Greenwaste Compost Site Emissions Reductions from Solar-powered Aeration and Biofilter Layer

Report from the contract team

5/14/2013

Funded by and prepared for the San Joaquin Valley Technology Advancement Program

Table of Contents

Abstract

This project was proposed as a technology development and testing project to evaluate an innovative extended aerated static pile (eASP) compost system design at commercial scale. The purpose was to determine whether the innovative design could produce compost of acceptable quality while reducing air emissions. The eASP was compared to standard windrow composting conducted at the same facility using the same feedstock. The eASP was tested in a single selected configuration; therefore, the results of this project do not establish optimal operational parameters, such as blower speeds or water application rates, but results are sufficient to establish proof of concept.

A prototype commercial-scale Aerated Static Pile (ASP) compost system was built using electric conveyors in place of diesel trucks and loaders. Three ASPs were built abutting each other to create an extended design which we define as an eASP. The eASP piles were deeper and wider than a typical windrow, were placed on a foundation of aeration tubing and chipped material, and were capped with a 1-foot-thick layer of finished, unscreened compost acting as a biofilter layer or “compost cap.” The three static piles of the eASP were aerated using power provided by an on-site photovoltaic array. The intent of this design was to take advantage of emissions reductions previously demonstrated by biofilters and ASPs with a design footprint more similar to existing windrow methods.

Windrows of identical greenwaste feedstock and of industry typical dimensions were created nearby with a loader and turned with a diesel-powered mechanical turner, which is the normal method of composting in much of the United States. No biofilter caps were applied to the windrow, as that is not the normal practice at this facility, nor is it required by air district regulation.

A series of three ASP zones and three windrows were built approximately one week apart. This allowed the in-the-field measurement period to be shorter while still collecting measurements representative of the full 22 day active composting period. Emissions of VOCs, ammonia and greenhouse gases from both sets of piles were sampled using the USEPA-approved flux chamber method, as modified for composting emissions by the South Coast Air Quality Management District. Emissions reductions from reduced diesel use were calculated by using the estimated time necessary to accomplish standard tasks, multiplied by the allowable tailpipe emissions for equipment normally found at commercial scale composting sites, such as trucks and loaders.

The comparison of emissions from the 22-day active composting phase between the eASP and standard windrows demonstrated emissions reductions by the eASP of 99% for total non-methane, non-ethane VOCs, 70% for ammonia (average of field and lab), 88% for nitrous oxide, and 13% for methane. The overall reduction for CO2 equivalents was nearly 65%. Diesel use in pile construction and active-phase management was 87% less for the eASP system, with commensurate reductions in criteria pollutant emissions associated with diesel fuel combustion. Water used during the composting process was reduced by 20%, and land necessary for active-phase composting is calculated to be reduced by 55.5%.

Samples of finished compost at 30 days of composting from the eASP and standard windrows were sent to an accredited laboratory for industry-standard testing. Maturity and stability of the eASP materials were equal to or better than their windrow counterparts.

Acknowledgements

This project was funded by the San Joaquin Valley Air Pollution Control District under Agreement C-15636 and consisted of the following team:

- Ross Badertscher, SJVUAPCD, grant manager
- Kevin Barnes, City of Bakersfield, conveyorization and diesel/water use calculations
- Tom Card, consultant, emissions calculations
- David Crohn, UC Riverside, science advisor
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- Robert Horowitz, CalRecycle: principal study author
- Peter Moon, O2 Compost, eASP design and solar array specification
- Dan Noble, Association of Compost Producers: project manager
- Chuck Schmidt, consultant: emissions study design and sampling

Special thanks to Brian Stalker, Elena Yates and Janelle Auyeung: CalRecycle; Paul Sellew, Wayne Davis, Antonio Cardenas, Samuel Villalobos, Alex Rivera, Velente Rivera: Harvest Power; Harold Ruppert and Derrick Santos, O2 Compost, and the City of Bakersfield.

Required Statement

The statements and conclusions in this report are those of the Contractor and not necessarily those of the San Joaquin Valley Air Pollution Control District or its employees. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products.

Executive Summary

A prototype extended Aerated Static Pile (eASP) composting process was assembled and operated to test both ability to produce quality compost and to quantify air emissions.   EASP differ from ASP only in that consecutive zones are laid alongside each other along the long axis. The eASP utilized ambient air blown into the pile from the bottom; the blowers were powered by photovoltaic panels and associated batteries. The eASP had a biofiltration layer added to the surface as an air pollution control measure. A series of compost windrows were built concurrent with the eASP using the same feedstock. The air emissions from the eASP were compared to the on-site measured air emissions of the current industry-standard windrow composting method.

Emissions were measured using the standard methods and techniques used for San Joaquin Valley Air Pollution Control District (SJVAPCD) regulatory compliance. This includes the use of the USEPA flux

chamber as modified under South Coast Air Quality Management District (SCAQMD) Rule 1133, and analysis using SCAQMD Method 25.3 and 207.1. In addition to these traditional methods, nitrous oxide (N2O) was measured using NIOSH 6600 and organic species were measured using USEPA TO-15.

Table ES-1 provides a summary of the emissions using the emission factor of pounds of pollutant emitted per ton of compost mix in the pile or windrow over the 22-day active composting period, as specified by SJVUAPCD Rule 4566. VOC reductions of 98.8% were achieved when compared to the control windrows. Reductions in ammonia emissions were 83% using tubes in the field, and 53% from the laboratory, when the eASP was compared to the control windrows. Reductions in emissions of greenhouse gases ranged from 13% for methane up to nearly 89% for N2O for the eASP system when compared to the controls.

Table ES-1: Project Results							
		NH3		**GHG**			
	VOC	**Field**	**Lab**	**CO2**	**CH4**	**N2O**	**CO2e**
Prototype ASP (22 Days)	0.099	0.017	0.007	205.70	5.05	0.010	315
Baseline Windrow (22 days)	8.604	0.099	0.014	731.63	5.81	0.093	883
% reduction from Baseline	**-98.8%**	**-83.2%**	**-53.3%**	**-71.9%**	**-13.0%**	**-88.8%**	**-64.3%**

Table ES-1: Results of emissions testing in pounds of pollutant per ton of feedstock over the 22-day active composting period.

To normalize the analysis of windrow (on-site control) emissions being higher than expected, project results were also compared to adopted emissions factors from the SJVUAPCD and the SCAQMD.

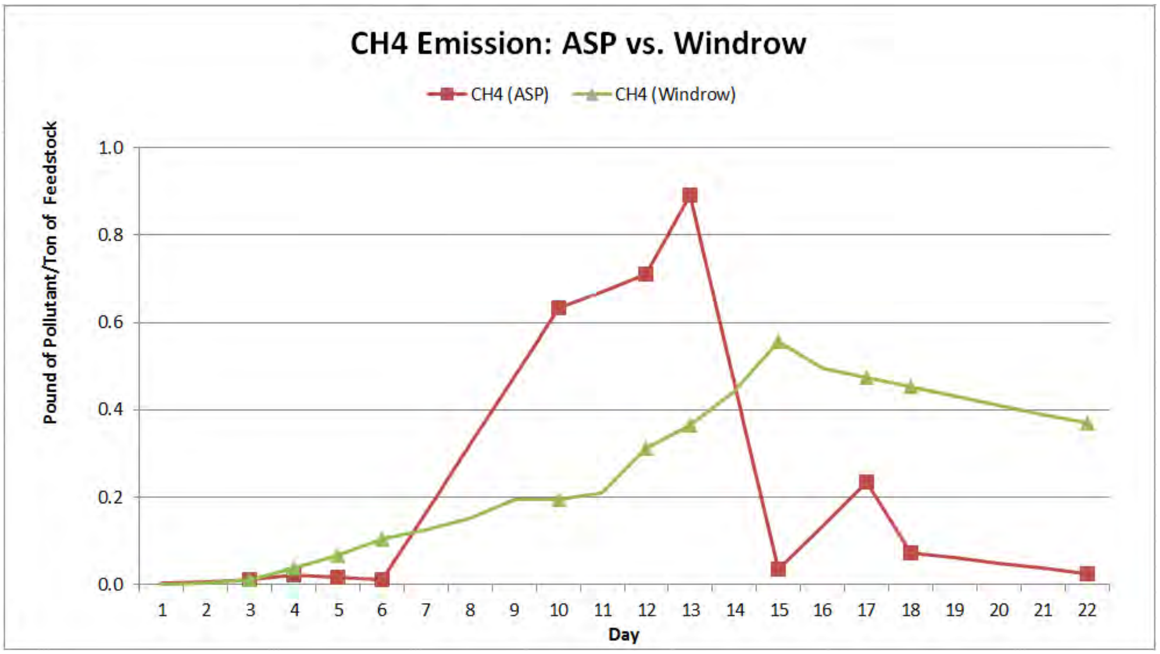
Table ES-2 Comparison to SCAQMD and SJVUAPCD VOC Emissions Factor			
	Prototype ASP	SJVUAPCD	SCAQMD
	22 days	22 days	life cycle
Emissions Factor	0.10	5.14	3.76
% Reduction		***-98.1%***	***-97.4%***

Table ES-2: VOC emissions reductions from 22-day active composting in pounds of pollutant per ton of materials using eASP system compared to emissions factors adopted by SJVUAPCD and SCAQMD.

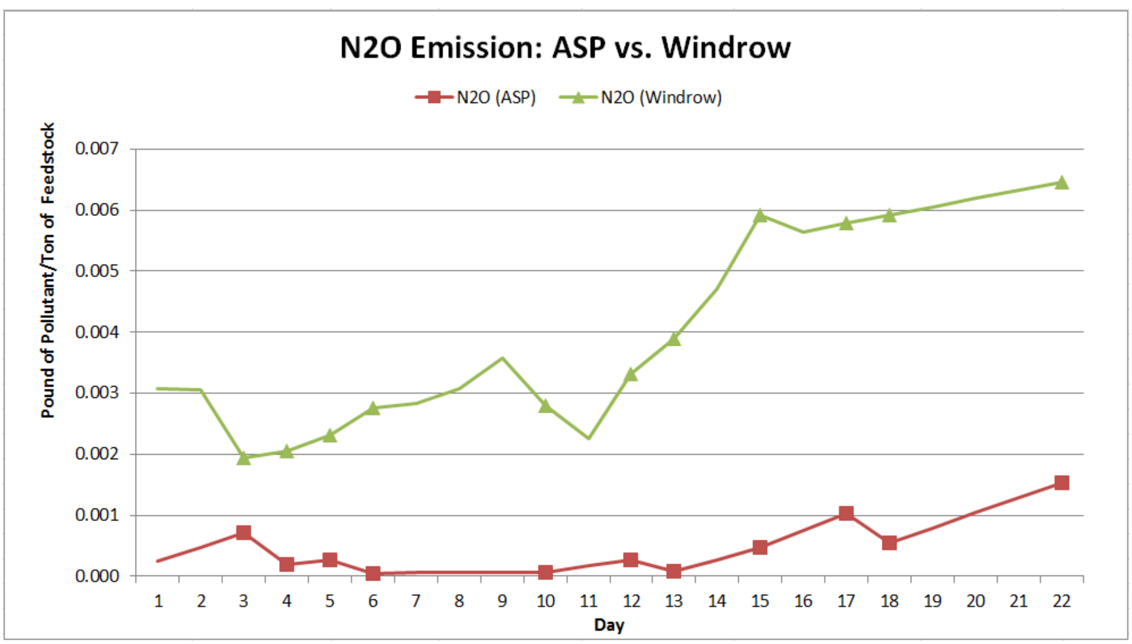
As with any composting emissions test, sampling opportunities seem limited when compared to the vast size of the composting piles and the time necessary to complete the composting process. A total of 92 samples were taken, including 84 samples and 8 quality control blanks. Sampling during the composting cycle ranged from day 3-to-day 23 for the eASP and day 2-to-day 29 for control windrows. For the eASP, pre-planned sampling locations were demarcated on top of all three zones to ensure those locations were neither walked upon nor perforated with the temperature probe. Because each sampling event takes approximately two hours, and the eASP blowers were set to operate two minutes out of every 20, eASP sampling included multiple blower-on and blower-off cycle conditions.

An additional sample was taken of a 63-day-old windrow. It was later revealed that this windrow contained a significant amount of food waste. Those data are reported in the appendices.

22-day emissions were graphed to look for differences in air emission for key target species over the composting cycle. Total non-methane non-ethane organic carbon emissions for the control windrows followed established trends; an initial spike followed by rapid decline. The eASP emissions line is nearly flat. Methane emissions from both the eASP and the windrow are greatest toward the middle of the active compost period, while N20 emissions from both piles tend to increase toward the end.



Graph ES-1: Time-series comparison of methane (CH4) emissions between the eASP and control windrows. Methane is an important greenhouse gas with a climate warming potential no less than 21 times greater than carbon dioxide.



Graph ES-2: Time-series comparison of nitrous oxide (N2O) emissions between the eASP and control windrows. Nitrous oxide is an important greenhouse gas with a climate warming potential no less than 298 times greater than carbon dioxide.

Total emissions and emissions per ton of feedstock were also calculated for 30-day and 60-day cycles. 60-day results for the eASP are necessarily extrapolated beyond day 23. 30-day totals require much less extrapolation. A complete accounting for all emissions testing is reported in Appendices A and B. In general, the longer calculation periods show greater benefits from using the eASP, particularly with regard to methane; VOC reduction benefits are virtually unchanged. These calculations and graphs are available in Appendix A.

Reductions in diesel use were calculated for pile construction and management during the active phase. For windrows this includes mechanized turning, but the eASP was not turned for the first 30 days. The overall reduction in diesel use was 87%. A commensurate 87% reduction in criteria pollutants from diesel emissions was also calculated. These data and calculations are discussed further in the body of the report as well as in Appendix C.

Water use reductions were also calculated. The initial watering of ASP feedstock and 30-days of timed sprinkling of the eASPs used approximately 20 percent less water than the traditional windrows, which were watered by a 4,000-gallon watering truck with a sprayer on the back. For a theoretical 100,000 ton per year facility, this would save about one million gallons of water per year, with commensurate GHG reductions from eliminating the water truck fuel use. These calculations are discussed in the body of the report.

EASP piles can be built wider and taller than windrows, which can be no larger than the largest windrow turning machine on site. This gives the piles a smaller surface area, potentially reducing both evaporation and emissions. Larger piles can also reduce the amount of land needed for a composting operation, thereby reducing costs to purchase land or to build working pads. For active composting, we calculate the EASP system can accommodate approximately 3,552 tons of material per acre, while a typical windrow system would handle around 1,580 tons per acre, an advantage of 55% for the eASP.

Introduction

The San Joaquin Valley (SJV) is an extreme non-attainment area for ground-level ozone, according to the United States Clean Air Act 8-hour ozone standard. Air quality officials in the SJV must reduce ozone precursors such as Volatile Organic Compounds (VOCs) and oxides of Nitrogen (NOx) as expeditiously as practical, as technologically feasible, and as economically reasonable. The SJV is home to numerous commercial-scale composting facilities that process urban organic wastes, including several that handle more than 100,000 tons of feedstock per year and one that handles more than 500,000 tons annually. Two large facilities import compostable feedstock from other air basins, including Los Angeles to the south and the San Francisco Bay Area, to the northwest. Because the SJV contains extensive agricultural operations, a local market exists for the finished compost products. The finished compost products are applied to farm fields generally less than 25 miles from the composting site, providing a source of nutrients and organic matter for SJV farmers and nourishing some of the most productive farmland on Earth.

During the natural process of organic degradation, compost piles emit VOCs. The SJV has a large inventory of man-made and natural VOCs and a much smaller inventory of NOx emissions. Ozone production in the SJV is considered “NOx limited” because of the lesser amount of NOx. Internal combustion engines, including heavy duty diesel engines, are the SJV’s primary source of NOx. When mixed with VOCs, NOx forms ground level ozone, particularly in the presence of the strong sunlight which blankets the SJV more than 300 days a year.

To facilitate a regional approach to air pollution problems, seven California Counties and part of an eighth county joined to form the San Joaquin Valley Unified Air Pollution Control District (the District), which covers more than 25,000 square miles from Stockton to Bakersfield. In 2011, the District adopted Rule 4566, which seeks to reduce emissions from commercial composting facilities. Existing composting facilities in the SJV were required to adopt a series of Best Management Practices which are scaled based on a facility’s annual throughput.

Because it is an extreme non-attainment area for ozone, any new facility in the SJV emitting more than 10 tons of VOC per year is classified as a Major Stationary Source. Using the SJV’s life-cycle composting emissions factor of 5.71 pounds of VOCs per ton of composting feedstock, a facility handling less than 4,000 tons per year would be considered a Major Stationary Source. Per Title 1 of the Federal Clean Air Act, all new major sources must go through New Source Review in order to be permitted to operate. This means that all new composting facilities in the SJV must implement Best Available Control Technologies (BACT) that reduce VOC emissions from materials handling and the composting process. BACT specifications for new compost facilities have not yet been determined. The impact of New Source Review has been to stifle the growth of new composting facilities in the SJV, as the current cost of VOC reduction systems exceeds the ability to recoup those costs through tipping fees and finished product sales. Composting facilities cannot raise tipping fees without losing feedstock to lower-cost alternatives, such as landfilling or direct land application.

In 2011, the California Legislature passed AB 341 (Chapter 476, statutes of 2011), which requires the State to achieve a 75% solid waste recycling, composting and reuse rate by 2020. The California Department of Resources Recycling and Recovery (CalRecycle) is charged with coordinating efforts to reach that goal. According to CalRecycle, organic materials--in particular food--comprise up to 50% of the remaining disposed waste stream. Therefore, the 75% goal will not be attainable without more composting facilities.

Large facilities in the SJV and around North America manage materials in windrows: long, narrow piles that can be as much as 20 feet wide, 8 feet tall, and hundreds or even more than 1000 feet long. Windrows are turned using a specialized machine called a windrow turner, which straddles the pile; the exact height and width of the windrows are determined by the size of the turning machine. All windrow turning machines are powered by diesel engines, with 450-600 horsepower being typical engine sizes for moderate to large machines. Generally, piles are built using diesel trucks and bucket loaders.

According to California regulation (14 CCR, Section 17868.3), compost piles must reach a temperature of 131 degrees Fahrenheit in order to reduce pathogens. Windrows must maintain that temperature for

15 days, during which the pile must be turned at least five times in order to ensure all materials in the windrow reach temperature. Static piles with an insulation layer at least 6 inches thick only need to attain that temperature for three days. Although attainment of pathogen destruction may occur any time during the composting process, it typically occurs early in the cycle, to ensure feedstocks have sufficient energy to meet the temperatures requirement. Most operators report turning piles 8-10 times during a complete compost process of between 60 to 90 days. Previous research indicates that the vast majority of composting emissions occur during the first three weeks of the composting process, hence the focus on "active phase" composting in Rule 4566 and in this research project. Per Rule 4566, several SJV compost facilities are required to put a fresh blanket of finished compost on top of a windrow following all turns during the first 22 days. Compost caps are effective on windrows, but applying so many caps is both labor and diesel intensive.

The Technology Advancement Program

The TAP program is administered by the San Joaquin Valleywide Air Pollution Study Agency (the Study Agency), which was "formed to commission and administer scientifically sound air quality studies to improve understanding of the contributing factors and conditions that result in poor air quality in our local area and in the surrounding areas of central California and to develop technical tools for use by decision makers to guide the development of policies, procedures, plans, rules and regulations necessary to fulfill the state and federal air quality mandates." The Study Agency is a Joint Powers Authority with its fiscal authority vested in a governing board.

In 2011 the Study Agency put out a Request for Proposals for the Technology Advancement Program with the objective to "demonstrate new and innovative emission reduction technologies that have the potential for broad applicability in the San Joaquin Valley." A portion of the available funding comes from collaboration with the USEPA's Clean Air Technology Initiative.

Specifically, the RFP sought "projects that demonstrate bold, innovative, and creative new emission reduction technologies" in three areas, renewable energy, waste solutions and mobile sources. The accepted proposal met all three criteria in the following ways:

- Focus Area I: Renewable Energy—This demonstration project proposed to overcome the barrier to utilizing renewable energy by installing solar energy/storage systems to power air blower motors to be used to aerate static compost piles, and to maintain aeration throughout the high-emissions active-composting phase.
- Focus Area II: Waste Solutions—Project used technology which had not been operationally demonstrated on a commercial scale, to minimize VOC and GHG emissions from existing compost production systems and processes. This technology was non-proprietary and created with components which should be available to any compost operator, thereby reducing costs of emissions reductions.
- Focus Area III: Mobile Sources—Project demonstrated the replacement of large diesel-powered compost loaders with electric powered conveyors, and demonstrated replacing diesel-powered

composting windrow turners with solar powered air blowers to reduce particulate matter and NOX emissions from those sources on compost operations in the San Joaquin Valley.

This project included construction of three abutted aerated static piles, each with its own aeration manifold and photovoltaic powered blower. This type of ASP System is referred to as an Extended Aerated Static Pile (eASP). In addition to the expected air emissions benefits and reducing the use of diesel power during the composting process, three key benefits of this approach include: 1) smaller foot-print and therefore a greater production capacity for a given compost pad; 2) reduced exposure to the elements; and 3) improved retention of process heat.

Project Components

Conveyorization of the construction of the eASP

Construction of windrows or static compost piles is traditionally done with diesel truck and loaders.

We built the eASP using electric-powered conveyors. The heart of the system was an electric-powered potato piler. Pilers are used for placing harvested potatoes into storage sheds. This potato piler had the ability to move the terminal end of the conveyor left and right up to 57 feet, as well as up and down approximately 27 feet. The terminal end of the piler also telescopes up to 18 feet. These maneuvers are accomplished using a remote joystick, much like a video game. This adaptability allows for the anchoring of one end of the piler, and connection to intermediate conveyors, while constructing a pile which was up to 35 feet wide and as much as 10 feet tall. It also allows for the feedstock to be switched after the base pile is formed, to allow for application of the one-foot-thick pseudo-biofilter compost cap made from finished, unscreened compost atop the entire surface of the previously constructed pile.

The potato piler is on wheels, and the spacing of those wheels allows for the pile to be set up within the aeration piping for the pile, and wheeled backward when needed, along with the rest of the electric conveyor train. The 90-foot-long eASP zones were constructed in three stages of about 30' each, then the conveyor train was rolled backward and the process of constructing the pile and placing the cap layer began anew.

The potato piler used in this experiment (Double L Manufacturing, Model 811) was smaller than some models used in the potato industry. The belt width was 30 inches and the rated capacity was 225 tons per hour. A commercial composting set up would likely use the largest available model, with a belt width of 42 inches. If the methodology described in this report were widely adopted, manufacturers of potato pilers might be persuaded to create composting-specific machines, which might feature larger wheels, wider belts, higher throughputs, and built in water sprayers at the terminus to ensure materials are properly moistened during pile construction. The smaller device was the only unit available locally for rent, because potatoes are not an important crop in the SJV. Larger devices would have needed to be shipped down from potato growing regions, and shipped back in time for the fall harvest, an added expense and constraint.

Photo 1: Potato piler at or near full extension. Pile under construction in foreground. Plenum material and aeration pipes are partially visible.

One problem encountered early on was the ability to match the output of the grinder with the capacity of the conveyance system. In a professionally engineered system, these would be balanced. In this case, the conveyors and potato piler were smaller than optimal. In addition, the existing on-site grinder at the Tulare compost site was designed for high-volume throughput, and the output was not variable. It was clear that the available grinder would overwhelm the conveyors. Because larger conveyors and pilers were not available, a decision was made to rent a slow-speed, variable output shredder. Although the shredder was able to keep a steady stream of materials on the conveyors, volume was slower than ideal, and eASP construction took most of the day.

At 446 horsepower, the shredder has an engine half as large as the typical grinders found at large composting sites. This particular unit, the Komptech Crambo 5000, was certified ARB Tier 4. The variable output solved the problem of matching grinder output to conveyance. Although there are emissions savings from moving to a smaller horsepower engine, those are beyond the purview of this project. This would be a moot point in an operation that uses electric powered grinders.

Grinders are essential equipment at compost operations, and it was not a goal of this project to replace the grinder. The same slow-speed shredder was used to prepare the feedstock for both the eASP and the windrows. Any composting operation that receives raw feedstock will still need to grind their materials. Electric grinders are becoming more commonplace, as greater emission reductions are needed

Conveyors and the potato piler can run off whatever voltage is available on site. 480 volt AC power is the most efficient and commonly used in potato storage and at compost facilities that have electrified their grinders. In this case, the conveyors were run off a diesel-powered generator. In a permanent setup, conveyors and pilers would be run off of the electric grid. The generator was equipped with a meter to measure electricity usage.

Also rented was an excavator to feed the shredder. This could also have been accomplished with loaders. Although the excavator is a large piece of equipment, its engine is generally smaller than those found in loaders. This is because loaders drive to and fro, while excavators can stay in one place and swing only their boom.   Again, there must be a means to move materials into the grinder/shredder. It was not a focus of this project to calculate emissions reductions from using an excavator for this purpose, but it was an opportunity to model an optimum equipment configuration.

Photo 2: Complete conveyor train. Material discharged from the shredder, far right, falls into a specially constructed hopper on the intermediate conveyor, and then is deposited into the hopper of the potato piler, center. From here the materials are carried upward and across the potato piler before being discharged at the far left,

where the piler is being operated by joystick. This is the very early morning of the first pile build. Plenum materials in foreground.

Moisture management

Moisture management was another key challenge identified early in the process. Because the eASP would not be disturbed for the entire 22-day active compost phase, there would be no way to deliver moisture into the core of the pile. Due to the action of the aeration system, as well as the hot and dry summer SJV climate, water would be needed to prevent the drying out of the eASP, which could slow the compost process or potentially lead to excessive heat buildup and fire.

An early idea to embed drip tape within the pile, just above the aeration pipes, was deemed unfeasible. Instead, a two-pronged approach was taken. The first phase was to wet all feedstocks during the eASP build. This was accomplished by the addition of a moisture system to the discharge of the potato piler. The system consisted of two 1 ¼" nozzles attached to a 1 ½"inch diameter water hose. The resulting system sprayed water at both sides of the feedstock discharge chute. The water was pumped out of the back of the on-site, 4,000-gallon water truck. In a real production scenario, the water truck would be eliminated by plumbing a flexible water supply to the piler conveyor.

Photo 3: Water sprayer system wetting composting feedstock as they are discharged from the potato piler.

The second half of the moisture solution was to design a series of sprinklers which would be placed on top of the eASP and run off a timer. One irrigation "sled" was used for every 30' of eASP length. Because of the time of year and the excessively hot conditions, the sprinklers were run on a cycle of an average of six minutes per cycle, six times per day.-The sprinklers were successful in keeping the top of the eASP moist. Because the aeration system tends to blow the water back up to the top, it was not clear how deep the water penetrated; however, field investigations indicated the water was seeping down more than two feet.

Rain gauges were used on the top of the eASP zones to measure the amount of water delivered, and as the basis for adjustment. The water delivered ranged from 1-5" per day, depending on location and timing of the irrigation system. Over and under-watering was a challenge in this project. An average of approximately 3" per day would likely be ideal, depending on the moisture content of the original feedstock and ambient conditions.

In this project, the combination of feedstock which were not uniformly wet, and occasional over-watering, caused the pile to weep water at the lower end. A French drain was constructed to capture that water and re-introduce it to the piles. A run off capture system should be an integral part of any eASP composting system.

Despite the potential that the eASPs were over-watered, actual water use for the eASP was nearly 17% less than a comparable windrow system per cubic yard of feedstock. Potential reasons for this include a lower ratio of surface area to pile volume, and the lack of turning, which tends to cause a visible spike in evaporation.

Table One - Windrow Turning Method

(Water applied to normal 2,962 cubic yard windrows in Bakersfield) Note: Windrows are watered within 3 hours prior to turning to achieve ball test for moisture per air district rule 4566.	Gallons per Water Truck Load	# Loads per Watering Event*	Gallons per Event	# of Events per Pile	Gallons per Pile	Gallons per Cubic Yard
1. Hydrate newly formed windrow with water truck	4,000	4	16,000	1	16,000	5
2. Hydrate windrow prior to 6 turnings (5 in 15 days PFRP and 1 @ day 22)	4,000	3	12,000	6	72,000	24
Total for 22 day active phase:					**88,000**	**30**
		*averaged for seasonal variation				

Table Two - Extended Aerated Static Pile Method

(Water applied to each 506 cubic yard pile in Tulare) Note: Item 2 (compost cover water) could be reduced since there was significant extra water runoff during pilot program.	Gallons per Minute Flow	Minutes per Watering Event*	Gallons per Event	# of Events per Pile	Gallons per Pile	Gallons per Cubic Yard
1. Hydrate incoming feedstock with 1 1/4" fire hose as pile is built	35	240	8,400	1	8,400	17
2. Moisten compost cover with 3 lawn sprinklers 6x/day till day 22	11	6	66	63	4,158	8
Total for 22 day active phase:					**12,558**	**25**
		*averaged for seasonal variation				

Table 1: Comparison of water use between eASP and traditional windrow method as modified by SJVUAPCD Rule 4566.

At 2 cubic yards per ton, a 100,000 ton-per-year facility would save a minimum of 1 million gallons of water annually using the eASP system. Using the ARB estimate of 1.5 thousand tons of CO2 equivalents (MTCO2e) for every acre foot of water saved in California, the potential GHG savings is slightly more than 4.5 MTCO2e per 100,000 tons of feedstock. These savings are probably underestimated at compost facilities, where water tends to be delivered via 400-500 hp, 4,000-gallon diesel water trucks. The savings rise, both in terms of water and GHG, when one considers the inefficiencies inherent in the water truck system, including water loss when filling the truck and water running off the sides of the windrows. The water at this composting site, and many others, is pumped from a well. GHG equivalents are generally higher for groundwater than the statewide average; however, this depends on the depth and flow of the well. If the well is powered by a diesel pump, criteria pollutants are reduced when less water is used.

The water use reductions provided in Table 1 are provided as an Excel Spreadsheet in Appendix H.

Photo 4: Irrigation sleds wetting top of prototype eASP. Note- test areas cordoned off for air emissions sampling.

Feedstock

Feedstock for this project consisted of municipally sourced greenwaste from the Visalia-Tulare area. Effort was made to get the freshest possible greenwaste feedstock for the project. The feedstock used arrived at the facility the day before the pile-building events. After the materials were tipped, they were spread out and handpicked for large trash or hazardous materials, then brought to the grinding area. The same protocol is used for all feedstock at this site.

During pile construction, the team from O2 Compost measured bulk density and water-holding pore space using bucket tests which are standard in the composting business. Moisture percentage of the feedstock was measured using a simple postage scale and an electric heat gun to dry the materials. The materials are weighed wet, and then are dried and weighed until the sample weight stabilizes. The process takes more than one hour to complete. Composite grab samples were taken for each zone constructed, and sent to a laboratory to measure carbon-to-nitrogen ratio on a dry and wet basis.

The overall parameters of the starting feedstock mix for the three zones are as follows.

eASP FEEDSTOCK SUMMARY

	Bulk Density wet	Free Air Space (FAS)	Moisture content	C/N
Zone 1 - Composite #1	828 lbs/cy	40.4%	45%	25.9
Zone 1 - Composite #2	822 lbs/cy	51.0%	50%	16.3
Zone 2 - North End	1004 lbs/cy	41.5%	46%	17.6
Zone 2 - South End				19.5
Zone 3 - North End	980 lbs/cy	44.20%		20.5
Zone 3 - South End				26.6

Table 2: Parameters for the starting eASP compost feedstock.

Laboratory tests for the initial C:N measurements are available in Appendix F.

Aeration System

Each of the three ASP zones had its own blower, manifold and pipes. The aeration piping was standard 4” drain pipes, such as can be purchased at any hardware store. These white PVC pipes come in standard 10’ sections and are flanged on one end so they may easily be attached. There are two kinds of pipes, perforated and not perforated. Each aeration line starts and finishes with 10 feet of non-perforated pipe, so air does not leak out from the sides of the piles. In between were seven sections of perforated pipe, with the holes pointed down. Each pipe section is tacked to the ones before and after using one screw, to ensure they are not pulled apart during pile construction. The aeration pipes were buried in a plenum of coarse-ground wood chips approximately 1 foot deep. The use of chips ensures the air coming out of the perforated pipes is not blocked by dense material compacted by the weight of the pile

The standard manifold for each ASP branches off to four 90’ long aeration pipes, each five feet apart. The manifold was constructed of 6” diameter PVC sewer pipe, again, standard at most large hardware stores. These pipes are green and are also sold in 10’ sections. For this project, the pipes were cut with a hand saw to construct the manifold. Standard T and elbow connections were used to assemble the pieces, and were tapped together using a rubber mallet. The 6” sewer pipe was stepped down to the 4” sewer pipe using standard connectors. The blower was connected to the manifold using a rubber fitting, which was purchased from the blower vendor.

With every Aerated Static Pile (ASP) Compost System, a key design objective is to provide uniform airflow across the base of the pile (side to side and end to end). The aeration zone is located beneath the core of the pile and consists of perforated pipe overlain by a layer of coarse woody material (referred to as the “plenum layer”). As the ASP System is constructed, the aeration zone is sealed on all sides by the overlying mix of materials to prevent short-circuiting of airflow to the atmosphere.

When the aeration blower turns on, the plenum layer pressurizes; the air first flows laterally across the base of the pile and then vertically up through the compost mix. By controlling the frequency and duration of airflow, the operator is able to maintain aerobic conditions throughout the pile and optimize the biology of the composting process.

For this project, each zone was aerated using independent solar powered blowers. Each system included a pair of photovoltaic panels, charge controller, inverter, batteries, and a 1.5 hp 3-phase blower).

Photo 5: Completed aeration manifold showing 6” pipes, connectors and step down to 4” pipes. The blower is protected inside the modified trash container.

Photo 6: View of project with completed eASP zone 1 on right, and aeration pipes in place for Zone 2. Zone 1 photovoltaic system is complete; panels are in place for Zone 2.

Two sets of field tests were conducted on each of the three aeration manifolds to confirm that: 1) the airflow was balanced within the aeration system; and 2) sufficient air volume was delivered to the compost mix. These tests evaluated static pressure and airflow velocity. For the two tests, 3/8-inch diameter holes were drilled into the PVC aeration manifold at five junctions (pressure and velocity) and at the down-stream ends of each of the four lateral aeration pipes (pressure only). Figure 1 provides a schematic drawing of one aeration system to illustrate the layout of the aeration pipes and the locations for the two sets of tests.

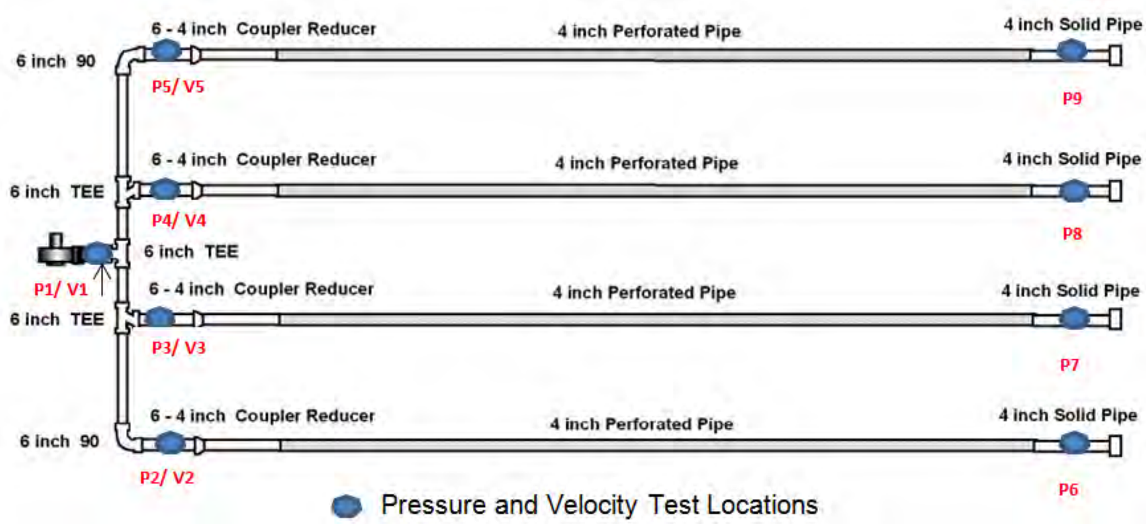


Figure 1: Schematic of an ASP manifold system, with the blower and manifold at the left and testing locations noted with blue dots and red numbers.

The pressure at nine different locations in each of the three aeration systems was determined using a magnehelic pressure gauge. The velocity of airflow was determined using a hot-wire anemometer. An example of each monitoring device is shown below.

Photo 7: Magnehelic pressure gauge and hot-wire anemometer.

Extended Aerated Static Pile			**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Zone 1	Pressure	(in-sp)	3.0	2.5	2.2	2.2	2.4	2.2	2.4	2.4	2.3
	Velocity	(ft / min)	3200	2100	1950	1900	2200	--	--	--	--
Zone 2	Pressure	(in-sp)	2.8	2.6	2.4	2.4	2.8	1.6	1.4	1.3	0.7
	Velocity	(ft / min)	2600	2200	1850	2100	800	--	--	--	--
Zone 3	Pressure	(in-sp)	1.5	1.5	1.7	1.6	1.7	1.3	1.3	1.3	1.2
	Velocity	(ft / min)	3300	1700	1750	1800	2100	--	--	--	--

Table 3: Results of pressure and velocity tests for all 3 eASP zones. Velocity readings are not taken at the ends of the aeration lines (sites 6-9).

These test results confirmed that uniform airflow and sufficient air volume was delivered to the EASP System to meet the objectives of the project.

Photovoltaic System

Recent advances in photovoltaic (PV) technology make powering small motors at remote locations more feasible than ever before. The blower motors weigh about 90 pounds, and produce a maximum of 1.5 horsepower each. The blowers run directly from the four deep-cycle flooded lead acid batteries which were placed inside the white cabinets. The PV panels charge the batteries. The white cabinets also contain the inverter, which converts the direct current power produced by the panel into alternating current, as well as the timers, switches and the wiring harness, which limited the electrical operations in the field to basically a plug-and-play situation.

Specifications of the major components of each individual PV system are as follows:

Item	Manufacturer	Model	Specification
Panels	Astroenergy	CHSM 6612-290 Crystalline PV module	290 watt, 24 volt DC panel; 2 per zone
Inverter	Samlex	Pure Sine Wave SA 2000K-124	Converts 24 Volts DC to 2000 watts AC power at 120 Volts, 60 Hz
Charge Controller	Samlex	PR 3030	30 amp, 12 or 24 volt, fully programmable with LCD display
Batteries	U.S. Battery	AGM L16	390 amp hour 6V; 4 per zone
Blower	New York Blower	Compact GI 105	1.5 max HP; 3500 max rpm.

Table 4: Major components of the photovoltaic array.

The full PV systems were specified by O2 Compost and shipped to the site by Automation Electric and Controls of Mt. Vernon, Washington. The arrays were assembled on site by the study team. The hard cost for the complete units, including panels, batteries, inverter, timers, switches and blowers, as well as all piping, was about $10,000 each.

The PV panels were mounted on specially constructed aluminum frames. The frames were bolted to standard 4 x 4 wooden posts with lag screws. The posts were nailed to standard concrete/metal footings available at any hardware store. The panels were angled 45 degrees to the south. Because the summer sun in the SJV is so strong, and there was no shade at the site, it was not necessary for the panels to track the movement of the sun, or to match the angle of the panels with the angle of the sun. These steps may be necessary for winter operations.

Photo 8: Interior of the power array box. From bottom to top: batteries, inverter, timer and switches, and exhaust fan at very top. From left to right: Harold Ruppert and Peter Moon of 02 Compost, and Kevin Barnes, City of Bakersfield.

The blowers were cycled to operate 2 minutes out of every 20, easily achievable with summer sunlight in California. The only problem with the PV system concerned the small exhaust fan which was used to cool the components inside the white metal cabinet. August 2012 was an extremely hot month in the southern SJV, with nominal daytime temperatures above 100 degrees F nearly every day the project was in operation. This caused the exhaust fan to work overtime, drawing down the batteries. The thermostat on the exhaust fan ultimately had to be raised to its maximum level, potentially exposing the batteries and inverter to damaging heat buildup. Although the system continued to function throughout the life of the project, the batteries were degraded. For a permanent system, care should be given to place sensitive electronics in the shade.

Temperatures and pathogen reduction

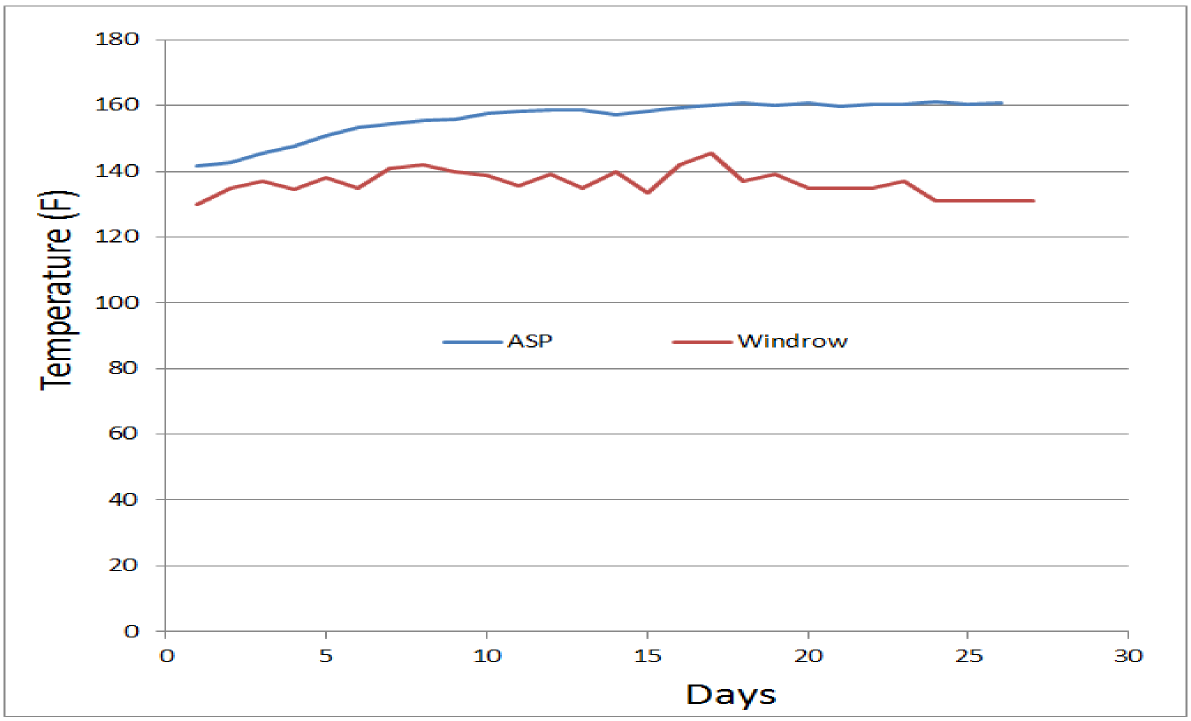
Section 17868.3 of Title 14 of the California Code of Regulations sets minimum temperature standards for pathogens reductions during composting. These standards, known as PFRP, are as follows:

- If the operation or facility uses a windrow composting process, active compost shall be maintained under aerobic conditions at a temperature of 55 degrees Celsius (131 degrees Fahrenheit) or higher for a pathogen reduction period of 15 days or longer. During the period when the compost is maintained at 55 degrees Celsius or higher, there shall be a minimum of five (5) turnings of the windrow.
- If the operation or facility uses an aerated static pile composting process, all active compost shall be covered with 6 to 12 inches of insulating material, and the active compost shall be maintained at a

temperature of 55 degrees Celsius (131 degrees Fahrenheit) or higher for a pathogen reduction period of 3 days.

These temperature standards are backed up by pathogen testing at the end of the curing stage, before finished compost may be sold.

A five-foot long temperature probe was purchased in order to take temperature readings. Temperatures for the eASP were taken at three different depths (2', 3' and 5' down) and at two locations on the pile. For control windrows, temperatures were taken at two locations per pile. Control windrows were turned on the operator's regular turning schedule, but were not turned on the basis of the age of any individual control.



Graph 1: Comparison of temperature readings between eASP and windrow over 22-day active composting period.

All eASP and control windrows met or exceeded state minimum temperature requirements for pathogen reduction. On average, eASPs ran hotter than windrows in this experiment. This is likely due to the larger pile size and the thick blanket of finished compost, both of which tend to hold in heat. Full temperature data is available in Appendix G.

Curing and testing

All eASP zones and windrows were allowed to compost for 30 days. At 30 days, composite samples were taken of each eASP zone and control windrow using the process described in California regulations (14 CCR, Section 17868.1) and were sent to Soil Control Laboratories in Watsonville, CA. Soil Control

Labs is one of two laboratories in California approved by the U.S. Compost Council's Seal of Testing Assurance (STA) program. The program was created in 2000 by the leading compost research scientists in the United States. The science behind the development of the STA Program and the various tests that are used is contained in 'Test Methods for the Examination of Composting & Compost', a publication which includes a suite of physical, chemical and biological tests. STA testing can be performed by a group of independent, certified labs across the U.S. and Canada.

Results of the 30-day STA testing are below.

30 DAYS		Zone 1	Control 1		Zone 2	Control 2		Zone 3	Control 3
	Sampled Date	9/7/2012			9/12/2012			9/17/2012	
	Unit Measures								
Moisture Content	%, Wet weight	43.3	42.3		37.8	39.8		38.5	43.3
Organic Matter	%, Dry weight	43	44.9		46.5	42.6		42.9	46.5
C/N Ratio	Ratio	18	18		17	19		18	17
pH		5.37	5.72		6.2	6.32		6.28	5.03
Particle Size	Max aggregate size, Inches	0.38	0.64		0.64	0.64		0.64	0.64
Nitrogen - Total	Total N, % dry weight	1.3	1.4		1.6	1.3		1.4	1.5
Nitrogen - Organic	%, dry weight	1.2	1.2		1.5	1.1		1.3	1.3
Maturity									
•Ammonia	NH4-N, mg/kg dry weight	1300	1800		1200	1500		670	2000
•Nitrate	NO3-N, mg/kg dry weight	33	16		38	9.6		10	51
•Vigor (bio-assay)	Avg. % of Control	90	91.7		91.7	91.7		86.7	81.7
Stability									
•CO2 Evolution	mg CO2-C/g OM/day	7.9	9.1		7.9	10		7.5	13
Potassium	K2O, % dry weight	1.2	1.2		1.4	1.3		1.3	1.4
Carbon - Organic	lb/ton	23	24		27	25		25	25
Soluble Salts	EC5, dS/m (mmhos/cm)	9.9	11		7.4	9.7		6.8	11
Safety									
•Fecal Coliform	Pass/Fail	Pass	Pass		Pass	Pass		Pass	Pass
•Salmonella	Pass/Fail	Pass	Pass		Pass	Pass		Pass	Pass
•Trace Metals	Pass/Fail	Pass	Pass		Pass	Pass		Pass	Pass
Iron	Fe, mg/kg dry weight	11,000	9000		9300	8600		9700	9300
Bulk Density	lbs/cu ft dry weight	25	22		22	22		25	22
AgIndex	Ratio	10	8		9	8		10	9

Table 5: Comparison of 30-day laboratory results for all three eASP zones and control windrows.

In order to reach maturity, the compost process generally needs to run 60 days or more. So it comes as no surprise that all 30-day-old samples show an immature product. In nearly all maturity measurements, however, the eASP appears to be slightly more mature or more stable than its windrow counterpart, despite the lack of turning. In terms of CO_2 evolution--the stability measurement--the eASP is superior in all 3 pairings. Therefore, we may conclude that the eASP will have a beneficial impact for operators on compost production issues; that is; we see no evidence of a time penalty for switching to the no-turn active compost method.

We should note that starting C:N ratios were below what is considered optimum. Composting experts agree an ideal C:N ratio for initial feedstock is between 25 and 35 parts carbon to one part nitrogen. This is particularly important for small manure facilities. Practically speaking, it is very difficult for large-scale operators to change the C:N ratio of large volumes of material. Sampling bias in C:N measurements is inherent because large particles are filtered out before final testing, and larger particles tend to be high in carbon, so actual stating C:N is likely higher than reported.

After 30 days, the control windrows moved into the regular composting operation on site. They were not sampled again. The three eASP zones were treated differently, as follows:

- Zone 1: Scooped up and placed into a windrow, treated the same as other curing piles on the site
- Zone 2: Flipped over onto Zone 1 and aerated for an additional 30 days
- Zone 3: Left in place and aerated for an additional 30 days

After 60 days, the three zones were again sampled, and the composite sample was sent to Soil Control Labs for a second round of STA testing.

Results of the 60-day STA testing are below.

60 DAYS		Zone 1 - Cure		Zone 2 - Cure		Zone 3 - Cure
Sampled Date						
Unit Measures						
Moisture Content	%, Wet weight	33.7		27.6		33.1
Organic Matter	%, Dry weight	37.3		32.9		53.8
C/N Ratio	Ratio	15		14		18
pH		6.12		7.33		4.71
Particle Size	Max aggregate size, Inches					
Nitrogen - Total	Total N, % dry weight	1.4		1.2		1.5
Nitrogen - Organic	%, dry weight	1.3		1.2		1.3
Maturity						
◆Ammonia	NH4-N, mg/kg dry weight	690		290		1,500
◆Nitrate	NO3-N, mg/kg dry weight	6.1		5.7		43
◆Vigor (bio-assay)	Avg. % of Control	100		100		88
Stability						
◆CO2 Evolution	mg CO2-C/g OM/day	7.5		6.2		23
Potassium	K2O, % dry weight	1.4		1.4		1.4
Carbon - Organic	lb/ton	21		17		28
Soluble Salts	EC5, dS/m (mmhos/cm)	7.5		4.2		10
Safety						
◆Fecal Coliform	Pass/Fail	Fail		Pass		Pass
◆Salmonella	Pass/Fail	Pass		Pass		Pass
◆Trace Metals	Pass/Fail	Pass		Pass		Pass
Iron	Fe, mg/kg dry weight	11,000		12,000		8,000
Bulk Density	lbs/cu ft dry weight	22		28		18
AgIndex	Ratio	>10		>10		9

Table 6: 60-day laboratory results for three eASP zones.

The complete tests for 30 and 60 days are found in Appendix D. Zone 1 failed the pathogen test at 60 days, even though it passed a similar test at 30 days. Per state law, this material could not be sold until it was re-composted and passed a subsequent test. Contamination of previously pathogen reduced materials is not uncommon at large composting sites. It can come from many sources, including handling by equipment that comes into contact non-pathogen-reduced materials, as well as external sources such as birds. The failure to achieve criteria is not believed to be related to the eASP composting technology employed, as this pile did pass its pathogen test at 30 days.

The complete 30-day laboratory tests are available in Appendix D. The 60-day tests are available in Appendix E.

Diesel Emissions Reductions

Reducing diesel emissions are important for mitigating the air quality impacts of composting. The VOCs emitted from the degradation of organic materials are much more voluminous than equipment emissions, but are biogenic in nature and comprised primarily of light alcohols (Kumar et al 2009). Light alcohols are not strongly implicated in ozone or secondary aerosol formation. (Carter et al 1995). NOx from diesel engines is implicated in both. Any process changes which reduce overall diesel use on the compost site are real, permanent reductions which will lead to reduced criteria pollutant levels in the SJV.

The project resulted in an average reduction in diesel use per ton of feedstock of approximately 87%, with commensurate reductions in all criteria pollutants and greenhouse gases associated with diesel use. When compared against older equipment, this could result in a reduction of as much as 7.5 tons of NOx and 2.5 tons of non-methane hydrocarbons per year per 100,000 tons processed. Savings against newer equipment generally run less than one ton of pollutant per 100,000 tons. Based on the estimates, and assuming two cubic yards per ton, diesel savings are calculated to be 2,940 gallons per year for the theoretical 100,000-ton-per-year facility. Lower density materials actually increase the diesel savings.

Cleaner diesel engines, electrification of grinders and other diesel equipment on compost sites, and the potential future advent of hybrid diesel-electric or natural-gas-powered heavy duty equipment will all contribute to a gradual shift toward less diesel use. However, bringing three-phase power to remote composting sites can be very expensive; costs exceeded $1 million for the Mt. Vernon composting site in Bakersfield. Newer loaders and trucks will be phased in under mobile source programs run by the SJV and the ARB, and are also expensive propositions for compost operators. Natural gas and hybrid loaders are still not commercially available, and will likely remain cost prohibitive for some time.

This project measures the reductions in diesel use from conveying materials directly from a grinder output to a pile. In a typical composting site, these tasks would be performed by diesel loaders, typically working in concert with diesel powered end-dump or side-dump trucks. For the purposes of this exercise, we measured only a short run covered by one telescopic-transfer conveyor that was available to rent for the project. However, a full scale production would realize much greater diesel reductions.

Facility-wide reductions could be estimated on a facility-by-facility basis, using a point half the distance from the site's grinder to the property line, as an average distance materials would need to be moved, and then calculate the amount of diesel hours needed to perform that operation.

We also measured the amount of time necessary to operate a water truck in order to maintain moisture in composting windrows. With the eASP, these functions were provided during pile build, and thereafter by a sprinkler system. One of the main drawbacks of using sprinklers on windrows is the potential for them to become ensnared in windrow turning equipment, resulting in their destruction and loss of valuable turner time. This is not a problem with the no-turn eASP system.

Even with extensive use of conveyors, loaders will remain indispensable equipment at compost site because of their speed, maneuverability and versatility. However, it may be possible to significantly reduce their use, which represents a cost savings and an air pollution benefit. Compared to grinders, conveyors use relatively little electricity, and can easily be powered by generators if necessary.

This project used a slow-speed shredder instead of a high speed grinder to prepare the feedstock for composting. The shredder uses an engine roughly half the size of a comparable grinder. It was also a newer model, with a Tier 4 compliant engine. The emissions reductions gained from this type of replacement are not considered as benefits from this project.

Overall, the eASP resulted in an 87% reduction in diesel fuel use per ton of production, and a corresponding reduction in the amount of criteria pollutants and GHGs from equipment use. The amount of actual pollutants reduced depends on the age of the diesel equipment in question. For the purposes of this project, pollutant reductions were calculated for both 1996 (Tier 0) engines and 2007 (Tier 3) engines.

The full diesel use calculations, and the calculations of reduced emissions from diesel use, are available in Appendix C.

Land Use Reductions

Taller, wider extended ASPs can process more materials per acre of land than traditional windrow. To the extent that many piles are laid parallel to one another, this advantage is increased. Larger piles can be moved or even cured using turner devices that rely on small conveyors rather than the spinning shaft typically used for windrows.

Land purchase is typically a concern when building a new compost site, but can also come into play if an existing operator was forced to construct a water-impermeable pad for active-phase composting. Based on the experiment, and compared to standard windrows at the Mt. Vernon compost facility in Bakersfield, the eASP can process approximately 3,552 tons per acre, while windrows (using some of the largest machines available) can process 1,580 tons per acre, an advantage of some 55.5% for the eASP.

For the theoretical 100,000 ton-per year-facility, the amount of acreage needed for active phase composting is also reduced by 55%. The amount of acreage necessary vary depending upon whether a composter uses a 70-day compost period or allows materials to cure to 90 days without being moved off the pad. The full calculations are available in Appendix I.

	Low acreage estimate (70-day compost cycle, 5 cycles per year)	**High acreage estimate (90-day compost cycle, 4 cycles per year)**
Extended ASP	5.63	7.03
Windrow	12.65	15.8

Table 7: Calculation of acres needed for active composting for theoretical 100,000 tons per year composting facility with 70-day or 90-day compost cycle. These calculations do not include land needed for feedstock receiving, grinding, screening, mixing or finished product storage.

Discussion

Composting is widely viewed as an inherently sustainable activity. The process of recycling nutrients and organic matter back into the soil will grow in importance over the coming years as the world's farmers struggle to feed billions of people. Composting is a critical part of California's efforts to achieve75% recycling and composting, as mandated by AB 341 (Chesbro, Statutes of 2011). In fact, attainment of the AB 341 standard is widely viewed as impossible without a rough doubling of composting capacity in California. This comes at a time when compost facilities are increasingly difficult and expensive to site, primarily due to air pollution issues.

The primary composting process used in California and much of North America, open windrows, may not be inherently sustainable. The process and profitability of operators heavily depends on the wide availability of relatively inexpensive diesel fuel. Composting facilities have little ability to raise their tipping fees or the prices for their finished product without losing market share to low-priced landfilling and relatively inexpensive manufactured fertilizer. If diesel fuel prices were to rise significantly in the future, compost facilities would find their profit margins squeezed and some may go out of business.

Composting facilities are difficult to site because of odor issues. Odor is most commonly associated with receiving and mechanical turning of relatively fresh feedstock. Rapid handling of fresh, odoriferous feedstock can be achieved by most operators; however, it is not always possible to reduce or alter turning schedules. Eliminating the need to turn during the odorous active composting phase may allow compost facilities to site closer to urban areas that generate feedstock, thus reducing diesel-intensive feedstock hauling.

As California increases its efforts to reduce landfilling and greenhouse gas generation, food waste composting will increase. Unlike green waste, food waste qualifies for GHG credits when composted. Food waste putrefies rapidly; however, often creating intense odors. No odorous emissions from the eASP built for this project were ever detected. Composting methods which reduce handling activities during the active phase seem likely to reduce odor issues, again, potentially allowing siting of composting facilities closer to the places where both food and green wastes are generated.

Previous emissions studies where foodwaste was a significant part of the feedstock suggest that VOC emissions could be significantly higher compared to green-waste -only piles, but this question has not been adequately researched. The South Coast AQMD already requires large foodwaste composting operators to install VOC capture systems. The high cost of these systems has limited food waste composting opportunities within the four counties of the SCQAMD.

Emissions reductions for VOCs (primarily non-methane, non-ethane organic compounds, or NMNEOC) from the eASP were expected in this study, but the measured reductions exceeded all expectations. In searching for potential explanations for the high rate of control, several factors come to the fore.

- EASPs reduce surface area. In a 2009 study for the San Joaquin Valley Unified Air Pollution Control District, very small windrows with high surface areas were shown to have higher emissions rates than the ordinary sized control windrow.
- The eASP surface was kept wet. In the same previous study for the San Joaquin Valley Unified Air Pollution Control District, wetting the surface of the windrow prior to turning reduced overall emissions by 19%. This study supports that finding and suggests that a consistently wet surface may produce even higher emissions control. With a smaller surface area, the eASP is less prone to drying out during hot SJV summers.
- The biofilter layer was 12" or more thick. In two previous studies, one by the California Integrated Waste Management Board and the aforementioned 2009 air district study, 6" thick compost caps delivered emissions reductions of 75% and 53%, respectively. Commercial biofilters are commonly 3' thick or greater, depending on the application. This study suggests that thicker biofilter compost cap layers are more capable of degrading NMNEOCs and other undesirable compounds.
- More uniform air and water. Aeration is applied uniformly to the greenwaste, maximizing aerobic decomposition and reducing anaerobic pockets. The other primary ingredient, water, is also applied regularly so that overly dry conditions never suppress microbial activity, further enhancing rapid and efficient aerobic decomposition. Controlling the aerobic activity is a key ingredient in maintaining more efficient and favorable aerobic decomposition regarding both the type of compounds generated and the amount of compound air emissions released per ton of greenwaste.

The main component of the compost cap, unscreened finished compost, is available at all composting sites. Methods to apply the cap on conventional windrows tend to be diesel intensive; however, conveyorization can be used to apply the layer on static piles with set site configurations. SJVUAPCD Rule 4566 requires the biofilter compost cap to be replenished after windrow turning at the very largest facilities, increasing their diesel footprint. State regulations require windrows to be turned five times in 15 days for pathogen reduction. However, state regulation does not require static piles with a one-foot-thick insulation layer to be turned for pathogen reduction purposes. By using the eASP system, operators can apply just one cap for the entire active composting phase.

The solar powered eASP system reduces dependency on diesel, and reduces feedstock handling during the critical active composting period, when odor and emissions potential is at its highest. The use of solar power means aeration systems can be located where they are needed, in remote locations, without expensive grid connections. In the SJV, available sunshine year-round is more than adequate for the relatively small motors needed for aeration, and with adequate battery backup such systems should be operable even during the rare prolonged foggy or rainy winter periods.

A drawback for the prototype eASP system was the, above-ground aeration pipes, which were destroyed during pile deconstruction. This problem can be overcome by substituting thick, durable pipes made of heavy plastic (typically used for water mains) in place of the thinner, low-cost pipes used in this project. Also, low-cost methods to embed aeration pipes in the ground should be technologically feasible for most operators, and are available commercially from some vendors.

Another challenge was setting proper moisture levels. Though the temporary eASP sprinkler system rigged for this project worked remarkably well, it was not as precise or as consistent as desirable. Once a compost operator configures an eASP site, designing a more effective, permanent system providing near-ideal moisture management should not prove a significant challenge. A similar situation occurred for the initial watering of the feedstock; the temporary system designed for this project proved adequate. However, permanent, engineered systems—perhaps integrated with the conveyor—would certainly provide more uniform feedstock moisture and would quite possibly save additional water.

A final drawback for larger pile sizes is the difficulty of monitoring conditions deep within the pile. The five-foot-long temperature probe purchased for this project is the longest readily available. However, it is not always possible or advisable to force the probe the full 5' into a pile. Also, this probe did not measure relative moisture. Technology is rapidly solving these problems. Low-cost remote data loggers are now available. These can be buried within piles, and can record a variety of parameters, including temperature and moisture, over the life of the project. Future projects should include the use of these devices.

Conclusions

This project compared standard windrow composting to an eASP design to compare emissions. The result of this project does establish that the eASP design tested reduces both water use and air emissions. The eASP was tested in a single selected configuration; therefore, the results of this project do not establish optimal blower speeds or water application rates. Additional testing would be required to establish a user guide to ensure minimum operating costs, best quality of product and minimum water use and air emissions.

The solar powered eASP with a biofilter compost cap appears to be a viable method for commercial-scale composting. The demonstrated NMNEOC, ammonia and GHG emissions reductions achieved in this project from the piles of decomposing organic materials were significant, in the range of 98%, 95% and 70% respectively. These levels of control match or exceed commercially available systems costing many times more. The practical effect of using electric conveyors instead of diesel-powered trucks and loaders to build the pile, and of using solar-powered aeration instead of diesel-powered windrow turners, creates additional emissions reductions of NOx and other criteria pollutants which are important in non-attainment air basins such as the San Joaquin Valley. The emission reductions cited are the result of a closely managed demonstration project and should not be considered as the expected performance of and “achieved in practice” permanent facility. Achieved in practice results might be less than the closely managed demonstration project; however additional reductions might be achieved by further work to establish optimal operating conditions.

In addition to the diesel reductions and the greatly reduced emissions from decomposing organic wastes, conversion to eASP systems has the potential to save operators money and reduce GHG impacts through process water savings and shrinking the amount of land needed to conduct active-phase composting.

In terms of product quality and maturity, the eASP appears to be at least as good as windrow systems.

List of Appendices

- Appendix A: Technical Emissions Testing Memo from Chuck Schmidt and Tom Card
- Appendix B: Emissions samples fluxes, calculations and charts
- Appendix C: Diesel fuel use reductions and calculated reductions of associated criteria pollutants and GHG emissions
- Appendix D: STA testing results on 30-day-old material
- Appendix E: Laboratory testing results on 60-day-old materials
- Appendix F: Carbon and nitrogen testing of initial feedstock
- Appendix G: ASP and windrow temperature readings
- Appendix H: Water use calculations
- Appendix I: Land-use calculations

San Joaquin Valley Air Pollution Control District
Technology Advancement Program (TAP) 11-01

Aerated Static Pile Composting
with
Surface Biofiltration Layer Air Emissions Control

Air Emissions Assessment

Summary of VOC and Greenhouse Gas Air Emissions
with
Comparison to Windrow Composting Emissions

Report
Revision 1

January 2012

Prepared by

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Table of Contents

Figures

Tables

Photos

Appendices

1. Summary

A prototype Aerated Static Pile (ASP) composting process was assembled and operated to test both ability to produce quality compost and to quantify air emissions. The ASP utilized ambient air blown into the pile from the bottom; the blowers were powered by photovoltaic panels and associated batteries. The ASP had a biofiltration layer added to the surface to reduce air emissions. A series of compost windrows were built concurrent with the ASP using the same materials. The air emissions from the ASP were compared to the on-site measured air emissions of the current industry-standard windrow composting method.

Emissions were measured using the standard methods and techniques used for San Joaquin Valley Air Pollution Control District (SJVAPCD) regulatory compliance. This includes the use of the USEPA flux chamber as modified under South Coast Air Quality Management District (SCAQMD) Rule 1133, and analysis using SCAQMD Method 25.3 for VOC and 207.1 for ammonia (NH3). In addition to these traditional methods, nitrous oxide (N2O) was measured using NIOSH 6600 and organic species were measured using USEPA TO-15.

Tables 1.1 and 1.2 provide the measured and extrapolated emissions for the ASP and window (respectively) for the cycle periods of 22 days (all measurements) as well as 30 days and 60 days (both measured and extrapolated). The units are pounds of emitted compound per ton of initial compost mix.

Table 1.1 ASP Air Emissions (pounds per ton compost mix) for a 22 day compost period with extrapolated estimates for 30 day and 60 day periods.

		NH3		Greenhouse Gas			
Cycle Length	**VOC**	**Field**	**Lab**	**CO2**	**CH4**	**N2O**	**CO2e**
22 Day	0.10	0.02	0.01	206	5.1	0.01	315
30 Day	0.13	0.02	0.01	271	5.2	0.02	387
60 Day	0.22	0.02	0.01	517	5.6	0.08	658

Table 1.2 Windrow Air Emissions (pounds per ton compost mix) for 22 day, 30 day, and 60 day periods.

		NH3		Greenhouse Gas			
Cycle Length	**VOC**	**Field**	**Lab**	**CO2**	**CH4**	**N2O**	**CO2e**
22 Day	8.6	0.10	0.01	732	5.8	0.09	883
30 Day	10.4	0.19	0.04	1,036	8.1	0.15	1,253
60 Day	19.9	0.38	0.11	1,816	12.4	0.26	2,158

Figure 1.1 and Table 1.3 provides a summary of the emissions reduction (ASP emissions as compared to the on-site measured windrow) for the measured emissions duration of the ASP of 22 days as well as extrapolated ASP emissions for 30 day and 60 day cycle periods.

Figure 1.1 Emissions Reduction Summary (as compared to tested control windrow).

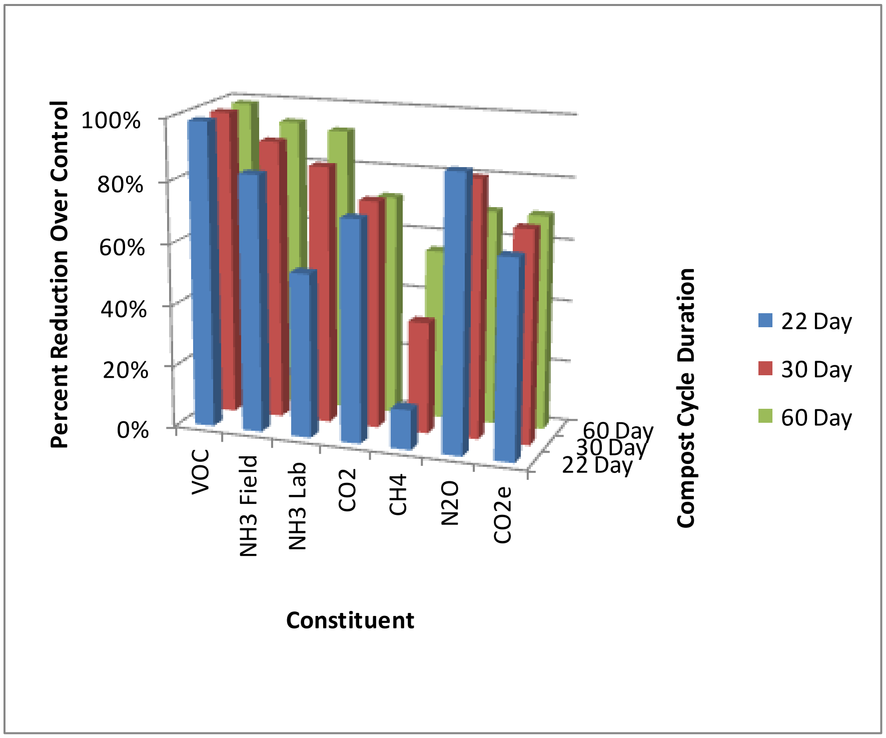


Table 1.3 Emissions Reduction Summary (as compared to tested control windrow).

		NH3		Greenhouse Gas			
Cycle Length	**VOC**	**Field**	**Lab**	**CO2**	**CH4**	**N2O**	**CO2e**
22 Day	98.8%	83%	53%	72%	13%	89%	64%
30 Day	98.8%	91%	84%	74%	36%	83%	69%
60 Day	98.9%	94%	92%	72%	55%	70%	70%

Table 1.4 provides the measured emissions in a regulatory context. The measured 22 day ASP emissions were compared to regulatory emission factors (nominally for windrow composting) from SJVAPCD and SCAQMD.

Table 1.4 Emissions Reduction Summary (pounds per ton mix) in a Regulatory Context.

Test Condition	VOC	NH3	CH4
Prototype ASP (22 Days)	0.10	0.01	5.05
SCAQMD (full life cycle)	3.76	0.82	0.87
% Reduction from SCAQMD Factor	97%	99%	-481%
SJVUAPCD (22-day active phase)	5.14		
% Reduction from SJV active phase	98%		

The VOC reduction achieved was greater than 97% when compared to any benchmark, and equal to or better than all known commercial VOC reduction technologies regardless of price. The windrow (on-site control) emissions were higher than expected, but even using the SJVAPCD emission factor, the control was still and impressive 98%.

Ammonia emission reductions were also substantial. However these varied based on the compared cycle time. For the complete cycle the ASP ammonia emissions, based on laboratory measurement, showed a 92% reduction over the on-site windrow. Greenhouse gas emissions were also reduced, but not as significantly as VOC and ammonia

The documentation for the emissions measurement and analysis is contained in this report as well as the attached Data Validation Technical Memorandum. All field notes and laboratory reports are attached following the technical memorandum.

2. Project Overview

This project was funded by a grant from the San Joaquin Valley Air Pollution Control District (SJVAPCD) to demonstrate the feasibility of a commercial-scale positively aerated, ASP compost system. The project was co-managed by the Association of Compost Producers and CalRecycle, with help from the City of Bakersfield and O2 Compost.

There were several facets to this project, including diesel fuel reduction and renewable energy, which were met by the use of electric conveyors to form the pile and photovoltaic power to run the blowers aerating the ASP. Our team was retained to sample and calculate the air emissions from the ASP compost system, and compare those emissions with those emitted by industry-standard composting windrows which were built out of the same materials on the same day.

The ASP was covered by a biofiltration layer of finished compost to control air emissions. The ASP was operated in a positive ventilation mode, meaning that the air to supply cooling, moisture control, and metabolic oxygen was blown into the pile with exhaust leaving the pile surface. Emissions sampling occurred during one hour cycles. Blowers generally ran two minutes out of every 20, meaning that one emissions sampling event would capture three full blower cycles.

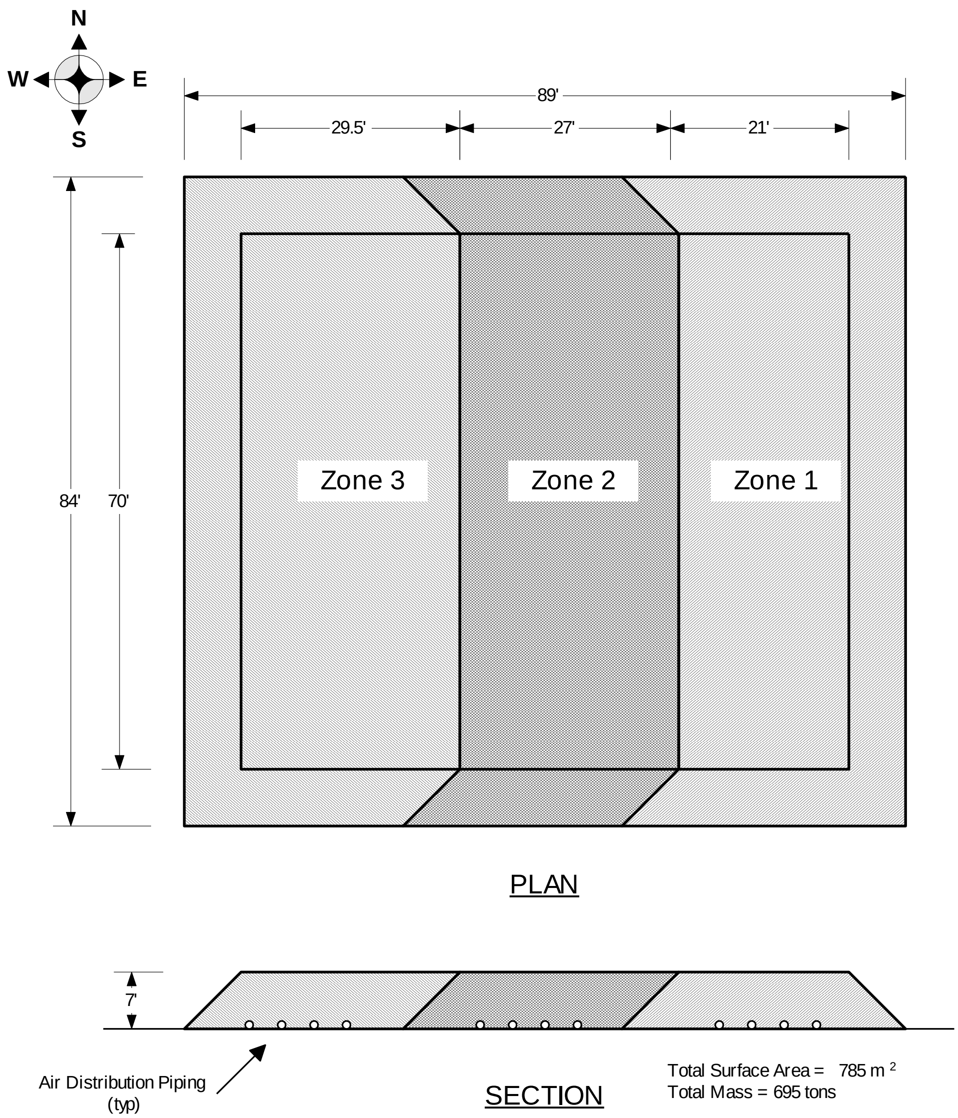
3. Process Description

Prototype ASP

Figure 3.1 shows a plan and section of the prototype ASPs. There were three separate zones constructed to represent three different ages of compost. The starting feedstock was placed on top of previously installed air distribution piping and a plenum of large nominal diameter wood chips roughly one foot deep. After the compost was placed to approximately 8 feet of average depth, a nominal 12 inches of finished, unscreened compost was placed on the top of the pile as a biofilter compost cap. The cap acts much like a biofilter, reducing pollutants as they migrate up to the surface of the pile.

Photo 3.1 Compost Pile Configuration.

Figure 3.1 Plan and Section of ASP Piles.



The compost pile with biofilter was used to calculate total surface area. The mass of biofilter material was not used in the compost mix mass calculation.

The total surface area of the ASP was 785 m^2 and the total mass of compost mix in the cells was 695 tons. The mass value of the compost cells was supplied by O2Compost. For emissions calculation purposes the ASP pile was assumed to be operational for a 21 day compost cycle.

Windrow

The host site normally composts in windrows. Windrows are the standard technology currently used in the United States to compost greenwaste. Figure 3.2 shows the layout of the windrows being tested for this study. The windrows shrink significantly during the compost duration. The initial area of a windrow was calculated to be 1,311 m2. At the end of cycle, this shrinks to 919 m2. For emissions calculation purposes it was assumed the shrinkage occurred linearly over the compost cycle. The site operator, Harvest Power, provided the mass of typical windrow as 782 tons of compost. Photo 3.2 shows a typical windrow on the site. The normal operating cycle for windrows at this site is 65 days or longer. The windrows are turned using a specialized mechanical device approximately eight times during the process cycle.

Photo 3.2 Windrow Configuration.

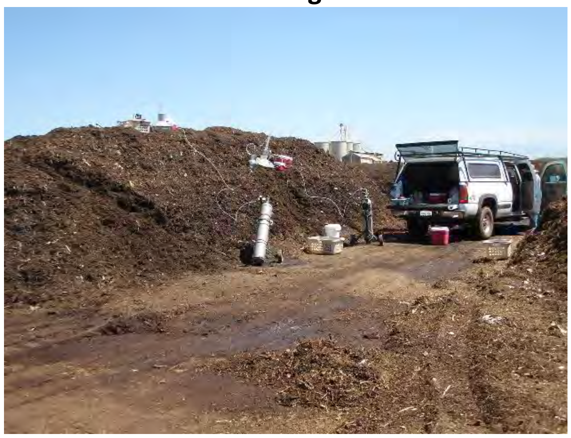
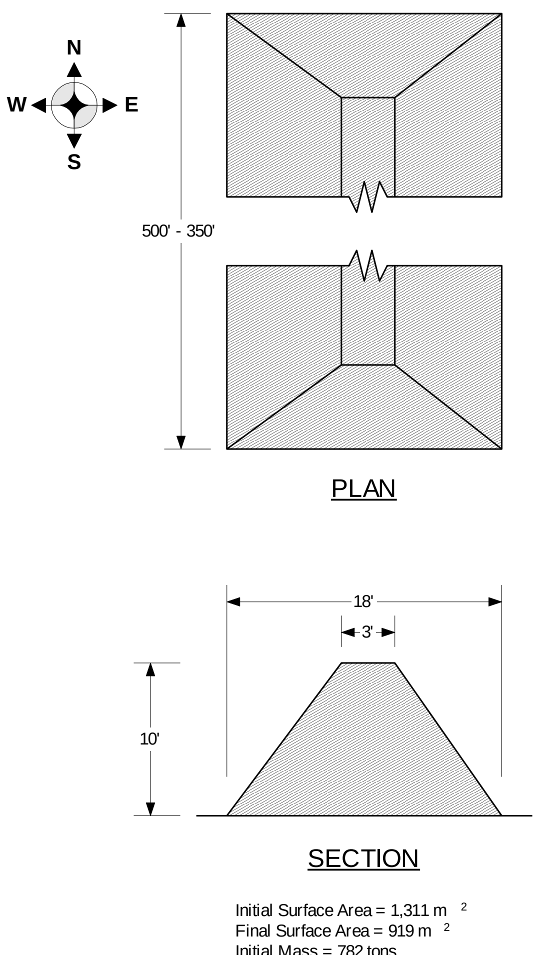


Figure 3.2 Plan and Section of Typical Site Windrows.



4. Emissions Measurement

All emissions measurements were made using USEPA validated flux chamber technology modified per SCAQMD Rule 1133 for measurement of composting air emissions. Photo 4.1 shows a typical measurement. The testing was conducted at pre-determined locations per zone (up to four measurements per zone and test condition) as a function of process day in the life cycle of the composting technology.

Photo 4.1 Typical Emissions Measurement.

Emissions were sampled and analyzed per SCAQMD Method 25.3 for VOC (total non-methane, non-ethane hydrocarbon), carbon dioxide (CO2), and methane (CH4). Ammonia (NH3) was sampled and analyzed using SCAQMD Method 207.1. Nitrous oxide (N2O) was sampled and analyzed using NIOSH Method 6600 (FTIR). Speciated organics were sampled and analyzed using USEPA Method TO-15.

Every test location completed measurements for Method 25.3. Only 25% of the test locations had the analysis completed for Method 207.1 (NH3), NIOSH 6600 (N2O), and TO-15.

For the ASPs, samples were taken on process days 3, 4, 5, 6, 10, 12, 13, 15, 17, 18, and 23. For the windrows, samples were taken on process days 0 (feed stock), 2, 3, 9, 11, 15, 29, and 63.

In general samples were taken in clusters of four representing near-field spatial variability for the ASPs and top/sides for the windrows. Far-field spatial measurements, that is measurements on the opposite end of the pile/windrow were taken on process day 4 for the ASPs and process day 15 for the windrows. These measurements were taken to determine if there were differences in emissions in different parts of the pile. In addition, a mixing event for the windrows was measured on process day 11.

A summary of the data is provided (in flux units) for the ASP (Table 4.1) and windrows/feedstock (Table 4.2). Complete data is provided in the Appendix. The accompanying Data Validation Technical Memorandum contains the complete data set, including QA/QC.

For emissions reporting purposes, only the laboratory ammonia data was used.

Table 4.1 Summary ASP Emission Measurement Data (flux in mg/m-m2).

SOURCE	DAY	LOCATION	Methane		CO2		NH3/Tube		NH3/Lab		TNMNEOC		N2O	
			Flux		Flux		Flux		Flux		Flux		Flux	
ASP ZONE 3	3	NW	2.49		2126		1.67		NA		**3.00**		NA	
ASP ZONE 3	3	SW	0.827		0.226		0.283		NA		**0.485**		NA	
ASP ZONE 3	3	NE	7.22		3644		0.485		0.439		**1.06**		0.201	
ASP ZONE 3	3	SE	1.97		2794		1.39				**3.37**		NA	
ASP ZONE 3	4	NW	2.76		3173		0.858		NA		**14.2**		NA	
ASP ZONE 3	4	SW	1.58		2256		0.436		NA		**3.31**		NA	
ASP ZONE 3	4	NE	9.18		3122		0.603		0.118		**2.02**		0.0520	<
ASP ZONE 3	4	SE	1.90		1918		0.741		NA		**2.50**		NA	
ASP ZONE 3	4	Top NW- Spatial	16.6		3768		1.73		NA		**3.25**		NA	
ASP ZONE 3	4	Side SE- Spatial	3.49		4174		1.01		NA		**18.9**		NA	
ASP ZONE 3	4	QC- Replicate	3.05		4.39		0.847		NA		**16.6**		NA	
ASP ZONE 3	5	NW	2.50		2031		0.0872		0.0318	<	**0.333**		0.0767	
ASP ZONE 3	5	SW	1.94		1888		0.0561		NA		**0.270**		NA	
ASP ZONE 3	5	NE	11.8		3537		0.0569		NA		**0.939**		NA	
ASP ZONE 3	5	SE	2.17		2279		0.3302		NA		**0.726**		NA	
ASP ZONE 3	6	NW	1.68		2115		0.00272	<	0.0378		**0.708**		0.0141	<
ASP ZONE 3	6	SW	1.31		1530		0.0845		NA		**0.339**		NA	
ASP ZONE 3	6	NE	8.39		2877		0.00556	<	NA		**0.458**		NA	
ASP ZONE 3	6	SE	1.80		2708		0.262		NA		**1.17**		NA	
ASP ZONE 2	10	NW	297		6329		0.371		0.0377	<	**2.50**		0.0192	<
ASP ZONE 2	10	SW	5.53		846		0.418		NA		**0.415**		NA	
ASP ZONE 2	10	NE	382		4360		0.257		NA		**0.821**		NA	
ASP ZONE 2	10	SE	20.7		0.290		0.317		NA		**0.838**		NA	
ASP ZONE 2	12	NW	489		6608		0.00580	<	0.0386	<	**2.15**		0.0751	
ASP ZONE 2	12	SW	16.06		740		0.00477	<	NA		**0.345**		NA	
ASP ZONE 2	12	NE	275		3892		0.0313		NA		**0.439**		NA	
ASP ZONE 2	12	SE	11.7		1721		0.133		NA		**0.429**		NA	
ASP ZONE 2	13	NW	369		10633		0.0158		0.0801		**6.36**		0.0204	<
ASP ZONE 2	13	SW	85.1		1515		0.0780		NA		**0.351**		NA	
ASP ZONE 2	13	NE	405		6452		0.00499	<	NA		**1.22**		NA	
ASP ZONE 2	13	SE	134		3935		0.00507	<	NA		**0.318**		NA	
ASP ZONE 1	15	NW	3.80		672		0.0450		0.023	<	**0.0846**	<	0.133	
ASP ZONE 1	15	SW	12.6		791		0.220		NA		**0.0518**	<		
ASP ZONE 1	15	NE	2.13		497		0.00414	<	NA		**0.0779**	<	NA	
ASP ZONE 1	15	SE	20.3		1669		0.0948		NA		**0.0973**		NA	
ASP ZONE 1	17	NW	39.6		2725		0.0877		0.0322	<	**0.747**		0.288	
ASP ZONE 1	17	SW	62.7		1784		0.0313		NA		**0.288**		NA	
ASP ZONE 1	17	NE	28.0		2144		0.00414	<	NA		**0.561**		NA	
ASP ZONE 1	17	SE	133		5274		0.0926		NA		**1.39**		NA	
ASP ZONE 1	18	NW	13.4		3067		0.00237	<	0.0985		**1.11**		0.151	
ASP ZONE 1	18	SW	20.7		2323		0.00499	<	NA		**0.871**		NA	
ASP ZONE 1	18	NE	4.94		2004		0.00553	<	NA		**1.09**		NA	
ASP ZONE 1	18	SE	42.2		4659		0.00321	<	NA		**1.17**		NA	
ASP ZONE 1	23	NW	3.67		2725		0.00229	<	0.0140	<	**1.05**		0.500	
ASP ZONE 1	23	SW	5.13		2279		0.00550		NA		**0.792**		NA	
ASP ZONE 1	23	NE	2.41		1847		0.143		NA		**0.918**		NA	
Media Blank	NA	QC-Blank	0.0256	ND	0.888		NA		NA		**0.0256**	ND	NA	
Media Blank	NA	QC-Blank	0.0256	ND	#####		NA		NA		**0.0256**	ND	NA	
Media Blank	NA	QC-Blank	0.0951		2.38		NA		0.00769	<	**0.0367**		NA	
Medial Blank	NA	QC- Blank	0.0256	ND	1340		NA		NA		**0.0256**	ND	0.00705	<
Media Blank	NA	QC-Blank					NA						NA	

Table 4.2 Summary Windrow Emission Measurement Data (flux in mg/m-m2).

SOURCE	DAY	LOCATION	Methan		CO2		NH3/Tu		NH3/La		TNMN		N2O	
			Flux		Flux		Flux		Flux		Flux		Flux	
ESH DAY OLD CH	1	Top	0.0895		3012		0.0242		NA		**35.4**		NA	
FRESH CHOP	0	Top	0.0916		5145		0.00262	<	NA		**81.7**		NA	
FRESH CHOP	0	QC- Replicate	0.0906		5157		0.00256	<	NA		**75.3**		NA	
WINDROW WR-1	2	Top- West	0.448		3534		0.0975		0.0320	<	**54.1**		0.548	
WINDROW WR-1	2	Top- East	0.527		4699		0.107		NA		**56.8**		NA	
WINDROW WR-1	2	Side- North	0.495		5644		0.379		NA		**44.9**		NA	
WINDROW WR-1	2	Side- South	0.689		6267		0.110		NA		**83.4**		NA	
WINDROW WR-1	3	Top- West	3.02		7566		0.00504	<	0.0300	<	**167**		0.324	
WINDROW WR-1	3	Top- East	0.519		4823		0.155		NA		**204**		NA	
WINDROW WR-1	3	Side- North	3.57		4363		0.00496	<	NA		**135**		NA	
WINDROW WR-1	3	Side- South	0.469		3204		2.01		NA		**143**		NA	
WINDROW WR-2	9	Top- West	48.9		1264		0.00349	<	0.0206	<	**77.7**		0.616	
WINDROW WR-2	9	Top- East	65.0		2320		0.640		NA		**76.5**		NA	
WINDROW WR-2	9	Side- North	15.1		1199		0.463		NA		**15.9**		NA	
WINDROW WR-2	9	Side- South	4.68		2712		0.632		NA		**5.29**		NA	
WINDROW WR-2	11	Top	63.8		8834		0.0379		0.0595		**105**		0.422	
WINDROW WR-2	11	Side- South	15.3		7687		0.387		NA		**48.0**		NA	
WR-2 POST MIX	11	Top	36.6		4062		0.0314		NA		**165**		NA	
WR-2 POST MIX	11	QC-Replicate	31.2		4011		0.0258		0.0467	<	**163**		0.255	
WR-2 POST MIX	11	Side- South	11.5		5686		0.0183		NA		**110**		NA	
WINDROW WR-3	15	Top- East	63.1		6383		4.38		NA		**47.4**		NA	
WINDROW WR-3	15	Top- West	70.0		7075		0.371		0.0692	<	**27.5**		1.05	
WINDROW WR-3	15	Side- North	104		11061		0.845		NA		**51.3**		NA	
WINDROW WR-3	15	Side- South	206		14227		0.680		NA		**62.1**		NA	
WINDROW WR-3	15	Side- N. Spat.	158		6725		0.616		NA		**13.6**		NA	
WINDROW WR-3	15	Top- Spatial	43.8		4582		0.714		NA		**64.0**		NA	
WINDROW WR-3	15	QC-Replicate	45.0		4931		0.768		NA		**71.0**		NA	
WINDROW WR-3	29	Top- West	44.2		8529		4.88		0.853		**50.2**		1.50	
WINDROW WR-3	29	Top- East	58.0		7108		0.00381	<	NA		**53.4**		NA	
WINDROW WR-3	29	Side- South	39.4		6871		2.84		NA		**22.8**		NA	
WINDROW WR-4	63	Top- North	22.8		3349		0.0341		0.0347	<	**76.9**		0.0176	<
WINDROW WR-4	63	Top- South	16.1		5420		0.0499		NA		**76.0**		NA	
WINDROW WR-4	63	Side- West	4.80		1396		0.216		NA		**96.4**		NA	
WINDROW WR-4	63	Side- East	2.89		1625		0.105		NA		**67.9**		NA	
Media Blank	NA	QC-Blank	0.0256	ND	0.888		NA		NA		**0.0256**	ND	NA	
Media Blank	NA	QC-Blank	0.0256	ND	0.0282		NA		NA		**0.0256**	ND	NA	
Media Blank	NA	QC-Blank	0.0951		2.38		NA		NA		**0.0367**		NA	
Medial Blank	NA	QC- Blank	0.0256	ND	1340		NA		0.00769	<	**0.0256**	ND	0.00705	<
Media Blank	NA	QC-Blank					NA						NA	

5. Emissions Calculations

In order to calculate emissions for the complete process cycle, a process cycle was simulated using the data collected on the specific process days. The process cycle days that were not tested had the emissions estimated based on linear interpolation of the test data.

ASP Emissions

The simulated emissions in pounds per ton per day for each cycle day are provided in Attachment 1. The program design for the ASP anticipated that the primary composting process would take 22 days. However emissions estimates were extrapolated to both a 30 day period and a 60 day period. Table 5.1 presents the results of the 22 day measured period as well as the extrapolated longer periods.

Table 5.1 ASP Air Emissions (pounds per ton compost mix) for a 22 day compost period with extrapolated estimates for 30 day and 60 day periods.

		NH3		Greenhouse Gas			
Cycle Length	**VOC**	**Field**	**Lab**	**CO2**	**CH4**	**N2O**	**CO2e**
22 Day	0.10	0.02	0.01	206	5.1	0.01	315
30 Day	0.13	0.02	0.01	271	5.2	0.02	387
60 Day	0.22	0.02	0.01	517	5.6	0.08	658

Windrow Emissions

The windrow emissions were calculated in the same manner as the ASP emissions. The only exception is that windrow emissions included mixing events. The measured mixing event data showed that mixing increased the daily emissions by 8% on the mix day. Therefore, for the simulated emissions profile, each mix day emissions were multiplied by a factor of 1.08.

Windrow emissions estimates were calculated for a 22 day period, a 30 day period and a 60 day period. Table 5.2 presents the results of the windrow emissions calculations

Table 5.2 Windrow Air Emissions (pounds per ton compost mix) for 22 day, 30 day, and 60 day periods.

		NH3		Greenhouse Gas			
Cycle Length	**VOC**	**Field**	**Lab**	**CO2**	**CH4**	**N2O**	**CO2e**
22 Day	8.6	0.10	0.01	732	5.8	0.09	883
30 Day	10.4	0.19	0.04	1,036	8.1	0.15	1,253
60 Day	19.9	0.38	0.11	1,816	12.4	0.26	2,158

6. Data Analysis and Discussion

Comparative Emissions

Figures 6.1 through 6.5 shows how each emissions species compares for ASPs and windrows. The emissions beyond Day 22 for the ASP were extrapolated based on the last measurement.

Figure 6.1 VOC Emissions (#/ton mix) for Each Process Day.

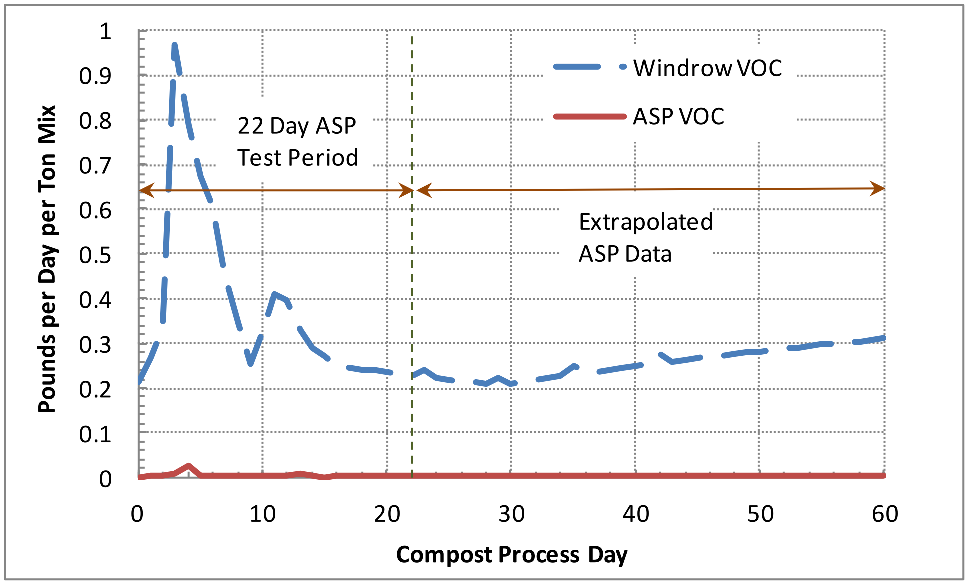


Figure 6.2 NH3 (Laboratory Data Only) Emissions (#/ton mix) for Each Process Day.

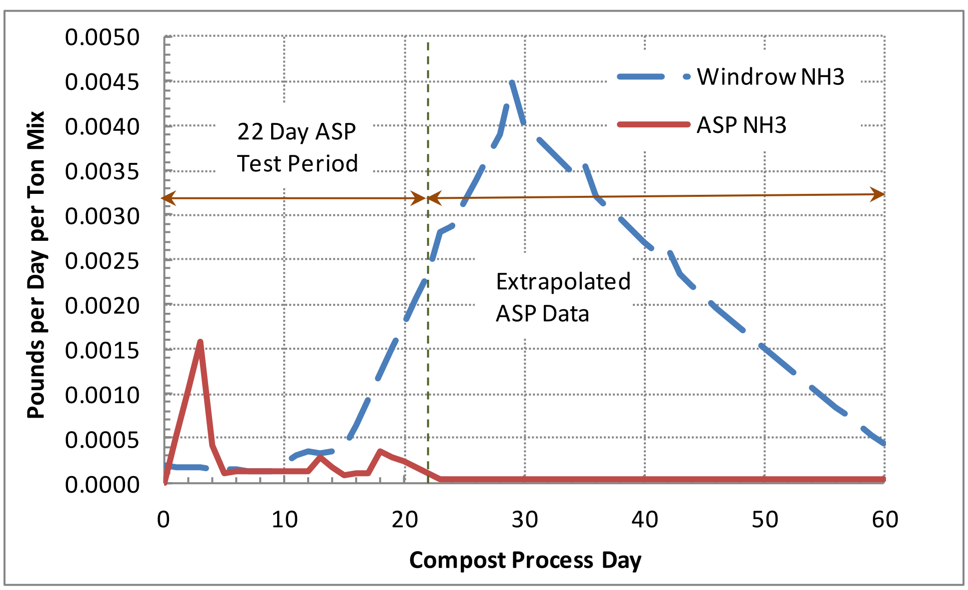


Figure 6.3 CO2 Emissions (#/ton mix) for Each Process Day.

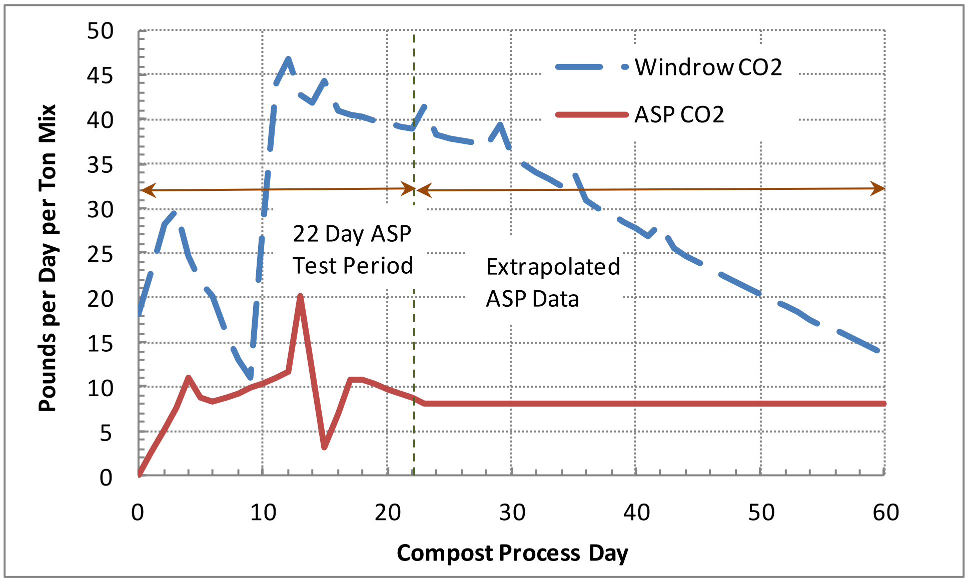


Figure 6.4 CH4 Emissions (#/ton mix) for Each Process Day.

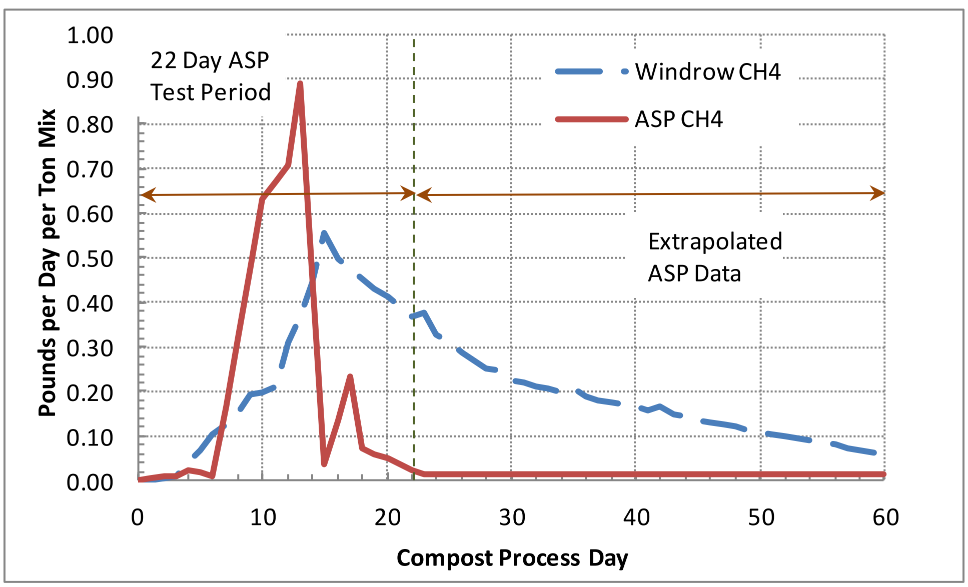
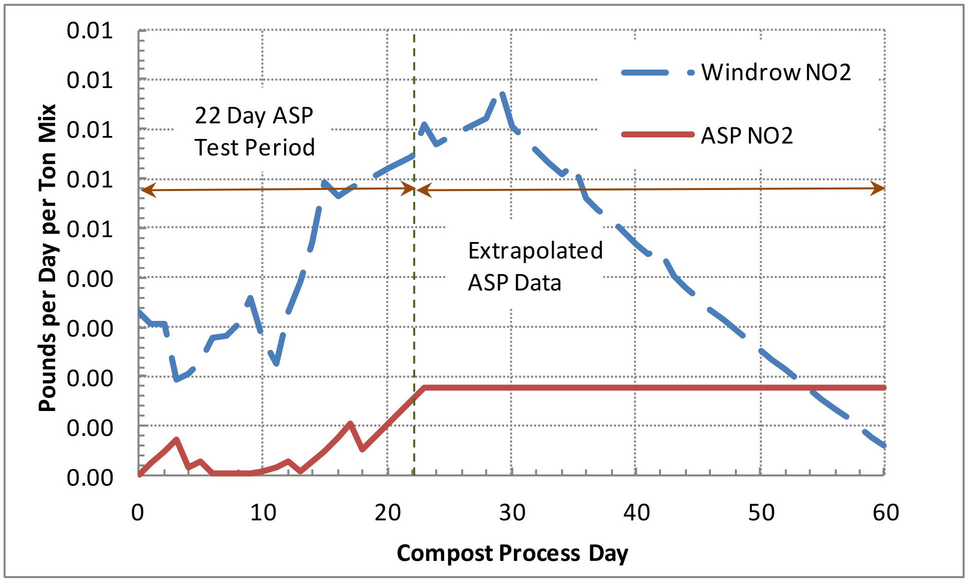


Figure 6.5 N2O Emissions (#/ton mix) for Each Process Day.



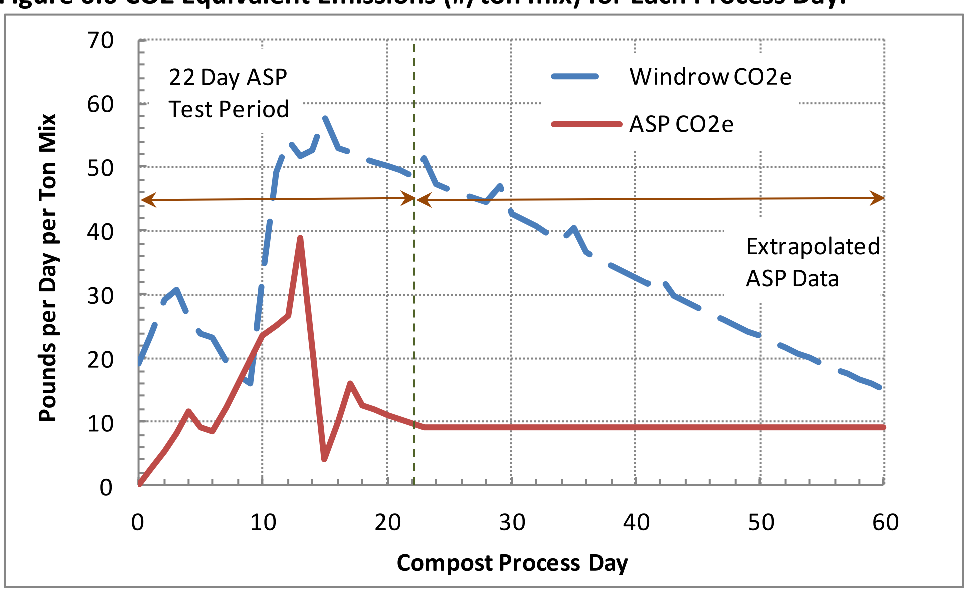
Greenhouse Gas Emissions

Using the CARB (40 CFR Part 98) CO_2 equivalency factors for the 100 yr planning horizon of

Methane 21
Nitrous Oxide 310

the CO2 equivalency of the all the greenhouse gases were calculated as are shown as a comparison of windrow to ASP in Figure 6.6. The ASP is shown to be significantly lower than windrow composting using this metric.

Figure 6.6 CO2 Equivalent Emissions (#/ton mix) for Each Process Day.



Emissions Reductions by ASP Technology

Figure 6.7 shows the emissions reductions for the ASP technology as compared to the control windrow technology. The calculation was made for the 22 day design period as well as extrapolated to 30 day and 60 day periods. Table 6.1 provides the quantitative data used to generate Figure 6.7.

Figure 6.7 Emissions Reduction Summary (as compared to tested control windrow).

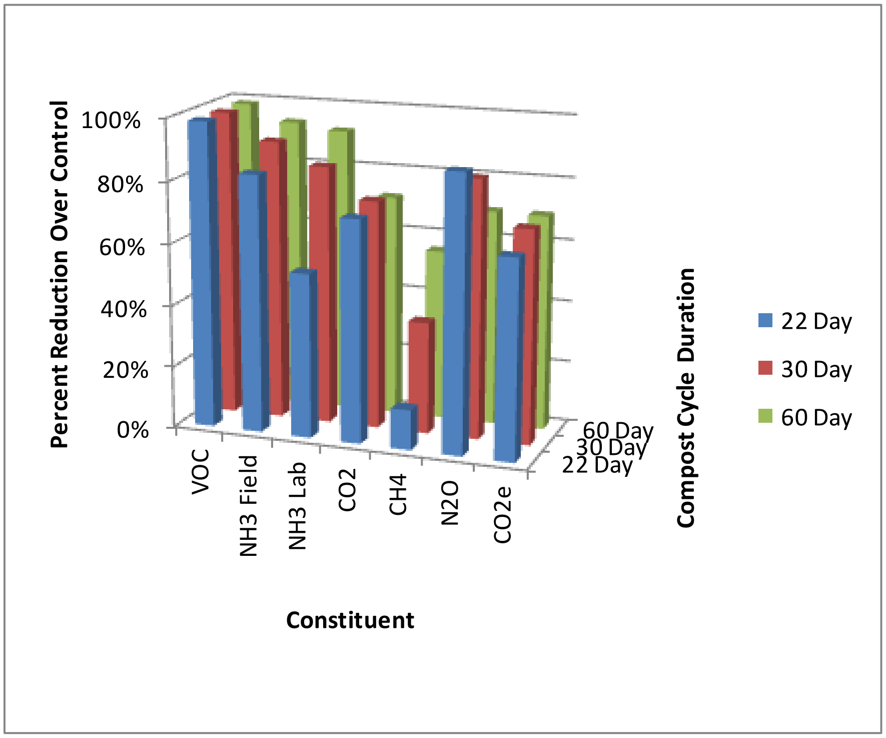


Table 6.1 Emissions Reduction Summary (as compared to tested control windrow).

		NH3		Greenhouse Gas			
Cycle Length	**VOC**	**Field**	**Lab**	**CO2**	**CH4**	**N2O**	**CO2e**
22 Day	98.8%	83%	53%	72%	13%	89%	64%
30 Day	98.8%	91%	84%	74%	36%	83%	69%
60 Day	98.9%	94%	92%	72%	55%	70%	70%

VOC emission reduction from ASP composting was nearly 99% based on the control windrows for all the cycle periods evaluated. The cycle period did affect both ammonia emissions reduction and methane emissions significantly. This is because the windrow ammonia emissions occurred late in the cycle and the ASP methane emissions occurred early in the cycle.

Table 6.2 presents the emissions reductions as compared to current regulatory emission factors from SJVAPCD and SCAQMD. VOC and ammonia emission reductions were ranged from 97% to 99%. The methane emissions from the ASP prototype were significantly higher than the current SCAQMD emission factor.

Table 6.2 Emissions Reduction Summary (pounds per ton mix) in a Regulatory Context.

Test Condition	VOC	NH3	CH4
Prototype ASP (22 Days)	0.10	0.01	5.05
SCAQMD (full life cycle)	3.76	0.82	0.87
% Reduction from SCAQMD Factor	97%	99%	-481%
SJVUAPCD (22-day active phase)	5.14		
% Reduction from SJV active phase	98%		

Discussion

The combination of better process control and the surface biofilter layer produced far lower emissions from the ASP as compared to the current industry-standard windrow. The degree of control for both VOCs and windrows exceeded that expected with even synthetic cover technologies. The relatively high level of control of greenhouse gas emissions was a surprise. It is important to note that this is the first thorough test of this technology, and further testing and evaluation should be completed before these high levels of control can be assured on an industry-wide basis.

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Appendix 1

Detailed Calculation Spreadsheets

Table 1A – ASP Calculations.

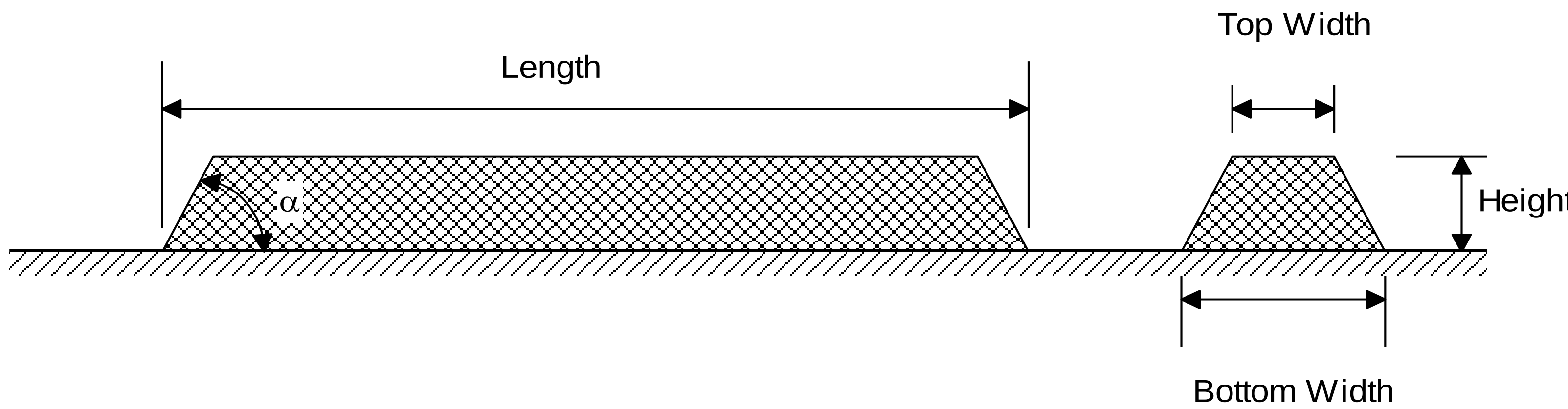
	Flux									Emissions (pounds)							Emissions (pounds/ton)						
Day	CH4	CO2	NH3 T	NH3 L	VOC	N2O		Area		CH4	CO2	NH3 T	NH3 L	VOC	N2O		CH4	CO2	NH3 T	NH3 L	VOC	N2O	CO2e
0	0	0	0	0	0	0.00		785													0.0000		
1	1.0	713.6	0.3	0.1	0.7	0.07		785		3	1,778	0.79	0.36	1.64	0.17		0.0037	2.56	0.0011	0.0005	0.0024	0.0002	2.7098
2	2.1	1427.2	0.6	0.3	1.3	0.13		785		5	3,556	1.59	0.73	3.28	0.33		0.0075	5.11	0.0023	0.0010	0.0047	0.0005	5.4195
3	3	2,141	0.96	0.44	1.98	0.20		785		8	5,335	2.38	1.09	4.93	0.50		0.0112	7.67	0.0034	0.0016	0.0071	0.0007	8.1293
4	6	3,069	0.90	0.12	7.37	0.05		785		15	7,647	2.23	0.29	18.36	0.13		0.0212	11.00	0.0032	0.0004	0.0264	0.0002	11.4984
5	5	2,434	0.13	0.03	0.57	0.08		785		11	6,065	0.33	0.08	1.41	0.19		0.0165	8.72	0.0005	0.0001	0.0020	0.0003	9.1514
6	3	2,308	0.09	0.04	0.67	0.01		785		8	5,750	0.22	0.09	1.67	0.04		0.0118	8.27	0.0003	0.0001	0.0024	0.0001	8.5314
7	46.6	2451.6	0.2	0.04	0.8	0.0		785		116	6,109	0.38	0.09	1.96	0.04		0.1668	8.78	0.0005	0.0001	0.0028	0.0001	12.3047
8	89.8	2595.7	0.2	0.04	0.9	0.0		785		224	6,468	0.53	0.09	2.26	0.04		0.3219	9.30	0.0008	0.0001	0.0032	0.0001	16.0779
9	133.1	2739.8	0.3	0.04	1.0	0.0		785		332	6,827	0.69	0.09	2.55	0.04		0.4769	9.82	0.0010	0.0001	0.0037	0.0001	19.8512
10	176	2,884	0.34	0.04	1.14	0.02		785		439	7,186	0.85	0.09	2.85	0.05		0.6319	10.33	0.0012	0.0001	0.0041	0.0001	23.6244
11	187.2	3062.2	0.2	0.0	1.0	0.0		785		466	7,630	0.48	0.10	2.47	0.12		0.6706	10.97	0.0007	0.0001	0.0036	0.0002	25.1072
12	198	3,240	0.04	0.04	0.84	0.08		785		493	8,075	0.11	0.10	2.10	0.19		0.7093	11.61	0.0002	0.0001	0.0030	0.0003	26.5900
13	248	5,634	0.03	0.08	2.06	0.02		785		619	14,038	0.06	0.20	5.14	0.05		0.8903	20.19	0.0001	0.0003	0.0074	0.0001	38.9050
14	129.1	3270.4	0.1	0.1	1.1	0.1		785		322	8,149	0.15	0.13	2.67	0.19		0.4626	11.72	0.0002	0.0002	0.0038	0.0003	21.5170
15	10	907	0.09	0.02	0.08	0.13		785		24	2,261	0.23	0.06	0.19	0.33		0.0348	3.25	0.0003	0.0001	0.0003	0.0005	4.1291
16	37.7	1944.5	0.1	0.0	0.4	0.2		785		94	4,845	0.18	0.07	1.03	0.52		0.1351	6.97	0.0003	0.0001	0.0015	0.0008	10.0382
17	66	2,982	0.05	0.03	0.75	0.29		785		164	7,430	0.13	0.08	1.86	0.72		0.2354	10.68	0.0002	0.0001	0.0027	0.0010	15.9473
18	20	3,013	0.00	0.10	1.06	0.15		785		51	7,509	0.01	0.25	2.64	0.38		0.0728	10.80	0.0000	0.0004	0.0038	0.0005	12.4929
19	17.0	2867.4	0.0	0.1	1.0	0.2		785		42	7,145	0.03	0.20	2.57	0.55		0.0609	10.27	0.0000	0.0003	0.0037	0.0008	11.7980
20	13.7	2721.5	0.0	0.1	1.0	0.3		785		34	6,782	0.06	0.16	2.50	0.72		0.0490	9.75	0.0001	0.0002	0.0036	0.0010	11.1032
21	10.4	2575.6	0.0	0.0	1.0	0.4		785		26	6,418	0.08	0.12	2.43	0.90		0.0371	9.23	0.0001	0.0002	0.0035	0.0013	10.4084
22	7.0	2429.6	0.0	0.0	0.9	0.4		785		18	6,054	0.10	0.08	2.36	1.07		0.0253	8.71	0.0001	0.0001	0.0034	0.0015	9.7135
23	4	2,284	0.05	0.01	0.92	0.50		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
24	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
25	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
26	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
27	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
28	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
29	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
30	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
31	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
32	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
33	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
34	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
35	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
36	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
37	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
38	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
39	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
40	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
41	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
42	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
43	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
44	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
45	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
46	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
47	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
48	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
49	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
50	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
51	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
52	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
53	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
54	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
55	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
56	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
57	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
58	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
59	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
60	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0187
									Tota	3,868	359,300	16	6	156	55	Pounds							658
										6	517	0.02	0.01	0.22	0.08	#/ton mix							

Table 1B – Windrow Calculations.

	Flux										Emissions (pounds)							Emissions (pounds per ton)						
Day	CH4	CO2	NH3 T	NH3 L	VOC	N2O		Area	MF		CH4	CO2	NH3 T	NH3 L	VOC	N2O		CH4	CO2	NH3 T	NH3 L	VOC	N2O	CO2e
0	0	3012	0	0	35	1		1311	1.08		0	13,486	0.11	0.14	158.36	2.45		0	18	0.0001	0.0002	0.214	0.0033	19.3018
1	0.3	4024.2	0.1	0.0	47.6	0.5		1305	1.00		1	16,675	0.41	0.13	197.15	2.27		0.002	23	0.0006	0.0002	0.267	0.0031	23.5687
2	0.5	5036.0	0.2	0.0	59.8	0.5		1299	1.00		2	20,772	0.72	0.13	246.58	2.26		0.003	28	0.0010	0.0002	0.334	0.0031	29.1371
3	2	4989	1	0	162	0		1293	1.08		8	22,028	2.40	0.13	715.72	1.43		0.011	30	0.0033	0.0002	0.969	0.0019	30.6640
4	7.1	4469.9	0.5	0.0	142.4	0.4		1287	1.00		29	18,265	2.15	0.12	581.86	1.52		0.040	25	0.0029	0.0002	0.788	0.0021	26.1999
5	12.4	3950.6	0.5	0.0	122.7	0.4		1281	1.00		50	16,067	2.07	0.11	498.97	1.71		0.068	22	0.0028	0.0001	0.676	0.0023	23.9078
6	17.6	3431.3	0.5	0.0	103.0	0.5		1275	1.08		77	14,938	2.13	0.11	448.30	2.04		0.104	20	0.0029	0.0001	0.607	0.0028	23.2687
7	22.9	2912.0	0.5	0.0	83.3	0.5		1269	1.00		92	11,732	1.90	0.10	335.47	2.09		0.125	16	0.0026	0.0001	0.454	0.0028	19.3849
8	28.2	2392.7	0.5	0.0	63.6	0.6		1263	1.00		113	9,594	1.82	0.09	254.85	2.27		0.153	13	0.0025	0.0001	0.345	0.0031	17.1541
9	33.4	1873.5	0.4	0.0	43.9	0.6		1257	1.08		143	8,040	1.87	0.09	188.19	2.64		0.194	11	0.0025	0.0001	0.255	0.0036	16.0714
10	36.5	5067.0	0.3	0.0	60.2	0.5		1251	1.00		145	20,122	1.29	0.16	239.03	2.06		0.196	27	0.0017	0.0002	0.324	0.0028	32.2296
11	39.5	8260.6	0.2	0.1	76.5	0.4		1245	1.00		156	32,646	0.84	0.24	302.45	1.67		0.212	44	0.0011	0.0003	0.410	0.0023	49.3478
12	54.3	8159.1	0.5	0.1	69.4	0.6		1239	1.08		230	34,510	1.94	0.26	293.65	2.45		0.311	47	0.0026	0.0004	0.398	0.0033	54.2874
13	69.1	8057.6	0.7	0.1	62.3	0.7		1233	1.00		270	31,535	2.76	0.25	243.91	2.88		0.366	43	0.0037	0.0003	0.330	0.0039	51.5956
14	83.8	7956.2	0.9	0.1	55.2	0.9		1227	1.00		327	30,986	3.70	0.26	215.04	3.48		0.442	42	0.0050	0.0004	0.291	0.0047	52.6995
15	99	7855	1	0	48	1		1221	1.08		411	32,737	4.98	0.29	200.52	4.38		0.556	44	0.0067	0.0004	0.272	0.0059	57.8490
16	94.9	7829.6	1.3	0.1	47.7	1.1		1215	1.00		366	30,192	4.99	0.48	183.88	4.17		0.496	41	0.0068	0.0007	0.249	0.0056	53.0417
17	91.3	7804.4	1.4	0.2	47.3	1.1		1209	1.00		350	29,946	5.34	0.69	181.32	4.27		0.474	41	0.0072	0.0009	0.246	0.0058	52.2981
18	87.6	7779.2	1.5	0.2	46.8	1.1		1203	1.00		334	29,700	5.69	0.91	178.78	4.37		0.453	40	0.0077	0.0012	0.242	0.0059	51.5594
19	83.9	7754.1	1.6	0.3	46.4	1.2		1196	1.00		319	29,455	6.04	1.11	176.26	4.47		0.432	40	0.0082	0.0015	0.239	0.0061	50.8254
20	80.2	7728.9	1.7	0.3	46.0	1.2		1190	1.00		303	29,212	6.38	1.32	173.75	4.57		0.411	40	0.0086	0.0018	0.235	0.0062	50.0962
21	76.6	7703.8	1.8	0.4	45.5	1.2		1184	1.00		288	28,969	6.72	1.52	171.26	4.67		0.390	39	0.0091	0.0021	0.232	0.0063	49.3718
22	72.9	7678.6	1.9	0.5	45.1	1.3		1178	1.00		273	28,727	7.06	1.72	168.79	4.77		0.369	39	0.0096	0.0023	0.229	0.0065	48.6523
23	69.2	7653.5	2.0	0.5	44.7	1.3		1172	1.08		277	30,636	7.94	2.07	178.88	5.23		0.375	41	0.0108	0.0028	0.242	0.0071	51.5548
24	65.6	7628.3	2.1	0.6	44.3	1.3		1166	1.00		243	28,246	7.71	2.12	163.89	4.95		0.329	38	0.0104	0.0029	0.222	0.0067	47.2275
25	61.9	7603.2	2.2	0.6	43.8	1.4		1160	1.00		228	28,007	8.04	2.32	161.47	5.04		0.309	38	0.0109	0.0031	0.219	0.0068	46.5223
26	58.2	7578.0	2.3	0.7	43.4	1.4		1154	1.00		213	27,769	8.36	2.51	159.06	5.14		0.289	38	0.0113	0.0034	0.215	0.0070	45.8219
27	54.5	7552.9	2.4	0.7	43.0	1.4		1148	1.00		199	27,532	8.67	2.70	156.67	5.23		0.269	37	0.0117	0.0037	0.212	0.0071	45.1263
28	50.9	7527.7	2.5	0.8	42.6	1.5		1142	1.00		184	27,296	8.99	2.89	154.29	5.31		0.250	37	0.0122	0.0039	0.209	0.0072	44.4355
29	47	7503	3	1	42	1.5		1136	1.08		183	29,103	10.00	3.31	163.40	5.81		0.248	39	0.0135	0.0045	0.221	0.0079	47.0508
30	46.2	7368.6	2.5	0.8	43.2	1.5		1130	1.00		166	26,437	8.98	2.97	155.05	5.22		0.224	36	0.0122	0.0040	0.210	0.0071	42.6939
31	45.1	7234.6	2.4	0.8	44.3	1.4		1124	1.00		161	25,817	8.68	2.87	158.12	5.03		0.218	35	0.0117	0.0039	0.214	0.0068	41.6471
32	44.1	7100.6	2.4	0.8	45.4	1.4		1118	1.00		156	25,203	8.37	2.77	161.15	4.85		0.212	34	0.0113	0.0038	0.218	0.0066	40.6091
33	43.0	6966.7	2.3	0.8	46.5	1.3		1112	1.00		152	24,594	8.07	2.67	164.14	4.67		0.206	33	0.0109	0.0036	0.222	0.0063	39.5799
34	42.0	6832.7	2.2	0.7	47.6	1.3		1106	1.00		147	23,990	7.77	2.57	167.09	4.49		0.200	32	0.0105	0.0035	0.226	0.0061	38.5595
35	40.9	6698.7	2.1	0.7	48.7	1.2		1100	1.08		154	25,156	8.04	2.66	182.82	4.64		0.208	34	0.0109	0.0036	0.248	0.0063	40.3812
36	39.9	6564.7	2.1	0.7	49.8	1.2		1094	1.00		138	22,798	7.18	2.38	172.86	4.14		0.188	31	0.0097	0.0032	0.234	0.0056	36.5451
37	38.8	6430.8	2.0	0.7	50.9	1.1		1088	1.00		134	22,209	6.89	2.28	175.68	3.97		0.182	30	0.0093	0.0031	0.238	0.0054	35.5510
38	37.8	6296.8	1.9	0.6	52.0	1.1		1082	1.00		130	21,626	6.60	2.18	178.46	3.80		0.176	29	0.0089	0.0030	0.242	0.0051	34.5658
39	36.7	6162.8	1.8	0.6	53.1	1.1		1076	1.00		125	21,047	6.31	2.09	181.20	3.63		0.170	28	0.0085	0.0028	0.245	0.0049	33.5894
40	35.7	6028.8	1.8	0.6	54.1	1.0		1070	1.00		121	20,474	6.03	2.00	183.89	3.46		0.164	28	0.0082	0.0027	0.249	0.0047	32.6218
41	34.6	5894.9	1.7	0.6	55.2	1.0		1064	1.00		117	19,906	5.75	1.90	186.54	3.29		0.158	27	0.0078	0.0026	0.253	0.0045	31.6630
42	33.6	5760.9	1.6	0.5	56.3	0.9		1058	1.08		121	20,803	5.89	1.95	203.43	3.36		0.164	28	0.0080	0.0026	0.275	0.0046	33.0305
43	32.6	5626.9	1.6	0.5	57.4	0.9		1052	1.00		109	18,786	5.20	1.72	191.73	2.96		0.147	25	0.0070	0.0023	0.260	0.0040	29.7717
44	31.5	5492.9	1.5	0.5	58.5	0.8		1046	1.00		105	18,233	4.93	1.63	194.25	2.80		0.142	25	0.0067	0.0022	0.263	0.0038	28.8392
45	30.5	5359.0	1.4	0.5	59.6	0.8		1039	1.00		101	17,686	4.66	1.54	196.74	2.64		0.136	24	0.0063	0.0021	0.266	0.0036	27.9156
46	29.4	5225.0	1.3	0.4	60.7	0.8		1033	1.00		97	17,143	4.39	1.46	199.18	2.49		0.131	23	0.0059	0.0020	0.270	0.0034	27.0007
47	28.4	5091.0	1.3	0.4	61.8	0.7		1027	1.00		93	16,606	4.13	1.37	201.59	2.33		0.125	22	0.0056	0.0019	0.273	0.0032	26.0947
48	27.3	4957.1	1.2	0.4	62.9	0.7		1021	1.00		89	16,074	3.87	1.28	203.95	2.17		0.120	22	0.0052	0.0017	0.276	0.0029	25.1974
49	26.3	4823.1	1.1	0.4	64.0	0.6		1015	1.00		85	15,547	3.61	1.20	206.26	2.02		0.115	21	0.0049	0.0016	0.279	0.0027	24.3090
50	25.2	4689.1	1.0	0.3	65.1	0.6		1009	1.00		81	15,025	3.36	1.11	208.54	1.87		0.110	20	0.0045	0.0015	0.282	0.0025	23.4293
51	24.2	4555.1	1.0	0.3	66.2	0.5		1003	1.00		77	14,509	3.10	1.03	210.78	1.72		0.104	20	0.0042	0.0014	0.285	0.0023	22.5585
52	23.1	4421.2	0.9	0.3	67.3	0.5		997	1.00		73	13,997	2.86	0.95	212.97	1.57		0.099	19	0.0039	0.0013	0.288	0.0021	21.6964
53	22.1	4287.2	0.8	0.3	68.4	0.5		991	1.00		70	13,491	2.61	0.87	215.12	1.43		0.094	18	0.0035	0.0012	0.291	0.0019	20.8431
54	21.1	4153.2	0.8	0.3	69.5	0.4		985	1.00		66	12,990	2.37	0.79	217.23	1.28		0.089	18	0.0032	0.0011	0.294	0.0017	19.9986
55	20.0	4019.2	0.7	0.2	70.5	0.4		979	1.00		62	12,494	2.12	0.71	219.29	1.14		0.084	17	0.0029	0.0010	0.297	0.0015	19.1630
56	19.0	3885.3	0.6	0.2	71.6	0.3		973	1.00		59	12,003	1.89	0.63	221.32	1.00		0.079	16	0.0026	0.0008	0.300	0.0013	18.3361
57	17.9	3751.3	0.5	0.2	72.7	0.3		967	1.00		55	11,517	1.65	0.55	223.30	0.86		0.075	16	0.0022	0.0007	0.302	0.0012	17.5180
58	16.9	3617.3	0.5	0.2	73.8	0.2		961	1.00		51	11,036	1.42	0.47	225.24	0.72		0.070	15	0.0019	0.0006	0.305	0.0010	16.7087
59	15.8	3483.3	0.4	0.1	74.9	0.2		955	1.00		48	10,561	1.19	0.40	227.14	0.58		0.065	14	0.0016	0.0005	0.308	0.0008	15.9082
60	14.8	3349.4	0.3	0.1	76.0	0.1		949	1.00		45	10,090	0.96	0.32	229.00	0.45		0.060	14	0.0013	0.0004	0.310	0.0006	15.1165
61	13.7	3215.4	0.2	0.1	77.1	0.10		943	1.00		41	9,625	0.74	0.25	230.81	0.31		0.056	13	0.0010	0.0003	0.313	0.0004	14.3336
62	12.7	3081.4	0.2	0.1	78.2	0.06		937	1.00		38	9,165	0.52	0.17	232.59	0.18		0.051	12	0.0007	0.0002	0.315	0.0002	13.5595
63	12	2947	0	0	79	0.02		931	1.00		34	8,710	0.30	0.10	234.32	0.05		0.047	12	0.0004	0.0001	0.317	0.0001	12.7942
64	12	2947	0	0	79	0.02		925	1.00		34	8,653	0.30	0.10	232.80	0.05		0.046	12	0.0004	0.0001	0.315	0.0001	12.7112
65	12	2947	0	0	79	0.02		919	1.00		34	8,597	0.29	0.10	231.28	0.05		0.046	12	0.0004	0.0001	0.313	0.0001	12.6282
										Total	9,184	1,341,525	284	78	14,728	191	Pou	12	1,816				0	2,158
											12	1,816.47	0.38	0.11	19.94	0.26	#/ton mix							

ACP Final Report fo Valley Air TAP Program, May 2013, Appendix B, ASP Area Calculation

Property	Units	Value
Length	ft	84
Height	ft	7.0
Bottom Width	ft	89
Top Width	ft	75.0
Top Length	ft	70
alpha	R	0.79
	o	45
Top Perimeter	ft	290
Top Area	ft2	5,250
Bottom Perimeter	ft	346
Bottom Area	ft2	7,476
Slant height	ft	9.9
Surface Area	ft2	8,398
	m2	785
Volume	ft3	44,312
	yd3	1,641
Conversion Factors	ft2/m2	10.7
	ft3/yd3	27
Top Area Ratio		0.625146
Density	#/yd	900
Weight	pounds	1477070
	tons	738.5351



Mensuration formulas

$$S = \frac{p_1 + p_2}{2} s + A_2$$

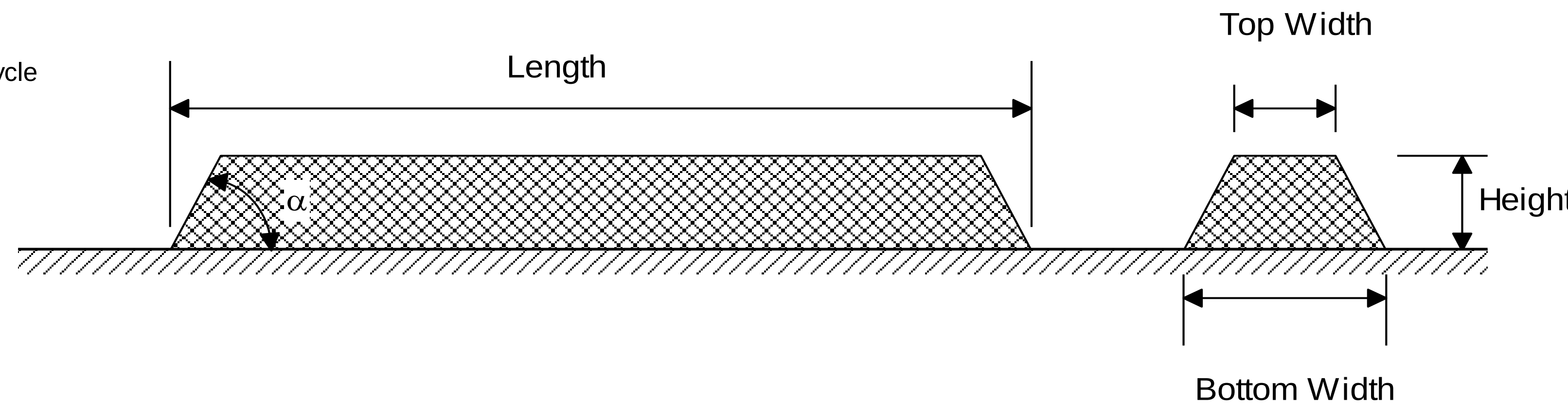
$$V = \frac{h(A_1 + A_2 + \sqrt{A_1 A_2})}{3}$$

$$s = \sqrt{h^2 + ((W_B - W_T)/2)}^{2}$$

where S = total surface area, p_1 = bottom perimeter, p_2 = top perimeter, s = slant height, V=volume, h=vertical height, A_1 = bottom area, A_2 = top area, α = bottom angle

ACP Final Report fo Valley Air TAP Program, May 2013, Appendix B, Windrow Area Calculation

Property	Units	Value	Value at the end of the cycle
Length	ft	500	350
Height	ft	10.0	10.0
Bottom Width	ft	18	18
Top Width	ft	3.0	3.0
Top Length	ft	485	335
alpha	R	0.93	0.93
	o	53	53
Top Perimeter	ft	976	676
Top Area	ft2	1,455	1,005
Bottom Perimeter	ft	1,036	736
Bottom Area	ft2	9,000	6,300
Slant height	ft	12.5	12.5
Surface Area	ft2	14,030	9,830
	m2	1,311	919
Volume	ft3	46,912	32,737
	yd3	1,737	1,212
Conversion Factors	ft2/m2	10.7	10.7
	ft3/yd3	27	27
Top Area Ratio		0.103706	0.102238
Density	#/yd	900	
Weight	pounds	1563745	
	tons	781.8723	



Mensuration formulas

$$S = \frac{p_1 + p_2}{2} s + A_2$$

$$V = \frac{h(A_1 + A_2 + \sqrt{A_1 A_2})}{3}$$

$$s = \sqrt{h^2 + ((W_B - W_T)/2)}^2$$

where S = total surface area, p_1 = bottom perimeter, p_2 = top perimeter, s = slant height, V=volume, h=vertical height, A_1 = bottom area, A_2 = top area, α = bottom angle

Table 1. Summary of Field Sample Collection Information and Field Data for ACP Valley Air TAP Compost Research Program; August 2012.

ACP Final Report fo Valley Air TAP Program, May 2013, Appendix B, Sample Data ASP and Windrow

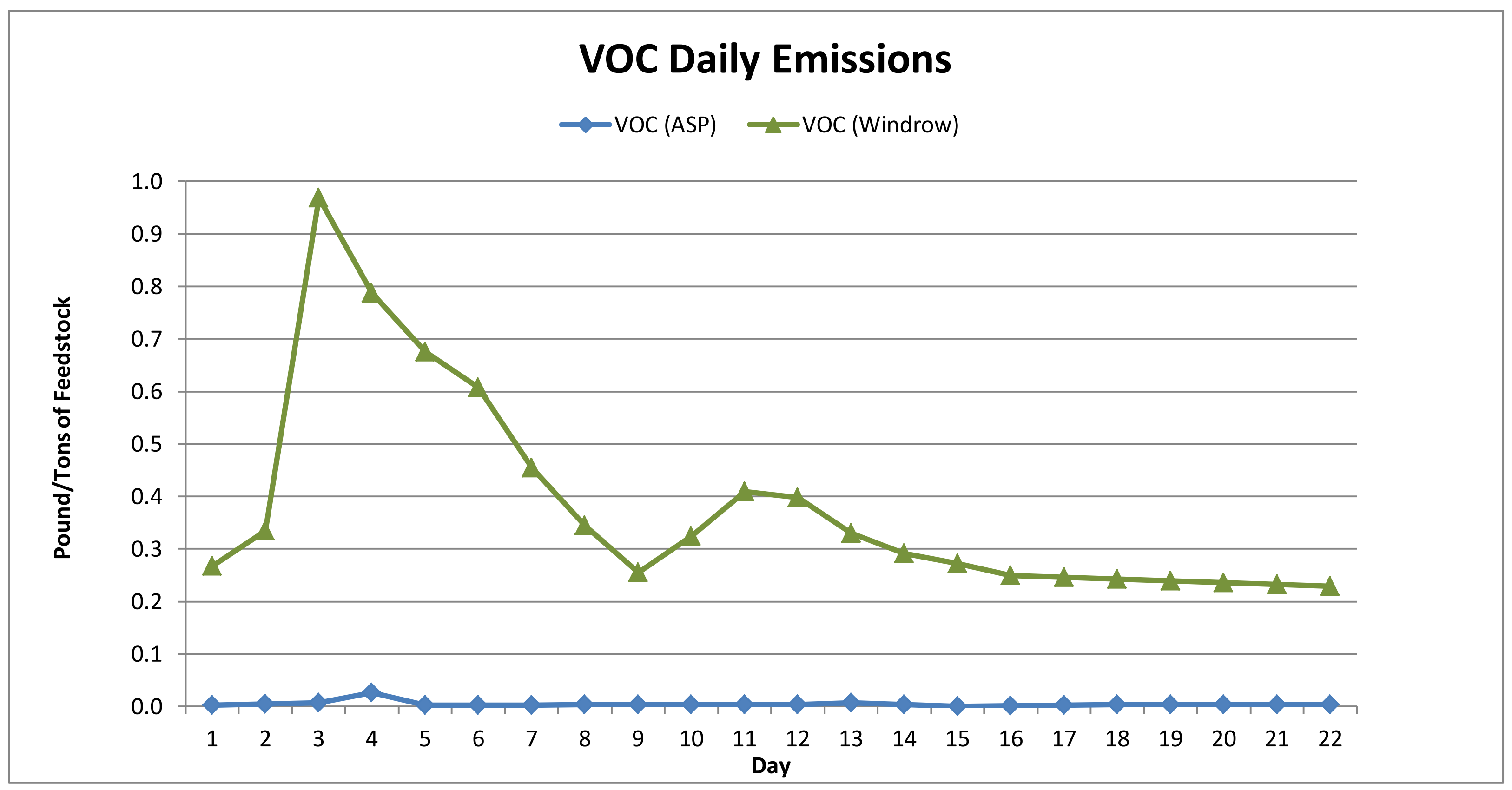
DATE	TIME	SOURCE	DAY	LOCATION	NH3 (ppmv)	25.3 ID	207.1 ID	TO-15 ID	N-6600 ID	FLOW (ft/min)	HELIUM ADDED (%)	HELIUM REC (%)	HELIUM RATIO	FLOW (m3/min)	IN SURF	STACK	IN AIR	OUT SURF	OUT AIR	COMMENT
8202012	916	ASP ZONE 1	15	NW	0.5	G-101	A-101	T-101	N-101	63	10.09	3.06	0.303	0.0165	98	87	90	91	79	ASP Zone 1 constructed on 08/05/2012
8202012	916	ASP ZONE 1	15	SW	4	G-102	NA	NA	NA	42	10.09	5.01	0.497	0.0101	94	88	90	91	84	
8202012	915	ASP ZONE 1	15	NE	<0.05	G-103	NA	NA	N	50	10.07	3.32	0.330	0.0152	91	85	87	91	80	
8202012	915	ASP ZONE 1	15	SE	1	G-104	NA	NA	N	61	10.07	2.90	0.288	0.0174	94	88	90	87	82	
8202012	1105	ASP ZONE 2	10	NW	5	G-105	A-102	T-102	N-102	48	10.09	3.70	0.367	0.0136	109	97	99	93	88	ASP Zone 2 constructed on 08/10/2012
8202012	1105	ASP ZONE 2	10	SW	3	G-106	NA	NA	NA	63	10.09	1.97	0.195	0.0256	108	95	94	97	88	
8202012	1105	ASP ZONE 2	10	NE	2	G-107	NA	NA	NA	99	10.07	2.13	0.212	0.0236	109	97	100	97	89	
8202012	1105	ASP ZONE 2	10	SE	3	G-108	NA	NA	NA	69	10.07	2.60	0.258	0.0194	105	97	98	97	88	
8202012	1244	ASP ZONE 3	3	NW	6.5	G-109	NA	NA	NA	92	10.07	1.07	0.106	0.0471	121	102	105	101	93	ASP Zone 3 constructed on 08/17/2012
8202012	1245	ASP ZONE 3	3	SW	4.0	G-110	NA	NA	NA	41	10.07	3.87	0.384	0.0130	115	103	107	96	92	
8202012	1245	ASP ZONE 3	3	NE	3	G-111	A-103	T-103	N-103	75	10.09	1.70	0.168	0.0297	116	103	103	99	92	
8202012	1245	ASP ZONE 3	3	SE	9	G-112	NA	NA	NA	65	10.09	1.78	0.176	0.0283	121	105	108	123	94	
8202012	1453	WINDROW WR-3	15	Top- East	22	G-113	NA	NA	NA	112	9.70	1.33	0.137	0.0365	131	107	109	112	98	Windrow WR-3 constructed on 08/05/2012
8202012	1454	WINDROW WR-3	15	Top- West	3	G-114	A-104	T-104	N-104	94	9.70	2.14	0.221	0.0227	133	108	111	112	97	
8202012	1459	WINDROW WR-3	15	Side- North	5	G-115	NA	NA	NA	80	9.72	1.57	0.162	0.0310	152	112	122	115	99	
8202012	1506	WINDROW WR-3	15	Side- South	6	G-116	NA	NA	NA	81	10.09	2.43	0.241	0.0208	140	131	134	123	103	
8202012	1634	WINDROW WR-3	15	Side- N. Spatial	5	G-117	NA	NA	NA	88	9.72	2.15	0.221	0.0226	117	107	110	107	96	Spatial test: One side test and one top test
8202012	1630	WINDROW WR-3	15	Top- Spatial	5	G-118	NA	NA	NA	79	9.70	1.85	0.191	0.0262	116	107	108	101	100	Spatial test: One side test and one top test
8202012	1630	WINDROW WR-3	15	QC-Replicate	5	G-119	NA	NA	NA	79	9.70	1.72	0.177	0.0282	116	107	108	101	100	Replicate sample
8202012	1755	Media Blank	NA	QC-Blank	NA	G-120	NA	NA	NA	NA	10.07	9.86	0.979	98%	NA	NA	NA	NA	NA	UHP air in clean canister- media blank sample
8212012	752	WINDROW WR-2	9	Top- West	<0.05	G-201	A-201	T-201	N-201	34	9.72	3.81	0.392	0.0128	123	89	97	91	75	Windrow WR-2 constructed on 08/12/2012
8212012	752	WINDROW WR-2	9	Top- East	5	G-202	NA	NA	NA	53	9.72	2.07	0.213	0.0235	119	93	101	109	75	
8212012	754	WINDROW WR-2	9	Side- North	5	G-203	NA	NA	NA	71	9.70	2.85	0.294	0.0170	131	100	110	91	76	
8212012	756	WINDROW WR-2	9	Side- South	5	G-204	NA	NA	NA	65	10.09	2.17	0.215	0.0232	96	90	96	89	63	
8212012	941	WINDROW WR-1	2	Top- West	1	G-205	A-202	T-202	N-202	36	9.72	2.72	0.280	0.0179	100	89	89	91	84	Windrow WR-1 constructed on 08/20/2012
8212012	941	WINDROW WR-1	2	Top- East	1	G-206	NA	NA	NA	53	9.72	2.48	0.255	0.0196	106	91	94	93	89	
8212012	942	WINDROW WR-1	2	Side- North	4	G-207	NA	NA	NA	55	10.09	2.90	0.287	0.0174	97	88	90	96	81	
8212012	942	WINDROW WR-1	2	Side- South	1	G-208	NA	NA	NA	49	9.70	2.40	0.247	0.0202	103	92	96	86	85	
8212012	1200	WINDROW WR-4	63	Top- North	0.5	G-209	A-203	T-203	N-203	42	9.72	3.90	0.401	0.0125	115	110	115	110	89	Windrow WR-4 constructed on 06/19/12
8212012	1211	WINDROW WR-4	63	Top- South	0.5	G-210	NA	NA	NA	65	9.72	2.65	0.273	0.0183	120	105	110	109	95	
8212012	1217	WINDROW WR-4	63	Side- West	2	G-211	NA	NA	NA	68	9.70	2.45	0.253	0.0198	117	99	111	110	100	
8212012	1220	WINDROW WR-4	63	Side- East	1.0	G-212	NA	NA	NA	71	10.12	2.63	0.260	0.0192	114	113	114	107	91	
8212012	1402	ASP ZONE 3	4	NW	7	G-213	NA	NA	NA	63	9.70	2.16	0.223	0.0225	108	NA	107	108	98	
8212012	1402	ASP ZONE 3	4	SW	5	G-214	NA	NA	NA	56	9.70	3.04	0.313	0.0160	113	109	114	107	99	
8212012	1403	ASP ZONE 3	4	NE	3	G-215	A-204	T-204	N-204	160	10.12	1.37	0.135	0.0369	112	103	102	105	98	
8212012	1404	ASP ZONE 3	4	SE	5	G-216	NA	NA	NA	90	10.12	1.86	0.184	0.0272	117	103	107	106	97	
8212012	1537	ASP ZONE 3	4	Top NW- Spatial	19	G-217	NA	NA	NA	73	9.70	2.90	0.299	0.0167	112	106	106	102	99	Spatial test: One side test and one top test
8212012	1537	ASP ZONE 3	4	Side SE- Spatial	5	G-218	NA	NA	NA	90	9.70	1.31	0.135	0.0370	110	107	109	105	100	Spatial test: One side test and one top test
8212012	1537	ASP ZONE 3	4	QC- Replicate	5	G-219	NA	NA	NA	90	9.70	1.56	0.161	0.0311	110	107	109	105	100	Replicate sample
8212012	1645	Media Blank	NA	QC-Blank	NA	G-220	NA	NA	NA	NA	10.12	10.2	1.008	101%	NA	NA	NA	NA	NA	UHP air in clean canister- media blank sample
8222012	745	ASP ZONE 1	17	NW	1	G-301	A-301	T-301	N-301	51	10.12	3.15	0.311	0.0161	92	80	79	82	76	
8222012	745	ASP ZONE 1	17	SW	0.5	G-302	NA	NA	NA	64	10.12	4.40	0.435	0.0115	82	77	79	78	76	
8222012	745	ASP ZONE 1	17	NE	<0.05	G-303	NA	NA	NA	51	9.72	3.20	0.329	0.0152	86	80	84	88	76	
8222012	745	ASP ZONE 1	17	SE	0.5	G-304	NA	NA	N	112	9.72	1.43	0.147	0.0340	85	80	80	80	77	
8222012	918	ASP ZONE 2	12	NW	<0.05	G-305	A-302	T-302	N-302	81	10.12	2.38	0.235	0.0213	94	88	90	88	78	Blower fan not functioning properly
8222012	918	ASP ZONE 2	12	SW	<0.05	G-306	NA	NA	NA	58	10.12	2.89	0.286	0.0175	94	91	91	88	83	
8222012	918	ASP ZONE 2	12	NE	0.5	G-307	NA	NA	NA	66	9.92	4.33	0.436	0.0115	92	88	87	83	83	
8222012	918	ASP ZONE 2	12	SE	1	G-308	NA	NA	NA	74	9.92	2.03	0.205	0.0244	87	86	86	87	81	
8222012	1101	ASP ZONE 3	5	NW	1	G-309	A-303	T-303	N-303	60	10.12	3.16	0.312	0.0160	116	99	104	103	87	
8222012	1104	ASP ZONE 3	5	SW	1	G-310	NA	NA	NA	22	10.12	4.90	0.484	0.0103	112	104	107	108	90	
8222012	1104	ASP ZONE 3	5	NE	0.5	G-311	NA	NA	NA	62	9.92	2.37	0.239	0.0209	109	104	106	108	93	
8222012	1109	ASP ZONE 3	5	SE	3	G-312	NA	NA	NA	64	9.92	2.46	0.248	0.0202	119	103	107	107	90	

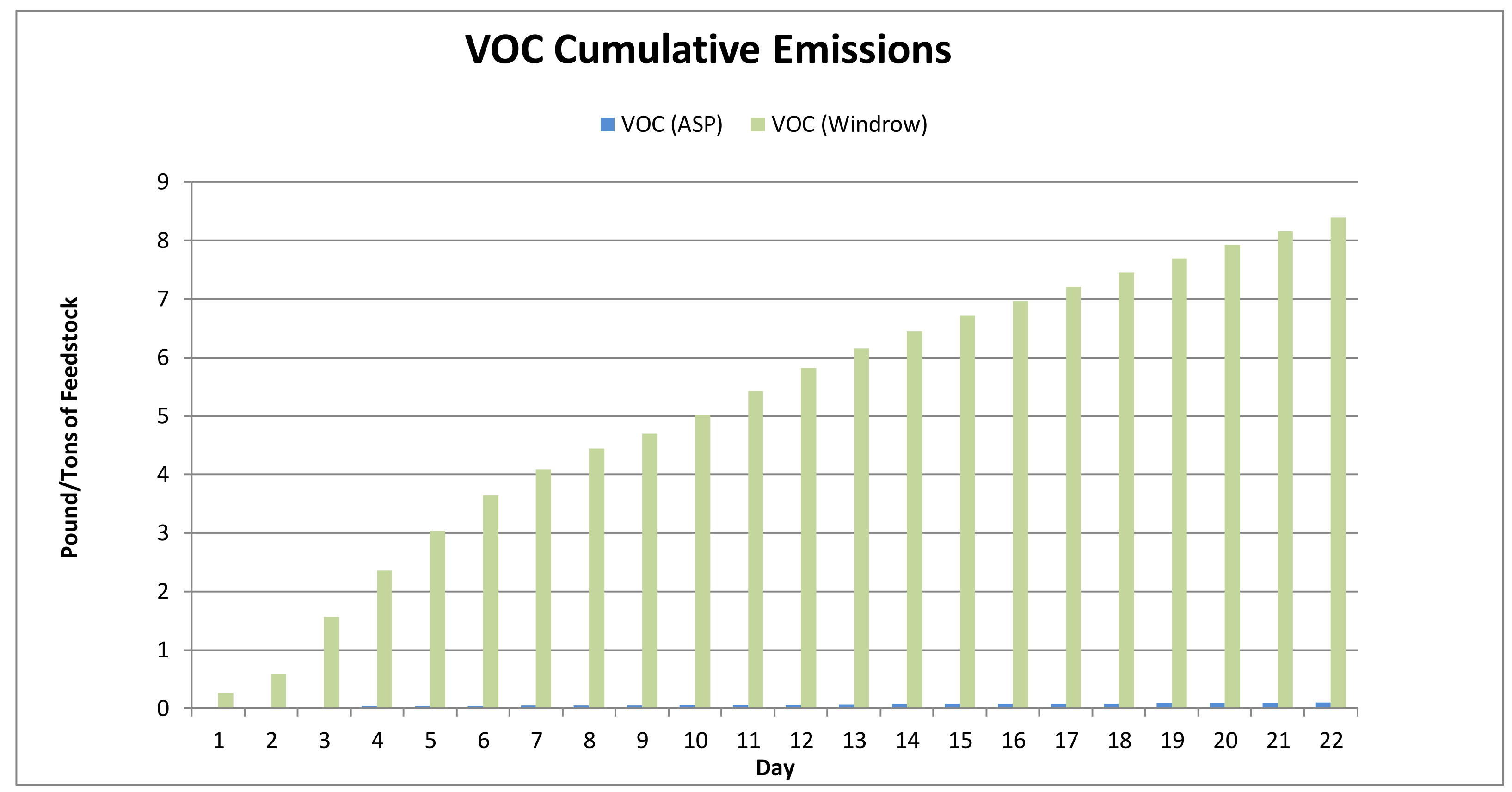
Table 1. Summary of Field Sample Collection Information and Field Data for ACP Valley Air TAP Compost Research Program; August 2012.

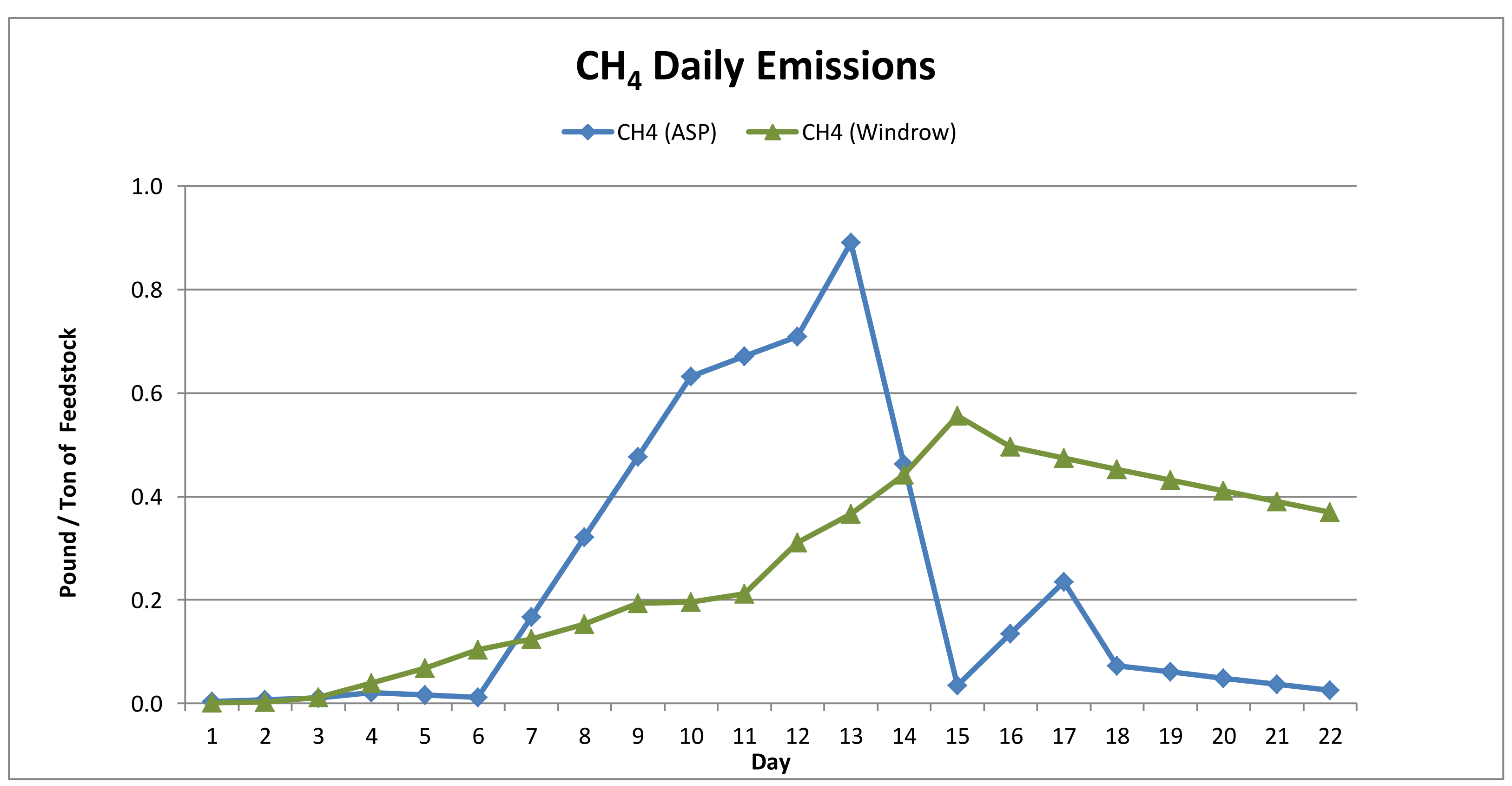
DATE	TIME	SOURCE	DAY	LOCATION	NH3 (ppmv)	25.3 ID	207.1 ID	TO-15 ID	N-6600 ID	FLOW (ft/min)	HELIUM ADDED (%)	HELIUM REC (%)	HELIUM RATIO	FLOW (m3/min)	IN SURF	STACK	IN AIR	OUT SURF	OUT AIR	COMMENT
8222012	1315	WINDROW WR-1	3	Top- West	<0.05	G-313	A-304	T-304	N-304	60	9.91	2.68	0.270	0.0185	116	106	108	105	95	
8222012	1318	WINDROW WR-1	3	Top- East	1	G-314	NA	NA	NA	88	9.91	1.74	0.176	0.0285	111	101	103	101	90	
8222012	1322	WINDROW WR-1	3	Side- North	<0.05	G-315	NA	NA	NA	89	9.89	2.71	0.274	0.0182	112	106	106	93	96	
8222012	1333	WINDROW WR-1	3	Side- South	13	G-316	NA	NA	NA	88	9.93	1.75	0.176	0.0284	120	102	112	117	97	
8222012	1028	RESH DAY OLD CHO	1	Top	0.5	G-317	NA	NA	NA	NA	9.89	5.55	0.561	0.0089	98	NA	99	102	86	Representative of fresh chop used to build piles, about 1 day old
8222012	1230	FRESH CHOP	0	Top	NA	G-318	NA	NA	NA	NA	9.92	5.18	0.522	0.0096	NA	NA	NA	NA	NA	Representative of fresh chop, about 2 hours old
8222012	1230	FRESH CHOP	0	QC- Replicate	NA	G-319	NA	NA	NA	NA	9.92	5.30	0.534	0.0094	NA	NA	NA	NA	NA	Replicate sample
8222012	1437	Media Blank	NA	QC-Blank	NA	G-320	NA	NA	NA	NA	9.92	3.41	0.344	34%	NA	NA	NA	NA	NA	UHP air in clean canister- media blank sample
8232012	747	ASP ZONE 1	18	NW	<0.05	G-401	A-401	T-401	N-401	42	9.93	5.71	0.575	0.0087	81	74	76	78	70	Blower cycle is short due to power level
8232012	749	ASP ZONE 1	18	SW	<0.05	G-402	NA	NA	NA	61	9.93	2.72	0.274	0.0183	84	74	74	82	70	
8232012	730	ASP ZONE 1	18	NE	<0.05	G-403	NA	NA	NA	63	9.89	2.43	0.246	0.0203	79	75	75	80	71	
8232012	730	ASP ZONE 1	18	SE	<0.05	G-404	NA	NA	NA	49	9.89	4.18	0.423	0.0118	82	75	77	79	70	
8232012	907	ASP ZONE 2	13	NW	0.2	G-405	A-402	T-402	N-402	47	9.89	3.41	0.345	0.0145	85	83	87	85	74	
8232012	907	ASP ZONE 2	13	SW	0.8	G-406	NA	NA	NA	89	9.89	2.76	0.279	0.0179	81	85	82	80	84	
8232012	907	ASP ZONE 2	13	NE	<0.05	G-407	NA	NA	NA	60	9.93	2.72	0.274	0.0183	95	87	90	85	80	
8232012	907	ASP ZONE 2	13	SE	<0.05	G-408	NA	NA	NA	63	9.93	2.67	0.269	0.0186	90	89	93	92	81	
8232012	1037	ASP ZONE 3	6	NW	<0.05	G-409	A-403	T-403	N-403	37	9.93	4.98	0.502	0.0100	110	96	104	100	88	
8232012	1037	ASP ZONE 3	6	SW	1	G-410	NA	NA	NA	51	9.93	3.21	0.323	0.0155	113	97	101	119	90	
8232012	1037	ASP ZONE 3	6	NE	<0.05	G-411	NA	NA	NA	67	9.89	2.42	0.245	0.0204	103	100	102	105	90	
8232012	1037	ASP ZONE 3	6	SE	4	G-412	NA	NA	NA	37	9.89	4.11	0.416	0.0120	122	104	107	110	90	
8232012	1235	WINDROW WR-2	11	Top	0.3	G-413	A-404	T-404	N-404	71	9.92	2.14	0.216	0.0232	127	110	112	109	95	Pile watered on site schedule (08/23/2012, 1015); A/T/N replicate '405'
8232012	1235	WINDROW WR-2	11	Side- South	3	G-414	NA	NA	NA	81	9.91	2.09	0.211	0.0237	143	122	128	110	95	
8232012	1409	WR-2 POST MIX	11	Top	0.2	G-415	NA	NA	NA	60	9.92	1.72	0.173	0.0288	138	111	116	126	98	Scarab mixing at 1325-1335; test started 4 minutes post mixing
8232012	1409	WR-2 POST MIX	11	QC-Replicate	0.2	G-416	A-405	T-405	N-405	60	9.92	2.09	0.211	0.0237	138	111	116	126	98	Ammonia, VOCs, and nitrogen oxide replicates of '404' series
8232012	1412	WR-2 POST MIX	11	Side- South	0.2	G-417	NA	NA	NA	65	9.91	2.95	0.298	0.0168	137	123	126	119	97	Scarab mixing at 1325-1335; test started 4 minutes post mixing
8232012	1512	Medial Blank	NA	QC- Blank	NA	G-418	A-406	T-406	N-406	NA	10.07	10.02	0.995	100%	NA	NA	NA	NA	NA	UHP air in clean canister- media blank sample
8282012	808	ASP ZONE 1	23	NW	<0.05	G-501	A-501	T-501	N-501	26	9.76	5.80	0.594	0.0084	91	81	89	93	78	
8282012	808	ASP ZONE 1	23	SW	0.1	G-502	NA	NA	NA	37	9.91	4.89	0.493	0.0101	96	84	92	97	73	
8282012	808	ASP ZONE 1	23	NE	1	G-503	NA	NA	NA	61	9.91	1.89	0.191	0.0262	95	84	87	93	74	
8282012	1030	WINDROW WR-3	29	Top- West	40	G-504	A-502	T-502	N-502	60	9.76	2.18	0.223	0.0224	146	107	112	118	89	
8282012	1030	WINDROW WR-3	29	Top- East	<0.05	G-505	NA	NA	NA	51	9.76	3.49	0.358	0.0140	119	103	110	115	86	
8282012	1030	WINDROW WR-3	29	Side- South	30	G-506	NA	NA	NA	47	9.91	2.84	0.287	0.0174	140	114	120	122	84	
8292012	1154	Media Blank	NA	QC-Blank	NA	G-605	NA	NA	NA	NA	9.91		0.000		NA	NA	NA	NA	NA	Media blank in BOC testing data set for the batch

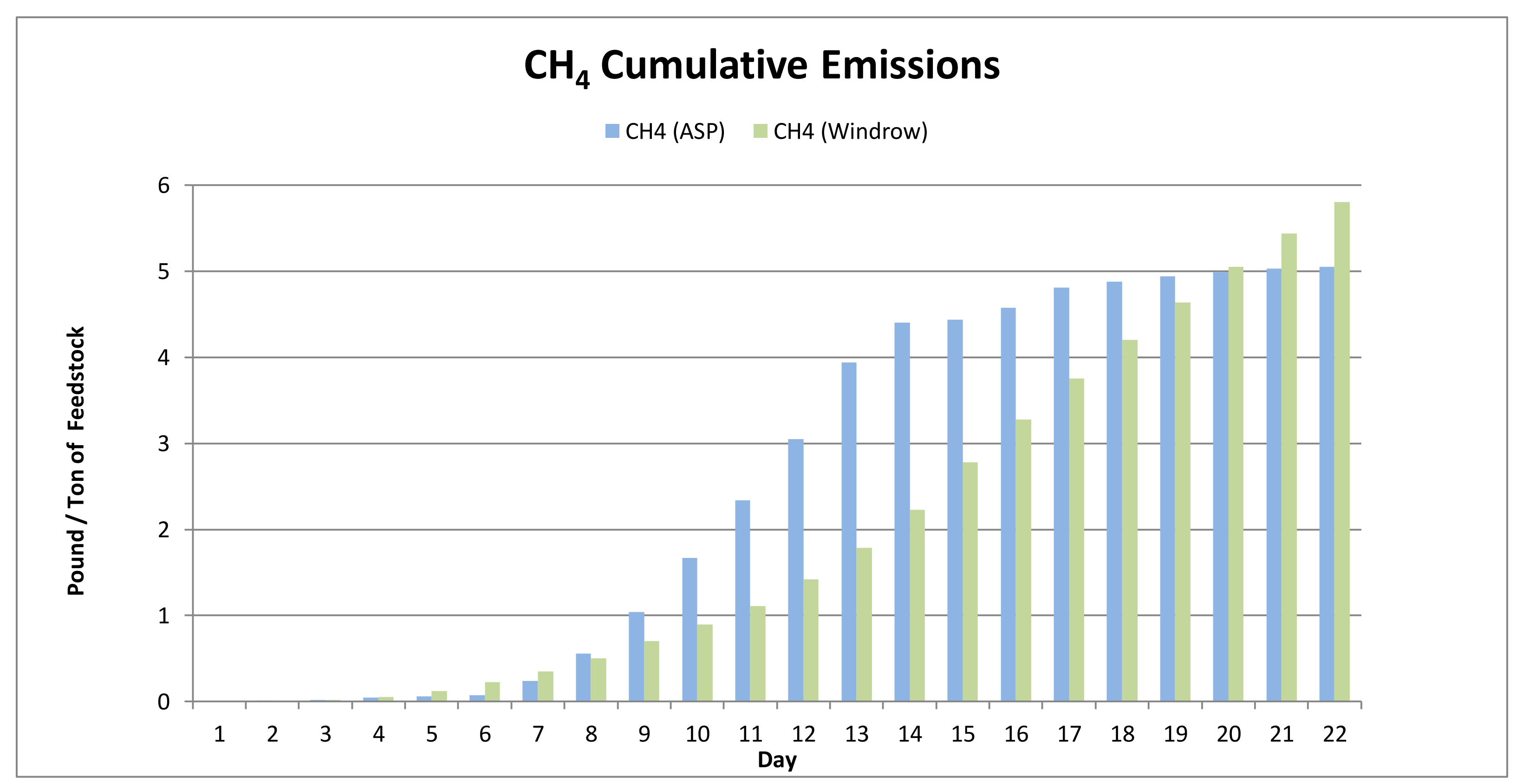
ACP Final Report fo Valley Air TAP Program, May 2013, Appendix B, Daily and Cumulative Emissions

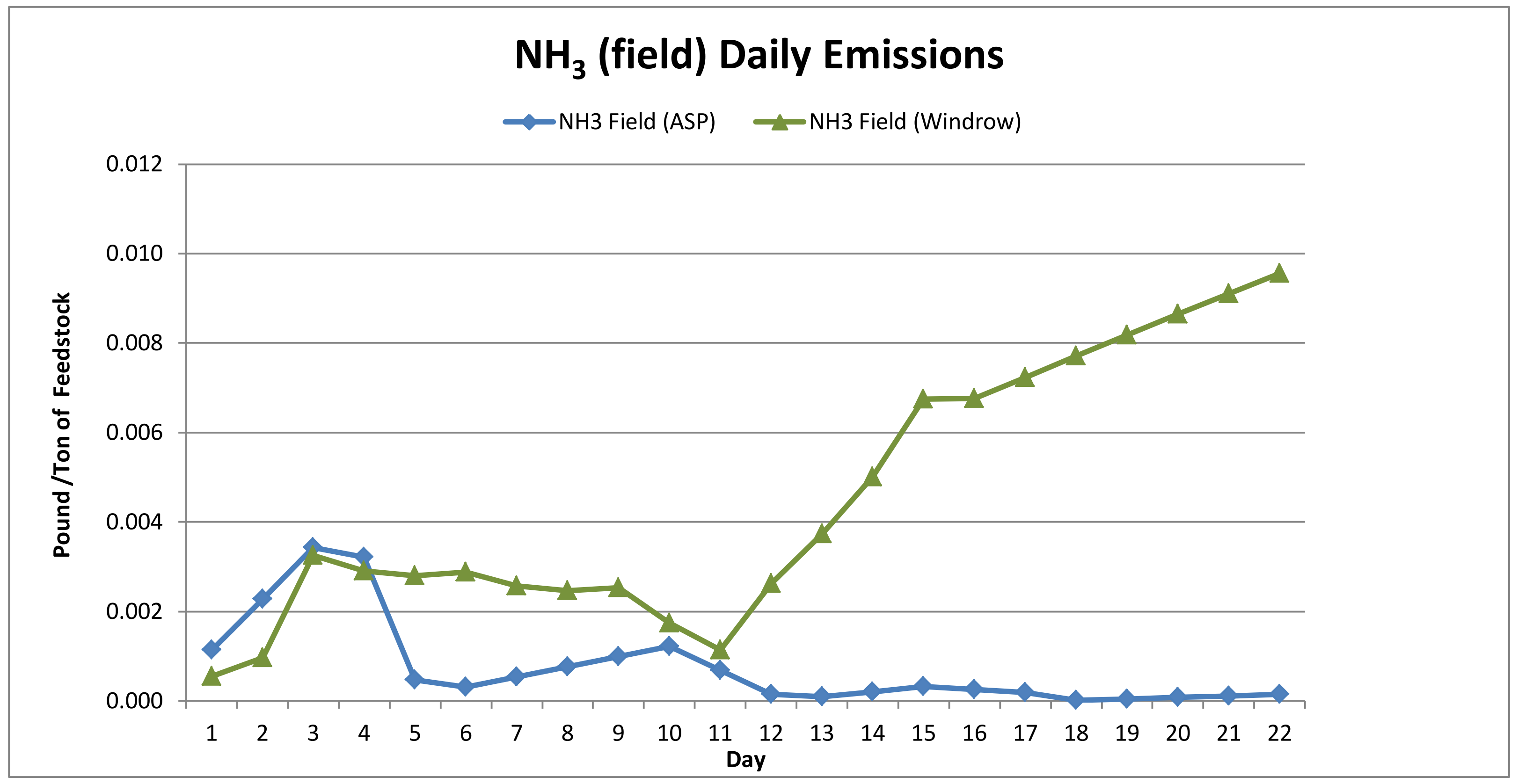
	CH4				VOC				NH3 Field				NH3 Lab				N2O			
	Daily		Cumulative		Daily		Cumulative		Daily		Cumulative		Daily		Cumulative		Daily		Cumulative	
Day	CH4 (ASP)	CH4 (Windrow)	CH4 (ASP)	CH4 (Windrow)	VOC (ASP)	VOC (Windrow)	VOC (ASP)	VOC (Windrow)	NH3 Field (ASP)	NH3 Field (Windrow)	NH3 Field (ASP)	NH3 Field (Windrow)	NH3 Lab (ASP)	NH3 Lab (Windrow)	NH3 Lab (ASP)	NH3 Lab (Windrow)	N2O (ASP)	N2O (Windrow)	N2O (ASP)	N2O (Windrow)
1	0.0037	0.002	0.0037	0.002	0.0024	0.267	0.0024	0.267	0.0011	0.001	0.0011	0.001	0.0005	0.000	0.0005	0.000	0.0002	0.003	0.0002	0.003
2	0.0075	0.003	0.0112	0.005	0.0047	0.334	0.0071	0.601	0.0023	0.001	0.0034	0.002	0.0010	0.000	0.0016	0.000	0.0005	0.003	0.0007	0.006
3	0.0112	0.011	0.0224	0.016	0.0071	0.969	0.0142	1.570	0.0034	0.003	0.0069	0.005	0.0016	0.000	0.0031	0.001	0.0007	0.002	0.0014	0.008
4	0.0212	0.040	0.0436	0.056	0.0264	0.788	0.0406	2.358	0.0032	0.003	0.0101	0.008	0.0004	0.000	0.0036	0.001	0.0002	0.002	0.0016	0.010
5	0.0165	0.068	0.0601	0.124	0.0020	0.676	0.0426	3.033	0.0005	0.003	0.0105	0.010	0.0001	0.000	0.0037	0.001	0.0003	0.002	0.0019	0.012
6	0.0118	0.104	0.0719	0.228	0.0024	0.607	0.0450	3.640	0.0003	0.003	0.0109	0.013	0.0001	0.000	0.0038	0.001	0.0001	0.003	0.0020	0.015
7	0.1668	0.125	0.2387	0.353	0.0028	0.454	0.0478	4.095	0.0005	0.003	0.0114	0.016	0.0001	0.000	0.0040	0.001	0.0001	0.003	0.0020	0.018
8	0.3219	0.153	0.5606	0.506	0.0032	0.345	0.0511	4.440	0.0008	0.002	0.0122	0.018	0.0001	0.000	0.0041	0.001	0.0001	0.003	0.0021	0.021
9	0.4769	0.194	1.0375	0.700	0.0037	0.255	0.0547	4.695	0.0010	0.003	0.0132	0.021	0.0001	0.000	0.0042	0.001	0.0001	0.004	0.0021	0.025
10	0.6319	0.196	1.6694	0.896	0.0041	0.324	0.0588	5.018	0.0012	0.002	0.0144	0.023	0.0001	0.000	0.0044	0.002	0.0001	0.003	0.0022	0.027
11	0.6706	0.212	2.3400	1.108	0.0036	0.410	0.0624	5.428	0.0007	0.001	0.0151	0.024	0.0001	0.000	0.0045	0.002	0.0002	0.002	0.0024	0.030
12	0.7093	0.311	3.0493	1.419	0.0030	0.398	0.0654	5.825	0.0002	0.003	0.0152	0.026	0.0001	0.000	0.0046	0.002	0.0003	0.003	0.0026	0.033
13	0.8903	0.366	3.9396	1.785	0.0074	0.330	0.0728	6.156	0.0001	0.004	0.0153	0.030	0.0003	0.000	0.0049	0.003	0.0001	0.004	0.0027	0.037
14	0.4626	0.442	4.4022	2.227	0.0038	0.291	0.0766	6.447	0.0002	0.005	0.0155	0.035	0.0002	0.000	0.0051	0.003	0.0003	0.005	0.0030	0.042
15	0.0348	0.556	4.4370	2.783	0.0003	0.272	0.0769	6.718	0.0003	0.007	0.0159	0.042	0.0001	0.000	0.0052	0.003	0.0005	0.006	0.0035	0.048
16	0.1351	0.496	4.5721	3.279	0.0015	0.249	0.0784	6.967	0.0003	0.007	0.0161	0.049	0.0001	0.001	0.0053	0.004	0.0008	0.006	0.0042	0.053
17	0.2354	0.474	4.8076	3.753	0.0027	0.246	0.0810	7.213	0.0002	0.007	0.0163	0.056	0.0001	0.001	0.0054	0.005	0.0010	0.006	0.0052	0.059
18	0.0728	0.453	4.8803	4.206	0.0038	0.242	0.0848	7.455	0.0000	0.008	0.0163	0.064	0.0004	0.001	0.0058	0.006	0.0005	0.006	0.0058	0.065
19	0.0609	0.432	4.9412	4.637	0.0037	0.239	0.0885	7.694	0.0000	0.008	0.0164	0.072	0.0003	0.002	0.0060	0.008	0.0008	0.006	0.0066	0.071
20	0.0490	0.411	4.9903	5.048	0.0036	0.235	0.0921	7.929	0.0001	0.009	0.0165	0.080	0.0002	0.002	0.0063	0.009	0.0010	0.006	0.0076	0.077
21	0.0371	0.390	5.0274	5.438	0.0035	0.232	0.0956	8.161	0.0001	0.009	0.0166	0.090	0.0002	0.002	0.0065	0.012	0.0013	0.006	0.0089	0.084
22	0.0253	0.369	5.0526	5.807	0.0034	0.229	0.0990	8.389	0.0001	0.010	0.0167	0.099	0.0001	0.002	0.0066	0.014	0.0015	0.006	0.0105	0.090

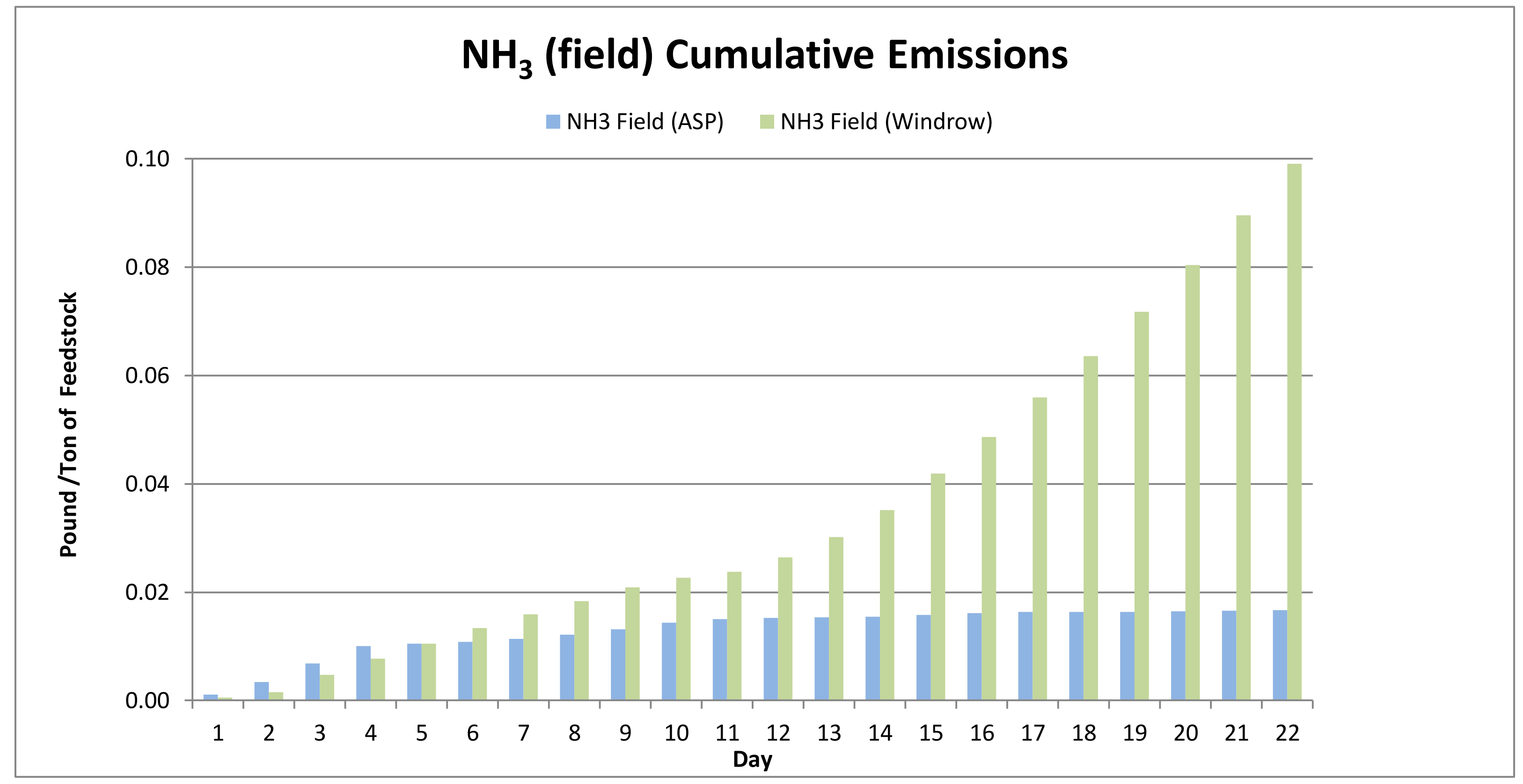


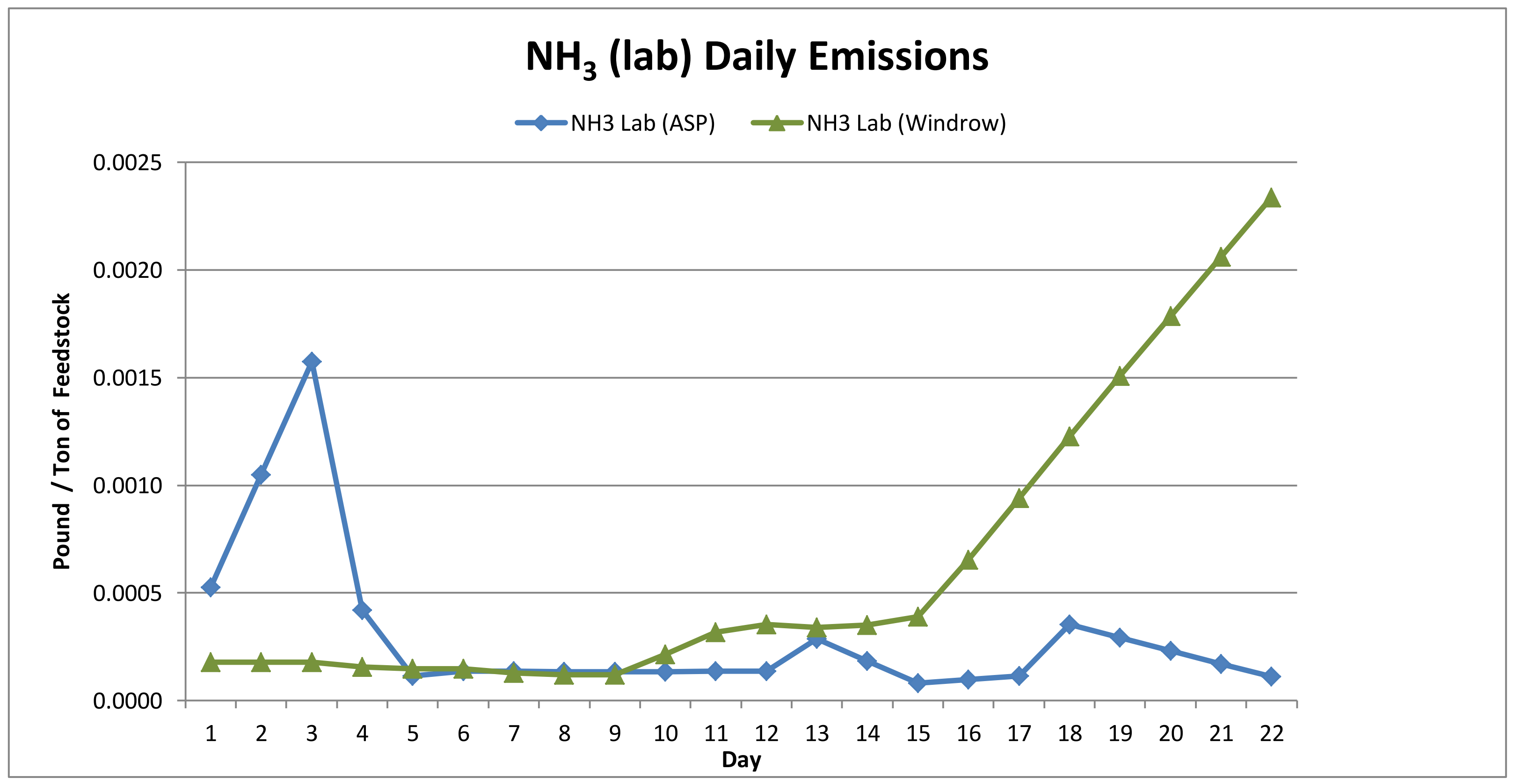


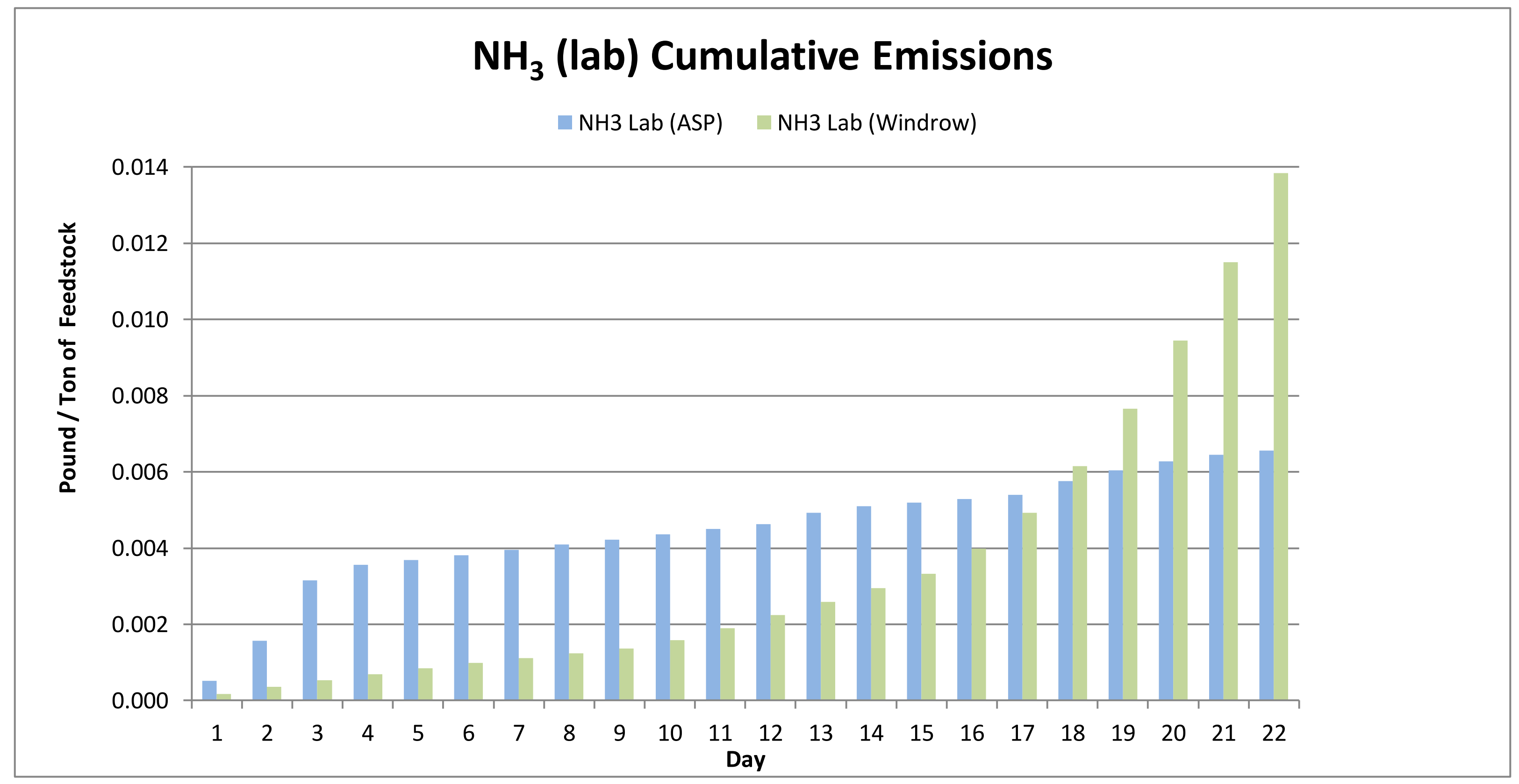





NH3 (field) Daily Emissions
NH3 Field (ASP)
NH3 Field (Windrow)
Pound /Ton of Feedstock
0.012
0.010
0.008
0.006
0.004
0.002
0.000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
Day


NH3 (field) Cumulative Emissions
NH3 Field (ASP)
NH3 Field (Windrow)
Pound /Ton of Feedstock
0.10
0.08
0.06
0.04
0.02
0.00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
Day


NH3 (lab) Daily Emissions
NH3 Lab (ASP)
NH3 Lab (Windrow)
Pound /Ton of Feedstock
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
Day


NH3 (lab) Cumulative Emissions
NH3 Lab (ASP)
NH3 Lab (Windrow)
Pound / Ton of Feedstock
0.014
0.012
0.010
0.008
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0.004
0.002
0.000
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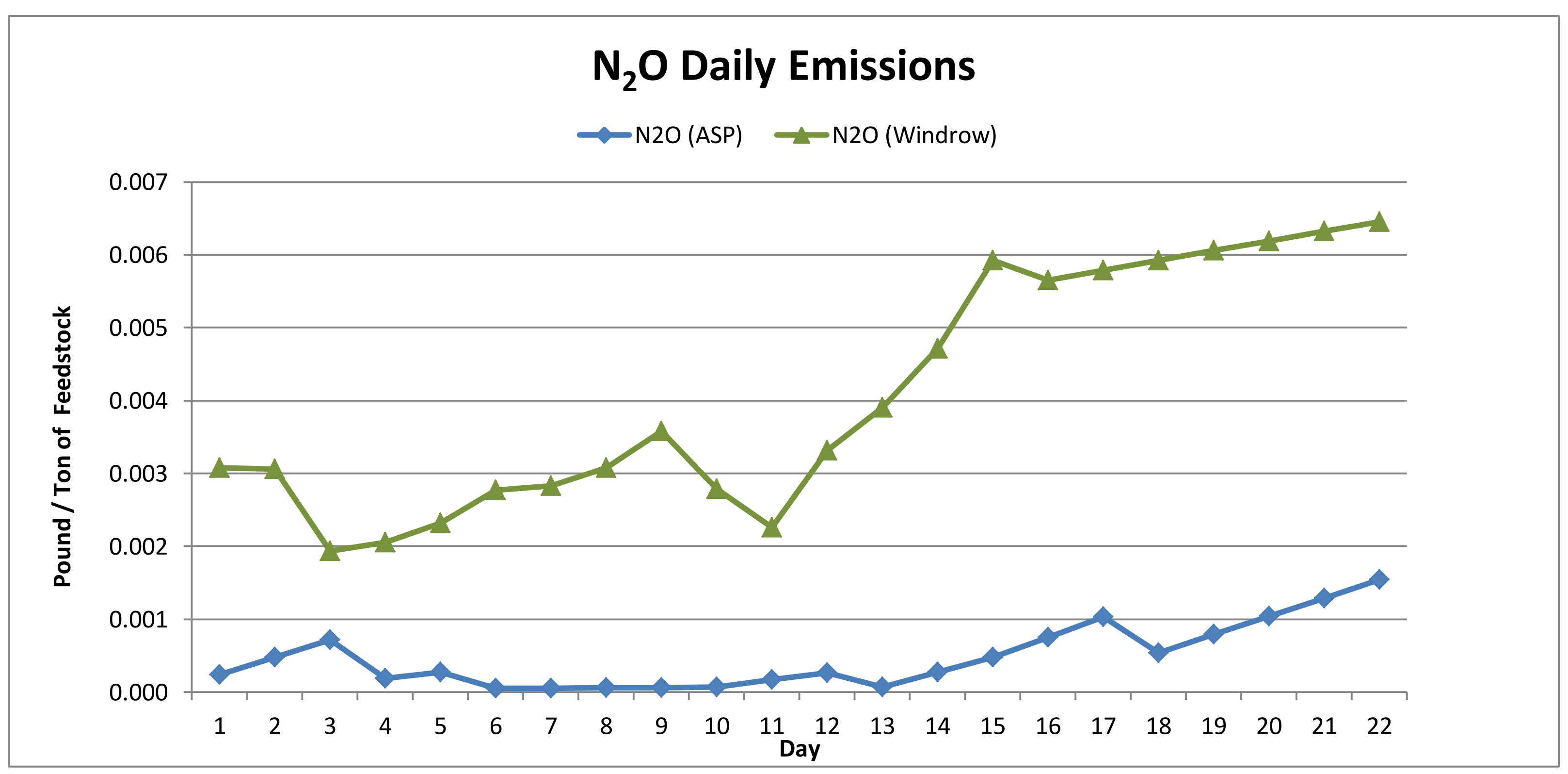
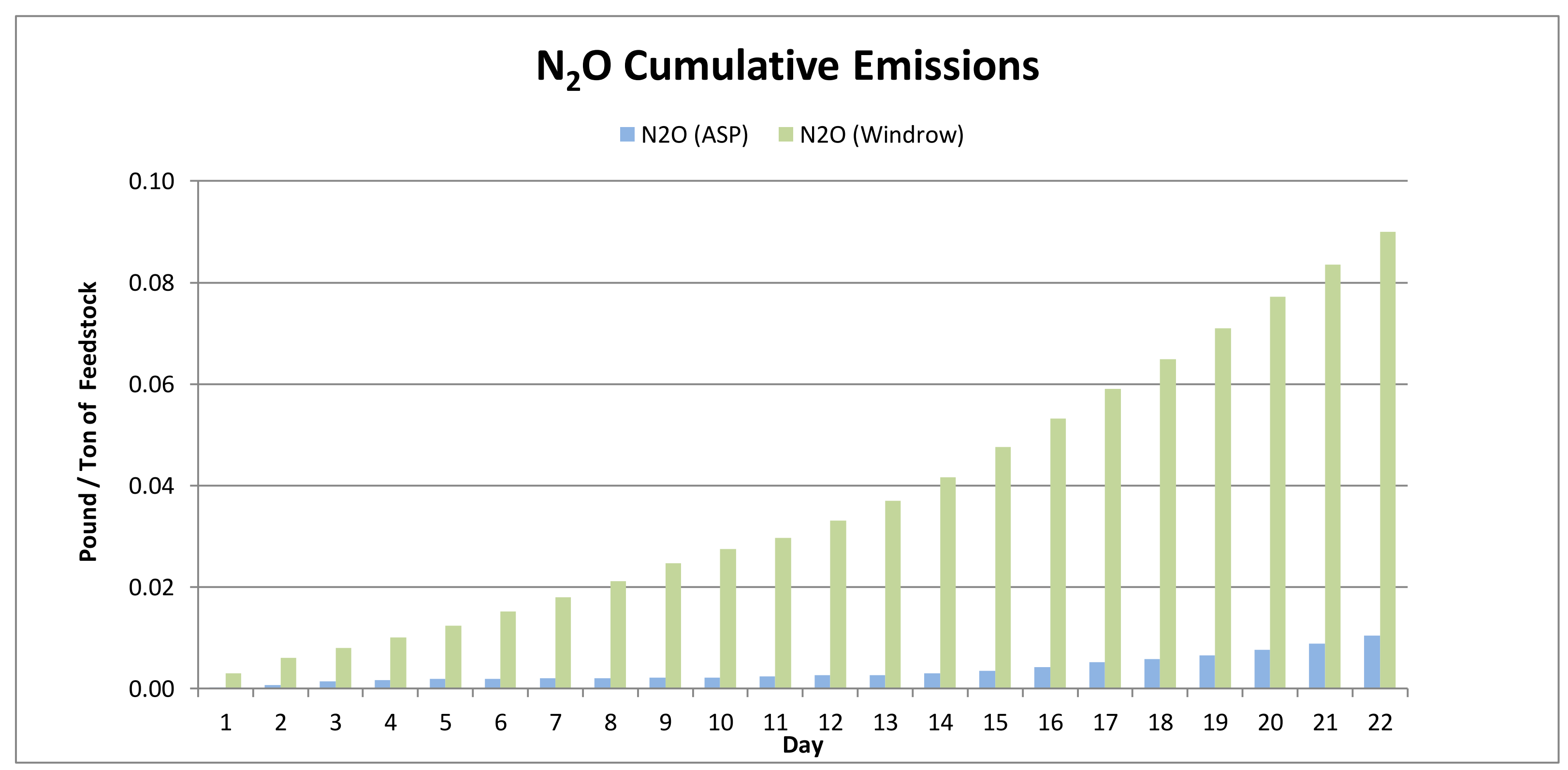
Day

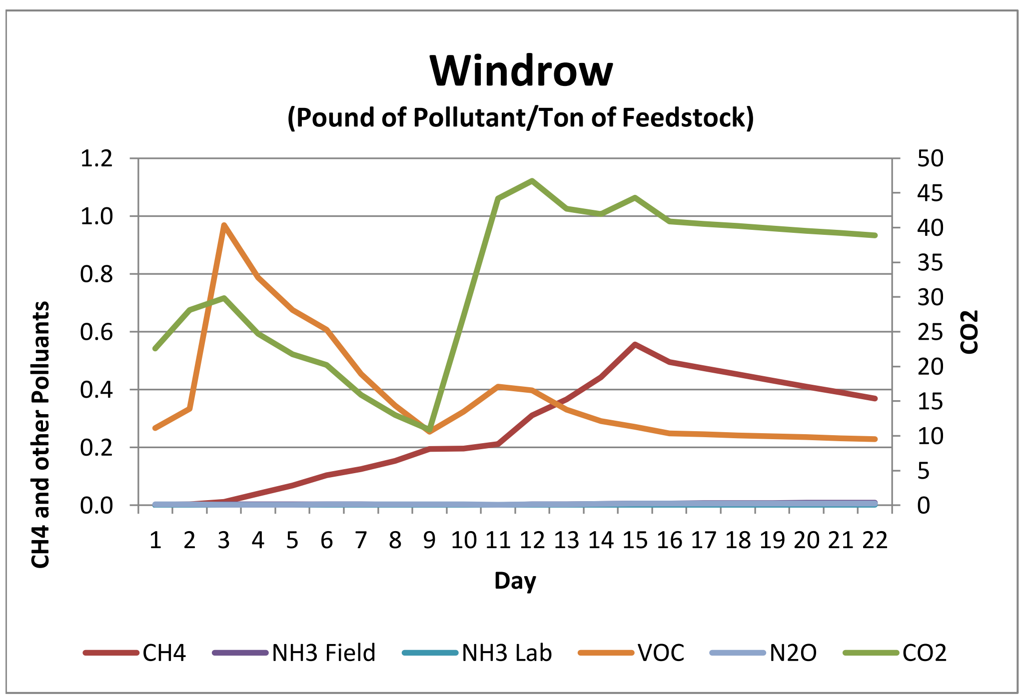

N2O Daily Emissions
N2O (ASP)
N2O (Windrow)
Pound / Ton of Feedstock
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
Day


N2O Cumulative Emissions
N2O (ASP)
N2O (Windrow)
Pound / Ton of Feedstock
0.10
0.08
0.06
0.04
0.02
0.00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
Day

ACP Final Report fo Valley Air TAP Program, May 2013, Appendix B, Combo Time Series

Emissions (pounds/ton)

	ASP						Windrow					
Day	CH4	CO2	NH3 Field	NH3 Lab	VOC	N2O	CH4	CO2	NH3 Field	NH3 Lab	VOC	N2O
1	0.0037	2.56	0.0011	0.0005	0.0024	0.0002	0.002	22.579	0.001	0.000	0.267	0.003
2	0.0075	5.11	0.0023	0.0010	0.0047	0.0005	0.003	28.125	0.001	0.000	0.334	0.003
3	0.0112	7.67	0.0034	0.0016	0.0071	0.0007	0.011	29.827	0.003	0.000	0.969	0.002
4	0.0212	11.00	0.0032	0.0004	0.0264	0.0002	0.040	24.731	0.003	0.000	0.788	0.002
5	0.0165	8.72	0.0005	0.0001	0.0020	0.0003	0.068	21.756	0.003	0.000	0.676	0.002
6	0.0118	8.27	0.0003	0.0001	0.0024	0.0001	0.104	20.226	0.003	0.000	0.607	0.003
7	0.1668	8.78	0.0005	0.0001	0.0028	0.0001	0.125	15.885	0.003	0.000	0.454	0.003
8	0.3219	9.30	0.0008	0.0001	0.0032	0.0001	0.153	12.990	0.002	0.000	0.345	0.003
9	0.4769	9.82	0.0010	0.0001	0.0037	0.0001	0.194	10.886	0.003	0.000	0.255	0.004
10	0.6319	10.33	0.0012	0.0001	0.0041	0.0001	0.196	27.246	0.002	0.000	0.324	0.003
11	0.6706	10.97	0.0007	0.0001	0.0036	0.0002	0.212	44.204	0.001	0.000	0.410	0.002
12	0.7093	11.61	0.0002	0.0001	0.0030	0.0003	0.311	46.728	0.003	0.000	0.398	0.003
13	0.8903	20.19	0.0001	0.0003	0.0074	0.0001	0.366	42.700	0.004	0.000	0.330	0.004
14	0.4626	11.72	0.0002	0.0002	0.0038	0.0003	0.442	41.956	0.005	0.000	0.291	0.005
15	0.0348	3.25	0.0003	0.0001	0.0003	0.0005	0.556	44.327	0.007	0.000	0.272	0.006
16	0.1351	6.97	0.0003	0.0001	0.0015	0.0008	0.496	40.881	0.007	0.001	0.249	0.006
17	0.2354	10.68	0.0002	0.0001	0.0027	0.0010	0.474	40.547	0.007	0.001	0.246	0.006
18	0.0728	10.80	0.0000	0.0004	0.0038	0.0005	0.453	40.215	0.008	0.001	0.242	0.006
19	0.0609	10.27	0.0000	0.0003	0.0037	0.0008	0.432	39.883	0.008	0.002	0.239	0.006
20	0.0490	9.75	0.0001	0.0002	0.0036	0.0010	0.411	39.553	0.009	0.002	0.235	0.006
21	0.0371	9.23	0.0001	0.0002	0.0035	0.0013	0.390	39.225	0.009	0.002	0.232	0.006
22	0.0253	8.71	0.0001	0.0001	0.0034	0.0015	0.37	38.8973	0.0096	0.0023	0.2285	0.0065



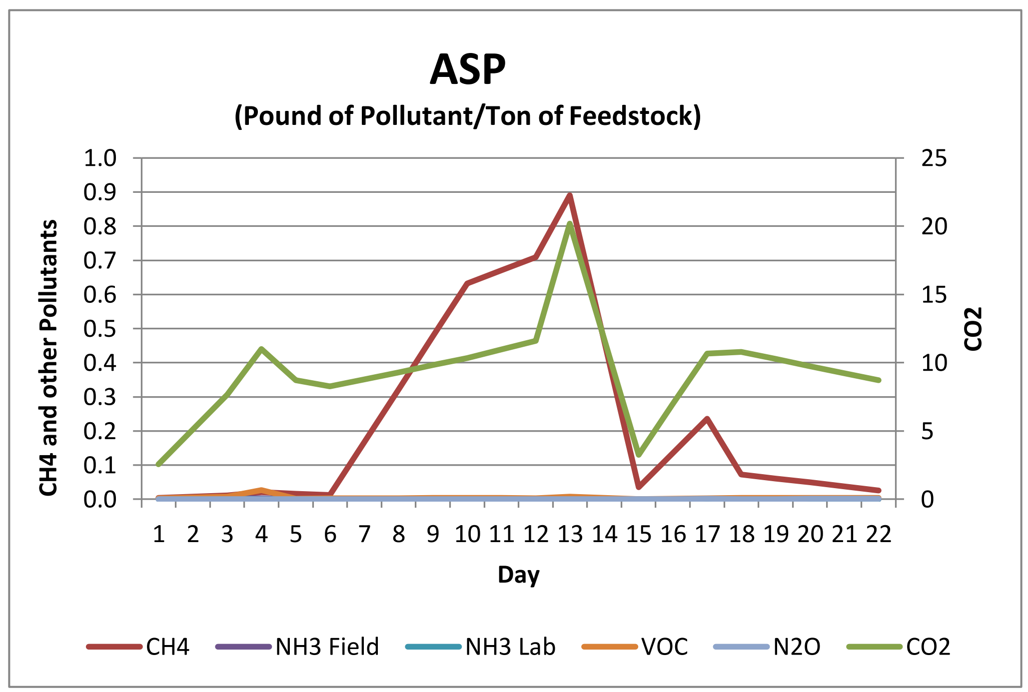


Table 2. Summary of ASP Flux Testing Data, Concentration Data (ppmvC, mg/m3), and Calculated Flux (mg/m2,min-1).

ACP Final Report fo Valley Air TAP Program, May 2013, Appendix B, Sample Data for ASP

SOURCE	DAY	LOCATION	25.3 ID	207.1 ID	TO-15 ID	N-6600 ID	NH3/T (ppmv)		NH3/T (mg/m3)		Methane (ppmvC)		Methane (ppmv)		CO2 (ppmvC)	CO2 (mg/m3)	TNMNEOC (ppmvC)		TNMNEOC (mg/m3)		NMNEO Trap (ppmv)		NMNEO Tank (ppmv)		NH3/Lab (mg)		NH3 Vol (m3)		NH3/Lab (mg/m3)		Total Flow (m3/min)	Methane Flux		CO2 Flux	NH3/Tube Flux		NH3/Lab Flux		TNMNEOC Flux		N2O Flux		SOURCE	DAY	COMMENT
ASP ZONE 3	3	NW	G-109	NA	NA	NA	6.5		4.6		10.3		6.87		3200	5867	**12.4**		8.27		1.87		10.5		NA		NA		NA		0.0471	2.49		2126	1.67		NA		**3.00**		NA		ASP ZONE 3	3	
ASP ZONE 3	3	SW	G-110	NA	NA	NA	4.0		2.8		12.4		8.27		1.23	2.26	**7.28**		4.85		1.67		5.61		NA		NA		NA		0.0130	0.827		0.226	0.283		NA		**0.485**		NA		ASP ZONE 3	3	CO2 % ??
ASP ZONE 3	3	NE	G-111	A-103	T-103	N-103	3		2.1		47.4		31.6		8700	15950	**6.96**		4.64		2.04		4.92		0.016		0.00832		1.92		0.0297	7.22		3644	0.485		0.439		**1.06**		0.201		ASP ZONE 3	3	
ASP ZONE 3	3	SE	G-112	NA	NA	NA	9		6.4		13.6		9.07		7000	12833	**23.2**		15.5		1.72		21.5		NA		NA		NA		0.0283	1.97		2794	1.39				**3.37**		NA		ASP ZONE 3	3	
ASP ZONE 3	4	NW	G-213	NA	NA	NA	7		5.0		23.9		15.9		10000	18333	**123**		82.0		88.0		35.4		NA		NA		NA		0.0225	2.76		3173	0.858		NA		**14.2**		NA		ASP ZONE 3	4	
ASP ZONE 3	4	SW	G-214	NA	NA	NA	5		3.5		19.2		12.8		10000	18333	**40.4**		26.9		37.9		2.54		NA		NA		NA		0.0160	1.58		2256	0.436		NA		**3.31**		NA		ASP ZONE 3	4	
ASP ZONE 3	4	NE	G-215	A-204	T-204	N-204	3		2.1		48.5		32.3		6000	11000	**10.7**		7.13		5.49		5.25		0.008		0.0193		0.415		0.0369	9.18		3122	0.603		0.118		**2.02**		0.0520	<	ASP ZONE 3	4	
ASP ZONE 3	4	SE	G-216	NA	NA	NA	5		3.5		13.6		9.07		5000	9167	**17.9**		11.9		8.30		9.60		NA		NA		NA		0.0272	1.90		1918	0.741		NA		**2.50**		NA		ASP ZONE 3	4	
ASP ZONE 3	4	Top NW- Spatial	G-217	NA	NA	NA	19		13.5		194		129		16000	29333	**37.9**		25.3		4.52		33.4		NA		NA		NA		0.0167	16.6		3768	1.73		NA		**3.25**		NA		ASP ZONE 3	4	Spatial variability test
ASP ZONE 3	4	Side SE- Spatial	G-218	NA	NA	NA	5		3.5		18.4		12.3		8000	14667	**99.8**		66.5		7.65		92.2		NA		NA		NA		0.0370	3.49		4174	1.01		NA		**18.9**		NA		ASP ZONE 3	4	Spatial variability test
ASP ZONE 3	4	QC- Replicate	G-219	NA	NA	NA	5		3.5		19.1		12.7		10	18.3	**104**		69.3		5.99		98.0		NA		NA		NA		0.0311	3.05		4.39	0.847		NA		**16.6**		NA		ASP ZONE 3	4	QC- replicate
ASP ZONE 3	5	NW	G-309	A-303	T-303	N-303	1		0.71		30.5		20.3		9000	16500	**4.06**		2.71		0.5	<	4.06		0.004	<	0.0155	<	0.258	<	0.0160	2.50		2031	0.0872		0.0318	<	**0.333**		0.0767		ASP ZONE 3	5	
ASP ZONE 3	5	SW	G-310	NA	NA	NA	1		0.71		36.7		24.5		13000	23833	**5.12**		3.41		3.44		1.68		NA		NA		NA		0.0103	1.94		1888	0.0561		NA		**0.270**		NA		ASP ZONE 3	5	
ASP ZONE 3	5	NE	G-311	NA	NA	NA	0.5		0.35		110		73.3		12000	22000	**8.76**		5.84		2.74		6.02		NA		NA		NA		0.0209	11.8		3537	0.0569		NA		**0.939**		NA		ASP ZONE 3	5	
ASP ZONE 3	5	SE	G-312	NA	NA	NA	3		2.1		20.9		13.9		8000	14667	**7.01**		4.67		1.98		5.04		NA		NA		NA		0.0202	2.17		2279	0.3302		NA		**0.726**		NA		ASP ZONE 3	5	
ASP ZONE 3	6	NW	G-409	A-403	T-403	N-403	0.05	<	0.035	<	32.7		21.8		15000	27500	**13.8**		9.20		8.28		5.53		0.009		0.0183		0.492		0.0100	1.68		2115	0.00272	<	0.0378		**0.708**		0.0141	<	ASP ZONE 3	6	
ASP ZONE 3	6	SW	G-410	NA	NA	NA	1		0.71		16.5		11.0		7000	12833	**4.26**		2.84		3.75		1.0	<	NA		NA		NA		0.0155	1.31		1530	0.0845		NA		**0.339**		NA		ASP ZONE 3	6	
ASP ZONE 3	6	NE	G-411	NA	NA	NA	0.05	<	0.035	<	80.2		53.5		10000	18333	**4.38**		2.92		0.5	<	4.38		NA		NA		NA		0.0204	8.39		2877	0.00556	<	NA		**0.458**		NA		ASP ZONE 3	6	
ASP ZONE 3	6	SE	G-412	NA	NA	NA	4		2.8		29.2		19.5		16000	29333	**19.0**		12.7		5.77		13.2		NA		NA		NA		0.0120	1.80		2708	0.262		NA		**1.17**		NA		ASP ZONE 3	6	
ASP ZONE 2	10	NW	G-105	A-102	T-102	N-102	5		3.5		4264		2843		33000	60500	**35.8**		23.9		0.5	<	35.8		0.004	<	0.0111	<	0.360	<	0.0136	297		6329	0.371		0.0377	<	**2.50**		0.0192	<	ASP ZONE 2	10	
ASP ZONE 2	10	SW	G-106	NA	NA	NA	3		2.1		42.1		28.1		2344	4297	**3.16**		2.11		3.09		1.0	<	NA		NA		NA		0.0256	5.53		846	0.418		NA		**0.415**		NA		ASP ZONE 2	10	
ASP ZONE 2	10	NE	G-107	NA	NA	NA	2		1.4		3155		2103		13100	24017	**6.78**		4.52		0.5	<	6.78		NA		NA		NA		0.0236	382		4360	0.257		NA		**0.821**		NA		ASP ZONE 2	10	
ASP ZONE 2	10	SE	G-108	NA	NA	NA	3		2.1		208		139		1.06	1.94	**8.42**		5.61		1.36		7.06		NA		NA		NA		0.0194	20.7		0.290	0.317		NA		**0.838**		NA		ASP ZONE 2	10	CO2% ??
ASP ZONE 2	12	NW	G-305	A-302	T-302	N-302	0.05	<	0.035	<	4480		2987		22000	40333	**19.7**		13.1		3.91		15.8		0.004	<	0.0170	<	0.235	<	0.0213	489		6608	0.00580	<	0.0386	<	**2.15**		0.0751		ASP ZONE 2	12	
ASP ZONE 2	12	SW	G-306	NA	NA	NA	0.05	<	0.035	<	179		119		3000	5500	**3.84**		2.56		2.71		1.14		NA		NA		NA		0.0175	16.06		740	0.00477	<	NA		**0.345**		NA		ASP ZONE 2	12	
ASP ZONE 2	12	NE	G-307	NA	NA	NA	0.5		0.35		4659		3106		24000	44000	**7.45**		4.97		0.5	<	7.45		NA		NA		NA		0.0115	275		3892	0.0313		NA		**0.439**		NA		ASP ZONE 2	12	
ASP ZONE 2	12	SE	G-308	NA	NA	NA	1		0.71		93.6		62.4		5000	9167	**3.43**		2.29		2.22		1.21		NA		NA		NA		0.0244	11.7		1721	0.133		NA		**0.429**		NA		ASP ZONE 2	12	
ASP ZONE 2	13	NW	G-405	A-402	T-402	N-402	0.2		0.14		4968		3312		52000	95333	**85.5**		57.0		0.5	<	85.5		0.013		0.0181		0.718		0.0145	369		10633	0.0158		0.0801		**6.36**		0.0204	<	ASP ZONE 2	13	
ASP ZONE 2	13	SW	G-406	NA	NA	NA	0.8		0.57		927		618		6000	11000	**3.82**		2.55		3.82		1.0	ND	NA		NA		NA		0.0179	85.1		1515	0.0780		NA		**0.351**		NA		ASP ZONE 2	13	
ASP ZONE 2	13	NE	G-407	NA	NA	NA	0.05	<	0.035	<	4315		2877		25000	45833	**13.0**		8.67		0.5	<	12.6		NA		NA		NA		0.0183	405		6452	0.00499	<	NA		**1.22**		NA		ASP ZONE 2	13	
ASP ZONE 2	13	SE	G-408	NA	NA	NA	0.05	<	0.035	<	1410		940		15000	27500	**3.33**		2.22		0.5	<	3.33		NA		NA		NA		0.0186	134		3935	0.00507	<	NA		**0.318**		NA		ASP ZONE 2	13	
ASP ZONE 1	15	NW	G-101	A-101	T-101	N-101	0.5		0.35		44.9		29.9		2890	5298	**1.0**	<	0.67	<	0.91		1.0	ND	0.004	<	0.0222	<	0.180	<	0.0165	3.80		672	0.0450		0.023	<	**0.0846**	<	0.133		ASP ZONE 1	15	Over watered; not representative
ASP ZONE 1	15	SW	G-102	NA	NA	NA	4		2.8		243		162		5554	10182	**1.0**	<	0.67	<	0.5	<	1.0	ND	NA		NA		NA		0.0101	12.6		791	0.220		NA		**0.0518**	<			ASP ZONE 1	15	Over watered; not representative
ASP ZONE 1	15	NE	G-103	NA	NA	N	0.05	<	0.035	<	27.3		18.2		2317	4248	**1.0**	<	0.67	<	0.78		1.0	ND	NA		NA		NA		0.0152	2.13		497	0.00414	<	NA		**0.0779**	<	NA		ASP ZONE 1	15	Over watered; not representative
ASP ZONE 1	15	SE	G-104	NA	NA	N	1		0.71		228		152		6801	12469	**1.09**		0.73		0.50	<	1.0	<	NA		NA		NA		0.0174	20.3		1669	0.0948		NA		**0.0973**		NA		ASP ZONE 1	15	Over watered; not representative
ASP ZONE 1	17	NW	G-301	A-301	T-301	N-301	1		0.71		480		320		12000	22000	**9.05**		6.03		0.5	<	9.05		0.004	<	0.0154	<	0.260	<	0.0161	39.6		2725	0.0877		0.0322	<	**0.747**		0.288		ASP ZONE 1	17	
ASP ZONE 1	17	SW	G-302	NA	NA	NA	0.5		0.35		1063		709		11000	20167	**4.89**		3.26		0.5	<	4.89		NA		NA		NA		0.0115	62.7		1784	0.0313		NA		**0.288**		NA		ASP ZONE 1	17	
ASP ZONE 1	17	NE	G-303	NA	NA	NA	0.05	<	0.035	<	359		239		10000	18333	**7.20**		4.80		2.79		4.41		NA		NA		NA		0.0152	28.0		2144	0.00414	<	NA		**0.561**		NA		ASP ZONE 1	17	
ASP ZONE 1	17	SE	G-304	NA	NA	N	0.5		0.35		760		507		11000	20167	**7.99**		5.33		2.80		5.20		NA		NA		NA		0.0340	133		5274	0.0926		NA		**1.39**		NA		ASP ZONE 1	17	
ASP ZONE 1	18	NW	G-401	A-401	T-401	N-401	0.05	<	0.035	<	300		200.0		25000	45833	**24.9**		16.6		9.14		15.7		0.024		0.0163		1.47		0.0087	13.4		3067	0.00237	<	0.0985		**1.11**		0.151		ASP ZONE 1	18	
ASP ZONE 1	18	SW	G-402	NA	NA	NA	0.05	<	0.035	<	221		147		9000	16500	**9.28**		6.19		6.55		2.73		NA		NA		NA		0.0183	20.7		2323	0.00499	<	NA		**0.871**		NA		ASP ZONE 1	18	
ASP ZONE 1	18	NE	G-403	NA	NA	NA	0.05	<	0.035	<	47.5		31.7		7000	12833	**10.5**		7.00		7.69		2.78		NA		NA		NA		0.0203	4.94		2004	0.00553	<	NA		**1.09**		NA		ASP ZONE 1	18	
ASP ZONE 1	18	SE	G-404	NA	NA	NA	0.05	<	0.035	<	697		465		28000	51333	**19.3**		12.9		0.5	<	19.0		NA		NA		NA		0.0118	42.2		4659	0.00321	<	NA		**1.17**		NA		ASP ZONE 1	18	
ASP ZONE 1	23	NW	G-501	A-501	T-501	N-501	0.05	<	0.035	<	85.2		56.8		23000	42167	**24.4**		16.3		1.17		23.2		0.004	<	0.0185	<	0.216	<	0.0084	3.67		2725	0.00229	<	0.0140	<	**1.05**		0.500		ASP ZONE 1	23	
ASP ZONE 1	23	SW	G-502	NA	NA	NA	0.1		0.071		99.0		66.0		16000	29333	**15.3**		10.2		2.57		12.8		NA		NA		NA		0.0101	5.13		2279	0.00550		NA		**0.792**		NA		ASP ZONE 1	23	
ASP ZONE 1	23	NE	G-503	NA	NA	NA	1		0.71		17.9		11.9		5000	9167	**6.83**		4.55		2.77		4.06		NA		NA		NA		0.0262	2.41		1847	0.143		NA		**0.918**		NA		ASP ZONE 1	23	
Media Blank	NA	QC-Blank	G-120	NA	NA	NA	NA		NA		1	ND	0.67	ND	12.6	23.1	**1.0**	ND	0.67	ND	0.8		1	ND	NA		NA		NA		0.005	0.0256	ND	0.888	NA		NA		**0.0256**	ND	NA		Media Blank	NA	
Media Blank	NA	QC-Blank	G-220	NA	NA	NA	NA		NA		1	ND	0.67	ND	0.4	0.733	**1.0**	ND	0.67	ND	0.51		1	ND	NA		NA		NA		0.005	0.0256	ND	0.0282	NA		NA		**0.0256**	ND	NA		Media Blank	NA	
Media Blank	NA	QC-Blank	G-320	NA	NA	NA	NA		NA		3.71		2.47		33.8	62.0	**1.43**		0.95		0.75		1	<	0.004	<	0.0200	<	0.200	<	0.005	0.0951		2.38	NA		0.00769	<	**0.0367**		NA		Media Blank	NA	
Medial Blank	NA	QC- Blank	G-418	A-406	T-406	N-406	NA		NA		1	ND	0.67	ND	19000	34833	**1.0**	ND	0.67	ND	0.6		1	ND	NA		NA		NA		0.005	0.0256	ND	1340	NA		NA		**0.0256**	ND	0.00705	<	Medial Blank	NA	CO2 ppmv ??
Media Blank	NA	QC-Blank	G-605	NA	NA	NA	NA		NA																						0.005				NA						NA		Media Blank	NA	

TNMNEO- Total non-methane non-ethane organic carbon reported as methane (carbon # = 1)
Flux = (concentration, mg/m3)(total flow, m3/min)/(surface area, 0.13 m2) = mg/m2,min-1

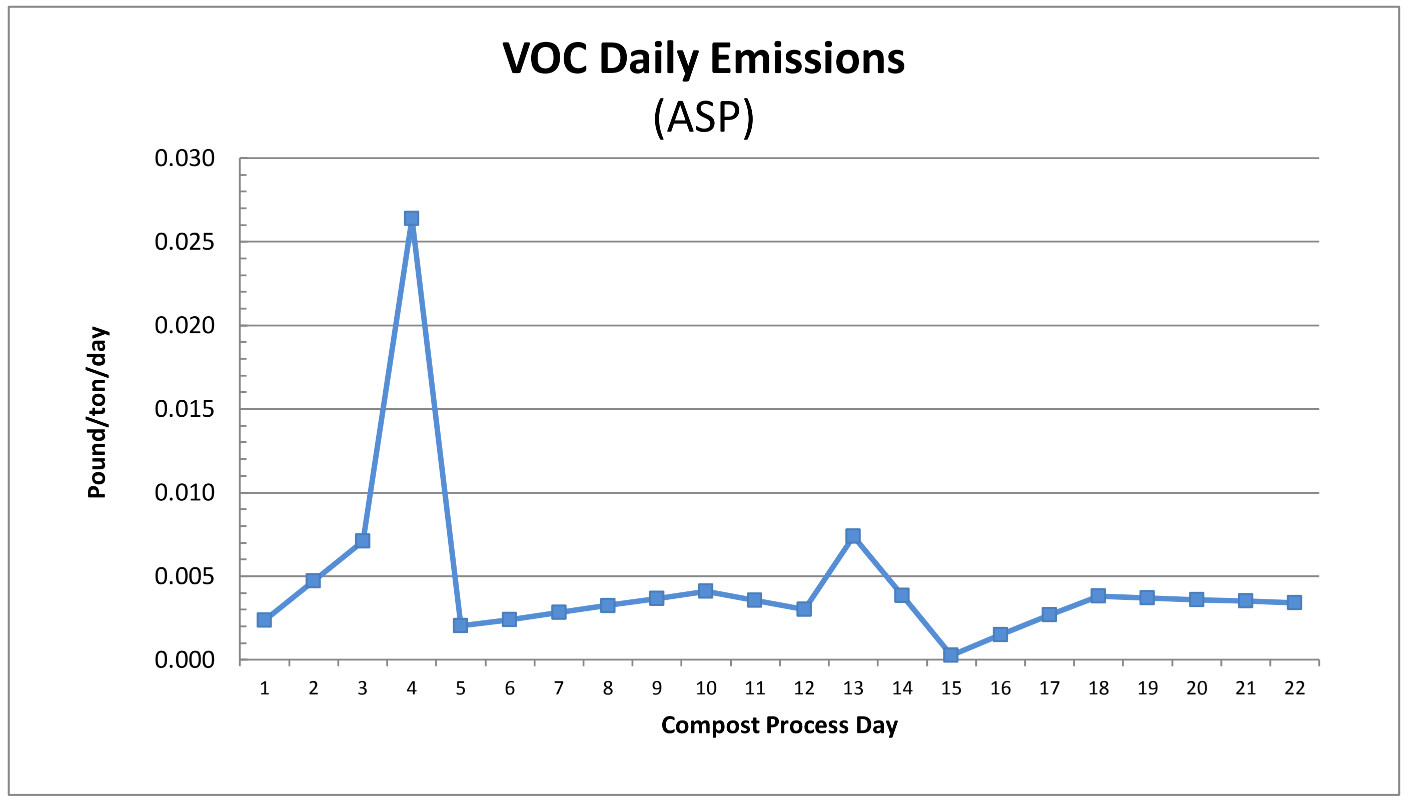
ACP Final Report fo Valley Air TAP Program, May 2013, Appendix B, ASP Daily Simulation

	Flux (mg/min-m2)									Emissions (pounds)							Emissions (pounds/ton)						
Day	CH4	CO2	NH3 T	NH3 L	VOC	N2O		Area		CH4	CO2	NH3 T	NH3 L	VOC	N2O		CH4	CO2	NH3 T	NH3 L	VOC	N2O	CO2e
0	0	0	0	0	0	0.00		785													0.0000		
1	1.0	713.6	0.3	0.1	0.7	0.07		785		3	1,778	0.79	0.36	1.64	0.17		0.0037	2.56	0.0011	0.0005	0.0024	0.0002	2.7211
2	2.1	1427.2	0.6	0.3	1.3	0.13		785		5	3,556	1.59	0.73	3.28	0.33		0.0075	5.11	0.0023	0.0010	0.0047	0.0005	5.4422
3	3	2,141	0.96	0.44	1.98	0.20		785		8	5,335	2.38	1.09	4.93	0.50		0.0112	7.67	0.0034	0.0016	0.0071	0.0007	8.1633
4	6	3,069	0.90	0.12	7.37	0.05		785		15	7,647	2.23	0.29	18.36	0.13		0.0212	11.00	0.0032	0.0004	0.0264	0.0002	11.5805
5	5	2,434	0.13	0.03	0.57	0.08		785		11	6,065	0.33	0.08	1.41	0.19		0.0165	8.72	0.0005	0.0001	0.0020	0.0003	9.2132
6	3	2,308	0.09	0.04	0.67	0.01		785		8	5,750	0.22	0.09	1.67	0.04		0.0118	8.27	0.0003	0.0001	0.0024	0.0001	8.5779
7	46.6	2451.6	0.2	0.04	0.8	0.0		785		116	6,109	0.38	0.09	1.96	0.04		0.1668	8.78	0.0005	0.0001	0.0028	0.0001	12.9712
8	89.8	2595.7	0.2	0.04	0.9	0.0		785		224	6,468	0.53	0.09	2.26	0.04		0.3219	9.30	0.0008	0.0001	0.0032	0.0001	17.3644
9	133.1	2739.8	0.3	0.04	1.0	0.0		785		332	6,827	0.69	0.09	2.55	0.04		0.4769	9.82	0.0010	0.0001	0.0037	0.0001	21.7577
10	176	2,884	0.34	0.04	1.14	0.02		785		439	7,186	0.85	0.09	2.85	0.05		0.6319	10.33	0.0012	0.0001	0.0041	0.0001	26.1510
11	187.2	3062.2	0.2	0.0	1.0	0.0		785		466	7,630	0.48	0.10	2.47	0.12		0.6706	10.97	0.0007	0.0001	0.0036	0.0002	27.7872
12	198	3,240	0.04	0.04	0.84	0.08		785		493	8,075	0.11	0.10	2.10	0.19		0.7093	11.61	0.0002	0.0001	0.0030	0.0003	29.4233
13	248	5,634	0.03	0.08	2.06	0.02		785		619	14,038	0.06	0.20	5.14	0.05		0.8903	20.19	0.0001	0.0003	0.0074	0.0001	42.4653
14	129.1	3270.4	0.1	0.1	1.1	0.1		785		322	8,149	0.15	0.13	2.67	0.19		0.4626	11.72	0.0002	0.0002	0.0038	0.0003	23.3632
15	10	907	0.09	0.02	0.08	0.13		785		24	2,261	0.23	0.06	0.19	0.33		0.0348	3.25	0.0003	0.0001	0.0003	0.0005	4.2612
16	37.7	1944.5	0.1	0.0	0.4	0.2		785		94	4,845	0.18	0.07	1.03	0.52		0.1351	6.97	0.0003	0.0001	0.0015	0.0008	10.5673
17	66	2,982	0.05	0.03	0.75	0.29		785		164	7,430	0.13	0.08	1.86	0.72		0.2354	10.68	0.0002	0.0001	0.0027	0.0010	16.8735
18	20	3,013	0.00	0.10	1.06	0.15		785		51	7,509	0.01	0.25	2.64	0.38		0.0728	10.80	0.0000	0.0004	0.0038	0.0005	12.7759
19	17.0	2867.4	0.0	0.1	1.0	0.2		785		42	7,145	0.03	0.20	2.57	0.55		0.0609	10.27	0.0000	0.0003	0.0037	0.0008	12.0298
20	13.7	2721.5	0.0	0.1	1.0	0.3		785		34	6,782	0.06	0.16	2.50	0.72		0.0490	9.75	0.0001	0.0002	0.0036	0.0010	11.2837
21	10.4	2575.6	0.0	0.0	1.0	0.4		785		26	6,418	0.08	0.12	2.43	0.90		0.0371	9.23	0.0001	0.0002	0.0035	0.0013	10.5376
22	7.0	2429.6	0.0	0.0	0.9	0.4		785		18	6,054	0.10	0.08	2.36	1.07		0.0253	8.71	0.0001	0.0001	0.0034	0.0015	9.7914
23	4	2,284	0.05	0.01	0.92	0.50		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
24	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
25	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
26	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
27	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
28	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
29	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
30	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
31	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
32	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
33	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
34	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
35	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
36	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
37	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
38	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
39	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
40	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
41	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
42	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
43	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
44	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
45	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
46	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
47	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
48	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
49	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
50	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
51	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
52	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
53	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
54	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
55	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
56	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
57	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
58	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
59	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
60	4	2284	0.05	0.01	0.9	0.5		785		9	5,691	0.13	0.03	2.29	1.25		0.0134	8.18	0.0002	0.0001	0.0033	0.0018	9.0453
		Simulations -- 60 Day							Total	3,868	359,300	16	6	156	55	Pounds							679
										6	517	0.02	0.01	0.22	0.08	#/ton mix							
				30 Day						3,588	188,582	13	5	87	17	Pounds							
										5	271	0.02	0.01	0.13	0.02	#/ton mix							
				22 Day						3,514	143,058	12	5	69	7								
										5	206	0.02	0.01	0.10	0.01	#/ton mix							

Process Day	CH4	CO2	NH3 T	NH3 L	VOC	N2O
3	3	2,141	0.96	0.44	1.98	0.20
4	6	3,069	0.90	0.12	7.37	0.05
5	5	2,434	0.13	0.03	0.57	0.08
6	3	2,308	0.09	0.04	0.67	0.01
10	176	2,884	0.341	0.038	1.142	0.019
12	198	3,240	0.044	0.039	0.841	0.075
13	248	5,634	0.026	0.080	2.061	0.020
15	10	907	0.091	0.023	0.078	0.133
17	66	2,982	0.054	0.032	0.747	0.288
18	20	3,013	0.004	0.099	1.061	0.151
23	4	2,284	0.050	0.014	0.920	0.500

Prototype Cell Dimensions		
Total Cell Area	785	m2
Zone 1 Mass	405,000	Pounds
Zone 2 Mass	490,000	Pounds
Zone 3 Mass	495,924	Pounds
Total	1,390,924	Pounds
	695.462	tons

		NH3		Greenhouse Gas			
Cycle Len	VOC	Field	Lab	CO2	CH4	N2O	CO2e
22 Day	0.10	0.017	0.007	206	5.1	0.01	335
30 Day	0.13	0.018	0.007	271	5.2	0.02	407
60 Day	0.22	0.024	0.008	517	5.6	0.08	679



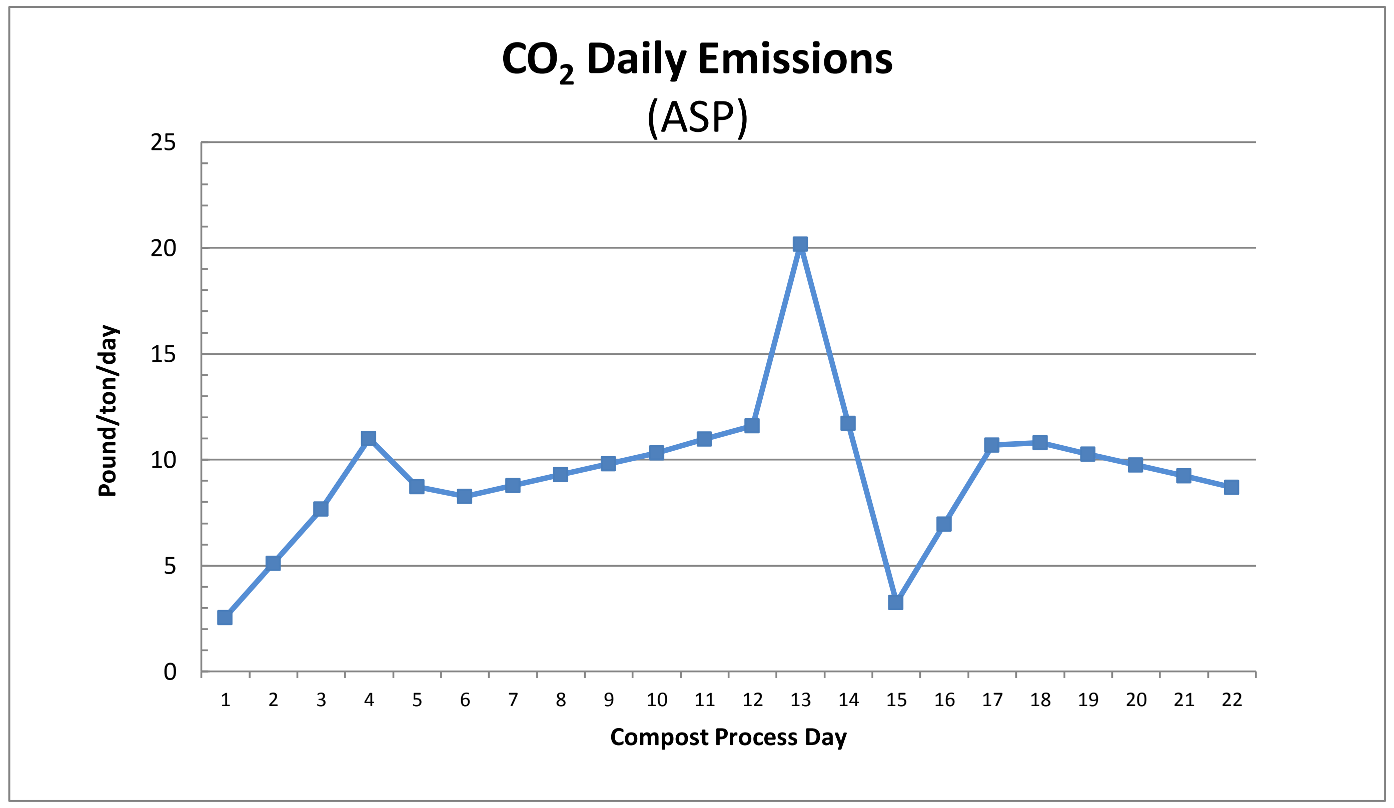


Table 3. Summary of Windrow Data; Concentration Data (ppmvC, mg/m3) and Flux Data (mg/m2,min-1).

ram, May 2013, Appendix B, Sample Data for Windrow

SOURCE	DAY	LOCATION	Methane Flux		CO2 Flux		NH3/Tub Flux		NH3/La Flux		TNMN Flux		N2O Flux		SOURCE	DAY	COMMENT
ESH DAY OLD CH	1	Top	0.0895		3012		0.0242		NA		**35.4**		NA		FRESH DAY OLD CHOP	1	Less than 24 hours old
FRESH CHOP	0	Top	0.0916		5145		0.00262	<	NA		**81.7**		NA		FRESH CHOP	0	About 2 hours old post chop
FRESH CHOP	0	QC- Replicate	0.0906		5157		0.00256	<	NA		**75.3**		NA		FRESH CHOP	0	QC- Replicate
WINDROW WR-1	2	Top- West	0.448		3534		0.0975		0.0320	<	**54.1**		0.548		WINDROW WR-1	2	
WINDROW WR-1	2	Top- East	0.527		4699		0.107		NA		**56.8**		NA		WINDROW WR-1	2	
WINDROW WR-1	2	Side- North	0.495		5644		0.379		NA		**44.9**		NA		WINDROW WR-1	2	
WINDROW WR-1	2	Side- South	0.689		6267		0.110		NA		**83.4**		NA		WINDROW WR-1	2	
WINDROW WR-1	3	Top- West	3.02		7566		0.00504	<	0.0300	<	**167**		0.324		WINDROW WR-1	3	
WINDROW WR-1	3	Top- East	0.519		4823		0.155		NA		**204**		NA		WINDROW WR-1	3	
WINDROW WR-1	3	Side- North	3.57		4363		0.00496	<	NA		**135**		NA		WINDROW WR-1	3	
WINDROW WR-1	3	Side- South	0.469		3204		2.01		NA		**143**		NA		WINDROW WR-1	3	
WINDROW WR-2	9	Top- West	48.9		1264		0.00349	<	0.0206	<	**77.7**		0.616		WINDROW WR-2	9	
WINDROW WR-2	9	Top- East	65.0		2320		0.640		NA		**76.5**		NA		WINDROW WR-2	9	
WINDROW WR-2	9	Side- North	15.1		1199		0.463		NA		**15.9**		NA		WINDROW WR-2	9	
WINDROW WR-2	9	Side- South	4.68		2712		0.632		NA		**5.29**		NA		WINDROW WR-2	9	
WINDROW WR-2	11	Top	63.8		8834		0.0379		0.0595		**105**		0.422		WINDROW WR-2	11	
WINDROW WR-2	11	Side- South	15.3		7687		0.387		NA		**48.0**		NA		WINDROW WR-2	11	
WR-2 POST MIX	11	Top	36.6		4062		0.0314		NA		**165**		NA		WR-2 POST MIX	11	
WR-2 POST MIX	11	QC-Replicate	31.2		4011		0.0258		0.0467	<	**163**		0.255		WR-2 POST MIX	11	QC- Replicate
WR-2 POST MIX	11	Side- South	11.5		5686		0.0183		NA		**110**		NA		WR-2 POST MIX	11	
WINDROW WR-3	15	Top- East	63.1		6383		4.38		NA		**47.4**		NA		WINDROW WR-3	15	
WINDROW WR-3	15	Top- West	70.0		7075		0.371		0.0692	<	**27.5**		1.05		WINDROW WR-3	15	
WINDROW WR-3	15	Side- North	104		11061		0.845		NA		**51.3**		NA		WINDROW WR-3	15	
WINDROW WR-3	15	Side- South	206		14227		0.680		NA		**62.1**		NA		WINDROW WR-3	15	
WINDROW WR-3	15	Side- N. Spat.	158		6725		0.616		NA		**13.6**		NA		WINDROW WR-3	15	Spatial variability test
WINDROW WR-3	15	Top- Spatial	43.8		4582		0.714		NA		**64.0**		NA		WINDROW WR-3	15	Spatial variability test
WINDROW WR-3	15	QC-Replicate	45.0		4931		0.768		NA		**71.0**		NA		WINDROW WR-3	15	QC-Replicate
WINDROW WR-3	29	Top- West	44.2		8529		4.88		0.853		**50.2**		1.50		WINDROW WR-3	29	
WINDROW WR-3	29	Top- East	58.0		7108		0.00381	<	NA		**53.4**		NA		WINDROW WR-3	29	
WINDROW WR-3	29	Side- South	39.4		6871		2.84		NA		**22.8**		NA		WINDROW WR-3	29	
WINDROW WR-4	63	Top- North	22.8		3349		0.0341		0.0347	<	**76.9**		0.0176	<	WINDROW WR-4	63	
WINDROW WR-4	63	Top- South	16.1		5420		0.0499		NA		**76.0**		NA		WINDROW WR-4	63	
WINDROW WR-4	63	Side- West	4.80		1396		0.216		NA		**96.4**		NA		WINDROW WR-4	63	
WINDROW WR-4	63	Side- East	2.89		1625		0.105		NA		**67.9**		NA		WINDROW WR-4	63	
Media Blank	NA	QC-Blank	0.0256	ND	0.888		NA		NA		**0.0256**	ND	NA		Media Blank	NA	QC-Blank
Media Blank	NA	QC-Blank	0.0256	ND	0.0282		NA		NA		**0.0256**	ND	NA		Media Blank	NA	QC-Blank
Media Blank	NA	QC-Blank	0.0951		2.38		NA		NA		**0.0367**		NA		Media Blank	NA	QC-Blank
Medial Blank	NA	QC- Blank	0.0256	ND	1340		NA		0.00769	<	**0.0256**	ND	0.00705	<	Medial Blank	NA	QC- Blank
Media Blank	NA	QC-Blank					NA						NA		Media Blank	NA	QC-Blank

TNMNEO- Total non-methane non-ethane organic carbon reported as methane (carbon # = 1)
Flux = (concentration, mg/m3)(total flow, m3/min)/(surface area, 0.13 m2) = mg/m2,min-1

ACP Final Report fo Valley Air TAP Program, May 2013, Appendix B, Daily Windrow Simulation

Day	Flux CH4	CO2	NH3 T	NH3 L	VOC	N2O	Area	MF
0	0	3012	0	0	35	1	1311	1.08
1	0.3	4024.2	0.1	0.0	47.6	0.5	1305	1.00
2	0.5	5036.0	0.2	0.0	59.8	0.5	1299	1.00
3	2	4989	1	0	162	0	1293	1.08
4	7.1	4469.9	0.5	0.0	142.4	0.4	1287	1.00
5	12.4	3950.6	0.5	0.0	122.7	0.4	1281	1.00
6	17.6	3431.3	0.5	0.0	103.0	0.5	1275	1.08
7	22.9	2912.0	0.5	0.0	83.3	0.5	1269	1.00
8	28.2	2392.7	0.5	0.0	63.6	0.6	1263	1.00
9	33.4	1873.5	0.4	0.0	43.9	0.6	1257	1.08
10	36.5	5067.0	0.3	0.0	60.2	0.5	1251	1.00
11	39.5	8260.6	0.2	0.1	76.5	0.4	1245	1.00
12	54.3	8159.1	0.5	0.1	69.4	0.6	1239	1.08
13	69.1	8057.6	0.7	0.1	62.3	0.7	1233	1.00
14	83.8	7956.2	0.9	0.1	55.2	0.9	1227	1.00
15	99	7855	1	0	48	1	1221	1.08
16	94.9	7829.6	1.3	0.1	47.7	1.1	1215	1.00
17	91.3	7804.4	1.4	0.2	47.3	1.1	1209	1.00
18	87.6	7779.2	1.5	0.2	46.8	1.1	1203	1.00
19	83.9	7754.1	1.6	0.3	46.4	1.2	1196	1.00
20	80.2	7728.9	1.7	0.3	46.0	1.2	1190	1.00
21	76.6	7703.8	1.8	0.4	45.5	1.2	1184	1.00
22	72.9	7678.6	1.9	0.5	45.1	1.3	1178	1.00
23	69.2	7653.5	2.0	0.5	44.7	1.3	1172	1.08
24	65.6	7628.3	2.1	0.6	44.3	1.3	1166	1.00
25	61.9	7603.2	2.2	0.6	43.8	1.4	1160	1.00
26	58.2	7578.0	2.3	0.7	43.4	1.4	1154	1.00
27	54.5	7552.9	2.4	0.7	43.0	1.4	1148	1.00
28	50.9	7527.7	2.5	0.8	42.6	1.5	1142	1.00
29	47	7503	3	1	42	1.5	1136	1.08
30	46.2	7368.6	2.5	0.8	43.2	1.5	1130	1.00
31	45.1	7234.6	2.4	0.8	44.3	1.4	1124	1.00
32	44.1	7100.6	2.4	0.8	45.4	1.4	1118	1.00
33	43.0	6966.7	2.3	0.8	46.5	1.3	1112	1.00
34	42.0	6832.7	2.2	0.7	47.6	1.3	1106	1.00
35	40.9	6698.7	2.1	0.7	48.7	1.2	1100	1.08
36	39.9	6564.7	2.1	0.7	49.8	1.2	1094	1.00
37	38.8	6430.8	2.0	0.7	50.9	1.1	1088	1.00
38	37.8	6296.8	1.9	0.6	52.0	1.1	1082	1.00
39	36.7	6162.8	1.8	0.6	53.1	1.1	1076	1.00
40	35.7	6028.8	1.8	0.6	54.1	1.0	1070	1.00
41	34.6	5894.9	1.7	0.6	55.2	1.0	1064	1.00
42	33.6	5760.9	1.6	0.5	56.3	0.9	1058	1.08
43	32.6	5626.9	1.6	0.5	57.4	0.9	1052	1.00
44	31.5	5492.9	1.5	0.5	58.5	0.8	1046	1.00
45	30.5	5359.0	1.4	0.5	59.6	0.8	1039	1.00
46	29.4	5225.0	1.3	0.4	60.7	0.8	1033	1.00
47	28.4	5091.0	1.3	0.4	61.8	0.7	1027	1.00
48	27.3	4957.1	1.2	0.4	62.9	0.7	1021	1.00
49	26.3	4823.1	1.1	0.4	64.0	0.6	1015	1.00
50	25.2	4689.1	1.0	0.3	65.1	0.6	1009	1.00
51	24.2	4555.1	1.0	0.3	66.2	0.5	1003	1.00
52	23.1	4421.2	0.9	0.3	67.3	0.5	997	1.00
53	22.1	4287.2	0.8	0.3	68.4	0.5	991	1.00
54	21.1	4153.2	0.8	0.3	69.5	0.4	985	1.00
55	20.0	4019.2	0.7	0.2	70.5	0.4	979	1.00
56	19.0	3885.3	0.6	0.2	71.6	0.3	973	1.00
57	17.9	3751.3	0.5	0.2	72.7	0.3	967	1.00
58	16.9	3617.3	0.5	0.2	73.8	0.2	961	1.00
59	15.8	3483.3	0.4	0.1	74.9	0.2	955	1.00
60	14.8	3349.4	0.3	0.1	76.0	0.1	949	1.00
61	13.7	3215.4	0.2	0.1	77.1	0.10	943	1.00
62	12.7	3081.4	0.2	0.1	78.2	0.06	937	1.00
63	12	2947	0	0	79	0.02	931	1.00
64	12	2947	0	0	79	0.02	925	1.00
65	12	2947	0	0	79	0.02	919	1.00

Day	Emissions (pounds) CH4	CO2	NH3 T	NH3 L	VOC	N2O
0	0	13,486	0.11	0.14	158.36	2.45
1	1	16,675	0.41	0.13	197.15	2.27
2	2	20,772	0.72	0.13	246.58	2.26
3	8	22,028	2.40	0.13	715.72	1.43
4	29	18,265	2.15	0.12	581.86	1.52
5	50	16,067	2.07	0.11	498.97	1.71
6	77	14,938	2.13	0.11	448.30	2.04
7	92	11,732	1.90	0.10	335.47	2.09
8	113	9,594	1.82	0.09	254.85	2.27
9	143	8,040	1.87	0.09	188.19	2.64
10	145	20,122	1.29	0.16	239.03	2.06
11	156	32,646	0.84	0.24	302.45	1.67
12	230	34,510	1.94	0.26	293.65	2.45
13	270	31,535	2.76	0.25	243.91	2.88
14	327	30,986	3.70	0.26	215.04	3.48
15	411	32,737	4.98	0.29	200.52	4.38
16	366	30,192	4.99	0.48	183.88	4.17
17	350	29,946	5.34	0.69	181.32	4.27
18	334	29,700	5.69	0.91	178.78	4.37
19	319	29,455	6.04	1.11	176.26	4.47
20	303	29,212	6.38	1.32	173.75	4.57
21	288	28,969	6.72	1.52	171.26	4.67
22	273	28,727	7.06	1.72	168.79	4.77
23	277	30,636	7.94	2.07	178.88	5.23
24	243	28,246	7.71	2.12	163.89	4.95
25	228	28,007	8.04	2.32	161.47	5.04
26	213	27,769	8.36	2.51	159.06	5.14
27	199	27,532	8.67	2.70	156.67	5.23
28	184	27,296	8.99	2.89	154.29	5.31
29	183	29,103	10.00	3.31	163.40	5.81
30	166	26,437	8.98	2.97	155.05	5.22
31	161	25,817	8.68	2.87	158.12	5.03
32	156	25,203	8.37	2.77	161.15	4.85
33	152	24,594	8.07	2.67	164.14	4.67
34	147	23,990	7.77	2.57	167.09	4.49
35	154	25,156	8.04	2.66	182.82	4.64
36	138	22,798	7.18	2.38	172.86	4.14
37	134	22,209	6.89	2.28	175.68	3.97
38	130	21,626	6.60	2.18	178.46	3.80
39	125	21,047	6.31	2.09	181.20	3.63
40	121	20,474	6.03	2.00	183.89	3.46
41	117	19,906	5.75	1.90	186.54	3.29
42	121	20,803	5.89	1.95	203.43	3.36
43	109	18,786	5.20	1.72	191.73	2.96
44	105	18,233	4.93	1.63	194.25	2.80
45	101	17,686	4.66	1.54	196.74	2.64
46	97	17,143	4.39	1.46	199.18	2.49
47	93	16,606	4.13	1.37	201.59	2.33
48	89	16,074	3.87	1.28	203.95	2.17
49	85	15,547	3.61	1.20	206.26	2.02
50	81	15,025	3.36	1.11	208.54	1.87
51	77	14,509	3.10	1.03	210.78	1.72
52	73	13,997	2.86	0.95	212.97	1.57
53	70	13,491	2.61	0.87	215.12	1.43
54	66	12,990	2.37	0.79	217.23	1.28
55	62	12,494	2.12	0.71	219.29	1.14
56	59	12,003	1.89	0.63	221.32	1.00
57	55	11,517	1.65	0.55	223.30	0.86
58	51	11,036	1.42	0.47	225.24	0.72
59	48	10,561	1.19	0.40	227.14	0.58
60	45	10,090	0.96	0.32	229.00	0.45
61	41	9,625	0.74	0.25	230.81	0.31
62	38	9,165	0.52	0.17	232.59	0.18
63	34	8,710	0.30	0.10	234.32	0.05
64	34	8,653	0.30	0.10	232.80	0.05
65	34	8,597	0.29	0.10	231.28	0.05

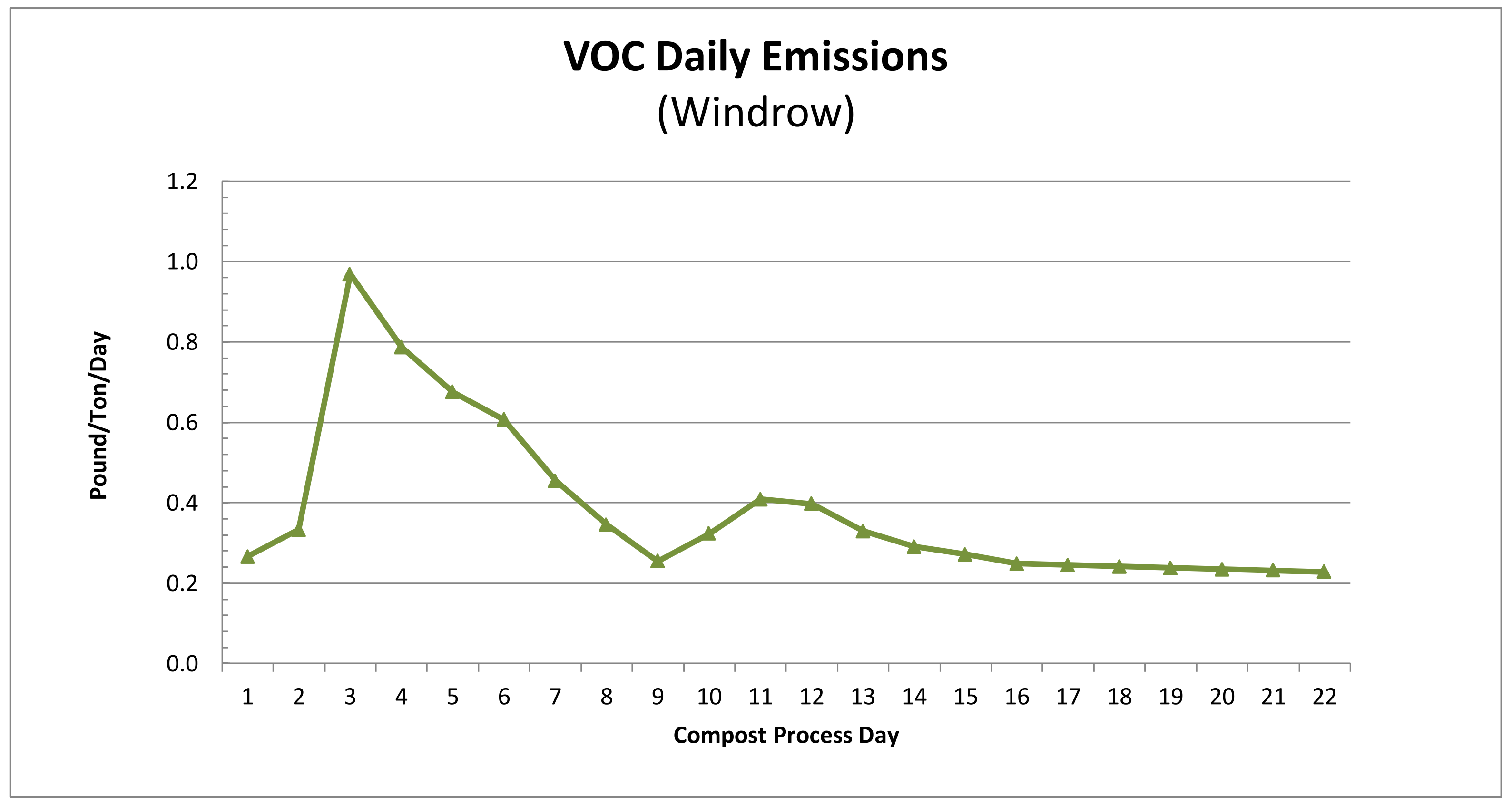
60 Day	Total	9,184	1,341,525	284	78	14,728	191	Pounds	
		12	1,816.47	0.38	0.11	19.94	0.26	#/ton mix	
30 Day		5,982	765,362	142	31	7,647	111		
		8	1,036.32	0.19	0.04	10.35	0.15	#/ton mix	
22 Day		4,289	540,334	73	10	6,354	69		
		6	731.63	0.10	0.01	8.60	0.09		

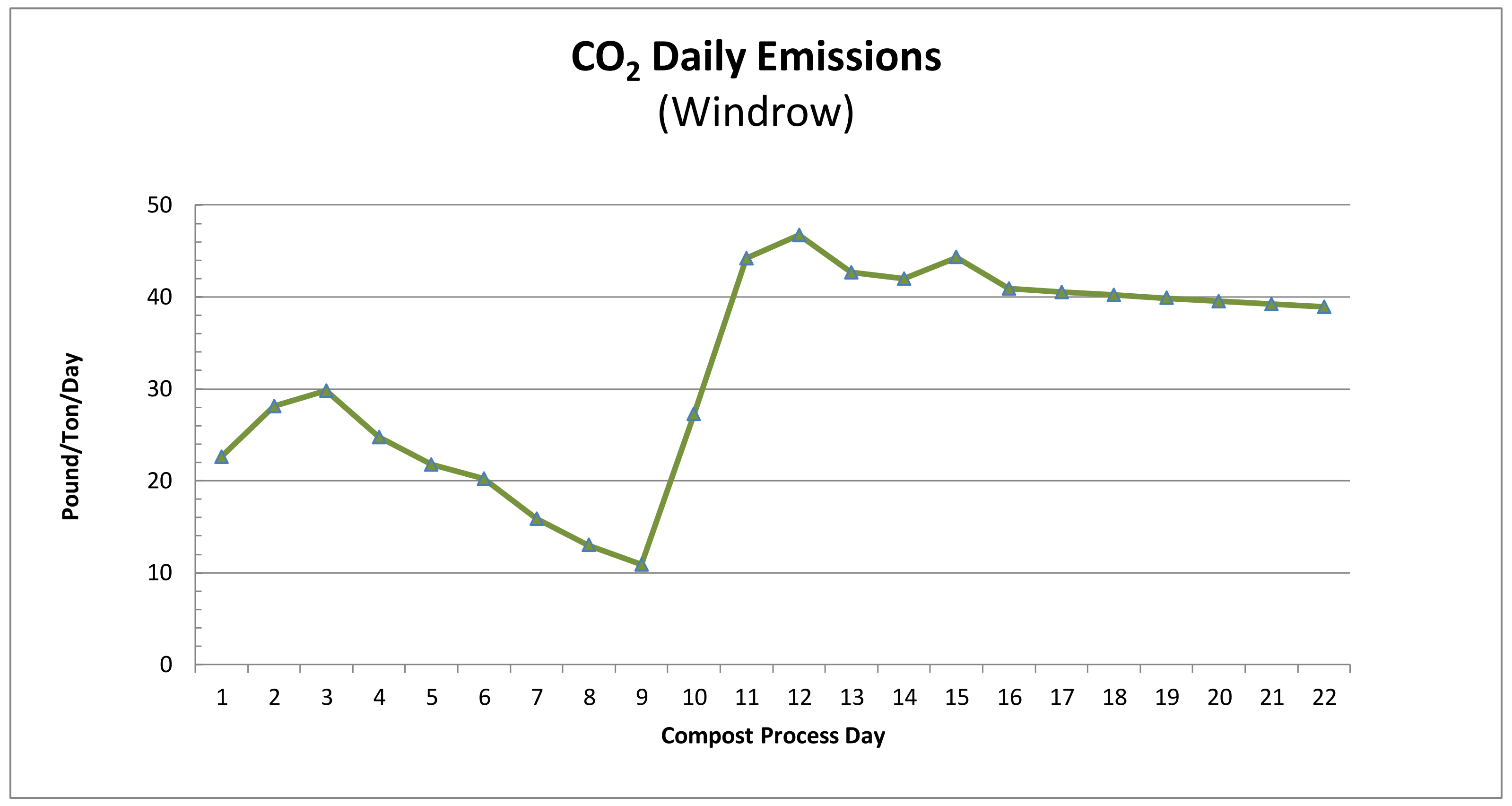
Day	Emissions (pounds per ton) CH4	CO2	NH3 T	NH3 L	VOC	N2O	CO2e	21 738.54 TAP	200.4 Site 2	163 Site 1
0	0	18	0.0001	0.0002	0.214	0.0033	19.3018	0.21		
1	0.002	23	0.0006	0.0002	0.267	0.0031	23.5687	0.27	0	0
2	0.003	28	0.0010	0.0002	0.334	0.0031	29.1371	0.33	0	1
3	0.011	30	0.0033	0.0002	0.969	0.0019	30.6640	0.97	0	1
4	0.040	25	0.0029	0.0002	0.788	0.0021	26.1999	0.79	0	1
5	0.068	22	0.0028	0.0001	0.676	0.0023	23.9078	0.68	0	1
6	0.104	20	0.0029	0.0001	0.607	0.0028	23.2687	0.61	0	1
7	0.125	16	0.0026	0.0001	0.454	0.0028	19.3849	0.45	0	0
8	0.153	13	0.0025	0.0001	0.345	0.0031	17.1541	0.35	0	0
9	0.194	11	0.0025	0.0001	0.255	0.0036	16.0714	0.25	0	0
10	0.196	27	0.0017	0.0002	0.324	0.0028	32.2296	0.32	0	0
11	0.212	44	0.0011	0.0003	0.410	0.0023	49.3478	0.41	0	0
12	0.311	47	0.0026	0.0004	0.398	0.0033	54.2874	0.40	0	0
13	0.366	43	0.0037	0.0003	0.330	0.0039	51.5956	0.33	0	0
14	0.442	42	0.0050	0.0004	0.291	0.0047	52.6995	0.29	0	0
15	0.556	44	0.0067	0.0004	0.272	0.0059	57.8490	0.27	0	0
16	0.496	41	0.0068	0.0007	0.249	0.0056	53.0417	0.25	0	0
17	0.474	41	0.0072	0.0009	0.246	0.0058	52.2981	0.25	0	0
18	0.453	40	0.0077	0.0012	0.242	0.0059	51.5594	0.24	0	0
19	0.432	40	0.0082	0.0015	0.239	0.0061	50.8254	0.24	0	0
20	0.411	40	0.0086	0.0018	0.235	0.0062	50.0962	0.24	0	0
21	0.390	39	0.0091	0.0021	0.232	0.0063	49.3718	0.23	0	0
22	0.369	39	0.0096	0.0023	0.229	0.0065	48.6523	0.23	0	0
23	0.375	41	0.0108	0.0028	0.242	0.0071	51.5548	0.24	0	0
24	0.329	38	0.0104	0.0029	0.222	0.0067	47.2275	0.22	0	0
25	0.309	38	0.0109	0.0031	0.219	0.0068	46.5223	0.22	0	0
26	0.289	38	0.0113	0.0034	0.215	0.0070	45.8219	0.22	0	0
27	0.269	37	0.0117	0.0037	0.212	0.0071	45.1263	0.21	0	0
28	0.250	37	0.0122	0.0039	0.209	0.0072	44.4355	0.21	0	0
29	0.248	39	0.0135	0.0045	0.221	0.0079	47.0508	0.22	0	0
30	0.224	36	0.0122	0.0040	0.210	0.0071	42.6939	0.21	0	0
31	0.218	35	0.0117	0.0039	0.214	0.0068	41.6471	0.21	0	0
32	0.212	34	0.0113	0.0038	0.218	0.0066	40.6091	0.22	0	0
33	0.206	33	0.0109	0.0036	0.222	0.0063	39.5799	0.22	0	0
34	0.200	32	0.0105	0.0035	0.226	0.0061	38.5595	0.23	0	0
35	0.208	34	0.0109	0.0036	0.248	0.0063	40.3812	0.25	0	0
36	0.188	31	0.0097	0.0032	0.234	0.0056	36.5451	0.23	0	0
37	0.182	30	0.0093	0.0031	0.238	0.0054	35.5510	0.24	0	0
38	0.176	29	0.0089	0.0030	0.242	0.0051	34.5658	0.24	0	0
39	0.170	28	0.0085	0.0028	0.245	0.0049	33.5894	0.25	0	0
40	0.164	28	0.0082	0.0027	0.249	0.0047	32.6218	0.25	0	0
41	0.158	27	0.0078	0.0026	0.253	0.0045	31.6630	0.25	0	0
42	0.164	28	0.0080	0.0026	0.275	0.0046	33.0305	0.28	0	0
43	0.147	25	0.0070	0.0023	0.260	0.0040	29.7717	0.26	0	0
44	0.142	25	0.0067	0.0022	0.263	0.0038	28.8392	0.26	0	0
45	0.136	24	0.0063	0.0021	0.266	0.0036	27.9156	0.27	0	0
46	0.131	23	0.0059	0.0020	0.270	0.0034	27.0007	0.27	0	0
47	0.125	22	0.0056	0.0019	0.273	0.0032	26.0947	0.27	0	0
48	0.120	22	0.0052	0.0017	0.276	0.0029	25.1974	0.28	0	0
49	0.115	21	0.0049	0.0016	0.279	0.0027	24.3090	0.28	0	0
50	0.110	20	0.0045	0.0015	0.282	0.0025	23.4293	0.28	0	0
51	0.104	20	0.0042	0.0014	0.285	0.0023	22.5585	0.29	0	0
52	0.099	19	0.0039	0.0013	0.288	0.0021	21.6964	0.29	0	0
53	0.094	18	0.0035	0.0012	0.291	0.0019	20.8431	0.29	0	0
54	0.089	18	0.0032	0.0011	0.294	0.0017	19.9986	0.29	0	0
55	0.084	17	0.0029	0.0010	0.297	0.0015	19.1630	0.30	0	0
56	0.079	16	0.0026	0.0008	0.300	0.0013	18.3361	0.30	0	0
57	0.075	16	0.0022	0.0007	0.302	0.0012	17.5180	0.30	0	0
58	0.070	15	0.0019	0.0006	0.305	0.0010	16.7087	0.30	0	0
59	0.065	14	0.0016	0.0005	0.308	0.0008	15.9082	0.31	0	0
60	0.060	14	0.0013	0.0004	0.310	0.0006	15.1165	0.31	0	0
61	0.056	13	0.0010	0.0003	0.313	0.0004	14.3336	0.31	0	
62	0.051	12	0.0007	0.0002	0.315	0.0002	13.5595	0.31	0	
63	0.047	12	0.0004	0.0001	0.317	0.0001	12.7942	0.32	0	
64	0.046	12	0.0004	0.0001	0.315	0.0001	12.7112	0.32	0	
65	0.046	12	0.0004	0.0001	0.313	0.0001	12.6282	0.31	0	
	12	1,816				0	2,158			

Process Day	CH4	CO2	NH3 T	NH3 L	VOC	N2O
0	0	3012	0	0	35	0.55
2	1	5036	0	0	60	0.55
3	2	4989	1	0	162	0.32
9	33	1873	0	0	44	0.62
11	40	8261	0	0	77	0.42
15	99	7855	1	0	48	1.05
29	47	7503	3	1	42	1.50
63	12	2947	0	0	79	0.02

		NH3		Greenhouse Gas			
Cycle Lengtl	**VOC**	**Field**	**Lab**	**CO2**	**CH4**	**2**	**CO2e**
22 Day	8.60	0.099	0.014	732	5.8		883
30 Day	10.35	0.192	0.042	1,036	8.1		1253
60 Day	19.94	0.385	0.106	1,816	12.4		2158

Mixing Event		
Pre-Mix	77	
Post Mix	146	
Est Decay Perod	2	hours
Estimated Daily Imp	8%	
Mix Factor	108%	





ACP Final Report fo Valley Air TAP Program, May 2013, Appendix C, Emissions from Fuel Use

California Emissions Standard for Heavy Duty Diesel Engines	NMHC	NOx	PM
1996 Emission Standard in grams/bhp/hour	1.2	4	0.05
2007 Emission Standard in grams/bhp/hour	0.14	0.2	0.01

Table One - Conventional Windrow Operation

(operation begins at grinder discharge point)

				Pollution production in pounds					
	Equipment	Hrs Oper	Average	1996	1996	1996	2007	2007	2007
Task Performed	Type	per Pile	bhp	NMHC	Nox	PM	NMHC	Nox	PM
1. Push ground feedstock from grinder output into stockpile	Loader	5.2	250	3.4	11	0.14	0.4	0.6	0.03
2. Load feedstock from stockpile into dump truck	Loader	10.5	250	6.9	23	0.29	0.8	1.2	0.06
3. Truck feedstock from stockpile to windrow space	Truck	12.6	450	15.0	50	0.63	1.8	2.5	0.13
4. Push up feedstock to shape and size windrow	Loader	0.5	250	0.3	1	0.01	0.0	0.1	0.00
5. Drive water truck during windrow formation	Truck	0.3	450	0.4	1	0.01	0.0	0.1	0.00
6. Drive water truck to re-water windrow prior to turning	Truck	3.5	450	4.2	14	0.17	0.5	0.7	0.03
7. Turn windrow (7 turns: 1 mixing, 5 for PFRP in 15 days, 1 at day 22)	Turner	1.7	500	2.2	7	0.09	0.3	0.4	0.02
Total pounds of pollutant for 1260 cy windrow/22 day active phase:				**32.49**	**108.29**	**1.35**	**3.79**	**5.41**	**0.27**
Total pounds of pollutant per ton of feedstock @ 2cy/ton				**0.052**	**0.172**	**0.002**	**0.006**	**0.009**	**0.000**
Tons of pollutant for 100,000 tons per year/22 day active phase				**2.58**	**8.59**	**0.11**	**0.30**	**0.43**	**0.02**

Table Two - Extended Aerated Static Pile Operation

(operation begins at grinder discharge point)

				Pollution production in pounds					
	Equipment	Hrs Oper	Average	1996	1996	1996	2007	2007	2007
Task Performed	Type	per Pile	bhp	NMHC	Nox	PM	NMHC	Nox	PM
1. Place wood chip plenum layer on ASP bed	Loader	0.3	250	0.20	0.66	0.01	0.02	0.03	0.00
2. Convey ground feedstock from grinder to ASP	Conveyor	6.7	0	0.00	0.00	0.00	0.00	0.00	0.00
3. Load finished compost from stockpile into dump truck	Loader	0.3	250	0.20	0.66	0.01	0.02	0.03	0.00
4. Truck finished compost from stockpile to conveyor station	Truck	0.6	450	0.71	2.38	0.03	0.08	0.12	0.01
5. Load finished compost into conveyor	Loader	0.8	250	0.53	1.76	0.02	0.06	0.09	0.00
6. Convey finished compost to ASP	Conveyor	0.8	0	0.00	0.00	0.00	0.00	0.00	0.00
Totals pounds of pollutants for 506 cy eASP / 22 day active phase:				**1.640**	**5.467**	**0.068**	**0.191**	**0.273**	**0.014**
Total pounds of pollutant per ton of feedstock @ 2cy/ton				**0.006**	**0.022**	**0.000**	**0.001**	**0.001**	**0.000**
Tons of pollutant for 100,000 tons per year/22 day active phase				**0.324**	**1.081**	**0.014**	**0.038**	**0.054**	**0.003**
Percent reduction over windrow system		`		***-87%***	***-87%***	***-87%***	***-87%***	***-87%***	***-87%***
Tons saved				2.25	7.51	0.09	0.26	0.38	0.02

ACP Final Report fo Valley Air TAP Program, May 2013, Appendix C, Diesel Fuel Use Comparison

Composting in Extended Aerated Static Piles vs. Windrows

Table One - Conventional Windrow Operation

(operation begins at grinder discharge point)

Windrow Dimensions: 425 feet long, 20 feet wide, 8 feet high

Windrow Volume: 1,260 cubic yards per pile

Task Performed	Equipment Type	Diesel Gal/Hr	Cubic Yd Per Hr	Cubic Yd Per Pile	Hrs Oper per Task	Number of Reps	Hrs Oper per Pile	Fuel Use per Pile
1. Push ground feedstock from grinder output into stockpile	Loader	3.9	240	1,260	5.2	1	5.2	20.2
2. Load feedstock from stockpile into dump truck	Loader	3.9	120	1,260	10.5	1	10.5	40.4
3. Truck feedstock from stockpile to windrow space	Truck	1.6	100	1,260	12.6	1	12.6	19.8
4. Push up feedstock to shape and size windrow	Loader	3.9	200	100	0.5	1	0.5	1.9
5. Drive water truck during windrow formation	Truck	1.6	NA	NA	0.25	1	0.3	0.4
6. Drive water truck to re-water windrow prior to turning	Truck	1.6	NA	NA	0.5	7	3.5	5.5
7. Turn windrow (7 turns: 1 mixing, 5 for PFRP in 15 days, 1 at day 22)	Turner	20.3	5,040	1,260	0.2	7	1.7	35.5
Totals for 22 day active phase:							**34.3**	**123.7**
Averages for 22 day active phase:	**37 Cubic Yards per Operator Hour**				**10 Cubic Yards per Gallon of Fuel**			

Table Two - Extended Aerated Static Pile Operation

(operation begins at grinder discharge point)

Pile Dimensions: Test piles averaged 85' long x 35' wide x approx 8' high.

Pile Volume: 506 average cubic yards of feedstock per test pile

Task Performed	Equipment Type	Diesel Gal/Hr	Cubic Yd Per Hr	Cubic Yd Per Pile	Hrs Oper per Task	Number of Reps	Hrs Oper per Pile	Fuel Use per Pile
1. Place wood chip plenum layer on ASP bed	Loader	3.9	120	40	0.33	1	0.3	1.3
2. Convey ground feedstock from grinder to ASP	Conveyor	0.0	75	506	6.75	1	6.7	0.0
3. Load finished compost from stockpile into dump truck	Loader	3.9	200	60	0.30	1	0.3	1.2
4. Truck finished compost from stockpile to conveyor station	Truck	1.6	100	60	0.60	1	0.6	0.9
5. Load finished compost into conveyor	Loader	3.9	75	60	0.80	1	0.8	3.1
6. Convey finished compost to ASP	Conveyor	0	75	60	0.80	1	0.8	0.0
Totals for 22 day active phase:							**9.6**	**6.5**
Averages for 22 day active phase:	**53 Cubic Yards per Operator Hour**				**78 Cubic Yards per Gallon of Fuel**			
					-87%			

34	Tons per gallon extra using ASP
2941.176	gallons saved per 100,000 tons
100000	e 38 * e 39

US COMPOSTING COUNCIL

Seal of Testing Assurance

TCCBI - Harvest Power
John Jones
24487 Rd. 140
Tulare
CA 93274

Product Identification	Compost
Zone 1	

Date Sampled/Received: 07 Sep. 12 / 14 Sep. 12

COMPOST TECHNICAL DATA SHEET

LABORATORY: Soil Control Lab; 42 Hangar Way; Watsonville, CA 95076 *tel:* 831.724.5422 *fax:* 831.724.3188

Compost Parameters	***Reported as** (units of measure)*	***Test Results***	***Test Results***
Plant Nutrients:	%, weight basis	Not reported	Not reported
Moisture Content	%, wet weight basis	43.3	
Organic Matter Content	%, dry weight basis	43.0	
pH	units	5.37	
Soluble Salts *(electrical conductivity EC_5)*	dS/m (mmhos/cm)	9.9	
Particle Size or Sieve Size	maxium aggregate size, inches	0.38	
Stability Indicator *(respirometry)*			*Stability Rating:*
CO_2 Evolution	mg CO_2-C/g OM/day	7.9	Moderately Un-Stable
	mg CO_2-C/g TS/day	3.4	
Maturity Indicator (bioassay)			
Percent Emergence	average % of control	100.0	
Relative Seedling Vigor	average % of control	90.0	
Select Pathogens	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.32(a)	Pass	*Fecal coliform*
		Pass	*Salmonella*
Trace Metals	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3.	Pass	*As,Cd,Cr,Cu,Pb,Hg*
			Mo,Ni,Se,Zn

Participants in the US Composting Council's Seal of Testing Assurance Program have shown the commitment to test their compost products on a prescribed basis and provide this data, along with compost end use instructions, as a means to better serve the needs of their compost customers.

Laboratory Group: Sep.12 B Laboratory Number: 2090380-1/2

Analyst: Assaf Sadeh

www.compostlab.com

US COMPOSTING COUNCIL

Seal of Testing Assurance

TCCBI - Harvest Power
John Jones
24487 Rd. 140
Tulare
CA 93274

Product Identification Compost
Zone 1

Date Sampled/Received: 07 Sep. 12 / 14 Sep. 12

COMPOST TECHNICAL DATA SHEET

LABORATORY: Soil Control Lab; 42 Hangar Way; Watsonville, CA 95076 *tel:* 831.724.5422 *fax:* 831.724.3188

Compost Parameters	***Reported as** (units of measure)*	***Test Results***	***Test Results***
Plant Nutrients:	%, weight basis	%, wet weight basis	%, dry weight basis
Nitrogen	Total N	0.75	1.3
Phosphorus	P_2O_5	0.32	0.57
Potassium	K_2O	0.69	1.2
Calcium	Ca	1.1	2.0
Magnesium	Mg	0.24	0.42
Moisture Content	%, wet weight basis	43.3	
Organic Matter Content	%, dry weight basis	43.0	
pH	units	5.37	
Soluble Salts *(electrical conductivity EC_5)*	dS/m (mmhos/cm)	9.9	
Particle Size or Sieve Size	% under 9.5 mm, dw basis	100.0	
Stability Indicator *(respirometry)*			*Stability Rating:*
CO_2 Evolution	mg CO_2-C/g OM/day	7.9	Moderately Un-Stable
	mg CO_2-C/g TS/day	3.4	
Maturity Indicator (bioassay)			
Percent Emergence	average % of control	100.0	
Relative Seedling Vigor	average % of control	90.0	
Select Pathogens	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.32(a)	Pass	*Fecal coliform*
		Pass	*Salmonella*
Trace Metals	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3.	Pass	*As,Cd,Cr,Cu,Pb,Hg* Mo,Ni,Se,Zn

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Laboratory Group: Sep.12 B Laboratory Number: 2090380-1/2

Analyst: Assaf Sadeh

www.compostlab.com

US COMPOSTING COUNCIL

Seal of Testing Assurance

Caltrans

TCCBI - Harvest Power
John Jones
24487 Rd. 140
Tulare CA 93274

Product Identification:

Zone 1

Date Sampled/Received: 07 Sep. 12 / 14 Sep. 12

COMPOST TECHNICAL DATA SHEET for Caltrans

LABORATORY: Soil Control Lab, 42 Hangar Way, Watsonville, CA 95076 tel (831) 724-5422 fax (831) 724-3188 www.compostlab.com

Compost Parameters	***Test Results***	***Reported as** (units of measure)*	***TMECC Test Method***
pH	5.37	Unitless	04.11-A 1:5 Slurry pH
Soluble Salts (electrical conductivity)	9.9	dS/m (mmhos/cm)	04.10-A 1:5 Slurry Method Mass Basis
Moisture content	43.3	%, wet weight basis	03.09-A - Total Solids and Moisture
Organic Matter Content	43.0	%, dry weight basis	05.07-A Loss-on-Ignition Organic Matter Method (LOI)
Maturity Indicator (bioassay)			
Percent Emergence	100.0	average % of control	05.05-A Germination and vigor
Relative Seedling Vigor	90.0	average % of control	
Stability Indicator	7.9	mg CO2-C/g OM/day	05.08-B Carbon Dioxide Evoultion Rate
Particle Size	100.0	%, dry weight passing through 9.5 mm	02.02-B Sample Sieving for Aggregate Size Classification
Pathogens	Pass	PASS/FAIL: Per US EPA Class A standard, 40 CFR 503.32(a)	07.01-B Fecal coliforms
Pathogens	Pass	PASS/FAIL: Per US EPA Class A standard, 40 CFR 503.32(a)	07.02 Samonella
Physical Contaminants	None Detected	%, dry weight basis	02.02-C - Man-Made Inerts Total content
Physical Contaminants	None Detected	%, dry weight basis	02.02-C - Man-Made Inerts Sharps content
Heavy Metals Content	Pass	PASS/FAIL: Per US EPA Class A 40 CFR 503.13, tables 1 and 3.	04.06-Heavy Metals standard, and Hazardous Elements

Participants in the US Composting Council's Seal of Testing Assurance Program have shown the commitment to test their compost products on a prescribed basis and provide this data, along with compost end use instructions, as a means to better serve the needs of their compost customers.

For additional information pertaining to compost use, the specific compost parameters tested for within the Seal of Testing assurance Program, or the program in general, log on to the US Composting Council's TMECC web-site at http://www.tmecc.org.

This compost product has been sampled and tested as required by the Seal of Testing assurance Program on the United States Composting Council (USCC), using certain methods from the "Test Methods for the Examination of Compost and Composting" manual. Test results are available upon request by contacting the compost producer (address at top of page). The USCC makes no warranties regarding this product or its content, quality. or suitability for any particular use.

Laboratory Group: Sep.12 B   Laboratory Number: 2090380-1/2

Analyst: Assaf Sadeh

www.compostlab.com

ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

TEL: 831-724-5422
FAX: 831-724-3188
www.compostlab.com

Account #: 2090380-1/2-6908
Group: Sep.12 B #27
Reporting Date: September 26, 2012

TCCBI - Harvest Power
24487 Rd. 140
Tulare, CA 93274
Attn: John Jones

Date Received: 14 Sep. 12
Sample Identification: Zone 1
Sample ID #: 2090380 - 1/2

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	1.3	0.75	%
Ammonia (NH_4-N):	1300	760	mg/kg
Nitrate (NO_3-N):	33	18	mg/kg
Org. Nitrogen (Org.-N):	1.2	0.68	%
Phosphorus (as P_2O_5):	0.57	0.32	%
Phosphorus (P):	2500	1400	mg/kg
Potassium (as K_2O):	1.2	0.68	%
Potassium (K):	10000	5700	mg/kg
Calcium (Ca):	2.0	1.1	%
Magnesium (Mg):	0.42	0.24	%
Sulfate (SO_4-S):	1900	1100	mg/kg
Boron (Total B):	27	15	mg/kg
Moisture:	0	43.3	%
Sodium (Na):	0.11	0.063	%
Chloride (Cl):	0.21	0.12	%
pH Value:	NA	5.37	unit
Bulk Density :	25	44	lb/cu ft
Carbonates ($CaCO_3$):	<0.1	<0.1	lb/ton
Conductivity (EC5):	9.9	NA	mmhos/cm
Organic Matter:	43.0	24.4	%
Organic Carbon:	23.0	13.0	%
Ash:	57.0	32.3	%
C/N Ratio	18	18	ratio
AgIndex	10	10	ratio

Stability Indicator:		Biologically
CO2 Evolution	Respirometery	Available C
mg CO_2-C/g OM/day	7.9	10
mg CO_2-C/g TS/day	3.4	4.4
Stability Rating	*moderately unstable*	*unstable*

Maturity Indicator: Cucumber Bioassay		
Compost:Vermiculite(v:v)	1:1	1:3
Emergence (%)	100	100
Seedling Vigor (%)	90	93
Description of Plants	*fungus*	*fungus*

Pathogens	Results	Units	Rating
Fecal Coliform	< 2.0	MPN/g	*pass*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 14 Sep. 12

Inerts	% by weight
Plastic	< 0.5
Glass	< 0.5
Metal	< 0.5
Sharps	ND

Metals	Dry wt.	EPA Limit	units
Aluminum (Al)	6700	-	mg/kg
Arsenic (As):	3.4	41	mg/kg
Cadmium (Cd):	< 1.0	39	mg/kg
Chromium (Cr):	14	1200	mg/kg
Cobalt (Co)	3.7	-	mg/kg
Copper (Cu):	60	1500	mg/kg
Iron (Fe):	11000	-	mg/kg
Lead (Pb):	25	300	mg/kg
Manganese (Mn):	200	-	mg/kg
Mercury (Hg):	< 1.0	17	mg/kg
Molybdenum (Mo):	1.8	75	mg/kg
Nickel (Ni):	10	420	mg/kg
Selenium (Se):	< 1.0	36	mg/kg
Zinc (Zn):	160	2800	mg/kg

Size & Volume Distribution			
MM	% by weight	% by volume	BD g/cc
> 50	0.0	0.0	0.00
25 to 50	0.0	0.0	0.00
16 to 25	0.0	0.0	0.00
9.5 to 16	0.0	0.0	0.00
6.3 to 9.5	2.7	2.6	0.41
4.0 to 6.3	6.0	6.2	0.39
2.0 to 4.0	13.7	17.0	0.32
< 2.0	77.6	74.2	0.42

Bulk Density Description:<.35 Light Materials, .35-.60 medium weight materials, >.60 Heavy Materials

Analyst: Assaf Sadeh

Assaf Sadeh

*Sample was received and handled in accordance with TMECC procedures.

Account No.: 2090380 - 1/2 - 6908
Group: Sep.12 B No. 27

Date Received 14 Sep. 12
Sample i.d. Zone 1
Sample I.d. No. 1/2 2090380

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate — Biodegradation Rate of Your Pile
7.9 mg CO2-C/ g OM/day
+++++++++++++++++++++++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Biologically Available Carbon (BAC) — Optimum Degradation Rate
10 mg CO2-C/ g OM/day
+++++++++++++++++++++++++++++++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Is Your Compost Mature?

AmmoniaN/NitrateN ratio
39 Ratio
+++
VeryMature>|< Mature >|< Immature

Ammonia N ppm
1300 mg/kg dry wt.
+++
VeryMature>|< Mature >|< Immature

Nitrate N ppm
33 mg/kg dry wt.
++++++++++++++++++++++++++
< Immature >|< Mature

pH value
5.37 units
++
< Immature >|< Mature >|< Immature

Cucumber Emergence
100.0 percent
++
< Immature >|< Mature

Is Your Compost Safe Regarding Health?

Fecal Coliform
< 1000 MPN/g dry wt.
+++++++
< Safe >|< High Fecal Coliform

Salmonella
Less than 3 /4g dry wt.
+++++++
<Safe (none detected) >|< High Salmonella Count(> 3 per 4 grams)

Metals US EPA 503
Pass dry wt.
+++++++++
<All Metals Pass >|< One or more Metals Fail

Does Your Compost Provide Nutrients or Organic Matter?

Nutrients (N+P2O5+K2O)
3.1 Percent dry wt.
++++++++++++++++++++++++
<Low >|< Average >|< High Nutrient Content

AgIndex (Nutrients / Sodium and Chloride Salts) — ((N+P2O5+K2O) / (Na + Cl))
10 Ratio
+++
Na & Cl >|< Nutrient and Sodium and Chloride Provider >|< Nutrient Provider

Plant Available Nitrogen (PAN) — Estimated release for first season
6 lbs/ton wet wt.
+++++++++++++++++++++++++
Low Nitrogen Provider>|< Average Nitrogen Provider >|<High Nitrogen Provider

C/N Ratio
18 Ratio
+++++++++++++++++++++++++++++++++++
< Nitrogen Release >|< N-Neutral >|< N-Demand>|< High Nitrogen Demand

Soluble Available Nutrients & Salts (EC5 w/w dw)
9.9 mmhos/cm dry wt.
+++
SloRelease>|< Average Nutrient Release Rate >|<High Available Nutrients

Lime Content (CaCO3)
0 Lbs/ton dry wt.
+
< Low >|< Average >|< High Lime Content (as CaCO3)

What are the physical properties of your compost?

Percent Ash
57.0 Percent dry wt.
+++
< High Organic Matter >|< Average >|< High Ash Content

Sieve Size % > 6.3 MM (0.25")
2.7 Percent dry wt.
+++++++++++++++++++++
All Uses >|< Size May Restrict Uses for Potting mix and Golf Courses

Account No.: 2090380 - 1/2 - 6908
Group: Sep.12 B No. 27

Date Received 14 Sep. 12
Sample i.d. Zone 1
Sample I.d. No. 1/2 2090380

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate

7.9 Moderate-selected use mg CO2-C/g OM/day

The respiration rate is a measurement of the biodegradation rate of the organic matter in the sample (as received). The respiration rate is determined by measuring the rate at which CO2 is released under optimized moisture and temperature conditions.

Biologically Available Carbon

10 Moderate-selected use mg CO2-C/g OM/day

Biologically Available Carbon (BAC) is a measurement of the rate at which CO2 is released under optimized moisture, temperature, porosity, nutrients, pH and microbial conditions. If both the RR and the BAC test values are close to the same value, the pile is optimized for composting. If both values are high the compost pile just needs more time. If both values are low the compost has stabilized and should be moved to curing. BAC test values that are higher than RR indicate that the compost pile has stalled. This could be due to anaerobic conditions, lack of available nitrogen due to excessive air converting ammonia to the unavailable nitrate form, lack of nitrogen or other nutrients due to poor choice of feedstock, pH value out of range, or microbes rendered non-active.

Is Your Compost Mature?

AmmoniaN:NitrateN ratio	
39	immature
Ammonia N ppm	
1300	immature
Nitrate N ppm	
33	immature
pH value	
5.37	immature

Composting to stabilize carbon can occur at such a rapid rate that sometimes phytotoxins remain in the compost and must be neutralized before using in high concentrations or in high-end uses. This step is called curing. Typically ammonia is in excess with the break-down of organic materials resulting in an increase in pH. This combination results in a loss of volatile ammonia (it smells). Once this toxic ammonia has been reduced and the pH drops, the microbes convert the ammonia to nitrates. A low ammonia + high nitrate score is indicative of a mature compost, however there are many exceptions. For example, a compost with a low pH (<7) will retain ammonia, while a compost with high lime content can lose ammonia before the organic fraction becomes stable. Composts must first be stable before curing indicators apply.

Cucumber Bioassay

100.0 Percent

Cucumbers are chosen for this test because they are salt tolerant and very sensitive to ammonia and organic acid toxicity. Therefore, we can germinate seeds in high concentrations of compost to measure phytotoxic effects without soluble salts being the limiting factor. Values above 80% for both percent emergence and vigor are indicative of a well-cured compost. Exceptions include very high salts that affect the cucumbers, excessive concentrations of nitrates and other nutrients that will be in range when formulated to make a growing media. In addition to testing a 1:1 compost: vermiculite blend, we also test a diluted 1:3 blend to indicate a more sensitive toxicity level.

Is Your Compost Safe Regarding Health?

Fecal Coliform

< 1000 / g dry wt.

Fecal coliforms can survive in both aerobic and anaerobic conditions and is common in all initial compost piles. Most human pathogens occur from fecal matter and all fecal matter is loaded in fecal coliforms. Therefore fecal coliforms are used as an indicator to determine if the chosen method for pathogen reduction (heat for compost) has met the requirements of sufficient temperature, time and mixing. If the fecal coliforms are reduced to below 1000 per gram dry wt. it is assumed all others pathogens are eliminated. Potential problems are that fecal coliform can regrow during the curing phase or during shipping. This is because the conditions are now more favorable for growth than during the composting process.

Salmonella Bacteria

Less than 3 3 / 4g dry wt.

Salmonella is not only another indicator organism but also a toxic microbe. It has been used in the case of biosolids industry to determine adequate pathogen reduction.

Metals

Pass

The ten heavy metals listed in the EPA 503 regulations are chosen to determine if compost can be applied to ag land and handled without toxic effects. Most high concentrations of heavy metals are derived from woodwaste feedstock such as chrome-arsenic treated or lead painted demolition wood. Biosolids are rarely a problem.

Does Your Compost Provide Nutrients or Organic Matter?

Nutrients (N+P2O5+K2O)

3.1 Average nutrient content

This value is the sum of the primary nutrients Nitrogen, Phosphorus and Potassium. Reported units are consistent with those found on fertilizer formulations. A sum greater than 5 is indicative of a compost with high nutrient content, and best used to supply nutrients to a receiving soil. A sum below 2 indicates low nutrient content, and is best-used to improve soil structure via the addition of organic matter. Most compost falls between 2 and 5.

Account No.:		Date Received	14 Sep. 12	
2090380 - 1/2 - 6908		Sample i.d.	Zone 1	
Group:	Sep.12 B No. 27	Sample I.d. No.	1/2	2090380

INTERPRETATION:

AgIndex (Nutrients/Na+Cl)

10 Average nutrient ratio Composts with low AgIndex values have high concentrations of sodium and/or chloride compared to nutrients. Repeated use of a compost with a low AgIndex (< 2) may result in sodium and/or chloride acting as the limiting factor compared to nutrients, governing application rates. These composts may be used on well-draining soils and/or with salt-tolerant plants. Additional nutrients form another source may be needed if the application rate is limited by sodium or chloride. If the AgIndex is above 10, nutrients optimal for plant growth will be available without concern of sodium and/or chloride toxicity. Composts with an AgIndex of above 10 are good for increasing nutrient levels for all soils. Most composts score between 2 and 10. Concentrations of nutrients, sodium, and chloride in the receiving soil should be considered when determining compost application rates. The AgIndex is a product of feedstock quality. Feedstock from dairy manure, marine waste, industrial wastes, and halophytic plants are likely to produce a finished compost with a low AgIndex.

Plant Available Nitrogen (lbs/ton)

6 Average N Provider Plant Available Nitrogen (PAN) is calculated by estimating the release rate of Nitrogen from the organic fraction of the compost. This estimate is based on information gathered from the BAC test and measured ammonia and nitrate values. Despite the PAN value of the compost, additional sources of Nitrogen may be needed during he growing season to off-set the Nitrogen demand of the microbes present in the compost. With ample nutrients these microbes can further breakdown organic matter in the compost and release bound Nitrogen. Nitrogen demand based on a high C/N ratio is not considered in the PAN calculation because additional Nitrogen should always be supplemented to the receiving soil when composts with a high C/N ratio are applied.

C/N Ratio

18 Indicates immaturity As a guiding principal, a C/N ratio below 14 indicates maturity and above 14 indicates immaturity, however, there are many exceptions. Large woodchips (>6.3mm), bark, and redwood are slow to breakdown and therefore can result in a relatively stable product while the C/N ratio value is high. Additionally, some composts with chicken manure and/or green grass feedstocks can start with a C/N ratio below 15 and are very unstable. A C/N ratio below 10 supplies Nitrogen, while a ratio above 20 can deplete Nitrogen from the soil. The rate at which Nitrogen will be released or used by the microbes is indicated by the respiration rate (BAC). If the respiration rate is too high the transfer of Nitrogen will not be controlable.

Soluble Nutrients & Salts (EC5 w/w dw - mmhos/cm)

9.9 High salts This value refers to all soluble ions including nutrients, sodium, chloride and some soluble organic compounds. The concentration of salts will change due to the release of salts from the organic matter as it degrades, volatilization of ammonia, decomposition of soluble organics, and conversion of molecular structure. High salts + high AgIndex is indicative of a compost high in readily available nutrients. The application rate of these composts should be limited by the optimum nutrient value based on soil analysis of the receiving soil. High Salts + low AgIndex is indicative of a compost low in nutrients with high concentrations of sodium and/or chloride. Limit the application rate according to the toxicity level of thesodium and/or chloride. Low salts indicates that the compost can be applied without risking salt toxicity, is likely a good source of organic matter, and that nutrients will release slowly over time.

Lime Content (lbs. per ton)

0 Low lime content Compost high in lime or carbonates are often those produced from chicken manure (layers) ash materials, and lime products. These are excellent products to use on a receiving soil where lime has been recommended by soil analysis to raise the pH. Composts with a high lime content should be closely considered for pH requirements when formulating potting mixes.

Physical Properties

Percent Ash

57.0 Average ash content Ash is the non-organic fraction of a compost. Most composts contain approximately 50% ash (dry weight basis). Compost can be high in ash content for many reasons including: excess minerilzation(old compost), contamination with soil base material during turning, poor quality feedstock, and soil or mineral products added. Finding the source and reducing high ash content is often the fastest means to increasing nutrient quality of a compost.

Particle Size % > 6.3 MM (0.25")

2.7 May restrict use Large particles may restrict use for potting soils, golf course topdressings, seed-starter mixes, and where a fine size distribution is required. Composts with large particles can still be used as excellent additions to field soils, shrub mixes and mulches.

Particle Size Distribution

Each size fraction is measured by weight, volume and bulk density. These results are particularly relevent with decisions to screen or not, and if screening, which size screen to use. The bulk density indicates if the fraction screened is made of light weight organic material or heavy mineral material. Removing large mineral material can greatly improve compost quality by increasing nutrient and organic concentrations.

Appendix:		Estimated available nutrients for use when calculating application rates	lbs/ton (As Rcvd.)
Plant Available Nitrogen (PAN) calculations:			
PAN = (X * (organic N)) + ((NH4-N) + (NO3-N))			
X value =	If BAC < 2 then X = 0.1	Plant Available Nitrogen (PAN)	6.4
	If BAC =2.1 to 5 then X = 0.2	Ammonia (NH4-N)	1.52
	If BAC =5.1 to 10 then X = 0.3	Nitrate (NO3-N)	0.04
	If BAC > 10 then X = 0.4	Available Phosphorus (P2O5*0.64)	4.1
Note: If C/N ratio > 15 additional N should be applied.		Available Potassium (K2O)	13.7

US COMPOSTING COUNCIL

Seal of Testing Assurance

TCCBI - Harvest Power
John Jones
24487 Rd. 140
Tulare
CA 93274

Product Identification	Compost
Zone 1 Control	

Date Sampled/Received: 07 Sep. 12 / 14 Sep. 12

COMPOST TECHNICAL DATA SHEET

LABORATORY: Soil Control Lab; 42 Hangar Way; Watsonville, CA 95076 *tel:* 831.724.5422 *fax:* 831.724.3188

Compost Parameters	***Reported as*** *(units of measure)*	***Test Results***	***Test Results***
Plant Nutrients:	%, weight basis	Not reported	Not reported
Moisture Content	%, wet weight basis	42.3	
Organic Matter Content	%, dry weight basis	44.9	
pH	units	5.72	
Soluble Salts *(electrical conductivity EC_5)*	dS/m (mmhos/cm)	11	
Particle Size or Sieve Size	maxium aggregate size, inches	0.64	
Stability Indicator *(respirometry)*			*Stability Rating:*
CO_2 Evolution	mg CO_2-C/g OM/day	9.1	Un-Stable
	mg CO_2-C/g TS/day	4.1	
Maturity Indicator (bioassay)			
Percent Emergence	average % of control	100.0	
Relative Seedling Vigor	average % of control	91.7	
Select Pathogens	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.32(a)	Pass	*Fecal coliform*
		Pass	*Salmonella*
Trace Metals	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3.	Pass	*As,Cd,Cr,Cu,Pb,Hg*
			Mo,Ni,Se,Zn

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Laboratory Group: Sep.12 B Laboratory Number: 2090380-2/2

Analyst: Assaf Sadeh

www.compostlab.com

US COMPOSTING COUNCIL

Seal of Testing Assurance

TCCBI - Harvest Power
John Jones
24487 Rd. 140
Tulare
CA 93274

Product Identification Compost
Zone 1 Control

Date Sampled/Received: 07 Sep. 12 / 14 Sep. 12

COMPOST TECHNICAL DATA SHEET

LABORATORY: Soil Control Lab; 42 Hangar Way; Watsonville, CA 95076 *tel:* 831.724.5422 *fax:* 831.724.3188

Compost Parameters	*Reported as (units of measure)*	*Test Results*	*Test Results*
Plant Nutrients:	%, weight basis	%, wet weight basis	%, dry weight basis
Nitrogen	Total N	0.78	1.4
Phosphorus	P_2O_5	0.32	0.57
Potassium	K_2O	0.71	1.2
Calcium	Ca	1.2	2.0
Magnesium	Mg	0.24	0.42
Moisture Content	%, wet weight basis	42.3	
Organic Matter Content	%, dry weight basis	44.9	
pH	units	5.72	
Soluble Salts *(electrical conductivity EC_5)*	dS/m (mmhos/cm)	11	
Particle Size or Sieve Size	% under 9.5 mm, dw basis	97.8	
Stability Indicator *(respirometry)*			*Stability Rating:*
CO_2 Evolution	mg CO_2-C/g OM/day	9.1	Un-Stable
	mg CO_2-C/g TS/day	4.1	
Maturity Indicator (bioassay)			
Percent Emergence	average % of control	100.0	
Relative Seedling Vigor	average % of control	91.7	
Select Pathogens	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.32(a)	Pass	*Fecal coliform*
		Pass	*Salmonella*
Trace Metals	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3.	Pass	*As,Cd,Cr,Cu,Pb,Hg*
			Mo,Ni,Se,Zn

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Laboratory Group: Sep.12 B Laboratory Number: 2090380-2/2

Analyst: Assaf Sadeh

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US COMPOSTING COUNCIL

Seal of Testing Assurance

Caltrans

TCCBI - Harvest Power
John Jones
24487 Rd. 140
Tulare CA 93274

Product Identification:
Zone 1 Control

Date Sampled/Received: 07 Sep. 12 / 14 Sep. 12

COMPOST TECHNICAL DATA SHEET for Caltrans

LABORATORY: Soil Control Lab, 42 Hangar Way, Watsonville, CA 95076 tel (831) 724-5422 fax (831) 724-3188 www.compostlab.com

Compost Parameters	*Test Results*	*Reported as (units of measure)*	*TMECC Test Method*
pH	5.72	Unitless	04.11-A 1:5 Slurry pH
Soluble Salts (electrical conductivity)	11	dS/m (mmhos/cm)	04.10-A 1:5 Slurry Method Mass Basis
Moisture content	42.3	%, wet weight basis	03.09-A - Total Solids and Moisture
Organic Matter Content	44.9	%, dry weight basis	05.07-A Loss-on-Ignition Organic Matter Method (LOI)
Maturity Indicator (bioassay)			
Percent Emergence	100.0	average % of control	05.05-A Germination and vigor
Relative Seedling Vigor	91.7	average % of control	
Stability Indicator	9.1	mg CO2-C/g OM/day	05.08-B Carbon Dioxide Evoultion Rate
Particle Size	97.8	%, dry weight passing through 9.5 mm	02.02-B Sample Sieving for Aggregate Size Classification
Pathogens	Pass	PASS/FAIL: Per US EPA Class A standard, 40 CFR 503.32(a)	07.01-B Fecal coliforms
Pathogens	Pass	PASS/FAIL: Per US EPA Class A standard, 40 CFR 503.32(a)	07.02 Samonella
Physical Contaminants	None Detected	%, dry weight basis	02.02-C - Man-Made Inerts Total content
Physical Contaminants	None Detected	%, dry weight basis	02.02-C - Man-Made Inerts Sharps content
Heavy Metals Content	Pass	PASS/FAIL: Per US EPA Class A 40 CFR 503.13, tables 1 and 3.	04.06-Heavy Metals standard, and Hazardous Elements

Participants in the US Composting Council's Seal of Testing Assurance Program have shown the commitment to test their compost products on a prescribed basis and provide this data, along with compost end use instructions, as a means to better serve the needs of their compost customers.

For additional information pertaining to compost use, the specific compost parameters tested for within the Seal of Testing assurance Program, or the program in general, log on to the US Composting Council's TMECC web-site at http://www.tmecc.org.

This compost product has been sampled and tested as required by the Seal of Testing assurance Program on the United States Composting Council (USCC), using certain methods from the "Test Methods for the Examination of Compost and Composting" manual. Test results are available upon request by contacting the compost producer (address at top of page). The USCC makes no warranties regarding this product or its content, quality. or suitability for any particular use.

Laboratory Group: Sep.12 B   Laboratory Number: 2090380-2/2

Analyst: Assaf Sadeh

www.compostlab.com

ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY
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CALIFORNIA
95076
USA

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FAX: 831-724-3188
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Account #: 2090380-2/2-6908
Group: Sep.12 B #28
Reporting Date: September 26, 2012

TCCBI - Harvest Power
24487 Rd. 140
Tulare, CA 93274
Attn: John Jones

Date Received: 14 Sep. 12
Sample Identification: Zone 1 Control
Sample ID #: 2090380 - 2/2

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	1.4	0.78	%
Ammonia (NH_4-N):	1800	1100	mg/kg
Nitrate (NO_3-N):	16	9.3	mg/kg
Org. Nitrogen (Org.-N):	1.2	0.69	%
Phosphorus (as P_2O_5):	0.57	0.33	%
Phosphorus (P):	2500	1400	mg/kg
Potassium (as K_2O):	1.2	0.70	%
Potassium (K):	10000	5900	mg/kg
Calcium (Ca):	2.0	1.2	%
Magnesium (Mg):	0.42	0.24	%
Sulfate (SO_4-S):	2500	1400	mg/kg
Boron (Total B):	32	18	mg/kg
Moisture:	0	42.3	%
Sodium (Na):	0.12	0.067	%
Chloride (Cl):	0.27	0.15	%
pH Value:	NA	5.72	unit
Bulk Density :	22	38	lb/cu ft
Carbonates ($CaCO_3$):	<0.1	<0.1	lb/ton
Conductivity (EC5):	11	NA	mmhos/cm
Organic Matter:	44.9	25.9	%
Organic Carbon:	24.0	14.0	%
Ash:	55.1	31.8	%
C/N Ratio	18	18	ratio
AgIndex	8	8	ratio

Stability Indicator:		Biologically
CO2 Evolution	Respirometery	Available C
mg CO_2-C/g OM/day	9.1	12
mg CO_2-C/g TS/day	4.1	5.3
Stability Rating	*unstable*	*unstable*

Maturity Indicator: Cucumber Bioassay		
Compost:Vermiculite(v:v)	1:1	1:3
Emergence (%)	100	100
Seedling Vigor (%)	92	93
Description of Plants	*fungus*	*fungus*

Pathogens	Results	Units	Rating
Fecal Coliform	< 2.0	MPN/g	*pass*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 14 Sep. 12

Inerts	% by weight
Plastic	< 0.5
Glass	< 0.5
Metal	< 0.5
Sharps	ND

Metals	Dry wt.	EPA Limit	units
Aluminum (Al)	6600	-	mg/kg
Arsenic (As):	3.6	41	mg/kg
Cadmium (Cd):	< 1.0	39	mg/kg
Chromium (Cr):	15	1200	mg/kg
Cobalt (Co)	3.5	-	mg/kg
Copper (Cu):	53	1500	mg/kg
Iron (Fe):	9000	-	mg/kg
Lead (Pb):	22	300	mg/kg
Manganese (Mn):	210	-	mg/kg
Mercury (Hg):	< 1.0	17	mg/kg
Molybdenum (Mo):	2.3	75	mg/kg
Nickel (Ni):	10	420	mg/kg
Selenium (Se):	< 1.0	36	mg/kg
Zinc (Zn):	170	2800	mg/kg

Size & Volume Distribution			
MM	% by weight	% by volume	BD g/cc
> 50	0.0	0.0	0.00
25 to 50	0.0	0.0	0.00
16 to 25	0.0	0.0	0.00
9.5 to 16	2.2	1.6	0.47
6.3 to 9.5	3.9	4.6	0.29
4.0 to 6.3	9.3	11.7	0.27
2.0 to 4.0	18.3	24.8	0.25
< 2.0	66.3	57.4	0.39

Bulk Density Description:<.35 Light Materials,
.35-.60 medium weight materials, >.60 Heavy Materials

Analyst: Assaf Sadeh

Assaf Sadeh

*Sample was received and handled in accordance with TMECC procedures.

Account No.: 2090380 - 2/2 - 6908
Group: Sep.12 B No. 28

Date Received: 14 Sep. 12
Sample i.d.: Zone 1 Control
Sample I.d. No.: 2/2 2090380

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate — Biodegradation Rate of Your Pile
9.1 mg CO2-C/ g OM/day
+++++++++++++++++++++++++++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Biologically Available Carbon (BAC) — Optimum Degradation Rate
12 mg CO2-C/ g OM/day
+++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Is Your Compost Mature?

AmmoniaN/NitrateN ratio
110 Ratio
++
VeryMature>|< Mature >|< Immature

Ammonia N ppm
1800 mg/kg dry wt.
++
VeryMature>|< Mature >|< Immature

Nitrate N ppm
16 mg/kg dry wt.
++++++++++++
< Immature >|< Mature

pH value
5.72 units
+++
< Immature >|< Mature >|< Immature

Cucumber Emergence
100.0 percent
+++
< Immature >|< Mature

Is Your Compost Safe Regarding Health?

Fecal Coliform
< 1000 MPN/g dry wt.
+++++++
< Safe >|< High Fecal Coliform

Salmonella
Less than 3 /4g dry wt.
+++++++
<Safe (none detected) >|< High Salmonella Count(> 3 per 4 grams)

Metals US EPA 503
Pass dry wt.
+++++++++
<All Metals Pass >|< One or more Metals Fail

Does Your Compost Provide Nutrients or Organic Matter?

Nutrients (N+P2O5+K2O)
3.2 Percent dry wt.
+++++++++++++++++++++++++
<Low >|< Average >|< High Nutrient Content

AgIndex (Nutrients / Sodium and Chloride Salts) — ((N+P2O5+K2O) / (Na + Cl))
8 Ratio
++
Na & Cl >|< Nutrient and Sodium and Chloride Provider >|< Nutrient Provider

Plant Available Nitrogen (PAN) — Estimated release for first season
8 lbs/ton wet wt.
+++++++++++++++++++++++++++++++++
Low Nitrogen Provider>|< Average Nitrogen Provider >|<High Nitrogen Provider

C/N Ratio
18 Ratio
+++++++++++++++++++++++++++++++++++
< Nitrogen Release >|< N-Neutral >|< N-Demand>|< High Nitrogen Demand

Soluble Available Nutrients & Salts (EC5 w/w dw)
11 mmhos/cm dry wt.
+++
SloRelease>|< Average Nutrient Release Rate >|<High Available Nutrients

Lime Content (CaCO3)
0 Lbs/ton dry wt.
+
< Low >|< Average >|< High Lime Content (as CaCO3)

What are the physical properties of your compost?

Percent Ash
55.1 Percent dry wt.
+++
< High Organic Matter >|< Average >|< High Ash Content

Sieve Size % > 6.3 MM (0.25")
6.1 Percent dry wt.
++
All Uses >|< Size May Restrict Uses for Potting mix and Golf Courses

Account No.:		Date Received	14 Sep. 12
2090380 - 2/2 - 6908		Sample i.d.	Zone 1 Control
Group:	Sep.12 B No. 28	Sample I.d. No.	2/2 2090380

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate

9.1 Moderate-selected use mg CO2-C/g OM/day

The respiration rate is a measurement of the biodegradation rate of the organic matter in the sample (as received). The respiration rate is determined by measuring the rate at which CO2 is released under optimized moisture and temperature conditions.

Biologically Available Carbon

12 Moderate-selected use mg CO2-C/g OM/day

Biologically Available Carbon (BAC) is a measurement of the rate at which CO2 is released under optimized moisture, temperature, porosity, nutrients, pH and microbial conditions. If both the RR and the BAC test values are close to the same value, the pile is optimized for composting. If both values are high the compost pile just needs more time. If both values are low the compost has stabilized and should be moved to curing. BAC test values that are higher than RR indicate that the compost pile has stalled. This could be due to anaerobic conditions, lack of available nitrogen due to excessive air converting ammonia to the unavailable nitrate form, lack of nitrogen or other nutrients due to poor choice of feedstock, pH value out of range, or microbes rendered non-active.

Is Your Compost Mature?

AmmoniaN:NitrateN ratio

110 immature

Ammonia N ppm

1800 immature

Nitrate N ppm

16 immature

pH value

5.72 immature

Composting to stabilize carbon can occur at such a rapid rate that sometimes phytotoxins remain in the compost and must be neutralized before using in high concentrations or in high-end uses. This step is called curing. Typically ammonia is in excess with the break-down of organic materials resulting in an increase in pH. This combination results in a loss of volatile ammonia (it smells). Once this toxic ammonia has been reduced and the pH drops, the microbes convert the ammonia to nitrates. A low ammonia + high nitrate score is indicative of a mature compost, however there are many exceptions. For example, a compost with a low pH (<7) will retain ammonia, while a compost with high lime content can lose ammonia before the organic fraction becomes stable. Composts must first be stable before curing indicators apply.

Cucumber Bioassay

100.0 Percent

Cucumbers are chosen for this test because they are salt tolerant and very sensitive to ammonia and organic acid toxicity. Therefore, we can germinate seeds in high concentrations of compost to measure phytotoxic effects without soluble salts being the limiting factor. Values above 80% for both percent emergence and vigor are indicative of a well-cured compost. Exceptions include very high salts that affect the cucumbers, excessive concentrations of nitrates and other nutrients that will be in range when formulated to make a growing media. In addition to testing a 1:1 compost: vermiculite blend, we also test a diluted 1:3 blend to indicate a more sensitive toxicity level.

Is Your Compost Safe Regarding Health?

Fecal Coliform

< 1000 / g dry wt.

Fecal coliforms can survive in both aerobic and anaerobic conditions and is common in all initial compost piles. Most human pathogens occur from fecal matter and all fecal matter is loaded in fecal coliforms. Therefore fecal coliforms are used as an indicator to determine if the chosen method for pathogen reduction (heat for compost) has met the requirements of sufficient temperature, time and mixing. If the fecal coliforms are reduced to below 1000 per gram dry wt. it is assumed all others pathogens are eliminated. Potential problems are that fecal coliform can regrow during the curing phase or during shipping. This is because the conditions are now more favorable for growth than during the composting process.

Salmonella Bacteria

Less than 3 3 / 4g dry wt.

Salmonella is not only another indicator organism but also a toxic microbe. It has been used in the case of biosolids industry to determine adequate pathogen reduction.

Metals

Pass

The ten heavy metals listed in the EPA 503 regulations are chosen to determine if compost can be applied to ag land and handled without toxic effects. Most high concentrations of heavy metals are derived from woodwaste feedstock such as chrome-arsenic treated or lead painted demolition wood. Biosolids are rarely a problem.

Does Your Compost Provide Nutrients or Organic Matter?

Nutrients (N+P2O5+K2O)

3.2 Average nutrient content

This value is the sum of the primary nutrients Nitrogen, Phosphorus and Potassium. Reported units are consistent with those found on fertilizer formulations. A sum greater than 5 is indicative of a compost with high nutrient content, and best used to supply nutrients to a receiving soil. A sum below 2 indicates low nutrient content, and is best-used to improve soil structure via the addition of organic matter. Most compost falls between 2 and 5.

Account No.:		Date Received	14 Sep. 12	
2090380 - 2/2 - 6908		Sample i.d.	Zone 1 Control	
Group:	Sep.12 B No. 28	Sample I.d. No.	2/2	2090380

INTERPRETATION:

AgIndex (Nutrients/Na+Cl)

8 Average nutrient ratio Composts with low AgIndex values have high concentrations of sodium and/or chloride compared to nutrients. Repeated use of a compost with a low AgIndex (< 2) may result in sodium and/or chloride acting as the limiting factor compared to nutrients, governing application rates. These composts may be used on well-draining soils and/or with salt-tolerant plants. Additional nutrients form another source may be needed if the application rate is limited by sodium or chloride. If the AgIndex is above 10, nutrients optimal for plant growth will be available without concern of sodium and/or chloride toxicity. Composts with an AgIndex of above 10 are good for increasing nutrient levels for all soils. Most composts score between 2 and 10. Concentrations of nutrients, sodium, and chloride in the receiving soil should be considered when determining compost application rates. The AgIndex is a product of feedstock quality. Feedstock from dairy manure, marine waste, industrial wastes, and halophytic plants are likely to produce a finished compost with a low AgIndex.

Plant Available Nitrogen (lbs/ton)

8 Average N Provider Plant Available Nitrogen (PAN) is calculated by estimating the release rate of Nitrogen from the organic fraction of the compost. This estimate is based on information gathered from the BAC test and measured ammonia and nitrate values. Despite the PAN value of the compost, additional sources of Nitrogen may be needed during he growing season to off-set the Nitrogen demand of the microbes present in the compost. With ample nutrients these microbes can further breakdown organic matter in the compost and release bound Nitrogen. Nitrogen demand based on a high C/N ratio is not considered in the PAN calculation because additional Nitrogen should always be supplemented to the receiving soil when composts with a high C/N ratio are applied.

C/N Ratio

18 Indicates immaturity As a guiding principal, a C/N ratio below 14 indicates maturity and above 14 indicates immaturity, however, there are many exceptions. Large woodchips (>6.3mm), bark, and redwood are slow to breakdown and therefore can result in a relatively stable product while the C/N ratio value is high. Additionally, some composts with chicken manure and/or green grass feedstocks can start with a C/N ratio below 15 and are very unstable. A C/N ratio below 10 supplies Nitrogen, while a ratio above 20 can deplete Nitrogen from the soil. The rate at which Nitrogen will be released or used by the microbes is indicated by the respiration rate (BAC). If the respiration rate is too high the transfer of Nitrogen will not be controlable.

Soluble Nutrients & Salts (EC5 w/w dw - mmhos/cm)

11 High salts This value refers to all soluble ions including nutrients, sodium, chloride and some soluble organic compounds. The concentration of salts will change due to the release of salts from the organic matter as it degrades, volatilization of ammonia, decomposition of soluble organics, and conversion of molecular structure. High salts + high AgIndex is indicative of a compost high in readily available nutrients. The application rate of these composts should be limited by the optimum nutrient value based on soil analysis of the receiving soil. High Salts + low AgIndex is indicative of a compost low in nutrients with high concentrations of sodium and/or chloride. Limit the application rate according to the toxicity level of thesodium and/or chloride. Low salts indicates that the compost can be applied without risking salt toxicity, is likely a good source of organic matter, and that nutrients will release slowly over time.

Lime Content (lbs. per ton)

0 Low lime content Compost high in lime or carbonates are often those produced from chicken manure (layers) ash materials, and lime products. These are excellent products to use on a receiving soil where lime has been recommended by soil analysis to raise the pH. Composts with a high lime content should be closely considered for pH requirements when formulating potting mixes.

Physical Properties

Percent Ash

55.1 Average ash content Ash is the non-organic fraction of a compost. Most composts contain approximately 50% ash (dry weight basis). Compost can be high in ash content for many reasons including: excess minerilzation(old compost), contamination with soil base material during turning, poor quality feedstock, and soil or mineral products added. Finding the source and reducing high ash content is often the fastest means to increasing nutrient quality of a compost.

Particle Size % > 6.3 MM (0.25")

6.1 May restrict use Large particles may restrict use for potting soils, golf course topdressings, seed-starter mixes, and where a fine size distribution is required. Composts with large particles can still be used as excellent additions to field soils, shrub mixes and mulches.

Particle Size Distribution

Each size fraction is measured by weight, volume and bulk density. These results are particularly relevent with decisions to screen or not, and if screening, which size screen to use. The bulk density indicates if the fraction screened is made of light weight organic material or heavy mineral material. Removing large mineral material can greatly improve compost quality by increasing nutrient and organic concentrations.

Appendix:			
		Estimated available nutrients for use when calculating application rates	
Plant Available Nitrogen (PAN) calculations:			lbs/ton (As Rcvd.)
PAN = (X * (organic N)) + ((NH4-N) + (NO3-N))			
X value =	If BAC < 2 then X = 0.1	Plant Available Nitrogen (PAN)	8.4
	If BAC =2.1 to 5 then X = 0.2	Ammonia (NH4-N)	2.20
	If BAC =5.1 to 10 then X = 0.3	Nitrate (NO3-N)	0.02
	If BAC > 10 then X = 0.4	Available Phosphorus (P2O5*0.64)	4.1
Note: If C/N ratio > 15 additional N should be applied.		Available Potassium (K2O)	14.2

US COMPOSTING COUNCIL

Seal of Testing Assurance

TCCBI - Harvest Power
John Jones
24487 Rd. 140
Tulare
CA 93274

Product Identification Compost
Zone 2

Date Sampled/Received: 12 Sep. 12 / 14 Sep. 12

COMPOST TECHNICAL DATA SHEET

LABORATORY: Soil Control Lab; 42 Hangar Way; Watsonville, CA 95076 *tel:* 831.724.5422 *fax:* 831.724.3188

Compost Parameters	***Reported as** (units of measure)*	***Test Results***	***Test Results***
Plant Nutrients:	%, weight basis	Not reported	Not reported
Moisture Content	%, wet weight basis	37.8	
Organic Matter Content	%, dry weight basis	46.5	
pH	units	6.20	
Soluble Salts *(electrical conductivity EC_5)*	dS/m (mmhos/cm)	7.4	
Particle Size or Sieve Size	maxium aggregate size, inches	0.64	
Stability Indicator *(respirometry)*			*Stability Rating:*
CO_2 Evolution	mg CO_2-C/g OM/day	7.9	Moderately Un-Stable
	mg CO_2-C/g TS/day	3.7	
Maturity Indicator (bioassay)			
Percent Emergence	average % of control	100.0	
Relative Seedling Vigor	average % of control	91.7	
Select Pathogens	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.32(a)	Pass	*Fecal coliform*
		Pass	*Salmonella*
Trace Metals	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3.	Pass	*As,Cd,Cr,Cu,Pb,Hg*
			Mo,Ni,Se,Zn

Participants in the US Composting Council's Seal of Testing Assurance Program have shown the commitment to test their compost products on a prescribed basis and provide this data, along with compost end use instructions, as a means to better serve the needs of their compost customers.

Laboratory Group: Sep.12 B Laboratory Number: 2090381-1/2

Analyst: Assaf Sadeh

www.compostlab.com

US COMPOSTING COUNCIL

Seal of Testing Assurance

Date Sampled/Received: 12 Sep. 12 / 14 Sep. 12

TCCBI - Harvest Power
John Jones
24487 Rd. 140
Tulare
CA 93274

Product Identification	Compost
Zone 2	

COMPOST TECHNICAL DATA SHEET

LABORATORY: Soil Control Lab; 42 Hangar Way; Watsonville, CA 95076 *tel:* 831.724.5422 *fax:* 831.724.3188

Compost Parameters	***Reported as** (units of measure)*	***Test Results***	***Test Results***
Plant Nutrients:	%, weight basis	%, wet weight basis	%, dry weight basis
Nitrogen	Total N	0.99	1.6
Phosphorus	P_2O_5	0.39	0.64
Potassium	K_2O	0.89	1.4
Calcium	Ca	1.3	2.1
Magnesium	Mg	0.30	0.48
Moisture Content	%, wet weight basis	37.8	
Organic Matter Content	%, dry weight basis	46.5	
pH	units	6.20	
Soluble Salts *(electrical conductivity EC_5)*	dS/m (mmhos/cm)	7.4	
Particle Size or Sieve Size	% under 9.5 mm, dw basis	94.7	
Stability Indicator *(respirometry)*			*Stability Rating:*
CO_2 Evolution	mg CO_2-C/g OM/day	7.9	Moderately Un-Stable
	mg CO_2-C/g TS/day	3.7	
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			Mo,Ni,Se,Zn

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Seal of Testing Assurance

Caltrans

TCCBI - Harvest Power
John Jones
24487 Rd. 140
Tulare CA 93274

Product Identification:

Zone 2

Date Sampled/Received: 12 Sep. 12 / 14 Sep. 12

COMPOST TECHNICAL DATA SHEET for Caltrans

LABORATORY: Soil Control Lab, 42 Hangar Way, Watsonville, CA 95076 tel (831) 724-5422 fax (831) 724-3188 www.compostlab.com

Compost Parameters	***Test Results***	***Reported as** (units of measure)*	***TMECC Test Method***
pH	6.20	Unitless	04.11-A 1:5 Slurry pH
Soluble Salts (electrical conductivity)	7.4	dS/m (mmhos/cm)	04.10-A 1:5 Slurry Method Mass Basis
Moisture content	37.8	%, wet weight basis	03.09-A - Total Solids and Moisture
Organic Matter Content	46.5	%, dry weight basis	05.07-A Loss-on-Ignition Organic Matter Method (LOI)
Maturity Indicator (bioassay)			
Percent Emergence	100.0	average % of control	05.05-A Germination and vigor
Relative Seedling Vigor	91.7	average % of control	
Stability Indicator	7.9	mg CO2-C/g OM/day	05.08-B Carbon Dioxide Evoultion Rate
Particle Size	94.7	%, dry weight passing through 9.5 mm	02.02-B Sample Sieving for Aggregate Size Classification
Pathogens	Pass	PASS/FAIL: Per US EPA Class A standard, 40 CFR 503.32(a)	07.01-B Fecal coliforms
Pathogens	Pass	PASS/FAIL: Per US EPA Class A standard, 40 CFR 503.32(a)	07.02 Samonella
Physical Contaminants	None Detected	%, dry weight basis	02.02-C - Man-Made Inerts Total content
Physical Contaminants	None Detected	%, dry weight basis	02.02-C - Man-Made Inerts Sharps content
Heavy Metals Content	Pass	PASS/FAIL: Per US EPA Class A 40 CFR 503.13, tables 1 and 3.	04.06-Heavy Metals standard, and Hazardous Elements

Participants in the US Composting Council's Seal of Testing Assurance Program have shown the commitment to test their compost products on a prescribed basis and provide this data, along with compost end use instructions, as a means to better serve the needs of their compost customers.

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This compost product has been sampled and tested as required by the Seal of Testing assurance Program on the United States Composting Council (USCC), using certain methods from the "Test Methods for the Examination of Compost and Composting" manual. Test results are available upon request by contacting the compost producer (address at top of page). The USCC makes no warranties regarding this product or its content, quality. or suitability for any particular use.

Laboratory Group: Sep.12 B | Laboratory Number: 2090381-1/2

Analyst: Assaf Sadeh

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ANALYTICAL CHEMISTS and BACTERIOLOGISTS
Approved by State of California
SOIL CONTROL LAB
42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

TEL: 831-724-5422
FAX: 831-724-3188
www.compostlab.com

Account #: 2090381-1/2-6908
Group: Sep.12 B #29
Reporting Date: September 26, 2012

TCCBI - Harvest Power
24487 Rd. 140
Tulare, CA 93274
Attn: John Jones

Date Received: 14 Sep. 12
Sample Identification: Zone 2
Sample ID #: 2090381 - 1/2

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	1.6	0.99	%
Ammonia (NH_4-N):	1200	760	mg/kg
Nitrate (NO_3-N):	38	24	mg/kg
Org. Nitrogen (Org.-N):	1.5	0.93	%
Phosphorus (as P_2O_5):	0.63	0.39	%
Phosphorus (P):	2800	1700	mg/kg
Potassium (as K_2O):	1.4	0.89	%
Potassium (K):	12000	7400	mg/kg
Calcium (Ca):	2.1	1.3	%
Magnesium (Mg):	0.48	0.30	%
Sulfate (SO_4-S):	1000	620	mg/kg
Boron (Total B):	34	21	mg/kg
Moisture:	0	37.8	%
Sodium (Na):	0.13	0.080	%
Chloride (Cl):	0.26	0.16	%
pH Value:	NA	6.20	unit
Bulk Density :	22	36	lb/cu ft
Carbonates ($CaCO_3$):	<0.1	<0.1	lb/ton
Conductivity (EC5):	7.4	NA	mmhos/cm
Organic Matter:	46.5	28.9	%
Organic Carbon:	27.0	17.0	%
Ash:	53.5	33.2	%
C/N Ratio	17	17	ratio
AgIndex	9	9	ratio

Stability Indicator:		Biologically
CO2 Evolution	Respirometery	Available C
mg CO_2-C/g OM/day	7.9	9.5
mg CO_2-C/g TS/day	3.7	4.4
Stability Rating	*moderately unstable*	*unstable*

Maturity Indicator: Cucumber Bioassay		
Compost:Vermiculite(v:v)	1:1	1:3
Emergence (%)	100	100
Seedling Vigor (%)	92	93
Description of Plants	*mushroom*	*mushroom*

Pathogens	Results	Units	Rating
Fecal Coliform	< 2.0	MPN/g	*pass*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 14 Sep. 12

Inerts	% by weight
Plastic	< 0.5
Glass	< 0.5
Metal	< 0.5
Sharps	ND

Metals	Dry wt.	EPA Limit	units
Aluminum (Al)	6300	-	mg/kg
Arsenic (As):	2.8	41	mg/kg
Cadmium (Cd):	< 1.0	39	mg/kg
Chromium (Cr):	14	1200	mg/kg
Cobalt (Co)	3.7	-	mg/kg
Copper (Cu):	61	1500	mg/kg
Iron (Fe):	9300	-	mg/kg
Lead (Pb):	20	300	mg/kg
Manganese (Mn):	230	-	mg/kg
Mercury (Hg):	< 1.0	17	mg/kg
Molybdenum (Mo):	2.7	75	mg/kg
Nickel (Ni):	12	420	mg/kg
Selenium (Se):	< 1.0	36	mg/kg
Zinc (Zn):	170	2800	mg/kg

Size & Volume Distribution

MM	% by weight	% by volume	BD g/cc
> 50	0.0	0.0	0.00
25 to 50	0.0	0.0	0.00
16 to 25	0.0	0.0	0.00
9.5 to 16	5.3	3.1	0.66
6.3 to 9.5	9.8	10.8	0.34
4.0 to 6.3	8.8	10.8	0.31
2.0 to 4.0	14.4	21.5	0.25
< 2.0	61.6	53.8	0.43

Bulk Density Description:<.35 Light Materials, .35-.60 medium weight materials, >.60 Heavy Materials

Analyst: Assaf Sadeh

*Sample was received and handled in accordance with TMECC procedures.

Account No.: 2090381 - 1/2 - 6908
Group: Sep.12 B No. 29

Date Received 14 Sep. 12
Sample i.d. Zone 2
Sample I.d. No. 1/2 2090381

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate — Biodegradation Rate of Your Pile
7.9 mg CO2-C/ g OM/day
++++++++++++++++++++++++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Biologically Available Carbon (BAC) — Optimum Degradation Rate
9.5 mg CO2-C/ g OM/day
++++++++++++++++++++++++++++++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Is Your Compost Mature?

AmmoniaN/NitrateN ratio
32 Ratio
++
VeryMature>|< Mature >|< Immature

Ammonia N ppm
1200 mg/kg dry wt.
++
VeryMature>|< Mature >|< Immature

Nitrate N ppm
38 mg/kg dry wt.
+++++++++++++++++++++++++++++++
< Immature >|< Mature

pH value
6.20 units
+++
< Immature >|< Mature >|< Immature

Cucumber Emergence
100.0 percent
+++
< Immature >|< Mature

Is Your Compost Safe Regarding Health?

Fecal Coliform
< 1000 MPN/g dry wt.
+++++++
< Safe >|< High Fecal Coliform

Salmonella
Less than 3 /4g dry wt.
+++++++
<Safe (none detected) >|< High Salmonella Count(> 3 per 4 grams)

Metals US EPA 503
Pass dry wt.
+++++++++
<All Metals Pass >|< One or more Metals Fail

Does Your Compost Provide Nutrients or Organic Matter?

Nutrients (N+P2O5+K2O)
3.7 Percent dry wt.
++++++++++++++++++++++++++++++
<Low >|< Average >|< High Nutrient Content

AgIndex (Nutrients / Sodium and Chloride Salts) ((N+P2O5+K2O) / (Na + Cl))
9 Ratio
++
Na & Cl >|< Nutrient and Sodium and Chloride Provider >|< Nutrient Provider

Plant Available Nitrogen (PAN) — Estimated release for first season
8 lbs/ton wet wt.
+++++++++++++++++++++++++++++++
Low Nitrogen Provider>|< Average Nitrogen Provider >|<High Nitrogen Provider

C/N Ratio
17 Ratio
++++++++++++++++++++++++++++++++++
< Nitrogen Release >|< N-Neutral >|< N-Demand>|< High Nitrogen Demand

Soluble Available Nutrients & Salts (EC5 w/w dw)
7.4 mmhos/cm dry wt.
+++++++++++++++++++++++++++++++++++++++
SloRelease>|< Average Nutrient Release Rate >|<High Available Nutrients

Lime Content (CaCO3)
0 Lbs/ton dry wt.
+
< Low >|< Average >|< High Lime Content (as CaCO3)

What are the physical properties of your compost?

Percent Ash
53.5 Percent dry wt.
+++
< High Organic Matter >|< Average >|< High Ash Content

Sieve Size % > 6.3 MM (0.25")
15.2 Percent dry wt.
++
All Uses >|< Size May Restrict Uses for Potting mix and Golf Courses

Account No.:		Date Received	14 Sep. 12	
2090381 - 1/2 - 6908		Sample i.d.	Zone 2	
Group:	Sep.12 B No. 29	Sample I.d. No.	1/2	2090381

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate

7.9 Moderate-selected use mg CO2-C/g OM/day

The respiration rate is a measurement of the biodegradation rate of the organic matter in the sample (as received). The respiration rate is determined by measuring the rate at which CO2 is released under optimized moisture and temperature conditions.

Biologically Available Carbon

9.5 Moderate-selected use mg CO2-C/g OM/day

Biologically Available Carbon (BAC) is a measurement of the rate at which CO2 is released under optimized moisture, temperature, porosity, nutrients, pH and microbial conditions. If both the RR and the BAC test values are close to the same value, the pile is optimized for composting. If both values are high the compost pile just needs more time. If both values are low the compost has stabilized and should be moved to curing. BAC test values that are higher than RR indicate that the compost pile has stalled. This could be due to anaerobic conditions, lack of available nitrogen due to excessive air converting ammonia to the unavailable nitrate form, lack of nitrogen or other nutrients due to poor choice of feedstock, pH value out of range, or microbes rendered non-active.

Is Your Compost Mature?

AmmoniaN:NitrateN ratio

32 immature

Ammonia N ppm

1200 immature

Nitrate N ppm

38 immature

pH value

6.20 immature

Composting to stabilize carbon can occur at such a rapid rate that sometimes phytotoxins remain in the compost and must be neutralized before using in high concentrations or in high-end uses. This step is called curing. Typically ammonia is in excess with the break-down of organic materials resulting in an increase in pH. This combination results in a loss of volatile ammonia (it smells). Once this toxic ammonia has been reduced and the pH drops, the microbes convert the ammonia to nitrates. A low ammonia + high nitrate score is indicative of a mature compost, however there are many exceptions. For example, a compost with a low pH (<7) will retain ammonia, while a compost with high lime content can lose ammonia before the organic fraction becomes stable. Composts must first be stable before curing indicators apply.

Cucumber Bioassay

100.0 Percent

Cucumbers are chosen for this test because they are salt tolerant and very sensitive to ammonia and organic acid toxicity. Therefore, we can germinate seeds in high concentrations of compost to measure phytotoxic effects without soluble salts being the limiting factor. Values above 80% for both percent emergence and vigor are indicative of a well-cured compost. Exceptions include very high salts that affect the cucumbers, excessive concentrations of nitrates and other nutrients that will be in range when formulated to make a growing media. In addition to testing a 1:1 compost: vermiculite blend, we also test a diluted 1:3 blend to indicate a more sensitive toxicity level.

Is Your Compost Safe Regarding Health?

Fecal Coliform

< 1000 / g dry wt.

Fecal coliforms can survive in both aerobic and anaerobic conditions and is common in all initial compost piles. Most human pathogens occur from fecal matter and all fecal matter is loaded in fecal coliforms. Therefore fecal coliforms are used as an indicator to determine if the chosen method for pathogen reduction (heat for compost) has met the requirements of sufficient temperature, time and mixing. If the fecal coliforms are reduced to below 1000 per gram dry wt. it is assumed all others pathogens are eliminated. Potential problems are that fecal coliform can regrow during the curing phase or during shipping. This is because the conditions are now more favorable for growth than during the composting process.

Salmonella Bacteria

Less than 3 3 / 4g dry wt.

Salmonella is not only another indicator organism but also a toxic microbe. It has been used in the case of biosolids industry to determine adequate pathogen reduction.

Metals

Pass

The ten heavy metals listed in the EPA 503 regulations are chosen to determine if compost can be applied to ag land and handled without toxic effects. Most high concentrations of heavy metals are derived from woodwaste feedstock such as chrome-arsenic treated or lead painted demolition wood. Biosolids are rarely a problem.

Does Your Compost Provide Nutrients or Organic Matter?

Nutrients (N+P2O5+K2O)

3.7 Average nutrient content

This value is the sum of the primary nutrients Nitrogen, Phosphorus and Potassium. Reported units are consistent with those found on fertilizer formulations. A sum greater than 5 is indicative of a compost with high nutrient content, and best used to supply nutrients to a receiving soil. A sum below 2 indicates low nutrient content, and is best-used to improve soil structure via the addition of organic matter. Most compost falls between 2 and 5.

Account No.:		Date Received	14 Sep. 12	
2090381 - 1/2 - 6908		Sample i.d.	Zone 2	
Group:	Sep.12 B No. 29	Sample I.d. No.	1/2	2090381

INTERPRETATION:

AgIndex (Nutrients/Na+Cl)

9 Average nutrient ratio Composts with low AgIndex values have high concentrations of sodium and/or chloride compared to nutrients. Repeated use of a compost with a low AgIndex (< 2) may result in sodium and/or chloride acting as the limiting factor compared to nutrients, governing application rates. These composts may be used on well-draining soils and/or with salt-tolerant plants. Additional nutrients form another source may be needed if the application rate is limited by sodium or chloride. If the AgIndex is above 10, nutrients optimal for plant growth will be available without concern of sodium and/or chloride toxicity. Composts with an AgIndex of above 10 are good for increasing nutrient levels for all soils. Most composts score between 2 and 10. Concentrations of nutrients, sodium, and chloride in the receiving soil should be considered when determining compost application rates. The AgIndex is a product of feedstock quality. Feedstock from dairy manure, marine waste, industrial wastes, and halophytic plants are likely to produce a finished compost with a low AgIndex.

Plant Available Nitrogen (lbs/ton)

8 Average N Provider Plant Available Nitrogen (PAN) is calculated by estimating the release rate of Nitrogen from the organic fraction of the compost. This estimate is based on information gathered from the BAC test and measured ammonia and nitrate values. Despite the PAN value of the compost, additional sources of Nitrogen may be needed during he growing season to off-set the Nitrogen demand of the microbes present in the compost. With ample nutrients these microbes can further breakdown organic matter in the compost and release bound Nitrogen. Nitrogen demand based on a high C/N ratio is not considered in the PAN calculation because additional Nitrogen should always be supplemented to the receiving soil when composts with a high C/N ratio are applied.

C/N Ratio

17 Indicates immaturity As a guiding principal, a C/N ratio below 14 indicates maturity and above 14 indicates immaturity, however, there are many exceptions. Large woodchips (>6.3mm), bark, and redwood are slow to breakdown and therefore can result in a relatively stable product while the C/N ratio value is high. Additionally, some composts with chicken manure and/or green grass feedstocks can start with a C/N ratio below 15 and are very unstable. A C/N ratio below 10 supplies Nitrogen, while a ratio above 20 can deplete Nitrogen from the soil. The rate at which Nitrogen will be released or used by the microbes is indicated by the respiration rate (BAC). If the respiration rate is too high the transfer of Nitrogen will not be controlable.

Soluble Nutrients & Salts (EC5 w/w dw - mmhos/cm)

7.4 Average salts This value refers to all soluble ions including nutrients, sodium, chloride and some soluble organic compounds. The concentration of salts will change due to the release of salts from the organic matter as it degrades, volatilization of ammonia, decomposition of soluble organics, and conversion of molecular structure. High salts + high AgIndex is indicative of a compost high in readily available nutrients. The application rate of these composts should be limited by the optimum nutrient value based on soil analysis of the receiving soil. High Salts + low AgIndex is indicative of a compost low in nutrients with high concentrations of sodium and/or chloride. Limit the application rate according to the toxicity level of thesodium and/or chloride. Low salts indicates that the compost can be applied without risking salt toxicity, is likely a good source of organic matter, and that nutrients will release slowly over time.

Lime Content (lbs. per ton)

0 Low lime content Compost high in lime or carbonates are often those produced from chicken manure (layers) ash materials, and lime products. These are excellent products to use on a receiving soil where lime has been recommended by soil analysis to raise the pH. Composts with a high lime content should be closely considered for pH requirements when formulating potting mixes.

Physical Properties

Percent Ash

53.5 Average ash content Ash is the non-organic fraction of a compost. Most composts contain approximately 50% ash (dry weight basis). Compost can be high in ash content for many reasons including: excess minerilzation(old compost), contamination with soil base material during turning, poor quality feedstock, and soil or mineral products added. Finding the source and reducing high ash content is often the fastest means to increasing nutrient quality of a compost.

Particle Size % > 6.3 MM (0.25")

15.2 May restrict use Large particles may restrict use for potting soils, golf course topdressings, seed-starter mixes, and where a fine size distribution is required. Composts with large particles can still be used as excellent additions to field soils, shrub mixes and mulches.

Particle Size Distribution

Each size fraction is measured by weight, volume and bulk density. These results are particularly relevent with decisions to screen or not, and if screening, which size screen to use. The bulk density indicates if the fraction screened is made of light weight organic material or heavy mineral material. Removing large mineral material can greatly improve compost quality by increasing nutrient and organic concentrations.

Appendix:			
		Estimated available nutrients for use when calculating application rates	
Plant Available Nitrogen (PAN) calculations:			lbs/ton (As Rcvd.)
PAN = (X * (organic N)) + ((NH4-N) + (NO3-N))			
X value =	If BAC < 2 then X = 0.1	Plant Available Nitrogen (PAN)	7.7
	If BAC =2.1 to 5 then X = 0.2	Ammonia (NH4-N)	1.52
	If BAC =5.1 to 10 then X = 0.3	Nitrate (NO3-N)	0.05
	If BAC > 10 then X = 0.4	Available Phosphorus (P2O5*0.64)	4.9
Note: If C/N ratio > 15 additional N should be applied.		Available Potassium (K2O)	17.8

US COMPOSTING COUNCIL

Seal of Testing Assurance

TCCBI - Harvest Power
John Jones
24487 Rd. 140
Tulare
CA 93274

Product Identification Compost
Zone 2 Control

Date Sampled/Received: 12 Sep. 12 / 14 Sep. 12

COMPOST TECHNICAL DATA SHEET

LABORATORY: Soil Control Lab; 42 Hangar Way; Watsonville, CA 95076 *tel:* 831.724.5422 *fax:* 831.724.3188

Compost Parameters	***Reported as*** ***(units of measure)***	***Test Results***	***Test Results***
Plant Nutrients:	%, weight basis	Not reported	Not reported
Moisture Content	%, wet weight basis	39.8	
Organic Matter Content	%, dry weight basis	42.6	
pH	units	6.32	
Soluble Salts *(electrical conductivity EC_5)*	dS/m (mmhos/cm)	9.7	
Particle Size or Sieve Size	maxium aggregate size, inches	0.64	
Stability Indicator *(respirometry)*			*Stability Rating:*
CO_2 Evolution	mg CO_2-C/g OM/day	10	Un-Stable
	mg CO_2-C/g TS/day	4.3	
Maturity Indicator (bioassay)			
Percent Emergence	average % of control	100.0	
Relative Seedling Vigor	average % of control	91.7	
Select Pathogens	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.32(a)	Pass	*Fecal coliform*
		Pass	*Salmonella*
Trace Metals	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3.	Pass	*As,Cd,Cr,Cu,Pb,Hg*
			Mo,Ni,Se,Zn

Participants in the US Composting Council's Seal of Testing Assurance Program have shown the commitment to test their compost products on a prescribed basis and provide this data, along with compost end use instructions, as a means to better serve the needs of their compost customers.

Laboratory Group: Sep.12 B Laboratory Number: 2090381-2/2

Analyst: Assaf Sadeh

www.compostlab.com

US COMPOSTING COUNCIL

Seal of Testing Assurance

TCCBI - Harvest Power
John Jones
24487 Rd. 140
Tulare
CA 93274

Product Identification Compost
Zone 2 Control

Date Sampled/Received: 12 Sep. 12 / 14 Sep. 12

COMPOST TECHNICAL DATA SHEET

LABORATORY: Soil Control Lab; 42 Hangar Way; Watsonville, CA 95076 *tel:* 831.724.5422 *fax:* 831.724.3188

Compost Parameters	***Reported as** (units of measure)*	***Test Results***	***Test Results***
Plant Nutrients:	%, weight basis	%, wet weight basis	%, dry weight basis
Nitrogen	Total N	0.80	1.3
Phosphorus	P_2O_5	0.34	0.55
Potassium	K_2O	0.79	1.3
Calcium	Ca	1.6	2.6
Magnesium	Mg	0.26	0.43
Moisture Content	%, wet weight basis	39.8	
Organic Matter Content	%, dry weight basis	42.6	
pH	units	6.32	
Soluble Salts *(electrical conductivity EC_5)*	dS/m (mmhos/cm)	9.7	
Particle Size or Sieve Size	% under 9.5 mm, dw basis	99.1	
Stability Indicator *(respirometry)*			*Stability Rating:*
CO_2 Evolution	mg CO_2-C/g OM/day	10	Un-Stable
	mg CO_2-C/g TS/day	4.3	
Maturity Indicator (bioassay)			
Percent Emergence	average % of control	100.0	
Relative Seedling Vigor	average % of control	91.7	
Select Pathogens	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.32(a)	Pass	*Fecal coliform*
		Pass	*Salmonella*
Trace Metals	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3.	Pass	*As,Cd,Cr,Cu,Pb,Hg*
			Mo,Ni,Se,Zn

Participants in the US Composting Council's Seal of Testing Assurance Program have shown the commitment to test their compost products on a prescribed basis and provide this data, along with compost end use instructions, as a means to better serve the needs of their compost customers.

Laboratory Group: Sep.12 B Laboratory Number: 2090381-2/2

Analyst: Assaf Sadeh

www.compostlab.com

US COMPOSTING COUNCIL

Seal of Testing Assurance

Caltrans

TCCBI - Harvest Power
John Jones
24487 Rd. 140
Tulare CA 93274

Product Identification:
Zone 2 Control

Date Sampled/Received: 12 Sep. 12 / 14 Sep. 12

COMPOST TECHNICAL DATA SHEET for Caltrans

LABORATORY: Soil Control Lab, 42 Hangar Way, Watsonville, CA 95076 tel (831) 724-5422 fax (831) 724-3188 www.compostlab.com

Compost Parameters	***Test Results***	***Reported as*** ***(units of measure)***	***TMECC Test Method***
pH	6.32	Unitless	04.11-A 1:5 Slurry pH
Soluble Salts (electrical conductivity)	9.7	dS/m (mmhos/cm)	04.10-A 1:5 Slurry Method Mass Basis
Moisture content	39.8	%, wet weight basis	03.09-A - Total Solids and Moisture
Organic Matter Content	42.6	%, dry weight basis	05.07-A Loss-on-Ignition Organic Matter Method (LOI)
Maturity Indicator (bioassay)			
Percent Emergence	100.0	average % of control	05.05-A Germination and vigor
Relative Seedling Vigor	91.7	average % of control	
Stability Indicator	10	mg CO2-C/g OM/day	05.08-B Carbon Dioxide Evoultion Rate
Particle Size	99.1	%, dry weight passing through 9.5 mm	02.02-B Sample Sieving for Aggregate Size Classification
Pathogens	Pass	PASS/FAIL: Per US EPA Class A standard, 40 CFR 503.32(a)	07.01-B Fecal coliforms
Pathogens	Pass	PASS/FAIL: Per US EPA Class A standard, 40 CFR 503.32(a)	07.02 Samonella
Physical Contaminants	None Detected	%, dry weight basis	02.02-C - Man-Made Inerts Total content
Physical Contaminants	None Detected	%, dry weight basis	02.02-C - Man-Made Inerts Sharps content
Heavy Metals Content	Pass	PASS/FAIL: Per US EPA Class A 40 CFR 503.13, tables 1 and 3.	04.06-Heavy Metals standard, and Hazardous Elements

Participants in the US Composting Council's Seal of Testing Assurance Program have shown the commitment to test their compost products on a prescribed basis and provide this data, along with compost end use instructions, as a means to better serve the needs of their compost customers.

For additional information pertaining to compost use, the specific compost parameters tested for within the Seal of Testing assurance Program, or the program in general, log on to the US Composting Council's TMECC web-site at http://www.tmecc.org.

This compost product has been sampled and tested as required by the Seal of Testing assurance Program on the United States Composting Council (USCC), using certain methods from the "Test Methods for the Examination of Compost and Composting" manual. Test results are available upon request by contacting the compost producer (address at top of page). The USCC makes no warranties regarding this product or its content, quality. or suitability for any particular use.

Laboratory Group: Sep.12 B   Laboratory Number: 2090381-2/2

Analyst: Assaf Sadeh

Assaf Sadeh

www.compostlab.com

ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

TEL: 831-724-5422
FAX: 831-724-3188
www.compostlab.com

Account #: 2090381-2/2-6908
Group: Sep.12 B #30
Reporting Date: September 26, 2012

TCCBI - Harvest Power
24487 Rd. 140
Tulare, CA 93274
Attn: John Jones

Date Received: 14 Sep. 12
Sample Identification: Zone 2 Control
Sample ID #: 2090381 - 2/2

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	1.3	0.80	%
Ammonia (NH_4-N):	1500	900	mg/kg
Nitrate (NO_3-N):	9.6	5.8	mg/kg
Org. Nitrogen (Org.-N):	1.1	0.66	%
Phosphorus (as P_2O_5):	0.55	0.33	%
Phosphorus (P):	2400	1500	mg/kg
Potassium (as K_2O):	1.3	0.79	%
Potassium (K):	11000	6600	mg/kg
Calcium (Ca):	2.6	1.6	%
Magnesium (Mg):	0.43	0.26	%
Sulfate (SO_4-S):	2400	1400	mg/kg
Boron (Total B):	28	17	mg/kg
Moisture:	0	39.8	%
Sodium (Na):	0.12	0.069	%
Chloride (Cl):	0.26	0.15	%
pH Value:	NA	6.32	unit
Bulk Density :	22	37	lb/cu ft
Carbonates ($CaCO_3$):	<0.1	<0.1	lb/ton
Conductivity (EC5):	9.7	NA	mmhos/cm
Organic Matter:	42.6	25.6	%
Organic Carbon:	25.0	15.0	%
Ash:	57.4	34.5	%
C/N Ratio	19	19	ratio
AgIndex	8	8	ratio

Stability Indicator:		Biologically
CO2 Evolution	Respirometery	Available C
mg CO_2-C/g OM/day	10	11
mg CO_2-C/g TS/day	4.3	4.8
Stability Rating	*unstable*	*unstable*

Maturity Indicator: Cucumber Bioassay		
Compost:Vermiculite(v:v)	1:1	1:3
Emergence (%)	100	100
Seedling Vigor (%)	92	93
Description of Plants	*healthy*	*healthy*

Pathogens	Results	Units	Rating
Fecal Coliform	< 2.0	MPN/g	*pass*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 14 Sep. 12

Inerts	% by weight
Plastic	< 0.5
Glass	< 0.5
Metal	< 0.5
Sharps	ND

Metals	Dry wt.	EPA Limit	units
Aluminum (Al)	6200	-	mg/kg
Arsenic (As):	3.1	41	mg/kg
Cadmium (Cd):	< 1.0	39	mg/kg
Chromium (Cr):	15	1200	mg/kg
Cobalt (Co)	3.6	-	mg/kg
Copper (Cu):	37	1500	mg/kg
Iron (Fe):	8600	-	mg/kg
Lead (Pb):	20	300	mg/kg
Manganese (Mn):	200	-	mg/kg
Mercury (Hg):	< 1.0	17	mg/kg
Molybdenum (Mo):	2.4	75	mg/kg
Nickel (Ni):	11	420	mg/kg
Selenium (Se):	< 1.0	36	mg/kg
Zinc (Zn):	430	2800	mg/kg

Size & Volume Distribution			
MM	% by weight	% by volume	BD g/cc
> 50	0.0	0.0	0.00
25 to 50	0.0	0.0	0.00
16 to 25	0.0	0.0	0.00
9.5 to 16	0.9	1.0	0.30
6.3 to 9.5	4.9	5.8	0.29
4.0 to 6.3	7.9	9.1	0.30
2.0 to 4.0	16.4	22.0	0.26
< 2.0	69.9	62.1	0.39

Bulk Density Description:<.35 Light Materials, .35-.60 medium weight materials, >.60 Heavy Materials

Analyst: Assaf Sadeh

*Sample was received and handled in accordance with TMECC procedures.

Account No.:		Date Received	14 Sep. 12
2090381 - 2/2 - 6908		Sample i.d.	Zone 2 Control
Group:	Sep.12 B No. 30	Sample I.d. No.	2/2 2090381

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate			Biodegradation Rate of Your Pile
10	mg CO2-C/ g OM/day		+++
			< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch
Biologically Available Carbon (BAC)			Optimum Degradation Rate
11	mg CO2-C/ g OM/day		+++
			< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Is Your Compost Mature?

AmmoniaN/NitrateN ratio		
160	Ratio	++
		VeryMature>|< Mature >|< Immature
Ammonia N ppm		
1500	mg/kg dry wt.	++
		VeryMature>|< Mature >|< Immature
Nitrate N ppm		
9.6	mg/kg dry wt.	+++++++
		< Immature >|< Mature
pH value		
6.32	units	+++
		< Immature >|< Mature >|< Immature
Cucumber Emergence		
100.0	percent	+++
		< Immature >|< Mature

Is Your Compost Safe Regarding Health?

Fecal Coliform		
< 1000	MPN/g dry wt.	+++++++
		< Safe >|< High Fecal Coliform
Salmonella		
Less than 3	/4g dry wt.	+++++++
		<Safe (none detected) >|< High Salmonella Count(> 3 per 4 grams)
Metals	US EPA 503	
Pass	dry wt.	++++++++++
		<All Metals Pass >|< One or more Metals Fail

Does Your Compost Provide Nutrients or Organic Matter?

Nutrients (N+P2O5+K2O)		
3.2	Percent dry wt.	++++++++++++++++++++++++++
		<Low >|< Average >|< High Nutrient Content
AgIndex (Nutrients / Sodium and Chloride Salts)		((N+P2O5+K2O) / (Na + Cl))
8	Ratio	+++
		Na & Cl >|< Nutrient and Sodium and Chloride Provider >|< Nutrient Provider
Plant Available Nitrogen (PAN)		Estimated release for first season
8	lbs/ton wet wt.	+++++++++++++++++++++++++++++++++
		Low Nitrogen Provider>|< Average Nitrogen Provider >|<High Nitrogen Provider
C/N Ratio		
19	Ratio	+++++++++++++++++++++++++++++++++++++++
		< Nitrogen Release >|< N-Neutral >|< N-Demand>|< High Nitrogen Demand
Soluble Available Nutrients & Salts (EC5 w/w dw)		
9.7	mmhos/cm dry wt.	++
		SloRelease>|< Average Nutrient Release Rate >|<High Available Nutrients
Lime Content (CaCO3)		
0	Lbs/ton dry wt.	+
		< Low >|< Average >|< High Lime Content (as CaCO3)

What are the physical properties of your compost?

Percent Ash		
57.4	Percent dry wt.	+++
		< High Organic Matter >|< Average >|< High Ash Content
Sieve Size % > 6.3 MM (0.25")		
5.8	Percent dry wt.	++
		All Uses >|< Size May Restrict Uses for Potting mix and Golf Courses

Account No.: 2090381 - 2/2 - 6908
Group: Sep.12 B No. 30

Date Received 14 Sep. 12
Sample i.d. Zone 2 Control
Sample I.d. No. 2/2 2090381

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate

10 Moderate-selected use mg CO2-C/g OM/day

The respiration rate is a measurement of the biodegradation rate of the organic matter in the sample (as received). The respiration rate is determined by measuring the rate at which CO2 is released under optimized moisture and temperature conditions.

Biologically Available Carbon

11 Moderate-selected use mg CO2-C/g OM/day

Biologically Available Carbon (BAC) is a measurement of the rate at which CO2 is released under optimized moisture, temperature, porosity, nutrients, pH and microbial conditions. If both the RR and the BAC test values are close to the same value, the pile is optimized for composting. If both values are high the compost pile just needs more time. If both values are low the compost has stabilized and should be moved to curing. BAC test values that are higher than RR indicate that the compost pile has stalled. This could be due to anaerobic conditions, lack of available nitrogen due to excessive air converting ammonia to the unavailable nitrate form, lack of nitrogen or other nutrients due to poor choice of feedstock, pH value out of range, or microbes rendered non-active.

Is Your Compost Mature?

AmmoniaN:NitrateN ratio	
160	immature
Ammonia N ppm	
1500	immature
Nitrate N ppm	
9.6	immature
pH value	
6.32	immature

Composting to stabilize carbon can occur at such a rapid rate that sometimes phytotoxins remain in the compost and must be neutralized before using in high concentrations or in high-end uses. This step is called curing. Typically ammonia is in excess with the break-down of organic materials resulting in an increase in pH. This combination results in a loss of volatile ammonia (it smells). Once this toxic ammonia has been reduced and the pH drops, the microbes convert the ammonia to nitrates. A low ammonia + high nitrate score is indicative of a mature compost, however there are many exceptions. For example, a compost with a low pH (<7) will retain ammonia, while a compost with high lime content can lose ammonia before the organic fraction becomes stable. Composts must first be stable before curing indicators apply.

Cucumber Bioassay

100.0 Percent

Cucumbers are chosen for this test because they are salt tolerant and very sensitive to ammonia and organic acid toxicity. Therefore, we can germinate seeds in high concentrations of compost to measure phytotoxic effects without soluble salts being the limiting factor. Values above 80% for both percent emergence and vigor are indicative of a well-cured compost. Exceptions include very high salts that affect the cucumbers, excessive concentrations of nitrates and other nutrients that will be in range when formulated to make a growing media. In addition to testing a 1:1 compost: vermiculite blend, we also test a diluted 1:3 blend to indicate a more sensitive toxicity level.

Is Your Compost Safe Regarding Health?

Fecal Coliform

< 1000 / g dry wt. Fecal coliforms can survive in both aerobic and anaerobic conditions and is common in all initial compost piles. Most human pathogens occur from fecal matter and all fecal matter is loaded in fecal coliforms. Therefore fecal coliforms are used as an indicator to determine if the chosen method for pathogen reduction (heat for compost) has met the requirements of sufficient temperature, time and mixing. If the fecal coliforms are reduced to below 1000 per gram dry wt. it is assumed all others pathogens are eliminated. Potential problems are that fecal coliform can regrow during the curing phase or during shipping. This is because the conditions are now more favorable for growth than during the composting process.

Salmonella Bacteria

Less than 3 3 / 4g dry wt. Salmonella is not only another indicator organism but also a toxic microbe. It has been used in the case of biosolids industry to determine adequate pathogen reduction.

Metals

Pass The ten heavy metals listed in the EPA 503 regulations are chosen to determine if compost can be applied to ag land and handled without toxic effects. Most high concentrations of heavy metals are derived from woodwaste feedstock such as chrome-arsenic treated or lead painted demolition wood. Biosolids are rarely a problem.

Does Your Compost Provide Nutrients or Organic Matter?

Nutrients (N+P2O5+K2O)

3.2 Average nutrient content

This value is the sum of the primary nutrients Nitrogen, Phosphorus and Potassium. Reported units are consistent with those found on fertilizer formulations. A sum greater than 5 is indicative of a compost with high nutrient content, and best used to supply nutrients to a receiving soil. A sum below 2 indicates low nutrient content, and is best-used to improve soil structure via the addition of organic matter. Most compost falls between 2 and 5.

Account No.:		Date Received	14 Sep. 12	
2090381 - 2/2 - 6908		Sample i.d.	Zone 2 Control	
Group:	Sep.12 B No. 30	Sample I.d. No.	2/2	2090381

INTERPRETATION:

AgIndex (Nutrients/Na+Cl)

8 Average nutrient ratio Composts with low AgIndex values have high concentrations of sodium and/or chloride compared to nutrients. Repeated use of a compost with a low AgIndex (< 2) may result in sodium and/or chloride acting as the limiting factor compared to nutrients, governing application rates. These composts may be used on well-draining soils and/or with salt-tolerant plants. Additional nutrients form another source may be needed if the application rate is limited by sodium or chloride. If the AgIndex is above 10, nutrients optimal for plant growth will be available without concern of sodium and/or chloride toxicity. Composts with an AgIndex of above 10 are good for increasing nutrient levels for all soils. Most composts score between 2 and 10. Concentrations of nutrients, sodium, and chloride in the receiving soil should be considered when determining compost application rates. The AgIndex is a product of feedstock quality. Feedstock from dairy manure, marine waste, industrial wastes, and halophytic plants are likely to produce a finished compost with a low AgIndex.

Plant Available Nitrogen (lbs/ton)

8 Average N Provider Plant Available Nitrogen (PAN) is calculated by estimating the release rate of Nitrogen from the organic fraction of the compost. This estimate is based on information gathered from the BAC test and measured ammonia and nitrate values. Despite the PAN value of the compost, additional sources of Nitrogen may be needed during he growing season to off-set the Nitrogen demand of the microbes present in the compost. With ample nutrients these microbes can further breakdown organic matter in the compost and release bound Nitrogen. Nitrogen demand based on a high C/N ratio is not considered in the PAN calculation because additional Nitrogen should always be supplemented to the receiving soil when composts with a high C/N ratio are applied.

C/N Ratio

19 Indicates immaturity As a guiding principal, a C/N ratio below 14 indicates maturity and above 14 indicates immaturity, however, there are many exceptions. Large woodchips (>6.3mm), bark, and redwood are slow to breakdown and therefore can result in a relatively stable product while the C/N ratio value is high. Additionally, some composts with chicken manure and/or green grass feedstocks can start with a C/N ratio below 15 and are very unstable. A C/N ratio below 10 supplies Nitrogen, while a ratio above 20 can deplete Nitrogen from the soil. The rate at which Nitrogen will be released or used by the microbes is indicated by the respiration rate (BAC). If the respiration rate is too high the transfer of Nitrogen will not be controlable.

Soluble Nutrients & Salts (EC5 w/w dw - mmhos/cm)

9.7 High salts This value refers to all soluble ions including nutrients, sodium, chloride and some soluble organic compounds. The concentration of salts will change due to the release of salts from the organic matter as it degrades, volatilization of ammonia, decomposition of soluble organics, and conversion of molecular structure. High salts + high AgIndex is indicative of a compost high in readily available nutrients. The application rate of these composts should be limited by the optimum nutrient value based on soil analysis of the receiving soil. High Salts + low AgIndex is indicative of a compost low in nutrients with high concentrations of sodium and/or chloride. Limit the application rate according to the toxicity level of thesodium and/or chloride. Low salts indicates that the compost can be applied without risking salt toxicity, is likely a good source of organic matter, and that nutrients will release slowly over time.

Lime Content (lbs. per ton)

0 Low lime content Compost high in lime or carbonates are often those produced from chicken manure (layers) ash materials, and lime products. These are excellent products to use on a receiving soil where lime has been recommended by soil analysis to raise the pH. Composts with a high lime content should be closely considered for pH requirements when formulating potting mixes.

Physical Properties

Percent Ash

57.4 Average ash content Ash is the non-organic fraction of a compost. Most composts contain approximately 50% ash (dry weight basis). Compost can be high in ash content for many reasons including: excess minerilzation(old compost), contamination with soil base material during turning, poor quality feedstock, and soil or mineral products added. Finding the source and reducing high ash content is often the fastest means to increasing nutrient quality of a compost.

Particle Size % > 6.3 MM (0.25")

5.8 May restrict use Large particles may restrict use for potting soils, golf course topdressings, seed-starter mixes, and where a fine size distribution is required. Composts with large particles can still be used as excellent additions to field soils, shrub mixes and mulches.

Particle Size Distribution

Each size fraction is measured by weight, volume and bulk density. These results are particularly relevent with decisions to screen or not, and if screening, which size screen to use. The bulk density indicates if the fraction screened is made of light weight organic material or heavy mineral material. Removing large mineral material can greatly improve compost quality by increasing nutrient and organic concentrations.

Appendix:

Plant Available Nitrogen (PAN) calculations:

PAN = (X * (organic N)) + ((NH4-N) + (NO3-N))

X value = If BAC < 2 then X = 0.1
If BAC =2.1 to 5 then X = 0.2
If BAC =5.1 to 10 then X = 0.3
If BAC > 10 then X = 0.4

Note: If C/N ratio > 15 additional N should be applied.

Estimated available nutrients for use when calculating application rates

	lbs/ton (As Rcvd.)
Plant Available Nitrogen (PAN)	8.2
Ammonia (NH4-N)	1.80
Nitrate (NO3-N)	0.01
Available Phosphorus (P2O5*0.64)	4.4
Available Potassium (K2O)	15.9

US COMPOSTING COUNCIL

Seal of Testing Assurance

TCCBI - Harvest Power
John Jones
24487 Rd. 140
Tulare
CA 93274 (559) 686-1622

Product Identification	Compost
Zone 3	

Date Sampled/Received: 17 Sep. 12 / 19 Sep. 12

COMPOST TECHNICAL DATA SHEET

LABORATORY: Soil Control Lab; 42 Hangar Way; Watsonville, CA 95076 *tel:* 831.724.5422 *fax:* 831.724.3188

Compost Parameters	***Reported as** (units of measure)*	***Test Results***	***Test Results***
Plant Nutrients:	%, weight basis	Not reported	Not reported
Moisture Content	%, wet weight basis	38.5	
Organic Matter Content	%, dry weight basis	42.9	
pH	units	6.28	
Soluble Salts *(electrical conductivity EC_5)*	dS/m (mmhos/cm)	6.8	
Particle Size or Sieve Size	maxium aggregate size, inches	0.64	
Stability Indicator *(respirometry)*			*Stability Rating:*
CO_2 Evolution	mg CO_2-C/g OM/day	7.5	Moderately Un-Stable
	mg CO_2-C/g TS/day	3.2	
Maturity Indicator (bioassay)			
Percent Emergence	average % of control	100.0	
Relative Seedling Vigor	average % of control	86.7	
Select Pathogens	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.32(a)	Pass	*Fecal coliform*
		Pass	*Salmonella*
Trace Metals	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3.	Pass	*As,Cd,Cr,Cu,Pb,Hg*
			Mo,Ni,Se,Zn

Participants in the US Composting Council's Seal of Testing Assurance Program have shown the commitment to test their compost products on a prescribed basis and provide this data, along with compost end use instructions, as a means to better serve the needs of their compost customers.

Laboratory Group: Sep.12 C_1 Laboratory Number: 2090507-1/2

Analyst: Assaf Sadeh

www.compostlab.com

US COMPOSTING COUNCIL

Seal of Testing Assurance

TCCBI - Harvest Power
John Jones
24487 Rd. 140
Tulare
CA 93274 (559) 686-1622

Product Identification Compost Zone 3

Date Sampled/Received: 17 Sep. 12 / 19 Sep. 12

COMPOST TECHNICAL DATA SHEET

LABORATORY: Soil Control Lab; 42 Hangar Way; Watsonville, CA 95076 *tel:* 831.724.5422 *fax:* 831.724.3188

Compost Parameters	***Reported as*** ***(units of measure)***	***Test Results***	***Test Results***
Plant Nutrients:	%, weight basis	%, wet weight basis	%, dry weight basis
Nitrogen	Total N	0.83	1.4
Phosphorus	P_2O_5	0.36	0.57
Potassium	K_2O	0.83	1.3
Calcium	Ca	1.2	2.0
Magnesium	Mg	0.31	0.50
Moisture Content	%, wet weight basis	38.5	
Organic Matter Content	%, dry weight basis	42.9	
pH	units	6.28	
Soluble Salts *(electrical conductivity EC_5)*	dS/m (mmhos/cm)	6.8	
Particle Size or Sieve Size	% under 9.5 mm, dw basis	99.5	
Stability Indicator *(respirometry)*			*Stability Rating:*
CO_2 Evolution	mg CO_2-C/g OM/day	7.5	Moderately Un-Stable
	mg CO_2-C/g TS/day	3.2	
Maturity Indicator (bioassay)			
Percent Emergence	average % of control	100.0	
Relative Seedling Vigor	average % of control	86.7	
Select Pathogens	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.32(a)	Pass	*Fecal coliform*
		Pass	*Salmonella*
Trace Metals	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3.	Pass	*As,Cd,Cr,Cu,Pb,Hg* Mo,Ni,Se,Zn

Participants in the US Composting Council's Seal of Testing Assurance Program have shown the commitment to test their compost products on a prescribed basis and provide this data, along with compost end use instructions, as a means to better serve the needs of their compost customers.

Laboratory Group: Sep.12 C_1 Laboratory Number: 2090507-1/2

Analyst: Assaf Sadeh

www.compostlab.com

US COMPOSTING COUNCIL

Seal of Testing Assurance

Caltrans

TCCBI - Harvest Power
John Jones
24487 Rd. 140
Tulare CA 93274 (559) 686-1622

Product Identification:
Zone 3

Date Sampled/Received: 17 Sep. 12 / 19 Sep. 12

COMPOST TECHNICAL DATA SHEET for Caltrans

LABORATORY: Soil Control Lab, 42 Hangar Way, Watsonville, CA 95076 tel (831) 724-5422 fax (831) 724-3188 www.compostlab.com

Compost Parameters	***Test Results***	***Reported as** (units of measure)*	***TMECC Test Method***
pH	6.28	Unitless	04.11-A 1:5 Slurry pH
Soluble Salts (electrical conductivity)	6.8	dS/m (mmhos/cm)	04.10-A 1:5 Slurry Method Mass Basis
Moisture content	38.5	%, wet weight basis	03.09-A - Total Solids and Moisture
Organic Matter Content	42.9	%, dry weight basis	05.07-A Loss-on-Ignition Organic Matter Method (LOI)
Maturity Indicator (bioassay)			
Percent Emergence	100.0	average % of control	05.05-A Germination and vigor
Relative Seedling Vigor	86.7	average % of control	
Stability Indicator	7.5	mg CO2-C/g OM/day	05.08-B Carbon Dioxide Evoultion Rate
Particle Size	99.5	%, dry weight passing through 9.5 mm	02.02-B Sample Sieving for Aggregate Size Classification
Pathogens	Pass	PASS/FAIL: Per US EPA Class A standard, 40 CFR 503.32(a)	07.01-B Fecal coliforms
Pathogens	Pass	PASS/FAIL: Per US EPA Class A standard, 40 CFR 503.32(a)	07.02 Samonella
Physical Contaminants	None Detected	%, dry weight basis	02.02-C - Man-Made Inerts Total content
Physical Contaminants	None Detected	%, dry weight basis	02.02-C - Man-Made Inerts Sharps content
Heavy Metals Content	Pass	PASS/FAIL: Per US EPA Class A 40 CFR 503.13, tables 1 and 3.	04.06-Heavy Metals standard, and Hazardous Elements

Participants in the US Composting Council's Seal of Testing Assurance Program have shown the commitment to test their compost products on a prescribed basis and provide this data, along with compost end use instructions, as a means to better serve the needs of their compost customers.

For additional information pertaining to compost use, the specific compost parameters tested for within the Seal of Testing assurance Program, or the program in general, log on to the US Composting Council's TMECC web-site at http://www.tmecc.org.

This compost product has been sampled and tested as required by the Seal of Testing assurance Program on the United States Composting Council (USCC), using certain methods from the "Test Methods for the Examination of Compost and Composting" manual. Test results are available upon request by contacting the compost producer (address at top of page). The USCC makes no warranties regarding this product or its content, quality. or suitability for any particular use.

Laboratory Group: Sep.12 C_1 Laboratory Number: 2090507-1/2

Analyst: Assaf Sadeh

Assaf Sadeh

www.compostlab.com

ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

TEL: 831-724-5422
FAX: 831-724-3188
www.compostlab.com

Account #: 2090507-1/2-6908
Group: Sep.12 C_1 #8
Reporting Date: October 5, 2012

TCCBI - Harvest Power
24487 Rd. 140
Tulare, CA 93274
Attn: John Jones

Date Received: 19 Sep. 12
Sample Identification: Zone 3
Sample ID #: 2090507 - 1/2

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	1.4	0.83	%
Ammonia (NH_4-N):	670	410	mg/kg
Nitrate (NO_3-N):	10	6.4	mg/kg
Org. Nitrogen (Org.-N):	1.3	0.80	%
Phosphorus (as P_2O_5):	0.58	0.36	%
Phosphorus (P):	2500	1600	mg/kg
Potassium (as K_2O):	1.3	0.82	%
Potassium (K):	11000	6900	mg/kg
Calcium (Ca):	2.0	1.2	%
Magnesium (Mg):	0.50	0.31	%
Sulfate (SO_4-S):	640	390	mg/kg
Boron (Total B):	30	18	mg/kg
Moisture:	0	38.5	%
Sodium (Na):	0.12	0.073	%
Chloride (Cl):	0.22	0.14	%
pH Value:	NA	6.28	unit
Bulk Density :	25	40	lb/cu ft
Carbonates ($CaCO_3$):	6.9	4.2	lb/ton
Conductivity (EC5):	6.8	NA	mmhos/cm
Organic Matter:	42.9	26.4	%
Organic Carbon:	25.0	15.0	%
Ash:	57.1	35.1	%
C/N Ratio	18	18	ratio
AgIndex	10	10	ratio

Stability Indicator:		Biologically
CO2 Evolution	Respirometery	Available C
mg CO_2-C/g OM/day	7.5	7.9
mg CO_2-C/g TS/day	3.2	3.4
Stability Rating	*moderately unstable*	*moderately unstable*

Maturity Indicator: Cucumber Bioassay		
Compost:Vermiculite(v:v)	1:1	1:3
Emergence (%)	100	100
Seedling Vigor (%)	87	87
Description of Plants	*fungus*	*fungus*

Pathogens	Results	Units	Rating
Fecal Coliform	< 2.0	MPN/g	*pass*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 19 Sep. 12

Inerts	% by weight
Plastic	< 0.5
Glass	< 0.5
Metal	< 0.5
Sharps	ND

Metals	Dry wt.	EPA Limit	units
Aluminum (Al)	6900	-	mg/kg
Arsenic (As):	3.1	41	mg/kg
Cadmium (Cd):	< 1.0	39	mg/kg
Chromium (Cr):	14	1200	mg/kg
Cobalt (Co)	3.8	-	mg/kg
Copper (Cu):	49	1500	mg/kg
Iron (Fe):	9700	-	mg/kg
Lead (Pb):	20	300	mg/kg
Manganese (Mn):	220	-	mg/kg
Mercury (Hg):	< 1.0	17	mg/kg
Molybdenum (Mo):	1.6	75	mg/kg
Nickel (Ni):	11	420	mg/kg
Selenium (Se):	< 1.0	36	mg/kg
Zinc (Zn):	170	2800	mg/kg

Size & Volume Distribution			
MM	% by weight	% by volume	BD g/cc
> 50	0.0	0.0	0.00
25 to 50	0.0	0.0	0.00
16 to 25	0.0	0.0	0.00
9.5 to 16	0.5	0.4	0.50
6.3 to 9.5	2.7	2.9	0.41
4.0 to 6.3	5.1	5.7	0.39
2.0 to 4.0	12.6	19.3	0.29
< 2.0	79.0	71.6	0.48

Bulk Density Description:<.35 Light Materials,
.35-.60 medium weight materials, >.60 Heavy Materials

Analyst: Assaf Sadeh

*Sample was received and handled in accordance with TMECC procedures.

Account No.:
2090507 - 1/2 - 6908
Group: Sep.12 C_1 No. 8

Date Received 19 Sep. 12
Sample i.d. Zone 3
Sample I.d. No. 1/2 2090507

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate Biodegradation Rate of Your Pile
7.5 mg CO2-C/ g OM/day
+++++++++++++++++++++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Biologically Available Carbon (BAC) Optimum Degradation Rate
7.9 mg CO2-C/ g OM/day
+++++++++++++++++++++++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Is Your Compost Mature?

AmmoniaN/NitrateN ratio
67 Ratio
+++
VeryMature>|< Mature >|< Immature

Ammonia N ppm
670 mg/kg dry wt.
++
VeryMature>|< Mature >|< Immature

Nitrate N ppm
10 mg/kg dry wt.
+++++++
< Immature >|< Mature

pH value
6.28 units
++
< Immature >|< Mature >|< Immature

Cucumber Emergence
100.0 percent
++
< Immature >|< Mature

Is Your Compost Safe Regarding Health?

Fecal Coliform
< 1000 MPN/g dry wt.
+++++++
< Safe >|< High Fecal Coliform

Salmonella
Less than 3 /4g dry wt.
+++++++
<Safe (none detected) >|< High Salmonella Count(> 3 per 4 grams)

Metals US EPA 503
Pass dry wt.
+++++++++
<All Metals Pass >|< One or more Metals Fail

Does Your Compost Provide Nutrients or Organic Matter?

Nutrients (N+P2O5+K2O)
3.3 Percent dry wt.
++++++++++++++++++++++++++
<Low >|< Average >|< High Nutrient Content

AgIndex (Nutrients / Sodium and Chloride Salts) ((N+P2O5+K2O) / (Na + Cl))
10 Ratio
++
Na & Cl >|< Nutrient and Sodium and Chloride Provider >|< Nutrient Provider

Plant Available Nitrogen (PAN) Estimated release for first season
6 lbs/ton wet wt.
+++++++++++++++++++++++
Low Nitrogen Provider>|< Average Nitrogen Provider >|<High Nitrogen Provider

C/N Ratio
18 Ratio
++++++++++++++++++++++++++++++++++++
< Nitrogen Release >|< N-Neutral >|< N-Demand>|< High Nitrogen Demand

Soluble Available Nutrients & Salts (EC5 w/w dw)
6.8 mmhos/cm dry wt.
++++++++++++++++++++++++++++++++++++
SloRelease>|< Average Nutrient Release Rate >|<High Available Nutrients

Lime Content (CaCO3)
6.9 Lbs/ton dry wt.
+++++++++++
< Low >|< Average >|< High Lime Content (as CaCO3)

What are the physical properties of your compost?

Percent Ash
57.1 Percent dry wt.
++
< High Organic Matter >|< Average >|< High Ash Content

Sieve Size % > 6.3 MM (0.25")
3.2 Percent dry wt.
+++++++++++++++++++++++++
All Uses >|< Size May Restrict Uses for Potting mix and Golf Courses

Account No.:		Date Received	19 Sep. 12	
2090507 - 1/2 - 6908		Sample i.d.	Zone 3	
Group:	Sep.12 C_1 No. 8	Sample I.d. No.	1/2	2090507

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate

7.5 Moderate-selected use mg CO2-C/g OM/day

The respiration rate is a measurement of the biodegradation rate of the organic matter in the sample (as received). The respiration rate is determined by measuring the rate at which CO2 is released under optimized moisture and temperature conditions.

Biologically Available Carbon

7.9 Moderate-selected use mg CO2-C/g OM/day

Biologically Available Carbon (BAC) is a measurement of the rate at which CO2 is released under optimized moisture, temperature, porosity, nutrients, pH and microbial conditions. If both the RR and the BAC test values are close to the same value, the pile is optimized for composting. If both values are high the compost pile just needs more time. If both values are low the compost has stabilized and should be moved to curing. BAC test values that are higher than RR indicate that the compost pile has stalled. This could be due to anaerobic conditions, lack of available nitrogen due to excessive air converting ammonia to the unavailable nitrate form, lack of nitrogen or other nutrients due to poor choice of feedstock, pH value out of range, or microbes rendered non-active.

Is Your Compost Mature?

AmmoniaN:NitrateN ratio

67 immature

Ammonia N ppm

670 immature

Nitrate N ppm

10 immature

pH value

6.28 immature

Composting to stabilize carbon can occur at such a rapid rate that sometimes phytotoxins remain in the compost and must be neutralized before using in high concentrations or in high-end uses. This step is called curing. Typically ammonia is in excess with the break-down of organic materials resulting in an increase in pH. This combination results in a loss of volatile ammonia (it smells). Once this toxic ammonia has been reduced and the pH drops, the microbes convert the ammonia to nitrates. A low ammonia + high nitrate score is indicative of a mature compost, however there are many exceptions. For example, a compost with a low pH (<7) will retain ammonia, while a compost with high lime content can lose ammonia before the organic fraction becomes stable. Composts must first be stable before curing indicators apply.

Cucumber Bioassay

100.0 Percent

Cucumbers are chosen for this test because they are salt tolerant and very sensitive to ammonia and organic acid toxicity. Therefore, we can germinate seeds in high concentrations of compost to measure phytotoxic effects without soluble salts being the limiting factor. Values above 80% for both percent emergence and vigor are indicative of a well-cured compost. Exceptions include very high salts that affect the cucumbers, excessive concentrations of nitrates and other nutrients that will be in range when formulated to make a growing media. In addition to testing a 1:1 compost: vermiculite blend, we also test a diluted 1:3 blend to indicate a more sensitive toxicity level.

Is Your Compost Safe Regarding Health?

Fecal Coliform

< 1000 / g dry wt.

Fecal coliforms can survive in both aerobic and anaerobic conditions and is common in all initial compost piles. Most human pathogens occur from fecal matter and all fecal matter is loaded in fecal coliforms. Therefore fecal coliforms are used as an indicator to determine if the chosen method for pathogen reduction (heat for compost) has met the requirements of sufficient temperature, time and mixing. If the fecal coliforms are reduced to below 1000 per gram dry wt. it is assumed all others pathogens are eliminated. Potential problems are that fecal coliform can regrow during the curing phase or during shipping. This is because the conditions are now more favorable for growth than during the composting process.

Salmonella Bacteria

Less than 3 3 / 4g dry wt.

Salmonella is not only another indicator organism but also a toxic microbe. It has been used in the case of biosolids industry to determine adequate pathogen reduction.

Metals

Pass

The ten heavy metals listed in the EPA 503 regulations are chosen to determine if compost can be applied to ag land and handled without toxic effects. Most high concentrations of heavy metals are derived from woodwaste feedstock such as chrome-arsenic treated or lead painted demolition wood. Biosolids are rarely a problem.

Does Your Compost Provide Nutrients or Organic Matter?

Nutrients (N+P2O5+K2O)

3.3 Average nutrient content

This value is the sum of the primary nutrients Nitrogen, Phosphorus and Potassium. Reported units are consistent with those found on fertilizer formulations. A sum greater than 5 is indicative of a compost with high nutrient content, and best used to supply nutrients to a receiving soil. A sum below 2 indicates low nutrient content, and is best-used to improve soil structure via the addition of organic matter. Most compost falls between 2 and 5.

Account No.:		Date Received	19 Sep. 12	
2090507 - 1/2 - 6908		Sample i.d.	Zone 3	
Group:	Sep.12 C_1 No. 8	Sample I.d. No.	1/2	2090507

INTERPRETATION:

AgIndex (Nutrients/Na+Cl)

10 Average nutrient ratio Composts with low AgIndex values have high concentrations of sodium and/or chloride compared to nutrients. Repeated use of a compost with a low AgIndex (< 2) may result in sodium and/or chloride acting as the limiting factor compared to nutrients, governing application rates. These composts may be used on well-draining soils and/or with salt-tolerant plants. Additional nutrients form another source may be needed if the application rate is limited by sodium or chloride. If the AgIndex is above 10, nutrients optimal for plant growth will be available without concern of sodium and/or chloride toxicity. Composts with an AgIndex of above 10 are good for increasing nutrient levels for all soils. Most composts score between 2 and 10. Concentrations of nutrients, sodium, and chloride in the receiving soil should be considered when determining compost application rates. The AgIndex is a product of feedstock quality. Feedstock from dairy manure, marine waste, industrial wastes, and halophytic plants are likely to produce a finished compost with a low AgIndex.

Plant Available Nitrogen (lbs/ton)

6 Average N Provider Plant Available Nitrogen (PAN) is calculated by estimating the release rate of Nitrogen from the organic fraction of the compost. This estimate is based on information gathered from the BAC test and measured ammonia and nitrate values. Despite the PAN value of the compost, additional sources of Nitrogen may be needed during he growing season to off-set the Nitrogen demand of the microbes present in the compost. With ample nutrients these microbes can further breakdown organic matter in the compost and release bound Nitrogen. Nitrogen demand based on a high C/N ratio is not considered in the PAN calculation because additional Nitrogen should always be supplemented to the receiving soil when composts with a high C/N ratio are applied.

C/N Ratio

18 Indicates immaturity As a guiding principal, a C/N ratio below 14 indicates maturity and above 14 indicates immaturity, however, there are many exceptions. Large woodchips (>6.3mm), bark, and redwood are slow to breakdown and therefore can result in a relatively stable product while the C/N ratio value is high. Additionally, some composts with chicken manure and/or green grass feedstocks can start with a C/N ratio below 15 and are very unstable. A C/N ratio below 10 supplies Nitrogen, while a ratio above 20 can deplete Nitrogen from the soil. The rate at which Nitrogen will be released or used by the microbes is indicated by the respiration rate (BAC). If the respiration rate is too high the transfer of Nitrogen will not be controlable.

Soluble Nutrients & Salts (EC5 w/w dw - mmhos/cm)

6.8 Average salts This value refers to all soluble ions including nutrients, sodium, chloride and some soluble organic compounds. The concentration of salts will change due to the release of salts from the organic matter as it degrades, volatilization of ammonia, decomposition of soluble organics, and conversion of molecular structure. High salts + high AgIndex is indicative of a compost high in readily available nutrients. The application rate of these composts should be limited by the optimum nutrient value based on soil analysis of the receiving soil. High Salts + low AgIndex is indicative of a compost low in nutrients with high concentrations of sodium and/or chloride. Limit the application rate according to the toxicity level of thesodium and/or chloride. Low salts indicates that the compost can be applied without risking salt toxicity, is likely a good source of organic matter, and that nutrients will release slowly over time.

Lime Content (lbs. per ton)

6.9 Average lime content Compost high in lime or carbonates are often those produced from chicken manure (layers) ash materials, and lime products. These are excellent products to use on a receiving soil where lime has been recommended by soil analysis to raise the pH. Composts with a high lime content should be closely considered for pH requirements when formulating potting mixes.

Physical Properties

Percent Ash

57.1 Average ash content Ash is the non-organic fraction of a compost. Most composts contain approximately 50% ash (dry weight basis). Compost can be high in ash content for many reasons including: excess minerilzation(old compost), contamination with soil base material during turning, poor quality feedstock, and soil or mineral products added. Finding the source and reducing high ash content is often the fastest means to increasing nutrient quality of a compost.

Particle Size % > 6.3 MM (0.25")

3.2 May restrict use Large particles may restrict use for potting soils, golf course topdressings, seed-starter mixes, and where a fine size distribution is required. Composts with large particles can still be used as excellent additions to field soils, shrub mixes and mulches.

Particle Size Distribution

Each size fraction is measured by weight, volume and bulk density. These results are particularly relevent with decisions to screen or not, and if screening, which size screen to use. The bulk density indicates if the fraction screened is made of light weight organic material or heavy mineral material. Removing large mineral material can greatly improve compost quality by increasing nutrient and organic concentrations.

Appendix:			
		Estimated available nutrients for use when calculating application rates	
Plant Available Nitrogen (PAN) calculations:			lbs/ton (As Rcvd.)
PAN = (X * (organic N)) + ((NH4-N) + (NO3-N))			
X value =	If BAC < 2 then X = 0.1	Plant Available Nitrogen (PAN)	5.9
	If BAC =2.1 to 5 then X = 0.2	Ammonia (NH4-N)	0.82
	If BAC =5.1 to 10 then X = 0.3	Nitrate (NO3-N)	0.01
	If BAC > 10 then X = 0.4	Available Phosphorus (P2O5*0.64)	4.7
Note: If C/N ratio > 15 additional N should be applied.		Available Potassium (K2O)	16.6

US COMPOSTING COUNCIL

Seal of Testing Assurance

TCCBI - Harvest Power
John Jones
24487 Rd. 140
Tulare
CA 93274 (559) 686-1622

Product Identification	Compost
Zone 3 Control	

Date Sampled/Received: 17 Sep. 12 / 19 Sep. 12

COMPOST TECHNICAL DATA SHEET

LABORATORY: Soil Control Lab; 42 Hangar Way; Watsonville, CA 95076 *tel:* 831.724.5422 *fax:* 831.724.3188

Compost Parameters	***Reported as** (units of measure)*	***Test Results***	***Test Results***
Plant Nutrients:	%, weight basis	Not reported	Not reported
Moisture Content	%, wet weight basis	43.3	
Organic Matter Content	%, dry weight basis	46.5	
pH	units	5.03	
Soluble Salts *(electrical conductivity EC_5)*	dS/m (mmhos/cm)	11	
Particle Size or Sieve Size	maxium aggregate size, inches	0.64	
Stability Indicator *(respirometry)*			*Stability Rating:*
CO_2 Evolution	mg CO_2-C/g OM/day	13	Un-Stable
	mg CO_2-C/g TS/day	6.2	
Maturity Indicator (bioassay)			
Percent Emergence	average % of control	100.0	
Relative Seedling Vigor	average % of control	81.7	
Select Pathogens	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.32(a)	Pass	*Fecal coliform*
		Pass	*Salmonella*
Trace Metals	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3.	Pass	*As,Cd,Cr,Cu,Pb,Hg*
			Mo,Ni,Se,Zn

Participants in the US Composting Council's Seal of Testing Assurance Program have shown the commitment to test their compost products on a prescribed basis and provide this data, along with compost end use instructions, as a means to better serve the needs of their compost customers.

Laboratory Group: Sep.12 C_1 Laboratory Number: 2090507-2/2

Analyst: Assaf Sadeh

www.compostlab.com

US COMPOSTING COUNCIL

Seal of Testing Assurance

TCCBI - Harvest Power
John Jones
24487 Rd. 140
Tulare
CA 93274 (559) 686-1622

Product Identification Compost
Zone 3 Control

Date Sampled/Received: 17 Sep. 12 / 19 Sep. 12

COMPOST TECHNICAL DATA SHEET

LABORATORY: Soil Control Lab; 42 Hangar Way; Watsonville, CA 95076 *tel:* 831.724.5422 *fax:* 831.724.3188

Compost Parameters	***Reported as*** ***(units of measure)***	***Test Results***	***Test Results***
Plant Nutrients:	%, weight basis	%, wet weight basis	%, dry weight basis
Nitrogen	Total N	0.85	1.5
Phosphorus	P_2O_5	0.36	0.61
Potassium	K_2O	0.82	1.4
Calcium	Ca	0.86	1.5
Magnesium	Mg	0.25	0.44
Moisture Content	%, wet weight basis	43.3	
Organic Matter Content	%, dry weight basis	46.5	
pH	units	5.03	
Soluble Salts *(electrical conductivity EC_5)*	dS/m (mmhos/cm)	11	
Particle Size or Sieve Size	% under 9.5 mm, dw basis	98.4	
Stability Indicator *(respirometry)*			*Stability Rating:*
CO_2 Evolution	mg CO_2-C/g OM/day	13	Un-Stable
	mg CO_2-C/g TS/day	6.2	
Maturity Indicator (bioassay)			
Percent Emergence	average % of control	100.0	
Relative Seedling Vigor	average % of control	81.7	
Select Pathogens	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.32(a)	Pass	*Fecal coliform*
		Pass	*Salmonella*
Trace Metals	PASS/FAIL: per US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3.	Pass	*As,Cd,Cr,Cu,Pb,Hg*
			Mo,Ni,Se,Zn

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Laboratory Group: Sep.12 C_1 Laboratory Number: 2090507-2/2

Analyst: Assaf Sadeh

www.compostlab.com

US COMPOSTING COUNCIL

Seal of Testing Assurance

Caltrans

TCCBI - Harvest Power
John Jones
24487 Rd. 140
Tulare CA 93274 (559) 686-1622

Product Identification:
Zone 3 Control

Date Sampled/Received: 17 Sep. 12 / 19 Sep. 12

COMPOST TECHNICAL DATA SHEET for Caltrans

LABORATORY: Soil Control Lab, 42 Hangar Way, Watsonville, CA 95076 tel (831) 724-5422 fax (831) 724-3188 www.compostlab.com

Compost Parameters	*Test Results*	*Reported as (units of measure)*	*TMECC Test Method*
pH	5.03	Unitless	04.11-A 1:5 Slurry pH
Soluble Salts (electrical conductivity)	11	dS/m (mmhos/cm)	04.10-A 1:5 Slurry Method Mass Basis
Moisture content	43.3	%, wet weight basis	03.09-A - Total Solids and Moisture
Organic Matter Content	46.5	%, dry weight basis	05.07-A Loss-on-Ignition Organic Matter Method (LOI)
Maturity Indicator (bioassay) Percent Emergence Relative Seedling Vigor	 100.0 81.7	 average % of control average % of control	05.05-A Germination and vigor
Stability Indicator	13	mg CO2-C/g OM/day	05.08-B Carbon Dioxide Evoultion Rate
Particle Size	98.4	%, dry weight passing through 9.5 mm	02.02-B Sample Sieving for Aggregate Size Classification
Pathogens	Pass	PASS/FAIL: Per US EPA Class A standard, 40 CFR 503.32(a)	07.01-B Fecal coliforms
Pathogens	Pass	PASS/FAIL: Per US EPA Class A standard, 40 CFR 503.32(a)	07.02 Samonella
Physical Contaminants	None Detected	%, dry weight basis	02.02-C - Man-Made Inerts Total content
Physical Contaminants	None Detected	%, dry weight basis	02.02-C - Man-Made Inerts Sharps content
Heavy Metals Content	Pass	PASS/FAIL: Per US EPA Class A 40 CFR 503.13, tables 1 and 3.	04.06-Heavy Metals standard, and Hazardous Elements

Participants in the US Composting Council's Seal of Testing Assurance Program have shown the commitment to test their compost products on a prescribed basis and provide this data, along with compost end use instructions, as a means to better serve the needs of their compost customers.

For additional information pertaining to compost use, the specific compost parameters tested for within the Seal of Testing assurance Program, or the program in general, log on to the US Composting Council's TMECC web-site at http://www.tmecc.org.

This compost product has been sampled and tested as required by the Seal of Testing assurance Program on the United States Composting Council (USCC), using certain methods from the "Test Methods for the Examination of Compost and Composting" manual. Test results are available upon request by contacting the compost producer (address at top of page). The USCC makes no warranties regarding this product or its content, quality. or suitability for any particular use.

Laboratory Group: Sep.12 C_1 Laboratory Number: 2090507-2/2

Analyst: Assaf Sadeh

www.compostlab.com

ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

TEL: 831-724-5422
FAX: 831-724-3188
www.compostlab.com

Account #: 2090507-2/2-6908
Group: Sep.12 C_1 #9
Reporting Date: October 5, 2012

TCCBI - Harvest Power
24487 Rd. 140
Tulare, CA 93274
Attn: John Jones

Date Received: 19 Sep. 12
Sample Identification: Zone 3 Control
Sample ID #: 2090507 - 2/2

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	1.5	0.85	%
Ammonia (NH_4-N):	2000	1200	mg/kg
Nitrate (NO_3-N):	51	29	mg/kg
Org. Nitrogen (Org.-N):	1.3	0.74	%
Phosphorus (as P_2O_5):	0.62	0.35	%
Phosphorus (P):	2700	1600	mg/kg
Potassium (as K_2O):	1.4	0.81	%
Potassium (K):	12000	6800	mg/kg
Calcium (Ca):	1.5	0.86	%
Magnesium (Mg):	0.44	0.25	%
Sulfate (SO_4-S):	840	470	mg/kg
Boron (Total B):	23	13	mg/kg
Moisture:	0	43.3	%
Sodium (Na):	0.12	0.068	%
Chloride (Cl):	0.29	0.16	%
pH Value:	NA	5.03	unit
Bulk Density :	22	38	lb/cu ft
Carbonates ($CaCO_3$):	<0.1	<0.1	lb/ton
Conductivity (EC5):	11	NA	mmhos/cm
Organic Matter:	46.5	26.4	%
Organic Carbon:	25.0	14.0	%
Ash:	53.5	30.3	%
C/N Ratio	17	17	ratio
AgIndex	9	9	ratio

Stability Indicator:		Biologically
CO2 Evolution	Respirometery	Available C
mg CO_2-C/g OM/day	13	14
mg CO_2-C/g TS/day	6.2	6.7
Stability Rating	*unstable*	*unstable*

Maturity Indicator: Cucumber Bioassay		
Compost:Vermiculite(v:v)	1:1	1:3
Emergence (%)	100	100
Seedling Vigor (%)	82	83
Description of Plants	*mushroom*	*fungus*

Pathogens	Results	Units	Rating
Fecal Coliform	< 2.0	MPN/g	*pass*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 19 Sep. 12

Inerts	% by weight
Plastic	< 0.5
Glass	< 0.5
Metal	< 0.5
Sharps	ND

Metals	Dry wt.	EPA Limit	units
Aluminum (Al)	6600	-	mg/kg
Arsenic (As):	2.7	41	mg/kg
Cadmium (Cd):	< 1.0	39	mg/kg
Chromium (Cr):	13	1200	mg/kg
Cobalt (Co)	3.4	-	mg/kg
Copper (Cu):	38	1500	mg/kg
Iron (Fe):	9300	-	mg/kg
Lead (Pb):	15	300	mg/kg
Manganese (Mn):	190	-	mg/kg
Mercury (Hg):	< 1.0	17	mg/kg
Molybdenum (Mo):	1.6	75	mg/kg
Nickel (Ni):	13	420	mg/kg
Selenium (Se):	< 1.0	36	mg/kg
Zinc (Zn):	140	2800	mg/kg

Size & Volume Distribution

MM	% by weight	% by volume	BD g/cc
> 50	0.0	0.0	0.00
25 to 50	0.0	0.0	0.00
16 to 25	0.0	0.0	0.00
9.5 to 16	1.6	0.9	0.52
6.3 to 9.5	4.6	3.4	0.40
4.0 to 6.3	8.5	9.1	0.28
2.0 to 4.0	19.9	25.1	0.24
< 2.0	65.4	61.5	0.32

Bulk Density Description:<.35 Light Materials, .35-.60 medium weight materials, >.60 Heavy Materials

Analyst: Assaf Sadeh

*Sample was received and handled in accordance with TMECC procedures.

Account No.:
2090507 - 2/2 - 6908
Group: Sep.12 C_1 No. 9

Date Received 19 Sep. 12
Sample i.d. Zone 3 Control
Sample I.d. No. 2/2 2090507

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate — Biodegradation Rate of Your Pile
13 mg CO2-C/ g OM/day
+++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Biologically Available Carbon (BAC) — Optimum Degradation Rate
14 mg CO2-C/ g OM/day
++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Is Your Compost Mature?

AmmoniaN/NitrateN ratio
39 Ratio
+++
VeryMature>|< Mature >|< Immature

Ammonia N ppm
2000 mg/kg dry wt.
+++
VeryMature>|< Mature >|< Immature

Nitrate N ppm
51 mg/kg dry wt.
++
< Immature >|< Mature

pH value
5.03 units
++
< Immature >|< Mature >|< Immature

Cucumber Emergence
100.0 percent
++
< Immature >|< Mature

Is Your Compost Safe Regarding Health?

Fecal Coliform
< 1000 MPN/g dry wt.
+++++++
< Safe >|< High Fecal Coliform

Salmonella
Less than 3 /4g dry wt.
+++++++
<Safe (none detected) >|< High Salmonella Count(> 3 per 4 grams)

Metals US EPA 503
Pass dry wt.
+++++++++++
<All Metals Pass >|< One or more Metals Fail

Does Your Compost Provide Nutrients or Organic Matter?

Nutrients (N+P2O5+K2O)
3.6 Percent dry wt.
+++++++++++++++++++++++++++++++++++
<Low >|< Average >|< High Nutrient Content

AgIndex (Nutrients / Sodium and Chloride Salts) ((N+P2O5+K2O) / (Na + Cl))
9 Ratio
++
Na & Cl >|< Nutrient and Sodium and Chloride Provider >|< Nutrient Provider

Plant Available Nitrogen (PAN) — Estimated release for first season
9 lbs/ton wet wt.
+++
Low Nitrogen Provider>|< Average Nitrogen Provider >|<High Nitrogen Provider

C/N Ratio
17 Ratio
+++
< Nitrogen Release >|< N-Neutral >|< N-Demand>|< High Nitrogen Demand

Soluble Available Nutrients & Salts (EC5 w/w dw)
11 mmhos/cm dry wt.
+++
SloRelease>|< Average Nutrient Release Rate >|<High Available Nutrients

Lime Content (CaCO3)
0 Lbs/ton dry wt.
+
< Low >|< Average >|< High Lime Content (as CaCO3)

What are the physical properties of your compost?

Percent Ash
53.5 Percent dry wt.
++
< High Organic Matter >|< Average >|< High Ash Content

Sieve Size % > 6.3 MM (0.25")
6.2 Percent dry wt.
+++
All Uses >|< Size May Restrict Uses for Potting mix and Golf Courses

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate

13 High-for mulch mg CO_2-C/g OM/day

The respiration rate is a measurement of the biodegradation rate of the organic matter in the sample (as received). The respiration rate is determined by measuring the rate at which CO2 is released under optimized moisture and temperature conditions.

Biologically Available Carbon

14 High-for mulch mg CO_2-C/g OM/day

Biologically Available Carbon (BAC) is a measurement of the rate at which CO2 is released under optimized moisture, temperature, porosity, nutrients, pH and microbial conditions. If both the RR and the BAC test values are close to the same value, the pile is optimized for composting. If both values are high the compost pile just needs more time. If both values are low the compost has stabilized and should be moved to curing. BAC test values that are higher than RR indicate that the compost pile has stalled. This could be due to anaerobic conditions, lack of available nitrogen due to excessive air converting ammonia to the unavailable nitrate form, lack of nitrogen or other nutrients due to poor choice of feedstock, pH value out of range, or microbes rendered non-active.

Is Your Compost Mature?

AmmoniaN:NitrateN ratio	
39	immature
Ammonia N ppm	
2000	immature
Nitrate N ppm	
51	mature
pH value	
5.03	immature

Composting to stabilize carbon can occur at such a rapid rate that sometimes phytotoxins remain in the compost and must be neutralized before using in high concentrations or in high-end uses. This step is called curing. Typically ammonia is in excess with the break-down of organic materials resulting in an increase in pH. This combination results in a loss of volatile ammonia (it smells). Once this toxic ammonia has been reduced and the pH drops, the microbes convert the ammonia to nitrates. A low ammonia + high nitrate score is indicative of a mature compost, however there are many exceptions. For example, a compost with a low pH (<7) will retain ammonia, while a compost with high lime content can lose ammonia before the organic fraction becomes stable. Composts must first be stable before curing indicators apply.

Cucumber Bioassay

100.0 Percent Cucumbers are chosen for this test because they are salt tolerant and very sensitive to ammonia and organic acid toxicity. Therefore, we can germinate seeds in high concentrations of compost to measure phytotoxic effects without soluble salts being the limiting factor. Values above 80% for both percent emergence and vigor are indicative of a well-cured compost. Exceptions include very high salts that affect the cucumbers, excessive concentrations of nitrates and other nutrients that will be in range when formulated to make a growing media. In addition to testing a 1:1 compost: vermiculite blend, we also test a diluted 1:3 blend to indicate a more sensitive toxicity level.

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< 1000 / g dry wt. Fecal coliforms can survive in both aerobic and anaerobic conditions and is common in all initial compost piles. Most human pathogens occur from fecal matter and all fecal matter is loaded in fecal coliforms. Therefore fecal coliforms are used as an indicator to determine if the chosen method for pathogen reduction (heat for compost) has met the requirements of sufficient temperature, time and mixing. If the fecal coliforms are reduced to below 1000 per gram dry wt. it is assumed all others pathogens are eliminated. Potential problems are that fecal coliform can regrow during the curing phase or during shipping. This is because the conditions are now more favorable for growth than during the composting process.

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Less than 3 3 / 4g dry wt. Salmonella is not only another indicator organism but also a toxic microbe. It has been used in the case of biosolids industry to determine adequate pathogen reduction.

Metals

Pass The ten heavy metals listed in the EPA 503 regulations are chosen to determine if compost can be applied to ag land and handled without toxic effects. Most high concentrations of heavy metals are derived from woodwaste feedstock such as chrome-arsenic treated or lead painted demolition wood. Biosolids are rarely a problem.

Does Your Compost Provide Nutrients or Organic Matter?

Nutrients ($N+P_2O_5+K_2O$)

3.6 Average nutrient content

This value is the sum of the primary nutrients Nitrogen, Phosphorus and Potassium. Reported units are consistent with those found on fertilizer formulations. A sum greater than 5 is indicative of a compost with high nutrient content, and best used to supply nutrients to a receiving soil. A sum below 2 indicates low nutrient content, and is best-used to improve soil structure via the addition of organic matter. Most compost falls between 2 and 5.

Account No.:		Date Received	19 Sep. 12	
2090507 - 2/2 - 6908		Sample i.d.	Zone 3 Control	
Group:	Sep.12 C_1 No. 9	Sample I.d. No.	2/2	2090507

INTERPRETATION:

AgIndex (Nutrients/Na+Cl)

9 Average nutrient ratio Composts with low AgIndex values have high concentrations of sodium and/or chloride compared to nutrients. Repeated use of a compost with a low AgIndex (< 2) may result in sodium and/or chloride acting as the limiting factor compared to nutrients, governing application rates. These composts may be used on well-draining soils and/or with salt-tolerant plants. Additional nutrients form another source may be needed if the application rate is limited by sodium or chloride. If the AgIndex is above 10, nutrients optimal for plant growth will be available without concern of sodium and/or chloride toxicity. Composts with an AgIndex of above 10 are good for increasing nutrient levels for all soils. Most composts score between 2 and 10. Concentrations of nutrients, sodium, and chloride in the receiving soil should be considered when determining compost application rates. The AgIndex is a product of feedstock quality. Feedstock from dairy manure, marine waste, industrial wastes, and halophytic plants are likely to produce a finished compost with a low AgIndex.

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C/N Ratio

17 Indicates immaturity As a guiding principal, a C/N ratio below 14 indicates maturity and above 14 indicates immaturity, however, there are many exceptions. Large woodchips (>6.3mm), bark, and redwood are slow to breakdown and therefore can result in a relatively stable product while the C/N ratio value is high. Additionally, some composts with chicken manure and/or green grass feedstocks can start with a C/N ratio below 15 and are very unstable. A C/N ratio below 10 supplies Nitrogen, while a ratio above 20 can deplete Nitrogen from the soil. The rate at which Nitrogen will be released or used by the microbes is indicated by the respiration rate (BAC). If the respiration rate is too high the transfer of Nitrogen will not be controlable.

Soluble Nutrients & Salts (EC5 w/w dw - mmhos/cm)

11 High salts This value refers to all soluble ions including nutrients, sodium, chloride and some soluble organic compounds. The concentration of salts will change due to the release of salts from the organic matter as it degrades, volatilization of ammonia, decomposition of soluble organics, and conversion of molecular structure. High salts + high AgIndex is indicative of a compost high in readily available nutrients. The application rate of these composts should be limited by the optimum nutrient value based on soil analysis of the receiving soil. High Salts + low AgIndex is indicative of a compost low in nutrients with high concentrations of sodium and/or chloride. Limit the application rate according to the toxicity level of thesodium and/or chloride. Low salts indicates that the compost can be applied without risking salt toxicity, is likely a good source of organic matter, and that nutrients will release slowly over time.

Lime Content (lbs. per ton)

0 Low lime content Compost high in lime or carbonates are often those produced from chicken manure (layers) ash materials, and lime products. These are excellent products to use on a receiving soil where lime has been recommended by soil analysis to raise the pH. Composts with a high lime content should be closely considered for pH requirements when formulating potting mixes.

Physical Properties

Percent Ash

53.5 Average ash content Ash is the non-organic fraction of a compost. Most composts contain approximately 50% ash (dry weight basis). Compost can be high in ash content for many reasons including: excess minerilzation(old compost), contamination with soil base material during turning, poor quality feedstock, and soil or mineral products added. Finding the source and reducing high ash content is often the fastest means to increasing nutrient quality of a compost.

Particle Size % > 6.3 MM (0.25")

6.2 May restrict use Large particles may restrict use for potting soils, golf course topdressings, seed-starter mixes, and where a fine size distribution is required. Composts with large particles can still be used as excellent additions to field soils, shrub mixes and mulches.

Particle Size Distribution

Each size fraction is measured by weight, volume and bulk density. These results are particularly relevent with decisions to screen or not, and if screening, which size screen to use. The bulk density indicates if the fraction screened is made of light weight organic material or heavy mineral material. Removing large mineral material can greatly improve compost quality by increasing nutrient and organic concentrations.

Appendix:			
		Estimated available nutrients for use when calculating application rates	
Plant Available Nitrogen (PAN) calculations:			lbs/ton (As Rcvd.)
PAN = (X * (organic N)) + ((NH4-N) + (NO3-N))			
X value =	If BAC < 2 then X = 0.1	Plant Available Nitrogen (PAN)	9.3
	If BAC =2.1 to 5 then X = 0.2	Ammonia (NH4-N)	2.40
	If BAC =5.1 to 10 then X = 0.3	Nitrate (NO3-N)	0.06
	If BAC > 10 then X = 0.4	Available Phosphorus (P2O5*0.64)	4.7
Note: If C/N ratio > 15 additional N should be applied.		Available Potassium (K2O)	16.4

ANALYTICAL CHEMISTS and BACTERIOLOGISTS Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY WATSONVILLE CALIFORNIA 95076 USA

TEL: 831-724-5422
FAX: 831-724-3188
www.compostlab.com

Account #: 2100583-1/2-6908
Group: Oct.12 C #26
Reporting Date: November 1, 2012

TCCBI - Harvest Power
24487 Rd. 140
Tulare, CA 93274
Attn: John Jones

Date Received: 19 Oct. 12
Sample Identification: Zone #1- Cure
Sample ID #: 2100583 - 1/2

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	1.4	0.94	%
Ammonia (NH_4-N):	690	460	mg/kg
Nitrate (NO_3-N):	6.1	4.0	mg/kg
Org. Nitrogen (Org.-N):	1.3	0.86	%
Phosphorus (as P_2O_5):	0.65	0.43	%
Phosphorus (P):	2800	1900	mg/kg
Potassium (as K_2O):	1.4	0.92	%
Potassium (K):	11000	7600	mg/kg
Calcium (Ca):	2.3	1.5	%
Magnesium (Mg):	0.47	0.31	%
Sulfate (SO_4-S):	2000	1300	mg/kg
Boron (Total B):	19	13	mg/kg
Moisture:	0	33.7	%
Sodium (Na):	0.13	0.086	%
Chloride (Cl):	0.19	0.13	%
pH Value:	NA	6.12	unit
Bulk Density :	22	34	lb/cu ft
Carbonates ($CaCO_3$):	1.8	1.2	lb/ton
Conductivity (EC5):	7.5	NA	mmhos/cm
Organic Matter:	37.3	24.7	%
Organic Carbon:	21.0	14.0	%
Ash:	62.7	41.6	%
C/N Ratio	15	15	ratio
AgIndex	> 10	> 10	ratio

Stability Indicator:		Biologically
CO2 Evolution	Respirometery	Available C
mg CO_2-C/g OM/day	7.5	8.8
mg CO_2-C/g TS/day	2.8	3.3
Stability Rating	*moderately unstable*	*unstable*

Maturity Indicator: Cucumber Bioassay		
Compost:Vermiculite(v:v)	1:1	1:3
Emergence (%)	100	100
Seedling Vigor (%)	100	100
Description of Plants	*healthy*	*healthy*

Pathogens	Results	Units	Rating
Fecal Coliform	> 1200	MPN/g	*fail*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 19 Oct. 12

Inerts	% by weight
Plastic	< 0.5
Glass	< 0.5
Metal	< 0.5
Sharps	ND

Metals	Dry wt.	EPA Limit	units
Aluminum (Al)	8300	-	mg/kg
Arsenic (As):	3.0	41	mg/kg
Cadmium (Cd):	< 1.0	39	mg/kg
Chromium (Cr):	15	1200	mg/kg
Cobalt (Co)	2.7	-	mg/kg
Copper (Cu):	69	1500	mg/kg
Iron (Fe):	11000	-	mg/kg
Lead (Pb):	17	300	mg/kg
Manganese (Mn):	160	-	mg/kg
Mercury (Hg):	< 1.0	17	mg/kg
Molybdenum (Mo):	1.5	75	mg/kg
Nickel (Ni):	10	420	mg/kg
Selenium (Se):	< 1.0	36	mg/kg
Zinc (Zn):	140	2800	mg/kg

Size & Volume Distribution			
MM	% by weight	% by volume	BD g/cc
> 50	0.0	0.0	0.00
25 to 50	0.0	0.0	0.00
16 to 25	0.0	0.0	0.00
9.5 to 16	2.1	4.0	0.23
6.3 to 9.5	3.7	4.0	0.42
4.0 to 6.3	10.2	11.1	0.41
2.0 to 4.0	18.1	25.4	0.31
< 2.0	65.8	55.6	0.52

Bulk Density Description:<.35 Light Materials, .35-.60 medium weight materials, >.60 Heavy Materials

Analyst: Assaf Sadeh

*Sample was received and handled in accordance with TMECC procedures.

Account No.: 2100583 - 1/2 - 6908
Group: Oct.12 C No. 26

Date Received: 19 Oct. 12
Sample i.d.: Zone #1- Cure
Sample I.d. No.: 1/2 2100583

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate — Biodegradation Rate of Your Pile
7.5 mg CO2-C/ g OM/day
++++++++++++++++++++++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Biologically Available Carbon (BAC) — Optimum Degradation Rate
8.8 mg CO2-C/ g OM/day
+++++++++++++++++++++++++++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Is Your Compost Mature?

AmmoniaN/NitrateN ratio
110 Ratio
+++
VeryMature>|< Mature >|< Immature

Ammonia N ppm
690 mg/kg dry wt.
++
VeryMature>|< Mature >|< Immature

Nitrate N ppm
6.1 mg/kg dry wt.
++++
< Immature >|< Mature

pH value
6.12 units
++
< Immature >|< Mature >|< Immature

Cucumber Emergence
100.0 percent
++
< Immature >|< Mature

Is Your Compost Safe Regarding Health?

Fecal Coliform
> 1000 MPN/g dry wt.
++
< Safe >|< High Fecal Coliform

Salmonella
Less than 3 /4g dry wt.
+++++++
<Safe (none detected) >|< High Salmonella Count(> 3 per 4 grams)

Metals US EPA 503
Pass dry wt.
+++++++++
<All Metals Pass >|< One or more Metals Fail

Does Your Compost Provide Nutrients or Organic Matter?

Nutrients (N+P2O5+K2O)
3.4 Percent dry wt.
+++++++++++++++++++++++++++
<Low >|< Average >|< High Nutrient Content

AgIndex (Nutrients / Sodium and Chloride Salts) — ((N+P2O5+K2O) / (Na + Cl))
11 Ratio
+++
Na & Cl >|< Nutrient and Sodium and Chloride Provider >|< Nutrient Provider

Plant Available Nitrogen (PAN) — Estimated release for first season
7 lbs/ton wet wt.
+++++++++++++++++++++++++++
Low Nitrogen Provider>|< Average Nitrogen Provider >|<High Nitrogen Provider

C/N Ratio
15 Ratio
++++++++++++++++++++++++++++++
< Nitrogen Release >|< N-Neutral >|< N-Demand>|< High Nitrogen Demand

Soluble Available Nutrients & Salts (EC5 w/w dw)
7.5 mmhos/cm dry wt.
++
SloRelease>|< Average Nutrient Release Rate >|<High Available Nutrients

Lime Content (CaCO3)
1.8 Lbs/ton dry wt.
++
< Low >|< Average >|< High Lime Content (as CaCO3)

What are the physical properties of your compost?

Percent Ash
62.7 Percent dry wt.
+++
< High Organic Matter >|< Average >|< High Ash Content

Sieve Size % > 6.3 MM (0.25")
5.9 Percent dry wt.
++
All Uses >|< Size May Restrict Uses for Potting mix and Golf Courses

Account No.:		Date Received	19 Oct. 12	
2100583 - 1/2 - 6908		Sample i.d.	Zone #1- Cure	
Group:	Oct.12 C No. 26	Sample I.d. No.	1/2	2100583

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate

7.5 Moderate-selected use mg CO2-C/g OM/day

The respiration rate is a measurement of the biodegradation rate of the organic matter in the sample (as received). The respiration rate is determined by measuring the rate at which CO2 is released under optimized moisture and temperature conditions.

Biologically Available Carbon

8.8 Moderate-selected use mg CO2-C/g OM/day

Biologically Available Carbon (BAC) is a measurement of the rate at which CO2 is released under optimized moisture, temperature, porosity, nutrients, pH and microbial conditions. If both the RR and the BAC test values are close to the same value, the pile is optimized for composting. If both values are high the compost pile just needs more time. If both values are low the compost has stabilized and should be moved to curing. BAC test values that are higher than RR indicate that the compost pile has stalled. This could be due to anaerobic conditions, lack of available nitrogen due to excessive air converting ammonia to the unavailable nitrate form, lack of nitrogen or other nutrients due to poor choice of feedstock, pH value out of range, or microbes rendered non-active.

Is Your Compost Mature?

AmmoniaN:NitrateN ratio	
110	immature
Ammonia N ppm	
690	immature
Nitrate N ppm	
6.1	immature
pH value	
6.12	immature

Composting to stabilize carbon can occur at such a rapid rate that sometimes phytotoxins remain in the compost and must be neutralized before using in high concentrations or in high-end uses. This step is called curing. Typically ammonia is in excess with the break-down of organic materials resulting in an increase in pH. This combination results in a loss of volatile ammonia (it smells). Once this toxic ammonia has been reduced and the pH drops, the microbes convert the ammonia to nitrates. A low ammonia + high nitrate score is indicative of a mature compost, however there are many exceptions. For example, a compost with a low pH (<7) will retain ammonia, while a compost with high lime content can lose ammonia before the organic fraction becomes stable. Composts must first be stable before curing indicators apply.

Cucumber Bioassay

100.0 Percent

Cucumbers are chosen for this test because they are salt tolerant and very sensitive to ammonia and organic acid toxicity. Therefore, we can germinate seeds in high concentrations of compost to measure phytotoxic effects without soluble salts being the limiting factor. Values above 80% for both percent emergence and vigor are indicative of a well-cured compost. Exceptions include very high salts that affect the cucumbers, excessive concentrations of nitrates and other nutrients that will be in range when formulated to make a growing media. In addition to testing a 1:1 compost: vermiculite blend, we also test a diluted 1:3 blend to indicate a more sensitive toxicity level.

Is Your Compost Safe Regarding Health?

Fecal Coliform

> 1000 / g dry wt.

Fecal coliforms can survive in both aerobic and anaerobic conditions and is common in all initial compost piles. Most human pathogens occur from fecal matter and all fecal matter is loaded in fecal coliforms. Therefore fecal coliforms are used as an indicator to determine if the chosen method for pathogen reduction (heat for compost) has met the requirements of sufficient temperature, time and mixing. If the fecal coliforms are reduced to below 1000 per gram dry wt. it is assumed all others pathogens are eliminated. Potential problems are that fecal coliform can regrow during the curing phase or during shipping. This is because the conditions are now more favorable for growth than during the composting process.

Salmonella Bacteria

Less than 3 3 / 4g dry wt.

Salmonella is not only another indicator organism but also a toxic microbe. It has been used in the case of biosolids industry to determine adequate pathogen reduction.

Metals

Pass

The ten heavy metals listed in the EPA 503 regulations are chosen to determine if compost can be applied to ag land and handled without toxic effects. Most high concentrations of heavy metals are derived from woodwaste feedstock such as chrome-arsenic treated or lead painted demolition wood. Biosolids are rarely a problem.

Does Your Compost Provide Nutrients or Organic Matter?

Nutrients (N+P2O5+K2O)

3.4 Average nutrient content

This value is the sum of the primary nutrients Nitrogen, Phosphorus and Potassium. Reported units are consistent with those found on fertilizer formulations. A sum greater than 5 is indicative of a compost with high nutrient content, and best used to supply nutrients to a receiving soil. A sum below 2 indicates low nutrient content, and is best-used to improve soil structure via the addition of organic matter. Most compost falls between 2 and 5.

Account No.:		Date Received	19 Oct. 12	
2100583 - 1/2 - 6908		Sample i.d.	Zone #1- Cure	
Group:	Oct.12 C No. 26	Sample I.d. No.	1/2	2100583

INTERPRETATION:

AgIndex (Nutrients/Na+Cl)

11 High nutrient ratio Composts with low AgIndex values have high concentrations of sodium and/or chloride compared to nutrients. Repeated use of a compost with a low AgIndex (< 2) may result in sodium and/or chloride acting as the limiting factor compared to nutrients, governing application rates. These composts may be used on well-draining soils and/or with salt-tolerant plants. Additional nutrients form another source may be needed if the application rate is limited by sodium or chloride. If the AgIndex is above 10, nutrients optimal for plant growth will be available without concern of sodium and/or chloride toxicity. Composts with an AgIndex of above 10 are good for increasing nutrient levels for all soils. Most composts score between 2 and 10. Concentrations of nutrients, sodium, and chloride in the receiving soil should be considered when determining compost application rates. The AgIndex is a product of feedstock quality. Feedstock from dairy manure, marine waste, industrial wastes, and halophytic plants are likely to produce a finished compost with a low AgIndex.

Plant Available Nitrogen (lbs/ton)

7 Average N Provider Plant Available Nitrogen (PAN) is calculated by estimating the release rate of Nitrogen from the organic fraction of the compost. This estimate is based on information gathered from the BAC test and measured ammonia and nitrate values. Despite the PAN value of the compost, additional sources of Nitrogen may be needed during he growing season to off-set the Nitrogen demand of the microbes present in the compost. With ample nutrients these microbes can further breakdown organic matter in the compost and release bound Nitrogen. Nitrogen demand based on a high C/N ratio is not considered in the PAN calculation because additional Nitrogen should always be supplemented to the receiving soil when composts with a high C/N ratio are applied.

C/N Ratio

15 Indicates immaturity As a guiding principal, a C/N ratio below 14 indicates maturity and above 14 indicates immaturity, however, there are many exceptions. Large woodchips (>6.3mm), bark, and redwood are slow to breakdown and therefore can result in a relatively stable product while the C/N ratio value is high. Additionally, some composts with chicken manure and/or green grass feedstocks can start with a C/N ratio below 15 and are very unstable. A C/N ratio below 10 supplies Nitrogen, while a ratio above 20 can deplete Nitrogen from the soil. The rate at which Nitrogen will be released or used by the microbes is indicated by the respiration rate (BAC). If the respiration rate is too high the transfer of Nitrogen will not be controlable.

Soluble Nutrients & Salts (EC5 w/w dw - mmhos/cm)

7.5 Average salts This value refers to all soluble ions including nutrients, sodium, chloride and some soluble organic compounds. The concentration of salts will change due to the release of salts from the organic matter as it degrades, volatilization of ammonia, decomposition of soluble organics, and conversion of molecular structure. High salts + high AgIndex is indicative of a compost high in readily available nutrients. The application rate of these composts should be limited by the optimum nutrient value based on soil analysis of the receiving soil. High Salts + low AgIndex is indicative of a compost low in nutrients with high concentrations of sodium and/or chloride. Limit the application rate according to the toxicity level of thesodium and/or chloride. Low salts indicates that the compost can be applied without risking salt toxicity, is likely a good source of organic matter, and that nutrients will release slowly over time.

Lime Content (lbs. per ton)

1.8 Low lime content Compost high in lime or carbonates are often those produced from chicken manure (layers) ash materials, and lime products. These are excellent products to use on a receiving soil where lime has been recommended by soil analysis to raise the pH. Composts with a high lime content should be closely considered for pH requirements when formulating potting mixes.

Physical Properties

Percent Ash

62.7 High ash content Ash is the non-organic fraction of a compost. Most composts contain approximately 50% ash (dry weight basis). Compost can be high in ash content for many reasons including: excess minerilzation(old compost), contamination with soil base material during turning, poor quality feedstock, and soil or mineral products added. Finding the source and reducing high ash content is often the fastest means to increasing nutrient quality of a compost.

Particle Size % > 6.3 MM (0.25")

5.9 May restrict use Large particles may restrict use for potting soils, golf course topdressings, seed-starter mixes, and where a fine size distribution is required. Composts with large particles can still be used as excellent additions to field soils, shrub mixes and mulches.

Particle Size Distribution

Each size fraction is measured by weight, volume and bulk density. These results are particularly relevent with decisions to screen or not, and if screening, which size screen to use. The bulk density indicates if the fraction screened is made of light weight organic material or heavy mineral material. Removing large mineral material can greatly improve compost quality by increasing nutrient and organic concentrations.

Appendix:			
		Estimated available nutrients for use when calculating application rates	
Plant Available Nitrogen (PAN) calculations:			lbs/ton (As Rcvd.)
PAN = (X * (organic N)) + ((NH4-N) + (NO3-N))			
X value =	If BAC < 2 then X = 0.1	Plant Available Nitrogen (PAN)	6.6
	If BAC =2.1 to 5 then X = 0.2	Ammonia (NH4-N)	0.92
	If BAC =5.1 to 10 then X = 0.3	Nitrate (NO3-N)	0.01
	If BAC > 10 then X = 0.4	Available Phosphorus (P2O5*0.64)	5.5
Note: If C/N ratio > 15 additional N should be applied.		Available Potassium (K2O)	18.3

ANALYTICAL CHEMISTS
and
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www.compostlab.com

Account #: 2100583-2/2-6908
Group: Oct.12 C #27
Reporting Date: November 1, 2012

TCCBI - Harvest Power
24487 Rd. 140
Tulare, CA 93274
Attn: John Jones

Date Received: 19 Oct. 12
Sample Identification: Zone #2- Cure
Sample ID #: 2100583 - 2/2

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	1.2	0.90	%
Ammonia (NH_4-N):	290	210	mg/kg
Nitrate (NO_3-N):	5.7	4.1	mg/kg
Org. Nitrogen (Org.-N):	1.2	0.87	%
Phosphorus (as P_2O_5):	0.72	0.52	%
Phosphorus (P):	3200	2300	mg/kg
Potassium (as K_2O):	1.4	0.98	%
Potassium (K):	11000	8100	mg/kg
Calcium (Ca):	2.4	1.7	%
Magnesium (Mg):	0.61	0.45	%
Sulfate (SO_4-S):	1300	910	mg/kg
Boron (Total B):	28	20	mg/kg
Moisture:	0	27.6	%
Sodium (Na):	0.11	0.080	%
Chloride (Cl):	0.19	0.14	%
pH Value:	NA	7.33	unit
Bulk Density :	28	38	lb/cu ft
Carbonates ($CaCO_3$):	15	11	lb/ton
Conductivity (EC5):	4.2	NA	mmhos/cm
Organic Matter:	32.9	23.8	%
Organic Carbon:	17.0	13.0	%
Ash:	67.1	48.6	%
C/N Ratio	14	14	ratio
AgIndex	> 10	> 10	ratio

Stability Indicator:		Biologically
CO2 Evolution	Respirometery	Available C
mg CO_2-C/g OM/day	6.2	7.1
mg CO_2-C/g TS/day	2.1	2.3
Stability Rating	*moderately unstable*	*moderately unstable*

Maturity Indicator: Cucumber Bioassay		
Compost:Vermiculite(v:v)	1:1	1:3
Emergence (%)	100	100
Seedling Vigor (%)	100	100
Description of Plants	*healthy*	*healthy*

Pathogens	Results	Units	Rating
Fecal Coliform	340	MPN/g	*pass*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 19 Oct. 12

Inerts	% by weight
Plastic	< 0.5
Glass	< 0.5
Metal	< 0.5
Sharps	ND

Metals	Dry wt.	EPA Limit	units
Aluminum (Al)	9100	-	mg/kg
Arsenic (As):	3.0	41	mg/kg
Cadmium (Cd):	< 1.0	39	mg/kg
Chromium (Cr):	13	1200	mg/kg
Cobalt (Co)	4.0	-	mg/kg
Copper (Cu):	54	1500	mg/kg
Iron (Fe):	12000	-	mg/kg
Lead (Pb):	20	300	mg/kg
Manganese (Mn):	230	-	mg/kg
Mercury (Hg):	< 1.0	17	mg/kg
Molybdenum (Mo):	1.7	75	mg/kg
Nickel (Ni):	11	420	mg/kg
Selenium (Se):	< 1.0	36	mg/kg
Zinc (Zn):	170	2800	mg/kg

Size & Volume Distribution			
MM	% by weight	% by volume	BD g/cc
> 50	0.0	0.0	0.00
25 to 50	0.0	0.0	0.00
16 to 25	0.0	0.0	0.00
9.5 to 16	0.0	0.0	0.00
6.3 to 9.5	1.7	1.8	0.55
4.0 to 6.3	3.9	5.3	0.42
2.0 to 4.0	10.8	17.5	0.36
< 2.0	83.6	75.4	0.64

Bulk Density Description:<.35 Light Materials,
.35-.60 medium weight materials, >.60 Heavy Materials

Analyst: Assaf Sadeh

*Sample was received and handled in accordance with TMECC procedures.

Account No.: 2100583 - 2/2 - 6908
Group: Oct.12 C No. 27

Date Received 19 Oct. 12
Sample i.d. Zone #2- Cure
Sample I.d. No. 2/2 2100583

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate — Biodegradation Rate of Your Pile
6.2 mg CO2-C/ g OM/day
++++++++++++++++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Biologically Available Carbon (BAC) — Optimum Degradation Rate
7.1 mg CO2-C/ g OM/day
++++++++++++++++++++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Is Your Compost Mature?

AmmoniaN/NitrateN ratio
51 Ratio
+++
VeryMature>|< Mature >|< Immature

Ammonia N ppm
290 mg/kg dry wt.
++++++++++++++++++++++++++++++++
VeryMature>|< Mature >|< Immature

Nitrate N ppm
5.7 mg/kg dry wt.
++++
< Immature >|< Mature

pH value
7.33 units
+++
< Immature >|< Mature >|< Immature

Cucumber Emergence
100.0 percent
+++
< Immature >|< Mature

Is Your Compost Safe Regarding Health?

Fecal Coliform
< 1000 MPN/g dry wt.
+++++++
< Safe >|< High Fecal Coliform

Salmonella
Less than 3 /4g dry wt.
+++++++
<Safe (none detected) >|< High Salmonella Count(> 3 per 4 grams)

Metals US EPA 503
Pass dry wt.
+++++++++
<All Metals Pass >|< One or more Metals Fail

Does Your Compost Provide Nutrients or Organic Matter?

Nutrients (N+P2O5+K2O)
3.3 Percent dry wt.
+++++++++++++++++++++++++
<Low >|< Average >|< High Nutrient Content

AgIndex (Nutrients / Sodium and Chloride Salts) ((N+P2O5+K2O) / (Na + Cl))
11 Ratio
+++
Na & Cl >|< Nutrient and Sodium and Chloride Provider >|< Nutrient Provider

Plant Available Nitrogen (PAN) — Estimated release for first season
6 lbs/ton wet wt.
++++++++++++++++++++++
Low Nitrogen Provider>|< Average Nitrogen Provider >|<High Nitrogen Provider

C/N Ratio
14 Ratio
+++++++++++++++++++++++++++
< Nitrogen Release >|< N-Neutral >|< N-Demand>|< High Nitrogen Demand

Soluble Available Nutrients & Salts (EC5 w/w dw)
4.2 mmhos/cm dry wt.
++++++++++++++++++++++
SloRelease>|< Average Nutrient Release Rate >|<High Available Nutrients

Lime Content (CaCO3)
15 Lbs/ton dry wt.
++++++++++++++++++++++++
< Low >|< Average >|< High Lime Content (as CaCO3)

What are the physical properties of your compost?

Percent Ash
67.1 Percent dry wt.
+++
< High Organic Matter >|< Average >|< High Ash Content

Sieve Size % > 6.3 MM (0.25")
1.7 Percent dry wt.
+++++++++++++
All Uses >|< Size May Restrict Uses for Potting mix and Golf Courses

Account No.:		Date Received	19 Oct. 12	
2100583 - 2/2 - 6908		Sample i.d.	Zone #2- Cure	
Group:	Oct.12 C No. 27	Sample I.d. No.	2/2	2100583

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate

6.2 Moderate-selected use mg CO2-C/g OM/day

The respiration rate is a measurement of the biodegradation rate of the organic matter in the sample (as received). The respiration rate is determined by measuring the rate at which CO2 is released under optimized moisture and temperature conditions.

Biologically Available Carbon

7.1 Moderate-selected use mg CO2-C/g OM/day

Biologically Available Carbon (BAC) is a measurement of the rate at which CO2 is released under optimized moisture, temperature, porosity, nutrients, pH and microbial conditions. If both the RR and the BAC test values are close to the same value, the pile is optimized for composting. If both values are high the compost pile just needs more time. If both values are low the compost has stabilized and should be moved to curing. BAC test values that are higher than RR indicate that the compost pile has stalled. This could be due to anaerobic conditions, lack of available nitrogen due to excessive air converting ammonia to the unavailable nitrate form, lack of nitrogen or other nutrients due to poor choice of feedstock, pH value out of range, or microbes rendered non-active.

Is Your Compost Mature?

AmmoniaN:NitrateN ratio

51 immature

Ammonia N ppm

290 mature

Nitrate N ppm

5.7 immature

pH value

7.33 mature

Composting to stabilize carbon can occur at such a rapid rate that sometimes phytotoxins remain in the compost and must be neutralized before using in high concentrations or in high-end uses. This step is called curing. Typically ammonia is in excess with the break-down of organic materials resulting in an increase in pH. This combination results in a loss of volatile ammonia (it smells). Once this toxic ammonia has been reduced and the pH drops, the microbes convert the ammonia to nitrates. A low ammonia + high nitrate score is indicative of a mature compost, however there are many exceptions. For example, a compost with a low pH (<7) will retain ammonia, while a compost with high lime content can lose ammonia before the organic fraction becomes stable. Composts must first be stable before curing indicators apply.

Cucumber Bioassay

100.0 Percent

Cucumbers are chosen for this test because they are salt tolerant and very sensitive to ammonia and organic acid toxicity. Therefore, we can germinate seeds in high concentrations of compost to measure phytotoxic effects without soluble salts being the limiting factor. Values above 80% for both percent emergence and vigor are indicative of a well-cured compost. Exceptions include very high salts that affect the cucumbers, excessive concentrations of nitrates and other nutrients that will be in range when formulated to make a growing media. In addition to testing a 1:1 compost: vermiculite blend, we also test a diluted 1:3 blend to indicate a more sensitive toxicity level.

Is Your Compost Safe Regarding Health?

Fecal Coliform

< 1000 / g dry wt.

Fecal coliforms can survive in both aerobic and anaerobic conditions and is common in all initial compost piles. Most human pathogens occur from fecal matter and all fecal matter is loaded in fecal coliforms. Therefore fecal coliforms are used as an indicator to determine if the chosen method for pathogen reduction (heat for compost) has met the requirements of sufficient temperature, time and mixing. If the fecal coliforms are reduced to below 1000 per gram dry wt. it is assumed all others pathogens are eliminated. Potential problems are that fecal coliform can regrow during the curing phase or during shipping. This is because the conditions are now more favorable for growth than during the composting process.

Salmonella Bacteria

Less than 3 3 / 4g dry wt.

Salmonella is not only another indicator organism but also a toxic microbe. It has been used in the case of biosolids industry to determine adequate pathogen reduction.

Metals

Pass

The ten heavy metals listed in the EPA 503 regulations are chosen to determine if compost can be applied to ag land and handled without toxic effects. Most high concentrations of heavy metals are derived from woodwaste feedstock such as chrome-arsenic treated or lead painted demolition wood. Biosolids are rarely a problem.

Does Your Compost Provide Nutrients or Organic Matter?

Nutrients (N+P2O5+K2O)

3.3 Average nutrient content

This value is the sum of the primary nutrients Nitrogen, Phosphorus and Potassium. Reported units are consistent with those found on fertilizer formulations. A sum greater than 5 is indicative of a compost with high nutrient content, and best used to supply nutrients to a receiving soil. A sum below 2 indicates low nutrient content, and is best-used to improve soil structure via the addition of organic matter. Most compost falls between 2 and 5.

Account No.:		Date Received	19 Oct. 12	
2100583 - 2/2 - 6908		Sample i.d.	Zone #2- Cure	
Group:	Oct.12 C No. 27	Sample I.d. No.	2/2	2100583

INTERPRETATION:

AgIndex (Nutrients/Na+Cl)

11 High nutrient ratio Composts with low AgIndex values have high concentrations of sodium and/or chloride compared to nutrients. Repeated use of a compost with a low AgIndex (< 2) may result in sodium and/or chloride acting as the limiting factor compared to nutrients, governing application rates. These composts may be used on well-draining soils and/or with salt-tolerant plants. Additional nutrients form another source may be needed if the application rate is limited by sodium or chloride. If the AgIndex is above 10, nutrients optimal for plant growth will be available without concern of sodium and/or chloride toxicity. Composts with an AgIndex of above 10 are good for increasing nutrient levels for all soils. Most composts score between 2 and 10. Concentrations of nutrients, sodium, and chloride in the receiving soil should be considered when determining compost application rates. The AgIndex is a product of feedstock quality. Feedstock from dairy manure, marine waste, industrial wastes, and halophytic plants are likely to produce a finished compost with a low AgIndex.

Plant Available Nitrogen (lbs/ton)

6 Average N Provider Plant Available Nitrogen (PAN) is calculated by estimating the release rate of Nitrogen from the organic fraction of the compost. This estimate is based on information gathered from the BAC test and measured ammonia and nitrate values. Despite the PAN value of the compost, additional sources of Nitrogen may be needed during he growing season to off-set the Nitrogen demand of the microbes present in the compost. With ample nutrients these microbes can further breakdown organic matter in the compost and release bound Nitrogen. Nitrogen demand based on a high C/N ratio is not considered in the PAN calculation because additional Nitrogen should always be supplemented to the receiving soil when composts with a high C/N ratio are applied.

C/N Ratio

14 Indicates maturity As a guiding principal, a C/N ratio below 14 indicates maturity and above 14 indicates immaturity, however, there are many exceptions. Large woodchips (>6.3mm), bark, and redwood are slow to breakdown and therefore can result in a relatively stable product while the C/N ratio value is high. Additionally, some composts with chicken manure and/or green grass feedstocks can start with a C/N ratio below 15 and are very unstable. A C/N ratio below 10 supplies Nitrogen, while a ratio above 20 can deplete Nitrogen from the soil. The rate at which Nitrogen will be released or used by the microbes is indicated by the respiration rate (BAC). If the respiration rate is too high the transfer of Nitrogen will not be controlable.

Soluble Nutrients & Salts (EC5 w/w dw - mmhos/cm)

4.2 Average salts This value refers to all soluble ions including nutrients, sodium, chloride and some soluble organic compounds. The concentration of salts will change due to the release of salts from the organic matter as it degrades, volatilization of ammonia, decomposition of soluble organics, and conversion of molecular structure. High salts + high AgIndex is indicative of a compost high in readily available nutrients. The application rate of these composts should be limited by the optimum nutrient value based on soil analysis of the receiving soil. High Salts + low AgIndex is indicative of a compost low in nutrients with high concentrations of sodium and/or chloride. Limit the application rate according to the toxicity level of thesodium and/or chloride. Low salts indicates that the compost can be applied without risking salt toxicity, is likely a good source of organic matter, and that nutrients will release slowly over time.

Lime Content (lbs. per ton)

15 Average lime content Compost high in lime or carbonates are often those produced from chicken manure (layers) ash materials, and lime products. These are excellent products to use on a receiving soil where lime has been recommended by soil analysis to raise the pH. Composts with a high lime content should be closely considered for pH requirements when formulating potting mixes.

Physical Properties

Percent Ash

67.1 High ash content Ash is the non-organic fraction of a compost. Most composts contain approximately 50% ash (dry weight basis). Compost can be high in ash content for many reasons including: excess minerilzation(old compost), contamination with soil base material during turning, poor quality feedstock, and soil or mineral products added. Finding the source and reducing high ash content is often the fastest means to increasing nutrient quality of a compost.

Particle Size % > 6.3 MM (0.25")

1.7 May restrict use Large particles may restrict use for potting soils, golf course topdressings, seed-starter mixes, and where a fine size distribution is required. Composts with large particles can still be used as excellent additions to field soils, shrub mixes and mulches.

Particle Size Distribution

Each size fraction is measured by weight, volume and bulk density. These results are particularly relevent with decisions to screen or not, and if screening, which size screen to use. The bulk density indicates if the fraction screened is made of light weight organic material or heavy mineral material. Removing large mineral material can greatly improve compost quality by increasing nutrient and organic concentrations.

Appendix:			
		Estimated available nutrients for use when calculating application rates	
Plant Available Nitrogen (PAN) calculations:			lbs/ton (As Rcvd.)
PAN = (X * (organic N)) + ((NH4-N) + (NO3-N))			
X value =	If BAC < 2 then X = 0.1	Plant Available Nitrogen (PAN)	5.8
	If BAC =2.1 to 5 then X = 0.2	Ammonia (NH4-N)	0.42
	If BAC =5.1 to 10 then X = 0.3	Nitrate (NO3-N)	0.01
	If BAC > 10 then X = 0.4	Available Phosphorus (P2O5*0.64)	6.7
Note: If C/N ratio > 15 additional N should be applied.		Available Potassium (K2O)	19.5

ANALYTICAL CHEMISTS and BACTERIOLOGISTS
Approved by State of California
SOIL CONTROL LAB
42 HANGAR WAY
WATSONVILLE
CALIFORNIA
95076
USA

TEL: 831-724-5422
FAX: 831-724-3188
www.compostlab.com

Account #: 2100765-1/2-6908
Group: Oct.12 D #22
Reporting Date: November 6, 2012

TCCBI - Harvest Power
24487 Rd. 140
Tulare, CA 93274
Attn: John Jones

Date Received: 26 Oct. 12
Sample Identification: Zone-3 Cure
Sample ID #: 2100765 - 1/2

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	1.5	1.0	%
Ammonia (NH_4-N):	1500	1000	mg/kg
Nitrate (NO_3-N):	43	29	mg/kg
Org. Nitrogen (Org.-N):	1.3	0.87	%
Phosphorus (as P_2O_5):	0.63	0.42	%
Phosphorus (P):	2800	1900	mg/kg
Potassium (as K_2O):	1.4	0.94	%
Potassium (K):	12000	7800	mg/kg
Calcium (Ca):	1.8	1.2	%
Magnesium (Mg):	0.44	0.29	%
Sulfate (SO_4-S):	1300	900	mg/kg
Boron (Total B):	27	18	mg/kg
Moisture:	0	33.1	%
Sodium (Na):	0.13	0.085	%
Chloride (Cl):	0.27	0.18	%
pH Value:	NA	4.71	unit
Bulk Density :	18	27	lb/cu ft
Carbonates ($CaCO_3$):	<0.1	<0.1	lb/ton
Conductivity (EC5):	10	NA	mmhos/cm
Organic Matter:	53.8	36.0	%
Organic Carbon:	28.0	19.0	%
Ash:	46.2	30.9	%
C/N Ratio	18	18	ratio
AgIndex	9	9	ratio

Stability Indicator:		Biologically
CO2 Evolution	Respirometery	Available C
mg CO_2-C/g OM/day	23	23
mg CO_2-C/g TS/day	12	12
Stability Rating	*very unstable*	*very unstable*

Maturity Indicator: Cucumber Bioassay		
Compost:Vermiculite(v:v)	1:1	1:3
Emergence (%)	100	100
Seedling Vigor (%)	83	93
Description of Plants	*fungus*	*fungus*

Pathogens	Results	Units	Rating
Fecal Coliform	< 2.0	MPN/g	*pass*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 26 Oct. 12

Inerts	% by weight
Plastic	< 0.5
Glass	< 0.5
Metal	< 0.5
Sharps	ND

Metals	Dry wt.	EPA Limit	units
Aluminum (Al)	5700	-	mg/kg
Arsenic (As):	2.7	41	mg/kg
Cadmium (Cd):	< 1.0	39	mg/kg
Chromium (Cr):	12	1200	mg/kg
Cobalt (Co)	2.7	-	mg/kg
Copper (Cu):	58	1500	mg/kg
Iron (Fe):	8000	-	mg/kg
Lead (Pb):	19	300	mg/kg
Manganese (Mn):	170	-	mg/kg
Mercury (Hg):	< 1.0	17	mg/kg
Molybdenum (Mo):	1.8	75	mg/kg
Nickel (Ni):	8.9	420	mg/kg
Selenium (Se):	< 1.0	36	mg/kg
Zinc (Zn):	160	2800	mg/kg

Size & Volume Distribution

MM	% by weight	% by volume	BD g/cc
> 50	0.0	0.0	0.00
25 to 50	0.0	0.0	0.00
16 to 25	0.0	0.0	0.00
9.5 to 16	2.5	2.5	0.35
6.3 to 9.5	7.5	8.4	0.32
4.0 to 6.3	8.7	10.9	0.28
2.0 to 4.0	15.5	21.0	0.26
< 2.0	65.9	57.1	0.41

Bulk Density Description:<.35 Light Materials,
.35-.60 medium weight materials, >.60 Heavy Materials

Analyst: Assaf Sadeh

*Sample was received and handled in accordance with TMECC procedures.

Account No.: 2100765 - 1/2 - 6908
Group: Oct.12 D No. 22

Date Received: 26 Oct. 12
Sample i.d.: Zone-3 Cure
Sample I.d. No.: 1/2 2100765

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate — Biodegradation Rate of Your Pile
23 mg CO2-C/ g OM/day
+++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Biologically Available Carbon (BAC) — Optimum Degradation Rate
23 mg CO2-C/ g OM/day
+++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Is Your Compost Mature?

AmmoniaN/NitrateN ratio
35 Ratio
+++
VeryMature>|< Mature >|< Immature

Ammonia N ppm
1500 mg/kg dry wt.
+++
VeryMature>|< Mature >|< Immature

Nitrate N ppm
43 mg/kg dry wt.
+++++++++++++++++++++++++++++++++++
< Immature >|< Mature

pH value
4.71 units
+++++++++++++++++++++++++++++++++++++++
< Immature >|< Mature >|< Immature

Cucumber Emergence
100.0 percent
++
< Immature >|< Mature

Is Your Compost Safe Regarding Health?

Fecal Coliform
< 1000 MPN/g dry wt.
+++++++
< Safe >|< High Fecal Coliform

Salmonella
Less than 3 /4g dry wt.
+++++++
<Safe (none detected) >|< High Salmonella Count(> 3 per 4 grams)

Metals US EPA 503
Pass dry wt.
++++++++++
<All Metals Pass >|< One or more Metals Fail

Does Your Compost Provide Nutrients or Organic Matter?

Nutrients (N+P2O5+K2O)
3.6 Percent dry wt.
++++++++++++++++++++++++++++++
<Low >|< Average >|< High Nutrient Content

AgIndex (Nutrients / Sodium and Chloride Salts) — ((N+P2O5+K2O) / (Na + Cl))
9 Ratio
++
Na & Cl >|< Nutrient and Sodium and Chloride Provider >|< Nutrient Provider

Plant Available Nitrogen (PAN) — Estimated release for first season
10 lbs/ton wet wt.
++
Low Nitrogen Provider>|< Average Nitrogen Provider >|<High Nitrogen Provider

C/N Ratio
18 Ratio
+++++++++++++++++++++++++++++++++++++
< Nitrogen Release >|< N-Neutral >|< N-Demand>|< High Nitrogen Demand

Soluble Available Nutrients & Salts (EC5 w/w dw)
10 mmhos/cm dry wt.
+++
SloRelease>|< Average Nutrient Release Rate >|<High Available Nutrients

Lime Content (CaCO3)
0 Lbs/ton dry wt.
+
< Low >|< Average >|< High Lime Content (as CaCO3)

What are the physical properties of your compost?

Percent Ash
46.2 Percent dry wt.
++++++++++++++++++++++++++++++++++++++
< High Organic Matter >|< Average >|< High Ash Content

Sieve Size % > 6.3 MM (0.25")
10.0 Percent dry wt.
+++
All Uses >|< Size May Restrict Uses for Potting mix and Golf Courses

Account No.:		Date Received	26 Oct. 12
2100765 - 1/2 - 6908		Sample i.d.	Zone-3 Cure
Group:	Oct.12 D No. 22	Sample I.d. No.	1/2 2100765

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate

23 High-for mulch mg CO2-C/g OM/day

The respiration rate is a measurement of the biodegradation rate of the organic matter in the sample (as received). The respiration rate is determined by measuring the rate at which CO2 is released under optimized moisture and temperature conditions.

Biologically Available Carbon

23 High-for mulch mg CO2-C/g OM/day

Biologically Available Carbon (BAC) is a measurement of the rate at which CO2 is released under optimized moisture, temperature, porosity, nutrients, pH and microbial conditions. If both the RR and the BAC test values are close to the same value, the pile is optimized for composting. If both values are high the compost pile just needs more time. If both values are low the compost has stabilized and should be moved to curing. BAC test values that are higher than RR indicate that the compost pile has stalled. This could be due to anaerobic conditions, lack of available nitrogen due to excessive air converting ammonia to the unavailable nitrate form, lack of nitrogen or other nutrients due to poor choice of feedstock, pH value out of range, or microbes rendered non-active.

Is Your Compost Mature?

AmmoniaN:NitrateN ratio	
35	immature
Ammonia N ppm	
1500	immature
Nitrate N ppm	
43	immature
pH value	
4.71	immature

Composting to stabilize carbon can occur at such a rapid rate that sometimes phytotoxins remain in the compost and must be neutralized before using in high concentrations or in high-end uses. This step is called curing. Typically ammonia is in excess with the break-down of organic materials resulting in an increase in pH. This combination results in a loss of volatile ammonia (it smells). Once this toxic ammonia has been reduced and the pH drops, the microbes convert the ammonia to nitrates. A low ammonia + high nitrate score is indicative of a mature compost, however there are many exceptions. For example, a compost with a low pH (<7) will retain ammonia, while a compost with high lime content can lose ammonia before the organic fraction becomes stable. Composts must first be stable before curing indicators apply.

Cucumber Bioassay

100.0 Percent

Cucumbers are chosen for this test because they are salt tolerant and very sensitive to ammonia and organic acid toxicity. Therefore, we can germinate seeds in high concentrations of compost to measure phytotoxic effects without soluble salts being the limiting factor. Values above 80% for both percent emergence and vigor are indicative of a well-cured compost. Exceptions include very high salts that affect the cucumbers, excessive concentrations of nitrates and other nutrients that will be in range when formulated to make a growing media. In addition to testing a 1:1 compost: vermiculite blend, we also test a diluted 1:3 blend to indicate a more sensitive toxicity level.

Is Your Compost Safe Regarding Health?

Fecal Coliform

< 1000 / g dry wt.

Fecal coliforms can survive in both aerobic and anaerobic conditions and is common in all initial compost piles. Most human pathogens occur from fecal matter and all fecal matter is loaded in fecal coliforms. Therefore fecal coliforms are used as an indicator to determine if the chosen method for pathogen reduction (heat for compost) has met the requirements of sufficient temperature, time and mixing. If the fecal coliforms are reduced to below 1000 per gram dry wt. it is assumed all others pathogens are eliminated. Potential problems are that fecal coliform can regrow during the curing phase or during shipping. This is because the conditions are now more favorable for growth than during the composting process.

Salmonella Bacteria

Less than 3 3 / 4g dry wt.

Salmonella is not only another indicator organism but also a toxic microbe. It has been used in the case of biosolids industry to determine adequate pathogen reduction.

Metals

Pass

The ten heavy metals listed in the EPA 503 regulations are chosen to determine if compost can be applied to ag land and handled without toxic effects. Most high concentrations of heavy metals are derived from woodwaste feedstock such as chrome-arsenic treated or lead painted demolition wood. Biosolids are rarely a problem.

Does Your Compost Provide Nutrients or Organic Matter?

Nutrients (N+P2O5+K2O)

3.6 Average nutrient content

This value is the sum of the primary nutrients Nitrogen, Phosphorus and Potassium. Reported units are consistent with those found on fertilizer formulations. A sum greater than 5 is indicative of a compost with high nutrient content, and best used to supply nutrients to a receiving soil. A sum below 2 indicates low nutrient content, and is best-used to improve soil structure via the addition of organic matter. Most compost falls between 2 and 5.

Account No.:		Date Received	26 Oct. 12	
2100765 - 1/2 - 6908		Sample i.d.	Zone-3 Cure	
Group:	Oct.12 D No. 22	Sample I.d. No.	1/2	2100765

INTERPRETATION:

AgIndex (Nutrients/Na+Cl)

9 Average nutrient ratio Composts with low AgIndex values have high concentrations of sodium and/or chloride compared to nutrients. Repeated use of a compost with a low AgIndex (< 2) may result in sodium and/or chloride acting as the limiting factor compared to nutrients, governing application rates. These composts may be used on well-draining soils and/or with salt-tolerant plants. Additional nutrients form another source may be needed if the application rate is limited by sodium or chloride. If the AgIndex is above 10, nutrients optimal for plant growth will be available without concern of sodium and/or chloride toxicity. Composts with an AgIndex of above 10 are good for increasing nutrient levels for all soils. Most composts score between 2 and 10. Concentrations of nutrients, sodium, and chloride in the receiving soil should be considered when determining compost application rates. The AgIndex is a product of feedstock quality. Feedstock from dairy manure, marine waste, industrial wastes, and halophytic plants are likely to produce a finished compost with a low AgIndex.

Plant Available Nitrogen (lbs/ton)

10 Average N Provider Plant Available Nitrogen (PAN) is calculated by estimating the release rate of Nitrogen from the organic fraction of the compost. This estimate is based on information gathered from the BAC test and measured ammonia and nitrate values. Despite the PAN value of the compost, additional sources of Nitrogen may be needed during he growing season to off-set the Nitrogen demand of the microbes present in the compost. With ample nutrients these microbes can further breakdown organic matter in the compost and release bound Nitrogen. Nitrogen demand based on a high C/N ratio is not considered in the PAN calculation because additional Nitrogen should always be supplemented to the receiving soil when composts with a high C/N ratio are applied.

C/N Ratio

18 Indicates immaturity As a guiding principal, a C/N ratio below 14 indicates maturity and above 14 indicates immaturity, however, there are many exceptions. Large woodchips (>6.3mm), bark, and redwood are slow to breakdown and therefore can result in a relatively stable product while the C/N ratio value is high. Additionally, some composts with chicken manure and/or green grass feedstocks can start with a C/N ratio below 15 and are very unstable. A C/N ratio below 10 supplies Nitrogen, while a ratio above 20 can deplete Nitrogen from the soil. The rate at which Nitrogen will be released or used by the microbes is indicated by the respiration rate (BAC). If the respiration rate is too high the transfer of Nitrogen will not be controlable.

Soluble Nutrients & Salts (EC5 w/w dw - mmhos/cm)

10 High salts This value refers to all soluble ions including nutrients, sodium, chloride and some soluble organic compounds. The concentration of salts will change due to the release of salts from the organic matter as it degrades, volatilization of ammonia, decomposition of soluble organics, and conversion of molecular structure. High salts + high AgIndex is indicative of a compost high in readily available nutrients. The application rate of these composts should be limited by the optimum nutrient value based on soil analysis of the receiving soil. High Salts + low AgIndex is indicative of a compost low in nutrients with high concentrations of sodium and/or chloride. Limit the application rate according to the toxicity level of thesodium and/or chloride. Low salts indicates that the compost can be applied without risking salt toxicity, is likely a good source of organic matter, and that nutrients will release slowly over time.

Lime Content (lbs. per ton)

0 Low lime content Compost high in lime or carbonates are often those produced from chicken manure (layers) ash materials, and lime products. These are excellent products to use on a receiving soil where lime has been recommended by soil analysis to raise the pH. Composts with a high lime content should be closely considered for pH requirements when formulating potting mixes.

Physical Properties

Percent Ash

46.2 Average ash content Ash is the non-organic fraction of a compost. Most composts contain approximately 50% ash (dry weight basis). Compost can be high in ash content for many reasons including: excess minerilzation(old compost), contamination with soil base material during turning, poor quality feedstock, and soil or mineral products added. Finding the source and reducing high ash content is often the fastest means to increasing nutrient quality of a compost.

Particle Size % > 6.3 MM (0.25")

10.0 May restrict use Large particles may restrict use for potting soils, golf course topdressings, seed-starter mixes, and where a fine size distribution is required. Composts with large particles can still be used as excellent additions to field soils, shrub mixes and mulches.

Particle Size Distribution

Each size fraction is measured by weight, volume and bulk density. These results are particularly relevent with decisions to screen or not, and if screening, which size screen to use. The bulk density indicates if the fraction screened is made of light weight organic material or heavy mineral material. Removing large mineral material can greatly improve compost quality by increasing nutrient and organic concentrations.

Appendix:			
		Estimated available nutrients for use when calculating application rates	
Plant Available Nitrogen (PAN) calculations:			lbs/ton (As Rcvd.)
PAN = (X * (organic N)) + ((NH4-N) + (NO3-N))			
X value =	If BAC < 2 then X = 0.1	Plant Available Nitrogen (PAN)	9.9
	If BAC =2.1 to 5 then X = 0.2	Ammonia (NH4-N)	2.00
	If BAC =5.1 to 10 then X = 0.3	Nitrate (NO3-N)	0.06
	If BAC > 10 then X = 0.4	Available Phosphorus (P2O5*0.64)	5.5
Note: If C/N ratio > 15 additional N should be applied.		Available Potassium (K2O)	18.8

2120 South 'K' Street
Tulare, California 93274
Office: 559 - 688-5684
Fax: 559 - 688-5768

Valley Tech

AGRICULTURAL LABORATORY SERVICES

REPORT of ANALYSIS

Client: HARVEST POWER CALIFORNIA, LLC
24478 ROAD 140
TULARE, CALIFORNIA 93274

Lab No.: 08-08M167
Sampled Date: 08-08-12
Report Date: 08-14-12
Submitted By: JOHN JONES

Material: COMPOST

Sample Description	------- As Received Basis -------				---- 100% D.M. Basis ----		
	% H_2O	% Carbon	% Nitrogen	C/N	% H_2O	% Carbon	% Nitrogen
1. Zone 1 Composite #1 08/06/12	48.1	14.7	0.56	25.9	-	28.2	1.09
2. Zone 1 Composite #2 08/07/12	39.0	15.6	0.96	16.3	-	25.6	1.57

If you should have any questions, please call. Thank you.

Sam Modesitt
Chemist

Analysis by TMECC Method 03.09

TMECC - "Test Methods for the Examination of Composting and Compost," US Composting Council, June 2002

Valley Tech

2120 South 'K' Street
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AGRICULTURAL LABORATORY SERVICES

REPORT of ANALYSIS

Client: HARVEST POWER CALIFORNIA, LLC
24478 ROAD 140
TULARE, CALIFORNIA 93274

Lab No.: 08-13M298
Sampled Date: 08-13-12
Report Date: 08-24-12
Submitted By: JOHN JONES

Material: COMPOST
LOCATION: SJVAPCD

ZONE 2 Sample Description	As Received Basis % H_2O	As Received Basis % Carbon	As Received Basis % Nitrogen	As Received Basis C/N	100% D.M. Basis % H_2O	100% D.M. Basis % Carbon	100% D.M. Basis % Nitrogen
1. SJVAPCD - North	35.8	18.7	1.06	17.6	-	29.1	1.65
2. SJVAPCD - South	53.1	15.0	0.77	19.5	-	31.9	1.64

If you should have any questions, please call. Thank you.

Sam Modesitt
Chemist

Analysis by TMECC Method 03.09

TMECC - "Test Methods for the Examination of Composting and Compost," US Composting Council, June 2002

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Tulare, California 93274
Office: 559 - 688-5684
Fax: 559 - 688-5768

Valley Tech

AGRICULTURAL LABORATORY SERVICES

REPORT of ANALYSIS

Client: HARVEST POWER CALIFORNIA, LLC
24478 ROAD 140
TULARE, CALIFORNIA 93274

Lab No.: 08-20M549
Sampled Date: 08-17-12
Report Date: 08-24-12
Submitted By: JOHN JONES

Material: COMPOST
LOCATION: ZONE 3

	------- As Received Basis -------				---- 100% D.M. Basis ----		
Sample Description	% H_2O	% Carbon	% Nitrogen	C/N	% H_2O	% Carbon	% Nitrogen
1. Zone 3 - North End	56.6	11.9	0.58	20.5	-	27.3	1.34
2. Zone 3 - South End	57.2	16.5	0.62	26.6	-	38.6	1.44

If you should have any questions, please call. Thank you.

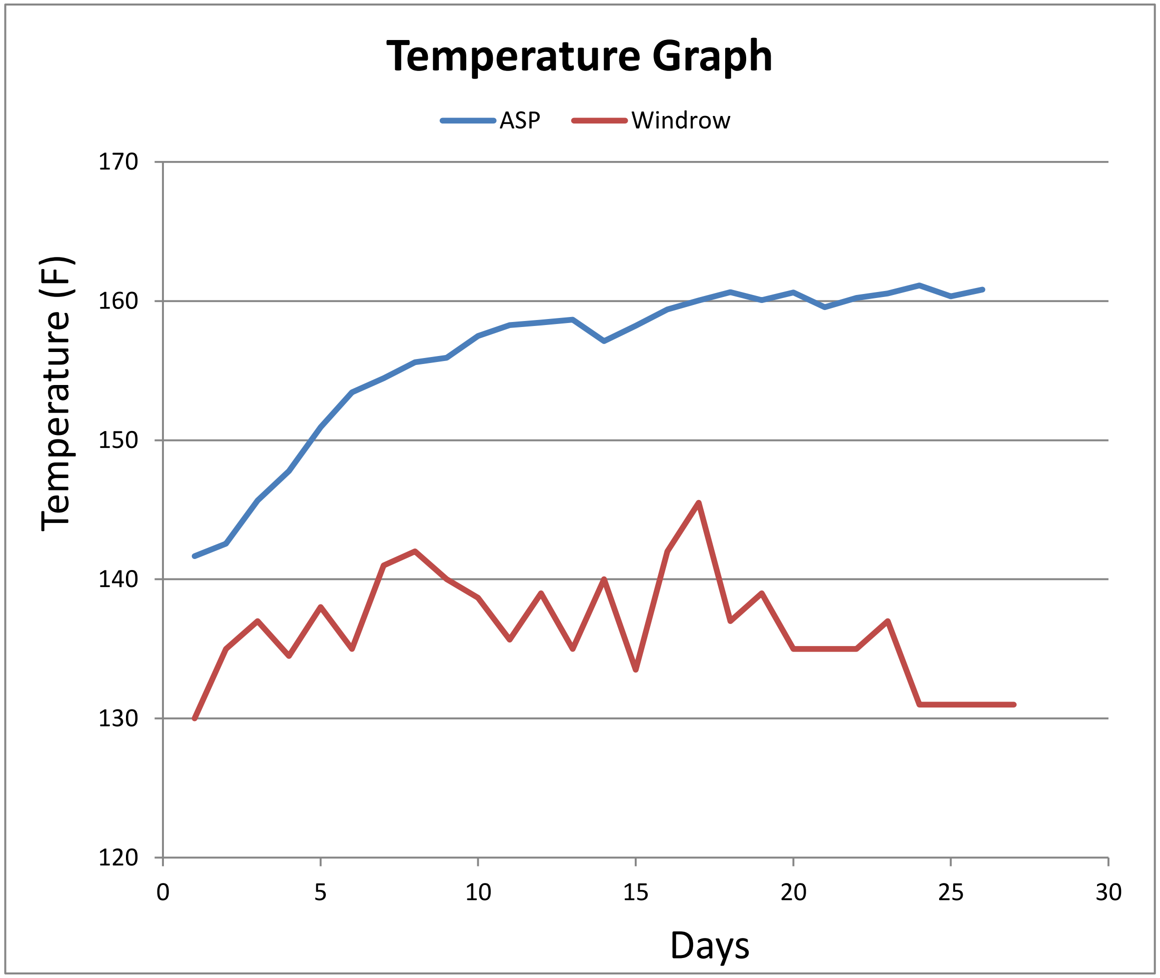
Sam Modesitt
Chemist

Analysis by TMECC Method 03.09

TMECC - "Test Methods for the Examination of Composting and Compost," US Composting Council, June 2002

ACP Final Report fo Valley Air TAP Program, May 2013, Appendix G, Temperature Graph

Day	ASP	Control
0		125
1	142	130
2	143	135
3	146	137
4	148	135
5	151	138
6	153	135
7	154	141
8	156	142
9	156	140
10	157	139
11	158	136
12	158	139
13	159	135
14	157	140
15	158	134
16	159	142
17	160	146
18	161	137
19	160	139
20	161	135
21	160	135
22	160	135
23	161	137
24	161	131
25	160	131
26	161	131
27		131
28		131



ACP Final Report fo Valley Air TAP Program, May 2013, Appendix G, Windrow Temperatures

Day	Zone	Temp 1	Temp 2	Temp Sum	# of Values	Average Temp
0	3	124	126	250	2	125
1	3	126	134	260	2	130
2	3	138	132	270	2	135
3	3	136	138	274	2	137
4	2	134	138	272	2	136
4	3	134	132	266	2	133
5	2	144	144	288	2	144
5	3	134	136	270	2	135
6	2	138	132	270	2	135
7	2	138	136	274	2	137
7	3	146	144	290	2	145
8	1	138	136	274	2	137
8	3	148	146	294	2	147
9	1	140	142	282	2	141
9	2	140	142	282	2	141
9	3	136	140	276	2	138
10	1	138	138	276	2	138
10	2	144	146	290	2	145
10	3	132	134	266	2	133
11	1	133	133	266	2	133
11	2	140	142	282	2	141
11	3	132	134	266	2	133
12	2	142	144	286	2	143
12	3	136	134	270	2	135
13	1	132	134	266	2	133
13	2	138	136	274	2	137
14	1	134	136	270	2	135
14	2	146	144	290	2	145
15	1	134	136	270	2	135
15	3	132	132	264	2	132
16	1	136	138	254	2	137
16	2	156	158	314	2	157
17	1	138	134	272	2	136
17	2	154	156	310	2	155
18	1	136	134	270	2	135
18	2	138	140	278	2	139
19	2	138	140	278	2	139
20	1	134	136	270	2	135
20	2	134	136	270	2	135
21	1	136	138	274	2	137
21	2	134	132	266	2	133
22	1	136	134	270	2	135
23	1	136	138	274	2	137
24	1	134	132	266	2	133
24	2	128	130	258	2	129
25	1	130	132	262	2	131
28	1	130	132	262	2	131

Average

Day	Temp Sum	# of Values	Average Temp
0	125	1	125
1	130	1	130
2	135	1	135
3	137	1	137
4	269	2	135
5	279	2	140
6	135	1	135
7	282	2	141
8	284	2	142
9	420	3	140
10	416	3	139
11	407	3	136
12	278	2	139
13	270	2	135
14	280	2	140
15	267	2	134
16	294	2	147
17	291	2	146
18	274	2	137
19	139	1	139
20	270	2	135
21	270	2	135
22	135	1	135
23	137	1	137
24	262	2	131
25	131	1	131
26	131	1	131
27	131	1	131
28	131	1	131

ACP Final Report fo Valley Air TAP Program, May 2013, Appendix G, ASP Temperatures

			T-X-1			T-X-2			T-X-3				Overall Combined			
Zone	Day	2'	3'	5'	2'	3'	5'	2'	3'	5'	Average		Day	Sum	# of Days	Average
1	0												0	141	1	140.7
	1												1	143	1	142.9
	2												2	287	2	143.3
	3												3	289	2	144.3
	4	138	154	154	140	151	158	166	164	146	152		4	448	3	149.4
	5												5	302	2	151.0
	6	150	152	156	142	146	160	168	166	150	154		6	306	2	153.2
	7	152	153	164	144	142	162	170	170	152	157		7	465	3	155.1
	8	140	156	140	154	156	164	164	158	160	155		8	311	2	155.7
	9	144	154	158	156	154	162	162	156	164	157		9	472	3	157.3
	10	142	152	156	158	156	160	164	158	163	157		10	474	3	158.0
	11	144	156	158	166	158	162	162	156	160	158		11	474	3	158.0
	12												12	318	2	159.0
	13	150	156	158	162	156	156	164	158	154	157		13	314	2	157.1
	14	152	160	160	164	158	158	162	160	156	159		14	315	2	157.7
	15	154	158	162	160	162	160	164	162	154	160		15	319	2	159.7
	16	156	160	160	162	160	162	160	164	156	160		16	477	3	159.1
	17	154	158	162	164	162	160	162	166	154	160		17	479	3	159.7
	18	156	160	164	162	164	162	160	164	152	160		18	481	3	160.4
	19												19	321	2	160.6
	20	158	162	162	160	160	160	158	162	154	160		20	319	2	159.4
	21	160	164	160	162	158	156	160	160	156	160		21	482	3	160.7
	22	162	162	164	160	160	158	162	162	158	161		22	321	2	160.6
	23	160	164	162	162	164	160	160	164	160	162		23	322	2	161.1
	24	158	162	160	158	160	162	158	162	158	160		24	481	3	160.4
	25	160	158	162	160	162	160	162	160	160	160		25	322	2	160.8
	26	158	160	160	158	160	158	158	162	158	159		26	320	2	159.8
2	0															
	1															
	2	120	130	124	154	154	160	162	134	146	143					
	3	124	132	126	136	156	164	164	136	142	142					
	4	140	138	118	160	162	168	166	140	134	147					
	5	138	140	130	142	166	164	164	154	144	149					
	6	140	142	144	160	162	162	160	152	146	152					
	7	144	146	148	158	160	164	158	160	148	154					
	8															
	9	148	150	146	158	162	162	164	158	150	155					
	10	150	152	148	160	164	164	160	156	154	156					
	11	152	154	144	158	158	160	162	158	156	156					
	12	154	156	146	156	160	162	160	162	158	157					
	13	156	146	150	158	162	164	162	164	152	157					
	14	154	144	148	160	164	162	160	162	154	156					
	15															
	16	160	158	146	158	162	160	158	160	156	158					
	17	164	160	148	160	164	162	160	158	154	159					
	18	162	162	158	162	160	160	162	160	158	160					
	19	160	164	160	160	162	162	164	162	160	162					
	20	158	160	162	158	160	158	160	160	158	159					
	21	160	162	164	160	162	160	162	164	160	162					
	22															
	23															
	24	162	160	162	162	160	158	160	162	158	160					
	25															
	26															
	27															
	28															
3	0	130	132	132	148	142	154	148	138	142	141					
	1	132	134	136	154	144	156	146	140	144	143					
	2	134	136	138	156	148	154	144	142	144	144					
	3	136	138	140	158	150	158	146	146	146	146					
	4	138	140	144	160	154	156	148	148	148	148					
	5	144	146	148	162	160	160	154	150	152	153					
	6															
	7	154	150	150	160	158	158	158	152	154	155					
	8	156	152	154	158	160	160	160	154	156	157					
	9	160	162	158	160	162	162	162	158	156	160					
	10	162	160	160	162	164	160	164	160	158	161					
	11	160	162	158	160	162	162	160	158	160	160					
	12	162	160	160	162	164	160	162	160	158	161					
	13															
	14															
	15	160	158	162	158	160	162	160	158	160	160					
	16	160	159	160	160	158	160	162	158	160	160					
	17	160	160	158	161	160	161	160	160	161	160					
	18	162	158	159	161	160	160	162	160	162	160					
	19	160	160	161	160	160	159	158	159	160	160					
	20															
	21	160	162	160	162	160	161	161	160	162	161					
	22	160	161	162	160	160	161	160	159	160	160					
	23	161	160	159	162	161	160	160	160	161	160					
	24	160	161	157	161	161	161	164	161	162	161					
	25	160	162	160	159	169	162	161	159	159	161					
	26	161	161	161	159	159	161	161	160	161	160					

ACP Final Report fo Valley Air TAP Program, May 2013, Appendix H, Water Use Calculations

Composting in Windrows vs. Extended Aerated Static Piles

EASP data is from the 2012 TAP research project in Tulare, CA.
Windrow data is from the City of Bakersfield's normal operation for reference.

Table One - Windrow Turning Method

(Water applied to normal 2,962 cubic yard windrows in Bakersfield)

Note: Windrows are watered within 3 hours prior to turning to achieve ball test for moisture per air district rule 4566.

	Gallons per Water Truck Load	**# Loads per Watering Event***	**Gallons per Event**	**# of Events per Pile**	**Gallons per Pile**	**Gallons per Cubic Yard**
1. Hydrate newly formed windrow with water truck	4,000	4	16,000	1	16,000	5
2. Hydrate windrow prior to 6 turnings (5 in 15 days PFRP and 1 @ day 22)	4,000	3	12,000	6	72,000	24
Total for 22 day active phase:					**88,000**	**30**

*averaged for seasonal variation

Table Two - Extended Aerated Static Pile Method

(Water applied to each 506 cubic yard pile in Tulare)

Note: Item 2 (compost cover water) could be reduced since there was significant extra water runoff during pilot program.

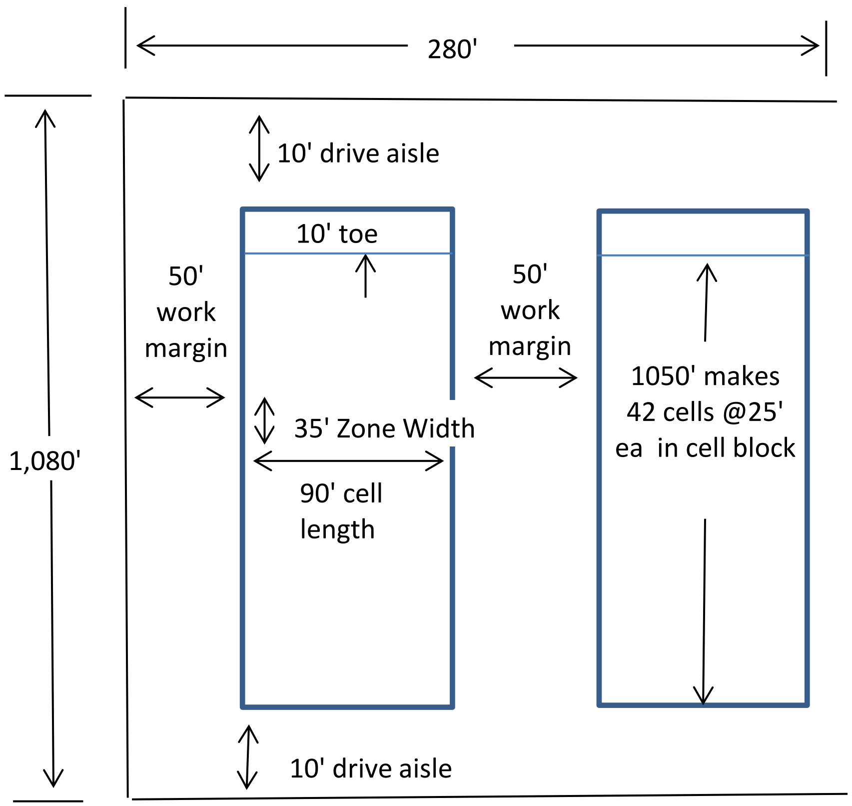
	Gallons per Minute Flow	**Minutes per Watering Event***	**Gallons per Event**	**# of Events per Pile**	**Gallons per Pile**	**Gallons per Cubic Yard**
1. Hydrate incoming feedstock with 1 1/4" fire hose as pile is built	35	240	8,400	1	8,400	17
2. Moisten compost cover with 3 lawn sprinklers 6x/day till day 22	11	6	66	63	4,158	8
Total for 22 day active phase:					**12,558**	**25**

*averaged for seasonal variation

Comparsion of ASP and Windrow Layouts

ACP Final Report fo Valley Air TAP Program, May 2013, Appendix I, Facility Layour Comparison

A - EASP Facility Layout



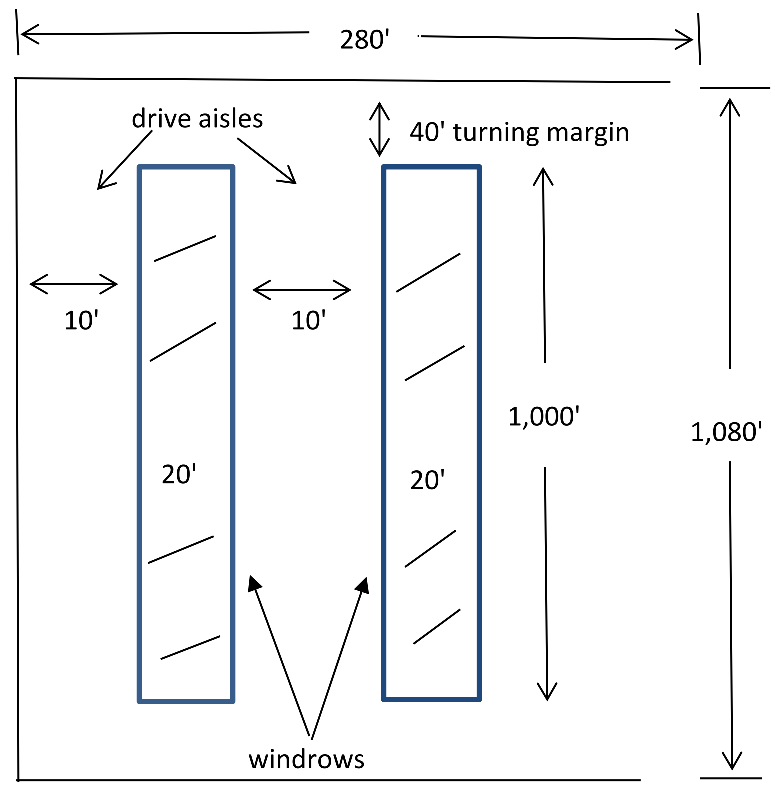
Footprint:

- 1080' X 140' = 151,200 sq.ft. / 43,560 ft^2/acre = 3.5 acres per cell block

Volume/Acre:

- 740 yd/cell X 42 cells/cell block = 31,080 cu yd per cell block
- Divide 3.5 acres per cell block = **8,880 cu.yd/acre**

B - Windrow Facility Layout



Footprint:

- 1080' X 30' = 32,400 sq.ft. / 43,560 ft per acre = 0.75 acres per row

Volume/Acre:

- 2,963 cu.yd/row
- Divide 0.75 acres/row = **3,950 cu.yd/acre**

ACP Final Report fo Valley Air TAP Program, May 2013, Appendix I, 100,000 TPY Facility Calculation

100,000 Ton/Year Facility Example

Number of cycles or turn over per year is facility specific. Therefore, assume range of four cycles (90 days) or five cycles (70 days)

Extended Aerated Static Pile (EASP)

$$\frac{8{,}880 \text{ cu yd/acre}}{2.5 \text{ cu yd/ton}} = 3{,}552 \text{ tons/acre}$$

90 day (4 cycles year):

$$\frac{100{,}000 \text{ tons/year}}{4 \text{ cycles/year}} = 25{,}000 \text{ tons/cycle}$$

$$\frac{25{,}000 \text{ tons/cycle}}{3{,}552 \text{ tons/acre}} = \mathbf{7.03 \text{ acre/cycle}}$$

70 day (5 cycles year):

$$\frac{100{,}000 \text{ tons/year}}{5 \text{ cycles/year}} = 20{,}000 \text{ tons/cycle}$$

$$\frac{20{,}000 \text{ tons/cycle}}{3{,}552 \text{ tons/acre}} = \mathbf{5.63 \text{ acre/cycle}}$$

Windrow

$$\frac{3{,}950 \text{ cu yd/acre}}{2.5 \text{ cu yd/ton}} = 1{,}580 \text{ tons/acre}$$

90 day (4 cycles year):

$$\frac{100{,}000 \text{ tons/year}}{4 \text{ cycles/year}} = 25{,}000 \text{ tons/cycle}$$

$$\frac{25{,}000 \text{ tons/cycle}}{1{,}580 \text{ tons/acre}} = \mathbf{15.8 \text{ acre/cycle}}$$

70 day (5 cycles year):

$$\frac{100{,}000 \text{ tons/year}}{5 \text{ cycles/year}} = 20{,}000 \text{ tons/cycle}$$

$$\frac{20{,}000 \text{ tons/cycle}}{1{,}580 \text{ tons/acre}} = \mathbf{12.65 \text{ acre/cycle}}$$

ACP Final Report fo Valley Air TAP Program, May 2013, Appendix I,
Formula for Land Use Reduction

100,000 Ton/Year Facility Example (Short Formula)

Extended Aerated Static Pile (EASP)

$\frac{\text{8,880 cu yd/acre}}{\text{2.5 cu yd/ton}}$ = 3,552 tons/acre

90 day (4 cycles year): **7.03 acre/cycle**

70 day (5 cycles year): **5.63 acre/cycle**

	Pad Acres Low	Pad Acres High
eASP	5.63	7.03
Windrow	12.65	15.8

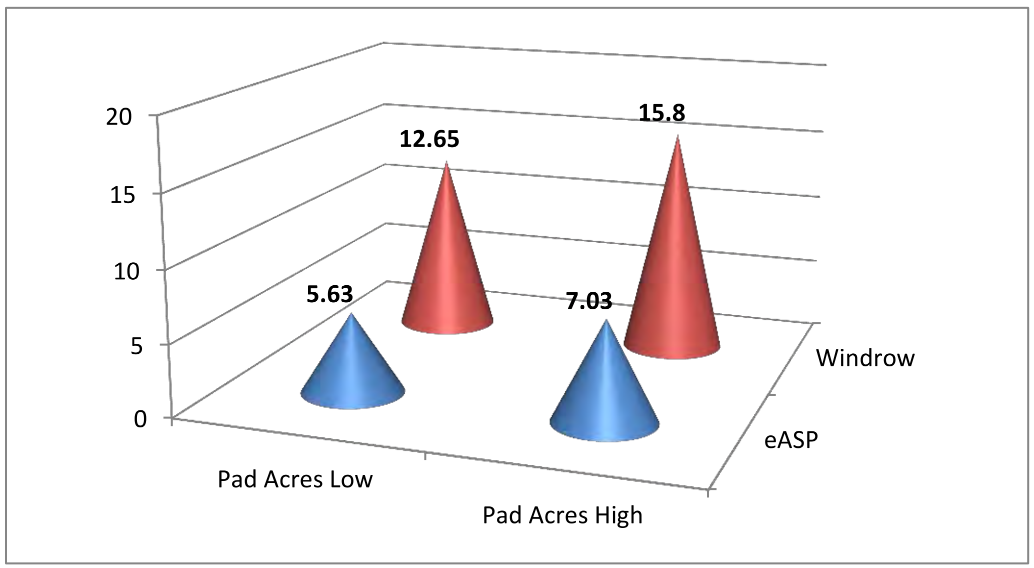
Windrow

$\frac{\text{3,950 cu yd/acre}}{\text{2.5 cu yd/ton}}$ = 1,580 tons/acre

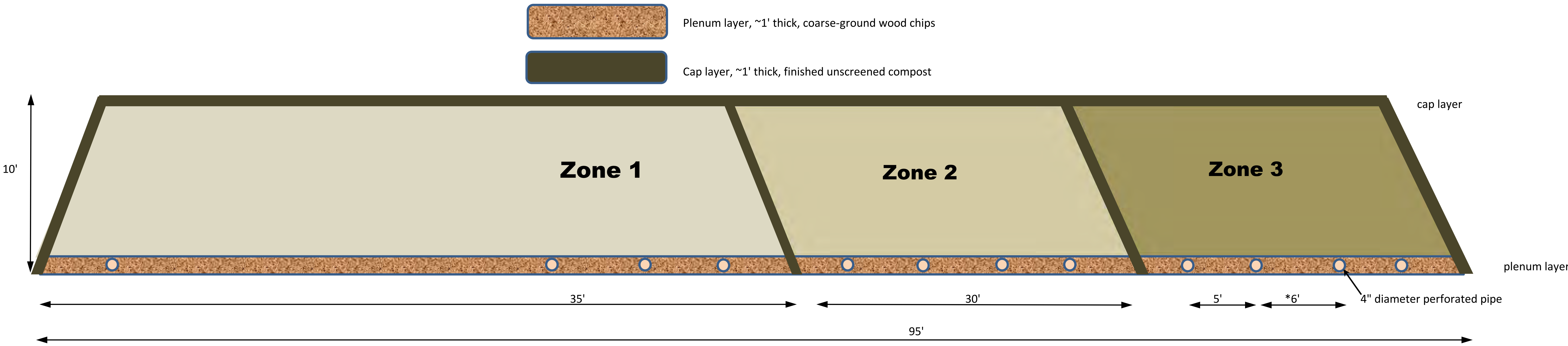
90 day (4 cycles year): **15.8 acre/cycle**

70 day (5 cycles year): **12.65 acre/cycle**

-55.5%
44.5%
44.5%

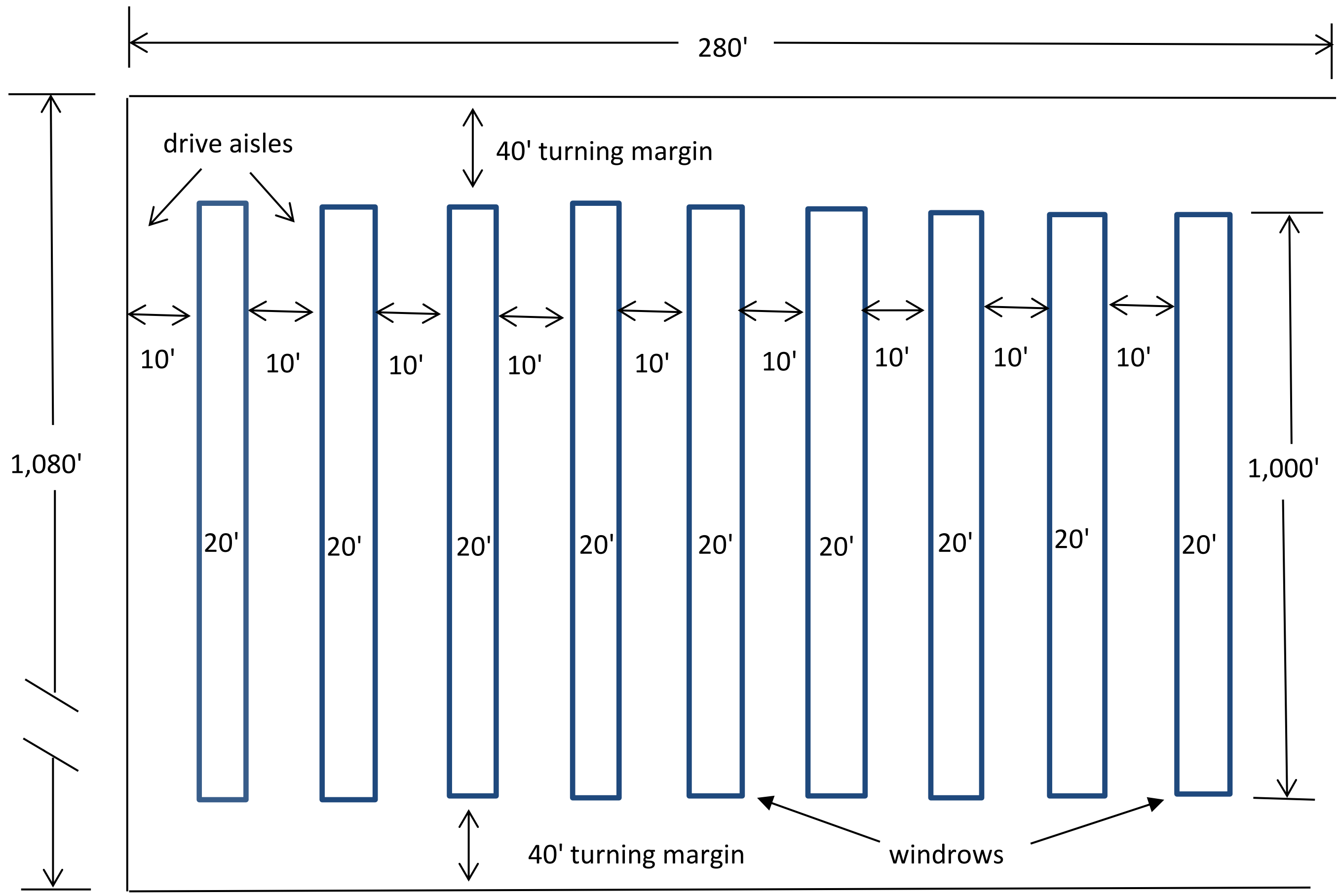


ACP Final Report fo Valley Air TAP Program, May 2013, Appendix I, Starting cross-section dimensions for ASP and Windrow
(shrinkage will occur)
(drawings not exactly to scale)



* Center two aeration pipes tend to be slightly farther apart due to presence of blower and T-connector.

ACP Final Report fo Valley Air TAP Program, May 2013, Appendix I, Windrow Facility Layout



Footprint:

- 1080' X 30' = 32,400 sq.ft. / 43,560 ft per acre = 0.75 acre per row

Volume/Acre:

- 2,963 cu.yd/row
- Divide 0.75 acres/row = **3,950 cu.yd/acre**