NORTH CAROLINA DIVISION OF AIR QUALITY

Application Review

Issue Date: DRAFT

Region: Fayetteville Regional Office
County: Richmond
NC Facility ID: 7700096
Inspector's Name: Stephen Allen
Date of Last Inspection: 04/01/2021
Compliance Code: In Compliance

Facility Data

Applicant (Facility's Name): Enviva Pellets Hamlet, LLC

Facility Address:
Enviva Pellets Hamlet, LLC
1125 North NC Highway 177
Hamlet, NC 28345

SIC: 2499 / Wood Products, Nec
NAICS: 321999 / All Other Miscellaneous Wood Product Manufacturing

Facility Classification: Before: Title V **After:** Title V
Fee Classification: Before: Title V **After:** Title V

Permit Applicability (this application only)

SIP: 15A NCAC 02D .0515, .0516, .0521, .0524, .1111, 02Q .0317 avoidance of 02D .0530, 02Q .0317 avoidance of 02D .1112, and .0504(d)
NSPS: Subpart IIII
NESHAP: Subpart ZZZZ
PSD: N/A
PSD Avoidance: VOC, NOx, and CO
NC Toxics: N/A
112(r): N/A
Other: HAPs Avoidance after control installed

Contact Data

Facility Contact	Authorized Contact	Technical Contact
Kaylie Hogan EHS Mgr. (910) 501-7130 1125 North NC Hwy 177 Hamlet, NC 28345	Paul Pereira Plant Manager (919) 218-6800 1125 North NC Highway 177 Hamlet, NC 28345	Kai Simonsen Air Permit Engineer (919) 428-0289 4242 Six Forks Road, Suite 1050 Raleigh, NC 27609

Application Data

Application Number: 7700096.20B and .20C
Date Received: 07/24/2020 and 11/25/2020
Application Type: Modification
Application Schedule: TV-1st Time

Existing Permit Data

Existing Permit Number: 10365/R05
Existing Permit Issue Date: 07/20/2020
Existing Permit Expiration Date: 02/28/2021

Total Actual emissions in TONS/YEAR:

CY	SO2	NOX	VOC	CO	PM10	Total HAP	Largest HAP
2019	9.43	79.91	47.44	79.03	23.96	6.87	1.66 [Methanol (methyl alcohol)]

Review Engineer: Kevin Godwin

Review Engineer's Signature: **Date:**

Comments / Recommendations:
Issue 10365/T06
Permit Issue Date: DRAFT
Permit Expiration Date: DRAFT

I. Introduction and Purpose of Application

This permit action is for the 1st Time Title V Permit for Enviva Pellets Hamlet, LLC. The application was received on July 24, 2020 and application for renewal of Permit No. 10365R05 with requested modifications was received on November 25, 2020. According to the application, the plant commenced operation on July 24, 2019. This application for the 1st Time Title V Permit was submitted within 12 months of commencing initial operation in accordance with Condition 2.2.A.6 of Air Quality Permit No. 10365R05 and 15A NCAC 02Q .0504(d).

As described in the application, "Enviva Pellets Hamlet, LLC (Enviva) owns and operates a wood pellets manufacturing plant (referred to herein as "the Hamlet plant" or "the facility") in Richmond County, North Carolina under Air Quality Permit No. 10365R05 issued by the North Carolina Department of Environmental Quality (NCDEQ), Division of Air

Quality (DAQ) on July 20, 2020. The plant commenced operation on July 24, 2019 and is permitted to produce up to 625,011 oven dried tons (ODT) per year of wood pellets utilizing up to 85% softwood on a 12-month rolling basis. The plant consists of the following processes: Log Chipper, Debarker, Bark Hog, Green Hammermills, Rotary Dryer, Dry Hammermills, Pellet Mills, Pellet Coolers, Product Loadout operations and other ancillary activities. The Hamlet plant is currently permitted as a major source with respect to the Title V permitting program and a minor Prevention of Significant Deterioration (PSD) stationary source. Potential facility-wide emissions of one or more criteria pollutants are estimated to exceed the Title V major source threshold of 100 tons per year (tpy) but are limited below the PSD major source threshold of 250 tpy. Air Quality Permit No. 10365R05 authorizes implementation of emissions controls for the Dry Hammermills and upon controlling the Dry Hammermill exhaust, the plant will become a minor source of hazardous air pollutants (HAP)."

On November 25, 2020, DAQ received an application (.20C) for renewal of Permit No. 10365R05 with requested modifications. The requested modifications are outlined below:

• Update potential emissions to reflect the results of compliance testing completed in January 2020 for the regenerative thermal oxidizer (CD-RTO) which currently controls the Dryer and Green Hammermills and will control the Dry Hammermills, the Regenerative Catalytic Oxidizer/RTO (RCO)/RTO that controls the Pellet Mills and Coolers (ES-CLR-1 through 6), and Dried Wood Handling (ES-DWH). Emissions from these sources have also been updated to reflect an increase in hourly throughput from 80 ODT/hr to 120 ODT/hr.

DAQ Response – DAQ does agree with updates to potential emissions calculations based on January 2020 compliance testing. The testing was approved by DAQ, Stationary Source Compliance Branch (SSCB) on May 4, 2020 (ref. Brent W. Hall, SSCB - Enviva Pellets Hamlet, LLC, Initial Compliance Test for Multiple Emission Sources).

DAQ also agrees with increasing the hourly throughput from 80 ODT/hr to 120 ODT/hr with this 1st Time Title V Permit. Increasing the short-term plant throughput rate to reflect the Facility's maximum hourly operating rate does not change the facility permitted potential emissions and will not impact the Facility's ability to comply with all existing and proposed permit limits. This increase in hourly throughput was requested in a permit modification application submitted in accordance with 15A NCAC 02Q .0504, allowing issuance of a construction and operating permit under 15A NCAC 02Q .0300. DAQ preferred to process this modification application concurrent with the application for the initial Title V permit, and Enviva agreed with DAQ's preference to do so. The appropriate permitting mechanism was utilized to request this change, and this change would result in the facility continuing to comply with all existing permit emission limits and other permit requirements.

• The addition of two (2) natural gas-fired burners, each with a heat input of 2.5 million British thermal units per hour (MMBtu/hr), to heat the dryer system ducts (IES-DB-1 and IES-DB-2). As flue gas exits the dryer and begins to cool, wood tar can condense and coat the inner walls of the ducts creating a risk of fire. In order to prevent condensation from occurring, and thus reduce the risk of fire, the two (2) ducts (herein referred to as double ducts) on the dryer system will be heated. Potential emissions from the duct burners are below the thresholds in 15A NCAC 02Q .0503(8) and they are thus considered insignificant activities.

DAQ Response – DAQ agrees with this request to include the natural gas-fired duct burners in the insignificant activities list attached to the cover letter of the 1st Time Title V Permit.

• The addition of two (2) propane vaporizers to vaporize propane received by truck for combustion by the RTO burners, RCO/RTO burners, and burners for the dryer system double ducts. Each vaporizer has a maximum heat input capacity of 1 MMBtu/hr and combusts propane. Potential emissions from the propane vaporizers are below the thresholds in 15A NCAC 02Q .0503(8) and they are thus considered insignificant activities.

DAQ Response – DAQ agrees to include the propane vaporizers in the insignificant activities list attached to the cover letter of the 1st Time Title V Permit.

• Modifications to optimize operation of the RTO (CD-RTO) including enlarging the ductwork and poppet valves to allow for more air flow and the addition of two (2) canisters with combustion zone and additional burners. Enviva is also requesting authorization for injection of natural gas into the RTO which will reduce the amount of combustion air added to the RTO, thereby increasing fuel efficiency and reducing nitrogen oxide (NO_X) generation. The heat input of the RTO will be increased from 32 MMBtu/hr to 54.4 MMBtu/hr as a result of the additional burners and natural gas injection.

DAQ Response – DAQ agrees to modifications to the RTO as mentioned above and will update the description in the 1st Time Title V Permit.

- Diesel fuel may be used as an accelerant for cold start-up of the furnace. The amount of fuel used per event is typically 15-30 gallons and typically 100-200 gallons per year. Emissions from diesel combustion during cold start-ups are insignificant.

DAQ Response – DAQ agrees to the use of diesel fuel as an accelerant for cold start-up of the furnace.

- Enviva is providing clarification on use of the dryer bypass stack. The dryer bypass stack is used when the furnace is started up from a cold shutdown and when the furnace transitions from idle mode to normal operation. Emissions are vented through the dryer bypass stack for approximately 10 minutes as exhaust flow is transitioned from the furnace bypass stack to the WESP and RTO. The dryer is not operational during this time and emissions are due solely to combustion of fuel in the furnace. Emissions during these brief transition periods are insignificant and are not separately quantified to avoid double-counting, as these emissions are already accounted for under the furnace cold start-up and idle mode scenarios.

DAQ Response – DAQ accepts this updated description of the use of the dryer and furnace bypass stacks.

- Removal of the additive storage silo and baghouse (ES-ADD) from the permit since these will not be installed. Additive is delivered by truck in 2,000 pound supersacks and emptied into a hopper. The additive is transferred from the hopper via enclosed screw conveyor and added to sized wood from the Pellet Mill Feed Silo discharge screw conveyor prior to transfer to the Pellet Mills. Emissions from additive handling operations are below the thresholds in 15A NCAC 02Q .0503(8) and it is thus considered an insignificant activity.

DAQ Response – DAQ agrees with removing the additive storage silo (ES-ADD) and associated baghouse from the permitted equipment list and placing the additive hopper on the insignificant activities list attached to the 1st Time Title V Permit.

- Update the process description for Green Wood Handling (IES-GWH) to more accurately reflect the plant as constructed. Specifically, hardwood and softwood chips are stored in separate piles. Green Wood Storage Pile No. 5 (IES-GWSP-5) is specifically used for storage of hardwood chips. Green hardwood chips are unloaded via the truck dumpers and transferred to the dedicated hardwood storage pile by front-end loader. Hardwood and softwood chips from their respective storage piles are transferred to a mix pile via a front-end loader where they are manually mixed using a front-end loader. From the mix pile, the chips are then transferred to a reclaim hopper (previously referred to as the Wet Hardwood Hopper) via front-end loader. From the hopper a drag chain feeds the chips through an enclosed chute onto the enclosed conveyor to the Green Hammermills.

DAQ Response – DAQ agrees with the process description update for the Green Wood Handling activities.

- Update to the Green Wood Handling (IES-GWH) throughputs and moisture contents to more accurately reflect material moisture weights and to account for material blending operations in the mix storage pile.

DAQ Response – DAQ agrees with updating throughputs and moisture contents for the Green Wood Handling activities.

- Increase the maximum annual throughput for the Bark Hog (IES-BARKHOG) from 113,638 ODT/yr to 175,000 ODT/yr.

DAQ Response – DAQ agrees with increasing the maximum annual throughput for the Bark Hog with the 1st Time Title V Permit. The bark hog is currently an insignificant activity and will remain an insignificant activity after the proposed increase in annual throughput. Potential emissions at the proposed throughput rate from the bark hog are conservatively estimated to be less than 0.5 tpy per pollutant.

• In the updated initial Title V application submitted on July 24, 2020, the previously assumed particulate control efficiency of 90% for partial enclosure of the Debarker was removed. With this application, the potential emissions have been updated to reflect a 90% control efficiency for use of water spray. The Debarker is considered an insignificant activity per 15A NCAC 02Q .0503 due to potential uncontrolled PM emissions less than 5 tpy.

DAQ Response – DAQ agrees with using a 90% control efficiency for the use of water spray in the debarker.

• Removal of Pellet Cooler Low Pressure (LP) Fines Relay System (ES-PCLP) and associated baghouse (CD-PCLP-BH) from the permit because this is part of a closed loop system and does not vent to the atmosphere.

DAQ Response – DAQ agrees with removing the Pellet Cooler Low Pressure Fines Relay System and associated baghouse from the permit because it is part of a closed loop not venting to the atmosphere.

• Update the fraction of PM that is PM2.5 for the Finished Product Handling baghouse (CD-FPH-BH) to more accurately reflect emissions based on a review of National Council for Air and Stream Improvements (NCASI) particle size distribution data for similar baghouses in the wood products industry.

DAQ Response – DAQ agrees with this request.

• Update potential emissions for front-end loader traffic on unpaved areas (IUNPAVEDROADS) to account for additional front-end loader activity between the hardwood and softwood piles, the mix pile, and the reclaim hopper.

DAQ Response – DAQ agrees with this request.

• Addition of a second small parts washer to the maintenance building. Potential emissions associated with the parts-washer (IES-PW-2) are less than the thresholds in 15A NCAC 02Q .0503(8) so it is considered an insignificant activity.

DAQ Response – DAQ agrees with the addition of one parts washer and will include the second parts washer in the insignificant activities list attached to the cover letter of the 1st Time Title V Permit.

• Update the calculation methodology for diesel storage tanks from EPA TANKS 4.0 to AP-42 Section 7.1, Organic Liquid Storage Tanks because the TANKS software is no longer supported by EPA.2

DAQ Response – DAQ agrees with updating the calculation methodology for diesel storage tanks as mentioned above.

• Removal of the 8-hour limit on the furnace cold start-up duration included in Condition 2.2.A.3.l. Duration of cold start-up at the Hamlet plant typically ranges from 8 to 12 hours. Enviva minimizes the duration of each cold start-up to the maximum extent possible.

DAQ Response – DAQ agrees with removing the 8-hour limit on the furnace cold start-up duration. Potential emission estimates from furnace start-ups are based on an annual maximum hourly operating rate of 50 hrs/yr and the 8-hour startup duration is not used in the emission basis. Note the typical startup duration ranges from 8 to 12 hours.

• Addition of the following as a footnote to the equipment table in the permit to clarify the control of emissions from the Dry Hammermills:

“All air flow from the dry hammermills is controlled by the baghouses (ID Nos. CD-HM-BH1 through CD-HM-BH8), the WESP (ID No. CD-WESP), and the RTO (ID No. CD-RTO). Under normal operations, all air flow from the baghouses on the dry hammermills is ducted to the dryer furnace for treatment by the WESP and the RTO. In the event of reduced furnace/dryer operation, a portion of the air flow from the baghouses on the dry hammermills is ducted directly to the WESP for treatment by the WESP and RTO. In the event of the shutdown of the furnace/dryer system, all air flow from the baghouses on the dry hammermills is ducted directly to the WESP for treatment by the WESP and RTO.”

DAQ Response – DAQ agrees with this request and will add the requested language as a footnote to the equipment table.

• Modify Condition 2.1 A.1.e as follows to reflect that the dryer furnace is not considered a control device: Particulate matter emissions from dry hammermills (ES-HM-1 through 8) shall be controlled by baghouses (CD-HM-1 through 8), in series with one wet electrostatic precipitator (CD-WESP), and one regenerative thermal oxidizer (CD-RTO).

DAQ Response – DAQ agrees with this request and will update Condition 2.1 A.1.e.

• Correct labeling of Condition 2.2 A.3.e.i through vi;

DAQ Response – DAQ agrees with this request and will update Condition 2.2 A.3.e.i through vi.

• Modify Condition 2.2.A.3.n to more accurately reflect the actual operation of the Dry Hammermills. Enviva requests that the current language be replaced with the following:

"All air flow from the dry hammermills shall be controlled by the baghouses (ID Nos. CD-HM-BH1 through CD-HM-BH8), the WESP (ID No. CD-WESP), and the RTO (ID No. CD-RTO). Under normal operations, all air flow from the baghouses on the dry hammermills shall be ducted to the dryer furnace for treatment by the WESP and the RTO. In the event of reduced furnace/dryer operation, a portion of the air flow from the baghouses on the dry hammermills may be ducted directly to the WESP for treatment by the WESP and RTO. In the event of the shutdown of the furnace/dryer system, all air flow from the baghouses on the dry hammermills may be ducted directly to the WESP for treatment by the WESP and RTO."

DAQ Response – DAQ agrees with this request and will update Condition 2.2 A.3.n

• Reflect the use of steam in the pellet production process. Steam will be generated using electric boilers. Use of steam in the pelletizing process may result in a slight increase in actual production rate; however, will not result in an increase in potential production rate or emissions, or result in noncompliance with any Permit requirement.

DAQ Response – DAQ agrees with using steam in the pellet production process generated by an electric boiler. Two electric boilers will be included in the insignificant activities list attached to the cover letter of the 1st Time Title V Permit.

• Incorporate previously unquantified emissions from chip screening as part of the Green Wood Handling insignificant activity (IES-GWH). Total emissions from all Green Wood Handling activities, including chip screening, are insignificant (i.e., less than 5 tpy).

DAQ Response – DAQ agrees with updating total emissions from the Green Wood Handling activities and will keep this source on the insignificant activities list attached to the cover letter of the 1st Time Title V Permit.

Process Description Changes

Control VOC, HAPs, and PM emissions from the dry hammermills

Enviva proposes to implement an air flow recirculation process to route a portion of the exhaust from each dry hammermill back to the front end of the respective dry hammermill to reduce fresh intake air and thus decrease the volume of air that is routed to the initial downstream control device (i.e., a dry hammermill baghouse). All exhaust gases ultimately exiting the dry hammermill baghouses will be routed to a quench duct and then to either the dryer furnace in series with the WESP (ID No. CD-WESP) in series with the RTO (ID No. CD-RTO) or directly to the WESP (or a combination of the two) in series with the RTO (ID No. CD-RTO) for emissions control. As designed, all exhaust gas from the dry hammermill baghouses will be exhausted to the dryer furnace, unless the required combustion air is less than the dry hammermill exhaust. In that case, the surplus of air supplied by the dry hammermills would be diverted directly to the dryer WESP and RTO. This scenario results in reduced production rates of the furnace, dryer, and dry hammermills. At all times during normal operations 100% of the exhaust gas from the dry hammermills will be controlled by a baghouse, WESP and RTO.

The purpose of the quench duct is to protect the RTO by reducing the risk of fire. The safety water quench duct is a water curtain and air/water separator system designed to provide a break (non-combustible zone) within the process exhaust ductwork and control device that is intended to defeat any potential deflagration that occurs upstream or downstream of the quench duct to eliminate the potential risk of fire/catastrophic explosion in the process and/or control equipment. Operation of the dry hammermills will be interlocked with operation of the quench duct (i.e., the quench duct must operate for the dry hammermills to operate). If flow in the quench duct drops below the safe level, the dry hammermills will shut down, and the associated control devices, if not affected by the event, will return to an idle ready state.

<u>Control VOC and HAP emissions from the pellet presses and pellet coolers</u>
Enviva proposes to install a dedicated RTO/RCO (ID No. CD-RCO) to control VOC and HAP emissions from the pellet presses and pellet coolers. Exhaust from the six (6) existing pellet cooler cyclones will be routed to a quench duct and then to an RTO/RCO that will primarily operate in catalytic mode with thermal as a back-up during catalyst cleaning. The purpose of the quench duct is to protect the RTO/RCO by reducing the risk of fire, as discussed above.

With control of VOC and HAP emissions from the pellet presses and pellet coolers and the dry hammermills, Enviva will become a minor source under PSD and an area source of HAP emissions. The Title V permit will include federally enforceable avoidance conditions for both PSD and 112(g) Case-by-Case MACT.

<u>Add duct burners</u>
Enviva proposes to add two (2) natural gas/propane-fired burners, each with a maximum heat input of 2.5 MMBtu/hr, to heat the dryer system ducts (ID Nos. IES-DDB-1 and IES-DDB-2). As flue gas exits the dryer and begins to cool, wood tar can condense and coat the inner walls of the dryer ducts creating a fire risk. To prevent condensation from occurring, and thus reduce the fire risk, the two ducts (herein referred to as double ducts) on the dryer system will be heated. The duct from the cyclone outlet to the ID fan will be heated by one (1) low-NOx burner with a maximum heat input rating of 2.5 MMBtu/hr and a second 2. 5 MMBtu/hr low-NOx burner will be used to heat the duct used for exhaust gas recirculation and the WESP. The burners will combust natural gas, with propane as back-up, and will exhaust directly to the atmosphere. Potential emissions from the duct burners are below the thresholds in 15A NCAC 02Q. 0503(8), and they are thus considered insignificant activities.

<u>Optimize operation of existing RTO</u>
Enviva is proposing several modifications to optimize operation of the existing RTO (ID No. CD-RTO) following the WESP (ID No. CD-WESP), including changing the media to decrease the differential pressure, enlarging the ductwork and poppet valves to allow for more air flow, addition of two (2) canisters with combustion zone (i.e., firebox), and additional burners. Enviva is also requesting authorization for injection of natural gas into the RTO, which will reduce the amount of combustion air added to the RTO, thereby increasing fuel efficiency and reducing generation of nitrogen oxides (NOx). The heat input of the RTO will be increased from 32 MMBtu/hr to 54.4 MMBtu/hr as a result of the additional burners and natural gas injection.

<u>Revise emission data</u>
Enviva proposes to revise the potential emissions for dried wood handling (ID No. ES-DWH) and the dryer and green hammermills (both controlled by CD-RTO) to reflect results from the most recent compliance testing.

<u>Modify bypass scenarios</u>
Enviva proposes to increase the heat input of furnace idle mode from 5 MMBtu/hr to 15 MMBtu/hr (ID No. ES-FBYPASS). The facility has determined that 5 MMBtu/hr is insufficient for maintaining a flame in the furnace. Enviva also clarified that diesel fuel may be used as an accelerant for cold start-up of the furnace. The amount of fuel used per event will typically be 15-30 gallons and 100-200 gallons per year.

The renewal/modification application includes the following description of the dryer bypass operations:

- *Cold Start-ups and Transition from Furnace Idle*: The dryer bypass stack is used when the furnace is started up from a cold shutdown and when the furnace transitions from idle mode to normal operation. Emissions are vented through the dryer bypass stack for approximately 10 minutes as exhaust flow is transitioned from the furnace bypass stack to the WESP and RTO. The dryer is not operational during this time and emissions are due solely to combustion of fuel in the furnace.

- *Planned Shutdown*: During planned shutdowns, as the remaining fuel is combusted by the furnace, the Operator reduces the chip input to the dryer. When only a small amount of chips remains, the dryer drum is emptied. The dryer bypass stack is then opened, and a purge air fan is used to ensure no explosive build-up occurs in the drum. Emissions during this time are negligible and have not been quantified, as the furnace is directed to its abort stack and the dryer is no longer operating.

- *Malfunction:* The dryer system automatically aborts due to power failure, equipment failure, or furnace abort. For example, if the RTO goes offline because of an interlock failure, the dryer will immediately abort. Dryer abort may also occur if the dryer temperature is out of range, or if a spark is detected.

  Malfunctions are infrequent, unpredictable, and minimized to the maximum extent possible. They cannot be permitted, as they are by definition, unplanned events. These emissions cannot reasonably be quantified and are not included in the facility-wide potential emissions. As described above, emissions during cold start-ups, planned shutdowns, and furnace idle are due solely to combustion of fuel in the furnace. The dryer is not operational during these periods.

The potential emissions included in the application for the furnace bypass stack (ID No. ES-FBYPASS) accurately reflect emissions from fuel combustion in the furnace during each of these operating modes and thus fully account for emissions from the dryer bypass stack.

Modify PM2.5 from finished product handling

Enviva proposes to increase the fraction of PM that is PM2.5 for the finished product handling baghouse (ID No. CD-FPH-BH). The previous permit application incorrectly calculated PM2.5 emissions as 0.35% of PM emissions. This fraction results in an exit grain loading rate that is cleaner than ambient air and would require a sampling run of over 100 hours to quantify [0.000014 grains per standard cubic feet (gr/scf)]. The facility has not been able to find any documentation to support a value of 0.35% and, given that this results in a concentration that is cleaner than ambient air, Enviva believes this value was used in error. Based on a review of National Council for Air and Stream Improvement, Inc. (NCASI) particle size distribution data for similar baghouses used in the wood products industry, Enviva has determined the correct fraction of PM that is PM2.5 is 40%. As such, Enviva is revising the potential emissions for the finished production handling baghouse to reflect an exit grain loading rate of 0.0016 gr/scf (filterable only).

II. Application Chronology

July 24, 2020	1st Time Title V application received date, but the application was considered complete on August 5, 2020,
November 25, 2020	Renewal application with modifications received date, but the application was considered complete on November 30, 2020,
February 24, 2021	Draft to Supervisor,
April 20, 2021	2nd Draft to Supervisor,
April 22, 2021	Draft to the Fayetteville Regional Office (FRO) and the applicant,
April 29, 2021	Response to the draft received from FRO and the applicant,
May 5, 2021	2nd Draft to FRO and the applicant,
May 13, 2021	Response from FRO with no comments,
May 14, 2021	Response from the applicant with minor comments. For consistency with other Enviva permits, the following language will remain in permit condition 2.2 A.1.g. (the second half of the oxidizer away from the flame zone),
May 17, 2021	Final draft to Supervisor,
May 27, 2021	Draft permit, review, and hearing statement submitted to administrative staff for public notice preparation,

III. Summary of Changes

The following changes were made to the existing Permit:

Page No.	Section	Description of Changes
Cover letter pages 1 & 2	N/A	Changed Responsible Official to Paul Pereira, Plant Manager.
	N/A	Changed: dates, revision number of permit, issue date of permit, increment tracking for NOx, PM10, PM2.5
N/A	Summary of Changes Table	Updated the "summary of changes to permit" table
N/A	Insignificant Activities List	Included the following sources: Two natural gas-fired duct burners (IES-DB-1 and DB-2), Two propane-fired vaporizers (IES-PV-1 and PV-2), Additive hopper (IES-ADD), A second small parts washer (IES-PW-2), and Two electric boilers (ID Nos. IES-ELECTRICBOILER-1 and 2)
1	Permit cover letter	Revised: Permit No., replaces permit No., permit issuance date, application number, complete application date
Throughout	N/A	Updated Specific Emission Source, Multiple Emission Source, and General Conditions to Title V template.
3	Table of Emission Sources	Updated natural gas-fired regenerative thermal oxidizer (ID No. CD-RTO) firing rate to 54.4 million Btu per hour, Removed low pressure fines relay system (ID No. ES-PCLP) and associated baghouse from the permit, Removed the Pellet Dust Collection Transfer Bin (ES-PDCTB) and associated baghouse from the permit, Added language to reflect use of diesel as an accelerant during cold start-up of the furnace, Included the following footnote; "All air flow from the dry hammermills is controlled by the baghouses (ID Nos. CD-HM-BH1 through CD-HM-BH8), the WESP (ID No. CD-WESP), and the RTO (ID No. CD-RTO). Under normal operations, all air flow from the baghouses on the dry hammermills is ducted to the dryer furnace for treatment by the WESP and the RTO. In the event of reduced furnace/dryer operation, a portion of the air flow from the baghouses on the dry hammermills is ducted directly to the WESP for treatment by the WESP and RTO. In the event of the shutdown of the furnace/dryer system, all air flow from the baghouses on the dry hammermills is ducted directly to the WESP for treatment by the WESP and RTO."
6	2.1 A. 1. e.	Modified condition to remove the dryer furnace as a control device and to read, "Particulate matter emissions from dry hammermills (ES-HM-1 through 8) shall be controlled by baghouses (CD-HM-1 through 8), in series with one wet electrostatic precipitator (CD-WESP), and one regenerative thermal oxidizer (CD-RTO)."
11	2.2 A. 1. and 2.	Removed Conditions relating to 15A NCAC 02D .0535 and 02D .0540 as they are covered under the Title V General Conditions.

Page No.	Section	Description of Changes
	new 2.2 A.1. n. (old 2.2 A.3. n.)	Modified language to the following: "All air flow from the dry hammermills shall be controlled by the baghouses (ID Nos. CD-HM-BH1 through CD-HM-BH8), the WESP (ID No. CD-WESP), and the RTO (ID No. CD-RTO). Under normal operations, all air flow from the baghouses on the dry hammermills shall be ducted to the dryer furnace for treatment by the WESP and the RTO. In the event of reduced furnace/dryer operation, a portion of the air flow from the baghouses on the dry hammermills may be ducted directly to the WESP for treatment by the WESP and RTO. In the event of the shutdown of the furnace/dryer system, all air flow from the baghouses on the dry hammermills may be ducted directly to the WESP for treatment by the WESP and RTO."
17	2.2 A. 4., 5., and 6.	Removed Conditions relating to 15A NCAC 02Q .0207, 02Q .0304, and 02Q .0504 as they are either no longer applicable or covered under the Title V General Conditions.
22	2.2 A. 1. l	Modified language to reflect that the duration of cold start-up is typically 8 to 12 hours.

IV. Process Description

The application includes a process description as follows:

Green Wood Handling - "Green" (i.e., wet) wood is delivered to the plant via trucks as either pre-chipped wood or unchipped logs from commercial harvesting for on-site chipping. Purchased chips and bark are unloaded from trucks via truck dumpers which gravity feed the chips and bark into hoppers. The hoppers feed a conveyor (IES-GWH) that transfers the material to Green Wood Storage Piles (IESGWSP-1 through 4) or to Bark Fuel Storage Piles (IES-BFSP-1 and 2). Purchased chips are screened prior to transfer to the Green Wood Storage Piles.3 Conveyors transferring green wood chips are partially enclosed. Green Wood Storage Pile No. 5 (IES-GWSP-5) is specifically used for storage of hardwood chips. Green hardwood chips are unloaded via the truck dumpers and transferred to the dedicated hardwood storage pile by front-end loader. Hardwood and softwood chips from their respective storage piles are transferred to a mix pile via a front-end loader where they are manually mixed using a front-end loader. From the mix pile, the chips are then transferred to a reclaim hopper (previously referred to as the Wet Hardwood Hopper) via front-end loader.4 From the hopper a drag chain feeds the chips through an enclosed chute onto the enclosed conveyor to the Green Hammermills. Additionally, with this application Enviva is incorporating previously unquantified emissions from chip screening as part of the Green Wood Handling insignificant activity (IES-GWH).

Total emissions from all Green Wood Handling activities, including chip screening, are insignificant (i.e., less than 5 tpy). Enviva is also making updates to the Green Wood Handling (IES-GWH) throughputs and moisture contents to more accurately reflect material moisture weights and to account for material blending operations in the mix storage pile.

Debarking, Chipping, Bark Hog, and Bark Fuel Storage Piles and Bin - Logs are debarked by the electric-powered rotary drum Debarker (IES-DEBARK-1) and then sent to the Chipper (IES-CHIP-1) to chip the wood to specification for drying. Water spray will be used to control particulate emissions from the Debarker. Bark from the Debarker and purchased bark/chips are transferred to the Bark Hog (IES-BARKHOG) via conveyor for further processing.

Material processed by the Bark Hog is transferred to the Bark Fuel Storage Piles (IES-BFSP-1 and 2) via conveyor. The primary Bark Fuel Storage Pile (IES-BFSP-1) is located under a covered structure. The secondary Bark Fuel Storage Pile (IES-BFSP-2) serves as overflow storage as needed. Following storage in the Bark Fuel Storage Piles (IES-BFSP-1 and 2), the bark is transferred via a walking floor to a covered conveyor which feeds the fully enclosed Bark Fuel Bin (IES-BFB) where the material is pushed into the furnace. As previously described, with this application Enviva is updating the potential emissions for the Debarker to reflect a particulate control efficiency of 90% for use of water spray. The Debarker is considered an insignificant activity per 15A NCAC 02Q .0503 due to potential uncontrolled PM emissions less than 5 tpy.

Green Hammermills, Dryer, Dry Hammermills - Chipped wood used in pellet production is further processed by the three (3) Green Hammermills (ES-GHM-1, 2, and 3) to reduce material to the proper size prior to drying. Exhaust from the Green Hammermills is routed to the dryer line WESP/RTO control system (CD-WESP/CD-RTO-1) to control emissions of particulate matter (PM), volatile organic compounds (VOC), and HAPs.

After processing by the Green Hammermills, green wood is conveyed to a single pass rotary Dryer system (ES-DRYER). Direct contact heat is provided to the system via a 250.4 MMBtu/hr furnace that uses bark and wood chips as fuel. Green wood is fed into the Dryer where the moisture content is reduced to the desired level and routed to four (4) identical material recovery cyclones operating in parallel, which capture dried wood for further processing. Emissions from the Dryer cyclones are combined into a common duct which includes the vent from the Green Hammermills (ES-GHM-1 through 3) and routed to a WESP (CD-WESP) for particulate, metallic HAP, and hydrogen chloride removal. Emissions of VOC and organic HAP are controlled by a RTO (CD-RTO-1) following the WESP. The primary fuel for the RTO is natural gas but propane may be used as a back-up.

Prior to pelletization, dried wood is reduced to the appropriate size using eight (8) Dry Hammermills operating in parallel (ES-HM-1 through ES-HM-8). Each Dry Hammermill includes a material recovery cyclone for capturing additional dried wood for further processing. Particulate emissions from each of the Dry Hammermills are controlled using individual baghouses (CD-HM-BH1 through 8).

As authorized by Permit No. 10365R05, Enviva will be implementing an air flow recirculation process in which a portion of the exhaust from each Dry Hammermill will be recirculated back into the Dry Hammermill to reduce fresh intake air and thus decrease the volume of air that is routed to the downstream control devices (i.e., the Dry Hammermill baghouse, WESP and RTO). Specifically, the reduced Dry Hammermill exhaust stream will be routed to the Dry Hammermill baghouse then through a quench system and then to either 1) the inlet of the furnace with subsequent control by the WESP/RTO control system, 2) the inlet of the WESP/RTO control system, or a combination of the two. Since the WESP and RTO were sized for full operation of the dryer alone, adding additional air flow from Dry Hammermills for treatment requires that the furnace combustion air be reduced or replaced in its entirety. As such, the portion of Dry Hammermill exhaust that is directed to the furnace (offsetting fresh combustion air) is automatically adjusted depending on the furnace operating rate. At high furnace/dryer operating rates the air flow volume to the WESP and RTO are already maximized, thus more of the Dry Hammermill exhaust must be sent to the furnace to replace incoming combustion air so as not to exceed the air flow capacity of the WESP and RTO. At low furnace/dryer operating rates and associated exhaust rates more of the Dry Hammermill exhaust is sent directly to the WESP.

At all times 100% of the Dry Hammermill exhaust will be controlled by a baghouse, WESP, and RTO. The furnace is not a control device and has no impact on estimated potential to emit regardless of whether the Dry Hammermill exhaust is routed to the inlet of the furnace or directly to the inlet of the WESP. As such, Enviva requests that Condition 2.2.A.3.n of Air Quality Permit No. 10365R05 be modified, to more accurately reflect the actual operation of the Dry Hammermills.

The WESP will provide a reduction in PM, metallic HAP, and hydrogen chloride and the RTO will provide a reduction in VOC and organic HAP/TAP emissions. The quench system is considered inherent process equipment that is required to safely operate the RTO (i.e., reduce the risk of fire) and is not a control device. Safety interlocks will be installed to cease operation of the Dry Hammermills if a minimum flow rate is not maintained in the quench system or in the event of a malfunction that would prevent the WESP and/or RTO from controlling emissions from the Dry Hammermills.

With this application, Enviva is proposing modifications to optimize operation of the existing Dryer line RTO (CD-RTO) including enlarging the ductwork and poppet valves to allow for more air flow and the addition of two (2) canisters with combustion zone and additional burners. Enviva is also requesting authorization for injection of natural gas into the RTO which will reduce the amount of combustion air added to the RTO, thereby increasing fuel efficiency and reducing generation of NOX. The heat input of the RTO will be increased from 32 MMBtu/hr to 54.4 MMBtu/hr as a result of the additional burners and natural gas injection. Potential emissions have been revised to reflect January 2020 compliance test data for the Dryer, Green Hammermills, and Dry Hammermills.

<u>Furnace and Dryer Bypass Stacks</u> - Bypass stacks for the furnace and dryer are used to exhaust hot gases during start-ups (for temperature control), shutdowns, and malfunctions. Specifically, the Furnace Bypass Stack is used in the following situations:

- Cold Start-ups: The furnace bypass stack is used when the furnace is started up from a cold shutdown until the refractory is sufficiently heated and can sustain operations at a low level (approximately 15% of the maximum heat input rate). The bypass stack is then closed, and the furnace is slowly brought up to a normal operating rate. Diesel fuel may be used as an accelerant for cold start-up. The amount used per event is approximately 30 gallons and the annual usage is approximately 200 gallons; therefore, emissions resulting from diesel combustion are insignificant.

- Malfunction: The furnace can self-abort and open the bypass stack in the event of a malfunction. This may be caused by failsafe interlocks associated with the furnace or dryer and emissions control systems as well as failures of, or interruptions in, utility supply systems (e.g., electricity, compressed air, water/fire protection). As soon as the furnace aborts it automatically switches to “idle mode” (defined as operation at up to a maximum heat input rate of 15 MMBtu/hr). The fuel feed is then stopped and the heat input rate drops rapidly.

- Planned Shutdown: In the event of a planned shutdown, the furnace heat input is decreased and all remaining fuel is moved through the system to prevent a fire. The remaining fuel is combusted prior to opening the furnace bypass stack. The furnace bypass stack is not utilized until after the furnace achieves an idle state (15 MMBtu/hr or less). Until this time, emissions continue to be controlled by the WESP and RTO.

Conditions under which the dryer bypass stack is used are as follow:

- Cold Start-ups and Transition from Furnace Idle: The dryer bypass stack is used when the furnace is started up from a cold shutdown and when the furnace transitions from idle mode to normal operation. Emissions are vented through the dryer bypass stack for approximately 10 minutes as exhaust flow is transitioned from the furnace bypass stack to the WESP and RTO. The Dryer is not operational during this time and emissions are due solely to combustion of fuel in the furnace. Emissions during these brief transition periods are insignificant and are not separately quantified to avoid double-counting, as these emissions are already accounted for under the furnace cold start-up and idle mode scenarios.

- Malfunction: The dryer system can self-abort due to power failure, equipment failure, or furnace abort. If the RTO goes offline because of an interlock failure, the dryer will immediately abort. This may occur if the dryer temperature is out of range or due to equipment or power failure. Dryer abort is also triggered if a spark is detected in the dryer system.

- Planned Shutdown: During planned shutdowns, as the remaining fuel is combusted by the furnace, the Operator reduces the chip input to the dryer. When only a small amount of chips remain the dryer drum is emptied. The dryer bypass stack is then opened, and a purge air fan is used to ensure no explosive build-up occurs in the drum. Emissions during this time are negligible, as the furnace is directed to its abort stack (see furnace planned shutdown above) and the dryer is no longer operating.

Use of the Furnace Bypass Stack for start-up and shutdown will not exceed 50 hours per year. Additionally, the furnace may operate up to 500 hours per year in "idle mode" with emissions routed to the Furnace Bypass Stack. The purpose of operation in "idle mode" is to maintain the temperature of the fire brick lining the furnaces which may be damaged if it cools too rapidly. Operation in "idle mode" also significantly reduces the amount of time required to restart the furnace. Emissions from start-up, shutdown, and furnace idle mode operations are quantified and included in the facility-wide potential emissions presented in this permit application. Malfunctions are infrequent, unpredictable, and minimized to the maximum extent possible. They cannot be permitted, as they are by definition, unplanned events. Malfunction emissions cannot reasonably be quantified and are not included in the facility-wide potential emissions.

<u>Dryer Duct Burners</u> - As flue gas exits the dryer and begins to cool, wood tar can condense and coat the inner walls of the dryer ducts creating a risk of fire. In order to prevent condensation from occurring and thus reduce the risk of fire, the duct from the cyclone outlet to the ID fan and the duct used for exhaust gas recirculation and the WESP are each heated by a low-NOX burner with a maximum heat input capacity of 2.5 MMBtu/hr. The two (2) burners combust natural gas or propane as back-up and exhaust directly to the atmosphere. Potential emissions from each duct burner are below the thresholds in 15A NCAC 02Q .0503(8) and they are thus considered insignificant activities. Enviva requests that the duct burners be added to the list of insignificant activities.

<u>Dried Wood Handling</u> - Dried materials from the Dryer material recovery cyclones are conveyed to screening operations that remove smaller wood particles. Oversized wood is diverted to the Dry Hammermills (ES-HM-1 through 8) for further size reduction prior to pelletization, each of which is followed by a material recovery cyclone that is controlled by a baghouse. Smaller particles passing through the screens bypass the hammermills and are pneumatically conveyed directly to the material recovery cyclones for the Dry Hammermills. The screens may or may not be used during normal process operations. There are several other conveyor transfer points located between the Dryer and Dry Hammermills comprising the Dried Wood Handling (ES-DWH) emission source. These transfer points are completely enclosed with only two (2) emission points that are controlled by individual baghouses (CD-DWH-BH1 and 2). Potential emissions for Dried Wood Handling have been revised to reflect January 2020 compliance test data.

<u>Dried Shavings Handling</u> - Dry shavings are also used in the pellet production process in addition to green chips and logs, forgoing the drying process and thus reducing VOC and HAP emissions. Purchased dry shavings are unloaded from trucks via a truck dumper into a hopper that gravity feeds material via enclosed conveyors to a bucket elevator that ultimately fills a silo. Each of these material transfer points are entirely enclosed except for truck unloading (IES-DRYSHAVE). From the silo, the dry shavings are then transferred via an enclosed screw conveyor to the Dry Hammermills for additional processing.

<u>Dry Hammermills</u> - Prior to pelletization, dried wood is reduced to the appropriate size using eight (8) Dry Hammermills operating in parallel (ES-HM-1 through ES-HM-8). Each Dry Hammermill includes a material recovery cyclone for capturing additional dried wood for further processing. Particulate emissions from each of the Dry Hammermills are controlled using individual baghouses (CD-HM-BH1 through 8).

As authorized by Air Quality Permit No. 10365R05, an air flow recirculation process will be implemented in which a portion of the exhaust from each Dry Hammermill will be recirculated back into the Dry Hammermill to reduce fresh intake air and thus decrease the volume of air that is routed to the downstream control devices (i.e., the Dry Hammermill baghouse, WESP and RTO). Specifically, the reduced Dry Hammermill exhaust stream will be routed to the Dry Hammermill baghouse then through a quench system and then to either 1) the inlet of the furnace with subsequent control by the WESP/RTO control system, 2) the inlet of the WESP/RTO control system, or a combination of the two. Since the WESP and RTO were sized for full operation of the dryer alone, adding additional air flow from Dry Hammermills for treatment requires that the furnace combustion air be reduced or replaced in its entirety. As such, the portion of Dry Hammermill exhaust that is directed to the furnace (offsetting fresh combustion air) is automatically adjusted depending on the furnace operating rate. At high furnace/dryer operating rates the air flow volume to the WESP and RTO are already maximized, thus more of the Dry Hammermill exhaust must be sent to the furnace to replace incoming combustion air so as not to exceed the air flow capacity of the WESP and RTO. At low furnace/dryer operating rates and associated exhaust rates more of the Dry Hammermill exhaust can be sent directly to the WESP.

At all times 100% of the Dry Hammermill exhaust will be controlled by a baghouse, WESP, and RTO. The furnace is not a control device and has no impact on estimated potential to emit emissions regardless of whether the Dry Hammermill exhaust is routed to the inlet of the furnace or directly to the inlet of the WESP. The WESP will provide a reduction in PM and metallic HAP and the RTO will provide a reduction in VOC and organic HAP/TAP emissions. The quench system is considered inherent process equipment that is required to safely operate the RTO (i.e., reduce fire risk) and is not a control device. Safety interlocks will be installed to cease operation of the Dry Hammermills if a minimum flow rate is not maintained in the quench system or in the event of a malfunction that would prevent the WESP and/or RTO from controlling emissions from the Dry Hammermills.

Hammermill Conveyors - The Hammermill Conveyors (ES-HMC) transport material from the material recovery cyclones associated with the Dry Hammermills (ES-HM-1 through 8) to the pelletizing process. Emissions from the Hammermill Conveyors are captured and controlled by the Hammermill Conveyor baghouse (CD-HMC-BH).

Pellet Mill Feed Silo - Sized wood from the Dry Hammermill material recovery cyclones is transported by a set of conveyors to the Pellet Mill Feed Silo (ES-PMFS) prior to pelletization. Particulate emissions from the Pellet Mill Feed Silo are controlled by a baghouse (CD-PMFS-BH).

Additive Handling and Storage - Additive may be used in the pellet production process to increase the durability of the final product. Additive is delivered by truck in 2,000 pound supersacks, stored, and moved from storage to a feed system via fork truck where it’s emptied into a hopper. The additive is transferred from the hopper via enclosed screw conveyor and added to sized wood from the Pellet Mill Feed Silo discharge screw conveyor prior to transfer to the Pellet Mills. The additive contains no hazardous chemicals or VOCs. Emissions from additive handling are below the thresholds in 15A NCAC 02Q .0503(8) and it is thus considered an insignificant activity. After further engineering review Enviva has decided not to install an Additive Storage Silo and baghouse (ES-ADD) and requests that these be removed from the permit.

Pellet Mills and Coolers - Dried processed wood is mechanically compacted through pellet press dies. Exhaust from the Pellet Mills is vented through the Pellet Cooler aspiration material recovery cyclones, to the emission controls as described below, and then to the atmosphere. No resin or other chemical binding agents are used in the pelletization process. As part of this application Enviva is proposing to install electric boilers to generate steam for use in the pelletizing process. The boilers will not be sources of air emissions and are thus exempt from permitting. Use of steam in the pelletizing process will improve the durability of the final product and will not result in an increase in emissions or production. Formed pellets are discharged from the twelve (12) Pellet Mills into one of six (6) Pellet Coolers (ES-PCLR-1 through ES-PCLR-6) where cooling air is passed through the pellets. At this point, the pellets contain a small amount of wood fines which are swept out with the cooling air and removed by the pellet cooler cyclones while the air is routed to a quench duct. The exhaust from the quench duct is then sent to a RCO/RTO (CD-RCO/RTO) for control of VOC, HAP, and PM emissions. The RCO is able to operate in thermal mode during catalyst cleaning. The purpose of the quench duct is to protect the RCO/RTO by reducing the risk of fire. Operation of the Pellet Mills and Coolers is interlocked with operation of the quench duct (i.e., the quench duct must be ready for operation in order for the Pellet Mills and Coolers to operate). Potential emissions have been revised to reflect January 2020 compliance test data. An aspiration system, previously referred to as the Pellet Cooler LP Fines Relay System (ESPCLP), is used to recirculate air for the Pellet Coolers. This system and its associated baghouse (CD-PCLP-BH) are currently identified as an emission point to the atmosphere in Air Quality Permit No. 10365R05;

however, this is a closed loop system and does not exhaust to the atmosphere. Enviva requests that this source (ES-PCLP) and associated baghouse (CD-PCLP-BH) be removed from the permit.

Finished Product Handling and Loadout - Finished product is conveyed to two (2) storage bins (ES-PB-1 and ES-PB-2) that feed a rail loadout station. At the rail loadout station, pellets are gravity fed into closed top rail cars. Atmospheric emissions from pellet loadout are minimal because dried wood fines have already been removed in the pellet screener, and a slight negative pressure is maintained in the loadout area of the building as a fire prevention measure to prevent any build-up of dust on surfaces within the building. This slight negative pressure is produced via an induced draft fan that exhausts to the Finished Product Handling baghouse (CD-FPH-BH). This baghouse controls emissions from Finished Product Handling (ES-FPH) and the two (2) Pellet Loadout Bins (ES-PB-1 to ES-PB-2). Rail car loading is entirely enclosed because pellets are loaded into closed top hopper cars.

Parts Washers - Two (2) small parts washers are used in the maintenance building. Waste solvent is collected by the vendor and transported off-site. Potential emissions associated with each of the parts washers (IES-PW-1 and 2) are less than the thresholds in 15A NCAC 02Q .0503(8) so they are considered insignificant activities. Enviva requests that both parts washers be included on the list of insignificant activities.

Emergency Generator, Fire Water Pump Engine, and Diesel Storage Tanks – The Hamlet plant includes a 671 brake horsepower (bhp) diesel-fired Emergency Generator (IES-GN) for emergency operations and a 131 bhp diesel-fired Fire Water Pump Engine (IESFWP). Aside from maintenance and readiness testing, the generator and fire water pump engines are only utilized for emergency operations.

Diesel for the emergency generator is stored in a tank of up to 1,000 gallons capacity (IESTK-1) and diesel for the fire water pump engine is stored in a storage tank of up to 185 gallons capacity (IES-TK-2). The plant also has a third diesel storage tank with a capacity of up to 5,000 gallons (IES-TK-3) for distributing diesel fuel to mobile equipment.

Unpaved Roads - Front-end loaders are used to transfer chips: 1) to the hardwood pile, 2) from the hardwood pile to the mix pile, 3) from the softwood piles to the mix pile, and 4) from the mix pile to the reclaim hopper. Potential emissions have been revised to more accurately reflect front-end loader movements on unpaved areas at the plant.

Propane Vaporizers - The Hamlet plant includes two (2) propane vaporizers to vaporize propane received by truck for combustion by the RTO burners, RCO/RTO burners, and burners for the dryer system double ducts. Each vaporizer has a maximum heat input capacity of 1 MMBtu/hr and combusts propane. The propane vaporizers are exempt from construction permitting pursuant to 15A NCAC 02Q .0102(h)(1)(B) but should be added to the list of insignificant activities in the Hamlet plant's permit.

V. Statement of Compliance

The most recent inspection was completed on April 1, 2021 by Mr. Stephen Allen. According to Mr. Allen's inspection report dated April 24, 2021 the facility appeared to be in compliance with their Air Quality Permit.

On August 12, 2020, FRO DAQ issued Enviva a Notice of Violation/Notice of Recommendation for Enforcement for failing to meet the 3-hour average temperatures in CD-RTO-1 and failing to meet the 3-hour inlet temperature for CD-RCO as required under permit condition 2.2 A.2.e. On January 26, 2021, a civil penalty was assessed to Enviva Hamlet Pellets, LLC of $11,197 for violation of 15A NCAC 02Q .0317 Avoidance Conditions.

VI. Potential to Emit (PTE) Quantification

Attachments I and II of this report include spreadsheets with calculations used for applications .20B and .20C, respectively. The application includes a description of the methodology used in calculating PTE as follows:

A. Green Wood Handling (IES-GWH) - Fugitive PM emissions result from unloading purchased chips and bark from trucks into hoppers and transfer of these materials to storage piles via conveyors. Similarly, emissions also result from front-end loaders transferring purchased hardwood chips to Green Wood Storage Pile No. 5 (IES-GWSP-5), transferring hardwood and softwood chips to the mix pile, blending chips in the mix pile, and transfer of chips from the mix pile to the reclaim hopper (IES-GWH). Fugitive PM emissions from chip and bark transfer operations were calculated based on AP-42 Section 13.2.4, Aggregate Handling and Storage Piles. Chip conveyors are partially enclosed; therefore, emissions were only quantified for the final drop points (i.e., from conveyor to pile). Bark conveyors are not enclosed; however, due to the large size of this material any fugitive PM emissions occurring along the conveyor itself are negligible. As such, emissions were only quantified for the final drop points (i.e., from conveyor to pile). Transfer from the Reclaim Hopper to the conveyor that feeds the Green Hammermills is completely enclosed; therefore, emissions were only quantified for the drop points to the storage pile and into the hopper. The number of transfer points for Green Wood Storage Pile No. 5 was conservatively multiplied by a factor of 10 to account for emissions associated with front-end loaders blending hardwood and softwood chips in the mix pile.

Emissions from screening of purchased chips are included under IES-GWH and were calculated based on the potential throughput and an emission factor for chip screening from the National Council for Air and Stream Improvement (NCASI) Technical Bulleting No. 1020.

Green wood and bark contain a high moisture content approaching 50 percent water by weight. As such, per 15A NCAC 02Q .0503, Green Wood Handling (IES-GWH) is an insignificant activity because potential uncontrolled PM emissions are less than 5 tpy.

B. Green Wood Storage Piles (IES-GWSP-1 through 5) and Bark Fuel Storge Piles (IES-BWSP-1 and 2) - Particulate emission factors used to quantify emissions from storage pile wind erosion for the five (5) Green Wood Storage Piles and two (2) Bark Fuel Storage Piles were calculated based on USEPA's Control of Open Fugitive Dust Sources. The number of days with rainfall greater than 0.01 inch was obtained from AP-42 Section 13.2.2, Unpaved Roads, and the percentage of time that wind speed exceeds 12 miles per hour (mph) was determined based on the AERMOD-ready meteorological dataset for the Maxton National Weather Service (NWS) Station provided by DAQ. The mean silt content of 8.4% for unpaved roads at lumber mills from AP-42 Section 13.2.2 was conservatively applied in the absence of site-specific data. The exposed surface area of the pile was calculated based on worst-case pile dimensions.

VOC emissions from storage piles were quantified based on the exposed surface area of the pile and emission factors from NCASI. NCASI emission factors range from 1.6 to 3.6 pounds (lb) VOC as carbon/acre-day; however, emissions were conservatively based on the maximum emission factor.

Per 15A NCAC 02Q .0503, the Green Wood Storage Piles (IES-GWSP-1 through 5) and the Bark Fuel Storage Piles (IES-BFSP-1 and 2) are insignificant activities based on potential uncontrolled PM and VOC emissions each less than 5 tpy.

C. Debarker - PM emissions occur as a result of log debarking. Potential PM emissions from debarking were quantified based on emission factors from EPA's AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants for Source Classification Code (SCC) 3-07-008-01 (Log Debarking). All PM was assumed to be larger than 2.5 microns in diameter. PM emissions from debarking are minimal due to the high moisture content of green wood (~50%) and the fact that the debarking drum is enclosed, except for the two ends where logs enter and material exits after debarking. A 90% control efficiency was applied for use of water spray.

D. Barkhog (IES-BARKHOG) - Processing of bark by the Bark Hog results in emissions of PM, VOC, and methanol. Particulate emission factors were not available for this specific operation; therefore, potential PM emissions were quantified based on emission factors from EPA's AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants for log debarking (SCC 3-07-008-01). The Bark Hog is largely enclosed and thus has minimal PM emissions. A 90% control efficiency was applied for partial enclosure. VOC and methanol emissions were quantified based on emission factors for log chipping from AP-42 Section 10.6.3, Medium Density Fiberboard.

The Bark Hog is considered an insignificant activity per 15A NCAC 02Q .0503 due to potential uncontrolled emissions less than 5 tpy.

E. Chipper (IES-CHIP-1) - The Chipper is located inside of a building; therefore, PM emissions are negligible and were not quantified. The chipping process also results in emissions of VOC and methanol. VOC and methanol emissions were quantified based on emission factors for log chipping from AP-42 Section 10.6.3, Medium Density Fiberboard.

The Chipper is considered an insignificant activity per 15A NCAC 02Q .0503 due to potential uncontrolled emissions less than 5 tpy.

F. Bark Fuel Bin (IES-BFB) - Bark is transferred from the Bark Fuel Storage Piles via a walking floor to a covered conveyor and then to the fully enclosed Bark Fuel Bin (IES-BFB). Due to complete enclosure of the Bark Fuel Bin, emissions from transfer of material into the bin were not explicitly quantified. Per 15A NCAC 02Q .0503(8), the Bark Fuel Bin is an insignificant activity due to potential uncontrolled PM emissions less than 5 tpy.

G. Dryer (ES-DRYER), Green Hammermills (ES-GHM-1 through 3), and Dry Hammermills (ES-HM-1 through 8) - **Normal Operation -** Exhaust from the Green Hammermills, Dryer, and Dry Hammermills will be routed to the WESP/RTO control system for control of PM, VOC, and HAP. Potential emissions of VOC, PM, PM less than 10 microns in diameter (PM_{10}), PM less than 2.5 microns in diameter ($PM_{2.5}$), carbon monoxide (CO) and NO_X from the Furnace/Dryer, Green Hammermills, and RTO fuel combustion were calculated based on January 2020 compliance test data with an appropriate contingency based on engineering judgement to account for inherent variability in stack test results.

Potential emissions of sulfur dioxide (SO_2) were calculated based on an emission factor from AP-42 Section 10.6.2, Particle Board Manufacturing. Potential criteria pollutant emissions from injection of natural gas into the RTO were calculated based on AP-42 Section 1.4, Natural Gas Combustion.
Potential criteria pollutant emissions from the Dry Hammermills were calculated based on January 2020 compliance test data with an appropriate contingency based on engineering judgement to account for inherent variability in stack test results. A 95% control efficiency was applied to VOC emissions for control by the RTO. Thermally generated emissions of CO and NO_X resulting from combustion of VOC in the Dry Hammermill exhaust stream by the RTO were calculated using emission factors from AP-42 Section 1.4, Natural Gas Combustion14, and the maximum heating value of the anticipated VOC constituents.

HAP and toxics air pollutant (TAP) emissions at the RTO outlet were calculated based on emission factors from several data sources including emission factors from AP-42 Section 1.6, Wood Residue Combustion in Boilers, NC DAQ's Wood Waste Combustion Spreadsheet, and emission factors derived based on process knowledge with an appropriate contingency based on engineering judgement. The RTO burners combust natural gas with propane as back-up. HAP emissions from natural gas injection and natural gas and propane combustion by the RTO burners were calculated based on AP-42 Section 1.4, Natural Gas Combustion and Section 1.5, Liquified Petroleum Gas Combustion.

Combustion of wood by the Dryer furnace and fuel combustion by the RTO will also result in emissions of GHG. The emissions were quantified based on emission factors from AP-42, Section 10.6.1 for a rotary dryer with an RTO control device. Enviva has conservatively calculated the CO_2 emissions using the higher hardwood emission factor because the dryer at the Hamlet facility processes a combination of hardwood and softwood. GHG emissions from RTO natural gas injection were calculated based on AP-42 Section 1.4, Natural Gas Combustion. Emissions were converted to carbon dioxide equivalent (CO_{2e}) using global warming potentials from 40 CFR Part 98 Table A-1.

Furnace and Dryer Bypass – Cold Start-up (ID No. ES-FURNACEBYPASS) - Potential emissions of CO, NO_X, SO_2, PM, VOC and HAP for furnace and dryer bypass conditions were calculated based on emission factors from AP-42 Section 1.6, Wood Residue Combustion in Boilers.18 GHG emissions were calculated based on emission factors for biomass combustion from Tables C-1 and C-2 of 40 CFR Part 98 and global warming potentials from Table A-1. Emissions were based on 15% of the maximum heat input capacity of the furnace (15% of 250.4 MMBtu/hr) and 50 hours per year of operation. During cold start-ups emissions may be released through the dryer bypass stack for approximately 10 minutes during transition from the furnace bypass stack to the WESP and RTO. Emissions during these brief transition periods are insignificant and are not separately quantified to avoid double-counting, as they are already accounted for under the 50 hours per year of furnace bypass. Emissions from diesel combustion during cold start-ups are insignificant and were not explicitly quantified.

Furnace and Dryer Bypass – Idle Mode (ES-FURNACEBYPASS) - The furnace may operate up to 500 hours per year in "idle mode", which is defined as operation up to a maximum heat input rate of 15 MMBtu/hr. During this time, emissions from biomass combustion in the furnace exhaust out of the furnace bypass stack. Potential emissions of CO, NO_X, SO_2, VOC, and HAP were calculated based on emission factors from AP-42 Section 1.6, Wood Residue

Combustion in Boilers. GHG emissions were calculated based on emission factors for biomass combustion from Tables C-1 and C-2 of 40 CFR Part 98 and global warming potentials from Table A-1. As the furnace ramps up from idle mode to normal operation, emissions may be released through the dryer bypass stack for approximately 10 minutes during transition from the furnace bypass stack to the WESP and RTO. Emissions during these brief transition periods are insignificant and are not separately quantified to avoid double-counting, as they are already accounted for under the 500 hours per year of furnace bypass.

H. Dryer Duct Burners (IES-DB-1 and DB-2) - Emissions from natural gas and propane combustion by the dryer duct burners (IES-DDB) were calculated based on emission factors from AP-42 Section 1.4, Natural Gas Combustion and AP-42 Section 1.5, Liquefied Petroleum Gas Combustion and the maximum heat input capacity of the burners (2.5 MMBtu/hr each). Per 15A NCAC 02Q.0503, the duct burners are considered insignificant activities because potential uncontrolled criteria pollutant and HAP emissions are less than 5 tpy and 1,000 pounds per year (lb/yr), respectively.

I. Dried Wood Handling (ES-DWH) - ES-DWH includes conveyor transfer points located between the Dryer and Dry Hammermills with emissions controlled by two (2) baghouses (CD-DWH-BH-1 and 2). PM emissions from these baghouses were calculated based on a maximum exit grain loading rate and the maximum nominal exhaust flow rate of the baghouses. Additionally, dried wood may continue to emit VOC and HAP as it is transferred between the Dryer and Dry Hammermills due to the elevated temperature of the material. Potential VOC and HAP emissions were calculated based on January 2020 compliance testing data with an appropriate contingency based on engineering judgement to account for inherent variability in stack test results.

J. Additive Handling and Storage (ES-ADD) - An additive may be used in the pellet production process to increase the durability of the final product. Potential emissions from transfer of additive from supersacks to the hopper were calculated based on AP-42, Section 13.2.4, Aggregate Handling and Storage Piles.

K. Dry Shavings Handling (IES-DRYSHAVE) - Particulate emissions occur during unloading of dry shavings from trucks and may also occur when air is displaced during silo loading and unloading. Potential emissions were calculated based on AP-42, Section 13.2.4, Aggregate Handling and Storage Piles. Dry shavings are transferred into the dry shavings silo via an enclosed bucket elevator. Because the actual transfer is enclosed within the silo, a 90% control efficiency was applied for this material transfer point. Per 15A NCAC 02Q .0503, Dry Shavings Handling (IES-DRYSHAVE) is considered an insignificant activity because potential uncontrolled PM emissions are less than 5 tpy.

L. Pellet Cooler HP Fines Relay System (ES-PCHP) - Fines from the pellet screens and pellet cooler cyclones are collected in the Pellet Cooler HP Fines Relay System (ES-PCHP) which are discharged into the Pellet Cooler HP Fines Filter (CD-PCHP-BH). PM emissions from the Pellet Cooler HP Fines Filter were calculated based on a maximum exit grain loading rate and the maximum nominal exhaust flow rate of the baghouse.

M. Dry Hammermill Conveying System (ES-HMC) - Fugitive PM emissions that escape the Hammermill Collection Conveyor are controlled by a baghouse (CD-HMC-BH). PM emissions from this baghouse were calculated based on a maximum exit grain loading rate and the maximum nominal exhaust flow rate of the baghouse.

N. Pellet Mill Feed Silo (ES-PMFS) - The Pellet Mill Feed Silo is equipped with a baghouse (CD-PMFS-BH) to control PM emissions associated with silo loading and unloading operations. PM emissions are calculated based on a maximum exit grain loading rate and the maximum nominal exhaust flow rate of the baghouse.

O. Pellet Mills and Pellet Cooler (ES-CLR-1 through 6) - Pellet Mills and Pellet Cooler operations generate PM, HAP, and VOC emissions during the forming and cooling of wood pellets. The Pellet Mills and Coolers are routed to a quench duct, followed by an RCO/RTO (CD-RCO/RTO) for VOC and HAP. The oxidizer operates in thermal mode as an RTO during catalyst cleaning. Potential emissions from the Pellet Mills and Pellet Coolers were calculated based on January 2020 compliance test data with an appropriate contingency based on engineering judgement to account for inherent variability in stack test results. Potential emissions from fuel combustion by the RCO/RTO were calculated based on emission factors from AP-42 Sections 1.4 and 1.5.

Potential GHG emissions from natural gas combustion were quantified based on emission factors from Subpart C of 40 CFR Part 98. Emissions were converted to carbon dioxide equivalent (CO_{2e}) based on Global Warming Potentials from Subpart A of 40 CFR 98.

P. Pellet Loadout Bins (ES-PB-1 and 2), Finished Product Handling (ES-FPH), and Pellet Loadouts (ES-PL-1 through 3) PM emissions result from the transfer of finished product to the Pellet Loadout Bins. No emissions are anticipated for the transfer of pellets from the bins to rail cars because wood pellets are loaded into closed top rail cars. PM emissions from Finished Product Handling, the two (2) Pellet Loadout Bins, and three (3) Pellet Loadouts are controlled by a baghouse (CDFPH-BH). Potential PM emissions from the baghouse were calculated based on a maximum exit grain loading rate and the maximum nominal exhaust flow rate of the baghouse.

Q. Diesel Storage Tanks (IES-TK-1 through 3) - The storage of diesel in on-site storage tanks generates emissions of VOC. VOC emissions from the three (3) Diesel Storage Tanks were calculated based on AP-42 Section 7.1, Organic Liquid Storage Tanks using actual tank characteristics (e.g., orientation, dimensions, etc.) and potential annual throughput. VOC emissions from the storage tanks are below 5 tpy and thus, per 15A NCAC 02Q .0503(8), they are listed as insignificant sources in the permit.

R. Emergency Generator (ES-GN) and Fire Water Pump Engine (IES-FWP) - Operation of the Emergency Generator and Fire Water Pump generates emissions of criteria pollutants, HAP, and GHG. Potential PM, NO_X, VOC, and CO emissions from operation of the Emergency Generator and Fire Water Pump Engine were calculated based on emission factors from their respective manufacturer specification sheets and the maximum horsepower rating of the engines. VOC emissions were calculated based on the manufacturer's emission factor for hydrocarbons. Potential SO_2 emissions were calculated based on the fuel sulfur restriction in NSPS Subpart IIII, and by assuming that all the sulfur present in the diesel fuel becomes SO_2 air emissions. Potential HAP emissions from the Emergency Generator were quantified based on emission factors from AP-42 Section 3.4, Large Stationary Diesel and All Stationary Dual-Fuel Engines. Potential HAP emissions from the Fire Water Pump were quantified based on emission factors from AP-42 Section 3.3, Gasoline and Diesel Industrial Engines. Annual potential emissions were conservatively calculated based on 500 hours per year.

Combustion of diesel fuel by the engines also results in emissions of GHG. Potential GHG emissions from each engine were quantified based on emission factors from Subpart C of 40 CFR Part 98. Emissions were converted to CO_{2e} based on Global Warming Potentials from Subpart A of 40 CFR 98. The Emergency Generator and Fire Water Pump Engine are considered insignificant activities pursuant to 15A NCAC 02Q .0503.

S. Paved Roads - Fugitive PM emissions will occur as a result of trucks, front-end loaders, and employee vehicles traveling on paved roads on the Hamlet plant property. Emission factors were calculated based on Equation 2 from AP-42 Section 13.2.1, Paved Roads using the mean silt loading for quarries (8.2 g/m^2) and 110 days with rainfall greater than 0.01 inch based on Figure 13.2.1-2. A 90% control efficiency was applied for water/dust suppression activities followed by sweeping. This control efficiency is based on data from the Air Pollution Engineering Manual of the Air and Waste Management Association.

T. Unpaved Roads - Fugitive PM emissions occur as a result of front-end loaders traveling on unpaved roads to transfer hardwood and softwood chips to storage piles and the reclaim hopper. Emission factors were calculated based on Equation 1a from AP-42 Section 13.2.2, Unpaved Roads using a surface material silt content (8.4%) and 110 days with rainfall greater than 0.01 inch based on Figure 13.2.2-9. A 90% control efficiency was applied for water/dust suppression activities. This control efficiency is based on data from the Air Pollution Engineering Manual of the Air and Waste Management Association.

U. Propane Vaporizers (IES-PV-1 and 2) - The direct-fired propane vaporizers are used to heat liquid propane to convert it to a gas for combustion by the RTO burners, RCO/RTO burners, and dryer system double duct burners. Combustion of propane by each vaporizer's 1 MMBtu/hr burner results in emissions of criteria pollutants, HAP, and GHG. Potential criteria pollutant emissions were quantified based on emission factors from AP-42 Section 1.5, Liquefied Petroleum Gas Combustion. Potential SO_2 emissions assume a sulfur content of 0.54 grains per 100 cubic feet for propane. Potential HAP emissions were quantified based on emission factors from the South Coast Air Quality Management District's (SCAQMD's) Air Emissions Reporting (AER) Tool for external combustion equipment fired with liquid petroleum gas (LPG).

Potential GHG emissions were quantified based on emission factors from AP-42 Section 1.5, Liquefied Petroleum Gas Combustion. Emissions were converted to CO_{2e} based on Global Warming Potentials from Subpart A of 40 CFR 98. Potential emissions from the propane vaporizers were quantified based on a rated capacity of 1 MMBtu/hr (each) and assume continuous operation (8,760 hours per year). The propane vaporizers are considered insignificant activities per 15A NCAC 02Q .0503 because potential uncontrolled emissions for each vaporizer are less than 5 tpy.

Copies of detailed potential emission calculation spreadsheets and tables are included in Attachments I and II of this document and Appendix D of the application.

The following table provides a comparison summary of facility-wide potential criteria pollutant and CO_2e emissions (including fugitives) for the existing permit (R05) and the proposed permit (T06).

Pollutant	**Potential Emissions (R05)** (tpy)	**Potential Emissions (T06)** (tpy)
CO	235	187
NOx	238	153
PM	96.8	95.3
PM-10	62.0	65
PM-2.5	43.5	50.3
SO2	27.6	27.7
VOC	121	108
CO_2e	277,556	273,878

Sample calculation:
NOx and CO emissions from the site were calculated for two emission components: thermal generation and natural gas/biomass combustion. The emissions of NOx and CO will be generated during the combustion of VOCs in the gas stream by the RTO and RCO, as well as fuel combustion by the furnace, emergency generator, and the firewater pump.

Example Calculations for NOx emissions:

Data in Application:
- Maximum design throughput = 1200 ODT/hr
- Annual throughput = 625,011 ODT/yr
- Design heat input = 250.4 million Btu/hr
- Annual heat input = 2,193,504 million Btu/year
- Hours of operation = 8,760 hours/yr
- RTO Heat Input = 44.4 million Btu/hour (burners plus natural gas injection)
- Control efficiency of RTO = 95%
- AP-42 NOx emission factor = 0.098 lbs NOx/million Btu

- RTO Emission Factor = 0.45 lb/ODT
- AP-42 emission factor (furnace bypass) = 0.22 lbs NOx/million Btu
- AP-42 emission factor (furnace idle mode) = 0.22 lbs NOx/million Btu
- Manufacturer's spec sheet emission factor (emergency gen.) = 6.65 g/hp-hr
- Manufacturer's spec sheet emission factor (firewater pump) = 3.4 g/kW-hr

- NOx emissions from the furnace, Dryer (ES-Dryer), Green Hammermills (ES-GHM-1 through 3) out of RTO stack

  0.45 lbs NOx/ODT x 625,011 ODT/year x 1 ton/2000 lbs = 141 tons NOx/year

- NOx emissions from natural gas injection out of RTO stack

  0.098 lb NO_X/MMBtu x10 MMBtu/hr x 1 ton/2,000 lb = 2.15 tons NO_X/year

- NO_X emissions from combustion of VOC in the dry hammermill exhaust stream by the RTO:

  0.098 lb NOX/MMBtu x 7.497 MMBtu/yr x 1 ton/2,000 lb = 0.37 tons NO_X/year

- NOx emissions from the furnace bypass (Idle Mode) at a maximum of 500 hours per year @ 15 mmBtu/hour and cold start-up at a maximum of 50 hours per year at 37.6 MMBtu/hour

  15 million Btu/hour x 500 hours/year x 0.22 lbs NOx/million Btu x 1 ton/2000 lbs = 0.83 tons NOx/year
  37.6 million Btu/hour x 50 hours/year x 0.22 lbs NOx/million Btu x 1 ton/2000 lbs = 0.21 tons NOx/year
  1.04 tons NOx/year

- NOx emissions from the twelve pellet presses and 6 pellet coolers controlled by RCO
  0.0077 lb NO_X/ODT x 625,011 ODT/yr x 1 ton/2,000 lbs = 2.40 tons NOx/yr

- NOx from 500 KW Diesel-fired Emergency Generator at a maximum of 500 hours per year = 2.46 tons NOx/yr

- NOx emissions from 250 hp Diesel-fired Fire water pump = 0.18 tons NOx/yr

Total facility NOx emissions: 141 + 2.15 + 0.37 + 1.04 + 2.40 + 2.46 + 0.18 + 1.56 (dryer duct burners) + 1.24 (propane vaporizers) = 152.4 tons NOx/yr

The CO emissions, the other criteria pollutants and HAP emissions were calculated in a similar fashion (See Attachment I at the end of this review).

VII. Regulatory Review – Specific Emission Source Limitations and Conditions

A. 15A NCAC 02D .0515 "Particulates from Miscellaneous Industrial Processes" – This regulation establishes an allowable emission rate for particulate matter from any stack, vent, or outlet resulting from any industrial process for which no other emission control standards are applicable. This regulation applies to Total Suspended Particulate (TSP) or PM less than 100 micrometers (µm). The allowable emission rate is calculated using the following equation:

$E = 4.10 \times P^{0.67}$ for $P < 30$ tph
$E = 55 \times P^{0.11} - 40$ for $P \geq 30$ tph

Where, E = allowable emission rate (lbs/hr)
P = process weight rate (tph)

According to the application, the most significant source of PM emissions is the dryer system operating at 120 ODT/hr. The allowable emission rate is calculated to be 60.5 lbs/hr. Maximum PM emission rate estimate is provided by the dryer vendor. The maximum hourly controlled emission rate is 7.6 lbs/hr. The Dry Hammermills will also comply with this requirement. Therefore, compliance is expected.

B. 15A NCAC 02D .0516 "Sulfur Dioxide from Combustion Sources" – This regulation establishes a sulfur dioxide emission standard of 2.3 lbs/million Btu heat input for combustion sources. The Dryer furnace combusts bark and wood chips and ultra-low sulfur diesel during cold start-up, and the existing RTO and proposed RTO/RCO utilize natural gas, each of which contain low amounts of sulfur and will result in SO_2 emissions well below the limit. Therefore, compliance is expected.

C. 15A NCAC 02D .0521 "Control of Visible Emissions" – This regulation establishes a visible emission standard for sources based on the manufacture date. For sources manufactured after July 1, 1971, the standard is 20 percent opacity when averaged over a 6-minute period except under the following conditions:
   1. No six-minute period exceeds 87 percent opacity,
   2. No more than one 6-minute period exceeds 20 percent opacity in any hour, and
   3. No more than four 6-minute periods exceed 20 percent opacity in any 24-hour period.

The Permittee will be required to establish 'normal' visible emissions from these sources within the first 30-days following completion of the dry hammermill control systems (i.e., baghouses in series with CD-WESP and CD-RTO). In order to demonstrate compliance, the Permittee will be required to observe actual visible emissions on a monthly basis for comparison to 'normal'. If emissions are observed outside of 'normal', the Permittee shall take corrective action. Recordkeeping and reporting are required. Because all emission sources are designed to be well controlled, compliance with this standard is expected.

VIII. Regulatory Review – Multiple Emission Source Limitations and Conditions

A. 15A NCAC 02D .0524 "New Source Performance Standards (NSPS), Subpart IIII" – This regulation applies to owners or operators of compression ignition (CI) reciprocating internal combustion engines (RICE) manufactured after April 1, 2006 that are not fire pump engines, and fire pump engines manufactured after July 1, 2006. The 671 horsepower emergency generator and the 131 horsepower fire pump engine are subject to the requirements of this regulation. This permit application does not affect this status.

B. 15A NCAC 02D .1111 "Generally Available Control Technology, Subpart ZZZZ" – 40 CFR Part 63 applies to RICE located at a major or area source of hazardous air pollutants (HAP). Pursuant to 40 CFR §63.6590(c) (amended January 30, 2013), a new stationary RICE located at a major source must meet the requirements of this part by meeting the requirements of 40 CFR Part 60 Subpart IIII for compression ignition engines. 40 CFR Part 63, Subpart ZZZZ compliance is ensured by meeting the requirements of 40 CFR Part 60, Subpart IIII. No further requirements apply to such engines under this part. This permit application does not affect this status.

C. 15A NCAC 02D .1112, 112(g) "Case by Case MACT" - Clean Air Act (CAA) Section 112(g)(2)(B) requires that a new or reconstructed stationary source that does not belong to a regulated "source category" for which a NESHAP has been promulgated must control emissions to levels that reflect "maximum achievable control technology" (MACT). The facility is currently considered a major source of HAP due to total HAP emissions and maximum individual HAP emissions exceeding the major source thresholds of 25 tpy total HAPs and 10 tpy of a single HAP.

The modification requested in the application for Air Quality Permit No. 10365R05 for the implementation of control for the exhaust stream from the Dry Hammermills (ES-HM-1 through 8) is expected to result in a significant decrease in HAP emissions and the plant would no longer be considered a major source of HAPs, based on the single or aggregate HAP major source criteria. Total HAP emissions from the facility after control are estimated to be 24.88 tpy (See Table 3, Appendix D of the November 20 application). Therefore, the facility is expected to be classified as an area source of HAPs when using the permitted dry hammermill controls at the facility.

However, Specific Condition 2.1 A.4, 15A NCAC 02D .1112 "National Emissions Standards for Hazardous Air Pollutants", 112(g) Case-by-Case Maximum Achievable Control Technology will remain in the current permit until the control devices are in place and operational in accordance with DAQ approval.

A separate HAP avoidance condition was added to the permit for the future situation after emissions from the dry hammermills are controlled.

D. Compliance Assurance Monitoring (CAM) - Compliance Assurance Monitoring (CAM) under 40 CFR 64 is applicable to emission units located at a Title V major source that use a control device to achieve compliance with an emission limit and whose pre-controlled emissions exceed the major source thresholds. A CAM plan is required to be submitted with the initial Title V operating permit application for emission units whose post-controlled emissions exceed the major source thresholds (i.e., large pollutant-specific emission units [PSEU]). For emission units with post-controlled emissions below the major source thresholds, a CAM plan must be submitted with the first Title V permit renewal application. All emission units at the Hamlet plant have post-controlled emissions below the major source threshold and thus, if CAM is applicable, it does not need to be addressed until the first Title V permit renewal application.

E. 15A NCAC 02Q .0317 "Avoidance Conditions" for avoidance of 15A NCAC 02D .0530 "Prevention of Significant Deterioration (PSD)" – The existing Permit includes conditions in Section 2.2 A.2 limiting the potential emissions of VOC, NOx, and CO to less than 250 tpy in order to avoid applicability of PSD with the Dry Hammermills uncontrolled. With this Permit modification, the existing condition will remain in the permit until the requested modifications are completed and functional. The future PSD avoidance condition in this modified permit will become effective when the facility begins using the proposed Dry Hammermill control option.

This avoidance condition is similar to the PSD Avoidance Condition in the "sister facility's" permit for Enviva Northampton Permit No. 10203R06.

1. In order to avoid applicability of 15A NCAC 02D .0530(g), facility-wide emission sources shall discharge into the atmosphere less than 250 tons of volatile organic compounds (VOC), 250 tons of carbon monoxide (CO), and 250 tons of NOx per consecutive 12-month period. [15A NCAC 02D .0530]
   a. To ensure that the limits (less than 250 tpy NOx, CO, VOCs) established above in this Section are not exceeded prior to the construction and operation of the proposed control devices:
      i. the green wood hammermills and dryer will be controlled by regenerative thermal oxidizer (CD-RTO),
      ii. the pellet mills and pellet coolers will be controlled by regenerative catalytic oxidizer/regenerative thermal oxidizer (CD-RCO/RTO),
      iii. the facility shall not process more than 625,011 oven-dried tons (ODT) of wood per year with a maximum of 85% softwood, on a 12 month average basis,
      iv. the total dry hammermill throughput shall not exceed 85% of the total facility-wide wood pellet production, on a rolling 12 month basis, and
      v. calculations of the facility-wide CO, NOx, and VOC emissions shall be recorded monthly in a log (written or electronic format).

   b. To ensure that the limits (less than NOx, CO, VOCs) established above in this Section are not exceeded after the construction and operation of the proposed control devices:
      i. the green hammermills, dryer, and dry hammermills will be controlled by an electrostatic precipitator (CD-WESP) in series with a regenerative thermal oxidizer (CD-RTO),
      ii. the pellet mills and pellet coolers will be controlled by regenerative catalytic oxidizer/regenerative thermal oxidizer (CD-RCO/RTO),
      iii. the facility will not process more than 625,011 oven dried tons per year (ODT/year) with a maximum of 85% softwood, on a rolling 12-month average basis, and
      iv. Calculations of the facility-wide CO, NOx, and VOC emissions shall be recorded monthly in a log (written or electronic format).

2. Monitoring and Recordkeeping [15A NCAC 02Q .0508(f)]
   The Permittee shall demonstrate compliance with the facility-wide VOC, NOx and CO emission limitations by calculating the rolling 12-month annual facility-wide VOC, NOx and CO emissions on a monthly basis (by the 30th day following the end of each calendar month) as follows.

   Note. The VOC, NOx and CO emissions shall be calculated in a manner consistent with the calculation methodologies in the air permit. Emission factors used in the calculations for each source shall be appropriate for the annual average softwood content that has been processed in the previous 12-month period. All emission factors used shall be reviewed and approved by the DAQ.

   a. The process rates and percent softwood from the dryer, dry hammermill, and pellet mill/cooler systems shall be recorded monthly in a logbook (written or electronic format) kept on-site and made available to an authorized representative upon request.
   b. Calculations of CO, NOx, and VOC emissions from the dryer system (ES-DRYER), the green hammermills (ES-GHM-1 through 3), and the dry hammermills (ES-HM-1 through 8) shall be made at the end of each month.
   c. Calculations of CO, NOx, and VOC emissions from the furnace bypass (idle mode) and furnace bypass (cold starts) shall be made at the end of each month.

d. Calculations of CO, NOx, and VOC emissions from the pellet mills and pellet coolers (ES-CLR-1 to 6) shall be made at the end of each month.
e. Calculations of CO, NOx, and VOC emissions from the Diesel fuel-fired emergency generator (IES-GN) and fire pump (IES-FWP) shall be made at the end of each month.
f. Calculation of VOC emissions from wood yard sources and storage tanks shall be made at the end of each month.
g. Calculations of the facility-wide CO, NOx, and VOC emissions shall be recorded monthly in a log (written or electronic format).

Example Equation for NOx monthly calculation:

$$E_{\text{NOx (Total)}} = \sum E_{\text{NOx (CD-RTO)}} + \sum E_{\text{NOx (CD-RCO/RTO)}} + \sum E_{\text{NOx (furnace and dryer bypass)}} + Constant$$

Where:

$E_{NOx\ (total)}$	=	total tons of NOx emissions per month
E_{NOxRTO}	=	NOx emissions per month from the outlet of CD-RTO (controls the green hammermills, dryer system, and dry hammermills)
$E_{NOxRCO/RTO}$	=	NOx emissions per month from the outlet of CD-RCO/RTO (control pellet coolers and pellet press system)
$E_{NOx(bypass)}$	=	NOx emissions per month from the furnace bypass
Constant	=	equates to the monthly PTE for the miscellaneous sources including the emergency generator and the fire water pump

The calculations for CO and VOC emissions will be performed in a similar fashion.

3. Reporting Requirements [15A NCAC 02Q .0508(f)]
The Permittee shall submit the results of any maintenance performed on the wet electrostatic precipitator cyclones, and/or baghouses within 30 days of a written request by the DAQ.
   a. The Permittee shall submit a semi-annual summary report of monitoring and recordkeeping activities listed above, postmarked on or before January 30 of each calendar year for the preceding six-month period between July and December, and July 30 of each calendar year for the preceding six-month period between January and June. The report shall contain the following:
      i. The monthly NOx, VOC and CO emissions for the previous 17 months. The emissions must be calculated for each of the 12-month periods over the previous 17 months.
      ii. The monthly ODT of pellets per 12-month consecutive period for the previous 17 months.
      iii. The monthly hardwood/softwood mix for the previous 17 months.

4. Notifications [15A NCAC 02Q .0508(f)]
The completion of the modification in this application is defined as the installation of equipment and ductwork that completes the routing of the exhaust from the eight dry hammermills (ES-HM-1 to 8) to the WESP in series with CD-RTO and ductwork that routes the exhaust from the eight hammermills (ES-HM-1 to 8) directly to the furnace of the ES-DRYER in series with the WESP and CD-RTO.

The Permittee shall notify the DAQ of the actual completion date of the modification postmarked within 15 days after such date.

5. Testing [15A NCAC 02Q .0508(f)]

<u>Initial Performance Tests</u> – Under the provisions of North Carolina General Statute 143-215.108, the Permittee shall demonstrate compliance with PSD avoidance limits in the permit by conducting an initial performance test on the control device systems. Initial testing shall be conducted in accordance with the following:

   a. The pollutants and emission sources to be tested during the initial performance test are listed in the following table:

Emission Sources*	Pollutant
Dryer system, green and dry hammermills controlled via WESP and CD-RTO	VOC
	NOx
	CO

b. The Permittee shall utilize EPA reference methods contained in 40 CFR 60, Appendix A, 40 CFR Part 63, and OTM 26 AND in accordance with a testing protocol (using testing protocol submittal form) approved by the DAQ.

c. The Permittee shall submit a protocol to the DAQ at least 45 days prior to compliance testing and shall submit a notification of periodic compliance testing at least 15 days in advance of the testing.

d. The Permittee shall be responsible for ensuring, within practicable limits, that the equipment or processes being tested are operated at or near the maximum normal production rate or at a lesser rate if specified by the Director or his delegate.

e. To the extent possible, testing shall be conducted at the maximum normal operating softwood percentage.

f. CD-RTO and RCO/RTO are each comprised of fireboxes, with each firebox containing two temperature probes. During the initial compliance test, the Permittee shall establish the minimum average firebox temperature for each of the fireboxes comprising the regenerative thermal oxidizer and the minimum average firebox temperature of the regenerative catalytic oxidizer/regenerative thermal oxidizer. "Average firebox temperature" means the average temperature of the two temperature probes in each firebox. The minimum average firebox temperature for each firebox shall be based upon the average temperature of the two temperature probes over the span of the test runs. Documentation for the minimum average firebox temperature for each firebox shall be submitted to the DAQ as part of the initial compliance test report.

g. Testing shall be completed for the CD-RTO stack within 180 days of commencement of operation of the rerouted dry hammermill exhaust unless an alternate date is approved in advance by DAQ.

h. The Permittee shall submit a written report of the test results to the Regional Supervisor, DAQ, within 30 days following sample collection in accordance with 15A NCAC 02D .2602(f) unless an alternate date is approved in advance by DAQ.

6. Periodic Performance Tests – The periodic performance tests shall be done in the same manner as indicated in the current permit.

7. Reporting Requirements: [15A NCAC 02Q .0508(f)]
The Permittee shall submit the results of any maintenance performed on the control devices and any reporting requirements as described in the current permit.

F. 15A NCAC 02Q .0317: AVOIDANCE CONDITIONS for 15A NCAC 02D .1112, 112(g) "Case-by-Case MACT"

1. The following conditions in this section are enforceable after all of the controls have been constructed and operational to reduce the facility-wide HAP emissions to below the major source thresholds. Following the applicability of this condition, the facility will be classified as a HAP minor source.

2. In order to remain classified a minor source for hazardous air pollutants (HAP) and avoid applicability of 15A NCAC 02D .1112, 112(g) "Case-by-Case Maximum Achievable Control Technology," facility-wide HAP emissions shall be less than the following limitations:
    a. 25 tons per consecutive 12-month period of total, combined HAP; and,
    b. 10 tons per consecutive 12-month period of any individual HAP.

Testing [15A NCAC 02Q .0508(f)]

3. Initial Performance Tests -
    a. The pollutants and emission sources to be tested during the initial performance test are listed in the following table:

Emission Source	Pollutant
Green hammermills, dryer system, and dry hammermills controlled via RTO	Acetaldehyde Acrolein Formaldehyde Methanol Phenol Propionaldehyde

b. Initial testing shall be conducted in accordance with the permit 10365R04 issued on October 30, 2019. (Note, initial testing for all of these sources was completed in January 2020 and approved by DAQ on May 4, 2020.)

c. Periodic Performance Tests – Periodic Performance tests shall be performed in accordance with permit No. 10365R05.

G. PSD Increment Tracking:
Richmond County has triggered increment tracking under PSD for NOx, PM-10, and PM-2.5. This modification will result in a decrease in NOx emissions of 19.4 pounds per hour and an increase in PM-10 and PM-2.5 of 0.68 pounds per hour and 1.55 pounds per hour, respectively.

H. 15A NCAC 02D .1100 "Control of Toxic Air Pollutant (TAP) Emissions" (State-enforceable only) – 15A NCAC 02D .1100 outlines the procedures that must be followed if a TAP permit and associated modeling are required under 15A NCAC 02Q .0700. Under 15A NCAC 02Q .0704(d), a TAP permit application is required to include evaluation of the TAP emissions from a facility's sources, excluding exempt sources listed in Rule .0702 of this Section. The proposed changes requested in this application will not result in an increase in TAP emissions. Rather, potential TAP emissions will decrease by 19.4 tpy. As such, a TAP permit, associated TAP evaluation and TAP modeling are not required with this modification.

IX. Public Notice/EPA and Affected State(s) Review

A notice of the DRAFT Title V Permit will be made pursuant to 15A NCAC 02Q .0521. The notice will provide for a 30-day comment period, with an opportunity for a public hearing. Copies of the public notice will be sent to persons on the Title V mailing list and EPA. Pursuant to 15A NCAC 02Q .0522, a copy of each permit application, each proposed permit and each final permit pursuant will be provided to EPA. Also pursuant to 02Q .0522, a notice of the DRAFT Title V Permit will be provided to each affected State at or before the time notice provided to the public under 02Q .0521 above. The public notice period expired on DRAFT with DRAFT comments received. The EPA review period expired on DRAFT with DRAFT comments received.

IX. Other Regulatory Considerations

- An application fee of $970.00 was received by DAQ via ePay on August 5, 2020 for the 1st Time Title V application and on November 30, 2020 for the renewal/modification application.
- The appropriate number of application copies was received by DAQ.
- A Professional Engineer's Seal is required for this application and was provided (ref. Russell Kemp, P.E. Seal # 19628, 22 July 2020).
- A zoning consistency determination was received for application No. 770096.20C and was acknowledged by Tracy R. Parris, Planning Director, Richmond County on December 1, 2020 that the proposed operation is consistent with applicable zoning ordinances.
- As noted above, public notice is required for this 1st Time Title V Permit.
- Emission Source Module (ESM) update was verified on XXXX.

- According to the application, the facility does not store any materials in excess of the 112r applicability threshold and is therefore not required to maintain a written risk management plan (RMP).
- The application for the 1st Time Title V Permit was signed by Mr. Paul Pereira, Plant Manager on July 21, 2020 as the Responsible Official. Mr. Pereira also signed the renewal/modification application on November 25, 2020.

X. Recommendations

This application has been reviewed by DAQ to determine compliance with all procedures and requirements. The Division has determined that this facility appears to be or is expected to achieve compliance as specified in the permit with all applicable requirements.

A draft of this permit was provided to the applicant and Fayetteville Regional Office (FRO) on April 22, 2021. The applicant responded on April 29, 2021 with comments. FRO responded on April 29, 2021 with comments. All comments have been addressed. A second draft was provided to FRO and the applicant on May 5, 2021. FRO responded on May 13, 2021 with no comments. The applicant responded on May 14, 2021 with minor comments. The applicant requested that the following language be removed from permit condition 2.2 A.1.g. (the second half of the oxidizer away from the flame zone). For consistency with other Enviva permits, the language is not removed. Following the public comment and EPA review periods, DAQ will make a recommendation regarding issuance of the 1st Time Title V Permit No. 10365T06.

Permit issued on XXXX.

ATTACHMENT I
For Application No. 770096.20B

Table 1:	**Calculation Inputs**
Table 2:	**Summary of Facility-wide Potential Emissions Criteria Pollutants**
Table 3:	**Summary of Facility-wide Potential Emissions HAPs**
Table 4:	**Potential Emissions from Green Wood Handling sources (ES-GWH)**
Table 5:	**Potential Emissions from Storage Pile Wind Erosion (IES-GWSP-1 through 5, IES-BFSP-1 and 2)**
Table 6:	**Potential Emissions from Debarker (IES-DEBARK-1)**
Table 7:	**Potential Emissions from Bark hog (IES-BARKHOG)**
Table 8:	**Potential Emissions from Log Chipper (IES-CHIP-1)**
Table 9:	**Potential Emissions from Outlet of RTO-1 stack (ES-DRYER, ES-GHM-1 through 3, ES-DHM-1 through 8)**
Table 10:	**Potential Emissions for Furnace Bypass (Cold Start-up) (ES-FURNACEBYPASS)**
Table 11:	**Potential Emissions for Furnace Bypass (Idle mode) (ES-FURNACEBYPASS)**
Table 12:	**Potential Emissions from Duct Burner (IES-DB-1 and 2)**
Table 13:	**Potential Emissions from Dried Wood Handling (ES-DWH)**
Table 14:	**Potential Emissions from Dry Shaving Material Handling (IES-DRYSHAVE)**
Table 15:	**Potential Emissions from sources controlled by bagfilters (ES-HMC, ES-PCHP, ES-PMFS, ES-FPH, ES-PB-1 and 2, ES-PL-1 through 3, ES-DWH)**
Table 16:	**Potential Emissions from Additive Handling (IES-ADD)**
Table 17:	**Potential Emissions of VOC and HAP at outlet of Pellet Mill/Pellet Cooler RTO/RCO stack (ES-CLR-1 through 6)**
Table 18:	**Potential Emissions from Emergency Generator (IES-GN)**
Table 19:	**Potential Emissions from Fire Water Pump (IES-FWP)**
Table 20:	**Potential Emissions from Diesel Storage tanks (IES-TK-1 through 3)**
Table 21:	**Potential Fugitive Emissions from Paved Roads**
Table 22:	**Potential Fugitive Emissions from Unpaved Roads**

Table 1
Calculation Inputs
Enviva Pellets Hamlet, LLC Hamlet,
Richmond County, North Carolina

Operational Data	
Green Hammermills, Dryer, Dry Hammermills, Pellet Mills, Pellet Coolers	
Short-Term Maximum Throughput (ODT/hr)	80
Annual Throughput (ODT/yr)	625,011
Hours of Operation (hr/yr)	8,760
Softwood Composition	85%

Table 2
Summary of Facility-wide Potential Emissions Enviva Pellets
Hamlet, LLC
Hamlet, Richmond County, North Carolina

Emission Unit ID	Source Description	Control Device ID	Control Device Description	CO (tpy)	NO_x (tpy)	PM (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_2 (tpy)	VOC (tpy)	CO_2e (tpy)
IES-CHIP-1	Log Chipping	--	--	--	--	--	--	--	--	1.56	--
IES-BARKHOG	Bark Hog	--	--	--	--	0.35	0.19	--	--	0.44	--
IES-DEBARK-1	Debarker	--	--	--	--	10.8	5.93	--	--	--	--
ES-DRYER	250.4 MMBtu/hr Wood-fired Direct Heat Drying System	CD-WESP CD-RTO-1	WESP; RTO	159	144	43.0	43.0	42.3	27.4	79.6	248,938
ES-GHM-1 through 3	Three (3) Green Wood Hammermills										
ES-HM-1 through 8[1]	Eight (8) Dry Hammermills	CD-HM-BH1 through 8; CD-WESP; CD-RTO-1	Eight (8) baghouses; WESP; RTO								
ES-FURNACEBYPASS	Furnace Bypass Stacks	–	–	2.81	1.03	2.71	2.42	2.10	0.12	0.080	935
IES-DB-1 and 2	Dryer Duct Burners	–	–	1.80	1.07	0.16	0.16	0.16	0.013	0.12	180
ES-HMC	Hammermill Collection Conveyor	CD-HMC-BH	One (1) baghouse	--	--	0.23	0.23	0.23	--	--	--
ES-PCHP	Pellet Cooler HP Fines Relay System	CD-PCHP-BH	One (1) baghouse	--	--	0.075	0.075	0.075	--	--	--
ES-PMFS	Pellet Mill Feed Silo	CD-PMFS-BH	One (1) baghouse	--	--	0.37	0.37	0.37	--	--	--
ES-CLR-1 through 6[2]	Six (6) Pellet Coolers	CD-RCO/RTO	RCO/RTO	22.1	2.40	1.01	1.01	0.51	0.082	1.23	16,412
ES-FPH	Finished Product Handling	CD-FPH-BH	One (1) baghouse	--	--	1.28	1.16	0.51	--	--	--
ES-PB-1 and 2	Two (2) Pellet Loadout Bins										
ES-PL-1 through 3	Three (3) Pellet Loadouts										
ES-DWH	Dried Wood Handling Operations	CD-DWH-BH1 and 2	Two (2) baghouses	--	--	0.30	0.30	0.30	--	15.7	--
IES-ADD	Additive Handling and Storage	--	--	--	--	3.5E-04	1.7E-04	2.5E-05	--	--	--
IES-GWH	Green Wood Handling Operations	--	--	--	--	1.80	1.55	1.37	--	--	--
IES-TK-1	1,000 gallon Diesel Storage Tank	--	--	--	--	--	--	--	--	3.1E-04	--
IES-TK-2	185 gallon Diesel Storage Tank	--	--	--	--	--	--	--	--	6.8E-05	--
IES-TK-3	5,000 gallon Diesel Storage Tank	--	--	--	--	--	--	--	--	0.0020	--
IES-GWSP-1 through 5	Green Wood Storage Piles	--	--	--	--	13.5	6.73	1.01	--	7.02	--
IES-BFSP-1 and 2	Bark Fuel Storage Piles	--	--	--	--	0.56	0.28	0.042	--	0.29	--
IES-DRYSHAVE	Dry Shaving Material Handling	--	--	--	--	0.054	0.025	0.0039	--	--	--
IES-BFB[3]	Bark Fuel Bin	--	--	--	--	--	--	--	--	--	--
IES-GN	500 kW Diesel-fired Emergency Generator	--	--	0.14	2.46	0.0078	0.0078	0.0078	6.6E-04	1.68	179
IES-FWP	250 hp Diesel-fired Fire Water Pump	--	--	0.070	0.18	0.0092	0.0092	0.0092	4.8E-04	0.0081	50.4
IES-PW1 and 2[4]	Two (2) Parts Washers	--	--	--	--	--	--	--	--	--	--
--	Paved Roads	--	--	--	--	16.3	3.27	0.80	--	--	--
--	Unpaved Roads	--	--	--	--	12.5	3.55	0.36	--	--	--
Total Emissions:				**186**	**151**	**105**	**70.3**	**50.2**	**27.7**	**108**	**266,694**
Total Excluding Fugitives[5]:				**186**	**151**	**60.3**	**54.9**	**46.6**	**27.7**	**100**	**266,694**
PSD Major Source Threshold:				**250**	**250**	**250**	**250**	**250**	**250**	**250**	**--**

Notes:

1. The dry hammermills are equipped with eight (8) baghouses for PM control. The Dry Hammermill baghouse exhaust will be routed to either the furnace followed by the WESP/RTO, directly to the WESP/RTO, or a combination of the two. The RTO provides 95% control of VOC and HAP emissions.
2. The pellet coolers are equipped with an RCO for VOC control that will operate primarily in catalytic mode with thermal (RTO) mode as a backup. The RTO and RCO modes have the same control efficiency so there will be no impact on emissions during thermal mode usage.
3. Bark is transferred from the primary Bark Fuel Storage Pile by walking floor to covered conveyors which transfer the bark into the fully enclosed Bark Fuel Bin. There are no emissions expected from transfer of material into the bin.
4. Emissions from the parts washers are insignificant.
5. Fugitive emissions are not included in comparison against the major source threshold because the facility is not on the list of 28 source categories in 40 CFR 52.21.

Abbreviations:

ES - Emission Source
IES - Insignificant Emission Source
CO - carbon monoxide
CO_2e - carbon dioxide equivalent
NO_x - nitrogen oxides
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RTO - Regenerative Thermal Oxidizer
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compounds
WESP - Wet Electrostatic Precipitator

Table 3

Summary of Facility-wide HAP Emissions Enviva

Pellets Hamlet, LLC

Hamlet, Richmond County, North Carolina

Pollutant	CD-RTO-1[1] (tpy)	ES-FURNACEBYPASS (tpy)	CD-RCO-1[2] (tpy)	ES-DWH (tpy)	IES-GN (tpy)	IES-FWP (tpy)	IES-BARKHOG (tpy)	IES-CHIP-1 (tpy)	IES-DB-1 and 2 (tpy)	Total HAP (tpy)
Acetaldehyde	0.60	0.0039	0.90	0.15	2.96E-05	1.76E-04	--	--	3.26E-07	1.65
Acetophenone	1.75E-07	1.50E-08	--	--	--	--	--	--	--	1.90E-07
Acrolein	2.01	0.019	0.79	--	9.25E-06	2.12E-05	--	--	3.86E-07	2.81
Antimony and compounds	6.28E-04	3.70E-05	--	--	--	--	--	--	--	6.65E-04
Arsenic	0.0018	1.03E-04	2.75E-05	--	--	--	--	--	4.29E-06	0.0019
Benzene	0.23	0.020	2.89E-04	--	9.11E-04	2.14E-04	--	--	4.51E-05	0.25
Benzo(a)pyrene	1.43E-04	1.22E-05	1.65E-07	--	3.02E-07	4.31E-08	--	--	2.58E-08	1.56E-04
Beryllium	9.03E-05	5.16E-06	1.65E-06	--	--	--	--	--	2.58E-07	9.73E-05
Butadiene, 1,3-	--	--	--	--	--	8.96E-06	--	--	--	8.96E-06
Cadmium	5.83E-04	1.92E-05	1.51E-04	--	--	--	--	--	2.36E-05	7.77E-04
Carbon tetrachloride	0.0025	2.11E-04	--	--	--	--	--	--	--	0.0027
Chlorine	0.87	0.0037	--	--	--	--	--	--	--	0.87
Chlorobenzene	0.0018	1.55E-04	--	--	--	--	--	--	--	0.0020
Chloroform	0.0015	1.31E-04	--	--	--	--	--	--	--	0.0017
Chromium VI	6.05E-04	1.64E-05	1.92E-04	--	--	--	--	--	3.01E-05	8.44E-04
Chromium–Other compounds	0.0014	8.21E-05	--	--	--	--	--	--	--	0.0015
Cobalt	5.36E-04	3.05E-05	1.15E-05	--	--	--	--	--	1.80E-06	5.80E-04
Dichlorobenzene	2.80E-04	--	1.65E-04	--	--	--	--	--	2.58E-05	4.71E-04
Dichloroethane, 1,2-	0.0016	1.36E-04	--	--	--	--	--	--	--	0.0017
Dichloropropane, 1,2-	0.0018	1.55E-04	--	--	--	--	--	--	--	0.0020
Dinitrophenol, 2,4-	9.87E-06	8.44E-07	--	--	--	--	--	--	--	1.07E-05
Di(2-ethylhexyl)phthalate	2.58E-06	2.20E-07	--	--	--	--	--	--	--	2.80E-06
Ethyl benzene	0.0017	1.45E-04	--	--	--	--	--	--	--	0.0018
Formaldehyde	3.46	0.021	0.94	0.14	9.26E-05	2.71E-04	--	--	0.0016	4.56
Hexane	0.42	--	0.25	--	--	--	--	--	0.039	0.71
Hydrochloric acid	0.15	0.089	--	--	--	--	--	--	--	0.24
Lead	0.0039	2.25E-04	6.87E-05	--	--	--	--	--	1.07E-05	0.0042
Manganese	0.13	0.0075	5.22E-05	--	--	--	--	--	8.16E-06	0.13
Mercury	3.39E-04	1.64E-05	3.57E-05	--	--	--	--	--	5.58E-06	3.97E-04
Methanol	2.35	--	0.28	0.28	--	--	0.088	0.31	--	3.30
Methyl bromide	8.23E-04	7.03E-05	--	--	--	--	--	--	--	8.93E-04
Methyl chloride	0.0013	1.08E-04	--	--	--	--	--	--	--	0.0014
Methylene chloride	0.016	1.36E-03	--	--	--	--	--	--	--	0.017
Naphthalene	0.0055	4.55E-04	8.38E-05	--	1.53E-04	1.95E-05	--	--	1.31E-05	0.0062
Nickel	0.0031	1.55E-04	2.89E-04	--	--	--	--	--	4.51E-05	0.0036
Nitrophenol, 4-	6.03E-06	5.16E-07	--	--	--	--	--	--	--	6.55E-06
Pentachlorophenol	5.59E-05	2.39E-07	--	--	--	--	--	--	--	5.62E-05
Perchloroethylene	0.042	1.78E-04	--	--	--	--	--	--	--	0.042
Phenol	0.20	2.39E-04	0.34	--	--	--	--	--	--	0.5
Phosphorus metal, yellow or white	0.0021	1.27E-04	--	--	--	--	--	--	--	0.0023
Polychlorinated biphenyls	4.47E-07	3.82E-08	--	--	--	--	--	--	--	4.85E-07
Propionaldehyde	9.01	2.86E-04	0.16	0.044	--	--	--	--	--	9.2
Selenium	2.28E-04	1.31E-05	3.30E-06	--	--	--	--	--	5.15E-07	2.45E-04
Styrene	0.10	0.0089	--	--	--	--	--	--	--	0.11
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	4.72E-10	4.03E-11	--	--	--	--	--	--	--	5.12E-10
Toluene	0.051	0.0043	4.67E-04	--	3.30E-04	9.38E-05	--	--	7.30E-05	0.057
Polycyclic Organic Matter	0.14	5.85E-04	9.59E-05	--	2.49E-04	3.85E-05	--	--	1.50E-05	0.14
Trichloroethane, 1,1,1-	0.034	1.45E-04	--	--	--	--	--	--	--	0.034
Trichloroethylene	0.0016	1.41E-04	--	--	--	--	--	--	--	0.0018
Trichlorophenol, 2,4,6-	1.21E-06	1.03E-07	--	--	--	--	--	--	--	1.31E-06
Vinyl chloride	9.87E-04	8.44E-05	--	--	--	--	--	--	--	0.0011
Xylene	0.0014	1.17E-04	--	--	2.26E-04	6.53E-05	--	--	--	0.0018
Total HAP Emissions[3] (tpy)	**19.8**	**0.18**	**3.65**	**0.61**	**0.0018**	**8.88E-04**	**0.09**	**0.31**	**0.041**	**24.7**
Maximum Individual HAP	**Propionaldehyde**	**Hydrochloric acid**	**Formaldehyde**	**Methanol**	**Benzene**	**Formaldehyde**	**Methanol**	**Methanol**	**Hexane**	**Propionaldehyde**
Maximum Individual HAP Emissions (tpy)	**9.01**	**0.089**	**0.94**	**0.28**	**9.11E-04**	**2.71E-04**	**0.09**	**0.31**	**0.039**	**9.21**

Notes:

1. Includes emissions at outlet of RTO-1 stack as well as the HAP combustion emissions resulting from natural gas combustion by the RTO-1 burners. RTO-1 controls emissions from the green hammermills (ES-GHM-1 through 3), furnace/dryer (ES-DRYER), and dry hammermills (ES-DHM-1 through 8).
2. Includes emissions at the outlet of RCO stack as well as the HAP combustion emissions resulting from natural gas combustion by the RCO burners. RCO controls emissions from the pellet mills and pellet coolers (ES-CLR-1 through 6). The RCO operates primarily in catalytic mode with thermal (RTO) mode as a backup. The RTO and RCO modes have the same control efficiency so there is no impact on emissions during thermal mode usage.
3. Because benzo(a)pyrene and naphthalene emissions were presented individually and as components of total PAH emissions, the total HAP emissions presented here do not match the sum of all pollutant emissions to avoid double counting benzo(a)pyrene and naphthalene emissions.

Abbreviations:

HAP - hazardous air pollutant

RCO - regenerative catalytic oxidizer

RTO - regenerative thermal oxidizer

tpy - tons per year

Table 4
Green Wood Handling
IES-GWH
Enviva Pellets Hamlet, LLC Hamlet,
Richmond County, North Carolina

Source	Transfer Activity[1]	Number of Drop Points	Material Moisture Content[2]	PM Emission Factor[3]	PM_{10} Emission Factor[3]	$PM_{2.5}$ Emission Factor[3]	Potential Throughput[4]		Potential PM Emissions		Potential PM_{10} Emissions		Potential $PM_{2.5}$ Emissions	
			(%)	(lb/ton)	(lb/ton)	(lb/ton)	(tph)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
ES-GWH	Purchased Bark/Fuel Chips Transfer to Outdoor Storage Area	1	48%	5.0E-05	2.4E-05	3.6E-06	50	350,000	0.0025	0.0087	0.0012	0.0041	1.78E-04	6.24E-04
	Purchased Wood Chips to Outdoor Storage Area	4	48%	5.0E-05	2.4E-05	3.6E-06	148	1,300,000	0.030	0.13	0.014	0.061	0.0021	0.0093
	Purchased Wood Chips to Wet Hardwood Pile[5]	10	48%	5.0E-05	2.4E-05	3.6E-06	74	650,000	0.037	0.16	0.017	0.076	0.0026	0.012
	Purchased Wood Chips Transfer to Wet Hardwood Hopper	1	48%	5.0E-05	2.4E-05	3.6E-06	148	1,300,000	0.0074	0.032	0.0035	0.015	5.29E-04	0.0023
	Processed Wood Chips to Outdoor Storage Area	2	48%	5.0E-05	2.4E-05	3.6E-06	275	1,300,000	0.027	0.065	0.013	0.031	0.0020	0.0046
	Chip Truck Dump to Dumpers	2	48%	5.0E-05	2.4E-05	3.6E-06	148	1,300,000	0.015	0.065	0.0070	0.031	0.0011	0.0046
								Total Emissions:	**0.12**	**0.46**	**0.056**	**0.22**	**0.0085**	**0.033**

Notes:

1. These green wood handling emissions are representative of the fugitive emissions at the site.
2. Average moisture content for bark based on material balance provided by design engineering firm (Mid-South Engineering). Moisture content for purchased and process wood chips provided by Enviva on July 12, 2017. Assumed the lower moisture content between pine and hardwood to conservatively estimate PM emissions. (Hardwood 42% moisture; pine 51% (purchased wood chips) and 49% (processed wood chips).
3. Emission factor calculation based on formula from AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles, Equation 13.2.1, (11/06). where: E = emission factor (lb/ton)

k = particle size multiplier (dimensionless) for PM	0.74
k = particle size multiplier (dimensionless) for PM_{10}	0.35
k = particle size multiplier (dimensionless) for $PM_{2.5}$	0.053
U = mean wind speed (mph)	7.85

4. Potential throughputs based on engineering estimates.
5. Conservative assumption used for the number of drop points to account for mixing of softwood and hardwood chips in the mix pile.

Calculation Basis for Chip Screening

Hourly Throughput	77 ODT/hr
Annual Throughput	676,000 ODT/yr

Potential Criteria Pollutant Emissions from Screening of Purchased Chips

Pollutant	Emission Factor[1]	Potential Emissions	
	(lb/ODT)	(lb/hr)	(tpy)
$PM/PM_{10}/PM_{2.5}$	0.0040	0.30	1.34

Notes:

1. Emission factor from NCASI Technical Bulletin No. 1020 Table 9.1 for chip screening converted from units of bone dry tons (BDT) to ODT based on a moisture content of 48%.

Abbreviations:

hr - hour
lb - pound
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year
yr - year

References:

U.S. EPA. AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles, (11/06).
National Council for Air and Stream Improvement, Inc. (NCASI). 2013. *Compilation of criteria air pollutant emissions data for sources at pulp and paper mills including boilers – an update to Technical Bulletin No. 884.* Technical Bulletin No. 1020. Research Triangle Park, NC: National Council for Air and Stream Improvement, Inc.

Table 5
Storage Pile Wind Erosion
IES-GWSP-1 through -5, and IES-BFSP-1 and-2 Enviva
Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Source	Description	PM Emission Factor[1]		VOC Emission Factor[2]		Pile Width	Pile Length	Pile Height	Outer Surface Area of Pile[3]	Potential PM Emissions		Potential PM_{10} Emissions		Potential $PM_{2.5}$ Emissions		Potential VOC Emissions as propane[4]	
		(lb/day/acre)	(lb/hr/ft²)	(lb/day/acre)	(lb/hr/ft²)	(ft)	(ft)	(ft)	(ft²)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
IES-GWSP-1	Green Wood Storage Pile No. 1	8.6	8.2E-06	3.6	3.4E-06	100	310	30	66,720	0.55	2.40	0.27	1.20	0.041	0.18	0.28	1.23
IES-GWSP-2	Green Wood Storage Pile No. 2	8.6	8.2E-06	3.6	3.4E-06	100	310	30	66,720	0.55	2.40	0.27	1.20	0.041	0.18	0.28	1.23
IES-GWSP-3	Green Wood Storage Pile No. 3	8.6	8.2E-06	3.6	3.4E-06	220	310	30	120,000	0.99	4.32	0.49	2.16	0.074	0.32	0.50	2.21
IES-GWSP-4	Green Wood Storage Pile No. 4	8.6	8.2E-06	3.6	3.4E-06	220	310	30	120,000	0.99	4.32	0.49	2.16	0.074	0.32	0.50	2.21
IES-GWSP-5	Green Wood Storage Pile No. 5	8.6	8.2E-06	3.6	3.4E-06	51	51	20	8,105	0.067	0.29	0.033	0.15	0.0050	0.022	0.034	0.15
IES-BFSP-1	Bark Fuel Storage Pile No. 1	8.6	8.2E-06	3.6	3.4E-06	60	100	15	12,960	0.11	0.47	0.053	0.23	0.0080	0.035	0.054	0.24
IES-BFSP-2	Bark Fuel Storage Pile No. 2	8.6	8.2E-06	3.6	3.4E-06	25	25	15	2,550	0.021	0.092	0.010	0.046	0.0016	0.0069	0.011	0.047
									Total Emissions:	**3.27**	**14.3**	**1.63**	**7.15**	**0.24**	**1.07**	**1.67**	**7.31**

Notes:

1. PM emission factor based on U.S. EPA Control of Open Fugitive Dust Sources. Research Triangle Park, North Carolina, EPA-450/3-88-008. September 1988, Page 4-17.

$$E = 1.7\left(\frac{s}{1.5}\right)\left(\frac{365-p}{235}\right)\left(\frac{f}{15}\right)(lb/day/acre)$$

where: s, silt content of wood chips (%): 8.4 s - silt content (%) for lumber sawmills (mean) from AP-42, Section 13.2.2 - Unpaved Roads, 11/06, Table 13.2.2-1 p, number of days with rainfall greater than 0.01 inch: 110 Based on AP-42, Section 13.2.2 - Unpaved Roads, 11/06, Figure 13.2.1-2.

f (time that wind exceeds 5.36 m/s - 12 mph) (%): 12.5 Based on meteorological data averaged for 2012-2016 for Maxton, NC National Weather Service (NWS) Station

PM_{10}/TSP ratio: 50% — PM_{10} is assumed to equal 50% of TSP based on U.S. EPA Control of Open Fugitive Dust Sources, Research Triangle Park, North Carolina, EPA-450/3-88-008. September 1988.

$PM_{2.5}$/TSP ratio: 7.5% — $PM_{2.5}$ is assumed to equal 7.5 % of TSP U.S. EPA Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors. November 2006.

2. Emission factors obtained from NCASI document provided by the South Carolina Department of Health and Environmental Control (DHEC) for the calculation of fugitive VOC emissions from Douglas Fir wood storage piles. Emission factors ranged from 1.6 to 3.6 lb C/acre-day. Enviva chose to employ the maximum emission factor for purposes of conservatism.

3. The surface area is calculated as [2*H*L+2*W*H+L*W] + 20% to consider the sloping pile edges. Length and width based on proposed site design with a conservative height.

4. Emissions are calculated in tons of carbon per year by the following formula:

tons C/year = 5 acres * 365 days * 1.6 lb C/acre-day/ 2000 lb/ton Emission factor converted from as carbon to as propane by multiplying by 1.22.

Abbreviations:

EPA - Environmental Protection Agency
ft - feet
ft² - square feet
lb - pound
mph - miles per hour
NC - North Carolina
NCASI - National Council for Air and Stream Improvement, Inc.
NWS - National Weather Service
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year
TSP - total suspended particulate
yr - year
VOC - volatile organic compound

References:

U.S. EPA. AP-42, Section 13.2.2 - Unpaved Roads, 11/06.
U.S. EPA Control of Open Fugitive Dust Sources, Research Triangle Park, North Carolina, EPA-450/3-88-008. September 1988.
U.S. EPA Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors. November 2006.

Table 6

Debarker Potential Emissions

ES-DEBARK-1

Enviva Pellets Hamlet, LLC Hamlet, Richmond County, North Carolina

Calculation Basis

Maximum Hourly Throughput	275 ton/hr
Annual Throughput[1]	1,078,143 ton/yr

Potential Criteria Pollutant Emissions

Source	Pollutant	Emission Factor (lb/ton)	Potential Emissions	
			(lb/hr)	(tpy)
ES-DEBARK-1	TSP[2]	0.020	5.50	10.8
	PM_{10}[2]	0.011	3.03	5.93

Notes:

1. Approximately 2 tons of green material is needed for every 1 ODT of pellets, and 1.15 times that amount for purchased logs. At most, Enviva would purchase 75% of the needed logs with the remaining 25% of green material coming from purchased chips.
2. Particulate matter emission factors from the USEPA document titled *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants.* Source Classification Code 3-07-008- 01 (Log Debarking). All PM is assumed to be larger than 2.5 microns in diameter.

Abbreviations:

hr - hour lb -
pound
ODT - oven dried tons tpy -
tons per year
yr - year

Reference:

U.S. EPA. 1990. *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants* . Source Classification Code 3-07-008-01 (Log Debarking).

Table 7

Bark Hog Potential Emissions

IES-BARKHOG

Enviva Pellets Hamlet, LLC Hamlet,
Richmond County, North Carolina

Calculation Basis

Maximum Hourly Throughput	50 ton/hr, wet
	25 ODT/hr
Annual Throughput[1]	175,000 ODT/yr
	350,000 ton/yr, wet
Approx. Moisture Content	50% of total weight

Potential Criteria Pollutant and HAP Emissions

Pollutant	Emission Factor	Potential Emissions	
		(lb/hr)	(tpy)
THC as carbon[2]	0.0041 lb/ODT	0.10	0.36
VOC as propane[3]	0.0050 lb/ODT	0.13	0.44
Methanol[2]	0.0010 lb/ODT	0.025	0.09
PM[4]	0.020 lb/ton	0.10	0.35
PM_{10}[4]	0.011 lb/ton	0.055	0.19

Notes:

1. Maximum annual throughput provided by Enviva.
2. Emission factor obtained from available emissions factors for chippers in AP-42 Section 10.6.3, Medium Density Fiberboard, 08/02, Table 7 and Section 10.6.4, Hardboard and Fiberboard, 10/02, Tables 7 and 9. Emission factors for THC and Methanol are the same across all three tables.
3. Emission factor for VOC as propane is from AP-42, Section 10.6.3., Medium Density Fiberboard, 08/02, Table 7.
4. Particulate matter emission factors from the USEPA document titled *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants. Source Classification Code 3-07-008- 01 (Log Debarking)* . All PM is assumed to be larger than 2.5 microns. PM emissions are assumed to be controlled due to the bark hog being partially enclosed (assumed 90% control).

Abbreviations:

hr - hour lb -
pound
ODT - oven dried tons THC -
total hydrocarbon tpy - tons
per year
yr - year

References:

U.S. EPA. AP-42, Section 10.6.3 - Medium Density Fiberboard, (08/02).
U.S. EPA. AP-42, Section 10.6.4 - Hardboard and Fiberboard, (10/02).
U.S. EPA. 1990. AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants. Source Classification Code 3-07-008-01 (Log Debarking).

Table 8

Log Chipper Potential Emissions

IES-CHIP-1

Enviva Pellets Hamlet, LLC Hamlet, Richmond County, North Carolina

Calculation Basis

Maximum Hourly Throughput	275 ton/hr, wet
	138 ODT/hr
Annual Throughput	625,011 ODT/yr

Potential Criteria Pollutant Emissions

Pollutant	Emission Factor	Potential Emissions	
		(lb/hr)	(tpy)
THC as carbon[1]	0.0041 lb/ODT	0.56	1.28
VOC as propane[2]	0.0050 lb/ODT	0.69	1.56
Methanol[1]	0.0010 lb/ODT	0.14	0.31

Notes:

1. Emission factor obtained from available emissions factors for chippers in AP-42 Section 10.6.3, Medium Density Fiberboard, 08/02, Table 7 and Section 10.6.4, Hardboard and Fiberboard, 10/02, Table 9. Emission factors for THC and methanol are the same across all three tables.
2. Emission factor for VOC as propane is from AP-42, Section 10.6.3., Medium Density Fiberboard, 08/02, Table 7.

Abbreviations:

hr - hour lb - pound
ODT - oven dried tons THC - total hydrocarbon tpy - tons per year
yr - year

References:

U.S. EPA. AP-42, Section 10.6.3 - Medium Density Fiberboard, (08/02).
U.S. EPA. AP-42, Section 10.6.4 - Hardboard and Fiberboard, (10/02).

Table 9

Potential Emissions at Outlet of RTO-1 Stack

ES-DRYER, ES-GHM-1 through 3, ES-DHM-1 through 8 Enviva

Pellets Hamlet, LLC

Hamlet, Richmond County, North Carolina

Calculation Basis

Maximum Hourly Throughput	80 ODT/hr
Annual Throughput	625,011 ODT/yr
Hourly Heat Input Capacity	250.4 MMBtu/hr
Annual Heat Input Capacity	2,193,504 MMBtu/yr
Hours of Operation	8,760 hr/yr
RTO Heat Input	54.4 MMBtu/hr
RTO Control Efficiency	95%

Total Potential Emissions at RTO Stack

Pollutant	Potential Emissions[1]	
	(lb/hr)	(tpy)
CO	40.6	159
NO_x	36.8	144
SO_2	6.27	27.4
VOC	20.4	79.6
PM	11.0	43.0
PM_{10}	11.0	43.0
$PM_{2.5}$	10.8	42.3
CO_2e	63,583	248,938
Total HAP	5.02	19.8
Total TAP	2.24	9.1

Notes:

1. Total emissions from the furnace/dryer, green hammermills, dry hammermills, natural gas combustion by the RTO burners, and natural gas injection. Detailed calculations are provided below.

Potential Criteria Pollutant and Greenhouse Gas Emissions from Dryer/Furnace and Green Hammermills

Pollutant	Controlled Emission Factor	Units	Potential Emissions[1]	
			(lb/hr)	(tpy)
CO	0.50	lb/ODT[2]	39.7	155
NO_X	0.45	lb/ODT[2]	36.2	141
SO_2	0.025	lb/MMBtu[3]	6.26	27.4
VOC	0.22	lb/ODT[2]	17.7	69.3
$PM/PM_{10}/PM_{2.5}$ (Filterable + Condensable)	0.088	lb/ODT[2]	7.02	27.4
CO_2	780	lb/ODT[4]	62,400	243,754

Notes:

1. Exhaust from the dryer (ES-DRYER) and green hammermills (ES-GHM-1 through 3) are routed to a WESP and then RTO for control of VOC, HAP, and particulates. Additional emissions routed to the RTO from the Dry Hammermills are shown in the tables below.
2. Emission factor based on January 2020 compliance testing with a 20% contingency to account for inherent variability in stack testing results. The VOC emission factor was adjusted to account for the difference in pine percentage during testing and the maximum allowable.
3. No emission factor is provided in AP-42, Section 10.6.2 for SO_2 for rotary dryers. Enviva has conservatively calculated SO_2 emissions based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
4. Emission factor for CO_2 from AP-42, Section 10.6.1 for rotary dryer with RTO control device. Enviva has conservatively calculated the CO_2 emissions using the hardwood emission factor because the dryer at Hamlet processes a combination of hardwood and softwood and the hardwood emission factor is greater than the softwood emission factor.

Potential Criteria Pollutant Emissions from Dry Hammermills[1]

Pollutant	Emission Factor (lb/ODT)[2]	Potential Emissions	
		(lb/hr)	(tpy)
PM	0.049	3.91	15.3
PM_{10}	0.049	3.91	15.3
$PM_{2.5}$	0.047	3.74	14.6
VOC	0.032	2.59	10.1

Notes:

1. A portion of the exhaust from each Dry Hammermill will be recirculated back into the Dry Hammermill to reduce the volume of air that will be routed to CD-RTO-1. All emissions from the Dry Hammermills will be controlled by a baghouse. Exhaust from the eight (8) dry hammermill baghouses (ES-DHM-1 through 8) will be controlled by the WESP and RTO.
2. Emission factor based on January 2020 compliance testing with a 20% contingency to account for inherent variability in stack testing results. The VOC emission factor was adjusted to account for the difference in pine percentage during testing and the maximum allowable. A 95% control efficiency is applied to VOC emission for control by the RTO.

Table 9

Potential Emissions at Outlet of RTO-1 Stack

ES-DRYER, ES-GHM-1 through 3, ES-DHM-1 through 8 Enviva

Pellets Hamlet, LLC

Hamlet, Richmond County, North Carolina

Thermally Generated Potential Criteria Pollutant Emissions from Dry Hammermill VOC

Maximum high heating value of VOC constituents	0.018	MMBtu/lb
Uncontrolled VOC emissions	203	tons/yr
Heat input of uncontrolled VOC emissions	7,497	MMBtu/yr

Pollutant	Emission Factor	Units	Potential Emissions	
			(lb/hr)	(tpy)
CO	0.082	lb/MMBtu[1]	0.070	0.31
NO_X	0.10	lb/MMBtu[1]	0.084	0.37

Notes:

[1] Emission factors from AP-42, Section 1.4 - Natural Gas Combustion, 07/98. Emission factors converted from lb/MMscf to lb/MMBtu based on assumed heating value of 1,020 Btu/scf for natural gas per AP-42 Section 1.4.

Potential Criteria Pollutant and Greenhouse Gas Emissions from RTO Natural Gas Injection[1]

Pollutant	Emission Factor[2] (lb/MMscf)	Potential Emissions	
		(lb/hr)	(tpy)
CO	84.0	0.82	3.61
NO_X	50	0.49	2.15
VOC	5.50	0.054	0.24
SO_2	0.60	0.0059	0.026
$PM/PM_{10}/PM_{2.5}$ Condensable	5.70	0.056	0.24
$PM/PM_{10}/PM_{2.5}$ Filterable	1.90	0.019	0.082
Total $PM/PM_{10}/PM_{2.5}$	--	0.075	0.33
CO_2	120,000	1,176	5,153
CH_4	2.30	0.023	0.099
N_2O	2.20	0.022	0.094
CO_2e	--	1,183	5,184

Notes:

[1] Enviva is requesting authorization for injection of natural gas into the RTO (10 MMBtu/hr) which will reduce the amount of combustion air added to the RTO, thereby increasing fuel efficiency and reducing generation of NO_X.

[2] Emission factors for natural gas combustion from AP-42 Section 1.4 - Natural Gas Combustion, 07/98. Natural gas heating value of 1,020 Btu/scf assumed per AP-42.

Potential HAP and TAP Emissions

Pollutant	HAP	NC TAP	VOC	Emission Factor	Units	Footnote	Potential Emissions	
							(lb/hr)	(tpy)
Furnace Biomass Combustion, Drying, Green Hammermills, and Dry Hammermills								
Acetaldehyde	Y	Y	Y	0.0019	lb/ODT	1	0.15	0.60
Acrolein	Y	Y	Y	0.0064	lb/ODT	1	0.51	2.01
Formaldehyde	Y	Y	Y	0.011	lb/ODT	1	0.89	3.46
Methanol	Y	N	Y	0.0075	lb/ODT	1	0.60	2.35
Phenol	Y	Y	Y	0.00063	lb/ODT	1	0.05	0.20
Propionaldehyde	Y	N	Y	0.029	lb/ODT	1	2.31	9.01
Acetophenone	Y	N	Y	3.20E-09	lb/MMBtu	1	4.0E-08	1.8E-07
Antimony and compounds	Y	N	N	7.90E-06	lb/MMBtu	2,4	1.4E-04	6.3E-04
Arsenic	Y	Y	N	2.20E-05	lb/MMBtu	2,4	4.0E-04	0.0017
Benzene	Y	Y	Y	0.0042	lb/MMBtu	2,3	0.053	0.23
Benzo(a)pyrene	Y	Y	Y	2.60E-06	lb/MMBtu	2,3	3.3E-05	1.4E-04
Beryllium	Y	Y	N	1.10E-06	lb/MMBtu	2,4	2.0E-05	8.7E-05
Cadmium	Y	Y	N	4.10E-06	lb/MMBtu	2,4	7.4E-05	3.3E-04
Carbon tetrachloride	Y	Y	Y	4.50E-05	lb/MMBtu	2,3	5.6E-04	0.0025
Chlorine	Y	Y	N	7.90E-04	lb/MMBtu	2	0.20	0.87
Chlorobenzene	Y	Y	Y	3.30E-05	lb/MMBtu	2,3	4.1E-04	0.0018
Chloroform	Y	Y	Y	2.80E-05	lb/MMBtu	2,3	3.5E-04	0.0015
Chromium VI	-[5]	Y	N	3.50E-06	lb/MMBtu	2,4,5	6.4E-05	2.8E-04
Chromium–Other compounds	Y	N	N	1.75E-05	lb/MMBtu	2,4	3.2E-04	0.0014
Cobalt	Y	N	N	6.50E-06	lb/MMBtu	2,4	1.2E-04	5.2E-04
Dichloroethane, 1,2-	Y	Y	Y	2.90E-05	lb/MMBtu	2,3	3.6E-04	0.0016
Dichloropropane, 1,2-	Y	N	Y	3.30E-05	lb/MMBtu	2,3	4.1E-04	0.0018
Dinitrophenol, 2,4-	Y	N	Y	1.80E-07	lb/MMBtu	2,3	2.3E-06	9.9E-06
Di(2-ethylhexyl)phthalate	Y	Y	Y	4.70E-08	lb/MMBtu	2,3	5.9E-07	2.6E-06
Ethyl benzene	Y	N	Y	3.10E-05	lb/MMBtu	2,3	3.9E-04	0.0017
Hexachlorodibenzo-p-dioxin, 1,2,3,6,7,8-	N	Y	Y	1.79E-11	lb/MMBtu	2,3	2.2E-10	9.8E-10
Hydrochloric acid	Y	Y	N	1.33E-03	lb/MMBtu	2,6	0.03	0.15
Lead	Y	N	N	4.80E-05	lb/MMBtu	2,4	8.7E-04	0.0038
Manganese	Y	Y	N	0.0016	lb/MMBtu	2,4	0.029	0.13
Mercury	Y	Y	N	3.50E-06	lb/MMBtu	2,4	6.4E-05	2.8E-04
Methyl bromide	Y	N	Y	1.50E-05	lb/MMBtu	2,3	1.9E-04	8.2E-04
Methyl chloride	Y	N	Y	2.30E-05	lb/MMBtu	2,3	2.9E-04	0.0013
Methyl ethyl ketone	N	Y	Y	5.40E-06	lb/MMBtu	2,3	6.8E-05	3.0E-04
Methylene chloride	Y	Y	Y	2.90E-04	lb/MMBtu	2,3	0.0036	0.016
Naphthalene	Y	N	Y	9.70E-05	lb/MMBtu	2,3	0.0012	0.0053
Nickel	Y	Y	N	3.30E-05	lb/MMBtu	2,4	6.0E-04	0.0026
Nitrophenol, 4-	Y	N	Y	1.10E-07	lb/MMBtu	2,3	1.4E-06	6.0E-06
Pentachlorophenol	Y	Y	N	5.10E-08	lb/MMBtu	2	1.3E-05	5.6E-05
Perchloroethylene	Y	Y	N	3.80E-05	lb/MMBtu	2	0.0095	0.042
Phosphorus metal, yellow or white	Y	N	N	2.70E-05	lb/MMBtu	2,4	4.9E-04	0.0021
Polychlorinated biphenyls	Y	Y	Y	8.15E-09	lb/MMBtu	2,3	1.0E-07	4.5E-07
Polycyclic Organic Matter	Y	N	N	1.25E-04	lb/MMBtu	2	0.031	0.14
Selenium	Y	N	N	2.80E-06	lb/MMBtu	2,4	5.1E-05	2.2E-04
Styrene	Y	Y	Y	0.0019	lb/MMBtu	2,3	0.024	0.10
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	Y	Y	8.60E-12	lb/MMBtu	2,3	1.1E-10	4.7E-10
Toluene	Y	Y	Y	9.20E-04	lb/MMBtu	2,3	0.012	0.050
Trichloroethane, 1,1,1-	Y	Y	N	3.10E-05	lb/MMBtu	2	0.0078	0.034
Trichloroethylene	Y	Y	Y	3.00E-05	lb/MMBtu	2,3	3.8E-04	0.0016
Trichlorofluoromethane	N	Y	Y	4.10E-05	lb/MMBtu	2,3	5.1E-04	0.0022
Trichlorophenol, 2,4,6-	Y	N	Y	2.20E-08	lb/MMBtu	2,3	2.8E-07	1.2E-06
Vinyl chloride	Y	Y	Y	1.80E-05	lb/MMBtu	2,3	2.3E-04	9.9E-04
Xylene	Y	Y	Y	2.50E-05	lb/MMBtu	2,3	3.1E-04	0.0014
						Total HAP Emissions:	**4.92**	**19.4**
						Total TAP Emissions:	**1.98**	**7.90**

Table 9

Potential Emissions at Outlet of RTO-1 Stack

ES-DRYER, ES-GHM-1 through 3, ES-DHM-1 through 8 Enviva

Pellets Hamlet, LLC

Hamlet, Richmond County, North Carolina

Pollutant	HAP	NC TAP	VOC	Emission Factor	Units	Footnote	Potential Emissions	
							(lb/hr)	(tpy)
RTO Natural Gas Combustion								
2-Methylnaphthalene	Y	N	Y	2.40E-05	lb/MMscf	7	1.28E-06	5.61E-06
3-Methylchloranthrene	Y	N	Y	1.80E-06	lb/MMscf	7	9.60E-08	4.20E-07
7,12-Dimethylbenz(a)anthracene	Y	N	Y	1.60E-05	lb/MMscf	7	8.53E-07	3.74E-06
Acenaphthene	Y	N	Y	1.80E-06	lb/MMscf	7	9.60E-08	4.20E-07
Acenaphthylene	Y	N	Y	1.80E-06	lb/MMscf	7	9.60E-08	4.20E-07
Ammonia	N	Y	N	3.2	lb/MMscf	7	0.17	0.75
Anthracene	Y	N	Y	2.40E-06	lb/MMscf	7	1.28E-07	5.61E-07
Arsenic	Y	Y	N	2.00E-04	lb/MMscf	7	1.07E-05	4.67E-05
Benz(a)anthracene	Y	N	Y	1.80E-06	lb/MMscf	7	9.60E-08	4.20E-07
Benzene	Y	N	Y	2.10E-03	lb/MMscf	7	1.12E-04	4.91E-04
Benzo(a)pyrene	Y	Y	Y	1.20E-06	lb/MMscf	7	6.40E-08	2.80E-07
Benzo(b)fluoranthene	Y	N	Y	1.80E-06	lb/MMscf	7	9.60E-08	4.20E-07
Benzo(g,h,i)perylene	Y	N	Y	1.20E-06	lb/MMscf	7	6.40E-08	2.80E-07
Benzo(k)fluoranthene	Y	N	Y	1.80E-06	lb/MMscf	7	9.60E-08	4.20E-07
Beryllium	Y	Y	N	1.20E-05	lb/MMscf	7	6.40E-07	2.80E-06
Cadmium	Y	Y	N	0.0011	lb/MMscf	7	5.87E-05	2.57E-04
Chromium VI	Y	N	N	0.0014	lb/MMscf	7	7.47E-05	3.27E-04
Chrysene	Y	N	Y	1.80E-06	lb/MMscf	7	9.60E-08	4.20E-07
Cobalt	Y	N	N	8.40E-05	lb/MMscf	7	4.48E-06	1.96E-05
Dibenzo(a,h)anthracene	Y	N	Y	1.20E-06	lb/MMscf	7	6.40E-08	2.80E-07
Dichlorobenzene	Y	Y	Y	0.0012	lb/MMscf	7	6.40E-05	2.80E-04
Fluoranthene	Y	N	Y	3.00E-06	lb/MMscf	7	1.60E-07	7.01E-07
Fluorene	Y	N	Y	2.80E-06	lb/MMscf	7	1.49E-07	6.54E-07
Hexane	Y	Y	Y	1.8	lb/MMscf	7	0.096	0.42
Indeno(1,2,3-cd)pyrene	Y	N	Y	1.80E-06	lb/MMscf	7	9.60E-08	4.20E-07
Lead	Y	N	N	5.00E-04	lb/MMscf	7	2.67E-05	1.17E-04
Manganese	Y	Y	N	3.80E-04	lb/MMscf	7	2.03E-05	8.88E-05
Mercury	Y	Y	N	2.60E-04	lb/MMscf	7	1.39E-05	6.07E-05
Naphthalene	Y	N	Y	6.10E-04	lb/MMscf	7	3.25E-05	1.42E-04
Nickel	Y	Y	N	0.0021	lb/MMscf	7	1.12E-04	4.91E-04
Phenanthrene	Y	N	Y	1.70E-05	lb/MMscf	7	9.07E-07	3.97E-06
Pyrene	Y	N	Y	5.00E-06	lb/MMscf	7	2.67E-07	1.17E-06
Selenium	Y	N	N	2.40E-05	lb/MMscf	7	1.28E-06	5.61E-06
Toluene	Y	Y	Y	0.0034	lb/MMscf	7	1.81E-04	7.94E-04
						Total HAP Emissions:	**0.10**	**0.42**
						Total TAP Emissions:	**0.27**	**1.17**

Notes:

1. Emission factor derived from process information and an appropriate contingency based on engineering judgement.
2. Emission factors (criteria and HAP/TAP) for wood combustion in a stoker boiler from NCDAQ Wood Waste Combustion Spreadsheet/AP-42, Fifth Edition, Volume 1, Chapter 1.6 - Wood Residue Combustion in Boilers, 09/03.
3. A control efficiency of 95% for the RTO is applied to all VOC hazardous and toxic pollutants for those emission factors that are not derived from Enviva stack test data.
4. The control efficiency of the wet electrostatic precipitator (WESP) for filterable particulate matter is applied to all metal hazardous and toxic pollutants. Actual design filterable efficiency is estimated to 96.4%, but 92.75% is assumed for toxics permitting.
5. Chromium VI is a subset of chrome compounds, which is accounted for separately as a HAP. As such, Chromium VI is only calculated as a TAP.
6. The WESP employs a caustic solution in its operation in which hydrochloric acid will have high water solubility. This caustic solution will neutralize the acid and effectively control it by 90%, per conversation on October 18, 2011 with Steven A. Jaasund, P.E. of Lundberg Associates, a manufacturer of WESPs.
7. Emission factors for natural gas combustion are from NCDAQ Natural Gas Combustion Spreadsheet and AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98 for small boilers. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.

Abbreviations:

CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NC - North Carolina
NO_x - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

References:

U.S. EPA. AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03
U.S. EPA. AP-42, Section 1.4 - Natural Gas Combustion, 07/98
U.S. EPA. AP-42, Section 10.6.2 - Particleboard, 06/02

Table 10

Potential Emissions for Furnace Bypass (Cold Start-up)[1]

ES-FURNACEBYPASS

Enviva Pellets Hamlet, LLC

Hamlet, Richmond County, North Carolina

Calculation Basis

Hourly Heat Input Capacity (HHV)	37.6 MMBtu/hr
Annual Heat Input Capacity	1,878 MMBtu/yr
Hours of Operation	50 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions from Dryer Line Cold Start-up[1]

Pollutant	Emission Factor[2] (lb/MMBtu)	Potential Emissions	
		(lb/hr)	(tpy)
CO	0.60	22.5	0.56
NO_x	0.22	8.26	0.21
SO_2	0.025	0.94	0.023
VOC	0.017	0.64	0.016
Total PM	0.58	21.7	0.54
Total PM_{10}	0.52	19.4	0.49
Total $PM_{2.5}$	0.45	16.8	0.42
CO_2	195	7,324	183
CH_4	0.021	0.79	0.020
N_2O	0.013	0.49	0.012
CO_2e	--	7,489	187

Notes:

1. During cold start-ups, the furnace bypass stack is used until the refractory is sufficiently heated and can sustain operations at a low level (approximately 15% of the maximum heat input rate). The furnace bypass stack is then closed, and the furnace is slowly brought up to a normal operating rate.

2. Emission factors from AP-42, Chapter 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. VOC emission factor excludes formaldehyde.

Table 10

Potential Emissions for Furnace Bypass (Cold Start-up)[1]

ES-FURNACEBYPASS

Enviva Pellets Hamlet, LLC

Potential HAP and TAP Emissions from Dryer Line Cold Start-up

Pollutant	HAP	NC TAP	Emission Factor[1] (lb/MMBtu)	Potential Emissions (lb/hr)	Potential Emissions (tpy)
Furnace Biomass Combustion					
Acetaldehyde	Y	Y	8.30E-04	0.031	7.79E-04
Acrolein	Y	Y	0.0040	0.15	0.0038
Formaldehyde	Y	Y	0.0044	0.17	0.0041
Phenol	Y	Y	5.10E-05	0.0019	4.79E-05
Propionaldehyde	Y	N	6.10E-05	0.0023	5.73E-05
Acetophenone	Y	N	3.20E-09	1.20E-07	3.00E-09
Antimony and compounds	Y	N	7.90E-06	2.97E-04	7.42E-06
Arsenic	Y	Y	2.20E-05	8.26E-04	2.07E-05
Benzene	Y	Y	0.0042	0.16	0.0039
Benzo(a)pyrene	Y	Y	2.60E-06	9.77E-05	2.44E-06
Beryllium	Y	Y	1.10E-06	4.13E-05	1.03E-06
Cadmium	Y	Y	4.10E-06	1.54E-04	3.85E-06
Carbon tetrachloride	Y	Y	4.50E-05	0.0017	4.23E-05
Chlorine	Y	Y	7.90E-04	0.030	7.42E-04
Chlorobenzene	Y	Y	3.30E-05	0.0012	3.10E-05
Chloroform	Y	Y	2.80E-05	0.0011	2.63E-05
Chromium VI	Y	Y	3.50E-06	1.31E-04	3.29E-06
Chromium–Other compounds	Y	N	1.75E-05	6.57E-04	1.64E-05
Cobalt	Y	N	6.50E-06	2.44E-04	6.10E-06
Dinitrophenol, 2,4-	Y	N	1.80E-07	6.76E-06	1.69E-07
Di(2-ethylhexyl)phthalate	Y	Y	4.70E-08	1.77E-06	4.41E-08
Ethyl benzene	Y	N	3.10E-05	0.0012	2.91E-05
Dichloroethane, 1,2-	Y	Y	2.90E-05	0.0011	2.72E-05
Hydrochloric acid	Y	Y	0.019	0.71	0.018
Lead	Y	N	4.80E-05	0.0018	4.51E-05
Manganese	Y	Y	0.0016	0.060	0.0015
Mercury	Y	Y	3.50E-06	1.31E-04	3.29E-06
Methyl bromide	Y	N	1.50E-05	5.63E-04	1.41E-05
Methyl chloride	Y	N	2.30E-05	8.64E-04	2.16E-05
Methylene chloride	Y	Y	2.90E-04	1.09E-02	2.72E-04
Trichloroethane, 1,1,1-	Y	Y	3.10E-05	0.0012	2.91E-05
Naphthalene	Y	N	9.70E-05	0.0036	9.11E-05
Nickel	Y	Y	3.30E-05	0.0012	3.10E-05
Nitrophenol, 4-	Y	N	1.10E-07	4.13E-06	1.03E-07
Pentachlorophenol	Y	Y	5.10E-08	1.92E-06	4.79E-08
Perchloroethylene	Y	Y	3.80E-05	0.0014	3.57E-05
Phosphorus metal, yellow or white	Y	N	2.70E-05	0.0010	2.54E-05
Polychlorinated biphenyls	Y	Y	8.15E-09	3.06E-07	7.65E-09
Polycyclic Organic Matter	Y	N	1.25E-04	0.0047	1.17E-04
Dichloropropane, 1,2-	Y	N	3.30E-05	0.0012	3.10E-05
Selenium compounds	Y	N	2.80E-06	1.05E-04	2.63E-06
Styrene	Y	Y	0.0019	0.071	0.0018
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	Y	8.60E-12	3.23E-10	8.08E-12
Toluene	Y	Y	9.20E-04	0.035	8.64E-04
Trichloroethylene	Y	Y	3.00E-05	0.0011	2.82E-05
Trichlorophenol, 2,4,6-	Y	N	2.20E-08	8.26E-07	2.07E-08
Vinyl chloride	Y	Y	1.80E-05	6.76E-04	1.69E-05
Xylene	Y	Y	2.50E-05	9.39E-04	2.35E-05
			Total HAP Emissions:	**1.45**	**0.036**
			Total TAP Emissions:	**1.44**	**0.036**

Notes:

1. Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Abbreviations:

- CH_4 - methane
- CO - carbon monoxide
- CO2 - carbon dioxide
- CO_2e - carbon dioxide equivalent
- HAP - hazardous air pollutant
- hr - hour
- lb - pound
- MMBtu - Million British thermal units
- NO_x - nitrogen oxides
- N_2O - nitrous oxide
- ODT - oven dried tons
- PM - particulate matter
- PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
- $PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
- SO_2 - sulfur dioxide
- TAP - toxic air pollutant
- tpy - tons per year
- VOC - volatile organic compound
- yr - year

Reference:

U.S. EPA. AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

Table 11

Potential Emissions for Furnace Bypass (Idle Mode)[1]

ES-FURNACEBYPASS

Enviva Pellets Hamlet, LLC

Hamlet, Richmond County, North Carolina

Calculation Basis

Hourly Heat Input Capacity (HHV)	15.0 MMBtu/hr
Annual Heat Input Capacity	7,500 MMBtu/yr
Hours of Operation	500 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions from Furnace Idle Mode[1]

Pollutant	Emission Factor[2] (lb/MMBtu)	Potential Emissions	
		(lb/hr)	(tpy)
CO	0.60	9.00	2.25
NO_x	0.22	3.30	0.83
SO_2	0.025	0.38	0.094
VOC	0.017	0.26	0.064
Total PM	0.58	8.66	2.16
Total PM_{10}	0.52	7.76	1.94
Total $PM_{2.5}$	0.45	6.71	1.68
CO_2	195	2,925	731
CH_4	0.021	0.32	0.079
N_2O	0.013	0.20	0.049
CO_2e	--	2,991	748

Notes:

1. Hours of operation in furnace "idle mode" are limited to 500 hours per year. Idle mode is defined as operation up to 15 MMBtu /hr.
2. Emission factors from AP-42, Chapter 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. VOC emission factor excludes formaldehyde.

Table 11

Potential Emissions for Furnace Bypass (Idle Mode)[1]

ES-FURNACEBYPASS

Enviva Pellets Hamlet, LLC

Potential HAP and TAP Emissions from Furnace Idle Mode

Pollutant	HAP	NC TAP	Emission Factor[1] (lb/MMBtu)	Potential Emissions	
				(lb/hr)	(tpy)
Furnace Biomass Combustion					
Acetaldehyde	Y	Y	8.30E-04	0.012	0.0031
Acrolein	Y	Y	0.0040	0.060	0.015
Formaldehyde	Y	Y	0.0044	0.066	0.017
Phenol	Y	Y	5.10E-05	7.65E-04	1.91E-04
Propionaldehyde	Y	N	6.10E-05	9.15E-04	2.29E-04
Acetophenone	Y	N	3.2E-09	4.80E-08	1.20E-08
Antimony and compounds	Y	N	7.9E-06	1.19E-04	2.96E-05
Arsenic	Y	Y	2.2E-05	3.30E-04	8.25E-05
Benzene	Y	Y	0.0042	0.063	0.016
Benzo(a)pyrene	Y	Y	2.6E-06	3.90E-05	9.75E-06
Beryllium	Y	Y	1.1E-06	1.65E-05	4.13E-06
Cadmium	Y	Y	4.1E-06	6.15E-05	1.54E-05
Carbon tetrachloride	Y	Y	4.5E-05	6.75E-04	1.69E-04
Chlorine	Y	Y	7.9E-04	0.012	0.0030
Chlorobenzene	Y	Y	3.3E-05	4.95E-04	1.24E-04
Chloroform	Y	Y	2.8E-05	4.20E-04	1.05E-04
Chromium VI	Y	Y	3.5E-06	5.25E-05	1.31E-05
Chromium–Other compounds	Y	N	1.8E-05	2.63E-04	6.56E-05
Cobalt	Y	N	6.5E-06	9.75E-05	2.44E-05
Dinitrophenol, 2,4-	Y	N	1.8E-07	2.70E-06	6.75E-07
Di(2-ethylhexyl)phthalate	Y	Y	4.7E-08	7.05E-07	1.76E-07
Ethyl benzene	Y	N	3.1E-05	4.65E-04	1.16E-04
Dichloroethane, 1,2-	Y	Y	2.9E-05	4.35E-04	1.09E-04
Hydrochloric acid	Y	Y	0.019	0.29	0.071
Lead	Y	N	4.8E-05	7.20E-04	1.80E-04
Manganese	Y	Y	0.0016	0.024	0.0060
Mercury	Y	Y	3.5E-06	5.25E-05	1.31E-05
Methyl bromide	Y	N	1.5E-05	2.25E-04	5.63E-05
Methyl chloride	Y	N	2.3E-05	3.45E-04	8.63E-05
Methylene chloride	Y	Y	2.90E-04	4.35E-03	1.09E-03
Trichloroethane, 1,1,1-	Y	Y	3.1E-05	4.65E-04	1.16E-04
Naphthalene	Y	N	9.7E-05	0.0015	3.64E-04
Nickel	Y	Y	3.3E-05	4.95E-04	1.24E-04
Nitrophenol, 4-	Y	N	1.1E-07	1.65E-06	4.13E-07
Pentachlorophenol	Y	Y	5.1E-08	7.65E-07	1.91E-07
Perchloroethylene	Y	Y	3.8E-05	5.70E-04	1.43E-04
Phosphorus metal, yellow or white	Y	N	2.7E-05	4.05E-04	1.01E-04
Polychlorinated biphenyls	Y	Y	8.1E-09	1.22E-07	3.05E-08
Polycyclic Organic Matter	Y	N	1.2E-04	0.0019	4.68E-04
Dichloropropane, 1,2-	Y	N	3.3E-05	4.95E-04	1.24E-04
Selenium compounds	Y	N	2.8E-06	4.20E-05	1.05E-05
Styrene	Y	Y	0.0019	0.029	0.0071
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	Y	8.6E-12	1.29E-10	3.23E-11
Toluene	Y	Y	9.2E-04	0.014	0.0035
Trichloroethylene	Y	Y	3.0E-05	4.50E-04	1.13E-04
Trichlorophenol, 2,4,6-	Y	N	2.2E-08	3.30E-07	8.25E-08
Vinyl chloride	Y	Y	1.8E-05	2.70E-04	6.75E-05
Xylene	Y	Y	2.5E-05	3.75E-04	9.38E-05
			Total HAP Emissions:	**0.58**	**0.15**
			Total TAP Emissions:	**0.57**	**0.14**

Notes:

1. Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Abbreviations:

CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
lb - pound
MMBtu - Million British thermal units
NO_x - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
SO_2 - sulfur dioxide
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:

U.S. EPA. AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

Table 12

Dryer System Duct Burner Potential Emissions IES-DB-1 and 2

Enviva Pellets Hamlet, LLC Hamlet, Richmond County, North Carolina

Calculation Basis

Duct Burner Rating	2.5	MMBtu/hr
Number of Duct Burners	2	
Annual Operation	8,760	hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions - Dryer System Duct Burners[1]

Pollutant	Emission Factor[2] (lb/MMscf)	Potential Emissions (lb/hr)	Potential Emissions (tpy)
CO	84.0	0.41	1.80
NO_X	50.0	0.25	1.07
SO_2	0.60	0.0029	0.013
VOC	5.50	0.027	0.12
$PM/PM_{10}/PM_{2.5}$ Condensable	5.70	0.028	0.12
$PM/PM_{10}/PM_{2.5}$ Filterable	1.90	0.0093	0.041
Total $PM/PM_{10}/PM_{2.5}$	--	0.037	0.16
CO_2	120,000	0.047	0.20
CH_4	2.30	0.084	0.37
N_2O	0.64	0.13	0.57
CO_2e	--	41.0	180

Notes:

1. A natural gas-fired low-NOx burner is used to heat the dryer system ducts to prevent condensation of wood tar from occurring and thus reduce the fire risk.
2. Emission factors for natural gas combustion from AP-42 Section 1.4 - Natural Gas Combustion, 07/98. Natural gas heating value of 1,020 Btu/scf assumed per AP-42.

Table 12

Dryer System Duct Burner Potential Emissions IES-DB-1 and 2

Enviva Pellets Hamlet, LLC Hamlet, Richmond County, North Carolina

Potential HAP and TAP Emissions

Pollutant	HAP	NC TAP	VOC	Emission Factor[1] (lb/MMscf)	Potential Emissions (lb/hr)	Potential Emissions (tpy)
2-Methylnaphthalene	Y	N	Y	2.40E-05	1.18E-07	5.15E-07
3-Methylchloranthrene	Y	N	Y	1.80E-06	8.82E-09	3.86E-08
7,12-Dimethylbenz(a)anthracene	Y	N	Y	1.60E-05	7.84E-08	3.44E-07
Acenaphthene	Y	N	Y	1.80E-06	8.82E-09	3.86E-08
Acenaphthylene	Y	N	Y	1.80E-06	8.82E-09	3.86E-08
Acetaldehyde	Y	Y	Y	1.52E-05	7.45E-08	3.26E-07
Acrolein	Y	Y	Y	1.80E-05	8.82E-08	3.86E-07
Ammonia	N	Y	N	3.2	1.57E-02	6.87E-02
Anthracene	Y	N	Y	2.40E-06	1.18E-08	5.15E-08
Arsenic	Y	Y	N	2.00E-04	9.80E-07	4.29E-06
Benz(a)anthracene	Y	N	Y	1.80E-06	8.82E-09	3.86E-08
Benzene	Y	N	Y	2.10E-03	1.03E-05	4.51E-05
Benzo(a)pyrene	Y	Y	Y	1.20E-06	5.88E-09	2.58E-08
Benzo(b)fluoranthene	Y	N	Y	1.80E-06	8.82E-09	3.86E-08
Benzo(g,h,i)perylene	Y	N	Y	1.20E-06	5.88E-09	2.58E-08
Benzo(k)fluoranthene	Y	N	Y	1.80E-06	8.82E-09	3.86E-08
Beryllium	Y	Y	N	1.20E-05	5.88E-08	2.58E-07
Cadmium	Y	Y	N	1.10E-03	5.39E-06	2.36E-05
Chromium VI	Y	N	N	1.40E-03	6.86E-06	3.01E-05
Chrysene	Y	N	Y	1.80E-06	8.82E-09	3.86E-08
Cobalt	Y	N	N	8.40E-05	4.12E-07	1.80E-06
Dibenzo(a,h)anthracene	Y	N	Y	1.20E-06	5.88E-09	2.58E-08
Dichlorobenzene	Y	Y	Y	1.20E-03	5.88E-06	2.58E-05
Fluoranthene	Y	N	Y	3.00E-06	1.47E-08	6.44E-08
Fluorene	Y	N	Y	2.80E-06	1.37E-08	6.01E-08
Formaldehyde	Y	Y	Y	7.50E-02	3.68E-04	1.61E-03
Hexane	Y	Y	Y	1.8	8.82E-03	3.86E-02
Indeno(1,2,3-cd)pyrene	Y	N	Y	1.80E-06	8.82E-09	3.86E-08
Lead	Y	N	N	5.00E-04	2.45E-06	1.07E-05
Manganese	Y	Y	N	3.80E-04	1.86E-06	8.16E-06
Mercury	Y	Y	N	2.60E-04	1.27E-06	5.58E-06
Naphthalene	Y	N	Y	6.10E-04	2.99E-06	1.31E-05
Nickel	Y	Y	N	2.10E-03	1.03E-05	4.51E-05
Phenanthrene	Y	N	Y	1.70E-05	8.33E-08	3.65E-07
Pyrene	Y	N	Y	5.00E-06	2.45E-08	1.07E-07
Selenium	Y	N	N	2.40E-05	1.18E-07	5.15E-07
Toluene	Y	Y	Y	3.40E-03	1.67E-05	7.30E-05
Total HAP Emissions:					**0.0093**	**0.041**
Total TAP Emissions:					**0.025**	**0.11**

Notes:

[1] Emission factors for natural gas combustion are from NCDAQ Natural Gas Combustion Spreadsheet and AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.

Abbreviations:

CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NC - North Carolina
NO_x - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

Reference:

U.S. EPA. AP-42, Section 1.4 - Natural Gas Combustion, 07/98.

Table 14

Table 13

Dried Wood Handling Potential Emissions ES-DWH

Enviva Pellets Hamlet, LLC Hamlet, Richmond County, North Carolina

Calculation Basis

Maximum Hourly Throughput[1]	80 ODT/hr
Annual Throughput[1]	625,011 ODT/yr

Potential VOC and HAP Emissions

Pollutant	Emission Factor[2] (lb/ODT)	Potential Emissions (lb/hr)	Potential Emissions (tpy)
Formaldehyde	4.32E-04	0.035	0.14
Methanol	8.88E-04	0.071	0.28
Acetaldehyde	4.80E-04	0.038	0.15
Propionaldehyde	1.42E-04	0.011	0.044
Total HAP Emissions:		**0.16**	**0.61**
VOC as propane	0.050	4.02	15.7

Notes:

1. Hourly and annual throughputs assumed to be the same as the dryer throughput.
2. Emission factor based on January 2020 compliance testing at the Hamlet plant and December 2019 compliance testing at the Enviva Sampson plant plus a 20% contingency to account for inherent variability in stack test results. The VOC emission factor was adjusted to account for the difference in pine percentage during testing and the maximum allowable.

Abbreviations:

hr - hour lb - pound
ODT - oven dried tons tpy - tons per year
VOC - volatile organic compound yr - year

Table 14
Dry Shaving Material Handling
IES-DRYSHAVE
Enviva Pellets Hamlet, LLC Hamlet,
Richmond County, North Carolina

Source	Transfer Activity	Number of Drop Points	Material Moisture Content	PM Emission Factor[1]	PM_{10} Emission Factor[1]	$PM_{2.5}$ Emission Factor[1]	Potential Throughput[2,3]		Potential PM Emissions		Potential PM_{10} Emissions		Potential $PM_{2.5}$ Emissions	
			(%)	(lb/ton)	(lb/ton)	(lb/ton)	(tph)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
IES-DRYSHAVE	Dry Shaving Material Handling - Truck dump to truck dumper	1	10%	4.47E-04	2.12E-04	3.20E-05	25	219,000	0.011	0.049	0.0053	0.023	8.01E-04	0.0035
	Dry Shaving Material Handling - Bucket elevator to silo[4]	1	10%	4.47E-04	2.12E-04	3.20E-05	25	219,000	0.0011	0.0049	5.29E-04	0.0023	8.01E-05	3.51E-04
							Total Emissions:		**0.012**	**0.054**	**0.0058**	**0.025**	**8.81E-04**	**0.0039**

Notes:

1. Emission factor calculation based on formula from AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles, Equation 13.2.1, (11/06). where: E = emission factor (lb/ton)

k = particle size multiplier (dimensionless) for PM 0.74

k = particle size multiplier (dimensionless) for PM_{10} 0.35

k = particle size multiplier (dimensionless) for $PM_{2.5}$ 0.053

U = mean wind speed (mph) 7.85

2. Hourly throughput based on a maximum transfer rate of 100 ton/hr of dry shaving material.

3. Annual throughput based on 4 dry shaving deliveries per week and a maximum storage capacity of 1360 tons for the dry shaving material storage silo.

4. Bucket elevator to silo material handling transfer point emissions account for a 90% control efficiency due to the enclosed nature of the silo (San Diego County, 1993).

Abbreviations:

hr - hour lb - pound
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns $PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less tpy - tons per year
yr - year

References:

U.S. EPA. AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles, 11/06.

San Diego County. 1993. Cement & Fly Ash Storage Silos. June 7. Available online at: https://www.sandiegocounty.gov/content/dam/sdc/apcd/PDF/Toxics_Program/APCD_silo1.pdf.

Table 15
Summary of Potential Emissions from Baghouses Enviva Pellets
Hamlet, LLC
Hamlet, Richmond County, North Carolina

Emission Unit ID	Source Description	Control Device ID	Control Device Description	Exhaust Flow Rate	Exit Grain Loading	Particulate Speciation		Potential Emissions					
								PM		PM_{10}		$PM_{2.5}$	
				(cfm)	(gr/cf)	PM_{10} (% of PM)	$PM_{2.5}$ (% of PM)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
ES-HMC	Hammermill Collection Conveyor	CD-HMC-BH	One (1) baghouse[1, 2]	1,500	0.004	100%	100%	0.051	0.23	0.051	0.23	0.051	0.23
ES-PCHP	Pellet Cooler HP Fines Relay System	CD-PCHP-BH	One (1) baghouse[1, 2]	500	0.004	100%	100%	0.017	0.075	0.017	0.075	0.017	0.075
ES-PMFS	Pellet Mill Feed Silo	CD-PMFS-BH	One (1) baghouse[1, 2]	2,444	0.004	100%	100%	0.084	0.37	0.084	0.37	0.084	0.37
ES-FPH	Finished Product Handling	CD-FPH-BH	One (1) baghouse[3, 4]	8,500	0.004	91%	40.0%	0.29	1.28	0.27	1.16	0.12	0.51
ES-PB-1 and 2	Two (2) Pellet Loadout Bins												
ES-PL-1 through 3	Three (3) Pellet Loadouts												
ES-DWH	Dried Wood Handling Operations (conveyors)	CD-DWH-BH1	One (1) baghouse[1, 2]	1,000	0.004	100%	100%	0.034	0.15	0.034	0.15	0.034	0.15
		CD-DWH-BH2	One (1) baghouse[1, 2]	1,000	0.004	100%	100%	0.034	0.15	0.034	0.15	0.034	0.15

Notes:

1. No speciation data is available for PM_{10}. Therefore, it is conservatively assumed to be equal to total PM.
2. No speciation data is available for $PM_{2.5}$. Therefore, it is conservatively assumed to be equal to total PM.
3. Finished product handling PM_{10} speciation is based on emission factors for wet wood combustion controlled by a mechanical separator from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03. Because the particle size of particulate matter from finished product handling is anticipated to be larger than flyash, this factor is believed to be a conservative indicator of speciation.
4. Finished product handling $PM_{2.5}$ speciation is based on a review of NCASI particle size distribution data for similar baghouses in the wood products industry.

Abbreviations:

cf - cubic feet
cfm - cubic feet per minute
ES - Emission Sources
IES - Insignificant Emission Source
gr - grain
hr - hour
lb - pound
NCASI - National Council for Air and Stream Improvement, Inc.
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year

Reference:

U.S. AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

Table 16
Additive Handling
IES-ADD
Enviva Pellets Hamlet, LLC Hamlet,
Richmond County, North Carolina

Source	Transfer Activity	Number of Drop Points	Material Moisture Content	PM Emission Factor[1]	PM_{10} Emission Factor[1]	$PM_{2.5}$ Emission Factor[1]	Potential Throughput[2,3]		Potential PM Emissions		Potential PM_{10} Emissions		Potential $PM_{2.5}$ Emissions	
			(%)	(lb/ton)	(lb/ton)	(lb/ton)	(tph)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
IES-ADD	Transfer from Supersacks to Hopper	1	10%	4.47E-04	2.12E-04	3.20E-05	0.18	1,563	8.22E-05	3.49E-04	3.89E-05	1.65E-04	5.89E-06	2.50E-05

Notes:
[1] Emission factor calculation based on formula from AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles, Equation 13.2.1, (11/06). where: E = emission factor (lb/ton)

k = particle size multiplier (dimensionless) for 0.74
k = particle size multiplier (dimensionless) for 0.35
k = particle size multiplier (dimensionless) for 0.053
U = mean wind speed (mph) 7.85

[2] Hourly and annual additive throughputs based on expected maximum usage.

Abbreviations:
hr - hour lb - pound
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns $PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less tpy - tons per year
yr - year

References:
U.S. EPA. AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles, 11/06.

Table 17

Potential VOC and HAP Emissions at Outlet of Pellet Mill/Pellet Cooler RTO/RCO Stack ES-CLR-1 through 6

Enviva Pellets Hamlet, LLC

Hamlet, Richmond County, North Carolina

Calculation Basis

Maximum Hourly Throughput	80 ODT/hr
Annual Throughput	625,011 ODT/yr
Hours of Operation	8,760 hr/yr
Number of Burners	4 burners
RCO/RTO Burner Rating	8 MMBtu/hr
RCO/RTO Control Efficiency	95%

Pellet Mill and Pellet Cooler Potential Emissions

Pollutant	CAS No.	NC TAP	VOC	Controlled Emission Factor[1,2]	Potential Emissions at RTO/RCO Stack[3]	
				(lb/ODT)	(lb/hr)	(tpy)
Acetaldehyde	75-07-0	Y	Y	0.0029	0.23	0.90
Acrolein	107-02-8	Y	Y	0.0025	0.20	0.79
Formaldehyde	50-00-0	Y	Y	0.0030	0.24	0.94
Methanol	67-56-1	N	Y	0.00088	0.071	0.28
Phenol	108-95-2	Y	Y	0.0011	0.087	0.34
Propionaldehyde	123-38-6	N	Y	5.16E-04	0.041	0.16
				Total HAP Emissions	**0.87**	**3.40**
				Total TAP Emissions	**0.76**	**2.96**
VOC (as propane)	--	--	Y	0.079	0.32	1.23
CO	--	--	--	0.071	5.66	22.1
NO_X	--	--	--	0.0077	0.61	2.40
PM	--	--	--	0.0032	0.26	1.01
PM_{10}	--	--	--	0.0032	0.26	1.01
$PM_{2.5}$	--	--	--	0.0016	0.13	0.51

Notes:

1. Emission factor derived from process information and an appropriate contingency based on engineering judgement.
2. Emission factors for VOC and HAP are based on post-RTO/RCO test data. The pellet mills and coolers are equipped with an RCO that operates primarily in catalytic mode with thermal (RTO) mode as a backup. The RTO and RCO modes have the same control efficiency so there is no impact on emissions during thermal mode usage.
3. Particulate, CO, and NO_X emissions are based on post-RCO test data and include emissions from fuel combustion by the RTO/RCO.

Potential Criteria Pollutant and Greenhouse Gas Emissions from RTO/RCO Natural Gas Combustion

Pollutant	Emission Factor	Units	Potential Emissions[1]	
			(lb/hr)	(tpy)
SO_2	5.9E-04	lb/MMBtu[2]	0.019	0.082
CO_2	53.06	kg/MMBtu[3]	3,743	16,396
CH_4	0.0010	kg/MMBtu[3]	0.071	0.31
N_2O	1.0E-04	kg/MMBtu[3]	0.0071	0.031
CO_2e			3,747	16,412

Notes:

1. Emissions of VOC, CO, NO_X, PM, PM_{10}, and $PM_{2.5}$ are not included in this table because they are already reflected in the lb/ODT factors in the first table which are based on post-RTO/RCO test data.
2. Emission factor from AP-42, Section 1.4 - Natural Gas Combustion, 07/98. Emission factors converted from lb/MMscf to lb/MMBtu based on assumed heating value of 1,020 Btu/scf for natural gas per AP-42 Section 1.4.
3. Emission factors for natural gas combustion by the burners obtained from Table C-1 and C-2 of 40CFR Part 98 and Global Warming Potentials from Table A-1.

Table 17

Potential VOC and HAP Emissions at Outlet of Pellet Mill/Pellet Cooler RTO/RCO StackES-CLR-1 through 6

Enviva Pellets Hamlet, LLC

Hamlet, Richmond County, North Carolina

Potential HAP and TAP Emissions from RTO/RCO Natural Gas Combustion

Pollutant	HAP	NC TAP	VOC	Emission Factor[3] (lb/MMscf)	Potential Emissions (lb/hr)	Potential Emissions (tpy)
RTO/RCO Natural Gas Combustion						
2-Methylnaphthalene	Y	N	Y	2.40E-05	7.53E-07	3.30E-06
3-Methylchloranthrene	Y	N	Y	1.80E-06	5.65E-08	2.47E-07
7,12-Dimethylbenz(a)anthracene	Y	N	Y	1.60E-05	5.02E-07	2.20E-06
Acenaphthene	Y	N	Y	1.80E-06	5.65E-08	2.47E-07
Acenaphthylene	Y	N	Y	1.80E-06	5.65E-08	2.47E-07
Ammonia	N	Y	N	3.2	0.10	0.44
Anthracene	Y	N	Y	2.40E-06	7.53E-08	3.30E-07
Arsenic	Y	Y	N	2.00E-04	6.27E-06	2.75E-05
Benz(a)anthracene	Y	N	Y	1.80E-06	5.65E-08	2.47E-07
Benzene	Y	N	Y	0.0021	6.59E-05	2.89E-04
Benzo(a)pyrene	Y	Y	Y	1.20E-06	3.76E-08	1.65E-07
Benzo(b)fluoranthene	Y	N	Y	1.80E-06	5.65E-08	2.47E-07
Benzo(g,h,i)perylene	Y	N	Y	1.20E-06	3.76E-08	1.65E-07
Benzo(k)fluoranthene	Y	N	Y	1.80E-06	5.65E-08	2.47E-07
Beryllium	Y	Y	N	1.20E-05	3.76E-07	1.65E-06
Cadmium	Y	Y	N	0.0011	3.45E-05	1.51E-04
Chromium VI	Y	N	N	0.0014	4.39E-05	1.92E-04
Chrysene	Y	N	Y	1.80E-06	5.65E-08	2.47E-07
Cobalt	Y	N	N	8.40E-05	2.64E-06	1.15E-05
Dibenzo(a,h)anthracene	Y	N	Y	1.20E-06	3.76E-08	1.65E-07
Dichlorobenzene	Y	Y	Y	0.0012	3.76E-05	1.65E-04
Fluoranthene	Y	N	Y	3.00E-06	9.41E-08	4.12E-07
Fluorene	Y	N	Y	2.80E-06	8.78E-08	3.85E-07
Hexane	Y	Y	Y	1.8	0.056	0.25
Indeno(1,2,3-cd)pyrene	Y	N	Y	1.80E-06	5.65E-08	2.47E-07
Lead	Y	N	N	5.00E-04	1.57E-05	6.87E-05
Manganese	Y	Y	N	3.80E-04	1.19E-05	5.22E-05
Mercury	Y	Y	N	2.60E-04	8.16E-06	3.57E-05
Naphthalene	Y	N	Y	6.10E-04	1.91E-05	8.38E-05
Nickel	Y	Y	N	0.0021	6.59E-05	2.89E-04
Phenanthrene	Y	N	Y	1.70E-05	5.33E-07	2.34E-06
Pyrene	Y	N	Y	5.00E-06	1.57E-07	6.87E-07
Selenium	Y	N	N	2.40E-05	7.53E-07	3.30E-06
Toluene	Y	Y	Y	0.0034	1.07E-04	4.67E-04
				Total HAP Emissions:	**0.057**	**0.25**
				Total TAP Emissions:	**0.16**	**0.69**

Notes:

1. Emission factors from AP-42, Section 1.4 - Natural Gas Combustion, 07/98. Emission factors converted from lb/MMscf to lb/MMBtu based on assumed heating value of 1,020 Btu/scf for natural gas per AP-42 Section 1.4.
2. Emission factors for natural gas combustion by the burners obtained from Table C-1 and C-2 of 40 CFR Part 98 and Global Warming Potentials from Table A-1.
3. Emission factors for natural gas combustion are from NCDAQ Natural Gas Combustion Spreadsheet and AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98 for small boilers. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.

Abbreviations:

CAS - chemical abstract service
HAP - hazardousair pollutant
hr - hour
lb - pound
NC - North Carolina
ODT - oven dried tons
RCO - regenerative catalytic oxidizer
RTO - regenerative thermal oxidizer
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:

U.S. EPA. AP-42, Section 1.4 - Natural Gas Combustion, 07/98.

Table 18

Emergency Generator Potential Emissions IES-GN

Enviva Pellets Hamlet, LLC Hamlet,

Richmond County, North Carolina

Calculation Basis

Engine Output	500 kW
Horsepower Rating	671 brake hp
Diesel Heating Value	19,300 Btu/lb
Hours of Operation	500 hr/yr
Conversion factor	2,545 Btu/hr/hp
Hourly Fuel Consumption	31.9 gal/hr[1]
Energy Input	4.37 MMBtu/hr[2]

Notes:

1. Fuel consumption calculated using a factor of 0.0476 gal/hr-hp. Advanced Environmental Interface, Inc. (1998). General Permits for Emergency Engines. INSIGHTS, 98-2, 3.
2. Energy calculated on a fuel consumption basis, using an energy factor of 0.137 MMBtu/gal.

Potential Criteria Pollutant and Greenhouse Gas Emissions

Pollutant	Emission Factor	Units	Potential Emissions[1]	
			(lb/hr)	(tpy)
CO[2]	0.39	g/hp-hr	0.58	0.14
NO_X[2]	6.65	g/hp-hr	9.83	2.46
SO_2[3]	15	ppmw	0.0027	6.6E-04
VOC[2]	0.01	lb/hp-hr	6.71	1.68
PM[2]	0.021	g/hp-hr	0.031	0.0078
PM_{10}[2]	0.021	g/hp-hr	0.031	0.0078
$PM_{2.5}$[2]	0.021	g/hp-hr	0.031	0.0078
CO_2	74.0	kg/MMBtu[4]	713	178
CH_4	0.0030	kg/MMBtu[4]	0.029	0.0072
N_2O	6.0E-04	kg/MMBtu[4]	0.0058	0.0014
CO_2e			715	179

Notes:

1. NSPS allows for only 100 hr/yr of non-emergency operation of these engines. Potential emissions for the emergency generator are conservatively based on 500 hr/yr.
2. Emission factors for Particulate Matter ($PM/PM_{10}/PM_{2.5}$), Nitrous Oxide (NO_x), Volatile Organic Matter (VOC), and Carbon Monoxide (CO) obtained from generator's spec sheet. The generator's spec sheet does not include an emission factor for VOC so the hydrocarbon (HC) emission factor was used as a surrogate for VOC.
3. Sulfur content in accordance with 40 CFR 80.510(b) as required by NSPS Subpart IIII [40 CFR §60.4207(b)].
4. Emission factors from Table C-1 and C-2 of 40 CFR Part 98 and Global Warming Potentials from Table A-1.

Potential HAP and TAP Emissions

Pollutant	CAS No.	NC TAP	VOC	Emission Factor[1]	Potential Emissions[2]	
				(lb/hp-hr)	(lb/hr)	(tpy)
Acetaldehyde	75-07-0	Y	Y	1.76E-07	1.18E-04	2.96E-05
Acrolein	107-02-8	Y	Y	5.52E-08	3.70E-05	9.25E-06
Benzene	71-43-2	Y	Y	5.43E-06	3.64E-03	9.11E-04
Benzo(a)pyrene[3]	50-32-8	Y	Y	1.80E-09	1.21E-06	3.02E-07
Formaldehyde	50-00-0	Y	Y	5.52E-07	3.70E-04	9.26E-05
Naphthalene[3]	91-20-3	N	Y	9.10E-07	6.10E-04	1.53E-04
Total PAH (POM)	--	N	Y	1.48E-06	9.95E-04	2.49E-04
Toluene	108-88-3	Y	Y	1.97E-06	1.32E-03	3.30E-04
Xylene	1330-20-7	Y	Y	1.35E-06	9.06E-04	2.26E-04
				Total HAP Emissions:	**0.0074**	**0.0018**
				Total TAP Emissions:	**0.0064**	**0.0016**

Notes:

1. Emission factors obtained from AP-42 Section 3.4 - Large Stationary Diesel and All Stationary Dual-fuel Engines, 10/96.
2. NSPS allows for only 100 hr/yr of non-emergency operation of these engines. Potential emissions for the emergency generator are conservatively based on 500 hr/yr.
3. Benzo(a)pyrene and naphthalene are included as HAPs in Total PAH.

Abbreviations:

Btu - British thermal unit
CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
g - gram
gal - gallon
HAP - hazardous air pollutant
hp - horsepower
hr - hour
kg - kilogram
kW - kilowatt
lb - pound
MW - megawatt
MMBtu - Million British thermal units
NO_X - nitrogen oxides
NC - North Carolina
N_2O - nitrous oxide
ODT - oven dried tons
PAH - polycyclic aromatic hydrocarbon
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
POM - polycyclic organic matter
SO_2 - sulfur dioxide
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
yr - year

References:

Advanced Environmental Interface, Inc. (1998). General Permits for Emergency Engines. INSIGHTS, 98-2, 3.
U.S. EPA. AP-42 Chapter 3.4, Large Stationary Diesel and All Stationary Dual-fuel Engines, 10/96.

Table 19

Fire Pump Potential Emissions

IES-FWP

Enviva Pellets Hamlet, LLC Hamlet,

Richmond County, North Carolina

Calculation Basis

Engine Output	0.10 MW
Horsepower Rating	131 brake hp
Diesel Density[1]	7.1 lb/gal
Hours of Operation	500 hr/yr
Hourly Fuel Consumption	9 gal/hr[1]
Energy Input	1.23 MMBtu/hr[2]

Notes:

[1] Diesel density from AP-42 Section 3.4 - Large Stationary Diesel and All Stationary Dual-fuel Engines, 10/96, Table 3.4-1, footnote a.

[2] Energy calculated on a fuel consumption basis, using an energy factor of 0.137 MMBtu/gal.

Potential Criteria Pollutant and Greenhouse Gas Emissions

Pollutant	Emission Factor	Units	Potential Emissions[1] (lb/hr)	Potential Emissions[1] (tpy)
CO[2]	1.3	g/kW-hr	0.28	0.070
NO_x[2]	3.4	g/kW-hr	0.72	0.18
SO_2[3]	15	ppmw	0.0019	4.79E-04
VOC[2]	0.15	g/kW-hr	0.032	0.0081
PM[2]	0.17	g/kW-hr	0.037	0.0092
PM_{10}[2]	0.17	g/kW-hr	0.037	0.0092
$PM_{2.5}$[2]	0.17	g/kW-hr	0.037	0.0092
CO_2	74	kg/MMBtu[4]	201	50
CH_4	3.0E-03	kg/MMBtu[4]	0.0082	0.0020
N_2O	6.0E-04	kg/MMBtu[4]	0.0016	4.08E-04
CO_2e			202	50

Notes:

[1] NSPS allows for only 100 hr/yr of non-emergency operation of these engines. Potential emissions for the fire pump are conservatively based on 500 hr/yr.

[2] Emissions factors for PM/PM_{10}/$PM_{2.5}$, NO_X, hydrocarbons, and CO obtained from generator's spec sheet.

[3] Sulfur content in accordance with 40 CFR 80.510(b) as required by NSPS Subpart IIII [40 CFR §60.4207(b)].

[4] Emission factors from Table C-1 and C-2 of 40 CFR Part 98 and Global Warming Potentials from Table A-1.

Potential HAP Emissions

Pollutant	CAS No.	NC TAP	VOC	Emission Factor[1] (lb/hp-hr)	Potential Emissions[2] (lb/hr)	Potential Emissions[2] (tpy)
Acetaldehyde	75-07-0	Y	Y	5.37E-06	7.03E-04	1.76E-04
Acrolein	107-02-8	Y	Y	6.48E-07	8.48E-05	2.12E-05
Benzene	71-43-2	Y	Y	6.53E-06	8.56E-04	2.14E-04
Benzo(a)pyrene	50-32-8	Y	Y	1.32E-09	1.72E-07	4.31E-08
1,3-Butadiene	106-99-0	Y	Y	2.74E-07	3.59E-05	8.96E-06
Formaldehyde	50-00-0	Y	Y	8.26E-06	0.0011	2.71E-04
Naphthalene	91-20-3	N	Y	5.94E-07	7.78E-05	1.95E-05
Total PAH (POM)[3]	--	N	Y	1.18E-06	1.54E-04	3.85E-05
Toluene	108-88-3	Y	Y	2.86E-06	3.75E-04	9.38E-05
Xylene	1330-20-7	Y	Y	2.00E-06	2.61E-04	6.53E-05
				Total HAP Emissions:	**0.0036**	**8.88E-04**
				Total TAP Emissions:	**0.0034**	**8.50E-04**

Notes:

[1] Emission factor obtained from NCDAQ Internal Combustion (Small Gasoline and Diesel Engines) Spreadsheet/AP-42 Section 3.3 - Stationary Internal Combustion Engines, 10/96, Table 3.3-2.

[2] NSPS allows for only 100 hr/yr of non-emergency operation of these engines. Potential emissions for the fire pump are conservatively based on 500 hr/yr.

[3] The PAH emission factor includes all the PAH compounds listed in AP-42. Emissions for naphthalene and benzo(a)pyrene are also calculated separately. For the purposes of calculating total HAP emissions, the naphthalene and benzo(a)pyrene are not included separately to avoid double counting these emissions.

Abbreviations:

Btu - British thermal unit
CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
g - gram
gal - gallon
HAP - hazardous air pollutant
hp - horsepower
hr - hour
kg - kilogram
kW - kilowatt
lb - pound
MW - megawatt
MMBtu - Million British thermal units
NO_X - nitrogen oxides
NC - North Carolina
N_2O - nitrous oxide
ODT - oven dried tons
PAH - polycyclic aromatic hydrocarbon
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
POM - polycyclic organic matter
SO_2 - sulfur dioxide
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
yr - year

References:

U.S. EPA. AP-42 Chapter 3.3, Stationary Internal Combustion Engines, 10/96.
U.S. EPA. AP-42 Chapter 3.4, Large Stationary Diesel and All Stationary Dual-fuel Engines, 10/96.

Table 20 Diesel Storage Tanks IES-TK-1 through 3
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Calculation Constants

Description	IES-TK-1	IES-TK-2	IES-TK-3	Units	Notes
α - Tank Paint Solar Absorptance	0.25			dimensionless	AP-42, Chapter 7 - Table 7.1-6 for White Tank, Average Condition
I - Annual Avg Total Solar Insolation Factor	1,395			dimensionless	AP-42, Chapter 7 - Table 7.1-7 for Charlotte, NC
T_{AX} - Annual Avg Maximum Ambient Temperature	530.5			R	AP-42, Chapter 7 - Table 7.1-7 for Charlotte, NC
T_{AN} - Annual Avg Minimum Ambient Temperature	510.8			R	AP-42, Chapter 7 - Table 7.1-7 for Charlotte, NC
R - Ideal Gas Constant	10.731			psia*ft³/lb-mole R	AP-42, Chapter 7 - Page 7.1-23
Kp - Product Factor	1			dimensionless	Assume conservative value of 1
P_{VX} - Vapor Pressure at T_{AX}	0.0092			psia	AP-42, Chapter 7 - Equation 1-25 (exp[A-(B/T_{LA})])
P_{VN} - Vapor Pressure at T_{AN}	0.0048			psia	AP-42, Chapter 7 - Equation 1-25 (exp[A-(B/T_{LA})])
ΔP_V - Daily Vapor Pressure Range	0.0044			psia	AP-42, Chapter 7 - Equation 1-9
ΔP_B - Breather Vent Pressure Setting Range	0.06			psia	AP-42, Chapter 7 - Page 7.1-19 Note 3 (default)
P_A - Atmospheric Pressure	14.32			psia	AP-42, Chapter 7 - Table 7.1-7 for Charlotte, NC

Calculation Inputs

Description	IES-TK-1	IES-TK-2	IES-TK-3	Units	Notes
Tank Diameter	5.3	3.3	6.0	ft	Dimensions were provided by Enviva
Tank Length	6.0	3.3	23.7	ft	Dimensions were provided by Enviva
Tank Design Volume	1,000	185	5,000	gal	Conservative design specifications
Tank Working Volume	500	92.5	2,500	gal	50% of tank design volume because tanks will not be full at all times
Tank Throughput	15,958	4,500	200,000	gal/yr	Throughput for IES-TK-1 and IES-TK-2 based on fuel consumption provided by Enviva and 500 hours of operation per year for the fire pump and emergency generator. Throughput for IES-TK-3 provided by Enviva.
Equivalent Tank Diameter (D_E)	6.4	3.7	13.4	ft	AP-42, Chapter 7 - Equation 1-14 (SQRT(LD/(PI/4)))
Effective Height (H_E)	4.2	2.6	4.7	ft	AP-42, Chapter 7 - Equation 1-15 (PI/4*D)
V_v - Vapor Space Volume	66.2	13.8	334.6	ft³	AP-42, Chapter 7 - Equation 1-3 (PI/4*D²*H_{VO}), substitute D_E for D for horizontal tanks
H_{vo} - Vapor Space Outage	2.1	1.3	2.4	ft	AP-42, Chapter 7 - H_{VO} = 0.5*H_E for horizontal tanks
P_{VA} - Vapor Pressure	0.009	0.009	0.009	psia	Vapor pressure for Distillate Fuel Oil No. 2 at 70°F
M_v - Vapor Molecular Weight	130	130	130	lb/lb-mole	AP-42, Chapter 7 - Table 7.1-2 for diesel
Q - Throughput	380.0	107.1	4,762	bbl/yr	

Table 20 Diesel Storage Tanks IES-TK-1 through 3
Enviva Pellets Hamlet, LLC

Calculated Values

Description	IES-TK-1	IES-TK-2	IES-TK-3	Units	Notes
K_e - Vapor Space Expansion Factor	0.036	0.036	0.036	dimensionless	AP-42, Chapter 7 - Equation 1-5 ($\Delta T_V/T_{LA}$ + ((ΔP_V - ΔP_B)/(P_A - ΔP_{VA}))
ΔT_v - Daily Vapor Temperature Range	20.77	20.77	20.77	R	AP-42, Chapter 7 - Equation 1-7 (0.7*ΔT_A + 0.02*α*I)
ΔT_A - Daily Ambient Temperature Range	19.7	19.7	19.7	R	AP-42, Chapter 7 - Equation 1-11 (T_{AX} - T_{AN})
K_S - Vented Vapor Saturation Factor	1.00	1.00	1.00	dimensionless	AP-42, Chapter 7 - Equation 1-21 (1/(1 + 0.053P_{VA}*H_{VO}))
W_v - Stock Vapor Density	0.00021	0.00021	0.00021	lb/ft^3	AP-42, Chapter 7 - Equation 1-22 (Mv * P_{VA}) / (R * T_V)
T_V - Average Vapor Temperature	524.1	524.1	524.1	R	AP-42, Chapter 7 - Equation 1-33 (0.7*T_{AA} + 0.3T_B + 0.009α*I)
T_{AA} - Daily Average Ambient Temperature	520.7	520.7	520.7	R	AP-42, Chapter 7 - Equation 1-30 ((T_{AX} + T_{AN})/2)
T_B - Liquid Bulk Temperature	521.7	521.7	521.7	R	AP-42, Chapter 7 - Equation 1-31 (T_{AA} + 0.003αI)
T_{LA} - Daily Average Liquid Surface Temperature	523.0	521.7	521.7	R	AP-42, Chapter 7 - Equation 1-28 (0.4*T_{AA} + 0.6T_B + 0.005*α*I)
N - Number of Turnovers	31.9	48.6	80.0	dimensionless	
K_N - Working Loss Turnover (Saturation) Factor	1	0.78	0.54	dimensionless	AP-42, Chapter 7 - Page 7.1-28 (For N>36, K_N = (180 + N)/6N; For N≤36, K_N = 1)
V_Q - Net Working Loss Throughput	2,133	602	26,733	ft^3/yr	AP-42 Chapter 7 - Equation 1-39 (5.614*Q)
K_p - Working Loss Product Factor	1	1	1	dimensionless	AP-42 Chapter 7 - Page 7.1-28
K_B - Vent Setting Correction Factor	1	1	1	dimensionless	AP-42 Chapter 7 - Page 7.1-28

Potential VOC Emissions

Description	IES-TK-1	IES-TK-2	IES-TK-3	Units	Notes
L_s - Standing Loss	0.18	0.038	0.91	lbs/yr	AP-42, Chapter 7 - Equation 1-2 (365 * Vv * Wv * Ke * Ks)
L_w - Working Loss	0.44	0.098	3.0	lbs/yr	AP-42, Chapter 7 - Equation 1-35 (V_Q * K_N * K_p * W_V * K_B)
L_t - Total Loss	0.62	0.14	3.9	lbs/yr	AP-42, Chapter 7 - Equation 1-1 (Ls + Lw)
Contingency Factor	1.00	1.00	1.00	dimensionless	Assumed contingency factor to account for unaccounted variables.
Total VOC Emissions per Tank	0.62	0.14	3.9	lbs/yr	
Total VOC Emissions	**3.1E-04**	**6.8E-05**	**0.0020**	**tons/yr**	

Reference:

U.S. AP-42, Section 7.1 - Organic Liquid Storage Tanks, 07/2020

Potential Fugitive PM Emissions from Paved Roads Enviva Pellets
Hamlet, LLC
Hamlet, Richmond County, North Carolina

Vehicle Activity	Distance Traveled per Roundtrip[1] (ft)	Trips Per Day[2]	Daily VMT	Events Per Year (days)	Empty Truck Weight (lb)	Loaded Truck Weight (lb)	Average Truck Weight (ton)	Annual VMT	PM Emission Factor[3] (lb/VMT)	PM_{10} Emission Factor[3] (lb/VMT)	$PM_{2.5}$ Emission Factor[3] (lb/VMT)	Potential PM Emissions (lb/day)	Potential PM Emissions (tpy)	Potential PM_{10} Emissions (lb/day)	Potential PM_{10} Emissions (tpy)	Potential $PM_{2.5}$ Emissions (lb/day)	Potential $PM_{2.5}$ Emissions (tpy)
Logs Delivery to Crane Storage Area	9,000	47	80	365	40,480	102,540	35.8	29,241	2.65	0.53	0.13	21.2	3.88	4.25	0.78	1.04	0.19
Logs Delivery to South Log Storage Area	11,700	31	69	365	40,480	102,540	35.8	25,089	2.65	0.53	0.13	18.2	3.33	3.64	0.67	0.89	0.16
Logs Delivery to North Log Storage Area	8,475	14	23	365	40,480	102,540	35.8	8,261	2.65	0.53	0.13	6.00	1.09	1.20	0.22	0.29	0.054
Chips/Hog Fuel Delivery	8,475	94	151	365	40,960	101,440	35.6	55,071	2.64	0.53	0.13	39.8	7.27	7.96	1.45	1.95	0.36
Pellet Truck Delivery to Pellet Loadout Area (Truck Back-up)	9,075	60	103	10	40,480	102,540	35.8	1,031	2.65	0.53	0.13	27.3	0.14	5.47	0.027	1.34	0.0067
Pellet Truck Delivery to Pellet Loadout Area (Normal Operations)	900	2	0.34	300	40,480	102,540	35.8	102	2.65	0.53	0.13	0.090	0.014	0.018	0.0027	0.0044	6.7E-04
Front End Loader to Green Wood Storage Pile No. 5	200	343	13	350	56,375	63,375	29.9	4,545	2.21	0.44	0.11	2.87	0.50	0.57	0.10	0.14	0.025
Employee Car Parking	2,250	75	32	365	4,000	4,000	2.0	11,665	0.14	0.028	0.0069	0.45	0.082	0.089	0.016	0.022	0.0040
Additive Delivery	5,000	1	0.95	350	40,480	102,540	35.8	331	2.65	0.53	0.13	0.25	0.044	0.050	0.0088	0.012	0.0022
											Total Emissions:	**116**	**16.3**	**23.3**	**3.27**	**5.71**	**0.80**

Notes:

1. Distance traveled per round trip was estimated based on truck route and site layout.
2. Daily trip counts based on original permit application estimations and maximum material throughputs.
3. Emission factors calculated based on Equation 2 from AP-42 Section 13.2.1 - Paved Roads, 01/11.

where:

E = emission factor (lb/ton)

k = particle size multiplier (dimensionless) for PM 0.011 k = particle size multiplier (dimensionless) for PM_{10} 0.0022

k = particle size multiplier (dimensionless) for $PM_{2.5}$ 0.00054

sL - mean road surface silt loading from AP-42 Table 13.2.1-3 for quarries (g/m²) 8.2

P - No. days with rainfall greater than 0.01 inch 110 Per AP-42, Section 13.2.1, Figure 13.2.1-2 (Richmond County, NC).

4. Potential emissions calculated from appropriate emission factor times vehicle miles traveled with control efficiency of 90% for water / dust suppression activities followed by sweeping. Per Table 5 in Chapter 4 of the Air Pollution Engineering Manual, Air and Waste Management Association, page 141 Control efficiency (%) = 96-0.263*V, where V is the number of vehicle passes since application of water.

Abbreviations:

ft - feet
hr - hour
lb - pound
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year
yr - year
VMT - vehicle miles traveled
VOC - volatile organic compound

References:

U.S. EPA. AP-42, Section 13.2.1 - Paved Roads, 01/11.
Air Pollution Engineering Manual, Air and Waste Management Association.

Table 22
Potential Fugitive PM Emissions from Unpaved Roads Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Vehicle Activity	Distance Traveled per Roundtrip[1] (ft)	Trips Per Day[2]	Daily VMT	Events Per Year (days)	Empty Truck Weight (lb)	Loaded Truck Weight (lb)	Average Truck Weight (ton)	Annual VMT
Front End Loader to Hardwood Pile	600	343	39	365	56,375	63,375	30	14,221
Front End Loader from Hardwood Pile to Mix Pile	300	82	5	365	56,375	63,375	30	1,706
Front End Loader from Softwood Pile to Mix Pile	300	466	26	365	56,375	63,375	30	9,670
Front End Loader from Mix Pile to Reclaim Hopper	200	549	21	365	56,375	63,375	30	7,584
							30	**33,182**

Notes:
1. Distance traveled per round trip was estimated based on truck route and site layout.
2. Daily trip counts based on engineering estimates.

Emission Calculations Unpaved Roads:

Pollutant	Empirical Constant (k)[1]	Silt Content (S)[2]	Particle Constant a[1]	Particle Constant b[1]	Emission Factor[3]	Potential Emissions[4]
	(lb/VMT)	(%)	(-)	(-)	(lb/VMT)	(tpy)
PM	4.9	8.4	0.7	0.45	7.51	12.5
PM_{10}	1.5	8.4	0.9	0.45	2.14	3.55
$PM_{2.5}$	0.15	8.4	0.9	0.45	0.21	0.36

Notes:
1. Constants (k, a, & b) based on AP-42, Section 13.2.2 (Unpaved Roads), Table 13.2.2-2 for Industrial Roads, November 2006
2. Silt loading factor based on AP-42, Section 13.2.2 (Unpaved Roads), Table 13.2.2-1, Lumber Sawmills, November 2006
3. Emission factors calculated based on Equation 1a from AP-42 Section 13.2.2 - Unpaved Roads, 11/06. Particulate Emission Factor: $E_{ext} = k\,(s/12)^a \times (W/3)^b * (365\text{-}P/365)$

k = particle size multiplier for particle size range and units of interest E = size-specific emission factor (lb/VMT)
s = surface material silt content (%) W = mean vehicle weight (tons)
P=number of days with at least 0.01 in of precipitation during the averaging period = 110 Per AP-42, Section 13.2.1, Figure 13.2.1-2 (Richmond County, NC).

4. Potential emissions calculated from appropriate emission factor times vehicle miles traveled with control efficiency of 90% for water / dust suppression activities.

Abbreviations:
ft - feet
hr - hour
lb - pound
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns $PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year
yr - year
VMT - vehicle miles traveled
VOC - volatile organic compound

Reference:
U.S. EPA. AP-42, Section 13.2.2 - Unpaved Roads, 11/06.

ATTACHMENT II
For Application No. 770096.20C

Table 1 Calculation Inputs
Enviva Pellets Hamlet, LLC Hamlet, Richmond County, North Carolina

Operational Data	
Green Hammermills, Dryer, Dry Hammermills, Pellet Mills, Pellet Coolers	
Short-Term Maximum Throughput (ODT/hr)	120
Annual Throughput (ODT/yr)	625,011
Hours of Operation (hr/yr)	8,760
Softwood Composition	85%

Table 2

Summary of Facility-wide Potential Emissions Enviva Pellets

Hamlet, LLC

Hamlet, Richmond County, North Carolina

Emission Unit ID	Source Description	Control Device ID	Control Device Description	CO (tpy)	NO_x (tpy)	PM (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_2 (tpy)	VOC (tpy)	CO_2e (tpy)
IES-CHIP-1	Log Chipping	--	--	--	--	--	--	--	--	1.56	--
IES-BARKHOG	Bark Hog	--	--	--	--	0.35	0.19	--	--	0.44	--
IES-DEBARK-1	Debarker	--	--	--	--	1.08	0.59	--	--	--	--
ES-DRYER	250.4 MMBtu/hr Wood-fired Direct Heat Drying System	CD-WESP CD-RTO-1	WESP; RTO	159	144	43.0	43.0	42.3	27.4	79.6	248,938
ES-GHM-1 through 3	Three (3) Green Wood Hammermills										
ES-HM-1 through 8[1]	Eight (8) Dry Hammermills	CD-HM-BH1 through 8; CD-WESP; CD-RTO-1	Eight (8) baghouses; WESP; RTO								
ES-FURNACEBYPASS	Furnace Bypass Stack	--	--	2.81	1.03	2.71	2.42	2.10	0.12	0.080	935
IES-DB-1 and 2	Dryer Duct Burners	--	--	1.80	1.56	0.17	0.17	0.17	0.013	0.24	3,048
ES-HMC	Hammermill Collection Conveyor	CD-HMC-BH	One (1) baghouse	--	--	0.23	0.23	0.23	--	--	--
ES-PCHP	Pellet Cooler HP Fines Relay System	CD-PCHP-BH	One (1) baghouse	--	--	0.075	0.075	0.075	--	--	--
ES-PMFS	Pellet Mill Feed Silo	CD-PMFS-BH	One (1) baghouse	--	--	0.37	0.37	0.37	--	--	--
ES-CLR-1 through 6[2]	Twelve (12) Pellet Mills Six (6) Pellet Coolers	CD-RCO/RTO	RCO/RTO	22.1	2.40	1.01	1.01	0.51	0.083	1.23	19,505
ES-FPH	Finished Product Handling	CD-FPH-BH	One (1) baghouse	--	--	1.28	1.16	0.51	--	--	--
ES-PB-1 and 2	Two (2) Pellet Loadout Bins										
ES-PL-1 through 3	Three (3) Pellet Loadouts										
ES-DWH	Dried Wood Handling Operations	CD-DWH-BH1 and 2	Two (2) baghouses	--	--	0.30	0.30	0.30	--	15.7	--
IES-ADD	Additive Handling and Storage	--	--	--	--	3.5E-04	1.7E-04	2.5E-05	--	--	--
IES-GWH	Green Wood Handling Operations	--	--	--	--	1.80	1.55	1.37	--	--	--
IES-TK-1	1,000 gallon Diesel Storage Tank	--	--	--	--	--	--	--	--	3.1E-04	--
IES-TK-2	185 gallon Diesel Storage Tank	--	--	--	--	--	--	--	--	6.8E-05	--
IES-TK-3	5,000 gallon Diesel Storage Tank	--	--	--	--	--	--	--	--	0.0020	--
IES-GWSP-1 through 5	Green Wood Storage Piles	--	--	--	--	13.5	6.73	1.01	--	7.02	--
IES-BFSP-1 and 2	Bark Fuel Storage Piles	--	--	--	--	0.56	0.28	0.042	--	0.29	--
IES-DRYSHAVE	Dry Shaving Material Handling	--	--	--	--	0.054	0.025	0.0039	--	--	--
IES-BFB[3]	Bark Fuel Bin	--	--	--	--	--	--	--	--	--	--
IES-GN	671 hp Diesel-fired Emergency Generator	--	--	0.14	2.46	0.0078	0.0078	0.0078	6.6E-04	1.68	179
IES-FWP	131 hp Diesel-fired Fire Water Pump	--	--	0.070	0.18	0.0092	0.0092	0.0092	4.8E-04	0.0081	50.4
IES-PW1 and 2[4]	Two (2) Parts Washers	--	--	--	--	--	--	--	--	--	--
IES-PV-1 and 2	Two (2) Propane Vaporizers	--	--	0.72	1.24	0.067	0.067	0.067	0.0052	0.096	1,223
--	Paved Roads	--	--	--	--	16.3	3.27	0.80	--	--	--
--	Unpaved Roads	--	--	--	--	12.5	3.55	0.36	--	--	--
			Total Emissions:	**187**	**153**	**95.3**	**65.0**	**50.3**	**27.7**	**108**	**273,878**
			Total Excluding Fugitives[5]:	**187**	**153**	**50.7**	**49.6**	**46.7**	**27.7**	**101**	**273,878**
			PSD Major Source Threshold:	**250**	**250**	**250**	**250**	**250**	**250**	**250**	**--**

Notes:

1. The dry hammermills are equipped with eight (8) baghouses for PM control. The Dry Hammermill baghouse exhaust will be routed to either the furnace followed by the WESP/RTO, directly to the WESP/RTO, or a combination of the two. The RTO provides 95% control of VOC and HAP emissions.
2. The pellet coolers are equipped with an RCO for VOC control that will operate primarily in catalytic mode with thermal (RTO) mode as a backup. The RTO and RCO modes have the same control efficiency so there will be no impact on emissions during thermal mode usage.
3. Bark is transferred from the primary Bark Fuel Storage Pile by walking floor to covered conveyors which transfer the bark into the fully enclosed Bark Fuel Bin. There are no emissions expected from transfer of material into the bin.
4. Emissions from the parts washers are insignificant.
5. Fugitive emissions are not included in comparison against the major source threshold because the facility is not on the list of 28 source categories in 40 CFR 52.21.

Abbreviations:

ES - Emission Source
IES - Insignificant Emission Source
CO - carbon monoxide
CO_2e - carbon dioxide equivalent
NO_x - nitrogen oxides
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
RTO - Regenerative Thermal Oxidizer
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compounds
WESP - Wet Electrostatic Precipitator

Table 3

Summary of Facility-wide HAP Emissions Enviva

Pellets Hamlet, LLC

Hamlet, Richmond County, North Carolina

Pollutant	CD-RTO[1] (tpy)	ES-FURNACEBYPASS (tpy)	CD-RCO/RTO[2] (tpy)	ES-DWH (tpy)	IES-GN (tpy)	IES-FWP (tpy)	IES-BARKHOG (tpy)	IES-CHIP-1 (tpy)	IES-PV-1 and 2 (tpy)	IES-DB-1 and 2 (tpy)	Total HAP (tpy)
Acetaldehyde	0.60	0.0039	0.90	0.15	2.96E-05	1.76E-04	--	--	--	3.26E-07	1.65
Acetophenone	1.75E-07	1.50E-08	--	--	--	--	--	--	--	--	1.90E-07
Acrolein	2.01	0.019	0.79	--	9.25E-06	2.12E-05	--	--	--	3.86E-07	2.81
Antimony and compounds	6.28E-04	3.70E-05	--	--	--	--	--	--	--	--	6.65E-04
Arsenic	0.0018	1.03E-04	2.75E-05	--	--	--	--	--	--	--	0.0019
Benzene	0.23	0.020	9.95E-02	--	9.11E-04	2.14E-04	--	--	0.0062	1.55E-02	0.37
Benzo(a)pyrene	1.43E-04	1.22E-05	1.65E-07	--	3.02E-07	4.31E-08	--	--	--	2.58E-08	1.56E-04
Beryllium	9.03E-05	5.16E-06	1.65E-06	--	--	--	--	--	--	2.58E-07	9.73E-05
Butadiene, 1,3-	--	--	--	--	--	8.96E-06	--	--	--	--	8.96E-06
Cadmium	5.83E-04	1.92E-05	1.51E-04	--	--	--	--	--	--	2.36E-05	7.77E-04
Carbon tetrachloride	0.0025	2.11E-04	--	--	--	--	--	--	--	--	0.0027
Chlorine	0.87	0.0037	--	--	--	--	--	--	--	--	0.87
Chlorobenzene	0.0018	1.55E-04	--	--	--	--	--	--	--	--	0.0020
Chloroform	0.0015	1.31E-04	--	--	--	--	--	--	--	--	0.0017
Chromium VI	6.05E-04	1.64E-05	1.92E-04	--	--	--	--	--	--	3.01E-05	8.44E-04
Chromium–Other compounds	0.0014	8.21E-05	--	--	--	--	--	--	--	--	0.0015
Cobalt	5.36E-04	3.05E-05	1.15E-05	--	--	--	--	--	--	--	5.78E-04
Dichlorobenzene	2.80E-04	--	1.65E-04	--	--	--	--	--	--	2.58E-05	4.71E-04
Dichloroethane, 1,2-	0.0016	1.36E-04	--	--	--	--	--	--	--	--	0.0017
Dichloropropane, 1,2-	0.0018	1.55E-04	--	--	--	--	--	--	--	--	0.0020
Dinitrophenol, 2,4-	9.87E-06	8.44E-07	--	--	--	--	--	--	--	--	1.07E-05
Di(2-ethylhexyl)phthalate	2.58E-06	2.20E-07	--	--	--	--	--	--	--	--	2.80E-06
Ethyl benzene	0.0017	1.45E-04	--	--	--	--	--	--	--	--	0.0018
Formaldehyde	3.46	0.021	0.94	0.14	9.26E-05	2.71E-04	--	--	0.013	3.29E-02	4.60
Hexane	0.42	--	0.25	--	--	--	--	--	--	3.86E-02	0.71
Hydrochloric acid	0.15	0.089	--	--	--	--	--	--	--	--	0.24
Lead	0.0039	2.25E-04	6.87E-05	--	--	--	--	--	--	--	0.0042
Manganese	0.13	0.0075	5.22E-05	--	--	--	--	--	--	--	0.13
Mercury	3.39E-04	1.64E-05	3.57E-05	--	--	--	--	--	--	5.58E-06	3.97E-04
Methanol	2.35	--	0.28	0.28	--	--	0.088	0.31	--	--	3.30
Methyl bromide	8.23E-04	7.03E-05	--	--	--	--	--	--	--	--	8.93E-04
Methyl chloride	0.0013	1.08E-04	--	--	--	--	--	--	--	--	0.0014
Methylene chloride	0.016	1.36E-03	--	--	--	--	--	--	--	--	0.017
Naphthalene	0.0055	4.55E-04	8.38E-05	--	1.53E-04	1.95E-05	--	--	--	1.31E-05	0.0062
Nickel	0.0031	1.55E-04	2.89E-04	--	--	--	--	--	--	4.51E-05	0.0036
Nitrophenol, 4-	6.03E-06	5.16E-07	--	--	--	--	--	--	--	--	6.55E-06
Pentachlorophenol	5.59E-05	2.39E-07	--	--	--	--	--	--	--	--	5.62E-05
Perchloroethylene	0.042	1.78E-04	--	--	--	--	--	--	--	--	0.042
Phenol	0.20	2.39E-04	0.34	--	--	--	--	--	--	--	0.54
Phosphorus metal, yellow or white	0.0021	1.27E-04	--	--	--	--	--	--	--	--	0.0023
Polychlorinated biphenyls	4.47E-07	3.82E-08	--	--	--	--	--	--	--	--	4.85E-07
Propionaldehyde	9.01	2.86E-04	0.16	0.044	--	--	--	--	--	--	9.21
Selenium	2.28E-04	1.31E-05	3.30E-06	--	--	--	--	--	--	--	2.45E-04
Styrene	0.10	0.0089	--	--	--	--	--	--	--	--	0.11
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	4.72E-10	4.03E-11	--	--	--	--	--	--	--	--	5.12E-10
Toluene	0.051	0.0043	4.67E-04	--	3.30E-04	9.38E-05	--	--	--	7.30E-05	0.057
Polycyclic Organic Matter	0.14	5.85E-04	5.61E-03	--	2.49E-04	3.85E-05	--	--	3.50E-04	8.76E-04	0.14
Trichloroethane, 1,1,1-	0.034	1.45E-04	--	--	--	--	--	--	--	--	0.034
Trichloroethylene	0.0016	1.41E-04	--	--	--	--	--	--	--	--	0.0018
Trichlorophenol, 2,4,6-	1.21E-06	1.03E-07	--	--	--	--	--	--	--	--	1.31E-06
Vinyl chloride	9.87E-04	8.44E-05	--	--	--	--	--	--	--	--	0.0011
Xylene	0.0014	1.17E-04	--	--	2.26E-04	6.53E-05	--	--	--	--	0.0018
Total HAP Emissions[4] (tpy)	**19.8**	**0.18**	**3.76**	**0.61**	**0.0018**	**8.88E-04**	**0.088**	**0.31**	**0.020**	**0.088**	**24.88**
Maximum Individual HAP	**Propionaldehyde**	**Hydrochloric acid**	**Formaldehyde**	**Methanol**	**Benzene**	**Formaldehyde**	**Methanol**	**Methanol**	**Formaldehyde**	**Hexane**	**Propionaldehyde**
Maximum Individual HAP Emissions (tpy)	**9.01**	**0.089**	**0.94**	**0.28**	**9.11E-04**	**2.71E-04**	**0.088**	**0.31**	**0.013**	**0.039**	**9.21**

Notes:

1. Includes emissions at outlet of the RTO stack as well as the HAP combustion emissions resulting from natural gas combustion by the RTO burners. CD-RTO controls emissions from the green hammermills (ES-GHM-1 through 3), furnace/dryer (ES-DRYER), and dry hammermills (ES-DHM-1 through 8).
2. Includes emissions at the outlet of RCO/RTO stack as well as the HAP combustion emissions resulting from natural gas combustion by the RCO/RTO burners. CD-RCO/RTO controls emissions from the pellet mills and pellet coolers (ES-CLR-1 through 6). The RCO/RTO operates primarily in catalytic mode with thermal (RTO) mode as a backup. The RTO and RCO modes have the same control efficiency so there is no impact on emissions during thermal mode usage.
3. Because benzo(a)pyrene and naphthalene emissions were presented individually and as components of total PAH emissions, the total HAP emissions presented here do not match the sum of all pollutant emissions to avoid double counting benzo(a)pyrene and naphthalene emissions.
4. Several combustion sources at the Hamlet plant may fire either natural gas or propane (i.e., RTO and RCO/RTO burners, duct burners). For conservatism, worst-case emissions across both fuel types were selected for each individual HAP. This results in an unrealistic estimate of total HAP emissions. Annual potential emissions based on sources firing natural gas are 24.7 tpy and 24.2 tpy for propane combustion.

Abbreviations:

HAP - hazardous air pollutant

RCO - regenerative catalytic oxidizer

RTO - regenerative thermal oxidizer

tpy - tons per year

Table 4
Green Wood Handling
IES-GWH
Enviva Pellets Hamlet, LLC Hamlet,
Richmond County, North Carolina

Source	Transfer Activity[1]	Number of Drop Points	Material Moisture Content[2]	PM Emission Factor[3]	PM_{10} Emission Factor[3]	$PM_{2.5}$ Emission Factor[3]	Potential Throughput[4]		Potential PM Emissions		Potential PM_{10} Emissions		Potential $PM_{2.5}$ Emissions	
			(%)	(lb/ton)	(lb/ton)	(lb/ton)	(tph)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
ES-GWH	Purchased Bark/Fuel Chips Transfer to Outdoor Storage Area	1	48%	5.0E-05	2.4E-05	3.6E-06	50	350,000	0.0025	0.0087	0.0012	0.0041	1.78E-04	6.24E-04
	Purchased Wood Chips to Outdoor Storage Area	4	48%	5.0E-05	2.4E-05	3.6E-06	148	1,300,000	0.030	0.13	0.014	0.061	0.0021	0.0093
	Purchased Wood Chips to Wet Hardwood Pile[5]	10	48%	5.0E-05	2.4E-05	3.6E-06	74	650,000	0.037	0.16	0.017	0.076	0.0026	0.012
	Purchased Wood Chips Transfer to Wet Hardwood Hopper	1	48%	5.0E-05	2.4E-05	3.6E-06	148	1,300,000	0.0074	0.032	0.0035	0.015	5.29E-04	0.0023
	Processed Wood Chips to Outdoor Storage Area	2	48%	5.0E-05	2.4E-05	3.6E-06	275	1,300,000	0.027	0.065	0.013	0.031	0.0020	0.0046
	Chip Truck Dump to Dumpers	2	48%	5.0E-05	2.4E-05	3.6E-06	148	1,300,000	0.015	0.065	0.0070	0.031	0.0011	0.0046
								Total Emissions:	**0.12**	**0.46**	**0.056**	**0.22**	**0.0085**	**0.033**

Notes:

1. These green wood handling emissions are representative of the fugitive emissions at the site.
2. Average moisture content for bark based on material balance provided by design engineering firm (Mid-South Engineering). Moisture content for purchased and process wood chips provided by Enviva on July 12, 2017. Assumed the lower moisture content between pine and hardwood to conservatively estimate PM emissions. (Hardwood 42% moisture; pine 51% (purchased wood chips) and 49% (processed wood chips).
3. Emission factor calculation based on formula from AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles, Equation 13.2.1, (11/06). where: E = emission factor (lb/ton)

k = particle size multiplier (dimensionless) for PM	0.74
k = particle size multiplier (dimensionless) for PM_{10}	0.35
k = particle size multiplier (dimensionless) for $PM_{2.5}$	0.053
U = mean wind speed (mph)	7.85

4. Potential throughputs based on engineering estimates.
5. Conservative assumption used for the number of drop points to account for mixing of softwood and hardwood chips in the mix pile.

Calculation Basis for Chip Screening

Hourly Throughput	77 ODT/hr
Annual Throughput	676,000 ODT/yr

Potential Criteria Pollutant Emissions from Screening of Purchased Chips

Pollutant	Emission Factor[1]	Potential Emissions	
	(lb/ODT)	(lb/hr)	(tpy)
$PM/PM_{10}/PM_{2.5}$	0.0040	0.30	1.34

Notes:

1. Emission factor from NCASI Technical Bulletin No. 1020 Table 9.1 for chip screening converted from units of bone dry tons (BDT) to ODT based on a moisture content of 48%.

Abbreviations:

hr - hour
lb - pound
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year
yr - year

References:

U.S. EPA. AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles, (11/06).
National Council for Air and Stream Improvement, Inc. (NCASI). 2013. *Compilation of criteria air pollutant emissions data for sources at pulp and paper mills including boilers – an update to Technical Bulletin No. 884.* Technical Bulletin No. 1020. Research Triangle Park, NC: National Council for Air and Stream Improvement, Inc.

Table 6

Debarker Potential Emissions

IES-DEBARK-1

Enviva Pellets Hamlet, LLC Hamlet,
Richmond County, North Carolina

Calculation Basis

Maximum Hourly Throughput	275 ton/hr
Annual Throughput[1]	1,078,143 ton/yr

Potential Criteria Pollutant Emissions

Source	Pollutant	Emission Factor (lb/ton)	Potential Emissions[3]	
			(lb/hr)	(tpy)
IES-DEBARK-1	TSP[2]	0.020	0.55	1.08
	PM_{10}[2]	0.011	0.30	0.59

Notes:

1. Approximately 2 tons of green material is needed for every 1 ODT of pellets, and 1.15 times that amount for purchased logs. At most, Enviva would purchase 75% of the needed logs with the remaining 25% of green material coming from purchased chips.
2. Particulate matter emission factors from the USEPA document titled *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants*. Source Classification Code 3-07-008- 01 (Log Debarking). All PM is assumed to be larger than 2.5 microns in diameter.
3. A 90% control efficiency was applied for use of water spray.

Abbreviations:

hr - hour lb -
pound
ODT - oven dried tons tpy -
tons per year
yr - year

Reference:

U.S. EPA. 1990. *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants* . Source Classification Code 3-07-008-01 (Log Debarking).

Table 7

Bark Hog Potential Emissions

IES-BARKHOG

Enviva Pellets Hamlet, LLC Hamlet, Richmond County, North Carolina

Calculation Basis

Maximum Hourly Throughput	50 ton/hr, wet
	25 ODT/hr
Maximum Annual Throughput	175,000 ODT/yr
	350,000 ton/yr, wet
Approx. Moisture Content	50% of total weight

Potential Criteria Pollutant and HAP Emissions

Pollutant	Emission Factor	Potential Emissions	
		(lb/hr)	(tpy)
THC as carbon[1]	0.0041 lb/ODT	0.10	0.36
VOC as propane[2]	0.0050 lb/ODT	0.13	0.44
Methanol[1]	0.0010 lb/ODT	0.025	0.09
PM[3]	0.020 lb/ton	0.10	0.35
PM_{10}[3]	0.011 lb/ton	0.055	0.19

Notes:

1. Emission factor obtained from available emissions factors for chippers in AP-42 Section 10.6.3, Medium Density Fiberboard, 08/02, Table 7 and Section 10.6.4, Hardboard and Fiberboard, 10/02, Tables 7 and 9. Emission factors for THC and Methanol are the same across all three tables.
2. Emission factor for VOC as propane is from AP-42, Section 10.6.3., Medium Density Fiberboard, 08/02, Table 7.
3. Particulate matter emission factors from the USEPA document titled *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants. Source Classification Code 3-07-008- 01 (Log Debarking)* . All PM is assumed to be larger than 2.5 microns. PM emissions are assumed to be controlled due to the bark hog being partially enclosed (assumed 90% control).

Abbreviations:

hr - hour lb - pound
ODT - oven dried tons THC - total hydrocarbon tpy - tons per year
yr - year

References:

U.S. EPA. AP-42, Section 10.6.3 - Medium Density Fiberboard, (08/02).

U.S. EPA. AP-42, Section 10.6.4 - Hardboard and Fiberboard, (10/02).

U.S. EPA. 1990. AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants. Source Classification Code 3-07-008-01 (Log Debarking).

Table 9

Potential Emissions at Outlet of CD-RTO Stack

ES-DRYER, ES-GHM-1 through 3, ES-DHM-1 through 8 Enviva

Pellets Hamlet, LLC

Hamlet, Richmond County, North Carolina

Calculation Basis

Maximum Hourly Throughput	120 ODT/hr
Annual Throughput	625,011 ODT/yr
Hourly Heat Input Capacity	250.4 MMBtu/hr
Annual Heat Input Capacity	2,193,504 MMBtu/yr
Hours of Operation	8,760 hr/yr
RTO Burners Total Heat Input	44.4 MMBtu/hr
RTO Natural Gas Injection	10.0 MMBtu/hr
RTO Control Efficiency	95%

Total Potential Emissions at RTO Stack

Pollutant	Potential Emissions[1]	
	(lb/hr)	(tpy)
CO	60.5	159
NO_x	54.9	144
SO_2	6.27	27.4
VOC	30.5	79.6
PM	16.5	43.0
PM_{10}	16.5	43.0
$PM_{2.5}$	16.2	42.3
CO_2e	94,783	248,938
Total HAP	7.30	19.8
Total TAP	3.05	9.07

Notes:

1. Total emissions from the furnace/dryer, green hammermills, dry hammermills, natural gas combustion by the RTO burners, and natural gas injection. Detailed calculations are provided below.

Potential Criteria Pollutant and Greenhouse Gas Emissions from Dryer/Furnace and Green Hammermills

Pollutant	Controlled Emission Factor	Units	Potential Emissions[1]	
			(lb/hr)	(tpy)
CO	0.50	lb/ODT[2]	59.6	155
NO_X	0.45	lb/ODT[2]	54.3	141
SO_2	0.025	lb/MMBtu[3]	6.26	27.4
VOC	0.22	lb/ODT[2]	26.6	69.3
$PM/PM_{10}/PM_{2.5}$ (Filterable + Condensable)	0.088	lb/ODT[2]	10.5	27.4
CO_2	780	lb/ODT[4]	93,600	243,754

Notes:

1. Exhaust from the dryer (ES-DRYER) and green hammermills (ES-GHM-1 through 3) are routed to a WESP and then RTO for control of VOC, HAP, and particulates. Additional emissions routed to the RTO from the dry hammermills are shown in the tables below.
2. Emission factor based on January 2020 compliance testing with a 20% contingency to account for inherent variability in stack testing results. The VOC emission factor was adjusted to account for the difference in pine percentage during testing and the maximum allowable.
3. No emission factor is provided in AP-42, Section 10.6.2 for SO_2 for rotary dryers. Enviva has conservatively calculated SO_2 emissions based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
4. Emission factor for CO_2 from AP-42, Section 10.6.1 for rotary dryer with RTO control device. Enviva has conservatively calculated the CO_2 emissions using the hardwood emission factor because the dryer at Hamlet processes a combination of hardwood and softwood and the hardwood emission factor is greater than the softwood emission factor.

Potential Criteria Pollutant Emissions from Dry Hammermills[1]

Pollutant	Emission Factor (lb/ODT)[2]	Potential Emissions	
		(lb/hr)	(tpy)
PM	0.049	5.86	15.3
PM_{10}	0.049	5.86	15.3
$PM_{2.5}$	0.047	5.61	14.6
VOC	0.032	3.89	10.1

Notes:

1. A portion of the exhaust from each dry hammermill will be recirculated back into the dry hammermill to reduce the volume of air that will be routed to CD-RTO. All emissions from the dry hammermills will be controlled by a baghouse. Exhaust from the eight (8) dry hammermill baghouses (ES-DHM-1 through 8) will be controlled by the WESP and RTO.
2. Emission factor based on January 2020 compliance testing with a 20% contingency to account for inherent variability in stack testing results. The VOC emission factor was adjusted to account for the difference in pine percentage during testing and the maximum allowable. A 95% control efficiency is applied to VOC emission for control by the RTO.

Table 9

Potential Emissions at Outlet of CD-RTO Stack

ES-DRYER, ES-GHM-1 through 3, ES-DHM-1 through 8 Enviva

Pellets Hamlet, LLC

Hamlet, Richmond County, North Carolina

Thermally Generated Potential Criteria Pollutant Emissions from Dry Hammermill VOC

Maximum high heating value of VOC constituents	0.018	MMBtu/lb
Uncontrolled VOC emissions	203	tons/yr
Heat input of uncontrolled VOC emissions	7,497	MMBtu/yr

Pollutant	Emission Factor	Units	Potential Emissions (lb/hr)	Potential Emissions (tpy)
CO	0.082	lb/MMBtu[1]	0.070	0.31
NO_X	0.10	lb/MMBtu[1]	0.084	0.37

Notes:

1. Emission factors from AP-42, Section 1.4 - Natural Gas Combustion, 07/98. Emission factors converted from lb/MMscf to lb/MMBtu based on assumed heating value of 1,020 Btu/scf for natural gas per AP-42 Section 1.4.

Potential Criteria Pollutant and Greenhouse Gas Emissions from RTO Natural Gas Injection[1]

Pollutant	Emission Factor[2] (lb/MMscf)	Potential Emissions (lb/hr)	Potential Emissions (tpy)
CO	84.0	0.82	3.61
NO_X	50	0.49	2.15
VOC	5.50	0.054	0.24
SO_2	0.60	0.0059	0.026
$PM/PM_{10}/PM_{2.5}$ Condensable	5.70	0.056	0.24
$PM/PM_{10}/PM_{2.5}$ Filterable	1.90	0.019	0.082
Total $PM/PM_{10}/PM_{2.5}$	--	0.075	0.33
CO_2	120,000	1,176	5,153
CH_4	2.30	0.023	0.099
N_2O	2.20	0.022	0.094
CO_2e	--	1,183	5,184

Notes:

1. Enviva is requesting authorization for injection of natural gas into the RTO (10 MMBtu/hr) which will reduce the amount of combustion air added to the RTO, thereby increasing fuel efficiency and reducing generation of NO_X.
2. Emission factors for natural gas combustion from AP-42 Section 1.4 - Natural Gas Combustion, 07/98. Natural gas heating value of 1,020 Btu/scf assumed per AP-42.

Potential HAP and TAP Emissions

Pollutant	HAP	NC TAP	VOC	Emission Factor	Units	Footnote	Potential Emissions (lb/hr)	Potential Emissions (tpy)
Furnace Biomass Combustion, Drying, Green Hammermills, and Dry Hammermills								
Acetaldehyde	Y	Y	Y	0.0019	lb/ODT	1	0.23	0.60
Acrolein	Y	Y	Y	0.0064	lb/ODT	1	0.77	2.01
Formaldehyde	Y	Y	Y	0.011	lb/ODT	1	1.33	3.46
Methanol	Y	N	Y	0.0075	lb/ODT	1	0.90	2.35
Phenol	Y	Y	Y	0.00063	lb/ODT	1	0.08	0.20
Propionaldehyde	Y	N	Y	0.029	lb/ODT	1	3.46	9.01
Acetophenone	Y	N	Y	3.20E-09	lb/MMBtu	1	4.0E-08	1.8E-07
Antimony and compounds	Y	N	N	7.90E-06	lb/MMBtu	2,4	1.4E-04	6.3E-04
Arsenic	Y	Y	N	2.20E-05	lb/MMBtu	2,4	4.0E-04	0.0017
Benzene	Y	Y	Y	0.0042	lb/MMBtu	2,3	0.053	0.23
Benzo(a)pyrene	Y	Y	Y	2.60E-06	lb/MMBtu	2,3	3.3E-05	1.4E-04
Beryllium	Y	Y	N	1.10E-06	lb/MMBtu	2,4	2.0E-05	8.7E-05
Cadmium	Y	Y	N	4.10E-06	lb/MMBtu	2,4	7.4E-05	3.3E-04
Carbon tetrachloride	Y	Y	Y	4.50E-05	lb/MMBtu	2,3	5.6E-04	0.0025
Chlorine	Y	Y	N	7.90E-04	lb/MMBtu	2	0.20	0.87
Chlorobenzene	Y	Y	Y	3.30E-05	lb/MMBtu	2,3	4.1E-04	0.0018
Chloroform	Y	Y	Y	2.80E-05	lb/MMBtu	2,3	3.5E-04	0.0015
Chromium VI	-[5]	Y	N	3.50E-06	lb/MMBtu	2,4,5	6.4E-05	2.8E-04
Chromium–Other compounds	Y	N	N	1.75E-05	lb/MMBtu	2,4	3.2E-04	0.0014
Cobalt	Y	N	N	6.50E-06	lb/MMBtu	2,4	1.2E-04	5.2E-04
Dichloroethane, 1,2-	Y	Y	Y	2.90E-05	lb/MMBtu	2,3	3.6E-04	0.0016
Dichloropropane, 1,2-	Y	N	Y	3.30E-05	lb/MMBtu	2,3	4.1E-04	0.0018
Dinitrophenol, 2,4-	Y	N	Y	1.80E-07	lb/MMBtu	2,3	2.3E-06	9.9E-06
Di(2-ethylhexyl)phthalate	Y	Y	Y	4.70E-08	lb/MMBtu	2,3	5.9E-07	2.6E-06
Ethyl benzene	Y	N	Y	3.10E-05	lb/MMBtu	2,3	3.9E-04	0.0017
Hexachlorodibenzo-p-dioxin, 1,2,3,6,7,8-	N	Y	Y	1.79E-11	lb/MMBtu	2,3	2.2E-10	9.8E-10
Hydrochloric acid	Y	Y	N	1.33E-03	lb/MMBtu	2,6	0.03	0.15
Lead	Y	N	N	4.80E-05	lb/MMBtu	2,4	8.7E-04	0.0038
Manganese	Y	Y	N	0.0016	lb/MMBtu	2,4	0.029	0.13
Mercury	Y	Y	N	3.50E-06	lb/MMBtu	2,4	6.4E-05	2.8E-04
Methyl bromide	Y	N	Y	1.50E-05	lb/MMBtu	2,3	1.9E-04	8.2E-04
Methyl chloride	Y	N	Y	2.30E-05	lb/MMBtu	2,3	2.9E-04	0.0013
Methyl ethyl ketone	N	Y	Y	5.40E-06	lb/MMBtu	2,3	6.8E-05	3.0E-04
Methylene chloride	Y	Y	Y	2.90E-04	lb/MMBtu	2,3	0.0036	0.016
Naphthalene	Y	N	Y	9.70E-05	lb/MMBtu	2,3	0.0012	0.0053
Nickel	Y	Y	N	3.30E-05	lb/MMBtu	2,4	6.0E-04	0.0026
Nitrophenol, 4-	Y	N	Y	1.10E-07	lb/MMBtu	2,3	1.4E-06	6.0E-06
Pentachlorophenol	Y	Y	N	5.10E-08	lb/MMBtu	2	1.3E-05	5.6E-05
Perchloroethylene	Y	Y	N	3.80E-05	lb/MMBtu	2	0.0095	0.042
Phosphorus metal, yellow or white	Y	N	N	2.70E-05	lb/MMBtu	2,4	4.9E-04	0.0021
Polychlorinated biphenyls	Y	Y	Y	8.15E-09	lb/MMBtu	2,3	1.0E-07	4.5E-07
Polycyclic Organic Matter	Y	N	N	1.25E-04	lb/MMBtu	2	0.031	0.14
Selenium	Y	N	N	2.80E-06	lb/MMBtu	2,4	5.1E-05	2.2E-04
Styrene	Y	Y	Y	0.0019	lb/MMBtu	2,3	0.024	0.10
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	Y	Y	8.60E-12	lb/MMBtu	2,3	1.1E-10	4.7E-10
Toluene	Y	Y	Y	9.20E-04	lb/MMBtu	2,3	0.012	0.050
Trichloroethane, 1,1,1-	Y	Y	N	3.10E-05	lb/MMBtu	2	0.0078	0.034
Trichloroethylene	Y	Y	Y	3.00E-05	lb/MMBtu	2,3	3.8E-04	0.0016
Trichlorofluoromethane	N	Y	Y	4.10E-05	lb/MMBtu	2,3	5.1E-04	0.0022
Trichlorophenol, 2,4,6-	Y	N	Y	2.20E-08	lb/MMBtu	2,3	2.8E-07	1.2E-06
Vinyl chloride	Y	Y	Y	1.80E-05	lb/MMBtu	2,3	2.3E-04	9.9E-04
Xylene	Y	Y	Y	2.50E-05	lb/MMBtu	2,3	3.1E-04	0.0014
						Total HAP Emissions:	**7.17**	**19.4**
						Total TAP Emissions:	**2.78**	**7.90**

Table 9

Potential Emissions at Outlet of CD-RTO Stack

ES-DRYER, ES-GHM-1 through 3, ES-DHM-1 through 8 Enviva

Pellets Hamlet, LLC

Hamlet, Richmond County, North Carolina

Pollutant	HAP	NC TAP	VOC	Emission Factor	Units	Footnote	Potential Emissions	
							(lb/hr)	(tpy)
RTO Natural Gas/Propane Combustion								
2-Methylnaphthalene	Y	N	Y	2.40E-05	lb/MMscf	7	1.28E-06	5.61E-06
3-Methylchloranthrene	Y	N	Y	1.80E-06	lb/MMscf	7	9.60E-08	4.20E-07
7,12-Dimethylbenz(a)anthracene	Y	N	Y	1.60E-05	lb/MMscf	7	8.53E-07	3.74E-06
Acenaphthene	Y	N	Y	1.80E-06	lb/MMscf	7	9.60E-08	4.20E-07
Acenaphthylene	Y	N	Y	1.80E-06	lb/MMscf	7	9.60E-08	4.20E-07
Ammonia	N	Y	N	3.2	lb/MMscf	7	0.17	0.75
Anthracene	Y	N	Y	2.40E-06	lb/MMscf	7	1.28E-07	5.61E-07
Arsenic	Y	Y	N	2.00E-04	lb/MMscf	7	1.07E-05	4.67E-05
Benz(a)anthracene	Y	N	Y	1.80E-06	lb/MMscf	7	9.60E-08	4.20E-07
Benzene	Y	N	Y	7.10E-04	lb/MMBtu	8	3.15E-02	1.35E-04
Benzo(a)pyrene	Y	Y	Y	1.20E-06	lb/MMscf	7	6.40E-08	2.80E-07
Benzo(b)fluoranthene	Y	N	Y	1.80E-06	lb/MMscf	7	9.60E-08	4.20E-07
Benzo(g,h,i)perylene	Y	N	Y	1.20E-06	lb/MMscf	7	6.40E-08	2.80E-07
Benzo(k)fluoranthene	Y	N	Y	1.80E-06	lb/MMscf	7	9.60E-08	4.20E-07
Beryllium	Y	Y	N	1.20E-05	lb/MMscf	7	6.40E-07	2.80E-06
Cadmium	Y	Y	N	0.0011	lb/MMscf	7	5.87E-05	2.57E-04
Chromium VI	Y	N	N	0.0014	lb/MMscf	7	7.47E-05	3.27E-04
Chrysene	Y	N	Y	1.80E-06	lb/MMscf	7	9.60E-08	4.20E-07
Cobalt	Y	N	N	8.40E-05	lb/MMscf	7	4.48E-06	1.96E-05
Dibenzo(a,h)anthracene	Y	N	Y	1.20E-06	lb/MMscf	7	6.40E-08	2.80E-07
Dichlorobenzene	Y	Y	Y	0.0012	lb/MMscf	7	6.40E-05	2.80E-04
Fluoranthene	Y	N	Y	3.00E-06	lb/MMscf	7	1.60E-07	7.01E-07
Fluorene	Y	N	Y	2.80E-06	lb/MMscf	7	1.49E-07	6.54E-07
Hexane	Y	Y	Y	1.8	lb/MMscf	7	0.096	0.42
Indeno(1,2,3-cd)pyrene	Y	N	Y	1.80E-06	lb/MMscf	7	9.60E-08	4.20E-07
Lead	Y	N	N	5.00E-04	lb/MMscf	7	2.67E-05	1.17E-04
Manganese	Y	Y	N	3.80E-04	lb/MMscf	7	2.03E-05	8.88E-05
Mercury	Y	Y	N	2.60E-04	lb/MMscf	7	1.39E-05	6.07E-05
Naphthalene	Y	N	Y	6.10E-04	lb/MMscf	7	3.25E-05	1.42E-04
Nickel	Y	Y	N	0.0021	lb/MMscf	7	1.12E-04	4.91E-04
Polycyclic Organic Matter	Y	Y	Y	4.00E-05	lb/MMBtu	8,9	1.74E-06	7.63E-06
Phenanthrene	Y	N	Y	1.70E-05	lb/MMscf	7	9.07E-07	3.97E-06
Pyrene	Y	N	Y	5.00E-06	lb/MMscf	7	2.67E-07	1.17E-06
Selenium	Y	N	N	2.40E-05	lb/MMscf	7	1.28E-06	5.61E-06
Toluene	Y	Y	Y	0.0034	lb/MMscf	7	1.81E-04	7.94E-04
						Total HAP Emissions:	**0.13**	**0.42**
						Total TAP Emissions:	**0.27**	**1.17**

Notes:

1. Emission factor derived from process information and an appropriate contingency based on engineering judgement.

2. Emission factors (criteria and HAP/TAP) for wood combustion in a stoker boiler from NCDAQ Wood Waste Combustion Spreadsheet/AP-42, Fifth Edition, Volume 1, Chapter 1.6 - Wood Residue Combustion in Boilers, 09/03.

3. A control efficiency of 95% for the RTO is applied to all VOC hazardous and toxic pollutants for those emission factors that are not derived from Enviva stack test data.

4. The control efficiency of the wet electrostatic precipitator (WESP) for filterable particulate matter is applied to all metal hazardous and toxic pollutants. Actual design filterable efficiency is estimated to 96.4%, but 92.75% is assumed for toxics permitting.

5. Chromium VI is a subset of chrome compounds, which is accounted for separately as a HAP. As such, Chromium VI is only calculated as a TAP.

6. The WESP employs a caustic solution in its operation in which hydrochloric acid will have high water solubility. This caustic solution will neutralize the acid and effectively control it by 90%, per conversation on October 18, 2011 with Steven A. Jaasund, P.E. of Lundberg Associates, a manufacturer of WESPs.

7. Emission factors for natural gas combustion are from NCDAQ Natural Gas Combustion Spreadsheet and AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98 for small boilers. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.

8. Propane is worst-case for these HAP emissions. Emission factors for propane combustion were obtained from the SCAQMD's AER Tool for external combustion equipment fired with LPG.

9. The PAH emission factor for propane combustion was used to estimate emissions of Polycyclic Organic Matter (POM). Individual constituents of POM were subtracted from the total to avoid double-counting.

Abbreviations:

AER - Air Emission Reporting
CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
kg - kilogram
lb - pound
MMBtu - Million British thermal units
NC - North Carolina
NO_x - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
POM - polycyclic organic matter
RTO - regenerative thermal oxidizer
SCAQMD - South Coast Air Quality Management District
SO_2 - sulfur dioxide
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

References:

U.S. EPA. AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03
U.S. EPA. AP-42, Section 1.4 - Natural Gas Combustion, 07/98
U.S. EPA. AP-42, Section 10.6.2 - Particleboard, 06/02
South Coast Air Quality Management District. AER Reporting tool. Emission factors available in the Help and Support Manual at:
http://www.aqmd.gov/home/rules-compliance/compliance/annual-emission-reporting

Table 10

Potential Emissions for Furnace Bypass (Cold Start-up)[1]

ES-FURNACEBYPASS

Enviva Pellets Hamlet, LLC

Hamlet, Richmond County, North Carolina

Calculation Basis

Hourly Heat Input Capacity (HHV)	37.6 MMBtu/hr
Annual Heat Input Capacity	1,878 MMBtu/yr
Hours of Operation	50 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions from Dryer Line Cold Start-up[1]

Pollutant	Emission Factor[2] (lb/MMBtu)	Potential Emissions	
		(lb/hr)	(tpy)
CO	0.60	22.5	0.56
NO_x	0.22	8.26	0.21
SO_2	0.025	0.94	0.023
VOC	0.017	0.64	0.016
Total PM	0.58	21.7	0.54
Total PM_{10}	0.52	19.4	0.49
Total $PM_{2.5}$	0.45	16.8	0.42
CO_2	195	7,324	183
CH_4	0.021	0.79	0.020
N_2O	0.013	0.49	0.012
CO_2e	--	7,489	187

Notes:

1. During cold start-ups, the furnace bypass stack is used until the refractory is sufficiently heated and can sustain operations at a low level (approximately 15% of the maximum heat input rate). The furnace bypass stack is then closed, and the furnace is slowly brought up to a normal operating rate.
2. Emission factors from AP-42, Chapter 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. VOC emission factor excludes formaldehyde.

Table 10

Potential Emissions for Furnace Bypass (Cold Start-up)[1]

ES-FURNACEBYPASS

Enviva Pellets Hamlet, LLC

Potential HAP and TAP Emissions from Dryer Line Cold Start-up

Pollutant	HAP	NC TAP	Emission Factor[1] (lb/MMBtu)	Potential Emissions	
				(lb/hr)	(tpy)
Furnace Biomass Combustion					
Acetaldehyde	Y	Y	8.30E-04	0.031	7.79E-04
Acrolein	Y	Y	0.0040	0.15	0.0038
Formaldehyde	Y	Y	0.0044	0.17	0.0041
Phenol	Y	Y	5.10E-05	0.0019	4.79E-05
Propionaldehyde	Y	N	6.10E-05	0.0023	5.73E-05
Acetophenone	Y	N	3.20E-09	1.20E-07	3.00E-09
Antimony and compounds	Y	N	7.90E-06	2.97E-04	7.42E-06
Arsenic	Y	Y	2.20E-05	8.26E-04	2.07E-05
Benzene	Y	Y	0.0042	0.16	0.0039
Benzo(a)pyrene	Y	Y	2.60E-06	9.77E-05	2.44E-06
Beryllium	Y	Y	1.10E-06	4.13E-05	1.03E-06
Cadmium	Y	Y	4.10E-06	1.54E-04	3.85E-06
Carbon tetrachloride	Y	Y	4.50E-05	0.0017	4.23E-05
Chlorine	Y	Y	7.90E-04	0.030	7.42E-04
Chlorobenzene	Y	Y	3.30E-05	0.0012	3.10E-05
Chloroform	Y	Y	2.80E-05	0.0011	2.63E-05
Chromium VI	Y	Y	3.50E-06	1.31E-04	3.29E-06
Chromium–Other compounds	Y	N	1.75E-05	6.57E-04	1.64E-05
Cobalt	Y	N	6.50E-06	2.44E-04	6.10E-06
Dinitrophenol, 2,4-	Y	N	1.80E-07	6.76E-06	1.69E-07
Di(2-ethylhexyl)phthalate	Y	Y	4.70E-08	1.77E-06	4.41E-08
Ethyl benzene	Y	N	3.10E-05	0.0012	2.91E-05
Dichloroethane, 1,2-	Y	Y	2.90E-05	0.0011	2.72E-05
Hydrochloric acid	Y	Y	0.019	0.71	0.018
Lead	Y	N	4.80E-05	0.0018	4.51E-05
Manganese	Y	Y	0.0016	0.060	0.0015
Mercury	Y	Y	3.50E-06	1.31E-04	3.29E-06
Methyl bromide	Y	N	1.50E-05	5.63E-04	1.41E-05
Methyl chloride	Y	N	2.30E-05	8.64E-04	2.16E-05
Methylene chloride	Y	Y	2.90E-04	1.09E-02	2.72E-04
Trichloroethane, 1,1,1-	Y	Y	3.10E-05	0.0012	2.91E-05
Naphthalene	Y	N	9.70E-05	0.0036	9.11E-05
Nickel	Y	Y	3.30E-05	0.0012	3.10E-05
Nitrophenol, 4-	Y	N	1.10E-07	4.13E-06	1.03E-07
Pentachlorophenol	Y	Y	5.10E-08	1.92E-06	4.79E-08
Perchloroethylene	Y	Y	3.80E-05	0.0014	3.57E-05
Phosphorus metal, yellow or white	Y	N	2.70E-05	0.0010	2.54E-05
Polychlorinated biphenyls	Y	Y	8.15E-09	3.06E-07	7.65E-09
Polycyclic Organic Matter	Y	N	1.25E-04	0.0047	1.17E-04
Dichloropropane, 1,2-	Y	N	3.30E-05	0.0012	3.10E-05
Selenium compounds	Y	N	2.80E-06	1.05E-04	2.63E-06
Styrene	Y	Y	0.0019	0.071	0.0018
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	Y	8.60E-12	3.23E-10	8.08E-12
Toluene	Y	Y	9.20E-04	0.035	8.64E-04
Trichloroethylene	Y	Y	3.00E-05	0.0011	2.82E-05
Trichlorophenol, 2,4,6-	Y	N	2.20E-08	8.26E-07	2.07E-08
Vinyl chloride	Y	Y	1.80E-05	6.76E-04	1.69E-05
Xylene	Y	Y	2.50E-05	9.39E-04	2.35E-05
			Total HAP Emissions:	**1.45**	**0.036**
			Total TAP Emissions:	**1.44**	**0.036**

Notes:

1. Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Abbreviations:

CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
lb - pound
MMBtu - Million British thermal units
NO_x - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
SO_2 - sulfur dioxide
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:

U.S. EPA. AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

Table 11

Potential Emissions for Furnace Bypass (Idle Mode)[1]
ES-FURNACEBYPASS
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Calculation Basis

Hourly Heat Input Capacity (HHV)	15.0 MMBtu/hr
Annual Heat Input Capacity	7,500 MMBtu/yr
Hours of Operation	500 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions from Furnace Idle Mode[1]

Pollutant	Emission Factor[2] (lb/MMBtu)	Potential Emissions	
		(lb/hr)	(tpy)
CO	0.60	9.00	2.25
NO_x	0.22	3.30	0.83
SO_2	0.025	0.38	0.094
VOC	0.017	0.26	0.064
Total PM	0.58	8.66	2.16
Total PM_{10}	0.52	7.76	1.94
Total $PM_{2.5}$	0.45	6.71	1.68
CO_2	195	2,925	731
CH_4	0.021	0.32	0.079
N_2O	0.013	0.20	0.049
CO_2e	--	2,991	748

Notes:

1. Hours of operation in furnace "idle mode" are limited to 500 hours per year. Idle mode is defined as operation up to 15 MMBtu/hr.
2. Emission factors from AP-42, Chapter 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. VOC emission factor excludes formaldehyde.

Table 11

Potential Emissions for Furnace Bypass (Idle Mode)[1]

ES-FURNACEBYPASS

Enviva Pellets Hamlet, LLC

Potential HAP and TAP Emissions from Furnace Idle Mode

Pollutant	HAP	NC TAP	Emission Factor[1] (lb/MMBtu)	Potential Emissions (lb/hr)	Potential Emissions (tpy)
Furnace Biomass Combustion					
Acetaldehyde	Y	Y	8.30E-04	0.012	0.0031
Acrolein	Y	Y	0.0040	0.060	0.015
Formaldehyde	Y	Y	0.0044	0.066	0.017
Phenol	Y	Y	5.10E-05	7.65E-04	1.91E-04
Propionaldehyde	Y	N	6.10E-05	9.15E-04	2.29E-04
Acetophenone	Y	N	3.2E-09	4.80E-08	1.20E-08
Antimony and compounds	Y	N	7.9E-06	1.19E-04	2.96E-05
Arsenic	Y	Y	2.2E-05	3.30E-04	8.25E-05
Benzene	Y	Y	0.0042	0.063	0.016
Benzo(a)pyrene	Y	Y	2.6E-06	3.90E-05	9.75E-06
Beryllium	Y	Y	1.1E-06	1.65E-05	4.13E-06
Cadmium	Y	Y	4.1E-06	6.15E-05	1.54E-05
Carbon tetrachloride	Y	Y	4.5E-05	6.75E-04	1.69E-04
Chlorine	Y	Y	7.9E-04	0.012	0.0030
Chlorobenzene	Y	Y	3.3E-05	4.95E-04	1.24E-04
Chloroform	Y	Y	2.8E-05	4.20E-04	1.05E-04
Chromium VI	Y	Y	3.5E-06	5.25E-05	1.31E-05
Chromium–Other compounds	Y	N	1.8E-05	2.63E-04	6.56E-05
Cobalt	Y	N	6.5E-06	9.75E-05	2.44E-05
Dinitrophenol, 2,4-	Y	N	1.8E-07	2.70E-06	6.75E-07
Di(2-ethylhexyl)phthalate	Y	Y	4.7E-08	7.05E-07	1.76E-07
Ethyl benzene	Y	N	3.1E-05	4.65E-04	1.16E-04
Dichloroethane, 1,2-	Y	Y	2.9E-05	4.35E-04	1.09E-04
Hydrochloric acid	Y	Y	0.019	0.29	0.071
Lead	Y	N	4.8E-05	7.20E-04	1.80E-04
Manganese	Y	Y	0.0016	0.024	0.0060
Mercury	Y	Y	3.5E-06	5.25E-05	1.31E-05
Methyl bromide	Y	N	1.5E-05	2.25E-04	5.63E-05
Methyl chloride	Y	N	2.3E-05	3.45E-04	8.63E-05
Methylene chloride	Y	Y	2.90E-04	4.35E-03	1.09E-03
Trichloroethane, 1,1,1-	Y	Y	3.1E-05	4.65E-04	1.16E-04
Naphthalene	Y	N	9.7E-05	0.0015	3.64E-04
Nickel	Y	Y	3.3E-05	4.95E-04	1.24E-04
Nitrophenol, 4-	Y	N	1.1E-07	1.65E-06	4.13E-07
Pentachlorophenol	Y	Y	5.1E-08	7.65E-07	1.91E-07
Perchloroethylene	Y	Y	3.8E-05	5.70E-04	1.43E-04
Phosphorus metal, yellow or white	Y	N	2.7E-05	4.05E-04	1.01E-04
Polychlorinated biphenyls	Y	Y	8.1E-09	1.22E-07	3.05E-08
Polycyclic Organic Matter	Y	N	1.2E-04	0.0019	4.68E-04
Dichloropropane, 1,2-	Y	N	3.3E-05	4.95E-04	1.24E-04
Selenium compounds	Y	N	2.8E-06	4.20E-05	1.05E-05
Styrene	Y	Y	0.0019	0.029	0.0071
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	Y	8.6E-12	1.29E-10	3.23E-11
Toluene	Y	Y	9.2E-04	0.014	0.0035
Trichloroethylene	Y	Y	3.0E-05	4.50E-04	1.13E-04
Trichlorophenol, 2,4,6-	Y	N	2.2E-08	3.30E-07	8.25E-08
Vinyl chloride	Y	Y	1.8E-05	2.70E-04	6.75E-05
Xylene	Y	Y	2.5E-05	3.75E-04	9.38E-05
			Total HAP Emissions:	**0.58**	**0.15**
			Total TAP Emissions:	**0.57**	**0.14**

Notes:

1. Emission factors for wood combustion in a stoker boiler from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.

Abbreviations:

CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
HAP - hazardous air pollutant
hr - hour
lb - pound
MMBtu - Million British thermal units
NO_x - nitrogen oxides
N_2O - nitrous oxide
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
SO_2 - sulfur dioxide
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:

U.S. EPA. AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

Table 12

Potential Emissions from Double Duct Burners IES-DB-1 and -2

Enviva Pellets Hamlet, LLC Hamlet, Richmond County, North Carolina

Duct Burner Inputs

Hourly Heat Input Capacity	2.5	MMBtu/hr
Number of Duct Burners	2	
Annual Heat Input Capacity	43,800	MMBtu/yr
Annual Operation	8,760	hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions - Natural Gas/Propane Combustion

Pollutant	Emission Factor	Units	Footnote	Potential Emissions Hourly (lb/hr)	Potential Emissions Annual (tpy)
Natural Gas Combustion					
CO	84.0	lb/MMscf	2	0.41	1.80
NO_X	50.0	lb/MMscf	3	0.25	1.07
SO_2	0.60	lb/MMscf	2	0.0029	0.013
VOC	5.50	lb/MMscf	2	0.027	0.12
$PM/PM_{10}/PM_{2.5}$ Condensable	5.70	lb/MMscf	2	0.028	0.12
$PM/PM_{10}/PM_{2.5}$ Filterable	1.90	lb/MMscf	2	0.0093	0.041
Total $PM/PM_{10}/PM_{2.5}$				0.037	0.16
CO_2	120,000	lb/MMscf	2	588	2,576
CH_4	2.30	lb/MMscf	2	0.011	0.049
N_2O	0.64	lb/MMscf	2	0.0031	0.014
CO_2e			4	589	2,582
Propane Combustion					
CO	7.50	lb/Mgal	5	0.41	1.80
NO_X	6.50	lb/Mgal	6	0.36	1.56
SO_2	0.054	lb/Mgal	5,7	0.0030	0.013
VOC	1.00	lb/Mgal	5	0.055	0.24
$PM/PM_{10}/PM_{2.5}$ Condensable	0.50	lb/Mgal	5	0.027	0.12
$PM/PM_{10}/PM_{2.5}$ Filterable	0.20	lb/Mgal	5	0.011	0.048
Total $PM/PM_{10}/PM_{2.5}$				0.038	0.17
CO_2	62.9	kg/MMBtu	4	693	3,035
CH_4	0.0030	kg/MMBtu	4	0.033	0.14
N_2O	0.0006	kg/MMBtu	4	0.0066	0.029
CO_2e			4	696	3,048

Notes:

1. The duct burners fire natural gas with propane as back-up. Potential emissions in Table 2 are based on worst-case emissions across the two fuels on a pollutant-by-pollutant basis.
2. Emission factors for natural gas combustion from AP-42 Section 1.4 - Natural Gas Combustion, 07/98. Natural gas heating value of 1,020 Btu/scf assumed per AP-42.
3. Emission factors for NO_X assume burners are low-NO_X burners.
4. Global Warming Potentials from 40 CFR Part 98 Table A-1.
5. Emission factors for propane combustion obtained from AP-42 Section 1.5 - Liquefied Petroleum Gas Combustion, 07/08. Propane heating value of 91.5 MMBtu/Mgal assumed per AP-42 Section 1.5.
6. AP-42 Section 1.5 does not include an emission factor for low-NO_X burners. Per AP-42 Section 1.4, low-NO_X burners reduce NO_X emissions by accomplishing combustion in stages, reducing NO_X emissions 40 to 85% relative to uncontrolled emission levels. A conservative control efficiency of 50% was applied to the uncontrolled NO_X emission factor from AP-42 Section 1.5. This reduction is consistent with the magnitude of reduction between the uncontrolled and low-NO_X emission factors in AP-42 Section 1.4.
7. SO_2 emissions are based on an assumed fuel sulfur content of 0.54 grains/100 ft^3 per *A National Methodology and Emission Inventory for Residential Fuel Combustion*.

Table 12
Potential Emissions from Double Duct Burners IES-DB-1 and -2
Enviva Pellets Hamlet, LLC Hamlet, Richmond County, North Carolina

Potential HAP and TAP Emissions

Pollutant	HAP	NC TAP	VOC	Emission Factor	Units	Footnote	Potential Emissions Hourly (lb/hr)	Potential Emissions Annual (tpy)
Duct Burners - Natural Gas/Propane Combustion								
2-Methylnaphthalene	Y	N	Y	2.40E-05	lb/MMscf	1	1.18E-07	5.15E-07
3-Methylchloranthrene	Y	N	Y	1.80E-06	lb/MMscf	1	8.82E-09	3.86E-08
7,12-Dimethylbenz(a)anthracene	Y	N	Y	1.60E-05	lb/MMscf	1	7.84E-08	3.44E-07
Acenaphthene	Y	N	Y	1.80E-06	lb/MMscf	1	8.82E-09	3.86E-08
Acenaphthylene	Y	N	Y	1.80E-06	lb/MMscf	1	8.82E-09	3.86E-08
Acetaldehyde	Y	Y	Y	1.52E-05	lb/MMscf	1	7.45E-08	3.26E-07
Acrolein	Y	Y	Y	1.80E-05	lb/MMscf	1	8.82E-08	3.86E-07
Ammonia	N	Y	N	3.2	lb/MMscf	1	1.57E-02	6.87E-02
Anthracene	Y	N	Y	2.40E-06	lb/MMscf	1	1.18E-08	5.15E-08
Arsenic & Compounds	Y	Y	N	2.00E-04	lb/MMscf	1	9.80E-07	4.29E-06
Benz(a)anthracene	Y	N	Y	1.80E-06	lb/MMscf	1	8.82E-09	3.86E-08
Benzene	Y	N	Y	7.10E-04	lb/MMBtu	2	3.55E-03	1.55E-02
Benzo(a)pyrene	Y	Y	Y	1.20E-06	lb/MMscf	1	5.88E-09	2.58E-08
Benzo(b)fluoranthene	Y	N	Y	1.80E-06	lb/MMscf	1	8.82E-09	3.86E-08
Benzo(g,h,i)perylene	Y	N	Y	1.20E-06	lb/MMscf	1	5.88E-09	2.58E-08
Benzo(k)fluoranthene	Y	N	Y	1.80E-06	lb/MMscf	1	8.82E-09	3.86E-08
Beryllium	Y	Y	N	1.20E-05	lb/MMscf	1	5.88E-08	2.58E-07
Cadmium	Y	Y	N	1.10E-03	lb/MMscf	1	5.39E-06	2.36E-05
Chromium VI	Y	N	N	1.40E-03	lb/MMscf	1	6.86E-06	3.01E-05
Chrysene	Y	N	Y	1.80E-06	lb/MMscf	1	8.82E-09	3.86E-08
Cobalt compounds	Y	N	N	8.40E-05	lb/MMscf	1	4.12E-07	1.80E-06
Dibenzo(a,h)anthracene	Y	N	Y	1.20E-06	lb/MMscf	1	5.88E-09	2.58E-08
Dichlorobenzene	Y	Y	Y	1.20E-03	lb/MMscf	1	5.88E-06	2.58E-05
Fluoranthene	Y	N	Y	3.00E-06	lb/MMscf	1	1.47E-08	6.44E-08
Fluorene	Y	N	Y	2.80E-06	lb/MMscf	1	1.37E-08	6.01E-08
Formaldehyde	Y	Y	Y	1.50E-03	lb/MMBtu	2	7.50E-03	3.29E-02
Hexane	Y	Y	Y	1.8	lb/MMscf	1	8.82E-03	3.86E-02
Indeno(1,2,3-cd)pyrene	Y	N	Y	1.80E-06	lb/MMscf	1	8.82E-09	3.86E-08
Lead and Lead Compounds	Y	N	N	5.00E-04	lb/MMscf	1	2.45E-06	1.07E-05
Manganese & Compounds	Y	Y	N	3.80E-04	lb/MMscf	1	1.86E-06	8.16E-06
Mercury	Y	Y	N	2.60E-04	lb/MMscf	1	1.27E-06	5.58E-06
Naphthalene	Y	N	Y	6.10E-04	lb/MMscf	1	2.99E-06	1.31E-05
Nickel	Y	Y	N	2.10E-03	lb/MMscf	1	1.03E-05	4.51E-05
Polycyclic Organic Matter	Y	N	N	4.00E-05	lb/MMBtu	2	2.00E-04	8.76E-04
Phenanthrene	Y	N	Y	1.70E-05	lb/MMscf	1	8.33E-08	3.65E-07
Pyrene	Y	N	Y	5.00E-06	lb/MMscf	1	2.45E-08	1.07E-07
Selenium compounds	Y	N	N	2.40E-05	lb/MMscf	1	1.18E-07	5.15E-07
Toluene	Y	Y	Y	3.40E-03	lb/MMscf	1	1.67E-05	7.30E-05
						Total HAP Emissions:	**0.020**	**0.088**
						Total TAP Emissions:	**0.032**	**0.14**

Notes:

1. Emission factors for natural gas combustion are from NCDAQ Natural Gas Combustion Spreadsheet and AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.

2. The duct burners can fire either natural gas or propane. Propane is worst-case for these HAP emissions. Emission factors for propane combustion from the South Coast Air Quality Management District's Air Emissions Reporting Tool for external combustion equipment fired with LPG.

Abbreviations:

CO - carbon monoxide
HAP - hazardous air pollutant
hr - hour
lb - pound
LPG - liquified petroleum gas
Mgal - thousand gallons
MMBtu - Million British thermal units
MMscf - Million standard cubic feet
NCDAQ - North Carolina Divison of Air Quality
NO_X - nitrogen oxides
ODT - oven dried tons
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
SO_2 - sulfur dioxide
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:

U.S. EPA. AP-42, Section 1.4 - Natural Gas Combustion, 07/98.

U.S. EPA. AP-42, Section 1.5 - Liquefied Petroleum Gas Production, 07/08.

South Coast Air Quality Management District. AER Reporting tool. Emission factors available in the Help and Support Manual at: http://www.aqmd.gov/home/rules-compliance/compliance/annual-emission-reporting

U.S. EPA WebFIRE database available at: https://cfpub.epa.gov/webfire/

A National Methodology and Emission Inventory for Residential Fuel Combustion (2001). Retrieved from https://www3.epa.gov/ttnchie1/conference/ei12/area/haneke.pdf.

Table 13

Dried Wood Handling Potential Emissions ES-DWH
Enviva Pellets Hamlet, LLC Hamlet,
Richmond County, North Carolina

Calculation Basis

Maximum Hourly Throughput[1]	120 ODT/hr
Annual Throughput[1]	625,011 ODT/yr

Potential VOC and HAP Emissions

Pollutant	Emission Factor[2] (lb/ODT)	Potential Emissions	
		(lb/hr)	(tpy)
Formaldehyde	4.32E-04	0.052	0.14
Methanol	8.88E-04	0.11	0.28
Acetaldehyde	4.80E-04	0.058	0.15
Propionaldehyde	1.42E-04	0.017	0.044
	Total HAP Emissions:	**0.23**	**0.61**
VOC as propane	0.050	6.04	15.7

Notes:

1. Hourly and annual throughputs assumed to be the same as the dryer throughput.
2. Emission factor based on January 2020 compliance testing at the Hamlet plant and December 2019 compliance testing at the Enviva Sampson plant plus a 20% contingency to account for inherent variability in stack test results. The VOC emission factor was adjusted to account for the difference in pine percentage during testing and the maximum allowable.

Abbreviations:

hr - hour lb -
pound
ODT - oven dried tons tpy -
tons per year
VOC - volatile organic compound yr -
year

Table 15
Summary of Potential Emissions from Baghouses Enviva Pellets
Hamlet, LLC
Hamlet, Richmond County, North Carolina

Emission Unit ID	Source Description	Control Device ID	Control Device Description	Exhaust Flow Rate	Exit Grain Loading	Particulate Speciation		Potential Emissions					
								PM		PM_{10}		$PM_{2.5}$	
				(cfm)	(gr/cf)	PM_{10} (% of PM)	$PM_{2.5}$ (% of PM)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
ES-HMC	Hammermill Collection Conveyor	CD-HMC-BH	One (1) baghouse[1, 2]	1,500	0.004	100%	100%	0.051	0.23	0.051	0.23	0.051	0.23
ES-PCHP	Pellet Cooler HP Fines Relay System	CD-PCHP-BH	One (1) baghouse[1, 2]	500	0.004	100%	100%	0.017	0.075	0.017	0.075	0.017	0.075
ES-PMFS	Pellet Mill Feed Silo	CD-PMFS-BH	One (1) baghouse[1, 2]	2,444	0.004	100%	100%	0.084	0.37	0.084	0.37	0.084	0.37
ES-FPH	Finished Product Handling	CD-FPH-BH	One (1) baghouse[3, 4]	8,500	0.004	91%	40.0%	0.29	1.28	0.27	1.16	0.12	0.51
ES-PB-1 and 2	Two (2) Pellet Loadout Bins												
ES-PL-1 through 3	Three (3) Pellet Loadouts												
ES-DWH	Dried Wood Handling Operations (conveyors)	CD-DWH-BH1	One (1) baghouse[1, 2]	1,000	0.004	100%	100%	0.034	0.15	0.034	0.15	0.034	0.15
		CD-DWH-BH2	One (1) baghouse[1, 2]	1,000	0.004	100%	100%	0.034	0.15	0.034	0.15	0.034	0.15

Notes:

1. No speciation data is available for PM_{10}. Therefore, it is conservatively assumed to be equal to total PM.
2. No speciation data is available for $PM_{2.5}$. Therefore, it is conservatively assumed to be equal to total PM.
3. Finished product handling PM_{10} speciation is based on emission factors for wet wood combustion controlled by a mechanical separator from AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03. Because the particle size of particulate matter from finished product handling is anticipated to be larger than flyash, this factor is believed to be a conservative indicator of speciation.
4. Finished product handling $PM_{2.5}$ speciation is based on a review of NCASI particle size distribution data for similar baghouses in the wood products industry.

Abbreviations:

cf - cubic feet
cfm - cubic feet per minute
ES - Emission Sources
IES - Insignificant Emission Source
gr - grain
hr - hour
lb - pound
NCASI - National Council for Air and Stream Improvement, Inc.
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year

Reference:

U.S. AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

Table 16 Additive

Handling

IES-ADD

Enviva Pellets Hamlet, LLC Hamlet,

Richmond County, North Carolina

Source	Transfer Activity	Number of Drop Points	Material Moisture Content	PM Emission Factor[1]	PM_{10} Emission Factor[1]	$PM_{2.5}$ Emission Factor[1]	Potential Throughput[2,3]		Potential PM Emissions		Potential PM_{10} Emissions		Potential $PM_{2.5}$ Emissions	
			(%)	(lb/ton)	(lb/ton)	(lb/ton)	(tph)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
IES-ADD	Transfer from Supersacks to Hopper	1	10%	4.47E-04	2.12E-04	3.20E-05	0.18	1,563	8.22E-05	3.49E-04	3.89E-05	1.65E-04	5.89E-06	2.50E-05

Notes:

[1] Emission factor calculation based on formula from AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles, Equation 13.2.1, (11/06). where: E = emission factor (lb/ton)

k = particle size multiplier (dimensionless) for 0.74

k = particle size multiplier (dimensionless) for 0.35

k = particle size multiplier (dimensionless) for 0.053

U = mean wind speed (mph) 7.85

[2] Hourly and annual additive throughputs based on expected maximum usage.

Abbreviations:

hr - hour lb - pound

PM - particulate matter

PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns $PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less tpy - tons per year

yr - year

References:

U.S. EPA. AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles, 11/06.

Table 17

Potential VOC and HAP Emissions at Outlet of Pellet Mill/Pellet Cooler RCO/RTO Stack ES-CLR-1 through 6

Enviva Pellets Hamlet, LLC

Hamlet, Richmond County, North Carolina

Calculation Basis

Maximum Hourly Throughput	120 ODT/hr
Annual Throughput	625,011 ODT/yr
Hours of Operation	8,760 hr/yr
Number of Burners	4 burners
RCO/RTO Burner Rating	8 MMBtu/hr
RCO/RTO Control Efficiency	95%

Pellet Mill and Pellet Cooler Potential Emissions

Pollutant	CAS No.	NC TAP	VOC	Controlled Emission Factor[1,2]	Potential Emissions at RCO/RTO Stack[3]	
				(lb/ODT)	(lb/hr)	(tpy)
Acetaldehyde	75-07-0	Y	Y	0.0029	0.35	0.90
Acrolein	107-02-8	Y	Y	0.0025	0.30	0.79
Formaldehyde	50-00-0	Y	Y	0.0030	0.36	0.94
Methanol	67-56-1	N	Y	0.00088	0.11	0.28
Phenol	108-95-2	Y	Y	0.0011	0.13	0.34
Propionaldehyde	123-38-6	N	Y	5.16E-04	0.062	0.16
Total HAP Emissions					**1.31**	**3.40**
Total TAP Emissions					**1.14**	**2.96**
VOC (as propane)	--	--	Y	0.079	0.47	1.23
CO	--	--	--	0.071	8.50	22.1
NO_X	--	--	--	0.0077	0.92	2.40
PM	--	--	--	0.0032	0.39	1.01
PM_{10}	--	--	--	0.0032	0.39	1.01
$PM_{2.5}$	--	--	--	0.0016	0.20	0.51

Notes:

1. Emission factor derived from process information and an appropriate contingency based on engineering judgement.

2. Emission factors for VOC and HAP are based on post-RCO/RTO test data. The pellet mills and coolers are equipped with an RCO that operates primarily in catalytic mode with thermal (RTO) mode as a backup. The RTO and RCO modes have the same control efficiency so there is no impact on emissions during thermal mode usage.

3. Particulate, CO, and NO_X emissions include emissions from fuel combustion by the RCO/RTO.

Table 17

Potential VOC and HAP Emissions at Outlet of Pellet Mill/Pellet Cooler RCO/RTO Stack ES-CLR-1 through 6

Enviva Pellets Hamlet, LLC

Hamlet, Richmond County, North Carolina

Potential Criteria Pollutant and Greenhouse Gas Emissions from RCO/RTO Fuel Combustion

Pollutant	Emission Factor	Units	Potential Emissions[1]	
			(lb/hr)	(tpy)
Natural Gas				
SO_2	5.9E-04	lb/MMBtu[2]	0.019	0.082
CO_2	53.06	kg/MMBtu[3]	3,743	16,396
CH_4	0.0010	kg/MMBtu[3]	0.071	0.31
N_2O	1.0E-04	kg/MMBtu[3]	0.0071	0.031
CO_2e			3,747	16,412
Propane				
SO_2	0.054	lb/Mgal[4]	0.019	0.083
CO_2	62.87	kg/MMBtu[3]	4,435	19,427
CH_4	0.0030	kg/MMBtu[3]	0.21	0.93
N_2O	6.0E-04	kg/MMBtu[3]	0.042	0.19
CO_2e			4,453	19,505

Notes:

1. Emissions of VOC, CO, NO_X, PM, PM_{10}, and $PM_{2.5}$ are not included in these tables because they are already reflected in the lb/ODT factors above. The RCO/RTO will fire natural gas with propane as back-up. Potential emissions in Table 2 are based on worst-case emissions across the two fuels on a pollutant-by-pollutant basis.
2. Emission factor from AP-42, Section 1.4 - Natural Gas Combustion, 07/98. Emission factors converted from lb/MMscf to lb/MMBtu based on assumed heating value of 1,020 Btu/scf for natural gas per AP-42 Section 1.4.
3. Emission factors for natural gas and propane combustion by the burners obtained from Table C-1 and C-2 of 40 CFR Part 98 and Global Warming Potentials from Table A-1.
4. Emission factors for propane combustion obtained from AP-42 Section 1.5 - Liquefied Petroleum Gas Combustion, 07/08. Heat content of propane was assumed to be 91.5 MMBtu/gal per AP-42 Section 1.5.

Table 17

Potential VOC and HAP Emissions at Outlet of Pellet Mill/Pellet Cooler RCO/RTO Stack ES-CLR-1 through 6

Enviva Pellets Hamlet, LLC

Hamlet, Richmond County, North Carolina

Potential HAP and TAP Emissions from RTO/RCO Natural Gas/Propane Combustion

Pollutant	HAP	NC TAP	VOC	Emission Factor[1,2] (lb/MMBtu)	Potential Emissions (lb/hr)	Potential Emissions (tpy)
RTO/RCO Natural Gas/Propane Combustion						
2-Methylnaphthalene	Y	N	Y	2.35E-08	7.53E-07	3.30E-06
3-Methylchloranthrene	Y	N	Y	1.76E-09	5.65E-08	2.47E-07
7,12-Dimethylbenz(a)anthracene	Y	N	Y	1.57E-08	5.02E-07	2.20E-06
Acenaphthene	Y	N	Y	1.76E-09	5.65E-08	2.47E-07
Acenaphthylene	Y	N	Y	1.76E-09	5.65E-08	2.47E-07
Ammonia	N	Y	N	3.14E-03	0.10	0.44
Anthracene	Y	N	Y	2.35E-09	7.53E-08	3.30E-07
Arsenic	Y	Y	N	1.96E-07	6.27E-06	2.75E-05
Benz(a)anthracene	Y	N	Y	1.76E-09	5.65E-08	2.47E-07
Benzene	Y	N	Y	7.10E-04	0.023	0.10
Benzo(a)pyrene	Y	Y	Y	1.18E-09	3.76E-08	1.65E-07
Benzo(b)fluoranthene	Y	N	Y	1.76E-09	5.65E-08	2.47E-07
Benzo(g,h,i)perylene	Y	N	Y	1.18E-09	3.76E-08	1.65E-07
Benzo(k)fluoranthene	Y	N	Y	1.76E-09	5.65E-08	2.47E-07
Beryllium	Y	Y	N	1.18E-08	3.76E-07	1.65E-06
Cadmium	Y	Y	N	1.08E-06	3.45E-05	1.51E-04
Chromium VI	Y	N	N	1.37E-06	4.39E-05	1.92E-04
Chrysene	Y	N	Y	1.76E-09	5.65E-08	2.47E-07
Cobalt	Y	N	N	8.24E-08	2.64E-06	1.15E-05
Dibenzo(a,h)anthracene	Y	N	Y	1.18E-09	3.76E-08	1.65E-07
Dichlorobenzene	Y	Y	Y	1.18E-06	3.76E-05	1.65E-04
Fluoranthene	Y	N	Y	2.94E-09	9.41E-08	4.12E-07
Fluorene	Y	N	Y	2.75E-09	8.78E-08	3.85E-07
Hexane	Y	Y	Y	1.76E-03	0.056	0.25
Indeno(1,2,3-cd)pyrene	Y	N	Y	1.76E-09	5.65E-08	2.47E-07
Lead	Y	N	N	4.90E-07	1.57E-05	6.87E-05
Manganese	Y	Y	N	3.73E-07	1.19E-05	5.22E-05
Mercury	Y	Y	N	2.55E-07	8.16E-06	3.57E-05
Naphthalene	Y	N	Y	5.98E-07	1.91E-05	8.38E-05
Nickel	Y	Y	N	2.06E-06	6.59E-05	2.89E-04
Polycyclic Organic Matter	Y	N	N	4.00E-05	1.28E-03	5.61E-03
Phenanthrene	Y	N	Y	1.67E-08	5.33E-07	2.34E-06
Pyrene	Y	N	Y	4.90E-09	1.57E-07	6.87E-07
Selenium	Y	N	N	2.35E-08	7.53E-07	3.30E-06
Toluene	Y	Y	Y	3.33E-06	1.07E-04	4.67E-04
				Total HAP Emissions:	**0.081**	**0.35**
				Total TAP Emissions:	**0.16**	**0.69**

Notes:

1. Emission factors for natural gas combustion are from NCDAQ Natural Gas Combustion Spreadsheet and AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98 for small boilers. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.

2. The RTO/RCO burners can fire either natural gas or propane. Propane is worst-case for benzene and polycyclic organic matter (POM) emissions. Emission factors for propane combustion were obtained from the South Coast Air Quality Management District's Air Emissions Reporting Tool for external combustion equipment fired with LPG.

Abbreviations:

CAS - chemical abstract service
HAP - hazardous air pollutant
hr - hour
lb - pound
NC - North Carolina
ODT - oven dried tons
POM - polycyclic organic matter
RCO - regenerative catalytic oxidizer
RTO - regenerative thermal oxidizer
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:

U.S. EPA. AP-42, Section 1.4 - Natural Gas Combustion, 07/98.

Table 20 Diesel Storage Tanks IES-TK-1 through 3
Enviva Pellets Hamlet, LLC
Hamlet, Richmond County, North Carolina

Calculation Constants

Description	IES-TK-1	IES-TK-2	IES-TK-3	Units	Notes
α - Tank Paint Solar Absorptance	0.25			dimensionless	AP-42, Chapter 7 - Table 7.1-6 for White Tank, Average Condition
I - Annual Avg Total Solar Insolation Factor	1,395			dimensionless	AP-42, Chapter 7 - Table 7.1-7 for Charlotte, NC
T_{AX} - Annual Avg Maximum Ambient Temperature	530.5			R	AP-42, Chapter 7 - Table 7.1-7 for Charlotte, NC
T_{AN} - Annual Avg Minimum Ambient Temperature	510.8			R	AP-42, Chapter 7 - Table 7.1-7 for Charlotte, NC
R - Ideal Gas Constant	10.731			psia*ft^3/lb-mole R	AP-42, Chapter 7 - Page 7.1-23
Kp - Product Factor	1			dimensionless	Assume conservative value of 1
P_{VX} - Vapor Pressure at T_{AX}	0.0092			psia	AP-42, Chapter 7 - Equation 1-25 (exp[A-(B/T_{LA})])
P_{VN} - Vapor Pressure at T_{AN}	0.0048			psia	AP-42, Chapter 7 - Equation 1-25 (exp[A-(B/T_{LA})])
ΔP_V - Daily Vapor Pressure Range	0.0044			psia	AP-42, Chapter 7 - Equation 1-9
ΔP_B - Breather Vent Pressure Setting Range	0.06			psia	AP-42, Chapter 7 - Page 7.1-19 Note 3 (default)
P_A - Atmospheric Pressure	14.32			psia	AP-42, Chapter 7 - Table 7.1-7 for Charlotte, NC

Calculation Inputs

Description	IES-TK-1	IES-TK-2	IES-TK-3	Units	Notes
Tank Diameter	5.3	3.3	6.0	ft	Dimensions were provided by Enviva
Tank Length	6.0	3.3	23.7	ft	Dimensions were provided by Enviva
Tank Design Volume	1,000	185	5,000	gal	Conservative design specifications
Tank Working Volume	500	92.5	2,500	gal	50% of tank design volume because tanks will not be full at all times
Tank Throughput	15,958	4,500	200,000	gal/yr	Throughput for IES-TK-1 and IES-TK-2 based on fuel consumption provided by Enviva and 500 hours of operation per year for the fire pump and emergency generator. Throughput for IES-TK-3 provided by Enviva.
Equivalent Tank Diameter (D_E)	6.4	3.7	13.4	ft	AP-42, Chapter 7 - Equation 1-14 (SQRT(LD/(PI/4)))
Effective Height (H_E)	4.2	2.6	4.7	ft	AP-42, Chapter 7 - Equation 1-15 (PI/4*D)
V_v - Vapor Space Volume	66.2	13.8	334.6	ft^3	AP-42, Chapter 7 - Equation 1-3 (PI/4*D^2*H_{VO}), substitute D_E for D for horizontal tanks
H_{vo} - Vapor Space Outage	2.1	1.3	2.4	ft	AP-42, Chapter 7 - H_{VO} = 0.5*H_E for horizontal tanks
P_{VA} - Vapor Pressure	0.009	0.009	0.009	psia	Vapor pressure for Distillate Fuel Oil No. 2 at 70°F
M_v - Vapor Molecular Weight	130	130	130	lb/lb-mole	AP-42, Chapter 7 - Table 7.1-2 for diesel
Q - Throughput	380.0	107.1	4,762	bbl/yr	

Table 20 Diesel Storage Tanks IES-TK-1 through 3
Enviva Pellets Hamlet, LLC

Calculated Values

Description	IES-TK-1	IES-TK-2	IES-TK-3	Units	Notes
K_e - Vapor Space Expansion Factor	0.036	0.036	0.036	dimensionless	AP-42, Chapter 7 - Equation 1-5 ($\Delta T_V/T_{LA}$ + ((ΔP_V - ΔP_B)/(P_A - ΔP_{VA}))
ΔT_v - Daily Vapor Temperature Range	20.77	20.77	20.77	R	AP-42, Chapter 7 - Equation 1-7 (0.7*ΔT_A + 0.02*α*I)
ΔT_A - Daily Ambient Temperature Range	19.7	19.7	19.7	R	AP-42, Chapter 7 - Equation 1-11 (T_{AX} - T_{AN})
K_S - Vented Vapor Saturation Factor	1.00	1.00	1.00	dimensionless	AP-42, Chapter 7 - Equation 1-21 (1/(1 + 0.053P_{VA}*H_{VO}))
W_v - Stock Vapor Density	0.00021	0.00021	0.00021	lb/ft^3	AP-42, Chapter 7 - Equation 1-22 (Mv * P_{VA}) / (R * T_V)
T_V - Average Vapor Temperature	524.1	524.1	524.1	R	AP-42, Chapter 7 - Equation 1-33 (0.7*T_{AA} + 0.3T_B + 0.009α*I)
T_{AA} - Daily Average Ambient Temperature	520.7	520.7	520.7	R	AP-42, Chapter 7 - Equation 1-30 ((T_{AX} + T_{AN})/2)
T_B - Liquid Bulk Temperature	521.7	521.7	521.7	R	AP-42, Chapter 7 - Equation 1-31 (T_{AA} + 0.003αI)
T_{LA} - Daily Average Liquid Surface Temperature	523.0	521.7	521.7	R	AP-42, Chapter 7 - Equation 1-28 (0.4*T_{AA} + 0.6T_B + 0.005*α*I)
N - Number of Turnovers	31.9	48.6	80.0	dimensionless	
K_N - Working Loss Turnover (Saturation) Factor	1	0.78	0.54	dimensionless	AP-42, Chapter 7 - Page 7.1-28 (For N>36, K_N = (180 + N)/6N; For N≤36, K_N = 1)
V_Q - Net Working Loss Throughput	2,133	602	26,733	ft^3/yr	AP-42 Chapter 7 - Equation 1-39 (5.614*Q)
K_p - Working Loss Product Factor	1	1	1	dimensionless	AP-42 Chapter 7 - Page 7.1-28
K_B - Vent Setting Correction Factor	1	1	1	dimensionless	AP-42 Chapter 7 - Page 7.1-28

Potential VOC Emissions

Description	IES-TK-1	IES-TK-2	IES-TK-3	Units	Notes
L_s - Standing Loss	0.18	0.038	0.91	lbs/yr	AP-42, Chapter 7 - Equation 1-2 (365 * Vv * Wv * Ke * Ks)
L_w - Working Loss	0.44	0.098	3.0	lbs/yr	AP-42, Chapter 7 - Equation 1-35 (V_Q * K_N * K_p * W_V * K_B)
L_t - Total Loss	0.62	0.14	3.9	lbs/yr	AP-42, Chapter 7 - Equation 1-1 (Ls + Lw)
Contingency Factor	1.00	1.00	1.00	dimensionless	Assumed contingency factor to account for unaccounted variables.
Total VOC Emissions per Tank	0.62	0.14	3.9	lbs/yr	
Total VOC Emissions	**3.1E-04**	**6.8E-05**	**0.0020**	**tons/yr**	

Reference:

U.S. AP-42, Section 7.1 - Organic Liquid Storage Tanks, 07/2020

Table 22
Potential Fugitive PM Emissions from Unpaved Roads Enviva Pellets
Hamlet, LLC
Hamlet, Richmond County, North Carolina

Vehicle Activity	Distance Traveled per Roundtrip[1] (ft)	Trips Per Day[2]	Daily VMT	Events Per Year (days)	Empty Truck Weight (lb)	Loaded Truck Weight (lb)	Average Truck Weight (ton)	Annual VMT
Front End Loader to Hardwood Pile	600	343	39	365	56,375	63,375	30	14,221
Front End Loader from Hardwood Pile to Mix Pile	300	82	5	365	56,375	63,375	30	1,706
Front End Loader from Softwood Pile to Mix Pile	300	466	26	365	56,375	63,375	30	9,670
Front End Loader from Mix Pile to Reclaim Hopper	200	549	21	365	56,375	63,375	30	7,584
							30	33,182

Notes:
[1] Distance traveled per round trip was estimated based on truck route and site layout.
[2] Daily trip counts based on engineering estimates.

Emission Calculations Unpaved Roads:

Pollutant	Empirical Constant (k)[1] (lb/VMT)	Silt Content (S)[2] (%)	Particle Constant a[1] (-)	Particle Constant b[1] (-)	Emission Factor[3] (lb/VMT)	Potential Emissions[4] (tpy)
PM	4.9	8.4	0.7	0.45	7.51	12.5
PM_{10}	1.5	8.4	0.9	0.45	2.14	3.55
$PM_{2.5}$	0.15	8.4	0.9	0.45	0.21	0.36

Notes:
[1] Constants (k, a, & b) based on AP-42, Section 13.2.2 (Unpaved Roads), Table 13.2.2-2 for Industrial Roads, November 2006
[2] Silt loading factor based on AP-42, Section 13.2.2 (Unpaved Roads), Table 13.2.2-1, Lumber Sawmills, November 2006
[3] Emission factors calculated based on Equation 1a from AP-42 Section 13.2.2 - Unpaved Roads, 11/06. Particulate Emission Factor:
$E_{ext} = k\ (s/12)^a \times (W/3)^b * (365\text{-}P/365)$

k = particle size multiplier for particle size range and units of interest E = size-specific emission factor (lb/VMT)
s = surface material silt content (%) W = mean vehicle weight (tons)
P=number of days with at least 0.01 in of precipitation during the averaging period = = 110 Per AP-42, Section 13.2.1, Figure 13.2.1-2 (Richmond County, NC).

[4] Potential emissions calculated from appropriate emission factor times vehicle miles traveled with control efficiency of 90% for water / dust suppression activities.

Abbreviations:
ft - feet
hr - hour
lb - pound
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10 microns $PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 microns or less
tpy - tons per year
yr - year
VMT - vehicle miles traveled
VOC - volatile organic compound

Reference:
U.S. EPA. AP-42, Section 13.2.2 - Unpaved Roads, 11/06.

Table 23

Potential Emissions from Propane Vaporizers IES-PV-1 and 2

Enviva Pellets Hamlet, LLC Hamlet, Richmond County, North Carolina

Calculation Basis[1]

Propane Heating Value[2]	91.5 MMBtu/Mgal
Hours of Operation	8,760 hr/yr
No. of Vaporizers	2
Maximum Heat Input Rate	1.0 MMBtu/hr
Hourly Fuel Consumption	0.011 Mgal/hr

Notes:

1. The propane vaporizers are considered insignificant activities per 15A NCAC 02Q .0503 .
2. Propane heat content from AP-42 Section 1.5 - Liquefied Petroleum Gas Production, 7/08.

Potential Criteria Pollutant and Greenhouse Gas Emissions

Pollutant	Emission Factor[1]	Units	Potential Emissions	
			(lb/hr)	(tpy)
CO	7.5	lb/Mgal	0.16	0.72
NO_X	13.0	lb/Mgal	0.28	1.24
SO_2[2]	0.054	lb/Mgal	0.0012	0.0052
VOC	1.0	lb/Mgal	0.022	0.096
$PM/PM_{10}/PM_{2.5}$ Condensable	0.50	lb/Mgal	0.011	0.048
$PM/PM_{10}/PM_{2.5}$ Filterable	0.20	lb/Mgal	0.0044	0.019
Total $PM/PM_{10}/PM_{2.5}$			0.015	0.067
CO_2	12,500	lb/Mgal	273	1,197
CH_4	0.20	lb/Mgal	0.0044	0.019
N_2O	0.90	lb/Mgal	0.020	0.086
CO_2e			279	1,223

Notes:

1. Emission factors obtained from AP-42 1.5- Liquefied Petroleum Gas Combustion, 07/08, Table 1.5-1.
2. SO_2 emissions are based on an assumed fuel sulfur content of 0.54 grains/100 ft^3 per *A National Methodology and Emission Inventory for Residential Fuel Combustion* .

Potential HAP Emissions

Pollutant	CAS No.	VOC	Emission Factor[1]	Potential Emissions	
			(lb/MMBtu)	(lb/hr)	(tpy)
Benzene	71-43-2	Y	7.1E-04	0.0014	0.0062
Formaldehyde	50-00-0	Y	0.0015	0.0030	0.013
PAHs	--	N	4.0E-05	8.0E-05	3.5E-04
			Total HAP Emissions	**0.0044**	**0.020**

Notes:

1. Emission factors for propane combustion from the South Coast Air Quality Management District's Air Emissions Reporting Tool for external combustion equipment fired with LPG.

Abbreviations:

Btu - British thermal unit
CAS - chemical abstract service
CH_4 - methane
CO - carbon monoxide
CO2 - carbon dioxide
CO_2e - carbon dioxide equivalent
gal - gallon
HAP - hazardous air pollutant
hr - hour
lb - pound
LPG - liquified petroleum gas
MMBtu - Million British thermal units
Mgal - Thousand gallons
NO_X - nitrogen oxides
N_2O - nitrous oxide
PAH - polycyclic aromatic hydrocarbon
PM - particulate matter
PM_{10} - particulate matter with an aerodynamic diameter less than 10
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 micro
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
yr - year

References:

A National Methodology and Emission Inventory for Residential Fuel Combustion (2001). Retrieved from https://www3.epa.gov/ttnchie1/conference/ei12/area/haneke.pdf.

U.S. EPA. AP-42, Chapter 1.5 - Liquid Petroleum Gas Combustion, 07/08.

South Coast Air Quality Management District. AER Reporting tool. Emission factors available in the Help and Support Manual at: http://www.aqmd.gov/home/rules-compliance/compliance/annual-emission-reporting