

Summary: Analysis of Data Collected during Well Stimulation Treatment Operations

This document provides a summary of results from air monitoring conducted during well stimulation (hydraulic fracturing, or “fracking”) events on California oil fields. CARB initially published the detailed air monitoring results and health analyses online¹ in Summer 2020.

Well stimulation treatment (WST) operations are regulated² by the California Geologic Energy Management Division (CalGEM), requiring every well stimulation event be permitted. Oil operators completed air monitoring to fulfill a CalGEM permit requirement requested by CARB for selected WST events.³ CARB funded data analysis to further evaluate monitoring efforts and better understand the data collected. These efforts are part of CARB’s efforts to better understand air quality impacts of oil and gas operations.

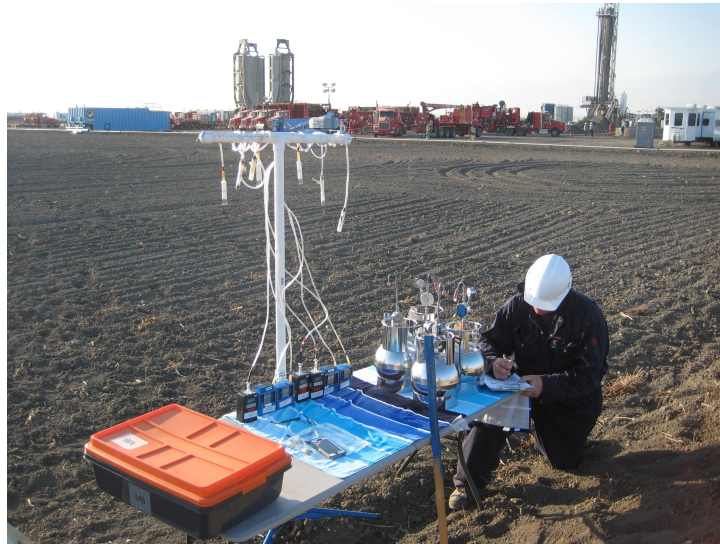


Figure 1. Air Sampling Station during WST.

Data Collection and Monitoring

- Between December 2016 and September 2018, oil field operators hired contractors to perform air monitoring (Figure 1) during 20 WST operations. CARB staff prepared the air monitoring plan and observed a majority of the events monitored.

¹ <https://ww2.arb.ca.gov/resources/documents/analysis-data-collected-during-well-stimulation-treatment-operations>

² California Code of Regulations Title 14, Division 2, Chapter 4, Subchapter 2

³ Memorandum of Agreement among the Department of Conservation, Division of Oil, Gas, and Geothermal Resources (now California Geologic Energy Management Division) and California Air Resources Board and Local Air Districts Regarding Well Stimulation Treatments and Well Stimulation Treatment Related Activities. 2014. https://www.conservation.ca.gov/calgem/for_operators/Pages/mou_moa.aspx

- CARB’s air monitoring plan⁴ targets over 100 compounds including volatile organic compounds and toxic air contaminants. These compounds were chosen to reflect compounds used in previous WST events and to match the capabilities of commercial laboratories.
- Air sampling occurred during WST operations in 5 oil fields (See Figure 2: North and South Belridge, Buena Vista Nose, Elk Hills and Lost Hills) and included:
 - 2 reference sites (one on the oil field ~1000 feet from any stimulated well, and one at the upwind boundary of the oil field, ~1,600 feet away from the stimulated well). These data were collected prior to the WST event.
 - 8 sampling stations in a 300-500-foot radius around the well stimulated. These stations were placed both in upwind and downwind positions.
 - 1 meteorological station
 - Air samples were collected continuously over an 8-hour period per sampling event (i.e., reference samples, WST event, and wellbore cleanout)

⁴ California Air Resources Board Air Sampling and Analysis Plan for Well Stimulation Treatment Operations.
https://ww2.arb.ca.gov/sites/default/files/2021-03/PSE_Appendix_A.pdf

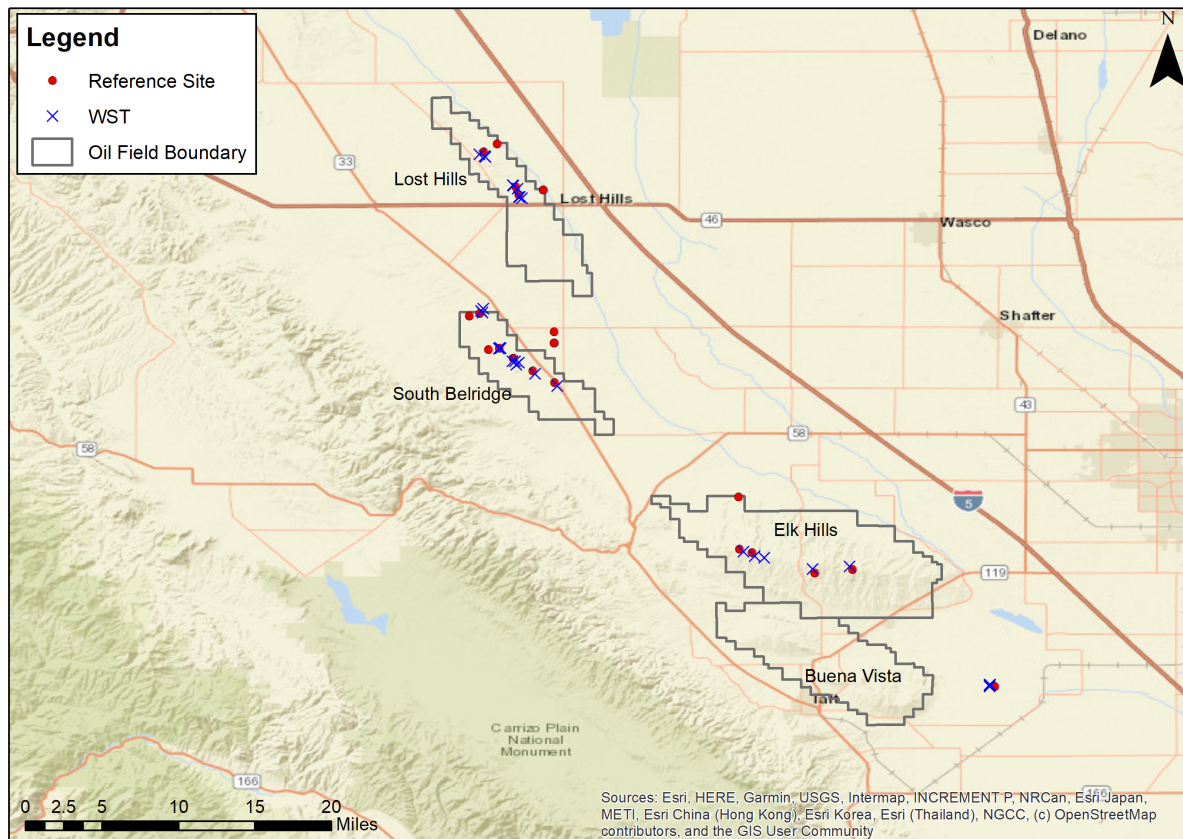


Figure 2. Map of WST and Reference Site Locations.

Results

- No statistically significant differences among results from all monitoring sites, including reference sites. This indicates similar air quality throughout the oil field.
- Health impacts analysis of the measured air quality estimates a cancer risk increase of ~90 in a million. Note: Cancer risk is based on a lifetime (70 years) of inhaling the measured compounds at the location sampled.
- Five compounds have the largest impact on the cancer risk estimate: benzene, formaldehyde, acetaldehyde, carbon tetrachloride and tetrachloroethene. Common sources of these compounds are oil production, combustion (vehicle exhaust), and pesticides.
- Non-cancer health risks were also estimated, and results for all sampling sites indicate exposure to benzene increases the potential for acute health risks such as irritation of the respiratory tract and headaches.⁵ Estimated results from the samples collected at the upwind oil field boundary also indicate an increased potential for chronic health

⁵ EPA, 2016. Benzene 71-43-2. <https://www.epa.gov/sites/production/files/2016-09/documents/benzene.pdf>

risks such as hematologic (blood) impacts, neurological effects, and developmental and reproductive toxicity.⁵

Comparability to Other Studies and Monitoring Efforts

This air monitoring was a unique effort to determine potential impacts of WST events on local air quality. Differences in sampling and analysis techniques can limit direct comparison to other monitoring efforts. Additionally, health risks calculated for this study are based only on the pollutants measured. Caution should be used in comparing these results to health risks reported in other studies, which may monitor for different, or more/less, pollutants. It is also important to note for this analysis, the short duration of the sampling period (8 hours) may overestimate acute risks and underestimate chronic risks.