PROJECT REPORT

Health Impact Assessment Protocol / Raymond CDK

Weyerhaeuser, Inc. / Raymond, WA

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1. EXECUTIVE SUMMARY

Weyerhaeuser Company (Weyerhaeuser) owns and operates a softwood lumber mill in Raymond, Washington (the Facility). The Facility is located at 51 Ellis Street, Raymond, WA 98577. The Raymond mill currently operates under Olympic Region Clean Air Agency (ORCAA) Air Operating Permit (AOP) 12AOP915 in an attainment or unclassified area for all pollutants. The Facility currently produces kiln dried lumber using batch kilns, and several other products from wood residuals generated in the milling process such as wood chips, sawdust, and shavings. The Facility is a major source of hazardous air pollutants (HAPs), carbon monoxide (CO), nitrogen oxides (NOx), and volatile organic compounds (VOCs) and therefore, subject to the Title V program.

Weyerhaeuser is proposing the addition of one new continuous dry kiln (CDK) to replace the existing batch kilns used in the lumber drying process. Additionally, the existing wood fired boiler will be shut down as part of this project.

Weyerhaeuser submitted a Notice of Construction (NOC) application for the project to ORCAA in September 2023. The NOC application showed project emissions over the significant quantity emission rates (SQERs) for five toxic air pollutants (TAPs): acetaldehyde, acrolein, formaldehyde, nitrogen dioxide (NO_2), and sulfur dioxide (SO_2).

Air dispersion modeling presented in the NOC application showed compliance with the acceptable source impact level (ASIL) for acrolein, NO_2, and SO_2. However, the first tier review included in the NOC application showed modeled concentrations over the ASIL for acetaldehyde and formaldehyde. Therefore, a second tier review is being conducted to demonstrate that acetaldehyde and formaldehyde emissions from the project do not have significant health impacts on the community. This report serves as the health impact assessment (HIA) protocol for the second tier review. A copy of the second tier review petition form required by Ecology is included in Appendix A. The original signed form and $10,000 fee are submitted directly to Ecology's Cashiering Office.

This HIA protocol contains the following elements:

- Section 2. Toxic Air Pollutant Screening Analysis
- Section 3. Modeling Methodology
- Section 4. First Tier Modeling Results
- Section 5. Identification of Exposed Populations
- Section 6. Hazard Identification
- Section 7. Proposed Toxicological Thresholds
- Appendix A: Second Tier Review Petition Form
- Appendix B: Emission Calculations
- Appendix C: Modeling Parameters
- Appendix D: Zoning Map

2. TOXIC AIR POLLUTANT SCREENING ANALYSIS

In Washington, all new sources emitting TAPs are required to show compliance with the Washington TAP program pursuant to WAC 173-460. Ecology has established an SQER and ASIL for each listed TAP. If the total project-related TAP emissions increase exceeds its respective SQER, further determination of compliance with the ASIL is required. Table 2-1 shows the emission increases for each TAP, which are compared to the SQER for each respective pollutant. Detailed calculations are provided in Appendix B.

The only source of TAPs from this project are related to the operation of the CDK. This section presents the methodology used to quantify TAPs emissions from the project.

2.1 Continuous Dry Kiln

As a direct-fired combustion unit, the CDK emits pollutants from the combustion of green sawdust and the drying of the wet wood product. There is no currently available data for direct-fired CDKs drying Douglas fir in the Pacific Northwest (PNW) region. Current data includes emission factors for direct-fired CDKs in the southern US, primarily drying southern pine, or indirect-heated batch kilns in the PNW, drying Douglas fir. However, one source cannot be used for all pollutants, since some pollutants are related to the fuel type and firing method (direct vs indirect, batch vs continuous), as compared to others that are related to wood species (e.g., Douglas fir), or even both fuel type and wood species. The following subsections detail the emission factors used in the calculation of CDK emissions from this Project.

2.1.1 Fuel-Based Emissions

Emissions of CO, NO_2 and SO_2 are dependent on the kiln's fuel type and firing method. Therefore, emissions are estimated using direct-fired continuous dry kiln emission factors from Georgia Environmental Protection Division's (EPD) document entitled "EPD Recommended Emission Factors for Lumber Kiln Permitting in Georgia". For CO and NO_2 the emission factor is used in conjunction with the annual dried lumber production rate (310 million board feet per year [MMBF/year]), whereas for SO_2, the emission factor is used with the total kiln heat input (50 million British thermal units per hour [MMBtu/hr]) and annual operating hours (8,400 hours/year).

2.1.2 Species-Based Emissions

Emissions of acetaldehyde, acrolein, methanol, and propionaldehyde rely on factors derived specifically for Douglas fir. Since the CDK is a fairly new technology, the direct-fired CDK emission factors are not available for drying Douglas fir. Emissions of these pollutants are assumed to consist of two components: combustion and drying. For combustion, TAP emissions are estimated based on "NCASI Technical Bulletin No. 1013: A Comprehensive Compilation and Review of Wood-Fired Boiler Emissions," Tables 4.1 and 5.1. For drying, the aforementioned TAP pollutants are estimated based on the Douglas fir indirect-heated batch dry kiln emission factors in EPA Region 10's guidance workbook, "EPA Region 10 HAP and VOC Emission Factors for Lumber Drying, January 2021," which depend on the maximum drying temperature of heated air entering the lumber (200 °F).

2.1.3 Fuel- and Species-Based Emissions

Formaldehyde is unique to all other TAP pollutants as it relies on both the wood species and the firing method. Due to formaldehyde's dependence on direct or indirect heating, the drying emission factor in the "EPA Region 10 HAP and VOC Emission Factors for Lumber Drying, January 2021" workbook may underrepresent formaldehyde emissions. Therefore, this emission factor is scaled up by the proportion of direct to indirect average batch kiln emission factors for formaldehyde in the "NCASI Wood Products Air Emission Factor Database – 2013 Update." Since this emission factor becomes a proxy for a direct-fired unit, the combustion emissions have been accounted for and therefore do not need to be included in addition to the scaled emission factor, as was done for the other TAP pollutants.

Table 2-1. TAP Emissions Summary

Pollutants	CAS Number	Averaging Period	SQER (lb/averaging period)	Project Emissions (lb/averaging period)	Modeling Required?
Acetaldehyde	75-07-0	year	60	8,644	**Yes**
Acrolein	107-02-8	24-hr	0.026	0.75	**Yes**
Formaldehyde	50-00-0	year	27	2,678	**Yes**
Methanol	67-56-1	24-hr	1,500	60.31	No
Propionaldehyde	123-38-6	24-hr	0.59	0.57	No
Carbon monoxide	630-08-0	1-hr	43	26.94	No
Nitrogen dioxide	10102-44-0	1-hr	0.87	10.33	**Yes**
Sulfur dioxide	7446-09-5	1-hr	1.2	1.25	**Yes**

3. MODELING METHODOLOGY

This section describes the modeling methodology that will be used for the second tier TAP analysis. This methodology described below represents the same methodology that was used in the first tier review presented in the NOC application.

3.1 Model Selection

Version 22112 of the AERMOD model is used to estimate maximum ground-level concentrations in the air dispersion analysis. AERMOD is a refined, steady-state, multi-source, air dispersion model used for industrial sources.[1]

The NO_2 modeling followed the three tier NO_2 modeling approach for the conversion of nitric oxide (NO) to NO_2 described in EPA's Guideline Section 4.2.3.4. The three tiers are:

- Tier 1 – Total Conversion of NO_X to NO_2
- Tier 2 – Ambient Ratio Method 2 (ARM2)
- Tier 3 – Ozone Limiting Method (OLM) or Plume Volume Molar Ratio Method (PVMRM)

The models prepared for this application use ARM2 with default ambient ratios for the NO_2 modeling demonstration. The ARM2 method multiplies the modeled NO_X impacts by estimates of representative NO_2/NO_X equilibrium ratios based on ambient levels of NO_2 and NO_X. The national default for ARM2 includes a minimum ambient NO_2/NO_X ratio of 0.5 and a maximum ambient ratio of 0.9.

3.2 Meteorological Data

AERMOD-ready meteorological data for the period 2016 - 2020 was prepared using the U.S. EPA's AERMET meteorological processing utility (version 19191). Standard U.S. EPA meteorological data processing guidance was used as outlined in a recent memorandum[2] and other documentation.

3.2.1 Surface Data

Raw hourly surface meteorological was obtained from the U.S. National Climactic Data Center (NCDC) for Hoquiam Bowerman Airport (KHQM, WMO ID: 727923) in the standard ISHD format. This data was supplemented with TD-6405 (so-called "1-minute") wind data from KHQM for 2016-2020. The 1-minute wind data was processed using the latest version of the U.S. EPA AERMINUTE pre-processing tool (version 15272). Quality of the 1-minute data was verified by comparison to the hourly ISHD data from KHQM, which showed only small differences typical of 1-minute and hourly wind data comparisons. The "Ice-Free Winds Group" AERMINUTE option was selected due to the fact that a sonic anemometer was used at KHQM for the entire period. Figure 3-1 shows the distribution of wind speed and direction for the site.

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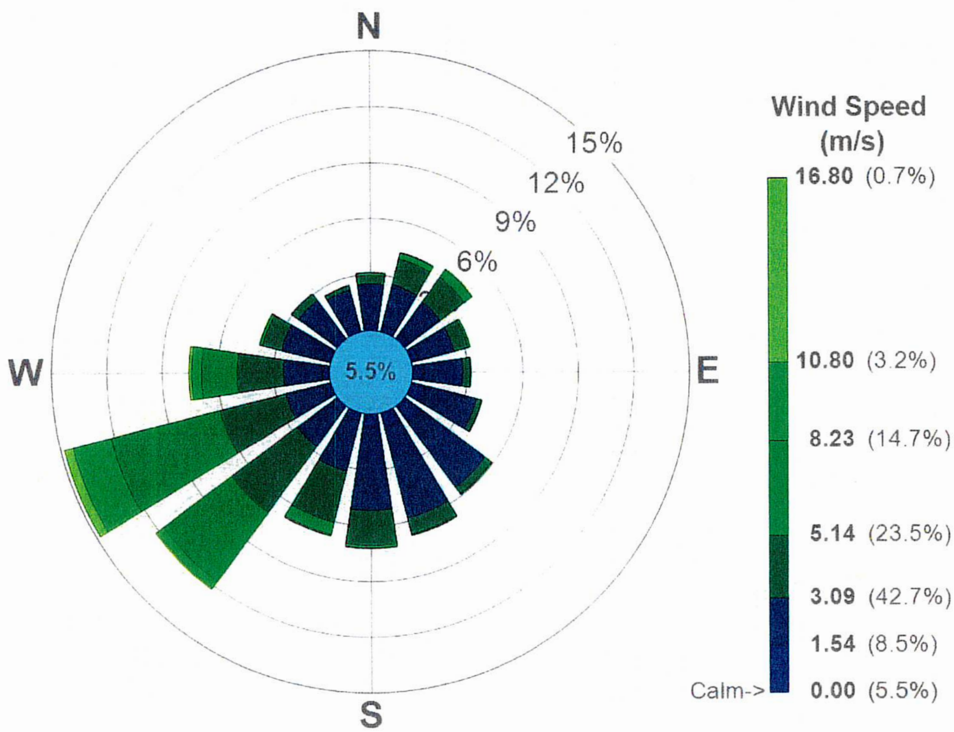
[1] 40 CFR 51, Appendix W-*Guideline on Air Quality Models*, Appendix A.1- AMS/EPA Regulatory Model (AERMOD).

[2] Fox, Tyler, U.S. Environmental Protection Agency. 2013. "Use of ASOS Meteorological Data in AERMOD Dispersion Modeling." Available Online:
https://www.epa.gov/sites/default/files/2020-10/documents/20130308_met_data_clarification.pdf

Figure 3-1. 2016-2020 Wind Rose for Hoquiam Bowerman Airport (KHQM)



3.2.2 Upper Air Data

In addition to surface meteorological data, AERMET requires the use of data from a near-sunrise-time upper air sounding to estimate daytime mixing heights. Upper air data from the nearest U.S. National Weather Service (NWS) upper-air balloon station, located in Quillayute, WA (UIL), was obtained from the National Oceanic and Atmospheric Administration (NOAA) in FSL format.

3.2.3 Land Use Analysis

Parameters derived from analysis of land use data (surface roughness, Bowen ratio, and albedo) are also required by AERMET. In accordance with U.S. EPA guidance, these values were determined using the latest version of the U.S. EPA AERSURFACE tool (version 20060).[3] The AERSUFACE settings used for processing are summarized in Table 3-1, below. The met station coordinates were determined by visually identifying the met station using Google Earth. NLCD 2016 (CONUS) Land Cover data, Canopy data, and Impervious data used in AERSURFACE processing were obtained from the Multi-Resolution Land Use Consortium (MRLC).

U.S. EPA guidance dictates that on at least an annual basis, precipitation at a surface site should be classified as wet, dry, or average in comparison to the 30-year climatological record at the site. This determination is used to adjust the Bowen ratio estimated by AERSURFACE. To make the determination,

[3] U.S. Environmental Protection Agency. February 2020. "User's Guide for AERSURFACE Tool." EPA-454/B-20-008. Available Online: https://gaftp.epa.gov/Air/aqmg/SCRAM/models/related/aersurface/aersurface_ug_v20060.pdf

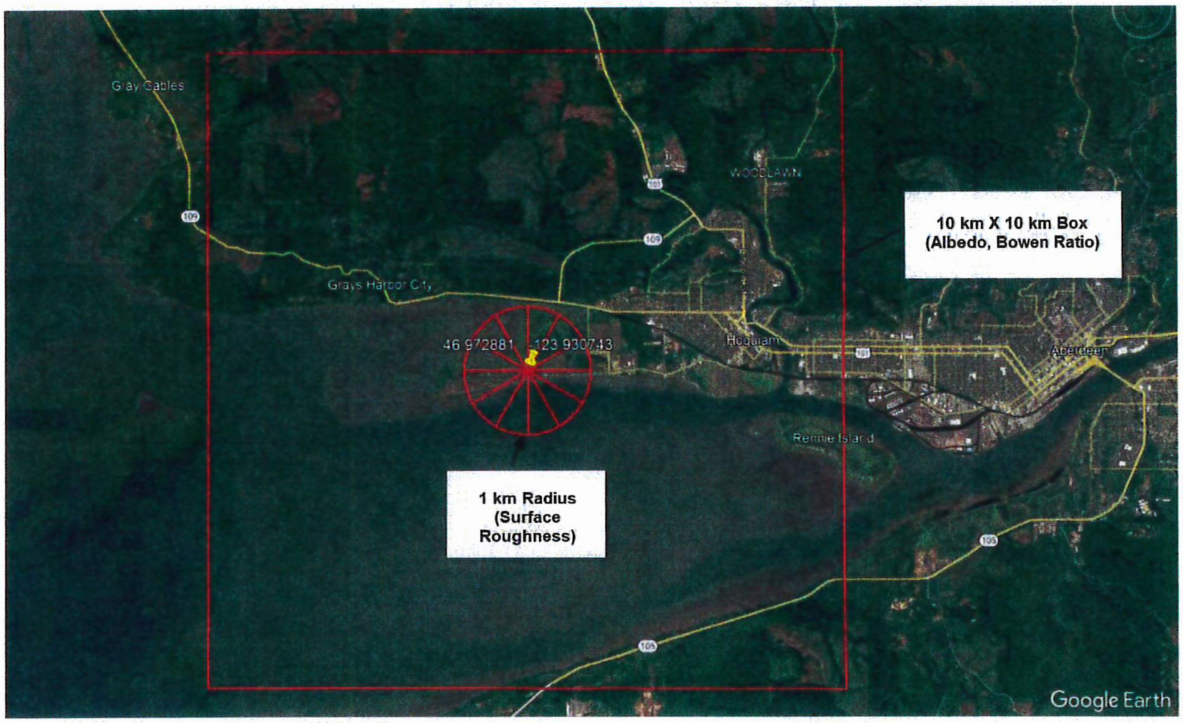
annual precipitation in each modeled year (2016-2020) was compared to the 1991-2020 climatological record for KHQM. The annual precipitation data is from the Climate Date Online platform provided by NOAA National Centers for Environmental Information. The 30th and 70th percentile values of the annual precipitation distribution from 1991-2020 were calculated. Per U.S. EPA guidance, each modeled year was classified for AERSUFACE processing as "wet" if its annual precipitation was higher than the 70th percentile value, "dry" if its annual precipitation was lower than the 30th percentile value, and "average" if it was between the 30th and 70th percentile values. The values used in this case are included in Table 6-1.

Table 3-1. AERSURFACE Input Parameters

AERSURFACE Parameter	Value
Met Station Latitude	46.972881
Met Station Longitude	-123.930743
Datum	NAD 1983
Radius for surface roughness (km)	1.0
Vary by Sector?	Yes
Number of Sectors	12
Temporal Resolution	Seasonal
Continuous Winter Snow Cover?	No
Station Located at Airport?	Airport Sector: 3, 4, 8-10 Non-Airport Sector: 1, 2, 5-7, 11, 12
Arid Region?	No
Surface Moisture Classification	Dry (2019) Average (2017, 2018, and 2020) Wet (2016)

U.S. EPA recommendations were used to specify the area used for the AERSURFACE analysis. Surface roughness was estimated based on land use within a 1 km radius of the meteorological station, with directional variation in roughness accounted for by using the maximum of twelve thirty-degree sectors. Albedo and Bowen ratio were estimated based on a 10x10 km box centered on the meteorological station. Figure 3-2 shows the areas used for the land use analysis.

Figure 3-2. Areas Used for AERSURFACE Land Use Analysis



3.2.4 AERMET Processing Options

Standard AERMET processing options were used in this case[4,5], with the exception of the ADJ_U* option. The options elected include:

- MODIFY keyword for upper air data
- THRESH_1MIN 0.5 keyword to provide a lower bound of 0.5 m/s for 1-minute wind data
- AUDIT keywords to provide additional QA/QC and diagnostic information
- ASOS1MIN keyword to incorporate 1-minute wind data
- NWS_HGT WIND 10 keyword to designate the anemometer height as 10 meters
- METHOD WIND_DIR RANDOM keyword to correct for any wind direction rounding in the raw ISHD data
- METHOD REFLEVEL SUBNWS keyword to allow use of airport surface station data
- Default substitution options for cloud cover and temperature data were not overridden
- Default ASOS_ADJ option for correction of truncated wind speeds was not overridden
- ADJ_U* option was used

[4] Fox, Tyler, U.S. Environmental Protection Agency. 2013. "Use of ASOS Meteorological Data in AERMOD Dispersion Modeling." Available Online:
https://www.epa.gov/sites/default/files/2020-10/documents/20130308_met_data_clarification.pdf

[5] U.S. Environmental Protection Agency. 2019. "User's Guide for the AERMOD Meteorological Preprocessor (AERMET)". EPA-454/B-19-028, August, 2019).

The ADJ_U* option adjusts the surface friction velocity parameter (U*) used by AERMET in certain low wind speed situations. This option, based on a peer-reviewed study[6], was added to AERMET by U.S. EPA to address the tendency of AERMET/AERMOD to underestimate dispersion and thus overestimate ground-level pollutant concentrations for low-level sources under low wind speed conditions, and became a default regulatory option with U.S. EPA's 2017 revision to the Guideline on Air Quality Models.[7]

3.3 Coordinate System

The locations of receptors, buildings and sources are represented in the Universal Transverse Mercator (UTM) coordinate system using the World Geodetic System, 1984 projection. The UTM grid divides the world into coordinates that are measured in north meters (measured from the equator) and east meters (measured from the central meridian of a particular zone, which is set at 500 km)/ UTM coordinates for this analysis are based on UTM zone 10. The location of the Raymond facility is approximately 5,170,748 m Northing and 443,644 m Easting in UTM zone 10.

3.4 Terrain Elevations

Terrain elevations for receptors, buildings, and sources are determined using National Elevation Dataset (NED) supplied by the United States Geological Survey (USGS). The NED is a seamless dataset with the best available raster elevation data of the contiguous United States. NED data retrieved for this model have a grid spacing of 1/3 arc-second or 10 m. The AERMOD preprocessor, AERMAP v18081, is used to compute model object elevations from the NED grid spacing. AERMAP also calculates hill height data for all receptors. All data obtained from the NED files are checked for completeness and spot-checked for accuracy.

3.5 Urban / Rural Determination

The facility is located in Raymond, Washington on the Willapa River. Raymond is a city with a population of approximately 3,000 people at the time of the 2020 census. Outside of the city, most of the land use is not considered urban (medium to high intensity developed land). For the purposes of this model, it is conservatively assumed that the area surrounding the facility does not meet the definition of urban land use. Therefore, the urban option is not selected in AERMOD.

3.6 Receptor Grid

The model has receptors along the fenceline spaced 12.5 m apart. There is also a variable density, square Cartesian receptor grid extending 10,000 m from the center of the facility. This receptor grid spacing is set up according to the following list:

- 12.5-meter spacing for at least the first 150 meters from the Facility fenceline;
- 25-meter spacing for the first 650 meters from the center of the Facility;
- 50-meter spacing from 650 to 1,150 meters from the center of the Facility;
- 100-meter spacing from 1,150 to 2,250 meters from the center of the Facility;
- 300-meter spacing from 2,250 to 4,650 meters from the center of the Facility; and
- 600-meter spacing from 4,650 to 10,000 meters from the center of the Facility.

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[6] Qian and Venkatram. 2011. "Performance of Steady-State Dispersion Models Under Low Wind-Speed Conditions." *Boundary-Layer Meteorology*, Volume 138, Issue 3, pp 475-491.

[7] U.S. Environmental Protection Agency. 2017. "Guideline on Air Quality Models." 40 CFR Part 51, Appendix W. https://www.epa.gov/sites/default/files/2020-09/documents/appw_17.pdf

All model receptors are placed at a flagpole height of 1.5 meters. Maps of the receptors are shown in Figure 3-3 and Figure 3-4 below. The Facility is shown in Figure 3-5 below with the fenceline represented by the purple outline surrounding the facility with included buildings.

Figure 3-3. Zoomed Out Receptor Grid

Figure 3-4. Zoomed In Receptor Grid

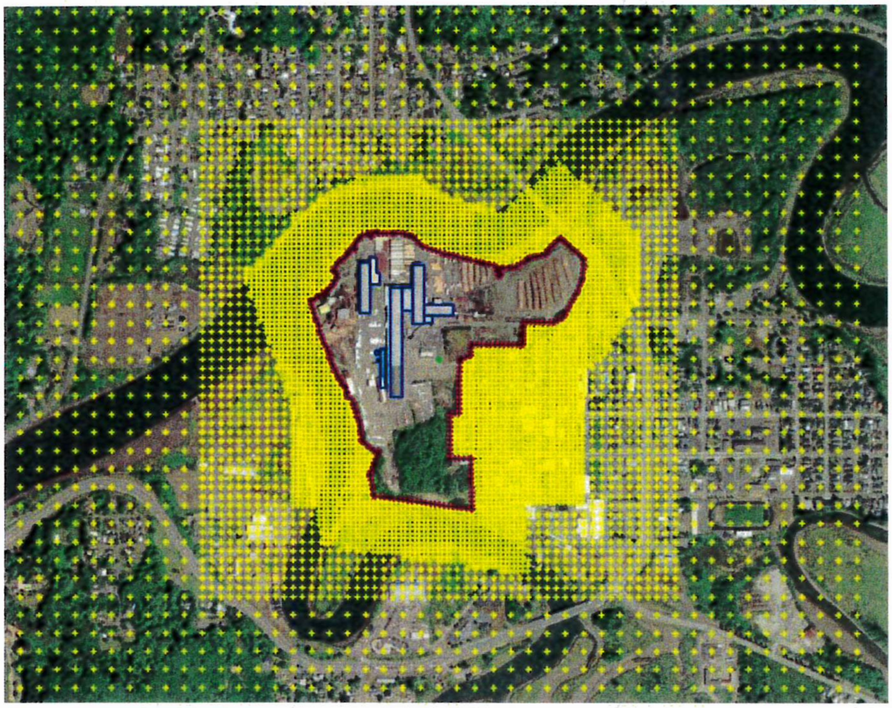
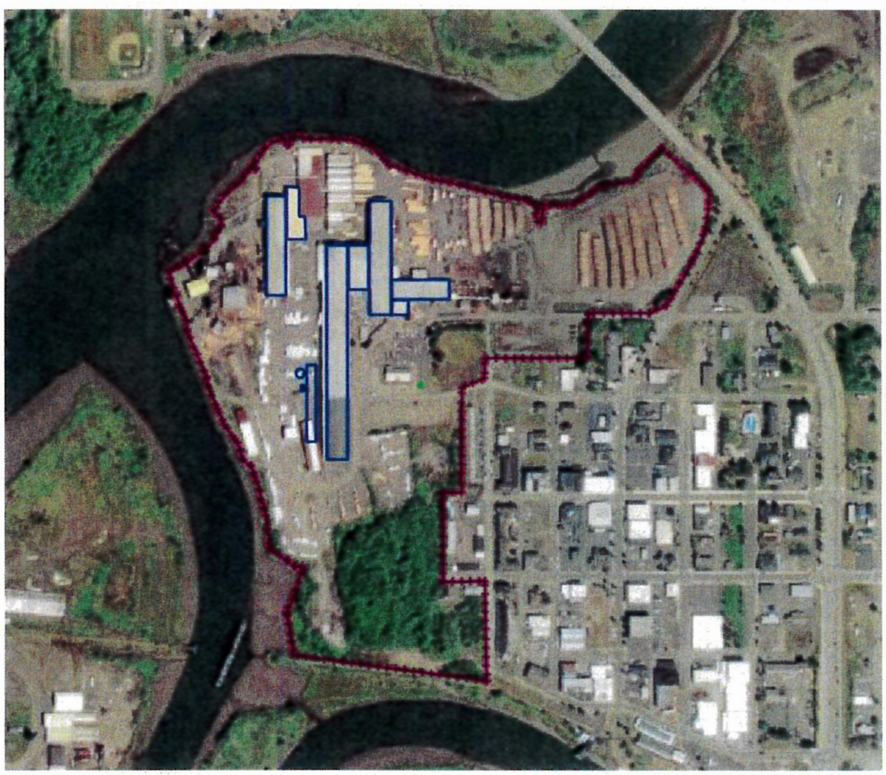


Figure 3-5. Facility Fenceline



3.7 Building Downwash

Emissions from each source will be evaluated in terms of their proximity to nearby structures. The purpose of this evaluation is to determine if stack discharges might become caught in the turbulent wakes of these structures. Wind blowing around a building creates zones of turbulence that are greater than if the buildings were absent. The concepts and procedures expressed in the GEP Technical Support document , the User's Guide to the Building Profile Input Program, and other related documents will be applied to all structures at the Raymond Facility. The Building Profile Input Program for PRIME (BPIPPRM) Version 04274 is used to calculate the downwash values for each point source.

3.8 Source Types and Parameters

Emission releases from the CDK are represented in the model as two point sources. The modeling parameters for the sources are determined based on the following and are included in Appendix C.

- Exhaust temperature, exhaust flowrate/velocity, stack height, and stack diameter are obtained from the CDK vendor and engineering firm.
- Emission rates are based on PTE calculations as described in Section 2. While daily sources are not anticipated to operate the entirety of a 24-hr period, the maximum hourly emission rate is applied for TAPs with 24-hr averaging periods.

The stacks for the CDK will be spaced closely enough for the exhaust plumes to merge, enhancing plume rise. AERMOD does not explicitly account for this enhanced plume rise. However, the use of a pseudo stack diameter in AERMOD based on the total volume flow rate of the adjacent stacks properly accounts for the enhanced plume rise. EPA has allowed this technique on a case-by-case basis.[8] The judgement as to whether combining flows is appropriate includes:

- Stack locations – Only stacks located within 1 diameter of each other are treated as a merged source.
- Stack height and diameter – All of the stacks treated as a merged source have the same stack height and diameter.
- Stack emission parameters (temperature, momentum or volume flow, emission rates, etc.) - All of the stacks treated as a merged source have the same emission parameters.

The proposed stack arrangement meets these criteria, and the EPA-accepted merged plume technique is used in the modeling analysis. The PSD regulations (40 CFR 51.118(a) and 40 CFR 52.21(h)) contain limits on the use of other dispersion techniques. Dispersion techniques are defined in 40 CFR 51.100(hh)(1) as "any technique which attempts to affect the concentration of a pollutant in the ambient air by...increasing final exhaust gas plume rise by... selective handling of exhaust gas streams so as to increase the exhaust gas plume rise." However, 40 CFR 51.100(hh)(2) exempts the merging of exhaust gas streams when the facility is originally designed and constructed with merged gas streams.

3.9 Background Concentrations

The second tier evaluation for acetaldehyde and formaldehyde will use a representative background concentration from the National Air Toxics Assessment (NATA) 2014 database to account for impacts from nearby sources. Weyerhaeuser is proposing to use background concentrations of 0.728 μg/m^3 and

[8] Model Clearinghouse Information Storage and Retrieval System Record Details - OH GM Defiance Bubble (97-V-02)

0.733 µg/m^3 for acetaldehyde and formaldehyde, respectively. These background concentrations were obtained for census tract 53049950200 from the NATA 2014 database, which is the census tract within which the facility is located.

4. FIRST TIER MODELING RESULTS

As previously described, a first tier TAP analysis was conducted using AERMOD to compare the impacts of acetaldehyde, acrolein, formaldehyde, NO_2, and SO_2 to their respective ASILs. Table 4-1 presents the results of this first tier review.

Table 4-1. Maximum Modeled TAP Concentrations

Pollutants	Averaging Period	Highest Modeled Concentration (µg/m³)	ASIL (µg/m³)	Exceeds ASIL?
Acetaldehyde	year	0.93	0.37	**Yes**
Acrolein	24-hr	0.12	0.35	No
Formaldehyde	year	0.29	0.17	**Yes**
Nitrogen dioxide	1-hr	129	470	No
Sulfur dioxide	1-hr	23.87	660	No

As shown in Table 4-1, acrolein, NO_2, and SO_2 are in compliance with their corresponding ASIL, however, acetaldehyde and formaldehyde are in exceedance of the ASIL. Figure 4-1 and Figure 4-2 show the areas exceeding the ASIL for acetaldehyde and formaldehyde, respectively. The receptors represented in Figure 4-1 and Figure 4-2 are the highest concentrations for each ASIL exceeding receptor across all five years modeled.

Weyerhaeuser will be conducting a second tier review for acetaldehyde and formaldehyde to demonstrate that the project does not have significant health impacts on the community. Section 5 of this report identifies exposed populations that will be considered in the second tier review. Section 6 identifies the hazards associated with each modeled pollutant, and Section 7 proposes toxicological modeling thresholds to use as the basis for the HIA.

Figure 4-1. Acetaldehyde ASIL-Exceeding Receptors

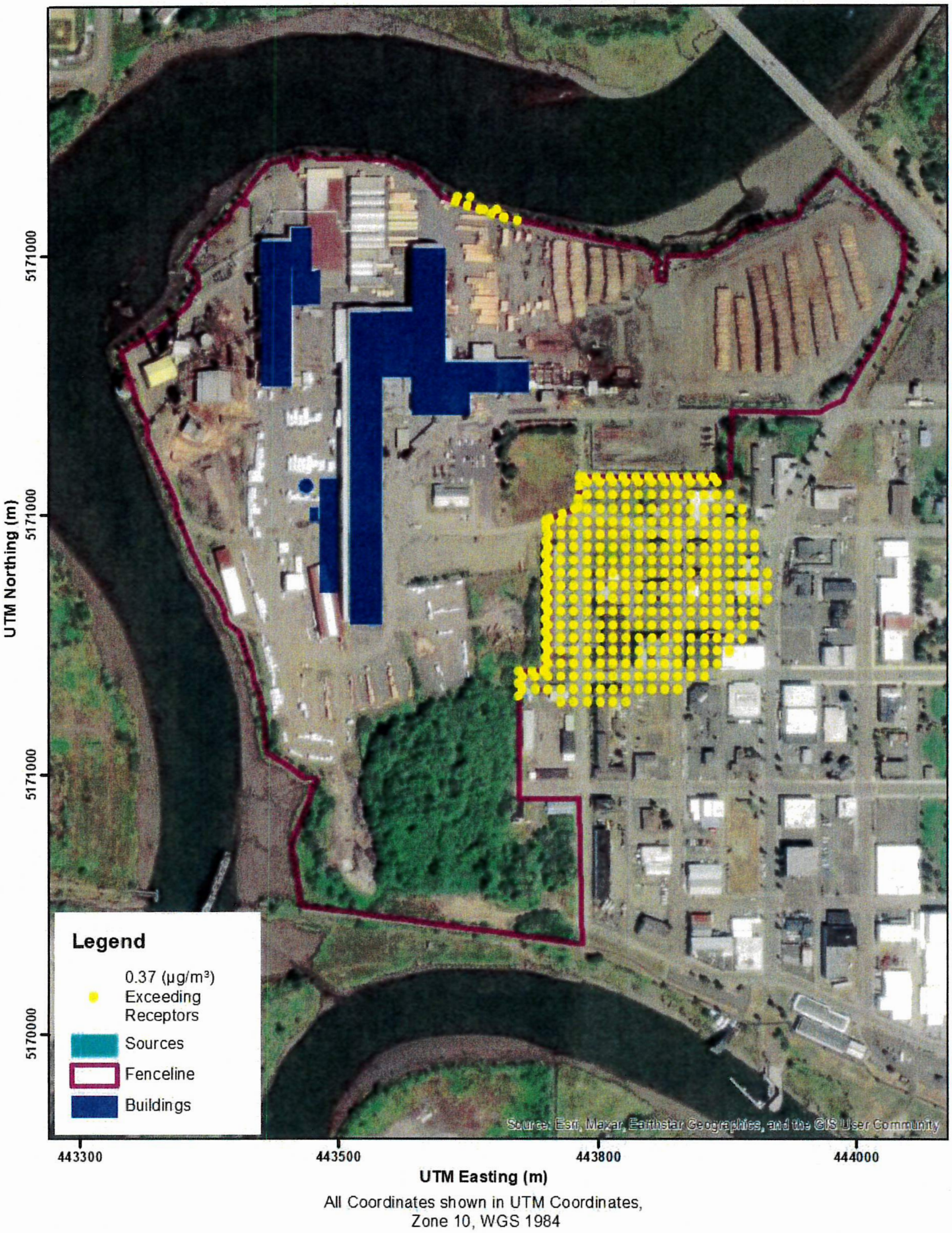
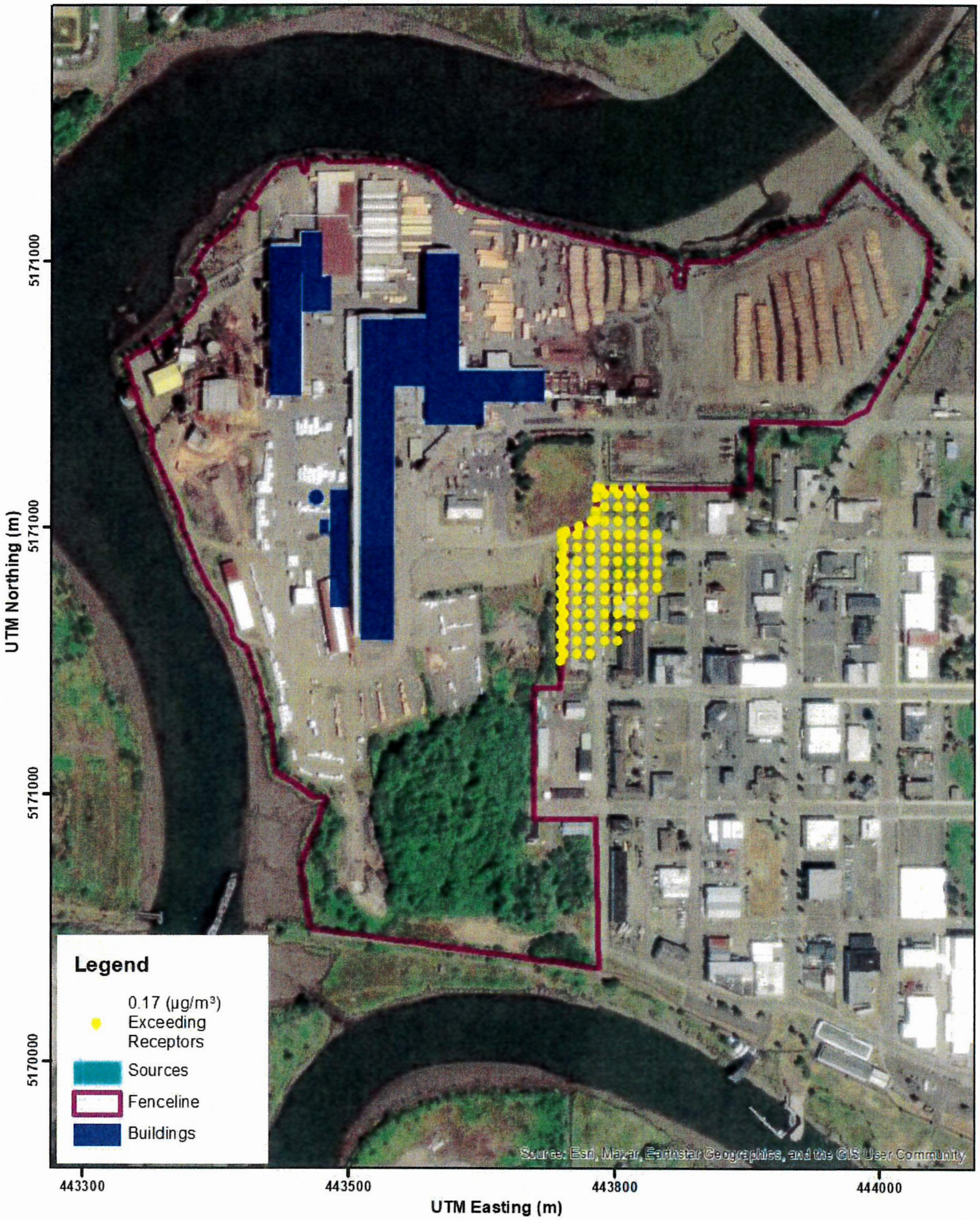


Figure 4-2. Formaldehyde ASIL-Exceeding Receptors



All Coordinates shown in UTM Coordinates,
Zone 10, WGS 1984

5. IDENTIFICATION OF EXPOSED POPULATIONS

The Facility is located in Raymond, WA. The zoning designation of the Facility is "Heavy Industrial". The property is immediately bordered by the Willapa River and South Willapa River to the west and north and "General Commercial", "Waterfront Commercial", and "Retail Core" to the east and south. Detailed zoning maps obtained from the City of Raymond are provided in Appendix D.

Within the "General Commercial" zoning area to the east and south of the Facility, there are residential properties near the Facility. The nearest residential area ("Village Green Apartments") is located on the eastern side of the Facility's ambient air boundary. There are also residential areas located across the river to the north and southwest of the facility in "Residential" zones.

While it is anticipated that the highest-impact receptors will be located in the commercial and residential zones immediately adjacent to the Facility, the second tier analysis will evaluate risk based on the maximum modeled concentrations for each pollutant among all modeled receptors. The maximum impact among those receptors will be used to determine the health impacts from the Facility.

6. HAZARD IDENTIFICATION

This section describes the tissues and organs that may be impacted by acetaldehyde, formaldehyde, acrolein, NO_2, and SO_2 and the potential acute and chronic health impacts associated with these pollutants. Only health impacts from acetaldehyde, formaldehyde, acrolein, NO_2, and SO_2 exposure are described here, since they are the only five pollutants whose emission increases exceed the SQER. The primary exposure pathway for the listed pollutants is through inhalation or direct contact with air. Therefore, health impacts due to cross-media transport into water and soil have not been considered in this analysis.[9]

6.1 Acetaldehyde

Acetaldehyde targets the nervous and respiratory systems. Acute exposure to acetaldehyde is associated with the following short-term health impacts:[10]

- Irritation of the eyes, skin, and respiratory tract;
- At higher exposure levels, erythema, coughing, pulmonary edema, and necrosis may occur; and
- In animals, acute inhalation of acetaldehyde produced the following symptoms: depressed respiratory rate and elevated blood pressure.

Chronic exposure to acetaldehyde is associated with symptoms of alcoholism. In animals, chronic inhalation has produced changes in the nasal mucosa and trachea, growth retardation, slight anemia, and increased kidney weight. There is insufficient information regarding reproductive and developmental effects of acetaldehyde in humans, but in animals, acetaldehyde has been shown to cross the placenta to the fetus, and cause skeletal malformation, reduced birth weight, and increased postnatal mortality. Acetaldehyde is considered a probable human carcinogen, as studies with animals have shown cancerous growth.

6.2 Acrolein

Acrolein targets the skin, eyes, and mucous membranes of the respiratory system. Acute exposure to acrolein is associated with the following short-term health impacts: [11]

- Mucous hypersecretion;
- Exacerbation of allergic air way response; and
- Eye, nose, and throat irritation.

Chronic exposure to acrolein is associated with lesions in the nasal mucosa and pulmonary inflammation. There is insufficient evidence to suggest that acrolein is a carcinogen.

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[9] Ecology's "Guidance on First, Second, and Third Tier Review of Air Toxics," does not include acetaldehyde, acrolein, formaldehyde, NO_2, or SO_2 on the list of TAPs that are required to have multi-pathway exposures assessed.

[10] Environmental Protection Agency (EPA) fact-sheet on formaldehyde from EPA's Health and Evironmental Effects Profile and the Integrated Risk Information System (IRIS). https://www.epa.gov/sites/default/files/2016-09/documents/acetaldehyde.pdf

[11] California Office of Environmental Health Hazard Assessment (OEHHA), "Draft Reference Exposure Level for Acrolein." November 25, 2008.

6.3 Formaldehyde

Formaldehyde targets the urinary and gastrointestinal systems. Acute exposure to formaldehyde is associated with the following short-term health impacts:[12]

- Eye, nose, and throat irritation;
- At higher exposure levels, coughing, wheezing, chest pains, and bronchitis may occur; and
- If ingested, formaldehyde may result in corrosion of the gastrointestinal tract and inflammation and ulceration of the mouth, esophagus, and stomach.

Chronic exposure to formaldehyde is associated with respiratory symptoms and eye, nose, and throat irritation. Repeated contact with liquid solutions is associated with skin irritation and allergic contact dermatitis. In animals, chronic inhalation has affected the nasal respiratory epithelium and caused lesions in the respiratory system. There is some information regarding reproductive and developmental effects of formaldehyde in humans, namely that an increased incidence of menstrual disorders were observed in workers using urea-formaldehyde resins. Formaldehyde is considered a probable human carcinogen, as there is limited evidence from occupational studies that exposure to formaldehyde increases lung and nasopharyngeal cancer.

6.4 Nitrogen Dioxide

NO_2 targets the respiratory system. Acute exposure to NO_2 is associated with the following short-term health impacts:[13]

- Respiratory irritation; and
- Pulmonary edema, pneumonitis, bronchitis, and bronchiolitis obliterans.

Chronic exposure to NO_2 may lead to an increased risk of developing asthma and of being susceptible to respiratory infections. There is insufficient evidence to suggest that NO_2 is a carcinogen and is not classified as a carcinogen by the EPA at this time.

6.5 Sulfur Dioxide

SO_2 targets the respiratory system. Acute exposure to SO_2 is associated with the following short-term health impacts:[13]

- Respiratory irritation;

Chronic exposure to SO_2 may lead to a decrease in respiratory health. There is insufficient evidence to suggest that SO_2 is a carcinogen and is not classified as a carcinogen by the EPA at this time.

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[12] EPA fact-sheet on formaldehyde from EPA's Health and Evironmental Effects Profile and the IRIS. https://www.epa.gov/sites/default/files/2016-09/documents/formaldehyde.pdf

[13] California Office of Environmental Health Hazard Assessment (OEHHA), Technical Supporting Document for Noncancer RELs, Appendix D2, "Acute RELs and toxicity summaries using the previous version of the Hot Spots Risk Assessment guidelines (OEHHA 1999)."

7. PROPOSED TOXICOLOGICAL THRESHOLDS

7.1 Toxicity Values

The toxicity values proposed for this second tier review are obtained from the California Office of Environmental Health Hazard Assessment (OEHAA). OEHHA establishes reference exposure levels (RELs) for acute and chronic non-carcinogenic health hazards.[14] OEHHA also establishes unit risk factors (URF) for carcinogenic health hazards.[15] Per Ecology guidance, the non-carcinogenic and carcinogenic risks need to be evaluated for all pollutants in excess of their SQERs to account for potential cumulative impacts among pollutants with the same averaging period and target organs. Table 7-1 lists the non-carcinogenic and carcinogenic toxicity values for these pollutants.

Table 7-1. Toxicity Values

Pollutants	Chronic REL (µg/m³)	Acute REL (µg/m³)	8-Hour REL (µg/m³)	Cancer URF (µg/m³)⁻¹
Acetaldehyde	140	470	300	2.70 E-6
Acrolein	0.35	2.5	0.7	--
Formaldehyde	9	55	9	6.00 E-6
Nitrogen dioxide	--	470	--	--
Sulfur dioxide	--	660	--	--

7.2 Non-Carcinogenic Risk Assessment

To quantify the acute and chronic non-carcinogenic impacts from the project, the RELs and the maximum modeled concentrations will be used to calculate hazard quotients (HQ). The chronic and acute HQs for acetaldehyde and formaldehyde will be calculated using the following equations:

$$Chronic\ HQ = \frac{Conc.of\ TAP\ \left(\frac{\mu g}{m^3}\right)(Annual\ Avg.Period)}{Chronic\ REL\ (\frac{\mu g}{m^3})}$$

$$Acute\ HQ = \frac{Conc.of\ TAP\ \left(\frac{\mu g}{m^3}\right)(Hourly\ Avg.Period)}{Acute\ REL\ (\frac{\mu g}{m^3})}$$

As discussed in Section 6, acetaldehyde and acrolein primarily target the nervous, respiratory, skin, and mucous membrane systems. Formaldehyde targets the respiratory, mucous membrane, urinary, and gastrointestinal systems. NO_2 and SO_2 also target the respiratory system. Since there are multiple chemicals that affect the same systems in the body, a Hazard Index (HI) will be calculated for each system.

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[14] RELs obtained from OEHHA "Acute, 8-hour and Chronic REL Summary, August 20, 2020. https://oehha.ca.gov/air/general-info/oehha-acute-8-hour-and-chronic-reference-exposure-level-rel-summary

[15] URFs obtained from the California Office of Environmental Health Hazard Assessment "Technical Support Document for Cancer Potency Factors - Appendix B". https://oehha.ca.gov/media/downloads/crnr/appendixb.pdf

The chronic and acute HIs for various systems will be calculated using the following equations:

$$Chronic\ HI_{system} = \sum Chronic\ HQ_{system}$$

$$Acute\ HI_{system} = \sum Acute\ HQ_{system}$$

An HI of less than one indicates that adverse health effects are unlikely to occur. If any of the calculated HIs exceed one, further analysis will be conducted by determining the frequency and geographic extent of concentrations that exceed the REL.

7.3 Carcinogenic Risk Assessment

The lifetime (70 year) increased cancer risk for acetaldehyde and formaldehyde will be evaluated in the HIA. Per WAC 173-460-090, the second tier review must demonstrate that the increase in TAP emissions will not result in an increased cancer risk of more than 10 in 1,000,000. The increase in cancer risk from the project will be calculated using the following formula,

$$Risk = \frac{Conc.of\ TAP\ \left(\frac{\mu g}{m^3}\right) \times URF\ \times EF1\ \times EF2\ \times ED}{AT}$$

where EF1 is the exposure frequency in days/year, EF2 is the exposure frequency in hours/day, ED is the exposure duration in years, and AT is the averaging time in hours (613,200 hours for a 70 year average). It will be assumed that all ASIL exceeding receptors are classified as residential receptors for ease of evaluation and conservatism. The exposure frequencies for the residential receptor type are presented in Table 7-2.

Table 7-2. Exposure Frequencies

Exposure Frequency	Residential Receptor
EF1	365
EF2	24
ED	70

The total increase in cancer risk from the project will be calculated by summing the individual increases in cancer risk for acetaldehyde and formaldehyde. In addition to calculating the project-related increase in cancer risk, the cumulative cancer risk will be calculated using the background concentration identified in Section 3.9.

APPENDIX A. SECOND TIER REVIEW PETITION FORM

Application for Second Tier Review or Third Tier Review

INSTRUCTIONS

Use this form to request Ecology review of a petition for second or third tier review. Review begins when you submit your health impact assessment protocol.

Fill out all pages of this form, front and back. Attach a check for the $10,000 initial fee to the form, and mail to:

Department of Ecology
Cashiering Unit
P.O. Box 47611
Olympia, WA 98504-7611

For Fiscal Office Use Only:
001-NSR-216-0299-000404

Check one box to indicate the review you are requesting.	**Initial Fee**
☒ Petition for Second Tier Review. The initial fee covers 106 hours of review.	$10,000
☐ Petition for Third Tier Review. The initial fee covers 106 hours of review.	$10,000

Read each statement, then check the box next to it to acknowledge what you have read.

☒	The initial fee you submit may not cover the cost of processing your petition. Ecology will track the number of hours spent on your project. If the number of hours exceeds the 106 hours included in your initial fee, Ecology will send you a bill for that extra time.
☒	Ecology will bill you $95 per hour for each hour worked beyond the initial 106 hours.
☒	You must pay the bill before Ecology will issue a decision on your petition.

Check one box to indicate the air agency with permitting jurisdiction over your project.

- ☐ Benton Clean Air Agency
- ☒ Olympic Region Clean Air Agency
- ☐ Puget Sound Clean Air Agency
- ☐ Southwest Clean Air Agency
- ☐ Spokane Regional Clean Air Agency
- ☐ Yakima Regional Clean Air Agency
- ☐ Ecology Central Regional Office Air Quality Program
- ☐ Ecology Eastern Regional Office Air Quality Program
- ☐ Ecology Industrial Section Waste 2 Resources Program
- ☐ Ecology Nuclear Waste Program – Hanford

For more information	
Science and Engineering Section Air Quality Program Ecology Headquarters Office	Matt Kadlec (360) 407-6817 matthew.kadlec@ecy.wa.gov Gary Palcisko (360) 407-7338 gary.palcisko@ecy.wa.gov

Application for Second Tier Review or Third Tier Review

Applicant Information
The applicant is the business requesting services from Ecology and is responsible for paying the costs Ecology incurs.

Name of business: Weyerhaeuser

Physical location of project (city, county): Raymond, Pacific County

Name of project: Raymond CDK Upgrades

Project Billing Contact Information
Ecology will send the responsible official the bills if there are any.

☒ If the project billing contact is different from the responsible official, check this box and provide the required information.

Name, Title: Angela Cameron, Facility Environmental Manager

Mailing address: 51 Ellis St

City, State, Zip: Raymond, WA 98577

Phone, Fax, E-mail: Phone: (360) 414-3464, email: angela.cameron@weyerhaeuser.com

Project Consultant Information
☒ If you hired a consultant to prepare the application (or materials), check this box and provide the required information.

Consultant Name, Title: Beth Ryder, Managing Consultant

Organization: Trinity Consultants

Mailing address: 8705 SW Nimbus Ave, Ste. 350

City, State, Zip: Beaverton, OR 97008

Phone, Fax, E-mail: Phone: (458) 206-6770, email: bryder@trinityconsultants.com

Responsible Official Signature Block (The responsible official is the person responsible for overall operation of and ongoing compliance at the facility.)

I certify, based on information and belief formed after responsible inquiry, the statements and information in this application are true, accurate, and complete.

Printed Name Spencer Headley Title Raymond Lumber Unit Manager

Signature [signature] Date 9/7/2023

APPENDIX B. EMISSION CALCULATIONS

Table B-1. CDK Parameter Inputs

Parameter	Value	Units	Source Notes
Total Kiln Heat Input	50	MMBtu/hr	Per vendor specification sheet received on May 16, 2023.
CDK Annual Operating Hours	8,400	hr/yr	Per vendor specification sheet received on May 16, 2023.
Annual Production	310	MMBF/yr	Per vendor specification sheet received on May 16, 2023.
Maximum Hourly Production	3.69E-02	MMBF/hr	Calculated by the following: Hourly Production (MMBF/hr) = Annual Production (MMBF/yr) / CDK Annual Operating Hours (hrs/yr).

Table B-2. CDK HAP/TAP Emissions

Pollutant	CAS #	HAP?	TAP?	Emission Factors[1] Combustion[2] (lb/MMBtu)	Drying[3, 4] (lb/MMBF)	Emissions (lb/hr)	(tpy)
Acetaldehyde	75-07-0	Yes	Yes	2.83E-04	27.5	1.03	4.32
Acrolein	107-02-8	Yes	Yes	2.60E-04	0.5	0.03	0.13
Formaldehyde	50-00-0	Yes	Yes	--	8.6	0.32	1.34
Methanol	67-56-1	Yes	Yes	7.32E-04	67.1	2.51	10.55
Propionaldehyde	123-38-6	Yes	Yes	2.52E-04	0.3	0.02	0.10
Carbon monoxide	630-08-0	No	Yes	--	--	26.94	113.15
Nitrogen dioxide[5]	10102-44-0	No	Yes	--	--	10.33	43.40
Sulfur dioxide	7446-09-5	No	Yes	--	--	1.25	5.25

1 Emissions for HAP determined by adding together indirect-heated batch dry kiln emission factors for douglas fir and wood-fired combustion emission factors, except for formaldehyde, which uses a direct-fired emission factor.

2 HAP combustion emission factors based on NCASI Technical Bulletin No. 1013: A Comprehensive Compilation and Review of Wood-Fired Boiler Emissions, Table 4.1. Mean values used.

3 HAP drying emission factors for acetaldehyde, acrolein, methanol, and propionaldehyde based on the emission factor summary table in "EPA Region 10 HAP and VOC Emission Factors for Lumber Drying, January 2021," where x = max drying temp of heated air entering the lumber (200 °F).

4 Due to formaldehyde's dependence on direct or indirect heating, the emission factor was scaled up from the value listed in the "EPA Region 10 HAP and VOC Emission Factors for Lumber Drying, January 2021," where x = max drying temp of heated air entering the lumber (200 °F). The value was scaled by the proportion of direct to indirect mean batch kiln emission factors for formaldehyde in the NCASI Wood Products Air Emission Factor Database -- 2013 Update, which is shown below:

NCASI Direct-Fired Batch Kiln EF:	7.35E-02	lb/MBF	EPA Region 10 Indirect-Heated Batch Kiln EF:	1.80	lb/MMBF
NCASI Indirect-Heated Batch Kiln EF:	1.53E-02	lb/MBF			
Ratio of Direct-to-Indirect:	4.80E+00				

5 It is conservatively assumed that all NO_X is converted to NO_2.

Appendix Table C-1. Rectangular Building Parameters

ID	Description	X Coordinate (m)	Y Coordinate (m)	Elevation (m)	Height (m)	X Length (m)	Y Length (m)	Angle Degree
BLDG_1	Planer Building	443426.8	5171013.2	3.92	18.29	138.1	27.7	90
BLDG_3	Large Dry Storage Building	443511.3	5170944.8	4.01	18.29	299.4	29.5	90
BLDG_4	Small Dry Storage Building	443541.1	5170945.1	4.10	18.29	62.1	29.8	90
BLDG_5	Trimmer Sorter Stacker Building	443571.2	5171006.3	4.07	18.29	159.2	30.7	90
BLDG_6	Sawmill Building	443602	5170896.9	4.25	13.72	28.2	80.4	90
BLDG_7	Sawmill Building_2	443602.6	5170868.2	4.19	13.72	20.7	22.7	90
CDK	CDK Building	443483	5170784.1	3.50	11.34	108.7	14.8	90
BURNER	CDK Burner	443473.3	5170756.7	3.48	24.97	11.5	6.7	90

Appendix Table C-2. Circular Building Parameters

ID	Description	X Coordinate (m)	Y Coordinate (m)	Elevation (m)	Height (m)	Radius (m)	Corners
F_SILO	Green Sawdust Silo	443469.2	5170778.2	3.65	25.60	6.10	24

Appendix Table C-3. Polygon Building Parameters

ID	Description	X Coordinate (m)	Y Coordinate (m)	Elevation (m)	Height (m)
BLDG_2	Planer Infeed Building	443455.3	5171026.3	4.13	12.19

Appendix Table C-4. Point Source Parameters

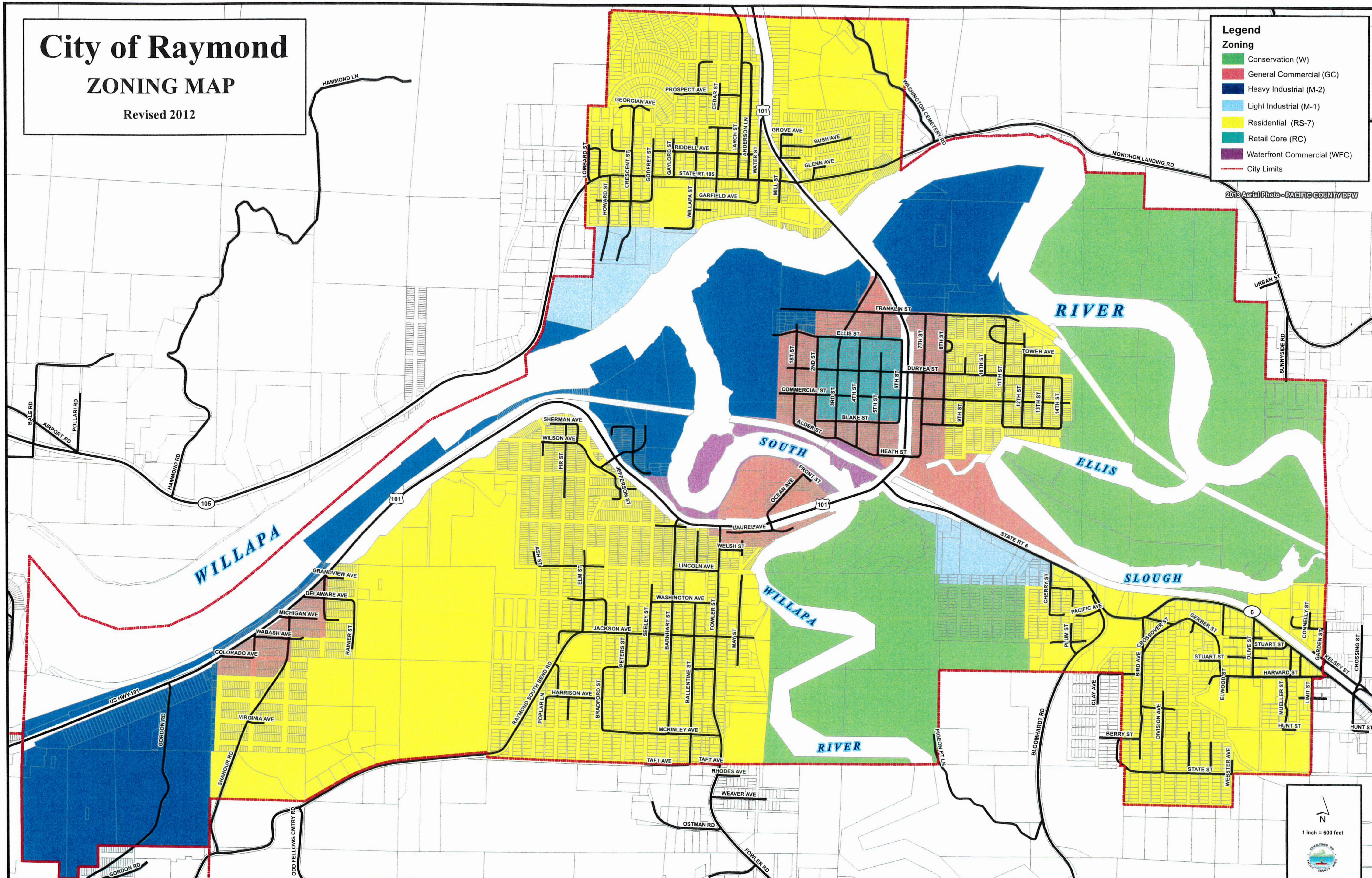
ID	Description	X Coordinate (m)	Y Coordinate (m)	Elevation (m)	Stack Height (m)	Stack Temp. (K)	Velocity (m/s)	Diameter (m)
CDK_S	CDK South Merged Stack	443492.7	5170676.4	3.31	13.47	333.15	21.75	1.18
CDK_N	CDK North Merged Stack	443485.6	5170783.2	3.48	13.47	333.15	21.75	1.18

Appendix Table C-5. Emission Rates

Pollutant CAS #	Acetaldehyde 75-07-0	Acrolein 107-02-8	Formaldehyde 50-00-0	Nitrogen Dioxide 10102-44-0	Sulfur Dioxide 7446-09-5
1-hr, 8-hr, 24-hr	6.48E-02	1.98E-03	2.01E-02	6.51E-01	7.87E-02
Annual	6.22E-02	1.90E-03	1.93E-02	6.24E-01	7.55E-02

a. It is assumed that emissions from the CDK will be split evenly between the four exhaust stacks (two modeled stacks) so emission rates are divided by two. Emission rates shown above are the individual rates for each stack.

APPENDIX D. ZONING MAP



City of Raymond
ZONING MAP
Revised 2012
Legend
Zoning
Conservation (W)
General Commercial (GC)
Heavy Industrial (M-2)
Light Industrial (M-1)
Residential (RS-7)
Retail Core (RC)
Waterfront Commercial (WFC)
City Limits
2013 Aerial Photo - PACIFIC COUNTY DPW
1 inch = 600 feet
N
WILLAPA
RIVER
SOUTH
WILLAPA
RIVER
ELLIS
SLOUGH
HAMMOND LN
HAMMOND RD
AIRPORT RD
BALE RD
POLLARI RD
MONOHON LANDING RD
WASHINGTON CEMETERY RD
URBAN ST
SUNNYSIDE RD
PROSPECT AVE
GEORGIAN AVE
RIDDELL AVE
STATE RT 105
GARFIELD AVE
GROVE AVE
BUSH AVE
GLENN AVE
FRANKLIN ST
ELLIS ST
TOWER AVE
DURYEA ST
COMMERCIAL ST
BLAKE ST
ALDER ST
HEATH ST
FRONT ST
OCEAN AVE
LAUREL AVE
WELSH ST
LINCOLN AVE
WASHINGTON AVE
JACKSON AVE
HARRISON AVE
MCKINLEY AVE
TAFT AVE
RHODES AVE
WEAVER AVE
OSTMAN RD
FOWLER RD
ODD FELLOWS CMTRY RD
SHERMAN AVE
WILSON AVE
GRANDVIEW AVE
DELAWARE AVE
MICHIGAN AVE
WABASH AVE
COLORADO AVE
VIRGINIA AVE
US HWY 101
GORDON RD
SHANOUR RD
RAYMOND SOUTH BEND RD
STATE RT 6
PACIFIC AVE
CROSSOVER ST
GERBER ST
STUART ST
HARVARD ST
HUNT ST
STATE ST
BERRY ST
KELSEY ST
CROSSING ST
PIGEON PT LN
BLOOMHARDT RD
101
105
6

Notice of Construction (NOC) Fee Schedule

Effective July 1, 2023

NOC Fees - ORCAA Rule 3.3(a)

	Filing Fee	9296
+	Additional NOC Processing Fees	0 1377
+	Other Costs	0
	NOC Fee	9296 10673

Filing Fee - ORCAA Rule 3.3(b)

	Complexity Fee	
+	Equipment Fee(s) (for each piece of equipment, unless they are identical per 3.3(b)(2)	
	Filing Fee	4281

Complexity Fee

2557+1279+491+688=5015

$9296

Complexity Level 1	$ 1279
Complexity Level 2[1]	$ 2560
Complexity Level 3[1]	$ 4281
Complexity Level 4[1]	$ 10358

Equipment Fee

Equipment/Activity	Fee	Base-Fee Hours
Abrasive Blasting	$ 491	5
Asphalt Plant	$ 3639	37
Combustion Equipment not otherwise listed (Million Btu/hr heat input at design capacity)		
Less than 10	$ 1180	12
10 or more but less than 30	$ 1279	13
30 or more but less than 100	$ 2557	26
More than 100	$ 6886	70
Temporary Combustion Equipment (Onsite < 1 year)	One half the filing fee	One half the base-fee hours
Coffee Roaster	$ 688	7
Composting Operation (Average material throughput – tons per day)		
Less than 50	$ 1279	13
50 or more but less than 200	$ 2262	23
More than 200	$ 3345	34
Concrete Batch Plant	$ 1967	20
Crematory	$ 1082	11
Dry Cleaner (per machine)	$ 688	7
Dry Kilns	$ 1279	13
Emergency Engine – cumulative horsepower < 2000 bhp	$ 885	9
Emergency Engine -cumulative horsepower ≥ 2000 bhp	$ 1770	18
Non-Emergency Engine (per engine)	$ 1279	13
Gasoline Dispensing Station	$ 688	7
Log yard	$ 688	7

Printing	$ 688	7
Process Equipment ≤20,000 cubic feet per minute at design capacity	$ 984	10
Rock Crushing Plant – includes General Order	$ 491	5
Soil Remediation	$ 1279	13
Spray Painting – Autobody (per operation/booth)	$ 786	8
Surface Coating – Aviation, Wood, Truck Bed Lining, Boat, Other (per operation/booth)	$ 1378	14
Storage Tanks ≤10,000-gallon total capacity (other than at retail gasoline dispensing stations)	$ 885	9
Wastewater Treatment Plant	$ 2065	21
Welding	$ 984	10

1x - New fuel silo/cyclone, new dry chip baghouse

Other Equipment not listed above - Small[2]	$ 491	5
Other Equipment not listed above - Medium[2]	$ 1377	14
Other Equipment not listed above - Large[2]	$ 3345	34
In-Kind Replacements –Replacement of equipment with a unit of same or smaller size and combusting the same or cleaner fuel (if applicable). This fee reduction does not apply to asphalt plants, combustion equipment >30 MMBtu/hr, or other replacements at the discretion of the Executive Director.	One half the applicable filing fee	One half the associated base-fee hours

Control Device Replacement/Change in Conditions (No Complexity Fee)

Equipment/Activity	Fee	Base-Fee Hours
Control Device Replacement per ORCAA Rule 6.1.10 NOC	$ 786	8
Change in Conditions per ORCAA Rule 6.1.11[4] NOC	$ 688	7

1x - Relocated bark cyclone, dry chip cyclone, roads

Additional NOC Processing Fees - ORCAA Rule 3.3(c)

Additional NOC Processing fees, including work that exceeds the base-fee hours, will be billed at the following hourly rate as specified in ORCAA Rule 3.3(d).

Hourly Rate	$ 98.36

Other Costs - ORCAA Rule 3.3(d)

Publishing and consulting costs incurred will be billed to the applicant as specified in ORCAA Rule 3.3(d).

Variance per ORCAA Rule 2.3, Compliance Schedule per ORCAA Rule 2.6(f), or Restricting the Potential to Emit per ORCAA Rule 5.3 (SMO)

Fees	Fee	Base-Fee Hours
Filing Fee	$ 1377	14
Add'l processing costs above allowed hours – per hour	$ 98.36	
Actual legal notice fees	Actual cost	
Actual ORCAA legal fees	Actual cost	

[1]Complexity – Level 1, Level 2, Level 3 and Level 4

The following includes equipment that would be considered in each permit complexity class if installed by themselves. If the application includes more than one piece of equipment/process or if your equipment/process is not listed, please contact ORCAA Engineering Department for a complexity determination for your project.

Level 1
Abrasive Blasting
Coffee Roaster
Dry Cleaner
Emergency Engine $\leq$2000bhp
Gasoline Dispensing Facilities
Rock Crushing Plant
Spray Painting – Autobody
Storage Tanks <10,000-gallon capacity - excluding gasoline dispensing facilities

Level 2
Combustion Equipment <30 MMBtu/hr
Compost <50 ton/day
Cremator
Emergency Engine $\geq$2000bhp
Non-Emergency Engine
Process Equipment
Soil Remediation
Surface Coating (excluding autobody)
Welding

Level 3
Combustion Equipment 30-100 MMBtu/hr
Compost 50-200 tons/day

Level 4
Asphalt Plant
Combustion Equipment >100 MMBtu/hr

[2]Equipment fees for other equipment not classified above is determined based on the size and the type of the unit. Please contact ORCAA Engineering Department for assistance.

[3]Per Rule 1.4, a "Modification" means any physical change in, or change in method of operation of, a stationary source that increases the amount of any air contaminant emitted by such stationary source or that result in the emissions of any air contaminant not previously emitted.

[4]Changes in Conditions that will result in an emissions increase are reviewed as a "modification"