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Jerry Wickham
Alameda County Environmental Health Department
1131 Harbor Bay Parkway
Alameda, California

Interim Corrective Action Plan
Former Gas Station
2547 East 27th Street
Oakland, California (Property)

Dear Mr. Wickham:

Ceres Associates is pleased to provide this Interim Corrective Action Plan (CAP) for the above referenced Property on behalf of Ted Dang of Tomorrow Development. This plan was requested by the Alameda County Environmental Health Department in an October 2005 letter to Mr. Dang.

This plan is based upon data collected as a part of past assessments conducted by Kleinfelder and Ceres Associates between 2002 and 2006.

SITE CONCEPTUAL MODEL

Developments

The Property was formerly developed with a fuel and service station between 1927 and 1994. In 1994, one 100-gallon waste oil UST and four 500-gallon gasoline USTs were removed from the Property. After the tanks were removed, the excavation pits were lined with visqueen plastic and backfilled with the excavated material. It was reported that eight soil samples were collected from below the tanks and two were collected from the stockpiled soil (from the excavation).

The Property is currently undeveloped with a chain-link fence along the perimeter. Some concrete pieces, remnants of the former foundation, were observed on the Property.

The Property is located amongst single and multiple family residences.

Soil

The soils on the Property consist of generally sandy gravel fill from the surface to four (4) feet below ground surface (bgs). From four (4) to twelve (12) feet bgs the soil appears to be fat and lean silty clays. Below twelve (12) feet the soil is generally gravel and sand with some clay. Off-site soils are generally consistent with on-site soils *(refer to Appendix - Soil Logs)*.

Groundwater

Groundwater has been encountered on the Property between approximately three and fourteen (14) feet bgs. Once encountered, groundwater appears to rise to within approximately three to five feet of the ground surface. The variable groundwater elevations across the Property suggest the possibility of a perched groundwater lense.

Groundwater flow appears to be predominantly to the east. Groundwater flow gradient will be reported once the monitoring well elevations have been surveyed.

Contamination

Soil and groundwater contamination at the Property appears to have originated from historic uses of underground storage tanks for the purposes of storing motor vehicle fuel and waste oil. Underground storage tanks were present on the Property between at least 1927 and 2002. Resulting contamination appears to have migrated from the soil to the groundwater on the Property. Based upon the results of this sampling event, it is apparent that contamination has migrated off-site as well, impacting groundwater from soil borings located more than 100 feet down-gradient of the Property.

Although initial sampling events by Kleinfelder indicated that soil, not groundwater, was predominantly impacted with petroleum hydrocarbons, subsequent sampling by Ceres Associates has revealed the opposite, that groundwater is more impacted than sampled soils:

Historic Soil and Groundwater Sampling at the Property:
Kleinfelder conducted soil and groundwater sampling activities at the Property on June 19 and July 10, 2002. Kleinfelder supervised the advance of three soil borings ranging in depth from 11 to 19 feet below ground surface (bgs). Kleinfelder reportedly advanced each boring until approximately two feet below groundwater. According to the report issued by Kleinfelder, dated August 2, 2002:

> "TPH-g was detected in the soil samples extracted from borings EB-1 and EB-2 at concentrations of 1,200 mg/kg and 1,800 mg/kg, respectively. TPH-d was detected in these samples, from borings EB-1 and EB-2, at concentrations of 650 mg/kg and 1,500 mg/kg, respectively. TPH-mo was detected in concentrations above laboratory reporting limits only in the sample from boring EB-1 at 14 mg/kg. Further, the laboratory described the detected TPH-g as strongly aged gasoline, and the TPH-d was described as Stoddard solvent."

Total lead was reported as high as 24 ppm in the soil samples collected from the Property.

Groundwater samples were reported to contain concentrations of TPH-g as high as 82 micrograms per liter (µg/l) or parts per billion (ppb); TPH-d as high as 360 ppb; motor oil as high as 540 ppb; benzene as high as 0.97 ppb; and toluene and xylenes as high as 1.3 ppb. Ethylbenzene and MTBE were not reported above their laboratory reporting limits.

On-site Contamination
Ceres Associates collected soil and groundwater samples from the Property on January 7, 2005.

Reported concentrations of soil samples from the Property itself do not exceed regulatory criteria for further action based on Residential Environmental Screening Levels (ESLs) established by the State of California Regional Water Quality Control Board (RWQCB) or Residential Preliminary Remediation Goals (PRGs) established by the United States Environmental Protection Agency, Region IX (US EPA).

Target analytes were reported above method reporting limits in all but one groundwater sample collected from the Property. Generally, samples collected after retrieving soil samples (using the continuous sampling macro-core device) were reported as containing higher concentrations of target analytes than from those samples collected using the hydro-punch device.

Concentrations of target analytes were reported by the laboratory as high as 90,000 micrograms per liter (µg/l) or parts per billion (ppb) for TPH-g; 750,000 ppb for TPH-d; 140 ppb for benzene; 1.5 ppb for toluene; 77 ppb for ethylbenzene; and 20 ppb for xylenes. Methyl tert butyl ether (MTBE) was not reported above the method reporting limits for any sample.

Concentrations of benzene far exceed the regulatory limit of 1.0 ppb as defined by the State of California Department of Health Services (CDHS) Maximum Contaminant Level (MCL). MCLs are not defined for petroleum hydrocarbons including gasoline and diesel. However, the RWQCB has established an ESL for TPH-g and TPH-d of 100 ppb. The ESL is designed to protect groundwater resources in the area.

Off-site Contamination
Ceres Associates collected on and off-site soil and groundwater sampling on February 16 and 17, 2006.

Laboratory results indicated that soil samples fell below the Residential ESL of 100 ppm for TPH-g and TPH-d in all but two samples: SB12-14 at 250 ppm of TPH-g and SB21-12 at 490 ppm of TPH-d.

Although concentrations of other target analytes were reported in many samples above the laboratory detection limits, the concentrations were reported below their respective ESLs or the Residential Preliminary Remediation Goals (PRGs).

Groundwater sampling results suggest that on-site contamination has migrated off-site, east of the

Property, in almost all sample points advanced by Ceres Associates.

Concentrations of TPH-g were reported as high as 1,500 parts per billion (ppb), but more generally between ND and 74 ppb. The highest concentration of TPH-g was reported in SB21, on the Property. Additional samples with concentration of TPH-g above ND include SB14, east of the Property; and, SB19, south of the Property. However, points between these sample locations were not reported above ND. It is unclear whether and how on-site TPH-g contamination has affected these off-site borings. Preferential pathways, including utility lines, soil-soil contact, or groundwater flow don't appear consistent with anticipated contamination migration. Even though a clear spatial disbursement of TPH-g is not clear, it is clear that on-site contamination of TPH-g remains above the ESL and that off-site contamination falls below the TPH-g ESL.

Concentrations of TPH-d were reported between ND and 3,600 ppb. The highest concentrations of TPH-d were reported off-site: SB22 at 3,600 ppb, immediately south of the Property and SB13 at 1,300 ppb, east of the Property. On-site contamination was reported as high as 910 ppb of TPH-d at SB21, located along the southern boundary of the Property. Samples further south and east of SB21 were also reported above ND at concentrations exceeding the ESL. In fact, approximately 2/3 of all samples were reported above the ESL for concentrations of TPH-d.

Concentrations of residual oils TPH-ro (motor oil and hydraulic oil) coincided with increased concentrations of TPH-d. Concentrations of these target analytes were, on average, higher than those concentrations reported for TPH-g or TPH-d, with a high value of 28,000 ppb of TPH-ro in SB22.

Overall, it is apparent that on-site contamination of petroleum hydrocarbons in groundwater has migrated off-site, down-gradient of the Property, in a generally easterly direction. Concentrations of petroleum hydrocarbons were reported above the ESL in groundwater samples collected as much as 100 feet down-gradient of the Property.

The relatively high concentrations of petroleum hydrocarbons was not accompanied by higher concentrations of BTEX compounds or fuel oxygenates. In fact, fuel oxygenates EDB and 1,2-DCA were reported as ND for all samples submitted to the laboratory. Concentrations of BTEX compounds fell below the Maximum Contaminant Levels (MCLs).

Generally

Contamination on the Property was historically attributable to soil contamination by petroleum hydrocarbons and associated BTEX compounds. Groundwater contamination was limited. However, during the January 2005 and January 2006 sampling events, petroleum hydrocarbon and BTEX compounds were identified above regulatory action limits in the groundwater, but generally not in the soil. This is true of both on and off-site sample points.

The Property lacks an impermeable surface layer, and given the rate of precipitation for Oakland (approximately 24.30 inches per year according to the National Oceanic and Atmospheric Administration) the rate of infiltration of contaminants from the soil to the groundwater has likely

increased since the removal of the asphalt surface during demolition.

The potential migration of target analyte contaminants to deeper aquifer layers is not yet known; however, based upon the general soil profiles of sites in the City of Oakland and at the Property, it is anticipated that clay layers of varying thickness, located throughout the soil horizon, will help retard the vertical flow of contaminants.

RISK ASSESSMENT

Contamination migration is anticipated to proceed through various media including soil, outdoor air, indoor air, and groundwater *(refer to Site Conceptual Model)*.

Primary sources of contamination identified on the Property include historic product storage and associated piping and operations of the former gasoline service station. These primary sources have impacted soil and groundwater as evidenced by the laboratory results laid out above. However, soil contamination appears minimal and limited.

Direct Exposure

Identified environmental concerns to human health include direct exposure to soil, outdoor air, and groundwater.

Soil and Outdoor Air
Risks associated with direct exposure to contaminated soil on the Property appear low because of the low concentrations of target analytes reported in the surface soils and because of the anticipated future development of the Property.

Risks associated with volatilization and wind erosion of soil contaminants also appear minimal because the Property is anticipated to be redeveloped with residential unit(s). Development of structures on the Property as well as the installation of impervious surfaces across the Property would reduce or almost eliminate the potential for contaminants in surface soils to be released to the outdoor air.

The California Environmental Protection Agency has issued Human Health Screening Levels (CHHSLs) for contaminants of concern in California. However, CHHSLs have not been promulgated for volatile organic compounds (VOCs). According to the agency, direct-exposure models such as those used by USEPA Region IX do not take into account the total amount (mass) of a volatile chemical that might be present at a site (refer to Appendix 2). This is important, since the direct-exposure models assume a continuous off-gassing of vapors throughout a 30-year exposure period. In addition, the models assume exposure both via inhalation of vapors emitted to outdoor air and via incidental ingestion of volatile chemicals in soil. These assumptions may be overly conservative for highly volatile chemicals that are not expected to remain at significant concentrations in the soil over time following off-gassing to the outdoor air.

The US EPA Region IX has issued preliminary remediation goals for VOCs, including benzene at 0.64 ppm, 520 ppm for toluene, 400 ppm for ethylbenzene and 270 ppm for xylenes.

PRGs or CHHSLs have not been established for petroleum hydrocarbons.

On-site soil contamination, based upon laboratory results from samples collected from approximately 5 feet below ground surface, were reported as high as 32 ppm of TPH-g, 52 ppm of TPH-d, 0.024 ppm of benzene, 0.017 ppm of ethylbenzene, and 0.013 ppm of xylenes. On-site concentrations of benzene, ethylbenzene, and xylenes fall well below their respective Residential PRG values.

Utilizing these VOC concentrations as an indicator of potential human health effects from direct exposure to contaminants in the soil, it appears that there is a low risk of such adverse effects.

Risks associated with potential direct exposure to contaminated soil can be reduced by redevelopment of the Property with impervious surfaces or other surfaces which inhibit the migration of contaminated soil into the outdoor air.

Groundwater

Direct exposure to groundwater is not anticipated, except where Ceres Associates personnel come into contact with groundwater during sampling activities. Currently there are no active tenants at the Property; however, if redeveloped with residential unit(s), such occupants may have the opportunity to come into direct contact with groundwater through monitoring well and/or remediation equipment. This risk is low because groundwater monitoring wells are locked and remediation equipment will be secured.

Vapor Intrusion

Vapor intrusion from contaminated soil and groundwater to the surface (and into anticipated new development) presents a risk of adverse human health effects.

Soil vapor analyses have not yet been conducted on the Property; however, given the relatively high concentrations of BTEX compounds in the groundwater beneath the Property and the relatively shallow nature of groundwater (between three and five feet below ground surface) at the Property there is a possibility the subsurface contaminants (including soil and groundwater contaminants) will migrate vertically into proposed future developments.

A soil vapor survey should be conducted on the Property to assess for the potential of vapor intrusion and/or volatilization from subsurface areas of contamination to the surface.

Vapor intrusion can be limited by development practices including the use of vapor barriers during construction of new buildings.

Leaching/Groundwater Impacts

Although soil contamination appears to be minimal, groundwater contamination is significant.

As risk criteria, Ceres Associates looked to the Maximum Contaminant Levels (MCLs) for specific target analytes because generally the RWQCB considers all sources of shallow groundwater a potential source of recharge to lower aquifers.

The MCLs for target compounds are: 1.0 ppb for benzene, 150 ppb for toluene, 300 ppb for ethylbenzene, and 1,750 ppb for xylenes. BTEX compounds are being considered as an indicator for the risk of petroleum hydrocarbons to human health.

Concentrations of BTEX compounds on the Property were reported as high as 140 ppb of benzene, 1.5 ppb of toluene, 77 ppb of ethylbenzene, and 20 ppb of xylenes. Concentrations of benzene far exceed the established MCL, but other target compounds fall below their respective MCL.

Relatively elevated concentrations of benzene pose increased health risks to consumers of affected groundwater. Groundwater which was identified as being affected is located between three and five feet below ground surface. Groundwater used for human consumption is taken from much great depths than the near surface groundwater of the Property. It is not anticipated that on-site contamination will adversely impact drinking water wells.

Concentrations of BTEX compounds off-site were reported as high as 1.4 ppb of toluene and 1.7 ppb of xylenes. These off-site concentrations fall well below the established MCLs for respective target compounds. As such, contamination which has migrated off-site is not anticipated to adversely impact human health.

Given the relatively high concentrations of benzene and petroleum hydrocarbons and the relatively small area of impact, removal of these compounds should be attempted to reduce the likelihood of off-site migration.

DISCUSSION

The risk assessment identifies principally two sources of potential concern: vapor intrusion into future buildings on the Property, and groundwater contamination migration.

Although currently vapor intrusion is not anticipated to be a significant health risk, site specific data regarding soil vapor concentrations have not yet been ascertained. A vapor survey should be conducted to confirm that subsurface contaminants have not migrated vertically and are not likely to contribute to vapor intrusion once buildings have been constructed on the Property. Further, during construction of future buildings, vapor barriers should be installed between the soil and the building to reduce the

potential for vapor intrusion of target analytes.

Groundwater contamination on the Property appears to be primarily composed of petroleum hyrdrocarbons and benzene. Benzene concentrations on the Property exceed MCLs. Utilizing the indicator method of assessing the risk of petroleum hydrocarbons via benzene concentrations, petroleum hydrocarbon concentrations exceed acceptable risk levels (presuming that MCLs provide for acceptable risk levels).

Although benzene appears to be confined to the groundwater beneath the Property, petroleum hydrocarbons have migrated laterally at least 100 feet off-site. A groundwater pump and treat system should be pilot tested utilizing on-site well EX-1. Prior to this system is pilot tested, soil vapor sampling may be conducted.

REMEDIAL ACTIVITIES RECOMMENDED

Extensive off-site benzene contamination was not observed by Ceres Associates during the most recent sampling event. Historic concentrations of benzene on the Property coupled with high concentrations of petroleum hydrocarbons need to be reduced. Using benzene as a risk indicator, benzene concentrations on the Property should be reduced to below 1.0 ppb.

Ceres Associates recommends utilizing a portable groundwater pump and treat system as a pilot test and interim remedial action. The following table outlines the parameters of the test:

Category	Test Parameter
Duration of Test	72 hours
Pump/Extraction System	Groundwater will be pumped, using a mobile pump and treat system placed on-site, from well directly into Baker Tank, pending analysis for disposal purposes
Pump Rate	Variable, dependant upon well capabilities
Well(s) Used	EX-1
Disposal of generated groundwater	On-site Baker Tank (1,000 gallons)
Groundwater Sampling	Effluent will be monitored every two (2) hours and a sample collected for laboratory analysis of target analytes
Laboratory Analyses	US EPA 8015/8020: TPH-g, TPH-d, and BTEX
Groundwater Elevations	Monitor MW-1, MW-3, and MW-5 hourly

In addition to removing elevated concentrations of benzene and petroleum hydrocarbons, the effectiveness of this removal method can be tested including the stress level on the aquifer, recovery rates, and horizontal effectiveness regarding contamination retrieval.

Soil vapor sampling should be conducted prior to initiation of the groundwater pump and treat pilot test:

Category	Sampling Parameter
Number of Samples	10
Location of Samples	Located across the Property (relatively even spacing)
Timing of Collection	Samples should be obtained prior to the initiation of the groundwater pump and treat system
Sample Collection	Ceres Associates will withdraw of an aliquot of soil vapor from the subsurface, utilizing with a sampling probe (direct push), followed by analysis of the withdrawn vapor. Soil vapor samples will be stored in gas-tight containers and analyzed at an off-site laboratory.
Laboratory Analyses	BTEX

After the 72-hour test, additional soil and groundwater samples should be obtained including:

Category	Sampling Parameter
Soil Samples	Utilizing a direct push rig, Ceres Associates proposes to advance a total of eight (8) soil borings on the Property in the vicinity of EX-1. Soil samples will be obtained from two feet (2) below ground surface and at the capillary fringe from each boring. Additionally, utilizing a dual-walled macro-core direct push rig, Ceres Associates will advance two of the above eight borings for lithology purposes from between 20 feet and 40 feet. Two soil samples, one from 25 feet and one from 40 feet will be submitted for laboratory analysis. If other, suspect samples are encountered, they too will be submitted for laboratory analysis.

Groundwater Samples	One groundwater sample from each of the eight (8) soil borings will be obtained. Additionally, during the 20-40 foot sampling interval, if a discrete groundwater bearing zone is encountered, groundwater from that zone will be collected and submitted for laboratory analysis.
Laboratory Analyses	US EPA 8015/8020: TPH-g, TPH-d, and BTEX

If the results of the subsequent sampling indicate that benzene concentrations on and off the Property are below the MCL, further remedial activities would not be warranted, and closure of the site should be granted:

Contaminant of Concern	Target Goal Concentration
Benzene (groundwater)	1.0 ppb

However, if results of the subsequent sampling indicate that benzene concentrations on and off the Property are significantly above the MCL, further remedial activities will be necessary. Such activities will be reviewed and recommendations made at the close of the pilot test.

If you have questions regarding this project please contact Ryan Meyer at (916) 485-2110 or via email at ryanmeyer@ceresassociates.com.

Sincerely,

Ryan Meyer
Project Manager

Ken Durand, RG CHG
Senior Project Manager