Health Impact Assessment Recommendation for

SDS LUMBER COMPANY NEW STUD MILL KILNS PROJECT

By

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For the

Air Quality Program

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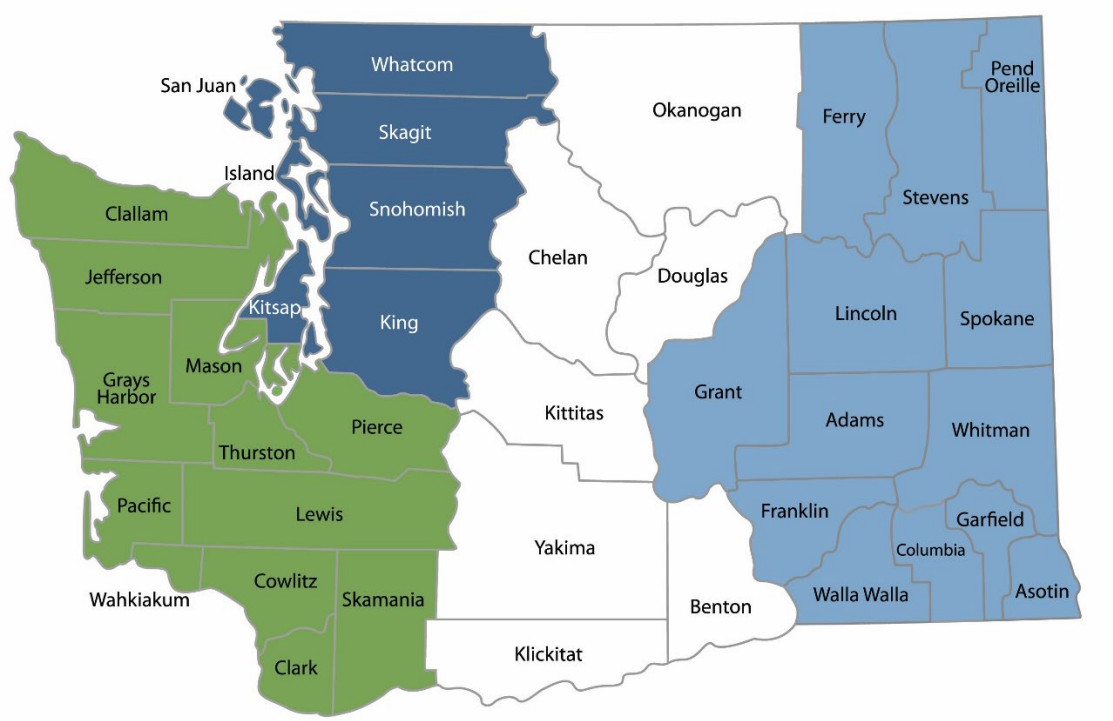

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Bingen, WA

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Headquarters Office
Olympia, WA

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Executive Summary

SDS Lumber Company (SDS) operates a lumber and plywood manufacturing facility as authorized under the Air Operating Permit No. 20AQ-C241 First Revision (Issued: July 22, 2020) located at Walnut and Steuben Street in the city of Bingen, Klickitat County, Washington.

Figure 2-1 Aerial View of SDS Lumber

Figure 1. Aerial photograph of the SDS Lumber Company Mill and surroundings

(Source: HIA Figure 2-1 Aerial view of SDS Lumber)

SDS's current lumber sawing operation consists of Stud Mills #1 and 2 processing either green or dried lumber. The lumber is dried in the kilns. SDS is proposing to install two new kilns (Kiln #3 and Kiln #4) for drying dimensional lumber. The proposed new kilns will be located north of and adjacent to Kilns #1 and #2. Kiln #3 will be a single-track 88' long kiln with annual production of 12.3 million board feet (BF). Kiln #4 will be an 88' double track with annual production of 24.7 million BF. Like the existing kilns, the new kilns will be "indirect-fired lumber drying kilns".

SDS submitted a Notice of Construction (NOC) to Ecology for approval to install the new kilns. The proposed kilns are likely to emit certain toxic air pollutants (TAPs) at rates requiring additional permitting review under Chapter 173-460 Washington Administrative Code (WAC). As part of this, a First Tier toxic review showed that the new emissions of acetaldehyde are greater than the applicable Acceptable Source Impact Level (ASIL) therefore a second tier review was performed. The Second Tier review includes a health impact assessment (HIA). SDS hired SRL, a consulting company, to prepare the HIA. The HIA assumes that the new kilns will be operated at no more than the limits set forth in the NOC. This document reviews the methods and results of the HIA.

Conclusions

In general, the toxic air pollutant impacts in the area will not result in excessive cancer risks nor in non-cancer health effects hazards. Ecology concludes the health risks are acceptable and recommends approval of construction and operation of Kiln #3 and Kiln #4 because:

- Ecology determined that the emission controls proposed for the new emission unit is the best available control technology for toxics (tBACT).
- The applicant demonstrated that the increase in emissions of TAPs is not likely to result in an increased cancer risk of more than one in one hundred thousand (10-in-one-million).
- Ecology determined that non-cancer hazards are acceptable.

Second Tier Review Processing and Approval Criteria

SDS and their consultant for this project completed and submitted the documents and related information required for Ecology to conduct a Second Tier Review process and to confirm approval criteria under Ch. 173-460 WAC. Ecology is responsible for reviewing Second Tier Review petitions.

Second tier review processing requirements

SDS paid the air toxics review fee and satisfied all five processing requirements for Ecology to review the Second Tier Petition under Chapter 173-460-090 WAC as listed below:

(a) The permitting authority has determined that other conditions for processing the NOC Order of Approval (NOC) have been met, and has issued a preliminary approval order.

(b) Emission controls contained in the preliminary NOC approval order represent at least best available control technology for toxics (tBACT).

(c) The applicant has developed an HIA Protocol that has been approved by Ecology.

(d) The ambient impact of the emissions increase of each toxic air pollutant (TAP) that exceed ASILs has been quantified using refined air dispersion modeling techniques as approved in the HIA protocol.

(e) The second tier review petition contains an HIA conducted in accordance with the approved HIA protocol.

Acting as the permitting authority for this project, Ecology's permit-writing engineer satisfied item (a)[2] and verified item (b) above on May 29 and 30, 2023.[3,4] Then, subsequent to the applicant's June 9, 2023 request to operate the new kilns at higher temperatures than originally requested, the permit-writing engineer issued a revised Draft NOC Approval Order (No. 23AQ-

[2] State of Washington Department of Ecology, Notice of Construction Approval Order, In the matter of approving a new air contaminant source for SDS Lumber Company, DRAFT Approval Order, No. 23AQ-C264, AQPID No. B0390002

[3] Technical Support Document, Notice of Construction Approval Order No. 23AQ-C264, Bingen, WA, Prepared by Ryan Vincente, Professional Engineer, Washington State Department of Ecology, May 26, 2023, AQPID No. B0390002

[4] Email From: Vicente, Ryan (ECY) <rvic461@ECY.WA.GOV>
Sent: Tuesday, May 30, 2023 5:09 PM
To: Kadlec, Matthew (ECY) <MKAD461@ECY.WA.GOV>
Subject: RE: TSD for draft SDS Lumber Permit

C264) and accompanying TSD on August 4, 2023.[5] Ecology approved the HIA Protocol (item (c)) on October 10, 2022.[6] The reviewing dispersion modeler confirmed that refined modeling (item (d)) was conducted appropriately on January 6, 2023.[7] Ecology Headquarters Office received the HIA (item (e)) on December 15, 2022.[8] The reviewing toxicologist determined the HIA was conducted in accordance with the approved HIA Protocol January 23, 2023, then prepared this Health Impact Assessment Recommendation.

On June 9, 2023, SLR proposed to use an alternative TAP emission rate factor for modeling impacts of the drying of wood from one species. The alternative factor was higher than the one used in their model as submitted to Ecology December 15, 2022. SLR also informed Ecology of SDS Lumber's preference to operate the new kilns at temperatures (180 to 200°F) [9], which is a

[5] From: Vicente, Ryan (ECY) <rvic461@ECY.WA.GOV>
Sent: Friday, August 4, 2023 11:04 AM
To: Kadlec, Matthew (ECY) <MKAD461@ECY.WA.GOV>; Berhane, Tesfamichael (ECY) <tghi461@ECY.WA.GOV>
Cc: Barik, Sanjay (ECY) <SABA461@ECY.WA.GOV>
Subject: RE: SDS Lumber AERMOD Modeling Files

[6] From: Kadlec, Matthew (ECY)
Sent: Monday, October 10, 2022 2:27 PM
To: Matthew Stresing <mstresing@slrconsulting.com>
Cc: Berhane, Tesfamichael (ECY) <tghi461@ECY.WA.GOV>; vernb@sdslumber.com; mike@wkoinc.com; charlie@wkoinc.com; chrisc@sdslumber.com; Sarah Kronholm <skronholm@slrconsulting.com>; Haller, Lynnette A. (ECY) <LHUL461@ECY.WA.GOV>
Subject: RE: SDS Lumber Health Impact Assessment Protocol

[7] From: Matthew Stresing <mstresing@slrconsulting.com>
Sent: Friday, January 6, 2023 1:37 PM
To: Kadlec, Matthew (ECY) <MKAD461@ECY.WA.GOV>
Cc: Berhane, Tesfamichael (ECY) <tghi461@ECY.WA.GOV>; Haller, Lynnette A. (ECY) <LHUL461@ECY.WA.GOV>; Sarah Kronholm <skronholm@slrconsulting.com>; Vicente, Ryan (ECY) <rvic461@ECY.WA.GOV>
Subject: RE: SDS Lumber Model Archive

[8] Ecology assessors received the HIA:
"SDS LUMBER KILN PROJECT Air Dispersion Modeling & Health Impact Assessment Report. Prepared for: SDS Lumber Company, 108.20937.00001, December 2022" within a 126-page document titled: " NEW STUD MILL KILNS PROJECT Notice of Construction (NOC) Application, Prepared for: SDS Lumber Company, Client Ref: 108.20927.00001, December 2022"
attached to email:
From: Sarah Kronholm <skronholm@slrconsulting.com>
Sent: Thursday, December 15, 2022 1:52 PM
To: Haller, Lynnette A. (ECY) <LHUL461@ECY.WA.GOV>
Cc: Berhane, Tesfamichael (ECY) <tghi461@ECY.WA.GOV>; Kadlec, Matthew (ECY) <MKAD461@ECY.WA.GOV>; Charlie@wkoinc.com; VernB@sdslumber.com
Subject: SDS Lumber - NOC Application for New Stud Mill Kilns

[9] From: Sarah Kronholm <skronholm@slrconsulting.com>
Sent: Friday, June 9, 2023 9:27 AM
To: Vicente, Ryan (ECY) <rvic461@ECY.WA.GOV>
Cc: Vernon Buchanan <vernb@sdslumber.com>; Kadlec, Matthew (ECY) <MKAD461@ECY.WA.GOV>; Haller, Lynnette A. (ECY) <LHUL461@ECY.WA.GOV>; Barik, Sanjay (ECY) <SABA461@ECY.WA.GOV>; Mike Engel <mike@wkoinc.com>
Subject: RE: SDS Lumber Company - opportunity for air permit factual review

higher range than the temperature (135°F) stated in the NOC they submitted to Ecology in December 2022.[10]

On August 4, 2023:

- Ecology received model results developed using the increased temperatures and emissions factor.[11]
- the permit writer issued an evaluation of the higher operation temperatures,[12] and approved the applicant's request to operate the new kilns at temperatures up to 200°F.[13]
- the Ecology modeler issued an evaluation of the higher kiln operation temperatures and emissions factor,[14] and a statement that the re-modeled TAP concentrations are all less than those modeled using the originally stated temperature and emissions rate.[15]

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[10] *SLR*. New Stud Mill Kilns Project, Notice of Construction (NOC) Application, Prepared for: SDS Lumber Company, Client Ref: 108.20927.00001, December 2022. Tables 3-1 and 4-1.

[11] From: Matthew Stresing <NAITNotifications@slrconsulting.com>
Sent: Friday, August 04, 2023 9:55 AM
To: Vicente, Ryan (ECY) <rvic461@ECY.WA.GOV>; Kadlec, Matthew (ECY) <MKAD461@ECY.WA.GOV>; Berhane, Tesfamichael (ECY) <tghi461@ECY.WA.GOV>
Cc: skronholm@slrconsulting.com
Subject: SDS Lumber AERMOD Modeling Files

[12] From: Vicente, Ryan (ECY) <rvic461@ECY.WA.GOV>
Sent: Friday, August 4, 2023 11:04 AM
To: Kadlec, Matthew (ECY) <MKAD461@ECY.WA.GOV>; Berhane, Tesfamichael (ECY) <tghi461@ECY.WA.GOV>
Cc: Barik, Sanjay (ECY) <SABA461@ECY.WA.GOV>
Subject: RE: SDS Lumber AERMOD Modeling Files

[13] From: Vicente, Ryan (ECY) <rvic461@ECY.WA.GOV>
Sent: Friday, August 4, 2023 5:47 PM
To: Sarah Kronholm <skronholm@slrconsulting.com>
Cc: Matthew Stresing <mstresing@slrconsulting.com>; Vernon Buchanan <vernb@sdslumber.com>; Berhane, Tesfamichael (ECY) <tghi461@ECY.WA.GOV>; Kadlec, Matthew (ECY) <MKAD461@ECY.WA.GOV>; Hanlon-Meyer, Christopher (ECY) <chrh461@ECY.WA.GOV>; Barik, Sanjay (ECY) <SABA461@ECY.WA.GOV>; Belsher, Jacob (ECY) <BELJ461@ECY.WA.GOV>
Subject: RE: SDS Lumber AERMOD Modeling Files

[14] From: Berhane, Tesfamichael (ECY) <tghi461@ECY.WA.GOV>
Sent: August 4, 2023 15:44
To: Kadlec, Matthew (ECY) <MKAD461@ECY.WA.GOV>; Vicente, Ryan (ECY) <rvic461@ECY.WA.GOV>
Cc: Barik, Sanjay (ECY) <SABA461@ECY.WA.GOV>; Hanlon-Meyer, Christopher (ECY) <chrh461@ECY.WA.GOV>
Subject: RE: SDS Lumber AERMOD Modeling Files

[15] From: Berhane, Tesfamichael (ECY) <tghi461@ECY.WA.GOV>
Sent: Friday, August 4, 2023 4:14 PM
To: Kadlec, Matthew (ECY) <MKAD461@ECY.WA.GOV>
Subject: RE: SDS Lumber AERMOD Modeling Files

Second Tier review approval criteria

As specified in Ch. 173-460-090(7) WAC, Ecology may recommend approval of a project that is likely to cause an exceedance of ASILs for one or more TAPs only if it:

(a) Determines that the emission controls for the new and modified emission units represent tBACT.

(b) The applicant demonstrates that the increase in emissions of TAPs is not likely to result in an increased cancer risk of more than one in one hundred thousand.

(c) Ecology determines that the non-cancer hazard is acceptable.

tBACT determination

Ecology's permit engineer determined that the proposed drying kiln emissions controls meet BACT and tBACT requirements.[16]

Health Impact Assessment Review

Chapter 173-460-090 WAC requires permit applicants to prepare a HIA. Then an Ecology engineer, toxicologist, and modeler review it to determine if the methods and assumptions are appropriate for assessing and quantifying risks to the surrounding community from a new project.

Table 1 provides an emissions summary and comparison to the Ch. 173-460-150 WAC *de minimis* and small quantity emission rates (SQERs). acetaldehyde, acrolein, formaldehyde, methanol, and propionaldehyde from the proposed kilns exceed their *de minimis* emission rates, therefore a tBACT analysis was conducted.

Based on the tBACT accepted by Ecology, the emission rates were quantified then compared to their Small Quantity Emission Rates (SQER) values. Acetaldehyde, acrolein and formaldehyde emissions are greater than their respective SQER, therefore air dispersion modeling was used to determine what their ambient air concentrations would be, then compare those to their ASILs.

[16] Technical Support Document, Notice of Construction Approval Order No. 23AQ-C264, Bingen, WA, Prepared by Ryan Vincente, Professional Engineer, Washington State Department of Ecology, May 26, 2023

Table 1. New Stud Mill Kilns TAP emissions estimates, and *de minimis* and SQER screenings

TAP	Chemical Abstract Service number (CAS)	Averaging Period	Emissions Estimate (lbs./avg. period)	De Minimis (lb./avg. period)	Exceeds De Minimis	SQER (lb./avg. period)	Exceeds SQER
Acetaldehyde	75-07-0	year	1679.80	3.00	Yes	60.00	Yes
Acrolein	107-02-8	24-hour	0.10	0.0013	Yes	0.026	Yes
Formaldehyde	50-00-0	year	94.72	1.40	Yes	27.00	Yes
Methanol	67-56-1	24-hour	8.59	74.00	No	1500	No
Propionaldehyde	123-38-6	24-hour	0.10	0.03	Yes	0.59	No

The maximum likely concentrations estimated by air dispersion modeling as submitted to Ecology at first. This suggested long term average concentrations of acetaldehyde could exceed its ASIL (Table 2), which triggered a Second Tier Analysis Health Impact Assessment to assess potential health hazards and limit public health risks as required under Ch. 173-460-090 WAC. The increased kiln operations temperature (approved August 4, 2023) together with higher than initially modeled TAP emissions rates resulted in the TAP concentrations all being slightly lower than those listed in Table 2.

Table 2. Modeled new kilns TAP concentrations and ASILs screening

TAP	WAC 173- 460-150 ASIL (µg/m^3)	WAC 173- 460-150 Averaging Period	Maximum Ambient Concentration (µg/m^3 per avg. period)	Exceeds ASIL
Acetaldehyde	0.37	year	1.09 [17]	Yes
Acrolein	0.35	24-hour	0.14	No
Formaldehyde	0.17	year	0.06	No

Health Effects Summaries

The HIA prepared by SLR for this project quantifies the non-cancer hazards and increased cancer risks attributable to acetaldehyde emissions from the proposed new drying kilns.

[17] In the HIA, the maximum ambient acetaldehyde concentration is stated to be 1.09-µg/m^3 in Table 3-3 First Tier Toxics Analysis Model Results, but 1.05-µg/m^3 in Figure 5-1 Heat Map Plot of Period Model Concentrations of Acetaldehyde.

Acetaldehyde Health Effects Summary

Depending on exposure levels, acetaldehyde can adversely affect the nose and throat (nasopharynx), the eyes, and the entire respiratory tract, including the bronchi.

Acetaldehyde exposure may cause nasal and laryngeal cancer. There is currently insufficient human data regarding the carcinogenic effects of acetaldehyde, however inhalation studies have shown an increased rate of nasal tumors in rats and laryngeal tumors in hamsters involving a hyperplasia mechanism. EPA has classified it as a Group B2, probable human carcinogen.

Acute noncancer effects of acetaldehyde may include irritation of eyes (redness and swelling), and irritation of the skin and respiratory tract (bronchoconstriction; degenerative, inflammatory and hyperplastic changes of the nasal mucosa). People with asthma may experience a decrease in lung function due to bronchoconstriction when exposed.

There is little information regarding health outcomes in humans related to long-term exposure to acetaldehyde. In animals, chronic inhalation has produced changes in the mucus membranes of the nose and trachea, and degeneration of the cells responsible for smell (the olfactory epithelium), as well as growth retardation, slight anemia, increased kidney weight. EPA derived a reference concentration for it based on degeneration of the olfactory epithelium in rats.

Only those co-emitted TAPs that exceeded their SQERs and that can cause effects like those potentially caused by acetaldehyde are carried forward in this HIA review. They are acrolein and formaldehyde, which may also affect the eyes, nasopharynx, and bronchi.

Acrolein Health Effects Summary

Acrolein is an irritant to skin and mucous membranes. Its effects typically occur at the points of exposure, i.e., nasal passages, eyes, and upper respiratory tract. Short-term exposure to acrolein can cause eye and nasal irritation at concentrations in air less than 1-part per million (ppm) (2.3-mg/m^3). Higher concentrations may also irritate the entire respiratory tract.

There are no available studies of humans exposed to acrolein over long periods. Longer-term studies in laboratory animals at higher concentrations have demonstrated severe nasal lesions as well as pronounced adverse effects on lung function leading to lethality. Thus, the hazard index targets are the eye and entire respiratory tract. Studies have indicated rats are the most sensitive species.

The International Agency for Research on Cancer (IARC) has classified acrolein as probably carcinogenic to humans (Group 2A) based on sufficient evidence of carcinogenicity in experimental animals and strong mechanistic evidence.[18] However, carcinogenicity of acrolein has not been quantified by USEPA or the California EPA California Office of Environmental

[18] IARC Monographs Volume 128 Working Group (2020). Carcinogenicity of acrolein, crotonaldehyde, and arecoline. Lancet Oncol, Published online 26 November 2020; https://doi.org/10.1016/S1470-2045(20)30727-0

Health Hazard Assessment (OEHHA) because the existing data are inadequate for an assessment of human carcinogenic potential.

Formaldehyde Health Effects Summary

Formaldehyde is an irritant to mucous membranes of eyes, nose, and throat. It can cause induce nasopharyngeal and respiratory tract cancer, and possibly brain cancer and leukemia. Non-cane effects may include inflammation, epithelial degeneration, respiratory epithelial hypertrophy, and squamous metaplasia. Prolonged or repeated exposures are associated with allergic sensitization, cough, wheeze, dyspnea, histopathological changes in respiratory epithelium, and decrements in lung function. Chronic exposure in children, especially those with asthma, is more likely to induce symptoms and impair pulmonary functioning than in adults. Thus, the hazard index targets are the nasopharynx and respiratory tract.

Toxicity risk-based reference values

Agencies develop toxicity values for evaluating exposures and characterizing risks from chemicals in the environment. In cases where USEPA and OEHHA risk-based concentrations are unequal, we evaluate risks separately with both values.

Table 3. Risk-based concentrations of the TAPs

Toxic Air Pollutant	CAS	IRIS: Cancer Unit Risk (per µg/m^3)	IRIS: Chronic Reference Concentration (RfC) (µg/m^3)	OEHHA: Cancer Unit Risk (per µg/m^3)	OEHHA: Reference exposure level (REL) (µg/m^3)
Acetaldehyde	75-07-0	2.2 E-6	9	2.7 E-6	Acute: 470; Chronic: 140
Acrolein	107-02-8	-	0.02	-	Acute: 2.5; Chronic: 0.35
Formaldehyde	50-00-0	1.3 E-5	-	6.0 E-6	Acute: 55; Chronic: 9

Community Receptors

SLR assessed health risks given concentrations of TAPs emitted from proposed kilns at the places the highest exposures could occur in various duration scenarios:

- Maximally exposed individual worker (MEIW) or other person, a location where the highest concentration of acetaldehyde could occur in ambient air just outside the SDS fence line
- Maximally exposed individual residential (MEIR) land use zone adjacent to SDS property, and

- Sensitive receptor locations are places where children or elderly people or people with respiratory illnesses are likely to concentrate such as daycares, preschools, K-12 schools, convalescent homes, and hospitals. The maximally exposed sensitive receptor (MESR) is Skyline Hospital in Bingen

SLR "normalized" emissions evenly among the 27 kiln vents. The emission point appears as close as 170-meters from some offsite commercial buildings and as close as 400-meters from some residential buildings. TAP concentration gradients change greatly over distances in these ranges.

SLR presented the following "heat map" of the 1-hour time-weighted maximum concentrations over the 5-year modeling period in Figure 2. Subsequent modeling at higher temperatures and different emissions rates indicated the TAP concentrations will be lower than those in the Figures 2 and 3.

Figure 5-2 Heat Map Plot of 1-hour Model Concentrations of Acetaldehyde

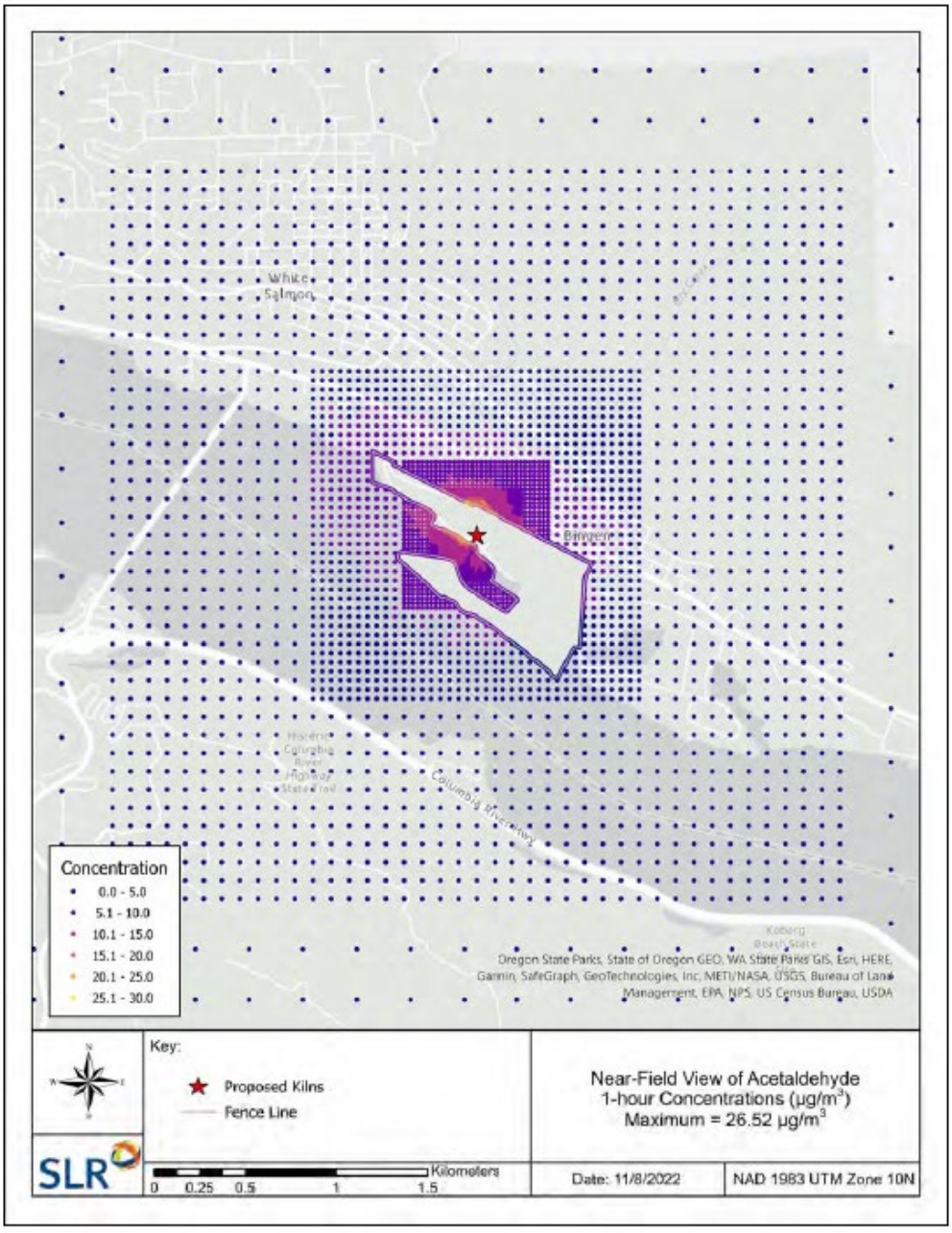

Figure 2. Map of 1-hour time-weighted average concentrations over the 5-year period

(Source: HIA Figure 5-2 Heat Map Plot of 1-hour Model Concentrations of Acetaldehyde)

SLR presented a map of the modeled 5-year average acetaldehyde concentration gradient in Figure 2.

Figure 5-1 Heat Map Plot of Period Model Concentrations of Acetaldehyde

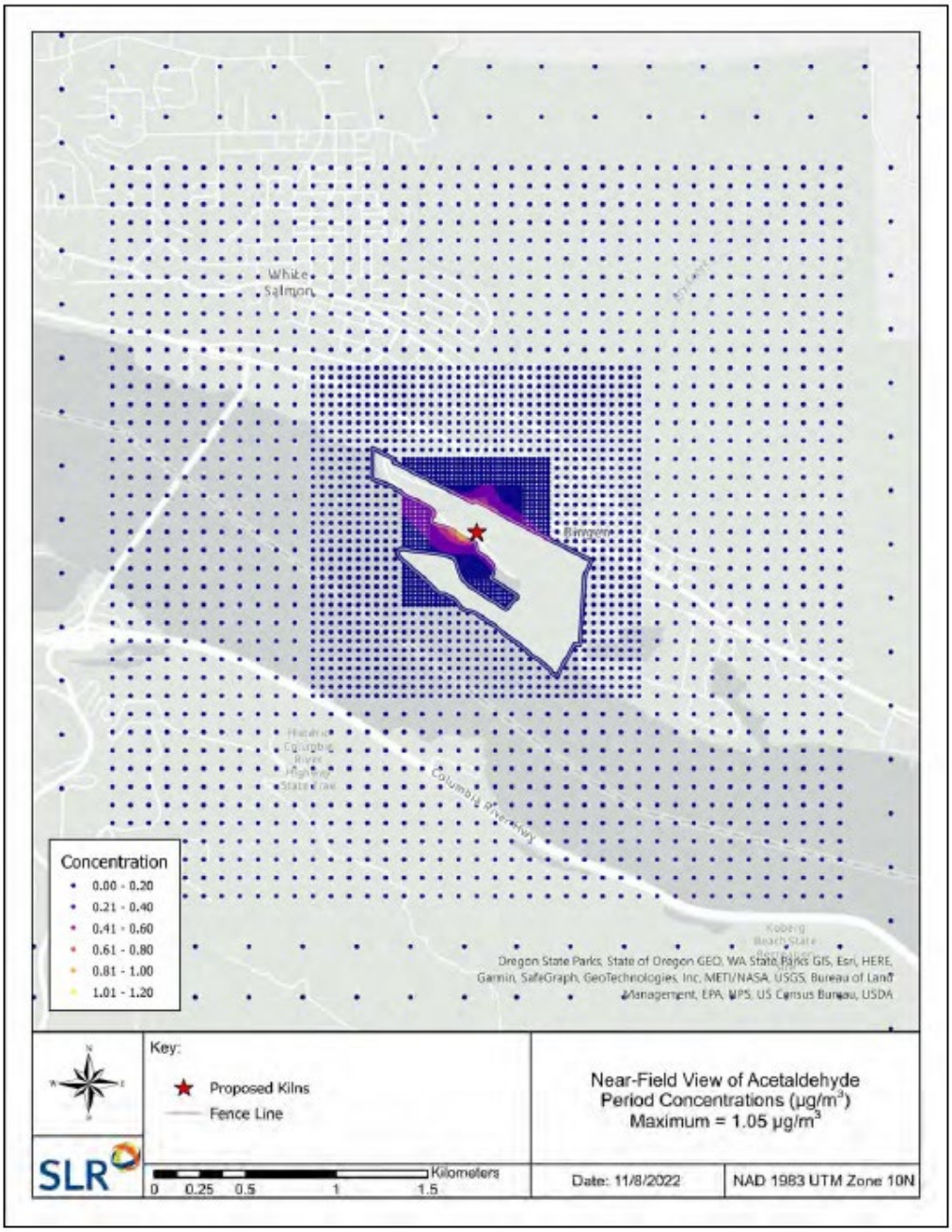

Figure 3. Map of the 5-year time-weighted average acetaldehyde concentrations

(Source: HIA Figure 5-1 Heat Map Plot of Period Model Concentrations of Acetaldehyde)

Health Risks

Increased risks of cancer

SLR calculated additional cancer risk posed by the new kilns' acetaldehyde emissions at the MEIR, MEIW, and MESR locations. Then presented maps of these cancer risks.

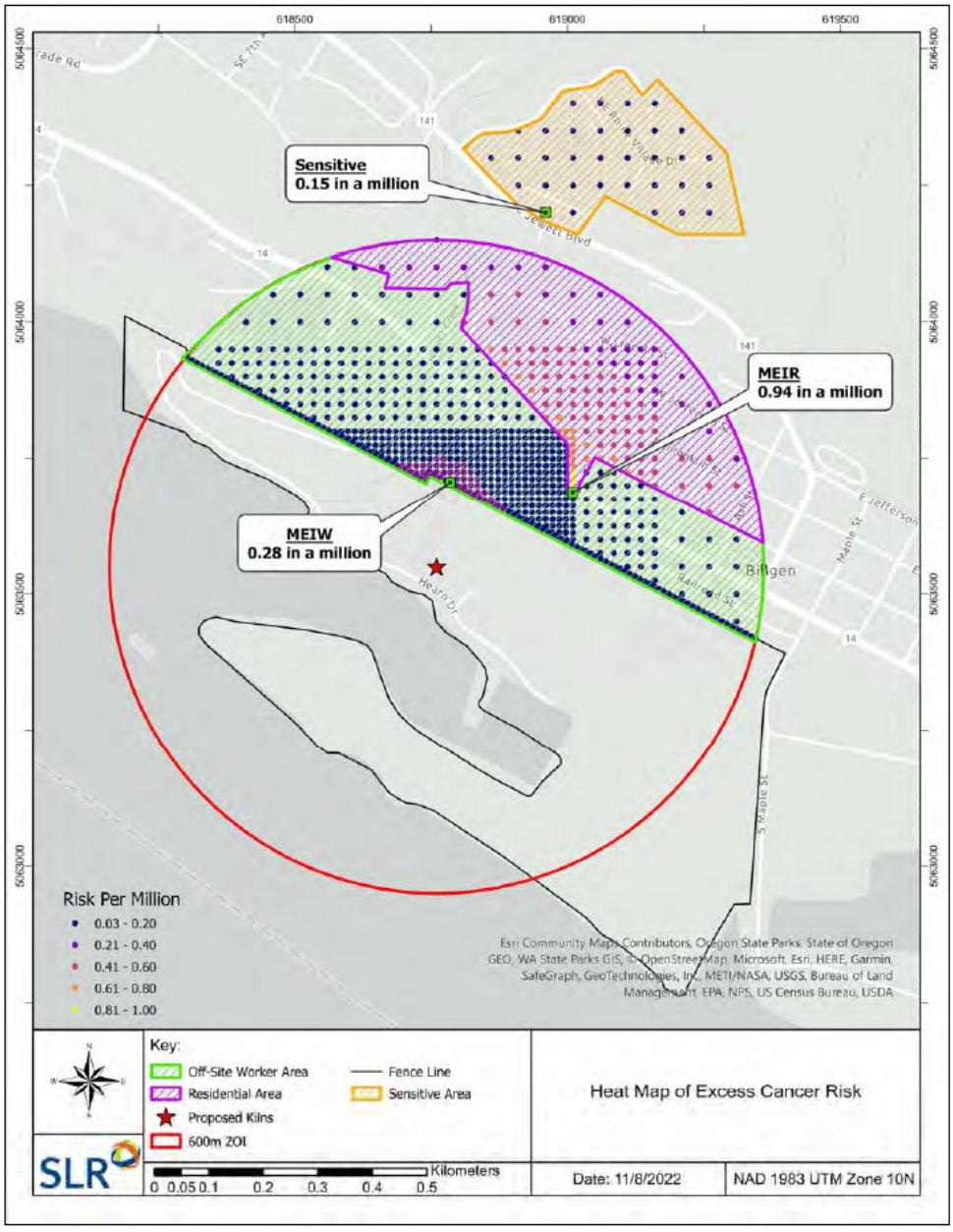

Figure 4. Cancer risk increases from added acetaldehyde exposures near SDS

(Source: HIA Figure 5-5 Heat Map of Excess Cancer Risk)

SLR estiamted additional lifetime cancer risk at the MEIR from the new kilns emissions based on modeled exposure to acetaldehyde as for a residence: extended over a 30-year exposure duration. They estimated cancer risk at the MEIR to be 0.94 per million. The location of the MEIR is predicted to occur 285-m to the northeast of the proposed kilns. It is a point in a parking lot at the south end of Daubenspeck Park.

Taking together the acectaldhyde and formaldhyde emissions from the two proposed kilns,[19] Ecology estimated the cumulative cancer risks that would be posed to long-term residents of a house at the MEIR if one was there. The increased in risk would be less than or equal to 1.06 per million. Subsequent modeling at higher temperatures and with different emissions rates indicated the TAP concentrations will be lower, therefore the cancer risk will be lower.

The MEIW is predicted to occur 158-m to the north-northeast of the proposed kilns by the SDS fence line. SLR calculated additional cancer risk posed by acectaldhyde there based on modeled exposure over a 25-year exposure duration. SDS operates continously (24-hours per day, 7-days per week) so SLR did not apply a worker exposure adjustment factor to account for non-continuous exposure. However, it is unlikely anyone will be at that location continuously so the cancer risk they calculated, 0.28 per million, is an overestimate. Subsequent modeling at higher temperatures and with different emissions rates indicated the TAP concentrations will be lower, therefore the actual cancer risk will be lower than those presented throughout the following text.

Taking together the acectaldhyde and formaldhyde emissions from the proposed kilns, Ecology estimated the cumulative cancer risks to be less than 1.58 per million at the MEIW.

SLR estimated additional cancer risks posed by the new acetaldehyde emissions to be less than or equal to 0.15 per million at the MESR, Skyline Hospital, based on modeled exposure over a 30-year period.

Taking together the new acectaldhyde and formaldhyde emissions, Ecology estimated the cumulative cancer risks to be less than or equal to 0.837 per million at the MESR.

For perspective, Ecology estimated the existing background cumulative cancer risks using USEPA's estimates of acetaldehyde and formaldehyde concentrations in 2019 (the most recent

[19] Based on relative emissions noted in Table 2. and Table 3 of the NOC, and Figure 5-2 and Table 3-3 of the HIA.

year available) in the 2010 US Census tract where Bingen is.[20] The maximum esidting background cancer risk was 12.6 per million.

Increased non-cancer hazards

Ecology assessed acute exposure health risks at the MEIW where the highest concentration of the three TAPs could occur in publicly-accessible outdoor areas along the SDS fence line.

Citing Ruth (1986), the National Research Council reported that acetaldehyde has an odor threshold concentration ranging from 0.0001- to 2.3-ppm, and that it is irritating at a concentration of 50-ppm.21 In contrast, USEPA, and Amoore and Hautala stated its odor threshold is 0.05-ppm.22 Acetaldehyde has a pungent, fruity odor.23 The modeled 1-hour time-weighted maximum fenceline concentration is estimated to be 26.52-µg/m3 so some people may be able to smell it depending on which odor threshold estimate is correct (0.0001-ppm = 1.90E-01--µg/m3 vs. 0.09 ppm = 1.71E+02-µg/m3). The maximum 1-hour time-weighted average acetaldehyde concentration will be less than the irritation threshold (50 ppm or 9480-µg/m3 at 10°C and standard pressure). Given the emission rates of acrolein and formaldehyde relative to acetaldehyde, their 1-hour time-weighted average maximum concentrations are likely to be 0.63-µg/m3 and 1.58-µg/m3, respectively. Applying the Acute RELs noted in Table 3 to derive hazard quotients for each, then summing them to get the hazard index yields 0.338. Because this the hazard index is less than one, the new emissions are unlikely to induce adverse effects on the eyes or respiratory tracts of people off-site.

Increased non-cancer health hazards attributable to the facility and existing sources

Using the OEHHA Derived Method risk analysis option, SLR calculated the 8-hour time-weighted average exposure and long-term Chronic exposure health hazard quotients at the MEIR, MEIW, and MESR locations that could result from acetaldehyde from the new kilns, then mapped the results (figure 4).24

Subsequent modeling at higher temperatures and different emissions rates indicated the TAP concentrations will be lower, therefore the actual non-cancer hazards will be lower than those stated throughout the following text.

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[20] The EPA AirToxScreen website provides estimated ambient concentrations for acetaldehyde, acrolein, formaldehyde, etc. https://www.epa.gov/AirToxScreen/2019-airtoxscreen-assessment-results#pollutant -- accessed 23 Jan 2023.

[21] Ruth. 1986. Odor thresholds and irritation levels of several chemical substances: A review. *Am. Ind. Hyg. Assoc. J.* 47(3): A142-A151; US National Research Council Committee on Emergency and Continuous Exposure Guidance Levels for Selected Submarine Contaminants. Washington, DC: National Academies Press, 2009.

[22] EPA/600/8-86-015a 1987; Amoore and Hautala. 1983. *J App. Tox.*

[23] HSDB, 2005

[24] Figures in the HIA: Figure 5-5 Heat Map of Excess Cancer Risk; Figure 5-6 Heat Map of Noncancer Chronic Hazard Quotients; and Figure 5-7 Heat Map of Noncancer 8-hour Chronic Hazard Quotients

Figure 5-6 Heat Map of Noncancer Chronic Hazard Quotients

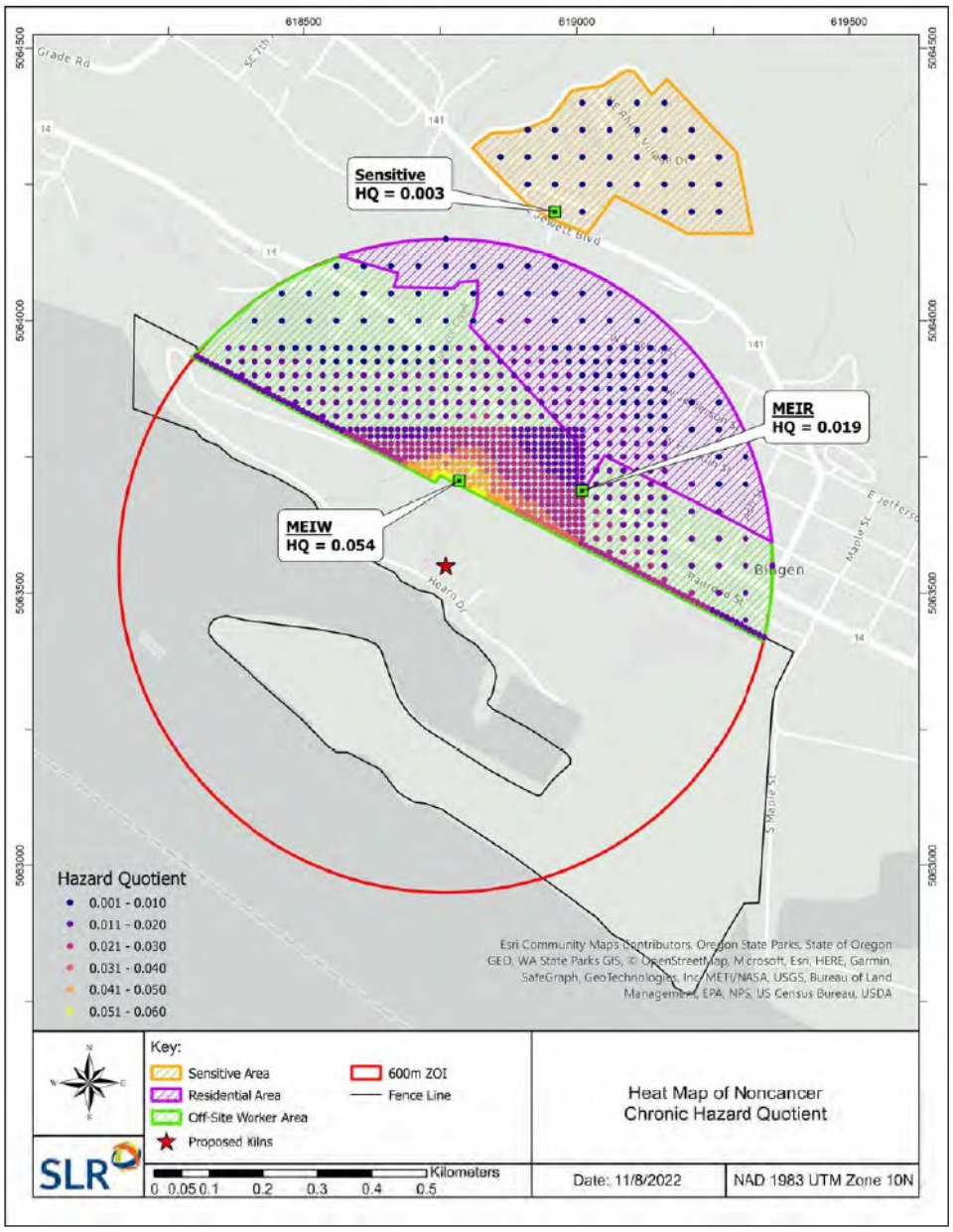

Figure 5. Chronic long term acetaldehyde exposure non-cancer hazard quotients near SDS

(Source: HIA Figure 5-6 Heat Map of Noncancer Chronic Hazard Quotients)

Ecology estimated the cumulative chronic non-cancer hazard index of the three TAPs to be approximately 0.117 or less at the MEIR; 0.409 or less at the MEIW, and 0.216 or less at the MESR.

For perspective, Ecology estimated the existing background cumulative non-cancer hazards in the 2010 US Census tract where Bingen is using estimates of acetaldehyde, acrolein, and

formaldehyde concentrations in 2019 (the most recent year available) published by the USEPA.[25] The maximum noncancer hazard index was slightly less than 1.01.

SLR estimated the chronic non-cancer hazard to people exposed for 8-hour intervals (the typical occupational exposure scenario) from the new kilns' acetaldehyde emissions. The results are in figure 5.

Figure 5-7 Heat Map of Noncancer 8-hour Chronic Hazard Quotients

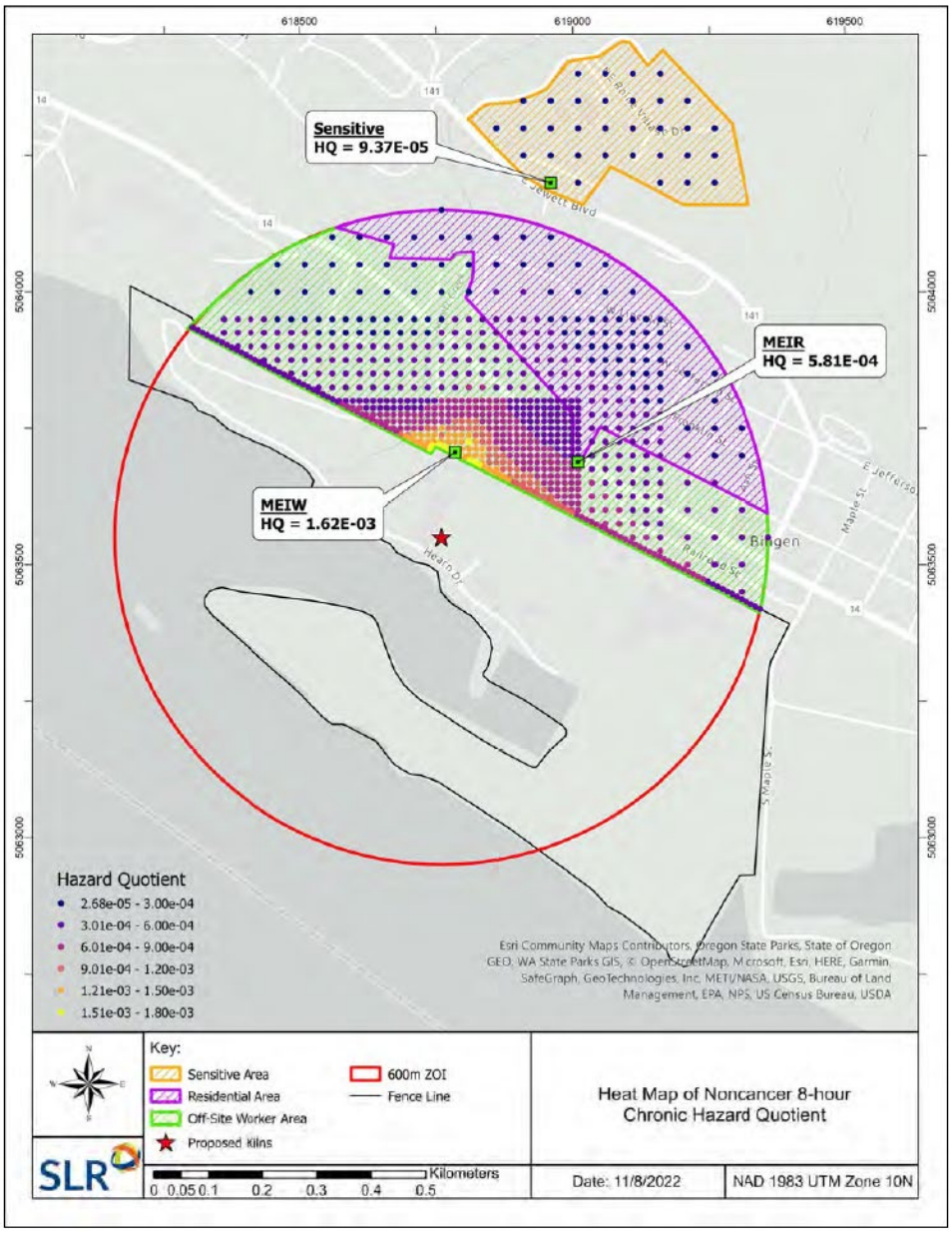

Figure 6. Chronic 8-hour acetaldehyde exposure non-cancer hazard quotients near SDS

(Source: HIA Figure 5-7 Heat Map of Noncancer 8-hour Chronic Hazard Quotients)

[25] https://www.epa.gov/AirToxScreen/2019-airtoxscreen-assessment-results#pollutant -- accessed 23 Jan 2023.

SLR estimated the acute non-cancer hazard to people exposed for 1-hour intervals (the typical occupational exposure scenario) from the new kilns' acetaldehyde emissions. The results are in figure 6.

Figure 5-8 Heat Map of Acute Hazard Quotients

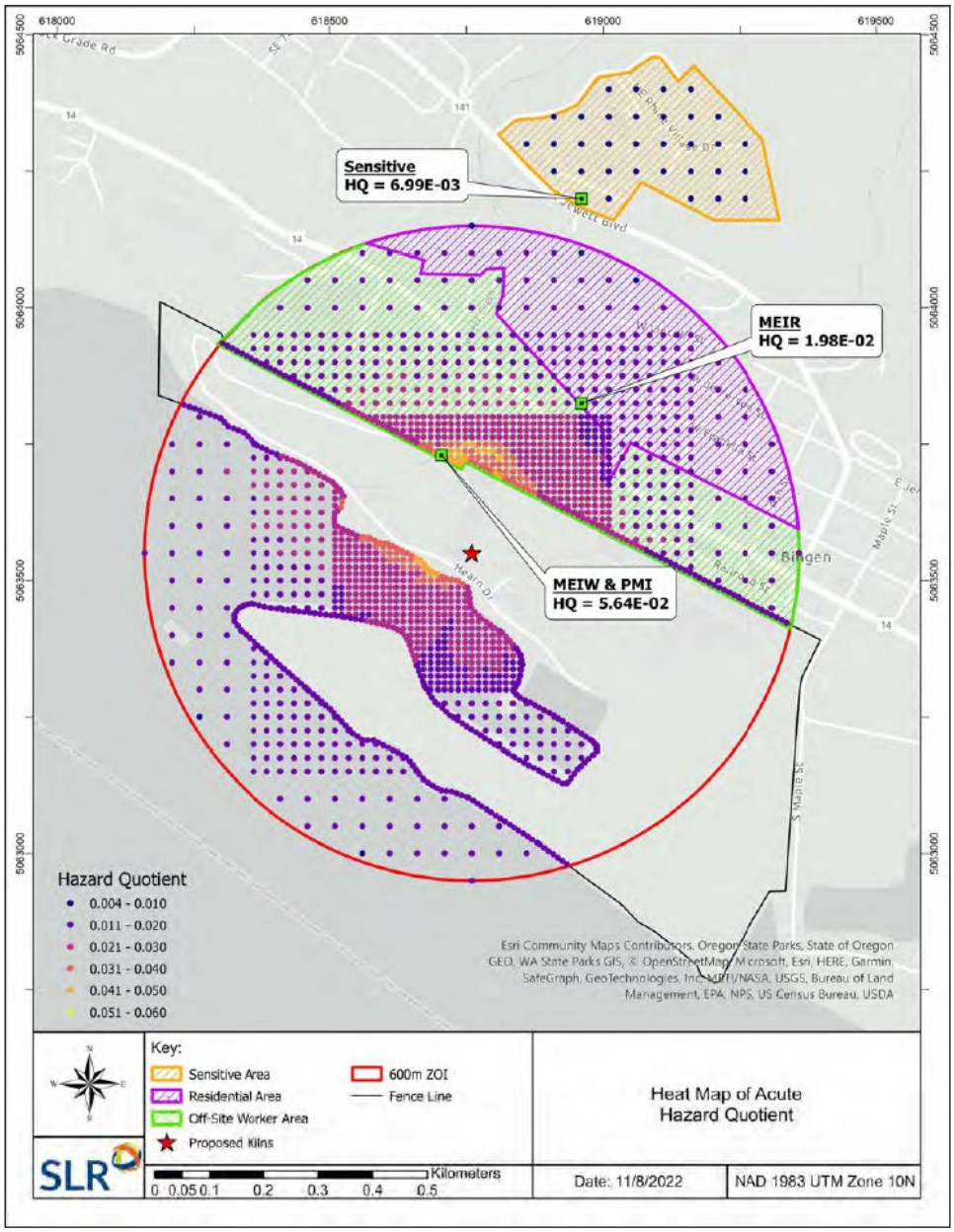

Figure 7.Acute 1-hour acetaldehyde exposure non-cancer hazard quotients near SDS

(Source: HIA Figure 5-8 Heat Map of Acute Hazard Quotients)

Ecology estimated the cumulative acute non-cancer hazard index of acetaldehyde, acrolein, and formaldehyde to be no more than 0.338 at the outdoor maximal exposure point along the SDS fence line.

Uncertainty

Uncertainty may be defined as imperfect knowledge concerning the present and future conditions of a system. In risk assessments undertaken in support of regulatory decisions, there are many uncertainties. Careful consideration of them allows us to assess the dependability of risk decisions.

Evaluating potential impacts of the new stud mill kilns to be installed at SDS involves elements including pollutant emissions rates, air dispersion modeling, and resulting ambient concentrations and exposures, as well as exposure-response relationships. Each of these elements is encumbered by uncertain science and measurement variability that prevents absolute confidence in predictions about the new source's adverse health impacts. Quantitative assessments of the effects of the impacts on human health cannot be made with greater confidence. The uncertainties are summarized in Table 9.

Table 4. Qualitative summary of how uncertainties affect the estimated risks and hazards

Source of Uncertainty	Effects on estimated risks and hazards
Emissions estimates	Likely to overestimate risks initially but to underestimate risk in coming decades
Concentration modeling	Possible underestimate of long-term risks and possible overestimate of acute risks
Exposure assumptions	Likely to slightly overestimate risks
Toxicity of emissions	Possible overestimate of cancer risk, and possible underestimate of non-cancer hazards for extremely sensitive people

Emissions uncertainty

Emissions uncertainty includes measurement uncertainty and process variability. The emissions factors used to estimate emission rates from the proposed new kilns are estimates of central tendency of measured emissions from comparable kilns. The modeling analysis and the emissions used in the modeling both assume constant and consistent operation of the proposed kilns throughout the 5-year meteorological data period. This is a conservative assumption in that the emissions will vary throughout the period and the kilns will not operate constantly due to the need to shut down for maintenance and repairs. The dispersion modeling also assumes that that the maximum emissions from the proposed kilns occur simultaneously with the worst-case meteorological conditions and could potentially result in elevated exposure concentrations.

Concentration modeling uncertainty

TAP concentration modeling uncertainty results from uncertainties about future meteorological conditions, and the measurement variability and applicability of past meteorological conditions of the air data used for the current analyses. Additionally, TAP concentrations uncertainty arises from uncertainty in the precision and accuracy of the air quality dispersion model used: The

American Meteorological Society/USEPA Regulatory Model (AERMOD) and its pre- and post-processors. The models are frequently updated as techniques that are more accurate become known but are written to avoid underestimating the modeled impacts. Even if all the input parameters to an air dispersion model were known precisely, random fluctuations in the atmosphere would continue to induce some uncertainty.

AERMOD tends to over predict in low wind conditions for some source types. It may slightly overestimate high end 1-hour average impacts and somewhat underestimate the annual concentrations, as is typical of other steady-state Gaussian dispersion models.

Natural variation in meteorological conditions year-to-year will also affect the concentrations of the emitted TAPs. Given this natural variation, a 30-year average concentration estimate, as would be ideal for cancer risk assessment, would be of uncertain reliability. To minimize the chance of under estimating cancer risk, SLR evaluated the highest concentration impact year among the five modeled years: 2015 to 2019.

Exposure uncertainty

Exposure uncertainty results from potential inaccuracies of assumptions about the time people will spend in various locations. The one location that could be affected by the SDS emissions at toxicologically relevant concentrations is the MEIW. SLR evaluated an extremely high exposure scenario for people entering this location. This ensured that uncertainty and variability are accounted for as much as possible and that maximal exposures are not underestimated, but it is likely to have overestimated the extent of exposures that will actually occur.

Toxicity uncertainty

Toxicity uncertainty results from potential inaccuracies in the toxicity reference values used in a risk assessment. Toxicity reference values are based on inherently variable experimental toxicology and observational epidemiological studies. Further, the methods and sources USEPA and OEHHA used to develop the cancer unit risk values and the RfCs and RELs differ. SLR dealt with these differences adequately by carrying all these values through the risk characterization.

To avoid underestimating the true cancer potency of acetaldehyde and formaldehyde, USEPA and OEHHA based the cancer unit risk values on the upper statistical confidence limits of tumor response data. In this way, they attempted to ensure that uncertainty and variability were addressed to avoid underestimating actual risks. Thus, the cancer risks quantified in this technical analysis are theoretical estimates of the highest possible risks.[26]

Although IARC has classified acrolein as probably carcinogenic to humans (Group 2A) neither the USEPA nor OEHHA have established a unit risk value for quantifying its carcinogenic potency.

[26] A URF is the upper-bound of a confidence interval around, most typically, a mean of expected carcinogenic response at a given concentration. The 95 percent confidence interval for a mean is the range of values that will contain the true population mean 95 percent of the time.

Conclusions and Recommendation

The project review team has reviewed the HIA and determined that:

(a) The TAP emissions estimates presented by SDS for this project are reasonable estimates of the new kilns' emissions.

Emission controls for the new emission unit meets the tBACT requirement.

(b) The ambient impact of the emissions increase of the TAP that exceeds its ASIL has been quantified using appropriate refined air dispersion modeling techniques.

(c) The HIA submitted by SDS adequately assesses project-related increased health risks attributable to TAP emissions.

In the HIA, SLR estimated lifetime increased cancer risks attributable to acetaldehyde emissions from the proposed new stud mill kilns. The emissions resulted in a worst-case increase cancer risk of less than about 0.94 per million. They defined this exposure scenario as the maximum exposed individual resident (MEIR) predicted to occur 285-m northeast of the proposed kilns at the south end of Daubenspeck Park – a parking lot – but assuming a continuous 30-year exposure there. The actual risk will be lower given the subsequent revisions noted previously.

Ecology assessed the cancer risk of the new kilns by adding estimated concentrations of formaldehyde that will be emitted from them to their modeled acetaldehyde concentrations. The cumulative cancer risk is 1.2 per million. The actual risk will be lower given the subsequent revisions noted. We also estimated the pre-existing cancer risk from estimated background concentrations of acetaldehyde and formaldehyde in 2019. The existing background cancer risk was 12.6 per million.

SLR also assessed chronic and acute non-cancer health hazards from the proposed kilns acetaldehyde emissions. Neither acute nor long-term adverse effects are likely to occur from exposure to acetaldehyde from them. Ecology also assessed the non-cancer hazards of the new emissions by adding estimated concentrations of the two other emitted carbonyls (formaldehyde and acrolein) to the modeled acetaldehyde concentrations. We also estimated the pre-existing non-cancer hazards in the Bingen area from estimated background concentrations of acetaldehyde, acrolein and formaldehyde in 2019. The existing background non-cancer hazard index was 1.009 suggesting a slight chance some residents are experiencing associated effects on their eyes or respiratory tracts. This is the case throughout most of the state due to residential wood-burning and wildfires.

In summary, the hazards index results for acute-, long-term residential-, and chronic 8-hour work shift exposures are all less than 0.5 indicating hazards are acceptable. To the extent people may be exposed to TAP emissions from the proposed kilns, and despite the uncertainties in estimates of concentrations, exposures, cancer potencies, and non-cancer hazards, the project review team concludes that the HIA represents an appropriate estimate of the potential increased health risks.

The risk manager may recommend approval of the permit because:

- The cancer risk from toxic air pollutant emissions is less than the maximum risk (10 in one million) allowed by under Ch. 173-460 WAC, and
- Long-term non-cancer hazards are very low, and short-term non-cancer hazards are unlikely.

Acronyms

AERMOD	American Meteorological Society/USEPA Regulatory Model
ASIL	Acceptable source impact level
BF	Board feet
CAS	Chemical Abstract Service number
Ecology	Washington Dept. of Ecology Air Quality Program
HIA	Health Impact Assessment
lbs./avg. period	pounds per time period
m	meter
MEIR	Maximally exposed individual residence
MEIW	Maximally exposed individual worker
MESR	Maximally exposed sensitive receptor
mg	milligram
NOC	Notice of Construction
NW	Northwest
OEHHA	California Office of Environmental Health Hazard Assessment
ppm	parts per million
REL	Reference exposure level
RfC	Reference Concentration
SLR	SLR International Corporation
SQER	Small quantity emission rate
TAP	toxic air pollutant
tBACT	Best Available Control Technology for toxics
USEPA	United States Environmental Protection Agency
WAC	Washington Administrative Code
µg/m^3	microgram per cubic meter