Clover Flat Landfill, Inc.

CEQA Project Description

Final Draft Air Emissions Study

for the Proposed Transition to the:

Clover Flat Resource Recovery Park

Prepared by:

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USE PERMIT APPLICATION SUMMARY

File:	Use Permit Modification #P09-0051
SCH:	State Clearinghouse No. 2011082050
Lead Agency:	Napa County Conservation, Development and Planning Department
Project Name:	Clover Flat Resource Recovery Park
Project Justification:	Transition the Clover Flat Landfill project that addressed Federal Subtitle D and AB 939 with recycling programs and safe landfill disposal, to the Clover Flat Resource Recovery Park project, which will address AB 32 by permitting new programs to reduce and avoid greenhouse gas emissions.
Project Applicant:	Clover Flat Landfill, Inc. 1285 Whitehall Lane St. Helena, California 94574 (707) 942-1412
Property Owner:	Vista Corporation 1285 Whitehall Lane St. Helena, California 94574 (707) 942-1412
Property Profile:	4380 Clover Flat Road, Calistoga, California, 94515 Assessor Parcel # 020-120-020 Parcel Size: 179.97 acres - no change Permitted Area: 78.0 acres - increase 1.01 acres Disposal Area: 44.0 acres - no change The Solid Waste Facility Permit area is proposed to increase by 1.01 acres to 79.01 acres to include recycling activities at the gate entrance area to necessitate a Solid Waste Facility Permit Revision to #28-AA-0002. The permitted tonnage of 600 tons per day will remain the same.
Hours of Operations:	The hours of operations will remain the same. Tuesday to Saturday 9am to 4 pm – Sunday 9am to 3 pm.
Landfill Profile:	The landfill capacity is proposed to decrease from 5.1 million cubic yards to 4.9 million cubic yards with the same disposal footprint of 44.0 acres and a maximum height of 1,000 feet above mean sea level, with the proposed extension of the closure date from 2021 to 2044 with increased compaction with an average annual disposal rate of 50,000 tons per year.

PROJECT BACKGROUND AND OVERVIEW

The Clover Flat Landfill (CFL) is the name of the current project and is located in upper Napa County, at 4380 Silverado Trail, about three miles east of Calistoga, California. CFL lies in a steep canyon in the mountains of east Napa Valley. CFL is operated by Clover Flat Landfill, Inc. (CFL, Inc.) on lands owned by the Vista Corporation. The landfill serves the upper Napa Valley, and the cities of Calistoga, St. Helena, and Yountville, and has been accepting municipal solid waste since 1963. The properties within one-mile of the landfill are designated as "Agricultural, Watershed, and Open Space" and "Agricultural Reserve" by the Napa County Conservation, Development & Planning Department.

CFL is a Class III municipal solid waste disposal site operating under Napa County Use Permit No. U-438889, and Waste Discharge Requirements adopted in November 1991 by the Regional Waste Quality Control Board, San Francisco Bay Region. The Facility also operates under Solid Waste Facility Permit (SWFP) No. 28-AA-0002, issued by the Napa County Executive Office, acting as the Local Enforcement Agency (LEA), for the state Department of Recycling, Resources, and Recovery (CalRecycle). The SWFP allows maximum receipt of 600 tons per day (TPD) of material and 275 round trip vehicles per day (VPD). The operating hours are Tuesday to Saturday, 9am to 4 pm, and Sunday from 9 am to 3 pm. The Facility is closed to the public on Mondays and legal holidays.

CFL is a Class III municipal solid waste disposal site. The permitted refuse area occupies 44 acres of a 78-acre permitted facility on a 179.97-acre parcel. The developed disposal area is approximately 36 acres. The final elevation will be 1,000-feet above mean sea level. Based upon the site development plan, the landfill has a permitted capacity of about 5.1 million cubic yards (CY) of material. CFL has an active landfill gas collection system with a flare, which is currently being converted over into a renewable energy project.

CFL is operated according to the Joint Technical Document (JTD) dated December 2005, which was the basis to issue the 5-Year Permit Review on April 3, 2006 for SWFP No. 28-AA-0002, and subsequent amendments. The landfill has an estimated closure date of 2021. The next 5-Year Permit Review due date is May 24, 2011, in which an application has been submitted where there is a commitment to apply for a SWFP Revision after the CEQA document is certified. Significant physical changes to the CFL are not proposed as part of this Use Permit application, as there will be no changes to the following major categories:

- **No changes in the tonnage amount or waste types.**
- **No changes in traffic counts.**
- **No changes in operating hours.**
- **No changes in disposal footprint or height of the landfill.**

With new mandates and emerging legislation, CFL plans to become the ***Clover Flat Resource Recovery Park*** (CFRRP)***,*** shifting the focus from just being a landfill with recycling into a resource recovery park which has a multitude of recycling and composting operations, and has already instituted AB 32 early action items to collect landfill gas and convert it to energy. The ***Clover Flat Resource Recovery Park*** is the new project name that will also have the ability to produce renewable energy from woody biomass and be able to supply landscape materials and commodities derived from recyclable material back to the community for sustainable business practices.

The Use Permit (UP) will need to be modified and the SWFP will need to be revised in 2011, to address a series of proposed changes, which are part of this UP Application package, to obtain the necessary entitlements:

- Extend the estimated closure date of the Landfill to from 2021 to 2044, due to increased recycling, increased compaction, the use of synthetic tarps as alternative daily cover, and using an average annual disposal rate of 50,000 tons per year.
- Decrease the landfill capacity from 5.1 million cubic yards to 4.9 million cubic yards in a discrete location only to allow the existing concrete operations pad to remain in place with a new Final Fill Plan for that specific area.
- Expand the gate operations area and the Recycling Operations area from 1.4 acres to 2.1 acres, increasing the permitted boundary of the SWFP by 1.01 acres.
- Apply for a Grading Permit for the proposed gate operations area which includes 70,000 cubic yards of cut material, and to create the proposed 2.1 acre Recycling Operations area.
- Add a 1 mega-watt biomass conversion facility that uses clean processed wood waste in a gasification unit.
- Add a Jenbacher engine to convert landfill gas into energy.
- Increase in-vessel food waste composting operations and food waste transfer and processing operations.
- Increase the storage of recyclable materials.
- Add a series of commodity bunkers for wood chips, compost, top soil blends, aggregate materials, and landscape materials for the general public to purchase recyclable materials.
- Add a residential food waste drop-off at Recycling Operations area.
- Allow new inert alternative daily cover (ADC) material.

Table 1 – Comparison of Existing CFL Project and the Proposed CFRRP Project

Characteristics	Existing CFL Project	Proposed CFRRP Project
Compliance with State Mandates	Compliance with AB 939 to maintain the 50% landfill diversion mandate on and after 2000, with operational modifications to get to 2012.	Ability to also address AB 32 goals from 2012 to 2044 to expand mandated commercial recycling capacity, expand food waste processing for composting and add on-site renewable energy from biomass.
Planning Horizon	An AB 939 planning horizon of 22 years from 1990 to 2012, with landfill closure in 2021.	An AB 32 planning horizon of 32 years from 2012 to 2044.
SWFP Operator/ UP Applicant	Clover Flat Landfill, Inc.	
Service Area	UVWMA and surrounding communities	
Permitted TPD	Remains the same at 600 TPD peak, no increase	
Permitted Vehicles Per Day	Remains the same at 275 round trip vehicles per day, no increase	
Hours of Operations	Remains the same Tues. – Sat. 9am to 4 pm and Sun. 9 am to 3 pm. No changes	
Total Permitted Landfill Capacity	5.1 million cubic yards of landfill capacity	4.9 million cubic yards of landfill capacity – Decrease due to use of the existing concrete pad on CFL
Landfill footprint and height	No increase in footprint or height – Same 44 acres and not to exceed 1,000 feet in above mean sea level.	
Landfill closure	2021	2044 Increase compaction and average annual disposal of 50,000 tons per year
Diversion Programs	• Recycling Drop-off Center • Material Recovery Facility • Green Waste Processing • Concrete/Inert Processing • Metal Processing • Food waste compost research operations	• Recycling Drop-off Center • Material Recovery Facility to continue to accommodate mixed dry commercial recyclables • Green Waste Processing • Concrete/Inert Processing • Metal Processing • Food waste compost and transfer operations • Residential food waste drop-off program • Recycled material bunker sales
Energy Production	• Landfill gas is flared with no energy capture.	• Landfill gas to energy generation facility of approximately 848 kilo-watts. • Biomass Conversion Facility in a gasification unit – 1 mega-watt.

The following emissions from this project have been quantified within this Study:

- Food waste either landfilled or composted
- Green waste processed
- Landfill Gas either flared or converted into energy
- Mobile and Equipment Emissions
- New Biomass Gasification Unit

The following scenarios have been evaluated within this Study:

- Baseline emissions from entitled operations
- Baseline emissions from current operations
- Proposed emissions with emission controls
- Proposed emissions without controls
- Net emissions from project

The Bay Area Air Quality Management District's updated their CEQA Air Quality Guidelines in May 2011. When quantifying the ***Significance Determination***, the BAAQMD recommends subtracting the existing emissions levels from the emissions levels estimated for the new proposed land use. The net calculation is permissible only if existing emissions sources were operational at the time of the initiation of the CEQA document. In this case, the increased green waste storage and the food waste composting were in operations. The food waste composting operation was authorized under a 2-year research project from the Napa County Local Enforcement Agency. The green waste storage has been exceeding it entitled limits. Table 2 below compares baseline entitlements to baseline operations for organic management strategies at the Clover Flat Resources Recovery Park:

Table 2 – Organics Management

Material	Baseline Entitlement	Baseline Operations	Proposed Project
Green Material	1,500 CYD up to 21 days handling up to 4,000 tons per year of greenwaste in current SWFP terms and conditions.	4,000 CYD up to 30 days handling up to 4,000 tons per year of greenwaste in current operations over the last five years	6,000 CYD up to 21 days handling up to 8,000 tons per year of greenwaste and co-collected residential green waste with an average of 10% residential food waste to be covered with emissions passed through a biofilter
Food Waste	7,888 tons per year of food waste landfilled.	881 tons per year of food waste in the research project and the rest is landfilled	7,888 tons per year of food waste composted.

ORGANIC STORAGE, PROCESSING AND COMPOSTING

Increase Green Waste Storage

The current entitled practice is receive up to 4,000 tons per year of green waste and store in stockpiles up to 1,500 cubic yards for up to 21 days with no emission controls, where actual operations store the same 4,000 tons per year in stockpiles up to 4,000 cubic yards for up to 30 days with no emission controls. The proposed project is to store up 8,000 tons per year of green waste and co-collected residential green waste with an average of 10% residential food material in stockpiles of up to 6,000 cubic yards for up to 21 days, but with emissions controls by collection of the emissions passed though a biofilter. The proposed storage of green waste and co-collected residential green waste with food waste would be overlain by perforated pipe and then covered with a tarp to prevent the escape of emissions to the atmosphere. A negative aeration would be applied to the perforated pipes and the exhaust gas would pass through a biofilter prior to being vented to the atmosphere.

Add In-Vessel Food Waste Composting

The CRPPP project will allow food waste composting on-site in-vessel up to 2,500 cubic yards and the potential transfer of food waste from the proposed bunkers or in the vessel from CRPPP to a permitted compost facility. The CFRRP proposes to add a containerized in-vessel food waste composting system, using modified containers (drop boxes or roll-off bins) to convert source-separated food wastes into valuable compost products.

Food waste is mixed with finished compost to reduce moisture content and provide porosity. Finished compost is added until there is no free liquid in the blended material and the moisture content is approximately 60%. Depending on the moisture content of the food waste, the final blend consists of approximately 50% finished compost by volume. A layer of finished compost about one foot thick is used to cover the top of the blended material to act as a biofilter for compost emissions.

Using containerized composting eliminates buildings, large concrete surfaces and storm water basins since the food waste is containerized. Source-separated food wastes from local restaurants, from zero-waste special events, and the residential food waste drop-off program will be delivered to one of two concrete bunkers on top of the intermediate cover on the landfill deck. The intermediate cover will be compacted soil of at least 1 foot, sloped at 1% for positive drainage, and will be maintained to prevent ponding due to settlement.

There will be a public drop-off of food waste at the Recycling Center that will be stored up to 24 hours prior to being transferred to the compost operations. Food waste will also arrive at the site via commercial packer trucks. The food waste will be stored in the bunkers for a period not to exceed 24 hours, and if stored overnight will be covered with a synthetic tarp. Each bunker will be approximately 20 feet by 20 feet and hold up to 75 cubic yards of food waste. The food waste will be mixed with finished compost, and then loaded into the food waste composting vessel. The food waste/green waste mixture will be composted in the enclosed compost vessel for a maximum time of 30 days. Following removal from the compost vessel the material will be stored at the CFL for curing for about 3 weeks.

Should on-site composting not be economically feasible due to the smaller scale, as an option, the food waste composting may occur at an off-site permitted compost facility, and the food waste would be transferred from the bunkers or in the full vessels to a permitted compost facility.

Tonnage Throughput Design Capacity

The proposed design capacity is for 2,500 cubic yards of capacity on-site in containerized vessels. The blend is approximately a 50/50 mix by volume, which corresponds to a 60% food waste content by weight based on a food waste density of 1,200 lbs./ft^3 and a finished compost density of 800 lbs./ft^3. Throughput for the food waste/compost blend is 42 tons per day up to a maximum of 6-days per week, resulting in a total throughput of 13,146 tons per year, with 7,888 tons per year of food waste being composting per year.

The proposal is to begin with a minimum capacity of 800 cubic yards capacity for the food waste/compost blend for the research project and potentially increase this to 2,500 cubic yards of in-vessel composting volume. If a density of 1,000 lbs. per cubic yard for the food waste/green waste mixture is assumed, with a retention time of 30 days, the result would be a minimum throughput of 14 tons per day and a maximum of 42 tons per day, which consists of both food and finished compost.

Food Waste Composting Vessels

There are many in-vessel compost systems available of the containerized, modular version envisioned for the CFL. The vessels anticipated for use are modified drop boxes (roll-off bin).

Moisture control is optimized where the compost retains the moisture without the generation of free liquids. Air is blown into the base of the vessel and exits the top. Space is left at the top of the feedstock in each vessel for the placement of a biofilter consisting of one foot of finished compost on top of the material. Prior to exiting the vessel, the emitted gas passes through the biofilter. Aeration will be provided by blowers that will be powered either through grid-provided power (PG&E) or power generated on-site by the proposed LFG energy system, the biomass gasification system, or a combination of those sources. Emissions from the on-site power sources are provided elsewhere in this document.

Emissions from Organic Materials Management

Four scenarios of emissions are estimated that correspond to the following scenarios:

1. Entitled emissions - these are the emissions resulting from the currently permitted emission source:
    - 4,000 tons per year of green waste for up to 10 days (BAAQMD Permit).

- 7,888 tons of food waste landfilled that would be composted in the proposed project.

2. Operational emissions - these are the emissions from the current operational practices:
   - 4,000 tons per year of green waste stored for up to 30 days.
   - In-vessel food waste composting of 881 tons per year (research project).
   - 7,007 tons of food waste landfilled that would be composted in the proposed project (i.e. 7,888 – 881 = 7,007).

3. Proposed project emissions with emission controls - these are the emissions that would result from implementation of the proposed project activities with controls.
   - In-vessel food waste composting of 7,888 tons per year, subject to biofiltration.
   - 8,000 tons per year of green waste (with up to 10% co-collected food waste) stored for up to 21 days, covered and subject to biofiltration.

4. Proposed project emissions without emission controls - these are the emissions that would result from implementation of the proposed project activities with controls.
   - Same as Scenario 3 but without emission controls; provided for comparison only.

Parameters used in the emissions estimate are described below.

Biofilter Performance

After the blend of food waste and finished compost is placed in the container a layer of finished compost one foot thick is placed on top to serve as a biofilter. Biofiltration is a well known treatment technology that has consistently documented destruction efficiencies of over 90% for VOCs. A pilot-scale experiment done at California State University, Fresno, demonstrated a 99% destruction efficiency for VOCs . Tests conducted at the Inland Empire Regional Compost Facility resulted in a measured VOC destruction efficiency of 94%. Additionally, the South Coast Air Quality Management District (SCAQMD) published a list of operational biofilters and estimated destruction efficiencies that can be found at: http://www.aqmd.gov/rules/doc/r1133/app_c_biofilter.pdf.

The use of finished compost material as a biofilter has been shown to reduce the amount of VOCs and ammonia in compost off-gas. A study by the California Integrated Waste Management Board (CIWMB, 2007) found that a layer of finished compost placed over a compost windrow reduced VOC emissions by 82% the first week and 75% over two weeks.

The SCAQMD, in their Staff report for Rule 1133 regulating emissions from composting, recommends biofilter control efficiencies of 75% and 90% for ammonia and VOCs, respectively.

Additionally, very high destruction efficiencies for methane and nitrous oxide have been demonstrated. A pilot-scale experiment done at California State University, Fresno, demonstrated a 99.7% destruction efficiency for methane and 97.1% for nitrous oxide.

- A 75% control efficiency is assumed in this analysis for VOCs, ammonia, methane and nitrous oxide for the passive biofilter placed over the food waste compost blend.

- An 85% control efficiency is used for the compost storage system where emissions are captured with negative aeration and forced through a biofilter.

Compost Emission Factors

<u>VOCs and Ammonia</u>: VOCs and ammonia are generated during the decomposition of organic waste. The San Joaquin Valley Air Pollution Control District (SJVAPCD) has adopted VOC emission factors for aerobic composting.

The SJVAPCD has adopted the following emission factors:

- 1.063 lbs.-VOCs/wet ton/day for feedstock storage and processing
- 5.14 lbs.-VOCs/wet ton for composting (minimum of 22 days)
- 0.57 lbs.-VOCs/wet ton for compost curing (minimum of 60 days)

The SCAQMD has also adopted an emission factor of 4.25 lbs.-VOCs/wet ton during active composting, which includes curing (62 days total). For VOCs, 90% of the compost emissions are assumed to occur during the 22-day active phase and 10% during curing; this is the same assumption used by the SJVAPCD. For ammonia, with an emission factor of 0.46 lbs.-NH3/wet ton, the split is assumed to be 50/50 between composting and curing, which is discussed in the SCAQMD Staff Report for the compost emission rule (Rule 1133).

The curing period for the material at the CFL after the 30 day compost period is up to 3 weeks, after which it is transported to UVDS for sale.

Emission factors used for VOCs and ammonia are:

- 1.063 lbs.-VOCs/wet ton/day for feedstock storage and processing
- 5.14 lbs.-VOCs/wet ton for composting (minimum of 22 days)
- 0.57 lbs.-VOCs/wet ton for compost curing (minimum of 40 days)
- 0 lbs.-NH3/wet ton/day for feedstock storage and processing
- 0.23 lbs.-NH3/wet ton for composting (minimum of 22 days)
- 0.23 lbs.-NH3/wet ton for compost curing (minimum of 40 days)

Methane and Nitrous Oxide: Methane and nitrous oxide are generated during composting from anaerobic pockets in the waste. The California Air Resources Board conducted an extensive literature review and published the results in a document entitled "Proposed Method for Estimating Greenhouse Gas Emission Reductions from Compost from Commercial Waste". The proposed emission factors for methane and nitrous oxide generation from compost are 0.078 MTCO2e/ton for methane and 0.025 MTCO2e/ton for nitrous oxide. The entire emission factor is applied for food or green waste storage of 30 days. For periods less than 30 days, the emission factor is reduced by the ratio of the storage period in days over 30.

Food Waste Composting Emissions Estimate

As previously described, an in-vessel food composting project is proposed at the CFL. The Climate Action Reserve, during the development of the Organic Waste Composting Protocol, determined that only 2.6% of food waste is diverted from landfill disposal. Therefore, it is assumed that the food waste proposed for composting would have been landfilled in the absence of the project.

Emissions are generated during: 1) the 24 hours of food waste storage prior to composting, 2) the active in-vessel composting period, and 3) the curing period before off-site shipment to a permitted compost facility following removal from the compost vessel.

Food Waste Entitled Baseline Emissions Scenario No. 1
The proposed project includes the composting of 7,888 tons per year of food waste that is currently landfilled. Therefore, because 7,888 tons of food waste would be diverted from landfill disposal and composted, baseline emissions accounting includes the emissions from landfilled food waste that would be avoided by the proposed project. Landfilled food waste generates emissions from the following sources:

- Fugitive methane emissions, which have a global warming potential of 21.
- Fugitive volatile organic compound emissions.

Fugitive Methane Emissions from Landfilled Food Waste
Landfill methane emissions from food waste are estimated using the USEPA Landgem Model. The methane generation potential of food waste is estimated at 128 m^3/tonne and the decay rate constant used is 0.072 (Climate Action Reserve). The landfill gas collection efficiency is assumed to be 0% for the first two years after waste placement, 50% the third year, 75% for years 4 – 7 and 95% thereafter (USEPA). Additionally, 10% of fugitive methane is assumed to be oxidized through landfill cover materials. Although alternative daily cover materials other than soil will be used in the landfill, the intermediate and final covers will still consist of soil. Therefore, the 10% oxidation is a reasonable expectation. Because landfilled waste decomposes and produces methane for many years, the cumulative impact of avoided landfill methane emissions is calculated. Avoided landfill methane emissions are shown in Table 3 for the first 15 years of the project.

Table 3 - Fugitive Landfill Methane Emissions from Food Waste – Entitled Baseline

Year of Food Waste Composting Project	Fugitive Methane Emissions Avoided (MTCO2e)
1	807
2	1,557
3	1,907
4	2,069
5	2,220
6	2,361
7	2,492
8	2,516
9	2,539
10	2,560
11	2,580
12	2,598
13	2,615
14	2,631
15	2,646
15-Year Average	2,273

Fugitive VOC Emissions from Landfilled Food Waste

Source testing of the flare at the CFL provides data for VOC content of landfill gas, resulting in a flow rate of 262 cubic feet per minute and a VOC rate of 1.15 lbs./hour. These parameters are applied to the landfill gas generation estimates from LandGem and the landfill gas collection rates previously described. Results are shown in Table 4 for avoided landfill emissions from the diversion of 7,888 tons per year of food waste.

Table 4 - Fugitive Landfill VOC Emissions from Food Waste – Entitled Baseline

Year of Food Waste Composting Project	Fugitive Methane Emissions Avoided (ton per year)
1	0.165
2	0.319
3	0.390
4	0.424
5	0.455
6	0.483
7	0.510
8	0.515
9	0.520
10	0.524
11	0.528
12	0.532
13	0.536
14	0.539
15	0.542
15-Year Average	0.466

Food Waste Operational Baseline Emissions Scenario No. 2

The CFL has a research project under way for in-vessel food waste composting to test the system that is included in the proposed project. The pilot project consists of composting an average of 881 tons per year of food waste.

Food Waste Landfilling

The entitled baseline emissions included the emissions from landfilling 7,888 tons of food waste annually that would be eliminated by the proposed project. However, the operational baseline emissions include the emissions from composting the 881 tons of food waste per year and the emissions from landfilling the balance, or 7,007 tons per year.

A food waste pilot project similar to the proposed project has been under way since September 2009. The average monthly amount of food waste during 2011 is 73.4 tons per month, or an average of 881 tons per year.

Using the LandGem Model as previously described for 7,888 tons of food waste (entitled baseline), fugitive landfill methane emissions and VOC emissions for 7,007 tons per year of food waste are provided in Tables 5 and 6.

Table 5 - Fugitive Landfill Methane Emissions from Food Waste – Operational Baseline

Year of Food Waste Composting Project	Fugitive Methane Emissions Avoided (MTCO2e)
1	717
2	1,383
3	1,694
4	1,838
5	1,972
6	2,097
7	2,214
8	2,235
9	2,255
10	2,274
11	2,292
12	2,308
13	2,323
14	2,337
15	2,350
15-Year Average	2,019

Therefore, the amount of fugitive landfill methane emissions avoided by composting 881 tons per year of food waste is:

Avoided fugitive landfill methane emissions = 2,273 $MTCO_2e$ – 2,019 $MTCO_2e$ = 254 $MTCO_2e$

Table 6 - Fugitive Landfill VOC Emissions from Food Waste – Operational Baseline

Year of Food Waste Composting Project	Fugitive Methane Emissions (MTCO2e)
1	0.147
2	0.283
3	0.347
4	0.376
5	0.404
6	0.429
7	0.453
8	0.458
9	0.462
10	0.466
11	0.469
12	0.473
13	0.476
14	0.479
15	0.481
15-Year Average	0.414

Food Waste Composting

VOC and Ammonia Emissions

- Processing Emissions: In general, one drop box of the food waste/compost blend is delivered to the CFL each day of food waste collection. Therefore, food waste is typically processed and aeration begins within 24 hours of receipt. Therefore, the emissions are:

  VOC emissions = (1.063 lbs. VOCs/ton/day)(1 day)(881 tons)/2000 = 0.47 tons

- Compost emissions: The in-vessel compost process lasts for up to 30 days.
  VOC emissions = (5.14 lbs. VOCs/ton)(881 tons)(1 - 0.75)/2000 = 0.57 tons
  NH_3 emissions = (0.23 lbs. NH_3/ton)(881 tons)(1 – 0.75)/2000 = 0.03 tons

- Curing emissions:
  VOC emissions = (0.57 lbs. VOCs/ton)(881 tons)/2000 = 0.25 tons
  NH_3 emissions = (0.23 lbs. NH_3/ton)(881 tons)/2000 = 0.10 tons

Total VOCs = 1.28 tons (Scenario No. 2 - Operational Baseline)

Total ammonia = 0.13 tons (Scenario No. 2 - Operational Baseline)

Greenhouse Gases (GHGs): Methane and Nitrous Oxide Emissions – 30 day storage

- Methane GHGs = (0.078 MTCO2e/ton)(881 tons)(1 – 0.75) = 17 MTCO2e
- Nitrous Oxide GHGs = (0.078 MTCO2e/ton)(881 tons)(1 – 0.75) = 6 MTCO2e

Proposed Project Scenario with Controls Scenario No. 3

The proposed project includes in-vessel composting of food waste with biofiltration in the amount of 7,888 tons per year. Proposed project emissions for VOCs, ammonia, methane and nitrous oxide are presented below.

VOC and Ammonia Emissions
Emission estimates below are based on the maximum tonnage throughput of 13,146 tons per year, of which 60%, or 7,888 tons per year of food waste. Because emissions from finished compost are negligible, only emissions from the food waste fraction are calculated.

- Processing Emissions: Food waste is processed and aeration begins within 24 hours of receipt. Therefore, the emissions are:

  VOC emissions = (1.063 lbs. VOCs/ton/day)(1 day)(7,888 tons)/2000 = 4.19 tons

- Compost emissions: The in-vessel compost process lasts for up to 30 days.

  VOC emissions = (5.14 lbs. VOCs/ton)(7,888 tons)(1 - 0.75)/2000 = 5.07 tons
  NH_3 emissions = (0.23 lbs. NH_3/ton)(7,888 tons)(1 – 0.75)/2000 = 0.23 tons

- Curing emissions:
  VOC emissions = (0.57 lbs. VOCs/ton)(7,888 tons)/2000 = 2.25 tons
  NH_3 emissions = (0.23 lbs. NH_3/ton)(7,888 tons)/2000 = 0.91 tons

Total VOCs = 11.51 tons

Total ammonia = 1.18 tons

Greenhouse gases (GHGs): Methane and Nitrous Oxide Emissions – 21-day storage

- Methane GHGs = (0.078 MTCO2e/ton)(7,888 tons)(1 – 0.75) = 154 MTCO2e/year
- Nitrous Oxide GHGs = (0.078 MTCO2e/ton)(7,888 tons)(1 – 0.75) = 49 MTCO2e/year

Proposed Project Scenario without Controls Scenario No. 4
The proposed project will include biofiltration with a destruction efficiency for the pollutants analyzed of 75%. As a point of reference, emissions from the proposed project if there were no biofilter in place would be:

VOCs:

- Storage = 4.19 tons per year
- Composting = 20.27 tons per year
- Curing = 2.25 tons per year

  Total = 26.71 tons per year

NH_3:

- Storage = 0 tons per year
- Composting = 0.91 tons per year
- Curing = 0.91 tons per year

  Total = 1.81 tons per year

Methane = 615 MTCO2e/year
Nitrous oxide = 197 MTCO2e/year

Food waste composting emissions for the baseline and proposed scenarios are shown in Tables 7.

Table 7 – Annual Emissions from Food Waste Composting

Scenario	VOC Emissions (tons/year)	NH_3 Emissions (tons/year)	Methane (MTCO2e)	Nitrous Oxide (MTCO2e)
Entitled Baseline[1]	0.47	0	2,273[3]	0
Operational Baseline[1]	1.69	0.13	2,036[3]	6
Proposed Project with Biofiltration[2]	11.51	1.18	154	49
Proposed Project without Biofiltration[2]	26.71	1.81	615	197

1. Avoided landfill emissions are based on the 15-year average annual fugitive methane emissions.
2. Food waste is proposed to be composted with biofiltration.
3. These food waste landfill emissions are avoided by the proposed project.

Green Waste Storage Emissions Estimates

The current entitled practice is receive up to 4,000 tons per year of green waste and store in stockpiles up to 1,500 cubic yards for up to 10 days with no emission controls (BAAQMD Permit), where actual operations store the same 4,000 tons per year in stockpiles up to 4,000 cubic yards for up to 30 days with no emission controls. The proposed project is to store up 8,000 tons per year of green waste and co-collected residential green waste with an average of 10% residential food material in stockpiles of up to 6,000 cubic yards for up to 21 days, but with emissions controls by collection of the emissions passed though a biofilter. The proposed storage of green waste and co-collected residential green waste with food waste would be overlain by perforated pipe and then covered with a tarp to prevent the escape of emissions to the atmosphere. A negative aeration would be applied to the perforated pipes and the exhaust gas would pass through a biofilter prior to being vented to the atmosphere.

The SJVAPCD emission factor for green waste storage is used to estimate VOC emissions. It is also reasonable to assume that greenhouse gases in the form of methane and nitrous oxide would be generated. These are estimated by applying the CARB emission factors for windrow composting. A control efficiency of 85% is used for the proposed scenario, where emissions are collected and subject to biofiltration.

Entitled Baseline Emissions: Scenario No. 1

An amount of 4,000 tons per year of green waste up to 1,500 cubic yards of storage for up to 10 days.

VOC emissions = (1.063 lbs. VOCs/ton/day)(10 days)(4,000 tons)/2000 = 21.26 tons

Methane GHGs = (0.078 MTCO2e/ton)(4,000 tons)(10/30) = 104 MTCO2e/year

Nitrous Oxide GHGs = (0.025 MTCO2e/ton)(4,000 tons)(10/30) = 33 MTCO2e/year

Operational Baseline: Scenario No. 2

An amount of 4,000 tons per year of green waste up to 4,000 cubic yards of storage for up to 30 days. This corresponds to the same 4,000 tons per year, but stored longer in larger stockpiles.

VOC emissions = (1.063 lbs. VOCs/ton/day)(30 days)(4,000 tons)/2000 = 63.8 tons

Methane GHGs = (0.078 MTCO2e/ton)(4,000 tons) = 312 MTCO2e/year

Nitrous Oxide GHGs = (0.078 MTCO2e/ton)(4,000 tons) = 100 MTCO2e/year

Proposed Project Emissions with Controls Scenario No. 3

The proposed project is to store up 8,000 tons per year of green waste and co-collected residential green waste with an average of 10% residential food material in stockpiles of up to 6,000 cubic yards for up to 21 days, with controls. The material would be covered to prevent emissions and subject negative aeration to collect emissions and pass them through a biofilter. The emissions from this material are estimated below using the SJVAPCD emission factor for green waste storage and a control efficiency of 85% for VOCs.

VOC emissions = (1.063 lbs. VOCs/ton/day)(21 days)(8,000 tons)(1-0.85)/2000 = 13.39 tons

Methane GHGs = (0.078 MTCO2e/ton)(8,000 tons)(1 – 0.85)(21/30) = 66 MTCO2e/year

Nitrous Oxide GHGs = (0.025 MTCO2e/ton)(8,000 tons)(1 – 0.85)(21/30) = 21 MTCO2e/year

Proposed Project Emissions without Controls Scenario No. 4

As a point of reference, if Scenario No.3 were implemented without biofiltration the emissions would be:

VOC emissions = (1.063 lbs. VOCs/ton/day)(21 days)(8,000 tons)/2000 = 89.3 tons

Methane GHGs = (0.078 MTCO2e/ton)(8,000 tons)(1 – 0.85)(21/30) = 437 MTCO2e/year

Nitrous Oxide GHGs = (0.025 MTCO2e/ton)(8,000 tons)(1 – 0.85)(21/30) = 140 MTCO2e/year

A summary of emissions from green waste storage is provided in Table 8.

Table 8 – Annual Emissions from Green Waste Storage

Scenario	VOC Emissions (tons/year)	Methane (MTCO2e)	Nitrous Oxide (MTCO2e)
Entitled Baseline[1]	21.3	104	33
Operational Baseline[1]	63.8	312	100
Proposed Project with Biofiltration[2]	13.4	66	21
Proposed Project without Biofiltration[2]	89.3	437	140

1. Avoided landfill emissions are based on the 15-year average annual fugitive methane emissions.
2. Food waste is proposed to be composted with biofiltration.

LANDFILL GAS TO ENERGY FACILITY

The state has adopted regulations in compliance with the 1993 Federal Subtitle D regulations. The regulations pertaining to 27 CCR 20919.5 modified California's program to include Subtitle D's minimum requirements for gas migration monitoring and control. The owners or operators of all municipal solid waste landfill units must implement routine landfill methane monitoring programs to ensure that concentrations of methane do not exceed 25 percent of the lower explosive limit (LEL) in facility structures, or the LEL at the facility property boundary. The monitoring program is based on site-specific factors, including soil conditions, hydrogeologic and hydraulic conditions, and the location of facility structures and property boundaries.

Methane levels monitored in previous reports indicate that gas is not migrating beyond the boundary of the landfill. In addition, the absence of nearby structures minimizes any concern for possible negative impacts from gas migration. Landfill gas monitoring was installed in 1995.

The Clover Flat Landfill (CFL) had a Negative Declaration prepared during 2000 for a series of activities that included landfill gas monitoring. In 2004, CFL installed a landfill gas collection system with 18 vertical wells, conveyance piping, blower skid unit, and a flare to burn the landfill gas. The Bay Area Quality Management District (BAAQMD) issued a Permit to Operate without further CEQA review. CFL expanded the landfill gas collection system with 5 vertical wells to collect additional landfill gas to fuel electrical generating equipment. A General Electric Jenbacher Gas Engine is planned to be installed. The existing flare will remain as back-up to burn the landfill gas when the generating equipment is being maintained. A Technical Memorandum dated October 10, 2011 was prepared by Air Permitting Specialists and is provided in Appendix A where the existing flare emissions and the proposed Jenbacher genset emissions are shown.

Existing flare emissions in Table 9 below are based on John Zinc emission factors for NOx and CO and source testing conducted in 2010 for NMHC. Emissions of NOx and CO are calculated based on measured 262 standard cubic feet (SCF) of landfill gas rated at 513 btu/scf from the 2010 CFL Flare Compliance Source Emission Test Report. This equates to energy flow to the flare of 8.06 million BTUs/hour (mmbtu/hr). Emissions of non-methane hydrocarbons (NMHC or VOCs) are based on the measurements of NMHC in terms of parts per million (ppm). The measured methane destruction rate is 99.996%.

Table 9 – Flare Emissions

Flare Emissions Based on 2003 and June 2, 2010 Source Tests				
	lbs/mmbtu	*lbs/hr*	*lbs/yr*	*tons/yr*
NOx	0.06	0.484	4,239	2.119
CO	0.2	1.613	14,129	7.064
NMHC	Based on <1 ppm NMOC	0.013	113.8	0.057
CH_4		0.013	113.8	0.057
Annual emissions based on 8,760 hours per year.				

Landfill Gas Collection System

The original Landfill Gas Collection and Control System Design Plan was prepared by The Shaw Group. The landfill gas (LFG) System started continuous operation on April 22, 2004. The system consists of 18 vertical LFG wells that deliver a flow of approximately 250 standard cubic feet per minutes (scfm) to the LFG blower skid where the LFG is burned in the flare at this time. BAAQMD regulations require that landfill sites containing over 1 million tons of refuse provide a landfill gas collection and extraction system. In-place refuse volume is approximately 1,068,000 tons as of September 2005, with the LFG collection system already in place in 2004.

CFL has expanded the landfill gas collection system with 5 more vertical wells to collect additional landfill gas to produce energy, and to capture fugitive methane gas to reduce greenhouse gas emissions. EBA Engineers designed the expansion and managed the construction of the 5 additional wells.

Landfill Gas Condensate Management

Landfill gas condensate generated within the landfill gas (LFG) collection header system is gravity fed to an aboveground storage tank (AST) located near the toe of the CFL landfill. The condensate that collects within the AST is discharged to a nearby leachate well (LEW-2) and subsequently pumped to a series of concrete ASTs located near the flare station. The condensate is mixed with the landfill leachate and is stored in the concrete ASTs which is used on-site for dust control.

The Joint Technical Document (JTD), the operation document prepared for CFL, and approved by the Regional Water Quality Control Board and the California Department of Resources Recycling and Recovery reviews and approves the JTD as part of the 5-year state permit review program. On page 52 of the JTD, the leachate collection system is fully described with the LEW-2 collection well and the storage of the leachate in the tanks. The JTD describes the use of the leachate as dust control over the lined portion of the landfill with a water truck. Both the leachate and the gas condensate is collected and returned to the landfill mass that generated the liquids, where the additional moisture contributes to the production of landfill gas. Discharge of landfill gas condensate from methane gas recovery operations at classified Units such as CFL is allowed as long as the condensate has no chemical additives which could adversely affect containment features (where no additives are introduced at CFL), and shall consist only of water and liquid contaminants removed from gas recovered at CFL, and is returned to the landfill units from which it came.

Future modifications to the condensate management system may include diverting a portion of the condensate to in-line condensate dropouts that will collect and discharge condensate directly back into the refuse mass. In-line condensate dropouts will only be installed within portions of the waste management unit equipped with a base liner system.

Landfill Gas-to-Energy

CFL proposes to generate renewable energy from the landfill gas with electrical generating equipment by installing a General Electric Jenbacher Gas Engine Model JGC 316. The engine will be located at the concrete pad location adjacent to the flare. The GE Jenbacher Gas Engine is a modular package unit that will not materially affect the profle or landscape of CFL. The GE Jenbacher Gas Engine specifications is provided in Attachment B for emission limits and the calculated emissions are provided in Table 10 below The GE Jenbacher will be permitted following the BAAQMD Regulation 8 – Rule 34 for Solid Waste Disposal Sites, which will facilitate obtaining Authority to Construct and a Permit to Operate.

Jenbacher has provided guarantees regarding emissions from their equipment, and emissions testing performed on the flare provide estimates of flare emissions. Emissions for the Jenbacher engine are calculated by applying the guaranteed emissions to the maximum landfill gas flow rate, assuming a 75% recovery landfill gas collection rate. Methane pass through emissions are calculated using a 98.43% destruction rate (SCS Engineers, 2007).

Table 10 – Jenbacher Emissions

Jenbacher Emissions Used in April 2011 Application Based on Guaranteed Emissions				
Pollutant	**g/hp-hr**	**gram/hr**	**lbs/hr**	**tons/yr**
NOx	0.6	705	1.55	6.80
CO	2.5	2937.5	6.47	28.34
VOCs (Total)	0.3	352.5	0.78	3.42
CH_4				33.96 $MTCO_2e$
Max HP:	1,175			
Annual Hours	8,760			

The generation of biogenic energy from recovered landfill gas is proposed at the CFL. Landfill gas would be combusted in a Jenbacher engine/generator set to produce electricity. The landfill gas would be routed to the Jenbacher energy system rather than to Zink model landfill gas flare.

The emissions from both the flare and energy generation systems are shown in Table 11. Air Quality Specialists provided a Technical Memorandum dated October 10, 2011 quantifying the anticipated change in emissions.

Table 11 – Landfill Gas Energy Emissions for Criteria Pollutants

Equipment	VOCs (tons/year)	NOx (tons/year)	CO (tons/year)	CH4 ($MYCO_2e$)
Jenbacher System – Proposed	3.42	6.80	28.34	33.96
Zink Flare - Baseline	0.06	2.12	7.06	0.057
Net Emissions	3.36	4.68	21.28	33.9

BIOMASS GASIFICATION UNIT

CFL proposes to add a biomass conversion facility that uses clean processed wood waste in a gasification unit at the location where the MRF is now located. The proposed layout shows a vertical bucket feed conveyor. CFL may use a variation of the in-feed conveyor that is an inclined food conveyor at a 45 degree angle from the operations pad to conversion chamber. A minimum of 2 days of feedstock, or 80 tons of wood chips, or 400 CYD, is required to be next to the feed conveyor, where the remaining wood chip may be stored elsewhere on the landfill intermediate cover.

Fuel Types
The Biomass Gasification Unit will be design to handle 40 TPD of biomass feedstock and will be operating 24 hours per day, 7 days per week, with about 6 planned maintenance days per year. The following biomass material types will be used: (1) Wood, wood chips, and wood waste; (2) Agricultural crop residuals; (3) Bark, lawn, yard, and garden clipping; (4) Leaves, silivicultural residue, and tree and brush pruning. The primary fuel type will be wood chips from on-site wood grinding operations. Agricultural crop residuals from vineyard wastes and biomass waste from quarantined materials such as Sudden Oak Death could be treated at the biomass gasification unit.

Fuel Storage
A minimum of 2 days of feedstock, or 80 tons of wood chips, or 400 CYD, is required to be next to the feed conveyor, where the remaining wood chips may be stored elsewhere on the landfill cover. The size of the pile will not exceed 15 feet in height, and will have a minimum of 20 feet fire lane around the perimeter of the pile. The proposed Site Plan for the Biomass Gasification Operations with the wood chip storage piles shows 2 piles with 5,000 CYD of storage capacity.

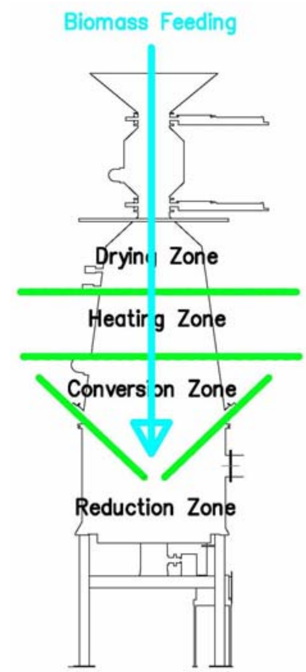
Fuel Sources
Most of the wood chips will be generated on-site from incoming vehicles delivery source-separated lumber and brush, or recovered from mixed C&D loads. The MRF could process an average of 200 TPD during peak construction seasons with has typically 30% recoverable wood material, providing 60 TPD of wood chips to fuel the biomass conversion facility. At 100 TPD of incoming mixed C&D, about 30 TPD of wood waste could be recovered and processed into wood chips. To account for seasonal low peaks and down construction cycles, the amount of wood recovered from the processing line and delivered from source-separate loads is assumed to be about 20 TPD. The other 20 TPD will need to be imported from off-site sources in a transfer trailer

To ensure a sustainable supply of wood chips, 1.5 transfer trailers per day carrying 30 tons of wood chips per day may be needed on a seasonally or intermittent basis. The wood chips may be processed at out-of-county wood waste processing operations scattered around the Bay Area. It is typical that transfer trailers haul wood chips from the Bay Area wood waste processing operations to Central Valley biomass-to-energy facilities. The Clover Flat facility offers a closer and convenient operation that will reduce overall vehicle emissions.

In the future, additional agricultural wastes will be generated from “no-burn” days and policies. Agricultural wastes, such as vineyards and orchards, may be processed into wood chips to generate another 20 TPD locally where importation may not be needed.

Aesthetics

The current MRF is 27 feet tall with the canopied along the processing line. The location is not located in a sensitive ridge line identified in the 1990 EIR for the original landfill CEQA analysis. The proposed Biomass Gasification Unit will be located on the same pad area after relocation of the MRF. The Unit will peak out at 41. Most of the mass of the unit will be less than 20 feet, such as the massing of the MRF, which is 27 feet tall. The in-feed conveyor and the biomass feed into the chamber will be 41 feet in an area of less than 25 feet by 25 feet. The in-feed conveyor and the chamber will be painted a neutral earth tone color that would blend into the color of the landfill cover material. There is no proposed lattice or landscaping at this location, since the Unit is coated below the sensitive ridge lines indentified in the 1990 EIR.



Biomass Conversion Operations

The applicant proposes to add biomass conversion operations on the concrete pad where the current Material Processing Facility is located on the landfill deck, to produce electricity out of the clean processed wood waste materials that is currently recovered and planning to be recovered. The concrete pad will remain in place and all the equipment will be new including one front-end loader to manage the wood chips. The applicant proposes to utilize 40 TPD of clean wood chips processed on-site from the wood recovery operations to generate approximately 1 MW of electricity. The biomass conversion facility will only receive clean processed wood chips, and will obtain the necessary air permits from the BAAQMD. The lumber that is recovered and processed into biomass wood chips is currently being hauled to the Central Valley (to Woodland, Tracy, Rocklin or Andersen), to be combusted at biomass-to-energy facilities. Additional wood chips may be delivered by transfer trailers. The electricity is considered renewable power and is sold to the utilities for their achievement of the state mandate of utilizing 20% renewable energy by 2010. Current state policy and future laws could increase the amount of renewable energy used in California to 33% by 2020.

The applicant proposes to use technologies that convert biomass into a synthetic natural gas (syngas) through the process of thermo-chemical conversion in a gasification unit. This syngas is then used to fuel a specially modified natural gas genset that provides renewable electricity and heat. The biomass gasification process is a thermo-chemical one that ‘cooks’ biomass in an oxygen starved environment. By depriving the fuel of sufficient oxygen the biomass does not burn, but rather gives off a hydrogen rich syngas. As the biomass gives off the syngas, it is transformed into bio-char and ash of approximately 1-5% of the volume of biomass fuel. The syngas is then captured, cleaned and cooled before being sent as fuel to the Genset. The gensets are provided by a variety of nationally known vendors such as Cummins, Caterpillar, or GE. This ensures that there are readily available spare parts and maintenance technicians available locally. The bio-char has demonstrated ability to sequester carbon in solid form for upward of 1,000 years if applied as a soil amendment.

A conveyor fed hopper provides the most flexible solution to deliver biomass wood chips into the unit into the fuel hopper. Once in the hopper, the system uses a robust platform and fuel metering sensors to continuously feed the conversion unit in small batches as needed.

The biomass conversion chamber is essentially a chemical reactor where various complex thermo-chemical processes take place. As it flows through the reactor, the biomass gets dried, heated, converted into gas and reduced into bio-char and ash. Although there is a considerable overlap, each process can be considered to be occupying a separate zone, in which fundamentally different chemical and thermal reactions take place. The fuel must pass through all of these zones to be completely converted. The downdraft conversion unit, employed by the technology, is under vacuum drawn by a high-pressure blower ("negative air"). The essential characteristic of the downdraft design is that the tars given off in the heating zone are drawn through the conversion zone, where they will be broken down or oxidized. When this happens, the energy they contain is usefully recovered and the mixture of gases in the exit stream is relatively clean. Expected total gas contaminant concentration prior to filtration is up to 100 times less than is often seen in updraft and fluid bed systems.

Gas cleansing

After the syngas has been extracted from the conversion chamber it is cooled and cleaned by a series of scrubbers and filters. First the gas passes through a venturi scrubber, which is known to remove particulate in the submicrometer range. The gas is then passed through a series of four filters. The first is a coarse filter to coalesce residual liquids. The second is a rejuvenating active sawdust filter, the third is a similar passive filter, and the fourth is a fabric bag filter. The filter media are sawdust and biomass chips so instead of using expensive synthetic filters that need to be thrown away, the used filter media can be simply placed into the fuel hopper and consumed.

Power Generation

The power units are based on a spark-ignited engine genset. Depending on the model chosen, the engines are capable of providing up to 1 mega-watt (net) operating on syngas. The applicant will customize to allow syngas carburetion for this engine and provide standard paralleling switchgear for electrical output with up to 1 mega-watt.

The applicant plans to utilize a CAT 3516 or the Cummins 1710 as the most attractive engine options. These engines also have unique features of better fuel economy, better emissions, durability, and extended oil and filter change period. Both CAT and Cummins engines have been designed to combine compact size, low emission levels and excellent performance characteristics of high-speed technology with the medium speed benefits of water-cooled exhaust valve seats, steel-crown pistons & combustion control. A Bay Area Air Management Quality District Permit to Operate will be obtained. The San Joaquin Valley Air Pollution Control District has issued a Permit to operate for similar biomass conversion unit.

Emission Estimates

An **Authority to Construct** was granted by the San Joaquin Valley Air Pollution Control District (SJVAPCD) for a project to produce syngas from biomass feed stocks (SJVAPCD, 2009). The emissions estimates in this document are based on the permit limits placed on the engine by the SJVSPCD. Those limits are shown in Table 12.

Table 12 – SJVAPCD Permit Limits for Biogasification Energy Production

Constituent	SJVAPCD Permit Limit
NOx	9 ppmv @ 15% O2
Sox	0.03 g/hp-hr
PM-10	0.05 g/hp-hr
CO	75 ppmv @ 15% O2
VOC	25 ppmv @ 15% O2

The following parameters are used in the estimate of emissions are provided in Table 13:

Table 13 – Parameter Values used in Calculations

Parameter	Value	Source
Power Generation	1 MW	Applicant
Syngas Heat Content	131 Btu/scf	ATC – Application Review
Syngas F-Factor	7,648 dscf/MMBtu	ATC – Application Review
Engine Efficiency	30%	Typical for IC Engine
Thermal Energy Required	273 MMBtu/day	Calculated
Syngas Flow to Engine	2,083,861 scf/day	Calculated

Constituent limits given in terms of ppmv are converted grams per day using the calculations shown below.

EF-NOx = (9/10^6)*(7,648 $dscf_{out}$/MMBTU)*(131 MMBtu/MMscf)*(2.083861 MMscf/day)*(46 lb/lb-mole)*(1 lb-mole/379.5 scf)*(453.6 g/lb)*((20.9/(20.9 – 15))

EF-NOx = 3,660 g/day

EF-CO = (75/10^6)*(7,648 $dscf_{out}$/MMBTU)*(131 MMBtu/MMscf)*(2.083861 MMscf/day)*(28 lb/lb-mole)*(1 lb-mole/379.5 scf)*(453.6 g/lb)*((20.9/(20.9 – 15))

EF-CO = 18,564 g/day

EF-VOC = (25/10^6)*(7,648 $dscf_{out}$/MMBTU)*(131 MMBtu/MMscf)*(2.083861 MMscf/day)*(16 lb/lb-mole)*(1 lb-mole/379.5 scf)*(453.6 g/lb)*((20.9/(20.9 – 15))

EF-VOC = 3,536 g/day

Constituent limits in units of grams per brake horsepower-hour (g/bhp-hr) are converted to g/MW-hr using the conversion of 1,341 g/bhp-hr = 1 g/Mw-hr (CARB Fleet Emission Calculator), and further converted to grams per day.

EF-SOx = 966 g/day

EF-PM10 = 1,609 g/day

No permit limit was established by the SJVAPCD for formaldehyde. Formaldehyde emissions are estimated using an emission factor provided by Jenbacher, a subsidiary of General Electric that manufactures engine-generator systems. The same emissions factor is used for the syngas system as for the landfill gas engine-generator set.

EF-Formaldehyde = 0.2 g/hp-hr = 6,437 g/day

Criteria Pollutant Emissions

Annual criteria pollutant emissions are shown in Table 14. The annual emissions provided assume that the engine-generator set operates 24 hours per day, 365 days per year, generating 1 MW of power.

Table 14 – Annual Criteria Pollutant Emissions – SynGas Engine

Constituent	Annual Emissions Lbs./year	Annual Emissions tons/year
Volatile Organic Compounds	2,846	1.42
Carbon Monoxide	14,941	7.47
NOx	2,946	1.47
PM10	1,295	0.65
SOx	777	0.39
Formaldehyde	5,181	2.59

The engine-generator system will be shut down from time to time for maintenance or repair. In this case, the gasifier would either be shut down and the wood chip fuel alternatively managed, or the syngas would be routed to the flare that burns landfill gas.

Bio-char & Ash Handling

Bio-char & ash is removed from the conversion chamber using pumped slurry. Scrubbed particulate is combined with the bio-char stream. A closed water loop is used for cooling as well as to provide a seal to the bottom of the gasifier. Water slurry level is maintained in a tank and pumped to an automated filter. The automated filter is typical for river sludge treatment and separates the solids from the recirculated water. The char byproduct, also called biochar, is separated out using a special mechanical separator for resale as a soil amendment, sequestering carbon in the ground in solid form for up to 1,000 years. Water leaving the filter is passed through a final stationary filter prior to heat exchange. The scrubbing water is absorbing heat from the product gas and must be cooled in a cooling tower prior to returning to the closed-loop scrubber.

ON-ROAD MOBILE SOURCES EMISSIONS

The "Analysis of Air Quality and Public Health Risks: Clover Flat Resource Recovery Project" prepared by Air Permitting Specialists, Inc., is provided in Appendix B. Baseline and proposed project emissions from mobile sources are the same as no increase in traffic is anticipated by implementing the project. Results are summarized in Table 15.

Table 15 – Emissions from On-Road Mobile Sources

Emission Source	PM-10 (tons/year)	NOx (tons/year)	VOCs (tons/year)	CO (tons/year)	CO_2 ($MTCO_2e$/year)
Mobile Sources	0.03	0.8	0.05	1.02	1,281

ON-SITE EQUIPMENT EMISSIONS

On-site equipment consists of the following:

- 826 Compactor
- 963C Loader
- 637 D Scraper
- D10 Dozer
- KW Water Truck

Emissions are estimated using the URBEMIS model; results are shown in Table 16. URBEMIS output is provided in Appendix C.

Table 16 – Emissions from On-Site Equipment

Emission Source	PM (tons/year)	NOx (tons/year)	VOCs (tons/year)	CO (tons/year)	CO_2 ($MTCO_2e$/year)
Mobile Sources	0.04	0.89	0.09	0.36	111

Under the Baseline Scenario, on-site equipment emissions related to landfilling would end in 2022 as the landfill capacity would be exhausted in 2021 and emissions related to managing materials would continue. Under the Proposed Project Scenario, on-site equipment emissions would continue until 2045 as the landfill would be full in 2044.

GREENHOUSE GAS ANALYSIS

Clover Flat Landfill, Inc. is committed to voluntarily estimate their combined GHG emissions inventory for the Calendar Year 2006 as a means to understand their GHG impacts. A summary of the GHG inventory for 2006 baseline operations shows that there are 4.5 times more avoided GHG emissions attributed to recycling than generated with the collection, processing and disposal of materials. A total of 1,556.2 metric tons of GHGs were emitted from CFL and UVDS fleets and electricity use on a companywide basis, and 2,737 metric tons of GHGs were emitted from fugitive methane emissions from the landfill. The avoided indirect emissions due to recycling and composting add up to 19,386 metric tons not being generated. A copy of the GHG Inventory Management Plan is provided in Appendix D.

Greenhouse Gas Reductions attributed to the Biomass Conversion Facility
As noted in the Table 17, the greenhouse gas emissions are significantly reduced with less hauling and converting energy from biogenic "carbon-neutral" sources such as wood chips, instead of using anthropogenic energy from fossil fuel sources. Approximately 151 metric tons of greenhouse gases can be reduced by utilizing 40 tons of biomass fuel from local sources as shown in the Table 16 below.

Greenhouse Gas Reductions due to Biogenic Energy Generation
The Biomass Gasification Unit will generate 1 MW of biogenic electrical power, offsetting an equal amount of utility provided power. The landfill gas energy facility will generate 0.848 MW. The combined energy generation is 16,188 megawatt hours per year. The Climate Registry General Reporting Protocol provides the anthropogenic carbon intensity of electrical energy provided by utilities in California of 681.01 pounds of carbon dioxide per megawatt hour, 0.569 pounds of methane per megawatt hour and 2.31 pounds of nitrous oxide per megawatt hour. Applying these emission factors results in avoided emissions of 5,002 MTCO2e of carbon dioxide, 4.18 of MTCO2e of methane and 16.94 MTCO2e of nitrous oxide, for a total of 5,023 MTCO2e of avoided anthropogenic emissions.

Greenhouse Gas Emissions attributed to Clover Flat Landfill waste
GHG emissions generated by the project are principally methane generation from decomposing landfilled waste. However, GHGs are also generated by the fuel combusted on-site and from indirect emissions generated elsewhere from the provision of electricity for use on-site.

As previously described, the project is to increase the life of the landfill from a current closure date of 2021 to an anticipated closure date of 2044, which will prolong the generation of project emissions. Therefore, emissions from landfill operations and emissions of landfill methane would remain largely the same until 2021.

Table 17 – Current Baseline and Proposed Operation for Biomass Wood Chips

	Current System – Baseline	Proposed Biomass Gasification Unit
Fuel Type	Processed clean wood chips from on-site facilities, or nearby facilities, that remove treated wood waste and other contaminants.	
Fuel Supply	40 TPD of clean wood chips from on-site Facility with source-separated wood waste and agricultural wastes, wood waste recovered from the on-site MRF, and overs from the green material processing operations; or up to 30 TPD of wood ships imported from Bay Area facilities.	
Technology	Large biomass energy facilities from the mid-1980s are in California's Central Valley that utilizes upgraded steam-turbine cycles with 20% efficiency.	On-Site gasification technologies with 30% efficiency.
Permits	Local air district permit and land use entitlements.	Local air district permit and land use entitlements. San Joaquin Valley APCD has issued Permit to Operate for a similar biomass gasification unit in Merced County.
Haul	40 TPD, or 2 trips, about 90 miles to a large Central Valley biomass energy facility.	40 TPD on-site or local sources. Reduced 2 transfer trailers of traffic per day through Napa County to the Central Valley.
GHG emissions from hauling	0.36 metric tons per trip, or 151.2 metric tons per year.	Reduce GHG emission by 151.2 metric tons per year.
Residual	Biomass ash from 7% to 10% of feedstock that can be used for land application.	Bio-Char from 1% to 5% of feedstock that offers long-term soil sequestration of carbon.

A GHG estimate for facility operations has not been conducted for the current year, but an estimate of GHGs for the CFL was previously done using 2006 data as a baseline, following the California Climate Action Registry General Reporting Protocol. Emissions for facility operation, excluding landfill methane, for the 2006 calendar year were 494 metric tons carbon dioxide equivalent emissions ($MTCO_2$-e). Current emissions are estimated at 600 $MTCO_2e$.

An engine generator system is proposed to generate electricity from landfill gas. The pass-through emissions of methane is estimated at less than 2%, which is the same as the pass through emissions for the landfill gas flare. Therefore, these emissions are included in the estimate of emissions from the landfill gas flare.

Landfill Gas Methane Emissions

The USEPA LandGem model is used to estimate methane emissions from waste decomposition. The project emissions are the increase in emissions beyond the year 2021 when, under the project scenario, the facility is able to continue landfilling waste until 2047. Therefore, maximum methane emissions from the landfill occur in the year 2047and the first year that project emissions are generated is 2023. The methane generation potential of mixed solid waste is estimated at 100 m^3/tonne and the decay rate constant used is 0.04, which are standard LandGem default values.

A landfill gas collection system is in place at CFL. Landfill gas is assumed to be collected at an efficiency of 75% and combusted at a flare with an assumed destruction efficiency of 98%. Of the remaining 25% of landfill methane, 10% is assumed to be oxidized in the soil cover and the remainder is emitted directly to the atmosphere. Results are shown for selected years in Table 18.

Table 18 – Net Landfill Methane Emissions for Selected Years (Proposed – Baseline)[1]

Year	Net Landfill Methane Generated ($MTCO_2e$)	Net Landfill Methane Recovered[1] ($MTCO_2e$)	Fugitive Methane Emissions ($MTCO_2e$)	Landfill Flare Pass Through (0.004%) ($MTCO_2e$)	Jenbacher Pass Through (1.66%) ($MTCO_2e$)	Total Net Landfill Methane Emissions ($MTCO_2e$)
2023	2,502	1,877	563	38	31	594
2030	17,474	13,106	3,932	262	218	4,149
2040	32,750	24,563	7,369	491	408	7,777
2048	41,256	30,942	9,283	619	514	9,796
2050	38,084	28,563	8,569	571	474	9,043
2060	25,528	19,146	5,744	383	318	6,062
2070	17,112	12,834	3,850	257	213	4,063
2080	11,471	8,603	2,581	172	143	2,724
2090	7,689	5,767	1,730	115	96	1,826
2100	5,154	3,866	1,160	77	64	1,224

1. 2048 is the peak year for emissions. 2047 is the last year waste would be landfilled.
2. Assumes a 75% collection efficiency.

To provide a value for the average annual fugitive landfill methane emissions it is necessary to choose a range of years over which the emissions are averaged. The fugitive methane emissions are averaged over the period from the present until 2072. This encompasses the period until 2022 when the baseline and project emissions are equal and 50 years beyond that year, including the peak emissions year of 2048.

- The average annual baseline fugitive landfill methane emissions are 4,477 $MTCO_2e$/year.

The average annual proposed project methane emissions are 7,601 $MTCO_2e$/year; however, note that this estimate of fugitive landfill gas methane emissions includes emissions from the food waste that would be diverted to composting by implementation of the proposed project. The annual diversion of 7,888 tons of food waste to composting under the Proposed Project Scenario avoids fugitive landfill methane emissions of 2,273 $MTCO_2e$ per year. Therefore:

- Proposed Project average annual fugitive landfill methane emissions are 5,328 $MTCO_2e$/year (7,601 – 2,273 = 5,328).

Due to increased recycling, increased compaction and the use of synthetic tarps as ADC, the closure date of the landfill will be extended from 2021 to 2044 based on an average annual fill rate of 50,000 tons per year. The landfill capacity will decrease from 5.1 million CYD to 4.9 million CYD to allow the existing concrete operations pad currently being used for the MRF operations to remain in place.

Therefore, the average annual fugitive landfill methane emissions increase under the proposed project scenario because the extended landfill life results in peak landfill gas generation in 2048 instead of 2022 under the baseline scenario.

The increased landfill life is not expected to increase overall greenhouse gas emissions relative to baseline because, in the absence of the CFL, the organic material landfilled would have undergone landfill disposal at another facility with a comparable landfill gas control system.

Bio

TEMPORARY CONSTRUCTION RELATED EMISSIONS

Construction activities associated with the proposed project involve paving 2.1 acres and relocating 70,000 cubic yards of soil within the CFL footprint. The duration of oil borrow and placement is expected to be 3 months with an average of 1,200 cubic yards moved per day. The time required for paving is 3 days. Emissions are estimated using the Sac Metro ROADWAY model. Results are provided in Tables 19, 20 and 21 and model output is provided in Appendix E.

Table 19 – Temporary Construction Emissions

Project Phase	VOC (lbs./day)	CO (lbs./day)	NOx (lbs./day)	CO_2 (lbs./day)
Grubbing/Land Clearing	3.2	12.8	28.9	2,888
Grading/Excavation	-	-	-	-
Drainage/Utilities/Subgrade	-	-	-	-
Paving	1.7	5.4	10.0	720.9
Maximum Daily[1]	3.2	12.8	28.9	2,888

1. Soil displacement and paving will not occur simultaneously.

Table 20 – Temporary Construction Emissions – PM-10

Project Phase	PM-10: Exhaust (lbs./day)	PM-10: Fugitive Dust (lbs./day)	PM-10: Total (lbs./day)
Grubbing/Land Clearing	1.2	10.0	11.2
Grading/Excavation	-	-	-
Drainage/Utilities/Subgrade	-	-	-
Paving	0.9	-	0.9
Maximum Daily	1.2	10.0	11.2

Table 21 – Temporary Construction Emissions – PM-2.5

Project Phase	PM-2.5: Exhaust (lbs./day)	PM-2.5: Fugitive Dust (lbs./day)	PM-2.5: Total (lbs./day)
Grubbing/Land Clearing	1.1	2.1	3.1
Grading/Excavation	-	-	-
Drainage/Utilities/Subgrade	-	-	-
Paving	0.8	-	0.8
Maximum Daily	1.1	2.1	3.1

OVERALL CRITERIA POLLUTANT EMISSIONS

Overall criteria pollutant emissions for the project activities described above are presented in Tables 22, 23, 24 and 25.

Table 22 – Scenario No. 1 - Entitled Baseline Scenario Emissions for Criteria Pollutants

Process	VOCs (tons/year)	NOx (tons/year)	PM (tons/year)	Sox (tons/year)	CO (tons/year)
Landfilled Food Waste[1] (7,888 tons per year)	0.47	-	-	-	-
Green Waste Storage (4,000 TPY, 1,500 CY for 10 days)	21.26	-	-	-	-
Landfill Gas Flare	0.06	2.12		-	7.06
Mobile & Equipment[2]	0.14	1.69	0.07	-	1.38
Total	21.9	3.81	0.07	0	8.44

1. The landfilled food waste represents landfill gas emissions that would be avoided by implementation of the proposed full-scale food waste composting project.

2. After 2021, baseline mobile emissions would decrease because landfill disposal at the CFL is scheduled to stop under the current permit.

Table 23 – Scenario No. 2 - Operational Baseline Scenario Emissions for Criteria Pollutants

Process	VOCs (tons/year)	NOx (tons/year)	PM (tons/year)	Sox (tons/year)	CO (tons/year)
Food Waste Composting[1] (881 tons per year)	1.28	-	-	-	-
Landfilled Food Waste[2] (7,007 tons per year)	0.41				
Green Waste Storage (4,000 TPY, 4,000 CY for 30 days)	63.80	-	-	-	-
Landfill Gas Flare	0.06	2.12		-	7.06
Mobile & Equipment[3]	0.14	1.69	0.07	-	1.38
Total	65.69	3.81	0.07	0	8.44

1. The 881 tons is the average annual food waste throughput in the pilot scale in-vessel composting project.
2. "Landfilled Food Waste" represents the emissions from the landfilled tons that would be avoided by implementation of the proposed full-scale food waste composting project (7,888 – 881= 7,007 tons).
3. After 2021, baseline mobile emissions would decrease because landfill disposal at the CFL is scheduled to stop under the current permit.

Scenario No. 3 adds food composting with controls instead of landfilling, and increases green waste storage to also include co-collected residential green waste and food waste up you 8,000 tons per year, in larger piles to 6,000 cubic yards and for a longer time period up to 21 days with biofilteration controls. The Jenbacher engine and the biomass gasification unit are installed, both with controls.

Table 24 – Scenario No. 3- Proposed Scenario Emissions for Criteria Pollutants with Biofiltration[1]

Process	VOCs (tons/year)	NOx (tons/year)	PM (tons/year)	Sox (tons/year)	CO (tons/year)
Food Waste Composting (7,888 tons per year)	11.51	-	-	-	-
Green Waste Storage[1] (8,000 TPY, 6,000 CY for 21 days with biolfilter)	13.39	-	-	-	-
Biomass Gasification Unit	1.42	1.47	0.65	0.39	7.47
Landfill Gas Energy (Jenbacher LFG Engine)	3.42	6.8	-	-	28.34
Mobile & Equipment	0.14	1.69	0.07	-	1.38
Total	29.88	9.96	0.72	0.39	37.19

1. Does not include temporary construction emissions.

Scenario No. 4 adds food composting without controls instead of landfilling, and increases green waste storage to also include co-collected residential green waste and food waste up you 8,000 tons per year, in larger piles to 6,000 cubic yards and for a longer time period up to 21 days without controls. The Jenbacher engine and the biomass gasification unit are installed, both with controls.

Table 25 – Scenario No. 4 - Proposed Scenario Emissions for Criteria Pollutants without Biofiltration[1]

Process	VOCs (tons/year)	NOx (tons/year)	PM (tons/year)	Sox (tons/year)	CO (tons/year)
Food Waste Composting (7,888 tons per year)	26.71	-	-	-	-
Green Waste Storage (8,000 TPY includes co-collected organics, 6,000 CY for 21 days no biofilter)	89.3	-	-	-	-
Biomass Gasification Unit	1.42	1.47	0.65	0.39	7.47
Landfill Gas Energy (Jenbacher LFG Engine)	3.42	6.8	-	-	28.34
Mobile & Equipment	0.14	1.69	0.07	-	1.38
Total	120.99	9.96	0.72	0.39	37.19

1. Does not include temporary construction emissions.

The Bay Area Air Quality Management District's updated their CEQA Air Quality Guidelines in May 2011. When quantifying the *Significance Determination*, the BAAQMD recommends subtracting the existing emissions levels from the emissions levels estimated for the new proposed land use. The net calculation is permissible only if existing emissions sources were operational at the time of the initiation of the CEQA document. In this case, the increased green waste storage and the food waste composting were in operations. The food waste composting operation was authorized under a 2-year research project from the Napa County Local Enforcement Agency. The green waste storage has been exceeding it entitled limits. Table 26 below compares baseline operations for compared to proposed project emissions with controls to yield net emissions.

Table 26 – Net Project Criteria Pollutant Emissions (Project with controls – Entitled Baseline)

Category	VOCs (tons/year)	NOx (tons/year)	PM (tons/year)	Sox (tons/year)	CO (tons/year)
Net Emissions	7.95	6.15	0.65	0.39	28.75
Thresholds of Significance	10	10	15	-	9.0 ppm (8-hour) 20 ppm (1-hour)

OVERALL GREENHOUSE GAS EMISSIONS

Stationary Sources

Overall greenhouse gas emissions from stationary sources for the project activities are presented in Tables 27 through 31. A global warming potential of 21 is used for methane.

Table 27 – Entitled Baseline Scenario Greenhouse Gas Emissions – Stationary Sources

Process	Methane ($MTCO_2e$/year)	Nitrous Oxide ($MTCO_2e$/year)	Total ($MTCO_2e$/year)
Green Waste Storage[1] (1,500 CY for 10 days)	104	33	137
Fugitive Landfill Methane	4,477	0	4,477
Total	4,581	33	4,614

1. The SJVAPCD emission factor for organic storage is used and the result is multiplied by 21/30 to account for the smaller storage period relative to the proposed 30 days.

Table 28 – Operational Baseline Scenario Greenhouse Gas Emissions – Stationary Sources

Process	Methane ($MTCO_2e$/year)	Nitrous Oxide ($MTCO_2e$/year)	Total ($MTCO_2e$/year)
Food Waste Composting (881 tons per year)	17	6	23
Green Waste Storage (4,000 CY for 30 days)	312	100	412
Fugitive Landfill Methane	4,223	0	4,223
Total	4,552	106	4,658

Table 29 - Proposed Scenario Greenhouse Gas Emissions with Biofiltration – Stationary Sources[1]

Process	Methane ($MTCO_2e$/year)	Nitrous Oxide ($MTCO_2e$/year)	Total ($MTCO_2e$/year)
Food Waste Composting (7,888 tons per year)	154	49	203
Green Waste Storage (6,000 CY for 21 days)	94	30	124
Fugitive Landfill Methane	5,328	0	5,328
Total	5,576	79	5,655

1. Does not include temporary construction emissions.

Note that the proposed scenario also includes the generation of biogenic energy from biomass gasification and landfill gas combustion, which will offset utility provided electrical energy. Using California utility emission factors provided by the Climate Registry General Reporting Protocol, these avoided indirect emissions are 5,023 $MTCO_2e$ (see Page 27).

Table 30 – Proposed Scenario Greenhouse Gas Emissions without Biofiltration – Stationary Sources[1]

Process	Methane ($MTCO_2e$/year)	Nitrous Oxide ($MTCO_2e$/year)	Total ($MTCO_2e$/year)
Food Waste Composting (7,888 tons per year)	615	197	812
Green Waste Storage (6,000 CY for 21 days)	624	200	824
Fugitive Landfill Methane	5,328	0	5,328
Total	6,567	397	6,964

1. Does not include temporary construction emissions.

Table 31 – Net Project Greenhouse Gas Emissions – Stationary Sources
(Project with controls – Entitled Baseline)

Category	Methane ($MTCO_2e$/year)	Nitrous Oxide ($MTCO_2e$/year)	Total ($MTCO_2e$/year)
Net Emissions	995	46	1,041

MOBILE SOURCES

Emissions generated from mobile sources are shown in Table 32.

Table 32 – Entitled Baseline Scenario Greenhouse Gas Emissions – Mobile Sources[1]

Process	Methane ($MTCO_2e$/year)	Nitrous Oxide ($MTCO_2e$/year)	Total ($MTCO_2e$/year)
Mobile & Equipment[2]	1,392	-	1,392

2. Does not include temporary construction emissions.
3. After 2021, baseline mobile emissions would decrease because landfill disposal at the CFL is scheduled to stop under the current permit.
4. The proposed project will not require the addition of equipment, other than the Jenbacher engine and biomass gasification unit included as stationary sources.

The number of vehicles accessing the facility is not expected to change until 2022. The baseline scenario is for the landfill to reach capacity in 2021 while the proposed project scenario is for capacity to be reached in 2044. Therefore, the same amount of traffic will be generated but for a longer period of time. The two scenarios are compared using 2011 as a base year.

Baseline emissions = (1,392 $MTCO_2e$)(2021 - 2011) = 13,918 $MTCO_2e$

Proposed Project Emissions = (1,392 $MTCO_2e$)(2044 - 2011) = 45,930 $MTCO_2e$

Net annual emissions increase = (45,930 – 13,918)/(2044 – 2011) = 970 $MTCO_2e$

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