Fiscal Note and Addendum to Fiscal Note to Include Additional Options for the Control of Emissions from Log Fumigation Operations

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Rule Topic:	Control of Emissions from Log Fumigation Operations
DEQ Division:	Division of Air Quality
Agency Contact:	Patrick Knowlson, Rule Development Branch Supervisor Division of Air Quality (DAQ) (919) 707-8711 patrick.knowlson@ncdenr.gov
Analyst:	Bradley Nelson, DAQ (919) 707-8705 bradley.nelson@ncdenr.gov Rahatul Ashique, DAQ (919) 707-8701 rahatul.ashique@ncdenr.gov
Impact Summary:	State government: Yes Local government: No Substantial impact: Yes Private Sector: Yes
Authority:	G.S. 143-215.3(a)(1); 143-215.65; 143-215.66
Necessity:	To permanently adopt a rule for Control of Emissions from Log Fumigation Operations.

I. Executive Summary

The purpose of this document is to provide an analysis detailing the fiscal impacts associated with the proposed adoption of 15A NCAC 02D .0546, Control of Emissions from Log Fumigation Operations, and the amendment of 15A NCAC 02D .1104 to add methyl bromide to the list of North Carolina toxic air pollutants (TAP). This proposed rule was developed to address hazardous air pollutants (HAP) and North Carolina TAP emitted from the log fumigation process. The fumigants used in this process have chronic (long-term) and acute (short-term) effects on human health.

II. Background

Before logs can be shipped overseas for sale, they must either be treated with a pesticide to kill insects and other pests or have the bark removed. This prevents insects and other pests that may be indigenous to the U.S. from being transported to other countries. In the case of pesticide treatment, logging exporters in North Carolina subcontract this task to companies that specialize in the fumigation of logs for shipment overseas. In North Carolina, there is currently only one company that is performing log fumigation for all of the log exporters. This company is also listed as the permit facility for three of the five existing permits for log fumigation. Debarking is another option that can be used to prepare logs for shipment overseas and is typically done by the logging company. The debarking option does not require a North Carolina air quality permit, but is still subject to air quality rules.

The log fumigation process uses chemicals as pesticides to kill insects and other pests from logs before they are exported to other countries. Methyl bromide or bromomethane (CH_3Br or MeBr) is the most widely used pesticide for log fumigation, and is the required fumigant by many countries that import logs from North Carolina. Phosphine and sulfuryl fluoride are also used as fumigants. Methyl bromide is classified as a HAP and the DAQ is currently requesting to add this pollutant to the list of TAP. Phosphine is classified as a HAP and TAP, however sulfuryl fluoride is classified as neither. Methyl bromide is a highly toxic halogenated hydrocarbon and human exposure to high concentrations of this compound, both acute (short-term) and chronic (long-term), can cause central nervous system and respiratory system failures and may harm the lungs, eyes, and skin.[1] Other characteristics of methyl bromide exposures of relevance to protecting the general public from fumigation operation releases includes the rapid adsorption and distribution to sensitive target organs following inhalation exposures, the steep inhalation exposure-effect curve, the potential for large segments of the human population to have increased sensitivity to neurotoxic effects, and the potential for delayed onset of adverse effects following exposures. The U.S. signed on to the Montreal Protocol which banned the use of substances that deplete the ozone layer. Accordingly, the Environmental Protection Agency (EPA) phased out the use of methyl bromide with the following exemptions; critical use exemption (CUE), quarantine and pre-shipment exemption (QPS), or emergency exemption[2]. Log fumigation operations are considered a quarantine and pre-shipment exemption.

The process of log fumigation consists of exposing the logs to a specified fumigant concentration over a period of 14 to 72 hours, depending on the type of wood. Typically, log fumigation is done in shipping containers, where the logs are loaded inside, the doors are closed, and a fumigant is added to the shipping container. At the end of the fumigation period, the doors are opened and the fumigant is allowed to vent to the atmosphere, also known as the aeration process. Other types of log fumigation include chamber fumigation or tarpaulin fumigation. Chamber fumigation is similar to container fumigation, except that the logs are loaded into a chamber or building rather than a shipping container. In tarpaulin fumigation,

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[1] Toxicological Profile for Bromomethane, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, U.S. Department of Health & Human Services, Atlanta, GA, September 1992. https://www.atsdr.cdc.gov/substances/index.asp

[2] 40 CFR Part 82, Protection of Stratospheric Ozone: Process for Exempting Quarantine and Preshipment Applications of Methyl Bromide, Final rule. Effective January 1, 2003.

the logs are placed in a pile on the ground and covered with a tarpaulin. The fumigant is injected under the tarpaulin and the tarpaulin is then removed at the end of the fumigation period.

To address the human health effects of log fumigation, the Division of Air Quality (DAQ) proposes to require log fumigation operations to comply with the Toxic Air Pollutant Guidelines specified in 15A NCAC 02D .1104. These guidelines state that facilities cannot emit any TAP in a quantity that may cause or contribute to any significant ambient air concentration beyond the facility's premises that may adversely affect human health.

III. Reason for Rule Change

China and India are driving strong market demand for southern yellow pine logs. Their importation specifications require the logs to be quarantined, fumigated with methyl bromide, a federally listed hazardous air pollutant, or debarked to control wood-boring pests prior to acceptance at a foreign port. Due to the strict foreign import specifications and strong market demand, North Carolina is currently experiencing an increase in permit applications and inquiries from entities interested in methyl bromide whole log fumigation.

The EPA implements restrictions on methyl bromide use in response to phase-out requirements established under the Montreal Protocol signed April 12, 1988 and enacted on January 1, 1989. The EPA authorizes use of methyl bromide for QPS applications by the specific QPS exemption under Title VI (Stratospheric Ozone Protection) of the Clean Air Act. The final regulation published on January 2, 2003 in the Federal Register, 68 FR 238, exempted use for methyl bromide as a fumigant for QPS. North Carolina has five permitted synthetic minor log fumigation facilities utilizing methyl bromide in the following counties: 1 facility in Wayne County, 1 facility in Bladen County, 2 facilities in New Hanover County, and 1 facility in Columbus County. Of these permitted synthetic minor facilities, there are no additional requirements other than limiting the emissions of methyl bromide to less than 10 tons per year.[3] All of the facilities are currently operating with the exception of the Bladen County facility. The Bladen County facility applied for a permit to change the name of the facility and increase its use of methyl bromide from 9.9 to 60 tons per year, and therefore becoming a major source of HAP emissions. During the public comment period for the permit, the DEQ received about 1,100 comments about the permit, with most opposing the project. On March 29, 2018, the DEQ announced that the company withdrew their permit application and the landowner requested that no further fumigation occur on the property. Even though this company stills holds a synthetic minor permit, it currently does not have a location to perform log fumigation and it is not expected to recommence operations in the near future. Therefore, this analysis will only include the four currently operating facilities for purposes of estimating the impacts of the proposed rule.

The DAQ is concerned about the potential for chronic (long-term) and acute (short-term) exposures to the general public since methyl bromide is a hazardous air pollutant pursuant to Section 112 of the Clean Air Act. Methyl bromide is highly toxic and human studies suggest the lungs may be severely injured by

[3] 40 CFR 70.2 defines a major source of hazardous air pollutant at 10 tons per year or greater. A source that otherwise has the potential to emit a hazardous air pollutant more than 10 tons per year, but has taken a restriction that limits emissions to less than this amount defines the facility as a synthetic minor source.

acute inhalation exposures. Acute and chronic inhalation of methyl bromide can also lead to deleterious neurological effects in humans. There are no federal or state air quality regulations to protect the public from these particular emissions. Also, unlike many agricultural uses, log fumigation facilities are more of an industrial point source where large quantities of methyl bromide are used.

IV. Proposed Rule

To address this potential health hazard, the DAQ is proposing to regulate log fumigation sources by setting an acceptable ambient level (AAL) for fumigants used in this operation. AALs are airborne chemical concentrations below which a substance is not expected to have any adverse impacts on human health. They are used in pollution permitting to ensure that stationary source emissions do not add concentrations of toxic air pollutants to the air that may possibly be harmful to human health. Phospene and other HAP used as fumigants already have an AAL under 15A NCAC 02D .1104, however methyl bromide currently does not have an AAL.

To determine an AAL for methyl bromide, the DAQ identified the EPA Integrated Risk Information System (IRIS) program chronic inhalation reference concentration (RfC) as the most appropriate and scientifically valid human health value to provide protection for the long-term health of persons in North Carolina, including sensitive subpopulations that may live adjacent to a log fumigation facility that repeatedly releases methyl bromide to the ambient air during operations. Sensitive subpopulations to methyl bromide exposures include infants, children, the elderly and those persons with pre-existing health conditions that may pre-dispose them to the adverse health effects associated with the inhalation of methyl bromide. The EPA IRIS program set a human population chronic inhalation RfC for methyl bromide in their 1992 assessment[4] based on laboratory animal inhalation exposure studies. The EPA defines a human chronic exposure as a repeated exposure by the oral, dermal, or inhalation route for more than approximately 10 percent of the life span in humans. IRIS chronic reference concentrations are set at exposure levels to protect the most sensitive subpopulations from daily exposures that may result in an adverse health effects. The current chronic reference concentration for methyl bromide is 5 micrograms per cubic meter ($\mu g/m^3$), approximately 1 part per billion, and represents a value below which no appreciable daily inhalation health risks are anticipated. The DAQ believes that this RfC will provide health protections to the general public from fumigation operation releases and proposes this RfC as the AAL for methyl bromide. The DAQ is also proposing a 24-hour averaging time for the methyl bromide AAL to reflect potential chronic systemic (non-cancer) effects associated with the chronic RfC endpoint. In February, the DAQ submitted a risk analysis and AAL recommendation to the Secretaries' Science Advisory Board.[5] In this report, the DAQ recommended the EPA IRIS RfC as the appropriate value to serve as the basis for developing an AAL to protect the health of all persons that may live or work in areas subject to airborne releases of methyl bromide from log fumigation operations. The Secretaries' Science Advisory agreed with the DAQ's assessment and recommended to the Environmental

[4] Toxicological Profile for Bromomethane, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, U.S. Department of Health & Human Services, Atlanta, GA, September 1992. https://www.atsdr.cdc.gov/substances/index.asp

[5] Risk Analysis and Acceptable Ambient Level Recommendation for Methyl Bromide, North Carolina Department of Environmental Quality Division of Air Quality, April 12, 2019. https://files.nc.gov/ncdeq/GenX/SAB/Methyl-Bromide-AAL-FINAL-0412019-signed.pdf

Management Commission a range of AAL values to be considered for methyl bromide as an upper bound AAL of 0.005 milligrams per cubic meter (mg/m^3) and a lower bound of 0.002 mg/m^3 with a 24-hour averaging time for the protection of public health.

In addition to the AAL, the DAQ is also proposing the following rules:

15A NCAC 02D .0546, Control of Emissions from Log Fumigation Operations, is proposed for adoption to require compliance with an AAL for hazardous air pollutant and toxic air pollutant emissions from bulk, chamber, and container log fumigation operations.

15A NCAC 02D .1104, Toxic Air Pollutant Guidelines, is proposed for amendment to add methyl bromide to the toxic air pollutant list with EPA's chronic reference concentration of 5$\mu g/m^3$ (0.005 mg/m^3) as the 24-hour AAL.

V. Estimating the Fiscal Impacts

As discussed above, the current process of log fumigation emits all of the fumigant to the atmosphere from the containers. This fumigant, in nearly all cases, is methyl bromide which is listed as a HAP. This rule proposes to set a limit of 5$\mu g/m^3$ as the 24-hour AAL for methyl bromide. Other HAPs used as fumigants are already listed as a North Carolina TAP and have AALs and therefore were not proposed in this rule. The sections below provide a summary of the costs associated with complying with the rule for facilities and the cost of enforcing the rule for state and local agencies.

Number of facilities

The DAQ lists five active log fumigation facilities on their log fumigation permitting actions and information website.[6] Each of these facilities have synthetic minor permits, which means these facilities are limited to emitting 10 tons per year of any individual HAP or 25 tons per year of total HAP to avoid becoming a major source. As noted previously, one of the companies has a permit (Bladen County), but does not have a location to perform log fumigation. It is not expected that this facility will recommence operations and therefore will not be included in the calculation of the impacts for this fiscal note. The DAQ has received three new permit applications for Greenfield facilities proposing individual HAP emissions below 10 tons per year.

Facility Impacts

For 15A NCAC 02D .0546, the DAQ is proposing to adopt a rule that requires log fumigation facilities to meet an AAL when using a North Carolina TAP as a fumigant. As stated previously, phosphine is already listed as a North Carolina TAP and the DAQ is proposing to set a chronic reference concentration of 5 $\mu g/m^3$ as the 24-hour AAL for methyl bromide in 15A NCAC 02D .1104. The proposed rule would require the concentration of methyl bromide to be below this AAL at the fenceline of the facility. Log

[6] https://deq.nc.gov/about/divisions/air-quality/air-quality-permitting/methyl-bromide-log-fumigation

fumigation facilities have several options to achieve compliance with the AAL for methyl bromide or other NC TAP. These options include the following methods for achieving compliance:

1. Install a stack to disperse emissions into the atmosphere;
2. Facility relocation or lease additional land for performing fumigation or lease additional land for performing fumigation;
3. Limit the number of containers that are fumigated; or
4. Install control equipment.

The facility may choose to select one or a combination of the different options to achieve compliance with the methyl bromide or other TAP AAL or they may decide to not perform any log fumigations in North Carolina. If the fumigation companies decide to not provide log fumigation services in North Carolina, the log exporting companies have a couple of options to continue exporting logs overseas. These options include debarking the logs themselves or fumigate the logs in a neighboring state. These options will be discussed in more detail in the Possible Regulatory Outcomes section in this analysis. For fumigation companies that decide to comply with the proposed rule, the following sections will describe and provide costs for each of the options.

Option 1

This option involves the installation of a stack and fan system to exhaust the methyl bromide or other HAP emissions into the atmosphere. The use of a stack helps promote sufficient dispersion and dilution of released pollutants within the atmosphere. This dispersion may help in ensuring that subsequent ground level concentrations of the released pollutants remain within acceptable limits. This option requires the installation of an enclosed fan and duct system to move the methyl bromide or other HAP pollutant used for fumigation from the container, chamber, or bulk pile to the atmosphere. This works by attaching an enclosed fan using flexible duct to the container, bulk pile tarp, or chamber and allowing the air from the fan to force the fumigant to an exhaust duct which is then vented to the atmosphere through a stack.

To evaluate this option, max monthly usage data from the past two years (2017-2018) were used to model the emissions using AERMOD, along with corresponding meteorological data. No usage data was available for the Flowers facility therefore, the modeled emissions were based on the average methyl bromide loading rates per container for hardwoods and non-hardwoods. The Chadbourn facility uses bulk piles and tarps for fumigation and aeration, whereas the other facilities use containers. The daily emissions were calculated based on maximum monthly fumigation charging data assuming 15 days per month and average container aeration batches at each site based on inspections and permit records. This 15 day per month assumption is based on the duration of time that is required to complete the fumigation process, typically 24 hours, depending on the type of log that is treated. Therefore, the fumigant that is added to the container or tarpaulin one day is released to the atmosphere on the following day. The emissions assume 100 percent of the methyl bromide is released in the first hour for each container. In addition, the HAP emissions from the Chadbourn site were assumed to be released using a 25-foot stack connected to a 9,500 cubic feet per minute fan. The methyl bromide emissions from other facilities were assumed to be released from a 30-foot stack connected to a 5,200 cubic feet per minute fan. All models assumed 100 percent fan capture efficiency.

The equipment needed for this option includes the purchase of an enclosed fan, collar, flexible duct, and a 30 foot stand to hold the stack. We received costs from vendors for a 9,500 cubic feet per minute (CFM) enclosed fan and a 5,200 CFM enclosed fan. The 9,500 CFM enclosed fan is used in bulk tarpaulin fumigation operations, whereas the 5,200 CFM enclosed fan is used in container fumigation operations. The 9,500 CFM fan was determined to be $5,857 and an additional $255 for the collar adapter to connect the fan to 24-inch diameter ducts. The 5,200 CFM enclosed fan was determined to be $3,642 and an additional $237 for the collar adapter to connect to 20-inch ducts. The cost for 250 feet of flexible duct was listed as $3,520 for 24-inch ventilation duct and $2,846 for 20-inch ventilation duct. A 30 foot stand to create a stack from the flexible duct was found to be $400. So for a bulk tarpaulin fumigation operation, the cost for ventilation of the tarps to a stack was calculated to be $10,032. The ventilation system for a container fumigation operation to an exhaust stack was calculated to be $7,125. For containers, a special door or wedge may need to be purchased to allow ventilation of the shipping container. The special door has inlet and outlet ports built into the door and it would temporarily replace one of the existing doors on the shipping container during fumigation. A wedge fits into the space of one of the open container doors to seal the container and has inlet and outlet connections. Some of the container operations already have the special doors or wedges to use in the fumigation process, but some facilities will need to purchase these items. Because of the limited need for these items, the DAQ was unable to estimate or receive vendor quotations for these specialized items.

In addition to the cost of the equipment, it is assumed that it would also take two workmen approximately 0.5 technical hours to set up the ventilation system for each container at a labor rate of $74.17 per hour for a total of $74.17. The labor rate was estimated using average hourly wages obtained from the Bureau of Labor Statistics (BLS) North Carolina wage estimates for Architecture and Engineering Occupations for the technical labor cost. A benefits percentage of 30.5% and an overhead percentage of 50.0% was used to estimate the final labor cost. Other costs associated with this option include the cost of demonstrating compliance with the proposed AAL through modeling. The facility has the option of either having the DAQ perform the modeling or the facility can use a contractor to perform the modeling. The cost for hiring a contractor to perform the modeling is estimated to $8,332. This estimate includes a 100 technical hours for modeling at a labor rate of $74.17 per hour, 10 clerical hours at a labor rate of $33.34 per hour, and 5 managerial hours at a labor rate of $116.35 per hour. The labor costs were estimated using average hourly wages obtained from the BLS North Carolina wage estimates for Architecture and Engineering Occupations for the technical labor cost, Office and Administrative Support Occupations for the clerical labor cost, and Management Occupations for the management labor cost. A benefits percentage of 30.5% and an overhead percentage of 50.0% was used to estimate the final labor cost. Note that the total cost in the Table 1 only includes the cost of the ventilation system and compliance modeling. This total does not include the ventilation labor because this is a variable cost. The annual ventilation labor costs are estimated to range from $16,000 to $73,000 depending on the number of containers that are ventilated per year.

The results of the modeling are shown in Table 1. The results show that the modeled fenceline concentrations decreased by approximately 60 to 90 percent when emissions were elevated using a stack in comparison to ground level emissions (i.e., non-stack results) for each of the four facilities. However, none of these fenceline concentrations were less than the proposed AAL. Therefore, this option will have to be used with one or more of the other options in order to meet the proposed AAL.

Table 1. Summary of Stack and Non-Stack Fenceline Concentrations – Option 1

Facility Name	*Daily MeBr Emissions (lbs/day)* [1]	*Annual MeBr Emissions (Tons/yr)*	*Afternoon Max Model Result w/ Stack (mg/m^3)* [2]	*Afternoon Max Model Result w/o Stack (mg/m^3)* [3]	*Percent Reduction of Modeled Concentration with a Stack* [4]	*Stack Concentration Result Percent of Proposed AAL* [5]	*Cost of Stack Option* [6]
Existing Facilities							
Chadbourn	79.6	7.16	0.0670	0.7060	90.51%	1240%	$18,364
River Rd	34.2	3.08	0.0225	0.9313	97.58%	350%	$15,457
Port	24.1	2.17	0.0130	0.0369	64.77%	160%	$15,457
Flowers	38.5	3.47	0.0383	0.3856	90.07%	666%	$15,457

[1] The daily emissions were calculated based on maximum monthly fumigation charging data assuming 15 days per month and average container aeration batches at each site based on inspections and permit records.

[2] Chadbourn emissions modeled assuming 1 pile aeration through 25 ft stack using 9500 cfm fan. Other facilities emissions modeled assuming 1 container aeration through a 30 ft stack with 5200 cfm flow.

[3] Chadbourn 3 bulk log piles modeled assuming dimensions: 40 ft long x 40 ft wide x 10 ft tall. Log piles placed north-south ~40 ft apart. Volume source parameters at other faclities were based on high cube container dimensions: 40 ft long x 8 ft wide x 9.5 ft tall. Single containers were placed near the center of the property. Volume source locations were based on information from regional offices.

[4] Calculation of the percent reduction between the non-stack and the stack concentrations at the fenceline of the facility.

[5] Comparison of modeled concentration for stack with the proposed AAL of 0.005 mg/m^3.

[6] The stack option cost includes the capital cost for the purchase of the ventilation equipment and the compliance modeling. The costs do not include the labor costs for set up of the ventilation system for each container or bulk pile.

Option 2

This option for achieving compliance with the AAL involves the relocation of the facility or the leasing of additional land to increase the size of the facility and hence increasing the distance from the source of the HAP emissions to the fenceline. By increasing the distance, more dispersion may occur on site so that the concentration of the pollutant is reduced at the fenceline. This determination is done by modeling the methyl bromide emissions from the facilities using AERMOD. The modeling takes into account historical weather patterns in the area of the facilities as well as the velocity, temperature, and release height of the HAP emissions. The program determines the distance from the HAP emission source to the point where the concentration is below the AAL. The distance was then used to calculate the area that would be needed to meet the AAL using the area of a square formula. This calculated area was compared to the current area leased by the facility to determine if additional land would be needed. For this option, the emissions from the facility were assumed to be emitted from a stack. Therefore, this option also includes the costs estimated in Option 1.

To determine the fenceline concentration for this option, max monthly usage data from the past two years (2017-2018) were used to model the emissions using AERMOD, along with corresponding meteorological data. No usage data was available for the Flowers facility therefore, the modeled emissions were based on the average methyl bromide loading rates per container for hardwoods and non-hardwoods. The Chadbourn facility uses bulk piles and tarps for fumigation and aeration, whereas the other facilities use containers. The daily emissions were calculated based on maximum monthly fumigation charging data assuming 15 days per month and average container aeration batches at each site based on inspections and permit records. The emissions assume 100 percent of the methyl bromide is released in the first hour for each container. In addition, the HAP emissions from the Chadbourn site were assumed to be released using a 25-foot stack connected to a 9,500 cubic feet per minute fan. The methyl bromide emissions from other facilities were assumed to be released from a 30-foot stack connected to a 5,200 cubic feet per minute fan. All models assumed 100 percent fan capture efficiency.

The cost for leasing additional land in North Carolina was obtained from the U.S. Department of Agriculture, National Agriculture Statistics Service, Cash Rent Survey for NC Pasturelands[7]. This land type was chosen because we believe that it best describes the category of property used by log fumigation companies. The properties used by fumigation companies are not appropriate for agricultural use and are only required to have road access and do not require access to electricity, natural gas, or water. Based on this judgement, the cost for leasing additional land was determined to be $28 per acre per month and was used to estimate the annual cost of leasing the additional property needed for compliance with the AAL for the existing facilities. Table 2 presents a summary of the results. The cost for the additional acreage for the existing facilities ranged from $0 to $287,228. Note that even though the Port facility shows no additional acreage is needed, the property is rectangular and would require additional acreage. Other costs associated with this option include: $10,032 for a ventilation system for bulk fumigation operations, $7,125 for container fumigation operations, and $8,332 for modeling this option for compliance. There are also labor costs associated with moving the ventilation system from one bulk pile or container to the

[7] https://quickstats.nass.usda.gov/results/58B27A06-F574-315B-A854-9BF568F17652#7878272B-A9F3-3BC2-960D-5F03B7DF4826

next aeration site and is estimated to $74.17 per transfer. The costs for the ventilation system, compliance modeling, and ventilation labor are described in more detail in the costs summary section of Option 1. Note that the total cost in the Table 2 only includes the cost of leasing, compliance modeling, and the cost of the ventilation system. This total does not include the ventilation labor because this is a variable cost. The annual ventilation labor costs are estimated to range from $16,000 to $73,000 depending on the number of containers that are ventilated per year.

To estimate the leasing cost for a new synthetic minor facility with a stack system, a model plant was developed using the maximum emissions from this facility. The maximum emissions were assumed to be 9.9 tons of HAP per year for a synthetic minor facility. The estimated annual maximum emissions were converted to hourly emissions by assuming that fumigation occurs 15 days per month annually. An average afternoon dispersion buffer per acre factor was calculated by dividing the estimated daily emissions for each of the existing facilities by the calculated afternoon dispersion buffer area to <AAL and averaging the results. The estimated daily maximum emissions from the synthetic minor facility was divided by the average afternoon dispersion buffer per acre value to estimate the property area needed for compliance, which was determined to be 1,026 acres. The average property area for the existing facilities was calculated to be 79.1 acres and was used as the baseline property area of the new synthetic minor facility. To determine the annual cost of leasing land for performing log fumigation, the property area needed for compliance was subtracted from the baseline property area to determine the additional area needed, which was calculated to be 947 acres. The additional area was multiplied by the average monthly land leasing cost of $28 per acre to estimate the annual cost for leasing land for a new synthetic minor facility, which was estimated to be $318,192. The new synthetic minor facility will also incur costs of $7,125 for container fumigation operations and $8,332 for modeling. A summary of these costs for the new synthetic minor facility are provided in Table 2.

In many cases for the existing facilities, the ability to lease additional property adjacent to their current property may be difficult. The majority of these facilities are bordered by other industrial facilities and commercial properties or residential properties. Therefore, these existing facilities may need to relocate in order to meet the proposed AAL at the fenceline of the property. The cost for leasing the new property would be comparable to the costs calculated for the expansion of the property area discussed previously. Relocation would require the replacement or transfer of any offices or equipment to the new location. The costs for moving or replacing these items are dependent on the distance between the new and existing sites and the number of items that are moved and are estimated to range from $800 to $2,000.

Table 2. Summary of Leased Property Area Needed for Compliance – Option 2

Facility Name	Daily MeBr Emissions (lbs/day)[1]	Annual MeBr Emissions (Tons/yr)	Afternoon Max Model Result (mg/m^3)	Afternoon Dispersion Buffer Distance to <AAL (m)	Afternoon Dispersion Buffer Area to <AAL (m^2)[2]	Afternoon Dispersion Buffer Area to <AAL (acres)[3]	Approximate Property Area (acres)[4]	Additional Area Needed (acres)	Annual Cost to Lease Additional Area ($/yr)[5]	Total Cost for Compliance[6]
Existing Facilities										
Chadbourn	79.6	7.16	0.0670	941	3,541,924	875	20.4	854.8	$287,228	$305,592
River Rd	34.2	3.08	0.0225	535	1,144,900	283	2.2	280.8	$94,337	$109,794
Port[7]	24.1	2.17	0.0130	424	719,104	178	272.0	0.0	NA	--------
Flowers	38.5	3.47	0.0383	692	1,915,456	473	22.0	451.3	$151,646	$167,103
Proposed Facilities[8]										
Synthetic Minor Facility	110.0	9.9				1,026	79.1	947	$318,192	$319,399

[1] The daily emissions were calculated based on maximum monthly fumigation charging data assuming 15 days per month and average container aeration batches at each site based on inspections and permit records.

[2] Buffer area asumed to be square and is calculated using the formula Area = 4*(Buffer Distance)^2.

[3] Square meters converted to acres using a conversion of 0.0002471 acres per square meter.

[4] For the existing facilities, the approximate property area was determined using a map of the property and calculating the area. The approximate property area for the proposed facility is the average of the existing facilities.

[5] Cost to rent land in North Carolina obtained from the U.S. Department of Agriculture, National Agriculture Statistics Service, Cash Rent Survey for NC Pasturelands.
https://quickstats.nass.usda.gov/results/58B27A06-F574-315B-A854-9BF568F17652#7878272B-A9F3-3BC2-960D-5F03B7DF4826

[6] The total cost of compliance includes the annual cost to lease additional land, the cost for performing the compliance modeling, and the cost of the ventilation system.

[7] Note that even though the additional acreage for this facility is zero, the modeled result is still greater than the proposed AAL. This is due to the rectangular shape of the facility property.

[8] The afternoon dispersion buffer area to <AAL for these proposed facilities were calculated by dividing the daily emissions by the average emissions per buffer acre factor calculated for the four existing facilities. The average daily emissions per buffer acre factor was calculated by dividing the daily emissions by the afternoon dispersion buffer area to <AAL for each of the existing facilities and averaging the results.

Other costs associated with this option include the cost of demonstrating compliance with the proposed AAL through modeling. The facility has the option of either having the DAQ perform the modeling or the facility can use a contractor to perform the modeling. The cost for hiring a contractor to perform the modeling is estimated to $8,332. This estimate includes a 100 technical hours for modeling at a labor rate of $74.17 per hour, 10 clerical hours at a labor rate of $33.34 per hour, and 5 managerial hours at a labor rate of $116.35 per hour. The labor costs were estimated using average hourly wages obtained from the Bureau of Labor Statistics (BLS) North Carolina wage estimates for Architecture and Engineering Occupations for the technical labor cost, Office and Administrative Support Occupations for the clerical labor cost, and Management Occupations for the management labor cost. A benefits percentage of 30.5% and an overhead percentage of 50.0% was used to estimate the final labor cost.

Option 3

Another option for meeting the proposed AAL is to limit the number of containers that are being aerated per day. The facilities currently aerate numerous containers per day depending on their supply of logs and the demand for the logs overseas. To evaluate this option, the DAQ modeled the maximum concentration at the fenceline for a single container or tarp aeration for the four operating facilities and compared that value to the proposed AAL. Using the typical fumigation charge rate for southern yellow pine, methyl bromide emissions were modeled for each of the facilities and the modeled results showed that none of the facilities would be able to meet the AAL. The same emission rate was modeled for each of the sites assuming that the emissions are released to the atmosphere using a stack. Again, the modeled fenceline concentration exceeded the AAL for each of the facilities. A summary of the modeled results is provided in Table 3. Based on the modeling results, the DAQ has concluded that this option is not a viable for meeting the proposed AAL for log fumigation and therefore no costs were estimated.

Option 4

This option involves the facility purchasing and installing capture and control equipment to reduce HAP emissions to the atmosphere. The most proven technology for reducing HAP emissions from log fumigation operations is exhausting the fumigant to an activated carbon bed. In this process, the HAP is adsorbed onto the activated carbon and the cleaned aeration air is exhausted to the atmosphere. Once all of the activated carbon has been depleted, the activated carbon is either replaced or desorbed and used again. A new system that is being marketed uses a diesel reciprocating internal combustion engine (RICE) to control methyl bromide emissions. A description and cost estimate for each of these control systems is provided in the proceeding paragraphs. Each of these control technologies can be used in conjunction with a stack, increased property size or limiting of the number of containers to meet the AAL at the property fenceline.

Table 3. Summary of Number of Containers – Option 3

Site Name	Approximate Property Acreage[1]	Number of Containers/Day Modeled[2]	Stack Release Modeled Emissions (lb/day)[3]	Afternoon Max Model Result w/o Stack (mg/m^3) [4]	Afternoon Max Model Result w/ Stack (mg/m^3) [5]	Proposed Methyl Bromide 24-hour AAL (mg/m^3)	Control Efficiency to Meet 24-hour AAL w/o Stack[6]	Control Efficiency to Meet 24-hour AAL w/ Stack[7]
Chadbourn	20.4	[1 log piles]	14.0	0.125	0.012	0.005	96%	58%
River Rd	2.15	1	14.0	0.382	0.009	0.005	99%	44%
Port	272	1	14.0	0.022	0.008	0.005	77%	38%
Flowers	22	1	14.0	0.141	0.014	0.005	96%	64%

[1] Property acreage based on rough outline of property line as indicated in county GIS web pages.

[2] Modeled one container aeration per day at each site. All emissions were assumed to occur in the 1st hour of aeration and the aeration occured at 1 PM.

[3] The emission rate is based on the typical fumigation charge rate for southern yellow pine logs.

[4] Chadbourn utilizes bulk piles and tarps for fumigation and aeration. Other sites simply open container doors.

[5] Chadbourn emissions modeled assuming 1 pile aeration through 25 ft stack using 9500 cfm fan. Other facilities emissions modeled assuming 1 container aeration through a 30 ft stack with 5200 cfm flow.

[6] Percent reduction of methyl bromide that would be needed to the meet the AAL assuming aeration is performed without a stack.

[7] Percent reduction of methyl bromide that would be needed to the meet the AAL assuming aeration is performed with a stack.

Three companies that sell log fumigation HAP control systems were contacted and some cost estimate information was provided by the contacts. The three companies were; Value Recovery, Nordiko, and Mebrom. The Value Recovery system uses an activated carbon bed and then desorbs the carbon using a scrubber that chemically destroys the methyl bromide. The vendor stated that the system is expected to achieve at least 90 percent reduction of HAP. The Nordiko Recapture Technology also uses an activated carbon bed and the company provided two costs depending on whether the spent activated carbon is disposed in a landfill or whether it is disposed of using high temperature incineration. The vendor stated that the system can be sized and designed to achieve up to 99 percent reduction of HAP. Mebrom markets a new technology that uses the HAP exhaust from the container as combustion air in a reciprocating internal combustion engine (RICE). The RICE exhaust is then passed through a scrubber that removes acid gases formed during combustion. The vendor stated that this technology is expected to achieve 99 percent reduction of HAP.

The installed and operating costs for this option were calculated using model plants. This approach was selected because of the variable nature of the actual emissions from the facilities. It was also selected because the facilities will most likely size the control equipment to the maximum emissions that can be emitted by the facility. The maximum emissions for a synthetic minor facility were assumed to be 9.9 tons of HAP per year.

Since most of the costs for the control equipment were based on the number of containers that are fumigated, the emissions from each of the model plants were converted to containers per day. This conversion was done by dividing the maximum annual emissions by 15 days of operation per month for 12 months and assuming an average of 27 pounds of methyl bromide per container. The 27 pounds of methyl bromide per container value is the average of the dosage for oak (15 pounds per 1000 cubic feet) and the dosage for yellow pine (5 pounds per 1000 cubic feet) for a 2,700 cubic feet shipping container recommended by the U.S. Department of Agriculture.[8] As an example, a synthetic minor facility is limited to 9.9 tons of HAP emissions per year, therefore the estimated number of containers per day is as follows;

$$N\left(\frac{containers}{day}\right) = \left(\frac{9.9\ Tons}{yr}\right) * \left(2000\frac{lbs}{Ton}\right) * \left(\frac{yr}{12\ mo.}\right) * \left(\frac{mo.}{15\ days}\right) * \left(\frac{Container}{27\ lbs}\right)$$

This calculates to an estimate of 4.1 containers per day that are aerated for a synthetic minor facility.

Using cost information provided by the vendors, the installed and operating costs for each of the control technologies were calculated. Table 4 provides a summary of the control costs using the model plants. Value Recovery provided the most comprehensive costs estimate and included both the installed cost of the control equipment and the operating cost for the control equipment. The Nordiko Recapture Technology quote only included the annual cost for the capture and control options. Mebrom only provided a cost per container controlled.

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[8] U.S. Department of Agriculture, Animal and Plant Health Inspection Service Treatment Manual (APHIS Treatment Manual), January 2019.
https://www.aphis.usda.gov/import_export/plants/manuals/ports/downloads/treatment.pdf

Even though, the costs for the Mebrom control technology is the lowest, the cost information provided by the vendor is limited to the cost per container with no basis for the costs. It is expected that the log fumigation facilities would select either the Value Recovery or the Nordiko control technologies because they have been proven to work for this application. The Mebrom system is still an emerging control technology and is expected to be continually evaluated.

An additional cost associated with the control technology option is the determination of the controlled emissions from the outlet of the control device to be used in the modeling for compliance. The controlled emissions are used as an input into the modeling program to calculate the concentration at the fenceline of the facility. The modeling will be used to determine process operational and air pollution control parameters and emission rates for toxic air pollutants to place in the air quality permit for that facility that will prevent the acceptable ambient level from being exceeded. The determination would involve the measurement of the pollutant concentration and the velocity at the outlet of the control device during aeration of the container or tarpaulin pile. The typical approach to measuring this concentration is to use a hydrocarbon analyzer with a flame ionization detector that is calibrated to measure the fumigant that is used. The hydrocarbon analyzer would need to measure the concentration during the entire aeration period, typically four hours for soft wood lumber. The velocity of the exhaust gas from the control device would also need to be measured. The EPA estimated that he cost to the facility for completing an emission test can typically range from $10,000 to $50,000 per stack in Year 2000 dollars.[9] Using the Chemical Engineering Chemical Plant Index, these costs were escalated to $14,400 to $72,000 in current year dollars. In this cost analysis, it is assumed that the control device outlet testing would be at the lower end of the cost range, because only the velocity and the concentration of one compound will be measured. Also added to this cost would be the cost for hiring a contractor to do the modeling which was estimated to be $8,332. The cost for testing and the modeling cost are not included in the installed and annual costs presented in Table 4.

[9] EPA Office of Inspector General Audit Report of EPA's Oversight of State Stack Testing Programs, Report Number 2000-P-00019, September 11, 2000.

Table 4. Summary of Control Technologies Costs – Option 4

Facility Name	Number of Containers Per Day [1]	Estimated Maximum Emissions (Tons/yr) [2]	Value Recovery: Total Installed Equipment Cost [3]	Value Recovery: Annual Operating Cost ($/yr) [4]	Nordiko Recapture Technology: AC Waste to Landfill Annual Cost ($/yr) [5]	Nordiko Recapture Technology: AC Waste to Incinerator Annual Cost ($/yr) [6]	Mebrom: Installed Equipment Cost [7]	Mebrom: Annual Operating Cost ($/yr) [8]
Synthetic Minor Facility	4.1	9.9	$364,716	$138,600	$147,886	$60,535	NA	$7,333

[1] Number of containers per day estimated by dividing the maximum emissions per year by 15 days per month of operation for 12 months and an average of 27 pounds of methyl bromide per container.

[2] Synthetic minor facility are permitted to emit less than 10 tons of HAP per year.

[3] The installed equipment cost is calculated using the amortized capital expenditure value of $6,000 per ton obtained from Value Recovery on 5/18/2018. The amortized cost at 10% interest for 10 years is multiplied by 6.14 and the annual MeBr emissions to get the actual installed equipment cost.

[4] Annual operating cost is calculated using the operating cost value of $14,000 per ton obtained from Value Recovery on 5/18/2018 and multiplying by the annual MeBr emissions.

[5] Annual Cost based on average cost of $179.50 to 373 per container converted to U.S. dollars for activated carbon absorber and waste to landfill provided in 8/14/2018 email from Eve Lancaster, TasPorts. Includes both operating and amortized installed equipment cost.

[6] Annual Cost based on average cost of $49.80 to 179.50 per container converted to U.S. dollars for activated carbon absorber and waste to incinerator provided in 8/14/2018 email from Eve Lancaster, TasPorts. Includes both operating and amortized installed equipment cost.

[7] Equipment costs not available for this technology.

[8] Calculated using estimated estimated number of containers per day and added cost of $10 per container based on 9/18/2018 presentation by Spectros Instruments, Inc.

Alternative Option to Log Fumigation

Companies have an alternative option for preparing logs for shipment overseas, which is the removal of bark from the logs prior to shipment. For de-barked logs, countries allow tolerances for bark at five percent for any individual log and two percent for any batch of logs. Bark from logs can be removed using hand tools or by a debarking machine depending on the number of logs that need to be debarked. One facility, that applied and later withdrew their application for a log fumigation facility, is now operating a log debarker to prepare their logs for shipping.[10] They are currently in the process of obtaining a second log debarker to increase production. Costs for purchasing a log debarking machine ranges from $100,000 to $40,000[11] depending on whether it is a batch or continuous operation. Another vendor[12] provided a more detailed cost of $413,250 for the debarking machine and associated equipment installed at the site. This cost includes $215,000 for the debarking machine with a hydraulic power system, $30,000 for the operating pad, and $40,000 for log moving equipment. He stated that installation, wiring, and electrical conduits are approximately 45 percent ($128,250) of the equipment cost. Operating costs for these machines are estimated to be $84,730 per year using the BLS North Carolina wage estimate for a logging equipment operator (Occupational Code 45-4022) of $20.81 per hour. A benefits percentage of 30.5%, an overhead percentage of 50.0%, and a total of 2,080 hours per year were used to estimate the final annual labor cost. For the purposes of this fiscal note, the estimated cost for installing a debarking machine will be $413,250, and the cost for operating the log debarking machine will be $84,730 per year.

In some cases, the debarking of logs may be more economical than fumigation. One log exporter in the Pacific Northwest noted that the cost of debarking is significantly less expensive than fumigation and they avoid any environmental and regulatory issues resulting from the use of Methyl Bromide.[13] They added that by removing the bark, they can load 10 percent more wood into each container, in comparison to exporters that fumigate; and they recapture 40 percent of the cost of debarking by selling the removed bark to an industrial mulch operation. However, there are tolerances on the amount of bark that can remain on the exported logs. For China, the tolerances for bark are 5 percent on any individual log and 2 percent on any batch of logs. This determination can be very subjective and could potentially allow the country to refuse the container. In comparison, fumigated logs only require certification that the logs were fumigated to be accepted by China or India.

Possible Regulatory Outcomes

There are several regulatory outcomes that are possible as a result of the proposed rule. The determination of the most likely outcome is difficult to assess because of the many variables associated with this industry. Tariffs on exports have created a variability in the demand for logs from North Carolina, which may affect the decisions of the log exporters. Also public awareness of the hazards of methyl bromide emissions from these facilities and the public's participation in the permitting process have caused two

[10] NC Department of Environmental Quality, Memo: Malec Brothers Transport Permit Application Withdrawn, January 30, 2019. https://deq.nc.gov/news/press-releases/2019/01/30/memo-malec-brothers-transport-permit-application-withdrawn
[11] Costs obtained from telephone conversations with debarker salesmen at HMC Corporation and Acrowood.
[12] Telephone conversation with Peter McCarty from T&S Equipment.
[13] http://icrowdnewswire.com/2016/07/25/fiber-international-exports-debarked-southern-yellow-pine-logs-via-containers-asian-marketplace-china-vietnam/

major source permit applications to be withdrawn.[14] Log exporters, whom are a separate business from the log fumigation companies, may decide to use other options for preparing logs for shipment overseas because of the increased public awareness of methyl bromide emissions. As noted previously, one facility withdrew a Title V permit for log fumigation and is now debarking logs as a method for shipping logs overseas. The method of debarking does not require an air permit and is a viable option for preparing logs for shipment overseas. Therefore, this analysis will focus on three of the most likely outcomes as a result of the proposed rule.

The first possible regulatory outcome assumes that fumigation companies will continue to operate their log fumigation activities and install and operate control technology. As discussed in the previous section, Option 1, the installation of a stack to disperse emissions, will not meet the proposed AAL. Option 2, the relocation or leasing of additional land, may not be possible for some facilities because of the size of the property that would be needed to meet the fenceline concentration. Facilities may not choose Option 3 because limiting the number of containers that can be fumigated, thus limiting their production, will not satisfy the proposed AAL, alone or in combination with a stack system. Therefore, Option 4, the installation and operation of control technology, is expected to be the most likely outcome. However, depending on the type of technology, the facility may also have to lease additional property, add a stack, or limit the number of containers that are aerated at the facility to meet the fenceline concentration. Table 5 presents a summary of the additional methyl bromide reduction that is needed to meet the proposed AAL of 0.005 milligrams per cubic meter. These reductions were calculated using the modeling results from Option 1. This option was modeled using the existing property area for the four facilities and aerating the methyl bromide emissions with and without a stack. The percent reduction needed for aerating the methyl bromide without a stack ranged from 86 to 99 percent. For the aeration of emissions through a stack, the percent reduction needed ranged from 62 to 93 percent. Based on this information, an existing facility could install control technology and a stack to meet the proposed AAL.

To determine the control costs for each of the facilities, the Nordiko Recapture Technology was chosen because this technology provided the easiest installation path and lowest cost for the facilities of the proven technologies. Using these costs, the total annual control costs were estimated to be $1.2 million for the five currently operating synthetic minor facilities and the three new synthetic minor facilities. This control technology is estimated by the vendor to add an average of $276 to the cost of each container that is aerated. The value of the logs in the container were estimated to be $6,166 per container. This cost was estimated from a vendor log value estimate of $100 per cubic meter, a shipping container volume of 2,700 cubic feet, and assuming the containers are 80 percent full. A comparison of the estimated control cost and the value of the logs in the container gives a percentage of 4.5 percent. Due to market data limitations, the DAQ is unable to determine whether fumigators, log exporters, or log importers will ultimately bear these additional costs, or how the costs may be shared along the supply chain.

[14] NC Department of Environmental Quality, Companies inform state officials fumigation operations will cease at site in Wilmington, March 29, 2018. https://deq.nc.gov/news/press-releases/2018/03/29/companies-inform-state-officials-fumigation-operations-will-cease

Table 5. Additional Methyl Bromide Reduction Needed to Meet AAL for Existing Facilities

Facility Name	Daily MeBr Emissions (lbs/day)[1]	Afternoon Max Model Result w/ Stack (mg/m^3)[2]	Afternoon Max Model Result w/o Stack (mg/m^3)[3]	Additional Percent Reduction Needed to Meet AAL w/ Stack	Additional Percent Reduction Needed to Meet AAL w/o Stack
Existing Facilities					
Chadbourn	79.6	0.0670	0.7060	92.5%	99.3%
River Rd	34.2	0.0225	0.9313	77.8%	99.5%
Port	24.1	0.0130	0.0369	61.5%	86.4%
Flowers	38.5	0.0383	0.3856	86.9%	98.7%

[1] The daily emissions were calculated based on maximum monthly fumigation charging data assuming 15 days per month and average container aeration batches at each site based on inspections and permit records.

[2] Chadbourn emissions modeled assuming 1 pile aeration through 25 ft stack using 9500 cfm fan. Other facilities emissions modeled assuming 1 container aeration through a 30 ft stack with 5200 cfm flow.

[3] Chadbourn 3 bulk log piles modeled assuming dimensions: 40 ft long x 40 ft wide x 10 ft tall. Log piles placed north-south approximately 40 feet apart. Volume source parameters at other faclities were based on high cube container dimensions: 40 ft long x 8 ft wide x 9.5 ft tall. Single containers were placed near the center of the property.

[4] Calculation of the percent reduction needed to meet the proposed AAL of 0.005 mg/m^3 with and without a stack.

The second possible regulatory outcome is that the log exporters use fumigation services in South Carolina or Virginia. Both of these states have higher AALs for methyl bromide than the proposed North Carolina standard and have available ports for the shipping of logs overseas. In this scenario, the fumigation companies would decide to no longer fumigate logs in North Carolina, but would still continue to provide pest elimination services to buildings and facilities, food service operations, hospitals and healthcare offices, hospitality buildings, retail buildings, commodity storage buildings, milling operations, and other exports.

The same log fumigation company that provides log fumigation services in North Carolina, also offers pest control services in these other states and is not a North Carolina owned company. The estimated number of log fumigation jobs in North Carolina is estimated to be 12. This estimate assumes two technicians and one supervisor at each of the four currently operating fumigation sites. If log exporters decide to have the logs fumigated in other states, then there is a potential for job losses for these fumigation workers. However, these workers could be transferred to these other states to handle the log fumigation operations. In fact, the log fumigation companies in the Wilmington, North Carolina area could move their operations across the state line and continue their log fumigation services for the log exporters. The cost impact of this scenario is difficult to assess because of the various options that are available for the fumigation companies as well as the log exporters. The worst outcome would be the loss of all of the jobs of the North Carolina fumigation companies. Using a loaded managerial hourly rate of $77.57 per hour which includes a benefits percentage of 30.5 percent and no overhead, a loaded technical hourly rate of $49.45 per hour which includes a benefits percentage of 30.5 percent and no overhead, and a total annual number of 2,080 hours per year, the potential income loss for the 12 workers would be $1,468,165 for the first year. The labor costs were estimated using average hourly wages obtained from the BLS North Carolina wage estimates[15] for Architecture and Engineering Occupations for the technical labor cost and Management Occupations for the management labor cost. It is assumed the workers would obtain comparable salary work in subsequent years.

The log exporting companies may also see impacts due to moving logs for fumigation to other states. It is unclear from the information that we have whether impacts will affect exporting companies that are North Carolina owned. The information in the permits list the fumigation company as the permit holder in four of the five permits with Flowers Timber Company listed as the other permit holder. Flowers Timber Company is a North Carolina company based in Seven Springs, NC that exports hardwoods to China. The North Carolina Forest Service maintains a list of timber companies in North Carolina on their website,[16] and a search of the list for log exporters found only one company, Tima Capital. Tima Capital is a Wilmington, NC company that provides hardwoods and softwoods to buyers in Asia and Middle Eastern countries. Because there are North Carolina based companies that provide log exporting services, this analysis will assume that all impacts associated with moving fumigation to other states will impact North Carolina exporting businesses. To determine the impacts, the additional mileage and driver costs were calculated using mileage factors from the American Transportation Research Institute (ATRI)[17] and using the average distance from the fumigation sites to the closer port of Charleston, South Carolina or Norfolk, Virginia. The ATRI estimated the trucking cost, which includes, fuel costs, truck lease or purchase payments, repair and maintenance, insurance, permits and licenses, tires, tolls, and driver wages and benefits which total $1.691 per mile. The average distance to the fumigation sites to the closest port outside of North Carolina was determined to 170 miles. Using the estimate for the annual number of containers of containers per year calculated for the control device option for a synthetic minor facility (733 containers per year), the cost of trucking the containers to a port outside the of North Carolina was calculated to be $210,811 per facility. For the four existing facilities and the three potential new facilities, this totals to be $1.5 million. There are no permitting or compliance costs associated with this option, however there would be a loss of revenue to the North Carolina DAQ because they would not receive permitting fees of $1,600 from the existing facilities.

If the fumigation providers decide that they will no longer provide fumigation services in North Carolina, the third possible outcome is the log exporters decide to debark the logs rather than fumigate them. In this scenario, the log exporters will either debark the logs themselves or hire another company to debark the logs for them. A search of businesses in North Carolina did not find any companies that provided debarking services. As noted previously, one log exporting company that previously applied for a permit to fumigate logs has withdrawn that permit and is now debarking logs. They have installed one debarker and are currently in the process of installing a second debarker at their location. Therefore, we speculate that other log exporting companies would follow this same scenario if log fumigation companies decide not to offer log fumigation services. While it is possible that log fumigation companies may begin to provide log debarking services, the DAQ believes that it is unlikely that this will happen because the skills required for debarking are much different than the skills need for pest control. Because of this, there

[15] https://www.bls.gov/oes/current/oes_nc.htm

[16] NC Forest Service, North Carolina Timber Buyers by Company Name, 1/17/2019. https://www.ncforestservice.gov/Managing_your_forest/pdf/timberbuyers_alphabetical.PDF

[17] American Transportation Research Institute, An analysis of the Operational Costs of Trucking: 2018 Update, October 2018. https://atri-online.org/wp-content/uploads/2018/10/ATRI-Operational-Costs-of-Trucking-2018.pdf

would be a potential loss of fumigation jobs in North Carolina, but the creation of debarking jobs. There are a number of advantages to debarking logs prior to shipping. More debarked logs can fit into a shipping container in comparison to fumigated logs that still have bark. Also the bark that is removed can be sold to wood pellet manufacturers, paper companies, or landscapers as a product. The installed cost for a debarking machine was estimated to be $413,250. Operating costs for these units were estimated to be $84,730 per year. If the log exporters decided to debark logs themselves, the cost of purchasing and installing the debarking equipment for the four existing sites and three new sites would be $2.9 million and the total annual operating cost would be $0.59 million. Any potential job losses from the fumigation companies could potentially be replaced by jobs with the debarking companies. There are no permitting or compliance costs associated with this option, however there would be a loss of revenue to the North Carolina DAQ because they would not receive permitting fees of $1,600 from the existing facilities.

Facility Permitting and Compliance Costs

Only the control option regulatory outcome would have permitting and compliance costs. The facilities are currently required to provide a monthly accounting of their fumigant usage to comply with their existing synthetic minor permit. The proposed rule would require facilities to modify their permit and subject the facilities to submit a quarterly report of their daily and monthly fumigant usage to comply with new modified permit. Parameters used in the modeling will be added to the permit to ensure compliance with the AAL. These parameters may include daily emissions of methyl bromide, time of aeration, ambient temperature, prevailing wind direction, and control device operating conditions. The permit will include any monitoring, which may include monitoring of the control device to ensure it is operating as prescribed by the manufacturer's instructions. Any violations of the terms of their permit are subject to enforcement action by the DAQ.

The costs for obtaining a permit and the recordkeeping and reporting costs were calculated using the current DAQ fees associated with modifying a synthetic minor permit. The labor costs for recordkeeping and reporting were estimated assuming a total of 4 hours per month or 48 hours per year would be needed to gather the appropriate data and develop a report. Managerial and clerical hours were assumed to be 5% and 10% of the technical labor hours, respectively. Labor rates were calculated using 2017 State Occupational Employment and Wage Estimates for North Carolina from the U.S. Department of Labor, Bureau of Labor Statistics.[18] A benefits percentage of 30.5 and an overhead percentage of 50.0 were used to get the final labor cost for each of the categories.

Table 6 presents a summary of the permit, reporting, and recordkeeping costs. The total permitting costs were calculated to be $2,000 for modification of the existing permits. Note that the proposed facilities and the one facility seeking a permit renewal are not included in the total permitting cost because actions are not a result of the proposed rule. Recordkeeping and reporting costs were estimated to be $31,995 per year which includes submittal of the methyl bromide usage per month.

[18] https://www.bls.gov/oes/current/oes_nc.htm

Table 6. Summary of Facility Permit, Recordkeeping, and Reporting Costs

Facility Name	*Permit Cost*	*Fumigation Warning Signs* [1]	*Facility Recordkeeping & Reporting Labor Costs* Technical Labor Cost ($/yr) [2]	Clerical Labor Cost ($/yr) [3]	Managerial Labor Cost ($/yr) [4]	*Total Facility Costs ($/yr)*
Existing Facilities						
Chadbourn	$400	$200	$3,560	$160	$279	$4,199
River Rd	$400	$200	$3,560	$160	$279	$4,199
Port	$400	$200	$3,560	$160	$279	$4,199
Flowers	$400	$200	$3,560	$160	$279	$4,199
Proposed Facilities						
Renewable Green	$0	$200	$3,560	$160	$279	$4,199
Royal Pest - Halifax	$0	$200	$3,560	$160	$279	$4,199
Pinnacle World Trade	$0	$200	$3,560	$160	$279	$4,199
Total Permit & Recordkeeping Costs	**$1,600**	**$1,400**	**$24,921**	**$1,120**	**$1,955**	**$29,396**

[1] Assumes 4 signs per facility at a cost of $50 per sign.

[2] The technical labor cost was calculated assuming 4 hours per month (48 hr/yr) to collect required data and prepare report at a technical labor cost of $74.17 per hour. The technical labor cost was determined using an average hourly wage of $37.89 obtained from the Bureau of Labor Statistics (BLS) wage estimates for NC for Architecture and Engineering Occupations. A benefits percentage of 30.5% and an overhead percentage of 50.0% was used to get the final labor cost.

[3] Clerical labor assumed to 10% of total technical labor or 4.8 hr/yr. Clerical labor cost estimated to $33.34 per hour using an average hourly wage of $17.03 from the BLS NC wage estimates for Office and Administrative Support Occupations. A benefits percentage of 30.5% and an overhead percentage of 50.0% were used to get the final labor cost.

[4] Managerial labor assumed to 5% of total technical labor or 2.4 hr/yr. Managerial labor cost estimated to $116.35 per hour using an average hourly wage of $59.44 from the BLS NC wage estimates for Management Occupations. A benefits percentage of 30.5% and an overhead percentage of 50.0% were used to get the final labor cost.

State Government Impacts

Again, only the control regulatory option will impact state government. Currently, there are five permitted log fumigation facilities, but only four are currently operating. Each of these facilities holds a synthetic minor permit, which limits them to less than 10 tons per year of hazardous air pollutant (HAP) emissions. The DAQ has received four new permit applications, three of these applications were for synthetic minor permits and one was for a Title V permit. The Title V permit has since been withdrawn due to public pressure during the permit public hearing and the uncertainty of future regulations for log fumigation. Because of this, the DAQ does not anticipate any future Title V permits. Title V permits apply to sources that emit more than 10 tons per year and are subject to 02Q .0500 rules. These facilities are spread out across North Carolina and would be overseen by the Fayetteville, Raleigh, Washington, and Wilmington Regional Offices.

As a result of the new log fumigation rule, the DAQ will require a permit modification for the existing facilities. Currently in 2018 dollars, a synthetic minor permit modification costs $400. Therefore, DAQ will receive a total of $2,000 from the existing facilities.

The State Government costs are presented in Table 7 and are estimated in 2018 dollars. For both new and existing facilities, either a new permit or a permit modification would be required. None of the existing or proposed facilities would be permitted by local air quality agencies, therefore, we do expect any cost impacts to these agencies as a result of the proposed rule. For facilities permitted by the State, the proposed rule would require these facilities to meet an AAL and other monitoring, recordkeeping and reporting requirements of the rule. Even though the existing facilities would keep their same permit class and be classified as a synthetic minor permit, the DAQ will incur added hours to either develop new permits or review the permit modification application and complete all compliance activities. The DAQ estimates a total of 288 staff hours, which include the hours for a Permit engineer, a Compliance Engineer, an Engineer I, an Engineer II, a Meteorologist, and a Supervisor to complete both initial permit development, permit modification, modeling review and compliance activities as a result of the new rule. Even though the DAQ's current permitting and compliance program budget will absorb these additional activities, the salaries and benefits for these staff categories that are involved in performing the permit modification review and complete compliance activities are estimated to be $17,241 in 2018 dollars as result of the rule change.

Table 7. State Government Costs

State Government Costs	***4 Existing Facilities***	***3 New Facilities***	***Total Hours***	***Total Compensation ($/hr)***[1]	***Total DAQ Cost***
	Hours				
Initial Permit Development Hours					
Permit Engineer		80	80	49	$ 3,922
Modeling Review Hours					
Meteorologist	32	112	144	47	$ 6,712
Permit Review Hours					
Engineer I	30	30	60	40	$ 2,413
Engineer II	30	30	60	49	$ 2,941
Supervisor	8	8	16	63	$ 1,013
Compliance Hours					
Compliance Engineer	2	4	6	40	$ 241
				Total	$ 17,241

[1] To estimate total compensation, assumed years of service for the following work title categories on an average 5 years for Engineer I, 10 years for Engineer II, 20 years for Supervisor, 10 years for Meteorologist and compliance engineer. Also, an estimated 2080 works hours per years was used. Total Compensation is estimated from https://oshr.nc.gov/state-employee-resources/classification-compensation/total-compensation-calculator

Local Community Costs

The local community impacts are expected to be minimal. The proposed rule would only affect the fumigation subcontractors that are hired to fumigate the logs before shipping. Logging companies in North Carolina that ship logs overseas will have the option of either hiring a fumigation subcontractor that can comply with the rule, or use another option such as debarking to prepare logs for shipping overseas. The log exporters will still continue to ship logs and are not expected to have any local job impacts as a result of the proposed rule. There may be a local impact to the fumigation contractors as a result of the proposed rule. The number of employees that work for the fumigation industry in North Carolina was estimated to be 12. This estimate assumes two technicians and one supervisor at each of the four currently operational fumigation sites. Fumigation companies that choose to comply with the rule will continue to operate and will not experience any job losses. Fumigation companies that choose to close their log fumigation site may experience job losses as a result of the proposed rule. However, the proposed rule does not restrict these fumigation companies from the fumigation of other goods, such as tobacco or other agricultural products that require fumigation prior to be exported. As noted previously, these fumigation companies also provide other pest control services for buildings and facilities, food service operations, hospitals and healthcare offices, hospitality buildings, retail buildings, commodity storage buildings, milling operations, and other exports. Any local job losses as a result of fumigation site closures may be replaced by jobs from sites that debark the logs. Log debarking requires personnel to move logs in and out of the machine, operate the debarker, and remove the bark from the machinery. This is in addition to the personnel required to load the logs into the containers after they are debarked.

With regard to county or local property taxes, the four currently operational log fumigation sites are not owned by the companies. They rent space based on the number of containers that come onto the property. Therefore, the proposed rules would not have an impact on county or local property taxes.

Another issue that may affect the local community are tariffs on exports. Tariffs on logs shipped from the U.S. have made the demand for yellow pine and oak logs in China and India unpredictable. These tariffs are in retaliation to tariffs put on exports from these countries by the U.S. Future trade agreements between the U.S. and these countries may resolve this issue, but currently the demand for North Carolina timber has been volatile.

Some local communities will benefit from not having log fumigation facilities operating in their town or city. In 2018, an operating permit for a log fumigation operation that planned to emit 60 tons of methyl bromide per year was proposed at one of the existing permitted sites. During the public comment period for the proposed permit, the DAQ received 1,100 comments, with the majority opposing the issuance of the permit. The facility decided to withdraw their permit application and the landowner now does not allow log fumigation on the property.[19] Another company withdrew their log fumigation permit application which would have emitted 140 tons of methyl bromide per year as a result of the protests at public hearings and comments opposing the facility. The company has opted to prepare logs for shipment at that site using debarking methods, which does not require an air quality permit.[20] While these communities may lose jobs or tax income from log fumigation facilities, they will receive the health benefits from not having tons of HAP emitted in their town or city on a yearly basis.

VI. Public Health and Environmental Benefits

Methyl bromide, also referred to as Bromomethane within the trade, functions as a neurotoxin broad-spectrum pesticide for fumigation treatment of bark and wood boring beetles for the international exportation of whole logs to Asia.[21,22,23] The EPA first recognized methyl bromide on their HAP list in

[19] NC Department of Environmental Quality, Companies inform state officials fumigation operations will cease at site in Wilmington, March 29, 2018. https://deq.nc.gov/news/press-releases/2018/03/29/companies-inform-state-officials-fumigation-operations-will-cease
[20] NC Department of Environmental Quality, Memo: Malec Brothers Transport Permit Application Withdrawn, January 30, 2019. https://deq.nc.gov/news/press-releases/2019/01/30/memo-malec-brothers-transport-permit-application-withdrawn
[21] Clarke, Stephen R. and Nowak, J.T. *Forest Insect & Disease Leaflet 49* : *Southern Pine Beetle,* U.S. Department of Agriculture, Revised April 2009.
[22] http://www.ncforestservice.gov/forest_health/forest_insects.htm
[23] APHIS Treatment Manual Webpage available at: https://www.aphis.usda.gov/aphis/ourfocus/planthealth/import-information/SA_Quarantine_Treatments/CT_Quarantine-treatment

1990 as a transparent, tasteless, and odorless toxicant. Previously an odorant, chloropicrin (PS)[24], was added to methyl bromide to alert workers to the presence of the gas mixture (MeBr 98%, PS 2%)[25], however the toxicity of the odorant was found to greater than methyl bromide, so the industry removed it from the formula. Despite the planned total phaseout of methyl bromide by 2005 according to the Montreal Protocol[26], on January 2, 2003, the EPA instituted an exception for methyl bromide use for Quarantine and Preshipment, dubbed the QPS Rule.[27] This federal allowance provides the export logging industry an exception use for methyl bromide application to logs quarantined before shipment overseas to Asian markets where local governments require either debarking or fumigation of whole logs.
Sources for reliable health information on methyl bromide include the EPA's IRIS, the Agency for Toxic Substances and Disease Registry's (ASTDR) toxicological profile, and the EPA's Health Affects Assessment, INCHEM 2001 SIDS Report and Bromomethane Fact Sheet. Methyl Bromide at ambient atmospheric pressure exists as a gas above 4° Celsius (39.2° Fahrenheit). The primary risk of exposure to the public from QPS application involves inhaling methyl bromide in gaseous state just after the containers open for aeration. The APHIS manual describes the greatest risk of exposure occurs within the first hour of open aeration to the surrounding environment. Currently the fumigators in North Carolina open container doors after treatment with no stacks for dispersion, technology to capture, or site-specific modeled buffer zone to protect public health beyond the fumigation site's boundary. This proposed rule introduces air quality methods to protect public health from this emerging toxicant for persons outside the facility's property line where none previously existed.

Human Health Benefits from Reduced Risk of Exposure to Methyl Bromide

On February 22, 2019, the DEQ presented a document for methyl bromide air quality recommendations to the Secretaries' Scientific Advisory Board (SAB) relating extensive toxicological research on the health outcomes from methyl bromide exposure.[28] In this document, the DEQ determined that fumigation with methyl bromide poses a potential inhalation risk to the public. Methyl bromide once inhaled through the mouth or nose readily adsorbs and rapidly distributes to target tissues causing damage within the human body including to the respiratory, nervous and cardiovascular systems, the kidneys, and the liver. In addition, developmental effects have been reported in both human and animal studies. As with other toxicants, the goal in setting an AAL is to provide a level of health protection for the general public to prevent symptoms at the property boundary of a permitted facility. The general public includes sensitive subgroups of the population not found in the fumigation workforce. Sensitive subgroups of North Carolina citizens include infants, children, the elderly, and persons with pre-existing health conditions such as chronic respiratory disease, cardiovascular disease, liver disease, and kidney disease. Beyond the

[24] Centers for Disease Control (CDC) NIOSH Index for Lung Damaging Agents: Chloropicrin (PS) https://www.cdc.gov/niosh/ershdb/emergencyresponsecard_29750034.html
[25] (bromo-o-gas): methyl bromide 98%, chloropicrin 2% https://www3.epa.gov/pesticides/chem_search/ppls/005785-00042-19871105.pdf ; http://fs1.agrian.com/pdfs/Brom-O-Gas_2_(Bog2-2_Revar-42-X)_Label.pdf
[26] Treaty signed by Lee M. Thomas for the United States of America as of 04-12-1988 coming into force on 1-1-1989 as agreed. Bromine is listed under Group II in the Table of Ozone Depleting Potential Substances.
[27] Protection of Stratospheric Ozone: Process for Exempting Quarantine and Preshipment Applications of Methyl Bromide (January 2, 2003, 68 FR 238).
[28] Risk Analysis and Acceptable Ambient Level Recommendation for Methyl Bromide, North Carolina Department of Environmental Quality Division of Air Quality, April 12, 2019. https://files.nc.gov/ncdeq/GenX/SAB/Methyl-Bromide-AAL-FINAL-0412019-signed.pdf

animal studies, researchers have discovered an increased neurotoxic sensitivity in a large segment of the human population due to genetic polymorphisms not present in the mammalian species studied under lab conditions. Therefore, the health effects of methyl bromide in humans varies due to age, pre-existing health conditions, and an individual's genetic predisposition.

Inhalation of methyl bromide at chronic levels frequently leads to a spectrum of neurological effects with initial symptoms developing several hours or even weeks after exposure including headache, dizziness, nausea, confusion, agitation, fatigue, numbness, slurred speech, and visual disturbances. Neurological effects may develop into ataxia (loss of muscle control), muscle tremors, seizures, and coma at increasing levels of exposure. Of noted concern, the exposure-response curve of methyl bromide is steep, meaning a slight increase in exposure concentration results in an atypically rapidly escalating severity of symptoms relative to many other inhalation hazards. Other symptoms reported after acute inhalation exposure include nasal and lung tissue irritation-damage, lung edema, kidney damage, liver damage, unconsciousness, and death. The cancer potential of methyl bromide associated with inhalation exposures is uncertain, with the EPA classifying it as "Class D; not classifiable as to human carcinogenicity" due to lack of appropriate animal or human studies. About 1,000 human poisoning incidents caused by methyl bromide exposure have been documented (as of 1993), with effects ranging from skin and eye irritation to death.[29] While quantifying the specific value of the proposed rule for prevention of the above symptoms from methyl bromide inhalation remains beyond the ability of state personnel to reliably calculate, logically, prevention of any of the above symptoms holds value to the state and our citizens. The delayed exposure-effect response, lack of taste or odor recognition, and the lack of measurements of exposure concentrations further limit the ability to quantify impacts. Regardless, the risk for adverse effects exists at exposures above the proposed AAL. Prevention would minimize risk of lowered productive work hours, health care visits, and hospitalization costs.

While the DAQ was unable to reliably estimate the cost impacts as the result of lowered work production, health care visits, and hospitalization costs, the DAQ has approximated the population of citizens adjacent to log fumigation operations that may have experienced acute methyl bromide exposures (exposures of 24 hours or less) or longer-term chronic exposures. Due to the absence of exposure concentration measurements, this was done by modeling the maximum daily emissions for the four sites that are currently operating. The maximum daily emissions were calculated using the maximum monthly methyl bromide usage and assuming aeration occurs 15 days per month. Using the monthly data and the number of aeration days, the maximum daily emissions from one of the aeration days was calculated. The emissions from each site were assumed to be emitted between the hours of 8:00 am and 4:00 pm and were modeled as volume sources using a 24-hour averaging period. A volume source of pollution is a three-dimensional source of pollutant emissions and the model determines the ground level dispersion of the pollutant emissions from this source. Meteorological data from the 2013-2017 time period were used in the model to estimate the dispersion of the methyl bromide. The minimum and maximum dispersion concentrations at the fenceline calculated by the model are presented in Table 8. The model also calculated the distance from the source where the concentration of the methyl bromide dispersion was below the proposed AAL from the emission source. The population was calculated by mapping the maximum modeled dispersion distance as a radius of a circle around each facility and summing the

[29] Cornell Cooperative Extension, Pesticide Management Education Program, Pesticide Information Profile – Methyl Bromide. http://pmep.cce.cornell.edu/profiles/extoxnet/haloxyfop-methylparathion/methyl-bromide-ext.html

population of the census block groups within each zone. A block group is a subdivision of a census tract, typically including about 1,500 people. Smaller block groups are located in more densely populated areas, and larger block groups are located in more rural areas. In cases where the circle surrounding each emission source site encompasses only a portion of the census block, the entire block was included in the population estimate because the location of households within a block group is unknown. Note there is a margin of error in the population estimates at the granular block group level.

Table 8 provides a summary of the affected populations using the census block groups. The River Road and Port facilities had the highest number of affected population, because both sites are located in New Hanover County, which is a highly populated county. The other facilities are located in more rural counties, Chadbourne in Columbus County and Flowers in Wayne County. The DAQ estimates the total number of people that may be exposed to methyl bromide above the proposed concentration of 0.005 milligrams per cubic meter (mg/m^3) from existing operations is 150,000. Note that the dispersion circles for the Port and River Road facilities overlapped, therefore the populations were combined to prevent overlap of the census blocks. This analysis provides an estimate of the order of magnitude of the population affected by existing operations, based on modeling and demographic data. However, there is a high degree of uncertainty in this estimate due to the lack of exposure concentration measurements.

As shown in the table, the methyl bromide concentrations ranged from 0.613 to 29.0 mg/m^3 (0.16 to 7.4 parts per million or ppm) at the fenceline of the fumigation sites. With ground level dispersion, the methyl bromide concentration decreases as the distance from the property increases. Health outcomes for the population that is exposed to methyl bromide emissions vary depending on the concentration and the duration of exposure. The 1992 IRIS assessment[30] found health effects in animals from chronic exposure to methyl bromide inhalation. These health effects include degenerative and proliferative lesions of the olfactory epithelium in the nasal cavity at 12 mg/m^3 (3 ppm) levels, basal cell hyperplasia and decrease in relative kidney weight at 120 mg/m^3 (30 ppm), and decrease in absolute brain weight and body weight, heart lesions, metaplasia (atypical tissue transformations), myocardial degeneration, thrombus, and mortality at 350 mg/m^3 (90 ppm). While the maximum concentrations from modeling for the current operating facilities are below the concentrations where adverse health outcomes in animals were observed, humans are assumed to be more sensitive to methyl bromide than animals. A subset of humans, roughly 60-70 percent,[31] has a special genetic variation that metabolizes methyl bromide into a more toxic compound within the individual. Based on this percentage, 91,000 to 107,000 of the estimated population may have this special genetic variation.

[30] U.S. Environmental Protection Agency, Bromomethane Integrated Risk Information System (IRIS) Chemical Assessment Summary, 1992.
https://cfpub.epa.gov/ncea/iris/iris_documents/documents/subst/0015_summary.pdf#nameddest=rfc

[31] Risk Analysis and Acceptable Ambient Level Recommendation for Methyl Bromide, North Carolina Department of Environmental Quality Division of Air Quality, April 12, 2019. https://files.nc.gov/ncdeq/GenX/SAB/Methyl-Bromide-AAL-FINAL-0412019-signed.pdf

Table 8. AERMOD Results for Methyl Bromide Emissions at Currently Operating Facilities

Site Name	Approximate Property Acreage	Volume Source Modeled Emissions (lb/day)	Dispersion Minimum Model Result (mg/m^3)	Dispersion Maximum Model Result (mg/m^3)	Dispersion Buffer to < AAL (m)	Number of People Who May Benefit
Chadbourne	20.4	239	0.7452 (0.19 ppm)	5.7252 (1.5 ppm)	5,289 (3.28 miles)	7,251
River Road	2.15	342	7.0743 (1.8 ppm)	24.0282 (6.2 ppm)	6,904 (4.28 miles)	125,211
Port	272	361	0.6130 (0.16 ppm)	4.4299 (1.1 ppm)	7,067 (4.38 miles)	
Flowers	22	1,155	4.9184 (1.3 ppm)	28.9949 (7.4 ppm)	7,091 (4.40 miles)	19,987
Total						152,449

In addition to the animal studies, the DAQ recommendation report[32] reviewed occupational health values and compared these values with IRIS exposure guidance levels. The Occupational Safety and Health Administration (OSHA) lists the permissible exposure limits (PEL) as 78 mg/m^3 (20 ppm). This OSHA PEL was developed to protect workers during an 8-hour work day and 40-hour work week.[33] The National Institute for Occupational Safety and Health (NIOSH) lists the "immediately dangerous to life and health" (IDLH) value at 970 mg/m^3 (250 ppm).[34] Both of these values are much higher than the dispersion concentrations that were estimated at the fenceline, however these values are intended to be protective of a healthy adult working population and does not take into account sensitivities of the general population, which includes infants, children, the elderly, and persons with pre-existing conditions or a genetic predisposition to increased susceptibility to methyl bromide exposure. The proposed AAL is also based on the IRIS value which is derived using more current study data than the data used for the OSHA and NIOSH values.

None of the studies referenced in this fiscal note provided any data related to specific human health outcomes as a result of exposure to methyl bromide. As a result, the DAQ is unable to quantify the cost benefit for regulating emissions of methyl bromide from log fumigation. It was previously noted in this section that approximately 1,000 human poisoning incidents have occurred since 1993. While the DAQ does not have reports of injuries as a result of inhalation of methyl bromide in North Carolina, we believe

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[32] Risk Analysis and Acceptable Ambient Level Recommendation for Methyl Bromide, North Carolina Department of Environmental Quality Division of Air Quality, April 12, 2019. https://files.nc.gov/ncdeq/GenX/SAB/Methyl-Bromide-AAL-FINAL-0412019-signed.pdf

[33] U.S. Department of Labor, Occupational Safety and Health Administration, Permissible Exposure Limits /OSHA Annotated Table Z-1. https://www.osha.gov/dsg/annotated-pels/tablez-1.html

[34] Center for Disease Control, National Institute for Occupational Safety and Health, Methyl bromide. https://www.cdc.gov/niosh/npg/npgd0400.html

that prevention of the above negative health effects from methyl bromide inhalation holds value to the state and our citizens.

Environmental Benefits

Methyl bromide readily evaporates from open air bodies of water. In instances of deposition from methyl bromide fumigation, the toxicant gas quickly escapes past the surface of the water due to evaporative transfer. Only in a laboratory setting with zero available surface water to air contact was methyl bromide shown to impact aquatic life. Therefore, this rule will provide no benefit to water sources, as methyl bromide is not a recognized aquatic hazard.[35] Once emitted from a source, methyl bromide remains close to the ground surface for up to year and a half before breaking down chemically.[36] This allows time and exposure potential for native North Carolinian beneficial insects, animals, and plants to come into contact with the toxicant. Despite this risk of exposure, terrestrial studies on egg laying hens showed no harmful impact from eating food treated with methyl bromide.[37] Animals face the same inhalation danger as humans from methyl bromide fumigation. Additionally, a crop of rice showed no impact from methyl bromide exposure.[38] Because the rule proposes an AAL protective of human health, the surrounding plants, insects and wildlife will also benefit from this protection or see no change. This rule does not cause harm to the existing native life in the environment surrounding a permitted facility.

The EPA commissioned INCHEM to produce a Screening Information Data Set for Methyl Bromide finalized in 2001. This report concluded: "because of its long half-life in the lower atmosphere and consequent eventual dispersion to the upper atmosphere, methyl bromide may be dissociated to form activated bromine species that may have a depleting effect on ozone."[39] Exact figures for the benefit of this rule in regards to the stratospheric ozone are impossible to quantify with practical and technological limitations, but it follows logic a reduction in a precursor to known ozone depleting compounds would provide some benefit even if marginal in scale.

VII. Cost and Benefit Analysis

The DAQ developed a cost and benefit analysis of the proposed rule 15A NCAC 02D .0546 and the amendment to 15A NCAC 02D .1104. The analysis is based on the three most likely compliance scenarios that are most likely to be pursued by the affected facilities. This analysis uses the cost impacts developed in the previous sections for the private sector and state government.

The fiscal analysis was performed over a 2-year period for two reasons. First, costs to both the private sector and state government are expected to remain constant after the second year of the fiscal analysis and these Year 2 costs will continue for the lifetime of the facility. Second, estimating costs for compliance beyond 2 years is difficult due to changes in markets that influence the compliance and operations decisions made by affected facilities. As discussed previously, the DAQ determined the most

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[35] INCHEM, MeBr Report, 2001, page 4 available at: http://www.inchem.org/documents/sids/sids/methbrom.pdf
[36] INCHEM, MeBr Report, 2001, page 9 available at: http://www.inchem.org/documents/sids/sids/methbrom.pdf
[37] INCHEM, MeBr Report, 2001, page 23 available at: http://www.inchem.org/documents/sids/sids/methbrom.pdf
[38] INCEM 2001 MeBr Report p. 23 available at: http://www.inchem.org/documents/sids/sids/methbrom.pdf (Id.)
[39] INCEM 2001 MeBr Report p. 23 available at: http://www.inchem.org/documents/sids/sids/methbrom.pdf (Id.)

likely regulatory outcomes are that the facilities would install and operate control equipment to meet the proposed AAL, move the fumigation operation to another state, or debark logs prior to shipment.

For the control technology option, the DAQ developed a table laying out the estimated cash flows for the analysis from 2019, in which the proposed rule is expected to be finalized, through 2020, one year later. The greatest cost impact occurs in 2019 when the four currently operational facilities must modify their permits, purchase and install control equipment prior to the rule being published. In addition to the cost impacts for existing facilities, new facilities will need purchase or lease additional property and install the appropriate controls to be able to meet the proposed AAL. In 2020 and subsequent years, the costs and benefits are limited to those associated with the annual operation of the control equipment, recordkeeping, and reporting costs.

The DAQ then calculated the total financial impact for each year by adding the costs and subtracting savings or benefits. Table 9 presents the cash flows and the summation of the impacts. Over 2 years, the proposed rule would cost the private sector and state government approximately $2.0 million in 2018 dollar terms.[40] As discussed in Section VI, the consequences from exposure to methyl bromide results in negative health outcomes. The value of the benefits of reducing the risk of exposure to methyl bromide could include the avoided cost of healthcare, lost work hours and earnings, permanent disability, or premature mortality. The goal of the proposed rule is to minimize these consequences and to protect public health. Control technology would reduce emissions of methyl bromide by at least 90 percent, which would be a reduction of approximately 45 tons of methyl bromide per year from the existing facilities. This rule would also reduce the fenceline concentration from an average of 0.515 to less than 0.005 milligrams per cubic meter, a reduction of nearly 99 percent. Although not quantified, the avoidance of impacts associated with exposure to this neurotoxin are of great value to the general public.

The State of North Carolina requires calculating whether a new or revised regulation has a "substantial economic impact." Substantial economic impact is defined in North Carolina's Administrative Procedures Act in NC General Statute 150B-21.4, Fiscal and Regulatory Impact Analysis on Rules as an aggregate financial impact on all persons affected of at least one million dollars in a 12-month period. The highest aggregate 12-month quantified impact is $1.5 million for this rule, excluding unquantified costs and benefits. Therefore, the proposed rule and amendments are considered to have a substantial economic impact on North Carolina. Over two years, the proposed rule would cost the private sector and state government approximately $2.0 million in 2018 dollar terms.

[40] The total impact of the proposed rules over the next 2 years, in 2018 dollar value terms, was calculated by computing the "net present value" of the rule. This calculation allows for an apples-to-apples comparison of future costs and benefits on a common dollar value basis. The method accounts for the "time value of money," the concept that money is worth more in the near term than in the long term because of the capacity to earn interest over time. The present value of a future stream of costs and benefits answers the question, "What is the investment/action worth to me in today's dollar value equivalent?" Different investments/actions can be accurately compared using their net present values.

Table 9. Analysis of Costs and Benefits Associated with Proposed 15A NCAC 02D .0546 Control Technology Option

Costs/Benefits	Year 2019	Year 2020
Private Sector Costs		
Permit Application Fee	$1,600	
Annual Control Cost[1]	$1,035,201	$1,035,201
Installation of Stack & Fan	$52,782	
Modeling, Data Gathering & Testing[2]	$182,455	
Reporting & Recordkeeping	$27,996	$27,996
Warning Signs	$1,400	
Total Private Sector Costs	$1,301,433	$1,063,197
State/Local Government Costs		
Permit Application Fee	-$1,600	
Permit Development	$3,922	
Meteorologist	$6,712	$6,712
Permit Review	$6,367	
Compliance	$241	$241
Total Government Costs	$15,642	$6,953
Local Community Costs and Benefits		
Job Impacts	$0	$0
Health Benefits	----	----
Total Local Community Costs and Benefits	$0	$0
Private Sector Benefits		
Modeling Contractors	$58,324	
Testing Contractors	$100,800	
Sign Makers	$1,400	
Total Private Sector Benefits	$160,524	
Total Impact (+Cost -Savings)	$1,156,551	$1,070,150

Net Present Value of Quantified Impacts	**$2,015,599**
Substantial Impact Analysis	**$1,477,599**
Local Community Health Benefits	**See Note**

[1] Includes control costs for 4 currently operational synthetic minor facilities and 3 new synthetic minor facilities. Control costs are based on Nordiko technology and sending the waste to a landfill.

[2] Includes $14,400 for testing costs, $3,333 for data collection, and $8,332 for modeling costs per facility.

Note: The health benefits for local communities were unable to be quantified. See the "Human Health Benefits from Reduced Risk of Exposure to Methyl Bromide" section in the fiscal note for information on the potential benefits.

For the option of fumigating logs outside the State of North Carolina, the DAQ looked at the impact of potential lost jobs to the fumigation industry. We estimated a total of 12 people are employed in the fumigation field, with four being supervisors and eight being technicians. While it is possible that these workers may continue to fumigate other agricultural products or be transferred to log fumigation locations outside the state, the DAQ assumed that these were job losses. Using a loaded managerial hourly rate of $77.57 per hour which includes a benefits percentage of 30.5 percent and no overhead, a loaded technical hourly rate of $49.45 per hour which includes a benefits percentage of 30.5 percent and no overhead, and a total annual number of 2,080 hours per year, the potential income loss for the 12 workers would be $1.5 million for the first year. It was assumed that these workers would find comparable paying jobs in the future years, therefore the job impacts costs in subsequent years is assumed to be zero. The DAQ would lose revenue from permitting fees as a result of companies moving their fumigation services out of state. There are additional costs associated with moving logs to fumigation sites outside the state.

These include the costs for additional gasoline for the hauling trucks and additional working time needed for drivers. The DAQ estimated these costs to be $1.5 million for the four currently operating facilities and 3 new facilities. There also benefits associated with this option for the truckers whom would receive an additional $0.64 million of wages and benefits from trucking the logs to ports outside of North Carolina. This benefit was calculated using the wage and benefits factor of $0.729 per mile from the ATRI document, an average mileage of 170 miles to the closest port outside of North Carolina, and 733 containers per year for each of the four currently operating facilities and 3 new facilities.

The DAQ then calculated the total financial impact for this option of moving fumigation operations outside the state of North Carolina by adding the costs and subtracting savings or benefits over two years. Table 10 presents the cash flows and the summation of the impacts. Over two years, the proposed rule would cost the private sector and state government approximately $2.9 million in 2018 dollar terms. However, this option would significantly reduce the amount of methyl bromide that is emitted into the atmosphere, and hence reduce the risks associated with exposure to this neurotoxin.

Table 10. Analysis of Costs and Benefits Associated with Proposed 15A NCAC 02D .0546 Fumigation Moved to Other States

Costs/Benefits	***Year 2019***	***Year 2020***
Private Sector Costs		
Additional Shipping Costs[1]	$1,475,679	$1,475,679
Total Private Sector Costs	$1,475,679	$1,475,679
State/Local Government Costs		
Permit Application Fee	$1,600	
Total Government Costs	$1,600	$0
Local Community Costs and Benefits		
Job Impacts[2]	$1,468,165	$0
Health Benefits	----	----
Total Local Community Costs	$1,468,165	$0
Private Sector Benefits		
Trucking[3]	$636,174	$636,174
Benefit of no Permitting Fee	$1,600	
Total Private Sector Benefits	$637,774	$636,174
Total Impact (+Cost -Savings)	$2,307,670	$839,505

Net Present Value of Quantified Impacts	**$2,889,957**
Substantial Impact Analysis	**$3,583,218**
Local Community Health Benefits	**See Note**

[1] Additional trucking costs calculated using a truck cost of $1.691 per mile, 170 additional miles per container, and 733 containers for each of the 4 facilities.

[2] Estimated job income loss of 12 fumigation workers during the first year. Assumed workers will receive comparable income in subsequent years.

[3] Trucking benefits calculated using a wage/benefits factor of $0.729 per mile, 170 additional miles per container, and 733 containers for each of the 4 facilities.

Note: The health benefits for local communities were unable to be quantified. See the "Human Health Benefits from Reduced Risk of Exposure to Methyl Bromide" section in the fiscal note for information on the potential benefits.

For the log debarking option, the DAQ considered the cost of purchasing log debarking equipment, the potential job loss to the fumigation industry in North Carolina, and the sale of bark from the debarking operation. For the equipment cost, we contacted several vendors of debarking equipment and estimated the cost of an installed debarking system to be $413,250. Also length and width of the logs that are to be debarked are a factor in the price for the equipment. Operating costs were estimated to be $84,730 per year for a logging equipment operator. This cost was estimated using the BLS North Carolina wage estimate for a logging equipment operator (Occupational Code 45-4022) of $20.81 per hour. A benefits percentage of 30.5%, an overhead percentage of 50.0%, and a total of 2,080 hours per year were used to estimate the final annual labor cost. Assuming that all of the log fumigation sites are converted to log debarking sites (4 existing, 3 new), the costs for the debarking equipment was estimated to be $2.9 million and the operating cost was estimated to be $0.59 million per year. The DAQ estimated the value of the bark to be $1.2 million per year. This value was calculated using the following assumptions, an average volume of bark from a tree of 12 percent,[41] a percentage of logs in a container of 80 percent, a volume of 2,700 cubic feet for the container, and a value of $25 per cubic yard for the bark as mulch. The DAQ would lose revenue from permitting fees as a result of companies no longer fumigating logs in the state.

The DAQ then calculated the total financial impact for this option by adding the costs and subtracting savings or benefits over two years. Table 11 presents the cash flows and the summation of the impacts. Over two years, the proposed rule would cost the private sector and state government approximately $1.5 million in 2018 dollar terms. Again, this option would significantly reduce the amount of methyl bromide that is emitted into the atmosphere, and hence reduce the risks associated with exposure to this neurotoxin.

VIII. Rule Alternatives

The DAQ is required to analyze alternative approaches under the proposed rulemaking if a substantial economic impact to the state and/or private sector entities is expected to result from the rulemaking. The alternatives to the proposed rulemaking are discussed below.

The first alternative is for North Carolina to take no action on the proposed log fumigation rule. This alternative may have a negative effect on the citizens of North Carolina because of the interest in increasing production of log fumigation in this state. Methyl bromide is a HAP and is currently uncontrolled, which means that 100 percent of the emissions are emitted to the atmosphere. As discussed in the previous section, methyl bromide is a neurotoxin that impacts the health of people with chronic respiratory disease, circulatory conditions, children, elderly, liver disease, kidney disease, and certain humans with a special genetic variation metabolizing methyl bromide into an acutely toxic compound within the individual. This special genetic variation is estimated to be present in 60-70 percent of the human population.[42]

[41] U.S. Department of Agriculture, Forest Service Research Note, Bark and Its Possible Uses, FPL-091, Revised 1971. https://www.fpl.fs.fed.us/documnts/fplrn/fplrn091.pdf

[42] Risk Analysis and Acceptable Ambient Level Recommendation for Methyl Bromide, North Carolina Department of Environmental Quality Division of Air Quality, April 12, 2019. https://files.nc.gov/ncdeq/GenX/SAB/Methyl-Bromide-AAL-FINAL-0412019-signed.pdf

Table 11. Analysis of Costs and Benefits Associated with Proposed 15A NCAC 02D .0546 Log Debarking

Costs/Benefits	***Year 2019***	***Year 2020***
Private Sector Costs		
Debarking Machines	$2,892,750	
Operating Costs	$593,110	$593,110
Total Private Sector Costs	$3,485,860	$593,110
State/Local Government Costs		
Permit Fee	$1,600	
Total Government Costs	$1,600	$0
Local Community Costs and Benefits		
Job Impacts[1]	$0	$0
Health Benefits	----	----
Total Local Community Costs	$0	$0
Private Sector Benefits		
Sale of Bark[2]	$1,232,000	$1,232,000
Benefit of No Permit Fee	$1,600	
Total Private Sector Benefits	$1,233,600	$1,232,000
Total Impact (+Cost -Savings)	$2,253,860	-$638,890

Net Present Value of Quantified Impacts	**$1,548,380**
Substantial Impact Analysis	**$4,721,060**
Local Community Health Benefits	**See Note**

[1] The impact of losing log fumigation jobs are assumed to be offset by the gain in debarking jobs. However, those debarking jobs may not be located within the local community.

[2] The value of the bark generated from the debarking process is calculated assuming a value of $25/yard, container size of 2,700 ft3, 80% container log capacity, and 733 containers per year for each of the 4 existing facilities.

Note: The health benefits for local communities were unable to be quantified. See the "Human Health Benefits from Reduced Risk of Exposure to Methyl Bromide" section in the fiscal note for information on the potential benefits.

The second alternative is for North Carolina would be to set a control technology standard. The control technology standard would require that facilities capture and control HAP emissions by a defined percentage. The technologies presented in Option 4 achieve approximately 90 percent reduction of HAP, and could be used to set a standard. This alternative would achieve significant reductions of HAP, however, it still may not protect the public from exposure to the HAP. This exposure would depend on the size of the facility, frequency and timing of the aerations. This alternative would come at a much higher cost in comparison to the proposed standard. This alternative would require periodic testing of the capture and control system to ensure it is compliance with the control technology standard. In addition, this alternative would increase recordkeeping and reporting costs to the facility.

A third alternative would be to develop a rule that has an emission limit, such as, limiting the amount of HAP that could be released per day or month. The emission limit would be difficult to determine because of the various sizes of the properties and would limit the production capability of the facility. Again, a limit may not be protective of HAP exposure from the facility, because the HAP could be released in a short period of time. This could potentially expose the public to a high concentration of HAP.

The DAQ determined that the development of a rule based on the facility meeting an AAL provided the most flexibility for the fumigation companies, but also provided protection to the citizens of North Carolina. There were several rule alternatives that were explored for this AAL approach which included; choosing between a reference concentration or an occupational-based threshold for the AAL value, and determining an appropriate averaging time. For the AAL value, the DAQ determined that the occupational values are not inclusive of all validated studies in the current database of methyl bromide toxicity studies and do not apply health-value derivation methods appropriate for protection of the general public. The DAQ concluded that the IRIS reference concentration was developed with a margin-of-safety to be protective over a life-time of exposures to all segments of the population, whereas occupational values were developed to be protective of a "healthy worker" population over a very reduced exposure duration. Based on this assessment, The DAQ determined that the IRIS reference concentration be proposed as the AAL for chronic (long-term) exposure to methyl bromide. With regard to the averaging time for the AAL, the DAQ considered different chronic averaging times that would be protective of the general public including sensitive sub-groups. Based on this evaluation, the DAQ determined that the 24-hour averaging time addresses the concerns associated with the rapid uptake and distribution of methyl bromide following inhalation exposures, the lack of odor, taste or color to alert persons to a methyl bromide exposure. The 24-hour averaging time also provides protection for delayed recognition of exposures at harmful concentrations, and concerns associated with the segment of the human population that has increased susceptibility to neurotoxic effects due to genetic polymorphisms. A more detailed explanation of the alternatives that were considered can be found in the DAQ recommendation report submitted to the North Carolina SAB[43].

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[43] Risk Analysis and Acceptable Ambient Level Recommendation for Methyl Bromide, North Carolina Department of Environmental Quality Division of Air Quality, April 12, 2019. https://files.nc.gov/ncdeq/GenX/SAB/Methyl-Bromide-AAL-FINAL-0412019-signed.pdf

IX. Conclusion

As stated previously in this analysis, the DAQ is concerned about the potential chronic and acute exposures to the general public from methyl bromide. Methyl bromide is a hazardous air pollutant and is highly toxic to human health. Studies suggest that acute inhalation exposures to methyl bromide may severely injure lungs. Acute and chronic inhalation of methyl bromide can also lead to deleterious neurological effects in humans. There are currently no federal or state air quality regulations to protect the public from these particular emissions from log fumigation operations. Based on the increased activity of permit requests for this operation, the DAQ believes that a rule needs to be in place to protect human health from this HAP.

Based on the analysis of the possible options presented in this Fiscal Note, the installation of control technology to reduce the fenceline concentration, the moving of fumigation sites out of state, and the debarking of logs prior to shipment are the most likely outcomes for this industry. As discussed in Section VII, the total impact for the control option in the first year was estimated to be $1.2 and the total impact in the second and subsequent years was $1.1 million dollars. The total impacts for the option of moving fumigation out of state was estimated to be $2.3 million in the first year and $0.84 million in the second and subsequent years. For the debarking option, the total impacts were estimated to be $2.3 million for the first year and -$0.64 for the second and subsequent years. While these options all have varying impacts on the State of North Carolina, all of these options protect the citizens from the harmful effects of methyl bromide and other HAP that may be used as a fumigant. As shown in Table 8, approximately 100,000 North Carolinians may have been exposed to methyl bromide concentrations that are above levels that have caused health effects in animals. These health effects include degenerative and proliferative lesions of the olfactory epithelium in the nasal cavity at 3 ppm levels, basal cell hyperplasia and decrease in relative kidney weight at 30 ppm, and decrease in absolute brain weight and body weight, heart lesions, metaplasia, myocardial degeneration, thrombus, and mortality at 90 ppm. While the range of fenceline concentrations of 0.16 to 7.4 parts per million for the current operating facilities are below the concentrations where adverse health outcomes in animals were observed, humans are assumed to be more sensitive to methyl bromide than animals. The risk assessment for humans errs on the side of health protection and sets a margin-of-safety intended to be protective of sensitive human subpopulations. Therefore, the DAQ determined that IRIS program chronic inhalation reference concentration is the most appropriate value for the proposed AAL and the impacts associated with the implementation of this proposed rule are appropriate to protect all persons that may live or work in areas subject to repeated airborne releases of methyl bromide from fumigation operations.

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Addendum to Approved Fiscal Note

INTRODUCTION

This Addendum estimates and compares the costs and benefits of three potential emission control requirements for hazardous air pollutant and toxic air pollutant emissions from bulk, chamber, and container log fumigation operations. The proposed requirements would limit the concentration of methyl bromide or other HAP fumigants beyond the fence line of a facility, reducing human exposure and associated risk of neurological and respiratory health effects.

In June 2019, the agency proposed an acceptable ambient level (AAL) for the fumigant methyl bromide (also known as bromomethane) of 0.005 mg/m^3 with a 24-hour averaging period. In response to public comments, the DAQ is considering three options as potential AALs for methyl bromide and seeking further public input based on this new analysis. Including the previously proposed option, the AAL options are:

- 0.005 mg/m^3 with a 24-hour averaging time;
- 0.078 mg/m^3 with a 24-hour averaging time; and
- 0.005 mg/m^3 with an annual averaging time paired with 0.078 mg/m^3 with a 24-hour averaging time.

The pollutant concentration threshold and the averaging time are both important considerations for any methyl bromide control requirement. The fumigants used in this process have potentially severe chronic (long-term) and acute (short-term) neurological and respiratory human health effects. Methyl bromide emissions from fumigation operations are generally continuous throughout the year with periods of higher concentrations. Typically, logs are placed in a container, chamber, or covered by a tarp and exposed to the fumigant over a period of 14 to 72 hours and then the fumigant is vented to the atmosphere during the aeration process. Among populations adjacent to log fumigation operations, exposure to methyl bromide may be both chronic and acute.

In addition to these AAL options, this Addendum addresses issues raised by several commenters about the costs assumptions used in the approved Fiscal Note. A discussion of these issues and additional analyses are provided in the following sections below.

BACKGROUND

Prior to the public comment period for the proposed AAL of 0.005 mg/m^3 with a 24-hour averaging time, the Environmental Management Commission (EMC) requested comment on a value within a range of AALs from 0.005 mg/m^3 to 0.078 mg/m^3 for methyl bromide. The AAL value of 0.005 mg/m^3 is the upper bound value recommended by the SAB in their April 2019 meeting. The value was obtained from the 1992 Integrated Risk Information System (IRIS) assessment,[44] which set a human population chronic

[44] Integrated Risk Information System (IRIS) Chemical Assessment Summary, U.S. Environmental Protection Agency, National Center for Environmental Assessment, April 1, 1992. https://www.epa.gov/iris

inhalation reference concentration (RfC) based on laboratory animal inhalation exposure studies.[45] The 0.078 mg/m^3 AAL value is based on the minimal risk level (MRL) for intermediate exposure (15-364 day exposure period) from the April 2018 Draft for Public Comment Toxicological Profile for Bromomethane prepared by the Agency for Toxic Substances and Disease Registry (ATSDR), a federal public health agency of the U.S. Department of Health and Human Services.[46] A MRL is an estimate of the daily exposure of a human being to a chemical that is likely to be without an appreciable risk of deleterious effects (e.g., non-carcinogenic) over a defined exposure period. This definition differs from the IRIS RfC which is defined as an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure of a human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. While both the MRL and RfC for methyl bromide are protective of human health, both are intended for chronic exposures. The 0.078 mg/m^3 value was not discussed in the approved Fiscal Note, but was presented in the NC DEQ's *Risk Analysis and Acceptable Ambient Level Recommendation for Methyl Bromide*.[47]

The 0.005 mg/m^3 AAL value with an annual averaging time is based on comments received during the public comment period for the proposed Rule and amendment. Several commenters expressed concern with the 24-hour averaging time for the proposed AAL of 0.005 mg/m^3 for methyl bromide. The commenters agreed with the IRIS value of 0.005 mg/m^3 for chronic exposures; however, the commenters argued that the DAQ was inappropriately applying this value to an acute averaging time. They pointed out that the IRIS program's definition of chronic exposure is: *"Repeated exposure by the oral, dermal, or inhalation route for more than approximately 10% of the life span in humans,"* and recommended an annual averaging time. The commenters also stated that California, New York, and New Jersey use an annual AAL of 0.005 mg/m^3 and also have a short-term AAL of 3.9 mg/m^3 with 1-hour averaging time. While there is value in having both an acute and chronic AAL, the DEQ previously rejected the short-term AAL of 3.9 mg/m^3 with 1-hour averaging time in the *Risk Analysis and Acceptable Ambient Level Recommendations for Methyl Bromide*.[48] The SAB also expressed concern with the short-term AAL of 3.9 mg/m^3 with 1-hour averaging time in their December 2019 meeting. They had concerns with extrapolating the 2-hour exposure value in the reference documents for the value to a 1-hour exposure. The SAB also expressed concern with the uncertainty factors that were applied to the value and that there were no safety factors for sensitive subpopulations and the episodic nature of exposures. It was the consensus of the SAB that California's acute value of 3.9 mg/m^3 averaged over a 1-hour period was not scientifically adequate and was suspect for exposure characterizations in regulatory decision-making.

The paired AALs of 0.078 mg/m^3 with a 24-hour averaging time and 0.005 mg/m^3 with an annual averaging is the result of discussions with the SAB. The SAB noted that the 0.005 mg/m^3 value is intended to protect the public from continuous emissions of methyl bromide. However, when applied to intermittent emissions of methyl bromide, like log fumigation, it may be overly protective. The SAB stated it would ideal to have a short-term AAL to address acute effects of methyl bromide, but noted that the DEQ was uncomfortable with the acute values used by other states because of the available

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[45] See additional discussion on page 4 of the analysis

[46] A copy of this profile can be found at https://www.atsdr.cdc.gov/ToxProfiles/tp.asp?id=822&tid=160

[47] Risk Analysis and Acceptable Ambient Level Recommendation for Methyl Bromide, North Carolina Department of Environmental Quality Division of Air Quality, April 12, 2019. https://files.nc.gov/ncdeq/GenX/SAB/Methyl-Bromide-AAL-FINAL-0412019-signed.pdf

[48] See Page 19, *California's 1-hour REL Value*.

toxicological science. Therefore, without an acute standard, a shorter averaging time of 24-hours for the 0.005 mg/m^3 chronic value was recommended by the SAB because of the toxicity of the chemical. The SAB did find that the short-term ATSDR value of 0.078 mg/m^3 has potential to be utilized as a 24-hour AAL value. While intended for exposures from 15 to 364 days, the ATSDR value with a 24-hour averaging time would be protective of the public from short-term exposures of methyl bromide in conjunction with the chronic value of 0.005 mg/m^3 averaged annually to protect from long-term exposures.

DISCUSSION OF AAL OPTIONS

The DAQ is presenting three AAL options for consideration by the EMC for addressing methyl bromide emission from log fumigation activities. The first option, 0.005 mg/m^3 with a 24-hour averaging time, was evaluated in the previously approved Fiscal Note. In that Fiscal Note, the DAQ determined the most likely outcomes to be: installation of control technology; relocation of fumigation activities; or change to debarking to meet the proposed AAL. An analysis of the second option, 0.078 mg/m^3 with a 24-hour averaging time, and third option, paired AAL of 0.078 mg/m^3 with a 24-hour averaging time and 0.005 mg/m^3 with an annual averaging time, are provided in the following sections.

AAL of 0.078 mg/m^3 with a 24-Hour Averaging Time

While the 0.078 mg/m^3 value is intended for chronic exposures, the SAB in their December 2019 meeting stated that this value can reasonably be used with a 24-hour averaging time for short-term exposures but that it would need to be paired with the annual 0.005 mg/m^3 chronic value. However, we are including the 0.078 mg/m^3 with 24-hour averaging time alone as a potential AAL for consideration by the public.

The EMC requested public comment on an AAL value for methyl bromide within a range from 0.005 mg/m^3 to 0.078 mg/m^3. While the 0.0078 mg/m^3 value was discussed in the DAQ Risk Analysis and Acceptable Ambient Level Recommendation for Methyl Bromide, it was not analyzed in the approved Fiscal Note. The approved Fiscal Note provided the maximum 24-hour methyl bromide concentration at the fenceline in Table 1 using the average daily emissions from the four currently operating facilities.

Table A-1 presents the maximum 24-hour average fenceline concentrations before implementing any controls. Based on this modeling of current operations without any controls, all of the facilities' maximum concentrations exceed the fenceline AAL of 0.005 mg/m^3 averaged over 24 hours, and three of the facilities' maximum concentrations exceed the AAL of 0.078 mg/m^3 averaged over 24 hours.

These same modeling results were used to compare the maximum fenceline concentration after installing a fan and stack system with an AAL of 0.005 mg/m^3 and 0.078 mg/m^3 in Table A-1. The results of this analysis shown that none of the facilities would be able to meet the 0.005 mg/m^3 24-hour AAL with a fan and stack system, but all of the facilities would be able to meet the 0.078 mg/m^3 value with a 24-hour averaging time when a fan and stack system is used. Table A-2 estimates the number of containers that could be aerated and meet the AAL of 0.078 mg/m^3 with a 24-hour averaging time for each of the four currently operating permitted facilities that were modeled. The installation of the fan and stack system is the most likely outcome for complying with an AAL of 0.078 mg/m^3 with a 24-hour averaging time. Comments from industry on the previously proposed AAL of 0.005 mg/m^3 state that the installation of control technology, relocation of existing facilities, and debarking are cost-prohibitive, therefore, these options were not addressed in this analysis.

The modeling results show that the four currently operating permitted facilities would be able to meet the 0.078 mg/m^3 AAL with a 24-hour average if the facilities operated a fan and stack system to disperse methyl bromide emissions during the aeration process. While the Port facility would be able to meet this AAL option without a fan and stack system, the facility would be limited to aerating only two containers in a day. To increase the operational flexibility of the Port facility, the DAQ assumed that they would also install a fan and stack system to disperse the methyl bromide emissions from the containers. The costs for purchase and installation of a fan and stack system were estimated to be to be $7,125 for container ventilation system and $10,032 for a tarpaulin ventilation system (See Section V, Option 1 of the Fiscal Note). Labor costs for operating the fan system were estimated to be $16,000 to $73,000 per year, depending on the number of containers or piles that are aerated. For the purposes of this analysis, the average of the labor costs ($44,500) was used to estimate the labor costs of operating the aeration system. This analysis also includes the cost for modeling to show compliance with the AAL of 0.078 mg/m^3. The total impact was calculated to be $465,000 in the first year and $39,000 in the second year. The impact is based on a total of eight facilities, the five facilities that are currently permitted and the three facilities that have applied for a synthetic minor permit application. A summary of the costs and benefits are presented in Table A-3.

The 0.078 mg/m^3 value is derived from the ATSDR study of methyl bromide and is intended for an exposure duration of 15 to 364 days and is not intended for exposures over a lifetime to emissions from currently operating log fumigation sites. While this AAL of 0.078 mg/m^3 with a 24-hour averaging time provides benefits to the public from short-term or acute exposures to methyl bromide, this AAL may pose a risk of long-term or chronic effects from methyl bromide if a facility were to emit this concentration every day. To address this issue, the SAB recommended that this value be paired with a chronic value of 0.005 mg/m^3 with an annual average. The 0.005 mg/m^3 value is intended to protect the public from the effects of methyl bromide over a lifetime of exposure. Even though the DAQ is proposing the 0.078 mg/m^3 with a 24-hour averaging time as a separate option, we fully support the SAB's recommendation that this value be paired with an annual AAL of 0.005 mg/m^3 to protect the health of the citizens of North Carolina.

Table A-1. Summary of Modeling Results for 24-Hour Averaging Time

Facility Name	*Area of Facility (Acres)*	*Daily MeBr Emissions (lbs/day)*[1]	*24-Hour Max Model Result (mg/m^3)*	*Reduction Needed to Meet AAL of 0.005 mg/m^3*	*Reduction Needed to Meet AAL of 0.078 mg/m^3*
Modeled Without a Stack (Volume Source)					
Chadbourn	20.4	79.6	0.706	99.3%	89.0%
River Rd	2.2	34.2	0.931	99.5%	91.6%
Port	272.0	24.1	0.037	86.4%	0.0%
Flowers	22.0	38.5	0.386	98.7%	79.8%
Modeled With a Stack (Point Source)[2]					
Chadbourn	20.4	79.6	0.067	92.5%	0.0%
River Rd	2.2	34.2	0.023	77.8%	0.0%
Port	272.0	24.1	0.013	61.6%	0.0%
Flowers	22.0	38.5	0.038	86.9%	0.0%

[1] The daily emissions were calculated based on maximum monthly fumigation charging data assuming 15 days per month and average container aeration batches at each site based on inspections and permit records.

[2] Chadbourn emissions modeled assuming 1 pile aeration through 25 ft stack using 9500 cfm fan. Other facilities emissions modeled assuming 1 container aeration through a 30 ft stack with 5200 cfm flow.

Table A-2. Estimate of the Number of Containers That Meet the 24-Hour AAL of 0.078 mg/m3

Facility Name	*Proposed 24-Hour AAL (mg/m^3)*	*24-Hour Max Model Result (mg/m^3)*	*Estimated Daily MeBr Emissions to Meet 24-Hour AAL (lbs/day)*	*Estimated Amount of MeBr per Container (lbs/container)*[1]	*Estimated Number of Containers per Day (Containers/day)*
Modeled Without a Stack (Volume Source)					
Chadbourn	0.078	0.706	8.8	27	< 1
River Rd	0.078	0.931	2.9	27	< 1
Port	0.078	0.037	50.9	27	2
Flowers	0.078	0.386	7.8	27	< 1
Modeled With a Stack (Point Source)[2]					
Chadbourn	0.078	0.067	92.7	27	3
River Rd	0.078	0.023	118.7	27	4
Port	0.078	0.013	144.1	27	5
Flowers	0.078	0.038	78.4	27	3

[1] Average dosage of methyl bromide per container.

Table A-3. Analysis of Costs and Benefits Associated with 24-Hour AAL of 0.078 mg/m^3

Costs/Benefits	***Year 2019***	***Year 2020***
Private Sector Costs		
Permit Application Fee	$2,000	
Installation of Stack & Fan[1]	$59,907	
Labor Costs for Operation of Fan and Stack System[2]	$356,000	
Modeling Cost[3]	$66,657	
Reporting & Recordkeeping	$31,995	$31,995
Warning Signs	$1,600	
Total Private Sector Costs	$518,159	$31,995
State/Local Government Costs		
Permit Application Fee	-$2,000	
Permit Development	$3,922	
Meteorologist	$6,712	$6,712
Permit Review	$6,367	
Compliance	$241	$241
Total Government Costs	$15,242	$6,953
Local Community Costs and Benefits		
Job Impacts	$0	$0
Health Benefits	----	----
Total Local Community Costs and Benefits	$0	$0
Private Sector Benefits		
Modeling Contractors	$66,657	
Sign Makers	$1,600	
Total Private Sector Benefits	$68,257	
Total Impact (+Cost -Savings)	$465,144	$38,948

Net Present Value of Quantified Impacts	**$468,733**
Substantial Impact Analysis	**$601,658**
Local Community Health Benefits	**See Note**

[1] Container ventilation system estimated to be $7,125 and $10,032 for pile ventilation system.
There are 7 facilities that fumigate in containers and 1 that fumigates in piles.

[2] The average ($44,500) of the range of labor costs was used.

[3] Includes $8,332 for modeling costs per facility.

Note: The health benefits for local communities were unable to be quantified. See the "Human Health Benefits from Reduced Risk of Exposure to Methyl Bromide" section in the fiscal note for information on the potential benefits.

Paired 0.078 mg/m^3 with 24-Hour Averaging Time and 0.005 mg/m^3 with Annual Averaging Time

The SAB noted in their December 2019 meeting that there was value to the public health in having both a short-term and long-term AAL to account for different types of methyl bromide exposures. The SAB stated that the ATSDR value of 0.078 mg/m^3 as a 24-hour value would be protective of public health in compliment with the 0.005 mg/m^3 annual value. The modeling results for the 0.078 mg/m^3 with a 24-hour averaging time are provided in the preceding section. An analysis of the 0.005 mg/m^3 AAL with an annual averaging time is provided below.

For the annual averaging time, the DAQ modeled the methyl bromide emissions from four of the five currently permitted log fumigation facilities using the maximum permitted emissions. The fifth facility (Elizabethtown) is permitted, but has not operated in the last four years, therefore the DAQ has no emissions information from this facility to do the 24-hour modeling. The maximum permitted emissions of 10 tons per year were averaged over 365 days per year and 8 hours per day for a daily emission rate of 6.85 pounds per day. This emission rate was used to determine the annual maximum ambient fenceline concentration for three scenarios: (1) aeration of fumigated piles or containers during the daytime hours; (2) aeration of fumigated piles and containers during the nighttime hours; and (3) aeration of fumigated piles and containers during daytime and nighttime hours (e.g., 24-hour period).

The annual modeling results are presented in Table A-4. As shown in this table, the daytime aeration schedule provides the best dispersion of methyl bromide emissions, along with the use of a stack. That is because air closest to the ground is heated by solar heat during the daytime hours. This warmed air near the ground will have a lower density than the air above it, and want to rise up and expand creating rapid vertical mixing with the air above, thus dispersing emissions. During nighttime conditions, the ground cools and the air near the ground becomes denser causing vertical mixing to stop. Two of the facilities, River Rd and Port can meet the annual 0.005 mg/m^3 AAL without any further reduction in methyl bromide emissions when a stack is used to disperse methyl bromide emissions during the daytime. The other two facilities, Chadbourn and Flowers would need to further reduce methyl bromide emissions by 18.1 and 8.4 percent, respectively, to comply with the annual AAL. Without further controls, this would limit the annual emissions of methyl bromide from Chadbourn to 8.2 tons per year and 9.2 tons per year for Flowers when a stack is used to disperse emissions during daytime aeration. A summary of the estimated annual emissions that meet an annual AAL of 0.005 mg/m^3 are provided in Table A-5 of this Addendum.

Based on the results from the 24-hour and annual modeling, the DAQ has determined that the facilities would need to install a fan and stack system to meet both the 0.078 mg/m^3 24-hour AAL and the 0.005 annual AAL. Even though the Port facility can meet the 0.078 mg/m^3 24-hour AAL without any controls, it would need to install the fan and stack system to meet the annual AAL of 0.005 mg/m^3, otherwise they would be limited to emitting 8.0 tons of methyl bromide per year. In the case of the Chadbourne and Flowers facilities, the DAQ assumes that these facilities would comply with an annual AAL of 0.005 mg/m^3 by accepting operational limits of 8.2 tons per year and 9.2 tons per year, respectively. This assumption is based on industry comments which stated that the control technologies provided in the approved Fiscal Note were not readily available and are not cost effective to operate. In the case of debarking, the industry noted that the debarked logs are not accepted in every country and the acceptance of debarked logs is subjective based on bark removal requirements.

Table A-4. Summary of Modeling Results for Annual Averaging Time

Facility Name	Proposed Annual AAL (mg/m³)	Aeration Schedule - 24 hr/day[1]		Areation Schedule - Daytime[2]		Areation Schedule - Nightime[3]	
		Annual Max Model Result (mg/m³)	Reduction Needed to Meet AAL	Annual Max Model Result (mg/m³)	Reduction Needed to Meet AAL	Annual Max Model Result (mg/m³)	Reduction Needed to Meet AAL
Modeled Without a Stack (Volume Source)							
Chadbourn	0.005	0.105	95.2%	0.039	87.1%	0.171	97.1%
River Rd	0.005	0.242	97.9%	0.097	94.8%	0.422	98.8%
Port	0.005	0.021	76.2%	0.006	19.9%	0.037	86.6%
Flowers	0.005	0.092	94.6%	0.055	90.9%	0.148	96.6%
Modeled With a Stack (Point Source)[4]							
Chadbourn	0.005	0.018	72.1%	0.006	18.1%	0.028	82.3%
River Rd	0.005	0.008	40.7%	0.003	0.0%	0.016	68.9%
Port	0.005	0.008	38.5%	0.003	0.0%	0.013	62.2%
Flowers	0.005	0.014	64.4%	0.005	8.4%	0.024	78.8%

[1] Assumes maximum monthly methyl bromide usage divided over 15 days and emitted over a 24-hour period.

[2] Assumes 10 Tons of methyl bromide emitted per year averaged over 365 days/year and 8 hours per day (e.g., 6.85 lb/hr) over an 8-hour period in the daytime.

[3] Assumes 10 Tons of methyl bromide emitted per year averaged over 365 days/year and 8 hours per day (e.g., 6.85 lb/hr) over an 8-hour period in the nighttime.

[4] Stack release height assumed to be 30 feet for Chadbourn and 25 feet for River Rd, Port, and Flowers.

Table A-5. Estimated Methyl Bromide Emissions that Meet Annual AAL of 0.005 mg/m³ in combination with the 24-hr 0.078 mg/m³ AAL

Facility Name	Proposed Annual AAL (mg/m³)	Aeration Schedule - 24 hr/day		Areation Schedule - Daytime[2]		Areation Schedule - Nightime[3]	
		Annual Max Model Result (mg/m³)	Estimated Annual MeBr Emissions to Meet Annual AAL (Tons/yr)	Annual Max Model Result (mg/m³)	Estimated Annual MeBr Emissions (Tons/yr)	Annual Max Model Result (mg/m³)	Estimated Annual MeBr Emissions (Tons/yr)
Modeled Without a Stack (Volume Source)							
Chadbourn	0.005	0.105	0.5	0.039	1.3	0.171	0.3
River Rd	0.005	0.242	0.2	0.097	0.5	0.422	0.1
Port	0.005	0.021	2.4	0.006	8.0	0.037	1.3
Flowers	0.005	0.092	0.5	0.055	0.9	0.148	0.3
Modeled With a Stack (Point Source)							
Chadbourn	0.005	0.018	2.8	0.006	8.2	0.028	1.8
River Rd	0.005	0.008	5.9	0.003	10.0	0.016	3.1
Port	0.005	0.008	6.2	0.003	10.0	0.013	3.8
Flowers	0.005	0.014	3.6	0.005	9.2	0.024	2.1

[1] Assumes methyl bromide emitted over a 24-hour period.

[2] Assumes methyl bromide emitted over 8-hour period in the daytime.

[3] Assumes methyl bromide emitted over 8-hour period in the nighttime.

Neither of these facilities have used 10 tons of methyl bromide in the last three years. The highest rolling annual methyl bromide usage for this time period was 7.2 tons for the Chadbourne site and 2.1 tons for the Flowers site. Therefore, the DAQ believes that these facilities would accept this operational limitation.

The cost of installing a fan and stack system was estimated to be $7,125 for container ventilation system and $10,032 for a tarpaulin ventilation system (See Section V, Option 1 of the Fiscal Note). Labor costs for operating the fan system were estimated to be $16,000 to $73,000 per year, depending on the number of containers or piles that are aerated. For the purposes of this analysis, the average of the labor costs ($44,500) was used to estimate the labor costs of operating the fan system. This option also estimated the cost for modeling this scenario to be $8,332 for each of the eight facilities.

As a whole, fumigated log exports from North Carolina has decreased over the past three years as shown by the methyl bromide usage graph in Figure A-1. This is a result of current trade policies with other countries and perhaps the uncertainty of proposed regulations for the log fumigation industry. While this trend is expected to continue in the near future, changes to the trade policy may increase the demand for North Carolina logs and the demand for fumigated logs may increase. Therefore, the production limitations assumed in this Addendum for the Chadbourne and Flowers facilities may be a loss of revenue for these two facilities. To estimate the potential loss of revenue from the facilities that would have to limit the amount of methyl bromide used, the value of the wood per amount of methyl bromide used was calculated. This value was calculated using the export price of the wood, the size of the shipping container (2,700 ft^3), the volume percentage of wood in the container (80 percent), and the amount of methyl bromide used per container (27 lbs/container). An export value of $97 per cubic meter of wood[49] ($2.75 per cubic foot) based on the export price for southern yellow pine logs was used as the export price. The value of the wood per amount of methyl bromide used is provided below:

$$\left(\frac{\$2.75}{ft^3}\right) * \left(\frac{2{,}700\ ft^3}{Container}\right) * (0.80) * \left(\frac{Container}{27\ lb\ MB}\right) = \$220\ per\ lb\ MB\ used$$

Using this value of the wood per amount of methyl bromide used and the methyl bromide usage limit of 8.2 tons per year for the Chadbourne site and 9.2 tons per year for the Flowers site, the estimated potential annual lost revenue was calculated to be $791,000 for the Chadbourne site and $352,000 for the Flowers site.

A summary of the total impacts from the five permitted facilities and the three proposed facilities is provided in Table A-6. The Proposed Rule and amendment are expected to cost between $0.469 to $2.54 million on net over 2 years, at a discount rate of 7 percent depending on whether the potential annual loss of $1.14 million is included. The annual cost impact is estimated to range from $0.465 to $1.61 million in the first year and $0.039 to $1.18 million in the second year, again depending on whether the impacts associated with the potential annual lost revenue estimate of $1.14 million are included.

[49] This value was obtained from the Mid-Year Log Export Update: Pacific Northwest and US South, Forest2Market, June 26, 2019. https://www.forest2market.com/blog/mid-year-log-export-update-pacific-northwest-and-us-south

Figure A-1. Methyl Bromide Usage for the Years 2017-2019

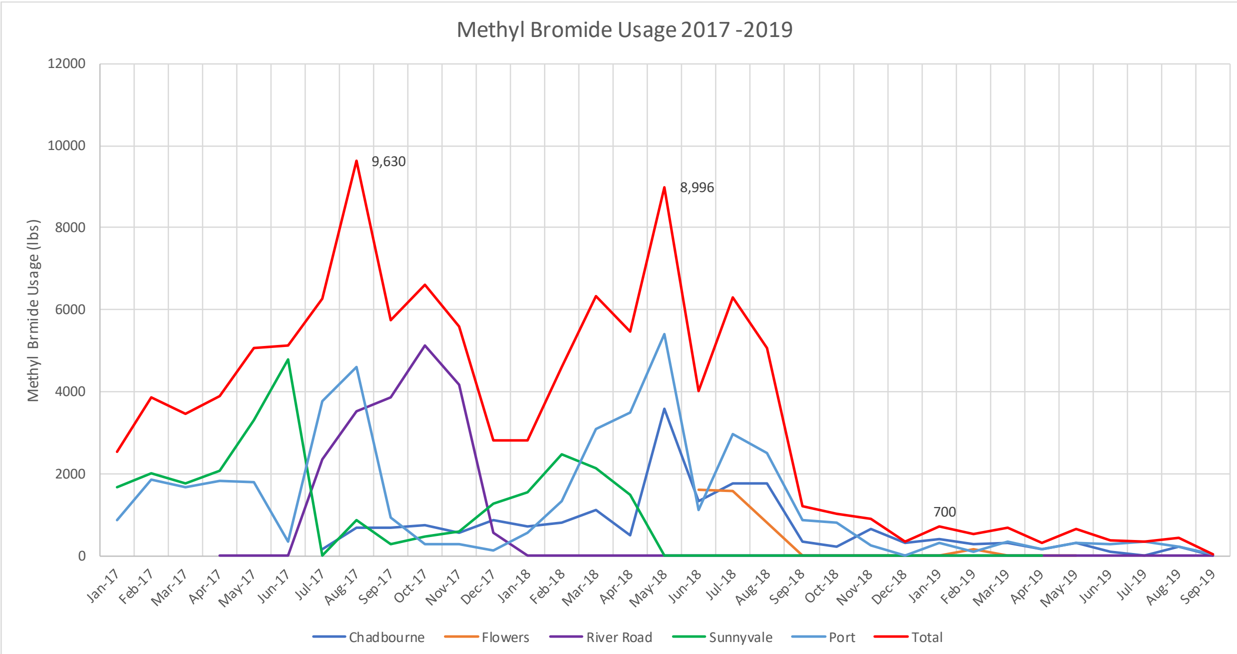

Table A-6. Analysis of Costs and Benefits Associated with Annual AAL of 0.005 mg/m^3 in combination with the 24-hr 0.078 mg/m^3 AAL

Costs/Benefits	***Year 2019***	***Year 2020***
Private Sector Costs		
Permit Application Fee	$2,000	
Installation of Stack & Fan[1]	$59,907	
Labor Costs for Operation of Fan and Stack System[2]	$356,000	
Modeling Cost[3]	$66,657	
Reporting & Recordkeeping	$31,995	$31,995
Warning Signs	$1,600	
Potential Lost Revenue from Limiting Production[4]	$1,143,000	$1,143,000
Total Private Sector Costs	$1,661,159	$1,174,995
State/Local Government Costs		
Permit Application Fee	-$2,000	
Permit Development	$3,922	
Meteorologist	$6,712	$6,712
Permit Review	$6,367	
Compliance	$241	$241
Total Government Costs	$15,242	$6,953
Local Community Costs and Benefits		
Job Impacts	$0	$0
Health Benefits	----	----
Total Local Community Costs and Benefits	$0	$0
Private Sector Benefits		
Modeling Contractors	$66,657	
Sign Makers	$1,600	
Total Private Sector Benefits	$68,257	
Total Impact (+Cost -Savings)	$1,608,144	$1,181,948

Net Present Value of Quantified Impacts	**$2,535,298**
Substantial Impact Analysis	**$1,744,658**
Local Community Health Benefits	**See Note**

[1] Container ventilation system estimated to be $7,125 and $10,032 for pile ventilation system. There are 7 facilities that fumigate in containers and 1 that fumigates in piles.

[2] The average ($44,500) of the range of labor costs was used.

[3] Includes $8,332 for modeling costs per facility.

[4] Two facilities would need to limit production to meet the Annual AAL.

Note: The health benefits for local communities were unable to be quantified. See the "Human Health Benefits from Reduced Risk of Exposure to Methyl Bromide" section in the fiscal note for information on the potential benefits.

Health Benefits from Reduced Risk to Methyl Bromide Exposure

The human health discussion in the approved Fiscal Note was based on a 0.005 mg/m^3 using a 24-hour averaging time. While the DAQ was unable to reliably monetize the benefits of methyl bromide regulation which includes the avoided cost impacts as the result of lowered work production, health care visits, and hospitalization costs, the DAQ approximated the population of citizens adjacent to log fumigation operations that may have experienced acute methyl bromide exposures (exposures of 24 hours or less) or longer-term chronic exposures. Based on modeling of current facilities' maximum monthly usage, the DAQ estimated that 150,000 people adjacent to the four existing operations could be exposed to methyl bromide at or above 0.005 mg/m^3 over 24 hours. This population estimate is provided in Table 8 of the approved Fiscal Note (see pages 26-27 for methodology).

For this Addendum, the DAQ used the same emissions used in the previous analysis for the approved Fiscal Note to estimate the population that may be exposed to concentrations of 0.005 mg/m^3 and 0.078 mg/m^3 averaged over 24 hours. Note, there are slight differences in the buffer distances for the 24-hour 0.005 mg/m^3 option for this analysis in comparison to the approved Fiscal Note. The differences in buffer distance results in a lower affected population estimate of 149,717 in comparison to the 152,449 that was estimated in the approved Fiscal Note. This difference is a result of adjustments to some of the modeling input parameters based on information received from the DAQ Regional Offices. Note also, that the Port and River Rd. facilities are close in proximity to each other and in some areas share the same population. For this analysis, we showed the affected populations for each facility, but for the total population, only the unduplicated population is provided. The results of this population analysis are provided in Table A-7.

As shown in Table A-7, the 24-hour AAL of 0.078 mg/m^3 had shorter buffer distances than the buffer distances for the 24-hour AAL of 0.005 mg/m^3 from each of the four sites and hence a smaller affected population. The total affected population for the 0.078 mg/m^3 option was estimated to be 6,304, whereas the affected population for the 24-hour 0.005 mg/m^3 AAL was 149,717.

The population analysis for the annual 0.005 mg/m3 AAL was done using a maximum of 10 tons per year averaged over 8760 hours per year to get an average emission rate of 2.28 pounds per hour. This emission rate was used in the model to estimate the buffer distance for an annual concentration of 0.005 mg/m^3. As shown in the Table A-7, the affected population was estimated to be 491. As a standalone AAL, the annual AAL of 0.005 mg/m^3 would have an effect on a small population set, however, when paired with a 24-hour AAL of 0.078 mg/m^3 the affected population would increase to 6,304. This is because of the shorter term AAL shows the result of the maximum emissions on the surrounding area, whereas the annual AAL only provides an average of the day-to-day operations. The day-to-day operations may include days or weeks of little to no fumigation, therefore the 24-hour average population analysis provides the best estimate of affected population for the paired AALs. While this option would affect less people in comparison to the 0.005 mg/m^3 24-hour AAL, it would provide protection to the general public from both short-term and long-term exposures to methyl bromide from log fumigation.

Table A-7. Comparison of the Buffer Distances for the 0.005 mg/m^3 and 0.078 mg/m^3 Options

Facility Name	Area of Facility (Acres)	Daily MeBr Emissions (lbs/day)[1]	Afternoon Dispersion Buffer Distance to <AAL (m)	Afternoon Dispersion Buffer Area to <AAL (Acres)	Population Affected	Unduplicated Population Affected
0.005 mg/m^3 AAL with 24-hour Averaging						
Chadbourn	20.4	238.9	5,325	22,013	7,350	7,350
River Rd	2.2	342.3	6,903	36,993	107,974	122,374
Port	272.0	360.8	6,896	36,918	91,485	
Flowers	22.0	1155.0	7,092	39,046	19,993	19,993
Population Totals						149,717
0.078 mg/m^3 AAL with 24-hour Averaging						
Chadbourn	20.4	238.9	382	113.3	38	38
River Rd	2.2	342.3	443	152.4	445	613
Port	272.0	360.8	537	223.9	555	
Flowers	22.0	1155.0	3,771	11,040	5,653	5,653
Population Totals						6,304
0.005 mg/m^3 AAL with Annual Averaging						
Chadbourn	20.4	238.9	313	76	25	25
River Rd	2.2	342.3	366	104	304	370
Port	272.0	360.8	364	103	300	
Flowers	22.0	1155.0	489	186	542	95
Population Totals						491

All of these AALs are intended to provide health protections from long-term or chronic exposure to methyl bromide, however in discussions with the SAB in October 2019, the SAB agreed with their earlier assessment that 0.005 mg/m^3 was the correct AAL value to protect the public from chronic exposures to methyl bromide. However, they added that using this value with a 24-hour averaging time may be overly protective. The SAB originally approved this value because the DEQ was uncomfortable utilizing an acute value due to the available toxicological science. Without an acute standard, the SAB chose a shorter averaging time of 24 hours for the proposed AAL value of 0.005 mg/m^3. In discussions with the SAB in December 2019, they recommended the DAQ consider the ATSDR value of 0.078 mg/m^3 as an acute value. While this ATSDR value is intended for a 15-364 days of exposure, if applied as a 24-hour average, it would tend to provide an additional layer of protection to the public. The SAB added that if the 0.078 mg/m^3 value were to be utilized for short-term exposures, it would need to be done so in complement with the 0.005 mg/m^3 chronic value as opposed to a replacement. The DAQ agreed with the assessment by the SAB and has proposed a paired AAL of 0.078 mg/m^3 with a 24-hour averaging time and 0.005 mg/m^3 with an annual averaging time. However, we are still providing the analysis of the 0.078 mg/m^3 with a 24-hour averaging time that was proposed by the EMC prior to the public hearing for the initial proposal.

AAL Options Conclusion

The Division of Air Quality identified that the general public adjacent to log fumigation operations may experience both acute exposures, as well as longer-term chronic exposures to methyl bromide as a result of these operations. Studies suggest that acute inhalation exposures to methyl bromide may severely injure lungs. Acute and chronic inhalation of methyl bromide can also lead to deleterious neurological effects in humans. The proposed rules would regulate these emissions using an Acceptable Ambient Level (AAL), which limits the concentration of methyl bromide or other fumigant beyond the fence line of a facility. The DAQ is presenting three AAL options for consideration by the EMC for addressing methyl bromide emission from log fumigation activities.

A summary of the net present value costs and potential populations that benefits from the option are provided in Table A-8. Note that the benefiting population estimates reflect only those adjacent to the four currently operating facilities because the regulatory benefit depends on the unique location and operation of each facility. The population estimates should only be compared to the costs for the currently operating facilities. Table A-8 also provides the estimated total costs including the four currently operating facilities, one non-operational permitted facility, and three proposed facilities.

As shown in this table, the 0.005 mg/m3 with a 24-hour averaging time may have the highest cost for compliance, depending upon the compliance pathway, but also may benefit the greatest number of people. However, in their October 2019 meeting, the SAB stated that an AAL of 0.005 mg/m3 with a 24-hour averaging time may be overly protective. The two additional options for consideration are expected to benefit the same number of people. However, using the modeling results and additional information provided by the SAB, the DAQ has determined that the paired AAL values of 0.078 mg/m^3 with a 24-averaging period and 0.005 mg/m^3 with an annual averaging period may provide both short-term and long-term public health protections. In contrast, an AAL of 0.078 mg/m^3 with 24-hour averaging time alone would reduce risk of acute methyl bromide exposure but may not provide sufficient protection from chronic exposure. However, we are including the 0.005 mg/m^3 with 24-hour averaging time as initially proposed and the additional option of 0.078 mg/m^3 with 24-hour averaging time as potential AAL for consideration by the public. There are currently no federal or state air quality regulations to protect the public from these particular emissions from log fumigation operations, and the DAQ believes adding one of these AAL options for methyl bromide to the toxics air pollutant guidelines will reduce risk to the public from harmful exposure to this compound.

Table A-8. Cost Comparison of AAL Options

Compliance Options	*Total Cost, 2-Year NPV (Millions)* [1]	*Currently Operating Facilities Cost, 2-Year NPV (Millions)* [2]	*Number of People Who May Benefit (based on the 4 operating permitted facilities only)*
Original Proposal - 24-hour 0.005 mg/m^3 AAL			
Install Control Technology	$2.02	$1.16	149,717
Ship Logs Out of State	$2.89	$2.24	149,717
Debarking	$1.55	$0.885	149,717
Additional AAL Options			
24-hour 0.078 mg/m^3 AAL, Install Fan & Stack System	$0.469	$0.236	6,304
Annual 0.005 mg/m^3 and 24-hour 0.078 mg/m^3 AALs, Install Fan & Stack System			
Low Cost Range - Current production levels with no lost revenue	$0.469	$0.236	6,304
High Cost Range - Includes potential lost revenue from limiting production at higher levels	$2.54	$2.30	6,304

[1] Total NPV cost for all 8 facilities (4 operating permitted facilities, 1 non-operational permitted facility, and 3 proposed facilities).

[2] Total NPV cost for the 4 operational permitted facilities.

Comments on the Most Likely Scenarios in the Approved Fiscal Note

The DAQ received several comments on the relocation of fumigation activities to another state. Many commenters noted that the over the past six years, China has prohibited the import of softwood logs from South Carolina and Virginia, and therefore this option is not an alternative for fumigation of North Carolina timber. The DAQ reviewed numerous sources to verify this claim, but was unable to find any prohibition of softwoods from these states to China. The US Department of Agriculture (USDA) export data[50] shows that South Carolina and Virginia exported $13.7 and $38.3 million, respectively of "Wood in the Rough" to China in 2018. These values are less than the $61.6 million that North Carolina exported to China in 2018, but still a significant amount of timber. From 2014 to 2018, "Wood in the Rough" exports from South Carolina ranged from a high of $30.2 million in 2017 to a low of 4.9 million in 2015. For Virginia, "Wood in the Rough" exports ranged from $53.8 million in 2017 to $23.7 million 2015. The data shows a continuing decline of these exports to China from all three of the states. The USDA information does not provide any data on the type of wood that is categorized as "Wood in the Rough," but the data does show that are significant exports of timber from South Carolina and Virginia. Based on this information, we still see the relocation to another state scenario as a viable option for North Carolina forestry product companies.

Several commenters also stated that the Fiscal Note did not adequately address the job loss implications of the relocation scenario. They pointed out that forestry product companies and truckers will also be affected in this scenario. However, no new data was provided to the DAQ. The Fiscal Note estimated that 12 fumigation workers would be impacted (assuming two technicians and one supervisor at each of the four currently operating fumigation sites) at a cost of $1.47 million dollars by the relocation of fumigation activities to another state. This cost does not include any impacts to forestry product companies or truckers. However, the Fiscal Note does include additional income to truckers of $0.636 million per year for the additional distance need for moving the logs to locations outside the State. The DAQ assumes that the forestry product companies would not be impacted by this scenario, because they would continue to cut down logs for shipment overseas. The only costs would be attributed to the exporter for preparing the logs for shipment overseas and are included in the cost of moving the logs to ports out of North Carolina.

Other Comments on the Fiscal Note Costs

Commenters also stated that the Fiscal Note did not adequately account for transportation costs, zoning laws, and additional real estate purchases or leases in its impact statement. The commenters added that local zoning laws only allow fumigations operations in areas designated for "industrial," but more often "heavy industry" use and that the use of the USDA lease cost for pastureland is not appropriate for these operations. These comments are addressed in the following sections with updates to the Fiscal Note. To address these issues, the DAQ reviewed the information submitted by the commenters and determined that some of the costs are underestimated in the Fiscal Note.

The Fiscal Note did not take into consideration the cost of building roads into the properties used for fumigation. Google Earth views of the facilities that are currently operating did not show any roads into

[50] USDA. "USDA Foreign Agricultural Service's Global Agricultural Trade System." *USDA*, USDA Foreign Agricultural Service, 2019.

the properties and it was assumed that this type of infrastructure was not needed. The Fiscal Note also did not consider zoning laws when considering relocation of the properties. Again, Google Earth showed that a majority of the currently operating facilities are located in what appears to be industrial areas. With respect to the availability, the fiscal note did state that the ability of leasing of additional land contiguous to the existing property may be difficult. The Fiscal Note also did not consider the cost for access to electricity at a new site.

To address these issues, the DAQ reviewed real estate listings for vacant industrial properties in the New Hanover County and found prices ranging from $800 to $1,000 per acre. Using an average of $900 per acre, the lease cost for a 79.1-acre property for the model plant would be $854,685 per year. These industrial properties would address the commenter’s issues with transportation, zoning, and utility requirements. However, the largest property that we found was only 2 acres and would most likely not meet an AAL of 0.005 mg/m^3 with a 24-hour average. The cost for an electrical panel is approximately $1,000 and the cost for hooking up electricity to the panel is $17. A deposit may be required to start electricity and depends on the credit worthiness of the applicant and the amount of electricity that is planned to be used at the site.

Even though we explore did list this as a potential option (See Section V, Option 1 of the Fiscal Note), this option was not selected as one of the most likely scenarios for the complying with the proposed rules, because of the same reasons expressed by the commenter. This option was also not discussed in the cost and benefit analysis or conclusion of the fiscal note, and was not presented to the EMC as a potential outcome of compliance with the proposed rules.