NORTH CAROLINA DIVISION OF AIR QUALITY

Application Review

Issue Date: TBD, 2019

Region: Raleigh Regional Office
County: Northampton
NC Facility ID: 6600167
Inspector's Name: Dawn Reddix
Date of Last Inspection: 04/30/2019
Compliance Code: 3 / Compliance - inspection

Facility Data

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

Facility Address:
Enviva Pellets Northampton, LLC
309 Enviva Boulevard
Garysburg, NC 27831

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 02Q .0300, .0711, 02D .0515, .0516, .0521, .0540, .1100,
NSPS: 15A NCAC 02D .0524 – 40 CFR Part 60, Subpart IIII
NESHAP: 15A NCAC 02D .1111 – 40 CFR Part 63, Subpart ZZZZ, 15A NCAC 02Q .0317 less than 25 tpy all HAPs and 10 tpy of single HAP
PSD: N/A
PSD Avoidance: 15A NCAC 02Q .0317 less than 250 tpy VOC
NC Toxics: 15A NCAC 02D .1100 and 02Q .0711
112(r): N/A
Other: N/A

Contact Data

Facility Contact	Authorized Contact	Technical Contact
Heath Lucy EH&S Manager (910) 318-2743 309 Enviva Blvd Garysburg, NC 27831	Mark Jordan Plant Manager (252) 541-2631 309 Enviva Blvd Garysburg, NC 27831	Joe Harrell Corporate EHS Manager (252) 209-6032 142 NC Route 561 East Ahoskie, NC 27910

Application Data

Application Number: 6600167.18A
Date Received: 10/01/2018
Application Type: Modification
Application Schedule: State

Existing Permit Data

Existing Permit Number: 10203/R05
Existing Permit Issue Date: 03/03/2017
Existing Permit Expiration Date: 02/28/2025

Total Actual emissions in TONS/YEAR:

CY	SO2	NOX	VOC	CO	PM10	Total HAP	Largest HAP
2017	19.14	130.68	382.86	63.50	72.82	25.25	10.73 [Methanol (methyl alcohol)]
2016	18.00	130.36	381.42	63.35	72.92	21.90	9.63 [Methanol (methyl alcohol)]
2015	17.68	126.53	337.00	61.47	71.52	18.61	8.43 [Methanol (methyl alcohol)]
2014	19.20	107.54	213.08	52.23	89.86	17.22	7.33 [Methanol (methyl alcohol)]
2013	10.80	60.32	113.88	29.51	53.49	9.32	3.31 [Formaldehyde]

Review Engineer: Richard Simpson

Review Engineer's Signature: **Date: TBD, 2019**

Comments / Recommendations:
Issue: 10203/R06
Permit Issue Date: TBD, 2019
Permit Expiration Date: February 28, 2025

I. Introduction and Purpose of Application

A. Enviva Pellets Northampton, LLC (referred to as Enviva or Northampton throughout this document) currently holds Air Permit No. 10203R05 with an expiration date of February 28, 2025 for a wood pellets manufacturing plant in Garysburg, Northampton County, North Carolina. The plant is currently permitted to produce up to 535,260 oven-dried tons (ODT) per year of wood pellets utilizing up to 30% softwood on a 12-month rolling basis. The plant consists of a log chipper, green wood hammermills, bark hog, wood-fired rotary dryer, dry hammermills, pellet presses and coolers, product loadout operations, and other ancillary activities.

B. Permit application No. 6600167.18A was received on October 1, 2018 and an amended version was received on April 1, 2019 for a modification that incorporates emission reduction efforts to comply with 15A NCAC 02Q .0317 Avoidance Conditions for 15A NCAC 02D .0530: Prevention of Significant Deterioration and 15A NCAC 02Q .0317 Avoidance Condition for 15A NCAC 02D .1111: Maximum Available Control Technology (MACT) Standards for HAPs. The proposed modification is also being implemented to meet new customer demands for increased softwood percentage and production rates. The Table of Changes located in Section III includes details associated with the proposed modification such as Insignificant Activities, emission source name changes, etc. This permit action will address the following main changes associated with the modification as outlined in the application:

- Increase production rate from an approximate actual facility throughput of 535,260 ODT per year to a potential facility throughput at 781,255 ODT per year by upgrading pellet dies with a new prototype;
- Increase the amount of softwood processed from 30% to a maximum of 80%;
- For the existing Dryer (ES-DRYER-1), add a regenerative thermal oxidizer (CD-RTO-1) after the existing wet electrostatic precipitator (CD-WESP-1) for volatile organic compound (VOC), HAP and particulate matter (PM) emissions control;
- Install a new direct-fired wood dryer (ES-DRYER-2) equipped with a new wet electrostatic precipitator (CD-WESP-2) in series with a regenerative thermal oxidizer (CD-RTO-2);
- Add a new dryer bypass stack (ES-DRYBYP-2) and furnace bypass stack (ES-FURNACEBYP-2) for malfunctions and low load startups, shutdowns, and idling operations;
- Remove two existing Green Wood Hammermills (previously referred to as wood re-chippers) and construct five new Green Hammermills (ES-GWH-1 through ES-GWH-5) and route the exhaust to the existing wet electrostatic precipitator (CD-WESP-1) in series with a new regenerative thermal oxidizer (CD-RTO-1). The Green Hammermills will have the capability to be exhausted to CD-WESP-2 and CD-RTO-2 when CD-WESP-1 and CD-RTO-1 are shut down;
- Existing Dry Wood Handling (ES-DWH-1 and ES-DWH-2) will exhaust to new bagfilters (CD-DWH-BF-1 and CD-DWH-BF-2);
- Install Dry Shaving Material Handling (ES-DRYSHAVE-1), Dry Shavings Reception (ES-DSR-1) with associated bagfilter (CD-DSR-BF), and a Dry Shavings Silo (ES-DSS) with associated bagfilter (CD-DSS-BF);
- Install two new Dry Shavings Hammermills (ES-DSHM-1 and ES-DSHM-2) for dry shavings and route the exhaust to a new wet scrubber (CD-WS-1) in series with a new regenerative catalytic oxidizer (CD-RCO-1) that can also operate as a regenerative thermal oxidizer;
- Existing Dry Hammermills (ES-HM-1 through 8) will exhaust from the existing bagfilters to a new wet scrubber (CD-WS-1) in series with a new regenerative catalytic oxidizer (CD-RCO-1);
- Route exhaust from the existing dust control system to a new wet scrubber (CD-WS-1_and regenerative catalytic oxidizer (CD-RCO-1) that can also operate as an RTO and

- Exhaust from the Pellet Presses and Pellet Coolers cyclones will be routed to a new wet scrubber (CD-WS-2) in series with a new regenerative catalytic oxidizer (CD-RCO-2) that can also operate as a regenerative thermal oxidizer.

III. History/Background/Application Chronology

April 22, 2014 -Application 6600167.14B was received for a first time Title V permit.

August 9, 2016 - Amendment 6600167.16A was received and incorporated into 600167.14B.

March 3, 2017 - Air Permit R05 was issued.

August 28, 2018 - The facility was inspected by Raleigh Regional Office engineer Steven Carr. At the time of the inspection, the facility appeared to operate in compliance with all applicable regulations and permit conditions.

September 20, 2017 - October 20, 2018 – The first time Title V application went through public notice and major comments were received during the public comment period from the Environmental Integrity Project (EIP). Issuance of the 1st time Title V permit was placed on hold and DEQ was notified that another permit application from the facility would add controls to make the facility minor for PSD.

October 1, 2018 – Permit application 6600167.18A was received for several modifications and a permit acknowledgement was sent to the facility on the same day.

November 16, 2018 – The facility requested that permit application processing be put on hold due to an upcoming addendum to the previous modification.

January 10-14, 2019 – A permit addendum was received from the facility. DAQ permit engineer Richard Simpson called the facility and requested the facility send in a signed A1 permit application form. An A1 form was received from the facility a few days later.

January 30, 2019 - February 6, 2019 – Through emails and a conference call with the facility, discrepancies were found for several sources in the permit application and the addendum. To help simplify the modification, the facility agreed to send an amended application that would combine the October 1, 2018 application with the January 10, 2019 addendum.

March 6, 2019 - Current – DAQ created an Enviva Workgroup for Enviva's Northampton, Hamlet, and Sampson facilities to provide consistency to each of the updated air permits.

March 14, 2019 - Permit engineer Richard Simpson preformed a facility site visit.

March 29, 2019 – April 1, 2019 – An amended permit was received by email and paper copy.

April 10 - 19, 2019 – The facility sent particulate testing emission factor results from their Greenwood facility for Northampton's Dry Shavings Hammermill. DAQ's SSCB Supervisor Gary Saunders reviewed the testing data and no issues were noted in the reported values.

April 12, 2019 - May 23, 2019 - DAQ requested by letter additional information on NC air toxics modeling and emission sources. The facility was requested to remodel. The facility sent the additional information on May 2, 2019 and the electronic modeling files a few weeks later. Ray Stewart and Dawn Reddix of RRO inspected the facility on April 30, 2019.

May 7 - 23, 2019 – DAQ's permit engineers, Raleigh Regional Office, and Stationary Compliance Section were requested to comment on a version of the draft permit. Comments were received and included in the permit from DAQ.

May 23 - June 5, 2019 – The Air Quality Analysis Branch received updated facility modeling. On June 3, 2019, the modeling was approved by DAQ meteorologist Nancy Jones and Tom Anderson. By email, the modeling review was sent to the facility on June 5, 2019.

May 31 – June 5, 2019 – The facility submitted a request to replace four failing presses without increasing throughput to RRO. RRO forward the information to the Permitting Section where the request was entered into the DAQ data system as Applicability Determination No. 3432. The request was approved and a letter was sent to the facility on June 5, 2019.

May 31 - June 7, 2019 – A first draft of the permit was sent to facility representatives, Kai Simonsen and Theron Grim of Enviva Raleigh office, consultant Michael Carbon and DAQ engineers for comments and any potential updates since the amended application. Comments and updates were received.

June 19 – June 21, 2019 – An email was sent to the facility's representatives on items that needed to be addressed or clarified. Updates and clarifications were provided by the facility.

June 20 – July 15, 2019 – An email was sent to the facility about the zoning consistency determination status. On July 15, 2019, William Flynn, Director of the Northampton County Code Enforcement, signed the zoning consistency determination and approved that the facility's proposed operations are consistent with applicable zoning ordinances.

June 26 – July 2, 2019 – The facility, Raleigh Regional Office, and Stationary Compliance Section were requested by the Permitting Section to comment on the draft permit and review. Comments were received and included in the permit from DAQ

July 1 – July 5, 2019 – A second draft of the permit and a first draft of the review were sent to facility representatives, Kai Simonsen and Theron Grim of Enviva Raleigh office, consultant Michael Carbon for comments and any potential updates. Comments and updates were received.

July 8 – 17, 2019 – Phone calls and emails were made to facility representatives on items that needed to be addressed or clarified along with sending a draft of the permit and review. Updates, clarifications, and comments were received and incorporated into the documents.

July 19, 2019 – Draft permit sent to public notice prior to issuance.

TBD, 2019 – TVEE changes were approved by Ms. Jenny Sheppard TVEE Coordinator.

TBD, 2019 – Permit 10203R06 was signed and issued.

III. Permit Modifications/Changes and ESM Discussion

The following changes were made to Enviva Pellets Northampton, LLC, Garysburg, NC., Air Permit No. 10203R05.

Page No.	Section	Description of Changes
Cover Letter	N/A	Updated cover letter with application number, permit numbers, dates, fee class, and Director name.
NA	Insignificant Activities	Added new sources debarker IES-Debark, bark hog IES-Bark, four natural gas/propane double duct burners IES-DDB-1 through IES-DDB-4, dry shaving handling and storage systems IES-DRYSHAVE, dry shaving handling and storage systems IES-DRYSHAVE-1 with one bagfilter CD-DSR-BF, propane vaporizer IES-PVAP, additive handling and storage IES-ADD with one bagfilter CD-ADD-BF, one emergency use generator IES-GN-2, mobile diesel storage tank IES-TK3, and diesel storage tank IES-TK4.
NA	Insignificant Activities	Reclassified dry line hopper to an insignificant source and changed ID No. to IES-DLH.
NA	Insignificant Activities	Reclassified dry wood handling IES-DWH and green wood handling and storage IES-GWHS as significant sources and changed ID Nos. to ES-DWH-1 and ES-GWHS.
NA	Insignificant Activities	Pellet press system IES-PP was deleted since it is incorporated with the pellet coolers.
NA	Insignificant Activities	Finished product handling IES-FPH was deleted since it is incorporated with handling ES-FPH.
NA	Insignificant Activities	Log chipper IES-CHIP-1 was deleted since it is incorporated with chipper IES-EPWC.
NA	Insignificant Activities	Two electric powered wood re-chippers, IES-RCHP-1 and IES-RCHP-2, were deleted since they are being replaced by five new green hammermills (ES-GHM-1 through ES-GHM-5).
NA	Insignificant Activities	Generator ID No. was changed from IES-GN to IES-GN-1. Diesel storage tanks ID Nos. were changed from IS-TK1 and IS-TK2 to IES-TK1 and IES-TK2. IES-TK2 capacity was updated from 500 gallons to 600 gallons.
3, 6	Section 1 and Section 2.1 A.	Add five (5) new closed-loop green hammermills (ES-GHM-1 through ES-GHM-5) and route the exhaust to the existing wet electrostatic precipitator (CD-WESP-1) and the new regenerative thermal oxidizer (CD-RTO-1). The Green hammermills exhaust will also have the ability to be routed and controlled by new CD-WESP-2 and new CD-RTO-2 when the CD-WESP-1 and CD-RTO-1 are shut down. Simple cyclone CD-DC is for product handling and deleted from the permit as a control device.
3, 6	Section 1 and Section 2.1 A.	Updated wood dryer ID No. from (ES-DRYER) to (ES-DRYER-1). The exhaust will route to existing wet electrostatic precipitator (CD-WESP-1) and the new regenerative thermal oxidizer (CD-RTO-1).
3, 6	Section 1 and Section 2.1 A.	Added dryer 1 bypass ES-DRYERBYP-1 and furnace 1 bypass (ES-FURNACEBYP-1).

Page No.	Section	Description of Changes
3, 6	Section 1 and Section 2.1 A.	Added a new direct heat wood fired dryer (ES-DRYER-2) controlled by new wet electrostatic precipitator CD-WESP-2 in series with a new regenerative thermal oxidizer (CD-RTO-2).
3, 6	Section 1 and Section 2.1 A.	Added dryer 2 bypass (ES-DRYERBYP-2) and furnace 2 bypass (ES-FURNACEBYP-2).
3, 6	Section 1 and Section 2.1 A.	Added a new dry wood handling (ES-DWH-2) controlled by a new bagfilter (CD-DWH-BF-2).
3, 6	Section 1 and Section 2.1 A.	Assigned source ID Nos. (ES-PS-1) and (ES-PS-2) to existing dry hammermill pre-screeners.
4, 6	Section 1 and Section 2.1 A.	The eight existing dry hammermills exhaust will also route through new wet scrubber (CD-WS-1) and regenerative catalytic oxidizer (CD-RCO-1) that can also operate as an RTO.
4, 6	Section 1 and Section 2.1 A.	Renamed existing nuisance system to dust control system (ES-DCS) and update the permit to reflect that the exhaust will route through new wet scrubber (CD-WS-1) and regenerative catalytic oxidizer (CD-RCO-1) that can operate as an RTO.
4, 6	Section 1 and Section 2.1 A.	Added a new dry shavings reception (ES-DSR) controlled by a new bagfilter (CD-DSR-BF).
4, 6	Section 1 and Section 2.1 A.	Added a new dry shavings silo (ES-DSS) controlled by a new bagfilter (CD-DSS-BF).
4, 6	Section 1 and Section 2.1 A.	Added two new dry shavings hammermills (ES-DSHM-1 and ES-DSHM-2) controlled by new wet scrubber (CD-WS-1) and regenerative catalytic oxidizer (CD-RCO-1) that can operate as an RTO.
5, 6	Section 1 and Section 2.1 A.	The six existing pellet coolers exhaust will also route through new wet scrubber (CD-WS-2) and regenerative catalytic oxidizer (CD-RCO-2) that can operate as an RTO.
5, 6	Section 1 and Section 2.1 A.	Rename the currently permitted Pellet Fines Bin (ES-PFB-1) and associated bin vent filter (CD-PFB-BV) to Pellet Cooler Fines Relay System (ES-PCHP) and baghouse (CD-PCHP-BV.)
NA	Section 1 and Section 2.1 A.	Since the sources will not be utilized, deleted bagging system conveyor and screens (ES-BSC-1, ES-BSS-1, and ES-BSS-2) and associated filters (CD-BS-BF-1 and CD-BS-BF-2).
NA	Section 1 and Section 2.1 A.	Since the sources will not be utilized, deleted bagging systems (ES-BSC-2, ES-BSC-3, ES-BSB-1, and ES-BSB-2).
6	Section 2.1 A. and Section 2.1 4.	Added 15A NCAC 02D .0535 Excess emissions reporting and malfunctions rule to the table and section.
6	Section 2.1 A.	Added PM, NOx, and CO to the table for PSD avoidance.
8	Section 2.1 A.1.c.	To demonstrate compliance with 15A NCAC 02D .0515, added particulate testing.
8, 9	Section 2.1 A.1.d through i.	Added the new control devices for monitoring requirements.
9	Section 2.1 A.1.j.	Added the recordkeeping requirements.
10	Section 2.1 A.2.	Added the new wood dryer to the 15A NCAC 02D .0516 requirements.
11	Section 2.2 A.	Added the table for the regulated pollutants and applicable standards.

Page No.	Section	Description of Changes
12	Section 2.2 A.1.	Added regulation 15A NCAC 02D .0540 Particulates from Fugitive Dust Emissions.
12	Section 2.2 A.2.	Included existing PSD avoidance conditions until the facility meets Construction Schedule per Section 2.3. Also updated conditions to include dryer, dry hammermill, and pellet cooler systems throughput limitations along with associated percent softwood limitations on a rolling 12-month average basis.
13	Section 2.2 A.3.	Added regulation 15A NCAC 02Q .0317 Avoidance Condition for 15A NCAC 02D .0530: Prevention of Significant Deterioration facility-wide for PM, VOCs, and NOx. Conditions include throughput and softwood limits along with initial and periodic testing, monitoring, recordkeeping, and reporting for the proposed modification.
18	Section 2.2 A.4.	Added regulation 15A NCAC 02Q .0317 Avoidance Condition for 15A NCAC 02D .1111: Maximum Available Control Technology (MACT) Standards facility-wide for HAPs. Conditions include initial and periodic testing, monitoring, recordkeeping, and reporting.
18	Section 2.2 A.5.	Included existing 15A NCAC 02D .1100 Toxics Air Pollutant Emissions Limitation and Requirement until the facility meets Construction Schedule per Section 2.3.
19	Section 2.2 A.6.	Added eleven toxics pollutants and new associated equipment to 15A NCAC 02D .1100 Toxics Air Pollutant Emissions Limitation and Requirement.
20	Section 2.2 A.7.	Deleted the eleven toxics pollutants that were moved to Section 2.2 A.4.
21	Section 2.2 A.8.	Added regulation 15A NCAC 02Q .1806 Control and Prohibition of Odorous Emissions.
21	Section 2.2 A.9.	Added regulation 15A NCAC 02Q .0207 Annual Emissions Reporting.
22	Section 2.2 A.10.	Added regulation 15A NCAC 02Q .0304 Applications Annual Emissions Reporting.
22	Section 2.2 A.11.	Added regulation 15A NCAC 02Q .0504 Option for Obtaining Construction and Operation Permit.
22	Section 2.3.	Added Section 2.3 for a Construction Schedule.
23-25	Section 3	The General Conditions were updated to the latest version of DAQ shell.

The changes mentioned above will be made to the Title V Equipment Editor (TVEE) under this permit modification.

IV. Statement of Compliance

The most recent inspection conducted on April 30, 2019 by Ray Stewart and Dawn Reddix of RRO. According the RRO compliance databases, no Notices of Violation (NOVs) have been issued to this facility. A Notice of Deviation (NOD) dated December 7, 2016 was issued for failing to submit a permit renewal application. Previously, a NOD dated August 22, 2014 was issued for failing to submit a semiannual report.

V. Process Description

The flow diagram is located in Attachment 1. The wood pellet manufacturing process description is detailed in the application as follows:

A. Green Wood Handling and Storage

"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 will be unloaded from trucks into hoppers that feed conveyors that transfer the material to Green Wood Handling and Storage Piles (ES-GWHS). Conveyors transferring green wood chips will be enclosed.

Purchased chips will be screened prior to transfer to the Green Wood Storage Piles.

B. Debarking, Chipping, Bark Hog, Storage Piles and Bin

Unchipped logs are to be debarked by the electric-powered rotary drum Debarker (IES-DEBARK) and then sent to the electric-powered Green Wood Chipper (IES-EPWC) to chip the wood to specification for drying. Bark from the Debarker and purchased bark/chips are transferred to the Bark Hog (IES-BARK) via conveyor for further processing.

Material processed by the Electric Chipper and Bark Hog are handled and transferred to the Storage Piles (ES-GWHS) via conveyor. The Green Wood Fuel Storage Bin (IES-GWFB) is to be located under a covered structure. Following storage in the Fuel Storage Bin, the fuel is transferred and pushed into the furnace.

C. Green Hammermills

Chipped wood used in pellet production will be further processed in the Green Hammermills (ES-GHM-1 through 5) to reduce material to the proper size. The Green Hammermills will route the vent streams to the existing wet electrostatic precipitator (CD-WESP-1) and the new natural gas/propane-fired regenerative thermal oxidizer (CD-RTO-1) to control PM, VOC, and HAP emissions. The Green Hammermills will have the ability to be routed and controlled by the new Dryer 2 wet electrostatic precipitator (CD-WESP-2) in series with regenerative thermal oxidizer (CD-RTO-2) when CD-WESP-1 and CD-RTO-1 are shutdown.

D. Dryers

Green wood will be conveyed to two rotary Dryer systems (ES-DRYER-1 rated at 175.3 million Btu/hr and ES-DRYER-2 rated at 180 million Btu/hr). Direct contact heat will be from the furnaces that use 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 a multicyclone separator consisting of three identical cyclones equipped to control the discharge of the rotary dryer system. The cyclones are closed loop and are used for material handling for the dryer system. Emissions from Dryer 1 will exhaust to existing wet electrostatic precipitator (CD-WESP-1) in series with a new natural gas/propane-fired regenerative thermal oxidizer (CD-RTO-1) to provide further PM, VOC, and HAP emissions control. Emissions from Dryer 2 will exhaust to a new wet electrostatic precipitator (CD-WESP-2) in series with a new natural gas/propane-fired regenerative thermal oxidizer (CD-RTO-2).

As the flue gas exits the dryers 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, each dryer system will include double ducts which will be heated. The duct from the cyclone outlet to the induced draft fan will be heated by one low-NOx burner with a maximum heat input rating of 1 million Btu/hr and a second 1 million Btu/hr low-NOx burner will be used to heat the duct used for exhaust gas recirculation and the WESP. The double duct burners (IES-DDB-1 through IES-DDB-4) will combust natural gas, or propane as back-up, and will exhaust directly to atmosphere.

E. Bypass Stacks

There are bypass stacks following each rotary drum dryer (ES-DRYERBYP-1 and ES-DRYERBYP-2). Venting of emissions through the dryer bypass stacks only occurs in the event of a malfunction, during which the furnace or dryer itself can abort and open the bypass stack. An abort may be caused by failsafe interlocks associated with the dryer and emissions control systems as well as utility supply systems (i.e., electricity, compressed air, water/fire protection). Dryer abort may also be triggered if a spark is detected. Malfunctions are infrequent and unpredictable. Use of the Dryer Bypass Stacks for malfunctions will be limited to 100 hours per year (i.e., 50 hours per stack of dryer bypass at full capacity).

The furnace bypass stacks (ES-FURNACEBYP-1 and ES-FURNACEBYP-2) may be used to exhaust hot gases during cold start-ups (for temperature control), planned shutdowns, and malfunctions. Venting at full capacity only occurs in the event of a malfunction.
- Cold Start-ups: The furnace bypass stacks will be 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 (limited to 15% of the maximum heat input rate or 26.3 million Btu/hr for furnace 1 and 27.0 million Btu/hr for furnace 2). The bypass stack will then be closed, and the furnace will slowly be brought up to a normal operating rate. The duration of a cold start-up is typically between 6 to 8 hours and there are generally two (2) cold start-ups per year.
- Malfunction: The furnace itself can abort and open the bypass stack in the event of a malfunction. This may occur as a result of a number of different interlocks such as power failure, dryer induced draft fan failure, etc. As soon as the furnace aborts it will automatically switch to "idle mode" (limited operation up to a maximum heat input rate of 5 million Btu/hr). The fuel feed is significantly reduced, and the heat input rate drops rapidly. Malfunctions are infrequent and unpredictable.

- Planned Shutdown: In the event of a planned shutdown the furnace heat input will be decreased, and all remaining fuel will be moved through the system to prevent a fire during the shutdown period. The remaining fuel will be combusted prior to opening the furnace bypass stack.

Use of the Furnace Bypass Stacks for start-up, shutdown, and malfunctions will be limited to 100 hours per year (i.e., 50 hours of furnace bypass per stack at full capacity). Each Furnace Bypass Stack is limited to 500 hours per year in "idle mode". 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 dryers.

F. Dried Wood Handling

Dried materials from the Dryer product recovery cyclones will be conveyed to screening operations that remove smaller wood particles. These smaller particles are diverted to the dry hammermill discharge conveyor, while oversized wood is sent to the dry hammermills (ID Nos. ES-HM-1 through 8) for further size reduction prior to pelletization. Smaller particles passing through the screens (ES-PS-1 and ES-PS-2) will bypass these hammermills and be pneumatically conveyed directly to the product recovery for the Dry Hammermills. Enviva estimates that approximately 15% of the total material leaving the Dryer will bypass the Dry Hammermills and be sent directly to the pelletizing operations.

There will be several other conveyor transfer points located between the Dryer and Dry Hammermills comprising the Dried Wood Handling (ES-DWH-1 and ES-DWH-2) emission sources. These transfer points will be completely enclosed with only two (2) emission points that will be controlled by individual bagfilters (CD-DWH-1 and CD-DWH-2).

G. Dry Hammermills

After screening, oversized dry wood is reduced to the appropriate size using one of eight (8) existing Dry Hammermills (ES-HM-1 through ES-HM-8) for further size reduction prior to pelletization. Each Dry Hammermill includes a product recovery cyclone (CD-HM-CYC-1 through CD-HM-CYC-8) which is routed to one of three (3) bagfilters (CD-HM-BF-1 through CD-HM-BF-3) for particulate matter control. Following the dry hammermills, the Dust Control System (ES-DCS) collects smaller wood and is controlled by a bagfilter (CD-HM-BF-3). The facility will route the exhaust from the existing dry hammermill baghouses to the new wet scrubber (CD-WS-1) in series with a regenerative catalytic oxidizer (CD-RCO-1) that can also operate as an RTO for control of PM, VOC, and HAP emissions.

H. Dry Shavings Process

As part of this application, Enviva will purchase dry shavings to produce wood pellets in addition to green chips or logs, forgoing the drying process and thus lowering VOC and HAP emissions. The purchased dry shavings will be unloaded from trucks into a hopper that feeds material via enclosed conveyors to a bucket elevator that ultimately fills a silo. Each of these material transfer points will be entirely enclosed except for truck unloading (IES-DRYSHAVE). From the silo, the dry shavings will then be transferred via an enclosed screw conveyor to the Dry Hammermills for additional processing.
Currently the plant receives dry shavings at the bark truck dump where they are moved to an open dry shavings pile (IES-DRYSHAVE) via front end loader or are received via walking floor trailer at the pile. Dry shavings are added to the Dry Line Hopper (IES-DLH) which transfers via Dry Line Feed Conveyor (ES-DLC-1) to the dry hammermill feed conveyor at the point of the hammermill pre-screens.

As part of this application, Enviva is proposing to add a new Dry Shavings Material Handling and Storage source (IES-DRYSHAVE-1) and assign a source ID for the Dry Shavings Reception (ES-DSR) both of which will be controlled by a proposed new Dry Shavings Reception Dust Control Baghouse (CD-DSR-BF). The facility will also install a Dry Shavings Silo (IES-DSS) controlled by a bagfilter (CD-DSS-BF) to store dry shavings and two new Dry Shavings Hammermills (ES-DSHM-1 and ES-DSHM-2). The purchased dry shavings will be unloaded from trucks via a new truck dump into a hopper that feeds material via enclosed conveyors to a bucket elevator that ultimately fills a silo. From the silo, the dry shavings will then be transferred via an enclosed conveyor to the new Dry Shavings Hammermills for additional processing. Milled dry shavings will be transferred to the pellet mill feed silo. The dry shavings hammermill exhaust will be routed to the new wet scrubber (CD-WS-1) in series with a regenerative catalytic oxidizer (CD-RCO-1) that can also operate as an RTO for control of PM, VOC, and HAP emissions.

I. Pellet Mill Feed Silo and Relay System

Milled wood from the Dry Hammermill product 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 will be controlled by a bagfilter (CD-PMFS-BH). Fines from Finished Product Handling (ES-FPH) are collected by the Pellet Cooler HP Fines Relay System (ES-PCHP) which is controlled by a bagfilter (CD-PCHP-BV). The Pellet Cooler HP Fines Relay System transfers this material to the Pellet Mill Feed Silo.

J. Additive Handling and Storage

Additive may be used in the pellet production process to increase the durability of the final product. The additive will be added to sized wood from the Pellet Mill Feed Silo discharge screw conveyor prior to transfer to the Pellet Presses. The additive contains no hazardous chemicals or VOCs. Bulk additive material will be delivered by truck and pneumatically unloaded into a storage silo (ES-ADD) equipped with a bagfilter (CD-ADD-BF) to control emissions from air displaced during the loading of additive material to the silo. The additive will then be conveyed via screw conveyor from the storage silo to the milled conveyor which transfers milled wood to the Pellet Presses.

K. Pellet Press System and Pellet Coolers

Dried processed wood is mechanically compacted through twelve (12) presses in the Pellet Press System. Exhaust from the Pellet Press System and Pellet Press conveyors will be vented through the Pellet Cooler aspiration material recovery cyclones and pollutant controls as described below, and then to the atmosphere. Formed pellets are discharged into one of six (6) pellet coolers (ES-CLR-1 thru ES-CLR-6). Chilled 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 are controlled utilizing six (6) cyclones (CD-CLR-1 thru CD-CLR-6). Following the cyclones, the exhaust will be routed to a new wet (scrubber CD-WS-2) in series with a regenerative catalytic oxidizer (CD-RCO-2) that can also operate as an RTO for control of PM, VOC, and HAP emissions. The facility will also upgrade the pellet press dies to a new design. The manufacturer of the pellet presses does not make the same 1250 mm size press or any replacement parts. The replacement is a 1500 mm press along with the associated screw conveying system.

L. Finished Product Handling and Loadout

Final product is conveyed to pellet load-out bins (ES-PB-1 through ES-PB-12) that will feed pellet truck loadout operations (ES-PL-1 and ES-PL-2). Pellet loadout is accomplished by gravity feed of the pellets through a covered chute to reduce emissions. Emissions from pellet loadout are minimal because dried wood fines will have been removed in the pellet screener and future screener, and a slight negative pressure is maintained in the loadout area 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-BF). This baghouse controls emissions from Finished Product Handling (ES-FPH), Pellet Loadout Bins (ES-PB-1 through ES-PB-12), and pellet truck loadout operations (ES-PL-1 and ES-PL-2. Fine material from loadout operations is transferred to the Pellet Mill Feed Silo (ES-PMFS).

M. Emergency Generator, Fire Water Pump Engine, and Diesel Storage Tanks

The plant has a 350 brake horsepower (bhp) diesel-fired Emergency Generator (IES-GN) for emergency operations and a 300 bhp diesel-fired Fire Water Pump Engine (IES-FWP). Aside from maintenance and readiness testing, the generator and fire water pump engines are only utilized for emergency operations. The facility proposes to change the existing Emergency Generator ID from IES-GN to IES-GN-1 and add a second diesel-fired Emergency Generator (IES-GN-2) rated at 671 bhp. The facility also proposes to add a third diesel storage tank with a capacity of up to 5,000 gallons (IES-TK-3) for distributing diesel fuel to mobile equipment and a fourth diesel storage tank with a capacity of 1,000 gallons (IES-TK-4) for the proposed generator (IES-GN-2).

N. Propane Vaporizer

With this application, Enviva proposes to add a propane vaporizer. A direct-fired propane vaporizer (IES-PVAP) rated at 1 million Btu/hour will be located on-site to vaporize propane gas for combustion by the RTO burners, RCO burners, and double duct burners. The vaporizer will have a maximum heat input capacity of 1 million Btu/hour and will combust propane. Propane may be used initially until natural gas service is completed. Natural gas will be the primary fuel for all burners and propane may be used as a back-up fuel.

VI. Emissions

The following table is a comparison of the currently permitted PTE to the proposed estimated PTE after incorporating the changes proposed in this application.

Emissions Scenario	CO (tpy)	NO_X (tpy)	PM (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	SO_2 (tpy)	VOC (tpy)	CO_2e (tpy)	Total HAPs (tpy)
Proposed PTE[1]	182.73	242.21	148.97	118.75	83.75	39.52	129.68	399,490.52	21.71
Previous PTE	61.88	126.57	128.84	121.79	93.79	19.20	456.40	162,292.20	37.82
Change in PTE	**+120.85**	**+115.64**	**+20.13**	**-3.04**	**-10.04**	**+20.32**	**-326.72**	**+237,198.3**	**-16.11**

The following table provides a summary of facility-wide criteria pollutant emissions on a source by source basis.

Table 1
Facility-wide Criteria and CO_2e Emissions Summary
Enviva Pellets Northampton, LLC

Emission Unit ID	Source Description	Control Device ID	Control Device Description	CO (tpy)	NOx (tpy)	TSP (tpy)	PM-10 (tpy)	PM-2.5 (tpy)	SO2 (tpy)	Total VOC (tpy)	CO_{2e} (tpy)
ES-GHM-1 through ES-GHM-5	Green Hammermills 1 through 5	CD-WESP-1; CD-RTO-1	WESP; RTO	156.44	194.96	66.58	66.58	66.58	38.91	28.93	365,608.88
ES-DRYER-1[1]	Dryer #1										
ES-DRYER-2[1]	Dryer #2	CD-WESP-2; CD-RTO-2	WESP; RTO								
ES-DRYERBYP-1	Dryer #1 Bypass	--	--	0.54	0.66	1.52	1.52	1.52	0.11	0.35	918.37
ES- FURNACEBYP-1	Furnace #1 Bypass	--	--	3.38	1.24	3.25	3.17	3.09	0.14	0.10	1,180.31
IES-DDB-1 and -2	Dryer #1 Double Duct Burners	--	--	0.72	0.62	0.07	0.07	0.07	0.01	0.10	1,219.07
ES-DRYERBYP-2	Dryer #2 Bypass	--	--	0.54	0.66	1.56	1.56	1.56	0.11	0.35	942.99
ES- FURNACEBYP-2	Furnace #2 Bypass	--	--	3.45	1.27	3.32	3.24	3.16	0.13	0.10	1,204.93
IES-DDB-3 and -4	Dryer #2 Double Duct Burners	--	--	0.72	0.62	0.07	0.07	0.07	0.01	0.10	1,219.07
IES-PVAP	Propane Vaporizer	--	--	0.36	0.62	0.03	0.03	0.03	0.003	0.05	609.53
ES-HM-1 through ES-HM-8; ES-NDS[5]	Dry Hammermills 1 through 8; Nuisance Dust System	CD-HM-CYC-1 through CD-HM-CYC-8; CD-HM-BF-1 through CD-HM-BF-3; CD-WS-1; CD-RCO-1	Cyclones; Baghouses; Wet Scrubber; RCO	7.60	14.88	20.93	20.93	1.00	0.05	18.32	12,841.84
ES-DSHM-1 and ES-DSHM-2	Dry Shavings Hammermills 1 and 2	CD-WS-1; CD-RCO-1	Wet Scrubber; RCO			2.01	2.01	2.01			
ES-CLR-1 through ES-CLR-6	Pellet Coolers 1 through 6	CD-CLR-1 through CD-CLR-6; CD-WS-2; CD-RCO-2	Simple Cyclones; Wet Duct Scrubber; RCO	7.91	23.16	39.18	10.71	1.89	0.05	28.53	13,367.45
ES-DWH-1[4]	Dried Wood Handling-1	CD-DWH-BF-1	Baghouse	--	--	0.38	0.38	0.38	--	48.53	--
ES-DWH-2[4]	Dried Wood Handling-2	CD-DWH-BF-2	Baghouse	--	--	0.38	0.38	0.38	--		--
ES-PS-1 and -2	Dry Hammermill Prescreeners 1 and 2	--	--	--	--	0.30	0.16	0.02	--	--	--
ES-PCHP	Pellet Cooler HP Fines Relay System	CD-PCHP-BV	Baghouse	--	--	0.54	0.54	0.54	--	--	--
ES-PMFS	Pellet Mill Feed Silo	CD-PMFS-BV	Baghouse	--	--	0.38	0.38	0.38	--	--	--
ES-FPH; ES-PB-1 through ES-PB-12; ES-PL-1 and ES-PL-2	Finished Product Handling; Twelve pellet loadout bins; Pellet mill load-out 1 and 2	CD-FPH-BF	Baghouse	--	--	5.33	4.85	0.09	--	--	--
IES-ADD	Additive Handling and Storage	CD-ADD-BF	Baghouse	--	--	3.31E-03	3.31E-03	3.31E-03	--	--	--
IES-DLH	Dry Line Hopper	--	--	--	--	0.15	0.07	0.01	--	--	--
ES-DLC-1	Dry Line Feed Conveyor	--	--	--	--	0.15	0.07	0.01	--	--	--
IES-DRYSHAVE	Dry Shaving Material Handling and Storage	--	--	--	--	0.77	0.38	0.06	--	0.19	--
ES-DSS	Dry Shaving Silo	CD-DSS-BF	Baghouse	--	--	0.54	0.54	0.54	--	--	--
ES-DSR; IES-DRYSHAVE-1	Dry Shavings Reception; Dry Shaving Material Handling	CD-DSR-BF	Baghouse	--	--	0.38	0.38	0.38	--	--	--
ES-GWHS	Green Wood Handling and Storage	--	--	--	--	16.32	8.35	1.22	--	8.30	--
IES-EPWC	Electric Powered Green Wood Chipper	--	--	--	--	--	--	--	--	1.95	--
IES-BARK	Bark Hog	--	--	--	--	0.47	0.26	--	--	0.59	--
IES-DEBARK	Debarker	--	--	--	--	1.56	0.86	--	--	--	--
IES-GWFB[2]	Green Wood Fuel Bin	--	--	--	--	--	--	--	--	--	--
IES-GN-1	Emergency Generator 1	--	--	0.50	0.58	0.03	0.03	0.03	0.001	0.002	100.21
IES-GN-2	Emergency Generator 2	--	--	0.14	2.46	0.01	0.01	0.01	0.002	1.68	191.98
IES-FWP	Fire Water Pump	--	--	0.43	0.49	0.02	0.02	0.02	0.001	0.001	85.90
IES-TK-1	Diesel Storage Tank for Emergency Generator #1	--	--	--	--	--	--	--	--	5.75E-04	--
IES-TK-2	Diesel Storage Tank for Fire Water Pump	--	--	--	--	--	--	--	--	1.60E-04	--
IES-TK-3	Mobile Fuel Diesel Storage Tank	--	--	--	--	--	--	--	--	3.33E-03	--
IES-TK-4	Diesel Storage Tank for Emergency Generator #2	--	--	--	--	--	--	--	--	5.75E-04	--
--	Haul Road Emissions	--	--	--	--	43.31	11.41	0.923	--	--	--
			Total Emissions:	**182.73**	**242.21**	**209.53**	**138.95**	**85.96**	**39.52**	**138.17**	**399,490.52**
			Total Excluding Fugitives[3]:	**182.73**	**242.21**	**148.97**	**118.75**	**83.75**	**39.52**	**129.68**	**399,490.52**
			PSD Major Source Threshold:	**250**	**250**	**250**	**250**	**250**	**250**	**250**	**--**
			Major Source?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**--**

Notes:

1. Each dryer line is routed to a separate RTO (CD-RTO-1 and CD-RTO-2). Although dryer line 1 and dryer line 2 are capable of processing up to 537,625 ODT/yr and 620,000 ODT/yr, respectively, the combined throughput of both dryers will not exceed 781,255 ODT/yr. In order to provide Enviva with the flexibility to use either dryer line up to its individual capacity, the total emissions from the two RTO's are based on the total facility throughput and are calculated as follows:
   - Where individual dryer emissions were calculated based on throughput (i.e. lb/ODT), the total emissions are estimated based on the total throughput of 781,255 ODT/yr, plus the emissions from the green hammermills.
   - Where individual dryer emissions were calculated based on fuel use (i.e. lb/MMBtu or lb/MMscf) or hourly test/vendor data (i.e., lb/hr), the total emissions are conservatively set equal to the sum of the emissions from the two dryer lines plus the emissions from the green hammermills assuming both dryer lines operate 8,760 hrs/yr.
2. Bark is transferred from the raw wood chip storage pile by walking floor to covered conveyors which transfer the material into the fully enclosed Green Wood Fuel Storage Bin. There are no emissions expected from transfer of material into the bin.
3. 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.
4. As Total VOC emissions are based on throughput, the calculated VOC emissions represent the total emissions from Dried Wood Handling 1 and 2 (ES-DWH-1 and ES-DWH-2).
5. Emissions from the Nuisance Dust System (ES-NDS) are routed to the inlet of CD-HM-BF-3.

Reference footnotes are located at the end of this section. Copies of detailed potential emissions calculations spreadsheets are included in Attachment 1 of this document and in Appendix C of the permit application.

A. Green Wood Handling and Storage (ES-GWHS)
Fugitive PM emissions will result from unloading purchased chips and bark from trucks into hoppers and transfer of these materials to storage piles via conveyors. Fugitive PM emissions from chip and bark transfer operations were calculated based on AP-42 Section 13.2.4, *Aggregate Handling and Storage Piles*.[1] Chip conveyors are enclosed; therefore, emissions were only quantified for the final drop points (i.e., from conveyor to pile). Bark conveyors will not be enclosed; however, due to the large size of this material any fugitive PM emissions occurring along the conveyor itself will be negligible. Green wood and bark contain a high moisture content approaching 50 percent water by weight. As such, particulate emissions were only quantified for the final drop points from the conveyors.

Particulate emission factors used to quantify emissions from storage pile wind erosion for the four (4) Green Wood Storage Piles and three (3) Bark Fuel Storage Piles were calculated based on USEPA's *Control of Open Fugitive Dust Sources*.[2] The number of days with rainfall greater than 0.01 inches was obtained from AP-42 Section 13.2.2, *Unpaved Roads*[3], 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[4]. 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 the National Council for Air and Stream Improvement (NCASI) for Douglas Fir wood storage piles. 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.

B. Debarker (IES-DEBARK) and Bark Hog (IES-BARK)
PM emissions will occur from log debarking and processing. Potential PM emissions from debarking and bark hog 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).[5] All PM was assumed to be larger than 2.5 microns in diameter. PM emissions from debarking will be minimal due to the high moisture content of green wood (~50%) and the fact that bark is removed in pieces larger than that which can become airborne. A 90% control efficiency was applied for the use of water spray. VOC and methanol emissions were quantified based on emission factors for log chipping from AP-42 Section 10.6.3, *Medium Density Fiberboard*.[6]

The Debarker (IES-DEBARK) and Bark Hog (IES-BARK) are considered insignificant activities per 15A NCAC 02Q .0102(h) due to potential uncontrolled PM emissions less than 5 tpy.

D. Chipper (IES-EPWC)
The chipping process will result in emissions of VOC and HAPs. VOC and HAPs emissions were quantified based on emission factors for log chipping from AP-42 Section 10.6.3, *Medium Density Fiberboard*.[6] and AP-42 Section 10.6.4, *Hardboard and Fiberboard*.[7] The Chipper is

considered an insignificant activity per 15A NCAC 02Q .0102(h) due to potential uncontrolled emissions less than 5 tpy.

E. Green Wood Storage Bin (IES-GWFB)
Bark is transferred from the fuel storage piles via a walking floor to a covered conveyor and then to the fully enclosed Green Wood Fuel Storage Bin (IES-GWFB). Due to complete enclosure of the Green Wood Fuel Storage Bin (IES-GWFB), emissions from transfer of material into the bin were not specifically quantified.[8] Both the Green Wood Storage Bin and the Bark Fuel Bin have emissions of less than 5 tons per year each and are each insignificant activities per 15A NCAC 02Q .0102(h).

F. Dryers (ES-DRYER-1 and ES-DRYER-2) and Green Hammermills (ES-GHM-1 through 5)
Exhaust from the Dryers and Green Hammermills will be routed to a shared WESP/RTO control system for control of PM, VOC, and HAP. The Green Hammermills will have the ability to be routed and controlled by the Dryer #2 WESP and RTO when the Dryer #1 WESP and RTO are shut down. It should be noted that potential-to-emit emission estimates from the Green Hammermills are accounted for under the Dryer #1 WESP and RTO. Potential uncontrolled emissions of PM, PM less than 10 microns in diameter (PM_{10}) and PM less than 2.5 microns in diameter ($PM_{2.5}$) are based on guaranteed pound per hour (lb/hr) emission rates provided by the RTO vendor. Carbon monoxide (CO) emissions generated during green wood combustion are based on data from similar Enviva facilities and information from the NCASI database. Oxides of nitrogen (NO_X) emissions are based on stack test results from similar facilities plus a 30% contingency. Potential emissions of sulfur dioxide (SO_2) from green wood combustion were calculated based on the heat input of the dryer burners and an emission factor for wood combustion from AP-42, Section 1.6, *Wood Residue Combustion in Boilers*[9]. VOC emissions were calculated using an emission factor derived from stack testing conducted at Enviva and other similar wood pellet manufacturing facilities.

HAP and toxic air pollutant (TAP) emissions from green wood combustion were calculated based on emission factors from several data sources including stack testing data from other similar facilities, engineering judgement/process knowledge, emission factors from AP-42 Section 1.6, *Wood Residue Combustion in Boilers*[9], and NC DAQ's Wood Waste Combustion Spreadsheet[10]. HAP emissions from natural gas and propane combustion by the RTO burners were calculated based on AP-42 Section 1.4, *Natural Gas Combustion*[11] AP-42 Section 1.5, *Liquefied Petroleum Gas Combustion*[12], NC DAQ's Wood Waste Combustion Spreadsheet[10], and emission factors from the South Coast Air Quality Management District's (SCAQMD) Air Emissions Reporting (AER) Tool.

G. Dryer Bypass Stacks (Full Capacity)
Bypass stacks following each rotary drum dryer (ES-DRYERBYP-1 and ES-DRYERBYP-2) may be used to exhaust hot gases during malfunctions. Venting of emissions through the dryer bypass stacks only occurs in the event of a malfunction, during which the furnace or dryer itself can abort and open the bypass stack. An abort may be caused by failsafe interlocks associated with the furnace or dryer and emissions control systems as well as utility supply systems (i.e., electricity, compressed air, water/fire protection). Dryer abort may also be triggered if a spark is detected. Malfunctions are infrequent and unpredictable. Potential emissions associated with dryer bypass were calculated based on stack testing data from comparable Enviva facilities with the exception of condensable PM and SO_2 emissions which were calculated based on emission factors from AP-42 Section 1.6, *Wood Residue Combustion in Boilers*[9]. Emissions were based on the full capacity of the furnaces and limited to 50 hours per year per dryer.

H Furnace Bypass Stacks

The furnace bypass stacks (ES-FURNACEBYP-1 and ES-FURNACEBYP-2) may be used to exhaust hot gases during start-ups (for temperature control), planned shutdowns, and malfunctions. Venting at full capacity only occurs in the event of a malfunction. As soon as the furnace aborts during a malfunction, the fuel feed is significantly reduced, and the heat input rate drops rapidly as the furnace quickly transitions to "idle mode". In the event of a planned dryer shutdown, the dryer throughput and furnace heat input are decreased. Dryer raw material input ceases, and all remaining material is moved through the system to prevent a fire. On shutdown of the dryer, the furnace operating rate quickly approaches idle state. As such, emissions during planned shutdowns are minimal.

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. The duration of a cold start-up is typically between 6 to 8 hours and there are generally two (2) cold start-ups per year. The furnace bypass stack is not utilized during a planned shutdown until after the furnace achieves an idle state. Until this time, emissions continue to be controlled by the WESP and RTO. Only one dryer line will be operated in cold start-up at a time.

Potential emissions of CO, NO_X, SO_2, PM, VOC, and HAP for furnace bypass conditions were calculated based on emission factors from AP-42 Section 1.6, *Wood Residue Combustion in Boilers*[9]. Emissions were based on the full capacity of the furnaces and limited to 50 hours per year per furnace.

I. Furnace Bypass Stacks (Idle Mode)

During furnace "idle mode" operation, emissions will be vented through the furnace bypass stacks (ES-FURNACEBYP-1 and ES-FURNACEBYP-2). Each 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 5 million Btu/hr. During this time, emissions will exhaust out of the furnace bypass stacks. Potential emissions of CO, NO_X, SO_2, PM, VOC, and HAP were calculated based on emission factors from AP-42 Section 1.6, *Wood Residue Combustion in Boilers*.[9]

J. Double Duct Burners (IES-DDB-1 through IES-DDB-4) and Propane Vaporizer (IES-PVAP)

Emissions from natural gas and propane combustion by the double duct burners (IES-DDB-1 through IES-DDB-4) and propane vaporizer (IES-PVAP) were calculated based on AP-42 Section 1.4, *Natural Gas Combustion*[11], AP-42 Section 1.5, *Liquefied Petroleum Gas Combustion*[12], and emission factors from the South Coast Air Quality Management District's (SCAQMD) Air Emissions Reporting (AER) Tool.

Per 15A NCAC 02Q .0102(h), the double duct burners (IES-DDB-1 through IES-DDB-4) and propane vaporizer (IES-PVAP) are considered insignificant activities because potential uncontrolled emissions are less than 5 tpy.

K. Dried Wood Handling (ES-DWH-1 and ES-DWH-2)

Dried Wood Handling (ES-DWH-1 and ES-DWH-2) will include conveyor transfer points located after each dryer. Emissions from these transfers will be routed through either baghouse CD-DWH-BF-1 or CD-DWH-BF-2 (one on each dryer line) at the post dryer conveyors. Particulate emissions from the baghouse were calculated based on the exhaust flow rate and exit grain loading.

Additionally, the dried material 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 NCASI dry wood handling emission factors.

L. Dry Shavings Handling (IES-DRYSHAVE), Dry Line Feed Conveyor (ES-DLC-1) and Dry Line Hopper (IES-DLH)

Particulate emissions will occur during unloading of dry shavings walking floor trucks to the dry shavings pile (IES-DRYSHAVE). Potential emissions were calculated based on AP-42, Section 13.2.4, *Aggregate Handling and Storage Piles*.[1] A front end loader fills the Dry Line Hopper (IES-DLH) which feeds the Dry Line Feed Conveyor (ES-DLC-1) to introduce pre-dried wood into the process prior to the hammermills.

Emissions from the Dry Line Hopper (IES-DLH) and Dry Line Feed Conveyor (ES-DLC-1) were calculated using equation 1 in AP-42 Section 13.2.4. Per 15A NCAC 02Q .0102(h), the Dry Line Hopper will be re-classified as an insignificant activity due to emissions being below 5 tpy.

M. Dry Shavings Reception, Handling, and Silo (ES-DSR, IES-DRYSHAVE-1, and ES-DSS)

Particulate emissions will occur during unloading of dry shavings from existing and new dry shavings truck dump (IES-DRYSHAVE and IES-DRYSHAVE-1). Potential emissions from dry shavings storage piles and dry shavings transfer activities associated with IES-DRYSHAVE were calculated based on AP-42, Section 13.2.4, *Aggregate Handling and Storage Piles*.[1]

The Dry Shavings Reception Dust Control Baghouse (CD-DSR-BF) controls particulate emissions from the receiving area, from IES-DRYSHAVE, and from Dry Shavings Reception (ES-DSR). Particulate emissions from the baghouse were calculated based on the exhaust flow rate and exit grain loading. Dry shavings will be transferred into the new dry shavings silo (ES-DSS) via an enclosed conveyor and bucket elevator. Particulate emissions from the baghouse on the dry shavings silo (CD-DSS-BF) were calculated based on the exhaust flow rate and exit grain loading.

Per 15A NCAC 02Q .0102(h), Dry Shavings Handling (IES-DRYSHAVE-1) is considered an insignificant activity because potential uncontrolled PM emissions are less than 5 tpy.

N. Dry Hammermills (ES-HM-1 through 8) and Dry Shavings Hammermills (ESDSHM-1 and ES-DSHM-2)

The Dry Hammermills generate PM, VOC, and HAP emissions during the process of reducing wood chips to the required size. PM emissions from the existing Dry Hammermill cyclones (CD-HM-CYC-1 through 8) are controlled using baghouses (CD-HM-BF-1 through CD-HM-BF- 3). PM emissions from the Dust Control System (ES-DCS) are controlled by a bagfilter (CD-HM-BF-3). Particulate emissions from each baghouse were calculated using a manufacturer guaranteed exit grain loading rate and the maximum nominal exhaust flow rate of the baghouse.

The Dry Hammermill and Dry Shavings Hammermill exhaust will be routed to the proposed new wet scrubber (CD-WS-1) and RCO/RTO (CD-RCO-1) for HAP and VOC control. The oxidizer will operate in thermal mode as an RTO during maintenance of the RCO. The RTO and RCO modes have the same control efficiency so there will be no impact on emissions when operating in thermal mode. VOC and HAP emissions were calculated based on stack testing data from comparable Enviva facilities. PM emissions from the Dry Shavings Hammermills are based on test data performed at Enviva's Greenwood facility.[13] Criteria and HAP emissions from natural gas and propane combustion by the RTO burners were calculated based on AP-42 Section 1.4, *Natural Gas Combustion*,[11] AP-42 Section 1.5, *Liquefied Petroleum Gas Combustion.*[12]

O. Pellet Cooler HP Fines Relay System (ES-PCHP) and Pellet Mill Feed Silo (ES-PMFS)
Pellet material fines will be conveyed from finished product handling to the Pellet Cooler High Pressure Fines Relay System (ES-PCHP) and controlled by a baghouse (CD-PCHP-BV). The Pellet Mill Feed Silo (ES-PMFS) is equipped with a bin vent filter (CD-PMFS-BV) to control PM emissions associated with silo loading and unloading operations. PM emissions from these baghouses were calculated based on a manufacturer guaranteed exit grain loading rate and the maximum nominal exhaust flow rate of the baghouse.

P. Additive Handling and Storage (IES-ADD)
An additive may be used in the pellet production process to increase the durability of the final product. Material will be pneumatically conveyed from the delivery trucks to the storage silo equipped with a bagfilter (CD-ADD-BH). PM emissions from the bagfilter were calculated based on an assumed exit grain loading rate and the maximum nominal exhaust flow rate of the baghouse.

Q. Pellet Press System and Pellet Coolers (ES-CLR-1 through 6)
Pellet Press and Pellet Cooler operations will generate PM, HAP, and VOC emissions during the forming and cooling of wood pellets. The Pellet Mills and Coolers are equipped with six (6) simple cyclones (CD-CLR-1 through CD-CLR-6) and will be routed to a proposed new wet scrubber (CD-WS-2) for PM control and then through the proposed RCO/RTO (CD-RCO-2) for VOC and HAP control. The oxidizer will operate in thermal mode as an RTO during backup of the RCO. PM emissions from the Pellet Press System (Pellet Mills) and Pellet Coolers were calculated based on a maximum exit grain loading rate and the maximum nominal exhaust flow rate for the proposed scrubber.

Uncontrolled VOC and HAP emissions at the outlet of the Pellet Cooler wet scrubber (CD-WS-2) were quantified based on stack testing data from comparable Enviva plants and/or engineering judgement/process knowledge, including any appropriate contingency. This includes emissions from both the Pellet Mills and the Pellet Coolers. Controlled emissions were estimated based on a 95% control efficiency for the RCO. The RTO and RCO modes have the same control efficiency so there will be no impact on emissions when operating in thermal mode. Criteria and HAP emissions from natural gas and propane combustion by the oxidizer’s burners were calculated based on AP-42 Section 1.4, *Natural Gas Combustion*,[11] AP-42 Section 1.5, *Liquefied Petroleum Gas Combustion.*[12]

R. Pellet Loadout Bins (ES-PB-1 through 12), Pellet Mill Loadout (ES-PL-1 and ES-PL-2), and Finished Product Handling (ES-FPH)
PM emissions result from the transfer of finished product handling to the Pellet Loadout Bins. PM emissions from Finished Product Handling, the two (2) Pellet Loadout Bins, and the Pellet Mill Loadout will be controlled by a bagfilter (CD-FPH-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 bagfilter.

S. Emergency Generator (IES-GN) and Fire Water Pump Engine (IES-FWP)
Operation of the Emergency Generator and Fire Water Pump generates emissions of criteria pollutants and HAP. Potential PM, NO_X, VOC, and CO emissions from operation of the Emergency Generators and Fire Water Pump Engine were calculated based on emission standards from NSPS Subpart IIII (or 40 CFR 89 where applicable) and the maximum horsepower rating of the engines. 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.[14] Potential VOC and HAP emissions were quantified based on emission factors from AP-42 Section 3.3, *Stationary Internal Combustion Engines*.[15] Annual potential emissions were conservatively calculated based on 500 hours per year. The Emergency Generators and Fire Water Pump Engine are considered insignificant activities pursuant to 15A NCAC 02Q .0102(h).

T. Diesel Storage Tanks (IES-TK-1 through 4)
The storage of diesel in on-site storage tanks will generate emissions of VOC. VOC emissions from the four (4) Diesel Storage Tanks were calculated using EPA's TANKS 4.0 software based on 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 .0102(h), they are listed as insignificant sources in the permit.

U. Haul Roads
Fugitive PM emissions occur as a result of trucks and employee vehicles traveling on paved and unpaved roads on the Northampton plant property. Emission factors for paved roads were calculated based on Equation 2 from AP-42 Section 13.2.1, *Paved Roads*[16] using the mean silt loading for quarries (8.2 g/m2) and 120 days with rainfall greater than 0.01 inch based on Figure 13.2.1-2. Emission factors for unpaved roads were calculated based on Equation 1a from AP-42 Section 13.2.2, *Unpaved Roads*[3] using a surface material silt content (8.4%) and 120 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. This control efficiency is based on data from the *Air Pollution Engineering Manual* of the Air and Waste Management Association.

Reference footnotes:

1. USEPA AP-42 Section 13.2.4, *Aggregate Handling and Storage Piles* (11/06).
2. USEPA *Control of Open Fugitive Dust Sources*, Research Triangle Park, North Carolina, EPA-450/3-88-008. September 1988.
3. USEPA AP-42 Section 13.2.2, *Unpaved Roads* (11/06).
4. Data provided via email to Aubrey Jones (Ramboll) by Matthew Porter (NC DAQ) on July 27, 2017.
5. USEPA. Office of Air Quality Planning and Standards. *AIRS Facility Subsystem Source Classification Codes and Emission Factor Listing for Criteria Air Pollutants.* EPA 450/4-90-003. March 1990.
6. USEPA. AP-42 Section 10.6.3, *Medium Density Fiberboard* (08/02).
7. AP-42 Section 10.6.4, *Hardboard and Fiberboard*
8. Due to complete enclosure of the Green Wood Storage Bin, emissions were not quantified.
9. USEPA AP-42 Section 1.6, *Wood Residue Combustion in Boilers* (09/03).
10. NCDAQ Wood Waste Combustion Spreadsheet for a wood stoker boiler. Available online at: https://files.nc.gov/ncdeq/Air%20Quality/permits/files/WWC_rev_K_20170308.xlsx.
11. USEPA AP-42 Section 1.4, *Natural Gas Combustion* (07/98).
12. AP-42 Section 1.5, *Liquefied Petroleum Gas Combustion* (07/08)
13. Enviva's Greenwood South Carolina facility stack test performed 12/4/2018 with PM approval by SSCB on April 29, 2019
14. Sulphur content in accordance with Year 2010 standards of 40 CFR 80.510(b) as required by NSPS Subpart IIII.
15. USEPA AP-42 Section 3.3, *Stationary Internal Combustion Engines* (10/96).
16. USEPA AP-42 Section 13.2.1, *Paved Roads* (01/11).

VII. Regulatory Review – Specific Emission Source Limitations and Conditions

A. <u>15A NCAC 02D .0515 “Particulates from Miscellaneous Industrial Processes”</u> – 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 equations:

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

where, E = allowable emission rate (lb/hr)
P = process weight rate (tph)

According to the application, the most significant source of PM emissions is Green Wood Handling and Storage (ES-GWHS) operating at 400 tons per hour. The allowable emission rate is calculated to be 66.3 lb/hr. Maximum PM emission rate estimates are based on EPA AP-42 factors, see Section VI.A. The maximum hourly nonfugitive uncontrolled emission rate is less than a pound per hour. Therefore, compliance is indicated.

The second most significant source of PM emissions is the Green Hammermills (ES-GHM-1 through ES-GHM-5) operating at 299 ODT/hr. The allowable emission rate is calculated to be 63.0 lb/hr. Maximum PM emission rate estimate is provided by stack test data at similar Enviva facility. Since the Green Hammermills exhaust to the Dryer, the combined maximum hourly controlled emission rate is 7.6 lb/hr. Therefore, compliance is indicated.

The Green Hammermills PM emissions are controlled by a wet electrostatic precipitator (WESP) that removes particles from a gas stream through the use of electrical forces. Discharge electrodes apply a negative charge to particles passing through a strong electrical field. These charged particles then migrate to a collecting electrode having an opposite, or positive, charge. Collected particles are removed from the collecting electrodes by washing using a mild hydroxide solution to prevent buildup of resinous materials present in the dryer exhaust. According to the application, the WESP has 29,904 square feet of collection plate area and can handle a maximum air flow of 117,000 acfm.

<u>Control Device Monitoring</u>

For bagfilters and cyclones:
To ensure compliance, the Permittee shall perform inspections and maintenance as recommended by the manufacturer. In addition to the manufacturer’s inspection and maintenance recommendations, or if there are no manufacturer’s inspection and maintenance recommendations, as a minimum, the inspection and maintenance requirement shall include the following:
i. a monthly visual inspection of the system ductwork and material collection unit for leaks, and
ii. an annual (for each 12-month period following the initial inspection) internal inspection of the bagfilters and structural integrity.

For WESP:
To ensure compliance, the Permittee shall perform inspections and maintenance as recommended by the manufacturer. In addition to the manufacturer's inspection and maintenance recommendations, or if there are no manufacturer's inspection and maintenance recommendations, as a minimum, the inspection and maintenance requirement shall include the following:

> The Permittee shall maintain the minimum secondary voltage and minimum current at the level established during compliance testing. To ensure compliance and effective operation of the wet electrostatic precipitator, the Permittee shall monitor and record the secondary voltage and current for each grid of the precipitator daily. The daily observation must be made for each day of the calendar year period. The Permittee shall be allowed three (3) days of absent observations per semi-annual period.

For WS:
To ensure compliance, the Permittee shall perform inspections and maintenance as recommended by the manufacturer. In addition to the manufacturer's inspection and maintenance recommendations, or if there are no manufacturer's inspection and maintenance recommendations, as a minimum, the inspection and maintenance requirement shall include the following:

> The Permittee shall maintain the required minimum liquid recirculation rate at the level established during compliance testing. To ensure compliance and effective operation of the wet scrubber, the Permittee shall monitor and record the minimum liquid recirculation rate daily. The daily observation must be made for each day of the calendar year period. The Permittee shall be allowed three (3) days of absent observations per semi-annual period.

Because the application relies on vendor guaranteed emission factors and stack tests from similar Enviva facilities, performance testing will be required to establish control efficiency within 180 days of commencement of operation.

B. 15A NCAC 02D .0516 "Sulfur Dioxide Emissions from Combustion Sources" – Under this regulation, sulfur dioxide emissions from combustion sources cannot exceed 2.3 lb/million Btu heat input. Wood is fired in the dryer and low sulfur diesel is combusted in the three emergency engines. Diesel is the worst-case fuel. Firing diesel fuel (0.5% sulfur by weight) will not cause this limit to be exceeded. Therefore, compliance is indicated.

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% opacity when averaged over a 6-minute period. For the new or replaced sources, the Permittee will be required to establish 'normal' visible emissions from these sources within the first 30-days following the commencement of operation. In order to demonstrate compliance, the Permittee will be required to observe actual visible emissions on a weekly 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.

D. 15A NCAC 02D .0535 "Excess Emissions Reporting and Malfunctions" – This regulation establishes reporting and corrective action measures when a source has excess emissions that last for more than four hours and that results from a malfunction, a breakdown of process or control equipment or any other abnormal conditions. The facility must notify the Division within an appropriate amount of time and describe the nature and cause of the malfunction or breakdown, the time when the malfunction or breakdown is first observed, the expected duration, and an estimated rate of emissions. Malfunctions are infrequent and unpredictable. 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 350 and 671 horsepower emergency generators and the 300 horsepower fire pump engine are subject to the requirements of this regulation.

Under NSPS Subpart IIII, owners or operators of emergency generators manufactured in 2007 or later with a maximum engine power greater than or equal to 50 hp are required to comply with the emission standards for new nonroad CI engines in §60.4202, for all pollutants, for the same model year and maximum engine power for their 2007 model year and later emergency stationary CI ICE. These limits are as follows: 0.20 g/kW for PM; 3.5 g/kW for CO; and 4 g/kW for NOx + nonmethane hydrocarbons (NMHC).

Under NSPS Subpart IIII, owners or operators of fire pump engines manufactured after July 1, 2006 must comply with the emission limits in Table 4 of the subpart. The limits are as follows: 0.20 g/kW for PM and 4 g/kW for NOx + NMHC.

As stated in the application, Enviva will comply with these limits by operating the engines as instructed in the manufacturer's operating manual in accordance with 40 CFR 60.4211(a), and purchasing an engine certified to meet the referenced emission limits in accordance with 40 CFR 60.4211(b). The engines will be equipped with a non-resettable hour meter in accordance with 40 CFR 60.4209(a). Emergency and readiness testing will be limited to 100 hours per year.

In addition, the engines are required to comply with fuel requirements in 40 CFR 60.4207, which limit sulfur content to a maximum of 15 ppm and a cetane index of at least 40.

B. 15A NCAC 02D .1111 "Generally Achievable 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.

C. Compliance Assurance Monitoring (CAM)
This permit (revision R06) is a non-Title V permit and CAM will be addressed at the time the Title V permit is developed.

D. <u>15A NCAC 02Q .0317 "Avoidance Conditions" for avoidance of 15A NCAC 02D .1111 "Maximum Achievable Control Technology, 112(g)"</u> – After all of Permit 10203R06 Specific Limitations and Conditions from Section 2.3 A., "Actions to be Taken by the Permittee", have been met, the facility will accept a permit condition to limit emissions of any single HAP to less than 10 tpy and to less than 25 tpy for any combination of HAPs for avoidance of becoming a Title III major facility. Most of the HAP emissions are from the dryers, hammermills, and pellet cooler systems. The facility will ensure the avoidance limits are met by proper operation and maintenance of existing and proposed control devices.

For the facility to comply with the avoidance condition, the Green Hammermills will exhaust to an existing wet electrostatic precipitator (CD-WESP-1) and a new regenerative thermal oxidizer (CD-RTO-1 or 2). Dryer 1 HAPs will be controlled by the existing wet electrostatic precipitator (CD-WESP-1) in series with a new regenerative thermal oxidizer (CD-RTO-1) and Dryer 2 HAPs will be controlled with a new wet electrostatic precipitator (CD-WESP-2) in series with a new regenerative thermal oxidizer (CD-RTO-2). Emissions from the Dry Hammermills (ES-HM-1 through ES-HM-8) and the Dry Shavings Hammermills (ES-DSHM-1 and ES-DSHM-2) are controlled by new wet scrubber (CD-WS-1) in series with a regenerative catalytic oxidizer (CD-RCO-1) that can also operate as an RTO. The Pellet Press System and the six (6) pellet coolers (ES-CLR-1 thru ES-CLR-6) will control HAPs with new wet scrubber (CD-WS-2) in series with a regenerative catalytic oxidizer (CD-RCO-2) that can also operate as an RTO.

As part of the proposed project, the facility is requesting to increase the throughput from 535,260 ODT to 781,255 ODT and increase in the maximum amount of softwood that can be used from 30% up to a maximum of 80%. The proposed permit modifications outlined in this application include changes to the wood pellet manufacturing process that will decrease total potential HAP emissions by approximately 16 tpy. Other sources of organic HAP emissions at the plant include the following: Furnace Bypass Stacks (ES-FURNACE-1 and 2), Dryer Bypass Stacks (ES-DRYERBYP-1 and 2), Double Duct Burners (IES-DDB-1 through 4), Propane Vaporizer (IES-PVAP), Dried Wood Handlings (ES-DWH-1 and 2), Emergency Generators (IES-GEN-1 and 2), Fire Water Pump (IES-FWP), Electric Powered Green Wood Chipper (IES-EPWC), and a Bark Hog (IES-BARKHOG).

Under the provisions of North Carolina General Statute 143-215.108, the Permittee shall establish emission factors for HAPs by conducting an initial and periodic performance tests on the green hammermills (ID Nos. ES-GHM-1 through ES-GHM-5), the wood-fired direct heat drying systems (ID No. ES-DRYER-1 and ES-DRYER-2), the dry hammermills (ID Nos. ES-HM-1 to ES-HM-8), the dry shavings hammermills (ID Nos. ES-DSHM-1 and ES-DSHM-2), and the pellet coolers (ID Nos. ES-CLR-1 through ES-CLR-6).

The pollutants and emission sources to be tested during the initial and periodic performance tests are listed in the following table:

Emission Sources	Pollutant
Green hammermills and dryer system controlled via RTO	Acetaldehyde Acrolein Formaldehyde Methanol Phenol
Dry and dry shavings hammermills controlled via RCO	

Pellet coolers controlled via RCO	Propionaldehyde

Monitoring, recordkeeping, and reporting are required according to the MACT Avoidance Condition. Because the facility has accepted an avoidance condition to limit emissions of HAPs, it remains a Title III minor facility and avoids applicability to MACT standards.

E. 15A NCAC 02Q .0317 "Avoidance Conditions" for avoidance of 15A NCAC 02D .0530 "Prevention of Significant Deterioration" – The avoidance conditions in Permit 10203R06 Section 2.2 A.2 apply until all of Section 2.3 A., "Actions to be Taken by the Permittee", have been met. Until such time as this condition is no longer applicable, the facility remains classified as PSD major. The facility has enforceable limits so that emissions sources shall discharge into the atmosphere less than 456.4 tons of volatile organic compounds (VOC) and 250 tons of carbon monoxide (CO) per consecutive 12-month period. To ensure that the limits established above are not exceeded, the facility's wood-fired dryer system will not process more than 537,625 oven dried tons per year ODT/year. To ensure that the limits established above are not exceeded, the facility's dry hammermill system will not process more than 531,441 ODT/year. To ensure that the limits established above are not exceeded, the facility's the pellet cooler system will not process more than 625,225 ODT/year. All process limits include a maximum softwood content of 30% and are for a rolling 12-month period. The conditions are included in the permit with the limits and restrictions necessary to ensure compliance.

F. 15A NCAC 02Q .0317 "Avoidance Conditions" for avoidance of 15A NCAC 02D .0530 "Prevention of Significant Deterioration" – The avoidance conditions in Permit 10203R06 Section 2.2 A.3 apply after all of Section 2.3 A., "Actions to be Taken by the Permittee", have been met. Following the applicability of this condition, the facility will be classified as PSD minor. The facility has enforceable limits so that emissions of particulate matter, particulate matter 10 micrometers, particulate matter 2.5 micrometers, volatile organic compounds (VOC), nitrogen oxides (NOx), and carbon monoxide (CO) remain below the 250 tpy PSD major source thresholds. The facility will be limited to an annual process rate 781,255 ODT/year on a rolling 12-month average basis, with a maximum 80% softwood content and use RTOs and RCOs to control VOC emissions. The dry hammermills will not process more than 85% of the maximum facility throughput or a total of 664,067 oven dried tons per year (ODT/year) on a rolling 12-month average basis. The conditions are included in the permit with the limits and restrictions necessary to ensure compliance.

Under the provisions of North Carolina General Statute 143-215.108, the Permittee shall demonstrate compliance with the PSD avoidance limits by conducting initial and periodic performance tests on the Green Hammermills (ID Nos. ES-GHM-1 through ES-GHM-5), the wood-fired direct heat drying systems (ID No. ES-DRYER-1 and ES-DRYER-2), the dry hammermills (ID Nos. ES-HM-1 to ES-HM-8), the dry shavings hammermills (ID Nos. ES-DSHM-1 and ES-DSHM-2), and the pellet coolers (ID Nos. ES-CLR-1 through ES-CLR-6). The pollutants and emission sources to be tested during the initial and periodic performance tests are listed in the following table:

Emission Sources	Pollutant
Greenwood hammermills and dryer systems controlled via RTO	VOC
	PM/PM10/PM2.5
	NOx
	CO
Dry and dry shavings hammermills controlled via RCO	VOC
	PM/PM10/PM2.5
Pellet coolers controlled via RCO	VOC
	PM/PM10/PM2.5

Initial testing shall be completed within 180 days of commencement of operation.

The Permittee shall conduct periodic performance tests when the following conditions are met:

(A) The monthly average softwood content exceeds the average softwood percentage documented during prior performance testing by more than 10 percentage points, or

(B) The monthly production rate exceeds the average production rate documented during prior performance testing by more than 10 percentage points, or

(C) At a minimum testing shall be conducted annually. Annual performance tests shall be completed no later than 13 months after the previous performance test.

The Permittee shall install, calibrate, operate, maintain, and inspect a continuous temperature monitoring, and recording system, in accordance with manufacturer's recommendations and the most recent performance test, for the regenerative thermal oxidizers and the regenerative catalytic oxidizers (ID Nos. CD-RTO-1, CD-RTO-2, CD-RCO-1, and CD-RCO-2). To ensure compliance and effective operation of the oxidizers, the Permittee shall maintain a 3-hour rolling average firebox temperature for each of the two fireboxes comprising the RTO or RCO at or above the minimum average temperatures established during the most recent performance testing. The Permittee shall maintain records of the 3-hour rolling average temperatures for each firebox. The monitoring shall be recorded continuously and data logged.
For the oxidizers, the Permittee shall develop and maintain a malfunction plan for the temperature monitoring and recording system that describes, in detail, the operating procedures for periods of malfunctions so that corrective actions can immediately be investigated. The malfunction plan shall identify malfunctions, as described by the manufacturer, and ensure the operators are prepared to correct such malfunctions as soon as practical. The Permittee shall keep any necessary parts for routine repairs of the temperature monitoring and recording system readily available. The Permittee shall perform periodic inspection and maintenance for the oxidizers as recommended by the manufacturer. At a minimum, the Permittee shall perform an annual internal inspection of the primary heat exchanger and associated inlet/outlet valves of the control device to ensure structural integrity.

To ensure compliance and effective operation of the wet scrubbers (ID No. CD-WS-1 and CD-WS-2), the Permittee shall perform inspections, maintenance, and maintain the required minimum liquid recirculation rate. To ensure compliance and effective operation of the wet electrostatic precipitators (ID No. CD-WESP-1 and CD-WESP-2), the Permittee shall perform inspections and maintenance and maintain the minimum secondary voltage and minimum current of the wet electrostatic precipitator. To ensure compliance and effective operation of the bagfilters and cyclones, the Permittee shall perform inspections and maintenance.

The process rate and hardwood/softwood mix shall be recorded in a monthly log kept on site. The results of the calculations and the total amount of PM, PM_{10}, $PM_{2.5}$, VOC, NOx, and CO emissions shall be recorded monthly in a logbook (written or electronic format) and made available to an authorized representative upon request. Semi-annual reporting of monitoring activities is required.

For the dryer system, GHG (CO_2e) emissions shall be calculated on a monthly basis and compliance demonstrated using the applicable Part 98 emission factors. Compliance shall be documented on a 12-month rolling basis.

G. <u>15A NCAC 02D .0540 Particulate from Fugitive Dust Emission Sources</u>
15A NCAC 02D .0540 requires that a fugitive dust control plan be prepared if ambient monitoring or air dispersion modeling show violation or a potential for a violation of a PM NAAQS, or if NC DAQ observes excess fugitive dust emissions from the facility beyond the property boundary for six (6) minutes in any one hour using EPA Method 22. If substantive complaints or excessive fugitive dust emissions from the facility are observed beyond the property boundaries for six minutes in any one hour (using Reference Method 22 in 40 CFR, Appendix A), the owner or operator may be required to submit a fugitive dust plan as described in 02D .0540(f). A fugitive dust control plan is not required at this time.

H. <u>15A NCAC 02D .1806: Control and Prohibition of Odorous Emissions</u>
The Permittee shall not operate the facility without implementing management practices or installing and operating odor control equipment sufficient to prevent odorous emissions from the facility from causing or contributing to objectionable odors beyond the facility's boundary.

I. <u>15A NCAC 02D .1100 Control of Toxic Air Pollutant (TAP) Emissions and 15A NCAC 02Q Toxic Air Pollutant Emission Rates Requiring a Permit – Pursuant to 15A NCAC 02Q .0711</u>
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 an evaluation of the TAP emissions from a facility’s sources, excluding exempt sources listed in Rule .0702 of this Section. Per NCAC 02Q .0706, the facility shall submit an application that complies with 15A NCAC 02D .1100(1) if the modification results in a net increase in emissions or ambient concentration as determined in 15A NCAC 02D .1106 and 15A NCAC 02Q .0709 of any toxic air pollutant that the facility was emitting before the modification; or (2) emissions of any toxic air pollutant that the facility was not emitting before the modification if such emissions exceed the levels set forth in 15A NCAC 02Q .0711. Air toxics modeling was performed for this facility.

15A NCAC 02D .1100 outlines the procedures that must be followed if a TAP permit and associated modeling is required under 15A NCAC 02Q .0700. Modeling was completed for the Northampton plant in April 2014. DAQ Air Quality Analysis Branch (AQAB) meteorologist Tom Anderson reviewed Enviva’s modeling and approved the analysis on May 8, 2014. The toxics emissions limitations and requirements located in permit Section 2.2 A.4. shall remain in effect until all of the requirements from permit Section 2.3 A. have been met.

Modeling for this modification was completed for the Northampton plant in September 2018. Thirteen TAPs were evaluated in the updated facility-wide modeling: acetaldehyde, acrolein, arsenic, benzene, beryllium, cadmium, chlorine, formaldehyde, HCl, manganese, mercury, nickel, and phenol. The modeled concentrations for eleven (11) of the thirteen (13) TAP were less than 1% of their respective Acceptable Ambient Level (AAL). The worst-case TAP was benzene, with a maximum modeled concentration that was less than 22% of its AAL. Although several changes are being proposed, (e.g., addition of a separate wet scrubber and RCO to control the Pellet Mills/Pellet Coolers) to the facility since the September 2018 modeling analysis was completed, given the magnitude of the previous modeled concentrations it was not anticipated that these design changes would significantly impact the previous results. Due to equipment changes from the initial application, Enviva conducted revised modeling at the request of DAQ and submitted the report on May 7, 2019 with the electronic files received on May 23, 2019. The worst-case TAP for the most recent modeling was benzene, with a maximum modeled concentration that was less than 24% of its AAL.

Enviva conducted air dispersion modeling for 13 TAPs with emissions in excess of the TPER thresholds in 15A NCAC 02Q .0711 to demonstrate compliance with the Acceptable Ambient Levels (AALs) in 15A NCAC 02D .1100. The AALs are in place to ensure that emissions from a facility do not adversely affect human health. Modeling for each TAP was conducted for the most recent year of meteorological data available (2017) and maximum concentrations were compared to the AALs. Enviva utilized AERMOD-ready meteorological data processed by NC DAQ for the Rocky Mount National Weather Service (NWS) surface station (ID: 93759) and upper air data from the Newport NWS Station (ID: 93768) for the period 2012-2016.20. The meteorological data were processed by NC DAQ using version 18081 of AERMET.

DAQ Air Quality Analysis Branch (AQAB) meteorologist Nancy Jones and supervisor Tom Anderson reviewed Enviva's modeling. Enviva's modeling was approved on June 3, 2019. Below is a summary of AQAB Enviva modeling results.

TAP	**Averaging Period**	**Scenario**	**Max. Conc. (μg/m^3)**	**AAL (μg/m^3)**	**% of AAL**
Acetaldehyde	1-hour	NORM	0.54	27,000	<1 %
Acrolein	1-hour	FBYP2	1.36	80	2 %
Arsenic	Annual	FBYP1	1.9e-4	0.0021	9 %
Benzene	Annual	NORM	0.028	0.12	24 %
Beryllium	Annual	FBYP1	9.7e-6	0.0041	<1 %
Cadmium	Annual	FBYP1	4e-5	0.0055	1 %
Chlorine	1-hour	FBYP2	6.45	900	1 %
	24-hour	FBYP2	2.23	37.5	6 %
Formaldehyde	1-hour	FBYP1	8	150	5 %
HCl	1-hour	FBYP2	6.45	700	1 %
Manganese	24-hour	FBYP2	0.19	31	1 %
Mercury	24-hour	FBYP2	4.2E-4	0.6	<1 %
Nickel	24-hour	FBYP2	3.9E-3	6	<1 %
Phenol	1-hour	NORM	0.22	95	<1 %

This compliance demonstration assumes the source parameters and pollutant emission rates used in the analysis are correct. The modeling adequately demonstrates compliance, on a source-by-source basis, for all toxics modeled. The toxics emissions limitations and requirements located in permit Section 2.2 A.5. and approved in the AAL Table above shall become effective after all of the requirements from permit Section 2.3 A. have been met.

I. <u>15A NCAC 02Q .0500 “Title V Permitting”</u>
This facility is being processed under the state construction and operating permit program initially. Within one year after commencement of facility operation, the Permittee was required to submit a complete Title V application. From September 20, 2017 - October 20, 2018, the first time Title V application went through public notice and major comments were received during the public comment period from the Environmental Integrity Project (EIP). Issuance of the 1st time Title V permit was placed on hold and DEQ received an updated permit application from the facility that would add controls to make the facility minor for PSD. The Permittee shall file a Title V Air Quality Permit Application pursuant to 15A NCAC 02Q .0504., to amend the existing Title V first time application (6600167.14B) on or before 12 months after commencing operation of any of the new sources or control devices listed in this permit.

IX. Other Regulatory Considerations

- An application fee of $947.00 was received by the DAQ on October 1, 2018.
- The appropriate number of application copies was received by the DAQ.
- A Professional Engineer’s Seal is required for this amended application and was provided (ref. Russell Kemp, P.E. Seal # 19628, 5-27-2019).
- Receipt of the request for a zoning consistency determination was acknowledged by William Flynn, Director, Northampton County Code Enforcement on October 31, 2018. On July 15, 2019, Mr. Flynn signed the zoning consistency determination and approved that the facility’s proposed operations are consistent with applicable zoning ordinances.
- Public notice is not required for this modification to the State Permit issued under 15A NCAC 02Q .0300. Due to public interest in this project, the DAQ Director did require a public hearing. The hearing was held on TBD, 2019.
- IBEAM Emission Source Module (ESM) update was verified on TBD, 2019.
- According to the application, the facility does not store any materials in excess of the 112r applicability threshold.
- The application was signed by Mr. Royal Smith Executive Vice President Operations, on March 27, 2019.

X. Recommendations

This application has been reviewed by the DAQ to determine compliance with all procedures and requirements. The DAQ has determined that this facility appears to be or is expected to achieve compliance as specified in the permit with all applicable requirements. A final draft permit was provided to the Raleigh Regional Office (RRO) on TBD, 2019. The RRO responded with “no comments” to the draft on TBD, 2019. A draft permit was provided to the applicant on May 31, 2019. The applicant responded with minor comments on June 7, 2019. All comments have been addressed. According to a TBD, 2019 memo from Michael Abraczinskas, Director, the DAQ recommends issuance of Permit No. 10203R06.

ATTACHMENT 1

Table 1: Revised June 21, 2019

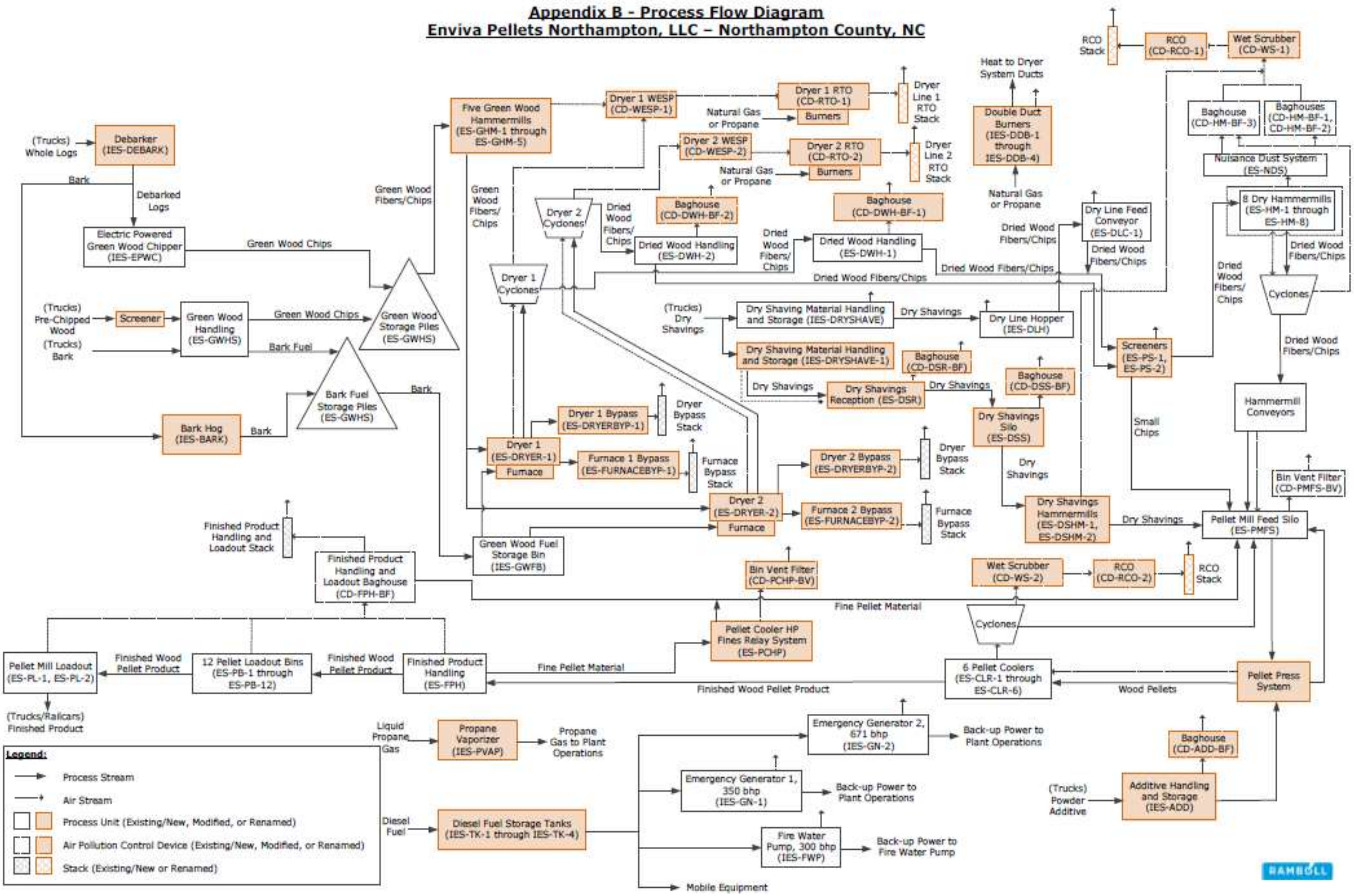

Table 2
Facility-Wide HAP Emissions Summary
Enviva Pellets Northampton, LLC

Description	HAP	CD-RTO-1 and CD-RTO-2 [1] (tpy)	ES-DRYER-BYP-1 (tpy)	ES-FURNACE-BYP-1 (tpy)	IES-DDB-1 and 2 (tpy)	ES-DRYER-BYP-2 (tpy)	ES-FURNACE-BYP-2 (tpy)	IES-DDB-3 and 4 (tpy)	IES-PVAP (tpy)	CD-RCO-1 (tpy)	CD-RCO-2 (tpy)	ES-DWH-1 and 2 (tpy)	IES-GN-1 (tpy)	IES-GN-2 (tpy)	IES-FWP (tpy)	IES-EPWC (tpy)	IES-BARK (tpy)	Total (tpy)	Major Source?
Acetaldehyde	Y	1.73E+00	3.02E-01	4.67E-03	1.31E-07	3.46E-01	4.77E-03	1.31E-07	-	1.66E-01	4.92E-01	-	4.70E-04	2.96E-05	4.03E-04	-	-	3.04E+00	No
Acrolein	Y	1.23E+00	1.97E-01	2.25E-02	1.55E-07	2.26E-01	2.30E-02	1.55E-07	-	2.09E-01	9.75E-01	-	5.67E-05	9.25E-06	4.86E-05	-	-	2.88E+00	No
Formaldehyde	Y	1.87E+00	2.57E-01	2.48E-02	1.31E-02	2.95E-01	2.53E-02	1.31E-02	6.57E-03	2.90E-01	2.50E-01	3.28E-01	7.23E-04	9.26E-05	6.20E-04	-	-	3.37E+00	No
Methanol	Y	1.39E+00	1.88E-01	-	-	2.15E-01	-	-	-	1.61E-01	4.14E-01	7.62E-01	-	-	-	3.91E-01	1.17E-01	3.64E+00	No
Phenol	Y	6.07E-01	1.03E-01	2.87E-04	-	1.18E-01	2.93E-04	-	-	6.36E-02	4.92E-01	-	-	-	-	-	-	1.39E+00	No
Propionaldehyde	Y	3.88E-01	6.90E-02	3.44E-04	-	7.90E-02	3.51E-04	-	-	2.82E-01	2.85E-01	-	-	-	-	-	-	1.10E+00	No
Acetophenone	Y	1.24E-07	1.40E-08	1.80E-08	-	1.44E-08	1.84E-08	-	-	-	-	-	-	-	-	-	-	1.89E-07	No
Ammonia	N	8.79E-01	-	-	2.75E-02	-	-	2.75E-02	-	2.69E-01	2.69E-01	-	-	-	-	-	-	1.47E+00	No
Antimony and compounds	Y	8.91E-04	3.46E-05	4.45E-05	-	3.56E-05	4.54E-05	-	-	-	-	-	-	-	-	-	-	1.05E-03	No
Arsenic	Y	2.54E-03	9.64E-05	1.24E-04	1.72E-06	9.90E-05	1.27E-04	1.72E-06	-	1.68E-05	1.68E-05	-	-	-	-	-	-	3.02E-03	No
Benzene	Y	3.62E-01	-	-	6.22E-03	-	-	6.22E-03	3.11E-03	6.10E-02	6.10E-02	-	5.71E-04	9.11E-04	4.90E-04	-	-	5.02E-01	No
Benzo(a)pyrene	Y	1.01E-04	1.14E-05	1.46E-05	1.03E-08	1.17E-05	1.50E-05	1.03E-08	-	1.01E-07	1.01E-07	-	2.39E-05	3.02E-07	9.87E-08	-	-	1.79E-04	No
Beryllium	Y	1.27E-04	4.82E-06	6.20E-06	1.03E-07	4.95E-06	6.33E-06	1.03E-07	-	1.01E-06	1.01E-06	-	-	-	-	-	-	1.52E-04	No
1,3-Butadiene	Y	-	-	-	-	-	-	-	-	-	-	-	2.39E-05	-	2.05E-05	-	-	4.45E-05	No
Cadmium	Y	7.65E-04	1.80E-05	2.31E-05	9.45E-06	1.85E-05	2.36E-05	9.45E-06	-	9.26E-05	9.26E-05	-	-	-	-	-	-	1.05E-03	No
Carbon tetrachloride	Y	1.75E-03	1.97E-04	2.53E-04	-	2.03E-04	2.59E-04	-	-	-	-	-	-	-	-	-	-	2.66E-03	No
Chlorine	Y	1.23E+00	3.46E-03	4.45E-03	-	3.56E-03	4.54E-03	-	-	-	-	-	-	-	-	-	-	1.25E+00	No
Chlorobenzene	Y	1.28E-03	1.45E-04	1.86E-04	-	1.49E-04	1.90E-04	-	-	-	-	-	-	-	-	-	-	1.95E-03	No
Chloroform	Y	1.09E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.09E-03	No
Chromium VI	Y	7.80E-04	-	-	1.20E-05	-	-	1.20E-05	-	1.18E-04	1.18E-04	-	-	-	-	-	-	1.04E-03	No
Chromium – Other compounds	Y	1.97E-03	7.67E-05	1.18E-04	-	7.88E-05	1.21E-04	-	-	-	-	-	-	-	-	-	-	2.37E-03	No
Cobalt compounds	Y	7.33E-04	2.85E-05	3.66E-05	-	2.93E-05	3.74E-05	-	-	7.07E-06	7.07E-06	-	-	-	-	-	-	8.79E-04	No
Dichlorobenzene	Y	3.30E-04	-	-	1.03E-05	-	-	1.03E-05	-	1.01E-04	1.01E-04	-	-	-	-	-	-	5.52E-04	No
Dichloroethane, 1,2-	Y	1.13E-03	1.27E-04	1.63E-04	-	1.31E-04	1.67E-04	-	-	-	-	-	-	-	-	-	-	1.72E-03	No
Dichloropropane, 1,2-	Y	1.28E-03	1.45E-04	1.86E-04	-	1.49E-04	1.90E-04	-	-	-	-	-	-	-	-	-	-	1.95E-03	No
Dinitrophenol, 2,4-	Y	7.00E-06	7.89E-07	1.01E-06	-	8.10E-07	1.04E-06	-	-	-	-	-	-	-	-	-	-	1.07E-05	No
Di(2-ethylhexyl)phthalate	Y	1.83E-06	2.06E-07	2.06E-07	-	2.12E-07	2.70E-07	-	-	-	-	-	-	-	-	-	-	2.72E-06	No
Ethyl benzene	Y	1.21E-03	1.36E-04	1.75E-04	-	1.40E-04	1.78E-04	-	-	-	-	-	-	-	-	-	-	1.83E-03	No
Hexachlorodibenzo-p-dioxin, 1,2,3,6,7,8-	N	6.96E-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.96E-10	No
Hexane	Y	4.95E-01	-	-	1.55E-02	-	-	1.55E-02	-	1.51E-01	1.51E-01	-	-	-	-	-	-	8.29E-01	No
Indeno(1,2,3-cd)pyrene	Y	4.95E-07	-	-	1.55E-08	-	-	1.55E-08	-	1.51E-07	1.51E-07	-	-	-	-	-	-	8.29E-07	No
Hydrochloric acid	Y	2.96E+00	8.33E-02	1.07E-01	-	8.55E-02	1.09E-01	-	-	-	-	-	-	-	-	-	-	3.34E+00	No
Lead	Y	5.55E-03	-	-	4.29E-06	-	-	4.29E-06	-	4.21E-05	4.21E-05	-	-	-	-	-	-	5.65E-03	No
Manganese	Y	1.81E-01	7.01E-03	9.01E-03	3.26E-06	7.20E-03	7.20E-03	3.26E-06	-	3.20E-05	3.20E-05	-	-	-	-	-	-	2.11E-01	No
Mercury	Y	4.66E-04	1.53E-05	1.97E-05	2.23E-06	1.58E-05	2.01E-05	2.23E-06	-	2.19E-05	2.19E-05	-	-	-	-	-	-	5.86E-04	No
Methyl bromide	Y	5.84E-04	6.57E-05	8.45E-05	-	6.75E-05	8.63E-05	-	-	-	-	-	-	-	-	-	-	8.88E-04	No
Methyl chloride	Y	8.95E-04	1.01E-04	1.30E-04	-	1.04E-04	1.32E-04	-	-	-	-	-	-	-	-	-	-	1.36E-03	No
Methyl ethyl ketone	N	2.10E-04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.10E-04	No
3-Methylchloranthrene	Y	4.95E-07	-	-	1.55E-08	-	-	1.55E-08	-	1.51E-07	1.51E-07	-	-	-	-	-	-	8.29E-07	No
Methylene chloride	Y	1.13E-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.13E-02	No
Naphthalene	Y	3.95E-03	4.25E-04	5.46E-04	5.24E-06	4.37E-04	5.58E-04	5.24E-06	-	5.13E-05	5.13E-05	-	-	1.53E-04	-	-	-	6.18E-03	No
Nickel	Y	4.30E-03	1.45E-04	1.86E-04	1.80E-05	1.49E-04	1.90E-04	1.80E-05	-	1.77E-04	1.77E-04	-	-	-	-	-	-	5.36E-03	No
Nitrophenol, 4-	Y	4.28E-06	4.82E-07	6.20E-07	-	4.95E-07	6.33E-07	-	-	-	-	-	-	-	-	-	-	6.51E-06	No
Pentachlorophenol	Y	1.98E-06	2.24E-07	2.87E-07	-	2.30E-07	2.93E-07	-	-	-	-	-	-	-	-	-	-	3.02E-06	No
Perchloroethylene	Y	1.48E-03	1.67E-04	2.14E-04	-	1.71E-04	2.19E-04	-	-	-	-	-	-	-	-	-	-	2.25E-03	No
Phosphorus metal, yellow or white	Y	3.05E-03	1.18E-04	1.52E-04	-	1.22E-04	1.55E-04	-	-	-	-	-	-	-	-	-	-	3.59E-03	No
Polychlorinated biphenyls	Y	3.17E-07	3.57E-08	4.59E-08	-	3.67E-08	4.69E-08	-	-	-	-	-	-	-	-	-	-	4.82E-07	No
Polycyclic Organic Matter	Y	1.61E-02	5.48E-04	7.04E-04	3.50E-04	5.63E-04	7.19E-04	3.50E-04	1.75E-04	3.43E-03	3.43E-03	-	1.03E-04	2.49E-04	8.82E-05	-	-	2.68E-02	No
Selenium compounds	Y	3.23E-04	1.23E-05	1.58E-05	2.06E-07	1.26E-05	1.61E-05	2.06E-07	-	2.02E-06	2.02E-06	-	-	-	-	-	-	3.84E-04	No
Styrene	Y	7.39E-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.39E-02	No
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	3.35E-10	3.77E-11	4.84E-11	-	3.87E-11	4.95E-11	-	-	-	-	-	-	-	-	-	-	5.09E-10	No
Toluene	Y	2.10E-03	-	-	2.92E-05	-	-	2.92E-05	-	2.86E-04	2.86E-04	-	2.51E-04	3.30E-04	2.15E-04	-	-	3.53E-03	No
Trichloroethane, 1,1,1-	Y	1.21E-03	1.36E-04	1.75E-04	-	1.40E-04	1.78E-04	-	-	-	-	-	-	-	-	-	-	1.83E-03	No
Trichloroethylene	Y	1.17E-03	1.31E-04	1.31E-04	-	1.35E-04	1.73E-04	-	-	-	-	-	-	-	-	-	-	1.74E-03	No
Trichlorofluoromethane	N	1.60E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.60E-03	No
Trichlorophenol, 2,4,6-	Y	8.56E-07	9.64E-08	1.24E-07	-	9.90E-08	1.27E-07	-		-	-	-	-	-	-	-	-	1.30E-06	No
Vinyl chloride	Y	7.00E-04	7.89E-05	1.01E-04	-	8.10E-05	1.04E-04	-	-	-	-	-	-	-	-	-	-	1.07E-03	No
Xylene	Y	9.73E-04	-	-	-	-	-	-	-	-	-	-	1.75E-04	2.26E-04	1.50E-04	-	-	1.52E-03	No
TOTAL HAP		**12.57**	**1.21**	**0.18**	**0.04**	**1.38**	**0.18**	**0.04**	**0.01**	**1.39**	**3.12**	**1.09**	**2.37E-03**	**1.85E-03**	**2.03E-03**	**0.39**	**0.12**	**21.71**	No

Notes:

[1] Each dryer line is routed to a separate RTO (CD-RTO-1 and CD-RTO-2). Although dryer line 1 and dryer line 2 are capable of processing up to 537,625 ODT/yr and 620,000 ODT/yr, respectively, the combined throughput of both dryers will not exceed 781,255 ODT/yr. In order to provide Enviva with the flexibility to use either dryer line up to its individual capacity, the total emissions from the two RTO's are based on the total facility throughput and are calculated as follows:
- Where individual dryer emissions were calculated based on throughput (i.e. lb/ODT), the total emissions are estimated based on the total throughput of 781,255 ODT/yr, plus the emissions from the green hammermills.
- Where individual dryer emissions were calculated based on fuel use (i.e. lb/MMBtu or lb/MMscf) or hourly test/vendor data (i.e., lb/hr), the total emissions are conservatively set equal to the sum of the emissions from the two dryer lines plus the emissions from the green hammermills assuming both dryer lines operate 8,760 hrs/yr.

Table 3a
Potential Criteria Emissons
Dryer #1 (ES-DRYER-1, CD-WESP-1, CD-RTO-1)
Enviva Pellets Northampton, LLC

Calculation Basis

Annual Dried Wood Throughput[1]	781,255 ODT/year
Max. Hourly Dried Wood Throughput of Dryer	71.71 ODT/hr
Burner Heat Input	175.3 MMBtu/hr
Percent Hardwood	20.0%
Percent Softwood	80.0%
Annual Operation	8,760 hr/yr
Annual Heat Input	1,535,628 MMBtu/yr
Number of RTO Burners	4
RTO Burner Rating	8 MMBtu/hr
RTO Control Efficiency	97.50%

Potential Criteria Emissions

Pollutant	Biomass Emission Factor	Units	Emission Factor Source	Uncontrolled Emissions		Controlled Emissions	
				Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
CO	0.4	lb/ODT	Note 2	--	--	28.68	156.3
NO_x	22.23	lb/hr	Note 2	--	--	22.23	97.4
$PM/PM_{10}/PM_{2.5}$ (Filterable + Condensable)	7.6	lb/hr	Note 4	--	--	7.60	33.3
SO_2	0.025	lb/MMBtu	AP-42, Section 1.6[3]	--	--	4.38	19.2
Total VOC (as propane)	2.64	lb/ODT	Note 5	189.31	1031.3	4.73	25.8

Notes:

[1] Annual dried wood throughput is based on total facility production. Although dryer line 1 and dryer line 2 are capable of processing up to 537,625 ODT/yr and 620,000 ODT/yr, respectively, the combined throughput of both dryers will not exceed 781,255 ODT/yr. In order to to provide Enviva with the flexibility to use either dryer line up to its individual capacity, the total emissions from the two dryer lines are based on the total facility throughput and calculated as follows:

- Where individual dryer emissions are calculated based on throughput (i.e. lb/ODT), the total emissions are estimated based on the total throughput of 781,255 ODT/yr.
- Where individual dryer emissions are calculated based on fuel use (i.e. lb/MMBtu or lb/MMscf) or hourly test/vendor data (i.e., lb/hr), the total emissions are conservatively set equal to the sum of the emissions from the two dryer lines assuming both dryer lines operate 8,760 hrs/yr.
- Dryer line 1 described as 175.3 MMBtu/hr = 155.3 MMBtu/hr from the grate and 2 additional 10 MMBtu/hr dust burners permitted but not added.

[2] CO emissions based on data from similar Enviva facilities and information from NCASI database.
NOx emissions based on stack test results from similar Enviva facility plus 30% contingency.

[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 upon the heat input of the dryer burners using an emission factor for wood combustion from AP-42, Section 1.6.

[4] Particulate emission factor is based on data from similar Enviva facilities.

[5] VOC emission factor based on source test data for similar pellet manufacturing facilities and represents uncontrolled emissions.

Table 3b
Potential VOC Emissons
Green Hammermills (ES-GHM-1 through ES-GHM-5, CD-WESP-1, CD-RTO-1 or CD-WESP-2, CD-RTO-2)
Enviva Pellets Northampton, LLC

Calculation Basis

Hourly Throughput[1]	150.0 ODT/hr
Annual Throughput	781,255 ODT/yr
Hours of Operation	8,760 hr/yr
RTO Control Efficiency	97.50%

Potential VOC Emissions

Pollutant	CAS No.	HAP	NC TAP	VOC	Emission Factor[2]	Potential Emissions[3]	
					(lb/ODT)	Max (lb/hr)	Annual (tpy)
Acetaldehyde	75-07-0	Y	Y	Y	8.4E-03	0.032	0.082
Acrolein	107-02-8	Y	Y	Y	1.6E-02	0.059	0.15
Formaldehyde	50-00-0	Y	Y	Y	4.8E-03	0.018	0.047
Methanol	67-56-1	Y	N	Y	3.7E-02	0.140	0.36
Phenol	108-95-2	Y	Y	Y	4.6E-03	0.017	0.045
Propionaldehyde	123-38-6	Y	N	Y	1.2E-03	0.005	0.012
Total TAP Emissions						0.125	0.326
Total HAP Emissions						**0.27**	**0.70**
Total VOC (as propane)	--	N/A	N/A	Y	0.32	1.21	3.15

Notes:
1. The max hourly throughput is based on the maximum capacity for the 2 existing green hammermills ratioed up to reflect 3 additional hammermills (i.e. 119.4 tph * 5/2).
2. Emission factors were derived based on stack testing data from comparable Enviva facilities and/or engineering judgement and include contingency. The emission factors represent uncontrolled emissions.
3. The emissions from the green hammermills will primarily be controlled by the RTO on the existing dryer line (CD-RTO-1). During periods when the existing dryer line is down, the emissions from the green hammermills will be controlled by the RTO on the new dryer line (CD-RTO-2).

Thermal Generated Potential Criteria Pollutant Emissions

Maximum high heating value of VOC constituents	0.018 MMBtu/lb
Uncontrolled VOC emissions	126 tons/yr
Uncontrolled VOC emissions	48 lb/hr
Heat input of uncontrolled VOC emissions	4,666 MMBtu/yr
Heat input of uncontrolled VOC emissions	0.9 MMBtu/hr

Pollutant	Emission Factor	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	8.2E-02	lb/MMBtu[1]	0.07	0.19
NO_x	9.8E-02	lb/MMBtu[1]	0.09	0.23

Notes:
1. CO and NO_x emission factors are from AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98 for small boilers.

Abbreviations:

CAS - chemical abstract service
HAP - hazardous air pollutant
hr - hour
lb - pound
NC - North Carolina
ODT - oven dried tons
RTO - Regenerative Thermal Oxidizer
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
yr - year

Table 3c
Potential HAP and TAP Emissions
Dryer #1 (ES-DRYER-1, CD-WESP-1, CD-RTO-1)
Enviva Pellets Northampton, LLC

Calculation Basis

Annual Dried Wood Throughput[10]	781,255 ODT/year
Max. Hourly Dried Wood Throughput of Dryer	71.71 ODT/hr
Burner Heat Input	175.3 MMBtu/hr
Percent Hardwood	20.0%
Percent Softwood	80.0%
Annual Operation	8,760 hr/yr
Annual Heat Input	1,535,628 MMBtu/yr
Number of RTO Burners	4
RTO Burner Rating	8 MMBtu/hr
RTO Control Efficiency	97.50%

Potential HAP and TAP Emissions

Pollutant	HAP	NC TAP	VOC	Emission Factor	Units	Footnote	Potential Emissions	
							Max (lb/hr)	Annual (tpy)
Dryer Burner - Biomass Source								
Acetaldehyde	Y	Y	Y	1.7E-01	lb/ODT	1	0.30	1.64
Acrolein	Y	Y	Y	1.1E-01	lb/ODT	1	0.20	1.07
Formaldehyde	Y	Y	Y	1.4E-01	lb/ODT	1	0.26	1.40
Methanol	Y	N	Y	1.0E-01	lb/ODT	1	0.19	1.02
Phenol	Y	Y	Y	5.8E-02	lb/ODT	1	0.10	0.56
Propionaldehyde	Y	N	Y	3.9E-02	lb/ODT	1	0.07	0.38
Acetophenone	Y	N	Y	3.2E-09	lb/MMBtu	2,3	1.4E-08	6.1E-08
Antimony and compounds	Y	N	N	7.9E-06	lb/MMBtu	2,4	1.0E-04	4.4E-04
Arsenic	Y	Y	N	2.2E-05	lb/MMBtu	2,4	2.8E-04	1.2E-03
Benzene	Y	Y	Y	4.2E-03	lb/MMBtu	2,3	1.8E-02	8.1E-02
Benzo(a)pyrene	Y	Y	Y	2.6E-06	lb/MMBtu	2,3	1.1E-05	5.0E-05
Beryllium	Y	Y	N	1.1E-06	lb/MMBtu	2,4	1.4E-05	6.1E-05
Cadmium	Y	Y	N	4.1E-06	lb/MMBtu	2,4	5.2E-05	2.3E-04
Carbon tetrachloride	Y	Y	Y	4.5E-05	lb/MMBtu	2,3	2.0E-04	8.6E-04
Chlorine	Y	Y	N	7.9E-04	lb/MMBtu	2,9	1.4E-01	6.1E-01
Chlorobenzene	Y	Y	Y	3.3E-05	lb/MMBtu	2,3	1.4E-04	6.3E-04
Chloroform	Y	Y	Y	2.8E-05	lb/MMBtu	2,3	1.2E-04	5.4E-04
Chromium VI	-	Y	N	3.5E-06	lb/MMBtu	2,4,5	4.4E-05	1.9E-04
Chromium–Other compounds	Y	N	N	1.8E-05	lb/MMBtu	2,4	2.2E-04	9.7E-04
Cobalt compounds	Y	N	N	6.5E-06	lb/MMBtu	2,4	8.3E-05	3.6E-04
Dichloroethane, 1,2-	Y	Y	Y	2.9E-05	lb/MMBtu	2,3	1.3E-04	5.6E-04
Dichloropropane, 1,2-	Y	N	Y	3.3E-05	lb/MMBtu	2,3	1.4E-04	6.3E-04
Dinitrophenol, 2,4-	Y	N	Y	1.8E-07	lb/MMBtu	2,3	7.9E-07	3.5E-06
Di(2-ethylhexyl)phthalate	Y	Y	Y	4.7E-08	lb/MMBtu	2,3	2.1E-07	9.0E-07
Ethyl benzene	Y	N	Y	3.1E-05	lb/MMBtu	2,3	1.4E-04	6.0E-04
Hexachlorodibenzo-p-dioxin, 1,2,3,6,7,8-	N	Y	Y	1.8E-11	lb/MMBtu	2,3	7.8E-11	3.4E-10
Hydrochloric acid	Y	Y	N	1.9E-02	lb/MMBtu	2,6	3.3E-01	1.5E+00
Lead	Y	N	N	4.8E-05	lb/MMBtu	2,4	6.1E-04	2.7E-03
Manganese	Y	Y	N	1.6E-03	lb/MMBtu	2,4	2.0E-02	8.9E-02
Mercury	Y	Y	N	3.5E-06	lb/MMBtu	2,4	4.4E-05	1.9E-04
Methyl bromide	Y	N	Y	1.5E-05	lb/MMBtu	2,3	6.6E-05	2.9E-04
Methyl chloride	Y	N	Y	2.3E-05	lb/MMBtu	2,3	1.0E-04	4.4E-04
Methyl ethyl ketone	N	Y	Y	5.4E-06	lb/MMBtu	2,3	2.4E-05	1.0E-04
Methylene chloride	Y	Y	Y	2.9E-04	lb/MMBtu	2,3	1.3E-03	5.6E-03
Naphthalene	Y	N	Y	9.7E-05	lb/MMBtu	2,3	4.3E-04	1.9E-03
Nickel	Y	Y	N	3.3E-05	lb/MMBtu	2,4	4.2E-04	1.8E-03
Nitrophenol, 4-	Y	N	Y	1.1E-07	lb/MMBtu	2,3	4.8E-07	2.1E-06
Pentachlorophenol	Y	Y	N	5.1E-08	lb/MMBtu	2	2.2E-07	9.8E-07
Perchloroethylene	Y	Y	N	3.8E-05	lb/MMBtu	2	1.7E-04	7.3E-04
Phosphorus metal, yellow or white	Y	N	N	2.7E-05	lb/MMBtu	2,4	3.4E-04	1.5E-03
Polychlorinated biphenyls	Y	Y	Y	8.2E-09	lb/MMBtu	2,3	3.6E-08	1.6E-07
Polycyclic Organic Matter	Y	N	N	1.3E-04	lb/MMBtu	2	5.5E-04	2.4E-03
Selenium compounds	Y	N	N	2.8E-06	lb/MMBtu	2,4	3.6E-05	1.6E-04
Styrene	Y	Y	Y	1.9E-03	lb/MMBtu	2,3	8.3E-03	3.6E-02
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	Y	Y	8.6E-12	lb/MMBtu	2,3	3.8E-11	1.7E-10
Toluene	Y	Y	Y	3.0E-05	lb/MMBtu	2,3	1.3E-04	5.8E-04
Trichloroethane, 1,1,1-	Y	Y	N	3.1E-05	lb/MMBtu	2	1.4E-04	6.0E-04
Trichloroethylene	Y	Y	Y	3.0E-05	lb/MMBtu	2,3	1.3E-04	5.8E-04
Trichlorofluoromethane	N	Y	Y	4.1E-05	lb/MMBtu	2,3	1.8E-04	7.9E-04
Trichlorophenol, 2,4,6-	Y	N	Y	2.2E-08	lb/MMBtu	2,3	9.6E-08	4.2E-07
Vinyl chloride	Y	Y	Y	1.8E-05	lb/MMBtu	2,3	7.9E-05	3.5E-04
Xylene	Y	Y	Y	2.5E-05	lb/MMBtu	2,3	1.1E-04	4.8E-04
Total HAP Emissions (related to biomass)							**1.64**	**8.38**
Total TAP Emissions (related to biomass)							**1.38**	**6.97**

Table 3c
Potential HAP and TAP Emissions
Dryer #1 (ES-DRYER-1, CD-WESP-1, CD-RTO-1)
Enviva Pellets Northampton, LLC

Pollutant	HAP	NC TAP	VOC	Emission Factor	Units	Footnote	Potential Emissions Max (lb/hr)	Potential Emissions Annual (tpy)
RTO - Natural Gas/Propane Source								
2-Methylnaphthalene	Y	N	Y	2.4E-05	lb/MMscf	7	7.5E-07	3.3E-06
3-Methylchloranthrene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
7,12-Dimethylbenz(a)anthracene	Y	N	Y	1.6E-05	lb/MMscf	7	5.0E-07	2.2E-06
Acenaphthene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Acenaphthylene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Acetaldehyde	Y	Y	Y	1.5E-05	lb/MMscf	7	4.8E-07	2.1E-06
Acrolein	Y	Y	Y	1.8E-05	lb/MMscf	7	5.6E-07	2.5E-06
Ammonia	N	Y	N	3.2	lb/MMscf	7	1.0E-01	4.4E-01
Anthracene	Y	N	Y	2.4E-06	lb/MMscf	7	7.5E-08	3.3E-07
Arsenic	Y	Y	N	2.0E-04	lb/MMscf	7	6.3E-06	2.7E-05
Benz(a)anthracene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Benzene	Y	N	Y	7.1E-04	lb/MMBtu	8	2.3E-02	1.0E-01
Benzo(a)pyrene	Y	Y	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.6E-07
Benzo(b)fluoranthene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Benzo(g,h,i)perylene	Y	N	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.6E-07
Benzo(k)fluoranthene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Beryllium	Y	Y	N	1.2E-05	lb/MMscf	7	3.8E-07	1.6E-06
Cadmium	Y	Y	N	1.1E-03	lb/MMscf	7	3.5E-05	1.5E-04
Chromium VI	Y	N	N	1.4E-03	lb/MMscf	7	4.4E-05	1.9E-04
Chrysene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Cobalt	Y	N	N	8.4E-05	lb/MMscf	7	2.6E-06	1.2E-05
Dibenzo(a,h)anthracene	Y	N	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.6E-07
Dichlorobenzene	Y	Y	Y	1.2E-03	lb/MMscf	7	3.8E-05	1.6E-04
Fluoranthene	Y	N	Y	3.0E-06	lb/MMscf	7	9.4E-08	4.1E-07
Fluorene	Y	N	Y	2.8E-06	lb/MMscf	7	8.8E-08	3.8E-07
Formaldehyde	Y	Y	Y	1.5E-03	lb/MMBtu	8	4.8E-02	2.1E-01
Hexane	Y	Y	Y	1.8	lb/MMscf	7	5.6E-02	2.5E-01
Indeno(1,2,3-cd)pyrene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Lead	Y	N	N	5.0E-04	lb/MMscf	7	1.6E-05	6.9E-05
Manganese	Y	Y	N	3.8E-04	lb/MMscf	7	1.2E-05	5.2E-05
Mercury	Y	Y	N	2.6E-04	lb/MMscf	7	8.2E-06	3.6E-05
Naphthalene	Y	N	Y	6.1E-04	lb/MMscf	7	1.9E-05	8.4E-05
Nickel	Y	Y	N	2.1E-03	lb/MMscf	7	6.6E-05	2.9E-04
Polycyclic Organic Matter	Y	N	N	4.0E-05	lb/MMBtu	8	1.3E-03	5.6E-03
Phenanthrene	Y	N	Y	1.7E-05	lb/MMscf	7	5.3E-07	2.3E-06
Pyrene	Y	N	Y	5.0E-06	lb/MMscf	7	1.6E-07	6.9E-07
Selenium compounds	Y	N	N	2.4E-05	lb/MMscf	7	7.5E-07	3.3E-06
Toluene	Y	Y	Y	3.4E-03	lb/MMscf	7	1.1E-04	4.7E-04
						Total HAP Emissions (related to natural gas/propane)	**0.13**	**0.56**
						Total TAP Emissions (related to natural gas/propane)	**0.21**	**0.46**

Notes:

1. Emission factor derived based on stack testing data from comparable Enviva facilities and/or engineering judgement and include contingency. The emission factors represent uncontrolled emissions.
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. The control efficiency of 97.5% for the RTO is applied to all VOC hazardous and toxic pollutants.
4. The control efficiency of the wet electrostatic precipitator (WESP) for filterable particulate matter is applied to all metal hazardous and toxic pollutants from the dryer and duct burners. Actual design filterable efficiency is estimated to 96.4%, but 92.75% is assumed for toxics permitting.

   WESP Control Efficiency for metal HAP 92.8%
5. Chromium VI is a subset of chromium 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.

   WESP HCl Control Efficiency 90.00%
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. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.
8. The RTO 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.
9. It was assumed that chlorine is not oxidized in the RTO.
10. Annual dried wood throughput is based on total facility production. Although dryer line 1 and dryer line 2 are capable of processing up to 537,625 ODT/yr and 620,000 ODT/yr, respectively, the combined throughput of both dryers will not exceed 781,255 ODT/yr. In order to to provide Enviva with the flexibility to use either dryer line up to its individual capacity, the total emissions from the two dryer lines are based on the total facility throughput and calculated as follows:
    - Where individual dryer emissions are calculated based on throughput (i.e. lb/ODT), the total emissions are estimated based on the total throughput of 781,255 ODT/yr.
    - Where individual dryer emissions are calculated based on fuel use (i.e. lb/MMBtu or lb/MMscf), the total emissions are conservatively set equal to the sum of the emissions from the two dryer lines assuming both dryer lines operate 8,760 hrs/yr.

Table 3c
Potential HAP and TAP Emissions
Dryer #1 (ES-DRYER-1, CD-WESP-1, CD-RTO-1)
Enviva Pellets Northampton, LLC

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

Table 3d
Potential Emissions
Dryer #1 Bypass (ES-DRYERBYP-1) (Full Capacity)[1]
Enviva Pellets Northampton, LLC

Calculation Basis

Hourly Throughput[1]	71.71 ODT/hr
Hourly Heat Input Capacity	175.3 MMBtu/hr
Annual Heat Input Capacity	8,765 MMBtu/yr
Hours of Operation[1]	50 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions per Dryer Line

Pollutant	Emission Factor	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	21.4	lb/hr[2]	21.4	0.54
NO_X	26.3	lb/hr[2]	26.3	0.66
SO_2	0.025	lb/MMBtu[3]	4.38	0.110
VOC	14.0	lb/hr[2]	14.0	0.35
$PM/PM_{10}/PM_{2.5}$ Condensable	0.017	lb/MMBtu[4]	2.98	0.075
$PM/PM_{10}/PM_{2.5}$ Filterable	0.33	lb/MMBtu[5]	57.8	1.45
Total $PM/PM_{10}/PM_{2.5}$			60.8	1.52

Notes:

1. During startup and shutdown (for temperature control) or malfunction, excess emissions can be vented out either the dryer bypass stacks or the furnace bypass stacks. Use of the bypass stacks is limited to 2 hours in any 24-hour period and 50 hours per 12-month rolling period for each dryer line. As the feed to the dryer is typically stopped during shutdown and malfunction events, the hourly throughput is equal to the annual average of the dryer feed rate.
2. CO, NO_X, and VOC emission rates based on data from a comparable Enviva facility.
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 condensable PM based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
5. Uncontrolled filterable PM emission factor is based on testing at a comparable Enviva facility.

Table 3d
Potential Emissions
Dryer #1 Bypass (ES-DRYERBYP-1) (Full Capacity)[1]
Enviva Pellets Northampton, LLC

Potential HAP Emissions per Dryer Line

Pollutant	Emission Factor	Units	Footnote	Potential Emissions[1]	
				Max (lb/hr)	Annual (tpy)
Acetaldehyde	0.168	lb/ODT	2	12.1	0.30
Acrolein	0.110	lb/ODT	2	7.89	0.197
Formaldehyde	0.144	lb/ODT	2	10.29	0.26
Methanol	0.105	lb/ODT	2	7.52	0.19
Phenol	0.058	lb/ODT	2	4.13	0.10
Propionaldehyde	0.039	lb/ODT	2	2.76	0.069
Acetophenone	3.2E-09	lb/MMBtu	3	5.61E-07	1.40E-08
Antimony and compounds	7.9E-06	lb/MMBtu	3	1.38E-03	3.46E-05
Arsenic	2.2E-05	lb/MMBtu	3	3.86E-03	9.64E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	3	4.56E-04	1.14E-05
Beryllium	1.1E-06	lb/MMBtu	3	1.93E-04	4.82E-06
Cadmium	4.1E-06	lb/MMBtu	3	7.19E-04	1.80E-05
Carbon tetrachloride	4.5E-05	lb/MMBtu	3	7.89E-03	1.97E-04
Chlorine	7.9E-04	lb/MMBtu	3	1.38E-01	3.46E-03
Chlorobenzene	3.3E-05	lb/MMBtu	3	5.78E-03	1.45E-04
Chromium–Other compounds	1.8E-05	lb/MMBtu	3	3.07E-03	7.67E-05
Cobalt compounds	6.5E-06	lb/MMBtu	3	1.14E-03	2.85E-05
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	3	3.16E-05	7.89E-07
Di(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	3	8.24E-06	2.06E-07
Ethyl benzene	3.1E-05	lb/MMBtu	3	5.43E-03	1.36E-04
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	3	5.08E-03	1.27E-04
Hydrochloric acid	1.9E-02	lb/MMBtu	3	3.33E+00	8.33E-02
Lead	4.8E-05	lb/MMBtu	3	8.41E-03	2.10E-04
Manganese	1.6E-03	lb/MMBtu	3	2.80E-01	7.01E-03
Mercury	3.5E-06	lb/MMBtu	3	6.14E-04	1.53E-05
Methyl bromide	1.5E-05	lb/MMBtu	3	2.63E-03	6.57E-05
Methyl chloride	2.3E-05	lb/MMBtu	3	4.03E-03	1.01E-04
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	3	5.43E-03	1.36E-04
Naphthalene	9.7E-05	lb/MMBtu	3	1.70E-02	4.25E-04
Nickel	3.3E-05	lb/MMBtu	3	5.78E-03	1.45E-04
Nitrophenol, 4-	1.1E-07	lb/MMBtu	3	1.93E-05	4.82E-07
Pentachlorophenol	5.1E-08	lb/MMBtu	3	8.94E-06	2.24E-07
Perchloroethylene	3.8E-05	lb/MMBtu	3	6.66E-03	1.67E-04
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	3	4.73E-03	1.18E-04
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	3	1.43E-06	3.57E-08
Polycyclic Organic Matter	1.3E-04	lb/MMBtu	3	2.19E-02	5.48E-04
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	3	5.78E-03	1.45E-04
Selenium compounds	2.8E-06	lb/MMBtu	3	4.91E-04	1.23E-05
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	3	1.51E-09	3.77E-11
Trichloroethylene	3.0E-05	lb/MMBtu	3	5.26E-03	1.31E-04
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	3	3.86E-06	9.64E-08
Vinyl chloride	1.8E-05	lb/MMBtu	3	3.16E-03	7.89E-05
			Total HAP Emissions	**48.5**	**1.21**

Notes:

1. During dryer bypass emissions are not controlled by the WESP and RTO; however, combustion in the furnace still results in a reduction in organic HAP emission rates.
2. Organic HAP emissions rates were derived based on stack testing data from other similar Enviva plants and/or engineering judgement.
3. 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
kg - kilogram
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
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

Reference:

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

Table 3e
Potential Emissions
Dryer #1 Furnace Bypass (ES-FURNACEBYP-1) (Full Capacity)[1]
Enviva Pellets Northampton, LLC

Calculation Basis

Hourly Heat Input Capacity	175.3 MMBtu/hr
Annual Heat Input Capacity	8,765 MMBtu/yr
Hours of Operation[1]	50 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions per Dryer Line

Pollutant	Emission Factor	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	0.60	lb/MMBtu[2]	105.2	2.63
NO_X	0.22	lb/MMBtu[2]	38.57	0.96
SO_2	0.025	lb/MMBtu[2]	4.38	0.110
VOC	0.017	lb/MMBtu[2]	2.98	0.075
Total $PM/PM_{10}/PM_{2.5}$	0.58	lb/MMBtu[2]	101.1	2.53

Notes:

1. During startup and shutdown (for temperature control) or malfunction, excess emissions can be vented out either the dryer bypass stacks or the furnace bypass stacks. Use of the bypass stacks is limited to 2 hours in any 24-hour period and 50 hours per 12-month rolling period for each dryer line.
2. CO, NO_X, SO_2, PM, and VOC emission rates based on 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 3e
Potential Emissions
Dryer #1 Furnace Bypass (ES-FURNACEBYP-1) (Full Capacity)[1]
Enviva Pellets Northampton, LLC

Potential HAP Emissions per Dryer Line

Pollutant	Emission Factor	Units	Footnote	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
Acetaldehyde	8.30E-04	lb/MMBtu	1	1.45E-01	3.64E-03
Acrolein	4.00E-03	lb/MMBtu	1	7.01E-01	1.75E-02
Formaldehyde	4.40E-03	lb/MMBtu	1	7.71E-01	1.93E-02
Phenol	5.10E-05	lb/MMBtu	1	8.94E-03	2.24E-04
Propionaldehyde	6.10E-05	lb/MMBtu	1	1.07E-02	2.67E-04
Acetophenone	3.2E-09	lb/MMBtu	1	5.61E-07	1.40E-08
Antimony and compounds	7.9E-06	lb/MMBtu	1	1.38E-03	3.46E-05
Arsenic	2.2E-05	lb/MMBtu	1	3.86E-03	9.64E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	1	4.56E-04	1.14E-05
Beryllium	1.1E-06	lb/MMBtu	1	1.93E-04	4.82E-06
Cadmium	4.1E-06	lb/MMBtu	1	7.19E-04	1.80E-05
Carbon tetrachloride	4.5E-05	lb/MMBtu	1	7.89E-03	1.97E-04
Chlorine	7.9E-04	lb/MMBtu	1	1.38E-01	3.46E-03
Chlorobenzene	3.3E-05	lb/MMBtu	1	5.78E-03	1.45E-04
Chromium–Other compounds	2.1E-05	lb/MMBtu	1	3.68E-03	9.20E-05
Cobalt compounds	6.5E-06	lb/MMBtu	1	1.14E-03	2.85E-05
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	1	3.16E-05	7.89E-07
Di(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	1	8.24E-06	2.06E-07
Ethyl benzene	3.1E-05	lb/MMBtu	1	5.43E-03	1.36E-04
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	1	5.08E-03	1.27E-04
Hydrochloric acid	1.9E-02	lb/MMBtu	1	3.33E+00	8.33E-02
Lead	4.8E-05	lb/MMBtu	1	8.41E-03	2.10E-04
Manganese	1.6E-03	lb/MMBtu	1	2.80E-01	7.01E-03
Mercury	3.5E-06	lb/MMBtu	1	6.14E-04	1.53E-05
Methyl bromide	1.5E-05	lb/MMBtu	1	2.63E-03	6.57E-05
Methyl chloride	2.3E-05	lb/MMBtu	1	4.03E-03	1.01E-04
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	1	5.43E-03	1.36E-04
Naphthalene	9.7E-05	lb/MMBtu	1	1.70E-02	4.25E-04
Nickel	3.3E-05	lb/MMBtu	1	5.78E-03	1.45E-04
Nitrophenol, 4-	1.1E-07	lb/MMBtu	1	1.93E-05	4.82E-07
Pentachlorophenol	5.1E-08	lb/MMBtu	1	8.94E-06	2.24E-07
Perchloroethylene	3.8E-05	lb/MMBtu	1	6.66E-03	1.67E-04
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	1	4.73E-03	1.18E-04
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	1	1.43E-06	3.57E-08
Polycyclic Organic Matter	1.3E-04	lb/MMBtu	1	2.19E-02	5.48E-04
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	1	5.78E-03	1.45E-04
Selenium compounds	2.8E-06	lb/MMBtu	1	4.91E-04	1.23E-05
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	1	1.51E-09	3.77E-11
Trichloroethylene	3.0E-05	lb/MMBtu	1	5.26E-03	1.31E-04
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	1	3.86E-06	9.64E-08
Vinyl chloride	1.8E-05	lb/MMBtu	1	3.16E-03	7.89E-05
Total HAP Emissions (Biomass Combustion)				**5.51**	**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
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:
AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

Table 3f
Potential Emissions
Dryer #1 Furnace Bypass (ES-FURNACEBYP-1) (Idle Mode)[1]
Enviva Pellets Northampton, LLC

Calculation Basis

Hourly Heat Input Capacity	5 MMBtu/hr
Annual Heat Input Capacity	2,500 MMBtu/yr
Hours of Operation[1]	500 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions per Dryer Line

Pollutant	Emission Factor	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	0.60	lb/MMBtu[2]	3.00	0.75
NO_X	0.22	lb/MMBtu[2]	1.10	0.28
SO_2	0.025	lb/MMBtu[2]	0.13	0.031
VOC	0.017	lb/MMBtu[2]	0.085	0.021
Total PM	0.58	lb/MMBtu[2]	2.89	0.72
Total PM_{10}	0.52	lb/MMBtu[2]	2.59	0.65
Total $PM_{2.5}$	0.45	lb/MMBtu[2]	2.24	0.56

Notes:

1. As part of this submittal Enviva is requesting a limit of 500 hours per year of "idle mode" for each furnace.
2. CO, NO_X, SO_2, PM, PM_{10}, $PM_{2.5}$, and VOC emission rates based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. PM_{10} and $PM_{2.5}$ factors equal to the sum of the filterable and condensible factors from Table 1.6-1. VOC emission factor excludes formaldehyde.

Table 3f
Potential Emissions
Dryer #1 Furnace Bypass (ES-FURNACEBYP-1) (Idle Mode)[1]
Enviva Pellets Northampton, LLC

Potential HAP Emissions per Dryer Line

Pollutant	Emission Factor	Units	Footnote	Potential Emissions Max (lb/hr)	Potential Emissions Annual (tpy)
Acetaldehyde	8.30E-04	lb/MMBtu	1	4.15E-03	1.04E-03
Acrolein	4.00E-03	lb/MMBtu	1	2.00E-02	5.00E-03
Formaldehyde	4.40E-03	lb/MMBtu	1	2.20E-02	5.50E-03
Phenol	5.10E-05	lb/MMBtu	1	2.55E-04	6.38E-05
Propionaldehyde	6.10E-05	lb/MMBtu	1	3.05E-04	7.63E-05
Acetophenone	3.2E-09	lb/MMBtu	1	1.60E-08	4.00E-09
Antimony and compounds	7.9E-06	lb/MMBtu	1	3.95E-05	9.88E-06
Arsenic	2.2E-05	lb/MMBtu	1	1.10E-04	2.75E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	1	1.30E-05	3.25E-06
Beryllium	1.1E-06	lb/MMBtu	1	5.50E-06	1.38E-06
Cadmium	4.1E-06	lb/MMBtu	1	2.05E-05	5.13E-06
Carbon tetrachloride	4.5E-05	lb/MMBtu	1	2.25E-04	5.63E-05
Chlorine	7.9E-04	lb/MMBtu	1	3.95E-03	9.88E-04
Chlorobenzene	3.3E-05	lb/MMBtu	1	1.65E-04	4.13E-05
Chromium–Other compounds	2.1E-05	lb/MMBtu	1	1.05E-04	2.63E-05
Cobalt compounds	6.5E-06	lb/MMBtu	1	3.25E-05	8.13E-06
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	1	9.00E-07	2.25E-07
Bis(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	1	2.35E-07	5.88E-08
Ethyl benzene	3.1E-05	lb/MMBtu	1	1.55E-04	3.88E-05
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	1	1.45E-04	3.63E-05
Hydrochloric acid	1.9E-02	lb/MMBtu	1	9.50E-02	2.38E-02
Lead	4.8E-05	lb/MMBtu	1	2.40E-04	6.00E-05
Manganese	1.6E-03	lb/MMBtu	1	8.00E-03	2.00E-03
Mercury	3.5E-06	lb/MMBtu	1	1.75E-05	4.38E-06
Methyl bromide	1.5E-05	lb/MMBtu	1	7.50E-05	1.88E-05
Methyl chloride	2.3E-05	lb/MMBtu	1	1.15E-04	2.88E-05
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	1	1.55E-04	3.88E-05
Naphthalene	9.7E-05	lb/MMBtu	1	4.85E-04	1.21E-04
Nickel	3.3E-05	lb/MMBtu	1	1.65E-04	4.13E-05
Nitrophenol, 4-	1.1E-07	lb/MMBtu	1	5.50E-07	1.38E-07
Pentachlorophenol	5.1E-08	lb/MMBtu	1	2.55E-07	6.38E-08
Perchloroethylene	3.8E-05	lb/MMBtu	1	1.90E-04	4.75E-05
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	1	1.35E-04	3.38E-05
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	1	4.08E-08	1.02E-08
Polycyclic Organic Matter	1.3E-04	lb/MMBtu	1	6.25E-04	1.56E-04
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	1	1.65E-04	4.13E-05
Selenium compounds	2.8E-06	lb/MMBtu	1	1.40E-05	3.50E-06
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	1	4.30E-11	1.08E-11
Trichloroethene	3.0E-05	lb/MMBtu	1	1.50E-04	3.75E-05
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	1	1.10E-07	2.75E-08
Vinyl chloride	1.8E-05	lb/MMBtu	1	9.00E-05	2.25E-05
Total HAP Emissions (Biomass Combustion)				**0.16**	**0.039**

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
kg - kilogram
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
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:

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

Table 3g
Potential Emissions
Dryer #1 Double Duct Burners (IES-DDB-1 and -2)
Enviva Pellets Northampton, LLC

Duct Burner Inputs

Duct Burner Rating	1	MMBtu/hr
Number of Duct Burners	2	
Annual Operation	8,760	hr/yr

Potential Criteria Pollutant Emissions:

Potential Criteria Pollutant Emissions - Natural Gas Combustion

Pollutant	Emission Factor	Units	Emission Factor Source	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
CO	84.0	lb/MMscf	Note 1	0.16	0.72
NO_X	50.0	lb/MMscf	Note 2	0.10	0.43
SO_2	0.60	lb/MMscf	Note 1	0.0012	0.005
VOC	5.50	lb/MMscf	Note 1	0.01	0.05
$PM/PM_{10}/PM_{2.5}$ Condensable	5.70	lb/MMscf	Note 1	0.01	0.05
$PM/PM_{10}/PM_{2.5}$ Filterable	1.90	lb/MMscf	Note 1	0.004	0.02
Total $PM/PM_{10}/PM_{2.5}$				0.015	0.065

Potential Criteria Pollutant Emissions - Propane Combustion

Pollutant	Emission Factor[3]	Units	Emission Factor Source	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
CO	7.50	lb/Mgal	Note 3	0.16	0.72
NO_X	6.50	lb/Mgal	Note 4	0.14	0.62
SO_2	0.054	lb/Mgal	Note 3,5	0.001	0.005
VOC	1.00	lb/Mgal	Note 3	0.02	0.10
$PM/PM_{10}/PM_{2.5}$ Condensable	0.50	lb/Mgal	Note 3	0.01	0.05
$PM/PM_{10}/PM_{2.5}$ Filterable	0.20	lb/Mgal	Note 3	0.004	0.02
Total $PM/PM_{10}/PM_{2.5}$				0.015	0.067

Notes:

1. 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.
2. Emission factors for NO_X assume burners are low NO_X burners, per email from Kai Simonsen (Enviva) on August 8, 2018.
3. 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.
4. 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.
5. 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 3g
Potential Emissions
Dryer #1 Double Duct Burners (IES-DDB-1 and -2)
Enviva Pellets Northampton, LLC

Potential HAP and TAP Emissions

Pollutant	HAP	NC TAP	VOC	Emission Factor	Units	Footnote	Potential Emissions Max (lb/hr)	Potential Emissions Annual (tpy)
Duct Burners - Natural Gas/Propane Source								
2-Methylnaphthalene	Y	N	Y	2.4E-05	lb/MMscf	1	4.7E-08	2.1E-07
3-Methylchloranthrene	Y	N	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
7,12-Dimethylbenz(a)anthracene	Y	N	Y	1.6E-05	lb/MMscf	1	3.1E-08	1.4E-07
Acenaphthene	Y	N	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Acenaphthylene	Y	N	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Acetaldehyde	Y	Y	Y	1.5E-05	lb/MMscf	1	3.0E-08	1.3E-07
Acrolein	Y	Y	Y	1.8E-05	lb/MMscf	1	3.5E-08	1.5E-07
Ammonia	N	Y	N	3.2	lb/MMscf	1	6.3E-03	2.7E-02
Anthracene	Y	N	Y	2.4E-06	lb/MMscf	1	4.7E-09	2.1E-08
Arsenic	Y	Y	N	2.0E-04	lb/MMscf	1	3.9E-07	1.7E-06
Benz(a)anthracene	Y	N	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Benzene	Y	N	Y	7.1E-04	lb/MMBtu	2	1.4E-03	6.2E-03
Benzo(a)pyrene	Y	Y	Y	1.2E-06	lb/MMscf	1	2.4E-09	1.0E-08
Benzo(b)fluoranthene	Y	N	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Benzo(g,h,i)perylene	Y	N	Y	1.2E-06	lb/MMscf	1	2.4E-09	1.0E-08
Benzo(k)fluoranthene	Y	N	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Beryllium	Y	Y	N	1.2E-05	lb/MMscf	1	2.4E-08	1.0E-07
Cadmium	Y	Y	N	1.1E-03	lb/MMscf	1	2.2E-06	9.4E-06
Chromium VI	Y	N	N	1.4E-03	lb/MMscf	1	2.7E-06	1.2E-05
Chrysene	Y	N	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Cobalt	Y	N	N	8.4E-05	lb/MMscf	1	1.6E-07	7.2E-07
Dibenzo(a,h)anthracene	Y	N	Y	1.2E-06	lb/MMscf	1	2.4E-09	1.0E-08
Dichlorobenzene	Y	Y	Y	1.2E-03	lb/MMscf	1	2.4E-06	1.0E-05
Fluoranthene	Y	N	Y	3.0E-06	lb/MMscf	1	5.9E-09	2.6E-08
Fluorene	Y	N	Y	2.8E-06	lb/MMscf	1	5.5E-09	2.4E-08
Formaldehyde	Y	Y	Y	1.5E-03	lb/MMBtu	2	3.0E-03	1.3E-02
Hexane	Y	Y	Y	1.8	lb/MMscf	1	3.5E-03	1.5E-02
Indeno(1,2,3-cd)pyrene	Y	N	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Lead	Y	N	N	5.0E-04	lb/MMscf	1	9.8E-07	4.3E-06
Manganese	Y	Y	N	3.8E-04	lb/MMscf	1	7.5E-07	3.3E-06
Mercury	Y	Y	N	2.6E-04	lb/MMscf	1	5.1E-07	2.2E-06
Naphthalene	Y	N	Y	6.1E-04	lb/MMscf	1	1.2E-06	5.2E-06
Nickel	Y	Y	N	2.1E-03	lb/MMscf	1	4.1E-06	1.8E-05
Polycyclic Organic Matter	Y	N	N	4.0E-05	lb/MMBtu	8	8.0E-05	3.5E-04
Phenanthrene	Y	N	Y	1.7E-05	lb/MMscf	1	3.3E-08	1.5E-07
Pyrene	Y	N	Y	5.0E-06	lb/MMscf	1	9.8E-09	4.3E-08
Selenium compounds	Y	N	N	2.4E-05	lb/MMscf	1	4.7E-08	2.1E-07
Toluene	Y	Y	Y	3.4E-03	lb/MMscf	1	6.7E-06	2.9E-05
Total HAP Emissions (related to natural gas/propane)							**0.008**	**0.035**
Total TAP Emissions (related to natural gas/propane)							**0.01**	**0.056**

Table 3g
Potential Emissions
Dryer #1 Double Duct Burners (IES-DDB-1 and -2)
Enviva Pellets Northampton, LLC

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:

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

Table 3h
Potential Emissions
Dryer #1 Furnace Bypass (ES-FURNACEBYP-1) (Cold Startup)
Enviva Pellets Northampton, LLC

Calculation Basis

Hourly Heat Input Capacity[1]	26.3 MMBtu/hr
Annual Heat Input Capacity	1,315 MMBtu/yr
Hours of Operation[2]	50 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions per Dryer Line

Pollutant	Emission Factor	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	0.60	lb/MMBtu[3]	15.78	0.39
NO_X	0.22	lb/MMBtu[3]	5.78	0.14
SO_2	0.025	lb/MMBtu[3]	0.66	0.016
VOC	0.017	lb/MMBtu[3]	0.447	0.011
Total PM	0.58	lb/MMBtu[3]	15.17	0.38
Total PM_{10}	0.52	lb/MMBtu[3]	13.59	0.34
Total $PM_{2.5}$	0.45	lb/MMBtu[3]	11.75	0.29

Notes:

1. The hourly heat input for cold startup is estimated as follows (Hours 1-2, 6.75 MMBtu/hr; Hours 3-4, 13.5 MmBtu/hr; Hours 5-6, 20.25 MMBtu/hr; and Hours 7-8, 27 MMBtu/hr). Emissions are conservatively based on the heat input rate of 27 MMBtu/hr.
2. Estimated annual hours for cold startup.
3. CO, NO_X, SO_2, PM_{10}, $PM_{2.5}$, and VOC emission rates based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. PM_{10} and $PM_{2.5}$ factors equal to the sum of the filterable and condensible factors from Table 1.6-1. VOC emission factor excludes formaldehyde.

Table 3h
Potential Emissions
Dryer #1 Furnace Bypass (ES-FURNACEBYP-1) (Cold Startup)
Enviva Pellets Northampton, LLC

Potential HAP Emissions per Dryer Line

Pollutant	Emission Factor	Units	Footnote	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
Acetaldehyde	8.30E-04	lb/MMBtu	1	2.18E-02	5.46E-04
Acrolein	4.00E-03	lb/MMBtu	1	1.05E-01	2.63E-03
Formaldehyde	4.40E-03	lb/MMBtu	1	1.16E-01	2.89E-03
Phenol	5.10E-05	lb/MMBtu	1	1.34E-03	3.35E-05
Propionaldehyde	6.10E-05	lb/MMBtu	1	1.60E-03	4.01E-05
Acetophenone	3.2E-09	lb/MMBtu	1	8.41E-08	2.10E-09
Antimony and compounds	7.9E-06	lb/MMBtu	1	2.08E-04	5.19E-06
Arsenic	2.2E-05	lb/MMBtu	1	5.78E-04	1.45E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	1	6.84E-05	1.71E-06
Beryllium	1.1E-06	lb/MMBtu	1	2.89E-05	7.23E-07
Cadmium	4.1E-06	lb/MMBtu	1	1.08E-04	2.70E-06
Carbon tetrachloride	4.5E-05	lb/MMBtu	1	1.18E-03	2.96E-05
Chlorine	7.9E-04	lb/MMBtu	1	2.08E-02	5.19E-04
Chlorobenzene	3.3E-05	lb/MMBtu	1	8.68E-04	2.17E-05
Chromium–Other compounds	2.1E-05	lb/MMBtu	1	5.52E-04	1.38E-05
Cobalt compounds	6.5E-06	lb/MMBtu	1	1.71E-04	4.27E-06
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	1	4.73E-06	1.18E-07
Di(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	1	1.24E-06	3.09E-08
Ethyl benzene	3.1E-05	lb/MMBtu	1	8.15E-04	2.04E-05
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	1	7.63E-04	1.91E-05
Hydrochloric acid	1.9E-02	lb/MMBtu	1	5.00E-01	1.25E-02
Lead	4.8E-05	lb/MMBtu	1	1.26E-03	3.16E-05
Manganese	1.6E-03	lb/MMBtu	1	4.21E-02	1.05E-03
Mercury	3.5E-06	lb/MMBtu	1	9.20E-05	2.30E-06
Methyl bromide	1.5E-05	lb/MMBtu	1	3.94E-04	9.86E-06
Methyl chloride	2.3E-05	lb/MMBtu	1	6.05E-04	1.51E-05
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	1	8.15E-04	2.04E-05
Naphthalene	9.7E-05	lb/MMBtu	1	2.55E-03	6.38E-05
Nickel	3.3E-05	lb/MMBtu	1	8.68E-04	2.17E-05
Nitrophenol, 4-	1.1E-07	lb/MMBtu	1	2.89E-06	7.23E-08
Pentachlorophenol	5.1E-08	lb/MMBtu	1	1.34E-06	3.35E-08
Perchloroethylene	3.8E-05	lb/MMBtu	1	9.99E-04	2.50E-05
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	1	7.10E-04	1.77E-05
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	1	2.14E-07	5.36E-09
Polycyclic Organic Matter	1.3E-04	lb/MMBtu	1	3.29E-03	8.22E-05
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	1	8.68E-04	2.17E-05
Selenium compounds	2.8E-06	lb/MMBtu	1	7.36E-05	1.84E-06
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	1	2.26E-10	5.65E-12
Trichloroethylene	3.0E-05	lb/MMBtu	1	7.89E-04	1.97E-05
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	1	5.78E-07	1.45E-08
Vinyl chloride	1.8E-05	lb/MMBtu	1	4.73E-04	1.18E-05
Total HAP Emissions (Biomass Combustion)				**0.83**	**0.021**

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
kg - kilogram
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
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:
AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

Table 4a
Potential Criteria Emissons
Dryer #2 (ES-DRYER-2, CD-WESP-2, CD-RTO-2)
Enviva Pellets Northampton, LLC

Calculation Basis

Annual Dried Wood Throughput[1]	781,255 ODT/year
Max. Hourly Dried Wood Throughput of Dryer	82.10 ODT/hr
Burner Heat Input	180.0 MMBtu/hr
Percent Hardwood	20.0%
Percent Softwood	80.0%
Annual Operation	8,760 hr/yr
Annual Heat Input	1,576,800 MMBtu/yr
Number of RTO Burners	4
RTO Burner Rating	8 MMBtu/hr
RTO Control Efficiency	97.50%

Potential Criteria Emissions

Pollutant	Biomass Emission Factor	Units	Emission Factor Source	Uncontrolled Emissions		Controlled Emissions	
				Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
CO	0.4	lb/ODT	Note 2	--	--	32.84	156.3
NO_X	22.23	lb/hr	Note 2	--	--	22.23	97.4
$PM/PM_{10}/PM_{2.5}$ (Filterable + Condensable)	7.6	lb/hr	Note 4	--	--	7.60	33.3
SO_2	0.025	lb/MMBtu	AP-42, Section 1.6[3]	--	--	4.50	19.7
Total VOC (as propane)	2.640	lb/ODT	Note 5	216.74	1031.3	5.42	25.8

Notes:

[1] Annual dried wood throughput is based on total facility production. Although dryer line 1 and dryer line 2 are capable of processing up to 537,625 ODT/yr and 620,000 ODT/yr, respectively, the combined throughput of both dryers will not exceed 781,255 ODT/yr. In order to to provide Enviva with the flexibility to use either dryer line up to its individual capacity, the total emissions from the two dryer lines are based on the total facility throughput and calculated as follows:

- Where individual dryer emissions are calculated based on throughput (i.e. lb/ODT), the total emissions are estimated based on the total throughput of 781,255 ODT/yr.
- Where individual dryer emissions are calculated based on fuel use (i.e. lb/MMBtu or lb/MMscf) or hourly test/vendor data (i.e., lb/hr), the total emissions are conservatively set equal to the sum of the emissions from the two dryer lines assuming both dryer lines operate 8,760 hrs/yr.
- Dryer line 1 described as 175.3 MMBtu/hr = 155.3 MMBtu/hr from the grate and 2 additional 10 MMBtu/hr dust burners permitted but not added.

[2] CO emissions based on data from similar Enviva facilities and information from NCASI database.
NOx emissions based on stack test results from similar Enviva facility plus 30% contingency.

[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 upon the heat input of the dryer burners using an emission factor for wood combustion from AP-42, Section 1.6.

[4] Particulate emission factor is based on data from similar Enviva facilities.

[5] VOC emission factor based on source test data for similar pellet manufacturing facilities and represents uncontrolled emissions.

Table 4b
Potential HAP and TAP Emissions
Dryer #2 (ES-DRYER-2, CD-WESP-2, CD-RTO-2)
Enviva Pellets Northampton, LLC

Calculation Basis

Annual Dried Wood Throughput[1]	781,255	ODT/year
Max. Hourly Dried Wood Throughput of Dryer	82.10	ODT/hr
Burner Heat Input	180.0	MMBtu/hr
Percent Hardwood	20.0%	
Percent Softwood	80.0%	
Annual Operation	8,760	hr/yr
Annual Heat Input	1,576,800	MMBtu/yr
Number of RTO Burners	4	
RTO Burner Rating	8	MMBtu/hr
RTO Control Efficiency	97.50%	

Potential HAP and TAP Emissions

Pollutant	HAP	NC TAP	VOC	Emission Factor	Units	Footnote	Potential Emissions Max (lb/hr)	Potential Emissions Annual (tpy)
Biomass Source								
Acetaldehyde	Y	Y	Y	1.7E-01	lb/ODT	1	0.35	1.64
Acrolein	Y	Y	Y	1.1E-01	lb/ODT	1	0.23	1.07
Formaldehyde	Y	Y	Y	1.4E-01	lb/ODT	1	0.29	1.40
Methanol	Y	N	Y	1.0E-01	lb/ODT	1	0.22	1.02
Phenol	Y	Y	Y	5.8E-02	lb/ODT	1	0.12	0.56
Propionaldehyde	Y	N	Y	3.9E-02	lb/ODT	1	0.08	0.38
Acetophenone	Y	N	Y	3.2E-09	lb/MMBtu	2,3	1.4E-08	6.3E-08
Antimony and compounds	Y	N	N	7.9E-06	lb/MMBtu	2,4	1.0E-04	4.5E-04
Arsenic	Y	Y	N	2.2E-05	lb/MMBtu	2,4	2.9E-04	1.3E-03
Benzene	Y	Y	Y	4.2E-03	lb/MMBtu	2,3	1.9E-02	8.3E-02
Benzo(a)pyrene	Y	Y	Y	2.6E-06	lb/MMBtu	2,3	1.2E-05	5.1E-05
Beryllium	Y	Y	N	1.1E-06	lb/MMBtu	2,4	1.4E-05	6.3E-05
Cadmium	Y	Y	N	4.1E-06	lb/MMBtu	2,4	5.4E-05	2.3E-04
Carbon tetrachloride	Y	Y	Y	4.5E-05	lb/MMBtu	2,3	2.0E-04	8.9E-04
Chlorine	Y	Y	N	7.9E-04	lb/MMBtu	2,9	1.4E-01	6.2E-01
Chlorobenzene	Y	Y	Y	3.3E-05	lb/MMBtu	2,3	1.5E-04	6.5E-04
Chloroform	Y	Y	Y	2.8E-05	lb/MMBtu	2,3	1.3E-04	5.5E-04
Chromium VI	-[5]	Y	N	3.5E-06	lb/MMBtu	2,4,5	4.6E-05	2.0E-04
Chromium–Other compounds	Y	N	N	1.8E-05	lb/MMBtu	2,4	2.3E-04	1.0E-03
Cobalt compounds	Y	N	N	6.5E-06	lb/MMBtu	2,4	8.5E-05	3.7E-04
Dichloroethane, 1,2-	Y	Y	Y	2.9E-05	lb/MMBtu	2,3	1.3E-04	5.7E-04
Dichloropropane, 1,2-	Y	N	Y	3.3E-05	lb/MMBtu	2,3	1.5E-04	6.5E-04
Dinitrophenol, 2,4-	Y	N	Y	1.8E-07	lb/MMBtu	2,3	8.1E-07	3.5E-06
Di(2-ethylhexyl)phthalate	Y	Y	Y	4.7E-08	lb/MMBtu	2,3	2.1E-07	9.3E-07
Ethyl benzene	Y	N	Y	3.1E-05	lb/MMBtu	2,3	1.4E-04	6.1E-04
Hexachlorodibenzo-p-dioxin, 1,2,3,6,7,8-	N	Y	Y	1.8E-11	lb/MMBtu	2,3	8.1E-11	3.5E-10
Hydrochloric acid	Y	Y	N	1.9E-02	lb/MMBtu	2,6	3.4E-01	1.5E+00
Lead	Y	N	N	4.8E-05	lb/MMBtu	2,4	6.3E-04	2.7E-03
Manganese	Y	Y	N	1.6E-03	lb/MMBtu	2,4	2.1E-02	9.1E-02
Mercury	Y	Y	N	3.5E-06	lb/MMBtu	2,4	4.6E-05	2.0E-04
Methyl bromide	Y	N	Y	1.5E-05	lb/MMBtu	2,3	6.8E-05	3.0E-04
Methyl chloride	Y	N	Y	2.3E-05	lb/MMBtu	2,3	1.0E-04	4.5E-04
Methyl ethyl ketone	N	Y	Y	5.4E-06	lb/MMBtu	2,3	2.4E-05	1.1E-04
Methylene chloride	Y	Y	Y	2.9E-04	lb/MMBtu	2,3	1.3E-03	5.7E-03
Naphthalene	Y	N	Y	9.7E-05	lb/MMBtu	2,3	4.4E-04	1.9E-03
Nickel	Y	Y	N	3.3E-05	lb/MMBtu	2,4	4.3E-04	1.9E-03
Nitrophenol, 4-	Y	N	Y	1.1E-07	lb/MMBtu	2,3	5.0E-07	2.2E-06
Pentachlorophenol	Y	Y	N	5.1E-08	lb/MMBtu	2	2.3E-07	1.0E-06
Perchloroethylene	Y	Y	N	3.8E-05	lb/MMBtu	2	1.7E-04	7.5E-04
Phosphorus metal, yellow or white	Y	N	N	2.7E-05	lb/MMBtu	2,4	3.5E-04	1.5E-03
Polychlorinated biphenyls	Y	Y	Y	8.2E-09	lb/MMBtu	2,3	3.7E-08	1.6E-07
Polycyclic Organic Matter	Y	N	N	1.3E-04	lb/MMBtu	2	5.6E-04	2.5E-03
Selenium compounds	Y	N	N	2.8E-06	lb/MMBtu	2,4	3.7E-05	1.6E-04
Styrene	Y	Y	Y	1.9E-03	lb/MMBtu	2,3	8.6E-03	3.7E-02
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	Y	Y	8.6E-12	lb/MMBtu	2,3	3.9E-11	1.7E-10
Toluene	Y	Y	Y	3.0E-05	lb/MMBtu	2,3	1.4E-04	5.9E-04
Trichloroethane, 1,1,1-	Y	Y	N	3.1E-05	lb/MMBtu	2	1.4E-04	6.1E-04
Trichloroethylene	Y	Y	Y	3.0E-05	lb/MMBtu	2,3	1.4E-04	5.9E-04
Trichlorofluoromethane	N	Y	Y	4.1E-05	lb/MMBtu	2,3	1.8E-04	8.1E-04
Trichlorophenol, 2,4,6-	Y	N	Y	2.2E-08	lb/MMBtu	2,3	9.9E-08	4.3E-07
Vinyl chloride	Y	Y	Y	1.8E-05	lb/MMBtu	2,3	8.1E-05	3.5E-04
Xylene	Y	Y	Y	2.5E-05	lb/MMBtu	2,3	1.1E-04	4.9E-04
Total HAP Emissions (related to biomass)							**1.82**	**8.44**
Total TAP Emissions (related to biomass)							**1.52**	**7.03**

Table 4b
Potential HAP and TAP Emissions
Dryer #2 (ES-DRYER-2, CD-WESP-2, CD-RTO-2)
Enviva Pellets Northampton, LLC

Pollutant	HAP	NC TAP	VOC	Emission Factor	Units	Footnote	Potential Emissions	
							Max (lb/hr)	Annual (tpy)
RTO - Natural Gas/Propane Source								
2-Methylnaphthalene	Y	N	Y	2.4E-05	lb/MMscf	7	7.5E-07	3.3E-06
3-Methylchloranthrene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
7,12-Dimethylbenz(a)anthracene	Y	N	Y	1.6E-05	lb/MMscf	7	5.0E-07	2.2E-06
Acenaphthene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Acenaphthylene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Acetaldehyde	Y	Y	Y	1.5E-05	lb/MMscf	7	4.8E-07	2.1E-06
Acrolein	Y	Y	Y	1.8E-05	lb/MMscf	7	5.6E-07	2.5E-06
Ammonia	N	Y	N	3.2	lb/MMscf	7	1.0E-01	4.4E-01
Anthracene	Y	N	Y	2.4E-06	lb/MMscf	7	7.5E-08	3.3E-07
Arsenic	Y	Y	N	2.0E-04	lb/MMscf	7	6.3E-06	2.7E-05
Benz(a)anthracene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Benzene	Y	N	Y	7.1E-04	lb/MMBtu	8	2.3E-02	1.0E-01
Benzo(a)pyrene	Y	Y	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.6E-07
Benzo(b)fluoranthene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Benzo(g,h,i)perylene	Y	N	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.6E-07
Benzo(k)fluoranthene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Beryllium	Y	Y	N	1.2E-05	lb/MMscf	7	3.8E-07	1.6E-06
Cadmium	Y	Y	N	1.1E-03	lb/MMscf	7	3.5E-05	1.5E-04
Chromium VI	Y	N	N	1.4E-03	lb/MMscf	7	4.4E-05	1.9E-04
Chrysene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Cobalt	Y	N	N	8.4E-05	lb/MMscf	7	2.6E-06	1.2E-05
Dibenzo(a,h)anthracene	Y	N	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.6E-07
Dichlorobenzene	Y	Y	Y	1.2E-03	lb/MMscf	7	3.8E-05	1.6E-04
Fluoranthene	Y	N	Y	3.0E-06	lb/MMscf	7	9.4E-08	4.1E-07
Fluorene	Y	N	Y	2.8E-06	lb/MMscf	7	8.8E-08	3.8E-07
Formaldehyde	Y	Y	Y	1.5E-03	lb/MMBtu	8	4.8E-02	2.1E-01
Hexane	Y	Y	Y	1.8	lb/MMscf	7	5.6E-02	2.5E-01
Indeno(1,2,3-cd)pyrene	Y	N	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Lead	Y	N	N	5.0E-04	lb/MMscf	7	1.6E-05	6.9E-05
Manganese	Y	Y	N	3.8E-04	lb/MMscf	7	1.2E-05	5.2E-05
Mercury	Y	Y	N	2.6E-04	lb/MMscf	7	8.2E-06	3.6E-05
Naphthalene	Y	N	Y	6.1E-04	lb/MMscf	7	1.9E-05	8.4E-05
Nickel	Y	Y	N	2.1E-03	lb/MMscf	7	6.6E-05	2.9E-04
Polycyclic Organic Matter	Y	N	N	4.0E-05	lb/MMBtu	8	1.3E-03	5.6E-03
Phenanthrene	Y	N	Y	1.7E-05	lb/MMscf	7	5.3E-07	2.3E-06
Pyrene	Y	N	Y	5.0E-06	lb/MMscf	7	1.6E-07	6.9E-07
Selenium compounds	Y	N	N	2.4E-05	lb/MMscf	7	7.5E-07	3.3E-06
Toluene	Y	Y	Y	3.4E-03	lb/MMscf	7	1.1E-04	4.7E-04
Total HAP Emissions (related to natural gas/propane)							**0.13**	**0.56**
Total TAP Emissions (related to natural gas/propane)							**0.21**	**0.46**

Notes:

1. Emission factor derived based on stack testing data from comparable Enviva facilities and/or engineering judgement and include contingency. The emission factors represent uncontrolled emissions.
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. The control efficiency of 97.5% for the RTO is applied to all VOC hazardous and toxic pollutants
4. The control efficiency of the wet electrostatic precipitator (WESP) for filterable particulate matter is applied to all metal hazardous and toxic pollutants from the dryer and duct burners. Actual design filterable efficiency is estimated to 96.4%, but 92.75% is assumed for toxics permitting.
   WESP Control Efficiency for metal HAP 92.8%
5. Chromium VI is a subset of chromium 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.
   WESP HCl Control Efficiency 90.00%
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. The emission factors for acetaldehyde, acrolein, and ammonia are cited in the NCDAQ spreadsheet as being sourced from the USEPA's WebFIRE database.
8. The RTO 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.
9. It was assumed that chlorine is not oxidized in the RTO.
10. Annual dried wood throughput is based on total facility production. Although dryer line 1 and dryer line 2 are capable of processing up to 537,625 ODT/yr and 620,000 ODT/yr, respectively, the combined throughput of both dryers will not exceed 781,255 ODT/yr. In order to to provide Enviva with the flexibility to use either dryer line up to its individual capacity, the total emissions from the two dryer lines are based on the total facility throughput and calculated as follows:
    - Where individual dryer emissions are calculated based on throughput (i.e. lb/ODT), the total emissions are estimated based on the total throughput of 781,255 ODT/yr.
    - Where individual dryer emissions are calculated based on fuel use (i.e. lb/MMBtu or lb/MMscf), the total emissions are conservatively set equal to the sum of the emissions from the two dryer lines assuming both dryer lines operate 8,760 hrs/yr.

Table 4b
Potential HAP and TAP Emissions
Dryer #2 (ES-DRYER-2, CD-WESP-2, CD-RTO-2)
Enviva Pellets Northampton, LLC

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

Table 4c
Potential Emissions
Dryer #2 Bypass (ES-DRYERBYP-2) (Full Capacity)[1]
Enviva Pellets Northampton, LLC

Calculation Basis

Hourly Throughput	82.10 ODT/hr
Hourly Heat Input Capacity	180 MMBtu/hr
Annual Heat Input Capacity	9,000 MMBtu/yr
Hours of Operation[1]	50 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions per Dryer Line

Pollutant	Emission Factor	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	21.4	lb/hr[2]	21.4	0.54
NO_X	26.3	lb/hr[2]	26.3	0.66
SO_2	0.025	lb/MMBtu[3]	4.50	0.113
VOC	14.0	lb/hr[2]	14.0	0.35
$PM/PM_{10}/PM_{2.5}$ Condensable	0.017	lb/MMBtu[4]	3.06	0.077
$PM/PM_{10}/PM_{2.5}$ Filterable	0.33	lb/MMBtu[5]	59.4	1.49
Total $PM/PM_{10}/PM_{2.5}$			62.5	1.56

Notes:

1. During startup and shutdown (for temperature control) or malfunction, excess emissions can be vented out either the dryer bypass stacks or the furnace bypass stacks. Use of the bypass stacks is limited to 2 hours in any 24-hour period and 50 hours per 12-month rolling period for each dryer line. As the feed to the dryer is typically stopped during shutdown and malfunction events, the hourly throughput is equal to the annual average of the dryer feed rate.
2. CO, NO_X, and VOC emission rates based on data from a comparable Enviva facility.
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 condensable PM based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03.
5. Uncontrolled filterable PM emission factor is based on testing at a comparable Enviva facility.

Table 4c
Potential Emissions
Dryer #2 Bypass (ES-DRYERBYP-2) (Full Capacity)[1]
Enviva Pellets Northampton, LLC

Potential HAP Emissions per Dryer Line

Pollutant	Emission Factor	Units	Footnote	Potential Emissions[1]	
				Max (lb/hr)	Annual (tpy)
Acetaldehyde	0.168	lb/ODT	2	13.8	0.35
Acrolein	0.110	lb/ODT	2	9.03	0.23
Formaldehyde	0.144	lb/ODT	2	11.78	0.29
Methanol	0.105	lb/ODT	2	8.61	0.22
Phenol	0.058	lb/ODT	2	4.73	0.12
Propionaldehyde	0.039	lb/ODT	2	3.16	0.079
Acetophenone	3.2E-09	lb/MMBtu	3	5.76E-07	1.44E-08
Antimony and compounds	7.9E-06	lb/MMBtu	3	1.42E-03	3.56E-05
Arsenic	2.2E-05	lb/MMBtu	3	3.96E-03	9.90E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	3	4.68E-04	1.17E-05
Beryllium	1.1E-06	lb/MMBtu	3	1.98E-04	4.95E-06
Cadmium	4.1E-06	lb/MMBtu	3	7.38E-04	1.85E-05
Carbon tetrachloride	4.5E-05	lb/MMBtu	3	8.10E-03	2.03E-04
Chlorine	7.9E-04	lb/MMBtu	3	1.42E-01	3.56E-03
Chlorobenzene	3.3E-05	lb/MMBtu	3	5.94E-03	1.49E-04
Chromium-Other compounds	1.8E-05	lb/MMBtu	3	3.15E-03	7.88E-05
Cobalt compounds	6.5E-06	lb/MMBtu	3	1.17E-03	2.93E-05
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	3	3.24E-05	8.10E-07
Di(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	3	8.46E-06	2.12E-07
Ethyl benzene	3.1E-05	lb/MMBtu	3	5.58E-03	1.40E-04
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	3	5.22E-03	1.31E-04
Hydrochloric acid	1.9E-02	lb/MMBtu	3	3.42E+00	8.55E-02
Lead	4.8E-05	lb/MMBtu	3	8.64E-03	2.16E-04
Manganese	1.6E-03	lb/MMBtu	3	2.88E-01	7.20E-03
Mercury	3.5E-06	lb/MMBtu	3	6.30E-04	1.58E-05
Methyl bromide	1.5E-05	lb/MMBtu	3	2.70E-03	6.75E-05
Methyl chloride	2.3E-05	lb/MMBtu	3	4.14E-03	1.04E-04
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	3	5.58E-03	1.40E-04
Naphthalene	9.7E-05	lb/MMBtu	3	1.75E-02	4.37E-04
Nickel	3.3E-05	lb/MMBtu	3	5.94E-03	1.49E-04
Nitrophenol, 4-	1.1E-07	lb/MMBtu	3	1.98E-05	4.95E-07
Pentachlorophenol	5.1E-08	lb/MMBtu	3	9.18E-06	2.30E-07
Perchloroethylene	3.8E-05	lb/MMBtu	3	6.84E-03	1.71E-04
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	3	4.86E-03	1.22E-04
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	3	1.47E-06	3.67E-08
Polycyclic Organic Matter	1.3E-04	lb/MMBtu	3	2.25E-02	5.63E-04
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	3	5.94E-03	1.49E-04
Selenium compounds	2.8E-06	lb/MMBtu	3	5.04E-04	1.26E-05
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	3	1.55E-09	3.87E-11
Trichloroethylene	3.0E-05	lb/MMBtu	3	5.40E-03	1.35E-04
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	3	3.96E-06	9.90E-08
Vinyl chloride	1.8E-05	lb/MMBtu	3	3.24E-03	8.10E-05
			Total HAP Emissions	**55.12**	**1.38**

Notes:

1. During dryer bypass emissions are not controlled by the WESP and RTO; however, combustion in the furnace still results in a reduction in organic HAP emission rates.
2. Organic HAP emissions rates were derived based on stack testing data from other similar Enviva plants and/or engineering judgement.
3. 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
kg - kilogram
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
RTO - regenerative thermal oxidizer
SO_2 - sulfur dioxide
tpy - tons per year
VOC - volatile organic compound
WESP - wet electrostatic precipitator
yr - year

Reference:

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

Table 4d
Potential Emissions
Dryer #2 Furnace Bypass (ES-FURNACEBYP-2) (Full Capacity)[1]
Enviva Pellets Northampton, LLC

Calculation Basis

Hourly Heat Input Capacity	180 MMBtu/hr
Annual Heat Input Capacity	9,000 MMBtu/yr
Hours of Operation[1]	50 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions per Dryer Line

Pollutant	Emission Factor	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	0.60	lb/MMBtu[2]	108.0	2.70
NO_X	0.22	lb/MMBtu[2]	39.60	0.99
SO_2	0.025	lb/MMBtu[2]	4.50	0.113
VOC	0.017	lb/MMBtu[2]	3.06	0.077
Total PM/PM_{10}/$PM_{2.5}$	0.58	lb/MMBtu[2]	103.9	2.60

Notes:

1. During startup and shutdown (for temperature control) or malfunction, excess emissions can be vented out either the dryer bypass stacks or the furnace bypass stacks. Use of the bypass stacks is limited to 2 hours in any 24-hour period and 50 hours per 12-month rolling period for each dryer line.
2. CO, NO_X, SO_2, PM, and VOC emission rates based on 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 4d
Potential Emissions
Dryer #2 Furnace Bypass (ES-FURNACEBYP-2) (Full Capacity)[1]
Enviva Pellets Northampton, LLC

Potential HAP Emissions per Dryer Line

Pollutant	Emission Factor	Units	Footnote	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
Acetaldehyde	8.30E-04	lb/MMBtu	1	1.49E-01	3.74E-03
Acrolein	4.00E-03	lb/MMBtu	1	7.20E-01	1.80E-02
Formaldehyde	4.40E-03	lb/MMBtu	1	7.92E-01	1.98E-02
Phenol	5.10E-05	lb/MMBtu	1	9.18E-03	2.30E-04
Propionaldehyde	6.10E-05	lb/MMBtu	1	1.10E-02	2.75E-04
Acetophenone	3.2E-09	lb/MMBtu	1	5.76E-07	1.44E-08
Antimony and compounds	7.9E-06	lb/MMBtu	1	1.42E-03	3.56E-05
Arsenic	2.2E-05	lb/MMBtu	1	3.96E-03	9.90E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	1	4.68E-04	1.17E-05
Beryllium	1.1E-06	lb/MMBtu	1	1.98E-04	4.95E-06
Cadmium	4.1E-06	lb/MMBtu	1	7.38E-04	1.85E-05
Carbon tetrachloride	4.5E-05	lb/MMBtu	1	8.10E-03	2.03E-04
Chlorine	7.9E-04	lb/MMBtu	1	1.42E-01	3.56E-03
Chlorobenzene	3.3E-05	lb/MMBtu	1	5.94E-03	1.49E-04
Chromium–Other compounds	2.1E-05	lb/MMBtu	1	3.78E-03	9.45E-05
Cobalt compounds	6.5E-06	lb/MMBtu	1	1.17E-03	2.93E-05
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	1	3.24E-05	8.10E-07
Di(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	1	8.46E-06	2.12E-07
Ethyl benzene	3.1E-05	lb/MMBtu	1	5.58E-03	1.40E-04
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	1	5.22E-03	1.31E-04
Hydrochloric acid	1.9E-02	lb/MMBtu	1	3.42E+00	8.55E-02
Lead	4.8E-05	lb/MMBtu	1	8.64E-03	2.16E-04
Manganese	1.6E-03	lb/MMBtu	1	2.88E-01	7.20E-03
Mercury	3.5E-06	lb/MMBtu	1	6.30E-04	1.58E-05
Methyl bromide	1.5E-05	lb/MMBtu	1	2.70E-03	6.75E-05
Methyl chloride	2.3E-05	lb/MMBtu	1	4.14E-03	1.04E-04
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	1	5.58E-03	1.40E-04
Naphthalene	9.7E-05	lb/MMBtu	1	1.75E-02	4.37E-04
Nickel	3.3E-05	lb/MMBtu	1	5.94E-03	1.49E-04
Nitrophenol, 4-	1.1E-07	lb/MMBtu	1	1.98E-05	4.95E-07
Pentachlorophenol	5.1E-08	lb/MMBtu	1	9.18E-06	2.30E-07
Perchloroethylene	3.8E-05	lb/MMBtu	1	6.84E-03	1.71E-04
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	1	4.86E-03	1.22E-04
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	1	1.47E-06	3.67E-08
Polycyclic Organic Matter	1.3E-04	lb/MMBtu	1	2.25E-02	5.63E-04
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	1	5.94E-03	1.49E-04
Selenium compounds	2.8E-06	lb/MMBtu	1	5.04E-04	1.26E-05
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	1	1.55E-09	3.87E-11
Trichloroethylene	3.0E-05	lb/MMBtu	1	5.40E-03	1.35E-04
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	1	3.96E-06	9.90E-08
Vinyl chloride	1.8E-05	lb/MMBtu	1	3.24E-03	8.10E-05
Total HAP Emissions (Biomass Combustion)				**5.66**	**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
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:
AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03

Table 4e
Potential Emissions
Dryer #2 Furnace Bypass (ES-FURNACEBYP-2) (Idle Mode)[1]
Enviva Pellets Northampton, LLC

Calculation Basis

Hourly Heat Input Capacity	5 MMBtu/hr
Annual Heat Input Capacity	2,500 MMBtu/yr
Hours of Operation[1]	500 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions per Dryer Line

Pollutant	Emission Factor	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	0.60	lb/MMBtu[2]	3.00	0.75
NO_X	0.22	lb/MMBtu[2]	1.10	0.28
SO_2	0.025	lb/MMBtu[2]	0.13	0.031
VOC	0.017	lb/MMBtu[2]	0.085	0.021
Total PM	0.58	lb/MMBtu[2]	2.89	0.72
Total PM_{10}	0.52	lb/MMBtu[2]	2.59	0.65
Total $PM_{2.5}$	0.45	lb/MMBtu[2]	2.24	0.56

Notes:

1. As part of this submittal Enviva is requesting a limit of 500 hours per year of "idle mode" for each furnace.
2. CO, NO_X, SO_2, PM_{10}, $PM_{2.5}$, and VOC emission rates based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. PM_{10} and $PM_{2.5}$ factors equal to the sum of the filterable and condensible factors from Table 1.6-1. VOC emission factor excludes formaldehyde.

Table 4e
Potential Emissions
Dryer #2 Furnace Bypass (ES-FURNACEBYP-2) (Idle Mode)[1]
Enviva Pellets Northampton, LLC

Potential HAP Emissions per Dryer Line

Pollutant	Emission Factor	Units	Footnote	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
Acetaldehyde	8.30E-04	lb/MMBtu	1	4.15E-03	1.04E-03
Acrolein	4.00E-03	lb/MMBtu	1	2.00E-02	5.00E-03
Formaldehyde	4.40E-03	lb/MMBtu	1	2.20E-02	5.50E-03
Phenol	5.10E-05	lb/MMBtu	1	2.55E-04	6.38E-05
Propionaldehyde	6.10E-05	lb/MMBtu	1	3.05E-04	7.63E-05
Acetophenone	3.2E-09	lb/MMBtu	1	1.60E-08	4.00E-09
Antimony and compounds	7.9E-06	lb/MMBtu	1	3.95E-05	9.88E-06
Arsenic	2.2E-05	lb/MMBtu	1	1.10E-04	2.75E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	1	1.30E-05	3.25E-06
Beryllium	1.1E-06	lb/MMBtu	1	5.50E-06	1.38E-06
Cadmium	4.1E-06	lb/MMBtu	1	2.05E-05	5.13E-06
Carbon tetrachloride	4.5E-05	lb/MMBtu	1	2.25E-04	5.63E-05
Chlorine	7.9E-04	lb/MMBtu	1	3.95E-03	9.88E-04
Chlorobenzene	3.3E-05	lb/MMBtu	1	1.65E-04	4.13E-05
Chromium–Other compounds	2.1E-05	lb/MMBtu	1	1.05E-04	2.63E-05
Cobalt compounds	6.5E-06	lb/MMBtu	1	3.25E-05	8.13E-06
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	1	9.00E-07	2.25E-07
Di(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	1	2.35E-07	5.88E-08
Ethyl benzene	3.1E-05	lb/MMBtu	1	1.55E-04	3.88E-05
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	1	1.45E-04	3.63E-05
Hydrochloric acid	1.9E-02	lb/MMBtu	1	9.50E-02	2.38E-02
Lead	4.8E-05	lb/MMBtu	1	2.40E-04	6.00E-05
Manganese	1.6E-03	lb/MMBtu	1	8.00E-03	2.00E-03
Mercury	3.5E-06	lb/MMBtu	1	1.75E-05	4.38E-06
Methyl bromide	1.5E-05	lb/MMBtu	1	7.50E-05	1.88E-05
Methyl chloride	2.3E-05	lb/MMBtu	1	1.15E-04	2.88E-05
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	1	1.55E-04	3.88E-05
Naphthalene	9.7E-05	lb/MMBtu	1	4.85E-04	1.21E-04
Nickel	3.3E-05	lb/MMBtu	1	1.65E-04	4.13E-05
Nitrophenol, 4-	1.1E-07	lb/MMBtu	1	5.50E-07	1.38E-07
Pentachlorophenol	5.1E-08	lb/MMBtu	1	2.55E-07	6.38E-08
Perchloroethylene	3.8E-05	lb/MMBtu	1	1.90E-04	4.75E-05
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	1	1.35E-04	3.38E-05
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	1	4.08E-08	1.02E-08
Polycyclic Organic Matter	1.3E-04	lb/MMBtu	1	6.25E-04	1.56E-04
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	1	1.65E-04	4.13E-05
Selenium compounds	2.8E-06	lb/MMBtu	1	1.40E-05	3.50E-06
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	1	4.30E-11	1.08E-11
Trichloroethylene	3.0E-05	lb/MMBtu	1	1.50E-04	3.75E-05
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	1	1.10E-07	2.75E-08
Vinyl chloride	1.8E-05	lb/MMBtu	1	9.00E-05	2.25E-05
Total HAP Emissions (Biomass Combustion)				**0.16**	**0.039**

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
kg - kilogram
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
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:

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

Table 4f
Potential Emissions
Dryer #2 Double Duct Burners (IES-DDB-3 and -4)
Enviva Pellets Northampton, LLC

Duct Burner Inputs

Duct Burner Rating	1	MMBtu/hr
Number of Duct Burners	2	
Annual Operation	8,760	hr/yr

Potential Criteria Pollutant Emissions:

Potential Criteria Pollutant Emissions - Natural Gas Combustion

Pollutant	Emission Factor	Units	Emission Factor Source	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
CO	84.0	lb/MMscf	Note 1	0.16	0.72
NO_x	50.0	lb/MMscf	Note 2	0.10	0.43
SO_2	0.60	lb/MMscf	Note 1	0.0012	0.005
VOC	5.50	lb/MMscf	Note 1	0.01	0.05
$PM/PM_{10}/PM_{2.5}$ Condensable	5.70	lb/MMscf	Note 1	0.01	0.05
$PM/PM_{10}/PM_{2.5}$ Filterable	1.90	lb/MMscf	Note 1	0.004	0.02
Total $PM/PM_{10}/PM_{2.5}$				0.015	0.065

Potential Criteria Pollutant Emissions - Propane Combustion

Pollutant	Emission Factor	Units	Emission Factor Source	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
CO	7.50	lb/Mgal	Note 3	0.16	0.72
NO_x	6.50	lb/Mgal	Note 4	0.14	0.62
SO_2	0.054	lb/Mgal	Note 3,5	0.001	0.005
VOC	1.00	lb/Mgal	Note 3	0.02	0.10
$PM/PM_{10}/PM_{2.5}$ Condensable	0.50	lb/Mgal	Note 3	0.01	0.05
$PM/PM_{10}/PM_{2.5}$ Filterable	0.20	lb/Mgal	Note 3	0.004	0.02
Total $PM/PM_{10}/PM_{2.5}$				0.015	0.067

Notes:

1. 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.
2. Emission factors for NO_x assume burners are low NO_x burners, per email from Kai Simonsen (Enviva) on August 8, 2018.
3. 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.
4. 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.
5. 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 4f
Potential Emissions
Dryer #2 Double Duct Burners (IES-DDB-3 and -4)
Enviva Pellets Northampton, LLC

Potential HAP and TAP Emissions

Pollutant	HAP	NC TAP	VOC	Emission Factor	Units	Footnote	Potential Emissions Max (lb/hr)	Potential Emissions Annual (tpy)
Duct Burners - Natural Gas/Propane Source								
2-Methylnaphthalene	Y	N	Y	2.4E-05	lb/MMscf	1	4.7E-08	2.1E-07
3-Methylchloranthrene	Y	N	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
7,12-Dimethylbenz(a)anthracene	Y	N	Y	1.6E-05	lb/MMscf	1	3.1E-08	1.4E-07
Acenaphthene	Y	N	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Acenaphthylene	Y	N	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Acetaldehyde	Y	Y	Y	1.5E-05	lb/MMscf	1	3.0E-08	1.3E-07
Acrolein	Y	Y	Y	1.8E-05	lb/MMscf	1	3.5E-08	1.5E-07
Ammonia	N	Y	N	3.2	lb/MMscf	1	6.3E-03	2.7E-02
Anthracene	Y	N	Y	2.4E-06	lb/MMscf	1	4.7E-09	2.1E-08
Arsenic	Y	Y	N	2.0E-04	lb/MMscf	1	3.9E-07	1.7E-06
Benz(a)anthracene	Y	N	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Benzene	Y	N	Y	7.1E-04	lb/MMBtu	2	1.4E-03	6.2E-03
Benzo(a)pyrene	Y	Y	Y	1.2E-06	lb/MMscf	1	2.4E-09	1.0E-08
Benzo(b)fluoranthene	Y	N	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Benzo(g,h,i)perylene	Y	N	Y	1.2E-06	lb/MMscf	1	2.4E-09	1.0E-08
Benzo(k)fluoranthene	Y	N	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Beryllium	Y	Y	N	1.2E-05	lb/MMscf	1	2.4E-08	1.0E-07
Cadmium	Y	Y	N	1.1E-03	lb/MMscf	1	2.2E-06	9.4E-06
Chromium VI	Y	N	N	1.4E-03	lb/MMscf	1	2.7E-06	1.2E-05
Chrysene	Y	N	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Cobalt	Y	N	N	8.4E-05	lb/MMscf	1	1.6E-07	7.2E-07
Dibenzo(a,h)anthracene	Y	N	Y	1.2E-06	lb/MMscf	1	2.4E-09	1.0E-08
Dichlorobenzene	Y	Y	Y	1.2E-03	lb/MMscf	1	2.4E-06	1.0E-05
Fluoranthene	Y	N	Y	3.0E-06	lb/MMscf	1	5.9E-09	2.6E-08
Fluorene	Y	N	Y	2.8E-06	lb/MMscf	1	5.5E-09	2.4E-08
Formaldehyde	Y	Y	Y	1.5E-03	lb/MMBtu	2	3.0E-03	1.3E-02
Hexane	Y	Y	Y	1.8	lb/MMscf	1	3.5E-03	1.5E-02
Indeno(1,2,3-cd)pyrene	Y	N	Y	1.8E-06	lb/MMscf	1	3.5E-09	1.5E-08
Lead	Y	N	N	5.0E-04	lb/MMscf	1	9.8E-07	4.3E-06
Manganese	Y	Y	N	3.8E-04	lb/MMscf	1	7.5E-07	3.3E-06
Mercury	Y	Y	N	2.6E-04	lb/MMscf	1	5.1E-07	2.2E-06
Naphthalene	Y	N	Y	6.1E-04	lb/MMscf	1	1.2E-06	5.2E-06
Nickel	Y	Y	N	2.1E-03	lb/MMscf	1	4.1E-06	1.8E-05
Polycyclic Organic Matter	Y	N	N	4.0E-05	lb/MMBtu	8	8.0E-05	3.5E-04
Phenanthrene	Y	N	Y	1.7E-05	lb/MMscf	1	3.3E-08	1.5E-07
Pyrene	Y	N	Y	5.0E-06	lb/MMscf	1	9.8E-09	4.3E-08
Selenium compounds	Y	N	N	2.4E-05	lb/MMscf	1	4.7E-08	2.1E-07
Toluene	Y	Y	Y	3.4E-03	lb/MMscf	1	6.7E-06	2.9E-05
Total HAP Emissions (related to natural gas/propane)							**0.008**	**0.035**
Total TAP Emissions (related to natural gas/propane)							**0.01**	**0.056**

Table 4f
Potential Emissions
Dryer #2 Double Duct Burners (IES-DDB-3 and -4)
Enviva Pellets Northampton, LLC

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:

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

Table 4g
Potential Emissions
Dryer #2 Furnace Bypass (ES-FURNACEBYP-2) (Cold Startup)
Enviva Pellets Northampton, LLC

Calculation Basis

Hourly Heat Input Capacity[1]	27.0 MMBtu/hr
Annual Heat Input Capacity	1,350 MMBtu/yr
Hours of Operation[2]	50 hr/yr

Potential Criteria Pollutant and Greenhouse Gas Emissions per Dryer Line

Pollutant	Emission Factor	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	0.60	lb/MMBtu[3]	16.20	0.41
NO_X	0.22	lb/MMBtu[3]	5.94	0.15
SO_2	0.025	lb/MMBtu[3]	0.68	0.017
VOC	0.017	lb/MMBtu[3]	0.459	0.011
Total PM	0.58	lb/MMBtu[3]	15.58	0.39
Total PM_{10}	0.52	lb/MMBtu[3]	13.96	0.35
Total $PM_{2.5}$	0.45	lb/MMBtu[3]	12.07	0.30

Notes:

1. The hourly heat input for cold startup is estimated as follows (Hours 1-2, 6.75 MMBtu/hr; Hours 3-4, 13.5 MmBtu/hr; Hours 5-6, 20.25 MMBtu/hr; and Hours 7-8, 27 MMBtu/hr). Emissions are conservatively based on the heat input rate of 27 MMBtu/hr.
2. Estimated annual hours for cold startup.
3. CO, NO_X, SO_2, PM_{10}, $PM_{2.5}$, and VOC emission rates based on AP-42, Section 1.6 - Wood Residue Combustion in Boilers, 09/03 for bark/bark and wet wood/wet wood-fired boilers. PM_{10} and $PM_{2.5}$ factors equal to the sum of the filterable and condensible factors from Table 1.6-1. VOC emission factor excludes formaldehyde.

Table 4g
Potential Emissions
Dryer #2 Furnace Bypass (ES-FURNACEBYP-2) (Cold Startup)
Enviva Pellets Northampton, LLC

Potential HAP Emissions per Dryer Line

Pollutant	Emission Factor	Units	Footnote	Potential Emissions	
				Max (lb/hr)	Annual (tpy)
Acetaldehyde	8.30E-04	lb/MMBtu	1	2.24E-02	5.60E-04
Acrolein	4.00E-03	lb/MMBtu	1	1.08E-01	2.70E-03
Formaldehyde	4.40E-03	lb/MMBtu	1	1.19E-01	2.97E-03
Phenol	5.10E-05	lb/MMBtu	1	1.38E-03	3.44E-05
Propionaldehyde	6.10E-05	lb/MMBtu	1	1.65E-03	4.12E-05
Acetophenone	3.2E-09	lb/MMBtu	1	8.64E-08	2.16E-09
Antimony and compounds	7.9E-06	lb/MMBtu	1	2.13E-04	5.33E-06
Arsenic	2.2E-05	lb/MMBtu	1	5.94E-04	1.49E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	1	7.02E-05	1.76E-06
Beryllium	1.1E-06	lb/MMBtu	1	2.97E-05	7.43E-07
Cadmium	4.1E-06	lb/MMBtu	1	1.11E-04	2.77E-06
Carbon tetrachloride	4.5E-05	lb/MMBtu	1	1.22E-03	3.04E-05
Chlorine	7.9E-04	lb/MMBtu	1	2.13E-02	5.33E-04
Chlorobenzene	3.3E-05	lb/MMBtu	1	8.91E-04	2.23E-05
Chromium–Other compounds	2.1E-05	lb/MMBtu	1	5.67E-04	1.42E-05
Cobalt compounds	6.5E-06	lb/MMBtu	1	1.76E-04	4.39E-06
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	1	4.86E-06	1.22E-07
Di(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	1	1.27E-06	3.17E-08
Ethyl benzene	3.1E-05	lb/MMBtu	1	8.37E-04	2.09E-05
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	1	7.83E-04	1.96E-05
Hydrochloric acid	1.9E-02	lb/MMBtu	1	5.13E-01	1.28E-02
Lead	4.8E-05	lb/MMBtu	1	1.30E-03	3.24E-05
Manganese	1.6E-03	lb/MMBtu	1	4.32E-02	1.08E-03
Mercury	3.5E-06	lb/MMBtu	1	9.45E-05	2.36E-06
Methyl bromide	1.5E-05	lb/MMBtu	1	4.05E-04	1.01E-05
Methyl chloride	2.3E-05	lb/MMBtu	1	6.21E-04	1.55E-05
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	1	8.37E-04	2.09E-05
Naphthalene	9.7E-05	lb/MMBtu	1	2.62E-03	6.55E-05
Nickel	3.3E-05	lb/MMBtu	1	8.91E-04	2.23E-05
Nitrophenol, 4-	1.1E-07	lb/MMBtu	1	2.97E-06	7.43E-08
Pentachlorophenol	5.1E-08	lb/MMBtu	1	1.38E-06	3.44E-08
Perchloroethylene	3.8E-05	lb/MMBtu	1	1.03E-03	2.57E-05
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	1	7.29E-04	1.82E-05
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	1	2.20E-07	5.50E-09
Polycyclic Organic Matter	1.3E-04	lb/MMBtu	1	3.38E-03	8.44E-05
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	1	8.91E-04	2.23E-05
Selenium compounds	2.8E-06	lb/MMBtu	1	7.56E-05	1.89E-06
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	1	2.32E-10	5.81E-12
Trichloroethylene	3.0E-05	lb/MMBtu	1	8.10E-04	2.03E-05
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	1	5.94E-07	1.49E-08
Vinyl chloride	1.8E-05	lb/MMBtu	1	4.86E-04	1.22E-05
Total HAP Emissions (Biomass Combustion)				**0.85**	**0.021**

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
kg - kilogram
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
tpy - tons per year
VOC - volatile organic compound
yr - year

Reference:

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

Table 5
Potential Emissions
Propane Vaporizer (IES-PVAP)
Enviva Pellets Northampton, LLC

Calculation Basis

Heat Content[1]	91.5 MMBtu/10^3 gal propane
Hours of Operation	8,760 hr/yr
Vaporizer Heat Input[2]	1.00 MMBtu/hr

Notes:
1. Propane heat content from AP-42 Section 1.5 - Liquefied Petroleum Gas Production, 7/08, Table 1.5-1, footnote a.
2. Heat input based on information provided by Enviva in August 2018.

Potential Criteria Pollutant Emissions

Pollutant	Emission Factor [1]	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	7.5	lb/10^3 gal	0.08	0.36
NO_X	13.0	lb/10^3 gal	0.14	0.62
SO_2[2]	0.05	lb/10^3 gal	0.001	0.003
TOC	1.0	lb/10^3 gal	0.01	0.05
$PM/PM_{10}/PM_{2.5}$[3]	0.70	lb/10^3 gal	0.01	0.03

Notes:
1. Emission factors obtained from AP 42 1.5, Liquefied Petroleum Gas Production, 10/96, Table 1.5-1.
2. AP 42 1.5, Liquefied Petroleum Gas Production, 10/96, Table 1.5-1 provides an SO_2 emission factor of 0.10S, where S equals the sulfur content of the fuel. The national sulfur fuel content for LPG of 0.54 grains/100 ft^3 as assigned by EPA was used (Source: A National Methodology and Emission Inventory for Residential Fuel Combustion).
3. All particulate matter was conservatively assumed to be less than 2.5 microns in size.

Potential HAP Emissions

Pollutant	CAS No.	Emission Factor[1] (lb/MMBtu)	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
Benzene	71-43-2	7.1E-04	7.10E-04	3.11E-03
Formaldehyde	50-00-0	1.5E-03	1.50E-03	6.57E-03
PAHs		4.0E-05	4.0E-05	1.75E-04
		Total HAP Emissions	**0.002**	**0.010**

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
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
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
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.
AP-42 Chapter 3.3, Stationary Internal Combustion Engines, 10/96.

Table 6a
Potential Emissions at Outlet of RCO-1 Stack (CD-RCO-1)
Dry Hammermills (ES-HM-1 through ES-HM-8)
Enviva Pellets Northampton, LLC

Calculation Basis

Total Plant Throughput	781,255	ODT/yr
% of Total Throughput to the Hammermills	85%	
Hours of Operation	8760	hr/yr

Hammermills Annual Throughput	664,067	ODT/yr
Hammermills Hourly Throughput	144	ODT/hr
Number of Burners	2	burners
RCO/RTO Burner Rating	9.8	MMBtu/hr
Control Efficiency[1]	95.0%	

Potential VOC and HAP Emissions

Pollutant	CAS No.	HAP	NC TAP	VOC	Emission Factor[2] (lb/ODT)	Potential Emissions Max (lb/hr)	Potential Emissions Annual (tpy)
Acetaldehyde	75-07-0	Y	Y	Y	0.0073	0.05	0.12
Acrolein	107-02-8	Y	Y	Y	0.0092	0.07	0.15
Formaldehyde	50-00-0	Y	Y	Y	0.0071	0.05	0.12
Methanol	67-56-1	Y	N	Y	0.0071	0.05	0.12
Phenol	108-95-2	Y	Y	Y	0.0028	0.02	0.05
Propionaldehyde	123-38-6	Y	N	Y	0.0124	0.09	0.21
					Total HAP Emissions	**0.33**	**0.76**
					Total TAP Emissions	**0.19**	**0.44**
Total VOC (as propane)	--		--	Y	0.77	5.51	12.70

Notes:

1. Emission factors were derived based on stack testing data from comparable Enviva facilities and/or engineering judgement and include contingency. The emission factors represent uncontrolled emissions.
2. A 95.0% control efficiency is applied to the potential emissions for the RCO.

Emissions from the pellet mills and pellet coolers will be controlled by an RCO 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 when operating in thermal mode.

Thermal Generated Potential Criteria Pollutant Emissions

Maximum high heating value of VOC constituents	1.8E-02	MMBtu/lb
Uncontrolled VOC emissions	254	tons/yr
Uncontrolled VOC emissions	110	lb/hr
Heat input of uncontrolled VOC emissions	9,396	MMBtu/yr
Heat input of uncontrolled VOC emissions	2	MMBtu/hr

Pollutant	Emission Factor[1]	Units	Potential Emissions Max (lb/hr)	Potential Emissions Annual (tpy)
CO	8.2E-02	lb/MMBtu	0.17	0.39
NO_X	9.8E-02	lb/MMBtu	0.20	0.46

Table 6a
Potential Emissions at Outlet of RCO-1 Stack (CD-RCO-1)
Dry Hammermills (ES-HM-1 through ES-HM-8)
Enviva Pellets Northampton, LLC

Natural Gas Combustion Potential Criteria Pollutant Emissions

Pollutant	Emission Factor[1]	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	8.2E-02	lb/MMBtu	1.61	7.07
NO_x	3.25	lb/hr [3]	3.25	14.25
SO_2	5.9E-04	lb/MMBtu	0.01	0.05
VOC	5.4E-03	lb/MMBtu	0.11	0.46
Total PM	7.5E-03	lb/MMBtu	0.15	0.64
Total PM_{10}	7.5E-03	lb/MMBtu	0.15	0.64
Total $PM_{2.5}$	7.5E-03	lb/MMBtu	0.15	0.64

Potential Criteria Pollutant Emissions - Propane Combustion

Pollutant	Emission Factor[2]	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	7.50	lb/Mgal	1.61	7.04
NO_x	3.25	lb/hr [3]	3.25	14.25
SO_2	0.054	lb/Mgal	0.01	0.05
VOC	1.00	lb/Mgal	0.21	0.94
$PM/PM_{10}/PM_{2.5}$ Condensable	0.50	lb/Mgal	0.11	0.47
$PM/PM_{10}/PM_{2.5}$ Filterable	0.20	lb/Mgal	0.04	0.19
Total $PM/PM_{10}/PM_{2.5}$			0.15	0.66

Natural Gas Combustion Potential HAP and TAP Emissions

Pollutant	HAP	NC TAP	VOC	Emission Factor	Units	Footnote	Potential Emissions	
							Max (lb/hr)	Annual (tpy)
Natural Gas Source								
2-Methylnaphthalene	Y	N	Y	2.4E-05	lb/MMscf	4	4.6E-07	2.0E-06
3-Methylchloranthrene	Y	N	Y	1.8E-06	lb/MMscf	4	3.5E-08	1.5E-07
7,12-Dimethylbenz(a)anthracene	Y	N	Y	1.6E-05	lb/MMscf	4	3.1E-07	1.3E-06
Acenaphthene	Y	N	Y	1.8E-06	lb/MMscf	4	3.5E-08	1.5E-07
Acenaphthylene	Y	N	Y	1.8E-06	lb/MMscf	4	3.5E-08	1.5E-07
Acetaldehyde	Y	Y	Y	1.5E-05	lb/MMscf	4	2.9E-07	1.3E-06
Acrolein	Y	Y	Y	1.8E-05	lb/MMscf	4	3.5E-07	1.5E-06
Ammonia	N	Y	N	3.2	lb/MMscf	4	6.1E-02	2.7E-01
Anthracene	Y	N	Y	2.4E-06	lb/MMscf	4	4.6E-08	2.0E-07
Arsenic	Y	Y	N	2.0E-04	lb/MMscf	4	3.8E-06	1.7E-05
Benz(a)anthracene	Y	N	Y	1.8E-06	lb/MMscf	4	3.5E-08	1.5E-07
Benzene	Y	N	Y	7.1E-04	lb/MMBtu	5	1.4E-02	6.1E-02
Benzo(a)pyrene	Y	Y	Y	1.2E-06	lb/MMscf	4	2.3E-08	1.0E-07
Benzo(b)fluoranthene	Y	N	Y	1.8E-06	lb/MMscf	4	3.5E-08	1.5E-07
Benzo(g,h,i)perylene	Y	N	Y	1.2E-06	lb/MMscf	4	2.3E-08	1.0E-07
Benzo(k)fluoranthene	Y	N	Y	1.8E-06	lb/MMscf	4	3.5E-08	1.5E-07
Beryllium	Y	Y	N	1.2E-05	lb/MMscf	4	2.3E-07	1.0E-06
Cadmium	Y	Y	N	1.1E-03	lb/MMscf	4	2.1E-05	9.3E-05
Chromium VI	Y	N	N	1.4E-03	lb/MMscf	4	2.7E-05	1.2E-04
Chrysene	Y	N	Y	1.8E-06	lb/MMscf	4	3.5E-08	1.5E-07
Cobalt Compounds	Y	N	N	8.4E-05	lb/MMscf	4	1.6E-06	7.1E-06
Dibenzo(a,h)anthracene	Y	N	Y	1.2E-06	lb/MMscf	4	2.3E-08	1.0E-07
Dichlorobenzene	Y	Y	Y	1.2E-03	lb/MMscf	4	2.3E-05	1.0E-04
Fluoranthene	Y	N	Y	3.0E-06	lb/MMscf	4	5.8E-08	2.5E-07
Fluorene	Y	N	Y	2.8E-06	lb/MMscf	4	5.4E-08	2.4E-07
Formaldehyde	Y	Y	Y	1.5E-03	lb/MMBtu	5	2.9E-02	1.3E-01
Hexane	Y	Y	Y	1.8	lb/MMscf	4	3.5E-02	1.5E-01
Indeno(1,2,3-cd)pyrene	Y	N	Y	1.8E-06	lb/MMscf	4	3.5E-08	1.5E-07
Lead	Y	N	N	5.0E-04	lb/MMscf	4	9.6E-06	4.2E-05
Manganese	Y	Y	N	3.8E-04	lb/MMscf	4	7.3E-06	3.2E-05
Mercury	Y	Y	N	2.6E-04	lb/MMscf	4	5.0E-06	2.2E-05
Naphthalene	Y	N	Y	6.1E-04	lb/MMscf	4	1.2E-05	5.1E-05
Nickel	Y	Y	N	2.1E-03	lb/MMscf	4	4.0E-05	1.8E-04
Polycyclic Organic Matter	Y	N	N	4.0E-05	lb/MMBtu	5	7.8E-04	3.4E-03
Phenanthrene	Y	N	Y	1.7E-05	lb/MMscf	4	3.3E-07	1.4E-06
Pyrene	Y	N	Y	5.0E-06	lb/MMscf	4	9.6E-08	4.2E-07
Selenium compounds	Y	N	N	2.4E-05	lb/MMscf	4	4.6E-07	2.0E-06
Toluene	Y	Y	Y	3.4E-03	lb/MMscf	4	6.5E-05	2.9E-04
Total HAP Emissions (natural gas combustion)							**0.079**	**0.35**
Total TAP Emissions (natural gas combustion)							**0.13**	**0.55**

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 propane combustion obtained from AP-42 Section 1.5 - Liquefied Petroleum Gas Combustion, 07/08.
3. Emission factor for NOx based on Vendor Guarantee.
4. 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.
5. The RCO burner 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.

Table 6a
Potential Emissions at Outlet of RCO-1 Stack (CD-RCO-1)
Dry Hammermills (ES-HM-1 through ES-HM-8)
Enviva Pellets Northampton, LLC

Abbreviations:

CAS - chemical abstract service
HAP - hazardous air pollutant
hr - hour
lb - pound
NC - North Carolina
ODT - oven dried tons
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
yr - year

Table 6b
Potential Emissions at Outlet of RCO-1 Stack (CD-RCO-1)
Dry Shavings Hammermills (ES-DSHM-1 and -2)
Enviva Pellets Northampton, LLC

Calculation Basis

Hammermills Hourly Throughput	28	ODT/hr
Hammermills Annual Throughput	245,000	ODT/yr
RCO Control Efficiency[1]	95.0%	
Wet Scrubber PM Control Efficiency	99.9%	

Potential PM, VOC, and HAP Emissions

Pollutant	CAS No.	HAP	NC TAP	VOC	Emission Factor[2] (lb/ODT)	Potential Emissions Max (lb/hr)	Potential Emissions Annual (tpy)
Acetaldehyde	75-07-0	Y	Y	Y	0.0073	0.010	0.04
Acrolein	107-02-8	Y	Y	Y	0.0092	0.013	0.06
Formaldehyde	50-00-0	Y	Y	Y	0.0071	0.010	0.04
Methanol	67-56-1	Y	N	Y	0.0071	0.010	0.04
Phenol	108-95-2	Y	Y	Y	0.0028	0.004	0.02
Propionaldehyde	123-38-6	Y	N	Y	0.0124	0.017	0.08
					Total HAP Emissions	**0.06**	**0.28**
					Total TAP Emissions	**0.04**	**0.16**
Total VOC (as propane)	--		--	Y	0.765	1.07	4.69
$PM/PM_{10}/PM_{2.5}$	--	--	--	--	16.44	0.46	2.01

Thermal Generated Potential Criteria Pollutant Emissions

Maximum high heating value of VOC constituents	1.8E-02	MMBtu/lb
Uncontrolled VOC emissions	94	tons/yr
Uncontrolled VOC emissions	21	lb/hr
Heat input of uncontrolled VOC emissions	3,467	MMBtu/yr
Heat input of uncontrolled VOC emissions	0.40	MMBtu/hr

Pollutant	Emission Factor[3]	Units	Potential Emissions Max (lb/hr)	Potential Emissions Annual (tpy)
CO	8.2E-02	lb/MMBtu	0.03	0.14
NO_X	9.8E-02	lb/MMBtu	0.04	0.17

Notes:

1. Exhaust from the two drying shavings hammermills will be routed to the wet scrubber and RCO at the pellet building, which control PM and VOC/HAP emissions with a 99.9% and 95.0% control efficiency, respectively.
2. Emission factors were derived based on stack testing data from comparable Enviva facilities and/or engineering judgement and include contingency. The emission factors represent uncontrolled emissions.
3. All particulate matter was conservatively assumed to be less than 2.5 microns in size.
4. CO and NOx emission factors are from AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98 for small boilers.

Abbreviations:

CAS - chemical abstract service
HAP - hazardous air pollutant
hr - hour
lb - pound
NC - North Carolina
ODT - oven dried tons
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
yr - year

Table 7
Potential Emissions at Outlet of RCO-2 Stack (CD-RCO-2)
Pellet Coolers (ES-CLR-1 through ES-CLR-6)
Enviva Pellets Northampton, LLC

Calculation Basis

Annual Throughput	781,255 ODT/yr
Hourly Throughput	144 ODT/hr
Hours of Operation	8,760 hr/yr
Number of Burners	2 burners
RCO/RTO Burner Rating	9.8 MMBtu/hr
RCO/RTO Control Efficiency	95.0%

Pellet Cooler and Pellet Mill Potential Process VOC and HAP Emissions

Pollutant	CAS No.	NC TAP	VOC	Emission Factor[1]	Emissions at RCO Outlet[2]	
				(lb/ODT)	Max (lb/hr)	Annual (tpy)
Acetaldehyde	75-07-0	Y	Y	0.025	0.181	0.49
Acrolein	107-02-8	Y	Y	0.050	0.36	0.97
Formaldehyde	50-00-0	Y	Y	0.006	0.04	0.12
Methanol	67-56-1	N	Y	0.021	0.15	0.41
Phenol	108-95-2	Y	Y	0.025	0.18	0.49
Propionaldehyde	123-38-6	N	Y	0.015	0.105	0.29
				Total HAP Emissions	**1.02**	**2.78**
				Total TAP Emissions	**0.77**	**2.08**
Total VOC (as propane)	--	--	Y	1.4	10.17	27.60

Notes:

1. Emission factors were derived based on stack testing data from comparable Enviva facilities and/or engineering judgement and include contingency. The emission factors represent uncontrolled emissions.
2. A 95.0% control efficiency is applied to the potential emissions for the RCO.

Emissions from the pellet mills and pellet coolers will be controlled by an RCO 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 when operating in thermal mode.

Thermal Generated Potential Criteria Pollutant Emissions

Maximum high heating value of VOC constituents	1.8E-02 MMBtu/lb
Uncontrolled VOC emissions	552 tons/yr
Uncontrolled VOC emissions	203 lb/hr
Heat input of uncontrolled VOC emissions	20,417 MMBtu/yr
Heat input of uncontrolled VOC emissions	4 MMBtu/hr

Pollutant	Emission Factor[1]	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	8.2E-02	lb/MMBtu	0.31	0.84
NO_x	9.8E-02	lb/MMBtu	0.37	1.00

Natural Gas Combustion Potential Criteria Pollutant Emissions

Pollutant	Emission Factor[1]	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	8.2E-02	lb/MMBtu	1.61	7.07
NO_x	5.06	lb/hr [3]	5.06	22.16
SO_2	5.9E-04	lb/MMBtu	1.2E-02	0.05
VOC	5.4E-03	lb/MMBtu	0.11	0.46
Total PM	7.5E-03	lb/MMBtu	0.15	0.64
Total PM_{10}	7.5E-03	lb/MMBtu	0.15	0.64
Total $PM_{2.5}$	7.5E-03	lb/MMBtu	0.15	0.64

Potential Criteria Pollutant Emissions - Propane Combustion

Pollutant	Emission Factor[2]	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
CO	7.50	lb/Mgal	1.61	7.04
NO_x	5.06	lb/hr [3]	5.06	22.16
SO_2	0.054	lb/Mgal	0.01	0.05
VOC	1.00	lb/Mgal	0.21	0.94
$PM/PM_{10}/PM_{2.5}$ Condensable	0.50	lb/Mgal	0.11	0.47
$PM/PM_{10}/PM_{2.5}$ Filterable	0.20	lb/Mgal	0.04	0.19
Total $PM/PM_{10}/PM_{2.5}$			0.15	0.66

Table 7
Potential Emissions at Outlet of RCO-2 Stack (CD-RCO-2)
Pellet Coolers (ES-CLR-1 through ES-CLR-6)
Enviva Pellets Northampton, LLC

Natural Gas Combustion Potential HAP and TAP Emissions

Pollutant	HAP	NC TAP	VOC	Emission Factor	Units	Footnote	Potential Emissions Max (lb/hr)	Potential Emissions Annual (tpy)
Natural Gas Source								
2-Methylnaphthalene	Y	N	Y	2.4E-05	lb/MMscf	4	4.6E-07	2.0E-06
3-Methylchloranthrene	Y	N	Y	1.8E-06	lb/MMscf	4	3.5E-08	1.5E-07
7,12-Dimethylbenz(a)anthracene	Y	N	Y	1.6E-05	lb/MMscf	4	3.1E-07	1.3E-06
Acenaphthene	Y	N	Y	1.8E-06	lb/MMscf	4	3.5E-08	1.5E-07
Acenaphthylene	Y	N	Y	1.8E-06	lb/MMscf	4	3.5E-08	1.5E-07
Acetaldehyde	Y	Y	Y	1.5E-05	lb/MMscf	4	2.9E-07	1.3E-06
Acrolein	Y	Y	Y	1.8E-05	lb/MMscf	4	3.5E-07	1.51E-06
Ammonia	N	Y	N	3.2	lb/MMscf	4	6.15E-02	2.69E-01
Anthracene	Y	N	Y	2.4E-06	lb/MMscf	4	4.6E-08	2.0E-07
Arsenic	Y	Y	N	2.0E-04	lb/MMscf	4	3.8E-06	1.7E-05
Benz(a)anthracene	Y	N	Y	1.8E-06	lb/MMscf	4	3.5E-08	1.5E-07
Benzene	Y	N	Y	7.1E-04	lb/MMBtu	5	1.4E-02	6.1E-02
Benzo(a)pyrene	Y	Y	Y	1.2E-06	lb/MMscf	4	2.3E-08	1.0E-07
Benzo(b)fluoranthene	Y	N	Y	1.8E-06	lb/MMscf	4	3.5E-08	1.5E-07
Benzo(g,h,i)perylene	Y	N	Y	1.2E-06	lb/MMscf	4	2.3E-08	1.0E-07
Benzo(k)fluoranthene	Y	N	Y	1.8E-06	lb/MMscf	4	3.5E-08	1.5E-07
Beryllium	Y	Y	N	1.2E-05	lb/MMscf	4	2.3E-07	1.0E-06
Cadmium	Y	Y	N	1.1E-03	lb/MMscf	4	2.1E-05	9.3E-05
Chromium VI	Y	N	N	1.4E-03	lb/MMscf	4	2.7E-05	1.2E-04
Chrysene	Y	N	Y	1.8E-06	lb/MMscf	4	3.5E-08	1.5E-07
Cobalt Compounds	Y	N	N	8.4E-05	lb/MMscf	4	1.6E-06	7.1E-06
Dibenzo(a,h)anthracene	Y	N	Y	1.2E-06	lb/MMscf	4	2.3E-08	1.0E-07
Dichlorobenzene	Y	Y	Y	1.2E-03	lb/MMscf	4	2.3E-05	1.0E-04
Fluoranthene	Y	N	Y	3.0E-06	lb/MMscf	4	5.8E-08	2.5E-07
Fluorene	Y	N	Y	2.8E-06	lb/MMscf	4	5.4E-08	2.4E-07
Formaldehyde	Y	Y	Y	1.5E-03	lb/MMBtu	5	2.9E-02	1.3E-01
Hexane	Y	Y	Y	1.8	lb/MMscf	4	3.5E-02	1.51E-01
Indeno(1,2,3-cd)pyrene	Y	N	Y	1.8E-06	lb/MMscf	4	3.5E-08	1.5E-07
Lead	Y	N	N	5.0E-04	lb/MMscf	4	9.6E-06	4.2E-05
Manganese	Y	Y	N	3.8E-04	lb/MMscf	4	7.3E-06	3.2E-05
Mercury	Y	Y	N	2.6E-04	lb/MMscf	4	5.0E-06	2.2E-05
Naphthalene	Y	N	Y	6.1E-04	lb/MMscf	4	1.2E-05	5.1E-05
Nickel	Y	Y	N	2.1E-03	lb/MMscf	4	4.0E-05	1.8E-04
Polycyclic Organic Matter	Y	N	N	4.0E-05	lb/MMBtu	5	7.8E-04	3.4E-03
Phenanthrene	Y	N	Y	1.7E-05	lb/MMscf	4	3.3E-07	1.4E-06
Pyrene	Y	N	Y	5.0E-06	lb/MMscf	4	9.6E-08	4.2E-07
Selenium compounds	Y	N	N	2.4E-05	lb/MMscf	4	4.6E-07	2.0E-06
Toluene	Y	Y	Y	3.4E-03	lb/MMscf	4	6.5E-05	2.9E-04
						Total HAP Emissions (natural gas combustion)	**0.079**	**0.35**
						Total TAP Emissions (natural gas combustion)	**0.13**	**0.55**

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 propane combustion obtained from AP-42 Section 1.5 - Liquefied Petroleum Gas Combustion, 07/08.
3. Emission factor for NOx based on Vendor Guarantee.
4. 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.
5. The RCO burner 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:

CAS - chemical abstract service
HAP - hazardous air 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

Table 8
Potential VOC and HAP Emissions
Dried Wood Handling 1 and 2 (ES-DWH-1 and ES-DWH-2)
Enviva Pellets Northampton, LLC

Calculation Basis

Hourly Throughput[1]	154 ODT/hr
Annual Throughput[1]	781,255 ODT/yr

Potential Criteria Pollutant Emissions

Pollutant	Emission Factor (lb/ODT)	Potential Emissions[4]	
		Max (lb/hr)	Annual (tpy)
Formaldehyde[2]	8.4E-04	0.129	0.33
Methanol[2]	2.0E-03	0.30	0.76
Total HAP Emissions		**0.43**	**1.09**
VOC as carbon[2]	0.10	15.6	39.5
VOC as propane[3]	0.12	19.1	48.5

Notes:

1. Hourly and annual throughputs assumed to be the same as dry hammermill throughput.
2. Emission factors derived from NCASI's Wood Products Database (February 2013) for dry wood handling operations at an OSB mill, mean emission factors. The emission factors were converted from lb/MSF (3/8") to lb/ODT using the typical density and moisture content of an OSB panel.

3. VOC as propane = (1.22 x VOC as carbon) + formaldehyde.
4. As emissions are based on throughput, the calculated emissions represent the total emissions from Dried Wood Handling 1 and 2 (ES-DWH-1 and ES-DWH-2).

Abbreviations:

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

Table 9
Potential PM Emissions from Baghouses/Cyclones
Enviva Pellets Northampton, LLC

Emission Unit ID	Source Description	Control Device ID	Control Device Description	Exhaust Flow Rate[1]	Exit Grain Loading[2]	Annual Operation	Particulate Speciation		Potential Emissions					
									PM		PM_{10}		$PM_{2.5}$	
				(cfm)	(gr/cf)	(hours)	PM_{10} (% of PM)	$PM_{2.5}$ (% of PM)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
ES-HM-1 through 3	Dry Hammermills 1 through 3	CD-HM-BF-1; CD-WS-1	One (1) existing baghouse and one (1) new wet scrubber[3,4]	45,000	0.004	8760	100%	1.7%	1.54	6.76	1.54	6.76	0.03	0.11
ES-HM-4 through 6	Dry Hammermills 4 through 6	CD-HM-BF-2; CD-WS-1	One (1) existing baghouse and one (1) new wet scrubber[3,4]	45,000	0.004	8760	100%	1.7%	1.54	6.76	1.54	6.76	0.03	0.11
ES-HM-7 and 8; ES-NDS	Dry Hammermills 7 through 8; Nuisance Dust System	CD-HM-BF-3; CD-WS-1	One (1) existing baghouse and one (1) new wet scrubber[3,4]	45,000	0.004	8760	100%	1.7%	1.54	6.76	1.54	6.76	0.03	0.11
ES-PCHP	Pellet Cooler HP Fines Relay System	CD-PCHP-BV	One (1) baghouse[5]	3,600	0.004	8760	100%	100%	0.12	0.54	0.12	0.54	0.12	0.54
ES-PMFS	Pellet Mill Feed Silo	CD-PMFS-BV	One (1) baghouse[5]	2,500	0.004	8760	100%	100%	0.09	0.38	0.09	0.38	0.09	0.38
ES-CLR-1	Pellet Cooler	CD-CLR-1; CD-WS-2	One (1) existing Cyclone and one new wet scrubber[6]	17,100	0.01	8760	26.1%	3.2%	1.47	6.42	0.38	1.68	0.05	0.21
ES-CLR-2	Pellet Cooler	CD-CLR-2; CD-WS-2	One (1) existing Cyclone and one new wet scrubber[6]	17,100	0.01	8760	26.1%	3.2%	1.47	6.42	0.38	1.68	0.05	0.21
ES-CLR-3	Pellet Cooler	CD-CLR-3; CD-WS-2	One (1) existing Cyclone and one new wet scrubber[6]	17,100	0.01	8760	26.1%	3.2%	1.47	6.42	0.38	1.68	0.05	0.21
ES-CLR-4	Pellet Cooler	CD-CLR-4; CD-WS-2	One (1) existing Cyclone and one new wet scrubber[6]	17,100	0.01	8760	26.1%	3.2%	1.47	6.42	0.38	1.68	0.05	0.21
ES-CLR-5	Pellet Cooler	CD-CLR-5; CD-WS-2	One (1) existing Cyclone and one new wet scrubber[6]	17,100	0.01	8760	26.1%	3.2%	1.47	6.42	0.38	1.68	0.05	0.21
ES-CLR-6	Pellet Cooler	CD-CLR-6; CD-WS-2	One (1) existing Cyclone and one new wet scrubber[6]	17,100	0.01	8760	26.1%	3.2%	1.47	6.42	0.38	1.68	0.05	0.21
ES-DWH-1	Dried Wood Handling-1	CD-DWH-BF-1	One (1) baghouse[5]	2,500	0.004	8760	100%	100%	0.09	0.38	0.09	0.38	0.09	0.38
ES-DWH-2	Dried Wood Handling-2	CD-DWH-BF-2	One (1) baghouse[5]	2,500	0.004	8760	100%	100%	0.09	0.38	0.09	0.38	0.09	0.38
ES-DSR; IES-DRYSHAVE-1	Dry Shavings Reception; Dry Shaving Material Handling	CD-DSR-BF	One (1) baghouse[5]	2,500	0.004	8760	100%	100%	0.09	0.38	0.09	0.38	0.09	0.38
ES-FPH; ES-PB-1 through 12; ES-PL-1 and -2	Finished Product Handling; Twelve pellet loadout bins; Pellet mill load-out 1 and 2	CD-FPH-BF	One (1) baghouse[4,7]	35,500	0.004	8760	91%	2%	1.22	5.33	1.11	4.85	0.02	0.09
ES-DSS	Dry Shavings Silo	CD-DSS-BF	One (1) baghouse[5]	3,600	0.004	8760	100%	100%	0.12	0.54	0.12	0.54	1.2E-01	0.54
IES-ADD	Additive Handling and Storage	CD-ADD-BF	One (1) baghouse[5]	1,652	0.004	117	100%	100%	0.057	0.00	0.057	0.003	0.057	0.003

Notes:

1. Filter, Vent, and Cyclone inlet flow rate (cfm) provided by design engineering firm (Mid-South Engineering Co.). The exit flowrate was conservataively assumed to be the same as the inlet flowrate.
2. Pollutant loading provided by Aircon. For Pellet Coolers, pollutant loading based on data from other Enviva facilities reflecting addition of either a WESP or baghouse.
3. No speciation data is available for PM_{10}. Therefore, it is conservatively assumed to be equal to total PM.
4. Dry Hammermills and finished product handling $PM_{2.5}$ speciation based on April 2014 Enviva Southampton $PM_{2.5}$ speciation tests.
5. No speciation data is available for PM_{10}/$PM_{2.5}$. Therefore, it is conservatively assumed to be equal to total PM.
6. Pellet cooler PM_{10}/$PM_{2.5}$ speciation based on data for similar Enviva facility.
7. Finished product handling PM_{10} speciation based on AP-42 factors for wet wood combustion (Section 1.6) controlled by a mechanical separator. Since the particle size of particulate matter from a pellet cooler is anticipated to be larger than flyash, this factor is believed to be a conservative indicator of speciation.

Abbreviations:

cf - cubic feet
cfm - cubic feet per minute
ES - Emission Sources
IES - Insignificant Emission Source
gr - grain
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

Table 10a
Potential Emissions from Material Handling
Enviva Pellets Northampton, LLC

Source	Transfer Activity[1]	Control	Control Description	Number of Drop Points	Material Moisture Content	PM Emission Factor[2]	PM_{10} Emission Factor[2]	$PM_{2.5}$ Emission Factor[2]	Potential Throughput[3]		Potential PM Emissions		Potential PM_{10} Emissions		Potential $PM_{2.5}$ Emissions	
					(%)	(lb/ton)	(lb/ton)	(lb/ton)	(tph)	(tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
ES-GWHS	Material feed conveyance system to dryer burner fuel storage bin	--	--	5	48%	3.7E-05	1.8E-05	2.7E-06	30	252,692	5.6E-03	2.4E-02	2.7E-03	1.1E-02	4.0E-04	1.7E-03
	Material feed conveyance system to raw wood chip storage pile	--	--	1	48%	3.7E-05	1.8E-05	2.7E-06	400	1,502,414	1.5E-02	2.8E-02	7.1E-03	1.3E-02	1.1E-03	2.0E-03
	Material feed conveyance system to dryer burner	--	--	0	45%	4.1E-05	1.9E-05	2.9E-06	30	545,455	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Material feed conveyance system to rotary drum wood dryer	--	--	0	48%	3.7E-05	1.8E-05	2.7E-06	300	1,652,655	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Material feed conveyance system to fuel storage piles	--	--	3	45%	4.1E-05	1.9E-05	2.9E-06	30	238,909	3.7E-03	1.5E-02	1.7E-03	6.9E-03	2.6E-04	1.0E-03
IES-DLH	Drop point for dry shavings to dry line hopper	--	--	1	17%	1.6E-04	7.6E-05	1.1E-05	185.3	1,882,542	3.0E-02	1.5E-01	1.4E-02	7.1E-02	2.1E-03	1.1E-02
ES-DLC-1	Drop point for dry line hopper to dry line feed conveyor	--	--	1	17%	1.6E-04	7.6E-05	1.1E-05	185.3	1,882,542	3.0E-02	1.5E-01	1.4E-02	7.1E-02	2.1E-03	1.1E-02
IES-DRYSHAVE	Existing dry shaving walking floor truck dump	--	--	1	8.0%	4.6E-04	2.2E-04	3.3E-05	48.0	219,000	2.2E-02	5.0E-02	1.0E-02	2.4E-02	1.6E-03	3.6E-03
	Existing dry shaving loader	--	--	2	8.0%	4.6E-04	2.2E-04	3.3E-05	153.8	750,000	1.4E-01	3.4E-01	6.7E-02	1.6E-01	1.0E-02	2.5E-02
ES-PS-1 and 2	Drop points from the dry line feed conveyor to the Dry Hammermill Pre-screeners	--	--	2	17.0%	1.6E-04	7.6E-05	1.1E-05	185.3	1,882,542	5.9E-02	3.0E-01	2.8E-02	1.4E-01	4.2E-03	2.2E-02
										Total Emissions:	**2.47E-01**	**7.62E-01**	**1.17E-01**	**3.60E-01**	**1.77E-02**	**5.46E-02**

Notes:

[1] These dry wood handling emissions are representative of the fugitive emissions at the site.

[2] Emission factor calculation based on formula from AP-42, Section 13.2.4 - Aggregate Handling and Storage Piles, Equation 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) — 6.3

[3] Throughputs represent dry weight of materials, calculated based on listed material moisture contents. Throughput for dry shaving material handling is based on comparable Enviva facilities.

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

Table 10b
Potential Emissions from Wood Storage Pile Wind Erosion
Enviva Pellets Northampton, LLC

Source	Description	PM Emission Factor[1]		VOC Emission Factor[2]		Pile Width/ Diamter	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)	($lb/hr/ft^2$)	(lb/day/acre)	($lb/hr/ft^2$)	(ft)	(ft)	(ft)	(ft^2)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)	Max (lb/hr)	Annual (tpy)
IES-DRYSHAVE	Dry Shaving Storage Pile	8.6	8.2E-06	3.6	3.4E-06	100	--	25	10,537	0.09	0.4	0.04	0.2	0.007	0.03	0.04	0.2
IES-GWHS	Green Wood Storage Pile No. 1	8.6	8.2E-06	3.6	3.4E-06	155	--	72	30,907	0.25	1.1	0.13	0.6	0.019	0.08	0.13	0.6
	Green Wood Storage Pile No. 2	8.6	8.2E-06	3.6	3.4E-06	350	400	25	213,000	1.75	7.7	0.88	3.8	0.131	0.58	0.89	3.9
	Green Wood Storage Pile No. 3	8.6	8.2E-06	3.6	3.4E-06	150	150	25	45,000	0.37	1.6	0.19	0.8	0.028	0.12	0.19	0.8
	Green Wood Storage Pile No. 4	8.6	8.2E-06	3.6	3.4E-06	200	200	25	72,000	0.59	2.6	0.30	1.3	0.044	0.19	0.30	1.3
	Bark Fuel Storage Pile No. 1	8.6	8.2E-06	3.6	3.4E-06	150	150	25	45,000	0.37	1.62	0.185	0.81	2.8E-02	0.122	0.189	0.83
	Bark Fuel Storage Pile No. 2	8.6	8.2E-06	3.6	3.4E-06	100	200	25	42,000	0.345	1.513	0.173	0.757	2.6E-02	1.1E-01	0.176	0.773
	Bark Fuel Storage Pile No. 3	8.6	8.2E-06	3.6	3.4E-06	50	--	25	3,332	0.027	0.120	0.014	0.060	2.1E-03	9.0E-03	0.014	0.061
									Total Emissions:	**3.80**	**16.64**	**1.90**	**8.32**	**0.28**	**1.25**	**1.94**	**8.50**

Notes:

1. TSP 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.

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

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. As Enviva has engineering data that shows VOC emissions from greenwood storage piles are less than the low end of the range of the factors listed, Enviva chose to employ the minimum emission factor from the NCASI dosument for purposes of conservatism.

3. The surface area for rectangular piles is calculated as [2*H*L+2*W*H+L*W] + 20% to consider the sloping pile edges. Pile dimensions were provided by Enviva.
The surface area for circular piles is calculated as $[\Pi*R*(R^2+H^2)^{0.5}]$ + 20% to consider the sloping pile edges. Diameter and height were provided by Enviva.

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
ft^2 - 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

Table 11
Potential Emissions
Electric Powered Green Wood Chipper (IES-EPWC)
Enviva Pellets Northampton, LLC

Calculation Basis

Annual Throughput of Chipper	781,255	tons/year (dry wood)[1]
Short Term Throughput	119.40	tons/hr (dry wood)[1]
Approximate Moisture Content	50%	of total weight

Pollutant	Emission Factor		Emissions	
			Max (lb/hr)	Annual (tpy)
THC as Carbon[2]	0.0041	lb/ODT	0.49	1.60
VOC as propane[3]	0.0050	lb/ODT	**0.60**	**1.95**
Methanol[2]	0.0010	lb/ODT	**0.12**	**0.39**

Notes:

[1] The hourly and annual throughputs used for the chipper are conservatively assumed to be the same as the throughput of the dryer (note that 50% of the dryer throughput normally comes from purchased chips).

[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.

Table 12
Potential Emissions
Bark Hog (IES-BARK)
Enviva Pellets Northampton, LLC

Calculation Basis

Annual Throughput of Bark Hog	234,377	tons/year (dry wood)[1]
Short-term Throughput of Bark Hog	31.50	tons/hr (dry wood)[1]
Approximate Moisture Content	50%	of total weight

Pollutant	Emission Factor		Emissions Max (lb/hr)	Emissions Annual (tpy)
THC as Carbon[2]	0.0041	lb/ODT	0.13	0.48
VOC as propane[3]	0.0050	lb/ODT	0.16	0.59
PM[4]	0.02	lb/ton	0.13	0.47
PM_{10}[4]	0.011	lb/ton	0.07	0.26
Methanol[2]	0.0010	lb/ODT	0.03	0.12

Notes:

[1] The annual throughput used for the bark hog is 30% of the annual throughput of the facility.
The short-term throughput is 15% of maximum hourly capacity of the debarker.

[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).

Table 13
Potential Emissions
Debarker (IES-DEBARK)
Enviva Pellets Northampton, LLC

Calculation Basis

Hourly Throughput[1]	210 ton/hr
Annual Throughput[1]	781,255 ton/yr
Approximate Moisture Content	50% of total weight

Potential Criteria Pollutant Emissions

Source	Pollutant	Emission Factor (lb/ton)	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
IES-DEBARK	TSP[2]	2.0E-02	0.84	1.56
	PM_{10}[2]	1.1E-02	0.46	0.86

Notes:

1. The annual throughput used for the debarker is equal to the annual throughput of the dryers. The short-term throughput is based upon the maximum capacity of the debarker.
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. PM emissions are assumed to be controlled due to the use of water spray and the bark hog being partially enclosed (assumed 90% control).

Abbreviations:

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

Table 14
Potential Emissions
Emergency Generators (IES-GN-1 and IES-GN-2) and Fire Water Pump (IES-FWP)
Enviva Pellets Northampton, LLC

Emergency Generator 1 - Emissions (IES-GN-1)

Equipment and Fuel Characteristics

Engine Output	0.26 MW
Engine Power	350 hp (brake)
Hours of Operation	500 hr/yr[1]
Heating Value of Diesel	19,300 Btu/lb
Power Conversion	7,000 Btu/hr/hp

Criteria Pollutant Emissions

Pollutant	Category	Emission Factor	Units	Emissions Max lb/hr	Emissions Annual tpy
TSP	PSD	4.41E-04	lb/kW-hr (2)	0.12	2.88E-02
PM_{10}	PSD	4.41E-04	lb/kW-hr (2)	0.12	2.88E-02
$PM_{2.5}$	PSD	4.41E-04	lb/kW-hr (2)	0.12	2.88E-02
NO_x	PSD	8.82E-03	lb/kW-hr (5)	2.30	5.75E-01
SO_2	PSD	15	ppmw (3)	3.81E-03	9.52E-04
CO	PSD	7.72E-03	lb/kW-hr (2)	2.01	5.03E-01
VOC (NMHC)	PSD	2.51E-03	lb/MMBtu (4)	6.15E-03	1.54E-03

Hazardous Air Pollutant Emissions

Pollutant	Category	Emission Factor	Units	Emissions Max lb/hr	Emissions Annual tpy
Acetaldehyde	HAP	5.37E-06	lb/hp-hr (4)	1.88E-03	4.70E-04
Acrolein	HAP	6.48E-07	lb/hp-hr (4)	2.27E-04	5.67E-05
Benzene	HAP	6.53E-06	lb/hp-hr (4)	2.29E-03	5.71E-04
Benzo(a)pyrene[6]	HAP	1.32E-09	lb/hp-hr (4)	4.61E-07	1.15E-07
1,3-Butadiene	HAP	2.74E-07	lb/hp-hr (4)	9.58E-05	2.39E-05
Formaldehyde	HAP	8.26E-06	lb/hp-hr (4)	2.89E-03	7.23E-04
Total PAH (POM)	HAP	1.18E-06	lb/hp-hr (4)	4.12E-04	1.03E-04
Toluene	HAP	2.86E-06	lb/hp-hr (4)	1.00E-03	2.51E-04
Xylenes	HAP	2.00E-06	lb/hp-hr (4)	6.98E-04	1.75E-04
			Highest HAP (Formaldehyde)	2.89E-03	7.23E-04
			Total HAPs	9.49E-03	2.37E-03

Notes:

1 NSPS allows for only 100 hrs/yr of non-emergency operation of these engines (not the 500 hours shown). The PTE for the emergency generator is based on 500 hr/yr, though, because the regs allow non-emergency operation and EPA guidance is 500 hr/yr for emergency generators.
2 Emissions factors from NSPS Subpart IIII (or 40 CFR 89.112 where applicable) in compliance with post-2009 construction.
3 Sulfur content in accordance with Year 2010 standards of 40 CFR 80.510(a) as required by NSPS Subpart IIII.
4 Emission factor obtained from AP-42 Section 3.3, Tables 3.3-1 Table 3.3-2.
5 Emission factor for NOx is listed as NOx and NMHC (Non-Methane Hydrocarbons or VOC) in Table 4 of NSPS Subpart IIII. Conservatively assumed entire limit attributable to NOx.
6 Benzo(a)pyrene is included as a HAP in Total PAH.

Table 14
Potential Emissions
Emergency Generators (IES-GN-1 and IES-GN-2) and Fire Water Pump (IES-FWP)
Enviva Pellets Northampton, LLC

Emergency Generator 2 - Emissions (IES-GN-2)

Equipment and Fuel Characteristics

Engine Output	500 kW
Engine Power	671 hp (brake)
Hours of Operation	500 hr/yr[1]
Heating Value of Diesel	19,300 Btu/lb
Power Conversion	7,000 Btu/hr/hp

Criteria Pollutant Emissions

Pollutant	Category	Emission Factor	Units	Emissions Max lb/hr	Emissions Annual tpy
PM	PSD	0.021	g/hp-hr (2)	0.03	7.8E-03
PM_{10}	PSD	0.021	g/hp-hr (2)	0.03	7.8E-03
$PM_{2.5}$	PSD	0.021	g/hp-hr (2)	0.03	7.8E-03
NO_x	PSD	6.65	g/hp-hr (2)	9.83	2.46
SO_2	PSD	15.0	ppmw (3)	7.3E-03	1.8E-03
CO	PSD	0.39	g/hp-hr (2)	0.58	0.14
VOC (NMHC)	PSD	0.01	lb/hp-hr (2)	6.71	1.68

Hazardous Air Pollutant Emissions

Pollutant	Category	Emission Factor	Units	Emissions Max lb/hr	Emissions Annual tpy
Acetaldehyde	HAP	2.52E-05	lb/MMTbu (4)	1.18E-04	2.96E-05
Acrolein	HAP	7.88E-06	lb/MMTbu (4)	3.70E-05	9.25E-06
Benzene	HAP	7.76E-04	lb/MMTbu (4)	3.64E-03	9.11E-04
Benzo(a)pyrene[5]	HAP	2.57E-07	lb/MMTbu (4)	1.21E-06	3.02E-07
Formaldehyde	HAP	7.89E-05	lb/MMTbu (4)	3.70E-04	9.26E-05
Naphthalene[5]	HAP	1.30E-04	lb/MMTbu (4)	6.10E-04	1.53E-04
Total PAH (POM)	HAP	2.12E-04	lb/MMTbu (4)	9.95E-04	2.49E-04
Toluene	HAP	2.81E-04	lb/MMTbu (4)	1.32E-03	3.30E-04
Xylenes	HAP	1.93E-04	lb/MMTbu (4)	9.06E-04	2.26E-04
			Highest HAP (Benzene)	3.64E-03	9.11E-04
			Total HAPs	7.39E-03	1.85E-03

Notes:

[1] NSPS allows for only 100 hrs/yr of non-emergency operation of these engines (not the 500 hours shown). The PTE for the emergency generator is based on 500 hr/yr, though, because the regs allow non-emergency operation and EPA guidance is 500 hr/yr for emergency generators.

[2] Emission factors for Particulate Matter (TSP/PM10/PM2.5), Nitrous Oxide (NOx), 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 Year 2013 standards of 40 CFR 80.510(a) as required by NSPS Subpart IIII.

[4] Emission factor obtained from AP-42 Section 3.4, Tables 3.4-3 Table 3.4-4.

[5] Benzo(a)pyrene and naphthalene are included as HAPs in Total PAH.

Table 14
Potential Emissions
Emergency Generators (IES-GN-1 and IES-GN-2) and Fire Water Pump (IES-FWP)
Enviva Pellets Northampton, LLC

Firewater Pump Emissions (IES-FWP)

Equipment and Fuel Characteristics

Engine Output	0.22 MW
Engine Power	300 hp
Hours of Operation	500 hr/yr[1]
Heating Value of Diesel	19,300 Btu/lb
Power Conversion	7,000 Btu/hr/hp

Criteria Pollutant Emissions

Pollutant	Category	Emission Factor	Units	Emissions Max lb/hr	Emissions Annual tpy
TSP	PSD	4.41E-04	lb/kW-hr (2)	0.10	2.47E-02
PM_{10}	PSD	4.41E-04	lb/kW-hr (2)	0.10	2.47E-02
$PM_{2.5}$	PSD	4.41E-04	lb/kW-hr (2)	0.10	2.47E-02
NO_x	PSD	8.82E-03	lb/kW-hr (5)	1.97	4.93E-01
SO_2	PSD	15	ppmw (3)	3.26E-03	8.16E-04
CO	PSD	7.72E-03	lb/kW-hr (2)	1.73	4.32E-01
VOC (NMHC)	PSD	2.51E-03	lb/MMBtu (4)	5.27E-03	1.32E-03

Hazardous Air Pollutant Emissions

Pollutant	Category	Emission Factor	Units	Emissions Max lb/hr	Emissions Annual tpy
Acetaldehyde	HAP	5.37E-06	lb/hp-hr (4)	1.61E-03	4.03E-04
Acrolein	HAP	6.48E-07	lb/hp-hr (4)	1.94E-04	4.86E-05
Benzene	HAP	6.53E-06	lb/hp-hr (4)	1.96E-03	4.90E-04
Benzo(a)pyrene[6]	HAP	1.32E-09	lb/hp-hr (4)	3.95E-07	9.87E-08
1,3-Butadiene	HAP	2.74E-07	lb/hp-hr (4)	8.21E-05	2.05E-05
Formaldehyde	HAP	8.26E-06	lb/hp-hr (4)	2.48E-03	6.20E-04
Total PAH (POM)	HAP	1.18E-06	lb/hp-hr (4)	3.53E-04	8.82E-05
Toluene	HAP	2.86E-06	lb/hp-hr (4)	8.59E-04	2.15E-04
Xylenes	HAP	2.00E-06	lb/hp-hr (4)	5.99E-04	1.50E-04
			Highest HAP (Formaldehyde)	2.48E-03	6.20E-04
			Total HAPs	8.13E-03	2.03E-03

Notes:

1 NSPS allows for only 100 hrs/yr of non-emergency operation of these engines (not the 500 hours shown). The PTE for the emergency generator is based on 500 hr/yr, though, because the regs allow non-emergency operation and EPA guidance is 500 hr/yr for emergency generators.

2 Emissions factors from NSPS Subpart IIII (or 40 CFR 89.112 where applicable) in compliance with post-2009 construction.

3 Sulfur content in accordance with Year 2010 standards of 40 CFR 80.510(a) as required by NSPS Subpart IIII.

4 Emission factor obtained from AP-42 Section 3.3, Tables 3.3-1 Table 3.3-2.

5 Emission factor for NOx is listed as NOx and NMHC (Non-Methane Hydrocarbons or VOC) in Table 4 of NSPS Subpart IIII. Conservatively assumed entire limit attributable to NOx.

6 Benzo(a)pyrene is included as a HAP in Total PAH.

Table 15
Potential Emissions
Diesel Storage Tanks (IES-TK-1 through IES-TK-4)
Enviva Pellets Northampton, LLC

Source ID	Description	Design Volume[1]	Working Volume[2]	Tank Dimensions[5]		Orientation	Throughput[3]	Turnovers	VOC Emissions[4]	
				Diameter	Height/ Length					
		(gal)	(gal)	(ft)	(ft)		(gal/yr)		(lb/hr)	(tpy)
IES-TK-1	Emergency Generator #1 Fuel Storage Tank[2]	2,500	1,250	6.0	12	Horizontal	8,803	7.0	1.3E-04	5.8E-04
IES-TK-2	Fire Pump Fuel Storage Tank[2]	500	250	3.0	10.0	Horizontal	7,554	30.2	3.7E-05	1.6E-04
IES-TK-3	Mobile Fuel Diesel Storage Tank	5,000	2,500	6.0	23.7	Horizontal	200,000	80.0	7.6E-04	3.3E-03
IES-TK-4	Emergency Generator #2 Fuel Storage Tank[2]	1,000	500	5.3	6.0	Horizontal	15,958	31.9	1.3E-04	5.8E-04
								Total Emissions:	**1.1E-03**	**4.6E-03**

Notes:

1. Conservative design specifications.
2. Working volume conservatively assumed to be 50% of tank design volume because tanks will not be full at all times.
3. Throughput for IES-TK-1, IES-TK-2, and IES-TK-4 based on fuel consumption provided by Enviva and 500 hours of operation per year. Throughput for IES-TK-3 provided by Enviva.
4. Emissions calculated using EPA TANKS 4.0 software. A minimum tank length for the TANKS program of 5 feet was used to estimate the emissions for IES-TK-2.
5. IES-TK-3 length was estimated based on the capacity of the tank and the diameter.

Abbreviations:

EPA - Environmental Protection Agency
ft - feet
gal - gallon
lb - pound
yr - year
VOC - volatile organic compound

Table 16a
Haul Road Emissions
Potential Fugitive PM Emissions from Paved Roads
Enviva Pellets Northampton, LLC

Vehicle Activity	Distance Traveled per Roundtrip[1] (ft)	Trips Per Day[1]	Daily VMT	Events Per Year (days)	Empty Truck Weight (lb)	Loaded Truck Weight (lb)	Average Truck Weight (ton)	Annual VMT	PM Emission Factor[2] (lb/VMT)	PM_{10} Emission Factor[2] (lb/VMT)	$PM_{2.5}$ Emission Factor[2] (lb/VMT)	Potential PM Emissions[3] (lb/day)	Potential PM Emissions[3] (tpy)	Potential PM_{10} Emissions[3] (lb/day)	Potential PM_{10} Emissions[3] (tpy)	Potential $PM_{2.5}$ Emissions[3] (lb/day)	Potential $PM_{2.5}$ Emissions[3] (tpy)
Bark Delivery - Dumper	2,800	11	6	365	41,000	81,000	30.5	2,134	2.24	0.45	0.11	1.31	0.24	0.26	0.05	0.06	0.01
Bark Delivery - Self Unload	3,730	11	8	365	41,000	81,000	30.5	2,842	2.24	0.45	0.11	1.74	0.32	0.35	0.06	0.09	0.02
Log Delivery to Crane Storage Area	2,800	93	49	365	40,400	85,400	31.5	18,004	2.31	0.46	0.11	11.39	2.08	2.28	0.42	0.56	0.10
Log Delivery to Log Storage Area	2,800	93	49	365	40,400	85,400	31.5	18,004	2.31	0.46	0.11	11.39	2.08	2.28	0.42	0.56	0.10
Purchased Chip Delivery	2,800	114	61	365	41,000	91,000	33.0	22,095	2.42	0.48	0.12	14.68	2.68	2.94	0.54	0.72	0.13
Additive Delivery	2,000	0.26	0.1	365	41,000	91,000	33.0	36	2.42	0.48	0.12	0.02	0.00	0.00	0.00	0.00	0.00
Pellet Truck Delivery to Pellet Loadout Area (Normal Operations)	3,730	86	61	365	41,000	91,000	33.0	22,182	2.42	0.48	0.12	14.73	2.69	2.95	0.54	0.72	0.13
Dry Shavings	3,730	32	23	365	41,000	77,000	29.5	8,251	2.16	0.43	0.11	4.89	0.89	0.98	0.18	0.24	0.04
Contractor Vehicle	2,000	18	7	365	4,000	4,000	2.0	2,462	0.14	0.03	0.01	0.09	0.02	0.02	0.00	0.00	0.00
Employee Car Parking	2,000	68	26	365	4,000	4,000	2.0	9,470	0.14	0.03	6.8E-03	0.36	0.07	0.07	0.01	0.02	0.00
											Total Emissions:	**60.60**	**11.06**	**12.12**	**2.21**	**2.97**	**0.54**

Notes:

[1] Distance traveled per round trip and daily trip counts were provided by Enviva.

[2] 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/m^2) 8.2
P - No. days with rainfall greater than 0.01 inch 120 Per AP-42, Section 13.2.1, Figure 13.2.1-2 (Northampton County, NC).

[3] 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

Table B-16b
Haul Road Emissions
Potential Fugitive PM Emissions from Unpaved Roads
Enviva Pellets Northampton, LLC

Vehicle Activity	Distance Traveled per Roundtrip[1] (ft)	Trips Per Day[1]	Daily VMT	Events Per Year (days)	Empty Truck Weight (lb)	Loaded Truck Weight (lb)	Average Truck Weight (ton)	Annual VMT
Log Delivery to Crane Storage Area	2,000	93	35	365	40,400	85,400	31.5	12,860
Log Delivery to Log Storage Area	2,000	93	35	365	40,400	85,400	31.5	12,860
Purchased Chip Delivery	7,000	114	151	365	41,000	91,000	33.0	55,238
Bark Delivery - Dumper	7,000	11	15	365	41,000	81,000	30.5	5,334
Additive Delivery	500	0.26	0.02	365	41,000	91,000	33.0	9
							32.4	**86,300**

Notes:

1. Distance traveled per round trip and daily trip counts were provided by Enviva.

Emission Calculations Unpaved Roads:

Pollutant	Emeperical 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	7.47	32.25
PM_{10}	1.5	8.4	0.9	0.45	2.13	9.19
$PM_{2.5}$	0.15	8.4	0.9	0.45	0.21	0.92

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 =

= 120 Per AP-42, Section 13.2.1, Figure 13.2.1-2 (Northampton, VA).

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

Table 17
Potential GHG Emissions
Facility-wide
Enviva Pellets Northampton, LLC

Operating Data:

Dryer-1 Heat Input	175.3 MMBtu/hr
Annual Heat Input	1,540,294 MMBtu/yr
Duct Burner 1 and 2 Heat Input	1 MMBtu/hr
Number of Burners	2
Operating Schedule	8,760 hrs/yr
Dryer 1 Bypass Heat Input	175 MMBtu/hr
Operating Schedule	50 hrs/yr
Dryer-2 Heat Input	180.0 MMBtu/hr
Annual Heat Input	1,576,800 MMBtu/yr
Duct Burner 3 and 4 Heat Input	1 MMBtu/hr
Number of Burners	2
Operating Schedule	8,760 hrs/yr
Dryer 2 Bypass Heat Input	180 MMBtu/hr
Operating Schedule	50 hrs/yr
RTO-1 Heat Input	32.0 MMBtu/hr
Operating Schedule	8,760 hrs/yr
Furnace 1 Bypass Heat Input	175 MMBtu/hr
Operating Schedule	50 hrs/yr
Furnace 1 Idle Heat Input	5 MMBtu/hr
Operating Schedule	500 hrs/yr
RTO-2 Heat Input	32.0 MMBtu/hr
Operating Schedule	8,760 hrs/yr
Furnace 2 Bypass Heat Input	180 MMBtu/hr
Operating Schedule	50 hrs/yr
Furnace 2 Idle Heat Input	5 MMBtu/hr
Operating Schedule	500 hrs/yr
RCO-1 Heat Input	184,558.6 MMBtu/yr
Operating Schedule	8,760 hrs/yr
RCO-2 Heat Input	192,112.5 MMBtu/yr
Operating Schedule	8,760 hrs/yr
Propane Vaporizer Heat Input	1 MMBtu/hr
Operating Schedule	8,760 hrs/yr
Emergency Generator 1 Output	350 bhp
Operating Schedule	500 hrs/yr
Power Conversion	7,000 Btu/hr/hp
Energy Input	2.450 MMBtu/hr
Emergency Generator 2 Output	671 bhp
Operating Schedule	500 hrs/yr
Power Conversion	7,000 Btu/hr/hp
Energy Input	4.69 MMBtu/hr
Fire Water Pump Output	300 bhp
Operating Schedule	500 hrs/yr
Power Conversion	7,000 Btu/hr/hp
Energy Input	2.100 MMBtu/hr

Table 17
Potential GHG Emissions
Facility-wide
Enviva Pellets Northampton, LLC

Emission Unit ID	Fuel Type	Emission Factors from Table C-1 (kg/MMBtu)[1, 2]			Tier 1 Emissions (short tons)[2]			
		CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total CO_2e
ES-DRYER-1	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	159,259.79	306	1,821	161,387
IES-DDB-1 and -2	Propane	62.87	7.50E-02	1.79E-01	1214.16	1.45	3.45	1,219
ES-DRYERBYP-1	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	906.26	1.74	10.37	918
ES-DRYER-2	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	163,034.40	313	1,865	165,212
IES-DDB-3 and -4	Propane	62.87	7.50E-02	1.79E-01	1214.16	1.45	3.45	1,219
ES-DRYERBYP-2	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	930.56	1.79	10.64	943
CD-RTO-1	Propane	62.87	7.50E-02	1.79E-01	19426.62	23.17	55.25	19,505
ES-FURNACEBYP-1	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	906.26	1.74	10.37	918
ES-FURNACEBYP-1 (Idle Mode)	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	258.49	0.50	2.96	262
CD-RTO-2	Propane	62.87	7.50E-02	1.79E-01	19426.62	23.17	55.25	19,505
ES-FURNACEBYP-2	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	930.56	1.79	10.64	943
ES-FURNACEBYP-2 (Idle Mode)	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	258.49	0.50	2.96	262
CD-RCO-1	Propane	62.87	7.50E-02	1.79E-01	12790.20	15.26	36.37	12,842
CD-RCO-2	Propane	62.87	7.50E-02	1.79E-01	13313.70	15.88	37.86	13,367
IES-PVAP	Propane	62.87	7.50E-02	1.79E-01	607.08	0.72	1.73	610
IES-GN-1	No. 2 Fuel Oil (Distillate)	73.96	7.50E-02	1.79E-01	100	1.01E-01	2.41E-01	100
IES-GN-2	No. 2 Fuel Oil (Distillate)	73.96	7.50E-02	1.79E-01	191	1.94E-01	4.63E-01	192
IES-FWP	No. 2 Fuel Oil (Distillate)	73.96	7.50E-02	1.79E-01	86	8.68E-02	2.07E-01	86

[1] Emission factors from Table C-1 and C-2 of GHG Reporting Rule. Emission factors for methane and N_2O already multiplied by their respective GWPs of 25 and 298.
[2] As per VADEQ guidance, VADEQ has adopted the GHG Biomass Deferral Rule which excludes CO_2 emissions from biomass combustion.