TECHNICAL MEMORANDUM

Cedar Grove Composting, Inc. Tipping Building Ventilation Review

PREPARED FOR:	Puget Sound Clean Air Agency
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DATE:	December 18, 2017

On April 17, 2017, Cedar Grove Composting, Inc. (Cedar Grove) and the Puget Sound Clean Air Agency (PSCAA) had a meeting to discuss two items: (1) the smoke test procedure developed by PSCAA, and (2) how the new smoke test procedure resulted in the establishment of a Reasonably Available/Best Available Control Technology (RACT/BACT) level of 100 percent control on the tipping building ventilation system at Cedar Grove's Maple Valley facility. Before the meeting, CH2M HILL (CH2M) submitted a memorandum to PSCAA titled "Cedar Grove Composting, Inc. Building Ventilation Test Procedures" dated April 13, 2017. The memorandum provided a history of the ventilation smoke test procedures at Cedar Grove Maple Valley. Cedar Grove appreciates PSCAA taking the time to discuss these issues and for suggesting some potential paths forward. This memorandum provides the agency an update on Cedar Grove's and CH2M's progress on this issue and proposed next steps forward.

The main types of potential paths forward discussed during the meeting were:

1. Proposing modifications to the test procedures so that the procedures will still challenge the system, while more closely representing the flow pattern of the odors in the building.
2. Investigating new mechanical options to assist the system with achieving the goal of no visible smoke.
3. Implementing a combination of test procedure modification and mechanical options.

Current Situation

The tipping building is an existing structure that was designed for four air exchanges per hour, which also results in the building being under negative air pressure. Order of Approval No. 10645, Condition 14 established the requirement that during the smoke test "no visible smoke" escape the building. The condition was established earlier in Order of Approval No. 10052 dated December 22, 2010. PSCAA has stated the "no visible smoke" is not a goal, but an enforceable condition.

In 2008, the tipping building had a design ventilation rate of 24,000 cubic feet per minute(cfm). The basic procedure for the 2008 smoke test involved using a smoke candle that released smoke at approximately the same rate as the ventilation system for one minute. The smoke was generated at the centroid of the interior resident feedstock pile. The smoke generation point was generally located 25 to 50 feet from the rear wall and half the distance from the top of pile to the center ridge in the roof section (which is approximately 32 feet high), since warm air from the feedstock will rise to fill this space and the smoke generated was intended to move with the warm air coming off the feedstock. The generation point was later moved to the floor in front of the center of the pile because of fire and other safety issues.

The ventilation design requirement for composting facilities that are not co-composting is four air exchanges per hour. The 2008 smoke test was structured to evaluate whether the ventilation system was being operated as designed, so the test was used to demonstrate that the smoke was going to the ventilation system and that all of the smoke was removed from the building within 15 minutes from the time the candle stopped generating smoke. But there was also a permit condition that there be no visible emissions from the tipping building.

It was also stated in the test procedures that high winds were not compatible with this test procedure, since the winds would induce a vacuum effect on the building shell. In addition, when high winds are present, atmospheric mixing is more vigorous and odor impacts are less likely. Therefore, the smoke test was only to be conducted when the ambient wind speed was less than approximately 5 miles per hour and no wind gusts were observed.

In 2012, the tipping building had a continuous exhaust ventilation system with the exhaust point located near the peak of the interior south wall. This exhaust airflow was discharged into the tipping biofilter for odor removal prior to discharge to the atmosphere. The sorting building air was controlled by the sorting biofilter. The systems had been passing the 2008 smoke tests, and meeting the requirement of no visible emissions from the doorway, so the tipping and sorting buildings had not been identified by the PSCAA as an issue. When it came time to replace the media in the existing tipping and sorting biofilters, Cedar Grove decided to increase the size of the biofilters in order to increase the biofilters' residence times, improve moisture retention, and potentially increase the ventilation rates for the tipping and sorting buildings. The electric Hammermill grinder and its conveyor system, which was located next to the sorting biofilter was removed to make room for a new sorting biofilter. The new biofilter would be approximately three times the size of the existing biofilter. The larger sorting biofilter (4,500 square feet) allowed for a larger exhaust fan (35,300 cfm vs 16,000 cfm). Cedar Grove and PSCAA determined that this additional airflow would be used to draw emissions from both the sorting building and the tipping building extension.

The tipping biofilter size was also redesigned to allow for increasing the size of the biofilter by about 23 percent.

During the design review phase for the new biofilters, PSCAA visited Cedar Grove's Maple Valley facility to observe a smoke test. The tipping building passed the existing smoke tests, but Inspector Rick Hess of PSCAA decided that the test was not rigorous enough. PSCAA modified the existing smoke test procedures on July 15, 2013.

The 2013 smoke test procedures use two Superior Smoke candles #3WC (or Agency-approved equivalent) in line with wicks attached together so the first, once spent, ignites the second to assure a minimum 3-minute burn time. Each candle produces 40,000 cubic feet of white smoke over a 3- to 4-minute period, resulting in 6 to 7 minutes of smoke. The smoke candles are placed at ground level at a location where *waste material is not extending and will not extend beyond and will not be handled beyond following the test*. Handling would include the loading of material into a grinder for processing. This location tends to be in line with the edge of the grinder in the tipping extension building and in the middle of the open door. The distance from the smoke candles to the open door is about 25 feet, but can vary a little based on the placement of the grinder. The test must proceed regardless of climatic conditions unless there are safety concerns or Cedar Grove would not process (receive or handle) waste due to existing climatic conditions.

The discussions on the new smoke test procedures occurred before the new tipping and sorting biofilters were installed. Cedar Grove and CH2M pointed out that with the new location of the smoke candles and the increased volume of smoke, the condition of "no visible smoke" would require 100 percent capture for the tipping building, whereas with the previous smoke test procedures, smoke would only leave the building if the system was not operating well. The building and the existing process were not designed for that level of control. The building was designed for four air exchanges per hour, which maintains the building being under negative air. PSCAA's position has been that the building is not under negative air if 100 percent of the smoke is not captured.

Comparison to Other Facilities

Cedar Grove and CH2M have not seen the 100 percent capture requirement applied to other facilities, including smaller, fully enclosed composting or co-composting facilities. Cedar Grove requested information on the smoke test requirements for the other composting facilities in PSCAA's region. PSCAA provided information on two facilities: Lenz Enterprises, Inc. (Lenz) in Stanwood, Washington, and EMU Topsoil (EMU) in Poulsbo, Washington. The smoke test procedures for the other facilities were much less rigorous than Cedar Grove's.

PSCAA also provided a couple of examples of Lenz's tipping building inspection reports. The reports appear to include the ventilation airflow measurement and confirmation that the measured flowrate was above the design flow rate. The reports also include observations during the smoke tests that a large percentage of the smoke moved into the blower intake during the tests, verifying operation of the blower.

The smoke test procedure at Lenz appears to involve holding a smoke generator on the end of a 20-foot piece of pipe somewhere in front of the blower intake to confirm the intake is working, and does not involve distributing the smoke throughout the entire building.

Most of the conditions for EMU were similar to the conditions for Lenz; however, EMU does not appear to have the requirement to measure the ventilation flowrate. Lenz did not have the requirement for no smoke to leave the open face of the building or the requirements to submit a test plan and digitally record the smoke test.

The objective of Lenz's smoke test procedures appeared to be to confirm the tipping building's ventilation system was operating as designed by confirming the airflow rate was above design and that the blower was in fact in operation. EMU's procedures appear to be closer to Cedar Grove's 2008 procedures; however, that could not be confirmed since the test procedures were not provided by PSCAA.

South Coast Air Quality Management District Rule 1133.3 states that "any active phase of composting containing more than 10 percent food waste, by weight, shall be conducted using an emission control device designed and operated with an overall system control efficiency of at least 80 percent, by weight, each for VOC and ammonia emissions." This is generally considered to be Best Available Control Technology (BACT) for the active phase of composting operations. The tipping and grinding building are not part of the active phase of the composting process; however, past emission tests conducted on Cedar Grove's biofilters have demonstrated well over 90 percent removal of VOCs and ammonia. Therefore, a ventilation system operating at over 90 percent capture should be considered BACT when operated effectively and as designed.

We have discussed with Rick Hess the possibility of continuing with the smoke test, but reducing the requirement to greater than 90 percent of the smoke captured. Mr. Hess was opposed to this approach because it required a judgement about how much smoke could be lost and still achieve 90 percent and, therefore, was subjective.

Ventilation System Performance

The tipping building biofilter was redesigned and new media was added to it in June 2014. The sorting building biofilter was redesigned and went into operation March 10, 2015. PSCAA issued Notice of Construction, Order of Approval No. 10645 for the new biofilters. The permit contains Condition No. 14:

> **Condition No. 14** - Emissions from the tipping building, and the pre-processing, sorting, and grinding building, shall be captured and passed through the biofilter. Compliance with this

requirement shall be determined by the observation of no visible emissions from any open building face during the release of test smoke or other methods specified in an Agency approved test plan. Compliance with this requirement shall be determined by the observation of no visible emissions from any open building face during the release of test smoke or other methods specified in an Agency approved test plan.

In general, smoke tests on the new tipping building ventilation system have demonstrated a strong draw along the floor away from the doorway and into the building. A portion of the smoke is immediately removed by both intakes, while some of the smoke remains in the building moving in a swirling pattern. After approximately 5 to 8 minutes into the test, a light haze may exit from the top right hand side of the doorway. Most of the smoke will turn and re-enter the building. However, because the air inside the building is warmer than the air outside, some of the smoke may rise above the door and exit from the top of the doorway. Alternatively, because of wind conditions outside, some of the smoke may escape the pull of the ventilation system and not re-enter the building. The proportion of smoke leaving the building is less than 5 percent based on observation and, generally, there is no smoke observed more than 6 to 10 feet from the door of the building. The entire building and the area in front of the doorway and on the sides of the building are usually clear of smoke before the 15-minute test is over, but that can depend on how long the candles produce smoke, which can be from 5 to 8 minutes.

The tipping building has also been tested when the wind speeds were significant and affected the building's ability to pass the zero visible emissions requirement for the smoke test. The exact wind speed that is required to overcome the pull at the door is not known, since it also depends on wind direction and temperature. In the tests conducted when wind speeds were an issue, the wind gusts were over 10 mph. The pull inside the building appeared to still be effective, but some of smoke in the area near the door was pulled out by the vacuum created by the wind. It is worth noting that when high winds are present, atmospheric mixing is more vigorous and odor impacts are less likely.

It is important to understand that the intake behaves much like a vacuum. If you put your hand right in front of the vacuum, the pull is strong, but as you move your hand farther away the pull diminishes. However, air that is not in the direct pull of the vacuum moves toward the intake to fill the "void" or low pressure area created by the vacuum. Because the intake is near the ceiling, and the smoke candle is located on the floor, the air flow is not necessarily straight into the intake. The air appears to move across the floor and then up the walls to the ceiling area in a vertical swirling pattern as well as a horizontal swirling pattern. The smoke tends to concentrate in the main tipping building where the feedstock material is located, but a lighter concentration of smoke is present in the tipping building extension. There appears to be less pull by the ventilation system on the area between the grinding building doorway and the closed tipping building door, which is probably because it is easier for the system to pull air in through the door to the sorting building and over the grinding area than it is to pull the air on the other side of the grinding building doorway.

With the tipping and sorting building currently operating at or above a flow rate of 35,000 cfm, we have observed a greater than 95 percent capture in the building using the current smoke test. In addition, the tipping and sorting buildings have not been identified as a significant odor source.

Potential Modifications to Test Procedures

CH2M discussed the current smoke test procedures with the owner of Superior Signal Company, which manufactures the Superior Smoke candles, and he indicated that we were not using the smoke candles as intended. He indicated that the smoke candles are intended to confirm performance according to the design criteria. When testing the ventilation of a building, the testers first close all openings and then fill the building with smoke. They use fans or multiple smaller candles to uniformly spread the smoke throughout the building. Once the candles have finished burning, the testers start timing how long it takes for all the smoke to clear the building. The elapsed time is compared to the design air exchange rate requirement.

In the meeting on April 17, 2017, we discussed modifying the smoke test procedure to more closely resemble the procedure described by Superior Signal. PSCAA stated that the "no visible emissions" condition is an established part of Cedar Grove's permit and will remain in the permit. However, if we conducted the ventilation test with the doors closed, there would be no visible emissions.

Next we discussed whether there might be a way to modify the smoke test so that it still challenged the system but more closely represented the flow pattern of the odors in the building. This included a discussion of where the odors are located in the building and the pattern of airflow created by the ventilation system.

As noted above, the current smoke test calls for placing the candle at ground level at a location where waste material is not present and would not be present or be handled during operations. Handling would include the loading of material into a grinder for processing. This location tends to be in line with the edge of the grinder in the tipping building extension and in the middle of the open door. The distance from the smoke candles to the open door is about 25 feet, but can vary slightly based on the placement of the grinder.

Material is not stored in the tipping extension building. Material may be unloaded from trucks into that area, but it is immediately moved either into the grinder or into the main tipping building. Woody material may be placed near the excavator so that it can be mixed in with the feedstock being added to the grinder. Feedstock material that is not in the process of being unloaded from trucks or loaded into the grinder is located in the main tipping building. The odors from the feedstock tend to rise with the warm air above the material and move into the upper portion of the main building. There is a partial curtain between the main building and the extension, which helps keeps these odors (and the test candle smoke) in the main part of the building. However, the ventilation intake above the grinder also pulls some of the odors or smoke from the main building into the extension.

Because the tipping building extension is not used as a storage area, Cedar Grove requests that the location of the smoke candle be moved from the extension to the main tipping building where the majority of the feedstock material is located. In the next section, we discuss control options we have evaluated and which options may help contain odors/smoke in the main tipping building.

Potential Modifications to Tipping Building

Buildings that have 100 percent capture are generally fully enclosed with no open doors. Cedar Grove and CH2M have not seen the 100 percent capture requirement applied to other facilities similar to Cedar Grove's, including smaller, fully enclosed composting or co-composting facilities. For this reason, there are no examples of proven technology that Cedar Grove and CH2M can reference and use to achieve this requirement. Cedar Grove and CH2M did look at several options that may improve capture efficiency, but none of these methods has demonstrated 100 percent capture efficiency at similar facilities.

When smoke is lost during a smoke test at Cedar Grove, it tends to be a light haze that exits from the upper portion of the right-hand side of the doorway. Most of the smoke turns and re-enters the building. However, because the air inside the building is warmer than the air outside, some of the smoke rises and exits from the top of the doorway. Also, when wind conditions outside create a vacuum at the doorway, some of the smoke can escape the pull of the ventilation system and not re-enter the building.

CH2M and Cedar Grove reviewed available control technologies designed to control emissions from doorways and how those technologies might be employed at Cedar Grove. CH2M and Cedar Grove also investigated methods to potentially alter the air flow pattern in the building to try to contain the smoke in the building until the ventilation system could capture the smoke and send it to the biofilters.

Control Technologies for Doorways

CH2M and Cedar Grove investigated the use of controls that would improve the capture efficiency of the Tipping building at the doorway. These controls included the potential of adding an "air knife" to the door of the tipping building, an air intake over the top of the doorway, or an odor curtain at the doorway.

Air Knife across Open Door

The potential of adding an "air knife" to the door of the tipping building was investigated. The idea was to create a wall of air that would push the air at the edge of the doorway back into the building. However, with a large door opening like the one on the tipping building extension, a traditional push-pull ventilation system or air-knife system has not been shown to be effective. CH2M has not found any yard waste or food waste drop-off systems with that type of ventilation system on an open walled structure or large open door. If smaller doorways are part of a structure, a push-pull ventilation system or an air-knife system can be employed if a door is opened only intermittently, to prevent migration of exhaust out of the open door.

Even though this type of system has not been used on large doorways, Cedar Grove and CH2M conducted a test using one of Cedar Grove's large misters. The misters are typically used to disperse odor-neutralizing liquids over process areas or operations that might generate odors, such as screening or transferring operations.

If an air knife were employed, it would be installed on the edge of the doorway and would direct a vertical column of air into the building to move the smoke heading toward the open doorway back into the building. Misters are equipped with large fans. It was decided to test the possibility of using an air knife by using the mister's fan to simulate the airflow created by an air knife.

For the first test, the fan was placed outside of the tipping building, and the airflow was directed towards the upper right-hand edge of the door. The location of the fan is indicated on Figure 1 by the red square.

Figure 1. Air Knife Test 1

While the fan was operating, a smoke test was conducted following the current procedures. In addition, a baseline smoke test was conducted according to the current smoke test procedures without any modification to the facility. The videos from the smoke tests are available upon request. The idea was to compare the results from the air knife simulation smoke test to a baseline test.

The airflow from the fan did push the smoke directly in front of it into the building; however, it also appeared to over-pressurize the building, pushing smoke from other parts of the building out the door. More smoke was lost during this test than during the baseline test, so it was determined that an air knife at this location would not improve the capture efficiency of the tipping building.

Another test was performed where the mister was placed inside the building near the centerline, which is also near the right-hand side of the open door. The location of the fan inside the building is indicated on Figure 2 by the red square.

Figure 2. Air Knife Test 2

Locating the fan inside the building would avoid the problem of over-pressurizing the building with outside air. At this location, the fan would be pulling air through it that was already in the building, near the doorway, and pushing it toward the back of the building. During this test, it was observed that the action of the fan pulling in air also pulled the smoke towards the door and worked against the ventilation system that was trying to pull the air into the building. Once again, more smoke was lost out of the door during this test than during the baseline test.

Intake over the Open Door

The next doorway control technology discussed was the installation of an intake over the entire door. It was determined that this option is not technically feasible for this existing process. The issues associated with installing a doorway intake include:

- It would require more air flow than is available and might actually draw air from further in the building to the door.
- The extra ducting would add back pressure to the system and reduce the amount of air the fan could pull from the building.

- The building was not designed to support a ventilation system over the doorway and does not have enough available space for the equipment.

Additionally, this type of control technology is typically used on much smaller openings than the tipping building door. There is no evidence that this type of control has ever been used at a composting facility or that it has demonstrated its effectiveness on large openings.

Door Curtain Odor Control

Odor curtains are designed to treat odor emissions that pass through an open doorway or open exterior wall. Odor-neutralizing liquids are converted to a vapor and dispersed by diffusion nozzles placed around the frame of the doorway. This technology is often used to control odors at waste transfer facilities. The main issues with this type of technology are:

- Employees and truck drivers will be exposed to the odor-neutralizing chemicals every time they pass through the door.
- The technology is designed for the control of odors, not smoke. Smoke candles work by "painting" the moisture in the air with zinc chloride. The odor-neutralizing chemical is applied as a very fine mist that can move along with the odors and react with them beyond the doorway. It is not intended to capture and remove particles or moisture in the air. Although the technology might help prevent potential odor emissions from the doorway, it would likely have no effect on smoke exiting the door and would not solve the issue of visible emissions.

Modifications to Airflow Pattern

In general, smoke tests on the new tipping building ventilation system have demonstrated a strong draw along the floor away from the doorway and into the building. A portion of the smoke is immediately removed by both intakes and some of the smoke remains in the building, moving in a swirling pattern. After a time, a small amount may exit from the doorway, but it usually turns and re-enters the building. With the tipping and sorting building ventilation system currently operating at or above 35,000 cfm, we have typically observed (using the current smoke test) a greater than 95 percent smoke capture.

One possible way to increase the capture efficiency is to modify the airflow pattern in the building so that the air remains contained in the building until the ventilation system can capture the odors or smoke and send it to the biofilters. The intake inside the building behaves much like a vacuum, pulling nearby air into the system. Air that is not in the direct pull of the vacuum moves toward the intake to fill the "void" or low-pressure area created by the vacuum. Because the intake is near the ceiling, and the smoke candle is located on the floor, the air flow is not necessarily straight into the intake.

During a typical smoke test, the smoke tends to concentrate in the main tipping building where the feedstock material is located, but a lighter concentration of smoke is present in the tipping building extension. If more of the smoke could be contained in the main tipping building and not in the extension where the door is located, then capture efficiency of the smoke could improve.

Additional Structure

Initially, the tipping building extension was added to act as a windbreak for the main tipping building and the feedstock material being delivered to the facility. Later, the sorting building was added and grinding operations were moved from outside into the area connecting the tipping building to the sorting building. Feedstock material is now temporarily located in the tipping building extension while it is being sent through the grinder. For this reason, PSCAA has indicated that it no longer considers the extension to be a windbreak, but instead considers it an additional process building.

PSCAA has suggested the option of adding a new extension to the tipping building extension to act as a windbreak. The minimum size of the structure would be 100 feet long by 25 feet wide with a peak height to match the height of the tipping building extension. The approximate location of the extension is shown as a red outline on Figure 3.

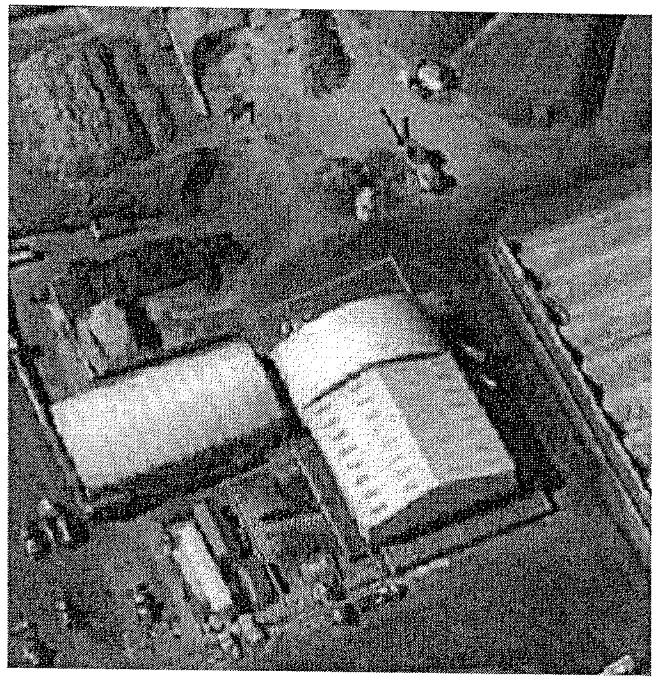

Figure 3. Possible Location of Additional Building Extension

The main issue with this new extension is space. The facility was not designed with space for an additional extension. The extension would block existing travel pathways and the delivery trucks need room to pull forward and straighten out before they back through the doorway. Piles of oversize and clean woody materials may need to be moved, but still need to be close to the tipping building where they can be added to the grinder.

There would also be the challenge to truck drivers of backing up an additional 25 feet, and potentially through two doors, to reach the feedstock unloading area. This would likely lead to more collisions with the building and more time needed to unload, increasing the line of idling trucks waiting to unload.

Although the additional building would act as a windbreak, there would still be an issue with winds across the doorway potentially creating a vacuum at the doorway. The vacuum could pull the smoke from the existing extension into the new extension and then potentially out the doorway. There is no existing evidence available that would guarantee that an additional extension would result in 100 percent capture of the smoke.

Fans in Main Tipping Building

Cedar Grove conducted an additional smoke test with a fan located in the main tipping building, at the junction between the tipping building and the extension on the east side of the building. The fan location is indicated by the red square on Figure 4. The fan was directed towards the back of the tipping building. The idea was to modify the airflow pattern in the building so that the smoke would move from the extension into the main tipping building and then stay in a swirling pattern in the main building until the ventilation system could collect the smoke and send it to the biofilter. There is a curtain along the roofline between the main tipping building and tipping extension which helps hold the warm air in the main building.

Figure 4. Fan Location During Airflow Pattern Test

The test indicated a decrease in the amount of smoke lost through the door when compared to the baseline smoke test. However, the control efficiency for the smoke was still not 100 percent and some smoke was visible leaving the doorway. It was thought that a second fan located on the west side of the building, indicated by an X on the figure, might help with establishing a swirling pattern in the main tipping building. This pattern would help hold the smoke in the main building instead of letting it move into the extension. However, this option was not tested.

Move Location of Ventilation Intake

Typically, exhaust collection systems are used to draw outside air in through the open side of a structure and sweep it to exhaust points located farther back in the structure. With a door as large as the opening on the tipping building extension at the Cedar Grove facility, the ventilation design tends to add collection points for the exhaust ventilation system well within the building to maximize the exhaust capture effectiveness. The tipping biofilter ventilation intake is located well within the building, at the south end of the building on the back wall.

The sorting biofilter ventilation intake is currently located over the grinder in the tipping building extension as indicated by the red square on Figure 5. This location has a tendency to pull the smoke from the main tipping building into the tipping building extension, which is where the door is located. If the ventilation intake were moved from the tipping building extension to the other side of the roofline curtain on the northwest corner of the main tipping building, it might reduce the amount of smoke that is pulled into the tipping extension.

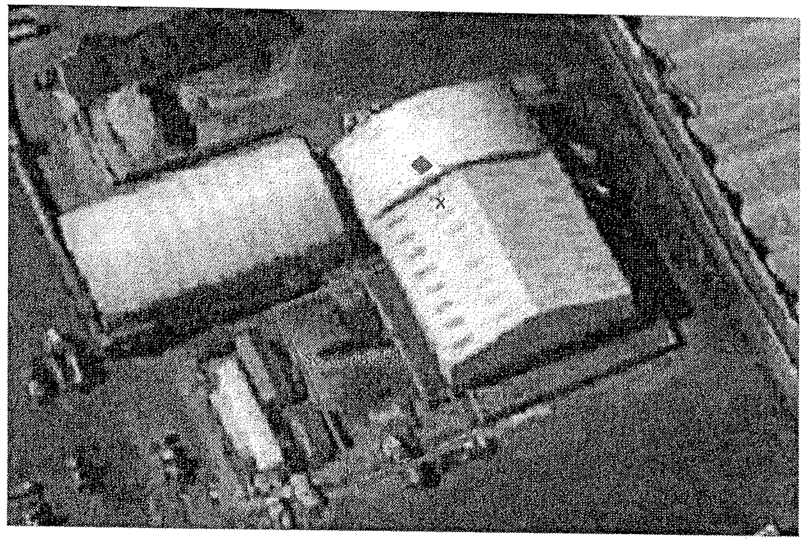

Figure 5. Tipping Building Intake

Selection of Proposed Action

The U.S. Environmental Protection Agency (EPA) has developed a process for conducting a BACT analysis referred to as the "top-down" method. The steps involved in conducting a "top-down" analysis are listed in EPA's Draft *New Source Review Workshop Manual* (October 1990). The steps are:

- Step 1—Identify All Control Technologies
- Step 2—Eliminate Technically Infeasible Options
- Step 3—Rank Remaining Control Technologies by Control Effectiveness
- Step 4—Evaluate Most Effective Controls and Document Results
- Step 5—Select BACT

As part of Step 2 – Eliminate Technically Infeasible Option, for a technology to be considered technically feasible, it needs to have demonstrated in practice that it is effective on a similar emission unit or process. Cedar Grove and CH2M have not seen the 100 percent capture requirement applied to other facilities similar to Cedar Grove's, including smaller, fully enclosed composting or co-composting facilities. For this reason, there are no examples of proven technology that Cedar Grove and CH2M can reference.

The odor curtain technology has been used on a doorway as large as the one on the tipping building. It has demonstrated effectiveness at reducing odors, but not to a level of 100 percent control. None of the control technologies for the doorway have demonstrated the ability to have no visible emissions during a smoke test. Therefore, the technologies could not be considered technically feasible as a means to provide 100 percent control of visible emissions.

There is some evidence that placing a fan in the northeast corner of the main tipping building, as indicated in Figure 4, may help with the capture efficiency of the building, but will not achieve zero visible emissions on its own. If the location of the smoke candle was moved from the extension to the main tipping building where the majority of the feedstock material is located, as discussed above, the new location would also help with containing the smoke in the main tipping building. If necessary, a possible additional step could be to move the ventilation intake from the tipping building extension to the main tipping building, which would reduce the amount of smoke pulled into the tipping extension. However, none of these options has demonstrated the ability to have no visible emissions from the doorway.

It has been indicated that visible emissions of white smoke from the doorway using the current smoke test procedures may not be the best way to test the performance of the ventilation system. This may be part of the reason why there is no evidence, in practice, that the control technologies discussed above have the ability to capture 100 percent of smoke in a building or at a doorway. Superior Signal Company, which manufactures the Superior Smoke candles, indicated that we were not using the smoke candles as intended. The smoke candles are intended to confirm performance according to the design criteria. When testing the ventilation of a building, the testers first close all openings and then fill the building with smoke. Once the smoke is uniformly spread throughout the building and the candles have finished burning, the testers start timing how long it takes for all the smoke to clear the building. The elapsed time is compared to the design air exchange rate requirement to determine performance.