R0433

CAMBRIA

September 12, 2002

Mr. Barney Chan
Alameda County Health Care Services Agency
Department of Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502

Re: **Subsurface Investigation Report and Corrective Action Plan - Addendum**
Former Shell Service Station
1230 14th Street
Oakland, California
Incident #: 97088250
Cambria Project #: 244-0233

Dear Mr. Chan,

Cambria Environmental Technology, Inc. (Cambria) is submitting this addendum to our August 26, 2002 *Subsurface Investigation Report and Corrective Action Plan* (SI and CAP) on behalf of Equilon Enterprises LLC dba Shell Oil Products US (Shell). The purpose of this addendum is to clarify Alameda County Health Care Services Agency's (ACHCSA) concerns identified in your email dated August 30, 2002.

1. ***Public participation process:*** Cambria acknowledges that a 30 day public review comment period will be required before ACHCSA will approve the CAP. As requested, the names and addresses of the property owners and residents of the immediate neighboring homes and businesses as available from Alameda County Assessor's records are provided in Table 1.

2. ***Confirmation of non-existence of DeFremery Park Well:*** As noted in your email dated August 30, 2002, the copy of Cambria's letter to Mr. Abercrombie was not signed. Cambria acknowledges that the copy was unsigned, however the original was printed on letterhead and was signed. Unfortunately, we are unable to locate a copy of the original letter at this time. However, the US Postal Service return receipt indicates that the letter was received, and subsequent telephone conversation with Mr. Abercrombie confirms that he did, in fact, receive the original letter from Cambria.

   ACHCSA requested that Mr. Abercrombie state what records were reviewed or the basis for his conclusion that, to his knowledge, no irrigation or other well, has been sited (or used) at DeFremery Park since 1975. As reported in the SI and CAP, Mr. James Abercrombie is Supervisor of City of Oakland Parks and Recreation, Area One. According to Mr. Abercrombie, he has worked for the City of Oakland Parks and Recreation department since 1975. He stated that his original work assignment was as a gardener at deFremery Park, where he worked for several years. Thus, Cambria concluded that Mr. Abercrombie is a

Oakland, CA
San Ramon, CA
Sonoma, CA

**Cambria Environmental Technology, Inc.**

1144 65th Street
Suite B
Oakland, CA 94608
Tel (510) 420-0700
Fax (510) 420-9170

knowledgeable and reliable person regarding the existence of the reported well at deFremery Park. Cambria contacted Mr. Abercrombie by telephone on September 3, 2002 and was redirected to Anne Hyde, City of Oakland Plumbing and Area Maintenance Supervisor for the City of Oakland Building and Grounds Department. Ms. Hyde is on vacation until September 10. Cambria will follow up when Ms. Hyde returns. OK

It should be noted that the *East Bay Plain Groundwater Basin Beneficial Use Evaluation Report for Alameda and Contra Costa Counties, CA* (CRWQCB, San Francisco Bay Region Groundwater Committee, June 1999) estimates that "in the range of 15,000 wells were drilled in the East Bay Plain between 1860 and 1950 . . . A few are still in use today, but most were abandoned and forgotten." If the potential continued existence of this well is of concern to ACHCSA, Cambria recommends that ACHCSA pursue this further with the City of Oakland.

3. ***Cleanup Goals:*** The ACHCSA has requested that Cambria provide cleanup levels for "all COC's" (chemicals of concern) in soil and groundwater. According to the *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites*(ASTM 1739-95), chemicals of concern (COCs) commonly selected when assessing impacts of unleaded gasoline, based on knowledge of their concentration in the specific fuel, as well as their toxicity, water solubility, subsurface mobility, aesthetic characteristics and the availability of sufficient information to conduct risk assessments are benzene, toluene, ethylbenzene, xylenes (BTEX) and methyl-tertiary-butyl ether (MTBE), when suspected. MTBE was not considered to be a COC for this site since the site ceased operation prior to the widespread use of MTBE as a fuel oxygenate. Furthermore, repeated quarterly groundwater monitoring data show that MTBE is not detected above the laboratory detection limits using EPA Method 8260. In addition to the regular quarterly analysis for total petroleum hydrocarbons as gasoline (TPHg), BTEX and MTBE, groundwater from monitoring well MW-4 was analyzed April 17, 2002 for four additional oxygenates: di-isopropyl ether (DIPE), ethyl tert-butyl ether (ETBE), tert-amyl methyl ether (TAME), tert-butyl alcohol (TBA) and two lead scavengers 1,2-Dichloroethane and 1,2-Dibromoethane. None of the additional analytes were detected above the laboratory detection limits.

   Cambria's March 7, 2002 RBCA Report identified inhalation of vapors volatilized from soil or groundwater to indoor and outdoor air in a commercial setting, inhalation of vapors volatilized from soil or groundwater to outdoor air in a residential setting and direct contact with surface soil for construction workers as complete exposure pathways. It should be noted that inhalation of vapors volatilized from soil or groundwater by residential occupants is not considered a complete pathway. The Alameda County Assessor's office records indicate that the site's use is "Improved Commercial Service Station." In Cambria's discussion of remedial objectives for the site, benzene in groundwater was identified as the primary COC for the site due to its carcinogenic effects. Since the City of Oakland's risk-based screening levels (RBSLs) for toluene, ethylbenzene and xylene in groundwater exceed the solubility of each chemical in water, these chemicals are not considered COCs for groundwater. The Oakland RBSLs do not include an RBSL for TPHg. Although the maximum concentration of benzene in groundwater at the site (15,000 ppb or 15 mg/L) is below the City of Oakland's established Tier 2 risk-based screening level (RBSL) concentration for inhalation of indoor air vapors originating from groundwater in Merritt Sands in a commercial industrial setting (22,000 ppb or 22 mg/L), Shell voluntarily recommended using the more conservative residential RBSL concentration (1,400 ppb or 1.4 mg/L) as the cleanup goal for the site.

The *Oakland Urban Land Redevelopment Program: Guidance Document* (City of Oakland Public Works Agency, January 2000), which details the appropriate use of the Oakland RBSLs, defines subsurface soil as "all soil deeper than one meter and above groundwater." Since no benzene was detected above the method detection limit in soil samples collected above groundwater during the current investigation, no cleanup goals for soil are necessary.

4. ***Evaluation of proposed remedial alternatives:*** In Cambria's August 26, 2002 SI and CAP, air sparging, monitored natural attenuation (MNA), barrier system, SVE, GWE, dual-phase or vacuum-enhanced GWE (DVE), and in-situ oxidation were evaluated against their ability to meet the proposed cleanup goal, their feasibility, their cost, and their ability to remediate the site in the shortest time frame feasible. As requested, a summary of the results of evaluation of the potential remedial alternatives, including anticipated effectiveness of each alternative, anticipated costs and expected time for remediation and monitoring activities, is provided in Table 1.

5. ***Consideration of effects of residual pollution in relation to decreasing water levels:*** Analytical results from the July 2002 subsurface investigation show that there is no current indication of hydrocarbon impact to unsaturated soil above 12.5 feet below grade (fbg), in spite of water levels having risen to as high as 5 fbg in the past. During July 2002, water levels were measured at 11.1 to 12.7 fbg. The historic low water levels recorded in December 1999 were 11.0 to 13.9 fbg. Since the July 2002 water levels were within approximately 2.2 feet of the historic low water levels, Cambria believes that the July 2002 subsurface investigation results accurately represent the "worst-case" uns~~ta~~aturated soil concentrations. The vadose zone soil sample (MW-5-9.5) collected during the installation of monitoring well MW-5 in September 2001 contained 3.9 ppm TPHg and <0.005 ppb benzene, and the capillary fringe soil sample (MW-5-14.5) contained 790 ppm TPHg and 2.7 ppm benzene. These results suggest that residual impact resulting from decreasing water levels is unlikely to pose a risk to human health or the environment.

Cambria believes that it would be technically inappropriate to use saturated soil sample analytical results (i.e., from soil samples collected below static water levels) to represent unsaturated soil chemical concentrations in a risk assessment.

6. ***Proposed Soil and Groundwater Verification Monitoring Plan:*** Preliminary groundwater samples will be collected prior to the start of the in-situ field test and confirmation gw samples will be collected immediately following, and one month after completion of the test. Fourth quarter 2002 groundwater monitoring results will be used as the preliminary sample set. Confirmation samples will be collected from six existing onsite monitoring wells in and surrounding the test area: MW-1, MW-5, MW-6, VW/AS-1, VW/AS-3 and VW/MW-2. As proposed in the August 26, 2002 SI and CAP, groundwater samples will be analyzed for TPHg, BTEX, total chromium and hexavalent chromium. Since this remedial action is driven by potential risks due to benzene concentrations in groundwater, no further soil sampling is proposed.

7. ***Confirmation that proposed injection work plan will not pose any risk to neighboring residents:*** Since the proposed injection work will take place within the confines of the site, at least 20 feet from any site boundary, we do not anticipate this activity will create any risk to neighboring residents. The following safety issues have been considered for onsite activities:

    - Chemical Storage: No chemicals will be stored onsite. The required volume of chemicals will be transported to the site daily and any surplus will be removed at the end of each day. Secondary containment will be utilized for chemicals while onsite. Incompatible materials will be stored and used away from chemical containers while on site.

    - Offsite Migration of Chemicals: The reaction time for the in-situ oxidation is very rapid and no subsurface offsite migration of chemicals is anticipated. Followup groundwater monitoring has been proposed to monitor groundwater quality after the proposed remedial action, and Cambria believes this monitoring will be satisfactory to demonstrate whether any migration of injected chemicals or chemicals of concern is caused by the remedial action.

    - Off-gases: The only offgases that may be produced are water vapor (as steam) and carbon dioxide and do not represent a risk to neighboring residents. It is not expected that hydrocarbon vapors will be released into the atomosphere. Nonetheless, during site activities, air monitoring will be conducted using a photoionization detector (PID) downwind of the injection ports, in the breathing zone, within the treament area and at the site boundary. Monitoring will be performed everly 10 minutes for the first hour, then, if no hydrocarbons are detected, monitoring will be performed once per hour. Injection will stop if levels exceed the acceptable ceiling concentration (25 ppm). ok

- Fire: The maximum concentration of hydrogen peroxide to be used (<20%) does not constitute a fire or explosion risk. However, as precautionary measures, the grass onsite will be cut prior to start of work, and a fire extinguisher will be onsite at all times during the field work. As stated above, incompatible materials will be stored and used away from chemical containers while on site.

- Worker Health and Safety: All onsite workers and observers will be required to follow Cambria's Job Safety Analysis for Hydrogen Peroxide Injection (Attachment A) and the job-specific Health and Safety Plan.

8. ***Information available to concerned citizens:*** A copy of *A Citizen's Guide to Chemical Oxidation* (US EPA 542-F-1-013), included as Attachment B, can be made available to concerned citizens. As noted in our August 26, 2002 SI and CAP, the following reference documents are available from the USEPA CLU-IN website www.clu-in.org:

- *Technical and Regulatory Guidance for In Situ Chemical Oxidation of Contaminated Soil and Groundwater,* Interstate Technology and Regulatory Cooperation Work Group, June 2001

- Yin and Allen, *In Situ Chemical Treatment*, GWRTAC Technology Evaluation Report TE-99-01, July 1999
- *Fenton's Reagent*, Innovative Technology Summary Report DOE/EM-0484, October 1999
- *Field Applications of In Situ Remediation Technologies: Chemical Oxidation*, USEPA 542-R-98-008, September 1998

Should the ACHCSA wish to hold a public forum to provide information about the remedial activities and allow neighborhood residents to express any concerns they may have, Cambria and Shell would be pleased to participate.

## CLOSING

If you have any questions or comments, please call Melody Munz at (510) 420-3324.

Sincerely,
**Cambria Environmental Technology, Inc.**

Melody Munz
Project Engineer

Matthew W. Derby

Matthew W. Derby, P.E.
Senior Project Engineer

No. C055475
Exp. 12/31/07

Table: 1 – Names and addresses of property owners of immediately neighboring homes and businesses
2 – Remedial Alternative Evaluation Summary

Attachment: A – Job Safety Analysis – Hydrogen Peroxide Injection
B – A Citizen's Guide to Chemical Oxidation (EPA 542-F-1-013)

cc: Karen Petryna, Shell Oil Products US, P.O. Box 7869, Burbank, CA 91510-7869
Tom Saberi, 1045 Airport Boulevard, Suite 12, South San Francisco, CA 94080
Matthew Dudley, Sedgwick, Detert, Moran, & Arnold, 1 Embarcadero Center, 16th Floor, San Francisco, CA 94111-3628

G:\Oakland 1230 14th\2002 CAP\1230 14th CAP Addendum.doc

## Table 1. Neighboring Property Owners/Residents

Former Shell Service Station, Incident #97088250, 1230 14th Street, Oakland, CA

| Address | Property Owner Name* | Property Owner Telephone | Resident Name | Residednt Telephone |
|---|---|---|---|---|
| 1418-1420 Union (2) | Matthew Willingham | 510-451-7877 | Harris | |
| 1426 Union | Grobelny | 925-676-2610 | Grobelny | 925-676-2610 |
| 1430 Union | Kelly | | Occupant | |
| 1434-36 Union | Willingham | 510-451-5340 | Willingham | 510-451-5340 |
| 1504 Union | Narcisse | 510-813-7208 | Roberts | 510-813-7208 |
| 1508-10 Union | Mack & Cleveland | | Mack | |
| 1520 Union | Robinson | | Robinson | |
| 1528-30 Union | Robinson | | Occupant | |
| 1266 14th Street | | 510-839-1500 | Comm-Air Mechanical | 510-839-1500 |
| 1210 14th Street | Jones | | Occupant | |
| 1204-06-08 14th Street | Secrease | | Occupant | |
| 1216 14th Street(2) | Irene Rong | 510-272-0290 | Jones | 510-272-0290 |
| 1415 Magnolia | Bracey & Wilson | | Occupant | |
| 1419 Magnolia | Mackey | 510-452-5547 | Mackey | 510-452-5547 |
| 1421-23 Magnolia | Tyler | | Scott | |
| 1424 Magnolia | Miles & Wormley | 510-625-9271 | Pector | 510-625-9271 |
| 1427 Magnolia | Sweeney | | Sweeny | |
| 1501Magnolia | Kuang | | Occupant | |
| 1509 Magnolia | Garcia | | Occupant | |
| 1515 Magnolia | Donald | | Donald | |
| 1521 Magnolia | Phung | | Fong | |
| 1527 Magnolia | Harrison | | Occupant | |
| 1533 Magnolia | Lake | | Occupant | |
| 1539 Magnolia | Lee | | Lee | |
| 1219-21 16th Street | Young | | Occupant | |
| 1225-27 16th Street | Quin | | Winslow | |
| 1229-31 16th Street | Daniels | | Occupant | |
| 1532 Magnolia | Cannon | | Occupant | |
| 1522 Magnolia | Quiyan | | Quiyan | |
| 1518-16 Magnolia | Robinson | | Robinson | |
| 1512 Magnolia | Dawson | | Occupant | |
| 1508 Magnolia | Miles | 510-832-7743 | Miles | 510-832-7743 |
| 1504 Magnolia | Bowie | | Bowie | |
| 1420 Magnolia | Parkinson | 510-835-2290 | Parkinson | 510-835-2290 |
| 1416 Magnolia | Rambo | | Rambo | |
| 1410 Magnolia | Brooks | | Occupant | |

* Owner name according to Alameda County Assessor's Records May 1999

(1) **Ellen Wyrick-Parkinson, owner/tenant at 1420 Magnolia, is the president of the neighborhood association.**

(2) Propeties immediately adjacent to subject site

**Table 2: Remedial Alternative Evaluation – 1230 14th Street, Oakland, CA**

Former Shell Service Station, Incident #97088250, 1230 14th Street, Oakland, CA

| Remediation Technique | Anticipated Effectiveness and Disadvantages | Anticipated Costs (in $\$x10^3$) | | | | | | Expected Time for Remediation | Monitoring Activities |
|---|---|---|---|---|---|---|---|---|---|
| | | Design | Con-struction | Monthly O&M | Months | Total O&M | Total Cost | | |
| Air Sparging | Commonly used to treat organic compounds such as benzene. Costs and duration shown are for "biosparging". Air sparging w/o vapor collection (i.e. "bio-sparging") may be of limited effectiveness, and is slow. Noise issues for blowers is a concern.<br>Air sparging with vapor recovery by SVE transfers chemicals to vapor phase where they are extracted by SVE. Additional equipment for SVE and vapor abatement, air emissions permitting, and air emissions monitoring would be required. Costs would be greater than those shown. | 10 | 45 | 2 | 24 | 48 | 103 | 2 Years or more | Continued quarterly groundwater monitoring |
| MNA | Conditions at the site suggest that natural processes will continue to degrade the hydrocarbon plume. Likely to be effective, least expensive, but slow. | - | - | 1 | 48 | 48 | 48 | 4 Years or more | Continued quarterly groundwater monitoring |

**Table 2: Remedial Alternative Evaluation – 1230 14th Street, Oakland, CA**
Former Shell Service Station, Incident #97088250, 1230 14th Street, Oakland, CA

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| SVE | SVE is effective at removing hydrocarbons from unsaturated soil. Since there is no current indication of hydrocarbon impact to unsaturated soil, SVE will not directly remediate hydrocarbons in groundwater. Not effective. | 10 | 75 | 5 | 12 | 60 | 145 | Not applicable due to site conditions | Continued quarterly groundwater monitoring plus monthly vapor extraction rates and concentrations |
| Mobile GWE & DVE | Due to low groundwater yields, mass removal rate is very low. DVE may enhance groundwater extraction rate and natural attenuation processes. Likely to be more effective than MNA, but also slow. | 1 | 2 | 2 | 24 | 48 | 51 | Years | Continued quarterly groundwater monitoring |
| In-Situ Oxidation (Fenton's Reagent) | Commonly used in the environmental industry to remediate hydrocarbon-impacted soil and groundwater by directly oxidizing carbonaceous material found in gasoline constituents. Very effective, near-immediate results, more expensive than MNA or mobile GWE & DVE, but less expensive than other alternatives. | 5 | 60 | 1 | 6 | 6 | 71 | Weeks to months | Pre- and post-treatment samples from site monitoring wells<br>plus<br>Continued quarterly groundwater monitoring |

# ATTACHMENT A

## Job Safety Analysis – Hydrogen Peroxide Injection

# Job Safety Analysis

## Hydrogen Peroxide Injection DRAFT

JSA Type: ☒ SAR Operations ☐ Transport ☐ Office ☐ Construction ☒ New ☐ Revised Date: 05/10/02

Co: Dept: Div: Org Unit: Loc:

Work Type: Environmental

Work Activity: Hydrogen Peroxide Injection

Personal Protective Equipment (PPE):

Minimum PPE is Level D including: safety goggles, rubber or vinyl rainsuit, hard hat with face shield, rubber steel-toed and shank boots, hearing protection, and rubber or nitrile gloves

**Additional PPE may be required in the Health & Safety Plan (HSP). Also refer to the HSP for required traffic control, air monitoring, and emergency procedures.**

| Development Team | Position/Title | Reviewed By | Position/Title | Date |
|---|---|---|---|---|
| Berry, Thomas R. | Operations Manager | N. Scott MacLeod | Principal Geologist | |
| Barbara Jakub | Project Geologist | | | |
| Brian Busch | Project Scientist | | | |

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, permitting, access agreements, and notification to required contacts (e.g. site managers, inspectors, clients, subcontractors, etc.). A tailgate safety meeting must be performed and documented at the beginning of each workday. Self Performance Safety Analysis (SPSA) procedures must be used throughout the project. Weather conditions (heat, cold, rain, and lightning) must also be considered.

| ❶ Job Steps | ❷ Potential Hazard | ❸ Critical Actions |
|---|---|---|
| Order $H_2O_2$ delivered to site if concentration is above 7.5 % or volume is greater than 1000 lbs. | Accident during transportation could cause $H_2O_2$ release. | Follow DOT regulations for $H_2O_2$ transport. Get a copy of the regulations and have a copy with you. |
| Review hydrogen peroxide hazards | Reacts with anything organic, incompatible with iron, steel, brass, bases, acids, lime, ammonia. Can cause burns, ignite combustible organic material, and/or produce pressure bursts caused by contamination or lack of ventilation. | Verify water supply is onsite or bring with you. Ensure that no organic or incompatible chemicals are stored near $H_2O_2$. Ensure that no $H_2O_2$ gets onto skin or in eyes by wearing appropriate PPE. Do not drop anything in drums containing $H_2O_2$. Rinse with water thoroughly if spilled. |
| Pick up $H_2O_2$ and transport to site. | Accident during transportation could cause $H_2O_2$ release. $H_2O_2$ can cause burns, ignite combustible material and produce pressure bursts caused by contamination or inadequate ventilation. | Follow DOT regulations for $H_2O_2$ transport. If $H_2O_2$ concentration is over 7.5 % or greater than 1000 lbs., have it delivered to the site by a hazardous materials hauler. Ensure that the proper emergency response equipment is in your truck in case of spill. Ensure adequate water supply is onsite or that you bring it with you. Ensure that you have the proper MSDS. Ensure that containers are properly labeled, secured, and in proper shipping containers. |
| Mobilize with proper equipment/ safety supplies for testing. | Vehicle accident. Lifting hazards. Delay or improper performance of work due to improper equipment onsite. | Follow safe driving procedures. Employ safe lifting procedures. Make sure sub-contractors are aware of their responsibilities for labor, equipment and supplies. Review HSP and permit conditions and gather necessary PPE. |
| Set up necessary traffic control. | Struck by vehicle during placement. Vehicle accident as a result of improper traffic control equipment placement. | Use buddy system for placing traffic control. Face oncoming traffic when placing traffic control. Reference traffic control plan section of HSP (may include specific requirements based on permits). |
| Set up exclusion zone(s) including eyewash, safety shower and decon station, and workstation. | Struck by vehicle during set up. Slip/fall hazards, lifting hazard. | Implement exclusion zone set-up instructions of HSP. Set up workstation with clear walking paths to all testing locations. Face oncoming traffic. |
| Inspect injection wells for separate phase hydrocarbons (SPH) | SPH and $H_2O_2$ can react violently and create excessive heat or an explosion | Remove SPH if you need to inject into a well with SPH. Otherwise avoid placing $H_2O_2$ in well containing SPH. |

| | | |
|---|---|---|
| Unload $H_2O_2$ drum and set up equipment. | Struck by vehicle. Trip hazards. Accident when maneuvering equipment. Lifting hazard. Adverse impacts to station sales. Contamination of equipment may cause ignition of material. | Have water available before unloading. Place equipment away from pump islands or other high traffic areas. Protect drums with traffic control equipment (cones, barricades, etc). Provide as-needed hand signals and guidance to driver when placing dropping off large quantities of $H_2O_2$. Visually inspect equipment (fire extinguisher on board/available on site, no damaged hoses, all hoses and connections firmly connected and compatible with $H_2O_2$?). Use proper lifting techniques. Use dedicated equipment. |
| Gauge water levels and product thickness (where applicable). | Back strain. Inhalation or dermal exposure to chemical hazards. Repetitive motion. Traffic hazards. | Don necessary PPE and initiate air quality monitoring in accordance with the HSP. Maintain safe distance from well heads. Bend at knees, not waist. Decontaminate equipment between each measurement. Face oncoming traffic. |
| $H_2O_2$ injection | Burns to skin and eyes. Accelerating reaction with leather/metal can lead to explosion or fire. Unvented containers can build pressure and explode. Oxygen-enriched atmosphere. Spills, material reactions, trip hazards. Unauthorized release of contaminants. Exposure to contaminants (dermal contact). | Wear rubber gloves, rubber boots, coveralls, rain suit, and hard hat with eye shield (no leather!) in accordance with HSP. Use dilute concentration ($\leq$8% when possible). Store and transport $H_2O_2$ in approved and labeled containers in accordance with DOT regulations. Have source of water on hand. Rinse spills with copious amounts of water. Try not to spill material. Refer to $H_2O_2$-specific safety procedures for all work with $H_2O_2$. Do not use $H_2O_2$ unless you know and understand the hazards and safety procedures. Keep work area tidy and free of loose equipment. |
| Store waste (water, carbon canisters, etc.) in accordance with site-specific requirements. | Back strain. Traffic hazard. Improper storage or disposal. | Use proper equipment to transport waste containers (drum dollies, etc.). Have proper storage containment and labeling available onsite. Place materials in isolated location away from traffic and other site functions. Label waste. Coordinate proper disposal offsite (where applicable). Review instructions for use of onsite treatment systems. |
| Clean site/demobilize | Traffic hazard. Lifting hazards. Safety hazards left on site. Leaving $H_2O_2$ on surfaces to react. | Use buddy system as necessary to remove traffic control. Use proper lifting techniques. Leave site clean of refuse and debris. Notify station personnel of departure and location of any stored waste. Ensure that no $H_2O_2$ is has been spilled. If so rinse down any spills with copious amounts of water. |
| Transporting left-over $H_2O_2$. | Struck by vehicle. Trip hazards. Accident when maneuvering equipment. Lifting hazard. Adverse impacts to station sales. Contamination of equipment may cause ignition of material. | Follow DOT regulations for $H_2O_2$ transport. Ensure that you use all $H_2O_2$ so you don't have to transport or store material. |

# ATTACHMENT B

## A Citizen's Guide to Chemical Oxidation

United States
Environmental Protection
Agency

Office of Solid Waste and
Emergency Response
(5102G)

EPA 542-F-01-013
April 2001
www.epa.gov/superfund/sites
www.cluin.org

# A Citizen's Guide to Chemical Oxidation

## The Citizen's Guide Series

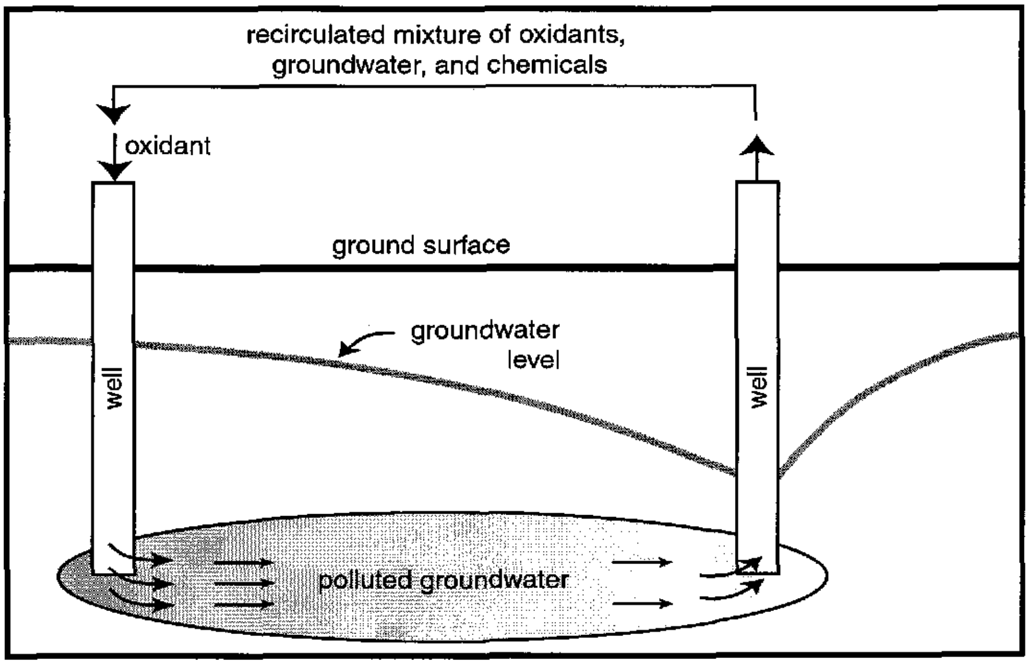
EPA uses many methods to clean up pollution at Superfund and other sites. Some, like chemical oxidation, are considered new or *innovative*. Such methods can be quicker and cheaper than more common methods. If you live, work, or go to school near a Superfund site, you may want to learn more about cleanup methods. Perhaps they are being used or are proposed for use at your site. How do they work? Are they safe? This Citizen's Guide is one in a series to help answer your questions.

### What is chemical oxidation?

Chemical oxidation uses chemicals called *oxidants* to destroy pollution in soil and groundwater. Oxidants help change harmful chemicals into harmless ones, like water and carbon dioxide. Chemical oxidation can destroy many types of chemicals like fuels, solvents, and pesticides.

### How does it work?

Chemical oxidation does not involve digging up polluted soil or groundwater. Instead, wells are drilled at different depths in the polluted area. The wells pump the oxidant into the ground. The oxidant mixes with the harmful chemicals and causes them to break down. When the process is complete, only water and other harmless chemicals are left behind.



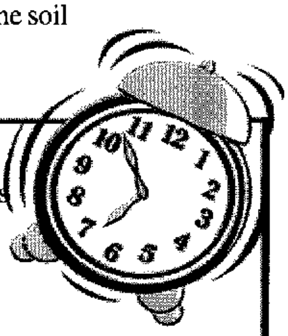
To clean up a site faster, oxidants can be pumped in one well and out another well. This approach helps mix the oxidant with the harmful chemicals in the groundwater and soil. After the mixture is pumped out, it is pumped back (*recirculated*) down the first well. As pumping and mixing continues, more polluted soil and groundwater are cleaned up.

It can be hard to pump oxidants to the right spots in the ground. So before drilling starts, EPA must study the conditions underground by testing the soil and groundwater. Where is the pollution? How will the oxidant spread through the soil and groundwater to reach it?

The most common oxidant to clean up pollution is *hydrogen peroxide*. Another is *potassium permanganate*, which is cheaper. Both oxidants are pumped as liquids. And both have advantages depending on the site. Ozone is another strong oxidant, but because it is a gas, it can be difficult to use.

At some sites, a *catalyst* is used with the oxidant. A catalyst is a chemical that increases the strength or speed of a process. For instance, if hydrogen peroxide is mixed with an iron catalyst, it produces a strong chemical called a *free radical*. Free radicals can destroy more harmful chemicals than hydrogen peroxide alone.

Chemical oxidation can create enough heat to boil water. The heat can cause the chemicals underground to *evaporate*, or change into gases. The gases rise through the soil to the ground surface where they are captured and cleaned up.



## How long will it take ?

The time it takes for chemical oxidation to clean up a site depends on several factors:

- size and depth of the polluted area
- type of soil and conditions present
- how groundwater flows through the soil (How fast? Along what path?)

In general, chemical oxidation offers rapid cleanup times compared to other methods. Cleanup times can be measured in months, rather than years.

## Is chemical oxidation safe?

Chemical oxidation can be quite safe to use, but there are potential hazards. Oxidants are *corrosive*, which means they can wear away certain materials and can burn the skin. People who work with oxidants must wear protective clothing. Some oxidants can explode if used under the wrong conditions. Explosions can be prevented, however, through proper design of the chemical oxidation system. EPA makes sure that the system is properly designed. Workers also test the soil, groundwater, and air after chemical oxidation to make sure the site is cleaned up.

## Why use chemical oxidation?

Chemical oxidation is being used at hundreds of sites across the country. It destroys pollution underground without having to dig it up or pump it out for transport to a treatment system. This saves time and money. Often chemical oxidation is used to clean up pollution that other methods can't reach, like pollution deep within the groundwater. Chemical oxidiation can be used to clean up the source of pollution. Most other methods that are used to remove the source are very slow and more expensive.

*NOTE: This fact sheet is intended solely as general guidance and information to the public. It is not intended, nor can it be relied upon, to create any rights enforceable by any party in litigation with the United States, or to endorse the use of products or services provided by specific vendors. The Agency also reserves the right to change this fact sheet at any time without public notice.*

### For more information

write the Technology Innovation Office at:

U.S. EPA (5102G)
1200 Pennsylvania Ave., NW
Washington, DC 20460

**or call them at** (703) 603-9910.

Further information also can be obtained at **www.cluin.org** or **www.epa.gov/superfund/sites**.