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Region 10, Air & Radiation Division
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AFS Plant I.D. Number: 16-009-00001

FACT SHEET

Prevention of Significant Deterioration Permit

Permit Writer: Dan Meyer

PotlatchDeltic Land and Lumber, LLC – St. Maries Complex

Coeur d'Alene Reservation
St. Maries, Idaho

Purpose of Permit and Fact Sheet

New major stationary sources of air pollution and major modifications to major stationary sources are required by the Clean Air Act to obtain an air pollution permit before commencing construction. The process is called new source review and is required whether the major source or modification is planned for an area where the national ambient air quality standards (NAAQS) are exceeded or an area where air quality is acceptable. Permits for sources in attainment areas are referred to as prevention of significant air quality deterioration (PSD) permits, and Title 40 of the Code of Federal Regulations (CFR), 52.21, establishes the federal PSD program that applies in Indian Country.

40 CFR Part 124 establishes EPA's procedures for issuing PSD permits. This document, the Fact Sheet, fulfills the requirements of 40 CFR 124.8 by setting forth the principal facts and the significant factual, legal, methodological and policy questions considered in preparing the draft permit. Unlike the PSD permit, this Fact Sheet is not legally enforceable. The Permittee is obligated to comply with the terms of the permit. Any errors or omissions in the summaries provided here do not excuse the Permittee from the requirements of the permit.

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1. Introduction and Project Summary

On November 16, 2017, EPA Region 10 received a combined PSD/mNSR application from PotlatchDeltic Land and Lumber, LLC (PotlatchDeltic) requesting authorization to construct a lumber kiln.[1] The application was determined incomplete on December 15, 2017. On February 2, 2018, Region 10 received from PotlatchDeltic a response to the incompleteness determination. PotlatchDeltic also provided additional information in response to requests from Region 10, as shown below in Table 1-1:

Table 1-1 – List of PSD/mNSR Application Material Submitted before Start of the Public Comment Period

Request from Region 10	Receipt from PotlatchDeltic
February 22, 2018	March 2, 2018
March 26, 2018	April 16, 2018
May 2, 2018	May 15, 2018
July 17, 2018	July 29, 2018
July 31, 2018	August 7, 2018
August 10, 2018	August 17, 20 and 21, 2018

Region 10 drafted a PSD permit and supporting Fact Sheet for the proposed project and presented the documents to the public for review and comment from September 6 through October 11, 2018. Region 10 received comments from the public, including PotlatchDeltic, during the comment period. Region 10 and PotlatchDeltic continued to discuss the proposed permit after the close of the comment period, and in the process, PotlatchDeltic submitted additional information that has been added to the administrative record.

Region 10 considered all of the comments received during the comment period as well as the additional information submitted by the Permittee after the close of the public comment period to support its application. The final permit and final Fact Sheet reflect our consideration of all input received. See Region 10's separate Response to Comments document in the administrative record for this permit action.

PotlatchDeltic is proposing to construct a 280,000 board foot dual-track batch-type indirect steam-heated lumber kiln to dry White Fir, Grand Fir and Western Hemlock lumber at its St. Maries Complex (SMC). The track system is used for moving carts carrying stacks of lumber into and out of the kiln between batch drying cycles. The lumber carried by the carts on a single track inside the kiln is considered one load, so there are two loads (one on each track system) in each batch of lumber dried. A batch drying cycle duration can range from about one day to several days depending upon several factors. The kiln is designed with ten heating zones arranged along the length of the kiln from the entrance to the exit wherein the drying process can be separately controlled. See Figure 1-1 for illustration.

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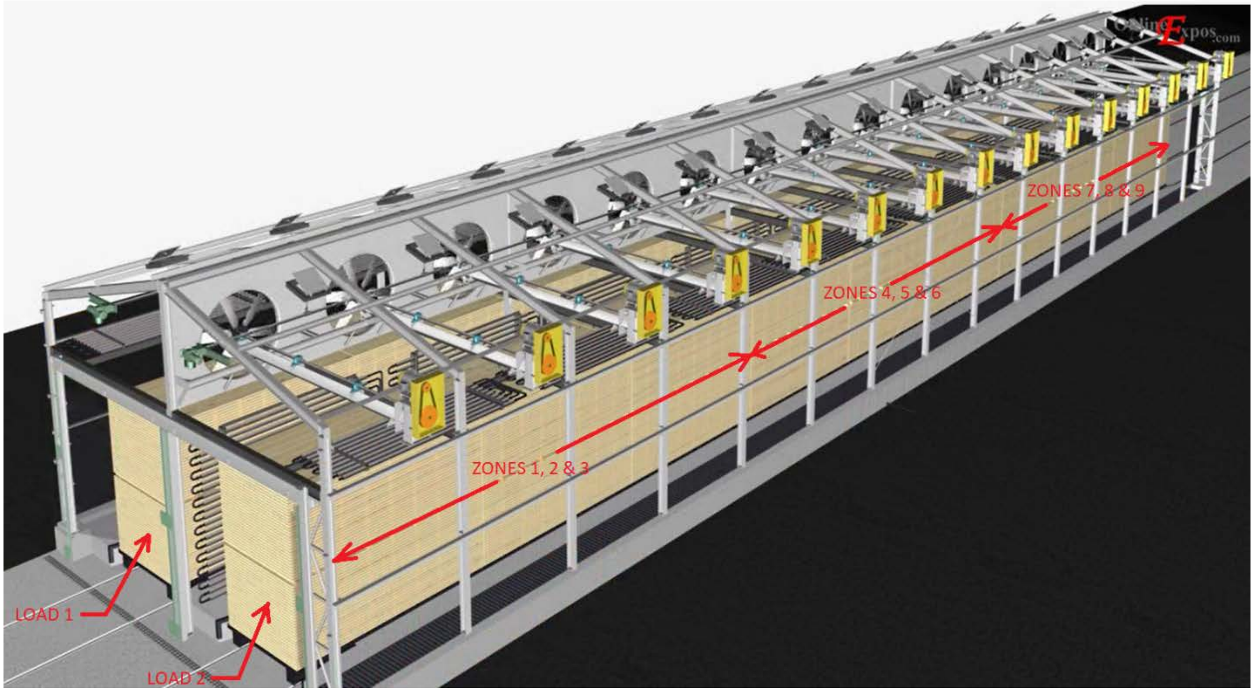
[1] The facility began operating as PotlatchDeltic Land and Lumber, LLC as of March 2, 2018 pursuant to a commercial transaction completed February 20, 2018. Prior to March 2, 2018, the facility was operating as Potlatch Land and Lumber, LLC.

Figure 1-1 – Illustration of a Typical Dual-track Batch-type Indirect Steam-heated Lumber Dry Kiln



The objective of the project is to eliminate the need for contract drying of green lumber (manufactured at SMC) at an off-site, independent mill. Existing boiler capacity is available to provide steam to existing equipment at current operating levels and to meet the steam demand of the new kiln. Following installation of the new kiln, the sawmill and the planer mill will operate on a schedule similar to its current one, and the new kiln will operate as near to continuously as possible.

2. Source Information

PotlatchDeltic's SMC is located along the St. Joe River near the intersection of Railroad Avenue and Mill Road in northwest St. Maries, Idaho. The facility is within the Coeur d'Alene Indian Reservation and is in Indian Country as defined in 40 CFR part 71. The SMC consists of a sawmill, lumber dry kiln, planer mill and plywood mill. The SMC is part of a larger "stationary source" (as that term is defined by the Clean Air Act) that consists of PotlatchDeltic's activities at both the SMC and the Lumber Drying Division (LDD). Region 10 refers to the larger "stationary source" as St. Maries Operations (SMO). The LDD (AFS Plant I.D. Number 16-009-00030) is adjacent to the SMC but outside the reservation within state jurisdiction. At the LDD, Potlatch operates a biomass boiler to generate steam, and that steam is employed to indirectly heat kilns that dry rough green lumber. Some of the rough green lumber produced at the SMC is transported to the nearby LDD where it is kiln dried and then returned to the SMC's planer mill. The permit supported by this Fact Sheet authorizes emission-generating activities at the SMC only.

<u>Sawmill</u>

Logs are transported to the SMC via trucks. Wood species typically consist of Western Hemlock, Grand Fir and Douglas Fir. Smaller amounts of Engelmann Spruce, Lodgepole Pine, Subalpine Fir, Western Red Cedar, Ponderosa Pine and White Pine are also processed. The logs are unloaded from delivery trucks and stacked in the log yard. Sprinklers are used to keep the logs wet during storage.

Logs are transferred from the log yard to the sawmill merchandiser, where the logs are loaded onto one of two decks and "singulated." On one deck, the log is debarked with an A8 22-inch debarker and then cut to length by the #2 cut-off saw. On the other deck, log defects are removed by the #1 cut-off saw, and then the log is debarked with an A5 22-inch debarker and then cut -to-length by the #3 cut-off saw. The logs from both decks are then conveyed into the Sawmill Building. Sawdust and trim from the cut-off saws, along with bark from the debarkers, are routed to an enclosed hog crusher. The resultant hog fuel is conveyed by chain conveyers to the hog fuel bin, fuel storage truck bin or ground storage.

Logs entering the Sawmill Building are directed to the Chip-and-Saw which consists of the following three machine centers: four-sided canter, quad band mill and vertical arbor gang saw. The four-sided canter removes the exterior of the log through a chipping process and produces a profiled log and chips. The quad band mill removes the sideboards of the log and produces a cant, sideboards and sawdust. The vertical arbor gang breaks the cant down into lumber and sawdust.

Sideboards from the quad band mill are conveyed to a chipper edger, which produces squared-end lumber and wood chips. The lumber from the edger and the lumber from the vertical arbor gang are conveyed to trim saws, where they are scanned for defects and trimmed. Lumber is then transferred to the bin sorter and stacked according to size in rough green lumber storage. Trim ends are sent to a chipper. Fine dust from the quad band mill, trimmer, chipping edger and vertical arbor gang is controlled by baghouse BH-10. Collected dust goes to the hog fuel storage bin.

Wood chips from the Chip-and-Saw, chipper edger and chipper are conveyed to a screener. The screener sorts the incoming material into overs, wood chips and sawdust. Overs are sent back to the chipper. Chips are pneumatically routed to the chip bin through the Sawmill Chip Bin Cyclone CY-2. Sawdust from the screen, quad band mill, and vertical arbor gang are pneumatically conveyed to the sawdust truck bin. Sawdust Bin Baghouse BH-11 controls the bin exhaust.

From rough green lumber storage, the lumber is either planed green in the planer mill or dried in a lumber dry kiln located at the SMC, Potlatch's adjacent LDD or at Stimson's St. Maries mill. The existing lumber dry kiln located at the SMC has a capacity of 290,000 board feet per batch. Dry kiln operating temperature and dry time per batch is wood species dependent. Potlatch operates the existing SMC dry kiln at a temperature up to 245°F for air exiting the load (the temperature of air entering the load is hotter), but some wood species (i.e. Western Red Cedar and Ponderosa Pine) are dried at lower temperatures.

Planer Mill

As lumber enters the planer mill, a break down hoist "singulates" and transfers the lumber to the pineapple rollers, which feeds the rough lumber into the planer. Planer shavings are pneumatically conveyed to the planer shavings bin through the Planer Shavings Baghouse BH-2.

Baghouse BH-5 controls the exhaust from the planer shavings bin. The surfaced lumber is graded and trimmed to length. A sorter is used to separate planed lumber by grade and length. The sorted lumber is then stacked, banded and wrapped with paper. Finished units are transferred to surfaced lumber storage until shipment off-site.

Trim ends are sent to a chipper or stored for finger joints. Dust pickups from the breakdown hoist, pineapple rolls, trimmer and chipper are controlled by the Trimmer/Chipper Baghouse BH-3. Collected dust goes to the planer shavings bin. Chips from the chipper are pneumatically conveyed to the plytrim bin. The Plytrim Truck Bin Baghouse BH-4 controls the ply trim bin exhaust.

Plywood Mill
PotlatchDeltic operates a plywood mill at SMC separate and apart from the sawmill and planer mill. Logs are received at the mill, and plywood is manufactured by employing various equipment including log steaming vats, a lathe, veneer dryers, presses and sanders. The veneer dryers' heating zone emissions are captured and controlled employing a regenerative catalytic oxidizer. No equipment within the plywood mill is participating in PotlatchDeltic's Kiln No. 6 project.

Steam Generating Plant
Potlatch operates two biomass boilers at the SMC to provide steam for block conditioning vaults, veneer dryers, plywood presses, the lumber dry kiln and building heat. Heat for the CE boiler (PB-1) is provided by two Wellons fuel cells, which are controlled by a multiclone and a two-cell PPC dry electrostatic precipitator (ESP). The CE boiler's demonstrated heat input capacity is 58 mmbtu/hr and produces up to 43,034 pounds of steam per hour. The Riley boiler (PB-2) is controlled by a multiclone and a three-cell PPC dry ESP. The Riley boiler's demonstrated heat input capacity is 131 mmbtu/hr and produces up to 98,000 pounds of steam per hour. The Riley boiler is also capable of burning sander dust generated from dry-end plywood operations. Fly ash from both the CE and Riley boilers is re-injected into the Riley boiler.

The air pollution emission units and control devices that are a part of the project and emit VOC are listed and described in Table 2-1. The only emission unit that is a part of the project but that does not emit VOC is plant traffic. It is not listed in Table 2-1.

Table 2-1 – Emission Units and Control Devices

EU ID	Emission Unit Description	VOC Control Device/Work Practices[1]
New (Proposed) Emission Generating Activities		
LK-6	Lumber Dry Kiln No. 6. Dual-track, 280,000 board foot per batch, indirect steam-heated lumber dry kiln	Wood species restriction, air temperature ≤ 245°F, final lumber moisture content ≥ 13% (dry basis), operation and maintenance requirements
Existing Emission Generating Activities		
PB-1	CE Boiler. 43,034 lb steam/hr and 58 mmbtu/hr, fuel cell wet biomass-fired boiler, installed 1964, dutch oven firebox replaced with fuel cells in 1979	None

EU ID	Emission Unit Description	VOC Control Device/Work Practices[1]
PB-2	Riley Boiler. 98,000 lb steam/hr and 131 mmbtu/hr, spreader stoker wet biomass-fired boiler with fly ash reinjection, installed 1966	None
PCWR-PM-SH	Planer shavings pneumatically conveyed to baghouse BH-2	None
PCWR-PM-SD	Planed lumber trimmer, trim ends chipper, breakdown hoist and infeed rolls dust generating activities	None
PCWR-PM-PTB	Plywood Mill dry veneer chips and fines and Planer Mill trim ends chips pneumatic conveyance to ply trim bin	None
PCWR-PM-PSB	Dust transfer from baghouses BH-2 and BH-3 to planer shavings bin	None
PCWR-SM-SD	Dust from vertical arbor gang, vertical arbor gang trimmer, quad band mill and edger	None
PCWR-SM-SDB	Sawdust from vertical arbor gang and hog fuel screen pneumatic conveyance to sawdust bin	None
PCWR-SM-CH	Green chips pneumatically conveyed from sawmill chipper screen to chip bin via cyclone CY-2	None
BV-2	Building Vent No. 2 exhausts emissions from miscellaneous indoor activities within Sawmill Building	None
BV-3	Building Vent 3 exhausts emissions from miscellaneous indoor activities within Boiler Building	None
DB	Log debarking (22-inch two debarkers; A8 and A5)	None
COS	Log bucking (three cut-off saws)	None
WRD-SH	Wood residue drops into trucks – shavings	None
WRD-CH	Wood residue drops into trucks – chips (all chips assumed green)	None
WRD-SD	Wood residue drops into trucks – sawdust (all sawdust assumed green)	None
WRD-HF	Wood residue drops into trucks & fuel bin – hog fuel	None
HFP	Wind erosion of outdoor hog fuel pile	None

[1] Use of the listed control devices and work practices is required by the permit.

3. Applicability

Region 10 is co-processing PotlatchDeltic's PSD permit application along with one for mNSR. See the mNSR permitting action for the analysis determining that pollutants CO, NO_X, PM, PM10 and PM2.5 are subject to review under minor NSR.

3.1 Pre-Project Potential to Emit

PotlatchDeltic's combined application for PSD and mNSR permits does not include a complete emissions inventory documenting the facility's pre-project potential to emit. Region 10 created one based upon information presented in PotlatchDeltic's combined construction application and Title V application. Region 10's Emissions Evaluation presented in Appendix A to this Fact Sheet estimates the facility's pre-project potential emissions on an emission-unit-by-emission-unit basis. In some instances, Region 10 revised the emission estimates provided by PotlatchDeltic (in its March 25, 2015 Part 71 application) to more accurately reflect the potential to emit of the facility.

A summary of PotlatchDeltic's pre-project non-fugitive PTE (except for HAPs which are not subject to the PSD program) is presented in Table 3-2 below. Note that fugitive emissions are not included for non-HAP emissions because, for wood products facilities, fugitive emissions are not considered in determining whether the source is a major source for the PSD program. Because the facility's non-fugitive CO and VOC emissions are greater than 250 tpy, it is a major source for the purpose of determining PSD and mNSR applicability.

Table 3-2 – SMO Potential to Emit[1], tons per year

Portion of Facility	CO	Pb	NO_X	PM	PM10	PM2.5	SO_2	VOC	H_2SO_4	CO_2e[2]
LDD	249	0.01	40	7	12	12	2	284	1	42,184
SMC	945	0.04	172	227	225	212	8	367	2	179,465
Total	1,194	0.05	212	234	237	224	10	651	3	221,648

[1] Fugitive emissions are not included in this table because fugitives are not considered in determining whether the facility is major for this source type (see Section 4.1). For fugitive emission estimates, see Appendix A.

[2] Greenhouse gas emissions are quantified as CO_2e. CO_2e is regulated through the PSD program only if the project is major for other regulated PSD pollutants.

3.2 Attainment Status

The PSD program applies in areas designated as either attaining the national ambient air quality standards (NAAQS) or unclassifiable for a particular regulated NSR pollutant. The area in which the SMO is located is currently designated unclassifiable/attainment for ozone.

3.3 PSD Applicability Thresholds

For existing major sources like the SMO proposing a modification to the facility, the project is subject to PSD review for a regulated NSR pollutant if the emissions increase (considering increases and decreases)[2] and net emissions increase are equal to or exceed the PSD significant emission rate thresholds presented in Table 3-3. A major modification to an existing major source is required to get a PSD permit pursuant to 40 CFR 52.21 prior to beginning actual construction of the project.

Table 3-3 – PSD Thresholds for Modifications to Existing Major Sources, tons per year

Regulated NSR Pollutant	PSD Significant Emission Rate Threshold
CO	100
Pb	0.6
NO_X	40
PM	25

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[2] March 13, 2018 Administrator E. Scott Pruitt memorandum entitled, "Project Emissions Accounting Under the New Source Review Preconstruction Permitting Program."

Regulated NSR Pollutant	PSD Significant Emission Rate Threshold
PM10	15
PM2.5	10
SO_2	40
VOC	40
H_2SO_4	7
CO_2e[1]	75,000

[1] The modification is subject to review under PSD for greenhouse gases, quantified as CO_2e, only if subject to review for some other regulated NSR pollutant. See 40 CFR 52.21(b)(49)(iv)(b).

3.4 The Project's Emissions Increase and Net Emissions Increase

The emission units participating in this project that emit VOC are listed in Table 2-1. This project involves both new and existing emission units, and the emissions increase calculation is different for the two categories of units. The only new unit participating in this project is LK-6, so its emissions increase is calculated employing the actual-to-potential test pursuant to 40 CFR 52.21(a)(2)(iv)(d) and (f). For existing emission units, the emissions increases (and decreases) are calculated employing the actual-to-projected-actual applicability test pursuant to 40 CFR 52.21(a)(2)(iv)(c) and (f). Fugitive emissions are considered in determining the emissions increases (and decreases) associated with both categories of emission units.[3]

PotlatchDeltic performed calculations to determine the project's emissions increase considering the emission units listed in Table 2-1. See Appendix B to this Fact Sheet for PotlatchDeltic's calculations. Table 3-4 summarizes the project's emissions increases (and decreases). For each NSR regulated pollutant, PotlatchDeltic is anticipating no emissions decreases at any emission unit.

Table 3-4 – Emissions Increase, tons per year

Emission Generating Activity	CO	Pb	NO_X	PM	PM10	PM2.5	SO_2	VOC	H_2SO_4	CO_2e
LK-6				1.7	1.7	1.7		50.0		
PB-1 & PB-2	49.5		15.4	1.0	1.3	0.9	1.9	0.5	0.1	16,958
Building Vents and Baghouses				2.6	2.5	1.3				
Fugitives				10.5	2.1	0.265		12		
Total	50	0.004	15	16	8	4	2	63	0.058	16,958

PotlatchDeltic did not calculate the project's net emissions increase. In the interest of processing the application based upon the information submitted, and for those pollutants for which PSD would otherwise be triggered based upon the project's emissions increase, Region 10 is assuming

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[3] See 76 Fed. Reg. 17548 (March 30, 2011) indefinitely staying 40 CFR 52.21(b)(2)(v).

that the project's net emissions increase is at least equal to or greater than the relevant PSD applicability threshold. For those pollutants for which PSD would otherwise not be triggered based upon the project's emissions increase, PSD applicability is not contingent upon the net emissions increase.

3.5 Applicability Determination

Based upon PotlatchDeltic's calculations, the project is subject to PSD review for VOC.

4. Best Available Control Technology (BACT)

The Permittee is required to apply best available control technology for each regulated NSR pollutant for which the project results in both a significant emissions increase and a significant net emission increase. This requirement only applies to each proposed emission unit at which a net emissions increase in the pollutant would occur as a result of a physical change or change in the method of operation of the unit. See 40 CFR 52.21(j). For this project, only the proposed new lumber dry kiln LK-6 is subject to BACT for VOC emissions.

After determining the initial BACT analysis incomplete, the Permittee supplied additional information relevant to the five-step BACT analysis throughout the application review process. In July 2018, the Permittee also requested that 50 tpy of VOC (the Permittee's estimate of the upper bound VOC emissions expected from the project) be used to define baseline emissions for evaluating the cost effectiveness of the various control options considered in the BACT analysis and agreed to accept a permit condition to ensure this estimate would not be exceeded. See Draft New Source Review Workshop Manual, October 1990, pp. B-37-41.

Region 10 supplemented information from the Permittee with independent research. Twelve control options were identified in Step 1 of the BACT process. Region 10 evaluated all 12 control technologies, discarding four as technically infeasible in Step 2. Ranking the technologies in Step 3 showed emission reductions ranging from 98 to 24% (not counting the base case proposed by the Permittee, which represents a 0% emission reduction). In Step 4, Region 10 evaluated the economic, energy, and environmental impacts using information from the Permittee as well as information independently obtained by Region 10. Based on that evaluation, the average cost effectiveness of the remaining eight technologies ranged from $15,729/ton to $173,120/ton. In Step 5, Region 10 concluded that, based on the analysis conducted and the information provided by the Permittee, the Permittee's proposed option (high temperature drying in one kiln) is the BACT for this project because none of the remaining control technologies were cost effective.

This BACT Review was prepared for the proposed PSD permit. As discussed in more detail in the Response to Comments (see the Administrative Record for this permit action), commenters disagreed with numerous statements and proposed conclusions in the draft Region 10 BACT Analysis Review for LK-6 with respect to the availability and technical feasibility of the control options considered by Region 10. None of the commenters disagreed with the final proposed conclusion of the BACT Review, and two of the commenters expressly supported Region 10's proposed BACT determination: high temperature drying in a single kiln with no additional controls, as proposed by the Permittee. In taking final action on this permit, Region 10 is not making a final determination on whether any of the other options considered would redefine the source, are otherwise unavailable, or are technically infeasible for this project. As explained in response to comments, making a final determination on these issues is not necessary because Region 10 has concluded that none of these other options are economically feasible.

BACT is a site-specific determination resulting in the selection of an emission limitation that represents application of control technology or control methods appropriate for the particular facility. Permit Conditions 3.3 through 3.7 are the BACT work practice requirements associated with high temperature drying in only one kiln. The requirements include limiting the dry-bulb temperature inside the kiln to no more than 245°F, limiting the final moisture content to no less than 15% (dry basis), employing a computerized kiln management system to control the drying process, and developing and implementing an operation and maintenance manual to assure good air pollution control practices and efficient operation. The requirements are explained in Section 7 of this Fact Sheet. Although Region 10 is not aware of any available tools to help quantify the emissions reductions associated with implementing these requirements, following them will help PotlatchDeltic avoid over-drying its lumber and unnecessarily generating additional emissions.

5. Ambient Air Quality Impact Analysis (AQIA)

The Permittee is required to demonstrate that allowable emission increases from the proposed modification will not cause or contribute to a violation of any NAAQS or any applicable maximum allowable increase over the baseline concentration. See 40 CFR 52.21(k). The Permittee performed an AQIA of VOC emissions as part of its PSD application for the LK-6 project. The AQIA was used to assess ozone impacts attributable to projected emissions from the proposed project. Region 10 revised the ozone analysis after the Permittee requested the new 50 tpy of VOC baseline and permit limit for BACT purposes explained in Section 4 above. This resulted in a substantial reduction of the emissions originally projected from the project. See Appendix D to this Fact Sheet for the details.

The emission increases were used to determine the estimated maximum ozone impact using the methodologies proposed in the draft modeled emission rates for precursors guidance. The estimated maximum 8-hour ozone concentration impact attributable to the project is 0.51 parts per billion (ppb). This value is about half of the value of the ozone NAAQS significant impact level (SIL) of 1.0 ppb. Therefore, based on the April 2018 ozone SILs guidance and supporting technical and legal documents, which are incorporated into the administrative record for this permit, Region 10 concludes that the project will not cause or contribute to a violation of the ozone NAAQS. Even without relying on the SIL, a projected cumulative impact associated with the new project can be estimated by combining the results of the estimated ozone impacts from the project source (i.e., 0.51 ppb) and the monitored background concentration (i.e., 63 ppb). The resulting cumulative projection of 63.51 ppb of ozone is below the ozone 8-hour NAAQS of 70 ppb.

6. Additional Analyses

<u>EPA Trust Responsibility</u>. As part of EPA's direct federal implementation and oversight responsibilities in Indian Country, Region 10 has a trust responsibility to each of the 271 federally recognized Indian tribes within the Pacific Northwest and Alaska. The trust responsibility stems from various legal authorities including the U.S. Constitution, Treaties, statutes, executive orders, historical relations with Indian tribes and, in this case, the 1873

Executive Order and subsequent series of treaty agreements. In general terms, EPA is charged with considering the interest of tribes in planning and decision-making processes. Each office within EPA is mandated to establish procedures for regular and meaningful consultation and collaboration with Indian tribal governments in the development of EPA decisions that have tribal implications. Region 10's Office of Air and Waste has contacted the Tribe to invite consultation on this PSD permit and has maintained ongoing communications with Tribal environmental staff throughout the permitting process.

Endangered Species Act. Under this act, EPA is obligated to consider the impact that a federal project may have on listed species or critical habitats. The bull trout is a listed species and the North American wolverine is proposed for listing. Correspondence from the U.S. Fish and Wildlife Service (USFWS) indicates that bull trout are the only ESA threatened or endangered aquatic species with critical habitat in the vicinity of the proposed project. Region 10 has concluded that the proposed project may affect, but is not likely to adversely affect, ESA-listed bull trout and their designated critical habitat, and we have received concurrence from the USFWS on our determination. The project will have no effect on the North American wolverine.

National Historic Preservation Act. Section 106 of the National Historic Preservation Act of 1966 (NHPA) requires federal agencies to consider the effects on historic properties of projects they carry out, assist, fund, permit, license, or approve throughout the country. If a federal or federally-assisted project has the potential to affect historic properties, a Section 106 review is conducted. As noted earlier, the issuance of this PSD permit would authorize construction of a 104-foot kiln beside an existing 104-foot kiln installed in 2006. The new kiln would be constructed on ground currently serving as a roadway within the SMC and which has therefore already been disturbed to some extent. PotlatchDeltic states that the new lumber dry kiln will likely not affect cultural resources. A review of the National Register of Historic Places finds no record of historic places within the SMC. The nearest historic place to where the proposed kiln is to be constructed is the St. Maries 1910 Fire Memorial within Woodlawn Cemetery, about a quarter mile south of the proposed construction site with trees, residences, streets, a highway and a railway coming between the two.

On the Coeur d'Alene Reservation, the Tribal Historic Preservation Officer (THPO) is the lead for the historic preservation program. On June 20, 2018, Region 10 contacted the THPO requesting concurrence on Region 10's preliminary determination that no historic properties would be affected by the proposed project. On July 27, 2018, the THPO responded that she did not expect to see in-situ cultural resources or any human remains being disturbed by the project and concurred with a finding of "no historic properties affected." The THPO requested that the Permittee agree to a protocol in the event of inadvertent discoveries of human remains or cultural resources. Region 10 shared the protocol with the Permittee on July 31, 2018. During the public comment period, the Permittee indicated that the Permittee and the THPO have agreed to a protocol in the event of inadvertent discoveries of human remains or cultural resources. Based on the THPOs concurrence that this project will not adversely affect historical or cultural resources, Region 10 is concluding the Section 106 process.

Environmental Justice Policy - Under Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,* signed on February 11, 1994, EPA is directed, to the greatest extent practicable and permitted by law, to make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States. Region 10 employed EPA's Environmental Justice Screening and Mapping Tool (EJSCREEN)[4] to identify places that may be candidates for further review, analysis or outreach to support implementation of the executive order as it relates to this proposed permitting action. EJSCREEN identified a candidate area (score of 86.0) southwest of the facility. The area is as close as about 1,500 feet from the property line at Danielson Rock/Danielson Logging on the south side of Idaho State Highway 5. The area roughly extends 18 miles northwest, 22 miles west (to the Idaho/Washington border) and 16 miles southwest. EJSCREEN screen areas are those with a score over the 80th percentile benchmark. Based upon our review of the ozone air quality impact analysis (AQIA) performed by the Permittee, Region 10 has determined that the project, when operating in compliance with the draft permit, will not cause or contribute to an ozone NAAQS violation. See Appendix D to this Fact Sheet for further details. Region 10 therefore concludes that this permit action will not have a disproportionately high or adverse human health effects on nearby communities, including the candidate EJ area.

Title V Operating Permit Program. Title V of the CAA and the implementing regulation found in 40 CFR part 71 require Title V major sources (as well as a selection of non-major sources) of air pollution to obtain operating permits. A source is major for Title V purposes if it has the potential to emit 100 tons per year or more of any air pollutant subject to regulation, 25 tons per year or more of HAPs (in aggregate) or 10 tons per year or more of any single HAP (see 40 CFR 71.2). PotlatchDeltic's St. Maries Operations (SMC and LDD, together) is a single Title V major source because it has the potential to emit more than 100 tons per year CO, NO_X, PM10, PM2.5 and VOC[5]. It is also considered major because it has the potential to emit 25 tons per year or more of HAPs (in aggregate) or 10 tons per year or more of any single HAP. With respect to SMC, PotlatchDeltic submitted a timely application for a Title V permit, which Region 10 will act on through a separate permitting process.

New Source Performance Standards. Region 10 considered the applicability of four combustion-related NSPS standards to boilers PB-1 and PB-2 at SMC, each a steam generating unit: 40 CFR 60, Subparts D (Fossil-Fuel-Fired Steam Generators), Da (Electric Utility Steam Generating Units), Db (Industrial-Commercial-Institutional Steam Generating Units) and Dc (Small Industrial-Commercial-Institutional Steam Generating Units). NSPS Subparts D and Da do not apply to either PB-1 or PB-2 because each boiler's heat input capacity is less than the applicability threshold of 250 mmbtu/hr. PB-2's heat input capacity of 131 mmbtu/hr is within the applicability range of 100 mmbtu/hr to 250 mmbtu/hr of NSPS Subpart Db. But given that PB-2 was constructed in 1966 before the June 19, 1984 applicability date, and because it has not been modified or reconstructed since that date based on information provided by PotlatchDeltic, NSPS Db does not apply. PB-1's heat input capacity of 58 mmbtu/hr is within the applicability range of 10 mmbtu/hr and 100 mmbtu/hr of NSPS Dc. But given that PB-1 was constructed in 1964 before the June 9, 1989 applicability date, and because it has not been modified or reconstructed since that date based on information provided by PotlatchDeltic, NSPS Dc also does not apply. According to PotlatchDeltic's Title V application, PB-1 was last modified in

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[4] For more information on EJ SCREEN, See https://www.epa.gov/ejscreen/technical-information-about-ejscreen

[5] Although PM and greenhouse gas potential emissions exceed 100 tons per year, Title V applicability is not based upon either of these pollutants.

1979 when the Wellons firing system was installed.

National Emission Standards for Hazardous Air Pollutants. 40 CFR 63, Subpart DDDDD (Industrial, Commercial and Institutional Boilers and Process Heaters at Major Sources) applies to PB-1 and PB-2. CO, PM, hydrogen chloride and mercury emission limits apply to each boiler along with various operating limits. The Boiler MACT[6] compliance date was January 31, 2016.

Section 111(d) and Section 129 Regulations. There are no CAA Section 111(d) or 129 regulations that apply to the type of emission units at SMC.

Federal Air Rules for Reservations. On April 8, 2005, EPA promulgated a Federal Implementation Plan for Reservations in Idaho, Oregon and Washington, commonly referred to as the Federal Air Rules for Reservations, containing rules that generally apply to Indian Reservations in Idaho, Oregon, and Washington in 40 CFR 49.121 to 49.139. The FARR rules that specifically apply on the Coeur d'Alene Reservation (Sections 123, 124, 125, 126, 129, 130, 131, 135, 137, 138 and 139) are codified at 40 CFR 49.9921 to 49.9930. FARR requirements that limit potential to emit have been taken into consideration in calculating SMC potential emissions in Region 10's Emissions Evaluation in Appendix A.

Acid Rain Program. Title IV of the CAA created a SO_2 and NO_X reduction program found in 40 CFR Part 72. The program applies to any facility that includes one or more "affected units" that combust a fossil fuel and serve a generator that produces electricity. The boilers at SMC are not a "unit" as defined in 40 CFR 72.2 because neither boiler combusts a fossil fuel and neither serves a generator that produces electricity.

7. Permit Content

The permit is organized into the following five sections:

Permit Section 1: Source Information and Project Description
Permit Section 2: General Requirements
Permit Section 3: Emission Limitations and Work Practice Requirements
Permit Section 4: Monitoring and Recordkeeping Requirements
Permit Section 5: Reporting Requirements
Permit Section 6: Abbreviations and Acronyms

Each permit condition in the permit is explained below. Specific analyses that were performed in development of the permit are described or referenced.

Permit Section 1 – Source Information and Project Description

This permit section contains a brief description of the facility and a list of emission units. A more detailed description of the facility can be found in Section 2 of this Fact Sheet. The final permit provides a brief discussion of the basic components of a lumber kiln drying system, including use of the terms "batch," "track system," "load," and "heating zone" to provide clarity for their use later in the permit. The terms "charge" and "cross sectional area" from the proposed permit are no longer employed. Table 1-1 of the final permit provides a more accurate description of emission unit PCWR-PM-PTB. Table 1-1 of the final permit reflects the work practices Region 10 ultimately determined to be BACT. The final permit corrects an erroneous reference to the

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[6] MACT standards are a subset of NESHAP standards.

project as a minor modification (it is a major modification for VOC).

Permit Section 2 – General Requirements

Permit Condition 2.1 is a new condition that identifies the emission units subject to the terms and conditions of the permit and clarifies the scope of the permit.

Permit Conditions 2.2 and 2.8 contain standard language regarding severability of permit conditions and property rights. For consistency with the minor NSR permit for the project, Region 10 has used the language in 40 CFR 49.155(a)(6) and (a)(7)(v), which is consistent with the Title V requirements in 40 CFR 71.6(a)(5) and 71.6(a)(6)(iv).

Permit Condition 2.3 specifies the enforcement authority for violation of PSD regulations and this permit, as provided in 40 CFR 52.21. Operation in violation of a permit term or condition is not authorized under this permit.

Permit Condition 2.4 ensures operations under the permit are consistent with the requirements of 40 CFR 52.21(k).

Permit Condition 2.5 makes clear that the permit does not relieve the Permittee of the responsibility to comply fully with all other requirements of federal law, as provided in 40 CFR 52.21(r)(3).

Permit Condition 2.6 makes clear that the need to avoid production losses is not an excuse for failing to comply with permit requirements. For consistency with the minor NSR permit for the project, Region 10 has used the language in 40 CFR 49.155(a)(7)(v), which is consistent with the Title V requirements in 40 CFR 71.6(a)(6)(v).

Permit Condition 2.7 contains provisions for revision, termination, or revocation and reissuance of the permit. Although 40 CFR Part 124 does not contain such procedures for PSD permits, see 40 CFR 124.5(g)(1), Region 10 has inherent authority to revise, terminate, or revoke and reissue a permit for cause, including a material mistake, inaccurate statements made during permit issuance, failure to comply with permit requirements, or ensuring compliance with the requirements of the CAA. For consistency with the minor NSR permit for the project, Region 10 has used the language in 40 CFR 49.155(a)(7)(iv), which is consistent with the Title V requirements in 40 CFR 71.7(f). Should Region 10 decide cause exists to revise, terminate, or revoke and reissue the permit, Region 10 will follow 40 CFR Part 124. Region 10 intends to give the Permittee reasonable notice prior to initiating such action.

Permit Condition 2.9. Region 10 has authority under Section 114 of the CAA to require the Permittee to furnish information, some of which is required to be recorded by the permit, that is necessary to carry out effective administration of this permit. For consistency with the minor NSR permit for the project, Region 10 has used the language in 40 CFR 49.155(a)(7)(v), which is consistent with the Title V requirements in 40 CFR 71.6(a)(6)(v).

Permit Condition 2.10 includes EPA's inspection authority under Section 114 of the CAA. The Permittee is a Title V source and has applied for a Title V operating permit under 40 CFR Part 71. For consistency with the minor NSR permit for the project, Region 10 has used the inspection language in 40 CFR 49.155(a)(7)(vii), which is consistent with the Title V requirements in 40 CFR 71.6(c).

Permit Condition 2.11 contains provisions relating to automatic expiration of PSD permits as provided in 40 CFR 52.21(r)(2) in the event of a failure to timely commence or complete construction or of a delay in construction. As provided in 40 CFR 124.5(g)(2), such permit expiration is not subject to the procedural requirements of 40 CFR Part 124.

Permit Condition 2.12 requires the Permittee to construct and operate the source in accordance with its application and supporting materials and in accordance with the final permit, as provided in 40 CFR 52.21(r)(1).

Permit Condition 2.13 provides authority to establish alternative testing, monitoring, recordkeeping and reporting requirements through our Title V monitoring authority through issuance, renewal, or significant modification of a Part 71 permit.

Permit Condition 2.14 contains provisions for rescission of the permit, as provided in 40 CFR 52.21(w).

Permit Condition 2.15 clarifies that the specification of a reference test method does not preclude the use of other credible evidence for the purpose of establishing whether or not the Permittee is in compliance with a particular requirement. This is consistent with EPA's interpretation of the CAA requirements. See 40 CFR 52.12(c), 60.11(g), 61.12(e), and 62 Fed. Reg. 8314 (February 24, 1997).

Permit Condition 2.16 requires the certification of all documents submitted under the permit. To facilitate incorporation of this requirement into the Permittee's Title V permit, Region 10 used language consistent with 40 CFR 71.5(d).

Permit Condition 2.17 requires notification of change of ownership of the source. Information presented in the notice helps to clarify who is responsible for complying with the terms and conditions of the permit and when the responsibility begins and ends.

Permit Condition 2.18 provides that, except for reporting requirements in Permit Condition 5.1, the Permittee must comply with permit requirements only after initial startup of LK-6. Initial startup occurs when lumber is dried in LK-6 for the first time. Compliance with Permit Condition 5.1 is required upon the effective date of the permit.

Permit Section 3 – Emission Limitations and Work Practice Requirements

Region 10 evaluated the project's VOC contribution to ambient ozone impacts as required in 40 CFR 52.21(k), and performed a VOC BACT analysis of the proposed kiln LK-6 as required in 40 CFR 52.21(j). Details of the AQIA evaluation and BACT analysis are in Appendices D and C, respectively. The emission limits and work practice requirements in Permit Section 3 reflect the results of Region 10's AQIA evaluation and BACT analysis and PotlatchDeltic's proposal to dry only three lower-emitting species of wood.

Permit Condition 3.1 reflects the revised scope of the project proposed by PotlatchDeltic on November 13, 2018: that LK-6 will be used to dry only Grand Fir, White Fir and Western Hemlock. The term "White Fir" in this context refers to the species White Fir and not to the group of several species of true fir grown in the West. As explained further below, the final permit does not require VOC testing for LK-6 (nor a limit on the kiln's maximum heated air temperature entering a load established during testing to determine the emission factor) based on this restriction.[7] This restriction on wood species effectively limits the VOC emissions because these species of wood are generally lower emitting species than Ponderosa Pine and Douglas Fir. See Appendix E to this Fact Sheet for further explanation.

Permit Condition 3.2 restricts VOC emissions from LK-6 to 50 tpy to reflect Potlatch's upper bound estimate of VOC emissions expected from the project considering the species of wood that will be dried. Region 10 considered this restriction on emissions in finalizing the AQIA evaluation and BACT analysis referred to previously in this document. The limit is an annual limit, consistent with the annual emissions used in the ambient air quality and BACT analyses, rather than a rolling 12-month limit used for limiting "potential" emissions.

Certain categories of species generate more VOC emissions than others during kiln drying and emit greater VOC emissions when dried at higher temperature. The emission factors used to determine compliance with the 50 tpy limit are based on a best-fit, linear relationship between maximum drying temperature and emissions (lb/mbf) using actual test data and assuming the species of wood being dried. See Appendix E to this Fact Sheet for further explanation.

The following formula is a mathematical expression for the calculation of a batch's VOC emission factor (lb/mbf) for drying Grand Fir or White Fir:

$$Emission\ Factor = (0.0066 * X) - 0.5818$$

where X = the highest 60-minute average dry bulb temperature of the heated air that enters each load of lumber in each zone of the kiln (°F)

The following formula is a mathematical expression for the calculation of a batch's VOC emission factor (lb/mbf) for drying Western Hemlock:

$$Emission\ Factor = (0.0037 * X) - 0.3085$$

where X = the highest 60-minute average dry bulb temperature of the heated air that enters each load of lumber in each zone of the kiln (°F)

If fan reversals are not synchronized with the start/finish of the 60-minute periods (during which data is used to calculate an average temperature used in the equations above) that begin with the start of the drying cycle, then it will be necessary for the Permittee to gather data from two separate dry bulb temperature sensors to calculate the 60-minute average temperatures of heated air that enters a load of lumber.

The emission factors were derived from source testing and the methodology of EPA's Interim VOC Measurement Protocol for the Wood Products Industry – July 2007, otherwise known as Other Test Method 26, or OTM-26[8]. This protocol establishes calculation procedures and emission measurement methods to approximate VOC emissions. Following the protocol generally means expressing Reference Method 25A total hydrocarbons as propane and adding separately measured contributions of methanol, formaldehyde and other known compounds to approximate total mass of VOC emissions. Historically, the forest products industry has reported its VOC emissions in terms of the mass of carbon atoms in the VOC compounds because the analytical methods (such as Reference Method 25A) measured VOCs in those terms. For softwood lumber drying, using the protocol results in the more accurate reporting of the total

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[7] For this reason, draft Permit Conditions 3.2 and 4.1 are not included in the final permit.
[8] https://www3.epa.gov/ttn/emc/prelim/otm26.pdf

mass of VOCs emitted.

For the White Fir and Grand Fir emission factors in Appendix E, the quantification of individual compounds includes methanol and formaldehyde, as specified in OTM-26, as well as acetaldehyde, which is known to be emitted from lumber kilns. The Western Hemlock emission factor includes methanol, formaldehyde and acetaldehyde, as well as propionaldehyde and acrolein, also known to be emitted from lumber kilns.

Permit Condition 4.1.2 requires tracking the volume of lumber dried, and 4.1.3 requires tracking the temperature entering each load of lumber and in each zone of the kiln for use in the emission factor equations. Using the temperature entering the load is consistent with the historical use of test data to create emission factors for lumber kilns. If testing is required to determine compliance, the permit requires that VOC emission factors be determined using OTM-26. In that case, Permit Condition 3.2.4 and Table 3-1 of the permit requires the testing and OTM-26 procedure to include contributions of all the compounds known to be emitted: methanal, formaldehyde, acetaldehyde, propionaldehyde, acrolein, phenol, acetic acid and ethanol.

The permit, however, does not require PotlatchDeltic to perform emission testing as Region 10 has determined there is not a reasonable possibility that annual emissions would exceed 50 tpy given the wood species the Permittee is restricted to drying and other factors discussed above. Region 10 estimates that the kiln will emit under 50 tons of VOC annually.[9] At the time the draft permit was proposed, the expected margin of compliance was closer to 50 tpy, and so the draft permit proposed to require testing to determine source-specific emission factors to strengthen the confidence that actual emissions would not exceed 50 tpy. The draft permit restricted the kiln's maximum heated air temperature entering a load based upon measurements to be taken during the testing to help to assure the ongoing representativeness of the source-specific emission factor. Because the final permit does not require testing due to the increased expected margin of compliance, the restriction on temperature entering a load is also not included in the final permit.

<u>Permit Condition 3.3</u> reflects a BACT work practice requirement. Limiting maximum drying temperature limits emissions. Data in Appendix E to this Fact Sheet illustrates that higher drying temperatures generate more emissions. The Permittee committed to a maximum temperature of 245°F exiting each load of lumber. The 245°F load exit temperature limitation is different than the 245°F limit proposed by the Permittee in two ways. First, the permit condition limits the actual temperature in the kiln and not the "set point" value that is an element of the computerized kiln management system. Secondly, the limit applies to each load (there is one load per track) in each zone of the kiln. This second change (applying the temperature limit to each load) was made in the final permit to better reflect the permittee's existing monitoring and better ensure that neither load is overdried, which would result in more emissions. By using the term "60-minute average" in the final permit, Region 10 is clarifying that compliance is determined over 60-minute periods of time that do not necessarily correspond to clock hours. The first 60-minute period begins when drying begins. Condition 4.1.4 of the final permit requires tracking the zone-specific temperatures exiting each load to confirm compliance with this permit condition. If fan

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[9] 38.6 tpy = (1.1342 lb/mbf)*(mbf/1000 bf)*(280,000 bf/charge)*(charge/36 hr)*(8760 hr/yr)*(ton/2000 lb); where 1.1342 lb/mbf = (0.0066 lb/mbf-°F)*(260°F) – 0.5818 lb/mbf. Region 10 assumes a 36-hour drying schedule based upon PotlatchDeltic's November 13, 2018 submittal. For this estimate, Region 10 assumes that the maximum one-hour average temperature of heated air entering the charge is 260°F given the 245°F BACT limit on the heated air exiting the charge.

reversals are not synchronized with the start/finish of the 60-minute periods (during which data is used to calculate an average temperature used to assure compliance with the 245°F limit) that begin with the start of the drying cycle, then it will be necessary for the Permittee to gather data from two separate dry bulb temperature sensors to calculate the 60-minute average temperatures of heated air that exits a load of lumber.

Permit Condition 3.4 also reflects a BACT work practice requirement. Limiting the lowest moisture content of the lumber also limits emissions. Drying lumber beyond the target moisture content extends the drying schedule and unnecessarily generates additional emissions. The Permittee indicates that its lowest target moisture content for any lumber that would be dried in this kiln is 13 percent (dry basis). More typically, the target moisture content would be 15 percent (dry basis). Unlike the temperature limit in Condition 3.3, this limit applies to the batch as a whole and not separately to individual portions of a load. Condition 4.1.5 requires measuring and tracking lumber moisture content in the kiln.

As evidenced by information presented in undated slides from a presentation at the June 2018 NCASI Region Conference in Atlanta, Georgia entitled, “Development of a Proposed PCWP MACT Work Practice Standard for Lumber Kilns,” other facilities are also subject to limits on the final moisture content of the dried lumber. According to the document, Georgia Pacific sawmills in Alabama, Georgia, North Carolina and South Carolina currently have kiln work practices in Title V permits, including a minimum limit on dried lumber moisture content.

Permit Condition 3.5 also reflects a BACT work practice requirement. Employing a computerized kiln management system with software developed by the kiln manufacturer enables the Permittee to avoid over-drying its lumber and unnecessarily generating additional emissions.

Permit Condition 3.6 also reflects a BACT work practice requirement. This permit condition requires the development and implementation of an operating and maintenance manual to assure good air pollution control practices and efficient operation. It requires that specified minimum elements be addressed to minimize over-drying lumber and thus minimize emissions. These minimum required elements are practices recommended by the United States Forest Services – Forest Products Laboratory in its September 1991 General Technical Report FPL-IMP-GTR-1 entitled, “Quality Drying of Softwood Lumber.” A copy of the document is provided in the administrative record for this permit action, and the document is also available online at https://www.fpl.fs.fed.us/documnts/fplgtr/impgtr01.pdf.

Permit Condition 3.7 is a common work practice requirement that is also added as a BACT work practice for the kiln. In the final permit, the phrase “including associated air pollution control equipment” has been added in reference to LK-6 to clarify that the requirement applies to the emission unit and associated control device and/or work practices to minimize emissions and for consistency with requirements in federal regulations such as 40 CFR 60.11(d).

Permit Section 4 – Monitoring and Recordkeeping Requirements

Permit Condition 4.1 requires the Permittee to track various parameters characterizing a particular batch of lumber dried in LK-6. Table 7-1 summarizes the information to be recorded and what the information is used for:

Table 7-1 – LK-6 Recording of Operations and Associated Emission Limitation

Monitoring Provision		Emission Limitation Provision	
Permit Condition…	Summary of Information Recorded about a Batch	Permit Conditions…	Summary of Emission Limitation
4.1.1	Identity of wood species present	3.1	Species limited to Grand Fir, White Fir and Western Hemlock
4.1.2	Volume of lumber	3.2	50 tpy VOC limit
4.1.3	60-minute average dry bulb temperature of heated air that enters each load of lumber in each zone of the kiln	3.2	50 tpy VOC limit. The maximum 60-minute average temperature is selected from among all the values in each of the lumber loads and in each of the kiln zones. The selected value is used to calculate the batch-specific emission factor.
4.1.4	60-minute average dry bulb temperature of heated air that exits each load of lumber in each zone of the kiln	3.3	245°F maximum temperature limit. The maximum 60-minute average temperature is selected from among all the values in each of the lumber loads and in each of the kiln zones. The selected value is compared directly to 245°F.
4.1.5	Every 60 seconds, the average moisture content of lumber measured at four equally-spaced locations along the length of each load	3.4	13% minimum moisture (dry basis) limit. The lowest average of instantaneous measurements taken every 60 seconds at eight monitoring locations. The selected value is compared directly to 13%.

Permit Condition 4.1.3 of the final permit requires tracking the zone-specific (10 zones across the kiln) temperatures entering each load (not just the upstream load as was proposed in the draft permit) and requires 60-minute average values (clarified from draft permit) be recorded. For each of the 10 zones, record a 60-minute average entering air temperature for each load. Permit Condition 4.1.4 of the final permit requires tracking the zone-specific temperatures (10 zones across the kiln) exiting each load (not just the downstream load as was proposed in the draft permit) and requires 60-minute average values (clarified from draft permit) be recorded. For each of the 10 zones, record a 60-minute average exiting air temperature for each load. Permit Condition 4.1.5 of the final permit requires tracking the moisture content at four equally-spaced locations in each load of lumber. Calculate a two-load average value every 60 seconds and record the lowest average value calculated during the drying cycle. These changes were made in the final permit to better reflect the permittee’s monitoring.

Permit Condition 4.2 requires that the temperature and moisture monitoring systems/equipment be maintained and accurate, consistent with the calibration schedule presented in the United States Forest Service document referenced above. This provision was added after the draft permit was proposed to ensure the monitoring equipment is properly maintained and the data quality assured.

Permit Condition 4.3 requires the calculations and records necessary to document compliance with the 50 tpy VOC emission limit. The final permit clarifies that compliance with the annual limit is required to be determined once per year, not once every month.

Permit Condition 4.4 is a common condition that requires certain records be maintained and retained for at least five years. The condition is the same as in the minor NSR permit for this project, based on language in 40 CFR 49.155(a)(4) and 63.10(b) and consistent with language in Part 71.

Permit Section 5 – Reporting Requirements

Permit Condition 5.1 requires the Permittee to notify Region 10 of initial startup of LK-6 and a few other key milestone dates. Some of these milestones must be reported before initial startup of LK-6.

Permit Condition 5.2 requires prompt reporting of deviations. For consistency with the minor NSR permit for the project, Region 10 has used the language in 40 CFR 49.155(a)(5), which is consistent with the Title V requirements in 40 CFR 71.6(a)(3)(iii)(B) and (C). An initial notification by phone and follow-up written notification is required. The permit defines "promptly" consistent with Region 10-issued Title V permits.

Permit Condition 5.3 requires an annual report to be submitted to Region 10. The requirement is consistent with one established in the accompanying minor NSR permit to satisfy 40 CFR 49.155(a)(5)(i).

Permit Condition 5.4 requires that the operation and maintenance manual in Permit Condition 3.6 be submitted and kept up to date.

Permit Condition 5.5 specifies where to submit reports and requires a copy be sent to the Tribal environmental office.

8. Public Participation

8.1 Public Notice and Comment

As required in 40 CFR 124.10(b), all draft PSD permits must be publicly noticed and made available for public comment for 30 days. For the draft permit, the public comment period began on September 6 and ended on October 11, 2018.

40 CFR 124.10(a)(1) requires the reviewing authority to give public notice that a draft permit has been prepared. The public notice must provide an opportunity for public comment and notice of a public hearing, if any, on the draft permit. For the draft permit, the notice was posted on Region 10's website for the duration of the comment period at https://www.epa.gov/publicnotices/notices-search/location/Idaho and mailed to required persons prior to the start of the comment period. Region 10 announced an opportunity for a public hearing on the draft permit contingent upon the public expressing interest. Region 10 cancelled the hearing after receiving no requests for a public hearing. The cancellation announcement was posted on Region 10's website.

40 CFR 124.10(c)(1) requires the reviewing authority to mail a copy of the notice to certain persons. 40 CFR 124.10(c)(2)(iii)(C) requires the reviewing authority to post the administrative record on an identified public Web site if the record is not available for public inspection at a physical location. Pursuant to 40 CFR 124.9(b), the record consists of the application and any supporting data furnished by the Permittee, the draft permit, the Fact Sheet, all documents cited in the Fact Sheet, and other documents contained in the supporting file for the draft permit. In accordance with 40 CFR 124.9(c), material readily available at Region 10 or published material that is generally available, and that is included in the record need not be posted with the rest of the record as long as it is specifically referred to in the Fact Sheet. For the draft permit, access to the record was available for the duration of the comment period through Region 10's website at https://www.epa.gov/publicnotices/notices-search/location/Idaho as well as at the St. Maries public library and EPA's Region 10 library.

8.2 Response to Public Comments and Permit Issuance

During the public comment period, Region 10 received comments from the following parties: Benewah County Board of Commissioners, PotlatchDeltic, Idaho Forest Group, National Council for Air and Stream Improvement, American Wood Council and Western Wood Products Association. Region 10 considered all comments received during the public comment period, as well as application updates received from the Permittee after the close of the comment period, in making a final permit decision. See Region 10's separate Response to Comments document for a summary of the comments and our responses. As required in 40 CFR 124.15, Region 10 will provide notice of the final permit decision to the Permittee and each person who submitted written comments or requested notice of the final permit decision. The notice to the commenters includes a reference to the procedures for appealing the final permit decision to EPA's Environmental Appeals Board.

As provided in 40 CFR 124.15(b), this final permit decision becomes effective 30 days after the service of notice of the decision unless review of the final permit is requested under 40 CFR 124.19. The effective date is noted on the first page of this permit.

9. Abbreviations and Acronyms

bf	Board feet
BACT	Best Available Control Technology
CAA	Clean Air Act [42 U.S.C. section 7401 et seq.]
CBI	Confidential business information
CFR	Code of Federal Regulations
EPA	United States Environmental Protection Agency (also U.S. EPA)
hr	Hour
lb	Pound (lbs = pounds)
m	Thousand
mm	Million
PSD	Prevention of significant deterioration
Region 10	U.S. EPA, Region 10
sf	Square feet
SIC	Standard Industrial Code
tpy	Tons per year

VOC	Volatile organic compound

Appendix A

EPA Estimation of PotlatchDeltic St. Maries Operations Non-HAP Potential Air Pollutant Emissions

St. Maries Operations Consist of Activities at St. Maries Lumber Drying Division (AFS ID No. 16-009-00030) and St. Maries Complex (AFS ID No. 16-009-00001)

Technical Support Document
PSD Permit No. R10PSD00100 &
Minor NSR Permit No. R10TNSR01800

St. Maries, Idaho

Summary of St. Maries Operations Non-HAP Potential to Emit[1]

Potential to Emit, (tons per year)

Non-Fugitive Emissions[2], (tons per year)

Pollutant	LDD Lumber Drying Division	SMC St. Maries Complex	**Non-Fugitive Subtotal**
Carbon Monoxide (CO)	249.1	945	1,194
Lead (Pb)	0.01	0.04	0.05
Nitrogen Oxides (NO_X)	40.3	172	212
Particulate (PM)	7.5	226.9	234
Inhalable Coarse Particulate (PM_{10})	12.3	225.0	237
Fine Particulate ($PM_{2.5}$)	12.3	211.6	224
Sulfur Dioxide (SO_2)	1.8	8.2	10
Volatile Organic Compounds (VOC)	284.2	367.1	651
Sulfuric Acid Mist (H_2SO_4)	0.9	2.3	3
Greenhouse Gas (CO_2e)	42,184	179,465	221,648

Fugitive Emissions, (tons per year)

Pollutant	LDD Lumber Drying Division	SMC St. Maries Complex	**Fugitive Subtotal**
Carbon Monoxide (CO)			
Lead (Pb)			
Nitrogen Oxides (NO_X)			
Particulate (PM)		597.5	598
Inhalable Coarse Particulate (PM_{10})		156.0	156
Fine Particulate ($PM_{2.5}$)		18.7	19
Sulfur Dioxide (SO_2)			
Volatile Organic Compounds (VOC)			
Sulfuric Acid Mist (H_2SO_4)			
Greenhouse Gas (CO_2e)			

All Emissions[3], (tons per year)

Pollutant	LDD Lumber Drying Division	SMC St. Maries Complex	**Total**
Carbon Monoxide (CO)	249.1	945.3	1,194
Lead (Pb)	0.01	0.04	0.05
Nitrogen Oxides (NO_X)	40.3	172.1	212
Particulate (PM)	7.5	824.5	832
Inhalable Coarse Particulate (PM_{10})	12.3	381.0	393
Fine Particulate ($PM_{2.5}$)	12.3	230.3	243
Sulfur Dioxide (SO_2)	1.8	8.2	10
Volatile Organic Compounds (VOC)	284.2	367.1	651
Sulfuric Acid Mist (H_2SO_4)	0.9	2.3	3
Greenhouse Gas (CO_2e)	42,184	179,465	221,648

[1] LDD non-HAP PTE estimates presented here do not reflect hog-fuel pile emissions and plant traffic emissions as Potlatch provided no information to EPA regarding these emission generating activities.

[2] Only non-fugitive emissions are considered for this facility in determining whether it is a major PSD source given that neither its sawmill or plywood mill are one of the 27 listed source categories required to consider fugitive emissions. See definition of "major stationary source" at 40 CFR 52.21(b)(1)(iii).

[3] The "All Emissions" table sums the values in the "Non-Fugitive Emissions" and "Fugitive Emissions" tables.

Appendix A: Potential Emissions Inventory

Summary of LDD Non-HAP Potential to Emit[1]

Potential to Emit, (tons per year)

Non-Fugitive Emissions[2], (tons per year)

Pollutant	PB-3 Hurst Boiler	LK-1 to LK-4 Lumber Drying Kilns 1, 2, 3 and 4	**Non-Fugitive Subtotal**
Carbon Monoxide (CO)	249.1	0	249
Lead (Pb)	0.01	0	0
Nitrogen Oxides (NO_X)	40.3	0	40
Particulate (PM)	7.4	0.1	8
Inhalable Coarse Particulate (PM_{10})	10.8	1.5	12
Fine Particulate ($PM_{2.5}$)	10.8	1.5	12
Sulfur Dioxide (SO_2)	1.8	0	2
Volatile Organic Compounds (VOC)	0.5	283.7	284
Sulfuric Acid Mist (H_2SO_4)	0.9	0	1
Greenhouse Gas (CO_2e)	42,184	0	42,184

Fugitive Emissions, (tons per year)

Pollutant	PB-3 Hurst Boiler	LK-1 to LK-4 Lumber Drying Kilns 1, 2, 3 and 4	**Fugitive Subtotal**
Carbon Monoxide (CO)			0
Lead (Pb)			0
Nitrogen Oxides (NO_X)			0
Particulate (PM)			0
Inhalable Coarse Particulate (PM_{10})			0
Fine Particulate ($PM_{2.5}$)			0
Sulfur Dioxide (SO_2)			0
Volatile Organic Compounds (VOC)			0
Sulfuric Acid Mist (H_2SO_4)			0
Greenhouse Gas (CO_2e)			0

All Emissions[3], (tons per year)

Pollutant	PB-3 Hurst Boiler	LK-1 to LK-4 Lumber Drying Kilns 1, 2, 3 and 4	**Total**
Carbon Monoxide (CO)	249.1		249
Lead (Pb)	0.01		0
Nitrogen Oxides (NO_X)	40.3		40
Particulate (PM)	7.4	0.1	8
Inhalable Coarse Particulate (PM_{10})	10.8	1.5	12
Fine Particulate ($PM_{2.5}$)	10.8	1.5	12
Sulfur Dioxide (SO_2)	1.8		2
Volatile Organic Compounds (VOC)	0.5	283.7	284
Sulfuric Acid Mist (H_2SO_4)	0.9		1
Greenhouse Gas (CO_2e)	42,184		42,184

[1] LDD non-HAP PTE estimates presented here do not reflect hog-fuel pile emissions and plant traffic emissions as Potlatch provided no information to EPA regarding these emission generating activities.

[2] Only non-fugitive emissions are considered for this facility in determining whether it is a major PSD source source given that neither its sawmill or plywood mill are one of the 27 listed source categories required to consider fugitive emissions. See definition of "major stationary source" at 40 CFR 52.21(b)(1)(iii).

[3] The "All Emissions" table sums the values in the "Non-Fugitive Emissions" and "Fugitive Emissions" tables.

Appendix A: Potential Emissions Inventory

LDD Non-HAP Potential to Emit

Emission Unit:	**HB - Hurst Boiler**	
Manufacturer:	Hurst Boiler & Welding Company	
Manufacture/Modification Date:	1987	
Model:	HYB-6500-150	
Serial Number:	?	
Burner Type:	Underfeed stokers(?)	
Oxygen Trim System:	No (as defined by Boiler MACT)	
Fly Ash Reinjection:	?	
Sand Classifier:	?	
Maximum Steam Production:	34,500	pounds saturated steam per hour at __ psig and ___ °F
Nameplate Heat Input Capcity:	49	MMBtu/hr
FHISOR:	1.321	MMBtu/Mlb steam. Fuel heat input (based upon HHV) to steam output ratio measured during February 25, 2016 Boiler MACT testing @ 28,492 lb/hr stea
Maximum Operation:	8760	hours per year
Fuel:	Wet biomass (greater than 20% moisture content, wet basis) comprised of SMC wood residuals. Dry biomass combusted during startup.	
Boiler MACT Subcategory:	Stokers/sloped grate/other units designed to burn wet biomass/bio-based solid	
Particulate Matter Control Device No. 1:	Multiclone (required by Idaho DEQ Title V permit No. T1-2012.0059)	
Manufacturer:	Hurst	
Manufacture Date:	1987	
Particulate Matter Control Device No. 2:	Two-field dry electrostatic precipitator (required by Idaho DEQ Title V permit No. T1-2012.0059)	
Manufacturer:	McGill	
Model:	AirClean Intercept Model 2-75	
Installation Date:	2003	

NON-FUGITIVE EMISSIONS

Potential to Emit, (tons per year)

Criteria Pollutant Emissions	EF (lb/MMBtu)	EF (lb/Mlb steam)	PTE (tpy)	EF Reference
Carbon Monoxide (CO)	1.248	~~0.641~~	249.1	Boiler MACT CO emission limit of 1500 ppmdv @ 3% O2 equivalent to 1.248 lb/MMBtu for biomass combusted during February 2016 Boiler MACT testing in which Fd = 9806 dscf/MMBtu. See July 8, 2016 Notification of Compliance Status for Potlatch's selection of 3-hour average compliance option rather than 720 ppmdv @ 3% O2 30-day rolling average. Row 7.a of Table 2 to 40 CFR 63 subpart DDDDD. Boiler MACT emission limit applicable at all times unit is operating except startup and shutdown. For derivation of the "lb/MMBtu" emission rates, see EPA Region 10 Non-HAP Potential to Emit Emission Factors for Biomass Boilers Located in Pacific Northwest Indian Country, May 8, 2014. See https://www.epa.gov/sites/production/files/2016-09/documents/bbnonhappteef_memo.pdf. See Option 2 for Boiler MACT CO emission limit applicable to existing stokers/sloped grate/others designed to burn wet biomass fuel. Measured CO emission rate of 0.641 lb/MMBtu is not employed because the source is not required to achieve the emission rate observed. See Bison Engineering, Inc. April 22, 2016 Boiler MACT Stack Test Report prepared for Potlatch Land and Lumber, LLC. Table 7 of the report documents February 25, 2016 testing of Hurst boiler while generating approximately 28,500 lb steam/hr. 0.641 lb CO/Mlb steam = [(28.0 lb/hr / 28.389 Mlb steam/hr) + (5.9 lb/hr / 27.844 Mlb steam/hr) + (21.2 lb/hr / 29.244 Mlb steam/hr)] / 3.
Lead (Pb)	0.000048		0.01	AP-42, September 2003. Table 1.6-4.
Nitrogen Oxides (NO_X)		0.267	40.3	Spidell and Associates. August 27, 2004 Source Test Report prepared for Potlatch Corporation. Table 2 of the report documents August 4, 2004 testing of Hurst boiler while generating approximately 31,500 lb steam/hr. 0.267 lb NO_X/Mlb steam = [(8.84 lb/hr / 30.990 Mlb steam/hr) + (7.02 lb/hr / 32.271 Mlb steam/hr) + (9.32 lb/hr / 31.113 Mlb steam/hr)] / 3. No NO_X testing reported in 2016 Boiler MACT Stack Test Report.

Particulate (PM)	0.037	~~0.033~~	7.4	Boiler MACT PM emission limit applicable at all times unit is operating except startup and shutdown. See July 8, 2016 Notification of Compliance Status for Potlatch's selection of PM compliance option rather than total selected metals. For PM limit, see row 7.b of Table 2 to 40 CFR 63 subpart DDDDD. PM emissions are the "filterable" fraction quantified via EPA RM5. PM emissions do not include the "condensible" fraction. See EPA final rulemaking in the October 25, 2012 Federal Register, pages 65107-65119, at http://www.gpo.gov/fdsys/pkg/FR-2012-10-25/pdf/2012-25978.pdf. The 0.033 lb/mlb steam PM EF derived from stack testing is not employed to determine PTE because (a) control devices (multiclones and electrostatic precipitator (ESP)) were employed to reduce PM emission during the test and (b) the source is not required to achieve the emission rates observed. See Bison Engineering, Inc. April 22, 2016 Boiler MACT Stack Test Report prepared for Potlatch Land and Lumber, LLC. Table 7 of the report documents February 25, 2016 testing of Hurst boiler while generating approximately 28,500 lb steam/hr. 0.033 lb PM/Mlb steam = [(1.01 lb/hr / 28.389 Mlb steam/hr) + (0.81 lb/hr / 27.844 Mlb steam/hr) + (0.98 lb/hr / 29.244 Mlb steam/hr)] / 3.
Inhalable Coarse Particulate (PM_{10})	0.054		10.8	Boiler MACT for filterable portion and AP-42's Table 1.6-1, September 2003 for condensible portion. Assume all PM is also PM_{10}. 0.037 lb/MMBtu (filterable) + 0.017 lb/MMBtu (condensible) = 0.054 lb/MMBtu.
Fine Particulate ($PM_{2.5}$)	0.054		10.8	Boiler MACT for filterable portion and AP-42's Table 1.6-1, September 2003 for condensible portion. Assume all PM is also PM_{10}. 0.037 lb/MMBtu (filterable) + 0.017 lb/MMBtu (condensible) = 0.054 lb/MMBtu.
Sulfur Dioxide (SO_2)	0.009		1.8	Biomass fuel upper bound sulfur estimate of 0.026% by weight (dry) and 15% conversion to SO_2. See derivation of 0.009 lb/MMBtu EF below.
Volatile Organic Compounds (VOC)	0.0023		0.5	Travis Energy & Environment, Inc. December 18, 1994 Emission Test Report prepared for Potlatch Corp. Table 3-3b of the report documents November 16, 1994 testing of the Hurst boiler. The portions of the report provided to EPA do not present the heat input or steam generating rates experienced during testing. We assume the heat input was approximately 49 MMBtu/hr during November 1994 testing as that was the rate calculated for the 2016 Boiler MACT testing. The 2016 Boiler MACT Stack Test Report indicates that no VOC testing was performed at that time, and the VOC testing conducted on August 4, 2004 was determined to be invalid by Idaho DEQ. See derivation of 0.002 lb/MMBtu EF below.
Sulfuric Acid Mist (H_2SO_4)	0.0043		0.9	8 percent of PM2.5 emissions, based on BART-recommended PM2.5 / sulfate speciation for hog fuel boilers.

Greenhouse Gas Emissions (CO_2 Equivalent)	EF (lb/MMBtu)	EF (lb/mlb steam)	PTE (tpy)	EF Reference
Carbon Dioxide (CO_2)	206.8		41,280.7	GHG Reporting Rule (40 CFR 98) is considered the primary reference for estimating GHG emissions when preparing or processing permit applications.
Methane (CH_4)	1.764		352.1	GHG Reporting Rule (40 CFR 98) is considered the primary reference for estimating GHG emissions when preparing or processing permit applications.
Nitrous Oxide (N_2O)	2.759		550.7	GHG Reporting Rule (40 CFR 98) is considered the primary reference for estimating GHG emissions when preparing or processing permit applications.
TOTAL			42,184	

<u>SO_2 EF: 0.009 lb/MMBtu</u>

Basis: Maximum sulfur content of 0.026% by weight, dry basis was measured during March 2017 sampling event at the facility. Upper bound 15% conversion to SO_2. See H. S. Oglesby & R. O. Blosser (1980) Information on the Sulfur Content of Bark and its Contribution to SO_2 Emissions when Burned as a Fuel, Journal of the Air Pollution Control Association, 30:7, 769-772, DOI:10.1080/00022470.1980.10465107. A 15% sulfur to SO_2 conversion factor is a reasonable upper bound estimate given 10% conversion measured by Oglesby and Blosser based upon limited amount of data from a handful of species.

EF (lb/MMBtu) = {[Upper bound S Content (%S) / 100] X $CF_{S \rightarrow SO2}$ / HV_{fuel} (Btu/lb)} X $CF_{Btu \rightarrow MMBtu}$ (Btu/MMBtu)

- $CF_{S \rightarrow SO2}$ = 2 lb SO_2/lb S. S + O_2 → SO_2. For every 1 mol S (16 lb/lb-mol) reactant, there is 1 mol SO_2 (32 lb/lb-mol) product. 32 / 16 = 2. Assume that only 15% of sulfur is exhausted to atmosphere as SO_2. The balance precipitates out as sulfates in the ash. Multiplying by 0.15, resultant CFS→SO_2 = 0.3 lb SO_2/lb S.
- HHV (higher heating value) fuel= 8587 Btu/lb. This is the heating value of the fuel sample with sulfur content of 0.026% by weight, dry.

Reasonable Upper Bound Fuel Sulfur Content (% by weight)	Reasonable Upper Bound 15% Conversion $CF_{S \rightarrow SO2}$ (lb SO_2/lb S)	HHV_{fuel} (Btu/lb)	$CF_{Btu \rightarrow MMBtu}$ (Btu/MMBtu)	Calculated EF (lb/MMBtu)
0.026	0.3	8587	1.0E+06	0.009

Calculation to convert VOC (as carbon) to VOC (as compound)

VOC (as weighted-average VOC) = (VOC_C) X [($MW_{wt\text{-}avg\ VOC}$) / (MW_C)] X [($\#C_C$) / ($\#C_{wt\text{-}avg\ VOC}$)]

where:

VOC_C equals "0.0017 lb/MMBtu" from December 18, 1994 Emission Test Report. Method 25A 0.0017 lb/MMBtu = 0.082 lb/hr / 49 MMBtu/hr.

$MW_{wt\text{-}avg\ VOC}$ equals "64.689 lb/lb-mol" and is the weighted-average molecular weight for VOC assuming speciated organic compound ratios supported by AP-42 Table 1.6-3

MW_C equals "12.0110 lb/lb-mol" and represents the molecular weight for carbon

$\#C_C$ equals "1" as the single carbon atom was the "basis" for which Method 25A VOC test results were determined

$\#C_{wt\text{-}avg\ VOC}$ equals "3.975" and is the weighted-average number of carbon atoms present in VOC assuming speciated organic compound ratios supported by AP-42 Table 1.6-3

Calculating value for VOC (as weighted-average VOC):

VOC (as carbon):	0.0017	lb/MMBtu
$MW_{wt\text{-}avg\ VOC}$:	64.689	lb/lb-mol
MW_C:	12.011	lb/lb-mol
$\#C_C$:	1	
$\#C_{wt\text{-}avg\ VOC}$:	3.975	
VOC (as weighted average VOC)	0.0023	lb/MMBtu

Factor to convert VOC_C to VOC (as weighted average VOC) = 1.355

The first two columns of the following table are extracted from AP-42, September 2003. Table 1.6-3. The third and fourth columns were created based upon information widely available over the internet. The fifth and sixth columns illustrate calculations necessary to determine weighted-average molecular weight and weighted-average number of carbon atoms comprising VOC emissions resulting from wood residue combustion.

Wood Residue Combustion Organic Compounds	EF (lb/MMBtu)	MW lb/lb-mol	Number of Carbon Atoms	EF x MW	EF X #C atoms
Acenaphthene	9.10E-07	154.21	12	1.40E-04	1.09E-05
Acenaphthylene	5.00E-06	152.19	12	7.61E-04	6.00E-05
Acetaldehyde	8.30E-04	44.05	2	3.66E-02	1.66E-03
Acetone	1.90E-04	58.08	3	1.10E-02	5.70E-04
Acetophenone	3.20E-09	120.15	8	3.84E-07	2.56E-08
Acrolein	4.00E-03	56.06	3	2.24E-01	1.20E-02
Anthracene	3.00E-06	178.23	14	5.35E-04	4.20E-05
Benzaldehyde	8.50E-07	106.12	7	9.02E-05	5.95E-06
Benzene	4.20E-03	78.11	6	3.28E-01	2.52E-02
Benzo(a)anthracene	6.50E-08	228.29	18	1.48E-05	1.17E-06
Benzo(a)pyrene	2.60E-06	252.31	20	6.56E-04	5.20E-05
Benzo(b)fluoranthene	1.00E-07	252.31	20	2.52E-05	2.00E-06
Benzo(e)pyrene	2.60E-09	252.31	20	6.56E-07	5.20E-08
Benzo(g,h,i)perylene	9.30E-08	276.33	22	2.57E-05	2.05E-06
Benzo(j,k)fluoranthene	1.60E-07	202.26	16	3.24E-05	2.56E-06
Benzo(k)fluoranthene	3.60E-08	252.31	20	9.08E-06	7.20E-07
Benzoic acid	4.70E-08	122.12	7	5.74E-06	3.29E-07
Bis(2-ethylhexyl)phthalate (DEHP)	4.70E-08	390.56	24	1.84E-05	1.13E-06
Bromomethane (Methyle bromide)	1.50E-05	94.94	1	1.42E-03	1.50E-05
2-Butanone (MEK)	5.40E-06	72.11	4	3.89E-04	2.16E-05
Carbazole	1.80E-06	167.21	12	3.01E-04	2.16E-05
Carbon tetrachloride	4.50E-05	153.82	1	6.92E-03	4.50E-05
Chlorobenzene	3.30E-05	112.56	6	3.71E-03	1.98E-04
Chloroform	2.80E-05	119.38	1	3.34E-03	2.80E-05
Chloromethane (Methyl chloride)	2.30E-05	50.49	1	1.16E-03	2.30E-05
2-Chloronaphthalene	2.40E-09	162.62	10	3.90E-07	2.40E-08
2-Chlorophenol	2.40E-08	128.56	6	3.09E-06	1.44E-07
Chrysene	3.80E-08	228.28	18	8.67E-06	6.84E-07
Crotonaldehyde	9.90E-06	70.09	4	6.94E-04	3.96E-05
Decachlorobiphenyl	2.70E-10	498.6584	12	1.35E-07	3.24E-09
Dibenzo(a,h)anthracene	9.10E-09	278.35	22	2.53E-06	2.00E-07
1,2-Dibromoethene	5.50E-05	185.85	2	1.02E-02	1.10E-04

Dichlorobiphenyl	7.40E-10	223.09792	12	1.65E-07	8.88E-09
1,2-Dichloroethane (Ethylene dichloride)	2.90E-05	98.96	2	2.87E-03	5.80E-05
Dichloromethane (Methylene chloride)	2.90E-04	84.93	2	2.46E-02	5.80E-04
1,2-Dichloropropane (Propylene dichloride)	3.30E-05	122.99	3	4.06E-03	9.90E-05
2,4-Dinitrophenol	1.80E-07	184.11	6	3.31E-05	1.08E-06
Ethyl benzene	3.10E-05	106.17	8	3.29E-03	2.48E-04
Fluoranthene	1.60E-06	202.26	16	3.24E-04	2.56E-05
Fluorene	3.40E-06	166.22	13	5.65E-04	4.42E-05
Formaldehyde	4.40E-03	30.03	1	1.32E-01	4.40E-03
Heptachlorobiphenyl	6.60E-11	395.32322	12	2.61E-08	7.92E-10
Hexachlorobiphenyl	5.50E-10	360.87816	12	1.98E-07	6.60E-09
Hexanal	7.00E-06	100.15888	6	7.01E-04	4.20E-05
Heptachlorodibenzo-p-dioxins	2.00E-09	425.30614	12	8.51E-07	2.40E-08
Heptachlorodibenzo-p-furans	2.40E-10	409.30674	12	9.82E-08	2.88E-09
Hexachlorodibenzo-p-dioxins	1.60E-06	390.82	12	6.25E-04	1.92E-05
Hexachlorodibenzo-p-furans	2.80E-10	374.86168	12	1.05E-07	3.36E-09
Indeno(1,2,3-cd)pyrene	8.70E-08	326.34	22	2.84E-05	1.91E-06
Isobutyraldehyde	1.20E-05	72.10572	4	8.65E-04	4.80E-05
2-Methylnaphthalene	1.60E-07	142.20	11	2.28E-05	1.76E-06
Monochlorobiphenyl	2.20E-10	187.64492	12	4.13E-08	2.64E-09
Naphthalene	9.70E-05	128.17	10	1.24E-02	9.70E-04
2-Nitrophenol	2.40E-07	139.11	6	3.34E-05	1.44E-06
4-Nitrophenol	1.10E-07	139.11	6	1.53E-05	6.60E-07
Octachlorodibenzo-p-dioxins	6.60E-08	459.7512	12	3.03E-05	7.92E-07
Octachlorodibenzo-p-furans	8.80E-11	443.7518	12	3.91E-08	1.06E-09
Pentachlorodibenzo-p-dioxins	1.50E-09	356.41602	12	5.35E-07	1.80E-08
Pentachlorodibenzo-p-furans	4.20E-10	340.41662	12	1.43E-07	5.04E-09
Pentachlorobiphenyl	1.20E-09	326.4331	12	3.92E-07	1.44E-08
Pentachlorophenol	5.10E-08	266.34	6	1.36E-05	3.06E-07
Perylene	5.20E-10	252.31	20	1.31E-07	1.04E-08
Phenanthrene	7.00E-06	178.23	14	1.25E-03	9.80E-05
Phenol	5.10E-05	94.11	6	4.80E-03	3.06E-04
Propanal	3.20E-06	58.08	3	1.86E-04	9.60E-06
Propionaldehyde	6.10E-05	58.08	3	3.54E-03	1.83E-04
Pyrene	3.70E-06	202.25	16	7.48E-04	5.92E-05
Styrene	1.90E-03	104.15	8	1.98E-01	1.52E-02
2,3,7,8-Tetrachlorodibenzo-p-dioxins	8.60E-12	321.97096	12	2.77E-09	1.03E-10
Tetrachlorodibenzo-p-dioxins	4.70E-10	321.97096	12	1.51E-07	5.64E-09
2,3,7,8-Tetrachlorodibenzo-p-furans	9.00E-11	305.97156	12	2.75E-08	1.08E-09
Tetrachlorodibenzo-p-furans	7.50E-10	305.97156	12	2.29E-07	9.00E-09
Tetrachlorobiphenyl	2.50E-09	291.98804	12	7.30E-07	3.00E-08
Tetrachloroethene (Tetrachloroethylene)	3.80E-05	165.83	2	6.30E-03	7.60E-05
o-Tolualdehyde	7.20E-06	120.15	8	8.65E-04	5.76E-05
p-Tolualdehyde	1.10E-05	120.15	8	1.32E-03	8.80E-05
Toluene	9.20E-04	92.14	7	8.48E-02	6.44E-03
Trichlorobiphenyl	2.60E-09	257.54298	12	6.70E-07	3.12E-08
1,1,1-trichloroethane (Methyl chloroform)	3.10E-05	133.40	2	4.14E-03	6.20E-05
Trichloroethene (Trichloroethylene)	3.00E-05	131.39	2	3.94E-03	6.00E-05
Trichlorofluoromethane	4.10E-05	137.37	1	5.63E-03	4.10E-05
2,4,6-Trichlorophenol	2.20E-08	197.45	6	4.34E-06	1.32E-07
Vinyl chloride	1.80E-05	62.50	2	1.13E-03	3.60E-05
o-Xylene	2.50E-05	106.16	8	2.65E-03	2.00E-04
TOTAL	1.75E-02			1.13E+00	6.96E-02
				64.689	3.975

weighted-average molecular weight of VOC ↗ 64.689

weighted-average number of carbon atoms comprising VOC ↖ 3.975

LDD Non-HAP Potential to Emit

Emission Unit: **LK-1, LK-2, LK-3 and LK-4 - Lumber Drying Kilns 1, 2, 3 and 4**
Description: Four double-track 68-foot-long lumber drying kiln
Manufacturer: Coe/Moore
Installed: 1987
Heat Source: Indirect steam provided by emission unit PB-3
Control Device: None
Work Practice: None
Fuel: None
Potential Species Dried: Douglas fir, western red cedar, grand fir, hemlock, lodgepole pine, subalpine fir, elgelmann spruce, ponderosa pine and western white pine
Annual Capacity: 149 MMbf/yr

NON-FUGITIVE EMISSIONS

Potential to Emit, (tons per year)

Pollutant Emissions	EF (lb/Mbf)	PTE (tpy)	EF Reference
Carbon Monoxide (CO)	0	0	
Lead (Pb)	0	0	
Nitrogen Oxides (NO_X)	0	0	
Particulate (PM)	0.002	0.1	1 - PM emissions testing conducted in 2013 at Chemco in Ferndale, Washington. Based upon information presented by Potlatch in its February 1, 2018 submittal to EPA Region 10, PM emissions testing conducted by Horizon Engineering at Oregon State University pilot-scale kiln in 1998 is invalid.
Inhalable Coarse Particulate (PM_{10})	0.020	1.5	1 - PM emissions testing conducted in 2013 at Chemco in Ferndale, Washington. Based upon information presented by Potlatch in its February 1, 2018 submittal to EPA Region 10, PM emissions testing conducted by Horizon Engineering at Oregon State University pilot-scale kiln in 1998 is invalid.
Fine Particulate ($PM_{2.5}$)	0.020	1.5	1 - PM emissions testing conducted in 2013 at Chemco in Ferndale, Washington. Based upon information presented by Potlatch in its February 1, 2018 submittal to EPA Region 10, PM emissions testing conducted by Horizon Engineering at Oregon State University pilot-scale kiln in 1998 is invalid.
Sulfur Dioxide (SO_2)	0	0	
Volatile Organic Compounds (VOC)	3.8087	284	2 - Because the facility has the ability to dry resinous and non-resinous softwood species at temperatures in excess of 200ºF, select the highest WPP1 VOC EF from among all softwood species for drying above 200ºF. The Ponderosa Pine EF is highest.
Sulfuric Acid Mist (H_2SO_4)	0	0	

Greenhouse Gas Emissions (CO_2 Equivalent)	EF (lb/Mbf)	PTE (tpy)	EF Reference
Carbon Dioxide (CO_2)	0	0	
Methane (CH_4)	0	0	
Nitrous Oxide (N_2O)	0	0	
TOTAL		0	

EF Reference	Description
1	February & May/June 2013 emissions testing of Hemlock lumber drying at less than 180°F within a pilot-scale kiln at Chemco in Ferndale, Washington. Testing was performed by Emission Technologies, Inc. on behalf of Sierra Pacific Industries and consisted of RM5 and 202. http://www.swcleanair.org/docs/Dry%20Kilns/SourceTests/2013-02-21%20Sierra%20Pacific%20-%20Chemco%20-%20Ferndale%20-%20Dry%20Kiln%20PM%20Test%20Report.pdf & http://www.swcleanair.org/docs/Dry%20Kilns/SourceTests/2013-05-29%20Sierra%20Pacific%20-%20Mt%20Vernon%20-%20Pilot%20Dry%20Kiln%20Filterable%20and%20Condensable%20PM%20Test%20Report.pdf
2	EPA Region 10 HAP and VOC Emission Factors for Lumber Drying, December 2012. https://www.epa.gov/sites/production/files/2016-09/documents/ldkhapvocpteef_memo.pdf

Appendix A: Potential Emissions Inventory

Summary of SMC Non-HAP Potential to Emit

Potential to Emit, (tons per year)

Non-Fugitive Emissions[1], (tons per year)

Emission Unit ID →	PB-1	PB-2	LK-5	VD-1 to VD-4			PV-1 & PV-2	LS-1	PCWR-SM[3]	PCWR-PM	IC-1 & IC-2	IC-3 to IC-10	CA	ES	PP & WP	BV-1 to BV-4	DB & COS	WRD-SM[4]	HFP-SM	PT	**Non-Fugitive Subtotal**
				VDHS-1 to VDHS-4	VDL-1 to VDL-4	VDCS-1 to VDCS-4															
Emission Unit / Emission Generating Activity →	CE Boiler	Riley Boiler	Lumber Drying Kiln 5	Veneer Dryer Heating Section	Veneer Dryer Leaks	Veneer Dryer Cooling Section	Plywood Presses 1 & 2	Log Steaming Vault	Pneumatic Conveyance of Wood Residue at Sawmill	Pneumatic Conveyance of Wood Residue at Plywood Mill	Diesel-Fired Engines	Propane-Fired Engines	Compressed Air Drying Agent System	Edge Seal and Surface Coating Line	Plywood Panel Patching	Building Vents 1 to 4	Log Debarking and Cut-Off Saws	Wood Residue Drops at Sawmill	Wind Erosion of Hog Fuel Pile at Sawmill	Plant Traffic	
Carbon Monoxide (CO)	231.2	705.4		0.7							0.2	7.8									945
Lead (Pb)	0.01	0.03																			0
Nitrogen Oxides (NO_X)	54.7	115.9		0.6							0.8	0.1									172
Particulate (PM)	5.1	21.2	0.2	2.9	4.1	1.5	21.0		81.1	85.8	0.04	0.01				4.1					227
Inhalable Coarse Particulate (PM_{10})	6.3	22.3	1.6	5.9	8.5	3.2	35.6		56.2	81.3	0.04	0.01				4.1					225
Fine Particulate ($PM_{2.5}$)	6.3	22.3	1.6	5.9	8.5	3.2	35.6		53.3	70.8	0.04	0.01				4.1					212
Sulfur Dioxide (SO_2)	2.3	5.2		0.6							0.0934	0.001									8
Volatile Organic Compounds (VOC)	1.7	4.5	112.5	18.2	0.8	6.0	18.0	15.3	68.7	75.1	0.1	0.002	3.3	20.5	22.4						367
Sulfuric Acid Mist (H_2SO_4)	0.5	1.8																			2
Greenhouse Gas (CO_2e)	53,455	121,096		4,876							30	8									179,465

Fugitive Emissions, (tons per year)

Emission Unit ID →	PB-1	PB-2	LK-5	VD-1 to VD-4			PV-1 & PV-2	LS-1	PCWR-SM[3]	PCWR-PM	IC-1 & IC-2	IC-3 to IC-10	CA	ES	PP & WP	BV-1 to BV-4	DB & COS	WRD-SM[4]	HFP-SM	PT	**Fugitive Subtotal**
				VDHS-1 to VDHS-4	VDL-1 to VDL-4	VDCS-1 to VDCS-4															
Emission Unit / Emission Generating Activity →	CE Boiler	Riley Boiler	Lumber Drying Kiln 5	Veneer Dryer Heating Section	Veneer Dryer Leaks	Veneer Dryer Cooling Section	Plywood Presses 1 & 2	Log Steaming Vault	Pneumatic Conveyance of Wood Residue at Sawmill	Pneumatic Conveyance of Wood Residue at Plywood Mill	Diesel-Fired Engines	Propane-Fired Engines	Compressed Air Drying Agent System	Edge Seal and Surface Coating Line	Plywood Panel Patching	Building Vents 1 to 4	Log Debarking and Cut-Off Saws	Wood Residue Drops at Sawmill	Wind Erosion of Hog Fuel Pile at Sawmill	Plant Traffic	
Carbon Monoxide (CO)																					0
Lead (Pb)																					0
Nitrogen Oxides (NO_X)																					0
Particulate (PM)																	20.8	0.16	0.20	576.4	598
Inhalable Coarse Particulate (PM_{10})																	0.6	0.004	0.005	155.4	156
Fine Particulate ($PM_{2.5}$)																	0.1	0.001	0.001	18.6	19
Sulfur Dioxide (SO_2)																					0
Volatile Organic Compounds (VOC)																		59.9			60
Sulfuric Acid Mist (H_2SO_4)																					0
Greenhouse Gas (CO_2e)																					0

All Emissions[2], (tons per year)

Emission Unit ID →	PB-1	PB-2	LK-5	VD-1 to VD-4			PV-1 & PV-2	LS-1	PCWR-SM[3]	PCWR-PM	IC-1 & IC-2	IC-3 to IC-10	CA	ES	PP & WP	BV-1 to BV-4	DB & COS	WRD-SM[4]	HFP-SM	PT	**Total**
				VDHS-1 to VDHS-4	VDL-1 to VDL-4	VDCS-1 to VDCS-4															
Emission Unit / Emission Generating Activity →	CE Boiler	Riley Boiler	Lumber Drying Kiln 5	Veneer Dryer Heating Section	Veneer Dryer Leaks	Veneer Dryer Cooling Section	Plywood Presses 1 & 2	Log Steaming Vault	Pneumatic Conveyance of Wood Residue at Sawmill	Pneumatic Conveyance of Wood Residue at Plywood Mill	Diesel-Fired Engines	Propane-Fired Engines	Compressed Air Drying Agent System	Edge Seal and Surface Coating Line	Plywood Panel Patching	Building Vents 1 to 4	Log Debarking and Cut-Off Saws	Wood Residue Drops at Sawmill	Wind Erosion of Hog Fuel Pile at Sawmill	Plant Traffic	
Carbon Monoxide (CO)	231.2	705.4		0.7							0.2	7.8									945
Lead (Pb)	0.01	0.03																			0
Nitrogen Oxides (NO_X)	54.7	115.9		0.6							0.8	0.1									172
Particulate (PM)	5.1	21.2	0.2	2.9	4.1	1.5	21.0		81.1	85.8	0.04	0.01				4.1	20.8	0.16	0.20	576.4	824
Inhalable Coarse Particulate (PM_{10})	6.3	22.3	1.6	5.9	8.5	3.2	35.6		56.2	81.3	0.04	0.01				4.1	0.6	0.004	0.005	155.4	381
Fine Particulate ($PM_{2.5}$)	6.3	22.3	1.6	5.9	8.5	3.2	35.6		53.3	70.8	0.04	0.01				4.1	0.1	0.001	0.001	18.6	230
Sulfur Dioxide (SO_2)	2.3	5.2		0.6							0.0934	0.001									8
Volatile Organic Compounds (VOC)	1.7	4.5	112.5	18.2	0.8	6.0	18.0	15.3	68.7	75.1	0.1	0.002	3.3	20.5	22.4			59.9			427
Sulfuric Acid Mist (H_2SO_4)	0.5	1.8																			2
Greenhouse Gas (CO_2e)	53,455	121,096		4,876							30	8									179,465

Notes:

[1] Only non-fugitive emissions are considered for this facility in determining whether it is a major PSD source source given that neither its sawmill or plywood mill are one of the 27 listed source categories required to consider fugitive emissions. See definition of "major stationary source" at 40 CFR 52.21(b)(1)(iii).

[2] The "All Emissions" table sums the values in the "Non-Fugitive Emissions" and "Fugitive Emissions" tables.

[3] PCWR-SM consists of individual emission units S-CH, P-SH, P-SD, P-PTB, P-PSB, S-SD, S-SDB and other miscellaneous emission generating activities.

[4] WRD-SM consists of individual emission units WRD-SM-CH, WRD-SM-SD, WRD-SM-HF and WRD-SM-SH.

Appendix A: Potential Emissions Inventory

SMC Non-HAP Potential to Emit

Emission Unit: **PB-1 - C.E. Boiler**
Purpose: Provide steam to block conditioning vaults, veneer dryers, plywood presses, lumber dry kiln and building heat
Manufacturer: Combustion Engineering Company Inc.
Manufacture/Modification Date: July 1964. 1979 modification replaced original pre-1965 "dutch oven" firebox with two Wellons fuel cells
Model: EC2-S-CI-VESSEL
Serial Number: 8045
Burner Type: Fuel cell (2)
Oxygen Trim System: No (as defined by Boiler MACT)
Fly Ash Reinjection: No, not into PB-1 (fly ash collected from PB-1 and PB-2 exhaust is screened and reinjected into PB-2 furnace)
Sand Classifier: Yes (fly ash collected from PB-1 and PB-2 exhaust is screened and reinjected into PB-2 furnace)
Maximum Steam Production: 43,034 pounds saturated steam per hour. Maximum daily average steaming rate observed 2016-2017.
Maximum Heat Input Capacity: 58 MMBtu/hr
Nameplate Heat Input Capcity: 43 MMBtu/hr
FHISOR: 1.342 MMBtu/Mlb steam. Fuel heat input (based upon HHV) to steam output ratio measured during February 24, 2016 Boiler MACT testing @ 34,311 l
Maximum Operation: 8760 hr/yr
Fuel: Wet biomass (greater than 20% moisture content, wet basis) comprised of SMC wood residuals. Dry biomass combusted during startup.
Boiler MACT Subcategory: Fuel cell unit designed to burn biomass/bio-based solid fuel
Particulate Matter Control Device No. 1: Multiclone (required by minor NSR permit)
Manufacturer:
Model:
Installation Date: March 1979
Particulate Matter Control Device No. 2: Two-field dry electrostatic precipitator (required by minor NSR permit)
Manufacturer: PPC Industries
Model: S-1212
Installation Date: April 12, 1995

NON-FUGITIVE EMISSIONS

Potential to Emit, (tons per year)

Criteria Pollutant Emissions	EF (lb/MMBtu)	EF (lb/Mlb steam)	PTE (tpy)	EF Reference
Carbon Monoxide (CO)	0.914	~~0.635~~	231.2	EPA Region 10 Non-HAP Potential to Emit Emission Factors for Biomass Boilers Located in Pacific Northwest Indian Country, May 8, 2014. CO Option 2 for Boiler MACT CO emission limit applicable to existing fuel cell units designed to burn biomass/bio-based solid fuel. See https://www.epa.gov/sites/production/files/2016-09/documents/bbnonhappteef_memo.pdf Boiler MACT CO emission limit of 1100 ppmdv @ 3% O_2 equivalent to 0.914 lb/MMBtu for biomass combusted during February 2016 Boiler MACT testing in which F_d = 9791 dscf/MMBtu. There is only a 3-run average compliance option; there is no 30-day rolling average available. Row 12.a of Table 2 to 40 CFR 63 subpart DDDDD. Boiler MACT emission limit applicable at all times unit is operating except startup and shutdown. Measured CO emission rate of 0.635 lb/Mlb steam is not employed because the source is not required to achieve the emission rate observed. See Bison Engineering, Inc. April 22, 2016 Boiler MACT Stack Test Report prepared for Potlatch Land and Lumber, LLC. Table 5 of the report documents February 24, 2016 testing of CE boiler while generating approximately 34,300 lb steam/hr. 0.635 lb CO/Mlb steam = [(20.2 lb/hr / 33.355 Mlb steam/hr) + (21.2 lb/hr / 34.509 Mlb steam/hr) + (24.0 lb/hr / 35.069 Mlb steam/hr)] / 3.

Lead (Pb)	0.000048		0.01	EPA Region 10 Non-HAP Potential to Emit Emission Factors for Biomass Boilers Located in Pacific Northwest Indian Country, May 8, 2014. Pb Option 1 as no emission limits apply. See https://www.epa.gov/sites/production/files/2016-09/documents/bbnonhappteef_memo.pdf
Nitrogen Oxides (NO_X)		0.29	54.7	Horizon Engineering. Project No. 3020 Source Evaluation Report prepared for Potlatch Forest Products Corporation. Table 2 of the report documents April 30, 2008 testing of CE boiler while generating approximately 23,700 lb steam/hr. No NO_X testing reported in 2016 Boiler MACT Stack Test Report.
Particulate (PM)	0.020	~~0.006~~	5.1	EPA Region 10 Non-HAP Potential to Emit Emission Factors for Biomass Boilers Located in Pacific Northwest Indian Country, May 8, 2014. PM Option 4 for Boiler MACT PM emission limit applicable to existing fuel cell units designed to burn biomass/bio-based solid fuel. See https://www.epa.gov/sites/production/files/2016-09/documents/bbnonhappteef_memo.pdf Boiler MACT PM emission limit applicable at all times unit is operating except startup and shutdown. See July 8, 2016 Notification of Compliance Status for Potlatch's selection of PM compliance option rather than total selected metals. For PM limit, see row 7.b of Table 2 to 40 CFR 63 subpart DDDDD. PM emissions are the "filterable" fraction quantified via EPA RM5. PM emissions do not include the "condensible" fraction. See EPA final rulemaking in the October 25, 2012 Federal Register, pages 65107-65119, at http://www.gpo.gov/fdsys/pkg/FR-2012-10-25/pdf/2012-25978.pdf. The 0.008 lb/Mlb steam PM EF derived from stack testing is not employed to determine PTE because (a) control devices (multiclones and electrostatic precipitator (ESP)) were employed to reduce PM emission during the test and (b) the source is not required to achieve the emission rates observed. See Bison Engineering, Inc. April 22, 2016 Boiler MACT Stack Test Report prepared for Potlatch Land and Lumber, LLC. Table 5 of the report documents February 24, 2016 testing of CE boiler while generating approximately 34,300 lb steam/hr. 0.008 lb PM/Mlb steam = [(0.38 lb/hr / 33.355 Mlb steam/hr) + (0.19 lb/hr / 34.509 Mlb steam/hr) + (0.26 lb/hr / 35.069 Mlb steam/hr)] / 3.
Inhalable Coarse Particulate (PM_{10})	0.025		6.3	EPA Region 10 Non-HAP Potential to Emit Emission Factors for Biomass Boilers Located in Pacific Northwest Indian Country, May 8, 2014. PM_{10} Option 4 for Boiler MACT PM emission limit applicable to existing fuel cell units designed to burn biomass/bio-based solid fuel. See https://www.epa.gov/sites/production/files/2016-09/documents/bbnonhappteef_memo.pdf. Assume all of filterable PM is PM10. Based upon April 2008 testing, condensible fraction is 6.3 lb/MMlb steam which is equivalent to 0.005 lb/MMBtu assuming FHISOR of 1.342 MMBtu/Mlb steam. 0.020 lb/MMBtu (filterable) + 0.005 lb/MMBtu (condensible) = 0.025 lb/MMBtu.
Fine Particulate ($PM_{2.5}$)	0.025		6.3	EPA Region 10 Non-HAP Potential to Emit Emission Factors for Biomass Boilers Located in Pacific Northwest Indian Country, May 8, 2014. $PM_{2.5}$ Option 4 for Boiler MACT PM emission limit applicable to existing fuel cell units designed to burn biomass/bio-based solid fuel. See https://www.epa.gov/sites/production/files/2016-09/documents/bbnonhappteef_memo.pdf. Assume all of filterable PM is PM10. Based upon April 2008 testing, condensible fraction is 6.3 lb/MMlb steam which is equivalent to 0.005 lb/MMBtu assuming FHISOR of 1.342 MMBtu/Mlb steam. 0.020 lb/MMBtu (filterable) + 0.005 lb/MMBtu (condensible) = 0.025 lb/MMBtu.
Sulfur Dioxide (SO_2)	0.009		2.3	Biomass fuel upper bound sulfur estimate of 0.026% by weight (dry) and 15% conversion to SO_2. See derivation of 0.009 lb/MMBtu EF below.

Appendix A: Potential Emissions Inventory

Volatile Organic Compounds (VOC)		0.0091	1.7	Horizon Engineering. Project No. 3020 Source Evaluation Report prepared for Potlatch Forest Products Corporation. Table 2 of the report documents April 30, 2008 testing of CE boiler while generating approximately 23,700 lb steam/hr. No VOC testing reported in 2016 Boiler MACT Stack Test Report. The three-run average value (as carbon) of 0.0067 lb/mlb steam is converted to 0.009 lb/Mlb steam (as compound emitted) assuming a weighted average VOC molecular weight of 64.7 lb/lb-mol and 4 carbon atoms per compound. The calculation to convert VOC (as carbon) to VOC (as compound) is displayed below.
Sulfuric Acid Mist (H_2SO_4)	0.0020		0.5	8 percent of PM2.5 emissions, based on BART-recommended PM2.5 / sulfate speciation for hog fuel boilers.

Greenhouse Gas Emissions (CO_2 Equivalent)	EF (lb/MMBtu)	EF (lb/Mlb steam)	PTE (tpy)	EF Reference
Carbon Dioxide (CO_2)	206.8		52,310.5	EPA Region 10 Non-HAP Potential to Emit Emission Factors for Biomass Boilers Located in Pacific Northwest Indian Country, May 8, 2014. CO_2 Option 2 because the GHG Reporting Rule (40 CFR 98) is considered the primary reference for estimating GHG emissions when preparing or processing permit applications. See https://www.epa.gov/sites/production/files/2016-09/documents/bbnonhappteef_memo.pdf.
Methane (CH_4)	1.764		446.2	EPA Region 10 Non-HAP Potential to Emit Emission Factors for Biomass Boilers Located in Pacific Northwest Indian Country, May 8, 2014. CH_4 Option 2 because the GHG Reporting Rule (40 CFR 98) is considered the primary reference for estimating GHG emissions when preparing or processing permit applications. See https://www.epa.gov/sites/production/files/2016-09/documents/bbnonhappteef_memo.pdf.
Nitrous Oxide (N_2O)	2.759		697.9	EPA Region 10 Non-HAP Potential to Emit Emission Factors for Biomass Boilers Located in Pacific Northwest Indian Country, May 8, 2014. N_2O Option 2 because the GHG Reporting Rule (40 CFR 98) is considered the primary reference for estimating GHG emissions when preparing or processing permit applications. See https://www.epa.gov/sites/production/files/2016-09/documents/bbnonhappteef_memo.pdf.
TOTAL			53,455	

SO_2 EF: 0.009 lb/MMBtu

Basis: Maximum sulfur content of 0.026% by weight, dry basis was measured during March 2017 sampling event at the facility. Upper bound 15% conversion to SO_2. See H. S. Oglesby & R. O. Blosser

EF (lb/MMBtu) = {[Upper bound S Content (%S) / 100] X $CF_{S\rightarrow SO2}$ / HV_{fuel} (Btu/lb)} X $CF_{Btu\rightarrow MMBtu}$ (Btu/MMBtu)

- $CF_{S\rightarrow SO2}$ = 2 lb SO_2/lb S. S + $O_2 \rightarrow SO_2$. For every 1 mol S (16 lb/lb-mol) reactant, there is 1 mol SO_2 (32 lb/lb-mol) product. 32 / 16 = 2. Assume that only 15% of sulfur is exhausted to atmosphere as SO_2.
- HHV (higher heating value) fuel= 8587 Btu/lb. This is the heating value of the fuel sample with sulfur content of 0.026% by weight, dry.

Reasonable Upper Bound Fuel Sulfur Content (% by weight)	Reasonable Upper Bound 15% Conversion $CF_{S\rightarrow SO2}$ (lb SO_2/lb S)	HHV_{fuel} (Btu/lb)	$CF_{Btu\rightarrow MMBtu}$ (Btu/MMBtu)	Calculated EF (lb/MMBtu)
0.026	0.3	8587	1.0E+06	0.009

Calculation to convert VOC (as carbon) to VOC (as compound)

VOC (as weighted-average VOC) = (VOC_C) X [($MW_{wt\text{-}avg\ VOC}$) / (MW_C)] X [($\#C_C$) / ($\#C_{wt\text{-}avg\ VOC}$)]

where:

VOC_C equals "0.0067 lb/Mlb steam" from April 30, 2008 testing of CE boiler. Value represents average value among three Method 25A test runs.

$MW_{wt\text{-}avg\ VOC}$ equals "64.689 lb/lb-mol" and is the weighted-average molecular weight for VOC assuming speciated organic compound ratios supported by AP-42

MW_C equals "12.0110 lb/lb-mol" and represents the molecular weight for carbon

$\#C_C$ equals "1" as the single carbon atom was the "basis" for which Method 25A VOC test results were determined

$\#C_{wt\text{-}avg\ VOC}$ equals "3.975" and is the weighted-average number of carbon atoms present in VOC assuming speciated organic compound ratios supported by AP-42 Table 1.6-3

Calculating value for VOC (as weighted-average VOC):

VOC (as carbon):	0.0067	lb/Mlb steam
$MW_{wt\text{-}avg\ VOC}$:	64.689	lb/lb-mol
MW_C:	12.011	lb/lb-mol
$\#C_C$:	1	
$\#C_{wt\text{-}avg\ VOC}$:	3.975	
VOC (as weighted average VOC)	0.0091	lb/Mb steam

Factor to convert VOC_C to VOC (as weighted average VOC) = 1.355

The first two columns of the following table are extracted from AP-42, September 2003. Table 1.6-3. The third and fourth columns were created based upon information widely available over the internet. The fifth and sixth columns illustrate calculations necessary to determine weighted-average molecular weight and weighted-average number of carbon atoms comprising VOC emissions resulting from wood residue combustion.

Wood Residue Combustion Organic Compounds	EF (lb/MMBtu)	MW lb/lb-mol	Number of Carbon Atoms	EF x MW	EF X #C atoms
Acenaphthene	9.10E-07	154.21	12	1.40E-04	1.09E-05
Acenaphthylene	5.00E-06	152.19	12	7.61E-04	6.00E-05
Acetaldehyde	8.30E-04	44.05	2	3.66E-02	1.66E-03
Acetone	1.90E-04	58.08	3	1.10E-02	5.70E-04
Acetophenone	3.20E-09	120.15	8	3.84E-07	2.56E-08
Acrolein	4.00E-03	56.06	3	2.24E-01	1.20E-02
Anthracene	3.00E-06	178.23	14	5.35E-04	4.20E-05
Benzaldehyde	8.50E-07	106.12	7	9.02E-05	5.95E-06
Benzene	4.20E-03	78.11	6	3.28E-01	2.52E-02
Benzo(a)anthracene	6.50E-08	228.29	18	1.48E-05	1.17E-06
Benzo(a)pyrene	2.60E-06	252.31	20	6.56E-04	5.20E-05
Benzo(b)fluoranthene	1.00E-07	252.31	20	2.52E-05	2.00E-06
Benzo(e)pyrene	2.60E-09	252.31	20	6.56E-07	5.20E-08
Benzo(g,h,i)perylene	9.30E-08	276.33	22	2.57E-05	2.05E-06
Benzo(j,k)fluoranthene	1.60E-07	202.26	16	3.24E-05	2.56E-06
Benzo(k)fluoranthene	3.60E-08	252.31	20	9.08E-06	7.20E-07
Benzoic acid	4.70E-08	122.12	7	5.74E-06	3.29E-07
Bis(2-ethylhexyl)phthalate (DEHP)	4.70E-08	390.56	24	1.84E-05	1.13E-06
Bromomethane (Methyle bromide)	1.50E-05	94.94	1	1.42E-03	1.50E-05
2-Butanone (MEK)	5.40E-06	72.11	4	3.89E-04	2.16E-05
Carbazole	1.80E-06	167.21	12	3.01E-04	2.16E-05
Carbon tetrachloride	4.50E-05	153.82	1	6.92E-03	4.50E-05
Chlorobenzene	3.30E-05	112.56	6	3.71E-03	1.98E-04
Chloroform	2.80E-05	119.38	1	3.34E-03	2.80E-05
Chloromethane (Methyl chloride)	2.30E-05	50.49	1	1.16E-03	2.30E-05
2-Chloronaphthalene	2.40E-09	162.62	10	3.90E-07	2.40E-08
2-Chlorophenol	2.40E-08	128.56	6	3.09E-06	1.44E-07
Chrysene	3.80E-08	228.28	18	8.67E-06	6.84E-07
Crotonaldehyde	9.90E-06	70.09	4	6.94E-04	3.96E-05
Decachlorobiphenyl	2.70E-10	498.6584	12	1.35E-07	3.24E-09
Dibenzo(a,h)anthracene	9.10E-09	278.35	22	2.53E-06	2.00E-07
1,2-Dibromoethene	5.50E-05	185.85	2	1.02E-02	1.10E-04
Dichlorobiphenyl	7.40E-10	223.09792	12	1.65E-07	8.88E-09
1,2-Dichloroethane (Ethylene dichloride)	2.90E-05	98.96	2	2.87E-03	5.80E-05
Dichloromethane (Methylene chloride)	2.90E-04	84.93	2	2.46E-02	5.80E-04
1,2-Dichloropropane (Propylene dichloride)	3.30E-05	122.99	3	4.06E-03	9.90E-05
2,4-Dinitrophenol	1.80E-07	184.11	6	3.31E-05	1.08E-06
Ethyl benzene	3.10E-05	106.17	8	3.29E-03	2.48E-04
Fluoranthene	1.60E-06	202.26	16	3.24E-04	2.56E-05
Fluorene	3.40E-06	166.22	13	5.65E-04	4.42E-05
Formaldehyde	4.40E-03	30.03	1	1.32E-01	4.40E-03
Heptachlorobiphenyl	6.60E-11	395.32322	12	2.61E-08	7.92E-10
Hexachlorobiphenyl	5.50E-10	360.87816	12	1.98E-07	6.60E-09
Hexanal	7.00E-06	100.15888	6	7.01E-04	4.20E-05
Heptachlorodibenzo-p-dioxins	2.00E-09	425.30614	12	8.51E-07	2.40E-08
Heptachlorodibenzo-p-furans	2.40E-10	409.30674	12	9.82E-08	2.88E-09
Hexachlorodibenzo-p-dioxins	1.60E-06	390.82	12	6.25E-04	1.92E-05
Hexachlorodibenzo-p-furans	2.80E-10	374.86168	12	1.05E-07	3.36E-09
Indeno(1,2,3-cd)pyrene	8.70E-08	326.34	22	2.84E-05	1.91E-06
Isobutyraldehyde	1.20E-05	72.10572	4	8.65E-04	4.80E-05

2-Methylnaphthalene	1.60E-07	142.20	11	2.28E-05	1.76E-06
Monochlorobiphenyl	2.20E-10	187.64492	12	4.13E-08	2.64E-09
Naphthalene	9.70E-05	128.17	10	1.24E-02	9.70E-04
2-Nitrophenol	2.40E-07	139.11	6	3.34E-05	1.44E-06
4-Nitrophenol	1.10E-07	139.11	6	1.53E-05	6.60E-07
Octachlorodibenzo-p-dioxins	6.60E-08	459.7512	12	3.03E-05	7.92E-07
Octachlorodibenzo-p-furans	8.80E-11	443.7518	12	3.91E-08	1.06E-09
Pentachlorodibenzo-p-dioxins	1.50E-09	356.41602	12	5.35E-07	1.80E-08
Pentachlorodibenzo-p-furans	4.20E-10	340.41662	12	1.43E-07	5.04E-09
Pentachlorobiphenyl	1.20E-09	326.4331	12	3.92E-07	1.44E-08
Pentachlorophenol	5.10E-08	266.34	6	1.36E-05	3.06E-07
Perylene	5.20E-10	252.31	20	1.31E-07	1.04E-08
Phenanthrene	7.00E-06	178.23	14	1.25E-03	9.80E-05
Phenol	5.10E-05	94.11	6	4.80E-03	3.06E-04
Propanal	3.20E-06	58.08	3	1.86E-04	9.60E-06
Propionaldehyde	6.10E-05	58.08	3	3.54E-03	1.83E-04
Pyrene	3.70E-06	202.25	16	7.48E-04	5.92E-05
Styrene	1.90E-03	104.15	8	1.98E-01	1.52E-02
2,3,7,8-Tetrachlorodibenzo-p-dioxins	8.60E-12	321.97096	12	2.77E-09	1.03E-10
Tetrachlorodibenzo-p-dioxins	4.70E-10	321.97096	12	1.51E-07	5.64E-09
2,3,7,8-Tetrachlorodibenzo-p-furans	9.00E-11	305.97156	12	2.75E-08	1.08E-09
Tetrachlorodibenzo-p-furans	7.50E-10	305.97156	12	2.29E-07	9.00E-09
Tetrachlorobiphenyl	2.50E-09	291.98804	12	7.30E-07	3.00E-08
Tetrachloroethene (Tetrachloroethylene)	3.80E-05	165.83	2	6.30E-03	7.60E-05
o-Tolualdehyde	7.20E-06	120.15	8	8.65E-04	5.76E-05
p-Tolualdehyde	1.10E-05	120.15	8	1.32E-03	8.80E-05
Toluene	9.20E-04	92.14	7	8.48E-02	6.44E-03
Trichlorobiphenyl	2.60E-09	257.54298	12	6.70E-07	3.12E-08
1,1,1-trichloroethane (Methyl chloroform)	3.10E-05	133.40	2	4.14E-03	6.20E-05
Trichloroethene (Trichloroethylene)	3.00E-05	131.39	2	3.94E-03	6.00E-05
Trichlorofluoromethane	4.10E-05	137.37	1	5.63E-03	4.10E-05
2,4,6-Trichlorophenol	2.20E-08	197.45	6	4.34E-06	1.32E-07
Vinyl chloride	1.80E-05	62.50	2	1.13E-03	3.60E-05
o-Xylene	2.50E-05	106.16	8	2.65E-03	2.00E-04
TOTAL	1.75E-02			1.13E+00	6.96E-02
				64.689	3.975

64.689 ← weighted-average molecular weight of VOC

3.975 ← weighted-average number of carbon atoms comprising VOC

Appendix A: Potential Emissions Inventory

SMC Non-HAP Potential to Emit

Emission Unit: **PB-2 - Riley Boiler**
Purpose: Provide steam to block conditioning vaults, veneer dryers, plywood presses, lumber dry kiln and building heat
Manufacturer: Riley Power, Inc.
Manufacture/Modification Date: August 26, 1966
Model: N/A
Serial Number: 23433 130.83
Burner Type: Spreader Stoker (3)
Oxygen Trim System: No (as defined by Boiler MACT)
Fly Ash Reinjection: Yes (fly ash collected from PB-1 and PB-2 exhaust is screened and reinjected into PB-2 furnace)
Sand Classifier: Yes (fly ash collected from PB-1 and PB-2 exhaust is screened and reinjected into PB-2 furnace)
Maximum Steam Production: 98,000 pounds saturated steam per hour. Maximum daily average steaming rate observed 2016-2017.
Maximum Heat Input Capacity: 131 MMBtu/hr
Nameplate Heat Input Capcity: 113 MMBtu/hr
FHISOR: 1.335 MMBtu/Mlb steam. Fuel heat input (based upon HHV) to steam output ratio measured during February 23, 2016 Boiler MACT testing @ 90,101 l
Maximum Operation: 8760 hr/yr
Fuel: Wet biomass (greater than 20% moisture content, wet basis) comprised of SMC wood residuals. Dry sanderdust. Dry biomass combusted during startup.
Boiler MACT Subcategory: Stokers/sloped grate/other units designed to burn wet biomass/bio-based solid fuel
Particulate Matter Control Device No. 1: Multiclone (required by minor NSR permit)
Manufacturer:
Model:
Installation Date: October 1987
Particulate Matter Control Device No. 2: Three-field dry electrostatic precipitator (required by minor NSR permit)
Manufacturer: PPC Industries
Model: 11R-1328-3712S
Installation Date: June 24, 1995

NON-FUGITIVE EMISSIONS

Potential to Emit, (tons per year)

Criteria Pollutant Emissions	EF (lb/MMBtu)	EF (lb/Mlb steam)	PTE (tpy)	EF Reference
Carbon Monoxide (CO)	1.231	~~0.967~~	705.4	EPA Region 10 Non-HAP Potential to Emit Emission Factors for Biomass Boilers Located in Pacific Northwest Indian Country, May 8, 2014. CO Option 2 for Boiler MACT CO emission limit applicable to existing stokers/sloped grate/others designed to burn wet biomass fuel. See https://www.epa.gov/sites/production/files/2016-09/documents/bbnonhappteef_memo.pdf. Boiler MACT CO emission limit of 1500 ppmdv @ 3% O2 equivalent to 1.231 lb/MMBtu for biomass combusted during February 2016 Boiler MACT testing in which F_d = 9669 dscf/MMBtu. See July 8, 2016 Notification of Compliance Status for Potlatch's selection of 3-hour average compliance option rather than 720 ppmdv @ 3% O_2 30-day rolling average. Row 7.a of Table 2 to 40 CFR 63 subpart DDDDD. Boiler MACT emission limit applicable at all times unit is operating except startup and shutdown. Measured CO emission rate of 0.967 lb/Mlb steam is not employed because the source is not required to achieve the emission rate observed. See Bison Engineering, Inc. April 22, 2016 Boiler MACT Stack Test Report prepared for Potlatch Land and Lumber, LLC. Table 3 of the report documents February 23, 2016 testing of CE boiler while generating approximately 90,100 lb steam/hr. 0.967 lb CO/Mlb steam = [(91.7 lb/hr / 90.026 Mlb steam/hr) + (98.2 lb/hr / 89.287 Mlb steam/hr) + (71.3 lb/hr / 90.990 Mlb steam/hr)] / 3.

Lead (Pb)	0.000048		0.03	EPA Region 10 Non-HAP Potential to Emit Emission Factors for Biomass Boilers Located in Pacific Northwest Indian Country, May 8, 2014. Pb Option 1 as no emission limits apply. See https://www.epa.gov/sites/production/files/2016-09/documents/bbnonhappteef_memo.pdf
Nitrogen Oxides (NO_X)		0.27	115.9	Horizon Engineering. Project No. 3020 Source Evaluation Report prepared for Potlatch Forest Products Corporation. Table 4 of the report documents May 1, 2008 testing of Riley boiler while generating approximately 96,900 lb steam/hr. No NO_X testing reported in 2016 Boiler MACT Stack Test Report.
Particulate (PM)	0.037	~~0.005~~	21.2	EPA Region 10 Non-HAP Potential to Emit Emission Factors for Biomass Boilers Located in Pacific Northwest Indian Country, May 8, 2014. PM Option 4 for Boiler MACT PM emission limit applicable to existing stokers/sloped grate/others designed to burn wet biomass fuel. See https://www.epa.gov/sites/production/files/2016-09/documents/bbnonhappteef_memo.pdf Boiler MACT PM emission limit applicable at all times unit is operating except startup and shutdown. See July 8, 2016 Notification of Compliance Status for Potlatch's selection of PM compliance option rather than total selected metals. For PM limit, see row 7.b of Table 2 to 40 CFR 63 subpart DDDDD. PM emissions are the "filterable" fraction quantified via EPA RM5. PM emissions do not include the "condensible" fraction. See EPA final rulemaking in the October 25, 2012 Federal Register, pages 65107-65119, at http://www.gpo.gov/fdsys/pkg/FR-2012-10-25/pdf/2012-25978.pdf. The 0.005 lb/mlb steam PM EF derived from stack testing is not employed to determine PTE because (a) control devices (multiclones and electrostatic precipitator (ESP)) were employed to reduce PM emission during the test and (b) the source is not required to achieve the emission rates observed. See Bison Engineering, Inc. April 22, 2016 Boiler MACT Stack Test Report prepared for Potlatch Land and Lumber, LLC. Table 3 of the report documents February 23, 2016 testing of Riley boiler while generating approximately 90,100 lb steam/hr. 0.005 lb PM/Mlb steam = [(0.37 lb/hr / 90.026 Mlb steam/hr) + (0.49 lb/hr / 89.287 Mlb steam/hr) + (0.43 lb/hr / 90.990 Mlb steam/hr)] / 3.
Inhalable Coarse Particulate (PM_{10})	0.039		22.3	EPA Region 10 Non-HAP Potential to Emit Emission Factors for Biomass Boilers Located in Pacific Northwest Indian Country, May 8, 2014. PM Option 4 for Boiler MACT PM emission limit applicable to existing stokers/sloped grate/others designed to burn wet biomass fuel. See https://www.epa.gov/sites/production/files/2016-09/documents/bbnonhappteef_memo.pdf. Assume all of filterable PM is PM10. Based upon May 2008 testing, condensible fraction is 2.3 lb/MMlb steam which is equivalent to 0.002 lb/MMBtu assuming FHISOR of 1.335 MMBtu/Mlb steam. 0.037 lb/MMBtu (filterable) + 0.002 lb/MMBtu (condensible) = 0.039 lb/MMBtu.
Fine Particulate ($PM_{2.5}$)	0.039		22.3	EPA Region 10 Non-HAP Potential to Emit Emission Factors for Biomass Boilers Located in Pacific Northwest Indian Country, May 8, 2014. PM2.5 Option 4 for Boiler MACT PM emission limit applicable to existing stokers/sloped grate/others designed to burn wet biomass fuel. See https://www.epa.gov/sites/production/files/2016-09/documents/bbnonhappteef_memo.pdf. Assume all of filterable PM is PM2.5. Based upon May 2008 testing, condensible fraction is 2.3 lb/MMlb steam which is equivalent to 0.002 lb/MMBtu assuming FHISOR of 1.335 MMBtu/Mlb steam. 0.037 lb/MMBtu (filterable) + 0.002 lb/MMBtu (condensible) = 0.039 lb/MMBtu.
Sulfur Dioxide (SO_2)	0.009		5.2	Biomass fuel upper bound sulfur estimate of 0.026% by weight (dry) and 15% conversion to SO_2. See derivation of 0.009 lb/MMBtu EF below.
Volatile Organic Compounds (VOC)		0.0106	4.5	Horizon Engineering. Project No. 3020 Source Evaluation Report prepared for Potlatch Forest Products Corporation. Table 4 of the report documents May 1, 2008 testing of Riley boiler while generating approximately 96,900 lb steam/hr. No VOC testing reported in 2016 Boiler MACT Stack Test Report. The three-run average value (as carbon) of 0.0078 lb/mlb steam is converted to 0.011 lb/Mlb steam (as compound emitted) assuming a weighted average VOC molecular weight of 64.7 lb/lb-mol and 4 carbon atoms per compound. The calculation to convert VOC (as carbon) to VOC (as compound) is displayed below.
Sulfuric Acid Mist (H_2SO_4)	0.0031		1.8	8 percent of PM2.5 emissions, based on BART-recommended PM2.5 / sulfate speciation for hog fuel boilers.

Appendix A: Potential Emissions Inventory

Greenhouse Gas Emissions (CO_2 Equivalent)	EF (lb/MMBtu)	EF (lb/Mlb steam)	PTE (tpy)	EF Reference
Carbon Dioxide (CO_2)	206.8		118,503.7	EPA Region 10 Non-HAP Potential to Emit Emission Factors for Biomass Boilers Located in Pacific Northwest Indian Country, May 8, 2014. CO_2 Option 2 because the GHG Reporting Rule (40 CFR 98) is considered the primary reference for estimating GHG emissions when preparing or processing permit applications. See https://www.epa.gov/sites/production/files/2016-09/documents/bbnonhappteef_memo.pdf.
Methane (CH_4)	1.764		1,010.8	EPA Region 10 Non-HAP Potential to Emit Emission Factors for Biomass Boilers Located in Pacific Northwest Indian Country, May 8, 2014. CH_4 Option 2 because the GHG Reporting Rule (40 CFR 98) is considered the primary reference for estimating GHG emissions when preparing or processing permit applications. See https://www.epa.gov/sites/production/files/2016-09/documents/bbnonhappteef_memo.pdf.
Nitrous Oxide (N_2O)	2.759		1,581.0	EPA Region 10 Non-HAP Potential to Emit Emission Factors for Biomass Boilers Located in Pacific Northwest Indian Country, May 8, 2014. N2O Option 2 because the GHG Reporting Rule (40 CFR 98) is considered the primary reference for estimating GHG emissions when preparing or processing permit applications. See https://www.epa.gov/sites/production/files/2016-09/documents/bbnonhappteef_memo.pdf.
TOTAL			121,096	

SO_2 EF: 0.009 lb/MMBtu

Basis: Maximum sulfur content of 0.026% by weight, dry basis was measured during March 2017 sampling event at the facility. Upper bound 15% conversion to SO_2. See H. S. Oglesby & R. O. Blosser

EF (lb/MMBtu) = {[Upper bound S Content (%S) / 100] X $CF_{S\rightarrow SO2}$ / HV_{fuel} (Btu/lb)} X $CF_{Btu\rightarrow MMBtu}$ (Btu/MMBtu)

- $CF_{S\rightarrow SO2}$ = 2 lb SO_2/lb S. $S + O_2 \rightarrow SO_2$. For every 1 mol S (16 lb/lb-mol) reactant, there is 1 mol SO_2 (32 lb/lb-mol) product. 32 / 16 = 2. Assume that only 15% of sulfur is exhausted to atmosphere as SO_2.
- HHV (higher heating value) fuel= 8587 Btu/lb. This is the heating value of the fuel sample with sulfur content of 0.026% by weight, dry.

Reasonable Upper Bound Fuel Sulfur Content (% by weight)	Reasonable Upper Bound 15% Conversion $CF_{S\rightarrow SO2}$ (lb SO_2/lb S)	HHV_{fuel} (Btu/lb)	$CF_{Btu\rightarrow MMBtu}$ (Btu/MMBtu)	Calculated EF (lb/MMBtu)
0.026	0.3	8587	1.0E+06	0.009

Calculation to convert VOC (as carbon) to VOC (as compound)

VOC (as weighted-average VOC) = (VOC_C) X [($MW_{wt\text{-}avg\ VOC}$) / (MW_C)] X [($\#C_C$) / ($\#C_{wt\text{-}avg\ VOC}$)]

where:

VOC_C equals "0.0078 lb/Mlb steam" from May 1, 2008 testing of Riley boiler. Value represents average value among three Method 25A test runs.

$MW_{wt\text{-}avg\ VOC}$ equals "64.689 lb/lb-mol" and is the weighted-average molecular weight for VOC assuming speciated organic compound ratios supported by AP-42

MW_C equals "12.0110 lb/lb-mol" and represents the molecular weight for carbon

$\#C_C$ equals "1" as the single carbon atom was the "basis" for which Method 25A VOC test results were determined

$\#C_{wt\text{-}avg\ VOC}$ equals "3.975" and is the weighted-average number of carbon atoms present in VOC assuming speciated organic compound ratios supported by AP-42 Table 1.6-3

Calculating value for VOC (as weighted-average VOC):

VOC (as carbon):	0.0078	lb/Mlb steam
$MW_{wt\text{-}avg\ VOC}$:	64.689	lb/lb-mol
MW_C:	12.011	lb/lb-mol
$\#C_C$:	1	
$\#C_{wt\text{-}avg\ VOC}$:	3.975	
VOC (as weighted average VOC)	0.0106	lb/Mlb steam

Factor to convert VOC_C to VOC (as weighted average VOC) = 1.355

Appendix A: Potential Emissions Inventory

The first two columns of the following table are extracted from AP-42, September 2003. Table 1.6-3. The third and fourth columns were created based upon information widely available over the internet. The fifth and sixth columns illustrate calculations necessary to determine weighted-average molecular weight and weighted-average number of carbon atoms comprising VOC emissions resulting from wood residue combustion.

Wood Residue Combustion Organic Compounds	EF (lb/MMBtu)	MW lb/lb-mol	Number of Carbon Atoms	EF x MW	EF X #C atoms
Acenaphthene	9.10E-07	154.21	12	1.40E-04	1.09E-05
Acenaphthylene	5.00E-06	152.19	12	7.61E-04	6.00E-05
Acetaldehyde	8.30E-04	44.05	2	3.66E-02	1.66E-03
Acetone	1.90E-04	58.08	3	1.10E-02	5.70E-04
Acetophenone	3.20E-09	120.15	8	3.84E-07	2.56E-08
Acrolein	4.00E-03	56.06	3	2.24E-01	1.20E-02
Anthracene	3.00E-06	178.23	14	5.35E-04	4.20E-05
Benzaldehyde	8.50E-07	106.12	7	9.02E-05	5.95E-06
Benzene	4.20E-03	78.11	6	3.28E-01	2.52E-02
Benzo(a)anthracene	6.50E-08	228.29	18	1.48E-05	1.17E-06
Benzo(a)pyrene	2.60E-06	252.31	20	6.56E-04	5.20E-05
Benzo(b)fluoranthene	1.00E-07	252.31	20	2.52E-05	2.00E-06
Benzo(e)pyrene	2.60E-09	252.31	20	6.56E-07	5.20E-08
Benzo(g,h,i)perylene	9.30E-08	276.33	22	2.57E-05	2.05E-06
Benzo(j,k)fluoranthene	1.60E-07	202.26	16	3.24E-05	2.56E-06
Benzo(k)fluoranthene	3.60E-08	252.31	20	9.08E-06	7.20E-07
Benzoic acid	4.70E-08	122.12	7	5.74E-06	3.29E-07
Bis(2-ethylhexyl)phthalate (DEHP)	4.70E-08	390.56	24	1.84E-05	1.13E-06
Bromomethane (Methyle bromide)	1.50E-05	94.94	1	1.42E-03	1.50E-05
2-Butanone (MEK)	5.40E-06	72.11	4	3.89E-04	2.16E-05
Carbazole	1.80E-06	167.21	12	3.01E-04	2.16E-05
Carbon tetrachloride	4.50E-05	153.82	1	6.92E-03	4.50E-05
Chlorobenzene	3.30E-05	112.56	6	3.71E-03	1.98E-04
Chloroform	2.80E-05	119.38	1	3.34E-03	2.80E-05
Chloromethane (Methyl chloride)	2.30E-05	50.49	1	1.16E-03	2.30E-05
2-Chloronaphthalene	2.40E-09	162.62	10	3.90E-07	2.40E-08
2-Chlorophenol	2.40E-08	128.56	6	3.09E-06	1.44E-07
Chrysene	3.80E-08	228.28	18	8.67E-06	6.84E-07
Crotonaldehyde	9.90E-06	70.09	4	6.94E-04	3.96E-05
Decachlorobiphenyl	2.70E-10	498.6584	12	1.35E-07	3.24E-09
Dibenzo(a,h)anthracene	9.10E-09	278.35	22	2.53E-06	2.00E-07
1,2-Dibromoethene	5.50E-05	185.85	2	1.02E-02	1.10E-04
Dichlorobiphenyl	7.40E-10	223.09792	12	1.65E-07	8.88E-09
1,2-Dichloroethane (Ethylene dichloride)	2.90E-05	98.96	2	2.87E-03	5.80E-05
Dichloromethane (Methylene chloride)	2.90E-04	84.93	2	2.46E-02	5.80E-04
1,2-Dichloropropane (Propylene dichloride)	3.30E-05	122.99	3	4.06E-03	9.90E-05
2,4-Dinitrophenol	1.80E-07	184.11	6	3.31E-05	1.08E-06
Ethyl benzene	3.10E-05	106.17	8	3.29E-03	2.48E-04
Fluoranthene	1.60E-06	202.26	16	3.24E-04	2.56E-05
Fluorene	3.40E-06	166.22	13	5.65E-04	4.42E-05
Formaldehyde	4.40E-03	30.03	1	1.32E-01	4.40E-03
Heptachlorobiphenyl	6.60E-11	395.32322	12	2.61E-08	7.92E-10
Hexachlorobiphenyl	5.50E-10	360.87816	12	1.98E-07	6.60E-09
Hexanal	7.00E-06	100.15888	6	7.01E-04	4.20E-05
Heptachlorodibenzo-p-dioxins	2.00E-09	425.30614	12	8.51E-07	2.40E-08
Heptachlorodibenzo-p-furans	2.40E-10	409.30674	12	9.82E-08	2.88E-09
Hexachlorodibenzo-p-dioxins	1.60E-06	390.82	12	6.25E-04	1.92E-05
Hexachlorodibenzo-p-furans	2.80E-10	374.86168	12	1.05E-07	3.36E-09
Indeno(1,2,3-cd)pyrene	8.70E-08	326.34	22	2.84E-05	1.91E-06
Isobutyraldehyde	1.20E-05	72.10572	4	8.65E-04	4.80E-05

2-Methylnaphthalene	1.60E-07	142.20	11	2.28E-05	1.76E-06
Monochlorobiphenyl	2.20E-10	187.64492	12	4.13E-08	2.64E-09
Naphthalene	9.70E-05	128.17	10	1.24E-02	9.70E-04
2-Nitrophenol	2.40E-07	139.11	6	3.34E-05	1.44E-06
4-Nitrophenol	1.10E-07	139.11	6	1.53E-05	6.60E-07
Octachlorodibenzo-p-dioxins	6.60E-08	459.7512	12	3.03E-05	7.92E-07
Octachlorodibenzo-p-furans	8.80E-11	443.7518	12	3.91E-08	1.06E-09
Pentachlorodibenzo-p-dioxins	1.50E-09	356.41602	12	5.35E-07	1.80E-08
Pentachlorodibenzo-p-furans	4.20E-10	340.41662	12	1.43E-07	5.04E-09
Pentachlorobiphenyl	1.20E-09	326.4331	12	3.92E-07	1.44E-08
Pentachlorophenol	5.10E-08	266.34	6	1.36E-05	3.06E-07
Perylene	5.20E-10	252.31	20	1.31E-07	1.04E-08
Phenanthrene	7.00E-06	178.23	14	1.25E-03	9.80E-05
Phenol	5.10E-05	94.11	6	4.80E-03	3.06E-04
Propanal	3.20E-06	58.08	3	1.86E-04	9.60E-06
Propionaldehyde	6.10E-05	58.08	3	3.54E-03	1.83E-04
Pyrene	3.70E-06	202.25	16	7.48E-04	5.92E-05
Styrene	1.90E-03	104.15	8	1.98E-01	1.52E-02
2,3,7,8-Tetrachlorodibenzo-p-dioxins	8.60E-12	321.97096	12	2.77E-09	1.03E-10
Tetrachlorodibenzo-p-dioxins	4.70E-10	321.97096	12	1.51E-07	5.64E-09
2,3,7,8-Tetrachlorodibenzo-p-furans	9.00E-11	305.97156	12	2.75E-08	1.08E-09
Tetrachlorodibenzo-p-furans	7.50E-10	305.97156	12	2.29E-07	9.00E-09
Tetrachlorobiphenyl	2.50E-09	291.98804	12	7.30E-07	3.00E-08
Tetrachloroethene (Tetrachloroethylene)	3.80E-05	165.83	2	6.30E-03	7.60E-05
o-Tolualdehyde	7.20E-06	120.15	8	8.65E-04	5.76E-05
p-Tolualdehyde	1.10E-05	120.15	8	1.32E-03	8.80E-05
Toluene	9.20E-04	92.14	7	8.48E-02	6.44E-03
Trichlorobiphenyl	2.60E-09	257.54298	12	6.70E-07	3.12E-08
1,1,1-trichloroethane (Methyl chloroform)	3.10E-05	133.40	2	4.14E-03	6.20E-05
Trichloroethene (Trichloroethylene)	3.00E-05	131.39	2	3.94E-03	6.00E-05
Trichlorofluoromethane	4.10E-05	137.37	1	5.63E-03	4.10E-05
2,4,6-Trichlorophenol	2.20E-08	197.45	6	4.34E-06	1.32E-07
Vinyl chloride	1.80E-05	62.50	2	1.13E-03	3.60E-05
o-Xylene	2.50E-05	106.16	8	2.65E-03	2.00E-04
TOTAL	1.75E-02			1.13E+00	6.96E-02
				64.689	3.975

weighted-average molecular weight of VOC ↗

↖ weighted-average number of carbon atoms comprising VOC

SMC Non-HAP Potential to Emit

Emission Unit: **LK-5 - Lumber Drying Kiln 5**
Description: One lumber drying kiln
Manufacturer: Wellons
Model: DT104-HPW
Installed: February 2006
Heat Source: Indirect steam provided by emission unist PB-1 and PB-2
Control Device: None
Work Practice: None
Fuel: None
Potential Species Dried: Douglas fir, western red cedar, grand fir, hemlock, lodgepole pine, subalpine fir, elgelmann spruce, ponderosa pine and western white pine
Annual Capacity: 158 MMbf/yr assuming exclusive drying of either Douglas Fir or ESLP (Engelmann Spruce, Lodgepole Pine, Subalpine Fir)

NON-FUGITIVE EMISSIONS

Potential to Emit, (tons per year)

Pollutant Emissions	EF (lb/Mbf)	PTE (tpy)	EF Reference
Carbon Monoxide (CO)	0	0	
Lead (Pb)	0	0	
Nitrogen Oxides (NO_X)	0	0	
Particulate (PM)	0.002	0.2	1 - PM emissions testing conducted in 2013 at Chemco in Ferndale, Washington. Same emission factor applies for all species and at all drying temperatures. Based upon information presented by Potlatch in its February 1, 2018 submittal to EPA Region 10, PM emissions testing conducted by Horizon Engineering at Oregon State University pilot-scale kiln in 1998 is invalid.
Inhalable Coarse Particulate (PM_{10})	0.020	1.6	1 - PM emissions testing conducted in 2013 at Chemco in Ferndale, Washington. Same emission factor applies for all species and at all drying temperatures. Based upon information presented by Potlatch in its February 1, 2018 submittal to EPA Region 10, PM emissions testing conducted by Horizon Engineering at Oregon State University pilot-scale kiln in 1998 is invalid.
Fine Particulate ($PM_{2.5}$)	0.020	1.6	1 - PM emissions testing conducted in 2013 at Chemco in Ferndale, Washington. Same emission factor applies for all species and at all drying temperatures. Based upon information presented by Potlatch in its February 1, 2018 submittal to EPA Region 10, PM emissions testing conducted by Horizon Engineering at Oregon State University pilot-scale kiln in 1998 is invalid.
Sulfur Dioxide (SO_2)	0	0	
Volatile Organic Compounds (VOC)	species specific	112.5	2 - Because the facility has the ability to dry resinous and non-resinous softwood species at temperatures in excess of 200ºF, employ emission factors representative of drying lumber at maximum temperatures in excess of 200°F. Based upon calculations presented below, drying Ponderosa Pine results in highest emissions. Thus, PTE is based upon drying Ponderosa Pine.
Sulfuric Acid Mist (H_2SO_4)	0	0	

Greenhouse Gas Emissions (CO_2 Equivalent)	EF (lb/Mbf)	PTE (tpy)	EF Reference
Carbon Dioxide (CO_2)	0	0	
Methane (CH_4)	0	0	
Nitrous Oxide (N_2O)	0	0	
TOTAL		0	

EF Reference	Description
1	February & May/June 2013 emissions testing of Hemlock lumber drying at less than 180°F within a pilot-scale kiln at Chemco in Ferndale, Washington. Testing was performed by Emission Technologies, Inc. on behalf of Sierra Pacific Industries and consisted of RM5 and 202. http://www.swcleanair.org/docs/Dry%20Kilns/SourceTests/2013-02-21%20Sierra%20Pacific%20-%20Chemco%20-%20Ferndale%20-%20Dry%20Kiln%20PM%20Test%20Report.pdf & http://www.swcleanair.org/docs/Dry%20Kilns/SourceTests/2013-05-29%20Sierra%20Pacific%20-%20Mt%20Vernon%20-%20Pilot%20Dry%20Kiln%20Filterable%20and%20Condensable%20PM%20Test%20Report.pdf
2	EPA Region 10 HAP and VOC Emission Factors for Lumber Drying, December 2012. https://www.epa.gov/sites/production/files/2016-09/documents/ldkhapvocpteef_memo.pdf

Species-Specific VOC Emissions Calculations

Species	Drying Time (hr/charge)	Maximum Annual Charges (charges/yr)	Average Volume per Charge (bf/charge)	Maximum Throughput (MMbf/yr)	VOC Emission Factor (lb/Mbf)	VOC PTE (tpy)
HemFir (Hemlock/Grand Fir)	37	237	290,000	69	1.09	37.4
Douglas Fir	21	417	290,000	121	1.70	102.8
Larch	37	237	290,000	69	1.70	58.4
ESLP (Engelmann Spruce, Lodgepole Pine, Subalpine Fir)	21	417	290,000	121	1.53	92.5
Ponderosa Pine	43	204	290,000	59	3.81	112.5
Cedar	16	545	290,000	158	1.15	90.9

SMC Non-HAP Potential to Emit

Emission Units: **VDHS-1, VDHS-2, VDHS-3 and VDHS-4**

Description: Heating sections of four steam-heated veneer dryers. Steam provided by PB-1 and PB-2.

	VD-1	VD-2	VD-3	VD-4
Make:	Moore	Moore	E.V. Preutire	Moore
Dryer Technology:	Longitudinal	Longitudinal	Prentice	Longitudinal
Number of Heated Sections:	2	4	1	4
Installation Date:	February 1964	February 1964	July 1967	September 1980
Classification of Veneer Dried:	Re-dry	Strips	Full Sheets	Full Sheets
Observed Operating Rate during September 24, 2008 PCWP MACT Testing (msf 3/8"/hr):	7.48	7.19	16.19	15.76
Operation (hr/yr):	8760	8760	8760	8760
Heated Section Control Technology:	Exhaust from heated sections of four veneer dryers is collected and routed to a two-chamber Geoenergy GeoCat regenerative catalytic oxidizer (RCO) employing two 4 MMBtu/hr Maxon Kinemax burners.			
Observed RCO Exhaust Flow Rate during September 24, 2008 PCWP MACT Testing:	45,300	dscf/min		
RCO Heat Input:	8	MMBtu/hr		
RCO Operation:	8760	hr/yr		

NON-FUGITIVE EMISSIONS

Potential to Emit, (tons per year)

Criteria Pollutant Emissions	EF (lb/msf 3/8")	EF (lb/MMBtu)	VDHS-1 PTE (tpy)	VDHS-2 PTE (tpy)	VDHS-3 PTE (tpy)	VDHS-4 PTE (tpy)	Total PTE (tpy)	EF Reference
Carbon Monoxide (CO)	0.0035		0.11	0.11	0.25	0.24	0.7	1
Lead (Pb)	-							
Nitrogen Oxides (NO_X)	0.0029		0.10	0.09	0.21	0.20	0.6	1
Particulate (PM)	0.014		0.46	0.44	0.99	0.97	2.9	1
Inhalable Coarse Particulate (PM_{10})	0.029		0.95	0.91	2.06	2.00	5.9	1
Fine Particulate ($PM_{2.5}$)	0.029		0.95	0.91	2.06	2.00	5.9	1
Sulfur Dioxide (SO_2)		0.0173					0.6	2
Volatile Organic Compounds (VOC)	0.089		2.91	2.80	6.31	6.14	18.2	3
Sulfuric Acid Mist (H_2SO_4)								

Greenhouse Gas Emissions (CO_2 Equivalent)	EF (lb/msf 3/8")	EF (lb/MMBtu)	PTE (tpy)	EF Reference
Carbon Dioxide (CO_2)		138.6	4,857	4
Methane (CH_4)		0.165	6	
Nitrous Oxide (N_2O)		0.394	14	
TOTAL			4,876	

<table>
<tr><th>EF Reference</th><th>Description</th></tr>
<tr><td>1</td><td>Horizon Engineering. Project No. 3086-2. Source Evaluation Report prepared for Potlatch Forest Products Corporation. Veneer Dryers Nos. 1, 2, 3, 4 - Regenerative Catalytic Oxidizer Outlet - Particulate Matter, Carbon Monoxide, Nitrogen Oxide, and Opacity Emission Factors. September 24, 2008. Table 1 of the report documents filterable and condensable particulate matter emission measurements downstream of the regenerative catalytic oxidizer.
For PM, PM_{10} and $PM_{2.5}$, neither the FARR's combustion source stack PM emission limit of 0.1 gr/dscf corrected to 7% O_2 at 40 CFR 49.125(d)(1) nor the FARR's process source stack PM emission limit of 0.1 gr/dscf at 40 CFR 49.125(d)(3) are employed to determine PTE for VDHS. Because the PCWP MACT requires that VDHS emissions be controlled, emission test results are employed to determine PTE. Employing the FARR PM limits 40 CFR 49.125(d)(1) and (3) would result in higher PTE values that are unrealistic given that the PCWP MACT requires the emissions be controlled. Note that a three-run average PM emission rate of 0.0015 gr/dscf was measured during September 2008 testing. The FARR PM PTE calculations are presented below for informational purposes:
A. The FARR process source stack PM emission limit of 0.1 gr/dscf at 40 CFR 49.125(d)(3) corresponds to a PTE of 170 tpy assuming September 2008 observed flow rate reflects capacity of system.
<table>
<tr><th>FARR PM Calculated PTE (tpy)</th><th>FARR PM Emission Limit (gr/dscf)</th><th>September 2008 Observed Flow Rate (dscf/min)</th><th>$CF_{gr\rightarrow lb}$ (gr/lb)</th><th>$CF_{min\rightarrow hr}$ (min/hr)</th><th>$CF_{min\rightarrow hr}$ (hr/yr)</th><th>$CF_{lb\rightarrow ton}$ (lb/ton)</th></tr>
<tr><td>170.1</td><td>0.1</td><td>45,300</td><td>7,000</td><td>60</td><td>8760</td><td>2000</td></tr>
</table>
B. The FARR combustion source stack PM emission limit of 0.1 gr/dscf corrected to 7% O_2 at 40 CFR 49.125(d)(1) corresponds to an emission factor of 0.1871 lb/MMBtu and a corresponding PTE of 6.6 tpy assuming only combustion of propane with heat input of 8 MMBtu/hr. This calculation neglects combustion of veneer dryer heating zone exhaust, which if considered would increase PTE. The application does not provide a value for the heat input corresponding to combustion of the veneer dryer heating zone exhaust.
EF (lb/MMBtu) = FARR PM Limit (gr/dscf@7%O_2) X $CF_{7\rightarrow 0\%O2}$ X F_d (dscf/MMBtu) / $CF_{gr\rightarrow lb}$ (gr/lb)
• $CF_{7\rightarrow 0\%O2}$ = (20.9 - X_{O2Fd}) / (20.9 - X_{O2FARR}). To create a correction factor that adjusts the basis of the FARR emission limit from 7% O_2 to 0% O_2 (the basis for F_d), X_{O2Fd} = 0 and X_{O2FARR} = 7. The value 20.9 is the percent by volume of the ambient air that is O_2. Decreasing the O_2 from the FARR baseline increases the pollutant concentration. See Equation 19-1 of EPA Method 19 at Appendix A-7 to 40 CFR Part 60.
• F_d = 8,710 dscf/MMBtu for combustion of propane. See Table 19-2 of EPA Method 19 at Appendix A-7 to 40 CFR Part 60.
<table>
<tr><th>FARR PM Calculated EF (lb/MMBtu)</th><th>FARR PM Emission Limit (gr/dscf @7%O_2)</th><th>$CF_{7\rightarrow 0\%O2}$ (unitless)</th><th>F_d (dscf/MMBtu)</th><th>$CF_{gr\rightarrow lb}$ (gr/lb)</th></tr>
<tr><td>0.1871</td><td>0.1</td><td>1.504</td><td>8,710</td><td>7,000</td></tr>
</table>
</td></tr>
<tr><td>2</td><td>Option 1: 0.0173 lb/MMBtu. This emission factor is employed to determine PTE as it limits emissions to less than Options 2 and 3 below.
Basis: Pursuant to ASTM D1835-16 and Gas Processors Association (GPA) Standard 2140, the sulfur content of commerical propane must not exceed 185 ppm by mass.
EF (lb/MMBtu) = [ASTM & GPA Fuel S Limit (ppm) / $1x10^6$] X $CF_{S\rightarrow SO2}$ X $CF_{lb\rightarrow gal}$ (lb/gal) X $CF_{Btu\rightarrow MMBtu}$ (Btu/MMBtu) / $CF_{gal\rightarrow Btu}$ (Btu/gal)
• $CF_{S\rightarrow SO2}$ = 2 lb SO_2/lb S. S + O_2 → SO_2. For every 1 mol S (16 lb/lb-mol) reactant, there is 1 mol SO_2 (32 lb/lb-mol) product. 32 / 16 = 2.
• $CF_{lb\rightarrow gal}$ = 4.24 lb/gal fuel at 60°F. See weight of liquid propane on page A-6 of Appendix A to AP-42, September 1985.
• $CF_{gal\rightarrow Btu}$ = 90,500 Btu/gal fuel. See heating value of liquid propane on page A-6 of Appendix A to AP-42, September 1985.
<table>
<tr><th>ASTM D1835-16 & GPA Standard 2140 Fuel Sulfur Calculated SO_2 EF (lb/MMBtu)</th><th>ASTM D1835-16 & GPA Standard 2140 Fuel Sulfur Limit for Commercial Propane (ppm by mass)</th><th>$CF_{S\rightarrow SO2}$ (lb SO_2/lb S)</th><th>$CF_{lb\rightarrow gal}$ (lb/gal fuel)</th><th>$CF_{gal\rightarrow Btu}$ (Btu/gal fuel)</th><th>$CF_{Btu\rightarrow MMBtu}$ (Btu/MMBtu)</th></tr>
<tr><td>0.0173</td><td>185</td><td>2</td><td>4.24</td><td>90,500</td><td>1.E+06</td></tr>
</table>
Option 2: 0.0539 lb/MMBtu.
Basis: FARR gaseous fuel sulfur limit of 1.1 g/dry standard cubic meter at 40 CFR 49.130(d)(8)
EF (lb/MMBtu) = FARR Fuel S Limit (g/m^3) / $CF_{m3\rightarrow ft3}$ / $CF_{ft3\rightarrow Btu}$ X $CF_{Btu\rightarrow MMBtu}$ / $CF_{g\rightarrow lb}$ X $CF_{S\rightarrow SO2}$
• $CF_{S\rightarrow SO2}$ = 2 lb SO_2/lb S. S + O_2 → SO_2. For every 1 mol S (16 lb/lb-mol) reactant, there is 1 mol SO_2 (32 lb/lb-mol) product. 32 / 16 = 2.
• $CF_{ft3\rightarrow Btu}$ = 2550 Btu/ft^3 fuel. See heating value of propane gas at 60°F at http://www.engineeringtoolbox.com/energy-content-d_868.html
<table>
<tr><th>FARR Fuel S Calculated SO_2 EF (lb/MMBtu)</th><th>FARR Fuel Sulfur Limit (g/m^3)</th><th>$CF_{m3\rightarrow ft3}$ (ft^3/m^3)</th><th>$CF_{ft3\rightarrow Btu}$ (Btu/ft^3)</th><th>$CF_{Btu\rightarrow MMBtu}$ (Btu/MMBtu)</th><th>$CF_{g\rightarrow lb}$ (g/lb)</th><th>$CF_{S\rightarrow SO2}$ (lb SO_2/lb S)</th></tr>
<tr><td>0.0539</td><td>1.1</td><td>35.3147</td><td>2550</td><td>1.E+06</td><td>453.592</td><td>2</td></tr>
</table>
Option 3: 1.087 lb/MMBtu.
Basis: FARR combustion source stack SO_2 emission limit of 500 parts per million by volume dry basis (ppmvd) corrected to 7% O_2 at 40 CFR 49.129(d)(1)
EF (lb/MMBtu) = FARR SO_2 Limit (ppmvd@7%O_2) X $CF_{7\rightarrow 0\%O2}$ X $CF_{ppm\rightarrow lb/dscfSO2}$ X F_d (dscf/MMBtu)
• $CF_{7\rightarrow 0\%O2}$ = (20.9 - X_{O2Fd}) / (20.9 - X_{O2FARR}). To create a correction factor that adjusts the basis of the FARR emission limit from 7% O_2 to 0% O_2 (the basis for F_d), X_{O2Fd} = 0 and X_{O2FARR} = 7. The value 20.9 is the percent by volume of the ambient air that is O_2. Decreasing the O_2 from the FARR baseline increases the pollutant concentration. See Equation 19-1 of EPA Method 19 at Appendix A-7 to 40 CFR Part 60.
• $CF_{ppm\rightarrow lb/dscfSO2}$ = 1.660 X 10^{-7} lb SO_2/dscf / ppm SO_2. See Table 19-1 of EPA Method 19 at Appendix A-7 to 40 CFR Part 60.
• F_d = 8,710 dscf/MMBtu for combustion of propane. See Table 19-2 of EPA Method 19 at Appendix A-7 to 40 CFR Part 60.
<table>
<tr><th>FARR 500 ppm Calculate SO_2 EF</th><th>FARR SO_2 Emission Limit</th><th>$CF_{7\rightarrow 0\%O2}$</th><th>$CF_{ppm\rightarrow lb/dscfSO2}$</th><th>$F_d$</th></tr>
</table>
</td></tr>
</table>

(lb/MMBtu)	($ppmvd@7\%O_2$)	(unitless)	(lb/dscf / ppm)	(dscf/MMBtu)
1.087	500	1.504	1.66E-07	8710

3

Horizon Engineering. Project No. 3086-1. Source Evaluation Report prepared for Potlatch Forest Products Corporation. Veneer Dryers Nos. 1, 2, 3, 4 - Regenerative Catalytic Oxidizer Inlet and Outlet - Total Hazardous Air Pollutant Measured as Total Hydrocarbon - Plywood and Composite Wood Products MACT. September 24, 2008. Table 1 of the report documents three-run average total gaseous organic carbon pre-control emission rate of 29.6 lb/hr. Because individual HAPs were not measured, we cannot take them into consideration with respect to a WPP1 VOC calculation. Although a 94.2 percent RM25A destruction removal efficiency (DRE) was measured, PCWP MACT requires only 90 percent DRE across the regenerative catalytic oxidizer. The enforceable 90 percent DRE is employed to calculate PTE.

VOC_{carbon} Emission Factor Calculation

VOC_{carbon} EF = [(100 - PCWP MACT DRE) / 100] X (VOC_{carbon} Uncontrolled Emission Rate) / (Veneer Dryer Production Rate)

VOC_{carbon} EF (lb/msf 3/8")	PCWP MACT Control Device Limit (% DRE)	VOC_{carbon} Uncontrolled Emission Rate (lb/hr)	Veneer Dryer Production Rate (msf 3/8"/hr)
0.073	90	29.6	40.720

$VOC_{propane}$ Emission Factor Calculation

VOC expressed as propane = (VOC_{carbon}) X [($MW_{propane}$) / (MW_{carbon})] X [($\#C_{carbon}$) / ($\#C_{propane}$)]

where: $Compound_X$ represents mass emission rate of $Compound_X$

$MW_{propane}$ equals "44.0962" and represents the molecular weight for propane; the compound that is the "basis" for expressing mass of VOC per WPP1 VOC

$MW_{Compound\ X}$ represents the molecular weight for $Compound_X$

$\#C_{compound\ X}$ equals number of carbon atoms in $Compound_X$

$\#C_{propane}$ equals "3" as three carbon atoms are present within propane; the compound that is the "basis" for expressing mass of VOC per WPP1 VOC

$VOC_{propane}$ = 0.089 lb/msf 3/8"

Reference Information

Element and Compound Information

Element / Compound	MW (lb/lb-mol)	Formula	Carbon Atoms	Hydrogen Atoms	Oxygen Atoms
Propane	44.0962	C_3H_8	3	8	0
Carbon	12.0110	C	1	-	-
Hydrogen	1.0079	H	-	1	-
Oxygen	15.9994	O	-	-	1

4

EPA's March 2011 guidance document "PSD and Title V Permitting Guidance for Greenhouse Gases" states that the GHG Report Rule (40 CFR 98), "should be considered a primary reference for sources and permitting authorities in estimating GHG emissions and establishing measurement techniques when preparing or processing permit applications." Therefore, GHG Reporting Rule emission factors will be employed to determine GHG PTE for propane combustion.

Carbon Dioxide (CO_2)

EF (lb CO_2e/MMBtu) = EF (kg CO_2/MMBtu) X $CF_{kg\to lb}$ (lb/kg) X GWP_{CO2} (lb CO_2e/lb CO_2)

Calculated CO_2e EF for CO_2 (lb CO_2e/MMBtu)	40 CFR 98 Table C-1 EF (kg CO_2/MMBtu)	$CF_{kg\to lb}$ (lb/kg)	40 CFR 98 Table A-1 GWP_{CO2} (lb CO_2e/lb CO_2)
138.605	62.87	2.20462262	1

Methane (CH_4)

EF (lb CO_2e/MMBtu) = EF (kg CH_4/MMBtu) X $CF_{kg\to lb}$ (lb/kg) X GWP_{CH4} (lb CO_2e/lb CH_4)

Calculated CO_2e EF for CH_4 (lb CO_2e/MMBtu)	40 CFR 98 Table C-2 EF (kg CH_4/MMBtu)	$CF_{kg\to lb}$ (lb/kg)	40 CFR 98 Table A-1 GWP_{CH4} (lb CO_2e/lb CH_4)
0.165	0.003	2.20462262	25

Nitrous Oxide (N_2O)

EF (lb CO_2e/MMBtu) = EF (kg N_2O/MMBtu) X $CF_{kg\to lb}$ (lb/kg) X GWP_{N2O} (lb CO_2e/lb N_2O)

Calculated CO_2e EF for N_2O (lb CO_2e/MMBtu)	40 CFR 98 Table C-2 EF (kg N_2O/MMBtu)	$CF_{kg\to lb}$ (lb/kg)	40 CFR 98 Table A-1 GWP_{N2O} (lb CO_2e/lb N_2O)
0.394	0.0006	2.20462262	298

SMC Non-HAP Potential to Emit

Emission Units: **VDL-1, VDL-2, VDL-3 and VDL-4**

Description: Leaks from four steam-heated veneer dryers. Steam provided by PB-1 and PB-2.

	VD-1	VD-2	VD-3	VD-4
Make:	Moore	Moore	E.V. Preutire	Moore
Dryer Technology:	Longitudinal	Longitudinal	Prentice	Longitudinal
Number of Heated Sections:	2	4	1	4
Installation Date:	February 1964	February 1964	July 1967	September 1980
Classification of Veneer Dried:	Re-dry	Strips	Full Sheets	Full Sheets
Maximum Observed Operating Rate during September 24, 2008 PCWP MACT Testing (msf 3/8"/hr):	7.48	7.19	16.19	15.76
Operation:	8760	8760	8760	8760
Heated Section Control Technology:	Exhaust from heated sections of four veneer dryers is collected and routed to a two-chamber Geoenergy GeoCat regenerative catalytic oxidizer (RCO) employing two 4 MMBtu/hr Maxon Kinemax burners.			
Observed RCO Exhaust Flow Rate during September 24, 2008 PCWP MACT Testing:	45,300	dscf/min		
RCO Heat Input:	8	MMBtu/hr		
RCO Operation:	8760	hr/yr		

NON-FUGITIVE EMISSIONS

Potential to Emit, (tons per year)

Criteria Pollutant Emissions	EF (lb/msf 3/8")	VDL-1 PTE (tpy)	VDL-2 PTE (tpy)	VDL-3 PTE (tpy)	VDL-4 PTE (tpy)	Total PTE (tpy)	EF Reference
Particulate (PM)	0.0200	0.66	0.63	1.42	1.38	4.1	1, 2 & 3 - see calculation below for estimating EF for processing douglas fir
Inhalable Coarse Particulate (PM$_{10}$)	0.04152	1.36	1.31	2.94	2.87	8.5	
Fine Particulate (PM$_{2.5}$)	0.04152	1.36	1.31	2.94	2.87	8.5	
Wood Products Protocol 1 (WPP1) Volatile Organic Compounds (VOC)	0.0039	0.13	0.12	0.28	0.27	0.8	3

Hazardous Air Pollutants	EF (lb/msf 3/8")	VDL-1 PTE (tpy)	VDL-2 PTE (tpy)	VDL-3 PTE (tpy)	VDL-4 PTE (tpy)	Total PTE (tpy)	EF Reference
Methanol	0.0039	0.13	0.12	0.28	0.27	0.8	3
TOTAL		0.13	0.12	0.28	0.27	0.8	

EF Reference	Description
1	Horizon Engineering. Project No. 3086-1. Source Evaluation Report prepared for Potlatch Forest Products Corporation. Veneer Dryers Nos. 1, 2, 3, 4 - Regenerative Catalytic Oxidizer Inlet and Outlet - Total Hazardous Air Pollutant Measured as Total Hydrocarbon - Plywood and Composite Wood Products MACT. September 24, 2008. Table 1 of the report documents total gaseous organic carbon destruction efficiency of 94.2 percent across the regenerative catalytic oxidizer.
2	Horizon Engineering. Project No. 3086-2. Source Evaluation Report prepared for Potlatch Forest Products Corporation. Veneer Dryers Nos. 1, 2, 3, 4 - Regenerative Catalytic Oxidizer Outlet - Particulate Matter, Carbon Monoxide, Nitrogen Oxide, and Opacity Emission Factors. September 24, 2008. Table 1 of the report documents filterable and condensable particulate matter emission measurements downstream of the regenerative catalytic oxidizer.
3	EPA Region 10 HAP and VOC Emission Factors for Veneer Dryer Employing Indirect Steam Heat without Air Pollution Controls, February 2016. See https://www.epa.gov/sites/production/files/2016-03/documents/veneer-dryer-hap-voc-emissionfactors.pdf

PM/PM$_{10}$/PM$_{2.5}$ Emission Factor Calculation

EPA Region 10 is not aware of any emissions testing to measure PM, PM$_{10}$ or PM$_{2.5}$ emissions resulting from veneer dryer leaks. EPA Region 10 has estimated what these emissions might be based upon (1) measurement of post-control (regenerative catalytic oxidizer) filterable and condensable PM emissions generated by Potlatch veneer dryer heating section while processing resinous softwood non-pine family wood species, (2) assumption that filterable and condensable PM control efficiency across the regenerative catalytic oxidizer is approximately equal to measured VOC control efficiency of 94.2 percent, (3) measurement of methanol emissions generated by veneer dryer heating section and veneer dryer leaks at similar source to Potlatch while processing resinous softwood non-pine family wood species, and (4) assumption that PM/PM$_{10}$/PM$_{2.5}$ emissions across the two emission generating activities (veneer dryer heating section and veneer dryer leaks) are proportional to methanol emissions. The degree of uncertainty surrounding assumptions associated with items (2) and (4) is unknown. For further information with respect to item (3), see EPA Region 10 HAP and VOC Emission Factors for Veneer Dryer Employing Indirect Steam Heat without Air Pollution Controls, February 2016, at http://www.epa.gov/sites/production/files/2016-03/documents/veneer-dryer-hap-voc-emissionfactors.pdf

VDHS-1 to 4 PM Uncontrolled EF = (VDHS-1 to 4 Filterable PM Controlled EF) / (1 - VOC control efficiency)
= (0.014 lb/msf 3/8") / (1 - 0.942); Potlatch St. Maries September 2008 VDHS post-control (RCO) test measurements while processing "larch and red fir"
= 0.2414 lb/msf 3/8"

VDL-1 to 4 PM EF estimation: VDL-1 to 4 PM EF = (VDHS-1 to 4 PM EF) X (VDL-1 to 4 Methanol EF) / (VDHS-1 to 4 Methanol EF)

Average Uncontrolled VDL-1 to 4 Methanol EF (estimated based on NCASI TB No. 768 - douglas fir measurement): 2.40E-03 VDL-1 to 4 PM EF (calculated): 2.00E-02

Average Uncontrolled VDHS-1 to 4 Methanol EF (estimated based on NCASI No. 768 - douglas fir measurement): 2.89E-02 Uncontrolled VDHS-1 to 4 PM EF: 2.41E-01

VDHS-1 to 4 $PM_{10}/PM_{2.5}$ Uncontrolled EF = (VDHS-1 to 4 Filterable + Condensable PM Controlled EF) / (1 - VOC control efficiency)
= (0.029 lb/msf 3/8") / (1 - 0.942); Potlatch St. Maries September 2008 VDHS post-control (RCO) test measurements while processing "larch and red fir"
= 0.5 lb/msf 3/8"

VDCS-1 to 4 $PM_{10}/PM_{2.5}$ EF estimation: VDCS-1 to 4 $PM_{10}/PM_{2.5}$ EF = (VDHS-1 to 4 $PM_{10}/PM_{2.5}$ EF) X (VDCS-1 to 4 WPP1 VOC EF) / (VDHS-1 to 4 WPP1 VOC EF)

Average Uncontrolled VDL-1 to 4 Methanol EF (estimated based on NCASI TB No. 768 - douglas fir measurement): 2.40E-03 VDL-1 to 4 $PM_{10}/PM_{2.5}$ EF (calculated): 4.15E-02

Average Uncontrolled VDHS-1 to 4 Methanol EF (estimated based on NCASI No. 768 - douglas fir measurement): 2.89E-02 Uncontrolled VDHS-1 to 4 $PM_{10}/PM_{2.5}$ EF: 5.00E-01

SMC Non-HAP Potential to Emit

Emission Units: **VDCS-1, VDCS-2, VDCS-3 and VDCS-4**

Description: Cooling sections of four steam-heated veneer dryers. Steam provided by PB-1 and PB-2.

	VD-1	VD-2	VD-3	VD-4
Make:	Moore	Moore	E.V. Preutire	Moore
Dryer Technology:	Longitudinal	Longitudinal	Prentice	Longitudinal
Number of Heated Sections:	2	4	1	4
Installation Date:	February 1964	February 1964	July 1967	September 1980
Classification of Veneer Dried:	Re-dry	Strips	Full Sheets	Full Sheets
Maximum Observed Operating Rate during September 24, 2008 PCWP MACT Testing (msf 3/8"/hr):	7.48	7.19	16.19	15.76
Operation:	8760	8760	8760	8760
Heated Section Control Technology:	Exhaust from heated sections of four veneer dryers is collected and routed to a two-chamber Geoenergy GeoCat regenerative catalytic oxidizer (RCO) employing two 4 MMBtu/hr Maxon Kinemax burners.			
Observed RCO Exhaust Flow Rate during September 24, 2008 PCWP MACT Testing:	45,300	dscf/min		
RCO Heat Input:	8	MMBtu/hr		
RCO Operation:	8760	hr/yr		

NON-FUGITIVE EMISSIONS

Potential to Emit, (tons per year)

Criteria Pollutant Emissions	EF (lb/msf 3/8")	VDCS-1 PTE (tpy)	VDCS-2 PTE (tpy)	VDCS-3 PTE (tpy)	VDCS-4 PTE (tpy)	Total PTE (tpy)	EF Reference
Particulate (PM)	0.0075	0.25	0.24	0.53	0.52	1.5	1, 2 & 3 - see calculation below for estimating EF for processing douglas fir
Inhalable Coarse Particulate (PM_{10})	0.01562	0.51	0.49	1.11	1.08	3.2	
Fine Particulate ($PM_{2.5}$)	0.01562	0.51	0.49	1.11	1.08	3.2	
Wood Products Protocol 1 (WPP1) Volatile Organic Compounds (VOC)	0.0295	0.97	0.93	2.09	2.04	6.0	3

EF Reference	Description
1	Horizon Engineering. Project No. 3086-1. Source Evaluation Report prepared for Potlatch Forest Products Corporation. Veneer Dryers Nos. 1, 2, 3, 4 - Regenerative Catalytic Oxidizer Inlet and Outlet - Total Hazardous Air Pollutant Measured as Total Hydrocarbon - Plywood and Composite Wood Products MACT. September 24, 2008. Table 1 of the report documents total gaseous organic carbon destruction efficiency of 94.2 percent across the regenerative catalytic oxidizer.
2	Horizon Engineering. Project No. 3086-2. Source Evaluation Report prepared for Potlatch Forest Products Corporation. Veneer Dryers Nos. 1, 2, 3, 4 - Regenerative Catalytic Oxidizer Outlet - Particulate Matter, Carbon Monoxide, Nitrogen Oxide, and Opacity Emission Factors. September 24, 2008. Table 1 of the report documents filterable and condensable particulate matter emission measurements downstream of the regenerative catalytic oxidizer.
3	EPA Region 10 HAP and VOC Emission Factors for Veneer Dryer Employing Indirect Steam Heat without Air Pollution Controls, February 2016. See https://www.epa.gov/sites/production/files/2016-03/documents/veneer-dryer-hap-voc-emissionfactors.pdf

4

Interpoll Laboratories, Inc. Results of the May 2005 Air Emission Testing Conducted for The Potlatch Corporation Plywood Facility Located in St. Maries, Idaho. July 1, 2005. Potlatch Land and Lumber, LLC's March 2015 Consolidated Title V Operating Permit Application - Appendix C (Detailed Emission Calculations). The report does not indicate which species of wood was being dried while emissions testing was being conducted.

Emission Unit	Run No.	Acetaldehyde	Acrolein	Benzene	Formaldehyde	Methanol	Phenol	Propionaldehyde
VDCS-1	1	0.0017	0.0018	0.0017	0.0017	0.001	0.001	0.0017
	2	0.0017	0.0018	0.0017	0.0017	0.001	0.001	0.0017
	3	0.0017	0.0018	0.0017	0.0017	0.003	0.007	0.0017
VDCS-2	1	0.0018	0.0018	0.0018	0.0018	0.001	0.0018	0.0018
	2	0.0018	0.0018	0.0018	0.0018	0.004	0.0018	0.0018
	3	0.0018	0.0018	0.0018	0.0018	0.004	0.0018	0.0018
VDCS-3	1	0.003	0.0017	0.0023	0.002	0.004	0.0028	0.0017
	2	0.0005	0.0017	0.0023	0.0001	0.0015	0.0028	0.0017
	3	0.006	0.0017	0.0023	0.004	0.006	0.0028	0.0017
VDCS-4	1	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	2	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	3	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	Average Emission Factor:	0.0022	0	0	0.0019	0.0026	0.0024	0

The appearance of thin diagonal stripes indicates that the concentration of the HAP was less than the method detection limit. Values appearing with thin diagonal stripes in the background reflect the method detection limit for that run. For those instances when none of the 12 runs resulted in the detection of the HAP at a concentration equal to or greater than the method detection limit, the concentration of the HAP was assumed to be zero in all instances. When at least one of the 12 runs resulted in the detection of the HAP at a concentration equal to or greater than the method detection limit, the concentration of the HAP was assumed equal to the method detection limit in those instances when the HAP was not detected.

PM/PM_{10}/$PM_{2.5}$ Emission Factor Calculation

EPA Region 10 is not aware of any emissions testing to measure PM, PM_{10} or $PM_{2.5}$ emissions resulting from veneer dryer cooling section. EPA Region 10 has estimated what these emissions might be based upon (1) measurement of post-control (regenerative catalytic oxidizer) filterable and condensable PM emissions generated by Potlatch veneer dryer heating section while processing resinous softwood non-pine family wood species, (2) assumption that filterable and condensable PM control efficiency across the regenerative catalytic oxidizer is approximately equal to measured VOC control efficiency of 94.2 percent, (3) measurement of WPP1 VOC emissions generated by veneer dryer heating section and veneer dryer cooling section at similar source to Potlatch while processing resinous softwood non-pine family wood species, and (4) assumption that PM/PM_{10}/$PM_{2.5}$ emissions across the two emission generating activities (veneer dryer heating section and veneer dryer cooling section) are proportional to WPP1 VOC emissions. The degree of uncertainty surrounding assumptions associated with items (2) and (4) is unknown. For further information with respect to item (3), see EPA Region 10 HAP and VOC Emission Factors for Veneer Dryer Employing Indirect Steam Heat without Air Pollution Controls, February 2016, at http://www.epa.gov/sites/production/files/2016-03/documents/veneer-dryer-hap-voc-emissionfactors.pdf

VDHS-1 to 4 PM Uncontrolled EF = (VDHS-1 to 4 Filterable PM Controlled EF) / (1 - VOC control efficiency)
= (0.014 lb/msf 3/8") / (1 - 0.942); Potlatch St. Maries September 2008 VDHS post-control (RCO) test measurements while processing "larch and red fir"
= 0.2414 lb/msf 3/8"

VDCS-1 to 4 PM EF estimation: VDCS-1 to 4 PM EF = (VDHS-1 to 4 PM EF) X (VDCS-1 to 4 WPP1 VOC EF) / (VDHS-1 to 4 WPP1 VOC EF)

Average Uncontrolled VDCS-1 to 4 WPP1 VOC EF (estimated based on NCASI TB No. 768 - douglas fir measurement):	1.96E-02	VDCS-1 to 4 PM EF (calculated):	7.54E-03
Average Uncontrolled VDHS-1 to 4 WPP1 VOC EF (estimated based on NCASI No. 768 - douglas fir measurement):	6.27E-01	Uncontrolled VDHS-1 to 4 PM EF:	2.41E-01

VDHS-1 to 4 PM_{10}/$PM_{2.5}$ Uncontrolled EF = (VDHS-1 to 4 Filterable + Condensable PM Controlled EF) / (1 - VOC control efficiency)
= (0.029 lb/msf 3/8") / (1 - 0.942); Potlatch St. Maries September 2008 VDHS post-control (RCO) test measurements while processing "larch and red fir"
= 0.5 lb/msf 3/8"

VDCS-1 to 4 PM_{10}/$PM_{2.5}$ EF estimation: VDCS-1 to 4 PM_{10}/$PM_{2.5}$ EF = (VDHS-1 to 4 PM_{10}/$PM_{2.5}$ EF) X (VDCS-1 to 4 WPP1 VOC EF) / (VDHS-1 to 4 WPP1 VOC EF)

Average Uncontrolled VDCS-1 to 4 WPP1 VOC EF (estimated based on NCASI TB No. 768 - douglas fir measurement):	1.96E-02	VDCS-1 to 4 PM_{10}/$PM_{2.5}$ EF (calculated):	1.56E-02
Average Uncontrolled VDHS-1 to 4 WPP1 VOC EF (estimated based on NCASI No. 768 - douglas fir measurement):	6.27E-01	Uncontrolled VDHS-1 to 4 PM_{10}/$PM_{2.5}$ EF:	5.00E-01

SMC Non-HAP Potential to Emit

Emission Unit:	**PV-1**	
Description:	Heated pressing of pre-pressed dried veneer sheets into panels employing urea-formaldehyde resin	
Control Device:	none	
Wood Species:	Hemlock, douglas fir, grand fir and western red cedar. Smaller amounts of lodgepole pine, subalpine fir, engelmann spruce, ponderosa pine and white pine	
Installation Date:	February 1964	
Capacity:	20	msf 3/8"/hr
Operation:	8760	hours per year

Emission Unit:	**PV-2**	
Description:	Heated pressing of pre-pressed dried veneer sheets into panels employing urea-formaldehyde resin	
Control Device:	none	
Wood Species:	Hemlock, douglas fir, grand fir and western red cedar. Smaller amounts of lodgepole pine, subalpine fir, engelmann spruce, ponderosa pine and white pine	
Installation Date:	February 1974	
Design Maximum Capacity:	20	msf 3/8"/hr
Operation:	8760	hours per year

NON-FUGITIVE EMISSIONS

Potential to Emit, (tons per year)

Criteria Air Pollutants	EF (lb/msf)	PV-1 PTE (tpy)	PV-2 PTE (tpy)	Total PTE (tpy)	EF Reference
Particulate (PM)	1.20E-01	10.5	10.5	21.0	1
Inhalable Coarse Particulate (PM_{10})	2.03E-01	17.8	17.8	35.6	
Fine Particulate ($PM_{2.5}$)	2.03E-01	17.8	17.8	35.6	
Wood Products Protocol 1 (WPP1) Volatile Organic Compounds (VOC)	1.03E-01	9.0	9.0	18.0	2

EF Reference	Description
1	AP-42, Table 10.5-4, January 2002. In the absence of any $PM_{2.5}$ EF, assume PM_{10} EF representative of $PM_{2.5}$ EF.
2	Derivation of emission factor presented at the conclusion of this emissions inventory.

Appendix A: Potential Emissions Inventory

SMC Non-HAP Potential to Emit

Emission Unit:	**LS-1**	
Description:	Three steam-heated log steaming vault	
Control Device:	None	
Wood Species:	Hemlock, douglas fir, grand fir and western red cedar. Smaller amounts of lodgepole pine, subalpine fir, engelmann spruce, ponderosa pine and white pine	
Installation Date:	1964	
Capacity:	40	msf (3/8")/hr
Operation:	8760	hr/yr

NON-FUGITIVE EMISSIONS

Potential to Emit, (tons per year)

Criteria Air Pollutants	EF (lb/msf)	PTE (tpy)
Wood Products Protocol 1 (WPP1) Volatile Organic Compounds (VOC)	8.72E-02	15.3

Derivation of emission factor presented at the conclusion of this emissions inventory.

SMC Non-HAP Potential to Emit

Emission Unit: **PCWR-SM**
Description: Pneumatic conveyance of wood residue related to sawmill operations, including planer
Wood Species: Hemlock, douglas fir, grand fir and western red cedar. Smaller amounts of lodgepole pine, subalpine fir, engelmann spruce, ponderosa pine and white pine
Operation: 8760 hr/yr
Maximum Dry Lumber Production: 307 MMbf/yr SMC's LK-5 + LDD's LK-1, LK-2, LK-3 and LK-4

NON-FUGITIVE EMISSIONS

Potential to Emit, (tons per year)

Emissions Generating Activity	Emission Unit ID	Process Unit / Control Device ID	Maximum Airflow (mcf/hr) (1 mcf = 1000 cf)	Highest Annual Ratio of Residue to Dry Lumber Production for Years '11 to '16 (bdt/MMbf)	Criteria Air Pollutants							
					Particulate PM		Inhalable Coarse Particulate PM10		Fine Particulate PM2.5		Volatile Organic Compounds (VOC)	
					EF (gr/dscf)	PTE (tpy)	EF (gr/dscf)	PTE (tpy)	EF (gr/dscf)	PTE (tpy)	EF (lb/bdt)	PTE (tpy)
Pneumatic conveyance of green wood chips from Screener to Chip Bin via Cyclone CY-2. Screener receives chips generated by CNS, Edger and Chipper. Exhaust from CY-2 is discharged to atmosphere.	S-CH	CY-2	510	540.1	0.1	31.9	0.085	7.0	0.05	4.1	0.5017	41.6
Pneumatic conveyance of metal filings (not a wood residue) to Cyclone CY-9		CY-9	Information not provided by applicant.									
Pneumatic conveyance of unknown material to Carpenter Shop Baghouse BH-1		BH-1	180		0.01	1.1	0.01	1.1	0.01	1.1		
Pneumatic conveyance of planer shavings (green or dry) from Planer to Planer Shavings Truck Bin via Baghouse BH-2	P-SH	BH-2	1,800	113.5	0.01	11.3	0.01	11.3	0.01	11.3	0.5017	8.7
Pneumatic conveyance of Trimmer (green or dry) sawdust and Chipper residue (green or dry) to Planer Shavings Truck Bin via Baghouse BH-3	P-SD	BH-3	1,620		0.01	10.1	0.01	10.1	0.01	10.1	0.5017	?
Control of Ply Trim Bin vent with Baghouse BH-4. Sawmill chipped dry trim ends and plywood mill dry waste are pneumatically conveyed to Ply Trim Bin. See sheet "PCWR-PM" for emission calculations.	P-PTB	BH-4	360		0.01	2.3	0.01	2.3	0.01	2.3	0.5017	?
Control of Planer Shavings Truck Bin vent with BH-5. Material in bin can be green or dry.	P-PSB	BH-5	360	113.5	0.01	2.3	0.01	2.3	0.01	2.3	0.5017	8.7
Pneumatic conveyance of green sawdust from Quad Band Mill, Chipping Edger, Vertical Arbor Gand Saw, and Trimmer to Hog Fuel Truck Bin via Baghouse BH-10. Exhaust from BH-10 is discharged to atmosphere.	S-SD	BH-10	2,905	124.7	0.01	18.2	0.01	18.2	0.01	18.2	0.5017	9.6
Control of Sawmill Sawdust Truck Bin vent with BH-11. Material in bin is green.	S-SDB	BH-11	636		0.01	4.0	0.01	4.0	0.01	4.0	0.5017	?
TOTAL (tpy):						81.1		56.2		53.3		68.7

PM, PM10 and PM2.5 Emission Factors for Pneumatic Conveyance of Wood Residue

Process Unit/Control Device Receiving Wood Residue	PM EF (gr/dscf)	PM10 EF (gr/dscf)	PM2.5 EF (gr/dscf)	Basis
Cyclone	0.1	0.085	0.05	PM emission factor based on 0.1 gr/dscf emission limit at 40 CFR 49.125(d)(3) for process source stacks. Note that 0.03 gr/dscf PM EF in Table 10.4.1 of AP-42, February 1980 represents average EF for large diameter cyclones in “woodworking waste collection systems.” Range of PM EF is 0.001 to 0.16 gr/dscf and has an emission factor rating of “D.” Based on Oregon DEQ's AQ-EF03, assume PM10 is 85% of PM and PM2.5 is 50% of PM.

Baghouse	0.01	0.01	0.01	See EPA's document entitled, Fabric Filter Bag Leak Detection Guidance, EPA-454/R-98-015, September 1997 at https://www3.epa.gov/ttnemc01/cem/tribo.pdf. On page 2 of the document, EPA states, "Fabric filters are capable of extremely high control efficiencies of both coarse and fine particles; outlet concentrations as low as 20 mg/dscm (0.01 gr/dscf) can be achieved with most fabric filter systems. Conservatively assume PM2.5 and PM10 equivalent to EPA Reference Method 5 PM. Testing of two Potlatch baghouses in May 1996 measured three-run average RM5 PM emissions of 0.0059 and 0.0069 gr/dscf, respectively. The applicable FARR process source stack PM emission limit of 0.1 gr/dscf at 40 CFR § 49.125(d)(3) is not being employed to calculate PTE as its use would overstate PTE by an order of magnitude.

Oregon Department of Environmental Quality's AQ-EF03 entitled, "Emission Factors - Wood Products - PM10/PM2.5 Fraction." August 1, 2011 at https://www.oregon.gov/deq/FilterPermitsDocs/AQ-EF03.

Type of Control	PM10 Fraction of PM	PM2.5 Fraction of PM
Cyclone - high efficiency	95	80
Cyclone - medium efficiency	85	50

VOC Emission Factors for Pneumatic Conveyance of Green Wood Residue

Green Wood Residue Type	VOC as propane (lb/bdt)
Species: Non-Resinous Softwood (e.g. white fir[2], western hemlock and western red cedar)	
Sawdust	0.2386
Planer Shavings	0.2692
Chips	0.0734
Species: Resinous Softwood Non-Pine Family (e.g. douglas fir, engelman spruce and larch)	
Sawdust	0.2386
Planer Shavings	0.2692
Chips	0.0734
Species: Resinous Softwood Pine Family (e.g. lodgepole pine, ponderosa pine and western white pine)	
Sawdust	0.5017
Planer Shavings	0.5017
Chips	0.5017

Derivation of emission factors presented at the conclusion of this emissions inventory.

Appendix A: Potential Emissions Inventory

SMC Non-HAP Potential to Emit

Emission Unit: **PCWR-PM**
Description: Pneumatic conveyance of wood residue related to plywood mill operations
Wood Species: Hemlock, douglas fir, grand fir and western red cedar. Smaller amounts of lodgepole pine, subalpine fir, engelmann spruce, ponderosa pine and white pine
Operation: 8760 hr/yr

NON-FUGITIVE EMISSIONS

Potential to Emit, (tons per year)

Emissions Generating Activity	Emission Unit ID	NCASI TB No. 768 Facility and Activity ID	Maximum Airflow (mcf/hr) (1 mcf = 1000 cf)	2012 Operating Hours (hr/yr)	2012 Wood Residue Generation (bdt/yr)	Plywood Throughput (msf 3/8"/hr)	Criteria Air Pollutants							
							Particulate (PM)		Inhalable Coarse Particulate (PM10)		Fine Particulate (PM2.5)		Volatile Organic Compounds (VOC)	
							EF (gr/dscf)	PTE (tpy)	EF (gr/dscf)	PTE (tpy)	EF (gr/dscf)	PTE (tpy)	EF (lb/bdt or lb/msf 3/8")	PTE (tpy)
Pneumatic conveyance of green fines from Veneer Clipper to cyclone CY-1. CY-1 exhaust is discharged to air inside plywood mill building, and thereafter to atmosphere via plywood mill building vents. Green fines collected by CY-1 are ultimately delivered to one of two truck bins.	CY-1	N/A	Information not provided by applicant			☒	0.1		0.085		0.05		0.5017	
Pneumatic conveyance of green chips and fines from VD-3 infeed to hopper via cyclone CY-5. Exhaust from CY-5 is discharged to atmosphere.	CY-5	N/A	480	4,494	Information not provided by applicant	☒	0.1	30.0	0.085	25.5	0.05	15.0	0.5017	
Control of Ply Trim Bin vent with Baghouse BH-4. Sawmill chipped trim ends and plywood mill dry waste are pneumatically conveyed to Ply Trim Bin.	BH-4	165-1WD1	360	3,658		40	0.01	2.3	0.01	2.3	0.01	2.3	0.0793	13.9
Control of Cyclone CY-3 exhaust with Baghouse BH-6. Sanderdust from Kimwood Sander is pneumatically conveyed to CY-3 for recovery. BH-6 exhausts to atmosphere. Residue collected by BH-6 is pneumatically conveyed to either CY-7 or CY-8.	BH-6	170-1SD1	3,900	4,494		40	0.01	24.4	0.01	24.4	0.01	24.4	0.2614	45.8
Control of Cyclone CY-7 exhaust by Baghouse BH-7. Sanderdust collected from CY-3 and BH-6 is pneumatically conveyed to CY-7 for recovery into Plywood Sanderdust Truck Bin. BH-7 exhausts to atmosphere. Residue collected by BH-7 is also deposited into Plywood Sanderdust Truck Bin. BH-7 also controls Plywood Sanderdust Truck Bin vent.	BH-7	170-1SD1	240	4,494		Information not provided by applicant	0.01	1.5	0.01	1.5	0.01	1.5	0.2614	
Control of Cyclone CY-8 exhaust by Baghouse BH-8. Sanderdust collected from CY-3 and BH-6 is pneumatically conveyed to CY-8 for recovery ultimately into Surge Bin serving PB-2. CY-8 also pneumatically receives fines and dust from Raimann Patchline waste veneer Hog and Specialty Machine Center. BH-8 exhausts to atmosphere. Residue collected by BH-8 is pneumatically conveyed back to CY-8.	BH-8	170-1SD1	1,860	4,494		Information not provided by applicant	0.01	11.6	0.01	11.6	0.01	11.6	0.2614	
Dust pickups from dry veneer stacker, core composers, pre-press bandsaws, synthetic patch lines, trim saw line and exhaust from CY-4 are routed to baghouse BH-9. Fines collected by BH-9 are directed to the intermediate storage bin.	BH-9	170-XMW1	2,550	4,494		40	0.01	16.0	0.01	16.0	0.01	16.0	0.0883	15.5
						TOTAL (tpy):		85.8		81.3		70.8		75.1

PM, PM10 and PM2.5 Emission Factors for Pneumatic Conveyance of Wood Residue

Process Unit/Control Device Receiving Wood Residue	PM EF (gr/dscf)	PM10 EF (gr/dscf)	PM2.5 EF (gr/dscf)	Basis
Cyclone	0.1	0.085	0.05	PM emission factor based on 0.1 gr/dscf emission limit at 40 CFR 49.125(d)(3) for process source stacks. Note that 0.03 gr/dscf PM EF in Table 10.4.1 of AP-42, February 1980 represents average EF for large diameter cyclones in “woodworking waste collection systems.” Range of PM EF is 0.001 to 0.16 gr/dscf and has an emission factor rating of “D.” Based on Oregon DEQ's AQ-EF03, assume PM10 is 85% of PM and PM2.5 is 50% of PM.
Baghouse	0.01	0.01	0.01	See EPA's document entitled, Fabric Filter Bag Leak Detection Guidance, EPA-454/R-98-015, September 1997 at https://www3.epa.gov/ttnemc01/cem/tribo.pdf. On page 2 of the document, EPA states, "Fabric filters are capable of extremely high control efficiencies of both coarse and fine particles; outlet concentrations as low as 20 mg/dscm (0.01 gr/dscf) can be achieved with most fabric filter systems. Conservatively assume PM2.5 and PM10 equivalent to EPA Reference Method 5 PM. Testing of two Potlatch baghouses in May 1996 measured three-run average RM5 PM emissions of 0.0059 and 0.0069 gr/dscf, respectively. The applicable FARR process source stack PM emission limit of 0.1 gr/dscf at 40 CFR § 49.125(d)(3) is not being employed to calculate PTE as its use would overstate PTE by an order of magnitude.

Oregon Department of Environmental Quality's AQ-EF03 entitled, "Emission Factors - Wood Products - PM10/PM2.5 Fraction." August 1, 2011 at https://www.oregon.gov/deq/FilterPermitsDocs/AQ-EF03.

Type of Control	PM10 Fraction of PM	PM2.5 Fraction of PM
Cyclone - high efficiency	95	80
Cyclone - medium efficiency	85	50

Oregon Department of Environmental Quality's AQ-EF03 entitled, "Emission Factors - Wood Products - PM10/PM2.5 Fraction." August 1, 2011 at https://www.oregon.gov/deq/FilterPermitsDocs/AQ-EF03.

Type of Control	PM10 Fraction of PM	PM2.5 Fraction of PM
	Cyclones & Process Equipment	
Uncontrolled		
Bag filter system	99.5	99
Cyclone - high efficiency	95	80
Cyclone - medium efficiency	85	50

VOC Emission Factors for Pneumatic Conveyance of Green Wood Residue

Green Wood Residue Type	VOC as propane (lb/bdt)
Species: Non-Resinous Softwood (e.g. white fir[2], western hemlock and western red cedar)	
Sawdust	0.2386
Planer Shavings	0.2692
Chips	0.0734
Species: Resinous Softwood Non-Pine Family (e.g. douglas fir, engelman spruce and larch)	
Sawdust	0.2386
Planer Shavings	0.2692
Chips	0.0734
Species: Resinous Softwood Pine Family (e.g. lodgepole pine, ponderosa pine and western white pine)	
Sawdust	0.5017
Planer Shavings	0.5017
Chips	0.5017

Derivation of emission factors presented at the conclusion of this emissions inventory.

VOC and HAP Emission Factors for Pneumatic Conveyance of Resinated Wood Residue

Species	Activity	NCASI TB768 Facility & Activity ID	WPP1 VOC (lb/msf 3/8")	Total HAP (lb/msf 3/8")
All Pacific Northwest Softwood Species	Pneumatic Conveyance of Layup Trim Chipping Exhaust	165-1WD1	0.0793	0.0134
	Pneumatic Conveyance of Plywood Trim Chipping Exhaust & Plywood Sanderdust	165-1WR1	0.0664	0.0135
	Pneumatic Conveyance of Plywood Course Residue Streams	170-XMW1	0.0883	0.0185
	Pneumatic Conveyance of Plywood Sanderdust	170-1SD1	0.2614	0.0220

Derivation of emission factors presented at the conclusion of this emissions inventory.

SMC Non-HAP Potential to Emit

Emission Unit: **IC-1 - Internal Combustion Engine 1**
Description: Detroit Diesel PTA-1SD-50 compression ignition (CI) diesel fired engine. Installed 1964.
Two-stroke engine supplies mechanical work to water pump for fire suppression in the event facility loses electricity in an emergency.
Control Device: none
Fuel: No. 2 distillate oil
Design Maximum Power Output: 265 horsepower
Design Maximum Heat Input Capcity: 1.86 MMBtu/hr[1]
Operation: 100 hours per year[2]

Emission Unit: **IC-2 - Internal Combustion Engine 2**
Description: Detroit Diesel PTA-1SD-50 compression ignition (CI) diesel fired engine. Installed 1967.
Two-stroke engine supplies mechanical work to water pump for fire suppression in the event facility loses electricity in an emergency.
Control Device: none
Fuel: No. 2 distillate oil
Design Maximum Power Output: 265 horsepower
Design Maximum Heat Input Capcity: 1.86 MMBtu/hr[1]
Operation: 100 hours per year[2]

NON-FUGITIVE EMISSIONS
Potential to Emit, (tons per year)

Criteria Pollutant Emissions	EF (lb/MMBtu)	IC-1 PTE (tpy)	IC-2 PTE (tpy)	Total PTE (tpy)	EF Reference
Carbon Monoxide (CO)	0.95	0.1	0.1	0.2	1
Lead (Pb)	-	0	0	0	1
Nitrogen Oxides (NO_X)	4.41	0.4	0.4	0.8	1
Particulate (PM)	0.1974	0.02	0.02	0.04	2
Inhalable Coarse Particulate (PM_{10})	0.1974	0.02	0.02	0.04	2
Fine Particulate ($PM_{2.5}$)	0.1974	0.02	0.02	0.04	2
Sulfur Dioxide (SO_2)	0.5036	0.0467	0.0467	0.0934	3
Volatile Organic Compounds (VOC)	0.36	0.03	0.03	0.1	1
Sulfuric Acid Mist (H_2SO_4)					

Greenhouse Gas Emissions (CO_2 Equivalent)	EF (lb/MMBtu)	IC-1 PTE (tpy)	IC-2 PTE (tpy)	Total PTE (tpy)	EF Reference
Carbon Dioxide (CO_2)	163.054	15.1	15.1	30.2	4
Methane (CH_4)	0.165	0.02	0.02	0.03	4
Nitrous Oxide (N_2O)	0.394	0.04	0.04	0.1	4
TOTAL (tpy):		15	15	30	

[1] Heat Input = Power Output (MMBtu/hr) X Average BSFC (Btu/hp-hr) X (MMBtu/1x10^6 Btu), where BSFC stands for brake-specific fuel consumption. See footnote A of Table 3.3-1 of AP-42, October 1996. 1.86 MMBtu/hr = (265 hp-hr) X (7,000 Btu/hp-hr) X (MMBtu/1x10^6 Btu)

[2] The engines are emergency stationary reciprocating internal combustion engines subject to NESHAP subpart ZZZZ, and the proposed Title V permit prohibits the permittee from operating them in non-emergency situations for more than 100 hours per calendar year pursuant to 40 CFR 63.6640(f).

<table>
<tr><th>EF Reference</th><th>Description</th></tr>
<tr><td>1</td><td>Table 3.3-1 of AP-42, October 1996.</td></tr>
<tr><td>2</td><td>Basis: FARR combustion source stack PM emission limit of 0.1 gr/dscf corrected to 7% O_2 at 40 CFR 49.125(d)(1)
EF (lb/MMBtu) = FARR PM Limit (gr/dscf@7%O_2) X $CF_{7\rightarrow0\%O2}$ X F_d (dscf/MMBtu) / $CF_{gr\rightarrow lb}$ (gr/lb)
• $CF_{7\rightarrow0\%O2}$ = (20.9 - X_{O2Fd}) / (20.9 - X_{O2FARR}). To create a correction factor that adjusts the basis of the FARR emission limit from 7% O_2 to 0% O_2 (the basis for F_d), X_{O2Fd} = 0 and X_{O2FARR} = 7. The value 20.9 is the percent by volume of the ambient air that is O_2. Decreasing the O_2 from the FARR baseline increases the pollutant concentration. See Equation 19-1 of EPA Method 19 at Appendix A-7 to 40 CFR Part 60.
• F_d = 9,190 dscf/MMBtu for combustion of oil. See Table 19-2 of EPA Method 19 at Appendix A-7 to 40 CFR Part 60.
<table>
<tr><th>FARR PM Calculated EF (lb/MMBtu)</th><th>FARR PM Emission Limit (gr/dscf @7%O_2)</th><th>$CF_{7\rightarrow0\%O2}$ (unitless)</th><th>F_d (dscf/MMBtu)</th><th>$CF_{gr\rightarrow lb}$ (gr/lb)</th></tr>
<tr><td>0.1974</td><td>0.1</td><td>1.504</td><td>9,190</td><td>7,000</td></tr>
</table>
• Assume $PM_{2.5}$ = PM_{10} = PM</td></tr>
</table>

3

Option 1: 0.50357 lb/MMBtu. This emission factor is employed to determine PTE as it limits emissions to less than Options 2 below.
Basis: FARR distillate fuel oil No. 2 sulfur limit of 0.5% by weight at 40 CFR 49.130(d)(2)
EF (lb/MMBtu) = [FARR Fuel S Limit (%S) / 100] X $CF_{S \rightarrow SO2}$ X $CF_{lb \rightarrow gal}$ (lb/gal) X $CF_{Btu \rightarrow MMBtu}$ (Btu/MMBtu) / $CF_{gal \rightarrow Btu}$ (Btu/gal)

- $CF_{S \rightarrow SO2}$ = 2 lb SO_2/lb S. S + O_2 → SO_2. For every 1 mol S (16 lb/lb-mol) reactant, there is 1 mol SO_2 (32 lb/lb-mol) product. 32 / 16 = 2.
- $CF_{lb \rightarrow gal}$ = 7.05 lb/gal fuel. See weight of distillate oil on page A-6 of Appendix A to AP-42, September 1985.
- $CF_{gal \rightarrow Btu}$ = 140,000 Btu/gal fuel. See heating value of distillate oil on page A-5 of Appendix A to AP-42, September 1985.

FARR Fuel S Calculated SO_2 EF (lb/MMBtu)	FARR Fuel Sulfur Limit (% by weight)	$CF_{S \rightarrow SO2}$ (lb SO_2/lb S)	$CF_{lb \rightarrow gal}$ (lb/gal fuel)	$CF_{gal \rightarrow Btu}$ (Btu/gal fuel)	$CF_{Btu \rightarrow MMBtu}$ (Btu/MMBtu)
0.50357	0.5	2	7.05	140,000	1.E+06

Option 2: 1.147 lb/MMBtu.
Basis: FARR combustion source stack SO_2 emission limit of 500 parts per million by volume dry basis (ppmvd) corrected to 7% O_2 at 40 CFR 49.129(d)(1)
EF (lb/MMBtu) = FARR SO_2 Limit (ppmvd@7%O_2) X $CF_{7 \rightarrow 0\%O2}$ X $CF_{ppm \rightarrow lb/dscfSO2}$ X F_d (dscf/MMBtu)

- $CF_{7 \rightarrow 0\%O2}$ = (20.9 - X_{O2Fd}) / (20.9 - X_{O2FARR}). To create a correction factor that adjusts the basis of the FARR emission limit from 7% O_2 to 0% O_2 (the basis for F_d), X_{O2Fd} = 0 and X_{O2FARR} = 7. The value 20.9 is the percent by volume of the ambient air that is O_2. Decreasing the O_2 from the FARR baseline increases the pollutant concentration. See Equation 19-1 of EPA Method 19 at Appendix A-7 to 40 CFR Part 60.
- $CF_{ppm \rightarrow lb/dscfSO2}$ = 1.660 X 10^{-7} lb SO_2/dscf / ppm SO_2. See Table 19-1 of EPA Method 19 at Appendix A-7 to 40 CFR Part 60.
- F_d = 9,190 dscf/MMBtu for combustion of oil. See Table 19-2 of EPA Method 19 at Appendix A-7 to 40 CFR Part 60.

FARR 500 ppm Calculated SO_2 EF (lb/MMBtu)	FARR SO_2 Emission Limit (ppmvd@7%O_2)	$CF_{7 \rightarrow 0\%O2}$ (unitless)	$CF_{ppm \rightarrow lb/dscfSO2}$ (lb/dscf / ppm)	F_d (dscf/MMBtu)
1.147	500	1.504	1.66E-07	9190

4

EPA's March 2011 guidance document "PSD and Title V Permitting Guidance for Greenhouse Gases" states that the GHG Report Rule (40 CFR 98), "should be considered a primary reference for sources and permitting authorities in estimating GHG emissions and establishing measurement techniques when preparing or processing permit applications." Therefore, GHG Reporting Rule emission factors will be employed to determine GHG PTE.

Carbon Dioxide (CO_2)
EF (lb CO_2e/MMBtu) = EF (kg CO_2/MMBtu) X $CF_{kg \rightarrow lb}$ (lb/kg) X GWP_{CO2} (lb CO_2e/lb CO_2)

Calculated CO_2e EF for CO_2 (lb CO_2e/MMBtu)	40 CFR 98 Table C-1 EF (kg CO_2/MMBtu)	$CF_{kg \rightarrow lb}$ (lb/kg)	40 CFR 98 Table A-1 GWP_{CO2} (lb CO_2e/lb CO_2)
163.054	73.96	2.20462262	1

Methane (CH_4)
EF (lb CO_2e/MMBtu) = EF (kg CH_4/MMBtu) X $CF_{kg \rightarrow lb}$ (lb/kg) X GWP_{CH4} (lb CO_2e/lb CH_4)

Calculated CO_2e EF for CH_4 (lb CO_2e/MMBtu)	40 CFR 98 Table C-2 EF (kg CH_4/MMBtu)	$CF_{kg \rightarrow lb}$ (lb/kg)	40 CFR 98 Table A-1 GWP_{CO2} (lb CO_2e/lb CH_4)
0.165	0.003	2.20462262	25

Nitrous Oxide (N_2O)
EF (lb CO_2e/MMBtu) = EF (kg N_2O/MMBtu) X $CF_{kg \rightarrow lb}$ (lb/kg) X GWP_{N2O} (lb CO_2e/lb N_2O)

Calculated CO_2e EF for N_2O (lb CO_2e/MMBtu)	40 CFR 98 Table C-2 EF (kg N_2O/MMBtu)	$CF_{kg \rightarrow lb}$ (lb/kg)	40 CFR 98 Table A-1 GWP_{CO2} (lb CO_2e/lb N_2O)
0.394	0.0006	2.20462262	298

SMC Non-HAP Potential to Emit

Emission Units: **Internal Combustion Engines IC-3 to IC-10**

Description: Nonhandheld rich-burn four-stroke spark ignition propane-fired generator sets supplying electricity in the event facility loses grid-supplied electricity in an emergency. Engine displacement ≥ 225 cubic centimeters. No control devices employed.

	IC-3	IC-4	IC-5	IC-6	IC-7	IC-8	IC-9	IC-10
Make:	Kohler	Generac	Briggs & Stratton	Briggs & Stratton	Kohler	Kohler	Kohler	Generac
Generator Model:	14RESA-Q54	0058821	040243A	040220	14RESA-Q52	14RESA-QS9	20RESA-QS	0058822
Generator Serial Number:	SGV322CT9	7706022	1019656470	1013904961	SGM328KB5	SGV3235F5	SGV323VVJ	7981011
Year of Manufacture:							2016	
Installation Year:	2015	2013	2014	2014	2013	2015	2017	2013
In an emergency, provides electricity to:	Front Office	Scale House	Log Yard	Sawmill	Warehouse	Firehouse	Boilerhouse	Shipping
Generator Output Rating (kW):	14	8	11	7	14	14	20	8
Engine Output Rating (kW)[1]:	18	10	14	9	18	18	25	10
Engine Output Rating (hp)[2]:	23	13	18	12	23	23	34	13
Design Maximum Heat Input Capcity (MMBtu/hr)[3]:	0.16	0.09	0.13	0.08	0.16	0.16	0.23	0.09
Operation (hr/yr)[4]:	100	100	100	100	100	100	100	100

[1] Assume system is 80% efficient in converting mechanical energy to electricity.

[2] 1 hp = 0.7457 kW

[3] Heat Input = Power Output (MMBtu/hr) X Average BSFC (Btu/hp-hr) X (MMBtu/1x10^6 Btu), where BSFC stands for brake-specific fuel consumption. See footnote A of Table 3.3-1 of AP-42, October 1996. 1.86 MMBtu/hr = (265 hp-hr) X (7,000 Btu/hp-hr) X (MMBtu/1x10^6 Btu)

[4] The engines are emergency stationary reciprocating internal combustion engines. IC-9 is subject to NESHAP subpart ZZZZ, and the rest are subject to NSPS subpart JJJJ. The proposed Title V permit prohibits the permittee from operating the engines in non-emergency situations for more than 100 hours per calendar year pursuant to 40 CFR 63.6640(f) and 60.4243(d).

NON-FUGITIVE EMISSIONS
Potential to Emit, (tons per year)

Criteria Pollutant Emissions	EF (g/kW-hr)	EF (lb/MMBtu)	EF Reference	IC-3 PTE (tpy)	IC-4 PTE (tpy)	IC-5 PTE (tpy)	IC-6 PTE (tpy)	IC-7 PTE (tpy)	IC-8 PTE (tpy)	IC-9 PTE (tpy)	IC-10 PTE (tpy)	Total PTE (tpy)
Carbon Monoxide (CO)	610		1	1.2	0.7	0.9	0.6	1.2	1.2	N/A	0.7	7.8
	519		2	N/A	N/A	N/A	N/A	N/A	N/A	1.4	N/A	
Lead (Pb)	-	-	3	0	0	0	0	0	0	0	0	0
Nitrogen Oxides (NO_X)	8		1	0.02	0.01	0.01	0.01	0.02	0.02	N/A	0.01	0.1
	13.4		2	N/A	N/A	N/A	N/A	N/A	N/A	0.04	N/A	
Particulate (PM)		0.1871	4	0.0015	0.0009	0.0012	0.0008	0.0015	0.0015	0.0022	0.0009	0.01
Inhalable Coarse Particulate (PM_{10})		0.19701	5	0.0016	0.0009	0.0013	0.0008	0.0016	0.0016	0.0023	0.0009	0.01
Fine Particulate ($PM_{2.5}$)		0.19701	5	0.0016	0.0009	0.0013	0.0008	0.0016	0.0016	0.0023	0.0009	0.01
Sulfur Dioxide (SO_2)		0.0115	6	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001	0.001
Volatile Organic Compounds (VOC)		0.0296	3	0.0002	0.0001	0.0002	0.0001	0.0002	0.0002	0.0003	0.0001	0.002
Sulfuric Acid Mist (H_2SO_4)												

Greenhouse Gas Emissions (CO_2 Equivalent)	EF (g/kW-hr)	EF (lb/MMBtu)	EF Reference	IC-3 PTE (tpy)	IC-4 PTE (tpy)	IC-5 PTE (tpy)	IC-6 PTE (tpy)	IC-7 PTE (tpy)	IC-8 PTE (tpy)	IC-9 PTE (tpy)	IC-10 PTE (tpy)	Total PTE (tpy)
Carbon Dioxide (CO_2)		138.605	7	1.1385	0.6506	0.8945	0.5692	1.1385	1.1385	1.6264	0.6506	7.8
Methane (CH_4)		0.165	7	0.0014	0.0008	0.0011	0.0007	0.0014	0.0014	0.0019	0.0008	0.01
Nitrous Oxide (N_2O)		0.394	7	0.0032	0.0019	0.0025	0.0016	0.0032	0.0032	0.0046	0.0019	0.02
TOTAL				1.14	0.65	0.90	0.57	1.14	1.14	1.63	0.65	7.8

<table>
<tr><th>EF Reference</th><th>Description</th></tr>
<tr><td>1</td><td>NSPS subpart JJJJ. SI engines with maximum power less than 19 kW manufactured on or after July 1, 2008 are subject to emission standards in 40 CFR 60.4231(a) pursuant to 40 CFR 60.4233(a). 40 CFR 60.4231(a) makes the emission standards of 40 CFR part 1054 applicable. Class II engines are those with total displacement at or above 225 cubic centimeters. Pursuant to Table 1 to 40 CFR 1054.105, the Phase 3 Class II engine emission standards are as follows: HC + NO_X: 8 g/kW-hr, CO: 610 g/kW-hr.</td></tr>
<tr><td>2</td><td>Pursuant to Table 1 to 40 CFR 90.103(a), the Phase 1, Class II engine emission standards are as follows: HC + NO_X: 13.4 g/kW-hr, CO: 519 g/kW-hr.</td></tr>
<tr><td>3</td><td>Table 3.2-3 of AP-42, July 2000.</td></tr>
<tr><td>4</td><td>Basis: FARR combustion source stack PM emission limit of 0.1 gr/dscf corrected to 7% O_2 at 40 CFR 49.125(d)(1)
EF (lb/MMBtu) = FARR PM Limit (gr/dscf@7%O_2) X $CF_{7\rightarrow0\%O2}$ X F_d (dscf/MMBtu) / $CF_{gr\rightarrow lb}$ (gr/lb)
• $CF_{7\rightarrow0\%O2}$ = (20.9 - X_{O2Fd}) / (20.9 - X_{O2FARR}). To create a correction factor that adjusts the basis of the FARR emission limit from 7% O_2 to 0% O_2 (the basis for F_d), X_{O2Fd} = 0 and X_{O2FARR} = 7. The value 20.9 is the percent by volume of the ambient air that is O_2. Decreasing the O_2 from the FARR baseline increases the pollutant concentration. See Equation 19-1 of EPA Method 19 at Appendix A-7 to 40 CFR Part 60.
• F_d = 8,710 dscf/MMBtu for combustion of propane. See Table 19-2 of EPA Method 19 at Appendix A-7 to 40 CFR Part 60.
<table>
<tr><th>FARR PM Calculated EF (lb/MMBtu)</th><th>FARR PM Emission Limit (gr/dscf @7%O_2)</th><th>$CF_{7\rightarrow0\%O2}$ (unitless)</th><th>F_d (dscf/MMBtu)</th><th>$CF_{gr\rightarrow lb}$ (gr/lb)</th></tr>
<tr><td>0.1871</td><td>0.1</td><td>1.504</td><td>8,710</td><td>7,000</td></tr>
</table>
• Assume $PM_{2.5}$ = PM_{10} = PM</td></tr>
</table>

5	Basis: FARR PM limit for filterable portion and AP-42's Table 3.2-3, July 2000 for condensible portion of 0.00991 lb/MMBtu. Assume all PM is also PM_{10} and $PM_{2.5}$. 0.1871 lb/MMBtu (filterable) + 0.00991 lb/MMBtu (condensible) = 0.19701 lb/MMBtu.

6

Option 1: 0.0173 lb/MMBtu. This emission factor is employed to determine PTE as it limits emissions to less than Options 2 and 3 below.

Basis: Pursuant to ASTM D1835-16 and Gas Processors Association (GPA) Standard 2140, the sulfur content of commerical propane must not exceed 185 ppm by mass.

EF (lb/MMBtu) = [ASTM & GPA Fuel S Limit (ppm) / $1x10^6$] X $CF_{S \rightarrow SO2}$ X $CF_{lb \rightarrow gal}$ (lb/gal) X $CF_{Btu \rightarrow MMBtu}$ (Btu/MMBtu) / $CF_{gal \rightarrow Btu}$ (Btu/gal)

- $CF_{S \rightarrow SO2}$ = 2 lb SO_2/lb S. S + O_2 → SO_2. For every 1 mol S (16 lb/lb-mol) reactant, there is 1 mol SO_2 (32 lb/lb-mol) product. 32 / 16 = 2.
- $CF_{lb \rightarrow gal}$ = 4.24 lb/gal fuel at 60°F. See weight of liquid propane on page A-6 of Appendix A to AP-42, September 1985.
- $CF_{gal \rightarrow Btu}$ = 90,500 Btu/gal fuel. See heating value of liquid propane on page A-6 of Appendix A to AP-42, September 1985.

ASTM D1835-16 & GPA Standard 2140 Fuel Sulfur Calculated SO_2 EF (lb/MMBtu)	ASTM D1835-16 & GPA Standard 2140 Fuel Sulfur Limit for HD-5 Grade Propane (ppm by mass)	$CF_{S \rightarrow SO2}$ (lb SO_2/lb S)	$CF_{lb \rightarrow gal}$ (lb/gal fuel)	$CF_{gal \rightarrow Btu}$ (Btu/gal fuel)	$CF_{Btu \rightarrow MMBtu}$ (Btu/MMBtu)
0.0115	123	2	4.24	90,500	1.E+06

Option 2: 0.0539 lb/MMBtu.

Basis: FARR gaseous fuel sulfur limit of 1.1 g/dry standard cubic meter at 40 CFR 49.130(d)(8)

EF (lb/MMBtu) = FARR Fuel S Limit (g/m^3) / $CF_{m3 \rightarrow ft3}$ / $CF_{ft3 \rightarrow Btu}$ X $CF_{Btu \rightarrow MMBtu}$ / $CF_{g \rightarrow lb}$ X $CF_{S \rightarrow SO2}$

- $CF_{S \rightarrow SO2}$ = 2 lb SO_2/lb S. S + O_2 → SO_2. For every 1 mol S (16 lb/lb-mol) reactant, there is 1 mol SO_2 (32 lb/lb-mol) product. 32 / 16 = 2.
- $CF_{ft3 \rightarrow Btu}$ = 2550 Btu/ft^3 fuel. See heating value of propane gas at 60°F at http://www.engineeringtoolbox.com/energy-content-d_868.html

FARR Fuel S Calculated SO_2 EF (lb/MMBtu)	FARR Fuel Sulfur Limit (g/m^3)	$CF_{m3 \rightarrow ft3}$ (ft^3/m^3)	$CF_{ft3 \rightarrow Btu}$ (Btu/ft^3)	$CF_{Btu \rightarrow MMBtu}$ (Btu/MMBtu)	$CF_{g \rightarrow lb}$ (g/lb)	$CF_{S \rightarrow SO2}$ (lb SO_2/lb S)
0.0539	1.1	35.3147	2550	1.E+06	453.592	2

Option 3: 1.087 lb/MMBtu.

Basis: FARR combustion source stack SO_2 emission limit of 500 parts per million by volume dry basis (ppmvd) corrected to 7% O_2 at 40 CFR 49.129(d)(1)

EF (lb/MMBtu) = FARR SO_2 Limit (ppmvd@7%O_2) X $CF_{7 \rightarrow 0\%O2}$ X $CF_{ppm \rightarrow lb/dscfSO2}$ X F_d (dscf/MMBtu)

- $CF_{7 \rightarrow 0\%O2}$ = (20.9 - X_{O2Fd}) / (20.9 - X_{O2FARR}). To create a correction factor that adjusts the basis of the FARR emission limit from 7% O_2 to 0% O_2 (the basis for F_d), X_{O2Fd} = 0 and X_{O2FARR} = 7. The value 20.9 is the percent by volume of the ambient air that is O_2. Decreasing the O_2 from the FARR baseline increases the pollutant concentration. See Equation 19-1 of EPA Method 19 at Appendix A-7 to 40 CFR Part 60.
- $CF_{ppm \rightarrow lb/dscfSO2}$ = 1.660 X 10^{-7} lb SO_2/dscf / ppm SO_2. See Table 19-1 of EPA Method 19 at Appendix A-7 to 40 CFR Part 60.
- F_d = 8,710 dscf/MMBtu for combustion of propane. See Table 19-2 of EPA Method 19 at Appendix A-7 to 40 CFR Part 60.

FARR 500 ppm Calculate SO_2 EF (lb/MMBtu)	FARR SO_2 Emission Limit (ppmvd@7%O_2)	$CF_{7 \rightarrow 0\%O2}$ (unitless)	$CF_{ppm \rightarrow lb/dscfSO2}$ (lb/dscf / ppm)	F_d (dscf/MMBtu)
1.087	500	1.504	1.66E-07	8710

7

EPA's March 2011 guidance document "PSD and Title V Permitting Guidance for Greenhouse Gases" states that the GHG Report Rule (40 CFR 98), "should be considered a primary reference for sources and permitting authorities in estimating GHG emissions and establishing measurement techniques when preparing or processing permit applications." Therefore, GHG Reporting Rule emission factors will be employed to determine GHG PTE for propane combustion.

Carbon Dioxide (CO_2)

EF (lb CO_2e/MMBtu) = EF (kg CO_2/MMBtu) X $CF_{kg \rightarrow lb}$ (lb/kg) X GWP_{CO2} (lb CO_2e/lb CO_2)

Calculated CO_2e EF for CO_2 (lb CO_2e/MMBtu)	40 CFR 98 Table C-1 EF (kg CO_2/MMBtu)	$CF_{kg \rightarrow lb}$ (lb/kg)	40 CFR 98 Table A-1 GWP_{CO2} (lb CO_2e/lb CO_2)
138.605	62.87	2.20462262	1

Methane (CH_4)

EF (lb CO_2e/MMBtu) = EF (kg CH_4/MMBtu) X $CF_{kg \rightarrow lb}$ (lb/kg) X GWP_{CH4} (lb CO_2e/lb CH_4)

Calculated CO_2e EF for CH_4 (lb CO_2e/MMBtu)	40 CFR 98 Table C-2 EF (kg CH_4/MMBtu)	$CF_{kg \rightarrow lb}$ (lb/kg)	40 CFR 98 Table A-1 GWP_{CO2} (lb CO_2e/lb CH_4)
0.165	0.003	2.20462262	25

Nitrous Oxide (N_2O)

EF (lb CO_2e/MMBtu) = EF (kg N_2O/MMBtu) X $CF_{kg \rightarrow lb}$ (lb/kg) X GWP_{N2O} (lb CO_2e/lb N_2O)

Calculated CO_2e EF for N_2O (lb CO_2e/MMBtu)	40 CFR 98 Table C-2 EF (kg N_2O/MMBtu)	$CF_{kg \rightarrow lb}$ (lb/kg)	40 CFR 98 Table A-1 GWP_{CO2} (lb CO_2e/lb N_2O)
0.394	0.0006	2.20462262	298

Appendix A: Potential Emissions Inventory

SMC Non-HAP Potential to Emit

Emission Unit:	**CA**
Description:	Compressed air drying agent system (antifreeze for pneumatic controls)
Combined Dryer Rated Capacity:	40
Operation:	8760

NON-FUGITIVE EMISSIONS

Potential to Emit, (tons per year)

Patch Material	Material VOC Content (lb/gal)	Historical Maximum Material Usage (gal/yr)	VOC PTE (tpy)
Tanner Gas	6.58	990	3.3
TOTAL (tpy):			3.3

VOC PTE = (patch material VOC content) X (historical maximum material usage)

EF Reference

March 2015 Potlatch Part 71 Renewal Application

SMC Non-HAP Potential to Emit

Emission Unit: **ES**
Description: Oil and Edge Seal Line witihn Specialty Machine Center
Combined Dryer Rated Capacity: 40 msf 3/8"/hr
Operation: 8760 hr/yr

NON-FUGITIVE EMISSIONS

Potential to Emit, (tons per year)

Seal/Surface Coating Material	Material VOC Content (lb/gal)	2012 Actual Material Usage (gal/yr)	2012 Actual Plywood Coated (msf 3/8"/yr)	Maximum Plywood Throughput (msf 3/8"/yr)	Projected Maximum Mateial Usage (gal/yr)	VOC PTE (tpy)
Edge Seal	0.02	3,596	5,570	350,400	226,219	2.3
Surface Coating	0.83	700	5,570	350,400	44,036	18.3
TOTAL (tpy):						20.5

Projected maximum material usage = (2012 actual material usage) X (maximum plywood throughput) / (2012 actual plywood throughput)

VOC PTE = (material VOC content) X (projected maximum material usage)

EF Reference
March 2015 Potlatch Part 71 Renewal Application

SMC Non-HAP Potential to Emit

Emission Unit: **WP**
Description: Wood putty patching
Combined Dryer Rated Capacity: 40 msf 3/8"/hr
Operation: 8760 hr/yr

NON-FUGITIVE EMISSIONS
Potential to Emit, (tons per year)

Patch Material	Material VOC Content (lb/gal)	2014 Actual Material Usage (gal/yr)	2014 Actual Plywood Throughput (msf 3/8"/yr)	Maximum Plywood Throughput (msf 3/8"/yr)	Projected Maximum Material Usage (gal/yr)	VOC PTE (tpy)
Putty	0.32	57,701	144,313	350,400	140,101	22.4
TOTAL (tpy):						22.4

Projected maximum patch material usage = (2014 actual patch usage) X (maximum plywood throughput) / (2014 actual plywood throughput)

VOC PTE = (patch material VOC content) X (projected maximum patch material usage)

EF Reference
March 2015 Potlatch Part 71 Renewal Application

Emission Unit: **PP**
Description: Two synthetic patch lines
Combined Dryer Rated Capacity: 40 msf 3/8"/hr
Operation: 8760 hr/yr

NON-FUGITIVE EMISSIONS
Potential to Emit, (tons per year)

Patch Material	Material VOC Content (lb/gal)	2014 Actual Material Usage (gal/yr)	2014 Actual Plywood Throughput (msf 3/8"/yr)	Maximum Plywood Throughput (msf 3/8"/yr)	Projected Maximum Material Usage (gal/yr)	VOC PTE (tpy)
Part A	0	71,875	144,313	350,400	174,517	0
Part B	0	12,720	144,313	350,400	30,885	0
TOTAL (tpy):						0

Projected maximum patch material usage = (2014 actual patch usage) X (maximum plywood throughput) / (2014 actual plywood throughput)

VOC PTE = (patch material VOC content) X (projected maximum patch material usage)

EF Reference
March 2015 Potlatch Part 71 Renewal Application

SMC Non-HAP Potential to Emit

Emission Unit: **BV-1 to BV-4**
Description: Building Vents No. 1 to 4. Miscellaneous indoor activities.
Operation: 8760 hr/yr

NON-FUGITIVE EMISSIONS

Potential to Emit, (tons per year)

Emission Generating Activity	Measured PM Concentration in Building (µg/m³)	Building Volume (ft³)	Building Air Exhaust Rate (Changes per Hour)	PTE (tpy)		
				Particulate (PM)	Inhalable Coarse Particulate (PM10)	Fine Particulate (PM2.5)
BV-1. Miscellaneous Activities within Plywood Mill Building	1,250	5,428,500	2	3.7	3.7	3.7
BV-2. Miscellaneous Activities within Sawmill Building	1,020	387,520	2	0.2	0.2	0.2
BV-3. Miscellaneous Activities within Boiler Building	1,057	90,750	2	0.1	0.1	0.1
BV-4. Miscellaneous Activities within Planer Building	900	196,884	2	0.1	0.1	0.1
TOTAL (tpy):				4.1	4.1	4.1

Conversion Factors

1 m^3 =	35.3147	ft^3
1 g =	1000000	µg
1 lb =	453.592	g
1 ton =	2000	lb

Example Calculation

Plywood Mill Building PM PTE (tpy) = (8760 hr/yr) X (2 building volumes/hr) X (5,428,500 ft^3/building volume) X (1 m^3/35.3147 ft^3) X (1250 (µg/m^3) X (g/1x10^6 µg) X (1 lb/453.592 g) X (ton/2000 lb)

Assume measured PM = PM10 = PM2.5.

SMC Non-HAP Potential to Emit

Emission Unit: **DB**
Description: Log debarking

Debarker:	A8 22-inch	A5 22-inch
Mill:	Sawmill	Sawmill
Operation (hr/yr):	8760	8760
Lumber Drying Kilns LK-1 to LK-5 Combined Maximum Throughput (MMbf/yr):	307	

Debarker:	35-inch
Mill:	Plywood Mill
Operation (hr/yr):	8760
Plywood Mill Maximum Throughput (msf 3/8"/hr):	46.6

Emission Unit: **COS**
Description: Log bucking

Saw:	No.1	No. 2	No. 3
Mill:	Sawmill	Sawmill	Sawmill
Operation (hr/yr):	8760	8760	8760
Lumber Drying Kilns LK-1 to LK-5 Combined Maximum Throughput (MMbf/yr):	307		

Saw:	No. 4
Mill:	Plywood Mill
Operation (hr/yr):	8760
Plywood Mill Maximum Throughput (msf 3/8"/hr):	46.6

<u>FUGITIVE EMISSIONS</u>

Potential to Emit, (tons per year)

Emission Generating Activity (units of the EF)	Particulate (PM)		Inhalable Coarse Particulate (PM10)		Fine Particulate (PM2.5)	
	EF (lb/mmbf or lb/msf 3/8")	PTE (tpy)	EF (lb/mmbf or lb/msf 3/8")	PTE (tpy)	EF (lb/mmbf or lb/msf 3/8")	PTE (tpy)
Sawmill Log Debarking (lb/mbf)	0.074	11.3	0.002	0.3	0.0003	0.1
Plywood Mill Log Debarking (lb/msf 3/8")	0.033	6.8	0.001	0.2	0.0002	0.03
Sawmill Log Bucking (lb/mbf)	0.011	1.7	0.0003	0.05	0.00005	0.01
Plywood Mill Log Bucking (lb/msf 3/8")	0.005	1.0	0.0001	0.03	0.00002	0.00
TOTAL (tpy):		20.8		0.6		0.1

Calculation to convert Log Debarking PM, PM10 and PM2.5 EF from units of lb/ton incoming log to lb/mbf board produced:

Wood Species	EF based upon mass of incoming logs[1]			Log Density[4] (lb/ft^3)	PNW-East Lumber Recovery Factor[6] (bf/ft^3)	EF Based upon amount of boards produced		
	PM EF (lb/ton log)	PM10 EF[3] (lb/ton log)	PM2.5 EF[3] (lb/ton log)			PM EF (lb/mbf)	PM10 EF (lb/mbf)	PM2.5 EF (lb/mbf)
Grand Fir	0.024	0.000655344	0.00011148	46	7.81	0.071	0.002	0.0003
Ponderosa Pine	0.024	0.000655344	0.00011148	45	7.81	0.069	0.002	0.0003
Douglas Fir	0.024	0.000655344	0.00011148	38	7.81	0.058	0.002	0.0003
Hemlock	0.024	0.000655344	0.00011148	41	7.81	0.063	0.002	0.0003
Larch	0.024	0.000655344	0.00011148	48	7.81	0.074	0.002	0.0003
ESLP	0.024	0.000655344	0.00011148	39	7.81	0.060	0.002	0.0003
					Max:	0.074	0.002	0.0003

Appendix A: Potential Emissions Inventory

Calculation to convert Log Debarking PM, PM_{10} and $PM_{2.5}$ EF from units of lb/ton incoming log to lb/msf 3/8" veneer produced:

	EF based upon mass of incoming logs[1]			Log Density[4] (lb/ft^3)	PNW-East Veneer Recovery Factor[5] (ft^2 3/8"/ft^3)	EF Based upon amount of veneer produced		
Wood Species	PM EF (lb/ton log)	PM10 EF[3] (lb/ton log)	PM2.5 EF[3] (lb/ton log)			PM EF (lb/msf 3/8")	PM10 EF (lb/msf 3/8")	PM2.5 EF (lb/msf 3/8")
Cedar	0.024	0.000655344	0.00011148	27	17.2	0.019	0.001	0.0001
Douglas Fir	0.024	0.000655344	0.00011148	38	17.2	0.027	0.001	0.0001
Hemlock	0.024	0.000655344	0.00011148	41	17.2	0.029	0.001	0.0001
Larch	0.024	0.000655344	0.00011148	48	17.2	0.033	0.001	0.0002
Lodgepole Pine	0.024	0.000655344	0.00011148	39	17.2	0.027	0.001	0.0001
					Max:	0.033	0.001	0.0002

Calculation to convert Log Bucking PM, PM10 and PM2.5 EF from units of lb/ton incoming log to lb/mbf board produced:

	EF based upon mass of incoming logs[2]			Log Density[4] (lb/ft^3)	PNW-East Lumber Recovery Factor[6] (bf/ft^3)	EF Based upon amount of boards produced		
Wood Species	PM EF (lb/ton log)	PM10 EF[3] (lb/ton log)	PM2.5 EF[3] (lb/ton log)			PM EF (lb/mbf)	PM10 EF (lb/mbf)	PM2.5 EF (lb/mbf)
Grand Fir	0.0035	0.000095571	1.62575E-05	46	7.81	0.010	0.0003	0.00005
Ponderosa Pine	0.0035	0.000095571	1.62575E-05	45	7.81	0.010	0.0003	0.00005
Douglas Fir	0.0035	0.000095571	1.62575E-05	38	7.81	0.009	0.0002	0.00004
Hemlock	0.0035	0.000095571	1.62575E-05	41	7.81	0.009	0.0003	0.00004
Larch	0.0035	0.000095571	1.62575E-05	48	7.81	0.011	0.0003	0.00005
ESLP	0.0035	0.000095571	1.62575E-05	39	7.81	0.009	0.0002	0.00004
					Max:	0.011	0.0003	0.00005

Calculation to convert Log Bucking PM, PM10 and PM2.5 EF from units of lb/ton incoming log to lb/msf 3/8" veneer produced:

	EF based upon mass of incoming logs[2]			Log Density[4] (lb/ft^3)	PNW-East Veneer Recovery Factor[5] (ft^2 3/8"/ft^3)	EF Based upon amount of veneer produced		
Wood Species	PM EF (lb/ton log)	PM10 EF[3] (lb/ton log)	PM2.5 EF[3] (lb/ton log)			PM EF (lb/msf 3/8")	PM10 EF (lb/msf 3/8")	PM2.5 EF (lb/msf 3/8")
Cedar	0.0035	0.000095571	1.62575E-05	27	17.2	0.003	0.0001	0.00001
Douglas Fir	0.0035	0.000095571	1.62575E-05	38	17.2	0.004	0.0001	0.00002
Hemlock	0.0035	0.000095571	1.62575E-05	41	17.2	0.004	0.0001	0.00002
Larch	0.0035	0.000095571	1.62575E-05	48	17.2	0.005	0.0001	0.00002
Lodgepole Pine	0.0035	0.000095571	1.62575E-05	39	17.2	0.004	0.0001	0.00002
					Max:	0.005	0.0001	0.00002

[1] 0.024 lb PM/ton log for debarking, https://www.epa.gov/sites/production/files/2016-09/documents/spmpteef_memo.pdf

[2] 0.0035 lb PM/ton log for bucking based upon PotlatchDeltic 02/02/18 minor NSR application update

[3] 0.027 and 0046 is mass ratio of PM10 and PM2.5 to TSP, respectively, for fresh bark, NCASI Special Report No. 15-01, January 2015

[4] http://http://www.engineeringtoolbox.com/weigt-wood-d_821.html

[5] http://www.ruraltech.org/projects/conversions/briggs_conversions/briggs_append2/appendix02_combined.pdf

[6] Trends in Lumber Processing in the Western United States (Keegan et al. Forest Products Society 2010).

SMC Non-HAP Potential to Emit

Emission Unit: **WRD-SM**
Description: Wood residue drops at the sawmill
Lumber Drying Kilns LK-1 to LK-5 Combined Maximum Throughput (MMbf/yr): 307 MMbf/yr

FUGITIVE EMISSIONS
Potential to Emit, (tons per year)

Emission Generating Activity	Emission Unit ID	Highest Annual Ratio of Residue to Dry Lumber Production for Years '11 to '16 (bdt/MMbf)	PTE (tpy)			
			Particulate (PM)	Inhalable Coarse Particulate (PM10)	Fine Particulate (PM2.5)	VOC
Wood Chip Loadout into Trucks	WRD-SM-CH	540.1	6.22E-02	1.68E-03	2.86E-04	41.6
Sawdust Loadout into Trucks	WRD-SM-SD	124.7	1.44E-02	3.88E-04	6.60E-05	9.6
Shavings Loadout into Trucks	WRD-SM-SH	113.5	2.61E-02	7.06E-04	1.32E-04	8.7
Hog Fuel Loadout into Trucks and into Fuel Bin	WRD-SM-HF	462.0	5.32E-02	1.44E-03	2.45E-04	
TOTAL (tpy):			0.1559	0.0042	0.001	59.9

Wet Material Drop Emission Factor

Pollutant	Emission Factor (lb/bdt)	Basis
PM	0.00075	PM emission factors based on May 2014 EPA Region 10 memo on PM emission factors for sawmills for dry residue drop.
PM10	0.00002025	PM10 based on 2.7% of PM, NCASI Special Report 15-01, Table 5.18
PM2.5	0.00000345	PM2.5 based on 0.46% of PM, NCASI Special Report 15-01, Table 5.18

Dry Material Drop Emission Factor

Pollutant	Emission Factor (lb/bdt)	Basis
PM	0.0015	PM emission factors based on May 2014 EPA Region 10 memo on PM emission factors for sawmills for dry residue drop.
PM10	0.0000405	PM10 based on 2.7% of PM, NCASI Special Report 15-01, Table 5.18
PM2.5	0.0000069	PM2.5 based on 0.46% of PM, NCASI Special Report 15-01, Table 5.18

VOC Emission Factors for Pneumatic Conveyance of Green Wood Residue

Green Wood Residue Type	VOC as propane (lb/bdt)
Species: Non-Resinous Softwood (e.g. white fir[2], western hemlock and western red cedar)	
Sawdust	0.2386
Planer Shavings	0.2692
Chips	0.0734
Species: Resinous Softwood Non-Pine Family (e.g. douglas fir, engelman spruce and larch)	
Sawdust	0.2386
Planer Shavings	0.2692
Chips	0.0734
Species: Resinous Softwood Pine Family (e.g. lodgepole pine, ponderosa pine and western white pine)	
Sawdust	0.5017
Planer Shavings	0.5017
Chips	0.5017

Derivation of emission factors presented at the conclusion of this emissions inventory.

SMC Non-HAP Potential to Emit

Emission Unit: **HFP-SM**

Description: Wind erosion of sawmill's hog fuel pile

Lumber Drying Kilns LK-1 to LK-5 Combined Maximum Throughput (MMbf/yr): 307 MMbf/yr

FUGITIVE EMISSIONS

Potential to Emit, (tons per year)

Emission Generating Activity	Highest Annual Ratio of Hog Fuel Pile Area to Dry Dry Lumber Production for Years '11 to '16 (acres/MMbf)	Maximum Area Hog Fuel Pile (acres)	PTE (tpy)		
			Particulate (PM)	Inhalable Coarse Particulate (PM10)	Fine Particulate (PM2.5)
Wind Erosion of Sawmill's Hog Fuel Pile	0.001721	0.528347	0.20	0.005	0.0009

Wind Erosion Emission Factor

Pollutant	Emission Factor (ton/acre-yr)	Basis
PM	0.38	PM emission factors based on May 2014 EPA Region 10 memo on PM emission factors for sawmills for wind erosion of pile
PM10	0.01026	PM10 based on 2.7% of PM, NCASI Special Report 15-01, Table 5.18
PM2.5	0.00175	PM2.5 based on 0.46% of PM, NCASI Special Report 15-01, Table 5.18

SMC Non-HAP Potential to Emit

Emission Unit: **PT**
Description: Plant traffic

FUGITIVE EMISSIONS
Potential to Emit, (tons per year)

Emission Generating Activity	PTE (tpy)		
	Particulate (PM)	Inhalable Coarse Particulate (PM10)	Fine Particulate (PM2.5)
Paved Areas	104.8	21.0	5.1
Unpaved Areas	471.5	134.4	13
TOTAL:	576.4	155.4	18.6

PAVED AREAS
From AP-42 13.2.1
number of days with more than 0.01 in of rain = 129

The following equation may be used to estimate the dust emissions from a ***paved*** road.

$$E = k\,(sL)^{0.91}(W)^{1.02}\left(1-\frac{P}{4*365}\right)$$

k = base emission factor for particulate size range
sL = road surface silt loading (grams per square meter)
W = average weight (tons) of the vehicles traveling the road
P = number of days in year with at least 0.01 in of precipitation

Tabulated data for k values

Size Range	Multiplier (k)		
	g/VKT	g/VMT	lb/VMT
PM-2.5	0.15	0.25	0.00054
PM-10	0.62	1	0.0022
PM-15	0.77	1.23	0.0027
PM-30	3.23	5.24	0.011

UNITS	
g/VKT	grams per vehicle kilometer traveled
g/VMT	grams per vehicle mile traveled
lb/VMT	pounds per vehicle mile traveled

Values being used to calculate emission factor E:

	PM2.5	PM10	PM30	
sL =	9.700	9.700	9.700	(g/m^2)
k =	0.00054	0.0022	0.011	(lb/Vehicle Mile Traveled)

		E (lb/mile)			Total Vehicles Miles for Vehicles of this type	Emissions (lb/day)		
Equipment	W (tons)	$PM_{2.5}$	PM_{10}	TSP	Per Day	$PM_{2.5}$	PM_{10}	TSP
966 Bucket Loader	35	0.15	0.60	2.98	0.0	0.00	0.00	0.00
980 Wheel Loader	35	0.15	0.60	2.98	0.0	0.00	0.00	0.00
988 Wheel Loader	56	0.24	0.96	4.81	0.0	0.00	0.00	0.00
Letoum Log Stacker (lg)	100	0.43	1.74	8.69	0.0	0.00	0.00	0.00
Letoum Log Stacker (sm)	70	0.30	1.21	6.04	0.0	0.00	0.00	0.00
Dump Trucks	30	0.12	0.51	2.55	30.0	3.75	15.28	76.38
Log Trucks	40	0.17	0.68	3.41	97.5	16.34	66.58	332.88
By-Product Trucks	40	0.17	0.68	3.41	39.0	6.54	26.63	133.15
Lumber Trucks	40	0.17	0.68	3.41	9.0	1.51	6.15	30.73
Plywood Trucks	40	0.17	0.68	3.41	0.4	0.07	0.27	1.37
					TOTAL:	28.2	114.9	574.5

UNPAVED AREAS
The following information was found in AP-42 Chapter 13.2.2
number of days with more than 0.01 in of rain = 129
Reduction factor for unpaved surfaces = 0.65

The following expression may be used to calculate the particulate emissions (lb) from an ***unpaved*** road, per vehicle mile traveled

$$E = k\,({}^{s}/_{12})^{a}({}^{W}/_{3})^{b} * ((365\text{-}P)/365)$$

E = size-specific emission factor (lb/VMT)
s = surface material silt content (%)
W = mean vehicle weight (ton)
M = surface material moisture content (%)
P = number of days in year with at least 0.01 in of precipitation

a, b, k = empirical constants

Appendix A: Potential Emissions Inventory

For Loaders, Stackers, Letournous, Dump Trucks, Log

	PM2.5	PM_{10}	TSP	
s =	8.4	8.4	8.4	
a =	0.9	0.9	0.7	
b =	0.45	0.45	0.45	
k =	0.15	1.5	4.9	(lb/VMT)

		E (lb/mile)			Total Vehicles Miles for Vehicles of this type	Emissions (lb/day)		
Equipment	W (tons)	PM2.5	PM10	TSP	Per Day	PM2.5	PM10	TSP
966 Bucket Loader	35	0.21	2.13	7.46	56.0	11.90	119.02	417.54
980 Wheel Loader	35	0.21	2.13	7.46	56.0	11.90	119.02	417.54
988 Wheel Loader	56	0.26	2.63	9.21	20.0	5.25	52.52	184.24
Letoum Log Stacker (lg)	100	0.34	3.41	11.96	56.0	19.09	190.89	669.68
Letoum Log Stacker (sm)	70	0.29	2.90	10.19	56.0	16.26	162.58	570.38
Dump Trucks	30	0.20	1.98	6.96	6.0	1.19	11.90	41.74
Log Trucks	40	0.23	2.26	7.92	19.5	4.40	44.01	154.40
By-Product Trucks	40	0.23	2.26	7.92	13.0	2.93	29.34	102.93
Lumber Trucks	40	0.23	2.26	7.92	3.0	0.68	6.77	23.75
Plywood Trucks	40	0.23	2.26	7.92	0.2	0.05	0.45	1.58
					TOTAL:	73.6	736.5	2583.8

Derivation of Emission Factors Employed in Emissions Inventory

EPA Region 10 WPP1 VOC Emission Factor for Hot Pressing Pacific Northwest Softwood Plywood without Air Pollution Controls

This sheet presents full-scale test data for hot pressing, without air pollution controls, primarily douglas fir plywood as reported in National Council for Air and Stream Improvement (NCASI) January 1999 Technical Bulletin No. 768 (TB768) - Volatile Organic Compound Emissions from Wood Products Manufacturing Facilities Part I - Plywood. Based upon NCASI's test data and EPA's Interim VOC Measurement Protocol for the Wood Products Industry - July 2007 (WPP1 VOC), EPA Region 10 has calculated a hot pressing VOC emission factor of 0.1027 lb/msf (3/8 inch) for any one of several resinous softwood non-pine family species including the one tested; douglas fir. In the absence of any test data for the other two Pacific Northwest softwood categories (resinous pine family and non-resinous), EPA Region 10 assumes that each will have the same emission factor as the one derived for resinous non-pine family softwood.

To calculate WPP1 VOC emissions, EPA Region 10 employed NCASI test results quantifying both total and speciated VOC. NCASI employed EPA Reference Method 25A (RM25A) to measure VOC emissions not quantified through speciated sampling and analysis. Because RM25A quantifies total hydrocarbon (THC) emissions (and because THC and VOC are not quite the same), some adjustments to the RM25A results were necessary to determine VOC emissions. NCASI reported RM25A results “as carbon” which only accounts for the carbon portion of the compounds measured. EPA Region 10 adjusted the RM25A results to express THC “as propane” to better approximate the VOC compounds generated by veneer drying. RM25A results were further adjusted to deduct that portion attributable to acetone as acetone is not a VOC. The contribution of certain VOC compounds (already quantified through speciated sampling and analysis) to RM25A results have been deducted to avoid double-counting. These adjustments to RM25A results are consistent with EPA’s Interim VOC Measurement Protocol for the Wood Products Industry - July 2007 (WPP1 VOC). Finally, for each test run, the modified RM25A emission rate is added to speciated HAP emission rates to calculate WPP1 VOC. The resultant VOC emission factor is based on the 90th percentile value when three or more test runs are available, and on the maximum value when less than three runs are available. For a listing of the sampling and analysis techniques NCASI employed to measure each of the 29 targetted hydrocarbons (HAP and non-HAP), see Tables 2.1 and 2.2 of TB768.

In certain instances, one or two of the runs resulted in an actual measurement of a hydrocarbon while the other run(s) resulted in a non-detect. For those runs resulting in a non-detect, a substitute value has been generated to reflect what we think the actual measurement may have been had detection been possible. The substitute values are noted in **bold** and reflect the lesser of (a) the pollutant-specific method detection limit for that run or (b) a calculated value (Compound X_{RUNA}) representing mass emission rate of undetected individual compound "Compound X" during test run "Run A." The value for Compound X_{RUNA} is determined by multiplying known $\Sigma HC_{i\ RUNA}$ by the known ratio of Compound X_{RUNB} to $\Sigma HC_{i\ RUNB}$. Compound X_{RUNA} = ($\Sigma HC_{i\ RUNA}$) X (Compound X_{RUNB} / $\Sigma HC_{i\ RUNB}$) where $\Sigma HC_{i\ RUNA}$ is the summation of measurements of individual hydrocarbons (HC) during Run A except for Compound X and any other hydrocarbons not detected in Run A and/or Run B. Example calculations are provided below for illustration.

Step No. 1: Summarize test results

Emission Test Run ID	Run 112-1PB1N1	Run 112-1PB1N2	Run 112-1PB1N3	Run 115-1PB1N3
Facility No.	112	112	112	115
Species (Face/Core)	DF/PP	DF/DF	DF/DF	DF/DF
No. of Plies	4	4	4	7
Resin Type	PF	PF	PF	PF
NCASI TB768 Page No.	26-42 & B10	26-42 & B10	26-42 & B10	43-54 & B23

Mass Emission Rate as Measured (lb/msf 3/8")

Pollutant/Compound (as measured)	Run 112-1PB1N1	Run 112-1PB1N2	Run 112-1PB1N3	Run 115-1PB1N3
THC as carbon	0.086	0.070	0.080	0.042
Acetaldehyde	**0.0016**	0.0021	**0.0020**	0
Acetone (non-VOC)	0.0030	0.0036	0.0031	0.0079
Formaldehyde	0.0011	0.0031	0.0024	0
Methanol	0.027	0.031	0.041	0.061
Methyl Ethyl Ketone	0.0020	**0.0021**	**0.0022**	0

Example calculation to estimate acetaldehyde emission rate for Run 112-1PB1N3 based upon Run 112-1PB1N2 emission measurements while similarly pressing douglas fir veneer in the same hot press:
$\text{acetaldehyde}_{RUN112\text{-}1PB1N3}$ = ($\Sigma HC_{i\ RUN112\text{-}1PB1N3}$) X ($\text{acetaldehyde}_{RUN112\text{-}1PB1N2}$ / $\Sigma HC_{i\ RUN112\text{-}1PB1N2}$)
$\text{acetaldehyde}_{RUN112\text{-}1PB1N3}$ = (0.0031+0.0024+0.041) X (0.0021) / (0.0036+0.0031+0.031) = 0.0026 lb/msf 3/8"

Because the estimated value for $\text{acetaldehyde}_{RUN112\text{-}1PB1N3}$ of 0.0026 lb/msf 3/8" is greater than the test method detection limit of 0.0020 lb/msf 3/8" for that run, the detection limit value of 0.0020 lb/msf 3/8" is substituted instead of the calculated value.

Step No. 2: Convert measurements to a common propane basis

Compound_X expressed as propane = (Compound_X) X [($MW_{propane}$) / ($MW_{Compound\ X}$)] X [($\#C_{Compound\ X}$) / ($\#C_{propane}$)]

where: Compound_X represents mass emission rate of Compound_X
$MW_{propane}$ equals "44.0962" and represents the molecular weight for propane; the compound that is the "basis" for expressing mass of VOC
$MW_{Compound\ X}$ represents the molecular weight for Compound_X
$\#C_{compound\ X}$ equals number of carbon atoms in Compound_X
$\#C_{propane}$ equals "3" as three carbon atoms are present within propane; the compound that is the "basis" for expressing mass of VOC per

Mass Emission Rate as Propane (lb/msf 3/8")

Pollutant/Compound (as propane)	Run 112-1PB1N1	Run 112-1PB1N2	Run 112-PB1N3	Run 115-1PB1N3
THC	0.1052	0.0857	0.0979	0.0514
Acetaldehyde	0.0011	0.0014	0.0013	0
Acetone (non-VOC)	0.0023	0.0027	0.0024	0.0060
Formaldehyde	0.0005	0.0015	0.0012	0
Methanol	0.0124	0.0142	0.0188	0.0280
Methyl Ethyl Ketone	0.0016	0.0017	0.0018	0

Example calculation to convert methanol as $\text{measured}_{\text{RUN112-1PB1N1}}$ to methanol as propane:

Methanol as $\text{propane}_{\text{RUN112-1PB1N1}}$ = $(\text{Methanol}_{\text{RUN112-1PB1N1}})$ X $[(\text{MW}_{\text{propane}}) / (\text{MW}_{\text{methanol}})]$ X $[(\#\text{C}_{\text{methanol}}) / (\#\text{C}_{\text{propane}})]$

Methanol as $\text{propane}_{\text{RUN112-1PB1N1}}$ = (0.027) X (44.0962/32.042) X (1/3) = 0.0124 lb/msf 3/8"

Step No. 3: Calculate the contribution of individual compounds to THC analyzer measurements as propane

$\text{Compound}_{\text{X}}$ expressed as propane by analyzer = ($\text{Compound}_{\text{X}}$ expressed as propane) X ($\text{RF}_{\text{Compound X}}$)

where: $\text{RF}_{\text{Compound X}}$ represents the flame ionization detector (FID) response factor (RF) for $\text{Compound}_{\text{X}}$

Because THC was measured using a THC analyzer, we already know THC analyzer measurement of THC.

Mass Emission Rate as Propane Measured by THC Analyzer (lb/msf 3/8")

Pollutant/Compound (as propane per THC analyzer)	Run 112-1PB1N1	Run 112-1PB1N2	Run 112-PB1N3	Run 115-1PB1N3
Acetaldehyde	0.0005	0.0007	0.0007	0
Acetone (non-VOC)	0.0015	0.0018	0.0016	0.0040
Formaldehyde	0	0	0	0
Methanol	0.0062	0.0071	0.0094	0.0140
Methyl Ethyl Ketone	0.0012	0.0013	0.0013	0

Example calculation to determine amount of acetone measured by the THC analyzer as $\text{propane}_{\text{RUN112-1PB1N2}}$:

Acetone as $\text{propane}_{\text{RUN112-1PB1N2}}$ per THC analyzer = (Acetone as $\text{propane}_{\text{RUN112-1PB1N2}}$) X ($\text{RF}_{\text{acetone}}$)

Acetone as $\text{propane}_{\text{RUN112-1PB1N2}}$ per THC analyzer = (0.0027) X (0.6667) = 0.0018 lb/msf 3/8"

Step No. 4: Subtract the contribution of individual compounds measured by the THC analyzer as propane (Step No. 3) from the THC measurement as propane (Step No. 2)

Mass Emission Rate (lb/msf 3/8")

Pollutant/Compound (as propane per THC analyzer)	Run 112-1PB1N1	Run 112-1PB1N2	Run 112-PB1N3	Run 115-1PB1N3
THC	0.1052	0.0857	0.0979	0.0514
Acetaldehyde	-0.0005	-0.0007	-0.0007	0
Acetone (non-VOC)	-0.0015	-0.0018	-0.0016	-0.0040
Formaldehyde	0	0	0	0
Methanol	-0.0062	-0.0071	-0.0094	-0.0140
Methyl Ethyl Ketone	-0.0012	-0.0013	-0.0013	0
THC as propane w/o acetone and w/o double-counting VOC_{i}	0.1032	0.0831	0.0957	0.0474

Step No. 5: Calculate WPP1 VOC by adding the contribution of individual VOCs (Step No. 1) to the adjusted THC value (Step No. 4)

Mass Emission Rate (lb/msf 3/8")

Pollutant/Compound	Run 112-1PB1N1	Run 112-1PB1N2	Run 112-PB1N3	Run 115-1PB1N3
THC as propane w/o acetone and w/o double-counting VOC_{i}	0.1032	0.0831	0.0957	0.0474
Acetaldehyde as measured	**0.0016**	0.0021	**0.0020**	0
Formaldehyde as measured	0.0011	0.0031	0.0024	0
Methanol as measured	0.0270	0.0310	0.0410	0.0610
Methyl Ethyl Ketone as measured	0.0020	**0.0021**	**0.0022**	0
WPP1 VOC	0.1048	0.0852	0.0977	0.0474

Step No. 6: Calculate WPP1 VOC emission factor equal to 90th percentile value of 4 runs

WPP1 VOC (4-run 90th percentile value)	0.1027	lb/msf 3/8"
4-run average value (informational purposes only)	0.0838	lb/msf 3/8"

Reference Information

Element and Compound Information

Element / Compound	FID RF	MW (lb/lb-mol)	Formula	Carbon Atoms	Hydrogen Atoms	Oxygen Atoms
Acetaldehyde	0.5	44.0530	C_2H_4O	2	4	1
Acetone (non-VOC)	0.6667	58.0798	C_3H_6O	3	6	1
Acrolein	0.6667	56.0640	C_3H_4O	3	4	1
Benzene	1	78.1134	C_6H_6	6	6	0
3-carene	1	136.2364	$C_{10}H_{16}$	10	16	0
Formaldehyde	0	30.0262	CH_2O	1	2	1
Methanol	0.5	32.0420	CH_4O	1	4	1
Methyl Ethyl Ketone	0.75	72.1066	C_4H_8O	4	8	1
Methyl Isobutyl Ketone	0.8333	100.1602	$C_6H_{12}O$	6	12	1
Phenol	0.9167	94.1128	C_6H_6O	6	6	1
Alpha-pinene	1	136.2364	$C_{10}H_{16}$	10	16	0
Beta-pinene	1	136.2364	$C_{10}H_{16}$	10	16	0
Propionaldehyde	0.6667	58.0798	C_3H_6O	3	6	1
Toluene	1	92.1402	C_7H_8	7	8	0
m,p-Xylene	1	106.1670	C_8H_{10}	8	10	0
o-xylene	1	106.1670	C_8H_{10}	8	10	0
Propane	1	44.0962	C_3H_8	3	8	0
Carbon	-	12.0110	C	1	-	-
Hydrogen	-	1.0079	H	-	1	-
Oxygen	-	15.9994	O	-	-	1

FID RF = ECN / No. carbon atoms in compound. See Attachment No. 2 to NCASI's September 2011 Technical Bulletin No. 991 (TB768) - Volatile Organic Compound Emissions from Wood Products Manufacturing Facilities Part I - Plywood. In the absence of information related to the FID NCASI employed to conduct RM25A testing, empirical effective carbon number (ECN) values will be employed to estimate FID RF.

ECN = (no. aliphatic carbon) + (no. aromatic carbon) - (no. ether oxygen) - (0.5 x no. primary alcohol oxygen)
Calculations to estimate ECN for several compounds:

Element / Compound	Formula	No. Aliphatic Carbon	No. Aromatic Carbon	No. Carbonyl Carbon	No. Carboxyl Carbon	No. Ether Oxygen	No. Primary Alcohol Oxygen	Empirical ECN
Acetaldehyde	CH_3CHO	1		1				1
Acetone (non-VOC)	$(CH_3)_2CO$	2		1				2
Acrolein	CH_2CHCHO	2		1				2
Benzene	C_6H_6		6					6
3-carene	$C_{10}H_{16}$	10						10
Formaldehyde	CH_2O							0
Methanol	CH_3OH	1					1	0.5
Methyl Ethyl Ketone	$CH_3C(O)CH_2CH_3$	3		1				3
Methyl Isobutyl Ketone	$(CH_3)_2CHCH_2C(O)CH_3$	5		1				5
Phenol	C_6H_5OH		6				1	5.5
Alpha-pinene	$C_{10}H_{16}$	10						10
Beta-pinene	$C_{10}H_{16}$	10						10
Propane	C_3H_8	3						3
Propionaldehyde	CH_3CH_2CHO	2		1				2
Toluene	$C_6H_5CH_3$	1	6					7
m,p-Xylene	$C_6H_4CH_3CH_3$	2	6					8
o-xylene	$C_6H_4CH_3CH_3$	2	6					8

Abbreviations/Acronyms
DE: dryer exit
DF: douglas fir
ECN: effective carbon number
FID: flame ionization detector (aka THC analyzer)
GC/FID: gas chromatograph with a flame ionization detector
GC/MS: gas chromatograph with a mass spectrometer
HC: hydrocarbon
HZ: heating zone
J: jet
L: longitudinal
MSF: one thousand square feet
MW: molecular weight
NCASI: National Council for Air and Stream Improvement
NMP: no measurement performed
PF: phenol formaldehyde
PP: ponderosa pine
RM25A: EPA Reference Method 25A
RF: THC analyzer response factor
RM25A: EPA Reference Method 25A
THC: total hydrocarbon
WF: white fir
WPP1 VOC: EPA Interim VOC Measurement Protocol for the Wood Products Industry - July 2007

EPA Region 10 HAP and VOC Emission Factors for Pacific Northwest Softwood Log Steaming without Air Pollution Controls

This sheet presents full-scale test data for steaming Pacific Northwest resinous non-pine family softwood logs, without air pollution controls, as reported in National Council for Air and Stream Improvement (NCASI) January 1999 Technical Bulletin No. 768 (TB768) - Volatile Organic Compound Emissions from Wood Products Manufacturing Facilities Part I - Plywood. Based upon NCASI's test data, EPA Region 10 has calculated log steaming total HAP and VOC emission factors of 0.0140 and 0.0872 lb/msf 3/8", respectively, for the resinous non-pine family softwood category. In the absence of any test data for the other two Pacific Northwest softwood categories (resinous pine family and non-resinous), EPA Region 10 assumes that each will have the same emission factors as those derived for resinous non-pine family softwood. Because NCASI did not perform RM25A testing, VOC emissions are estimated to be equal to the sum of the individual VOCs detected. Of the 20 HAPs sampled and analyzed for, only acetaldehyde and methanol were detected while steaming douglas fir and larch (both from the resinous non-pine family) logs. Of the 9 non-HAP hydrocarbons sampled and analyzed for, only alpha-pinene and beta-pinene were detected. The emission factors are based on the 90th percentile value for three test runs. For a listing of the sampling and analysis techniques NCASI employed to measure each of the 29 targetted hydrocarbons (HAP and non-HAP), see Tables 2.1 and 2.2 of TB768.

The data presented below reflects NCASI TB768 log steaming test data for only those pollutants that were detected in three runs at one Pacific Northwest plywood mill. A total of 20 HAPs were analyzed for, but only two were detected. One of the three three runs resulted in an actual measurement of beta-pinene while the other two resulted in a non-detect. For those runs resulting in a non-detect, a substitute value has been generated to reflect what we think the actual measurement may have been had detection been possible. The substitute values are noted in **bold** and reflect the lesser of (a) the pollutant-specific method detection limit for that run or (b) a calculated value (Compound X_{RUNA}) representing mass emission rate of undetected individual compound "Compound X" during test run "Run A." The value for Compound X_{RUNA} is determined by multiplying known $\Sigma HC_{i\ RUNA}$ by the known ratio of Compound X_{RUNB} to $\Sigma HC_{i\ RUNB}$. Compound X_{RUNA} = ($\Sigma HC_{i\ RUNA}$) X (Compound X_{RUNB} / $\Sigma HC_{i\ RUNB}$) where $\Sigma HC_{i\ RUNA}$ is the summation of measurements of individual hydrocarbons (HC) during Run A except for Compound X and any other hydrocarbons not detected in Run A and/or Run B. Example calculations are provided below for illustration.

Emission Test Run ID	Facility No.	Species	NCASI TB768 Page No.	Volatile Organic Compounds (lb/msf 3/8")				
				Hazardous Air Pollutant Emissions (lb/msf 3/8")		Non-HAP (lb/msf 3/8")		TOTAL
				Acetaldehyde	Methanol	Alpha-Pinene	Beta-Pinene	
Run 112-1ML1N1	112	DF	26-42 & B11	0.0041	0.0077	0.044	**0.0062**	0.0620
Run 112-1ML1N2	112	DF	26-42 & B11	0.0037	0.0060	0.057	**0.0074**	0.0741
Run 112-1ML1N3	112	L	26-42 & B11	0.0062	0.0083	0.067	0.009	0.0905
3-run 90th percentile value				0.0058	0.0082			0.0872
3-run average value (informational purposes only)				0.0047	0.0073			0.0755
3-run 90th percentile value for total HAP				0.0140				
3-run average value (informational purposes only)				0.0120				

Example calculation to estimate beta-pinene emission rate for Run 112-1ML1N1 based upon Runs 112-1ML1N1 and N3 emission measurements:

$\text{Beta-Pinene}_{RUN112\text{-}1ML1N1} = (\Sigma HC_{i\ RUN112\text{-}1ML1N1})\ X\ (\text{Beta-Pinene}_{RUN112\text{-}1ML1N3} / \Sigma HC_{i\ RUN112\text{-}1ML1N3})$

$\text{Beta-Pinene}_{RUN112\text{-}1ML1N1}$ = (0.0041+0.0077+0.044) X [(0.009) / (0.0063+0.0083+0.067)] = 0.0062 lb/msf 3/8"

Abbreviations/Acronyms
DE: dryer exit
DF: douglas fir
ECN: effective carbon number
FID: flame ionization detector (aka THC analyzer)
GC/FID: gas chromatograph with a flame ionization detector
GC/MS: gas chromatograph with a mass spectrometer
HC: hydrocarbon
HZ: heating zone
J: jet
L: longitudinal
MSF: one thousand square feet
MW: molecular weight
NCASI: National Council for Air and Stream Improvement
NMP: no measurement performed
PF: phenol formaldehyde
PP: ponderosa pine
RM25A: EPA Reference Method 25A
RF: THC analyzer response factor
RM25A: EPA Reference Method 25A
THC: total hydrocarbon
WF: white fir
WPP1 VOC: EPA Interim VOC Measurement Protocol for the Wood Products Industry - July 2007

EPA Region 10 HAP and VOC Emission Factors for Pneumatic Conveyance of Pacific Northwest Softwood Green Wood Residue without Air Pollution Controls

This sheet presents full-scale VOC test data for pneumatically conveying green Pacific Northwest douglas fir and ponderosa pine wood residue, without air pollution controls, as reported in National Council for Air and Stream Improvement (NCASI) September 1996 Technical Bulletin No. 723 (TB723) - Laboratory and Limited Field Measurements of VOC Emissions from Wood Residuals. Based upon NCASI's test data, EPA Region 10 has calculated VOC emission factors for pneumatic conveyance of green wood residue for the following categories of wood species: non-resinous softwood, resinous non-pine family softwood and resinous pine family softwood. The emission factors are also categorized by the following types of wood residue: sawdust, planer shavings and chips. In the absence of any test data for non-resinous softwood, EPA Region 10 employs test data for the less-emitting (as compared to resinuous pine family softwood) resinuous non-pine family softwood to estimate VOC emissions for pneumatic conveyance of green non-resinous softwood residue. In the absence of any test data for pneumatic conveyance of sawdust and planer shavings for ponderosa pine, EPA Region 10 employs test data for the less-emitting (as compared to sawdust and planer shavings as evidenced by data for douglas fir) chip category of wood residue to estimate VOC emissions for pneumatic conveyance of ponderosa pine sawdust and planer shavings.

The sheet also presents full-scale HAP test data for pneumatically conveying Aspen hardwood chips, without air pollution controls, as reported in NCASI's January 1999 TB773 - Volatile Organic Compound Emissions from Wood Products Manufacturing Facilities, Part VI - Hardboard and Fiberboard. Of the 20 HAPs sampled and analyzed for, only methanol was detected while pneumatically conveying green Apsen hardwood chips. None of the 9 non-HAP hydrocarbons sampled and analyzed for were detected. The methanol emission factor is based on the higher value for two test runs. For a listing of the sampling and analysis techniques NCASI employed to measure each of the 29 targetted hydrocarbons (HAP and non-HAP), see Tables 2.1 and 2.2 of TB773.

Step No. 1: Summarize Test Results and Calculate Emission Factors

Volatile Organic Compounds

Residue Type	Species	Harvest Season	Number of One-Hour Runs	Arithmetic Average of Hourly Average Values (lb C/odt)	Standard Deviation (lb C/odt)	Range of Hourly Average Values (lb C/odt)	Arithmetic Average (informational (lb C/odt)	Arithmetic Average + Two Standard (lb C/odt)	Average 95th Percentile Value (lb C/odt)	VOC (as propane) (lb/odt)
Sawdust	DF	Fall	34	0.13	0.03	0.04 - 0.18	0.12	0.18	0.195	0.2386
		Spring	58	0.11	0.05	0.05 - 0.37		0.21		
Planer Shavings	DF	Fall	44	0.09	0.04	0.04 - 0.21	0.11	0.17	0.22	0.2692
		Spring	63	0.13	0.07	0.04 - 0.37		0.27		
Chips	DF	Fall	75	0.04	0.01	0.01 - 0.07	0.04	0.06	0.06	0.0734
		Spring	150	0.04	0.01	0.01 - 0.07		0.06		
Chips	PP	Fall	49	0.35	0.03	0.26 - 0.41	0.35	0.41	0.41	0.5017

Reference: September 1996 NCASI Technical Bulletin No. 723 entitled, "Laboratory and Limited Field Measurements of VOC Emissions from Wood Residuals," Table 7 on page 27.

Hazardous Air Pollutants: Methanol

Residue Type	Species	Harvest Season	Sampling Period (hr)	Methanol (lb/odt)
Chips	Aspen (hardwood)	Spring	1	0.00083
			1	0.0016
		2-run higher value		0.0016
		2-run average value (informational purposes only)		0.0012

Reference: January 1999 NCASI Technical Bulletin No. 773 entitled, "Volatile Organic Compound Emissions from Wood Products Manufacturing Facilities, Part VI - Hardboard and Fiberboard," Source ID No. 072-1LC1, page B46.

Step No. 2: Assign Emission Factors According to Wood Species and Type of Green Wood Residue Pneumatically Conveyed

Residue	VOC as propane (lb/odt)	Methanol (lb/odt)
Species: Non-Resinous Softwood (e.g. white fir, western hemlock and western red cedar)		
Sawdust	0.2386	0.0016
Planer Shavings	0.2692	
Chips	0.0734	
Species: Resinous Softwood Non-Pine Family (e.g. douglas fir, engelman spruce and larch)		
Sawdust	0.2386	0.0016
Planer Shavings	0.2692	
Chips	0.0734	
Species: Resinous Softwood Pine Family (e.g. lodgepole pine, ponderosa pine and western white pine)		
Sawdust	0.5017	0.0016
Planer Shavings	0.5017	
Chips	0.5017	

Reference Information

Element and Compound Information

Element / Compound	MW (lb/lb-mol)	Formula	Carbon Atoms	Hydrogen Atoms	Oxygen Atoms
Propane	44.0962	C_3H_8	3	8	0
Carbon	12.0110	C	1	-	-
Hydrogen	1.0079	H	-	1	-
Oxygen	15.9994	O	-	-	1

<u>Abbreviations/Acronyms</u>

DE: dryer exit
DF: douglas fir
ECN: effective carbon number
FID: flame ionization detector (aka THC analyzer)
GC/FID: gas chromatograph with a flame ionization detector
GC/MS: gas chromatograph with a mass spectrometer
HZ: heating zone
J: jet
L: longitudinal
MSF: one thousand square feet
MW: molecular weight
NCASI: National Council for Air and Stream Improvement
PF: phenol formaldehyde
PP: ponderosa pine
RM25A: EPA Reference Method 25A
RF: THC analyzer response factor
RM25A: EPA Reference Method 25A
THC: total hydrocarbon
WF: white fir
WPP1 VOC: EPA Interim VOC Measurement Protocol for the Wood Products Industry - July 2007

EPA Region 10 WPP1 VOC Emission Factor for Pacific Northwest Softwood Layup Trim Chipping without Air Pollution Controls

This sheet presents full-scale test data for chipping southern yellow pine layup trim, without air pollution controls, as reported in National Council for Air and Stream Improvement (NCASI) January 1999 Technical Bulletin No. 768 (TB768) - Volatile Organic Compound Emissions from Wood Products Manufacturing Facilities Part I - Plywood. Based upon NCASI's test data and EPA's Interim VOC Measurement Protocol for the Wood Products Industry - July 2007 (WPP1 VOC), EPA Region 10 has calculated a southern yellow pine layup trim chipping VOC emission factor of 0.0793 lb/msf (3/8 inch). NCASI conducted no testing of this emissions generating activity for Pacific Northwest softwoods. While southern yellow pine steam-heated veneer dryer heating zone THC (as carbon) emissions are five times greater than those generated by Pacific Northwest softwoods, southern yellowpine board cooling THC (as carbon) emissions are about one-half those generated by Pacific Northwest softwoods. (See NCASI TB768 tables 6.1.1, 6.1.2 and 6.1.4.) The southern yellow pine layup line (whose trim chipping NCASI tested) employed phenol formaldehyde resin, and that type of resin is typically employed at Pacific Northwest softwood mills as evidenced by information presented in NCASI TB 768. It is uncertain whether Pacific Northwest softwood layup trim chipping VOC emissions are greater or less than those generated by southern yellow pine, and EPA Region 10 is unable at this time to offer a methodology for calculating Pacific Northwest softwood emissions based upon adjustments to the results for southern yellow pine. Under these circumstances, EPA Region 10 estimates that the Pacific Northwest softwoods VOC emission factor for this activity is about the same as that for southern yellow pine, 0.0793 lb/msf 3/8".

The "msf" in the denominator of the emission factor refers to the layup line's finished board production rate. The factor is representative of emissions generated by pneumatic conveyance of layup trim chipping exhaust (not primary residue stream). The factor is not representative of emissions exhausted to atmosphere (perhaps via a cyclone or baghouse) as the resultant primary residue stream is pneumatically conveyed to downstream storage.

To calculate WPP1 VOC emissions, EPA Region 10 employed NCASI test results quantifying both total and speciated VOC. NCASI employed EPA Reference Method 25A (RM25A) to measure VOC emissions not quantified through speciated sampling and analysis. Because RM25A quantifies total hydrocarbon (THC) emissions (and because THC and VOC are not quite the same), some adjustments to the RM25A results were necessary to determine VOC emissions. NCASI reported RM25A results “as carbon” which only accounts for the carbon portion of the compounds measured. EPA Region 10 adjusted the RM25A results to express THC “as propane” to better approximate the VOC compounds generated by veneer drying. RM25A results were further adjusted to deduct that portion attributable to acetone as acetone is not a VOC. The contribution of certain VOC compounds (already quantified through speciated sampling and analysis) to RM25A results have been deducted to avoid double-counting. These adjustments to RM25A results are consistent with EPA’s Interim VOC Measurement Protocol for the Wood Products Industry - July 2007 (WPP1 VOC). Finally, for each test run, the modified RM25A emission rate is added to speciated HAP emission rates to calculate WPP1 VOC. The resultant VOC emission factor is based on the 90th percentile value when three or more test runs are available, and on the maximum value when less than three runs are available. For a listing of the sampling and analysis techniques NCASI employed to measure each of the 29 targetted hydrocarbons (HAP and non-HAP), see Tables 2.1 and 2.2 of TB768.

In certain instances, one or two of the runs resulted in an actual measurement of a hydrocarbon while the other run(s) resulted in a non-detect. For those runs resulting in a non-detect, a substitute value has been generated to reflect what we think the actual measurement may have been had detection been possible. The substitute values are noted in **bold** and reflect the lesser of (a) the pollutant-specific method detection limit for that run or (b) a calculated value (Compound X_{RUNA}) representing mass emission rate of undetected individual compound "Compound X" during test run "Run A." The value for Compound X_{RUNA} is determined by multiplying known $\Sigma HC_{i\ RUNA}$ by the known ratio of Compound X_{RUNB} to $\Sigma HC_{i\ RUNB}$. Compound X_{RUNA} = ($\Sigma HC_{i\ RUNA}$) X (Compound X_{RUNB} / $\Sigma HC_{i\ RUNB}$) where $\Sigma HC_{i\ RUNA}$ is the summation of measurements of individual hydrocarbons (HC) during Run A except for Compound X and any other hydrocarbons not detected in Run A and/or Run B. Example calculations are provided below for illustration.

Step No. 1: Summarize test results

Emission Test Run ID	Run 165-1WD1N1	Run 165-1WD1N2	Run 165-1WD1N3
Facility No.	165	165	165
Species (Face/Core)	SYP/SYP	SYP/SYP	SYP/SYP
No. of Plies[1]	4 or 5	4 or 5	4 or 5
Resin Type	PF	PF	PF
NCASI TB768 Page No.	65-78 & B33	65-78 & B33	65-78 & B33

	Mass Emission Rate as Measured (lb/msf 3/8")		
Pollutant/Compound (as measured)	Run 165-1WD1N1	Run 165-1WD1N2	Run 165-1WD1N3
THC as carbon	0.057	0.057	0.062
Acetaldehyde as measurd	0.0013	**0.0012**	**0.0011**
Acetone (non-VOC)	0.0013	**0.0012**	**0.0011**
Formaldehyde	0.00071	**0.00029**	**0.00030**
Methanol	0.0087	0.0093	0.0080
Phenol	0.0022	0.0024	**0.0020**
Alpha-pinene	0.032	0.032	0.032

[1] Estimate based upon operating information from downstream hot press XPB1. Testing of 1WD1 and XPB1 occurred within the same general period of time. See NCASI TB768, Table 4.5.1.

Example calculation to estimate acetone emission rate for Run 165-1WD1N2 based upon Runs 165-1WD1N1 and N2 emission measurements:
$\text{Acetone}_{RUN165\text{-}1WD1N2}$ = ($\Sigma HC_{i\ RUN165\text{-}1WD1N2}$) X ($\text{Acetone}_{RUN165\text{-}1WD1N1}$ / $\Sigma HC_{i\ RUN165\text{-}1WD1N1}$)
$\text{Acetone}_{RUN165\text{-}1WD1N2}$ = (0.0093+0.0024+0.032) X (0.0013) / (0.0087+0.0022+0.032) = 0.0013 lb/msf 3/8"

Because the estimated value for $\text{acetone}_{RUN165\text{-}1WD1N2}$ of 0.0013 lb/msf 3/8" is greater than the test method detection limit of 0.0012 lb/msf 3/8" for that run, the detection limit value of 0.0012 lb/msf 3/8" is substituted instead of the calculated value.
Emission measurements from Run 165-1WD1N3 were not considered because acetone was a non-detect for this run.

Step No. 2: Convert measurements to a common propane basis

Compound$_{X}$ expressed as propane = (Compound$_{X}$) X [(MW$_{propane}$) / (MW$_{\text{Compound X}}$)] X [(#C$_{\text{Compound X}}$) / (#C$_{propane}$)]

where: Compound$_{X}$ represents mass emission rate of Compound$_{X}$

MW$_{propane}$ equals "44.0962" and represents the molecular weight for propane; the compound that is the "basis" for expressing mass of VOC

MW$_{\text{Compound X}}$ represents the molecular weight for Compound$_{X}$

#C$_{\text{compound X}}$ equals number of carbon atoms in Compound$_{X}$

#C$_{propane}$ equals "3" as three carbon atoms are present within propane; the compound that is the "basis" for expressing mass of VOC per

Mass Emission Rate as Propane (lb/msf 3/8")

Pollutant/Compound (as propane)	Run 165-1WD1N1	Run 165-1WD1N2	Run 165-1WD1N3
THC	0.0698	0.0698	0.0759
Acetaldehyde	0.0009	0.0008	0.0007
Acetone (non-VOC)	0.0010	0.0009	0.0008
Formaldehyde	0.0003	0.0001	0.0001
Methanol	0.0040	0.0043	0.0037
Phenol	0.0021	0.0022	0.0019
Alpha-pinene	0.0345	0.0345	0.0345

Example calculation to convert methanol as measured$_{\text{RUN165-1WD1N1}}$ to methanol as propane:

Methanol as propane$_{\text{RUN165-1WD1N1}}$ = (Methanol$_{\text{RUN165-1WD1N1}}$) X [(MW$_{propane}$) / (MW$_{methanol}$)] X [(#C$_{methanol}$) / (#C$_{propane}$)]

Methanol as propane$_{\text{RUN165-1WD1N1}}$ = (0.0087) X (44.0962/32.042) X (1/3) = 0.0040 lb/msf 3/8"

Step No. 3: Calculate the contribution of individual compounds to THC analyzer measurements as propane

Compound$_{X}$ expressed as propane by analyzer = (Compound$_{X}$ expressed as propane) X (RF$_{\text{Compound X}}$)

where: RF$_{\text{Compound X}}$ represents the flame ionization detector (FID) response factor (RF) for Compound$_{X}$

Because THC was measured using a THC analyzer, we already know THC analyzer measurement of THC.

Mass Emission Rate as Propane Measured by THC Analyzer (lb/msf 3/8")

Pollutant/Compound (as propane per THC analyzer)	Run 165-1WD1N1	Run 165-1WD1N2	Run 165-1WD1N3
Acetaldehyde	0.0004	0.0004	0.0004
Acetone (non-VOC)	0.0007	0.0006	0.0006
Formaldehyde	0	0	0
Methanol	0.0020	0.0021	0.0018
Phenol	0.0019	0.0021	0.0017
Alpha-pinene	0.0345	0.0345	0.0345

Example calculation to determine amount of acetone measured by the THC analyzer as propane$_{\text{RUN165-1WD1N2}}$:

Acetone as propane$_{\text{RUN165-1WD1N2}}$ per THC analyzer = (Acetone as propane$_{\text{RUN165-1WD1N2}}$) X (RF$_{acetone}$)

Acetone as propane$_{\text{RUN165-1WD1N2}}$ per THC analyzer = (0.0009) X (0.6667) = 0.0006 lb/msf 3/8"

Step No. 4: Subtract the contribution of individual compounds measured by the THC analyzer as propane (Step No. 3) from the THC measurement as propane (Step No. 2)

Mass Emission Rate (lb/msf 3/8")

Pollutant/Compound (as propane per THC analyzer)	Run 165-1WD1N1	Run 165-1WD1N2	Run 165-1WD1N3
THC	0.0698	0.0698	0.0759
Acetaldehyde	-0.0004	-0.0004	-0.0004
Acetone (non-VOC)	-0.0007	-0.0006	-0.0006
Formaldehyde	0	0	0
Methanol	-0.0020	-0.0021	-0.0018
Phenol	-0.0019	-0.0021	-0.0017
Alpha-pinene	-0.0345	-0.0345	-0.0345
THC as propane w/o acetone and w/o double-counting VOC$_{i}$	0.0303	0.0300	0.0369

Step No. 5: Calculate WPP1 VOC by adding the contribution of individual VOCs (Step No. 1) to the adjusted THC value (Step No. 4)

	Mass Emission Rate (lb/msf 3/8")		
Pollutant/Compound	Run 165-1WD1N1	Run 165-1WD1N2	Run 165-1WD1N3
THC as propane w/o acetone and w/o double-counting VOC_i	0.0303	0.0300	0.0369
Acetaldehyde as measured	0.0013	**0.0012**	**0.0011**
Formaldehyde as measured	0.0007	**0.00029**	**0.00030**
Methanol as measured	0.0087	0.0093	0.0080
Phenol as measured	0.0022	0.0024	**0.0020**
Alpha-pinene as measured	0.0320	0.0320	0.0320
WPP1 VOC	0.0752	0.0752	0.0803

Step No. 6: Calculate WPP1 VOC emission factor equal to 90th percentile value of 3 runs

WPP1 VOC (3-run 90th percentile value)	0.0793	lb/msf 3/8"
Average value (for informational purposes only)	0.0769	lb/msf 3/8"

Reference Information

Element and Compound Information

Element / Compound	FID RF	MW (lb/lb-mol)	Formula	Carbon Atoms	Hydrogen Atoms	Oxygen Atoms
Acetaldehyde	0.5	44.0530	C_2H_4O	2	4	1
Acetone (non-VOC)	0.6667	58.0798	C_3H_6O	3	6	1
Acrolein	0.6667	56.0640	C_3H_4O	3	4	1
Benzene	1	78.1134	C_6H_6	6	6	0
3-carene	1	136.2364	$C_{10}H_{16}$	10	16	0
Formaldehyde	0	30.0262	CH_2O	1	2	1
Methanol	0.5	32.0420	CH_4O	1	4	1
Methyl Ethyl Ketone	0.75	72.1066	C_4H_8O	4	8	1
Methyl Isobutyl Ketone	0.8333	100.1602	$C_6H_{12}O$	6	12	1
Phenol	0.9167	94.1128	C_6H_6O	6	6	1
Alpha-pinene	1	136.2364	$C_{10}H_{16}$	10	16	0
Beta-pinene	1	136.2364	$C_{10}H_{16}$	10	16	0
Propionaldehyde	0.6667	58.0798	C_3H_6O	3	6	1
Toluene	1	92.1402	C_7H_8	7	8	0
m,p-Xylene	1	106.1670	C_8H_{10}	8	10	0
o-xylene	1	106.1670	C_8H_{10}	8	10	0
Propane	1	44.0962	C_3H_8	3	8	0
Carbon	-	12.0110	C	1	-	-
Hydrogen	-	1.0079	H	-	1	-
Oxygen	-	15.9994	O	-	-	1

FID RF = ECN / No. carbon atoms in compound. See Attachment No. 2 to NCASI's September 2011 Technical Bulletin No. 991 (TB768) - Volatile Organic Compound Emissions from Wood Products Manufacturing Facilities Part I - Plywood. In the absence of information related to the FID NCASI employed to conduct RM25A testing, empirical effective carbon number (ECN) values will be employed to estimate FID RF.

ECN = (no. aliphatic carbon) + (no. aromatic carbon) - (no. ether oxygen) - (0.5 x no. primary alcohol oxygen)
Calculations to estimate ECN for several compounds:

Element / Compound	Formula	No. Aliphatic Carbon	No. Aromatic Carbon	No. Carbonyl Carbon	No. Carboxyl Carbor	No. Ether Oxygen	No. Primary Alcohol Oxygen	Empirical ECN
Acetaldehyde	CH_3CHO	1		1				1
Acetone (non-VOC)	$(CH_3)_2CO$	2		1				2
Acrolein	CH_2CHCHO	2		1				2
Benzene	C_6H_6		6					6
3-carene	$C_{10}H_{16}$	10						10
Formaldehyde	CH_2O							0
Methanol	CH_3OH	1					1	0.5
Methyl Ethyl Ketone	$CH_3C(O)CH_2CH_3$	3		1				3
Methyl Isobutyl Ketone	$(CH_3)_2CHCH_2C(O)CH_3$	5		1				5
Phenol	C_6H_5OH		6				1	5.5
Alpha-pinene	$C_{10}H_{16}$	10						10
Beta-pinene	$C_{10}H_{16}$	10						10
Propane	C_3H_8	3						3
Propionaldehyde	CH_3CH_2CHO	2		1				2
Toluene	$C_6H_5CH_3$	1	6					7
m,p-Xylene	$C_6H_4CH_3CH_3$	2	6					8
o-xylene	$C_6H_4CH_3CH_3$	2	6					8

<u>Abbreviations/Acronyms</u>

DE: dryer exit
DF: douglas fir
ECN: effective carbon number
FID: flame ionization detector (aka THC analyzer)
GC/FID: gas chromatograph with a flame ionization detector
GC/MS: gas chromatograph with a mass spectrometer
HC: hydrocarbon
HZ: heating zone
J: jet
L: longitudinal
MSF: one thousand square feet
MW: molecular weight
NCASI: National Council for Air and Stream Improvement
NMP: no measurement performed
PF: phenol formaldehyde
PP: ponderosa pine
RM25A: EPA Reference Method 25A
RF: THC analyzer response factor
RM25A: EPA Reference Method 25A
THC: total hydrocarbon
WF: white fir
WPP1 VOC: EPA Interim VOC Measurement Protocol for the Wood Products Industry - July 2007

EPA Region 10 WPP1 VOC Emission Factor for Pacific Northwest Softwood Plywood Trim Chipping and Plywood Sanding without Air Pollution Controls

This sheet presents full-scale test data for chipping southern yellow pine plywood trim and associated downstream plywood sanding, without air pollution controls, as reported in National Council for Air and Stream Improvement (NCASI) January 1999 Technical Bulletin No. 768 (TB768) - Volatile Organic Compound Emissions from Wood Products Manufacturing Facilities Part I - Plywood. Based upon NCASI's test data and EPA's Interim VOC Measurement Protocol for the Wood Products Industry - July 2007 (WPP1 VOC), EPA Region 10 has calculated a southern yellow pine plywood trim chipping and plywood sanding VOC emission factor of 0.0664 lb/msf (3/8 inch). NCASI conducted no testing of this emissions generating activity for Pacific Northwest softwoods. While southern yellow pine steam-heated veneer dryer heating zone THC (as carbon) emissions are five times greater than those generated by Pacific Northwest softwoods, southern yellowpine board cooling THC (as carbon) emissions are about one-half those generated by Pacific Northwest softwoods. (See NCASI TB768 tables 6.1.1, 6.1.2 and 6.1.4.) The southern yellow pine plywood is bonded with phenol formaldehyde resin, and that type of resin is typically employed at Pacific Northwest softwood mills as evidenced by information presented in NCASI TB 768. It is uncertain whether Pacific Northwest softwood plywood trim chipping and plywood sanding VOC emissions are greater or less than those generated by southern yellow pine, and EPA Region 10 is unable at this time to offer a methodology for calculating Pacific Northwest softwood emissions based upon adjustments to the results for southern yellow pine. Under these circumstances, EPA Region 10 estimates that the Pacific Northwest softwoods VOC emission factor for this activity is about the same as that for southern yellow pine, 0.0664 lb/msf 3/8".

The "msf" in the denominator of the emission factor refers to the plywood finished board production rate. The factor is representative of emissions generated by pneumatic conveyance of plywood trim chipping exhaust (not primary residue stream) and plywood sanderdust. The factor is not representative of emissions exhausted to atmosphere (perhaps via cyclone or baghouse) as the chipper's resultant primary residue stream is pneumatically conveyed to downstream storage.

To calculate WPP1 VOC emissions, EPA Region 10 employed NCASI test results quantifying both total and speciated VOC. NCASI employed EPA Reference Method 25A (RM25A) to measure VOC emissions not quantified through speciated sampling and analysis. Because RM25A quantifies total hydrocarbon (THC) emissions (and because THC and VOC are not quite the same), some adjustments to the RM25A results were necessary to determine VOC emissions. NCASI reported RM25A results “as carbon” which only accounts for the carbon portion of the compounds measured. EPA Region 10 adjusted the RM25A results to express THC “as propane” to better approximate the VOC compounds generated by veneer drying. RM25A results were further adjusted to deduct that portion attributable to acetone as acetone is not a VOC. The contribution of certain VOC compounds (already quantified through speciated sampling and analysis) to RM25A results have been deducted to avoid double-counting. These adjustments to RM25A results are consistent with EPA’s Interim VOC Measurement Protocol for the Wood Products Industry - July 2007 (WPP1 VOC). Finally, for each test run, the modified RM25A emission rate is added to speciated HAP emission rates to calculate WPP1 VOC. The resultant VOC emission factor is based on the 90th percentile value when three or more test runs are available, and on the maximum value when less than three runs are available. For a listing of the sampling and analysis techniques NCASI employed to measure each of the 29 targetted hydrocarbons (HAP and non-HAP), see Tables 2.1 and 2.2 of TB768.

In certain instances, one or two of the runs resulted in an actual measurement of a hydrocarbon while the other run(s) resulted in a non-detect. For those runs resulting in a non-detect, a substitute value has been generated to reflect what we think the actual measurement may have been had detection been possible. The substitute values are noted in **bold** and reflect the lesser of (a) the pollutant-specific method detection limit for that run or (b) a calculated value (Compound X_{RUNA}) representing mass emission rate of undetected individual compound "Compound X" during test run "Run A." The value for Compound X_{RUNA} is determined by multiplying known $\Sigma HC_{i\ RUNA}$ by the known ratio of Compound X_{RUNB} to $\Sigma HC_{i\ RUNB}$. Compound X_{RUNA} = ($\Sigma HC_{i\ RUNA}$) X (Compound X_{RUNB} / $\Sigma HC_{i\ RUNB}$) where $\Sigma HC_{i\ RUNA}$ is the summation of measurements of individual hydrocarbons (HC) during Run A except for Compound X and any other hydrocarbons not detected in Run A and/or Run B. Example calculations are provided below for illustration.

Step No. 1: Summarize test results

Emission Test Run ID	Run 165-1WR1N1	Run 165-1WR1N2	Run 165-1WR1N3
Facility No.	165	165	165
Species (Face/Core)	SYP/SYP	SYP/SYP	SYP/SYP
No. of Plies	?	?	?
Resin Type	PF	PF	PF
NCASI TB768 Page No.	65-78 & B34	65-78 & B34	65-78 & B34

Mass Emission Rate as Measured (lb/msf 3/8")

Pollutant/Compound (as measured)	Run 165-1WR1N1	Run 165-1WR1N2	Run 165-1WR1N3
THC as carbon	NMP	0.056	NMP
Methanol	0.0073	**0.0015**	0.015
Alpha-Pinene	0.041	0.042	0.025

Example calculation to estimate methanol emission rate for Run 165-1WR1N2 based upon Runs 165-1WR1N1, N2 and N3 emission measurements:
$\text{Methanol}_{RUN165\text{-}1WR1N2}$ = 1/2 [($\Sigma HC_{i\ RUN165\text{-}1WR1N2}$ X $\text{Methanol}_{RUN165\text{-}1WR1N1}$ / $\Sigma HC_{RUN165\text{-}1WR1N1}$) + ($\Sigma HC_{i\ RUN165\text{-}1WR1N2}$ X $\text{Methanol}_{RUN165\text{-}1WR1N3}$ / $\Sigma HC_{i\ RUN165\text{-}1WR1N3}$)
$\text{Methanol}_{RUN165\text{-}1WR1N2}$ = 1/2 [(0.042 X 0.0073 / 0.041) + (0.042 X 0.015 / 0.025)] = 0.0163 lb/msf 3/8"

Because the estimated value for $\text{methanol}_{RUN165\text{-}1WR1N2}$ of 0.0163 lb/msf is greater than the test method detection limit of 0.0015 lb/msf for that run, the detection limit value of 0.0015 lb/msf is substituted instead of the calculated value.

Step No. 2: Convert measurements to a common propane basis

Compound_X expressed as propane = $(\text{Compound}_X) \times [(\text{MW}_{\text{propane}}) / (\text{MW}_{\text{Compound X}})] \times [(\#\text{C}_{\text{Compound X}}) / (\#\text{C}_{\text{propane}})]$

where: Compound_X represents mass emission rate of Compound_X

$\text{MW}_{\text{propane}}$ equals "44.0962" and represents the molecular weight for propane; the compound that is the "basis" for expressing mass of VOC per

$\text{MW}_{\text{Compound X}}$ represents the molecular weight for Compound_X

$\#\text{C}_{\text{compound X}}$ equals number of carbon atoms in Compound_X

$\#\text{C}_{\text{propane}}$ equals "3" as three carbon atoms are present within propane; the compound that is the "basis" for expressing mass of VOC per

Pollutant/Compound (as propane)	Mass Emission Rate as Propane (lb/msf 3/8") Run 165-1WR1N2
THC	0.0685
Methanol	0.0007
Alpha-Pinene	0.0453

Example calculation to convert methanol as $\text{measured}_{\text{RUN165-1WR1N2}}$ to methanol as propane:

Methanol as $\text{propane}_{\text{RUN165-1WR1N2}}$ = $(\text{Methanol}_{\text{RUN165-1WR1N2}}) \times [(\text{MW}_{\text{propane}}) / (\text{MW}_{\text{methanol}})] \times [(\#\text{C}_{\text{methanol}}) / (\#\text{C}_{\text{propane}})]$

Methanol as $\text{propane}_{\text{RUN165-1WR1N2}}$ = (0.0015) X (44.0962/32.042) X (1/3) = 0.0007 lb/msf 3/8"

Step No. 3: Calculate the contribution of individual compounds to THC analyzer measurements as propane

Compound_X expressed as propane by analyzer = (Compound_X expressed as propane) X $(\text{RF}_{\text{Compound X}})$

where: $\text{RF}_{\text{Compound X}}$ represents the flame ionization detector (FID) response factor (RF) for Compound_X

Because THC was measured using a THC analyzer, we already know THC analyzer measurement of THC.

Pollutant/Compound (as propane per THC analyzer)	Mass Emission Rate as Propane Measured by THC Analyzer (lb/msf 3/8") Run 165-1WR1N2
Methanol	0.0003
Alpha-Pinene	0.0453

Example calculation to determine amount of methanol measured by the THC analyzer as $\text{propane}_{\text{RUN165-1WR1N2}}$:

Methanol as $\text{propane}_{\text{RUN165-1WR1N2}}$ per THC analyzer = (Methanol as $\text{propane}_{\text{RUN165-1WR1N2}}$) X $(\text{RF}_{\text{methanol}})$

Methanol as $\text{propane}_{\text{RUN165-1WR1N2}}$ per THC analyzer = (0.0007) X (0.50) = 0.0003 lb/msf 3/8"

Step No. 4: Subtract the contribution of individual compounds measured by the THC analyzer as propane (Step No. 3) from the THC measurement as propane (Step No. 2)

Pollutant/Compound	Mass Emission Rate (lb/msf 3/8") Run 165-1WR1N2
THC as propane per THC analyzer	0.0685
Methanol	-0.0003
Alpha-Pinene	-0.0453
THC as propane w/o acetone and w/o double-counting VOC_i	0.0229

Step No. 5: Calculate WPP1 VOC by adding the contribution of individual VOCs (Step No. 1) to the adjusted THC value (Step No. 4)

Pollutant/Compound	Mass Emission Rate (lb/msf 3/8") Run 165-1WR1N2
THC as propane w/o acetone and w/o double-counting VOC_i	0.0229
Methanol as measured	**0.0015**
Alpha-Pinene as measured	0.042
WPP1 VOC	0.0664 lb/msf 3/8"

Reference Information

Element and Compound Information

Element / Compound	FID RF	MW (lb/lb-mol)	Formula	Carbon Atoms	Hydrogen Atoms	Oxygen Atoms
Acetaldehyde	0.5	44.0530	C_2H_4O	2	4	1
Acetone (non-VOC)	0.6667	58.0798	C_3H_6O	3	6	1
Acrolein	0.6667	56.0640	C_3H_4O	3	4	1
Benzene	1	78.1134	C_6H_6	6	6	0
3-carene	1	136.2364	$C_{10}H_{16}$	10	16	0
Formaldehyde	0	30.0262	CH_2O	1	2	1
Methanol	0.5	32.0420	CH_4O	1	4	1
Methyl Ethyl Ketone	0.75	72.1066	C_4H_8O	4	8	1
Methyl Isobutyl Ketone	0.8333	100.1602	$C_6H_{12}O$	6	12	1
Phenol	0.9167	94.1128	C_6H_6O	6	6	1
Alpha-pinene	1	136.2364	$C_{10}H_{16}$	10	16	0
Beta-pinene	1	136.2364	$C_{10}H_{16}$	10	16	0
Propionaldehyde	0.6667	58.0798	C_3H_6O	3	6	1
Toluene	1	92.1402	C_7H_8	7	8	0
m,p-Xylene	1	106.1670	C_8H_{10}	8	10	0
o-xylene	1	106.1670	C_8H_{10}	8	10	0
Propane	1	44.0962	C_3H_8	3	8	0
Carbon	-	12.0110	C	1	-	-
Hydrogen	-	1.0079	H	-	1	-
Oxygen	-	15.9994	O	-	-	1

FID RF = ECN / No. carbon atoms in compound. See Attachment No. 2 to NCASI's September 2011 Technical Bulletin No. 991 (TB768) - Volatile Organic Compound Emissions from Wood Products Manufacturing Facilities Part I - Plywood. In the absence of information related to the FID NCASI employed to conduct RM25A testing, empirical effective carbon number (ECN) values will be employed to estimate FID RF.

ECN = (no. aliphatic carbon) + (no. aromatic carbon) - (no. ether oxygen) - (0.5 x no. primary alcohol oxygen)

Calculations to estimate ECN for several compounds:

Element / Compound	Formula	No. Aliphatic Carbon	No. Aromatic Carbon	No. Carbonyl Carbo	No. Carboxyl Carbo	No. Ether Oxygen	No. Primary Alcohol Oxygen	Empirical ECN
Acetaldehyde	CH_3CHO	1		1				1
Acetone (non-VOC)	$(CH_3)_2CO$	2		1				2
Acrolein	CH_2CHCHO	2		1				2
Benzene	C_6H_6		6					6
3-carene	$C_{10}H_{16}$	10						10
Formaldehyde	CH_2O							0
Methanol	CH_3OH	1					1	0.5
Methyl Ethyl Ketone	$CH_3C(O)CH_2CH_3$	3		1				3
Methyl Isobutyl Ketone	$(CH_3)_2CHCH_2C(O)CH_3$	5		1				5
Phenol	C_6H_5OH		6				1	5.5
Alpha-pinene	$C_{10}H_{16}$	10						10
Beta-pinene	$C_{10}H_{16}$	10						10
Propane	C_3H_8	3						3
Propionaldehyde	CH_3CH_2CHO	2		1				2
Toluene	$C_6H_5CH_3$	1	6					7
m,p-Xylene	$C_6H_4CH_3CH_3$	2	6					8
o-xylene	$C_6H_4CH_3CH_3$	2	6					8

Abbreviations/Acronyms
DE: dryer exit
DF: douglas fir
ECN: effective carbon number
FID: flame ionization detector (aka THC analyzer)
GC/FID: gas chromatograph with a flame ionization detector
GC/MS: gas chromatograph with a mass spectrometer
HC: hydrocarbon
HZ: heating zone
J: jet
L: longitudinal
MSF: one thousand square feet
MW: molecular weight
NCASI: National Council for Air and Stream Improvement
NMP: no measurement performed
PF: phenol formaldehyde
PP: ponderosa pine
RM25A: EPA Reference Method 25A
RF: THC analyzer response factor
RM25A: EPA Reference Method 25A
SYP: southern yellow pine
THC: total hydrocarbon
WF: white fir
WPP1 VOC: EPA Interim VOC Measurement Protocol for the Wood Products Industry - July 2007

EPA Region 10 WPP1 VOC Emission Factor for Pacific Northwest Softwood Plywood Trim and Groover Chip Residue Recovery without Air Pollution Controls

This sheet presents full-scale test data for recovering southern yellow pine plywood trim and groover chips, without air pollution controls, as reported in National Council for Air and Stream Improvement (NCASI) January 1999 Technical Bulletin No. 768 (TB768) - Volatile Organic Compound Emissions from Wood Products Manufacturing Facilities Part I - Plywood. Based upon NCASI's test data and EPA's Interim VOC Measurement Protocol for the Wood Products Industry - July 2007 (WPP1 VOC), EPA Region 10 has calculated a southern yellow pine plywood trim and groover chip residue recovery VOC emission factor of 0.0883 lb/msf (3/8 inch). NCASI conducted no testing of this emissions generating activity for Pacific Northwest softwoods. While southern yellow pine steam-heated veneer dryer heating zone THC (as carbon) emissions are five times greater than those generated by Pacific Northwest softwoods, southern yellowpine board cooling THC (as carbon) emissions are about one-half those generated by Pacific Northwest softwoods. (See NCASI TB768 tables 6.1.1, 6.1.2 and 6.1.4.) The southern yellow pine plywood is bonded with phenol formaldehyde resin, and that type of resin is typically employed at Pacific Northwest softwood mills as evidenced by information presented in NCASI TB 768. It is uncertain whether Pacific Northwest softwood plywood trim and groover chip residue recovery VOC emissions are greater or less than those generated by southern yellow pine, and EPA Region 10 is unable at this time to offer a methodology for calculating Pacific Northwest softwood emissions based upon adjustments to the results for southern yellow pine. Under these circumstances, EPA Region 10 estimates that the Pacific Northwest softwoods VOC emissions factor for this activity is about the same as that for southern yellow pine, 0.0883 lb/msf 3/8".

The "msf" in the denominator of the emission factor refers to the plywood finished board production rate. The factor is representative of emissions exhausted to atmosphere as the residue streams are pneumatically conveyed to downstream storage.

To calculate WPP1 VOC emissions, EPA Region 10 employed NCASI test results quantifying both total and speciated VOC. NCASI employed EPA Reference Method 25A (RM25A) to measure VOC emissions not quantified through speciated sampling and analysis. Because RM25A quantifies total hydrocarbon (THC) emissions (and because THC and VOC are not quite the same), some adjustments to the RM25A results were necessary to determine VOC emissions. NCASI reported RM25A results “as carbon” which only accounts for the carbon portion of the compounds measured. EPA Region 10 adjusted the RM25A results to express THC “as propane” to better approximate the VOC compounds generated by veneer drying. RM25A results were further adjusted to deduct that portion attributable to acetone as acetone is not a VOC. The contribution of certain VOC compounds (already quantified through speciated sampling and analysis) to RM25A results have been deducted to avoid double-counting. These adjustments to RM25A results are consistent with EPA’s Interim VOC Measurement Protocol for the Wood Products Industry - July 2007 (WPP1 VOC). Finally, for each test run, the modified RM25A emission rate is added to speciated HAP emission rates to calculate WPP1 VOC. The resultant VOC emission factor is based on the 90th percentile value when three or more test runs are available, and on the maximum value when less than three runs are available. For a listing of the sampling and analysis techniques NCASI employed to measure each of the 29 targetted hydrocarbons (HAP and non-HAP), see Tables 2.1 and 2.2 of TB768.

In certain instances, one or two of the runs resulted in an actual measurement of a hydrocarbon while the other run(s) resulted in a non-detect. For those runs resulting in a non-detect, a substitute value has been generated to reflect what we think the actual measurement may have been had detection been possible. The substitute values are noted in **bold** and reflect the lesser of (a) the pollutant-specific method detection limit for that run or (b) a calculated value (Compound X_{RUNA}) representing mass emission rate of undetected individual compound "Compound X" during test run "Run A." The value for Compound X_{RUNA} is determined by multiplying known $\Sigma HC_{i\ RUNA}$ by the known ratio of Compound X_{RUNB} to $\Sigma HC_{i\ RUNB}$. Compound $X_{RUNA} = (\Sigma HC_{i\ RUNA})$ X (Compound X_{RUNB} / $\Sigma HC_{i\ RUNB}$) where $\Sigma HC_{i\ RUNA}$ is the summation of measurements of individual hydrocarbons (HC) during Run A except for Compound X and any other hydrocarbons not detected in Run A and/or Run B. Example calculations are provided below for illustration.

Step No. 1: Summarize test results

Emission Test Run ID	Run 170-XMW1N1	Run 170-XMW1N2	Run 170-XMW1N3
Facility No.	170	170	170
Species (Face/Core)	SYP/SYP	SYP/SYP	SYP/SYP
No. of Plies	?	?	?
Resin Type	PF	PF	PF
NCASI TB768 Page No.	79-92 & B43	79-92 & B43	79-92 & B43

Mass Emission Rate as Measured (lb/msf 3/8")

Pollutant/Compound (as measured)	Run 170-XMW1N1	Run 170-XMW1N2	Run 170-XMW1N3
THC as carbon	N/A	N/A	0.072
Acetaldehyde	**0.0013**	0.0013	**0.0012**
Acetone (non-VOC)	0.0020	0.0019	0.0018
Formaldehyde	0.00035	0.00046	**0.00038**
Methanol	0.016	0.017	0.0034
Alpha-Pinene	0.024	0.024	0.035

Example calculation to estimate acetaldehyde emission rate for Run 170-XMW1N3 based upon Runs 170-XMW1N1 and N3 emission measurements:
$\text{Acetaldehyde}_{RUN170\text{-}XMW1N3} = (\Sigma HC_{i\ RUN170\text{-}XMW1N3})$ X $(\text{Acetaldehyde}_{RUN170\text{-}XMW1N1} / \Sigma HC_{i\ RUN170\text{-}XMW1N1})$
$\text{Acetaldehyde}_{RUN170\text{-}XMW1N3}$ = (0.0018+0.0034+0.035) X [(0.0013) / (0.0019+0.017+0.024)] = 0.0012 lb/msf 3/8"
Formaldehyde was not considered in calculation of ΣHC_i because the compound was a non-detect in at least one of the two runs.

Step No. 2: Convert measurements to a common propane basis

Compound$_X$ expressed as propane = (Compound$_X$) X [(MW$_{\text{propane}}$) / (MW$_{\text{Compound X}}$)] X [($\#$C$_{\text{Compound X}}$) / ($\#$C$_{\text{propane}}$)]

where: Compound$_X$ represents mass emission rate of Compound$_X$

MW$_{\text{propane}}$ equals "44.0962" and represents the molecular weight for propane; the compound that is the "basis" for expressing mass of

MW$_{\text{Compound X}}$ represents the molecular weight for Compound$_X$

$\#$C$_{\text{compound X}}$ equals number of carbon atoms in Compound$_X$

$\#$C$_{\text{propane}}$ equals "3" as three carbon atoms are present within propane; the compound that is the "basis" for expressing mass of VOC per

	Mass Emission Rate as Propane (lb/msf 3/8")
Pollutant/Compound (as propane)	Run 170-XMW1N3
THC	0.0881
Acetaldehyde	0.0008
Acetone (non-VOC)	0.0014
Formaldehyde	0.0002
Methanol	0.0016
Alpha-Pinene	0.0378

Example calculation to convert methanol as measured$_{\text{RUN170-XMW1N3}}$ to methanol as propane:

Methanol as propane$_{\text{RUN170-XMW1N3}}$ = (Methanol$_{\text{RUN170-XMW1N3}}$) X [(MW$_{\text{propane}}$) / (MW$_{\text{methanol}}$)] X [($\#$C$_{\text{methanol}}$) / ($\#$C$_{\text{propane}}$)]

Methanol as propane$_{\text{RUN170-XMW1N3}}$ = (0.0034) X (44.0962/32.042) X (1/3) = 0.0016 lb/msf 3/8"

Step No. 3: Calculate the contribution of individual compounds to THC analyzer measurements as propane

Compound$_X$ expressed as propane by analyzer = (Compound$_X$ expressed as propane) X (RF$_{\text{Compound X}}$)

where: RF$_{\text{Compound X}}$ represents the flame ionization detector (FID) response factor (RF) for Compound$_X$

Because THC was measured using a THC analyzer, we already know THC analyzer measurement of THC.

	Mass Emission Rate as Propane Measured by THC Analyzer (lb/msf 3/8")
Pollutant/Compound (as propane per THC analyzer)	Run 170-XMW1N3
Acetaldehyde	0.0004
Acetone (non-VOC)	0.0009
Formaldehyde	0
Methanol	0.0008
Alpha-Pinene	0.0378

Example calculation to determine amount of methanol measured by the THC analyzer as propane$_{\text{RUN170-XMW1N3}}$:

Methanol as propane$_{\text{RUN170-XMW1N3}}$ per THC analyzer = (Methanol as propane$_{\text{RUN170-XMW1N3}}$) X (RF$_{\text{methanol}}$)

Methanol as propane$_{\text{RUN170-XMW1N3}}$ per THC analyzer = (0.0016) X (0.5) = 0.0008 lb/msf 3/8"

Step No. 4: Subtract the contribution of individual compounds measured by the THC analyzer as propane (Step No. 3) from the THC measurement as propane (Step No. 2)

	Mass Emission Rate (lb/msf 3/8")
Pollutant/Compound (as propane per THC analyzer)	Run 165-1WR1N2
THC	0.0881
Acetaldehyde	-0.0004
Acetone (non-VOC)	-0.0009
Formaldehyde	0
Methanol	-0.0008
Alpha-Pinene	-0.0378
THC as propane w/o acetone and w/o double-counting VOC$_i$	0.0483

Step No. 5: Calculate WPP1 VOC by adding the contribution of individual VOCs (Step No. 1) to the adjusted THC value (Step No. 4)

	Mass Emission Rate (lb/msf 3/8")
Pollutant/Compound	Run 165-1WR1N2
THC as propane w/o acetone and w/o double-counting VOC_i	0.0483
Acetaldehyde as measured	**0.0012**
Formaldehyde as measured	**0.00038**
Methanol as measured	0.0034
Alpha-Pinene as measured	0.035
WPP1 VOC	0.0883 lb/msf 3/8"

Reference Information

Element and Compound Information

Element / Compound	FID RF	MW (lb/lb-mol)	Formula	Carbon Atoms	Hydrogen Atoms	Oxygen Atoms
Acetaldehyde	0.5	44.0530	C_2H_4O	2	4	1
Acetone (non-VOC)	0.6667	58.0798	C_3H_6O	3	6	1
Acrolein	0.6667	56.0640	C_3H_4O	3	4	1
Benzene	1	78.1134	C_6H_6	6	6	0
3-carene	1	136.2364	$C_{10}H_{16}$	10	16	0
Formaldehyde	0	30.0262	CH_2O	1	2	1
Methanol	0.5	32.0420	CH_4O	1	4	1
Methyl Ethyl Ketone	0.75	72.1066	C_4H_8O	4	8	1
Methyl Isobutyl Ketone	0.8333	100.1602	$C_6H_{12}O$	6	12	1
Phenol	0.9167	94.1128	C_6H_6O	6	6	1
Alpha-pinene	1	136.2364	$C_{10}H_{16}$	10	16	0
Beta-pinene	1	136.2364	$C_{10}H_{16}$	10	16	0
Propionaldehyde	0.6667	58.0798	C_3H_6O	3	6	1
Toluene	1	92.1402	C_7H_8	7	8	0
m,p-Xylene	1	106.1670	C_8H_{10}	8	10	0
o-xylene	1	106.1670	C_8H_{10}	8	10	0
Propane	1	44.0962	C_3H_8	3	8	0
Carbon	-	12.0110	C	1	-	-
Hydrogen	-	1.0079	H	-	1	-
Oxygen	-	15.9994	O	-	-	1

FID RF = ECN / No. carbon atoms in compound. See Attachment No. 2 to NCASI's September 2011 Technical Bulletin No. 991 (TB768) - Volatile Organic Compound Emissions from Wood Products Manufacturing Facilities Part I - Plywood. In the absence of information related to the FID NCASI employed to conduct RM25A testing, empirical effective carbon number (ECN) values will be employed to estimate FID RF.

ECN = (no. aliphatic carbon) + (no. aromatic carbon) - (no. ether oxygen) - (0.5 x no. primary alcohol oxygen)
Calculations to estimate ECN for several compounds:

Element / Compound	Formula	No. Aliphatic Carbon	No. Aromatic Carbon	No. Carbonyl Carbon	No. Carboxyl Carbo	No. Ether Oxygen	No. Primary Alcohol Oxygen	Empirical ECN
Acetaldehyde	CH_3CHO	1		1				1
Acetone (non-VOC)	$(CH_3)_2CO$	2		1				2
Acrolein	CH_2CHCHO	2		1				2
Benzene	C_6H_6		6					6
3-carene	$C_{10}H_{16}$	10						10
Formaldehyde	CH_2O							0
Methanol	CH_3OH	1					1	0.5
Methyl Ethyl Ketone	$CH_3C(O)CH_2CH_3$	3		1				3
Methyl Isobutyl Ketone	$(CH_3)_2CHCH_2C(O)CH_3$	5		1				5
Phenol	C_6H_5OH		6				1	5.5
Alpha-pinene	$C_{10}H_{16}$	10						10
Beta-pinene	$C_{10}H_{16}$	10						10
Propane	C_3H_8	3						3
Propionaldehyde	CH_3CH_2CHO	2		1				2
Toluene	$C_6H_5CH_3$	1	6					7
m,p-Xylene	$C_6H_4CH_3CH_3$	2	6					8
o-xylene	$C_6H_4CH_3CH_3$	2	6					8

<u>Abbreviations/Acronyms</u>
DE: dryer exit
DF: douglas fir
ECN: effective carbon number
FID: flame ionization detector (aka THC analyzer)
GC/FID: gas chromatograph with a flame ionization detector
GC/MS: gas chromatograph with a mass spectrometer
HZ: heating zone
J: jet
L: longitudinal
MSF: one thousand square feet
MW: molecular weight
NCASI: National Council for Air and Stream Improvement
PF: phenol formaldehyde
PP: ponderosa pine
RM25A: EPA Reference Method 25A
RF: THC analyzer response factor
RM25A: EPA Reference Method 25A
THC: total hydrocarbon
WF: white fir
WPP1 VOC: EPA Interim VOC Measurement Protocol for the Wood Products Industry - July 2007

EPA Region 10 WPP1 VOC Emission Factor for Pacific Northwest Softwood Plywood Sanderdust Residue Recovery without Air Pollution Controls

This sheet presents full-scale test data for recovering southern yellow pine plywood sanderdust, without air pollution controls, as reported in National Council for Air and Stream Improvement (NCASI) January 1999 Technical Bulletin No. 768 (TB768) - Volatile Organic Compound Emissions from Wood Products Manufacturing Facilities Part I - Plywood. Based upon NCASI's test data and EPA's Interim VOC Measurement Protocol for the Wood Products Industry - July 2007 (WPP1 VOC), EPA Region 10 has calculated a southern yellow pine plywood sanderdust recovery VOC emission factor of 0.2614 lb/msf (3/8 inch). NCASI conducted no testing of this emissions generating activity for Pacific Northwest softwoods. While southern yellow pine steam-heated veneer dryer heating zone THC (as carbon) emissions are five times greater than those generated by Pacific Northwest softwoods, southern yellowpine board cooling THC (as carbon) emissions are about one-half those generated by Pacific Northwest softwoods. (See NCASI TB768 tables 6.1.1, 6.1.2 and 6.1.4.) The southern yellow pine plywood is bonded with phenol formaldehyde resin, and that type of resin is typically employed at Pacific Northwest softwood mills as evidenced by information presented in NCASI TB 768. It is uncertain whether Pacific Northwest softwood plywood sanderdust recovery VOC emissions are greater or less than those generated by southern yellow pine, and EPA Region 10 is unable at this time to offer a methodology for calculating Pacific Northwest softwood emissions based upon adjustments to the results for southern yellow pine. Under these circumstances, EPA Region 10 estimates that the Pacific Northwest softwoods VOC emissions factor for this activity is about the same as that for southern yellow pine, 0.2614 lb/msf 3/8".

The "msf" in the denominator of the emission factor refers to the plywood finished board production rate. The factor is representative of emissions exhausted to atmosphere as the sanderdust residue streams are pneumatically conveyed to downstream storage.

To calculate WPP1 VOC emissions, EPA Region 10 employed NCASI test results quantifying both total and speciated VOC. NCASI employed EPA Reference Method 25A (RM25A) to measure VOC emissions not quantified through speciated sampling and analysis. Because RM25A quantifies total hydrocarbon (THC) emissions (and because THC and VOC are not quite the same), some adjustments to the RM25A results were necessary to determine VOC emissions. NCASI reported RM25A results “as carbon” which only accounts for the carbon portion of the compounds measured. EPA Region 10 adjusted the RM25A results to express THC “as propane” to better approximate the VOC compounds generated by veneer drying. RM25A results were further adjusted to deduct that portion attributable to acetone as acetone is not a VOC. The contribution of certain VOC compounds (already quantified through speciated sampling and analysis) to RM25A results have been deducted to avoid double-counting. These adjustments to RM25A results are consistent with EPA’s Interim VOC Measurement Protocol for the Wood Products Industry - July 2007 (WPP1 VOC). Finally, for each test run, the modified RM25A emission rate is added to speciated HAP emission rates to calculate WPP1 VOC. The resultant VOC emission factor is based on the 90th percentile value when three or more test runs are available, and on the maximum value when less than three runs are available. For a listing of the sampling and analysis techniques NCASI employed to measure each of the 29 targetted hydrocarbons (HAP and non-HAP), see Tables 2.1 and 2.2 of TB768.

In certain instances, one or two of the runs resulted in an actual measurement of a hydrocarbon while the other run(s) resulted in a non-detect. For those runs resulting in a non-detect, a substitute value has been generated to reflect what we think the actual measurement may have been had detection been possible. The substitute values are noted in **bold** and reflect the lesser of (a) the pollutant-specific method detection limit for that run or (b) a calculated value (Compound X_{RUNA}) representing mass emission rate of undetected individual compound "Compound X" during test run "Run A." The value for Compound X_{RUNA} is determined by multiplying known $\Sigma HC_{i\ RUNA}$ by the known ratio of Compound X_{RUNB} to $\Sigma HC_{i\ RUNB}$. Compound X_{RUNA} = ($\Sigma HC_{i\ RUNA}$) X (Compound X_{RUNB} / $\Sigma HC_{i\ RUNB}$) where $\Sigma HC_{i\ RUNA}$ is the summation of measurements of individual hydrocarbons (HC) during Run A except for Compound X and any other hydrocarbons not detected in Run A and/or Run B. Example calculations are provided below for illustration.

Step No. 1: Summarize test results

Emission Test Run ID	Run 170-1SD1N1	Run 170-1SD1N2	Run 170-1SD1N3
Facility No.	170	170	170
Species (Face/Core)	SYP/SYP	SYP/SYP	SYP/SYP
No. of Plies	?	?	?
Type of Resin	PF	PF	PF
NCASI TB768 Page No.	79-92 & B42	79-92 & B42	79-92 & B42

Mass Emission Rate as Measured (lb/msf 3/8")

Pollutant/Compound (as measured)	Run 170-1SD1N1	Run 170-1SD1N2	Run 170-1SD1N3
THC as carbon	0.14	0.22	0.081
Acetaldehyde	0.0038	**0.0037**	0.0026
Acetone (non-VOC)	0.0064	0.0046	0.0031
Formaldehyde	0.0018	0.0028	0.00072
Methanol	0.014	0.016	0.0082
Alpha-Pinene	0.035	**0.0369**	**0.0197**

Example calculation to estimate alpha-pinene emission rate for Run 170-1SD1N3 based upon Runs170-1SD1N1 and N3 emission measurements:
Alpha-pinene$_{RUN170\text{-}1SD1N3}$ = ($\Sigma HC_{i\ RUN170\text{-}1SD1N3}$) X (Alpha-pinene$_{RUN170\text{-}1SD1N1}$ / $\Sigma HC_{i\ RUN170\text{-}1SD1N1}$)
Alpha-pinene$_{RUN170\text{-}1SD1N3}$ = (0.0026+0.0031+0.00072+0.0082) X [(0.035) / (0.0038+0.0064+0.0018+0.014)] = 0.0197 lb/msf 3/8"

Step No. 2: Convert measurements to a common propane basis

Compound$_X$ expressed as propane = (Compound$_X$) X [(MW$_{propane}$) / (MW$_{Compound\ X}$)] X [(#C$_{Compound\ X}$) / (#C$_{propane}$)]

where: Compound$_X$ represents mass emission rate of Compound$_X$

MW$_{propane}$ equals "44.0962" and represents the molecular weight for propane; the compound that is the "basis" for expressing mass of

MW$_{Compound\ X}$ represents the molecular weight for Compound$_X$

#C$_{compound\ X}$ equals number of carbon atoms in Compound$_X$

#C$_{propane}$ equals "3" as three carbon atoms are present within propane; the compound that is the "basis" for expressing mass of VOC per

Mass Emission Rate as Propane (lb/msf 3/8")

Pollutant/Compound (as propane)	Run 170-1SD1N1	Run 170-1SD1N2	Run 170-1SD1N3
THC	0.1713	0.2692	0.0991
Acetaldehyde	0.0025	0.0025	0.0017
Acetone (non-VOC)	0.0049	0.0035	0.0024
Formaldehyde	0.0009	0.0014	0.0004
Methanol	0.0064	0.0073	0.0038
Alpha-Pinene	0.0378	0.0398	0.0212

Example calculation to convert methanol as measured$_{RUN170\text{-}1SD1N2}$ to methanol as propane:

Methanol as propane$_{RUN170\text{-}1SD1N2}$ = (Methanol$_{RUN170\text{-}1SD1N2}$) X [(MW$_{propane}$) / (MW$_{methanol}$)] X [(#C$_{methanol}$) / (#C$_{propane}$)]

Methanol as propane$_{RUN170\text{-}1SD1N2}$ = (0.016) X (44.0962/32.042) X (1/3) = 0.0073 lb/msf 3/8"

Step No. 3: Calculate the contribution of individual compounds to THC analyzer measurements as propane

Compound$_X$ expressed as propane by analyzer = (Compound$_X$ expressed as propane) X (RF$_{Compound\ X}$)

where: RF$_{Compound\ X}$ represents the flame ionization detector (FID) response factor (RF) for Compound$_X$

Because THC was measured using a THC analyzer, we already know THC analyzer measurement of THC.

Mass Emission Rate as Propane Measured by THC Analyzer (lb/msf 3/8")

Pollutant/Compound (as propane per THC analyzer)	Run 170-1SD1N1	Run 170-1SD1N2	Run 170-1SD1N3
Acetaldehyde	0.0013	0.0012	0.0009
Acetone (non-VOC)	0.0032	0.0023	0.0016
Formaldehyde	0	0	0
Methanol	0.0032	0.0037	0.0019
Alpha-Pinene	0.0378	0.0398	0.0212

Example calculation to determine amount of methanol measured by the THC analyzer as propane$_{RUN170\text{-}1SD1N2}$:

Methanol as propane$_{RUN170\text{-}1SD1N2}$ per THC analyzer = (Methanol as propane$_{RUN170\text{-}1SD1N2}$) X (RF$_{methanol}$)

Methanol as propane$_{RUN170\text{-}1SD1N2}$ per THC analyzer = (0.0073) X (0.5) = 0.0037 lb/msf 3/8"

Step No. 4: Subtract the contribution of individual compounds measured by the THC analyzer as propane (Step No. 3) from the THC measurement as propane (Step No. 2)

Mass Emission Rate (lb/msf 3/8")

Pollutant/Compound	Run 170-1SD1N1	Run 170-1SD1N2	Run 170-1SD1N3
THC as propane per THC analyzer	0.1713	0.2692	0.0991
Acetaldehyde	-0.0013	-0.0012	-0.0009
Acetone (non-VOC)	-0.0032	-0.0023	-0.0016
Formaldehyde	0	0	0
Methanol	-0.0032	-0.0037	-0.0019
Alpha-Pinene	-0.0378	-0.0398	-0.0212
THC as propane w/o acetone and w/o double-counting VOC$_i$	0.1258	0.2222	0.0736

Step No. 5: Calculate WPP1 VOC by adding the contribution of individual VOCs (Step No. 1) to the adjusted THC value (Step No. 4)

	Mass Emission Rate (lb/msf 3/8")		
Pollutant/Compound	Run 170-1SD1N1	Run 170-1SD1N2	Run 170-1SD1N3
THC as propane w/o acetone and w/o double-counting VOC$_i$	0.1258	0.2222	0.0736
Acetaldehyde as measured	0.0038	**0.0037**	0.0026
Formaldehyde as measured	0.0018	0.0028	0.0007
Methanol as measured	0.0140	0.0160	0.0082
Alpha-Pinene as measured	0.035	**0.0369**	**0.0197**
WPP1 VOC	0.1804	0.2816	0.1048

Step No. 6: Calculate WPP1 VOC emission factor equal to 90th percentile value of 3 runs

WPP1 VOC (3-run 90th percentile value):	0.2614	lb/msf 3/8"
3-run average value (informational purposes only)	0.1889	lb/msf 3/8"

Converting EF to units of lb per msf of surface area sanded based upon information presented on page 92 of TB768 (SA means surface area sanded):

Emission Test Run ID	Production Rate	
	SA (msf/hr)	Sheet (msf 3/8")
Run 170-1SD1N1	46.2	65.1
Run 170-1SD1N2	56.0	32.7
Run 170-1SD1N3	65.0	68.0

	Mass Emission Rate (lb/msf SA)		
Pollutant/Compound	Run 170-1SD1N1	Run 170-1SD1N2	Run 170-1SD1N3
WPP1 VOC	0.2543	0.1644	0.1096

WPP1 VOC (3-run 90th percentile value):	0.2363	lb/msf SA
3-run average value (informational purposes only)	0.1761	lb/msf SA

Reference Information

Element and Compound Information

Element / Compound	FID RF	MW (lb/lb-mol)	Formula	Carbon Atoms	Hydrogen Atoms	Oxygen Atoms
Acetaldehyde	0.5	44.0530	C_2H_4O	2	4	1
Acetone (non-VOC)	0.6667	58.0798	C_3H_6O	3	6	1
Acrolein	0.6667	56.0640	C_3H_4O	3	4	1
Benzene	1	78.1134	C_6H_6	6	6	0
3-carene	1	136.2364	$C_{10}H_{16}$	10	16	0
Formaldehyde	0	30.0262	CH_2O	1	2	1
Methanol	0.5	32.0420	CH_4O	1	4	1
Methyl Ethyl Ketone	0.75	72.1066	C_4H_8O	4	8	1
Methyl Isobutyl Ketone	0.8333	100.1602	$C_6H_{12}O$	6	12	1
Phenol	0.9167	94.1128	C_6H_6O	6	6	1
Alpha-pinene	1	136.2364	$C_{10}H_{16}$	10	16	0
Beta-pinene	1	136.2364	$C_{10}H_{16}$	10	16	0
Propionaldehyde	0.6667	58.0798	C_3H_6O	3	6	1
Toluene	1	92.1402	C_7H_8	7	8	0
m,p-Xylene	1	106.1670	C_8H_{10}	8	10	0
o-xylene	1	106.1670	C_8H_{10}	8	10	0
Propane	1	44.0962	C_3H_8	3	8	0
Carbon	-	12.0110	C	1	-	-
Hydrogen	-	1.0079	H	-	1	-
Oxygen	-	15.9994	O	-	-	1

Appendix A: Potential Emissions Inventory

FID RF = ECN / No. carbon atoms in compound. See Attachment No. 2 to NCASI's September 2011 Technical Bulletin No. 991 (TB768) - Volatile Organic Compound Emissions from Wood Products Manufacturing Facilities Part I - Plywood. In the absence of information related to the FID NCASI employed to conduct RM25A testing, empirical effective carbon number (ECN) values will be employed to estimate FID RF.

ECN = (no. aliphatic carbon) + (no. aromatic carbon) - (no. ether oxygen) - (0.5 x no. primary alcohol oxygen)
Calculations to estimate ECN for several compounds:

Element / Compound	Formula	No. Aliphatic Carbon	No. Aromatic Carbon	No. Carbonyl Carbon	o. Carboxyl Carbon	No. Ether Oxygen	No. Primary Alcohol Oxygen	Empirical ECN
Acetaldehyde	CH_3CHO	1		1				1
Acetone (non-VOC)	$(CH_3)_2CO$	2		1				2
Acrolein	CH_2CHCHO	2		1				2
Benzene	C_6H_6		6					6
3-carene	$C_{10}H_{16}$	10						10
Formaldehyde	CH_2O							0
Methanol	CH_3OH	1					1	0.5
Methyl Ethyl Ketone	$CH_3C(O)CH_2CH_3$	3		1				3
Methyl Isobutyl Ketone	$(CH_3)_2CHCH_2C(O)CH_3$	5		1				5
Phenol	C_6H_5OH		6				1	5.5
Alpha-pinene	$C_{10}H_{16}$	10						10
Beta-pinene	$C_{10}H_{16}$	10						10
Propane	C_3H_8	3						3
Propionaldehyde	CH_3CH_2CHO	2		1				2
Toluene	$C_6H_5CH_3$	1	6					7
m,p-Xylene	$C_6H_4CH_3CH_3$	2	6					8
o-xylene	$C_6H_4CH_3CH_3$	2	6					8

<u>Abbreviations/Acronyms</u>

DE: dryer exit
DF: douglas fir
ECN: effective carbon number
FID: flame ionization detector (aka THC analyzer)
GC/FID: gas chromatograph with a flame ionization detector
GC/MS: gas chromatograph with a mass spectrometer
HZ: heating zone
J: jet
L: longitudinal
MSF: one thousand square feet
MW: molecular weight
NCASI: National Council for Air and Stream Improvement
PF: phenol formaldehyde
PP: ponderosa pine
RM25A: EPA Reference Method 25A
RF: THC analyzer response factor
RM25A: EPA Reference Method 25A
THC: total hydrocarbon
WF: white fir
WPP1 VOC: EPA Interim VOC Measurement Protocol for the Wood Products Industry - July 2007

Appendix B

PotlatchDeltic NSR Regulated Pollutant Emissions Increase Calculations for Kiln No. 6 Project at St. Maries Complex

EPA Region 10 statement: The material presented in this appendix to the statement of basis was created by PotlatchDeltic and submitted to EPA Region 10 on May 8, 2019. The material reflects the applicant's interpretation and implementation of 40 CFR 52.21(a)(2)(iv)(f)'s "hybrid test" to determine the project's emissions increase. The material does not reflect calculations to determine the project's "net emissions increase" because the applicant did not provide that analysis.

Technical Support Document
PSD Permit No. R10PSD00100 &
Minor NSR Permit No. R10TNSR01800

St. Maries, Idaho

PotlatchDeltic - St. Maries - Kiln #6 Project

PSD Applicability Analysis

Regulated Pollutant Emission Summary

	Kiln 6		**CE Boiler**	**Riley Boiler**	**BV-2**	**BV-3**	**BH-2**	**BH-3**	**BH-4**	**BH-5**	**BH-10**	**BH-11**	**CY-2**	**DB**	**CS**	**MH**	**PILE**	**Roadways**	**Project Increase**	
	PTE		Emission Increase	Emission Increase	Emission Increase	Emission Increase	Emission Increase	Emission Increase	Emission Increase	Emission Increase	Emission Increase	Emission Increase	Emission Increase	Emission Increase	Emission Increase	Emission Increase	Emission Increase	Emission Increase	Total	SER
Pollutant	lb/hr	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy	tpy
NOx	--	--	4.1	11.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15	40
CO	--	--	8.9	40.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	50	100
SO2	--	--	0.5	1.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	40
PM	0.40	1.7	0.2	0.8	0.012	0.001	0.46	0.41	0.26	0.09	0.66	0.14	0.54	2.4	0.3	0.055	0.04	7.7	16	25
PM10	0.40	1.7	0.2	1.0	0.012	0.001	0.46	0.41	0.26	0.09	0.66	0.14	0.46	0.1	0.0	0.006	0.00	2.1	8	15
PM2.5	0.40	1.7	0.2	0.7	0.012	0.001	0.23	0.21	0.13	0.05	0.33	0.07	0.27	0.01	0.0	0.001	0.00	0.25	4.2	10
VOC	8.4	50.0	0.1	0.4	--	--	--	--	--	--	--	--	--	--	--	12.0	--	--	63	40
Pb	--	--	0.001	0.003	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.004	0.6
H2SO4	--	--	0.02	0.04	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.06	7
CO2e	--	--	4,278	12,681	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16,958	75,000

notes:

1 - Significant Emission Rates (SERs). 40 CFR 52.21(b)(23)(i).

For each source evaluated in this PSD applicability analysis, the following pages present additional information regarding baseline actual emission rates, projected actual emission rates, and the emission factors and production values used to generate those emission rates.

PSD Baseline Periods	
NOx	2011-2012
CO	2011-2012
SO2	2011-2012
PM	2012-2013
PM10	2012-2013
PM2.5	2012-2013
VOC	2011-2012
CO2e	2011-2012
Pb	2011-2012
H2SO4	2011-2012

Pollutant	**Emission Rate (tpy)**					
	Lumber Dry Kiln No. 6[1]	**CE & Riley Boilers [2]**	**Building Vents and Baghouses[2]**	**Fugitives[2, 3]**	**Total Increase**	**PSD SERs[4]**
NO_X	--	15.4	0.0	0.0	15	40
CO	--	49.5	0.0	0.0	50	100
SO_2	--	1.9	0.0	0.0	2	40
PM (filterable)	1.7	1.0	2.6	10.5	16	25
PM_{10} (total)	1.7	1.3	2.5	2.1	8	15
$PM_{2.5}$ (total)	1.7	0.9	1.3	0.265	4	10
VOC	50.0	0.5	0.0	12.0	63	40
Lead	--	0.0	0.0	0.0	0.004	0.6
H_2SO_4	--	0.1	0.0	0.0	0.058	7
CO_2e	--	16958.4	0.0	0.0	16958	75,000

Lumber Dry Kiln ('Dry Kiln #6 Project')

	CO	VOC	PM2.5	PM10	PM	SO2	NOx
Emission factor - other species (lb/mbf dried)	-	*see notes*	*see notes*	*see notes*	*see notes*	-	-

Year	**Production Value (mbf dried/year)**	**Emission Rates (TPY)**						
Baseline Actual Emissions		**-**	**0.00**	**0.00**	**0.00**	**0.00**	**-**	**-**
(Years)		-	-	-	-	-	-	-
Projected Actual Emissions	see notes	**-**	**50.0**	**1.7**	**1.7**	**1.7**	**-**	**-**
Change in Emissions (Tons/Year)		***-***	***50.0***	***1.7***	***1.7***	***1.7***	***-***	***-***

Baseline Actual Emissions Notes:

The proposed lumber dry kiln would be a 'new unit' for the purposes of PSD applicability evaluations. Therefore, its baseline actual emission rate is set at 0 tons per year for all pollutants.

Projected Actual Emissions Notes:

The proposed lumber dry kiln would be a 'new unit' for the purposes of PSD applicability evaluations. Therefore, the kiln's projected actual emission rates would be its potential to emit (PTE) for each pollutant. The kiln's annual production capacity changes based on wood species. PotlatchDeltic proposed a 50 tpy VOC limit on the new kiln. Potential particulate matter emissions are also effectively limited through the VOC limit. Potlatch is capable of drying a variety of lumber species, the emission calculations presented here use the maximum throughput of each species and the emission factors associated with each species.

Emission Factor Notes: 245 Dry Kiln Temp (F)

Specie	*Maximum for Each Species (MMbf/yr)*	*PM/PM10/PM2.5 Factors (lb/Mbf)*	*VOC Factors (lb propane/Mbf)*	*PM10 / PM2.5 Emissions (tpy)*	*VOC Emissions (tpy)*
HemFir	*68*	*0.051*	*1.08*	1.74	36.8
				Proposed Limit	***50***

PM/PM10/PM2.5 Emission Factor Detail:

Hemlock/White Fir PM emission factor conservatively based on highest source test value (Dec. 1998 Horizon Engineering Study for Willamette Industries using OSU's kiln).

VOC Emission Factor Detail:

HemFir emissions based on EPA Region 10 Emission Factors December 2012 (>200 F).

CE Boiler ('Dry Kiln #6 Project')

	CO	VOC	PM2.5	PM10	PM	SO2	NOx	Pb	H2SO4	CO2e
Emission factor (lb/MMlb Steam)	*635*	*8.1*	*15*	*21*	*14*	*33.6*	*290*	0.064	1.6	305,229

Year	**Production Value (MMlb Steam/year)**	**Emission Rates (TPY)**									
		CO	**VOC**	**PM2.5**	**PM10**	**PM**	**SO2**	**NOx**	**Pb**	**H2SO4**	**CO2e**
2006	132.7	42.2	0.5	1.0	1.4	0.9	2.2	19.2	0.0043	0.1	20,252
2007	78.9	25.1	0.3	0.6	0.8	0.6	1.3	11.4	0.0025	0.1	12,047
2008	75.1	23.9	0.3	0.6	0.8	0.5	1.3	10.9	0.0024	0.1	11,468
2009	55.6	17.7	0.2	0.4	0.6	0.4	0.9	8.1	0.0018	0.0	8,481
2010	54.8	17.4	0.2	0.4	0.6	0.4	0.9	7.9	0.0018	0.0	8,359
2011	53.1	16.9	0.2	0.4	0.5	0.4	0.9	7.7	0.0017	0.0	8,096
2012	88.2	28.0	0.4	0.7	0.9	0.6	1.5	12.8	0.0028	0.1	13,457
2013	64.9	20.6	0.3	0.5	0.7	0.5	1.1	9.4	0.0021	0.1	9,897
2014	66.6	21.2	0.3	0.5	0.7	0.5	1.1	9.7	0.0021	0.1	10,169
2015	86.9	27.6	0.4	0.6	0.9	0.6	1.5	12.6	0.0028	0.1	13,263
2016	123.2	39.1	0.5	0.9	1.3	0.9	2.1	17.9	0.0040	0.1	18,795
Baseline Actual Emissions		**22.43**	**0.29**	**0.57**	**0.79**	**0.55**	**1.18**	**10.24**	**0.0023**	**0.06**	**10,777**
(Years)		2011-2012	2011-2012	2012-2013	2012-2013	2012-2013	2011-2012	2011-2012	2011-2012	2011-2012	2011-2012
Projected Actual Emissions	98.6	**31.34**	**0.40**	**0.73**	**1.02**	**0.71**	**1.65**	**14.30**	**0.0032**	**0.08**	**15,054**
Change in Emissions (Tons/Year)		***8.90***	***0.11***	***0.16***	***0.23***	***0.16***	***0.47***	***4.06***	***0.0009***	***0.02***	***4,278***
Potential Emissions	307	-	-	**2.28**	-	-	-	-	-	-	-
Change in Emissions (Tons/Year)		-	-	***1.50***	-	-	-	-	-	-	-

Projected Actual Emissions Notes:

Assumed CE Boiler would provide 25 percent of the annual steam necessary for the Dry Kiln no. 6 Project. Steam demand based on potential dry kiln no. 6 throughput and steam demand data for the exsting dry kiln no. 5. Ramboll Environ added the CE Boiler's expected steam demand increase to the boiler's average 2011 - 2012 steam production. Ramboll Environ assumed the CE boiler source test data were representative of past and future boiler operations. See below for additional detail.

- Potential emissions based on continuous maximum boiler operating rate (35 Mlb/hr).

Steam Production Increase Attributable to Project

112.1	MMlb steam/year necessary for project, dry kiln
28.0	MMlb steam/year for project, 25% from CE Boiler

Emission Factor Notes:

All emission factors except SO2, Lead, and H2SO4 based on emission factors from April 2008 CE Boiler source test. SO2 and Lead emission factors from AP-42 Section 1.6, September 2003. Factors in Section 1.6 are provided in lb/MMBtu heat input. Factors converted to lb/MMlb Steam using 1592.16 MMBtu/MMlb Steam as the conversion factor. Detailed conversion factor calculations provided below.

Pollutant	*Original AP-42 Factor*	*Source*
CO:	*635 lb/MMlb Steam*	*February 2016 Boiler MACT Performance Test*
VOC (as propane):	*8.1 lb/MMlb Steam*	*Boiler-specific source test, April 2008.*
PM10:	*21 lb/MMlb Steam*	*Maximum Boiler-specific source test (high load conditions) from April 2008, Feb 2016, and March 2017.*
PM2.5	*14.9 lb/MMlb Steam*	*NCASI TB 1013 indicates 41% of filterable PM from wood-fired boiler with ESP is PM2.5 (PotlatchDeltic, conservatively assumed 60%) from average of April 2008, Feb 2016, and March 2017 testing plus codensable PM.*
PM:	*14 lb/MMlb Steam*	*Maximum Boiler-specific source test (high load conditions) from April 2008, Feb 2016, and March 2017.*
SO2:	*0.025 lb/MMBtu*	*AP-42 Table 1.6-2, Bark/bark and wet wood/wet wood-fired boiler. All potlatchdeltic fuel tests from 2016 indicate sulfur is below detection limits (0.01% by mass, and 0.01 lb SO2/MMBtu).*
NOx:	*290 lb/MMlb Steam*	*Boiler-specific source test, April 2008.*
Lead:	*4.8E-05 lb/MMBtu*	*Table 1.6-4, Bark/bark and wet wood/wet wood-fired boiler.*
H2SO4:	*1.6 lb/MMlb Steam*	*8 percent of PM2.5 emissions, based on BART-recommended PM2.5 / sulfate speciation for hog fuel boilers.*
CO2e:	*305,229 lb/MMlb Steam*	*CO2 based on 2016 Hog Fuel testing during Boiler MACT Peformance Test; CH4, N2O, and Global Warming Potentials (GWPs) from EPA's Mandatory Reporting Rule.*

lb/MMBtu to lb/MMlb Steam Conversion Factor

February 2016 Boiler MACT Performance Testing

34,311	(lb Steam/hr) Average Steam Production
13,512	(dscf/min) Average Exhaust Flow Rate
17,605	(dscf/MMBtu) Average F-Factor from wood fuel testing
1,342	***MMBtu/MMlb steam***

Riley Boiler ('Dry Kiln #6 Project')

	CO	VOC	PM2.5	PM10	PM	SO2	NOx	Pb	H2SO4	CO2e
(lb/MMlb Steam from Hog Fuel)	*966*	*9.3*	*7.2*	*10.5*	*8.2*	*33.4*	*270*	*0.064*	*0.8*	*301,607*

Year	**Production Value (MMlb Steam/year)**	**Emission Rates (TPY)**									
		CO	**VOC**	**PM2.5**	**PM10**	**PM**	**SO2**	**NOx**	**Pb**	**H2SO4**	**CO2e**
2006	465.8	225.1	2.2	1.7	2.4	1.9	7.8	62.9	0.015	0.2	70,244
2007	531.6	256.9	2.5	1.9	2.8	2.2	8.9	71.8	0.017	0.2	80,174
2008	466.7	225.5	2.2	1.7	2.5	1.9	7.8	63.0	0.015	0.2	70,383
2009	483.1	233.4	2.3	1.7	2.5	2.0	8.1	65.2	0.015	0.2	72,851
2010	559.6	270.4	2.6	2.0	2.9	2.3	9.3	75.6	0.018	0.2	84,396
2011	567.8	274.3	2.6	2.0	3.0	2.3	9.5	76.7	0.018	0.2	85,626
2012	596.6	288.3	2.8	2.2	3.1	2.4	10.0	80.5	0.019	0.3	89,975
2013	337.0	162.8	1.6	1.2	1.8	1.4	5.6	45.5	0.011	0.1	50,819
2014	344.0	166.2	1.6	1.2	1.8	1.4	5.7	46.4	0.011	0.1	51,876
2015	406.3	196.3	1.9	1.5	2.1	1.7	6.8	54.9	0.013	0.2	61,275
2016	514.3	248.5	2.4	1.9	2.7	2.1	8.6	69.4	0.016	0.2	77,558
Baseline Actual Emissions		**281.31**	**2.72**	**1.69**	**2.45**	**1.91**	**9.71**	**78.60**	**0.02**	**0.24**	**87,801**
(Years)		2011-2012	2011-2012	2012-2013	2012-2013	2012-2013	2011-2012	2011-2012	2011-2012	2011-2012	2011-2012
Projected Actual Emissions	666.3	**321.93**	**3.11**	**2.41**	**3.50**	**2.73**	**11.12**	**89.95**	**0.02**	**0.28**	**100,481**
Change in Emissions (Tons/Year)		***40.63***	***0.39***	***0.72***	***1.05***	***0.82***	***1.40***	***11.35***	***0.0027***	***0.04***	***12,681***
Potential Emissions	885	-	-	**3.19**	-	-	-	-	-	-	-
Change in Emissions (Tons/Year)		-	-	***1.53***	-	-	-	-	-	-	-

Projected Actual Emissions Notes:

Assumed Riley Boiler would provide 75 percent of the annual steam necessary for the Dry Kiln no. 6 Project. Steam demand based on potential dry kiln no. 6 throughput and steam demand data for the exsting dry kiln no. 5. Ramboll Environ added the Riley Boiler's expected steam demand increase to the boiler's average 2011 - 2012 steam production. Ramboll Environ assumed the Riley boiler source test data were representative of past and future boiler operations. See below for additional detail.

- Potential emissions based on continuous maximum boiler operating rate (101 Mlb/hr).

Steam Production Increase Attributable to Project

112.1	MMlb steam/year necessary for project, dry kiln
84.1	MMlb steam/year for project, 75% from Riley Boiler

Emission Factor Notes:

All emission factors except SO2, Lead, and H2SO4 based on emission factors derived from May 2008 Riley Boiler source test. SO2 and Lead emission factors are from AP-42 Section 1.6, September 2003. Factors in Section 1.6 are provided in lb/MMBtu heat input. Factors converted to lb/MMlb Steam using 1594.48 MMBtu/MMlb Steam as the conversion factor. Detailed conversion factor calculations provided below.

Pollutant	*Emission Factor*	*Source*
CO:	*966 lb/MMlb Steam*	*February 2016 Boiler MACT Performance Test*
VOC (as propane):	*9.3 lb/MMlb Steam*	*Boiler-specific source test, May 2008.*
PM10:	*10.5 lb/MMlb Steam*	*Maximum Boiler-specific source test (mid and high load conditions) from May 2008, Feb 2016, and March 2017.*
PM2.5	*7.22 lb/MMlb Steam*	*NCASI TB 1013 indicates 41% of filterable PM from wood-fired boiler with ESP is PM2.5 (PotlatchDeltic, conservatively assumed 60%) from average of May 2008, Feb 2016, and March 2017 testing plus condensable PM.*
PM:	*8.2 lb/MMlb Steam*	*Maximum Boiler-specific source test (mid and high load conditions) from May 2008, Feb 2016, and March 2017.*
SO2:	*0.025 lb/MMBtu*	*AP-42 Table 1.6-2, Bark/bark and wet wood/wet wood-fired boiler. All PotlatchDeltic fuel tests from 2016 indicate sulfur is below detection limits (0.01% by mass, and 0.01 lb SO2/MMBtu).*
NOx:	*270 lb/MMlb Steam*	*Boiler-specific source test, May 2008.*
Lead:	*4.8E-05 lb/MMBtu*	*AP42 Table 1.6-4, Bark/bark and wet wood/wet wood-fired boiler.*
H2SO4:	*0.8 lb/MMlb Steam*	*8 percent of PM2.5 emissions, based on BART-recommended PM2.5 / sulfate speciation for hog fuel boilers.*
CO2e:	*301,607 lb/MMlb Steam*	*CO2 based on 2016 Hog Fuel testing during Boiler MACT Peformance Test; CH4, N2O, and Global Warming Potentials (GWPs) from EPA's Mandatory Reporting Rule.*

lb/MMBtu to lb/MMlb Steam Conversion Factor

February 2016 Boiler MACT Performance Testing

90,101	(lb Steam/hr) Average Steam Production
31,648	(dscf/min) Average Exhaust Flow Rate
15,789	(dscf/MMBtu) Average F-Factor from wood fuel testing
1,335	***MMBtu/MMlb steam***

Building Vents, Sawmill Building ('Dry Kiln #6 Project')

	CO	VOC	PM2.5	PM10	PM	SO2	NOx
Emission factor (lb/hour of operation)	-	-	*0.05*	*0.05*	*0.05*	-	-

Year	**Production Value (hrs of operation/yr)**	**Emission Rates (TPY)**					
2006	4,094	-	-	0.1	0.1	0.1	-	-
2007	4,112	-	-	0.1	0.1	0.1	-	-
2008	3,891	-	-	0.1	0.1	0.1	-	-
2009	3,492	-	-	0.1	0.1	0.1	-	-
2010	4,036	-	-	0.1	0.1	0.1	-	-
2011	3,964	-	-	0.1	0.1	0.1	-	-
2012	4,162	-	-	0.1	0.1	0.1	-	-
2013	4,199	-	-	0.1	0.1	0.1	-	-
2014	4,145	-	-	0.1	0.1	0.1	-	-
2015	4,168	-	-	0.1	0.1	0.1	-	-
2016	4,109	-	-	0.1	0.1	0.1	-	-
Baseline Actual Emissions		**-**	**-**	**0.10**	**0.10**	**0.10**	**-**	**-**
(Years)		-	-	2012-2013	2012-2013	2012-2013	**-**	**-**
Projected Actual Emissions	4,679	**-**	**-**	**0.12**	**0.12**	**0.12**	**-**	**-**
Change in Emissions (Tons/Year)		**-**	**-**	***0.012***	***0.012***	***0.012***	**-**	**-**
Potential Emissions	8,760	**-**	**-**	**0.22**	-	-	-	-
Change in Emissions (Tons/Year)		-	-	***0.11***	-	-	-	-

Projected Actual Emissions Notes:

Existing sawmill cyclone, baghouses, and building vents are similarly not expected to increase annual hours of operation, compared to baseline actual operation. However, to be conservative for the PSD applicability analysis, PD has assumed that annual sawmill operations will increase by 480 hours per year, compared to baseline actual operation.

Emission Factor Notes:

The PM emission factor is based on OSHA testing of the particulate matter concentration in the building, the airspace in the building, and the number of air changes per hour. Detailed conversion calculations provided below.

Pollutant	*Emission Factor Basis*	*Source*
PM:	*1020 ug/m3*	*OSHA Testing (From Table C-1, Note H, in Attachment C to October 1999 Part 71 Application.)*
PM10/PM2.5:	*Assume equivalent to PM emission factor*	

ug/m3 to lb/hr Conversion

Flow Rate:		*Conversions:*	
387,520 cubic feet	*Building volume*	*1,000,000*	*ug/g*
2	*Air changes per hour*	*453.59*	*g/lb*
12,917 cfm	*Total flow rate from building*	*60*	*min/hr*
		0.0283	*m3/ft3*

Building Vents, Boiler Building (BV-3) ('Dry Kiln #6 Project')

	CO	VOC	PM2.5	PM10	PM	SO2	NOx
Emission factor (lb/hour of operation)	-	-	*0.01*	*0.01*	*0.01*	-	-

Year	**Production Value (hrs of operation/yr)**	**Emission Rates (TPY)**					
		CO	**VOC**	**PM2.5**	**PM10**	**PM**	**SO2**	**NOx**
2006	8,568	-	-	0.05	0.05	0.05	-	-
2007	8,616	-	-	0.05	0.05	0.05	-	-
2008	8,540	-	-	0.05	0.05	0.05	-	-
2009	8,544	-	-	0.05	0.05	0.05	-	-
2010	8,544	-	-	0.05	0.05	0.05	-	-
2011	8,544	-	-	0.05	0.05	0.05	-	-
2012	8,676	-	-	0.05	0.05	0.05	-	-
2013	8,560	-	-	0.05	0.05	0.05	-	-
2014	8,640	-	-	0.05	0.05	0.05	-	-
2015	8,640	-	-	0.05	0.05	0.05	-	-
2016	8,588	-	-	0.05	0.05	0.05	-	-
Baseline Actual Emissions		**-**	**-**	**0.05**	**0.05**	**0.05**	-	-
(Years)		-	-	2012-2013	2012-2013	2012-2013	-	-
Projected Actual Emissions	8,712	**-**	**-**	**0.05**	**0.05**	**0.05**	-	-
Change in Emissions (Tons/Year)		-	-	***0.001***	***0.001***	***0.001***	-	-
Potential Emissions	8,760	**-**	**-**	**0.05**	-	-	-	-
Change in Emissions (Tons/Year)		-	-	***0.001***	-	-	-	-

Projected Actual Emissions Notes:

The maximum number of hours recorded for this process (8,712 hrs, 2004).

Emission Factor Notes:

The PM emission factor is based on OSHA testing of the particulate matter concentration in the building, the airspace in the building, and the number of air changes per hour. Detailed conversion calculations provided below.

Pollutant	*Emission Factor Basis*	*Source*
PM:	*1057 ug/m3*	*OSHA Testing (From Table C-1, Note H, in Attachment C to October 1999 Part 71 Application.)*

ug/m3 to lb/hr Conversion

Flow Rate:		*Conversions:*	
90,750 cubic feet	*Building volume*	*1,000,000*	*ug/g*
2	*Air changes per hour*	*453.59*	*g/lb*
3,025 cfm	*Total flow rate from building*	*60*	*min/hr*
		0.0283	*m3/ft3*

BH-2: Planer Baghouse ('Dry Kiln #6 Project')

	CO	VOC	PM2.5	PM10	PM	SO2	NOx
Emission factor (lb/hour of operation)	-	-	*0.82*	*1.65*	*1.65*	-	-

Year	Production Value (hrs of operation/yr)	Emission Rates (TPY)						
2006	4,000	-	-	1.6	3.3	3.3	-	-
2007	3,888	-	-	1.6	3.2	3.2	-	-
2008	3,647	-	-	1.5	3.0	3.0	-	-
2009	3,553	-	-	1.5	2.9	2.9	-	-
2010	4,077	-	-	1.7	3.4	3.4	-	-
2011	4,101	-	-	1.7	3.4	3.4	-	-
2012	4,394	-	-	1.8	3.6	3.6	-	-
2013	4,552	-	-	1.9	3.7	3.7	-	-
2014	4,155	-	-	1.7	3.4	3.4	-	-
2015	4,258	-	-	1.8	3.5	3.5	-	-
2016	4,077	-	-	1.7	3.4	3.4	-	-
Baseline Actual Emissions		**-**	**-**	**1.84**	**3.68**	**3.68**	-	-
(Years)		-	-	2012-2013	2012-2013	2012-2013	-	-
Projected Actual Emissions	5,032	**-**	**-**	**2.07**	**4.14**	**4.14**	-	-
Change in Emissions (Tons/Year)		-	-	***0.23***	***0.46***	***0.46***	-	-
Potential Emissions	7,488	**-**	**-**	**3.08**	-	-	-	-
Change in Emissions (Tons/Year)		-	-	***1.4***	-	-	-	-

Projected Actual Emissions Notes:

Existing sawmill cyclone, baghouses, and building vents are similarly not expected to increase annual hours of operation, compared to baseline actual operation. However, to be conservative for the PSD applicability analysis, PD has assumed that annual sawmill operations will increase by 480 hours per year, compared to baseline actual operation.

Emission Factor Notes:

The Actual Emissions PM, PM10, and PM2.5 emission factors are based on a June 13, 1996 source tested grain loading and the existing baghouse fan's airflow rating.

Pollutant	*Emission Factor Basis*	*Source*
PM/PM10:	*0.0064 grains/dscf*	*6-13-96 source test (from Table C-1, Note B, in Attachment C of October 1999 Part 71 Permit Application.)*
PM2.5	*0.0032 grains/dscf*	*Conservatively assume 50% of filterable PM from past testing is PM2.5. NCASI Special Report 15-01 indicates that PM2.5 fraction to TSP is 0.46% for wood chips and bark, and EPA's PM Augmentation Tool assumes the PM2.5 fraction of TSP is 0.15% for planning and transferring sawdust/shavings with baghouse controls.*

gr/dscf to lb/hr Conversion

BH-2 Fan Rating	*Conversions:*	
1800 mcf per hour	*7,000 gr/lb*	*60 min/hr*
	1,000 cf/mcf	

BH-3: Trimmer/Chipper Baghouse ('Dry Kiln #6 Project')

	CO	VOC	PM2.5	PM10	PM	SO2	NOx
Emission factor (lb/hour of operation)	-	-	*0.74*	*1.48*	*1.48*	-	-

Year	**Production Value (hrs of operation/yr)**	**Emission Rates (TPY)**						
2006	4,000	-	-	1.5	3.0	3.0	-	-
2007	3,888	-	-	1.4	2.9	2.9	-	-
2008	3,647	-	-	1.4	2.7	2.7	-	-
2009	3,553	-	-	1.3	2.6	2.6	-	-
2010	4,077	-	-	1.5	3.0	3.0	-	-
2011	4,101	-	-	1.5	3.0	3.0	-	-
2012	4,394	-	-	1.6	3.3	3.3	-	-
2013	4,552	-	-	1.7	3.4	3.4	-	-
2014	4,155	-	-	1.5	3.1	3.1	-	-
2015	4,258	-	-	1.6	3.2	3.2	-	-
2016	4,126	-	-	1.5	3.1	3.1	-	-
Baseline Actual Emissions		**-**	**-**	**1.66**	**3.31**	**3.31**	-	-
(Years)		-	-	2012-2013	2012-2013	2012-2013	-	-
Projected Actual Emissions	5,032	**-**	**-**	**1.86**	**3.73**	**3.73**	-	-
Change in Emissions (Tons/Year)		-	-	***0.21***	***0.41***	***0.41***	-	-
Potential Emissions	7,488	**-**	**-**	**2.77**	-	-	-	-
Change in Emissions (Tons/Year)		-	-	***1.2***	-	-	-	-

Projected Actual Emissions Notes:

Existing sawmill cyclone, baghouses, and building vents are similarly not expected to increase annual hours of operation, compared to baseline actual operation. However, to be conservative for the PSD applicability analysis, PD has assumed that annual sawmill operations will increase by 480 hours per year, compared to baseline actual operation.

Emission Factor Notes:

The Actual Emissions PM, PM10, and PM2.5 emission factors are based on a June 13, 1996 source tested grain loading and the existing baghouse fan's airflow rating.

Pollutant	*Emission Factor Basis*	*Source*
PM/PM10:	*0.0064 grains/dscf*	*6-13-96 source test (from Table C-1, Note B, in Attachment C of October 1999 Part 71 Permit Application.)*
PM2.5	*0.0032 grains/dscf*	*Conservatively assume 50% of filterable PM from past testing is PM2.5. NCASI Special Report 15-01 indicates that PM2.5 fraction to TSP is 0.46% for wood chips and bark, and EPA's PM Augmentation Tool assumes the PM2.5 fraction of TSP is 0.15% for planning and transferring sawdust/shavings with baghouse controls.*

gr/dscf to lb/hr Conversion

BH-3 Fan Rating

1620 mcf per hour

Conversions:

7,000 gr/lb

1,000 cf/mcf

60 min/hr

BH-4: Plytrim Truck Bin Baghouse ('Dry Kiln #6 Project')

	CO	VOC	PM2.5	PM10	PM	SO2	NOx
Emission factor (lb/hour of operation)	-	-	*0.16*	*0.33*	*0.33*	-	-

Year	**Production Value (hrs of operation/yr)**	**Emission Rates (TPY)**					
2008	4,760	-	-	0.4	0.8	0.8	-	-
2009	3,656	-	-	0.3	0.6	0.6	-	-
2010	4,636	-	-	0.4	0.8	0.8	-	-
2011	4,774	-	-	0.4	0.8	0.8	-	-
2012	3,658	-	-	0.3	0.6	0.6	-	-
2013	3,698	-	-	0.3	0.6	0.6	-	-
2014	3,799	-	-	0.3	0.6	0.6	-	-
2015	4,168	-	-	0.3	0.7	0.7	-	-
2016	4,126	-	-	0.3	0.7	0.7	-	-
Baseline Actual Emissions		**-**	**-**	**0.30**	**0.61**	**0.61**	-	-
(Years)		-	-	2012-2013	2012-2013	2012-2013	-	-
Projected Actual Emissions	5,254	**-**	**-**	**0.43**	**0.86**	**0.86**	-	-
Change in Emissions (Tons/Year)		-	-	***0.13***	***0.26***	***0.26***	-	-
Potential Emissions	7,488	**-**	**-**	**0.62**	-	-	-	-
Change in Emissions (Tons/Year)		-	-	***0.3***	-	-	-	-

Projected Actual Emissions Notes:

Plytrim truck bin handles plywood mill dry waste and chipped trim ends from the planar mill. Hours of operation are primarily due to plywood mill operations; therefore projected actual hours of operation are not anticipated to increase, compared to baseline actual operation, as a result of the Kiln 6 project. However, to be conservative for the PSD applicability analysis, PD has assumed that annual sawmill operations will increase by 480 hours per year, compared to baseline actual operation.

Emission Factor Notes:

The Actual Emissions PM, PM10, and PM2.5 emission factors are based on a June 13, 1996 source tested grain loading and the existing baghouse fan's airflow rating.

Pollutant	*Emission Factor Basis*	*Source*
PM/PM10:	*0.0064 grains/dscf*	*6-13-96 source test (from Table C-1, Note B, in Attachment C of October 1999 Part 71 Permit Application.)*
PM2.5	*0.0032 grains/dscf*	*Conservatively assume 50% of filterable PM from past testing is PM2.5. NCASI Special Report 15-01 indicates that PM2.5 fraction to TSP is 0.46% for wood chips and bark, and EPA's PM Augmentation Tool assumes the PM2.5 fraction of TSP is 0.15% for planning and transferring sawdust/shavings with baghouse controls.*

gr/dscf to lb/hr Conversion

BH-4 Fan Rating

360 mcf per hour

Conversions:

7,000 gr/lb

1,000 cf/mcf

60 min/hr

BH-5: Planer Shaving Truck Bin Baghouse ('Dry Kiln #6 Project')

	CO	VOC	PM2.5	PM10	PM	SO2	NOx
Emission factor (lb/hour of operation)	-	-	*0.16*	*0.33*	*0.33*	-	-

Year	Production Value (hrs of operation/yr)	Emission Rates (TPY)						
2006	4,000	-	-	0.3	0.7	0.7	-	-
2007	3,888	-	-	0.3	0.6	0.6	-	-
2008	3,647	-	-	0.3	0.6	0.6	-	-
2009	3,553	-	-	0.3	0.6	0.6	-	-
2010	4,077	-	-	0.3	0.7	0.7	-	-
2011	4,101	-	-	0.3	0.7	0.7	-	-
2012	4,394	-	-	0.4	0.7	0.7	-	-
2013	4,552	-	-	0.4	0.7	0.7	-	-
2014	4,155	-	-	0.3	0.7	0.7	-	-
2015	4,258	-	-	0.4	0.7	0.7	-	-
2016	4,077	-	-	0.3	0.7	0.7	-	-
Baseline Actual Emissions		**-**	**-**	**0.37**	**0.74**	**0.74**	-	-
(Years)		-	-	2012-2013	2012-2013	2012-2013	-	-
Projected Actual Emissions	5,032	**-**	**-**	**0.41**	**0.83**	**0.83**	-	-
Change in Emissions (Tons/Year)		-	-	***0.05***	***0.09***	***0.09***	-	-
Potential Emissions	7,488	**-**	**-**	**0.62**		-	-	-
Change in Emissions (Tons/Year)		-	-	***0.3***	-	-	-	-

Projected Actual Emissions Notes:

Existing sawmill cyclone, baghouses, and building vents are similarly not expected to increase annual hours of operation, compared to baseline actual operation. However, to be conservative for the PSD applicability analysis, PD has assumed that annual sawmill operations will increase by 480 hours per year, compared to baseline actual operation.

Emission Factor Notes:

The Actual Emissions PM, PM10, and PM2.5 emission factors are based on a June 13, 1996 source tested grain loading and the existing baghouse fan's airflow rating.

Pollutant	*Emission Factor Basis*	*Source*
PM/PM10:	*0.0064 grains/dscf*	*6-13-96 source test (from Table C-1, Note B, in Attachment C of October 1999 Part 71 Permit Application.)*
PM2.5	*0.0032 grains/dscf*	*Conservatively assume 50% of filterable PM from past testing is PM2.5. NCASI Special Report 15-01 indicates that PM2.5 fraction to TSP is 0.46% for wood chips and bark, and EPA's PM Augmentation Tool assumes the PM2.5 fraction of TSP is 0.15% for planning and transferring sawdust/shavings with baghouse controls.*

gr/dscf to lb/hr Conversion

BH-5 Exhaust Flowrate	*Conversions:*	
360 mcf per hour	*7,000 gr/lb*	*60 min/hr*
	1,000 cf/mcf	

BH-10: Sawmill Baghouse ('Dry Kiln #6 Project')

	CO	VOC	PM2.5	PM10	PM	SO2	NOx
2006 - Current emission factor (lb/hour of operation)	-	-	*1.33*	*2.66*	*2.66*	-	-

Year	**Production Value (hrs of operation/yr)**	**Emission Rates (TPY)**						
2006	4,094	-	-	2.7	5.4	5.4	-	-
2007	4,112	-	-	2.7	5.5	5.5	-	-
2008	3,891	-	-	2.6	5.2	5.2	-	-
2009	3,492	-	-	2.3	4.6	4.6	-	-
2010	4,036	-	-	2.7	5.4	5.4	-	-
2011	3,964	-	-	2.6	5.3	5.3	-	-
2012	4,162	-	-	2.8	5.5	5.5	-	-
2013	4,199	-	-	2.8	5.6	5.6	-	-
2014	4,145	-	-	2.8	5.5	5.5	-	-
2015	4,168	-	-	2.8	5.5	5.5	-	-
2016	4,109	-	-	2.7	5.5	5.5	-	-
Baseline Actual Emissions		**-**	**-**	**2.78**	**5.55**	**5.55**	-	-
(Years)		-	-	2012-2013	2012-2013	2012-2013	-	-
Projected Actual Emissions	4,679	**-**	**-**	**3.11**	**6.21**	**6.21**	-	-
Change in Emissions (Tons/Year)		-	-	***0.33***	***0.66***	***0.66***	-	-
Potential Emissions	7,488	**-**	**-**	**4.97**	-	-	-	-
Change in Emissions (Tons/Year)		-	-	***2.2***	-	-	-	-

Projected Actual Emissions Notes:

Existing sawmill cyclone, baghouses, and building vents are similarly not expected to increase annual hours of operation, compared to baseline actual operation. However, to be conservative for the PSD applicability analysis, PD has assumed that annual sawmill operations will increase by 480 hours per year, compared to baseline actual operation.

Emission Factor Notes:

The Baseline and Projected Actual Emissions PM, PM10, and PM2.5 emission factors are based on a June 13, 1996 source tested grain loading and the baghouse fan's airflow rating.

Pollutant	*Emission Factor Basis*	*Source*
PM/PM10:	*0.0064 grains/dscf*	*6-13-96 source test (from Table C-1, Note B, in Attachment C of October 1999 Part 71 Permit Application.)*
PM2.5	*0.0032 grains/dscf*	*Conservatively assume 50% of filterable PM from past testing is PM2.5. NCASI Special Report 15-01 indicates that PM2.5 fraction to TSP is 0.46% for wood chips and bark, and EPA's PM Augmentation Tool assumes the PM2.5 fraction of TSP is 0.15% for planning and transferring sawdust/shavings with baghouse controls.*

gr/dscf to lb/hr Conversion

	Conversions:	
2006 and current BH-10 Fan Design Rating	*7,000 gr/lb*	*60 min/hr*
48,418 cfm	*1,000 cf/mcf*	

BH-11: Sawdust Bin Baghouse ('Dry Kiln #6 Project')

	CO	VOC	PM2.5	PM10	PM	SO2	NOx
Emission factor (lb/hour of operation)	-	-	*0.29*	*0.58*	*0.58*	-	-

Year	**Production Value (hrs of operation/yr)**	**Emission Rates (TPY)**						
2006	4,094	-	-	0.6	1.2	1.2	-	-
2007	4,112	-	-	0.6	1.2	1.2	-	-
2008	3,891	-	-	0.6	1.1	1.1	-	-
2009	3,492	-	-	0.5	1.0	1.0	-	-
2010	4,036	-	-	0.6	1.2	1.2	-	-
2011	3,964	-	-	0.6	1.2	1.2	-	-
2012	4,162	-	-	0.6	1.2	1.2	-	-
2013	4,199	-	-	0.6	1.2	1.2	-	-
2014	4,145	-	-	0.6	1.2	1.2	-	-
2015	4,168	-	-	0.6	1.2	1.2	-	-
2016	4,109	-	-	0.6	1.2	1.2	-	-
Baseline Actual Emissions		**-**	**-**	**0.61**	**1.22**	**1.22**	-	-
(Years)		-	-	2012-2013	2012-2013	2012-2013	-	-
Projected Actual Emissions	4,679	**-**	**-**	**0.68**	**1.36**	**1.36**	-	-
Change in Emissions (Tons/Year)		-	-	***0.07***	***0.14***	***0.14***	-	-
Potential Emissions	7,488	**-**	**-**	**1.09**	-	-	-	-
Change in Emissions (Tons/Year)		-	-	***0.5***	-	-	-	-

Projected Actual Emissions Notes:

Existing sawmill cyclone, baghouses, and building vents are similarly not expected to increase annual hours of operation, compared to baseline actual operation. However, to be conservative for the PSD applicability analysis, PD has assumed that annual sawmill operations will increase by 480 hours per year, compared to baseline actual operation.

Emission Factor Notes:

The Baseline and Projected Actual Emissions PM, PM10, and PM2.5 emission factors are based on a June 13, 1996 source tested grain loading and the baghouse fan's airflow rating.

Pollutant	*Emission Factor Basis*	*Source*
PM/PM10:	*0.0064 grains/dscf*	*6-13-96 source test (from Table C-1, Note B, in Attachment C of October 1999 Part 71 Permit Application.)*
PM2.5	*0.0032 grains/dscf*	*Conservatively assume 50% of filterable PM from past testing is PM2.5. NCASI Special Report 15-01 indicates that PM2.5 fraction to TSP is 0.46% for wood chips and bark, and EPA's PM Augmentation Tool assumes the PM2.5 fraction of TSP is 0.15% for planning and transferring sawdust/shavings with baghouse controls.*

gr/dscf to lb/hr Conversion

	Conversions:	
BH-11 Fan Design Rating	*7,000 gr/lb*	*60 min/hr*
10,600 cfm	*1,000 cf/mcf*	

CY-2: Chip Bin Cyclone ('Dry Kiln #6 Project')

	CO	VOC	PM2.5	PM10	PM	SO2	NOx
Emission factor (lb/hour of operation)	-	-	*1.09*	*1.86*	*2.19*	-	-

Year	**Production Value (hrs of operation/yr)**	**Emission Rates (TPY)**						
2006	4,094	-	-	2.2	3.8	4.5	-	-
2007	4,112	-	-	2.2	3.8	4.5	-	-
2008	3,891	-	-	2.1	3.6	4.3	-	-
2009	3,492	-	-	1.9	3.2	3.8	-	-
2010	4,036	-	-	2.2	3.7	4.4	-	-
2011	3,964	-	-	2.2	3.7	4.3	-	-
2012	4,162	-	-	2.3	3.9	4.5	-	-
2013	4,199	-	-	2.3	3.9	4.6	-	-
2014	4,145	-	-	2.3	3.9	4.5	-	-
2015	4,168	-	-	2.3	3.9	4.6	-	-
2016	4,109	-	-	2.2	3.8	4.5	-	-
Baseline Actual Emissions		**-**	**-**	**2.28**	**3.88**	**4.57**	-	-
(Years)		-	-	2012-2013	2012-2013	2012-2013	-	-
Projected Actual Emissions	4,679	**-**	**-**	**2.56**	**4.35**	**5.11**	-	-
Change in Emissions (Tons/Year)		-	-	***0.27***	***0.46***	***0.54***	-	-
Potential Emissions	7,488	**-**	**-**	**4.09**	-	-	-	-
Change in Emissions (Tons/Year)		-	-	***1.8***	-	-	-	-

Projected Actual Emissions Notes:

Existing sawmill cyclone, baghouses, and building vents are similarly not expected to increase annual hours of operation, compared to baseline actual operation. However, to be conservative for the PSD applicability analysis, PD has assumed that annual sawmill operations will increase by 480 hours per year, compared to baseline actual operation.

Emission Factor Notes:

The Baseline and Projected Actual Emissions PM, PM10, and PM2.5 emission factors are based on a June 13, 1996 source tested grain loading and the baghouse fan's airflow rating.

Pollutant	*Emission Factor Basis*	*Source*
PM	*0.030 grains/dscf*	*AP-42 4th Ed, Section 10.4.1 (2/80) (from Table C-1, Note I, in Attachment C of Part 71 application*
PM10	*0.026 grains/dscf*	*Based on EPA guidance, assume PM10 is 85% of PM and PM2.5 is 50% of PM.*
PM2.5	*0.015 grains/dscf*	

gr/dscf to lb/hr Conversion

Conversions:

CY-2 Fan Design Rating
8,500 cfm

7,000 gr/lb
1,000 cf/mcf
60 min/hr

DB: Fugitives from Debarking ('Dry Kiln #6 Project')

	CO	VOC	PM2.5	PM10	PM	SO2	NOx
Emission Factor (lb/mbf)	-	-	*0.000*	*0.002*	*0.066*	-	-

Year	**Production Value (mbf/yr)**	**Emission Rates (TPY)**						
2008	116,217	-	-	0.02	0.1	3.8	-	-
2009	125,363	-	-	0.02	0.1	4.1	-	-
2010	147,612	-	-	0.02	0.1	4.9	-	-
2011	163,678	-	-	0.02	0.1	5.4	-	-
2012	175,939	-	-	0.03	0.2	5.8	-	-
2013	176,622	-	-	0.03	0.2	5.8	-	-
2014	176,775	-	-	0.03	0.2	5.8	-	-
2015	178,366	-	-	0.03	0.2	5.9	-	-
2016	180,510	-	-	0.03	0.2	5.9	-	-
Baseline Actual Emissions		**-**	**-**	**0.03**	**0.16**	**5.80**	-	-
(Years)		-	-	2012-2013	2012-2013	2012-2013	-	-
Projected Actual Emissions	248,643	**-**	**-**	**0.04**	**0.22**	**8.18**	-	-
Change in Emissions (Tons/Year)		-	-	***0.01***	***0.06***	***2.38***	-	-
Potential Emissions	285,267	**-**	**-**	**0.04**	-	-	-	-
Change in Emissions (Tons/Year)		-	-	***0.02***	-	-	-	-

Projected Actual Emissions Notes:

Based on increasing sawmill throughput by capacity of Kiln 6 (average from drying varous wood species, 84,560 mbf/yr).

Emission Factor Notes:

Pollutant	*Emission Factor Basis*	*Source*
PM (Filt.)	*0.066 lb/mbf*	*PM emission factor based on May 2014 EPA Region 10 memo on PM emission factors for sawmills. Coverted 0.024 lb PM/ton log to lb PM/mbf based log density (lb/ft^3) and lumber recovery factor (bf / ft^3 log input).*
PM10 (Filt. & Cond.)	*0.002 lb/mbf*	*PM10 based on 2.7% of PM, NCASI Special Report 15-01, Table 5.18*
PM2.5 (Filt.& Cond.)	*0.0003 lb/mbf*	*PM2.5 based on 0.46% of PM, NCASI Special Report 15-01, Table 5.18*

EPA Region 10 Emission Factor for debarking

0.024 lb PM/ton log

Wood Specie	*Log Density(lb/ft^3)*	*Lumber Re*	*lb PM/mbf*
Grand Fir	*46*	*7.81*	*0.071*
Ponderosa Pine	*45*	*7.81*	*0.069*
Douglas Fir	*38*	*7.81*	*0.058*
Hemlock	*41*	*7.81*	*0.063*
Larch	*48*	*7.81*	*0.074*
ESLP	*39*	*7.81*	*0.060*
		average	*0.066*

Log Density from http://www.engineeringtoolbox.com/weigt-wood-d_821.html
Recevery Factors from Trends in Lumber Processing in the Western United States (Keegan et al. Forest Products Society 2010).

CS: Fugitives from Cut-Off Saws ('Dry Kiln #6 Project')

	CO	VOC	PM2.5	PM10	PM	SO2	NOx
Emission Factor (lb/mbf)	-	-	*0.000*	*0.000*	*0.010*	-	-

Year	**Production Value (mbf/yr)**	**Emission Rates (TPY)**					
2008	116,217	-	-	0.0	0.0	0.6	-	-
2009	125,363	-	-	0.0	0.0	0.6	-	-
2010	147,612	-	-	0.0	0.0	0.7	-	-
2011	163,678	-	-	0.0	0.0	0.8	-	-
2012	175,939	-	-	0.0	0.0	0.8	-	-
2013	176,622	-	-	0.0	0.0	0.8	-	-
2014	176,775	-	-	0.0	0.0	0.8	-	-
2015	178,366	-	-	0.0	0.0	0.9	-	-
2016	180,510	-	-	0.0	0.0	0.9	-	-
Baseline Actual Emissions		**-**	**-**	**0.00**	**0.02**	**0.85**	-	-
(Years)		-	-	2012-2013	2012-2013	2012-2013	-	-
Projected Actual Emissions	248,643	**-**	**-**	**0.01**	**0.03**	**1.19**	-	-
Change in Emissions (Tons/Year)		-	-	***0.0016***	***0.01***	***0.35***	-	-
Potential Emissions	285,267	**-**	**-**	**0.01**	-	-	-	-
Change in Emissions (Tons/Year)		-	-	***0.002***	-	-	-	-

Projected Actual Emissions Notes:

Based on increasing sawmill throughput by capacity of Kiln 6 (average from drying varous wood species, 84,560 mbf/yr).

Emission Factor Notes:

Pollutant	*Emission Factor Basis*	*Source*
PM (Filt.)	*0.010 lb/mbf*	*PM emission factor based on May 2014 EPA Region 10 memo on PM emission factors for sawmills. Coverted 1% of the 0.35 lb PM/ton log to lb PM/mbf based log density (lb/ft^3) and lumber recovery factor (bf / ft^3 log input).*
PM10 (Filt. & Cond.)	*0.00026 lb/mbf*	*PM10 based on 2.7% of PM, NCASI Special Report 15-01, Table 5.18*
PM2.5 (Filt.& Cond.)	*0.00004 lb/mbf*	*PM2.5 based on 0.46% of PM, NCASI Special Report 15-01, Table 5.18*

Based on 1% of EPA Region 10 Emission Factor for sawing, fugitive emissions from bucking/cut-off saw operation is negligable.

0.004 lb PM/ton log

Wood Specie	*Log Density(lb/ft^3)*	*Lumber Re*	*lb PM/mbf*
Grand Fir	*46*	*7.81*	*0.010*
Ponderosa Pine	*45*	*7.81*	*0.010*
Douglas Fir	*38*	*7.81*	*0.009*
Hemlock	*41*	*7.81*	*0.009*
Larch	*48*	*7.81*	*0.011*
ESLP	*39*	*7.81*	*0.009*
		average	*0.010*

Log Density from http://www.engineeringtoolbox.com/weigt-wood-d_821.html
Recevery Factors from Trends in Lumber Processing in the Western United States (Keegan et al. Forest Products Society 2010).

MH: Fugitives from Material Handling ('Dry Kiln #6 Project')

	CO	VOC	PM2.5	PM10	PM	SO2	NOx
Emission Factor (lb/BDT) - Wet Material Drop (Chips)	-	*0.18*	*0.00000*	*0.00002*	*0.00075*	-	-
Emission Factor (lb/BDT) - Wet Material Drop (Sawdust)	-	*0.24*	*0.00000*	*0.00002*	*0.00075*	-	-
Emission Factor (lb/BDT) - Dry Material Drop (Shavings)	-	*0.23*	*0.00010*	*0.00070*	*0.0015*	-	-

Year	**Dried Lumber**	**Material Loaded into Trucks (BDT/yr)**				**Hog Fuel Bin**	**Emission Rates (TPY)**						
	(mbf/yr)	**Wood Chips**	**Sawdust**	**Shavings**	**Hog Fuel**	**BDT/yr**							
2011	163,678	86,183	16,674	18,580	0	73,420	-	18.1	0.001	0.008	0.080	-	-
2012	175,939	95,017	16,873	16,824	0	81,281	-	19.4	0.001	0.008	0.085	-	-
2013	176,622	91,826	22,032	18,419	0	47,826	-	17.0	0.001	0.008	0.074	-	-
2014	176,775	93,526	21,900	16,118	21,526	48,876	-	18.9	0.001	0.008	0.082	-	-
2015	178,366	95,506	19,287	13,421	19,099	58,776	-	19.1	0.001	0.007	0.082	-	-
2016	180,510	88,168	20,990	13,326	4,553	76,071	-	18.9	0.001	0.007	0.081	-	-
Emissions							**-**	**18.8**	**0.001**	**0.008**	**0.080**	-	-
(Years)							-	2011-2012	2012-2013	2012-2013	2012-2013	-	-
Projected Actual Emissions	265,425	143,344	33,109	30,130	32,321	90,794	**-**	**30.8**	**0.002**	**0.01**	**0.13**	-	-
Change in Emissions (Tons/Year)							-	***12.0***	***0.001***	***0.006***	***0.055***	-	-
Potential Emissions	381,960	206,280	47,646	43,358	46,512	176,459	-	-	**0.0030**	-	-	-	-
Change in Emissions (Tons/Year)							-	-	***0.002***	-	-	-	-

Projected Actual Emissions Notes:

Scaled up past actual wood chip, sawdust, and shaving shipments by the increased sawmill throughput by capacity of Kiln 6 (average from drying varous wood species, 84,560 mbf/yr).

Past actual and projected actual hog fuel bin handling emissions based on wood chip emission factors, annual steam production from Riley and CE boilers, boiler efficiency estimates (lb fuel / lb steam) from 2016 source testing.

Note: Wood Chips, Sawdust, and Hog Fuel are wet materials; and planer shavings are dry materials.

Emission Factor Notes:

Pollutant	*Emission Factor Basis*	*Source*
PM (Filt.)	*0.00075 lb/BDT*	*PM emission factors based on May 2014 EPA Region 10 memo on PM emission factors for sawmills for wet drop.*
PM10 (Filt. & Cond.)	*0.00002 lb/BDT*	*PM10 based on 2.7% of PM, NCASI Special Report 15-01, Table 5.18*
PM2.5 (Filt.& Cond.)	*0.000003 lb/BDT*	*PM2.5 based on 0.46% of PM, NCASI Special Report 15-01, Table 5.18*
PM (Filt.)	*0.00150 lb/BDT*	
PM10 (Filt. & Cond.)	*0.00070 lb/BDT*	
PM2.5 (Filt.& Cond.)	*0.00010 lb/BDT*	*PM emission factors based on May 2014 EPA Region 10 memo on PM emission factors for sawmills for dry material drop.*
VOC (as Propane)	*0.18 lb/BDT*	*Average chipping emission factor from NCASI TB723 (average Douglas Fir fall, Douglas Fir Spring, and Ponderosa Pine fall)*
VOC (as Propane)	*0.24 lb/BDT*	*Average sawdust emission factor from NCASI TB723 (average Douglas Fir fall, Douglas Fir Spring, and Ponderosa Pine chipping EF)*
VOC (as Propane)	*0.23 lb/BDT*	*Average planing emission factor from NCASI TB723 (average Douglas Fir fall, Douglas Fir Spring, and Ponderosa Pine chipping EF)*

PILE: Fugitives from Hog Fuel Pile ('Dry Kiln #6 Project')

	CO	VOC	PM2.5	PM10	PM	SO2	NOx
Emission Factor (ton/acre-yr) - Hog Fuel Pile	-	-	*0.00175*	*0.01026*	*0.38000*	-	-

Year	**Dried Lumber (mbf/yr)**	**Hog Fuel Pile (acres)**	**Emission Rates (TPY)**						
2008	116,217	0.2	-	-	0.0003	0.002	0.08	-	-
2009	125,363	0.2	-	-	0.0003	0.002	0.08	-	-
2010	147,612	0.2	-	-	0.0003	0.002	0.08	-	-
2011	163,678	0.2	-	-	0.0003	0.002	0.08	-	-
2012	175,939	0.2	-	-	0.0003	0.002	0.08	-	-
2013	176,622	0.2	-	-	0.0003	0.002	0.08	-	-
2014	176,775	0.2	-	-	0.0003	0.002	0.08	-	-
2015	178,366	0.2	-	-	0.0003	0.002	0.08	-	-
2016	180,510	0.2	-	-	0.0003	0.002	0.08	-	-
Emissions			**-**	**-**	**0.0003**	**0.002**	**0.08**	-	-
(Years)			-	-	2012-2013	2012-2013	2012-2013	-	-
Projected Actual Emissions	248,643	0.3	**-**	**-**	**0.0005**	**0.003**	**0.12**	-	-
Change in Emissions (Tons/Year)			-	-	***0.0002***	***0.001***	***0.04***	-	-
Potential Emissions	285,267	**0.3**	-	-	**0.0006**	-	-	-	-
Change in Emissions (Tons/Year)		-	-	-	***0.0003***	-	-	-	-

Projected Actual Emissions Notes:

PotlatchDeltic maintains a small hog fuel pile southeast of the primary hog fuel silo. Only excess hog fuel is stored outside. PotlatchDeltic has conservatively scaled up the hog fuel pile area by the increased sawmill throughput by capacity of Kiln 6 (average from drying varous wood species, 84,560 mbf/yr).

Note: The hog fuel is a wet material (~50% moisture) and fugitive emissions are negligable.

Emission Factor Notes:

Pollutant	*Emission Factor Basis*	
PM (Filt.)	*0.38 ton/acre-yr*	*PM emission factors based on May 2014 EPA Region 10 memo on PM emission factors for sawmills for piles.*
PM10 (Filt. & Cond.)	*0.010 ton/acre-yr*	*PM10 based on 2.7% of PM, NCASI Special Report 15-01, Table 5.18*
PM2.5 (Filt.& Cond.)	*0.002 ton/acre-yr*	*PM2.5 based on 0.46% of PM, NCASI Special Report 15-01, Table 5.18*

PT: Fugitives from Sawmill Plant Traffic ('Dry Kiln #6 Project')

CO	VOC	PM2.5	PM10	PM	SO2	NOx
-	-	-	-	-	-	-

Year	Production Value (hours/yr)	Emission Rates (TPY)						
2006	4,094	-	-	2.1	16.9	63.0	-	-
2007	4,112	-	-	2.1	16.9	63.3	-	-
2008	3,891	-	-	2.0	16.0	59.9	-	-
2009	3,492	-	-	1.8	14.4	53.8	-	-
2010	4,036	-	-	2.0	16.6	62.1	-	-
2011	3,964	-	-	2.0	16.3	61.0	-	-
2012	4,162	-	-	2.1	17.1	64.1	-	-
2013	4,199	-	-	2.1	17.3	64.7	-	-
2014	4,145	-	-	2.1	17.1	63.8	-	-
2015	4,168	-	-	2.1	17.2	64.2	-	-
2016	4,109	-	-	2.1	16.9	63.3	-	-
Baseline Actual Emissions		**-**	**-**	**2.11**	**17.21**	**64.37**	**-**	**-**
(Years)		-	-	2012-2013	2012-2013	2012-2013	-	-
Projected Actual Emissions	4,679	-	-	2.4	19.3	72.1	-	-
Change in Emissions (Tons/Year)		-	-	***0.25***	***2.05***	***7.68***	-	-
Potential Emissions	7,488	**-**	**-**	**2.52**	-	-	-	-
Change in Emissions (Tons/Year)		-	-	***0.43***	-	-	-	-

Projected Actual Emissions Notes:

Increases in fugitive dust from roadway traffice is expected to be minimial as a result of the project. PD currently trucks green lumber to Stimson Lumber Company and PD Lumber Drying Division for drying. The dried lumber is then trucked to the Complex for planing. It is likely there will be no change in fugitive emissions from plant traffic, as the decrease in on-site truck traffic associated with delivering and returning lumber to and from the Stimson Lumber Company and the Lumber Drying Division, will be balanced by additional on-site vehicle operations associated with the additional 480 hours per year of operation. The PSD applicability analysis assumes that projected annual fugitive roadway dust emissions will be similar to maximum annual emissions from the baseline period.

PAVED AREAS

From AP-42 13.2.1

number of days with more than 0.01 in of rain = 129

Reduction factor for unpaved surfaces = 0.65

Control Efficiency for sweeping and watering paved areas = 75% Ref: Reasonably Available Control Measures for Fugitive Dust Sources (Sept. 1980), Table 2.1.1-3.

The following equation may be used to estimate the dust emissions from a ***paved*** road.

$$E = k\,(sL)^{0.91}(W)^{1.02}\left(1-\frac{P}{4*365}\right)$$

k = base emission factor for particulate size range
sL = road surface silt loading (grams per square meter)
W = average weight (tons) of the vehicles traveling the road
P = number of days in year with at least 0.01 in of precipitation

Tabulated data for k values

Size Range	Multiplier (k)		
	g/VKT	g/VMT	lb/VMT
PM-2.5	0.15	0.25	0.00054
PM-10	0.62	1	0.0022
PM-15	0.77	1.23	0.0027
PM-30	3.23	5.24	0.011

UNITS

g/VKT	grams per vehicle kilometer traveled
g/VMT	grams per vehicle mile traveled
lb/VMT	pounds per vehicle mile traveled

Values being used to calculate emission factor E:

	PM2.5	PM10	PM30	
sL =	9.700	9.700	9.700	(g/m^2)
k =	0.00054	0.0022	0.011	(lb/Vehicle Mile Traveled)

		E (lbs/mile)			Total Vehicles Miles for Vehicles of this type	Emissions (lb/day)		
Equipment	W (tons)	$PM_{2.5}$	PM_{10}	TSP	Per Day	$PM_{2.5}$	PM_{10}	TSP
966 Bucket Loader	35	0.15	0.60	2.98	0.0	0.00	0.00	0.00
980 Wheel Loader	35	0.15	0.60	2.98	0.0	0.00	0.00	0.00
988 Wheel Loader	56	0.24	0.96	4.81	0.0	0.00	0.00	0.00
Letoum Log Stacker (lg)	100	0.43	1.74	8.69	0.0	0.00	0.00	0.00
Letoum Log Stacker (sm)	70	0.30	1.21	6.04	0.0	0.00	0.00	0.00

PT: Fugitives from Sawmill Plant Traffic ('Dry Kiln #6 Project')

Dump Trucks	30	0.12	0.51	2.55	21.0	2.62	10.69	53.46
Log Trucks	40	0.17	0.68	3.41	68.3	11.44	46.60	233.02
By-Product Trucks	40	0.17	0.68	3.41	27.3	4.58	18.64	93.21
Lumber Trucks	40	0.17	0.68	3.41	9.0	1.51	6.15	30.73
Plywood Trucks	40	0.17	0.68	3.41	0.0	0.00	0.00	0.00

- Except for lumber trucks, vehicle trips reduced by 30%, and plywood trucks to zero in order to estimate emissions from only the sawmill operations.

UNPAVED AREAS

The following information was found in AP-42 Chapter 13.2.2

57% Control Efficiency for reducing speed limit to 15 mph, with electronic radar. WRAP Fugitive Dust Handbook, Table 3-7.
50% Control Efficiency for watering unpaved areas (overhead sprinklers & water trucks). AP-42 13.2.2 and WRAP Fugitive Dust Handbook Chapter 6 note that a small increase in moisture content of results in up to 75% control. PotlatchDeltic conservatively uses 50% control for watering.
79% Combined Control Efficiency for unpaved roadways

The following expression may be used to calculate the particulate emissions (lb) from an ***unpaved*** road, per vehicle mile traveled

$$E = k\,({}^{s}/_{12})^{a}({}^{W}/_{3})^{b} - ((365-P)/365)$$

E = size-specific emission factor (lb/VMT)
s = surface material silt content (%)
W = mean vehicle weight (ton)
M = surface material moisture content (%)
P = number of days in year with at least 0.01 in of precipitation

a, b, k = empirical constants

For Loaders, Stackers, Letournous, Dump Trucks, Log Trucks, By-Product Trucks

	PM2.5	PM_{10}	TSP	
s =	8.4	8.4	8.4	
a =	0.9	0.9	0.7	
b =	0.45	0.45	0.45	
k =	0.15	1.5	4.9	(lb/VMT)

		E (lb/mile)			Total Vehicles Miles for Vehicles of this type	Emissions (lb/day)		
Equipment	W (tons)	PM2.5	PM_{10}	TSP	Per Day	PM2.5	PM_{10}	TSP
966 Bucket Loader	35	0.21	2.13	7.46	39.2	8.33	83.31	292.28
980 Wheel Loader	35	0.21	2.13	7.46	39.2	8.33	83.31	292.28
988 Wheel Loader	56	0.26	2.63	9.21	14.0	3.68	36.76	128.97
Letoum Log Stacker (lg)	100	0.34	3.41	11.96	39.2	13.36	133.62	468.78
Letoum Log Stacker (sm)	70	0.29	2.90	10.19	39.2	11.38	113.81	399.26
Dump Trucks	30	0.20	1.98	6.96	4.2	0.83	8.33	29.22
Log Trucks	40	0.23	2.26	7.92	13.7	3.08	30.81	108.08
By-Product Trucks	40	0.23	2.26	7.92	9.1	2.05	20.54	72.05
Lumber Trucks	40	0.23	2.26	7.92	3.0	0.68	6.77	23.75
Plywood Trucks	40	0.23	2.26	7.92	0.0	0.00	0.00	0.00

- Except for lumber trucks, vehicle trips reduced by 30%, and plywood trucks to zero in order to estimate emissions from only the sawmill operations.

Technical Analysis
BACT Analysis Review: PotlatchDeltic Kiln 6 VOC Emissions
June 11, 2019

Note: This document is unchanged from the version included with the draft permit proposed for public comment on September 6, 2018. In light of comments received during the public comment period on the availability and technical feasibility of Options 1-8 and 10-12 discussed below, and because Region 10 has concluded that none of these options are economically feasible, Region 10 is not making a final determination on whether Options 1-8 and 10-12 would redefine the source, are otherwise unavailable, or are technically infeasible for this project.

The following describes EPA's technical review of the Best Available Control Technology (BACT) analysis for emissions of volatile organic compounds (VOC) associated with the Potlatch Land and Lumber[1], (Potlatch, the permittee or the facility) Prevention of Significant Deterioration permit application for the proposed lumber drying kiln No. 6. The proposed new lumber kiln is to be located at the facility described by Potlatch as the St. Maries Complex in St. Maries, Idaho. This memo also includes supplementary research and analysis conducted by EPA staff related to this BACT analysis.

Introduction

A BACT analysis, as described in the EPA "puzzlebook"[2], is comprised of the following sequential steps:

1. Identify All Control Technologies
2. Eliminate Technically Infeasible Options
3. Rank Remaining Control Technologies by Control Effectiveness
4. Evaluate Economic, Energy, and Environmental Impacts
5. Select BACT

The analysis submitted by the permittee (Potlatch or its consultant) as part of the initial November 2017 permit application consisted only of generic information regarding EPA's BACT process, a table of data elements drawn from the EPA RBLC[3], and the proposal of BACT as the standard computerized kiln management system, and a limit on the "maximum hourly average kiln temperature" of less than or equal to 245 ˚F[4]. The initial BACT analysis did not evaluate any available emission reduction options for VOCs.

In comments to the facility regarding the initial BACT analysis submitted in November 2017, EPA identified several control technologies considered to be "available" for evaluation under the BACT analysis for reduction of VOC emissions from the proposed new lumber kiln. These

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[1] Note that the facility name has been changed to PotlatchDeltic since the application was submitted.

[2] October 1990 Draft New Source Review Workshop Manual, Part I, Chapter B.

[3] RACT-BACT-LAER Clearinghouse. Available at: https://cfpub.epa.gov/RBLC/

[4] In subsequent submittals, the facility clarified that their proposed maximum drying temperature was to be as measured where the air exits the wood charge within the kiln (see "Potlatch-St Maries Kiln No 6 - Incompleteness Response.pdf" submitted February 2, 2018. Specifically, the response to EPA Question 4, near the bottom of page number 5.). The issue of temperature measurement location is discussed in detail later in this memo.

technologies, as well as others identified during supplemental research and analysis conducted by EPA staff, are identified below.

In response to the EPA comments, the permittee submitted an addendum to the BACT analysis on February 2, 2018. The addendum analysis evaluated the list of control technologies or operating practices identified by EPA as “available” in its comments, but did not include evaluation of any additional control options, nor indicate that the facility had conducted a thorough analysis to identify all available control options.

EPA staff gathered additional technical information to conduct the analysis necessary to support a BACT determination. To accomplish this, additional information has been requested from or obtained from other sources and discussed with the permittee on several occasions (particularly on April 16, July 16, July 29 and August 7), concluding with EPA’s receipt of new cost information from the permittee on August 17 and 20, 2018.

Prior to examination of specific control options, the following topics warrant discussion since each is related to multiple control options.

Exhaust Gas Flow Rate

One foundational issue that must be addressed early in the analytical process when considering control options for lumber drying kilns is to define the exhaust gas stream that must be routed to the control device[5]. Based on the application materials submitted by the permittee and their consultant, the exhaust gas flow rate from the proposed lumber kiln would generally be around 10,000 acfm (actual cubic feet per minute) or less during more than 95% of the average batch drying cycle of the kiln. However, the exhaust gas flow rate was stated to spike to around 80,000 acfm during the remaining < 5% of the drying cycle.

During a phone conversation with the permittee following submittal of the initial application, EPA staff stated the expectation that any technical and cost evaluation of control technologies should include the standard exhaust gas flow rate that would prevail over more than 95% of the batch cycle (10,000 acfm) rather than just the short term high flow periods where the exhaust gas flow rate would increase by a factor of eight (80,000 acfm). This expectation is based on the reasoning that any control device sized for a flow rate eight times higher would have a significantly increased cost, and would not form a reasonable basis for rejecting that technology based on cost effectiveness. While the full control scenario (80,000 acfm) should be evaluated, designing the control device for the standard flow (10,000 acfm) must also be evaluated since it would control the exhaust gas stream for more than 95% of operating time. The control system could be designed with a bypass valve which would allow the excess gas flow during high flow periods to bypass the control device. The fact that the control system could be designed to operate with such a bypass valve was confirmed by multiple control device vendors[6].

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[5] The question of capture of the kiln exhaust will be addressed later in this memo.

[6] 5/3/18 phone conversation with Steve Jaasund of AH Lundberg, LLC, 5/7/18 and 7/18/18 phone conversations with and 5/17/18 email proposal submitted by Charlie Schafer of Babcock & Wilcox Megtec, and 5/14/18 and

Despite these advance discussions, the addendum BACT analysis submitted by the permittee is based solely on controlling the 80,000 acfm flow rate. Pages 3 and 4 of the addendum BACT analysis states that any control device must be designed for the high flow periods because "Allowing periods of high flow and unknown VOC concentration to bypass the emission reduction equipment results in an unknown control effectiveness, which renders Steps 3 and 4 of EPA's recommended five-step BACT process essentially useless."

On the contrary, the bypassed emissions may be accounted for by making the following two reasonable assumptions: first, that the mass emission rate of VOC from the wood does not change solely due to the increased exhaust gas flow rate, and second, that no control occurs during the high flow periods. Therefore, EPA's analysis assumes that by designing the control device for the standard exhaust flow rate (i.e., 10,000 acfm), the entire exhaust stream is controlled for more than 95% of operating time, and that during high exhaust flow periods (less than 5% of operating time), no control is achieved. The mass of VOC allowed to bypass the control device is assumed to be proportional to the time the bypass occurs. This is reasonable, since there is no reason to expect that the VOC mass emission rate would increase simply because the exhaust flow rate increased. Additionally, the assumption that no control is achieved during the high flow periods is conservative, since during the time that the exhaust flow rate is 80,000 acfm, the control device would still be providing control for 10,000 acfm. Therefore, this assumption slightly underestimates the control effectiveness in the analysis. The analysis could be refined to account for this 1/8th control during high flow periods, which would slightly improve the tons of VOC removed, and reduce the cost effectiveness values correspondingly.

Therefore, all the control options/scenarios discussed later in this memo that include capture and control are based on the assumption that the control device is sized for the standard exhaust flow rate that exists more than 95% of operating time (unless otherwise stated), and that the control device exhaust ducting system is equipped with a bypass valve which would open during high flow periods and allow any exhaust gas in excess of the capacity of the control device to be released directly to atmosphere. The cost information obtained by EPA in preparing this analysis clearly indicates that increasing the size of the control device by a factor of eight results in the control system being cost prohibitive.

Kiln Temperature Measurement Location

In EPA's supplemental analysis, two low temperature drying scenarios were evaluated: maximum drying temperatures of 200 ˚F and 170/160 ˚F[7]. These scenarios are described in more detail later in this memo. For purposes of this analysis, the maximum drying temperatures of 200

7/17/18 phone conversations with and 5/18/18 RTO proposal submitted by Tim Jaglinski of Anguil Environmental Systems, Inc.

[7] The lowest temperature control options evaluated in this memo are set at 160 ˚F when the control option includes a capture system, and at 170 ˚F when no capture system is included in the control option. Use of the Oroville-type capture system is assumed to require limiting the drying temperature to 160 ˚F. However, the lowest temperature emissions data available is based on a maximum drying temperature of 170 ˚F. Therefore, for the control options that do not include a capture system, a limit on maximum drying temperature of 170 ˚F is most appropriate.

˚F and 170/160 ˚F refer to the temperature of the air inside the kiln as the air enters the wood charge being dried. This is the standard reference point at which temperature has been measured for most emission testing from lumber drying kilns. This is an important contrast to the Potlatch application, which indicates that the proposed drying temperature of 245 ˚F would be measured as the air exits the wood charge[8]. The following graphic illustrates these two measurement points.

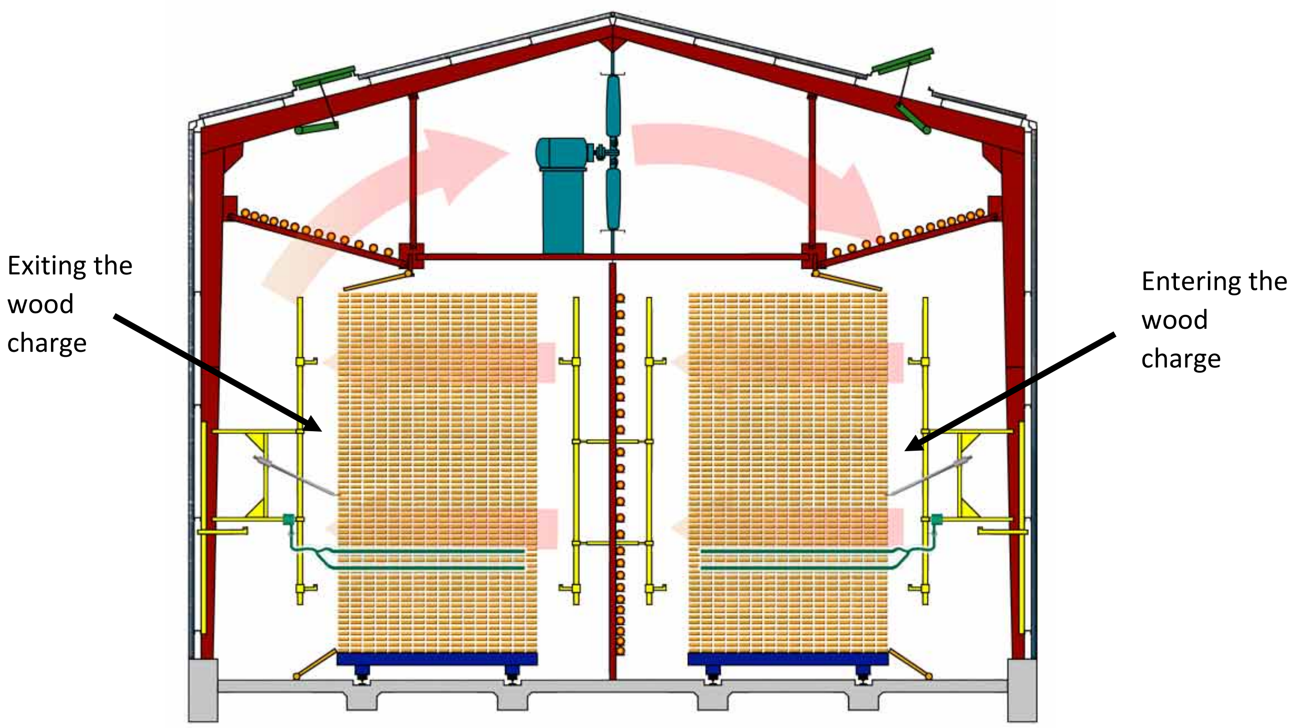

Diagram of Wellons Double Track Lumber Kiln[9]

Since the air would cool as it heats and dries the wood, a temperature of 245 ˚F exiting the wood charge would correspond to a temperature higher than 245 ˚F entering the wood charge. In other words, by proposing that the temperature be measured as the air exits the wood charge, the permittee is comparing "apples to oranges", in a way that is likely to underestimate the actual emissions since available emissions data indicates that VOC emissions per board foot of lumber dried increase with maximum drying temperature[10]. If the temperature of the air exiting the wood charge is 245 ˚F, the temperature of the air entering the wood charge will be higher, likely

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[8] "Potlatch-St Maries Kiln No 6 - Incompleteness Response.pdf" submitted February 2, 2018. Specifically, the response to EPA Question 4, near the bottom of page number 5.

[9] http://www.wellons.com/trackkilns.html

[10] In a July 16, 2018 meeting, the facility informed EPA that they use a modified drying schedule which they believe results in lower emissions of VOC as compared to available emissions data obtained using traditional drying schedules. The facility did not provide any emissions data to support this assertion.

indicating higher VOC and organic HAP emission rates. Unfortunately, emissions data for drying temperatures above 245 ˚F entering the wood charge are not available.

The following sections of this memo address the respective steps in the "top down" BACT process, evaluating the information submitted by the consultant, and including substantive comments and independent supplemental research and analysis conducted by EPA staff to produce a more comprehensive BACT analysis for VOC emissions from the proposed new lumber drying kiln No. 6.

Step 1: Identify All Control Technologies

The following list of control scenarios are evaluated in this analysis. The control scenarios are listed in order of VOC reduction as compared to the baseline proposal submitted by the facility (scenario 9):

Option 1

The top control option in terms of control effectiveness is installation of a single batch kiln rated at 280,000 bf/charge as proposed by Potlatch. The maximum drying temperature would be limited to 160 ˚F entering the wood charge to allow the kiln to be designed with a balanced air flow system. Emissions would be routed to a RTO via an electrically heated duct. The RTO would be sized for approximately 8,000 acfm and would be constructed of stainless steel due to the moist exhaust gas stream. This option achieves reductions in VOC emissions via reduced production capacity (50% according to Potlatch), reduced temperature drying, and destruction in the RTO. Overall, this option reduces VOC emissions by about 98% from the baseline option proposed by Potlatch, to a VOC PTE of about 1 ton/year.

Option 2

Based on cost information provided by the kiln manufacturer[11], EPA staff analyzed an option where Potlatch would purchase an additional 280,000 bf/charge kiln and operate both kilns at a drying temperature not to exceed 160 ˚F. Emissions from both kilns would be captured using balanced air flow systems, and would be controlled via a new RTO sized for about 16,000 acfm. The second, identical kiln would double the physical capacity, resulting in zero production loss compared to the base case (Option 9). This option achieves reductions in VOC emissions via reduced temperature drying and destruction in the RTO. Overall, this option reduces VOC emissions by about 96% from the baseline option proposed by Potlatch, to a VOC PTE of about 2 tons/year.

Option 3

Under this option, the single, 280,000 bf/charge batch kiln would be installed and operated with the peak drying temperature proposed by Potlatch (245 ˚F exiting the wood charge). This option is premised on the assumption that a capture system could be designed for a batch kiln operating

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[11] 5/4/18 email from Dave Butler of Wellons, Inc.

at high drying temperature, which is unknown at this time. Emissions from the kiln would be controlled via a new RTO sized for about 10,000 acfm. This option would not result in any production loss compared to the baseline proposal from the facility (option 9), and would achieve reductions in VOC emissions solely via destruction in the RTO. Overall, this option reduces VOC emissions by about 90%[12] from the baseline option proposed by Potlatch, to a VOC PTE of about 5 tons/year.

Option 4

This option includes installation of a single batch kiln rated at 280,000 bf/charge as proposed by Potlatch. The maximum drying temperature would be limited to 170 ˚F entering the wood charge. Potlatch estimates that this option would reduce the kiln production capacity by 50% as compared to the baseline option using high temperature drying (option 9). Emissions would be released through conventional roof vents with no control. This option achieves reductions in VOC emissions via reduced production capacity (50% according to Potlatch) and reduced temperature drying. Overall, this option reduces VOC emissions by about 80% from the baseline option proposed by Potlatch, to a VOC PTE of about 10 ton/year.

Option 5

In this option, the single batch kiln proposed by Potlatch is replaced with a continuous lumber drying kiln (CDK) of equivalent size in terms of production capacity. The CDK operates at high temperature as proposed (245 ˚F), and is equipped with capture hoods above each end door. The capture hoods are available as standard equipment from some kiln manufacturers, and are estimated to capture 80% of the kiln exhaust gasses. In this option, the captured exhaust gasses are routed to either a single RTO centrally positioned near the kiln, or two smaller RTO’s positioned at each end of the kiln. This option is estimated to achieve approximately 76% overall VOC reduction[13] from the baseline option, to a VOC PTE of about 12 tons/year.

Option 6

This option includes installation of two batch kilns, each rated at 280,000 bf/charge. The maximum drying temperature would be limited to 170 ˚F entering the wood charge. By doubling the physical kiln capacity, this option would not result in any reduction in kiln production capacity as compared to the baseline option using high temperature drying (option 9). Emissions would be released through conventional roof vents with no control. This option achieves reductions in VOC emissions only via reduced temperature drying. Overall, this option reduces VOC emissions by about 60% from the baseline option proposed by Potlatch, to a VOC PTE of about 20 ton/year.

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[12] Although the RTO is assumed to achieve at least 95% DRE, high flow periods would still occur resulting in uncontrolled release of exhaust gasses which lower the overall pollutant reduction to about 90%.

[13] This estimate assumes 80% capture followed by 95% DRE in the RTO. There are no high flow periods where emissions would bypass the RTO because this operational scenario does not occur with CDK’s.

Option 7

This option includes installation of a single batch kiln rated at 280,000 bf/charge as proposed by Potlatch. The maximum drying temperature would be limited to 200 ˚F entering the wood charge. Potlatch estimates that this option would reduce the kiln production capacity by 20% as compared to the baseline option using high temperature drying (option 9). Emissions would be released through conventional roof vents with no control. This option achieves reductions in VOC emissions via reduced production capacity (20% according to Potlatch) and reduced temperature drying. Overall, this option reduces VOC emissions by about 39% from the baseline option proposed by Potlatch, to a VOC PTE of about 30 ton/year.

Option 8

This option includes installation of two batch kilns, each rated at 175,000 bf/charge. The maximum drying temperature would be limited to 200 ˚F entering the wood charge. By increasing the physical kiln capacity by 20%, this option would not result in any reduction in kiln production capacity as compared to the baseline option using high temperature drying (option 9). Emissions would be released through conventional roof vents with no control. This option achieves reductions in VOC emissions only via reduced temperature drying. Overall, this option reduces VOC emissions by about 24% from the baseline option proposed by Potlatch, to a VOC PTE of about 38 ton/year.

Option 9

This is the baseline option proposed by Potlatch, and includes installation of a single batch kiln rated at 280,000 bf/charge. Kiln drying temperature would be limited to 245 ˚F exiting the wood charge, and emissions would be released through conventional roof vents with no control. This option does not achieve any VOC reductions (0%), and VOC PTE is determined by the facility requested value of 50 tons/year.

Option 10

Under this option, the single, 280,000 bf/charge batch kiln would be installed and operated with the peak drying temperature proposed by Potlatch (245 ˚F exiting the wood charge). This option is premised on the assumption that a capture system could be designed for a batch kiln operating at high drying temperature, which is unknown at this time. Emissions from the kiln would be controlled via a new biofilter. This option would not result in any production loss compared to the baseline proposal from the facility (option 9), and would achieve reductions in VOC emissions solely via destruction in the biofilter. VOC reduction compared to the baseline option and the resulting VOC PTE for this option have not been calculated.

Option 11

Under this option, the single, 280,000 bf/charge batch kiln would be installed and operated with the peak drying temperature proposed by Potlatch (245 ˚F exiting the wood charge). This option is premised on the assumption that a capture system could be designed for a batch kiln operating at high drying temperature, which is unknown at this time. Emissions from the kiln would be controlled via the existing regenerative catalytic oxidizer at the facility. This option would not result in any production loss compared to the baseline proposal from the facility (option 9), and would achieve reductions in VOC emissions solely via destruction in the RCO. VOC reduction compared to the baseline option and the resulting VOC PTE for this option have not been calculated.

Option 12

Under this option, the single, 280,000 bf/charge batch kiln would be installed and operated with the peak drying temperature proposed by Potlatch (245 ˚F exiting the wood charge). This option is premised on the assumption that a capture system could be designed for a batch kiln operating at high drying temperature, which is unknown at this time. Emissions from the kiln would be controlled via the existing combustion units (boilers) at the facility. This option would not result in any production loss compared to the baseline proposal from the facility (option 9), and would achieve reductions in VOC emissions solely via destruction in the boilers. VOC reduction compared to the baseline option and the resulting VOC PTE for this option have not been calculated.

Available Control Technologies / Scenarios – Potlatch Kiln No. 6 VOC Emissions

Option	Kiln Type	No. of Kilns	Kiln Size (bf)	Max Temp (F)	Assumed Production Decrease	Capture System	Control Device	Technically Feasible?	VOC Reduction	Potential Emissions (tons/year)	Avg. Cost Effectiveness ($/ton)
1	Batch	1	280,000	160	40-50%	Oroville	RTO	Y	98 %	1	$149,936
2	Batch	2	280,000	160	0%	Oroville	RTO	Y	96 %	2	$20,831
3	Batch	1	280,000	245	0%	Unknown	RTO	Unknown	90 %	5	Unknown
4	Batch	1	280,000	170	40-50%	None	None	Y	80 %	10	$173,120
5	CDK[14]	1	280,000[15]	245	0%	Hood	RTO	Y	76 %	12	Unknown[16]
6	Batch	2	280,000	170	0%	None	None	Y	60 %	20	$15,729
7	Batch	1	280,000	200	20%	None	None	Y	39 %	30	$142,288
8	Batch	2	175,000	200	0%	None	None	Y	24 %	38	$28,883
9	Batch	1	280,000	245	0%	None	None	Y	0 %	50[17]	$0
10	Batch	1	280,000	245	0%	TBD	Biofilter	N	Unknown	Unknown	Unknown
11	Batch	1	280,000	245	0%	TBD	Ex. RCO	N	Unknown	Unknown	Unknown
12	Batch	1	280,000	245	0%	TBD	Ex. Comb.	N	Unknown	Unknown	Unknown

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[14] Continuous Dry Kiln

[15] Continuous kiln would be designed to have equivalent production capacity to the proposed 280,000 bf batch kiln.

[16] EPA was unable to obtain the necessary information to complete the cost analysis for the equivalent CDK scenario. Due to the requested PTE limit of 50 tpy, available information is sufficient to conclude that this control scenario would be cost prohibitive.

[17] In an email dated July 29, 2018, the facility requested that VOC emissions from Kiln No. 6 be limited to 50 tons per year.

Step 2: Eliminate Technically Infeasible Options

Options 1, 2, 3, 5 – Control Using an RTO

The addendum BACT analysis submitted by the permittee concludes that RTO control systems "are commercially available, and can be configured to accommodate most any exhaust volume and VOC mixture, and is considered technically feasible for reducing VOC emissions from the proposed lumber dry kiln". EPA agrees that an RTO control system is technically feasible for controlling the emissions from the proposed lumber drying kiln.

There are two primary issues to be evaluated in considering the technical feasibility of an add-on control device such as an RTO as applied to a lumber drying kiln. These issues are not discussed in the technical feasibility discussion contained within the addendum BACT analysis.

The first, and most significant issue to be evaluated is simply whether the emissions from a batch lumber drying kiln can feasibly be collected into a duct or stack such that they could then be routed to a control device such as an RTO. In research exploring this question, EPA staff identified three batch lumber kilns currently in operation in Oroville, Washington[18] that are equipped with balanced air flow systems that use fans and ducts to control the air flow into and out of the kilns. The existence and successful operation of these batch kilns equipped with balanced air flow systems which release exhaust gasses through stacks establish that capture of batch lumber kiln emissions is technically feasible[19].

Based on information provided by the owner of the kilns in Oroville, the rated capacity of these kilns in terms of board feet per charge (140,000 bf/charge) is half the size of the kiln #6 proposed by Potlatch (280,000 bf/charge). Also, the Oroville kilns operate at very low drying temperature of around 140 ˚F, and automatically shut down if the temperature exceeds 160 ˚F inside the kiln. Therefore, two additional issues that must be evaluated are whether increased kiln size or increased drying temperature are likely to cause technical feasibility issues with a balanced air flow system.

In discussions with kiln manufacturers[20], EPA staff explored these specific questions, in addition to various other considerations related to lumber drying in general. These discussions with highly experienced personnel at kiln manufacturers made it clear that drying temperature is the more significant of the issues. While the information from kiln manufacturers indicated that a balanced air flow or powered vent system such as the one installed on the Oroville kilns could be scaled up to a larger kiln, and in fact had been installed by at least one manufacturer on additional kilns, increasing the drying temperature may cause significant problems with the air flow necessary to properly dry the lumber charge without compromising quality. Therefore, it follows that any

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[18] See "180610 epa r10 description of r&r lumber dry kiln operation - draft.pdf" for a description of the Oroville kilns. Also see accompanying photos and video clips from May 8 and 9, 2018 EPA staff visit to Oroville Reman & Reload.

[19] The Oroville kilns were manufactured by Wellons, Inc., who is also the manufacturer of the proposed kiln #6 to be installed by Potlatch, as referenced in communications related to this permitting action.

[20] 5/16/18 phone conversation and emails between 5/16/18 and 5/21/18 with Rob Girardi of KDS Windsor, and 6/6/18 phone conversation with Alan Robbins of USNR.

significant increase in drying temperature beyond that demonstrated in practice (the Oroville kilns) should not be assumed to be technically feasible without additional information. However, operation at, or near, the drying temperature employed in the Oroville kilns is demonstrated as technically feasible.

In this evaluation, EPA is not concluding that installation of a balanced air flow system on a lumber drying kiln could not be designed and successfully operated at higher drying temperatures. Since the Oroville kilns use internal ducts to distribute inflow air along the length of the fan deck, it is certainly possible that a physically larger kiln may result in less air flow obstruction issues, and may allow higher drying temperatures without compromising lumber quality. Additionally, design of a balanced air flow system that utilized ducts external to the kiln housing is another possibility.

For purposes of this BACT analysis, however, EPA is not considering those (and other) theoretical capture options as technically feasible since the information necessary to thoroughly explore the technical feasibility of those options would require analysis beyond the scope of a BACT analysis conducted largely by agency personnel. Therefore, evaluation of capture and control emission reduction options in this BACT analysis are limited to operating scenarios where batch kilns are used, and the lumber drying temperature is limited to 160 ˚F. Specifically, option 3 in this analysis is listed as having unknown technical feasibility because the necessary analysis to determine whether capture of emissions from a batch lumber kiln drying at 245 ˚F and above has not been conducted. Further analysis on this topic to determine the technical feasibility of option 3 is considered unnecessary for this project only because the requested limit on VOC PTE at 50 tons per year results in capture and control options using an RTO cost prohibitive, as discussed later in this memo.

The second primary issue is whether control of an exhaust gas stream with the characteristics expected from a lumber drying kiln is technically feasible using an RTO. Despite the determination made in the addendum BACT analysis submitted by the permittee that the exhaust from a lumber drying kiln would be technically feasible using an RTO, substantive evaluation of the question was not included in the analysis to support the conclusion. Additionally, the RTO equipment supplier engaged by the permittee for this project (Lundberg) later submitted a letter[21] expressing the opinion that controlling the emissions from a lumber kiln using an RTO was not advisable and was in their opinion infeasible. The letter raised two primary technical challenges with this potential application of RTO control technology, specifically:

- The high moisture content of the exhaust gas could result in excess liquid condensation in the RTO and in the duct leading from the kiln to the control device. This would be exacerbated by the batch-wise operation of the kiln, which would result in the duct cooling between charges.

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[21] 4/12/18 letter from Steve Jaasund of AH Lundberg, LLC. See “AH Lundberg - PotlatchDeltic Infeasible Letter_04-12-2018.pdf”.

- The variable quantity of VOC in the exhaust gas would be difficult for the RTO burner system to track, and could result in compromised safety.

The letter did not elaborate on the potential safety issues, and went on to base the infeasibility opinion heavily on the fact that this type of control device had not yet been applied to reduce VOC emissions from a lumber kiln. The letter thus created a classic “chicken and egg” situation by basing the technical feasibility opinion partially on the question of whether this application had ever been demonstrated in practice. Rejecting a certain application of an established control technology based solely on the question of whether it has been demonstrated in practice on the emission unit in question is not a valid basis for rejection under BACT. The BACT process has a long history of including evaluation of established control technologies (such as RTO’s) under the paradigm of technology transfer to evaluate their suitability for controlling emission units on which they have not previously been applied. In other words, established control technologies may be applied to new types of emission units or exhaust gas streams under BACT, provided the application is technically feasible[22].

However, the technical challenges raised in the Lundberg letter warranted further exploration to determine whether these issues were sufficient to establish the application of an RTO to lumber kiln emissions as technically infeasible. In pursuing this question, multiple RTO equipment suppliers were contacted, including Lundberg[23].

Initially, EPA staff contacted Lundberg to further explore the technical issues identified in the letter. Additional discussion highlighted the difficulties inherent in new applications of control technology, i.e., “shakedown” issues. During the conversation, Lundberg acknowledged that the control scenario should be possible “on paper”, but that the challenges would be significant enough that their firm would be reluctant to take on the project. The application would include several layers of complexity to try to address the technical challenges, which would substantially increase the difficulty of successful operation of the control device. Using a bypass valve as discussed above and heating the duct between the kiln and RTO could help to mitigate the variability issues, but would add complexity. Based on the information provided by Lundberg, EPA staff understood that the application would include unique challenges, and may require additional expense, but did not see a solid basis for rejection of the technology as technically infeasible.

In addition to Lundberg, EPA staff held substantive discussions and received information in writing from two firms (Anguil and Megtec) regarding these technical feasibility issues, as well as cost information. Based on the exhaust gas characteristics contained in the application materials submitted by the permittee, and through substantive conversation with vendor

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[22] October 1990 Draft New Source Review Workshop Manual, Section IV. A. 1. and page B. 16. “*Technology transfer must be considered in identifying control options. The fact that a control option has never been applied to process emission units similar or identical to that proposed does not mean it can be ignored in the BACT analysis if the potential for its application exists.*”

[23] 5/3/18 phone conversation with Steve Jaasund of AH Lundberg, LLC, 5/7/18 and 7/18/18 phone conversations with and 5/17/18 email proposal submitted by Charlie Schafer of Babcock & Wilcox Megtec, and 5/14/18 and 7/17/18 phone conversations with and 5/18/18 RTO proposal submitted by Tim Jaglinski of Anguil Environmental Systems, Inc.

personnel, both firms indicated that control of this type of exhaust gas stream with an RTO is technically feasible, and that the moisture and VOC variability issues were not insurmountable. Related to the specific technical concerns raised in the Lundberg letter, discussions with Anguil and Megtec identified the following information or potential solutions:

- Both firms indicated that control of high moisture exhaust streams is feasible using an RTO, but that stainless steel construction is necessary to avoid degradation of the control device.
- Heating the duct between the kiln and the RTO to reduce or avoid condensation in the duct is feasible. Pricing information was provided regarding stainless steel ducting with insulation and electrical heating. Another approach to heating the duct which has been successfully implemented is using “double duct”, which has hot air flowing in the annular space between the inner and outer ducts to heat the exhaust gas prior to the control device.
- In the case where the duct is not heated to the point where condensation is eliminated, the duct can be sloped to a sump, where condensation can be collected. There is a trade-off between heating the duct, avoiding condensation, wastewater disposal, and RTO propane usage which is discussed under Step 4 in this memo.

Option 5 in this analysis considers the installation of a continuous lumber drying kiln (CDK, or continuous kiln) instead of the batch kiln proposed by Potlatch. Through research, EPA staff learned that continuous lumber kilns are more energy efficient, produce more lumber for a given heat demand, and produce lumber with a lower defect rate as compared to batch kilns. Another advantage of continuous kilns from an environmental protection perspective is that the emissions from continuous kilns are not released via a series of roof vents, but instead are released via the doorway openings at each end of the kiln. One standard venting option available from USNR (and perhaps other manufacturers) includes hoods installed above the kiln doorways which pull an estimated 80% of kiln emissions upward and exhaust them through a single stack at each end of the kiln. Emissions released through these stacks could therefore be conveyed to a control device such as an RTO.

Based on information discussed above, options 1 and 2 for capture and control of emissions from batch lumber drying kilns using an RTO are considered technically feasible, and move forward for further consideration in the BACT analysis. This analysis has not determined whether option 3 for capture and control of emissions from a batch lumber drying kiln operating at high temperature (>245 ˚F) is technically feasible or not because the necessary analysis to determine whether capture of emissions from a batch lumber kiln drying at 245 ˚F and above has not been conducted. Further analysis on this topic to determine the technical feasibility of option 3 is considered unnecessary for this project only because the requested limit on VOC PTE at 50 tons per year results in capture and control options using an RTO cost prohibitive, as discussed later in this memo. Finally, option 5 for capture and control of emissions from a CDK using an RTO is considered technically feasible, but the cost analysis of this option has not been completed for reasons similar to those described here for option 3.

Options 4, 6, 7, 8 – Control Using Reduced Drying Temperature

The addendum BACT analysis concludes that limiting kiln drying temperature is technically feasible. EPA agrees. The consultant analysis goes on to state that the facility has estimated that reducing drying temperature from 245 ˚F to 200 ˚F would reduce the production capacity of the kiln by approximately 20%. In an email dated July 29, 2018, the facility estimated that reducing drying temperature from >245 ˚F to 160 ˚F would reduce the production capacity of the kiln by approximately 50%.

Despite determining that reduced temperature drying is technically feasible, the permittee has claimed that there is no regulatory basis for imposing work practice limitations (such as the drying temperature limit) that result in significant production limitations. The analysis further includes an argument that limiting drying temperature would constitute redefining the source, which is prohibited under the BACT process. Within this argument, the permittee claims that limiting the drying temperature of the proposed kiln would "require Potlatch to seek to install additional kiln capacity to achieve the business goal of the proposed project". In conclusion, the permittee states that limiting drying temperature is therefore not "available" to be considered within the BACT analysis. The permittee further claims that any such limit on drying temperature would "place the Complex at a competitive disadvantage".

Because EPA has concluded that requiring low temperature drying to reduce VOC emissions, which in turn curtails production in this case, is not cost effective, EPA is not deciding at this time whether requiring low temperature drying, either alone or in conjunction with recouping lost capacity through installation of a second kiln, is redefining the source.

Based on this information and information provided by the permittee, EPA further evaluated options 4, 6, 7, and 8 in the BACT analysis.

Option 9 – No Controls

Operation of the batch lumber kiln sized for 280,000 bf per charge, with maximum drying temperature of 245 ˚F exiting the wood charge with no emissions capture or control is the BACT proposed by Potlatch. This option is technically feasible, and moves forward for further consideration in the BACT analysis.

Option 10 – Control Using a Biofilter

The addendum BACT analysis submitted by the permittee determines that biofilter technology is technically infeasible for controlling VOC emissions from lumber drying kilns, based on the following considerations:

- The microbes that consume organic constituents in biofilters generally require a temperature between about 60 and 105 ˚F. Because the exhaust gas temperature from the proposed lumber kiln would be around 245 ˚F, the high gas temperature would be expected to kill off the microbes. Further, dilution of the exhaust gas with ambient air to cool the temperature down to the acceptable biofilter range would reduce the VOC concentration to levels too low to support the microbes in the biofilter.

- Biofilters work best to control water soluble, low molecular weight VOCs. The VOCs are destroyed when the compounds enter the "aqueous biofilm" where the microbes in the biofilter reside, allowing the microbes to consume the VOCs. VOC emissions from lumber drying kilns are primarily comprised of relatively high molecular weight compounds which are not highly soluble in water. Therefore, the most significant VOCs (by mass emission rate) would not be expected to enter the "aqueous biofilm" and therefore not be effectively controlled by the biofilter microbes.
- This would be a new application of biofilter control technology, given that "…there is no evidence that a biofilter has ever been used to reduce VOC emissions from a lumber dry kiln".

EPA agrees that a biofilter can be eliminated from further consideration based on technical infeasibility due solely to the ability of a biofilter to effectively control the specific VOCs emitted by a lumber drying kiln. Given that these compounds are high molecular weight, not highly water soluble, and of complex structure is sufficient basis for rejection of this technology.

The remaining issues identified in the addendum BACT analysis submitted do not form adequate technical justification for elimination of a biofilter from consideration. Specifically, as discussed above, rejecting a certain application of an established control technology based solely on the question of whether it has been demonstrated in practice on the emission unit in question is not a valid basis for rejection under BACT. Further, the gas stream temperature issue could be addressed by installing sufficient length of ducting to allow the gas stream to cool to meet the temperature requirements of a biofilter.

Option 11 – Control Using the Existing RCO

The addendum BACT analysis submitted by the permittee determines that routing emissions from the proposed new lumber dry kiln #6 to the existing RCO is technically infeasible because the existing RCO does not have capacity for any additional emission streams. The addendum BACT analysis states that the RCO is designed to control a maximum flow rate of 82,204 acfm in RCO mode, and 73,000 acfm when operating in RTO mode. A 2008 emission test of the exhaust from the veneer dryers measured the exhaust gas flow rate at 75,000 acfm while the veneer dryers were operating at about 87% of rated capacity. Based on this information, EPA agrees that routing the emissions from the proposed new lumber drying kiln to the existing RCO can be eliminated from further consideration within this BACT analysis based on technical infeasibility.

Option 12 – Control Using Existing Combustion Units

The addendum BACT analysis submitted by the permittee determines that routing emissions from the proposed new lumber dry kiln #6 to the existing combustion units at the facility is technically infeasible based on the following considerations:

- Collection of the kiln emissions from the vents, and installation of ducting and fans to convey the exhaust to the boilers would disrupt kiln performance.

- Routing the kiln exhaust approximately 700 feet would result in cooling of the exhaust, and condensation of volatile/flammable compounds in the duct, even if insulated. This would create a safety hazard.
- The operation of the boilers would be disrupted, since they require steady combustion air, while the exhaust from the new lumber drying kiln would vary significantly. A sophisticated damper system would be required to mix ambient air with the kiln exhaust stream. The existing boiler control systems are unlikely to be able to respond effectively to the variation in moisture in the kiln exhaust stream.
- This would be a new application of this control option, given that it has been "…employed with limited success to treat veneer dryer exhaust, there are no known examples where this alternative was successfully applied to treat lumber dry kiln exhaust".

EPA agrees that routing the emissions from the proposed new lumber dry kiln can be eliminated from further consideration within this BACT analysis as technically infeasible based on the difficulties inherent in ducting the exhaust the extended distance to the existing combustion units. Over a distance of approximately 700 feet, the challenges related to condensation of volatile compounds in the duct become impractical to address via duct heating or condensation removal taps. EPA also agrees that disruption of the operation of the boilers is a significant issue, given the age of the boilers and their antiquated control systems. Requiring installation of modern combustion controls on the boilers in order that they become equipped to handle the variable moisture and flow rate of the kiln exhaust would be beyond the scope of this VOC BACT analysis.

The remaining issues identified in the addendum BACT analysis submitted do not form adequate technical justification for elimination of this option from consideration. Specifically, as discussed above, rejecting a certain application of an established control technology based solely on the question of whether it has been demonstrated in practice on the emission unit in question is not a valid basis for rejection under BACT. Also, the issue of whether emissions from lumber drying kilns can feasibly be collected into exhaust ducts or stacks in order that they be routed to a control device is addressed elsewhere in this memo.

Step 3: Rank Remaining Control Technologies by Control Effectiveness

Based on the above information, the following control alternatives, ranked in order of control effectiveness, move forward to the next step in the BACT analysis:

Option 1. Single batch lumber kiln sized for 280,000 bf per charge, maximum drying temperature of 160 ˚F, emissions captured and controlled using a regenerative thermal oxidizer (RTO) sized for approximately 8,000 acfm. VOC reduction of 98%.

Option 2. Two batch lumber kilns, each sized for 280,000 bf per charge, maximum drying temperature of 160 ˚F, emissions captured and controlled using a RTO sized for approximately 16,000 acfm. VOC reduction of 96%.

Option 4. Single batch lumber kiln sized for 280,000 bf per charge, maximum drying temperature of 170 ˚F, no emissions capture or control. VOC reduction of 80%.

Option 6. Two batch lumber kilns, each sized for 280,000 bf per charge, maximum drying temperature of 170 ˚F, no emissions capture or control. VOC reduction of 60%.

Option 7. Single batch lumber kiln sized for 280,000 bf per charge, maximum drying temperature of 200 ˚F, no emissions capture or control. VOC reduction of 39%.

Option 8. Two batch lumber kilns, each sized for 175,000 bf per charge, maximum drying temperature of 200 ˚F, no emissions capture or control. VOC reduction of 24%.

Option 9. Single batch lumber kiln sized for 280,000 bf per charge, maximum drying temperature of 245 ˚F exiting the wood charge, no emissions capture or control. VOC reduction of 0%.

Step 4: Evaluate Economic, Energy, and Environmental Impacts of Each Control Option

The following summarizes the economic, energy, and environmental impacts of each control option listed under Step 3 above. Cost and emission reduction values cited in this memo were developed in EPA's calculations for the Potlatch Kiln 6 VOC BACT project (see the spreadsheets appended to this analysis).

Option 1 – Single batch lumber kiln sized for 280,000 bf per charge, maximum drying temperature of 160 ˚F, emissions captured and controlled using a regenerative thermal oxidizer (RTO) sized for approximately 8,000 acfm. VOC reduction of 98% with annual emissions of around 1 ton/year.

Cost Effectiveness

Average cost effectiveness of this control option is estimated at $149,936 per ton. The vast majority of this cost is due to the lost profit on finished lumber, calculated at nearly $7 million per year based on the profit rate provided by the permittee ($150 per thousand board feet of lumber, $150/Mbf). If the lost profit is not included, average cost effectiveness drops to $8,569/ton. Another significant factor is the proposed VOC limit of 50 ton/year. Without this limit proposed by the facility, VOC PTE would be around 124 tons/year. Average cost effectiveness at the uncontrolled PTE without including the lost profit is estimated at $3,100/ton. These calculations illustrate the importance of the lost profit rate provided by the permittee and the proposed limit on annual emissions.

Energy and Environmental Impacts

Under this option, the RTO is estimated to burn around 188,000 gallons of propane annually, resulting in an estimated 1.2 tons/year of nitrogen oxides (NO_X), 0.7 tons/year of carbon monoxide (CO), and 0.07 ton/year of particulate matter with median aerodynamic diameter of

2.5 micrometers ($PM_{2.5}$). Operation of the capture system fans, RTO, and electrically heated duct are estimated to require about 80 kilowatts (kw) of electricity.

Some amount of liquid condensation in the duct conveying exhaust gasses from the kiln to the RTO is likely, despite the heated duct. There is a tradeoff between heating the duct and the amount of condensation that would be expected to form, and therefore require disposal. If the duct is heated sufficiently to maintain internal temperatures above the dew point, all the moisture can be kept in the gaseous phase and would be combusted in the RTO. If the duct is unheated or minimally heated, the quantity of condensation would be higher, saving on propane costs, but requiring disposal of this liquid wastewater stream. This analysis assumes an average moisture content of 45% over the entire batch drying cycle in order to minimize condensation and route the majority of the moisture in the exhaust gas through the RTO for pollutant destruction purposes.

Option 2 – Two batch lumber kilns, each sized for 280,000 bf per charge, maximum drying temperature of 160 ˚F, emissions captured and controlled using a RTO sized for approximately 16,000 acfm. VOC reduction of 96% with annual emissions of around 2 tons/year.

Cost Effectiveness

Average cost effectiveness of this control option is estimated at $20,831 per ton. A significant factor is the proposed VOC limit of 50 ton/year. Without this limit proposed by the facility, VOC PTE would be around 124 tons/year. Average cost effectiveness at the uncontrolled PTE is estimated at $7,800/ton.

Energy and Environmental Impacts

Under this option, the RTO is estimated to burn around 378,000 gallons of propane annually, resulting in an estimated 2.5 tons/year of NO_X, 1.4 tons/year of CO, and 0.13 ton/year of $PM_{2.5}$. Operation of the capture system fans, RTO, and electrically heated duct are estimated to require about 160 kilowatts (kw) of electricity. The discussion pertaining to liquid condensation and propane usage included under option 1 above also apply to option 2.

Option 4 – Single batch lumber kiln sized for 280,000 bf per charge, maximum drying temperature of 170 ˚F, no emissions capture or control. VOC reduction of 80%.

Cost Effectiveness

Average cost effectiveness of this control option is estimated at $173,120 per ton. This cost is entirely due to the lost profit on finished lumber, calculated at nearly $7 million per year based on the profit rate provided by the permittee ($150 per thousand board feet of lumber, $150/Mbf). This illustrates the importance of the lost profit rate provided by the permittee and the proposed limit on annual emissions.

Energy and Environmental Impacts

No additional energy or environmental impacts are expected under this option since the only change to the facility’s proposed scenario is reducing the drying temperature. This option would be expected to reduce steam demand from the existing biomass fired boilers at the facility, and therefore would correspondingly reduce emissions of combustion related pollutants from the boilers.

Option 6 – Two batch lumber kilns, each sized for 280,000 bf per charge, maximum drying temperature of 170 ˚F, no emissions capture or control. VOC reduction of 60%.

Cost Effectiveness

The capital cost to add a second new kiln to meet the permittee's production goals was estimated by the kiln supplier to be $1.8 mil. The permittee provided additional capital costs associated with adding a second new kiln to meet their production goals, including the costs of preparing the ground for a foundation, upgrading the steam plant piping, and adding an additional transformer and related switchgear. The permittee also provided additional annual costs, including increased maintenance, two additional forklifts and operators, additional electricity usage, and increased taxes and insurance costs.

The permittee also suggested that the two boilers that provide steam in the facility do not have enough capacity to add a second new kiln. According to the permittee (and the kiln manufacturer), operating two kilns at 170 °F requires approximately 20% more steam than operating one kiln at 245 °F. The two boilers have a combined capacity of 140 mlb/hr steam. During normal operation, the proposed facility-wide steam demand with one new kiln will be 93 mlb/hr (80+6.5+6.5) as compared to 94.3 mlb/hr (80+6.5+7.8) with two new kilns. During the peak demand in the winter (other than during plywood plant startups), the proposed facility-wide steam demand with one new kiln will be 124 mlb/hr (80+22+22) as compared to 128.4 mlb/hr (80+22+26.4) with two new kilns. Thus, the facility-wide steam demand with two new kilns, even during the peak winter season, is still well below the capacity of the boilers. During winter-time plywood plant startups, the proposed facility-wide steam demand with one new kiln will be 164 mlb/hr (120+22+22) as compared to 168.4 mlb/hr (120+22+26.4) with two new kilns. Both scenarios will require the permittee to use only kiln #5 (existing kiln) or kilns #6&7 (new kilns) when the plywood plant is starting up. Thus, the two boilers appear to have adequate steam capacity for two new kilns to run at 170 °F, so no additional costs for additional steam capacity have been considered in this evaluation.

The permittee also claimed that there is inadequate space in their plant for a second new kiln. The permittee claims that they will have to move an existing building (a small kiln control room is located on one side the existing #5 kiln), a plant road and possibly log and lumber storage off site, and hire additional employees to manage the offsite storage operation. The permittee did not provide a detailed analysis on the space issue or the costs to remedy it, so no additional costs to address the permittee's space concerns have been considered in this evaluation.

The permittee also provided additional capital costs for lost revenue due to the delay in installing and operating a second new kiln (the wait period for new kiln orders is approximately one year). EPA excluded this cost from the BACT cost effectiveness calculations because the permittee could have planned for this option (or a single larger kiln) had it timely considered low temperature drying in its BACT analysis. Including the additional costs suggested by the permittee, with the exception of the claimed lost revenue (and assuming no additional steam capacity is needed), results in an average cost effectiveness for this control option of $15,729 per ton.

Energy and Environmental Impacts

Operation of a second lumber kiln would result in additional electricity usage, but this value is not available to EPA, so it has not been estimated. Information provided by the kiln manufacturer indicates that operation of two lower temperature kilns would require a small increase in steam demand over the operation of a single high temperature kiln assuming the overall annual lumber production is the same.

Option 7 – Single batch lumber kiln sized for 280,000 bf per charge, maximum drying temperature of 200 ˚F, no emissions capture or control. VOC reduction of 39%.

Cost Effectiveness

Average cost effectiveness of this control option is estimated at $142,288 per ton. This cost is entirely due to the lost profit on finished lumber, calculated at nearly $3 million per year based on the profit rate provided by the permittee ($150 per thousand board feet of lumber, $150/Mbf). This illustrates the importance of the lost profit rate provided by the permittee and the proposed limit on annual emissions.

Energy and Environmental Impacts

No additional energy or environmental impacts are expected under this option since the only change to the facility's proposed scenario is reducing the drying temperature. This option would be expected to reduce steam demand from the existing biomass fired boilers at the facility, and therefore would correspondingly reduce emissions of combustion related pollutants from the boilers.

Option 8 – Two batch lumber kilns, each sized for 175,000 bf per charge, maximum drying temperature of 200 ˚F, no emissions capture or control. VOC reduction of 24%.

Cost Effectiveness

The permittee provided the claims and same additional costs regarding adding a second new kiln that are discussed for Option 6 above. Average cost effectiveness of this control option is estimated at $29,883 per ton.

Energy and Environmental Impacts

Operation of two 175,000 bf/charge lumber kilns would result likely in additional electricity usage compared to a single 280,000 bf/charge kiln, but this value is not available to EPA, so it has not been estimated. Information provided by the kiln manufacturer indicates that operation of two lower temperature kilns would require a similar steam demand to operation of a single high temperature kiln assuming the overall annual lumber production is the same.

Option 9. Single batch lumber kiln sized for 280,000 bf per charge, maximum drying temperature of 245 ˚F exiting the wood charge, no emissions capture or control. VOC reduction of 0%.

Cost Effectiveness

This is the proposed baseline option, and includes no additional cost.

Energy and Environmental Impacts

This is the proposed baseline option, and includes no energy and environmental impacts since no control is proposed as BACT.

Step 5: Select BACT / Conclusion

Based on the analysis described above and the information provided by the permittee, EPA concludes that the permittee’s proposed option (Option 9 – high temperature drying in one kiln) is the BACT for this project.

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OFFICE OF
AIR AND WASTE

MEMORANDUM [DRAFT]

SUBJECT: Potlatch Kiln 6 PSD Permit Application Review:
Air Quality Source Impact Analysis

FROM: Jay McAlpine, Regional Air Permit Modeler

TO: Doug Hardesty, Permit Lead

This memorandum is a summary of findings from the review of the PSD permit application for the Potlatch Land and Lumber LLC (PLL) Kiln 6 project and of revised modeling conducted by EPA using PLL's proposed modeling methodology and revised emissions estimates. This review focused on all aspects of the air quality source impact analysis used for the PSD permit application. The following documents and information were considered:

a) St. Maries Complex Kiln 6 Project New Source Review Application dated Nov. 13, 2017, hereafter referred to as "the Application."
b) St. Maries Complex Kiln 6 Project Permit Application Incompleteness Response Letter dated Feb. 1, 2018, hereafter referred to as the "Response Letter."
c) July 2018 team communications regarding PLL's proposal for an enforceable annual VOC emissions limit of 50 tons per year for Kiln #6.
d) Revised ozone air quality impact analysis accounting for the Kiln #6 emissions limit.

1. PROJECT OVERVIEW

PLL owns and operates a lumber and plywood mill in St. Maries, Idaho. PLL has submitted an application for the construction of a new lumber drying kiln (Kiln 6). The PLL facility is an existing major source of air pollutants. Potential emission increases of Volatile Organic Compounds (VOCs) attributable to the new unit and increased utilization of existing units trigger PSD review of the project. Figure 2-2 in Section 2.1 of the Application shows the location of the proposed new unit. The figure does not show the location of the existing units, including the affected units and units with increased utilization. These units are labeled on Figure 2-4 of the revised $PM_{2.5}$ air quality analysis included in the Response Letter.

Emission increases of NO_x, CO, SO_2, PM_{10}, and $PM_{2.5}$ will occur with the proposed project but are all below the PSD significant emission rates (SERs). A revision of the potential project emission increases was included in the Response Letter and confirms only project VOC emissions exceed the PSD SER. Therefore, the increases of NO_x, CO, SO_2, PM_{10}, and $PM_{2.5}$ are not evaluated as part of the PSD permitting process, although the contribution of NO_x emissions to ozone formation is considered in the air quality compliance demonstration, as discussed below. A compliance demonstration of $PM_{2.5}$ emissions was conducted as part of the minor NSR permit application.

VOC emission rates are reported in Table 2-4 of the Application for various species of wood inputs. PLL has asked for an enforceable VOC emissions limit of 50 tons per year (tpy) for Kiln #6. This annual emission rate of VOC is greater than the 40 tpy SER for ozone, and so the project remains subject to PSD for VOC (ozone).

2. PSD REQUIREMENTS AND EPA's *GUIDELINE ON AIR QUALTY MODELS*

A compliance demonstration is required under 40 CFR Part 52.21(k) as part of the PSD application:

§52.21(k): The owner or operator of the proposed source or modification shall demonstrate that allowable emission increases from the proposed source or modification, in conjunction with all other applicable emission increases (including secondary emissions), would not cause or contribute to air pollution in violation of:

(i) a National Ambient Air Quality Standard (NAAQS) or
(ii) any applicable maximum allowable increase over the baseline concentrations in any area (PSD increment).

The compliance demonstration must be conducted using models or methods specified under 40 CFR Part 51 Appendix W (EPA's *Guideline on Air Quality Models*, hereafter referred to as the "Guideline"), as specified in 40 CFR Part 52.21(l):

§52.21(l): All estimates of ambient concentrations required under this paragraph shall be based on applicable air quality models, databases, and other requirements specified in appendix W of part 51 of this chapter (Guideline on Air Quality Models).

Air quality impact assessment of direct VOC emissions is not required because there are no national ambient air quality standards or PSD increments for VOC. However, ozone formation is driven by precursor emissions of VOCs and NO_x. Section 5.3.2(a) of the Guideline explains that, depending on the level of project emissions, an assessment of the project's impacts on ambient ozone may be necessary:

5.3.2(a) Depending on the magnitude of emissions, estimating the impact of an individual source's emissions of NO_x *and VOC on ambient ozone is necessary for obtaining a permit.*

Because there are no PSD increments for ozone, the compliance demonstration for the PSD permit application looked only at the air quality impacts of the project in relation to the ozone NAAQS.

Section 5.3.2 of the Guideline outlines a two-tier process for ozone assessment where the first tier of assessment is conducted using existing technical information, where available, to provide a credible and representative estimate of ozone impacts from the project source:

> *5.3.2(b): The first tier of assessment for ozone impacts involves those situations where existing technical information is available (e.g., results from existing photochemical grid modeling, published empirical estimates of source specific impacts, or reduced-form models) in combination with other supportive information and analysis for the purposes of estimating secondary impacts from a particular source. The existing technical information should provide a credible and representative estimate of the secondary impacts from the project source. The appropriate reviewing authority and appropriate EPA guidance should be consulted to determine what types of assessments may be appropriate on a case-by-case basis.*

A second-tier analysis may be conducted if it is determined that a more refined assessment is needed, or if existing technical information is not available. The second-tier assessment for ozone impacts would typically involve photochemical transport modeling to directly assess the project's precursor emissions impacts on ozone formation.

The Guideline recommends consulting current EPA guidance in determining appropriate first-tier and second-tier analysis methods. Section 5.3.2 of the Guideline specifically cites the document *Guidance on the Use of Models for Assessing the Impacts of Emissions from Single Sources on the Secondarily Formed Pollutants: Ozone and $PM_{2.5}$*[1] as authoritative guidance for these assessments. For first-tier assessments, this document focuses on the utility of existing photochemical modeling results to provide appropriate and technically credible relationships between source emission rates and ambient impacts. The document also refers to EPA's work to develop the draft Modeled Emission Rates for Precursors (MERPs) guidance[2]. The MERPs guidance was finalized in April 2019[3].

The MERPs methodology is described in detail in the next section of this memo. In short, the MERPs guidance provides a framework on how air quality modeling can be used to develop relationships between precursors and ambient impacts for the purposes of developing and using MERPs as a Tier 1 demonstration tool under the PSD permitting program. MERPs are the emission rates of precursors for which the modeled change in ambient concentrations likely would be less than an applicable significant impact level (SIL) for ozone or $PM_{2.5}$. The MERPs guidance provides illustrative MERP values based on EPA photochemical modeling

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[1] US EPA, 2016: Guidance on the Use of Models for Assessing the Impacts of Emissions from Single Sources on the Secondarily Formed Pollutants: Ozone and $PM_{2.5}$. Office of Air Quality Planning and Standards, EPA-454/R-16-005, Dec 2016.

[2] US EPA, 2016: Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program (DRAFT). EPA-454/R-16-006, Dec. 2016.

[3] US EPA, 2019: Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program. EPA-454/R-19-003, Apr. 2019.

for a set of hypothetical sources across the country that may be applied for a particular PSD permit application.

In a preliminary meeting with PLL, EPA Region 10 agreed with the applicant's proposed technical approach for assessing ozone impacts. Section 2.2.6 of PLL's modeling protocol[4] laid out the proposal to use EPA's estimated MERPs value from the most representative hypothetical source to derive an estimated ozone concentration attributable to project emissions. EPA Region 10 agreed with the proposed methodology because it applied an appropriately representative estimate of ozone impact based on rigorous photochemical modeling results, consistent with Section 5.3.2(b) of the Guideline.

2.1 VOC speciation and reactivity

The MERPs guidance provides examples and evaluation of ozone impacts using 100% formaldehyde emissions to demonstrate ozone impacts when VOC emissions are highly reactive. The guidance demonstrates a highly reactive VOC species (formaldehyde in this case) can result in higher ozone concentrations than the default industrial VOC species mix used in the base modeling cases. Consistent with the MERPs guidance, an adjustment to the estimated ozone impacts may be appropriate based on an assessment of project VOC speciation and reactivity.

EPA Region 10 suggested during pre-application discussions that PLL evaluate the speciation and reactivity of the project VOC emissions and determine if an adjustment to the ozone impact concentration was warranted.

2.2 Emissions

The Tier-1 assessment for ozone is conducted as a source impact analysis, as defined in Section 9.2.3(a)(i) of the *Guideline*.

Consistent with the EPA's *Guideline* and associated EPA technical guidance, the emissions increase used for the analysis is determined as follows:

i. Emissions for project new units are based on the unit's "allowable" emissions, consistent with Section 8.2.2(c) of the Guideline.

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[4] Ramboll Environ U.S. Corp., 2017: Potlatch St. Maries Kiln 6 PSD and Tribal Minor NSR Permit Application Modeling Protocol. Prepared for Potlatch Forest Products Corporation, St. Maries, Idaho, Project #29-22725N, September 2017.

ii. Emission increases for project modified, debottlenecked, affected, or associated units are based on the actual-to-potential basis, consistent with EPA guidance[5,6]. The emissions increase is determined as the difference of the existing unit's potential emission rate and actual emission rate, where the actual emission rate is determined as defined in 40 CFR 52.21(b)(21).

2.3 *Ozone Significant Impact Level*

The Tier 1 assessment provides an ozone impact from the project source precursor emissions that is then compared to the ozone Significant Impact Level (SIL). EPA has identified a SIL for ozone, based on supporting technical and legal analyses, to assist in determining whether a proposed PSD source would cause or contribute to a violation of the ozone NAAQS.[7] The SIL value for ozone identifies the air quality impact from a proposed PSD source that would not "cause or contribute to" a violation of an air quality standard, consistent with CAA 165(a)(3) and 40 CFR 52.21(k).

The EPA developed an 8-hour ozone NAAQS SIL of 1.0 ppb and released the ozone and fine particulate matter SILs draft memorandum, with the accompanying technical and legal supporting documents,[8] to the public on August 1, 2016 (corrected memorandum released on August 18, 2016). The EPA finalized the SILs guidance, including the technical and legal documents, in April 2018, maintaining a 1.0 ppb ozone SIL value. The MERPs guidance uses the same air quality impact level for ozone of 1.0 ppb to derive illustrative MERP values based on EPA modeling of a set of hypothetical sources across the country and to demonstrate how to use the MERPs approach in various example scenarios. Consistent with EPA guidance, PLL proposed to use the illustrative MERP values from the guidance to demonstrate that the projected ozone impacts from the proposed project would be less than the recommended ozone NAAQS SIL of 1.0 ppb. As such, this analysis would be sufficient to demonstrate that

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[5] U.S. EPA, 1990: New Source Review Workshop Manual [DRAFT]. Available at: https://www.epa.gov/sites/production/files/2015-07/documents/1990wman.pdf;

[6] Preamble to PSD and Nonattainment NSR: Baseline Emissions Determination, Actual-to-Future-Actual Methodology, Plantwide Applicability Limitations, Clean Units, Pollution Control Projects, 67 Fed. Reg. No. 251 (Dec. 31, 2002);

[7] Tsirigotis, P., 2018: Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program. U.S. EPA Office of Air Quality Planning and Standards memorandum to the Regional Air Division Directors, Region 1-10, dated April 17, 2018.

[7] Page, S., 2016: Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program [DRAFT]. U.S. EPA Office of Air Quality Planning and Standards memorandum to the Regional Air Division Directors, Region 1-10, first posted Aug. 1, 2016 and revised Aug. 18, 2016. [9] It should be noted, however, that the ozone assessment in the application was based on preliminary project emission estimates that were revised as part of the applicant's response to EPA's incompleteness determination. In addition, the ozone assessment in the application used the projected project emission calculations that are used to determine PSD applicability to represent the emissions increases from the project. As provided in Section 8.2.2(c) of the Guideline, emission increases used for the assessment are to be based on unit allowable emissions instead of projected actual emissions. These issues became irrelevant, however, when the applicant agreed to limit VOC emissions from the kiln to 50 tpy and EPA conducted an ozone assessment using the applicant's proposed methodology and the 50 tpy limit for the kiln.

the project would not cause or contribute to an ozone NAAQS violation. EPA Region 10 agreed with this proposed approach in our preliminary discussions with PLL.

3. SOURCE IMPACT ANALYSIS METHODOLOGY AND RESULTS

The source impact analysis for ozone conducted by PLL is included in Section 5.8 of the Application. The assessment was conducted in accordance with the agreed methodology outlined in PLL's modeling protocol[9] and in accordance with the EPA's *Guideline*, MERPs guidance, and final SILs guidance. In July 2018, PLL proposed an enforceable limit on the VOC emission increase from the new kiln of 50 tpy, resulting in a substantial reduction from the emissions originally projected from the project. EPA Region 10 conducted a revised ozone assessment based on the proposed emission limit with the methods and results summarized in this memo.

3.1 Project emissions

The projected actual-to-potential increases of VOC and NO_x emissions due to the project are 82.2 tpy and 86.6 tpy, respectively[10] (emission calculations provided in the Appendix to this memo). EPA used the project emission increases, summarized in **Table 1.** in the air quality analysis to estimate maximum ozone concentrations attributable to the project.

Table 1. Total project emissions increase for Ozone compliance demonstration.

Unit:	VOC emission (tpy)	NO_x emission (tpy)
New Kiln	50[a]	--
CE Boiler	0.8	29.3
Riley Boiler	2.0	57.3
Material handling fugitives	29.4	--
Total:	**82.2**	**86.6**

[a] Proposed enforceable VOC emission limit of 50 tpy

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[9] It should be noted, however, that the ozone assessment in the application was based on preliminary project emission estimates that were revised as part of the applicant's response to EPA's incompleteness determination. In addition, the ozone assessment in the application used the projected project emission calculations that are used to determine PSD applicability to represent the emissions increases from the project. As provided in Section 8.2.2(c) of the Guideline, emission increases used for the assessment are to be based on unit allowable emissions instead of projected actual emissions. These issues became irrelevant, however, when the applicant agreed to limit VOC emissions from the kiln to 50 tpy and EPA conducted an ozone assessment using the applicant's proposed methodology and the 50 tpy limit for the kiln.

[10] As discussed above, emission increases used in the source impact analysis are based on unit allowable emissions instead of projected actual emissions. PSD applicability determination is based on emission increases determined using projected actual emissions.

3.2 *Tier 1 Demonstration using MERPs*

The MERPs guidance provides modeled ozone concentration results based on EPA modeling for a set of hypothetical sources distributed about the lower 48 states. A number of scenarios were modeled for each hypothetical source. The scenarios varied by stack height and emission rate.

The MERPs guidance outlines an approach for determining the expected ambient concentration of pollutants attributable to emissions from a proposed project. The estimated level of ambient impact then can be compared to a SIL to determine, in conjunction with other available information, whether the proposed project would cause or contribute to a violation of a NAAQS. An assessment of ozone impacts must account for project VOC and NO_x emissions, even where project NO_x emissions are below the PSD SER. Ambient concentrations are estimated through a three-step process outlined in the MERPs guidance:

> Step 1) Identify a representative hypothetical source (or group of sources) from the EPA MERP guidance (see Table A-1 of the guidance). The hypothetical source(s) should be reflective of the source characteristics and located in a region with similar climate, background pollutant concentration, and regional emissions as the region of the project source.
>
> Step 2) Obtain the maximum 8-hour ozone impact concentration (and associated source emissions rate in tpy) from VOC and NO_x for the hypothetical source(s) from Table A-1 of the MERPs guidance.
>
> Step 3) Apply the EPA's hypothetical source modeling results for both VOC and NOx to estimate the projected maximum project ozone impact:
>
> $$Projected\ ozone\ impact\ (ppb) = \frac{TPY\ VOC\ from\ project}{TPY\ VOC\ from\ hypo.source} * C_{VOC\ contrib}(ppb) + \frac{TPY\ NOx\ from\ project}{TPY\ NOx\ from\ hypo.source} * C_{NOx\ contrib}(ppb)$$
>
> where C_{VOC} and C_{NOx} are the modeled maximum ozone concentrations attributable to emissions of VOC and NO_x, respectively, from the selected representative hypothetical source.

The applicant proposed in the modeling protocol to apply this three-step process using the most conservative hypothetical sources in the Pacific Northwest region.

3.2.1 *VOC speciation and reactivity analysis*

The applicant did not conduct a thorough examination of VOC speciation and reactivity, but did note formaldehyde represents at most 2% of VOC emissions from the project. The applicant also did not assess the reactivity of the other project VOCs.

EPA Region 10 conducted an examination of the VOC speciation from kiln emissions. VOC speciation was estimated using characteristic emission factors for wood kiln drying[11]. The estimated distribution of VOC species is reported in **Table 2**.

Table 2. Kiln #6 VOC emissions distribution.

VOC	Emission fraction
β-pinene	47%
α-pinene	22%
ethanol	14%
methanol	5%
acetic acid	2%
beta-phellandrene	2%
acetaldehyde	2%
others, including formaldehyde	6%

The maximum incremental reactivity (grams of ozone formed per gram of VOC added, "MIR") of pinenes is about 42% that of formaldehyde[12]. Ethanol and methanol are less reactive, with maximum incremental reactivities 16% and 7% of formaldehyde, respectively. The mixture of VOC species from the kiln emissions results in an average maximum reactivity much less than the formaldehyde scenario used in the MERPs guidance. EPA Region 10 estimated the Kiln 6 VOC mix will result in a MIR of about 3.2, compared to formaldehyde MIR of 9.2. The VOC emission mixture used in EPA's MERPs modeling had a combined average MIR of about 3.3. Therefore, direct use of the guidance modeling results without a reactivity adjustment is justified for this PSD compliance demonstration.

3.3 Tier 1 ozone source impact analysis results

The applicant identified five hypothetical sources in the Pacific Northwest region located nearest to St. Maries. These are listed in **Table 3** below. The maximum modeled ambient ozone concentrations for each source under the 500 tpy emission scenarios (scenarios with the least emissions in the MERPs guidance) for both VOC and NO_x were selected. Given the project emissions of 82.2 tpy of VOC and 86.6 tpy of NO_x are well below the modeled emission levels of 500 tpy, the applicant is justified in applying the 500 tpy emission scenarios (as opposed to the 1000 and 3000 tpy precursor emission scenarios).

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[11] National Council for Air and Stream Improvement, Inc. (NCASI), 2011: *Characterization, Measurement and Reporting of Volatile Organic Compounds Emitted from Southern Pine Wood Products Sources.* Technical Bulletin No. 991. Research Triangle Park, N.C.: National Council for Air and Stream Improvement, Inc.

[12] Carter, W.P., 2009: Updated maximum incremental reactivity scale and hydrocarbon bin reactivities for regulatory applications. UC Riverside Center for Environmental Research and Technology, CARB contract 07-339. Available at: https://www.arb.ca.gov/research/reactivity/reactivity.htm

Table 3. Hypothetical EPA sources identified by applicant and corresponding maximum 8-hour ozone impacts attributable to precursors (500 tpy scenarios, elevated stack).

Hypothetical Source	Precursor Pollutant	8-hour O_3 (ppb), elevated stack	8-hour O_3 (ppb), surface-level stack
Powder River, MT (source 7)	NO_x	1.70	1.51
	VOC	0.08	0.05
Yellowstone, MT (source 11)	NO_x	1.39	1.41
	VOC	0.13	0.16
Morrow, OR (source 18)	NO_x	1.94	1.94
	VOC	0.46	**0.46***
Skagit, WA (source 22)	NO_x	0.14	0.16
	VOC	0.22	0.19
Klickitat, WA (source 23)	NO_x	2.32	**2.52***
	VOC	0.03	0.04

* Selected scenarios for the source impact analysis highlighted in red

Hypothetical sources were modeled in both "elevated release" and "surface release" scenarios. In the elevated scenarios, a stack height of 90 meters was applied. The surface release scenarios used a stack height of 1 meter. All scenarios used stacks of 5 meters diameter, exit velocity of 27 m/s, and temperature of 311 ˚K. EPA Region 10 originally approved the use of the "elevated stack" scenarios proposed by the applicant because the maximum VOC response value was the same in both elevated and surface stack scenarios. Upon further consideration, the surface-level stack scenario is most representative, given project emissions will be emitted nearer to ground level than the 90 meters used in the elevated stack cases.

The applicant did not evaluate the representativeness of each source in terms of regional climate, terrain, or background concentrations. Instead, the applicant selected the most conservative source (i.e., with the highest modeled impact) for each precursor (source 23 for NO_x and source 18 for VOC). EPA Region 10 assessed the representativeness of these sources and agrees they are reasonably representative of the St. Maries region and the Potlatch source. Sources 18 and 23, selected for VOC and NO_x, respectively, are both located roughly 350 km southwest of the Potlatch facility and in an area generally similar in climate, background air quality, and regional background emission characteristics.

The project emissions reported in Table 1 and maximum 8-hour ozone impacts reported in Table 5 can be applied to the ozone impacts equation:

$$Projected\ ozone\ impact\ (ppb) = \frac{82.2\ tpy\ VOC}{500.0\ tpy\ VOC} * 0.46\ ppb + \frac{86.6\ tpy\ NOx}{500.0\ tpy\ NOx} * 2.52\ ppb = 0.51\ ppb$$

The Tier-1 estimate of maximum 8-hour ozone concentration impact attributable to the project is 0.51 ppb. This value is about half of the value of the ozone NAAQS SIL of 1.0 ppb. Therefore, based on the April 2018 ozone SILs guidance and supporting technical and legal documents, which are incorporated into the administrative record for this permit, we are able to conclude that the project will not cause or contribute to a violation of the ozone NAAQS.

3.4 *Considerations of Cumulative Impacts for Ozone*

In addition to the source impact analysis above, EPA Region 10 assessed the potential cumulative ozone impacts. EPA Region 10 identified the Cheney-Turnbill ozone monitor as the nearest and most representative active ozone monitor to the project site. The monitor is located roughly 75 kilometers west of St. Maries near the Turnbill Wildlife Refuge south of Cheney, WA. The fourth highest daily maximum 8-hour ozone concentrations measured in 2015, 2016, and 2017 were obtained from EPA's AQS system[13]. The ozone 8-hr NAAQS is based on the 3-year average of the annual 4th highest daily 8-hour maximum concentrations, reported in **Table 4**.

Table 4. Background ozone concentrations from the Cheney-Turnbill ozone monitor.

	4th high maximum 8-hr ozone concentration (ppb)
2015	66
2016	58
2017	65
3-year average	63
NAAQS	70

The background value of 63 ppb is below the ozone NAAQS of 70 ppb.

Therefore, even without relying on the SIL, a projected cumulative impact associated with the new project can be estimated by combining the results of the estimated Tier 1 ozone impacts from the project source (i.e., 0.51 ppb) and the monitored background concentration (i.e., 63 ppb). The resulting cumulative projection of 63.51 ppb of ozone is below the ozone 8-hour NAAQS of 70 ppb.

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[13] Ozone data from the Cheney-Turnbill monitor downloaded from EPA's AQS site at: https://epa.maps.arcgis.com/apps/webappviewer/index.html

APPENDIX: EMISSION CALCULATIONS

Table A-1. Total project emissions increase.

Unit:	VOC emission (tpy)	NO_x emission (tpy)
New Kiln	50[a]	--
CE Boiler	0.8	29.3
Riley Boiler	2.0	57.3
Material handling fugitives	29.4	--
Total:	**82.2**	**86.6**

[a]Proposed enforceable VOC emission limit of 50 tpy

Table A-2. CE Boiler project emissions.

Category	Steam (mmlb)	VOC emission* (tpy)	NO_x emission (tpy)
2015 operations	86.9	0.35	12.60
2016 operations	123.2	0.50	17.86
Actual (2-yr. average)	105.1	0.43	15.23
Potential	307.0	1.25	44.52
Increase (Potential – Actual)	--	**0.82**	**29.28**

*based on 8.15 lbs VOC/mmlb steam and 290 lbs NO_x/mmlb steam CE Boiler emission rates provided in the Response Letter.

Table A-3. Riley Boiler project emissions.

Category	Steam (mmlb)	VOC emission* (tpy)	NO_x emission (tpy)
2015 operations	406.3	1.9	54.85
2016 operations	514.3	2.4	69.43
Actual (2-yr. average)	460.3	2.15	62.14
Potential	885	4.13	119.48
Increase (Potential – Actual)	--	**2.0**	**57.33**

*based on 9.33 lbs VOC/mmlb steam and 270 lbs NO_x/mmlb steam Riley Boiler emission rates provided in the Response Letter

Table A-4. Material handling project emissions.

Category	Chips (BDT)	Sawdust (BDT)	Shavings (BDT)	Emissions VOC (tpy)
2015 operations	173381	19287	13421	19.06
2016 operations	168792	20990	13326	18.85
Actual (2-yr. average)	171086	20139	13374	18.96
Potential	429251	47649	43358	48.36
Increase (Potential – Actual)	--	--	--	**29.4**

*based on emission factors provided in the Response Letter:
0.175 lb/BDT chips, 0.240 lb/BDT sawdust, 0.232 lb/BDT shavings

Appendix E

EPA Region 10 HAP and VOC Emission Factors for Drying White Fir, Western Hemlock, Douglas Fir and Ponderosa Pine Lumber, April 2019

Lumber Kiln No. 6 Project
PotlatchDeltic - St. Maries Complex

Fact Sheet
PSD Permit No. R10PSD00100

St. Maries, Idaho

EPA Region 10 HAP and VOC Emission Factors for Drying White Fir, Western Hemlock, Douglas Fir and Ponderosa Pine Lumber, April 2019

This spreadsheet calculates and compiles volatile organic compound (VOC) and hazardous air pollutant (HAP) emission factors (EF) in units of pounds of pollutant per thousand board feet of lumber dried (lb/mbf) that EPA Region 10 is employing to estimate emissions from a lumber dry kiln that PotlatchDeltic is proposing to construct. The EFs are based on actual lab-scale emission test data.

A summary of the EFs for each species of wood is included on this sheet. The sheets that follow present the original test data as well as the calculations for creating each EF. There are two sheets per lumber species: one for HAPs and one for VOCs. The EFs represent the average of the data.

Species	Maximum Kiln Temperature (°F)	WPP1 VOC[1] (lb/mbf)	Total HAP (lb/mbf)	Methanol[2] (lb/mbf)	Formaldehyde[2] (lb/mbf)	Acetaldehyde (lb/mbf)	Propionaldehyde (lb/mbf)	Acrolein (lb/mbf)
Non-Resinous Softwood Species								
White Fir[3]	180	0.4271	0.1798	0.1220	0.0028	0.0550	0.0000	0.0000
	190	0.8657	0.2575	0.1964	0.0061			
	200	0.8229	0.2575	0.1964	0.0061			
	225	0.7046	0.3351	0.2708	0.0094			
	240	1.0800	0.4905	0.4195	0.0160			
Western Hemlock	180	0.3412	0.1778	0.0609	0.0011	0.1128	0.0012	0.0018
	200	0.4160	0.2180	0.1008	0.0014			
	215	0.5894	0.2581	0.1380	0.0043			
	225	0.5641	0.3181	0.1987	0.0036			
	235	0.4958	0.3073	0.1870	0.0045			
Resinous Softwood Species (Non-Pine Family)								
Douglas Fir	145	0.4521	0.0586	0.0130	0.0010	0.0430	0.0009	0.0008
	160	0.7718	0.0687	0.0230	0.0011			
	170	0.7127	0.0670	0.0217	0.0007			
	175	0.8323	0.0974	0.0515	0.0013			
	180	0.9495	0.1137	0.0670	0.0021			
	200	1.1337	0.1192	0.0723	0.0022			
	220	1.7632	0.1426	0.0947	0.0033			
	235	1.7253	0.1659	0.1170	0.0043			
Resinous Softwood Species (Pine Family)								
Ponderosa Pine	170	2.8489	0.1329	0.0350	0.0027	0.0884	0.0029	0.0039
	176	2.3950	0.1631	0.0650	0.0029			
	180	2.6586	0.1582	0.0580	0.0050			
	235	4.4337	0.2484	0.1440	0.0092			

[1] VOC emissions approximated consistent with EPA's Interim VOC Measurement Protocol for the Wood Products Industry - July 2007 (WPP1 VOC). WPP1 VOC underestimates emissions when the mass-to-carbon ratio of unidentified VOC exceeds that of propane. Ethanol and acetic acid are examples of compounds that contribute to lumber drying VOC emissions (for some species more than others), and both have mass-to-carbon ratios exceeding that of propane. Contribution of ethanol and acetic acid to VOC emissions has been quantified here when emissions testing data is available.

[2] Because methanol and formaldehyde emissions appear to be dependent upon drying temperature, separate values are calculated for different drying temperatures.

[3] White fir in this context refers to any one of several species of true fir grown in the West. The collection of timber commonly referred to as "white fir" includes the following species: white fir, grand fir, noble fir and subalpine fir.

Hazardous Air Pollutant Emission Factors for Drying White Fir Lumber

This sheet presents lab-scale test data and calculations used to create HAP EF for drying any one of several species of true fir grown in the West commonly referred to as "white fir." True fir includes the following species: white fir, grand fir, noble fir and subalpine fir; all classified in the same Abies genus. The EFs are based on the average value of actual lab-scale HAP test data.

Step One: Compile White Fir HAP Emission Test Data by Drying Temperature

Maximum Dry Bulb Temperature (°F)	Methanol (lb/mbf)	Formaldehyde (lb/mbf)	Acetaldehyde (lb/mbf)	Propionaldehyde (lb/mbf)	Acrolein (lb/mbf)	Lumber Dimensions	Moisture Content[1] (%) (Initial / Final)	Time to Final Moisture Content (hours)	HAP Sample Collection Technique	Reference
	0.096	0.0022	no data	no data	no data	2x6	122.0 / 15	42.6	NCASI Method IM/CAN/WP-99.01 without cannisters.	3, 4, 5, 12, 14
180	0.148	0.0034	no data	no data	no data	2x6	133.2 / 15	46.9		
225	no data	no data	0.0550	no data	no data	2x4	170 / 13	54	Dinitrophenylhydrazine coated cartridges.	7
240	0.42	0.0156	no data	no data	no data	2x6	126.3 / 15	24	NCASI chilled impinger method.	5
240	0.419	0.0163	no data	no data	no data	2x6	119.0 / 15	24		

[1] Dry basis. Moisture content = (weight of water / weight wood) x 100

Step Two: Calculate White Fir HAP Emission Factors Based on Average Test Data

Maximum Dry Bulb Temperature[1] (°F)	Methanol (lb/mbf)	Formaldehyde (lb/mbf)	Acetaldehyde (lb/mbf)	Propionaldehyde (lb/mbf)	Acrolein (lb/mbf)
180	0.1220	0.0028	0.0550	no data	no data
225	0.2708	0.0094			
240	0.4195	0.0160			

[1] Because methanol and formaldehyde emissions are dependent upon drying temperature, separate values are calculated for different drying temperatures.

Volatile Organic Compound Emission Factors for Drying White Fir Lumber

This sheet presents lab-scale VOC and HAP test data and calculations used to create VOC EF for drying any one of several species of true fir grown in the West commonly referred to as "white fir." True fir includes the following species: white fir, grand fir, noble fir and subalpine fir; all classified in the same Abies genus. The VOC test method used (EPA Reference Method 25A) has some limitations in that it misses some HAP (or portions of HAP) compounds that are VOC and known to exist and reports the results “as carbon” which only accounts for the carbon portion of each compound measured. The missed HAP compounds are accounted for through separate testing. The VOC test data is adjusted to fully account for five known HAPs that are VOC using separate HAP (speciated) test data and is reported “as propane” to better represent all of the unspeciated VOC compounds. This technique is consistent with EPA’s Interim VOC Measurement Protocol for the Wood Products Industry - July 2007 (WPP1 VOC) except that the VOC results are adjusted to account for not only methanol and formaldehyde but also acetaldehyde, propionaldehyde and acrolein.

Specifically, EFs are calculated from the VOC and HAP test data based on the average values of actual lab-scale test data. That portion of the (speciated) HAP compounds that are measured by the VOC test method (based on known flame ionization detector response factors) is subtracted from the VOC EF. The remaining “unspeciated” VOC EF is adjusted to represent propane rather than carbon and then added to the speciated HAP EF to provide the “total” VOC EF.

Note that reporting the unspeciated VOC as propane (mass-to-carbon ratio of 1.22 and a response factor of 1) may underestimate the actual mass of VOC for certain wood species because VOC compounds like ethanol and acetic acid with higher mass-to-carbon ratios (1.92 and 2.5, respectively) and lower response factors (0.66 and 0.575, respectively) can be a significant portion of the total VOC. Based upon the mass-to-carbon ratios and response factors noted above, 1 lb/mbf ethanol is reported as 0.4194 lb/mbf propane and 1 lb/mbf acetic acid is reported as 0.2806 lb/mbf propane through the use of EPA Reference Method 25A unless compound-specific sampling and analysis is performed. The contribution of ethanol and acetic acid has been quantified through sampling and analysis for Douglas Fir and Ponderosa Pine. For Douglas Fir, ethanol's contribution over three tests was measured to be 0, 1.4 and 5.4 percent of WPP1 VOC, and acetic acid's contribution over the same three tests was measured to be 37, 20 and 13 percent of WPP1 VOC. For Ponderosa Pine, ethanol's contribution over one test was measured to be 32 percent of WPP1 VOC, and acetic acid's contribution over the same test was measured to be 6.4 percent. Without reliable White Fir lumber drying test data for ethanol and acetic acid, EPA assumes propane adequately represents the mix of unspeciated VOC.

Step One: Compile White Fir VOC Emission Test Data by Drying Temperature

Temperature (°F)	Method 25A VOC as Carbon (lb/mbf)	Lumber Dimensions	Moisture Content[1] (%) (Initial/Final)	Time to Final Moisture Content (hours)	Method 25A Analyzer	Reference
180	0.26	2x6	106.3 / 15	36.6	JUM 3-200	3, 4
180	0.27	2x6	113.6 / 15	43.2		
180	0.22	2x6	122.0 / 15	42.6	JUM 3-200	3, 4, 5, 12
180	0.25	2x6	133.2 / 15	46.9		
190	0.63	2x4	138.1 / 15	70	JUM VE-7	2
190	0.50	2x4	138.1 / 15	75		
200	0.53	2x4	96.1 / 15	47		
225	0.39	2x4	170 / 13	54	JUM VE-7	7
240	0.62	2x6	126.3 / 15	25	JUM 3-200	5
240	0.6	2x6	119.0 / 15	25		

[1] Dry basis. Moisture content = (weight of water / weight wood) x 100

Step Two: Calculate White Fir VOC Emission Factors "as Carbon" Based on Average Test Data

Maximum Dry Bulb Temperature[1] (°F)	Method 25A VOC as Carbon (lb/mbf)
180	0.2500
190	0.5650
200	0.5300
225	0.3900
240	0.6100

[1] Because VOC emissions are dependent upon drying temperature, separate values are calculated for different drying temperatures.

Step Three: Compile White Fir Speciated HAP Emission Factors Based on Average Test Data[1]

Maximum Dry Bulb Temperature (°F)	Methanol (lb/mbf)	Formaldehyde (lb/mbf)	Acetaldehyde (lb/mbf)	Propionaldehyde (lb/mbf)	Acrolein (lb/mbf)
180	0.1220	0.0028	0.0550		
190[2]	0.1964	0.0061			
200[2]	0.1964	0.0061			
225	0.2708	0.0094			
240	0.4195	0.0160			

[1] See white fir HAP sheet for lab-scale test data and calculations.

[2] In the absence of actual measurements, values for methanol and formaldehyde at 190F and 200F are average of values for nearest surrounding drying temperatures at 180F and 225F.

Step Four: Convert White Fir Speciated HAP Emission Factors to "as Carbon" and Total

Speciated Compound "X" expressed as carbon = (RF_X) X (SC_X) X $[(MW_C) / (MW_X)]$ X $[(\#C_X) / (\#C_C)]$

where: RF_X represents the flame ionization detector (FID) response factor (RF) for speciated compound "X"

SC_X represents emissions of speciated compound "X" expressed as the entire mass of compound emitted

MW_C equals "12.0110" representing the molecular weight (MW) for carbon as carbon is becoming the "basis" for expressing mass of speciated compound "X"

MW_X represents the molecular weight for speciated compound "X"

$\#C_X$ represents the number of carbon atoms in speciated compound "X"

$\#C_C$ equals "1" as the single carbon atom is becoming the "basis" for expressing mass of speciated compound "X"

Maximum Dry Bulb Temperature (°F)	Methanol as Carbon (lb/mbf)	Formaldehyde as Carbon (lb/mbf)	Acetaldehyde as Carbon (lb/mbf)	Propionaldehyde as Carbon (lb/mbf)	Acrolein as Carbon (lb/mbf)		Speciated Compounds as Carbon (lb/mbf)
180	0.0329	0	0.0150	0.0000	0.0000		0.0479
190	0.0530	0					0.0680
200	0.0530	0					0.0680
225	0.0731	0				SUM ⇨	0.0881
240	0.1132	0					0.1282

Element and Compound Information

Element / Compound	FID RF[1]	Molecular Weight (lb/lb-mol)	Formula	Number of Carbon Atoms	Number of Hydrogen Atoms	Number of Oxygen Atoms	Reference
Methanol	0.72	32.042	CH_40	1	4	1	1
Formaldehyde	0	30.0262	CH_2O	1	2	1	16
Acetaldehyde	0.5	44.053	C_2H_4O	2	4	1	20
Propionaldehyde	0.66	58.0798	C_3H_6O	3	6	1	20
Acrolein	0.66	56.064	C_3H_4O	3	4	1	20
Propane	1	44.0962	C_3H_8	3	8	0	16
Carbon	-	12.0110	C	1	-	-	-
Hydrogen	-	1.0079	H	-	1	-	-
Oxygen	-	15.9994	O	-	-	1	-

[1] FID RF = volumetric concentration or "instrument display" / compound's actual known concentration. Numerator and denominator expressed on same basis (ie. carbon, propane, etc) and concentration in units of "ppm."

Step Five: Subtract Speciated HAP Compounds from White Fir VOC Emission Factors and Convert Result to "as Propane"

	FROM STEP TWO		FROM STEP FOUR				
Maximum Dry Bulb Temperature (°F)	Method 25A VOC as Carbon (lb/mbf)		Speciated Compounds as Carbon (lb/mbf)		Method 25A VOC as Carbon without Speciated Compounds (lb/mbf)	Propane Mass Conversion Factor	Method 25A VOC as Propane without Speciated Compounds (lb/mbf)
180	0.2500		0.0479		0.2021		0.2473
190	0.5650		0.0680		0.4970		0.6082
200	0.5300		0.0680		0.4620		0.5654
225	0.3900	MINUS	0.0881	EQUALS	0.3019		0.3695
240	0.6100	⇨	0.1282	⇨	0.4818	X 1.2238 =	0.5896

Method 25A VOC as propane without speciated compounds = (VOC_C) X $(1/RF_{C3H8})$ X $[(MW_{C3H8}) / (MW_C)]$ X $[(\#C_C) / (\#C_{C3H8})]$

where: VOC_C represents Method 25A VOC as carbon without speciated compounds

RF_{C3H8} equals "1" and represents the FID RF for propane. All alkanes, including propane, have a RF of 1.

MW_{C3H8} equals "44.0962" and represents the molecular weight for propane; the compound that is the "basis" for expressing mass of VOC per WPP1 VOC

MW_C equals "12.0110" and represents the molecular weight for carbon

$\#C_C$ equals "1" as the single carbon atom was the "basis" for which Method 25A VOC test results were determined as illustrated in Step One of this spreadsheet

$\#C_{C3H8}$ equals "3" as three carbon atoms are present within propane; the compound that is the "basis" for expressing mass of VOC per WPP1 VOC

Note: The following portion from the equation immediately above, $(1/RF_{C3H8})$ X $[(MW_{C3H8}) / (MW_C)]$ X $[(\#C_C) / (\#C_{C3H8})]$, equals 1.2238 and can be referred to as the "propane mass conversion factor."

Step Six: Calculate WPP1 VOC by Adding Speciated HAP Compounds to White Fir VOC Emission Factors "as Propane"

WPP1 VOC = Method 25A VOC as propane without speciated compounds + ∑ speciated compounds expressed as the entire mass of compound

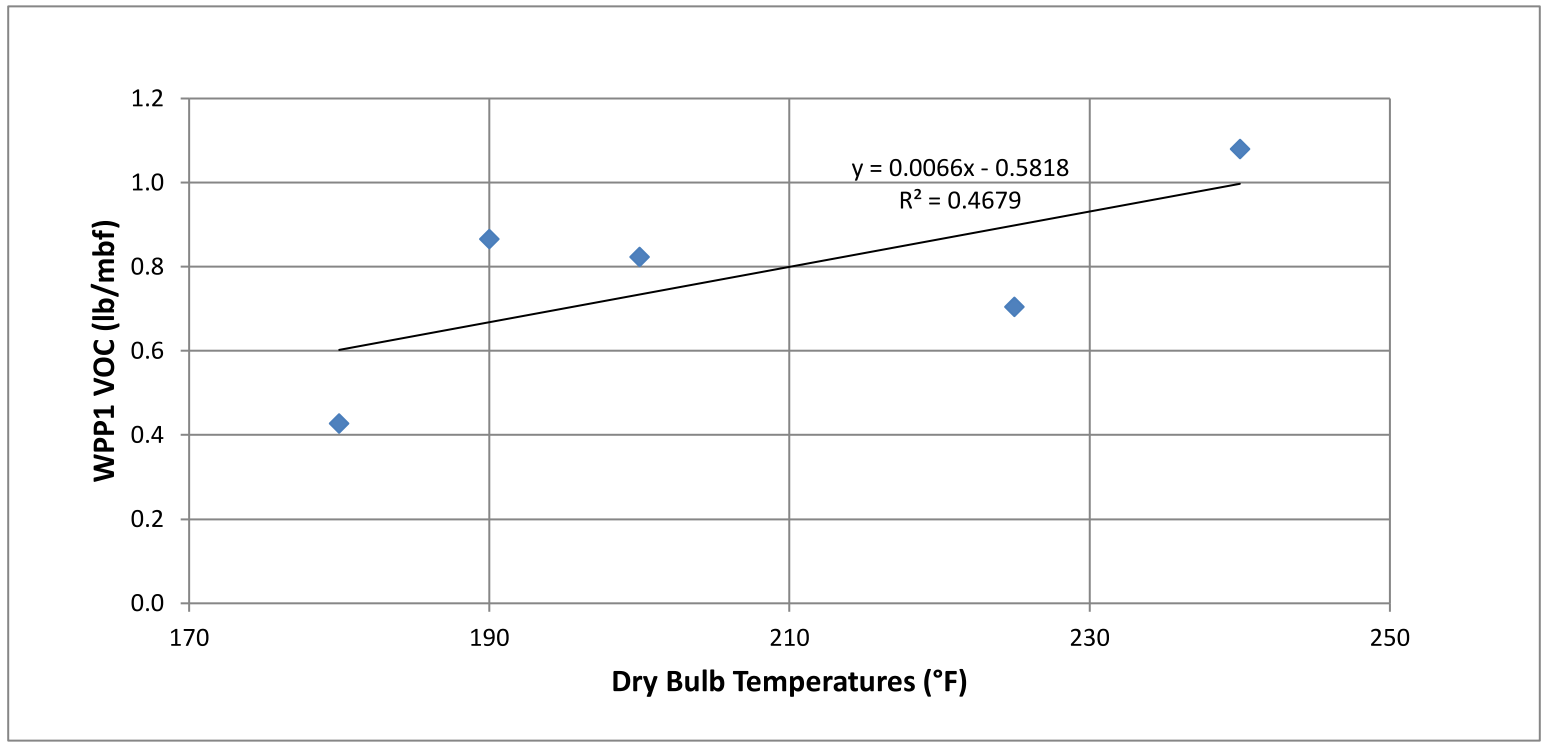
	FROM STEP FIVE
Maximum Dry Bulb Temperature (°F)	Method 25A VOC as Propane without Speciated Compounds (lb/mbf)
180	0.2473
190	0.6082
200	0.5654
225	0.3695
240	0.5896

PLUS

FROM STEP THREE				
Methanol (lb/mbf)	Formaldehyde (lb/mbf)	Acetaldehyde (lb/mbf)	Propionaldehyde (lb/mbf)	Acrolein (lb/mbf)
0.1220	0.0028	0.0550	0.0000	0.0000
0.1964	0.0061			
0.1964	0.0061			
0.2708	0.0094			
0.4195	0.0160			

EQUALS

WPP1 VOC (lb/mbf)
0.4271
0.8657
0.8229
0.7046
1.0800



Hazardous Air Pollutant Emission Factors for Western Hemlock Lumber

This sheet presents lab-scale test data and calculations used to create HAP EF for drying western hemlock lumber. The EFs are based on the average value of actual lab-scale HAP test data.

Step One: Compile Western Hemlock HAP Emission Test Data by Drying Temperature

Maximum Dry Bulb Temperature (°F)	Methanol (lb/mbf)	Formaldehyde (lb/mbf)	Acetaldehyde (lb/mbf)	Propionaldehyde (lb/mbf)	Acrolein (lb/mbf)	Lumber Dimensions	Moisture Content[1] (%) (Initial / Final)	Time to Final Moisture Content (hours)	HAP Sample Collection Technique	Reference
	0.083	0.0013	no data	no data	no data	2x4	102.3 / 14.7	49.5	NCASI Method 98.01	14, 15
180	0.075	0.0014	0.078	0.002	0.0012	2x4	102.3 / 14.7	49.5	NCASI Method 105	14, 15, 18
180	0.094	0.0015	0.141	0.0008	0.0012	2x4 or 2x6	93.5 / 17.5	no data	NCASI Method 105	18
180	0.052	0.0007	no data	no data	no data	2x4	88.8 / 15	46.2	NCASI Method CI//WP-98.01	13
180	0.0312	0.00082	no data	no data	no data	2x4	56.8 / 15	38.35	NCASI Method CI//WP-98.01	8, 11, 14
180	0.0304	0.00082	no data	no data	no data	2x4	51.1 / 15	35.75		
200	0.098	0.0015	no data	no data	no data	2x6	81.0 / 15	45.2	NCASI Method CI//WP-98.01	11, 14
200	0.175	0.0016	no data	no data	no data	2x6	73.7 / 15	36.5		
200	0.154	0.0018	no data	no data	no data	2x6	100.1 / 15	47.4		
200	0.044	0.0008	0.133	0.0008	0.0024	2x4 or 2x6	83.9 / 15.0	no data	NCASI Method 105	14, 18
200	0.077	0.0014	0.128	0.001	0.0011	2x4 or 2x6	98.6 / 15.0	no data		
200	0.057	0.0014	no data	no data	no data	2x4	76.0 / 15	30.25	NCASI Method CI//WP-98.01	9, 11, 14
215	0.138	0.0043	no data	no data	0.0027	2x4	119.7 / 15	38	no data	6, 11, 14
225	0.189	0.0035	no data	no data	no data	2x6	82 / 15	31.3	NCASI Method CI//WP-98.01	11, 14
225	0.167	0.0034	no data	no data	no data	2x6	77.4 / 15	28.6		
225	0.24	0.004	no data	no data	no data	2x6	101.7 / 15	33.5		
235	0.187	0.0045	0.084	0.0014	0.0019	2x4 or 2x6	76.2 / 15.0	no data	NCASI Method 105	18

[1] Dry basis. Moisture content = (weight of water / weight wood) x 100

Step Two: Calculate Western Hemlock HAP Emission Factors Based on Average Test Data

Maximum Dry Bulb Temperature[1] (°F)	Methanol (lb/mbf)	Formaldehyde (lb/mbf)	Acetaldehyde (lb/mbf)	Propionaldehyde (lb/mbf)	Acrolein (lb/mbf)
180	0.0609	0.0011	0.1128	0.0012	0.0018
200	0.1008	0.0014			
215	0.1380	0.0043			
225	0.1987	0.0036			
235	0.1870	0.0045			

[1] Because methanol and formaldehyde emissions are dependent upon drying temperature, separate values are calculated for different drying temperatures.

Volatile Organic Compound Emission Factors for Drying Western Hemlock Lumber

This sheet presents lab-scale VOC and HAP test data and calculations used to create VOC EF for drying any one of several species of true fir grown in the West commonly referred to as "white fir." True fir includes the following species: white fir, grand fir, noble fir and subalpine fir; all classified in the same Abies genus. The VOC test method used (EPA Reference Method 25A) has some limitations in that it misses some HAP (or portions of HAP) compounds that are VOC and known to exist and reports the results “as carbon” which only accounts for the carbon portion of each compound measured. The missed HAP compounds are accounted for through separate testing. The VOC test data is adjusted to fully account for five known HAPs that are VOC using separate HAP (speciated) test data and is reported “as propane” to better represent all of the unspeciated VOC compounds. This technique is consistent with EPA’s Interim VOC Measurement Protocol for the Wood Products Industry - July 2007 (WPP1 VOC) except that the VOC results are adjusted to account for not only methanol and formaldehyde but also acetaldehyde, propionaldehyde and acrolein.

Specifically, EFs are calculated from the VOC and HAP test data based on the average values of actual lab-scale test data. That portion of the (speciated) HAP compounds that are measured by the VOC test method (based on known flame ionization detector response factors) is subtracted from the VOC EF. The remaining “unspeciated” VOC EF is adjusted to represent propane rather than carbon and then added to the speciated HAP EF to provide the “total” VOC EF.

Note that reporting the unspeciated VOC as propane (mass-to-carbon ratio of 1.22 and a response factor of 1) may underestimate the actual mass of VOC for certain wood species because VOC compounds like ethanol and acetic acid with higher mass-to-carbon ratios (1.92 and 2.5, respectively) and lower response factors (0.66 and 0.575, respectively) can be a significant portion of the total VOC. Based upon the mass-to-carbon ratios and response factors noted above, 1 lb/mbf ethanol is reported as 0.4194 lb/mbf propane and 1 lb/mbf acetic acid is reported as 0.2806 lb/mbf propane through the use of EPA Reference Method 25A unless compound-specific sampling and analysis is performed. The contribution of ethanol and acetic acid has been quantified through sampling and analysis for Douglas Fir and Ponderosa Pine. For Douglas Fir, ethanol's contribution over three tests was measured to be 0, 1.4 and 5.4 percent of WPP1 VOC, and acetic acid's contribution over the same three tests was measured to be 37, 20 and 13 percent of WPP1 VOC. For Ponderosa Pine, ethanol's contribution over one test was measured to be 32 percent of WPP1 VOC, and acetic acid's contribution over the same test was measured to be 6.4 percent. Without reliable Western Hemlock lumber drying test data for ethanol and acetic acid, EPA assumes propane adequately represents the mix of unspeciated VOC.

Step One: Compile Western Hemlock VOC Emission Test Data by Drying Temperature[1]

Temperature (°F)	Method 25A VOC as Carbon (lb/mbf)	Lumber Dimensions	Moisture Content[2] (%) (Initial/Final)	Time to Final Moisture Content (hours)	Method 25A Analyzer	Reference
180	~~0.73~~	2x6	126.6 / 15	66.5	no data	11
180	~~0.66~~	2x6	139.3 / 15	67.9		
180	~~0.6~~	2x6	127.8 / 15	65.7		
180	~~0.67~~	2x6	132.7 / 15	67		
180	0.17	2x4	114.8 / 15	45	no data	11
180	0.07	2x4	103.1 / 15	40.7		
180	0.12	2x4	98.0 / 15	37.5		
180	0.4	2x4	115.7 / 15	52.9		
180	0.236	2x4 or 2x6	93.5 / 17.5	no data	JUM VE-7	18
180	0.142	2x4	102.3 / 14.7	49.5	JUM VE-7	15, 18
180	0.18	2x4	88.8 / 15	46.2	JUM VE-7	13
180	0.198	2x4	56.8 / 15	38.35	JUM 3-200	8, 11
180	0.122	2x4	51.1 / 15	35.75		
200	0.24	2x4	112.8 / 15	40	JUM VE-7	2
200	0.2	2x6	81.0 / 15	45.2	no data	11
200	0.15	2x6	73.7 / 15	36.5		
200	0.3	2x6	100.1 / 15	47.4		
200	0.204	2x4	76.0 / 15	30.25	JUM 3-200	9, 11
200	0.214	2x4 or 2x6	83.9 / 15.0	no data	JUM VE-7	18
200	0.239	2x4 or 2x6	98.6 / 15.0	no data		
215	0.34	2x4	112.9 / 15	32.7	no data	11
215	0.34	2x4	119.7 / 15	38	JUM 3-200	6, 11
225	0.28	2x6	82 / 15	31.3	no data	11
225	0.27	2x6	77.4 / 15	28.6		
225	0.31	2x6	101.7 / 15	33.5		
235	0.247	2x4 or 2x6	81.6 / 15.0	no data	JUM VE-7	18
235	0.226	2x4 or 2x6	76.2 / 15.0	no data		

[1] Blue highlight denotes data not considered by EPA Region 10 in 2012. The four test runs not considered here were obtained from a single "sample" and appeared to use a much longer drying cycle than would be in common use in the Pacific Northwest. Therefore, these highlighted values were not used in the EF derivation.

[2] Dry basis. Moisture content = (weight of water / weight wood) x 100

Step Two: Calculate Western Hemlock VOC Emission Factors "as Carbon" Based on Average Test Data

Maximum Dry Bulb Temperature[1] (°F)	Method 25A VOC as Carbon (lb/mbf)
180	0.1820
200	0.2210
215	0.3400
225	0.2867
235	0.2365

[1] Because VOC emissions are dependent upon drying temperature, separate values are calculated for different drying temperatures.

Step Three: Compile Western Hemlock Speciated HAP Emission Factors Based on Average Test Data[1]

Maximum Dry Bulb Temperature (°F)	Methanol (lb/mbf)	Formaldehyde (lb/mbf)	Acetaldehyde (lb/mbf)	Propionaldehyde (lb/mbf)	Acrolein (lb/mbf)
180	0.0609	0.0011	0.1128	0.0012	0.0018
200	0.1008	0.0014			
215	0.1380	0.0043			
225	0.1987	0.0036			
235	0.1870	0.0045			

[1] See western hemlock HAP sheet for lab-scale test data and calculations.

Step Four: Convert Western Hemlock Speciated HAP Emission Factors to "as Carbon" and Total

Speciated Compound "X" expressed as carbon = $(RF_X) \times (SC_X) \times [(MW_C) / (MW_X)] \times [(\#C_X) / (\#C_C)]$

where: RF_X represents the flame ionization detector (FID) response factor (RF) for speciated compound "X"

SC_X represents emissions of speciated compound "X" expressed as the entire mass of compound emitted

MW_C equals "12.0110" representing the molecular weight (MW) for carbon as carbon is becoming the "basis" for expressing mass of speciated compound "X"

MW_X represents the molecular weight for speciated compound "X"

$\#C_X$ represents the number of carbon atoms in speciated compound "X"

$\#C_C$ equals "1" as the single carbon atom is becoming the "basis" for expressing mass of speciated compound "X"

Maximum Dry Bulb Temperature (°F)	Methanol as Carbon (lb/mbf)	Formaldehyde as Carbon (lb/mbf)	Acetaldehyde as Carbon (lb/mbf)	Propionaldehyde as Carbon (lb/mbf)	Acrolein as Carbon (lb/mbf)		Speciated Compounds as Carbon (lb/mbf)
180	0.0164	0	0.0308	0.0005	0.0007		0.0484
200	0.0272	0					0.0592
215	0.0372	0					0.0692
225	0.0536	0				SUM	0.0856
235	0.0505	0				⇨	0.0825

Element and Compound Information

Element / Compound	FID RF[1]	Molecular Weight (lb/lb-mol)	Formula	Number of Carbon Atoms	Number of Hydrogen Atoms	Number of Oxygen Atoms	Reference
Methanol	0.72	32.042	CH_40	1	4	1	1
Formaldehyde	0	30.0262	CH_2O	1	2	1	16
Acetaldehyde	0.5	44.053	C_2H_4O	2	4	1	20
Propionaldehyde	0.66	58.0798	C_3H_6O	3	6	1	20
Acrolein	0.66	56.064	C_3H_4O	3	4	1	20
Propane	1	44.0962	C_3H_8	3	8	0	16
Carbon	-	12.0110	C	1	-	-	-
Hydrogen	-	1.0079	H	-	1	-	-
Oxygen	-	15.9994	O	-	-	1	-

[1] FID RF = volumetric concentration or "instrument display" / compound's actual known concentration. Numerator and denominator expressed on same basis (ie. carbon, propane, etc) and concentration in units of "ppm."

Step Five: Subtract Speciated HAP Compounds from Western Hemlock VOC Emission Factors and Convert Result to "as Propane"

	FROM STEP TWO
Maximum Dry Bulb Temperature (°F)	Method 25A VOC as Carbon (lb/mbf)
180	0.1820
200	0.2210
215	0.3400
225	0.2867
235	0.2365

MINUS

FROM STEP FOUR
Speciated Compounds as Carbon (lb/mbf)
0.0484
0.0592
0.0692
0.0856
0.0825

EQUALS

Method 25A VOC as Carbon without Speciated Compounds (lb/mbf)
0.1336
0.1618
0.2708
0.2011
0.1540

Propane Mass Conversion Factor

X 1.2238 =

Method 25A VOC as Propane without Speciated Compounds (lb/mbf)
0.1635
0.1980
0.3314
0.2461
0.1885

Method 25A VOC as propane without speciated compounds = (VOC_C) X ($1/RF_{C3H8}$) X [(MW_{C3H8}) / (MW_C)] X [($\#C_C$) / ($\#C_{C3H8}$)]

where: VOC_C represents Method 25A VOC as carbon without speciated compounds

RF_{C3H8} equals "1" and represents the FID RF for propane. All alkanes, including propane, have a RF of 1.

MW_{C3H8} equals "44.0962" and represents the molecular weight for propane; the compound that is the "basis" for expressing mass of VOC per WPP1 VOC

MW_C equals "12.0110" and represents the molecular weight for carbon

$\#C_C$ equals "1" as the single carbon atom was the "basis" for which Method 25A VOC test results were determined as illustrated in Step One of this spreadsheet

$\#C_{C3H8}$ equals "3" as three carbon atoms are present within propane; the compound that is the "basis" for expressing mass of VOC per WPP1 VOC

Note: The following portion from the equation immediately above, ($1/RF_{C3H8}$) X [(MW_{C3H8}) / (MW_C)] X [($\#C_C$) / ($\#C_{C3H8}$)], equals 1.2238 and can be referred to as the "propane mass conversion factor."

Step Six: Calculate WPP1 VOC by Adding Speciated HAP Compounds to Western Hemlock VOC Emission Factors "as Propane"

WPP1 VOC = Method 25A VOC as propane without speciated compounds + ∑ speciated compounds expressed as the entire mass of compound

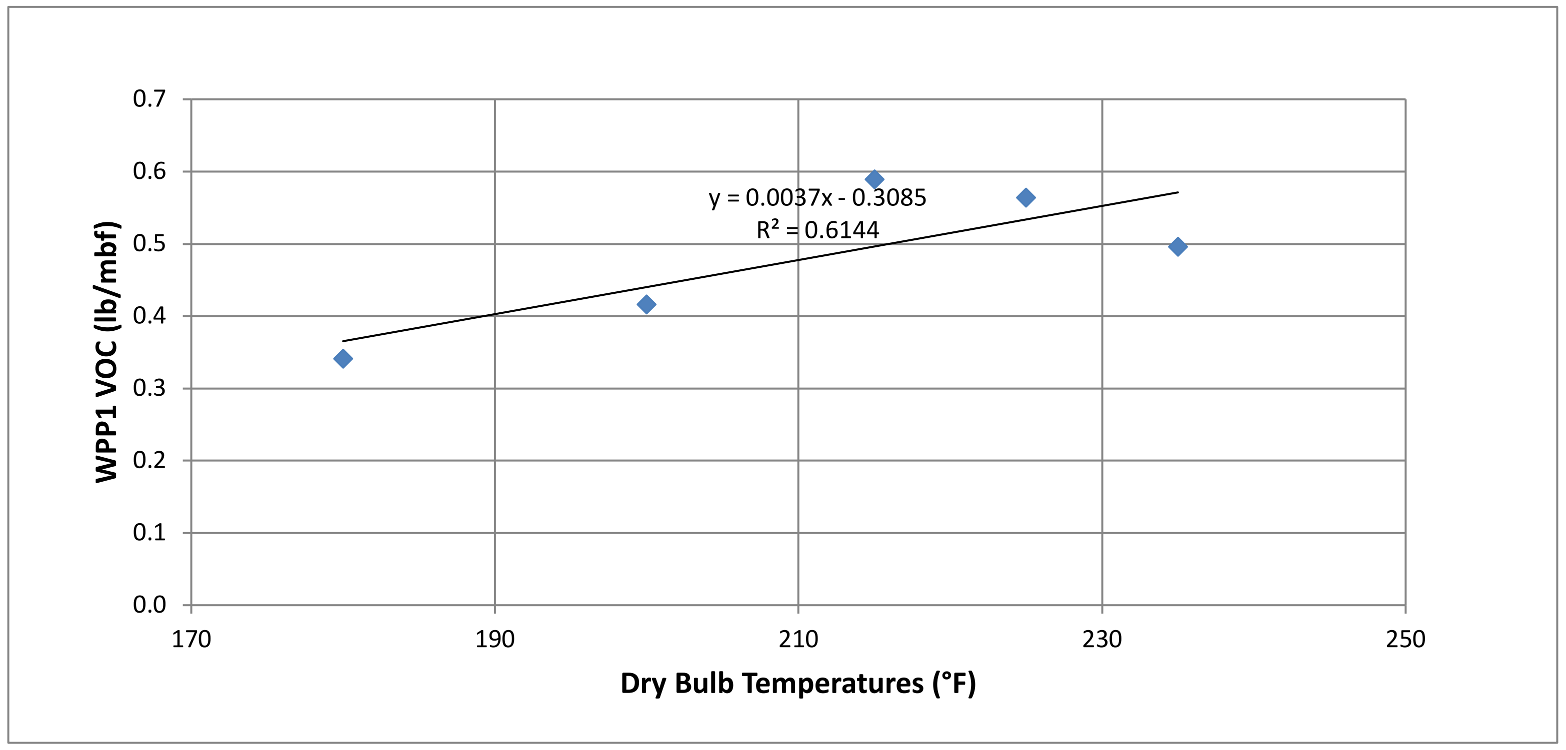
	FROM STEP FIVE
Maximum Dry Bulb Temperature (°F)	Method 25A VOC as Propane without Speciated Compounds (lb/mbf)
180	0.1635
200	0.1980
215	0.3314
225	0.2461
235	0.1885

PLUS

FROM STEP THREE				
Methanol (lb/mbf)	Formaldehyde (lb/mbf)	Acetaldehyde (lb/mbf)	Propionaldehyde (lb/mbf)	Acrolein (lb/mbf)
0.0609	0.0011	0.1128	0.0012	0.0018
0.1008	0.0014			
0.1380	0.0043			
0.1987	0.0036			
0.1870	0.0045			

EQUALS

WPP1 VOC (lb/mbf)
0.3412
0.4160
0.5894
0.5641
0.4958



Hazardous Air Pollutant Emission Factors for Drying Douglas Fir Lumber

This sheet presents lab-scale test data and calculations used to create HAP EF for drying douglas fir lumber. The EFs are based on the average value of actual lab-scale HAP test data.

Step One: Compile Douglas Fir HAP Emission Test Data by Drying Temperature[1]

Maximum Dry Bulb Temperature (°F)	Methanol (lb/mbf)	Formaldehyde (lb/mbf)	Acetaldehyde (lb/mbf)	Propionaldehyde (lb/mbf)	Acrolein (lb/mbf)	Lumber Dimensions	Moisture Content[2] (%) (Initial / Final)	Time to Final Moisture Content (hours)	HAP Sample Collection Technique	Reference
	0.013	0.001	0.057	0.005	0.000	2x4	49.6 / 15	39.7	NCASI ISS/FP-A105.01	Link to June 8, 2012 Exterior Wood Test Report
160	0.025	0.0008	no data	no data	no data	2x6	37.3 / 15	23.5	NCASI Method IM/CAN/WP-99.01 without cannisters.	3, 4, 12, 14
160	0.023	0.0008	no data	no data	no data	2x6	44.9 / 15	28.5		
160	0.026	0.0017	no data	no data	no data	2x6	40.3 / 15	27.1		
160	0.018	0.0011	no data	no data	no data	2x6	31.9 / 15	25.2		
170	0.015	0.0005	no data	no data	no data	2x4	79.9 / 15	40.5	NCASI Method CI//WP-98.01	13
170	0.026	0.0008	no data	no data	no data	2x4	56.9 / 15	27.5	NCASI Method 98.01	15
170	0.024	0.0008	0.03	0.0004	0.0005	2x4	56.9 / 15	27.5	NCASI Method 105	15, 18
175	0.019	0.001	0.006	0.0001	0.0004	2x4	32.5 / 15	17.8	NCASI ISS/FP-A105.01	Link to May 23, 2013 Sierra Pacific Industries - Centralia Test
175	0.084	0.0016	0.042	0.0002	0.0008	4x5	39.5 / 15	150	NCASI ISS/FP-A105.01	Link to March 24, 2015 Columbia Vista Test Report
180	0.050	0.0023	0.050	0.0005	0.0009	2x4	43.7 / 15	48	NCASI Method 105	18, 22
180	0.084	0.0019	0.061	0.0003	0.0007	4x4	44.7 / 15	111	NCASI Method 105	19
200	0.068	0.0018	0.043	0.0005	0.0009	2x4	64.3 / 15	60	NCASI Method 105	14, 18, 22
200	0.069	0.0019	0.071	0.0006	0.0004	2x4	59.5 / 15	56		
200	0.080	0.003	0.037	0.0006	0.0017	2x4	69.3 / 15	20.8	NCASI ISS/FP-A105.01	Link to February 10, 2012 Hampton Lumber - Morton Test Report
220	no data	no data	0.030	no data	no data	2x4	73 / 12	46	Dinitrophenylhydrazine coated cartridges.	7
220	no data	no data	0.022	no data	no data	2x4	73 / 15	46		
235	0.117	0.0043	0.067	0.0008	0.0012	2x4 or 2x6	47.7 / 15	19	NCASI Method 105	18, 21

[1] Yellow highlight denotes data first considered by EPA Region 10 after developing December 2012 EFs. Notice of December 2012 EFs was provided to Indian Country sawmill industry in a February 8, 2013 letter.

[2] Dry basis. Moisture content = (weight of water / weight wood) x 100

Step Two: Calculate Douglas Fir HAP Emission Factors Based on Average Test Data

Maximum Dry Bulb Temperature[1] (°F)	Methanol (lb/mbf)	Formaldehyde (lb/mbf)	Acetaldehyde (lb/mbf)	Propionaldehyde (lb/mbf)	Acrolein (lb/mbf)
145	0.0130	0.0010	0.0430	0.0009	0.0008
160	0.0230	0.0011			
170	0.0217	0.0007			
175	0.0515	0.0013			
180	0.0670	0.0021			
200	0.0723	0.0022			
220[2]	0.0947	0.0033			
235	0.1170	0.0043			

[1] Because methanol and formaldehyde emissions are dependent upon drying temperature, separate values are calculated for different drying temperatures.

[2] In the absence of actual measurements, values for methanol and formaldehyde at 220F are average of values for nearest surrounding drying temperatures at 200F and 235F.

Volatile Organic Compound Emission Factors for Drying Douglas Fir Lumber

This sheet presents lab-scale VOC and HAP test data and calculations used to create VOC EF for drying any one of several species of true fir grown in the West commonly referred to as "white fir." True fir includes the following species: white fir, grand fir, noble fir and subalpine fir; all classified in the same Abies genus. The VOC test method used (EPA Reference Method 25A) has some limitations in that it misses some HAP (or portions of HAP) compounds that are VOC and known to exist and reports the results “as carbon” which only accounts for the carbon portion of each compound measured. The missed HAP compounds are accounted for through separate testing. The VOC test data is adjusted to fully account for five known HAPs that are VOC using separate HAP (speciated) test data and is reported “as propane” to better represent all of the unspeciated VOC compounds. This technique is consistent with EPA’s Interim VOC Measurement Protocol for the Wood Products Industry - July 2007 (WPP1 VOC) except that the VOC results are adjusted to account for not only methanol and formaldehyde but also acetaldehyde, propionaldehyde and acrolein.

Specifically, EFs are calculated from the VOC and HAP test data based on the average values of actual lab-scale test data. That portion of the (speciated) HAP compounds that are measured by the VOC test method (based on known flame ionization detector response factors) is subtracted from the VOC EF. The remaining “unspeciated” VOC EF is adjusted to represent propane rather than carbon and then added to the speciated HAP EF to provide the “total” VOC EF.

Step One: Compile Douglas Fir VOC Emission Test Data by Drying Temperature[1]

Maximum Dry Bulb	Method 25A VOC as Carbon (lb/mbf)	Lumber Dimensions	Moisture Content[2] (%) (Initial/Final)	Time to Final Moisture Content (hours)	Method 25A Analyzer	Reference
145	0.24	2x4	49.6 / 15	39.7	JUM VE-7	Link to June 8, 2012 Exterior Wood Test Report
160	0.51	2x6	37.3 / 15	23.5	JUM 3-200	3, 4, 12
160	0.55	2x6	44.9 / 15	28.5		
160	0.45	2x6	40.3 / 15	27.1		
160	0.46	2x6	31.9 / 15	25.2		
170	0.65	2x4	79.9 / 15	40.5	JUM VE-7	13
170	0.24	2x4	56.9 / 15	27.5	JUM VE-7	15, 18
175	0.185	2x4	32.5 / 15	17.8	JUM VE-7	Link to May 23, 2013 Sierra Pacific Industries - Centralia Test Report
175	0.86	4x5	39.5 / 15	150	JUM VE-7	Link to March 24, 2015 Columbia Vista Test Report
180	0.942	2x4	38.9 / 15	63	JUM VE-7	2
180	0.669	2x4	44.9 / 15	42		
180	0.21	2x4	56.3 / 15	27		
180	0.575	2x4 or 2x6	43.7 / 15	no data	JUM VE-7	18
180	0.39	4x4	29.8 / 19	67.5	JUM 3-200	10
180	0.845	4x4	44.7 / 15	111	JUM VE-7	19
200	0.707	2x4 or 2x6	64.3 / 15	no data	JUM VE-7	18
200	0.879	2x4 or 2x6	59.5 / 15	no data		
200	0.66	2x4	69.3 / 15	20.8	JUM VE-7	Link to February 10, 2012 Hampton Lumber - Morton Test Report
220	1.2	2x4	73 / 12	46	JUM VE-7	7
220	1.3	2x4	73 / 15	46		
235	1.206	2x4 or 2x6	47.7 / 15	19	JUM VE-7	18, 21

[1] Yellow highlight denotes data first considered by EPA Region 10 after developing December 2012 EFs. Notice of December 2012 EFs was provided to Indian Country sawmill industry in a February 8, 2013 letter.

[2] Dry basis. Moisture content = (weight of water / weight wood) x 100.

Step Two: Calculate Douglas Fir VOC Emission Factors "as Carbon" Based on Average Test Data

Maximum Dry Bulb Temperature[1] (°F)	Method 25A VOC as Carbon (lb/mbf)
145	0.2400
160	0.4925
170	0.4450
175	0.5225
180	0.6052
200	0.7487
220	1.2500
235	1.2060

[1] Because VOC emissions are dependent upon drying temperature, separate values are calculated for different drying temperatures.

Step Three: Compile Douglas Fir Speciated HAP Emission Factors Based on Average Test Data[1]

Maximum Dry Bulb Temperature (°F)	Methanol (lb/mbf)	Formaldehyde (lb/mbf)	Acetaldehyde (lb/mbf)	Propionaldehyde (lb/mbf)	Acrolein (lb/mbf)
145	0.0130	0.0010	0.0430	0.0009	0.0008
160	0.0230	0.0011			
170	0.0217	0.0007			
175	0.0515	0.0013			
180	0.0670	0.0021			
200	0.0723	0.0022			
220	0.0947	0.0033			
235	0.1170	0.0043			

[1] See douglas fir HAP sheet for lab-scale test data and calculations.

Step Four: Compile Douglas Fir Speciated Non-HAP Emission Test Data by Drying Temperature[1]

Maximum Dry Bulb Temperature (°F)	Ethanol (lb/mbf)	Acetic Acid (lb/mbf)	Lumber Dimensions	Moisture Content[2] (%) (Initial / Final)	Time to Final Moisture Content (hours)	VOC Sample Collection Technique	Reference
145	0.0000	0.166	2x4	49.6 / 15	39.7	NCASI ISS/FP-A105.01	Link to June 8, 2012 Exterior Wood Test Report
175	0.0010	0.094	2x4	32.5 / 15	17.8	NCASI ISS/FP-A105.01	Link to May 23, 2013 Sierra Pacific Industries - Centralia Test Report
175	0.0230	0.242	4x6	39.5 / 15	150	NCASI ISS/FP-A105.01	Link to March 24, 2015 Columbia Vista Test Report
200	0.0610	0.142	2x4	69.3 / 15	20.8	NCASI ISS/FP-A105.01	Link to February 10, 2012 Hampton Lumber - Morton Test Report

[1] Yellow highlight denotes data first considered by EPA Region 10 <u>after</u> developing December 2012 EFs. Notice of December 2012 EFs was provided to Indian Country sawmill industry in a February 8, 2013 letter.

Step Five: Calculate Douglas Fir Speciated Non-HAP Emission Factors Based on Average Test Data[1]

Maximum Dry Bulb Temperature (°F)	Ethanol (lb/mbf)	Acetic Acid (lb/mbf)
145	0.0000	0.1660
160[2]	0.0060	0.1665
170[2]	0.0060	0.1670
175	0.0120	0.1680
180[2]	0.0365	0.1550
200	0.0610	0.1420
220[2]	0.0610	0.1420
235[2]	0.0610	0.1420

[1] EPA Region 10 assumes ethanol and acetic acid emissions are dependent upon drying temperature based upon Method 25A observations. Therefore, separate speciated VOC values are calculated for different drying temperatures.

[2] In the absence of actual measurements, estimated values for ethanol and acetic acid at 160F and 170F are average of measured values for nearest surrounding drying temperatures at 145F and 175F, estimated value at 180F is average of measured values at 175F and 200F, and estimated values at 220F and 235F are equal to measured value at 200F.

Step Six: Convert Douglas Fir Speciated HAP and Non-HAP Emission Factors to "as Carbon" and Total

Speciated Compound "X" expressed as carbon = (RF_X) X (SC_X) X [(MW_C) / (MW_X)] X [($\#C_X$) / ($\#C_C$)]

where: RF_X represents the flame ionization detector (FID) response factor (RF) for speciated compound "X"

SC_X represents emissions of speciated compound "X" expressed as the entire mass of compound emitted

MW_C equals "12.0110" representing the molecular weight (MW) for carbon as carbon is becoming the "basis" for expressing mass of speciated compound "X"

MW_X represents the molecular weight for speciated compound "X"

$\#C_X$ represents the number of carbon atoms in speciated compound "X"

$\#C_C$ equals "1" as the single carbon atom is becoming the "basis" for expressing mass of speciated compound "X"

Maximum Dry Bulb Temperature (°F)	Methanol as Carbon (lb/mbf)	Formaldehyde as Carbon (lb/mbf)	Acetaldehyde as Carbon (lb/mbf)	Propionaldehyde as Carbon (lb/mbf)	Acrolein as Carbon (lb/mbf)	Ethanol as Carbon (lb/mbf)	Acetic Acid as Carbon (lb/mbf)
145	0.0035	0	0.0117	0.0004	0.0003	0.0000	0.0382
160	0.0062	0				0.0021	0.0383
170	0.0058	0				0.0021	0.0384
175	0.0139	0				0.0041	0.0386
180	0.0181	0				0.0126	0.0357
200	0.0195	0				0.0210	0.0327
220	0.0255	0				0.0210	0.0327
235	0.0316	0				0.0210	0.0327

SUM ⇨

Speciated Compounds as Carbon (lb/mbf)
0.0541
0.0590
0.0587
0.0691
0.0787
0.0856
0.0916
0.0976

Element and Compound Information

Element / Compound	FID RF[1]	Molecular Weight (lb/lb-mol)	Formula	Number of Carbon Atoms	Number of Hydrogen Atoms	Number of Oxygen Atoms	Reference
Methanol	0.72	32.042	CH_40	1	4	1	1
Formaldehyde	0	30.0262	CH_2O	1	2	1	16
Acetaldehyde	0.5	44.053	C_2H_4O	2	4	1	20
Propionaldehyde	0.66	58.0798	C_3H_6O	3	6	1	20
Acrolein	0.66	56.064	C_3H_4O	3	4	1	20
Ethanol	0.66	46.0688	C_2H_6O	2	6	1	1
Acetic Acid	0.575	60.0524	$C_2H_4O_2$	2	4	2	1
Propane	1	44.0962	C_3H_8	3	8	0	16
Carbon	-	12.0110	C	1	-	-	-
Hydrogen	-	1.0079	H	-	1	-	-
Oxygen	-	15.9994	O	-	-	1	-

[1] FID RF = volumetric concentration or "instrument display" / compound's actual known concentration. Numerator and denominator expressed on same basis (ie. carbon, propane, etc) and concentration in units of "ppm."

Step Seven: Subtract Speciated HAP and Non-HAP Compounds from Douglas Fir VOC Emission Factors and Convert Result to "as Propane"

	FROM STEP TWO		FROM STEP SIX				
Maximum Dry Bulb Temperature (°F)	Method 25A VOC as Carbon (lb/mbf)		Speciated Compounds as Carbon (lb/mbf)		Method 25A VOC as Carbon without Speciated Compounds (lb/mbf)		Method 25A VOC as Propane without Speciated Compounds (lb/mbf)
145	0.2400		0.0541		0.1859		0.2275
160	0.4925		0.0590		0.4335		0.5305
170	0.4450		0.0587		0.3863	Propane Mass Conversion	0.4727
175	0.5225		0.0691		0.4534		0.5549
180	0.6052		0.0787		0.5265		0.6443
200	0.7487		0.0856		0.6631		0.8115
220	1.2500	MINUS	0.0916	EQUALS	1.1584		1.4176
235	1.2060		0.0976		1.1084	X 1.2238 =	1.3564

Method 25A VOC as propane without speciated compounds = (VOC_C) X $(1/RF_{C3H8})$ X $[(MW_{C3H8}) / (MW_C)]$ X $[(\#C_C) / (\#C_{C3H8})]$

where: VOC_C represents Method 25A VOC as carbon without speciated compounds

RF_{C3H8} equals "1" and represents the FID RF for propane. All alkanes, including propane, have a RF of 1.

MW_{C3H8} equals "44.0962" and represents the molecular weight for propane; the compound that is the "basis" for expressing mass of VOC per WPP1 VOC

MW_C equals "12.0110" and represents the molecular weight for carbon

$\#C_C$ equals "1" as the single carbon atom was the "basis" for which Method 25A VOC test results were determined as illustrated in Step One of this spreadsheet

$\#C_{C3H8}$ equals "3" as three carbon atoms are present within propane; the compound that is the "basis" for expressing mass of VOC per WPP1 VOC

Note: The following portion from the equation immediately above, $(1/RF_{C3H8})$ X $[(MW_{C3H8}) / (MW_C)]$ X $[(\#C_C) / (\#C_{C3H8})]$, equals 1.2238 and can be referred to as the "propane mass conversion factor."

Step Eight: Calculate WPP1 VOC by Adding Speciated HAP and Non-HAP Compounds to Douglas Fir VOC Emission Factors "as Propane"

WPP1 VOC = Method 25A VOC as propane without speciated compounds + ∑ speciated compounds expressed as the entire mass of compound

	FROM STEP SEVEN
Maximum Dry Bulb Temperature (°F)	Method 25A VOC as Propane without Speciated Compounds (lb/mbf)
145	0.2275
160	0.5305
170	0.4727
175	0.5549
180	0.6443
200	0.8115
220	1.4176
235	1.3564

PLUS

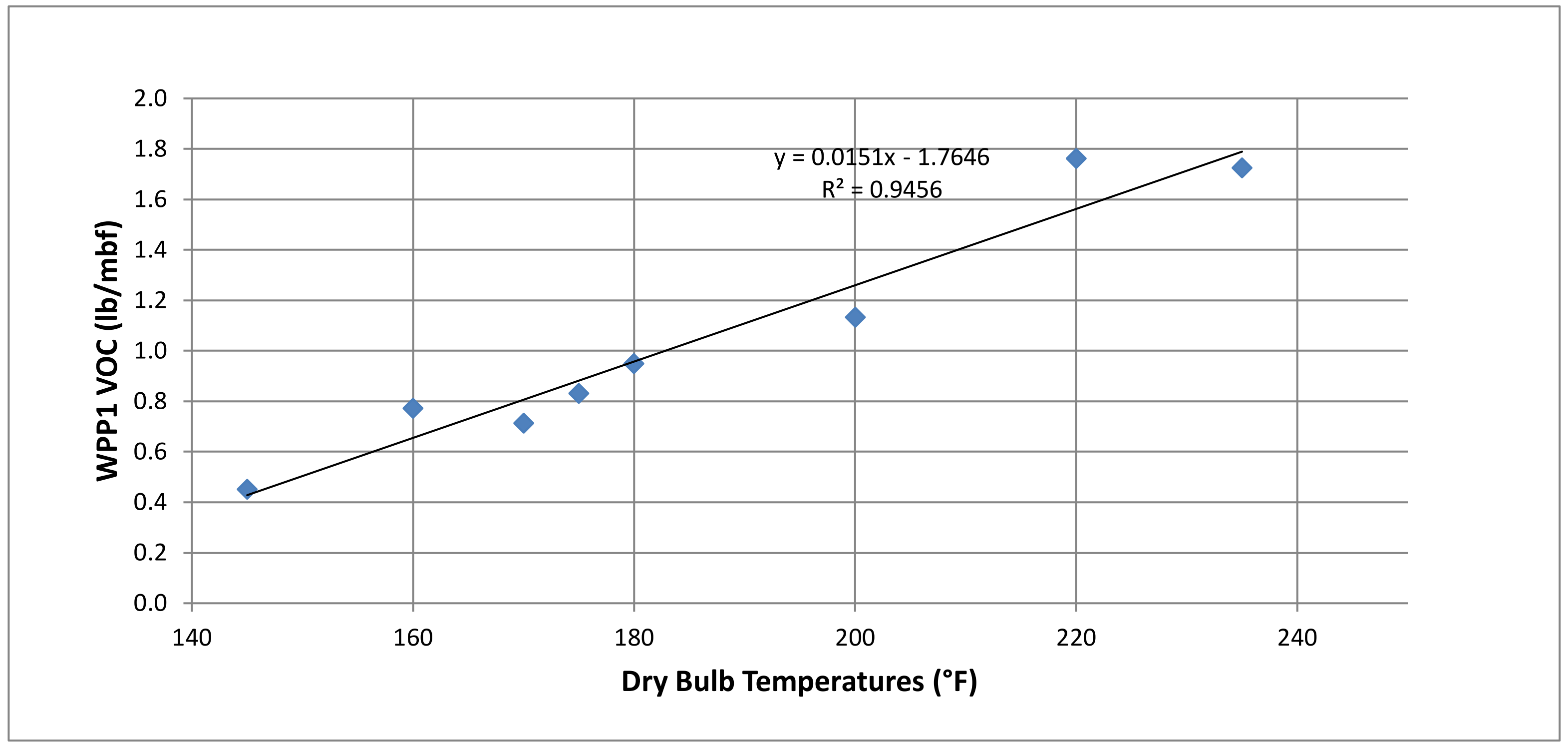
FROM STEP THREE				
Methanol (lb/mbf)	Formaldehyde (lb/mbf)	Acetaldehyde (lb/mbf)	Propionaldehyde (lb/mbf)	Acrolein (lb/mbf)
0.0130	0.0010	0.0430	0.0009	0.0008
0.0230	0.0011			
0.0217	0.0007			
0.0515	0.0013			
0.0670	0.0021			
0.0723	0.0022			
0.0947	0.0033			
0.1170	0.0043			

PLUS

FROM STEP FIVE	
Ethanol (lb/mbf)	Acetic Acid (lb/mbf)
0.0000	0.1660
0.0060	0.1665
0.0060	0.1670
0.0120	0.1680
0.0365	0.1550
0.0610	0.1420
0.0610	0.1420
0.0610	0.1420

EQUALS

WPP1 VOC (lb/mbf)
0.4521
0.7718
0.7127
0.8323
0.9495
1.1337
1.7632
1.7253



y = 0.0151x - 1.7646
R² = 0.9456
WPP1 VOC (lb/mbf)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
140
160
180
200
220
240
Dry Bulb Temperatures (°F)

Hazardous Air Pollutant Emission Factors for Drying Ponderosa Pine Lumber

This sheet presents lab-scale test data and calculations used to create HAP EF for drying ponderosa pine lumber. The EFs are based on the average value of actual lab-scale HAP test data.

Step One: Compile Ponderosa Pine HAP Emission Test Data by Drying Temperature[1]

Maximum Dry Bulb Temperature (°F)	Methanol (lb/mbf)	Formaldehyde (lb/mbf)	Acetaldehyde (lb/mbf)	Propionaldehyde (lb/mbf)	Acrolein (lb/mbf)	Lumber Dimensions	Moisture Content[2] (%) (Initial / Final)	Time to Final Moisture Content (hours)	HAP Sample Collection Technique	Reference
	0.035	0.0027	0.042	0.0019	0.0017	2x4	82.6 / 15	42	NCASI Method 105	17, 18
176	0.05	0.0022	no data	no data	no data	2x10 & 2x12	107.1 / 12	55	NCASI Method IM/CAN/WP-99.01 without cannisters	3, 4, 12, 14
176	0.08	0.0036	no data	no data	no data	2x10 & 2x12	124.1 / 12	57		
180	0.058	0.005	0.100	0.0035	0.0055	2x4	103.9 / 15	39.4	NCASI Method 105	Link to March 7, 2013 Hampton Affiliates - Randle Test Report
235	0.144	0.0092	0.028	0.0032	0.0045	2x4 or 2x6	89.1 / 15	19	NCASI Method 105	18, 21

[1] Yellow highlight denotes data first considered by EPA Region 10 after developing December 2012 EFs. Notice of December 2012 EFs was provided to Indian Country sawmill industry in a February 8, 2013 letter.

[2] Dry basis. Moisture content = (weight of water / weight wood) x 100

Step Two: Calculate Ponderosa Pine HAP Emission Factors Based on Average Test Data

Maximum Dry Bulb Temperature[1] (°F)	Methanol (lb/mbf)	Formaldehyde (lb/mbf)	Acetaldehyde (lb/mbf)	Propionaldehyde (lb/mbf)	Acrolein (lb/mbf)
170	0.0350	0.0027	0.0884	0.0034	0.0053
176	0.0650	0.0029			
180	0.0580	0.0050			
235	0.1440	0.0092			

[1] Because methanol and formaldehyde emissions are dependent upon drying temperature, separate values are calculated for different drying temperatures.

Volatile Organic Compound Emission Factors for Drying Ponderosa Pine Lumber

This sheet presents lab-scale VOC and HAP test data and calculations used to create VOC EF for drying any one of several species of true fir grown in the West commonly referred to as "white fir." True fir includes the following species: white fir, grand fir, noble fir and subalpine fir; all classified in the same Abies genus. The VOC test method used (EPA Reference Method 25A) has some limitations in that it misses some HAP (or portions of HAP) compounds that are VOC and known to exist and reports the results “as carbon” which only accounts for the carbon portion of each compound measured. The missed HAP compounds are accounted for through separate testing. The VOC test data is adjusted to fully account for five known HAPs that are VOC using separate HAP (speciated) test data and is reported “as propane” to better represent all of the unspeciated VOC compounds. This technique is consistent with EPA’s Interim VOC Measurement Protocol for the Wood Products Industry - July 2007 (WPP1 VOC) except that the VOC results are adjusted to account for not only methanol and formaldehyde but also acetaldehyde, propionaldehyde and acrolein.

Specifically, EFs are calculated from the VOC and HAP test data based on the average values of actual lab-scale test data. That portion of the (speciated) HAP compounds that are measured by the VOC test method (based on known flame ionization detector response factors) is subtracted from the VOC EF. The remaining “unspeciated” VOC EF is adjusted to represent propane rather than carbon and then added to the speciated HAP EF to provide the “total” VOC EF.

Step One: Compile Ponderosa Pine VOC Emission Test Data by Drying Temperature[1]

Maximum Dry Bulb	Method 25A VOC as Carbon (lb/mbf)	Lumber Dimensions	Moisture Content[2] (%) (Initial/Final)	Time to Final Moisture Content (hours)	Method 25A Analyzer	Reference
170	1.59	2x4	82.6 / 15	42	JUM VE-7	17, 18
170	1.795	1x4	112.8 / 15	29	JUM VE-7	2
170	1.925	1x4	88.7 / 15	28		
176	1.29	2x10 & 2x12	107.1 / 12	55	JUM 3-200	3, 4, 12
176	1.54	2x10 & 2x12	124.1 / 12	57		
176	1.40	2x10 & 2x12	114.8 / 12	58.5	JUM 3-200	3, 4
176	1.30	2x10 & 2x12	93.0 / 12	57.1		
180	1.48	2x4	103.9 / 15	39.4	JUM VE-7	Link to March 7, 2013 Hampton Affiliates - Randle Test Report
180	1.72	2x4	122.0 / 15	43.6		
235	3.00	2x4 or 2x6	89.1 / 15	19	JUM VE-7	18, 21

[1] Yellow highlight denotes data first considered by EPA Region 10 after developing December 2012 EFs. Notice of December 2012 EFs was provided to Indian Country sawmill industry in a February 8, 2013 letter.

[2] Dry basis. Moisture content = (weight of water / weight wood) x 100

Step Two: Calculate Ponderosa Pine VOC Emission Factors "as Carbon" Based on Average Test Data

Maximum Dry Bulb Temperature[1] (°F)	Method 25A VOC as Carbon (lb/mbf)
170	1.7700
176	1.3825
180	1.6000
235	3.0000

[1] Because VOC emissions are dependent upon drying temperature, separate values are calculated for different drying temperatures.

Step Three: Compile Ponderosa Pine Speciated HAP Emission Factors Based on Average Test Data[1]

Maximum Dry Bulb Temperature (°F)	Methanol (lb/mbf)	Formaldehyde (lb/mbf)	Acetaldehyde (lb/mbf)	Propionaldehyde (lb/mbf)	Acrolein (lb/mbf)
170	0.0350	0.0027	0.0884	0.0029	0.0039
176	0.0650	0.0029			
180	0.0580	0.0050			
235	0.1440	0.0092			

[1] See ponderosa pine HAP sheet for lab-scale test data and calculations.

Step Four: Compile Ponderosa Pine Speciated Non-HAP Emission Test Data by Drying Temperature[1]

Maximum Dry Bulb Temperature (°F)	Ethanol (lb/mbf)	Acetic Acid (lb/mbf)	Lumber Dimensions	Moisture Content[2] (%) (Initial / Final)	Time to Final Moisture Content (hours)	VOC Sample Collection Technique	Reference
180	0.826	0.162	2x4	103.9 / 15	39.4	NCASI Method 105	Link to March 7, 2013 Hampton Affiliates - Randle Test Report

[1] Yellow highlight denotes data first considered by EPA Region 10 after developing December 2012 EFs. Notice of December 2012 EFs was provided to Indian Country sawmill industry in a February 8, 2013 letter.

[2] Dry basis. Moisture content = (weight of water / weight wood) x 100

Step Five: Calculate Ponderosa Pine Speciated Non-HAP Emission Factors Based on Average Test Data[1]

Maximum Dry Bulb Temperature (°F)	Ethanol (lb/mbf)	Acetic Acid (lb/mbf)
170[2]	0.826	0.162
176[2]	0.826	0.162
180	0.826	0.162
235[2]	0.826	0.162

[1] EPA Region 10 assumes ethanol and acetic acid emissions are dependent upon drying temperature based upon Method 25A observations. Therefore, separate speciated VOC values are calculated for different drying temperatures.

[2] In the absence of actual measurements, estimated values for ethanol and acetic acid at 170F, 176F and 235F are equal to measured value at 180F.

Step Six: Convert Ponderosa Pine Speciated HAP and Non-HAP Emission Factors to "as Carbon" and Total

Speciated Compound "X" expressed as carbon = $(RF_X) \times (SC_X) \times [(MW_C) / (MW_X)] \times [(\#C_X) / (\#C_C)]$

where: RF_X represents the flame ionization detector (FID) response factor (RF) for speciated compound "X"

SC_X represents emissions of speciated compound "X" expressed as the entire mass of compound emitted

MW_C equals "12.0110" representing the molecular weight (MW) for carbon as carbon is becoming the "basis" for expressing mass of speciated compound "X"

MW_X represents the molecular weight for speciated compound "X"

$\#C_X$ represents the number of carbon atoms in speciated compound "X"

$\#C_C$ equals "1" as the single carbon atom is becoming the "basis" for expressing mass of speciated compound "X"

Maximum Dry Bulb Temperature (°F)	Methanol as Carbon (lb/mbf)	Formaldehyde as Carbon (lb/mbf)	Acetaldehyde as Carbon (lb/mbf)	Propionaldehyde as Carbon (lb/mbf)	Acrolein as Carbon (lb/mbf)	Ethanol as Carbon (lb/mbf)	Acetic Acid as Carbon (lb/mbf)
170	0.0094	0	0.0241	0.0012	0.0017	0.2843	0.0373
176	0.0175	0				0.2843	0.0373
180	0.0157	0				0.2843	0.0373
235	0.0389	0				0.2843	0.0373

SUM ⇨

Speciated Compounds as Carbon (lb/mbf)
0.3579
0.3660
0.3641
0.3873

Element and Compound Information

Element / Compound	FID RF[1]	Molecular Weight (lb/lb-mol)	Formula	Number of Carbon Atoms	Number of Hydrogen Atoms	Number of Oxygen Atoms	Reference
Methanol	0.72	32.042	CH_40	1	4	1	1
Formaldehyde	0	30.0262	CH_2O	1	2	1	16
Acetaldehyde	0.5	44.053	C_2H_4O	2	4	1	20
Propionaldehyde	0.66	58.0798	C_3H_6O	3	6	1	20
Acrolein	0.66	56.064	C_3H_4O	3	4	1	20
Ethanol	0.66	46.0688	C_2H_6O	2	6	1	1
Acetic Acid	0.575	60.0524	$C_2H_4O_2$	2	4	2	1
Propane	1	44.0962	C_3H_8	3	8	0	16
Carbon	-	12.0110	C	1	-	-	-
Hydrogen	-	1.0079	H	-	1	-	-
Oxygen	-	15.9994	O	-	-	1	-

[1] FID RF = volumetric concentration or "instrument display" / compound's actual known concentration. Numerator and denominator expressed on same basis (ie. carbon, propane, etc) and concentration in units of "ppm."

Step Seven: Subtract Speciated HAP and Non-HAP Compounds from Ponderosa Pine VOC Emission Factors and Convert Result to "as Propane"

	FROM STEP TWO
Maximum Dry Bulb Temperature (°F)	Method 25A VOC as Carbon (lb/mbf)
170	1.7700
176	1.3825
180	1.6000
235	3.0000

MINUS

FROM STEP SIX
Speciated Compounds as Carbon (lb/mbf)
0.3579
0.3660
0.3641
0.3873

EQUALS

Method 25A VOC as Carbon without Speciated Compounds (lb/mbf)
1.4121
1.0165
1.2359
2.6127

Propane Mass Conversion Factor

X 1.2238 =

Method 25A VOC as Propane without Speciated Compounds (lb/mbf)
1.7281
1.2440
1.5124
3.1973

Method 25A VOC as propane without speciated compounds = (VOC_C) X ($1/RF_{C3H8}$) X [(MW_{C3H8}) / (MW_C)] X [($\#C_C$) / ($\#C_{C3H8}$)]

where: VOC_C represents Method 25A VOC as carbon without speciated compounds

RF_{C3H8} equals "1" and represents the FID RF for propane. All alkanes, including propane, have a RF of 1.

MW_{C3H8} equals "44.0962" and represents the molecular weight for propane; the compound that is the "basis" for expressing mass of VOC per WPP1 VOC

MW_C equals "12.0110" and represents the molecular weight for carbon

$\#C_C$ equals "1" as the single carbon atom was the "basis" for which Method 25A VOC test results were determined as illustrated in Step One of this spreadsheet

$\#C_{C3H8}$ equals "3" as three carbon atoms are present within propane; the compound that is the "basis" for expressing mass of VOC per WPP1 VOC

Note: The following portion from the equation immediately above, ($1/RF_{C3H8}$) X [(MW_{C3H8}) / (MW_C)] X [($\#C_C$) / ($\#C_{C3H8}$)], equals 1.2238 and can be referred to as the "propane mass conversion factor."

Step Eight: Calculate WPP1 VOC by Adding Speciated HAP and Non-HAP Compounds to Ponderosa Pine VOC Emission Factors "as Propane"

WPP1 VOC = Method 25A VOC as propane without speciated compounds + ∑ speciated compounds expressed as the entire mass of compound

	FROM STEP SEVEN
Maximum Dry Bulb Temperature (°F)	Method 25A VOC as Propane without Speciated Compounds (lb/mbf)
170	1.7281
176	1.2440
180	1.5124
235	3.1973

PLUS

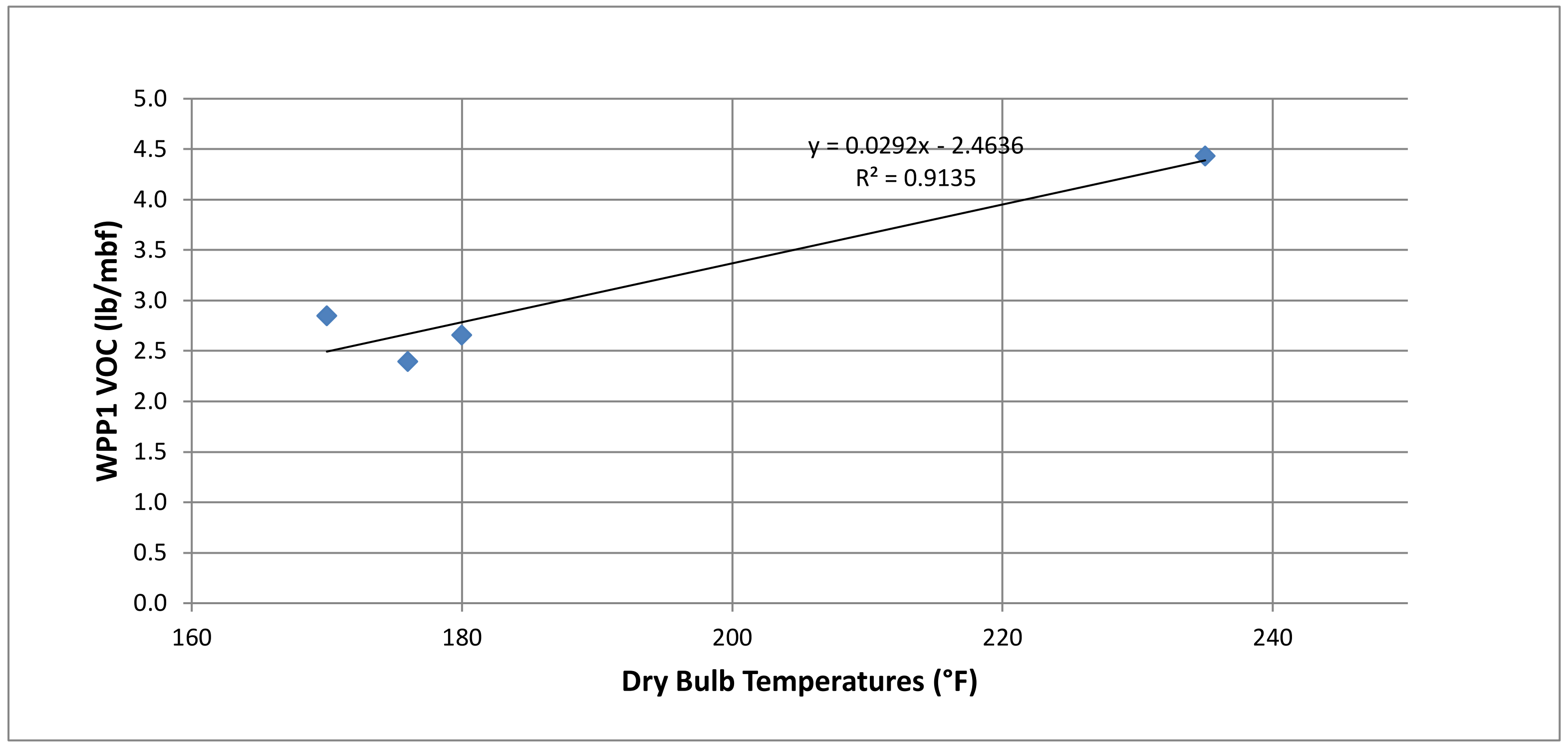
FROM STEP THREE				
Methanol (lb/mbf)	Formaldehyde (lb/mbf)	Acetaldehyde (lb/mbf)	Propionaldehyde (lb/mbf)	Acrolein (lb/mbf)
0.0350	0.0027	0.0884	0.0029	0.0039
0.0650	0.0029			
0.0580	0.0050			
0.1440	0.0092			

PLUS

FROM STEP FIVE	
Ethanol (lb/mbf)	Acetic Acid (lb/mbf)
0.8260	0.1620
0.8260	0.1620
0.8260	0.1620
0.8260	0.1620

EQUALS

WPP1 VOC (lb/mbf)
2.8489
2.3950
2.6586
4.4337


WPP1 VOC (lb/mbf)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
160
180
200
220
240
Dry Bulb Temperatures (°F)
y = 0.0292x - 2.4636
R² = 0.9135

Index to References Appearing in
EPA Region 10 HAP and VOC Emission Factors for Drying White Fir, Western Hemlock, Douglas Fir and Ponderosa Pine Lumber, April 2019

Reference No. 1
(Undated) J.U.M. Flame Ionization Detector Response Factor Technical Information presented at http://www.jum-aerosol.com/images/E-Fakt-02.pdf

Notes
Methanol response factor (RF) of 0.72 equals average of three response factors 0.69, 0.68 and 0.79 for J.U.M. models 3-200 and VE-7. These two models were exclusively employed to determine Method 25A VOC in the testing EPA Region 10 is relying upon to support VOC emission factor derivation.

An alternative RF of 0.65 from Appendix 3 to EPA's Interim VOC Measurement Protocol for the Wood Products Industry - July 2007 at http://www.epa.gov/ttn/emc/prelim/otm26.pdf could have been employed instead.

Employing RF of 0.72 (as opposed to 0.65) generates lower VOC emission factors (EF). A higher RF means that the EPA Method 25A flame ionization detector (FID) measures more of the compound. With the methanol EF having already been determined through speciated sampling and analysis, assuming the FID measures a greater portion of the methanol leaves less of the Method 25A measurement to be accounted for as unspeciated VOC.

Reference No. 2
National Council of the Paper Industry for Air and Stream Improvement, Inc. Technical Bulletin No. 718. July 1, 1996. A Small-Scale Kiln Study on Method 25A Measurements of Volatile Organic Compound Emissions from Lumber Drying.

Notes
To convert Method 25A VOC from "lb C/ODT" to "lb C/mbf," the following calculations were performed:

White Fir – Runs 15 and 16.
(0.85 lb/ODT) X (0.57 lb/mbf) / (0.77 lb/ODT) = 0.63 lb/mbf
(0.68 lb/ODT) X (0.57 lb/mbf) / (0.77 lb/ODT) = 0.50 lb/mbf
See pages 14 and 15 of the reference document.

Western Red Cedar – Runs 10 and 11.
(0.12 lb/ODT) X (0.12 lb/mbf) / (0.15 lb/ODT) = 0.096 lb/mbf
(0.17 lb/ODT) X (0.12 lb/mbf) / (0.15 lb/ODT) = 0.136 lb/mbf
See pages 14 and 15 of the reference document.

Douglas fir – Runs 1 and 3.
(1.00 lb/ODT) X (0.81 lb/mbf) / (0.86 lb/ODT) = 0.942
(0.71 lb/ODT) X (0.81 lb/mbf) / (0.86 lb/ODT) = 0.669
See pages 12 and 15 of the reference document.

Ponderosa Pine – Runs 5 and 6.
(1.92 lb/ODT) X (1.86 lb/mbf) / (1.99 lb/ODT) = 1.795 lb/mbf
(2.06 lb/ODT) X (1.86 lb/mbf) / (1.99 lb/ODT) = 1.925 lb/mbf
See pages 14 and 15 of the reference document.

The moisture content of wood was originally reported on a wet basis. It has been corrected to be on a dry basis using the following equation:
(moisture content on dry basis) = (moisture content on wet basis) / [1 – (moisture content on wet basis)]

Reference No. 3
Small-scale Kiln Study Utilizing Ponderosa Pine, Lodgepole Pine, White Fir, and Douglas-fir. Report by Michael R. Milota to Intermountain Forest Association. September 29, 2000.

Reference No. 4
Milota, Michael. VOC and HAP Emissions from Western Species. Western Dry Kiln Association: May 2001, p. 62-68.

Reference No. 5
Milota, M.R. 2003. HAP and VOC Emissions from White Fir Lumber Dried at High and Conventional Temperatures. Forest Prod. J. 53(3):60-64.

Reference No. 6
VOC and HAP Emissions from the High Temperature Drying of Hemlock Lumber. Report by Michael R. Milota to Hampton Affiliates. June 21, 2004.

Reference No. 7
Fritz, Brad. 2004. Pilot- and Full-Scale Measurements of VOC Emissions from Lumber Drying of Inland Northwest Species. Forest Prod. J. 54(7/8):50-56.

Notes
To convert acetaldehyde from "µg/min-bf" to "lb/mbf," the following calculations were performed:

White fir.
0.0550 lb/mbf = (7.7 µg/min-bf) X (60 min/hr) X (54 hr) X (kg/1x10^9g) X (2.205 lb/kg) X (1,000 bf/mbf).
See page 54 of the reference document.

Douglas fir.
0.030 lb/mbf = (4.9 µg/min-bf) X (60 min/hr) X (46 hr) X (kg/1x10^9g) X (2.205 lb/kg) X (1,000 bf/mbf).
0.022 lb/mbf = (3.6 µg/min-bf) X (60 min/hr) X (46 hr) X (kg/1x10^9g) X (2.205 lb/kg) X (1,000 bf/mbf).
See page 53 of the reference document.

Reference No. 8
VOC and Methanol Emissions from the Drying of Hemlock Lumber. Report by Michael R. Milota to Hampton Affiliates. August 24, 2004.

Reference No. 9
VOC, Methanol, and Formaldehyde Emissions from the Drying of Hemlock Lumber. Report by Michael R. Milota to Hampton Affiliates. October 15, 2004.

Reference No. 10
VOC Emissions from the Drying of Douglas-fir Lumber. Report by Michael R. Milota to Columbia Vista Corporation. June 14, 2005.

Reference No. 11
Milota, M.R. and P. Mosher. 2006. Emissions from Western Hemlock Lumber During Drying. Forest Prod. J. 56(5):66-70.

Reference No. 12
Milota, M.R. 2006. Hazardous Air Pollutant Emissions from Lumber Drying. Forest Prod. J. 56(7/8):79-84.

Reference No. 13
VOC, Methanol, and Formaldehyde Emissions from the Drying of Hemlock, ESLP, and Douglas Fir Lumber. Report by Michael R. Milota to Hampton Affiliates. March 23, 2007.

Reference No. 14
Oregon Department of Environmental Quality memorandum May 8, 2007 entitled, "Title III Implications of Drying Kiln Source Test Results."

Notes
The reference document presents a compilation of EF.

Reference No. 15
HAP Emissions from the Drying of Hemlock and Douglas-fir Lumber by NCASI 98.01 and 105. Report by Michael R. Milota to Hampton Affiliates. May 22, 2007 report.

Reference No. 16
EPA Interim VOC Measurement Protocol for the Wood Products Industry - July 2007 presented at http://www.epa.gov/ttn/emc/prelim/otm26.pdf

Notes
VOC determined through use of this document is referred to as WPP1 VOC. The document is alternatively known as EPA Other Test Method 26 or “OTM26.”

Default formaldehyde RF of 0 and propane (an alkane) RF of 1 appear in Appendix 3 – Procedure for Response Factor Determination for the Interim VOC Measurement Protocol for the Wood Products Industry.

Reference No. 17
HAP Emissions by NCASI 98.01 and 105 from Drying of Ponderosa Pine and White Wood Lumber. Report by Michael R. Milota to Hampton Affiliates. July 25, 2007.

Reference No. 18
Milota, M.R. and P. Mosher. 2008. Emission of Hazardous Air Pollutants from Lumber Drying. Forest Prod. J. 58(7/8):50-55.

Reference No. 19
VOC Emissions From the Drying of Douglas-fir Lumber. Report by Michael R. Milota to Columbia Vista Corp. November 12, 2010.

Reference No. 20
NCASI Technical Bulletin No. 991. September 2011. Characterization, Measurement, and Reporting of Volatile Organic Compounds Emitted from Southern Pine Wood Products Sources.

Notes
Acetaldehyde and propionaldehyde RF appear in Table C-1 of Appendix C. The values are estimates based upon dividing the compound’s effective carbon numbers (ECN) by the number of carbon atoms in the compound. See Attachment 2 to Appendix C.

Acrolein RF is also an estimate based upon dividing the compound’s ECN by the number of carbon atoms in the compound. In this case, the RF estimate does not appear in Table C-1 of Appendix C. The value is calculated as described above pursuant to Attachment 2 to Appendix C.
RF = (ECN) / (number of carbon atoms in compound)

where ECN = 2 given the aliphatic carbon contribution of CH_2CHCHO (see Table 2.1 to Appendix C) and the number of carbon atoms in acrolein = 3.
RF = 2/3 or 0.66

Reference No. 21
Email of 03/26/12 email from Oregon State University's Michael Milota to EPA Region 10's Dan Meyer.

Reference No. 22
Email of 03/27/12 from Oregon State University's Michael Milota to EPA Region 10's Dan Meyer.