On-Site Study Protocol and Work Plan

This protocol describes the experimental protocols and procedure that are to be followed on site to study emissions of volatile organic compounds and green house gases from green waste composting operations in San Joaquin Valley; and the investigation of selected mitigation alternatives.

Sampling Schedule:

Tentative sampling schedule presented in Table 1 will be followed. Two sampling events, which are July 29th and September 14th, are modified form the proposal to allow sampling days to coincide with a weekday. These sampling events were on Sundays according to the proposal. It should be noted that the below schedule is tentative; and might be further modified based on the facility operations and weather.

Sampling Day	Date		Day
1	June	8	Monday
2	June	9	Tuesday
3	June	10	Wednesday
5	June	12	Friday
7	June	14	Sunday
10	June	17	Wednesday
15	June	22	Monday
21	June	29	Monday
29	**July**	**6**	**Monday**
38	July	15	Wednesday
50	July	27	Monday
65	August	11	Tuesday
80	August	25	Tuesday
101	**Septermber**	**14**	**Monday**

The research team is to arrive to the Tulare County Compost and Biosolids facility on June 5th with the required equipment and to prepare for the start the study on June 8th, Monday morning. The major equipments and supplies include:

- Utility trailer
- Platform lift (to be delivered on June 5th by a local company)
- Thermal imaging camera
- 3-D Scanning camera
- RAE Plus handheld multi-gas analyzer
- TVA-1000 portable gas analyzer
- Flux chambers (6)
- Tracer gases (10)
- Gas bottle carts
- Evacuated sampling canisters (60)
- Flow meters-5L range (4)
- Sampling trains (4)

- Pre-weighted condensate traps
- Electricity generator with fuel
- Reotemp temperature probe

On June 7th, Sunday, the facility is to re-blend enough feedstock to for 5 windrows. The re-blending will assure that the windrows are formed with comparable type and age feedstock. The windrow characteristics are:

1. Interactively Managed Windrow: This one is to be constructed identical to the control windrow; however, it is to be managed (turning and moisture addition) based on the real-time analysis of the windrow. The research team will alert the facility for turning moisture addition requirements.
2. Control Windrow: This one will be constructed and managed per standard facility operations. The approximate dimensions are 8 ft wide-50 ft long.
3. Surface-Moisture Managed Windrow: This windrow is also to be constructed and managed identical to the control windrow except that the surface moisture is to be kept at high at all times (at least for several hours prior to testing). An irrigation system, which is to be constructed on site, will be utilized for this purpose.
4. Smaller Windrow: This windrow is to be constructed with 6-ft base width; and it will be managed according to the facility operations.
5. Psuedo-Biofilter Windrow: This windrow is also to be constructed identical to the control windrow. After forming, finished compost will be applied on to the top of the windrow at a thickness of 4-6". Facility is to manage this windrow per their standard operations; however, a new biofilter cap is to be applied after each turning event for the first month of composting.

Tasks on the Day of Sampling

Imaging

In the morning of sampling days, the imaging team of two will first get the thermograph of the all five windrows. One person will take the thermograph of the windrows form a platform lift; and will determine the coldest and hottest points on each windrow; and will guide the second person to mark these "emission sampling" points. The thermography work is to be completed by 10:00 (preferably earlier). After completing the thermography work, the same team is to get 3-D scans of the each windrow. The scan data will be later analyzed to determine:

- Entire surface area
- Entire volume
- Surface area of the ridge-top, which is one-quarter from the center to each side
- Volume under the ridge-top

A series of 3-D scans of the windrows is to be taken during and right after a turning event to determine the changes in bulk density. This work needs to be done only one or two times during the course of study.

Emission Sampling:

Sampling team will place the isolation flux chambers on the coldest and hottest points determined by the imaging team. After placing the flux chambers, the mixer and the sweep air (at a rate of 5L/min) is to be turned on, and the time needs to be recorded.

While the isolation chambers reach presumed equilibrium for 20 minutes, evacuated canisters and sampling train need to be prepared.

1. Take a canister and connect it to a sampling train as presented in Figure 1. Make sure that impenger has cold DI water in it.
2. Close the inlet of the sampling line with a cap.
3. Turn on the valve of the canister.
4. Record the vacuum; if it is less than XX inches of Hg; replace the canister.
5. If the initial vacuum is satisfactory, then turn of the valve and observe the vacuum drop in the sampling train for 30 seconds. If a significant drop is observed, replace the sampling train and retest.
6. If it passes both leak tests, mark it on the canister log. It is ready for sample collection.
7. Place the cold trap (impenger) in ice water.
8. Connect the inlet line sampling train to the sampling probe of the isolation chamber; record time, chamber temperature and vacuum and start sampling by opening the valve.
9. The time and the remaining vacuum need to be recorded with approx. 10 min intervals.
10. After 25-30 minutes of sampling, stop sample collection.
11. Introduce a small slug of DI water into the inlet of the sampling line, and turn on the vacuum valve until the slug of water reaches to the trap. Then turn of the valve tightly.
12. Mark the canister and impenger numbers for with their sample ID; place the impenger in ice box.
13. Remove the sampling train and close the inlet of the canister with a plug.

Compost Characteristics and Windrow Samples and:

On the first and the last day of sampling, composite samples comprised of 4 subsamples needs to be collected from each windrow in 5-gallon buckets. After homogenizing (blending), subsamples need to be taken in Zip-Lock bags and placed in ice-box for shipment to the university for further testing (C:N, moisture, ash contents).

On each day of sampling, the inner temperatures of the windrows are to be determined at 6 different points (3 in each side) with a Reotemp that is inserted to the center of the windrow.

Using the REAMulti analyzer, determine oxygen, nitric oxide, hydrogen sulfide and methane (measured as LEL) concentrations in the core of the Windrow #1 (i.e. interactively managed windrow). These measurements to be taken at locations those temperature readings were taken. These measurements can be extended to other windrows as time and resources permit. Furthermore, core compost samples from the Windrow #1 need to be taken in Zip-Lock bags and placed in ice-box. These samples should be analyzed for ammonia, nitrate and nitrite at minimum. Furthermore, enumeration of nitrifying and denitrifying bacteria should be conducted time permitting.

On the sampling day, the surface of the Windrow #2 needs to be irrigated for at least one hour prior to sampling. However, the irrigation must start after obtaining a thermograph of the windrow.

Analysis of Emission Samples

Condensate Traps:
The condensate traps need to be weight for volume change during the sampling event; and then, they should be analyzed with Shimadzu TOC-5000 TOC analyzer as soon as possible. If samples cannot be analyzed, they should be stored in the cold room. The total TOC value should be calculated from the TOC reading and the volume of trap determined by weighing.

Summa Canisters:
Connect the sample extraction train to the canister and measure the arrival vacuum; record this value on the log sheet, and compare it to the end-of-the-sampling vacuum to determine if canister had leaked during transport and handling—leaky canisters must be reported and not used for further samples unless they are thoroughly evaluated. Regardless of presence or absence of a leak, proceed to the analysis. Fill the canister with nitrogen till a slight pressure is obtained inside the canister. Then, it must be analyzed with Method AQMD 25.3 twice and once with ECD detector for nitrous oxide content. Prior to sampling of a canister, the GC and Catalyst temperatures must be checked and recorded; and a blank (nitrogen) and standard gas sample must be analyzed to ensure the proper operation of the GCs.

Check the chromatograph outputs for any irregularity. If faulty reading(s) are suspected, analyze the canisters again. Once, satisfactory chromatographs are obtained, canisters must be cleaned by filling and purging with nitrogen for 7 times. The final vacuum, at the end of the cleaning cycle must be recorded on the log sheet of the canister.

Compost Samples:
All compost samples and parameters must be analyzed per TMECC methods.