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ENVIRONMENT
& HEALTH

Laura Corl
Air Permit Manager
Virginia Department of Environmental Quality
5636 Southern Blvd.
Virginia Beach, Virginia 23462

Re: **Addendum to Application for Modification of Stationary Source Permit for Increased Softwood Utilization and Installation of Emission Controls**
Enviva Pellets Southampton, LLC
Southampton County, Virginia
Registration No.: 61653
AFS Id. No.: 51-175-00060

Dear Ms. Corl:

March 22, 2019

Ramboll US Corporation (Ramboll) is submitting this addendum to the application dated September 28, 2018 for a permit modification to incorporate facility changes at the Enviva Pellets Southampton, LLC (Enviva) facility (Facility) located in Southampton County (Facility ID #51-175-00060). This addendum is being submitted as discussed with the Virginia Department of Environmental Quality (VA DEQ) during the November 13, 2018 meeting in Virginia Beach, as well as to address questions raised during the meeting by VA DEQ. Results from air dispersion modeling will be provided to VA DEQ under separate cover following approval of the revised modeling protocol, which is also being submitted today under separate cover to Mr. Mike Kiss.

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The following summarizes the proposed revisions and additions to the September 28, 2018 permit application addressed in this addendum:

1. Provide an updated construction schedule that includes an anticipated date of commencement of operation based on calendar days following issuance of the permit.
2. Revise estimates of volatile organic compound (VOC) emissions associated with Green Wood Handling (ES-GWHS) and Dried Wood Handling (ES-DWH) as requested by VA DEQ, and provide descriptions of Enviva work practices employed to minimize fugitive particulate matter (PM) emissions from these sources.
3. Update PM emissions from Dried Wood Handling (ES-DWH) to reflect increased flow rate associated with the dried wood handling baghouse (CD-DWH-BF).
4. Update the material drop emission estimates under the Green Wood Handling (ES-GWHS) emission source to reflect final design plans of material transfer operations.
5. Correct previously-proposed throughputs for the Chipper (ES-CHIP) and Bark Hog (ES-BARK).

6. Provide flexibility to route emissions from the Green Wood Hammermills (ES-GHM-1 – 5) to the Dryer 2 (ES-DRYER-2) control system when Dryer 1 (ES-DRYER-1) is not operational.
7. Update the Dryer 1 and 2 (ES-DRYER-1 and 2) throughputs to allow each Dryer to produce up to its individual capacity. The combined throughput for both Dryers would not exceed the proposed facility-wide throughput limit.
8. Update nitrogen oxide (NO_X) emission estimates for Dryer 2 (ES-DRYER-2) based on a review of additional test data for comparable Enviva facilities, and supplement the Best Available Control Technology (BACT) analysis for NO_X emissions from this unit.
9. Update sulfur dioxide (SO_2) emissions from the Dryers (ES-DRYER-1 and 2) based on wood sulfur content information to better reflect potential-to-emit.
10. Reduce the number of proposed hours for the dryer idle mode for Dryers 1 and 2 (ES-DRYER-1 and 2) from 500 hours per year to 438 hours per year, which represents 5% of the annual operating hours, as requested by VA DEQ.
11. Clarify that good combustion practices and the use of regenerative thermal oxidizers (RTOs) are employed to minimize carbon monoxide (CO) emissions from the Dryers (ES-DRYER-1 and 2) as requested by VA DEQ.
12. Describe changes to the control strategy for the Pellet Presses (ES-PP), Pellet Coolers (ES-CLR-1 – 6), and the Dry Hammermills (ES-HM-1 – 8).
13. Incorporate an additional Dry Hammermill (ES-HM-9) to reflect final Dry Hammermill design plans.
14. Retain the existing Hammermill Area (ES-HMA) emission source in the permit.
15. A new pellet screener will not be added; instead, the existing pellet screener (ES-PCHP) will be upgraded.
16. Update fugitive emissions from vehicle traffic to reflect final roadway configuration at the facility.
17. Add one new diesel-fired Emergency Generator engine (ES-EG-2) and associated 1,000-gallon diesel fuel Storage Tank (ES-TK-4) to reflect final design plans.
18. Provide additional clarification regarding Enviva's use of oven-dried tons (ODT) as a basis for emission estimates as requested by VA DEQ.
19. Make other minor corrections to previously-submitted emissions estimates and provide other clarifications.

Additional information regarding these items is provided in the following sub-sections.

1. Updated Construction Schedule

Enviva's proposed construction and testing schedule is provided in **Table 1-1** below. Milestones are provided in terms of calendar days from the date of issuance of all necessary government approvals.

Table 1-1. Proposed Construction and Testing Schedule (Days from Permit Issuance)

Key Project Milestones	RTO on Existing Dryer	RCOs on PM / DHM	New GHM Island and Ducting of Emissions	New Dryer and Controls, and Stacker / Reclaimer
Commence Foundations	30	60	120	210
Commence M&E Install	210	240	270	240
Installation Complete (Commence Operation)	365	365	365	545
Emissions Testing	545	545	545	725

Abbreviations:
DHM = Dry Hammermills
GHM = Green Hammermills
M&E = Mechanical and Electrical systems
PM = Pellet Mills (Pellet Presses and Pellet Coolers)
RTO = Regenerative Thermal Oxidizer
RCO = Regenerative Catalytic Oxidizer

2. Green Wood and Dried Wood Handling

2.1. Emission Estimates

In response to VA DEQ's request that Enviva re-evaluate emission estimates from Green Wood Handling and Storage (ES-GWHS) and Dried Wood Handling (ES-DWH), Enviva is making the following updates to the calculations provided in the September 28, 2018 application:

- Enviva had previously used the high end of the emission factor range reported by the National Council for Air and Stream Improvement (NCASI) for fugitive volatile organic compound (VOC) emissions from wood storage piles (ES-GWHS). However, based on further review, Enviva agrees with VA DEQ's assessment that fugitive VOC emissions were previously overestimated and is now proposing to use the low end of the NCASI emission factor range.

- Enviva is replacing the previously-used VOC emission factor for the Dried Wood Handling (ES-DWH), which was based on a NCASI emission factor for oriented strand board handling, with test data from a comparable Enviva facility plus a 20% contingency factor.

In addition, Enviva is making the following changes to green wood and dried wood handling sources:

- Enviva removed one of the Green Wood Storage Piles and adjusted pile dimensions for the remaining Green Wood Storage Piles and the three Fuel Storage Piles to more accurately reflect final design plans for the facility's wood storage piles.
- Enviva is making corrections to the throughputs for the Chipper (ES-CHIP) and Bark Hog (ES-BARK) included in the September 28, 2018 application and is updating emissions from material transfer points under Green Wood Handling (ES-GWHS) to reflect changes to material transfer activities that will result from the proposed increased softwood utilization project.
- Based on additional engineering review, Enviva is updating estimates of PM emissions from Dried Wood Handling (ES-DWH) and the associated baghouse (CD-DWH-BF) to account for an increase in exhaust flow rate from 1,500 cubic feet per minute (cfm) to 2,500 cfm for this source.

Updated emission estimates and, where applicable, application forms for the sources discussed above are provided in **Appendix 1** and **Appendix 2**, respectively.

2.2. Work Practice Standards for Minimization of PM Emission from Green Wood Handling and Dried Wood Handling

This section provides additional information regarding the nature of PM emissions from Green Wood Handling and Storage (ES-GWHS) and Dried Wood Handling (ES-DWH), and describes measures employed by Enviva to minimize these emissions. This information further supports Enviva's claim that Green Wood Handling and Storage sources have insignificant emissions and are consistent with activities conducted at exempt wood sawmills and planing mills.

Green wood and bark contain a high moisture content approaching 50% water by weight. Therefore, PM emissions from Green Wood Handling and Storage (ES-GWHS) are insignificant. In addition, Enviva employs a number of emissions minimization work practices and methods for both Green Wood Handling and Storage (ES-GWHS) and Dried Wood Handling (ES-DWH). Specifically:

- Except for drops to piles, chipped wood or bark material and fuel feed conveyance from the raw green wood storage piles to the Dryer are covered (ES-GWHS).
- Water spray and partial enclosure are used for the Debarker (ES-DEBARK).
- Partial enclosure is used for the Bark Hog (ES-BARK).
- The Chipper (ES-CHIP) is located inside a building and a water spray is used to lubricate the logs and also acts to reduce fugitive dust losses.
- Enclosures are employed for the majority of the dried wood material transfer systems (ES-DWH).
- PM emissions from the following dried wood handling equipment are currently controlled or proposed to be controlled with baghouses:
    - New and existing DHM prescreeners (part of ES-DWH).
    - Hammermill Area (ES-HMA).
    - Pellet Cooler HP Fines Relay System (ES-PCHP).
    - Pellet Mill Feed Silo (ES-PMFS).
    - Finished Product Handling and Storage (ES-FPH).
    - Truck Loadout (ES-TL).

3. Green Wood Hammermills

Enviva's September 28, 2018 permit application proposed to route emissions from the five Green Wood Hammermills (ES-GHM-1 – 5) to the control devices for Dryer 1 (ES-DRYER-1). Enviva now proposes to route the Green Wood Hammermill emissions to either the Dryer 1 or Dryer 2 (ES-DRYER-1 or 2) control devices. This will provide additional redundancy in the control of emissions from the Green Wood Hammermills in the event the Dryer 1 control system is not operational. An updated Process Flow Diagram reflecting this proposed change is provided in **Appendix 3**.

4. Dryers

4.1. Dryer Throughputs

The total proposed facility pellet production rate is 781,255 oven-dried tons per year (ODT/yr), which is based on the design capacity of the Pellet Presses/Pellet Coolers. Dryer 1 is capable of processing up to 535,260 ODT/yr and Dryer 2 will be capable of processing up to 620,000 ODT/yr. In order to provide Enviva with the flexibility to use either dryer line up to its individual capacity, Enviva is proposing that the permitted throughput for each dryer line be equal to the total facility production rate. However, the combined throughput of both dryers will not exceed the total proposed facility production rate of 781,255 ODT/yr. Updated emission calculations reflecting this change are provided in **Appendix 1**. With the exception of NO_X, emissions that are based on throughput (i.e. lb/ODT) are estimated based on the total throughput of 781,255 ODT/yr, and emissions that are based on fuel usage (i.e. lb/MMBtu or lb/MMscf) or hourly test data (i.e. lb/hr) are conservatively set as the sum of emissions from the two dryer lines assuming both dryer lines operate 8,760 hrs/yr. As NO_X emissions from Dryer 1 are based on throughput (i.e. lb/ODT) and NO_X emission from Dryer 2 are based on hourly test data (i.e., lb/hr), the total NO_X emissions are conservatively estimated based on the maximum annual capacity of Dryer 1 (i.e., 535,260 ODT/yr) plus the emissions from Dryer 2. This calculation methodology ensures that potential emissions from both dryer lines are adequate to accommodate production of each dryer line up to its individual capacity and total production up to the proposed facility throughput of 781,255 ODT/yr through both dryer lines.

4.2. Dryer 2 NO_X Emissions and BACT Analysis Update

Based on a review of additional test data from comparable Enviva facilities, Enviva is proposing to increase Dryer 2 (ES-DRYER-2) NO_X emission factor from 14.28 lb/hr to 27.73 lb/hr, which represents a more conservative estimate of emissions from the proposed dryer. In the September 28, 2018 application's BACT analysis for NO_X emissions from Dryer 2, Enviva concluded that selective non-catalytic reduction (SNCR) and combustion controls were the only technically-feasible options for this unit. Enviva further concluded that, since the NO_X emission rate proposed in the September 2018 application for Dryer 2 was lower than the emission rate for the existing Dryer 1 (ES-DRYER-1), which is equipped with SNCR, the proposed Dryer 2 emission limits exceeded Virginia BACT requirements for these types of units.

The Dryer 2 NO_X emission rate proposed in this addendum is now higher than the emission rate for the existing Dryer 1. Therefore, Enviva analyzed the costs associated with installation of an SNCR system on Dryer 2. The SNCR capital expenditure was estimated to be $1,000,374 with annualized operating costs of $327,225. The installation of the SNCR would reduce emissions by a maximum of 48.6 tpy, resulting in a cost effectiveness of $6,735 per ton of NO_X removed. This high cost of control associated

with installing and operating an SNCR to control NO_X emissions from Dryer 2 is excessive and not representative of Virginia BACT. Detailed cost estimates are included in **Appendix 4**.

4.3. Dryer Idle Mode Emissions

As requested by VA DEQ, Enviva is proposing to reduce the hours of operation in dryer idle mode for Dryers 1 and 2 (ES-DRYER-1 and 2) from 500 hours per year to 438 hours per year per line, which represents 5% of the annual operating hours. Updated emission calculations reflecting this change are provided in **Appendix 1**.

4.4. Sulfur Dioxide Emissions

Enviva is proposing with this addendum to revise the SO_2 emission estimates for the Dryers. The new estimates are based on wood sulfur content data and NCASI guidance indicating that the majority (approximately 95%) of sulfur contained in wood is captured in wood ash and not emitted as SO_2. A contingency factor was applied to account for variability in the sulfur content of wood. Updated emission calculations reflecting this change are provided in **Appendix 1**.

4.5. Carbon Monoxide Emissions Minimization

In Table 6-1 of the September 28, 2018 application, Enviva neglected to specify that good combustion practices are employed for Dryers 1 and 2 (ES-DRYER-1 and 2) to promote complete oxidation of carbon material and reduce the formation of CO. Furthermore, although the RTOs are primarily employed to reduce VOC, hazardous air pollutants (HAP), and toxic air pollutants (TAP) emissions, based on discussions with control device vendors, a reduction of approximately 50% of CO emissions is also expected to occur in the RTOs at normal combustion chamber temperatures (1,500°F).

5. Pellet Presses/Pellet Coolers and Dry Hammermills

5.1. Control Devices

In the September 28, 2018 application, Enviva proposed to install a new RTO/RCO to control emissions of VOC, HAP, and TAP from the Pellet Presses/Pellet Coolers (ES-PP and ES-CLR-1 – 6) and Dry Hammermills (ES-HM-1 - 8). To accommodate routing these emissions to a single RTO/RCO, Enviva also proposed to install double duct burners to reduce the risk of moisture condensation in the ductwork associated with the Pellet Press/Pellet Cooler and Dry Hammermill exhaust. Based on additional engineering review, Enviva has determined that the addition of the double duct burners will not adequately address safety and quality issues associated with condensation. As such, Enviva no longer proposes to add the double duct burners and, instead, Enviva will route emissions from the Pellet Presses/Pellet Coolers to a second scrubber and RTO/RCO instead of the same scrubber and RTO/RCO used for the Dry Hammermills. This proposed change will have minimal impact on the overall VOC and HAP emissions included in the September 28, 2018 application since the additional combustion emissions associated with the new RTO/RCO burners are partly offset by the removal of the duct burners.

5.2. Additional Dry Hammermill

Enviva is also proposing to install an additional Dry Hammermill (ES-HM-9) which would be controlled by the existing baghouse that controls ES-HM-7 and 8 (CD-HM-BF-3), the Dry Hammermill wet scrubber (CD-WS-1), and RCO (CD-RCO-1). Enviva is not proposing changes to the combined annual Dry

Hammermill throughput specified in the September 28, 2018 application. Therefore, annual potential emissions will not change as a result of adding a ninth Dry Hammermill.

Updated emission calculations and permit application forms reflecting these changes are provided in **Appendix 1** and **Appendix 2**, respectively.

5.3. Hammermill Area

In the September 28, 2018 application, Enviva requested removal of the Hammermill Area (ES-HMA) emission source from the permit. However, upon further engineering review, Enviva is requesting that this emission source remain in the permit. This source does not emit directly to the atmosphere. Emissions are controlled by one of the Dry Hammermill baghouses (CD-HM-BF-3) which is subsequently routed to the Dry Hammermill scrubber (CD-WS-1) and RCO (CD-RCO-1).

6. Roadway Emissions

Enviva updated paved roadway emission estimates to reflect changes to roadways that will be implemented as part of the proposed Increased Softwood Utilization project. In addition, no vehicle traffic will occur on unpaved roads. Updated emission estimates reflecting these changes are provided in **Appendix 1**.

7. Emergency Generator and Diesel Fuel Storage Tank

Enviva has determined that a 671-horsepower (hp), diesel-fired Emergency Generator engine (ES-EG-2) and associated 1,000-gallon diesel fuel Storage Tank (ES-TK-4) are required to support the operation of the new Dryer (ES-DRYER-2).

7.1. Emissions

Operation of the Emergency Generator engine will generate emissions of criteria pollutants, HAP, and TAP. With the exception of SO_2, potential criteria pollutant emissions from operation of the Emergency Generator engine were calculated based on the manufacturer's specification sheet 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 of the sulfur present in the diesel fuel becomes SO_2 air emissions.[1] Potential emissions of HAP and TAP were quantified based on emission factors from AP-42 Section 3.4, *Large Stationary Diesel and All Stationary Dual-fuel Engines*.[2] Annual potential emissions were conservatively calculated based on 500 hours per year.

The storage of diesel in the new proposed Storage Tank will also generate emissions of VOC. Emissions of VOC from the diesel Storage Tank were calculated using EPA's TANKS 4.0 software based on actual tank characteristics (e.g., orientation, dimensions, etc.) and potential annual throughput.

[1] Sulfur content in accordance with Year 2010 standards of 40 CFR 80.510(b) as required by NSPS Subpart IIII.

[2] USEPA AP-42 Section 3.4, *Large Stationary and All Stationary Duel-fuel Engines* (10/96).

7.2. Regulatory Applicability

7.2.1. Virginia Permitting Requirements

In accordance with 9VAC5-80-1105.B(2), as a diesel engine with a rated brake horsepower of less than 1,675, the proposed Emergency Generator engine is exempt from Article 6 permitting requirements. In accordance with 9VAC5-80-1105.B(8), fuel oil storage tanks such as the proposed Storage Tank are also exempt from Article 6 permitting requirements.

7.2.2. 40 CFR 60 Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines

Subpart IIII applies to owners or operators of compression ignition (CI) internal combustion engines (ICE) manufactured after April 1, 2006 that are not fire pump engines. The 671-hp Emergency Generator will be subject to the New Source Performance Standards (NSPS) of 40 CFR Part 60, Subpart IIII.

Under NSPS Subpart IIII, owners and operators of emergency generators manufactured in calendar year 2007 or later with a maximum engine power greater than or equal to 50 hp are required to comply with the emission limits in §60.4205(b). These limits are as follows: 0.20 grams per kilowatt (g/kW) for PM, 3.5 g/kW for CO, and 4.0 g/kW for oxides of nitrogen (NOx) plus nonmethane hydrocarbons (NMHC).

Enviva will purchase an engine certified to meet the referenced emission limits in accordance with §60.4211(c) and will comply with the applicable emission limits by operating the emergency generator as instructed in the manufacturer's operating manual in accordance with §60.4211(a). The engine will be equipped with a non-resettable hour meter in accordance with §60.4209(a). Emergency and readiness testing of the unit is limited to 100 hours per year.

The emergency generator will be required to comply with the fuel requirements in §80.510(b), as required in §60.4207(b), which limits sulfur to a maximum of 15 parts per million by weight (ppmw) and a cetane index of at least 40 or a maximum aromatic content of 35 volume percent.

7.2.3. 40 CFR 63 Subpart ZZZZ – National Emissions Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines

Subpart ZZZZ applies to reciprocating internal combustion engines (RICE) located at a major or area source of HAP emissions. Emergency stationary RICE are defined in §63.6675 as any stationary RICE that operates in an emergency situation. These situations include engines used for power generation when a normal power source is interrupted, or when engines are used to pump water in the case of fire or flood. The proposed Emergency Generator will be classified as emergency RICE under Subpart ZZZZ. Further, the engine will be classified as a new source, as it will be constructed after June 12, 2006.

In accordance with §63.6590(c)(1), new and reconstructed emergency generator engines located at an area source of HAP emissions, such as the proposed Emergency Generator, are subject only to the requirement to comply with the applicable provisions of NSPS Subpart IIII and no further requirements apply under Subpart ZZZZ.

8. Other Corrections and Clarifications

8.1. Other Corrections to Emission Estimates

Enviva is also proposing the updates below to the emissions estimates included with the September 28, 2018 application. These changes will have a minimal impact on previously estimated emissions (see **Appendix 1**).

- Enviva is correcting the NOx emission factor for propane combustion associated with the Pellet Press/Pellet Cooler RCO (CD-RCO-1). The emission factor in the September 28, 2018 application incorrectly assumed low NO_X burners would be used.
- Enviva is updating estimates of thermally generated emissions for its RTOs and RCOs to more accurately reflect maximum hourly emission rates.
- Enviva is adding emissions of NO_X resulting from oxidation of VOC in the exhaust stream for Dryer 1 (ES-DRYER-1) by the RTO since the previously-submitted NO_X emission factor for this Dryer did not include these emissions.

8.2. Oven Dried Ton Basis

Enviva's September 28, 2018 permit application presents throughputs and emission factors for the main process emission units on an oven-dried short ton (ODT) basis, which is defined as an "amount of wood that weighs 2,000 pounds at 0% moisture content".[3] Due to the varying moisture content of wood throughout the pellet manufacturing process, the use of ODT allows for better comparison and validation of throughputs and emissions factors. It should be noted that using ODT does not impact emissions compared to using wet tons since both the emissions factors and the throughputs they are applied to are adjusted consistently.

8.3. Chiller Emissions

Enviva would like to clarify that the facility's chiller is powered by electricity and uses an air-to-air heat exchanger. As such, this equipment is not a source of emissions.

9. Closing

Thank you for your prompt attention to this matter. If you have any questions regarding this request, please contact me at (225) 408-2691 or Kai Simonsen, Air Permit Engineer at Enviva, at (984) 789-3628.

[3] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Bioenergy Technologies Office. *Full Text Glossary*. Retrieved January 7, 2019, from: https://www.energy.gov/eere/bioenergy/full-text-glossary#O

Yours sincerely

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APPENDIX 1
POTENTIAL EMISSION CALCULATIONS

TABLE C-1
FACILITY-WIDE CRITERIA & CO_2e POLLUTANT SUMMARY
ENVIVA PELLETS SOUTHAMPTON, 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-DRYER-1[1]	DRYER 1	CD-DC-1; CD-WESP-1; CD-RTO-1; SNCR	Multiclone; WESP; RTO; SNCR	156.44	212.18	66.58	66.58	66.58	23.51	28.93	365,609
ES-GHM-1 thru -5	Green Hammermills 1 thru 5										
ES-DRYER #2[1]	ES - DRYER #2	CD-DC-2; CD-WESP-2; CD-RTO-2	Multiclone; WESP; RTO								
ES-DRYERBYP-1	Dryer Bypass	--	--	0.54	0.66	1.52	1.52	1.52	0.11	0.35	918
ES-FURNACEBYP-1	Furnace Bypass	--	--	3.29	1.21	3.16	3.09	2.76	1.99	0.09	1,148
ES-DDB-1 & 2	Dryer Line 1 - Double Duct Burner	--	--	0.72	0.62	0.07	0.07	0.07	0.01	0.10	1,219
ES-DRYERBYP-2	Dryer Bypass	--	--	0.54	0.66	1.56	1.56	1.56	0.11	0.35	943
ES-FURNACEBYP-2	Furnace Bypass	--	--	3.36	1.23	3.23	2.89	2.50	0.14	0.10	1,172
ES-DDB-3 & -4	Dryer Line 2 - Double Duct Burner	--	--	0.72	0.62	0.07	0.07	0.07	0.01	0.10	1,219
ES-PVAP	Propane Vaporizer	--	--	0.36	0.62	0.03	0.03	0.03	0.003	0.05	610
ES-EG-1	Emergency Generator 1	--	--	0.50	0.58	0.03	0.03	0.03	0.001	0.002	100
ES-EG-2	Emergency Generator 2	--	--	0.14	2.46	0.01	0.01	0.01	0.002	1.68	192
ES-FWP	Fire Water Pump	--	--	0.43	0.49	0.02	0.02	0.02	0.001	0.001	85.9
ES-CLR1 thru -6	Pellet Presses and Coolers	CD-CLR-1 thru 6; CD-WS-1; CD-RCO-1	Simple Cyclones; Wet Duct Scrubber; RCO	7.91	13.20	39.18	10.71	1.89	0.05	28.53	13,367
ES-HM-1 thru -9; ES-HMA	Dry Hammermills 1 thru 9; Hammermill Area	CD-HM-CYC-1 thru 9; CD-HM-BF-1 thru 3; CD-WS-2; CD-RCO-2	Cyclones; Baghouses; Wet Duct Scrubber; RCO	7.46	12.66	20.93	20.93	1.00	0.05	13.64	12,601
ES-DWH	Dry Wood Handling	CD-DWH-BF	Baghouse	--	--	0.38	0.38	0.38	--	5.62	--
ES-PCHP	Pellet Cooler HP Fines Relay System, including Pellet Screeners	CD-PCHP-BF	Baghouse	--	--	0.54	0.54	0.54	--	--	--
ES-PMFS	Pellet Mill Feed Silo	CD-PMFS-BF	Bin Vent Filter	--	--	0.38	0.38	0.38	--	--	--
ES-FPH, ES-TL	Finished Product Handling and Truck Loadout	CD-FPH-BF	Baghouse	--	--	5.33	4.85	0.09	--	--	--
ES-ADD	Starch Additive Handling and Storage	CD-ADD-BF	Baghouse	--	--	3.21E-03	3.21E-03	3.21E-03	--	--	--
ES-GWHS	Green Wood Handling and Storage	--	--	--	--	5.88	2.91	0.44	--	1.04	--
ES-CHIP	Log Chipping	--	--	--	--	--	--	--	--	0.90	--
ES-DEBARK	Debarker	--	--	--	--	1.56	0.86	--	--	--	--
ES-BARK	Bark Hog	--	--	--	--	0.11	0.06	--	--	0.14	--
ES-BFB2	Bark Fuel Bin	--	--	--	--	--	--	--	--	--	--
ES-TK-1	Diesel Storage Tank for Emergency Generator #1	--	--	--	--	--	--	--	--	5.75E-04	--
ES-TK-2	Diesel Storage Tank for Fire Water Pump	--	--	--	--	--	--	--	--	1.60E-04	--
ES-TK-3	Mobile Fuel Diesel Storage Tank	--	--	--	--	--	--	--	--	3.33E-03	--
ES-TK-4	Diesel Storage Tank for Emergency Generator #2			--	--	--	--	--	--	5.75E-04	--
--	Haul Road Emissions	--	--	--	--	19.5	3.90	0.96	--	--	--
			Total Emissions:	**182**	**247**	**170**	**121**	**80.8**	**26.0**	**81.6**	**399,184**
			Total Excluding Fugitives[3]:	**182**	**247**	**145**	**115**	**79.4**	**26.0**	**80.6**	**399,184**
			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 1 and Dryer 2 are capable of processing up to 535,260 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:
- Except for NO_x, 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.
- As NO_x emissions from dryer 1 are based on throughput (i.e. lb/ODT) and NO_x emission from dryer 2 are based on hourly test/vendor data (i.e., lb/hr), the total NO_x emissions are conservatively estimated based on the max annual capacity of dryer 1 (i.e., 535,260 ODT/yr) plus the emissions from dryer 2 plus the emissions from the green hammermills.

2. Bark is transferred from the primary Bark Fuel Storage Pile by walking floor to covered conveyors which transfer the bark into the fully enclosed Bark Fuel Bin. There are no emissions expected from transfer of material into the bin.

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.

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TABLE C-2
FACILITYWIDE HAP EMISSIONS SUMMARY
ENVIVA PELLETS SOUTHAMPTON, LLC

Description	HAP	VA TAP	CD-RTO-1 and CD-RTO-2 [1] (tpy)	Dryer 1 Bypass (tpy)	Furnace 1 Bypass (tpy)	ES-DDB-1 & -2 (tpy)	Dryer 2 Bypass (tpy)	Furnace 2 Bypass (tpy)	ES-DDB-3 & -4 (tpy)	ES-PVAP (tpy)	CD-RCO-1 (tpy)	CD-RCO-2 (tpy)	ES-DWH (tpy)	ES-EG-1 (tpy)	ES-EG-2 (tpy)	ES-FWP (tpy)	ES-BARK (tpy)	ES-CHIP (tpy)	Total (tpy)	Major Source?
Acetaldehyde	Y	Y	1.73E+00	2.98E-01	4.55E-03	1.31E-07	3.46E-01	4.64E-03	1.31E-07	-	4.92E-01	1.21E-01	-	4.70E-04	2.96E-05	4.03E-04	-	-	2.99E+00	No
Acrolein	Y	Y	1.23E+00	1.95E-01	2.19E-02	1.55E-07	2.26E-01	2.24E-02	1.55E-07	-	9.75E-01	1.53E-01	-	5.67E-05	9.25E-06	4.86E-05	-	-	2.82E+00	No
Formaldehyde	Y	Y	1.87E+00	2.54E-01	2.41E-02	1.31E-02	2.95E-01	2.46E-02	1.31E-02	6.57E-03	2.50E-01	2.47E-01	3.28E-01	7.23E-04	9.26E-05	6.20E-04	-	-	3.33E+00	No
Methanol	Y	Y	1.39E+00	1.86E-01	-	-	2.15E-01	-	-	-	4.14E-01	1.18E-01	7.62E-01	-	-	-	2.70E-02	1.80E-01	3.29E+00	No
Phenol	Y	Y	6.07E-01	1.02E-01	2.79E-04	-	1.18E-01	2.85E-04	-	-	4.92E-01	4.65E-02	-	-	-	-	-	-	1.37E+00	No
Propionaldehyde	Y	Y	3.88E-01	6.82E-02	3.34E-04	-	7.90E-02	3.41E-04	-	-	2.85E-01	2.06E-01	-	-	-	-	-	-	1.03E+00	No
Acetophenone	Y	Y	1.24E-07	1.40E-08	1.75E-08	-	1.44E-08	1.79E-08	-	-	-	-	-	-	-	-	-	-	1.88E-07	No
Ammonia	N	N	8.79E-01	-	-	2.75E-02	-	-	2.75E-02	-	2.69E-01	2.69E-01	-	-	-	-	-	-	1.47E+00	No
Antimony and compounds	Y	Y	8.91E-04	3.46E-05	4.33E-05	-	3.56E-05	4.42E-05	-	-	-	-	-	-	-	-	-	-	1.05E-03	No
Arsenic	Y	Y	2.54E-03	9.64E-05	1.21E-04	1.72E-06	9.90E-05	1.23E-04	1.72E-06	-	1.68E-05	1.68E-05	-	-	-	-	-	-	3.01E-03	No
Benzene	Y	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	N	1.01E-04	1.14E-05	1.42E-05	1.03E-08	1.17E-05	1.45E-05	1.03E-08	-	1.01E-07	1.01E-07	-	1.15E-07	3.02E-07	9.87E-08	-	-	1.54E-04	No
Beryllium	Y	Y	1.27E-04	4.82E-06	6.03E-06	1.03E-07	4.95E-06	6.15E-06	1.03E-07	-	1.01E-06	1.01E-06	-	-	-	-	-	-	1.52E-04	No
1,3-Butadiene	Y	Y	-	-	-	-	-	-	-	-	-	-	-	2.39E-05	-	2.05E-05	-	-	4.45E-05	No
Cadmium	Y	Y	7.65E-04	1.80E-05	2.25E-05	9.45E-06	1.85E-05	2.29E-05	9.45E-06	-	9.26E-05	9.26E-05	-	-	-	-	-	-	1.05E-03	No
Carbon tetrachloride	Y	Y	1.75E-03	1.97E-04	2.46E-04	-	2.03E-04	2.52E-04	-	-	-	-	-	-	-	-	-	-	2.65E-03	No
Chlorine	Y	Y	1.23E+00	3.46E-03	4.33E-03	-	3.56E-03	4.42E-03	-	-	-	-	-	-	-	-	-	-	1.25E+00	No
Chlorobenzene	Y	Y	1.28E-03	1.45E-04	1.81E-04	-	1.49E-04	1.85E-04	-	-	-	-	-	-	-	-	-	-	1.94E-03	No
Chloroform	Y	Y	1.09E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.09E-03	No
Chromium VI	Y	Y	7.80E-04	-	-	1.20E-05	-	-	1.20E-05	-	1.18E-04	1.18E-04	-	-	-	-	-	-	1.04E-03	No
Chromium–Other compounds	Y	Y	1.97E-03	7.67E-05	1.15E-04	-	7.88E-05	1.17E-04	-	-	-	-	-	-	-	-	-	-	2.36E-03	No
Cobalt compounds	Y	Y	7.33E-04	2.85E-05	3.56E-05	7.21E-07	2.93E-05	3.64E-05	7.21E-07	-	7.07E-06	7.07E-06	-	-	-	-	-	-	8.79E-04	No
Dichlorobenzene	Y	Y	3.30E-04	-	-	1.03E-05	-	-	1.03E-05	-	1.01E-04	1.01E-04	-	-	-	-	-	-	5.52E-04	No
Dichloroethane, 1,2-	Y	Y	1.13E-03	1.27E-04	1.59E-04	-	1.31E-04	1.62E-04	-	-	-	-	-	-	-	-	-	-	1.71E-03	No
Dichloropropane, 1,2-	Y	Y	1.28E-03	1.45E-04	1.81E-04	-	1.49E-04	1.85E-04	-	-	-	-	-	-	-	-	-	-	1.94E-03	No
Dinitrophenol, 2,4-	Y	Y	7.00E-06	7.89E-07	9.86E-07	-	8.10E-07	1.01E-06	-	-	-	-	-	-	-	-	-	-	1.06E-05	No
Di(2-ethylhexyl)phthalate	Y	Y	1.83E-06	2.06E-07	2.06E-07	-	2.12E-07	2.12E-07	-	-	-	-	-	-	-	-	-	-	2.66E-06	No
Ethyl benzene	Y	Y	1.21E-03	1.36E-04	1.70E-04	-	1.40E-04	1.73E-04	-	-	-	-	-	-	-	-	-	-	1.82E-03	No
Hexachlorodibenzo-p-dioxin, 1,2,3,6,7,8-	N	N	6.96E-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.96E-10	No
Hexane	Y	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	N	4.95E-07	-	-	1.55E-08	-	-	1.55E-08	-	1.51E-07	1.51E-07	-	-	-	-	-	-	8.29E-07	No
Hydrochloric acid	Y	Y	2.96E+00	8.33E-02	1.04E-01	-	8.55E-02	1.06E-01	-	-	-	-	-	-	-	-	-	-	3.34E+00	No
Lead	Y	Y	5.55E-03	2.10E-04	2.63E-04	4.29E-06	2.16E-04	2.69E-04	4.29E-06	-	4.21E-05	4.21E-05	-	-	-	-	-	-	6.60E-03	No
Manganese	Y	Y	1.81E-01	7.01E-03	8.76E-03	3.26E-06	7.20E-03	8.95E-03	3.26E-06	-	3.20E-05	3.20E-05	-	-	-	-	-	-	2.13E-01	No
Mercury	Y	Y	4.66E-04	1.53E-05	1.92E-05	2.23E-06	1.58E-05	1.96E-05	2.23E-06	-	2.19E-05	2.19E-05	-	-	-	-	-	-	5.84E-04	No
Methyl bromide	Y	Y	5.84E-04	6.57E-05	8.22E-05	-	6.75E-05	8.39E-05	-	-	-	-	-	-	-	-	-	-	8.83E-04	No
Methyl chloride	Y	Y	8.95E-04	1.01E-04	1.26E-04	-	1.04E-04	1.29E-04	-	-	-	-	-	-	-	-	-	-	1.35E-03	No
3-Methylchloranthrene	Y	N	4.95E-07	-	-	1.55E-08	-	-	1.55E-08	-	1.51E-07	1.51E-07	-	-	-	-	-	-	8.29E-07	No
Methylene chloride	Y	Y	1.13E-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.13E-02	No
Naphthalene	Y	Y	3.95E-03	4.25E-04	5.31E-04	5.24E-06	4.37E-04	5.43E-04	5.24E-06	-	5.13E-05	5.13E-05	-	-	1.53E-04	-	-	-	6.15E-03	No
Nickel	Y	Y	4.30E-03	1.45E-04	1.81E-04	1.80E-05	1.49E-04	1.85E-04	1.80E-05	-	1.77E-04	1.77E-04	-	-	-	-	-	-	5.35E-03	No
Nitrophenol, 4-	Y	Y	4.28E-06	4.82E-07	6.03E-07	-	4.95E-07	6.15E-07	-	-	-	-	-	-	-	-	-	-	6.47E-06	No
Pentachlorophenol	Y	Y	1.98E-06	2.24E-07	2.79E-07	-	2.30E-07	2.85E-07	-	-	-	-	-	-	-	-	-	-	3.00E-06	No
Perchloroethylene	Y	Y	1.48E-03	1.67E-04	2.08E-04	-	1.71E-04	2.13E-04	-	-	-	-	-	-	-	-	-	-	2.24E-03	No
Phosphorus metal, yellow or white	Y	Y	3.05E-03	1.18E-04	1.48E-04	-	1.22E-04	1.51E-04	-	-	-	-	-	-	-	-	-	-	3.59E-03	No
Polychlorinated biphenyls	Y	Y	3.17E-07	3.57E-08	4.46E-08	-	3.67E-08	4.56E-08	-	-	-	-	-	-	-	-	-	-	4.80E-07	No
Polycyclic Organic Matter	Y	Y	1.61E-02	5.48E-04	6.85E-04	3.50E-04	5.63E-04	6.99E-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	Y	3.23E-04	1.23E-05	1.53E-05	2.06E-07	1.26E-05	1.57E-05	2.06E-07	-	2.02E-06	2.02E-06	-	-	-	-	-	-	3.83E-04	No
Styrene	Y	Y	7.39E-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.39E-02	No
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	Y	3.35E-10	3.77E-11	4.71E-11	-	3.87E-11	4.81E-11	-	-	-	-	-	-	-	-	-	-	5.06E-10	No
Toluene	Y	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	Y	1.21E-03	1.36E-04	1.70E-04	-	1.40E-04	1.73E-04	-	-	-	-	-	-	-	-	-	-	1.82E-03	No
Trichloroethylene	Y	Y	1.17E-03	1.31E-04	1.31E-04	-	1.35E-04	1.35E-04	-	-	-	-	-	-	-	-	-	-	1.70E-03	No
Trichlorofluoromethane	N	N	1.60E-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.60E-03	No
Trichlorophenol, 2,4,6-	Y	Y	8.56E-07	9.64E-08	1.21E-07	-	9.90E-08	1.23E-07	-	-	-	-	-	-	-	-	-	-	1.29E-06	No
Vinyl chloride	Y	Y	7.00E-04	7.89E-05	9.86E-05	-	8.10E-05	1.01E-04	-	-	-	-	-	-	-	-	-	-	1.06E-03	No
Xylene	Y	Y	9.73E-04	-	-	-	-	-	-	-	-	-	-	1.75E-04	2.26E-04	1.50E-04	-	-	1.52E-03	No
TOTAL HAP			**12.57**	**1.20**	**0.17**	**0.04**	**1.38**	**0.18**	**0.04**	**0.01**	**3.12**	**1.11**	**1.09**	**0.002**	**0.002**	**0.002**	**0.027**	**0.18**	**21.11**	No
TOTAL TAP			12.57	1.20	0.17	0.04	1.38	0.18	0.04	0.01	3.12	1.11	1.09	0.00	0.00	0.00	0.03	0.18	21.11	

Notes:

1. Each dryer line is routed to a separate RTO (CD-RTO-1 and CD-RTO-2). Although Dryer 1 and Dryer 2 are capable of processing up to 535,260 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.

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TABLE C-3
POTENTIAL EMISSIONS AT OUTLET OF RTO-1 STACK
ROTARY DRYER 1 - CRITERIA POLLUTANT EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Dryer Inputs

Annual Dried Wood Throughput[1]	**781,255**	ODT/year
Max. Hourly Dried Wood Throughput of Dryer	70.83	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%**	

RTO and Dryer Criteria Pollutant Calculations:

Pollutant	Biomass Emission Factor	Units	Emission Factor Source	Controlled Emissions[2]	
				Max (lb/hr)	Annual (tpy)
CO	0.4	lb/ODT	Note 3	28.33	156.3
NO_X	0.282	lb/ODT	Southampton July 2015 VOC Compliance Stack Testing	19.97	110.2
$PM/PM_{10}/PM_{2.5}$ (Filterable + Condensable)	7.6	lb/hr	Note 4	7.60	33.3
SO_2	0.0151	lb/MMBtu	Note 5	2.65	11.6
Total VOC (as propane)	2.64	lb/ODT	Note 6	4.67	25.8

Note:

[1] Annual dried wood throughput is based on total facility production. Although Dryer 1 and Dryer 2 are capable of processing up to 535,260 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 dryer lines are based on the total facility throughput and calculated as follows:

- Except for NO_x, 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.
- Except for NO_x, 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.
- As NO_x emissions from dryer 1 are based on throughput (i.e. lb/ODT) and NO_x emission from dryer 2 are based on hourly test/vendor data (i.e., lb/hr), the total NO_x emissions are conservatively estimated based on the max annual capacity of dryer 1 (i.e., 535,260 ODT/yr) plus the emissions from dryer 2 plus the emissions from the green hammermills.
- 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] Exhaust from the dryer (ES-DRYER) and green hammermills (ES-GHM-1 through 3) are routed to a WESP and then RTO for control of VOC, HAP, and particulates.

[3] CO emissions based on data from similar Enviva facilities and information from NCASI database.

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

[5] Emission factor developed based on wood biomass composition test data and NCASI guidance that 95% of the sulfur contained in wood residue is captured in the boiler combustion zone within the alkaline wood ashes during wood combustion and only the remaining 5% escapes via the stack as SO_2. Includes contingency factor.

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

Thermal Generated Potential Criteria Pollutant Emissions [1]

Maximum high heating value of VOC constituents	0.018	MMBtu/lb
Uncontrolled VOC emissions	707	tons/yr
Uncontrolled VOC emissions	187	lb/hr
Heat input of uncontrolled VOC emissions	26,136	MMBtu/yr
Heat input of uncontrolled VOC emissions	3.5	MMBtu/hr

Pollutant	Emission Factor	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
NO_X	9.8E-02	lb/MMBtu[1]	0.34	1.28

Heat Input to RTO from Natural Gas	32	MMBtu/hr
Heat Input to RTO from Natural Gas	280,320	MMBtu/yr

Pollutant	Emission Factor	Units	Potential Emissions	
			Max (lb/hr)	Annual (tpy)
NO_x	9.8E-02	lb/MMBtu[2]	3.14	13.74

Notes:

1. The NO_x emission factor for existing Dryer 1 is based on stack testing at the WESP and, therefore, does not include thermally-generated NO_x.
2. NO_x emission factor is from AP-42, Fifth Edition, Volume 1, Chapter 1.4 - Natural Gas Combustion, 07/98 for small boilers.

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TABLE C-4
POTENTIAL EMISSIONS AT OUTLET OF RTO-1 STACK
GREEN HAMMERMILL - VOC, HAP AND TAP EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Max Hourly Throughput[1]	150 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	VOC	Emission Factor[2]	Potential Emissions[3]	
				(lb/ODT)	Max (lb/hr)	Annual (tpy)
Acetaldehyde	75-07-0	Y	Y	8.4E-03	0.032	0.082
Acrolein	107-02-8	Y	Y	1.6E-02	0.059	0.15
Formaldehyde	50-00-0	Y	Y	4.8E-03	0.018	0.047
Methanol	67-56-1	Y	Y	3.7E-02	0.14	0.36
Phenol	108-95-2	Y	Y	4.6E-03	0.017	0.045
Propionaldehyde	123-38-6	Y	Y	1.2E-03	0.0045	0.012
				Total HAP Emissions	**0.27**	**0.70**
Total VOC (as propane)	--	N/A	Y	0.32	1.21	3.15

Notes:

1. The max hourly throughput is based on the currently permitted max hourly throughput 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 C-5
POTENTIAL EMISSIONS AT OUTLET OF RTO-1 STACK
ROTARY DRYER 1 - HAP & TAP POLLUTANT EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Dryer Inputs

Annual Dried Wood Throughput[10]	**781,255**	ODT/year
Max. Hourly Dried Wood Throughput of Dryer	70.83	ODT/hr
Burner Heat Input (HHV)	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	VOC	Emission Factor	Units	Footnote	Potential Emissions	
						Max (lb/hr)	Annual (tpy)
Dryer Burner - Biomass Source							
Acetaldehyde	Y	Y	1.7E-01	lb/ODT	1	0.30	1.64
Acrolein	Y	Y	1.1E-01	lb/ODT	1	0.19	1.07
Formaldehyde	Y	Y	1.4E-01	lb/ODT	1	0.25	1.40
Methanol	Y	Y	1.0E-01	lb/ODT	1	0.19	1.02
Phenol	Y	Y	5.8E-02	lb/ODT	1	0.10	0.56
Propionaldehyde	Y	Y	3.9E-02	lb/ODT	1	0.07	0.38
Acetophenone	Y	Y	3.2E-09	lb/MMBtu	2,3	1.4E-08	6.1E-08
Antimony and compounds	Y	N	7.9E-06	lb/MMBtu	2,4	1.0E-04	4.4E-04
Arsenic	Y	N	2.2E-05	lb/MMBtu	2,4	2.8E-04	1.2E-03
Benzene	Y	Y	4.2E-03	lb/MMBtu	2,3	1.8E-02	8.1E-02
Benzo(a)pyrene	Y	Y	2.6E-06	lb/MMBtu	2,3	1.1E-05	5.0E-05
Beryllium	Y	N	1.1E-06	lb/MMBtu	2,4	1.4E-05	6.1E-05
Cadmium	Y	N	4.1E-06	lb/MMBtu	2,4	5.2E-05	2.3E-04
Carbon tetrachloride	Y	Y	4.5E-05	lb/MMBtu	2,3	2.0E-04	8.6E-04
Chlorine	Y	N	7.9E-04	lb/MMBtu	2,9	1.4E-01	6.1E-01
Chlorobenzene	Y	Y	3.3E-05	lb/MMBtu	2,3	1.4E-04	6.3E-04
Chloroform	Y	Y	2.8E-05	lb/MMBtu	2,3	1.2E-04	5.4E-04
Chromium VI	-[5]	N	3.5E-06	lb/MMBtu	2,4,5	4.4E-05	1.9E-04
Chromium–Other compounds	Y	N	1.8E-05	lb/MMBtu	2,4	2.2E-04	9.7E-04
Cobalt compounds	Y	N	6.5E-06	lb/MMBtu	2,4	8.3E-05	3.6E-04
Dichloroethane, 1,2-	Y	Y	2.9E-05	lb/MMBtu	2,3	1.3E-04	5.6E-04
Dichloropropane, 1,2-	Y	Y	3.3E-05	lb/MMBtu	2,3	1.4E-04	6.3E-04
Dinitrophenol, 2,4-	Y	Y	1.8E-07	lb/MMBtu	2,3	7.9E-07	3.5E-06
Di(2-ethylhexyl)phthalate	Y	Y	4.7E-08	lb/MMBtu	2,3	2.1E-07	9.0E-07
Ethyl benzene	Y	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	1.8E-11	lb/MMBtu	2,3	7.8E-11	3.4E-10
Hydrochloric acid	Y	N	1.9E-02	lb/MMBtu	2,6	3.3E-01	1.5E+00
Lead	Y	N	4.8E-05	lb/MMBtu	2,4	6.1E-04	2.7E-03
Manganese	Y	N	1.6E-03	lb/MMBtu	2,4	2.0E-02	8.9E-02
Mercury	Y	N	3.5E-06	lb/MMBtu	2,4	4.4E-05	1.9E-04
Methyl bromide	Y	Y	1.5E-05	lb/MMBtu	2,3	6.6E-05	2.9E-04
Methyl chloride	Y	Y	2.3E-05	lb/MMBtu	2,3	1.0E-04	4.4E-04
Methyl ethyl ketone	N	Y	5.4E-06	lb/MMBtu	2,3	2.4E-05	1.0E-04
Methylene chloride	Y	Y	2.9E-04	lb/MMBtu	2,3	1.3E-03	5.6E-03
Naphthalene	Y	Y	9.7E-05	lb/MMBtu	2,3	4.3E-04	1.9E-03
Nickel	Y	N	3.3E-05	lb/MMBtu	2,4	4.2E-04	1.8E-03
Nitrophenol, 4-	Y	Y	1.1E-07	lb/MMBtu	2,3	4.8E-07	2.1E-06
Pentachlorophenol	Y	N	5.1E-08	lb/MMBtu	2	2.2E-07	9.8E-07
Perchloroethylene	Y	N	3.8E-05	lb/MMBtu	2	1.7E-04	7.3E-04
Phosphorus metal, yellow or white	Y	N	2.7E-05	lb/MMBtu	2,4	3.4E-04	1.5E-03

TABLE C-5
POTENTIAL EMISSIONS AT OUTLET OF RTO-1 STACK
ROTARY DRYER 1 - HAP & TAP POLLUTANT EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Polychlorinated biphenyls	Y	Y	8.2E-09	lb/MMBtu	2,3	3.6E-08	1.6E-07
Polycyclic Organic Matter	Y	N	1.3E-04	lb/MMBtu	2	5.5E-04	2.4E-03
Selenium compounds	Y	N	2.8E-06	lb/MMBtu	2,4	3.6E-05	1.6E-04
Styrene	Y	Y	1.9E-03	lb/MMBtu	2,3	8.3E-03	3.6E-02
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	Y	8.6E-12	lb/MMBtu	2,3	3.8E-11	1.7E-10
Toluene	Y	Y	3.0E-05	lb/MMBtu	2,3	1.3E-04	5.8E-04
Trichloroethane, 1,1,1-	Y	N	3.1E-05	lb/MMBtu	2	1.4E-04	6.0E-04
Trichloroethylene	Y	Y	3.0E-05	lb/MMBtu	2,3	1.3E-04	5.8E-04
Trichlorofluoromethane	N	Y	4.1E-05	lb/MMBtu	2,3	1.8E-04	7.9E-04
Trichlorophenol, 2,4,6-	Y	Y	2.2E-08	lb/MMBtu	2,3	9.6E-08	4.2E-07
Vinyl chloride	Y	Y	1.8E-05	lb/MMBtu	2,3	7.9E-05	3.5E-04
Xylene	Y	Y	2.5E-05	lb/MMBtu	2,3	1.1E-04	4.8E-04
Total HAP Emissions (related to biomass)						**1.6**	**8.4**
Pollutant	**HAP**	**VOC**	**Emission Factor**	**Units**	**Footnote**	**Potential Emissions**	
						Max (lb/hr)	**Annual (tpy)**
RTO - Natural Gas/Propane Source							
2-Methylnaphthalene	Y	Y	2.4E-05	lb/MMscf	7	7.5E-07	3.3E-06
3-Methylchloranthrene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
7,12-Dimethylbenz(a)anthracene	Y	Y	1.6E-05	lb/MMscf	7	5.0E-07	2.2E-06
Acenaphthene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Acenaphthylene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Acetaldehyde	Y	Y	1.5E-05	lb/MMscf	7	4.8E-07	2.1E-06
Acrolein	Y	Y	1.8E-05	lb/MMscf	7	5.6E-07	2.5E-06
Ammonia	N	N	3.2	lb/MMscf	7	1.0E-01	4.4E-01
Anthracene	Y	Y	2.4E-06	lb/MMscf	7	7.5E-08	3.3E-07
Arsenic	Y	N	2.0E-04	lb/MMscf	7	6.3E-06	2.7E-05
Benz(a)anthracene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Benzene	Y	Y	7.1E-04	lb/MMBtu	8	2.3E-02	1.0E-01
Benzo(a)pyrene	Y	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.6E-07
Benzo(b)fluoranthene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Benzo(g,h,i)perylene	Y	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.6E-07
Benzo(k)fluoranthene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Beryllium	Y	N	1.2E-05	lb/MMscf	7	3.8E-07	1.6E-06
Cadmium	Y	N	1.1E-03	lb/MMscf	7	3.5E-05	1.5E-04
Chromium VI	Y	N	1.4E-03	lb/MMscf	7	4.4E-05	1.9E-04
Chrysene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Cobalt	Y	N	8.4E-05	lb/MMscf	7	2.6E-06	1.2E-05
Dibenzo(a,h)anthracene	Y	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.6E-07
Dichlorobenzene	Y	Y	1.2E-03	lb/MMscf	7	3.8E-05	1.6E-04
Fluoranthene	Y	Y	3.0E-06	lb/MMscf	7	9.4E-08	4.1E-07
Fluorene	Y	Y	2.8E-06	lb/MMscf	7	8.8E-08	3.8E-07
Formaldehyde	Y	Y	1.5E-03	lb/MMBtu	8	4.8E-02	2.1E-01
Hexane	Y	Y	1.8	lb/MMscf	7	5.6E-02	2.5E-01
Indeno(1,2,3-cd)pyrene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Lead	Y	N	5.0E-04	lb/MMscf	7	1.6E-05	6.9E-05
Manganese	Y	N	3.8E-04	lb/MMscf	7	1.2E-05	5.2E-05
Mercury	Y	N	2.6E-04	lb/MMscf	7	8.2E-06	3.6E-05
Naphthalene	Y	Y	6.1E-04	lb/MMscf	7	1.9E-05	8.4E-05
Nickel	Y	N	2.1E-03	lb/MMscf	7	6.6E-05	2.9E-04
Polycyclic Organic Matter	Y	N	4.0E-05	lb/MMBtu	8	1.3E-03	5.6E-03
Phenanthrene	Y	Y	1.7E-05	lb/MMscf	7	5.3E-07	2.3E-06
Pyrene	Y	Y	5.0E-06	lb/MMscf	7	1.6E-07	6.9E-07
Selenium compounds	Y	N	2.4E-05	lb/MMscf	7	7.5E-07	3.3E-06
Toluene	Y	Y	3.4E-03	lb/MMscf	7	1.1E-04	4.7E-04
Total HAP Emissions (related to natural gas/propane)						**0.129**	**0.564**

TABLE C-5
POTENTIAL EMISSIONS AT OUTLET OF RTO-1 STACK
ROTARY DRYER 1 - HAP & TAP POLLUTANT EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

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. Actual design filterable efficiency is estimated to 96.4%, but 92.75% is assumed for toxics permitting.
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.
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 1 and Dryer 2 are capable of processing up to 535,260 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 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.

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
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
$PM_{2.5}$ - particulate matter with an aerodynamic diameter of 2.5 m
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 C-6
DRYER 1 BYPASS - POTENTIAL EMISSIONS [1]
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Hourly Throughput	70.83 ODT/hr
Hourly Heat Input Capacity (HHV)	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 C-6
DRYER 1 BYPASS - POTENTIAL EMISSIONS [1]
ENVIVA PELLETS SOUTHAMPTON, 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	11.9	0.30
Acrolein	0.110	lb/ODT	2	7.79	0.195
Formaldehyde	0.144	lb/ODT	2	10.16	0.25
Methanol	0.10	lb/ODT	2	7.43	0.19
Phenol	0.058	lb/ODT	2	4.08	0.10
Propionaldehyde	0.039	lb/ODT	2	2.73	0.068
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	**48.0**	**1.200**

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 Cottondale and other similar Enviva plants.
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 C-7
POTENTIAL EMISSIONS - FURNACE 1 BYPASS (FULL CAPACITY)[1]
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Hourly Heat Input Capacity (HHV)	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	0.58	lb/MMBtu[2]	101.1	2.53
Total PM_{10}	0.52	lb/MMBtu[2]	90.6	2.27
Total $PM_{2.5}$	0.45	lb/MMBtu[2]	78.4	1.96

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 C-7
POTENTIAL EMISSIONS - FURNACE 1 BYPASS (FULL CAPACITY)[1]
ENVIVA PELLETS SOUTHAMPTON, 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 C-8
POTENTIAL EMISSIONS - FURNACE 1 BYPASS (IDLE MODE)[1]
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Hourly Heat Input Capacity	5 MMBtu/hr
Annual Heat Input Capacity	2,190 MMBtu/yr
Hours of Operation[1]	438 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	0.66
NO_X	0.22	lb/MMBtu[2]	1.10	0.24
SO_2	0.025	lb/MMBtu[2]	0.13	0.027
VOC	0.017	lb/MMBtu[2]	0.085	0.019
Total PM	0.58	lb/MMBtu[2]	2.89	0.63
Total PM_{10}	0.52	lb/MMBtu[2]	2.59	0.57
Total $PM_{2.5}$	0.45	lb/MMBtu[2]	2.24	0.49

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 condensable factors from Table 1.6-1. VOC emission factor excludes formaldehyde.

TABLE C-8
POTENTIAL EMISSIONS - FURNACE 1 BYPASS (IDLE MODE)[1]
ENVIVA PELLETS SOUTHAMPTON, 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	9.09E-04
Acrolein	4.00E-03	lb/MMBtu	1	2.00E-02	4.38E-03
Formaldehyde	4.40E-03	lb/MMBtu	1	2.20E-02	4.82E-03
Phenol	5.10E-05	lb/MMBtu	1	2.55E-04	5.58E-05
Propionaldehyde	6.10E-05	lb/MMBtu	1	3.05E-04	6.68E-05
Acetophenone	3.2E-09	lb/MMBtu	1	1.60E-08	3.50E-09
Antimony and compounds	7.9E-06	lb/MMBtu	1	3.95E-05	8.65E-06
Arsenic	2.2E-05	lb/MMBtu	1	1.10E-04	2.41E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	1	1.30E-05	2.85E-06
Beryllium	1.1E-06	lb/MMBtu	1	5.50E-06	1.20E-06
Cadmium	4.1E-06	lb/MMBtu	1	2.05E-05	4.49E-06
Carbon tetrachloride	4.5E-05	lb/MMBtu	1	2.25E-04	4.93E-05
Chlorine	7.9E-04	lb/MMBtu	1	3.95E-03	8.65E-04
Chlorobenzene	3.3E-05	lb/MMBtu	1	1.65E-04	3.61E-05
Chromium–Other compounds	2.1E-05	lb/MMBtu	1	1.05E-04	2.30E-05
Cobalt compounds	6.5E-06	lb/MMBtu	1	3.25E-05	7.12E-06
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	1	9.00E-07	1.97E-07
Bis(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	1	2.35E-07	5.15E-08
Ethyl benzene	3.1E-05	lb/MMBtu	1	1.55E-04	3.39E-05
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	1	1.45E-04	3.18E-05
Hydrochloric acid	1.9E-02	lb/MMBtu	1	9.50E-02	2.08E-02
Lead	4.8E-05	lb/MMBtu	1	2.40E-04	5.26E-05
Manganese	1.6E-03	lb/MMBtu	1	8.00E-03	1.75E-03
Mercury	3.5E-06	lb/MMBtu	1	1.75E-05	3.83E-06
Methyl bromide	1.5E-05	lb/MMBtu	1	7.50E-05	1.64E-05
Methyl chloride	2.3E-05	lb/MMBtu	1	1.15E-04	2.52E-05
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	1	1.55E-04	3.39E-05
Naphthalene	9.7E-05	lb/MMBtu	1	4.85E-04	1.06E-04
Nickel	3.3E-05	lb/MMBtu	1	1.65E-04	3.61E-05
Nitrophenol, 4-	1.1E-07	lb/MMBtu	1	5.50E-07	1.20E-07
Pentachlorophenol	5.1E-08	lb/MMBtu	1	2.55E-07	5.58E-08
Perchloroethylene	3.8E-05	lb/MMBtu	1	1.90E-04	4.16E-05
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	1	1.35E-04	2.96E-05
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	1	4.08E-08	8.92E-09
Polycyclic Organic Matter	1.3E-04	lb/MMBtu	1	6.25E-04	1.37E-04
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	1	1.65E-04	3.61E-05
Selenium compounds	2.8E-06	lb/MMBtu	1	1.40E-05	3.07E-06
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	1	4.30E-11	9.42E-12
Trichloroethene	3.0E-05	lb/MMBtu	1	1.50E-04	3.29E-05
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	1	1.10E-07	2.41E-08
Vinyl chloride	1.8E-05	lb/MMBtu	1	9.00E-05	1.97E-05
Total HAP Emissions (Biomass Combustion)				**0.16**	**0.034**

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 C-9
Double Duct Burner (ES-DDB-1 & -2) Potential Emissions
ENVIVA PELLETS SOUTHAMPTON, 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

Note:

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 C-9
Double Duct Burner (ES-DDB-1 & -2) Potential Emissions
ENVIVA PELLETS SOUTHAMPTON, LLC

Potential HAP and TAP Emissions

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

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 C-10
POTENTIAL EMISSIONS AT OUTLET OF RTO-2 STACK
ROTARY DRYER 2 -CRITERIA POLLUTANT EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Dryer Inputs

Annual Dried Wood Throughput[1]	**781,255**	ODT/year
Max. Hourly Dried Wood Throughput of Dryer	82.10	ODT/hr
Burner Heat Input (HHV)	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%**	

RTO and Dryer Criteria Pollutant Calculations:

Pollutant	Biomass Emission Factor	Units	Emission Factor Source	Controlled Emissions[2]	
				Max (lb/hr)	Annual (tpy)
CO	0.4	lb/ODT	Note 3	32.84	156.3
NO_X	27.73	lb/hr	Note 3	27.73	121.5
$PM/PM_{10}/PM_{2.5}$ (Filterable + Condensable)	7.6	lb/hr	Note 4	7.60	33.3
SO_2	0.0151	lb/MMBtu	Note 5	2.72	11.9
Total VOC (as propane)	2.64	lb/ODT	Note 6	5.42	25.8

Note:

[1] Annual dried wood throughput is based on total facility production. Although Dryer 1 and Dryer 2 are capable of processing up to 535,260 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 dryer lines are based on the total facility throughput and calculated as follows:

- Except for NO_x, 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.
- Except for NO_x, 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.
- As NO_x emissions from dryer 1 are based on throughput (i.e. lb/ODT) and NO_x emission from dryer 2 are based on hourly test/vendor data (i.e., lb/hr), the total NO_x emissions are conservatively estimated based on the max annual capacity of dryer 1 (i.e., 535,260 ODT/yr) plus the emissions from dryer 2 plus the emissions from the green hammermills.
- 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] Exhaust from the dryer (ES-DRYER-2) is routed to a WESP and then RTO for control of VOC, HAP, and particulates.

[3] CO emissions based on data from similar Enviva facilities and information from NCASI database.
NOx emissions based on stack test data from similar Enviva facilities.

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

[5] Emission factor developed based on wood biomass composition test data and NCASI guidance that 95% of the sulfur contained in wood residue is captured in the boiler combustion zone within the alkaline wood ashes during wood combustion and only the remaining 5% escapes via the stack as SO_2.

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

TABLE C-11

POTENTIAL EMISSIONS AT OUTLET OF RTO-2 STACK
ROTARY DRYER 2 - HAP & TAP POLLUTANT EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Dryer Inputs

Annual Dried Wood Throughput[10]	**781,255**	ODT/year
Max. Hourly Dried Wood Throughput of Dryer	82.10	ODT/hr
Burner Heat Input (HHV)	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	VOC	Emission Factor	Units	Footnote	Potential Emissions	
						Max (lb/hr)	Annual (tpy)
Dryer Burner - Biomass Source							
Acetaldehyde	Y	Y	1.7E-01	lb/ODT	1	0.35	1.64
Acrolein	Y	Y	1.1E-01	lb/ODT	1	0.23	1.07
Formaldehyde	Y	Y	1.4E-01	lb/ODT	1	0.29	1.40
Methanol	Y	Y	1.0E-01	lb/ODT	1	0.22	1.02
Phenol	Y	Y	5.8E-02	lb/ODT	1	0.12	0.56
Propionaldehyde	Y	Y	3.9E-02	lb/ODT	1	0.08	0.38
Acetophenone	Y	Y	3.2E-09	lb/MMBtu	2,3	1.4E-08	6.3E-08
Antimony and compounds	Y	N	7.9E-06	lb/MMBtu	2,4	1.0E-04	4.5E-04
Arsenic	Y	N	2.2E-05	lb/MMBtu	2,4	2.9E-04	1.3E-03
Benzene	Y	Y	4.2E-03	lb/MMBtu	2,3	1.9E-02	8.3E-02
Benzo(a)pyrene	Y	Y	2.6E-06	lb/MMBtu	2,3	1.2E-05	5.1E-05
Beryllium	Y	N	1.1E-06	lb/MMBtu	2,4	1.4E-05	6.3E-05
Cadmium	Y	N	4.1E-06	lb/MMBtu	2,4	5.4E-05	2.3E-04
Carbon tetrachloride	Y	Y	4.5E-05	lb/MMBtu	2,3	2.0E-04	8.9E-04
Chlorine	Y	N	7.9E-04	lb/MMBtu	2	1.4E-01	6.2E-01
Chlorobenzene	Y	Y	3.3E-05	lb/MMBtu	2,3	1.5E-04	6.5E-04
Chloroform	Y	Y	2.8E-05	lb/MMBtu	2,3	1.3E-04	5.5E-04
Chromium VI	-[5]	N	3.5E-06	lb/MMBtu	2,4,5	4.6E-05	2.0E-04
Chromium–Other compounds	Y	N	1.8E-05	lb/MMBtu	2,4	2.3E-04	1.0E-03
Cobalt compounds	Y	N	6.5E-06	lb/MMBtu	2,4	8.5E-05	3.7E-04
Dichloroethane, 1,2-	Y	Y	2.9E-05	lb/MMBtu	2,3	1.3E-04	5.7E-04
Dichloropropane, 1,2-	Y	Y	3.3E-05	lb/MMBtu	2,3	1.5E-04	6.5E-04
Dinitrophenol, 2,4-	Y	Y	1.8E-07	lb/MMBtu	2,3	8.1E-07	3.5E-06
Di(2-ethylhexyl)phthalate	Y	Y	4.7E-08	lb/MMBtu	2,3	2.1E-07	9.3E-07
Ethyl benzene	Y	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	1.8E-11	lb/MMBtu	2,3	8.1E-11	3.5E-10
Hydrochloric acid	Y	N	1.9E-02	lb/MMBtu	2,6	3.4E-01	1.5E+00
Lead	Y	N	4.8E-05	lb/MMBtu	2,4	6.3E-04	2.7E-03
Manganese	Y	N	1.6E-03	lb/MMBtu	2,4	2.1E-02	9.1E-02
Mercury	Y	N	3.5E-06	lb/MMBtu	2,4	4.6E-05	2.0E-04
Methyl bromide	Y	Y	1.5E-05	lb/MMBtu	2,3	6.8E-05	3.0E-04
Methyl chloride	Y	Y	2.3E-05	lb/MMBtu	2,3	1.0E-04	4.5E-04
Methyl ethyl ketone	N	Y	5.4E-06	lb/MMBtu	2,3	2.4E-05	1.1E-04
Methylene chloride	Y	Y	2.9E-04	lb/MMBtu	2,3	1.3E-03	5.7E-03
Naphthalene	Y	Y	9.7E-05	lb/MMBtu	2,3	4.4E-04	1.9E-03
Nickel	Y	N	3.3E-05	lb/MMBtu	2,4	4.3E-04	1.9E-03
Nitrophenol, 4-	Y	Y	1.1E-07	lb/MMBtu	2,3	5.0E-07	2.2E-06
Pentachlorophenol	Y	N	5.1E-08	lb/MMBtu	2	2.3E-07	1.0E-06
Perchloroethylene	Y	N	3.8E-05	lb/MMBtu	2	1.7E-04	7.5E-04
Phosphorus metal, yellow or white	Y	N	2.7E-05	lb/MMBtu	2,4	3.5E-04	1.5E-03

TABLE C-11

POTENTIAL EMISSIONS AT OUTLET OF RTO-2 STACK
ROTARY DRYER 2 - HAP & TAP POLLUTANT EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Polychlorinated biphenyls	Y	Y	8.2E-09	lb/MMBtu	2,3	3.7E-08	1.6E-07
Polycyclic Organic Matter	Y	N	1.3E-04	lb/MMBtu	2	5.6E-04	2.5E-03
Selenium compounds	Y	N	2.8E-06	lb/MMBtu	2,4	3.7E-05	1.6E-04
Styrene	Y	Y	1.9E-03	lb/MMBtu	2,3	8.6E-03	3.7E-02
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	Y	Y	8.6E-12	lb/MMBtu	2,3	3.9E-11	1.7E-10
Toluene	Y	Y	3.0E-05	lb/MMBtu	2,3	1.4E-04	5.9E-04
Trichloroethane, 1,1,1-	Y	N	3.1E-05	lb/MMBtu	2	1.4E-04	6.1E-04
Trichloroethylene	Y	Y	3.0E-05	lb/MMBtu	2,3	1.4E-04	5.9E-04
Trichlorofluoromethane	N	Y	4.1E-05	lb/MMBtu	2,3	1.8E-04	8.1E-04
Trichlorophenol, 2,4,6-	Y	Y	2.2E-08	lb/MMBtu	2,3	9.9E-08	4.3E-07
Vinyl chloride	Y	Y	1.8E-05	lb/MMBtu	2,3	8.1E-05	3.5E-04
Xylene	Y	Y	2.5E-05	lb/MMBtu	2,3	1.1E-04	4.9E-04
Total HAP Emissions (related to biomass)						**1.8**	**8.4**
Pollutant	**HAP**	**VOC**	**Emission Factor**	**Units**	**Footnote**	**Potential Emissions**	
						Max (lb/hr)	**Annual (tpy)**
RTO - Natural Gas/Propane Source							
2-Methylnaphthalene	Y	Y	2.4E-05	lb/MMscf	7	7.5E-07	3.3E-06
3-Methylchloranthrene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
7,12-Dimethylbenz(a)anthracene	Y	Y	1.6E-05	lb/MMscf	7	5.0E-07	2.2E-06
Acenaphthene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Acenaphthylene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Acetaldehyde	Y	Y	1.5E-05	lb/MMscf	7	4.8E-07	2.1E-06
Acrolein	Y	Y	1.8E-05	lb/MMscf	7	5.6E-07	2.5E-06
Ammonia	N	N	3.2	lb/MMscf	7	1.0E-01	4.4E-01
Anthracene	Y	Y	2.4E-06	lb/MMscf	7	7.5E-08	3.3E-07
Arsenic	Y	N	2.0E-04	lb/MMscf	7	6.3E-06	2.7E-05
Benz(a)anthracene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Benzene	Y	Y	7.1E-04	lb/MMBtu	8	2.3E-02	1.0E-01
Benzo(a)pyrene	Y	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.6E-07
Benzo(b)fluoranthene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Benzo(g,h,i)perylene	Y	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.6E-07
Benzo(k)fluoranthene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Beryllium	Y	N	1.2E-05	lb/MMscf	7	3.8E-07	1.6E-06
Cadmium	Y	N	1.1E-03	lb/MMscf	7	3.5E-05	1.5E-04
Chromium VI	Y	N	1.4E-03	lb/MMscf	7	4.4E-05	1.9E-04
Chrysene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Cobalt	Y	N	8.4E-05	lb/MMscf	7	2.6E-06	1.2E-05
Dibenzo(a,h)anthracene	Y	Y	1.2E-06	lb/MMscf	7	3.8E-08	1.6E-07
Dichlorobenzene	Y	Y	1.2E-03	lb/MMscf	7	3.8E-05	1.6E-04
Fluoranthene	Y	Y	3.0E-06	lb/MMscf	7	9.4E-08	4.1E-07
Fluorene	Y	Y	2.8E-06	lb/MMscf	7	8.8E-08	3.8E-07
Formaldehyde	Y	Y	1.5E-03	lb/MMBtu	8	4.8E-02	2.1E-01
Hexane	Y	Y	1.8	lb/MMscf	7	5.6E-02	2.5E-01
Indeno(1,2,3-cd)pyrene	Y	Y	1.8E-06	lb/MMscf	7	5.6E-08	2.5E-07
Lead	Y	N	5.0E-04	lb/MMscf	7	1.6E-05	6.9E-05
Manganese	Y	N	3.8E-04	lb/MMscf	7	1.2E-05	5.2E-05
Mercury	Y	N	2.6E-04	lb/MMscf	7	8.2E-06	3.6E-05
Naphthalene	Y	Y	6.1E-04	lb/MMscf	7	1.9E-05	8.4E-05
Nickel	Y	N	2.1E-03	lb/MMscf	7	6.6E-05	2.9E-04
Polycyclic Organic Matter	Y	N	4.0E-05	lb/MMBtu	8	1.3E-03	5.6E-03
Phenanthrene	Y	Y	1.7E-05	lb/MMscf	7	5.3E-07	2.3E-06
Pyrene	Y	Y	5.0E-06	lb/MMscf	7	1.6E-07	6.9E-07
Selenium compounds	Y	N	2.4E-05	lb/MMscf	7	7.5E-07	3.3E-06
Toluene	Y	Y	3.4E-03	lb/MMscf	7	1.1E-04	4.7E-04
Total HAP Emissions (related to natural gas/propane)						**0.129**	**0.564**

TABLE C-11

POTENTIAL EMISSIONS AT OUTLET OF RTO-2 STACK
ROTARY DRYER 2 - HAP & TAP POLLUTANT EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

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. Actual design filterable efficiency is estimated to 96.4%, but 92.75% is assumed for toxics permitting.
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.
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 1 and Dryer 2 are capable of processing up to 535,260 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 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.

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} - PM with an aerodynamic diameter <= 10 microns
$PM_{2.5}$ - PM with an aerodynamic diameter <= 2.5 microns
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 C-12
POTENTIAL EMISSIONS - DRYER 2 BYPASS[1]
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Hourly Throughput	82.10	ODT/hr
Hourly Heat Input Capacity (HHV)	180.00	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.
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 C-12
POTENTIAL EMISSIONS - DRYER 2 BYPASS[1]
ENVIVA PELLETS SOUTHAMPTON, 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	9.0	0.226
Formaldehyde	0.144	lb/ODT	2	11.8	0.29
Methanol	0.10	lb/ODT	2	8.6	0.22
Phenol	0.058	lb/ODT	2	4.7	0.12
Propionaldehyde	0.039	lb/ODT	2	3.2	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	**55.1**	**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 Cottondale and other similar Enviva plants.
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 C-13
POTENTIAL EMISSIONS - FURNACE 2 BYPASS (FULL CAPACITY)[1]
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Hourly Heat Input Capacity (HHV)	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	0.58	lb/MMBtu[2]	103.9	2.60
Total PM_{10}	0.52	lb/MMBtu[2]	93.1	2.33
Total $PM_{2.5}$	0.45	lb/MMBtu[2]	80.5	2.01

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 C-14
POTENTIAL EMISSIONS - FURNACE 2 BYPASS (IDLE MODE)[1]
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Hourly Heat Input Capacity	5 MMBtu/hr
Annual Heat Input Capacity	2,190 MMBtu/yr
Hours of Operation[1]	438 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	0.66
NO_X	0.22	lb/MMBtu[2]	1.10	0.24
SO_2	0.025	lb/MMBtu[2]	0.13	0.027
VOC	0.017	lb/MMBtu[2]	0.085	0.019
Total PM	0.58	lb/MMBtu[2]	2.89	0.63
Total PM_{10}	0.52	lb/MMBtu[2]	2.59	0.57
Total $PM_{2.5}$	0.45	lb/MMBtu[2]	2.24	0.49

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 condensable factors from Table 1.6-1. VOC emission factor excludes formaldehyde.

TABLE C-14
POTENTIAL EMISSIONS - FURNACE 2 BYPASS (IDLE MODE)[1]
ENVIVA PELLETS SOUTHAMPTON, 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	9.09E-04
Acrolein	4.00E-03	lb/MMBtu	1	2.00E-02	4.38E-03
Formaldehyde	4.40E-03	lb/MMBtu	1	2.20E-02	4.82E-03
Phenol	5.10E-05	lb/MMBtu	1	2.55E-04	5.58E-05
Propionaldehyde	6.10E-05	lb/MMBtu	1	3.05E-04	6.68E-05
Acetophenone	3.2E-09	lb/MMBtu	1	1.60E-08	3.50E-09
Antimony and compounds	7.9E-06	lb/MMBtu	1	3.95E-05	8.65E-06
Arsenic	2.2E-05	lb/MMBtu	1	1.10E-04	2.41E-05
Benzo(a)pyrene	2.6E-06	lb/MMBtu	1	1.30E-05	2.85E-06
Beryllium	1.1E-06	lb/MMBtu	1	5.50E-06	1.20E-06
Cadmium	4.1E-06	lb/MMBtu	1	2.05E-05	4.49E-06
Carbon tetrachloride	4.5E-05	lb/MMBtu	1	2.25E-04	4.93E-05
Chlorine	7.9E-04	lb/MMBtu	1	3.95E-03	8.65E-04
Chlorobenzene	3.3E-05	lb/MMBtu	1	1.65E-04	3.61E-05
Chromium–Other compounds	2.1E-05	lb/MMBtu	1	1.05E-04	2.30E-05
Cobalt compounds	6.5E-06	lb/MMBtu	1	3.25E-05	7.12E-06
Dinitrophenol, 2,4-	1.8E-07	lb/MMBtu	1	9.00E-07	1.97E-07
Bis(2-ethylhexyl)phthalate	4.7E-08	lb/MMBtu	1	2.35E-07	5.15E-08
Ethyl benzene	3.1E-05	lb/MMBtu	1	1.55E-04	3.39E-05
Dichloroethane, 1,2-	2.9E-05	lb/MMBtu	1	1.45E-04	3.18E-05
Hydrochloric acid	1.9E-02	lb/MMBtu	1	9.50E-02	2.08E-02
Lead	4.8E-05	lb/MMBtu	1	2.40E-04	5.26E-05
Manganese	1.6E-03	lb/MMBtu	1	8.00E-03	1.75E-03
Mercury	3.5E-06	lb/MMBtu	1	1.75E-05	3.83E-06
Methyl bromide	1.5E-05	lb/MMBtu	1	7.50E-05	1.64E-05
Methyl chloride	2.3E-05	lb/MMBtu	1	1.15E-04	2.52E-05
Trichloroethane, 1,1,1-	3.1E-05	lb/MMBtu	1	1.55E-04	3.39E-05
Naphthalene	9.7E-05	lb/MMBtu	1	4.85E-04	1.06E-04
Nickel	3.3E-05	lb/MMBtu	1	1.65E-04	3.61E-05
Nitrophenol, 4-	1.1E-07	lb/MMBtu	1	5.50E-07	1.20E-07
Pentachlorophenol	5.1E-08	lb/MMBtu	1	2.55E-07	5.58E-08
Perchloroethylene	3.8E-05	lb/MMBtu	1	1.90E-04	4.16E-05
Phosphorus metal, yellow or white	2.7E-05	lb/MMBtu	1	1.35E-04	2.96E-05
Polychlorinated biphenyls	8.2E-09	lb/MMBtu	1	4.08E-08	8.92E-09
Polycyclic Organic Matter	1.3E-04	lb/MMBtu	1	6.25E-04	1.37E-04
Dichloropropane, 1,2-	3.3E-05	lb/MMBtu	1	1.65E-04	3.61E-05
Selenium compounds	2.8E-06	lb/MMBtu	1	1.40E-05	3.07E-06
Tetrachlorodibenzo-p-dioxin, 2,3,7,8-	8.6E-12	lb/MMBtu	1	4.30E-11	9.42E-12
Trichloroethene	3.0E-05	lb/MMBtu	1	1.50E-04	3.29E-05
Trichlorophenol, 2,4,6-	2.2E-08	lb/MMBtu	1	1.10E-07	2.41E-08
Vinyl chloride	1.8E-05	lb/MMBtu	1	9.00E-05	1.97E-05
Total HAP Emissions (Biomass Combustion)				**0.16**	**0.034**

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 C-15
Double Duct Burner (ES-DDB-3 & -4) Potential Emissions
ENVIVA PELLETS SOUTHAMPTON, 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

Note:

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 C-15
Double Duct Burner (ES-DDB-3 & -4) Potential Emissions
ENVIVA PELLETS SOUTHAMPTON, LLC

Potential HAP and TAP Emissions

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

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 C-16
PROPANE VAPORIZER POTENTIAL EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, 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]	0.054	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, 07/08, 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]	Potential Emissions	
		(lb/MMBtu)	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	4.00E-05	1.75E-04
		Total HAP Emissions	**2.25E-03**	**9.86E-03**

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 C-17
POTENTIAL PELLET PRESS AND COOLER EMISSIONS AT OUTLET OF RCO-1 STACK
ENVIVA PELLETS SOUTHAMPTON, 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%

Pellet Cooler and Pellet Mill Potential Process VOC and HAP Emissions

Pollutant	CAS No.	HAP	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	0.492
Acrolein	107-02-8	Y	Y	0.050	0.36	0.975
Formaldehyde	50-00-0	Y	Y	0.006	0.04	0.121
Methanol	67-56-1	Y	Y	0.021	0.15	0.414
Phenol	108-95-2	Y	Y	0.025	0.18	0.492
Propionaldehyde	123-38-6	Y	Y	0.015	0.105	0.285
				Total HAP Emissions	**1.02**	**2.779**
Total VOC (as propane)	--	--	Y	1.41	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 for the RCO is applied to VOC and organic HAP emissions.
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	9.8E-02	lb/MMBtu	1.92	8.42
SO_2	5.9E-04	lb/MMBtu	1.2E-02	5.0E-02
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

TABLE C-17
POTENTIAL PELLET PRESS AND COOLER EMISSIONS AT OUTLET OF RCO-1 STACK
ENVIVA PELLETS SOUTHAMPTON, LLC

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	13.00	lb/Mgal	2.78	12.20
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 and Propane Combustion Potential HAP and TAP Emissions

Pollutant	HAP	VOC	Emission Factor	Units	Footnote	Potential Emissions	
						Max (lb/hr)	Annual (tpy)
Natural Gas/Propane Source							
2-Methylnaphthalene	Y	Y	2.4E-05	lb/MMscf	3	4.6E-07	2.0E-06
3-Methylchloranthrene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
7,12-Dimethylbenz(a)anthracene	Y	Y	1.6E-05	lb/MMscf	3	3.1E-07	1.3E-06
Acenaphthene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Acenaphthylene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Acetaldehyde	Y	Y	1.5E-05	lb/MMscf	3	2.9E-07	1.3E-06
Acrolein	Y	Y	1.8E-05	lb/MMscf	3	3.5E-07	1.5E-06
Ammonia	N	N	3.2	lb/MMscf	3	0.06	0.27
Anthracene	Y	Y	2.4E-06	lb/MMscf	3	4.6E-08	2.0E-07
Arsenic	Y	N	2.0E-04	lb/MMscf	3	3.8E-06	1.7E-05
Benz(a)anthracene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Benzene	Y	Y	7.1E-04	lb/MMBtu	4	1.4E-02	6.1E-02
Benzo(a)pyrene	Y	Y	1.2E-06	lb/MMscf	3	2.3E-08	1.0E-07
Benzo(b)fluoranthene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Benzo(g,h,i)perylene	Y	Y	1.2E-06	lb/MMscf	3	2.3E-08	1.0E-07
Benzo(k)fluoranthene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Beryllium	Y	N	1.2E-05	lb/MMscf	3	2.3E-07	1.0E-06
Cadmium	Y	N	1.1E-03	lb/MMscf	3	2.1E-05	9.3E-05
Chromium VI	Y	N	1.4E-03	lb/MMscf	3	2.7E-05	1.2E-04
Chrysene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Cobalt Compounds	Y	N	8.4E-05	lb/MMscf	3	1.6E-06	7.1E-06
Dibenzo(a,h)anthracene	Y	Y	1.2E-06	lb/MMscf	3	2.3E-08	1.0E-07
Dichlorobenzene	Y	Y	1.2E-03	lb/MMscf	3	2.3E-05	1.0E-04
Fluoranthene	Y	Y	3.0E-06	lb/MMscf	3	5.8E-08	2.5E-07
Fluorene	Y	Y	2.8E-06	lb/MMscf	3	5.4E-08	2.4E-07
Formaldehyde	Y	Y	1.5E-03	lb/MMBtu	4	2.9E-02	1.3E-01
Hexane	Y	Y	1.8	lb/MMscf	3	3.5E-02	0.15
Indeno(1,2,3-cd)pyrene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Lead	Y	N	5.0E-04	lb/MMscf	3	9.6E-06	4.2E-05
Manganese	Y	N	3.8E-04	lb/MMscf	3	7.3E-06	3.2E-05
Mercury	Y	N	2.6E-04	lb/MMscf	3	5.0E-06	2.2E-05
Naphthalene	Y	Y	6.1E-04	lb/MMscf	3	1.2E-05	5.1E-05
Nickel	Y	N	2.1E-03	lb/MMscf	3	4.0E-05	1.8E-04
Polycyclic Organic Matter	Y	N	4.0E-05	lb/MMBtu	5	7.8E-04	3.4E-03
Phenanthrene	Y	Y	1.7E-05	lb/MMscf	3	3.3E-07	1.4E-06
Pyrene	Y	Y	5.0E-06	lb/MMscf	3	9.6E-08	4.2E-07
Selenium compounds	Y	N	2.4E-05	lb/MMscf	3	4.6E-07	2.0E-06
Toluene	Y	Y	3.4E-03	lb/MMscf	3	6.5E-05	2.9E-04
Total HAP Emissions (natural gas/propane combustion)						**0.079**	**0.346**

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 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.
4. 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 C-18
POTENTIAL DRY HAMMERMILL EMISSIONS AT OUTLET OF RCO-2 STACK
ENVIVA PELLETS SOUTHAMPTON, 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	VOC	Emission Factor[2] (lb/ODT)	Potential Emissions Max (lb/hr)	Potential Emissions Annual (tpy)
Acetaldehyde	75-07-0	Y	Y	0.0073	0.05	0.121
Acrolein	107-02-8	Y	Y	0.0092	0.07	0.153
Formaldehyde	50-00-0	Y	Y	0.0071	0.05	0.118
Methanol	67-56-1	Y	Y	0.0071	0.05	0.118
Phenol	108-95-2	Y	Y	0.0028	0.02	0.046
Propionaldehyde	123-38-6	Y	Y	0.0124	0.09	0.206
				Total HAP Emissions	**0.33**	**0.762**
Total VOC (as propane)	--		Y	0.765	5.51	12.70

Notes:

1. Emissions from the dry hammermills are controlled by the RCO with estimated control efficiency of 95.0%.
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.

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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)	Annual (tpy)
CO	8.2E-02	lb/MMBtu	0.17	0.39
NO_X	9.8E-02	lb/MMBtu	0.20	0.46

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	9.8E-02	lb/MMBtu	1.92	8.42
SO_2	5.9E-04	lb/MMBtu	1.2E-02	5.0E-02
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	13.00	lb/Mgal	2.78	12.20
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

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Natural Gas and Propane Combustion Potential HAP and TAP Emissions

Pollutant	HAP	VOC	Emission Factor	Units	Footnote	Potential Emissions	
						Max (lb/hr)	Annual (tpy)
Natural Gas/Propane Source							
2-Methylnaphthalene	Y	Y	2.4E-05	lb/MMscf	3	4.6E-07	2.0E-06
3-Methylchloranthrene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
7,12-Dimethylbenz(a)anthracene	Y	Y	1.6E-05	lb/MMscf	3	3.1E-07	1.3E-06
Acenaphthene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Acenaphthylene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Acetaldehyde	Y	Y	1.5E-05	lb/MMscf	3	2.9E-07	1.3E-06
Acrolein	Y	Y	1.8E-05	lb/MMscf	3	3.5E-07	1.5E-06
Ammonia	N	N	3.2	lb/MMscf	3	6.1E-02	2.7E-01
Anthracene	Y	Y	2.4E-06	lb/MMscf	3	4.6E-08	2.0E-07
Arsenic	Y	N	2.0E-04	lb/MMscf	3	3.8E-06	1.7E-05
Benz(a)anthracene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Benzene	Y	Y	7.1E-04	lb/MMBtu	4	1.4E-02	6.1E-02
Benzo(a)pyrene	Y	Y	1.2E-06	lb/MMscf	3	2.3E-08	1.0E-07
Benzo(b)fluoranthene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Benzo(g,h,i)perylene	Y	Y	1.2E-06	lb/MMscf	3	2.3E-08	1.0E-07
Benzo(k)fluoranthene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Beryllium	Y	N	1.2E-05	lb/MMscf	3	2.3E-07	1.0E-06
Cadmium	Y	N	1.1E-03	lb/MMscf	3	2.1E-05	9.3E-05
Chromium VI	Y	N	1.4E-03	lb/MMscf	3	2.7E-05	1.2E-04
Chrysene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Cobalt Compounds	Y	N	8.4E-05	lb/MMscf	3	1.6E-06	7.1E-06
Dibenzo(a,h)anthracene	Y	Y	1.2E-06	lb/MMscf	3	2.3E-08	1.0E-07
Dichlorobenzene	Y	Y	1.2E-03	lb/MMscf	3	2.3E-05	1.0E-04
Fluoranthene	Y	Y	3.0E-06	lb/MMscf	3	5.8E-08	2.5E-07
Fluorene	Y	Y	2.8E-06	lb/MMscf	3	5.4E-08	2.4E-07
Formaldehyde	Y	Y	1.5E-03	lb/MMBtu	4	2.9E-02	1.3E-01
Hexane	Y	Y	1.8	lb/MMscf	3	3.5E-02	1.5E-01
Indeno(1,2,3-cd)pyrene	Y	Y	1.8E-06	lb/MMscf	3	3.5E-08	1.5E-07
Lead	Y	N	5.0E-04	lb/MMscf	3	9.6E-06	4.2E-05
Manganese	Y	N	3.8E-04	lb/MMscf	3	7.3E-06	3.2E-05
Mercury	Y	N	2.6E-04	lb/MMscf	3	5.0E-06	2.2E-05
Naphthalene	Y	Y	6.1E-04	lb/MMscf	3	1.2E-05	5.1E-05
Nickel	Y	N	2.1E-03	lb/MMscf	3	4.0E-05	1.8E-04
Polycyclic Organic Matter	Y	N	4.0E-05	lb/MMBtu	5	7.8E-04	3.4E-03
Phenanthrene	Y	Y	1.7E-05	lb/MMscf	3	3.3E-07	1.4E-06
Pyrene	Y	Y	5.0E-06	lb/MMscf	3	9.6E-08	4.2E-07
Selenium compounds	Y	N	2.4E-05	lb/MMscf	3	4.6E-07	2.0E-06
Toluene	Y	Y	3.4E-03	lb/MMscf	3	6.5E-05	2.9E-04
Total HAP Emissions (natural gas/propane combustion)						**0.079**	**0.345**

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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 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.
4. 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
TAP - toxic air pollutant
tpy - tons per year
VOC - volatile organic compound
yr - year

TABLE C-19
DRIED WOOD HANDLING POTENTIAL EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Hourly Throughput[1]	153 ODT/hr
Annual Throughput[1]	781,255 ODT/yr

Potential VOC and HAP Pollutant Emissions

Pollutant	Emission Factor (lb/ODT)	Potential Emissions	
		Max (lb/hr)	Annual (tpy)
Formaldehyde[2]	8.4E-04	0.128	0.33
Methanol[2]	2.0E-03	0.30	0.76
Total HAP Emissions		**0.43**	**1.09**
Total VOC (as propane)[3]	1.44E-02	2.20	5.62

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. Emission factor was derived based on test data from comparable Enviva facility and includes 20% contingency.

Abbreviations:

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

TABLE C-20
DEBARKER POTENTIAL EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Annual Throughput	781,255	tons/year (dry wood)[1]
Short-term Throughput	105.0	tons/hr (dry wood)[1]
Approximate Moisture Content	50%	of total weight

Pollutant	Emission Factor		Emissions	
			Max (lb/hr)	Annual (tpy)
PM[2]	2.00E-02	lb/ton	**0.42**	**1.56**
PM_{10}[2]	1.10E-02	lb/ton	**0.23**	**0.86**

[1] The annual throughput used for the debarker is assumed to equal 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. PM emissions are assumed to be controlled due to the use of water spray and the debarker being partially enclosed (assumed 90% control).

TABLE C-21
BARK HOG POTENTIAL EMISSIONS
ENVIVA PELLETS SOUTHAMPTON, LLC

Calculation Basis

Annual Throughput of Bark Hog	54,000	tons/year (dry wood)[1]
Short-term Throughput of Bark Hog	105.00	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	0.43	0.11
VOC as propane[3]	0.0050	lb/ODT	0.53	0.14
PM[4]	0.02	lb/ton	0.42	0.11
PM_{10}[4]	0.011	lb/ton	0.23	0.06
Methanol[2]	0.0010	lb/ODT	0.11	0.03

Notes:

[1] The annual throughput used for the bark hog assumes 40% of the annual throughput of the facility is from logs and that 15% of the logs are bark. The short-term throughput is based upon the maximum 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 C-22
ELECTRIC POWERED CHIPPER EMISSIONS
ENVIVA PELLET SOUTHAMPTON, LLC

Calculation Basis

Annual Throughput of Chipper	360,000	tons/year (dry wood)[1]
Short Term Throughput	59.7	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]	4.10E-03	lb/ODT	0.24	0.74
VOC as propane[3]	5.00E-03	lb/ODT	**0.30**	**0.90**
Methanol[2]	1.00E-03	lb/ODT	**0.06**	**0.18**

[1] The annual throughput used for the chipper assumes 40% of the annual throughput of the facility is from logs and that 15% of the logs are bark.

[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 C-23
SUMMARY OF POTENTIAL EMISSIONS FROM BAGHOUSES AND CYCLONES
ENVIVA PELLETS SOUTHAMPTON, LLC

Emission Unit ID	Source Description	Control Device ID	Control Device Description	Exhaust Flow Rate[1]	Pollutant 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 thru 3	Dry Hammermills 1 thru 3	CD-HM-BF-1	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 thru 6	Dry Hammermills 4 thru 6	CD-HM-BF-2	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 thru 9; ES-HMA	Dry Hammermills 7 thru 9; Hammermill Area	CD-HM-BF-3	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, including Pellet Screeners	CD-PCHP-BF	One (1) baghouse[5]	3,600	0.004	8760	100%	100%	0.123	0.54	0.123	0.54	0.123	0.54
ES-PMFS	Pellet Mill Feed Silo	CD-PMFS-BF	Bin Vent Filter[5]	2,500	0.004	8760	100%	100%	0.086	0.38	0.086	0.38	0.09	0.38
ES-CLR-1	Pellet Cooler	CD-CLR-1	One (1) new wet scubber[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	One (1) new wet scubber[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	One (1) new wet scubber[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	One (1) new wet scubber[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	One (1) new wet scubber[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	One (1) new wet scubber[6]	17,100	0.01	8760	26.1%	3.2%	1.47	6.42	0.38	1.68	0.05	0.21
ES-DWH	Dried Wood Handling	CD-DWH-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-TL	Finished Product Handling and Truck Loadout	CD-FPH-BF	One (1) baghouse[4,7]	35,500	0.004	8760	91.0%	1.7%	1.22	5.33	1.11	4.85	0.02	0.09
ES-ADD	Starch Additive Handling and Storage	CD-ADD-BF	One (1) baghouse[5]	1,600	0.004	117	100%	100%	0.05	0.003	0.05	0.003	0.05	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 conservatively assumed to be the same as the inlet flowrate.
2. Pollutant loading provided by Enviva. For Pellet Coolers, pollutant loading based on data from other Enviva facilities reflecting addition of a wet scrubber.
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

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TABLE C-24
GREEN WOOD HANDLING
ENVIVA PELLETS SOUTHAMPTON, LLC

Source	Transfer Activity[1]	Number of Drop Points	Material Moisture Content[2]	PM Emission Factor[3]	PM_{10} Emission Factor[3]	$PM_{2.5}$ Emission Factor[3]	Potential Throughput		Potential PM Emissions		Potential PM_{10} Emissions[4]		Potential $PM_{2.5}$ Emissions[4]	
			(%)	(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	Truck Tipper - Green Chips	3	42%	4.51E-05	2.13E-05	3.23E-06	113	673,496	1.5E-02	4.6E-02	1.8E-03	5.4E-03	2.7E-04	8.2E-04
	Disc Screen	1	42%	4.51E-05	2.13E-05	3.23E-06	2	13,470	6.8E-05	3.0E-04	8.0E-06	3.6E-05	1.2E-06	5.4E-06
	Stacker Reclaimer to Chip Storage Pile	1	42%	4.51E-05	2.13E-05	3.23E-06	113	134,699	5.1E-03	3.0E-03	6.0E-04	3.6E-04	9.1E-05	5.4E-05
	Front End Loader to Fuel Storage Pile No. 1	1	48%	3.74E-05	1.77E-05	2.68E-06	42	370,527	1.6E-03	6.9E-03	1.9E-04	8.2E-04	2.8E-05	1.2E-04
	Front End Loader to Fuel Storage Pile No. 2	1	48%	3.74E-05	1.77E-05	2.68E-06	21	185,264	7.9E-04	3.5E-03	9.3E-05	4.1E-04	1.4E-05	6.2E-05
	Front End Loader to Fuel Storage Pile No. 3	1	48%	3.74E-05	1.77E-05	2.68E-06	21	185,264	7.9E-04	3.5E-03	9.3E-05	4.1E-04	1.4E-05	6.2E-05
	Bark Diverter Chute	1	48%	3.74E-05	1.77E-05	2.68E-06	42	370,527	1.6E-03	6.9E-03	1.9E-04	8.2E-04	2.8E-05	1.2E-04
	Front End Loader to Bark Reclaim - Furnace 1	1	48%	3.74E-05	1.77E-05	2.68E-06	21	182,813	7.8E-04	3.4E-03	9.2E-05	4.0E-04	1.4E-05	6.1E-05
	Front End Loader to Bark Reclaim - Furnace 2	1	48%	3.74E-05	1.77E-05	2.68E-06	21	187,714	8.0E-04	3.5E-03	9.5E-05	4.1E-04	1.4E-05	6.3E-05
	Bark Receiving Truck Dumper	1	48%	3.74E-05	1.77E-05	2.68E-06	210	157,000	7.8E-03	2.9E-03	9.3E-04	3.5E-04	1.4E-04	5.3E-05
								Total Emissions:	**3.5E-02**	**7.9E-02**	**4.1E-03**	**9.4E-03**	**6.2E-04**	**1.4E-03**

Notes:

1. These green wood handling emissions are representative of the fugitive emissions at the site.
2. Moisture content provided by Enviva on 8/2318.
3. 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
U = mean wind speed (mph) for enclosed drop points	2

4. PM10 control efficiency of 74.7% applied for three-sided enclosed structure with 50% porosity per Sierra Research "Final BACM Technological and Economic Feasibility Analysis" , report prepared for the San Joaquin Valley Unified Air Pollution Control District (3/03). The control efficiency is assumed equivalent for PM10 and PM2.5 emissions.

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

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TABLE C-25
STORAGE PILE WIND EROSION
ENVIVA PELLETS SOUTHAMPTON, LLC

Source	Description	PM Emission Factor[1]		VOC Emission Factor[2]		Pile Width/ Diameter	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)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)	(lb/hr)	(tpy)
ES-GWHS	Green Wood Storage Pile No. 1	10.9	1.0E-05	1.6	1.5E-06	328	--	69	110,004	1.15	5.0	0.57	2.51	0.086	0.38	0.21	0.90
	Fuel Storage Pile No. 1	10.9	1.0E-05	1.6	1.5E-06	100	--	25	10,537	0.11	0.48	0.05	0.24	0.01	0.04	0.020	0.09
	Fuel Storage Pile No. 2	10.9	1.0E-05	1.6	1.5E-06	50	--	25	3,332	0.03	0.15	0.02	0.08	0.00	0.01	0.01	0.03
	Fuel Storage Pile No. 3	10.9	1.0E-05	1.6	1.5E-06	50	--	25	3,332	0.03	0.15	0.02	0.08	0.00	0.01	0.01	0.03
									Total Emissions:	**1.32**	**5.80**	**0.66**	**2.90**	**0.10**	**0.44**	**0.24**	**1.04**

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:	120	Per AP-42, Section 13.2.1, Figure 13.2.1-2 (Southampton, VA).
	f (time that wind exceeds 5.36 m/s - 12 mph) (%):	16.5	Based on meteorological data averaged for 2012-2016 for Richmond, VA 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. Based on Enviva engineering data, VOC emissions from greenwood storage piles are expected to be less than the low end of the range of the factors listed. Enviva conservatively chose to employ the minimum emission factor from the NCASI document.
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 VOC per year by the following formula:
tons VOC/year = 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 C-26
EMERGENCY GENERATOR AND FIRE PUMP
ENVIVA PELLETS SOUTHAMPTON, LLC

Emergency Generator 1 - Emissions (ES-EG-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/hp-hr

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					
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)		8.26E-06	lb/hp-hr (4)	2.89E-03	7.23E-04
Total HAPs				9.49E-03	2.37E-03

Note:

[1] NSPS allows for only 100 hrs/yr of non-emergency operation of these engines (not the 500 hours shown); however, the PTE for the emergency generator is based on 500 hr/yr per 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 C-26
EMERGENCY GENERATOR AND FIRE PUMP
ENVIVA PELLETS SOUTHAMPTON, LLC

Emergency Generator 2 - Emissions (ES-EG-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	Annual tpy
TSP	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					
Acetaldehyde	HAP	2.52E-05	lb/MMBtu (4)	1.18E-04	2.96E-05
Acrolein	HAP	7.88E-06	lb/MMBtu (4)	3.70E-05	9.25E-06
Benzene	HAP	7.76E-04	lb/MMBtu (4)	3.64E-03	9.11E-04
Benzo(a)pyrene[5]	HAP	2.57E-07	lb/MMBtu (4)	1.21E-06	3.02E-07
Formaldehyde	HAP	7.89E-05	lb/MMBtu (4)	3.70E-04	9.26E-05
Naphthalene[5]	HAP	1.30E-04	lb/MMBtu (4)	6.10E-04	1.53E-04
Total PAH (POM)	HAP	2.12E-04	lb/MMBtu (4)	9.95E-04	2.49E-04
Toluene	HAP	2.81E-04	lb/MMBtu (4)	1.32E-03	3.30E-04
Xylenes	HAP	1.93E-04	lb/MMBtu (4)	9.06E-04	2.26E-04
			Highest HAP (Benzene)	3.64E-03	9.11E-04
			Total HAPs	8.00E-03	2.00E-03

Notes:

[1] NSPS allows for only 100 hrs/yr of non-emergency operation of these engines (not the 500 hours shown); however, the PTE for the emergency generator is based on 500 hr/yr per 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.

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TABLE C-26
EMERGENCY GENERATOR AND FIRE PUMP
ENVIVA PELLETS SOUTHAMPTON, LLC

Firewater Pump Emissions (ES-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/hp-hr

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					
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)		8.26E-06	lb/hp-hr (4)	2.48E-03	6.20E-04
Total HAPs				8.13E-03	2.03E-03

Note:

[1] NSPS allows for only 100 hrs/yr of non-emergency operation of these engines (not the 500 hours shown); however, the PTE for the emergency generator is based on 500 hr/yr per 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.

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TABLE C-27
Diesel Storage Tanks
ES-TK-1 through 3
Enviva Pellets Southampton, 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)
ES-TK-1	Emergency Generator Fuel Storage Tank[2]	2,500	1,250	6.0	12	Horizontal	8,813	7.1	1.3E-04	5.8E-04
ES-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
ES-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
ES-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 ES-TK-1, ES-TK-2, and ES-TK-4 based on fuel consumption provided by Enviva and 500 hours of operation per year. Throughput for ES-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 ES-TK-2.
5. ES-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

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TABLE C-28
Potential Fugitive PM Emissions from Paved Roads
Enviva Pellets Southampton, 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]		Potential PM_{10} Emissions[3]		Potential $PM_{2.5}$ Emissions[3]	
												(lb/day)	(tpy)	(lb/day)	(tpy)	(lb/day)	(tpy)
Bark Delivery - Dumper	4,800	14	13	365	41,000	81,000	30.5	4,764	2.2	0.45	0.11	2.92	0.53	0.58	0.11	0.14	0.03
Bark Delivery - Self Unload	13,200	2	5	365	41,000	81,000	30.5	1,965	2.2	0.45	0.11	1.20	0.22	0.24	0.044	0.059	0.011
Log Delivery to Crane Storage Area	9,600	49	90	365	40,400	85,400	31.5	32,827	2.3	0.46	0.11	20.8	3.79	4.15	0.76	1.02	0.19
Log Delivery to Log Storage Area	10,560	49	99	365	40,400	85,400	31.5	36,110	2.3	0.46	0.11	22.8	4.17	4.57	0.83	1.12	0.20
Purchased Chip Delivery	6,300	109	130	365	41,000	91,000	33.0	47,394	2.4	0.48	0.12	31.5	5.75	6.30	1.15	1.5	0.28
Additive Delivery	4,800	0.26	0.23	365	41,000	91,000	33.0	86	2.4	0.48	0.12	0.057	0.010	0.011	0.0021	0.0028	0.00051
Pellet Truck to Pellet Loadout Area (Normal Operations)	6,000	92	104	365	41,000	91,000	33.0	37,959	2.4	0.48	0.12	25.2	4.60	5.04	0.92	1.24	0.23
Contractor Vehicle	5,600	18	19	365	4,000	4,000	2.0	6,894	0.1	0.03	0.01	0.26	0.05	0.05	0.01	0.01	0.002
Employee Car Parking	5,600	68	73	365	4,000	4,000	2.0	26,515	0.14	0.028	0.01	1.01	0.18	0.20	0.04	0.05	0.009
Front End Loader to Furnace 1 Walking Floor	350	6	0.40	365	56,375	63,375	29.9	148	2.20	0.44	0.11	0.089	0.016	0.018	0.0032	0.0044	0.00080
Front End Loader to Furnace 2 Walking Floor	534	6	0.6	365	56,375	63,375	29.9	225	2.20	0.44	0.11	0.14	0.025	0.027	0.0049	0.0066	0.0012
Front End Loader to Fuel Storage Pile No. 1	300	14	0.8	365	56,375	63,375	29.9	298	2.20	0.44	0.11	0.18	0.033	0.036	0.007	0.0088	0.0016
Front End Loader to Fuel Storage Pile No. 2	1,100	7	1.5	365	56,375	63,375	29.9	546	2.20	0.44	0.11	0.33	0.060	0.066	0.012	0.016	0.0029
Front End Loader to Fuel Storage Pile No. 3	1,500	7	2.0	365	56,375	63,375	29.9	744	2.20	0.44	0.11	0.45	0.082	0.090	0.016	0.022	0.0040
											Total Emissions:	**107**	**19.5**	**21.4**	**3.90**	**5.25**	**0.96**

Notes:

1. Distance traveled per round trip and annual average 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 (Southampton, VA).

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

RAMBOLL

TABLE C-29
POTENTIAL SITE-WIDE GHG EMISSIONS
ENVIVA PELLET SOUTHAMPTON, LLC

Operating Data:

Dryer-1 Heat Input	175.3	MMBtu/hr
Annual Heat Input	1,540,294	MMBtu/yr
Duct Burners 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 Burners 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	438	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	438	hrs/yr
RCO-1 Heat Input	192,112.5	MMBtu/yr
Operating Schedule	8,760	hrs/yr
RCO-2 Heat Input	181,092.0	MMBtu/yr
Operating Schedule	8,760	hrs/yr
Propane Vaporizer Heat Input	1	MMBtu/hr
Operating Schedule	8,760	hrs/yr
Emergency 1 Generator Output	350	bhp
Operating Schedule	500	hrs/yr
Power Conversion	7,000	Btu/hr/hp
Energy Input	2.450	MMBtu/hr
Emergency 2 Generator Output	671	bhp
Operating Schedule	500	hrs/yr
Power Conversion	7,000	Btu/hr/hp
Energy Input	4.694	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 C-29
POTENTIAL SITE-WIDE GHG EMISSIONS
ENVIVA PELLET SOUTHAMPTON, 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
ES-DDB-1 and -2	Propane	62.87	7.50E-02	1.79E-01	1214.16	1.45	3.45	1,219
Dryer 1 Bypass	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
ES-DDB-3 and -4	Propane	62.87	7.50E-02	1.79E-01	1214.16	1.45	3.45	1,219
Dryer 2 Bypass	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	930.56	1.79	10.64	943
ES-RTO-1	Propane	62.87	7.50E-02	1.79E-01	19426.62	23.17	55.25	19,505
Furnace 1 Bypass	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	906.26	1.74	10.37	918
Furnace 1 Idle	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	226.44	0.43	2.59	229
ES-RTO-2	Propane	62.87	7.50E-02	1.79E-01	19426.62	23.17	55.25	19,505
Furnace 2 Bypass	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	930.56	1.79	10.64	943
Furnace 2 Idle	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	226.44	0.43	2.59	229
ES-RCO-1	Propane	62.87	7.50E-02	1.79E-01	13313.70	15.88	37.86	13,367
ES-RCO-2	Propane	62.87	7.50E-02	1.79E-01	12549.97	14.97	35.69	12,601
ES-PVAP	Propane	62.87	7.50E-02	1.79E-01	607.08	0.72	1.73	610
ES-EG-1	No. 2 Fuel Oil (Distillate)	73.96	7.50E-02	1.79E-01	100	1.01E-01	2.41E-01	100
ES-EG-2	No. 2 Fuel Oil (Distillate)	73.96	7.50E-02	1.79E-01	191	1.94E-01	4.63E-01	192
ES-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.

TABLE C-29
POTENTIAL SITE-WIDE GHG EMISSIONS
ENVIVA PELLET SOUTHAMPTON, 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
ES-DDB-1 and -2	Propane	62.87	7.50E-02	1.79E-01	1214.16	1.45	3.45	1,219
Dryer 1 Bypass	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
ES-DDB-3 and -4	Propane	62.87	7.50E-02	1.79E-01	1214.16	1.45	3.45	1,219
Dryer 2 Bypass	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	930.56	1.79	10.64	943
ES-RTO-1	Propane	62.87	7.50E-02	1.79E-01	19426.62	23.17	55.25	19,505
Furnace 1 Bypass	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	906.26	1.74	10.37	918
Furnace 1 Idle	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	226.44	0.43	2.59	229
ES-RTO-2	Propane	62.87	7.50E-02	1.79E-01	19426.62	23.17	55.25	19,505
Furnace 2 Bypass	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	930.56	1.79	10.64	943
Furnace 2 Idle	Wood and Wood Residuals	93.80	1.80E-01	1.07E+00	226.44	0.43	2.59	229
ES-RCO-1	Propane	62.87	7.50E-02	1.79E-01	13313.70	15.88	37.86	13,367
ES-RCO-2	Propane	62.87	7.50E-02	1.79E-01	12549.97	14.97	35.69	12,601
ES-PVAP	Propane	62.87	7.50E-02	1.79E-01	607.08	0.72	1.73	610
ES-EG-1	No. 2 Fuel Oil (Distillate)	73.96	7.50E-02	1.79E-01	100	1.01E-01	2.41E-01	100
ES-EG-2	No. 2 Fuel Oil (Distillate)	73.96	7.50E-02	1.79E-01	191	1.94E-01	4.63E-01	192
ES-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.

APPENDIX 2
UPDATED APPLICATION FORMS

PERMIT FORMS
PURSUANT TO
REGULATIONS FOR THE CONTROL AND ABATEMENT OF AIR POLLUTION

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY

AIR PERMITS
FORM 7 APPLICATION

NEW SOURCE REVIEW PERMITS
and STATE OPERATING PERMITS54

AIR PERMIT APPLICATION
CHECK ALL PAGES ATTACHED AND LIST ALL ATTACHED DOCUMENTS

___	Local Government Certification Form, Page 3
___	Application Fee Form, Pages 4-6
X	Document Certification Form, Page 7
___	General Information, Pages 8-9
X	Fuel Burning Equipment, Page 10
X	Stationary Internal Combustion Engines, Page 11
___	Incinerators, Page 12
X	Processing, Page 13
___	Inks, Coatings, Stains, and Adhesives, Page 14
X	VOC/Petroleum Storage Tanks, Pages 15-16
___	Loading Rack and Oil-Water Separators, Page 17
___	Fumigation Operations, Page 18
X	Air Pollution Control and Monitoring Equipment, Page 19
X	Air Pollution Control/Supplemental Information, Page 20
X	Stack Parameters and Fuel Data, Page 21
___	Proposed Permit Limits for Criteria Pollutants, Page 22
___	Proposed Permit Limits for Toxic Pollutants/HAPs, Page 23
___	Proposed Permit Limits for Other Reg. Pollutants, Page 24
___	Proposed Permit Limits for GHGs on Mass Basis, Page 25
___	Proposed Permit Limits for GHGs on CO_2e Basis, Page 26
___	BAE for Criteria Pollutants, Page 27
___	BAE for GHGs on Mass Basis, Page 28
___	BAE for GHGs on CO_2e Basis, Page 29
___	Operating Periods, Page 30
___	ATTACHED DOCUMENTS:
___	Map of Site Location
___	Facility Site Plan
X	Process Flow Diagram/Schematic
___	MSDS or CPDS Sheets
X	Estimated Emission Calculations
___	Stack Tests
___	Air Modeling Data
___	Confidential Information (see Instructions)
X	BACT Analysis

Check added form sheets above; also indicate the number of copies of each form in blank provided.

DOCUMENT CERTIFICATION FORM

I certify under penalty of law that this document and all attachments [as noted above] were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering and evaluating the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

I certify that I understand that the existence of a permit under [Article 6 of the Regulations] does not shield the source from potential enforcement of any regulation of the board governing the major NSR program and does not relieve the source of the responsibility to comply with any applicable provision of the major NSR regulations.

SIGNATURE:		DATE:	
NAME:	Royal Smith	REGISTRATION NO:	61653
TITLE:	Vice President, Operations	COMPANY:	Enviva Pellets Southampton, LLC
PHONE:	240-482-3770	ADDRESS:	7200 Wisconsin Avenue, Suite 1000
EMAIL:	Royal.Smith@envivabiomass.com		Bethesda, MD 20814

References: Virginia Regulations for the Control and Abatement of Air Pollution (Regulations), 9 VAC 5-20-230B and 9 VAC 5-80-1140E.

FUEL BURNING EQUIPMENT: (Boilers, Turbines, Kilns, and Other External Combustion Units)

Company Name: Enviva Pellets Southampton, LLC	Date: December 2018	Registration Number: 61653

Unit Ref. No.	Equipment Manufacturer, Type, and Model Number	Date of Manuf.	Date of Const.	Max. Rated Input Heat Capacity For Each Fuel (Million Btu/hr)	Type of Fuel	Type of Equip. (use Code A)	Usage (use Code B)	Requested Throughput* (hrs/yr OR fuel/yr)	Federal Regulations that Apply
ES-DRYER-1	Single pass rotary drum direct-heated wood dryer,	2013	2013	175.3	Wood/Bark	15. wood dryer	2	8760 hr/yr	N/A
ES-DRYER 2	Single pass rotary drum direct-heated wood dryer,	TBD	TBD	180	Wood/Bark	15. wood dryer	2	8760 hr/yr	N/A
ES-DDB-1	Duct burner for Dryer 1	TBD	TBD	1	Natural gas/propane	19. duct burner	4	8760 hr/yr	N/A
ES-DDB-2	Duct burner for Dryer 1	TBD	TBD	1	Natural gas/propane	19. duct burner	4	8760 hr/yr	N/A
ES-DDB-3	Duct burner for Dryer 2	TBD	TBD	1	Natural gas/propane	19. duct burner	4	8760 hr/yr	N/A
ES-DDB-4	Duct burner for Dryer 2	TBD	TBD	1	Natural gas/propane	19. duct burner	4	8760 hr/yr	N/A
CD-RTO-1	RTO for Dryer 1 and Green Hammermills	TBD	TBD	4 burners x 8 MMBtu/hr (each)	Natural gas/propane	19. oxidizer	8. emissions control	8760 hr/yr	N/A
CD-RTO-2	RTO for Dryer 2 and Green Hammermills	TBD	TBD	4 burners x 8 MMBtu/hr (each)	Natural gas/propane	19. oxidizer	8. emissions control	8760 hr/yr	N/A
CD-RCO-1	RCO/RTO for Pellet Coolers	TBD	TBD	2 burners x 9.8 MMBtu/hr (each)	Natural gas/propane	19. oxidizer	8. emissions control	8760 hr/yr	N/A
CD-RCO-2	RCO/RTO for Dry Hammermills	TBD	TBD	2 burners x 9.8 MMBtu/hr (each)	Natural gas/propane	19. oxidizer	8. emissions control	8760 hr/yr	N/A
ES-PVAP	**LP Vaporizer for RTOs, RCO, and double duct burners**	TBD	TBD	**1**	**Propane**	**15. propane vaporizer**	**4**	**8760 hr/yr**	N/A

[X] Estimated Emission Calculations Attached (include references of emission factors) and/or Stack Test Results if Available

Code A – Equipment		Code B - Usage
BOILER TYPE: 1. Pulverized Coal - Wet Bottom 2. Pulverized Coal - Dry Bottom 3. Pulverized Coal - Cyclone Furnace 4. Circulating Fluidized Bed 5. Spreader Stoke 6. Chain or Travelling Grate Stoker 7. Underfeed Stoker 8. Hand Fired Coal 9. Oil, Tangentially Fired 10. Oil, Horizontally Fired (except rotary cup)	11. Gas, Tangentially Fired 12. Gas, Horizontally Fired 13. Wood with Flyash Reinjection 14. Wood without Flyash Reinjection 15. Other (specify) _____ OTHER COMBUSTION UNITS: 16. Oven / Kiln 17. Rotary Kiln 18. Process Furnace 19. Other (specify) _____	1. Steam Production 2. Drying / Curing 3. Space Heating 4. Process Heat 5. Food Processing 6. Electrical Generation 7. Mechanical Work 8. Other (specify) _____

***Pick only one option for a requested throughput.**

NOTE: Dryers, kilns, and furnaces also have to fill out Page 13.

STATIONARY INTERNAL COMBUSTION ENGINES:

Company Name: Enviva Pellets Southampton, LLC	**Date:** December 2018	**Registration Number:** 61653

Unit Ref. No.	Equipment Manufacturer, Type, and Model Number	Date of Manuf.	Date of Const.	Output Brake Horsepower (bhp)	Output Electrical Power (kW)	Type of Fuel	Usage* (use Code C)	Requested Throughput** (hrs/yr OR fuel/yr)	Federal Regulations that Apply
ES-EG-1	TBD	TBD	TBD	671	500	Diesel	1	500	40 CFR 60 Subpart IIII 40 CFR 63 Subpart ZZZZ
The facility maintains two additional diesel-fired engines, which are not impacted by the proposed changes.									

[X] Estimated Emission Calculations Attached (include references of emission factors and manufacturer specifications per engine) and/or Stack Test Results if Available.

Code C – Usage

1. Emergency Generator
2. Participates in Emergency Load Response Program
3. Non-Emergency Generator
4. Participates in Demand Response Program(s)
5. Other (specify) _____

***Can pick more than one option**
(i.e. 1 and 2 **OR** 3 and 4)

****Pick only one option for a requested throughput.**

PROCESSING, MANUFACTURING, SURFACE COATING AND DEGREASING OPERATIONS:

Company Name: Enviva Pellets Southampton, LLC	Date: December 2018	Registration Number: 61653

Unit Ref. No.	Process or Operation Name	Equipment Manufacturer, Type, and Model Number	Date of Manuf.	Date of Const.	Max. Rated Capacity (_____/hr)*	Requested Throughput*			Federal Regulations that Apply
						(_____/hr)	(_____/day)	(_____/yr)	
ES-DRYER-1	Single pass rotary drum direct-heated wood dryer	Dryer		2013	175.3 MMBtu/hr	70.83 ODT/hr		781,255 ODT/yr	N/A
ES-DRYERBYP-1	Dryer bypass operating mode for dryer 1	Dryer			175.3 MMBtu/hr	70.83 ODT/hr		50 hr/yr	N/A
ES-FURNACEBYP-1	Furnace bypass operating mode for dryer 1	Dryer			175.3 MMBtu/hr			50 hr/yr	N/A
ES-FURNACEBYP-1	Furnace bypass idle mode for dryer 1	Dryer			5 MMBtu/hr			438 hr/yr	N/A
ES-CHIP	Log chipping using an electric-powered chipper	Chipper		2013	59.7 ODT/hr	59.7 ODT/hr		360,000 ODT/yr	N/A
ES- HM-1 – 9	Nine hammermills operating in parallel	Dry Hammermills		2013	144 ODT/hr	144 ODT/hr		664,067 ODT/yr	N/A
ES-CLR-1 thru 6	Wood Pellet Presses/Coolers	Pellet Press/Coolers		2013	144 ODT/hr	144 ODT/hr		781,255 ODT/yr	N/A
ES- PMFS	Pellet Mill Feed Silo	Silo		2013	144 ODT/hr	144 ODT/hr		781,255 ODT/yr	N/A
ES-FPH	Finished Product Handling	Bins		2013	144 ODT/hr	144 ODT/hr		781,255 ODT/yr	N/A
ES-DEBARK	De- barking operations for wood logs using an electric- powered debarker	--		2013	105 ODT/hr	105 ODT/hr		781,255 ODT/yr	N/A
ES-BARK	Log processing operations using	--		2013	105 ODT/hr	105		54,000 ODT/yr	N/A

Unit Ref. No.	Process or Operation Name	Equipment Manufacturer, Type, and Model Number	Date of Manuf.	Date of Const.	Max. Rated Capacity (_____/hr)*	Requested Throughput*			Federal Regulations that Apply
						(_____/hr)	(_____/day)	(_____/yr)	
	bark hog					ODT/hr			
ES- DWH	Dried Wood Handling Equipment	--			153 ODT/hr	153 ODT/hr		781,255 ODT/yr	N/A
ES-GHWS	Green Wood Handling	--			210 ton/hr[1]	210 ton/hr[2]		781,255 ODT/yr	N/A
ES-PCHP	Pellet Cooler HP Fines Relay System	--						8,760 hrs/yr	N/A
ES-TL	Truck Loadout	--			144 ODT/hr	144 ODT/hr		781,255 ODT/yr	N/A
ES-DRYER-2	Single pass rotary drum direct-heated wood dryer	Dryer		TBD	180 MMBtu/hr	82.1 ODT/hr		781,255 ODT/hr	N/A
ES-DRYERBYP-2	Dryer bypass operating mode for dryer 2	Dryer			180 MMBtu/hr	82.1 ODT/hr		50 hr/yr	N/A
ES-FURNACEBYP-2	Furnace bypass operating mode for dryer 2	Dryer			180 MMBtu/hr			50 hr/yr	N/A
ES-FURNACEBYP-2	Furnace bypass idle mode for dryer 2	Dryer			5 MMBtu/hr			438 hr/yr	N/A
ES-GHM-1 thru 5	Wood chip resizing using five (5) electric-powered Green hammermills	Green Hammermill	TBD	TBD	150 ODT/hr	150 ODT/hr		781,255 ODT/yr	N/A
ES-ADD	Additive Handling and Storage	Silo	TBD	TBD	22.5 ton/hr	22.5 ton/hr		2,344 ton/yr	N/A

[X] Estimated Emission Calculations Attached (include references of emission factors) and/or Stack Test Results if Available

*** Specify units for each operation in tons, pounds, gallons, etc., as applicable. <u>For coating operations</u>, the maximum rated capacity is the spray gun capacity.**

[1] Represents highest throughput associated with ES-GHWS for material conveyance to raw wood chip storage pile.
[2] See footnote 1.

VOLATILE ORGANIC COMPOUND (VOC)/PETROLEUM LIQUID STORAGE TANKS:

Company Name:	Enviva Pellets Southampton, LLC	Date:	December 2018	Registration Number:	61653

Unit Ref. No.	Tank Type (use Code H)	Source of Tank Contents (use Code I)	Date of Manuf.	Date of Const.	Material Stored - Name and CAS # (include Reid Vapor Pressure for Gasoline)	Max. True Vapor Pressure (psia)	Density* (lbs/gal)	Max. Average Storage Temp. (°F)	Tank Diameter (feet)	Tank Capacity (gal)	Requested Throughput (gal/yr)	Federal Regulations that Apply
ES-TK-3	1a	3			Diesel	~0.009	~6.9	64.41	6.0	5,000	200,000	None – Also exempt from state permitting requirements
ES-TK-4	1a	3			Diesel	~0.009	~6.9	64.41	5.3	1,000	16,000	None – Also exempt from state permitting requirements
The facility maintains two additional diesel fuel storage tanks, which are not impacted by the proposed changes.												

[X] Estimated Emission Calculations Attached (include TANKS Program printouts)

Code H – Tank Type		Code I – Source of Tank Contents
1. Fixed Roof a. Vertical Tank b. Horizontal Tank 2. Floating Roof a. Internal (welded deck) b. Internal (bolted deck) – Specify Panel or Sheet c. External (welded deck) d. External (riveted deck)	3. Variable Vapor Space 4. Pressure Tank (over 15 psig) 5. Underground Splash Loading 6. Underground Submerged Loading 7. Underground Submerged Loading, Balanced 8. Other:_____	1. Pipeline 2. Rail Car 3. Tank Truck 4. Ship or Barge 5. Process

*** Specify the ASTM temperature standard at which the density was measured.**

VOLATILE ORGANIC COMPOUND (VOC)/PETROLEUM LIQUID STORAGE TANKS (CONTINUED):

Company Name: Enviva Pellets Southampton, LLC	Date: December 2018	Registration Number: 61653

Unit Ref. No.	Tank Color		Fixed Roof Only					Floating Roof Only				
	Shell	Roof	Internal Tank Height or Length (feet)	Max. Hourly Filling (gallons)	External Fixed Roof			Seal Type (use Code J)	Max. Hourly Withdrawal (gallons)	Internal Floating Roof		
					Type of Roof (cone or dome)	Cone height (ft) and slope (ft/ft)	Dome height (ft) and radius (ft)			Self Supporting?	If no,	
											No. of Columns	Column Diameter (ft)
ES-TK-3			23.67	2500				N/A	N/A	N/A	N/A	N/A
ES-TK-4			6.0	1,000				N/A	N/A	N/A	N/A	N/A

Code J – Seal Type (Pontoon External Only)	(Double Deck External Only)	(Internal Only)
1. Mechanical Shoe a. Primary only b. Shoe mounted secondary c. Rim mounted secondary 2. Liquid Mounted a. Primary only b. Weather shield secondary c. Rim mounted secondary 3. Vapor Mounted a. Primary only b. Weather shield secondary c. Rim mounted secondary	4. Mechanical Shoe a. Primary only b. Shoe mounted secondary c. Rim mounted secondary 5. Liquid Mounted a. Primary only b. Weather shield secondary c. Rim mounted secondary 6. Vapor Mounted a. Primary only b. Weather shield secondary c. Rim mounted secondary	7. Mechanical Shoe a. Primary only b. Shoe mounted secondary c. Rim mounted secondary 8. Liquid Mounted a. Primary only b. Rim mounted secondary 9. Vapor Mounted a. Primary only b. Rim mounted secondary

AIR POLLUTION CONTROL AND MONITORING EQUIPMENT:
TABLE BELOW ADDRESSES NEW CONTROL DEVICES INCLUDED WITH THE PROPOSED CHANGES; EXISTING CONTROL DEVICES ARE NOT BEING MODIFIED

Company Name:	Enviva Pellets Southampton, LLC	Date:	December 2018	Registration Number:	61653

Unit Ref. No.	Vent/ Stack No.	Device Ref. No.	Pollutant/Parameter	Air Pollution Control Equipment			Monitoring Instrumentation
				Manufacturer and Model No.	Type (use Code N)	Percent Efficiency (%)	Specify Type, Measured Pollutant, and Recorder Used
ES-DRYER-1, ES-GHM-1 - 5	EP-1	CD-RTO-1	VOC, HAP/TAP	TBD	15	97.5%	Temperature, Data Acquisition System
ES-PCHP	EP-14	CD-PCHP-BF	Particulate	TBD	9a	>90%	Pressure drop
ES-DRYER-2	EP-19	CD-WESP-2	PM Metal HAP	TBD	10	>90%	Power Consumption (kW), Data Acquisition System
		CD-DC-2			3		
		CD-RTO-2	HAP, VOC	TBD	15	97.5%	Temperature, Data Acquisition System
ES-DWH	EP-22	CD-DWH-BF	Particulate	TBD	9a	>90%	Pressure drop
ES-HM-1 – 9, ES-HMA	EP-17	CD-WS-1	PM Metal HAP	TBD	21[3]	>90%	Water flow rate
		CD-RCO-1	VOC, HAP	TBD	21[4]	95%	Temperature, Data Acquisition System
ES-PP, ES-	EP-8	CD-WS-	PM	TBD	21[5]	>90%	Water flow rate

[3] Wet scrubber
[4] Regenerative Catalytic Oxidizer
[5] Wet scrubber (type TBD)

CLR-1 – 6		**2**	**Metal HAP**				
		CD-RCO-2	**VOC, HAP**	**TBD**	**21[6]**	**95%**	**Temperature, Data Acquisition System**
ES-ADD	**EP-26**	**CD-ADD-BF**	**Particulate**	**TBD**	**9a**	**>90%**	**Pressure drop**

☐ Manufacturer Specifications Included

Code N – Type of Air Pollution Control Equipment

1. Settling Chamber
2. Cyclone
3. Multicyclone
4. Cyclone scrubber
5. Orifice scrubber
6. Mechanical scrubber
7. Venturi scrubber
   a. Fixed throat
   b. Variable throat
8. Mist eliminator
9. Filter
   a. Baghouse
   b. Other:_____
10. Electrostatic Precipitator
    a. Hot side
    b. Cold side
    c. High voltage
    d. Low voltage
    e. Single stage
    f. Two stage
    g. Other:_____
11. Catalytic Afterburner
12. Direct Flame Afterburner
13. Diesel Oxidation Catalyst (DOC)
14. Thermal Oxidizer
15. Regenerative Thermal Oxidizer (RTO)
16. Selective Catalytic Reduction (SCR)
17. Selective Non-Catalytic Reduction (SNCR)
18. Absorber
    a. Packed tower
    b. Spray tower
    c. Tray tower
    d. Venturi
    e. Other:_____
19. Adsorber
    a. Activated carbon
    b. Molecular sieve
    c. Activated alumina
    d. Silica gel
    e. Other:_____
20. Condenser (specify)
21. Other:_____

[6] Regenerative Catalytic Oxidizer

AIR POLLUTION CONTROL EQUIPMENT - SUPPLEMENTAL INFORMATION:
TABLE BELOW ADDRESSES NEW CONTROL DEVICES INCLUDED WITH THE PROPOSED CHANGES; EXISTING CONTROL DEVICES ARE NOT BEING MODIFIED

Company Name: Enviva Pellets Southampton, LLC	Date: December 2018	Registration Number: 61653

Device Ref. No.	Type (use Code N)	Liquid Flow Rate (gpm) (4, 5, 6, 7, 17 ,19)	Liquid Medium (4, 5, 6, 7, 17, 19)	Cleaning Method (9, 10, 17, 18)	Number of Fields (10)	Number of Sections (9, 10)	Air to Cloth Ratio (fpm) (9)	Filter Material (9)	Inlet Temp. (°F)	Regeneration Method & Cycle Time (sec) (18)	Chamber Temp. (°F) (11, 12, 14, 15)	Retention Time (sec) (11, 12, 14, 15)	Pressure Drop (inch H_2O) (3, 4, 5, 6, 7, 9, 17)
CD-RTO-1	15								TBD		TBD	TBD	
CD-WESP-2	10			TBD	TBD	TBD			TBD				
CD-DC-2	3								TBD				TBD
CD-RTO-2	15								TBD		TBD	TBD	
CD-WS-1	21[7]	TBD	Water						TBD				
CD-RCO-1	21[8]								TBD				
CD-WS-2	21[9]	TBD	Water						TBD				
CD-RCO-2	21[10]								TBD				
CD-ADD-BF	9a			TBD	TBD	TBD	TBD	TBD	TBD				TBD
CD-PCHP-BF	9a			TBD	TBD	TBD	TBD	TBD	TBD				TBD
CD-DWH-BF	9a			TBD	TBD	TBD	TBD	TBD	TBD				TBD

[7] Wet scrubber.
[8] Regenerative Catalytic Oxidizer that can also operate in Regenerative Thermal Oxidizer mode.
[9] Wet scrubber.
[10] Regenerative Catalytic Oxidizer that can also operate in Regenerative Thermal Oxidizer mode.

NOTE: **Numbers listed in parenthesis in the columns above represent the Control Equipment in Code N below.**

Code N – Type of Air Pollution Control Equipment		
1. Settling Chamber 2. Cyclone 3. Multicyclone 4. Cyclone scrubber 5. Orifice scrubber 6. Mechanical scrubber 7. Venturi scrubber a. Fixed throat b. Variable throat 8. Mist eliminator 9. Filter a. Baghouse b. Other:_____ 10. Electrostatic Precipitator	a. Hot side b. Cold side c. High voltage d. Low voltage e. Single stage f. Two stage g. Other:_____ 11. Catalytic Afterburner 12. Direct Flame Afterburner 13. Diesel Oxidation Catalyst (DOC) 14. Thermal Oxidizer 15. Regenerative Thermal Oxidizer (RTO) 16. Selective Catalytic Reduction (SCR) 17. Selective Non-Catalytic Reduction (SNCR)	18. Absorber a. Packed tower b. Spray tower c. Tray tower d. Venturi e. Other:_____ 19. Adsorber a. Activated carbon b. Molecular sieve c. Activated alumina d. Silica gel e. Other:_____ 20. Condenser (specify) 21. Other:_____

STACK PARAMETERS AND FUEL DATA:

Company Name: Enviva Pellets Southampton, LLC	Date: December 2018	Registration Number: 61653

Unit Ref. No.	Vent/ Stack No.	Vent/Stack or Exhaust Data						Fuel(s) Data				
		Vent/ Stack Config (use Code O)	Vent/Stack Height (feet)	Exit Diameter (feet)	Exit Gas Velocity (ft/sec)	Exit Gas Flow Rate (acfm)	Exit Gas Temp. (°F)	Type of Fuel	Heating Value* (Btu/____)	Max. Rated Burned/hr (specify units)	Max. Sulfur %	Max. Ash %
Updated stack parameters will be provided under separate cover with modeling results.												

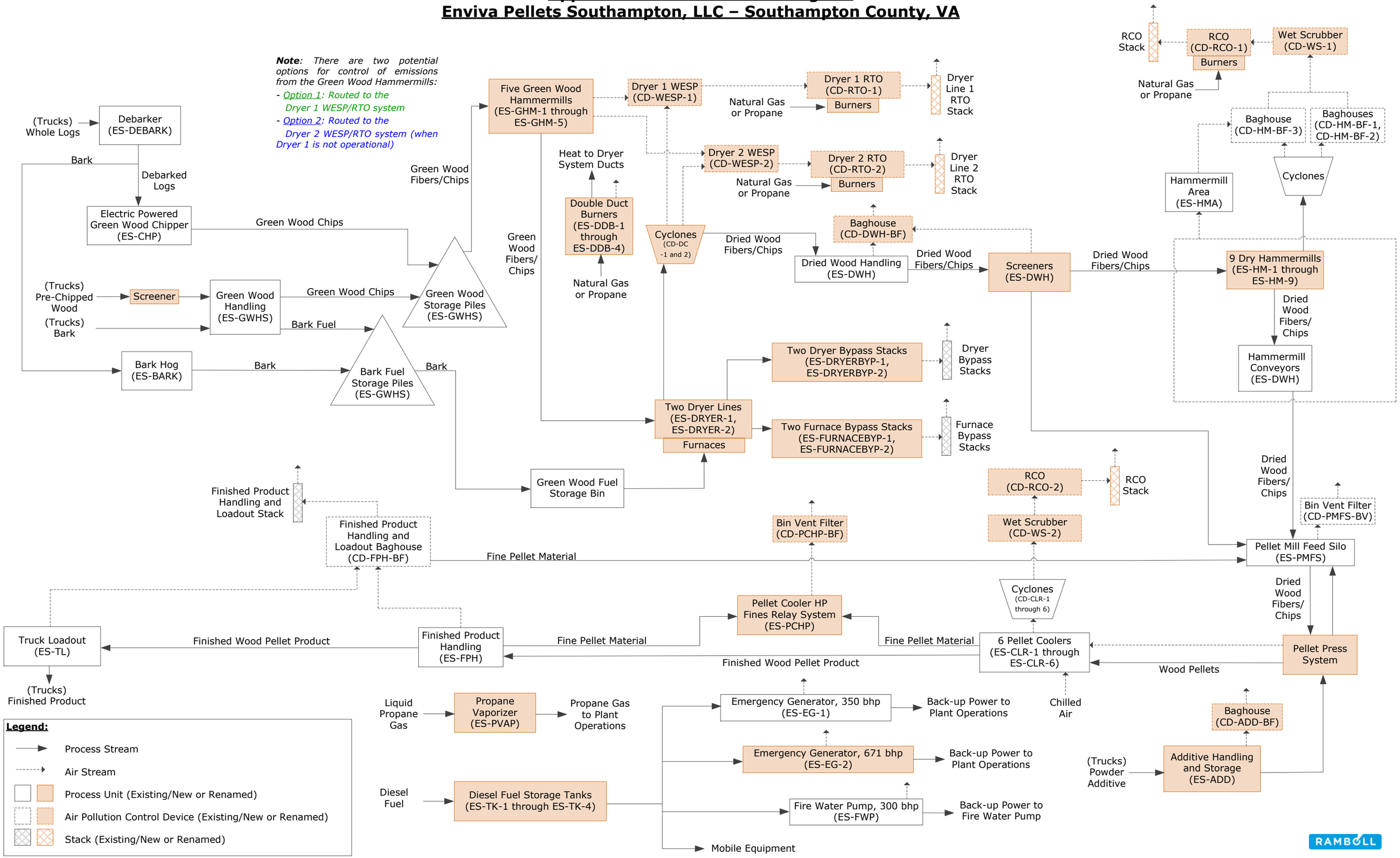
Code O – Vent/Stack Configuration

1. Stack discharging downward, or nearly download
2. Equivalent stack representing a combination of multiple actual stacks
3. Gooseneck stack
4. Stack discharging in a horizontal direction
5. Stack with an unobstructed opening discharge in a vertical direction
6. Vertical stack with a weather cap or similar obstruction in exhaust system

*** Specify units for each heating value in Btus per unit of fuel.**

APPENDIX 3
PROCESS FLOW DIAGRAM

Appendix B - Process Flow Diagram
Enviva Pellets Southampton, LLC – Southampton County, VA



APPENDIX 4
SNCR COST EFFECTIVENESS CALCULATION

SNCR Cost Effectiveness Calculation
Dryer 2 (ES-DRYER-2)
Enviva Pellets Southampton, LLC
Southampton County, Virginia

Emissions Unit	Control Option	Pollutant	Uncontrolled PTE Emissions (TPY)	Control Efficiency[1] (%)	Controlled Emission Rate (ton/yr)	Reduction (ton/yr)	Total Annualized Cost ($/yr)	Cost Effectiveness ($/ton NO_X Removed)
Dryer 2 (ES-DRYER-2)	SNCR	NO_X	121	40.0%	72.9	48.6	$327,225	$6,735

Notes:
[1] Represents control efficiency that can be consistently achieved by SNCR system for facility's Dryer 1.

SNCR Cost Calculations
Dryer 2 (ES-DRYER-2)
Enviva Pellets Southampton, LLC
Southampton County, Virginia

Capital Equipment Costs			
Total Capital Investment			
Direct Costs			
SNCR Equipment Cost	$	470,000	Vendor estimate
Civil	$	12,500	Vendor estimate
Structural	$	22,500	Vendor estimate
Electrical and Controls	$	150,800	Vendor estimate
Plumbing	$	7,500	Vendor estimate
Piping	$	57,800	Vendor estimate
Indirect Costs			
Engineering	$	125,000	Vendor estimate
Administration	$	10,000	Vendor estimate
Procurement	$	5,000	Vendor estimate
Overhead Fees	$	8,790	Vendor estimate
Contingency			
Contingency	$	130,484	15% of Direct + Indirect Costs per USEPA Air Pollution Control Cost Manual, Section 4, Chapter 1 (6th edition, January 2002)
Total Capital Investment	**$**	**1,000,374**	
Annual Operating Cost			
Direct Annual Costs			
Maintenance			
Maintenance	$	15,006	1.5% of TCI per EPA SNCR Control Cost Manual Eqn. 1.39 (7th edition, May 2016)
Reagent Consumption	$	187,464	Vendor estimate (10 gal/hr of 28% solution ammonium hydroxide at $2.14 per gallon)
Electricity	$	19,331	Vendor electricity usage estimate and regional electricity rates
Water	$	6,244	Vendor water usage estimate and regional water rates
Additional Fuel	$	4,301	Additional fuel required to evaporate water in injected reagent
Indirect Annual Costs			
Admin Charges	$	450	3% maintenance (Eqn 1.53)
Capital Recovery	$	94,428	CRF*TCI, based on 20 year equipment life and 7% interest per Eqn 1.54 of EPA SNCR Control Cost Manual Eqn. 1.39 (7th edition, May 2016)
TOTAL ANNUALIZED COST	**$**	**327,225**	

SNCR Cost Effectiveness Inputs and Supporting Calculations
Dryer 2 (ES-DRYER-2)
Enviva Pellets Southampton, LLC
Southampton County, Virginia

Dryer 2 and SNCR Parameters

Exhaust Gas Temperature	238.0	°F
Total Exhaust Gas Flow Rate	137,383	acfm
	104,317	scfm
Annual Operating Hours	8,760	hours
Maximum Annual Heat Input Rate (Q_B)	180	MMBtu/hour
Uncontrolled NOx Emission Rate	27.73	lb/hr
Reagent Solution Usage[1]	87,600	gal/year

Notes:
[1] Provided by vendor (TSI).

Electricity Cost

Power - pumps & mixers[1]	30	hp
Power - air compressor[2]	5.4	hp
HVAC power for pumphouse[1]	10,000	kWh/yr
Total annual power required	241,338	kWh/yr
Electricity Rate[3]	0.0801	$/kW
Electricity Cost	19,331	$/yr

Notes:
1 Provided by vendor (TSI).
2 Based on required 25 scfm compressed air at 100 psig, adding 20% for friction losses per vendor (TSI).
[3] Average industrial rate for Virginia as of November 2018 from the U.S. Energy Information Administration's December 2018 Electric Power Monthly report.

Water Cost

Water Usage[1]	180	gallons/hr
Water Rate[2]	3.96	$/10^3 gallons
Water Cost	6,244	$/yr

Notes:
1 Provided by vendor (TSI).
[2] Estimate based on City of Franklin, VA Schedule of City Fees & Charges, effective July 2016.

Additional Fuel Consumption

Solution Concentration (NH4OH)	28%	
Solution Density	7.51	lb/gal
Heat of Vaporization of Water (at 238 F)	953.4	Btu/lb
Fuel Heating Value	4200	Btu/lb
Additional Fuel Consumption[1]	452	MMBtu/yr
	54	ton/yr
Fuel Unit Cost[2]	80	$/ton
Total Fuel Cost	4,301	$/yr

Notes:
1 Based on Equation 1.47 of the EPA Control Cost Manual, Section 4, Chapter 1, Selective Non-Catalytic Reduction, May 2016.
[2] Average price from July 2018 Forest2Market "Chip and Pulpwood Price Trends in the US South & PNW" accessed 2/20/2019: https://blog.forest2market.com/chip-pulpwood-price-trends-in-the-us-south-pnw