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August 23, 2007

Mr. Barney Chan
Alameda County Health Care Services Agency
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502-6577

Re: **Response Letter**
Former Shell Service Station
1230 14th Street
Oakland, California
SAP Code 129403
Incident No. 97088250
RO#0433

Dear Mr. Chan:

Conestoga-Rovers & Associates (CRA) is submitting this *Response Letter* on behalf of Equilon Enterprises LLC dba Shell Oil Products US (Shell). This document presents Shell's response to Pangea Environmental Services, Inc.'s (Pangea) July 11, 2007 *Comments on Revised Remediation Work Plan* referring to the CRA May 16, 2007 *Response Letter and Revised Remediation Work Plan*.

Pangea Comment #1: Contaminant removal rates would be up to 200 times higher with DPE than SVE based on test data. DPE removal rates could be up to 75 pounds per day.

Shell Response to Comment #1: Pangea's comparison of soil vapor extraction (SVE) mass removal versus dual phase extraction (DPE) is irrelevant as SVE is not designed to remediate groundwater plumes; SVE is a vadose remediation technology. Shell is proposing SVE with air sparging, which has the potential to result in substantial mass removal from the saturated zone via volatilization and enhanced aerobic biodegradation.

DPE is a combination of soil vapor extraction and groundwater extraction, typically used in relatively low-permeability settings to increase groundwater yield, and to dewater the shallow saturated zone, exposing the dewatered strata to air-based remediation. DPE is not necessary, nor appropriate for the subject site as site impacts are due to residual hydrocarbons tied up in relatively permeable saturated zone (sands and silty sands). Groundwater extraction is typically an extremely inefficient final remedial approach when residual (trapped, immobile) hydrocarbons are present in the saturated zone, although, it may be valued as an interim remedial approach to hydraulically control the dissolved-phase hydrocarbon plume. SVE (without air sparging) is not needed at this site (as demonstrated by previous SVE testing), as vadose impacts are minimal.

Pangea is correct that SVE/AS removal rates are initially high, and then decrease fairly rapidly. This is because air sparging will quickly volatilize hydrocarbons from the saturated zone, removing most of the saturated zone impacts in a short period of time. Remaining hydrocarbon impacts are then removed via enhanced aerobic biodegradation. This is precisely why Shell believes SVE/AS is the most appropriate remedial approach for the site conditions.

As for the claim that DPE removal rates could be up to 75 pounds per day (or 200 times higher than SVE), those types of removal rates were only observed (at one of two wells) during the first hour of pilot testing on August 23, 2006, and then dropped off dramatically thereafter. To simply extrapolate that to another 5 locations and imply that it would be sustainable is not appropriate. The SVE/AS approach will result in substantially higher mass removal rates than SVE alone, but that too will decline fairly rapidly once the majority of volatile organic compounds (VOCs) have been volatilized from the upper portions of the saturated zone and capillary fringe.

Pangea Comment #2: SVE will likely be slower and more costly than DPE

Shell Response to Comment #2: Pangea is correct in stating SVE will be slower than DPE/AS, however, Shell is not recommending SVE alone; we are recommending SVE *with Air Sparging*. Pangea correctly states SVE/AS "does not provide the necessary dewatering to expose submerged, hydrocarbon-impacted soils......like DPE would". However, dewatering is not the intent with SVE/AS, and could be difficult in relatively permeable strata like the Merritt Sands. In addition, groundwater extraction (via DPE) requires ex-situ treatment (can be expensive) and disposal of treated groundwater (wasteful). Shell has extensive experience with DPE technology and it is substantially more expensive (and slower) than SVE/AS.

Pangea states that remediation costs will be much higher if remediation efforts are "not focused on directly targeting submerged hydrocarbon impacted soils beneath the site". Shell's SVE/AS proposal *is* specifically targeting the upper 6-8 feet of the saturated zone, where the majority of hydrocarbon impacts occur (due to trapped residual NAPL).

<u>Pangea Comment #3:</u> The probability of success with SVE is less than DPE due to water upwelling and likely air-flow short-circuiting.

<u>Shell Response to Comment #3</u>: Again, Shell is not recommending SVE-only, so the statement/comparison is irrelevant. As an aside, applying 40-inches of vacuum to a well screened in permeable strata DOES NOT produce 40-inches of water upwelling. The applied vacuum propagates outward into the vadose zone in permeable strata, with very minimal groundwater upwelling. The SVE/AS system is designed to operate at seasonal high water table conditions, but will be more efficient at seasonally low water table stands (June through December).

Shell agrees the potential for short-circuiting is less in a typical DPE approach (which focuses on the dewatered interval); however, Shell is not confident that the saturated zone could be effectively dewatered to fully expose residual impacts (none of the nearby observation wells revealed drawdown during the August 2006 DPE testing), and again, the extracted groundwater would require relatively expensive ex-situ treatment and disposal, and wastes a potentially-useful resource. Potential short-circuiting can be monitored by measuring O_2 and CO_2 values, as well as air temperature in the vapor stream.

<u>Pangea Comment #4</u>: SVE/AS could cause spreading of contaminant plume due to limited vacuum influence and capture of contaminant vapors.

<u>Shell Response to Comment #4</u>: The vacuum radius of influence (ROI) for SVE is typically 2 to 4 times larger than the sparging ROI. SVE wells will be located to ensure ROI coverage well-beyond the estimated sparging ROI. The sparging action will volatilize (strip out) saturated impacts….not simply push them around. SVE/AS is a well-established remedial technology for petroleum-hydrocarbon impacts in permeable settings. The primary question for Shell is whether or not the saturated zone is permeable enough to achieve adequate distribution of air/oxygen throughout the target interval (pilot testing will help determine this).

Although Shell does not believe SVE/AS will cause spreading of contaminants due to limited vacuum influence, the same could be said of DPE/AS, which is essentially the same technology with groundwater extraction added. Again, Shell believes this is a non-issue and will have adequate monitoring to prove the point.

Pangea Comment #5: SVE/AS could pose a risk to human health via vapor intrusion into identified nearby basements.

Shell Response to Comment #5: Shell will have adequate monitoring/observation wells to ensure the lateral extent of sparging and SVE impacts are well-understood. SVE wells will be located to ensure full capture of any volatilized hydrocarbons in the vadose zone well before they could possibly migrate to surface receptors.

Pangea Comment #6: SVE/AS does not aggressively target the primary contaminant zone at 16-18 ft depth or deeper contaminants.

Shell Response to Comment #6: The proposed SVE/AS remedy will very aggressively target impacts from approximately 18ft bgs and above. A review of historic soil data, as well as groundwater concentration trends over time, indicate most of the hydrocarbon impacts occur within a zone approximately 9-15ft bgs. As no remedial technology can remove 100% of in-place impacts (other than complete soil excavation and dewatering), Shell's proposed SVE/AS approach will target the bulk of in-place impacts, and the elevated dissolved-oxygen levels produced during the sparging operation will also facilitate enhanced aerobic biodegradation well above and (to a lesser extent) below the two-foot screen interval of the sparge wells.

The SVE/AS operation will be most effective at low water table conditions (typically June thru December); however, vapor extraction will be possible even at seasonally-high water table levels.

It is highly questionable whether DPE would be effective at dewatering the entire impacted area by more than a foot or two (while residual NAPL impacts may extend 6-8 feet below mean water table levels). More significant dewatering (if possible) would require extensive ex-situ water treatment and disposal (waste) of water resources (unless treated effluent were re-injected).

Pangea Comment #7: CRA's approach includes unnecessary, inefficient, time-consuming testing that is not required by Pangea's DPE/AS approach.

Shell Response to Comment #7: The proposed AS pilot testing will be conducted in a matter of 1-2 days, and will provide necessary site-specific data for efficient full-scale design. Pangea's DPE/AS approach is simply not as cost-effective as SVE/AS.

<u>Pangea Comment #8</u>: Surprised AS testing not conducted previously.

<u>Shell Response to Comment #8</u>: Air sparge wells AS-1 and AS-3 were installed in March 1996 during the initial subsurface investigation, which followed the 1995 UST pit re-sampling. Cambria's July 23, 1996 *Subsurface Investigation Report* suggests that these wells were installed as a contingency for possible, future remediation. Following a series of subsurface investigations, Cambria's August 26, 2002 *Subsurface Investigation Report and Corrective Action Plan* recommended in-situ oxidation using hydrogen peroxide. Hence, AS testing has not been conducted.

<u>Pangea Comment #9</u>: Proposed AS feasibility testing does not adequately evaluate AS effectiveness.

<u>Shell Response to Comment #9</u>: Pangea is concerned that more than 10 psi may be needed to induce a target sparge flow of 10-15 scfm. The appropriate injection pressures for air sparging are dependent on depth of the top of the well screen, and depth to water in the well. Based on an average depth to water of 10ft bgs, and top of the sparge well screen being 16ft bgs, approximately 2.6 psi will be needed to overcome hydrostatic head (and induce flow into the formation). If at a seasonally high water table condition (approximately 6ft bgs), only 4.3 psi would be needed to overcome hydrostatic head. In no instance should injection pressures exceed 10 psi for this sparging design (or we'd risk the possibility of fracturing the formation creating preferential pathways, which would certainly short-circuit the sparge air flow).

<u>Pangea Comment #10</u>: If short-term AS testing does not satisfy CRA's limited criteria, they will need to prepare another revised Remedial Action Plan.

<u>Shell Response to Comment #10</u>: Assuming the pilot testing confirms the feasibility of air sparging for this site hydrogeology, Shell is very confident SVE/AS will result in substantial mass removal creating satisfactory, risk-based conditions for site Closure. The testing is mostly to confirm feasibility and obtain optimal full-scale design criteria.

Pangea Comment #11: Pangea's DPE/AS approach does not require pilot testing and can be implemented immediately.

Shell Response to Comment #11: Except for sites that have very simple hydrogeologic settings, Shell believes even proven remedial technologies such as SVE/AS or DPE/AS require pilot testing to determine site-specific full-scale design parameters. Failure to pilot test will result in overly conservative well spacing and equipment sizing (inefficient), or will be overly optimistic (which can often result in "stagnation zones" and incomplete remedial sweep/influence). A short-term pilot test is good insurance to ensure reasonable success for a full-scale remedial application.

CLOSING

If you have any questions or comments regarding the contents of this document, please call Ana Friel at (707) 268-3812.

Sincerely,
Conestoga-Rovers & Associates

Dan Lescure, P.E.

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