MRS Environmental Inc.

April 18, 2019

Timothy Stapleton, AICP
Land Use Regulation Division
Department of Regional Planning
320 W. Temple Street
Los Angeles, CA 90012

Re: Oily Water Release: Odor and Health Impacts Estimates

Dear Mr. Stapleton,

On November 22, 2018 around 8:30 pm a tank overflowed at the BC Tank Setting due to the failure of the tank level controller. As a result, approximately 630 gallons (15 barrels) of oil/water mixture was spilled over a 15 to 20 minute time frame into the secondary containment area. Odors from the spill were noted by residents east of the oil field in the Ladera Heights neighborhood with fourteen odor complaints filed on the Inglewood Oil Field complaint system. Weather conditions during the spill were calm with low winds speeds, five to six mph, from the east/northeast.

In order to understand the potential odor and health impacts of the spill, an engineering analysis was conducted of the release by modeling a release of a similar size and composition using the Canary release modeling software. Although the resulting rate and composition of vapor that moved into the air at the time of the spill were not sampled at the time of the release, they can be simulated based on tank vapor space samples and crude oil composition using computer models. Components of the vapor released from the tank were estimated based on gas analysis provided by the operator, including a BTEX analysis performed on the tank vapor space. The estimated components of the released gas are shown in Table 1 below.

Table 1Estimated Released Vapor Components

Component	Gas Composition, mole percent (ppm)	Odor Threshold, ppm	OEHHA REL, Acute 1 hour exposure, ppm*
Carbon Dioxide	8.590 (85,900)	-	-
Methane	81.900 (819,000)	0	-
Ethane	4.820 (48,200)	20,328	-
Propane	1.770 (17,770)	12,225	-
Butane	1.350 (13,500)	1,262	-
Pentane	0.780 (7,800)	119	-
Hexane	0.790 (7,900)	65	1.98
Hydrogen Sulfide	0.003 (3)	0.0045	0.03

Component	Gas Composition, mole percent (ppm)	Odor Threshold, ppm	OEHHA REL, Acute 1 hour exposure, ppm*
Benzene	0.014 (140)	34	0.01
Toluene	0.011 (110)	1.6	9.66
Xylene	0.003 (3)	20	4.99
Ethylbenzene	0.001 (1)	0.3	0.45

*Notes: "-" indicates that the odor or REL is not developed for these materials. * Concentrations were converted from ug/m3 to ppm.*

The gas composition indicates the estimated components of the gas phase of the release in mole percentage, which is a commonly used unit to express the mixture values. Generally, 1 mole percent is equal to 10,000 ppm. The odor threshold is based on the levels defined by the American Industrial Hygiene Association (AIHA, "Odor Thresholds of Chemicals with Established Occupational Health Thresholds", 1989). The reference exposure level (REL) is the concentration at which acute health effects could be realized and is compiled by the California Office of Environmental and Health Hazard Assessment - OEHHA (https://oehha.ca.gov/air/general-info/oehha-acute-8-hour-and-chronic-reference-exposure-level-rel-summary).

In addition to a release from the gas phase in the tank, some crude oil was most likely released along with the produced water and some hydrocarbon components of the crude oil would move into the vapor phase. The amount of hydrocarbon vapor released from the liquid phase would be a function of the material and the respective water solubility and Henry's law constants; in other words, the propensity for the hydrocarbon to move in to the vapor phase when the materials are spilled. These values are difficult to estimate, but the analysis assumed a low level of water solubility (0.2 mg/liter) and default Henry's law constants to estimate the vapor phase of heavier hydrocarbons.

The Canary© model is a release and dispersion model used widely in the oil and gas industry to estimate hazards associated with material releases and vapor clouds. The Canary© model was used to estimate the size and vapor evolution rates from the spilled material. The Canary© heavy gas, gaussian dispersion model was used to estimate the downwind concentrations of the total vapor cloud. The vapor concentrations were then applied to the vapor cloud to determine the individual material concentrations at different distances from the release location. Canary© model does not incorporate the effects of terrain, which might increase air turbulence and diminish the effect of the impact area. Additionally, the traffic along La Cienega Blvd might also increase turbulence and further diminish the area of impact. Therefore, the modeling is considered a conservative estimate.

The individual material concentrations from the modeling were compared to the odor thresholds and the OEHHA REL for acute impacts. Following the standard risk assessment procedures, the level of exposure relative to the REL produces a "hazard index" which is then summed for all materials. A hazard index of 1.0 indicates that the concentration is at exactly the REL; below 1.0 indicates the concentration is below the REL; and greater than 1.0 indicates the concentration is above the REL. The exposure was adjusted using the probit method to account for the exposure duration being shorter than 1 hour.

The primary health effect was determined to be generated from benzene. Benzene health effects can be experienced based on OEHHA and EPA health effects thresholds as low as 0.01 ppm for acute exposures (short term). See Table 1 for a listing of health effects thresholds and potential health effects. The health effects thresholds as defined by OEHHA and EPA are developed to be conservative to protect sensitive individuals (children, elderly, etc.). Health effects from exposure to chemicals vary substantially throughout a population and some exposures greater than the thresholds recorded in the literature have not demonstrated health effects in healthy adults.

Figure 1 shows an estimate of the concentration plume for benzene from the tank spill. Figure 2 shows an estimate of the odor thresholds downwind of the spill. Note that areas outside of this plume area may also have been exposed due to wind meandering.

Figure 3 shows that health effects as a function of health index for all materials combined may have extended as far as 4,100 feet. Health effects produced a health index of about 6.9 at the oil field fence line. The primary contribution to health effects was benzene, which has a low acute REL of 0.01 ppm as per OEHHA and EPA.

For odor impacts, although odors do not necessarily act in the same way as health effects, the ratio of the concentration of the pollutant to the odor thresholds were also generated and then summed for all materials in order to estimate the potential for odor impacts. These values were then plotted versus the downwind distance for odor impact potentials. These levels are shown in Figure 4.

As can be seen from Figure 4, odor levels may have exceeded the odor threshold as far as 4,900 feet from the spill location. Odor levels at the oil field fence line were estimated to be a cumulative level of about 8 times the odor thresholds. Odors were estimated to be generated by primarily hydrocarbons and hydrogen sulfide. This is a conservative estimate as many people do not detect odors at the odor threshold. However, odor complaints were received during the spill at distances from between 1,750 and 3,100 feet.

Best Regards,

Greg Chittick

Greg Chittick
Senior Engineer

Table 1 Potential Benzene Exposure Health Effects and Regulatory Thresholds

PPM	Effect	Definition
0.01	OEHHA REL	The concentration level at or below which no adverse health effects are anticipated
0.01	EPA Reference concentration, RfC	Likely to be without an appreciable risk of deleterious effects
0.10	NIOSH REL	Protective of workplace safety and employee health over a working lifetime
0.49	ACGIH TLV	A level to which a worker can be exposed day after day for a working lifetime without adverse effects
0.98	OSHA PEL/NIOSH STEL	Protective of worker health
2.5	BMCL	Potential reduction in absolute lymphocyte count
5.0	OSHA STEL	Short term (15 minute) exposure limit to protect workers health
50	AIHA ERPG-1	Maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing more than mild, transient adverse health effects
47-110	Exposure Historical Event	No adverse effects in some studies
60	Exposure Historical Event	Mucous, membrane irritation, neurologic symptoms, dizziness, nausea
150	AIHA ERPG-2	The maximum airborne concentration below which nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects
1,000	Exposure Historical Event	Giddiness, euphoria, nausea, and headaches, mild irritation to the eyes and mucous membranes
3,000	Exposure Historical Event	Anesthesia
9,811	LC50 rats/mice	50% fatality in rats/mice

References:
EPA: https://www.epa.gov/sites/production/files/2016-09/documents/benzene.pdf),
OEHHA: https://oehha.ca.gov/air/general-info/oehha-acute-8-hour-and-chronic-reference-exposure-level-rel-summary
OEHHA: https://oehha.ca.gov/media/downloads/crnr/appendixd1final.pdf

Figure 1 Estimated Maximum Concentrations Downwind of the Spill: Benzene Exposure

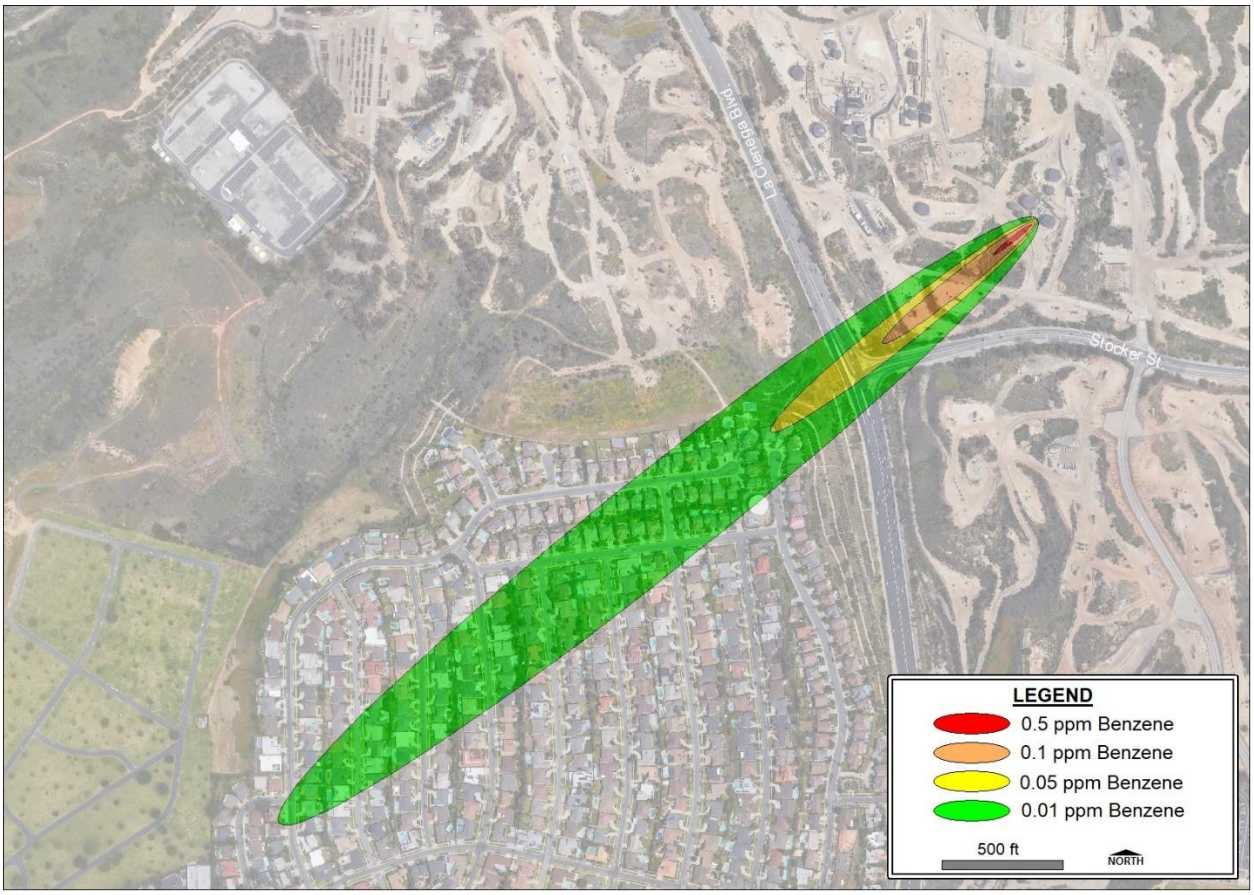

Figure 2 Estimated Odor Thresholds Downwind of the Spill

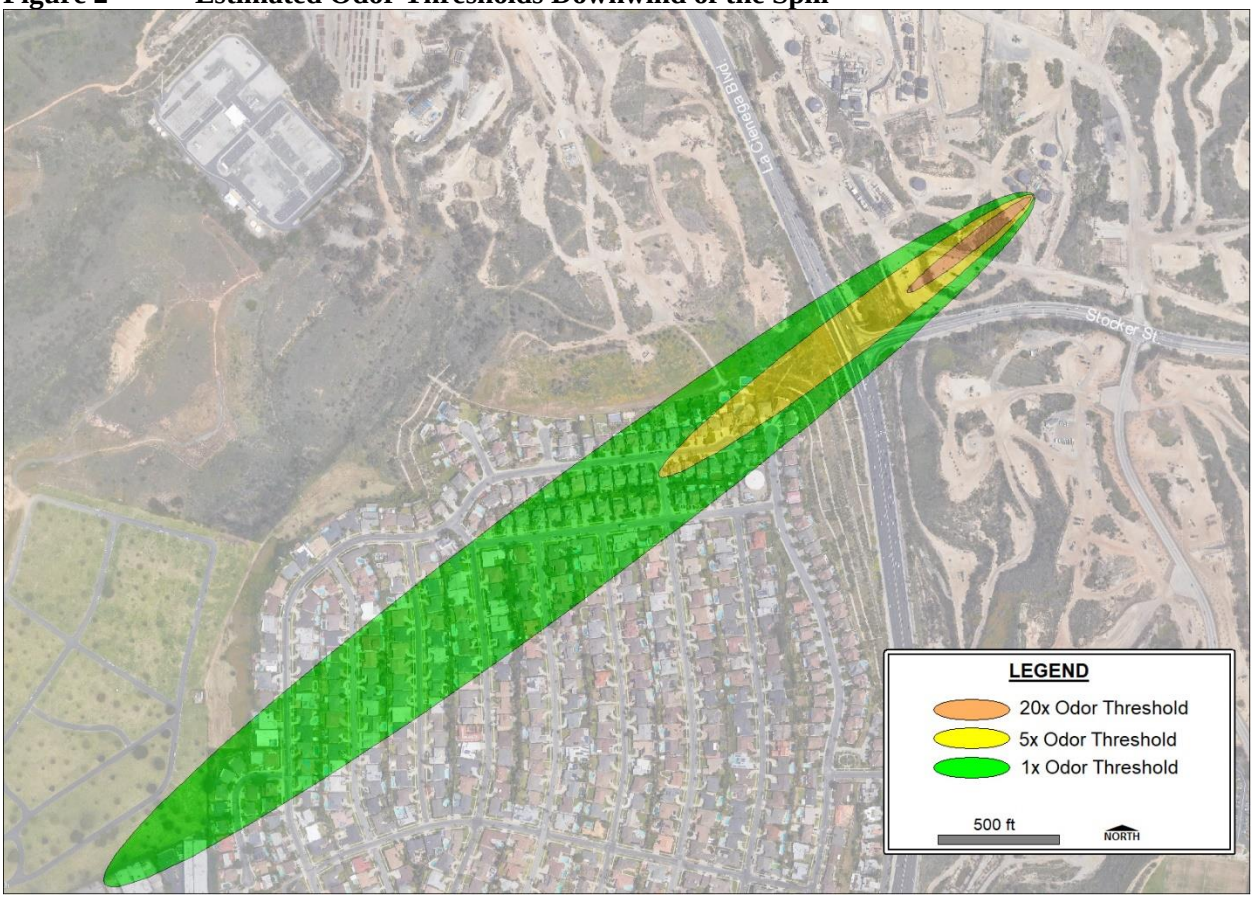

Figure 3 Estimated Health Indices Downwind of the Spill: Individual Components

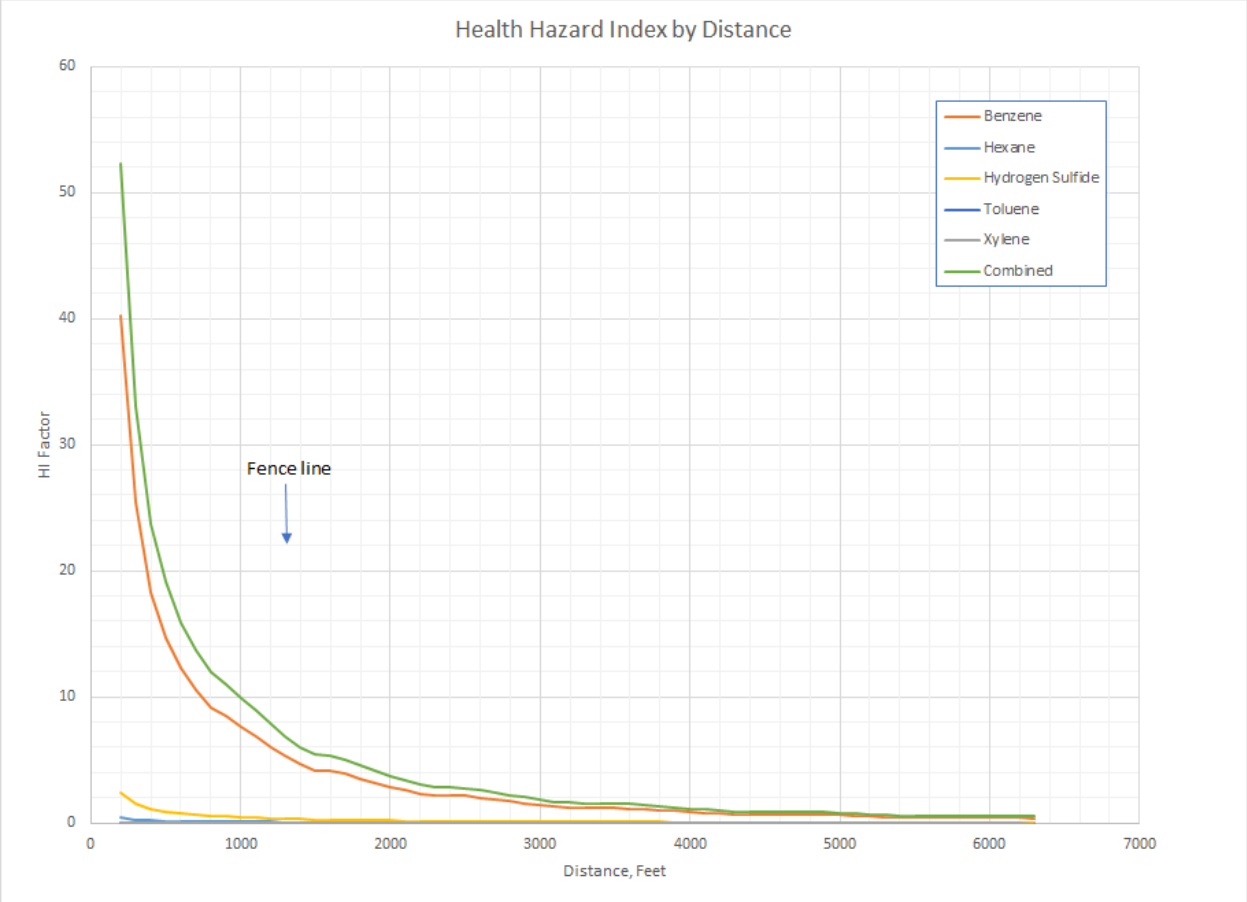

Figure 4 Estimated Odor Impacts Downwind of the Spill: Individual Components