Protecting Our Land, Air and Water Resources

Aerated Static Pile Compost Pilot Project and Operator Training Program

For the

City of Walla Walla, Washington

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O_2Compost
Compost Systems & Training

Introduction

Project Name

Aerated Static Pile Compost Pilot Project and Operator Training Program For the City of Walla Walla, Washington

Location

Sudbury Compost Facility; Landfill Rd., Walla Walla, WA 99362, with direct access from Hwy 12.

Contract Agreement

Walla Walla Professional Services Contract – ASP Compost Pilot: O2Compost; September 15, 2014

Grant Funding

Funding for this project was provided in part through a Coordinated Prevention Grant (CPG) Agreement between the State of Washington Department of Ecology and City of Walla Walla: Grant No. G1500016.

Goal Statement

The City of Walla Walla, Washington (The City) will determine the process and logistics to implement the Aerated Static Pile (ASP) Method of composting on a permanent basis at the Sudbury Landfill / Compost Facility.

Outcome Statement

The City will conduct a controlled assessment of ASP to showcase a more efficient and cost effective method of processing the county's green waste. The City will also explore the feasibility of including food waste from the adjoining Washington State Penitentiary.

Project Overview

The objective of this project was to construct two side-by-side aerated static piles, each approximately 200 cubic yards in volume. One of the piles was comprised of shredded yard debris (only), and the second consisted of a mix of shredded yard debris combined with food waste from the Walla Walla State Penitentiary (WSP). The project was conducted at the Regional Walla Walla (Sudbury) Compost Facility.

The compost facility does not have an onsite shredder and depends on contractors to grind its accumulated green waste semi-annually. The shredded waste is very dry and a potential fire hazard. Moisture and nutrients brought in with the WSP food waste are considered an asset.

The Pilot Project was designed by O_2Compost, a private environmental consulting company located in Snohomish, Washington. In addition, O_2Compost provided on-site operator training and remote technical support throughout the term of the project.

For this Pilot Project:

- O_2Compost provided all equipment and materials necessary to construct the two free standing aerated static piles. All equipment and materials were rented to the City as part of the contract agreement and the City will purchase all remaining equipment and materials at the completion of the project.

- The City provided the site to conduct the pilot test (Sudbury Compost Facility), front-end loader equipment to construct the piles, a water truck for moisture conditioning, electrical power; freshly shredded yard debris and labor throughout the project. The City also covered the cost for all laboratory testing;

- The Walla Walla State Penitentiary (WSP) provided approximately 2,500 gallons of food waste for the project. The food waste was delivered by WSP as very wet slurry, using a tank-trailer.

- At the outset of the project, laboratory tests were completed on each feedstock for nutrient and physical characteristics. From this information a mix recipe was developed for both the yard debris (only) and the yard debris plus food waste piles. Laboratory tests were also conducted on the finished compost. Laboratory services were provided by Soil Control Lab of Watsonville, California.

- Throughout the pilot test, City personnel collected and recorded temperature data from each of the piles to evaluate changes in the consistency of the composting materials and the aeration system. City personnel also conducted a series of field tests to determine oxygen demand (uptake); changes in bulk density and moisture content; and finished product stability.

- At the completion of the field study, City personnel conducted a detailed cost analysis to compare the two methods of composting: The current Turned Windrow Method compared to the proposed ASP Method.

Lessons Learned

- Through this Pilot Project, it was found that the ASP Method of Composting is more efficient than the turned windrow method currently being used.
    - The ASP Method produces higher quality, stable compost in less than half the time;
    - The proposed ASP Method incurred approximately half of the cost for labor, equipment time and fuel when compared to the current Turned Windrow Method;
- Because of this increased efficiency, the ASP Method represents an opportunity for The City to reduce the cost and time of composing operations;
- The addition of food waste from Washington State Penitentiary (WSP) was advantageous because of the increased moisture content and nutrients in the initial compost mix.
- The ASP Method was effective at mitigating off-site impacts from objectionable odors.
- By consolidating feedstock materials into larger piles and decreasing the time required for composting, the ASP Method significantly increases the annual flow-through capacity of the existing facility (at least fourfold).

Recommended Next Steps for Permanent Implementation

- Present findings to the Walla Walla City Council;
- Formalize a joint working agreement with WSP to continue receiving and processing prison wood waste;
- Evaluate the potential for receiving and processing pre-consumer food waste from the City and County of Walla Walla.
- Conduct a detailed evaluation of needs (i.e., grant funding, electrical power, grinding and screening equipment, staff training) to convert the entire facility to the ASP Method;
- Modify the facility Permit and Operations Plan to reflect the change to ASP Composting; and
- Update The City's Marketing Plan for the sale and distribution of Walla Walla Compost.

Turned Windrow Composting - Current Operation

Contract Grinding - Semi-Annual

The City currently does not own grinding equipment. Since the start of the Sudbury Compost Facility in July 2007, grinding operations have generally been contracted on a semi-annual basis. The most recent grinding event took place in March 2015, and materials processed during this grinding event were used in the ASP Pilot Project.

Turned Windrow Composting using a Front-End Loader

Historically, composting operations at the Sudbury Compost Facility have relied on the "Turned Windrow Method". With this approach, large, elongated piles (windrows) are constructed using a front-end loader. Piles typically measure 18 – 20 feet wide, 130 - 140 feet long, and 10 – 12 feet high, each windrow has a volume of approximately 450 – 500 cubic yards.

At the outset, piles are turned at least 5 times within a period of 15 days, during which time pile temperatures are maintained at 55^{o}C (131^{o}F) or higher. These are the criteria that are required for achieving pathogen destruction (referred to as a Process to Further Reduce Pathogens, or PFRP).

The piles are turned an average of 20 times during the 120 days of processing. This includes 5 turns to achieve PFRP and 15 additional turns – once per week for 15 weeks - to produce a stable, finished product ready for screening.

Contract Screening – Semi-Annual

The City currently does not own screening equipment. Since the start of the Sudbury Compost Facility, screening operations have been contracted on a semi-annual basis.

Marketing, Sales & Distribution

Marketing of the compost is largely done by word of mouth. Outreach includes a few newspaper articles and advertisements. A formal marketing plan is not in place at this time, but preparation of one is planned for 2016. Sale of the compost takes place at the landfill office and distribution is by self-haul.

Aerated Static Pile (ASP) Composting

ASP composting was originally developed by the U.S. Department of Agriculture in the mid-1970's and is used throughout the country to process a wide variety of municipal organic waste materials (e.g., biosolids, yard debris, food waste, livestock manure, livestock mortalities, etc.).

With aerated composting, aerobic conditions are maintained throughout the compost pile, optimizing biologic conditions and expediting the composting process.

As part of constructing an Aerated Static Pile, a 1-foot thick (or greater) layer of finished compost is placed over the raw feedstock materials. This cover layer serves several purposes:

- Insulating cover to achieve pile temperatures sufficient for pathogen destruction;
- Biofilter for odor management (i.e., in-situ treatment);
- Volatile organic compound (VOC) emission reduction;
- Vector barrier (i.e., flies, birds, rodents and larger wildlife);
- Moisture retention, to sustain the composting process;
- Nutrient retention, primarily nitrogen as ammonia; and
- Aesthetic cover ("People Smell with their Eyes")

With the ASP Method, PFRP conditions are met when pile temperatures equal or exceed 55^{o}C (131^{o}F) for a minimum period of 3-days, without pile turning.

ASP Pilot Project

Green Waste Pile Building Event & Operator Training

On March 4, 2015, a representative from O_2Compost met with the City's compost facility personnel to construct the first of two Aerated Static Piles (ASP #1). Yard debris grinding operations were underway at the time, and freshly ground materials were used to construct the first pile.

Prior to the pile building event, specific protocols were provided to City staff and these were used as part of the operator training exercise. The protocols included field tests for: 1) bulk density; 2) free-air space; and 3) moisture content. These protocols were used to confirm the suitability of the feedstocks, and are included as an appendix to this report.

A 200 cubic yard pile consisting of shredded yard waste was constructed over a four-pipe aeration system. The pipe network consisted of a 6-inch diameter manifold and four 4-inch diameter lateral pipes. The pile dimensions were approximately 24-feet wide by 60-feet long and 8-feet high. The raw feedstocks were covered with a 1-foot thick cover layer of finished compost from a nearby product storage pile.

Given the dry climate of South Central Washington, and the relatively dry consistency of the shredded yard debris, approximately 4,000 gallons of water was added to the pile as it was being constructed, using the facility water truck.

Once the pile was constructed, a 1.5 horsepower (high pressure – high volume) electric blower was attached to the aeration manifold. A cycle timer, used to control the On-Off cycles of the blower, was then connected and set to operate the blower 4-minutes On and 16 minutes Off.

A series of field tests were then conducted to confirm that the ASP System was properly constructed. These field tests included:

- A smoke test to check for airflow "short-circuiting";
- A pressure test to confirm uniform airflow distribution across the base of the pile;
- Airflow velocity test to confirm that aeration rates were being met;
- Initial pile temperature readings; and
- A representative sample was obtained for laboratory testing.

At the completion of the ASP #1 building event, a representative from Walla Walla State Penitentiary delivered approximately 750 gallons of food waste. Given the prison's method of processing and storing the food waste, it was delivered as slurry with a moisture content exceeding 90%.

The food waste was discharged onto a bed of shredded yard debris and then the two materials were mixed together using the City's front-end loader to produce a homogeneous blend. The ratio of yard debris to food waste was estimated to be 5:1 by volume. The mix was placed in a temporary storage pile, and a field bulk density test was conducted on the mix, confirming that it was suitable for ASP Composting. This pile was set aside until more food waste was provided for ASP #2

Addition of Prison Food Waste

On March 18, 2015 City personnel constructed the second aerated static pile (ASP #2). O_2Compost was not on-site for this pile building event, but provided remote technical support. The original plan was for ASP #2 to consist entirely of mixed shredded yard debris plus food waste. However, the prison was not able to supply sufficient quantities of food waste to prepare 200 cubic yards of initial mix. Therefore, City staff decided to construct ASP #2 in two-halves: the east side without food waste, and the west side with food waste.

The procedures for constructing and testing ASP #2 were identical to the approach previously discussed.

Oxygen Depletion Field Tests

One of the goals in composting is to maintain aerobic conditions throughout the compost pile in order to: 1) mitigate the generation of objectionable odors, 2) optimize the biology of the compost system, 3) expedite the rate of composting; and 4) produce a high quality finished compost product. Aerobic conditions are considered to be met when the oxygen level is maintained at 10% or higher. Note: The oxygen content in free-air at sea level is slightly greater than 20%.

O_2Compost loaned oxygen monitoring equipment to City staff to conduct oxygen depletion tests on the Aerated Static Piles and Turned Windrows.

The results of these field tests are summarized below:

- Turned Windrows: Immediately following windrow turning using a front-end loader, the oxygen content in the pile dropped from 20.9% to under 6.1 % in less than 1 minutes.

- Aerated Static Piles: Following a 2-minute aeration cycle, the blower was turned off and the oxygen content in the pile dropped from 20.1 % to 15.9 % in approximately 36 minutes. At no time did the oxygen levels fall below 10%.

The results of this test demonstrate that oxygen depletion in a turned windrow pile occurs very quickly, resulting in anaerobic conditions throughout much of the windrow's life cycle and explaining why the turned windrow method is a less efficient approach. Secondly, the test results also suggest that forced aeration is more effective at infusing oxygen throughout the matrix of the compost mix.

Purpose for Monitoring Pile Temperatures

Temperature is one of the primary means of monitoring the composting process. As discussed previously, the goal of composting is to meet the criteria for a "Process to Further Reduce Pathogens" or PFRP. This equates to pile temperatures of at least 55°C (131°F) for a designated period of time (15 days with 5 turnings using the Turned Windrow Method / 3-days with no turnings using the ASP Method).

Pile temperatures that exceed 70°C (~160°F) limit the number and diversity of the micro-organisms in the compost pile. As a result, high temperature effectively slows down the composting process. High pile temperatures can also lead to an increase in odor generation and VOC emissions.

With Turned Windrow Composting, pile temperatures can be adjusted by turning the pile, thereby exposing materials in the core of the pile to fresh air and releasing heat and moisture to the environment. Turning in the early stages can also result in odor emissions.

With ASP Composting, pile temperatures are managed by adjusting the frequency, duration and volume of airflow into the pile. A small amount of airflow stimulates the micro-organisms in the pile resulting in an increase in pile temperature. With an increase in airflow, cooler fresh air displaces heat out of the pile resulting in a decrease in pile temperatures.

With both Turned Windrow and ASP Composting methods, adjusting pile temperature can take several hours and in some cases several days to occur. Our ability to adjust pile temperatures is partly dependent on: 1) the amount of energy in the original feedstock mix; 2) the size of the pile (i.e., surface area to volume ratio); 3) age of the mix; and 4) ambient air temperatures.

There are three important reasons for taking pile temperatures. First, it is important for the pile to exceed 55°C (131°F) for a designated period of time to meet conditions for PFRP. By doing so, the operator can be assured that the compost is effectively free of pathogens and safe for unrestricted use.

Second, the amount of change in pile temperatures following a change in the aeration rate serves as an indicator of the remaining volatility (amount of energy) of the feedstock materials.

The third reason for taking pile temperatures is to observe the "life cycle" of the compost pile. With an ASP Compost System, the pile temperatures typically will increase quite rapidly (within 12 to 24 hours) when aeration is started, and then fall off slowly as the pile ages. This is a reflection of the time required for stabilization of the feedstocks and completion of the composting process.

Pilot Project ASP Temperature Readings

For this ASP Pilot Project, pile temperatures were taken on a daily basis and recorded on spreadsheets provided by O_2Compost. The data were relayed weekly to O_2Compost for review and comment.

Pile temperatures were recorded on the west and east sides of both piles - ASP #1 and ASP #2. Temperature readings were taken at the quarter point; mid-point; and three-quarter point along the length of the pile, at a height of approximately 4-feet above ground level. Two pile temperatures were taken at each location, at depths of 1-foot and 3-feet (horizontally) into the pile.

The daily temperature readings were recorded in the spreadsheet in the cell that corresponded to the day, position and depth for each of the two piles. The spreadsheet was formatted such that the cell turned green for temperature readings that equal or exceed 55^{o}C (131^{o}F). The numbers turned red in the case where the temperature was higher than the preceding day. The number turned black if there was no change, and it turned blue to indicate a decrease in temperature.

In all cases, the pile temperatures in the two Aerated Static Piles indicated that the goals of the project were accomplished:

- To achieve PFRP Conditions
- To be managed at levels which optimize the biology of the composting process; and
- To produce a stable product within a 45 to 60 day period.

The completed spreadsheets are included as an appendix to this report.

Laboratory Test Results

The following table compares important criteria for seven samples that were tested as part of this ASP Pilot Project. The complete laboratory test results are appended to this report.

Parameter	ASP #2 Green Waste Raw	ASP #2 GW & FW Raw	ASP #1 GW Finished	ASP #2 GW Unscreened	ASP #2 GW Screened	ASP #2 GW & FW Unscreened	ASP #2 GW & FW Screened
Total N %	0.49	0.59	0.56	0.78	0.92	1.0	0.99
Moisture	56.1	54.6	49.7	42.0	40.8	42.2	41.9
pH Value	6.62	7.39	5.08	7.26	7.26	7.48	7.81
Conductivity	3.5	2.5	5.0	2.1	2.1	2.9	3.2
Organic Mat.	28.5	29.3	32.1	35.2	35.1	34.7	34.9
C:N Ratio	32	28	29	26	22	19	19
Fecal Coliform	Fail	Pass	Pass	Pass	Pass	Pass	Pass
Salmonella	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Stability	Mod. Unstable	Mod. Unstable	Mod. Unstable	Stable	Stable	Stable	Stable

While more laboratory testing over time is recommended to draw firm conclusions about the quality of the compost produced using the ASP Method, several observations can be made from this set of data:

- Total Nitrogen is good for all samples tested, and increases with the addition of food waste
- The moisture content of the "Raw" or un-composted samples is adequate, but it is recommended to add water to increase the moisture content of the initial mix to 60% - 65%
- The moisture content of the finished compost is very good for screening efficiency, however dust may become a problem at or below 45%
- The pH of most samples tested is slightly alkaline, which would be good as a soil amendment for acidic soils. However, this may be a short term affect due to the presence of Ammonia. The pH may drop toward neutral (7.0) as the compost continues to cure over time.
- The conductivity (measure of salts) is low in all cases
- The organic matter is adequate, but on the low side of normal for compost. This may be due to the arid climate in the Central Washington Region, and the age of the feedstock materials.
- The Carbon to Nitrogen Ration (C:N) of the two raw feedstock samples tested is very good.
- The C:N of the finished green waste compost (ASP #1 & ASP #2) are somewhat higher than preferred, and may result in "tying up" nitrogen in the soil if used as a soil amendment
- The C:N of the screened green waste sample (ASP #2) and the two green waste plus food waste samples is good, with the expectation that Nitrogen will be plant available.
- With composting, both Fecal Coliform and Salmonella have been effectively destroyed
- The finished compost is considered to be stable in most cases. This will continue to improve with curing of the compost over time.

Economic Comparison

City staff tracked the cost of operating equipment for both the Turned Windrow and ASP Methods. These costs included labor and fuel usage because these factors can be easily measured. This evaluation did not consider maintenance on heavy equipment because the front end loader and water truck are relatively new. Nor did it include time and fuel required for breaking down the windrows and aerated static piles because these cost factors would have been roughly equal.

The results of the analysis are displayed in the following tables. The complete analysis is included as an appendix to this report.

Building & Turning Windrows – 2 Batches / Year	**Total Man / Loader Hrs Spent Building and Turning Rows**	**Total Avg. Fuel Used Building and Turning Rows**	**Total Avg. Man/ Water Truck Hrs Watering Rows**	**Total Avg. Fuel Used Watering Rows**
6,000 cubic yards	240 hrs	650 gal	240 hrs	655 gal
9,000 cubic yards	340 hrs	921 gal	340 hrs	928 gal

Building ASP 2 Batches / Year	**Man / Loader Hours Spent Building ASP**	**Avg. Fuel Used Building ASP**	**Avg. Man/ Water Truck Hours Building ASP**	**Avg. Fuel Used building ASP**
6,000 cubic yards	120 hrs	325 gal	120 hrs	328 gal
9,000 cubic yards	180 hrs	488 gal	180 hrs	491 gal

Total Hours / Fuel	**Total Hours 6,000 cy**	**Total Fuel 6,000 cy**	**Total Hours 9,000 cy**	**Total Fuel 9,000 cy**
Turned Windrow	480 hrs	1,305 gal	680 hrs	1,795 gal
ASP	240 hrs	653 gal	360 hrs	979 gal

The conclusion drawn from this comparison is that the proposed ASP Method requires approximately half of the cost for labor and fuel when compared to the current Turned Windrow Method.

An additional benefit is that the ASP Method is twice as fast as the Turned Windrow Method, effectively doubling the capacity of the compost facility.

Concept Designs for ASP and Extended ASP Alternatives

Prior to this ASP Pilot Project, O_2Compost assisted the City by conducting an evaluation of composting alternatives, two of which included individual ASP's and extended ASP's. This ASP Pilot Project evaluated individual ASP's.

Extended ASP's utilize exactly the same approach with the exception that new cells of compost mix are added directly onto the flank of the preceding cell, thereby making the pile progressively wider.

Extended ASP's (or EASP's) may consist of multiple aeration zones. Each zone is defined by that portion of the EASP that is aerated by an individual blower. The following pictures show two EASP systems that illustrate this concept.

The photo on the left is of a farm-based food waste compost facility in Royersford, Pennsylvania. This EASP System consists of three aeration zones with a total volume of approximately 2,000 cubic yards.

The photo on the right is of a grape pumace compost facility in Napa Valley, California. This EASP System consists of two piles (back to back), each with ten aeration zones and each with approximately 25,000 cubic yards of material.

The importance of the EASP Method is twofold. First, this approach results in the most efficient use of available space. When compared to a conventional turned windrow system, an EASP system requires 75% to 80% less area. This translates to a decrease in exposure to the elements, decreased travel distances, and ultimately a lower cost of operation.

Second, the EASP approach is scalable. As volumes of materials vary during the seasons of the year, so can the size of the compost pile(s).

For discussion purposes, four alternatives are presented in an appendix of this report. The first two alternatives include Individual ASP's, one for 5,000 tons per year (tpy) and one for 10,000 tpy. The second two alternatives include Extended ASP's, one for 5,000 tpy and one for 10,000 tpy.

Given the dimensions of the existing Sudbury Compost Facility, the paved area can be readily utilized for ASP and EASP Composting without a need to retrofit the site, and with nominal to moderate capital investment for improved infrastructure.

Lessons Learned

- Through this Pilot Project, it was found that the ASP Method of Composting is more efficient than the turned windrow method currently being used.
    - The ASP Method produces higher quality, stable compost in less than half the time;
    - The proposed ASP Method incurred approximately half of the cost for labor, equipment time and fuel when compared to the current Turned Windrow Method;
- Because of this increased efficiency, the ASP Method represents an opportunity for The City to reduce the cost and time of composing operations;
- The addition of food waste from Washington State Penitentiary (WSP) was advantageous because of the increased moisture content and nutrients in the initial compost mix.
- The ASP Method was effective at mitigating off-site impacts from objectionable odors.
- By consolidating feedstock materials into larger piles and decreasing the time required for composting, the ASP Method significantly increases the annual flow-through capacity of the existing facility (at least fourfold).

Recommended Next Steps for Permanent Implementation

- Present findings to the Walla Walla City Council;
- Formalize a joint working agreement with WSP to continue receiving and processing prison wood waste;
- Evaluate the potential for receiving and processing pre-consumer food waste from the City and County of Walla Walla.
- Conduct a detailed evaluation of needs (i.e., grant funding, electrical power, grinding and screening equipment, staff training) to convert the entire facility to the ASP Method;
- Modify the facility permit and Operations Plan to reflect the change to ASP Composting; and
- Update The City's Marketing Plan for the sale and distribution of Walla Walla Compost.

Appendices

A. Photographs
B. Economic Comparison
C. Concept Designs for ASP and Extended ASP Systems
D. ASP Pilot Project Log
E. Field Test Protocols
F. Airflow & Oxygen Depletion Test Results
G. Temperature Data
H. Laboratory Data
I. Coordinated Prevention Grant (CPG) Agreement

This report was prepared by Peter Moon, P.E.; Principal Engineer with O_2Compost

Appendix A

Photographs

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Assembling the 4-Pipe Aeration Manifold and the First Two Lateral Pipes

Placing Clean “Screen Overs” as a Plenum Layer on top of the Aeration Pipes

Placing Freshly Shredded Green Waste on Top of the Plenum Layer

Adding Water (~4,000 gallons) to Moisture Condition the Initial Mix

Food Waste Slurry from Walla Walla State Penitentiary; Moisture Content > 90%

Two Completed ASP's, each ~ 200 Cubic Yards in Volume

Appendix B

Economic Comparison

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Appendix B - ASP vs. Windrow Projections

Aerated Static Pile Method:

Each Windrow averages about 450 cubic yards of material

7 Windrows = 3,000 cubic yards of Material

10 windrows = 4,500 cubic yards of Material

60 **Days of processing** time (30 days of active composting and 30 days curing)

PFRP: 3 days

Average Turns 0

Man Hours on Loader: 4 hours per 200 cubic yards of ASP built

Fuel for John Deer Loader: 2.71 gal per hour

Man Hours on Water Truck: 4 hours per 200 yards of ASP built

Fuel Used in Water Truck: 2.73 gal per hour

Average Annual Equipment Operation and Maintenance cost for Water Truck: N/A (truck is barely a year old)

John Deer Loader and Water Truck usage while building ASP's:

Building ASP	Man / Loader Hours Spent building ASP	Avg. Fuel Used building ASP	Avg. Man/ Water Truck Hours building ASP	Avg. Fuel Used building ASP
3,000 cubic yards	60 hrs	162.6 gal	60 hrs	163.8 gal
4,500 cubic yards	90 hrs	243.9 gal	90 hrs	245.7 gal

Windrow Method:

120 **Days of processing** time (90 days of active composting 30 days curing)

PFRP: 15 days

Average Turns per 120 days of processing: 20 (5 for PFRP and 15 for a minimum turn of once a week after)

Man Hours on Loader: 4 hours for 7 Rows

Fuel for John Deer Loader: 2.71 gal per hour

Man Hours on Water Truck: 4 hours to water 7 rows

Fuel Used in Water Truck: 2.73 gal per hour

Average Annual Equipment Operation and Maintenance cost for Water Truck: N/A (truck is barely a year old)

Average amount of rows per batch: 7 – 10 rows

John Deer Loader and Water Truck usage while building windrows:

Building Windrow s	Total Man / Loader Hours Building Rows	Total Avg. Fuel Used Building Rows	Total Avg. Man/ Water Truck Hours Watering Rows	Total Avg. Fuel Used Watering Rows
7 rows (3,000cy)	40 hrs	216.8 gal	40 hrs	218.4 gal
10 rows (4,500cy)	60 hrs	298.1 gal	60 hrs	300.3 gal

After building windrows equipment usage is as follows:

Windrow Weekly Turning and Watering	Man / Loader Hours Spent Turning Rows	Avg. Fuel Used Turning Rows	Avg. Man/ Water Truck Hours Watering Rows	Avg. Fuel Used Watering Rows
7 rows	4 hrs	10.84 gal	4 hrs	10.92 gal
10 rows	5.5 hrs	14.90 gal	5.5 hrs	15.01 gal

Multiply above table by an average of 20 Turns / Waterings in 120 days:

Turning and Watering Batch (120 Day Process)	Total Man / Loader Hours Spent Turning Rows	Total Avg. Fuel Used Turning Rows	Total Avg. Man/ Water Truck Hours Watering Rows	Total Avg. Fuel Used Watering Rows
7 rows	80 hrs	216.8 gal	80 hrs	218.4 gal
10 rows	110 hrs	298.1 gal	110 hrs	300.3 gal

Add the Turning and Watering Batch table with the Building Windrow table to get the total hours and fuel used per batch:

Total Windrow Batch (Turning and watering + building windrows)	Total Man / Loader Hours Spent Turning Rows	Total Avg. Fuel Used Turning Rows	Total Avg. Man/ Water Truck Hours Watering Rows	Total Avg. Fuel Used Watering Rows
7 rows	120 hrs	352.2 gal	120 hrs	327.6 gal
10 rows	170 hrs	460.7 gal	170 hrs	464.1 gal

Projection and Comparison of ASP vs. Windrow Methods

Building ASP	Man / Loader Hours Spent building ASP	Avg. Fuel Used building ASP	Avg. Man/ Water Truck Hours building ASP	Avg. Fuel Used building ASP
3,000 cubic yards	60 hrs	162.6 gal	60 hrs	163.8 gal
4,500 cubic yards	90 hrs	243.9 gal	90 hrs	245.7 gal

Building Windrow s	Total Man / Loader Hours Building Rows	Total Avg. Fuel Used Building Rows	Total Avg. Man/ Water Truck Hours Watering Rows	Total Avg. Fuel Used Watering Rows
7 rows (3,000cy)	40 hrs	216.8 gal	40 hrs	218.4 gal
10 rows (4,500cy)	60 hrs	298.1 gal	60 hrs	300.3 gal

While ASP's take more hours initially to build than Windrows we now need to look at weekly and batch totals for the windrow system vs. ASP:

ASP Weekly Turning and Watering	Man / Loader Hours Spent building ASP	Avg. Fuel Used building ASP	Avg. Man/ Water Truck Hours building ASP	Avg. Fuel Used building ASP
3,000 cubic yards	0 hrs	0 gal	0 hrs	0 gal
4,500 cubic yards	0 hrs	0 gal	0 hrs	0 gal

Windrow Weekly Turning and Watering	Man / Loader Hours Spent Turning Rows	Avg. Fuel Used Turning Rows	Avg. Man/ Water Truck Hours Watering Rows	Avg. Fuel Used Watering Rows
7 rows	4 hrs	10.84 gal	4 hrs	10.92 gal
10 rows	5.5 hrs	14.90 gal	5.5 hrs	15.01 gal

Here is the total hours spent, on a per batch basis, building and maintaining the two types of systems:

Total ASP Batch	Man / Loader Hours Spent building ASP	Avg. Fuel Used building ASP	Avg. Man/ Water Truck Hours building ASP	Avg. Fuel Used building ASP
3,000 cubic yards	60 hrs	162.6 gal	60 hrs	163.8 gal
4,500 cubic yards	90 hrs	243.9 gal	90 hrs	245.7 gal

Total Windrow Batch (Turning and watering + building windrows)	Total Man / Loader Hours Spent Turning Rows	Total Avg. Fuel Used Turning Rows	Total Avg. Man/ Water Truck Hours Watering Rows	Total Avg. Fuel Used Watering Rows
7 rows	120 hrs	352.2 gal	120 hrs	327.6 gal
10 rows	170 hrs	460.7 gal	170 hrs	464.1 gal

We usually do 2-3 batches a year so multiply above tables by amount of batches in a year:

Annual Building ASP (2 batches)	Man / Loader Hours Spent building ASP	Avg. Fuel Used building ASP	Avg. Man/ Water Truck Hours building ASP	Avg. Fuel Used building ASP
6,000 cubic yards	120 hrs	325.2 gal	120 hrs	327.6 gal
9,000 cubic yards	180 hrs	487.8 gal	180 hrs	491.4 gal

Annual Windrow Batch (2 batches)	Total Man / Loader Hours Spent Turning Rows	Total Avg. Fuel Used Turning Rows	Total Avg. Man/ Water Truck Hours Watering Rows	Total Avg. Fuel Used Watering Rows
7 rows	240 hrs	650.4 gal	240 hrs	655.2 gal
10 rows	340 hrs	921.4 gal	340 hrs	928.2 gal

Annual Building ASP (3 batches)	Man / Loader Hours Spent building ASP	Avg. Fuel Used building ASP	Avg. Man/ Water Truck Hours building ASP	Avg. Fuel Used building ASP
9,000 cubic yards	180 hrs	487.8 gal	180 hrs	491.4 gal
10,500 cubic yards	270 hrs	731.7 gal	270 hrs	737.1 gal

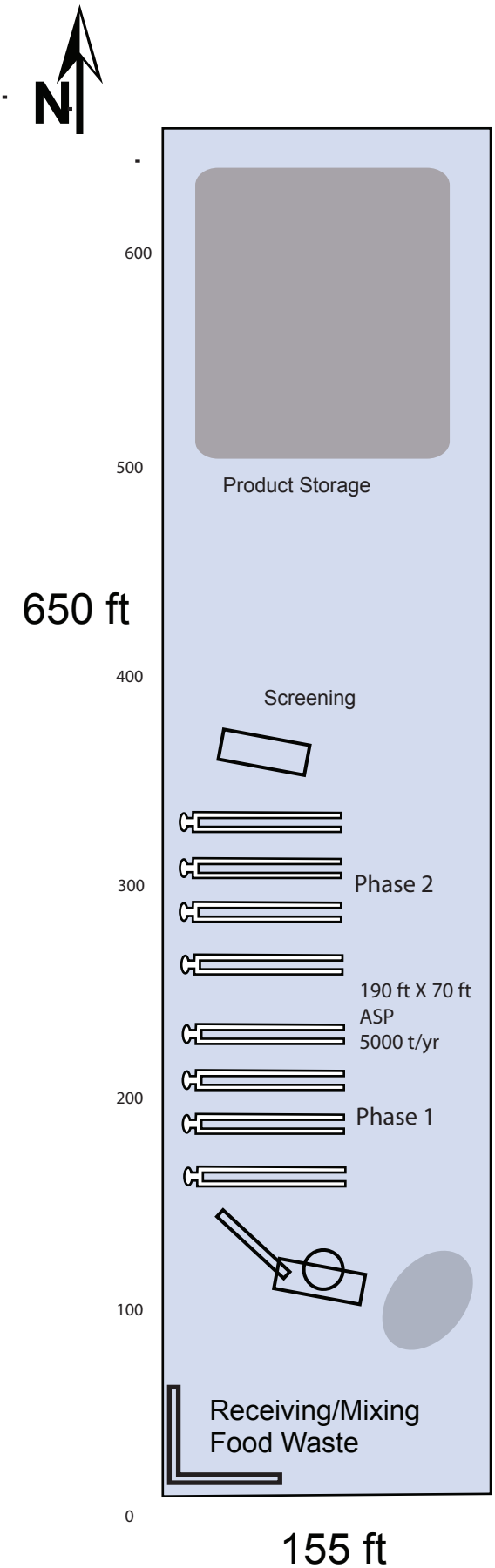
Annual Windrow Batch (3 batches)	Total Man / Loader Hours Spent Turning Rows	Total Avg. Fuel Used Turning Rows	Total Avg. Man/ Water Truck Hours Watering Rows	Total Avg. Fuel Used Watering Rows
7 rows	360 hrs	975.6 gal	360 hrs	982.8 gal
10 rows	510 hrs	1,382.1 gal	510 hrs	1,392.3 gal

Appendix C

Concept Designs for ASP and Extended ASP Systems

O2Compost
Compost Systems & Training

City of Walla Walla Compost Facility
414 Sudbury Road, Walla Walla, WA



5000 tons per year, 10000 cubic yards per year
200 cubic yards total per week
Foot Print 190 ft X 70 ft ASP

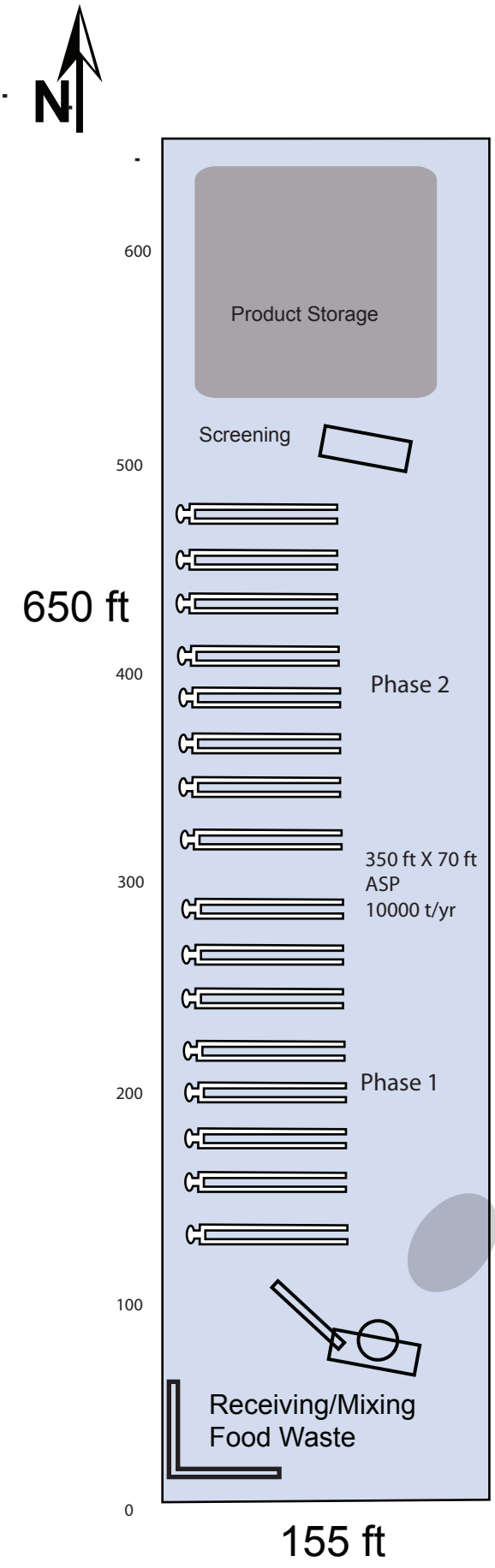
Bulking Agent

Scenario 1
Individual ASP Composting
5,000 TPY/420 TPM Avg.

WallaWallaCompostDec17_13

O2Compost
Compost Systems & Training

City of Walla Walla Compost Facility
414 Sudbury Road, Walla Walla, WA



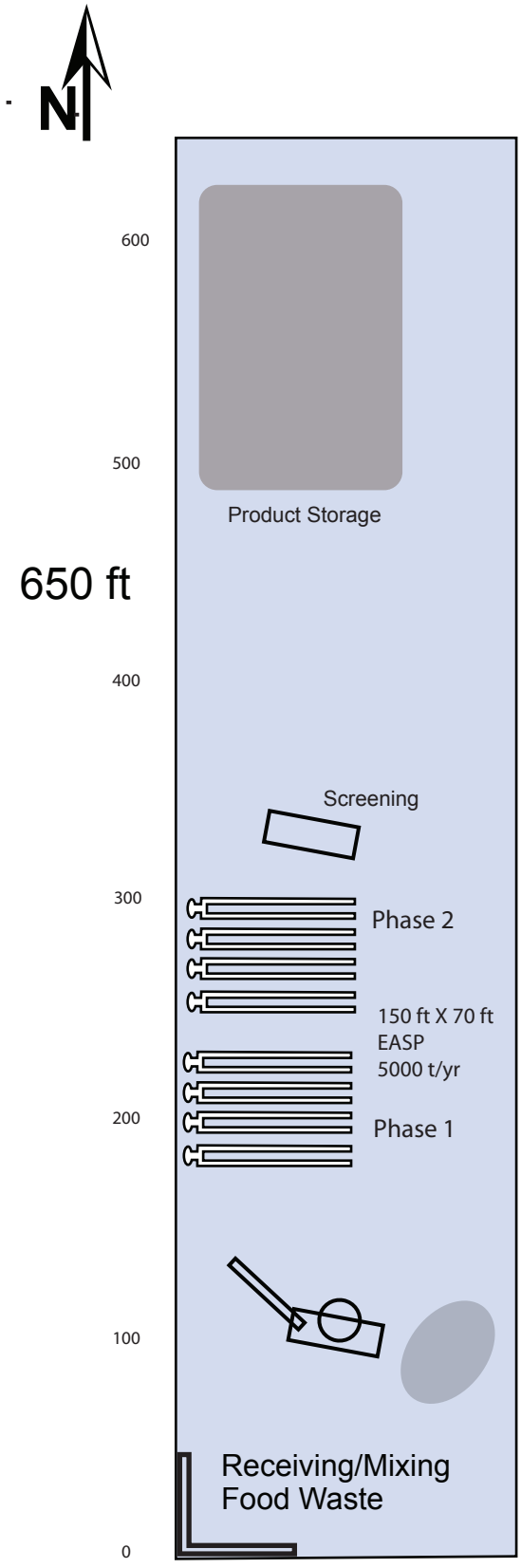
10000 tons per year, 20000 cubic yards per year
400 cubic yards total per week
Foot Print 350 ft X 70 ft ASP

Scenario 2
Individual ASP Composting
5,000 TPY/840 TPM Avg.

O2Compost
Compost Systems & Training

WallaWallaCompostDec17_13

City of Walla Walla Compost Facility
414 Sudbury Road, Walla Walla, WA



5000 tons per year, 10000 cubic yards per year
200 cubic yards total per week
Foot Print 150 ft X 70 ft EASP

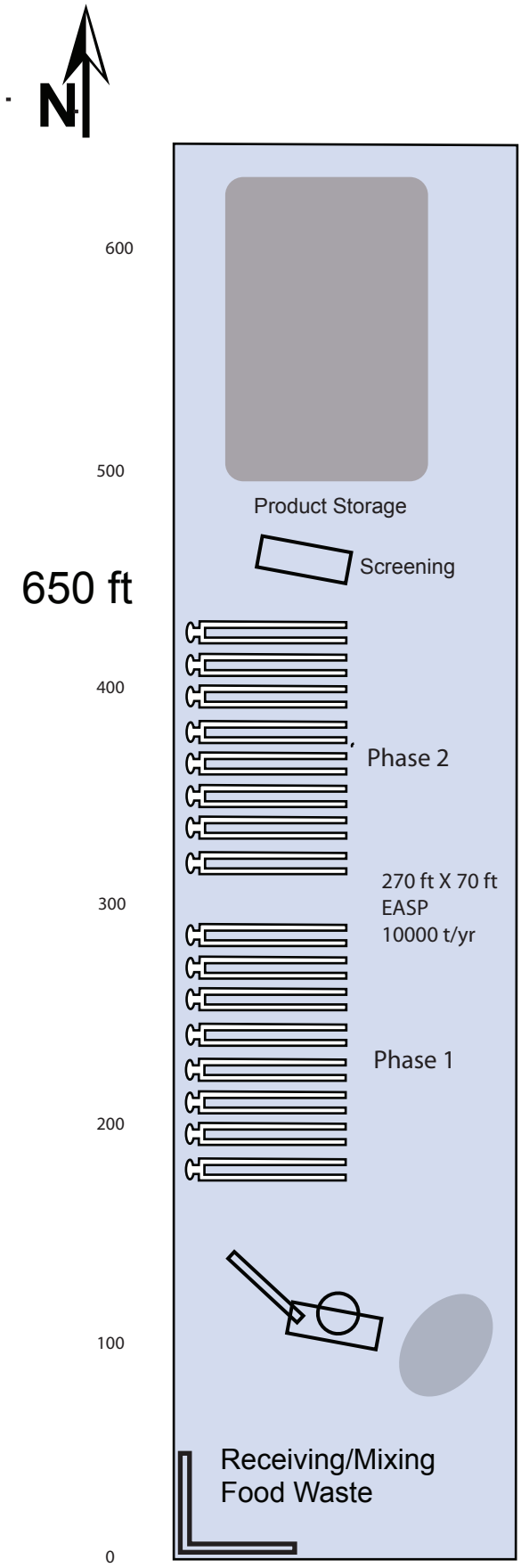
Bulking Agent

Scenario 3
Extended ASP Composting
5,000 TPY/420 TPM Avg.

WallaWallaCompostDec17_13

O2Compost
Compost Systems & Training

City of Walla Walla Compost Facility
414 Sudbury Road, Walla Walla, WA



10000 tons per year, 20000 cubic yards per year
400 cubic yards total per week
Foot Print 270 ft X 70 ft EASP

Bulking Agent

Scenario 4
Extended ASP Composting
10,000 TPY/840 TPM Avg.

WallaWallaCompostDec17_13

O2Compost
Compost Systems & Training

Appendix D

ASP Pilot Project Log

O2Compost
Compost Systems & Training

ASP Pilot Project Log

3/4/15

Peter Arrived around 9am and we discussed/started building our first ASP Pile. This pile Consisted of Ground Green Waste Material. We started with putting the piping layout in order and then put the piping together. We then covered the perforated piping with overs about a foot thick. Then we proceeded to build our pile with our ground green waste material using our front end loader. We also had our water truck moistening the grindings as the loader was building the pile. We capped the pile with roughly a foot of finished, ½ screened, compost as an insulating lair and biofilter. This process took roughly two to two and a half hours. We then proceeded to install the blower and timer, adjusted the timer for the first phase of the ASP process, and preformed leak detection tests. Peter Moon walked us through each step of the process and trained us on how to build/monitor the ASP system and Pile. Total time for pile to be built with instruction/training was roughly 5 hours. Pile Temps started out around 86 degrees Fahrenheit.

The Penitentiary brought out a load of food waste that measured roughly 750gal. We were expecting a minimum of 1,500gal for our second ASP pile that will consist of a green waste and food waste blend. We mixed the 750 gallons of food waste that did come in with our green waste grindings and came up roughly 60 cubic yards of blended material. We set this pile aside for the time being and are expecting to receive a full 1,500 gallons of food waste next week on Wednesday March 11th 2015; we will mix up more blended material on that day and build our second ASP System then.

3/5/15

Took Temps they were around 114 degrees Fahrenheit. Pile looked great. No noticeable odors, no leaching, and blower and timer were operating properly. Peter Moon stopped by on his way out of town to check everything over and we discussed our plan moving forward. We agreed that the second ASP system will consist of half food waste/green waste blend and the other half will be strictly green waste with no food waste added. This is due to a lack of food waste necessary to build a 200 to 250 cubic yard pile. We agreed it will be advantages to compare both types of materials on the same system rather than two separate systems and two separate materials all together.

3/6/15

Temps soared over night to the 150's and 160's throughout the entire ASP pile. Blower and timer still working properly, no odor or leaching, everything looked great!

3/7/15

Temps looked great, Blower working properly, no odors

3/11/15

PFRP was reached and finished as of 3/9/15. Temps have been dropping steadily over last couple of days. Talked to Peter Moon about falling temps and he recommended trying to adjusting the blowers to lower the frequency of air introduction so we weren't blowing out all our heat. Also he suggested raking the cap of the pile to plug up our temperature probe holes to help reduce preferential air flow through the pile. I adjusted the blower to 1.5 on and 18.5 min off.

Donna and I started building the framework for our second ASP pile which will consist of food waste/ green waste blend. The Penn was supposed to bring out 1500gal of food waste to us, but it was postponed until (Wednesday 3/18) next week.

3/12/15

Donna took temps this morning at 8:30am and recorded a high temp of 112 and low temp of 78. I adjust the blowers and raked the cap of the pile, per our conversation with peter the previous day, from 12:30pm to 2:00pm. I decided to retake temps because actinomycetes were riddled throughout the pile in my footsteps, and rake swaths, as I was raking the pile. The pile was also hot to the touch, indicating to me that the pile was still very active and temps vs visual and aesthetic indicators were telling me two different things. I recorded a high temp of 162 and a low of 126… I asked donna to explain to me how she took temps and she told me she was using the same methods I was. The pile looked and smelled great!

3/18/15

Started Construction of ASP #2; this pile was made in two sections, the east half is green waste, and the West half is roughly by 75% green waste and 25% Food Waste from the Walla Walla State Penitentiary. The Penn showed up around 1:30pm with 1500 gal of food waste. I spread out an area of green waste grindings, set aside for this purpose, and bermed the edges. The penn drove into the bed of grindings and proceeded to dump their load. This process took about 15 min. Afterwards I proceeded to mix the green waste and food waste. I also combined the previous batch from two weeks earlier with this current batch of food waste and green waste. I finished constructing ASP #2 just before closing. Total Time spent on pile was around 6 hours.

3/19/15

We pulled samples this morning around 8:30pm of both types of feedstock and shipped them over night to the lab in California for USCC STA testing. After that we finished capping ASP #2 and proceeded to attach and time the blower. The Initial Temps were 124 degrees on the east side of the pile (green waste) and 112 degrees on the west side of the pile (Green waste/Food waste blend). The initial blower time was set at 1 min on and 19 min off. Total time spent on pile was around 2 hours

3/21/15

This morning ASP #2 Temps were really high. I adjusted the blower to 2.5 min on and 17.5 minutes off to reduce temps. ASP #1 is looking and smelling great!

3/23/15

Large mushrooms growing at base on east side of ASP#1. Tiny Mushrooms growing on south and west side. Steam coming out of both piles and smelled great!

Temps are up in the 140's and 150's on both piles as well.

4/17/15

Adjusted blowers on ASP#2 to 1 min on and 19 min off today because temps were falling

4/23/15

Pulled Samples on ASP#1 and sent them into Lab for testing and analysis. This is day 51 of ASP#1.

5/4/15

Received test results back for ASP#1 and it passed everything. The PH was a bit low at 5.08

5/2/15

ASP#1 hit its 60 day mark today and is finished.

5/7/15

Pulled 4 different samples on ASP#2 today, 2 unscreened and 2 screened samples, one of each from both the west side (food waste and green waste blend) and one of each from the east side (green waste only). The food waste side had a bit more moisture when pulling samples. This was day 50 of ASP#2

5/17/15

Day 60 of ASP#2 has been reached

5/19/15

Received all four test results back from lab for ASP#2; they all passed with flying colors. The green waste side ph was normal at around 7.26 and the food waste side was 7.81. The food waste side seemed to test better all the way around.

5/20/15

We broke down ASP #1 and ASP #2 today and stock piled them on the south west corner of the asphalt pad for now. This is the high side of the south end of the pad so no leachate from the remaining windrows or feedstock pile with touch the finished product.

Appendix E

Field Test Protocols

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Appendix E – Field Tests

To Determine Compost Mix Bulk Density and Free Air Space

The procedures for measuring pile bulk density simulate the compaction of materials that you would expect under normal composting operations. Dropping the bucket 10 times from a given height helps to keep the measuring process consistent.

Volume of a Bucket

To determine the volume of a plastic bucket for the bulk density and free air space tests, complete the following four steps:

1. Weigh the empty bucket and record its weight (lb).
2. Fill the bucket to the top with water, weigh and record the weight (lb).
3. Subtract the weight of the bucket to determine the weight of water.
4. Divide the weight of water by 8.35 lbs / gallon to determine the volume of the bucket.

Bulk Density

To determine the bulk density (unit weight) of an individual feedstock or a compost mix, complete the following seven steps:

1. Weigh an empty 5-gallon bucket and record the weight; then
2. Fill the bucket 1/3 full with your mix of materials;
3. Raise the bucket approximately 6-inches above firm surface and let it drop 10 times. This will compact the material to reflect actual field conditions;
4. Next, place additional mix in the bucket to fill it 2/3 full then repeat Step 3;
5. Then, fill the bucket to the top with material and repeat Step 3;
6. Finally, fill the bucket to the top (water level) and weigh it to determine the weight of the bucket plus the compacted mix of materials;
7. Subtract the weight of empty bucket from the total weight and record the weight of the compacted materials;
8. The target range for the weight of the compacted material is 16 to 24 pounds

Note 1: A cubic yard is a common unit of measure when dealing with compost. One cubic yard equals a volume that measures 3-feet x 3-feet x 3-feet = 27 cubic feet.

Note 2: There are approximately 200 gallons in one cubic yard. Therefore, there are roughly forty 5-gallon buckets in one cubic yard.

Given the results of Step 8, above, the target range for bulk density is between 650 and 950 pounds per cubic yard, where:

- 16 pounds x 40 ~ 650 pounds per cubic yard (pcy)
- 24 pounds x 40 ~ 950 pcy

Free Air Space

Use the same full bucket from the bulk density test to complete the free air space test. This test uses water to approximate the amount of voids (free air space) in a bucket full of compost materials as an indirect measure of porosity. Complete the following five steps:

1. Place the bucket of material on level ground;
2. Fill the bucket with water completely without overflowing;
3. Weigh the filled bucket. Use caution – the bucket will be heavy;
4. Record the weight and calculate the volume of water in the bucket.
5. Calculate the percentage of voids.

The target range for free air space for compost piles is 35% to 60%

Example

Part 1 – Determine the Bulk Density of a Sample of Raw Feedstocks.

1. Your bucket holds 42 pounds of water and therefore it has a volume of about 5 gallons.

2. You complete the eight steps to determine the bulk density of your mix, and the net weight of materials is 22-pounds.

3. The bulk density of this material is (22-lbs x 40) = 880 lb / CY. This material is within the desired range.

Part 2 – Determine the Free Air Space of this mix.

4. You complete the five steps to determine the free air space of your mix, and the weight of your mix plus water 38 pounds.

5. You calculate the weight of the water by subtracting the weight of the mix: 38 pounds minus 22 pounds = 16 pounds of water.

6. You divide the weight of the water in the bucket by 8.35 pounds per gallon to determine that you have added 16 pounds of water = 1.92 gallons. But we don't like decimal points in composting and therefore we round up to get 2 gallons.

7. You divide the volume of water by the total volume of your bucket to determine the Free Air Space: (2 gallons / 5 gallons) x 100 = 40% FAS.

8. This is an acceptable FAS, albeit somewhat toward the low end of the range.

9. In this example, additional bulking agent (comprised of coarse woody material) could be added to increase the free air space to enhance the porosity for aeration.

10. Adding dry bulking material is also commonly done to adjust the moisture content of wet feedstocks, such as food waste or wet (sloppy) animal manure.

Appendix F

Airflow & Oxygen Depletion Test Results

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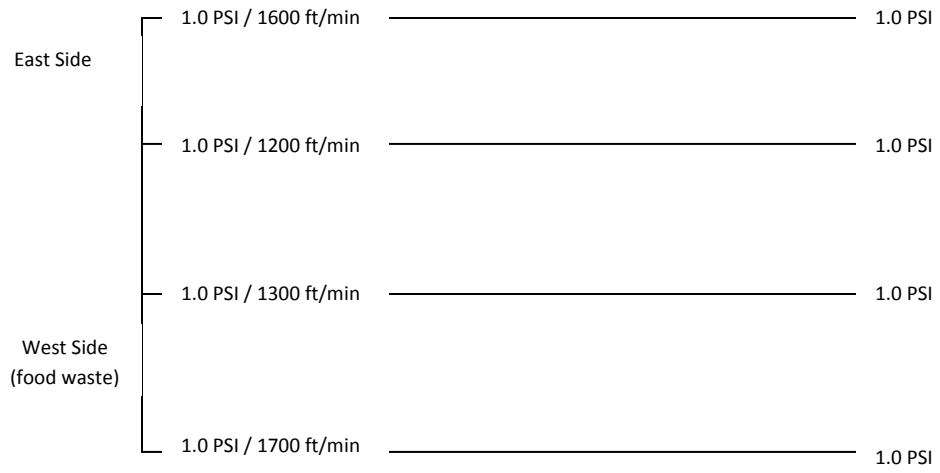
ASP #2 - PSI and air speed readings:



ASP #2 – Sample Taken at Half way point on West Side of Pile (Food Waste/Green Waste Blend)

Temp = 138 Degrees Fahrenheit/ O2 start point 20.1%

Windy (8mph – 22mph)

Minutes	O2 %	CO ppm
1	20.1	5
2	19.9	8
3	19.5	14
4	19.1	15
5	18.9	17
6	18.8	19
7	18.9	20
8	18.6	21
9	18.2	22
10	18.1	23
11	17.8	24
12	18.2	24
13	17.6	25
14	17.5	25
15	17.4	24
16	17.5	24
17	17.3	24
18	17.3	26
19	17.0	25
20	17.2	24
21	17.2	24

22	17.5	23
23	17.1	23
24	16.8	22
25	16.8	22
26	16.6	23
27	16.2	23
28	16.1	23
29	16.0	23
30	15.9	24
31	16.2	26
32	16.0	26
33	17.0	25
34	16.4	25
35	16.6	24
36	15.9	23

Amount of Time to bring O2 back to 19.08% (where we leveled off): 6 minutes (steady 0.0883% increments every 10 seconds.)

ASP #2 – Sample Taken at Half way point on East Side of Pile (Green Waste Only)

Temp = 114 Degrees Fahrenheit/ O2 start point 20.9%

Windy (8mph – 22mph)

Minutes	O2 %	CO ppm
1	20.9	0
2	20.9	0
3	20.9	0
4	20.9	0
5	20.9	0
6	20.2	0
7	20.2	0
8	20.2	0
9	20.1	0
10	20.0	0
11	20.0	0
12	19.9	0
13	19.8	0
14	19.8	0
15	19.8	0
16	19.7	0

17	19.7	0
18	19.7	0
19	19.6	0
20	19.5	0
21	19.6	0
22	19.5	0
23	19.5	0
24	19.5	0
25	19.4	0
26	19.5	0
27	19.4	0
28	19.4	0
29	19.3	0
30	19.3	0
31	19.3	0
32	19.2	0
33	19.2	0
34	19.2	0
35	19.1	0
36	19.2	0

Time to bring O2% back up to 20.4% (where we leveled off): 4 minutes (steady 0.05% increments every 10 seconds)

Windrow #5 was turned well… we stuck the o2 probe in and the starting O2% was 20.9 and before 1 minute was up we were down to 6.1% oxygen and 120 CO ppm and holding! We tried this again on Windrow #1 with virtually the same results. These windrows were also turned earlier that day before we turned them again for testing.

The aeration benefits for ASP composting vs. our current windrow system is very obvious when looking at these test results!

Appendix G

Temperature Data

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O_2Compost - Temperature Monitor

City of Walla Walla, WA - ASP Pilot Project — **ASP #1 East Side**

Day	2015	Day No.	Air Temp.	Pos. 1 (1/4) 1 ft	Pos. 1 (1/4) 3 ft	Pos. 2 (1/2) 1 ft	Pos. 2 (1/2) 3 ft	Pos. 3 (3/4) 1 ft	Pos. 3 (3/4) 3 ft	ON Duration	OFF Duration	Weather & Comments
Week 1												
M		1										
T		2										
W	4-Mar	3	60			82	82			4	16	Blower Time Set for 4:00 on and 16:00 off
T	5-Mar	4	60			113	113			4	16	
F	6-Mar	5	65	156	156	153	157	152	154	4	16	
S	7-Mar	6	40	162	166	164	170	162	168	4	16	
S		7								4	16	
Week 2												
M	9-Mar	8	41	132	138	136	132	132	134	4	16	
T	10-Mar	9	71	110	120	136	130	120	110	4	16	
W	11-Mar	10	63	118	120	130	130	130	118	4	16	
T	12-Mar	11	69	136	158	144	162	149	156	4	16	Adjusted Blower Time @ 1:30pm 1:30 on 18:30 off
F	13-Mar	12	51	138	156	141	161	150	160	1.5	18.5	
S	14-Mar	13	55	144	160	150	164	158	166	1.5	18.5	
S		14								1.5	18.5	
Week 3												
M	16-Mar	15		140	144	144	148	148	144	1.5	18.5	
T	17-Mar	16	46	140	144	138	144	136	136	1.5	18.5	
W	18-Mar	17	50	150	162	142	156	154	160	1.5	18.5	
T	19-Mar	18	44	144	146	140	146	138	142	1.5	18.5	
F	20-Mar	19								1.5	18.5	Donna Off / Brandon Sick No Temps Taken
S	21-Mar	20	53	146	148	145	147	143	152	1.5	18.5	
S		21								1.5	18.5	
Week 4												
M	23-Mar	22	46	134	138	136	140	134	142	1.5	18.5	
T	24-Mar	23	50	124	132	124	138	118	130	1.5	18.5	
W	25-Mar	24	56	132	140	135	144	132	141	1.5	18.5	
T	26-Mar	25	48	137	142	138	144	144	149	1.5	18.5	
F	27-Mar	26	50	142	148	144	148	142	148	1.5	18.5	
S	28-Mar	27	53	135	143	134	138	138	144	1.5	18.5	
S		28										
Week 5												
M	30-Mar	29	53	118	126	118	124	124	124	1.5	18.5	
T	31-Mar	30	68	130	138	138	140	124	130	1.5	18.5	
W	1-Apr	31	47	133	139	136	138	136	147	1.5	18.5	
T	2-Apr	32	51	134	140	136	140	136	143	1.5	18.5	
F	3-Apr	33	49	137	144	129	134	131	138	1.5	18.5	
S	4-Apr	34	46	138	152	152	164	144	148	1.5	18.5	
S		35										
Week 6												
M	6-Apr	36	52	126	136	120	124	114	118	1.5	18.5	
T	7-Apr	37	55	120	124	120	124	116	120	1.5	18.5	
W	8-Apr	38	58	132	120	125	132	124	132	1.5	18.5	
T	9-Apr	39	49	130	136	122	132	135	141	1.5	18.5	
F	10-Apr	40	45	122	128	120	126	127	133	1.5	18.5	
S	11-Apr	41	50	136	149	145	153	146	152	1.5	18.5	
S		42										
Week 7												
M	13-Apr	29	46	124	136	130	140	124	132	1.5	18.5	
T	14-Apr	30	41	120	136	110	118	108	116	1.5	18.5	
W	15-Apr	31	61	127	132	125	129	131	138	1.5	18.5	
T	16-Apr	32	42	120	131	124	124	127	134	1.5	18.5	
F	17-Apr	33	60	114	121	116	119	117	125	1.5	18.5	
S	18-Apr	34		122	128	118	122	126	134	1.5	18.5	
S		35										
Week 8												
M	20-Apr	29	53	120	114	124	130	112	122	1.5	18.5	
T		30										no temps taken
W	22-Apr	31	45	105	105	116	120	118	124	1.5	18.5	
T	23-Apr	32	52	118	126	115	116	114	123	1.5	18.5	
F	24-Apr	33	55	106	120	106	110	112	122	1.5	18.5	
S	25-Apr	34	53	114	124	110	121	118	127	1.5	18.5	

6/16/2015
E-Mail: derrick@o2compost.com

O2Compost
A Division of Price-Moon Enterprises, Inc.

Phone: 800-611-3718
Fax: 360-563-5790

O_2Compost - Temperature Monitor

City of Walla Walla, WA - ASP Pilot Project

ASP #1 West Side

Day	2015	Day No.	Air Temp.	Pos. 1 (1/4) 1 ft	Pos. 1 (1/4) 3 ft		Pos. 2 (1/2) 1 ft	Pos. 2 (1/2) 3 ft		Pos. 3 (3/4) 1 ft	Pos. 3 (3/4) 3 ft		ON Duration	OFF Duration	Weather & Comments
Week 1															
M		1													
T		2													
W	4-Mar	3	60				86	86					4	16	Blower Time Set for 4:00 on and 16:00 off
T	5-Mar	4	60				114	114					4	16	
F	6-Mar	5	65	160	162		164	167		166	170		4	16	
S	7-Mar	6	40	159	166		150	158		154	160		4	16	
S		7											4	16	
Week 2															
M	9-Mar	8	41	138	138		140	150		144	160		4	16	
T	10-Mar	9	71	124	130		130	140		98	122		4	16	
W	11-Mar	10	63	152	157		134	150		121	150		4	16	
T	12-Mar	11	69	131	138		126	135		133	136		4	16	Adjusted Blower Time @ 1:30pm 1:30 on 18:30 off
F	13-Mar	12	51	148	154		143	146		140	145		1.5	18.5	
S	14-Mar	13	55	156	164		157	160		150	155		1.5	18.5	
S		14											1.5	18.5	
Week 3															
M	16-Mar	15		138	142		138	146		140	144		1.5	18.5	
T	17-Mar	16	46	134	140		134	134		134	138		1.5	18.5	
W	18-Mar	17	50	140	162		152	165		152	162		1.5	18.5	
T	19-Mar	18	44	136	144		138	150		146	146		1.5	18.5	
F	20-Mar	19											1.5	18.5	Donna Off / Brandon Sick No Temps Taken
S	21-Mar	20	53	146	155		152	160		150	158		1.5	18.5	
S		21											1.5	18.5	
Week 4															
M	23-Mar	22	46	136	154		144	156		140	152		1.5	18.5	
T	24-Mar	23	50	110	130		124	140		118	140		1.5	18.5	
W	25-Mar	24	56	144	156		148	162		140	146		1.5	18.5	
T	26-Mar	25	48	142	155		150	158		145	150		1.5	18.5	
F	27-Mar	26	50	144	150		152	162		146	152		1.5	18.5	
S	28-Mar	27	53	135	145		136	146		132	143		1.5	18.5	
S		28													
Week 5															
M	30-Mar	29	53	120	132		132	154		126	138		1.5	18.5	
T	31-Mar	30	68	136	144		140	158		124	142		1.5	18.5	
W	1-Apr	31	47	122	144		137	155		132	143		1.5	18.5	
T	2-Apr	32	51	131	148		140	140		143	140		1.5	18.5	
F	3-Apr	33	49	132	145		133	144		136	144		1.5	18.5	
S	4-Apr	34	46	136	142		131	135		133	143		1.5	18.5	
S		35													
Week 6															
M	6-Apr	36	52	132	138		134	142		124	130		1.5	18.5	
T	7-Apr	37	55	124	134		120	130		120	128		1.5	18.5	
W	8-Apr	38	58	134	143		142	153		132	148		1.5	18.5	
T	9-Apr	39	49	130	138		124	138		136	142		1.5	18.5	
F	10-Apr	40	45	127	135		132	144		140	148		1.5	18.5	
S	11-Apr	41	50	147	154		153	158		158	162		1.5	18.5	
S		42													
Week 7															
M	13-Apr	29	46	120	128		116	126		122	132		1.5	18.5	
T	14-Apr	30	41	118	132		116	126		120	130		1.5	18.5	
W	15-Apr	31	61	132	138		132	145		132	138		1.5	18.5	
T	16-Apr	32	42	130	134		126	136		125	130		1.5	18.5	
F	17-Apr	33	60	128	130		124	133		127	132		1.5	18.5	
S	18-Apr	34		128	137		124	142		127	132		1.5	18.5	
S		35													
Week 8															
M	20-Apr	29	53	140	146		134	140		132	140		1.5	18.5	
T		30													no temps taken
W	22-Apr	31	45	112	124		118	124		114	114		1.5	18.5	
T	23-Apr	32	52	127	130		121	134		122	132		1.5	18.5	
F	24-Apr	33	55	115	126		112	118		120	126		1.5	18.5	
S	25-Apr	34	53	124	133		110	129		122	128		1.5	18.5	

6/16/2015
E-Mail: derrick@o2compost.com

O2Compost
A Division of Price-Moon Enterprises, Inc.

Phone: 800-611-3718
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O_2Compost - Temperature Monitor

City of Walla Walla, WA - ASP Pilot Project — **ASP #2 East Side**

Day	2015	Day No.	Air Temp.	Pos. 1 (1/4) 1 ft	Pos. 1 (1/4) 3 ft	Pos. 2 (1/2) 1 ft	Pos. 2 (1/2) 3 ft	Pos. 3 (3/4) 1 ft	Pos. 3 (3/4) 3 ft	ON Duration	OFF Duration	Weather & Comments
Week 1												
M		1										
T		2										
W		3										
T	19-Mar	4					124			1	19	Pile Completed/blower time set 2:30 pm
F	20-Mar	5								1	19	Donna Off / Brandon Sick No Temps Taken
S	21-Mar	6	53	166	142	170	174	168	174	1	19	Adjusted Blower time to 2.5 on and 17.5 off
S		7										
Week 2												
M	23-Mar	8	46	142	152	146	152	148	142	2.5	17.5	
T	24-Mar	9	50	122	126	124	130	140	148	2.5	17.5	
W	25-Mar	10	56	143	147	147	149	142	152	2.5	17.5	
T	26-Mar	11	48	142	146	142	144	146	149	2.5	17.5	
F	27-Mar	12	50	144	148	136	140	137	142	2.5	17.5	
S	28-Mar	13	53	138	144	136	139	137	140	2.5	17.5	
S		14										
Week 3												
M	30-Mar	15	53	120	120	108	112	100	92	2.5	17.5	
T	31-Mar	16	68	116	116	122	124	130	130	2.5	17.5	
W	1-Apr	17	47	118	120	132	138	124	134	2.5	17.5	Adjusted blower time 1min on 19min off
T	2-Apr	18	51	124	133	118	126	125	133	1	19	
F	3-Apr	19	49	138	146	136	145	134	140	1	19	
S	4-Apr	20	46	138	146	138	144	133	140	1	19	
S		21										
Week 4												
M	6-Apr	22	52	136	148	120	124	108	110	1	19	
T	7-Apr	23	55	140	150	120	130	126	138	1	19	
W	8-Apr	24	58	143	155	137	146	126	132	1	19	
T	9-Apr	25	49	135	145	140	148	154	163	1	19	
F	10-Apr	26	45	118	123	126	140	149	152	1	19	
S	11-Apr	27	50	140	147	134	146	135	144	1	19	
S		28										
Week 5												
M	13-Apr	29	46	140	148	144	148	142	146	1	19	
T	14-Apr	30	41	146	148	142	150	120	126	1	19	
W	15-Apr	31	61	151	158	149	153	148	154	1	19	
T	16-Apr	32	42	140	147	143	148	144	149	1	19	
F	17-Apr	33	60	146	150	149	153	146	154	1	19	
S	18-Apr	34		146	140	144	148	149	151	1	19	
S		35										
Week 6												
M	20-Apr	36	53	144	150	142	146	140	146	1	19	
T		37										no temps taken
W	22-Apr	38	45	124	130	140	142	138	146	1	19	
T	23-Apr	39	52	143	147	142	146	143	145	1	19	
F	24-Apr	40	55	139	143	140	142	142	145	1	19	
S	25-Apr	41	53	140	144	139	142	138	140	1	19	
S		42										
Week 7												
M	27-Apr	29		132	130	140	140	138	138	1	19	
T	28-Apr	30								1	19	No Temps Taken
W	29-Apr	31	57	141	144	139	144	130	135	1	19	
T	30-Apr	32	60	136	142	134	138	131	134	1	19	
F	1-May	33	63	134	140	132	134	128	130	1	19	
S	2-May	34	53	134	140	130	136	124	126	1	19	
S		35										
Week 8												
M	4-May	29	77	132	132	134	136	134	138	1	19	
T	5-May	30	53	134	138	132	136	130	132	1	19	
W	6-May	31	56	124	130	116	121	118	118	1	19	
T	7-May	32	57	127	130	123	125	118	122	1	19	
F	8-May	33	65	130	132	126	132	120	120	1	19	
S	9-May	34	51	127	128	122	125	115	117	1	19	

6/16/2015
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A Division of Price-Moon Enterprises, Inc.

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O_2Compost - Temperature Monitor

City of Walla Walla, WA - ASP Pilot Project | **ASP #2 Wast Side w/ Food Waste**

Day	2015	Day No.	Air Temp.	Pos. 1 (1/4) 1 ft	Pos. 1 (1/4) 3 ft	Pos. 2 (1/2) 1 ft	Pos. 2 (1/2) 3 ft	Pos. 3 (3/4) 1 ft	Pos. 3 (3/4) 3 ft	ON Duration	OFF Duration	Weather & Comments
Week 1												
M		1										
T		2										
W		3										
T	19-Mar	4					112			1	19	Pile Completed/blower time set 2:30 pm
F	20-Mar	5								1	19	Donna Off / Brandon Sick No Temps Taken
S	21-Mar	6	53	162	168	166	172	168	174	1	19	Adjusted Blower time to 2.5 on and 17.5 off
S		7										
Week 2												
M	23-Mar	8	46	148	152	146	154	136	150	2.5	17.5	
T	24-Mar	9	50	138	142	138	136	138	144	2.5	17.5	
W	25-Mar	10	56	136	147	141	151	140	148	2.5	17.5	
T	26-Mar	11	48	138	148	138	146	139	146	2.5	17.5	
F	27-Mar	12	50	134	144	142	146	140	144	2.5	17.5	
S	28-Mar	13	53	140	146	140	144	134	140	2.5	17.5	
S		14										
Week 3												
M	30-Mar	15	53	120	124	120	120	100	102	2.5	17.5	
T	31-Mar	16	68	100	104	102	106	96	104	2.5	17.5	
W	1-Apr	17	47	127	135	130	135	108	106	2.5	17.5	Adjusted blower time 1min on 19min off
T	2-Apr	18	51	132	140	132	137	123	131	1	19	
F	3-Apr	19	49	134	144	138	140	135	143	1	19	
S	4-Apr	20	46	138	145	134	141	134	140	1	19	
S		21										
Week 4												
M	6-Apr	22	52	112	104	116	120	124	130	1	19	
T	7-Apr	23	55	114	110	122	132	128	138	1	19	
W	8-Apr	24	58	124	136	139	148	136	147	1	19	
T	9-Apr	25	49	132	144	133	142	142	151	1	19	
F	10-Apr	26	45	134	135	134	141	134	138	1	19	
S	11-Apr	27	50	130	135	125	132	133	140	1	19	
S		28										
Week 5												
M	13-Apr	29	46	142	158	146	152	158	158	1	19	
T	14-Apr	30	41	134	138	138	148	136	140	1	19	
W	15-Apr	31	61	138	150	149	154	148	152	1	19	
T	16-Apr	32	42	137	150	146	150	145	146	1	19	
F	17-Apr	33	60	135	147	146	151	145	150	1	19	
S	18-Apr	34		148	150	145	147	145	147	1	19	
S		35										
Week 6												
M	20-Apr	36	53	142	144	140	148	144	150	1	19	
T		37										no temps taken
W	22-Apr	38	45	126	122	134	136	132	136	1	19	
T	23-Apr	39	52	134	144	142	146	147	148	1	19	
F	24-Apr	40	55	135	144	138	142	140	146	1	19	
S	25-Apr	41	53	142	143	140	142	140	144	1	19	
S		42										
Week 7												
M	27-Apr	29		116	124	132	130	136	134	1	19	
T	28-Apr	30								1	19	No Temps Taken
W	29-Apr	31	57	131	139	139	140	139	142	1	19	
T	30-Apr	32	60	128	135	132	134	136	140	1	19	
F	1-May	33	63	123	129	129	133	136	139	1	19	
S	2-May	34	53	124	132	126	133	132	136	1	19	
S		35										
Week 8												
M	4-May	29	77	134	138	136	136	136	140	1	19	
T	5-May	30	53	134	140	134	134	136	138	1	19	
W	6-May	31	56	109	116	119	126	123	126	1	19	
T	7-May	32	57	108	120	119	124	120	124	1	19	
F	8-May	33	65	125	132	127	128	124	127	1	19	
S	9-May	34	51	110	120	120	123	119	124	1	19	

6/16/2015
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Appendix H

Laboratory Data

O2Compost
Compost Systems & Training

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 #: 5030678-1/2-5322
Group: Mar.15 C #48
Reporting Date: April 7, 2015

City of Walla Walla Landfill
15 North 3rd Avenue
Walla Walla, WA 99362
Attn: City of Walla Walla

Date Received: 20 Mar. 15
Sample Identification: ASP #2 Feedstock (G.W.)
Sample ID #: 5030678 - 1/2

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	1.1	0.49	%
Ammonia (NH_4-N):	22	9.4	mg/kg
Nitrate (NO_3-N):	< 1.0	< 0.4	mg/kg
Org. Nitrogen (Org.-N):	1.1	0.48	%
Phosphorus (as P_2O_5):	0.37	0.16	%
Phosphorus (P):	1600	710	mg/kg
Potassium (as K_2O):	0.80	0.35	%
Potassium (K):	6700	2900	mg/kg
Calcium (Ca):	1.9	0.85	%
Magnesium (Mg):	0.31	0.13	%
Sulfate (SO_4-S):	43	19	mg/kg
Boron (Total B):	55	24	mg/kg
Moisture:	0	56.1	%
Sodium (Na):	0.029	0.013	%
Chloride (Cl):	0.074	0.032	%
pH Value:	NA	6.62	unit
Bulk Density :	14	32	lb/cu ft
Carbonates ($CaCO_3$):	<0.1	<0.1	lb/ton
Conductivity (EC5):	3.5	NA	mmhos/cm
Organic Matter:	65.0	28.5	%
Organic Carbon:	36.0	16.0	%
Ash:	35.0	15.4	%
C/N Ratio	32	32	ratio
AgIndex	> 10	> 10	ratio

Stability Indicator:		Biologically
CO2 Evolution	Respirometery	Available C
mg CO_2-C/g OM/day	4.8	4.9
mg CO_2-C/g TS/day	3.1	3.2
Stability Rating	*moderately unstable*	*moderately unstable*

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

Pathogens	Results	Units	Rating
Fecal Coliform	1800	MPN/g	*fail*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 20 Mar. 15

Inerts	% by weight
Plastic	0.13
Glass	< 0.5
Metal	< 0.5
Sharps	ND

Metals	Dry wt.	EPA Limit	units
Aluminum (Al):	2300	-	mg/kg
Arsenic (As):	2.3	41	mg/kg
Cadmium (Cd):	< 1.0	39	mg/kg
Chromium (Cr):	18	1200	mg/kg
Cobalt (Co)	3.9	-	mg/kg
Copper (Cu):	62	1500	mg/kg
Iron (Fe):	8800	-	mg/kg
Lead (Pb):	26	300	mg/kg
Manganese (Mn):	230	-	mg/kg
Mercury (Hg):	< 1.0	17	mg/kg
Molybdenum (Mo):	1.3	75	mg/kg
Nickel (Ni):	8.1	420	mg/kg
Selenium (Se):	< 1.0	36	mg/kg
Zinc (Zn):	110	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	5.9	5.3	0.28
6.3 to 9.5	14.8	13.8	0.27
4.0 to 6.3	14.1	13.8	0.26
2.0 to 4.0	19.9	20.2	0.25
< 2.0	45.3	47.0	0.25

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.: 5030678 - 1/2 - 5322
Group: Mar.15 C No. 48

Date Received: 20 Mar. 15
Sample i.d.: ASP #2 Feedstock (G.W.)
Sample I.d. No.: 1/2 5030678

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate
4.8 mg CO2-C/ g OM/day

Biodegradation Rate of Your Pile

++++++++++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Biologically Available Carbon (BAC)
4.9 mg CO2-C/ g OM/day

Optimum Degradation Rate

++++++++++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Is Your Compost Mature?

AmmoniaN/NitrateN ratio
NA Ratio

Ratio does not apply due to low concentrations of both Ammonia N and Nitrate N.
VeryMature>|< Mature >|< Immature

Ammonia N ppm
22 mg/kg dry wt.

++
VeryMature>|< Mature >|< Immature

Nitrate N ppm
< 1.0 mg/kg dry wt.

+
< Immature >|< Mature

pH value
6.62 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)
2.3 Percent dry wt.

++++++++++++++++++
<Low >|< Average >|< High Nutrient Content

AgIndex (Nutrients / Sodium and Chloride Salts) ((N+P2O5+K2O) / (Na + Cl))
15 Ratio

++
Na & Cl >|< Nutrient and Sodium and Chloride Provider >|< Nutrient Provider

Plant Available Nitrogen (PAN) Estimated release for first season
2 lbs/ton wet wt.

+++++++
Low Nitrogen Provider>|< Average Nitrogen Provider >|<High Nitrogen Provider

C/N Ratio
32 Ratio

++
< Nitrogen Release >|< N-Neutral >|< N-Demand>|< High Nitrogen Demand

Soluble Available Nutrients & Salts (EC5 w/w dw)
3.5 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
35.0 Percent dry wt.

++++++++++++++++++++++++++
< High Organic Matter >|< Average >|< High Ash Content

Sieve Size % > 6.3 MM (0.25")
20.6 Percent dry wt.

++
All Uses >|< Size May Restrict Uses for Potting mix and Golf Courses

Account No.:		Date Received	20 Mar. 15
5030678 - 1/2 - 5322		Sample i.d.	ASP #2 Feedstock (G.W.)
Group:	Mar.15 C No. 48	Sample I.d. No.	1/2 5030678

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate

4.8 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

4.9 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

NA	NA

(Ratio does not apply due to low concentrations of both Ammonia N and Nitrate N.)

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.

Ammonia N ppm	
22	very mature
Nitrate N ppm	
< 1.0	immature
pH value	
6.62	mature

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)

2.3 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	20 Mar. 15
5030678 - 1/2 - 5322		Sample i.d.	ASP #2 Feedstock (G.W.)
Group:	Mar.15 C No. 48	Sample I.d. No.	1/2 5030678

INTERPRETATION:

AgIndex (Nutrients/Na+Cl)

15 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)

2 Low 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

32 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)

3.5 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)

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

35.0 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")

20.6 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)	2.0
Ammonia (NH4-N)	0.02
Nitrate (NO3-N)	0.00
Available Phosphorus (P2O5*0.64)	2.1
Available Potassium (K2O)	7.0

ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
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TEL: 831-724-5422
FAX: 831-724-3188
www.compostlab.com

Account #: 5030678-2/2-5322
Group: Mar.15 C #49
Reporting Date: April 7, 2015

City of Walla Walla Landfill
15 North 3rd Avenue
Walla Walla, WA 99362
Attn: City of Walla Walla

Date Received: 20 Mar. 15
Sample Identification: ASP #2 Feedstock (F.W.)
Sample ID #: 5030678 - 2/2

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	1.3	0.59	%
Ammonia (NH_4-N):	< 10	< 4.5	mg/kg
Nitrate (NO_3-N):	2.9	1.3	mg/kg
Org. Nitrogen (Org.-N):	1.3	0.59	%
Phosphorus (as P_2O_5):	0.37	0.17	%
Phosphorus (P):	1600	750	mg/kg
Potassium (as K_2O):	0.92	0.42	%
Potassium (K):	7600	3500	mg/kg
Calcium (Ca):	1.8	0.80	%
Magnesium (Mg):	0.31	0.14	%
Sulfate (SO_4-S):	8.3	3.8	mg/kg
Boron (Total B):	50	23	mg/kg
Moisture:	0	54.6	%
Sodium (Na):	0.037	0.017	%
Chloride (Cl):	0.1	0.045	%
pH Value:	NA	7.39	unit
Bulk Density :	15	34	lb/cu ft
Carbonates ($CaCO_3$):	4.3	1.9	lb/ton
Conductivity (EC5):	2.5	NA	mmhos/cm
Organic Matter:	64.4	29.3	%
Organic Carbon:	36.0	16.0	%
Ash:	35.6	16.2	%
C/N Ratio	28	28	ratio
AgIndex	> 10	> 10	ratio

Stability Indicator:		Biologically
CO2 Evolution	Respirometery	Available C
mg CO_2-C/g OM/day	4.7	4.7
mg CO_2-C/g TS/day	3.0	3.1
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	*mushroom*	*mushroom*

Pathogens	Results	Units	Rating
Fecal Coliform	980	MPN/g	*pass*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 20 Mar. 15

Inerts	% by weight
Plastic	0.24
Glass	< 0.5
Metal	< 0.5
Sharps	ND

Metals	Dry wt.	EPA Limit	units
Aluminum (Al):	2500	-	mg/kg
Arsenic (As):	2.3	41	mg/kg
Cadmium (Cd):	< 1.0	39	mg/kg
Chromium (Cr):	12	1200	mg/kg
Cobalt (Co)	3.5	-	mg/kg
Copper (Cu):	50	1500	mg/kg
Iron (Fe):	7800	-	mg/kg
Lead (Pb):	18	300	mg/kg
Manganese (Mn):	210	-	mg/kg
Mercury (Hg):	< 1.0	17	mg/kg
Molybdenum (Mo):	1.2	75	mg/kg
Nickel (Ni):	6.0	420	mg/kg
Selenium (Se):	< 1.0	36	mg/kg
Zinc (Zn):	83	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	8.2	5.8	0.38
6.3 to 9.5	10.8	12.4	0.24
4.0 to 6.3	15.9	19.8	0.22
2.0 to 4.0	20.5	24.8	0.22
< 2.0	44.5	37.2	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.:		Date Received	20 Mar. 15
5030678 - 2/2 - 5322		Sample i.d.	ASP #2 Feedstock (F.W.)
Group:	Mar.15 C No. 49	Sample I.d. No.	2/2 5030678

INTERPRETATION: Page one of three

Is Your Compost Stable?

Respiration Rate Biodegradation Rate of Your Pile

4.7 mg CO2-C/ g OM/day

```
++++++++++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch
```

Biologically Available Carbon (BAC) Optimum Degradation Rate

4.7 mg CO2-C/ g OM/day

```
++++++++++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch
```

Is Your Compost Mature?

AmmoniaN/NitrateN ratio

NA Ratio

```
Ratio does not apply due to low concentrations of both Ammonia N and Nitrate N.
VeryMature>|< Mature >|< Immature
```

Ammonia N ppm

<10 mg/kg dry wt.

```
+
VeryMature>|< Mature >|< Immature
```

Nitrate N ppm

2.9 mg/kg dry wt.

```
++
< Immature >|< Mature
```

pH value

7.39 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)

2.6 Percent dry wt.

```
++++++++++++++++++++
<Low >|< Average >|< High Nutrient Content
```

AgIndex (Nutrients / Sodium and Chloride Salts) ((N+P2O5+K2O) / (Na + Cl))

15 Ratio

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Na & Cl >|< Nutrient and Sodium and Chloride Provider >|< Nutrient Provider
```

Plant Available Nitrogen (PAN) Estimated release for first season

2 lbs/ton wet wt.

```
+++++++++
Low Nitrogen Provider>|< Average Nitrogen Provider >|<High Nitrogen Provider
```

C/N Ratio

28 Ratio

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++
< Nitrogen Release >|< N-Neutral >|< N-Demand>|< High Nitrogen Demand
```

Soluble Available Nutrients & Salts (EC5 w/w dw)

2.5 mmhos/cm dry wt.

```
++++++++++++++
SloRelease>|< Average Nutrient Release Rate >|<High Available Nutrients
```

Lime Content (CaCO3)

4.3 Lbs/ton dry wt.

```
++++++
< Low >|< Average >|< High Lime Content (as CaCO3)
```

What are the physical properties of your compost?

Percent Ash

35.6 Percent dry wt.

```
++++++++++++++++++++++++++++
< High Organic Matter >|< Average >|< High Ash Content
```

Sieve Size % > 6.3 MM (0.25")

19.0 Percent dry wt.

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
All Uses >|< Size May Restrict Uses for Potting mix and Golf Courses
```

Account No.:		Date Received	20 Mar. 15
5030678 - 2/2 - 5322		Sample i.d.	ASP #2 Feedstock (F.W.)
Group:	Mar.15 C No. 49	Sample I.d. No.	2/2 5030678

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate

4.7 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

4.7 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

NA NA (Ratio does not apply due to low concentrations of both Ammonia N and Nitrate N.)

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.

Ammonia N ppm	
<10	NA
Nitrate N ppm	
2.9	immature
pH value	
7.39	mature

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)

2.6 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	20 Mar. 15
5030678 - 2/2 - 5322		Sample i.d.	ASP #2 Feedstock (F.W.)
Group:	Mar.15 C No. 49	Sample I.d. No.	2/2 5030678

INTERPRETATION:

AgIndex (Nutrients/Na+Cl)

15 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)

2 Low 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

28 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)

2.5 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)

4.3 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

35.6 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")

19.0 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:

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)	2.4
Ammonia (NH4-N)	0.00
Nitrate (NO3-N)	0.00
Available Phosphorus (P2O5*0.64)	2.2
Available Potassium (K2O)	8.4

ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
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WATSONVILLE
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TEL: 831-724-5422
FAX: 831-724-3188
www.compostlab.com

Account #: 5040762-1/1-5322
Group: Apr.15 D #34
Reporting Date: May 4, 2015

City of Walla Walla Landfill
15 North 3rd Avenue
Walla Walla, WA 99362
Attn: City of Walla Walla

Date Received: 24 Apr. 15
Sample Identification: ASP #1 Finished
Sample ID #: 5040762 - 1/1

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	1.1	0.56	%
Ammonia (NH_4-N):	330	170	mg/kg
Nitrate (NO_3-N):	11	5.4	mg/kg
Org. Nitrogen (Org.-N):	1.1	0.55	%
Phosphorus (as P_2O_5):	0.40	0.20	%
Phosphorus (P):	1800	880	mg/kg
Potassium (as K_2O):	0.84	0.42	%
Potassium (K):	7000	3500	mg/kg
Calcium (Ca):	1.7	0.87	%
Magnesium (Mg):	0.32	0.16	%
Sulfate (SO_4-S):	100	52	mg/kg
Boron (Total B):	41	21	mg/kg
Moisture:	0	49.7	%
Sodium (Na):	0.033	0.017	%
Chloride (Cl):	0.087	0.044	%
pH Value:	NA	5.08	unit
Bulk Density :	19	37	lb/cu ft
Carbonates ($CaCO_3$):	<0.1	<0.1	lb/ton
Conductivity (EC5):	5.0	NA	mmhos/cm
Organic Matter:	63.8	32.1	%
Organic Carbon:	33.0	16.0	%
Ash:	36.2	18.2	%
C/N Ratio	29	29	ratio
AgIndex	> 10	> 10	ratio

Stability Indicator:		Biologically
CO2 Evolution	Respirometery	Available C
mg CO_2-C/g OM/day	5.7	7.7
mg CO_2-C/g TS/day	3.6	4.9
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	< 2.0	MPN/g	*pass*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 24 Apr. 15

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

Metals	Dry wt.	EPA Limit	units
Aluminum (Al):	2800	-	mg/kg
Arsenic (As):	1.9	41	mg/kg
Cadmium (Cd):	< 1.0	39	mg/kg
Chromium (Cr):	30	1200	mg/kg
Cobalt (Co)	3.5	-	mg/kg
Copper (Cu):	53	1500	mg/kg
Iron (Fe):	11000	-	mg/kg
Lead (Pb):	16	300	mg/kg
Manganese (Mn):	200	-	mg/kg
Mercury (Hg):	< 1.0	17	mg/kg
Molybdenum (Mo):	1.0	75	mg/kg
Nickel (Ni):	5.6	420	mg/kg
Selenium (Se):	< 1.0	36	mg/kg
Zinc (Zn):	79	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	1.6	1.1	0.50
9.5 to 16	5.1	5.3	0.32
6.3 to 9.5	11.5	15.0	0.26
4.0 to 6.3	7.6	6.4	0.40
2.0 to 4.0	17.9	22.0	0.27
< 2.0	56.4	50.2	0.38

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.: 5040762 - 1/1 - 5322
Group: Apr.15 D No. 34

Date Received: 24 Apr. 15
Sample i.d.: ASP #1 Finished
Sample I.d. No.: 1/1 5040762

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate
5.7 mg CO2-C/ g OM/day

Biodegradation Rate of Your Pile

```
++++++++++++++++++++++
< Stable  >|<Moderately Unstable>|<  Unstable  >|< High For Mulch
```

Biologically Available Carbon (BAC)
7.7 mg CO2-C/ g OM/day

Optimum Degradation Rate

```
++++++++++++++++++++++++++++++
< Stable  >|<Moderately Unstable>|<  Unstable  >|< High For Mulch
```

Is Your Compost Mature?

AmmoniaN/NitrateN ratio
30 Ratio

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
VeryMature>|<  Mature  >|<  Immature
```

Ammonia N ppm
330 mg/kg dry wt.

```
++++++++++++++++++++++++++++++++++++
VeryMature>|<  Mature  >|<  Immature
```

Nitrate N ppm
11 mg/kg dry wt.

```
++++++++
<  Immature  >|<  Mature
```

pH value
5.08 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)
2.4 Percent dry wt.

```
++++++++++++++++++
<Low  >|< Average  >|< High Nutrient Content
```

AgIndex (Nutrients / Sodium and Chloride Salts) ((N+P2O5+K2O) / (Na + Cl))
15 Ratio

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Na & Cl  >|<  Nutrient and Sodium and Chloride Provider  >|<  Nutrient Provider
```

Plant Available Nitrogen (PAN) Estimated release for first season
4 lbs/ton wet wt.

```
+++++++++++++++
Low Nitrogen Provider>|<  Average Nitrogen Provider  >|<High Nitrogen Provider
```

C/N Ratio
29 Ratio

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
< Nitrogen Release  >|< N-Neutral >|< N-Demand>|<  High Nitrogen Demand
```

Soluble Available Nutrients & Salts (EC5 w/w dw)
5.0 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
36.2 Percent dry wt.

```
++++++++++++++++++++++++++++
<  High Organic Matter  >|<  Average  >|<  High Ash Content
```

Sieve Size % > 6.3 MM (0.25")
18.2 Percent dry wt.

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
All Uses  >|< Size May Restrict Uses for Potting mix and Golf Courses
```

Account No.:		Date Received	24 Apr. 15
5040762 - 1/1 - 5322		Sample i.d.	ASP #1 Finished
Group:	Apr.15 D No. 34	Sample I.d. No.	1/1 5040762

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate

5.7 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

7.7 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

30 immature

Ammonia N ppm

330 mature

Nitrate N ppm

11 immature

pH value

5.08 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)

2.4 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	24 Apr. 15
5040762 - 1/1 - 5322		Sample i.d.	ASP #1 Finished
Group:	Apr.15 D No. 34	Sample I.d. No.	1/1 5040762

INTERPRETATION:

AgIndex (Nutrients/Na+Cl)

15 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)

4 Low 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

29 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)

5.0 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

36.2 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")

18.2 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:

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)	3.6
Ammonia (NH4-N)	0.34
Nitrate (NO3-N)	0.01
Available Phosphorus (P2O5*0.64)	2.6
Available Potassium (K2O)	8.4

ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
Approved by State of California

SOIL CONTROL LAB

42 HANGAR WAY
WATSONVILLE
CALIFORNIA
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USA

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

Account #: 5050310-2/4-5322
Group: May.15 B #39
Reporting Date: May 19, 2015

City of Walla Walla Landfill
15 North 3rd Avenue
Walla Walla, WA 99362
Attn: City of Walla Walla

Date Received: 08 May. 15
Sample Identification: ASP #2 (F.W. Fines)
Sample ID #: 5050310 - 2/4

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	1.7	0.99	%
Ammonia (NH_4-N):	21	12	mg/kg
Nitrate (NO_3-N):	28	16	mg/kg
Org. Nitrogen (Org.-N):	1.7	0.99	%
Phosphorus (as P_2O_5):	0.51	0.29	%
Phosphorus (P):	2200	1300	mg/kg
Potassium (as K_2O):	1.2	0.71	%
Potassium (K):	10000	5900	mg/kg
Calcium (Ca):	2.4	1.4	%
Magnesium (Mg):	0.42	0.25	%
Sulfate (SO_4-S):	42	24	mg/kg
Boron (Total B):	60	35	mg/kg
Moisture:	0	41.9	%
Sodium (Na):	0.11	0.062	%
Chloride (Cl):	0.23	0.13	%
pH Value:	NA	7.81	unit
Bulk Density :	20	34	lb/cu ft
Carbonates ($CaCO_3$):	3.9	2.3	lb/ton
Conductivity (EC5):	3.2	NA	mmhos/cm
Organic Matter:	60.1	34.9	%
Organic Carbon:	33.0	19.0	%
Ash:	39.9	23.2	%
C/N Ratio	19	19	ratio
AgIndex	> 10	> 10	ratio

Stability Indicator:		Biologically
CO2 Evolution	Respirometery	Available C
mg CO_2-C/g OM/day	2.6	4.2
mg CO_2-C/g TS/day	1.6	2.5
Stability Rating	*stable*	*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	< 2.0	MPN/g	*pass*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 08 May. 15

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

Metals	Dry wt.	EPA Limit	units
Aluminum (Al):	3200	-	mg/kg
Arsenic (As):	2.1	41	mg/kg
Cadmium (Cd):	< 1.0	39	mg/kg
Chromium (Cr):	31	1200	mg/kg
Cobalt (Co)	3.7	-	mg/kg
Copper (Cu):	29	1500	mg/kg
Iron (Fe):	10000	-	mg/kg
Lead (Pb):	24	300	mg/kg
Manganese (Mn):	230	-	mg/kg
Mercury (Hg):	< 1.0	17	mg/kg
Molybdenum (Mo):	1.2	75	mg/kg
Nickel (Ni):	5.9	420	mg/kg
Selenium (Se):	< 1.0	36	mg/kg
Zinc (Zn):	87	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	0.7	0.53
6.3 to 9.5	4.6	3.0	0.62
4.0 to 6.3	7.9	7.0	0.46
2.0 to 4.0	17.4	22.0	0.32
< 2.0	69.2	67.3	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.:		Date Received	08 May. 15
5050310 - 2/4 - 5322		Sample i.d.	ASP #2 (F.W. Fines)
Group:	May.15 B No. 39	Sample I.d. No.	2/4 5050310

INTERPRETATION: Page one of three

Is Your Compost Stable?

Respiration Rate Biodegradation Rate of Your Pile

2.6 mg CO2-C/ g OM/day

++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Biologically Available Carbon (BAC) Optimum Degradation Rate

4.2 mg CO2-C/ g OM/day

++++++++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Is Your Compost Mature?

AmmoniaN/NitrateN ratio

0.75 Ratio

++++++++++++++
VeryMature>|< Mature >|< Immature

Ammonia N ppm

21 mg/kg dry wt.

++
VeryMature>|< Mature >|< Immature

Nitrate N ppm

28 mg/kg dry wt.

++++++++++++++++++++++
< Immature >|< Mature

pH value

7.81 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))

10 Ratio

++
Na & Cl >|< Nutrient and Sodium and Chloride Provider >|< Nutrient Provider

Plant Available Nitrogen (PAN) Estimated release for first season

4 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)

3.2 mmhos/cm dry wt.

++++++++++++++++++
SloRelease>|< Average Nutrient Release Rate >|<High Available Nutrients

Lime Content (CaCO3)

3.9 Lbs/ton dry wt.

++++++
< Low >|< Average >|< High Lime Content (as CaCO3)

What are the physical properties of your compost?

Percent Ash

39.9 Percent dry wt.

++++++++++++++++++++++++++++++
< High Organic Matter >|< Average >|< High Ash Content

Sieve Size % > 6.3 MM (0.25")

5.5 Percent dry wt.

++
All Uses >|< Size May Restrict Uses for Potting mix and Golf Courses

Account No.:		Date Received	08 May. 15
5050310 - 2/4 - 5322		Sample i.d.	ASP #2 (F.W. Fines)
Group:	May.15 B No. 39	Sample I.d. No.	2/4 5050310

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate

2.6 Low: Good for all uses 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

4.2 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

0.75 mature

Ammonia N ppm

21 very mature

Nitrate N ppm

28 immature

pH value

7.81 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

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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	08 May. 15
5050310 - 2/4 - 5322		Sample i.d.	ASP #2 (F.W. Fines)
Group:	May.15 B No. 39	Sample I.d. No.	2/4 5050310

INTERPRETATION:

AgIndex (Nutrients/Na+Cl)

10 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)

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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)

3.2 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)

3.9 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

39.9 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")

5.5 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)	4.0
Ammonia (NH4-N)	0.02
Nitrate (NO3-N)	0.03
Available Phosphorus (P2O5*0.64)	3.8
Available Potassium (K2O)	14.2

ANALYTICAL CHEMISTS
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Approved by State of California

SOIL CONTROL LAB

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Account #: 5050310-4/4-5322
Group: May.15 B #41
Reporting Date: May 19, 2015

City of Walla Walla Landfill
15 North 3rd Avenue
Walla Walla, WA 99362
Attn: City of Walla Walla

Date Received: 08 May. 15
Sample Identification: ASP #2 (G.W.) Fines
Sample ID #: 5050310 - 4/4

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	1.6	0.92	%
Ammonia (NH_4-N):	42	25	mg/kg
Nitrate (NO_3-N):	32	19	mg/kg
Org. Nitrogen (Org.-N):	1.6	0.95	%
Phosphorus (as P_2O_5):	0.45	0.27	%
Phosphorus (P):	2000	1200	mg/kg
Potassium (as K_2O):	0.98	0.58	%
Potassium (K):	8100	4800	mg/kg
Calcium (Ca):	2.4	1.4	%
Magnesium (Mg):	0.41	0.24	%
Sulfate (SO_4-S):	23	14	mg/kg
Boron (Total B):	66	39	mg/kg
Moisture:	0	40.8	%
Sodium (Na):	0.053	0.032	%
Chloride (Cl):	0.12	0.071	%
pH Value:	NA	7.26	unit
Bulk Density :	21	36	lb/cu ft
Carbonates ($CaCO_3$):	7.9	4.7	lb/ton
Conductivity (EC5):	2.1	NA	mmhos/cm
Organic Matter:	59.2	35.1	%
Organic Carbon:	34.0	20.0	%
Ash:	40.8	24.1	%
C/N Ratio	22	22	ratio
AgIndex	> 10	> 10	ratio

Stability Indicator:		Biologically
CO2 Evolution	Respirometery	Available C
mg CO_2-C/g OM/day	2.7	4.9
mg CO_2-C/g TS/day	1.6	2.9
Stability Rating	*stable*	*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	< 2.0	MPN/g	*pass*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 08 May. 15

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

Metals	Dry wt.	EPA Limit	units
Aluminum (Al):	3400	-	mg/kg
Arsenic (As):	1.9	41	mg/kg
Cadmium (Cd):	< 1.0	39	mg/kg
Chromium (Cr):	19	1200	mg/kg
Cobalt (Co)	3.8	-	mg/kg
Copper (Cu):	26	1500	mg/kg
Iron (Fe):	11000	-	mg/kg
Lead (Pb):	22	300	mg/kg
Manganese (Mn):	230	-	mg/kg
Mercury (Hg):	< 1.0	17	mg/kg
Molybdenum (Mo):	1.1	75	mg/kg
Nickel (Ni):	5.5	420	mg/kg
Selenium (Se):	< 1.0	36	mg/kg
Zinc (Zn):	89	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	2.0	1.6	0.49
6.3 to 9.5	3.7	4.0	0.36
4.0 to 6.3	10.1	10.0	0.40
2.0 to 4.0	18.6	24.1	0.30
< 2.0	65.6	60.2	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.:
5050310 - 4/4 - 5322
Group: May.15 B No. 41

Date Received 08 May. 15
Sample i.d. ASP #2 (G.W.) Fines
Sample I.d. No. 4/4 5050310

INTERPRETATION:

Is Your Compost Stable?

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

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

Is Your Compost Mature?

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

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

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

pH value
7.26 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)
3.0 Percent dry wt.
+++++++++++++++++++++++
<Low >|< Average >|< High Nutrient Content

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

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

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

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

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

What are the physical properties of your compost?

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

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

Account No.:		Date Received	08 May. 15
5050310 - 4/4 - 5322		Sample i.d.	ASP #2 (G.W.) Fines
Group:	May.15 B No. 41	Sample I.d. No.	4/4 5050310

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate

2.7 Low: Good for all uses 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

4.9 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

1.3 mature

Ammonia N ppm	
42	very mature
Nitrate N ppm	
32	immature
pH value	
7.26	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)

3.0 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	08 May. 15
5050310 - 4/4 - 5322		Sample i.d.	ASP #2 (G.W.) Fines
Group:	May.15 B No. 41	Sample I.d. No.	4/4 5050310

INTERPRETATION:

AgIndex (Nutrients/Na+Cl)

15 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)

4 Low 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

22 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)

2.1 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)

7.9 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

40.8 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")

5.7 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)	3.8
	If BAC =2.1 to 5 then X = 0.2	Ammonia (NH4-N)	0.05
	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)	3.5
Note: If C/N ratio > 15 additional N should be applied.		Available Potassium (K2O)	11.6

ANALYTICAL CHEMISTS
and
BACTERIOLOGISTS
Approved by State of California

SOIL CONTROL LAB

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Account #: 5050310-1/4-5322
Group: May.15 B #38
Reporting Date: May 19, 2015

City of Walla Walla Landfill
15 North 3rd Avenue
Walla Walla, WA 99362
Attn: City of Walla Walla

Date Received: 08 May. 15
Sample Identification: ASP #2 (F.W)
Sample ID #: 5050310 - 1/4

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	1.7	1.0	%
Ammonia (NH_4-N):	47	27	mg/kg
Nitrate (NO_3-N):	22	13	mg/kg
Org. Nitrogen (Org.-N):	1.7	0.98	%
Phosphorus (as P_2O_5):	0.50	0.29	%
Phosphorus (P):	2200	1300	mg/kg
Potassium (as K_2O):	1.2	0.69	%
Potassium (K):	10000	5800	mg/kg
Calcium (Ca):	2.4	1.4	%
Magnesium (Mg):	0.43	0.25	%
Sulfate (SO_4-S):	34	19	mg/kg
Boron (Total B):	61	35	mg/kg
Moisture:	0	42.2	%
Sodium (Na):	0.070	0.040	%
Chloride (Cl):	0.18	0.1	%
pH Value:	NA	7.48	unit
Bulk Density :	19	32	lb/cu ft
Carbonates ($CaCO_3$):	4.1	2.4	lb/ton
Conductivity (EC5):	2.9	NA	mmhos/cm
Organic Matter:	60.0	34.7	%
Organic Carbon:	34.0	20.0	%
Ash:	40.0	23.2	%
C/N Ratio	19	19	ratio
AgIndex	> 10	> 10	ratio

Stability Indicator:		Biologically
CO2 Evolution	Respirometery	Available C
mg CO_2-C/g OM/day	2.8	5.0
mg CO_2-C/g TS/day	1.7	3.0
Stability Rating	*stable*	*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	< 2.0	MPN/g	*pass*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 08 May. 15

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

Metals	Dry wt.	EPA Limit	units
Aluminum (Al):	3400	-	mg/kg
Arsenic (As):	2.0	41	mg/kg
Cadmium (Cd):	< 1.0	39	mg/kg
Chromium (Cr):	21	1200	mg/kg
Cobalt (Co)	3.8	-	mg/kg
Copper (Cu):	32	1500	mg/kg
Iron (Fe):	11000	-	mg/kg
Lead (Pb):	25	300	mg/kg
Manganese (Mn):	220	-	mg/kg
Mercury (Hg):	< 1.0	17	mg/kg
Molybdenum (Mo):	1.2	75	mg/kg
Nickel (Ni):	6.1	420	mg/kg
Selenium (Se):	< 1.0	36	mg/kg
Zinc (Zn):	88	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	0.6	0.6	0.33
9.5 to 16	6.5	8.2	0.28
6.3 to 9.5	9.5	9.7	0.35
4.0 to 6.3	7.6	8.4	0.33
2.0 to 4.0	15.3	18.5	0.30
< 2.0	60.6	54.5	0.40

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.: 5050310 - 1/4 - 5322
Group: May.15 B No. 38

Date Received 08 May. 15
Sample i.d. ASP #2 (F.W)
Sample I.d. No. 1/4 5050310

INTERPRETATION:

Is Your Compost Stable?

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

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

Is Your Compost Mature?

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

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

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

pH value
7.48 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))
14 Ratio
++
Na & Cl >|< Nutrient and Sodium and Chloride Provider >|< Nutrient Provider

Plant Available Nitrogen (PAN) — Estimated release for first season
4 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)
2.9 mmhos/cm dry wt.
+++++++++++++++
SloRelease>|< Average Nutrient Release Rate >|<High Available Nutrients

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

What are the physical properties of your compost?

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

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

Account No.:		Date Received	08 May. 15
5050310 - 1/4 - 5322		Sample i.d.	ASP #2 (F.W)
Group:	May.15 B No. 38	Sample I.d. No.	1/4 5050310

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate

2.8 Low: Good for all uses 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

5.0 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

2.1 mature

Ammonia N ppm

47 very mature

Nitrate N ppm

22 immature

pH value

7.48 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)

3.4 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	08 May. 15
5050310 - 1/4 - 5322		Sample i.d.	ASP #2 (F.W)
Group:	May.15 B No. 38	Sample I.d. No.	1/4 5050310

INTERPRETATION:

AgIndex (Nutrients/Na+Cl)

14 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)

4 Low 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)

2.9 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)

4.1 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

40.0 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")

16.5 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)	4.1
Ammonia (NH4-N)	0.05
Nitrate (NO3-N)	0.03
Available Phosphorus (P2O5*0.64)	3.8
Available Potassium (K2O)	14.0

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 #: 5050310-3/4-5322
Group: May.15 B #40
Reporting Date: May 19, 2015

City of Walla Walla Landfill
15 North 3rd Avenue
Walla Walla, WA 99362
Attn: City of Walla Walla

Date Received: 08 May. 15
Sample Identification: ASP #2 (G.W.)
Sample ID #: 5050310 - 3/4

Nutrients	Dry wt.	As Rcvd.	units
Total Nitrogen:	1.3	0.78	%
Ammonia (NH_4-N):	43	25	mg/kg
Nitrate (NO_3-N):	36	21	mg/kg
Org. Nitrogen (Org.-N):	1.3	0.75	%
Phosphorus (as P_2O_5):	0.52	0.30	%
Phosphorus (P):	2300	1300	mg/kg
Potassium (as K_2O):	1.2	0.70	%
Potassium (K):	10000	5800	mg/kg
Calcium (Ca):	2.9	1.7	%
Magnesium (Mg):	0.49	0.28	%
Sulfate (SO_4-S):	26	15	mg/kg
Boron (Total B):	81	47	mg/kg
Moisture:	0	42.0	%
Sodium (Na):	0.051	0.030	%
Chloride (Cl):	0.11	0.065	%
pH Value:	NA	7.26	unit
Bulk Density :	19	33	lb/cu ft
Carbonates ($CaCO_3$):	3.4	2.0	lb/ton
Conductivity (EC5):	2.1	NA	mmhos/cm
Organic Matter:	60.7	35.2	%
Organic Carbon:	36.0	21.0	%
Ash:	39.3	22.8	%
C/N Ratio	26	26	ratio
AgIndex	> 10	> 10	ratio

Stability Indicator:		Biologically
CO2 Evolution	Respirometery	Available C
mg CO_2-C/g OM/day	2.4	4.9
mg CO_2-C/g TS/day	1.4	3.0
Stability Rating	*stable*	*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	< 2.0	MPN/g	*pass*
Salmonella	< 3	MPN/4g	*pass*

Date Tested: 08 May. 15

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

Metals	Dry wt.	EPA Limit	units
Aluminum (Al):	3400	-	mg/kg
Arsenic (As):	2.4	41	mg/kg
Cadmium (Cd):	< 1.0	39	mg/kg
Chromium (Cr):	16	1200	mg/kg
Cobalt (Co)	4.6	-	mg/kg
Copper (Cu):	44	1500	mg/kg
Iron (Fe):	13000	-	mg/kg
Lead (Pb):	27	300	mg/kg
Manganese (Mn):	270	-	mg/kg
Mercury (Hg):	< 1.0	17	mg/kg
Molybdenum (Mo):	1.5	75	mg/kg
Nickel (Ni):	7.3	420	mg/kg
Selenium (Se):	< 1.0	36	mg/kg
Zinc (Zn):	120	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	2.0	1.6	0.50
9.5 to 16	7.5	7.8	0.37
6.3 to 9.5	7.0	7.8	0.34
4.0 to 6.3	9.5	10.5	0.35
2.0 to 4.0	16.3	20.6	0.30
< 2.0	57.7	51.7	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.: 5050310 - 3/4 - 5322
Group: May.15 B No. 40

Date Received 08 May. 15
Sample i.d. ASP #2 (G.W.)
Sample I.d. No. 3/4 5050310

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate Biodegradation Rate of Your Pile

2.4 mg CO2-C/ g OM/day

++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Biologically Available Carbon (BAC) Optimum Degradation Rate

4.9 mg CO2-C/ g OM/day

++++++++++++++++++++
< Stable >|<Moderately Unstable>|< Unstable >|< High For Mulch

Is Your Compost Mature?

AmmoniaN/NitrateN ratio

1.2 Ratio

++++++++++++++++++++++++
VeryMature>|< Mature >|< Immature

Ammonia N ppm

43 mg/kg dry wt.

++++
VeryMature>|< Mature >|< Immature

Nitrate N ppm

36 mg/kg dry wt.

++++++++++++++++++++++++++++
< Immature >|< Mature

pH value

7.26 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)

3.0 Percent dry wt.

++++++++++++++++++++++++
<Low >|< Average >|< High Nutrient Content

AgIndex (Nutrients / Sodium and Chloride Salts) ((N+P2O5+K2O) / (Na + Cl))

15 Ratio

++
Na & Cl >|< Nutrient and Sodium and Chloride Provider >|< Nutrient Provider

Plant Available Nitrogen (PAN) Estimated release for first season

3 lbs/ton wet wt.

++++++++++++
Low Nitrogen Provider>|< Average Nitrogen Provider >|<High Nitrogen Provider

C/N Ratio

26 Ratio

++
< Nitrogen Release >|< N-Neutral >|< N-Demand>|< High Nitrogen Demand

Soluble Available Nutrients & Salts (EC5 w/w dw)

2.1 mmhos/cm dry wt.

++++++++++++
SloRelease>|< Average Nutrient Release Rate >|<High Available Nutrients

Lime Content (CaCO3)

3.4 Lbs/ton dry wt.

+++++
< Low >|< Average >|< High Lime Content (as CaCO3)

What are the physical properties of your compost?

Percent Ash

39.3 Percent dry wt.

++++++++++++++++++++++++++++++++
< High Organic Matter >|< Average >|< High Ash Content

Sieve Size % > 6.3 MM (0.25")

16.5 Percent dry wt.

++
All Uses >|< Size May Restrict Uses for Potting mix and Golf Courses

Account No.:		Date Received	08 May. 15
5050310 - 3/4 - 5322		Sample i.d.	ASP #2 (G.W.)
Group:	May.15 B No. 40	Sample I.d. No.	3/4 5050310

INTERPRETATION:

Is Your Compost Stable?

Respiration Rate

2.4 Low: Good for all uses 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

4.9 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

1.2 mature

Ammonia N ppm	
43	very mature
Nitrate N ppm	
36	immature
pH value	
7.26	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)

3.0 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	08 May. 15
5050310 - 3/4 - 5322		Sample i.d.	ASP #2 (G.W.)
Group:	May.15 B No. 40	Sample I.d. No.	3/4 5050310

INTERPRETATION:

AgIndex (Nutrients/Na+Cl)

15 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)

3 Low 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

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

2.1 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)

3.4 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

39.3 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")

16.5 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)	3.2
Ammonia (NH4-N)	0.05
Nitrate (NO3-N)	0.04
Available Phosphorus (P2O5*0.64)	3.8
Available Potassium (K2O)	14.0

Appendix I

Coordinated Prevention Grant (CPG) Agreement

O2Compost
Compost Systems & Training

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COORDINATED PREVENTION GRANT (CPG) AGREEMENT

BETWEEN THE

STATE OF WASHINGTON DEPARTMENT OF ECOLOGY

AND

CITY OF WALLA WALLA

Grant No. G1500016

This is a binding agreement entered into by and between the state of Washington Department of Ecology, hereinafter referred to as the "DEPARTMENT" or as "ECOLOGY", and City of Walla Walla hereinafter referred to as the "RECIPIENT", to carry out the activities described herein.

JURISDICTION:	City of Walla Walla
MAILING ADDRESS:	15 N. Third Avenue
CITY, STATE, ZIP:	Walla Walla, WA 99362
RECIPIENT GRANT COORDINATOR:	Melissa Warner
TELEPHONE:	509-524-4549
E-MAIL:	mwarner@ci.walla-walla.wa.us
RECIPIENT BILLING/INVOICE COORDINATOR:	Jayne Likes
TELEPHONE:	509-524-4347
E-MAIL:	jlikes@ci.walla-walla.wa.us
ECOLOGY PROJECT/FINANCIAL MANAGER:	Laurie Dahmen
TELEPHONE:	509-329-3432
E-MAIL:	laurie.dahmen@ecy.wa.gov
FUNDING SOURCE:	Local Toxics Control Account
MAXIMUM ELIGIBLE COST:	$35,333.33
STATE GRANT SHARE:	$26,500
LOCAL SHARE:	$8,833.33
STATE MAXIMUM GRANT PERCENT:	75 %
FEDERAL TAX IDENTIFICATION NO.:	91-6001290
EFFECTIVE DATE OF THE AGREEMENT:	07-01-2014
EXPIRATION DATE OF THE AGREEMENT:	06-30-2015

PART 1: SCOPE OF WORK

The task(s) set forth below summarize the RECIPIENT'S activities to be performed under this agreement. Costs are limited to those approved by ECOLOGY as outlined in the current scope of work and budget. The RECIPIENT must complete all deliverables by the expiration date of this agreement, including delivery of purchases, unless otherwise stated in the scope of work or approved by ECOLOGY in writing.

Note: The term "task" as used in this agreement is interchangeable with the term "project" as used on the online Solid Waste Information Clearinghouse and "element" as used on payment request forms.

The "Maximum Eligible Cost" is the maximum amount of eligible costs incurred by a RECIPIENT that ECOLOGY can reimburse at a rate of 75 percent under this grant.

RECIPIENT shall identify the work plan and activities by "Quarter." A quarter is defined by calendar year and begins with the first three months of the grant period. RECIPIENT may negotiate changes to the work plan with the ECOLOGY financial/project manager. ECOLOGY shall document mutually agreed changes to the plan in writing.

Expenses relating to the collection and recycling of mercury containing lights shall be eligible for CPG reimbursement until such time that the Mercury Light Recycling program is fully implemented or the grant agreement expires, whichever is the earliest date.

This project is conditional upon submitting a revised operating plan to include the new compost system for review and approval by the jurisdictional health agency. The project may not begin until this is completed and a copy of the approved operating plan is submitted to ECOLOGY.

CATEGORY: Organics (ORG)

1. TASK TITLE: Aerated Static Pile Compost Project
Task Coordinator – Melissa Warner, 509-524-4549, mwarner@ci.walla-walla.wa.us

Maximum Eligible Task Cost: $35,333.33

Task Description: The RECIPIENT will participate in and contract with a composting contractor to set up an aerated static pile (ASP) system at the Sudbury Compost Facility (SCF). The contractor will set up two piles: one will be comprised of yard waste and a second will be comprised of yard waste and nitrogen rich food waste material. The RECIPIENT will partner with the Washington State Penitentiary in Walla Walla (immediately adjacent to the Landfill property) to provide a limited amount of food waste with which to build one ASP row. Electrical service for the blower system and a pump to provide moisture for the new system will be installed.

Implementing the aerated static pile method is beneficial to the facility's composting process since it reduces the amount of materials handling, manpower, equipment usage, and may complete the compost process in less time than the current system.

A detailed plan for a section of the existing composting pad at the SCF (not accessible to the public) will be developed by the contractor for the project. SCF staff will also be trained by the

contractor on how to operate and maintain the aerated static pile process and how to gather data throughout the process that can be analyzed and used for fine-tuning. Eliminating the extra area needed for turning windrows will allow more buffer area between the processing area and the customer area. The potentially decreased time to process material will also move feedstock material into composting more frequently and mitigate combustion concerns from the feedstock drying out.

The RECIPIENT will measure the amount of time it takes to compost, amount of resources, amount of space needed for greater composting capacity and through-put, and measuring compost nitrogen levels. The RECIPIENT will document the composting process and place information about this project on the city website. Other outreach opportunities such as information booths, landfill tours, compost training, and a newspaper article may be also be included.

The RECIPIENT will share the project findings with the Penitentiary to evaluate for its future food waste disposal plans. The RECIPIENT will also share the results of the project with the county's Solid Waste Advisory Committee (SWAC), the city's Sustainability Committee, and the City Council.

The following activities and associated costs are identified for reimbursement under this agreement:

- Salary and benefits for two (2) compost operators;
- Contractor expenses for project, including staff training and final assessment report;
- Compost training, education and outreach opportunities,
- Electrical contractor to install power to site;
- Equipment for project;
- Compost operation expenses.

Target Audience: The project will only engage one outside audience as the feedstock supplier for food waste component. Project information and project results will be available to the public through education and outreach. Project results will also be presented to the county's SWAC, the city's Sustainability Committee, and the City Council.

Goal Statement: The RECIPIENT will determine process and logistics to implement aerated static pile composting method on permanent basis.

Outcome Statement: The RECIPIENT will conduct a controlled assessment of aerated static pile to showcase a more efficient method of processing the county's green waste.

Note: the amount diverted and number of participants for other organic projects are stated in the outcomes for the regular cycle grant Agreement G1400201.

Organics Tons Diverted: 122.5

Recycling Tons Diverted: -0-

Moderate Risk Waste (MRW) Tons Diverted: -0-

Number of Residential Participants: -0-

Number of Business Participants: 1

Number of Residential Contacts: -0-

Number of Business Contacts: 1

Other: The RECIPIENT will receive a final assessment report from consultant outlining lessons learned from the project as well as recommended next steps for permanent implementation to a new processing method.

The current windrow method of composting requires a 90-120 day timeframe to produce finished compost. Switching to an aerated static pile method will decrease the processing time to approximately 60 days. A shorter processing time will create a marketable product in less time, utilize feedstock in a more consistent manner by adding nitrogen rich food waste to get needed carbon:nitrogen ratios for effective composting and reduce costs for both personnel and equipment due to the less labor intensive nature of an aerated static pile process.

Work Plan, Deliverables and Activities Timeline:

July - September, 2014

Execute contract with consultant and begin site prep work for project (install electrical access, irrigation system, public access barriers, etc.); consultant to provide system design drawings to start installation of system. Implement internal task tracking for personnel working on pilot project.

October - December, 2014

Conduct pilot project: building and maintenance of compost piles, record processing data, troubleshoot with consultant as needed.

January - March, 2015

Continuation of project and data logging; supply data to consultant for review and final assessment report preparation.

April - June, 2015

Consultant provides final report to RECIPIENT no later than June 30, 2015.

Method of Evaluation: The RECIPIENT will keep a data log throughout the project to record the progress of processing compost in a shorter time frame and by comparing a compost analysis to the previous windrow compost method. Amount of feedstock and finished compost will be tracked and recorded as part of on-going project data logging.

PART 2: BUDGET

Budget Information by CATEGORY/TASK	Maximum Eligible Cost	State Grant Share
CATEGORY: Organics	$ **35,333.33**	$ **26,500.00**
1. Aerated Static Pile Compost Pilot Project	$ 35,333.33	$ 26,500.00

TOTAL GRANT BUDGET	
TOTAL MAXIMUM ELIGIBLE COST	$ **35,333.33**
STATE GRANT SHARE (75%)	$ **26,500.00**
LOCAL CASH MATCH (25%)	**$ 8,833.33**
INTERLOCAL COSTS (0 %)	$ **- 0 -**

PART 3: BUDGET CONDITIONS

A. ECOLOGY requires the RECIPIENT to provide a match of 25 percent of the maximum eligible cost with cash or interlocal costs. Interlocal costs are the only type of in-kind contributions RECIPIENT may use as match.

B. If parties are contributing to the local share of task costs (match) through interlocal-in kind contributions, RECIPIENT shall negotiate a memorandum of understanding or other written agreement confirming the contribution between the parties. These agreements shall specify the exact work to be accomplished and be signed by all parties contributing to the local match of this task. Copies of these agreements shall be made part of RECIPIENT'S grant file and submitted to ECOLOGY.

C. Overhead is eligible at a rate up to 25 percent of staff salaries and benefits for actual time spent on tasks outlined in this agreement. Salaries and benefits to administer the grant agreement are eligible (excluding time spent to write a CPG grant application).

D. RECIPIENT must submit a written request to ECOLOGY to amend budgets between grant tasks, to modify a scope of work, or for a budget increase or decrease. To increase or decrease the agreement's total maximum eligible cost or change the scope of work for any tasks as outlined in this grant agreement, ECOLOGY requires a formal amendment.

E. RECIPIENT must provide ECOLOGY with an updated Spending Plan when requested by ECOLOGY.

F. Any work performed or costs incurred prior to the effective date or after the expiration date of this agreement will be at the sole expense of RECIPIENT.

PART 4: SPECIAL TERMS AND CONDITIONS

A. BILLING

1. Unless otherwise approved in writing by ECOLOGY, the RECIPIENT shall submit a payment request to ECOLOGY at least quarterly (by calendar year), but no more often than once per month.

2. RECIPIENT must submit payment requests on approved State Invoice Voucher form, A19-1A, and submit forms B1/B2 and C1/C2. The RECIPIENT must submit an A19-1A signed by an authorized person. The B1, B2, C1, and C2 forms are acceptable in electronic format. Forms B1 and C1 are used only when interlocal costs are used towards the 25 percent match.

3. Any income directly generated as a result of the activities funded by this grant shall be reported as a credit against the expenses of that activity, as defined by ECOLOGY'S *Administrative Requirements for Recipients of Ecology Grants and Loans,* Ecology Publication #91-18.

4. RECIPIENT shall submit supporting documents with each payment request. This includes copies of invoices, purchase receipts, payroll records, time and attendance records, contract award documents, and any document deemed relevant by ECOLOGY to establish the approval of an expense listed on Form C1/C2. Documentation shall be clear and legible, and organized by task in the order in which it is itemized on Form C1/C2.

5. RECIPIENT shall maintain grant related material and supporting documents including invoice vouchers sent to ECOLOGY in a common file. RECIPIENT shall keep all supporting documents for audit purposes for at least three years from the date the agreement is closed by ECOLOGY.

B. REPORTING

Progress reports and Final Performance Analyses must be submitted through the web-based database, the Solid Waste Information Clearinghouse.

RECIPIENT must submit a progress report with each payment request. RECIPIENT is required to submit a progress report for a quarter even when a quarterly payment request was not submitted. These progress reports shall include information that supports incurred costs identified on the corresponding C1 or C2 of the payment request, and provide a brief update in support of the outcomes and/or method of evaluation in the grant agreement.

A Final Performance Analysis (FPA) report must be submitted for each task in a *Planning and Implementation* grant before ECOLOGY can process a final payment request.

C. COMPENSATION

Payment to RECIPIENT will be issued through Department of Enterprise Services' (DES) Statewide Vendor/Payee Services. DES maintains a central vendor file for state agencies to use to process payments.

RECIPIENTS must register as a state-wide vendor by submitting a state-wide vendor registration form and an IRS W-9 form to DES.

For details and forms go to: http://des.wa.gov/services/IT/SystemSupport/Accounting/Pages/swps.aspx**.** If you have questions about the vendor registration process, please contact DES at the Payee Help Desk at (360) 407-8180 or email to payeehelpdesk@des.wa.gov.

D. TRAINING

RECIPIENT is expected to participate in any ECOLOGY recommended trainings related to managing a CPG agreement unless exempted by ECOLOGY in writing.

E. PROCUREMENT AND CONTRACTS

1. RECIPIENT must follow local procurement procedures or current state procurement procedures, whichever is stricter. A RECIPIENT with no formal procurement procedures must certify that they have complied with the "Standards for Competitive Solicitation" found in Part V of the *Administrative Requirements for Recipients of Ecology Grants and Loans – Yellow Book*, Ecology Publication #91-18.
2. Upon issuance, the RECIPIENT may submit a copy of all requests for qualifications (RFQs), requests for proposals (RFPs), and bid documents relating to this grant agreement to the ECOLOGY financial/project manager to be placed in the file.
3. Prior to contract execution, the RECIPIENT may submit all draft documents and a copy of the draft proposed contract to the ECOLOGY financial/project manager. RECIPIENT assumes any risks associated with the failure to consult with ECOLOGY financial/project manager. Following the contract execution, RECIPIENT shall submit a copy of the final contract to the ECOLOGY assigned financial/project manager to be placed in the file.
4. Unless a specific purchase of equipment or real property is already written into a task's scope of work, RECIPIENT must submit a written request to ECOLOGY to purchase any equipment or real property (Property) with a single unit purchase price of $5,000 or more. The request must include the justification for the purchase of the property, the total cost, the intended use, and the anticipated useful life of the property. The request must be approved in writing by ECOLOGY prior to the purchase.

F. USE OF EXISTING CONTRACTS

RECIPIENT may use existing contracts that conform to local adopted procurement procedures and applicable state laws. RECIPIENT shall notify ECOLOGY if intending to use contracts entered into prior to the execution of the grant agreement for performance of grant-funded activities. RECIPIENT shall submit a copy of the contract to its assigned ECOLOGY financial/project manager to be placed in the file. The grant eligibility of products or services secured by the RECIPIENT under existing contracts used to perform the scope of work in this agreement must be deemed allowable and reasonable by ECOLOGY prior to cost reimbursement.

G. PROPERTY AND EQUIPMENT MANAGEMENT AND DISPOSITION

For equipment or property purchased with a cost of at least $5,000 per unit or functional system, the RECIPIENT must utilize an inventory control system, including physical inventory to document the ongoing use, a description of the item, including serial or vehicle identification number (VIN when possible), and location. The information shall be submitted to ECOLOGY upon request until final disposition is made. RECIPIENT shall investigate, document, and report to ECOLOGY any loss, theft or damage upon discovery of such conditions. RECIPIENT will follow manufacturer recommended maintenance procedures to keep the property in good operating condition.

RECIPIENT shall submit a written request to the ECOLOGY for any intent to change the use of the equipment as outlined in this grant agreement, including uses past the expiration date of this agreement. Disposition of the equipment shall be determined by ECOLOGY and documented in writing. A copy of the determination will be provided to RECIPIENT upon ECOLOGY's closure of the grant agreement unless already identified in the task's scope of work.

- If the equipment is necessary for the continued operation of the project or other projects administered through ECOLOGY, the financial/project manager may instruct the RECIPIENT to retain the equipment with no further compensation to ECOLOGY.
- If the project has no further significant use for the equipment, the financial/project manager may instruct the RECIPIENT to retain or sell the equipment and pay ECOLOGY an amount equal to ECOLOGY's share of the current fair market value, sale proceeds or other price agreed upon by the financial/project manager.
- The financial/project manager may instruct the RECIPIENT to transfer title to ECOLOGY or to a third party named by ECOLOGY who is eligible under existing statutes.

H. ARCHEOLOGICAL AND CULTURAL RESOURCES

RECIPIENT shall take reasonable action to avoid, minimize, or mitigate adverse effects to archeological or cultural resources. Activities associated with archaeological and cultural resources are an eligible reimbursable cost subject to approval by ECOLOGY.

RECIPIENT shall:

1. Immediately cease work and notify ECOLOGY if any archeological or cultural resources are found while conducting work under this Agreement.
2. Immediately notify the Department of Archaeology and Historic Preservation at (360) 586-3064, in the event historical or cultural artifacts are discovered at a work site.
3. Comply with Governor Executive Order 05-05, Archaeology and Cultural Resources, for any capital construction projects prior to the start of any work.
4. Comply with RCW 27.53, Archaeological Sites and Resources, for any work performed under this Agreement, as applicable. National Historic Preservation Act (NHPA) may require the RECIPIENT to obtain a permit pursuant to Chapter 27.53 RCW prior to conducting on-site activity with the potential to impact cultural or historic properties.

I. ENVIRONMENTALLY PREFERABLE PURCHASING

In a joint effort to save costs, produce energy savings and prevent waste, RECIPIENT agrees to use both sides of paper sheets for copying and printing when feasible. RECIPIENT also agrees to

purchase paper products with a high level of post consumer recycled content when they are comparable in quality, available, and cost effective.

J. ALL WRITINGS CONTAINED HEREIN

This agreement, including the appended "General Terms and Conditions," the current cycle Program Guidelines - Coordinated Prevention Grants found at https://fortress.wa.gov/ecy/publications/summarypages/1107008.html, and ECOLOGY'S *Administrative Requirements for Recipients of Ecology Grants and Loans,* Ecology Publication #91-18, contain the entire understanding between the parties, and there are no other understandings or representations except as those set forth or incorporated by reference herein. No subsequent modification(s) or amendment(s) of this grant agreement shall be of any force or effect unless in writing, signed by authorized representatives of RECIPIENT and ECOLOGY, and made part of this agreement.

IN WITNESS WHEREOF, the parties sign this Agreement:

STATE OF WASHINGTON DEPARTMENT OF ECOLOGY	**CITY OF WALLA WALLA**
Laurie G. Davies Date Program Manager Waste 2 Resources Program	Signature Date Printed Name and Title of Signatory

APPROVED AS TO FORM ONLY Assistant Attorney General

APPENDIX A

ATTACHMENT I: General Terms And Conditions
Pertaining To Grant And Loan Agreements Of The Department Of Ecology

A. RECIPIENT PERFORMANCE

All activities for which grant/loan funds are to be used shall be accomplished by the RECIPIENT and RECIPIENT's employees. The RECIPIENT shall only use contractor/consultant assistance if that has been included in the agreement's final scope of work and budget.

B. SUBGRANTEE/CONTRACTOR COMPLIANCE

The RECIPIENT must ensure that all subgrantees and contractors comply with the terms and conditions of this agreement.

C. THIRD PARTY BENEFICIARY

The RECIPIENT shall ensure that in all subcontracts entered into by the RECIPIENT pursuant to this agreement, the state of Washington is named as an express third-party beneficiary of such subcontracts with full rights as such.

D. CONTRACTING FOR SERVICES (BIDDING)

Contracts for construction, purchase of equipment and professional architectural and engineering services shall be awarded through a competitive process, if required by State law. RECIPIENT shall retain copies of all bids received and contracts awarded, for inspection and use by the DEPARTMENT.

E. ASSIGNMENTS

No right or claim of the RECIPIENT arising under this agreement shall be transferred or assigned by the RECIPIENT.

F. COMPLIANCE WITH ALL LAWS

1. The RECIPIENT shall comply fully with all applicable Federal, State and local laws, orders, regulations and permits.

   Prior to commencement of any construction, the RECIPIENT shall secure the necessary approvals and permits required by authorities having jurisdiction over the project, provide assurance to the DEPARTMENT that all approvals and permits have been secured, and make copies available to the DEPARTMENT upon request.

2. Discrimination. The DEPARTMENT and the RECIPIENT agree to be bound by all Federal and State laws, regulations, and policies against discrimination. The RECIPIENT further agrees to affirmatively support the program of the Office of Minority and Women's Business Enterprises to the maximum extent possible. If the agreement is federally-funded, the RECIPIENT shall report to the DEPARTMENT the percent of grant/loan funds available to women or minority owned businesses.

3. Wages and Job Safety. The RECIPIENT agrees to comply with all applicable laws, regulations, and policies of the United States and the State of Washington which affect wages and job safety.

4. Industrial Insurance. The RECIPIENT certifies full compliance with all applicable state industrial insurance requirements. If the RECIPIENT fails to comply with such laws, the DEPARTMENT shall have the right to immediately terminate this agreement for cause as provided in Section K.1, herein.

G. KICKBACKS

The RECIPIENT is prohibited from inducing by any means any person employed or otherwise involved in this project to give up any part of the compensation to which he/she is otherwise entitled or, receive any fee, commission or gift in return for award of a subcontract hereunder.

H. AUDITS AND INSPECTIONS

1. The RECIPIENT shall maintain complete program and financial records relating to this agreement. Such records shall clearly indicate total receipts and expenditures by fund source and task or object. All grant/loan records shall be kept in a manner which provides an audit trail for all expenditures. All records shall be kept in a common file to facilitate audits and inspections.

   Engineering documentation and field inspection reports of all construction work accomplished under this agreement shall be maintained by the RECIPIENT.

2. All grant/loan records shall be open for audit or inspection by the DEPARTMENT or by any duly authorized audit representative of the State of Washington for a period of at least three years after the final grant payment/loan repayment or any dispute resolution hereunder. If any such audits identify discrepancies in the financial records, the RECIPIENT shall provide clarification and/or make adjustments accordingly.

3. All work performed under this agreement and any equipment purchased, shall be made available to the DEPARTMENT and to any authorized state, federal or local representative for inspection at any time during the course of this agreement and for at least three years following grant/loan termination or dispute resolution hereunder.

4. RECIPIENT shall meet the provisions in OMB Circular A-133 (Audits of States, Local Governments & Non Profit Organizations), including the compliance Supplement to OMB Circular A-133, if the RECIPIENT expends $500,000 or more in a year in Federal funds. The $500,000 threshold for each year is a cumulative total of all federal funding from all sources. The RECIPIENT must forward a copy of the audit along with the RECIPIENT'S response and the final corrective action plan to the DEPARTMENT within ninety (90) days of the date of the audit report.

I. PERFORMANCE REPORTING

The RECIPIENT shall submit progress reports to the DEPARTMENT with each payment request or such other schedule as set forth in the Special Conditions. The RECIPIENT shall also report in writing to the DEPARTMENT any problems, delays or adverse conditions which will materially affect their ability to meet project objectives or time schedules. This disclosure shall be accompanied by a statement of the action taken or proposed and any assistance needed from the DEPARTMENT to resolve the situation. Payments may be withheld if required progress reports are not submitted.

Quarterly reports shall cover the periods January 1 through March 31, April 1 through June 30, July 1 through September 30, and October 1 through December 31. Reports shall be due within thirty (30) days following the end of the quarter being reported.

J. COMPENSATION

1. Method of compensation. Payment shall normally be made on a reimbursable basis as specified in the grant agreement and no more often than once per month. Each request for payment will be submitted by the RECIPIENT on State voucher request forms provided by the DEPARTMENT along with documentation of the expenses. Payments shall be made for each task/phase of the project, or portion thereof, as set out in the Scope of Work when completed by the RECIPIENT and approved as satisfactory by the Project Officer.

The payment request form and supportive documents must itemize all allowable costs by major elements as described in the Scope of Work. Instructions for submitting the payment requests are found in "Administrative Requirements for Recipients of Ecology Grants and Loans", Part IV, published by the DEPARTMENT. A copy of this document shall be furnished to the RECIPIENT. When payment requests are approved by the DEPARTMENT, payments will be made to the mutually agreed upon designee. Payment requests shall be submitted to the DEPARTMENT and directed to the Project Officer assigned to administer this agreement.

2. Period of Compensation. Payments shall only be made for actions of the RECIPIENT pursuant to the grant/loan agreement and performed after the effective date and prior to the expiration date of this agreement, unless those dates are specifically modified in writing as provided herein.

3. Final Request(s) for Payment. The RECIPIENT should submit final requests for compensation within forty-five (45) days after the expiration date of this agreement and within fifteen (15) days after the end of a fiscal biennium. Failure to comply may result in delayed reimbursement.

4. Performance Guarantee. The DEPARTMENT may withhold an amount not to exceed ten percent (10%) of each reimbursement payment as security for the RECIPIENT's performance. Monies withheld by the DEPARTMENT may be paid to the RECIPIENT when the project(s) described herein, or a portion thereof, have been completed if, in the DEPARTMENT's sole discretion, such payment is reasonable and approved according to this agreement and, as appropriate, upon completion of an audit as specified under section J.5. herein.

5. Unauthorized Expenditures. All payments to the RECIPIENT may be subject to final audit by the DEPARTMENT and any unauthorized expenditure(s) charged to this grant/loan shall be refunded to the DEPARTMENT by the RECIPIENT.

6. Mileage and Per Diem. If mileage and per diem are paid to the employees of the RECIPIENT or other public entities, it shall not exceed the amount allowed under state law for state employees.

7. Overhead Costs. No reimbursement for overhead costs shall be allowed unless provided for in the Scope of Work hereunder.

K. TERMINATION

1. For Cause. The obligation of the DEPARTMENT to the RECIPIENT is contingent upon satisfactory performance by the RECIPIENT of all of its obligations under this agreement. In the event the RECIPIENT unjustifiably fails, in the opinion of the DEPARTMENT, to perform any obligation required of it by this agreement, the DEPARTMENT may refuse to pay any further funds there under and/or terminate this agreement by giving written notice of termination.

   A written notice of termination shall be given at least five working days prior to the effective date of termination. In that event, all finished or unfinished documents, data studies, surveys, drawings, maps, models, photographs, and reports or other materials prepared by the RECIPIENT under this agreement, at the option of the DEPARTMENT, shall become DEPARTMENT property and the RECIPIENT shall be entitled to receive just and equitable compensation for any satisfactory work completed on such documents and other materials.

   Despite the above, the RECIPIENT shall not be relieved of any liability to the DEPARTMENT for damages sustained by the DEPARTMENT and/or the State of Washington because of any breach of agreement by the RECIPIENT. The DEPARTMENT may withhold payments for the purpose of setoff until such time as the exact amount of damages due the DEPARTMENT from the RECIPIENT is determined.

2. Insufficient Funds. The obligation of the DEPARTMENT to make payments is contingent on the availability of state and federal funds through legislative appropriation and state allotment. When this agreement crosses over state fiscal years the obligation of the DEPARTMENT is contingent upon the appropriation of funds during the next fiscal year. The failure to appropriate or allot such funds shall be good cause to terminate this agreement as provided in paragraph K.1 above.

   When this agreement crosses the RECIPIENT's fiscal year, the obligation of the RECIPIENT to continue or complete the project described herein shall be contingent upon appropriation of funds by the RECIPIENT's governing body; provided, however, that nothing contained herein shall preclude the DEPARTMENT from demanding repayment of ALL funds paid to the RECIPIENT in accordance with Section O herein.

3. Failure to Commence Work. In the event the RECIPIENT fails to commence work on the project funded herein within four months after the effective date of this agreement, or by any date agreed upon in writing for commencement of work, the DEPARTMENT reserves the right to terminate this agreement.

L. WAIVER

Waiver of any RECIPIENT default is not a waiver of any subsequent default. Waiver of a breach of any provision of this agreement is not a waiver of any subsequent breach and will not be construed as a modification of the terms of this agreement unless stated as such in writing by the authorized representative of the DEPARTMENT.

M. PROPERTY RIGHTS

1. Copyrights and Patents. When the RECIPIENT creates any copyrightable materials or invents any patentable property, the RECIPIENT may copyright or patent the same but the DEPARTMENT retains a royalty-free, nonexclusive and irrevocable license to reproduce, publish, recover or otherwise use the material(s) or property and to authorize others to use the same for federal, state or local government purposes. Where federal funding is involved, the federal government may have a proprietary interest in patent rights to any inventions that are developed by the RECIPIENT as provided in 35 U.S.C. 200-212.

2. Publications. When the RECIPIENT or persons employed by the RECIPIENT use or publish information of the DEPARTMENT; present papers, lectures, or seminars involving information supplied by the DEPARTMENT; use logos, reports, maps or other data, in printed reports, signs, brochures, pamphlets, etc., appropriate credit shall be given to the DEPARTMENT.

3. Tangible Property Rights. The DEPARTMENT's current edition of "Administrative Requirements for Recipients of Ecology Grants and Loans", Part V, shall control the use and disposition of all real and personal property purchased wholly or in part with funds furnished by the DEPARTMENT in the absence of state, federal statute(s), regulation(s), or policy(s) to the contrary or upon specific instructions with respect thereto in the Scope of Work.

4. Personal Property Furnished by the DEPARTMENT. When the DEPARTMENT provides personal property directly to the RECIPIENT for use in performance of the project, it shall be returned to the DEPARTMENT prior to final payment by the DEPARTMENT. If said property is lost, stolen or damaged while in the RECIPIENT's possession, the DEPARTMENT shall be reimbursed in cash or by setoff by the RECIPIENT for the fair market value of such property.

5. Acquisition Projects. The following provisions shall apply if the project covered by this agreement includes funds for the acquisition of land or facilities:

a. Prior to disbursement of funds provided for in this agreement, the RECIPIENT shall establish that the cost of land/or facilities is fair and reasonable.

b. The RECIPIENT shall provide satisfactory evidence of title or ability to acquire title for each parcel prior to disbursement of funds provided by this agreement. Such evidence may include title insurance policies, Torrens certificates, or abstracts, and attorney's opinions establishing that the land is free from any impediment, lien, or claim which would impair the uses contemplated by this agreement.

6. Conversions. Regardless of the contract termination date shown on the cover sheet, the RECIPIENT shall not at any time convert any equipment, property or facility acquired or developed pursuant to this agreement to uses other than those for which assistance was originally approved without prior written approval of the DEPARTMENT. Such approval may be conditioned upon payment to the DEPARTMENT of that portion of the proceeds of the sale, lease or other conversion or encumbrance which monies granted pursuant to this agreement bear to the total acquisition, purchase or construction costs of such property.

N. SUSTAINABLE PRODUCTS

In order to sustain Washington's natural resources and ecosystems, the RECIPIENT is encouraged to implement sustainable practices where and when possible. These practices include use of clean energy, and purchase and use of sustainably produced products (e.g., recycled paper). For more information, see http://www.ecy.wa.gov/sustainability/.

O. RECOVERY OF PAYMENTS TO RECIPIENT

The right of the RECIPIENT to retain monies paid to it as reimbursement payments is contingent upon satisfactory performance of this agreement including the satisfactory completion of the project described in the Scope of Work. In the event the RECIPIENT fails, for any reason, to perform obligations required of it by this agreement, the RECIPIENT may, at the DEPARTMENT's sole discretion, be required to repay to the DEPARTMENT all grant/loan funds disbursed to the RECIPIENT for those parts of the project that are rendered worthless in the opinion of the DEPARTMENT by such failure to perform.

Interest shall accrue at the rate of twelve percent (12%) per year from the time the DEPARTMENT demands repayment of funds. If payments have been discontinued by the DEPARTMENT due to insufficient funds as in Section K.2 above, the RECIPIENT shall not be obligated to repay monies which had been paid to the RECIPIENT prior to such termination. Any property acquired under this agreement, at the option of the DEPARTMENT, may become the DEPARTMENT'S property and the RECIPIENT'S liability to repay monies shall be reduced by an amount reflecting the fair value of such property.

P. PROJECT APPROVAL

The extent and character of all work and services to be performed under this agreement by the RECIPIENT shall be subject to the review and approval of the DEPARTMENT through the Project Officer or other designated official to whom the RECIPIENT shall report and be responsible. In the event there is a dispute with regard to the extent and character of the work to be done, the determination of the Project Officer or other designated official as to the extent and character of the work to be done shall govern. The RECIPIENT shall have the right to appeal decisions as provided for below.

Q. DISPUTES

Except as otherwise provided in this agreement, any dispute concerning a question of fact arising under this agreement which is not disposed of in writing shall be decided by the Project Officer or other designated official who shall provide a written statement of decision to the RECIPIENT. The decision of

the Project Officer or other designated official shall be final and conclusive unless, within thirty days from the date of receipt of such statement, the RECIPIENT mails or otherwise furnishes to the Director of the DEPARTMENT a written appeal.

In connection with appeal of any proceeding under this clause, the RECIPIENT shall have the opportunity to be heard and to offer evidence in support of this appeal. The decision of the Director or duly authorized representative for the determination of such appeals shall be final and conclusive. Appeals from the Director's determination shall be brought in the Superior Court of Thurston County. Review of the decision of the Director will not be sought before either the Pollution Control Hearings Board or the Shoreline Hearings Board. Pending final decision of dispute hereunder, the RECIPIENT shall proceed diligently with the performance of this agreement and in accordance with the decision rendered.

R. CONFLICT OF INTEREST

No officer, member, agent, or employee of either party to this agreement who exercises any function or responsibility in the review, approval, or carrying out of this agreement, shall participate in any decision which affects his/her personal interest or the interest of any corporation, partnership or association in which he/she is, directly or indirectly interested; nor shall he/she have any personal or pecuniary interest, direct or indirect, in this agreement or the proceeds thereof.

S. INDEMNIFICATION

1. The DEPARTMENT shall in no way be held responsible for payment of salaries, consultant's fees, and other costs related to the project described herein, except as provided in the Scope of Work.
2. To the extent that the Constitution and laws of the State of Washington permit, each party shall indemnify and hold the other harmless from and against any liability for any or all injuries to persons or property arising from the negligent act or omission of that party or that party's agents or employees arising out of this agreement.

T. GOVERNING LAW

This agreement shall be governed by the laws of the State of Washington.

U. SEVERABILITY

If any provision of this agreement or any provision of any document incorporated by reference shall be held invalid, such invalidity shall not affect the other provisions of this agreement which can be given effect without the invalid provision, and to this end the provisions of this agreement are declared to be severable.

V. PRECEDENCE

In the event of inconsistency in this agreement, unless otherwise provided herein, the inconsistency shall be resolved by giving precedence in the following order: (a) applicable Federal and State statutes and regulations; (b) Scope of Work; (c) Special Terms and Conditions; (d) Any terms incorporated herein by reference including the "Administrative Requirements for Recipients of Ecology Grants and Loans"; and (e) the General Terms and Conditions.

W. FUNDING AVAILABILITY

The DEPARTMENT’s ability to make payments is contingent on availability of funding. In the event funding from state, federal, or other sources is withdrawn, reduced, or limited in any way after the effective date and prior to completion or expiration date of this agreement, the DEPARTMENT, at its sole discretion, may elect to terminate the agreement, in whole or part, or to renegotiate the agreement subject

to new funding limitations and conditions. The DEPARTMENT may also elect to suspend performance of the agreement until the DEPARTMENT determines the funding insufficiency is resolved. The DEPARTMENT may exercise any of these options with no notification restrictions.

SS-010 Rev. 04/04

Modified 12/13