November 14, 2023

Ms. Karen Gork, MPH, REHS
Chief Environmental Health Specialist
Solid Waste Management Inspection and Enforcement Program
Los Angeles County Department of Public Health – Environmental Health
5050 Commerce Drive
Baldwin Park, California 91706

Subject: Review Chiquita Canyon Landfill (19-AA-0052) Response Letter

Dear Ms. Gork:

CalRecycle staff are providing this letter in response to your request for technical assistance in reviewing the Chiquita Canyon Landfill (CCL) response letter concerning the odor incident.

The following comments are provided to the Los Angeles Local Enforcement Agency (LEA) as assistance to support the program in carrying out its responsibilities on permitted disposal sites. The final determination as to the comments to be provided to the responsible party is within the sole purview of the LEA, acting within the parameters of its discretion, in accordance with its vested authority under its certification as defined in Title 14, California Code of Regulations (14 CCR), Division 7, 27 CCR, Division 2, Subdivision 1 (Section 20005 et seq.), and Division 30 of the Public Resources Code.

For this response, I visited the site on November 2, 2023, and reviewed the following documents submitted to the LEA:

- Chiquita Canyon Landfill Response to CalRecycle Review of the Odor Issues at CCL, dated October 20, 2021;
- SCS Engineers Reaction Area Map, de-watering for CCL dated November 1, 2023;
- SCS Engineers Reaction Area Map, existing wells for CCL dated November 1, 2023;
- SCS Engineers De-watering System Layout or CCL dated September 15, 2023; and
- SCS Field Services Boring Log for the new wells installed July to October 2023.

Site Visit

A multi-agency site visit was conducted on November 2, 2023. Staff from the LEA, CalRecycle, South Coast Air Quality Management District (SCAQMD), Los Angeles

Regional Water Quality Control Board (RWQCB), Department of Toxic Substances Control (DTSC), and the United States Environmental Protection Agency (USEPA) toured the site with CCL staff. During the visit, CCL staff discussed the remedial and odor control actions they had implemented. The CCL has installed 48 new gas control wells. Based on temperature readings during drilling, the new gas wells were constructed using either PVC-SHC 80, CVPC-SHC 80, or stainless steel. While installing the stainless-steel gas wells in some areas with the highest recorded temperatures, three well borings (i.e., CV-1534A, CV-1532B, and CV2338) resulted in the release of leachate under pressure. The CCL is also installing a French drain along the western slope to mitigate the leachate outbreak. To address off-site odors, the CCL staff has placed several agricultural-size fans at the west boundary of the landfill. During the site visit, I detected odors onsite and used real-time field equipment to monitor temperatures, volatile organic compounds (VOCs), oxygen, carbon monoxide, methane, and hydrogen sulfide.

A leachate outbreak in the north at map grid A-5/6 was observed by CalRecycle staff during the site visit. The area around gas well CV-2201 at map grid C-5 was also viewed. See Attachment A photo log for CV-2201. This area has settled 25 to 30 feet since 2022. The slope to the original grade outside the settlement area at gas wells CV-2305 and CV-2315, map grid C/D-6, was walked. At the toe of the slope, a second leachate outbreak and the construction of the French drain at map grid D/E/F-2 were observed. The CCL stated some over-saturated waste had slipped down the toe of the west slope.

During the visit, we discussed whether CCL staff or its consultant had observed industrial waste in the 48 new borings. The staff said the boring materials were typical municipal solid waste, but the observed waste from the reaction area was very wet with little cohesiveness. We also discussed slope instability at the toe of the western slope and whether the French drain would be designed to account for the low shear strength of the wet waste. Lastly, we discussed developing a containment strategy for the reaction area if it expands to the east and impacts the current disposal face. A containment strategy would include the installation of a reaction break made of soil at some predesignated area if the reaction reached the designated containment line.

Reaction

The two CCL reaction site maps from July 2023 and September 2023 show that the incident has expanded in all directions, most notably to the north and west. The approximate size of the incident now is between 30 and 35 acres.

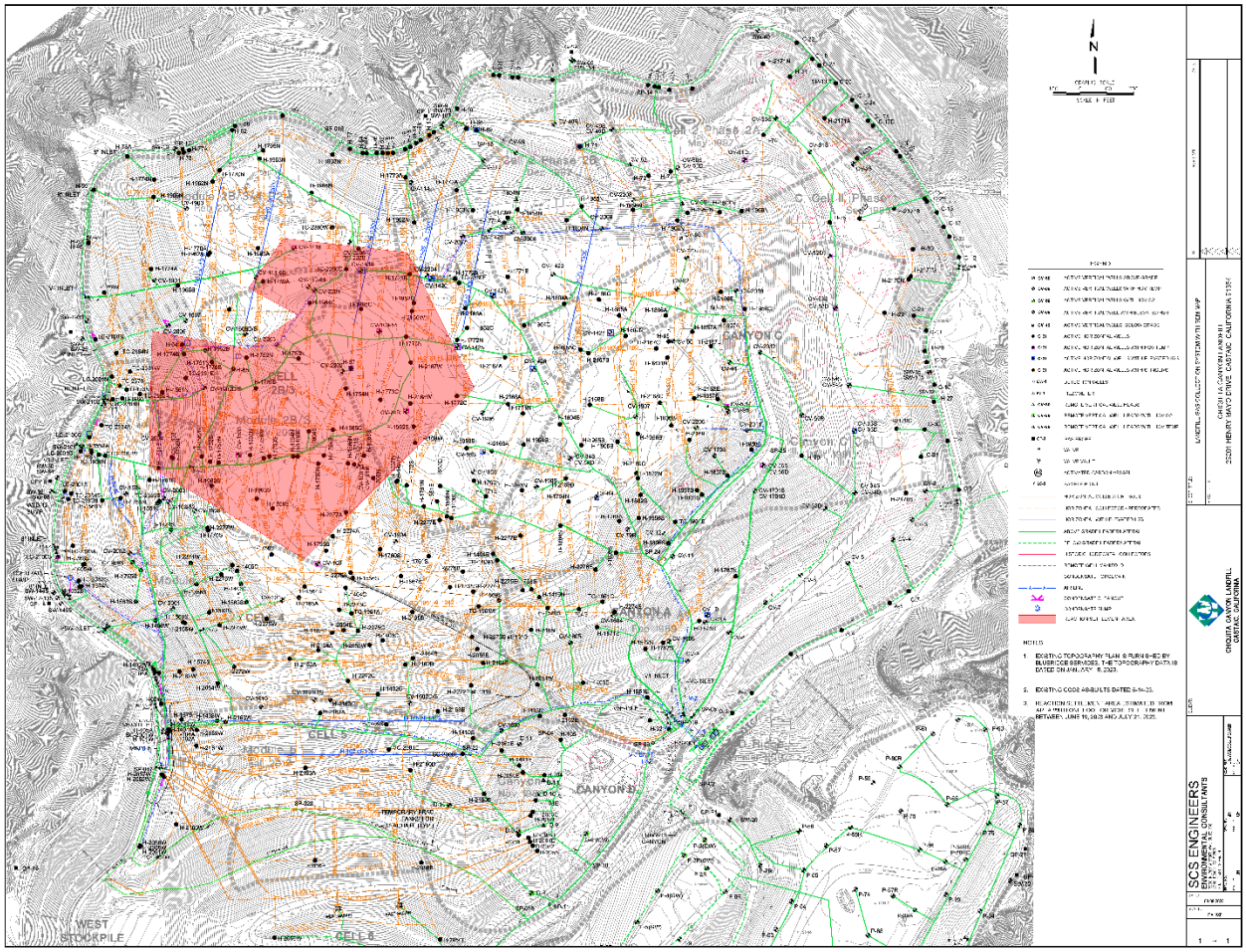


Figure 1. The reaction settlement area at the Chiquita Canyon Landfill. Red indicates one foot or more settlement between June 19, 2023, and July 21, 2023.

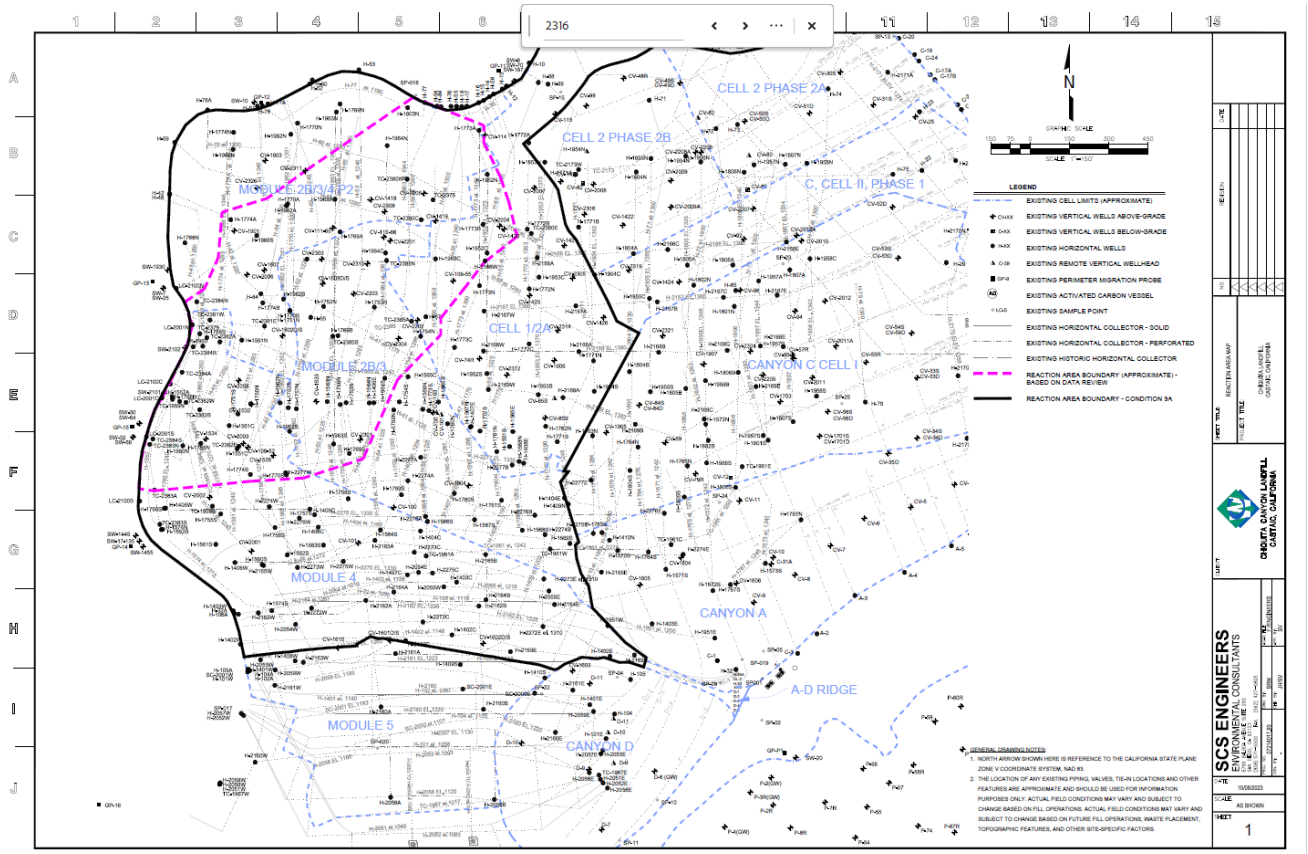


Figure 2. The reaction area is shown as pink dashed lines, September 15, 2023.

CCL Response and Discussions

Based on the site visit and the additional information provided in the CCL comment letter dated October 20, 2023, CalRecycle staff offer the following comments and recommendations.

I. Cause Analysis

Before 2014, the waste industry generally defined an elevated temperate landfill ("ETLF") event if a temperature greater than 131°F was observed at the wellhead, whether or not the site had accepted reactive industrial waste. Post 2014, a new definition for an ETLF was developed for Municipal Solid Waste (MSW) landfills to include temperatures above regulatory thresholds (i.e., 131 or 145 °F) due to abnormal chemical reactions within the waste mass that have not experienced a fire. Around 2015, multiple ETLF studies were carried out through the waste industry research foundation, Environmental Research and Education Foundation (EREF). The research group first proposed that ETLF events were a function of landfill depth. The hypothesis was that an ETLF was a function of the ideal gas law (i.e., PV = nRT) and that the waste at depth experienced higher temperatures because of pressure from the waste above. This hypothesis was disproved using temperature profiles from temperature monitoring

devices at ETLF and temperature data from California landfills with deep-fill designs. Their second hypothesis was that elevated temperatures were from a self-sustaining exothermic pyrolysis reaction; however, the EREF also showed that it did not cause elevated temperatures. The current industrial consensus is that ETLFs are due to abnormal chemical reactions from either an exothermic waste or an unknown reactive industrial waste. In my opinion, there are only three known causes of ETLF: (1) thermophilic bacteria, (2) reactive industrial waste, and (3) oxygen intrusion and resulting oxidation/smolder. Additionally, an ETLF can combine reactions such as aluminum dross, baghouse dust, salt cake, fly ash, or other metal oxide waste that can generate enough heat to ignite the surrounding MSW and cause pyrolysis or a smolder. Also, it is believed that hydrogen gas is only produced in landfill gas at concentrations above 2 percent with ETLFs with abnormal chemical reactions and not as a result of smoldering events. While it is true that the hydrogen gas concentration during the smolder phase is minimal since hydrogen gas is flammable and not a product of combustion if the four phases of smoldering are considered, one can see that a smolder can produce hydrogen gas well over 20 percent[1] [2] at the pre-combustion phase when gasification is occurring. A typical smolder event has a four-step process that consists of (1) pre-heating, (2) evaporation, (3) pyrolysis/gasification, and (4) oxidation/combustion. The pyrolysis/gasification phase is an endothermic reaction that is not self-sustaining and precedes the exothermic smoldering process (oxidation/combustion). The gasification phase will produce hydrogen gas, carbon monoxide, and short-chain hydrocarbons, while the oxidation/combustion phase will produce carbon dioxide, carbon monoxide, and water with substantial heat. It is also true the waste industry typically does not sample for hydrogen gas at the start of a suspected smolder event. The industry typically monitors for carbon monoxide and fixed gasses using field equipment.

Based on discussions with the landfill staff and a review of the 48 new boring logs, no reactive industrial waste was discovered in the reaction area. This result is expected since it would be remarkable that CCL accepted an unknown reactive industrial waste in an area over 35 acres in Cell 1/2A, Module 2B/3, Module 2B/3/4 P2, and Module 4.

II. CalRecycle's Recommendations 1 to 15 (Note: only 2, 8, 9, 13 are discussed further)

Regarding the previous set of recommendations presented to the LEA in our October 16, 2023, letter, we have the following changes and additions:

Recommendation #2: Place and compact a soil cover at least 24 inches in depth

Additional Comment: A flexible membrane liner ("FML") can prevent surface emissions

[1] Brown, Joshua K., "Hydrogen-Rich Syngas Derived from Smouldering Biomass and Hydrocarbon Wastes" (2022). Electronic Thesis and Dissertation Repository. 8496.
https://ir.lib.uwo.ca/etd/8496

[2] Jafar, Navid H. et al. “Progression of Elevated Temperatures in Municipal Solid Waste Landfills” (2017). American Society of Civil Engineers

of landfill gas while reducing oxygen infiltration. However, a soil cover can be implemented within weeks to reduce the exceptionally high concentrations of surface emissions and leachate seeps. Quickly implementing soil cover will reduce odors and impact the community. The FML can be installed at a later date to reduce odors further. The current intermediate cover should not be viewed as adequate to minimize odors.

Recommendation #8: Sample the leachate for benzene and other volatile organic compounds.

Additional Comment: It is recommended that all known liquids and soils/sludge from the reaction area be appropriately characterized. With temperatures documented over 200°F in the reaction area, all leachate and sludge should be tested in addition to the current leachate testing program. CCL should not assume the leachate at the sumps or on the liner is the same as the leachate from the reaction area. At least ten direct leachate samples from the highest temperature wells with pumps should be collected to ensure the leachate is not chemically different from the leachate as the outbreaks or at the leachate collection sumps. The samples should follow state and federal hazardous waste regulations for ignitable, corrosive, reactive, and toxic substances. The transporters and facilities receiving the leachate for processing and disposal must be aware of the chemical composition of the leachate and sludge. CCL should provide a list of facilities that have and are currently receiving the leachate from the reaction area. CalRecycle encourages LEA and CCL staff to work closely with staff from the SCAQMD and the Los Angeles Regional Water Quality Control Board (RWQCB).

Recommendation #9: Install temperature monitoring devices.

Additional Comment: While CalRecycle agrees that temperature monitoring devices should not be installed where leachate is under pressure, temperature devices in other locations are necessary to determine the intensity, depth, and direction of the reaction. Temperature devices are the primary method to track the reaction's progression accurately. Table 1 is provided as an initial recommendation for the location of temperature probes. The proposed temperature probe locations include sixteen assessments and six sentry temperature probes. This design would allow the CCL to track the reaction spatially and provide a decision matrix to develop a plan to contain the incident and prevent it from moving east and south.

Table 1. The proposed temperature probe locations using the SCS Engineering Reaction Area Map, dated 11/1/2023.

Area for Temperature Probes	**Number and Location of Temperature Probes**
Northern Flank, Map B3	One: In between CV-1908 and CV2326
Western Slope, Map C3 to H3	Three: Next to CV-2006, CV-2342A, CV-2002
Southern Flank, Map F3 to H5	Four: Next to CV-2344, CV-1610 (Sentry), 50 feet to the south of CV-2348
Eastern Flank, Map	Fourteen: Next to CV-2302, CV-2204, CV-100 (Sentry), H-2277A, CV-103, CV-74R, CV-1425, CV-1421, CV-2204, CV-1423 (Sentry), CV-2333, CV-99 (Sentry), CV-1906 (Sentry), CV-85S (Sentry)

Recommendation #13: Consider installing remote telemetry technology to continuously collect and analyze landfill gas data at the collection wells.

Additional Comment: CalRecycle agrees that wells with significant leachate issues, high temperatures, pressure, or material viability issues are unsuitable for telematic technology. CalRecycle recommends outfitting all temperature probes with remote telemetry technology to track the reaction.

Further Recommendations

Based on my site visit and discussions, CalRecycle staff recommend the LEA consider working with CCL and the other regulatory agencies toward implementing these additional actions:

1. CCL should develop a written plan that tracks the fissures, settlement, and tension cracks in the soil cover, marking the location and documenting the length and severity.
2. Given the prior slope instability on the western slope near the leachate outbreak, CCL should perform a slope stability analysis in this area, as saturated waste has very low shear strength.
3. CCL should collect temperatures in and around the reaction area to ensure all infrastructure improvements meet manufacturer maximum temperature design specifications and/or recommendations.
4. CCL should develop a reaction break plan and propose a set of criteria (e.g., what temperature at which temperature probes) that would require the CCL to install a soil barrier between the reaction and operational areas. The plan should propose the depth, width, and location of the containment trench (wall) based on temperature readings collected by the temperature probe network.

Attachment A contains several photos from the site visit on November 2, 2023. Please do not hesitate to contact me by telephone at (916) 341-6356 or by email at Todd.Thalhamer@Calrecycle.ca.gov if you have comments or questions.

Sincerely,



Todd Thalhamer, P.E.
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CalRecycle

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Attachment A
Photo Log
CCL Site Visit, November 2, 2023



Photo 1. Location of northern leachate outbreak, CCL November 2, 2023.



Photo 2. Gas well CV-2201 at CCL, November 2, 2023.



Photo 3. Location of western leachate outbreak, CCL November 2, 2023.



Photo 4. Location of western leachate outbreak, CCL November 2, 2023.

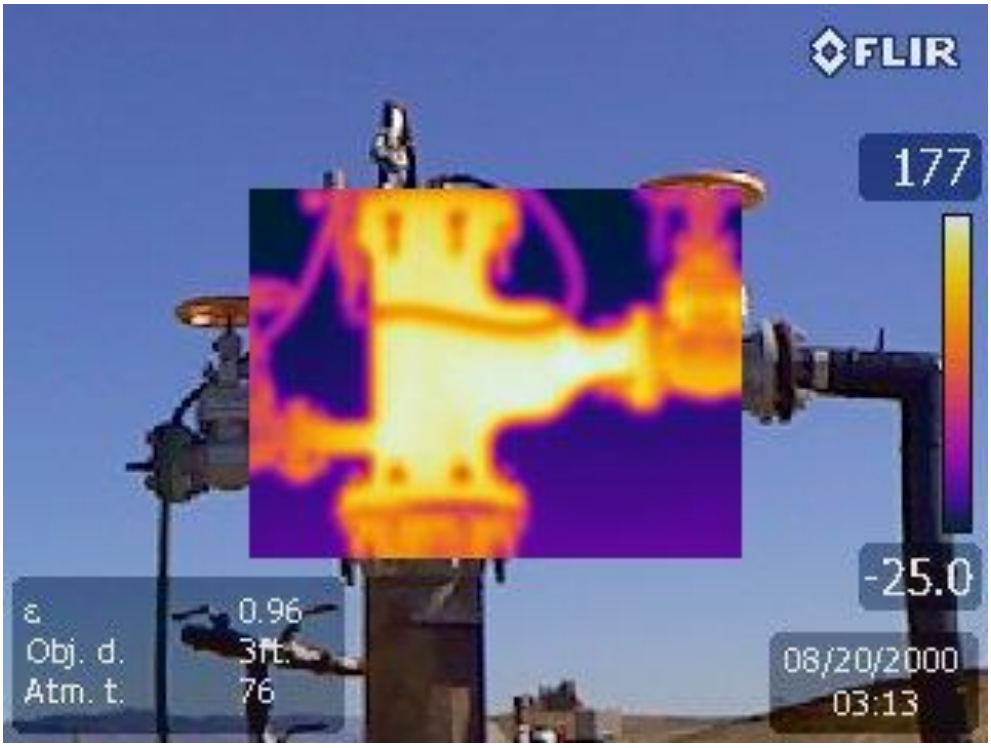


Photo 5. FLIR image of gas well with temperature range up to 177°F at CCL, November 2, 2023.

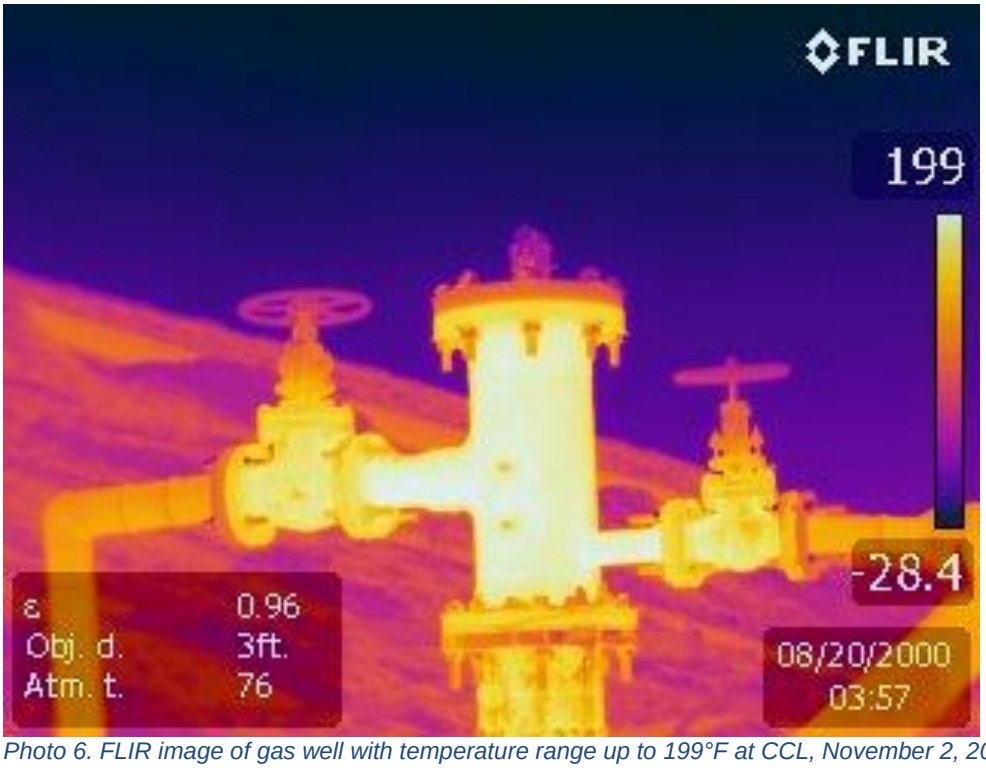


Photo 6. FLIR image of gas well with temperature range up to 199°F at CCL, November 2, 2023