INTRODUCTION

The West Contra Costa Sanitary Landfill Organic Materials Processing Facility (OMPF) is an outdoor, full solid waste permit, composting facility located on top of a closed landfill at 1 Parr Blvd., Richmond. The site is immediately adjacent to San Francisco Bay. The facility is operated by Republic Services. The operation is regulated by Contra Costa Environmental Health acting as the Local Enforcement Agency (LEA) for the enforcement of the State solid waste standards. The applicable standards include the Public Resources Code and the California Code of Regulations (CCR), Title 14, Chapter 3.1. Other state and local agencies also have regulatory authority over the facility (e.g., BAAQMD, RWQCB, Richmond Fire Department, etc.).

Based on site visits, review of documents, and conversations with facility personnel and others, a number of serious operational deficiencies and other issues have been identified. Of particular concern are the excessive amounts of organic material that were allowed to accumulate on site and the subsequent mishandling of this material that did not ensure aerobic conditions be maintained. These factors resulted in large scale anaerobic decomposition, and are believed to be the cause of numerous self-ignition events that have occurred since 2014 and the production and subsequent release of malodorous compounds commencing on or about September 22, 2016.

The initial onset of widespread odor complaints coincided with the spreading of large amounts of organic material that had been allowed to decompose under anaerobic conditions. The spreading was reportedly done for erosion control, which was ill-advised in this situation. The odors generated are consistent with those produced by the anaerobic decomposition of organic material (e.g., butyric acid). Some odor-causing compounds have very low thresholds for human detection. For example, butyric acid is detectable at levels as low as 0.3 μg/m³.
Since the spreading operation for erosion control ceased, there have been subsequent odor releases. These releases are believed to be the result of two factors: (1) further movement and/or modification of the anaerobic piles in an attempt to mitigate the self-ignition and odor issues, including physical screening of the material to remove contaminants and (2) elevated pile temperatures which may have driven off malodorous compounds from within the piles.

Republic Services transported material from the OMPF to the Keller Canyon Landfill (KCL) in Pittsburg, which resulted in odor complaints associated with that facility. The LEA had previously expressed concerns to Republic Services that bringing this material to KCL must not result in odor problems.

The Bay Area Air Quality Management District (BAAQMD) and the LEA have expended significant resources in response to the odor issues at both facilities. It is anticipated that increased regulatory oversight will be necessary for the foreseeable future. Under the State solid waste standards, the LEA is required to inspect the OMPF at least once per month. Since, early August, in response to concerns about fires, the LEA increased the inspection frequency to at least twice per month. The odor complaints, which began in September, necessitated the LEA visiting the site several times per week, including evenings and weekends. Since July 2016, the LEA has met with the operator on numerous occasions to discuss the fire and odor issues and needed improvements to the operation, including specific training recommendations. The LEA will encourage further discussion with the operator to help improve its operation and associated documents (e.g., the RFI).

**FIRES AND ODORS**

Since 2014, there have been at least 15 fires or other combustion events (e.g., smoldering) at the OMPF. Other combustion events included a visibly smoking pile or one where the smell of smoke is detected at the organic material piles. In July 2016, the LEA directed the operator to take steps to prevent further fires, including the removal of excessive amounts of material that had accumulated at the site.

The Report of Facility Information (RFI) for the OMPF specifies maximum amounts of certain types of materials and allowable process times (see Tables 1 and 2, respectively). In some cases, the amount of material on site greatly exceeded that allowed by the RFI. For example, the maximum amount of “curing compost” allowed onsite is 32,000 yd$^3$, but 359,054 yd$^3$ were found during an August 9, 2016 inspection by the LEA. Failure to follow the provisions in the RFI, if such a requirement is made a condition of the solid waste permit, is a violation of California Public Resources Code §44014(b).

LEA staff began directly measuring the piles in August 2016 and recorded the amounts of various types of materials associated with the compost operation (see Table 1).
Table 1. Volumes of Material Allowed and Observed at the OMPF, Fall 2016 (cubic-yards/yd³)

<table>
<thead>
<tr>
<th>Material</th>
<th>Permitted amount</th>
<th>Estimate on 8/9/16</th>
<th>Estimate on 8/26/16</th>
<th>Estimate on 9/9/16</th>
<th>Estimate on 9/27/16</th>
<th>Estimate on 10/6/16</th>
<th>Estimate on 10/8/16</th>
<th>Estimate on 11/17/16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedstock on site</td>
<td>59,000</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Active compost</td>
<td>150,000</td>
<td>0</td>
<td>42,489</td>
<td>14,739</td>
<td>3,962</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Curing piles</td>
<td>32,000</td>
<td>359,054</td>
<td>204,889</td>
<td>126,389</td>
<td>67,267</td>
<td>44,371&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>49,757&lt;sup&gt;(1)(2)&lt;/sup&gt;</td>
<td>41,147&lt;sup&gt;(3)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Stabilized compost</td>
<td>64,000</td>
<td>7,540</td>
<td>600</td>
<td>4,400</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total operating capacity</td>
<td>305,000</td>
<td>366,594</td>
<td>247,000</td>
<td>154,528</td>
<td>71,229</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) Just the anaerobic pile was measured these days.
(2) This number did not include the large windrow pile on the west side of the receiving and chipping area. The operator was screening material from that pile on this date.
(3) Only curing piles measured this day.

Table 2. Process Times for OMPF Materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Maximum allowable process times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedstock/material received</td>
<td>Within 7 days of receipt; food waste within 24 hours</td>
</tr>
<tr>
<td>Windrows/active compost pile</td>
<td>8-12 weeks depending on desired quality of product</td>
</tr>
<tr>
<td>Curing pile</td>
<td>Not specified in RFI; usually up to 6 months</td>
</tr>
<tr>
<td>Screened material/overs</td>
<td>Not specified in RFI; either removed or placed back in windrows for additional composting within 7 days of screening as per CCR, Title 14, 17867(a)(11).</td>
</tr>
<tr>
<td>Final compost product</td>
<td>Not specified in RFI. The material is not to leave the site as compost until laboratory results show the material passes pathogen/metal concentration requirements.</td>
</tr>
</tbody>
</table>
On or about September 22, 2016, the operator moved a large amount of organic material from the compost piles and spread it on the south, west, and north facing slopes of the closed landfill, reportedly as an erosion control measure. This disturbed material, especially in combination with the large surface area created by the spreading operation, released odors that were detected by numerous West County residents, in some cases more than 5 miles distant.

The operator is required by statute and regulations, as well as its solid waste permit, to not cause odors or other nuisances, and this operational requirement should have been taken into consideration before spreading or otherwise disturbing this material. The odors released are consistent with those produced by compost that has undergone anaerobic decomposition (e.g., butyric acid). An unprecedented number of complaints were received by various government agencies, including the BAAQMD, the LEA, Contra Costa Hazardous Materials Division, Supervisor John Gioia’s office, and the Contra Costa Fire District. As of November 8, 2016, various entities have received more than 300 odor complaints from area residents and businesses. It is believed the number of impacted residents was much greater.

The solid waste permit for the OMPF requires that aerobic conditions be maintained. Failure to maintain aerobic conditions can result in the production of malodorous odors or cause a self-ignition event, and may also result in an unusable final product for which diversion credits were obtained. In response to odor complaints, the BAAQMD conducted an extensive investigation that lasted several weeks. Both the BAAQMD and the LEA are confident that the source of the odor complaints was the compost operation at the OMPF.

The LEA issued a Cease & Desist order on October 4, 2016, which among other requirements prohibits the facility from causing further odor problems. This order was violated on several occasions and the operator is subject to the applicable penalties. The LEA is currently exploring enforcement options and cost recovery.

**ASSESSMENT OF THE COMPOST PROCESS AT THE OMPF**

LEA staff performed a review of the operation, including the facility’s RFI and Odor Impact Minimization Plan (OIMP). The flow of the compost material was assessed from collection to its final destination, with the goal of identifying steps where procedures and protocols must be implemented to minimize the risk of deleterious impacts (see Fig. 1). It is the intention of the LEA to require that the operator revise the RFI and OIMP so as to improve the composting operation. Other items may be of an advisory nature (e.g., issues associated with collection). Additionally, the LEA will conduct a review of the solid waste permit, and make any necessary revisions to that document.
Figure 1

Compost Operation Flow-Chart

**Step 1: Curbside and Business Collection** – During the LEA visit on October 7, 2016, a high level of contamination (i.e., plastic) was observed in both the feedstock material and the material that had been spread on the landfill slopes. This is reportedly a common condition at this facility. The current solid waste standards allow a one percent (by weight) contamination level for green material used to make compost. Even if the contaminant level meets the applicable solid waste standard, a layperson seeing the material as applied to the slopes would understandably confuse this practice with the land application of solid waste. Additionally, contaminants such as plastic may negatively impact the ability to find a beneficial use for the final product. New compost standards going into effect in 2018 lower the acceptable contaminant level for compost.
Irrespective of the contaminant level, should these contaminants blow offsite or into the bay, which seems likely considering the proximity to the water, or otherwise cause a nuisance, this would violate the State solid waste standards. Post-processing litter picking operations should not be considered a substitute for clean feedstock or final product. The operator should be aware that the Regional Water Quality Control Board (RWQCB) may have stricter standards for the protection of State waters from contaminants, including plastic materials.

The operator should take steps to ensure a much cleaner feedstock is collected from residences and businesses. The LEA does not directly oversee the curbside or other collection of waste materials, but it would benefit the operator to further educate its employees and customers about the importance of a clean feedstock. If collection vehicle drivers or OMPF employees (e.g., at the receiving stage) notice excess contaminants in a particular load, the operator should follow-up with the customer about the need to exercise greater care when placing compostable materials collection totes, bins, or dumpsters. Contaminated loads should be rejected.

An additional concern is the feedstock may be arriving having already undergone anaerobic decomposition prior to collection. A few years ago, several cities planned to go from a weekly pickup of waste materials to a lesser frequency, e.g. once every two weeks for “recyclable” items such as green waste, including that mixed with food waste and intended for composting. At that time the LEA informed them that the State standards require at least once per week collection (California Code of Regulations, Title 14, §17331). Furthermore, it was mentioned that food waste is the most malodorous component of the waste stream and that diverting it into the recycling stream could result in significant problems if not handled properly. The OMPF should verify the collection frequency of its feedstock and take into consideration the potential odor impacts of material that comes from a source subject to less than weekly collection frequency.

The composition of feedstock arriving at the facility may vary based on the location(s) from which it is collected on any particular day. There may also be seasonal variations. For example, in some neighborhoods the bulk of compostable waste is landscaping material versus other locations that provide a supply of source-separated food waste. The variety and variability of feedstock sources may impact the composting process, such as the rate of decomposition, nutrient balance in the finished compost (e.g., carbon:nitrogen ratios), odor production, bulk density, differential compaction, and oxygen demand.

Pre-collection handling of wastes by the customer (e.g., compaction) may also affect particle size and bulk density, which could impact the subsequent composting process. The size and construction of waste containers (totes, dumpsters), as well as their storage locations (e.g., shade versus exposure to sunlight), time of year (e.g., ambient temperature), may also have an impact on pre-collection anaerobic decomposition and the production of odor-causing compounds.
Curbside Considerations

- Collection frequency may result in anaerobic conditions prior to arrival at the facility.
- Monitor and regularly audit curbside collection to make sure the facility receives clean feedstock that has not already undergone anaerobic decomposition.
- Educate residents and businesses about the importance of clean feedstock (e.g., no plastic in bins intended for compostable materials). Such outreach should be done regularly (e.g., at least annually for all customers).
- Reject contaminated material at curb or dumpster prior to collection. Notify customer via a follow up contact.
- Take into consideration the variability in feedstock characteristics based on season, day of week, areas where collected, and types of businesses.
- Pesticides, fertilizers, herbicides, or other hazardous materials are not allowed in landscape waste.
- Container size, material, and location and may affect aerobic vs. anaerobic decomposition ahead of collection.
- Pre-collection packing of waste containers and physical altering of the material (e.g., chopping, crushing) may affect subsequent porosity and bulk density of the material when placed in windrows or aerated static piles (ASPs).
- Train collection personnel as a first line of defense for ensuring clean feedstock.

Step 2: Transport to Facility – Compostable material may result in significant odor impacts, especially if it includes a food waste component. The operation and maintenance of collection vehicles should be done in a manner to minimize odors. By extension, regular cleaning of collection vehicles and dumpsters can also help mitigate odors issues. Totes used to collect source-separated food waste should also be regularly cleaned.

Step 3: Feedstock Receiving – Upon arrival the material should be monitored for excessive contaminants that might result in issues of windblown litter or an unusable final product, as well as material that may have undergone anaerobic decomposition. The operator should regularly verify and document that the State contaminant standard is met. The RFI should describe the protocols used to make such a determination and the actions staff is to take if the standard is not met (e.g., reject or set aside unacceptable feedstock). The OIMP should contain provisions to deal with feedstock that may arrive in a malodorous state. The physical state of the arriving feedstock as it eventually relates to bulk density and porosity should also be monitored.
Feedstock Receiving Considerations

- Load checking (e.g., odors, plastic, usefulness as feedstock).
- Protocols for rejection (e.g., excess amounts of plastic).
- Awareness of the mixture of materials that is necessary at subsequent steps in order to produce usable compost (e.g., nutrient balance).
- Awareness of materials that have varying oxygen demand when composted.
- Defined location for the placement of rejected materials.
- Follow up with collection personnel if feedstock issues are observed.
- Clearly delineate boundaries on the map showing where this activity occurs. Provide physical reference points for use by both operation personnel and regulators (e.g., permanent boundary markers or reference points). This applies to all phases of the operation.
- Pad maintenance and monitoring to ensure proper drainage and disposal of both stormwater and compost leachate. Compost leachate must be collected and properly disposed of. A leachate collection system is not presently in place. Compost leachate must not enter the storm drainage system or impact waters of the State.
- Keep track of where various waste streams are coming from (e.g., onsite chip/grind, collection vehicles, self-haul, etc.).

Step 4: Initial Processing – The waste material received is reduced in size by mechanical processing. It is important that the particle size and shape resulting from this processing be consistent and regularly verified. Improper size, shape, and density can result in preferential pathways that may short-circuit oxygen from reaching areas of the pile(s) and allow these to become anaerobic. Maintaining aerobic conditions is critical for minimizing the production of malodorous compounds. This should be adequately described in the RFI.

Initial Processing Considerations

- Deadline to complete this step based on the type of waste (food waste, green waste, other waste) and also deadline to get the material into the windrows or ASPs.
- Protocols if contaminants or excess odors are found. This applies to all phases of the operation.
- Method of processing (e.g., chip and grind).
- Finished particle size and verification method. Protocols if this standard is not met.
- Instructions on where the materials go if not immediately placed in windrows or ASPs, including any temporary storage or holding area.
- Screening protocols and equipment, including any sorting.
- Protocols for the mixing of various types of waste, including any used to get the proper nutrient balance.
Step 5: Windrows and ASPs – The pile size and geometry are critical factors for ensuring proper oxygenation and temperature control. The pile geometry must ensure both sufficient and reliable oxygen flow and maintain the minimum composting temperature of 131 °F for the minimum required timeframe necessary to kill pathogens, but not become excessively hot and self-ignite. Overly large pile size can result in anaerobic conditions.

The pile geometry should be adequately described in the RFI. The type(s) of geometric shape(s) (e.g., trapezoidal prism) best suited to estimating the volume of the piles should be described in the RFI, along with the applicable formula that can be used by both the OMPF personnel and the regulatory officials. Maximum height, width, and length should be clearly described. The maximum amounts of material allowed at each stage of the process onsite must be readily verifiable. (As recently as November 7, 2016, the LEA found an excessively large windrow measuring 108’ wide at the base x 512’ long x 15’ high.)

Pile porosity and bulk density are also important factors. Equipment that compacts the material must not be used (e.g., bulldozer). A bulldozer was reportedly used at the OMPF after a piece of equipment specifically designed to turn windrows and not result in compaction broke down (i.e., Scarab windrow turner). LEA staff reported that it was sometimes not possible to check pile temperature due to the impenetrable nature of the piles (i.e., the inspector could not get thermometer into pile). This should’ve been a red flag that improper composting conditions were evident. Proper pile porosity should be adequately described in the RFI, including an acceptable bulk density range.

It is important that the operator regularly check representative temperatures to ensure minimum pathogen kill temperatures are maintained, but the piles not become excessively hot and self-ignite. In addition to the aforementioned issue of porosity, excessively large piles do not lend themselves to accurate temperature monitoring, since the thermometer cannot penetrate deep enough into the pile. Proper temperature monitoring should be adequately described in the RFI, including the measuring devices used and their calibration. The inability to penetrate a pile with a thermometer or reach representative areas of the pile should trigger immediate action by the operator to investigate and rectify the situation.

To prevent fires and other combustion events, temperature monitoring should be representative and of all organic material on site, including windrows, curing piles, finished product, and overs. In any contiguous pile, readings should be taken in multiple locations (e.g., specify the maximum distance spacing between reading locations). All readings should be recorded in a manner that readily shows the time and date, location, and results of each reading, as well as any action taken as a result. The OMPF is planning to use an automated temperature monitoring system for the ASPs. The LEA is concerned that an over-reliance on automated monitoring may result in problems if manual temperature checks are not also incorporated into the temperature monitoring protocols.
At the present time, the OMPF is currently performing three distinct operations: (1) maintaining the existing passively-aerated windrows; (2) removing the malodorous material; and (3) receiving new feedstock and placing this material in the newly constructed ASPs. The LEA is concerned that properly performing all three tasks concurrently may be difficult considering the facility resources and training.

Windrows and ASP Considerations

- Deadline to place received material into windrows or ASP.
- Geometry for windrow construction, with clear diagrams of shape, height, width, length, spacing, and uniformity. Include applicable formula(s) used to calculate the volume.
- Verifiable standard for porosity and bulk density. Bulk density needs to be low enough to allow oxygen penetration. Do not use bulldozer or other compacting-type equipment.
- Consider differential compaction over time, which can affect oxygen flow.
- Temperature monitoring (representative, reach adequate depth, adequate frequency, documented readings, procedures if problems are found). Careful records must be kept of each windrow or ASP showing age, temperature readings, location, etc.
- Temperature standards for pathogen reduction (minimum temperature) and the prevention of self-ignition (maximum temperature).
- Allowable contaminate levels in final product.
- Always aerobic. This applies to all phases of operation.
- Verifiable procedures to make sure carbon, nitrogen, moisture ratios are correct before making a windrow or ASP.
- Turning frequency and method, including equipment used (for windrows).
- Protocols if equipment breaks down (e.g., blowers for ASPs, Scarab for windrows).
- Equipment cleaned of residue daily to prevent fires.
- Biofilter specifications.

Step 6: Curing Piles – All terms, including “curing pile” needs to be clearly defined in the RFI or other applicable reference. An ability to clearly identify all the piles as to type and date of placement is critical.

Step 7: Finished material – The RFI does not specify a limit for the amount of time finished compost material that can remain on site. A maximum allowable time for this material should be established in the RFI.
Finished Compost Considerations

- Clearly define what is meant by finished compost (and the other stages as well).
- Describe physical screening procedures used to remove contaminants prior to compost leaving the site.
- Describe storage location, pile geometry, temperature monitoring, and other items as described above.
- Testing for pathogens and heavy metals, and lab results received prior to material leaving the OMPF.

**Step 8: Load for transport** – Monitor for odors and contaminants. Stop process if these are detected.

**Step 9: Final destination** – Recycling facilities pose environmental and public health risks if not operated properly. There is increasing pressure on cities and other entities to divert waste from landfills, including food wastes. Sending this waste to facilities for recycling or other beneficial use is a commonly used option to achieve diversion goals, but if there is no market for the final product, the problem of waste disposal is merely transferred downstream to another community. For this reason it is important the solid waste authorities, cities, etc. have a means to audit or verify that their waste, if sent for recycling or reuse, indeed ends up as intended.

For the OMPF, the *Destination Report* should list an actual address associated with a delivery location. This will aid in trace back and verification if downstream problems are alleged.

**OTHER ISSUES**

**Meteorological conditions** – The current OIMP has a brief description of meteorological conditions that does not coincide with the actual more complicated conditions at this site. For example, the OIMP mentions prevailing winds from the west with a mean speed of 8 mph. Significant wind shifts and much higher wind speeds are not uncommon at this location, changing significantly but somewhat predictably during the day. For example, the recent odor complaints tended to occur in Pt. Richmond in the morning (approximately southwest of the site) and in the El Sobrante and other areas in the evening (approximately north and northeast of the site). The RFI and/or OIMP should be more detailed and accurate, and describe both seasonal and daily variations that may occur.

The current weather station for the facility is located near the office, which is at a lower elevation than the more exposed composting operation pad. It is recommended that the weather station be located on the pad itself in order to more accurately gauge atmospheric conditions that might affect odor migration offsite.
Permit Conditions – The permit conditions for the OMPF should be reviewed and updated. For example, permit condition 17. bb states “Compost windrows shall also be handled in such a manner that does not create a public nuisance with offsite odor impacts to the surrounding neighborhoods.” This condition should be more comprehensive and require that no materials result in a nuisance condition, not just the material in the windrows. Another example is condition 17.o., which is overly specific and only references the amounts of various materials allowed on site at any time. This condition must be changed to require conformance with the entire RFI, rather than just one aspect of it.

RFI and OIMP – The RFI and OIMP need to be revised to provide improved management practices. These revised documents, once approved by the LEA, should be diligently implemented. If the operator finds that future changes are necessary to these revised documents, they should contact the LEA as soon as possible to discuss any proposed changes and the review and approval process that is required. The LEA has required the operator to prepare an Odor Best Management Practice Feasibility Report.

Fire Concerns – The LEA inspection on October 7, 2016, showed huge piles of combustible material (approximately 15 feet high), which could pose a fire danger irrespective of any compost issues. The RFI should describe a maximum temperature, which if exceeded, results in actions to cool the piles. The LEA remains very concerned about fire risks at the OMPF. As recently as November 4, 2016, the LEA measured pile temperature as high as 180 °F, at a three-foot depth of a 15’ high pile. The LEA has also observed equipment operators smoking while conducting compost operations. Since the operator blames at least one of the fires on a discarded cigarette, a no smoking policy for the compost facility is recommended.

Switchover to ASPs – The facility is currently switching over from passively-aerated windrows to the ASPs. The LEA is concerned that this new, more complicated process may result in odors if not properly managed, and that the transition may create additional problems.

Post-Windrow or ASP – Temperatures - Excessively high temperatures post-windrow or post-ASP are indicative of an incomplete composting process. The operator should have procedures in place to deal with such material (e.g., reintroduce to the composting process if this doesn’t result in odor or other problems).
RECOMMENDATIONS

The best management practices, as described in the RFI, OIMP, and the solid waste permit, need improvement, with particular emphasis on the following key issues:

- Fire prevention, including protocols if excessively high temperatures are found.
- Aerobic conditions at every stage.
- Control the amount of material onsite (i.e., clearly defined limits for each stage).
- Clearly defined terminology.
- Prevent the release of nuisance odors.
- Clean feedstock that does not arrive in an anaerobic condition (e.g., load checking).
- Eliminate the questionable use of material for “erosion” control.
- Routine, accurate, and representative temperature monitoring.
- Protocols to achieve pathogen reduction while preventing self-ignition.
- Clearly defined procedures if critical equipment breaks down.
- Time limits for each stage.
- Pile size, geometry, and density.
- Particle size and shape.
- Training in all aspects pertinent to the operation.
- Public education and outreach.
- Adequate details for each step of the composting process, for both passive-aerated windrows and the ASPs.