**SoundEarth Strategies, Inc.**
2811 Fairview Avenue East, Suite 2000
Seattle, Washington 98102
Phone: (206) 306-1900
Fax: (206) 306-1907

# WORK PLAN
## Tesoro Refining and Marketing Company
## Former Bulk Fuel Facility
## Biosparge Pilot Test
## Second Quarter 2018

SoundEarth Strategies, Inc. (SoundEarth) is in the process of evaluating possible remedial technologies to address residual petroleum contamination in shallow soil and groundwater at the Tesoro Refining and Marketing Former Bulk Fuel Facility (the site) located on West Fir Street in Mount Vernon, Washington. As part of this process, a pilot-scale biosparge test is proposed to gather field data to assess the efficacy of this remedial technology and whether it is suitable for full-scale implementation at the site.

Monitoring wells MW18, MW20, and MW22 were chosen as observation wells because groundwater collected from these wells has exhibited concentrations of chemicals of concern (COCs), including gasoline-range petroleum hydrocarbons (GRPH), diesel-range petroleum hydrocarbons (DRPH), oil-range petroleum hydrocarbons (ORPH), benzene, and naphthalene in excess of their respective Washington State Model Toxics Control Act Method A cleanup levels from 2006 to the present. Three biosparge test wells, AS01, AS02, and AS03, will be installed at upgradient hydrologic positions approximately 10 to 20 feet from the observation wells.

Biosparging is the injection of air into the subsurface to facilitate aerobic biodegradation of petroleum contamination by increasing concentrations of dissolved oxygen. Biosparging differs from air sparging in that air is injected into the subsurface at lower rates. As a result, biosparging does not cause volatilization of contaminants and does not necessitate soil vapor extraction for the collection of vapor-phase COCs.

If concentrations of dissolved oxygen in the observation wells are elevated relative to ambient conditions during the pilot test, it will indicate that biosparging is an effective remedial technology at the site and may be suitable for implementation at a larger scale.

The pilot test is anticipated to begin in Second Quarter (Date TBD), and will take approximately 5 days of field time to complete the pre-field and field activities. Once completed, the efficacy of the pilot test will be evaluated.

<u>The Expected Schedule is Shown Below:</u>

- Pre-field Activities 1 day Date TBD
- Mobilization 1/2 day Date TBD
- Biosparge Well Installation 1 day Date TBD

- Biosparge Pilot Test 2 days Date TBD
- Demobilization 1/2 day Date TBD

Details for the scope of work are outlined herein.

**PRE-FIELD ACTIVITIES**

Pre-field activities will include the following:

- Preparing and updating field forms:
  - Health and Safety Plan (HASP)
  - Job Safety Analysis Form (JSA)
  - Field Data Sheets (FDS)
  - Field Equipment Checklists
- Constructing the biosparge test wellhead assemblies.
- Constructing test manifold (air flow meter, pressure regulator).
- Procuring air compressor(s) capable of supplying design pressure and flow rates.
- Procuring a generator capable of powering air compressor(s).
- Procuring appropriate fittings, instruments, and gauges.
- Calibrating down-well dissolved oxygen probe(s).
- Scheduling and procuring rental equipment, air compressor(s), and generator.

**MOBILIZATION**

- Gathering necessary equipment and verifying that the tools, parts, and pieces are in good condition. Verify that the field equipment is ready by completing the attached Field Equipment Checklist.
- Organizing equipment in labeled containers and loading into vehicles
- Loading and securing equipment in field vehicle and transporting to site.

**BIOSPARGE WELL INSTALLATION**

Prior to initiating field activities, SoundEarth's field personnel will attend a health and safety meeting. The meeting will include a discussion of site and task-specific hazards, emergency shutdown procedures, proper personal protective equipment (PPE), and other health and safety topics brought up by workers on the site. A copy of the Tesoro Contractor Safety Manual will be on-site and will be reviewed and signed by all contractors on-site prior to starting work. SoundEarth will also prepare a Job-Safety-Analysis (JSA) form detailing the hazards associated with the installation of the biosparge wells. The JSA form will be reviewed and signed by all on-site personnel prior to starting work. All personnel on-site will have stop work authority.

Three biosparge wells (AS01, AS02, and AS03) will be installed at various distances away from their corresponding observation wells as shown in Table 1 below and on Figure 2. Each biosparge well will be

installed upgradient of its corresponding observation wells relative to the regional groundwater flow direction (Figure 2). Each biosparge well will be constructed with a 1-foot slotted section between 18 feet and 19 feet below ground surface.

SoundEarth personnel will use spray paint to mark the locations of the three biosparge wells to be installed. The locations will be recorded with x and y distances from a permanent landmark. The total distance between each biosparge well location and the immediate downgradient monitoring well (MW18, MW20, MW22) will also be recorded.

**Table 1**
**Biosparge Test Wells**

| Biosparge Test Well | Observation Well | Distance between Test and Observation Wells |
|---|---|---|
| AS01 | MW20 | 10 feet |
| AS02 | MW22 | 15 feet |
| AS03 | MW18 | 20 feet |

**BIOSPARGE PILOT TEST**

Prior to initiating field activities, SoundEarth's field personnel will attend a health and safety meeting. The meeting will include a discussion of site and task-specific hazards, emergency shutdown procedures, proper PPE, and other health and safety topics brought up by workers on the site. A copy of the Tesoro Contractor Safety Manual will be on-site and will be reviewed and signed by all contractors on-site prior to starting work. SoundEarth will also prepare a JSA form detailing the hazards associated with the installation of the biosparge wells. The JSA form will be reviewed and signed by all on-site personnel prior to starting work. All personnel on-site will have stop work authority.

This pilot test will be performed using an air compressor, pressure regulator, air flow meter, and a pressure indicator at the manifold and each wellhead. Diagram 1 below illustrates the layout and minimum parameter measurement devices for each test well. The air compressor will deliver flow to all three test wells simultaneously. SoundEarth will install a small manifold system to monitor and control the flow delivered to each test well. The air compressor will be plugged into the generator.

Steps for conducting the air sparge pilot test are outlined below:

1. Verify well locations on the base map by measuring and recording the distance from wells to landmarks.
2. Measure and record the distances between the biosparge test wells and observation wells.
3. Measure and record groundwater elevations and initial dissolved oxygen readings in the biosparge test wells and all observation wells prior to beginning test.
4. Locate the air compressor setup (generator, miscellaneous equipment, etc.) in the vicinity of the biosparge test wells.
5. Set up biosparge test well instrumentation as shown below in Diagram 1:

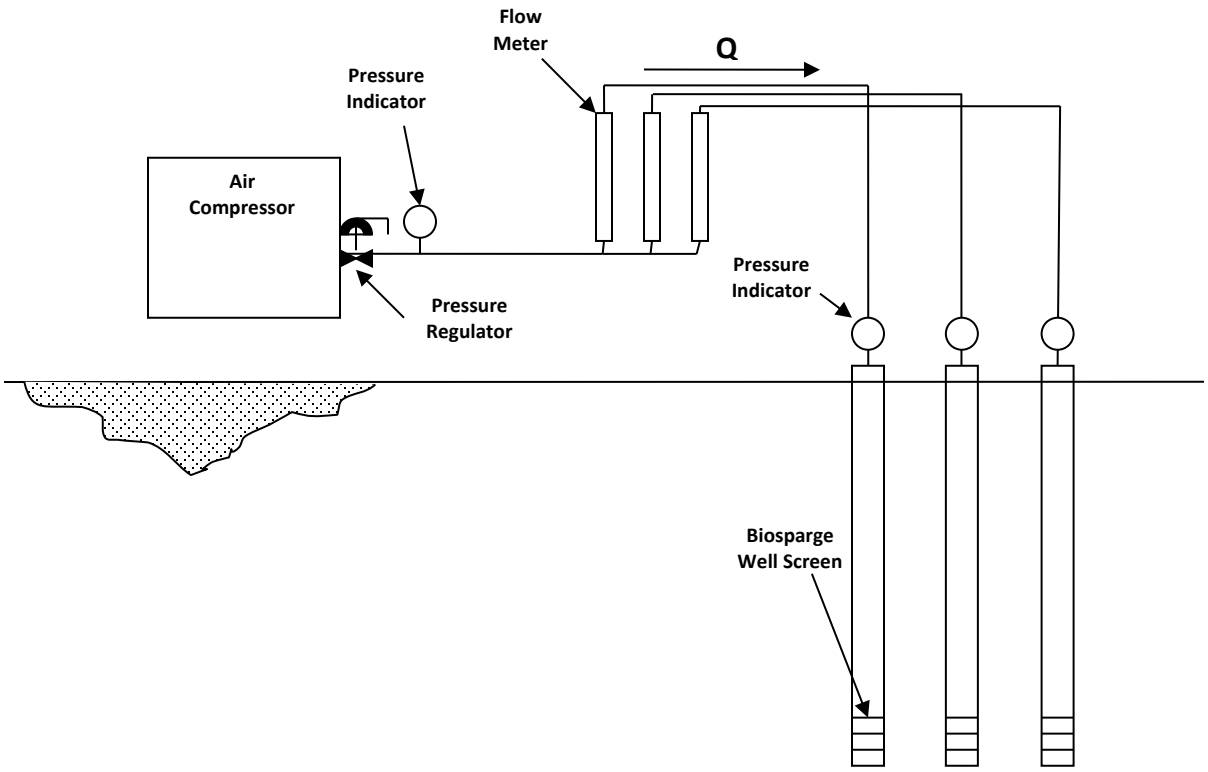



**Diagram 1**

6. Install the following instrumentation for measuring necessary parameter:
   - Pressure regulator on the compressor (note units on data sheet)
   - Pressure indicator on the compressor (note units on data sheet)
   - Three flow meters, one per test well (note units, make, and model on data sheet)
   - Pressure indicator at the manifold (note units on data sheet)
   - Pressure indicator at each observation wellhead (note units on data sheet)
7. Prepare observation points for monitoring dissolved oxygen and temperature during the test. A down-well dissolved oxygen meter shall be used to measure dissolved oxygen and temperature from the observation wells every 20 minutes throughout the test. In between these readings, use a 2-inch fernco to secure a wellhead assembly to each observation well, with the ball valve closed.
8. Begin the biosparge test by introducing enough air to overcome the hydrostatic head (water column) and friction loss in the piping. If no flow is observed through the flow meter, increase the pressure to the well incrementally until flow occurs. This additional pressure is the pressure required to overcome the formation at the biosparge point (Equation 1).

$$P_{req} = P_H + P_{friction} + P_{formation}$$

**Equation 1**

*where:*
*$P_{req}$ = required air pressure*
*$P_H$ = hydrostatic pressure*
*$P_{friction}$ = piping friction losses*
*$P_{formation}$ = air entry pressure*

9. The site specific minimum air pressure ($P_{req}$) was calculated to be approximately 3.2 pounds per square inch (psi), and the site specific maximum air pressure was calculated to be approximately 7.5 psi (with a 60 percent safety factor). The design engineer must approve the pressure increase prior to the pilot test exceeding the maximum air pressure during the test (7.5 psi).
10. Once air flow is observed, the regulator on the compressor shall not be adjusted and the field team shall observe the compressor pressure gauge and test wellhead pressure gauges to ensure back pressure is not being created down the test wells. The observation well and test well gauges should read approximately the same pressure.
11. Record the corresponding pressure and flow rates for each test well.
12. Record the following information every 20 minutes during the test on the appropriate field data sheets (Attachment A):
    - Pressure at the compressor
    - Air flow rates to each test well
    - Pressure at each test wellhead
    - Pressures at the observation wells
    - Temperature at the observation wells
    - Dissolved oxygen in the observation wells
    - Photoionization detector readings at the observation wells
13. At the conclusion of the first work day, secure equipment and site so that the test can safely continue overnight.
14. Upon arrival the morning of the second test day, measure the information listed in step 12 and resume the measurement and recording of the data every 20 minutes.
15. Within the first two hours of beginning work on the second test day, collect air samples from the wellhead assemblies on the observation wells using a vacuum lung sampler and vacuum pump.
16. At the conclusion of the test, measure and record groundwater elevations in biosparge test wells and observation wells.
17. Following analysis of the data collected during the pilot test, a report will be prepared summarizing the results and analysis.

**DEMOBILIZATION**

At the conclusion of the pilot test:

- System lines, wellhead assemblies, and other equipment will be stored in appropriate containers.
- Caution should be used when handling lines as they can be heavy and unwieldy.
- Once the wellheads, lines, and equipment are stored and loaded into the field vehicle or trailer, the equipment can be moved to a second location or returned to the storage facility.

Shop Work

- At the storage facility, equipment must be unpacked, repaired, and stored as needed, so it will be ready for use at the next pilot test.
- Equipment that was broken in the field must be replaced or fixed, and the new or repaired equipment should be stored properly with the pilot test equipment.
- During the pilot test, amendments to the procedure should be recorded. At the end of the pilot test, they should be included in an updated field procedure.

## Attachments

Figures

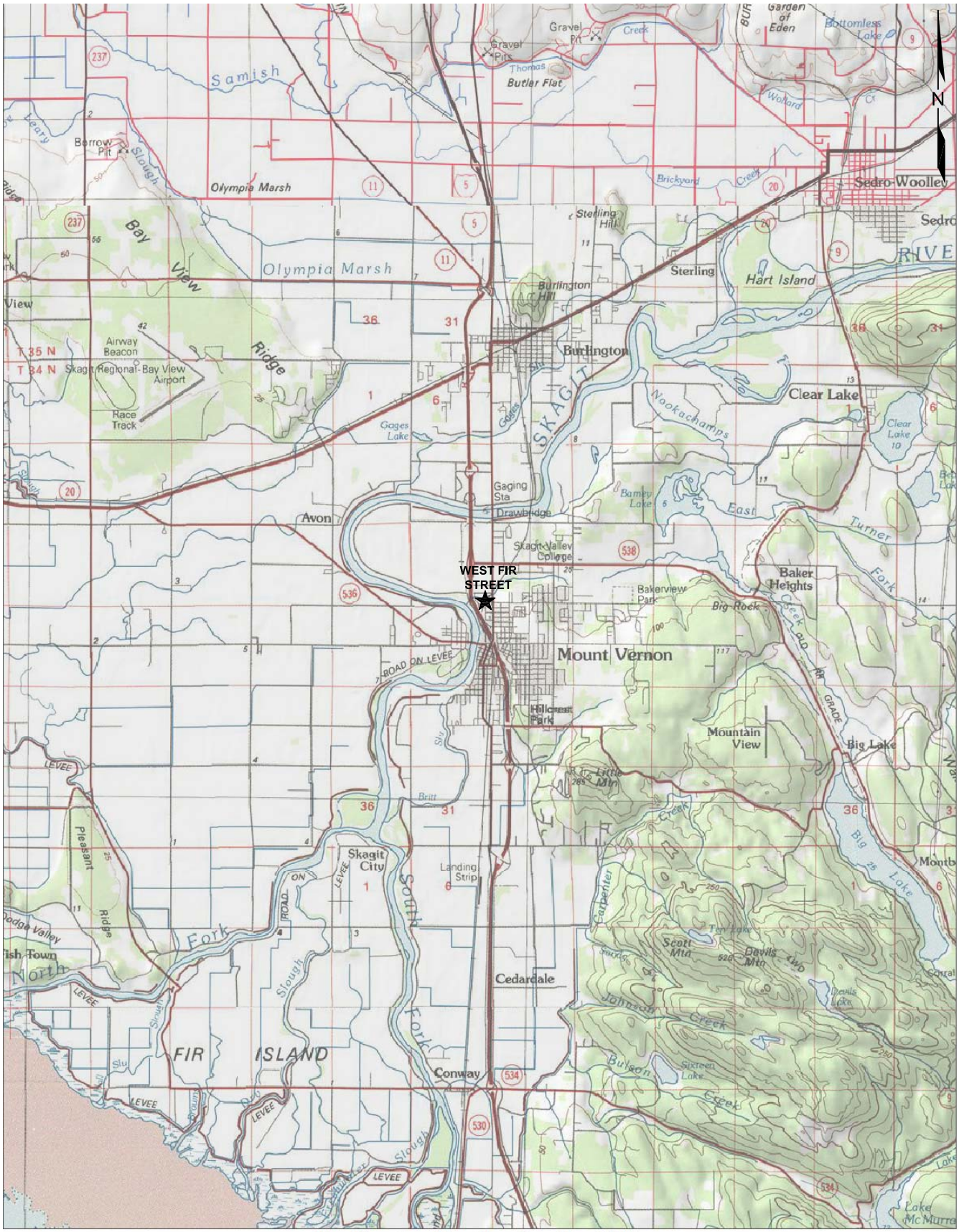
1, Property Location Map
2, Proposed Biosparge Pilot Test Plan

Field Forms

Field Equipment Checklist
Test Well Measurements Data Sheet
Observation Well Measurements Data Sheet
Depth to Water Measurements Data Sheet
Job Safety Analysis

# FIGURES

P:\0271 TESORO\0271-018 BULK FUEL FACILITY - MOUNT VERNON\TECHNICAL\CAD\FIGURE 1\0271-018_FIG1_F.DWG

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| DATE: | 06/15/10 |
| DRAWN BY: | NAC |
| CHECKED BY: | RKB |
| CAD FILE: | 0271-018_FIG1 |

| | |
|---|---|
| PROJECT NAME: | FORMER BULK FUEL FACILITY |
| PROJECT NUMBER: | 0271-018 |
| STREET ADDRESS: | WEST FIR STREET |
| CITY, STATE: | MOUNT VERNON, WASHINGTON |

**FIGURE 1**
PROPERTY LOCATION MAP

SOUNDENVIRONMENTAL.COM

3/15/2018

P:\0271 TESORO\0271-018 BULK FUEL FACILITY - MOUNT VERNON\TECHNICAL\CAD\ENGINEERING FIGURES\0271-18 2018PT.DWG

## LEGEND

- MW22 — MONITORING WELL
- PROPOSED BIOSPARGE WELLS
- FORMER BULK FUEL FACILITY BOUNDARY
- PARCEL BOUNDARY
- C — CABLE LINE
- OHP — OVERHEAD POWER LINE
- W — WATER LINE
- SS — SEWER LINE
- SV — STORMWATER LINE
- (88.26') — GROUNDWATER ELEVATION
- HISTORICAL GROUNDWATER FLOW DIRECTION

BURLINGTON NORTHERN RAILROAD TRACKS

MW15 (87.39')

MW16 (87.13')

MW04 (87.75')

CONVENIENCE STORE BUILDING

MW-12 (88.45')

SIDEWALK

MW-13 (87.99')

N

MW20 (87.55')

AS01

(87.08') MW05

MW22 (87.70')

FORMER BUILDINGS

MW19 (87.89')

MW18 (88.02')

MW-15 (88.04')

AS02

12,000-GALLON

12,000-GALLON

AS03

MW21 (88.26')

(88.56') MW17

MW06 (89.87')

19,500-GALLON

24,000-GALLON

19,500-GALLON

FORMER ABOVEGROUND STORAGE TANKS

PLANTER

SIDEWALK

DRIVEWAY

WEST FIR STREET

MW08

MW09

| | |
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| SoundEarth Strategies | WWW.SOUNDEARTHINC.COM |
| DATE: | 03/08/18 |
| DRAWN BY: | EAM |
| CHECKED BY: | TWM |
| CAD FILE: | 0271-018_2018PT |
| PROJECT NAME: | FORMER BULK FUEL FACILITY |
| PROJECT NUMBER: | 0271-018 |
| STREET ADDRESS: | WEST FIR STREET |
| CITY, STATE: | MOUNT VERNON, WASHINGTON |

REGION:

0 5 10 20 40

APPROXIMATE SCALE IN FEET

# FIGURE 2

PROPOSED BIOSPARGE PILOT TEST PLAN

# FIELD FORMS

**SoundEarth Strategies, Inc.**
2811 Fairview Avenue East, Suite 2000
Seattle, Washington 98102
Phone: (206) 306-1900
Fax: (206) 306-1907

# Field Equipment Checklist—Biosparge Pilot Test

Checklist for Biosparge Pilot Test with air compressor, needed Information and Equipment

Job Number: 0271-018 Date: _____

Project Name: Tesoro Bulk Fuel facility Location: West Fir Street, Mount Vernon, WA

Client Representative: _____ Work Goal: _____

Project Manager: Rob Roberts

| Loaded | Needed | Equipment and Materials |
|---|---|---|
| | | 1. HASP |
| | | 2. Field Forms, Clipboard: Field Report, Sketch Paper, Log Book |
| | | 3. Site Plan with test wells and observation wells marked |
| | | 4. Various ranges of pressure gauges |
| | 3 | 5. Test well, wellhead attachment |
| | 3 | 6. 2- and 4-inch observation well wellhead attachments |
| | | 7. Hand tools (5/16, 9/16, 5/8 sockets, screwdriver, multimeter, electrical tape, duct tape, misc) |
| | | 8. Test well air sparge manifold – flow meter and pressure gauge at compressor and pressure gauge at the wellhead |
| | | 9. Hoses to reach each well from compressor set up (note distance from compressor to well) |
| | | 10. Down well dissolved oxygen meter |
| | | 11. Polyethylene and silicon tubing (if applicable) |
| | | 12. Misc. air compression fittings |
| | | 13. Tape measure and measuring wheel |
| | | 14. Water level meter |
| | | 15. Camera |
| | | 16. Extra various fittings/connections |
| | | 17. Air compressor and generator if required |
| | | 18. PPE: Hard Hat, Safety Vest, gloves (big and small nitrile), safety glasses, etc. |
| | | 19. Traffic Cones and Yellow Caution Tape to delineate exclusion zone |
| | | 20. Cell phones and chargers |
| | | 21. First Aid Kit |
| | | 22. Fire Extinguisher |
| | | 23. Workplan – objective of work and any special instructions/guidelines |
| | | 24. Generator (for air compressor) |
| | | 25. Vacuum Pump |
| | | 26.Lung Sampler |
| | | |
| | | |

PM Initials: _____

Special Equipment / Notes: _____

**BIOSPARGE PILOT TEST**
**Former Bulk Fuel Facility**
**West Fir Street**
**Mt. Vernon, Washington**
**Test Well Measurements**

**Client:** Tesoro **Project Name/ Facility Number:** Former Bulk Fuel Facility **Date:**

**SoundEarth Project #** 0271-018 **Field Personnel:** **Project Address:** West Fir Street, Mount Vernon, WA

| AS Test Well: AS01 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Time | Regulator Pressure (psi) | Rotameter Pressure Gauge (psi) | Flow Meter (scfm) | Test Wellhead Pressure (psi) | Depth to Water (ft) | Temperature (°C) | DO (mg/L) | Notes |
| Baseline Measurements | | | | | | | | | |
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| Test Measurements | | | | | | | | | |
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| Final Measurements | | | | | | | | | |
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**COMMENTS:**

Baromentric Pressure:

-- = not available
° C = degrees Celsius
AS = air sparge
DO = dissolved oxygen
ft - feet
mg/L = milligrams per liter
NM = Not Measured
psi = pounds per square inch
scfm = standard cubic feet per minute

**BIOSPARGE PILOT TEST**
**Former Bulk Fuel Facility**
**West Fir Street**
**Mt. Vernon, Washington**
**Test Well Measurements**

**Client:** Tesoro **Project Name/ Facility Number:** Former Bulk Fuel Facility **Date:**

**SoundEarth Project #** 0271-018 **Field Personnel:** **Project Addres** West Fir Street, Mount Vernon, WA

**AS Test Well: AS02**

| Date | Time | Regulator Pressure (psi) | Rotameter Pressure Gauge (psi) | Flow Meter (scfm) | Test Wellhead Pressure (psi) | Depth to Water (ft) | Temperature (°C) | DO (mg/L) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| Baseline Measurements | | | | | | | | | |
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**COMMENTS:**

Baromentric Pressure:

-- = not available
° C = degrees Celsius
AS = air sparge
DO = dissolved oxygen
ft - feet
mg/L = milligrams per liter
NM = Not Measured
psi = pounds per square inch
scfm = standard cubic feet per minute

**BIOSPARGE PILOT TEST**
**Former Bulk Fuel Facility**
**West Fir Street**
**Mt. Vernon, Washington**
**Test Well Measurements**

**Client:** Tesoro **Project Name/ Facility Number:** Former Bulk Fuel Facility **Date:**

**SoundEarth Project #** 0271-018 **Field Personnel:** **Project Addres** West Fir Street, Mount Vernon, WA

**AS Test Well: AS03**

| Date | Time | Regulator Pressure (psi) | Rotameter Pressure Gauge (psi) | Flow Meter (scfm) | Test Wellhead Pressure (psi) | Depth to Water (ft) | Temperature (°C) | DO (mg/L) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| Baseline Measurements | | | | | | | | | |
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| Final Measurements | | | | | | | | | |
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**COMMENTS:**

Baromentric Pressure:

-- = not available
° C = degrees Celsius
AS = air sparge
DO = dissolved oxygen
ft - feet
mg/L = milligrams per liter
NM = Not Measured
psi = pounds per square inch
scfm = standard cubic feet per minute

SoundEarth Strategies

**STEP TEST OBSERVATION WELL MEASUREMENTS DATA SHEET**

**BIOSPARGE PILOT TEST**
**Observation Well Measurements**
**Former Bulk Fuel Facility**
**West Fir Street**
**Mt. Vernon, Washington**

**Client:** Tesoro **Project Name/ Facility Number:** Former Bulk Fuel Facility/ **Date:** **Project Address:** West Fir Street, Mount Vernon, WA

**SoundEarth Project #** 0271-018 **Field Personnel:**

**AS Test Wells: AS01, AS02, AS03 - Observation Wells: MW18, MW20, MW22**

| Date | Time | MW18 | | | | MW20 | | | | MW22 | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pressure (iow) | Temp (F) | DO (mg/L) | PID | Pressure (iow) | Temp (F) | DO (mg/L) | PID | Pressure (iow) | Temp (F) | DO (mg/L) | PID | |
| **Baseline Measurements** | | | | | | | | | | | | | | |
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| **Test Measurements** | | | | | | | | | | | | | | |
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**COMMENTS:**

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-- = not available ft - feet ° C = degrees Celsius NM = Not Measured

iow = inches of water mg/L = milligrams per liter AS = air sparge psi = pounds per square inch

**BIOSPARGE PILOT TEST**
**Former Bulk Fuel Facility**
**West Fir Street**
**Mt. Vernon, Washington**
**Depth to Water Measurements**

**Client:** Tesoro **Project Name/ Facility Number:** Former Bulk Fuel Facility/ **Date:**

**SoundEarth Project #** 0271-018 **Field Personnel:** **Project Address:** West Fir Street, Mount Vernon, WA

| Date | Time | Depth to Water (fet below TOC) | | | | | | Notes |
|---|---|---|---|---|---|---|---|---|
| | | AS01 | AS02 | AS03 | MW18 | MW20 | MW22 | |
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| **Measure Baseline and Record Above** | | | | | | | | |
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**COMMENTS:**

NM = Not Measured

TOC = Top of Casing

# Job Safety Analysis

**Biosparge Pilot Test**

| Work Activity: **Biosparge Pilot Test : Former Bulk Fuel Facility** | ☒ New ☐ Revised | Date: 3/27/18 |
|---|---|---|

**Personal Protective Equipment (PPE):** Minimum PPE is Level D including: safety glasses or goggles, hard hat, high visibility traffic vest, steel-toed boots, hearing protection, and gloves (type dependent on job-specific requirements) **Additional PPE may be required in the Site Specific Health & Safety Plan (HASP). Also refer to the HASP for required traffic control, air monitoring, and emergency procedures.**

| Development Team | Position/Title | Reviewed By | Position/Title | Date |
|---|---|---|---|---|
| Joe Ellingson | Staff Engineer | Ethan Marks | Project Engineer | 3/28/18 |

Field staff must review job-specific work plan and coordinate with project manager to verify that all up-front logistics are completed prior to starting work including, but not limited to, utility locates, permitting, access agreements, and notification to required contacts (e.g. site managers, inspectors, clients, subcontractors, etc.). Additionally, a tailgate safety meeting must be performed and documented at the beginning of each work day. Remind all participants of right and responsibility to use **STOP WORK AUTHORITY,** and Management of Change (MOC).

| ***Job # 0271-018*** | ***Date read*** | ***Signatures*** *(File signed copy with project paper work.)*<br>**1.**_____ **2.**_____ **3.**_____ |
|---|---|---|
| **❶ Job Steps** | **❷ Potential Hazard** | **❸ Critical Actions** |
| 1. Pre-Job | | • Conduct tailgate safety meeting<br>• Refer to site specific HASP and JSA<br>• Identify and address new or unforeseen hazards |
| 2. Staging Equipment | Proximity to traffic | • Delineators and caution tape must be used at all times<br>• Use vehicle as traffic control if possible |
| | Slips/Trips/Falls | • Minimize risk with good housekeeping and cleanliness<br>• Place delineators near all hoses to minimize tripping hazard |
| | Pinch points | • Be careful when working in or near generator or pilot test apparatus |
| 3. Biosparge Pilot Test | Pressurized Hoses | • Inform all personnel on site of where air compressor emergency shut off switch is<br>• Continually monitor pressure in sparge hoses<br>• Visually inspect all hoses and inspections prior to pilot test |
| | Energized Equipment | • Visually inspect all power chords and connections prior to use |
| 4. List Unforeseen Hazards & Critical Actions | A.<br>B.<br>C.<br>D.<br>E. | |