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Facility Audit and Recommendations

Protecting Our Land, Air and Water Resources

Technical Memorandum

Facility Audit and Recommendations
for
Upper Valley Disposal Service
St. Helena, California

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Compost Systems & Training

Technical Memorandum - Facility Audit and Recommendations

Operation and Enhancements of the Odor Impact Minimization Plan for

Upper Valley Disposal Service, St. Helena, CA

March 20, 2017

Prepared by: Peter Moon, P.E. of O_2Compost

Executive Summary

Composting operations have taken place at the Upper Valley Disposal Service (UVDS) compost facility since its inception in 1966. The primary feedstocks currently being composted consist of grape pomace (75%) mixed with processed yard waste and wood waste (25%). Since 2009, commercial food materials mixed with yard waste and wood waste are also being composted by UVDS at the Clover Flat Resource Recovery Park, using an aerated in-vessel system.

The primary goals of this project are to analyze the range of comparable feedstocks that may be composted and to consolidate all composting operations at the UVDS facility, without exceeding the current permit threshold of 34,000 tons per year. The proposed feedstocks include: 1) grape pomace; 2) commercial food material; 3) comingled yard waste with food waste from residential sources, and 4) processed wood waste to serve as a carbon source and bulking agent.

The primary objective is to minimize odor generation from sources at the UVDS facility and to avoid off-site impacts to neighbors and passersby. Additional objectives include: 1) increasing the diversion of food material from the commercial and residential waste streams as mandated by recent state laws without increasing odor generation; 2) implementing the goals of the county and the cities' Climate Action Plans by reducing greenhouse gas emissions in the community; and 3) producing a high quality compost product for use as a soil conditioner in vineyards and other agricultural venues.

The proposed strategy for composting at the UVDS Facility includes two seasons (on an annual basis). **The Non-Harvest Season - Composting Operation** will take place between January and August of each year, and **the Harvest Season - Composting Operation** will take place when grape pomace is delivered to the facility. The Harvest Season – Composting Operation will take place during a 4 month period starting as early as August each year and ending in December.

Composting in both cases will utilize the Extended Aerated Static Pile (EASP) Method. Given the average rates of in-put and out-put for each of the two composting seasons, there is adequate permitted operational space for all composting operations plus a capacity reserve of 10% – 20% to accommodate peak flow conditions, thus staying within current permitted area.

Summary Conclusion

The proposed feedstock blends are comparable to the current feedstock by adding processed wood waste and yard waste as bulking agents in order to provide carbon-nitrogen ratio, porosity, and moisture similarities. The food material will be source-separated and will be separated from solid waste at the point of generation and will be blended within a building.

As with the existing operations, odor has been a potentially significant impact but is mitigated to a level of insignificance by instituting the measures which include: proper handling and prompt mixing of raw feedstocks; fully aerating the piles; utilizing a 1-foot thick biofilter layer over the raw compost mix; and establishing good housekeeping practices. The addition of residential food material to the facxilitiy will not increase odor generation as long as the facility continues compliance with current use permit conditions and mitigation measures.

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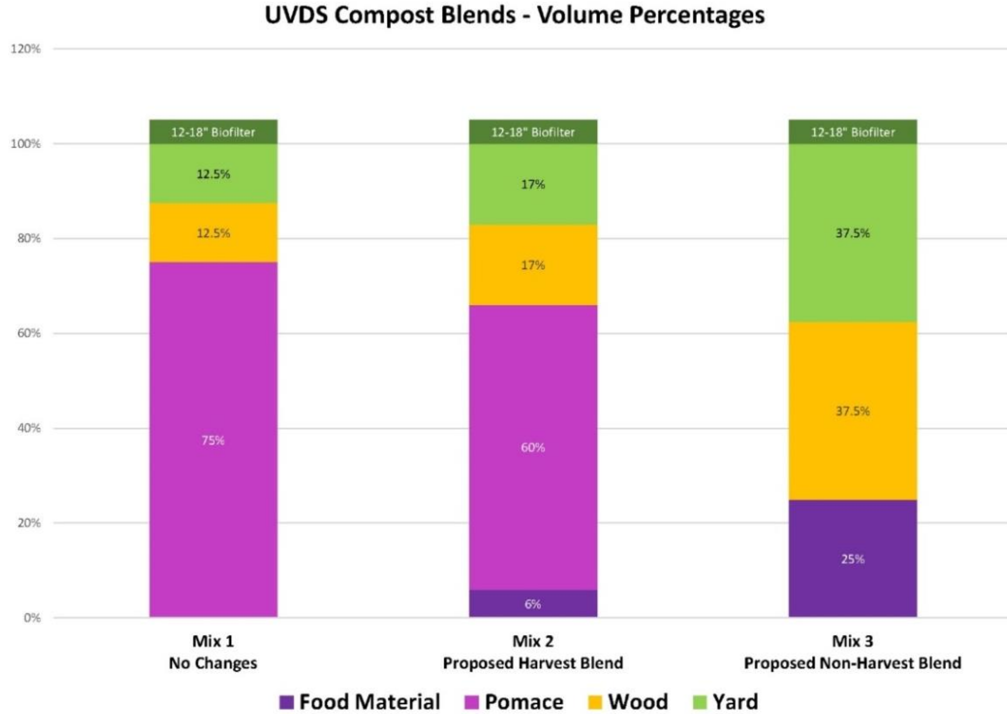
Current Status Overview

- Composting operations have taken place at the Upper Valley Disposal Service (UVDS) compost facility since its inception in 1966. The facility is located at 1285 Whitehall Lane, in St. Helena, CA 94574.
- At the time of this Technical Memorandum (TM), compost feedstocks consist of grape pomace (i.e., grape skins, seeds and stems) combined with approximately 25% processed yard waste and wood waste.
- The Extended Aerated Static Pile (EASP) Method of Composting is currently being utilized to process materials on an annual batch basis during the harvest season. Aerated Compost Piles are constructed starting as early as mid-August and ending during December each year averaging four months per season. The piles are subsequently broken down and screened the following spring and summer.
- The EASP method of composting has been utilized since 1993 when the facility converted from the turned windrow method, under the direction of Peter Moon, P.E. (employed by E&A Environmental Consultants at that time).
- On a research basis, source-separated commercial food material is combined with processed wood waste and yard waste at UVDS. This mix is placed in aerated, in-vessel 30-cubic yard roll off containers, covered with 1-foot of finished compost for odor control, and transported to the Clover Flat Resource Recovery Park where it is composted by UVDS. The containers are filled and transported to CFL on a weekly basis, and aerated for a period of 4 to 6 weeks. Finished compost is ultimately returned to UVDS for sale and distribution.
- A neighboring property owner registered complaints with UVDS and the Local Enforcement Agency (LEA) in October-November 2016. The last previous complaint was registered by the same property owner in the Fall of 2014 . No complaints have been verified by the LEA within the last 3 years.
- This TM serves to provide: 1) the results of a site audit conducted by Peter Moon, P.E.; 2) technical background information about current aerated composting practices; 3) site specific recommendations for current compost feedstock blends and proposed comparable compost feedstock blends; and 4) a set of Standard Operating Procedures (SOP's) in support of the UVDS Odor Impact Minimization Plan (OIMP). The SOP's apply to both the operation for 4 month harvest season and the proposed 8 month non-harvest season.

Goals and Objectives

The primary goals of this project are to analyze the range of comparable feedstocks that are composted and to consolidate all composting operations at the UVDS facility, without exceeding the current permit threshold of 34,000 tons per year.

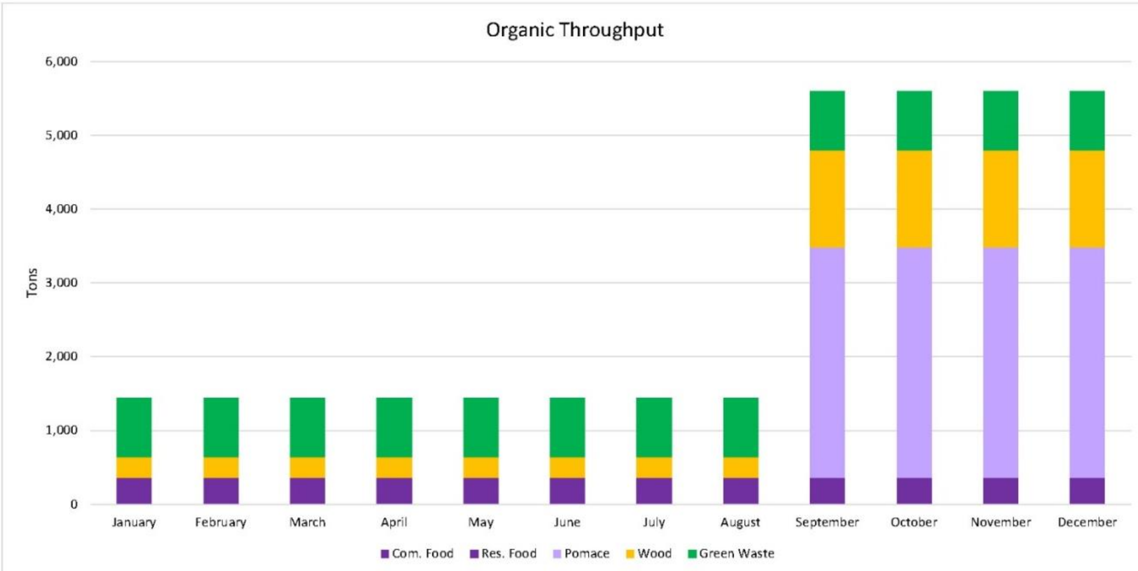
The current feedstocks include grape pomace and processed yard waste, as illustrated graphically, in Column 1 on the graph, below.



The proposed feedstocks include: 1) grape pomace; 2) commercial food material; 3) comingled yard waste with food waste from residential sources, and 4) processed wood waste to serve as a carbon source and bulking agent. These blends are mixed by volume, with respective proportions depicted in Columns 2 through 3.

The residential curbside blend is proposed to be delivered during the week throughout the year and will be used to blend with the pomace, commercial food material, and wood waste to achieve the desired blends.

The proposed monthly tonnage for each feedstock is presented below:



The primary objective of this audit is to minimize odor generation from sources at the UVDS facility and to mitigate off-site impacts to neighbors and passersby. Additional objectives include: 1) increasing the diversion of food material from the commercial and residential waste streams as mandated by recent state laws; 2) implementing the goals of the county and the cities' Climate Action Plans by reducing greenhouse gas emissions in the community; and 3) producing a high quality compost product for use as a soil conditioner in vineyards and other agricultural venues located throughout the region.

Composting Technology and Odor Management

Extended Aerated Static Pile (EASP) with Biofilter Cover

UVDS utilizes the Extended Aerated Static Pile (ASP) method of composting. With ASP composting, fresh air (i.e., oxygen) is delivered to the base of the compost pile under positive pressure to: 1) maintain aerobic conditions throughout the pile; and 2) eliminate the need for pile turning. The compost pile is not turned during the first 30-days of composting, thus minimizing odor generation.

With ASP Composting, the initial mix of compost materials is covered with a layer of unscreened compost (12-inches thick, or greater) to serve as a biofilter for odor control and to ensure that all raw materials reach time/temperature requirements for pathogen destruction.

By maintaining aerobic conditions throughout the pile, the rate of composting is dramatically increased, pathogen reduction criteria are achieved, and off-site impacts from offensive odors are mitigated. By eliminating the need to turn the compost pile, odorous gases are retained within the compost pile and treated in-situ by the biofilter cover.

Anatomy of and Extended ASP System

An Aerated Static Pile consists of four component parts, including:

1. Electric Blowers and an Aeration Pipe Network placed directly on the ground
2. Wood Chip (Plenum) Layer over the Perforated Zone
3. Compost Mix of Materials
4. Biofilter Cover Comprised of Unscreened Compost

Electric blowers are used to deliver fresh air into the compost pile under positive pressure. Each blower is connected to an aeration pipe manifold and a set of "lateral pipes" that include both solid and perforated sections. The pipes extend the full length of the pile, run parallel to one another, and are generally spaced on 5-foot centers, as illustrated on the following page.

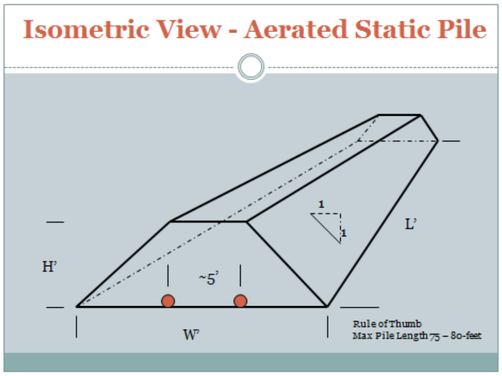
A layer of clean, course wood chips (or woody screen overs from the finished compost piles) is placed over the top of the perforated pipe to facilitate airflow across the base of the compost pile. This is referred to as the "Plenum Layer". In addition to facilitating airflow, the plenum layer also serves as a drain in situations where free water collects at the base of the pile.

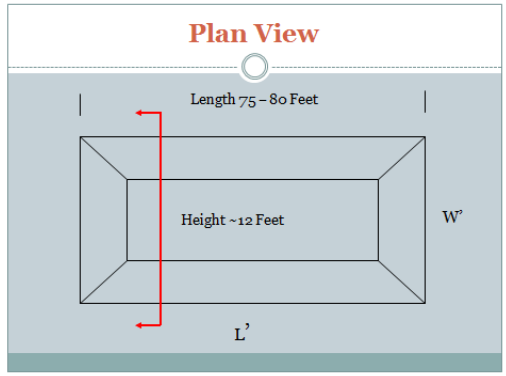
The compost mix is placed on top of the plenum layer to a height of 12 -feet. For complete and efficient composting to take place, the initial compost mix must fall within a range of "mix parameters" including: 1) nutrient balance – often referred to as the Carbon to Nitrogen Ratio; 2) bulk density – an indirect measure of mix porosity; 3) moisture content; and 4) pH. These parameters are discussed in greater detail below in this TM.

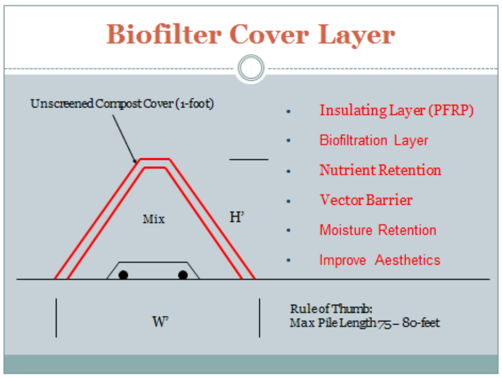
Finally, a 1-foot thick (or greater) layer of finished, unscreened compost and/or screened compost is placed over the entire pile. This layer serves five important functions:

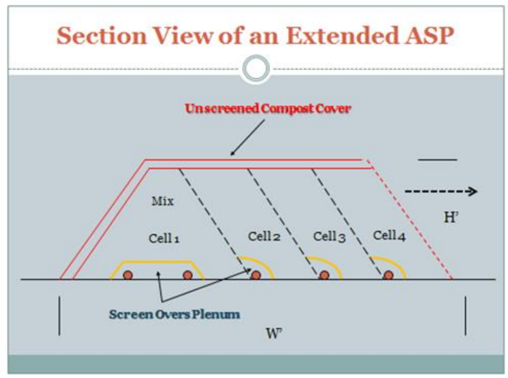
1. Biofiltration to capture and biologically treat odorous off-gases;
2. Insulation to ensure the destruction of pathogens, parasites and weed seeds;
3. Vector Attraction Reduction to eliminate access to flies, birds, rodents and other wildlife;
4. Nutrient Retention, with a primary focus on retaining nitrogen in the finished compost; and
5. Moisture Retention throughout the initial (Active) phase of composting.

Plan and cross section views of an ASP system are presented in the following illustrations.









An Extended Aerated Static Pile is constructed by adding aerated cells to the advancing flank of the compost pile, progressively over time. The blowers that are used to aerate the EASP provide airflow to an "aeration zone" that consists of 6 to 8 lateral pipes. As zones are constructed, the EASP gets progressively wider, and includes numerous blowers.

EASP Composting takes full advantage of the available space on a given composting pad, and minimizes the surface area to volume ratio, thereby helping to minimize the compost emissions and fugitive odors. Two back to back EASP's are illustrated in the photograph, on the following page.

Upper Valley Disposal Service EASP's, circa 1995

Initial Compost Mix Parameters

The prescribed ranges for the initial compost mix parameters and optimal operating conditions are summarized in Table 1, below and discussed in detail in Appendix A of this TM. Compost feedstocks in the ASP Preferred Range are considered appropriate for the proposed feedstocks in terms of minimizing odors.

Parameter	Reasonable Range	ASP Preferred Range
C:N Ratio	20:1 to 40:1	25:1 to 30:1
Moisture	40% to 65%	60% to 65%
Bulk Density	650 to 1,250 pcy	950 pcy (max)
Free Air Space	35% to 60%	35% to 50%
pH	5.5 to 8.5	6.5 to 8.0
Particle Size	1/16" to 3"	>50% 1/8" to 2" (max)
O_2 Concentration	>5%	>10%
Temperature	131^{o} to 170^{o}F	131^{o} to 150^{o}F

Table 1 – Compost Mix Parameters

Proposed Compost Mixes

The three trial mixes include the following by volume percentages:

Feedstock	Mix 1 (Current)	Mix 2 Harvest Commercial	Mix 3 Non-Harvest Commercial
Grape Pomace	75%	60%	--
Yard Waste	12.50%	17%	37.50%
Food Material	--	6%	25%
Processed Wood	12.50%	17%	37.50%

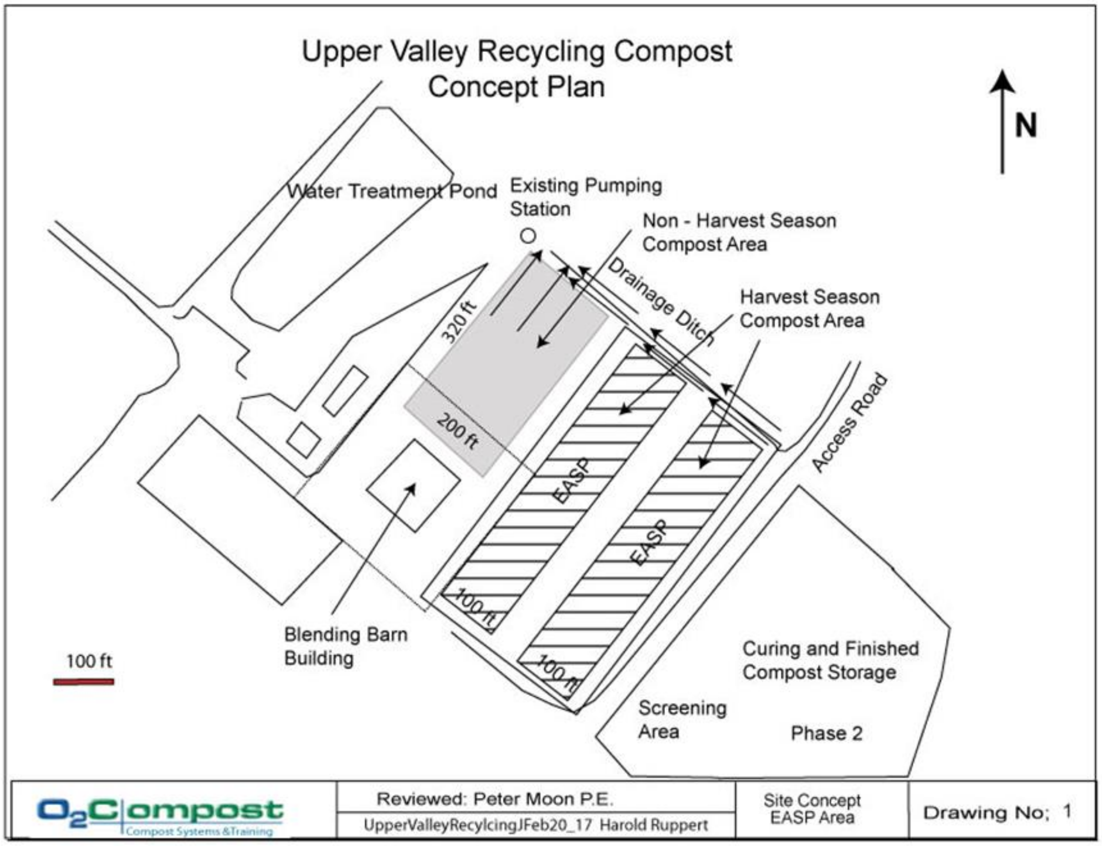
Table 2 – Proposed UVDS Compost Mixes

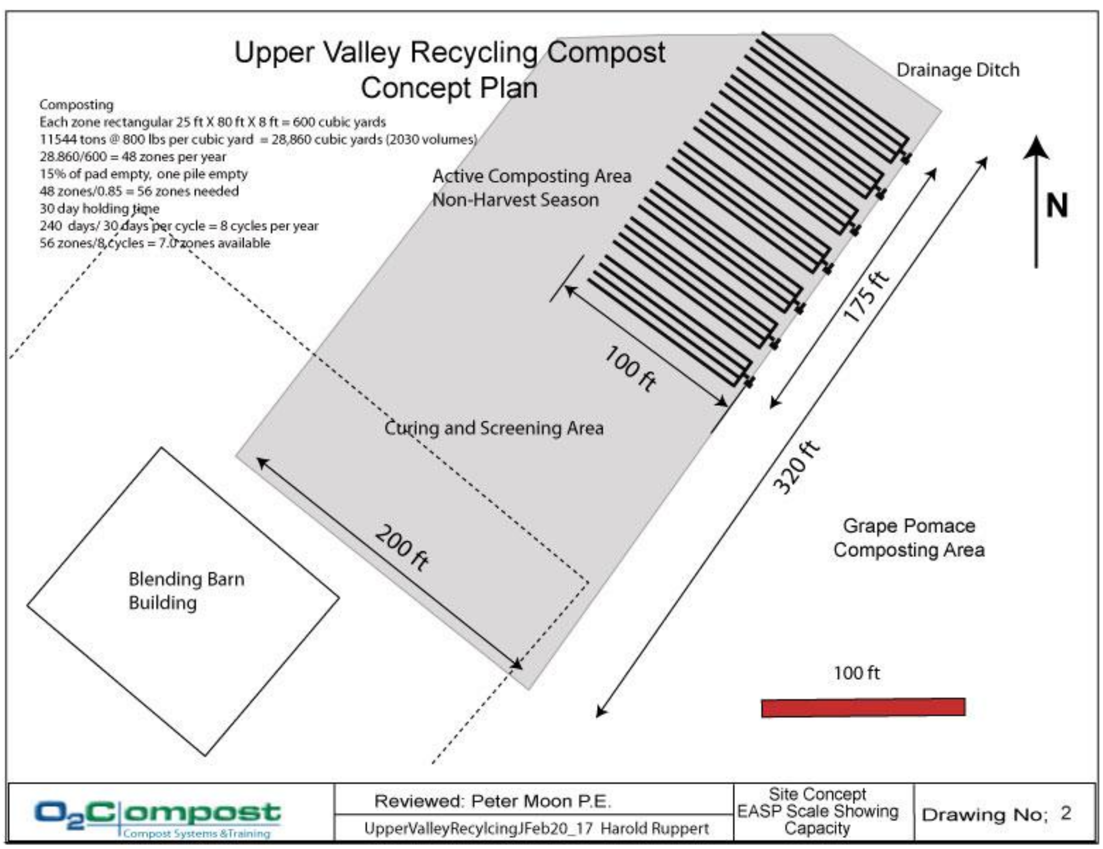
Site Capacity Analysis

The proposed strategy for composting at the UVDS Facility includes two seasons (on an annual basis). **The Non-Harvest Season - Composting Operation** will take place between January and August of each year, and **the Harvest Season - Composting Operation** will take place when grape pomace is delivered to the facility. The Harvest Season – Composting Operation will take place during a 4 month period starting as early as August each year and ending in December. Separate operating areas are designated for each of the two seasons, as illustrated in Drawing 1 and Drawing 2, below.

Harvest Season will compost a combination of feedstocks as represented by Mix 2 (Table 2), and Non-Harvest Season will compost a combination of feedstocks as represented by Mix 3.

To evaluate the site capacity for the two composting operations, a mass balance analysis was conducted. Mass balance estimates are used for planning purposes, and are not intended to be prescriptive. Because conditions and material properties vary seasonally, the site operator has developed and maintained a talent for making adjustments to the mix composition and ratio of bulking agents in order to prepare an initial mix that falls within the prescribed ranges as indicated in Table 1, above. This flexibility in preparing a suitable compost mix is critical to mitigating off-site odor impacts to neighbors and passersby.


Upper Valley Recycling Compost
Concept Plan
N
Water Treatment Pond
Existing Pumping Station
Non - Harvest Season Compost Area
Drainage Ditch
Harvest Season Compost Area
320 ft
200 ft
Access Road
EASP
EASP
100 ft
100 ft
Blending Barn Building
100 ft
Curing and Finished Compost Storage
Screening Area
Phase 2
O2Compost
Compost Systems &Training
Reviewed: Peter Moon P.E.
UpperValleyRecylcingJFeb20_17 Harold Ruppert
Site Concept EASP Area
Drawing No; 1


Upper Valley Recycling Compost
Concept Plan
Composting
Each zone rectangular 25 ft X 80 ft X 8 ft = 600 cubic yards
11544 tons @ 800 lbs per cubic yard = 28,860 cubic yards (2030 volumes)
28.860/600 = 48 zones per year
15% of pad empty, one pile empty
48 zones/0.85 = 56 zones needed
30 day holding time
240 days/ 30 days per cycle = 8 cycles per year
56 zones/8 cycles = 7.0 zones available
Drainage Ditch
N
Active Composting Area
Non-Harvest Season
175 ft
100 ft
320 ft
Curing and Screening Area
200 ft
Grape Pomace
Composting Area
Blending Barn
Building
100 ft
O2Compost
Compost Systems &Training
Reviewed: Peter Moon P.E.
UpperValleyRecylcingJFeb20_17 Harold Ruppert
Site Concept EASP Scale Showing Capacity
Drawing No; 2

The average monthly quantities of feedstock materials that will be received and processed at the UVDS Compost Facility are summarized in Table 3 and Table 4, below.

Given the average rates of in-put and out-put for each of the two phases of composting,. there is adequate permitted operational space for all composting operations plus a capacity reserve of 10% – 20% to accommodate peak flow conditions, thus staying within current permitted area.

Non-Harvest Season – Composting Procedures

The non-harvest season composting process will take place at the UVDS facility 8 months of each year, on average. The feedstocks will be received and processed in general accordance with the following flow chart. Each of the activities is discuss individually, below.

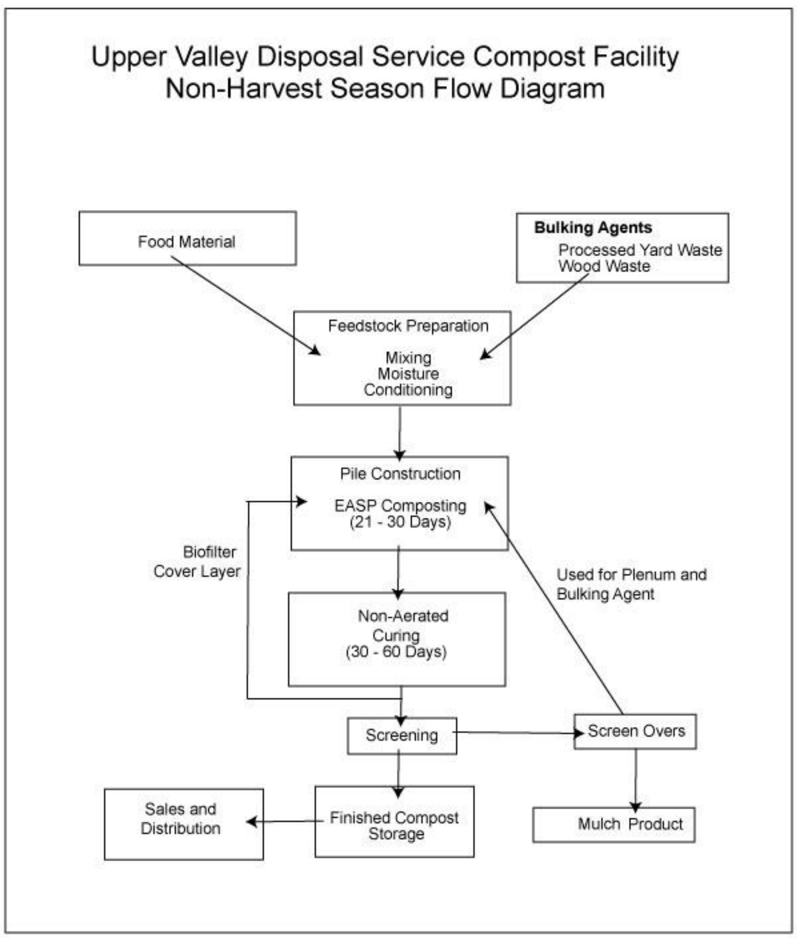


Figure 1 – Non-Harvest Process Flow Diagram

“Blending Barn” Mix Building

All waste materials will be received and processed in the proposed “Blending Barn” Mix Building. This building will measure 100-feet by 150-feet and will consist of tilt-up concrete walls with a concrete slab floor equipped with drainage for clean-up and sanitation. It will include roll-up doors on three sides and the internal height of the building will be sufficient for trucks to unload.

The building will be equipped with a negative ventilation system designed to capture and treat odors using a biofilter that is located outside of the building, as illustrated in Appendix C. The biofilter will be designed to have an Unoccupied Air Change Rate (ACH) of 7.0, based on calculations provided by Engineered Compost Systems (ECS Project Memo 236-5, March 31, 2016).

Bulking Agents

Bulking agents in the form of dry processed wood waste and yard waste will be kept in ready access and in ample supply to mix with food material promptly upon its arrival. The bulking agent serves two purposes: 1) to adjust the moisture content of the initial compost feedstock mix to within 60 – 65% moisture content; and 2) to provide sufficient porosity for uniform airflow through the compost pile once it has been constructed.

To a lesser degree, the bulking agent also provides available carbon to the mix to join with available nitrogen in support the biologic conversion the raw feedstock components to the final compost product.

Food Material

The commercial food material will be source-separated from other solid wastes at the point of generation (typically a restaurant or an institutional kitchen) and delivered to the UVDS facility and unloaded inside of the proposed “Blending Barn” building. Because food material can be quite wet at times, it will be discharged onto a bed of dry bulking agent material and immediately mixed using a front-end loader. Comingled yard waste with food waste from residential sources can also act as a bulking agent since food material from residential sources typically as less than 10% of the material. Additional bulking material such as yard waste and processed wood waste will be added at that time to adjust the mix moisture content and satisfy the bulk density parameters.

At this stage of the process, the primary objective is to mix the material on the same day of its arrival and transfer it to the EASP as quickly as possible (i.e., typically before the end of the day). In the event that food material cannot be mixed and placed in the aerated compost pile on the same day that it is delivered, it will blended with bulking agent and covered overnight with a layer of unscreened finished to temporarily retain odors and prevent access to vectors. Smaller piles may be stored overnight and never exceed a total of 48 hours.

Pile Construction and Active Composting

The compost mix will be transported to the advancing face of the EASP, and placed on top of the aeration pipe and plenum layer to the desired height of the pile (12-feet). Toward the end of each day, the fresh mix will be covered on top of the pile with 1-foot (or more) of unscreened compost and/or screened compost.

When each new compost cell is completed, aeration will be initiated and the Active Phase of composting will begin. Active composting will continue for a period of 21 to 30 days (or more), as determined by a set of field tests, including oxygen monitoring, Solvita™ stability testing, pile temperatures and sensory observations.

Compost Curing

Following the Active Phase, the pile will be deconstructed and the compost will be transported to the curing and storage area located to the southeast of the facility access road. Curing piles will be constructed to a maximum height of 15-feet and will not exceed 100-feet by 150-feet in area. Individual curing piles will be separated by a fire lane that is no less than 15-feet wide.

The curing piles will static (i.e., not aerated or turned) and will remain in place for 60 to 90-days, typically. Curing piles will be monitored for pile temperatures, although on a less frequent basis than piles in the Active Phase of Composting. Curing piles may be tarped to: 1) keep them from becoming saturated during periods of heavy rainfall; and 2) keep windblown weed seeds from contaminating the outer surface.

Biofilter Cover Layer

A portion of the cured, unscreened compost and/or screened compost will be used as the biofilter cover for newly constructed active compost piles. This material will ultimately be mixed in with the new compost as the aerated piles are deconstructed and this material is transferred to the Curing area.

Screening

The majority of the compost that has completed the Curing Phase will be screened to separate the fine (product) fraction from the course (“screen overs”) fraction.

Compost Storage

Following screening, the product fraction will be transferred to the storage area that adjoins the curing area. The actual location will depend on the volume of material in storage and proximity to the truck loading facilities.

Screen Overs

The screen-overs fraction will either be used back in the composting process either as a component of a new initial mix or as part of the plenum layer. It may also be sold as a mulch product (i.e., garden top-dressing material).

Harvest Season Composting Procedures

The feedstocks received and processed during the seasonal composting period will consist predominantly of grape pomace, with the addition of processed yard waste and wood waste and commercial food material (Refer to Table 2, Proposed UVDS Compost Mixes) as well as comingled yard waste with food waste from residential sources.

The procedures described below are effectively the same as those that have been practiced at the UVDS facility since approximately 1994 when the facility converted from the turned windrow composting method to the extended aerated static pile composting method.

Receiving and Mixing

Grape pomace will be delivered to the UVDS facility in roll-off containers and will be dumped in a long windrow that parallels the advancing face of the EASP. Source-separated commercial food material that is received that day will be pre-mixed with processed bulking material in the proposed blending barn building and then transferred and added to the top of the windrow. The windrow will then be thoroughly mixed using a straddle type windrow turner or with front-end loaders.

Pile Construction

The mixed feedstocks (i.e., grape pomace, food material and shredded bulking material) will be transferred onto the advancing face of the EASP and then covered with unscreened compost on the top (1-foot thick, or more) and the advancing face (2 – 3-inches for overnight odor suppression). Airflow will be initiated to the new compost cells each day.

Tarp Cover During Winter Months

Aerated composting will proceed without a tarp cover through the active phase of composting. In approximately Mid-November, most, if not all, of pile construction will be complete. At that time, the blowers will be disconnected and relocated to an equipment storage area, and the piles will be covered with impervious plastic tarps (i.e., Griffolyn by Reef Industries) to keep the piles dry during the rainy season and minimize the production of compost leachate.

Because the aeration pipes will remain in place during the winter months, some convective aeration of the compost piles is expected to occur, thereby facilitate the curing process.

Pile Deconstruction, Screening and Product Storage (Spring)

Beginning in April or May of each year, the tarps will be removed from the piles and stored in the equipment storage area. The EASP's will be progressively deconstructed and the compost will be screened in the area located to the southeast of the facility access road. Screened product will also be stored temporarily in this area, and ultimately loaded out and delivered to the end users.

Screen overs that are generated in the screening process will be reintroduced into the Non-Harvest Season Composting Process, as described above.

Routine Process Monitoring

Routine process monitoring is a critical part in managing a compost facility and mitigating the generation of objectionable odors. The UVDS Monitoring Plan includes the following tests and routines, all of which are described in greater detail in Appendix A of this TM.

- Pile Temperatures
- Oxygen Levels
- Site Inspections and General Observations
- Smoke Tests (Refer to Appendix B)
- Sampling and Laboratory Testing
- Off-site Odor Complaint Response
- Record Keeping

Potential Sources of Odor Generation

The primary areas of potential odor generation include the following.

- Feedstock Receiving and Blending Barn Building
- Active Composting Area
- Curing, Screening and Storage Areas
- Surface Water Drainage Facilities

Odor Management Plan

Introduction *Ref: The Practical Handbook of Compost Engineering; Dr. Roger T. Haug, 1993 P.546*

> *"All living systems, both plant and animal, excrete odorous molecules on a nearly continuous basis. The end products of anaerobic metabolism include methane, carbon dioxide, water and heat, along with odorous compounds such as hydrogen sulfide (H2S), volatile organic acids, mercaptans, and methyl sulfides.*
>
> *The main products of aerobic composting are carbon dioxide, water and heat. Many low molecular weight, odorous intermediates may also be produced during aerobic composting, including ammonia (NH3} acetic acid, and citric acid. For this reason, it is essential in designing and operating a compost facility to implement a thorough and active odor management program."*

Compost Facility Odor Management

Odor management at the UVDS Compost Facility is of critical importance and therefore is considered the first and highest priority. Odor management will consist of six steps in the operation of this facility:

1. Sufficient Carbon-rich bulking material will be kept on-hand at all times;
2. Food material will be mixed in with the bulking agent at of up to ~25% food material and at least 75% bulking material;
3. Food material will be source-separated at the place of generation, both from commercial and residential sources, separate from solid waste, typically be fresh, from local sources and will be mixed promptly upon arrival at the site;
4. The mix will be placed in the compost bay typically on the day of the mix and covered with a 12-inch (plus) thick layer of finished compost to serve as a biofilter layer (the biofilter will have proper moisture at all times);
5. Positive aeration will be initiated expeditiously to create and maintain aerobic conditions throughout the compost pile; and
6. Good housekeeping practices will be utilized to minimizes potential sources of odor other than the compost piles (i.e., cleaning mixing area, preventing standing water, etc.).

Odor Contingency Plan

In the event of odorous emissions, the following additional steps in the current OIMP may be taken to prevent odor releases:

1. One or more flexible perforated pipes will be placed on top of the biofilter cover and then;
2. An impervious cover (tarp) will be placed over the pipes and restrained with sandbags, forming a relatively tight seal on all sides of the pile;
3. A blower will be attached to the perforated pipes to the inlet side of the blower (i.e., negative aeration mode) to “scavenge” odorous air from above the pile surface and beneath the tarp;
4. The collected air will be directed to a stand-alone biofilter. The biofilter will be constructed in advance and maintained in the event that it is needed to mitigate odors.

Critical Mix Parameters

As discussed above, there are a range of mix parameters that are very important for aerated composting where feedstocks of various blends may be comparable in parameters to minimize odors. These are presented in Table 1, above. Of these, two parameters are of particular importance for odor management: moisture content and mix porosity (i.e., as measured by both bulk density and free-air space).

Maintaining the moisture content of a compost pile within the optimum range is critical to successful composting. Sufficient water must be available for microbial activity. Excessive moisture content reduces porosity, promotes odor producing anaerobic conditions and slows the decomposition process. Excessive moisture also acts as a heat sink, reducing pile temperatures. The optimum initial moisture content for aerated composting is considered to be 60 to 65 percent.

Porosity is of primary importance when preparing the initial mix. A mix with insufficient porosity will limit aeration and may lead to short-circuiting of airflow through the pile. Porosity is provided in a mix by large and small particle size woody materials, also referred to as "bulking agents". In general, the porosity of the initial mix is considered optimal if the bulk density ranges between 650 and 950 pounds per cubic yard.

Nutrient Balance and Heat Production

Heat is generated during the composting process as a result of the rapid decomposition of organic compounds that are readily available as substrates for microbial growth. Readily available forms of carbon include sugars, starches, fats and proteins.

Less available forms of carbon include hemicellulose, cellulose and lignin, all of which decompose at a much slower rate. The composting process requires a certain fraction of readily available compounds to be present. For example, a pile of sawdust will not generate much heat compared to a similar sized pile of sawdust mixed with food waste and yard waste.

Inorganic nutrients such as nitrogen, potassium and phosphorous are required for microbial growth. In most mixes, nitrogen is the limiting component. As a general rule of thumb, the ratio of carbon to nitrogen (C:N ratio) should be between 25:1 and 35:1. A lower C:N ratio (i.e., high nitrogen content) can result in the production of odorous nitrogen containing compounds such as amines and ammonia during composting. At higher C:N ratios, nitrogen may not be sufficient for active, thermophilic composting.

The desired heat range in an active compost pile is 131^{o}F to 150^{o}F. Pile temperatures that exceed ~160^{o}F will result in slower decomposition of the feedstocks and may lead to increased odor production due to the release of gases.

Positive Aeration of the Compost Pile to Maintain Aerobic Conditions

UVDS will utilize positive aeration given its demonstrated efficiency and comparative simplicity of operation. The following discussion elaborates on positive aeration.

The heat in an EASP System is managed by controlling the On/Off cycle time (i.e., the frequency that the blowers operate and the duration of airflow into the pile). The oxygen demand for managing the biology of the composting system is greatest in the first 10 – 14 days of composting, which coincides with the period of greatest potential odor generation. Our goal throughout the Active phase of composting is to maintain oxygen (O_2) content of 10% or greater.

Routine monitoring of the composting process will include both temperatures and oxygen content throughout the active phase of composting. These and other monitoring tests are described in detail in Appendix A of this TM.

Good Housekeeping Practices to Minimize Sources of Odor

Odor reduction is accomplished by practicing "good house-keeping" in all areas of the compost facility. It is essential to clean up the feedstock receiving and mixing areas daily and eliminate areas of standing water. A daily walk-through of the compost facility is important to identify potential sources of odor as well as problems with disconnected aeration pipes. In addition, equipment used to mix and process feedstock materials will be routinely cleaned to minimize exposure of raw materials to the open air.

The primary means to keeping odor minimized is aeration. This is done using blowers. UVDS will provide one blower per each fan group to use for aeration, with two additional blowers on-hand as backup if one of the blowers fails.

Odor Complaint Response

As required by the current OIMP, UVDS staff will record any complaint received and respond to each neighbor quickly and with respect. Odor complaints will be acted upon promptly and will be reported to the LEA after one call has been received (See below). The odor event will be correlated with local meteorological conditions at the time of the event to determine the activities and conditions that resulted in the off-site odor impact.

The person making a complaint will be given a follow-up call with the results of an inspection. Corrective actions taken will also be noted and shared with the caller. An odor complaint check sheet has been prepared to assure this procedure is followed.

In summary, UVDS staff will review operational information and weather information and take the following steps:

- All complaint calls will be recorded, analyzed, and reported on a monthly basis.
- Immediate action will be taken to identify and correct an odor source, if possible.
- The LEA will be notified if one call has been received.
- A written analysis will be generated explaining the suspected cause and corrective actions.
- Complaint records will be shared with the community when requested.

This response system is designed to insure that UVDS is listening to and respecting the surrounding community. It will also serve to inform the LEA and community of UVDS' response to any community concern.

Odor Complaint Records

Odor complaints will be recorded on a form and kept in a master record file that is maintained in the facility office. These complaints can be from individuals or relayed to the UVDS by the LEA. At the end of the month this record will be tabulated and reviewed and complaints will be noted as to time and location. They will be compared to meteorological data as recorded by the on-site meteorological station. The number of confirmed complaints will be tracked each month and trends will be observed. Records will be kept for 5 years.

Dust Control Procedures

Compost is a material that can have small particle sizes and low density. It can be a cause of dust especially during times of dry weather conditions and high wind. To decrease the opportunity for dust emission beyond the property boundary UVDS will take the following measures:

- Paved asphalt surfaces used by loaders to handle feedstocks and compost product will be swept or washed to prevent the accumulation and drying of spilled compost material.
- Piles of compost will be kept at moisture content high enough to prevent the creation of dust during material movement.
- Screening of compost will only be conducted on product with sufficient moisture content to prevent dust (greater than 40% moisture content). If the product is drier than 40% moisture content, sprinklers will be used to moisten the material before screening or sprinklers will be used directly on the screening equipment to prevent the release of dust.
- In the event that high winds cause dust to leave the UVDS property boundary, the activity generating the dust will be postponed until wind speed and direction allows for continued screening.

Recommendations for Minimizing Odor Generation and Mitigating Off-Site Neighbor Impacts

- Meteorological Station (on-site) to Monitor and Record Weather Conditions 24/7

  Recording on-site meteorological conditions would be of benefit to UVDS for two reasons. First, having a record of the weather conditions would allow operations staff to correlate site activities with odor events and thereby make adjustments to operations during similar weather conditions. Second, knowing the wind direction and wind speed at any given time, would help in working with neighbors who register formal odor complaints as a means of validating their complaints.

- Building for Receiving & Mixing Raw Feedstocks; Placed on EASP Expeditiously

  Constructing the Blending Barn for receiving and mixing raw feedstocks will greatly enhance the likelihood of reducing off-site odor impacts. As part of the design of the Blending Barn, I recommend installing a negative ventilation system with biofiltration of the captured off-gases. The biofilter should be designed for a minimum of six air exchanges per hour.

- Oxygen Levels in EASP Maintained at 10% or higher = Routine O_2 Monitoring

  As discussed in this TM, the objective of an aerated compost system is to keep the oxygen levels in the pile at or above 10%. This means routine (weekly) monitoring during the Active stages of composting and adjusting the blower On/Off cycles accordingly.

- Biofilter Cover (CASP): Composition / Placement / Maintenance

  In addition to preparing a proper compost mix and aeration, the biofilter cover is an extremely important component of the EASP design in terms of minimizing off-site odor impacts. I recommend using 1-foot of well cured, unscreened compost as your biofilter material. For it to function properly it needs to be relatively uniform in thickness and it must be kept wet. During dry weather, this may require top-irrigation using sprinklers.

- Standing Water and Drainage Facilities

  It is recommended to install a 10 to 15-foot wide concrete apron and v-ditch system along the east side of the site with catch basins tied to the pump station. The underground pipeline should include a clean-out located at the southeast corner of the site, allowing access for the operations staff to periodically flush the line to keep it clean.

- Odor Incident Response Form

  As required by the current OIMP, each recorded odor complaint should include the following information:

  - Day / Time / Name / Address (correlate with on-site Met. Station / site activities)
  - Strength & Character of Odor
  - Response to Complainant and Actions Taken to Resolve Odor Impacts
  - Procedures for Filing and Retaining Odor Complaint Records
  - Coordination with LEA

- On-site Manager

  It is recommended to have a dedicated employee serve as the "UVDS Environmental Manager". This employee could be responsible for the following tasks:

  - Weekly Site Inspection (Checklist)
  - Review & Record Meteorological Data and Odor Complaints
  - Follow-up with Neighbors and the LEA
  - Process Monitoring: Temperatures, O_2, Smoke Tests, etc.
  - Record Incident Reports / Annual Reports to LEA
  - Review information with Supervisor and Propose Operational Adjustments

Conclusion

The proposed feedstock blends are comparable to the current feedstock by adding processed wood waste and yard waste as bulking agents in order to provide carbon-nitrogen ratio, porosity, and moisture similarities. The food material will be source-separated and will be separated from solid waste at the point of generation and will be blended within a building.

As with the existing operations, odor has been a potentially significant impact but is mitigated to a level of insignificance by instituting the measures which include: proper handling and prompt mixing of raw feedstocks; fully aerating the piles; utilizing a 1-foot thick biofilter layer over the raw compost mix; and establishing good housekeeping practices. The addition of residential food material to the facility will not increase odor generation as long as the facility continues compliance with current use permit conditions and mitigation measures.

Appendix A – Mix Parameters & Process Monitoring Plan

Compost Monitoring and Control Parameters

Composting is a controlled biological process designed to rapidly convert waste organic material into a humus-like, rich material that is useful for a variety of purposes associated with landscaping, growing plants and erosion control. Controlling the compost process allows composting to be completed efficiently and mitigates adverse impacts to the environment.

The compost monitoring and control parameters are discussed in the following sections.

Initial Mix Ratios and Characteristics

Mix ratio development and characteristics are critical to successful composting. Mix ratio refers to the portions of each feedstock in the initial mix. The initial mix impacts a number of processing parameters including: processing time, aeration requirements, odor generation, leachate production and final product quality. The following parameters are significant in the initial mix:

- Porosity
- Moisture Content
- Available Carbon Content
- Nutrient Content (i.e., C:N Ratio)

Porosity

Porosity is of primary importance for initial mixing. A mix with insufficient porosity will limit aeration. Porosity is provided by large particle size materials such as chipped brush and wood chips. The moisture content of the mix also influences porosity. If the moisture content is excessive, pore spaces are filled with water instead of air. In general, the porosity is considered optimal if the moisture content is between 65 and 60 percent and the bulk density is between 650 and 950 pounds per cubic yard (pcy).

The optimum porosity/moisture is dependent on the moisture holding capacity of the initial mix. Experience working with the various feedstocks at a specific site will dictate what the optimum bulk density and moisture content of an initial mix should be.

Moisture Content

Maintaining the moisture content of a compost pile within the optimum range is critical. Excessive moisture content reduces the pore spaces and the availability of oxygen. This causes anaerobic conditions and slows the decomposition process. Excessive moisture also acts as a heat sink, reducing pile temperatures. Insufficient moisture, below 45%, is a poor environment for the bacteria and the composting process will stop. The optimum moisture content for composting is around 60 percent with the range being 50 – 65%.

Available Carbon Content

Heat is generated during the composting process as a by-product of the rapid decomposition of organic compounds that are readily available as a substrate for microbial growth. Carbon rich substrates such as sugars, starches, fats and proteins are considered readily available, whereas hemicellulose, cellulose and lignin decompose much more slowly and are therefore not considered readily available. The composting process requires a certain fraction of readily available compounds to be present. For example, a pile of sawdust will not generate much heat compared to a similar sized pile of sawdust and grass or manure. If the amount of readily available sugars, starches, and fats are too high, rapid oxygen depletion occurs (i.e. anaerobic conditions) and odor generation can result. Available carbon should be 30 times the available nitrogen for an ideal mix. This is customarily referred to as a Carbon to Nitrogen ratio (C:N) of 30:1.

Nutrient Content

Inorganic nutrients such as nitrogen, potassium and phosphorous are required for microbial growth. In some mixes, nitrogen can be limiting. However, given the year round consistency of the feedstocks used in this process, significant variations in nutrient content are not anticipated. All other nutrients are typically present in sufficient quantity. As a general rule of thumb, the ratio of carbon to nitrogen (C:N ratio) should be between 25:1 and 35:1. A lower C:N ratio can result in the production of odorous nitrogen containing compounds such as amines and ammonia, during composting. At higher C:N ratios, nitrogen may not be sufficient for active, thermophilic composting. However, initial mixes with C:N ratios as high as 60:1 have been noted to compost quite well.

pH

The initial pH of a compost mix should range between 6.0 and 7.5.
Either excessively acidic or basic conditions can inhibit biological activity. Initial pH outside of the desired range of 6 to 7.5 should be adjusted unless demonstrated to perform adequately in pilot testing operations. A mix that is slightly acidic will reduce off-gassing of ammonia thereby reducing the potential for odor impacts.

Visual/Qualitative

Trained and experienced compost facility operators can utilize simple qualitative tests as aids to operations. The visual appearance of the material at all phases of the mixing and composting process provides valuable insights into the status of the process. Color, moisture, particle size and void spaces, absence of mix "balls" and odor are useful visual/ qualitative indicators. Of primary use during the initial mix operation is: 1) the squeeze test for free moisture, 2) the bucket test to determine mix bulk density and free-air space and adequacy of void spaces in the mix and 3) the observed thoroughness of mixing.

Process Control Monitoring

Process monitoring entails the regular collection of data pertinent to the composting process. In addition, the data should be examined to determine if and what process adjustments need to be made. The following parameters should be monitored on a regular basis:

- Temperature
- Moisture Content
- Bulk Density Decomposition
- Qualitative Parameters: Odor, Color and Texture

Decomposition

Maintaining optimum decomposition rates will reduce processing time and improve product quality. Optimum decomposition rates are obtained by providing an initial mix with sufficient carbon and nutrients and maintaining adequate temperature, moisture and oxygen levels. In general, decomposition occurs over two phases.

The first phase, described as the thermophilic phase (or active phase) is evident by temperatures greater than 40 °C (105 °F). This phase is when the majority of the energy source is used (simple sugars, carbohydrates, and fats). As the energy is used, heat is produced as a by-product.

The elevated temperatures increase the kinetics of the system. The higher temperatures along with adequate moisture and oxygen levels also encourage the growth of aerobic microorganisms. This is significant, as aerobic decomposition occurs at a faster rate than anaerobic decomposition and has far lower odor potential.

If all other environmental conditions are optimal, temperatures dropping into the mesophilic range (less than 40°C (105^{o}F)) indicate microbial respiration or decomposition rates have been reduced and the composting process has entered the second phase of decomposition, called the curing phase. The first (active) phase of composting may last for a few weeks to a few months, depending on the substrates composted and the conditions provided. The second (curing) phase can take upwards of a few months before a mature final product is produced. Decomposition is assessed by evaluating several parameters throughout the process and measuring the stability of the final products. The following parameters are used to assess decomposition during processing:

Volume Reduction - As the material degrades, the volume of the pile decreases. With the aerated static pile process, this volume reduction is easily determined by monitoring pile height. For a consistent long-term program, the volume reduction could be correlated with other degradation parameters for use as an indicator of pile status.

Volatile Solids Reduction - A reduction from initial to final volatile solids of 50 to 60 percent is indicative of a stable compost product.

Respiration Rate - Respiration rate can be used as an indicator of biological activity throughout the composting process. This testing is discussed in a later section.

Bulk Density

Bulk density is a simple means of assessing porosity. The denser the material is, the lower the porosity. This field test procedure is described in the Appendix. The bulk density of composting material should remain less than 1200 pounds per cubic yard (pcy), with an initial target value between 650 and 950 pcy.

Moisture Content

Moisture content should be maintained between 50 and 65 percent throughout the composting process. If material is too dry, water can be added (although this is difficult with the ASP method of composting). If the material becomes too wet, additional bulking agent can be added to the initial mix or the aeration rate can be increased to drive off excess moisture. A simple field test, referred to as the "Squeeze Test".

Temperature

The use of temperature as a method of monitoring the composting process is the most common and most convenient. Temperature measurements can indicate several composting performance goals and may be used to do the following:

Determine the suitability of the initial mix- if the initial mix has the appropriate physical and chemical characteristics, then thermophilic temperature should be achieved within three to five days and maintained for three to six weeks thereafter. Monitoring temperatures enable the operator to:

- Document the achievement of pathogen reduction requirements.
- Document the achievement of vector attraction reduction.
- Document temperatures required for weed seed destruction.
- Indicate oxygen-limiting conditions- a drop in temperatures during the active process, indicates oxygen is limiting or excessive aeration is being provided.
- Determine compost stability- a 20 cubic yard pile of cured product should not reheat more than 68 °F above ambient temperatures.

Qualitative Parameters

Assessing the compost visually and by smell and feel can provide valuable insight to the process. It is generally recommended that the sample being assessed be taken from the pile interior (deeper than 36-inches) with a front-end loader. The senses can be used to assess the following parameters:

- Moisture content - composting material should feel moist but not excessively wet. When squeezed in a fist, free water should not drip from the material.

- Odor - a sour or pungent odor is an indication that the pile is anaerobic and that the blower-operating period (i.e., frequency and duration) should be increased.

- Porosity- the compost should have a granular, chunky appearance. A fine texture is an indication the material may not be sufficiently bulked.

Appendix B: Smoke Test Procedures

Aerated Static Pile Composting

The method of composting that we use with all of our compost systems is referred to as Aerated Static Pile (ASP) Composting. This simply means that we induce airflow through the mix of materials using an electric blower - we do not turn the pile during the active phase (first 30 days) of composting.

With aerated composting we maintain aerobic conditions throughout the compost pile and are able to control pile temperatures. This, in turn, expedites the composting process and yields a high-quality compost product that is effectively free of pathogens, parasites, and weed seeds. By composting in this manner, we are able to control offensive odors and flies, improve the aesthetics of the waste handling area, quickly produce a superior product and reduce your labor.

Aeration of the compost bin or pile is possible when the airflow is pressurized and confined to the base of the pile. Air leaks (i.e., short circuiting) reduce the effectiveness of the aeration system and therefore compromises the composting process. The enclosed Smoke Generators (produced by Superior Signal Company) will enable you to visually check for air leaks in your new compost system.

This following test can be accomplished by one person; however it is a much easier process with two or more people.

Test Procedure

1. Be sure that the bin is filled to capacity when running this test to provide sufficient back pressure to reveal all significant leaks;
2. Set the timer so that the blower runs continuously;
3. Open the valve to the bin being tested, to the full open position. Close all other valves;
4. Place a smoke generator on a pie tin (or alternate non-flammable surface), light the fuse and hold it next to the air inlet on the side of the blower (duration about 30-seconds).
5. The smoke will be pulled into the blower and distributed through the aeration system.
6. If there are leaks in the system, concentrated smoke will pour out of these openings;
7. If there are no significant leaks, the smoke will emerge in a diffused manner between cracks in boards and then through the compost pile itself. This is what we hope to see.
8. If the system does have significant leaks, these can be closed with caulk or lean concrete.
9. If you have questions, please contact O2Compost to discuss ways to seal the leaks.
10. Two smoke emitters have been provided. Contact us if more are needed for further testing.

Take Necessary Precautions

If you are conducting the test in a populated area, be sure to notify everyone that you will be creating a considerable amount of smoke and to not be concerned. If you are in a highly populated area (e.g., public horse venue, university, prison, etc.) be sure to notify the authorities (including the local fire department) that you will be conducting the test at a specific time. Provide the MSDS Sheet that is included with the smoke emitters to these same authorities before conducting the test.

Safety Note

The smoke is not harmful or malodorous. What odor you will detect is faintly similar to burning paper. Over exposure could be caused if the smoke generator is ignited in a confined area and a person remains in that area for 10-minutes or longer.

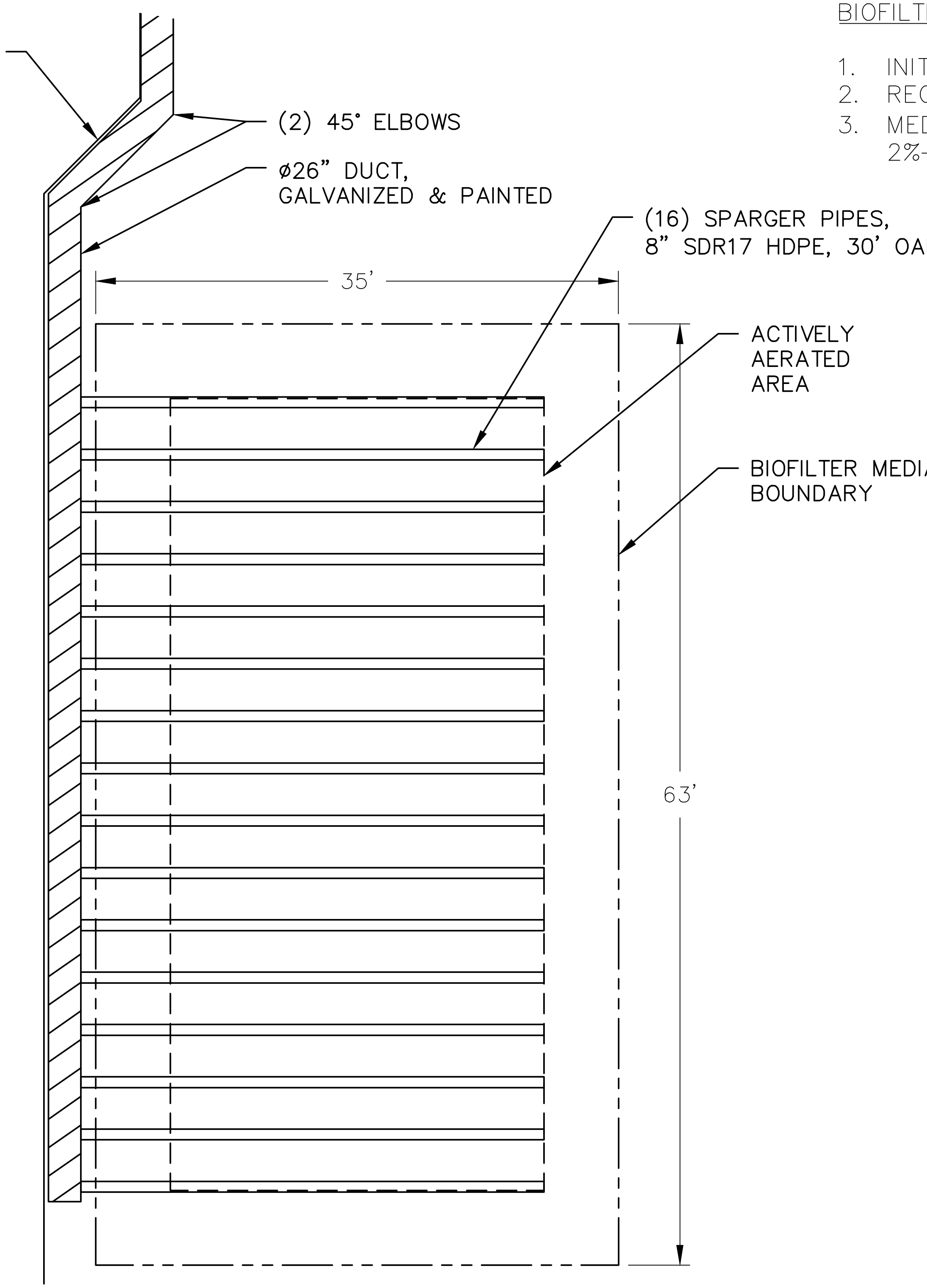
Over exposure could result in throat irritation and mucus membrane congestion requiring medical treatment. Should this occur, remove the individual to fresh air and if breathing is difficult, get medical attention immediately. The smoke is non-hazardous and safe when used outdoors as directed.

Link: The Material Safety Data Sheet (MSDS) https://www2.itap.purdue.edu/msds/docs/7967.pdf

Appendix C: Receiving Building Biofilter Concept

Prepared by Engineered Compost Systems

- Receiving Building Bioflter Concept – Drawing 1 of 1
- Tipping Structure Biofilter Operating Parameters and Design (Project Memo 236-5)

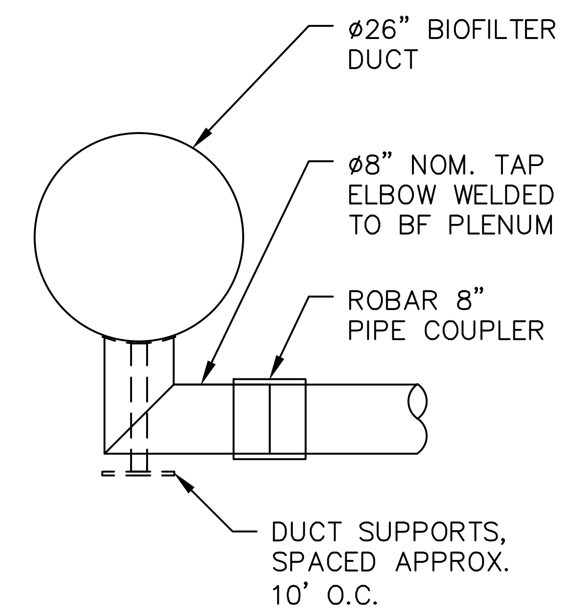


BIOFILTER PLAN DETAIL

SCALE 3/32"=1'

BIOFILTER NOTES:

1. INITIAL BIOFILTER BED DEPTH: 5.5 FT
2. REQUIRED BIOFILTER MEDIA VOLUME: ~350 CY
3. MEDIA IS 2"+ SCREENED GROUND WOOD W/ 2%–5% SCREENED OVERS



BIOFILTER PLENUM SECTION

SCALE 1/2"=1'

NO	REVISION		
–	–	–	–

TOLERANCES
UNLESS OTHERWISE SPECIFIED
2 PLACE DECIMALS: ± xx
3 PLACE DECIMALS: ± xx
FRACTIONS: ±xx
ANGLES: ±xx

ALL DIMS ARE IN INCHES
DO NOT SCALE DRAWING

THIRD ANGLE PROJECTION

ECS ENGINEERED COMPOST SYSTEMS
4211 24th Avenue West - Seattle, WA 98199
T 206.634.2625 F 206.634.1309 www.compostsystems.com

DRAWN: EWH	SIZE: B	TITLE: RECEIVING BUILDING BIOFILTER CONCEPT	
CHCKD: .			
DATE: 9 JUL 2015	PROJECT: NAPA	SHT: 1 OF 1	
SCALE: 1/32"=1'	DWG. NO: 236–M200		REV: 1

engineeredCOMPOSTsystems

Project Memo 236-5

DATE:	3/31/16	ECS PROJ. NO.:	P236
BY:	Tim O'Neill and Chris Anderson	PROJECT NAME:	Napa Composting Facility
TO:	Greg Kelley – NWRS, Rick Moore – Edgar & Assoc.	COPY TO:	Will Kelley
SUBJECT:	Tipping Structure Biofilter Operating Parameters and Design		

RESPONSE REQUESTED

Yes	X	No		Hard Copy		E-Mail	X	Phone Call	X

Biofilter Operating Parameters

ECS has designed and implemented organic media biofilters at over 45 client sites. To insure biofilter performance, the following operating parameters need to be managed and maintained:

1. Media Moisture: The below surface biofilter media moisture levels should be maintained above 50%. Moisture levels should be checked weekly by digging down 12" and taking several grab samples of the media for visual inspection. Additionally, a composite sample should be sent on a quarterly for % moisture analysis at a laboratory (can be done in-house if the equipment is available). The lab sample analysis is primarily to keep the on-site visual inspection in "calibration".
2. Biofilter Back-Pressure: Excessive back-pressure will cause flow channeling and degrade the scrubbing efficiency of the biofilter. Initial inlet back-pressure will be measured at system start-up (when both empty bed and new media system curves can be established). An upper limit for back-pressure will be established based on the system curve. Biofilter inlet back-pressure should be measured and recorded monthly at known flow rates. Media should be changed once the upper back-pressure limit is exceeded.
3. Media Height: The media height needs to be sufficient to produce an adequate "empty-bed-residence-time" (EBRT) to provide the desired control efficiency. The typical target for scrubbing efficiency in a biofilter is 90%. The EBRT required depends on the chemical loading in the airstream. In lightly loaded air streams (ie. tipping room air) an EBRT of 15 seconds is typically adequate. In highly loaded airstreams (ie. digester process air exhaust) and EBRT of 45 – 60 seconds can be required. Once the minimum EBRT/media height is established, the height should be measured and recorded monthly. When the height approaches this minimum, additional media can be added to the top of the biofilter (typically in 12-18" lifts). Additional lifts can be added until the back-pressure limit is exceeded.
4. Media Condition: Visually check media for signs of cracking and channeling on a monthly basis. Add an additional top layer (per 3) if cracking/channeling is visible in the media.
5. Media pH: Excessively high/low pH wil degrade biofilter efficiency; the pH should be between 5.0 and 8.0. A composite grab sample should be analyzed and recorded monthly. If out-of-range pH persists, change the media and find root cause.

Nappa Biofilter Basis of Design

The Napa tipping area shade structure biofilter has been conservatively designed to provide over 90% reduction in VOC's and 70% reduction in PM10. The biofilter basis of design is given in the table below.

Item	Unit	Quantity
Unoccupied Structure Volume (closed)	ft3	280,000
Occupied Structure Volume (head-space above the doors)	ft3	60,000
Unoccupied Air Change Rate	ACH	1.5
Occupied Air Change Rate	ACH	7.0
Air Flow Rate	cfm	7,000
Initial Media Bed Depth	ft	5.5
EBRT @ Initial Bed Depth	sec	60
EBRT @ Settled Bed Depth (4')	sec	45
Biofilter Area	ft2	2,200
Biofilter Irrigation Rate	gph	25
Design Air Temperature Range	F	32 – 90
Design Humidity Range	%RH	35 – 95

Media Height: Typical tipping building VOC concentrations are relatively low for source separated organics processing. A conservative EBRT 45 seconds was used the basis of design since air sample data was not available. In practice we are confident that better than 90% VOC reduction will be achieved over the entire range of ambient operating temperatures and biofilter media heights (above).

Irrigation Rate: Media moisture will be maintained by directly irrigating the media from both within and at the top surface. The media itself provide highly efficient moisture transfer to the air since the velocities are very low and the available surface area is very high. The irrigation rate needs to be sufficient to match/exceed the amount of moisture required to raise the incoming air to 100% RH at the highest temperature/lowest humidity anticipated. The irrigation is controlled by timers that are adjusted in response to moisture level observations.