User Name and Password
   a) Contact the Alameda County Environmental Health Department to obtain a User Name and Password to upload files to the ftp site
      i) Send an e-mail to dehloptoxic@acgov org
         Or
      ii) Send a fax on company letterhead to (510) 337-9335, to the attention of My Le Huynh
   b) In the subject line of your request, be sure to include **"ftp PASSWORD REQUEST"** and in the body of your request, include the **Contact Information, Site Addresses**, and the **Case Numbers (RO# available in Geotracker) you will be posting for**

2) Upload Files to the ftp Site
   a) Using Internet Explorer (IE4+), go to ftp //alcoftp1 acgov org
      (i) Note Netscape and Firefox browsers will not open the FTP site
   b) Click on File, then on Login As
   c) Enter your User Name and Password (Note Both are Case Sensitive)
   d) Open "My Computer" on your computer and navigate to the file(s) you wish to upload to the ftp site
   e) With both "My Computer" and the ftp site open in separate windows, drag and drop the file(s) from "My Computer" to the ftp window

3) Send E-mail Notifications to the Environmental Cleanup Oversight Programs
   a) Send email to dehloptoxic@acgov org notify us that you have placed a report on our ftp site
   b) Copy your Caseworker on the e-mail Your Caseworker's e-mail address is the entire first name then a period and entire last name @acgov org (e g , firstname lastname@acgov org)
   c) The subject line of the e-mail must start with the RO# followed by **Report Upload** (e g , Subject RO1234 Report Upload) If site is a new case without an RO# use the street address instead
   d) If your document meets the above requirements and you follow the submission instructions, you will receive a notification by email indicating that your document was successfully uploaded to the ftp site

APPENDIX B

PREVIOUS ENVIRONMENTAL INVESTIGATIONS

SUMMARY OF PREVIOUS ENVIRONMENTAL AND REMEDIAL ACTIVITES
FORMER TEXACO 21-1253

1984 Initial Investigation

In September 1984, J.H. Kleinfelder and Associates (Kleinfelder) discovered approximately 1-inch of non-aqueous phase liquid hydrocarbons during underground storage tank (UST) removal. No additional information was available.

1985 Hydrocarbon Investigation and UST/Product Line Removal

In May through July 1985, Groundwater Technology Incorporated (GTI) installed monitoring wells MW-1 through MW-3 around the tank pit area to assess the extent of hydrocarbons detected by Kleinfelder. Groundwater monitoring wells MW-A and MW-B were supposedly installed prior to this investigation, but no records were available. However, 0.07 foot was LNAPL was observed in well MW-B in May 1985. During the August 1985 groundwater sampling event, the highest hydrocarbon concentrations of 184,000 micrograms per liter (µg/L) TPHg and 8,950 µg/L benzene in well MW-B. Similar concentrations were detected in MW-A, whereas concentrations at least two orders of magnitude lower were detected in wells MW-1, MW-2, and MW-3.

On June 26, 1985, GTI collected soil samples beneath the USTs and product lines during the decommissioning of the Texaco station. Low hydrocarbon concentrations up to 3.2 milligrams per kilogram (mg/kg) total petroleum hydrocarbons as gasoline (TPHg) and 0.58 mg/kg benzene were detected in soil beneath the USTs. GTI concluded that the hydrocarbon release probably resulted from a product line leak or tank over filling rather than from a UST leak.

GTI conducted a ½-mile well survey through the Alameda Flood Control and Water Conservation District. Eight wells were identified north, east, and south of the site. More information available in GTI's August 1985 *Hydrocarbon Investigation Report*.

1987 Monitoring Well Installation

In March 1987, GTI installed wells MW-5 and MW-6. The highest hydrocarbon concentrations detected in soil were 2.1 mg/kg TPHg and 0.030 mg/kg benzene from MW-5 at 14 feet below grade (fbg). The new wells were surveyed and GTI began monthly monitoring of groundwater levels at the site. More information available in GTI's March 23, 1987 *Status Report*.

1990 Additional Site Assessment

In April 1990, GTI advanced four soil borings, two of which were converted to monitoring wells MW-7 and MW-8. No soil results from this investigation are available. Based on groundwater samples collected from the 10 monitoring wells, the highest dissolved TPHg and benzene concentrations of 39,000 µg/L TPHg and 2,700 µg/L benzene are detected in well MW-A, located approximately 60 feet west (downgradient) of the former UST pit. More information available in GTI's April 10, 1990 *Report of Additional Environmental Site Assessment*.

1991 Soil Vapor Extraction (SVE) Pilot Test

In July 1991, GTI conducted a SVE pilot test. The flow rate varied between 12 and 31 cubic feet per minute (cfm.) To determine radius of influence, the induced vacuum pressure was

measured with a Magnihelic gauge in monitoring wells at various distances from EX-1. The radius of influence was calculated as less than 30 feet. Samples of the extracted soil vapor were collected from MW-A, MW-B, and MW-5 after 1 hour of testing. The highest soil vapor concentrations of 15,000 µg/L was detected in MW-5. At 100 cfm, the hydrocarbon removal rate from MW-5 was calculated to be 135 lbs/day. More information is available in GTI's September 12, 1991 *Work Plan for Soil and Groundwater Remediation.*

1993 Extraction Well Installation and Feasibility Testing

In October 1992, Weiss Associates (WA) installed groundwater extraction well EW-1, vapor extraction well VE-1, and air sparge well SP-1. The groundwater extraction well was screened to recover hydrocarbons from the upper l5 to 20 feet of saturated soils. The air sparging well was screened above a low permeability zone that may have prevented the upward migration of injected air and caused spreading of hydrocarbons laterally. The vapor extraction well was screened immediately above the sparging well to recover hydrocarbon-bearing vapors displaced during air sparging. The highest hydrocarbon concentration detected in soil was 1,200 mg/kg TPHg at 14.5 fbg in EW-1. In November 1992, WA developed, sampled and conducted a 24 hour aquifer test on EW-1. Groundwater was extracted at an average flow rate of 7.85 gallons per minute (gpm). The average transmissivity of the aquifer was estimated to be 3,400 gallons per day per foot. Although most of the monitoring wells are screened over a length of 20 feet, boring logs indicate that the more permeable, sandy gravel zone is 15 ft thick. Using this thickness, an average hydraulic conductivity value of 225 gpd/foot^2 (0.021 ft/min), and a specific storage of 0.001 ff' are estimated for this aquifer. WA also conducted a vapor extraction test on vapor extraction well VE-1, groundwater extraction well EW-1, and existing monitoring wells MW-A, MW-B and MW-5. WA concluded that SVE could effectively remove vapors from a majority of the impacted areas. WA conducted an air sparging test from the air sparge well SP-1 and vapor extraction wells VE-1, and concluded that air sparging with vapor extraction would effectively remove hydrocarbons from saturated sediments. Additional information is available in WA's January 5, 1993 *Extraction Well Installation and Feasibility Testing*.

1994 Remediation System Start-Up

In November 1994, GTI started operation of a 100 cubic feet per minute (cfm) King Buck/Hasstech MMC-5a catalytic oxidizer SVE\Air Sparge system. The system was connected to wells MW-A, MW-B, MW-3, MW-5, VE-1 and SP-1. The initial influent Flame Ionization Detector (FID) reading collected in August, prior to system start-up, was 1,200 parts per million by volume (ppmv). The influent sample submitted for laboratory analysis contained 570 milligrams per cubic meter (mg/m^3) TPHg and no benzene. The system operated intermittently through August 1995, when it was shutdown due to insufficient influent concentrations. Additional information including system diagrams, startup testing, sampling activities and laboratory analytical data are available in GTI's March 10, 1995 *Remediation System Start-up/Air Monitoring and Sampling Report*.

1996 Well Destruction Report

In February 1996, Kaprealian Engineering Incorporated (KEI) destroyed monitoring well MW-6 because no hydrocarbon concentrations were detected in groundwater from the well and its close proximity to well MW-8, located in the same crossgradient direction from the source.

Well MW-7 was also destroyed because no hydrocarbons were detected in the well and its upgradient location from the source. Both wells were over-drilled to a maximum depth of 25 fbg, then backfilled with neat cement. More information is available in KEI's January 22, 1996 *Report of Destruction of Monitoring Wells*.

1997 Tier 2 Risk Based Corrective Action Analysis

In December 1997, KEI submitted a summary of the input parameters to be used for a subsequent Tier 2 Risk-Based Corrective Action (RBCA) analysis, including subsurface soil and groundwater sample analytic results. KEI modeled BTEX concentrations and concluded no onsite Site-Specific Target Levels (SSTLs) were exceeded for any of the pathways modeled, either cumulative or site specific levels. Additional information available in KEI's October 31, 1997 *Risk-Based Corrective Action Analysis*.

2001 RBCA Vadose Zone Investigation and RBCA Analysis

In August 2001, KHM Environmental Management (KHM) submitted an addendum to the previous RBCA in response to an ACEH email requesting an evaluation of risk to a "Residential Setting" and risk associated with potential vapor intrusion to the onsite building. In June 2001, KHM advanced geoprobe borings GP-1 through GP-4. Borings GP-1 and GP-3 were advanced adjacent to groundwater monitoring wells with the highest hydrocarbon concentration (MW-A and MW-B), GP-2 was advanced outside of the UST complex area, and GP-4 was advanced on the east side of the former UST complex. No benzene was detected in soil samples collected from the borings, but up to 27 mg/kg TPHg was detected in saturated soil from GP-4 at 14 fbg. Borings GP-1, GP-3, and GP-4 were first advanced to 3 fbg for collection of a vadose zone soil gas sample, then advanced to first encountered groundwater at approximately 15 fbg. Soil samples collected from boring GP-2 were analyzed for physical parameters. During vapor sampling, well MW-B contained 16,000 µg/L TPHg and 29 µg/L benzene, however no TPHg or benzene were detected in any of the soil gas samples. No grab-groundwater were collected from the geoprobe borings. KHM concluded the only potential pathway of exposure for a residential setting was vapor intrusion; however because no benzene was detected vadose zone soil gas, there was minimal risk to human health or the environment. Additional information is available in KHM's August 13, 2001 *Vadose Zone Investigation and Risk-Based Correction Action (RBCA) Analysis*.

2001 Closure Request

In December 2001, KHM submitted a case closure request under the direction of ACEH. KHM concluded all sources had been removed, the SVE system adequately removed hydrocarbons from the vadose zone, the dissolved hydrocarbons were defined and limited in extent, and no sensitive receptors were at risk. Based on these statements, KHM requested no further action. Additional information is available in KHM's December 10, 2001 letter requesting closure.

2002 Case Closure

ACEH's March 2002 letter stated the Regional Water Quality Control Board (RWQCB) concurred with ACEH's recommendation for case closure, and all wells must be destroyed prior to issuing a "Remedial Action Completion" letter.

2002 Well Destruction

In December 2002, KHM destroyed onsite and offsite wells MW-1 through MW-5, MW-A, MW-B, EW-1, VE-1, and SP-1 by pressure grouting. Additional information is available in KHM's January 7, 2003 *Well Destructions – MW-1 through MW-5, MW-8, MW-A, MW-B, EW-1, VE-1 and SP-1*.

2007/2008 Subsurface Investigation

By January 2007, no "Remedial Action Completion" letter had been issued, and during a file review, ACEH concluded the existing data did not warrant site closure. In a letter dated January 31, 2007, ACEH identified the following data gaps: plume extent and preferential pathways, vertical extent of contamination, and well decommissioning documentation. In 2007 and 2008, to address the ACEH's technical comments and re-evaluate site closure, Conestoga-Rovers & Associates (CRA) advanced cone penetration testing (CPT) borings CPT1 through CPT7 both on and offsite. The highest hydrocarbon concentrations of 1,700 mg/kg TPHg and 2.5 mg/kg benzene were detected in CPT7 at 10.5 fbg. No TPHg or BTEX were detected in soil from CPT2 through CPT6. No fuel oxygenates, including methyl tertiary butyl ether (MTBE), were detected soil. Discrete depth grab-groundwater samples were collected from each boring to assess current dissolved hydrocarbon concentrations. The highest hydrocarbon concentrations of 160,000 µg/L TPHg, 4,200 µg/L benzene, 20,000 µg/L toluene, 1,700 µg/L ethylbenzene and 15,000 µg/L xylenes were detected in CPT1 at 24 fbg. No fuel oxygenates, including MTBE were detected in groundwater with the exception of 4.0 µg/L 1,2-dibromoethene (EDB). Additional information is available in CRA's August 13, 2008 *Subsurface Investigation Report*.

2009 Monitoring Well Installation

In July 2009, CRA installed eight groundwater monitoring wells to obtain hydraulic, hydrocarbon concentration and plume extent data. The monitoring wells were generally clustered to provide vertical delineation of dissolved petroleum hydrocarbons. Onsite monitoring wells MW-9 through MW-15 were installed adjacent to or downgradient of the former USTs and the dispenser island. Offsite monitoring well MW-16 was installed near boring CPT3 to assess hydrocarbons previously detected in a grab-groundwater sample. The monitoring wells are divided into three different zones based on the screen intervals: shallow zone (wells MW-9, MW-11 and MW-14), intermediate zone (wells MW-10, MW-12, MW-13 and MW-16) and deep zone (well MW-15). The highest petroleum hydrocarbon concentrations in groundwater were 52, µg/L TPHg, 760 µg/L benzene, 6,200 µg/L toluene, 13,000 µg/L total xylenes in well MW-13 and 1,300 µg/L ethylbenzene in well MW-12. TPHg in soil was detected at a maximum concentration of 6,400 mg/kg in well MW-15 at 19.5 fbg. Benzene in soil was detected at a maximum concentration in well MW-15 of 4.5 mg/kg at 9.5 fbg. More information is available in CRA's August 19, 2009 *Monitoring Well Installation Report.*

APPENDIX C

SURFACTANT DOCUMENTATION

Ivey-sol® Non-ionic Surfactant
Biodegradability

The following discussion on Ivey-sol® biodegradability has been produced by Dr. Steven Nearhos, a Senior Microbiologist with Baseline (Australia) Pty. Ltd. This briefing was prepared to verify the product was biodegradable and safe for the proposed site application.

The product, Ivey-sol® based around MSDS 080123-01, has been validated using OECD Procedures 301 E and 301 B. Australian procedures for biodegradability are defined collectively under Australian Standard AS 4351.1-7. The Australia Standards have been individually internationalized to an ISO equivalent but these are based on OECD, Guidelines for Testing of Chemicals, Section 3 "Degradation and Accumulation". Test 301E is technically equivalent to ISO 7827: 1984 while AS 4351.2 (1996) is equivalent to ISO 7827:1994.

There are a variety of different parallel and suitable methodologies in the Australian Standard for assessing biodegradability and these are based around different methods for detection e.g. measurement of respiratory gases or reductions in dissolved organic carbon. What these methods show though is a reduction of the total quantity of surfactant by 90% within 28days.

It is further noted in regard to risk assessment at an in-situ pump and treatment site with hydraulic control, that most of the material introduced will ultimately be drawn off during the operation and pumping at an extraction well on-site. Introduction of surfactant at injection points will stop when the TPH level falls away so that the final concentration of surfactant will be quite low, even before biodegradation commences. The other part of reporting in the Ivey-sol® MSDS refers to the product having a CO_2 evolution after 28days of 70%. This reflects the apparent extent of complete mineralization without measuring new biomass or surfactant residues. On this test and there is no apparent Australian equivalent, there is a mechanism under the UK Offshore Chemical Notification Scheme to cause the reformulation of chemical products which have a lesser rate of decomposition under Test 301E i.e. when between 20 and 70% carbon dioxide is evolved. In this case 70 % compliance is shown so the product would be expected to be highly degradable under said conditions as encountered project sites.

References:

Ivey international Inc (2008) Material Safety Data Sheet Ivey-sol® Surfactant Technology pp1-4.

Australia Standard 4351.1 –1996 Biodegradability Organic Compounds in Aqueous solution Part 1: Method for determining & reporting biodegradability Standards Australia pp1-10

Australia Standard 4351.1 –1996 Biodegradability Organic Compounds in Aqueous solution Part 2: Determination by Analysis of Dissolved Organic Carbon (DOC) pp1-11.

Australia Standard 4351.1 –1996 Biodegradability Organic Compounds in Aqueous solution Part 3: Determination by Oxygen demand in a closed respirometer. pp1-16.

Australia Standard 4351.1 –1996 Biodegradability Organic Compounds in Aqueous solution Part 4: Determination by Analysis of Released Carbon Dioxide pp1-13.

Australia Standard 4351.1 –1996 Biodegradability Organic Compounds in Aqueous solution Part 5: Determination by Analysis of Biochemical Oxygen Demand (closed Bottle Test) pp1-13.

Australia Standard 4351.1 –1996 Biodegradability Organic Compounds in Aqueous solution Part 6:Guidance for the determination of biodegradability of poorly soluble organic compounds pp1-7.

Australia Standard 4351.1 –1996 Biodegradability Organic Compounds in Aqueous solution Part 7: Determination by semi-continuous activated sludge method (SCAS) pp1-12.

OECD (2003) Introduction to the OECD Guidelines for the testing of Chemicals Section 3: Part 1 Principles & Strategies Related to the Testing of Degradation of Organic Chemicals

Centre for Environment, Fisheries & Aquaculture Science (Cefas) (2007) Offshore Chemical Notification Scheme –Warning Notices.http:// www.cefas.co.uk/offshore chemical notification scheme-(ocns)/frequently asked Questions (FAQs)/warning notices.

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MATERIAL SAFETY DATA SHEET
Ivey-sol ® Surfactant Technology

SECTION 1: CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name:	Ivey-sol
Chemical Name:	Not Applicable (mixture)
Chemical Family:	Non-ionic Surfactants
Formula:	Not Applicable (mixture)
Synonym(s):	Ivey-sol 103, Ivey-sol 106, and Ivey-sol 108

COMPANY IDENTIFICATION

Ivey International (USA) Inc.	26 Berkeley Place, Newington, CT USA 06111
Ivey International (CAN) Inc	PO Box 706 Campbell River BC Canada V9W 6J3
Prepared By:	Technical Products Department
Telephone Number:	(250)923-6326 or Toll Free 1-800-246-2744
Prepared (Last Updated):	January 23, 2008

Ivey International Inc. (III) urges each customer or receipt of this MSDS to study it carefully to become aware of and understand the proper use and handling of the subject product. The reader should consider consulting reference materials, and/or III technical support personal, and/or other recognized experts, as necessary or appropriate to the use and understanding of the data contained in this MSDS. To promote the safe handling, storage and use of this product, each customer or recipient should (1) notify his employees, agents, contractors, and others whom he knows or believes will use this product, of the information in this MSDS and any other information regarding product use, storage and handling, (2) furnish this same information to each of his customers for the product, and (3) request his customers to notify their employees, customers, and other users of the product, and of this information.

SECTION 2: COMPOSITION INFORMATION

Components:	Ivey-sol 103 - 3 Molar Concentration In Water
Generic Description:	Water based biodegradable wetting agents and surfactants.

Ivey-sol® / SPT® Technology - Stock Mixtures. Patented and or proprietary blends. Information in this MSDS is applicable for all component products listed.

SECTION 3: HAZARDS IDENTIFICATION

Effects of A Single Exposure:

Swallowing:	Non to slightly toxic. May cause abdominal discomfort and nausea for some individuals.
Skin Absorption:	No evidence of harmful effects.
Inhalation:	No evidence of harmful effects.
Skin Contact:	Brief contact should not result in any significant effects. Prolong exposure may cause mild irritation with local itching and redness for individuals with sensitive skin.
Eye Contact:	May cause mild to moderate irritation.
Effects Of Repeated Exposure:	Repeated skin contact may cause mild dermatitis (dryness of skin).
Medical Conditions:	Existing dermatitis may be aggravated through repeated skin contact.
Other Effects:	None currently known.

Section 4: FIRST AID MEASURES

Swallowing:	If patient if fully conscious, give two glasses of water
Skin Absorption:	Wash with soap and water. Obtain medical attention if irritation or dermatitis persists. Wash any exposed clothing before reuse.
Inhalation:	Not applicable.
Eye Contact:	Immediately flush eyes with water and continue to flush as required. Remove any contact lenses, if worn. Obtain medical attention if deemed necessary.
Note To Physician:	There is no required antidote. Treatment should be directed tat the control of symptoms and the clinical condition of the patient.

Section 5: FIRE FIGHTER MEASURES

Flammability:	Not Flammable
Auto Ignition Temp.	Not Available
Upper Flammable Limit	Not Established
Lower Flammable Limit	Not Established
Explosive Date:	Explosive Power - Not Available Rate of Burning - Not Available
Hazardous Combustion Products:	Not applicable.
Special Protective Equipment:	Not Applicable.
Extinguishing Media:	Not Applicable.
Extinguishing Media To Be Avoided:	Not Applicable.
Special Fire Fighting Procedures:	Not Applicable.

Section 6: ACCIDENTAL RELEASE MEASURES

Step To Be Taken If Material Is Released or Spilled: Eliminate and/or contain source with inert material (sand, earth, absorbent pads, etc.). Wear basic eye and skin protection. Floor may be slightly slippery; so use care to avoid falling. Avoid discharge to natural waters, and/or dilute with water. Transfer liquids to suitable containers for recovery, re-use or disposal. Contact III for technical assistance if required.

Section 7: HANDLING AND STORAGE

Handling Procedures:	Avoid contact with eyes, skin, and clothing. Do not swallow. Keep containers closed or sealed when not in use. Wash thoroughly after handling.
Storage:	Keep closed or sealed when not in use. Do not allow to freeze, keep > $0^{o}C$ ($32^{o}F$).
Ventilation:	General (mechanical) room ventilation is expected to be satisfactory.

Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Gloves / Type Gloves / Type:	Latex, or similar would be sufficient.
Respiratory / Type:	None expected to be needed. However, if an engineered / industrial application where vapors and/or misting may occur, wear MSHA/NIOSH approved half mask air purifying respirator.
Eye / Type:	Mono Goggles or similar.
Footwear / Type:	No special requirements.
Clothing / Type:	Wear an apron and /or coveralls.
Other / Type:	Eye bath.
Engineering Controls:	General (mechanical) room ventilation is expected to be satisfactory.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Physical state:	Water Based Liquid
Appearance:	Clear to slightly Cloudy White Color
Odor:	Mild
Molecular Weight:	Mixture (Not Applicable)
Boiling Point:	Not Applicable
Freezing Point:	Around 0^{o}C (32 ^{o}F)
Pour Point:	Not Applicable
Melting Point:	Not Applicable
Specific Gravity:	0.99-1.04 (Water = 1.0)
Vapor Pressure:	<0.01 mm Hg
Vapor Density:	> 1 (Air = 1.00)
pH:	Not Available (Typically 6.5-7.5 Range)
Solubility In Water:	100%
Evaporation Rate:	<0.01
Coefficient of Oil/Water Distribution	Not Determined

Section 10: STABILITY AND REACTIVITY

Stability:	Stable
Conditions To Avoid:	Prolonged excessive heat may cause product decomposition. Freezing should also be avoided as it may cause product decomposition. In some cases it may cause irreversible changes.
Incompatible Materials:	Normally un-reactive; however avoid strong bases at high temperatures, strong acids, strong oxidizing agents, and materials with reactive hydroxyl compounds. These compounds would damage the mixture and reduce its effectiveness during application.
Hazardous Decomposition Products:	Not applicable.
Hazardous Polymerization:	Will not occur.

Section 11: TOXICOLOGICAL INFORMATION

Exposure Limit of Material:	Not Established
LD/50:	Not Available
LC/50:	Not Available
EL:	Not Established
Carcinogenicity of Material:	None Known
Reproductive Effects:	Not Available.
Irritancy of Material:	See Section 3
Sensitizing Capability:	Not Available
Synergistic Materials:	Not Available

LD: Lethal Dose LC: Lethal Concentration EL: Exposure Limit

Section 12: ECOLOGICAL CONSIDERATIONS

Environmental Toxicity:	Low Potential to affect aquatic organisms*
Biodegradability:	>90% in 28 days**
LC/50:	48 Hour: 0.11 %, Species: Daphnia magna
LC/50:	96 Hour: 0.07695% Species: Rainbow Trout

* When used in accordance with Ivey International Inc. In-situ and Ex-situ Remediation Application Guidelines.

** Based on actual testing or on data for similar material(s). Degradation Biodegradation reached in Modified OECD Screening Test (OECD Test No.301 E) after 28 days: 90 %. Biodegradation reached in CO2 Evolution Test (Modified Sturm Test, OECD Test No. 301 B) after 28 days: 70 %.

All available ecological data have been taken into account for the development of the hazard and precautionary information contained in this Material safety data Sheet.

Section 13: DISPOSAL CONSIDERATIONS

Waste Disposal Method:	For aqueous Ivey-sol mixture solutions; aerobic biological wastewater treatment systems are effective in treating said mixtures. Ivey-sol does not have any known negative affect on coagulant or flocculent water treatment processes.

Section 14: TRANSPORTATION INFORMATION

UN Number:	Not Applicable
TDG Classification:	Not Required
Shipping Name:	Ivey-sol (a.k.a. Selective Phase Transfer Mixtures)
Packing Group:	Not Applicable
Special Shipping Instructions:	Do not allow to freeze

Section 15: REGULATORY INFORMATION

WHMIS Classification:	Not Controlled as per WHMIS Regulation.
CPR Compliance:	This product has been classified in accordance with the hazard criteria of the CPR, and the MSDS contains all the information required by the CPR.
CEPA Compliance:	All ingredients of this product are listed on a DSL.

Section 16: OTHER INFORMATION

Available Literature and Brochures:	Additional information on this product may be obtained by calling our customer service representatives at (800) 246-2744 or (250) 923-6326.
Recommended Uses and restrictions:	For the application of air, soil, groundwater, shoreline, and off-shore spill petroleum reclamations purposes. Secondary recoveries of petroleum products form crude-oil, oil-shale, and oil-sands. Additional information on uses can be made available by contacting out technical sales director in your area by visiting www.ivey-sol.com, or by calling toll free (800) 246-2744 or (250) 923-6326.
Legend:	TS - Trade Secret D2B - Toxic Material causing Other Effects. mm - Millimeters LD - Lethal Dose LC - Lethal Concentration EL - Exposure Limit Hg - Mercury (760 mm Hg = 1 Atmosphere, Sea Level)

Ref:Ivey-sol/MSDS/080123-01(Revised January 23, 2008)

Ivey-sol® Surfactant Technology
"TODAY'S ENVIRONMENTAL SOLUTIONS FOR A BETTER TOMORROW" ®
1-800-246-2744 • www.iveyinternational.com

Specification Sheet
Ivey-sol® Surfactant Products

Product Information:

Product Name:	Ivey-sol®
Chemical Name:	Not Applicable (mixture)
Chemical Family:	Non-Ionic Surfactants
Formula:	Not Applicable (mixture)
Synonym(s):	Ivey-sol® 103, Ivey-sol® 106, and Ivey-sol® 108
MSDS NUMBER:	080123-01 (See MSDS for additional information)

Product Description:
Water based biodegradable wetting agents and surfactants.
Non hazardous
Non TDG Regulated
Phosphate Free
Salt Free

Physical and Chemical Properties:

Physical state:	Water Based Liquid
Appearance:	Clear to slightly Cloudy White Color
Odor:	Mild
Molecular Weight:	Mixture (Not Applicable)
Boiling Point:	Not Applicable
Freezing Point:	Approximately 0°C (32 °F)
Pour Point:	Not Applicable
Melting Point:	Not Applicable
Specific Gravity:	0.99-1.04 (Water = 1.0)
Vapor Pressure:	<0.01 mm Hg
Vapor Density:	>1 (Air = 1.00)
pH:	Typically 6.5-7.5 Range
Solubility in Water:	100%
Evaporation Rate:	<0.01

Coefficient of Oil/Water Distribution: Not Determined

Handling and Storage:
Handling Procedures: Avoid contact with eyes, skin, and clothing. Do not swallow. Keep containers closed or sealed when not in use. Wash thoroughly after handling.
Storage: Keep closed or sealed when not in use. Do not allow to freeze. Keep above 0°C (32°F). Ventilation general mechanical room ventilation is expected to be satisfactory.

Transport / Regulatory Information:

UN Number:	Not Applicable
TDG Classification:	Not Required
Shipping Name:	Ivey-sol® (a.k.a. Selective Phase Transfer Mixtures)
Packing Group:	Not Applicable
Shipping Instructions:	Do not allow to freeze.
Shipping Containers:	5 Gallon Plastic Pails, 55 Gallon Drums (Plastic or Steel), Totes (Plastic 264 Gallon)
WHMIS Classification:	Not controlled as per WHMIS regulation.
CPR Compliance:	This product has been classified in accordance with the hazard criteria of the CPR, and the MSDS contains all the information required by the CPR.
CEPA Compliance:	All ingredients of this product are listed on a DSL.

First Aid:

Swallowing:	If patient if fully conscious, give two glasses of water.
Skin Absorption:	Wash with soap and water. Obtain medical attention if irritation or dermatitis persists. Wash exposed clothing before reuse.
Inhalation:	Not applicable.
Eye Contact:	Immediately flush eyes with water and continue to flush as required. Remove any contact lenses, if worn. Obtain medical attention if deemed necessary.

Note to Physician: There is no required antidote. Treatment should be directed at the control of symptoms and the clinical condition of the patient.

Applications/Use:
For the application of air, soil, sediment, groundwater, shoreline, off-shore spill petroleum hydrocarbon remediation. Additional applications: Secondary recoveries of petroleum products form crude-oil, oil-shale, and oil-sands. Additional information on this product may be obtained by calling our customer service representatives at 1-800-246-2744 or 250-923-6326.

Ref: Ivey-sol/Spec. Sheet/100526-02