From:	Dilan Roe
To:	Lisa.Babcock@waterboards.ca.gov
Cc:	Roe, Dilan, Env. Health; Drogos, Donna, Env. Health
Subject:	Re: Conference call on 5yr reviews & 5 -Year Review Response - California Linen (RO0000337; Claim 3000; Global ID T0600100249)
Date:	Tuesday, August 28, 2012 5:20:57 PM
Attachments:	Att1_LTCP_Evaluation.pdf Table_1_Monitoring Well Network.pdf Table_2_-_LNAPL_Thickness.pdf Table_3_GW Flw Direction.pdf Table_4_-_Submerged_Dry_Well_Stats.pdf

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Hi Lisa:

Donna asked me to forward our resonse to you regarding 5502 (RO403).

We have reviewed the USTCF Second 5-Year Review Summary Report in conjunction with the Case Closure Summary Report dated November 30, 2011, prepared by ARCADIS on behalf of British Petroleum, and the case files contained in the ACEH FTP site and SWRCB Geotracker databases. Oour review also included an evaluation of the appropriateness of the recommendations for closure using the framework provided in the recently adopted State Water Resource Control Board's (SWRCB) Low Threat UST Case Closure Policy.

The attached file labled Att1_LTCP_Evaluation contains our evaluation of the site using the Low Threat Clsoure Policy Criteria. Tables 1 through 4 are referenced in the evalaution. The evaluation also references other exhibits that I will forward to you tomorrow with our formal submittal of our evaluation.

As Donna mentioned in her previous email. we do not agree with closure for this site & the consultant's 'Closure Report' contains numerous omissions, missing data and other inaccuracies. At face value the recent monitoring data appears to qualify the site for closure under the low threat closure policy. However, upon completing a thorough review of the case files, we request that British Petroleum provide a site conceptual model to support the validity of the data, assumptions, and conclusions and recommendations presented in the Case Closure Summary Report. Our main concerns includes the proximity of residential homes, apartment buildings, and a school to the site, data validity and sample biases due to a submerged monitoirng well network, lack of a preferential pathway study to assess contaminant migration in subsurface utility trenches present beneath and adjacent to the site, free product status, adequacy of vapor intrusion risk assessment, plume delineation and stability, and groundwater flow direction variablity.

I look forward to taking to you about the details of this case.

Regards,

Dilan Roe, P.E.
Hazardous Materials Specialist
Alameda County Environmental Health
Local Oversight Program

> **From:** Drogos, Donna, Env. Health
> **Sent:** Tuesday, August 28, 2012 12:12 PM
> **To:** 'Babcock, Lisa@Waterboards'; Detterman, Mark, Env. Health
> **Cc:** Russell, John@Waterboards; Trommer, Bob@Waterboards; Cullen, Pat@Waterboards
> **Subject:** RE: Conference call on 5yr reviews & 5 -Year Review Response - California Linen

Attachment 1

Alameda County Environmental Health Local Oversight Program

Case No. RO000403 Review Using the Low Treat Closure Policy Criteria

General Criteria a: The unauthorized release is located within the service area of a public water system.

The policy is limited to areas with available public water systems to reduce the likelihood that new wells in developing areas will be inadvertently impacted by residual petroleum in groundwater.

Although the site is located within the service area of East Bay Municipal Utility District, a well search conducted in October 2004 located 11 domestic wells, seven irrigation wells, and one industrial well within a one-mile radius of the site. Although no wells were identified within a 2,000 foot radius of the site, the complexity of the hydrogeology at the site (see and the possible influence of pumping of wells with respect to apparent changes in groundwater flow direction have not been addressed. A current Department of Water well search should be conducted, including a backyard survey of wells in the area to rule out the possibility of impacts to or influence of nearby wells.

General Criteria b: The unauthorized release consists only of petroleum.

The unauthorized release consists of petroleum hydrocarbons originating from gasoline underground storage tanks.

General Criteria c: The unauthorized ("primary") release from the UST system has been stopped.

Three gasoline USTs were removed and replaced in 1987. In 1998, the UST system including tanks, pipes, and dispensers were removed permanently removed from the site.

General Criteria d: Free product has been removed to the maximum extent practicable.

Free product has been historically detected in wells MW-1 and RW-1 at maximum thicknesses exceeding 3 feet in MW-1 and 1.6 feet in RW-1. Although free product has been removed by several techniques including passive floating product removal systems in RW-1, bailing in RW-1 and MW-1, and operation of a soil extraction system and groundwater extraction and treatment system, it is not clear from the data presented in the case files whether free product remains at the site or whether it has been removed to the maximum extent practicable.

ACEH is concerned about misrepresentation of data by BP, ARCADIS, and Broadbent and Associates, lack of evaluation of data contained in historical reports, and the validity of conclusions presented about free product in the November 30, 2011 Case Closure Summary Report prepared by ARCADIS on behalf of British Petroleum and the October 4, 2011 Second Five Year Review Report prepared by the Underground Storage Tank Cleanup (USTCF) staff. Our concerns include the following:

- Submerged Wells. All of the site wells (see Table 1), with the exception of vapor extraction wells VEW-6 and VEW-7 have been submerged during 6% to 80% of monitoring events conducted at the site, thereby making data about free product in the wells suspect. Although ARCADIS presents hydrographs for select site wells in the Case Closure Summary Report (see Exhibit 1) which show the submerged wells, no evaluation or discussion regarding the submerged wells and the effect on data quality has been conducted or even mentioned.

- Preferential Pathways. The depth to water in vapor extraction wells VW-2 and VW-3 has ranged between 0.25 to 6.06 feet below ground surface (bgs) during all monitoring events in which water levels were measured (i.e., from 2008 to 2011). These wells are adjacent to a sanitary sewer line that runs beneath the site at approximately the same depths and are within the estimated limits of free product and capillary fringe residual hydrocarbons prepared by RESNA and presented in the Remedial Action Plan for the site (see Exhibit 1 - Plate 7). Although this sanitary sewer line was identified in a utility survey conducted in 2005, there is no evaluation of it acting as a preferential pathway in the case files.

- Data Falsification/Omission. Light aqueous phase liquid (LNAPL) thicknesses are falsely reported as 0.00 feet or omitted (i.e., reported as not analyzed, applicable, measure, or available) in groundwater monitoring reports prepared by Broadbent and Associates on behalf of ARCADIS (see Table 2). Free product data was also omitted from summary tables contained in reports prepared by other consultants (i.e., free product observed in well RW-1 at a thickness of 1.6 feet subsequent to the shutdown of the groundwater extraction and treatment [GWET] system and soil vapor extraction [SVE] system in 1998 was reported in the 2nd quarter 1999 groundwater monitoring report, however reference to the measurement was omitted from subsequent monitoring reports).

- Product Removal Data. Free product was removed from wells MW-1 and RW-1 from 1993 until 2001 (see Table 2). Product removal data often conflicts with reported LNAPL product thickness data (e.g., LNAPL thickness reported as zero in summary tables are made without reference to product removal occurring immediately prior to well monitoring).

- Sheen. ARCADIS states that 0.70 gallons of free product were removed from well MW-1 between 1993 and 1996, and measureable free product has not been observed at this well since 1998; and approximately 161 gallons of free product were removed from well RW-1 between 1993 and 2001, and measurable free product has not been observed at this well since 2001. However, data regarding observations of sheen and gasoline odors documented in field notes is not presented nor discussed in reports.

- Corrective Action Effectiveness. No evaluation has been presented regarding the success or infeasibility of corrective actions implemented at the site, including presentation of valid long-term monitoring data to demonstrate that concentrations have not rebounded following the cessation of corrective action. For example, although the GWET and SVE systems were reportedly successful at removing approximately 13,495 pounds of total petroleum hydrocarbons as gasoline (TPH-g) vapors and 345 pounds of dissolved TPH-g from groundwater, no assessment was found in the case files regarding the subsequent observation of 1.6 feet of free product in recovery well RW-1 two months after the system was shutdown. Therefore, it is not clear whether corrective actions implemented at the site removed free product to the maximum extent possible or resulted in abatement of free product migration.

General Criteria e: A conceptual site model that assesses the nature, extent, and mobility of the release has been developed.

In the Case Closure Summary Report, ARCADIS contends that case closure is warranted for the site based on the following:

- The site has been adequately characterized through regular groundwater monitoring and various soil and/or soil vapor sampling events.

- Petroleum hydrocarbon sources and residual hydrocarbons in site soil have been removed as evidenced by the most recent site analytical data, and the absence of high concentrations of constituents of concern (COCs) observed in soil and groundwater suggests that residual hydrocarbons in soil have been removed via previous remedial activities and through natural attenuation. COCs in site soil were either non-detect or detected at very low concentrations below their respective ESLs, with the exception of methyl tertiary butyl ether (MTBE) which was detected slightly above the applicable environmental screening levels (ESLs).

- COCs in site groundwater have exhibited decreasing trends and this trend is expected to continue. Review of historical groundwater data indicates that concentrations of these analytes have declined and this trend is expected to continue.

- Active remediation was conducted at the site between 1994 and 1998.

- The plume is not migrating offsite as evidence by the non-detect or low detected COC concentrations in downgradient monitoring wells.

- No sensitive receptors are likely to be impacted, including surface water bodies, municipal wells, and drinking water sources.

- The site presents no significant risk to human health and the environment.

- Groundwater collected during the third quarter 2011 sampling event generally indicate that COCs in site wells are either non-detect or detected at concentrations below their respective ESLs. Exceptions included low levels of TPH-g in MW-1, AW-1, and RW-1; benzene in AW-1 and AW-4; MTBE in AW-1 and AW-6; and ethylbenzene and tert butyl alcohol (TBA) in AW-1.

Based on our review of the case files, these assertions are not supported by a conceptual site model (CSM). Although components of a CSM have been presented in pieces in historical reports, significant data gaps exist and include an accurate geologic and hydrogeologic assessment, identified stratigraphic and manmade migration pathways, delineation of the lateral and vertical extent of contamination in all affected media, an adequate assessment of vapor intrusion pathways, an evaluation of the effectiveness of corrective actions implemented at the site, and an evaluation of whether any site contamination is present in locations that have the potential to pose nuisance conditions during common or reasonably expected activities. A summary of identified data gaps is presented below and in subsequent General and Media Specific Criteria sections.

- Plume Delineation and Stability. The horizontal and vertical extent of the plume has not been adequately defined. ARCADIS presents plots of decreasing concentrations using data from a single well to demonstrate plume stability, however this analysis is not sufficient. Plume stability must be demonstrated using a valid technical analysis that considers the following factors that can affect data quality.

- Well Placement within the Plume. ACEH has concerns regarding the effectiveness of the remediation and monitoring well network at the site. A total of 26 wells have been installed in the vicinity of the site, including 12 groundwater monitoring wells (MW-1 through MW-3, and AW-1 through AW-9), one groundwater extraction well (RW-1), nine vapor extraction wells (VM-1 through VM-3, and VEW-4 through VEW-9), three pilot study injection wells (IW-1 through IW-3), and one pilot study observation well (OW-1). Details of the well locations and construction are provided in Figure 4 and Table 1. Although a similar table is provided in Section IB in the USTCF's Second Five Year Review Summary Report, the table contains errors and omits information pertinent to the evaluation of effectiveness of the remediation wells, and the well network to provide reliable measurements of chemical parameters and hydraulic head at each monitoring point (i.e., well type, installation date, screen interval and length, and type of geologic formations the wells are screened across). No such table is presented in Case Closure Summary report prepared by ARCADIS.

- Submerged Groundwater Monitoring Wells. Historical depth to water measurements in the sites 13 groundwater monitoring wells indicate that the wells have been under submerged conditions from 6 percent to 80 percent of monitoring events conducted (see Table 4). Six of the wells, including three on-site wells (MW-2, AW-5, and AW-6), and three off-site wells (AW-2, AW-7, and AW-8), have been submerged during more than 50 percent of monitoring events.

- Groundwater Flow Directions. Depth to groundwater in the on-site monitoring wells has historically varied by up to 14 feet within a short distance during a single monitoring event. In the Case Closure Summary Report, ARCADIS states that the groundwater flow direction has been highly variable, but is predominantly from the east to the west and provides a summary of historical groundwater flow directions and gradients. However, as seen on Table 3, ARCADIS presents groundwater flow directions and gradient data for 2006 through 2011, and omits from 1989 to 2006 that is pertinent to understanding contaminant transport at the site. The missing

data, included by ACEH in Table 4, shows that groundwater at the site has been characterized as westerly, easterly, northeasterly, southerly, southeasterly, southwesterly, radially inwards towards the site, and radially outward from the site. Select groundwater contour maps, included in Exhibit 1, demonstrate the widely variable interpretation of hydraulic head from water level measurements and the resultant conclusions about site hydrogeology and groundwater flow directions. Contour lines are interpretive based on water levels in select monitoring wells. Reported reasons for not using data from all monitoring wells include "anomalous" water levels, use of off-site wells only due to the complex hydrogeology beneath the site, free product in wells, well inaccessibility due to parked cars, and the inability to locate well AW-7. Based on our review of the data, ACEH is concerned that the site hydrogeology and potential anthropogenic influences in hydraulic conditions (e.g., leaking sewer/storm drain/water lines, groundwater pumping from nearby water supply and remediation wells) has not been adequately characterized.

- Groundwater Levels. Groundwater elevations at the site have exhibited an increasing trend since monitoring began in the late 1980's. Water level measurements in select site wells have been consistently and inappropriately labeled as "anomalous" data. Rather than investigating hypothesis for the rising trends over time and large deltas seen in water level measurements across the site during the same monitoring event, the site has been largely characterized as having "complex hydrogeology". Our review of the case files reveals two conflicting hypothesis:

  - The first hypothesis surmises that there are two separated, shallow water-bearing zones underlying the site, based on the relatively high water levels observed in MW-1 through MW-3 as compared to the lower levels observed in the other wells (a delta of ranging from 7 to 14 feet across a short distance).

  - The second hypothesis, presented in the Remedial Action Plan prepared in 1993, surmises that shallow groundwater underlying the site to the depth explored occurs in one hydraulically connected water-table aquifer, and that the apparently "anomalous" water levels observed by previous consultants in wells MW-1 through MW-3 are the result of external circumstances unrelated to natural hydrogeologic conditions (e.g., leakage from a water line or sewer along Bancroft Avenue, or perching of groundwater in the tank cavity).

  Based on our review of water level measurements, site maps showing the locations of underground utilities, and boring and monitoring well logs, each of these hypothesis are plausible, have not been validated, and warrant further investigation.

- Sample Biases and Cross Contamination. ACEH has concerns related to potential sample biases due to the construction of the wells and subsurface conditions at the well location. These concerns are include:

  - Long-Screen Monitoring Wells. All of the wells at the site can be classified as conventional single interval long-screened monitoring wells screened across multiple geologic formations (see Table 1). Water samples collected from these types of monitoring wells are actually blended or composite samples of groundwater within the vertical interval of the aquifer screened by the wells. If the dissolved contaminants are stratified within the aquifer, compositing in long screen wells during sampling results in underestimation of the maximum concentrations present in the aquifer. By using results obtained from composite samples, the risk to the downgradient receptors may be underestimated, including the risk posed to vapor receptors.

  - Partially Penetrating Wells. Wells that partially penetrate the aquifer, introduce an

additional bias due to ground water (either clean or contaminated) flowing into the well from above or below the well screens.

- Local Vertical Flow Systems. Installation of a monitoring well may set up a local vertical flow system because of the natural vertical gradient at the well location. The well can act as a "short circuit" along this gradient, with the resulting flow in the wellbore often of significant magnitude to compromise the integrity of any samples collected from the well. Therefore samples could yield biased and misleading data concerning solute concentration, source location, and plume geometry.

- Groundwater Recharge. Groundwater recharge at a site could create a layer of clean water atop a deeper dissolved contaminant plume. The layer of clean water may constitute an effective diffusion barrier that impedes the upward migration of volatile contaminants from the dissolved plume.

- Cross Contamination. Borehole flow and transport of contaminants in long-screen wells may contaminate parts of the aquifer that would not otherwise become contaminated in the absence of a long-screen well.

- Remediation System Design. The GWET and SVE system operated intermittently from 1994 until 1998. The system was initially connected to eight vapor extraction wells (VEW-1 through VEW-8) and one groundwater extraction well (RW-1). Although no boring logs or details of the monitoring well construction for the SVE wells were found in the case files, the total depths and screen intervals of the wells are inferred to be 20 feet bgs, and 5 to 20 feet bgs, respectively, based on the work plan for well installation. Off-site well VEW-9 was installed and connected to the SVE and GWET system in April 1996. This well is screened from 6 to 20 feet bgs. Water level measurements taken in 2008 through 2011 indicate that many of these well are submerged. Although the SVE and GWET systems were reportedly successful at removing approximately 13,495 pounds of TPH-g vapors and 345 pounds of dissolved TPH-g from groundwater, no assessment was found in the case files regarding the impacts of the submerged wells on the effectiveness of the SVE system or the subsequent observation of 1.6 feet of free product in recovery well RW-1 two months after the system was shutdown. Effective remediation systems can be designed only if the concentration and distribution of the contaminants are accurately defined.

- Preferential Pathway Study. ACEH is concerned given the uncertainty in the hydrogeology at the site and rising groundwater elevation trends, that the subsurface utilities have not been adequately investigated as discussed below:

  - During a preferential pathway study conducted in July 2005, URS measured depth to water and collected groundwater samples, if available, from three soil vapor extraction wells (VEW-4, VEW-5, and VEW-8) located in the vicinity of the sanitary sewer line (running beneath the north and northwestern section of the site at approximately 6.5 to 7 feet bgs) to assess the potential for the sewer line to act as a preferential pathway for contaminant migration. At the time of measurement in July 2005, the depth to water in wells VEW-4, VEW-5, and VEW-8 was 14.04 feet, greater than 20 feet bgs, and 16.10 feet bgs, respectively. Analytical results from groundwater samples collected from wells with water (VEW-4 and VEW) reported concentrations of total petroleum hydrocarbons as gasoline (TPHg) and benzene, toluene, ethylbenzene, and xylenes (BTEX) in well VEW-4 at concentrations of 680 micrograms per liter (ug/L), 41 ug/L, 24 ug/L, 20 ug/L, and 67 ug/L, respectively. No analytes were detected above laboratory reporting limits in well VEW-8. Based on this data it

was concluded that the sewer line in the north and northwestern section of the site did not act as a preferential pathway for contaminant migration.

- Although other underground utilities were identified beneath and adjacent to the site, no investigation activities were conducted in their vicinity to evaluate the potential for the utility trenches to serves as preferential pathways for contaminant migration. As previously discussed, our review of the case files indicates the depth to water in vapor extraction wells VW-2 and VW-3 has ranged between 0.25 to 6.06 feet bgs during all monitoring events in which water levels were measured (i.e., from 2008 to 2011). These wells are adjacent to a sanitary sewer line that runs beneath the southeastern portion of the site near the UST pit at approximately the same depths as the other sewer line bisecting the site and are within the estimated limits of free product and capillary fringe residual hydrocarbons prepared by RESNA and presented in the Remedial Action Plan for the site (Plate 7). Although this sanitary sewer line was identified in a utility survey conducted in 2005, there is no evaluation of it acting as a preferential pathway in the case files.

- Analytical Detection Limits. A review of site data indicates that analytical reporting limits have been higher than the corresponding ESLs for some of the COC and thus reports of non-detects are incorrect. For example, the reporting limits for 1,2-DCA consistently exceed the ESLs and therefore claims that this COC is below its corresponding ESL are not true.

- Changes in Areal Extent of the Plume. Isoconcentration contour maps for MTBE, benzene, and TPH-g groundwater plumes, presented in reports up until 2005, indicate the plumes had migrated offsite beyond the perimeter of the site in all directions with the maximum estimated plume length exceeding 300 feet in the southwest direction. Subsequent to 2005, isoconcentration maps were omitted from all reports. Plume maps should be provided to show the current spatial distribution of contaminants in the subsurface. The maps should display the contaminant distribution for soil gas, soil matrix, and groundwater for all the COCs. All data used to construct the contour maps should be clearly annotated on the maps. Ideally the base map for plume presentation should be provided on an aerial photograph.

- Geologic Cross Sections. Geologic cross sections illustrating the subsurface lithology, water levels, and distribution of contaminants in soil based on available boring logs, were provided in the 2005 Feasibility Study Report prepared by URS. However, since that time new data has been generated and should be presented on new cross-sections. This data should show the relationship between utility trenches and groundwater elevations at the site.

- Well Survey. A recent well survey that uses all available well from both the Department of Water Resources and local agencies (Zone 7 Water Agency or Alameda County Public Works as appropriate) should be conducted. Water supply wells located within 2,000 feet of the site are to be presented on a site figure with a table identifying each well along with the well construction details.

General Criteria f: Secondary source has been removed to the extent practicable.

The secondary source is the petroleum-impacted soil, free product, or groundwater that acts as a long-term source releasing contamination to the surrounding area. Unless site conditions prevent secondary source removal (e.g., physical or infrastructural constraints exist whose removal or relocation would be technically or economically infeasible), petroleum-release sites are required to undergo secondary source removal to the extent practicable.

According to the LTCP, to the extent practicable means implementing a cost-effective corrective action which removes or destroys-in-place the most readily recoverable fraction of source-area mass within one year or less. Following removal or destruction of the secondary source, additional removal or active remedial actions shall not be required by regulatory agencies unless (1) necessary to abate a demonstrated threat to human health or (2) the

groundwater plume does not meet the definition of low threat as described in this policy.

Although corrective action at the site has included soil excavation, free product removal, and operation of an SVE and GWET systems, it is not clear from our review of the case files whether the secondary source(s) at the site have been removed to the maximum extent practicable. As described in General Criteria d above, ACEH has concerns about the quality of soil, soil gas, and groundwater data and lack of a site conceptual model, and therefore the effectiveness of the corrective actions at removing secondary sources of petroleum hydrocarbons. Our concerns regarding the adequacy of secondary source removal include the following:

- No evaluation has been presented of the areas of success or infeasibility of corrective actions implemented at the site, including presentation of valid long-term monitoring data after the subsurface has reached equilibrium to demonstrate that concentrations have not rebounded following the cessation of corrective action. For example, although the GWET and SVE system were reportedly successful at removing approximately 13,495 pounds of TPH-g vapors and 345 pounds of dissolved TPH-g from groundwater, no assessment was found in the case files regarding the subsequent observation of 1.6 feet of free product in recovery well RW-1 two months after the system was shutdown.

- The SVE system and GWETS was connected to nine vapor extraction wells and recovery well RW-1, Although the drilling and installation activities associated with five of the SVE wells (VEW-4 through VEW-8) are not in the case files, no assessment has been made regarding the effectiveness of the wells. Even though groundwater data has been collected from all of the site's eight soil vapor extraction wells on a quarterly basis from January 2008 until July 2009, and then on a semi-annual basis from 2010 through 2011, no analysis has been presented to assess the effects of submerged conditions identified in two of the on-site soil vapor extraction wells (VW-2, VW-3) during 100% of the monitoring events, and one off-site soil vapor extraction well (VEW-9) during 30% of the monitoring events. Depth to water in on-site well VW-2 has ranged from 0.25 feet bgs to 1.99 feet bgs during all monitoring events in which depth to water measurements were reported.

- No subsurface confirmation sampling has been conducted to demonstrate the effectiveness of secondary source removal and verify that cleanup activities have reduced subsurface volatile chemical concentrations to levels protective of human health, including receptors subject to vapor intrusion. Site soil was last sampled in 2005.

- In 2009, groundwater contaminant concentrations exhibited an increasing trend in monitoring well AW-1. At that time, ACEH did not concur with USTCF staff that case closure should be considered in light of elevated concentrations of TPH-g and benzene and observations of a sheen in wells MW-1 & AW-1 during the 1st quarter 2010 monitoring event, indicating that the site may pose a potential risk to human health and the environment, an elementary school located directly down-gradient of the site, and adjacent residences. Subsequently, ACEH directed British Petroleum to implement the approved corrective action to abate elevated concentrations of petroleum hydrocarbons and sheen and proceed with a three month pilot study for the injection of nutrients to enhance biodegradation of TPH-g in soil and groundwater.

- In September 2010, ARCADIS installed three injection wells (IW-1 through IW-3) and one observation well (OW-1) at the site. Following the well installation activities, downgradient injection well IW-3 was sampled to further delineate the plume in the vicinity of the pilot study area. Based on the reported low levels of COCs (benzene at 5.8 ug/L, ethylbenzene at 8.3 ug/L, toluene at 2.9 ug/L, xylenes at 8.5 ug/L, MTBE at 2.5 ug/L, and TPHg at 1,000 ug/L) in groundwater samples collected from the well, ARCADIS requested that implementation of the pilot test be postponed until after additional sampling was conducted to evaluate groundwater concentrations in the wells in the vicinity injection wells. Results of groundwater samples collected from AW-1, AW-2, and MW-1 indicated that MTBE, benzene, and TAME were present

in AW-1 at low concentrations of 4.4 ug/L, 0.92 ug/L, and 0.80 ug/L, respectively; AW-2 contained MTBE at a concentration of 0.52 ug/L; and MW-1 contained TPHg at a concentration of 230 ug/L. Based on the low COC levels in these wells, ARCADIS recommended the postponement of the pilot injection test until third quarter 2011 sampling results could be reviewed. ARCADIS did not present data nor include a discussion regarding the potential low bias of the analytical results due to submerged conditions of the newly installed wells.

- The pilot study was never implemented as claimed by the USTCF staff in the Second Five Year Review Summary Report.

General Criteria g: Soil and groundwater have been tested for MTBE and results reported in accordance with Health and Safety Code section 25296.15.

The primary source of release at the site has been determined to be from the gasoline underground storage tank system including piping and dispensers. MTBE was not included in the list of analytes until after 1998, during the removal of the USTs, piping and dispenser islands.

As discussed above, MTBE has historically migrated off-site.

General Criteria h: Nuisance as defined by Water Code section 13050 does not exist at the site.

Water Code section 13050 defines "nuisance" as anything which meets all of the following requirements:

(1) Is injurious to health, or is indecent or offensive to the senses, or an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property.

(2) Affects at the same time an entire community or neighborhood, or any considerable number of persons, although the extent of the annoyance or damage inflicted upon individuals may be unequal.

(3) Occurs during, or as a result of, the treatment or disposal of wastes. For the purpose of the Policy, waste means a petroleum release.

Based on our review of the case files, and the fact that the site is located in a commercial and residential community, sufficient data has not been presented to support whether a nuisance condition currently exists or potentially could exist in the future. A nuisance evaluation should been incorporated into the CSM and should describe whether any site contamination is present in locations that have the potential to pose nuisance conditions during common or reasonably expected activities. The types of data relevant to determining whether nuisance exists at the site include:

- Descriptions of the type and vertical and lateral extent of shallow soil or lateral extent of surface soil contamination
- Depths to contamination
- Analytical results for surface soil, shallow soil, and groundwater samples
- Discussion of any odors or visual evidence of contamination
- Preferential pathway and utility conduit surveys
- Review of potential points for exposure (such as groundwater seeps into basements)
- Current use of the site
- Expected future use of site
- Description of surface water runoff from the property to storm drains or other sites

Please refer to the CSM discussion presented in General Criteria e above for details.

Media-Specific Criteria 1. Groundwater

In order to meet the low-threat groundwater-specific criteria, if groundwater with an existing or potential designated beneficial use is affected by an unauthorized release, the contaminant plume that exceeds water quality objectives must be:

- Stable or decreasing in areal extent (i.e., the contaminant mass that has expanded to its maximum extent: the distance from the release where attenuation exceeds migration)

- Meet all of the additional characteristics of one of the five classes of sites (groundwater-specific criteria) listed in the LTCP.

In the Second Five Year Review Summary Report, USTCF staff recommend closure of the site on the contention that based on the concentrations of other water quality parameters such as alkalinity, hardness, total dissolved solids, metals, nutrients, methane and carbon dioxide, the groundwater has no current or future beneficial use. Considering the poor water quality, this site should be considered for closure providing the land use remain commercial. This statement is not consistent with state policy for water quality control as prescribed in Resolution 92-49 (*Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304*) nor "the fundamental tenet of the LTCP that if the closure criteria described in this policy are satisfied at a petroleum unauthorized release site, attaining background water quality is not feasible, establishing an alternate level of water quality not to exceed that prescribed in the applicable Basin Plan is appropriate, and that water quality objectives will be attained through natural attenuation within a reasonable time, prior to the expected need for use of any affected groundwater.

Although, ARCADIS contends in the Case Closure Summary Report that the plume is not migrating offsite as evidenced by the non-detect or low detected COC concentrations in downgradient monitoring wells, our review of the case files indicates that sufficient data has not been presented to base a determination that threats to existing and anticipated beneficial uses of groundwater have been mitigated or are de minimis. Additional site characterization activities are required to adequately define the groundwater-specific criteria (i.e., contaminant plume length, status of free product removal, distance to the nearest groundwater or surface water receptor from the plume boundary, and dissolved concentrations of MTBE and benzene).

Please refer to the CSM discussion presented in General Criteria e above for details.

Media-Specific Criteria 2. Petroleum Vapor Intrusion to Indoor Air

The low-threat vapor-intrusion criteria in the Policy apply to release sites and impacted or potentially impacted adjacent parcels when:

(1) existing buildings are occupied or may be reasonably expected to be occupied in the future, or

(2) buildings for human occupancy are reasonably expected to be constructed in the near future.

According to the LTCP, petroleum release sites must be considered low-threat for the vapor-intrusion-to-indoor-air pathway if they satisfy the following media-specific criteria:

- Site-specific conditions satisfy all the assumptions, characteristics, and screening criteria of scenarios 1 through 3 as applicable, or all of the characteristics and screening criteria of scenario 4 of the Policy; or

- A site-specific risk assessment for the vapor intrusion pathway is conducted and demonstrates that human health is protected to the satisfaction of the regulatory agency; or

- As a result of controlling exposure through the use of mitigation measures or through the use of institutional or engineering controls, the regulatory agency determines that that petroleum vapors migrating from soil or groundwater will have no significant risk of adversely affecting human health.

The land use in the vicinity of the site is mixed commercial and residential with residential homes and an apartment building located immediately adjacent to the northeastern and southeastern property lines, residential and commercial property located across 98th Avenue to the northwest, and a school located across Bancroft Ave approximately 0.15 miles southwest of the site. Therefore, the vapor-intrusion criteria in the Policy must be satisfied to consider the site for low-threat closure under the LTCP.

Both ARCADIS and the USTCF staff use the results of an October 2001 soil gas investigation and Risk Based Corrective Action (RBCA) Tier 1 through 3 evaluations conducted in May 2002, to support their recommendation for site closure. Both the 2001 investigation and the RBCA evaluations were conducted to address the potential for inhalation potential risks from residual subsurface hydrocarbon concentration particularly to off-site residents. ARCADIS and the USTCF staff state that the results of the RBCA study indicate that the theoretical upper-bound incremental lifetime cancer hazard indices associated with levels of TPH, BTEX and MTBE in on-site soils and groundwater are below acceptable risks. Accordingly, it was concluded that no further action is necessary for the protection of human health at the site. However, ACEH has the following concerns regarding the adequacy of 2001 investigation and the 2002 RBCA evaluation:

- The methods used to evaluate the fate and transport of contaminants in the 2002 RBCA evaluation are outdated. The 2002 RBCA evaluations were guided by applicable standards at the time including the American Society for Testing and Materials (ASTM) Standard Guide for Risk-Based Corrective Acton Applied at Petroleum Release Sites (e1739-95e1; ASTM 1999), the Oakland Risk-Based Corrective Acton: Technical Background Document (2000), the Oakland Urban Land Redevelopment Program: Guidance Document (2000), the California Regional Water Quality Control Board – San Francisco Bay Region Application of Risk Based Screening Levels and Decision Making to Sites with Impacted Soil and Groundwater (2001), and the U.S. Environmental Protection Agency's Risk Assessment Guidance for Superfund: Volume 1 – Human Health Evaluation Manual (EPA, 1989).

- Technical justification for the input parameters used in the evaluations is not adequately supported by a CSM, including:

  - Depth to Groundwater. The depth to groundwater was assumed to range from 10 to 22 feet bgs; however groundwater elevations at the site have exhibited a rising trend since the evaluations were conducted.

  - Maximum Soil Concentrations. Samples collected during the second UST removal in 1998 (SW1, SW2, SW3, SW4) were considered representative of the current soil conditions in the pit area. However, a review of the data indicates that the 1998 samples were collected at 12 feet bgs whereas samples collected from soil beneath the tanks during the 1987 tank removal (A1, A2, B1, and C1) were collected at a depth of 13.5 feet bgs. A concentration of 33 mg/kg (detected at well RW-1 at 25 feet bgs) was used in the RBCA evaluations as the maximum TPH-g concentration in soil; however our review indicates TPH-g has been detected in six samples (collected at depths ranging from 11 to 25 feet bgs) above 33 mg/kg, up to a maximum concentration of 420 mg/kg at boring A1 at a depth of 13.5 feet bgs. The RBCA also states that TPHg was detected in one deep off-site soil location (AW-4 at 21 feet bgs); however historic soil data indicates that TPHg was also detected in off-site soil location AW-3 at depths of 21 and 26 feet bgs.

  - Groundwater Flow Direction. A westward flow direction was used in the evaluations; however groundwater flow direction has been variable at the site and has not yet been adequately characterized.

  - Free Product. The evaluation was based on the assumption that no free product remained at the site. Site characterization activities have not adequately justified this assumption.

  - Soil Vapor Concentrations. The RBCA evaluations used soil vapor data collected during a 2001 site investigation, to evaluate exposure to the residential properties adjacent to the site. Risks to off-site residents were addressed by the soil vapor data only collected adjacent to the off-site residential structures.

- The site-specific risk assessment for the vapor intrusion pathway used to satisfy the criteria under the LTCP, should be done in accordance with current industry standards as contained in the California Environmental Protection Agency's Department of Toxic Substances Control (DTSC) Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (October 2011. The DTSC Guidance recommends the following:

    - Use of multiple lines of evidence (i.e., soil gas, soil matrix and groundwater data) to reasonably estimate the level of risk posed by vapor intrusion;
    - Use of maximum contaminant concentration (i.e., data collected above the source);
    - Use of reasonable site-specific input parameters in the California version of USEPA's Vapor Intrusion Model by Johnson and Ettinger, created by the DTSC to include California-specific chemical toxicity factors;
    - Preferential pathways should not exist at the site;
    - Knowledge of adjacent building construction (slab-on-grade, crawl spaces, etc.);
    - Calculation of cumulative health effects;
    - Use of data representing seasonable variability before making a final risk determination as short term measurements rarely represent long-term conditions.

In the absence of an adequate site-specific risk assessment that demonstrates that petroleum vapors migrating from soil or groundwater will have no significant risk of adversely affecting human health, site-specific conditions must satisfy all the assumptions, characteristics, and screening criteria of Scenarios 1 through 3 as applicable, or Scenario 4 of the LTCP.

- Scenarios 1 and 2 pertain to sites with unweathered LNAPL in groundwater. Unweathered LNAPL is defined by the LTCP to mean petroleum product that has not been subjected to significant volatilization or solubilization, and therefore has not lost a significant portion of its volatile or soluble constituents (e.g., comparable to recently dispensed fuel).

- Scenario 3 provides low threat criteria based on the dissolved phase concentration of benzene in groundwater and characteristics of the bioattenuation zone including oxygen content and separation distance between building foundations and groundwater.

- Scenario 4 provides low threat criteria based on soil gas sampling data for benzene, ethylbenzene, and naphthalene.

Our review of the case files indicates that additional site characterization activities are required in order to define the characteristics of the bioattenuation zone and concentrations of COCs in groundwater (Scenario 3), or soil vapor concentration in soil (Scenario 4), and adequately assess the potential for human health risk due to vapor-intrusion into residential and commercial buildings in the vicinity of the site. Scenarios 1 and 2 do not apply to the site as the primary release occurred prior to 1998. ACEH is concerned about the data representativeness, data quality, spatial distribution relative to current or potential receptors and sources, temporal variability, and resultant conclusions. Examples of our concerns include:

- Misrepresentation of Soil Vapor Data. In the Case Closure Summary Report, ARCADIS states that soil vapor slightly exceeded the ESL for TPHg (6.9 parts per million by volume [ppmv]) in two of 18 samples collected in 2001. One sample (B-3-V1) was collected at 5 feet below ground surface (bgs) and contained 7.0 ppmv, the second sample (B-1-V2) was collected at 10 feet bgs and contained 9.0 ppmv. ARCADIS fails to identify a third soil vapor sample that exceeded the ESL for TPHg in the sample collected from B-2-V2 at 11 feet bgs and benzene (0.089) collected at a depth of 15 feet bgs. They also fail to identify one sample collected at 15 feet bgs from B-6-V3 that exceeded the ESL for benzene (0.089 ppmv) at a detected concentration of 0.340 ppmv.

- Lack of Seasonal and Temporal Soil Gas Data. Our review of the case files indicates that soil gas data is limited to the analytical data collected during the October 2001 investigation only, and therefore does not adequately determine long-term stability of contaminant concentrations.

- Spatial Distribution of Soil Vapor Data. Soil vapor samples were collected from six borings (B-1 through B-6) drilled in the eastern and southeastern property boundaries adjacent to a 2-story apartment building and a single story residence in October 2001. Although the locations of the borings were in the vicinity of a sanitary sewer line, no assessment was made on the potential dilution of samples in those locations due to migration of soil gas in the trench materials. Additionally, no borings were advanced along the northern property boundary adjacent to two additional single story residences (see Exhibit 2).

- Bioattenuation Zone Determination. Results from preferential pathway and utility conduit surveys need to be presented and evaluated to determine whether a continuous bioattenuation zone is present.

- Soil Gas Sampling Methodology. ARCADIS concludes that based on the depth and the years since the samples were collected it is unlikely a soil vapor threat to human health or the environment remains at the site. ACEH is concerned about the lack of discussion of the sampling methodology used to collect the soil gas samples and the validity of the data with respect to current protocols for conducting soil gas investigations in accordance with the DTSC's April 2012 Advisory – Active Soil Gas Investigations.

- Assessment of all COCs. There is a lack of an assessment of analytical data for all COCs in soil, including total petroleum hydrocarbons and MTBE, in order to determine whether unique conditions not considered in the Policy may exist at the site.

Please refer to the CSM discussion presented in General Criteria e above for details on the adequacy of site characterization activities with respect to evaluating vapor-intrusion potential.

Media-Specific Criteria 3. Direct Contact and Outdoor Air Exposure.

The LTCP describes conditions where direct contact with contaminated soil or inhalation of contaminants volatized to outdoor air poses a low threat to human health. According to the Policy, release sites where human exposure may occur shall be considered for closure if they meet any of the following media-specific criteria for direct contact and outdoor air exposure:

a. Maximum concentrations of petroleum constituents (i.e., benzene, ethylbenzene, naphthalene, and poly-aromatic hydrocarbons [PAHs]) in soil are less than or equal to those listed in Table 1 of the LTCP for the specified depth bgs;

a. Maximum concentrations of petroleum constituents in soil are less than levels that a site specific risk assessment demonstrates will have no significant risk of adversely affecting human health; or

b. As a result of controlling exposure through the use of mitigation measures or through the use of institutional or engineering controls, the regulatory agency determines that the concentrations of petroleum constituents in soil will have no significant risk of adversely affecting human health.

As previously described, the land use in the vicinity of the site is mixed commercial and residential with residential homes and an apartment building located immediately adjacent to the northeastern and southeastern property lines, residential and commercial property located across 98th Avenue to the northwest, and a school located across Bancroft Ave approximately 0.15 miles southwest of the site. Therefore, human exposure through direct contact and outdoor air exposure must be evaluated.

ARCADIS and the USTCF staff use the results of the Risk Based Corrective Action (RBCA) Tier 1 through 3 evaluations conducted in May 2002, to support their recommendation for site closure. As discussed previously in the Media-Specific Criteria 2 section for Petroleum Vapor Intrusion to Indoor Air**,** ACEH has the concerns regarding the adequacy of the 2002 RBCA evaluations and technical justification of input parameters. Therefore, in lieu of an adequate site-specific risk assessment that demonstrates that maximum concentrations of petroleum constituents in soil will have no significant risk of adversely affecting human health, maximum concentrations of petroleum constituents in soil must meet the soil criteria for the prescribed depth ranges of 0 to 5 feet and 5 to 10

feet bgs listed in Table 1 of the Policy.

Our review of the case files indicates that additional site characterization activities are required in order to adequately assess the potential for direct contact and outdoor air exposure to residential, commercial, and utility workers and determine that soil concentrations are protective of ingestion of soil, dermal contact with soil, inhalation of volatile soil emissions, and inhalation of particulate emissions. The assessment should present analytical data for all COCs in soil, including total petroleum hydrocarbons and MTBE, in order to assess whether unique conditions not considered in the Policy may exist at the site.

Please refer to the CSM discussion presented in General Criteria e above for details on the adequacy of site characterization activities.

Table 1: Site Remediation and Monitoring Well Network

Well No.	Date Installed	Screen Interval (feet bgs)	Screen Length (feet)	Well Stratigraphy (USCS Description)	Type of Well	Location
MW-1	May 1988	~~NA~~ 10 to 29	19	CL, CH	Groundwater Monitoring	On-site
MW-2	May 1988	~~NA~~ 12 to 32	20	CL, SC, CH	Groundwater Monitoring	On-site
MW-3	May 1988	~~NA~~ 14 to 34	20	SC, CL	Groundwater Monitoring	On-site
AW-1	~~April 1991~~ June 1990	~~NA~~ 15 to 35	20	ML, SC	Groundwater Monitoring	On-site
AW-2	~~April 1991~~ June 1990	~~NA~~ 20 to 40	20	CL, SC	Groundwater Monitoring	Off-site
AW-3	~~April 1991~~ June 1990	~~NA~~ 15 to 35	20	CL	Groundwater Monitoring	Off-site
AW-4	~~April 1991~~ June 1990	~~NA~~ 15 to 35	20	CL	Groundwater Monitoring	Off-site
AW-5	April 1991	~~NA~~ 20 to 45	25	SM, CL	Groundwater Monitoring	On-site
AW-6	April 1991	~~NA~~ 20 to 35	15	SM, CL	Groundwater Monitoring	On-site
AW-7	April 1991	~~NA~~ 20 to 35	15	CL	Groundwater Monitoring	Off-site
AW-8	April 1991	~~NA~~ 20 to 40	20	SM, SC, CL	Groundwater Monitoring	Off-site
AW-9	January 1997	~~NA~~ 12 to 28	16	SM, GM-GC	Groundwater Monitoring	Off-site
RW-1	~~1994~~ June 1990	~~NA~~ 15 to 40	25	ML, SC, CL	Groundwater Extraction	On-site
VW-1	~~1994~~ March 1992	~~NA~~ 9 to 16	7	ML, GM	Vapor Extraction	On-site
VW-2	~~1994~~ March 1992	~~NA~~ 9 to 16	7	CL, SM, SW	Vapor Extraction	On-site
VW-3	~~1994~~ March 1992	~~NA~~ 9 to 16	7	CL	Vapor Extraction	On-site
VEW-4	1994	~~NA~~ (5 to 20)*	NA	NA	Vapor Extraction	On-site
VEW-5	1994	~~NA~~ (5 to 20)*	NA	NA	Vapor Extraction	On-site
VEW-6	1994	~~NA~~ (5 to 20)*	NA	NA	Vapor Extraction	On-site
VEW-7	1994	~~NA~~ (5 to 20)*	NA	NA	Vapor Extraction	On-site
VEW-8	1994	~~NA~~ (5 to 20)*	NA	NA	Vapor Extraction	On-site
VEW-9	~~January 2008~~ May 1996	~~NA~~ 6 to 20	14	ML, CL, SC	Vapor Extraction	Off-site
IW-1	September 2010	20 to 40	20	CL, SM-SC, ML-SC	Injection Well (Pilot Test)	On-site
IW-2	September 2010	20 to 40	20	SM-SC, CL, ML, SC	Injection Well (Pilot Test)	On-site
IW-3	September 2010	20 to 40	20	CL, SM, ML-CL, ML	Injection Well (Pilot Test)	On-site
OW-1	September 2010	20 to 40	20	ML	Observation Well (Pilot Test)	On-site

Notes:

Shaded – Additional Data not included in USTCF Monitoring Well Information Table

Strikethrough – Inaccurate Data presented in USTCF Monitoring Well Information Table

NA – Information Not Available

USCS – United Soil Classification System Description

* No boring/well logs or well installation report in case files. Depths and screen intervals based on information presented in the Work Plan for Installation of Vapor Extraction Wells (Alisto, 1994)

Table 3 - Free Product Data for Wells MW-1 and RW-1

MW-1 (Screen Interval 10 to 29 feet below ground surface)

Date Sampled	LNAPL Thickness (teet)	Depth to Water (feet)	Well Submerged (Y/N)	Product Removed (gallons)
12/21/1988	>3	15.86		
1/17/1988	2.5	15.46		
2/15/1989	1.08	15.17		
1/24/1990	0.2	18.07		
7/5/1990	0.22	13.31		
4/5/1991	0.22	13.31		
6/1/1991	GLOBULES	14.76		
4/1/1992	~~0.00~~ 0.01	11.25		
7/6/1992	~~0.00~~ 0.02	13.61		
10/7/1992	~~0.00~~ 0.09	15.15		
1/14/1993	~~0.00~~ 0.01	10.73		
4/22/1993	~~0.00~~ 0.16	11.64		
7/15/1993	~~0.00~~ 1.11	13.50		
10/20/1993			**?**	**0.10**
10/21/1993	~~0.00~~ 1.00	15.21		
11/10/1993			**?**	**0.10**
1/27/1994	~~0.00~~ 0.81	17.48		
4/21/1994	0.00	10.94		
9/9/1994			**?**	**SHEEN**
9/19/1994	~~0.00~~ SHEEN	13.80		
10/26/1994			**?**	**SHEEN**
11/16/1994			**?**	**SHEEN**
12/21/1994	~~0.00~~ 0.02	12.60		**0.25**
1/30/1995	NM	NM	**?**	
2/8/1995			**?**	**0.00**
4/10/1995	0.00	10.62		**0.25**
6/29/1994	0.00	18.72		**SHEEN**
9/18/1995	0.00	12.92		**SHEEN**
12/7/1995	0.00	13.82		**SHEEN**
3/28/1996	~~0.00~~ 0.01	10.03		**<0.001**
6/20/1996	~~0.00~~ 0.02	11.29		**SHEEN**
10/11/1996	~~0.00~~ 0.01	14.86		**<0.001**
1/2/1997	~~0.00~~ 0.01	11.03		**<0.01**
4/14/1997	~~0.00~~ 0.01	12.25		**<0.01**
4/15/1997	NM	NM	**?**	
7/2/1997	0.00	14.11		**<0.01**
9/30/1997	0.00	14.40		
1/21/1998	~~0.00~~ 0.01	7.99	**Y**	**<0.01**
4/9/1998	0.00	7.89	**Y**	
4/10/1998	NM	NM	**?**	
6/19/1998	0.00	10.31		**<0.01**
11/30/1998	0.00	11.16		**0.00**

1/21/1999	0.00	10.76		**SHEEN**
4/30/1999	0.00	10.78		**SHEEN**
7/9/1999	0.00	12.62		**SHEEN**
11/3/1999	0.00	14.00		**0.00**
1/12/2000	0.00	15.25		**0.00**
4/13/2000	0.00	15.57		**0.00**
5/24/2000	0.00	11.75		**0.00**
6/1/2000			**?**	**0.00**
6/8/2000	0.00	11.68		**0.00**
6/15/2000	0.00	11.85		**0.00**
6/21/2000	0.00	11.41		
7/26/2000	0.00	16.19		
10/24/2000	0.00	13.89		
1/19/2001	0.00	12.90		
7/24/2001	0.00	13.55		
1/18/2002	0.00	10.91		
8/1/2002	0.00	12.97		
1/16/2003	0.00	10.45		
7/7/2003	~~0.00~~ SHEEN	12.40		
2/5/2004	0.00	10.26		
7/1/2004	~~0.00~~ SHEEN	13.20		
3/16/2005	0.00	9.62	**Y**	
7/22/2005	~~0.00~~ SHEEN	11.23		
1/25/2006	~~0.00~~ SHEEN	8.75	**Y**	
7/6/2006	0.00	10.36		
1/8/2007	0.00	11.55		
7/10/2007	~~0.00~~ SHEEN	13.01		
1/15/2008	0.00	10.96		
7/15/2008	0.00	13.82		
10/21/2008	0.00	14.70		
1/6/2009	0.00	13.67		
4/21/2009	0.00	12.31		
7/21/2009	0.00	13.85		
3/18/2010	~~0.00~~ SHEEN	9.29	**Y**	
7/29/2010	0.00	12.63		
2/22/2011	0.00	15.72		
5/9/2011	0.00	8.03	**Y**	
7/14/2011	0.00	10.96		

RW-1 (Screen Interval 15 to 40 feet below ground surface)

Date Sampled	LNAPL Thickness (teet)	Depth to Water (feet)	Well Submerged (Y/N)	Product Removed (gallons)
7/5/1990	1.21			
4/5/1991	NS **(Due to presence of free product)**			
4/1/1992	~~0.00~~ 0.30	22.81		
7/6/1992	~~0.00~~ 0.41	26.92		

10/7/1992	~~0.00~~ 1.26	28.51		
1/14/1993	~~0.00~~ 0.25	23.75		
4/22/1993	~~0.00~~ 1.38	22.70		
7/15/1993	~~0.00~~ 0.81	26.10		
10/6/1993			**?**	**1.00**
10/21/1993	~~0.00~~ 0.49	25.40		
1/27/1994	~~0.00~~ 037	28.02		
4/21/1994	~~0.00~~ 091	23.10		
9/19/1994	~~0.00~~ 1.04	24.39		
10/14/1994			**?**	**1.00**
10/20/1994			**?**	**18.00**
10/26/1994			**?**	**3.00**
11/2/1994			**?**	**5.00**
11/10/1994			**?**	**6.00**
11/16/1994			**?**	**2.50**
11/23/1994			**?**	**5.00**
11/30/1994			**?**	**2.00**
12/7/1994			**?**	**4.00**
12/17/1993			**?**	**1.50**
1/4/1994			**?**	**5.00**
1/12/1994			**?**	**3.50**
1/20/1994			**?**	**2.50**
2/11/1994			**?**	**4.00**
2/18/1994			**?**	**3.50**
2/25/1994			**?**	**3.00**
3/4/1994			**?**	**3.50**
3/18/1994			**?**	**5.50**
3/30/1994			**?**	**4.00**
4/13/1994			**?**	**4.60**
4/21/1994			**?**	**4.20**
4/29/1994			**?**	**4.50**
5/6/1994			**?**	**5.50**
5/13/1994			**?**	**3.50**
5/20/1994			**?**	**3.50**
5/26/1994			**?**	**4.50**
6/2/1994			**?**	**3.50**
6/9/1994			**?**	**2.50**
6/16/1994			**?**	**3.50**
6/23/1994			**?**	**4.00**
6/29/1994			**?**	**2.50**
7/7/1994			**?**	**2.00**
7/12/1994			**?**	**3.00**
7/20/1994			**?**	**1.50**
7/20/1994			**?**	**1.50**
7/29/1994			**?**	**3.50**
8/5/1994			**?**	**1.50**
8/12/1994			**?**	**2.00**

8/18/1994			**?**	**2.50**
9/9/1994			**?**	**3.50**
9/16/1994			**?**	**4.00**
9/23/1994			**?**	**2.00**
12/7/1994			**?**	**0.00**
12/21/1994	NM	NM		
1/30/1995	~~0.00~~ 1.04	25.71		
4/10/1995				
6/29/1994				
9/18/1995				
12/7/1995				
3/28/1996	~~0.00~~ 0.18	16.75		**0.01**
6/20/1996	~~0.00~~ 0.02	25.10		**0.00**
10/11/1996	0.00	25.51		
1/2/1997	~~0.00~~ 0.01	24.49		
4/14/1997	~~0.00~~ 0.04	23.99		**<0.05**
4/15/1997	NM	NM		
7/2/1997	~~0.00~~ 0.02	16.40		**0.25**
9/30/1997	0.00	27.97		**<0.01**
1/21/1998	~~0.00~~ 0.44	14.14	**Y**	**0.50**
4/9/1998	~~0.00~~ 0.05	25.01		
4/10/1998	NM	NM		**0.09**
6/19/1998	0.00	11.43	**Y**	**<0.01**
11/30/1998	0.00	7.87	**Y**	**0.00**
1/21/1999	0.00	18.90		**0.00**
4/30/1999				**0.11**
7/9/1999	0.00	18.58		**0.00**
11/3/1999	0.00	20.85		**1.06**
1/12/2000	0.00	21.20		**0.53**
2/14/2000				**0.13**
3/20/2000				**0.00**
4/13/2000	0.00	21.71		**0.26**
4/26/2000				**0.00**
5/17/2000				**0.00**
5/24/2000	0.00	21.89		**0.53**
6/1/2000				**0.00**
6/8/2000	0.00	17.88		**0.26**
6/15/2000	0.00	16.72		**0.13**
6/20/2000	0.00	21.04		**0.53**
6/21/2000	0.00	16.30		
6/28/2000	0.00			
7/7/2000	0.00	17.21		**0.01**
7/20/2000	0.00	21.87		**0.11**
7/26/2000	0.00	21.45		**0.13**
7/31/2000	0.00	22.11		**0.00**
8/8/2000	0.00	17.80		**0.01**
8/16/2000	0.00	17.92		**0.00**

8/23/2000	0.00	18.11		**0.13**
8/31/2000				**0.40**
9/8/2000				**0.53**
9/25/2000				**0.01**
10/24/2000	0.00	18.93		**0.00**
10/25/2000	0.00	19.04		
1/19/2001	0.00	18.19		**0.11**
2/14/2001				**0.01**
3/20/2001				**0.13**
4/26/2001				**0.00**
5/17/2001				**0.00**
6/28/2001				**0.00**
7/24/2001	0.00	17.93		**0.00**
9/21/2001				**0.01**
10/23/2001				**0.00**
11/30/2001				**0.00**
1/18/2002	0.00	14.87	**Y**	**0.00**
2/7/2002				**0.00**
8/1/2002	0.00	16.84		
1/16/2003	0.00	14.42	**Y**	
7/7/2003	~~0.00~~ SHEEN	16.11		
2/5/2004				
7/1/2004	0.00	16.75		
3/16/2005	0.00	12.48	**Y**	
7/22/2005	~~0.00~~ HEAVY SHEEN	14.40	**Y**	
1/25/2006	0.00	12.00	**Y**	
7/6/2006	0.00	13.01	**Y**	
1/8/2007	0.00	14.75	**Y**	
7/10/2007	0.00	16.21		
1/15/2008	0.00	14.63	**Y**	
7/15/2008	0.00	17.04		
10/21/2008	0.00	18.44		
1/6/2009	0.00	17.50		
4/21/2009	0.00	15.37		
7/21/2009	0.00	17.20		
3/18/2010	~~0.00~~ SHEEN	12.87	**Y**	
7/29/2010	0.00	15.90		
11/12/2010	0.00	17.25		
2/22/2011	0.00	12.60	**Y**	
5/9/2011			**Y**	
7/14/2011	0.00	13.87	Y	

Data complied by ACEH

Table 2 – Historic Groundwater Flow Direction

Date Measured	Flow Direction	Hydraulic Gradient (feet/feet)	Wells Used to Draw Contour Map	Wells not Used	Consultant
02/15/1989	Westerly	NA	MW-1, MW-2, MW-3	NA	Kaprealian
07/05/1990	West	0.01	Off-site wells only (AW-3, AW-4, AW-2	Onsite wells (MW-1, MW-2, MW-3, RW-1, AW-1)	Alton Geoscience
04/05/1991	Southerly	0.08	AW-1, AW-2, AW-3, AW-4, AW-5, AW-6, AW-7, AW-8	MW-1, MW-2, MW-3, RW-1	Alton Geoscience
6/28/1991	Radially inward towards site, southwest	0.01	AW-1 AW-2, AW-3, AW-4, AW-6, AW-7, AW-8, RW-1	MW-1, MW-2, MW-3, AW-5	Alton Geoscience
9/26/1991	Radially inward towards site, southwest	0.03	AW-1, AW-2, AW-3, AW-4, AW-5, AW-6, AW-7, AW-8, RW-1	MW-1, MW-2, MW-3	Alton Geoscience
12/11/1991	Radially inward towards site, southwest	0.015	AW-1, AW-2, AW-3, AW-4, AW-5, AW-6, AW-7, AW-8	MW-1, MW-2, MW-3, RW-1	Alton Geoscience
04/01/992	Radially inward towards site	NA	AW-1, AW-2, AW-3, AW-4, AW-5, AW-6, AW-7, AW-8, RW-1	MW-1, MW-2, MW-3	RESNA
07/06/1992	Radially outward from site	0.04	AW-1, AW-2, AW-3, AW-4, AW-5, AW-6, AW-7, AW-8, RW-1	MW-1, MW-2, MW-3	Alisto/RESNA
10/07/1992	Radially inward towards and outward from site, South-southeast	0.022 to 0.13	MW-1, MW-2, MW-3, AW-1, AW-2, AW-3, AW-4, AW-5, AW-6, AW-7, AW-8, RW-1		Alisto
01/14/1993	Radially inward towards and outward from site, South-southeast	0.05 to 0.3	MW-1, MW-2, MW-3, AW-1, AW-2, AW-3, AW-4, AW-5, AW-6, AW-7, AW-8, RW-1		Alisto
4/22/1993	Radially inward towards and outward from site, South-southeast	0.20	MW-1, MW-2, MW-3, AW-1, AW-2, AW-3, AW-4, AW-5, AW-6, AW-7, AW-8, RW-1		Alisto
07/15/1993	Radially inward towards and outward from site, South-southeast	0.10 to 0.20	MW-1, MW-2, MW-3, AW-1, AW-2, AW-3, AW-4, AW-5, AW-6, AW-7, AW-8, RW-1		Alisto
10/21/1993	Radially inward towards and outward from site, South-southeast	0.13 to 0.15	MW-1, MW-2, MW-3, AW-1, AW-2, AW-3, AW-4, AW-5, AW-6, AW-7, AW-8, RW-1		Alisto
01/27/1994	Radially inward towards and outward from site, South-southeast	0.13 to 0.2	MW-1, MW-2, MW-3, AW-1, AW-2, AW-3, AW-4, AW-5, AW-6, AW-7, AW-8, RW-1		Alisto
04/21/1994	Radially inward towards and outward from site, South-southeast	0.13	MW-1, MW-2, MW-3, AW-1, AW-2, AW-3, AW-4, AW-5, AW-6, AW-7, AW-8, RW-1		Alisto
09/09/1994	Radially inward towards and outward from site, South-southeast	0.10	MW-1, MW-2, MW-3, AW-1, AW-2, AW-3, AW-4, AW-5, AW-6, AW-7, AW-8, RW-1		Alisto
12/21/1994	Radially inward towards and outward from site,	0.07	MW-1, MW-2, MW-3, AW-1, AW-2, AW-5, AW-6, AW-7,	AW-3, AW-4 (inaccessible)	Alisto

Date Measured	Flow Direction	Hydraulic Gradient (feet/feet)	Wells Used to Draw Contour Map	Wells not Used	Consultant
	South-southeast		AW-8, RW-1		
01/30/1995	Radially inward towards and outward from site, South-southeast	0.06	MW-1, MW-2, MW-3, AW-1, AW-2, AW-5, AW-6, AW-7, AW-8, RW-1	AW-3, AW-4 (inaccessible)	Alisto
04/10/1995	Radially inward towards and outward from site, South-southeast	0.07	MW-1, MW-2, MW-3, AW-1, AW-2, AW-4, AW-5, AW-6, AW-7, AW-8, RW-1	AW-3 (inaccessible)	Alisto
06/29/1995	Radially inward towards and outwards from site	0.14	MW-1, MW-2, MW-3, AW-1, AW-2, AW-3, AW-4, AW-5, AW-6, AW-7, AW-8, RW-1		Alisto
09/18/1995					Alisto
12/07/1995	Southeast	0.11			Alisto
03/28/1996	East	0.05			Alisto
06/20/1996	East	0.07			Alisto
06/20/1996	West	0.04			Alisto
10/11/1996	East	0.06			Alisto
01/02/1997	East	0.15			Alisto
04/14/1997	East	0.08			Alisto
07/02/1997	East-northeast	0.05			Alisto
09/30/1997					Alisto
01/21/1998	Southeast	0.04			Alisto
04/09/1998					Alisto
06/19/1998					Alisto
11/30/1998					Blaine Tech
01/21/1999					Blaine Tech
04/30/1999					Blaine Tech
07/09/1999					Blaine Tech
11/03/1999					Blaine Tech
01/12/2000	East	0.07			Blaine Tech
01/12/2000	West	0.07			Blaine Tech
04/13/2000	East	0.05			Blaine Tech
04/13/2000	Southwest	0.05			Blaine Tech
07/26/2000	Southwest	0.03			Blaine Tech
10/24/2000	Southeast	0.04			Blaine Tech
01/19/2001	East-southeast	0.04			Blaine Tech
07/24/2001	East	0.08			Blaine Tech
07/24/2001	West	0.03			Blaine Tech
01/18/2002	West	0.04			Cambria
08/01/2002	East	0.05			URS
08/01/2002	Southwest-southwest	0.04			URS
01/16/2003	East-southeast	0.06			URS
01/16/2003	West	0.02			URS
03/14/2003	East	0.06			URS
03/14/2003	West	0.02			URS
02/05/2004	Southwest	0.03			URS

Date Measured	Flow Direction	Hydraulic Gradient (feet/feet)	Wells Used to Draw Contour Map	Wells not Used	Consultant
02/05/2004	Northwest	0.06			URS
07/07/2003	Southwest	0.03			URS
07/07/2003	East	0.08			URS
02/05/2004	Variable: Southwest to Northeast	Variable: 0.03 to 0.06			URS
07/01/2004	Southwest	0.03			URS
07/01/2004	East	0.08			URS
03/16/2005	Variable: Southwest to Northeast	Variable: 0.03 to 0.08			URS
07/22/2005				Heavy Sheen noted in RW-4	URS
01/25/2006	Variable: East to Southeast	0.03 to 0.09		Sheen noted in MW-1, odor in MW-1, MW-2, RW-1	URS
07/06/2006	Variable: East to West towards Center	0.04 to 0.05		MW-1, AW-1, AW-4, AW-5, RW-1 odor	Broadbent
01/08/2007	Variable: East to West towards Center	0.03 to 0.05			Broadbent
07/10/2007	West	0.01			Broadbent
01/15/2008	West-Southwest	0.006			Broadbent
07/15/2008	West-Southwest	0.01			Broadbent
10/21/2008	West-Southwest	0.01			Broadbent
01/06/2009	West	0.009			Broadbent
04/21/2009	West	0.01			Broadbent
07/21/2009	West	0.01			Broadbent
03/18/2010	West	0.008			Broadbent
07/29/2010	West	0.008			Broadbent
11/12/2010	West-Southwest	0.01			Broadbent
02/22/2011	Variable: North to West	0.03 to 0.04			Broadbent
07/14/2011	West	0.01			Broadbent

Table 4 - Submerged/Dry Well Statistics

Well ID	Location	# of Sampling Events	# of Events with Submerged Wells	# of Events with Dry Wells	Percent of Events Submerged (%)	Percent of Events Dry (%)	Notes
Groundwater Monitoring & Extraction Wells							
AW-1	On-site	70	4		6%		3/5 events since 2010
AW-2	Off-site	59	47		80%		5/5 events since 2010
AW-3	Off-site	65	24		37%		3/5 events since 2010
AW-4	Off-site	65	4		6%		1/5 events since 2010
Aw-5	On-site	63	32		51%		5/5 events since 2010
AW-6	On-site	61	48		79%		5/5 events since 2010
AW-7	Off-site	36	19		53%		Since 1,100 ug/L of MTBE detectedf in 9/30/1997, well was submerged in all subsequent monitoring events with ND
AW-8	Off-site	45	35		78%		Since 820 ug/L of MTBE detected in 9/30/1997, well was submerged in all subsequent monitoring events with ND
AW-9	Off-site	19	4		21%		4/6 events submerged before determining no off-site impacts
MW-1	On-site	63	6		10%		2/5 events since 2010
MW-2	On-site	62	46		74%		5/5 events since 2010
MW-3	On-site	63	21		33%		4/5 events since 2010
RW-1	On-site	67	13		19%		3/5 events since 2010
Vapor Extraction Wells							
VEW-4	On-site	11	0	1	0%	9%	depth to water greater than 20 feet
VEW-5	On-site	12	0	11	0%	92%	
VEW-6	On-site	11	0	0	0%	0%	
VEW-7	On-site	11	0	0	0%	0%	
VEW-8	On-site	12	0	5	0%	42%	
VEW-9	Off-site	10	3	4	30%	40%	
VM-1	On-site	11	0	9	0%	82%	
VM-2	On-site	11	11		100%	0%	All events since 2008
VM-3	On-site	11	11		100%	0%	All events since 2008
Pilot Test Injection and Observation Wells							
IW-1	On-site	1	1		100%		
IW-2	On-site	1	1		100%		
IW-3	On-site	1	1		100%		
OW-1	On-site						

Notes:

Off-Site Wells