California Environmental Protection Agency

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CalRecycle Department of Resources Recycling and Recovery

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September 20, 2024

Via Email:kgork@ph.lacounty.gov

Karen Gork Chief Environmental Health Specialist Los Angeles County Department of Public Health 5050 Commerce Drive Baldwin Park, California 91706

Subject: Chiquita Canyon Landfill (19-AA-0052) Review – Revised Soil Reaction Break/Barrier Plan dated July 8, 2024

Dear Ms. Gork:

CalRecycle staff is providing this letter in response to your July 2024 request for technical assistance in reviewing the subject Chiquita Canyon Landfill's (CCL) Revised Soil Reaction Break/Barrier Plan.

The following comments are provided to the Los Angeles County Department of Public Health [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.

Discussion

The main waste area, which contains the 40-acre reaction area, consists of cells 1 and 2, modules 1 to 5, and canyons A to D. Figure 1 identifies the current area covered by the geomembrane as of September 5, 2024.

The subject plan recommends installing additional temperature monitoring probes (TMP), placing a soil layer over where the reaction occurs, and injecting inert material as a barrier layer. The plan deems other methods, such as inert material barriers, air breaks, and trench excavations, implausible due to incompatible timelines, logistical and public concerns, increased air emissions and potentially hazardous conditions,

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increased fire risk, and/or impaired ability to address Elevated Temperature Landfills (ETLF).

CalRecycle staff has determined that the Revised Soil Reaction Break/Barrier Plan is insufficient to control shallow reaction expansions, which may lead to rapid reaction expansion and jeopardize the entire 190-acre main waste area.

It appears the CCL is no longer using the term "unknown chemical reaction" to describe the reaction at the landfill but has adopted an industry-developed term, Elevated Temperature Landfill (ETLF). However, this term also does not indicate a cause of the reaction. The waste industry claims ETLFs are generally characterized when municipal solid waste (MSW) decomposition is impeded by heat accumulation and are not smoldering fires.

To date no evidence to support this conclusion has been provided for this incident. Nor has a root cause analysis been performed for this incident by examining the conditions that led to the initial event at gas control wells CV-109-55, CV-1419, and CV-1418. Before 2014, the waste industry generally defined a Subsurface Elevated Temperature (SET) Event as a gas wellhead temperature measured greater than 131°F at a site that had accepted unknown or reactive industrial waste. After 2014, the waste industry changed the definition of a SET Event to a landfill that had measured wellhead temperatures above the regulatory thresholds of 131°F or 145°F from an abnormal chemical reaction and not a subsurface fire or waste smolder.

Around 2015, the Environmental Research and Education Foundation (EREF) conducted multiple studies on SET Events. The research group selected for the EREF study first proposed that SET Events were a function of landfill depth. This hypothesis for a SET Event was based on the ideal gas law (i.e., PV = nRT, where P is pressure, V is volume, n is the number of moles in the gas, R is the gas constant, and T is temperature). Using the ideal gas law, the EREF studies surmised that the increased pressure created by the waste above can generate higher temperatures as waste depth increases. This hypothesis was disproved using vertical temperature profiles derived from using thermocouples at several landfills experiencing a SET Event and temperature data from California landfills with deep-fill designs.

The second hypothesis of the EREF-sponsored research was that a self-sustaining exothermic pyrolysis reaction caused SET Events. This hypothesis was disproven in 2022 because EREF revealed that self-sustaining exothermic pyrolysis reactions did not cause SET Events. As a result, the current waste industry consensus is that SET Events are due to landfills accepting unknown industrial waste (e.g., aluminum dross) that causes unknown chemical exothermic reactions under certain conditions. The industry consensus that landfills with SET Events have accepted unknown reactive industrial wastes is not supported by any published research, root cause analysis per USEPA, New Source Performance Standard (NSPS) regulations, probable cause assessment, or post-industrial chemical investigation such as ones performed by the United States Chemical Safety Board. While some landfills knowingly and unknowingly

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accept reactive industrial waste, suggesting that a landfill can accept some unknown industrial waste disposed of over 20 to 80 acres at the same elevation in different waste cells with interim soil covers constructed 2 to 10 years apart is unlikely. Additionally, the CCL has stated the facility has not accepted any hazardous or reactive wastes during its operational period.

CalRecycle staff maintains there are only three known causes of a SET Event: (1) thermophilic bacteria, (2) reactive industrial waste causing heat, and (3) combustion, pyrolysis, and/or smoldering due to oxygen intrusion. To suggest a SET Event cannot be related to a fire or smolder and can only be caused by a landfill accepting industrial waste is unrealistic.

Lastly, the CCL stated they are "not aware of regulations or guidance published by federal or state regulatory agencies that inventory specific numerical values for these parameters," which is factually incorrect. The CCL is correct that no federal or state regulations or published guidance that inventory specific numerical values for these parameters for unknown chemical reactions or ETLFs.

However, SCS Engineer Robert P. Stearns was the first in the nation to establish criteria for identifying and controlling landfill fires in 1984. CalRecycle and other state regulatory agencies later referenced the Stearns criteria in many guidance documents. The USEPA also implemented new landfill gas control regulations to investigate and control SET Events. The USEPA and the Ohio EPA developed a set of criteria in the following document:

Final Report, Work Activities Pursuant to Administrative Agreement and Order on Consent for Removal Action (AOC), Docket No. V-W-'08-C-897, Countywide Recycling and Disposal Facility, East Sparta, Stark County, Ohio, dated October 2009

The criteria determined when and where to install the air break at the Countywide Landfill. There are also other documents available with specific break criteria for the Bridgeton Incident in Missouri.

Criteria for Reaction Area

Several criteria and details must be established to install a barrier in a SET Event. The first issue is to provide a starting point for the SET Event area. The recent TMP data from August 30, 2024, and September 12, 2024, the reaction is beginning to show the following:

- Temperature increases outside the geomembrane at shallow depths of 15 to 30 feet at TMP-8, TMP-10, TMP-13, TMP-15, and TMP-17.
- The 15-foot thermocouple at TMP-8 showed a change in maximum temperature of 16.2°F in 14 days from 115.3°F to 131.5°F from August 30 to September 11, 2024 and the 30-foot thermocouple showed a change in maximum temperature of 16.8°F in 14 days from 120.0°F to 136.8°F from September 1 to September 11, 2024.

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- TMP-10 increased by 19.8°F within 48 hours from August 30 to September 5, 2024, and 41.6°F in 14 days from 126.1°F to 167.7°F from August 25 to September 8, 2024.
- TMP-13, TMP-15, and TMP-17 also show temperature spikes of 20°F to 25°F during the week of August 16 to August 22, 2024. The most significant temperature spike was from TMP-15, where the temperature rose 33.4°F in one day from September 5 to September 6, 2024, at the 30-foot thermocouple. Figures 2 and 3 show examples of the shallow temperature spikes in TMP-13 and TMP-10, respectively.
- The CCL-identified reaction zone from the depths of 70 feet to approximately 140 feet has remained consistent since July 26, 2024.

Based on the CCL's project data, past settlement rates, fissure reports, drilling logs, TMP data, field observations, odor data, landfill gas (LFG) data, 24-hour high temperature reports required by Title 40 of the Code of Federal Regulations (40 CFR) Section 63.1981(k), physical evidence, and other factors there are three distinct areas of concern: the primary reaction reported by CCL and two newly identified smaller reaction areas to the east and the south. The data also indicates that the main reaction area is larger than reported by the CCL. As of August 1, 2024, CalRecycle considers the reaction boundary to be defined as the entire area under the geomembrane cover identified in Figure 1.

Criteria for Barrier Installation

The CCL proposes to install the reaction break/barrier at the primary and/or secondary engagement lines, as shown in Figure 4, only if all the Threshold Criteria Limits shown in Exhibit 1 are exceeded at the corresponding Sentinel Monitoring Network (i.e., TMPs and associated vertical LFG extraction wells). The criteria for implementing containment strategies will be the same as determining whether the reaction is expanding with several verifications to ensure the decision to install a barrier is valid. Temperature will be the primary standard for installing a barrier, with LFG data being the secondary standard.

CalRecycle Recommended Barrier Activation Requirements

Exhibit 2 presents the recommended barrier activation requirements. Should condition one or two in Exhibit 2 below be exceeded, the CCL will implement a barrier strategy based on the depth of the reaction.

Temperature Criteria

The CCL has proposed a temperature of 250°F as one of the metrics for installing a barrier. The highest recorded temperature to date in the reaction area has been approximately 230°F. Using a temperature requirement of 250°F would allow the reaction to continue to expand as it has since January 2022. Additionally, using a down well temperature of 250°F in PVC schedule 80 gas wells outside the reaction area is

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also problematic due to the thermal breakdown and the collapsing of PVC well casings at temperatures above 180°F.

Based on current reaction temperature data, CalRecycle recommends that the temperature criteria be based on actual recorded maximum temperature and changes in temperature observed over a short period. The temperature baseline for TMPs, wellheads, and down wells outside the reaction area will be August 1, 2024. Should new wells or TMPs be installed or new down well temperatures be collected, the baseline temperature will be the initial temperature collection.

CalRecycle recommends that if the in-situ waste temperature from a TMP exceeds 230°F, a down well gas temperature exceeds 230°F, or a temperature recorded from drill tailings using a forward-looking infrared (FLIR) device exceeds 250°F, the CCL will implement one of the barrier strategies discussed below within 30 days.

Landfill Gas Composition Criteria

CalRecycle concurs with the CCL's temperature requirement of 190°F for wellhead or down well temperatures and other LFG data to confirm that a barrier should be installed as a secondary standard. LFG data (i.e., O₂, CO, H₂, CH₄, CO₂) will be analyzed using laboratory methods.

If the temperature does not exceed the criteria listed in condition one but does exceed 190°F or increases by 50°F within 30 days, additional landfill gas will be collected twice and analyzed for CO, H₂, CH₄, and CO₂ within 15 days. The CCL will also sample the four adjacent wells for the field gas data. If the adjacent wells do not show indications of a reaction for temperature or landfill gas indicators, three additional monitoring events for temperature (i.e., wellhead and down well) and landfill gas (i.e., O₂, CO, H₂, CH₄, CO₂, and TO-15) will occur every 30 days. The landfill will submit the results of each sampling event to the LEA for consultation. Should the results in the adjacent wells not show an increase in temperature or problems with O₂, CO, H₂, CH₄, CO₂, or TO-15, the target well should continue to be monitored every thirty days until the temperature stabilizes and is repeatable.

The CCL will meet with the LEA and other agencies to discuss the results and determine whether additional sampling or a barrier is required. The barrier construction decision will be based on temperature and the following landfill gas criteria: CO above 1,500 ppm, H₂ above 5 percent, or CH₄ below 15 percent. For recommended criteria, see Exhibit 2. If the LEA determines a barrier is required, the CCL will submit a work plan for approval.

Settlement Rate Criteria

The CCL proposes to use strain rate and change in historic change strain rate as criteria to implement the barrier plan. Criteria based on settlement rates are post-SET Event indicators, and CalRecycle does not recommend their use as criteria to

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implement proactive protective measures such as a barrier. Settlement rates and tracking are critical physical properties that can help identify the reaction rate of expansion occurring through an area.

Other Criteria

There is little evidence that dimethyl sulfide and COD are reliable indicators of a SET Event, and CalRecycle does not recommend their use. While high benzene concentrations have been shown to occur at SET Events, the temperature in waste at which benzene is produced at the regulatory threshold level has yet to be determined. CalRecycle agrees with the CCL and will not use benzene as a criterion to install the barrier at the CCL. Benzene levels will be used to support the other known SET Event landfill gas criteria.

Barrier Strategies

As requested, the CCL reviewed historical documentation to research how waste disposal units were constructed and operated. The review efforts focused on the existence and location of any physical features that could impede the propagation and movement of reaction within the waste mass. The CCL found no cell separation berms or legacy roads that would prevent the reaction from limiting the movement. The evaluation of intermediate soil cover layers between cells to provide a fuel break was inconclusive. A 2004 imagery shows soil placed up against the western and southwestern side slopes of Cell 1/2A, Cell 2 Phase 2B, and Canyon A slopes, but recent well logs did not provide evidence that there was a substantial intermediate cover.

As such, the plan lists the following five potential scenarios to impede the reaction:

- 1) Air break through avoidance of placement of additional waste lifts overlying existing buried wastes.
- 2) Air break through excavation to "cut out" existing buried wastes.
- 3) Soil barrier through placement of soil layer atop existing landfill surface.
- 4) Soil barrier through excavation and backfilling of a deep trench.
- 5) Inert material barrier through borehole drilling, dewatering, and flowable fill injection.

The plan states that while an air break (Scenario #1), an air break excavation (Scenario #2), and a soil barrier through excavation (Scenario #5) may be plausible at other SET Events, the CCL deemed them implausible or unsuitable for implementation at the CCL. The CCL proposes to implement a combination of placing a soil layer atop the existing landfill surface and the construction of an inert material barrier through borehole drilling, dewatering, and flowable fill injection.

CalRecycle Recommended Barrier

If the reaction is less than 50 feet deep, a soil trench, soil boring, or combination will be required to create a fuel break and contain it.

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The trench will be 4 feet wide and at least 40 feet deep or to the leachate liquid level. Low-permeability soil will be placed and compacted in lifts to achieve a permeability of no greater than 1×10^{-5} cm/s. The excavated trash will be logged for physical properties, including temperature from a FLIR, physical condition, and color. If the waste is not reactive, it may be placed in the disposal area indicated in the work plan. If the waste is reactive, the material should be removed from the main waste cell, taken to a predesignated staging area, and handled in a method approved by the LEA.

For reactions at depths greater than 50 feet, an inert material barrier can be constructed through borehole drilling, dewatering, and flowable fill injection. Should the injection method be ineffective at containing the reaction, a vertical barrier would be drilled to a depth of at least 50 feet or the liquid level by a bucket auger drill rig with a 3 to 4-foot diameter auger. The resulting vertical elements will be backfilled with a soil-bentonite or cement-bentonite mix that will resist heat transmission through the barrier. The shafts would be tangent (i.e., touching or overlapped), as shown in Figure 5, to create a continuous barrier across the narrow point of the landfill.

Additional TMP Installation

CalRecycle recommends that the LEA accept the proposed additional TMPs listed in Appendix D, Proposed "Sentinel" Temperature Monitoring Probes and Primary & Secondary Engagement Lines. In addition, due to the recent temperature spike at TMP-10, the CCL should add one TMP at the location shown in Figure 6. This temperature probe should be the first TMP installed.

Summary of Recommendations for LEA Consideration

CalRecycle Staff recommends the LEA consider the following:

- Require the CCL to revise the plan to incorporate the threshold limit criteria presented in Exhibit 2.
- Require the CCL to revise the plan to incorporate the barrier construction recommendations.
- Accept the proposed additional TMPs listed in Appendix D, Proposed "Sentinel" Temperature Monitoring Probes and Primary & Secondary Engagement Lines. In addition, due to the recent temperature spike at TMP-10, the CCL should add one TMP at the location shown in Figure 6. This temperature probe should be the first TMP installed.
- Allow no waste to be placed closer than 500 feet from the current reaction area.
- Recommend that the CCL limit oxygen to no more than 2 percent in any interior gas well within the main waste area.

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If you have comments or questions, please call (916) 341-6356 or email Todd.Thalhamer@Calrecycle.ca.gov.

Sincerely,

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Figure 1. Current Reaction Area Under the Geomembrane Area as of September 5, 2024.

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Figure 2. Temperature Spike at TMP-13 as Measured at 30 Feet from July 12 to August 16, 2024.

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Vertical Temperature Profiles from Temperature Probes at Chiquita Landfill for TP-10

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Figure 3. Temperature Spike at TMP-10 as Measured at 30 Feet from July 26 to September 12, 2024.

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Figure 4. CCL's Temperature Probe Installation Project, Dated July 2024.

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Figure 5. Vertical Shaft Barrier.



Figure 6. Location of Additional TMP Shown on the CCL's Temperature Probe Installation Project Map, Dated July 2024.

Threshold Criteria Description	Limitation Value
Temperature	
In-Situ Waste Temperature	250°F
LFG Wellhead Temperature	190°F
Down Well Liquid/Gas Temperature	250°F
Temperature of Drill Tailings Removed from Borehole	N/A
Gas Composition	
Methane-to-Carbon Dioxide Ratio	< 0.75
Hydrogen	> 5.0%
Methane	< 30%
Carbon Monoxide	> 2,000 ppm
Dimethyl Sulfide	> 100 ppm
Benzene	N/A
Liquid Composition	
COD	> 30,000 mg/L
Settlement	
Strain Rate	> 3%/yr
Change in Historical Strain Rate	> 50%

Exhibit 1. CCL's Proposed Threshold Criteria Limits.

Exhibit 2. CalRecycle-Recommended Threshold Criteria Limits to Install a Barrier for the CCL Project.

CalRecycle Threshold Criteria Description	Limitation Value	
Condition 1. Temperature Only		
In-Situ Waste Temperature	> 230°F	
Down Well Liquid/Gas Temperature	> 230°F	
Temperature of Drill Tailings Removed from Borehole	> 250°F	
Condition 2. Temperature Exceedances Requiring Additional Landfill Gas Sampling, LEA Notification, and Consultation.		
Temperature Spike at TMP or Wellhead Within 30 Days	> 50°F	
LFG Wellhead Temperature or Down Well Temperature	> 190°F	
Required LFG Data Criteria ¹		
Hydrogen	> 5.0%	
Methane	< 15%	
Carbon Monoxide	> 1,500 ppm	

¹ LFG Data will be collected every 30 days for three consecutive sampling events from the vertical well or closest vertical well to the TMP. The four next closest vertical wells will also be sampled. Laboratory samples of LFG will be collected and analyzed for O₂, CO, H₂, CH₄, CO₂, and TO-15.