**MEMORANDUM**

**To:** Aaron Manley, Olympic Region Clean Air Agency

**cc:** Michael Nolan, Jack Carter, and Angela Cameron, Weyerhaeuser NR Company

**From:** Beth Ryder and Maddie Coates, Trinity Consultants

**Date:** November 27, 2023

**RE:** Weyerhaeuser Raymond NOC Application Addendum – Modeling Section (23NOC1614)

On October 10, 2023, Weyerhaeuser NR Company (Weyerhaeuser) received a data request from Aaron Manley, P.E. from the Olympic Region Clean Air Agency (ORCAA) regarding its Notice of Construction (NOC) application #23NOC1614. The NOC application was submitted to approve the installation of a direct-fired continuous dry kiln (CDK) at the Raymond facility (the "Facility"). This memo serves as an addendum to the NOC permit application and provides the data requested by ORCAA related to modeling.

## Data Request 1, Question 3 – Modeling

a. *ORCAA: The application states an outdated version of AERMET was used, (V19191) and we require confirmation the current version of AERMET was used (V22112) or that the modeling scenario be re-run using the current version of AERMET.*

**Response:** Weyerhaeuser updated the MET data to be processed with V22112 instead of V19191. The updated models submitted along with this addendum use the MET data processed with V22112.

b. *ORCAA: The application needs to use the most recent 5 calendar years of met data or be amended to address/justify why 2016-2020 was used and not 2018-2022.*

**Response:** Weyerhaeuser updated the MET data to use 2018-2022 data. The updated models submitted along with this addendum use this data set.

c. *ORCAA: Table G-4, footnote 1 states that the two merged CDK stacks (North and South) are based on guidance from* "Practical Guide to Atmospheric Dispersion Modeling" *(Tuner and Shulze). Please provide the relevant excerpts from this reference, in the context of how the merged pseudo stacks' exit velocity and stack diameter were determined.*

**Response:** The following passage from the "Practical Guide to Atmospheric Dispersion Modeling" was used to determine the parameters for the merged vapor extraction points:

> "When two or more stacks are in close proximity, in the range or two to 10 stack diameters apart, the merging of the stack effluents may enhance the plume rise. For segmented stacks containing multiple flues, a single effective diameter can be calculated to accommodate the sum of the stack gas volumes from the multiple flues at the same exit velocity and temperature as that from the single flues" (pg. 90-91).

The flowrate and diameter of a single vapor extraction point were provided by the CDK vendor. This information was used to calculate the velocity of a single vapor extraction point. The combined

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flowrate of two vapor extraction points and the velocity of a single vapor extraction point are used to determine the effective diameter of each of the merged vapor extraction points.

d. *ORCAA: Please provide an evaluation of ORCAA Rule 8.6(b), ORCAA's ambient formaldehyde standard.*

**Response:** ORCAA Rule 8.6(b) establishes a 1-hr standard for formaldehyde of 61 μg/m$^3$. An evaluation and demonstration of compliance with this standard is included in Table G-13 of Attachment A. See part e response below for link to model files and Attachment B for the model file directory.

e. *ORCAA: Please provide access to the modeling input/output files via DVD, a SharePoint link, or something similar (please note that we do not accept DropBox).*

**Response:** A file sharing link is provided in the email associated with this memo delivery. Please refer to Attachment B for the model file directory.

f. *ORCAA: Section 7.1, paragraph 2 of the NOC application states that all TAPs, except $NO_2$, were modeled at 1 g/s and scaled using the project emission increase per WAC 173-460-080. Please provide the "post processing" worksheet used to scale TAP modeling results at 1 g/s by the TAP emissions rates of each source modeled.* ***Why needed:*** *Because the NOC application states that 1 g/s was used, the modeling results must have been post-processed. ORCAA needs to review these calculations because it is a critical part of the impacts analysis.*

**Response:** During this model update, Weyerhaeuser updated the methodology of the modeled emission rates. Rather than proceeding with the 1 g/s and post-processing method, each pollutant is modeled using their respective PTE emission rate. Calculated model emission rates based on PTE calculations are provided in Attachment A. The Excel file is also included in the link provided in the part e response.

g. *ORCAA: Please provide the "front-end" calculations of criteria pollutants that converts the appropriate emission rates to the g/s used for each release point in the model.*
***Why needed:*** *ORCAA needs to review these calculations because they are a critical preliminary step in the impacts analysis.*

**Response:** Calculated model emission rates for criteria pollutants are based on PTE calculations and are provided in Attachment A. The Excel file is also included in the link provided in the part e response.

# Additional Model Updates

## Updated Source Parameters

Based on updated vendor specifications and the NCASI Control Device and Stack Testing Feasibility Assessment presented in the NOC Application Addendum, it is expected that the vapor extraction points will capture 80% of emissions from the CDK. The remaining 20% of emissions are expected to be emitted through the openings at the ends of the kiln. Because of the positive and negative pressure created by the internal fans near the kiln ends, it is expected that ambient air will be drawn into the kiln on the side where dry lumber is exiting and kiln gas is forced out on the side where green lumber is entering. As a result, one horizontal point source is placed at the green lumber entrance on each end of the kiln to represent emissions from the openings on the CDK. The effective diameter for each source is calculated from the area of the opening minus the area covered by the lumber, which is assumed to be 75% of the door opening. The release height is calculated as the height of the door minus half of the effective diameter. The exit velocity is conservatively assumed to be one foot per second.

The previous memo to ORCAA dated November 15, 2023, detailed startup, upset, idle, and shutdown operations. Startup operations will exhaust burner emissions into the main CDK causing emissions to be released from the vapor extraction points and end openings. Other operations will emit through the abort and/or bypass stacks. Startup operations are expected to quickly increase heat input until reaching maximum capacity and the desired dry bulb temperature for the wood. Idle operations will have a much lower heat input at <20% of capacity. The exhaust associated with the abort and bypass stacks are expected to have a higher temperature than the vapor extraction points and the CDK end openings. The temperature of biomass combustion is higher than the temperature of the CDK due to the inclusion of evaporation within the CDK. Therefore, emissions from the abort and bypass stacks are not included in the modeling analysis as emissions from the vapor extraction points and end openings are expected to have worse dispersion characteristics and higher emissions.

## Updated Emission Rates

Emission rates and the pollutants modeled for all averaging periods have changed as detailed in Trinity's memo to ORCAA dated November 15, 2023. Short term emissions are modeled as the maximum one hour operation for the expected time period, with the exception of 24-hour averaging period for $PM_{10}$ and $PM_{2.5}$ NAAQS compliance demonstration. These emissions are modeled with seven hours of potential startup time (firing at maximum capacity of 50 MMBtu/hr) and the remainder of the period at normal operation. This 350MMBtu/day is expected to incorporate any operations (startup, idle, shutdown, upsets) when the wet scrubbing impacts from the wood condensate are not impacting the resulting particulate matter emissions.

Annual emission rates are modeled as the total annual emissions averaged over 8,760 hours of operation. This includes 18,000 MMBtu/yr or 360 hours/yr of startup, shutdown, idle, and upsets.

## Updated Model Results

As discussed in response to Question 1 and 6 of the NOC Application Addendum, the PTE emission calculations were updated. As a result, the models completed for the NAAQS and TAP compliance demonstration were updated.

The criteria pollutant models for $PM_{10}$, $PM_{2.5}$, CO, $NO_2$, and $SO_2$ were updated to reflect changes to emission rates and include the new sources as described above. As demonstrated in the original NOC application, modeled CO concentrations are below the SIL and do not require further NAAQS compliance demonstration. Results can be found in Table 1 below.

**Table 1. SIL Model Results**

| Pollutant | Averaging Period | Design Concentration | Concentrations (μg/m³) | | Exceeds SIL? |
|---|---|---|---|---|---|
| | | | Modeled | SIL | |
| CO | 1-hr | H1H | 631.7 | 2,000 | No |
| | 8-hr | H1H | 261.3 | 500 | No |

Using the same background concentrations as the originally submitted NOC application, Table 2 below shows that all criteria pollutants (except for CO) are below the NAAQS; therefore, compliance with the NAAQS for the proposed project is demonstrated.

**Table 2. NAAQS Model Results**

| Pollutant | Averaging Period | Design Concentration | Concentrations (µg/m³) | | | Exceeds NAAQS? |
|---|---|---|---|---|---|---|
| | | | Modeled | Total | NAAQS | |
| $PM_{10}$ | 24-hr | H6H | 76.9 | 119.6 | 150 | No |
| $PM_{2.5}$ | 24-hr | H8H | 22.9 | 33.1 | 35 | No |
| | Annual | -- | 5.6 | 9.9 | 12 | No |
| $NO_2$ | 1-hr | H8H | 111.1 | 133 | 188 | No |
| | Annual | -- | 9.8 | 14.1 | 100 | No |
| $SO_2$ | 1-hr | H4H | 18.5 | 30.7 | 196 | No |

The TAP analysis models were also updated to demonstrate compliance with the Washington TAP program (WAC 173-460). Table G-13 in Attachment A shows the updated TAP analysis with SQER exceeding pollutants that were modeled. Table 3 below shows the results of the modeled TAP which are determined based on the maximum concentration increase across all receptors and model years. Results show that formaldehyde, benzene, and arsenic exceed their respective annual ASIL; therefore, a Tier II Health Impact Assessment is completed and submitted under separate cover.

**Table 3. TAP Model Results**

| Pollutants | Averaging Period | Highest Modeled Concentration (µg/m³) | ASIL (µg/m³) | Exceeds ASIL? |
|---|---|---|---|---|
| Formaldehyde | year | 0.43 | 0.17 | **Yes** |
| Formaldehyde | 1-hr | 9.81 | 61 | No |
| Benzene | year | 0.23 | 0.13 | **Yes** |
| Arsenic | year | 0.00054 | 0.0003 | **Yes** |
| Cadmium | year | 0.00017 | 0.00024 | No |
| Lead | year | 0.002 | 0.083 | No |
| Manganese | 24-hr | 0.01 | 0.3 | No |
| Nickel | year | 0.00047 | 0.0038 | No |

# Attachment A

## Emission Rates, Source Parameters, and Model Results

**Project Inputs and Assumptions**

| Parameter | Value | Units | Source Notes |
|---|---|---|---|
| ***CDK*** | | | |
| Total Kiln Heat Input | 50 | MMBtu/hr | Per vendor specification sheet received on May 16, 2023. |
| CDK Maximum Annual Operating Hours | 8,760 | hrs/yr | Assumed value for PTE basis. |
| CDK Expected Annual Operating Hours | 8,400 | hrs/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 Expected Annual Operating Hours (hrs/yr). |
| ***Truck Bins*** | | | |
| Bark Annual Throughput | 121,186 | tpy | See Fugitive PM tab. |
| Green Chips Annual Throughput | 414,070 | tpy | See Fugitive PM tab. |
| Planer Shavings Annual Throughput | 58,212 | tpy | See Fugitive PM tab. |
| Sawmill Operation - Hours per Day | 20 | hours/day | Per conversation with client, the sawmill operates in two 10-hour shifts. |
| Sawmill Operation - Days per Week | 5 | days/week | Per conversation with client, the sawmill operates Monday - Friday |
| Sawmill Operation - Weeks per Year | 52 | weeks/year | Per conversation with client, the sawmill operates 52 weeks per year. |
| Sawmill Operation - Annual Operating Hours | 5,200 | hours/year | Calculated by the following: Annual Operating Hours = (Hours/Day) * (Days/Week) * (Weeks/Year). |
| ***Fugitive Emissions - Green Sawdust*** | | | |
| Wet Green Sawdust Higher Heating Value | 3,500 | Btu/lb | Per the HHV of wet fuel in Weyerhaeuser's Greenville facility's CDK PTE calculations. |
| Green Sawdust Fuel Maximum Annual Throughput | 62,571 | tpy | Calculated by the following: Annual Green Sawdust Fuel (tpy) = Total Kiln Heat Input (MMBtu/hr) * CDK Maximum Annual Operating Hours (hrs/yr) * $10^{\wedge 6}$ (Btu/MMBtu) / HHV (Btu/lb) / 2000 (lb/ton). |
| Green Sawdust Fuel Maximum Hourly Throughput | 14,286 | lb/hr | Calculated by the following: Max Hourly Green Sawdust Fuel (lb/hr) = Total Kiln Heat Input (MMBtu/hr) * $10^{\wedge 6}$ (Btu/MMBtu) / HHV (Btu/lb). |
| Sawdust Surge - Hours per Week | 100 | hours/week | Per conversation with client, the operational surge is 100 hrs/wk (Monday - Friday). |
| Sawdust Surge - Days per Week | 5 | days/week | Assumed value, since the sawmill operates Monday - Friday. |
| Sawdust Surge - Hours per Day | 20 | hours/day | Calculated by the following: Hours per Day = (Hours/Week) / (Days/Week). |
| Sawdust Surge - Annual Operating Hours | 5,200 | hours/year | Calculated by the following: Annual Operating Hours = (Hours/Week) * (Weeks/Year). |
| ***Cyclones*** | | | |
| Cyclone Annual Operating Hours | 8,760 | hrs/yr | Assumed value for PTE basis. |
| Fuel Silo Cyclone Exhaust Flow Rate | 6,227 | scfm | Per vendor specs, received June 29, 2023. Per email with Angela Cameron on July 11, 2023, the stream is at ambient temperature and is assumed to be in standard conditions. |
| Bark Cyclone Exhaust Flow Rate | 8,564 | scfm | Per Table 3.0 in the TSD for 12AOP915 (Cyclone #11). The stream is assumed to be at ambient conditions. |
| Dry Chip Cyclone Exhaust Flow Rate | 5,150 | scfm | Per Table 3.0 in the TSD for 12AOP915 (Cyclone #21). The stream is assumed to be at ambient conditions. |
| Dry Chip Baghouse Control Efficiency | 99% | -- | Based on the 2021 ORCAA AEI workbook, baghouses are assumed to maintain a control efficiency of 99%. |
| Cyclone PM Grain Loading Rate | 0.03 | gr/dscf | Based on the 2021 ORCAA AEI workbook, the PM grain loading rate comes from FIRE 6.23 October 2000, SCC 30700804, 30700805, which is also in Table 10.4.1 AP-42, p. 10.4-2 (2/80). |

**Table F-1. Project-Wide Potential Emissions — Criteria Pollutant Summary**

| Emission Unit | Fugitive? | Potential Annual Emissions (tpy) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total PM | Total $PM_{10}$ | Total $PM_{2.5}$ | $SO_2$ | $NO_X$ | VOC | CO | $CO_2e$ |
| CDK | N | 24.82 | 18.95 | 17.76 | 5.48 | 44.40 | 224.66 | 116.39 | 45,893 |
| Chip and Bark Truck Bins | Y | 9.45 | 4.47 | 0.68 | -- | -- | -- | -- | -- |
| Fugitive Emissions - Green Sawdust | Y | 0.24 | 0.11 | 0.02 | -- | -- | -- | -- | -- |
| Haul Roads | Y | 0.90 | 0.18 | 0.04 | -- | -- | -- | -- | -- |
| Cyclones | N | 16.72 | 6.69 | 6.69 | -- | -- | -- | -- | -- |
| **Total:** | | **52.12** | **30.39** | **25.18** | **5.48** | **44.40** | **224.66** | **116.39** | **45,893** |

**Table F-2. Facility-Wide Potential Emissions — Criteria Pollutant Summary**

| Emission Unit | Fugitive? | Potential Annual Emissions (tpy) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total PM | Total $PM_{10}$ | Total $PM_{2.5}$ | $SO_2$ | $NO_X$ | VOC | CO | $CO_2e$ |
| Wood Waste Collection - Cyclones[2] | N | 18.36 | 7.36 | 7.36 | -- | -- | -- | -- | -- |
| Fugitive Emissions - Roads[3] | Y | 0.90 | 0.18 | 0.04 | -- | -- | -- | -- | -- |
| Log Debarking[4] | Y | 6.5 | 3.6 | 0.5 | -- | -- | -- | -- | -- |
| CDK | N | 24.82 | 18.95 | 17.76 | 5.48 | 44.40 | 224.66 | 116.39 | 45,893 |
| Chip and Bark Truck Bins | Y | 9.45 | 4.47 | 0.68 | -- | -- | -- | -- | -- |
| Fugitive Emissions - Green Sawdust | Y | 0.24 | 0.11 | 0.02 | -- | -- | -- | -- | -- |
| Fire Pump Engine | N | 0.03 | 0.03 | 0.03 | 0.02 | 0.37 | 0.03 | 0.08 | 13.73 |
| **Total Emissions (with fugitives):** | | **60.29** | **34.70** | **26.38** | **5.50** | **44.77** | **224.69** | **116.47** | **45,906** |
| **Total Emissions (without fugitives):** | | **43.21** | **26.34** | **25.14** | **5.50** | **44.77** | **224.69** | **116.47** | **45,906** |
| **PSD Major Source Thresholds:** | | **250** | **250** | **250** | **250** | **250** | **250** | **250** | **100,000** |
| **PSD Threshold Exceeded [1] (Yes/No):** | | **No** | **No** | **No** | **No** | **No** | **No** | **No** | **No** |

[1] PSD is only applicable for GHG if the PSD threshold is exceeded for it and another pollutant.

[2] "Wood Waste Collection - Cyclones" includes new cyclones added as part of the project and existing cyclones that remain unchanged.

[3] Vehicle usage has been updated as part of the project, so fugitive road emissions have been recalculated.

[4] "Log Debarking" emissions remain unchanged from the value included in Table 4.2 of the TSD to the current AOP (12AOP915). The PM value was estimated based on the PM/PM10 relationship displayed in ORCAA's 2021 AEI - Debarking tab.

**Table F-3. Project-Wide and Facility-Wide Potential Emissions — HAP Summary**

| | | |
|---|---|---|
| Total HAP [1] (tpy): | 21.68 | |
| Maximum HAP (tpy): | 14.04 | Methanol |

[1] After completion of the CDK Project, HAP emissions at the Facility will only be emitted from the CDK.

Table F-4. Project-Wide Potential Emissions — HAP/TAP Summary

| Pollutant | CAS # | HAP? | TAP? | CDK Emissions (lb/hr) | CDK Emissions (tpy) | Averaging Period | SQER[1] (lb/avg. period) | Project Emissions without netting (lb/avg. period) | Exceed SQER without netting? | Actual Emissions [2] (lb/avg. period) | Net Emissions [2] (lb/avg. period) | Exceed SQER with netting? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Formaldehyde | 50-00-0 | Yes | Yes | 0.42 | 1.76 | year | 27 | 3518.08 | Yes | 288.09 | 3,229.99 | Yes |
| Benzene | 71-43-2 | Yes | Yes | 0.21 | 0.92 | year | 21 | 1839.60 | Yes | 474.03 | 1,365.57 | Yes |
| Arsenic | 7440-38-2 | Yes | Yes | 5.05E-04 | 2.21E-03 | year | 0.049 | 4.42 | Yes | 0.11 | 4.31 | Yes |
| Cadmium | 7440-43-9 | Yes | Yes | 1.55E-04 | 6.77E-04 | year | 0.039 | 1.35 | Yes | 0.08 | 1.28 | Yes |
| Lead | 7439-92-1 | Yes | Yes | 1.75E-03 | 7.64E-03 | year | 14 | 15.29 | Yes | 0.13 | 15.16 | Yes |
| Manganese | 7439-96-5 | Yes | Yes | 6.35E-03 | 0.03 | 24-hr | 0.022 | 0.15 | Yes | 0.02 | 0.13 | Yes |
| Nickel | 7440-02-0 | Yes | Yes | 4.42E-04 | 1.94E-03 | year | 0.62 | 3.87 | Yes | 0.45 | 3.42 | Yes |
| | | | | **Total HAP (tpy):** | 21.68 | | | | | | | |
| | | | | **Max Individual HAP (tpy):** | 14.04 | Methanol | | | | | | |

[1] The SQER for each TAP is obtained from the 2019 WAC 173-460 TAP list.

[2] For each TAP that initially exceeds its SQER, netting was conducted to determine actual emissions based on the last ten years of annual emissions inventories (AEIs) for the current combustion and lumber drying operations (hog fuel boiler and indirect-heated batch kilns, respectively). The net emissions (proposed emissions - actual emissions) are then compared to the SQER. For pollutants that do not have previously quantified emissions, which are evidenced by "Not Calculated" in the Actual Emissions column, it is assumed that by using the same emission factor, proposed emissions will be lower than actual emissions due to the CDK's lower maximum heat input. In these instances, net emissions are set to zero and do not exceed the SQER.

CDK Maximum Heat Input (MMBtu/yr) = Heat Input Rating (MMBtu/hr) * Annual Hours of Operation (hrs/yr)

= 438,000 MMBtu/yr

Maximum two-year average hog fuel boiler heat input (MMBtu/yr) = 638,917 MMBtu/yr

**Table F-5. 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 Maximum Annual Operating Hours | 8,760 | hrs/yr | Assumed value for PTE basis. |
| CDK Expected Annual Operating Hours | 8,400 | hrs/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 Expected Annual Operating Hours (hrs/yr). |

**Table F-6. CDK Criteria Pollutant and GHG Emissions**

| Pollutant | Normal Operation Emission Factors | | | Normal Operation Emissions[6] | | Startup/Idling Emissions[6] | | Total CDK Emissions[6] | |
|---|---|---|---|---|---|---|---|---|---|
| | Emission Factor | Unit | Reference | Max Hourly (lb/hr) | Total Annual (tpy) | Max Hourly (lb/hr) | Total Annual (tpy) | Max Hourly[7] (lb/hr) | Total Annual (tpy) |
| PM | 140 | lb/MMBF | 1 | 5.17 | 21.70 | 17.35 | 3.12 | 17.35 | 24.82 |
| $PM_{10}$ | 104 | lb/MMBF | 1 | 3.84 | 16.12 | 15.70 | 2.83 | 15.70 | 18.95 |
| $PM_{2.5}$ | 99 | lb/MMBF | 1 | 3.65 | 15.35 | 13.39 | 2.41 | 13.39 | 17.76 |
| CO | 730 | lb/MMBF | 1 | 26.94 | 113.15 | 18.00 | 3.24 | 26.94 | 116.39 |
| $NO_X$ | 280 | lb/MMBF | 1 | 10.33 | 43.40 | 10.15 | 1.00 | 10.33 | 44.40 |
| Total VOC | -- | -- | 2 | 53.48 | 224.66 | -- | -- | 53.48 | 224.66 |
| VOC (Combustion) | 6.19E-03 | lb/MMBtu | 3 | 0.31 | 1.36 | -- | -- | 0.31 | 1.36 |
| VOC (Drying) | 1,440.7 | lb/MMBF | 4 | 53.17 | 223.31 | -- | -- | 53.17 | 223.31 |
| $SO_2$ | 0.025 | lb/MMBtu | 1 | 1.25 | 5.48 | -- | -- | 1.25 | 5.48 |
| $CO_2e$ | -- | lb/MMBtu | 5 | 10,478 | 45,893 | -- | -- | 10,478 | 45,893 |
| $CO_2$ | 207 | lb/MMBtu | 5 | 10,340 | 45,288 | -- | -- | 10,340 | 45,288 |
| $N_2O$ | 7.94E-03 | lb/MMBtu | 5 | 0.40 | 1.74 | -- | -- | 0.40 | 1.74 |
| $CH_4$ | 1.59E-02 | lb/MMBtu | 5 | 0.79 | 3.48 | -- | -- | 0.79 | 3.48 |

1 Emissions for PM, CO, $NO_X$, and $SO_X$ estimated using direct-fired continuous dry kiln emission factors from Georgia EPD's document entitled "EPD Recommended Emission Factors for Lumber Kiln Permitting in Georgia".

2 Emissions for VOC determined by adding together indirect-heated batch dry kiln emission factors for douglas fir and wood-fired combustion emission factors.

3 VOC combustion emission factor based on NCASI Technical Bulletin No. 1013: A Comprehensive Compilation and Review of Wood-Fired Boiler Emissions, Table 5.1. Mean values used. VOC reported as total non-methane hydrocarbons (TNMHC) "as-C", determined using EPA Method 25A, and converted to WPP1[1] per WPP1 Section 8.0 Equation 1: VOC (WPP1) = VOC (as-C) + Methanol + Formaldehyde.

4 VOC drying emission factor as derived by OTM26 based on the "EPA Region 10 HAP and VOC Emission Factors for Lumber Drying, January 2021". Emission Factor (lb/MBF) = 0.01460x - 1.77130, where x = max drying temp of heated air entering the lumber (220 °F).

5 GHG emissions are calculated based on the Global Warming Potentials (GWP) provided in Table A-1 of 40 CFR 98 and emission factors provided in Tables C-1 and C-2 for combustion of wood and wood residuals.

| | |
|---|---|
| $CO_2$ | 1 |
| $N_2O$ | 298 |
| $CH_4$ | 25 |

6 Emission rates for pollutants with only 'lb/MMBF' emission factors are based on the CDK's annual throughput of dried lumber [MMBF], so combustion emissions from startup and idling are added in order to determine total CDK emission rates. These startup and idling emissions are calculated in the CDK Startup and Idling tab of the workbook. Emission rates for pollutants with 'lb/MMBtu' emission factors are based on the kiln's maximum firing rate [MMBtu/hr] and continuous operating hours of 8,760 hours per year. Since emissions at the maximum firing rate are the most conservative, the 'lb/MMBtu' emission rates already include combustion emissions from startup and idling.

7 Max hourly emissions represent the maximum emissions from the following three scenarios: normal operation, startup, or idling.

**Table F-7. CDK HAP/TAP Emissions**

| | | | | Normal Operation Emission Factors[1,2] | | | Normal Operation Emissions[11] | | Startup/Idling Emissions[11] | | Total CDK Emissions[11] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pollutant | CAS # | HAP? | TAP? | Combustion (lb/MMBtu) | Drying (lb/MMBF) | Reference | Max Hourly (lb/hr) | Total Annual (tpy) | Max Hourly (lb/hr) | Total Annual (tpy) | Max Hourly[12] (lb/hr) | Total Annual (tpy) |
| Acetaldehyde | 75-07-0 | Yes | Yes | 1.57E-04 | 27.5 | 2,3 | 1.02 | 4.30 | -- | -- | 1.02 | 4.30 |
| Acrolein | 107-02-8 | Yes | Yes | 1.27E-04 | 0.5 | 2,3 | 0.02 | 0.11 | -- | -- | 0.02 | 0.11 |
| Formaldehyde | 50-00-0 | Yes | Yes | -- | 11.33 | 4 | 0.42 | 1.76 | 0.02 | 3.39E-03 | 0.42 | 1.76 |
| Methanol | 67-56-1 | Yes | Yes | 4.82E-04 | 89.9 | 2,3 | 3.34 | 14.04 | -- | -- | 3.34 | 14.04 |
| Propionaldehyde | 123-38-6 | Yes | Yes | 2.14E-05 | 0.3 | 2,3 | 0.01 | 0.05 | -- | -- | 1.21E-02 | 0.05 |
| Carbon monoxide | 630-08-0 | No | Yes | -- | -- | -- | 26.94 | 113.15 | 18.00 | 3.24 | 26.94 | 116.39 |
| Nitrogen dioxide | 10102-44-0 | No | Yes | -- | -- | 5 | 10.33 | 43.40 | 10.15 | 1.83 | 10.33 | 45.23 |
| Sulfur dioxide | 7446-09-5 | No | Yes | -- | -- | -- | 1.25 | 5.48 | -- | -- | 1.25 | 5.48 |
| Acetophenone | 98-86-2 | Yes | No | 1.84E-06 | -- | 2 | 9.20E-05 | 4.03E-04 | -- | -- | 9.20E-05 | 4.03E-04 |
| Benzene | 71-43-2 | Yes | Yes | 4.2E-03 | -- | 7 | 0.21 | 0.92 | -- | -- | 0.21 | 0.92 |
| Bis(2-ethylhexyl)phthalate | 117-81-7 | Yes | Yes | 4.65E-08 | -- | 2 | 2.33E-06 | 1.02E-05 | -- | -- | 2.33E-06 | 1.02E-05 |
| Bromobenzene | 108-86-1 | No | Yes | 7.67E-06 | -- | 2 | 3.84E-04 | 1.68E-03 | -- | -- | 3.84E-04 | 1.68E-03 |
| Bromodichloromethane | 75-27-4 | No | Yes | 5.90E-03 | -- | 2 | 0.30 | 1.29 | -- | -- | 0.30 | 1.29 |
| Bromomethane | 74-83-9 | Yes | Yes | 3.67E-06 | -- | 2 | 1.84E-04 | 8.04E-04 | -- | -- | 1.84E-04 | 8.04E-04 |
| Carbon Tetrachloride | 56-23-5 | Yes | Yes | 2.55E-06 | -- | 2 | 1.28E-04 | 5.58E-04 | -- | -- | 1.28E-04 | 5.58E-04 |
| Carbon-Disulfide | 75-15-0 | Yes | Yes | 1.25E-04 | -- | 2 | 6.25E-03 | 0.03 | -- | -- | 6.25E-03 | 0.03 |
| Chlorobenzene | 108-90-7 | Yes | Yes | 1.66E-05 | -- | 2 | 8.30E-04 | 3.64E-03 | -- | -- | 8.30E-04 | 3.64E-03 |
| Chloroform | 67-66-3 | Yes | Yes | 2.55E-06 | -- | 2 | 1.28E-04 | 5.58E-04 | -- | -- | 1.28E-04 | 5.58E-04 |
| Chloromethane | 74-87-3 | Yes | Yes | 2.66E-05 | -- | 2 | 1.33E-03 | 5.83E-03 | -- | -- | 1.33E-03 | 5.83E-03 |
| Cresols (mixed isomers) | 1319-77-3 | Yes | Yes | 2.00E-05 | -- | 2,8 | 1.00E-03 | 4.38E-03 | -- | -- | 1.00E-03 | 4.38E-03 |
| Cumene | 98-82-8 | Yes | Yes | 1.77E-05 | -- | 2 | 8.85E-04 | 3.88E-03 | -- | -- | 8.85E-04 | 3.88E-03 |
| 1,2-Dibromoethane | 106-93-4 | Yes | Yes | 1.83E-06 | -- | 2 | 9.15E-05 | 4.01E-04 | -- | -- | 9.15E-05 | 4.01E-04 |
| 1,2-Dibromo-3-chloropropane | 96-12-8 | Yes | Yes | 1.10E-06 | -- | 2 | 5.50E-05 | 2.41E-04 | -- | -- | 5.50E-05 | 2.41E-04 |
| 1,4-Dichlorobenzene | 106-46-7 | Yes | Yes | 2.79E-04 | -- | 2 | 1.40E-02 | 0.06 | -- | -- | 1.40E-02 | 0.06 |
| 1,1-Dichloroethane | 75-34-3 | Yes | Yes | 2.99E-05 | -- | 2 | 1.50E-03 | 6.55E-03 | -- | -- | 1.50E-03 | 6.55E-03 |
| 1,2-Dichloroethane | 107-06-2 | Yes | Yes | 2.92E-05 | -- | 2 | 1.46E-03 | 6.39E-03 | -- | -- | 1.46E-03 | 6.39E-03 |
| 1,2-Dichloropropane | 78-87-5 | Yes | Yes | 1.68E-05 | -- | 2 | 8.40E-04 | 3.68E-03 | -- | -- | 8.40E-04 | 3.68E-03 |
| Di-n-Butyl Phthalate | 84-74-2 | Yes | No | 3.33E-05 | -- | 2 | 1.67E-03 | 7.29E-03 | -- | -- | 1.67E-03 | 7.29E-03 |
| 4,6-Dinitro-2-methylphenol | 534-52-1 | Yes | No | 2.10E-06 | -- | 2 | 1.05E-04 | 4.60E-04 | -- | -- | 1.05E-04 | 4.60E-04 |
| 2,4-Dinitrophenol | 51-28-5 | Yes | No | 1.31E-07 | -- | 2 | 6.55E-06 | 2.87E-05 | -- | -- | 6.55E-06 | 2.87E-05 |
| 2,4-Dinitrotoluene | 121-14-2 | Yes | Yes | 9.42E-07 | -- | 2 | 4.71E-05 | 2.06E-04 | -- | -- | 4.71E-05 | 2.06E-04 |
| Ethyl Benzene | 100-41-4 | Yes | Yes | 3.13E-05 | -- | 2 | 1.57E-03 | 6.85E-03 | -- | -- | 1.57E-03 | 6.85E-03 |
| Hexachlorobenzene | 118-74-1 | Yes | Yes | 1.03E-06 | -- | 2 | 5.15E-05 | 2.26E-04 | -- | -- | 5.15E-05 | 2.26E-04 |
| n-Hexane | 110-54-3 | Yes | Yes | 2.88E-04 | -- | 2 | 1.44E-02 | 0.06 | -- | -- | 1.44E-02 | 0.06 |
| Hexachlorobutadiene | 87-68-3 | Yes | Yes | 3.65E-07 | -- | 2 | 1.83E-05 | 7.99E-05 | -- | -- | 1.83E-05 | 7.99E-05 |
| Hydrogen Chloride | 7647-01-0 | Yes | Yes | 1.11E-04 | -- | 7 | 5.55E-03 | 0.02 | -- | -- | 5.55E-03 | 0.02 |
| Hydrogen Fluoride | 7664-39-3 | Yes | Yes | 8.50E-06 | -- | 7 | 4.25E-04 | 1.86E-03 | -- | -- | 4.25E-04 | 1.86E-03 |
| Isopropanol | 67-63-0 | No | Yes | 1.10E-03 | -- | 2 | 0.06 | 0.24 | -- | -- | 0.06 | 0.24 |
| Methyl Ethyl Ketone | 78-93-3 | No | Yes | 5.39E-06 | -- | 2 | 2.70E-04 | 1.18E-03 | -- | -- | 2.70E-04 | 1.18E-03 |
| Methyl Isobutyl Ketone | 108-10-1 | Yes | Yes | 4.45E-04 | -- | 2 | 0.02 | 0.10 | -- | -- | 0.02 | 0.10 |
| Methylene Chloride | 75-09-2 | Yes | Yes | 2.82E-05 | -- | 2 | 1.41E-03 | 6.18E-03 | -- | -- | 1.41E-03 | 6.18E-03 |
| Naphthalene | 91-20-3 | Yes | Yes | 8.13E-06 | -- | 2 | 4.07E-04 | 1.78E-03 | -- | -- | 4.07E-04 | 1.78E-03 |
| 4-Nitrophenol | 100-02-7 | Yes | No | 9.41E-08 | -- | 2 | 4.71E-06 | 2.06E-05 | -- | -- | 4.71E-06 | 2.06E-05 |
| Pentachlorophenol | 87-86-5 | Yes | Yes | 4.48E-08 | -- | 2 | 2.24E-06 | 9.81E-06 | -- | -- | 2.24E-06 | 9.81E-06 |
| Phenol | 108-95-2 | Yes | Yes | 1.53E-05 | -- | 2 | 7.65E-04 | 3.35E-03 | -- | -- | 7.65E-04 | 3.35E-03 |
| Styrene | 100-42-5 | Yes | Yes | 1.54E-05 | -- | 2 | 7.70E-04 | 3.37E-03 | -- | -- | 7.70E-04 | 3.37E-03 |
| Tetrachloroethene | 127-18-4 | Yes | Yes | 2.46E-05 | -- | 2 | 1.23E-03 | 5.39E-03 | -- | -- | 1.23E-03 | 5.39E-03 |
| Toluene | 108-88-3 | Yes | Yes | 3.67E-06 | -- | 2 | 1.84E-04 | 8.04E-04 | -- | -- | 1.84E-04 | 8.04E-04 |
| Tribromomethane | 75-25-2 | Yes | Yes | 3.65E-07 | -- | 2 | 1.83E-05 | 7.99E-05 | -- | -- | 1.83E-05 | 7.99E-05 |
| 1,2,4-Trichlorobenzene | 120-82-1 | Yes | No | 1.10E-04 | -- | 2 | 5.50E-03 | 0.02 | -- | -- | 5.50E-03 | 0.02 |
| 1,1,1-Trichloroethane | 71-55-6 | Yes | Yes | 3.93E-05 | -- | 2 | 1.97E-03 | 8.61E-03 | -- | -- | 1.97E-03 | 8.61E-03 |
| 1,1,2-Trichloroethane | 79-00-5 | Yes | Yes | 2.40E-04 | -- | 2 | 1.20E-02 | 0.05 | -- | -- | 1.20E-02 | 0.05 |
| Trichloroethylene | 79-01-6 | Yes | Yes | 1.99E-05 | -- | 2 | 9.95E-04 | 4.36E-03 | -- | -- | 9.95E-04 | 4.36E-03 |
| 2,4,6-Trichlorophenol | 88-06-2 | Yes | Yes | 2.76E-07 | -- | 2 | 1.38E-05 | 6.04E-05 | -- | -- | 1.38E-05 | 6.04E-05 |

| Pollutant | CAS # | HAP? | TAP? | Normal Operation Emission Factors[1,2] Combustion (lb/MMBtu) | Drying (lb/MMBF) | Reference | Normal Operation Emissions[11] Max Hourly (lb/hr) | Total Annual (tpy) | Startup/Idling Emissions[11] Max Hourly (lb/hr) | Total Annual (tpy) | Total CDK Emissions[11] Max Hourly[12] (lb/hr) | Total Annual (tpy) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,2,3-Trichloropropane | 96-18-4 | No | Yes | 2.19E-06 | -- | 2 | 1.10E-04 | 4.80E-04 | -- | -- | 1.10E-04 | 4.80E-04 |
| Vinyl Chloride | 75-01-4 | Yes | Yes | 1.84E-05 | -- | 2 | 9.20E-04 | 4.03E-03 | -- | -- | 9.20E-04 | 4.03E-03 |
| Xylenes (mixed isomers) | 1330-20-7 | Yes | Yes | 5.22E-06 | -- | 2,9 | 2.61E-04 | 1.14E-03 | -- | -- | 2.61E-04 | 1.14E-03 |
| Antimony | 7440-36-0 | Yes | No | 1.47E-06 | -- | 6 | 7.35E-05 | 3.22E-04 | -- | -- | 7.35E-05 | 3.22E-04 |
| Arsenic | 7440-38-2 | Yes | Yes | 1.01E-05 | -- | 6 | 5.05E-04 | 2.21E-03 | -- | -- | 5.05E-04 | 2.21E-03 |
| Beryllium | 7440-41-7 | Yes | Yes | 4.23E-08 | -- | 6 | 2.12E-06 | 9.26E-06 | -- | -- | 2.12E-06 | 9.26E-06 |
| Cadmium | 7440-43-9 | Yes | Yes | 3.09E-06 | -- | 6 | 1.55E-04 | 6.77E-04 | -- | -- | 1.55E-04 | 6.77E-04 |
| Chromium | Cr(III) | Yes | Yes | 1.00E-05 | -- | 6 | 5.00E-04 | 2.19E-03 | -- | -- | 5.00E-04 | 2.19E-03 |
| Chromium, VI | 18540-29-9 | Yes | Yes | 2.35E-07 | -- | 6 | 1.18E-05 | 5.15E-05 | -- | -- | 1.18E-05 | 5.15E-05 |
| Cobalt | 7440-48-4 | Yes | Yes | 6.11E-07 | -- | 6 | 3.06E-05 | 1.34E-04 | -- | -- | 3.06E-05 | 1.34E-04 |
| Copper | 7440-50-8 | No | Yes | 1.34E-05 | -- | 6 | 6.70E-04 | 2.93E-03 | -- | -- | 6.70E-04 | 2.93E-03 |
| Lead | 7439-92-1 | Yes | Yes | 3.49E-05 | -- | 6 | 1.75E-03 | 7.64E-03 | -- | -- | 1.75E-03 | 7.64E-03 |
| Manganese | 7439-96-5 | Yes | Yes | 1.27E-04 | -- | 6 | 6.35E-03 | 0.03 | -- | -- | 6.35E-03 | 0.03 |
| Mercury | 7439-97-6 | Yes | Yes | 8.26E-07 | -- | 6 | 4.13E-05 | 1.81E-04 | -- | -- | 4.13E-05 | 1.81E-04 |
| Nickel | 7440-02-0 | Yes | Yes | 8.84E-06 | -- | 6 | 4.42E-04 | 1.94E-03 | -- | -- | 4.42E-04 | 1.94E-03 |
| Phosphorus | 7723-14-0 | Yes | Yes | 9.85E-05 | -- | 6 | 4.93E-03 | 0.02 | -- | -- | 4.93E-03 | 0.02 |
| Selenium | 7782-49-2 | Yes | Yes | 1.03E-06 | -- | 6 | 5.15E-05 | 2.26E-04 | -- | -- | 5.15E-05 | 2.26E-04 |
| Vanadium | 7440-62-2 | No | Yes | 9.8E-07 | -- | 10 | 4.90E-05 | 2.15E-04 | -- | -- | 4.90E-05 | 2.15E-04 |

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 calculated direct-fired emission factor.

2 Organic HAP combustion emission factors based on NCASI Technical Bulletin No. 1013: A Comprehensive Compilation and Review of Wood-Fired Boiler Emissions, Table 4.1. Median values used. When a median is not available, the maximum value is 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" and the methanol EF is based on max drying temp of heated air entering the lumber (220 °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 (220 °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: | 2.36 | lb/MMBF |
| NCASI Indirect-Heated Batch Kiln EF: | 1.53E-02 | lb/MBF | | | |
| Ratio of Direct-to-Indirect: | 4.80 | | | | |

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

6 Trace metal HAP combustion emission factors based on NCASI Technical Bulletin No. 1013: A Comprehensive Compilation and Review of Wood-Fired Boiler Emissions, Table 4.3. Median Wet Scrubber were used. When a median was not available, the maximum value was used.

7 For organic HAP that only had controlled factors in NCASI TB1013, if the control is a wet PM control, then NCASI TB1013 is still used. However, if the control is a dry PM control, then AP-42 Section 1.6, Table 1.6-3 emissions factors were used.

8 In NCASI TB1013, Table 4-1, cresol emission factors are reported separately as m,p-cresol and o-cresol. Since the separate isomers have the same SQER and ASIL as the Cresol (mixed isomer) TAP and the mixed isomer TAP is not reported in TB1013, the two different isomer emission rates are added together in order to assess the mixed isomer toxic. Exceedance of the mixed isomer SQER or ASIL will also dictate exceedances for the individual isomer toxics.

9 In NCASI TB1013, Table 4-1, xylene emission factors are reported separately as m,p-xylene, o-xylene, and xylenes (mixed isomers). Since the separate isomers have the same SQER and ASIL as the Xylene (mixed isomer) TAP and the mixed isomer TAP is reported in TB1013, the mixed isomer toxic is the only emission rate reported here. Exceedance of the mixed isomer SQER or ASIL will also dictate exceedances for the individual isomer toxics.

10 When a trace metal HAP combustion emission factor in NCASI TB1013 did not have a Wet Scrubber value, then AP-42 Section 1.6, Table 1.6-4 emissions factors were used.

11 Emission rates for pollutants with only 'lb/MMBF' emission factors are based on the CDK's annual throughput of dried lumber [MMBF], so combustion emissions from startup and idling are added in order to determine total CDK emission rates. These startup and idling emissions are calculated in the CDK Startup and Idling tab of the workbook. Emission rates for pollutants with 'lb/MMBtu' emission factors are based on the kiln's maximum firing rate [MMBtu/hr] and continuous operating hours of 8,760 hours per year. Since emissions at the maximum firing rate are the most conservative, the 'lb/MMBtu' emission rates already include combustion emissions from startup and idling.

12 Max hourly emissions represent the maximum emissions from the following three scenarios: normal operation, startup, or idling.

**Table F-5.1. CDK Startup and Idling - Input Parameters**

| Parameter | Value | Units | Source Notes |
|---|---|---|---|
| Total Kiln Heat Input | 50 | MMBtu/hr | Per vendor specification sheet received on May 16, 2023. |
| CDK Maximum Annual Operating Hours | 8,760 | hrs/yr | Assumed value for PTE basis. |
| CDK Expected Annual Operating Hours | 8,400 | hrs/yr | Per vendor specification sheet received on May 16, 2023. |
| CDK Maximum Startup and Idling Hours | 360 | hrs/yr | 8,760 hours - Expected operating hours (8,400 hr) |
| CDK Startup and Idling Maximum Heat Input | 18,000 | MMBtu/yr | Total Kiln Heat Input * Maximum Startup and Idling Hours |

Conservatively, assumed the startup and idling acitivies are occuring anytime beyond 8,400 hours/year (e.g. 360 hours) at burner firing capacity. In idling mode, the burner will be firing at a low rate of less than 1 MMBtu/hr. Emissions calculated are accounting for physical potential capacity to avoid additional restrictions on operating hours.

Note: Emission rates for pollutants with only 'lb/MMBF' emission factors are based on the CDK's annual throughput of dried lumber [MMBF], so combustion emissions from startup and idling are separately calculated here in order to determine total CDK emission rates. CDK emission rates for pollutants with 'lb/MMBtu' emission factors are conservatively based on the kiln's maximum firing rate [MMBtu/hr] and continuous operating hours of 8,760 hours per year, so combustion emissions from startup and idling do not need to be added.

**Table F-6.1. CDK Startup and Idling - Added Pollutant Emission Factors**

| Pollutant | Emission Factor (lb/MMBtu) | Reference |
|---|---|---|
| Condensable PM (CPM) | 0.017 | 1 |
| $CPM_{10}$ | 0.017 | 1 |
| $CPM_{2.5}$ | 0.017 | 1 |
| Filterable PM (FPM) | 0.33 | 2 |
| $FPM_{10}$ | 0.30 | 2 |
| $FPM_{2.5}$ | 0.25 | 2 |
| Total PM (TPM) | 0.347 | 3 |
| $TPM_{10}$ | 0.314 | 3 |
| $TPM_{2.5}$ | 0.268 | 3 |
| CO | 3.60E-01 | 4 |
| $NO_X$ | 2.03E-01 | 5 |
| Formaldehyde | 3.77E-04 | 6 |

[1] Condensable PM combustion emission factor based on AP-42 Section 1.6, Table 1.6-1. Assuming CPM = $CPM_{10}$ = $CPM_{2.5}$.

[2] Filterable PM combustion emission factor based on NCASI Technical Bulletin No. 1013, Table 5.2, value for Wet Wood.

| | | |
|---|---|---|
| $PM_{10}$ = | 90% | of FPM cumulative mass |
| $PM_{2.5}$ = | 76% | of FPM cumulative mass |

[3] Total PM = Condensable PM + Filterable PM

[4] CO combustion emission factor based on NCASI Technical Bulletin No. 1013, Table 5.1. Median value for Fuel Cells/Dutch Ovens was used.

[5] $NO_X$ combustion emission factor based on NCASI Technical Bulletin No. 1013, Table 5.1. Median value for Wood w/o Significant UF Resin Content was used.

[6] Formaldehyde combustion emission factor based on NCASI Technical Bulletin No. 1013, Table 4.1. Median value used.

**Table F-6.2. CDK Startup and Idling - Criteria Pollutant Emissions**

| Pollutant | Emission Factor (lb/MMBtu) | Hourly Emissions (lb/hr) | Annual Emissions (tpy) |
|---|---|---|---|
| TPM | 0.347 | 17.35 | 3.12 |
| $TPM_{10}$ | 0.314 | 15.70 | 2.83 |
| $TPM_{2.5}$ | 0.268 | 13.39 | 2.41 |
| CO | 0.360 | 18.00 | 3.24 |
| $NO_X$ | 0.203 | 10.15 | 1.00 |

**Table F-7.1. CDK Startup and Idling - HAP/TAP Emissions**

| Pollutant | CAS # | HAP? | TAP? | Emission Factor (lb/MMBtu) | Hourly Emissions (lb/hr) | Annual Emissions (tpy) |
|---|---|---|---|---|---|---|
| Formaldehyde | 50-00-0 | Yes | Yes | 3.77E-04 | 0.02 | 3.39E-03 |
| Carbon monoxide | 630-08-0 | No | Yes | 0.360 | 18.00 | 3.24 |
| Nitrogen dioxide[1] | 10102-44-0 | No | Yes | 0.203 | 10.15 | 1.83 |

[1] It is conservatively assumed that all $NO_X$ is converted to $NO_2$.

**Note: In order to determine actual emissions from the current batch kilns and hog fuel boiler, operational parameters and emissions rates are acquired from the 2013-2022 Annual Emission Inventories (AEIs). On a pollutant-by-pollutant basis, actual emissions are calculated from the annual average actual emission rates of the highest two consecutive years within the past ten years.**

**Table F-7.2. Baseline Calculations - Hog Fuel Boiler Heat Input**

| Year | Heat Input (MMBtu/yr) | Two-Year Period | Two-Year Average Heat Input (MMBtu/yr) |
|---|---|---|---|
| 2013 | 607,432 | 2013-2014 | 583,270 |
| 2014 | 559,108 | 2014-2015 | 580,756 |
| 2015 | 602,404 | 2015-2016 | 616,698 |
| 2016 | 630,993 | 2016-2017 | 638,917 |
| 2017 | 646,840 | 2017-2018 | 624,346 |
| 2018 | 601,852 | 2018-2019 | 554,475 |
| 2019 | 507,098 | 2019-2020 | 551,346 |
| 2020 | 595,594 | 2020-2021 | 596,827 |
| 2021 | 598,060 | 2021-2022 | 521,503 |
| 2022 | 444,945 | | |
| | | **Max Heat Input (MMBtu/yr):** | 638,917 |
| | | **Baseline Period:** | 2016-2017 |

**Table F-7.3. Baseline Calculations - Hog Fuel Boiler $NO_2$ and $SO_2$ Emissions**

| Year | Annual $NO_2$ Emissions [1] (tpy) | Annual $SO_2$ Emissions (tpy) | Two-Year Period | Two-Year Average $NO_2$ Emissions (tpy) | Two-Year Average $SO_2$ Emissions (tpy) |
|---|---|---|---|---|---|
| 2013 | 66.69 | 0.31 | 2013-2014 | 64.04 | 0.30 |
| 2014 | 61.39 | 0.29 | 2014-2015 | 54.79 | 1.50 |
| 2015 | 48.19 | 2.71 | 2015-2016 | 39.38 | 2.22 |
| 2016 | 30.57 | 1.72 | 2016-2017 | 41.16 | 2.32 |
| 2017 | 51.75 | 2.91 | 2017-2018 | 49.95 | 2.81 |
| 2018 | 48.15 | 2.71 | 2018-2019 | 44.36 | 2.50 |
| 2019 | 40.57 | 2.28 | 2019-2020 | 51.40 | 2.48 |
| 2020 | 62.24 | 2.68 | 2020-2021 | 62.37 | 2.69 |
| 2021 | 62.50 | 2.69 | 2021-2022 | 53.23 | 2.35 |
| 2022 | 43.97 | 2.00 | | | |
| | | | **Max Annual Emissions (tpy):** | 64.04 | 2.81 |
| | | | **Baseline Period:** | 2013-2014 | 2017-2018 |

[1] It is conservatively assumed that all $NO_X$ is converted to $NO_2$.

**Table F-7.4. Baseline Calculations - Lumber Drying TAP Emissions**

| Pollutant<br>CAS | Acetaldehyde<br>75-07-0 | Acrolein<br>107-02-8 | Formaldehyde<br>50-00-0 | Methanol<br>67-56-1 | Propionaldehyde<br>123-38-6 |
|---|---|---|---|---|---|
| **Year** | ***Annual Emissions (lb/yr) - Less than or Equal to 200 °F*** | | | | |
| 2013 | 1.62E+04 | 2.21E+02 | 1.98E+02 | 1.16E+04 | 1.46E+02 |
| 2014 | 1.47E+04 | 1.83E+02 | 1.95E+02 | 1.01E+04 | 1.39E+02 |
| 2015 | 1.57E+04 | 1.96E+02 | 2.01E+02 | 1.08E+04 | 1.50E+02 |
| 2016 | 1.69E+04 | 2.11E+02 | 2.31E+02 | 1.17E+04 | 1.60E+02 |
| 2017 | 1.46E+04 | 1.85E+02 | 2.45E+02 | 1.04E+04 | 1.36E+02 |
| 2018 | 1.32E+04 | 1.69E+02 | 2.27E+02 | 9.43E+03 | 1.23E+02 |
| 2019 | 1.30E+04 | 1.65E+02 | 2.13E+02 | 9.23E+03 | 1.22E+02 |
| 2020 | 1.37E+04 | 1.75E+02 | 2.35E+02 | 9.77E+03 | 1.28E+02 |
| 2021 | 1.48E+04 | 1.89E+02 | 2.55E+02 | 1.06E+04 | 1.39E+02 |
| 2022 | 9.66E+03 | 1.28E+02 | 2.34E+02 | 7.28E+03 | 8.76E+01 |
| **Year** | ***Annual Emissions (lb/yr) - Greater than 200 °F*** | | | | |
| 2013 | | | | | |
| 2014 | 1.28E+03 | 3.50E+01 | 5.99E+01 | 2.80E+03 | 2.13E+01 |
| 2015 | 5.32E+02 | 1.46E+01 | 2.50E+01 | 1.17E+03 | 8.87E+00 |
| 2016 | | | | | |
| 2017 | | | | | |
| 2018 | | | | | |
| 2019 | | | | | |
| 2020 | | | | | |
| 2021 | | | | | |
| 2022 | | | | | |
| **Year** | ***Total Annual Emissions (tpy) - All Temperatures*** | | | | |
| 2013 | 8.09E+00 | 1.10E-01 | 9.90E-02 | 5.78E+00 | 7.28E-02 |
| 2014 | 7.97E+00 | 1.09E-01 | 1.27E-01 | 6.47E+00 | 8.02E-02 |
| 2015 | 8.14E+00 | 1.05E-01 | 1.13E-01 | 6.00E+00 | 7.92E-02 |
| 2016 | 8.43E+00 | 1.06E-01 | 1.16E-01 | 5.84E+00 | 7.98E-02 |
| 2017 | 7.28E+00 | 9.27E-02 | 1.23E-01 | 5.18E+00 | 6.81E-02 |
| 2018 | 6.61E+00 | 8.43E-02 | 1.13E-01 | 4.71E+00 | 6.17E-02 |
| 2019 | 6.51E+00 | 8.27E-02 | 1.07E-01 | 4.61E+00 | 6.10E-02 |
| 2020 | 6.85E+00 | 8.74E-02 | 1.18E-01 | 4.89E+00 | 6.39E-02 |
| 2021 | 7.42E+00 | 9.46E-02 | 1.27E-01 | 5.29E+00 | 6.93E-02 |
| 2022 | 4.83E+00 | 6.39E-02 | 1.17E-01 | 3.64E+00 | 4.38E-02 |
| **Two-Year Period** | ***Two-Year Average Emissions (tpy)*** | | | | |
| 2013-2014 | 8.03E+00 | 1.10E-01 | 1.13E-01 | 6.12E+00 | 7.65E-02 |
| 2014-2015 | 8.06E+00 | 1.07E-01 | 1.20E-01 | 6.23E+00 | 7.97E-02 |
| 2015-2016 | 8.29E+00 | 1.05E-01 | 1.14E-01 | 5.92E+00 | 7.95E-02 |
| 2016-2017 | 7.86E+00 | 9.91E-02 | 1.19E-01 | 5.51E+00 | 7.39E-02 |
| 2017-2018 | 6.95E+00 | 8.85E-02 | 1.18E-01 | 4.95E+00 | 6.49E-02 |
| 2018-2019 | 6.56E+00 | 8.35E-02 | 1.10E-01 | 4.66E+00 | 6.13E-02 |
| 2019-2020 | 6.68E+00 | 8.50E-02 | 1.12E-01 | 4.75E+00 | 6.25E-02 |
| 2020-2021 | 7.14E+00 | 9.10E-02 | 1.22E-01 | 5.09E+00 | 6.66E-02 |
| 2021-2022 | 6.12E+00 | 7.93E-02 | 1.22E-01 | 4.47E+00 | 5.65E-02 |
| **Max Annual Emissions (tpy)** | **8.29E+00** | **1.10E-01** | **1.22E-01** | **6.23E+00** | **7.97E-02** |
| **Baseline Period** | **2015-2016** | **2013-2014** | **2020-2021** | **2014-2015** | **2014-2015** |

**Table F-7.5. Baseline Calculations - Hog Fuel Boiler TAP Emissions**

| Pollutant [1] | CAS | Emission Factor [2,3] (lb/MMBtu) | Baseline Period [4] | Max Annual Heat Input (MMBtu/yr) | Max Annual Combustion Emissions (tpy) | Max Annual Combined Emissions [5] (tpy) | Max Annual Combined Emissions [5] (lb/yr) | Max Hourly Combined Emissions [5] (lb/hr) | Max Daily Combined Emissions [5] (lb/day) |
|---|---|---|---|---|---|---|---|---|---|
| Acetaldehyde | 75-07-0 | 1.64E-04 | 2015-2016 | 6.17E+05 | 0.05 | 8.34 | 16,674.31 | 1.94 | 46.62 |
| Acrolein | 107-02-8 | 3.15E-05 | 2013-2014 | 5.83E+05 | 9.20E-03 | 0.12 | 237.74 | 0.03 | 0.66 |
| Formaldehyde | 50-00-0 | 7.24E-05 | 2020-2021 | 5.97E+05 | 0.02 | 0.14 | 288.09 | 0.03 | 0.81 |
| Nitrogen dioxide | 10102-44-0 | | 2013-2014 | | 64.04 | 64.04 | 128,079.75 | 14.92 | 358.06 |
| Sulfur dioxide | 7446-09-5 | | 2017-2018 | | 2.81 | 2.81 | 5,619.11 | 0.65 | 15.71 |
| Benzene | 71-43-2 | 7.42E-04 | 2016-2017 | 6.39E+05 | 0.24 | 0.24 | 474.03 | 0.06 | 1.33 |
| Bromodichloromethane | 75-27-4 | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated |
| 1,2-Dibromoethane | 106-93-4 | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated |
| 1,2-Dibromo-3-chloropropane | 96-12-8 | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated |
| 1,4-Dichlorobenzene | 106-46-7 | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated |
| 1,2-Dichloroethane | 107-06-2 | 2.92E-05 | 2016-2017 | 6.39E+05 | 9.33E-03 | 9.33E-03 | 18.66 | 2.17E-03 | 0.05 |
| Hexachlorobenzene | 118-74-1 | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated |
| 1,1,2-Trichloroethane | 79-00-5 | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated | Not Calculated |
| Arsenic | 7440-38-2 | 1.76E-07 | 2016-2017 | 6.39E+05 | 5.62E-05 | 5.62E-05 | 0.11 | 1.31E-05 | 3.14E-04 |
| Cadmium | 7440-43-9 | 1.21E-07 | 2016-2017 | 6.39E+05 | 3.87E-05 | 3.87E-05 | 0.08 | 9.01E-06 | 2.16E-04 |
| Chromium, VI | 18540-29-9 | 1.54E-06 | 2016-2017 | 6.39E+05 | 4.91E-04 | 4.91E-04 | 0.98 | 1.14E-04 | 2.74E-03 |
| Lead | 7439-92-1 | 2.03E-07 | 2016-2017 | 6.39E+05 | 6.49E-05 | 6.49E-05 | 0.13 | 1.51E-05 | 3.63E-04 |
| Manganese | 7439-96-5 | 1.32E-05 | 2016-2017 | 6.39E+05 | 4.22E-03 | 4.22E-03 | 8.43 | 9.82E-04 | 0.02 |
| Nickel | 7440-02-0 | 7.06E-07 | 2016-2017 | 6.39E+05 | 2.26E-04 | 2.26E-04 | 0.45 | 5.25E-05 | 1.26E-03 |

[1] Pollutants were chosen for baseline analysis due to an exceedance of their respective SQER from project emissions. These do not represent the comprehensive list of TAP pollutants from hog fuel combustion. If a pollutant initially exceeded its SQER but was not included in the former AEIs, emissions are marked as "Not Calculated".

[2] Organic and trace elemental metal TAP emission factors come from Weyerhaeuser's ORCAA Annual Emission Inventories.

[3] $NO_2$ and $SO_2$ emissions are calculated in Table F-7.4.

[4] The baseline periods for Acetaldehyde, Acrolein, and Formaldehyde are based on the maximum two-year average lumber drying TAP emission rates since drying emissions are significant comparing to combustion emissions.
The baseline periods for $NO_2$ and $SO_2$ are based on the maximum two-year average hog fuel boiler emission rates.
The baseline period for all other TAPs is based on the maximum two-year average hog fuel boiler heat input since the EF remains the same during the 10 year period.

[5] The combined emissions represents both hog fuel combustion and lumber drying emission rates for Acetaldehyde, Acrolein, and Formaldehyde.

[6] Based on a review of prior boiler operating data, the hog fuel boiler is running close to 99% of the time. Therefore, to determine hourly and daily emissions from annual emissions, the boiler is conservatively assumed to have operated 98% of the time, which is approximately:
8584.8 hours per year.

**Table F-8. Fugitive PM Input Parameters**

| Parameter | Value | Units | Source Notes |
|---|---|---|---|
| **Truck Bins** | | | |
| Bark Annual Throughput | 121,186 | tpy | See Fugitive PM tab. |
| Green Chips Annual Throughput | 414,070 | tpy | See Fugitive PM tab. |
| Planer Shavings Annual Throughput | 58,212 | tpy | See Fugitive PM tab. |
| Sawmill Operation - Hours per Day | 20 | hours/day | Per conversation with client, the sawmill operates in two 10-hour shifts. |
| Sawmill Operation - Days per Week | 5 | days/week | Per conversation with client, the sawmill operates Monday - Friday |
| Sawmill Operation - Weeks per Year | 52 | weeks/year | Per conversation with client, the sawmill operates 52 weeks per year. |
| Sawmill Operation - Annual Operating Hours | 5,200 | hours/year | Calculated by the following: Annual Operating Hours = (Hours/Day) * (Days/Week) * (Weeks/Year). |
| **Fugitive Emissions - Green Sawdust** | | | |
| Total Kiln Heat Input | 50 | MMBtu/hr | Per vendor specification sheet received on May 16, 2023. |
| CDK Maximum Annual Operating Hours | 8,760 | hrs/yr | Assumed value for PTE basis. |
| Wet Green Sawdust Higher Heating Value | 3,500 | Btu/lb | Per the HHV of wet fuel in Weyerhaeuser's Greenville facility's CDK PTE calculations. |
| Green Sawdust Fuel Maximum Annual Throughput | 62,571 | tpy | Calculated by the following: Annual Green Sawdust Fuel (tpy) = Total Kiln Heat Input (MMBtu/hr) * CDK Maximum Annual Operating Hours (hrs/yr) * 10^6 (Btu/MMBtu) / HHV (Btu/lb) / 2000 (lb/ton). |
| Green Sawdust Fuel Maximum Hourly Throughput | 14,286 | lb/hr | Calculated by the following: Max Hourly Green Sawdust Fuel (lb/hr) = Total Kiln Heat Input (MMBtu/hr) * 10^6 (Btu/MMBtu) / HHV (Btu/lb). |
| Sawdust Surge - Hours per Week | 100 | hours/week | Per conversation with client, the operational surge is 100 hrs/wk (Monday - Friday). |
| Sawdust Surge - Days per Week | 5 | days/week | Assumed value, since the sawmill operates Monday - Friday. |
| Sawdust Surge - Hours per Day | 20 | hours/day | Calculated by the following: Hours per Day = (Hours/Week) / (Days/Week). |

**Table F-9. Fugitive PM Throughput Data**

| Material | Annual Throughput [1] 2019 | 2020 | 2021 | 2022 | Throughput Unit | Section |
|---|---|---|---|---|---|---|
| Wood Product (Douglas Fir) | 99,914.33 | 125,245.32 | 143,303.83 | 166,910.44 | MBF | Production |
| Wood Product (Hemlock) | 67,220.85 | 70,590.17 | 61,250.57 | 0 | MBF | Production |
| Bark, Burned for Energy Recovery On-Site | 22,230 | 25,452.75 | 25,677.39 | 19,970.65 | bdtons | Energy Fuel Sources |
| Shavings, Burned for Energy Recovery On-Site | 12,554 | 8,484.25 | 8,558.13 | 6,656.88 | bdtons | Energy Fuel Sources |
| Chips | 93,387 | 129,120 | 134,236.57 | 111,472 | bdtons | Production |
| Hog Fuel Mfg. Res., Otherwise Beneficially Reused | 2,751 | 6,514 | 33,599.78 | 12,654 | bdtons | Residuals and Waste |
| Sawdust By-Product sold | 19,550 | 22,651 | 15,516.09 | 17,057 | bdtons | Residuals and Waste |
| Shavings By-Product sold | 12,554 | 13,244 | 9,842.07 | 6,193 | bdtons | Residuals and Waste |

| Categorized Material | Annual Throughput [1] (bdton) 2019 | 2020 | 2021 | 2022 | Components |
|---|---|---|---|---|---|
| Bark [2] | 24,981 | 31,966.75 | 0 | 32,624.65 | Bark, Burned for Energy Recovery On-Site; Hog Fuel Mfg. Res., Otherwise Beneficially Reused |
| Green Sawdust | 19,550 | 22,651 | 15,516.09 | 17,057 | Sawdust By-Product Sold |
| Planer Shavings | 25,108 | 21,728.25 | 18,400.2 | 12,849.88 | Shavings, Burned for Energy Recovery On-Site; Shavings By-Product sold |
| Chips | 93,387 | 129,120 | 134,236.57 | 111,472 | Chips |

| Categorized Material | Ratio [1] (bdton/MBF produced) 2019 | 2020 | 2021 | 2022 | Max Ratio | CDK Project |
|---|---|---|---|---|---|---|
| Bark | 0.15 | 0.16 | 0.00 | 0.20 | 0.20 | **121,186** |
| Green Sawdust | 0.12 | 0.12 | 0.08 | 0.10 | 0.12 | 72,522 |
| Planer Shavings | 0.15 | 0.11 | 0.09 | 0.08 | 0.15 | **58,212** |
| Green Chips | 0.56 | 0.66 | 0.66 | 0.67 | 0.67 | **414,070** |

[1] Since fugitive emissions relate to the handling of byproduct and residual materials, exact throughputs have not yet been determined, so the projected post-project throughputs were estimated using annual production values from 2019 through 2022. Materials from Weyerhaeuser's production data were then grouped into the relevant categories for this project: bark, green sawdust, planer shavings, and green chips. Ratios were then calculated to relate annual material throughput to annual wood product production. Of these ratios, the maximum ratio was multiplied by the annual production rate for the CDK project and converted to a wet basis, assuming a moisture content of 50% for bark, green sawdust, and green chips and 20% for planer shaving. Since a green sawdust throughput is already specified for the green sawdust CDK burner (via burner capacity), the value in this table was not used in the PTE calculations.

[2] Due to log yard clean up activities in 2021, the "hog fuel beneficially applied" value does not accurately represent expected annual production rates of bark, so the scaled annual throughput of bark for the CDK project is based on 2019, 2020, and 2022 production rates.

**Table F-10. Fugitive PM Emissions**

| Emission Unit | Material | Origin | Destination | Emission Factors (lb/ton) [1] PM | $PM_{10}$ | $PM_{2.5}$ | Capture Type | Capture Efficiency (%) | Annual Emissions (tpy) [3] PM | $PM_{10}$ | $PM_{2.5}$ | Daily Emissions (lb/day) [4] PM | $PM_{10}$ | $PM_{2.5}$ | Hourly Emissions (lb/hr) [5] PM | $PM_{10}$ | $PM_{2.5}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fugitive Emissions - Green Sawdust** | | | | | | | | | | | | | | | | | |
| Green Sawdust Sawmill Drop | Green Sawdust | Sawmill | Green Sawdust Conveyor | 7.55E-03 | 3.57E-03 | 5.41E-04 | Building Enclosure | See Footnote 1 (Min Wind Speed) | 0.24 | 0.11 | 0.02 | 1.08 | 0.51 | 0.08 | 0.05 | 0.03 | 3.86E-03 |
| *Fugitive Emissions - Green Sawdust Sub-Total:* | | | | | | | | | *0.24* | *0.11* | *0.02* | *1.08* | *0.51* | 0.08 | *0.05* | *0.03* | 3.86E-03 |
| **Truck Bins** | | | | | | | | | | | | | | | | | |
| Bark Bins Truck Loadout | Bark | Bark Bins | Truck | 0.064 | 0.030 | 4.56E-03 | Steel Sidings | 50% | 1.93 | 0.91 | 0.14 | 14.84 | 7.02 | 1.06 | 0.74 | 0.35 | 0.05 |
| Chips Bins Truck Loadout [6] | Chips, Planer Shavings | Chip Bins | Truck | 0.064 | 0.030 | 4.56E-03 | Steel Sidings | 50% | 7.52 | 3.56 | 0.54 | 57.83 | 27.35 | 4.14 | 2.89 | 1.37 | 0.21 |
| *Truck Bins Sub-Total:* | | | | | | | | | *9.45* | *4.47* | *0.68* | *72.67* | *34.37* | *5.20* | *3.63* | *1.72* | *0.26* |
| **Total:** | | | | | | | | | 9.68 | 4.58 | 0.69 | 73.75 | 34.88 | 5.28 | 3.69 | 1.74 | 0.26 |

[1] Methods from AP-42 Section 13.2.4, Aggregate Handling and Storage Piles, are used to determine the emission factors and total emissions from raw material handling.
Uncontrolled Emission Factor (lb/ton) = $0.0032 \times (k) \times (U / 5)^{1.3} / (M / 2)^{1.4}$, where:

| | | | |
|---|---|---|---|
| Particle Size Multiplier (k) = | 0.74 | for PM | |
| | 0.35 | for $PM_{10}$ | |
| | 0.053 | for $PM_{2.5}$ | |
| Mean Wind Speed (U) = | 6.7 | mph | This wind speed is used for outdoor emission calculations from truck bin loadout. Source: Western Regional Climatological Center, Olympia, WA station |
| Minimum Wind Speed (U) = | 1.3 | mph | This wind speed is used for the indoor emission calculations from the green sawdust drop. Source: AP-42 Section 13.2.4. |
| Material Moisture Content (M) = | 25% | | While the internal moisture of the wood particles may be around 50%, this variable (M) accounts for surface moisture. The lower end moisture content was chosen as a conservative estimate of annual surface moisture. |

[2] The truck bins will be fitted with steel sidings, which prevent approximately 50% of fugitive emissions.
[3] Annual Emissions = Emission Factor (lb/ton) x Qty Unloaded (ton/yr) / 2000 (lb/ton) * (100% - Capture Efficiency (%))
[4] Daily Emissions = Hourly Emissions (lb/hr) * Hours per Day
[5] For green sawdust sawmill drop, Hourly Emissions = Emission Factor (lb/ton) x Qty Unloaded (lb/hr) / 2000 (lb/ton).
For truck loadout, Hourly Emissions = Emission Factor (lb/ton) x Qty Unloaded (ton/yr) / Annual Operating Hours (hours/yr) * (100% - Capture Efficiency (%)). For the purpose of these calculations, it is assumed that the hourly truck loadout rate is equivalent to the hourly rate of material sent to the truck bin.
[6] While the planer shavings are blown to a cyclone on top of the chips bins that exausts to a baghouse, all planer shavings are assumed to be sent down into the truck bins in order to have a conservative estimate of the material transfer PM emissions from truck loadout.

**Table F-11. Cyclones Input Parameters**

| Parameter | Value | Units | Source Notes |
|---|---|---|---|
| Cyclone Annual Operating Hours | 8,760 | hrs/yr | Assumed value for PTE basis. |
| Fuel Silo Cyclone Exhaust Flow Rate | 6,227 | scfm | Per vendor specs, received June 29, 2023. Per email with Angela Cameron on July 11, 2023, the stream is at ambient temperature and is assumed to be in standard conditions. |
| Bark Cyclone Exhaust Flow Rate | 8,564 | scfm | Per Table 3.0 in the TSD for 12AOP915 (Cyclone #11). The stream is assumed to be at ambient conditions. |
| Dry Chip Cyclone Exhaust Flow Rate | 5,150 | scfm | Per Table 3.0 in the TSD for 12AOP915 (Cyclone #21). The stream is assumed to be at ambient conditions. |
| Dry Chip Baghouse Control Efficiency | 99% | -- | Based on the 2021 ORCAA AEI workbook, baghouses are assumed to maintain a control efficiency of 99%. |
| Cyclone PM Grain Loading Rate | 0.03 | gr/dscf | Based on the 2021 ORCAA AEI workbook, the PM grain loading rate comes from FIRE 6.23 October 2000, SCC 30700804, 30700805, which is also in Table 10.4.1 AP-42, p. 10.4-2 (2/80). |

**Table F-12. Cyclones Emissions**

| Emission Unit | Potential Operation | Exhaust Flow Rate | Loading Rate [1] (gr./dscf) | | | Control Efficiency | Filterable PM Emissions [2,3,4] | | Filterable $PM_{10}$ Emissions [2,3,4] | | Filterable $PM_{2.5}$ Emissions [2,3,4] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (hr/yr) | (scfm) | PM | $PM_{10}$ | $PM_{2.5}$ | (%) | (lb/hr) | (tpy) | (lb/hr) | (tpy) | (lb/hr) | (tpy) |
| Fuel Silo Cyclone | 8,760 | 6,227 | 0.03 | 0.012 | 0.012 | 0% | 1.60 | 7.01 | 0.64 | 2.81 | 0.64 | 2.81 |
| Bark Cyclone | 8,760 | 8,564 | 0.03 | 0.012 | 0.012 | 0% | 2.20 | 9.65 | 0.88 | 3.86 | 0.88 | 3.86 |
| Dry Chip Cyclone / Baghouse | 8,760 | 5,150 | 0.03 | 0.012 | 0.012 | 99% | 1.32E-02 | 0.06 | 5.30E-03 | 0.02 | 5.30E-03 | 0.02 |
| | | | | | | **Total:** | 3.82 | 16.72 | 1.53 | 6.69 | 1.53 | 6.69 |

[1] Based on the 2021 ORCAA AEI workbook, the FIRE 6.23 October 2000, SCC 30700804, 30700805 and EPA factor book 450/4-90-003 p. 144 assume that Filterable $PM_{10}$ is approximately equal to 40% of Filterable PM. It is also conservatively assumed that Filterable $PM_{10}$ = Filterable $PM_{2.5}$. As this source does not involve combustion units, it is assumed that condensable emissions are negligible.

[2] As a conservative measure, emissions of $PM_{2.5}$ are assumed to be equal to emissions of $PM_{10}$.

[3] Potential hourly PM emissions (lb/hr) = Exhaust Grain Loading Rate (gr./dscf) x Exhaust Air Flow Rate (dscf/min) x (60 min/hr) x (lb/7,000 gr.) x (100% - Control Efficiency (%)).

[4] Potential annual emissions (tpy) = Hourly Emission Rate (lb/hr) * Annual Operating Hours (hrs/yr) / 2000 (lb/ton).

**Table F-13. Pre-Project Wood Waste Collection (Cyclones) Emissions**

| Emission Unit | Potential Operation | Exhaust Flow Rate | Loading Rate [1] (gr./dscf) | | | Control Efficiency | Filterable PM Emissions [2,3,4] | | Filterable $PM_{10}$ Emissions [2,3,4] | | Filterable $PM_{2.5}$ Emissions [2,3,4] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (hr/yr) | (scfm) | PM | $PM_{10}$ | $PM_{2.5}$ | (%) | (lb/hr) | (tpy) | (lb/hr) | (tpy) | (lb/hr) | (tpy) |
| Dry Chip Cyclone / Baghouse [5] | 8,760 | 5,150 | 0.03 | 0.012 | 0.012 | 99% | 1.32E-02 | 0.06 | 5.30E-03 | 0.02 | 5.30E-03 | 0.02 |

[1] Based on the 2021 ORCAA AEI workbook, the FIRE 6.23 October 2000, SCC 30700804, 30700805 and EPA factor book 450/4-90-003 p. 144 assume that Filterable $PM_{10}$ is approximately equal to 40% of Filterable PM. It is also conservatively assumed that Filterable $PM_{10}$ = Filterable $PM_{2.5}$. As this source does not involve combustion units, it is assumed that condensable emissions are negligible.

[2] As a conservative measure, emissions of $PM_{2.5}$ are assumed to be equal to emissions of $PM_{10}$.

[3] Potential hourly PM emissions (lb/hr) = Exhaust Grain Loading Rate (gr./dscf) x Exhaust Air Flow Rate (dscf/min) x (60 min/hr) x (lb/7,000 gr.) x (100% - Control Efficiency (%)).

[4] Potential annual emissions (tpy) = Hourly Emission Rate (lb/hr) * Annual Operating Hours (hrs/yr) / 2000 (lb/ton).

[5] Parameters for the existing emission unit based on Table 4.2 in the TSD for 12AOP915. PTE was calculated assuming 8,760 hour/year operation.

**Table F-14. Pre- and Post-Project Wood Waste Collection (Cyclones) Emission Comparison**

| Emission Unit | PTE Emissions [1] (tpy) | | |
|---|---|---|---|
| | PM | $PM_{10}$ | $PM_{2.5}$ |
| **Pre-Project Wood Waste Collection** | | | |
| Dry Chip Cyclone / Baghouse | 0.06 | 0.02 | 0.02 |
| All Other Existing Cyclones | 1.64 | 0.68 | 0.68 |
| *Pre-Project Total:* | 1.7 | 0.7 | 0.7 |
| **Post-Project Wood Waste Collection** | | | |
| Dry Chip Cyclone / Baghouse | 0.06 | 0.02 | 0.02 |
| All Other Existing Cyclones | 1.64 | 0.68 | 0.68 |
| Fuel Silo Cyclone | 7.01 | 2.81 | 2.81 |
| Bark Cyclone | 9.65 | 3.86 | 3.86 |
| *Post-Project Total:* | 18.36 | 7.36 | 7.36 |

[1] Parameters for existing emission units based on Table 4.2 in the TSD for 12AOP915. PM Emissions were estimated using methods presented in ORCAA's 2021 AEI workbook.

**Table F-15. Haul Roads Input Parameters**

| Vehicle Name | Class | Vehicle Weight (Avg of Loaded + Unloaded) (tons) | Number of Trips per Day | Number of Days per Week | Number of Weeks per Year | Miles Round Trip (Paved) | Vehicle Miles Traveled per Day (VMT/day) | Vehicle Miles Traveled per Year (VMT/yr) |
|---|---|---|---|---|---|---|---|---|
| Chip | Trucks | 34 | 12 | 5 | 52 | 0.5 | 6 | 1560 |
| Sawdust | Trucks | 34 | 0 | 0 | 52 | 0.5 | 0 | 0 |
| Lumber | Trucks | 26 | 16 | 5 | 52 | 0.5 | 8 | 2080 |
| Hog Fuel | Trucks | 34 | 8 | 6 | 52 | 0.5 | 4 | 1248 |
| Production Stackers | Stacker | 75 | 75 | 6 | 52 | 0.1 | 7.5 | 2340 |
| Production Forklifts | Forklifts | 15 | 380 | 5 | 52 | 0.1 | 38 | 9880 |
| Co. Pickups | Co. Pickups | 2.5 | 8 | 6 | 52 | 0.5 | 4 | 1248 |
| Sales/Service | Vendor | 2.5 | 3 | 5 | 52 | 0.1 | 0.3 | 78 |
| Shavings | Trucks | 34 | 2 | 6 | 52 | 1 | 2 | 624 |
| On-site transfers | Trucks | 26 | 1 | 5 | 52 | 0.5 | 0.5 | 130 |
| Log Delivery | Trucks | 26 | 95 | 5 | 52 | 0.2 | 19 | 4940 |
| | | | | | | **Total:** | 89.3 | 24128 |

**Table F-16. Haul Roads Emissions**

| Vehicle Name | Weight (tons) | Vehicle Miles Traveled per Year (VMT/yr) | Vehicle Miles Traveled per Day (VMT/day) | Emission Factor, E [1] (lb/VMT) | | | Annual Controlled Emissions [2] (tpy) | | | Daily Controlled Emissions [3] (lb/day) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | PM | $PM_{10}$ | $PM_{2.5}$ | PM | $PM_{10}$ | $PM_{2.5}$ | PM | $PM_{10}$ | $PM_{2.5}$ |
| Chip | 34 | 1,560 | 6 | 0.44 | 0.09 | 0.02 | 0.08 | 0.02 | 3.73E-03 | 0.66 | 0.13 | 0.03 |
| Sawdust | 34 | 0 | 0 | 0.44 | 0.09 | 0.02 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lumber | 26 | 2,080 | 8 | 0.33 | 0.07 | 0.02 | 0.08 | 0.02 | 3.78E-03 | 0.67 | 0.13 | 0.03 |
| Hog Fuel | 34 | 1,248 | 4 | 0.44 | 0.09 | 0.02 | 0.06 | 1.21E-02 | 2.98E-03 | 0.44 | 0.09 | 0.02 |
| Production Stackers | 75 | 2,340 | 8 | 0.98 | 0.20 | 0.05 | 0.26 | 0.05 | 1.25E-02 | 1.84 | 0.37 | 0.09 |
| Production Forklifts | 15 | 9,880 | 38 | 0.19 | 0.04 | 0.01 | 0.21 | 0.04 | 1.02E-02 | 1.80 | 0.36 | 0.09 |
| Co. Pickups | 2.5 | 1,248 | 4 | 0.03 | 0.01 | 0.00 | 4.24E-03 | 8.48E-04 | 2.08E-04 | 0.03 | 6.11E-03 | 1.50E-03 |
| Sales/Service | 2.5 | 78 | 0 | 0.03 | 0.01 | 0.00 | 2.65E-04 | 5.30E-05 | 1.30E-05 | 2.29E-03 | 4.58E-04 | 1.12E-04 |
| Shavings | 34 | 624 | 2 | 0.44 | 0.09 | 0.02 | 0.03 | 6.07E-03 | 1.49E-03 | 0.22 | 0.04 | 1.07E-02 |
| On-site transfers | 26 | 130 | 1 | 0.33 | 0.07 | 0.02 | 4.81E-03 | 9.62E-04 | 2.36E-04 | 0.04 | 8.32E-03 | 2.04E-03 |
| Log Delivery | 26 | 4,940 | 19 | 0.33 | 0.07 | 0.02 | 0.18 | 0.04 | 8.97E-03 | 1.58 | 0.32 | 0.08 |
| | | | | | | **Total:** | 0.90 | 0.18 | 0.04 | 7.28 | 1.46 | 0.36 |

[1] Emission factor E is calculated according to AP-42 Section 13.2.1 for emissions from paved roads, equation 1:

E (lbs/VMT) = Paved Road Emission Factor, [ k * $(sL)^{0.91}$ * $(W)^{1.02}$ ]

0.011 = k, PM size multiplier (lb/VMT) from AP-42 Table 13.2.1-1.

0.0022 = k, $PM_{10}$ size multiplier (lb/VMT) from AP-42 Table 13.2.1-1.

0.00054 = k, $PM_{2.5}$ size multiplier (lb/VMT) from AP-42 Table 13.2.1-1.

1.1 = sL, roadway surface silt loading ($g/m^2$) AP-42 13.2.1, Table 13-2.1-3. The average silt loading value for corn wet mills is used because the sawmill is expected to store materials with a similar texture and moisture content.

[2] Emissions account for natural mitigation due to precipitation according to AP-42 Section 13.2.1 equation 2:

Annual emissions (tpy) = E * (1-P/4N)*(1-C)*[VMT/yr]/[lb/ton]

161.6 = P, mean number of days per year with measurable precipitation from Western Regional Climatological Center, Olympia, WA station.

365 = N, number of days in period for annual rainfall mitigation effect

75% = C, control efficiency applied for watering and sweeping.

Paved roads are watered and vacuumed quarterly as control measures. Control efficiency from ORCAA's AEI workbook.

[3] Daily emissions (lb/day) are calculated in the same manner as annual emissions, but with the daily Vehicle Miles Traveled per Day and not taking credits for precipitation.

## Table F-17. Fire Pump Input Parameters

| Parameter | Value | Units | Source Notes |
|---|---|---|---|
| Fire Pump Engine Rated Capacity | 238 | bhp | From the 2022 ORCAA Annual Emissions Inventory. |
| Fire Pump Engine Annual Hours of Operation | 100 | hrs/yr | Assumed value for PTE basis. |

## Table F-18. Fire Pump Emissions

| Emission Unit | Emission Factor [1,4] (lb/hp-hr) | Emissions Max Hourly (lb/hr) | Emissions Total Annual (tpy) |
|---|---|---|---|
| PM [2] | 2.20E-03 | 0.52 | 0.03 |
| $PM_{10}$ | 2.20E-03 | 0.52 | 0.03 |
| $PM_{2.5}$ [2] | 2.20E-03 | 0.52 | 0.03 |
| CO | 6.68E-03 | 1.59 | 0.08 |
| $NO_X$ | 0.031 | 7.38 | 0.37 |
| VOC [3] | 2.51E-03 | 0.60 | 0.03 |
| $SO_2$ | 2.05E-03 | 0.49 | 0.02 |
| $CO_2e$ | -- | 274.63 | 13.73 |
| $CO_2$ | 1.15 | 273.70 | 13.69 |
| $N_2O$ | 9.26E-06 | 2.20E-03 | 1.10E-04 |
| $CH_4$ | 4.63E-05 | 1.10E-02 | 5.51E-04 |

[1] Criteria pollutant and $CO_2$ emission factors for diesel industrial engines from AP-42, Table 3.3-1. HAP/TAP Pollutants with an emission factor rating of C, D, or E are not included.

[2] Assuming PM = $PM_{10}$ = $PM_{2.5}$.

[3] VOC emissions are equal to the sum of exhaust, evaporative, crankcase, and refueling TOC emissions.

[4] $CH_4$ and $N_2O$ emission factor is from 40 CFR 98, Subpart C, Table C-2. Global warming potential (GWP) for $CH_4$ is 25 and $N_2O$ is 298 for estimating $CO_2e$ emissions (40 CFR 98, Subpart A, Table A-1).

$CH_4$ and $N_2O$ emission factors assume the following average break-specific fuel consumption (BSFC), based on AP-42, Table 3.3-1, Footnote 'a'.

Average BSFC = 7,000 Btu/hp-hr

**Table G-1. Rectangular Buildings**

| 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 |

[1] Building elevations determined by AERMAP preprocessor.

**Table G-2. Circular Buildings**

| 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 |

[1] Building elevations determined by AERMAP preprocessor.

**Table G-3. Polygon Buildings**

| 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 |

[1] Building elevations determined by AERMAP preprocessor.

**Table G-4. Point Sources**

| ID | Description | X Coordinate (m) | Y Coordinate (m) | Elevation[3] (m) | Stack Height[2] (m) | Stack Temp (K) | Exit Vel. (m/s) | Stack Diam. (m) |
|---|---|---|---|---|---|---|---|---|
| CDK_S | CDK South Merged Stack [1] | 443492.7 | 5170676.4 | 3.31 | 13.47 | 333.15 | 21.75 | 1.18 |
| CDK_N | CDK North Merged Stack [1] | 443485.6 | 5170783.2 | 3.48 | 13.47 | 333.15 | 21.75 | 1.18 |
| C_FS | Fuel Silo Cyclone | 443469.3 | 5170777.8 | 3.65 | 34.75 | 0.00 | 7.64 | 0.70 |
| C_B | Bark Cyclone | 443754.9 | 5170852.1 | 3.75 | 11.58 | 0.00 | 5.12 | 1.00 |
| BAG2 | Baghouse #2 - Carter Day | 443417.1 | 5170941.8 | 4.14 | 9.14 | 0.00 | 22.85 | 1.00 |
| BAG_BS | Band Saw Filing Room Baghouse | 443628.5 | 5170906.2 | 4.29 | 3.30 | 0.00 | 21.83 | 0.406 |

[1] Because the emission points at each end of the CDK are located less than one diameter from eachother, are similar in height, have the same exhaust flowrate and temperature, and have the same source of emissions, they are modeled in total as two merged point sources based on guidance from "Practical Guide to Atmospheric Dispersion Modeling" (Turner and Schulze).

Exhaust data obtained from email from KDS Windsor on 3/28/2023 and engineering drawings of the CDK (March 29, 2023).

| | | | | |
|---|---|---|---|---|
| Flowrate per singular emission point: | 25,000 acfm | or | 11.80 | $m^3/s$ |
| Flowrate per mergerd point source: | 50,000 acfm | or | 23.60 | $m^3/s$ |
| Temperature: | 140 F | | | |
| Diameter per singluar stack: | 0.83 m | | | |
| Velocity per singular stack: | 21.75 m/s | | | |

[2] Based on engineering drawings of the CDK (March 29, 2023), the emission points have a less than 1.5 ft difference in height. The lower emission point height is used as the height of the merged point source for conservatism. Existing unit stack heights are based on measurement and site documentation.

[3] Source elevation determined by AERMAP preprocessor.

[4] Velocity for existing units is determined by exhaust flowrate as defined in 12AOP915 TSD (11/20/19).

[5] Stack diameter for existing units is determined by measurement.

**Table G-5. Horizontal Point Sources**

| ID | Description | X Coordinate (m) | Y Coordinate (m) | Elevation (m) | Stack Height (m) | Stack Temp (K) | Exit Vel. (m/s) | Stack Diam. (m) |
|---|---|---|---|---|---|---|---|---|
| BAG1 | Baghouse #1 - Clark | 443417.6 | 5170935.9 | 4.19 | 9.14 | 0.00 | 16.51 | 1.54 |
| BAG3 | Baghouse#3 - Package Saw Shaker | 443503.0 | 5170839.6 | 3.71 | 4.27 | 0.00 | 11.85 | 0.42 |
| BAG_SM | Sawmill Baghouse | 443661.0 | 5170864.3 | 4.31 | 11.58 | 0.00 | 23.81 | 1.06 |
| BAG_P | Powerhouse Baghouse | 443326.2 | 5170837.4 | 3.76 | 9.14 | 0.00 | 13.20 | 0.84 |
| BAG_DC | Dry Chips Baghouse | 443671.4 | 5170864.2 | 4.16 | 4.52 | 0.00 | 18.47 | 1.14 |
| CDK_SD | CDK South Inlet Door | 443492.2 | 5170674.8 | 3.29 | 5.87 | 333.15 | 0.305 | 2.90 |
| CDK_ND | CDK North Inlet Door | 443486.7 | 5170784.8 | 3.48 | 5.87 | 333.15 | 0.305 | 2.90 |

[1] Source elevation determined by AERMAP preprocessor.

[2] Velocity for existing units is determined by exhaust flowrate as defined in 12AOP915 TSD (11/20/19).

[3] Stack diameter for existing units is determined by measurement.

[4] Existing unit stack heights are based on measurement and site documentation.

[5] Dry Chip Baghouse exhaust parameters are determined by engineering drawings from Superior Systems.

[6] One horizontal source at the green lumber entrence on each end of the kiln are used to represent emissions from the doors of the CDK. Because of the positive and negative pressure created by the internal fans near the kiln ends, it is expected that ambient air will be drawn into the kiln on the side where dry lumber is exiting and kiln gas is forced out on the side where green lumber is entering. The effective diameter for each source is calculated from the area of the door opening minus the area covered by the lumber, which is assumed to be 75% of the door opening. The release height is calculated as the height of the door minus half of the effective diameter. The exit velocity is conservatively assumed to be 1 ft/s. Calculations for effective diameter and release height are below:

| | | |
|---|---|---|
| Wood stack height: | 6.49 | m |
| Wood stack width: | 3.05 | m |
| Wood stack area: | 19.78 | $m^2$ |
| Total door area: | 26.38 | $m^2$ |
| Door area - wood area: | 6.59 | $m^2$ |
| Effective diameter: | 2.90 | m |
| Door height: | 7.32 | m |
| Effective release height: | 5.87 | m |

**Table G-6. Volume Sources**

| ID | Description | X Coordinate (m) | Y Coordinate (m) | Elevation (m) | Release Height (m) | Init. Lat. Dim. (m) | Init. Vert. Dim. (m) |
|---|---|---|---|---|---|---|---|
| GSD | Green sawdust sawmill drop | 443614.2 | 5170857.3 | 4.23 | 6.86 | 4.81 | 6.38 |
| DB | Log Debarking | 443742.9 | 5170872.8 | 4.16 | 6.86 | 1.98 | 6.38 |
| CBL | Chip bin truck loadout | 443699.9 | 5170851.6 | 3.74 | 7.24 | 1.23 | 6.73 |
| BBL | Bark bin truck loadout | 443758.9 | 5170852.1 | 3.75 | 7.24 | 1.23 | 6.73 |

[1] Volume source dimensions for truck loadout determined using dimensions of the storage bins:

| | | |
|---|---|---|
| Bin height | 14.48 | m |
| Bin width: | 5.28 | m |

**Table G-7. Point Source - Criteria Pollutant Emission Rates**

| Source | Model ID | Emission Rate (g/s) $PM_{10}$ 24-hr[2] | $PM_{2.5}$ 24-hr[2] | $PM_{2.5}$ Annual | CO 1-hr/8-hr | $NO_2$ 1-hr | $NO_2$ Annual | $SO_2$ 1-hr |
|---|---|---|---|---|---|---|---|---|
| CDK South Merged Stack[1] | CDK_S | 3.43E-01 | 3.07E-01 | 2.04E-01 | 1.36E+00 | 5.21E-01 | 5.11E-01 | 6.30E-02 |
| CDK North Merged Stack[1] | CDK_N | 3.43E-01 | 3.07E-01 | 2.04E-01 | 1.36E+00 | 5.21E-01 | 5.11E-01 | 6.30E-02 |
| Fuel Silo Cyclone | C_FS | 8.07E-02 | 8.07E-02 | 8.07E-02 | -- | -- | -- | -- |
| Bark Cyclone | C_B | 1.11E-01 | 1.11E-01 | 1.11E-01 | -- | -- | -- | -- |
| Baghouse #2 - Carter Day | BAG2 | 1.75E-03 | 1.75E-03 | 1.75E-03 | -- | -- | -- | -- |
| Band Saw Filing Room Baghouse | BAG_BS | 7.75E-04 | 7.75E-04 | 7.75E-04 | -- | -- | -- | -- |

[1]Based on vendor information and the NCASI Control Device and Stack Testing Feasibility Assessment, it is assumed that 80% of emissions from the CDK will be split evenly between the four vapor extraction points (two modeled stacks) so emission rates are divided by two and represent emissions from one merged source. The remaining 20% is emitted through the openings at each end of the CDK.

[2]Emissions for 24-hr averaging periods associated with the CDK are modeled with 350 MMBtu/day (7 hours at full capacity of the burner) of operation without wood drying in the CDK -and the remainder of the period at normal operation to reflect potential operations associated with startup, idle, malfunction and shutdown.

**Table G-8. Horizontal Point Source - Criteria Pollutant Emission Rates**

| Source | Model ID | Emission Rate (g/s) $PM_{10}$ 24-hr[2] | $PM_{2.5}$ 24-hr[2] | $PM_{2.5}$ Annual | CO 1-hr/8-hr | $NO_2$ 1-hr | $NO_2$ Annual | $SO_2$ 1-hr |
|---|---|---|---|---|---|---|---|---|
| Baghouse #1 - Clark | BAG1 | 8.40E-03 | 8.40E-03 | 8.40E-03 | -- | -- | -- | -- |
| Baghouse#3 - Package Saw Shaker | BAG3 | 4.52E-04 | 4.52E-04 | 4.52E-04 | -- | -- | -- | -- |
| Sawmill Baghouse | BAG_SM | 5.78E-03 | 5.78E-03 | 5.78E-03 | -- | -- | -- | -- |
| Powerhouse Baghouse | BAG_P | 2.60E-03 | 2.60E-03 | 2.60E-03 | -- | -- | -- | -- |
| Dry Chips Baghouse | BAG_DC | 6.67E-04 | 6.67E-04 | 6.67E-04 | -- | -- | -- | -- |
| CDK South Door[1] | CDK_SD | 8.57E-02 | 7.67E-02 | 5.11E-02 | 3.39E-01 | 1.30E-01 | 1.28E-01 | 1.57E-02 |
| CDK North Door[1] | CDK_ND | 8.57E-02 | 7.67E-02 | 5.11E-02 | 3.39E-01 | 1.30E-01 | 1.28E-01 | 1.57E-02 |

[1]Based on vendor information and the NCASI Control Device and Stack Testing Feasibility Assessment, it is assumed that 80% of emissions from the CDK will be split evenly between the four vapor extraction points (two modeled stacks) so emission rates are divided by two and represent emissions from one merged source. The remaining 20% is emitted through the openings at each end of the CDK.

[2]Emissions for 24-hr averaging periods associated with the CDK are modeled with 350 MMBtu/day (7 hours at full capacity of the burner) of operation without wood drying in the CDK -and the remainder of the period at normal operation to reflect potential operations associated with startup, idle, malfunction and shutdown.

**Table G-9. Volume Source - Criteria Pollutant Emission Rates**

| Source | Model ID | Emission Rate (g/s) $PM_{10}$ 24-hr | $PM_{2.5}$ 24-hr | $PM_{2.5}$ Annual |
|---|---|---|---|---|
| Green sawdust sawmill drop | GSD | 2.68E-03 | 4.06E-04 | 4.87E-04 |
| Log Debarking | DB | 1.04E-01 | 1.44E-02 | 1.44E-02 |
| Chip bin truck loadout | CBL | 1.44E-01 | 2.17E-02 | 1.55E-02 |
| Bark bin truck loadout | BBL | 3.68E-02 | 5.58E-03 | 3.97E-03 |

**Table G-10. Volume Source - Vehicle Traffic - Criteria Pollutant Emission Rates**

| Vehicle Name | Model Route Name | Emission Rate (g/s) $PM_{10}$ 24-hr | Emission Rate (g/s) $PM_{2.5}$ 24-hr | Emission Rate (g/s) $PM_{2.5}$ Annual | Total Number of Sources | Emission Rate/Source (g/s) $PM_{10}$ 24-hr | Emission Rate/Source (g/s) $PM_{2.5}$ 24-hr | Emission Rate/Source (g/s) $PM_{2.5}$ Annual | Vehicle Height (m) | Vehicle Width (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| Chip | Chip Trucks | 6.89E-04 | 1.69E-04 | 1.07E-04 | 40 | 1.72E-05 | 4.23E-06 | 2.68E-06 | 3 | 3 |
| Lumber | | 6.99E-04 | 1.72E-04 | 1.09E-04 | | | | | | |
| Co. Pickups | Shipping Trucks | 3.21E-05 | 7.87E-06 | 5.98E-06 | 140 | 5.55E-06 | 1.36E-06 | 8.70E-07 | 3 | 3 |
| Sales/Service | | 2.41E-06 | 5.90E-07 | 3.74E-07 | | | | | | |
| On-site transfers | | 4.37E-05 | 1.07E-05 | 6.79E-06 | | | | | | |
| Hog Fuel | Bark/Hog Fuel Trucks | 4.60E-04 | 1.13E-04 | 8.58E-05 | 33 | 1.39E-05 | 3.42E-06 | 2.60E-06 | 3 | 3 |
| Production Stackers | Log Stackers | 1.93E-03 | 4.74E-04 | 3.60E-04 | 84 | 2.30E-05 | 5.64E-06 | 4.29E-06 | 4.32 | 3 |
| Production Forklifts | Green Lumber, Dry Lumber, Planer, shipping forklifts | 1.89E-03 | 4.65E-04 | 2.95E-04 | 189 | 1.00E-05 | 2.46E-06 | 1.56E-06 | 4.32 | 3 |
| Shavings | Shaving Trucks | 2.30E-04 | 5.64E-05 | 4.29E-05 | 158 | 1.45E-06 | 3.57E-07 | 2.71E-07 | 3 | 3 |
| Log Delivery | Log Trucks | 1.66E-03 | 4.08E-04 | 2.58E-04 | 28 | 5.93E-05 | 1.46E-05 | 9.22E-06 | 3 | 3 |

[1] Forklift dimensions based on vendor specification sheets. Truck dimensions are based on default average truck dimensions from EPA guidance memo on haul roads.

**Table G-11. TAP Emission Rates - Short Term (g/s)[1]**

| Pollutant<br>CAS # | Formaldehyde<br>50-00-0 | Benzene<br>71-43-2 | Arsenic<br>7440-38-2 | Cadmium<br>7440-43-9 | Lead<br>7439-92-1 | Manganese<br>7439-96-5 | Nickel<br>7440-02-0 |
|---|---|---|---|---|---|---|---|
| CDK_S | 2.11E-02 | 1.06E-02 | 2.55E-05 | 7.79E-06 | 8.79E-05 | 3.20E-04 | 2.23E-05 |
| CDK_N | 2.11E-02 | 1.06E-02 | 2.55E-05 | 7.79E-06 | 8.79E-05 | 3.20E-04 | 2.23E-05 |
| CDK_SD | 5.27E-03 | 2.65E-03 | 6.36E-06 | 1.95E-06 | 2.20E-05 | 8.00E-05 | 5.57E-06 |
| CDK_ND | 5.27E-03 | 2.65E-03 | 6.36E-06 | 1.95E-06 | 2.20E-05 | 8.00E-05 | 5.57E-06 |

[1]Based on vendor information and the NCASI Control Device and Stack Testing Feasibility Assessment, it is assumed that 80% of emissions from the CDK will be split evenly between the four vapor extraction points (two modeled stacks) so emission rates are divided by two and represent emissions from one merged source. The remianing 20% is emitted through the openings at each end of the CDK. Maximum hourly emission rates are used for all short term averaging periods.

**Table G-12. TAP Emission Rates - Long Term (g/s)[1]**

| Pollutant<br>CAS # | Formaldehyde<br>50-00-0 | Benzene<br>71-43-2 | Arsenic<br>7440-38-2 | Cadmium<br>7440-43-9 | Lead<br>7439-92-1 | Manganese<br>7439-96-5 | Nickel<br>7440-02-0 |
|---|---|---|---|---|---|---|---|
| CDK_S | 2.02E-02 | 1.06E-02 | 2.55E-05 | 7.79E-06 | 8.79E-05 | 3.20E-04 | 2.23E-05 |
| CDK_N | 2.02E-02 | 1.06E-02 | 2.55E-05 | 7.79E-06 | 8.79E-05 | 3.20E-04 | 2.23E-05 |
| CDK_SD | 5.06E-03 | 2.65E-03 | 6.36E-06 | 1.95E-06 | 2.20E-05 | 8.00E-05 | 5.57E-06 |
| CDK_ND | 5.06E-03 | 2.65E-03 | 6.36E-06 | 1.95E-06 | 2.20E-05 | 8.00E-05 | 5.57E-06 |

[1]Based on vendor information and the NCASI Control Device and Stack Testing Feasibility Assessment, it is assumed that 80% of emissions from the CDK will be split evenly between the four vapor extraction points (two modeled stacks) so emission rates are divided by two and represent emissions from one merged source. The remianing 20% is emitted through the openings at each end of the CDK.

**Table G-13. TAP Modeling Results**

| | | Model Results (µg/m³) | | | | Averaging | | |
|---|---|---|---|---|---|---|---|---|
| **Pollutant** | **CAS #** | **1-hr** | **8-hr** | **24-hr** | **Annual** | **Period** | **ASIL[1] (µg/m³)** | **Above ASIL?** |
| Formaldehyde | 50-00-0 | 9.81 | 4.06 | 1.84 | 0.43 | year | 0.17 | Yes |
| Formaldehyde[2] | 50-00-0 | 9.81 | 4.06 | 1.84 | 0.43 | 1-hr | 61 | No |
| Benzene | 71-43-2 | 4.93 | 2.04 | 0.92 | 0.23 | year | 0.13 | Yes |
| Arsenic | 7440-38-2 | 0.01 | 0.00 | 0.00 | 0.00054 | year | 0.0003 | Yes |
| Cadmium | 7440-43-9 | 0.00 | 0.00 | 0.00 | 0.00017 | year | 0.00024 | No |
| Lead | 7439-92-1 | 0.04 | 0.02 | 0.01 | 0.002 | year | 0.083 | No |
| Manganese | 7439-96-5 | 0.15 | 0.06 | 0.03 | 0.01 | 24-hr | 0.3 | No |
| Nickel | 7440-02-0 | 0.01 | 0.00 | 0.00 | 0.00047 | year | 0.0038 | No |

[1]The ASIL for each TAP is obtained from the 2019 WAC 173-460 TAP list.
[2]Formaldehyde 1-hr averaging period ASIL obtained from ORCAA 8.6(b).

**Table G-14. Criteria Pollutant NAAQS Results**

| Pollutant | Averaging Period | Design Concentration | Concentration ($\mu g/m^3$) Modeled | Background [1] | Combined | NAAQS | Exceeds NAAQS? |
|---|---|---|---|---|---|---|---|
| $PM_{10}$ | 24-hr | H6H | 76.9 | 42.70 | 119.6 | 150 | No |
| $PM_{2.5}$ | 24-hr | H8H | 22.9 | 10.2 | 33.1 | 35 | No |
| | Annual | -- | 5.6 | 4.3 | 9.9 | 12 | No |
| $NO_2$ | 1-hr | H8H | 111.1 | 21.81 | 133 | 188 | No |
| | Annual | -- | 9.8 | 4.34 | 14.1 | 100 | No |
| $SO_2$ | 1-hr | H4H | 18.5 | 12.28 | 30.7 | 196 | No |

# Attachment B

## Model File Directory

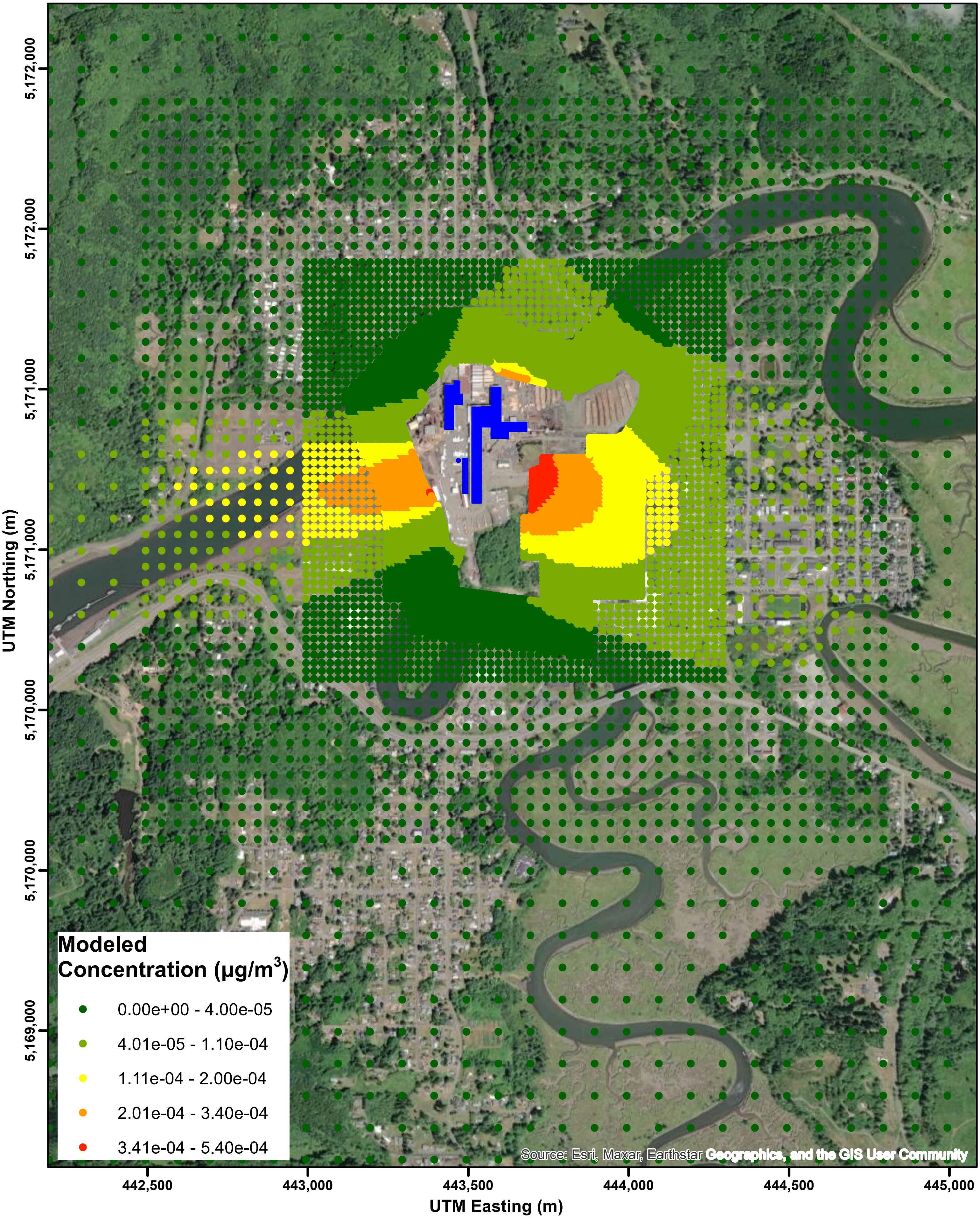
| File Name [a] | Pollutant | Averaging Period | Modeled Year(s) | Description |
|---|---|---|---|---|
| CNHXX | CO | 1-hr and 8-hr | 2018-2022 | Project significant impact modeling – maximum across 5 years |
| SNH1822 | $SO_2$ | 1-hr | 2018-2022 | NAAQS modeling – maximum (H4H) 5-year average |
| PM25NI1822 | $PM_{2.5}$ | 24-hr | 2018-2022 | NAAQS modeling – maximum (H8H) 5-year average |
| PM25_Annual_NH1822 | $PM_{2.5}$ | Annual | 2018-2022 | NAAQS modeling – maximum 5-year average |
| PM10NI1822 | $PM_{10}$ | 24-hr | 2018-2022 | NAAQS modeling – maximum (H2H) across 5 years |
| NNH1822 | $NO_2$ | 1-hr | 2018-2022 | NAAQS modeling – maximum (H8H) 5-year average |
| NNHXX | $NO_2$ | Annual | 2018-2022 | NAAQS modeling – maximum across 5 years |
| 20XX_arsenic_aermod | Arsenic | Annual | 2018-2022 | TAP modeling – maximum across 5 years |
| 20XX_benzene_aermod | Benzene | Annual | 2018-2022 | TAP modeling – maximum across 5 years |
| 20XX_cadmium_aermod | Cadmium | Annual | 2018-2022 | TAP modeling – maximum across 5 years |
| 20XX_formalde_aermod | Formaldehyde | Annual | 2018-2022 | TAP modeling – maximum across 5 years |
| 2018-2022_formalde_aermod | Formaldehyde | 1-hr | 2018-2022 | TAP modeling – maximum across 5 years |
| 20XX_lead_aermod | Lead | Annual | 2018-2022 | TAP modeling – maximum across 5 years |
| 2016_2020_manganes_aermod | $SO_2$ | 1-hr | 2018-2022 | TAP modeling – maximum across 5 years |
| 20XX_nickel_aermod | Nickel | Annual | 2018-2022 | TAP modeling – maximum across 5 years |
| HQMSLE1822 | -- | -- | 2018-2022 | Surface and Upper Air Meteorological Data |
| BPIP input/output file | -- | -- | -- | BPIP preprocessor files |

a. File names with "XX" denote multiple files for a single pollutant. "XX" represents the modeled meteorological year.
b. *.ami and *.inp files are input files. *.aml and *.out files are output files. Plot files can be provided upon request.

# Attachment C

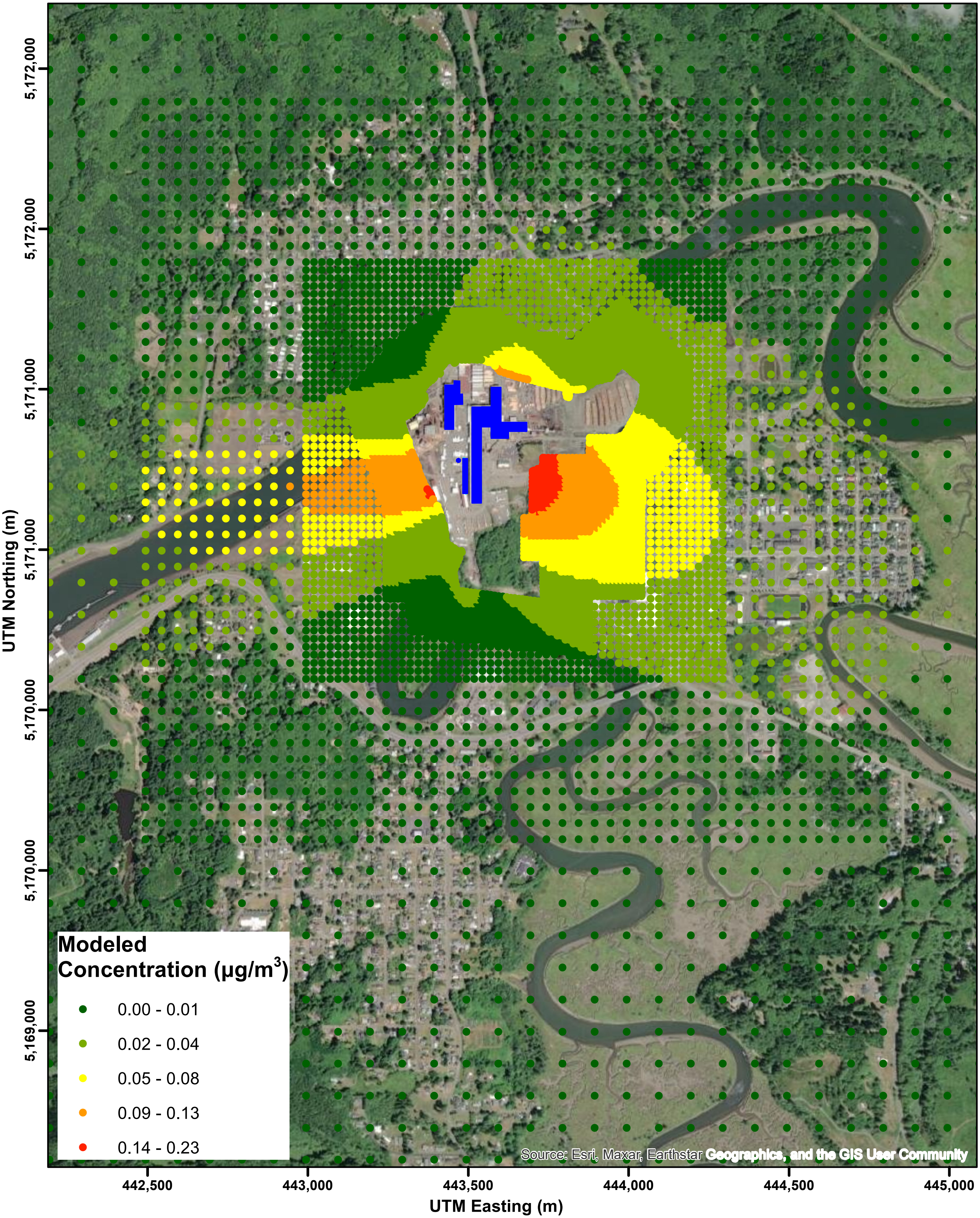
## Concentration Plots

## Maximum Modeled Arsenic Concentration
## Annual ASIL 0.0003 (µg/m$^3$)



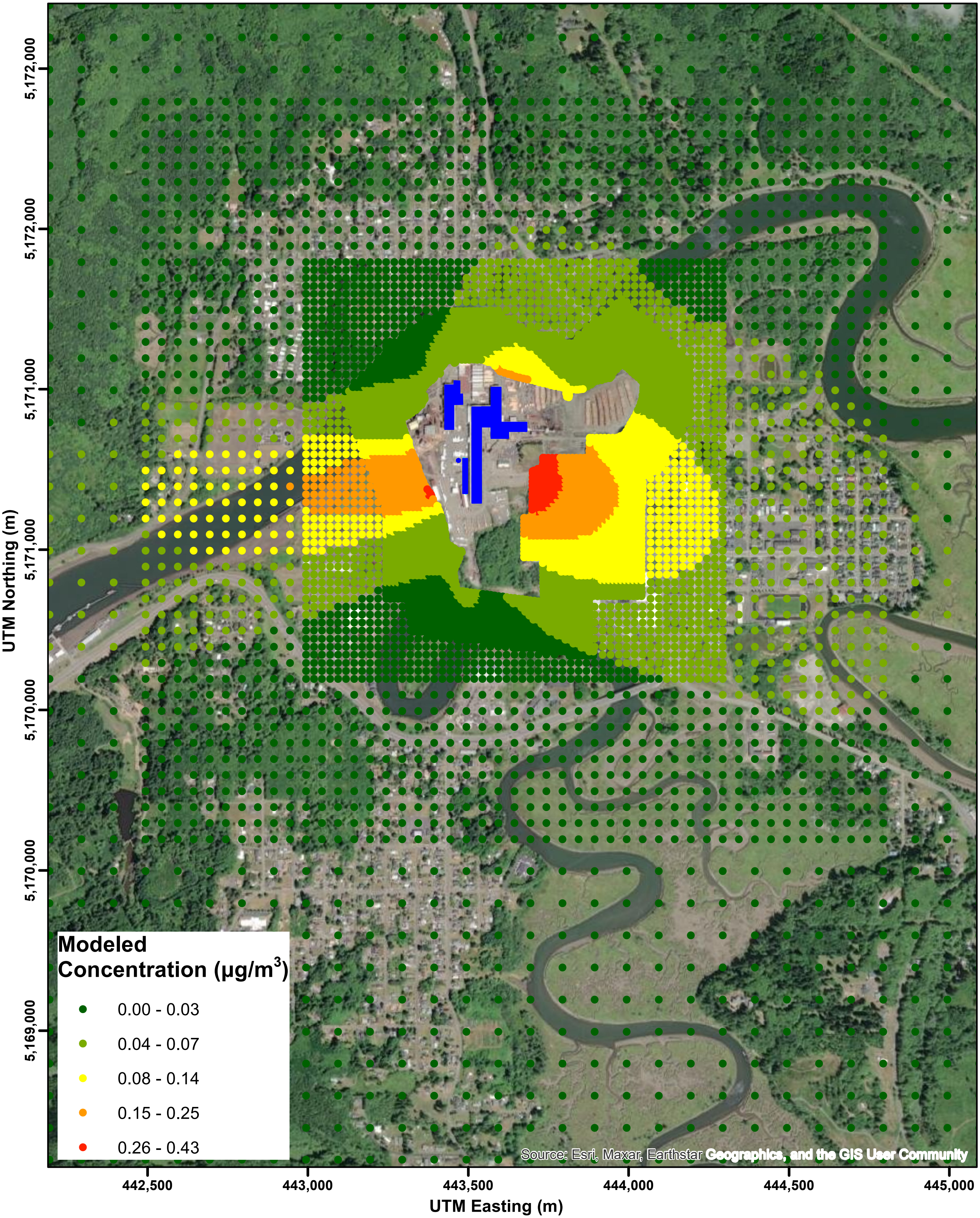

All Coordinates shown in UTM Coordinates,
Zone 10, WGS 1984

## Maximum Modeled Benzene Concentration
## Annual ASIL 0.13 (µg/m³)



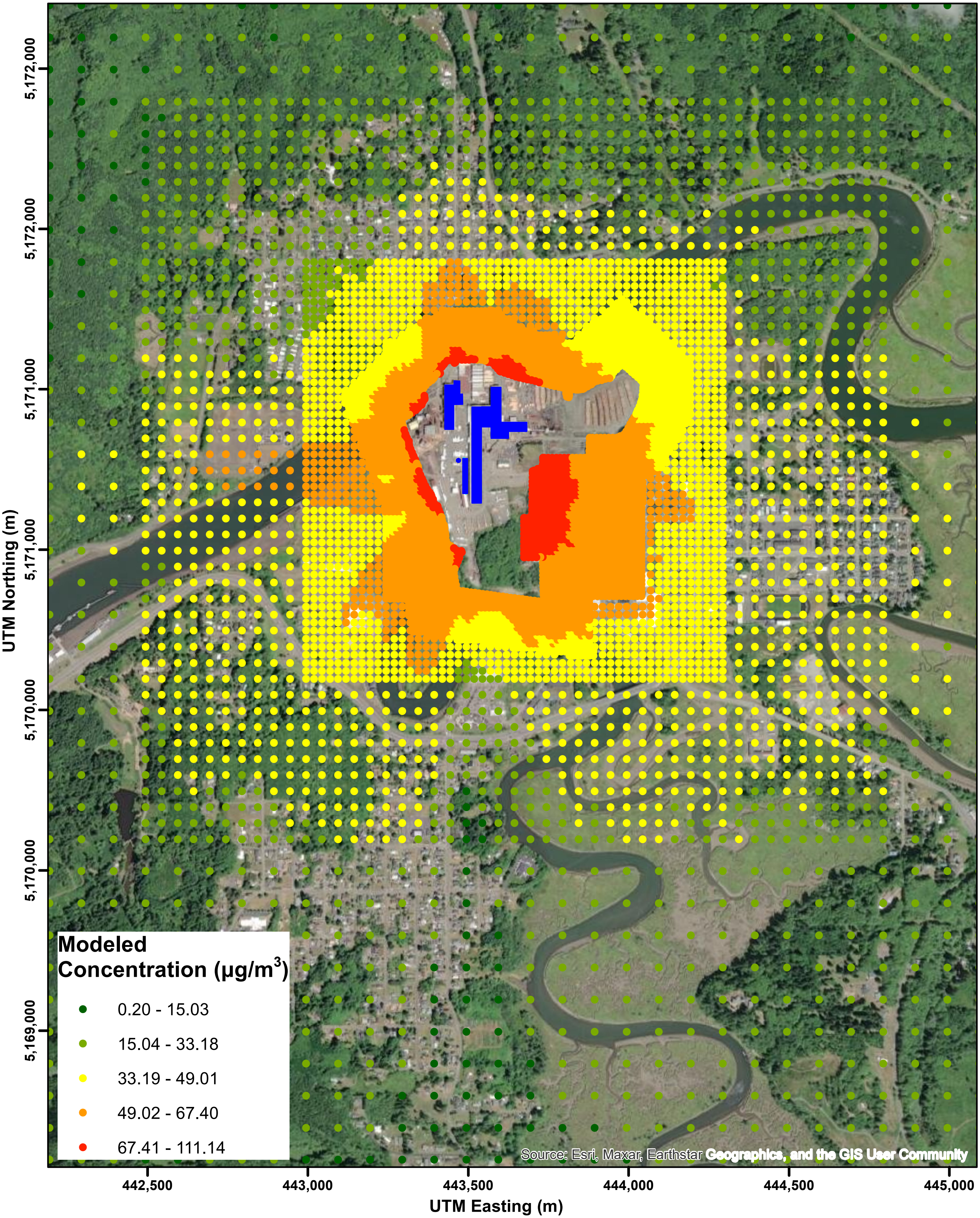

All Coordinates shown in UTM Coordinates,
Zone 10, WGS 1984

**Maximum Modeled Formaldehyde Concentration**
**Annual ASIL 0.17 (µg/m³)**



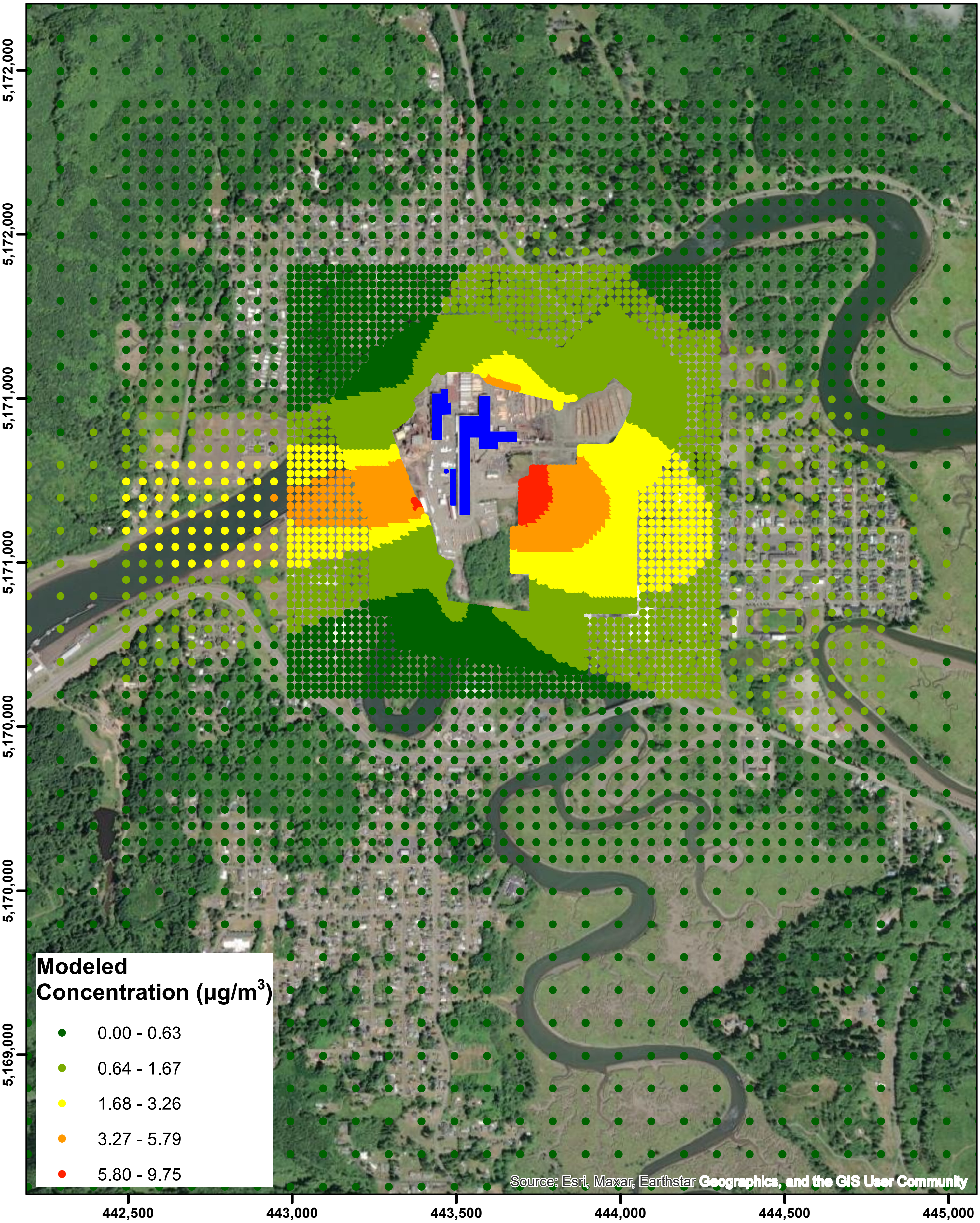

All Coordinates shown in UTM Coordinates,
Zone 10, WGS 1984

## High 8th High Modeled $NO_2$ Concentration
## 1-hr NAAQS 188 (µg/m³)



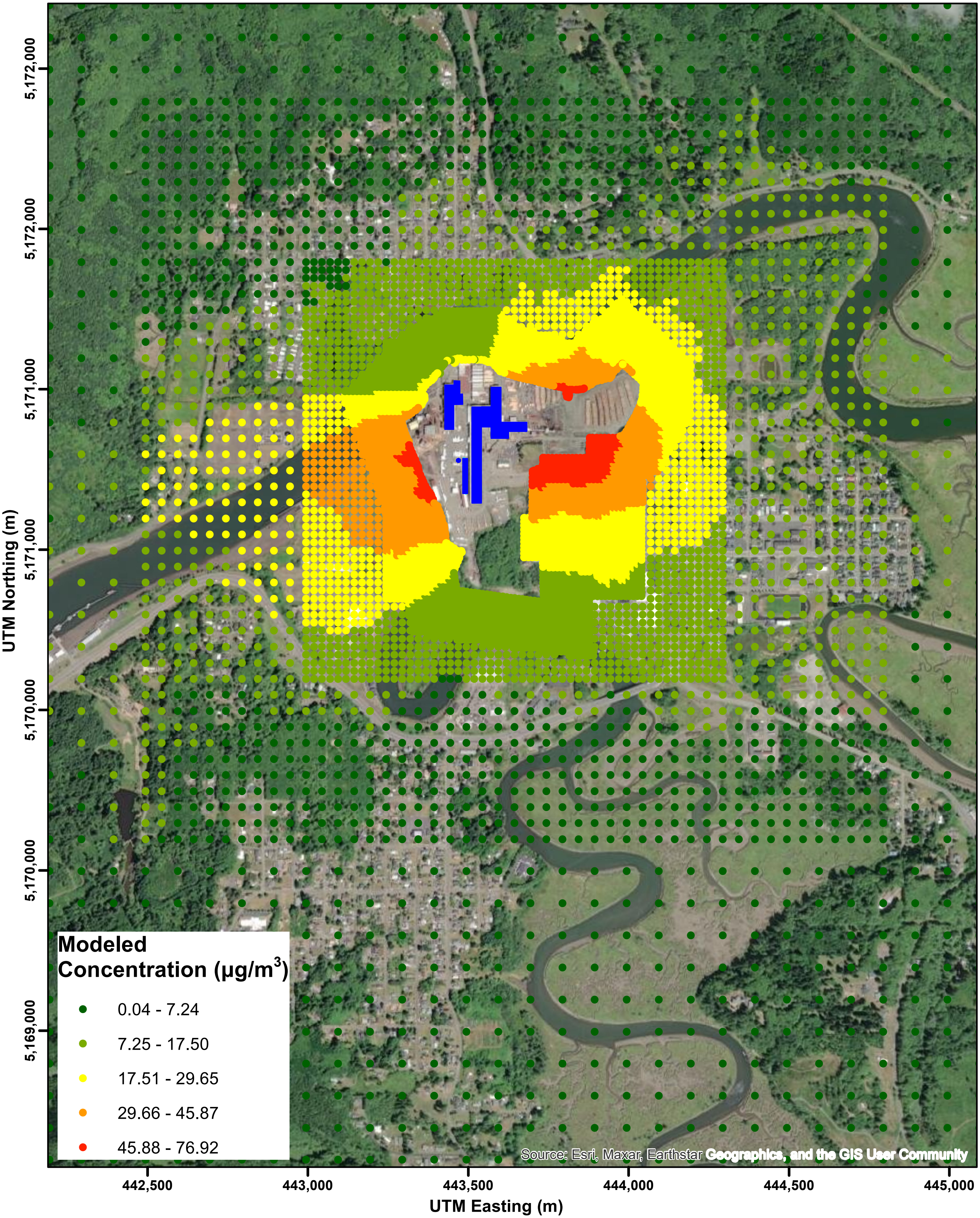

All Coordinates shown in UTM Coordinates,
Zone 10, WGS 1984

## Maximum Modeled $NO_2$ Concentration
## Annual NAAQS 100 ($\mu g/m^3$)



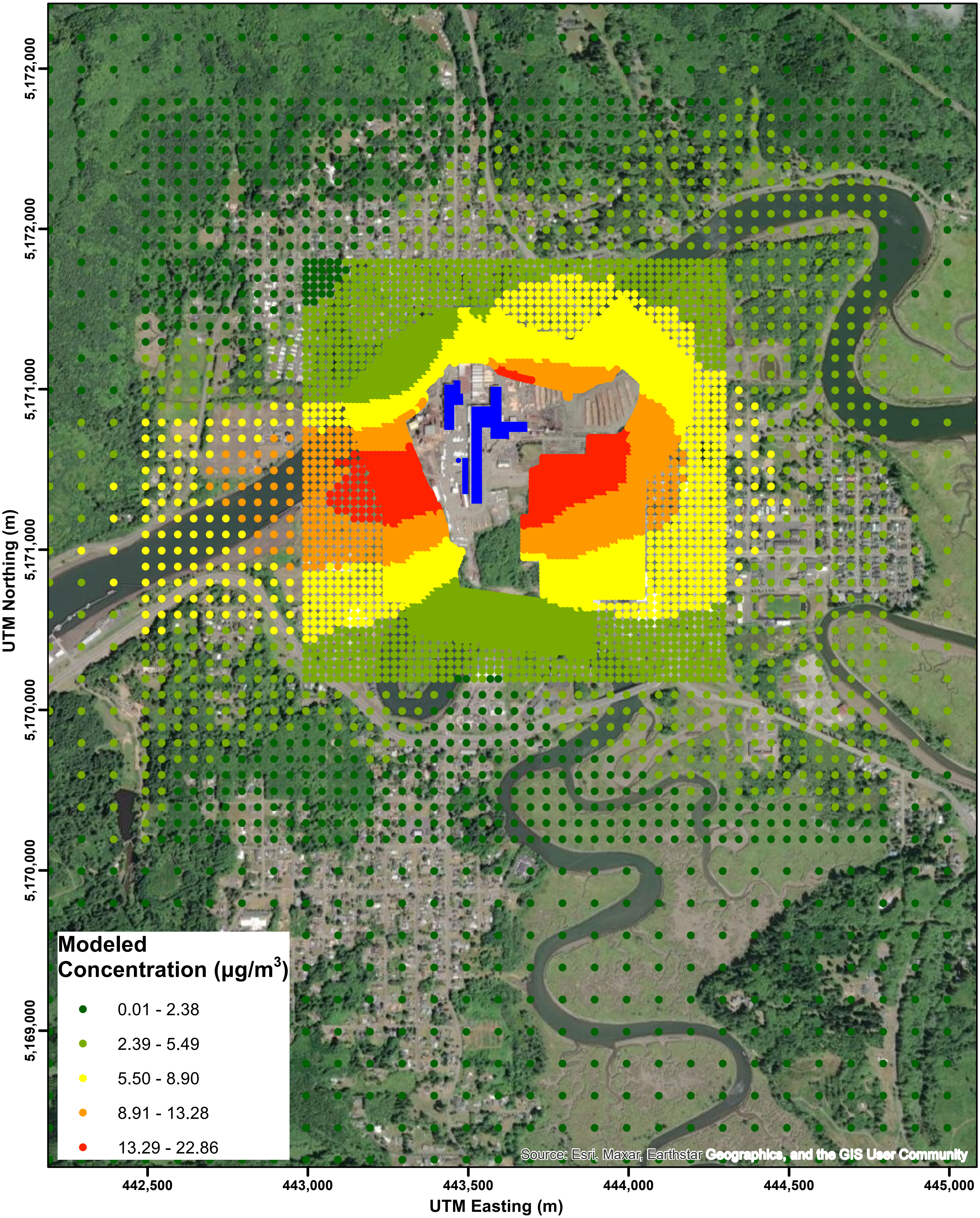

All Coordinates shown in UTM Coordinates,
Zone 10, WGS 1984

**High 6th High Modeled $PM_{10}$ Concentration**
**24-hr NAAQS 150 (µg/m³)**



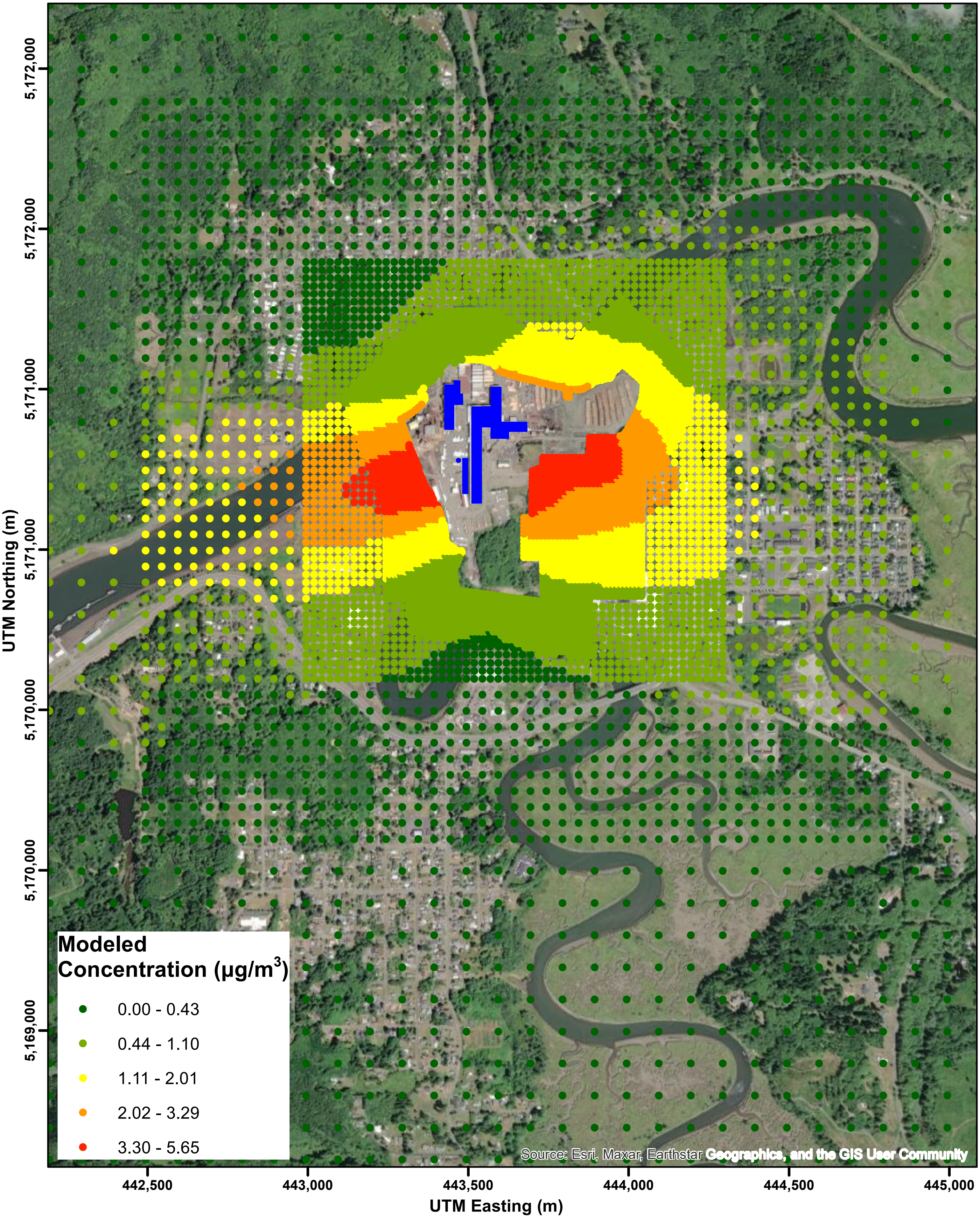

All Coordinates shown in UTM Coordinates,
Zone 10, WGS 1984

**High 8th High Modeled $PM_{2.5}$ Concentration**
**24-hr NAAQS 35 ($\mu g/m^3$)**



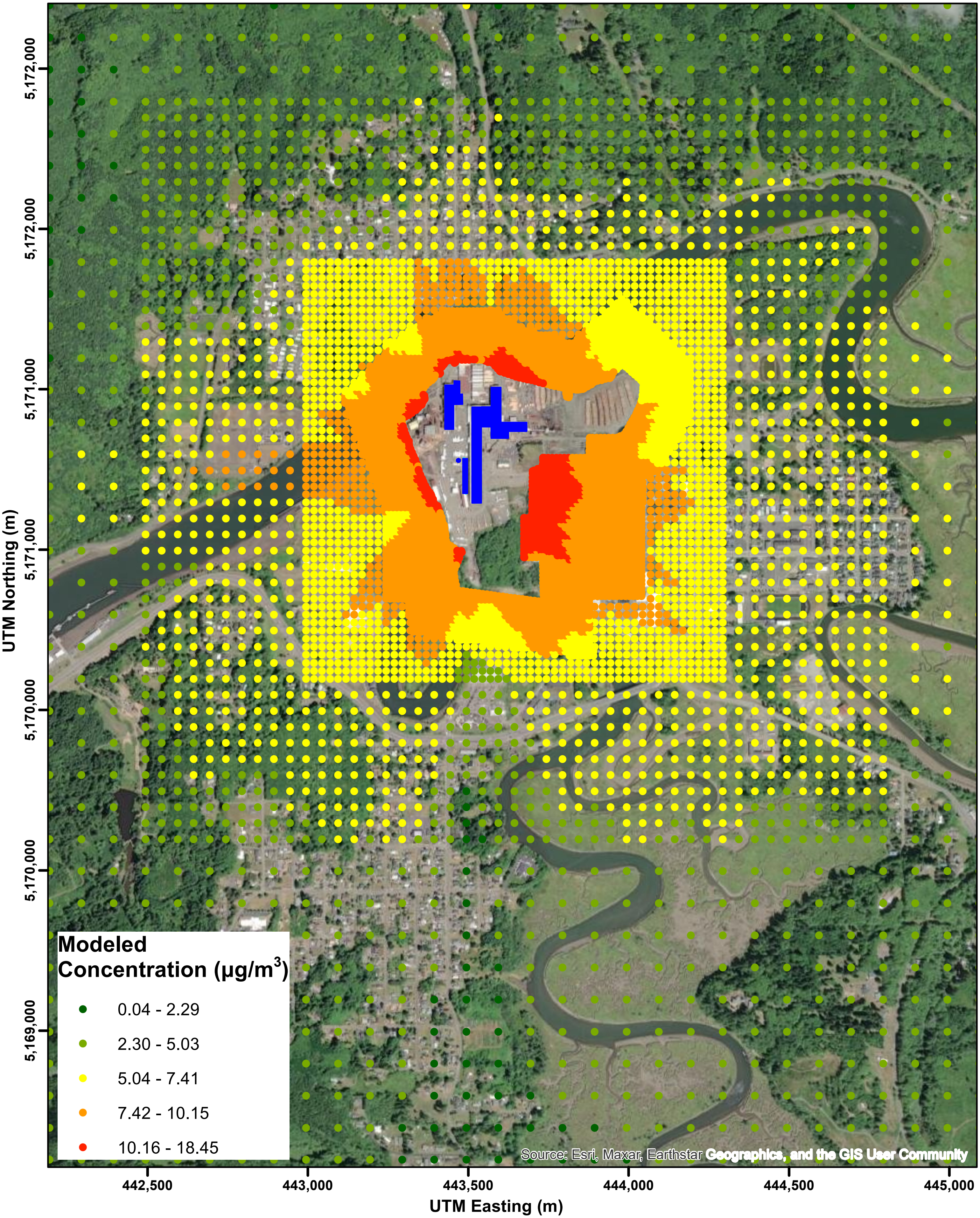

All Coordinates shown in UTM Coordinates,
Zone 10, WGS 1984

## Maximum Modeled $PM_{2.5}$ Concentration
## Annual NAAQS 12 ($\mu g/m^3$)




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

## High 4th High Modeled $SO_2$ Concentration
## 1-hr NAAQS 196 ($\mu g/m^3$)




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